Appendix D: Compliance Monitoring Reports

APPENDIX D.5: HOPE BAY PROJECT: 2023 AQUATIC EFFECTS MONITORING PROGRAM REPORT

Hope Bay Project

2023 Aquatic Effects Monitoring Program – Annual Report

PREPARED FOR

AGNICO EAGLE

Agnico Eagle Mines Limited

DATE
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REFERENCE
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Hope Bay Project

2023 Aquatic Effects Monitoring Program – Annual Report

March 2024

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EXECUTIVE SUMMARY

The Hope Bay Mine (the Project) is a gold mining development in the West Kitikmeot region of mainland Nunavut, operated by Agnico Eagle Mines Ltd. The Project is currently in Care and Maintenance status, though compliance management and monitoring activities, including the Aquatic Effects Monitoring Program (AEMP), still occur as indicated in the Doris-Madrid Care and Maintenance Plan (Agnico Eagle 2022).

The AEMP is outlined in the *Hope Bay Project: Aquatic Effects Monitoring Plan* (the Plan; TMAC 2018). The Plan defines Project-related activities that trigger monitoring of aquatic components under a detailed monitoring framework. The 2023 AEMP included lakes adjacent to the Doris and the Madrid North Development construction and operations: Doris, Little Roberts, Patch, Imniagut, P.O., Ogama, Windy, and Glenn lakes, as well as the reference lake (Reference Lake B). Aquatic components evaluated in 2023 included: fish habitat (water level, ice thickness, stream hydrology), under-ice dissolved oxygen concentration, water temperature, water quality, and phytoplankton biomass. Additional components (sediment quality and benthic invertebrates) are monitored every three years and are scheduled to next be included in the 2025 AEMP. The Plan also includes a Response Framework which provides low action level conditions that, if exceeded, can trigger the development of a Response Plan which adaptively manage potential Project-related effects.

No effects were detected for fish habitat (water level, ice thickness, and stream hydrology), under-ice dissolved oxygen concentrations, water temperature, or water quality variables for the exposure lakes (Table 1). An effect was detected for phytoplankton biomass in Doris Lake in 2023 (Table 1). However, based on a review of potential Project-related and natural sources of change through the *Aquatic Response Plan for Phytoplankton Biomass* (ERM 2024) developed in response to the 2022 low action level exceedance observed in Doris Lake, the change in phytoplankton biomass in Doris Lake was considered to be due to natural variability and/or regional non-Project-related factors, and not attributed to Project-related effects.

TABLE 1 SUMMARY OF EVALUATION OF EFFECTS FOR 2023 AEMP

Component	Exposure Lakes Included in Evaluation of Effects	Conclusion of Effect	Low Action Level Triggered?
Fish habitat (water level, ice thickness, and stream hydrology)	Windy Lake, Glenn Lake, Patch Lake, Imniagut Lake, P.O. Lake, Ogama Lake, Doris Lake, Little Roberts Lake	No Effect	NA
Physical limnology (under-ice dissolved oxygen and water temperature)	Windy Lake, Patch Lake, Doris Lake	No Effect	No
Water quality	Windy Lake, Patch Lake, Doris Lake	No Effect	No
Phytoplankton biomass (chlorophyll *a*)	Patch Lake, Doris Lake	Effect (Not Project-related)	No

Note:
NA = not applicable

No low action level exceedances were observed for the two physical limnological variables (water temperature and dissolved oxygen profiles), the 36 water quality variables evaluated, or phytoplankton biomass in 2023.

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ACRONYMS AND ABBREVIATIONS

%	Percent
°C	Degree Celsius
AEMP	Aquatic Effects Monitoring Program
Agnico Eagle	Agnico Eagle Mines Ltd.
ALS	ALS Laboratory Group
BA	Before-After
BACI	Before-After/Control-Impact
CCME	Canadian Council of Ministers of the Environment
Chl *a*	Chlorophyll *a*
cm	Centimetre
DL	Analytical detection limit
DO	Dissolved oxygen
DQO	Data quality objective as set by the analytical laboratory for quality control procedures
ERM	ERM Consultants Canada Ltd.
Exposure site	Site potentially influenced by Project-related activities (e.g., Doris Lake, Patch Lake, Windy Lake).
FEIS	Final Environmental Impact Statement
LME	Linear mixed effects
L	Litre
m	Metre
mg/L	Milligram per litre
NTU	Nephelometric turbidity units
the Plan	Hope Bay Project: Aquatic Effects Monitoring Plan
the Project	the Hope Bay Project
QA/QC	Quality assurance/quality control
Reference site	Site located beyond any Project influence (i.e., Reference Lake B).
RPD	Relative percent difference
TSS	Total suspended solids
µg	Microgram
µg/L	Microgram per litre
µm	Micrometre
µS/cm	Microsiemens per centimetre

GLOSSARY

Action level	The Response Framework includes three tiers of action levels: low, medium, and high. The low action level for each monitored component is based on baseline data, and/or water or sediment quality guidelines, and/or recommended critical effects sizes for that component.
Benthic	Pertaining to the bottom region of a water body, on or near bottom sediments or rocks.
Benthic invertebrates	Benthic invertebrate communities are a group of organisms that live associated with the bottom of lakes or streams. These communities contain a diverse assortment of organisms that have different mechanisms of feeding. Benthic invertebrates are an important food source for fish.
Biomass	The amount of living matter as measured on a weight or concentration basis. Biomass is an indication of the amount of food available for higher trophic levels. In the AEMP, phytoplankton biomass is estimated as chlorophyll *a.*
Censored value	A value that is only partially known, e.g., a variable concentration that is reported as being below a specified detection limit, although the actual concentration is not known. Interchangeably used with ‘less than detection limit’ in this report.
Chlorophyll *a*	An essential light-harvesting pigment for photosynthetic organisms including phytoplankton. Because of the difficulty involved in the direct measurement of plant carbon, chlorophyll *a* is routinely used as a ‘proxy’ estimate for plant biomass in aquatic studies.
Euphotic depth	The depth in the water column in which adequate light is present for photosynthesis to occur (i.e., which 1% of the surface irradiance reaches).
Low action level benchmark	One condition of a low action level exceedance: the value of a variable for water or sediment quality that is equivalent to 75% of the current benchmark value for that variable.
Phytoplankton	Phytoplankton are microscopic primary producers that live free-floating in water. These organisms are single-celled algae that photosynthesize.
Seasons	When not specified, refers to winter (under-ice) and spring/summer/autumn (open water) conditions.
Secchi depth	Secchi depth is the depth at which a Secchi disk (standardized white and back disc) can no longer be seen when it is lowered into a lake. Secchi depth is be used to calculate the depth of the euphotic zone.

1. INTRODUCTION

1.1 BACKGROUND

The Hope Bay Mine (the Project) is a gold mining development in the West Kitikmeot region of mainland Nunavut. The Project has been operated by Agnico Eagle Mines Ltd. (Agnico Eagle) since February 2021. The Project is currently in Care and Maintenance status. Compliance management and monitoring activities, including the Aquatic Effects Monitoring Program (AEMP), still occur as required in the Doris-Madrid Care and Maintenance Plan (Agnico Eagle 2022). Advanced exploration activities continued at the site in 2023.

The Project is located approximately 153 kilometres (km) southwest of Cambridge Bay on the southern shore of Melville Sound. The underlying geological substrate in the Project area includes a greenstone belt that runs 80 km in a north-south direction, varying in width from 7 km to 20 km. The Project consists of three developments: Doris, Madrid (North and South), and Boston. Current, permitted, and planned infrastructure associated with the Project is shown in Figure 1.1-1.

Doris is the northernmost development situated near Roberts Bay (Arctic Ocean) and contains the Doris Camp, lodging and support facilities for the Project, and the Doris North Gold Mine (Doris Mine). Construction of the Doris development began in 2010 and commercial operations were conducted from 2017 to 2022.

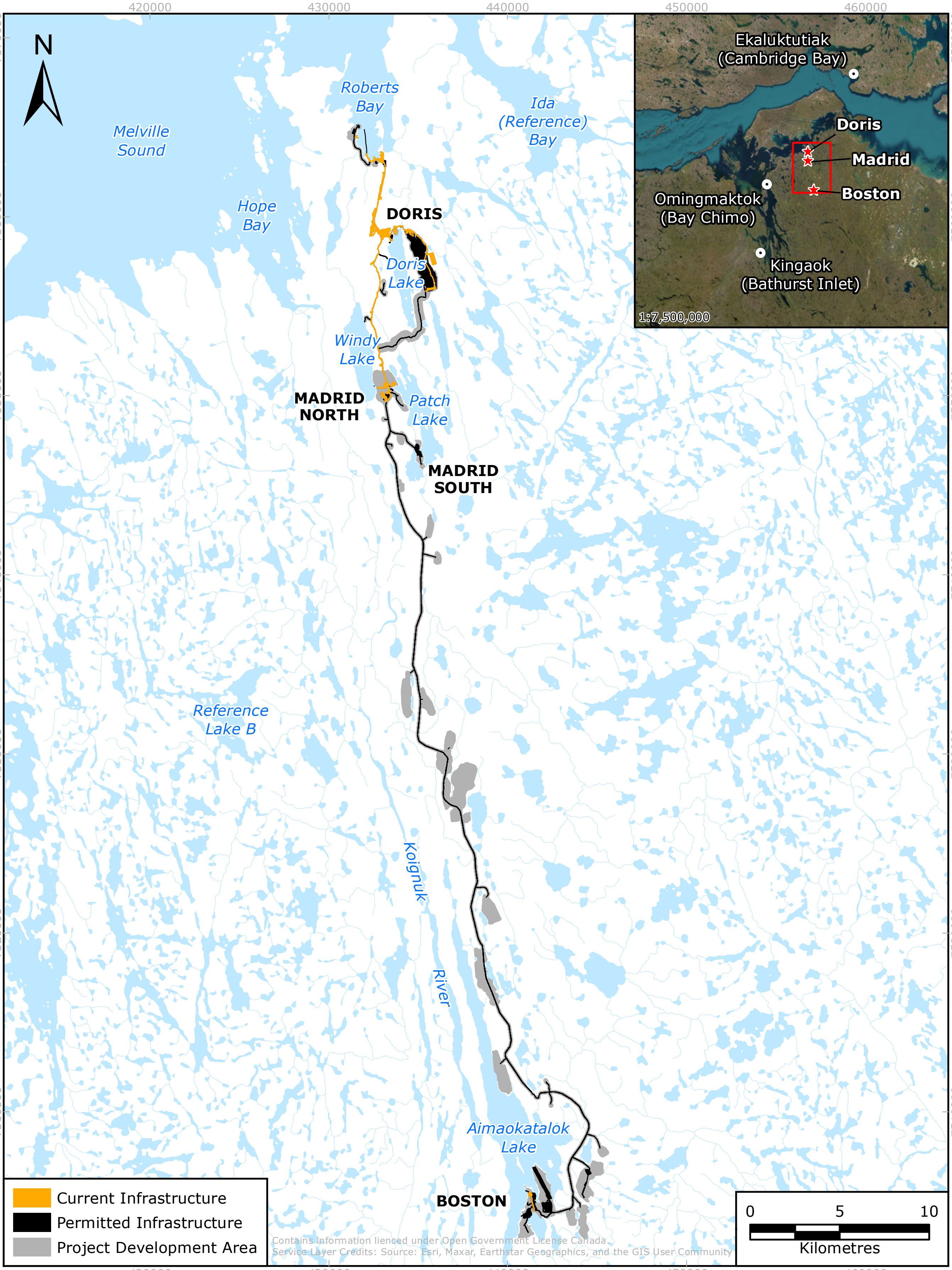
The Madrid developments are in the north-central area of the Project and accessible by road from the Doris development. Construction at the Madrid North development began in April 2019 and operation began in August 2019. All mining and development activity was suspended at Madrid North in March 2020 except for a brief period of activity at the Madrid North portal in January and February 2021.

The Boston development is located in the southernmost part of the Project. As of December 2023, construction had not begun at the Madrid South or Boston developments.

The Project operates under Project Certificate No. 009 (the Project Certificate) issued by the Nunavut Impact Review Board, and two Type A Water Licences (2AM-DOH1335 and 2AM-BOS1835) issued by the Nunavut Water Board. In April 2022, the Doris-Madrid Care and Maintenance Plan (Agnico Eagle 2022) was submitted to the Nunavut Water Board and Nunavut Impact Review Board as required under the Project Certificate and water licenses; approval of the plan was received on September 1, 2022.

The Hope Bay AEMP is a requirement of Agnico Eagle's Type A Water Licence and is outlined in *Hope Bay Project: Aquatic Effects Monitoring* Plan (the Plan; TMAC 2018). The Plan includes an adaptive management component through the Response Framework. The Response Framework sets environmental threshold levels that, if exceeded, would trigger further investigation and/or mitigation. The Plan also includes the Environment Effects Monitoring requirements under the *Metal and Diamond Mining Effluent Regulations* (Government of Canada 2022), when applicable to the Project activities.

FIGURE 1.1-1 THE HOPE BAY PROJECT, 2023



ERM

CLIENT: AGNICO EAGLE MINES LIMITED
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This AEMP annual report includes: a summary of annual Project activities relevant to the AEMP; a brief overview of the AEMP monitoring design, the evaluation of effects methods, and the Response Framework criteria; and the results and conclusions of the evaluation of effects and comparison to action level conditions. All the monitoring data collected for this year's AEMP along with the methods of sample collection and the quality assurance and quality control measures and results are provided in Appendix A – 2023 AEMP Data Report, with the exception of the stream hydrology monitoring and results which are provided in Appendix B - 2023 Hydrology Compliance Monitoring Summary. Detailed methods of the evaluation of effects dataset, methods, and the results of the statistical analyses are provided in Appendix C - 2023 Evaluation of Effects Supporting Information.

As an outcome of the public review process for the 2022 AEMP Annual Report (ERM 2023; Agnico Eagle 2023), a Response Plan for phytoplankton biomass in Doris Lake is provided under a separate cover titled *Aquatic Response Plan for Phytoplankton Biomass* (ERM 2024).

1.2 OBJECTIVES

The primary goals of the AEMP are to evaluate potential Project effects on the surrounding freshwater environment during the construction and operation of the Project, verify predictions from the *Madrid-Boston Final Environmental Impact Statement* (FEIS; TMAC 2017), support current and future *Fisheries Act* Authorizations, and provide a mechanism to respond to potential Project effects in the freshwater environment through mitigation and management actions.

1.3 PROJECT ACTIVITIES IN 2023

Care and Maintenance status remain in effect for all developments (Doris, Madrid and Boston sites) in 2023. Agnico Eagle continued advanced exploration activities as well as the management of facilities to remain in regulatory compliance with various permits, licenses, and approvals for the Project.

The Project-related activities (by development), relevant to the AEMP, that occurred in 2023 include the below.

Doris

- Milling activities remained suspended (since October 2021).
- Underground ore extraction in Doris mine remain suspended (since February 2022).
- Advanced Exploration continued using the Doris underground portal.
- The construction of an interim dike design in the TIA was mainly completed before freshet 2023, allowing the segregation of saline and non saline water.
- The Water Treatment Plant construction was completed and commissioned in the fall of 2023.
- Effluent from underground dewatering and/or the TIA that was compliant with the Metal and Diamond Mining Effluent Regulations requirements was discharged to Roberts Bay.
- Completed sealift operation with delivery of supplies. No bulk diesel fuel was delivered, and mill reagents were removed from site.

- Doris Air Quality Station was operational and upgrades were completed on the weather station.
- Quarry blasting occurred at various quarries in 2023 to support the access to Patch Lake, trail maintenance, interim dike and various small construction projects.
- Exploration surface drilling occurred from January to October 2023 at the Doris Deposit (16 sites); all drill sites were reclaimed following the decommissioning of drills.

Madrid

Madrid North

- Ore extraction and development at Madrid remained suspended (since October 2021).
- Dewatering from the Naartok Crown Pillar Recovery Trench was not required in 2023.
- Structures from the old Windy Camp were dismantled.
- Exploration surface drilling occurred from January to October 2023 at the Madrid Deposit (79 sites); all drill sites were reclaimed following the decommissioning of drills.

Madrid South

- As of December 2023, construction of the Madrid South development had not yet commenced.

Boston

- As of December 2023, construction of the Boston development had not yet commenced.
- The Hope Bay Project Boston Advanced Exploration site was maintained but not occupied in 2023.

2. METHODS

2.1 MONITORING DESIGN

The 2023 AEMP was conducted in accordance with the Plan (TMAC 2018). Project phases subsequently 'trigger' or mark the beginning of monitoring for a particular lake (Table 2.1-1; TMAC 2018). The 2023 AEMP monitored sites include exposure lakes (i.e., lakes potentially influenced by Project-related activities) based on potential to be influenced by Project-related activities to date and a reference site (TMAC 2018; Figure 2.1-1). Not all sites are triggered for monitoring based on the Project development/activities to date; as of 2023, AEMP monitoring has been triggered at the Doris and Madrid North developments based in construction and operation activities to date and includes sites proximate to infrastructure, that have the potential to receive non-point-source inputs (such as runoff or dust), and sites that could be affected by water loss due to permitted water withdrawal and groundwater seepage into the underground developments. Exposure lakes in 2023 include Doris and Little Roberts lakes in relation to the Doris Development and Imniagut, Patch, P.O., Ogama, Windy and Glenn lakes in relation to the Madrid North Development (Figure 2.1-1).

The 2023 AEMP included the following components (Table 2.1-2):

- fish habitat (ice thickness, water level, stream hydrology);
- under-ice physical limnology and water quality variables;
- open-water physical limnology and water quality variables; and
- open-water phytoplankton.

As per the Plan (TMAC 2018), not all components are monitored at each sampling site and not all components are monitored annually. Sediment quality and lake benthic invertebrates are monitored every three years with the next sampling for both components are scheduled for 2025.

Comprehensive details of the 2023 AEMP sampling design, schedule, sampling sites, and monitoring methods are provided in Appendix A and Appendix B (hydrological components, respectively).

2.2 EVALUATION OF EFFECTS METHODS

2.2.1 EVALUATED VARIABLES

The evaluated variables for fish habitat, physical limnology, water quality, and phytoplankton are outlined in the Plan (TMAC 2018; Table 2.2-1).

Project-related water use such as water withdrawal and seepage in underground mining have the potential to reduce lake water level and affect stream hydrology, which could adversely affect fish habitat. Fish habitat is evaluated through water level and ice thickness (Section 3.1), and open-water season streamflow (Appendix B).

Evaluated variables for physical limnology and water quality include those with guidelines established by the Canadian Council of Ministers of the Environment (CCME) for the protection of aquatic life (CCME 2023).

TABLE 2.1-1 RATIONALE FOR AEMP SAMPLING BASED ON DEFINED MONITORING TRIGGERS, 2023

Watershed	Sampling Site	Sampling Rationale	Monitoring Trigger	2023 Monitoring Requirement and Rationale
Doris	Wolverine Lake	Drawdown from Madrid South mine groundwater inflow; inputs (e.g., dust deposition, runoff) due to proximity to infrastructure	Madrid South construction and operations	No
	Patch Lake	Drawdown from Madrid North and South mines groundwater inflow; inputs (e.g., dust deposition, runoff) due to proximity to infrastructure	Madrid North and South construction and operations	Yes, Madrid North construction and operations
	Imniagut Lake	Drawdown from Madrid North mine groundwater inflow	Madrid North and South operations	Yes, Madrid North construction and operations
	P.O. Lake	Drawdown from Madrid North mine groundwater inflow	Madrid North and South operations	Yes, Madrid North construction and operations
	Ogama Lake	Drawdown from Madrid North mine groundwater inflow	Madrid North and South operations	Yes, Madrid North construction and operations
	Doris Lake	Water withdrawal for industrial use (e.g., dust suppression, wash bays and machine shops, process water); drawdown from Doris mine groundwater inflow; inputs (e.g., dust deposition, runoff) due to proximity to infrastructure	Doris, Madrid North, and Madrid South construction and operations; Boston operations	Yes, Doris and Madrid North construction and operations
	Little Roberts Lake	Little Roberts Lake is downstream of Doris Lake, therefore indirect effects may be observed in Little Roberts Lake as a result of drawdown and water withdrawal from Doris Lake	Doris, Madrid North, and Madrid South construction and operations; Boston operations	Yes, Doris and Madrid North construction and operations
Windy	Windy Lake	Water withdrawal for domestic use (potable water); drawdown from Madrid North mine groundwater inflow	Doris, Madrid North, and Madrid South construction and operations	Yes, Doris and Madrid North construction and operations
	Glenn Lake	Glenn Lake is downstream of Windy Lake, therefore indirect effects may be observed in Glenn Lake as a result of water withdrawal from Windy Lake	Doris, Madrid North, and Madrid South construction and operations	Yes, Doris and Madrid North construction and operations

Watershed	Sampling Site	Sampling Rationale	Monitoring Trigger	2023 Monitoring Requirement and Rationale
Aimaokatalok	Stickleback Lake	Inputs (e.g., dust deposition, runoff) due to proximity to infrastructure	Boston construction and operations	No
	Aimaokatalok Lake	Inputs (e.g., dust deposition, runoff) due to proximity to infrastructure; permitted discharge	Boston construction and operations	No
Reference	Reference Lake B	Reference area for AEMP located outside of the zone of Project influence	Doris, Madrid, and Boston construction and operations	Yes, Doris and Madrid North construction and operations

TABLE 2.1-2 AEMP SAMPLING SITES AND MONITORED COMPONENTS, 2023

Site	Ice Thickness	Water Level	Streamflow	Physical Limnology	Water Quality	Phytoplankton
Doris Watershed						
Wolverine Lake [a]	X	X	-	-	-	-
Patch Lake	X	-	-	X	X	X
Patch Outflow Hydro	-	X	X	-	-	-
Imniagut Lake	X	-	-	-	-	-
Imniagut Lake Hydro	-	X	-	-	-	-
P.O. Lake	X	-	-	-	-	-
P.O. Outflow Hydro	-	X	X	-	-	-
Ogama Lake	X	-	-	-	-	-
Ogama Outflow Hydro	-	X	X	-	-	-
Doris Lake	X	-	-	X	X	X
Doris Lake-2 Hydro	-	X	-	-	-	-
Doris Creek TL-2 Hydro	-	-	X	-	-	-
Little Roberts Lake	X	-	-	-	-	-
Little Roberts Outflow Hydro	-	X	X	-	-	-
Windy Watershed						
Windy Lake	X	-	-	X	X	-
Windy Outflow Hydro	-	X	X	-	-	-
Glenn Lake	X	-	-	-	-	-
Glenn Lake Hydro	-	X	-	-	-	-
Reference Lake						
Reference Lake B	X	-	-	X	X	X

[a] Wolverine Lake was monitored in 2023 for the support of baseline data collection (Appendices A and B) and its data is excluded from the temporal evaluation of effects.

FIGURE 2.1-1 SAMPLING SITES, HOPE BAY AEMP, 2023

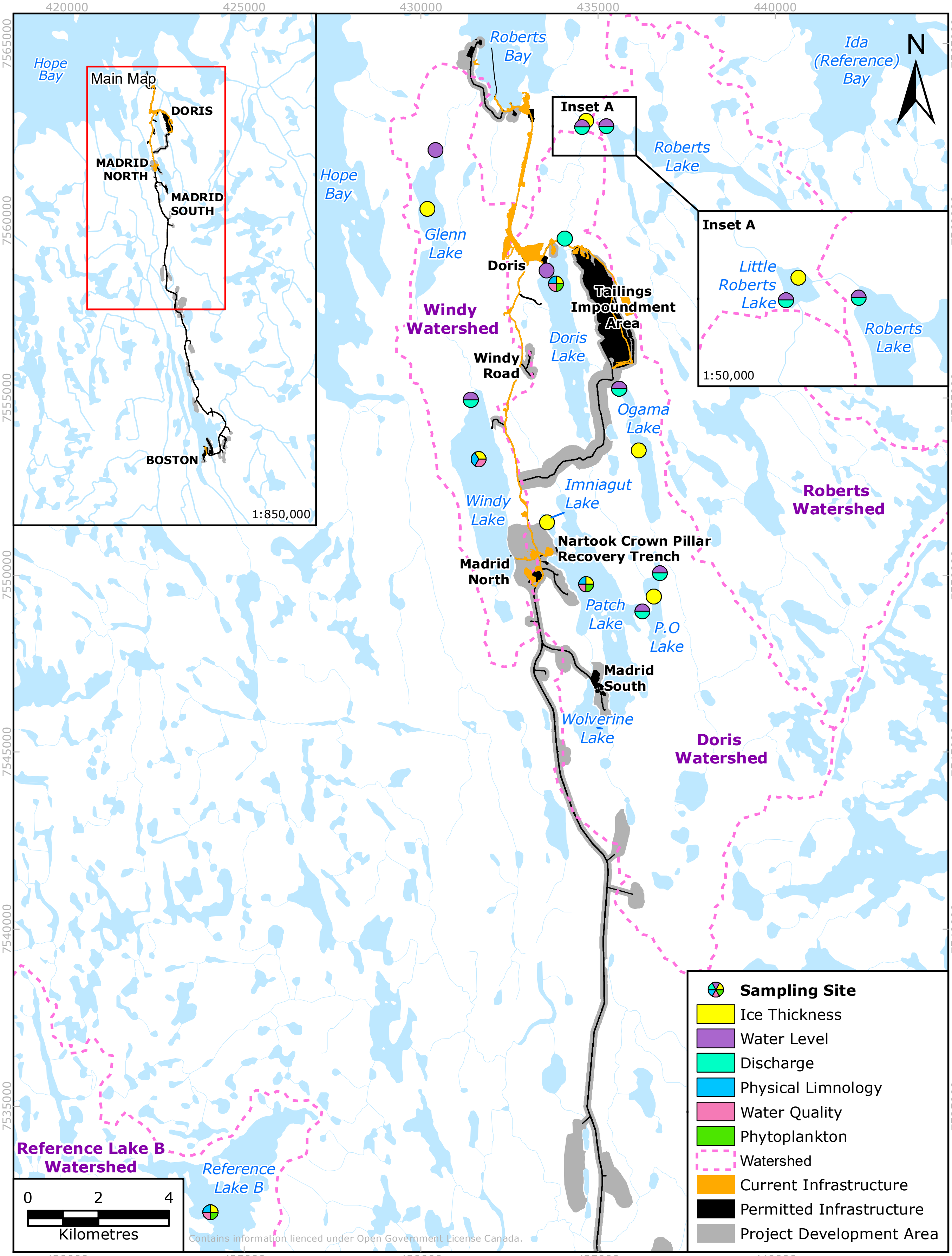

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TABLE 2.2-1 EVALUATED VARIABLES FOR THE HOPE BAY AEMP, 2023

Category	Evaluated Variable	
Fish Habitat	• Water Level • Ice Thickness • Stream Hydrology[a]	
Physical Limnology	• Under-ice Dissolved Oxygen • Temperature	
Water Quality	• pH • Total Suspended Solids • Turbidity • Chloride • Fluoride • Total Ammonia • Nitrate • Nitrite • Total Phosphorus[b] • Total Aluminum • Total Arsenic • Total Boron • Total Cadmium	• Total Chromium • Total Copper • Total Iron • Total Lead • Dissolved Manganese • Total Mercury • Total Molybdenum • Total Nickel • Total Selenium • Total Silver • Total Thallium • Total Uranium • Dissolved Zinc
Phytoplankton	• Biomass (chlorophyll *a*)	

[a] Stream hydrology evaluation is detailed in Appendix B but summarized in Section 4.
[b] Total phosphorus was assessed only for 2023 as a supporting parameter and is not an annual effects variable under the Plan (TMAC 2018).

Dissolved oxygen (DO) profiles are only evaluated for the under-ice season sampling event as DO concentrations are typically lowest during the ice-covered period representing 'worst case scenario' conditions. Lower DO concentrations occur during the under-ice season due to factors such as: microbial decomposition and respiration; exclusion of atmospheric sources of oxygen; and reduction of photosynthetic activity and oxygen production from phytoplankton due to ice and snow cover decreasing light penetration (Wetzel 2001).

Total phosphorus does not have a CCME guideline but is included as an evaluated effects variable in 2023 as a supporting parameter as it is linked to phytoplankton productivity (CCME 2004). The AEMP indicated that the phytoplankton biomass in Doris Lake has appeared to increase in 2022 (ERM 2023), and based on the exceedance of the low action level conditions a Response Plan was discussed (Agnico Eagle 2023). Total phosphorus is assessed in the 2023 evaluation of effects to support the *Aquatic Response Plan for Phytoplankton* (ERM 2024).

Phytoplankton biomass is estimated using the main photosynthetic pigment, chlorophyll *a* (chl *a*).

2.2.2 DATASETS

Physical limnology, water quality, and biological data have been collected in the Doris and Madrid development areas of the Hope Bay Project since 1995. Over time, historical samples collected have varied by location, depth, sampling date, and method of collection (Appendix C). Thus, historical data were evaluated for relevancy to the current sampling framework as detailed in the Plan (TMAC 2018) and were included in evaluation of effects when applicable (Appendix C).

Data from baseline years included in data analyses include:

- All years up to and including 2009 for the Doris development as Doris Mine construction began in 2010; and
- All years up to and including 2018 for the Madrid North development as construction and operations began in 2019.

2.2.3 OVERVIEW OF EFFECT ASSESSMENT METHODS

The potential effects for fish habitat variables (water level and ice thickness) were assessed relative to the predictions in the Madrid-Boston FEIS (TMAC 2017).

The evaluation of effects for physical limnology, water quality, and phytoplankton variables was conducted using statistical and/or graphical analyses to detect changes in evaluated variables in the exposure lakes over time and relative to the reference lake (Figure 4.2-1 in TMAC (2018). This section provides an overview of the evaluation of effect methods; however, a complete, including detailed methods, a description of the statistical analyses, and results is presented in Appendix C.

For the physical limnology evaluated variables (dissolved oxygen-DO and temperature profiles), any change over time was assessed using graphical analysis. The absolute values (concentration or temperature) and profile throughout the water column in each exposure lake were visually assessed relative to the profiles observed during baseline years and/or relative to the reference lake.

For water quality and phytoplankton variables, a two-step statistical analysis was completed. The first step investigated any change in the variable over time while the second step reviewed any trends in the exposure lake compared to a reference lake. Comparison to the reference lake was only completed using monitoring data collected during identical sampling years. The significance level for statistical analysis was 0.05.

For Doris Lake, based on the proportion of data that were less the DL, either linear mixed effects regression or Tobit regression models were used to examine temporal trends over the monitoring period (10+ years for most variables; Appendix C). Tobit regression was used when 10 to 50% of the data for a given analysis were below the analytical detection limit (DL). Statistical analyses were not conducted if more than 50% of the monitoring data, or current years' observations, were less than the DL.

For Patch and Windy lakes, there were fewer than 10 years of continuous historical data available for most variables, and with non-sequential years of collection. For these lakes, the statistical analysis consisted of a before-after (BA) analysis where the before period includes all the baseline data (i.e., up to and including 2018, Section 2.2.2) and the after period includes years since

Project-related activities may have affected the exposure lakes (i.e., since 2019). If there was a significant difference found between the before-and-after periods for an exposure lake in a given season, the analysis proceeded to a before-after/control-impact (BACI) analysis. The BACI analysis compares the before-after trend at the exposure site with the before-after trend at a corresponding reference site (Appendix C). The BACI analysis can only assess the years of data that were comparable between the reference and exposure lakes.

The evaluation of effects figures for water quality and phytoplankton variables included plotting all observations from each year, with the annual fitted mean (with the 95% confidence intervals) for Doris Lake or the before-after fitted means for Patch and Windy lakes, and the corresponding fitted mean for the reference lake, if applicable. Observations that were below the sample DL were plotted at half the DL and indicated by a hollow symbol. In the case where statistical analyses were not completed, graphical analysis was used to assess the data from the current year were less than the DL, or to visually assess for potential changes in variables.

Statistical assessments are not conclusive evidence of an effect. If a change was detected for an evaluated variable using statistical analyses, graphical analysis was used to identify the direction of the change. For most variables, only an increasing concentration over time would be considered an adverse effect (e.g., total suspended solids, arsenic and copper), although for some variables, an increasing or decreasing trend would be considered adverse (e.g., phytoplankton biomass or pH). In instances where a change was detected with statistical analysis, or statistical analysis were not completed, the observations from the current year were also compared to the baseline range to determine if the detected statistical change was applicable to the evaluated year to determine if an effect occurred.

If an effect was detected it was interpreted using best professional judgement (Figure 4.2-1 in TMAC [2018]) and any other supporting data to determine the potential cause of the effect. There are several reasons unrelated to Project-related activities that could influence the detection of a significant change in an exposure lake over time, and relative to the reference site. For example, trends over time could vary due to local differences in meteorological conditions, runoff from the natural landscape, or naturally variable inputs related to weathering and erosion. The detection of an effect may therefore not be conclusive evidence of a Project-related effect. The assessment for determining a potential Project-related effect would be supported by graphical analysis and professional judgement within the context of plausible Project-related mechanisms but may be outside the scope of the evaluation of effects (i.e., an inconclusive Project-related effect conclusion). The evaluation of effects results are linked to the Response Framework (TMAC 2018; Section 2.2.5) to pre-empt significant adverse effects to aquatic life if an effect is Project-related.

If a Project-related effect or an inconclusive potentially adverse change was identified, the data was compared to the FEIS (TMAC 2017) predictions.

2.2.4 BENCHMARKS

Annual AEMP results are compared to the CCME water quality guidelines for the protection of aquatic life (Table 2.2-2; CCME 2023) which are used as the benchmarks for physical limnology and water quality variables. Note that when multiple guidelines are given (e.g., short and long term or acute and chronic), the most conservative (i.e., lowest) guideline is included as the AEMP benchmark. The CCME guidelines for total suspended solids (TSS) and turbidity are lake-specific (Table 2.2-2) and presented for both the under-ice and open-water season for each exposure lake (Table 2.2-3), whereas the guideline for total ammonia-N is pH and temperature dependent (Table 2.2-4).

TABLE 2.2-2 WATER QUALITY BENCHMARKS

Water Quality Variable	Benchmark[a]
Dissolved Oxygen	9.5 mg/L (cold-water biota: early life stages); 6.5 mg/L (cold-water biota: other life stages)
Temperature	Thermal additions must not alter thermal stratification regime, turnover date(s), and maximum weekly temperature
pH	6.5 to 9.0
Total Suspended Solids	Maximum average increase of 5 mg/L from background (for clear-flow waters; long-term exposure); Table 2.2-3
Turbidity	Maximum average increase of 2 NTUs from background (for clear-flow waters; long-term exposure)
Chloride	120 mg/L (long term)
Fluoride	0.12 mg/L
Total Ammonia-N	Temperature- and pH-dependent; Table 2.2-4
Nitrate-N	3.0 mg/L (long term)
Nitrite-N	0.06 mg/L
Total Aluminum	0.005 mg/L (if pH < 6.5); 0.1 mg/L (if pH ≥ 6.5)
Total Arsenic	0.005 mg/L
Total Boron	1.5 mg/L
Total Cadmium	0.00004 mg/L for hardness (as $CaCO_3$) of < 17 mg/L; $10^{(0.83[\log(hardness)]-2.46)}$/1,000 mg/L for hardness of ≥ 17 to ≤ 280 mg/L; 0.00037 mg/L for hardness of > 280 mg/L (long term)
Total Chromium	0.001 mg/L for Cr (VI); 0.0089 mg/L for Cr (III)
Total Copper	0.002 mg/L for hardness (as $CaCO_3$) of < 82 mg/L; $e^{(0.8545[\ln(hardness)]-1.465)}$/1,000 mg/L for hardness of ≥ 82 to ≤ 180 mg/L; 0.004 mg/L for hardness of > 180 mg/L
Total Iron	0.3 mg/L
Total Lead	0.001 mg/L for hardness (as $CaCO_3$) of ≤ 60 mg/L; $e^{(1.273[\ln(hardness)]-4.705)}$/1,000 mg/L for hardness of > 60 to ≤ 180 mg/L; 0.007 mg/L for hardness of > 180 mg/L

Water Quality Variable	Benchmark[a]
Dissolved Manganese	Hardness- and pH-dependent benchmark is found in look-up table in CCME (2019). At hardness (as $CaCO_3$) of 50 mg/L and pH of 7.5, the benchmark is 0.43 mg/L. The values in the look-up table are valid between hardness 25 and 670 mg/L and pH 5.8 and 8.4.
Total Mercury	0.026 µg/L
Total Molybdenum	0.073 mg/L
Total Nickel	0.025 mg/L for hardness (as $CaCO_3$) of ≤ 60 mg/L; $e^{(0.76[\ln(\text{hardness})]+1.06)}$/1,000 mg/L for hardness of > 60 to ≤ 180 mg/L; 0.15 mg/L for hardness of > 180 mg/L
Total Selenium	0.001 mg/L
Total Silver	0.00025 mg/L
Total Thallium	0.0008 mg/L
Total Uranium	0.015 mg/L
Dissolved Zinc	$e^{(0.947[\ln(\text{hardness})]-0.815[\text{pH}]+0.398[\ln(\text{DOC})]+4.625)}$/1,000 mg/L for hardness of 23.4 to 399 mg/L, pH of 6.5 to 8.13, and DOC of 0.3 to 22.9 mg/L; 0.007 mg/L for hardness (as $CaCO_3$) of 50 mg/L, pH of 7.5, DOC of 0.5 mg/L

[a] Source: Canadian Water Quality Guidelines for the Protection of Aquatic Life, Summary Table (CCME 2023).
Note:
DOC = dissolved organic carbon

TABLE 2.2-3 TOTAL SUSPENDED SOLIDS AND TURBIDITY BENCHMARKS FOR EXPOSURE LAKES

Lake	Season	Total Suspended Solids Benchmark (mg/L)	Turbidity Benchmark (NTU)
Doris	Under-ice	7.18	4.91
	Open-water	9.85	5.69
Patch	Under-ice	6.11	3.10
	Open-water	7.06	4.77
Windy	Under-ice	6.21	2.46
	Open-water	6.10	3.04

TABLE 2.2-4 TOTAL AMMONIA BENCHMARK AS A FUNCTION OF PH AND TEMPERATURE

Temperature (˚C)	pH							
	6.0	6.5	7.0	7.5	8.0	8.5	9.0	10.0
0	190	60	19	6.0	1.9	0.62	0.21	0.035
5	126	40	13	4.0	1.3	0.41	0.14	0.028
10	84	27	8.5	2.7	0.86	0.28	0.10	0.024

Temperature (˚C)	pH							
	6.0	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**10.0**
15	57	18	5.7	1.8	0.59	0.20	0.073	0.021
20	39	13	4.0	1.3	0.41	0.14	0.055	0.020
25	28	8.7	2.8	0.89	0.29	0.10	0.044	0.018
30	19	6.2	2.0	0.63	0.21	0.077	0.035	0.017

Notes:
Total ammonia concentration units are mg/L.
Values outside of the shaded area should be used with caution owing to a lack of toxicity data to accurately determine toxic effects at the extreme of these ranges (CCME 2023).

2.2.5 RESPONSE FRAMEWORK

The Response Framework is an early-detection system with defined action levels that initiate monitoring and/or management actions within an adequate timeframe to preempt significant adverse effects to aquatic life (TMAC 2018). The Response Frameworks links the results of the AEMP evaluation of effects to management actions to avoid significant adverse effects arising from Project-related activities (Figure 4.2-1 in the Plan; TMAC 2018). All physical limnology, water quality, and phytoplankton evaluated variables were compared to the conditions required to trigger an action level response through the Response Framework (TMAC 2018). If the conditions of an action level response were attained, follow-up actions would be triggered as described in the Response Framework (TMAC 2018).

2.2.5.1 ACTION LEVEL CONDITIONS

The action level conditions by monitoring component required to trigger a low action level are outlined in the Response Framework (TMAC 2018). The annual AEMP results are compared to these conditions, when one condition is not met the conditions for that variable were not assessed further. In some cases, it may not be possible for a given variable to trigger all conditions, in this circumstance it is sufficient to demonstrate that all conditions were achieved excluding the ones that did not apply for a particular variable.

Water Quality

The conditions required to trigger a low action level response for water quality included:

1. Identification of a statistically significant and potentially adverse change from baseline concentrations;
2. The concentration of the water quality variable is outside of the normal range based on baseline concentrations;
3. The concentration of the water quality variable exceeds 75% of a benchmark; and
4. If a potentially adverse change is detected at the exposure site, there is no similar change at the reference site.

For most evaluated water quality variables, only an increase would be considered a potentially adverse change; however, for DO concentration, only a decrease would be considered potentially adverse, and for pH, a change in either direction would be considered potentially adverse.

For comparison to the baseline concentrations for water quality variables, all observations were compared to the range of observations from the baseline period, all observations were required to be outside of the baseline range in the same direction to exceed that condition.

The low action level condition is set at 75% of the water quality benchmark to allow for adaptive management measures to be implemented before concentrations could negatively affect the most sensitive freshwater life.

No Response Plans for water quality variables have been initiated to date, there are no medium or high action level conditions established for water quality variables.

Phytoplankton

The conditions required to trigger a low action level response for phytoplankton biomass included:

1. The identification of a statistically significant change from baseline concentrations;
2. The concentration of chl *a* is outside of the normal range based on baseline concentrations; and
3. If a change is detected at the exposure site, there is no similar change at the reference site.

For comparison to the baseline concentrations for phytoplankton biomass, the mean concentration from the current year was compared to the range of observations from the baseline period.

The Response Plan for phytoplankton biomass indicates that when the current year's mean chl *a* concentration is outside of the normal range based on the baseline observations (condition 2), a supplemental statistical test (two-tailed t-test) will be used in the AEMP to confirm the first (1) condition is met (that the current years mean is statistically different from the baseline mean; ERM 2024).

If the low action level conditions are exceeded for phytoplankton biomass, the AEMP results are compared to the medium action level conditions defined in the Response Plan (ERM 2024). Currently there are no high action levels established for phytoplankton biomass.

3. EVALUATION OF EFFECTS

3.1 FISH HABITAT

The observed water level fluctuation, ice thickness, and the reduction in under-ice lake surface elevation in 2023 compared to the maximum values predicted in the Madrid-Boston FEIS (TMAC 2017) indicated no potential effect except for the observed under-ice lake surface elevation for Imniagut Lake (Table 3.1-1).

TABLE 3.1-1 LAKE WATER LEVEL FLUCTUATION AND ICE THICKNESS COMPARED TO FEIS PREDICTIONS, 2023

Lake	FEIS[a]			2023 AEMP Under-ice Season		
	A	B	A + B	A	B	A + B
	Max. Baseline Water Level Fluctuation (m)	Max. Baseline Ice Thickness (m)	Max. Reduction in Under-ice Lake Surface Elevation (m)	Observed Water Level Fluctuation (m)[e]	Ice Thickness (m)	Reduction in Under-ice Lake Surface Elevation (m)
Windy	0.24	1.90	2.14	0.15	1.85	2.00
Glenn	0.26	1.95[b]	2.21	0.48	1.69	2.17
Patch	0.44	2.05	2.49	0.28	1.79	2.07
Imniagut	0.09[c]	1.91[c] (1.99[b])	2.00 (2.08)	0.19	1.82	**2.01**
P.O.	0.64	1.85	2.49	0.44	1.91	2.35
Ogama	0.46	1.95	2.41	0.30	1.80	2.1
Doris	0.74	2.00 (2.4[d])	2.74 (3.89)	0.37	1.67	2.04
Little Roberts	0.63	2.3[d]	2.93	0.59	1.93	2.52

Sources:
[a] Unless otherwise indicated, data source: Table 1.2.6 of Volume 5, Chapter 1 (Surface Hydrology) and Table 6.5-10 of Volume 5, Chapter 6 (Freshwater Fish); Madrid-Boston FEIS (TMAC 2017).
[b] Data source: Rescan (2010).
[c] Field collected baseline data not available, variation in open-water lake surface elevation calculated as the average difference between simulated baseline lake surface elevation in September and June (Years 1 to 22), and ice thickness estimated as the average of all other lakes with baseline data (TMAC 2017).
[d] Data source: Golder Associates Ltd. (2007).
[e] Data source: Appendix B.

Notes:
Values in parentheses indicate updates of baseline predictions from the FEIS based on the more complete baseline dataset of ice thickness.
Bold values indicate values that are higher than the baseline maximum.

There was a greater reduction in lake surface elevation over the 2023 under-ice season compared to the maximum predicted reduction of 1 cm for Imniagut Lake. However, no baseline data was collected at Imniagut Lake prior to the FEIS (TMAC 2017) and a modelled water level variation of 9 cm is used for comparison. Project development/activities have not progressed to the point that potential effects to water quantity in the Imniagut Lake watershed would occur. Therefore, supplemental baseline water levels at Imniagut Lake have been monitored since 2019, with observed variations of 15 cm to 20 cm. The supplemental baseline data suggests the 2023 under-ice observation is within the range of natural variability for Imniagut Lake. Therefore, no Project-related effects for water level fluctuation, ice thickness, and the reduction in under-ice lake surface elevation were identified for monitored lakes in 2023.

3.2 PHYSICAL LIMNOLOGY

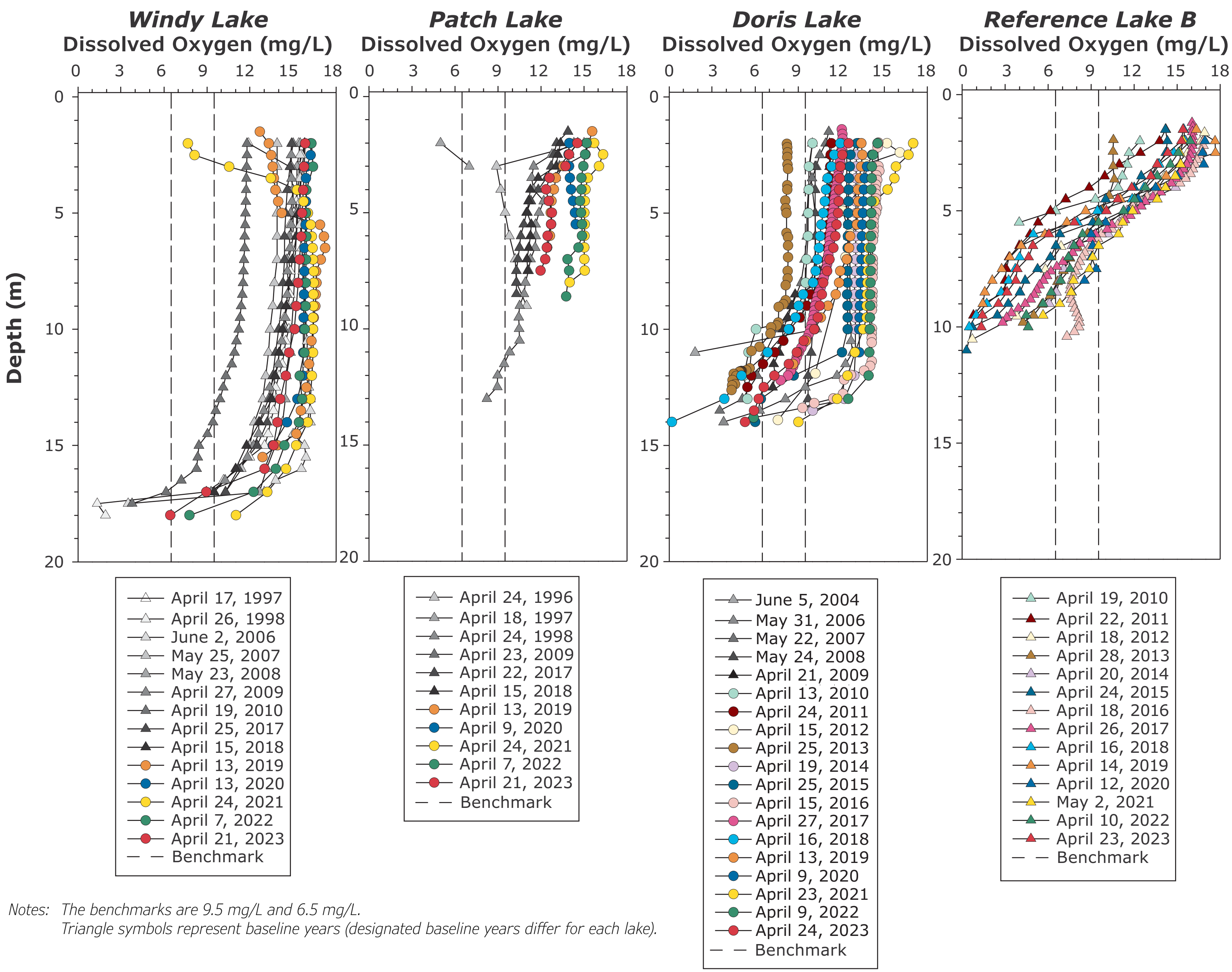
3.2.1 UNDER-ICE DISSOLVED OXYGEN

Under-ice DO concentrations in the exposure lakes in 2023 were within the range of baseline concentrations in Doris and Windy Lakes, and greater than the baseline range for a portion of the water column in Patch Lake (Figures 3.2-1 and 3.2-2). Absolute DO concentrations in Patch Lake were within the baseline range to a depth of 3.5 m (14.54 to 12.60 mg/L) but were greater (0.34 to 1.08 mg/L) than the baseline range at depth greater than 4.0 m. It is noted that an increase in under-ice dissolved oxygen concentrations is not an adverse change, as only a decrease in dissolved oxygen would be expected to adversely affect overwintering fish populations (TMAC 2018). The under-ice DO profiles followed a trend throughout the water column that was similar to the profiles observed during the baseline years. Patch Lake baseline DO concentrations were measured in the same basin but at a different station in 1996 to 1998 (Figure C.1-1 in Appendix C), resulting in the variation in the DO-depth profile (Figure 3.2-2).

The DO concentrations were greater than the benchmarks throughout the water column in Patch Lake in 2023 (Table 2.2-2; Figure 3.2-1; Table A.3-2 in Appendix A). In Doris and Windy lakes, DO concentrations less than the 9.5 mg/L benchmark at depth (>10.5 m in Doris Lake and >17 m in Windy Lake) and less than the 6.5 mg/L benchmark nearest the lakebed (>13 m in Doris Lake and >18 m in Windy Lake; Table 2.2-2; Figure 3.2-1; Table A.3-2 in Appendix A). However, DO concentrations less than the benchmarks at depth were observed in some baseline years in Doris (2004, 2006, 2007, and 2009) and Windy (1998, 2006, and 2009) lakes (Figures 3.2-1 and 3.2-2). In Doris Lake, DO concentrations less than 9.5 mg/L were observed at depth greater than 7.0 m and less than 6.5 mg/L at depth greater than 11 m throughout the baseline years. In Windy Lake, DO concentrations less than 9.5 mg/L were observed at depth greater than 14.0 m and less than 6.5 mg/L at depth greater than 17 m throughout the baseline years.

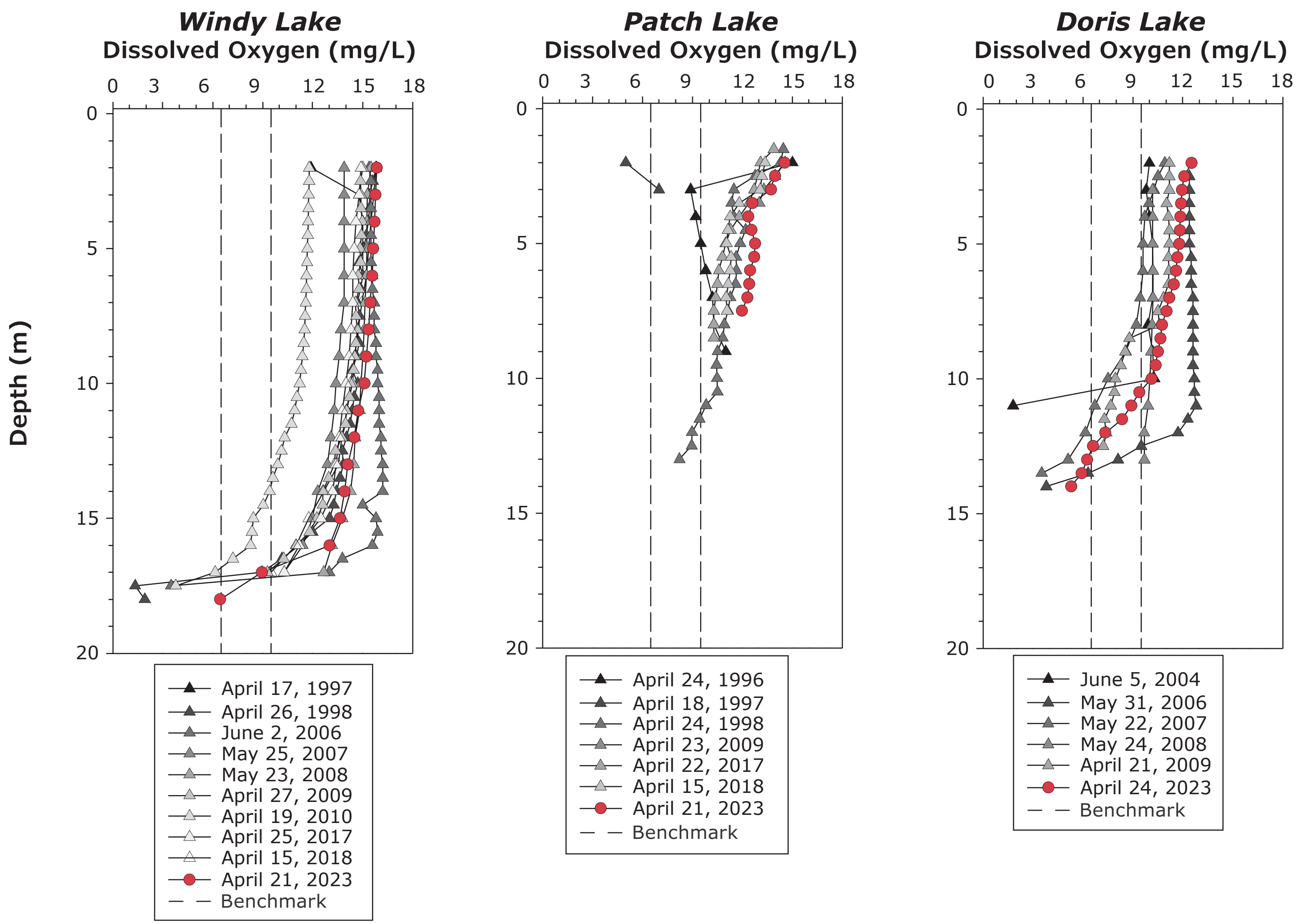
No potentially adverse effects were detected for under-ice DO concentrations in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for under-ice DO concentrations were not exceeded in 2023.

FIGURE 3.2-1 UNDER-ICE DISSOLVED OXYGEN PROFILES, HOPE BAY AEMP, 1996 TO 2023



Notes: *The benchmarks are 9.5 mg/L and 6.5 mg/L.*
Triangle symbols represent baseline years (designated baseline years differ for each lake).

FIGURE 3.2-2 UNDER-ICE DISSOLVED OXYGEN PROFILES FOR AEMP EXPOSURE LAKES, BASELINE YEARS AND 2023



Notes: The benchmarks are 9.5 mg/L and 6.5 mg/L.

3.2.2 WATER TEMPERATURE

Under-ice temperatures in Patch Lake in 2023 were within the range of baseline temperatures while under-ice temperatures in Doris and Windy lakes were colder compared to baseline years throughout a portion of the water column (Figures 3.2-3 and 3.2-4). Under-ice temperatures observed in 2023 were less than 0.5 °C colder than the baseline range in Doris Lake and less than 0.2 °C colder in Windy Lake. The under-ice temperature profiles in the exposure lakes followed a trend throughout the water column that was similar to under-ice temperature profiles measured during the baseline years (Figure 3.2-4).

Open-water temperature in the exposure lakes were within the range of baseline temperatures throughout the water column in 2023 (Figures 3.2-5 and 3.2-6). The open-water temperature profiles in the exposure lakes followed a trend throughout the water column that was similar to open-water temperature profiles measured during the baseline years (Figure 3.2-6).

No effects were detected for water temperature in Windy, Patch, or Doris lakes in 2023. The conditions required to consider a low action level for water temperature were not exceeded in 2023.

3.3 WATER QUALITY

3.3.1 PH

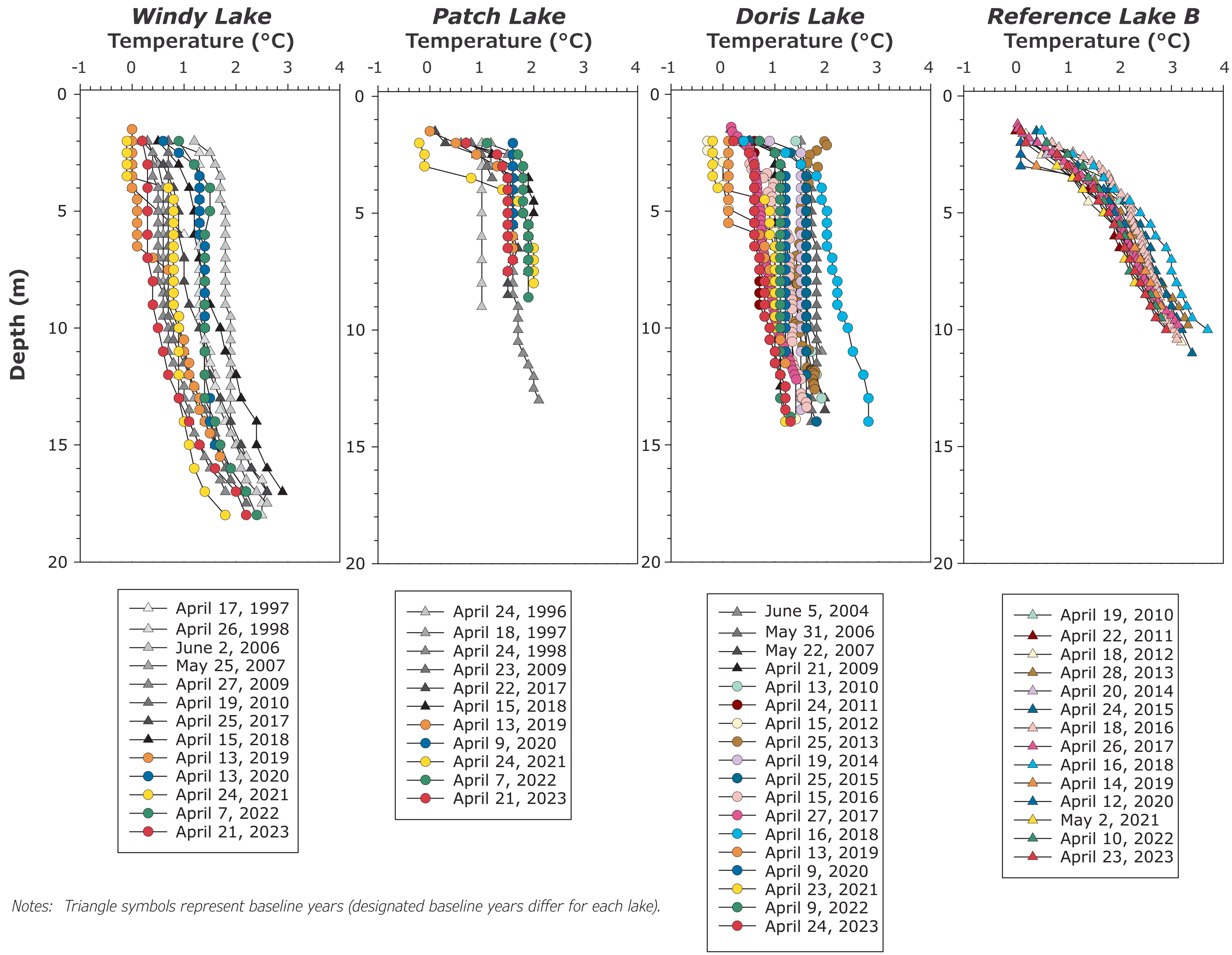
Statistical analyses indicated a significant change over time for pH in Doris Lake during both seasons but not relative to the reference lake (Table 3.3-1). Statistical analyses indicated no significant difference between the before-and-after period means for pH in Patch or Windy lakes during either season (Table 3.3-1). Under-ice and open-water pH for all monitored lakes were within the benchmark range in 2023 (Figures 3.3-1a and 3.3-1b).

TABLE 3.3-1 PH STATISTICAL RESULTS FOR EXPOSURE LAKES, 2023

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (0.0009)	No (0.4498)	NA	NA
	Open-Water	Yes (<0.00001)	No (0.0501)	NA	NA
Patch	Ice-covered	NA	NA	No (0.1237)	-
	Open-Water	NA	NA	No (0.2636)	-
Windy	Ice-covered	NA	NA	No (0.2006)	-
	Open-Water	NA	NA	No (0.1598)	-

Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.2-3 UNDER-ICE TEMPERATURE PROFILES, HOPE BAY AEMP, 1996 TO 2023



Notes: Triangle symbols represent baseline years (designated baseline years differ for each lake).

ERM

CLIENT: Agnico Eagles Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-004:2

FIGURE 3.2-4 UNDER-ICE TEMPERATURE PROFILES FOR AEMP EXPOSURE LAKES, BASELINE YEARS AND 2023

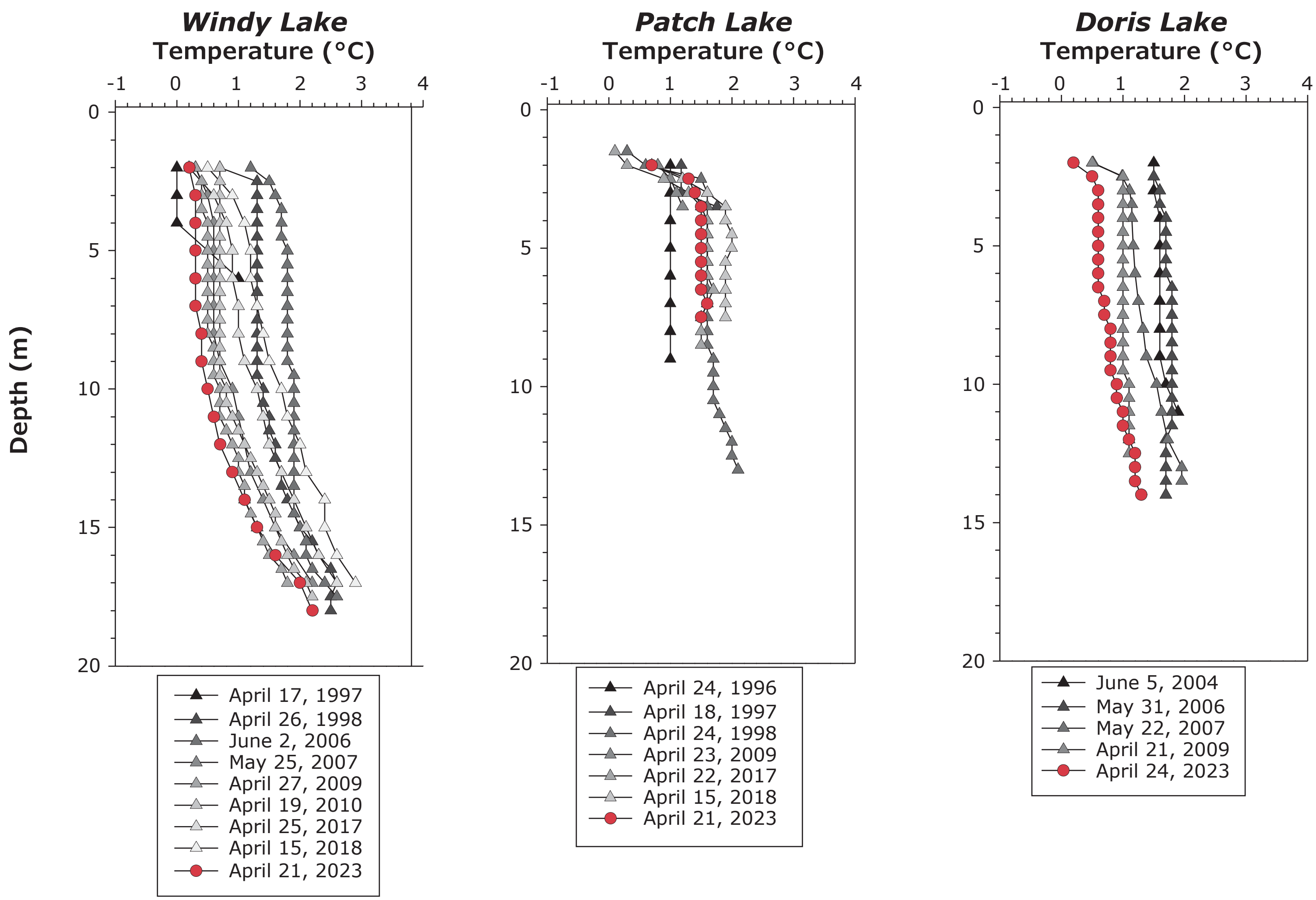
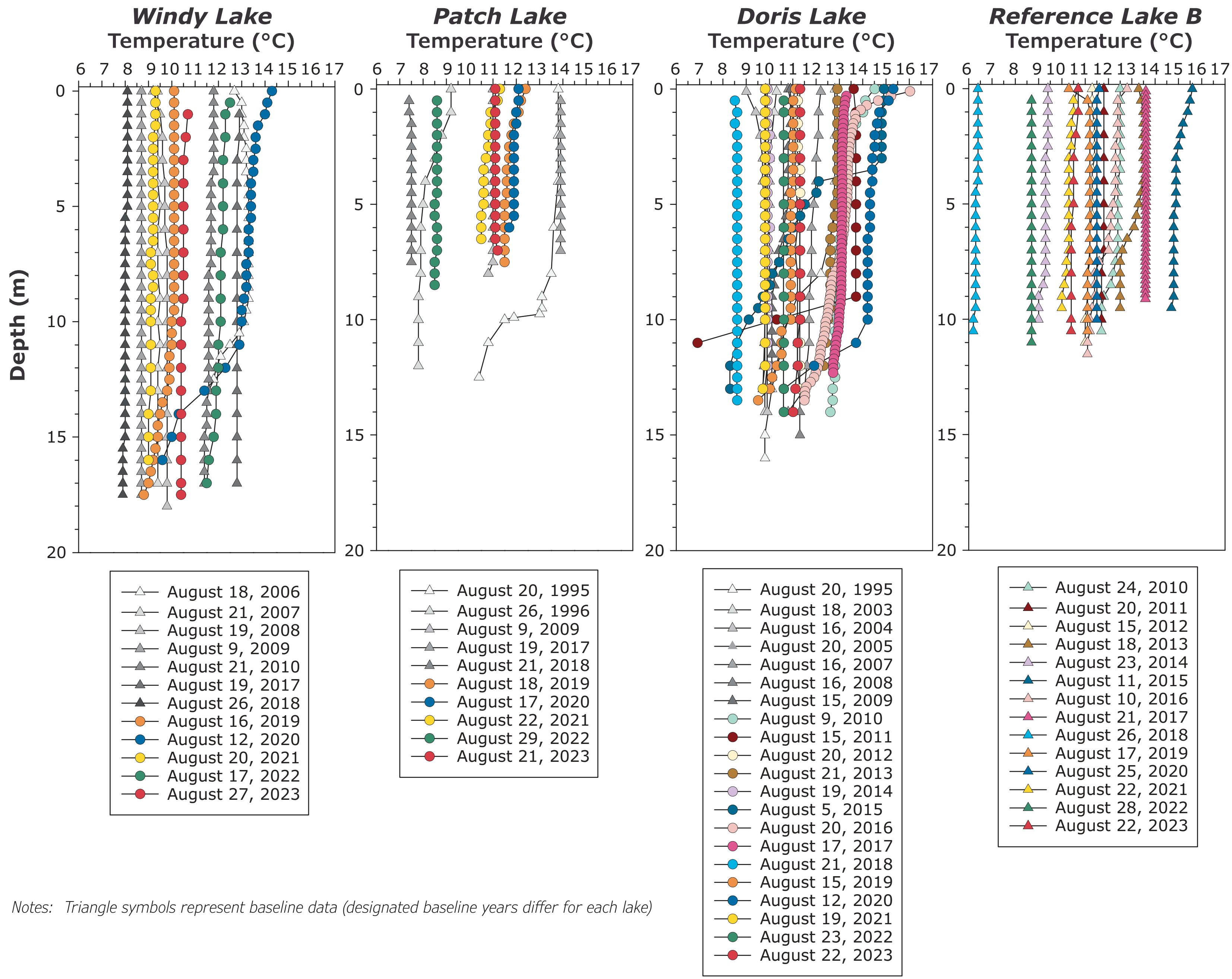


FIGURE 3.2-5 OPEN-WATER TEMPERATURE PROFILES, HOPE BAY AEMP, 1995 TO 2023



Notes: Triangle symbols represent baseline data (designated baseline years differ for each lake)

FIGURE 3.2-6 OPEN-WATER TEMPERATURE PROFILES FOR AEMP EXPOSURE LAKES, BASELINE YEARS AND 2023

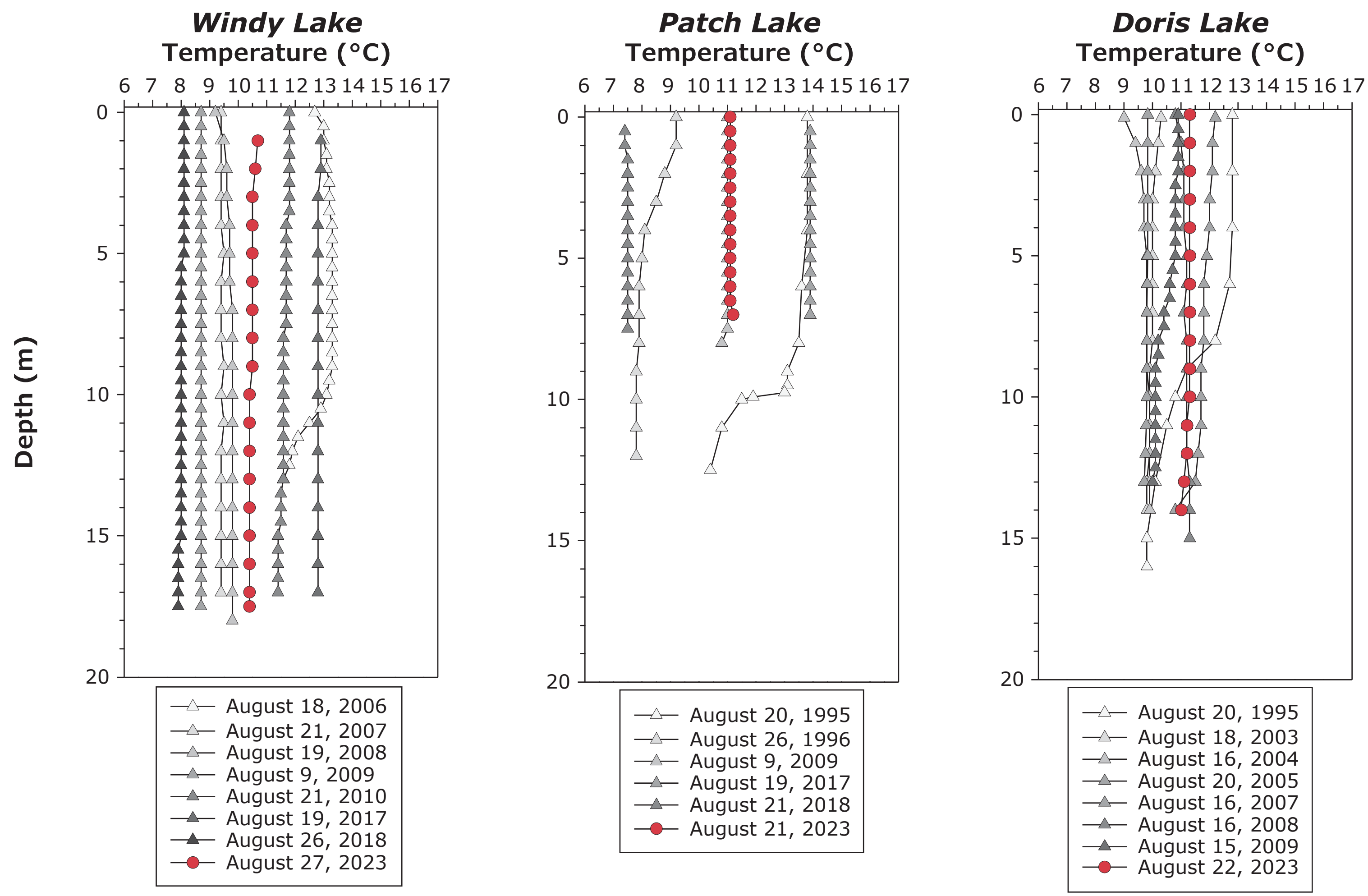
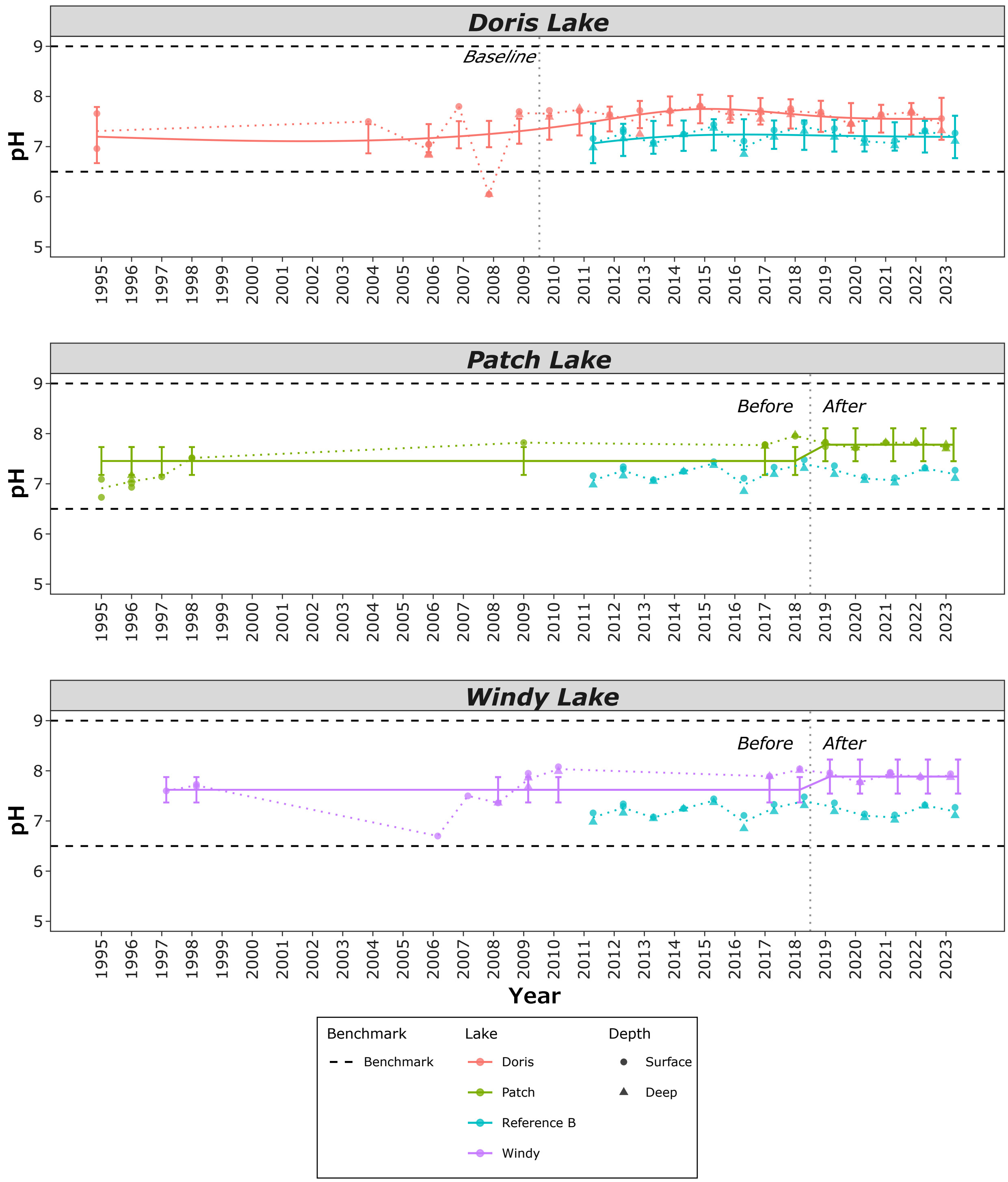
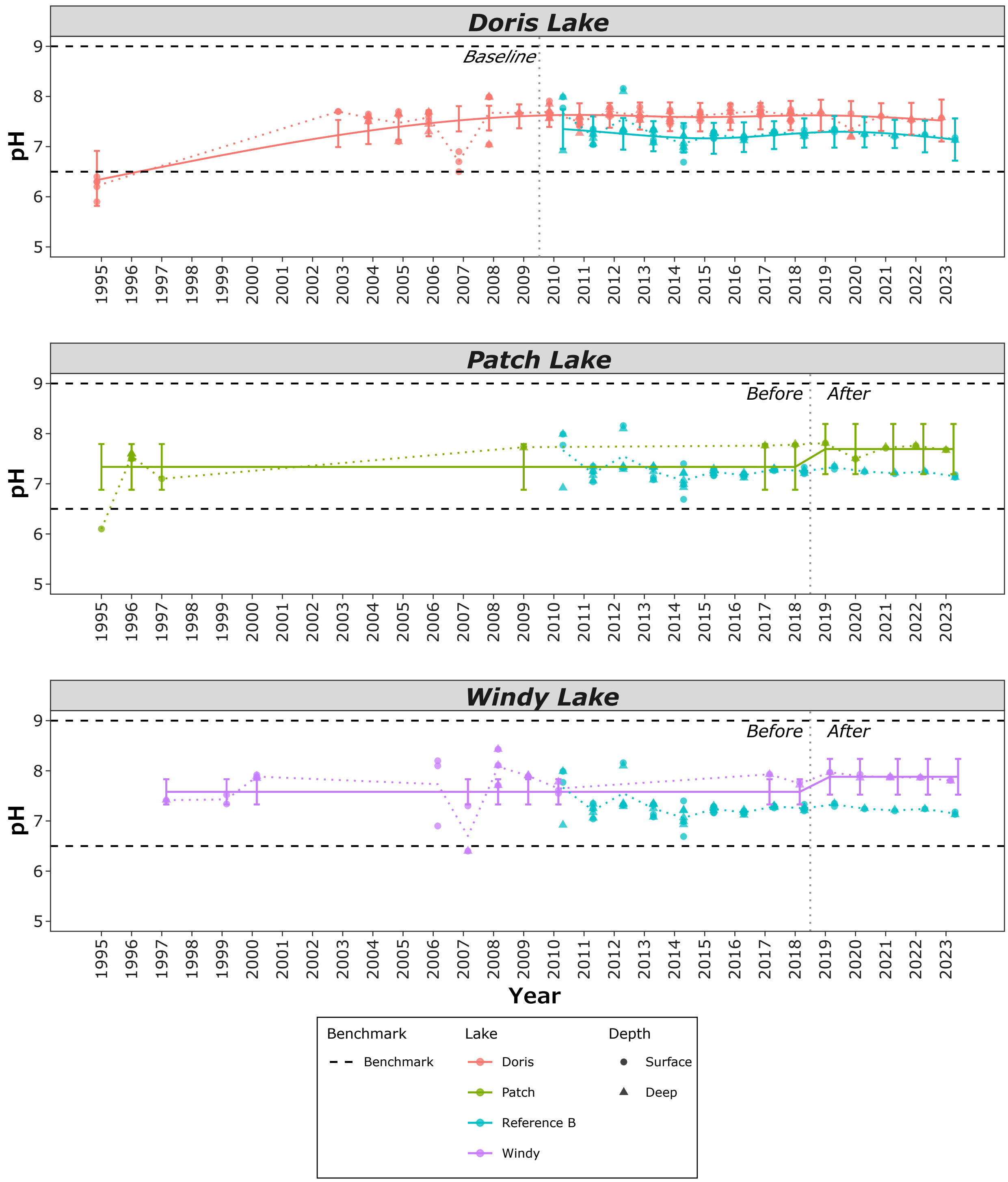


FIGURE 3.3-1A UNDER-ICE PH IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 6.5 to 9.0.

FIGURE 3.3-1B OPEN-WATER PH IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 6.5 to 9.0.

ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-002:2

No effects were detected for pH in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for pH were not exceeded in 2023.

3.3.2 TOTAL SUSPENDED SOLIDS

Statistical analyses indicated a significant change over time for TSS concentrations in Doris Lake during the under-ice season (Table 3.3-2). Statistical comparison to the reference lake were not completed as more than 50% of observations from the monitoring period, including all the 2023 observations, were less than the DL (<1 mg/L; Section C.3.1.2 in Appendix C). Graphical analysis indicated that during the under-ice season the trend over time in Doris Lake has not followed a consistent directional change and may be influenced by the decrease observed from 1995 to the next available monitoring year, 2004 (Figure 3.3-2a). Mean under-ice TSS concentrations in 2023 (1.45 mg/L) were within the observed baseline range (<1 to 4 mg/L) for Doris Lake.

Statistical analyses for Patch and Windy lakes were not completed as more than 50% of observations from the monitoring period and/or all the 2023 observations, were less than the DL (Section C.3.1.2 in Appendix C). Graphical analysis indicated that TSS concentrations in Patch and Windy lakes in 2023 were less than the DL or detectable and marginally (<2-times) greater the DL during the under-ice season (1.0 to 1.4 mg/L) but within the observed baseline range (Figures 3.3-2a and 3.3-2b).

Under-ice and open-water TSS for all three exposure lakes were less the benchmark in 2023 (Tables 2.2-2 and Table 2.2-3; Figures 3.3-2a and 3.3-2b).

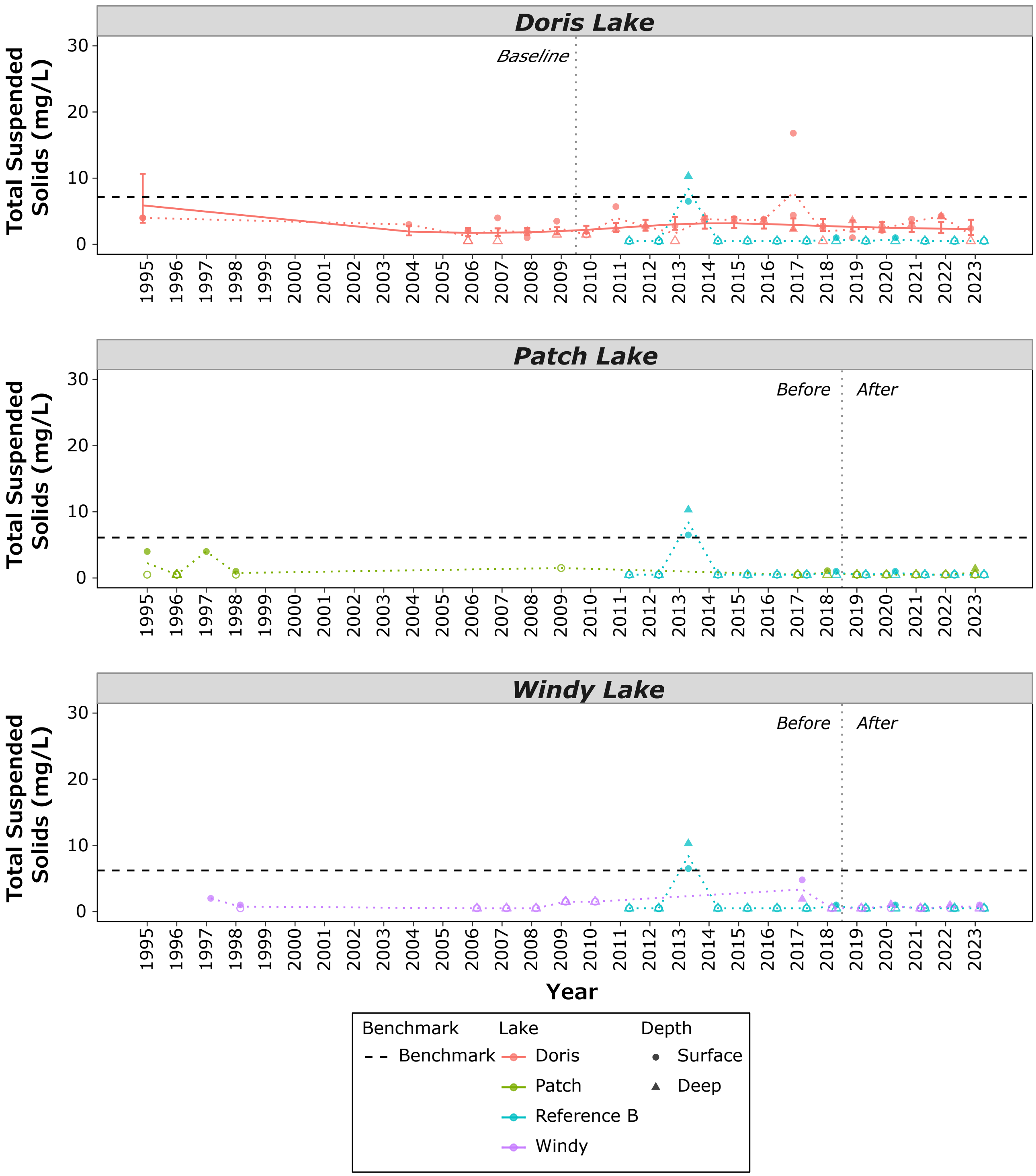
No effects were detected for TSS concentrations in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for TSS were not exceeded in 2023.

TABLE 3.3-2 TOTAL SUSPENDED SOLIDS STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (0.0116)	-	NA	NA
	Open-Water	No (0.6708)	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

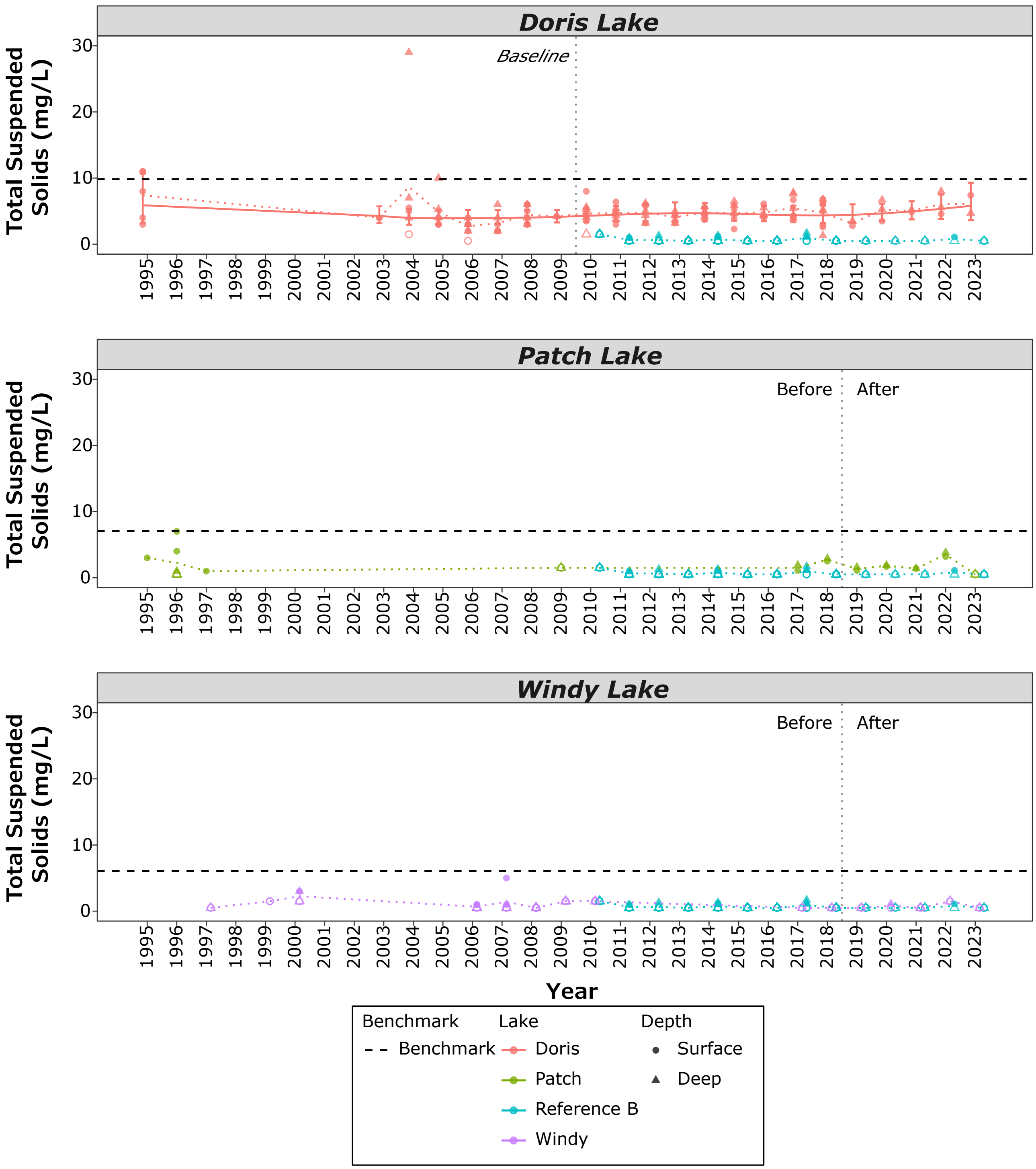
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-2A UNDER-ICE TOTAL SUSPENDED SOLIDS IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is lake specific, see Table 2.2-3.

FIGURE 3.3-2B OPEN-WATER TOTAL SUSPENDED SOLIDS IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is lake specific, see Table 2.2-3.

3.3.3 TURBIDITY

Statistical analyses indicated no significant change over time for turbidity in Doris Lake (Table 3.3-3). Under-ice turbidity in 2023 in Doris Lake was less than the benchmark; however, the open-water turbidity exceeded the benchmark (Tables 2.2-2 and 2.2-3; Figures 3.3-3a and 3.3-3b). The benchmark for turbidity is based on an increase of 2 NTU from the mean turbidity observed during baseline years for each season, and in Doris Lake for the open-water season there is limited baseline data (i.e., N=2) with a variance of 2.5 to 4.89 NTU. The 2023 open-water turbidity in Doris Lake is within 2 NTU of the mean 2009 turbidity.

There was no significant change between the before-and-after period means in Patch or Windy lakes (Table 3.3-3). Mean under-ice turbidity in Patch Lake in 2023 was elevated (3.26 NTU) compared to the long-term trend in Patch Lake (<2 NTU), except for an observation in 1997 (4.4 NTU; Figure 3.3-3a). Both under-ice observations in Patch Lake exceeded the benchmark. Turbidity observations in Windy Lake and the open-water season in Patch Lake were less than the benchmark in 2023 (Figures 3.3-3a and 3.3-3b). Although the 2023 under-ice turbidity exceeded the benchmark, the value is within the observed baseline range.

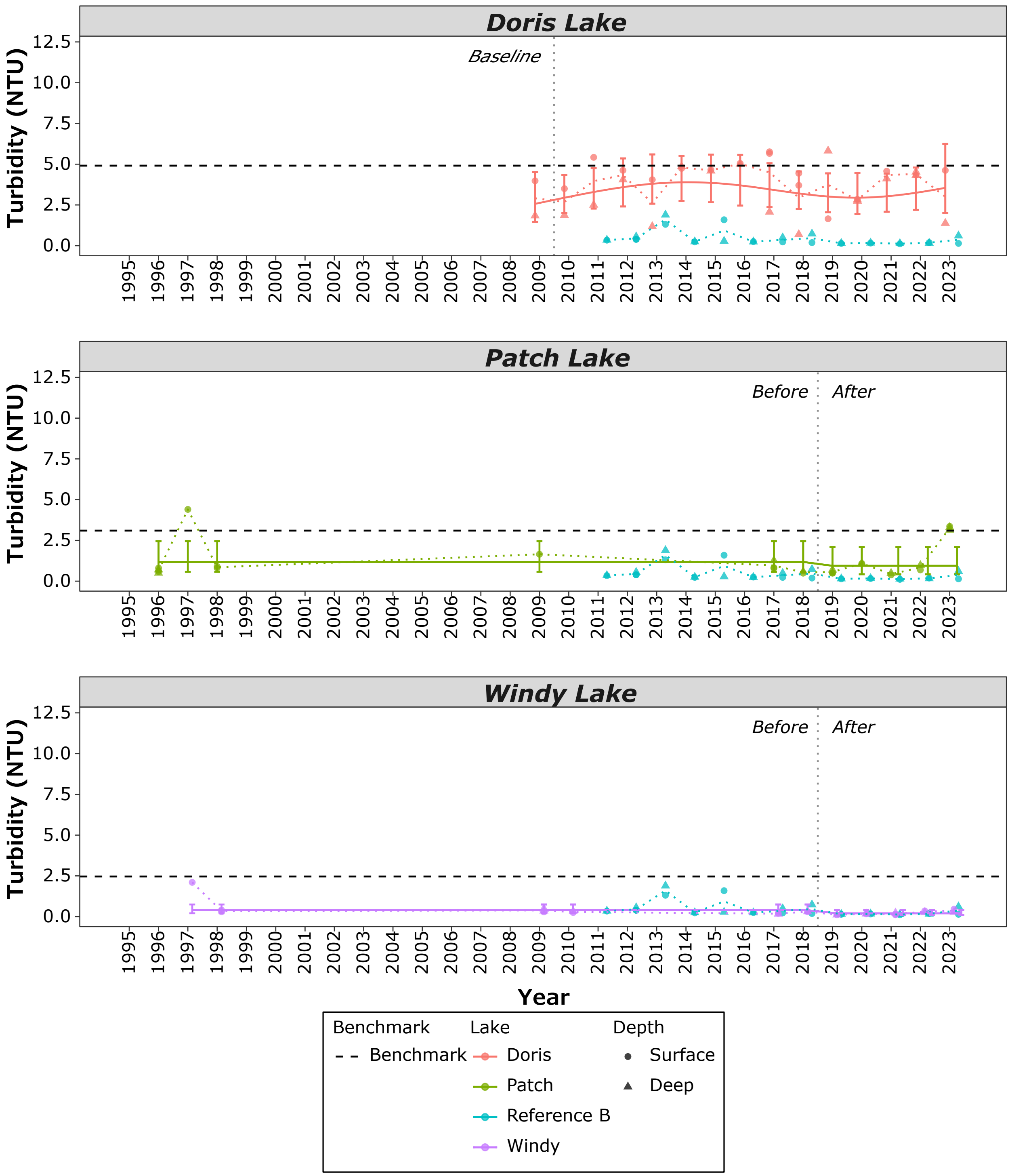
No effects were detected for turbidity in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for turbidity were not exceeded in 2023.

TABLE 3.3-3 TURBIDITY STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.6616)	-	NA	NA
	Open-Water	No (0.2623)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.6506)	-
	Open-Water	NA	NA	No (0.7413)	-
Windy	Ice-covered	NA	NA	No (0.1535)	-
	Open-Water	NA	NA	No (0.1169)	-

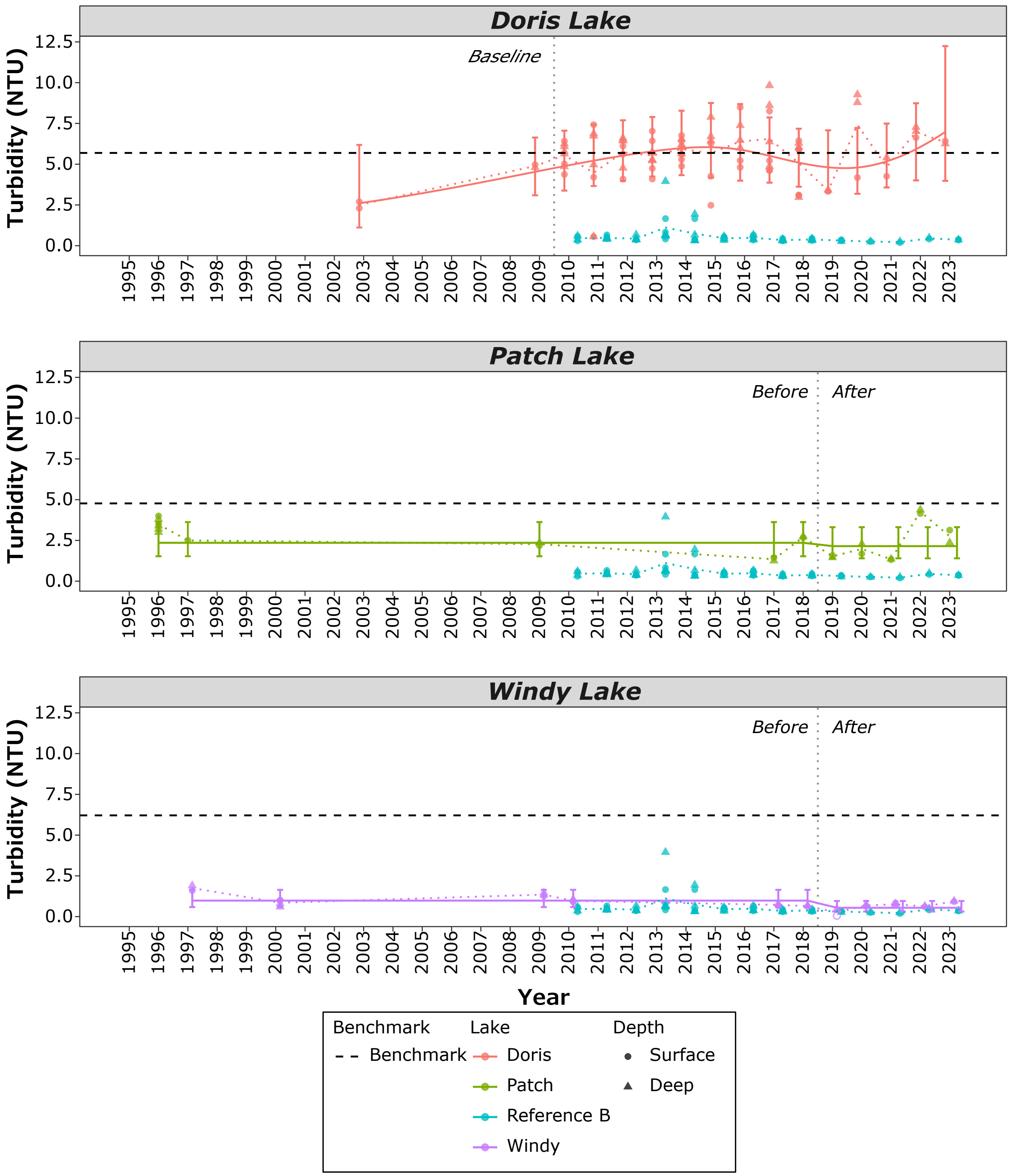
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-3A UNDER-ICE TURBIDITY IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is lake specific, see Table 2.2-3.

FIGURE 3.3-3B   OPEN-WATER TURBIDITY IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is lake specific, see Table 2.2-3.

3.3.4 CHLORIDE

Statistical analyses indicated a significant change over time for chloride concentrations in Doris Lake during both seasons, and relative to the reference lake (Table 3.3-4). Graphical analyses indicated that chloride concentrations in Doris Lake decreased from 2015 to 2019, and concentrations have been stable (within 10% of each annual measurement) since 2020 (Figures 3.3-4a and 3.3-4b). It is noted that a decrease in chloride concentrations is not considered to be an adverse effect (TMAC 2018).

Statistical analyses indicated no significant difference between the before-and-after period means for chloride concentrations in Patch or Windy lakes during either season (Table 3.3-4).

Under-ice and open-water chloride concentrations for all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-4a and 3.3-4b).

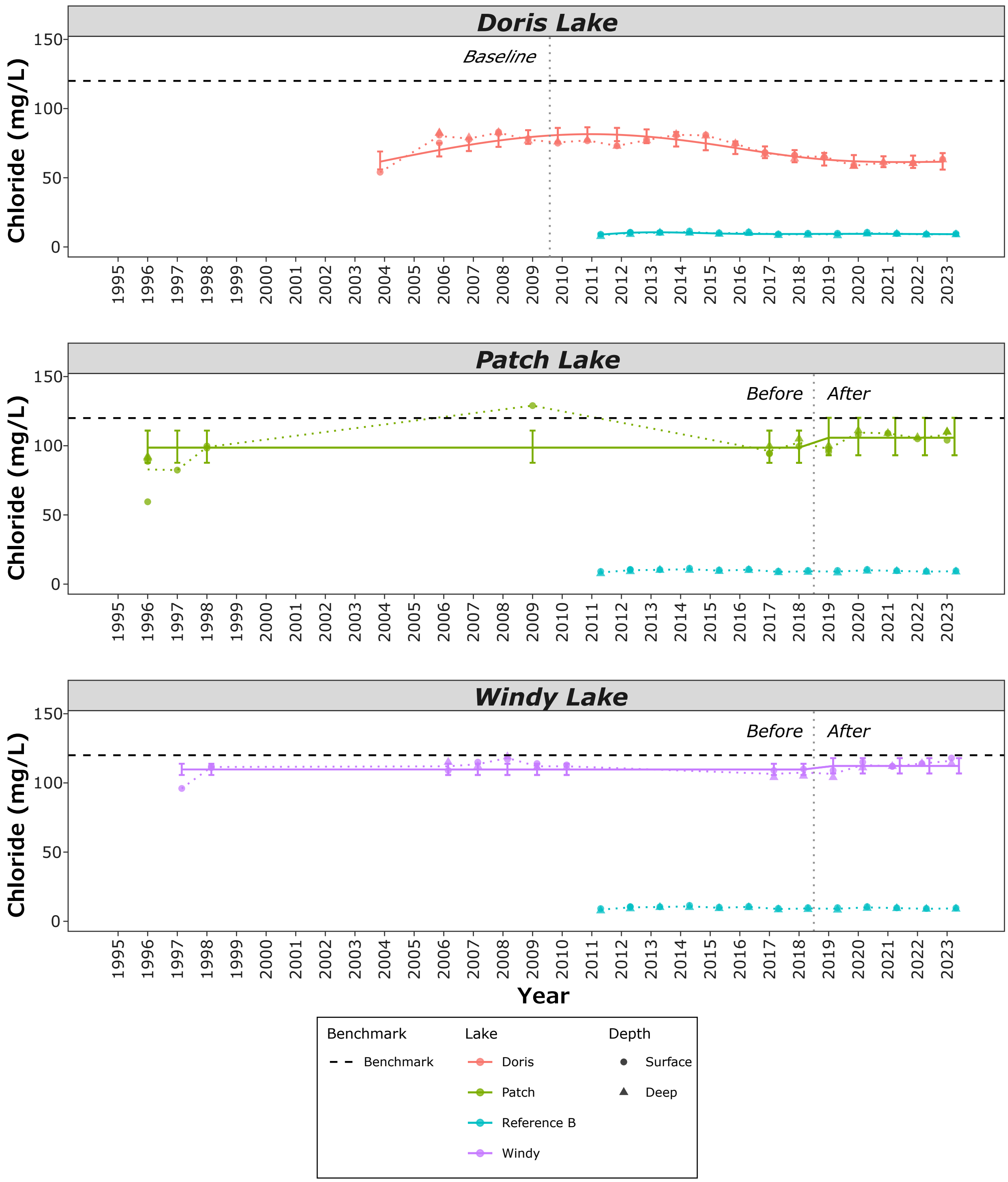
No effects were detected for chloride in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for chloride were not exceeded in 2023. \

TABLE 3.3-4 CHLORIDE STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (<0.00001)	Yes (<0.00001)	NA	NA
	Open-Water	Yes (<0.00001)	Yes (<0.00001)	NA	NA
Patch	Ice-covered	NA	NA	No (0.3886)	-
	Open-Water	NA	NA	No (0.7877)	-
Windy	Ice-covered	NA	NA	No (0.4382)	-
	Open-Water	NA	NA	No (0.4522)	-

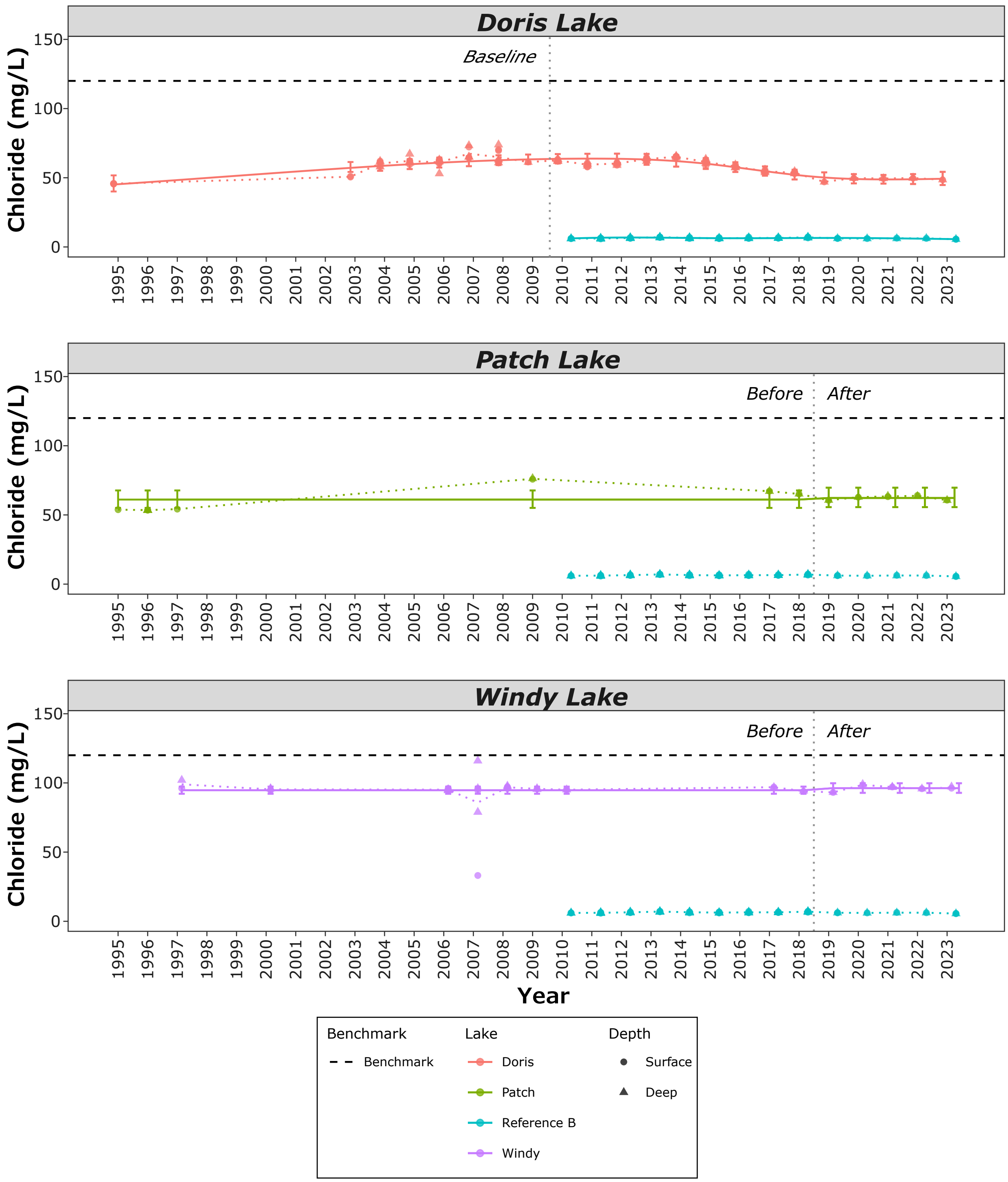
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-4A UNDER-ICE CHLORIDE IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 120 mg/L..

FIGURE 3.3-4B OPEN-WATER CHLORIDE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 120 mg/L.

3.3.5 FLUORIDE

Statistical analyses indicated no significant change over time for fluoride concentrations in Doris Lake and between the before-and-after period means in Patch and Windy lakes (Table 3.3-5). Graphical analyses indicated that fluoride concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-5a and 3.3-5b).

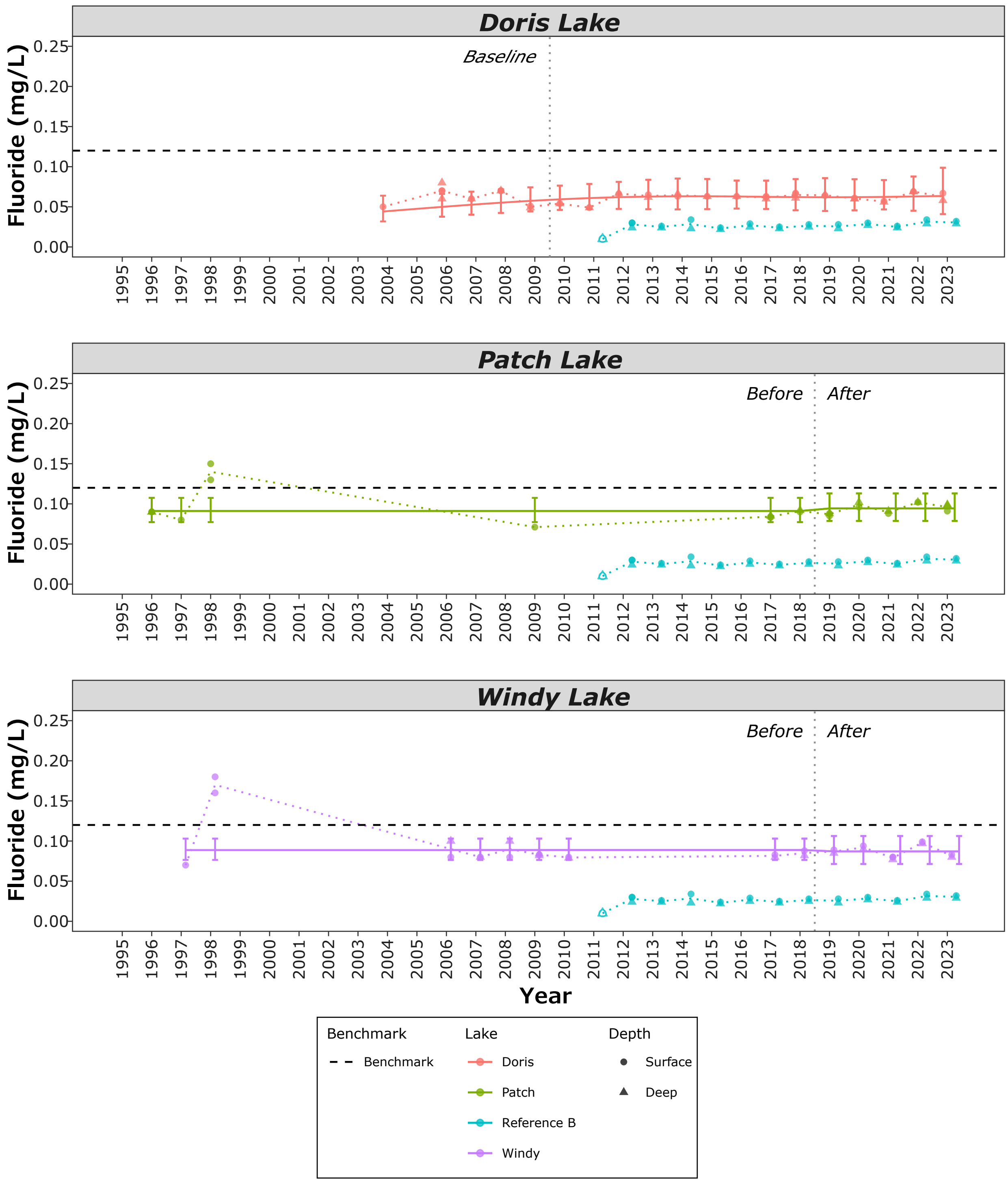
No effects were detected for fluoride in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for fluoride were not exceeded in 2023.

TABLE 3.3-5 FLUORIDE STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	**Season**	**Trend Analysis**		**BACI**	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	No (0.1920)	-	NA	NA
	Open-Water	No (0.8495)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.7577)	-
	Open-Water	NA	NA	No (0.6785)	-
Windy	Ice-covered	NA	NA	No (0.8724)	-
	Open-Water	NA	NA	No (0.3802)	-

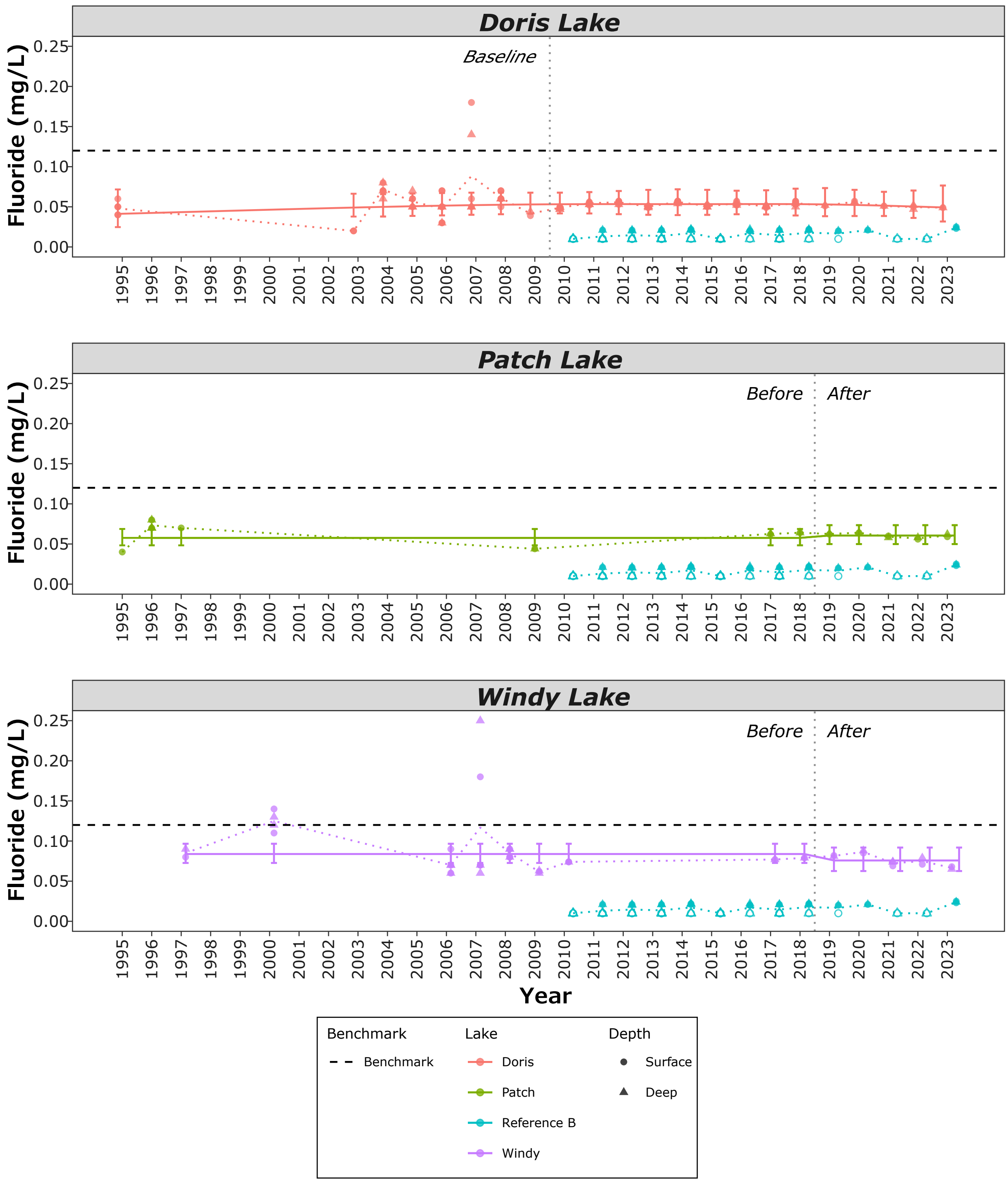
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-5A UNDER-ICE FLUORIDE IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.12 mg/L.

FIGURE 3.3-5B OPEN-WATER FLUORIDE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.12 mg/L.

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3.3.6 TOTAL AMMONIA

Statistical analyses indicated no significant changes over time for under-ice total ammonia concentrations in Doris Lake or between the before-and-after period means in Patch or Windy lakes (Table 3.3-6). Statistical analyses were not completed for the open-water season due to the high proportion of data, including the 2023 observations, that were less than the DL (<0.0050 mg/L; Section C.3.1.6 in Appendix C). Graphical analyses indicated that open-water total ammonia concentrations in all three exposure lakes were less than the DL, except for one observation in Patch Lake that was marginally greater (<5-times) than the DL (Figure 3.3-6b). The total ammonia benchmark is dependent on pH- and temperature (Table 2.2-4). The minimum benchmark based on the observed temperature and pH during the under-ice season was 1.3 mg/L and 0.86 mg/L during the open-water season (Table 2.2-4). Ammonia concentrations in all the exposure lakes were less than the benchmark in 2023 (Figures 3.3-6a and 3.3-6b; Table A.3-5 in Appendix A).

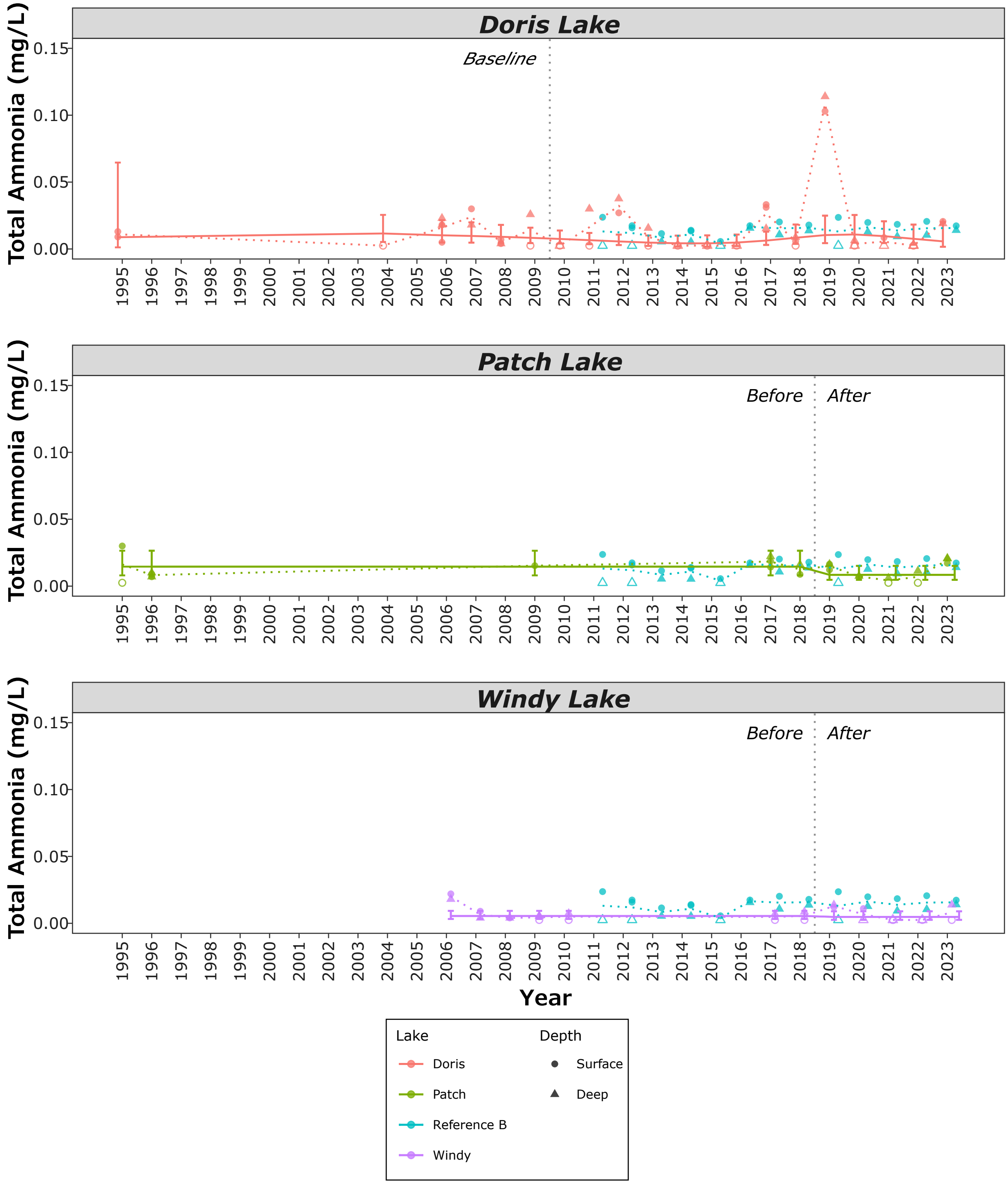
No effects were detected for total ammonia in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total ammonia were not exceeded in 2023.

TABLE 3.3-6 TOTAL AMMONIA STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.9500)	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.1683)	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	No (0.7181)	-
	Open-Water	NA	NA	-	-

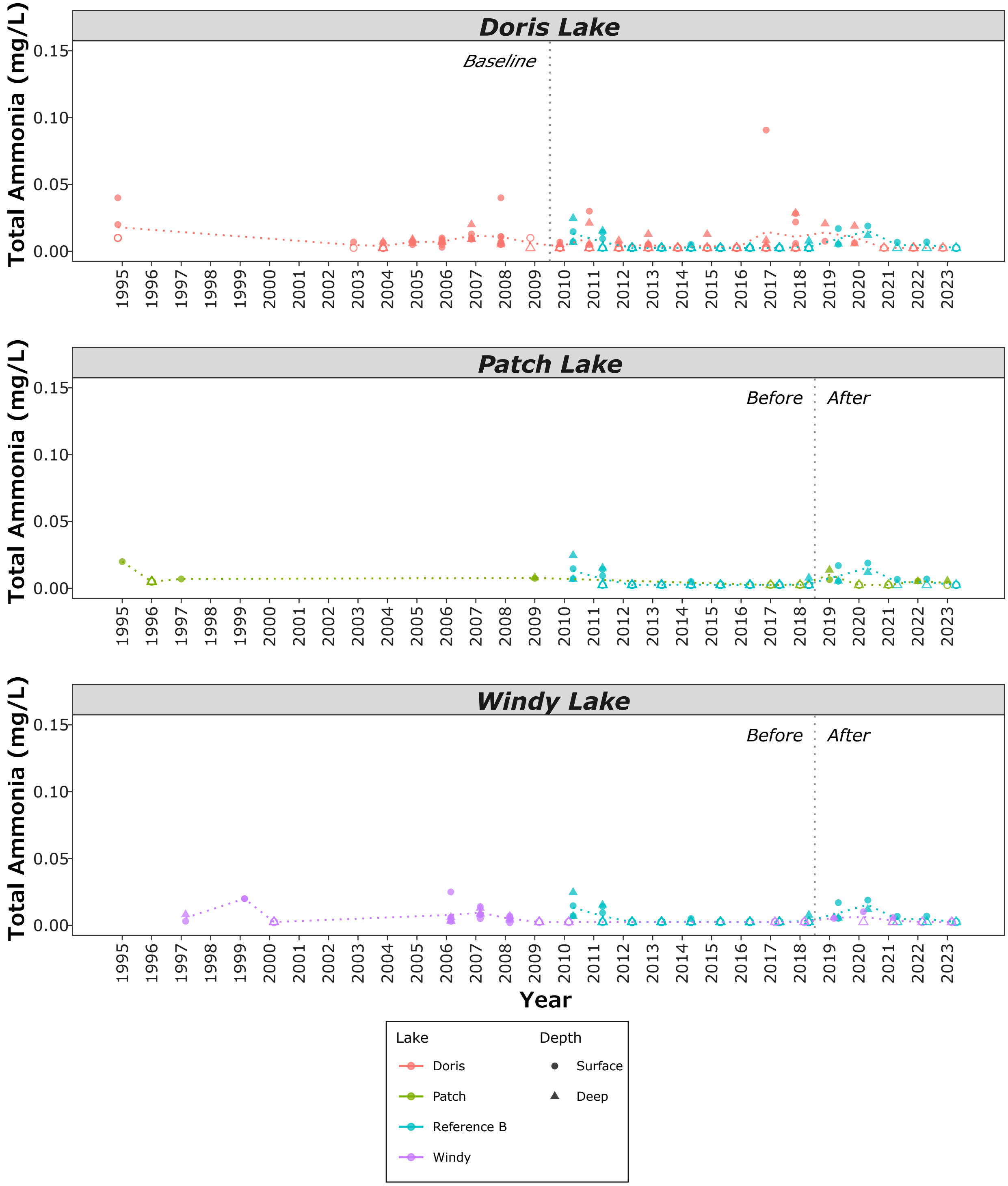
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-6A UNDER-ICE TOTAL AMMONIA IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: *Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.*
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is pH and temperature dependent, see Table 2.2-4.

FIGURE 3.3-6B   OPEN-WATER TOTAL AMMONIA IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is pH and temperature dependent, see Table 2.2-4.

3.3.7 NITRATE

Statistical analyses indicate no significant change over time for under-ice nitrate concentrations in Doris Lake or between the before-and-after period means in Patch Lake (Table 3.3-7). Statistical analyses were not completed for Windy Lake or for the open-water season due to the high proportion of data, including the 2023 observations, that were less than the DL (<0.005 mg/L; section C.3.1.7 in Appendix C). Graphical analyses indicated that nitrate concentrations in Windy Lake during the under-ice seasons and for all three exposure lakes during the open-water season were less than the DL or marginally greater (<5-times) than the DL (Figures 3.3-7a and 3.3-7b). Nitrate concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-7a and 3.3-7b).

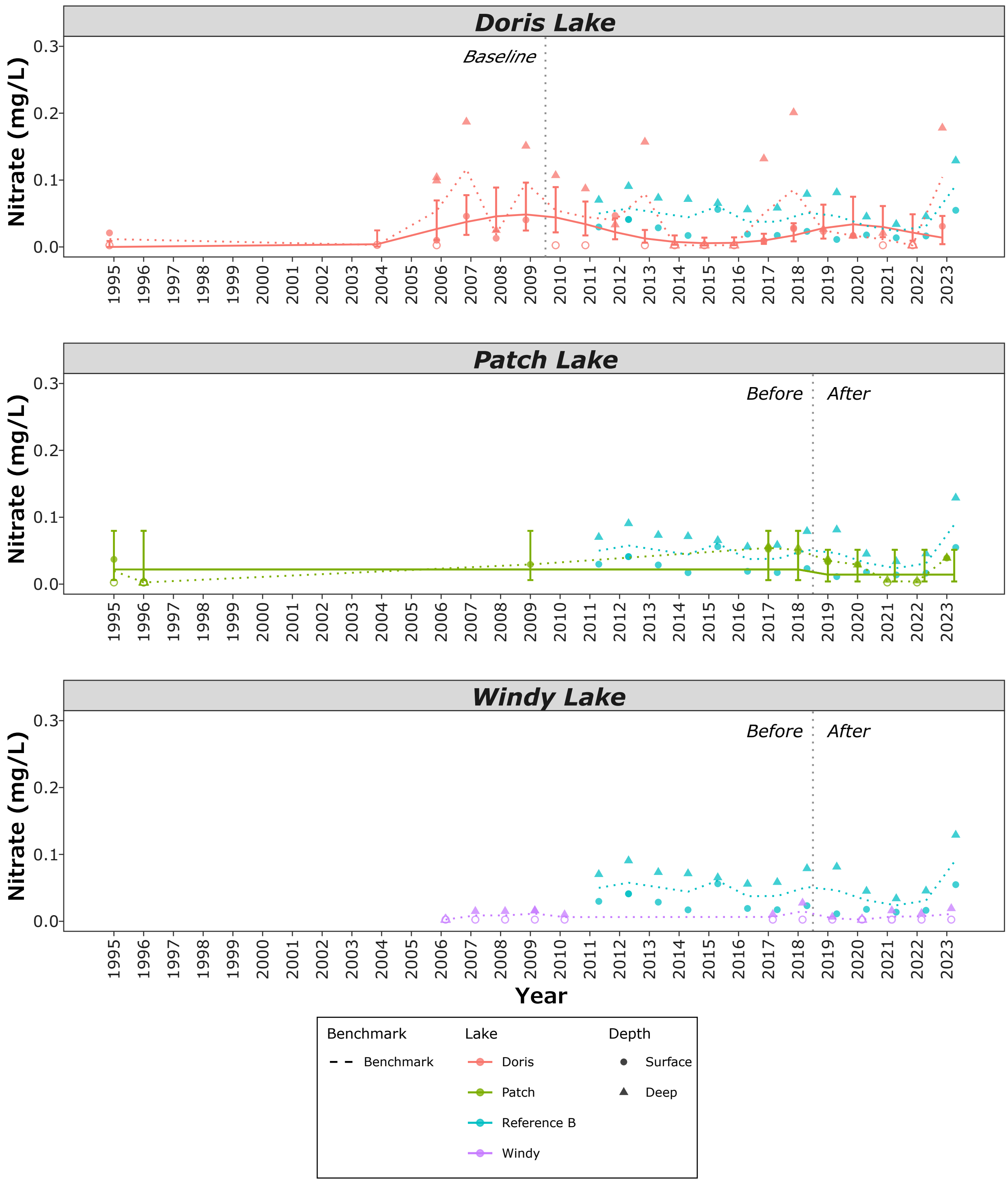
No effects were detected for nitrate in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for nitrate were not exceeded in 2023.

TABLE 3.3-7 NITRATE STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.3539)	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.5948)	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

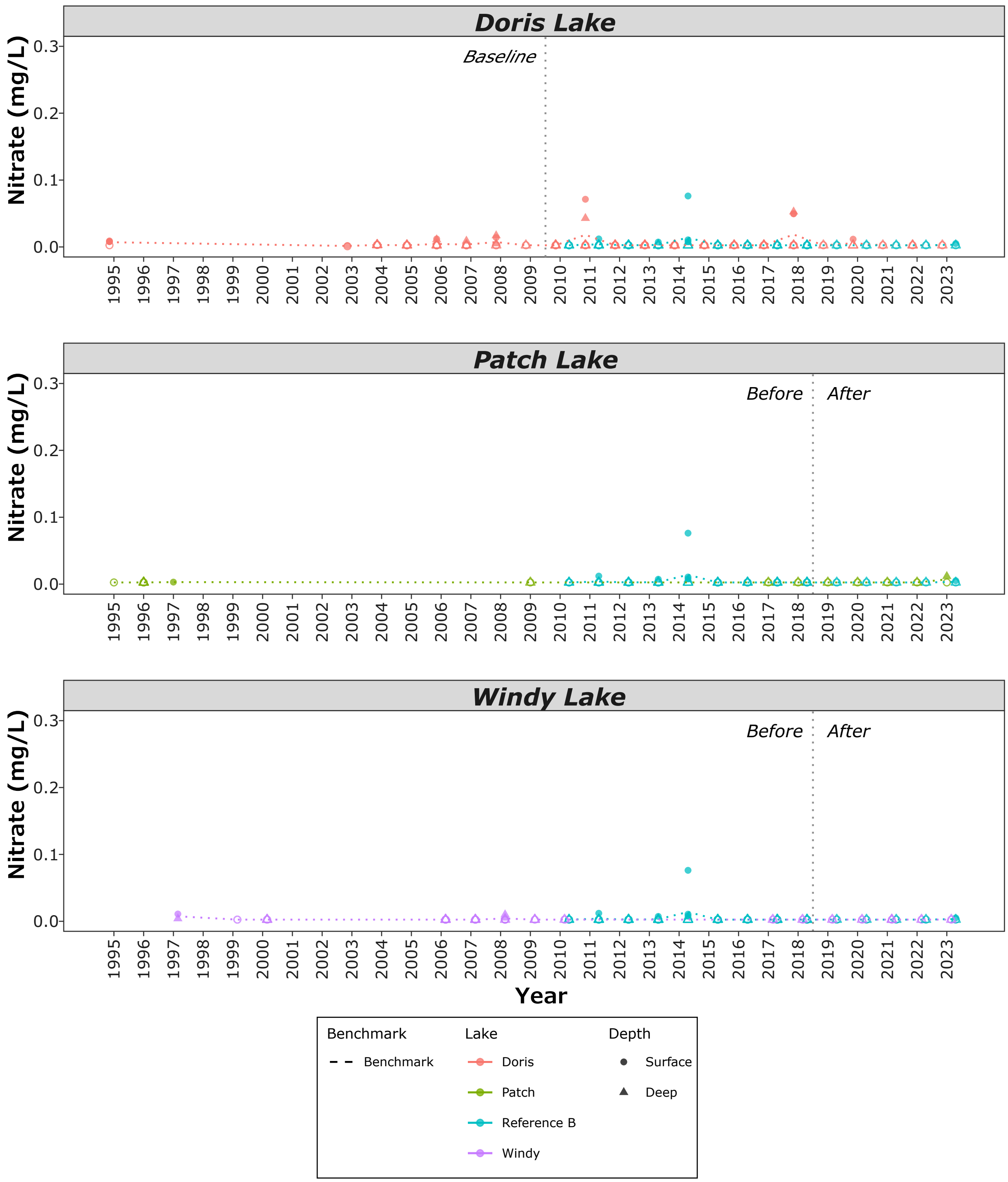
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-7A UNDER-ICE NITRATE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 3 mg/L (not visible on presented range).

FIGURE 3.3-7B OPEN-WATER NITRATE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 3 mg/L (not visible on presented range).

3.3.8 NITRITE

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.0010 mg/L; Table 3.3-8; Section C.3.1.8 in Appendix C). Graphical analyses indicate that all nitrite concentrations were less than DL and less than the benchmark in 2023 (Figures 3.3-8a and 3.3-8b).

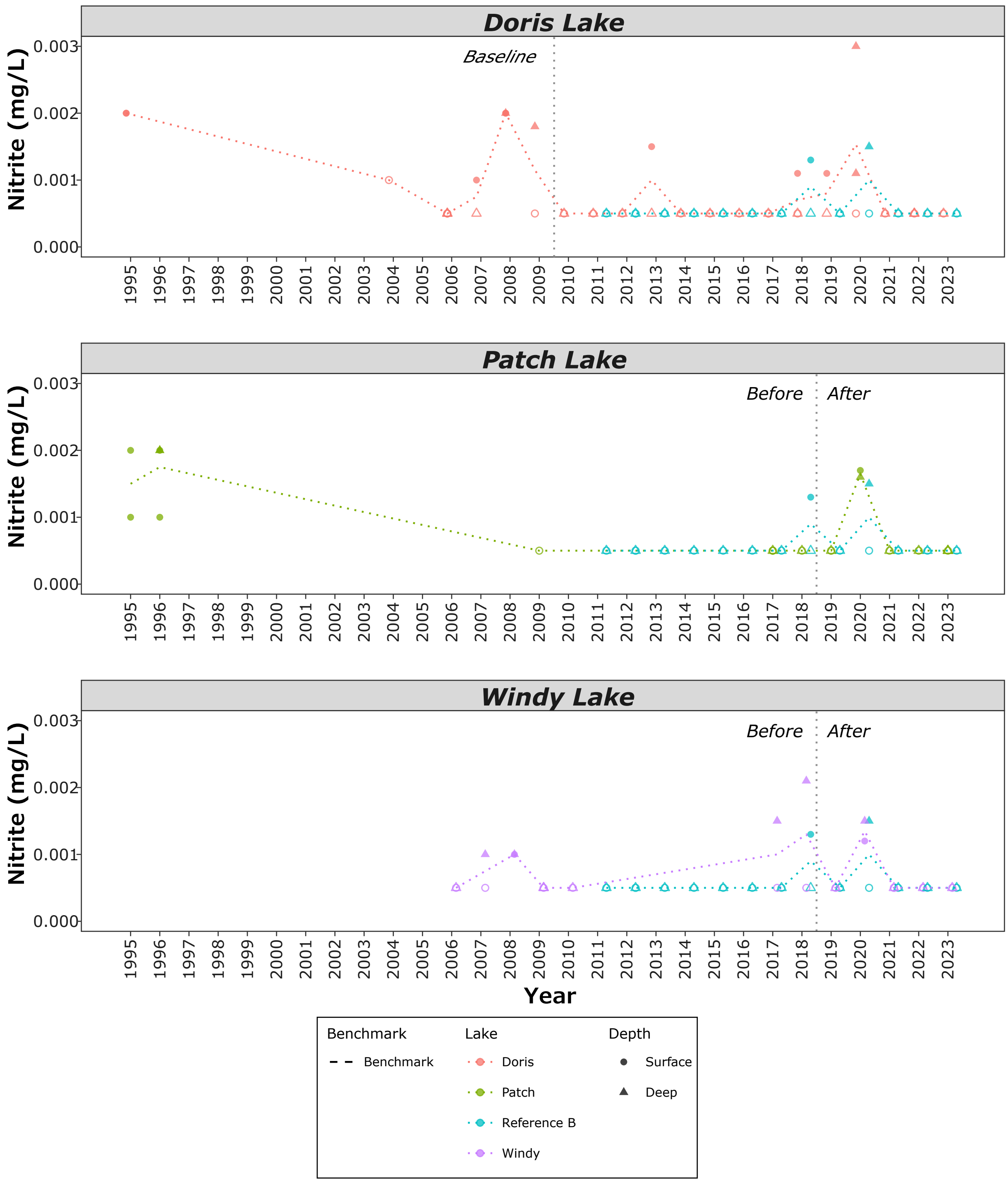
No effects were detected for nitrite in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for nitrite were not exceeded in 2023.

TABLE 3.3-8 NITRITE STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	**Season**	**Trend Analysis**		**BACI**	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

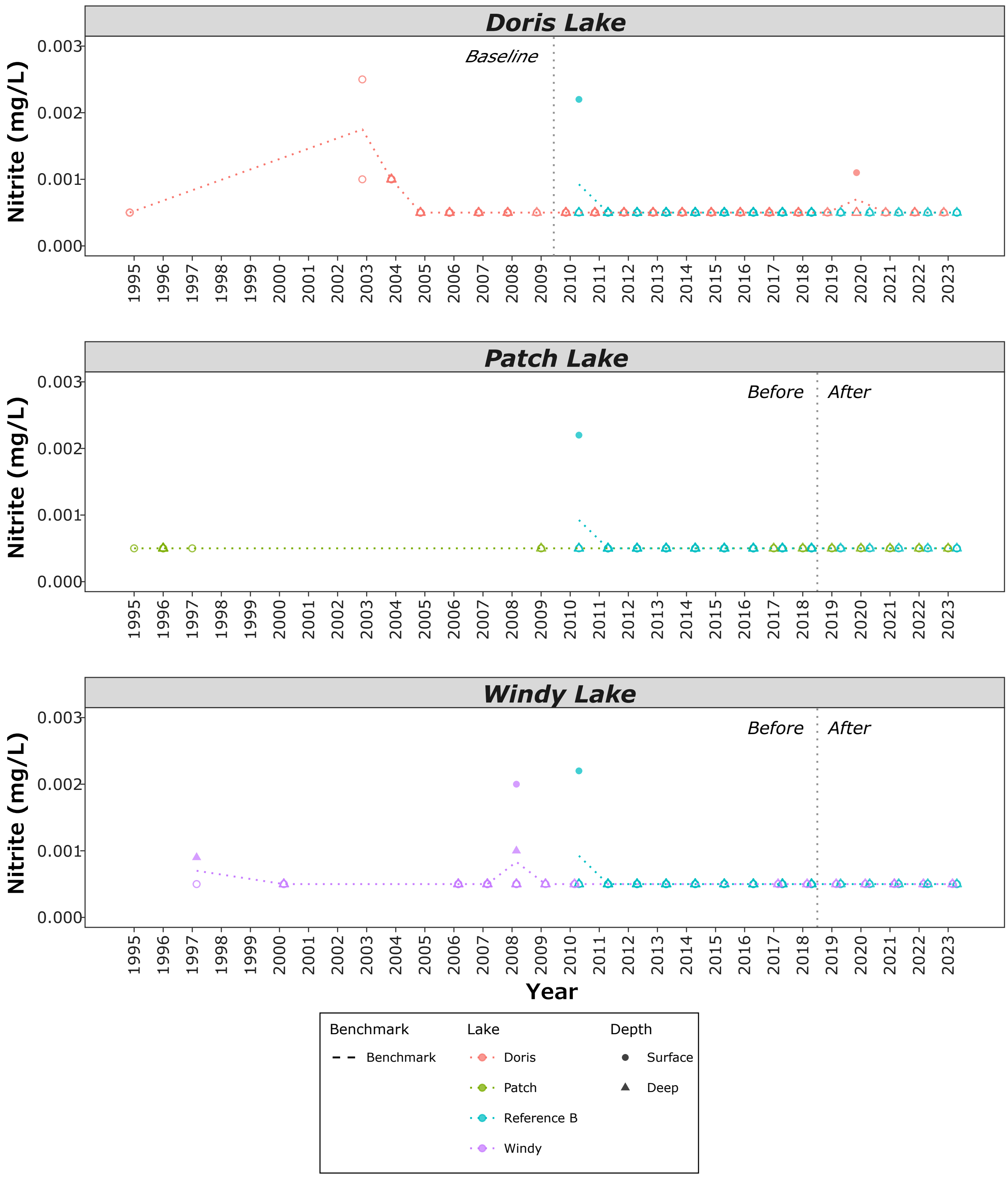
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-8A UNDER-ICE NITRITE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.06 mg/L (not visible on presented range).

FIGURE 3.3-8B OPEN-WATER NITRITE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.06 mg/L (not visible on presented range).

3.3.9 TOTAL PHOSPHORUS

Statistical analyses indicated no significant change over time for total phosphorus concentrations in Doris Lake or between the before-and-after period means in Patch Lake during the under-ice season or Windy Lake during both seasons (Table 3.3-9). A significant difference between the before-and-after period means for open-water season total phosphorus concentrations was detected in Patch Lake, but not relative to the reference lake. There is no benchmark for total phosphorus (Figures 3.3-9a and 3.3-9b).

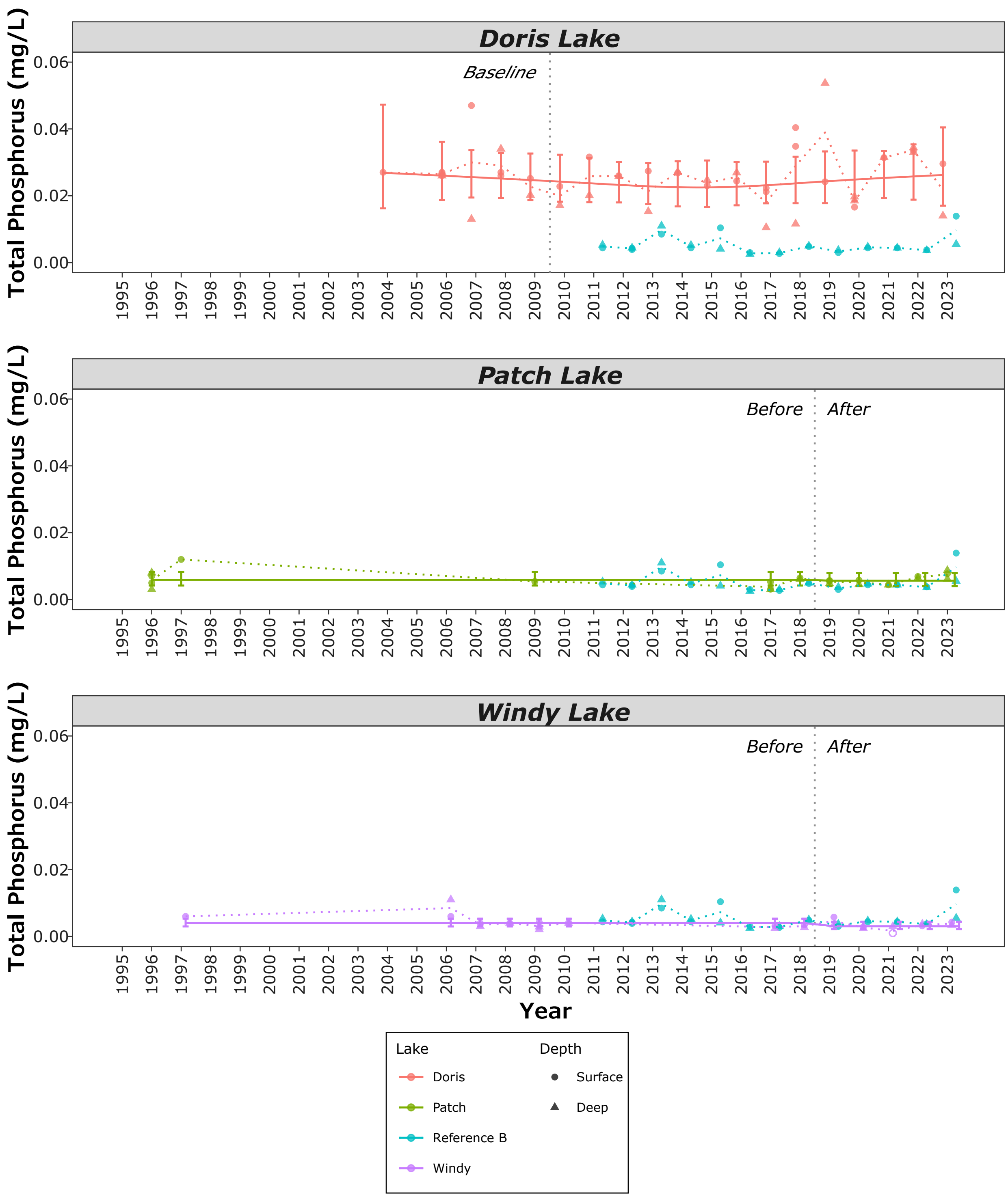
No effects were detected for total phosphorus in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total phosphorus were not exceeded in 2023.

TABLE 3.3-9 TOTAL PHOSPHORUS STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.9189)	-	NA	NA
	Open-Water	No (0.4131)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.8474)	-
	Open-Water	NA	NA	Yes (0.0254)	No (0.0915)
Windy	Ice-covered	NA	NA	No (0.2243)	-
	Open-Water	NA	NA	No (0.5601)	-

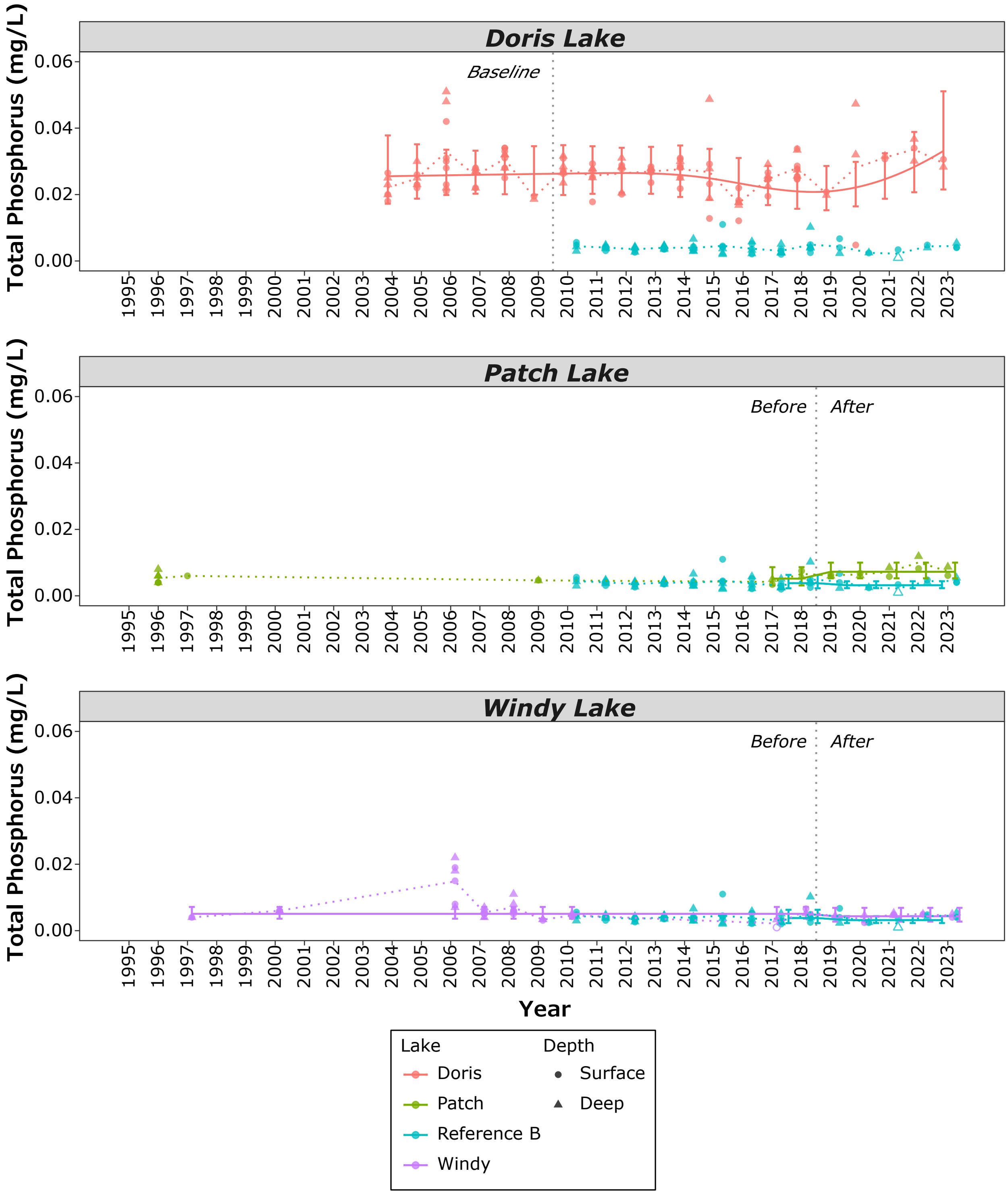
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-9A UNDER-ICE TOTAL PHOSPHORUS IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
There is no applicable benchmark.

FIGURE 3.3-9B   OPEN-WATER TOTAL PHOSPHORUS IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: *Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.*
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
There is no applicable benchmark.

3.3.10 TOTAL ALUMINUM

Statistical analyses indicated no significant changes over time for total aluminum concentrations in Doris Lake and between the before-and-after period means in Patch or Windy lakes (Table 3.3-10). Graphical analyses indicated that total aluminum concentrations were less than the benchmark in Doris and Windy lakes, but greater than the benchmark in Patch Lake, during both seasons in 2023 (Figures 3.3-10a and 3.3-10b). In Patch Lake, under-ice total aluminum concentrations were elevated (mean = 0.192 mg/L) in 2023, approximately 2-times, relative to the historically observed maximum baseline concentration range (0.099 mg/L; Figure 3.3-10a). Additional years of AEMP monitoring will confirm if the increased concentrations continue. During the open-water season in Patch Lake, the mean total aluminum concentration measured in 2023 (0.1280 mg/L) was greater than the benchmark but similar to before period before concentrations in 1996 and 2018 that also exceeded the benchmark (mean = 0.1278 mg/L and 0.1170 mg/L, respectively; Figure 3.3-10b).

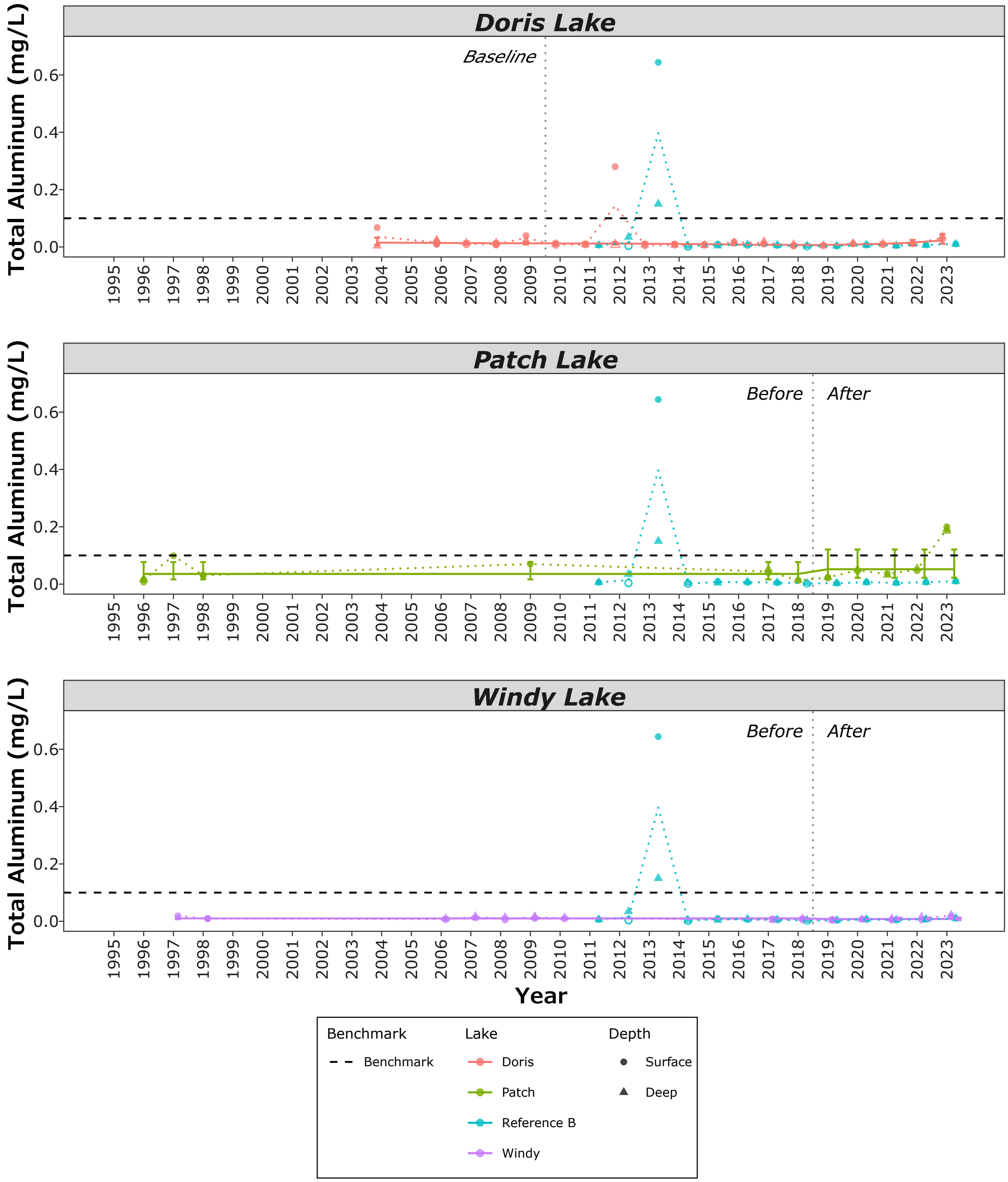
No effects were detected for total aluminum in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total aluminum were not exceeded in 2023.

TABLE 3.3-10 TOTAL ALUMINUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.0909)	-	NA	NA
	Open-Water	No (0.8410)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.4709)	-
	Open-Water	NA	NA	No (0.1449)	-
Windy	Ice-covered	NA	NA	No (0.3981)	-
	Open-Water	NA	NA	No (0.7535)	-

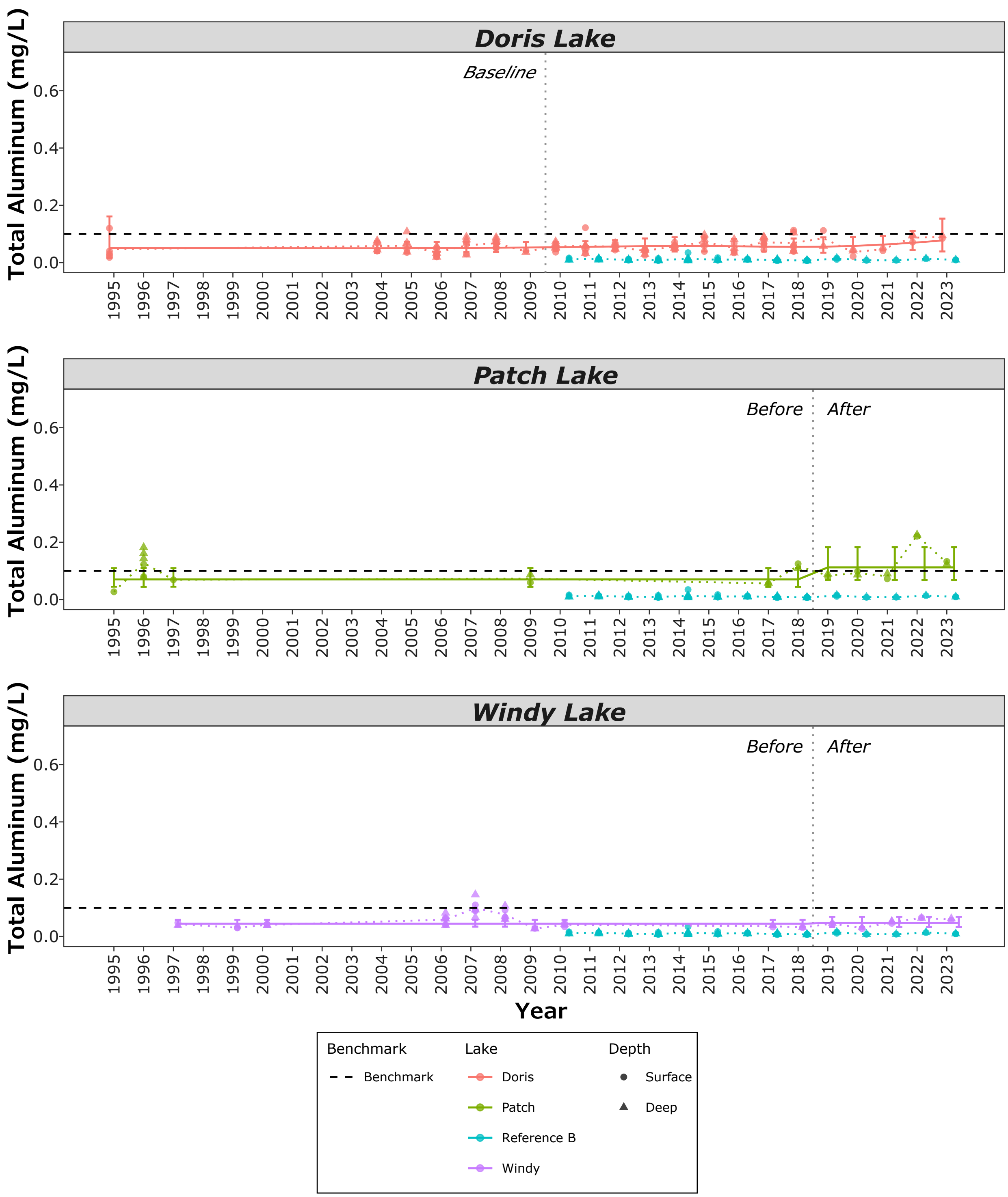
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-10A UNDER-ICE TOTAL ALUMINUM IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.1 mg/L.

FIGURE 3.3-10B OPEN-WATER TOTAL ALUMINUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.1 mg/L.

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3.3.11 TOTAL ARSENIC

Statistical analyses indicated a significant change over time for total arsenic concentrations in Doris Lake during both seasons and relative to the reference lake during the under-ice season (Table 3.3-11). Graphical analyses indicated that total arsenic decreased in Doris Lake during the baseline years (1995 to 2009) and concentrations have been stable (within 10% of each annual measurement) since 2012 (Figures 3.3-4a and 3.3-4b). It is noted that a decrease in total arsenic concentrations is not considered to be an adverse effect (TMAC 2018).

Statistical analyses indicated no significant difference between the before-and-after period means for total arsenic concentrations in Patch or Windy lakes (Table 3.3-11).

Graphical analyses indicated that total arsenic concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-11a and 3.3-11b).

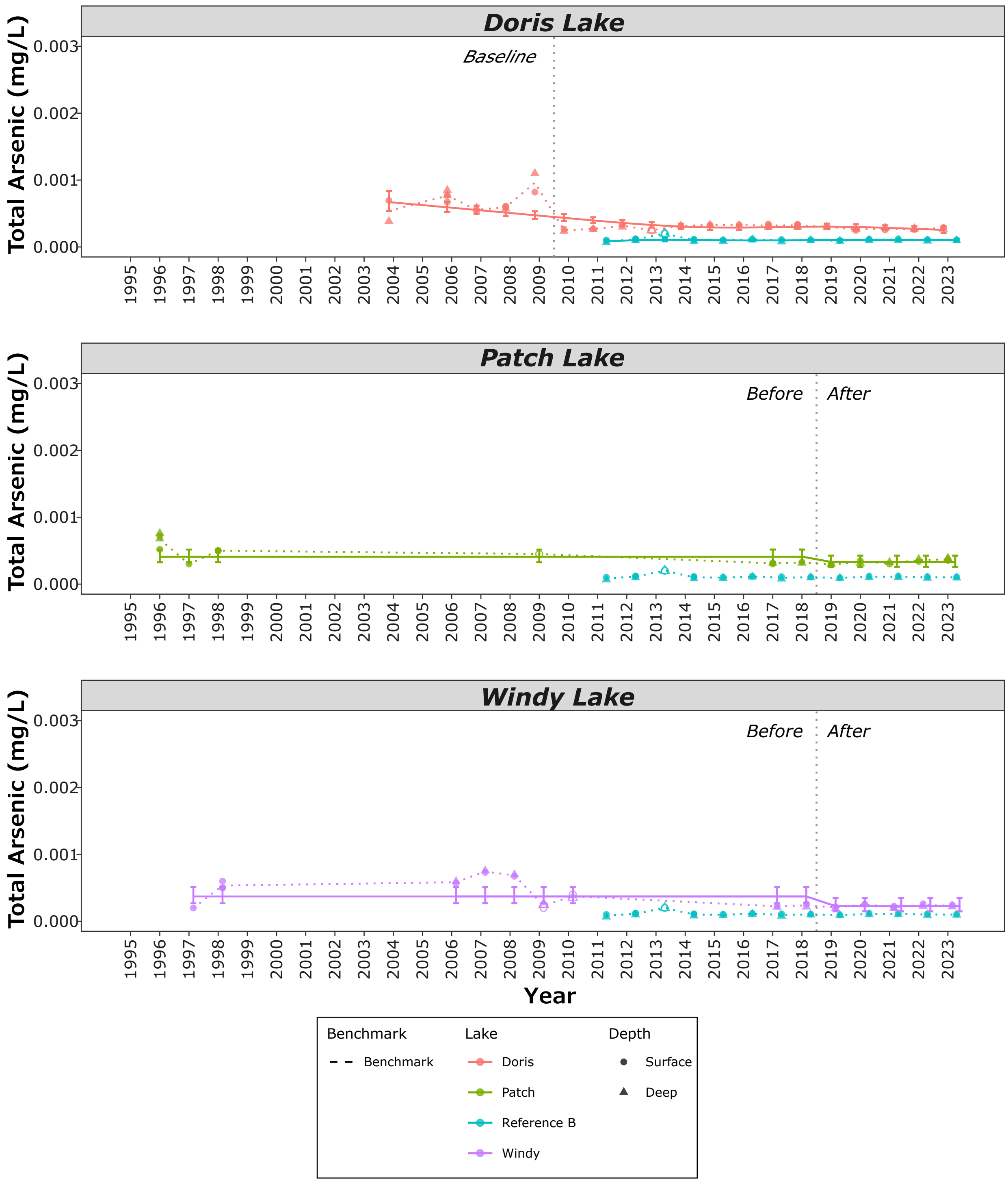
No effects were detected for total arsenic in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total arsenic were not exceeded in 2023.

TABLE 3.3-11 TOTAL ARSENIC STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (<0.00001)	Yes (0.0156)	NA	NA
	Open-Water	Yes (<0.00001)	No (0.1309)	NA	NA
Patch	Ice-covered	NA	NA	No (0.1831)	-
	Open-Water	NA	NA	No (0.6614)	-
Windy	Ice-covered	NA	NA	No (0.0689)	-
	Open-Water	NA	NA	No (0.2026)	-

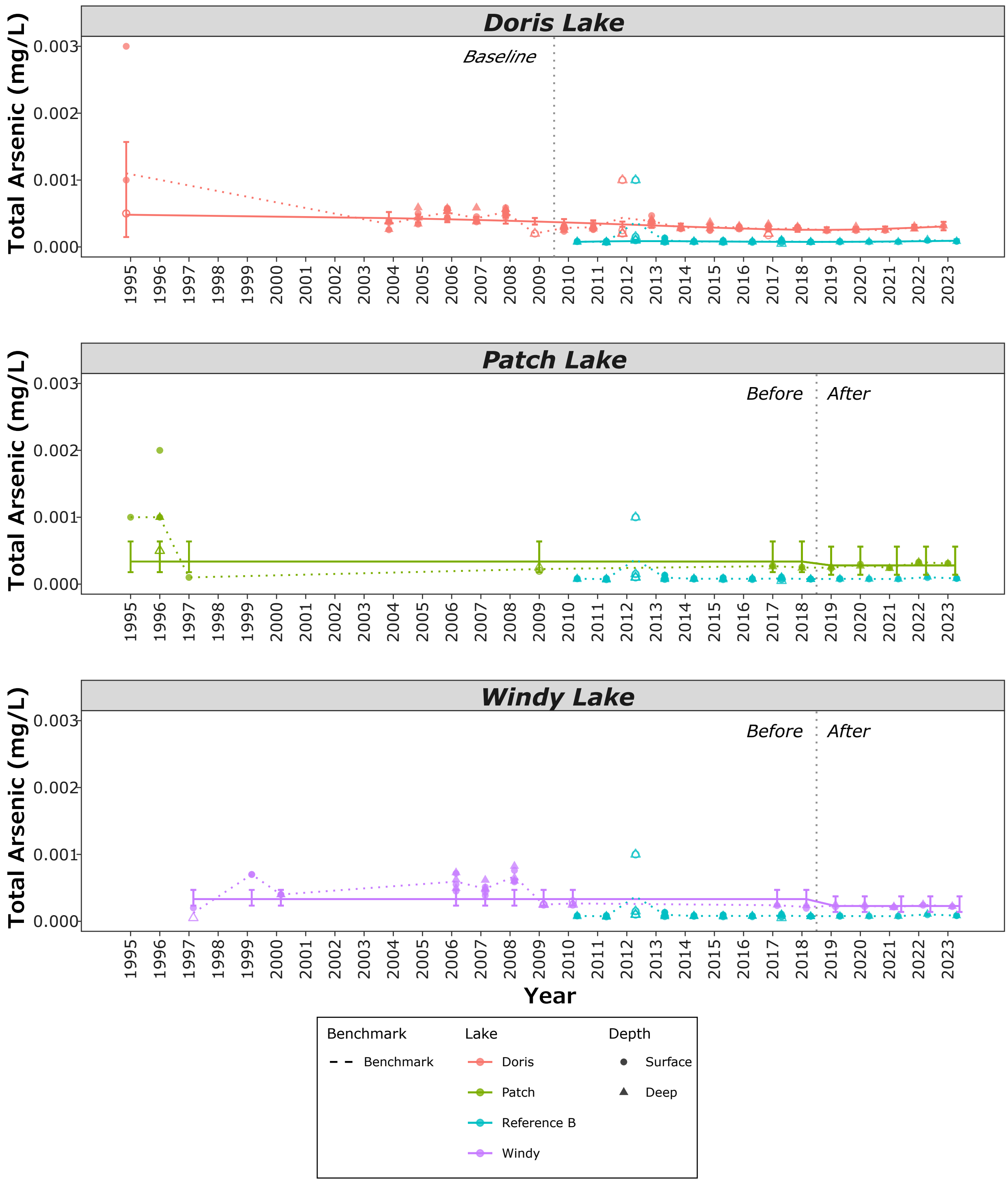
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-11A UNDER-ICE TOTAL ARSENIC IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.005 mg/L (not visible on presented range).

FIGURE 3.3-11B OPEN-WATER TOTAL ARSENIC IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.005 mg/L (not visible on presented range).

3.3.12 TOTAL BORON

Statistical analyses indicated a significant change over time for total boron concentrations in Doris Lake during both seasons (Table 3.3-12). Statistical comparison to the reference lake was not completed due to the high proportion of data, including the 2023 observations, that were less than the DL (<0.010 mg/L; Section C.3.1.12 in Appendix C). Graphical analyses indicated that total boron concentrations in Doris Lake increased from 2010 to 2015 (under-ice from 0.027 to 0.037 mg/L and open-water 0.029 to 0.041mg/L) but have decreased since 2015 (Figure 3.3-12a and 3.3-12b). Total boron concentrations in 2023 were within the baseline range for Doris Lake.

Statistical analyses indicate no significant difference between the before-and-after period means for total boron concentrations in Patch or Windy lakes (Table 3.3-12).

Graphical analyses indicated that total boron concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-12a and 3.2-11b).

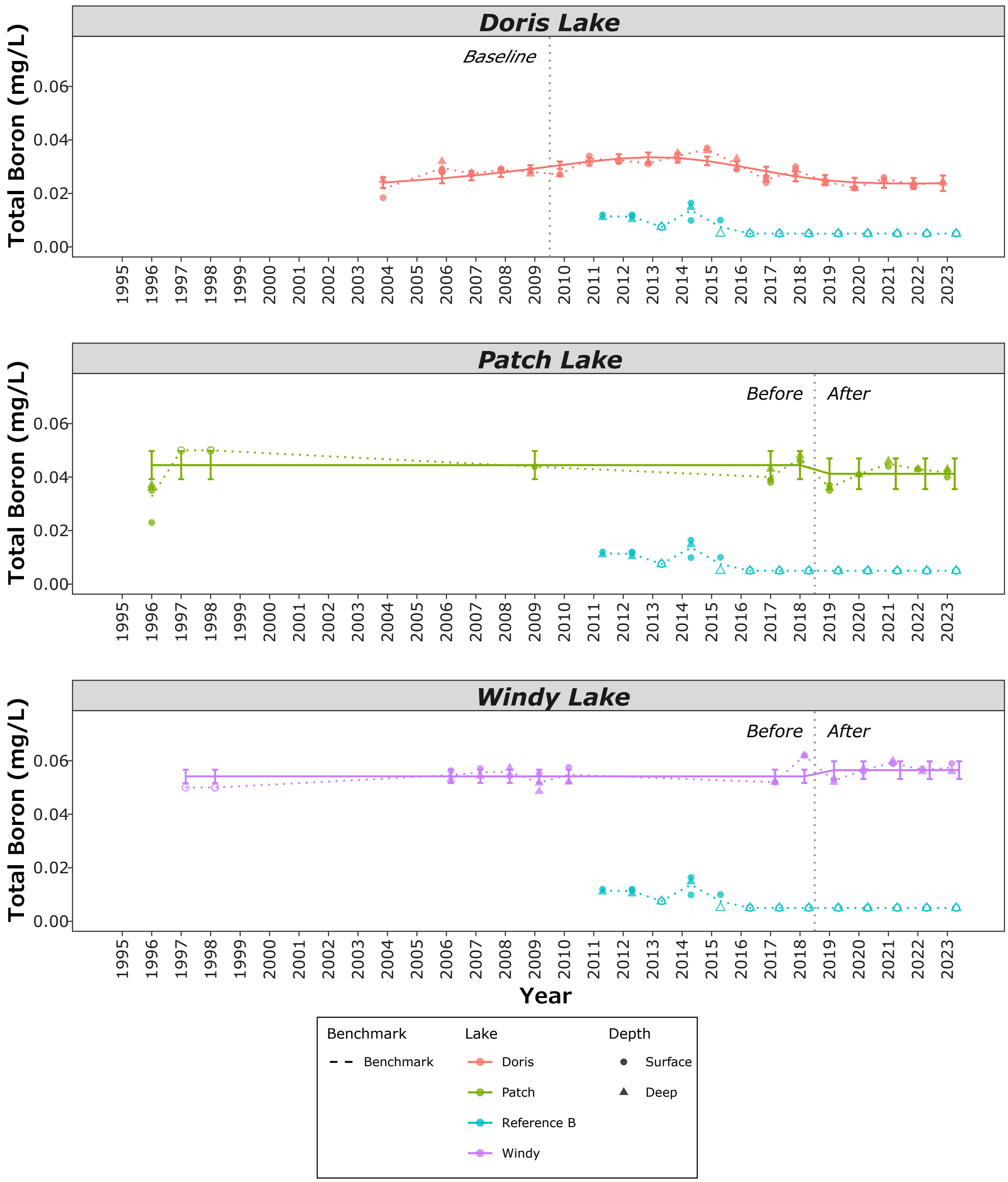
No effects were detected for total boron in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total boron were not exceeded in 2023.

TABLE 3.3-12 TOTAL BORON STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	Yes (<0.00001)	-	NA	NA
	Open-Water	Yes (<0.00001)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.3715)	-
	Open-Water	NA	NA	No (0.36)	-
Windy	Ice-covered	NA	NA	No (0.2475)	-
	Open-Water	NA	NA	No (0.1743)	-

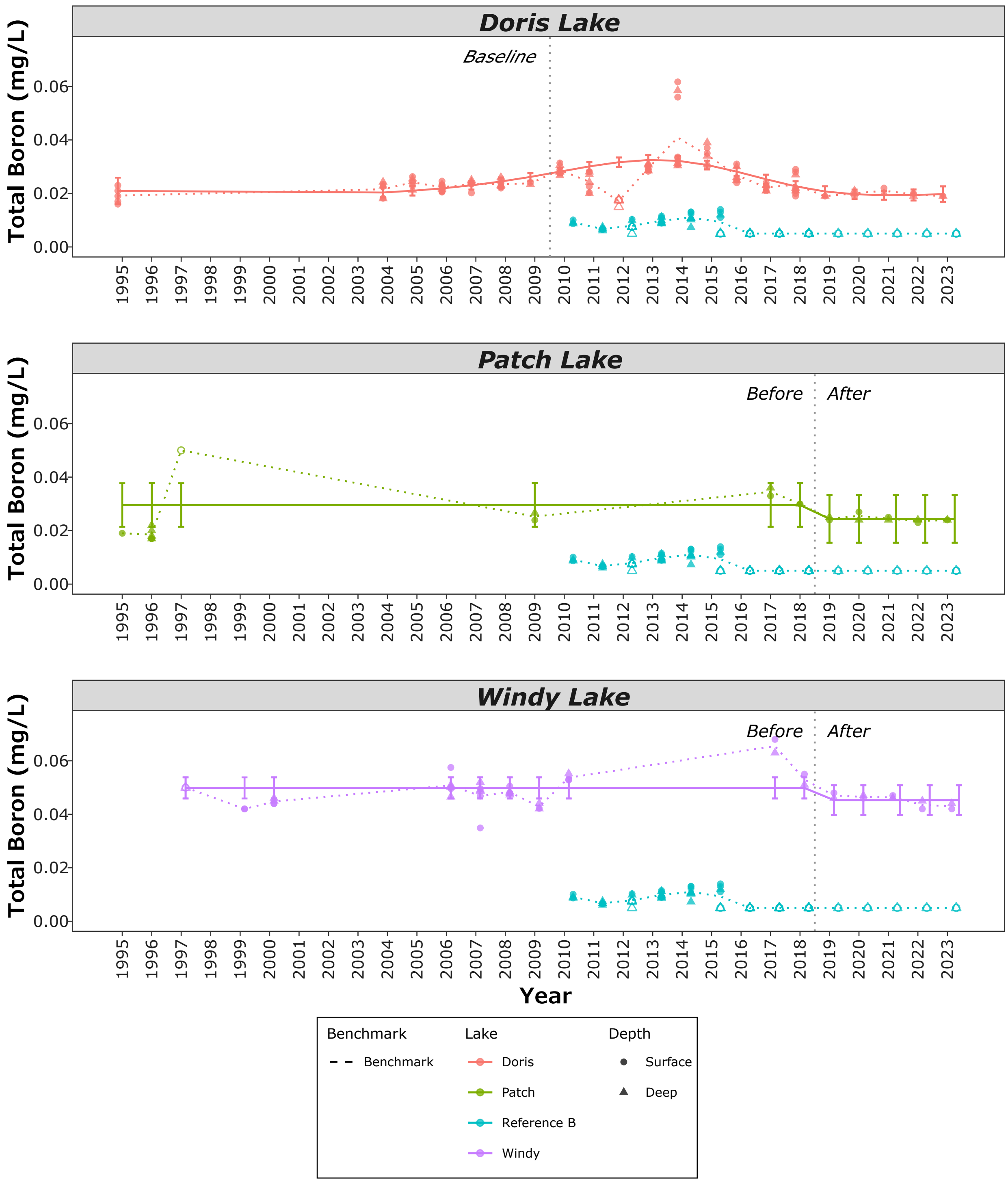
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-12A UNDER-ICE TOTAL BORON IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 1.5 mg/L (not visible on presented range).

FIGURE 3.3-12B OPEN-WATER TOTAL BORON IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 1.5 mg/L (not visible on presented range).

3.3.13 TOTAL CADMIUM

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.000005 mg/L; Table 3.3-13; Section C.3.1.13 in Appendix C). Graphical analyses confirm that total cadmium concentrations in all three exposure lakes were below the DL and the benchmark in 2023 (Figures 3.3-13a and 3.3-13b).

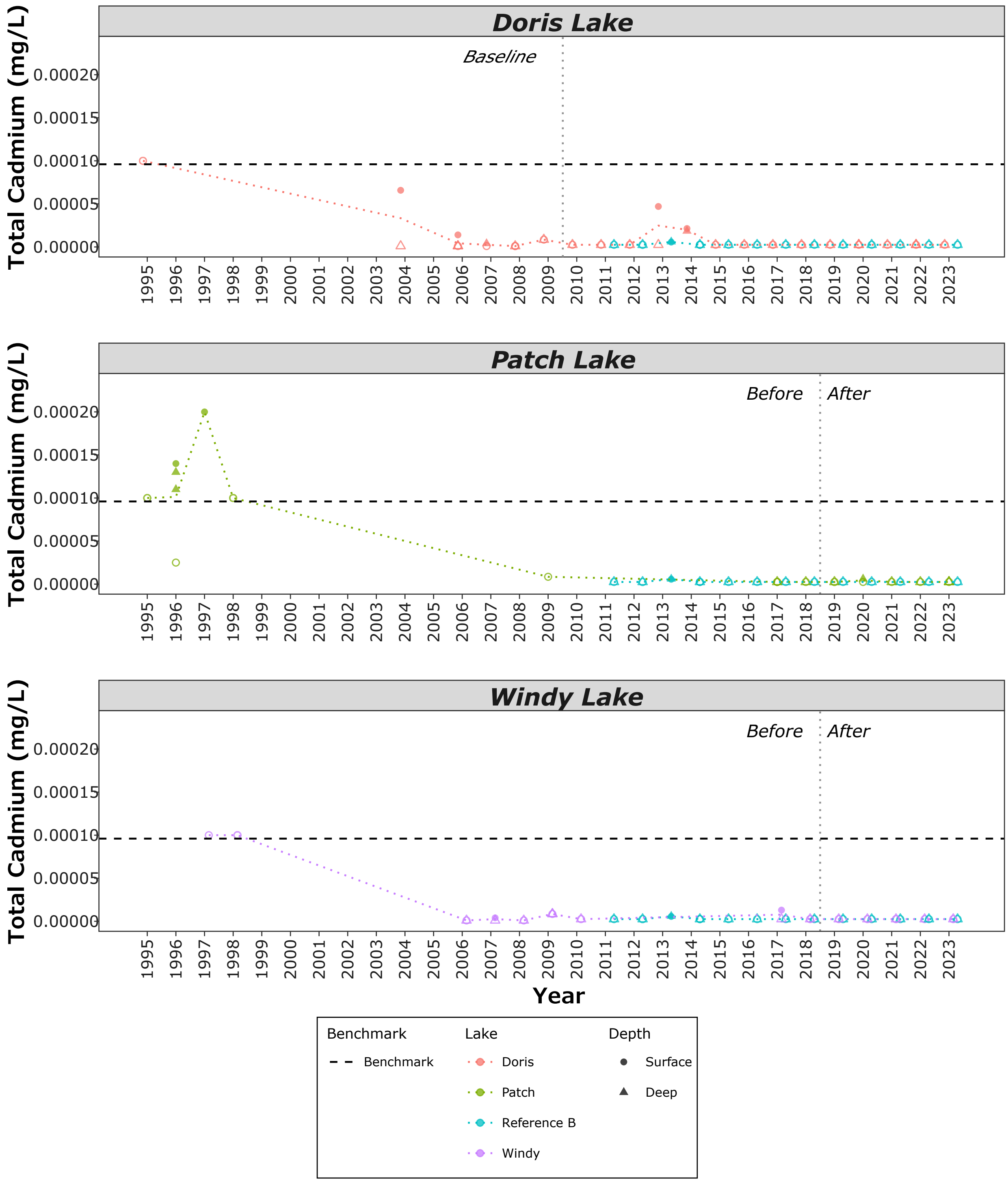
No effects were detected for total cadmium in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total cadmium were not exceeded in 2023.

TABLE 3.3-13 TOTAL CADMIUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

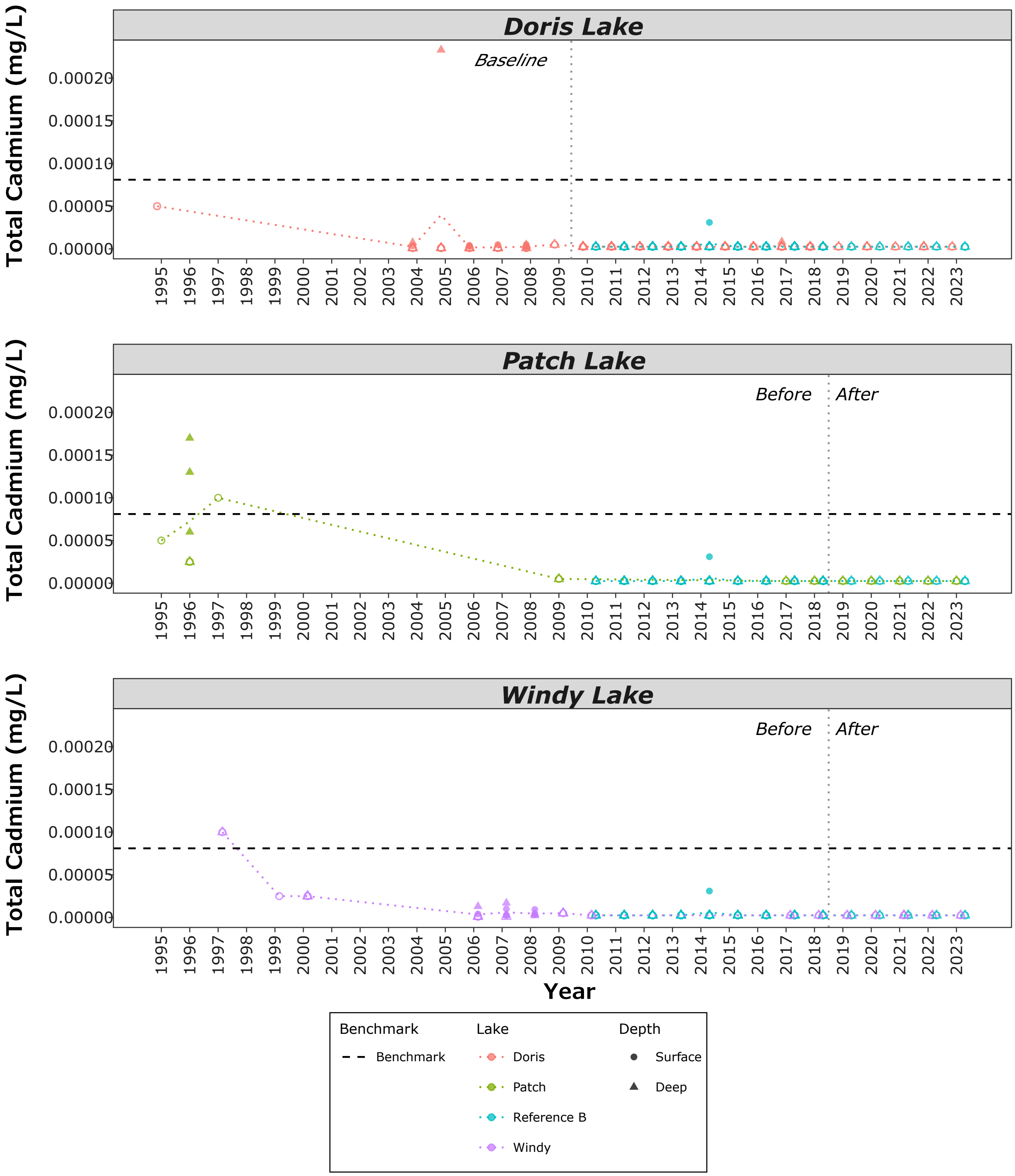
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-13A UNDER-ICE TOTAL CADMIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.000096 mg/L).

FIGURE 3.3-13B OPEN-WATER TOTAL CADMIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.000081 mg/L).

3.3.14 TOTAL CHROMIUM

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.0005 mg/L; Table 3.3-14; Section C.3.1.14 in Appendix C). Graphical analyses confirm that total chromium concentrations in all three exposure lakes were below the DL and the benchmark in 2023 (Figures 3.3-14a and 3.3-14b).

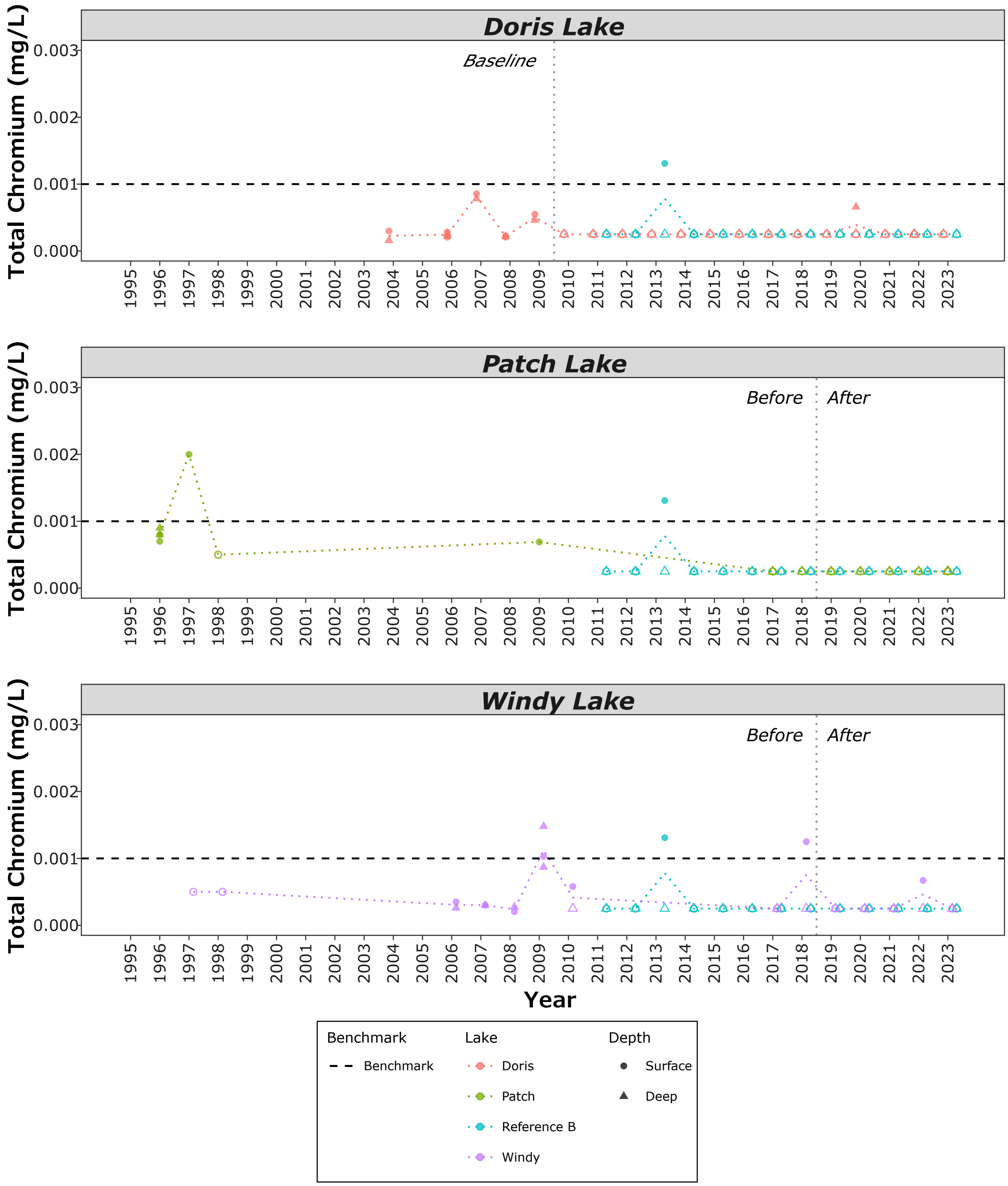
No effects were detected for total chromium in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total chromium were not exceeded in 2023.

TABLE 3.3-14 TOTAL CHROMIUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

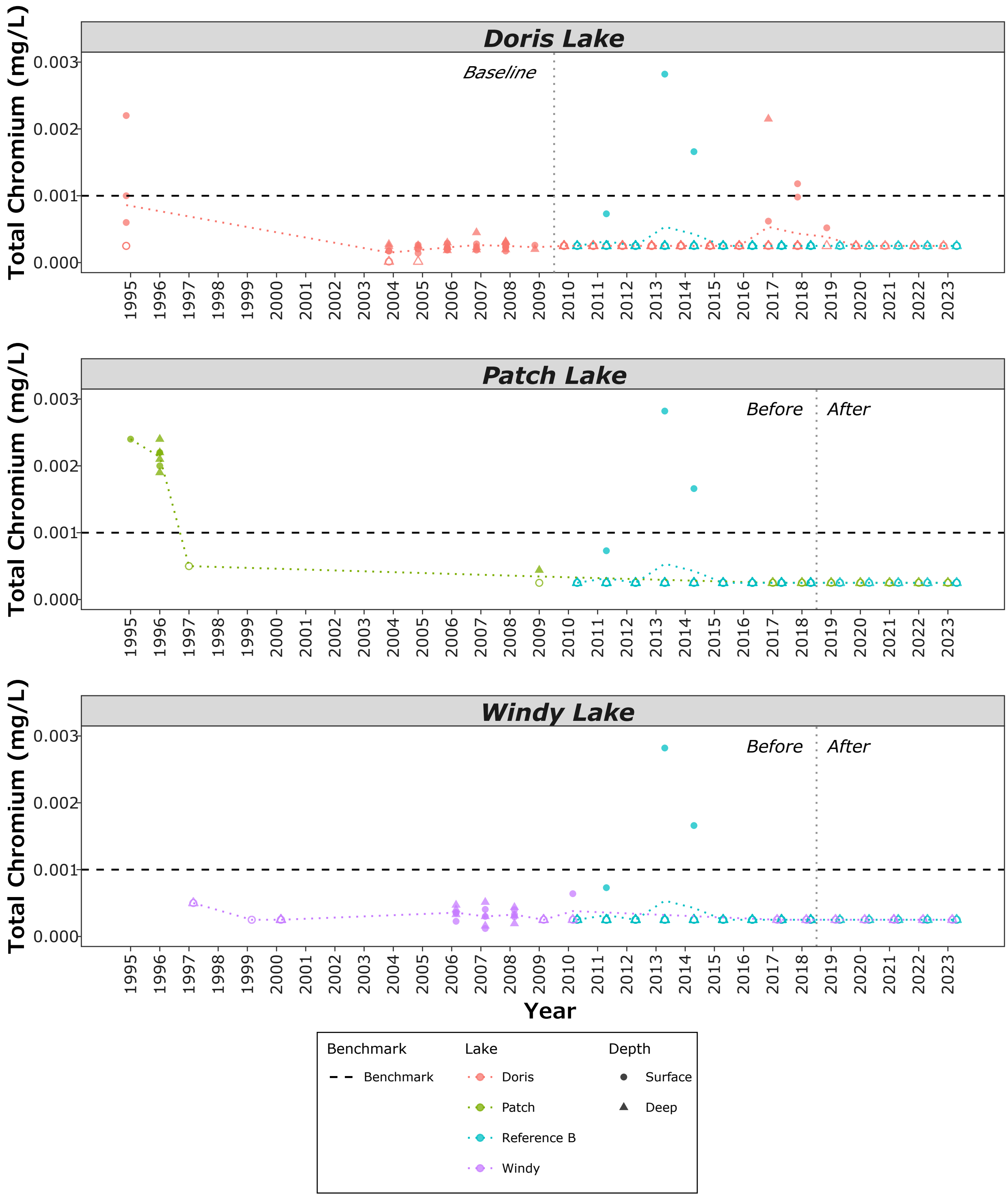
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-14A UNDER-ICE TOTAL CHROMIUM IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.001 mg/L for hexavalent chromium (presented) and 0.0089 mg/L for trivalent chromium (not visible on presented range).

FIGURE 3.3-14B OPEN-WATER TOTAL CHROMIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.001 mg/L for hexavalent chromium (presented) and 0.0089 mg/L for trivalent chromium (not visible on presented range).

3.3.15 TOTAL COPPER

Statistical analyses indicated no significant changes over time for total copper concentrations in Doris Lake or between the before-and-after period means in Patch or Windy lakes (Table 3.3-15). Graphical analyses indicated that mean total copper concentrations Doris and Patch lakes exceeded the minimum benchmark for total copper during the under-ice season (0.002 mg/L), which was equivalent to the calculated benchmark for these two lakes (Figures 3.3-15a and 3.3-15b). However, under-ice total copper concentrations were within the baseline range in Doris (0.00119 to 0.004 mg/L) and Patch (0.001 to 0.0066 mg/L) lakes. Windy Lake during the under-ice season and open-water total copper concentrations in all three exposure lakes were less than the benchmark.

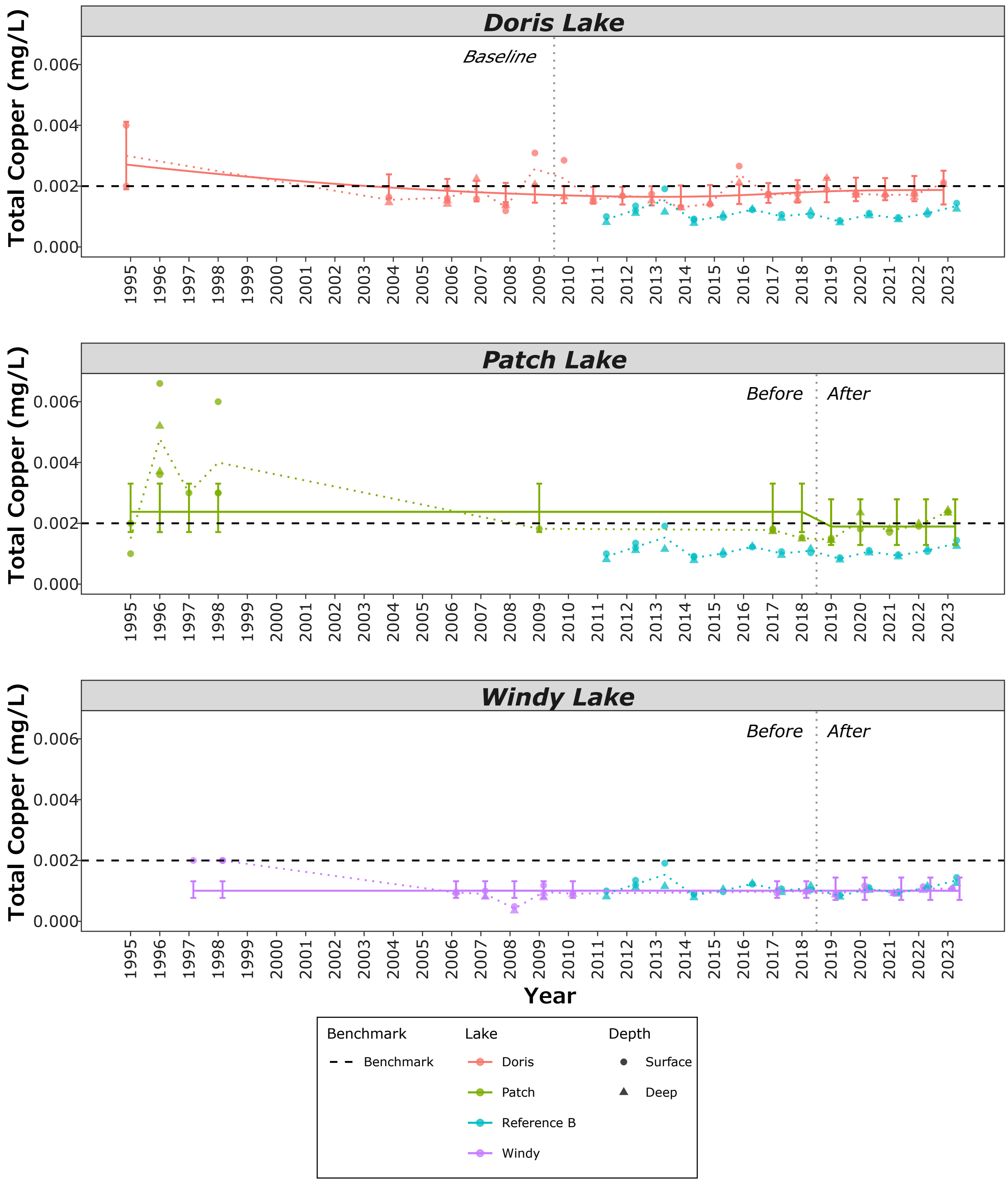
No effects were detected for total copper in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total copper were not exceeded in 2023.

TABLE 3.3-15 TOTAL COPPER STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	No (0.0692)	-	NA	NA
	Open-Water	No (0.8558)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.3421)	-
	Open-Water	NA	NA	No (0.2088)	-
Windy	Ice-covered	NA	NA	No (0.9973)	-
	Open-Water	NA	NA	No (0.1066)	-

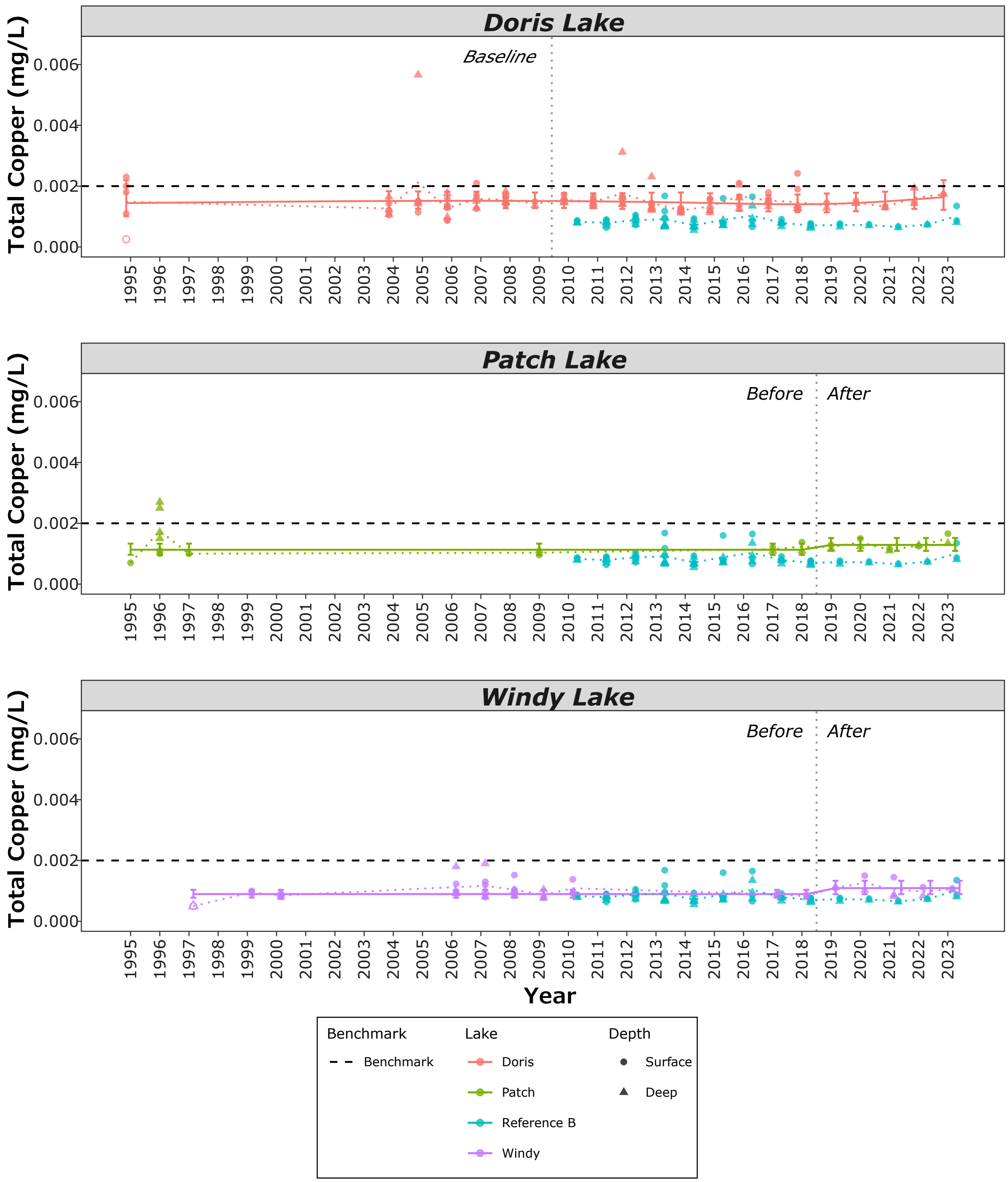
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-15A UNDER-ICE TOTAL COPPER IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.002 mg/L).

FIGURE 3.3-15B OPEN-WATER TOTAL COPPER IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.002 mg/L).

3.3.16 TOTAL IRON

Statistical analyses indicated a significant change over time for total iron concentrations in Doris Lake during the under-ice season but not during the open-water season (Table 3.3-16). Statistical comparison to the reference lake was not completed due to the high proportion of data that were less than the DL (<0.010 mg/L Section C.3.1.16 in Appendix C). Graphical analyses indicated that the highest range of under-ice total iron concentrations (0.07 to 0.09 mg/L) was observed during three baseline years (2004, 2006, and 2009), resulting in a decrease over time which may account for the statistically significant result (Figure 3.3-16a). It is noted that a decrease in total iron concentrations is not considered to be an adverse effect (TMAC 2018). Under-ice total iron concentrations in 2023 were within the baseline range for Doris Lake (Figure 3.3-16b).

Statistical analyses indicated no significant difference between the before-and-after period means for total iron concentrations in Patch Lake during both seasons and Windy Lake during the open-water season (Table 3.3-16). Statistical analysis was not completed for Windy Lake during the under-ice season due to the high proportion of data, including all the 2023 observations, that were less than the DL (Section C.3.1.16 in Appendix C). Graphical analysis confirm that total iron concentrations in Windy Lake during the under-ice season was less than the DL in 2023.

Graphical analyses indicated that total iron concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-16a and 3.3-16b).

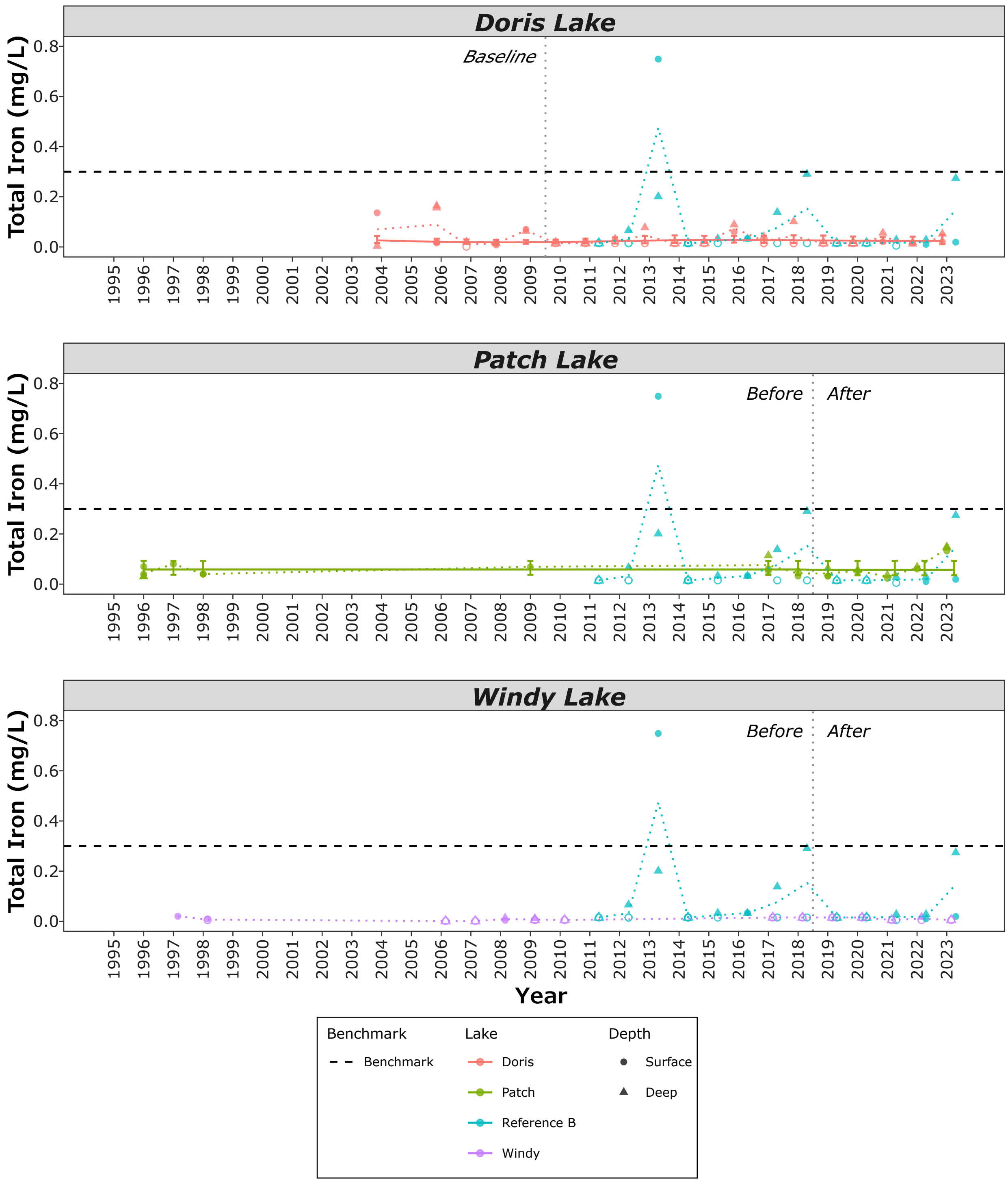
No effects were detected for total iron in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total iron were not exceeded in 2023.

TABLE 3.3-16 TOTAL IRON STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (0.0109)	-	NA	NA
	Open-Water	No (0.6459)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.9487)	-
	Open-Water	NA	NA	No (0.1312)	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	No (0.4032)	-

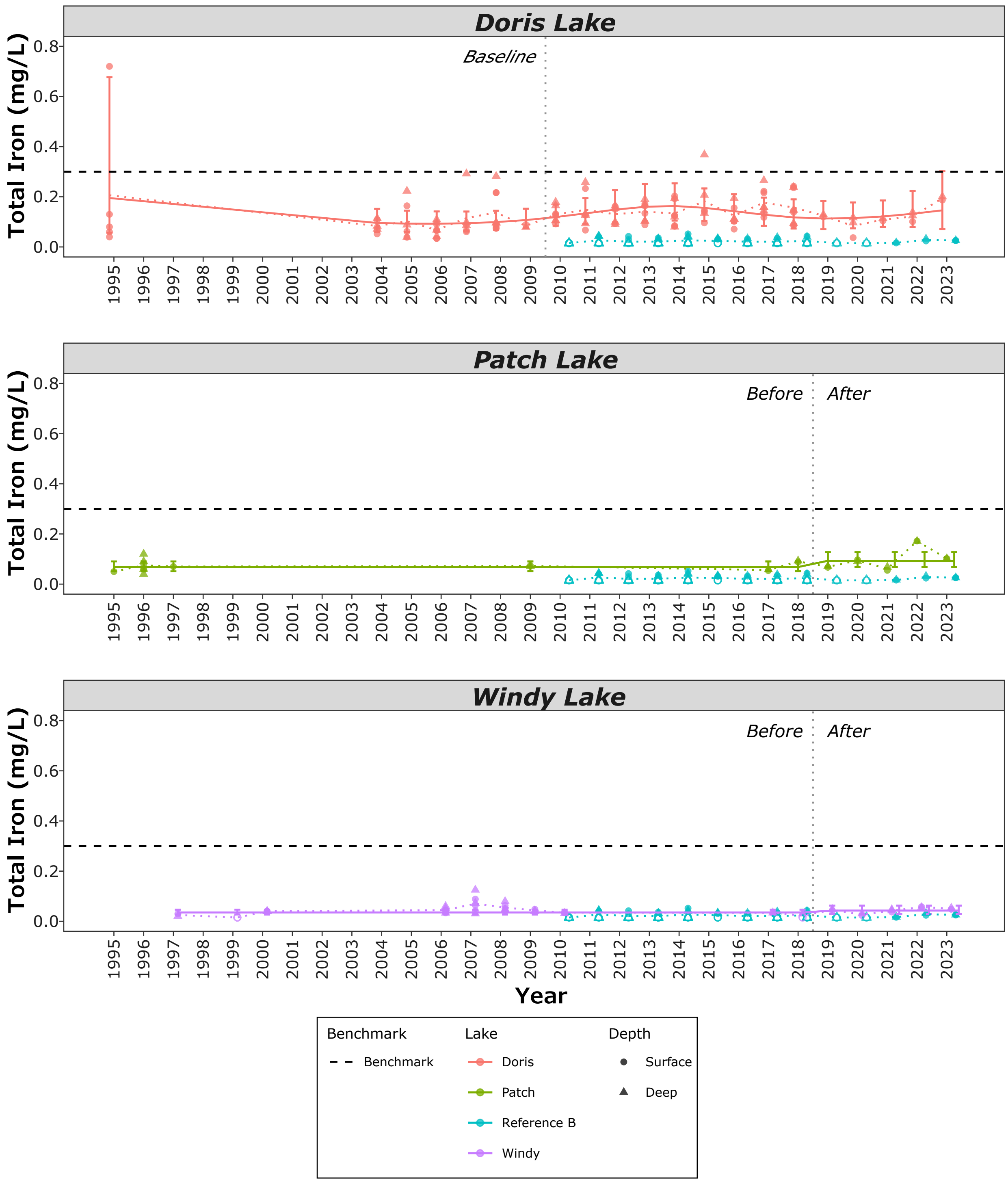
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-16A UNDER-ICE TOTAL IRON IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.3 mg/L.

FIGURE 3.3-16B OPEN-WATER TOTAL IRON IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.3 mg/L.

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3.3.17 TOTAL LEAD

Statistical analyses were not completed for Doris Lake, Patch Lake during the under-ice season, and Windy Lakes due to the high proportion of data that were less than the DL (<0.000050 mg/L) Table 3.3-17; Section C.3.1.17 in Appendix C). Statistical analysis indicated no significant difference between the before-and-after period means for total lead concentrations in Patch Lake during the open-water season (Table 3.3-17). Graphical analyses confirm that total lead concentrations were less than the DL in Doris and Windy lakes during both seasons and marginally greater (<5-times) than the DL in the majority of the Patch Lake samples or less than the DL (Figures 3.3-17a and 3.3-17b). All three exposure lake samples were less than their respective, calculated, total lead benchmarks (0.001 to 0.0029 mg/L; Table A.3-5 in Appendix A) as confirmed by graphical analyses where all three exposure lake samples were less that the minimum benchmark for each season (Figures 3.3-17a and 3.3-17b).

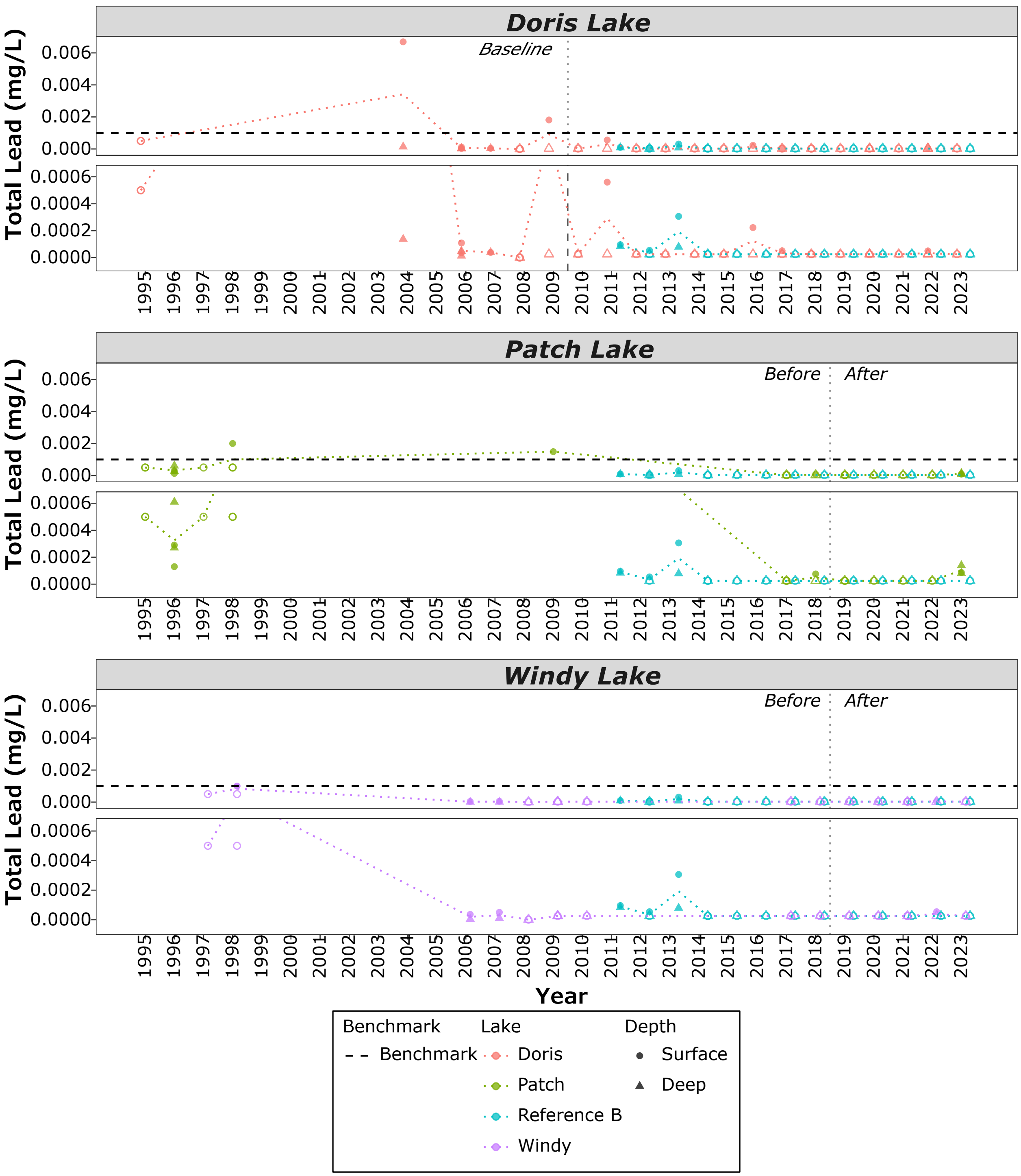
No effects were detected for total lead in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total lead were not exceeded in 2023.

TABLE 3.3-17 TOTAL LEAD STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	No (0.3060)	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

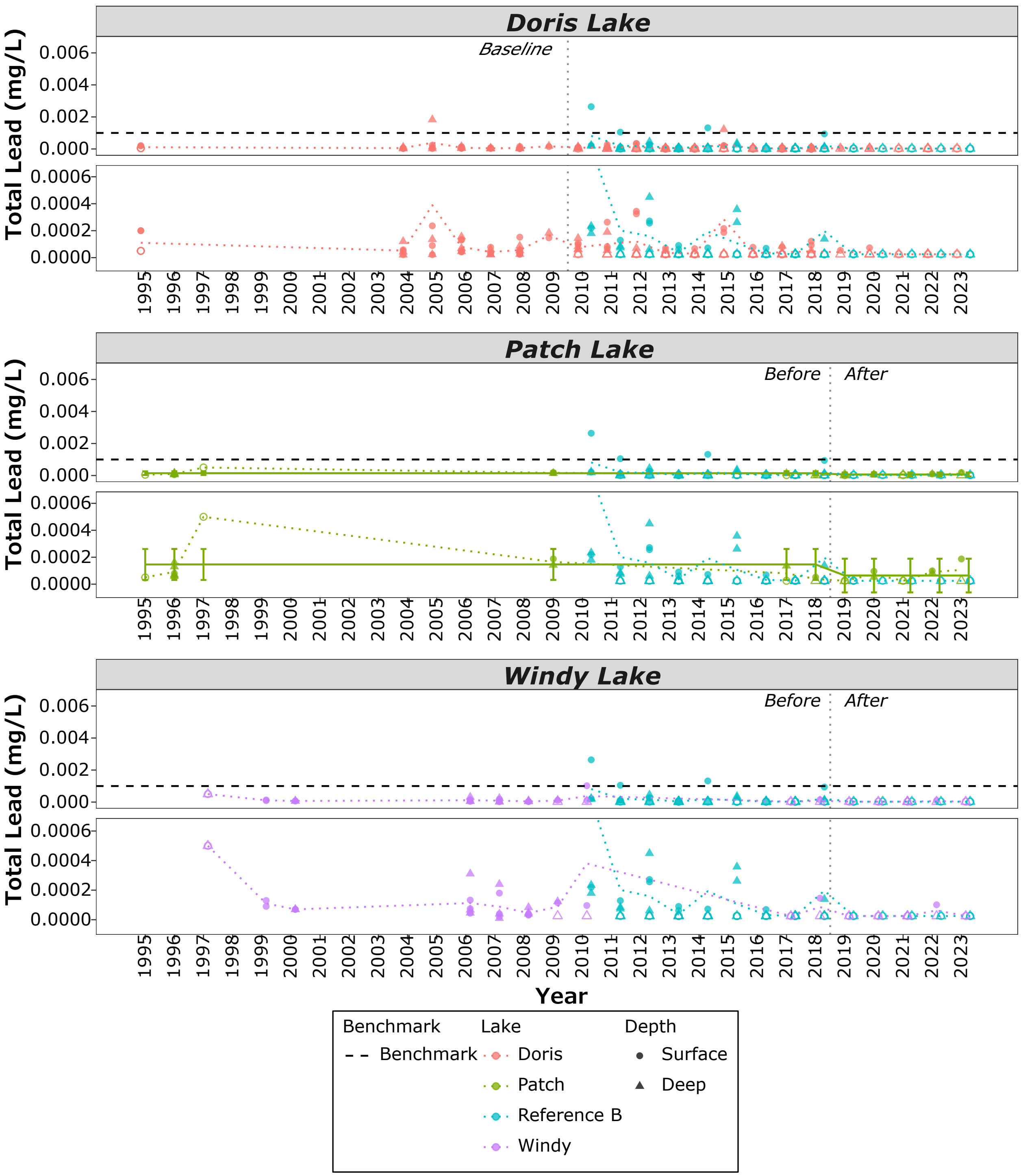
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-17A UNDER-ICE TOTAL LEAD IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.001 mg/L).

FIGURE 3.3-17B OPEN-WATER TOTAL LEAD IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.001 mg/L).

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3.3.18 DISSOLVED MANGANESE

Statistical analyses indicated a significant change over time for dissolved manganese concentrations in Doris Lake during the open-water season, and compared to the reference lake (Table 3.3-18). Statistical analyses indicate no significant change over time for dissolved manganese concentrations in Doris Lake during the under-ice season or between the before-and-after period means in Patch or Windy lakes. Graphical analyses indicated that a single, open-water dissolved manganese concentration measured in 1995 (0.127 mg/L) was elevated relative to the 2003 to 2009 baseline range (<0.000003 to 0.0175 mg/L) which resulted in a perceived decrease throughout the baseline period (Figure 3.3-18b), which may account for the statistically significant result. The comparable monitoring period between Doris Lake and Reference Lake B for the open-water season is 2020 to 2023, during which dissolved manganese concentrations in Reference Lake B have remained low and stable (<5-times the DL; i.e., 0.00021 to 0.00084 mg/L) whereas mean open-water dissolved manganese in Doris Lake have varied from 0.00087 to 0.0228 mg/L but with no consistent directional trend. Open-water dissolved manganese concentration in 2023 was within the complete baseline range (0.127 to 0.0175 mg/L) but greater than the range excluding the elevated 1995 value. It is noted that dissolved manganese concentrations are a magnitude less than the 75% of the benchmark condition (0.24 mg/L) in Doris Lake.

All three exposure lake samples were less than their respective, calculated, dissolved manganese benchmarks (0.25 to 0.44 mg/L; Table A.3-5 in Appendix A) as confirmed by graphical where all three exposure lake samples were less that the minimum benchmark for each season (Figures 3.3-18a and 3.3-18b).

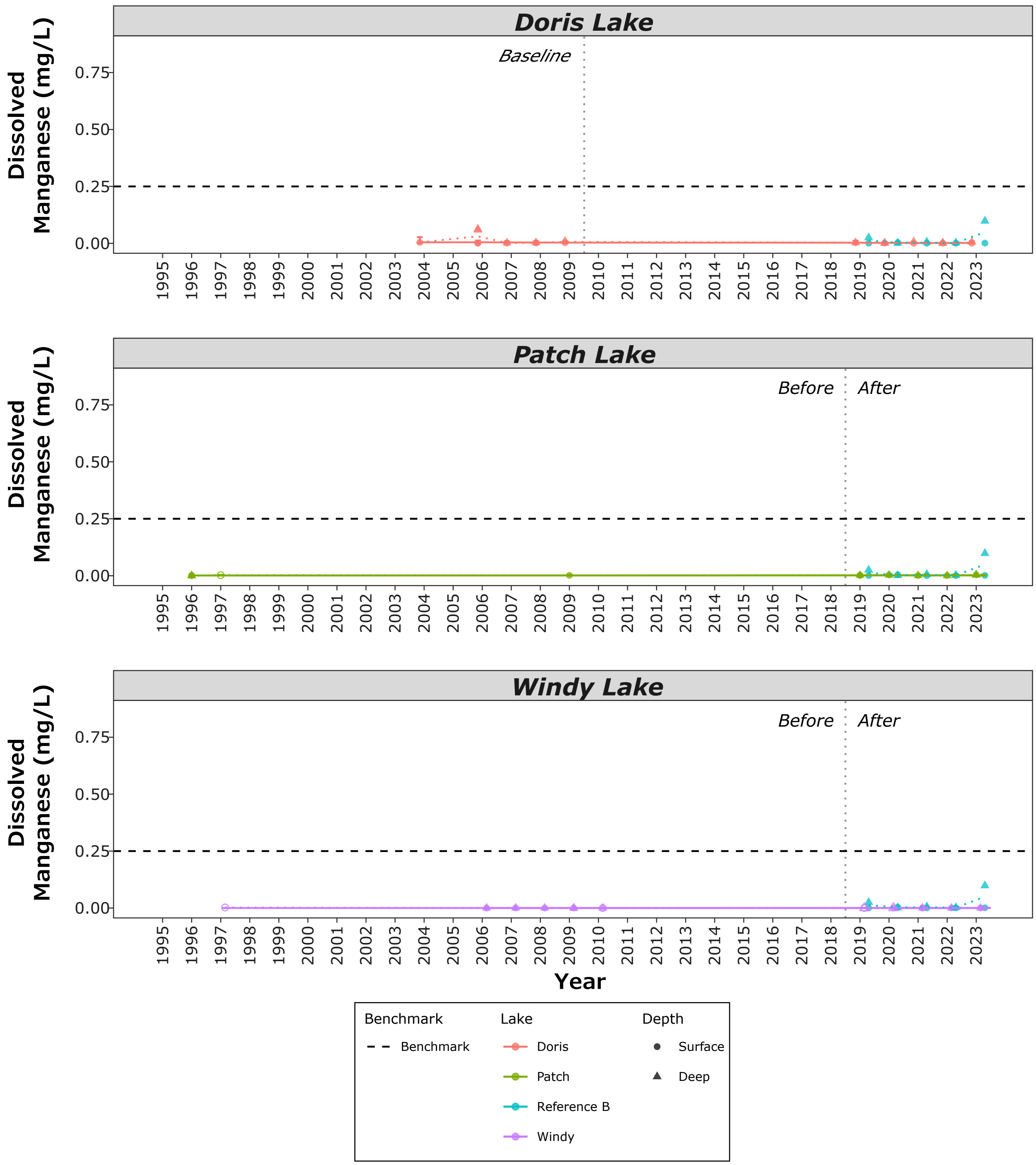
No effects were detected for dissolved manganese in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for dissolved manganese were not exceeded in 2023.

TABLE 3.3-18 DISSOLVED MANGANESE STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	No (0.5244)	-	NA	NA
	Open-Water	Yes (<0.00001)	Yes (0.0152)	NA	NA
Patch	Ice-covered	NA	NA	No (0.6226)	-
	Open-Water	NA	NA	No (0.4212)	-
Windy	Ice-covered	NA	NA	No (0.4755)	-
	Open-Water	NA	NA	No (0.1305)	-

Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-18A UNDER-ICE DISSOLVED MANGANESE IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is dependent on hardness and pH, see Section 2.2.4; the 2023 calculated minimum is presented (0.25mg/L).

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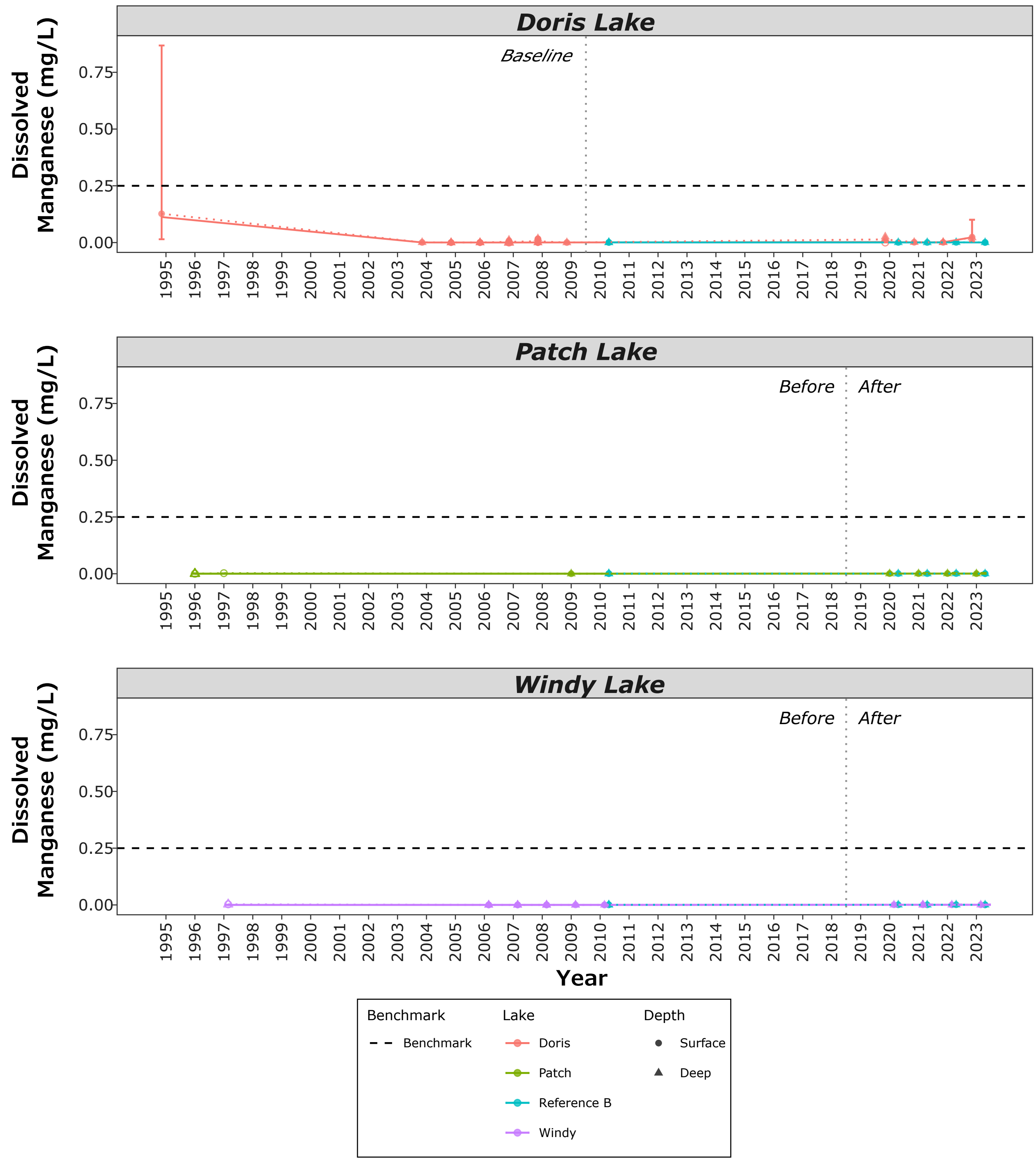
FIGURE 3.3-18B OPEN-WATER DISSOLVED MANGANESE IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is dependent on hardness and pH, see Section 2.2.4; the 2023 calculated minimum is presented (0.25mg/L).

3.3.19 TOTAL MERCURY

Statistical analyses indicated a significant change over time for total mercury concentrations in Doris Lake during the under-ice season but not relative to the reference lake (Table 3.3-19). Statistical analyses indicated no significant change over time for total mercury concentrations in Doris Lake during the open-water season. Analyses were not completed for Patch and Windy lakes due to the high proportion of data that were less than the DL over time (Table 3.3-19; Section C.3.1.19 in Appendix C). DLs have decreased over time (0.000050 to 0.0000001 mg/L) and baseline observations for Patch and Windy lakes are obscured by the higher DLs in those years (Figures 3.3-19a and 3.3-19b). During both seasons, total mercury concentrations remain low (<0.000000625 mg/L) in Patch and Windy lakes and similar to the observed concentrations in Reference Lake B in 2023 (0.0000005 to 0.0000009 mg/L). Graphical analyses indicated that total mercury concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-19a and 3.3-19b).

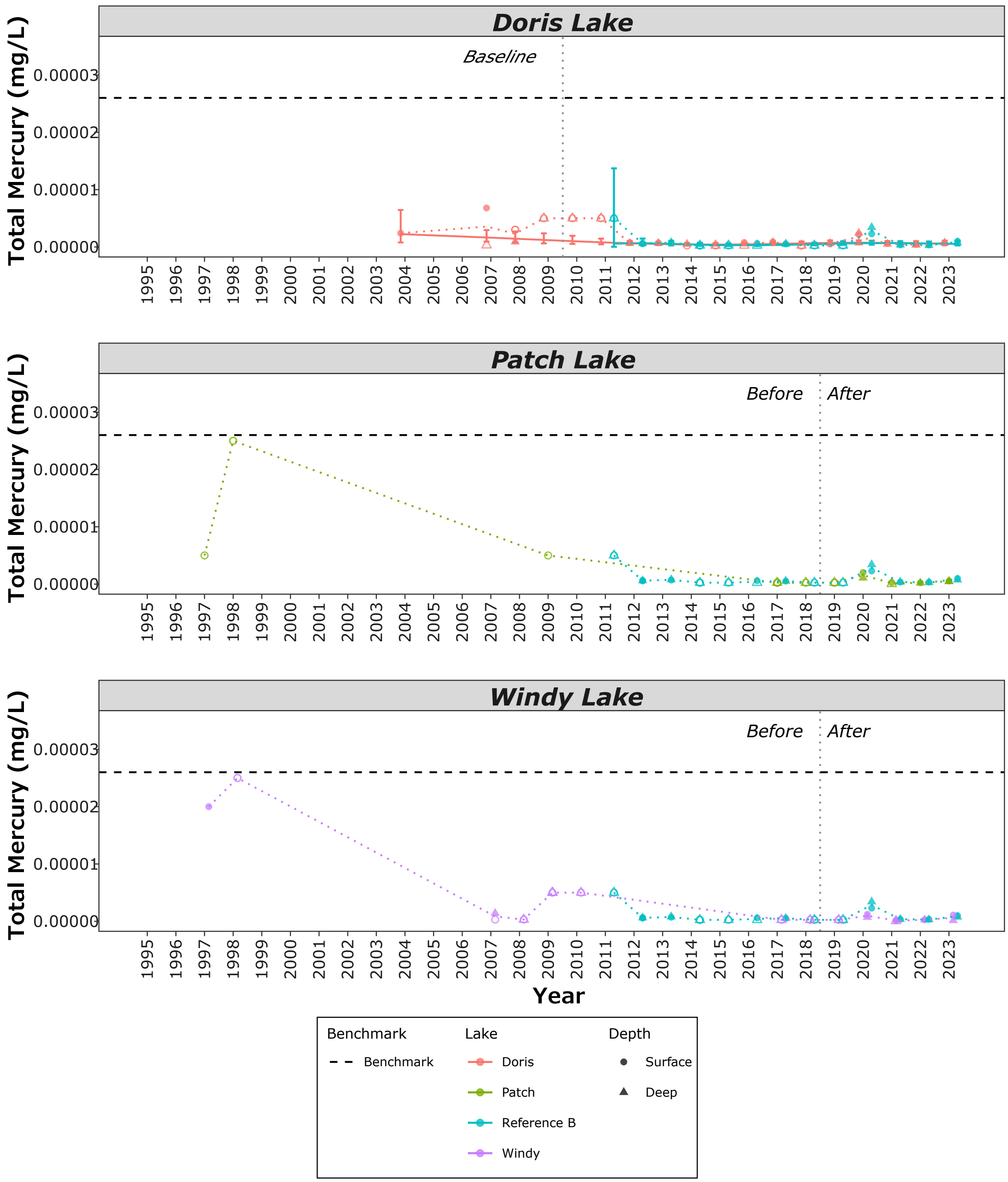
No effects were detected for total mercury in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total mercury were not exceeded in 2023.

TABLE 3.3-19 TOTAL MERCURY STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	**Season**	**Trend Analysis**		**BACI**	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	Yes (0.0087)	No (0.9639)	NA	NA
	Open-Water	No (0.6907)	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-19A UNDER-ICE TOTAL MERCURY IN LAKES, HOPE BAY AEMP, 1997 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.000026 mg/L.

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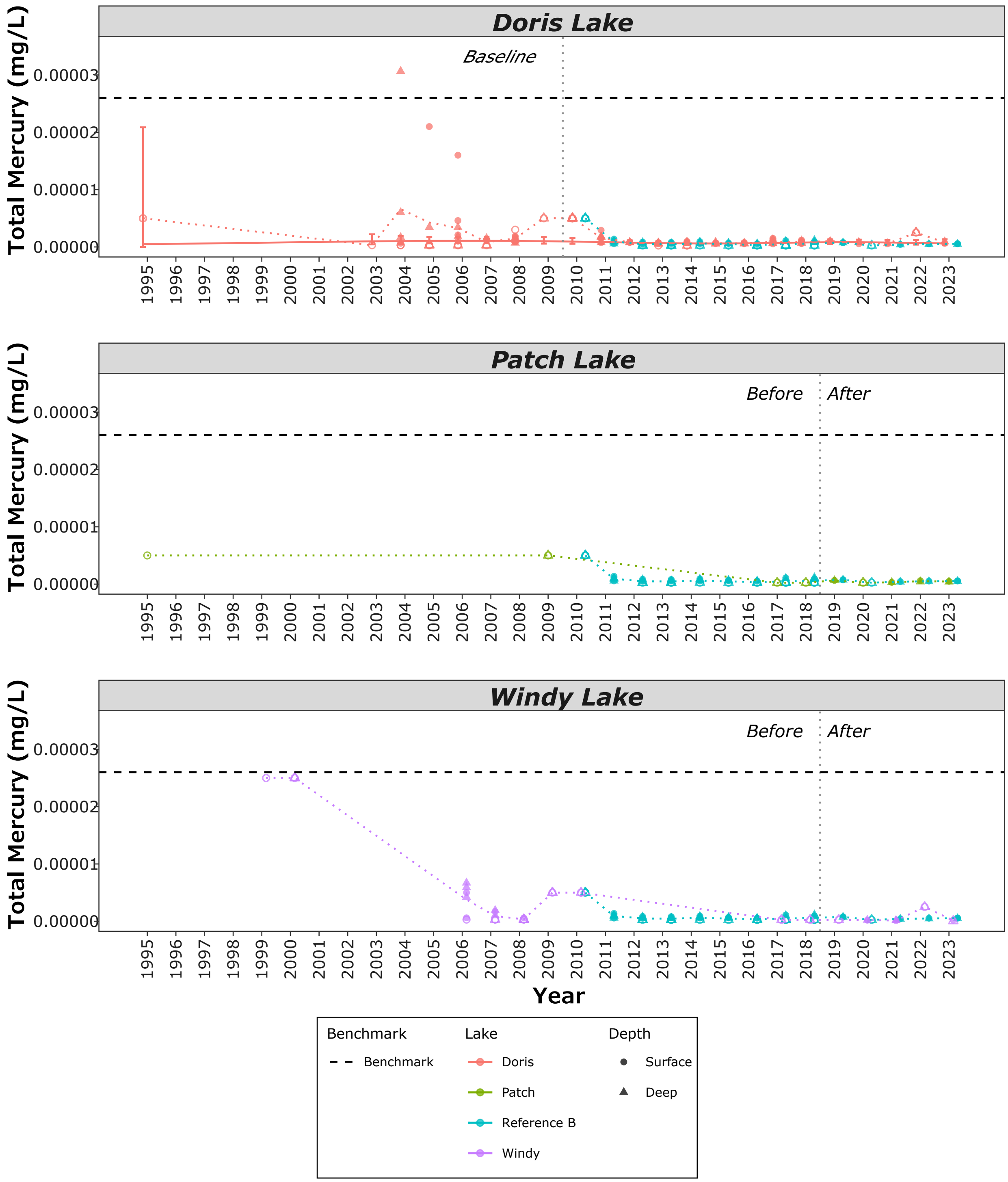
FIGURE 3.3-19B OPEN-WATER TOTAL MERCURY IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.000026 mg/L.

3.3.20 TOTAL MOLYBDENUM

Statistical analyses indicated a significant change over time for total molybdenum concentrations in Doris Lake during both seasons (Table 3.3-20). Statistical comparison to the reference lake was not completed due to the high proportion of data that were less than the DL (Section C.3.1.20 in Appendix C). Graphical analyses of Doris Lake indicated that overall mean total molybdenum concentrations during both seasons increased approximately 2-times between 2008 and 2018 (0.00014 mg/L to 0.000272 mg/L) but have decreased since (Figures 3.3-20a and 3.3-20b). In 2023, the mean concentrations were less than (under-ice 2023 mean = 0.000216 mg/L) or similar to (within 1%; open-water 2023 mean = 0.000213 mg/L) the upper baseline range in Doris Lake; at least one observation from each season (i.e., surface or deep) was within the baseline ranges in (under-ice = 0.000126 to 0.000221 mg/L and open-water = 0.000114 to 0.000211 mg/L).

Statistical analyses indicated there was no significant difference between the before-and-after period means for total molybdenum concentrations in Patch or Windy lakes (Table 3.3-20).

Graphical analyses indicated that total molybdenum concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-20a and 3.3-20b).

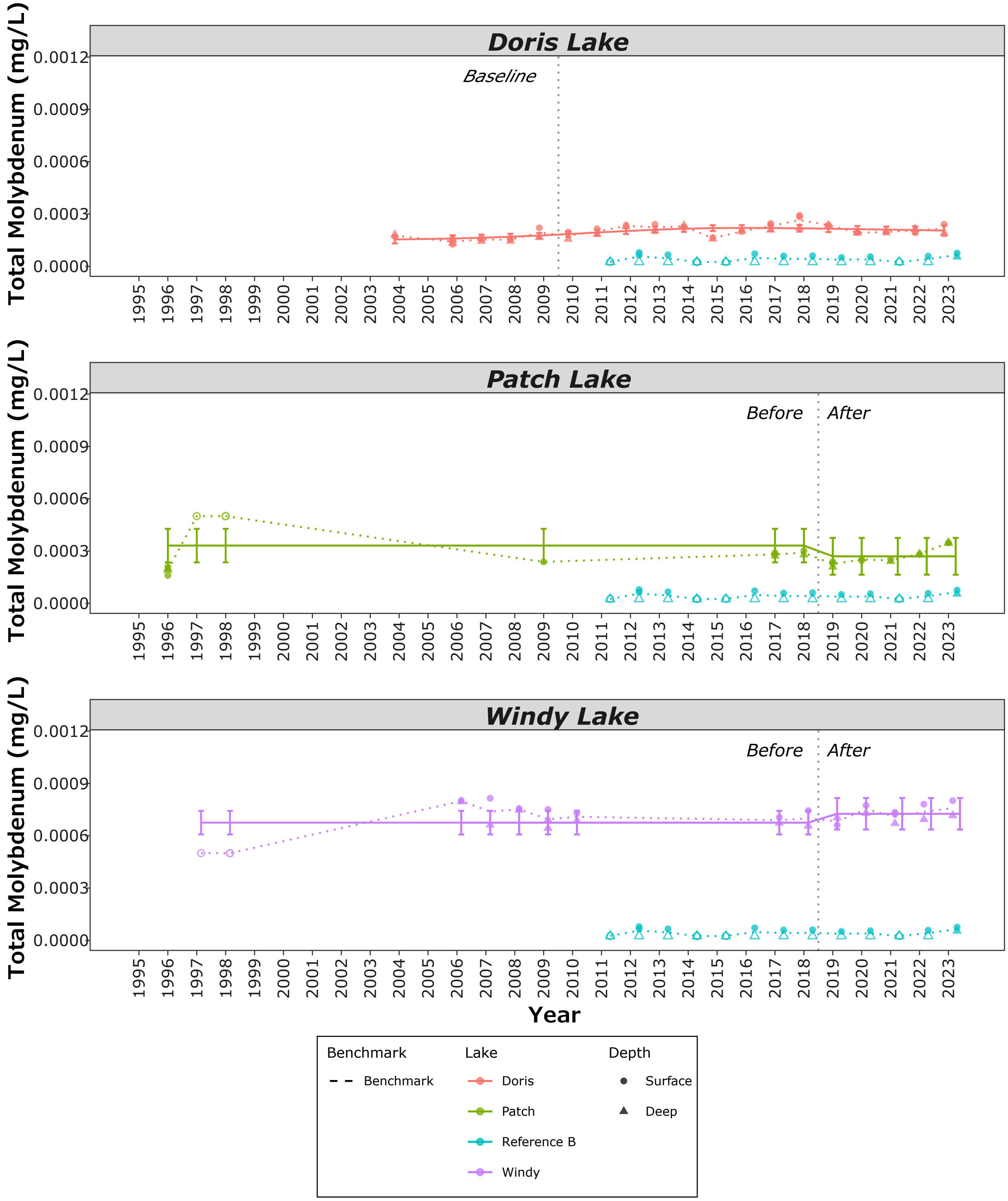
No effects were detected for total molybdenum in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total molybdenum were not exceeded in 2023.

TABLE 3.3-20 TOTAL MOLYBDENUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (<0.00001)	-	NA	NA
	Open-Water	Yes (0.0001)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.3335)	-
	Open-Water	NA	NA	No (0.7436)	-
Windy	Ice-covered	NA	NA	No (0.3474)	-
	Open-Water	NA	NA	No (0.7722)	-

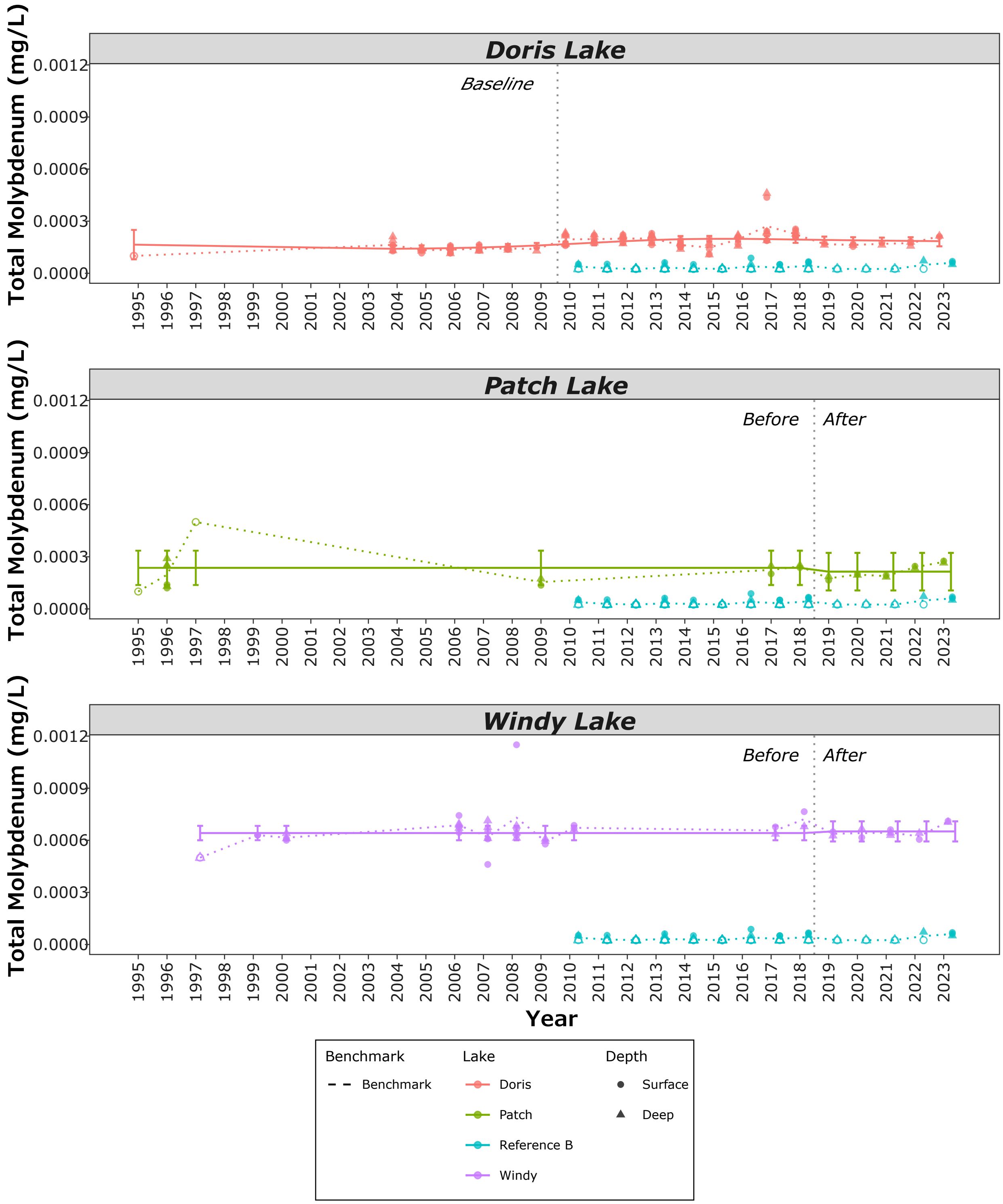
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-20A UNDER-ICE TOTAL MOLYBDENUM IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.073 mg/L (not visible on presented range).

FIGURE 3.3-20B OPEN-WATER TOTAL MOLYBDENUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.073 mg/L (not visible on presented range).

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3.3.21 TOTAL NICKEL

Statistical analyses indicated no significant changes over time for total nickel concentrations in Doris Lake and between the before-and-after period means in Patch or Windy lakes (Table 3.3-21). Graphical analyses indicated that total nickel concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-21a and 3.3-21b).

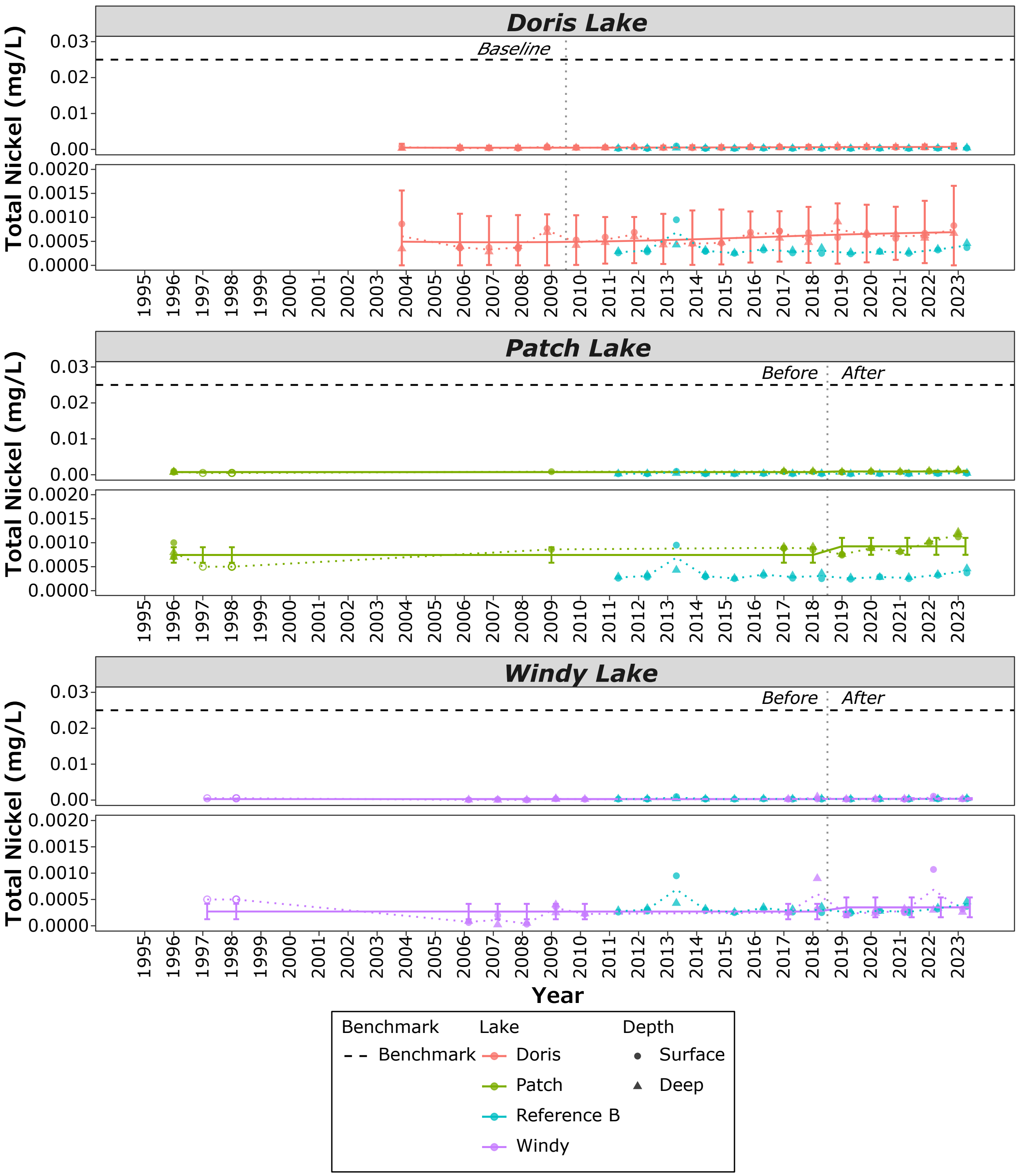
No effects were detected for total nickel in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total nickel were not exceeded in 2023.

TABLE 3.3-21 TOTAL NICKEL STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Ice-covered	No (0.9642)	-	NA	NA
	Open-Water	No (0.1485)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.123)	-
	Open-Water	NA	NA	No (0.3597)	-
Windy	Ice-covered	NA	NA	No (0.4825)	-
	Open-Water	NA	NA	No (0.2448)	-

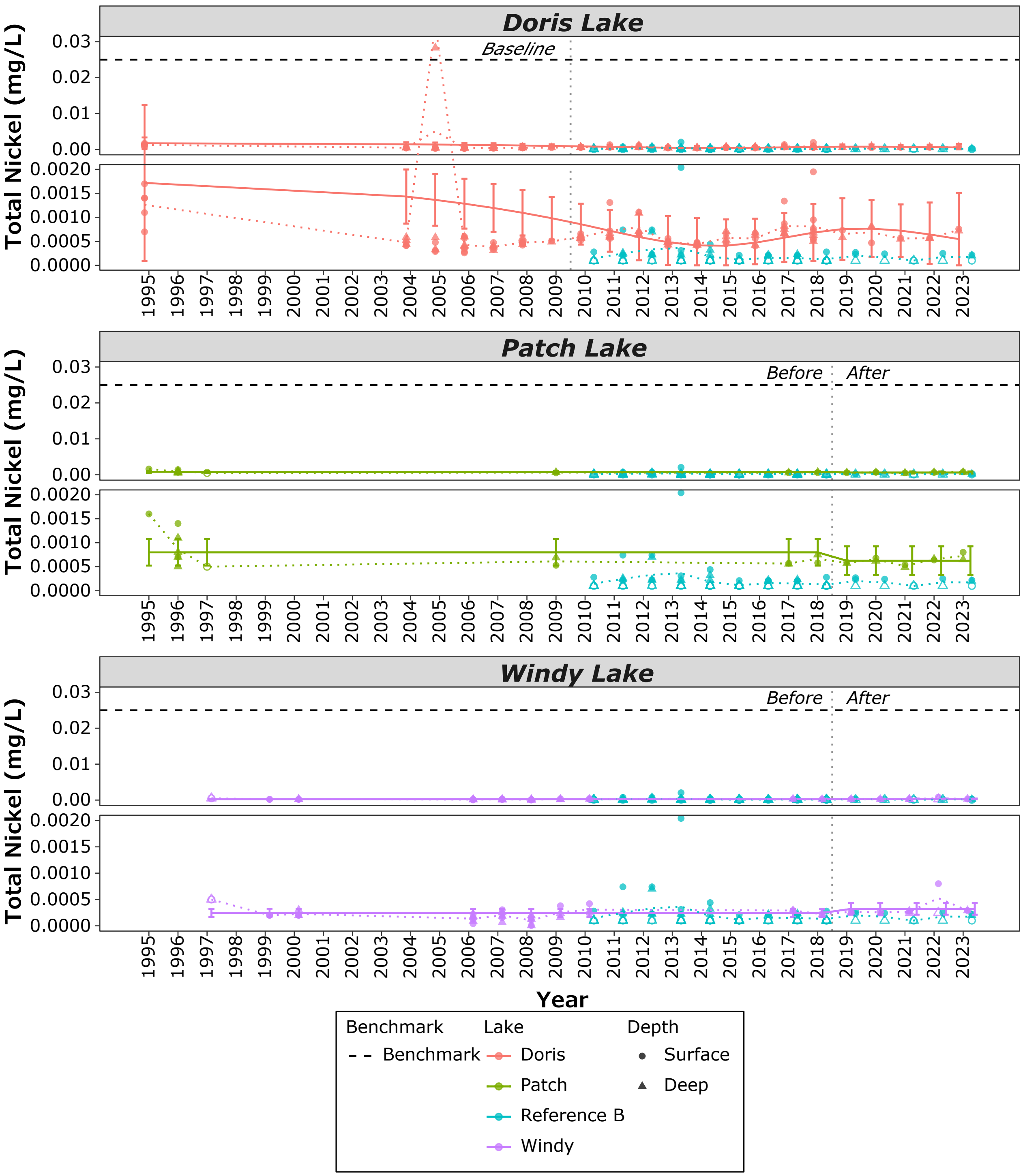
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-21A UNDER-ICE TOTAL NICKEL IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: *Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.*
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.025 mg/L).

FIGURE 3.3-21B OPEN-WATER TOTAL NICKEL IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is hardness dependent, see Section 2.2.4; the 2023 calculated minimum is presented (0.025 mg/L).

3.3.22 TOTAL SELENIUM

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.00020 mg/L; Table 3.3-22; Section C.3.1.22 in Appendix C). Graphical analyses confirm that total selenium concentrations in all three exposure lakes were less than the DL and the benchmark in 2023 (Figures 3.3-22a and 3.3-22b).

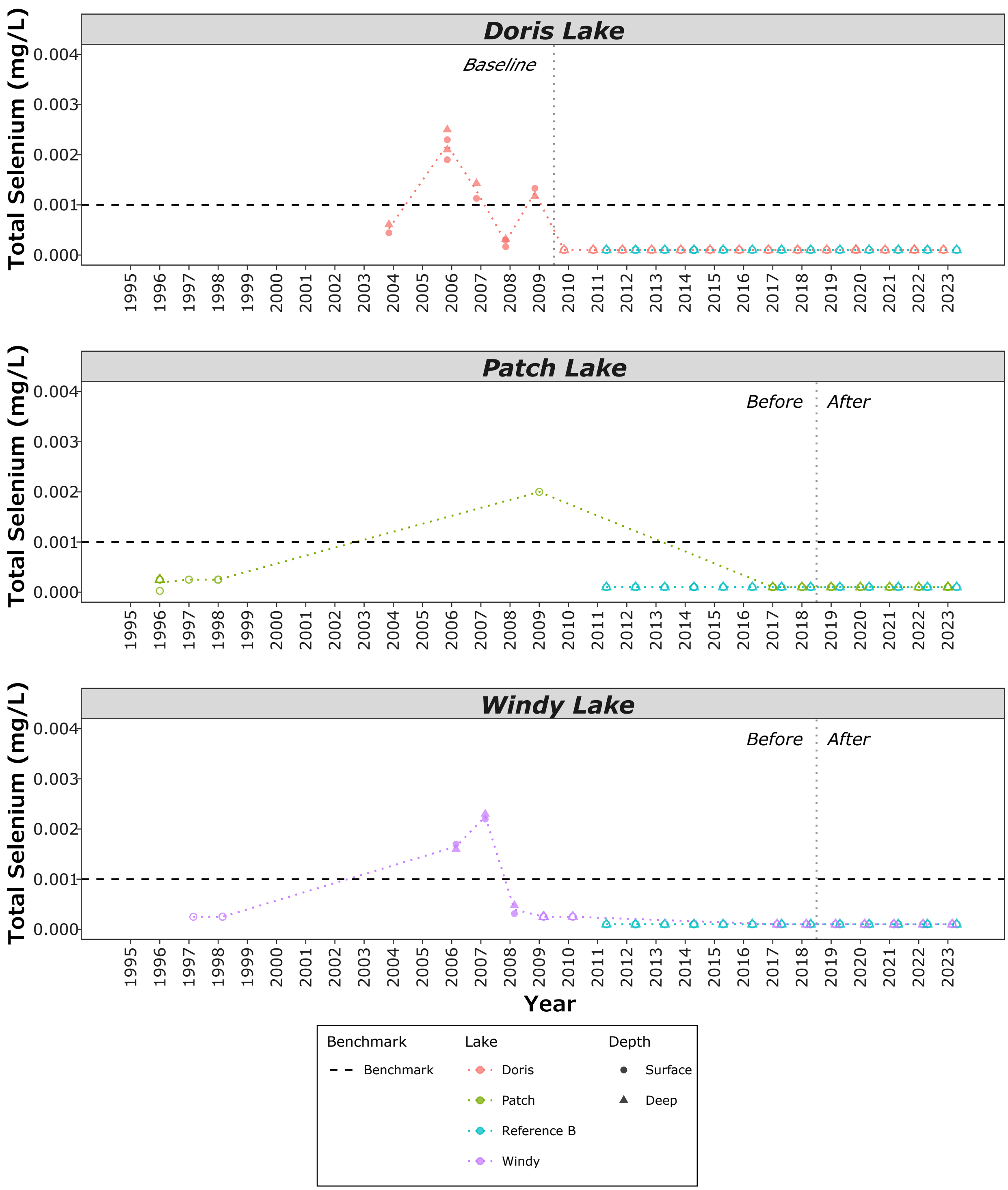
No effects were detected for total selenium in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total selenium were not exceeded in 2023.

TABLE 3.3-22 TOTAL SELENIUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

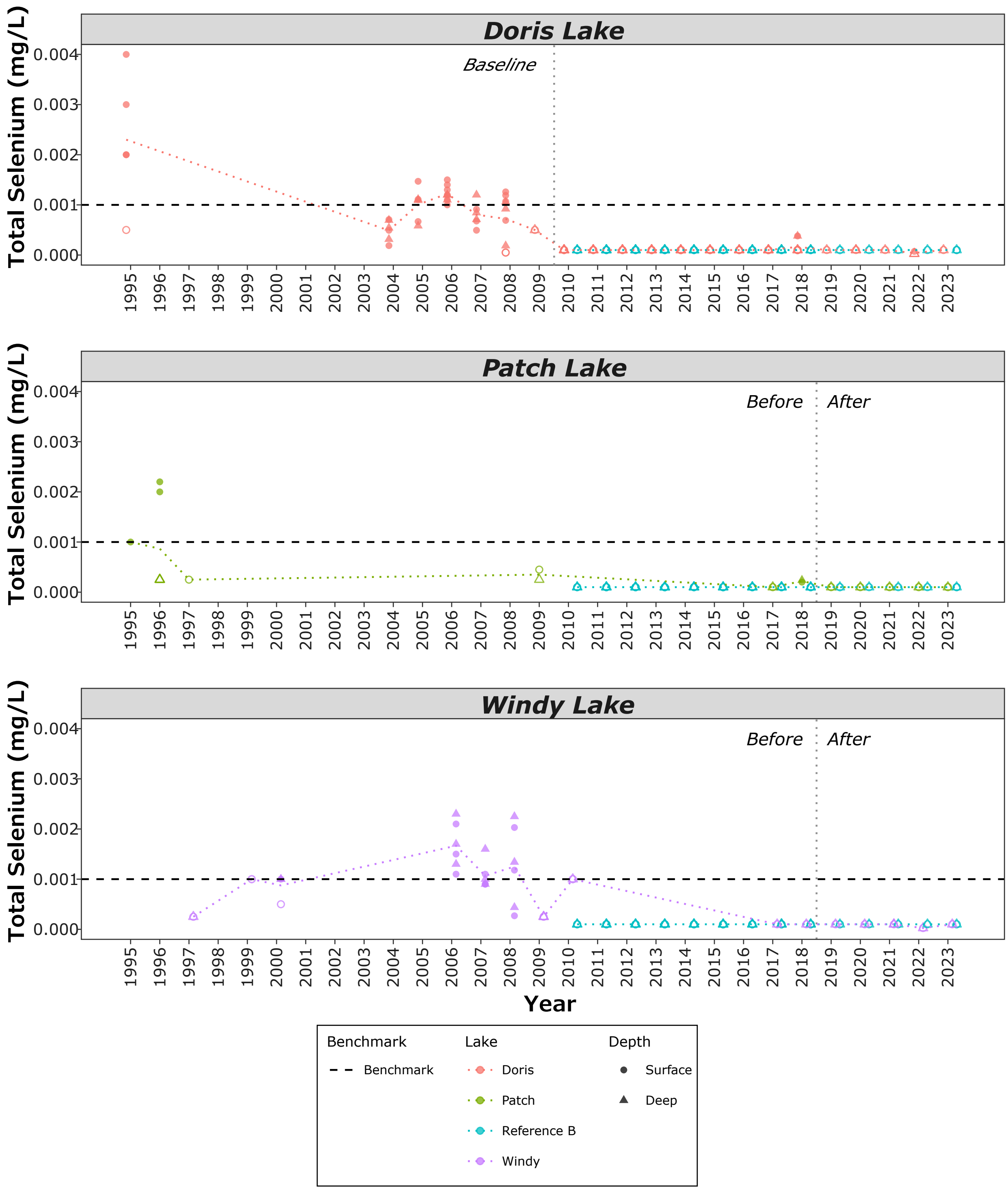
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-22A UNDER-ICE TOTAL SELENIUM IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.001 mg/L.

FIGURE 3.3-22B OPEN-WATER TOTAL SELENIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.001 mg/L.

3.3.23 TOTAL SILVER

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.0000050 mg/L; Table 3.3-23; Section C.3.1.23 in Appendix C). Graphical analyses confirm that total silver concentrations in all three exposure lakes were less than the DL and the benchmark in 2023 (Figures 3.3-23a and 3.3-23b).

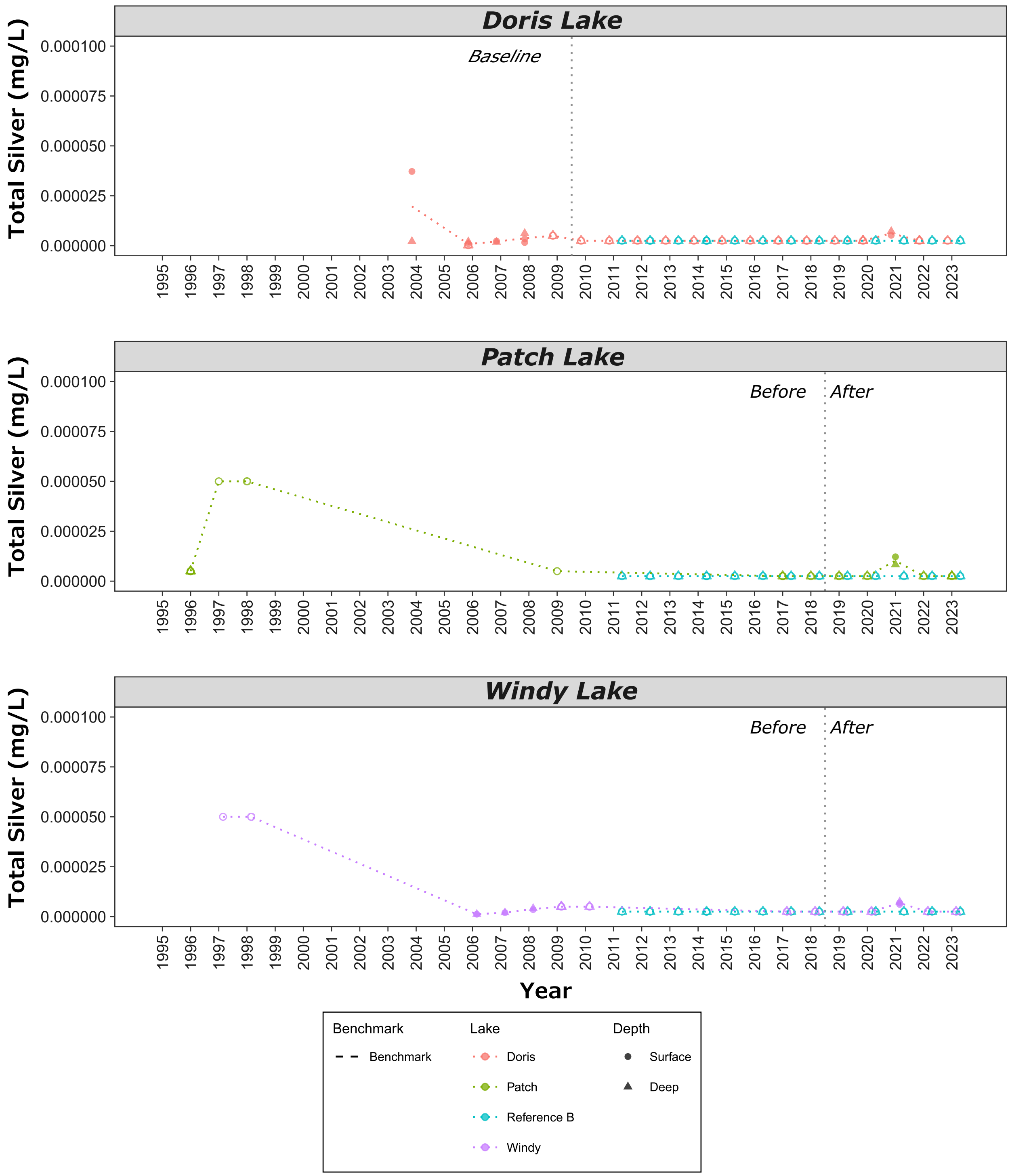
No effects were detected for total silver in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total silver were not exceeded in 2023.

TABLE 3.3-23 TOTAL SILVER STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

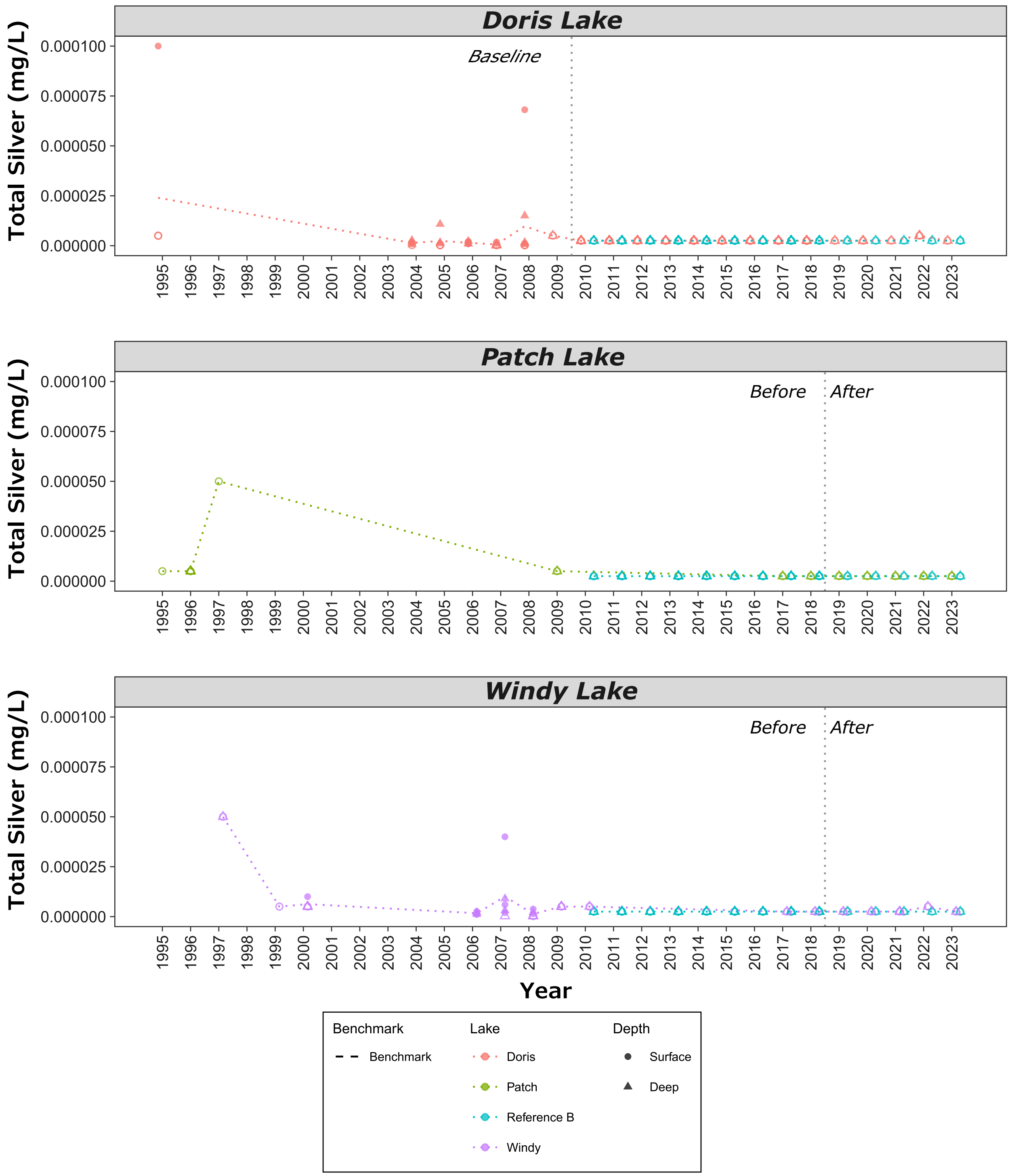
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-23A UNDER-ICE TOTAL SILVER IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.00025 mg/L (not visible on presented range).

FIGURE 3.3-23B OPEN-WATER TOTAL SILVER IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.00025 mg/L (not visible on presented range).

3.3.24 TOTAL THALLIUM

Statistical analyses were not completed for any exposure lakes due to the high proportion of data, including all the 2023 observations, that were less than the DL (<0.0000050 mg/L; Table 3.3-24; Section C.3.1.23 in Appendix C). Graphical analyses confirm that total thallium concentrations in all three exposure lakes were less than the DL and the benchmark in 2023 (Figures 3.3-24a and 3.3-24b).

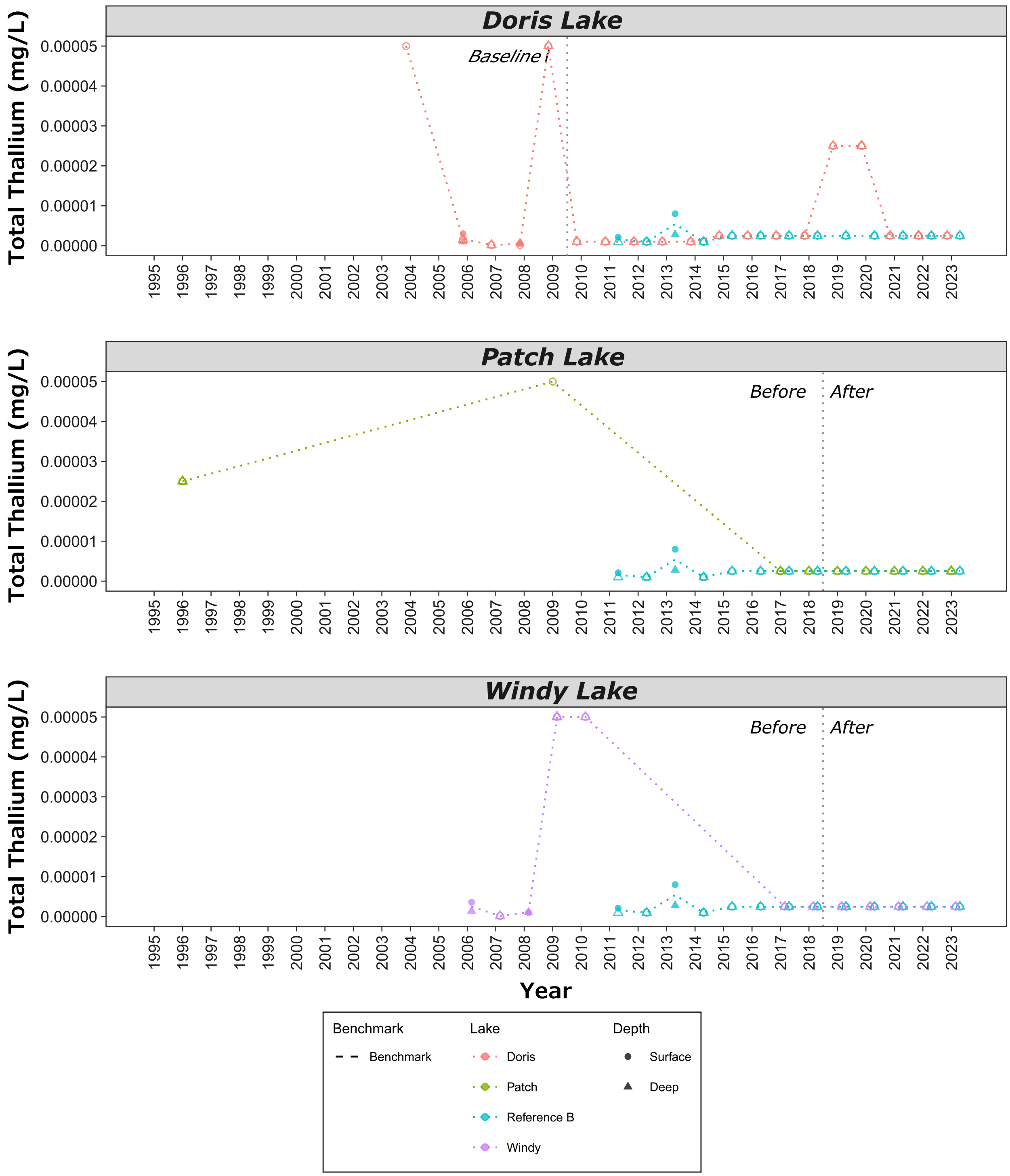
No effects were detected for total thallium in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total thallium were not exceeded in 2023.

TABLE 3.3-24 TOTAL THALLIUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	-	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

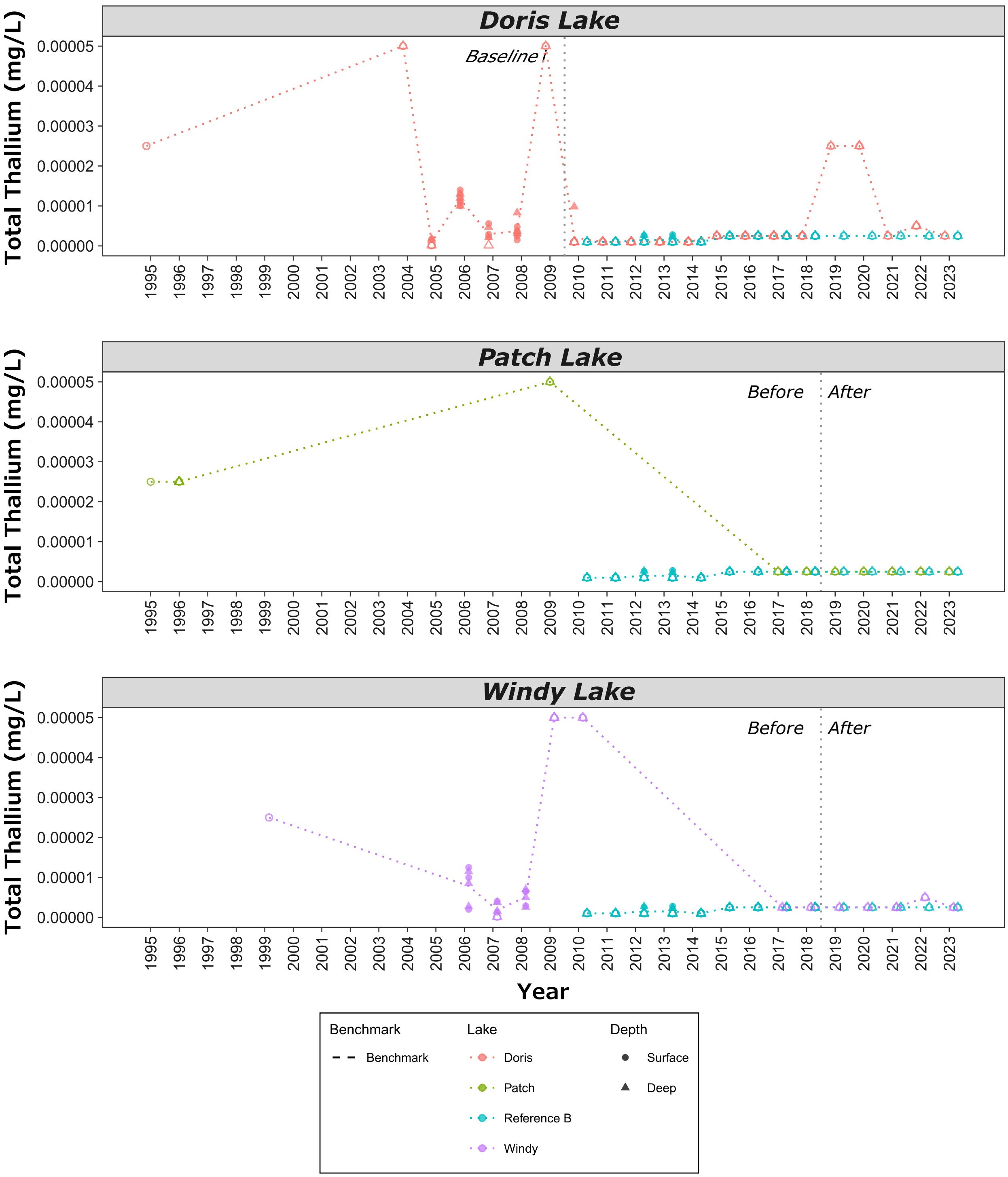
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-24B OPEN-WATER TOTAL THALLIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.0008 mg/L (not visible on presented range).

FIGURE 3.3-24B OPEN-WATER TOTAL THALLIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: *Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.*
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.0008 mg/L (not visible on presented range).

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3.3.25 TOTAL URANIUM

Statistical analyses indicated a significant change over time for total uranium concentrations in Doris Lake during the under-ice season but not compared to the reference lake (Table 3.3-25). Statistical analyses indicated no significant change over time for total uranium concentrations in Doris Lake during the open-water season and between the before-and-after period means in Patch and Windy lakes. Graphical analyses indicated that total uranium concentrations in all three exposure lakes were less than the benchmark in 2023 (Figures 3.3-25a and 3.3-25b).

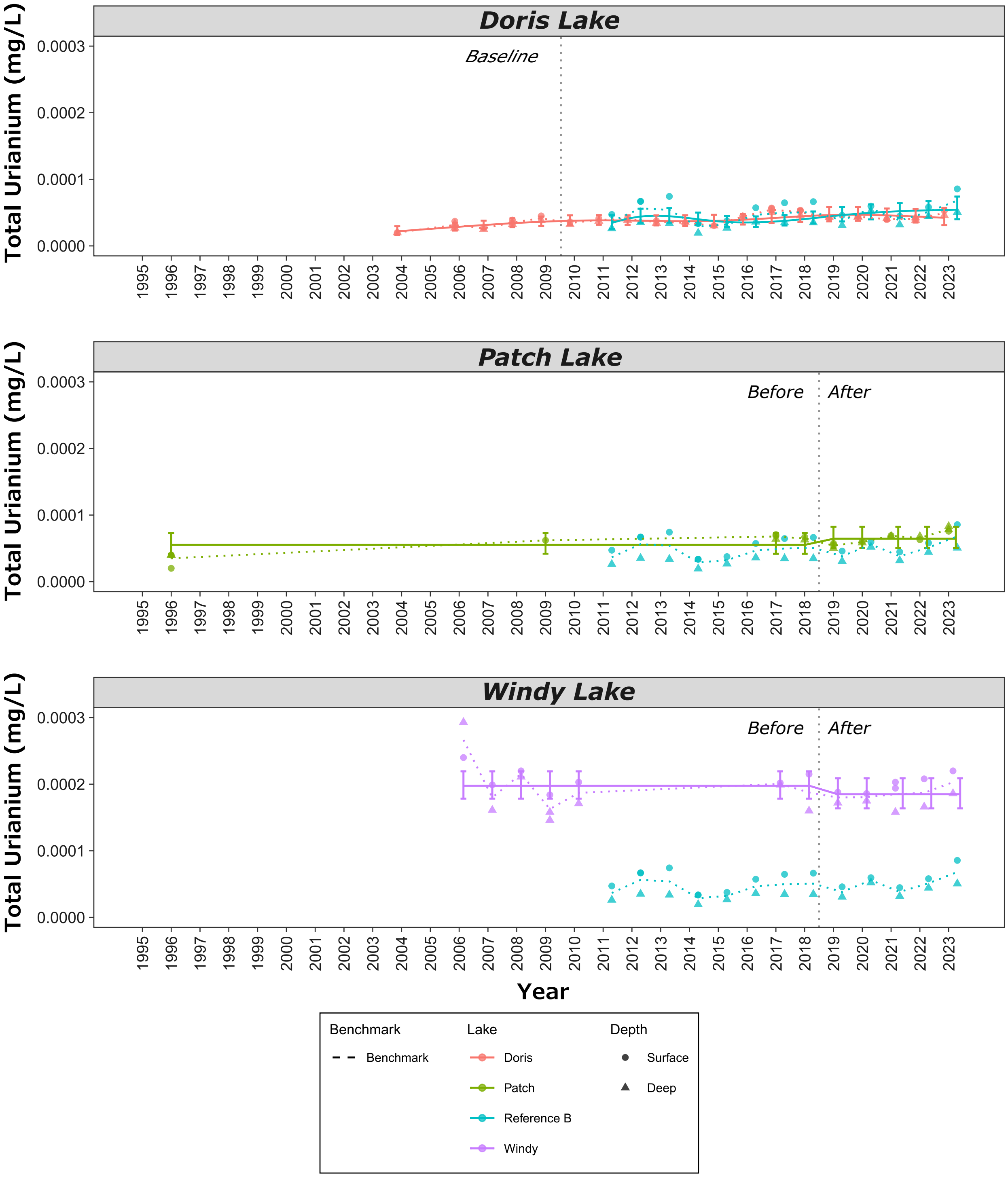
No effects were detected for total uranium in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for total uranium were not exceeded in 2023.

TABLE 3.3-25 TOTAL URANIUM STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (<0.00001)	No (0.2259)	NA	NA
	Open-Water	No (0.0965)	-	NA	NA
Patch	Ice-covered	NA	NA	No (0.3574)	-
	Open-Water	NA	NA	No (0.3166)	-
Windy	Ice-covered	NA	NA	No (0.369)	-
	Open-Water	NA	NA	No (0.142)	-

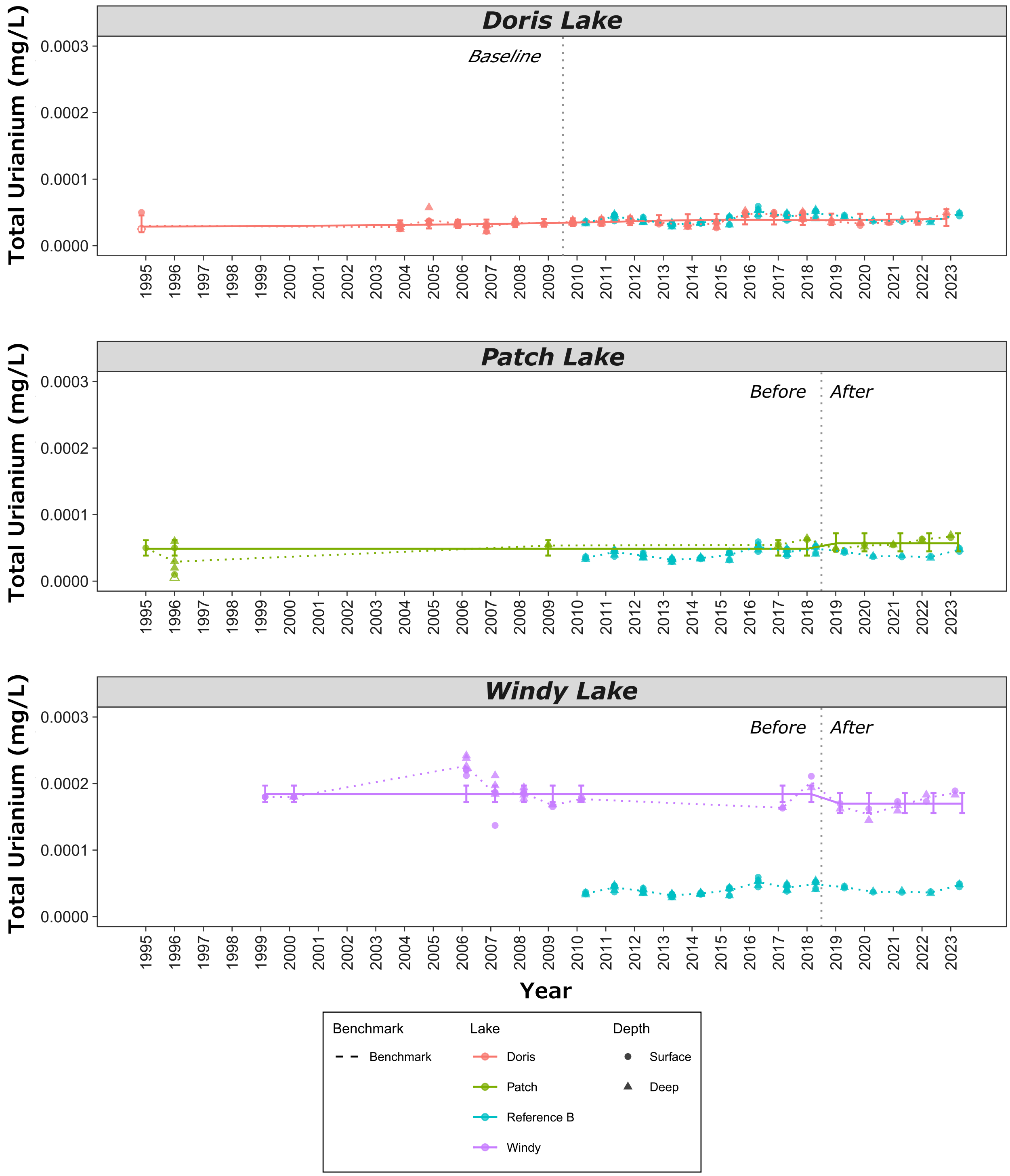
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-25A UNDER-ICE TOTAL URANIUM IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.015 mg/L (not visible on presented range).

FIGURE 3.3-25B OPEN-WATER TOTAL URANIUM IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is 0.015 mg/L (not visible on presented range).

3.3.26 DISSOLVED ZINC

Statistical analysis indicated a significant change over time for dissolved zinc concentrations in Doris Lake during the ice-covered season (Table 3.3-26). Statistical analyses were not completed relative to the reference lake, for Doris Lake during the open-water season, or for Patch and Windy lakes due to the high proportion of data that were less than the DL (Section C.3.1.14 in Appendix C). Graphical analyses indicated that under-ice dissolved zinc concentrations decreased in Doris Lake during the baseline years (1995 to 2009; 0.0161 to <0.00005 mg/L) and concentrations have been low (<0.0010 to 0.0026 mg/L) during the available monitoring period years (2019 to 2023; Figures 3.3-26a and 3.3-26b). It is noted that a decrease in dissolved zinc concentrations is not considered to be an adverse effect (TMAC 2018).

Graphical analysis confirm that dissolved zinc concentrations in Doris Lake during the open-water season and in Patch and Windy lakes were less than the DL (<0.0010 mg/L), except for one under-ice observation in Windy Lake which was marginally greater (<5-times) than the DL in 2023 (Figures 3.3-26a and 3.3-26b). All three exposure lake samples were less than their respective, calculated, dissolved zinc benchmark (0.0103 to 0.0334 mg/L; Table A.3-5 in Appendix A) as confirmed by graphical analyses where all three exposure lake samples were less that the minimum benchmark for each season (Figures 3.3-26a and 3.3-26b).

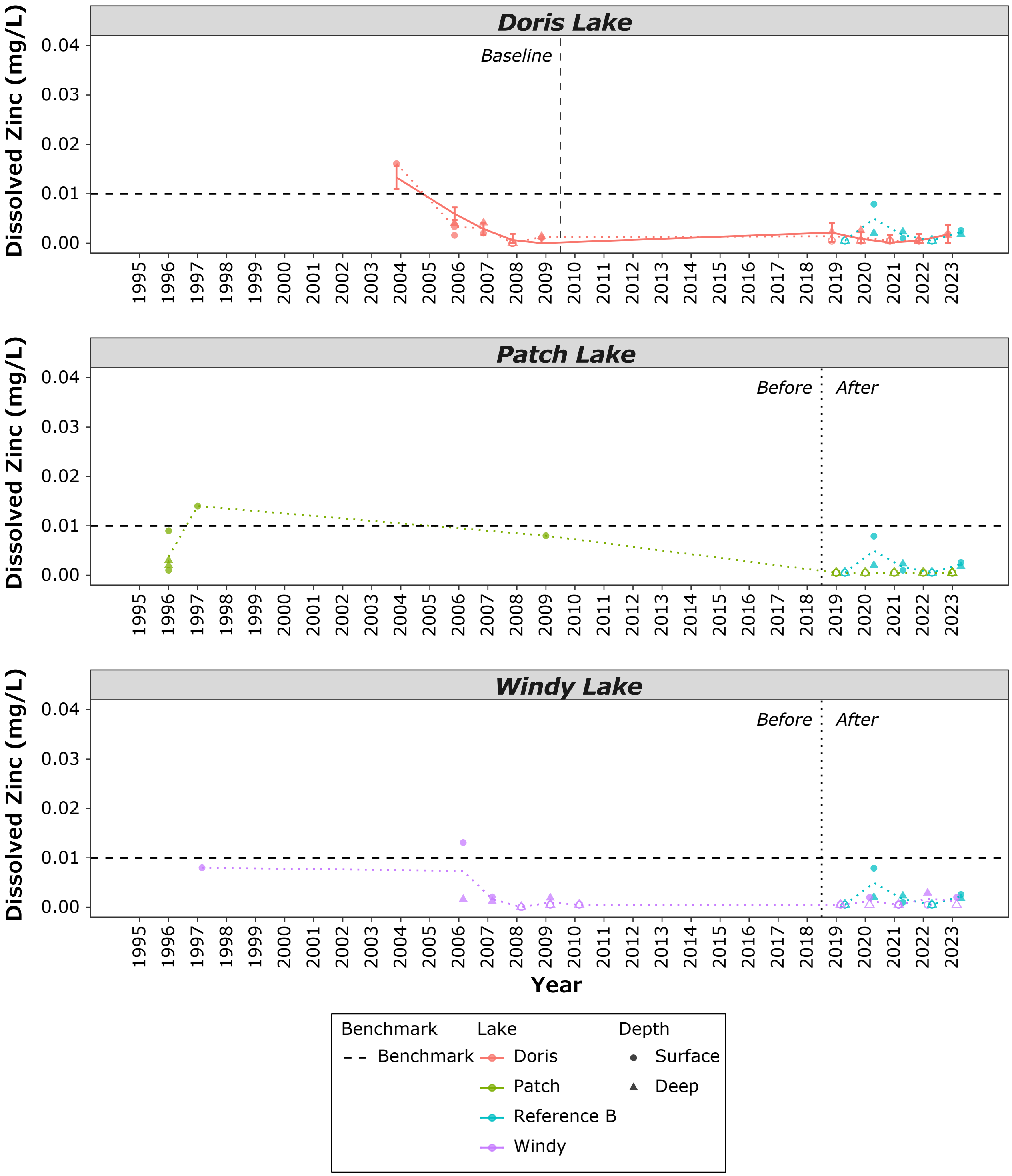
No effects were detected for dissolved zinc in Doris, Patch, or Windy lakes in 2023. The conditions required to consider a low action level for dissolved zinc were not exceeded in 2023.

TABLE 3.3-26 DISSOLVED ZINC STATISTICAL RESULTS FOR EXPOSURE LAKES

Lake	Season	Trend Analysis		BACI	
		Significant Change Relative to a Slope of Zero (p value)	Significant Trend Relative to Reference Lake B (p value)	Significant Before-After Change (p value)	Significant Before-After Change Relative to Reference Lake (p value)
Doris	Ice-covered	Yes (<0.00001)	-	NA	NA
	Open-Water	-	-	NA	NA
Patch	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-
Windy	Ice-covered	NA	NA	-	-
	Open-Water	NA	NA	-	-

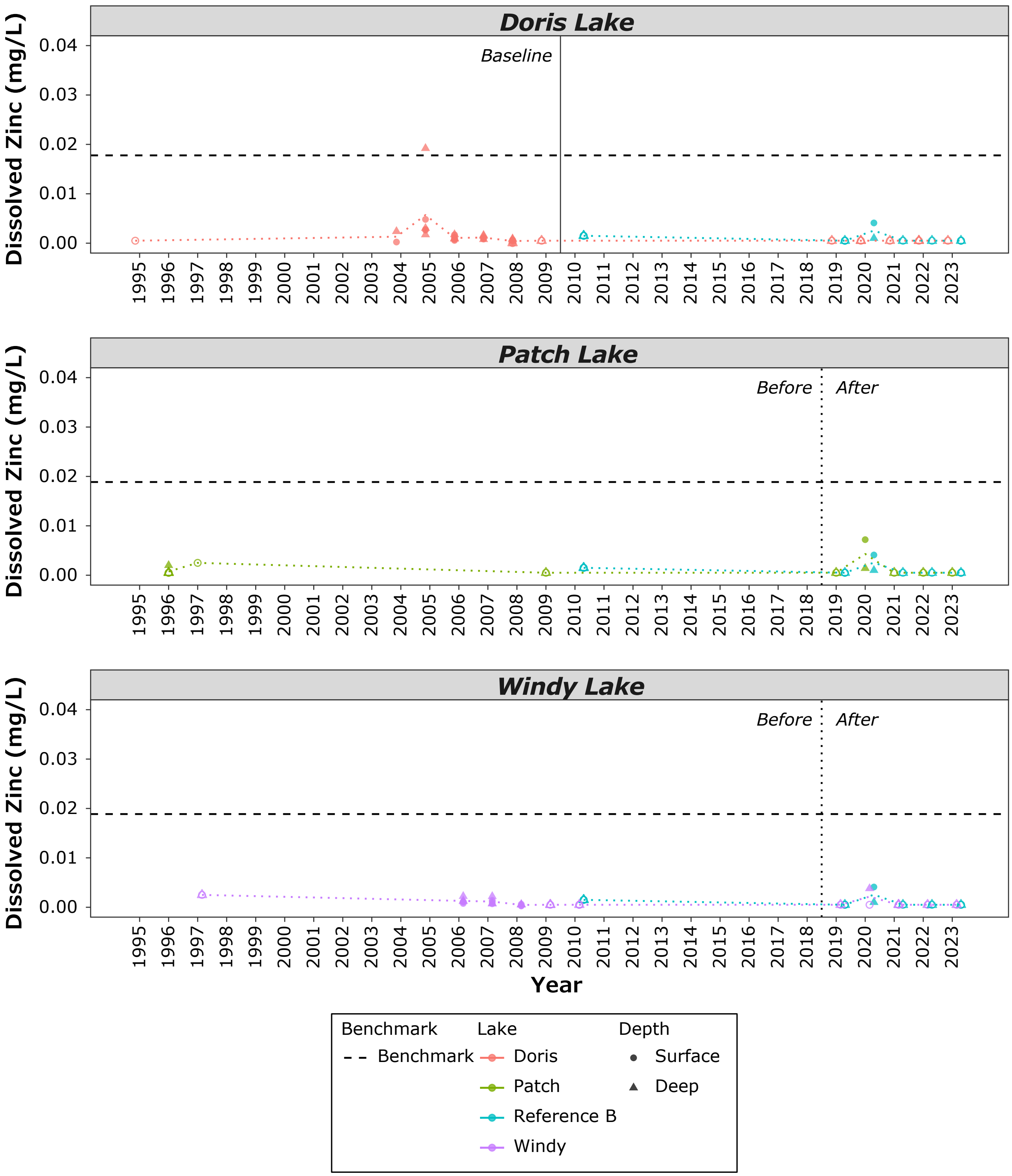
Notes:
BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.
Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.3-26A UNDER-ICE DISSOLVED ZINC IN LAKES, HOPE BAY AEMP, 1996 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is dependent on hardness, pH, and dissolved organic carbon concentrations, see Section 2.2.4 for details; the 2023 calculated minimum is presented (0.0103 mg/L).

FIGURE 3.3-26B OPEN-WATER DISSOLVED ZINC IN LAKES, HOPE BAY AEMP, 1995 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch and Windy lakes.
The error bars are the 95% confidence intervals of the fitted means.
The benchmark is dependent on hardness, pH, and dissolved organic carbon concentrations, see Section 2.2.4 for details;
the 2023 calculated minimum is presented (0.0107 mg/L).

3.4 PHYTOPLANKTON

3.4.1 BIOMASS

Statistical analyses indicated a significant change over time for phytoplankton biomass in Doris Lake (as measured by chl *a*), and relative to the reference lake (Table 3.4-1). Graphical analysis of mean chl *a* concentration in Doris Lake show that phytoplankton biomass decreased from 2011 to 2014 (range of 4.94 to 6.91 µg/L) compared to the 2009 and 2010 mean biomass (8.11 and 11.01 µg/L, respectively; Figure 3.4-1). Subsequently, chl *a* concentration increased between 2014 and 2016 (from 5.43 to 16.76 µg/L) and have since been consistently greater than the baseline and earlier monitoring mean concentrations since 2016, ranging from 11.05 to 22.81 µg/L. The mean chl *a* concentration was relatively elevated in 2022 (22.81 µg/L), compared to the historically observed mean concentrations for Doris Lake however, the concentration observed in 2022 did not continue. Relative to 2022, the observed mean concentration decreased in 2023 (13.30 µg/L); however, it remained greater than the upper baseline range observed in Doris Lake (12.10 µg/L) by approximately 10% (Figure 3.4-1). It is noted that there is only one year of baseline data for Doris Lake as collected in 2009.

In 2022, a low action level response was triggered. The *Aquatic Response Plan for Phytoplankton Biomass* indicated there was no evidence of effects for variables that influence phytoplankton biomass in Doris Lake (e.g., nutrients, water temperature, water levels). The change observed in chl *a* concentration over time in Doris Lake was considered to be due to natural variability and/or regional non-Project-related factors (ERM 2024). The 2023 AEMP results indicate the same conclusion (i.e., for nutrients see Section 3.3.7 to 3.3.10, for water temperature see Section 3.2.2, and for water levels see Section 3.1). Chl *a* concentrations have also shown signs of increase over time in Reference Lake B and changing climate conditions have been documented in this region (Adams et al. 2022; Benson et al. 2012; Forsström et al. 2005; Šmejkalová et al. 2016). As the observed trend in phytoplankton biomass over time in Doris Lake is non-linear, the Response Plan indicated that first (1) condition be confirmed with a supplement statistical test to confirm if the current year's mean chl *a* concentration was statistically different from baseline. A t-test indicated that the 2023 mean chl *a* concentration was not statistically different from the observed baseline mean ($t(2.68) = -2.389$; $p = 0.107$). Therefore, no low action level exceedance was concluded for Doris Lake in 2023.

Statistical analyses indicated no significant difference between the before-and-after period means for phytoplankton biomass in Patch Lake (Table 3.4-1). No effects were detected for phytoplankton biomass in Patch Lake in 2023. The conditions required to consider a low action level for phytoplankton biomass in Patch Lake were not exceeded in 2023.

TABLE 3.4-1 PHYTOPLANKTON BIOMASS STATISTICAL RESULTS FOR EXPOSURE LAKES

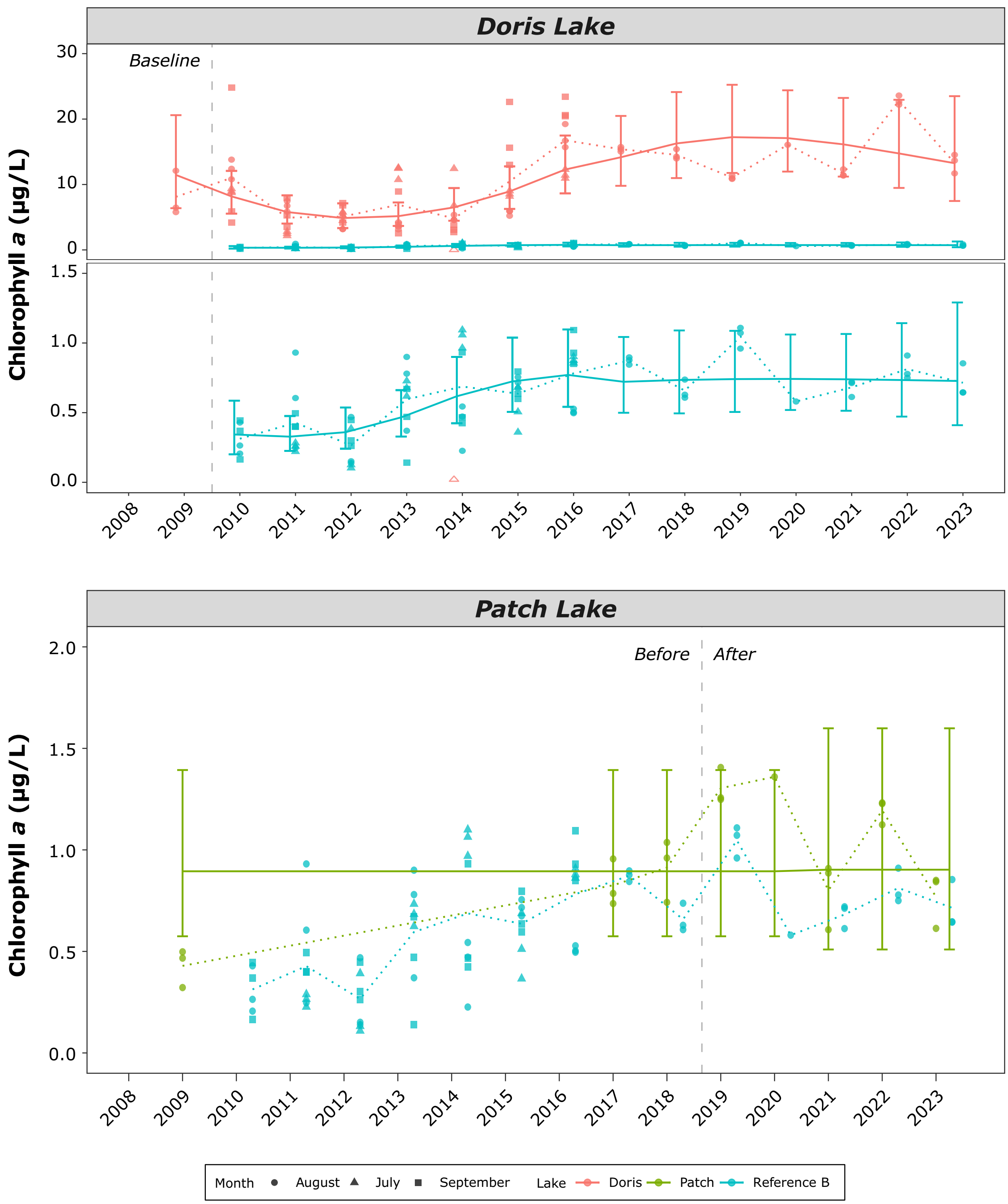
Lake	Trend Analysis		BACI	
	Significant Change Relative to a Slope of Zero (p value)	**Significant Trend Relative to Reference Lake B (p value)**	**Significant Before-After Change (p value)**	**Significant Before-After Change Relative to Reference Lake (p value)**
Doris	Yes (<0.00001)	Yes (0.0165)	NA	NA
Patch	NA	NA	No (0.9774)	-

Notes:

BACI = Before-After/Control-Impact; NA = statistical analysis was not relevant to the dataset.

Dash (-) = the statistical analysis was not completed due to limitations or because the first step of the statistical analysis indicated no significant difference (Appendix C).

FIGURE 3.4-1 PHYTOPLANKTON BIOMASS IN LAKES, HOPE BAY AEMP, 2009 TO 2023



Notes: Symbols represent observed data values, observations are slightly jittered along the x-axis for legibility.
Observations less than the detection limit are shown by hollow symbols and plotted at half the detection limit.
Dotted lines connect the annual observed means.
Solid lines represent the the annual fitted mean for Doris Lake and the fitted before and after means for Patch Lake.
The error bars are the 95% confidence intervals of the fitted means.

4. SUMMARY OF EFFECTS ANALYSIS

There were no Project-related effects concluded for the evaluated fish habitat, physical limnological, or water quality variables in 2023 (Table 4-1).

TABLE 4-1 SUMMARY OF EVALUATION OF EFFECTS, 2023

Variable	Exposure Lakes Included in Evaluation of Effects	Conclusion of Effect	Low Action Level Triggered?
Fish Habitat			
Water level and ice thickness	Windy Lake, Glenn Lake, Patch Lake, Imniagut Lake, P.O. Lake, Ogama Lake, Doris Lake, Little Roberts Lake	No effect	NA
Physical Limnology			
Under-ice dissolved oxygen	Doris Lake, Patch Lake, Windy Lake	No effect	No
Temperature		No effect	No
Water Quality			
pH	Doris Lake, Patch Lake, Windy Lake	No effect	No
Total Suspended Solids		No effect	No
Turbidity		No effect	No
Chloride		No effect	No
Fluoride		No effect	No
Total Ammonia		No effect	No
Nitrate		No effect	No
Nitrite		No effect	No
Total Phosphorus		No effect	No
Total Aluminum		No effect	No
Total Arsenic		No effect	No
Total Boron		No effect	No
Total Cadmium		No effect	No
Total Chromium		No effect	No
Total Copper		No effect	No
Total Iron		No effect	No
Total Lead		No effect	No
Dissolved Manganese		No effect	No
Total Mercury		No effect	No
Total Molybdenum		No effect	No

Variable	Exposure Lakes Included in Evaluation of Effects	Conclusion of Effect	Low Action Level Triggered?
Total Nickel		No effect	No
Total Selenium		No effect	No
Total Silver		No effect	No
Total Thallium		No effect	No
Total Uranium		No effect	No
Dissolved Zinc		No effect	No
Phytoplankton			
Biomass (chl *a*)	Doris Lake, Patch Lake	Effect (Not Project-related)	No

The fish habitat variables, water levels and ice thickness, were within the FEIS predicted range or observed baseline ranges and concluded to be a within natural variability for all exposure lakes (Table 3.1-2).

Under-ice DO, and under-ice and open-water temperatures profiles in the three exposure lakes assessed were either within the baseline observations or the change observed in 2023 relative to the baseline years, or any variance was not concluded as adverse. Under-ice and open-water DO and temperature profiles in the exposure lakes followed a similar trend throughout the water column as observed during their respective baseline years.

The evaluation of effect results for water quality variables indicated:

- There was no significant change over time in Doris Lake, or between the before-and-after periods in Patch and Windy lakes, or
- If a significant change was detected the trend was not a potentially adverse change for that variable (i.e., a decrease), or
- Concentrations remained within the baseline range for that lake in that particular season.

Comparisons to the FEIS water and load balance model for water quality variables were not completed as there were no potentially adverse effects detected in 2023.

An effect was detected for phytoplankton biomass in 2023. However, based on no evidence of effects for variables that influence phytoplankton biomass in Doris Lake (e.g., nutrients, water temperature, water levels), increased chl *a* concentrations over time in Reference Lake B, and changing climate conditions, the change observed in chl *a* concentration over time in Doris Lake was considered to be due to natural variability and/or regional non-Project-related factors (ERM 2024).

Any potential adverse conclusions of the AEMP evaluation of effects are addressed using the Response Framework through the assessment of action level conditions (TMAC 2018). For water temperature, DO concentrations, the 26 water quality variables evaluated, and phytoplankton biomass, the required conditions to exceed a low action level were not met in 2023 (Tables 4-2 and 4-3).

TABLE 4-2 COMPARISON OF WATER QUALITY TO RESPONSE FRAMEWORK CONDITIONS FOR TRIGGERING A LOW ACTION LEVEL RESPONSE, 2023

Exposure Lake	**Doris Lake**						**Patch Lake**						**Windy Lake**					
Season	**Under-ice**			**Open-water**			**Under-ice**			**Open-water**			**Under-ice**			**Open-water**		
Low Action Level Assessment	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**
pH	1	4	2, 3	1	4	2, 3	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Suspended Solids	-	1	2, 3, 4	-	1	2, 3, 4	-	2	1, 3, 4	-	-	1, 2, 3, 4	-	2	1, 3, 4	-	-	1, 2, 3, 4
Turbidity	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4
Chloride	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4	-	1	2,3,4
Fluoride	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Ammonia	-	1	2, 3, 4	-	-	1, 2, 3, 4	-	1	2, 3, 4	-	2	1, 3, 4	-	1	2, 3, 4	-	-	1, 2, 3, 4
Nitrate	-	1	2, 3, 4	-	-	1, 2, 3, 4	-	1	2, 3, 4	-	2	1, 3, 4	-	2	1, 3, 4	-	-	1, 2, 3, 4
Nitrite	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Total Phosphorus[b]	-	1	2, 3	-	1	2, 3	-	1	2, 3	1	4	2, 3	-	1	2, 3	-	1	2, 3
Total Aluminum	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Arsenic	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Boron	1	2	3, 4	1	2	3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Cadmium	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Total Chromium	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Total Copper	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Iron	-	1	2,3, 4	-	1	2,3, 4	-	1	2,3, 4	-	1	2,3, 4	-	-	1, 2, 3, 4	-	1	2,3, 4
Total Lead	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	2	1, 3, 4	-	1	2,3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Dissolved Manganese	-	1	2, 3, 4	1, 4	2	3	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Mercury	1	4	2, 3	-	1	2, 3, 4	-	4	1, 2, 3	-	4	1, 2, 3	-	4	1, 2, 3	-	4	1, 2, 3
Total Molybdenum	1	2	3, 4	1	2	3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Nickel	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Total Selenium	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Total Silver	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4
Total Thallium	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4

Exposure Lake	Doris Lake						Patch Lake						Windy Lake					
Season	**Under-ice**			**Open-water**			**Under-ice**			**Open-water**			**Under-ice**			**Open-water**		
Low Action Level Assessment	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**
Total Uranium	1	4	2, 3	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4	-	1	2, 3, 4
Dissolved Zinc	-	1	2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	-	1, 2, 3, 4	-	2	1,3,4	-	-	1, 2, 3, 4

Notes:
[a] Condition was not evaluated either because it was not necessary (i.e., at least one condition was not met) or because all 2023 observations were less than the DL.
[b] Total phosphorus was assessed only for 2023 as a supporting parameter and is not an annual effects variable under the Plan (TMAC 2018).
Dash (-) = no conditions to report for that category.
Condition 1: identification of a statistically significant and potentially adverse change from baseline conditions.
Condition 2: the concentration of the water quality variable is outside of the normal range based on baseline concentration.
Condition 3: the concentration of the water quality variable exceeds 75% of the benchmark.
Condition 4: if a potentially adverse change is detected at the exposure site, absence of a similar change at the reference site.

TABLE 4-3 COMPARISON OF PHYTOPLANKTON BIOMASS TO RESPONSE FRAMEWORK CONDITIONS FOR TRIGGERING A LOW ACTION LEVEL RESPONSE, 2023

Exposure Lake	Doris Lake			Patch Lake		
Conditions for Low Action Level Response	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**	**Conditions Exceeded**	**Conditions Not Exceeded**	**Conditions Not Evaluated[a]**
Biomass	2	1[b]	3	-	1	2, 3

Notes:
[a] Condition was not evaluated because it was not necessary (i.e., at least one other condition was not met).
[b] As confirmed using a supplemental statistical test, as outlined in the Aquatic Response Plan for Phytoplankton Biomass (ERM 2024).
Dash (-) = no conditions to report for that category.
Condition 1: the identification of a statistically significant change from baseline conditions.
Condition 2: the concentration is outside that the normal range based on baseline conditions.
Condition 3: if a change is detected, the absence of a similar change at the reference site.

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APPENDIX A 2023 DATA REPORT

Hope Bay Project

2023 Aquatic Effects Monitoring Program – Annual Report

Appendix A: 2023 Data Report

March 2024

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APPENDIX A: 2023 DATA REPORT

A.1 INTRODUCTION

This data report presents the sampling methods (Section A.2), and the monitoring data in tables (Section A.3) of the 2023 Aquatic Effects Monitoring Program (AEMP) for the Hope Bay Project (the Project).

The 2023 AEMP was conducted according to the *Hope Bay Project: Aquatic Effects Monitoring Plan* (the Plan; TMAC 2018). The 2023 AEMP included monitoring the following components in exposure and reference lakes:

- water level;
- streamflow;
- ice thickness;
- Secchi depth;
- temperature and dissolved oxygen profiles;
- water quality; and
- phytoplankton biomass.

All methods and data relating to water level and stream hydrological monitoring are presented in Appendix B.

A.1.1 SAMPLING PROGRAM SUMMARY

Table A.1-1 presents a summary of the AEMP components monitored in 2023. As per the Plan (TMAC 2018), not all components of the AEMP are monitored every year; components not monitored in 2023 included sediment quality and lake benthos which are monitored every three years and next scheduled to be monitored in 2025.

TABLE A.1-1 SAMPLING PROGRAM SUMMARY, HOPE BAY AEMP

Monitoring Component	Sampling Frequency	Sample Replication and Depths	Sample Timing	Sampling Device
Ice Thickness				
Ice thickness measurement	1× per year	n = 1 measurement/site	April	Metered rod
Physical Limnology				
Secchi depth; dissolved oxygen and temperature profiles	2× per year	n = 1 profile/site throughout water column	April (profiles only), August	Secchi disk, YSI ProODO optical dissolved oxygen and temperature probe

Monitoring Component	Sampling Frequency	Sample Replication and Depths	Sample Timing	Sampling Device
Water Quality				
Physical variable, nutrients, metals	2× per year	n = 1 at 1 m below the surface, n = 1 at 2 m above water-sediment interface, + 10% replication per sampling event	April, August	Niskin (under-ice) or GO-FLO (open-water) water sampler
Phytoplankton				
Biomass (chlorophyll *a*)	1× per year	n = 3/site at 1 m below the surface	August	GO-FLO water sampler, filtration equipment

Note:
m = metre

A.1.2 SAMPLING SITES

Table A.1-2 and Figure A.1-1 provides an overview of sampling sites and monitoring components completed for each site as part of the 2023 AEMP. Figures A.1-2 to A.1-6 show detailed maps of the sampling components and bathymetric contours when available for each sampled lake.

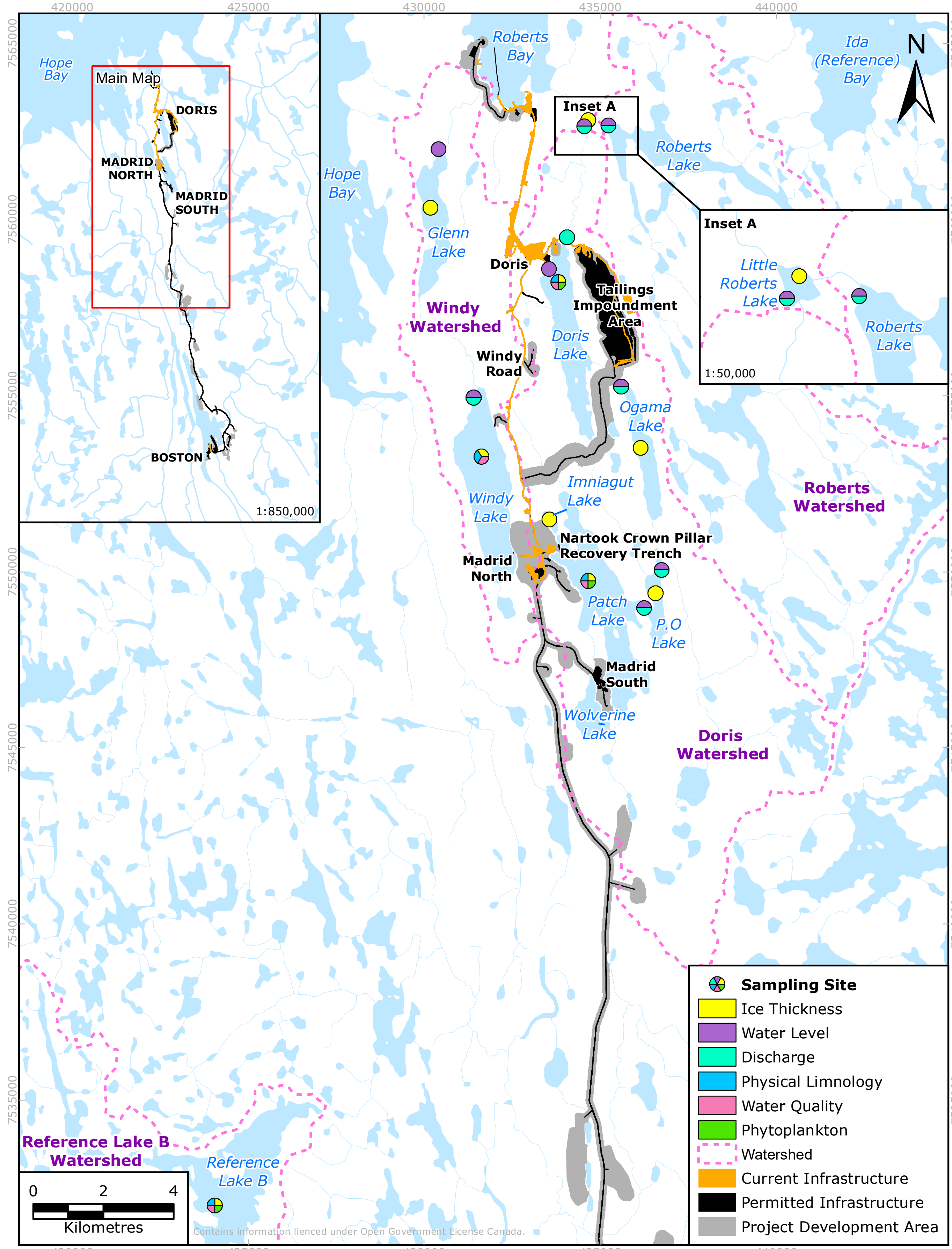
TABLE A.1-2 AEMP SAMPLING LOCATIONS AND MONITORING COMPONENTS, HOPE BAY PROJECT, 2023

Site	Easting	Northing	Ice Thickness	Water Level[2]	Streamflow[2]	Physical Limnology	Water Quality	Phytoplankton
Doris Watershed								
Wolverine Lake[1]	434720	7545890	X	X	-	-	-	-
Patch Lake	434660	7549739	X	-	-	X	X	X
Patch Outflow Hydro	436248	7548973	-	X	X	-	-	-
Imniagut Lake	433559	7551490	X	-	-	-	-	-
Imniagut Lake Hydro	433403	7551421	-	X	-	-	-	-
P.O. Lake	436576	7549393	X	-	-	-	-	-
P.O. Outflow Hydro	436749	7550055	-	X	X	-	-	-
Ogama Lake	436148	7553517	X	-	-	-	-	-
Ogama Outflow Hydro	435595	7555262	-	X	X	-	-	-
Doris Lake	433815	7558222	X	-	-	X	X	X

Site	Easting	Northing	Ice Thickness	Water Level[2]	Streamflow[2]	Physical Limnology	Water Quality	Phytoplankton
Doris Lake-2 Hydro	433547	7558601	-	X	-	-	-	-
Doris Creek TL-2 Hydro	434059	7559504	-	-	X	-	-	-
Little Roberts Lake	434665	7562826	X	-	-	-	-	-
Little Roberts Outflow Hydro	434548	7562652	-	X	X	-	-	-
Windy Watershed								
Windy Lake	431630	7553269	X	-	-	X	X	-
Windy Outflow Hydro	431404	7554948	-	X	X	-	-	-
Glenn Lake	430183	7560337	X	-	-	-	-	-
Glenn Lake Hydro	430410	7562001	-	X	-	-	-	-
Reference Lake								
Reference Lake B	424050	7532000	X	-	-	X	X	X

Notes:
[1] Wolverine Lake was monitored in 2023 to support baseline data collection.
[2] Hydrology components are reported in Appendix B.
Coordinates are NAD83, UTM Zone 13N.

FIGURE A.1-1 SAMPLING SITES, HOPE BAY AEMP, 2023



ERM

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GIS NUMBER: HB-01-297c
DATE: 01/12/2024
PROJECTION: NAD 1983 UTM Zone 13N
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FIGURE A.1-2 PATCH LAKE, IMNIAGUT LAKE, AND P.O. LAKE SAMPLING SITES, HOPE BAY AEMP, 2023

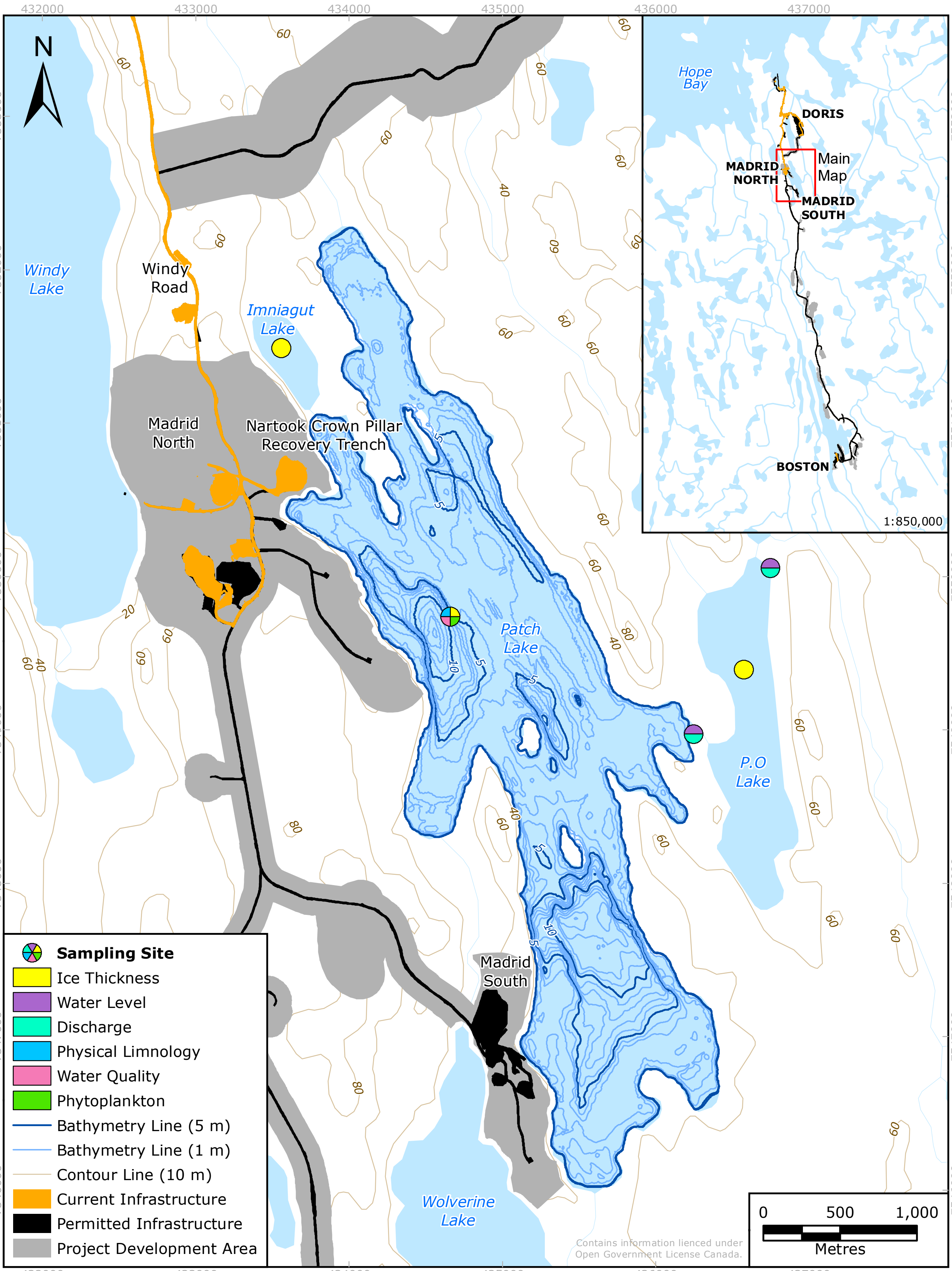

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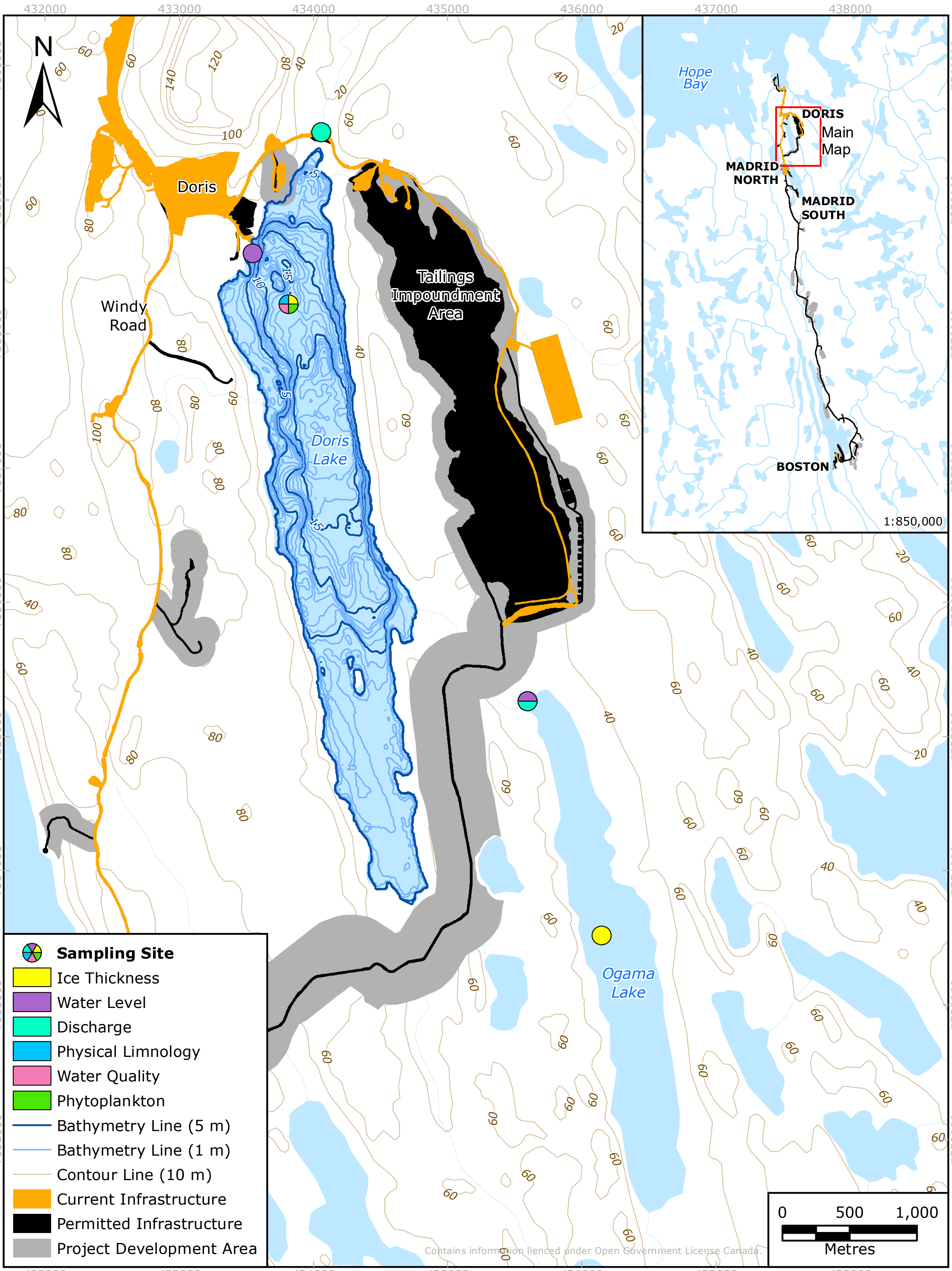
FIGURE A.1-3 DORIS LAKE AND OGAMA LAKE SAMPLING SITES, HOPE BAY AEMP, 2023



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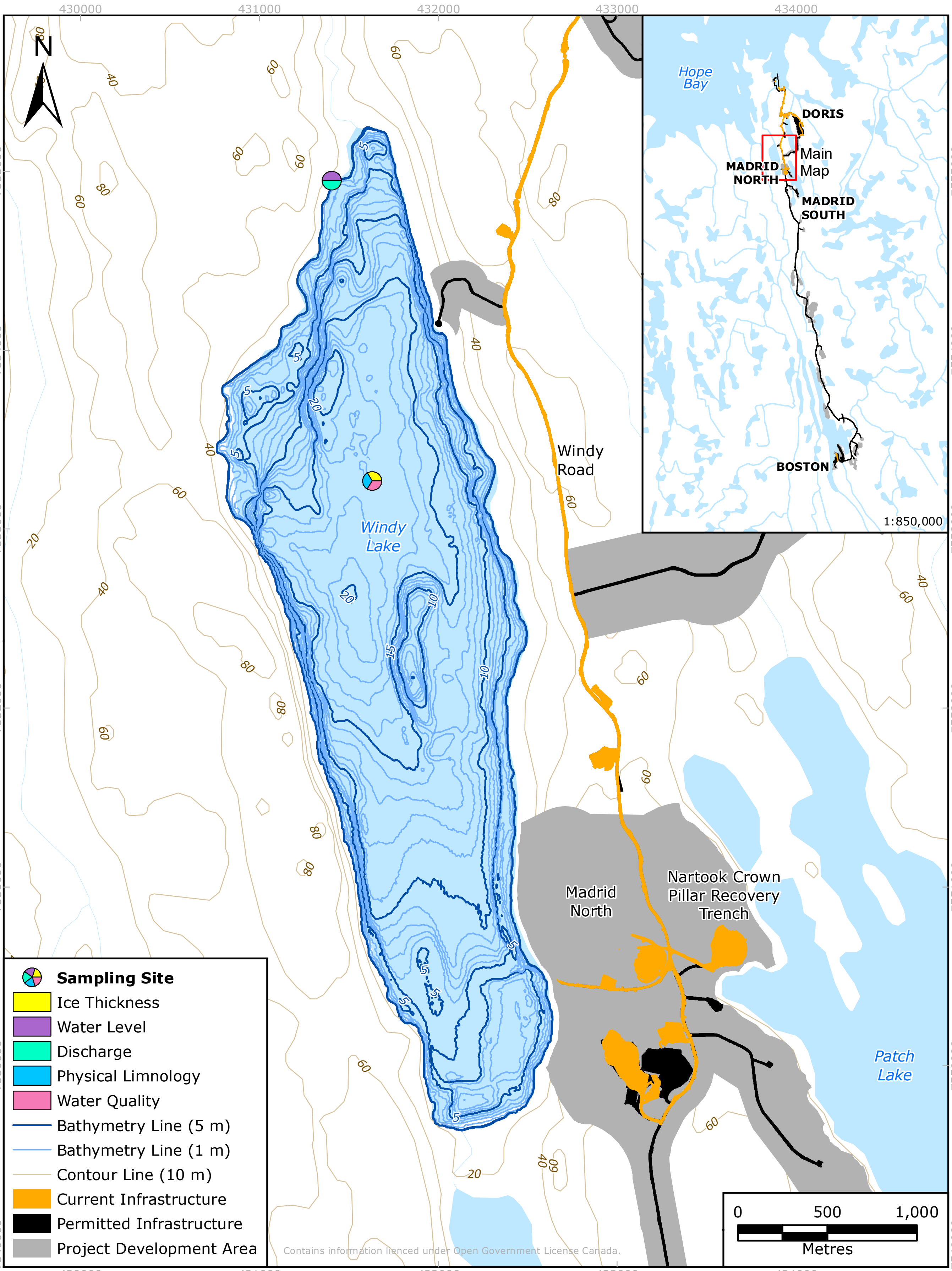
CLIENT: AGNICO EAGLE MINES LIMITED
GIS NUMBER: HB-01-297e

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:40,000 when printed at 8.5x11

FIGURE A.1-4 WINDY LAKE SAMPLING SITES, HOPE BAY AEMP, 2023



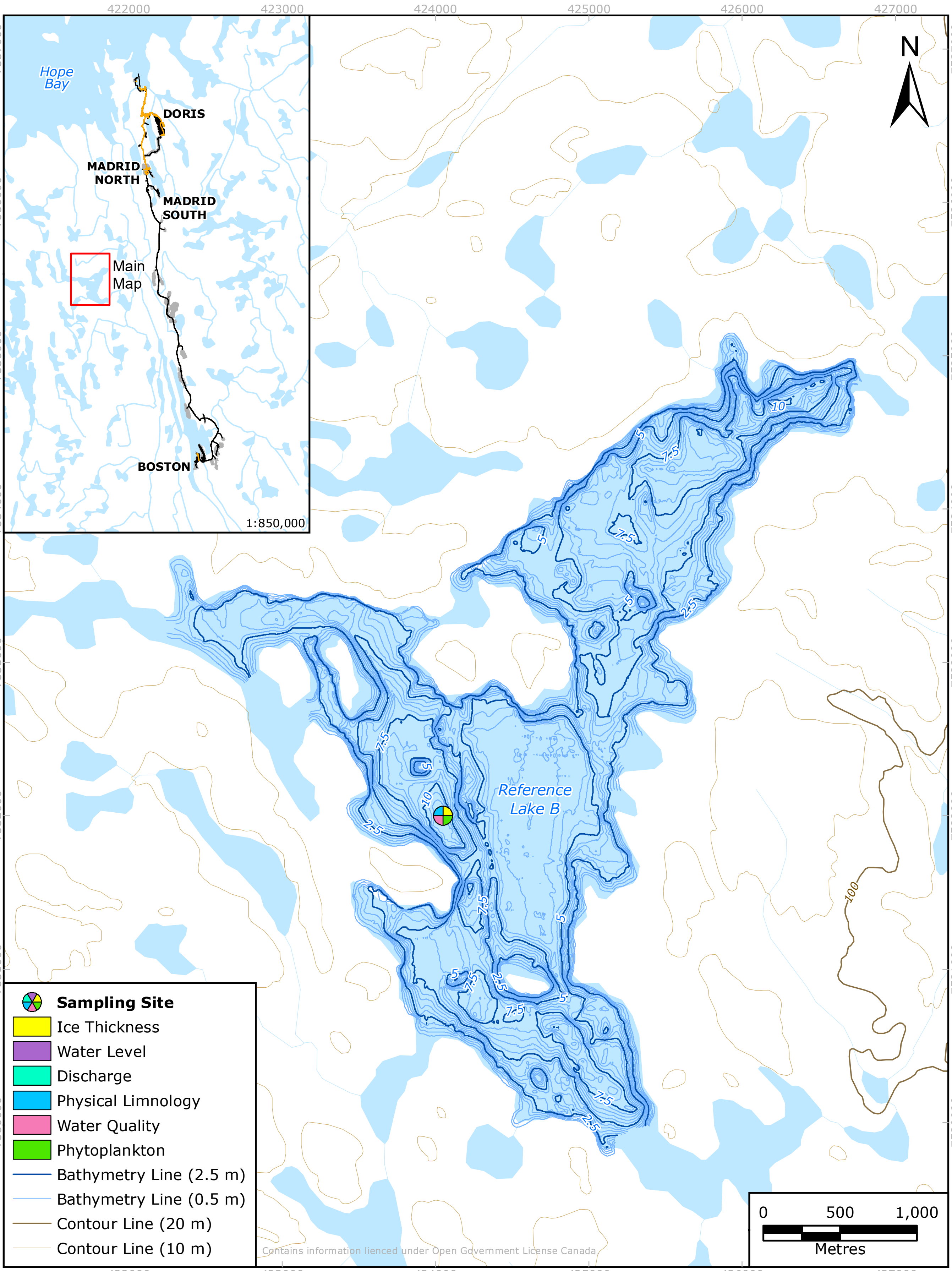
ERM

CLIENT: AGNICO EAGLE MINES LIMITED
GIS NUMBER: HB-01-297f

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:30,000 when printed at 8.5x11

FIGURE A.1-5 REFERENCE LAKE B SAMPLING SITES, HOPE BAY AEMP, 2023



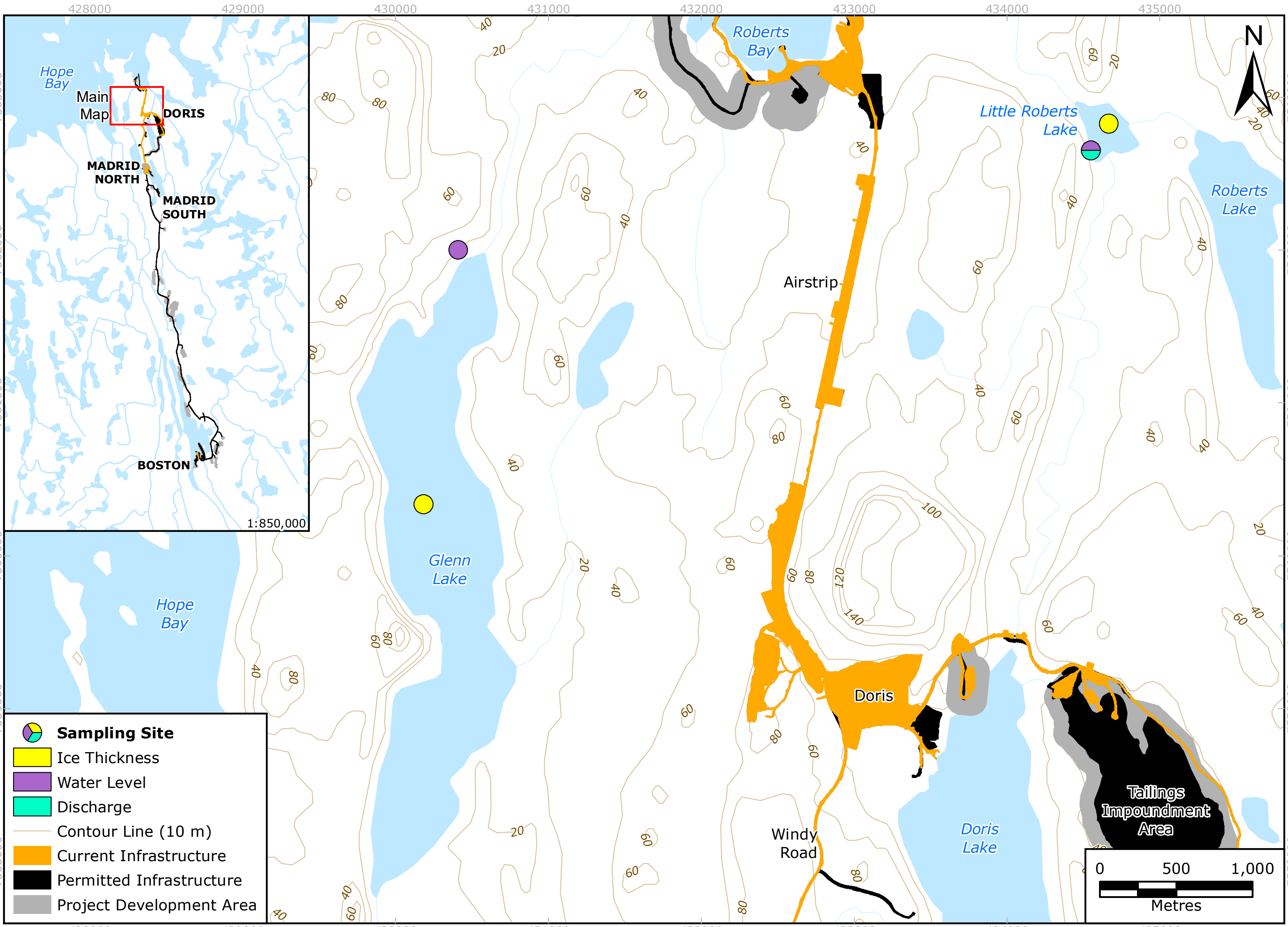
ERM

CLIENT: AGNICO EAGLE MINES LIMITED
GIS NUMBER: HB-01-297g

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:35,000 when printed at 8.5x11

FIGURE A.1-6   GLENN LAKE AND LITTLE ROBERTS LAKE SAMPLING SITES, HOPE BAY AEMP, 2023



ERM

CLIENT: AGNICO EAGLE MINES LIMITED
GIS NUMBER: HB-01-297h

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:35,000 when printed at 8.5x11

A.2 METHODS

A.2.1 ICE THICKNESS

Ice thickness was measured in April. Sampling sites are summarized in Table A.1-2 and presented in Figures A.1-1 to A.1-6.

A hole was augured through the ice, ice chips and snow were cleared from the ice surface and within the augured hole. The ice thickness was then measured from the bottom of the ice layer to the ice surface using a metered rod.

Ice thickness measurements at Windy Lake, Patch Lake, Doris Lake, and Reference Lake B were collected concurrently with water quality sampling and water profiling.

A.2.2 PHYSICAL LIMNOLOGY

A.2.2.1 UNDER-ICE SEASON

Under-ice physical limnology measurements were collected in April. Sampling sites are summarized in Table A.1-2 and presented in Figures A.1-1 to A.1-6.

A hole was augured through the ice, ice chips and snow were cleared from the ice surface and within the augured hole using a clean shovel and clean, plastic, ice scoop.

The water column depth under the ice was measured using a depth sounder lowered to the bottom of the ice layer.

After the collection of water quality samples, temperature and dissolved oxygen profiles were collected using a calibrated YSI ProODO meter equipped with an optical dissolved oxygen sensor. Profiles extended from the bottom of the ice layer to the sediments. Depth was monitored using markings on the cable and data were recorded at 0.5 m intervals for lakes less than 10 m deep and 1m intervals from lakes greater than 10 m deep.

A.2.2.2 OPEN-WATER SEASON

Open-water physical limnology measurements were collected in August from a boat. The water column depth was measured using a handheld depth sounder from the surface of the water.

After the collection of water quality samples, temperature and dissolved oxygen profiles were collected using a calibrated YSI ProODO meter equipped with an optical dissolved oxygen sensor. Profiles extended from the water surface to the sediments. Depth was monitored using markings on the cable and data were recorded at 0.5 m intervals for lakes less than 10 m deep and 1m intervals from lakes greater than 10 m deep.

The euphotic zone depth was estimated from the light attenuation in each lake using a Secchi disk. Light attenuation measurements were collected at each site by lowering the 20 cm black and white Secchi disk on a metred line through the water column on the shaded side of the boat until it disappeared from sight. The depth of disappearance was recorded. The disk was lowered further and then slowly raised until it once again became visible and this depth was also recorded. These depths were averaged to obtain an estimate of the Secchi depth (Ds). The 1% euphotic zone depth ($Z_{1\%}$) was computed by first calculating the light extinction coefficient (k) from Ds, and then calculating the 1% euphotic zone depth based on the appropriate light extinction coefficient. The 1% euphotic zone depth is the depth of the water column to which 1% of the surface irradiance reaches. It represents the depth at which the integrated gross water column photosynthetic production is equivalent to the integrated gross water column respiration; thus, there is net photosynthesis above this depth. The 1% euphotic zone depth is often referred to as the compensation depth, and is calculated as follows (Parsons et al. 1984):

$$\textit{Light extinction coefficient:}\ \ k\ (m^{-1}) = 1.7/D_s$$

$$\textit{Euphotic depth (1\%):}\ \ Z_{1\%}\ (m) = 4.6/k$$

A.2.3 WATER QUALITY

Water quality samples were collected at lake sites in April (under-ice season) and in August (open-water season) in 2023. Sampling sites are summarized in Table A.1-2 and presented in Figures A.1-1 to A.1-6.

Water quality sampling was completed prior to the physical limnology profiles to avoid the potential for sediment suspension if the meter was to disturb the lake sediments.

All samples were kept cold and in the dark while in the field and were refrigerated at Doris Camp until the first available transport off-site. Sample bottles were provided and sample analysis were completed by ALS Laboratory Group (ALS) in Burnaby, British Columbia. The variables analysed and reported detection limits (DL) are summarized in Table A.1-3.

TABLE A.1-3 ANALYSED WATER QUALITY VARIABLES AND REPORTED DETECTION LIMITS, HOPE BAY AEMP, 2023

Variable	Units	Reported Detection Limits	Variable	Units	Reported Detection Limits
Physical Tests					
Conductivity	µS/cm	2	pH	pH	0.1
Total Alkalinity (as $CaCO_3$)	mg/L	1	Total Suspended Solids	mg/L	1 to 1.5
Total Hardness (as $CaCO_3$)	mg/L	0.5	Turbidity	NTU	0.1
Dissolved Hardness (as $CaCO_3$)	mg/L	0.5			
Anions and Nutrients					
Total Ammonia (as N)	mg/L	0.005	Nitrate (as N)	mg/L	0.005
Bromide	mg/L	0.05	Nitrite (as N)	mg/L	0.001
Chloride	mg/L	0.5	Total Phosphorus	mg/L	0.002
Fluoride	mg/L	0.02	Sulphate (SO_4)	mg/L	0.3

Variable	Units	Reported Detection Limits	Variable	Units	Reported Detection Limits
Organic Carbon					
Dissolved Organic Carbon	mg/L	0.5	Total Organic Carbon	mg/L	0.5
Total Metals					
Aluminum	mg/L	0.003	Niobium	mg/L	0.0001
Antimony	mg/L	0.00003	Phosphorus	mg/L	0.05
Arsenic	mg/L	0.00005	Potassium	mg/L	0.03
Barium	mg/L	0.0001	Rhenium	mg/L	0.000005
Beryllium	mg/L	0.000005	Rubidium	mg/L	0.00002
Bismuth	mg/L	0.00005	Selenium	mg/L	0.0002
Boron	mg/L	0.01	Silicon	mg/L	0.1
Cadmium	mg/L	0.000005	Silver	mg/L	0.000005
Calcium	mg/L	0.02	Sodium	mg/L	0.02
Cesium	mg/L	0.000005	Strontium	mg/L	0.0002
Chromium	mg/L	0.0005	Sulphur	mg/L	0.5
Cobalt	mg/L	0.00005	Tantalum	mg/L	0.0001
Copper	mg/L	0.0005	Tellurium	mg/L	0.00005
Gallium	mg/L	0.00005	Thallium	mg/L	0.000005
Iron	mg/L	0.01	Thorium	mg/L	0.000005
Lanthanum	mg/L	0.00005	Tin	mg/L	0.0002
Lead	mg/L	0.00005	Titanium	mg/L	0.0002
Lithium	mg/L	0.0005	Tungsten	mg/L	0.00001
Magnesium	mg/L	0.01	Uranium	mg/L	0.000002
Manganese	mg/L	0.0002	Vanadium	mg/L	0.0002
Mercury	mg/L	0.0000001	Yttrium	mg/L	0.00001
Molybdenum	mg/L	0.00005	Zinc	mg/L	0.003
Nickel	mg/L	0.0002	Zirconium	mg/L	0.00005
Total Metals					
Manganese	mg/L	0.0002	Zinc	mg/L	0.001

A.2.3.1 UNDER-ICE SEASON

A hole was augured through the ice, ice chips and snow were cleared from the ice surface and within the augured hole using a clean shovel and clean, plastic, ice scoop.

Discrete water sample grabs were collected from 1 m below the ice-water interface and approximately 2 m from the water-sediment interface (lake bottom) using a 2.5-L Niskin water sampler. The water sampler was acid washed prior to the sampling event. The water sampler was set to open and lowered through the water column to the desired depth before being triggered close using a Teflon coated messenger on the line.

Samples for the various water quality components (e.g., physical variables, anions and nutrients, and total and dissolved metals) were collected from the water sampler using bottle sets provided from the analytical laboratory. Sample handling methods to reduce any potential contamination was completed, for example: new clean gloves were used when handling each sampling set, the bottle or cap was never in contact with the spigot, the 'clean hands-dirty hands' technique for filling the total mercury sample bottles, etc. Sample water was collected from the sampler and decanted into other sample bottles in the field. Due to cold temperatures potentially freezing the filters for the dissolved samples, only samples not requiring filtering were filled in the field and an additional bottle of raw sample water was collected and the processed back at Doris Camp (e.g., filtered and preserved) as appropriate using clean syringe filters.

A.2.3.2 OPEN-WATER SEASON

During open-water season sampling, water samples were collected from a boat. Discrete water sample grabs were collected from 1 m below the water surface and approximately 2 m from the water-sediment interface (lake bottom) using a 5-L Go Flo water sampler. The water sampler was acid washed prior to the sampling event. The water sampler was set to open and lowered through the water column to the desired depth before being triggered close using a Teflon coated messenger on the line.

Samples for the various water quality components were collected from the water sampler using bottle sets provided from the analytical laboratory. Sample handling methods to reduce any potential contamination was completed, for example: new clean gloves were used when handling each sampling set, the bottle or cap was never in contact with the spigot, the 'clean hands-dirty hands' technique for filling the total mercury sample bottles, etc. Sample water was collected from the sampler and decanted into other sample bottles in the field, including those that were field-filtered for dissolved analytes.

A.2.3.3 QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance/quality control (QA/QC) program for water quality sampling included the collection of replicates to account for within site variability (~10% of total samples) and the use of chain of custody forms to track samples. A set of travel, field, and equipment blanks were also collected/processed during each trip (~25% of total samples) and submitted with the water samples as part of the QA/QC program. These blanks were used to identify potential sources of contamination to the field samples.

The relative percent difference (RPD) between field duplicate water quality samples was calculated as described in Clark (2003) according to the formula:

$$RPD = 2*|A-B|/(A+B)*100\%$$

where A and B represent the concentrations of the water quality variable in each duplicate sample.

As recommended by Clark (2003), RPDs were calculated for specific water quality variables if at least one duplicate concentration was greater than five times the analytical DL, with RPD values >20% indicating a potential issue (caution interpreting results), and >50% indicating a problem (most likely sample contamination or lack of sample representativeness) that requires follow-up (e.g., determination of cause, effect on sample data).

The laboratory QA/QC program included reviews of maximum holding times, and the use of method blanks, laboratory replicates, certified reference materials, internal reference materials, laboratory control samples, matrix spikes, and calibration verification standards. ALS has set data quality objectives (DQOs) for QA/QC samples with acceptable limits for sample recovery, precision, and accuracy. When DQOs are not met, ALS flags the sample for follow-up or adjusts the DL as required.

A.2.4 PHYTOPLANKTON BIOMASS

Phytoplankton biomass is monitored using chlorophyll *a*. Chlorophyll *a* samples were collected in August, in conjunction with water quality sampling. Sampling sites are summarized in Table A.1-2 and presented in Figures A.1-1 to A.1-6.

Chlorophyll *a* samples were collected in opaque, clean, 1-L sample bottles that were thoroughly rinsed with surface water at each site. For each chlorophyll *a* sample, the water sampler (5-L GO-FLO) was lowered to the appropriately 1 m below the water surface and triggered to close with a messenger. Once retrieved, a subsample was drawn from the sampler for chlorophyll *a* determination.

The sample water was kept cold and dark and transported to Doris Camp, where the samples were filtered using gentle vacuum filtration (hand pump). The chlorophyll *a* samples were filtered onto 47 mm diameter, 0.45 μm pore size nitrocellulose membrane filters until there was an observed colour change on the filter. The filters were folded carefully in half using forceps and placed into a black plastic tube to prevent light penetration. The filters were kept frozen and sent to ALS Burnaby for analysis by way of ALS Yellowknife to facilitate the samples staying frozen.

A.2.4.1 QUALITY ASSURANCE AND QUALITY CONTROL

The QA/QC program for chlorophyll *a* sampling included the collection of replicates and the use of chain of custody forms to track samples.

The laboratory QA/QC program included the use of method blanks and laboratory control samples. ALS has set DQOs for QA/QC samples with acceptable limits for sample recovery, precision, and accuracy. When DQOs are not met, ALS flags the sample for follow-up or adjusts the DL as required.

A.3 2023 AEMP DATA

A.3.1 ICE THICKNESS

Table A.3-1 presents the ice thickness measurements recorded from April 20 to 24, 2023.

TABLE A.3-1 ICE THICKNESS MEASUREMENTS, HOPE BAY AEMP, 2023

Lake	Sampling Date	Measured Ice Thickness (m)
Windy	21-Apr-23	1.85
Glenn	20-Apr-23	1.69
Wolverine[1]	21-Apr-23	1.85
Patch	21-Apr-23	1.79
Imniagut	21-Apr-23	1.82
P.O.	24-Apr-23	1.91
Ogama	24-Apr-23	1.80
Doris	24-Apr-23	1.67
Little Roberts	20-Apr-23	1.93
Reference B	23-Apr-23	1.55

[1] Collected as supplemental baseline data.

A.3.2 PHYSICAL LIMNOLOGY

Under-ice physical limnology profiles were collected from April 20 to 24, 2023. Under-ice physical limnology data are presented in Table A.3-2. Open-water physical limnology (profiles and Secchi depth) were collected from August 21 to 27, 2023. Open-water physical limnology profiles are presented in Table A.3-3; Secchi depths and calculated euphotic depths are presented in Table A.3-4.

TABLE A.3-2 UNDER-ICE TEMPERATURE AND DISSOLVED OXYGEN PROFILES, HOPE BAY AEMP, 2023

Windy Lake – April 21, 2023			
Ice Thickness = 1.85 m			
Maximum Depth = 18 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.5	0.2	15.50	106.9
1	0.2	15.76	108.7
2	0.2	15.85	109

Windy Lake – April 21, 2023			
Ice Thickness = 1.85 m			
Maximum Depth = 18 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
3	0.3	15.77	108.7
4	0.3	15.71	108.3
5	0.3	15.63	107.8

Windy Lake – April 21, 2023			
Ice Thickness = 1.85 m			
Maximum Depth = 18 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
6	0.3	15.58	107.3
7	0.3	15.46	106.9
8	0.4	15.36	106.2
9	0.4	15.23	105.1
10	0.5	15.11	104.5
11	0.6	14.74	102.7
12	0.7	14.50	101.3
13	0.9	14.12	99.2
14	1.1	13.92	98.1
15	1.3	13.65	96.7
16	1.6	13.02	92.4
17	2.0	8.96	64.2
18	2.2	6.45	46.3

Patch Lake – April 21, 2023			
Ice Thickness = 1.79 m			
Maximum Depth = 7.5 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
0.5	0.5	14.27	99.0
1	0.3	14.35	98.9
1.5	0.3	14.51	100.4
2	0.7	14.54	101.6
2.5	1.3	13.95	98.7
3	1.4	13.71	97.4
3.5	1.5	12.60	89.7
4	1.5	12.34	88.0
4.5	1.5	12.54	89.5

Patch Lake – April 21, 2023			
Ice Thickness = 1.79 m			
Maximum Depth = 7.5 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
5	1.5	12.76	91.0
5.5	1.5	12.71	90.7
6	1.5	12.47	88.9
6.5	1.5	12.41	88.3
7	1.6	12.30	87.9
7.5	1.5	11.98	85.4

Doris Lake – April 24, 2023			
Ice Thickness = 1.67 m			
Maximum Depth = 14.5 m			
Depth (m)	Temp. (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% Saturation)
1	0.2	12.77	87.7
2	0.2	12.52	86.2
2.5	0.5	12.08	83.7
3	0.6	11.95	83.1
3.5	0.6	11.90	82.7
4	0.6	11.86	82.4
4.5	0.6	11.83	82.3
5	0.6	11.79	81.6
5.5	0.6	11.67	81.1
6	0.6	11.60	80.5
6.5	0.6	11.46	79.3
7	0.7	11.18	77.7
7.5	0.7	11.02	76.7
8	0.8	10.75	75.1
8.5	0.8	10.66	74.5
9	0.8	10.52	73.4

Doris Lake – April 24, 2023			
Ice Thickness = 1.67 m			
Maximum Depth = 14.5 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
9.5	0.8	10.36	72.6
10	0.9	10.12	70.8
10.5	0.9	9.40	66.0
11	1	8.91	62.1
11.5	1	8.35	58.7
12	1.1	7.35	51.4
12.5	1.2	6.61	46.3
13	1.2	6.25	43.8
13.5	1.2	5.93	42.0
14	1.3	5.29	37.5

Reference Lake B – April 23, 2023			
Ice Thickness = 1.55 m			
Maximum Depth = 10.5 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
0.5	0.1	15.20	104.2
1	0.1	15.18	104.2
1.5	0.1	15.40	106.2
2	0.2	15.29	105.7
2.5	0.8	14.33	100.2
3	1.0	13.60	95.5
3.5	1.2	13.16	92.9
4	1.5	11.82	84.0
4.5	1.6	10.84	77.5
5	1.8	10.05	72.0
5.5	1.9	7.83	56.2
6	2.0	6.05	43.4
6.5	2.1	4.92	35.6
7	2.2	4.64	33.6
7.5	2.3	3.85	27.8
8	2.4	3.74	27.6
8.5	2.5	3.12	22.7
9	2.6	2.52	18.2
9.5	2.7	1.41	10.1
10	2.9	1.34	0.5

TABLE A.3-3 OPEN-WATER TEMPERATURE AND DISSOLVED OXYGEN PROFILES, HOPE BAY AEMP, 2023

Windy Lake – August 27, 2023			
Maximum Depth = 17.5 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
1	10.7	10.91	98.2
2	10.6	10.91	98
3	10.5	10.92	97.9
4	10.5	10.91	97.8
5	10.5	10.9	97.7
6	10.5	10.89	97.5
7	10.5	10.87	97.4
8	10.5	10.85	97.3
9	10.5	10.86	97.1
10	10.4	10.84	96.9
11	10.4	10.82	96.8
12	10.4	10.79	96.5
13	10.4	10.78	96.4
14	10.4	10.76	96.2
15	10.4	10.74	96
16	10.4	10.72	95.9
17	10.4	10.72	95.9
17.5	10.4	10.71	95.8

Patch Lake – August 21, 2023			
Maximum Depth = 7 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
0	11.1	10.89	98.7
0.5	11.1	10.83	98.5
1	11.1	10.83	98.4
1.5	11.1	10.82	98.3
2	11.1	10.81	98.2
2.5	11.1	10.79	98.1
3	11.1	10.78	98
3.5	11.1	10.78	98
4	11.1	10.77	97.9
4.5	11.1	10.76	97.8
5	11.1	10.75	97.7
5.5	11.1	10.74	97.6
6	11.1	10.73	97.5
6.5	11.1	10.04	91
7	11.2	7.5	70.2

Doris Lake – August 22, 2023			
Maximum Depth = 14.6 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
0	11.3	10.24	93.4
1	11.3	10.2	93.2
2	11.3	10.17	92.9
3	11.3	10.15	92.6
4	11.3	10.12	92.5
5	11.3	10.12	92.4
6	11.3	10.11	92.3
7	11.3	10.09	92.1
8	11.3	10.07	92.0
9	11.3	10.05	91.8
10	11.3	10.04	91.6

Doris Lake – August 22, 2023			
Maximum Depth = 14.6 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
11	11.2	10.02	91.3
12	11.2	10.01	91.2
13	11.1	10.03	91.2
14	11.0	9.95	90.1

Reference Lake B – August 22, 2023			
Maximum Depth = 10.6 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
0.5	10.7	10.85	97.6
1	10.7	10.83	97.5

Reference Lake B – August 22, 2023			
Maximum Depth = 10.6 m			
Depth (m)	**Temp. (°C)**	**Dissolved Oxygen (mg/L)**	**Dissolved Oxygen (% Saturation)**
2	10.6	10.83	97.2
3	10.5	10.82	97.0
4	10.5	10.81	96.9
5	10.5	10.80	96.8
6	10.4	10.81	96.6
7	10.4	10.79	96.5
8	10.4	10.77	96.3
9	10.4	10.76	96.3
10	10.4	10.76	96.2
10.5	10.4	10.78	96.4

TABLE A.3-4 SECCHI DEPTHS AND EUPHOTIC ZONE DEPTHS, HOPE BAY AEMP, 2023

Lake	Sampling Date	Secchi Depth (m)	Euphotic Zone Depth 1% Light Level (m)
Windy	27-Aug-23	5.38	14.54
Patch	21-Aug-23	3.75	10.15*
Reference B	22-Aug-23	8.13	21.99*

Notes:
Secchi depth for Doris Lake is not available due to a field sampling error.
* Indicates that the euphotic zone extended to the bottom of the water column.

A.3.3 WATER QUALITY

Under-ice water quality samples were collected from April 20 to 24, 2023, and open-water season water quality samples were collected from August 21 to 27, 2023.

Water quality variables were screened against benchmarks (Tables 2.2-2 to 2.2-4 in main report). Table A.3-5 presents all analyzed variables for all water quality samples collected in 2023, if a sample exceeded the applicable guideline it was highlighted.

A.3.3.1 QUALITY ASSURANCE/QUALITY CONTROL DATA

Field QA/QC

Field sample variability was accounted for by collecting duplicate samples to represent 10% of the samples collected, one duplicate was collected per sampling season. Field duplicates were collected at Patch Lake (deep) during the under-ice season and Reference Lake B (surface) during the open-water season in 2023. RPD calculations for duplicate water quality samples are presented in Table A.3-6. For the 48 RPD calculations, no variables had an RPD greater than 20%. Overall, this indicates that there was good agreement between variable concentrations in duplicate samples, and no evidence of contamination or lack of sample representativeness that would influence the evaluation of effects in 2023.

Table A.3-7 presents the results of the QA/QC blank data (equipment, field, and travel blanks) collected to identify possible sources of contamination to water quality samples. QA/QC data collected for each sampling event represented a minimum of 10% of the samples collected.

A subset of variables for blank samples were detectable above DLs in at least one equipment, field, or travel blank: turbidity, total ammonia, nitrate, DOC, TOC, total aluminum, total lead, total mercury, and dissolved zinc. However, all these instances were less than five times the DL, which is the DQO for laboratory method blank analyses for reliable data and it is accepted that laboratory blanks would be more precise than field blanks.

Overall, the blank data indicate that potential for contamination from field handling, storage, transportation likely did not influence the water quality results for the sampled exposure and reference lakes and the results of the water quality samples collected in 2023 are of reliable quality.

TABLE A.3-5 WATER QUALITY RESULTS, HOPE BAY AEMP, 2023

Lake	Units	Doris Lake				Patch Lake				
Sampling Date		24-Apr-2023		22-Aug-2023		21-Apr-2023			21-Aug-2023	
Sampling Depth (m)		Surface (3 m)	Deep (12.5 m)	Surface (1 m)	Deep (14.5 m)	Surface (3 m)	Deep (5.5 m)		Surface (1 m)	Deep (5.5 m)
Replicate		1	1	1	1	1	1	2	1	1
ALS Sample ID		YL2300338-003	YL2300338-004	EO2307668-007	EO2307668-008	YL2300338-005	YL2300338-006	YL2300338-009	EO2307668-005	EO2307668-006
Physical Tests										
Specific conductivity	μS/cm	271	269	219	221	447	466	461	272	271
Total alkalinity (as $CaCO_3$)	mg/L	34.6	33.5	27.2	27.2	55.6	59.2	59.7	33.3	33.5
Dissolved hardness (as $CaCO_3$)	mg/L	49.3	48.6	46.7	44.8	82.2	84.1	87.4	54.1	55.7
Total hardness (as $CaCO_3$)	mg/L	55.6	54.6	44.6	46.3	89.8	96.9	92.7	53.3	53.7
Total suspended solids	mg/L	2.4	<1.0	7.4	4.7	<1.0	1.4	<1.0	<1.0	<1.0
Turbidity	NTU	4.62	1.38	6.42	6.26	3.36	3.14	3.3	3.13	2.36
pH	pH units	7.56	7.32	7.57	7.58	7.73	7.7	7.78	7.68	7.67
Anions and Nutrients										
Total ammonia (as N)	mg/L	0.0206	0.019	<0.0050	<0.0050	0.0171	0.0209	0.0205	<0.0050	0.0056
Bromide	mg/L	0.2	0.184	0.144	0.138	0.296	0.318	0.329	0.169	0.179
Chloride	mg/L	63.4	63.1	48.5	48.6	104	110	110	60.7	60.6
Fluoride	mg/L	0.067	0.058	0.049	0.049	0.091	0.098	0.099	0.059	0.062
Nitrate (as N)	mg/L	0.0309	0.178	<0.0050	<0.0050	0.039	0.0396	0.0389	<0.0050	0.0117
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total phosphorus	mg/L	0.0296	0.014	0.0306	0.0283	0.0077	0.0087	0.0061	0.0061	0.0087
Sulphate (as SO_4)	mg/L	2.84	2.76	1.5	1.53	4.02	4.24	4.3	1.56	1.48
Organic / Inorganic Carbon										
Dissolved organic carbon	mg/L	7.51	7.72	6.78	6.63	7.96	8	8.04	5.68	5.54
Total organic carbon	mg/L	7.87	7.26	6.94	6.87	8.05	8.62	8.45	5.69	5.76
Total Metals										
Aluminum	mg/L	0.026	0.0368	0.0842	0.0942	0.2	0.192	0.185	0.133	0.123
Antimony	mg/L	<0.000030	<0.000030	<0.000030	<0.000030	0.000036	0.000037	0.000037	<0.000030	<0.000030
Arsenic	mg/L	0.00029	0.000267	0.000312	0.000316	0.000354	0.00039	0.000372	0.000312	0.000304
Barium	mg/L	0.00273	0.00328	0.00304	0.00309	0.0053	0.00532	0.00542	0.00312	0.00294
Beryllium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000057	0.0000061	0.0000064	<0.0000050	<0.0000050
Bismuth	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Lake	Units	Doris Lake				Patch Lake				
Sampling Date		24-Apr-2023		22-Aug-2023		21-Apr-2023			21-Aug-2023	
Sampling Depth (m)		Surface (3 m)	Deep (12.5 m)	Surface (1 m)	Deep (14.5 m)	Surface (3 m)	Deep (5.5 m)		Surface (1 m)	Deep (5.5 m)
Replicate		1	1	1	1	1	1	2	1	1
ALS Sample ID		YL2300338-003	YL2300338-004	EO2307668-007	EO2307668-008	YL2300338-005	YL2300338-006	YL2300338-009	EO2307668-005	EO2307668-006
Total Metals *(cont'd)*										
Boron	mg/L	0.024	0.024	0.019	0.019	0.04	0.043	0.042	0.024	0.024
Cadmium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium	mg/L	10	9.74	8.33	8.68	15.5	16.7	16	9.5	9.54
Cesium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	0.0000068	0.0000075	0.000008	0.0000078	0.0000075
Chromium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt	mg/L	<0.000050	<0.000050	0.000057	0.000064	<0.000050	<0.000050	0.00005	0.000053	<0.000050
Copper	mg/L	0.00212	0.00206	0.00173	0.00174	0.00237	0.00243	0.00234	0.00166	0.00134
Gallium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron	mg/L	0.02	0.052	0.187	0.201	0.132	0.149	0.145	0.102	0.102
Lanthanum	mg/L	0.000074	0.000079	0.0001	0.000108	0.000201	0.000214	0.000206	0.000135	0.000125
Lead	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	0.000087	0.000081	0.000139	0.000187	<0.000050
Lithium	mg/L	0.00374	0.00378	0.00307	0.00305	0.00658	0.00702	0.00668	0.00414	0.00409
Magnesium	mg/L	7.43	7.35	5.79	5.98	12.4	13.4	12.8	7.19	7.26
Manganese	mg/L	0.00246	0.0224	0.0547	0.0571	0.00694	0.0107	0.01	0.00852	0.00848
Mercury	mg/L	0.00000073	0.00000073	0.00000063	0.00000092	0.00000055	0.00000046	0.0000005	0.00000049	0.0000004
Molybdenum	mg/L	0.000241	0.000191	0.000211	0.000215	0.000347	0.000349	0.000345	0.000276	0.000265
Nickel	mg/L	0.00083	0.00067	0.00076	0.00072	0.00112	0.00122	0.00117	0.0008	0.00065
Niobium	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus	mg/L	0.051	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium	mg/L	2.71	2.65	2.15	2.19	4.35	4.65	4.35	2.59	2.61
Rhenium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium	mg/L	0.00166	0.00167	0.00138	0.00144	0.00249	0.00264	0.00252	0.00162	0.0016
Selenium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon	mg/L	1.72	2.03	1.62	1.64	1.2	1.28	1.29	0.68	0.63
Silver	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium	mg/L	34.4	34	26.1	27.2	54.8	58.7	55.9	32.5	32.9
Strontium	mg/L	0.0473	0.0468	0.0352	0.0364	0.0813	0.088	0.0832	0.0462	0.0461

Lake	Units	Doris Lake				Patch Lake				
Sampling Date		24-Apr-2023		22-Aug-2023		21-Apr-2023			21-Aug-2023	
Sampling Depth (m)		Surface (3 m)	Deep (12.5 m)	Surface (1 m)	Deep (14.5 m)	Surface (3 m)	Deep (5.5 m)		Surface (1 m)	Deep (5.5 m)
Replicate		1	1	1	1	1	1	2	1	1
ALS Sample ID		YL2300338-003	YL2300338-004	EO2307668-007	EO2307668-008	YL2300338-005	YL2300338-006	YL2300338-009	EO2307668-005	EO2307668-006
Total Metals *(cont'd)*										
Sulfur	mg/L	1.26	1.19	1.02	1.03	1.62	1.77	1.72	1.08	1.03
Tantalum	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tellurium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thallium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium	mg/L	0.0000226	0.0000174	0.0000238	0.0000232	0.0000524	0.0000496	0.0000481	0.0000308	0.0000289
Tin	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	mg/L	0.0002	0.00029	0.00234	0.00237	0.00317	0.00339	0.00332	0.0045	0.00424
Tungsten	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	0.000018	0.000037	0.000041	0.000025	0.000027
Uranium	mg/L	0.0000528	0.0000458	0.0000448	0.0000501	0.0000757	0.000083	0.0000781	0.0000655	0.0000691
Vanadium	mg/L	<0.00020	<0.00020	0.00025	0.00028	0.00026	0.00026	0.00026	0.00029	0.00027
Yttrium	mg/L	0.000035	0.000034	0.000037	0.000039	0.000068	0.000074	0.000063	0.000036	0.000034
Zinc	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium	mg/L	0.000077	0.000066	0.000073	0.000075	0.000113	0.000113	0.000112	0.000068	0.000067
Dissolved Metals										
Manganese	mg/L	0.0006	0.00651	0.024	0.0216	0.00391	0.00372	0.00379	0.0003	0.00029
Zinc	mg/L	0.0019	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Lake	Units	Windy Lake				Reference Lake B				
Sampling Date		21-Apr-2023		27-Aug-2023		23-Apr-2023		22-Aug-2023		
Sampling Depth (m)		Surface (3 m)	Deep (15.5m)	Surface (1 m)	Deep (15.5 m)	Surface (2.5 m)	Deep (9 m)	Surface (1 m)		Deep (10.5 m)
Replicate		1	1	1	1	1	1	1	2	1
ALS Sample ID		YL2300338-007	YL2300338-008	EO2307893-001	EO2307893-002	YL2300338-001	YL2300338-002	EO2307668-009	EO2307668-004	EO2307668-010
Physical Tests										
Specific conductivity	µS/cm	507	482	405	411	72	70.2	48.1	47.7	47.2
Total alkalinity (as $CaCO_3$)	mg/L	57.8	55.5	47.6	48.1	17.2	17.3	10.3	10.6	10.5
Dissolved hardness (as $CaCO_3$)	mg/L	83.9	81.3	79.4	80.4	21.1	21.1	14.5	14.6	14.7
Total hardness (as $CaCO_3$)	mg/L	91.3	87.7	81.6	84.2	24.1	22.7	14.7	14.2	14.6
Total suspended solids	mg/L	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Turbidity	NTU	0.46	0.28	0.92	0.96	0.14	0.61	0.38	0.35	0.36
pH	pH units	7.94	7.87	7.81	7.8	7.27	7.11	7.18	7.13	7.13
Anions and Nutrients										
Total ammonia (as N)	mg/L	<0.0050	0.0138	<0.0050	<0.0050	0.0173	0.014	<0.0050	<0.0050	<0.0050
Bromide	mg/L	0.433	0.411	0.282	0.284	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride	mg/L	118	114	96.2	97.2	9.67	8.91	5.7	5.48	5.55
Fluoride	mg/L	0.083	0.08	0.068	0.065	0.032	0.029	0.023	0.025	0.024
Nitrate (as N)	mg/L	<0.0050	0.0192	<0.0050	<0.0050	0.0548	0.129	0.0051	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total phosphorus	mg/L	0.0043	0.0034	0.004	0.005	0.0139	0.0055	0.004	0.0041	0.0054
Sulphate (as SO_4)	mg/L	10.2	9.81	7.54	7.27	2.14	1.95	1.05	1.08	1.07
Organic / Inorganic Carbon										
Dissolved organic carbon	mg/L	2.51	2.24	3.08	3.43	4.72	4.25	4.6	4.26	4.43
Total organic carbon	mg/L	2.64	2.51	3.49	3.2	4.51	4.04	4.26	3.74	4.01
Total Metals										
Aluminum	mg/L	0.0176	0.0224	0.0563	0.0622	0.0102	0.01	0.0095	0.0092	0.0096
Antimony	mg/L	0.000081	0.000078	0.000076	0.000072	<0.000030	0.000237	<0.000030	<0.000030	<0.000030
Arsenic	mg/L	0.000247	0.000219	0.00022	0.000224	0.000106	0.000095	0.000087	0.000083	0.000085
Barium	mg/L	0.0028	0.00274	0.00262	0.00258	0.00257	0.00276	0.00134	0.0014	0.00136
Beryllium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron	mg/L	0.059	0.056	0.042	0.044	<0.010	<0.010	<0.010	<0.010	<0.010

Lake	Units	Windy Lake				Reference Lake B				
Sampling Date		21-Apr-2023		27-Aug-2023		23-Apr-2023		22-Aug-2023		
Sampling Depth (m)		Surface (3 m)	Deep (15.5m)	Surface (1 m)	Deep (15.5 m)	Surface (2.5 m)	Deep (9 m)	Surface (1 m)		Deep (10.5 m)
Replicate		1	1	1	1	1	1	1	2	1
ALS Sample ID		YL2300338-007	YL2300338-008	EO2307893-001	EO2307893-002	YL2300338-001	YL2300338-002	EO2307668-009	EO2307668-004	EO2307668-010
Total Metals *(cont'd)*										
Cadmium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium	mg/L	16.1	15	14.7	15.1	5.96	5.58	3.64	3.5	3.62
Cesium	mg/L	<0.0000050	<0.0000050	0.0000051	0.0000065	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000325	<0.000050	<0.000050	<0.000050
Copper	mg/L	0.00108	0.00106	0.00107	0.00104	0.00144	0.00125	0.00135	0.00087	0.00081
Gallium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron	mg/L	<0.010	<0.010	0.048	0.053	0.019	0.274	0.026	0.025	0.026
Lanthanum	mg/L	<0.000050	<0.000050	0.000065	0.000066	0.000101	0.000118	<0.000050	<0.000050	<0.000050
Lead	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium	mg/L	0.00365	0.00336	0.00284	0.00284	0.0007	0.00069	<0.00050	<0.00050	<0.00050
Magnesium	mg/L	12.4	12.2	10.9	11.3	2.24	2.12	1.37	1.32	1.36
Manganese	mg/L	0.00082	0.00096	0.00186	0.00199	0.00188	0.121	0.00228	0.00221	0.0022
Mercury	mg/L	0.00000109	0.00000016	0.00000021	<0.0000001	0.00000099	0.00000075	0.00000058	0.00000055	0.00000048
Molybdenum	mg/L	0.000801	0.000716	0.000711	0.000704	0.000076	0.000054	0.000061	0.000069	0.000051
Nickel	mg/L	0.00032	0.00026	0.00029	0.00029	0.00037	0.00046	<0.00020	0.00022	0.0002
Niobium	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium	mg/L	4.92	4.68	4.2	4.36	0.816	0.75	0.49	0.472	0.484
Rhenium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium	mg/L	0.00232	0.00216	0.00192	0.00194	0.0013	0.00128	0.000793	0.00078	0.000786
Selenium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon	mg/L	0.47	0.55	0.42	0.43	0.4	0.93	0.24	0.23	0.23
Silver	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium	mg/L	64.2	61.1	54.4	56.3	6.25	5.54	3.86	3.66	3.81
Strontium	mg/L	0.0764	0.0714	0.0649	0.0664	0.0308	0.0298	0.0171	0.0165	0.017
Sulfur	mg/L	3.72	3.54	3.23	3.28	0.93	0.88	0.58	0.58	0.58

Lake	Units	Windy Lake				Reference Lake B				
Sampling Date		21-Apr-2023		27-Aug-2023		23-Apr-2023		22-Aug-2023		
Sampling Depth (m)		Surface (3 m)	Deep (15.5m)	Surface (1 m)	Deep (15.5 m)	Surface (2.5 m)	Deep (9 m)	Surface (1 m)		Deep (10.5 m)
Replicate		1	1	1	1	1	1	1	2	1
ALS Sample ID		YL2300338-007	YL2300338-008	EO2307893-001	EO2307893-002	YL2300338-001	YL2300338-002	EO2307668-009	EO2307668-004	EO2307668-010
Total Metals *(cont'd)*										
Tantalum	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tellurium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Thallium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium	mg/L	0.0000084	0.0000081	0.0000207	0.0000148	0.000023	0.0000122	0.0000069	<0.0000050	<0.0000050
Tin	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	mg/L	0.00033	0.00046	0.00226	0.00345	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tungsten	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium	mg/L	0.00022	0.000186	0.000189	0.000183	0.0000856	0.0000506	0.0000446	0.0000494	0.0000483
Vanadium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Yttrium	mg/L	<0.000010	0.000012	0.000018	0.000018	0.000042	0.000026	<0.000010	<0.000010	0.00001
Zinc	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Metals										
Manganese	mg/L	0.00036	0.00041	0.00045	0.00043	0.00132	0.0982	0.00038	0.00036	0.00033
Zinc	mg/L	0.002	<0.0010	<0.0010	<0.0010	0.0026	0.0018	<0.0010	<0.0010	<0.0010

Note:
Gray shading indicates value was greater than the benchmark (see Table 2.2-2 to 2.2-4 in the main report).

TABLE A.3-6 WATER QUALITY DUPLICATE RELATIVE PERCENT DIFFERENCES, HOPE BAY AEMP, 2023

Lake	**Units**	**Patch Lake**			**Reference Lake B**		
Sampling Date		**21-Apr-23**			**22-Aug-23**		
Sampling Depth (m)		**5.5**			**1**		
Replicate		**1**	**2**	**RPD**	**1**	**2**	**RPD**
ALS Sample ID		**YL2300338-006**	**YL2300338-009**		**EO2307668-004**	**EO2307668-009**	
Physical Tests							
Conductivity	µS/cm	466	461	1.1	47.7	48.1	0.8
Total Alkalinity (as $CaCO_3$)	mg/L	59.2	59.7	0.8	10.6	10.3	2.9
Dissolved Hardness (as $CaCO_3$)	mg/L	84.1	87.4	3.8	14.6	14.5	0.7
Total Hardness (as $CaCO_3$)	mg/L	96.9	92.7	4.4	14.2	14.7	3.5
pH	pH units	7.7	7.78	1.0	7.13	7.18	0.7
Total Suspended Solids	mg/L	1.4	<1.0	-	<1.0	<1.0	-
Turbidity	NTU	3.14	3.3	5.0	0.35	0.38	-
Anions and Nutrients							
Total Ammonia (as N)	mg/L	0.0209	0.0205	-	<0.0050	<0.0050	-
Bromide	mg/L	0.318	0.329	3.4	<0.050	<0.050	-
Chloride	mg/L	110	110	0.0	5.48	5.7	3.9
Fluoride	mg/L	0.098	0.099	-	0.025	0.023	-
Nitrate (as N)	mg/L	0.0396	0.0389	1.8	<0.0050	0.0051	-
Nitrite (as N)	mg/L	<0.0010	<0.0010	-	<0.0010	<0.0010	-
Total Phosphorus	mg/L	0.0087	0.0061	-	0.0041	0.004	-
Sulphate	mg/L	4.24	4.3	1.4	1.08	1.05	-

Lake	Units	Patch Lake			Reference Lake B		
Sampling Date		21-Apr-23			22-Aug-23		
Sampling Depth (m)		5.5			1		
Replicate		1	2	RPD	1	2	RPD
ALS Sample ID		YL2300338-006	YL2300338-009		EO2307668-004	EO2307668-009	
Organic/Inorganic Carbon							
Dissolved Organic Carbon	mg/L	8	8.04	0.5	4.26	4.6	7.7
Total Organic Carbon	mg/L	8.62	8.45	2.0	3.74	4.26	13.0
Total Metals							
Aluminum	mg/L	0.192	0.185	3.7	0.0092	0.0095	-
Antimony	mg/L	0.000037	0.000037	-	<0.000030	<0.000030	-
Arsenic	mg/L	0.00039	0.000372	4.7	0.000083	0.000087	-
Barium	mg/L	0.00532	0.00542	1.9	0.0014	0.00134	4.4
Beryllium	mg/L	0.0000061	0.0000064	-	<0.0000050	<0.0000050	-
Bismuth	mg/L	<0.000050	<0.000050	-	<0.000050	<0.000050	-
Boron	mg/L	0.043	0.042	-	<0.010	<0.010	-
Cadmium	mg/L	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-
Calcium	mg/L	16.7	16	4.3	3.5	3.64	3.9
Cesium	mg/L	0.0000075	0.000008	-	<0.0000050	<0.0000050	-
Chromium	mg/L	<0.00050	<0.00050	-	<0.00050	<0.00050	-
Cobalt	mg/L	<0.000050	0.00005	-	<0.000050	<0.000050	-
Copper	mg/L	0.00243	0.00234	-	0.00087	0.00135	-
Gallium	mg/L	<0.000050	<0.000050	-	<0.000050	<0.000050	-
Iron	mg/L	0.149	0.145	2.7	0.025	0.026	-

Lake	Units	Patch Lake			Reference Lake B		
Sampling Date		21-Apr-23			22-Aug-23		
Sampling Depth (m)		5.5			1		
Replicate		1	2	RPD	1	2	RPD
ALS Sample ID		YL2300338-006	YL2300338-009		EO2307668-004	EO2307668-009	
Total Metals *(cont'd)*							
Lanthanum	mg/L	0.000214	0.000206	-	<0.000050	<0.000050	-
Lead	mg/L	0.000081	0.000139	-	<0.000050	<0.000050	-
Lithium	mg/L	0.00702	0.00668	5.0	<0.00050	<0.00050	-
Magnesium	mg/L	13.4	12.8	4.6	1.32	1.37	3.7
Manganese	mg/L	0.0107	0.01	6.8	0.00221	0.00228	3.1
Mercury	mg/L	0.00000046	0.0000005	-	0.00000055	0.00000055	-
Molybdenum	mg/L	0.000349	0.000345	1.2	0.000069	0.000061	-
Nickel	mg/L	0.00122	0.00117	4.2	0.00022	<0.00020	-
Niobium	mg/L	<0.00010	<0.00010	-	<0.00010	<0.00010	-
Phosphorus	mg/L	<0.050	<0.050	-	<0.050	<0.050	-
Potassium	mg/L	4.65	4.35	6.7	0.472	0.49	3.7
Rhenium	mg/L	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-
Rubidium	mg/L	0.00264	0.00252	4.7	0.00078	0.000793	1.7
Selenium	mg/L	<0.00020	<0.00020	-	<0.00020	<0.00020	-
Silicon	mg/L	1.28	1.29	0.8	0.23	0.24	-
Silver	mg/L	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-
Sodium	mg/L	58.7	55.9	4.9	3.66	3.86	5.3
Strontium	mg/L	0.088	0.0832	5.6	0.0165	0.0171	3.6

Lake	Units	Patch Lake			Reference Lake B		
Sampling Date		**21-Apr-23**			**22-Aug-23**		
Sampling Depth (m)		**5.5**			**1**		
Replicate		**1**	**2**	**RPD**	**1**	**2**	**RPD**
ALS Sample ID		**YL2300338-006**	**YL2300338-009**		**EO2307668-004**	**EO2307668-009**	
Total Metals *(cont'd)*							
Sulphur	mg/L	1.77	1.72	-	0.58	0.58	-
Tantalum	mg/L	<0.00010	<0.00010	-	<0.00010	<0.00010	-
Tellurium	mg/L	<0.000050	<0.000050	-	<0.000050	<0.000050	-
Thallium	mg/L	<0.0000050	<0.0000050	-	<0.0000050	<0.0000050	-
Thorium	mg/L	0.0000496	0.0000481	3.1	<0.0000050	0.0000069	-
Tin	mg/L	<0.00020	<0.00020	-	<0.00020	<0.00020	-
Titanium	mg/L	0.00339	0.00332	2.1	<0.00020	<0.00020	-
Tungsten	mg/L	0.000037	0.000041	-	<0.000010	<0.000010	-
Uranium	mg/L	0.000083	0.0000781	6.1	0.0000494	0.0000446	10.2
Vanadium	mg/L	0.00026	0.00026	-	<0.00020	<0.00020	-
Yttrium	mg/L	0.000074	0.000063	16.1	<0.000010	<0.000010	-
Zinc	mg/L	<0.0030	<0.0030	-	<0.0030	<0.0030	-
Zirconium	mg/L	0.000113	0.000112	-	<0.000050	<0.000050	-
Dissolved Metals							
Manganese	mg/L	0.00372	0.00379	1.9	0.00036	0.00038	-
Zinc	mg/L	<0.0010	<0.0010	-	<0.0010	<0.0010	-

Notes:
RPD = Relative Percent Difference
Dash (-) indicates that RPDs were not calculated (one or both replicates less than five times the detection limit).

TABLE A.3-7 WATER QUALITY QA/QC RESULTS, HOPE BAY AEMP, 2023

QAQC Sample	Units	Equipment Blank		Field Blank		Travel Blank	
Sampling Date		19-Apr-2023	19-Aug-2023	21-Apr-2023	22-Aug-2023	23-Apr-2023	21-Aug-2023
ALS Sample ID		YL2300338-010	EO2307668-001	YL2300338-011	EO2307668-003	YL2300338-012	EO2307668-002
Physical Tests							
Specific conductivity	µS/cm	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Total alkalinity (as $CaCO_3$)	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Dissolved hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	-	<0.50
Total hardness (as $CaCO_3$)	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Total suspended solids	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.5
Turbidity	NTU	<0.10	0.13	<0.10	<0.10	<0.10	<0.10
pH	pH units	5.7	5.28	5.52	5.24	5.46	5.4
Anions and Nutrients							
Total ammonia (as N)	mg/L	<0.0050	<0.0050	0.0055	<0.0050	<0.0050	<0.0050
Bromide	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Fluoride	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Nitrate (as N)	mg/L	<0.0050	<0.0050	0.0082	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Total phosphorus	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
Sulphate (as SO_4)	mg/L	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30

QAQC Sample	Units	Equipment Blank		Field Blank		Travel Blank	
Sampling Date		19-Apr-2023	19-Aug-2023	21-Apr-2023	22-Aug-2023	23-Apr-2023	21-Aug-2023
ALS Sample ID		YL2300338-010	EO2307668-001	YL2300338-011	EO2307668-003	YL2300338-012	EO2307668-002
Organic / Inorganic Carbon							
Dissolved organic carbon	mg/L	<0.50	1.56	<0.50	1.21	-	<0.50
Total organic carbon	mg/L	<0.50	1.14	<0.50	1.79	<0.50	<0.50
Total Metals							
Aluminum	mg/L	<0.0030	0.0103	<0.0030	<0.0030	<0.0030	<0.0030
Antimony	mg/L	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030	<0.000030
Arsenic	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Barium	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Beryllium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Bismuth	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Calcium	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Cesium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Chromium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Copper	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Gallium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Iron	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lanthanum	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

QAQC Sample	Units	Equipment Blank		Field Blank		Travel Blank	
Sampling Date		19-Apr-2023	19-Aug-2023	21-Apr-2023	22-Aug-2023	23-Apr-2023	21-Aug-2023
ALS Sample ID		YL2300338-010	EO2307668-001	YL2300338-011	EO2307668-003	YL2300338-012	EO2307668-002
Total Metals *(cont'd)*							
Lead	mg/L	<0.000050	0.000063	<0.000050	<0.000050	<0.000050	<0.000050
Lithium	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Magnesium	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Manganese	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Mercury	mg/L	0.00000011	0.00000017	0.00000019	0.00000026	<0.0000001	0.00000013
Molybdenum	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Nickel	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Niobium	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Phosphorus	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Potassium	mg/L	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Rhenium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Rubidium	mg/L	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020	<0.000020
Selenium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Silicon	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Silver	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Sodium	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Strontium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Sulfur	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Tantalum	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Tellurium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

QAQC Sample	Units	Equipment Blank		Field Blank		Travel Blank	
Sampling Date		**19-Apr-2023**	**19-Aug-2023**	**21-Apr-2023**	**22-Aug-2023**	**23-Apr-2023**	**21-Aug-2023**
ALS Sample ID		**YL2300338-010**	**EO2307668-001**	**YL2300338-011**	**EO2307668-003**	**YL2300338-012**	**EO2307668-002**
Total Metals *(cont'd)*							
Thallium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Thorium	mg/L	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050	<0.0000050
Tin	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Titanium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tungsten	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Uranium	mg/L	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020	<0.0000020
Vanadium	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Yttrium	mg/L	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Zinc	mg/L	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium	mg/L	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Metals							
Manganese	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	-	<0.00020
Zinc	mg/L	0.001	<0.0010	<0.0010	<0.0010	-	<0.0010

Notes:
Dash (-) = no data as analysis was not completed.
No detectable values were greater than five times the detection limit.

Laboratory QA/QC

The laboratory QA/QC program included reviews of maximum holding times, and the use of method blanks, laboratory replicates, certified reference materials, internal reference materials, laboratory control samples, matrix spikes, and calibration verification standards. A summary of occurrences of when laboratory QA/QC samples did not meet DQOs is presented in Table A.3-8.

TABLE A.3-8 LABORATORY QA/QC RESULTS, HOPE BAY AEMP, 2023

Sampling Event	ALS Reference	Hold Time Exceedance Details	ALS Data Quality Objective Exceedance Details	AEMP Data Quality Concern Details
Under-ice	YL2300338	pH, turbidity, total suspended solids, nitrate, and nitrite	Method blank for total silver exceeded ALS DQO	All under-ice total silver concentrations, including QA/QC samples were less than the DL, no concern of contamination.
Open-water	EO2307668	pH, turbidity, nitrate, and nitrite	None	-
	EO2307893	pH, turbidity, nitrate, and nitrite	None	-

Notes:
ALS = ALS Laboratory Group; QA/QC = quality assurance/quality control; DL = detection limit; DQO = data quality objective

Holding time recommendations were not met for a subset of variables during both sampling seasons (pH, total suspended solids, turbidity, nitrate, nitrite; Table A.3-8). Recommended hold times for these variables range from 15 minutes for pH to 7 days for total suspended solids, with the remaining variables having a 3-day recommended holding time. These recommended holding times are often unattainable when sampling in remote environments and having to ship samples long distances from the study area to the analytical laboratory.

The method blank for total silver in ALS work order YL2300338 exceeded ALS's DQOs. All sample results during the under-ice season that were within five times the method blank level of 0.0000065 mg/L (i.e., 0.0000325 mg/L) were not considered reliable, however, all total silver results were below the DL; therefore, there is no concern of potential contamination during analysis for total silver samples.

A.3.4 PHYTOPLANKTON BIOMASS

Phytoplankton biomass, as chlorophyll *a*, samples were collected from August 21 to 22, 2023. Table A.3-9 presents the measured chlorophyll *a* mass per sample and calculated concentrations.

TABLE A.3-9 PHYTOPLANKTON BIOMASS RESULTS, HOPE BAY AEMP, 2023

Lake	Sampling Date	Sampling Depth (m)	Replicate	ALS Sample ID	Chl *a* (µg/sample)	Volume Filtered (L)	Phytoplankton Biomass (µg chl *a*/L)
Patch Lake	21-Aug-23	1	1	EO2307665-001	0.184	0.3	0.61
			2	EO2307665-002	0.255	0.3	0.85
			3	EO2307665-003	0.253	0.3	0.84
Doris Lake	22-Aug-23	1	1	EO2307665-004	3.51	0.3	11.70
			2	EO2307665-005	4.36	0.3	14.53
			3	EO2307665-006	4.10	0.3	13.67
Reference Lake B	22-Aug-23	1	1	EO2307665-007	0.427	0.5	0.85
			2	EO2307665-008	0.323	0.5	0.65
			3	EO2307665-009	0.322	0.5	0.64

Notes:
chl *a* = chlorophyll *a*

A.3.4.1 QUALITY ASSURANCE/QUALITY CONTROL DATA

The laboratory QA/QC program included method blanks and laboratory control samples. There were no occurrences of laboratory QA/QC samples not meeting DQOs in 2023. Therefore, the chlorophyll *a* results are of good quality and reliable data.

A.4 REFERENCES

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TMAC. 2018. *Hope Bay Project: Aquatic Effects Monitoring Plan*. Prepared by TMAC Resources Inc.: Toronto, ON.

APPENDIX B 2023 HYDROLOGY COMPLIANCE MONITORING SUMMARY

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MEMO

TO	Agnico Eagle Mines Limited – Hope Bay
FROM	Michael Willcock (ERM), Daniel Aguilar (ERM), Cameron Evans (ERM)
CC	Madison Jerhoff (ERM), Rochelle Maitripala (ERM)
DATE	19 March 2024
REFERENCE	0685812-02
SUBJECT	Hope Bay Project 2023 Hydrology Compliance Monitoring Summary

1. INTRODUCTION

The Hope Bay Project (the Project) is a gold mining development in the West Kitikmeot region of mainland Nunavut. The Project property is approximately 153 km southwest of Cambridge Bay on the southern shore of Melville Sound and contains a greenstone belt (the Belt) that runs 80 km in a north-south direction varying in width between 7 km and 20 km. The Project is operated by Agnico Eagle Mines Ltd. (Agnico) who acquired it through the purchase of TMAC Resources Inc. (TMAC) on February 2, 2021.

This memorandum provides a summary of the hydrology compliance monitoring program performed for the Project in 2023. Compliance requirements for hydrometric monitoring, listed below, are set out in the Project Certificate (NIRB No. 003, amended September 23, 2016), the Type A and B Water License (NWB License No. 2AMDOH1335 Type A, amended December 7, 2018, and NWB License No. 2BE-HOP2232 Type B, renewed 2022), and the Hope Bay Project Aquatic Effects Monitoring Plan (the Plan).

The *Fisheries Act* Authorization (FAA) NU-02-0117.3 also has compliance requirements. Although the FAA does not explicitly state a monitoring requirement of Roberts Lake outflow, monitoring outflows of this lake is necessary, as it is considered a critical component for evaluating the success of the Roberts Lake Outflow Fish Habitat Compensation Monitoring Program. Monitoring of Roberts Lake also provides a control with which to compare the AEMP monitored lakes.

The Type A Water License (No. 2AM DOH1335) sets out the following requirements applying to aquatic effects monitoring:

- Part I. Item 3: The Licensee shall undertake the Monitoring Program provided in Tables 1, 2, and 3 of Schedule I. Table 3 outlines the requirement for monitoring Doris Outflow (TL-2) during Operations upon commencement of mining in or beneath the Doris Lake Talik and monitoring Doris Lake (ST-12) water levels during Operations and Closure.

The Type B Water License (No. 2BE-HOP2232) sets out the following requirements:

- Part J. Item 9: The Licensee shall monitor water levels in Windy Lake during open-water, in order to verify that additional water withdrawal for dust suppression activities does not result in drawdown beyond naturally occurring levels.

The New Project Certificate (NIRB No. 009) sets out the following requirements:

- New Term and Condition 10: the Proponent shall:
  a. monitor the effects of Project activities and infrastructure on surface water quality conditions;
  b. ensure the monitoring data is sufficient to compare the impact predictions made for the Project with actual monitoring results;
  c. ensure that the sampling locations and frequency of monitoring is consistent with and reflects the requirements of the Plan, and Water Management Plan; and
  d. on an annual basis, compare monitoring results with the impact assessment predictions in the FEIS and will identify any significant discrepancies between impact predictions and monitoring results.

The Plan prescribes monitoring requirements based on Project development phases. In February 2022, the Project went into care and maintenance. In April 2022, the Doris-Madrid Care and Maintenance Plan was submitted to the Nunavut Water Board (NWB) and Nunavut Impact Review Board (NIRB) as per compliance with the Type A Water Licence 2AM-DOH1335 and the Project Certificate No. 009. Prior to entering care and maintenance, the Doris development was in the operations phase and Madrid North was in the construction and operations phase, though operations at Madrid North were suspended in February 2021 to allow for a thorough review of the proposed work plan.

These construction and operations phases triggered water level monitoring at Glenn and Imniagut lakes, as well as water level and outflow monitoring at Doris, Little Roberts, Ogama, Patch, PO, and Windy lakes. Tables 3.11 and 3.2-1 of the Plan (TMAC 2018) outline these requirements.

The following sections consist of 2023 monitoring data and results. These results are based on the comparison of 2023 monitoring data with past monitoring data and the predicted Project effects from the Madrid-Boston Project Final Environmental Impact Statement (FEIS; TMAC 2017).

2. MONITORING STATIONS

The 2023 compliance monitoring program consisted of 10 hydrometric monitoring stations, as presented in Tables 2-1 and 2-2. Water level surveys and manual discharge measurements are typically conducted at these stations throughout the open-water season, after the installation of the pressure transducers in June. Pressure transducers were pulled from stations in late September.

TABLE 2-1 STATION TYPES

Station	Station Type	Monitoring Period
Windy Outflow	Discharge and Water Level	Seasonal
Glenn Lake	Lake Level Only	Seasonal
Imniagut Lake	Lake Level Only	Seasonal
Patch Outflow	Discharge and Water Level	Seasonal
PO Outflow	Discharge and Water Level	Seasonal
Ogama Outflow	Discharge and Water Level	Seasonal
Doris Lake-2	Lake Level Only	Year Round
Doris Creek TL-2	Discharge Only	Seasonal
Roberts Hydro-2	Discharge and Water Level	Seasonal[1]
Little Roberts Outflow	Discharge and Water Level	Seasonal

[1] Roberts Hydro-2 was previously operated as a year-round station but was destroyed by ice and was operated as a seasonal station in 2021 through 2023.

TABLE 2-2 2023 STATION LOCATIONS

Station	UTM Zone 13W		Watershed Area (km^2)	Lake Coverage (%)
	Easting	Northing		
Windy Outflow	431404	7554948	13.73	41
Glenn Lake	430410	7562001	20.59	13
Imniagut Lake	433403	7551421	1.31	12
Patch Outflow	436248	7548973	32.16	23
PO Outflow	436749	7550055	35.30	23
Ogama Outflow	435595	7555262	74.93	18
Doris Lake-2	433547	7558601	90.29	19
Doris Creek TL-2	434059	7559504	90.29	19
Roberts Hydro-2	435231	7562674	97.83	18
Little Roberts Outflow	434548	7562652	194.15	18

Hydrometric stations monitored either Lake level, Lake outflow (discharge) or both. Most hydrometric stations are operated seasonally (during the open-water season); however, Doris Lake-2 is operated year-round. Roberts Hydro-2 had previously been operated year-round; however, the station was destroyed by ice and was operated seasonally in 2021 through 2023.

Seasonal hydrometric stations consist of an INW PT2X vented pressure transducer placed on the lake or streambed in a weighted assembly, recording water level readings every 15 minutes. The Doris Lake-2 station consists of two Solinst Leveloggers, unvented pressure transducers, installed at depths of approximately 7 m to monitor lake level year-round. The Leveloggers are coupled with a Solinst Barologger, located at Doris Camp, to compensate for changes in atmospheric pressure.

Water level surveys were performed using an engineer's level and stadia rod using a minimum of three local benchmarks at each station. All benchmarks are tied to geodetic elevation. Manual discharge measurements were performed using the velocity area method with an OTT MF Pro electromagnetic current meter. The Doris North Project 2013 Hydrology Compliance Monitoring Report (ERM 2014) describes the details of the standard methods used for installation of hydrometric stations, development of stage-discharge rating equations, and daily flow hydrographs for the Project.

3. 2023 ANALYSIS AND RESULTS

Tables 3-1 to 3-8 present the 2023 compliance monitoring results that include stage discharge measurements, observed lake levels, rating equations, annual runoff, peak and low flows, and monthly runoff. Appendix A and Appendix B present the lake level graphs and the daily flow hydrographs, respectively. Appendix C and Appendix D present the mean daily lake level and the mean daily discharges, respectively.

3.1 STAGE DISCHARGE MEASUREMENTS

ERM, assisted by Agnico personnel, performed water level and discharge measurements during station remobilization in June and station demobilization in September. Agnico personnel conducted open-water season water level and discharge measurements in July, August and September. Seasonal stations were monitored throughout the open-water season from June to September, and lake level station Doris Lake-2 was monitored year-round, consistent with previous years. Manual measurements are presented in Table 3-1.

TABLE 3-1 SUMMARY OF 2023 STAGE AND DISCHARGE MEASUREMENTS

Station	Date	Stage (m)	Discharge (m^3/s)	Measurement Made By
Windy Outflow	6/15/2023	18.374	0.344	ERM
	6/19/2023	18.365	0.314	ERM
	7/22/2023	18.234	0.051	Agnico
	8/24/2023	18.147	-0.012	Agnico
	9/10/2023	18.176	0.000	Agnico
	9/29/2023	18.187	n/a[1]	ERM
Glenn Lake	6/12/2023	9.910	n/a[2]	ERM
	7/22/2023	9.605	n/a[2]	Agnico
	8/20/2023	9.564	n/a[2]	Agnico
	9/12/2023	9.535	n/a[2]	Agnico
	9/29/2023	9.606	n/a[2]	ERM
Imniagut Lake	6/12/2023	27.455	n/a[2]	ERM
	7/24/2023	27.253	n/a[2]	Agnico
	8/20/2023	27.274	n/a[2]	Agnico
	9/10/2023	27.323	n/a[2]	Agnico
	9/29/2023	27.345	n/a[2]	ERM
Patch Outflow	6/12/2023	26.476	0.624	ERM
	6/19/2023	26.460	0.717	ERM
	7/23/2023	26.217	0.139	Agnico
	8/28/2023	26.112	0.063	Agnico
	9/10/2023	26.139	0.068	Agnico
	9/29/2023	26.181	n/a[1]	ERM
PO Outflow	6/13/2023	26.407	0.593	ERM
	6/14/2023	26.403	n/a[1]	ERM
	6/18/2023	26.386	0.444	Agnico
	7/24/2023	26.109	0.159	Agnico
	8/20/2023	26.056	0.074	Agnico
	9/7/2023	26.096	0.094	Agnico
	9/29/2023	26.129	n/a[1]	ERM

Station	Date	Stage (m)	Discharge (m^3/s)	Measurement Made By
Ogama Outflow	6/11/2023	24.447	1.826	ERM
	6/18/2023	24.386	1.449	ERM
	7/24/2023	24.070	0.192	Agnico
	8/26/2023	24.115	0.203	Agnico
	9/10/2023	24.172	0.301	Agnico
	9/29/2023	24.201	n/a[1]	ERM
Doris Lake-2	6/15/2023	22.143	n/a[2]	ERM
	7/20/2023	21.799	n/a[2]	Agnico
	8/17/2023	21.712	n/a[2]	Agnico
	9/11/2023	21.763	n/a[2]	Agnico
	9/28/2023	21.823	n/a[2]	ERM
Doris Creek (TL-2)	6/10/2023	22.057	2.219	ERM
	6/20/2023	22.019	1.854	ERM
	7/20/2023	21.702	0.416	Agnico
	8/17/2023	21.656	0.155	Agnico
	9/11/2023	21.678	0.354	Agnico
	9/28/2023	21.746	n/a[1]	ERM
Roberts Hydro-2	6/16/2023	6.670	1.896	ERM
	6/20/2023	6.645	1.832	ERM
	7/27/2023	6.311	0.193	Agnico
	8/28/2023	6.338	0.353	Agnico
	9/12/2023	n/a[1]	0.679	Agnico
	9/28/2023	6.461	n/a[1]	ERM
Little Roberts Outflow	6/17/2023	5.095	3.448	ERM
	6/20/2023	5.067	3.021	ERM
	7/27/2023	4.547	0.447	Agnico
	8/28/2023	4.587	0.568	Agnico
	9/28/2023	4.763	n/a[1]	ERM

[1] Not measured due to time constraints, access limitations, or staffing limitations.

[2] Lake Level measured only.

3.2 HYDROGRAPHS

Seasonal stations were re-installed in June and were demobilized in late September. Discharge at TL-2 was modelled using linear regression with the Doris Lake-2 year-round monitoring station for open-water periods that were not recorded by the seasonal station. Discharge during the open-water season that was not monitored at the other stations was modelled using a linear regression with TL-2. For the periods where ice was known or suspected to have impacted flow, discharge was estimated using exponential growth/decay curves.

For the open-water period outside of the observed data, lake levels were back-calculated using the station rating curves for the periods when discharge had been modelled. For stations with no discharge monitoring, lake level was modelled using a linear regression with Doris Lake-2. For the periods where ice was known or suspected to have impacted flow, lake level was estimated using exponential growth/decay curves, stabilizing at the level surveyed during the April water level survey. In cases where the winter water level was not surveyed (Roberts Hydro-2), lake level was assumed to stabilize on the last day of modelled data.

Tables 3-2 and 3-3 present the estimated discharge and the lake level, respectively. Table 3-4 presents monthly mean, maximum and minimum lake levels, along with the maximum water level fluctuation during the open-water season, and over the full calendar year. These monthly statistics include observed, modelled and estimated data. Appendix A and B provide the Lake Level Graphs and Hydrographs for each monitored station in 2023. Appendix C and D provide the Mean Daily Lake Level Tables and the Mean Daily Discharge Tables. Appendix E and F provide historical lake level graphs and hydrographs for comparing 2023 with previous years.

TABLE 3-2 2023 OBSERVED, MODELLED AND ESTIMATED DISCHARGE

Station	Observed	Modelled	Estimated
Windy Outflow	Jul 21[1] – Sep 29	May 20 – Jul 20 Sep 30 – Nov 1	May 17 – May 19 Nov 1 – Nov 21
Patch Outflow	Jun 12 – Sep 29	May 20 – Jun 11 Sep 30 – Nov 1	May 17 – May 19 Nov 2 – Nov 21
PO Outflow	Jun 14 – Sep 29	May 20 – Jun 13 Sep 30 – Nov 1	May 17 – May 19 Nov 2 – Nov 21
Ogama Outflow	Jun 11 – Sep 29	May 20 – Jun 10 Sep 30 – Nov 1	May 17 – May 19 Nov 1 – Nov 21
Doris Creek TL-2	Jul 19[1] – Sep 28	May 20 – Jul 20 Sep 29 – Nov 1	May 17 – May 19 Nov 1 – Nov 21
Roberts Hydro-2	Jun 16 – Sep 28	May 20 – Jun 15 Sep 29 – Nov 1	May 17 – May 19 Nov 1 – Nov 21

Station	Observed	Modelled	Estimated
Little Roberts Outflow	Jun 17 – Sep 28	May 20 – Jun 16 Sep 29 – Nov 1	May 17 – May 19 Nov 1 – Nov 21

[1] There were issues downloading stage data from June and it could not be recovered.

TABLE 3-3 2023 OBSERVED, MODELLED AND ESTIMATED LAKE LEVELS

Station	Observed	Modelled	Estimated
Windy Outflow	Jul 21[1] – Sep 29	May 20 – Jul 20 Sep 30 – Nov 1	Jan 1 – May 19 Nov 2 – Dec 31
Glenn Lake	Jun 12 – Sep 29	May 18 – Jun 11 Sep 30 – Nov 20	Jan 1- May17 Nov 21 – Dec 31
Imniagut Lake	Jun 12 – Sep 29	May 18 – Jun11 Sep 30 – Nov 20	Jan 1 – May 17 Nov 21 – Dec 31
Patch Outflow	Jun 12 – Sep 29	May 20 – Jun 11 Sep 30 – Nov1	Jan 1 – May 19 Nov 2 – Dec 31
PO Outflow	Jun14 – Sep 29	May 20 – Jun 13 Sep 30 – Nov 1	Jan 1 – May 19 Nov 2 – Dec 31
Ogama Outflow	Jun 11 – Sep 29	May 20 – Jun 10 Sep 30 – Nov 1	Jan 1 – May19 Nov 2 – Jan 31
Doris Lake-2	Jan 1 – Dec 31	n/a	n/a
Roberts Hydro-2	Jun 16 – Sep 28	May 20 – Jun 15 Sep 29 – Nov 1	Jan 1 – May 19 Nov 2 – Dec 31
Little Roberts Outflow	Jun 17 - Sep 28	May 20 – Jun 16 Sep 29 – Nov 1	Jan 1 – May 19 Nov 2 – Dec 31

[1] There were issues downloading stage data from June and it could not be recovered.

Flow was predicted to have started on May 18, based on site photos taken at Doris Creek every 3 to 5 days, and ended on November 20, based on the Doris Lake water level no longer dropping and a significant cold snap. Freshet occurred relatively early compared to other years, which resulted in a relatively low peak but a prolonged freshet period.

Table 3-4 presents monthly mean, maximum and minimum lake levels, along with the maximum water level fluctuation during the open-water season, and over the full calendar year. These monthly statistics include observed, modelled and estimated data.

TABLE 3-4 SUMMARY OF 2023 LAKE LEVELS

Station	Parameter	2022 Monthly Lake Level[1] (m)												Lake Level Fluctuation[2]	
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jun-Sep	Annual
Windy Outflow	Mean	18.350	18.350	18.350	18.350	18.369	18.361	18.259	18.177	18.171	18.178	18.178	18.178	0.249	0.249
	Max	18.350	18.350	18.350	18.350	18.407	18.376	18.326	18.192	18.183	18.182	18.178	18.178		
	Min	18.350	18.350	18.350	18.350	18.350	18.329	18.196	18.160	18.158	18.175	18.178	18.178		
Glenn Lake	Mean	9.549	9.549	9.549	9.549	9.743	9.864	9.647	9.527	9.570	9.615	9.565	9.537	0.515	0.515
	Max	9.549	9.549	9.549	9.549	10.007	9.908	9.766	9.552	9.619	9.644	9.620	9.537		
	Min	9.549	9.549	9.549	9.549	9.549	9.775	9.545	9.492	9.528	9.591	9.537	9.537		
Imniagut Lake	Mean	27.101	27.101	27.101	27.101	27.312	27.436	27.323	27.271	27.309	27.306	27.279	27.263	0.290	0.416
	Max	27.101	27.101	27.101	27.101	27.517	27.464	27.398	27.321	27.346	27.322	27.309	27.263		
	Min	27.101	27.101	27.101	27.101	27.101	27.398	27.248	27.227	27.282	27.293	27.263	27.263		
Patch Outflow	Mean	26.111	26.111	26.111	26.111	26.294	26.450	26.278	26.141	26.140	26.158	26.157	26.157	0.409	0.409
	Max	26.111	26.111	26.111	26.111	26.514	26.477	26.386	26.181	26.170	26.176	26.157	26.157		
	Min	26.111	26.111	26.111	26.111	26.111	26.395	26.185	26.106	26.105	26.142	26.157	26.157		
PO Outflow	Mean	26.142	26.142	26.142	26.142	26.281	26.369	26.184	26.056	26.067	26.082	26.080	26.080	0.438	0.438
	Max	26.142	26.142	26.142	26.142	26.465	26.400	26.280	26.090	26.104	26.128	26.080	26.080		
	Min	26.142	26.142	26.142	26.142	26.142	26.289	26.095	26.027	26.027	26.039	26.080	26.080		
Ogama Outflow	Mean	24.008	24.008	24.008	24.008	24.230	24.378	24.179	24.103	24.168	24.189	24.068	24.008	0.450	0.510
	Max	24.008	24.008	24.008	24.008	24.518	24.444	24.277	24.133	24.201	24.225	24.188	24.008		
	Min	24.008	24.008	24.008	24.008	24.008	24.287	24.105	24.068	24.126	24.158	24.008	24.008		
Doris Lake-2	Mean	22.020	22.013	21.992	21.979	22.098	22.141	21.870	21.728	21.799	21.840	21.783	21.765	0.626	0.680
	Max	22.036	22.042	22.016	22.005	22.317	22.196	22.027	21.757	21.848	21.876	21.847	21.948		
	Min	22.000	21.985	21.971	21.954	21.922	22.038	21.746	21.691	21.722	21.811	21.653	21.637		
Roberts Hydro – 2	Mean	6.370	6.370	6.370	6.370	6.523	6.629	6.402	6.323	6.414	6.457	6.398	6.370	0.447	0.447
	Max	6.370	6.370	6.370	6.370	6.713	6.669	6.513	6.372	6.464	6.497	6.455	6.370		
	Min	6.370	6.370	6.370	6.370	6.370	6.525	6.317	6.265	6.358	6.421	6.370	6.370		
Little Roberts Outflow	Mean	4.862	4.862	4.862	4.862	4.987	5.043	4.667	4.546	4.684	4.740	4.737	4.737	0.699	0.699
	Max	4.862	4.862	4.862	4.862	5.154	5.096	4.858	4.621	4.767	4.800	4.737	4.737		
	Min	4.862	4.862	4.862	4.862	4.862	4.874	4.525	4.454	4.585	4.687	4.737	4.737		

[1] Water levels include observed, modelled and estimated data.
[2] Change in lake level refers to the difference between the highest June and lowest July to September lake levels.

3.3 RATING CURVES

Rating curves are empirical equations unique to each monitoring station that convert stage data recorded by the monitoring station to discharge and are developed using concurrent manual measurements of stage (water level) and discharge. Measurements from previous years are used in the development of rating curves. Older measurements are excluded from the rating curves when they no longer align with recent measurements. This adjustment is common as erosion and aggradation of the channel changes the stage-discharge relationship over time.

Minor updates to rating curves were made where appropriate based on the data collected in 2023. Stage data collected in 2023 was converted to discharge using the equations listed in Table 3-5.

TABLE 3-5 STAGE-DISCHARGE RATING EQUATIONS FOR MADRID HYDROMETRIC STATIONS IN 2023

Station	Rating Equation[1] $Q = C\ (h\text{-}a)^b$	Number of Measurements Used[2]	Root Mean Square – Error (m^3/s)
Windy Outflow	$Q = 5.322\ (h - 18.147)^{1.869}$	4	5.09
Patch Outflow	$Q = 2.261\ (h - 25.998)^{1.765}$; $h < 26.391$ $Q = 4.489\ (h - 26.028)^{2.304}$; $h > 26.391$	15	10.72
PO Outflow	$Q = 1.847\ (h - 25.89)^{1.83}$;	6	19.22
Ogama Outflow	$Q = 7.027\ (h - 23.994)^{1.725}$; $h < 24.233$ $Q = 5.396\ (h - 23.795)^{2.640}$; $h > 24.233$	26	10.44
Doris Creek TL-2	$Q = 4.714\ (h - 21.442)^{1.798}$; $h < 21.98$ $Q = 7.331\ (h - 21.531)^{1.943}$; $h > 21.98$	5	21.36
Roberts Outflow-2	$Q = 6.239\ (h - 6.150)^{1.828}$; $h < 6.641$ $Q = 29.612\ (h - 6.370)^{2.189}$; $h > 6.641$	5	11.14
Little Roberts Outflow	$Q = 4.354\ (h - 4.260)^{1.801}$; $h < 5.056$ $Q = 29.850\ (h - 4.760)^{1.918}$; $h > 5.056$	14	16.9

[1] Equation $Q = C(h - a)^b$: Q is the discharge (m^3/s), C and b are dimensionless coefficients, h is the stage (m), and a is the approximate stage at zero flow (m).
[2] The 2023 stage-discharge rating equations were developed using measurements from 2017 to 2023, where available.

3.4 HYDROLOGIC INDICES

Table 3-6 presents the 2023 hydrologic indices such as runoff, peak flows and 7-day low flows. Table 3-7 presents the monthly runoff distributions from the seven hydrometric stations that record discharges.

Annual runoff is the volume of streamflow over the year normalized by drainage area and reported as depth and is useful index for comparing the hydrologic responses of basins of different sizes. Estimates of annual runoff were calculated from the available data and interpolated using the equation:

$$Ro = \frac{(Q * t)}{A}$$

where: runoff (Ro; units = mm) is calculated as streamflow (Q; units = m^3/s) multiplied by time (t; units = seconds) divided by basin area (A; units = km^2).

Peak daily flows are the highest mean daily flow during the year and typically occur during freshet. The lowest 7-day averaged flow during the open-water season typically occurs during late summer or early fall. Annual low flows are zero and are not reported as the streams freeze solid in winter. Breaking runoff down by month shows that the majority of flow occurs during and shortly after freshet, with much less water flowing during late summer and fall. This flow distribution is typical of arctic streams.

TABLE 3-6 SUMMARY OF 2023 ANNUAL RUNOFF, PEAK FLOWS AND LOW FLOWS

Station	Annual Runoff (mm)	Annual Peak Daily Flows[1]		7-day Low Flows[2]	
		Peak Flow (m^3/s)	Date	7-day Low Flow (m^3/s)	Date
Windy Outflow	111	0.43	22-May	0.004	14-Aug
Patch Outflow	117	0.85	22-May	0.05	2-Sep
PO Outflow	89	0.67	22-May	0.05	2-Sep
Ogama Outflow	122	2.29	22-May	0.09	14-Aug
Doris Creek TL-2	130	2.49	22-May	0.12	14-Aug
Roberts Outflow-2	130	2.84	22-May	0.14	14-Aug
Little Roberts Outflow	113	5.00	22-May	0.27	14-Aug

[1] Peak flows refer to peak daily discharges in 2023 and are based on estimated and observed data.
[2] 7-day low flows are June peak to September 30 data only.

TABLE 3-7 SUMMARY OF 2023 MONTHLY RUNOFF DISTRIBUTIONS

Station	2023 Monthly Runoff (mm)							
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Windy Outflow	30	56	19	2	1	2	1	0
Patch Outflow	21	43	18	5	5	6	2	0
PO Outflow	20	40	17	6	7	8	2	0
Ogama Outflow	26	45	15	6	12	15	3	0
Doris Creek TL-2	25	51	19	5	11	15	3	0
Roberts Outflow-2	25	45	14	7	15	20	3	0
Little Roberts Outflow	22	41	12	6	13	16	2	0

3.5 ICE MEASUREMENTS

Agnico conducted ice thickness measurements in April at the same time as the under-ice aquatic sampling. Under-ice water level surveying occurred from April 19 to April 26, 2023. Table 3-8 presents surveyed water level, ice thickness, and water gap for each monitored lake. As the hydrometric station benchmarks are buried in snow and not necessarily close to the under-ice water level survey location, surveys were performed using a Real Time Kenmatic (RTK) system. Benchmarks at Windy Lake, Little Roberts Outflow and Doris Lake were able to be accessed during the survey and showed a level of accuracy within 10 cm at those locations. The RTK system has a lower accuracy than the water level surveys made during the open-water season. The lower accuracy could lead to some discrepancies in the results.

The under-ice volume determined using subsurface contours for the lakes created from bathymetric survey information collected in 2006 and 2008. The bathymetric survey elevations were not referenced to a geodetic elevation, so the lake surface of the bathymetric data for each lake was estimated from the average August water elevation for all years for which geodetic water levels were available from 2016-2020.
This provides a means to relate bathymetric data, with no elevation reference, with surveyed water levels tied to a geodetic datum. The value used remains constant and does not impact the comparison of water levels from year to year.

TABLE 3-8 SUMMARY OF 2023 UNDER-ICE LAKE LEVEL SURVEYS WITH UNDER-ICE VOLUMES OF MONITORED LAKES WITH BATHYMETRY INFORMATION

Station	2023				
	Water Surface Elevation[1] (masl)	Ice Thickness (m)	Water Gap (m)	Ice Bottom Elevation (masl)	Under-Ice Volume (mm^3)
Windy Outflow	18.35	1.85	0.11	16.61	50.44
Glenn Lake	9.55	1.69	0.05	7.91	N/A
Wolverine Lake	32.33	1.85	0.15	30.63	N/A
Imniagut Lake	27.10	1.82	0.07	25.35	0.11
Patch Outflow	26.11	1.79	0.09	24.41	13.44
PO Outflow	26.14	1.91	0.11	24.34	11.09
Ogama Outflow	24.01	1.80	0.08	22.29	1.26
Doris Lake-2	22.00	1.67	0.08	20.41	22.27
Little Roberts Outflow	4.86	1.93	0.14	3.07	0.08

[1] UTM Zone 13W.
[2] No bathymetric data available.

4. DISCUSSION AND COMPARISON WITH FEIS PREDICTIONS

4.1 PRECIPITATION INFLUENCE

Table 4.1-1 presents the precipitation at the Hope Bay meteorological station for the 2023 hydrologic year. The hydrologic year is the period where precipitation will contribute to the runoff of that year. It generally spans October of the prior year (2022) to September of the current reporting year (2023), starting at the beginning of freeze up when precipitation that falls will be stored until the spring and ends at the start of freeze up the following year.

Due to weather issues, the precipitation gauge at the meteorology station was not functioning properly for a substantial portion of the year (October 2022 – June 2023). Therefore, the total observed precipitation of 86.2 mm does not accurately represent precipitation totals for the 2023 hydrologic year.

TABLE 4.1-1 DORIS HYDROMETRIC STATION PRECIPITATION OCTOBER 2022 – SEPTEMBER 2023

Month	Total Rainfall (mm)	Total Snowfall (SWE; mm)	Total Precipitation (mm)	Expected Mean Monthly Precipitation[1] (mm)
Oct-22	INV[3]	INV[3]	INV[3]	24
Nov-22	M[2]	M[2]	M[2]	16
Dec-22	M[2]	M[2]	M[2]	11
Jan-23	M[2]	M[2]	M[2]	10
Feb-23	M[2]	M[2]	M[2]	9
Mar-23	M[2]	M[2]	M[2]	11
Apr-23	M[2]	M[2]	M[2]	11
May-23	M[2]	M[2]	M[2]	14
Jun-23	M[2]	M[2]	M[2]	18
Jul-23	3.5	0.0	3.5	29
Aug-23	43.3	0.0	43.3	31
Sep-23	37.4	2.0	39.4	26
Total	**84.2**	**2.0**	**86.2**	210

[1] Package P5-2 (Table 5) of the Hope Bay FEIS (SRK 2017).
[2] Missing data
[3] Incomplete data, intermittent data for the month of October

Table 4-2 presents the precipitation return periods using the Climate and Hydrological Parameters Summary Report, Package P5-2 of the Hope Bay FEIS (SRK 2017).

TABLE 4-2 HOPE BAY EXTREME PRECIPITATION DEPTHS

Return Period	Annual Precipitation (mm)
200 Wet	324
100 Wet	311
50 Wet	297
25 Wet	282
20 Wet	277
10 Wet	261
5 Wet	243
Average (MAP)	210

Return Period	Annual Precipitation (mm)
2 Wet	210
3 Dry	195
5 Dry	182
10 Dry	168
20 Dry	158
25 Dry	155
50 Dry	147
100 Dry	140
200 Dry	134

Source: Package P5-2 (Table 6) of the Hope Bay FEIS (SRK 2017)

Note: Annual precipitation values are based on calendar year totals. While the hydrologic year is October to September, total precipitation statistics will be comparable when using a large data set.

Due to the missing precipitation data for 2023, no comparison can be made between observed precipitation and the annual return period for 2023. An estimation of the annual runoff relative to historic runoff data is presented in Section 4.2.

4.2 RUNOFF

A portion of the precipitation is converted to runoff, which enters the lakes and streams, resulting in streamflow. Table 4-3 presents the comparison of the 2023 runoff with historical baseline data collected between 2004 and 2015, as well as the 2019 through 2023 monitoring data. Runoff in 2023 was similar and slightly above the 2004-2015 average, with the exception of Windy and PO.

Windy was slightly below average, likely due to uncertainty in discharge measurements as the outflow has substantial weed growth and deep mud. Additionally, the freshet portion of the Windy Outflow hydrograph was estimated as data collected prior to the July site visit were accidentally deleted during the July data download.

PO is below the observed average, likely due to backwatering from the downstream un-named lake occurring during spring discharge measurements which cause discrepancies in the relationship between stage and discharge. PO has historically had issues with backwatering and has greater uncertainty in results than other stations.

TABLE 4-3 COMPARISON OF 2023 RUNOFF WITH HISTORICAL AVERAGES AND PREDICTED VALUES

Station	Monitored Runoff (mm)						FEIS Predicted Runoff[1]		
	2019	2020	2021	2022	2023	2004-2015 Average[1]	Predicted Average Runoff	Predicted 20-y Dry Runoff	Predicted 20-y Wet Runoff
Windy Outflow	174	107	166	86	111	130	58	21	119
Patch Outflow	189	82	105	118	117	112	77	40	137
PO Outflow	222	102	157	117	89	153	80	41	143
Ogama Outflow	167	58	128	95	122	117	100	46	199
Doris Creek TL-2	191	75	153	121	130	110	101	48	213
Roberts Outflow-2	156	N/A	141	127	130	112	n/a	n/a	n/a
Little Roberts Outflow	175	83	144	100	113	93	161	64	347

[1] Data Source: V5-S1 (Table 1.2-7, 1.5-7 to 1.5-12) of the Hope Bay FEIS (TMAC 2017).

Table 4-4 presents model results from the FEIS Hope Bay Project Water and Load Balance Report (SRK 2017). Effects to Doris Lake were predicted due to water withdrawal and mine dewatering activities. A Doris Lake water level drawdown could result in downstream effects to Little Roberts Outflow. Effects to Windy Lake were predicted due to the withdrawal of water from Windy Lake.

TABLE 4-4 PREDICTED IMPACT DUE TO ANNUAL OUTFLOW FROM MONITORED LAKES

Station	FEIS Predicted Impact[1] to Annual Flow in 2023 under Average Climate Conditions (% Change)
Windy Outflow	-6.7
Patch Outflow	0
PO Outflow	0
Ogama Outflow	0
Doris Creek TL-2	-13.4
Little Roberts Outflow	-7.8
Glenn Outflow	-2.0

Source: V5-S1 (Table 1.2-7, 1.5-7 to 1.5-12) of the Hope Bay FEIS (TMAC 2017).

[1] Project Phase "Existing and Permitted Projects".

Drawdown to the Doris Lake water level was not detected in 2023 (Table 3-4 and Figure A8). An estimation of the annual runoff (Table 4-3) indicates average to slightly above average year. However, freshet started earlier than previous years.

Water withdrawal from Windy Lake did not cause a detectable impact in 2023. Total withdrawal for the year was 13,255 m^3, which represents 0.87% of the total volumetric discharge for the year.

In 2023, no detectable impact caused by the Project were observed to lake levels or lake outflow rates as part of the compliance monitoring.

5. CLOSING

We trust that the monitoring summaries and recommendations for improvement are sufficient for your needs. Please contact us if you have any questions.

Prepared by:

SIGNATURE REDACTED

Daniel Aguilar, B.A.Sc
Consultant, ERM

SIGNATURE REDACTED

Cameron Evans, B.A.Sc.
Managing Technical Consultant, ERM

6. REFERENCES

ERM Rescan. 2014. *Doris North Project: 2013 Hydrology Compliance Monitoring Report*. Prepared for TMAC Resources Inc. by ERM Rescan: Yellowknife, NT.

Golder Associates Ltd. 2007. *Doris North Project Aquatic Studies 2006*. Prepared for Miramar Hope Bay Ltd. by Golder Associates Ltd. Report No. 06-1373-026.

SRK. 2017. *Climate and Hydrological Parameters Summary Report, Hope Bay Project.* Prepared for TMAC Resources Inc. November 2017.

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TMAC. 2018. *Hope Bay Project: Aquatic Effects Monitoring Plan.* Prepared by TMAC Resources Inc.: Toronto, ON.

APPENDIX A LAKE LEVELS GRAPHS

FIGURE A1 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION WINDY OUTFLOW

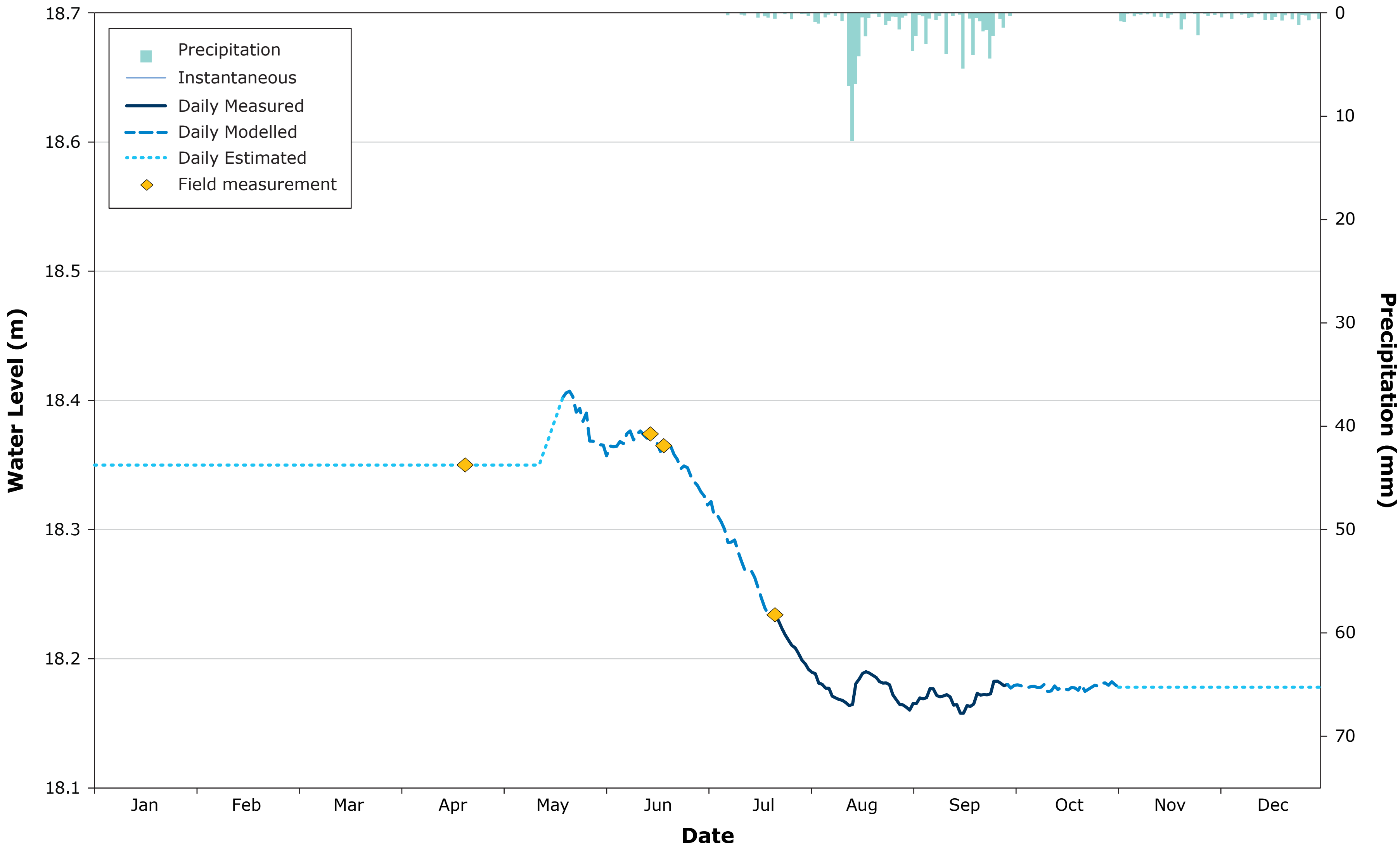


FIGURE A2 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION GLENN LAKE

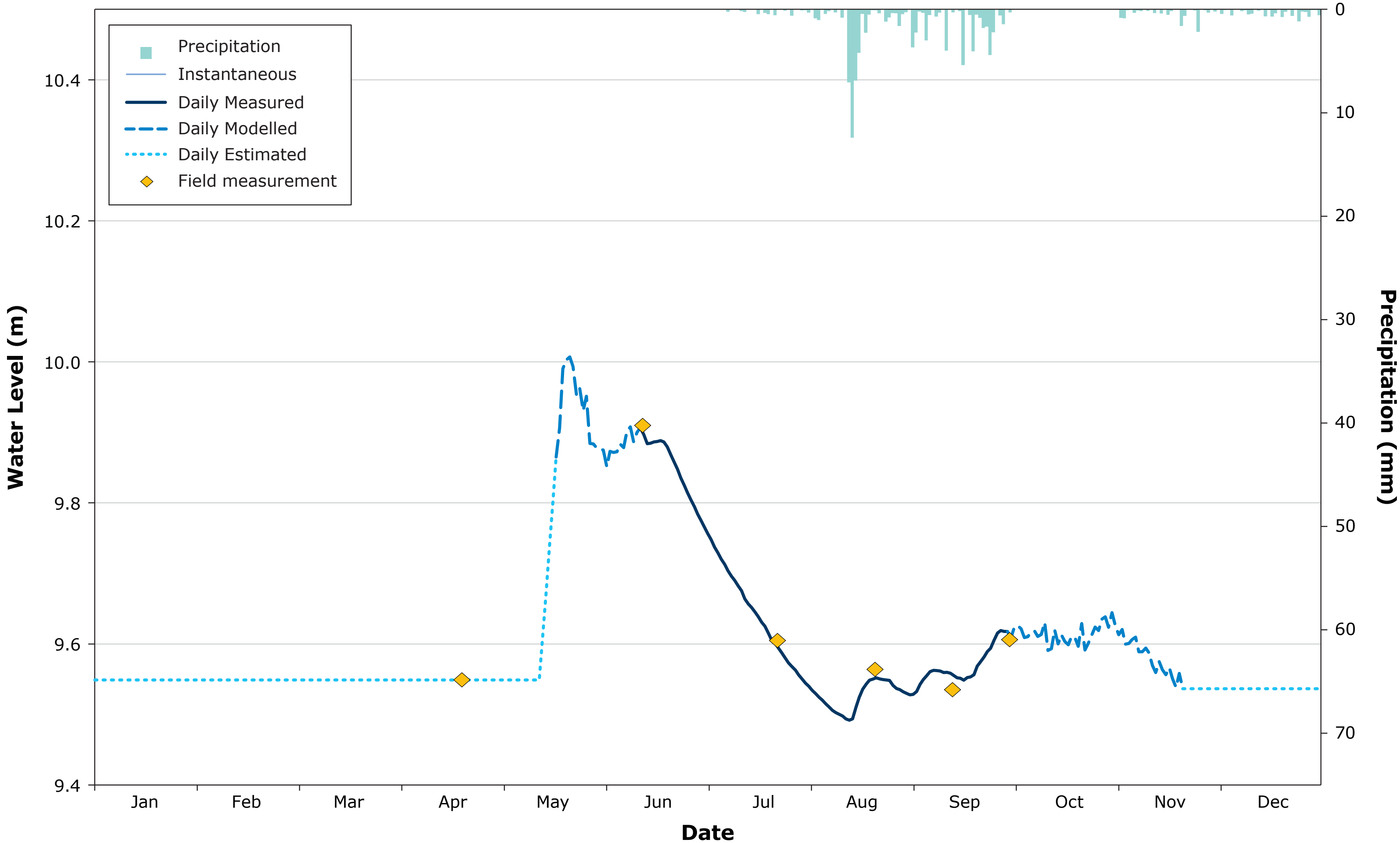
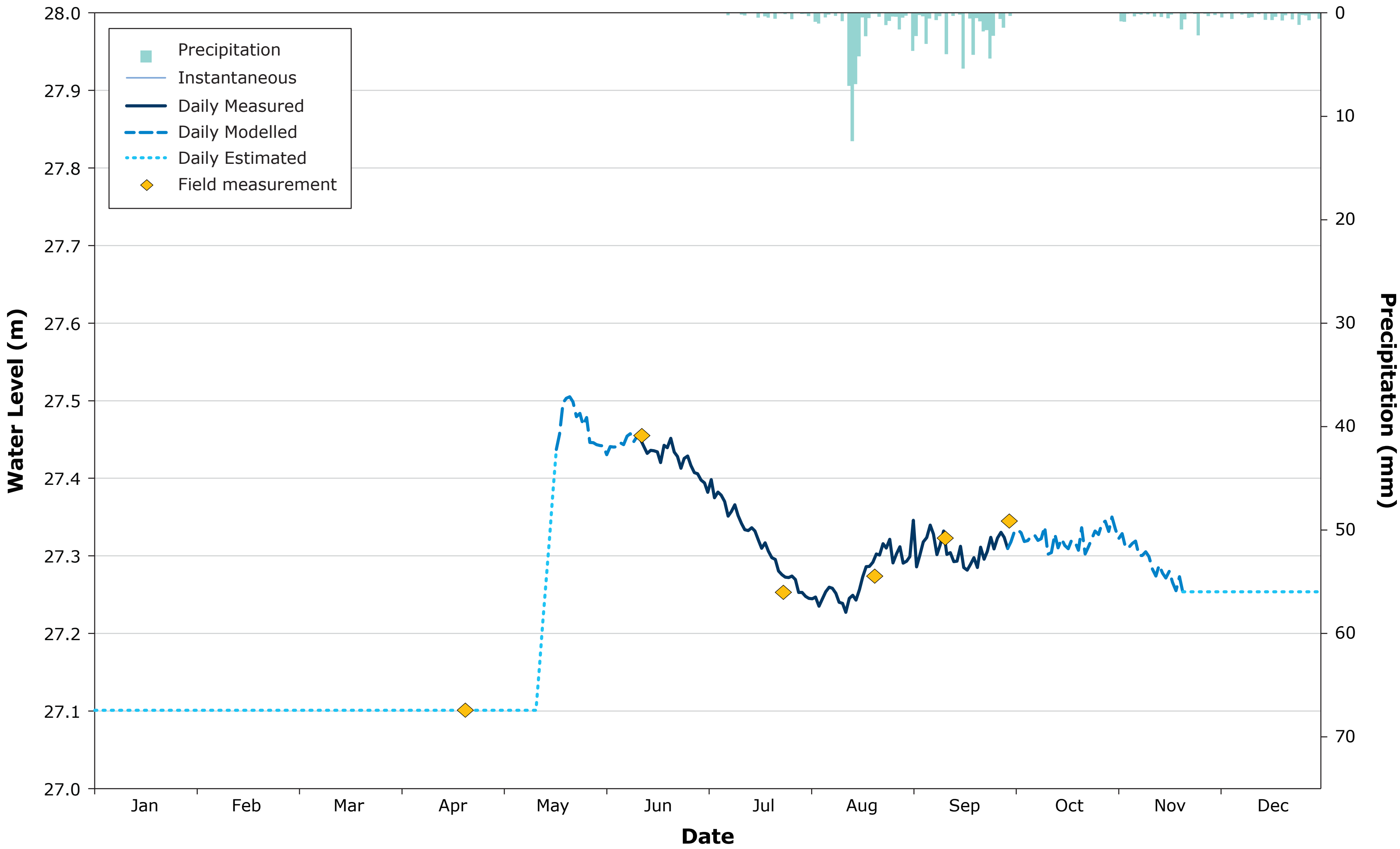


FIGURE A3 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION IMNIAGUT LAKE



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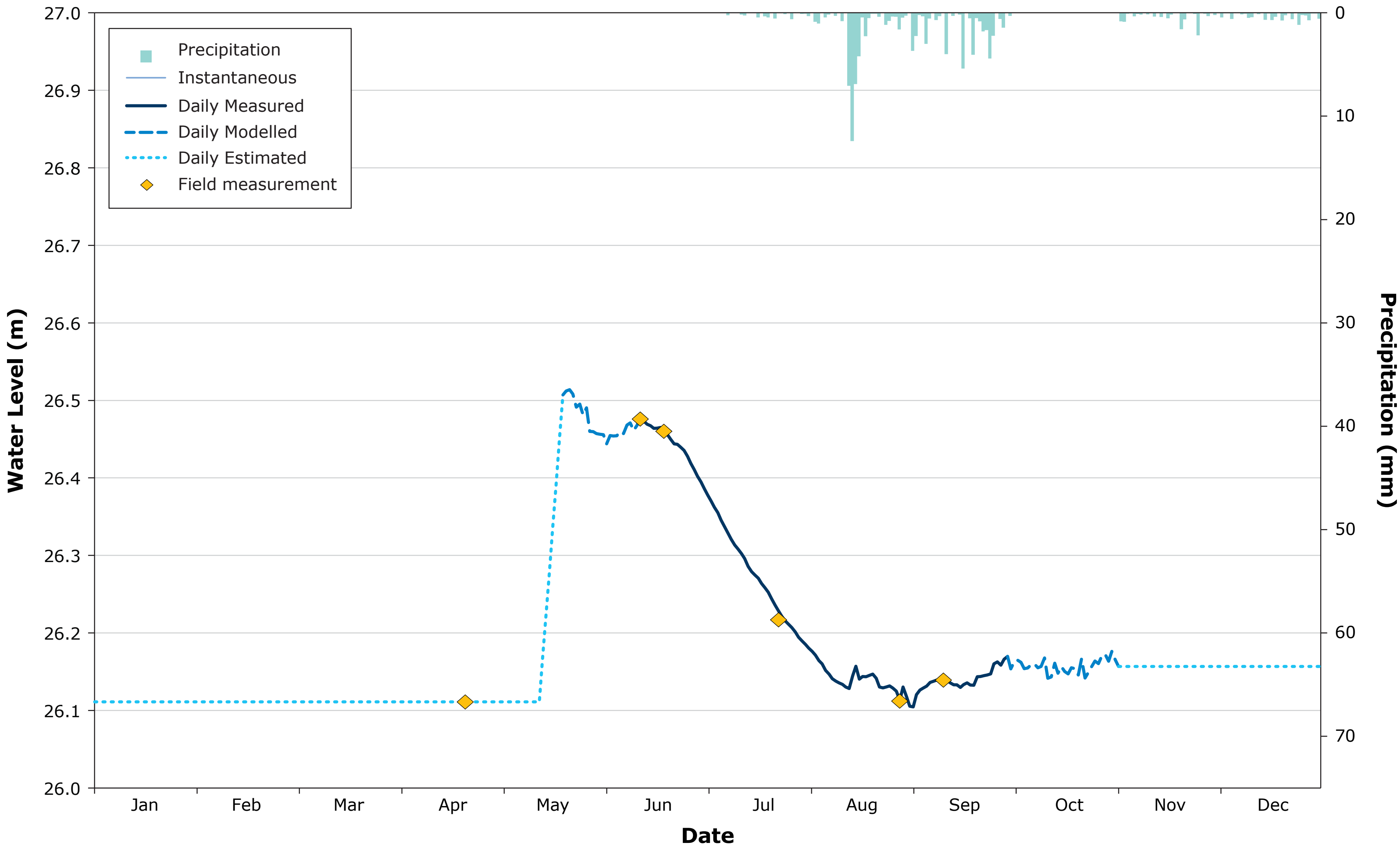
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-009:3

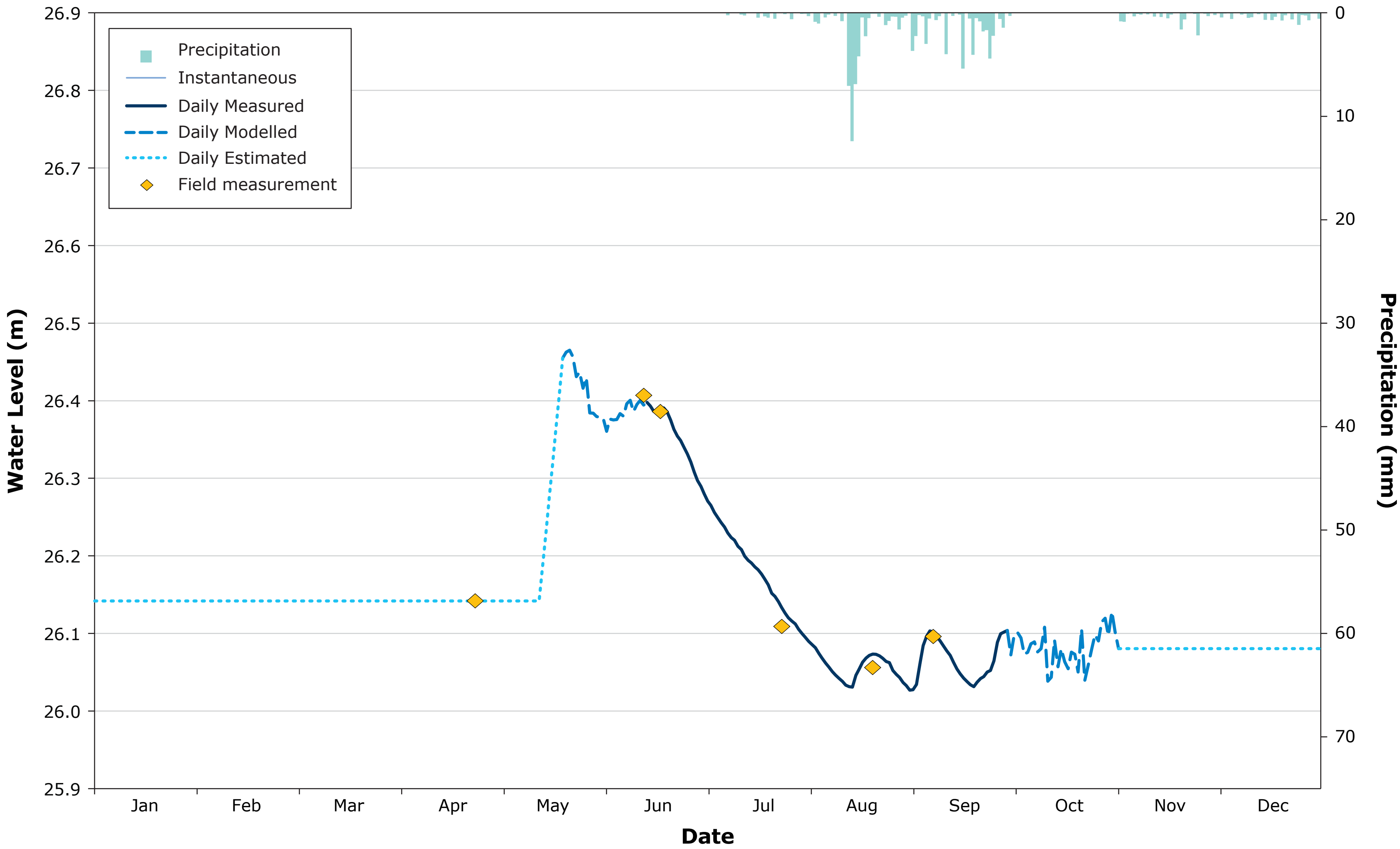
FIGURE A4 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION PATCH OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-009:4

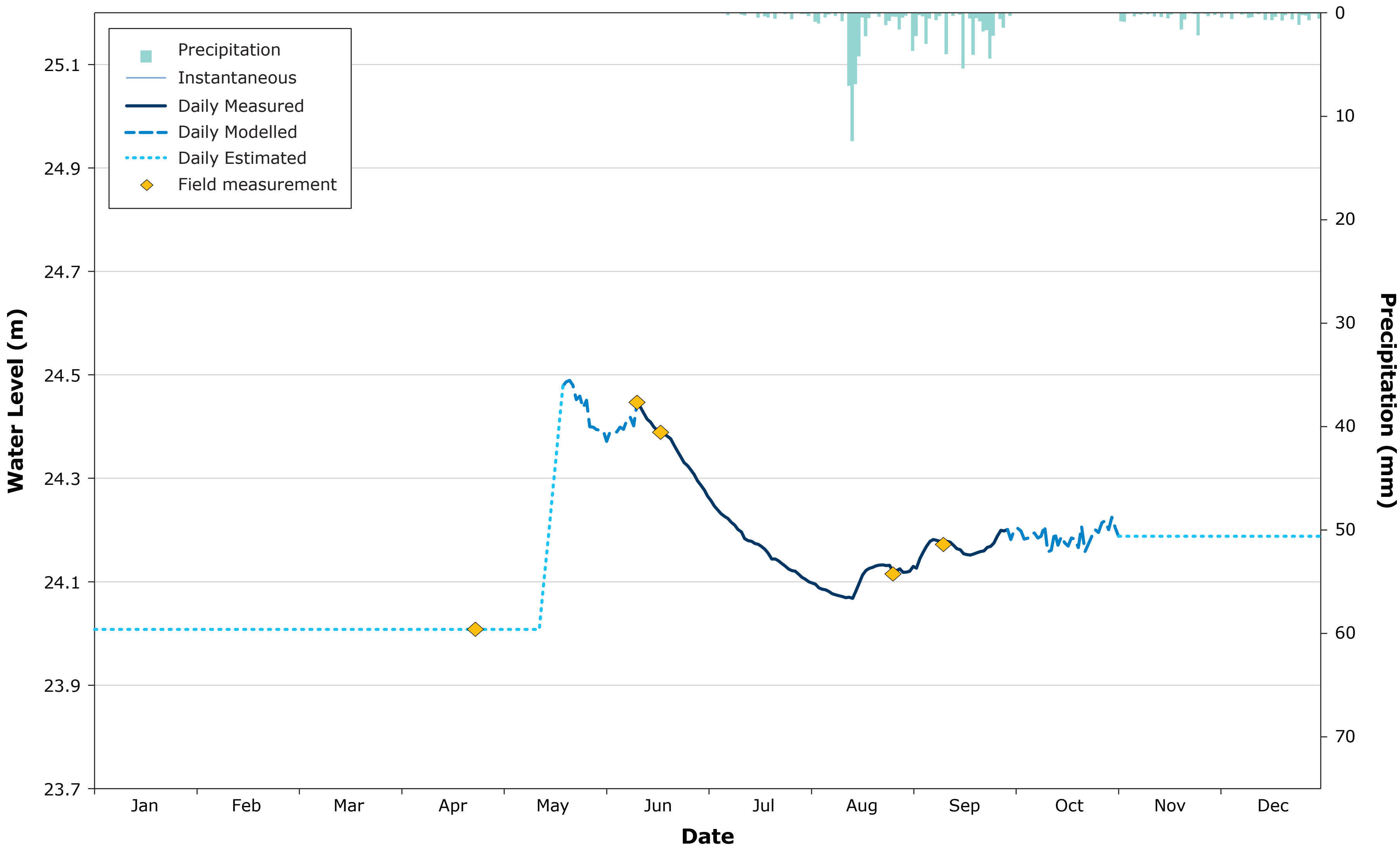
FIGURE A5   2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION PO OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-009:5

FIGURE A6   2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION OGAMA OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-009:6

FIGURE A7 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION DORRIS LAKE-2

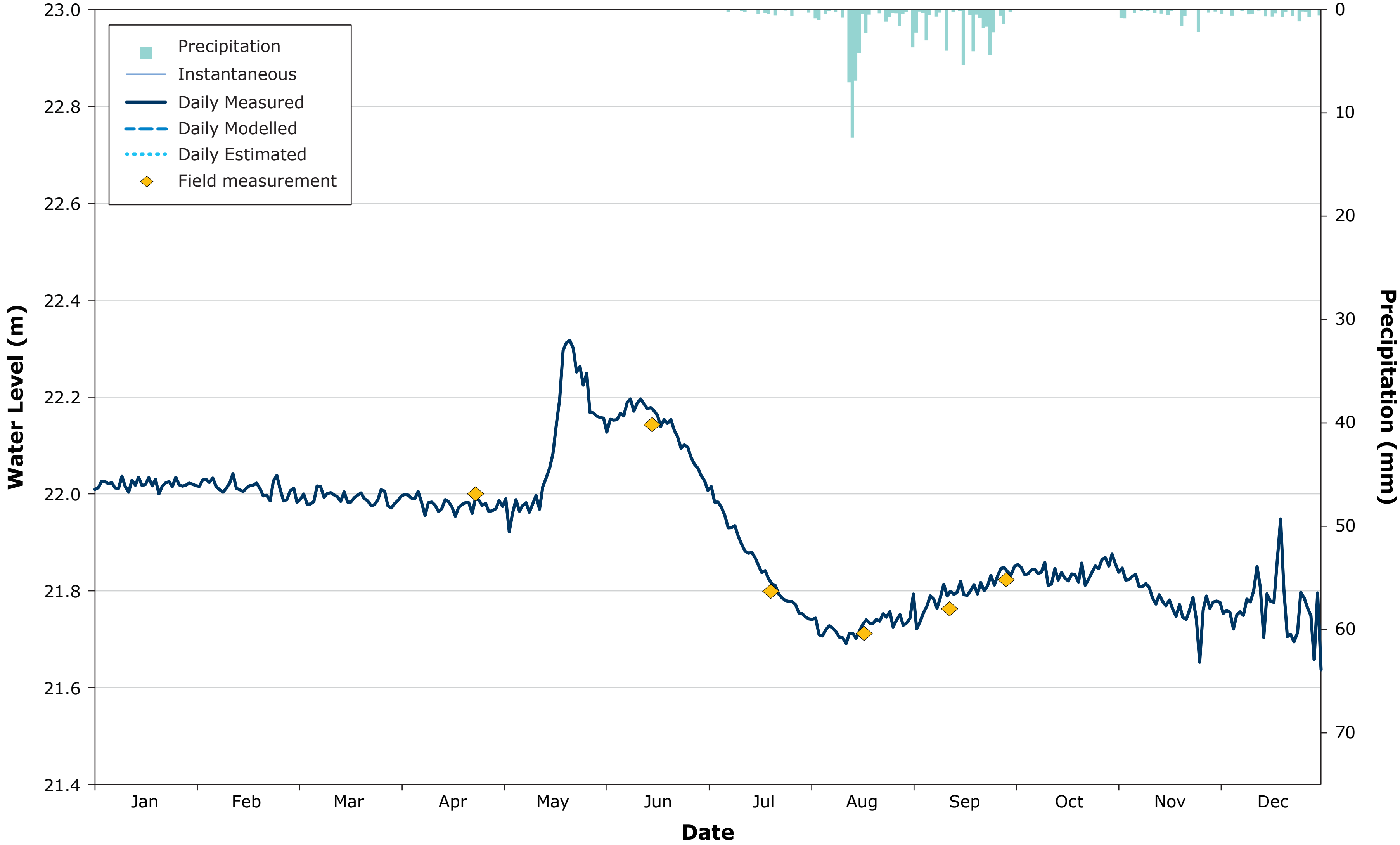
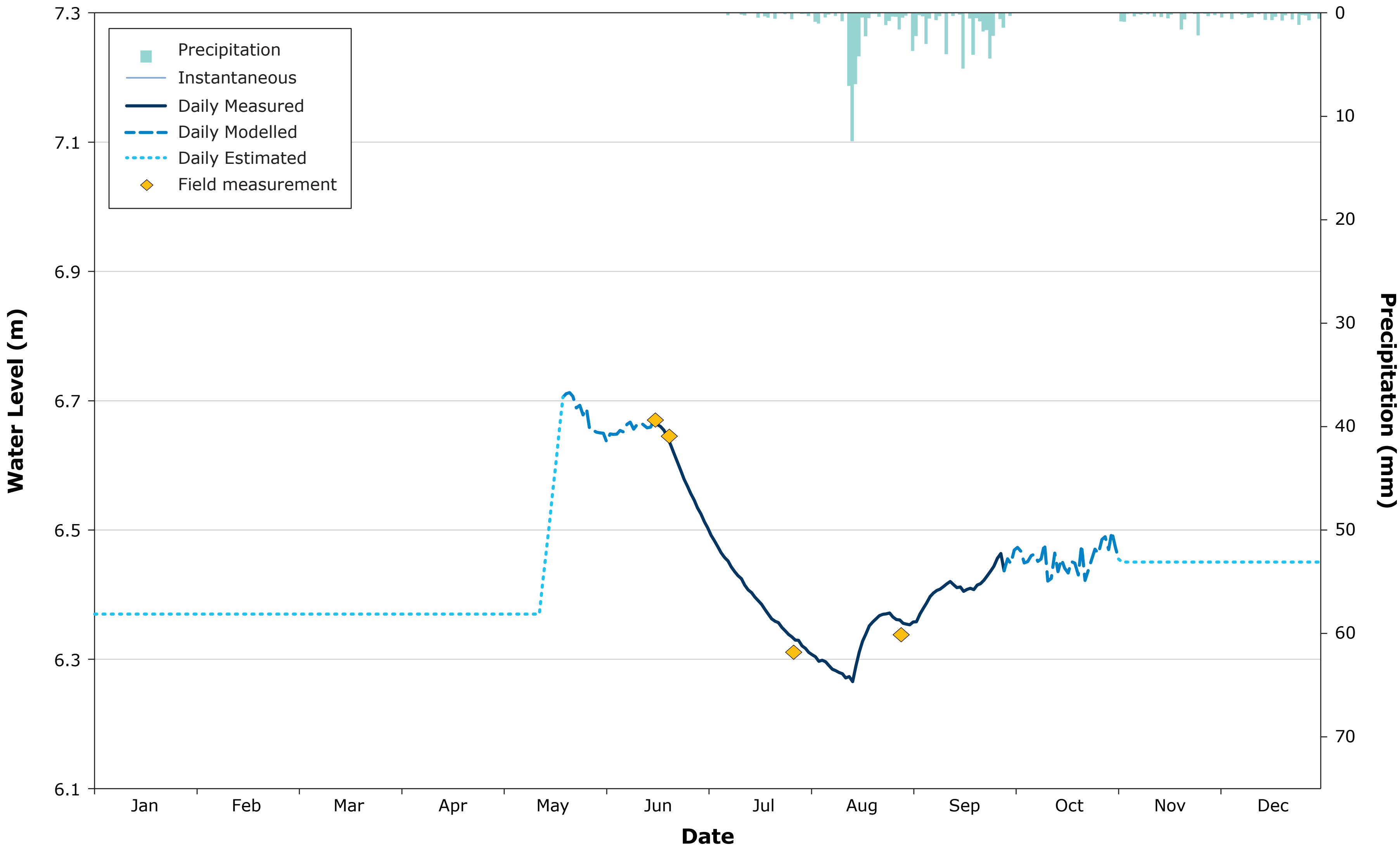


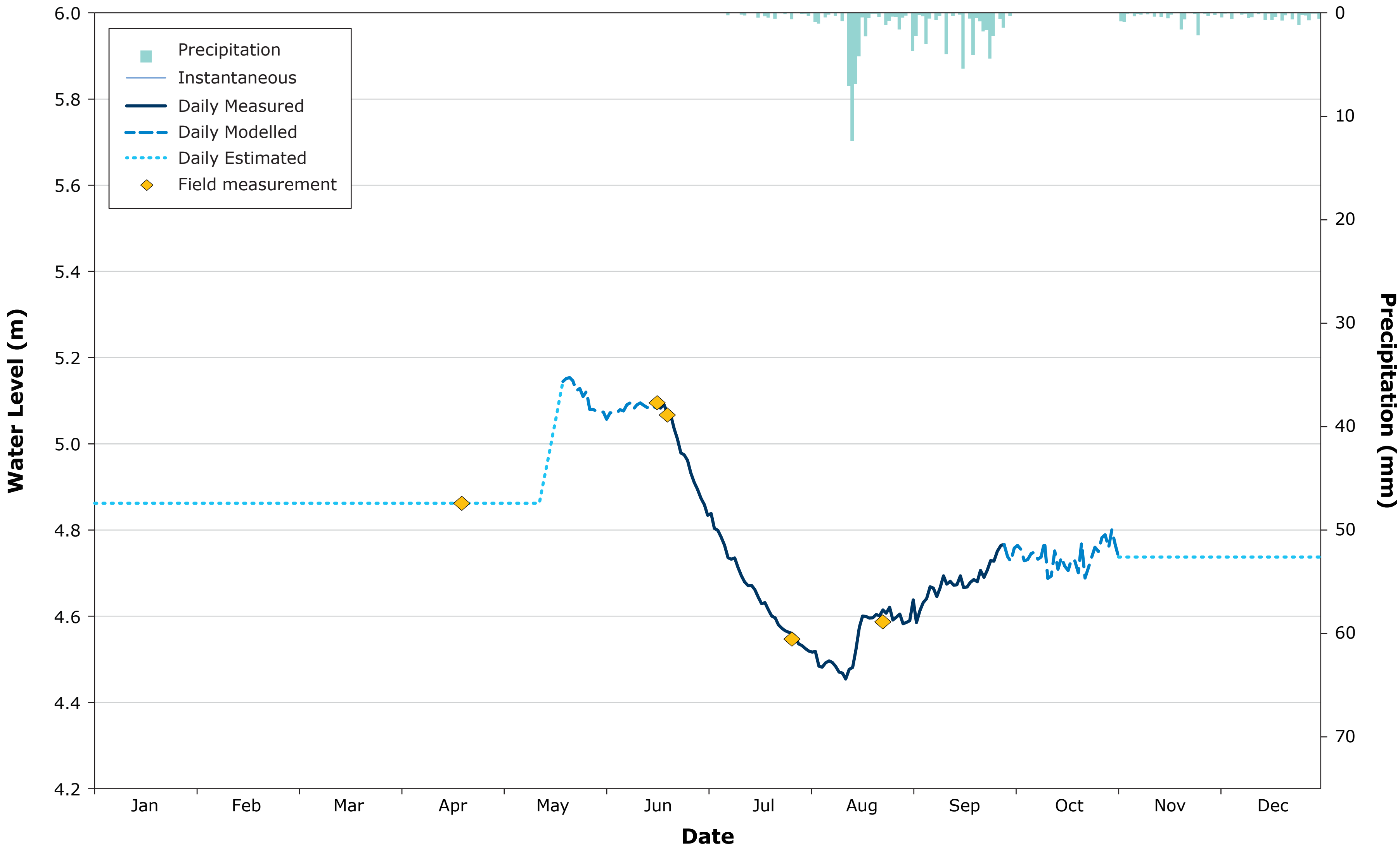
FIGURE A8 2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION ROBERTS HYDRO-2



ERM

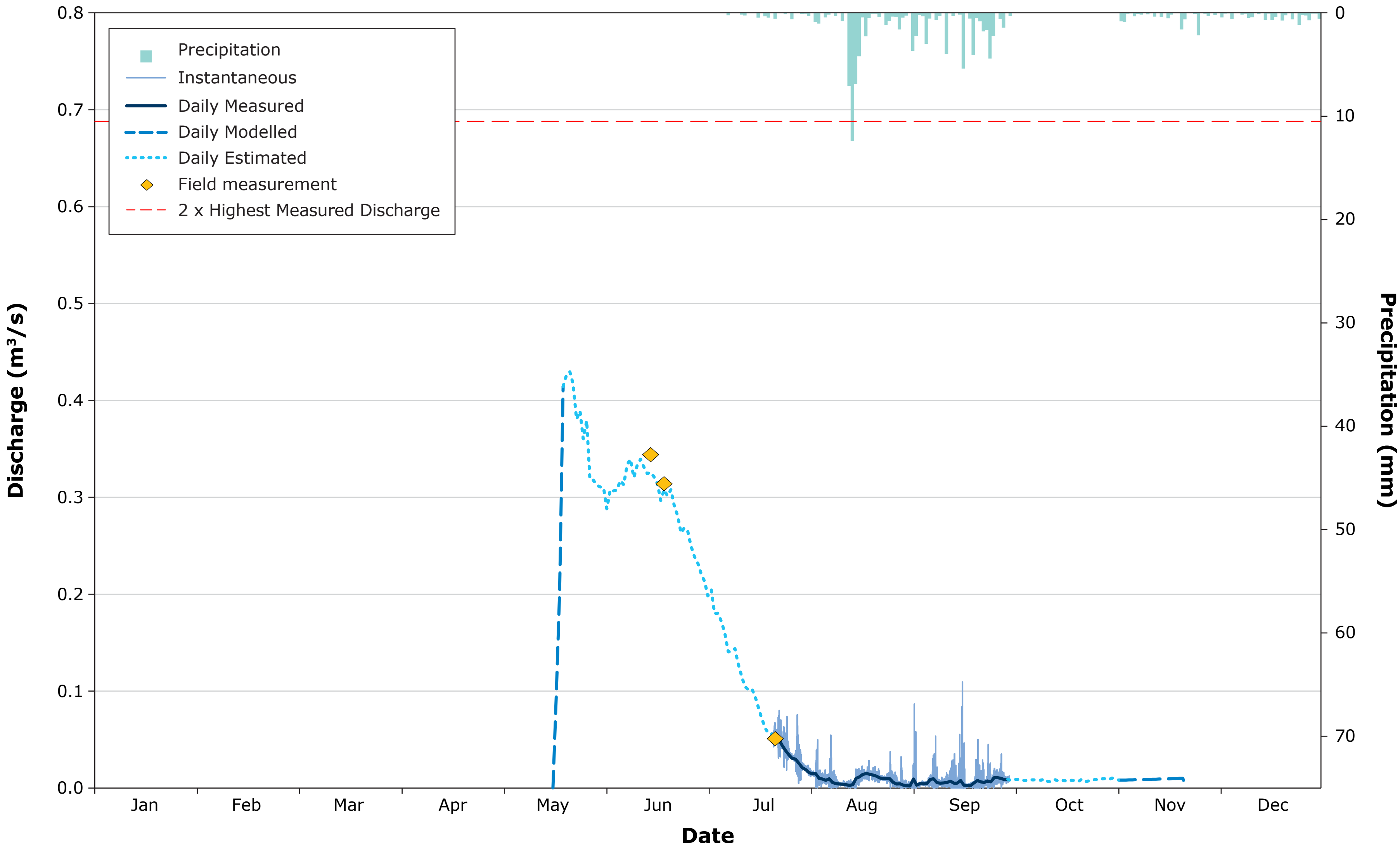
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-009:8

FIGURE A9   2023 MEAN DAILY LAKE LEVEL FOR MONITORING STATION LITTLE ROBERTS OUTFLOW



APPENDIX B HYDROGRAPHS

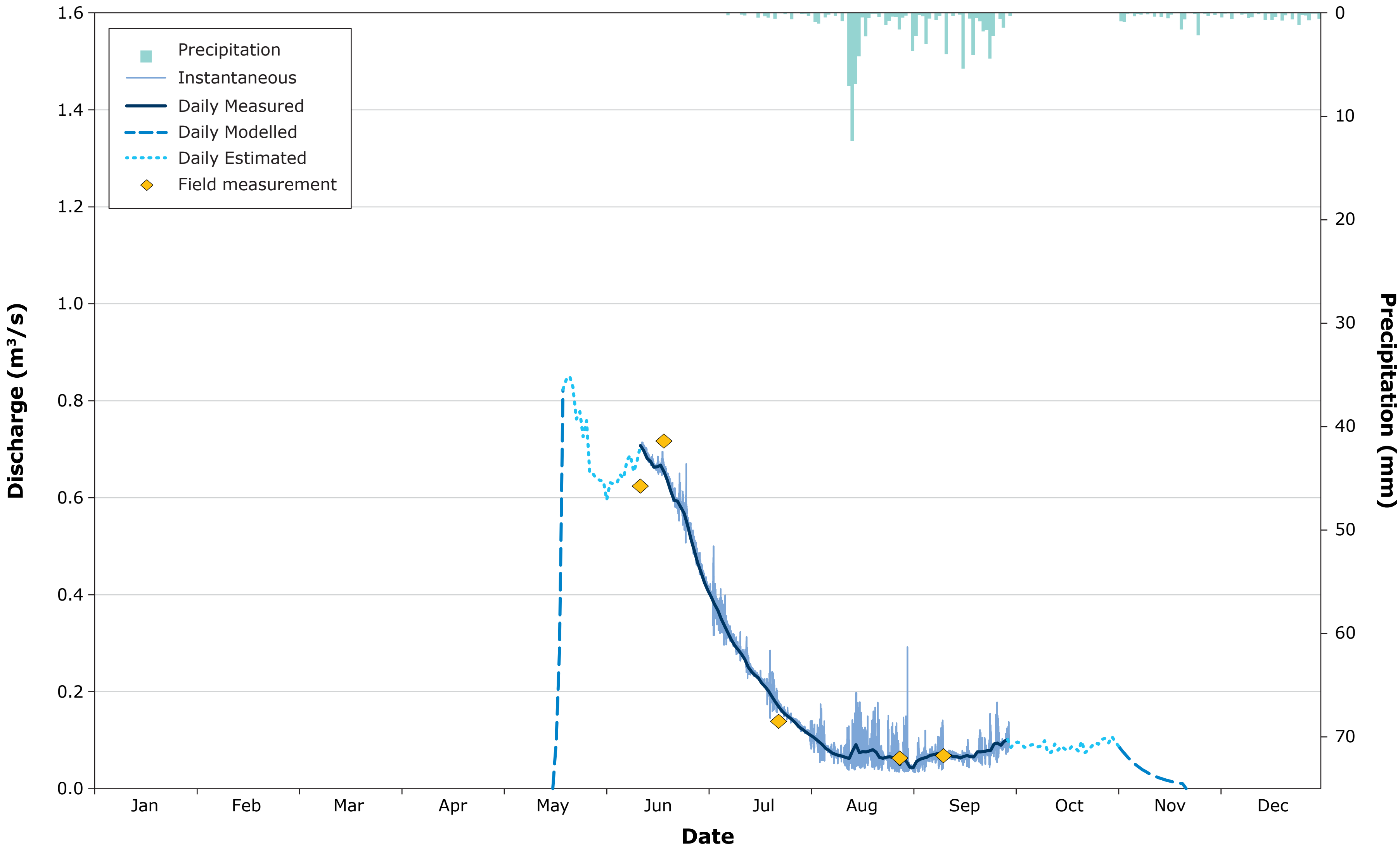
FIGURE B1 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION WINDY LAKE OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:1

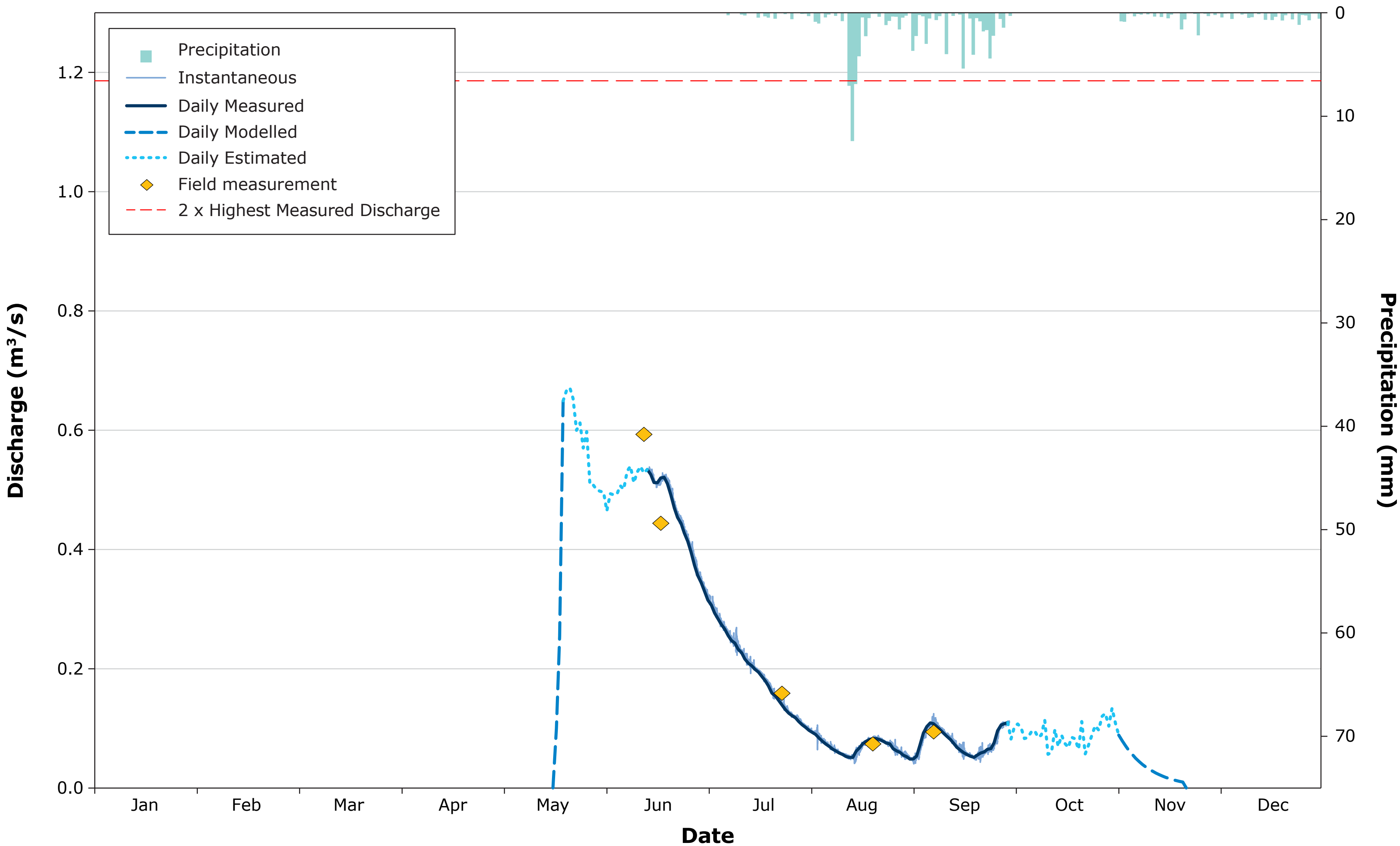
FIGURE B2 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION PATCH OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:2

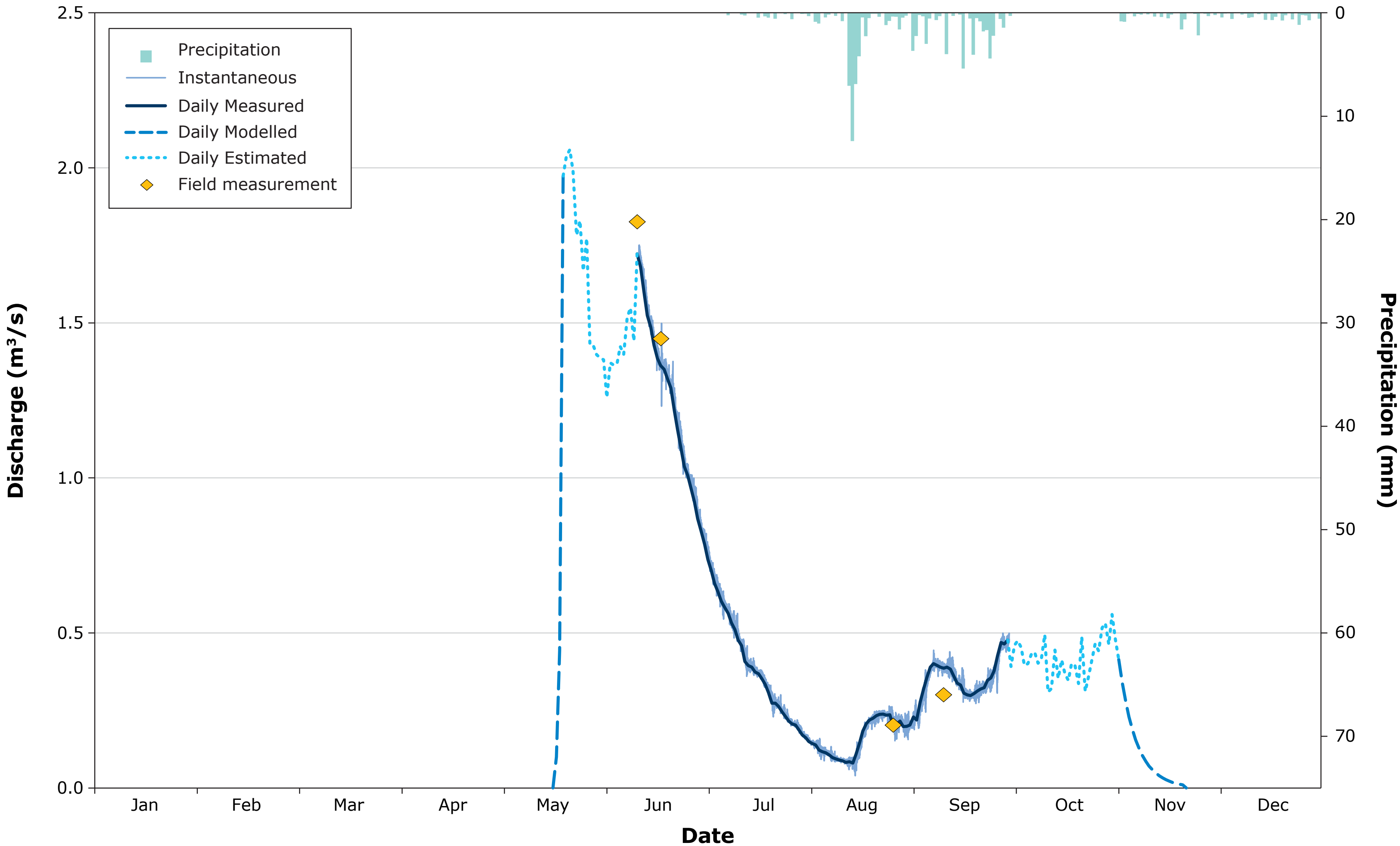
FIGURE B3 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION PO OUTFLOW



ERM

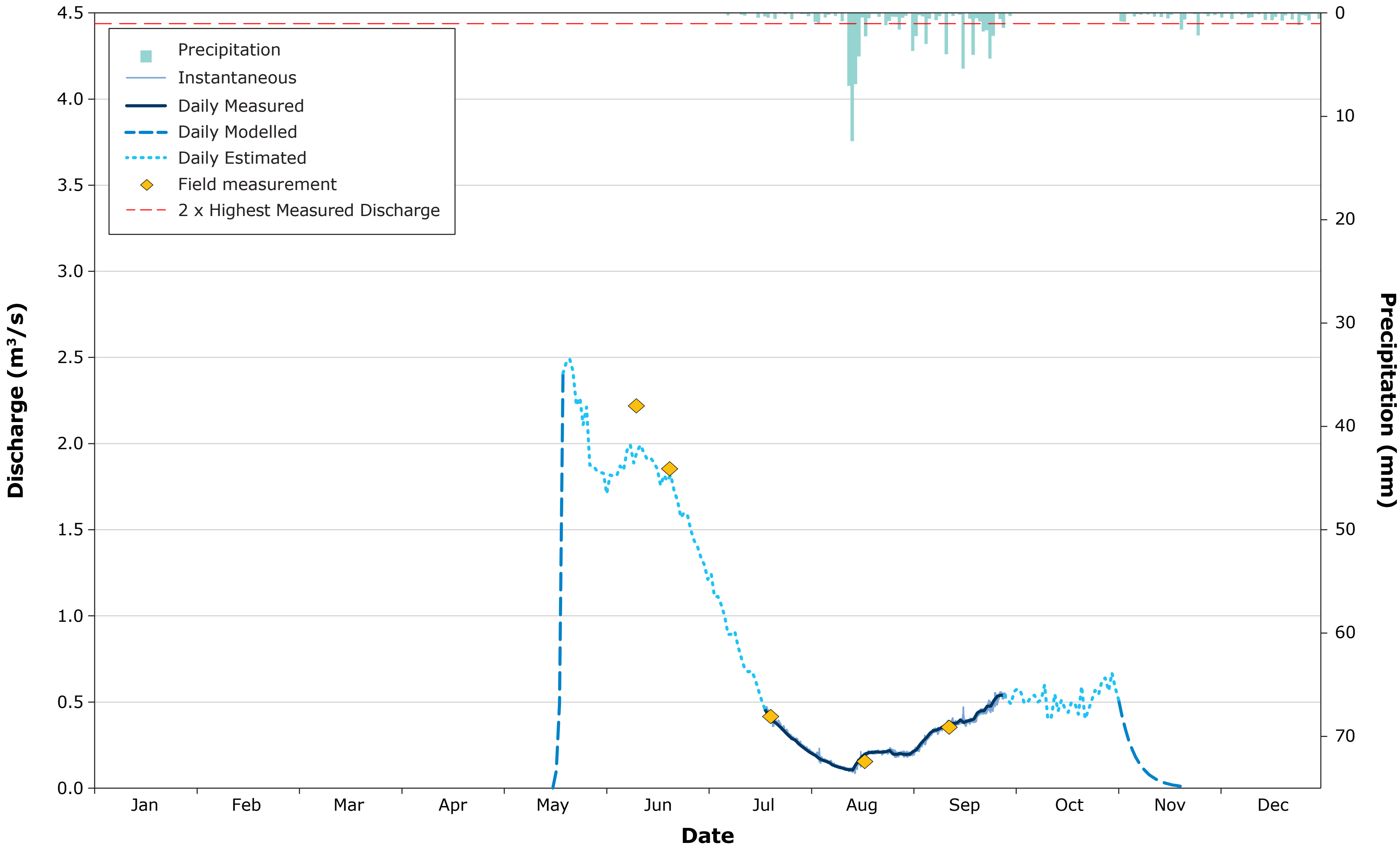
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:3

FIGURE B4 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION OGAMA OUTFLOW



CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:4

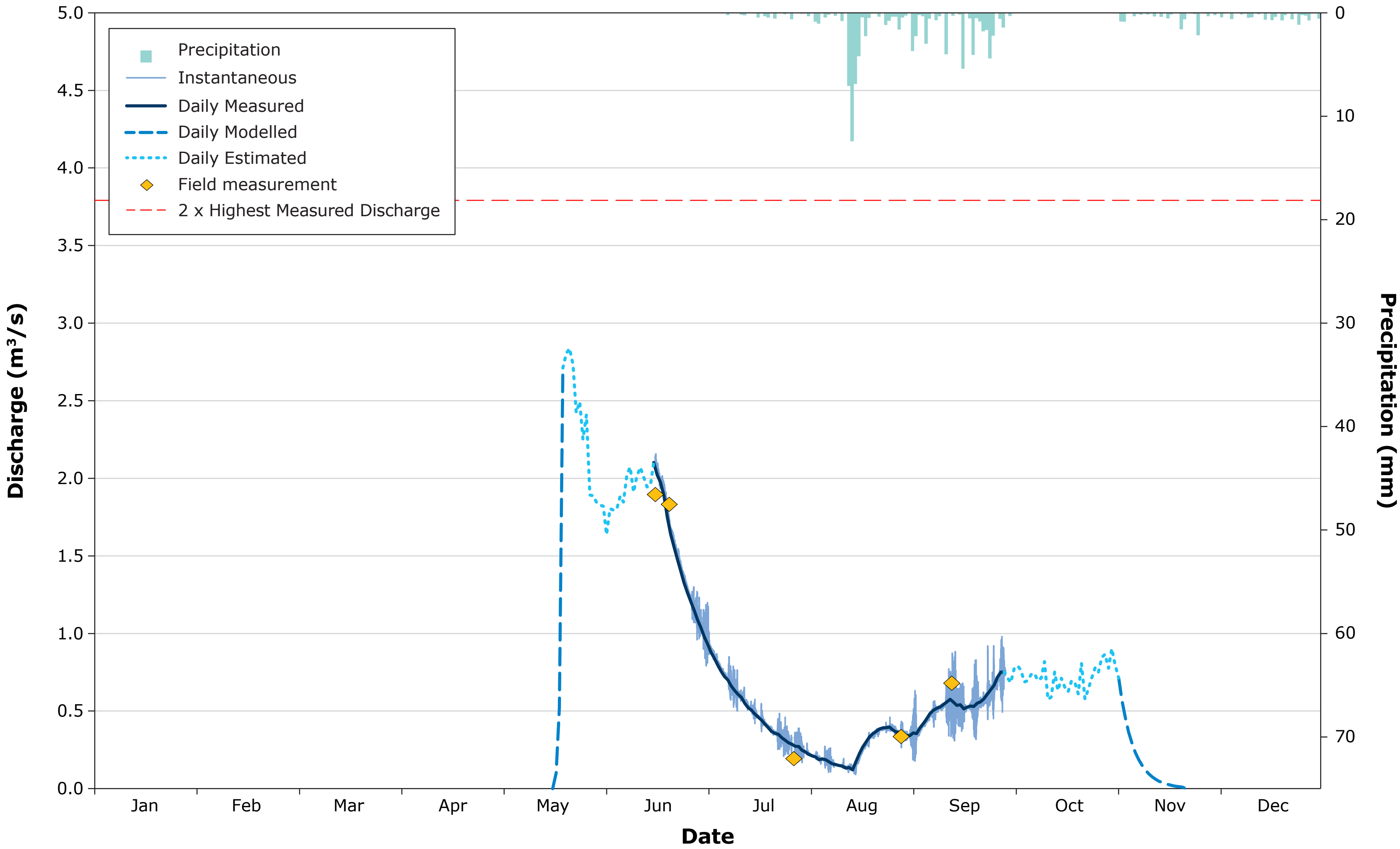
FIGURE B5 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION DORRIS CREEK



ERM

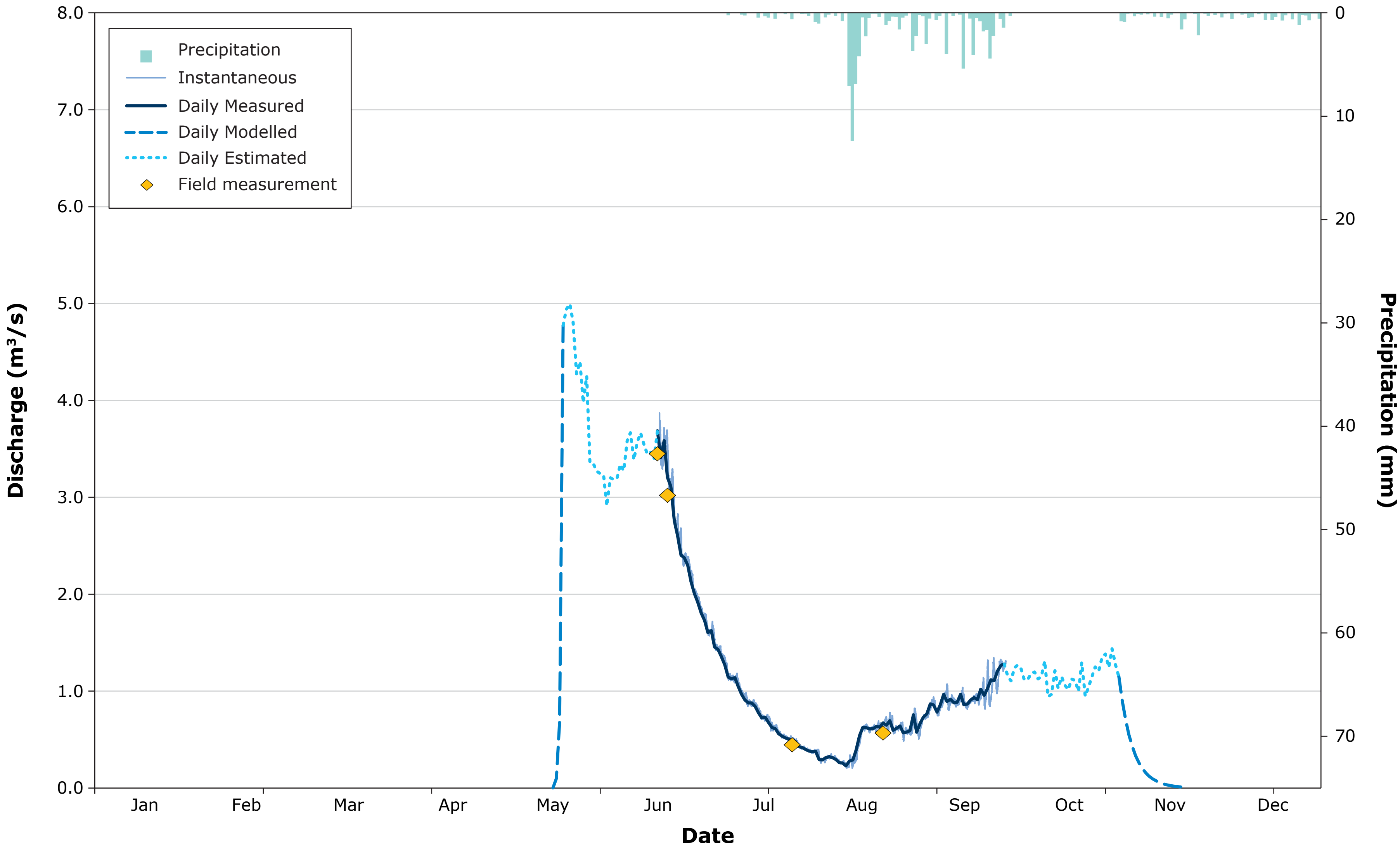
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:5

FIGURE B6 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION ROBERTS HYDRO-2



CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-010:6

FIGURE B7 2023 MEAN DAILY HYDROGRAPH AT MONITORING STATION LITTLE ROBERTS OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.

GRAPHICS NUMBER: HB-24ERM-010:7

APPENDIX C MEAN DAILY LAKE LEVEL TABLES

APPENDIX C1: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION WINDY OUTFLOW, 2023

Drainage Area 13.73 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.365*	*18.326*	18.192	18.166	*18.179*	*18.178*	*18.178*
2	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.357*	*18.319*	18.189	18.165	*18.180*	*18.178*	*18.178*
3	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.365*	*18.322*	18.188	18.170	*18.179*	*18.178*	*18.178*
4	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.364*	*18.310*	18.181	18.169	*18.177*	*18.178*	*18.178*
5	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.364*	*18.311*	18.180	18.170	*18.178*	*18.178*	*18.178*
6	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.368*	*18.306*	18.177	18.177	*18.179*	*18.178*	*18.178*
7	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.367*	*18.300*	18.177	18.177	*18.179*	*18.178*	*18.178*
8	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.374*	*18.290*	18.171	18.172	*18.178*	*18.178*	*18.178*
9	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.376*	*18.290*	18.170	18.171	*18.178*	*18.178*	*18.178*
10	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.369*	*18.292*	18.169	18.171	*18.180*	*18.178*	*18.178*
11	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.374*	*18.283*	18.168	18.172	*18.175*	*18.178*	*18.178*
12	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.376*	*18.276*	18.166	18.171	*18.175*	*18.178*	*18.178*
13	*18.350*	*18.350*	*18.350*	*18.350*	*18.350*	*18.373*	*18.269*	18.164	18.164	*18.179*	*18.178*	*18.178*
14	*18.350*	*18.350*	*18.350*	*18.350*	*18.357*	*18.371*	*18.267*	18.165	18.164	*18.176*	*18.178*	*18.178*
15	*18.350*	*18.350*	*18.350*	*18.350*	*18.365*	*18.371*	*18.268*	18.181	18.158	*18.178*	*18.178*	*18.178*
16	*18.350*	*18.350*	*18.350*	*18.350*	*18.372*	*18.370*	*18.263*	18.185	18.158	*18.177*	*18.178*	*18.178*
17	*18.350*	*18.350*	*18.350*	*18.350*	*18.380*	*18.367*	*18.255*	18.189	18.164	*18.176*	*18.178*	*18.178*
18	*18.350*	*18.350*	*18.350*	*18.350*	*18.387*	*18.360*	*18.247*	18.190	18.163	*18.178*	*18.178*	*18.178*
19	*18.350*	*18.350*	*18.350*	*18.350*	*18.395*	*18.365*	*18.239*	18.189	18.165	*18.177*	*18.178*	*18.178*
20	*18.350*	*18.350*	*18.350*	*18.350*	*18.402*	*18.362*	*18.235*	18.187	18.173	*18.176*	*18.178*	*18.178*
21	*18.350*	*18.350*	*18.350*	*18.350*	*18.406*	*18.365*	18.234	18.186	18.172	*18.180*	*18.178*	*18.178*
22	*18.350*	*18.350*	*18.350*	*18.350*	*18.407*	*18.358*	18.233	18.182	18.172	*18.175*	*18.178*	*18.178*
23	*18.350*	*18.350*	*18.350*	*18.350*	*18.403*	*18.354*	18.230	18.181	18.172	*18.176*	*18.178*	*18.178*
24	*18.350*	*18.350*	*18.350*	*18.350*	*18.391*	*18.347*	18.224	18.181	18.173	*18.178*	*18.178*	*18.178*
25	*18.350*	*18.350*	*18.350*	*18.350*	*18.394*	*18.349*	18.219	18.180	18.183	*18.180*	*18.178*	*18.178*
26	*18.350*	*18.350*	*18.350*	*18.350*	*18.384*	*18.348*	18.214	18.172	18.183	*18.179*	*18.178*	*18.178*
27	*18.350*	*18.350*	*18.350*	*18.350*	*18.390*	*18.342*	18.210	18.168	18.181	*18.181*	*18.178*	*18.178*
28	*18.350*	*18.350*	*18.350*	*18.350*	*18.369*	*18.337*	18.208	18.165	18.179	*18.181*	*18.178*	*18.178*
29	*18.350*		*18.350*	*18.350*	*18.368*	*18.334*	18.204	18.164	18.180	*18.179*	*18.178*	*18.178*
30	*18.350*		*18.350*	*18.350*	*18.366*	*18.329*	18.199	18.162	*18.177*	*18.182*	*18.178*	*18.178*
31	*18.350*		*18.350*		*18.366*		18.196	18.160		*18.180*		*18.178*
Mean	18.350	18.350	18.350	18.350	18.369	18.361	18.259	18.177	18.171	18.178	18.178	18.178
Max	18.350	18.350	18.350	18.350	18.407	18.376	18.326	18.192	18.183	18.182	18.178	18.178
Min	18.350	18.350	18.350	18.350	18.350	18.329	18.196	18.160	18.158	18.175	18.178	18.178

Note: Estimated and modelled values are italicized

APPENDIX C2: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION GLENN LAKE, 2023

Drainage Area 20.59 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.875*	9.766	9.540	9.528	*9.623*	*9.613*	*9.537*
2	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.851*	9.756	9.534	9.532	*9.626*	*9.620*	*9.537*
3	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.873*	9.748	9.530	9.543	*9.622*	*9.600*	*9.537*
4	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.872*	9.737	9.525	9.550	*9.609*	*9.601*	*9.537*
5	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.872*	9.729	9.520	9.555	*9.610*	*9.606*	*9.537*
6	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.883*	9.720	9.515	9.561	*9.617*	*9.610*	*9.537*
7	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.878*	9.713	9.511	9.563	*9.618*	*9.589*	*9.537*
8	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.901*	9.704	9.506	9.562	*9.611*	*9.589*	*9.537*
9	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.908*	9.696	9.503	9.562	*9.613*	*9.594*	*9.537*
10	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.887*	9.690	9.500	9.560	*9.631*	*9.587*	*9.537*
11	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	*9.900*	9.682	9.498	9.560	*9.591*	*9.569*	*9.537*
12	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	9.907	9.675	9.494	9.559	*9.593*	*9.559*	*9.537*
13	*9.549*	*9.549*	*9.549*	*9.549*	*9.549*	9.897	9.664	9.492	9.555	*9.620*	*9.575*	*9.537*
14	*9.549*	*9.549*	*9.549*	*9.549*	*9.611*	9.884	9.657	9.494	9.552	*9.600*	*9.564*	*9.537*
15	*9.549*	*9.549*	*9.549*	*9.549*	*9.674*	9.885	9.652	9.510	9.551	*9.613*	*9.556*	*9.537*
16	*9.549*	*9.549*	*9.549*	*9.549*	*9.737*	9.886	9.645	9.524	9.549	*9.603*	*9.566*	*9.537*
17	*9.549*	*9.549*	*9.549*	*9.549*	*9.801*	9.887	9.639	9.536	9.552	*9.599*	*9.550*	*9.537*
18	*9.549*	*9.549*	*9.549*	*9.549*	*9.865*	9.888	9.631	9.543	9.553	*9.611*	*9.538*	*9.537*
19	*9.549*	*9.549*	*9.549*	*9.549*	*9.906*	9.886	9.625	9.549	9.556	*9.609*	*9.558*	*9.537*
20	*9.549*	*9.549*	*9.549*	*9.549*	*9.990*	9.879	9.615	9.550	9.568	*9.597*	*9.537*	*9.537*
21	*9.549*	*9.549*	*9.549*	*9.549*	*10.003*	9.868	9.605	9.552	9.575	*9.629*	*9.537*	*9.537*
22	*9.549*	*9.549*	*9.549*	*9.549*	*10.007*	9.858	9.601	9.550	9.581	*9.591*	*9.537*	*9.537*
23	*9.549*	*9.549*	*9.549*	*9.549*	*9.993*	9.848	9.594	9.549	9.589	*9.601*	*9.537*	*9.537*
24	*9.549*	*9.549*	*9.549*	*9.549*	*9.953*	9.836	9.587	9.549	9.594	*9.613*	*9.537*	*9.537*
25	*9.549*	*9.549*	*9.549*	*9.549*	*9.962*	9.825	9.580	9.548	9.605	*9.624*	*9.537*	*9.537*
26	*9.549*	*9.549*	*9.549*	*9.549*	*9.931*	9.814	9.573	9.541	9.615	*9.619*	*9.537*	*9.537*
27	*9.549*	*9.549*	*9.549*	*9.549*	*9.951*	9.804	9.568	9.537	9.619	*9.635*	*9.537*	*9.537*
28	*9.549*	*9.549*	*9.549*	*9.549*	*9.884*	9.795	9.563	9.535	9.618	*9.638*	*9.537*	*9.537*
29	*9.549*		*9.549*	*9.549*	*9.884*	9.784	9.556	9.532	9.618	*9.624*	*9.537*	*9.537*
30	*9.549*		*9.549*	*9.549*	*9.878*	9.775	9.550	9.530	*9.608*	*9.644*	*9.537*	*9.537*
31	*9.549*		*9.549*		*9.876*		9.545	9.528		*9.627*		*9.537*
Mean	9.549	9.549	9.549	9.549	9.743	9.864	9.647	9.527	9.570	9.615	9.565	9.537
Max	9.549	9.549	9.549	9.549	10.007	9.908	9.766	9.552	9.619	9.644	9.620	9.537
Min	9.549	9.549	9.549	9.549	9.549	9.775	9.545	9.492	9.528	9.591	9.537	9.537

Note: Estimated and modelled values are italicized

APPENDIX C3: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION IMNIAGUT LAKE, 2023

Drainage Area 1.31 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.442*	27.394	27.245	27.346	*27.331*	*27.322*	*27.254*
2	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.430*	27.382	27.245	27.286	*27.334*	*27.329*	*27.254*
3	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.441*	27.398	27.247	27.302	*27.330*	*27.310*	*27.254*
4	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.440*	27.375	27.235	27.318	*27.319*	*27.311*	*27.254*
5	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.441*	27.382	27.244	27.324	*27.320*	*27.316*	*27.254*
6	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.446*	27.378	27.254	27.340	*27.326*	*27.319*	*27.254*
7	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.443*	27.370	27.260	27.328	*27.327*	*27.301*	*27.254*
8	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.454*	27.351	27.258	27.302	*27.320*	*27.300*	*27.254*
9	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.457*	27.357	27.252	27.314	*27.322*	*27.305*	*27.254*
10	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.447*	27.366	27.240	27.332	*27.338*	*27.299*	*27.254*
11	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	*27.454*	27.352	27.239	27.302	*27.302*	*27.283*	*27.254*
12	*27.101*	*27.101*	*27.101*	*27.101*	*27.101*	27.450	27.342	27.227	27.304	*27.304*	*27.274*	*27.254*
13	*27.101*	*27.101*	*27.101*	*27.101*	*27.157*	27.441	27.334	27.245	27.293	*27.328*	*27.288*	*27.254*
14	*27.101*	*27.101*	*27.101*	*27.101*	*27.378*	27.432	27.333	27.249	27.293	*27.310*	*27.278*	*27.254*
15	*27.101*	*27.101*	*27.101*	*27.101*	*27.394*	27.436	27.336	27.243	27.312	*27.322*	*27.271*	*27.254*
16	*27.101*	*27.101*	*27.101*	*27.101*	*27.409*	27.435	27.332	27.256	27.285	*27.314*	*27.280*	*27.254*
17	*27.101*	*27.101*	*27.101*	*27.101*	*27.425*	27.434	27.320	27.273	27.282	*27.309*	*27.266*	*27.254*
18	*27.101*	*27.101*	*27.101*	*27.101*	*27.437*	27.420	27.310	27.286	27.289	*27.320*	*27.255*	*27.254*
19	*27.101*	*27.101*	*27.101*	*27.101*	*27.457*	27.442	27.317	27.286	27.298	*27.318*	*27.273*	*27.254*
20	*27.101*	*27.101*	*27.101*	*27.101*	*27.497*	27.440	27.306	27.292	27.285	*27.307*	*27.254*	*27.254*
21	*27.101*	*27.101*	*27.101*	*27.101*	*27.503*	27.451	27.298	27.303	27.311	*27.336*	*27.254*	*27.254*
22	*27.101*	*27.101*	*27.101*	*27.101*	*27.505*	27.434	27.295	27.301	27.296	*27.303*	*27.254*	*27.254*
23	*27.101*	*27.101*	*27.101*	*27.101*	*27.499*	27.428	27.281	27.316	27.306	*27.311*	*27.254*	*27.254*
24	*27.101*	*27.101*	*27.101*	*27.101*	*27.479*	27.413	27.276	27.310	27.324	*27.322*	*27.254*	*27.254*
25	*27.101*	*27.101*	*27.101*	*27.101*	*27.484*	27.426	27.273	27.321	27.309	*27.332*	*27.254*	*27.254*
26	*27.101*	*27.101*	*27.101*	*27.101*	*27.469*	27.429	27.272	27.291	27.323	*27.328*	*27.254*	*27.254*
27	*27.101*	*27.101*	*27.101*	*27.101*	*27.478*	27.417	27.274	27.303	27.330	*27.342*	*27.254*	*27.254*
28	*27.101*	*27.101*	*27.101*	*27.101*	*27.446*	27.407	27.269	27.312	27.324	*27.345*	*27.254*	*27.254*
29	*27.101*		*27.101*	*27.101*	*27.446*	27.406	27.253	27.291	27.309	*27.332*	*27.254*	*27.254*
30	*27.101*		*27.101*	*27.101*	*27.443*	27.398	27.253	27.293	*27.318*	*27.350*	*27.254*	*27.254*
31	*27.101*		*27.101*		*27.442*		27.248	27.299		*27.334*		*27.254*
Mean	27.101	27.101	27.101	27.101	27.308	27.435	27.323	27.271	27.309	27.324	27.279	27.254
Max	27.101	27.101	27.101	27.101	27.505	27.457	27.398	27.321	27.346	27.350	27.329	27.254
Min	27.101	27.101	27.101	27.101	27.101	27.398	27.248	27.227	27.282	27.302	27.254	27.254

Note: Estimated and modelled values are italicized

APPENDIX C4: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION PATCH OUTFLOW, 2023

Drainage Area 32.16 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.456*	26.386	26.181	26.105	*26.163*	*26.157*	*26.157*
2	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.444*	26.378	26.176	26.120	*26.165*	*26.157*	*26.157*
3	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.455*	26.370	26.171	26.126	*26.162*	*26.157*	*26.157*
4	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.454*	26.362	26.164	26.129	*26.154*	*26.157*	*26.157*
5	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.454*	26.355	26.160	26.131	*26.155*	*26.157*	*26.157*
6	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.460*	26.346	26.152	26.136	*26.159*	*26.157*	*26.157*
7	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.457*	26.337	26.147	26.138	*26.160*	*26.157*	*26.157*
8	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.468*	26.329	26.141	26.139	*26.155*	*26.157*	*26.157*
9	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.471*	26.321	26.138	26.139	*26.157*	*26.157*	*26.157*
10	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.461*	26.313	26.136	26.139	*26.168*	*26.157*	*26.157*
11	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	*26.467*	26.308	26.134	26.139	*26.142*	*26.157*	*26.157*
12	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	26.477	26.303	26.130	26.136	*26.143*	*26.157*	*26.157*
13	*26.111*	*26.111*	*26.111*	*26.111*	*26.111*	26.474	26.296	26.128	26.133	*26.161*	*26.157*	*26.157*
14	*26.111*	*26.111*	*26.111*	*26.111*	*26.167*	26.469	26.286	26.145	26.133	*26.148*	*26.157*	*26.157*
15	*26.111*	*26.111*	*26.111*	*26.111*	*26.224*	26.467	26.279	26.157	26.130	*26.157*	*26.157*	*26.157*
16	*26.111*	*26.111*	*26.111*	*26.111*	*26.280*	26.464	26.275	26.140	26.133	*26.150*	*26.157*	*26.157*
17	*26.111*	*26.111*	*26.111*	*26.111*	*26.337*	26.464	26.271	26.144	26.136	*26.147*	*26.157*	*26.157*
18	*26.111*	*26.111*	*26.111*	*26.111*	*26.393*	26.465	26.264	26.143	26.133	*26.155*	*26.157*	*26.157*
19	*26.111*	*26.111*	*26.111*	*26.111*	*26.450*	26.461	26.258	26.145	26.133	*26.154*	*26.157*	*26.157*
20	*26.111*	*26.111*	*26.111*	*26.111*	*26.507*	26.456	26.252	26.147	26.144	*26.146*	*26.157*	*26.157*
21	*26.111*	*26.111*	*26.111*	*26.111*	*26.512*	26.450	26.244	26.141	26.144	*26.167*	*26.157*	*26.157*
22	*26.111*	*26.111*	*26.111*	*26.111*	*26.514*	26.444	26.236	26.130	26.145	*26.142*	*26.157*	*26.157*
23	*26.111*	*26.111*	*26.111*	*26.111*	*26.508*	26.443	26.229	26.129	26.146	*26.149*	*26.157*	*26.157*
24	*26.111*	*26.111*	*26.111*	*26.111*	*26.491*	26.439	26.221	26.130	26.147	*26.157*	*26.157*	*26.157*
25	*26.111*	*26.111*	*26.111*	*26.111*	*26.495*	26.436	26.216	26.132	26.160	*26.164*	*26.157*	*26.157*
26	*26.111*	*26.111*	*26.111*	*26.111*	*26.481*	26.428	26.211	26.129	26.163	*26.161*	*26.157*	*26.157*
27	*26.111*	*26.111*	*26.111*	*26.111*	*26.490*	26.419	26.207	26.125	26.158	*26.171*	*26.157*	*26.157*
28	*26.111*	*26.111*	*26.111*	*26.111*	*26.460*	26.411	26.201	26.113	26.166	*26.173*	*26.157*	*26.157*
29	*26.111*		*26.111*	*26.111*	*26.460*	26.402	26.195	26.130	26.170	*26.163*	*26.157*	*26.157*
30	*26.111*		*26.111*	*26.111*	*26.457*	26.395	26.190	26.118	*26.154*	*26.176*	*26.157*	*26.157*
31	*26.111*		*26.111*		*26.456*		26.185	26.106		*26.165*		*26.157*
Mean	26.111	26.111	26.111	26.111	26.294	26.450	26.278	26.141	26.140	26.158	26.157	26.157
Max	26.111	26.111	26.111	26.111	26.514	26.477	26.386	26.181	26.170	26.176	26.157	26.157
Min	26.111	26.111	26.111	26.111	26.111	26.395	26.185	26.106	26.105	26.142	26.157	26.157

Note: Estimated and modelled values are italicized

APPENDIX C5: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION PO OUTFLOW, 2023

Drainage Area 35.3 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.378*	26.280	26.090	26.027	*26.097*	*26.080*	*26.080*
2	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.360*	26.271	26.086	26.034	*26.101*	*26.080*	*26.080*
3	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.376*	26.265	26.082	26.061	*26.094*	*26.080*	*26.080*
4	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.375*	26.256	26.074	26.084	*26.073*	*26.080*	*26.080*
5	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.376*	26.249	26.068	26.097	*26.076*	*26.080*	*26.080*
6	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.384*	26.243	26.062	26.103	*26.087*	*26.080*	*26.080*
7	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.380*	26.237	26.057	26.102	*26.089*	*26.080*	*26.080*
8	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.396*	26.229	26.051	26.096	*26.076*	*26.080*	*26.080*
9	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.400*	26.224	26.046	26.091	*26.081*	*26.080*	*26.080*
10	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.386*	26.220	26.042	26.084	*26.108*	*26.080*	*26.080*
11	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.395*	26.212	26.038	26.078	*26.039*	*26.080*	*26.080*
12	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.400*	26.208	26.033	26.072	*26.044*	*26.080*	*26.080*
13	*26.142*	*26.142*	*26.142*	*26.142*	*26.142*	*26.395*	26.200	26.031	26.063	*26.091*	*26.080*	*26.080*
14	*26.142*	*26.142*	*26.142*	*26.142*	*26.186*	26.398	26.194	26.031	26.054	*26.057*	*26.080*	*26.080*
15	*26.142*	*26.142*	*26.142*	*26.142*	*26.231*	26.393	26.191	26.046	26.048	*26.080*	*26.080*	*26.080*
16	*26.142*	*26.142*	*26.142*	*26.142*	*26.276*	26.386	26.186	26.054	26.042	*26.063*	*26.080*	*26.080*
17	*26.142*	*26.142*	*26.142*	*26.142*	*26.320*	26.386	26.182	26.063	26.038	*26.054*	*26.080*	*26.080*
18	*26.142*	*26.142*	*26.142*	*26.142*	*26.365*	26.390	26.176	26.068	26.034	*26.076*	*26.080*	*26.080*
19	*26.142*	*26.142*	*26.142*	*26.142*	*26.410*	26.391	26.170	26.072	26.031	*26.073*	*26.080*	*26.080*
20	*26.142*	*26.142*	*26.142*	*26.142*	*26.455*	26.385	26.163	26.073	26.037	*26.050*	*26.080*	*26.080*
21	*26.142*	*26.142*	*26.142*	*26.142*	*26.463*	26.375	26.152	26.073	26.042	*26.106*	*26.080*	*26.080*
22	*26.142*	*26.142*	*26.142*	*26.142*	*26.465*	26.363	26.148	26.071	26.044	*26.040*	*26.080*	*26.080*
23	*26.142*	*26.142*	*26.142*	*26.142*	*26.457*	26.354	26.141	26.068	26.050	*26.059*	*26.080*	*26.080*
24	*26.142*	*26.142*	*26.142*	*26.142*	*26.431*	26.349	26.133	26.064	26.052	*26.080*	*26.080*	*26.080*
25	*26.142*	*26.142*	*26.142*	*26.142*	*26.437*	26.340	26.126	26.062	26.065	*26.098*	*26.080*	*26.080*
26	*26.142*	*26.142*	*26.142*	*26.142*	*26.416*	26.332	26.120	26.052	26.089	*26.090*	*26.080*	*26.080*
27	*26.142*	*26.142*	*26.142*	*26.142*	*26.430*	26.321	26.116	26.047	26.099	*26.115*	*26.080*	*26.080*
28	*26.142*	*26.142*	*26.142*	*26.142*	*26.384*	26.308	26.112	26.043	26.102	*26.120*	*26.080*	*26.080*
29	*26.142*		*26.142*	*26.142*	*26.384*	26.297	26.105	26.037	26.104	*26.097*	*26.080*	*26.080*
30	*26.142*		*26.142*	*26.142*	*26.380*	26.289	26.100	26.033	*26.072*	*26.128*	*26.080*	*26.080*
31	*26.142*		*26.142*		*26.378*		26.095	26.027		*26.102*		*26.080*
Mean	26.142	26.142	26.142	26.142	26.281	26.369	26.184	26.056	26.067	26.082	26.080	26.080
Max	26.142	26.142	26.142	26.142	26.465	26.400	26.280	26.090	26.104	26.128	26.080	26.080
Min	26.142	26.142	26.142	26.142	26.142	26.289	26.095	26.027	26.027	26.039	26.080	26.080

Note: Estimated and modelled values are italicized

APPENDIX C6: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION OGAMA OUTFLOW, 2023

Drainage Area 74.93 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.392*	24.277	24.100	24.129	*24.200*	*24.188*	*24.188*
2	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.371*	24.265	24.097	24.126	*24.204*	*24.188*	*24.188*
3	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.390*	24.256	24.095	24.145	*24.198*	*24.188*	*24.188*
4	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.389*	24.246	24.088	24.157	*24.183*	*24.188*	*24.188*
5	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.390*	24.239	24.086	24.169	*24.184*	*24.188*	*24.188*
6	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.399*	24.231	24.084	24.178	*24.192*	*24.188*	*24.188*
7	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.395*	24.227	24.081	24.181	*24.194*	*24.188*	*24.188*
8	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.413*	24.222	24.077	24.180	*24.185*	*24.188*	*24.188*
9	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.418*	24.215	24.075	24.178	*24.188*	*24.188*	*24.188*
10	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	*24.402*	24.210	24.073	24.177	*24.209*	*24.188*	*24.188*
11	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	24.444	24.201	24.071	24.178	*24.158*	*24.188*	*24.188*
12	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	24.438	24.197	24.069	24.177	*24.161*	*24.188*	*24.188*
13	*24.008*	*24.008*	*24.008*	*24.008*	*24.008*	24.426	24.183	24.070	24.170	*24.196*	*24.188*	*24.188*
14	*24.008*	*24.008*	*24.008*	*24.008*	*24.075*	24.414	24.180	24.068	24.164	*24.171*	*24.188*	*24.188*
15	*24.008*	*24.008*	*24.008*	*24.008*	*24.141*	24.409	24.178	24.082	24.162	*24.187*	*24.188*	*24.188*
16	*24.008*	*24.008*	*24.008*	*24.008*	*24.208*	24.399	24.174	24.098	24.154	*24.175*	*24.188*	*24.188*
17	*24.008*	*24.008*	*24.008*	*24.008*	*24.276*	24.392	24.172	24.113	24.152	*24.169*	*24.188*	*24.188*
18	*24.008*	*24.008*	*24.008*	*24.008*	*24.343*	24.389	24.168	24.122	24.152	*24.184*	*24.188*	*24.188*
19	*24.008*	*24.008*	*24.008*	*24.008*	*24.410*	24.387	24.163	24.126	24.154	*24.182*	*24.188*	*24.188*
20	*24.008*	*24.008*	*24.008*	*24.008*	*24.478*	24.382	24.155	24.128	24.156	*24.166*	*24.188*	*24.188*
21	*24.008*	*24.008*	*24.008*	*24.008*	*24.486*	24.377	24.144	24.131	24.158	*24.207*	*24.188*	*24.188*
22	*24.008*	*24.008*	*24.008*	*24.008*	*24.489*	24.364	24.144	24.132	24.160	*24.158*	*24.188*	*24.188*
23	*24.008*	*24.008*	*24.008*	*24.008*	*24.480*	24.353	24.141	24.133	24.166	*24.172*	*24.188*	*24.188*
24	*24.008*	*24.008*	*24.008*	*24.008*	*24.452*	24.341	24.135	24.131	24.169	*24.188*	*24.188*	*24.188*
25	*24.008*	*24.008*	*24.008*	*24.008*	*24.459*	24.330	24.130	24.132	24.175	*24.201*	*24.188*	*24.188*
26	*24.008*	*24.008*	*24.008*	*24.008*	*24.436*	24.325	24.125	24.120	24.188	*24.195*	*24.188*	*24.188*
27	*24.008*	*24.008*	*24.008*	*24.008*	*24.451*	24.316	24.122	24.121	24.199	*24.214*	*24.188*	*24.188*
28	*24.008*	*24.008*	*24.008*	*24.008*	*24.400*	24.307	24.120	24.125	24.198	*24.218*	*24.188*	*24.188*
29	*24.008*		*24.008*	*24.008*	*24.399*	24.296	24.115	24.118	24.201	*24.201*	*24.188*	*24.188*
30	*24.008*		*24.008*	*24.008*	*24.394*	24.287	24.108	24.119	*24.182*	*24.225*	*24.188*	*24.188*
31	*24.008*		*24.008*		*24.393*		24.105	24.120		*24.204*		*24.188*
Mean	24.008	24.008	24.008	24.008	24.222	24.378	24.179	24.103	24.168	24.189	24.188	24.188
Max	24.008	24.008	24.008	24.008	24.489	24.444	24.277	24.133	24.201	24.225	24.188	24.188
Min	24.008	24.008	24.008	24.008	24.008	24.287	24.105	24.068	24.126	24.158	24.188	24.188

Note: Estimated and modelled values are italicized

APPENDIX C7: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION DORIS LAKE-2, 2023

Drainage Area 90.29 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	22.009	22.016	22.012	21.987	21.986	22.156	22.027	21.742	21.793	21.850	21.838	21.776
2	22.013	22.029	21.983	21.996	21.974	22.128	22.007	21.741	21.722	21.854	21.847	21.753
3	22.026	22.030	21.989	21.999	21.990	22.154	22.015	21.744	21.736	21.848	21.822	21.760
4	22.025	22.024	22.000	21.997	21.922	22.152	21.983	21.709	21.755	21.833	21.823	21.756
5	22.021	22.033	21.979	21.991	21.960	22.153	21.983	21.707	21.768	21.835	21.830	21.721
6	22.023	22.016	21.979	21.990	21.988	22.167	21.972	21.720	21.790	21.843	21.834	21.750
7	22.012	22.009	21.984	22.005	21.964	22.161	21.956	21.728	21.784	21.845	21.809	21.757
8	22.011	22.003	22.016	21.982	21.976	22.188	21.930	21.723	21.764	21.835	21.809	21.749
9	22.036	22.011	22.015	21.955	21.982	22.196	21.930	21.716	21.785	21.838	21.815	21.783
10	22.016	22.023	21.993	21.982	21.962	22.171	21.934	21.704	21.814	21.859	21.807	21.777
11	22.003	22.042	22.001	21.983	21.980	22.187	21.913	21.703	21.789	21.811	21.785	21.799
12	22.028	22.012	22.002	21.977	21.997	22.196	21.896	21.691	21.799	21.814	21.773	21.850
13	22.018	22.009	21.998	21.964	21.968	22.186	21.882	21.712	21.792	21.846	21.792	21.808
14	22.035	22.005	21.994	21.969	22.015	22.176	21.878	21.712	21.797	21.822	21.778	21.704
15	22.017	22.012	21.985	21.988	22.033	22.178	21.879	21.702	21.820	21.838	21.769	21.794
16	22.020	22.017	22.004	21.984	22.054	22.172	21.868	21.717	21.792	21.826	21.781	21.779
17	22.033	22.018	21.983	21.973	22.083	22.162	21.852	21.731	21.791	21.821	21.762	21.776
18	22.016	22.023	21.983	21.954	22.144	22.139	21.838	21.740	21.801	21.835	21.747	21.860
19	22.031	22.011	21.992	21.972	22.194	22.154	21.841	21.733	21.812	21.833	21.772	21.948
20	22.000	21.996	21.997	21.978	22.297	22.145	21.825	21.733	21.793	21.818	21.745	21.804
21	22.015	21.997	22.002	21.982	22.312	22.154	21.814	21.741	21.817	21.857	21.741	21.705
22	22.023	21.985	21.991	21.982	22.317	22.131	21.811	21.737	21.800	21.812	21.760	21.710
23	22.026	22.027	21.985	21.960	22.300	22.118	21.793	21.753	21.810	21.824	21.786	21.695
24	22.015	22.038	21.976	21.991	22.251	22.094	21.785	21.746	21.832	21.838	21.739	21.714
25	22.035	22.010	21.978	21.987	22.263	22.101	21.780	21.757	21.812	21.851	21.653	21.797
26	22.019	21.986	21.988	21.976	22.224	22.096	21.778	21.725	21.831	21.845	21.761	21.785
27	22.016	21.988	22.009	21.980	22.249	22.076	21.778	21.740	21.847	21.865	21.789	21.765
28	22.018	22.007	22.006	21.963	22.168	22.061	21.772	21.751	21.848	21.869	21.764	21.749
29	22.022		21.975	21.966	22.167	22.053	21.754	21.729	21.839	21.851	21.776	21.658
30	22.020		21.971	21.969	22.160	22.038	21.753	21.734	21.832	21.876	21.779	21.796
31	22.017		21.980		22.158		21.746	21.743		21.854		21.637
Mean	22.020	22.013	21.992	21.979	22.098	22.141	21.870	21.728	21.799	21.840	21.783	21.765
Max	22.036	22.042	22.016	22.005	22.317	22.196	22.027	21.757	21.848	21.876	21.847	21.948
Min	22.000	21.985	21.971	21.954	21.922	22.038	21.746	21.691	21.722	21.811	21.653	21.637

Note: Estimated and modelled values are italicized

APPENDIX C8: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION DORIS CREEK TL-2, 2023

Drainage Area 90.29 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.020*	*21.940*	21.620	21.621	*21.749*	*21.733*	*21.733*
2	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.004*	*21.927*	21.614	21.625	*21.753*	*21.733*	*21.733*
3	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.019*	*21.932*	21.609	21.639	*21.746*	*21.733*	*21.733*
4	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.018*	*21.910*	21.601	21.647	*21.727*	*21.733*	*21.733*
5	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.018*	*21.910*	21.596	21.656	*21.729*	*21.733*	*21.733*
6	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.026*	*21.902*	21.592	21.666	*21.739*	*21.733*	*21.733*
7	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.023*	*21.890*	21.588	21.671	*21.741*	*21.733*	*21.733*
8	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.038*	*21.869*	21.581	21.673	*21.729*	*21.733*	*21.733*
9	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.042*	*21.869*	21.576	21.676	*21.733*	*21.733*	*21.733*
10	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.028*	*21.873*	21.573	21.680	*21.760*	*21.733*	*21.733*
11	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.037*	*21.856*	21.569	21.684	*21.695*	*21.733*	*21.733*
12	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.042*	*21.841*	21.566	21.688	*21.700*	*21.733*	*21.733*
13	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.037*	*21.828*	21.563	21.687	*21.743*	*21.733*	*21.733*
14	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.031*	*21.824*	21.563	21.688	*21.712*	*21.733*	*21.733*
15	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.032*	*21.825*	21.583	21.694	*21.733*	*21.733*	*21.733*
16	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.029*	*21.816*	21.597	21.689	*21.717*	*21.733*	*21.733*
17	*21.531*	*21.531*	*21.531*	*21.531*	*21.531*	*22.023*	*21.800*	21.608	21.692	*21.709*	*21.733*	*21.733*
18	*21.531*	*21.531*	*21.531*	*21.531*	*21.717*	*22.010*	*21.785*	21.615	21.693	*21.729*	*21.733*	*21.733*
19	*21.531*	*21.531*	*21.531*	*21.531*	*21.905*	*22.019*	21.715	21.618	21.696	*21.726*	*21.733*	*21.733*
20	*21.531*	*21.531*	*21.531*	*21.531*	*22.095*	*22.014*	21.704	21.618	21.708	*21.706*	*21.733*	*21.733*
21	*21.531*	*21.531*	*21.531*	*21.531*	*22.102*	*22.019*	21.693	21.619	21.712	*21.757*	*21.733*	*21.733*
22	*21.531*	*21.531*	*21.531*	*21.531*	*22.105*	*22.006*	21.689	21.618	21.712	*21.696*	*21.733*	*21.733*
23	*21.531*	*21.531*	*21.531*	*21.531*	*22.097*	*21.998*	21.683	21.619	21.721	*21.714*	*21.733*	*21.733*
24	*21.531*	*21.531*	*21.531*	*21.531*	*22.072*	*21.983*	21.676	21.620	21.721	*21.733*	*21.733*	*21.733*
25	*21.531*	*21.531*	*21.531*	*21.531*	*22.078*	*21.988*	21.668	21.623	21.732	*21.750*	*21.733*	*21.733*
26	*21.531*	*21.531*	*21.531*	*21.531*	*22.058*	*21.985*	21.660	21.614	21.740	*21.742*	*21.733*	*21.733*
27	*21.531*	*21.531*	*21.531*	*21.531*	*22.071*	*21.972*	21.654	21.612	21.742	*21.766*	*21.733*	*21.733*
28	*21.531*	*21.531*	*21.531*	*21.531*	*22.027*	*21.963*	21.649	21.615	21.741	*21.771*	*21.733*	*21.733*
29	*21.531*		*21.531*	*21.531*	*22.026*	*21.958*	21.641	21.613	*21.734*	*21.749*	*21.733*	*21.733*
30	*21.531*		*21.531*	*21.531*	*22.022*	*21.947*	21.634	21.612	*21.726*	*21.780*	*21.733*	*21.733*
31	*21.531*		*21.531*		*22.021*		21.627	21.613		*21.754*		*21.733*
Mean	21.531	21.531	21.531	21.531	21.756	22.011	21.783	21.601	21.692	21.735	21.733	21.733
Max	21.531	21.531	21.531	21.531	22.105	22.042	21.940	21.623	21.742	21.780	21.733	21.733
Min	21.531	21.531	21.531	21.531	21.531	21.947	21.627	21.563	21.621	21.695	21.733	21.733

Note: Estimated and modelled values are italicized

APPENDIX C9: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION ROBERTS HYDRO-2, 2023

Drainage Area 97.83 km^2

	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.650*	6.513	6.311	6.358	*6.469*	*6.455*	*6.451*
2	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.636*	6.504	6.307	6.358	*6.473*	*6.451*	*6.451*
3	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.649*	6.492	6.304	6.370	*6.467*	*6.451*	*6.451*
4	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.648*	6.484	6.297	6.379	*6.449*	*6.451*	*6.451*
5	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.648*	6.474	6.299	6.387	*6.451*	*6.451*	*6.451*
6	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.654*	6.465	6.296	6.397	*6.460*	*6.451*	*6.451*
7	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.652*	6.458	6.290	6.402	*6.462*	*6.451*	*6.451*
8	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.664*	6.452	6.285	6.406	*6.451*	*6.451*	*6.451*
9	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.667*	6.443	6.282	6.409	*6.455*	*6.451*	*6.451*
10	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.656*	6.436	6.280	6.413	*6.479*	*6.451*	*6.451*
11	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.663*	6.429	6.278	6.417	*6.421*	*6.451*	*6.451*
12	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.667*	6.425	6.271	6.420	*6.425*	*6.451*	*6.451*
13	*6.370*	*6.370*	*6.370*	*6.370*	*6.370*	*6.662*	6.415	6.273	6.415	*6.464*	*6.451*	*6.451*
14	*6.370*	*6.370*	*6.370*	*6.370*	*6.417*	*6.658*	6.407	6.265	6.411	*6.436*	*6.451*	*6.451*
15	*6.370*	*6.370*	*6.370*	*6.370*	*6.464*	*6.659*	6.403	6.290	6.412	*6.455*	*6.451*	*6.451*
16	*6.370*	*6.370*	*6.370*	*6.370*	*6.512*	6.669	6.396	6.312	6.405	*6.441*	*6.451*	*6.451*
17	*6.370*	*6.370*	*6.370*	*6.370*	*6.560*	6.663	6.390	6.328	6.408	*6.434*	*6.451*	*6.451*
18	*6.370*	*6.370*	*6.370*	*6.370*	*6.608*	6.660	6.385	6.340	6.410	*6.451*	*6.451*	*6.451*
19	*6.370*	*6.370*	*6.370*	*6.370*	*6.656*	6.655	6.377	6.352	6.408	*6.449*	*6.451*	*6.451*
20	*6.370*	*6.370*	*6.370*	*6.370*	*6.705*	6.644	6.370	6.358	6.415	*6.430*	*6.451*	*6.451*
21	*6.370*	*6.370*	*6.370*	*6.370*	*6.711*	6.632	6.362	6.363	6.417	*6.477*	*6.451*	*6.451*
22	*6.370*	*6.370*	*6.370*	*6.370*	*6.713*	6.618	6.359	6.368	6.422	*6.422*	*6.451*	*6.451*
23	*6.370*	*6.370*	*6.370*	*6.370*	*6.707*	6.605	6.357	6.370	6.429	*6.437*	*6.451*	*6.451*
24	*6.370*	*6.370*	*6.370*	*6.370*	*6.689*	6.592	6.349	6.370	6.436	*6.455*	*6.451*	*6.451*
25	*6.370*	*6.370*	*6.370*	*6.370*	*6.693*	6.579	6.344	6.372	6.444	*6.470*	*6.451*	*6.451*
26	*6.370*	*6.370*	*6.370*	*6.370*	*6.678*	6.567	6.338	6.365	6.456	*6.464*	*6.451*	*6.451*
27	*6.370*	*6.370*	*6.370*	*6.370*	*6.688*	6.556	6.335	6.362	6.464	*6.485*	*6.451*	*6.451*
28	*6.370*	*6.370*	*6.370*	*6.370*	*6.655*	6.546	6.330	6.361	6.437	*6.490*	*6.451*	*6.451*
29	*6.370*		*6.370*	*6.370*	*6.654*	6.534	6.329	6.356	*6.456*	*6.470*	*6.451*	*6.451*
30	*6.370*		*6.370*	*6.370*	*6.651*	6.525	6.321	6.354	*6.448*	*6.497*	*6.451*	*6.451*
31	*6.370*		*6.370*		*6.650*		6.317	6.353		*6.474*		*6.451*
Mean	6.370	6.370	6.370	6.370	6.523	6.629	6.402	6.323	6.414	6.457	6.451	6.451
Max	6.370	6.370	6.370	6.370	6.713	6.669	6.513	6.372	6.464	6.497	6.455	6.451
Min	6.370	6.370	6.370	6.370	6.370	6.525	6.317	6.265	6.358	6.421	6.451	6.451

Note: Estimated and modelled values are italicized

APPENDIX C10: SUMMARY OF MEAN DAILY WATER LEVEL (M) AT HYDROMETRIC STATION LITTLE ROBERTS, 2023

Drainage Area 194.15 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.074*	4.858	4.519	4.638	*4.758*	*4.737*	*4.737*
2	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.057*	4.834	4.517	4.585	*4.764*	*4.737*	*4.737*
3	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.072*	4.838	4.518	4.613	*4.755*	*4.737*	*4.737*
4	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.071*	4.804	4.484	4.632	*4.729*	*4.737*	*4.737*
5	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.072*	4.799	4.482	4.641	*4.731*	*4.737*	*4.737*
6	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.079*	4.784	4.492	4.668	*4.745*	*4.737*	*4.737*
7	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.076*	4.765	4.496	4.665	*4.748*	*4.737*	*4.737*
8	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.091*	4.736	4.493	4.646	*4.732*	*4.737*	*4.737*
9	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.095*	4.732	4.483	4.665	*4.738*	*4.737*	*4.737*
10	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.082*	4.735	4.470	4.694	*4.773*	*4.737*	*4.737*
11	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.090*	4.714	4.468	4.675	*4.687*	*4.737*	*4.737*
12	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.095*	4.694	4.454	4.681	*4.693*	*4.737*	*4.737*
13	*4.862*	*4.862*	*4.862*	*4.862*	*4.862*	*5.090*	4.679	4.477	4.672	*4.751*	*4.737*	*4.737*
14	*4.862*	*4.862*	*4.862*	*4.862*	*4.901*	*5.084*	4.671	4.481	4.673	*4.709*	*4.737*	*4.737*
15	*4.862*	*4.862*	*4.862*	*4.862*	*4.941*	*5.085*	4.671	4.522	4.694	*4.737*	*4.737*	*4.737*
16	*4.862*	*4.862*	*4.862*	*4.862*	*4.981*	*5.082*	4.662	4.574	4.666	*4.716*	*4.737*	*4.737*
17	*4.862*	*4.862*	*4.862*	*4.862*	*5.022*	5.096	4.644	4.601	4.668	*4.706*	*4.737*	*4.737*
18	*4.862*	*4.862*	*4.862*	*4.862*	*5.062*	5.083	4.629	4.600	4.678	*4.732*	*4.737*	*4.737*
19	*4.862*	*4.862*	*4.862*	*4.862*	*5.103*	5.091	4.631	4.596	4.685	*4.728*	*4.737*	*4.737*
20	*4.862*	*4.862*	*4.862*	*4.862*	*5.145*	5.072	4.615	4.596	4.680	*4.701*	*4.737*	*4.737*
21	*4.862*	*4.862*	*4.862*	*4.862*	*5.151*	5.068	4.601	4.604	4.707	*4.770*	*4.737*	*4.737*
22	*4.862*	*4.862*	*4.862*	*4.862*	*5.154*	5.035	4.596	4.601	4.690	*4.689*	*4.737*	*4.737*
23	*4.862*	*4.862*	*4.862*	*4.862*	*5.146*	5.012	4.580	4.614	4.706	*4.711*	*4.737*	*4.737*
24	*4.862*	*4.862*	*4.862*	*4.862*	*5.123*	4.979	4.572	4.607	4.729	*4.737*	*4.737*	*4.737*
25	*4.862*	*4.862*	*4.862*	*4.862*	*5.129*	4.975	4.566	4.621	4.728	*4.760*	*4.737*	*4.737*
26	*4.862*	*4.862*	*4.862*	*4.862*	*5.110*	4.961	4.563	4.591	4.751	*4.750*	*4.737*	*4.737*
27	*4.862*	*4.862*	*4.862*	*4.862*	*5.122*	4.933	4.560	4.598	4.764	*4.782*	*4.737*	*4.737*
28	*4.862*	*4.862*	*4.862*	*4.862*	*5.080*	4.910	4.553	4.605	4.767	*4.789*	*4.737*	*4.737*
29	*4.862*		*4.862*	*4.862*	*5.080*	4.895	4.536	4.582	*4.738*	*4.759*	*4.737*	*4.737*
30	*4.862*		*4.862*	*4.862*	*5.076*	4.874	4.532	4.586	*4.727*	*4.800*	*4.737*	*4.737*
31	*4.862*		*4.862*		*5.074*		4.525	4.590		*4.765*		*4.737*
Mean	4.862	4.862	4.862	4.862	4.987	5.043	4.667	4.546	4.684	4.740	4.737	4.737
Max	4.862	4.862	4.862	4.862	5.154	5.096	4.858	4.621	4.767	4.800	4.737	4.737
Min	4.862	4.862	4.862	4.862	4.862	4.874	4.525	4.454	4.585	4.687	4.737	4.737

Note: Estimated and modelled values are italicized

APPENDIX D MEAN DAILY DISCHARGE TABLES

APPENDIX D1: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION WINDY OUTFLOW, 2023

Drainage Area 13.73 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.310*	*0.213*	0.016	0.009	*0.009*	*0.008*	-
2	-	-	-	-	-	*0.288*	*0.198*	0.015	0.003	*0.009*	*0.008*	-
3	-	-	-	-	-	*0.308*	*0.204*	0.015	0.005	*0.009*	*0.008*	-
4	-	-	-	-	-	*0.307*	*0.180*	0.010	0.004	*0.008*	*0.008*	-
5	-	-	-	-	-	*0.307*	*0.181*	0.009	0.005	*0.008*	*0.008*	-
6	-	-	-	-	-	*0.317*	*0.172*	0.008	0.009	*0.008*	*0.009*	-
7	-	-	-	-	-	*0.313*	*0.160*	0.010	0.009	*0.008*	*0.009*	-
8	-	-	-	-	-	*0.334*	*0.141*	0.006	0.005	*0.008*	*0.009*	-
9	-	-	-	-	-	*0.339*	*0.141*	0.005	0.005	*0.008*	*0.009*	-
10	-	-	-	-	-	*0.320*	*0.144*	0.004	0.005	*0.009*	*0.009*	-
11	-	-	-	-	-	*0.333*	*0.128*	0.004	0.006	*0.007*	*0.009*	-
12	-	-	-	-	-	*0.339*	*0.115*	0.003	0.007	*0.007*	*0.009*	-
13	-	-	-	-	-	*0.332*	*0.105*	0.003	0.005	*0.009*	*0.009*	-
14	-	-	-	-	-	*0.324*	*0.102*	0.003	0.005	*0.007*	*0.009*	-
15	-	-	-	-	-	*0.326*	*0.102*	0.010	0.008	*0.008*	*0.009*	-
16	-	-	-	-	-	*0.321*	*0.095*	0.012	0.003	*0.007*	*0.010*	-
17	-	-	-	-	-	*0.314*	*0.083*	0.014	0.003	*0.007*	*0.010*	-
18	-	-	-	-	*0.100*	*0.297*	*0.072*	0.015	0.003	*0.008*	*0.010*	-
19	-	-	-	-	*0.204*	*0.308*	*0.062*	0.014	0.005	*0.008*	*0.010*	-
20	-	-	-	-	*0.415*	*0.302*	*0.056*	0.013	0.008	*0.007*	*0.010*	-
21	-	-	-	-	*0.426*	*0.308*	0.056	0.012	0.006	*0.009*	-	-
22	-	-	-	-	*0.430*	*0.291*	0.054	0.010	0.006	*0.007*	-	-
23	-	-	-	-	*0.417*	*0.281*	0.051	0.010	0.007	*0.007*	-	-
24	-	-	-	-	*0.381*	*0.263*	0.044	0.010	0.006	*0.008*	-	-
25	-	-	-	-	*0.389*	*0.268*	0.039	0.010	0.011	*0.009*	-	-
26	-	-	-	-	*0.360*	*0.265*	0.034	0.006	0.011	*0.008*	-	-
27	-	-	-	-	*0.379*	*0.250*	0.031	0.004	0.010	*0.010*	-	-
28	-	-	-	-	*0.318*	*0.239*	0.030	0.004	0.009	*0.010*	-	-
29	-		-	-	*0.318*	*0.233*	0.026	0.003	0.009	*0.009*	-	-
30	-		-	-	*0.313*	*0.221*	0.021	0.002	*0.008*	*0.010*	-	-
31	-		-		*0.311*		0.019	0.002		*0.009*		-
Mean	-	-	-	-	0.340	0.299	0.099	0.008	0.006	0.008	0.009	-
Max	0.000	0.000	0.000	0.000	0.430	0.339	0.213	0.016	0.011	0.010	0.010	0.000
Min	0.000	0.000	0.000	0.000	0.100	0.221	0.019	0.002	0.003	0.007	0.008	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured disch

APPENDIX D2: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION PATCH OUTFLOW, 2023

Drainage Area 32.16 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.634*	0.425	0.113	0.044	*0.094*	*0.088*	-
2	-	-	-	-	-	*0.595*	0.410	0.108	0.056	*0.096*	*0.078*	-
3	-	-	-	-	-	*0.631*	0.396	0.103	0.061	*0.093*	*0.070*	-
4	-	-	-	-	-	*0.629*	0.381	0.097	0.063	*0.085*	*0.062*	-
5	-	-	-	-	-	*0.630*	0.367	0.091	0.065	*0.086*	*0.056*	-
6	-	-	-	-	-	*0.648*	0.350	0.083	0.069	*0.090*	*0.050*	-
7	-	-	-	-	-	*0.640*	0.335	0.078	0.070	*0.091*	*0.044*	-
8	-	-	-	-	-	*0.677*	0.321	0.073	0.072	*0.086*	*0.039*	-
9	-	-	-	-	-	*0.688*	0.307	0.070	0.072	*0.088*	*0.035*	-
10	-	-	-	-	-	*0.653*	0.295	0.068	0.071	*0.099*	*0.031*	-
11	-	-	-	-	-	*0.675*	0.287	0.067	0.072	*0.073*	*0.028*	-
12	-	-	-	-	-	0.708	0.277	0.064	0.068	*0.075*	*0.025*	-
13	-	-	-	-	-	0.697	0.267	0.062	0.066	*0.092*	*0.022*	-
14	-	-	-	-	-	0.681	0.251	0.079	0.066	*0.079*	*0.020*	-
15	-	-	-	-	-	0.675	0.241	0.091	0.063	*0.088*	*0.018*	-
16	-	-	-	-	-	0.663	0.234	0.074	0.066	*0.082*	*0.016*	-
17	-	-	-	-	-	0.664	0.228	0.076	0.068	*0.079*	*0.014*	-
18	-	-	-	-	*0.100*	0.667	0.218	0.076	0.066	*0.086*	*0.013*	-
19	-	-	-	-	*0.287*	0.653	0.210	0.078	0.066	*0.085*	*0.011*	-
20	-	-	-	-	*0.823*	0.636	0.202	0.080	0.076	*0.077*	*0.010*	-
21	-	-	-	-	*0.844*	0.614	0.191	0.075	0.076	*0.098*	-	-
22	-	-	-	-	*0.851*	0.595	0.179	0.064	0.077	*0.074*	-	-
23	-	-	-	-	*0.828*	0.593	0.170	0.063	0.078	*0.080*	-	-
24	-	-	-	-	*0.762*	0.580	0.160	0.065	0.079	*0.088*	-	-
25	-	-	-	-	*0.777*	0.568	0.153	0.066	0.092	*0.095*	-	-
26	-	-	-	-	*0.726*	0.543	0.148	0.064	0.094	*0.092*	-	-
27	-	-	-	-	*0.759*	0.516	0.143	0.060	0.089	*0.102*	-	-
28	-	-	-	-	*0.649*	0.491	0.136	0.050	0.097	*0.104*	-	-
29	-		-	-	*0.648*	0.466	0.128	0.066	0.101	*0.094*	-	-
30	-		-	-	*0.639*	0.446	0.123	0.055	*0.085*	*0.108*	-	-
31	-		-		*0.636*		0.118	0.044		*0.096*		-
Mean	-	-	-	-	0.666	0.618	0.247	0.074	0.073	0.089	0.037	-
Max	0.000	0.000	0.000	0.000	0.851	0.708	0.425	0.113	0.101	0.108	0.088	0.000
Min	0.000	0.000	0.000	0.000	0.100	0.446	0.118	0.044	0.044	0.073	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX D3: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION PO OUTFLOW, 2023

Drainage Area 35.3 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*0.496*	0.330	0.097	0.049	*0.103*	*0.089*	-
2	-	-	-	-	-	*0.465*	0.315	0.093	0.053	*0.108*	*0.079*	-
3	-	-	-	-	-	*0.494*	0.307	0.090	0.073	*0.101*	*0.071*	-
4	-	-	-	-	-	*0.492*	0.294	0.083	0.092	*0.083*	*0.063*	-
5	-	-	-	-	-	*0.493*	0.283	0.078	0.103	*0.085*	*0.056*	-
6	-	-	-	-	-	*0.507*	0.275	0.074	0.109	*0.094*	*0.050*	-
7	-	-	-	-	-	*0.501*	0.266	0.070	0.108	*0.096*	*0.045*	-
8	-	-	-	-	-	*0.531*	0.256	0.065	0.103	*0.085*	*0.040*	-
9	-	-	-	-	-	*0.540*	0.248	0.062	0.098	*0.089*	*0.035*	-
10	-	-	-	-	-	*0.512*	0.243	0.059	0.092	*0.114*	*0.032*	-
11	-	-	-	-	-	*0.530*	0.233	0.056	0.086	*0.056*	*0.028*	-
12	-	-	-	-	-	*0.539*	0.227	0.053	0.081	*0.060*	*0.025*	-
13	-	-	-	-	-	*0.528*	0.216	0.052	0.075	*0.098*	*0.022*	-
14	-	-	-	-	-	0.534	0.209	0.051	0.068	*0.070*	*0.020*	-
15	-	-	-	-	-	0.526	0.205	0.062	0.063	*0.089*	*0.018*	-
16	-	-	-	-	-	0.512	0.199	0.067	0.059	*0.075*	*0.016*	-
17	-	-	-	-	-	0.512	0.194	0.075	0.056	*0.068*	*0.014*	-
18	-	-	-	-	*0.100*	0.520	0.187	0.079	0.053	*0.085*	*0.013*	-
19	-	-	-	-	*0.255*	0.521	0.180	0.081	0.052	*0.083*	*0.011*	-
20	-	-	-	-	*0.649*	0.510	0.171	0.083	0.055	*0.065*	*0.010*	-
21	-	-	-	-	*0.666*	0.491	0.159	0.083	0.059	*0.111*	-	-
22	-	-	-	-	*0.671*	0.469	0.154	0.081	0.060	*0.057*	-	-
23	-	-	-	-	*0.653*	0.454	0.147	0.078	0.065	*0.072*	-	-
24	-	-	-	-	*0.600*	0.444	0.139	0.075	0.066	*0.089*	-	-
25	-	-	-	-	*0.612*	0.428	0.132	0.074	0.076	*0.105*	-	-
26	-	-	-	-	*0.570*	0.414	0.126	0.066	0.096	*0.097*	-	-
27	-	-	-	-	*0.597*	0.396	0.121	0.062	0.106	*0.120*	-	-
28	-	-	-	-	*0.509*	0.374	0.118	0.060	0.108	*0.125*	-	-
29	-		-	-	*0.508*	0.357	0.111	0.055	0.110	*0.104*	-	-
30	-		-	-	*0.500*	0.344	0.106	0.052	*0.082*	*0.134*	-	-
31	-		-		*0.498*		0.102	0.048		*0.108*		-
Mean	-	-	-	-	0.528	0.481	0.202	0.070	0.079	0.091	0.037	-
Max	0.000	0.000	0.000	0.000	0.671	0.540	0.330	0.097	0.110	0.134	0.089	0.000
Min	0.000	0.000	0.000	0.000	0.100	0.344	0.102	0.048	0.049	0.056	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX D4: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION OGAMA OUTFLOW, 2023

Drainage Area 74.93 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*1.381*	0.786	0.150	0.229	*0.461*	*0.414*	-
2	-	-	-	-	-	*1.259*	0.737	0.144	0.219	*0.475*	*0.341*	-
3	-	-	-	-	-	*1.371*	0.701	0.139	0.276	*0.453*	*0.280*	-
4	-	-	-	-	-	*1.364*	0.660	0.122	0.317	*0.395*	*0.230*	-
5	-	-	-	-	-	*1.368*	0.632	0.117	0.356	*0.401*	*0.189*	-
6	-	-	-	-	-	*1.424*	0.603	0.114	0.390	*0.432*	*0.155*	-
7	-	-	-	-	-	*1.399*	0.582	0.107	0.401	*0.439*	*0.128*	-
8	-	-	-	-	-	*1.517*	0.563	0.098	0.395	*0.402*	*0.105*	-
9	-	-	-	-	-	*1.549*	0.533	0.094	0.390	*0.415*	*0.086*	-
10	-	-	-	-	-	*1.441*	0.511	0.090	0.387	*0.495*	*0.071*	-
11	-	-	-	-	-	1.723	0.477	0.087	0.390	*0.309*	*0.058*	-
12	-	-	-	-	-	1.680	0.459	0.083	0.384	*0.321*	*0.048*	-
13	-	-	-	-	-	1.604	0.408	0.085	0.360	*0.445*	*0.039*	-
14	-	-	-	-	-	1.524	0.395	0.081	0.339	*0.353*	*0.032*	-
15	-	-	-	-	-	1.486	0.390	0.110	0.332	*0.413*	*0.027*	-
16	-	-	-	-	-	1.428	0.374	0.145	0.306	*0.369*	*0.022*	-
17	-	-	-	-	-	1.386	0.368	0.184	0.300	*0.347*	*0.018*	-
18	-	-	-	-	*0.100*	1.362	0.353	0.208	0.298	*0.402*	*0.015*	-
19	-	-	-	-	*0.444*	1.350	0.334	0.219	0.304	*0.394*	*0.012*	-
20	-	-	-	-	*1.974*	1.320	0.308	0.225	0.313	*0.337*	*0.010*	-
21	-	-	-	-	*2.037*	1.290	0.273	0.233	0.320	*0.488*	-	-
22	-	-	-	-	*2.059*	1.217	0.273	0.238	0.324	*0.312*	-	-
23	-	-	-	-	*1.989*	1.156	0.263	0.239	0.347	*0.358*	-	-
24	-	-	-	-	*1.783*	1.095	0.246	0.235	0.356	*0.414*	-	-
25	-	-	-	-	*1.830*	1.038	0.232	0.236	0.378	*0.465*	-	-
26	-	-	-	-	*1.668*	1.008	0.216	0.201	0.427	*0.442*	-	-
27	-	-	-	-	*1.773*	0.967	0.207	0.206	0.469	*0.516*	-	-
28	-	-	-	-	*1.429*	0.923	0.203	0.216	0.464	*0.532*	-	-
29	-		-	-	*1.426*	0.868	0.188	0.198	0.477	*0.463*	-	-
30	-		-	-	*1.397*	0.828	0.171	0.199	*0.392*	*0.559*	-	-
31	-		-		*1.387*		0.162	0.203		*0.477*		-
Mean	-	-	-	-	1.521	1.311	0.407	0.161	0.355	0.422	0.114	-
Max	0.000	0.000	0.000	0.000	2.059	1.723	0.786	0.239	0.477	0.559	0.414	0.000
Min	0.000	0.000	0.000	0.000	0.100	0.828	0.162	0.081	0.219	0.309	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX D5: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION DORIS CREEK TL-2, 2023

Drainage Area 90.29 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*1.828*	*1.293*	0.212	0.213	*0.562*	*0.513*	-
2	-	-	-	-	-	*1.709*	*1.211*	0.199	0.223	*0.578*	*0.417*	-
3	-	-	-	-	-	*1.818*	*1.244*	0.189	0.253	*0.555*	*0.339*	-
4	-	-	-	-	-	*1.812*	*1.111*	0.172	0.274	*0.492*	*0.275*	-
5	-	-	-	-	-	*1.815*	*1.112*	0.163	0.295	*0.499*	*0.224*	-
6	-	-	-	-	-	*1.870*	*1.065*	0.156	0.320	*0.531*	*0.182*	-
7	-	-	-	-	-	*1.845*	*0.999*	0.149	0.334	*0.539*	*0.148*	-
8	-	-	-	-	-	*1.961*	*0.891*	0.135	0.338	*0.500*	*0.120*	-
9	-	-	-	-	-	*1.992*	*0.893*	0.127	0.347	*0.513*	*0.098*	-
10	-	-	-	-	-	*1.887*	*0.910*	0.121	0.357	*0.600*	*0.079*	-
11	-	-	-	-	-	*1.954*	*0.824*	0.116	0.367	*0.399*	*0.065*	-
12	-	-	-	-	-	*1.992*	*0.752*	0.110	0.377	*0.412*	*0.052*	-
13	-	-	-	-	-	*1.949*	*0.692*	0.106	0.375	*0.546*	*0.043*	-
14	-	-	-	-	-	*1.909*	*0.675*	0.106	0.378	*0.447*	*0.035*	-
15	-	-	-	-	-	*1.917*	*0.680*	0.139	0.397	*0.512*	*0.028*	-
16	-	-	-	-	-	*1.891*	*0.638*	0.165	0.381	*0.464*	*0.023*	-
17	-	-	-	-	-	*1.851*	*0.570*	0.187	0.389	*0.440*	*0.019*	-
18	-	-	-	-	*0.100*	*1.757*	*0.510*	0.201	0.393	*0.499*	*0.015*	-
19	-	-	-	-	*0.491*	*1.817*	0.455	0.207	0.401	*0.491*	*0.012*	-
20	-	-	-	-	*2.408*	*1.782*	0.424	0.207	0.436	*0.429*	*0.010*	-
21	-	-	-	-	*2.470*	*1.817*	0.392	0.210	0.448	*0.592*	-	-
22	-	-	-	-	*2.491*	*1.724*	0.381	0.208	0.449	*0.402*	-	-
23	-	-	-	-	*2.423*	*1.670*	0.364	0.210	0.475	*0.452*	-	-
24	-	-	-	-	*2.221*	*1.570*	0.345	0.212	0.476	*0.512*	-	-
25	-	-	-	-	*2.267*	*1.600*	0.326	0.219	0.510	*0.567*	-	-
26	-	-	-	-	*2.109*	*1.580*	0.304	0.198	0.534	*0.542*	-	-
27	-	-	-	-	*2.212*	*1.496*	0.289	0.196	0.540	*0.623*	-	-
28	-	-	-	-	*1.875*	*1.435*	0.278	0.201	0.539	*0.639*	-	-
29	-		-	-	*1.872*	*1.400*	0.258	0.197	*0.515*	*0.565*	-	-
30	-		-	-	*1.844*	*1.337*	0.242	0.195	*0.489*	*0.669*	-	-
31	-		-		*1.834*		0.226	0.196		*0.580*		-
Mean	-	-	-	-	1.901	1.766	0.657	0.175	0.394	0.521	0.135	-
Max	0.000	0.000	0.000	0.000	2.491	1.992	1.293	0.219	0.540	0.669	0.513	0.000
Min	0.000	0.000	0.000	0.000	0.100	1.337	0.226	0.106	0.213	0.399	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX D6: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION ROBERTS HYDRO-2, 2023

Drainage Area 97.83 km^2

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*1.820*	0.978	0.221	0.359	*0.773*	*0.712*	-
2	-	-	-	-	-	*1.637*	0.933	0.211	0.354	*0.792*	*0.569*	-
3	-	-	-	-	-	*1.805*	0.877	0.204	0.391	*0.764*	*0.455*	-
4	-	-	-	-	-	*1.795*	0.839	0.187	0.420	*0.687*	*0.363*	-
5	-	-	-	-	-	*1.800*	0.795	0.192	0.449	*0.695*	*0.290*	-
6	-	-	-	-	-	*1.884*	0.755	0.186	0.484	*0.735*	*0.232*	-
7	-	-	-	-	-	*1.847*	0.723	0.173	0.504	*0.744*	*0.185*	-
8	-	-	-	-	-	*2.024*	0.701	0.160	0.518	*0.697*	*0.148*	-
9	-	-	-	-	-	*2.073*	0.662	0.155	0.526	*0.713*	*0.118*	-
10	-	-	-	-	-	*1.911*	0.632	0.149	0.542	*0.818*	*0.094*	-
11	-	-	-	-	-	*2.014*	0.606	0.145	0.559	*0.574*	*0.075*	-
12	-	-	-	-	-	*2.071*	0.588	0.132	0.575	*0.590*	*0.060*	-
13	-	-	-	-	-	*2.006*	0.550	0.136	0.556	*0.753*	*0.048*	-
14	-	-	-	-	-	*1.945*	0.522	0.121	0.537	*0.632*	*0.038*	-
15	-	-	-	-	-	*1.957*	0.506	0.171	0.541	*0.711*	*0.031*	-
16	-	-	-	-	-	2.102	0.482	0.223	0.514	*0.653*	*0.025*	-
17	-	-	-	-	-	2.022	0.461	0.266	0.525	*0.623*	*0.020*	-
18	-	-	-	-	*0.100*	1.975	0.443	0.300	0.532	*0.696*	*0.016*	-
19	-	-	-	-	*0.521*	1.891	0.415	0.334	0.529	*0.686*	*0.013*	-
20	-	-	-	-	*2.711*	1.747	0.392	0.353	0.551	*0.610*	*0.010*	-
21	-	-	-	-	*2.805*	1.642	0.367	0.368	0.559	*0.809*	-	-
22	-	-	-	-	*2.838*	1.557	0.356	0.384	0.579	*0.578*	-	-
23	-	-	-	-	*2.733*	1.480	0.350	0.391	0.606	*0.639*	-	-
24	-	-	-	-	*2.423*	1.401	0.328	0.393	0.636	*0.712*	-	-
25	-	-	-	-	*2.494*	1.326	0.313	0.397	0.666	*0.779*	-	-
26	-	-	-	-	*2.251*	1.263	0.295	0.377	0.717	*0.749*	-	-
27	-	-	-	-	*2.409*	1.203	0.285	0.365	0.751	*0.846*	-	-
28	-	-	-	-	*1.893*	1.149	0.272	0.363	0.753	*0.867*	-	-
29	-		-	-	*1.888*	1.086	0.271	0.347	*0.715*	*0.776*	-	-
30	-		-	-	*1.844*	1.038	0.247	0.343	*0.683*	*0.903*	-	-
31	-		-		*1.829*		0.236	0.340		*0.794*		-
Mean	-	-	-	-	2.053	1.716	0.522	0.261	0.554	0.722	0.175	-
Max	0.000	0.000	0.000	0.000	2.838	2.102	0.978	0.397	0.753	0.903	0.712	0.000
Min	0.000	0.000	0.000	0.000	0.100	1.038	0.236	0.121	0.354	0.574	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX D7: SUMMARY OF DAILY DISCHARGE [Q, M³/S] AT HYDROMETRIC MONITORING STATION LITTLE ROBERTS OUTFLOW, 2023

Drainage Area 194.15 km^2

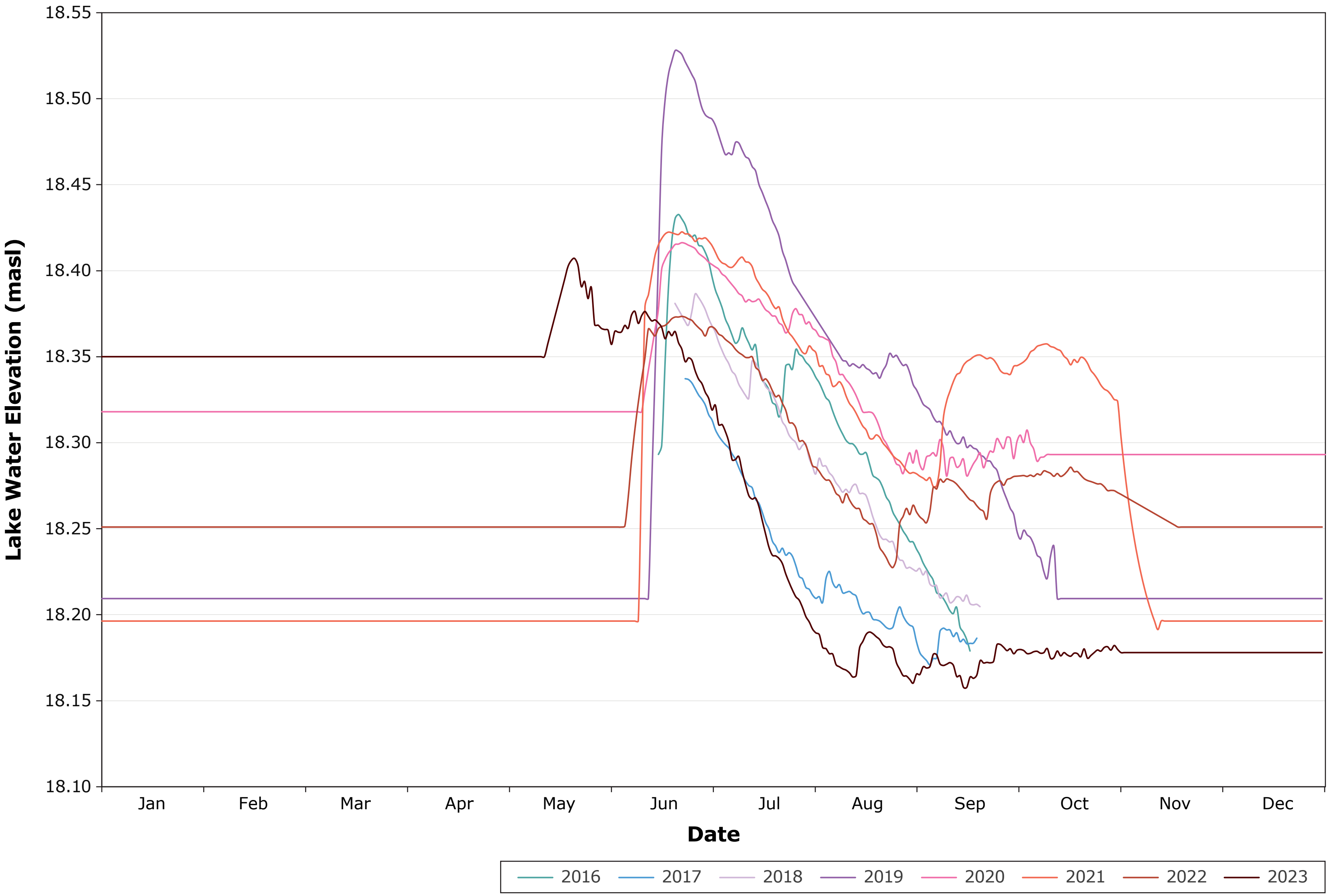
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	-	-	-	*3.229*	1.727	0.383	0.755	*1.241*	*1.150*	-
2	-	-	-	-	-	*2.912*	1.604	0.376	0.576	*1.270*	*0.903*	-
3	-	-	-	-	-	*3.203*	1.623	0.380	0.669	*1.227*	*0.703*	-
4	-	-	-	-	-	*3.185*	1.454	0.295	0.732	*1.112*	*0.547*	-
5	-	-	-	-	-	*3.194*	1.431	0.289	0.766	*1.124*	*0.426*	-
6	-	-	-	-	-	*3.340*	1.359	0.313	0.868	*1.184*	*0.332*	-
7	-	-	-	-	-	*3.275*	1.271	0.324	0.857	*1.198*	*0.258*	-
8	-	-	-	-	-	*3.582*	1.144	0.315	0.783	*1.127*	*0.201*	-
9	-	-	-	-	-	*3.667*	1.127	0.293	0.857	*1.151*	*0.157*	-
10	-	-	-	-	-	*3.386*	1.140	0.263	0.967	*1.310*	*0.122*	-
11	-	-	-	-	-	*3.565*	1.048	0.258	0.894	*0.942*	*0.095*	-
12	-	-	-	-	-	*3.665*	0.967	0.228	0.916	*0.965*	*0.074*	-
13	-	-	-	-	-	*3.551*	0.910	0.278	0.881	*1.211*	*0.058*	-
14	-	-	-	-	-	*3.445*	0.877	0.289	0.885	*1.029*	*0.045*	-
15	-	-	-	-	-	*3.466*	0.879	0.391	0.967	*1.148*	*0.035*	-
16	-	-	-	-	-	*3.397*	0.843	0.542	0.860	*1.060*	*0.027*	-
17	-	-	-	-	-	3.687	0.777	0.626	0.866	*1.016*	*0.021*	-
18	-	-	-	-	*0.100*	3.410	0.724	0.622	0.907	*1.126*	*0.017*	-
19	-	-	-	-	*0.691*	3.586	0.731	0.610	0.934	*1.110*	*0.013*	-
20	-	-	-	-	*4.775*	3.206	0.676	0.612	0.912	*0.996*	*0.010*	-
21	-	-	-	-	*4.940*	3.111	0.626	0.636	1.021	*1.295*	-	-
22	-	-	-	-	*4.997*	2.755	0.612	0.627	0.956	*0.947*	-	-
23	-	-	-	-	*4.815*	2.604	0.560	0.673	1.023	*1.039*	-	-
24	-	-	-	-	*4.276*	2.402	0.534	0.648	1.118	*1.149*	-	-
25	-	-	-	-	*4.399*	2.377	0.517	0.695	1.108	*1.250*	-	-
26	-	-	-	-	*3.977*	2.299	0.506	0.595	1.210	*1.205*	-	-
27	-	-	-	-	*4.251*	2.131	0.498	0.616	1.269	*1.352*	-	-
28	-	-	-	-	*3.355*	2.005	0.478	0.641	1.279	*1.382*	-	-
29	-		-	-	*3.346*	1.920	0.428	0.568	*1.153*	*1.246*	-	-
30	-		-	-	*3.271*	1.808	0.417	0.578	*1.106*	*1.437*	-	-
31	-		-		*3.245*		0.398	0.591		*1.273*		-
Mean	-	-	-	-	3.603	3.045	0.900	0.470	0.936	1.165	0.260	-
Max	0.000	0.000	0.000	0.000	4.997	3.687	1.727	0.695	1.279	1.437	1.150	0.000
Min	0.000	0.000	0.000	0.000	0.100	1.808	0.398	0.228	0.576	0.942	0.010	0.000

Note: Estimated and modelled values are italicized

Values in red denote high uncertainty based on extrapolation of the rating curve beyond 2 times the greatest measured discha

APPENDIX E HISTORICAL LAKE LEVEL COMPARISON GRAPHS

FIGURE E1 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION WINDY OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-011:1

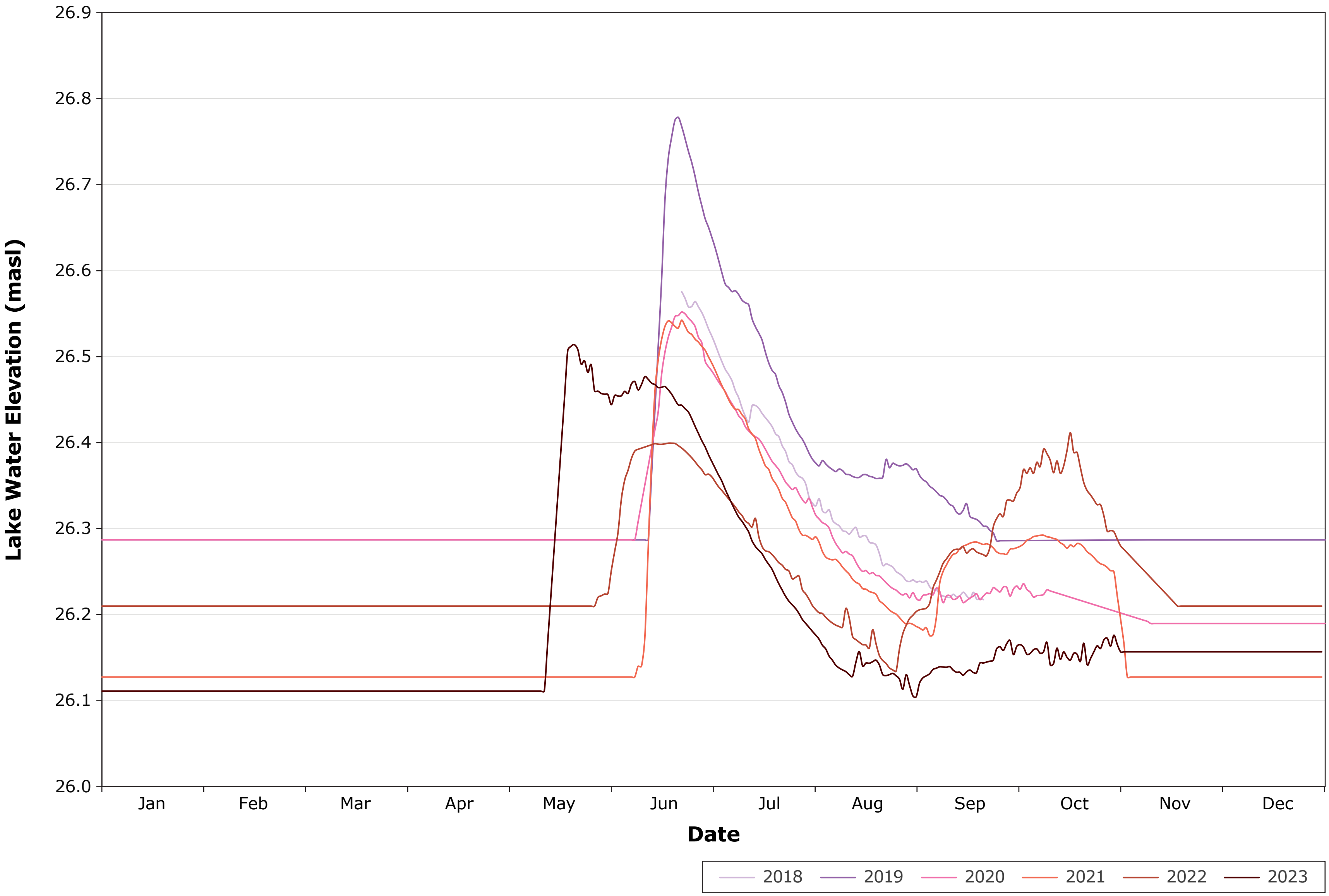
FIGURE E2 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION GLENN LAKE

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-011:2

FIGURE E3 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION IMNIAGUT LAKE

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-011:3

FIGURE E4 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION PATCH OUTFLOW



ERM

CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-011:4

FIGURE E5 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION PO OUTFLOW

ERM

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FIGURE E6 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION OGAMA OUTFLOW

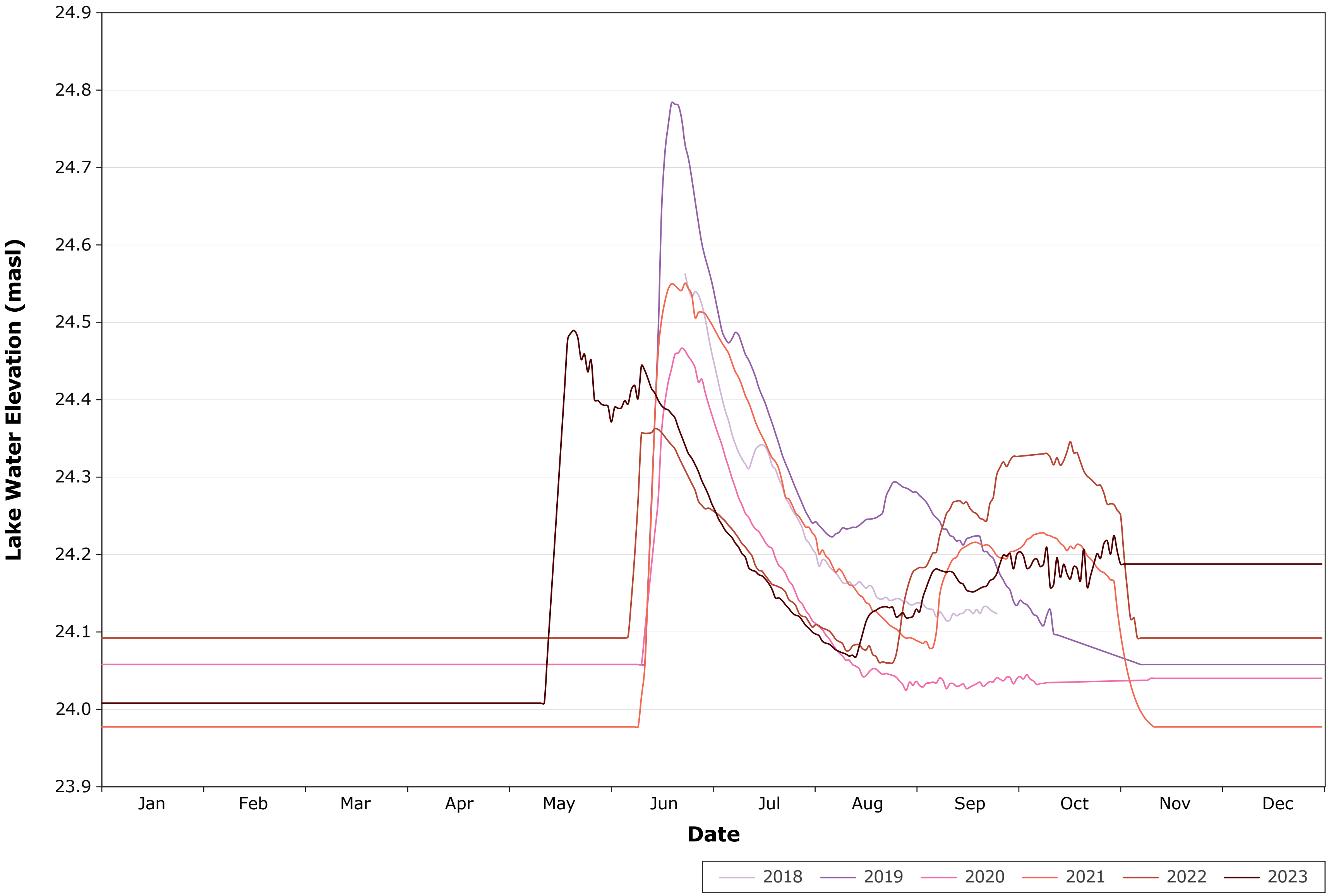
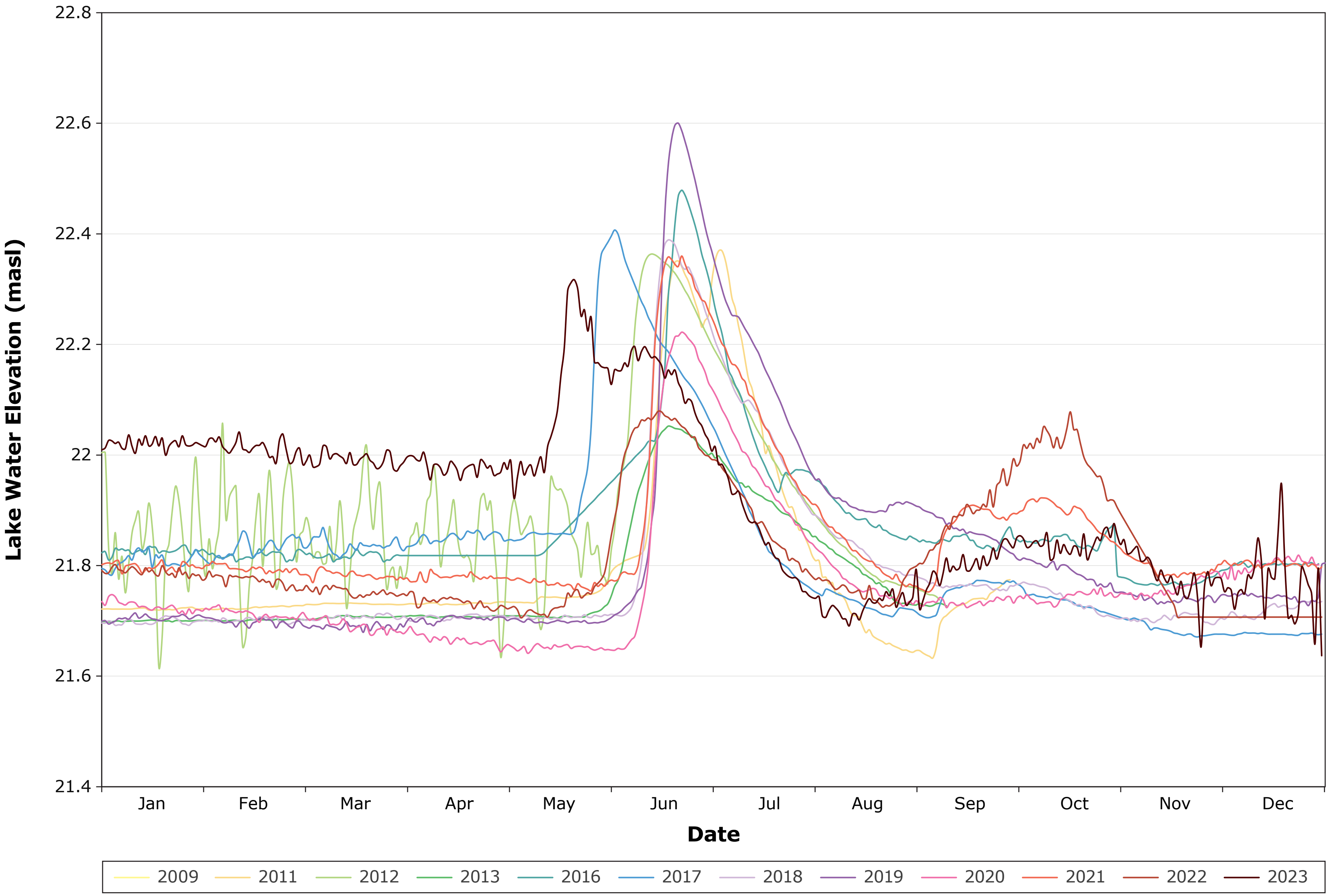


FIGURE E7 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION DORIS LAKE



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CLIENT: Agnico Eagle Mines Ltd.

GRAPHICS NUMBER: HB-24ERM-011:7

FIGURE E8 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION ROBERTS HYDRO-2

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GRAPHICS NUMBER: HB-24ERM-011:8

FIGURE E9 HISTORICAL MEAN DAILY LAKE LEVEL FOR MONITORING STATION LITTLE ROBERTS OUTFLOW

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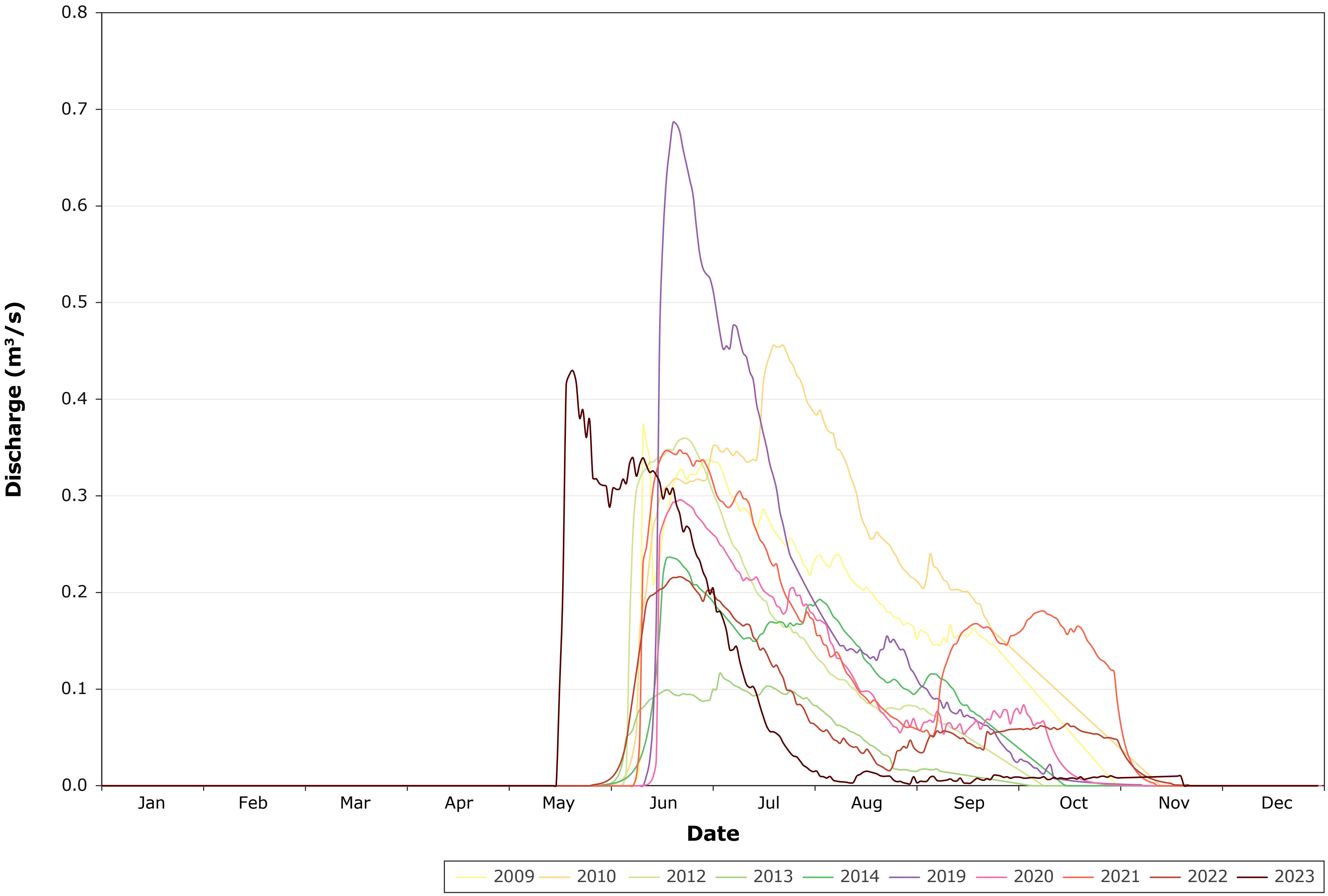
APPENDIX F HISTORICAL MEAN DAILY DISCHARGE COMPARISON GRAPHS

FIGURE F1   HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION WINDY OUTFLOW



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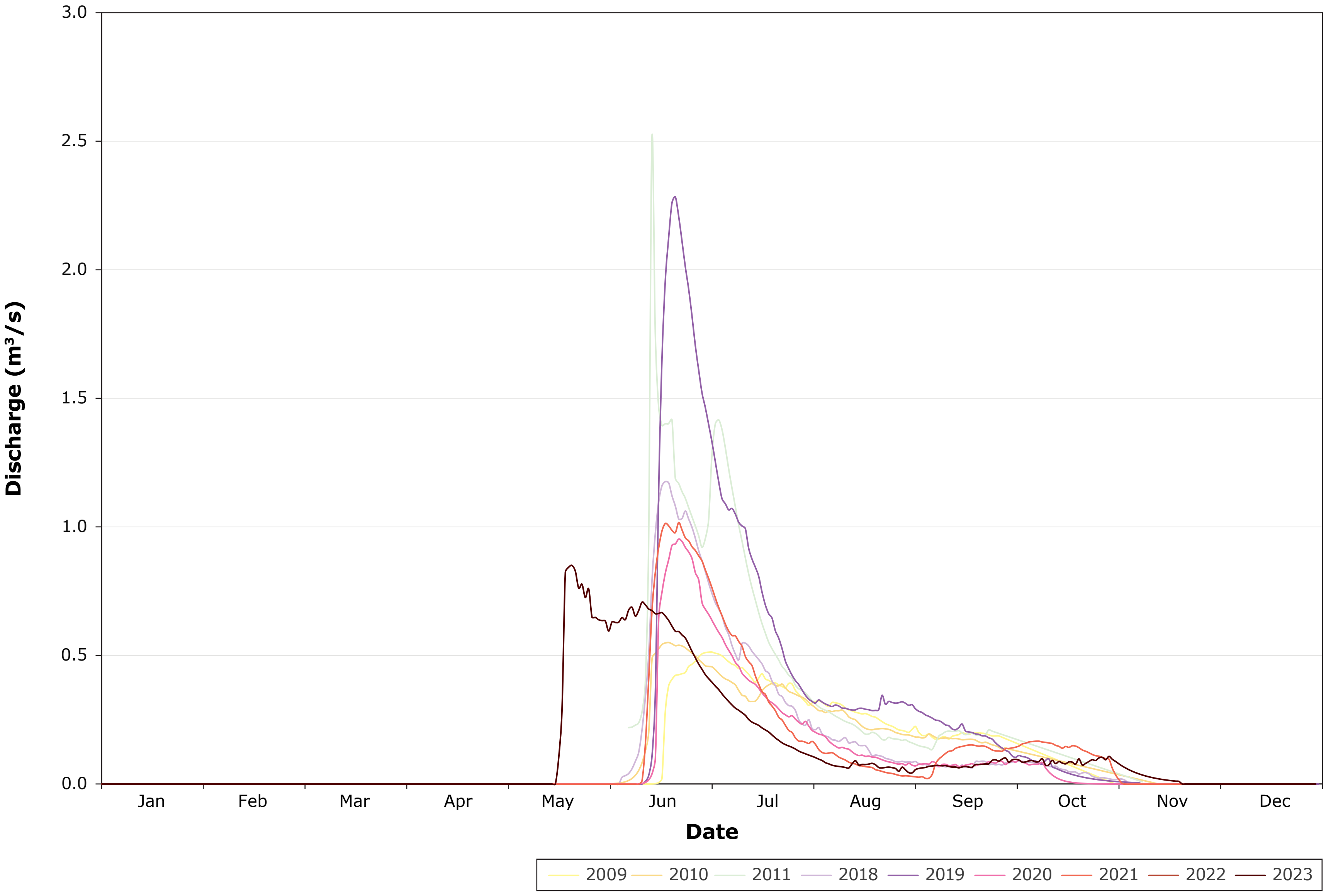
GRAPHICS NUMBER: HB-24ERM-012:1

FIGURE F2 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION PATCH OUTFLOW



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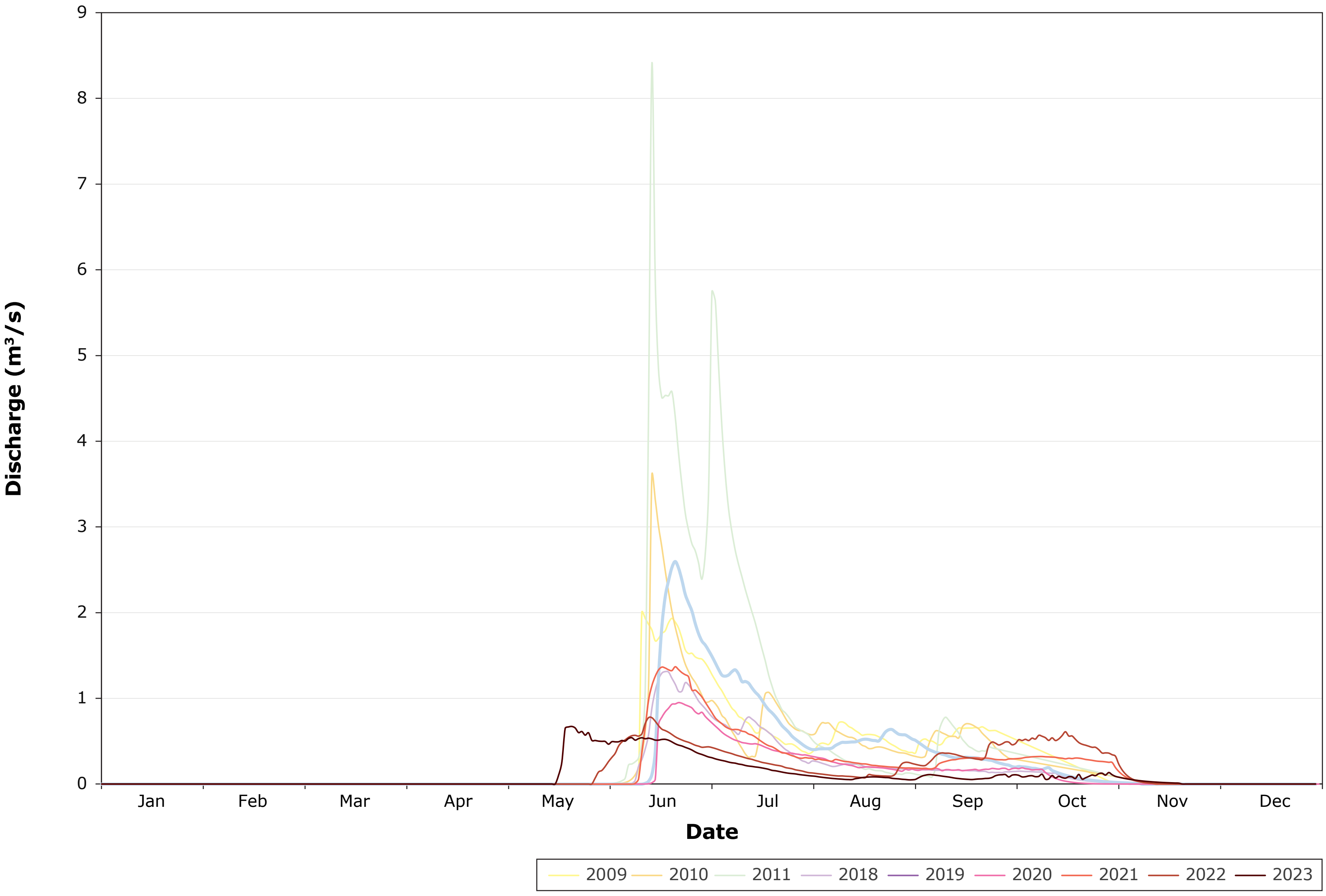
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-012:2

FIGURE F3 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION PO OUTFLOW



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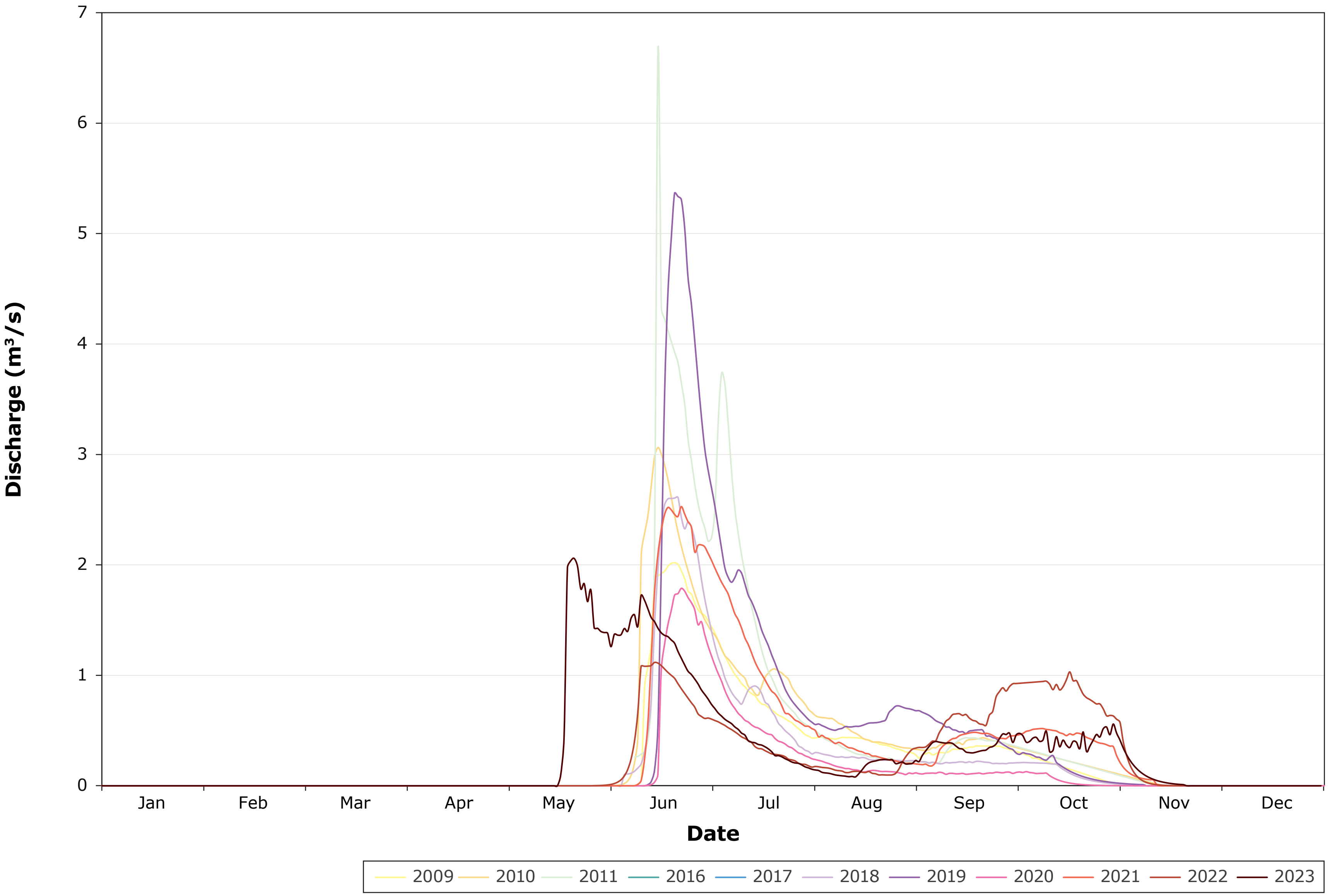
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-012:3

FIGURE F4 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION OGAMA OUTFLOW



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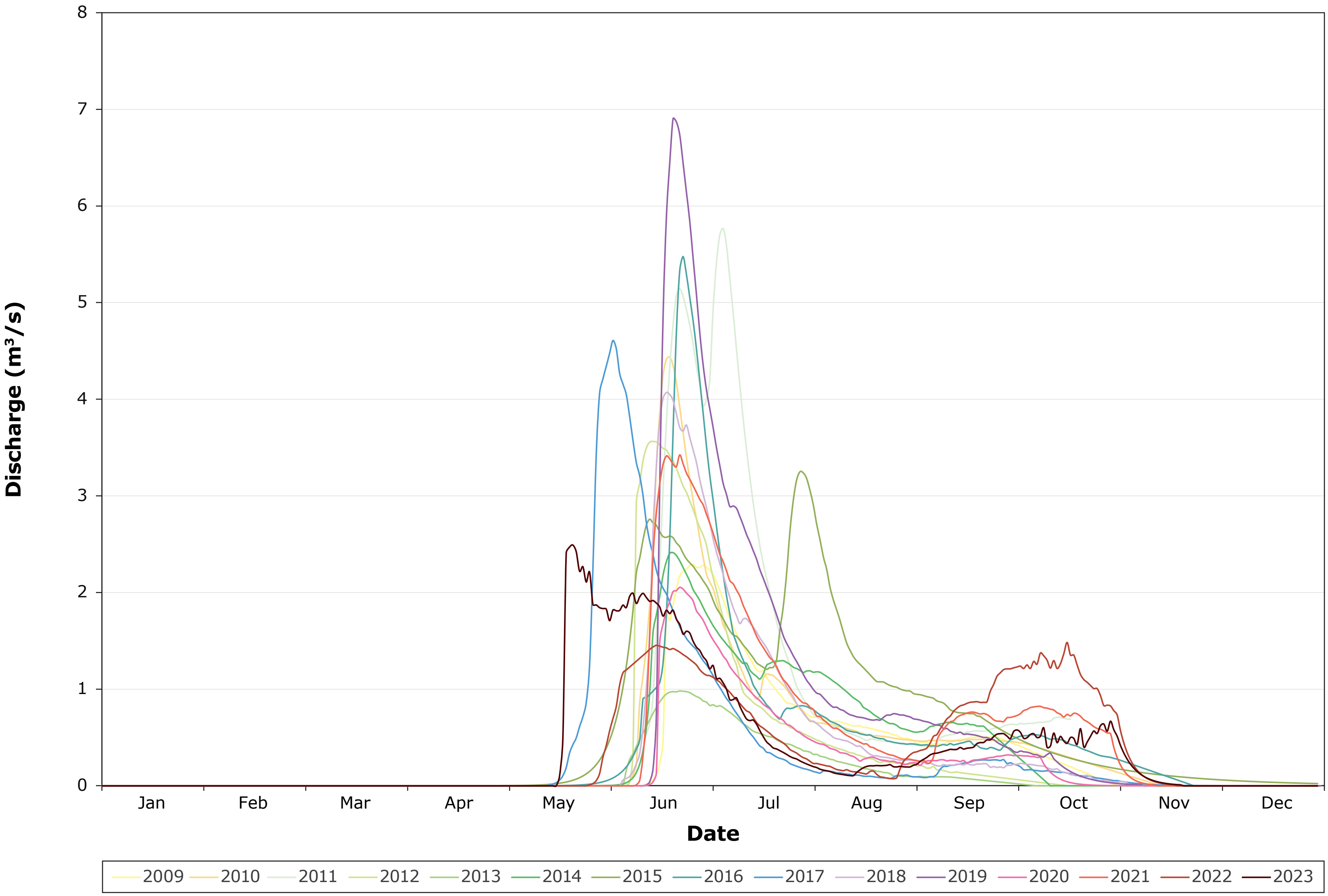
CLIENT: Agnico Eagle Mines Ltd.

GRAPHICS NUMBER: HB-24ERM-012:4

FIGURE F5 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION DORIS CREEK TL-2



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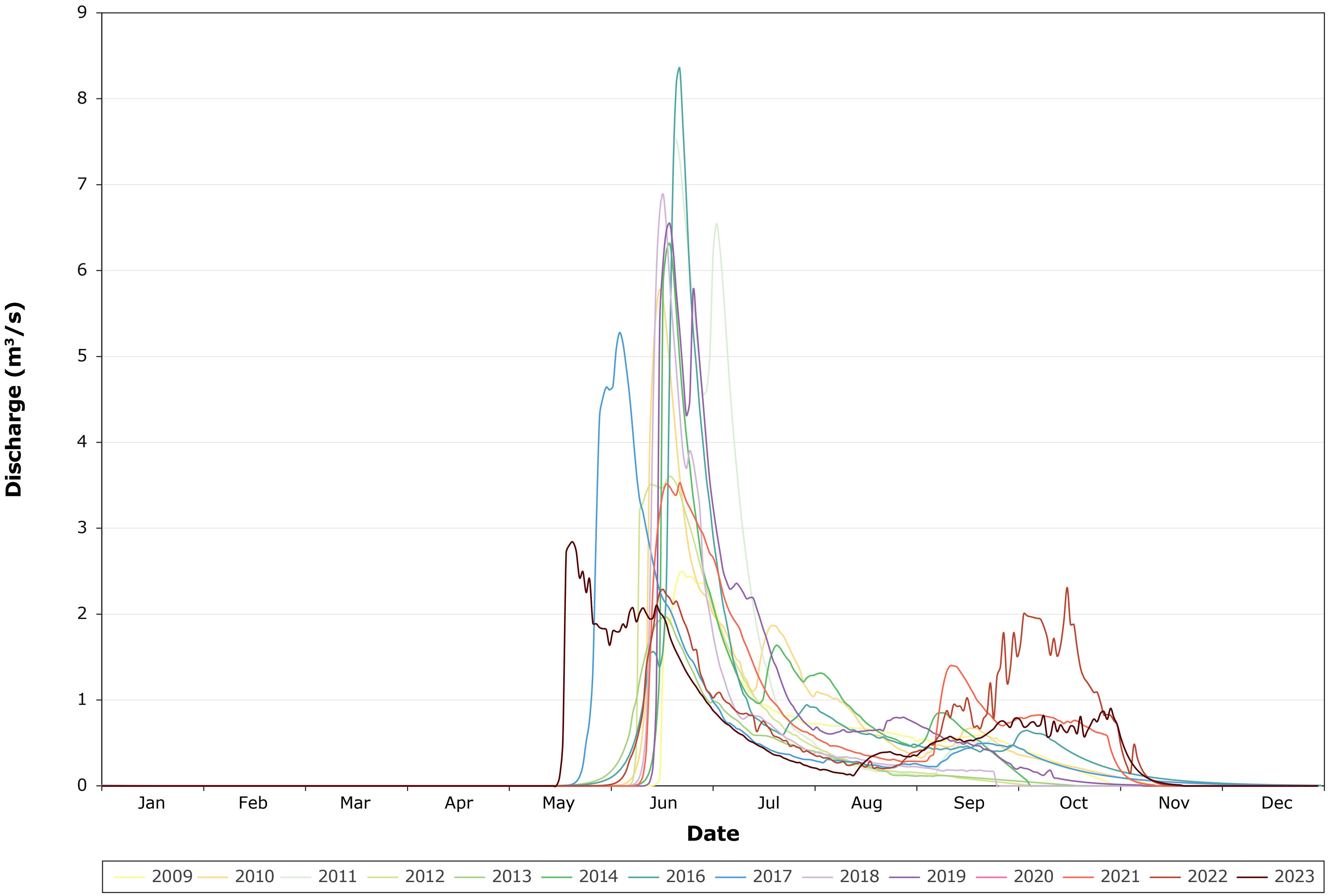
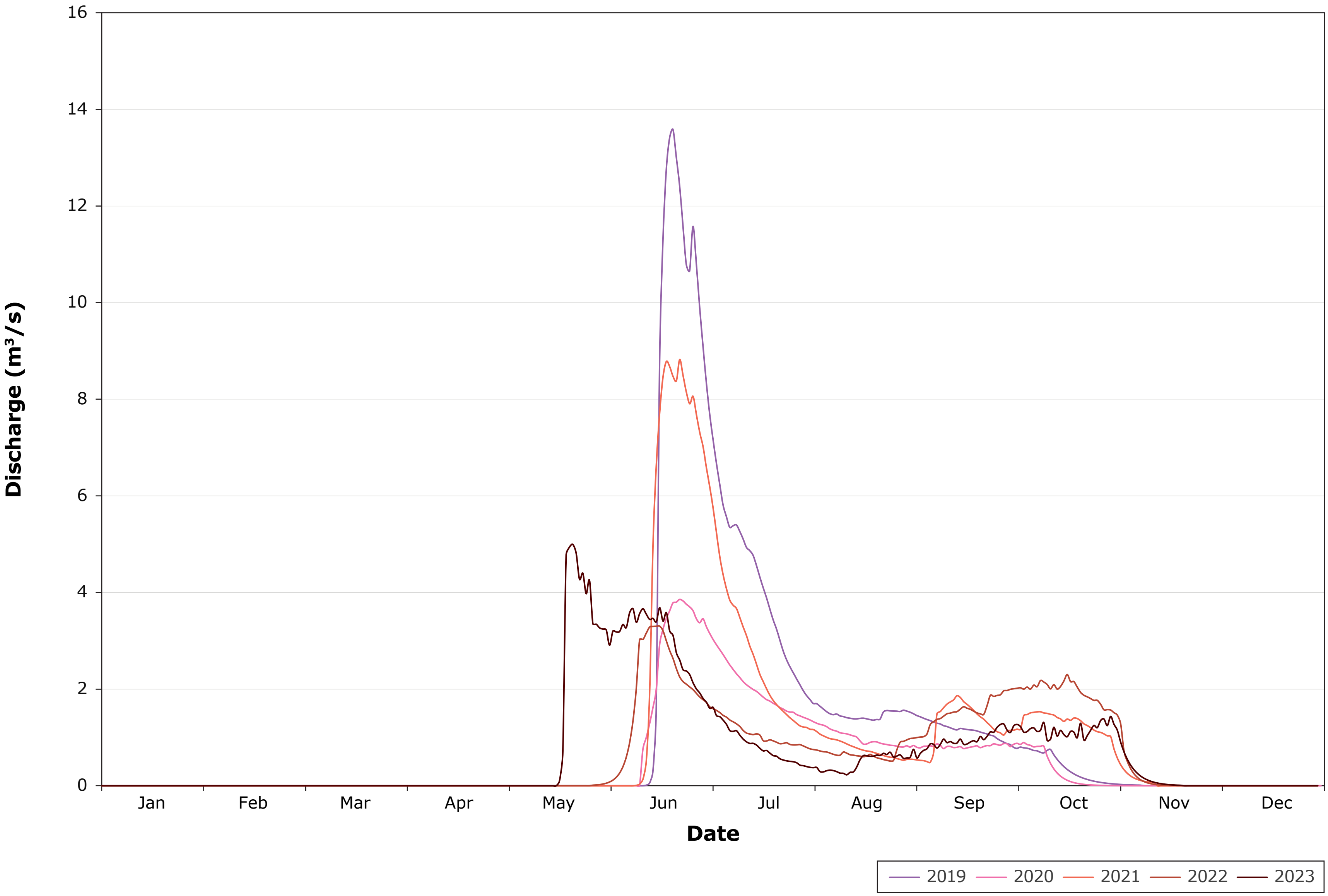
CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-012:5

FIGURE F6 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION ROBERTS HYDRO-2



CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-012:6

FIGURE F7 HISTORICAL MEAN DAILY DISCHARGE FOR MONITORING STATION LITTLE ROBERTS OUTFLOW



CLIENT: Agnico Eagle Mines Ltd.
GRAPHICS NUMBER: HB-24ERM-012:7

APPENDIX C 2023 EVALUATION OF EFFECTS SUPPORTING INFORMATION – HISTORICAL DATASET AND STATISTICAL METHODS AND RESULTS

Hope Bay Project

2023 Aquatic Effects Monitoring Program – Annual Report

Appendix C: 2023 Evaluation of Effects Supporting Information – Historical Dataset and Statistical Methods and Results

March 2024

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APPENDIX C: 2023 EVALUATION OF EFFECTS SUPPORTING INFORMATION – HISTORICAL DATASET AND STATISTICAL METHODS AND RESULTS

C.1 HISTORICAL DATA SELECTION

Not all historical data collected at the Hope Bay Aquatic Effects Monitoring Program (AEMP) lake sites is valid for inclusion in the AEMP evaluation of effects. Inclusion of historical data for the evaluation of effects was assessed based on relevancy to the current AEMP sampling sites and timing of sample collection, and comparability of sampling methods as currently implemented the approved Hope Bay Project: Aquatic Effects Monitoring Plan (the Plan; TMAC 2018). For the relevant components of the 2023 AEMP (i.e., temperature and dissolved oxygen profiles, water quality, and phytoplankton biomass), the data included in the evaluation of effects is summarised in the tables and figures below, along with the rationale for exclusion of historical data when applicable (Tables C.1-1 to C.1-3 and Figures C.1-1 to C.1-3).

TABLE C.1-1 HISTORICAL DATA SELECTION RATIONALE FOR TEMPERATURE AND DISSOLVED OXYGEN EVALUATION OF EFFECTS, HOPE BAY AEMP, 2023

Lake	Years Sampled	Months Sampled	Data Included in Graphs and Analyses	Data Excluded from Graphs and Analyses	Rationale for Exclusion
Doris	1995	August	Data from northern end of the lake	Data from southern end of the lake	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	1996	April, August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	1997	April, July, August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	1998	April	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2000	August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2003	July, August, September	August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2004	June, July, August, September	June and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2005	July, August, September	August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2006, 2007, 2008	May, July, August, September	May and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2009	April, August	Data collected at “Doris North” sampling location	Data collected at “Doris South” sampling location	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2010 to 2016	April, July, August, September	April and August data collected at “Doris North” sampling location	All data collected at “Doris South” sampling location; all July and September data	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake. Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2017, 2018	April, July, August, September	April and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2019 to 2023	April, August	All	None	
Patch	1995	August	All	None	
	1996	April, August	All	None	Note: Data were estimated from plots of the profiles.
	1997	April, July	April data	July data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded. Note: April data were estimated from plots of the profiles.
	1998	April	All	None	
	2006	June, July, and September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2007, 2008	May, July, August, September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2009	April, August	Data collected at “Patch North” sampling location	Data collected at “Patch South” sampling location	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2017 to 2023	April, August	All	None	

Lake	Years Sampled	Months Sampled	Data Included in Graphs and Analyses	Data Excluded from Graphs and Analyses	Rationale for Exclusion
Windy	1995	August	None	All	Excluded data collected from southern end of Windy Lake, as current AEMP sampling site is at northern end of the lake.
	1996	August	None	All	Excluded data collected from southern end of Windy Lake, as current AEMP sampling site is at northern end of the lake.
	1997	April, July	April data	July data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded. Note: April data were estimated from plots of the profiles.
	1998	April	All	None	
	2006	June, July, August, September	June and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2007, 2008	May, July, August, September	May and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2009, 2010, 2017 to 2020	April, August	All	None	
Reference B	2009	May, August	None	All	Excluded data collected from northeastern end of Reference Lake B, as current AEMP sampling site is in the central basin of the lake.
	2010	April, July, August September	August data	April, July, and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded. Excluded data collected from April (and July) as these were collected from northeastern end of the lake.
	2011 to 2018	April, July, August, September	April and August data	July and September data	Currently, profiles for the open-water season are collected in August, so historical data collected in August were included and data from other months were excluded.
	2019 to 2023	April, August	All	None	

TABLE C.1-2 HISTORICAL DATA SELECTION RATIONALE FOR WATER QUALITY EVALUATION OF EFFECTS, HOPE BAY AEMP, 2023

Lake	Years Sampled	Months Sampled	Data Included in Graphs and Statistical Analyses	Data Excluded from Graphs and Statistical Analyses	Rationale for Exclusion
Doris	1995	May, June, July, August	Data from northern end of the lake	Data from southern end of the lake, and all shoreline grab samples	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake; excluded shoreline grabs, which are not comparable to samples collected from a boat over deep areas of the lake.
	1996	April, August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	1997	April, July, August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	1998	April	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2000	July, August	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2003	July, August, September	All	None	
	2004	June, July, August, September	All	None	
	2005	July, August, September	All	None	
	2006, 2007, 2008	May, July, August, September	All	None	
	2009	April, August	Data collected at "Doris" sampling location	Data collected at "Doris South" sampling location	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2010 to 2016	April, July, August, September	Data collected at "Doris" sampling location	Data collected at "Doris South" sampling location	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2017, 2018	April, July, August, September	All	None	
	2019 to 2023	April, August	All	None	
Patch	1995	May, June, July, August	Data from northern end of the lake	Data from southern end of the lake, and all shoreline grab samples	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake; excluded shoreline grabs, which are not comparable to samples collected from a boat over deep areas of the lake.
	1996	April, August	All	None	
	1997	April, July	All	None	
	1998	April	All	None	
	2006	June, July, August, September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2007 and 2008	May, July, August, September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2009	April, August	Data collected at "Patch" sampling location	Data collected at "Patch South" sampling location	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2017 to 2023	April, August	All	None	

Lake	Years Sampled	Months Sampled	Data Included in Graphs and Statistical Analyses	Data Excluded from Graphs and Statistical Analyses	Rationale for Exclusion
Windy	1995	May, June, July, August	None	All	Excluded data collected from southern end of Windy Lake, as current AEMP sampling site is at northern end of the lake; excluded shoreline grabs, which are not comparable to samples collected from a boat over deep areas of the lake.
	1996	August	None	All	Excluded data collected from southern end of Windy Lake, as current AEMP sampling site is at northern end of the lake.
	1997	April, July	All	None	
	1998	April	All	None	
	1999	July	Samples collected from boat	All shoreline grab samples	Some samples were shoreline grabs, which are not comparable to samples collected from a boat over deep areas of the lake.
	2000	July	All	None	
	2006	June, July, August, September	All	None	
	2007, 2008	May, July, August, September	All	None	
	2009, 2010, 2017 to 2023	April, August	All	None	.
Reference B	2009	May, August	None	All	Excluded data collected from northeastern end of Reference Lake B, as current AEMP sampling site is in the central basin of the lake.
	2010	April, July, August September	August and September data	April and July data	Excluded data collected from April and July, as these were collected from northeastern end of the lake. The August and September samples were collected at the current AEMP sampling site.
	2011 to 2018	April, July, August, September	All	None	
	2019 to 2023	April, August	All	None	

TABLE C.1-3 HISTORICAL DATA SELECTION RATIONALE FOR PHYTOPLANKTON BIOMASS EVALUATION OF EFFECTS, HOPE BAY AEMP, 2023

Lake	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Doris	1997	July	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake. Potential issue with sample integrity, as samples were lost and then found and analyzed more than one year after sample collection.
	2000	July	None	All	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake.
	2003	July, August, September	None	All	Excluded because of methodological differences, as samples consisted of a composite of subsamples collected throughout the euphotic zone (not comparable to discrete surface samples currently collected in the AEMP).
	2006	September	None	All	Methods not described. Assumed to be a composite sample from throughout euphotic zone.
	2007, 2008	July, August, September	None	All	Excluded because of methodological differences, as samples consisted of a composite of subsamples collected throughout the euphotic zone (not comparable to discrete surface samples currently collected in the AEMP).
	2009	April, August	August data collected at “Doris” sampling location	All April data and August data collected at “Doris South” sampling location	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake; currently only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2010 to 2016	April, July, August, September	July, August, September data collected at “Doris” sampling location	April data and all data collected at “Doris South” sampling location	Excluded data collected from southern end of Doris Lake, as current AEMP sampling site is at northern end of the lake; currently only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2017 to 2023	August	All	None	
Patch	1997	July	None	All	Potential issue with sample integrity, as samples were lost and then found and analyzed more than one year after sample collection.
	2006	September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake.
	2007, 2008	July, August, September	None	All	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake; excluded because of methodological differences, as samples consisted of a composite of subsamples collected throughout the euphotic zone (not comparable to discrete surface samples currently collected in the AEMP).
	2009	April, August	August data collected at “Patch” sampling location	All April data and August data collected at “Patch South” sampling location	Excluded data collected from southern end of Patch Lake, as current AEMP sampling site is at northern end of the lake; currently, only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2017, 2018	April, August	August data	April data	Currently, only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2019	August	All	None	
	2020	August	Sample (n= 1) collected at 1m	Sample collected at deeper depth	Samples collected at bottom depth (5 m) are not comparable to discrete surface sample currently collected in the AEMP.
	2021 to 2023	August	All	None	

Lake	Years Sampled	Months Sampled	Data Included in Historical Graphs and Statistical Analyses	Data Excluded from Historical Graphs and Statistical Analyses	Rationale for Exclusion
Reference B	2009	August	None	All	Excluded data collected from northeastern end of Reference Lake B, as current AEMP sampling site is in the central basin of the lake.
	2010	April, July, August, September	August, September data	April, July data	Excluded April and July data collected from northeastern end of Reference Lake B, as current AEMP sampling site is in the central basin of the lake; currently only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2011 to 2016	April, July, August, September	July, August, September data	April data	Currently, only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2017	April, August	August data	April data	Currently, only open-water season chlorophyll *a* data included in the evaluation of effects, so excluded historical under-ice data.
	2018 to 2023	August	All	None	

Note:
Phytoplankton biomass is represented as chlorophyll *a*.

FIGURE C.1-1 HISTORICAL PHYSICAL LIMNOLOGY SAMPLING SITES, HOPE BAY AEMP, 1995 TO 2023

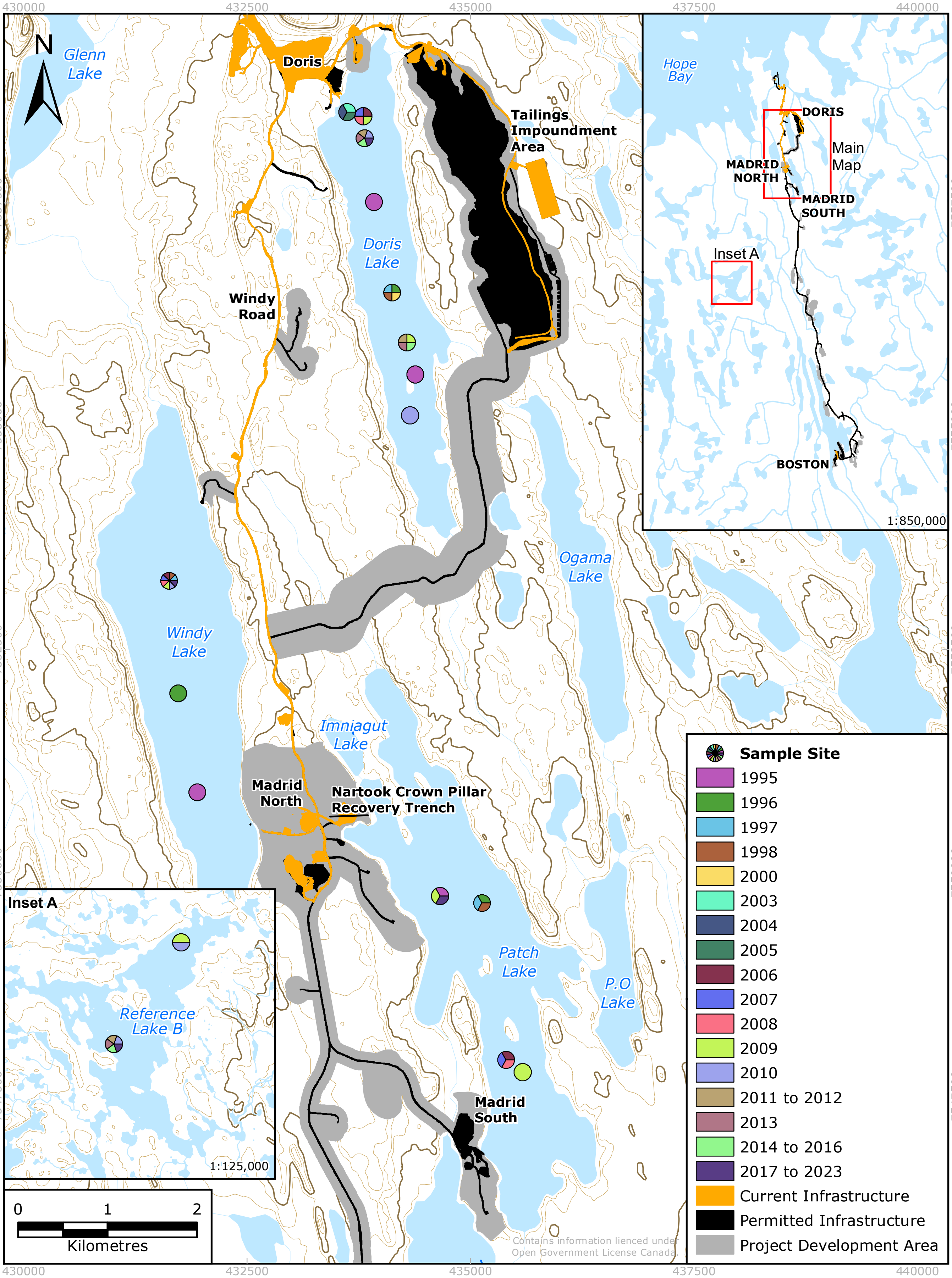
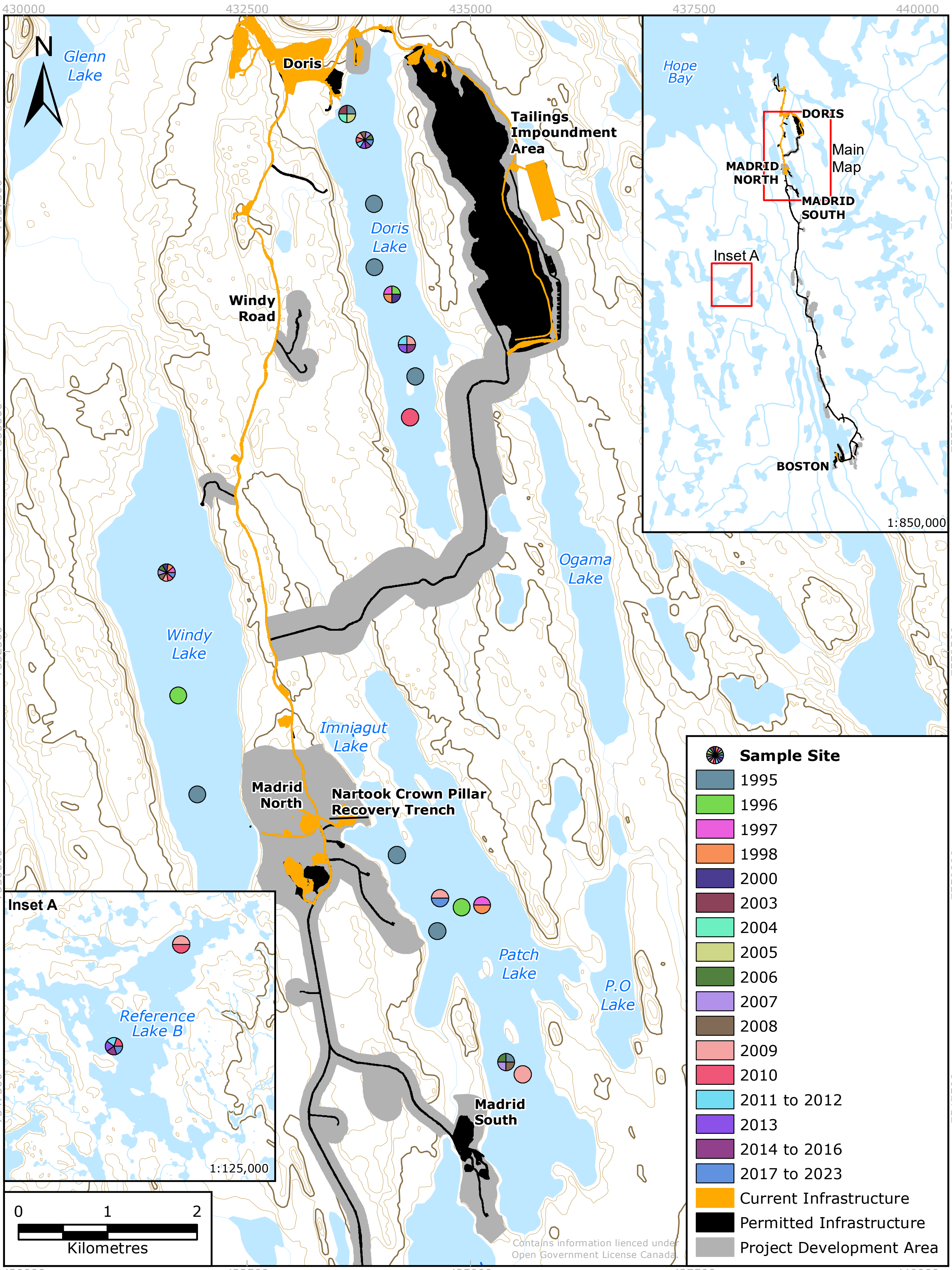


FIGURE C.1-2 HISTORICAL WATER QUALITY SAMPLING SITES, HOPE BAY AEMP, 1995 TO 2023



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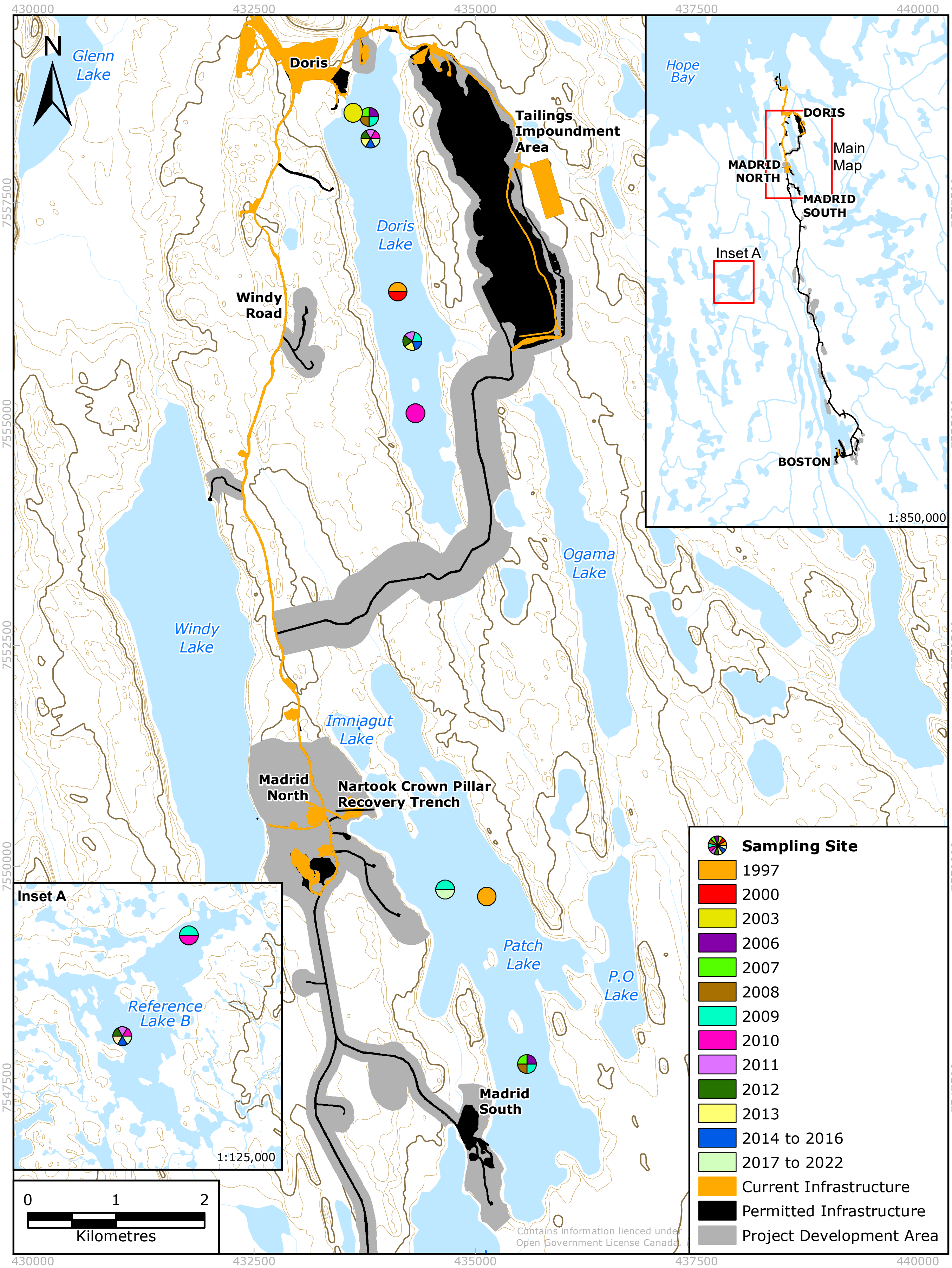
GIS NUMBER: HB-01-297j

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:60,000 when printed at 8.5x11

FIGURE C.1-3 HISTORICAL PHYTOPLANKTON SAMPLING SITES, HOPE BAY AEMP, 1995 TO 2023



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CLIENT: AGNICO EAGLE MINES LIMITED
GIS NUMBER: HB-01-297k

DATE: 01/12/2024

PROJECTION: NAD 1983 UTM Zone 13N
SCALE: 1:60,000 when printed at 8.5x11

C.2 STATISTICAL METHODS FOR EVALUATION OF EFFECTS

Statistical analyses were completed for some AEMP components to determine if a statistically significant change through time is present for evaluated variables to support the evaluation of effects in determining if there are Project-related effects for a given variable or lake. In the 2023 AEMP, water quality and phytoplankton variables were assessed using statistical analyses.

Unless there were limitations of the dataset due to censored values (Section 2.1.1), two statistical approaches are used to assess the AEMP data based on the data availability, temporal trend analysis (Section C.2.2) or a before-after/control-impact (BACI) analysis (Section C.2.3).

Statistical assessments are not conclusive evidence of an effect, it is noted that graphical analysis and professional judgement is always used in conjunction with the results of the statistical analyses, to determine an effect. The results of the statistical analyses were plotted with the observed data to support the evaluation of effects (Section C.2.4).

Statistical analysis can result in a type I error (finding a significant effect where an effect is not present, i.e., false positive) or a type II error (failing to find a significant effect where an effect is present, i.e., false negative). In the monitoring context, a false positive is more tolerable than a false negative. There is a direct trade-off between the two error rates, as reducing one type of error generally increases the other type of error. No correction for the large number of statistical tests was applied to the false positive (type I) error rate. Therefore, there may be false positives in the analyses that were conducted, which is a conservative and environmentally protective approach. For this AEMP, the unadjusted type I error rate (or significance level) was set to 0.05, indicating that approximately 5% of the time, statistical results will show a significant effect (i.e., p value of < 0.05) by random chance alone where an effect is not actually present.

C.2.1 CENSORED DATA

If all data in the current assessment year (2023) were below the analytical detection limit (DL), no statistical analysis was performed for that variable/lake. For any variable, if a large amount of data (>50% of the dataset) for a was below the DL for lake, the lake was removed from the analyses. In cases where the reference lake data were removed, it was not possible to make comparisons between exposure and reference lakes, and inference about the exposure lake was based on the within-lake regression analysis and plots of the observed data when required.

If more than 10% of observations from a site were censored, tobit analysis was used. If censored data were included in the analyses, the data were assumed to be equal to half the DL unless indicated differently for the analysis methods detailed below (Tobit analysis).

C.2.2 TEMPORAL TREND ANALYSIS

Regression models were used to assess data from lakes with 10 or more years of continuous historical data available for most variables and examine any time trends over the monitoring period. The regression model trend analysis is applicable to Doris Lake for the 2023 AEMP. Hypothesis tests were conducted to assess time trends for particular variables. In brief, if there was a significant change over time (i.e., relative to a slope of zero), the trend in the exposure lake was compared to the time trend in the reference lake (Reference Lake B). For comparisons between exposure and reference lakes, only years in which both lakes were sampled were included in the analysis and there must be greater than three years of comparable sampling years to conduct the comparison. All the observed and fitted data are presented graphically to support the interpretation of results.

Time effects were modelled using natural cubic regression spline curves to allow for non-linearity. The first step of the regression analysis was to determine whether there was evidence of a change in a given variable over time (i.e., is the slope of the fitted spline curve significantly different from a slope of zero). This first step revealed whether or not there was a significant change in the variable over time. Note that the statistical result does not give any information about the direction of the trend (e.g., increasing or decreasing). If the first step of the analysis determined that there was evidence of a significant change in a variable over time in Doris Lake (i.e., the trend was significantly different from zero), the variable was carried forward to the second step of the statistical analysis where the exposure lake trend was compared to the trend in Reference Lake B. This second step of the analysis included modelling only the data for monitoring years in the exposure lake that align with monitoring in the reference lake.

Either linear mixed effects (LME) or Tobit regression analyses were fit to the data, depending on the fraction of samples that were less than the DL (censored). Tobit regression was used when a moderate amount of data (between 10 and 50%) from a given lake were below the DL. For Tobit models, the fact that each censored measurement falls between zero and the DL was used to obtain the estimated range for the mean in a given lake and year (as well as depth and season, if applicable). This interval was used in the Tobit regression analysis.

C.2.2.1 LINEAR MIXED EFFECTS REGRESSION

Model Form

Let y denote a variable of interest, and $y_i(x)$ be an observation from lake *i* in year x. The model fitted to the data have the basic regression model form:

$$y = Lake + s(Year) + Lake*s(Year)$$

where the mean level of a variable is modelled with separate intercepts and time effects, *s*(Year), in each lake. Separate intercepts allowed for differences in the initial values of the variable between lakes. Time effects were modelled using natural cubic regression splines to allow for non-linearity. Cubic regression splines are piecewise cubic polynomials joined together at points, called knots, often chosen at quantile points, and continuous up to the second derivative at each knot. Natural cubic splines have the additional constraint that the spline is linear beyond the boundaries of the data. The advantage of using regression splines over linear and quadratic effects is improved flexibility in capturing fluctuations in the data where a quadratic relationship appears inadequate. Regression splines are an extension of linear and quadratic effects where instead of representing an effect x with x and x^2, functions of x, called basis functions, are used.

Mathematically, the regression model can be written as:

$$E[y_i(x)] = \beta_{0i} + \sum_{n=1}^{K} \beta_{ki} h_k(x)$$

where:

- $E[y_i(x)]$ represents the expected mean value of the variable in lake i in year x;
- β_{0i} represents the intercept for lake i;
- β_{ki} represents the basis coefficients for lake i; and
- $\{h_k\}$ are known functions called basis functions.

The regression model is linear in the new variables, $h_k(x)$, and usual LME or Tobit approaches for model fitting and inference may be used. The splines are represented as linear combinations of basis functions evaluated at *x* and the number of basis functions is dependent on the number of knots (*K*) chosen. As 10 or more years of data are available, the number of knots chosen was 4 and 5 for variables with 10 years of data and more than 10 years of data, respectively. Plots of the fitted curves were used to assess the adequacy of the number of knots and to avoid over- or under-fitting the data.

Pseudoreplication

For water quality variables, the mean was calculated from all observations from the same lake in the same year. Since comparisons were made across years and across lakes, using the mean value from the lake had little effect on the tests of interest. For phytoplankton biomass, the mean was calculated using observations from the same lake on the same sampling date. If a sample result was less the DL, half the DL was substituted for calculating the mean.

Random Variation

Random sources of variation can affect variable measurements. Potential sources of variability include environmental factors affecting all lakes equally in a given year, sampling variation that affects samples taken from a lake in a single year, and true measurement errors from laboratory analysis. The main sources of variation can be broken down into two components: yearly effects that affect the measurements in all lakes and effects that affect each lake individually.
Random effects are included in the LME model to account for these sources of variation. The final model of the mean variable value observed in lake *i* in year *x* becomes:

*y = Lake + s(Year) + Lake*s(Year) + Year-R + Error-R*

or mathematically:

$$y_i(x) = \beta_{0i} + \sum_{k=1}^{K} \beta_{ki} h_k(x) + \varepsilon_x + \varepsilon_{ix}$$

where ε_x and ε_{ix} represent random variables that affect all lakes identically in year x, and those that only affects lake i, respectively. These random variables are assumed to follow normal distributions with zero mean and variance σ_x^2 and σ_{ix}^2, respectively.

Assessing Model Fit and Outliers

The goodness-of-fit of the regression models was examined through plots of the residuals. Let $\hat{y}_i(x)$ denote the fitted value for lake i in year x, defined as:

$$\hat{y}_i(x) = \hat{\beta}_{0i} + \sum_{k=1}^{K} \hat{\beta}_{ki} h_k(x) + \varepsilon_x + \varepsilon_{ix}$$

The residual for each observation, denoted e_{ix}, is the difference between the fitted and observed values:

$$e_{ix} = y_i(x) - \hat{y}_i(x)$$

The residuals estimate the true error or unexplained variation for lake *i* in year *x.* The key assumption is that the true errors are normally distributed with equal variance. That is, the residuals are normally distributed and their variance does not depend on either lake or year. Normal quantile-quantile (Q-Q) plots were used to assess the distribution of residuals for each fitted model. Plots of the residuals by year and against the fitted values were used to assess homogeneity of variance over time and across values of the variable. A common deviation from this assumption is that variance increases as the value of the variable increases since values tend to vary more at larger scales. A natural logarithm transformation was often required to stabilize variance and meet the assumption of approximately normally distributed residuals. Standardized residuals greater than three were identified as outliers and flagged to caution interpretation of results, but not removed from the analysis.

C.2.2.2 TOBIT REGRESSION

Often values below the DL are replaced with half the upper bound and statistical analyses are performed as if the value is actually observed. Results from this type of analysis can be misleading, particularly when the DLs are not consistent from year to year. For example, if all observations for a given variable in one lake have been below the DL in every year but the DL for that variable has consistently decreased (perhaps due to improving technology), then the imputed observations will appear to decrease over time. In reality, there is no information to conclude if the value is increasing, decreasing or remaining constant. Further, replacing these values with half of the DL ignores any uncertainty in these observations and the analysis will tend to underestimate the standard deviation (SD) of the variables.

Model Form

Tobit regression, accounts for the censoring below the DL. In a maximum likelihood analysis of a standard regression model (as above) the likelihood contribution of a single observation *y* given the covariates x_1 , …, x_p and a single error term $\varepsilon \sim N(0, \sigma^2)$ is:

$$L(y) = \left(2\pi\sigma^2\right)^{-1/2} \exp\left(\frac{-1}{2\sigma^2}\left(y - \sum_{i=1}^{p} \beta_i x_i\right)^2\right)$$

which is simply a normal probability density function of an observation, *y*, with mean $\sum \beta_i x_i$ and variance σ^2 .

Now consider the case where y is censored and is only known to lie in the interval (a,b). Tobit regression replaces the likelihood contribution with the integrated density:

$$L(y) = \int_a^b \exp\left(\frac{-1}{2\sigma^2}\left(y - \sum_{i=1}^{p}\beta_i x_i\right)^2\right)dy = \Phi\left(\frac{b - \sum_{i=1}^{p}\beta_i x_i}{\sigma}\right) - \Phi\left(\frac{a - \sum_{i=1}^{p}\beta_i x_i}{\sigma}\right)$$

where $\Phi(x)$ is the standard normal cumulative distribution function. The likelihood can then be formed by multiplying the appropriate censored or uncensored contributions for each observation and maximum likelihood inference can be conducted to compute variable estimates and their standard errors, and perform hypothesis tests (Tobin 1958).

Pseudoreplication

The same concern with pseudoreplication in the LME regression models exists in the Tobit regression. However, when values were censored it was not possible to mean the observations in each lake to obtain a single value for each year or season and a different solution was necessary. Suppose that observations $y_1, ..., y_{n1}$ and $y'_1,....,y'_{n2}$ are available from a given lake in a given year where each y_i is known exactly and each y'_i is censored so that y'_i belongs to the interval (a_i, b_i). Given these observations, the sample mean, $\bar{y}$, was bounded such that:

$$a = \frac{\sum_{i=1}^{n_1} y_i + \sum_{i=1}^{n_2} a_i}{n_1 + n_2} < \bar{y} < \frac{\sum_{i=1}^{n_1} y_i + \sum_{i=1}^{n_2} b_i}{n_1 + n_2} = b$$

and Tobit regression was performed with (a, b) as the censoring interval for the sample mean. If all measurements are known exactly, then $n_2 = 0$ and $a = b = \bar{y}$.

C.2.2.3 HYPOTHESIS TESTING

Once the LME or Tobit regression models were fit, hypothesis tests were performed to determine if there was evidence that the mean variable values in the exposure lake (E) had changed over time. If there was no evidence of change over time, differences were attributed to random variation. If there was evidence of change over time, the time trend at the exposure lake was compared to the reference lake (R) to determine if there was a parallel trend over time at the exposure and reference lakes. For comparisons between exposure and reference lakes, only years in which both lakes were sampled were included in the analysis.

Test 1: Comparison within Exposure Lake

The fitted pattern of means in the exposure lake were compared to a constant value to determine if there was evidence suggesting the mean value of the variable had changed over time.

The hypothesis of this test was:

$$H_0: \beta_{kE} = 0 \text{ for } k = 1 \ldots K$$

$$H_a: \beta_{kE} \neq 0 \text{ for at least one } k = 1 \ldots K$$

Rejection of the null hypothesis provides evidence that the mean variable value in the exposure lake had changed over time and the analysis proceeded with Test 2. If the reference lake was removed from the analysis then plots of the fitted and observed values were used to identify the changes.

Test 2: Comparison to Reference Lake

If there was enough evidence to suggest that the variable changed over time, the fitted patterns of means in the exposure lake were compared to the reference lake. Only years in which both lakes were sampled were included in the analysis.

The hypotheses of these tests were:

$$H_0: \beta_{kE} = \beta_{kR} \text{ for } k = 1 \ldots K$$

$$H_a: \beta_{kE} \neq \beta_{kR} \text{ for at least one } k = 1 \ldots K$$

Rejection of the null hypothesis provided evidence that the time trend in the mean variable value in the exposure lake differed from the time trend in the reference lake.

Structure of Tests

All of the hypothesis tests were performed using Wald-type chi-square tests based on the normal approximation for maximum likelihood estimation. Each null hypothesis can be written as a matrix equation with the form, $L'\beta = 0$, where L' denotes the vector of regression coefficients. The Wald theory then states that the quantity:

$$X^2 = (L'\hat{\beta})(L'\Sigma L)(\hat{\beta}'L)$$

is approximately distributed as a chi-square with degrees of freedom equal to the row rank of L, where $\hat{\beta}$ is the vector of maximum likelihood estimates and Σ is its estimated variance-covariance matrix. The p-values for the tests are computed from the upper-tail probabilities of this distribution.

C.2.3 BEFORE-AFTER CONTROL-IMPACT ANALYSIS

For water quality and phytoplankton variables in Patch and Windy lakes, there were fewer than 10 years of continuous historical data available for most variables and with non-sequential years of collection. For these lakes, BACI statistical analyses were used. The BACI analysis consisted of a before-after analysis; where before represents the baseline years and after represents the period where Project-related activities may potentially have influenced the exposure lakes. If there was no significant difference between time periods, the analysis was concluded. However, if there was a significant difference, the analysis proceeded to the second step: the control-impact analysis. The control-impact analysis compares the before-after trend at the exposure site with the before-after trend at a corresponding reference site and included only the years of data that were comparable between the reference and exposure lakes. Each site and evaluated variable was treated independently.

Data Transformations

Initial model assessment was carried out to determine if data transformation was appropriate. The general approach was to compare the normalized residuals and overall model performance for the basic linear model using both untransformed and natural log-transformed data. Plots of standardized residuals, fitted values and normal Q-Q plots were examined to establish the most appropriate choice of transformation. A data transformation was conducted if it produced a more uniform random distribution of residuals and a closer distribution along the 1:1 reference line on the Q-Q plot.

Outliers

The standardized residuals from the model fit were examined and outliers were identified as standardized residuals greater than three. The outliers (if any) were flagged to caution interpretation of results but not removed from the model.

Model Form – Before-After Design

Regression models were constructed for each exposure site based on a BA design. A model was constructed for each exposure site and season. The models follow the general form given the equation:

$$y = period + \textit{Year-R} + \textit{Error-R}$$

This model identifies variation associated with different components, where:

period describes the differences between the before and after periods, or mathematically:

$$E[y_p] = \beta_0 + \beta_p$$

where:

- $\mathrm{E}[y_p]$ represents the expected mean value of the variable in period *p*;
- β_0 represents the intercept; and
- β_p represents the expected difference in the variable between the before and after periods.

Model Form – Before-After Control-Impact Design

LME models were constructed for each exposure site based on a BACI. The models follow the general form given below:

$$y = site\ class + period + site\ class{:}period.$$

This model identifies variation associated with different components, where:

- *site class* describes the differences between the reference and exposure sites;
- *period* describes the differences between the before and after periods across all sites (reference and exposure); and
- *site class:period* is the interaction term describing reference and exposure site-specific differences between periods (the BACI term).

The *site class:period* term is the key statistical term that describes differential changes to the exposure site during the period of potential mine effects relative to changes at the reference sites.

Let $y_{i\,sc\,p}$ denote observation *i* at site *sc* in period *p*, where period is before or after. The basic regression model specifies:

$$E(y_{i\,sc\,p}) = \beta_0 + \beta_{sc} + \beta_p + \beta_{sc:p}$$

where β_0 is the intercept, β_{sc} is the expected difference between reference and exposure site effects, β_p is the expected period effect, and $\beta_{sc:p}$ is a vector of expected site specific period effects.

Pseudoreplication

All observations from the same site and season were presented in the plots of the observed data and modelled values. However, repeated observations from each lake in each season were collected from similar locations at similar times and the variability between these observations may not reflect the true variation between random replicates from the entire lake in the given season. Analyzing these measurements as independent observations may underestimate the true variability and lead to overly sensitive statistical tests. Thus, LME models were used to incorporate random effects for site and year, and improve error variance modelling.

Random Variation

Random effects were included in the model to control for natural inter-annual variation (*year*) and natural site to site variation. Including random effects for site, year, and the interaction between site and year provided an adjustment for dependence among observations in a given season, at a specific site, and in a given year.

The model can be represented as:

$$E(y_{isp}) = \beta_0 + \beta_{sc} + \beta_p + \beta_{sc:p} + \varepsilon_s + \varepsilon_y + \varepsilon_{s:y}$$

where β_0 is the intercept, β_{sc} is the expected value for site class *sc*, β_p is the expected value for period *p*, $\beta_{sc:p}$ is the expected value for site class *sc* in period *p*, and $\varepsilon_s + \varepsilon_y + \varepsilon_{s:y}$ are the predicted random component for site *s* and year *y*.

C.2.3.1 HYPOTHESIS TESTING

Test 1: BA Analysis – Comparison within Exposure Lake

A Project-related effect would be expected to result in a significant difference between the before-after change observed at the exposure site. The period term describes the change from the before period to the after period. For each exposure site, the period effect was assessed using an F-test.

The hypothesis of this test was:

$$H_0: \beta_p = 0$$

$$H_a: \beta_p \neq 0$$

If the p-value for this *period* hypothesis test was less than α = 0.05, then it was concluded that a significant difference between the before and after periods was observed in the exposure site and the analysis proceeded to a BACI analysis.

Test 2: BACI Analysis – Comparison of Exposure and Reference Lake

A Project-related effect would be expected to result in a significant difference between the before-after change observed at the exposure sites and the reference sites. For BACI comparisons, only years in which both lakes were sampled were included in the analysis. The *site class:period* term describes the site class-specific variability in the change from the before period to the after period.

The hypothesis of this test was:

$$H_0: \beta_{sc:p} = 0$$

$$H_a: \beta_{sc:p} \neq 0$$

For each exposure site, the overall *site class:period* effect was assessed using an F-test. If the p-value for this *site class:period* hypothesis test was less than α = 0.05, then it was concluded that a significant site class-specific difference between the before and after periods was observed.

Confidence Intervals for Contrast Terms

Contrasts were calculated to compare the difference between the change at the exposure site and reference sites. In this approach, any contrast substantially different from zero would represent a differential before/after effect between the exposure site and the reference site currently being contrasted. For the contrasts, 95% confidence intervals were calculated to support the interpretation and, in turn, support the identification of significant site-specific differences. If the confidence interval for a contrast did not cover zero, it was concluded that a significant site-specific difference between the *before* and *after* periods was observed between the exposure site and that particular reference site.

C.2.4 PLOTS OF OBSERVED AND FITTED VALUES

Plots of the observed and fitted values were used to visually assess and compare the values within and among lakes, and aid in the interpretation of the hypothesis test results. Observations below the DL were plotted at half the DL and indicated by a hollow symbol.

For the temporal trend analyses (Doris Lake) the fitted mean values were represented with curves and error bars represent the 95% confidence intervals for the model estimate of the annual mean. For the BACI analyses (Patch and Windy lakes) the fitted mean for the before and after period were represented with curves and error bars represent the 95% confidence intervals for the fitted period mean.

C.2.5 COMPUTING

All steps of the analysis were performed using the statistical computing package R version 4.1.2. The following versions of packages were used for the analyses:

- dplyr (1.0.10);
- stringr (1.5.0);
- tidyr (1.3.0);
- lubridate (1.8.0);

- ggplot2 (3.4.0);
- knitr (1.40.2);
- readxl (1.4.2);
- here (1.0.1);
- survival (3.2.12); and
- lme4 (1.1-35.1).

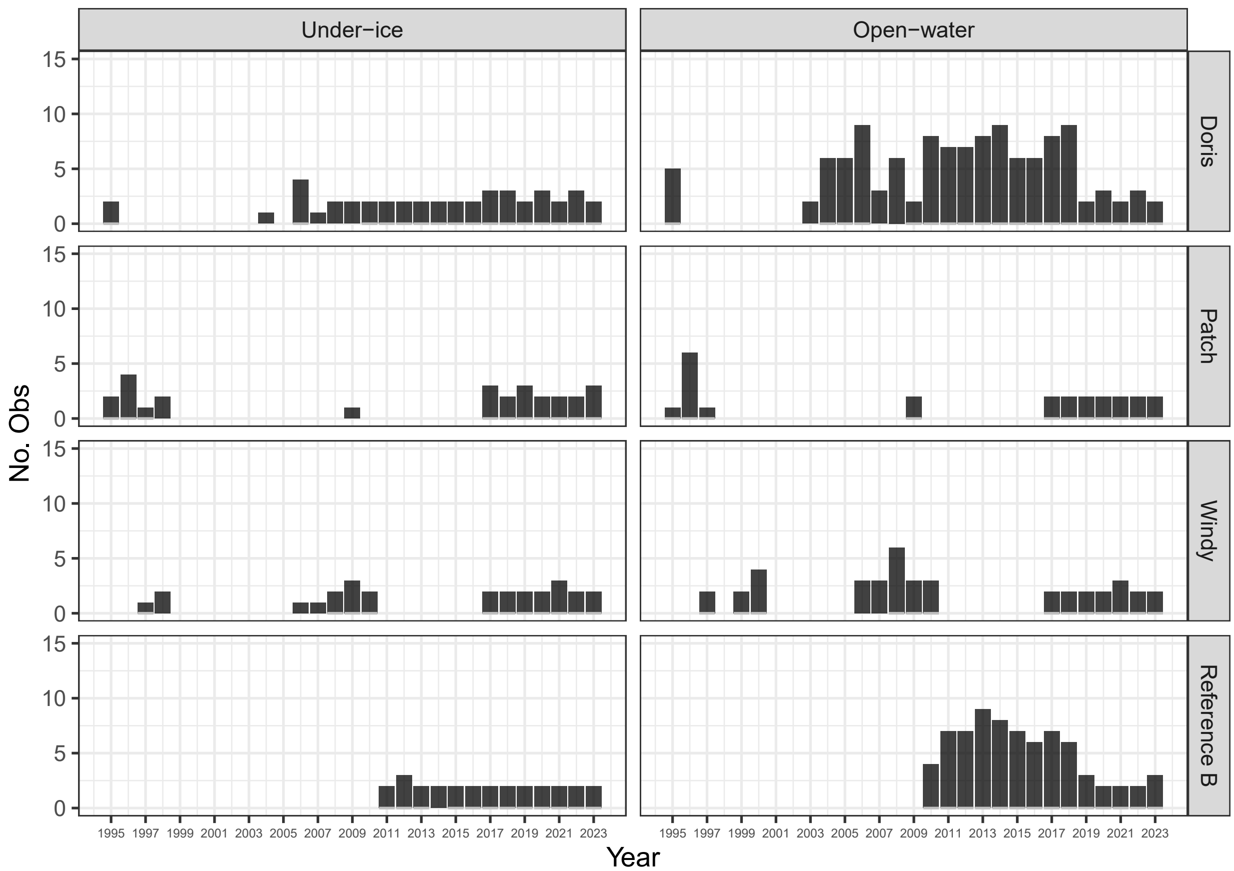
C.3 STATISTICAL RESULTS FOR EVALUATION OF EFFECTS

C.3.1 WATER QUALITY

C.3.1.1 pH

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

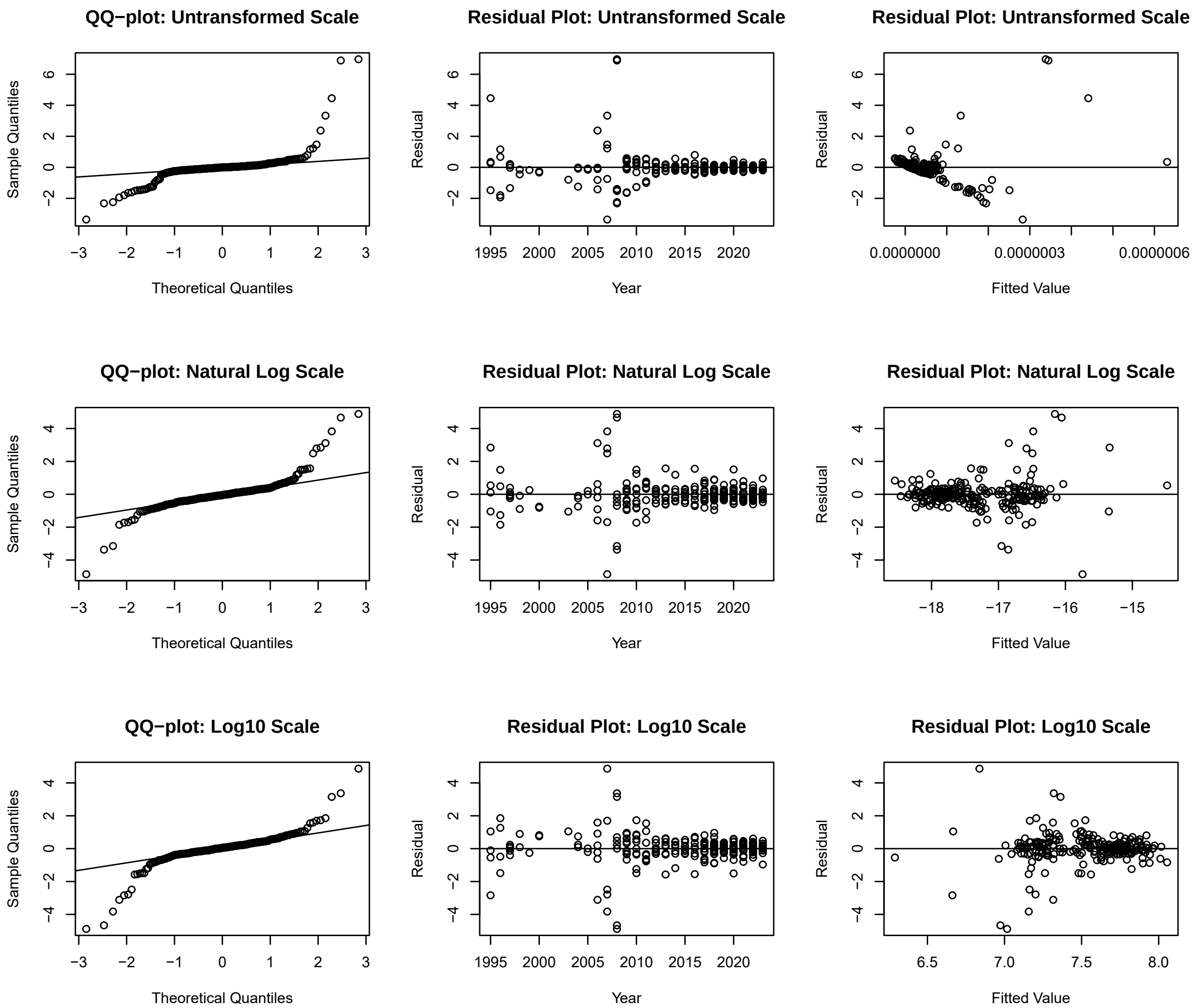
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	44	0	0	0
Doris	Open-water	119	0	0	0
Patch	Under-ice	27	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	27	0	0	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	27	0	0	0
Windy	Open-water	41	0	0	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
15	Doris	2007	Under-ice	Surface	0.0000000	0	-3.365
18	Doris	2008	Under-ice	Deep	0.0000009	0	6.890
19	Doris	2008	Under-ice	Surface	0.0000009	0	6.969
83	Patch	1995	Open-water	Surface	0.0000008	0	4.456
189	Windy	2007	Open-water	Deep	0.0000004	0	3.333

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
15	Doris	2007	Under-ice	Surface	0.0000000	-15.744	-4.865
18	Doris	2008	Under-ice	Deep	0.0000009	-16.056	4.666
19	Doris	2008	Under-ice	Surface	0.0000009	-16.157	4.887
184	Windy	2006	Under-ice	Surface	0.0000002	-16.846	3.114
189	Windy	2007	Open-water	Deep	0.0000004	-16.480	3.828
193	Windy	2008	Open-water	Deep	0.0000000	-16.854	-3.369
194	Windy	2008	Open-water	Surface	0.0000000	-16.955	-3.148

Outliers on log10 scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
15	Doris	2007	Under-ice	Surface	0.0000000	6.837	4.865
18	Doris	2008	Under-ice	Deep	0.0000009	6.973	-4.666
19	Doris	2008	Under-ice	Surface	0.0000009	7.017	-4.887
184	Windy	2006	Under-ice	Surface	0.0000002	7.316	-3.114
189	Windy	2007	Open-water	Deep	0.0000004	7.157	-3.828
193	Windy	2008	Open-water	Deep	0.0000000	7.320	3.369
194	Windy	2008	Open-water	Surface	0.0000000	7.363	3.148

The log10 data meets residual assumptions better than the untransformed data. Analysis proceeds with log10 data since pH is in log base 10 units.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	18.645	4	0.00090	sig.
Compare to Reference B	3.688	4	0.44980	not sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake did not exhibit significant deviation from the trend of Reference Lake B

Doris Open-Water

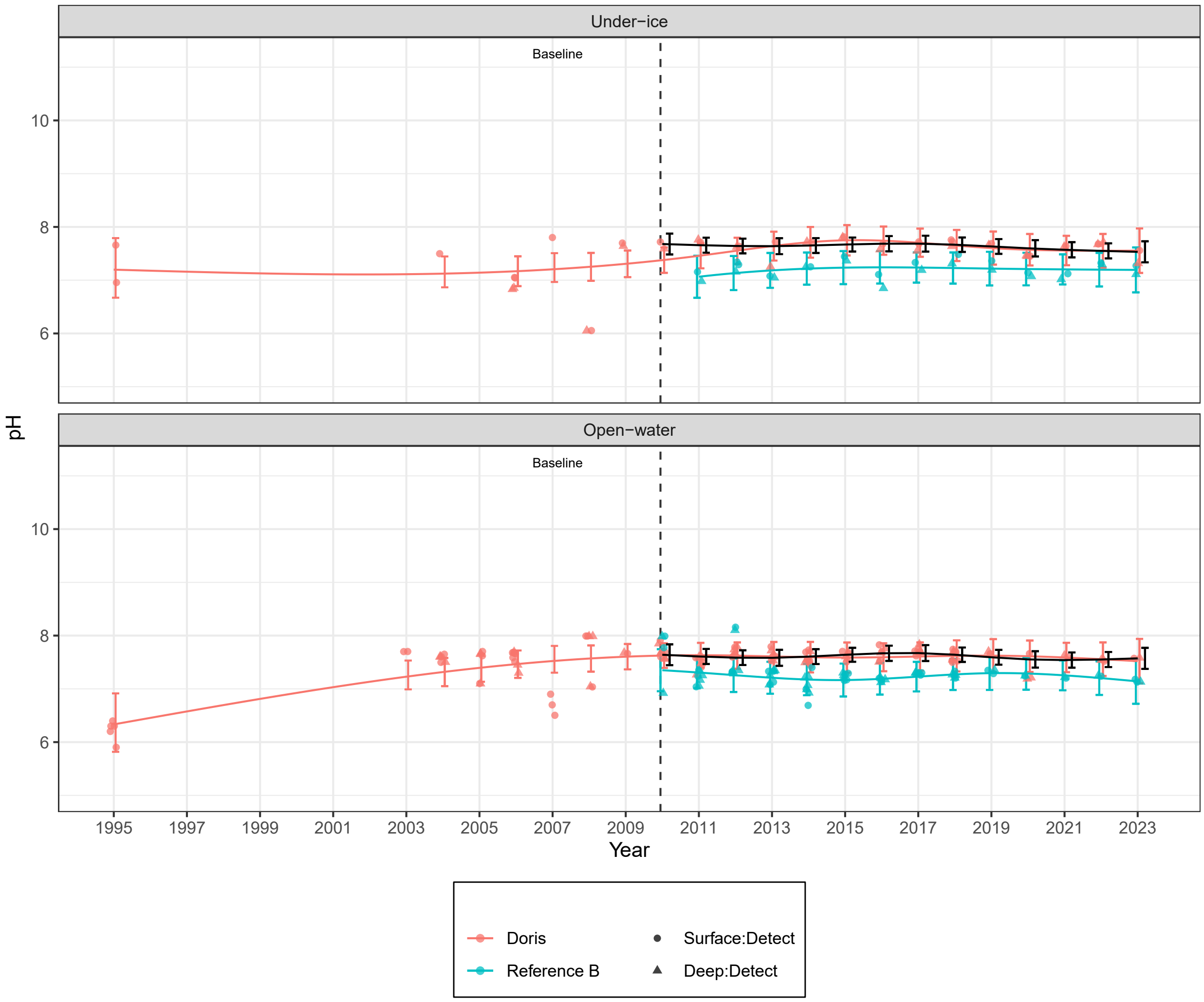
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	29.298	4	<0.00001	sig.
Compare to Reference B	9.482	4	0.05010	not sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake did not exhibit significant deviation from the trend of Reference Lake B

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

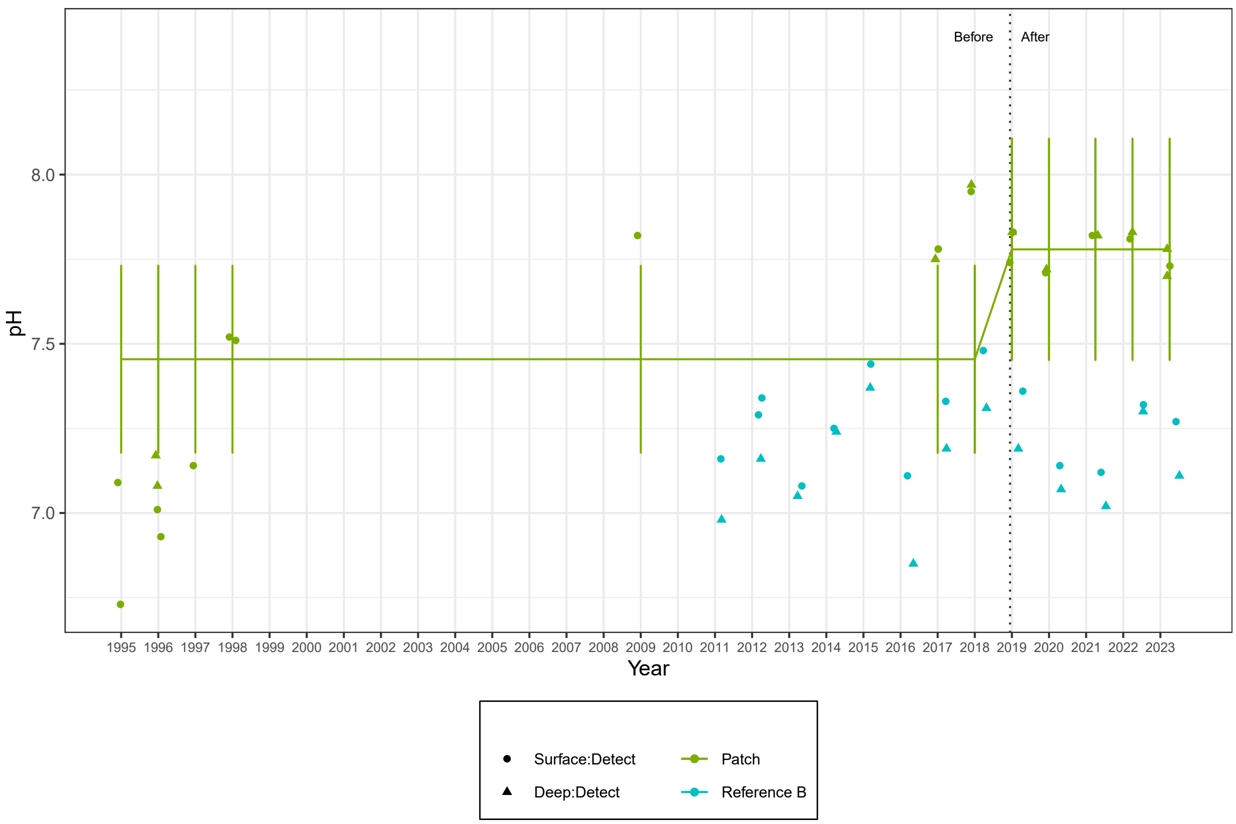
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3247	0.1931	9.975	1.681	0.1237	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

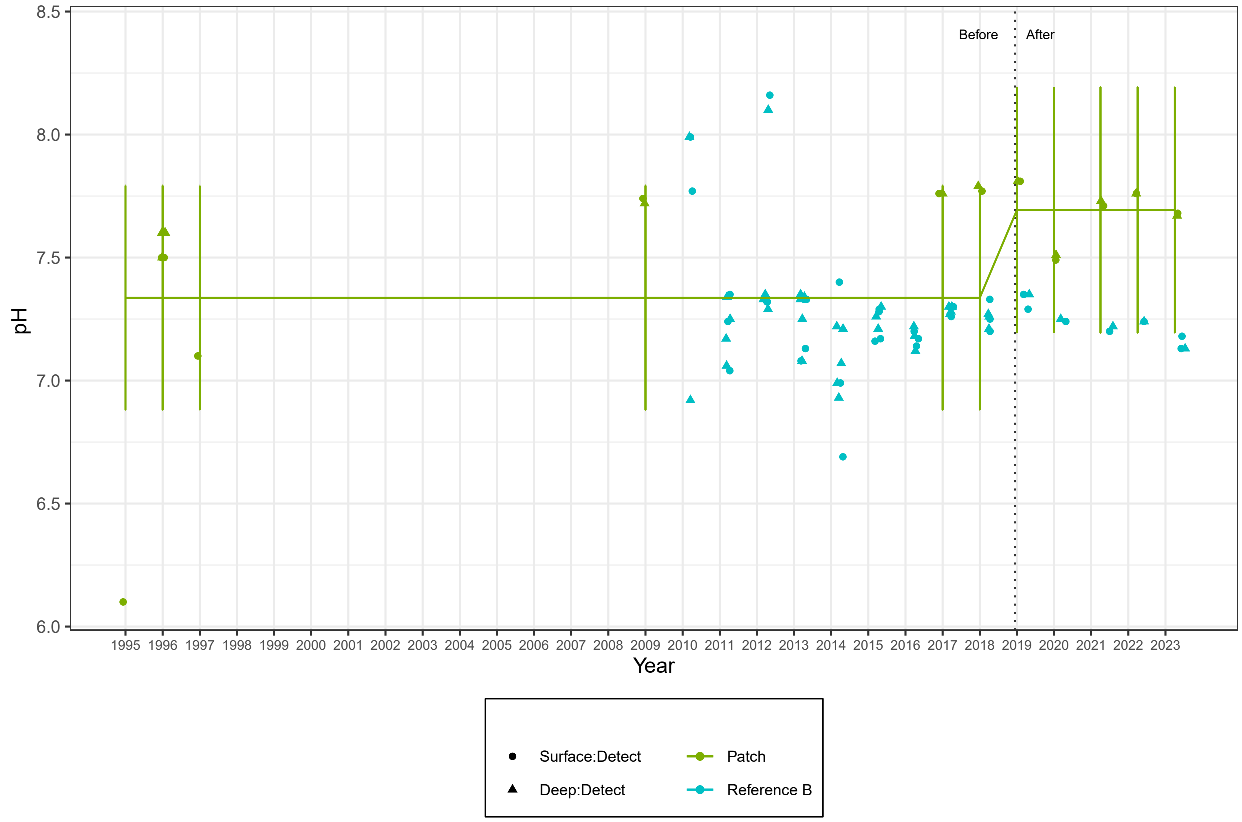
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3565	0.2989	8.991	1.192	0.2636	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

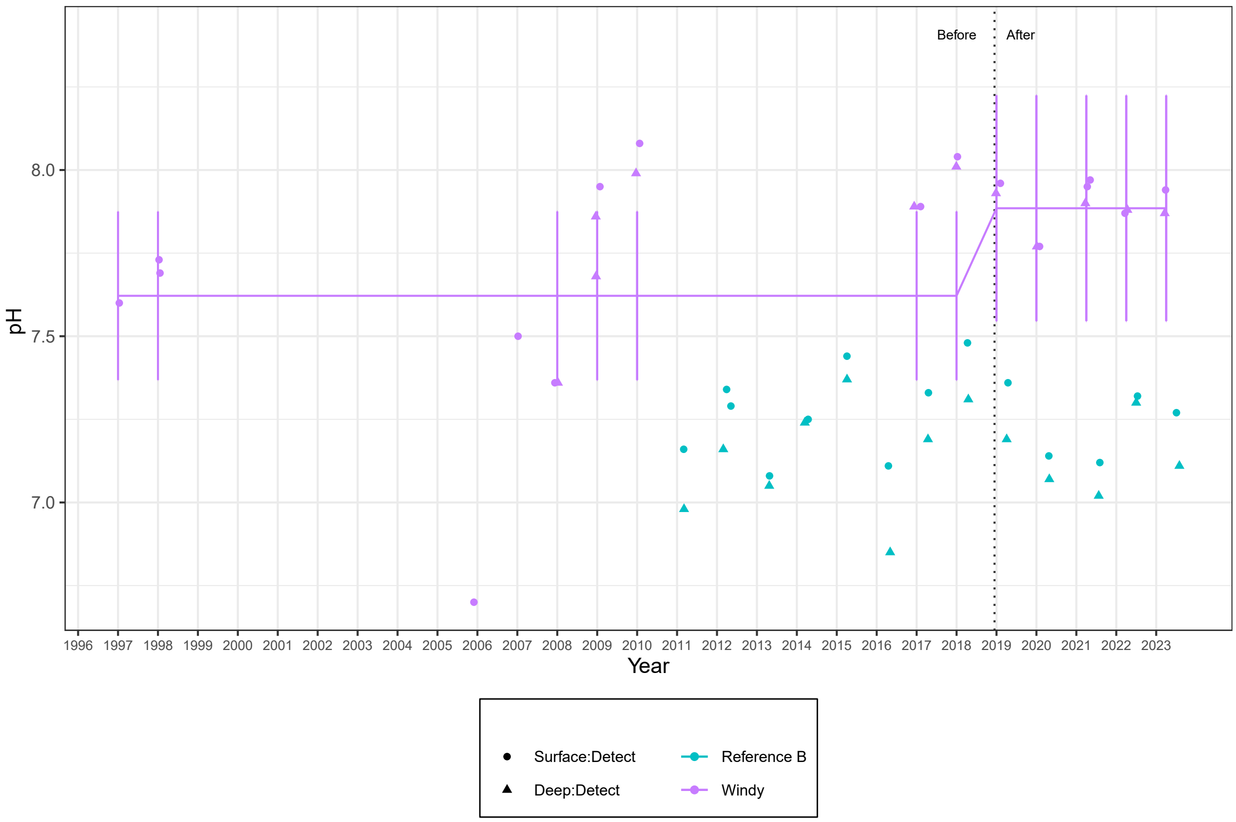
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.2634	0.1944	11.91	1.355	0.2006	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

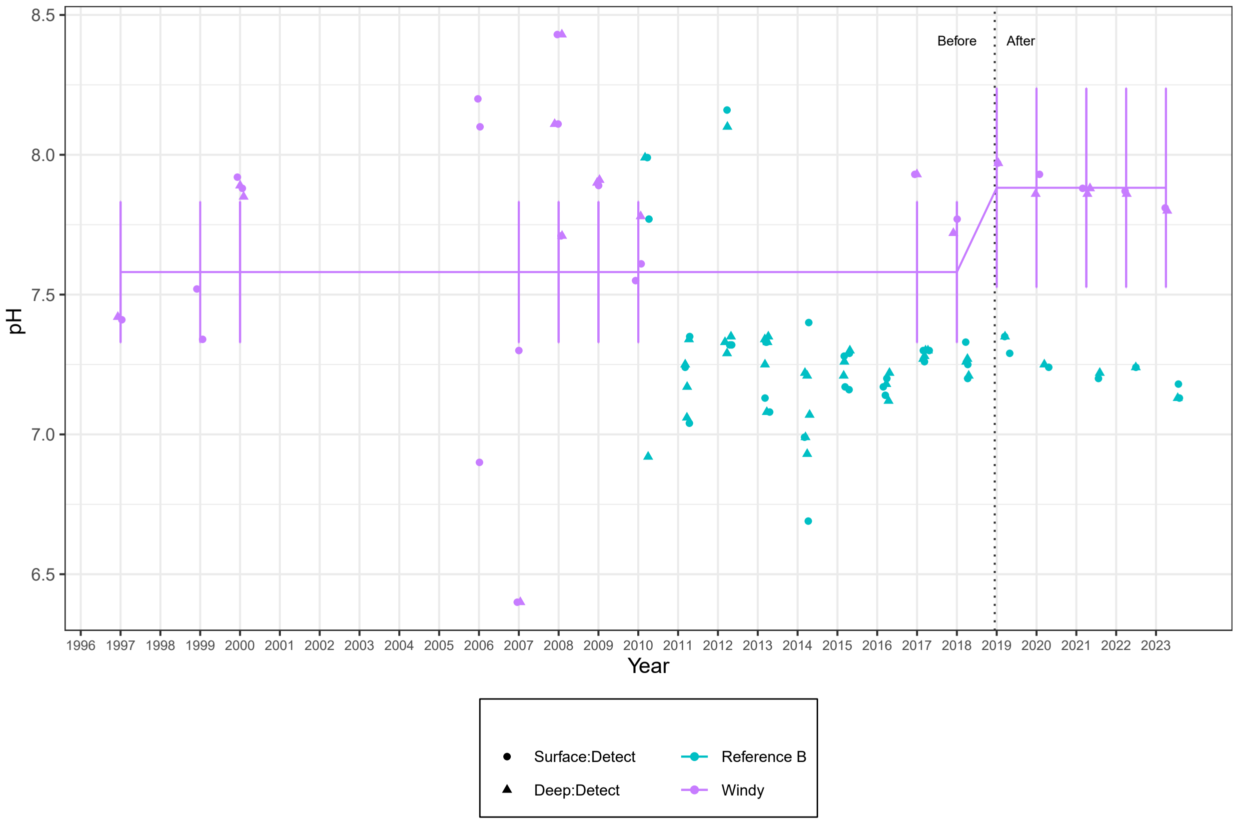
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3014	0.2021	13.01	1.491	0.1598	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

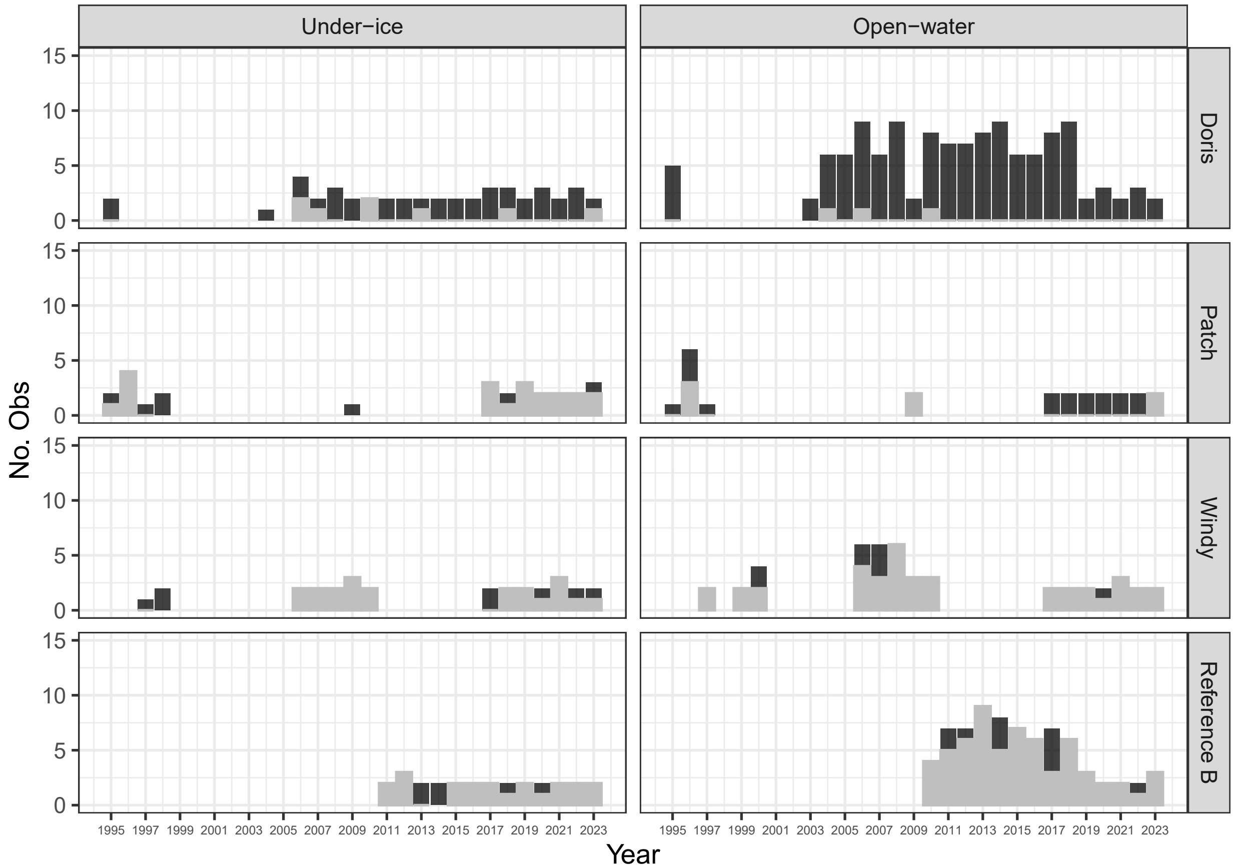
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Before
After
pH
8.5
8.0
7.5
7.0
6.5
Year
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Surface:Detect
Deep:Detect
Reference B
Windy

C.3.1.2 Total Suspended Solids

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

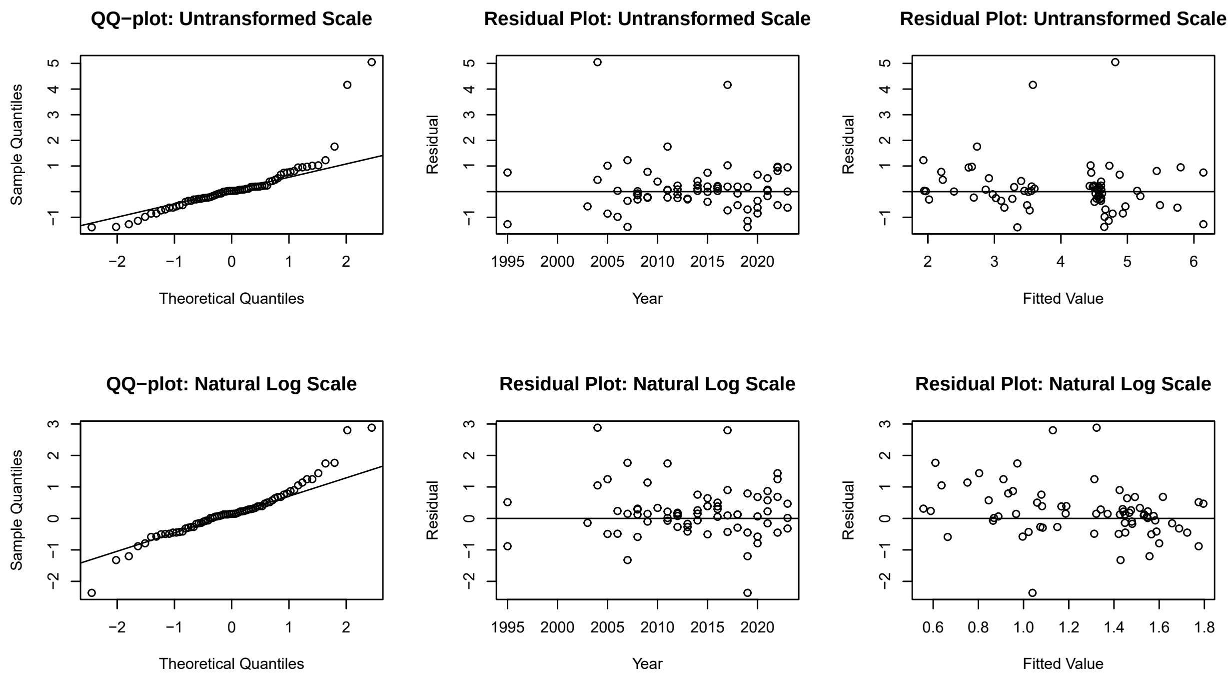
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	46	9	20	50
Doris	Open-water	125	3	2	0
Patch	Under-ice	27	22	81	67
Patch	Open-water	24	7	29	100
Reference B	Under-ice	27	23	85	100
Reference B	Open-water	73	62	85	100
Windy	Under-ice	29	22	76	50
Windy	Open-water	47	39	83	100

More than 50% of data under detection limit in Patch Under-ice, Patch Open-water, Reference B Under-ice, Reference B Open-water, Windy Under-ice, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice and Patch Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
6	Doris	2004	Open-water	Deep	13.33	4.818	5.050
55	Doris	2017	Under-ice	Surface	10.60	3.579	4.163

Outliers on natural log scale:

None

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	11.03	3	0.01160	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

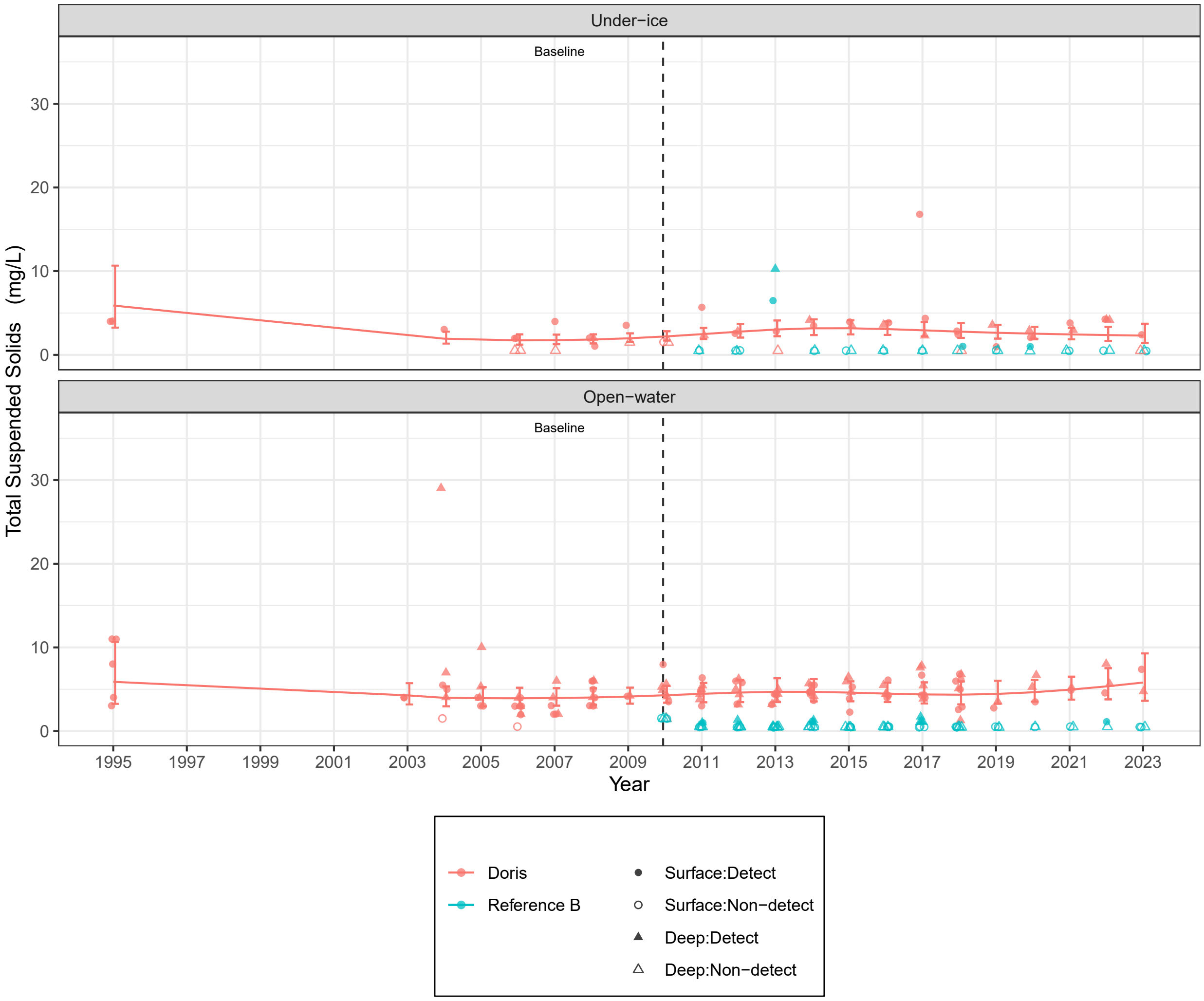
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	1.55	3	0.67080	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis Analysis not performed.

Patch Open-Water Before-After Analysis Analysis not performed.

Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

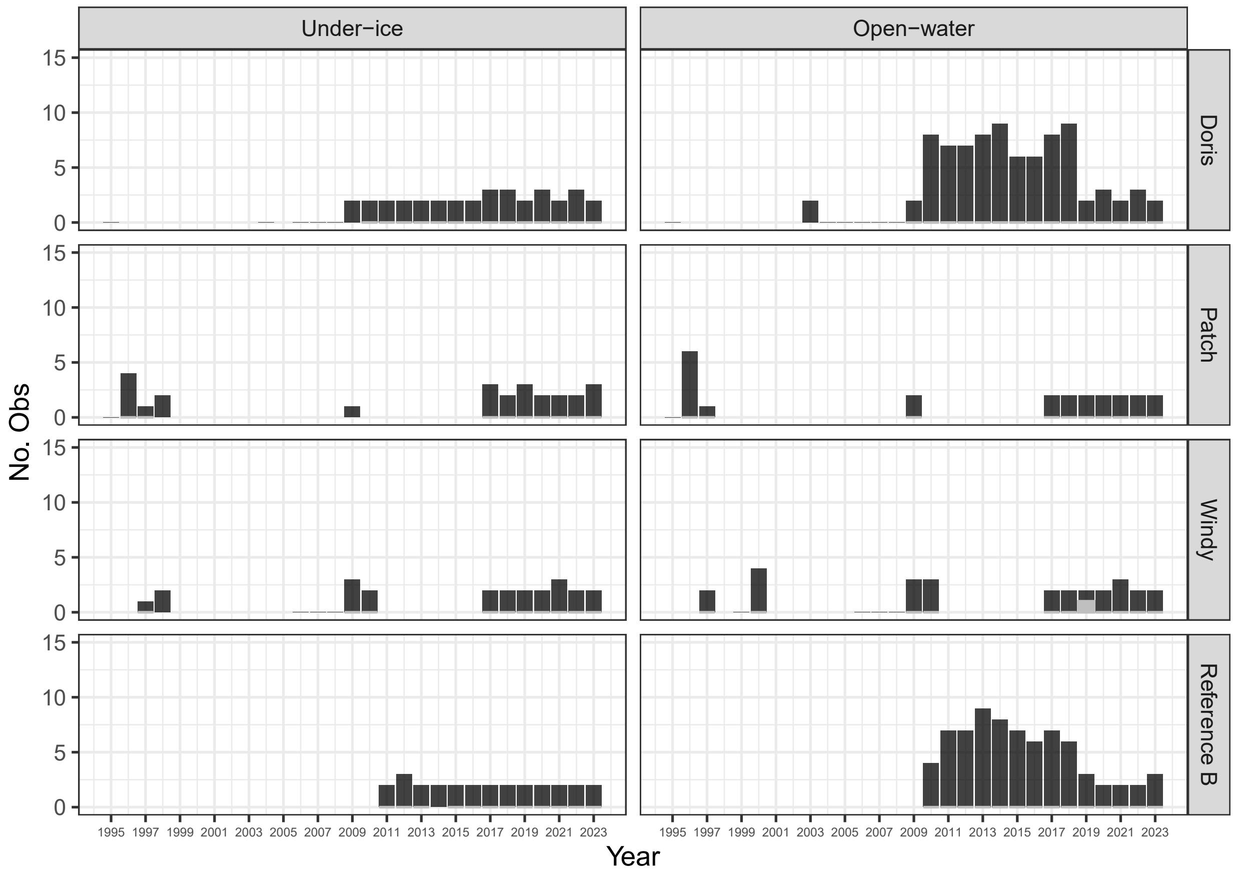
Windy Under-Ice Before-After Analysis Analysis not performed.

Windy Open-water Before-After Analysis Analysis not performed.

C.3.1.3 Turbidity

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

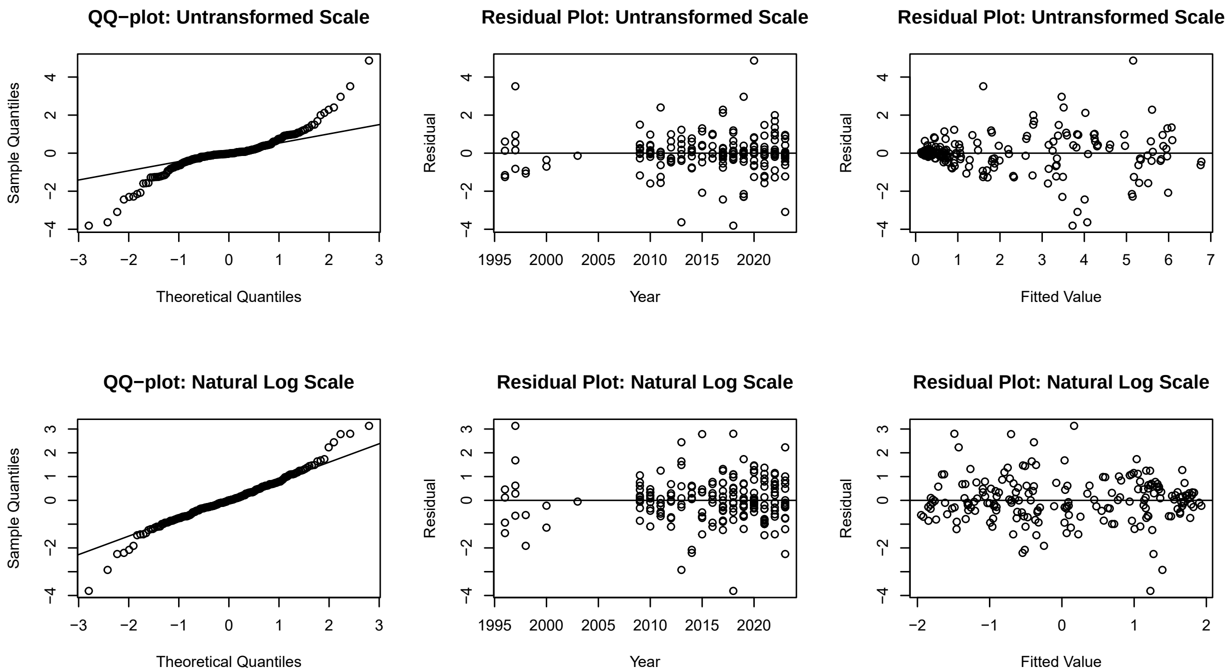
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	34	0	0	0
Doris	Open-water	84	0	0	0
Patch	Under-ice	25	0	0	0
Patch	Open-water	23	0	0	0
Reference B	Under-ice	27	0	0	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	23	0	0	0
Windy	Open-water	27	1	4	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
38	Doris	2013	Under-ice	Deep	1.18	4.071	-3.634
58	Doris	2018	Under-ice	Deep	0.69	3.722	-3.811
68	Doris	2020	Open-water	Deep	9.03	5.159	4.865
78	Doris	2023	Under-ice	Deep	1.38	3.839	-3.090
88	Patch	1997	Under-ice	Surface	4.40	1.603	3.515

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
58	Doris	2018	Under-ice	Deep	0.69	1.225	-3.808
88	Patch	1997	Under-ice	Surface	4.40	0.169	3.132

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	2.406	4	0.66160	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

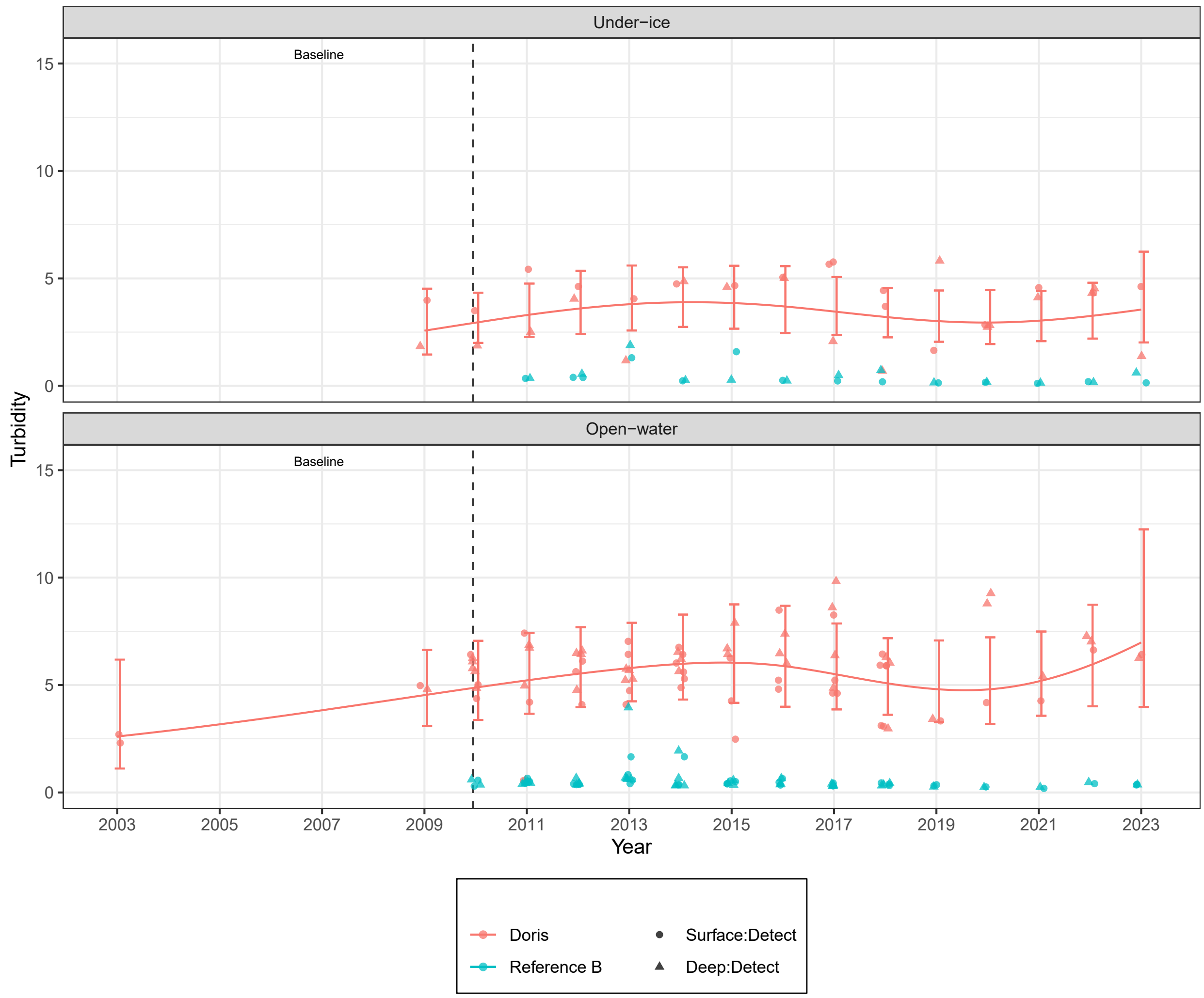
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	5.253	4	0.26230	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

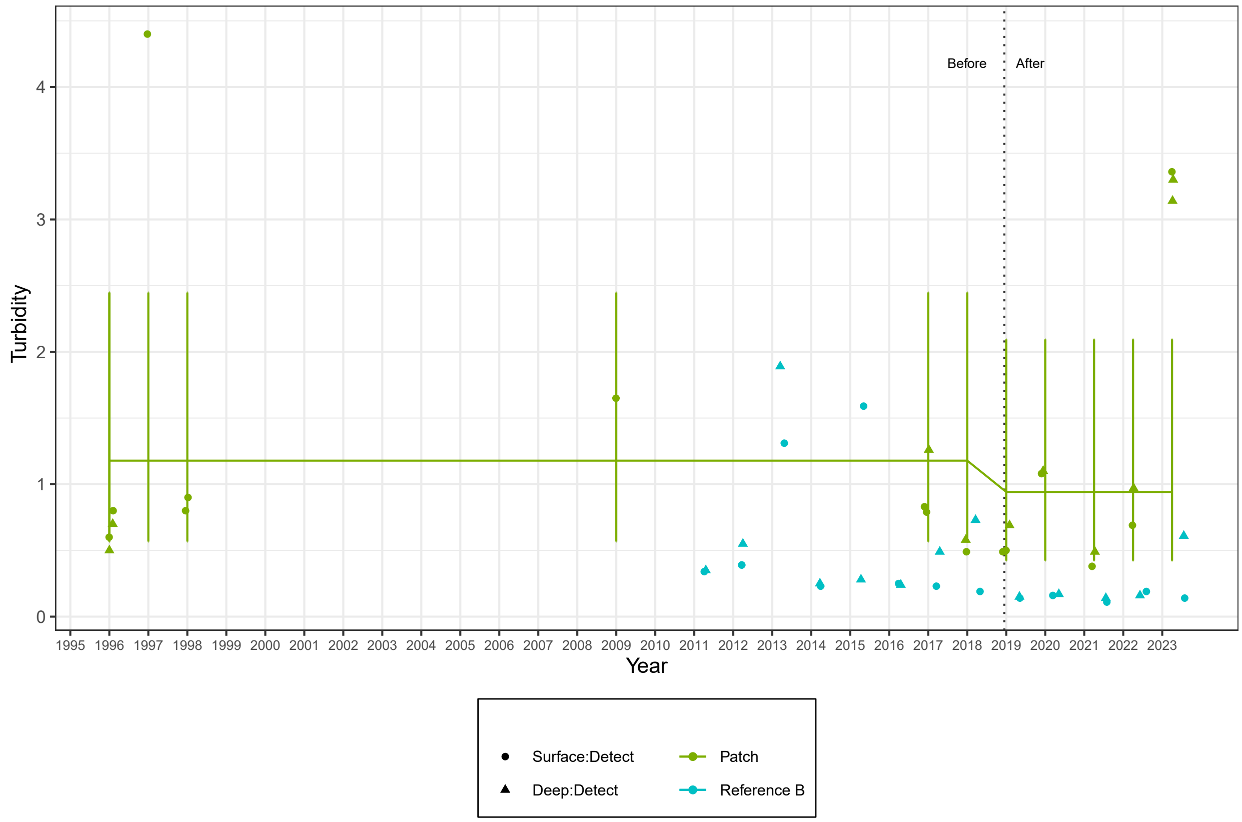
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.2243	0.4789	8.959	-0.4685	0.6506	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

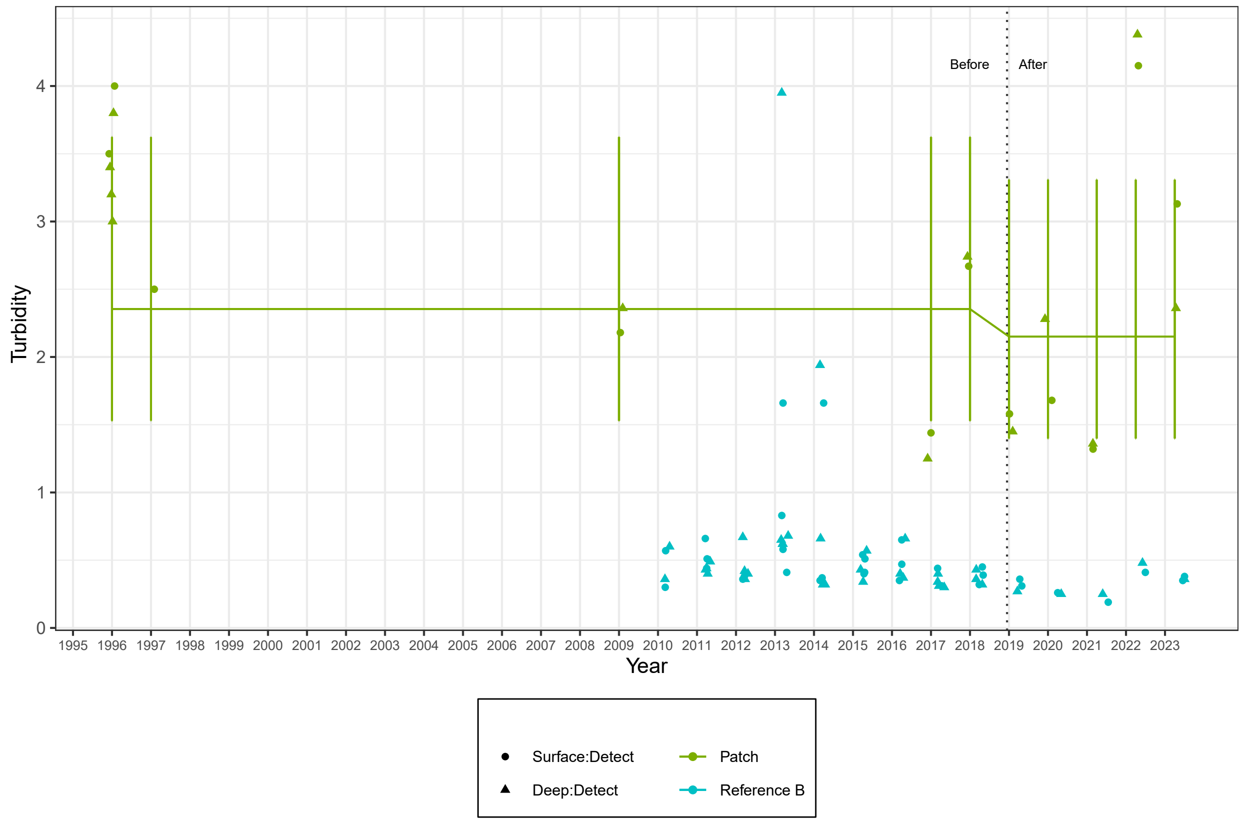
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0903	0.2644	8.063	-0.3417	0.7413	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

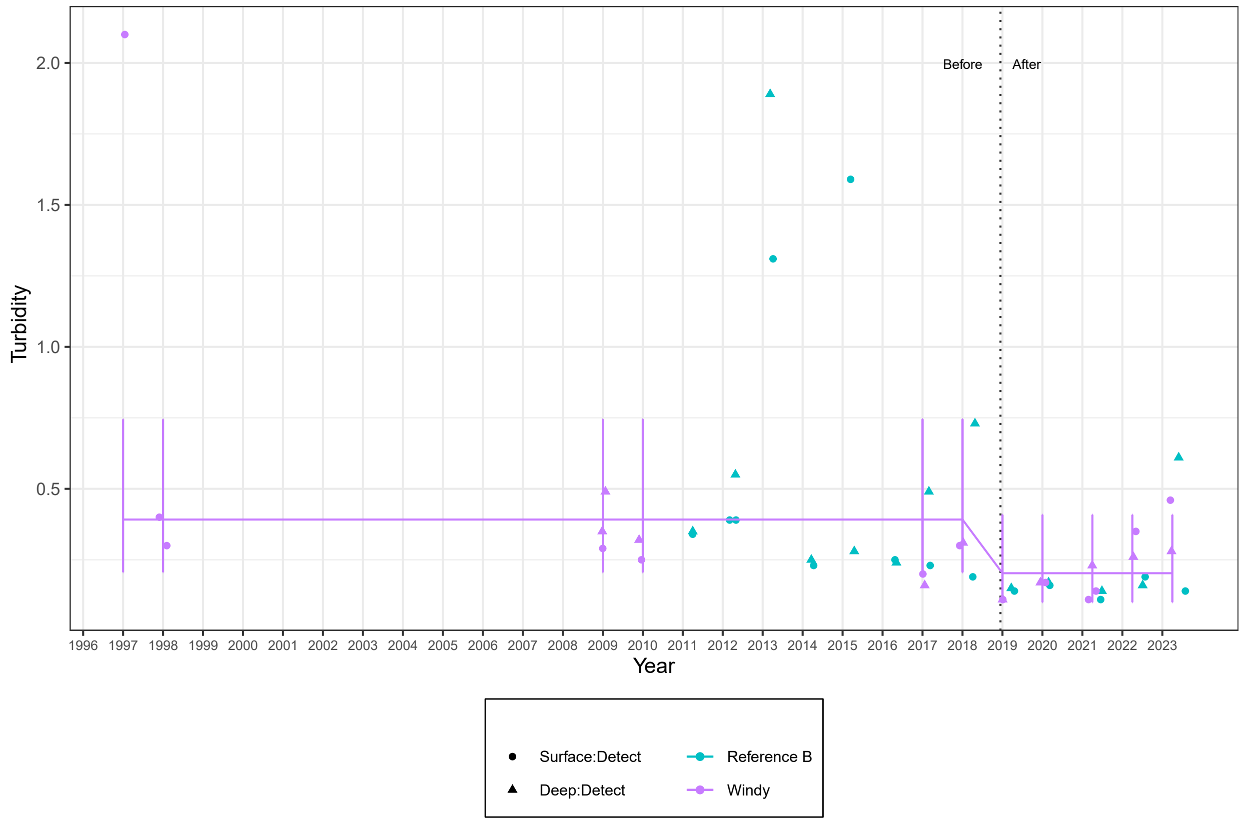
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.6585	0.4198	8.433	-1.569	0.1535	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

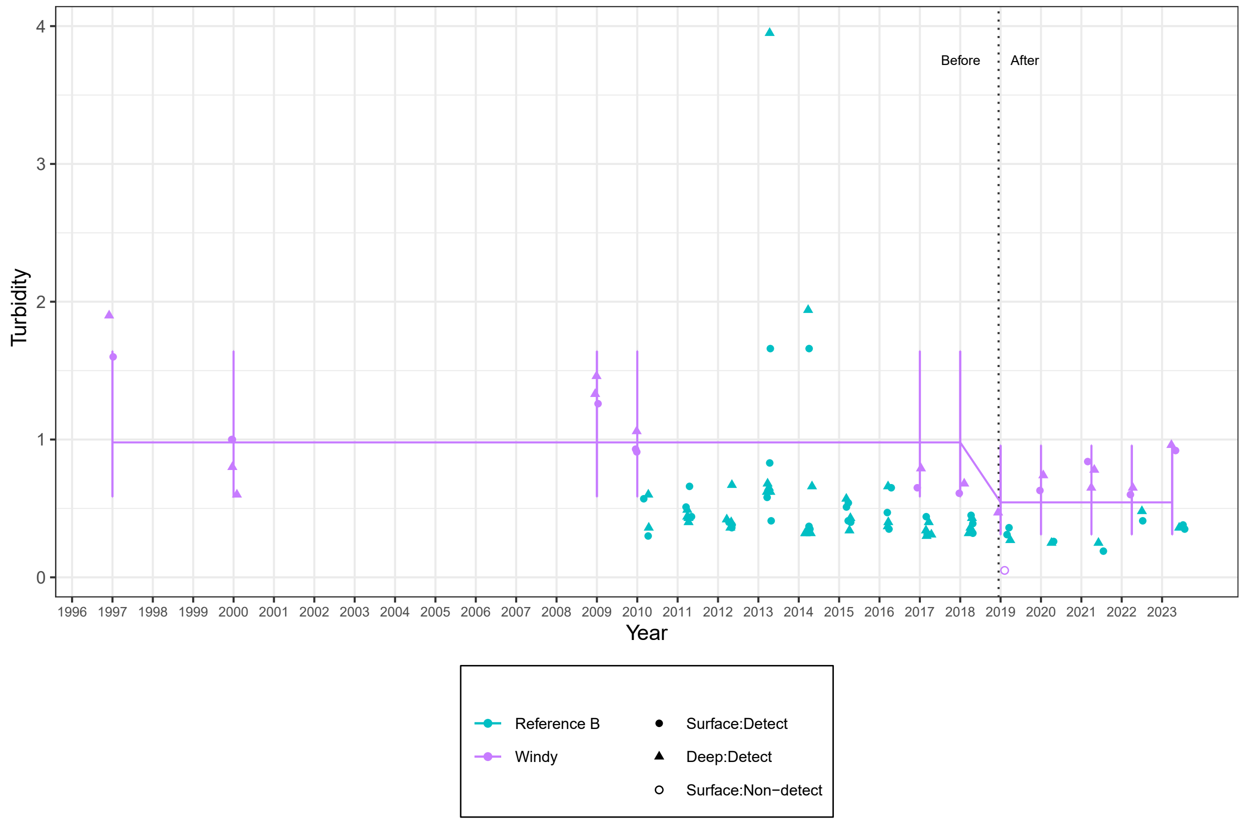
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.5879	0.339	9	-1.734	0.1169	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

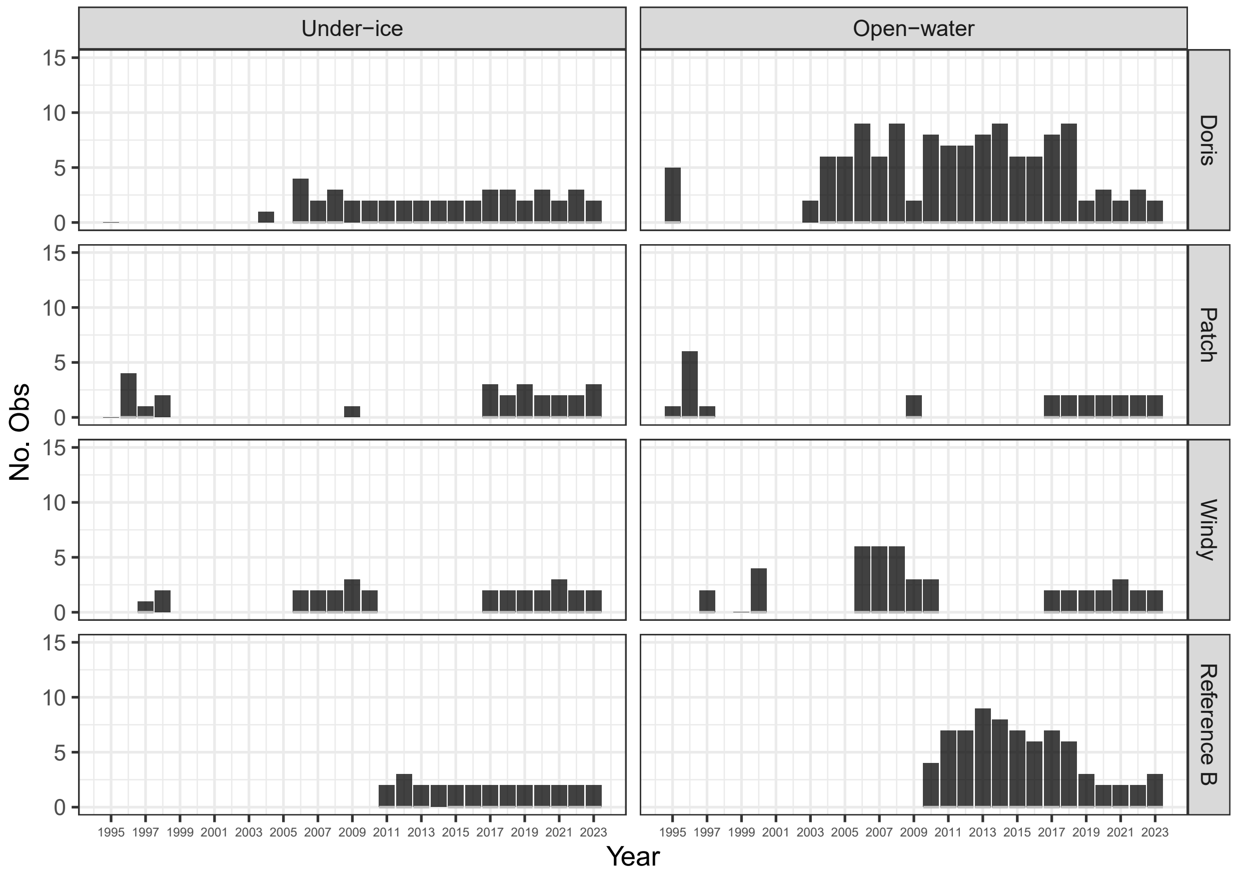
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Turbidity
Year
Before
After
Reference B
Windy
Surface:Detect
Deep:Detect
Surface:Non-detect

C.3.1.4 Chloride

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

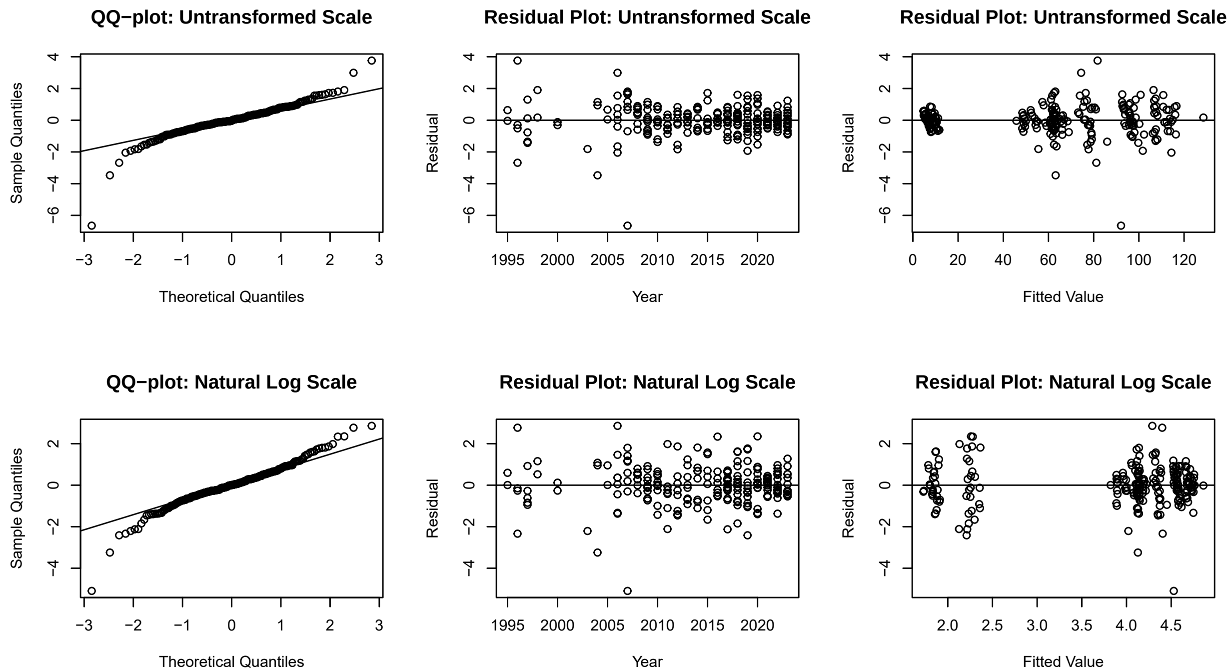
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	44	0	0	0
Doris	Open-water	125	0	0	0
Patch	Under-ice	25	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	27	0	0	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	29	0	0	0
Windy	Open-water	45	0	0	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
5	Doris	2004	Under-ice	Surface	54.00	63.16	-3.472
84	Patch	1996	Under-ice	Deep	91.65	81.73	3.760
190	Windy	2007	Open-water	Surface	74.57	92.11	-6.647

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
5	Doris	2004	Under-ice	Surface	54.00	4.127	-3.245
190	Windy	2007	Open-water	Surface	74.57	4.529	-5.095

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	101.58	4	<0.00001	sig.
Compare to Reference B	89.88	4	<0.00001	sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake exhibited significant deviation from the trend of Reference Lake B

Doris Open-Water

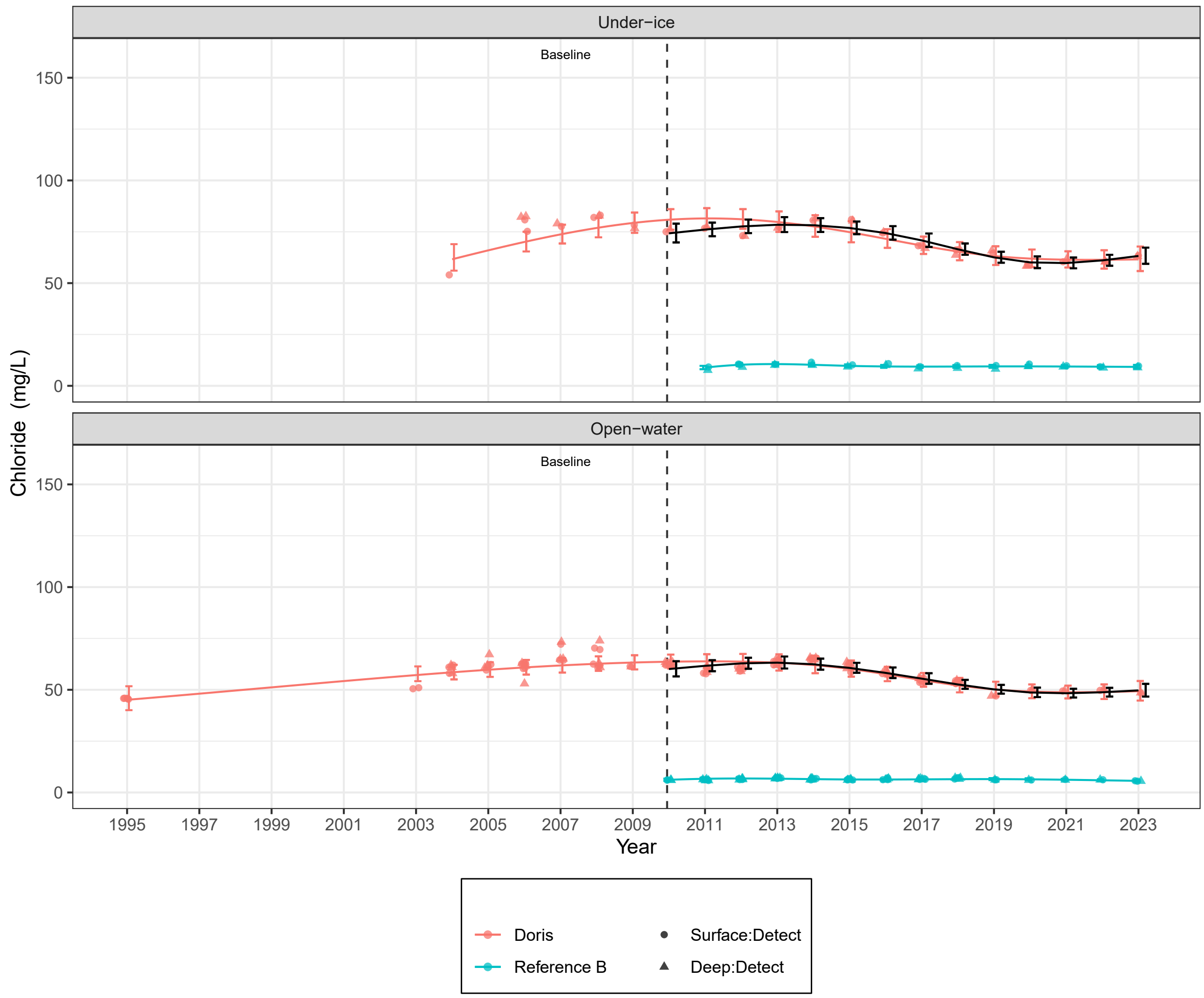
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	110.02	4	<0.00001	sig.
Compare to Reference B	61.97	4	<0.00001	sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake exhibited significant deviation from the trend of Reference Lake B

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

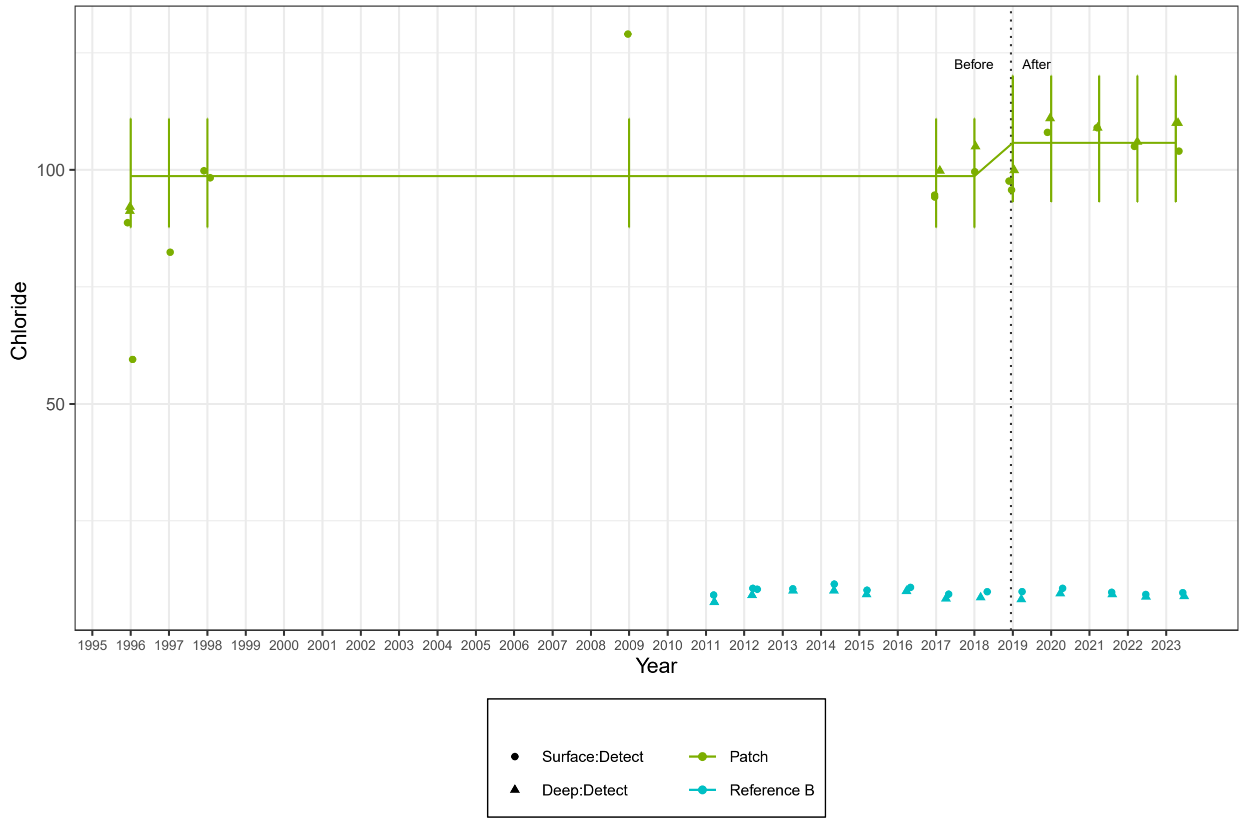
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0697	0.0766	8.405	0.9091	0.3886	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

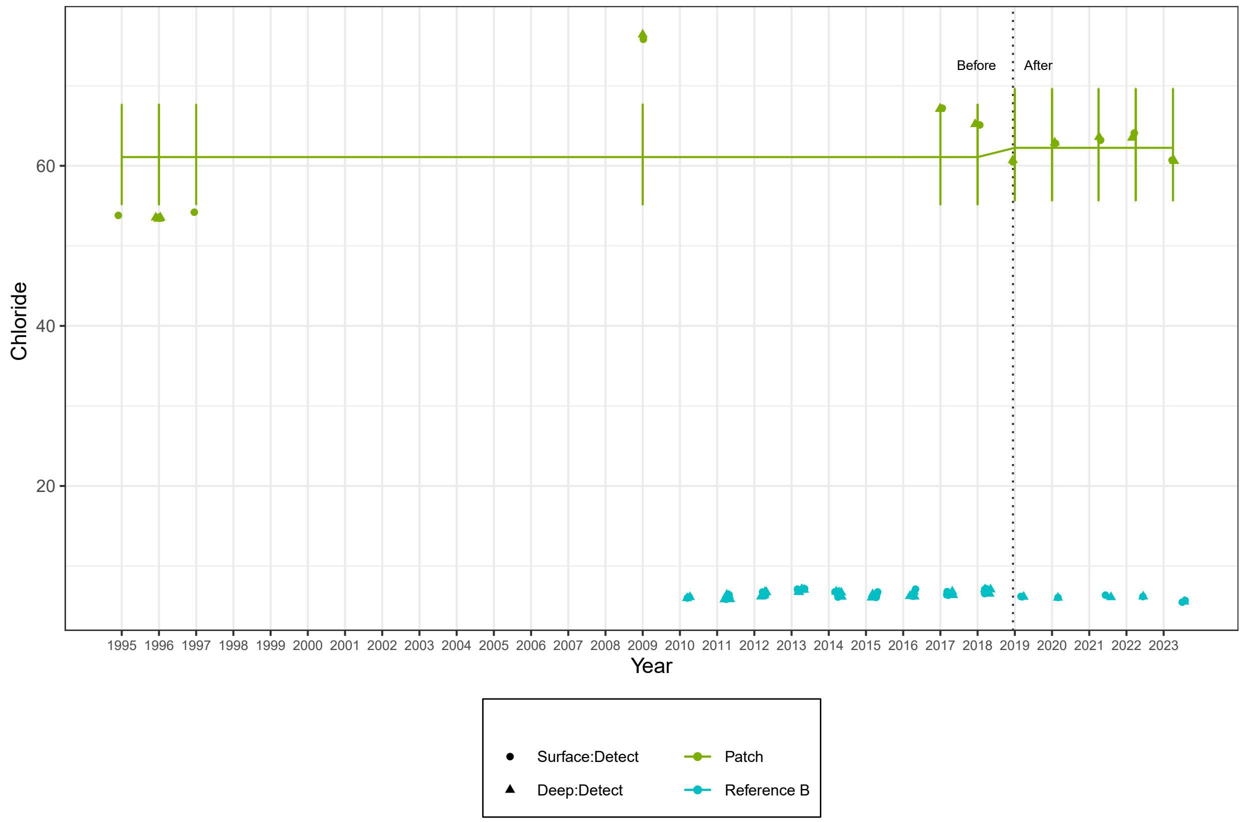
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0187	0.0675	8.999	0.2775	0.7877	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

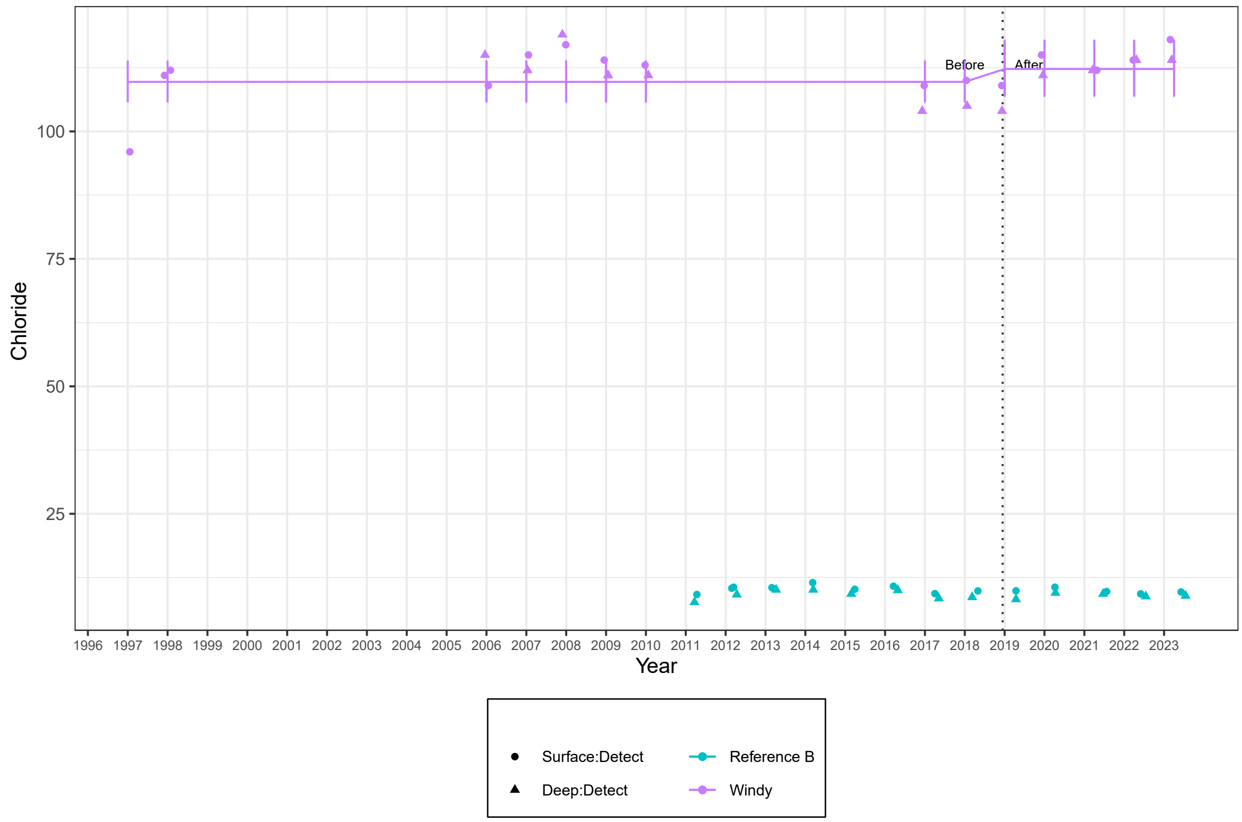
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0227	0.0282	10.81	0.8049	0.4382	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

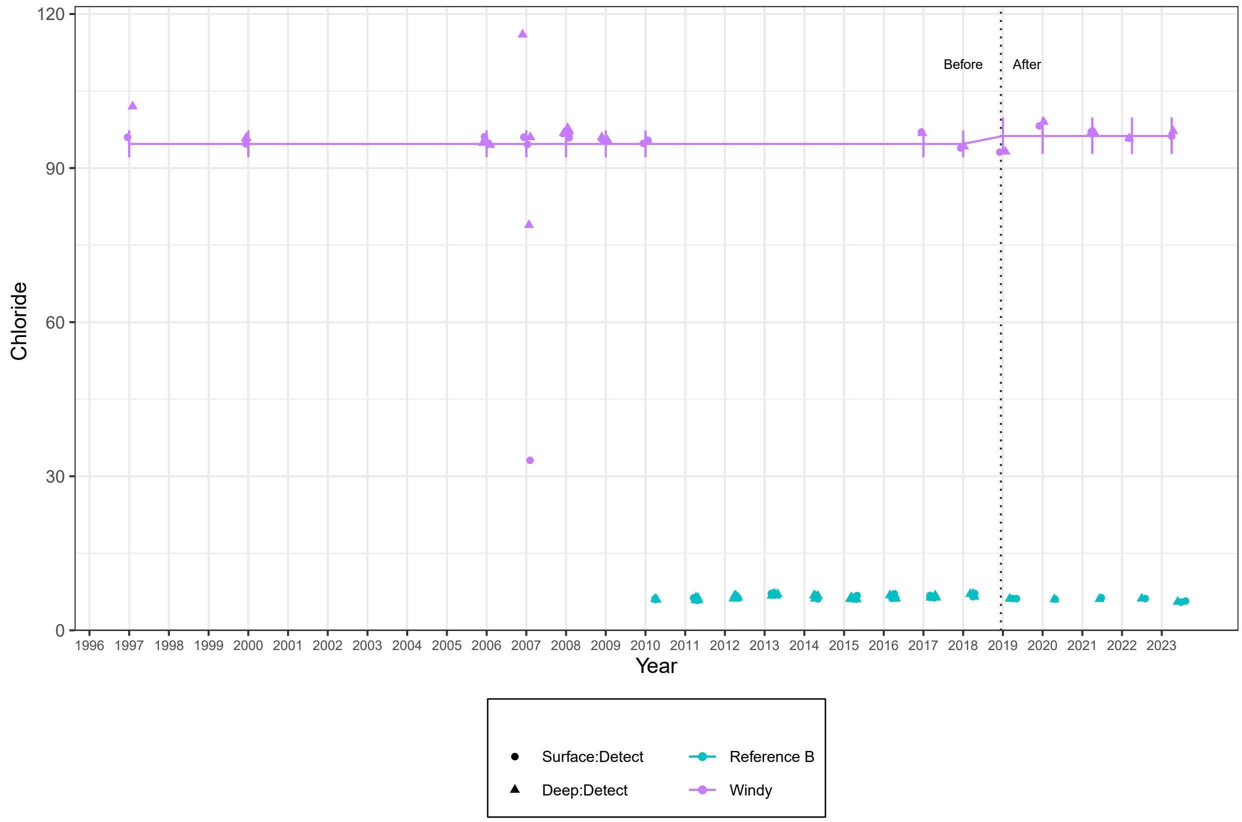
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0161	0.0207	12	0.7771	0.4522	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

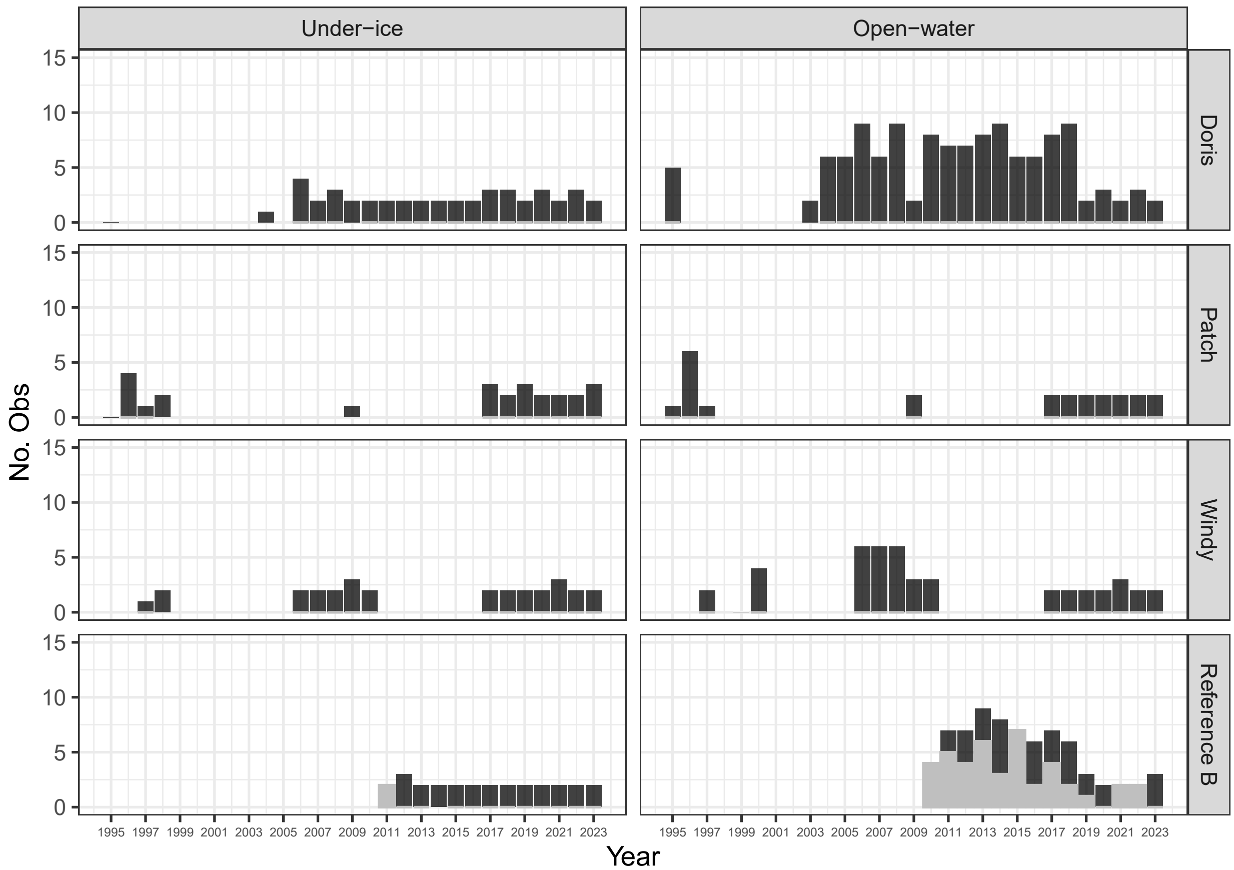
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Chloride
Year
Before
After
0
30
60
90
120
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Surface:Detect
Deep:Detect
Reference B
Windy

C.3.1.5 Fluoride

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

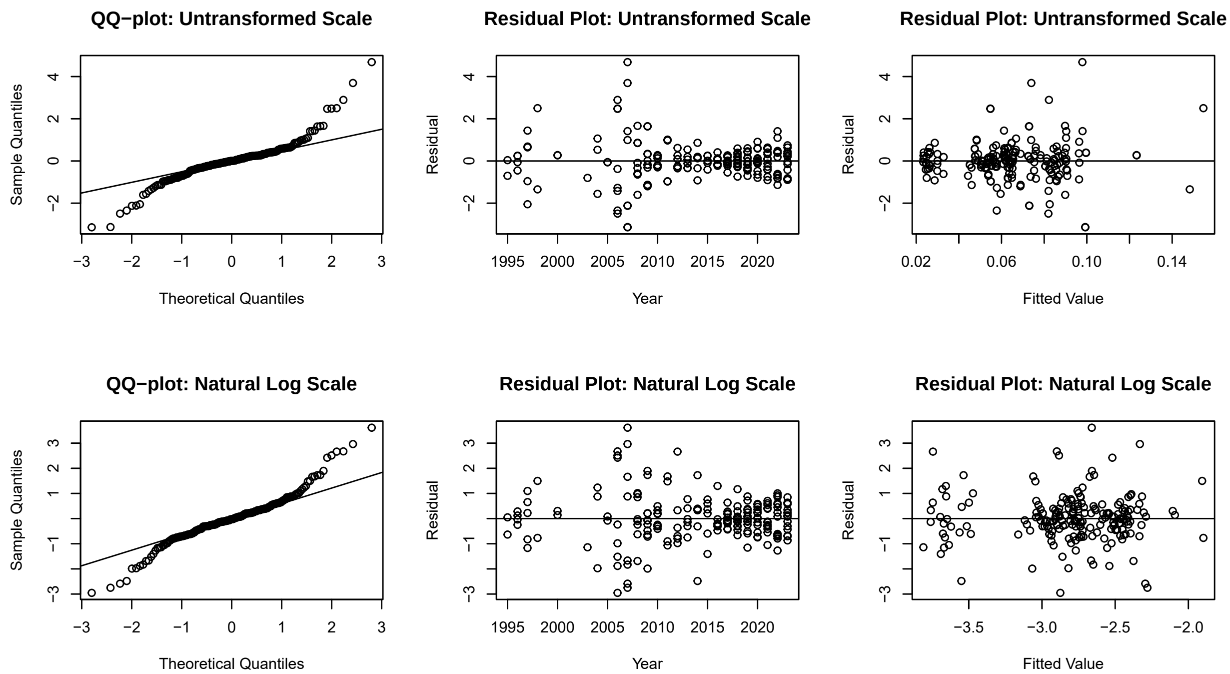
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	44	0	0	0
Doris	Open-water	125	0	0	0
Patch	Under-ice	25	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	27	2	7	0
Reference B	Open-water	73	42	58	0
Windy	Under-ice	29	0	0	0
Windy	Open-water	45	0	0	0

More than 50% of data under detection limit in Reference B Open-water. Data from those site-season groupings will be removed from the analysis.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
17	Doris	2007	Open-water	Surface	0.0967	0.074	3.695
159	Windy	2007	Under-ice	Deep	0.0800	0.099	-3.132
160	Windy	2007	Under-ice	Surface	0.0800	0.099	-3.144
161	Windy	2007	Open-water	Deep	0.1267	0.098	4.684

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
17	Doris	2007	Open-water	Surface	0.0967	-2.66	3.615

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	6.098	4	0.19200	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

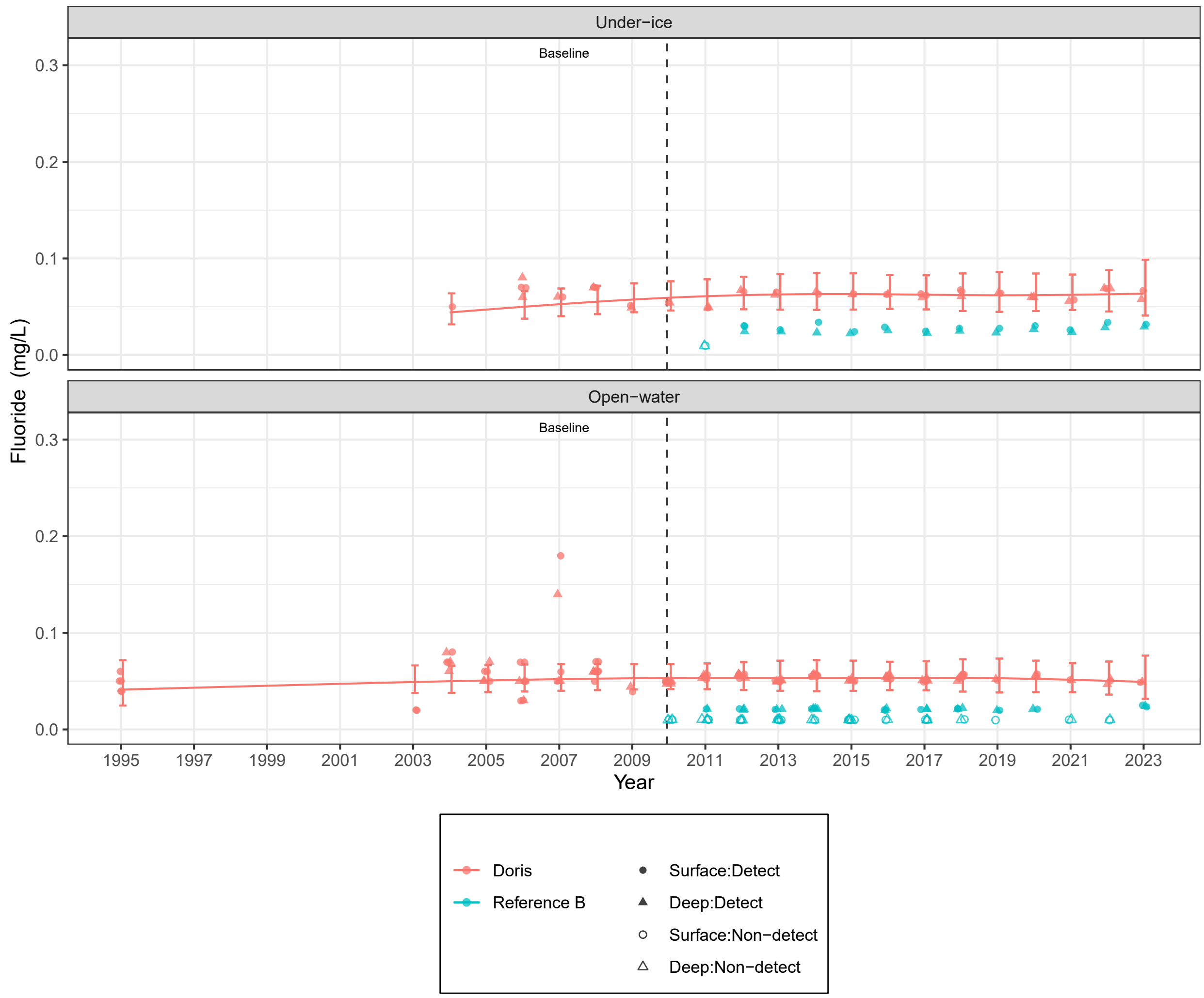
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	1.369	4	0.84950	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

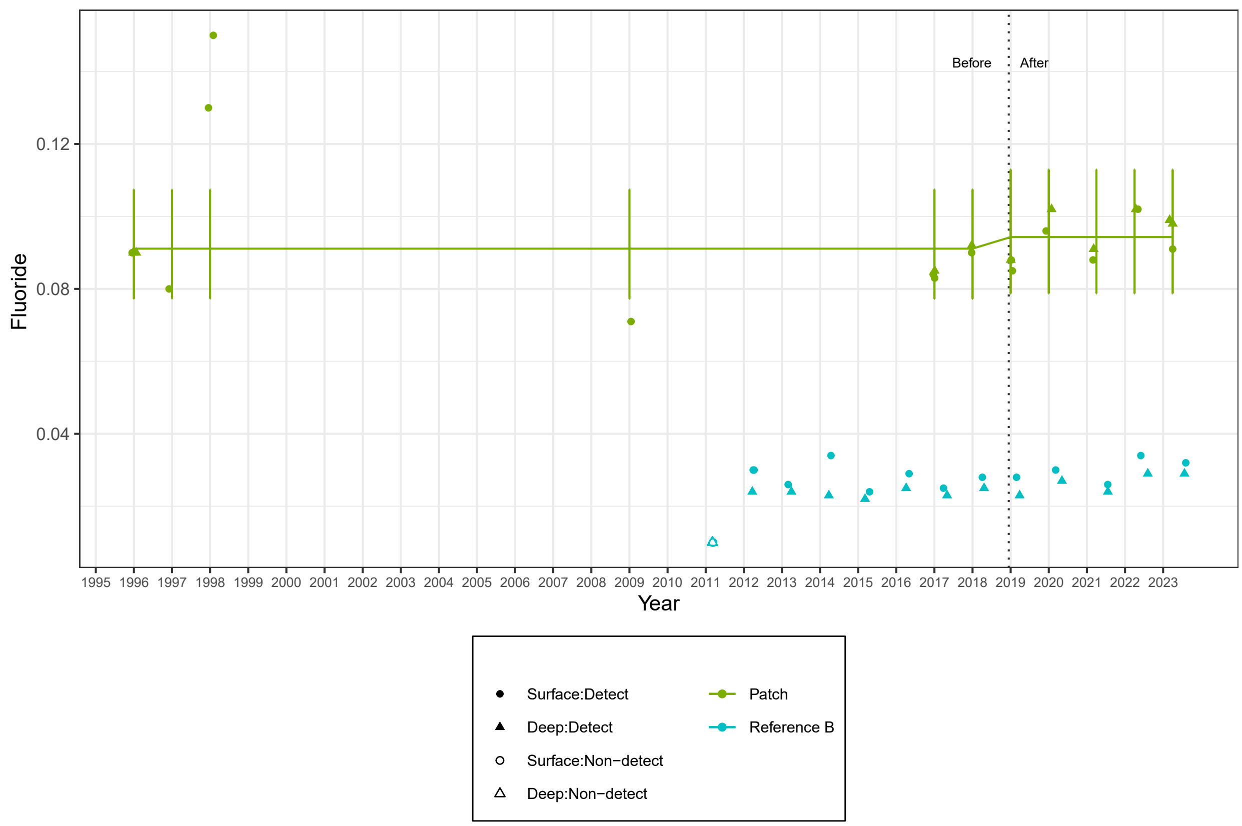
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0344	0.1081	8.931	0.3181	0.7577	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

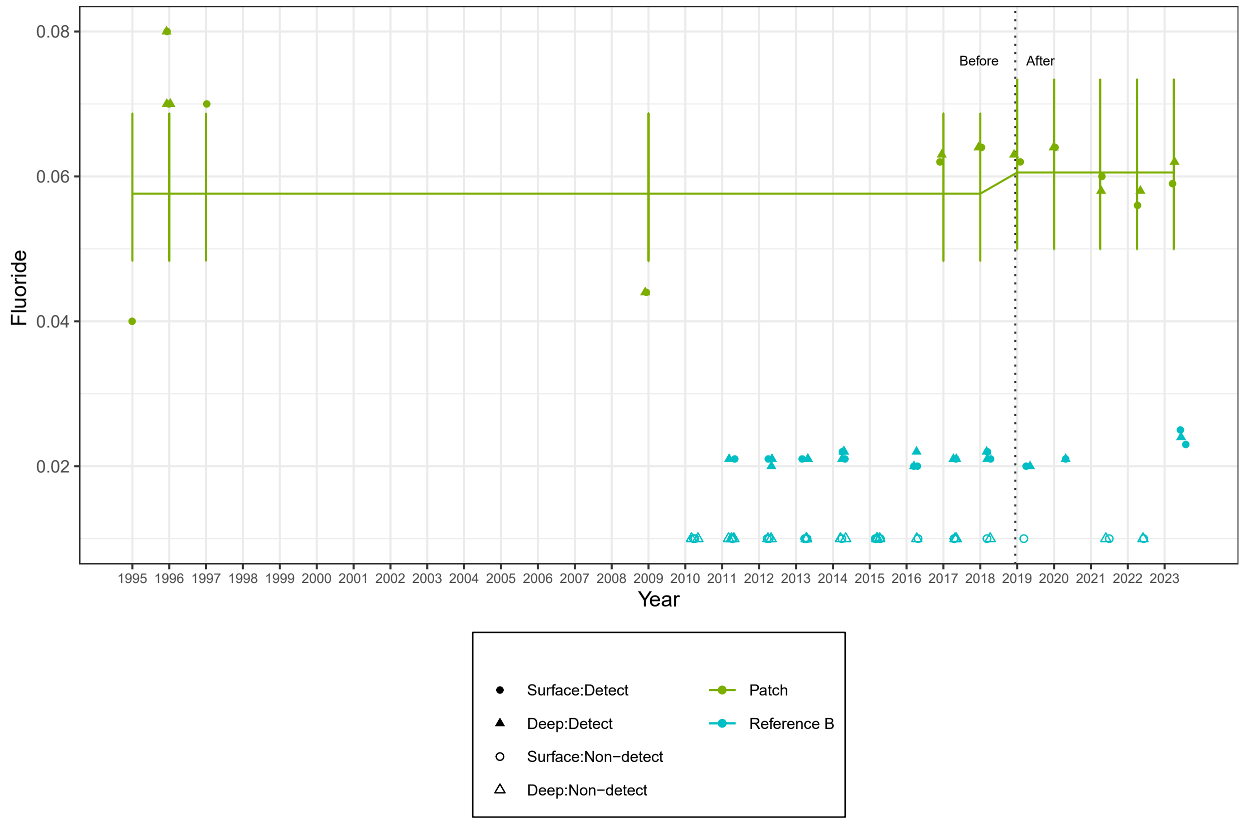
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0496	0.1157	8.967	0.4283	0.6785	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

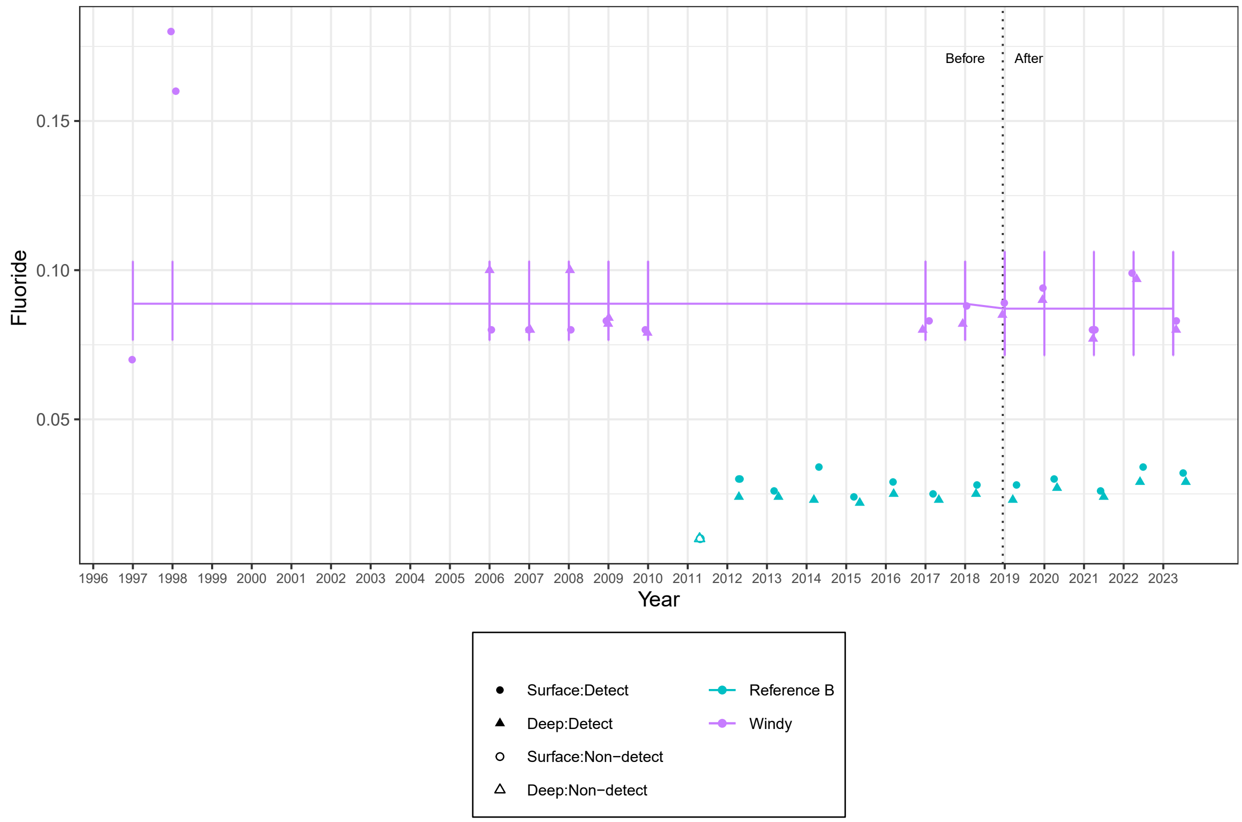
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0188	0.1141	10.71	-0.1645	0.8724	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

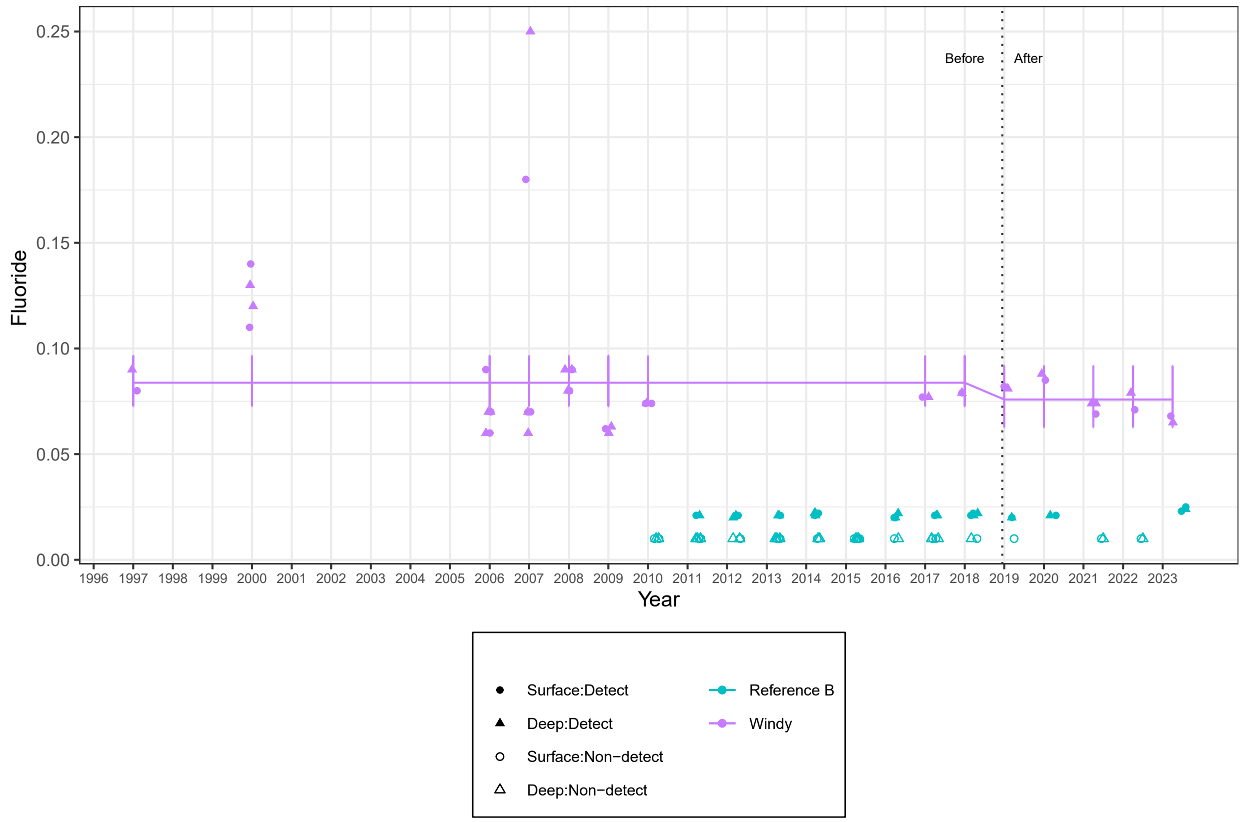
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0998	0.1096	12	-0.911	0.3802	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

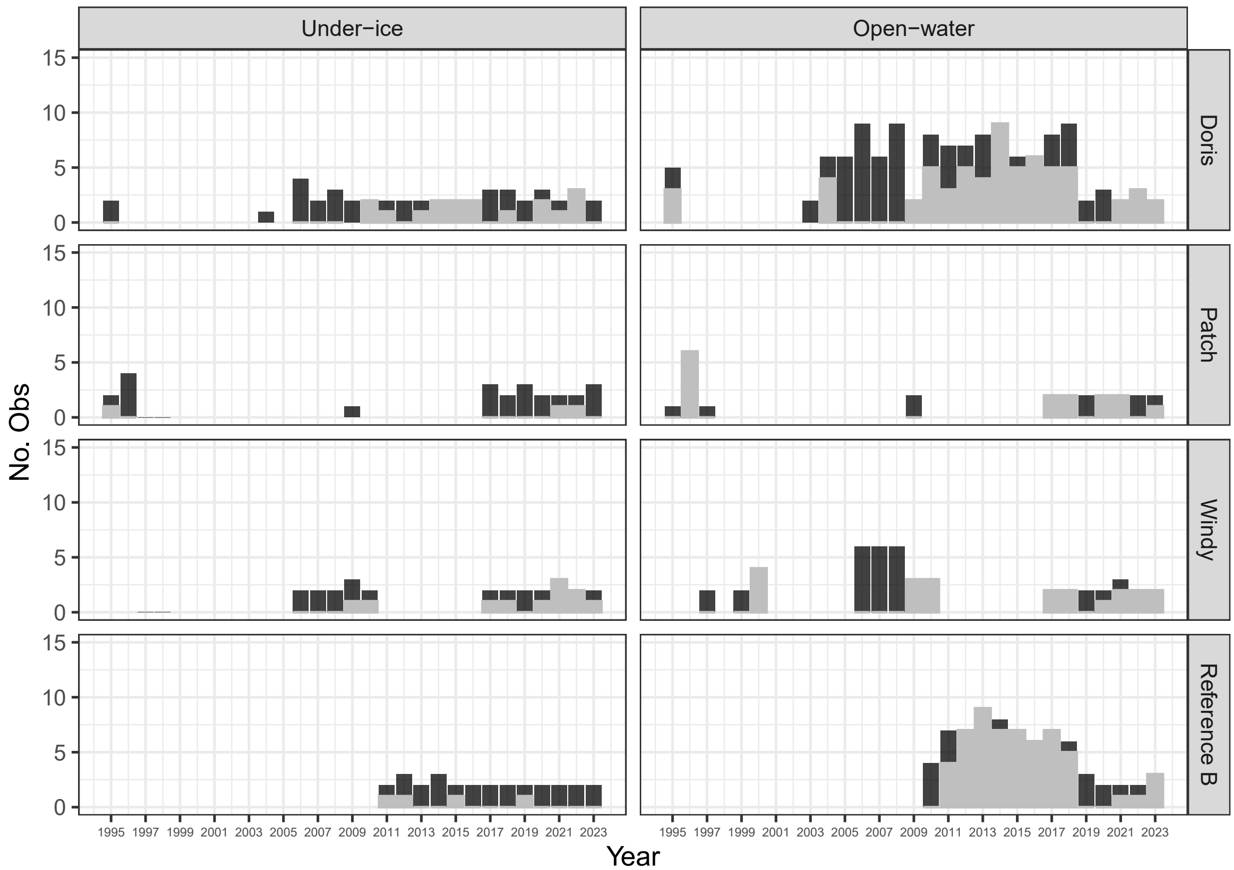
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Fluoride
Year
Before
After
0.00
0.05
0.10
0.15
0.20
0.25
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Surface:Detect
Deep:Detect
Surface:Non−detect
Deep:Non−detect
Reference B
Windy

C.3.1.6 Total Ammonia

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

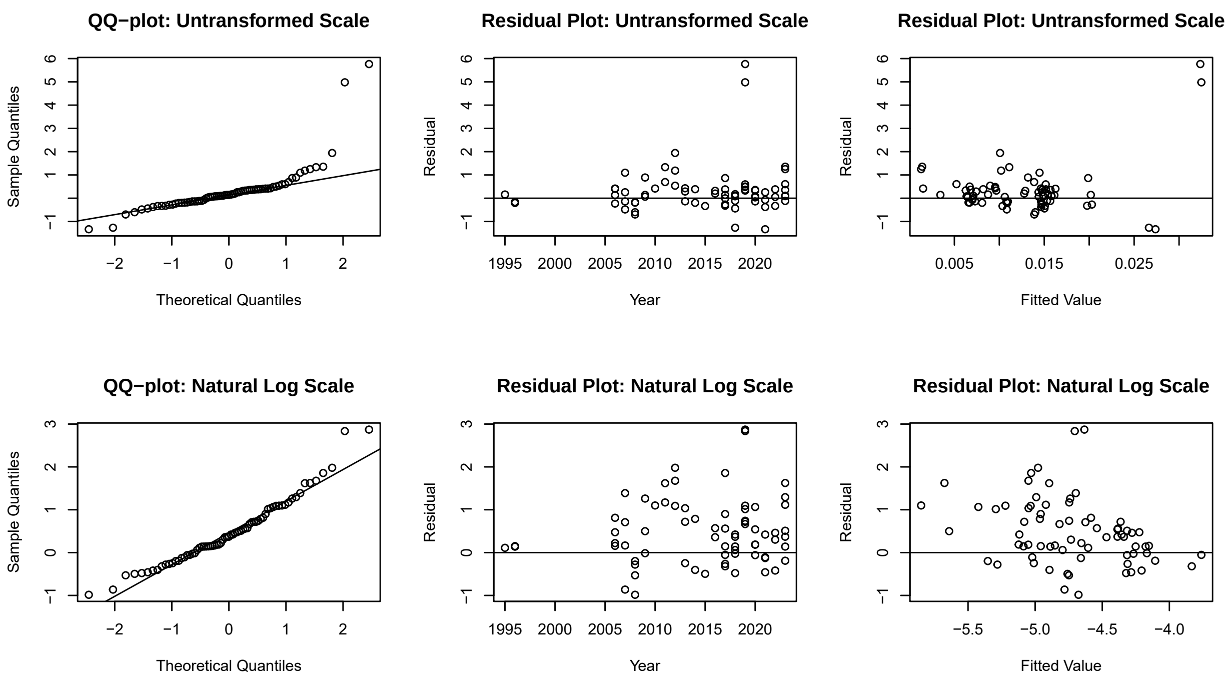
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	46	19	41	0
Doris	Open-water	125	64	51	100
Patch	Under-ice	24	3	12	0
Patch	Open-water	24	15	62	50
Reference B	Under-ice	28	4	14	0
Reference B	Open-water	73	57	78	100
Windy	Under-ice	26	11	42	50
Windy	Open-water	47	21	45	100

More than 50% of data under detection limit in Doris North Open-water, Patch Open-water, Reference B Open-water, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice, Patch Under-ice, Reference B Under-ice, Windy Under-ice, and Windy

Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
30	Doris	2019	Under-ice	Deep	0.114	0.032	5.765
31	Doris	2019	Under-ice	Surface	0.103	0.032	4.980

Outliers on natural log scale:

None

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	0.352	3	0.95000	not sig.

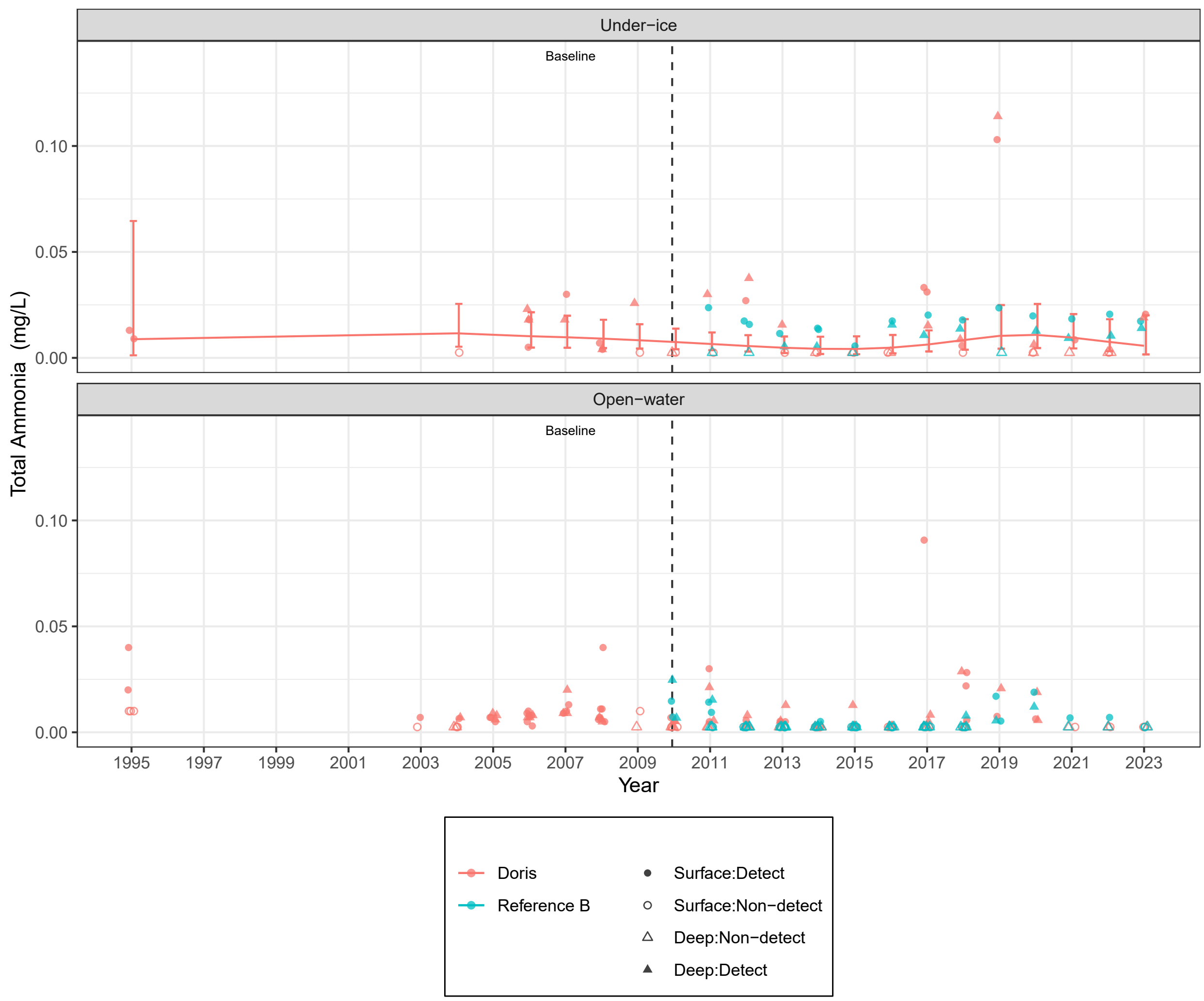
Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Doris Open-Water

All data from Doris Lake open-water removed from the analysis. No analysis performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

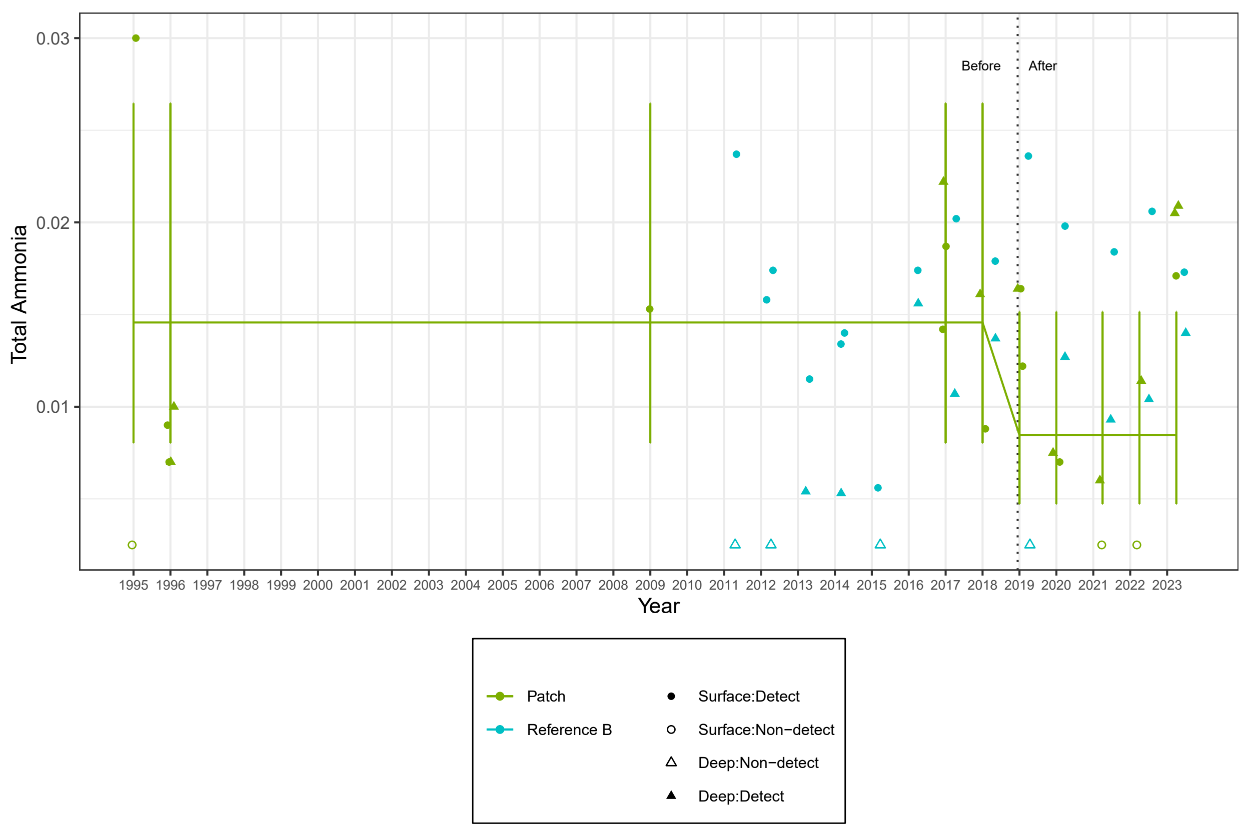
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.5444	0.361	8.358	-1.508	0.1683	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis Analysis not performed.

Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

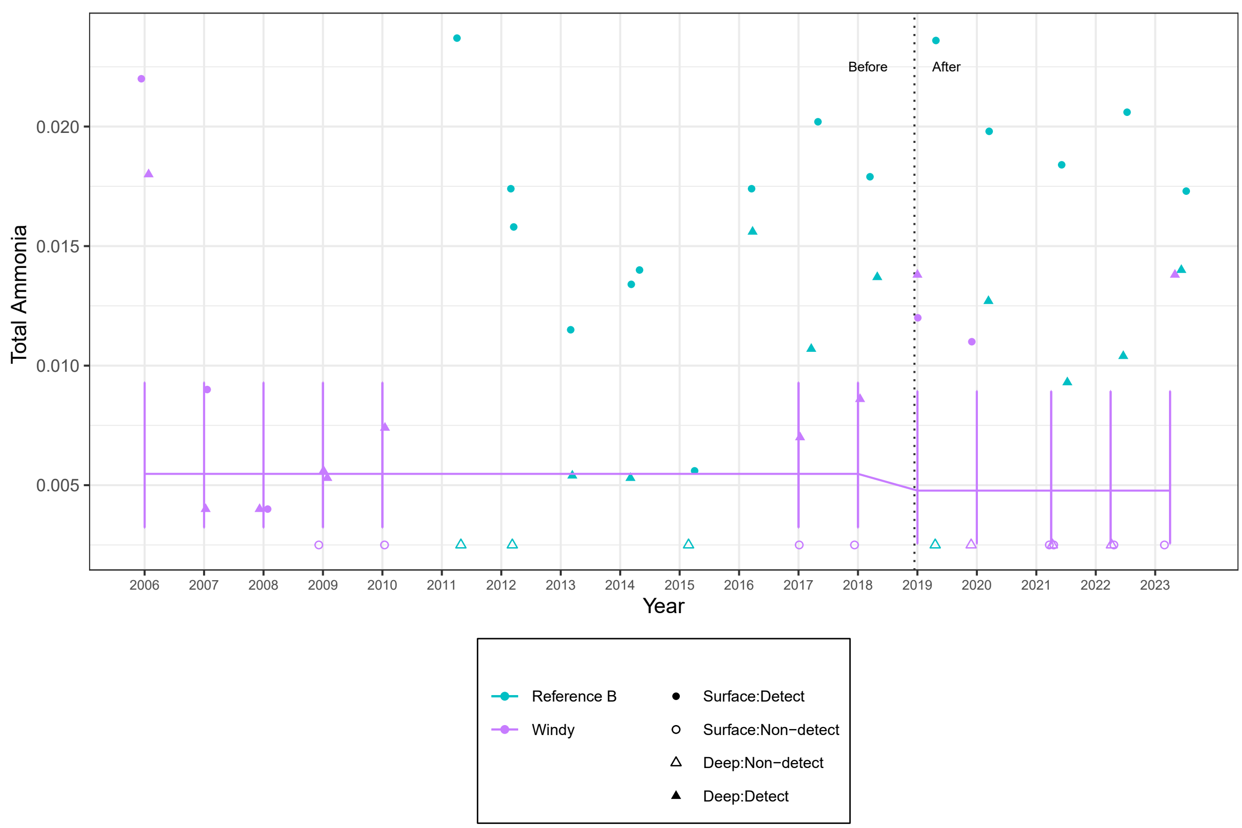
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.1368	0.3684	10	-0.3714	0.7181	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.

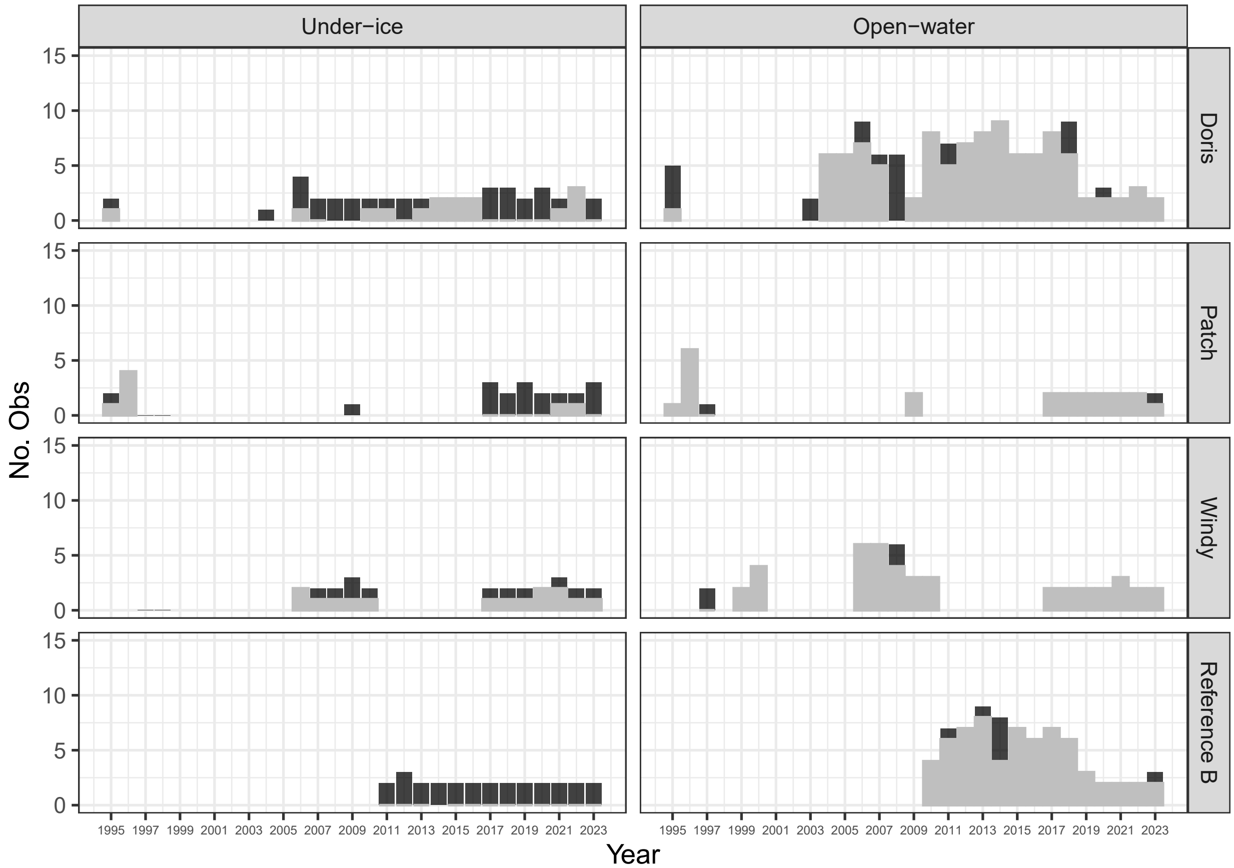


Windy Open-water Before-After Analysis Analysis not performed.

C.3.1.7 Nitrate

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

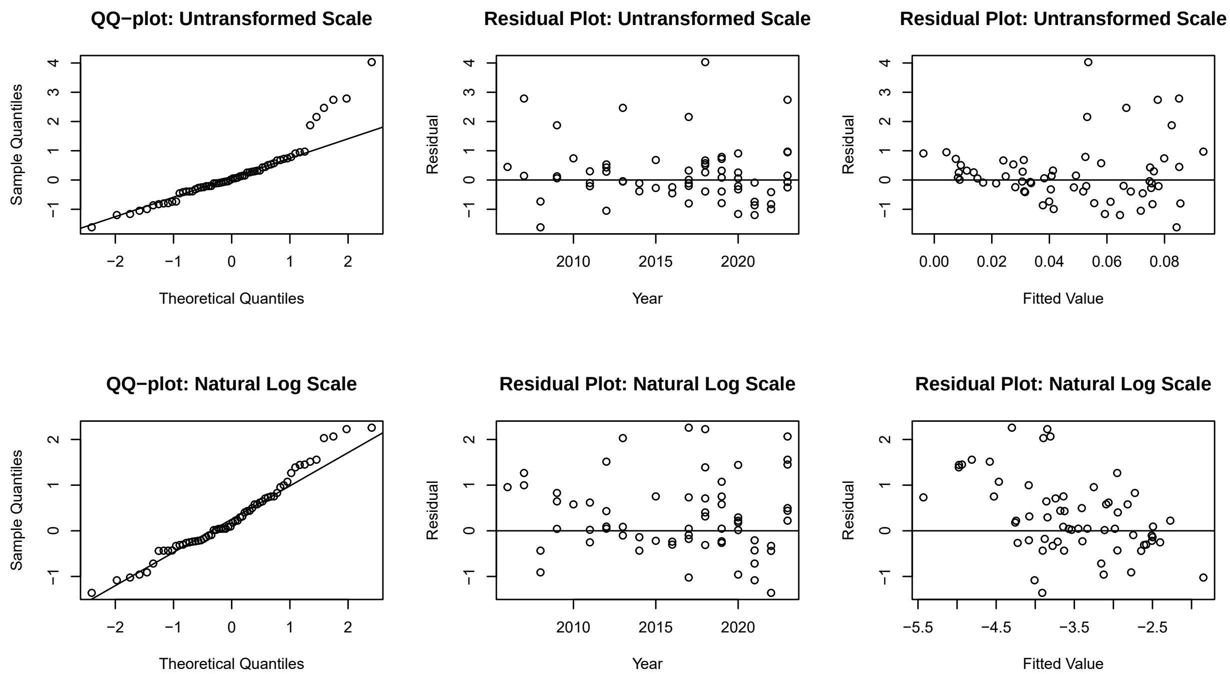
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	16	36	0
Doris	Open-water	122	105	86	100
Patch	Under-ice	24	7	29	0
Patch	Open-water	24	22	92	50
Reference B	Under-ice	27	0	0	0
Reference B	Open-water	73	66	90	67
Windy	Under-ice	26	15	58	50
Windy	Open-water	47	43	91	100

More than 50% of data under detection limit in Doris North Open-water, Patch Open-water, Reference B Open-water, Windy Under-ice, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice and Patch Under-ice exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
28	Doris	2018	Under-ice	Deep	0.201	0.054	4.029

Outliers on natural log scale:

None

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	3.255	3	0.35390	not sig.

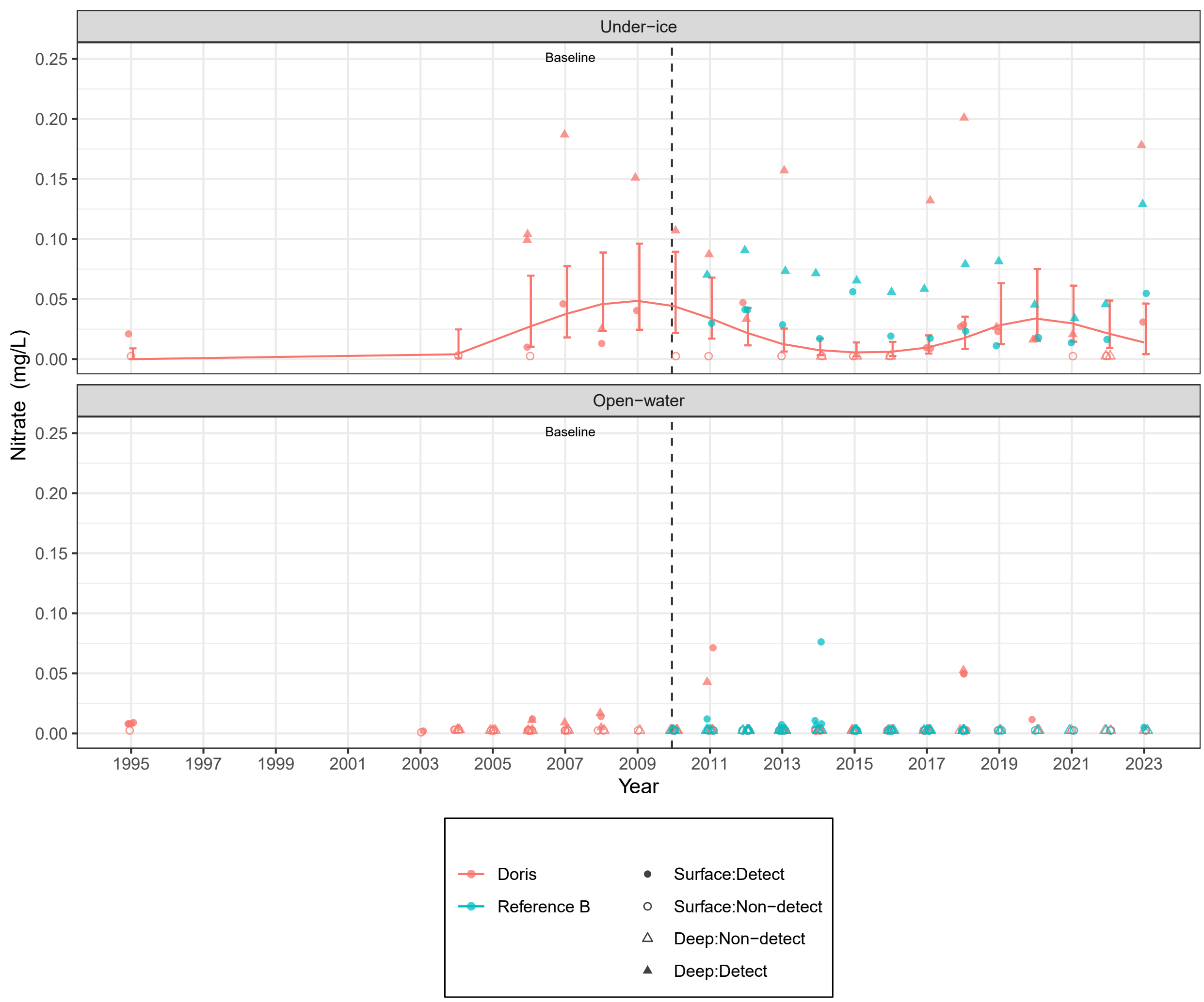
Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Doris Open-Water

All data from Doris Lake open-water removed from the analysis. No analysis performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

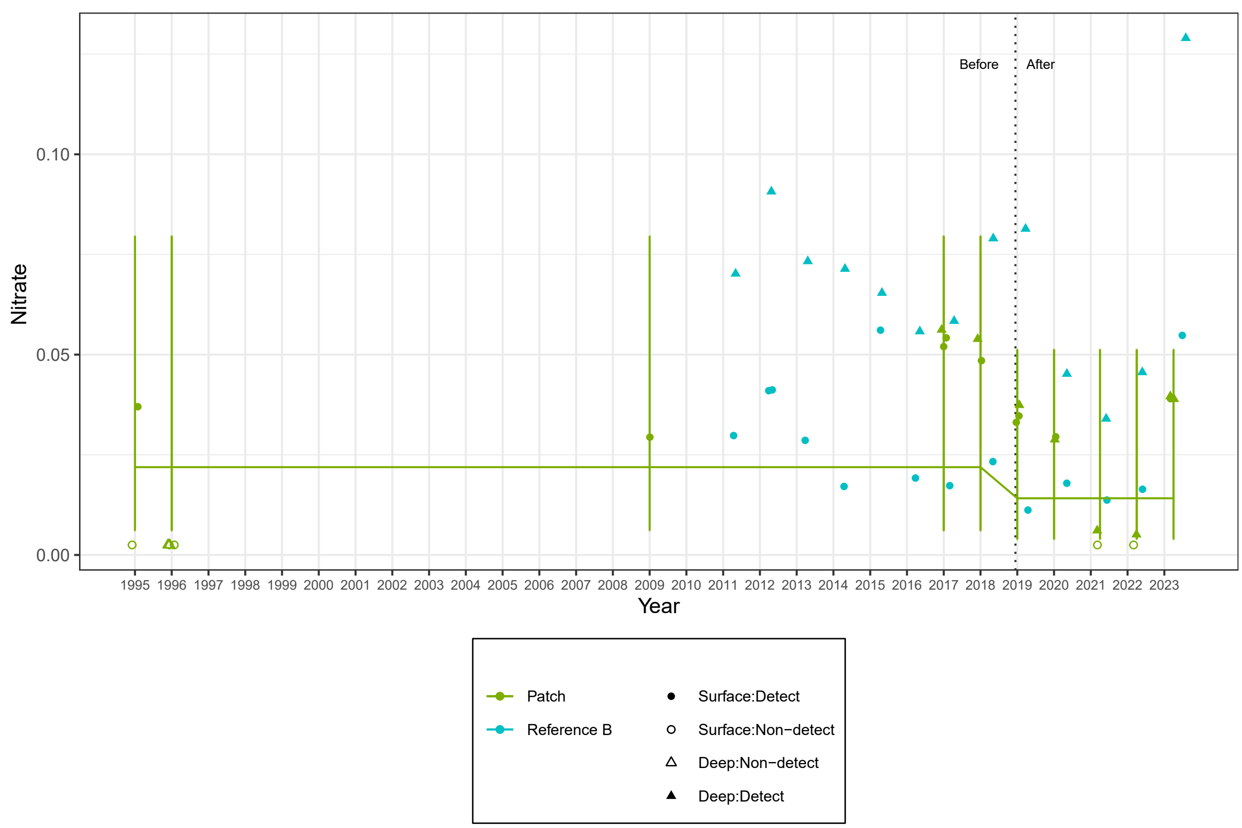
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.4378	0.7907	8.074	-0.5537	0.5948	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis Analysis not performed.

Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

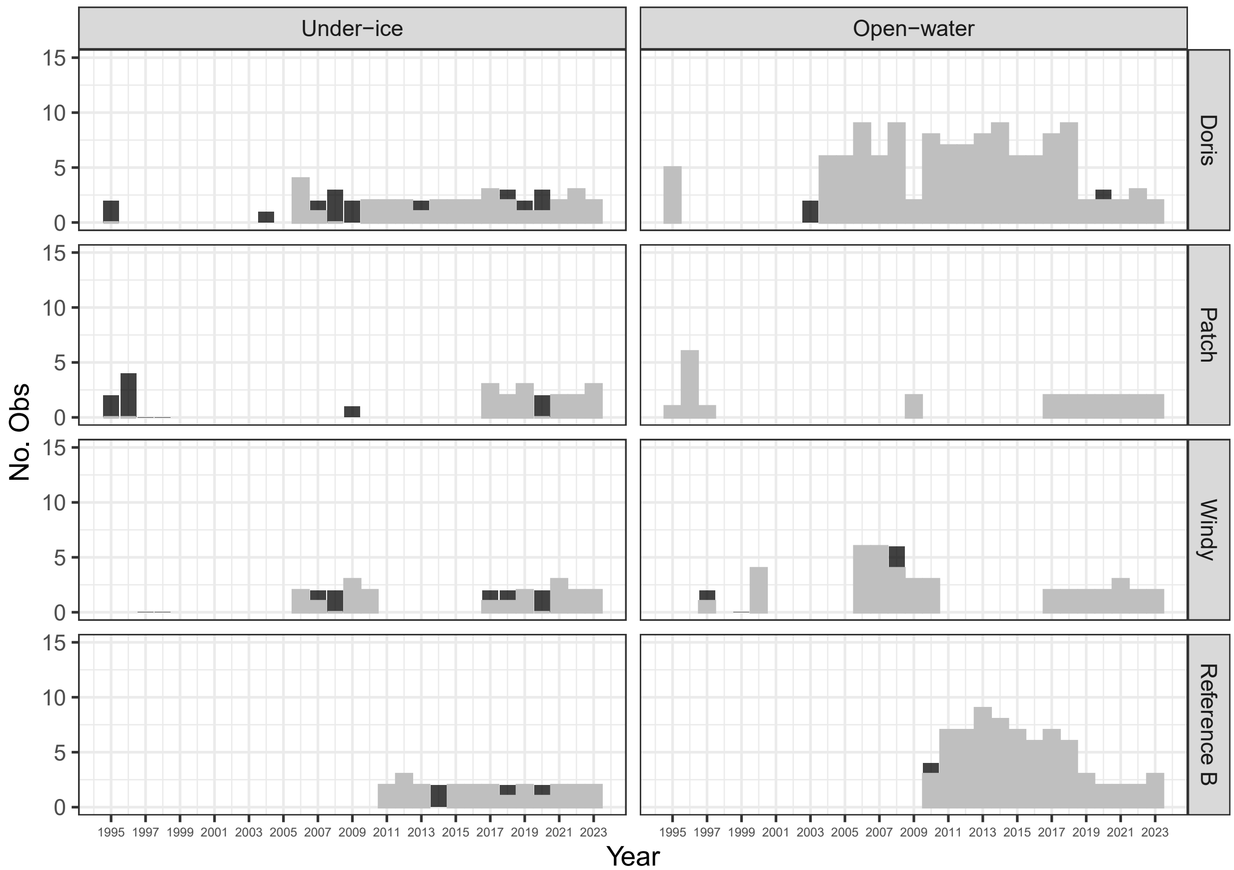
Windy Under-Ice Before-After Analysis Analysis not performed.

Windy Open-water Before-After Analysis Analysis not performed.

C.3.1.8 Nitrite

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

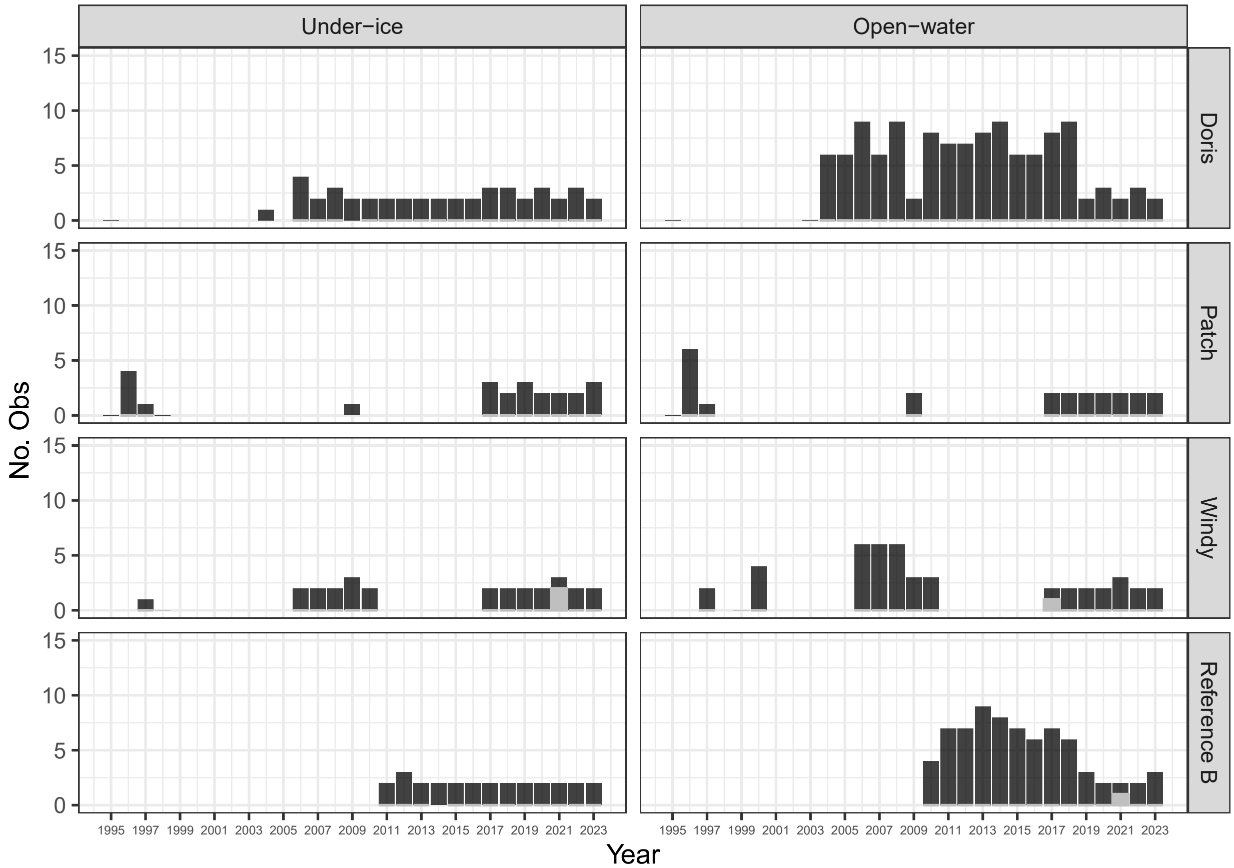
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	46	34	74	100
Doris	Open-water	125	124	99	100
Patch	Under-ice	24	16	67	100
Patch	Open-water	24	24	100	100
Reference B	Under-ice	27	25	93	100
Reference B	Open-water	73	72	99	100
Windy	Under-ice	26	19	73	100
Windy	Open-water	45	42	93	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.9 Total Phosphorus

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

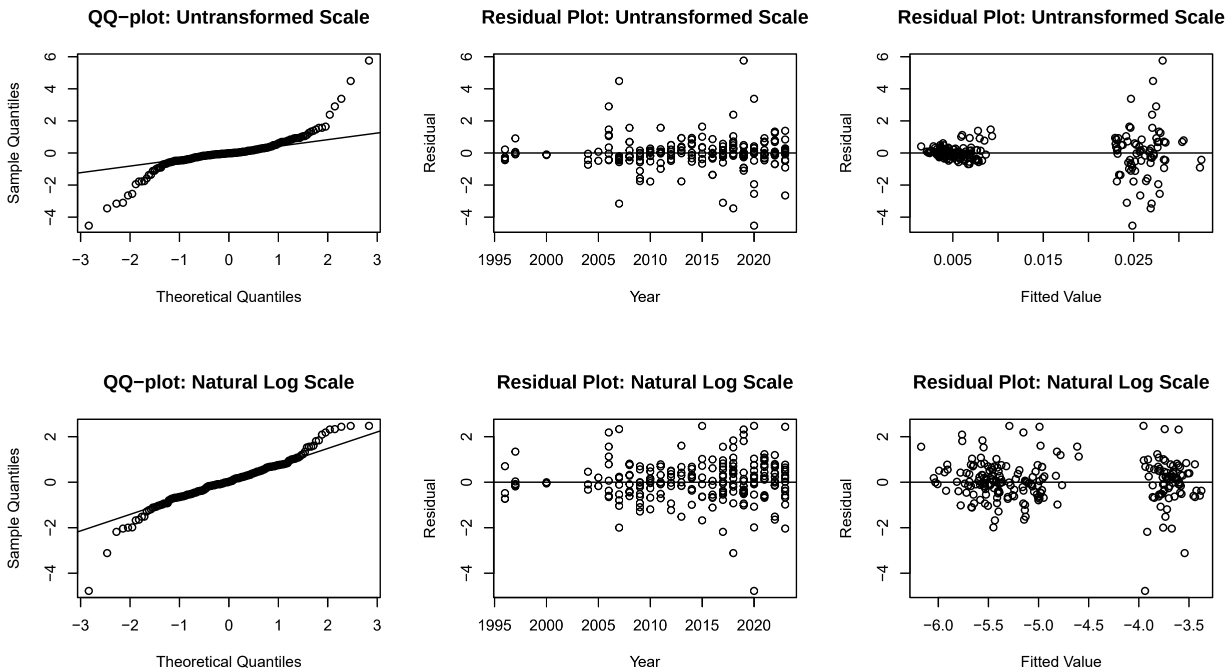
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	44	0	0	0
Doris	Open-water	118	0	0	0
Patch	Under-ice	23	0	0	0
Patch	Open-water	23	0	0	0
Reference B	Under-ice	27	0	0	0
Reference B	Open-water	73	1	1	0
Windy	Under-ice	27	2	7	0
Windy	Open-water	45	1	2	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
14	Doris	2007	Under-ice	Deep	0.0130	0.027	-3.159
15	Doris	2007	Under-ice	Surface	0.0470	0.027	4.487
54	Doris	2017	Under-ice	Deep	0.0105	0.024	-3.105
58	Doris	2018	Under-ice	Deep	0.0116	0.027	-3.452
62	Doris	2019	Under-ice	Deep	0.0537	0.028	5.760
68	Doris	2020	Open-water	Deep	0.0397	0.025	3.377
69	Doris	2020	Open-water	Surface	0.0048	0.025	-4.531

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
58	Doris	2018	Under-ice	Deep	0.0116	-3.543	-3.116
69	Doris	2020	Open-water	Surface	0.0048	-3.938	-4.779

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	0.939	4	0.91890	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

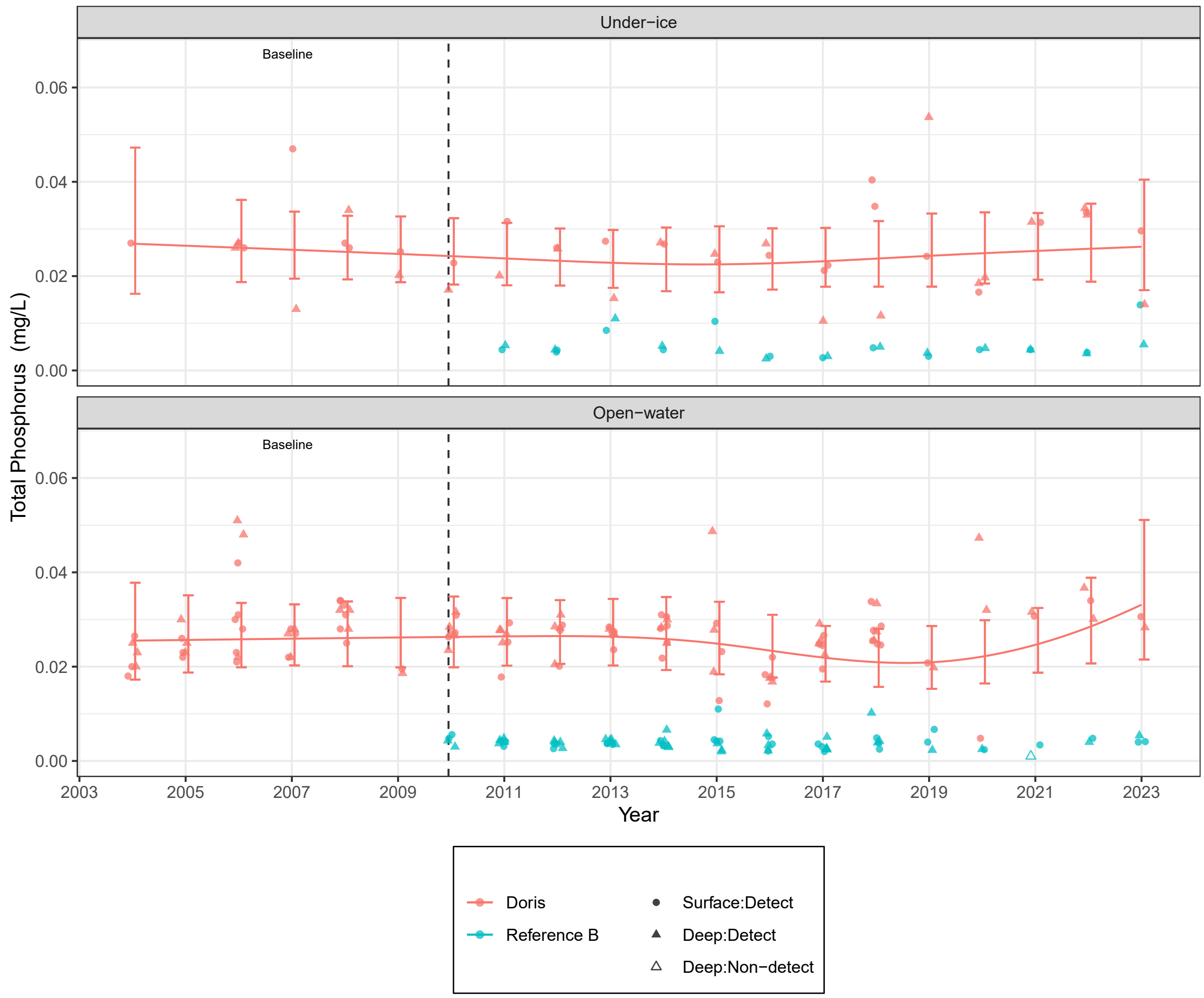
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	3.948	4	0.41310	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

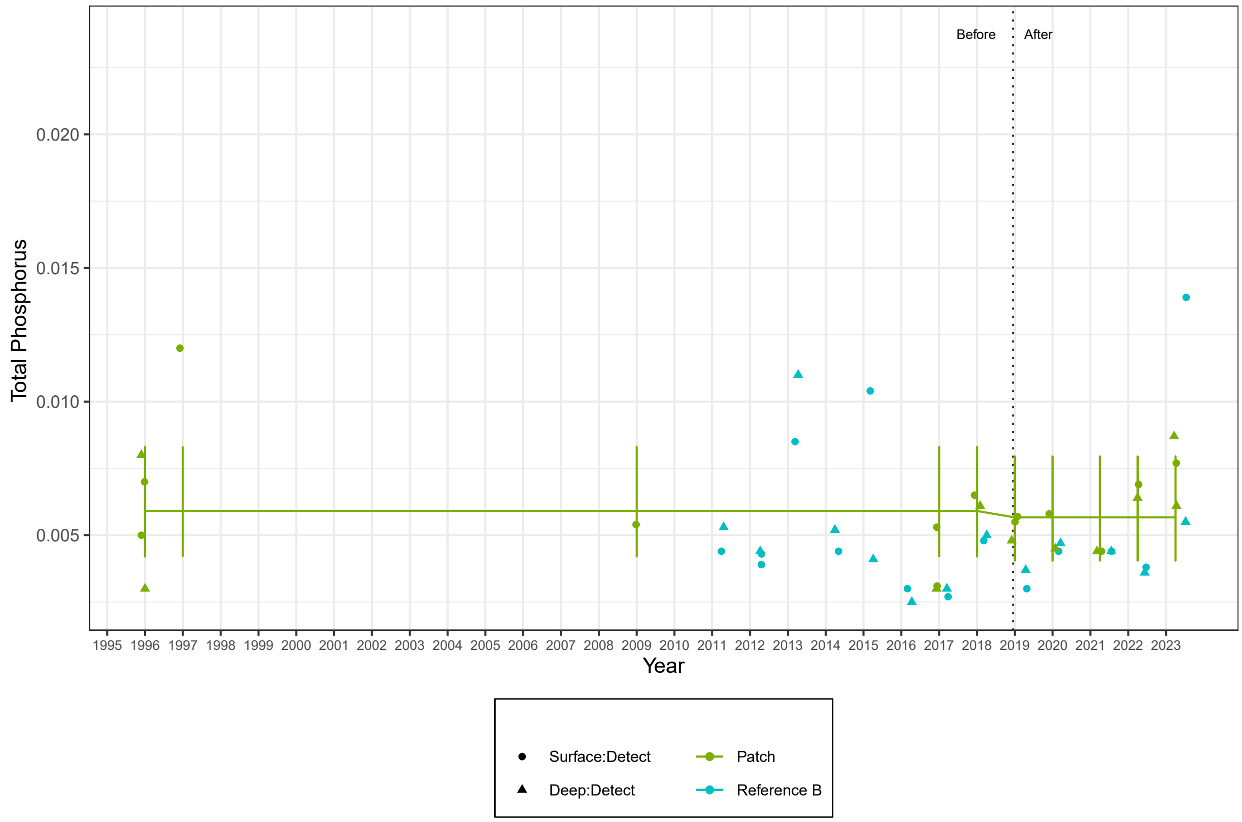
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0417	0.2097	7.869	-0.1989	0.8474	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3388	0.123	7.839	2.755	0.0254	sig.

Conclusion:

The change from before to after was significantly different.

BACI Analysis with Comparable Years

Results of the ANOVA test on the fixed effects of the model:

	Sum Sq.	Mean Sq.	NumDF	DenDF	F value	p
class	1.8496	1.8496	1	18	15.7818	<0.001
period	0.0141	0.0141	1	5	0.1206	0.742
Depth.Zone	0.0025	0.0025	1	18	0.0214	0.885
class:period	0.3724	0.3724	1	18	3.1777	0.0915

Estimated marginal means for site class by period:

Class	Period	LSmean	SE	DF	LowerCL	UpperCL
Monitored	after	-4.927	0.1428	9.419	-5.248	-4.606
Reference	after	-5.751	0.1428	9.419	-6.072	-5.430
Monitored	before	-5.261	0.2258	9.419	-5.768	-4.753
Reference	before	-5.574	0.2258	9.419	-6.082	-5.067

- Results are given on the natural log scale.

Summary of BACI contrasts for relative difference between changes from the before to after in Patch North and Reference Lake B, with 95% confidence intervals:

Patch North vs:	Estimate	Lower C.I.	Upper C.I.	Significance
Reference Sites	0.5106	-0.0912	1.112	not sig.

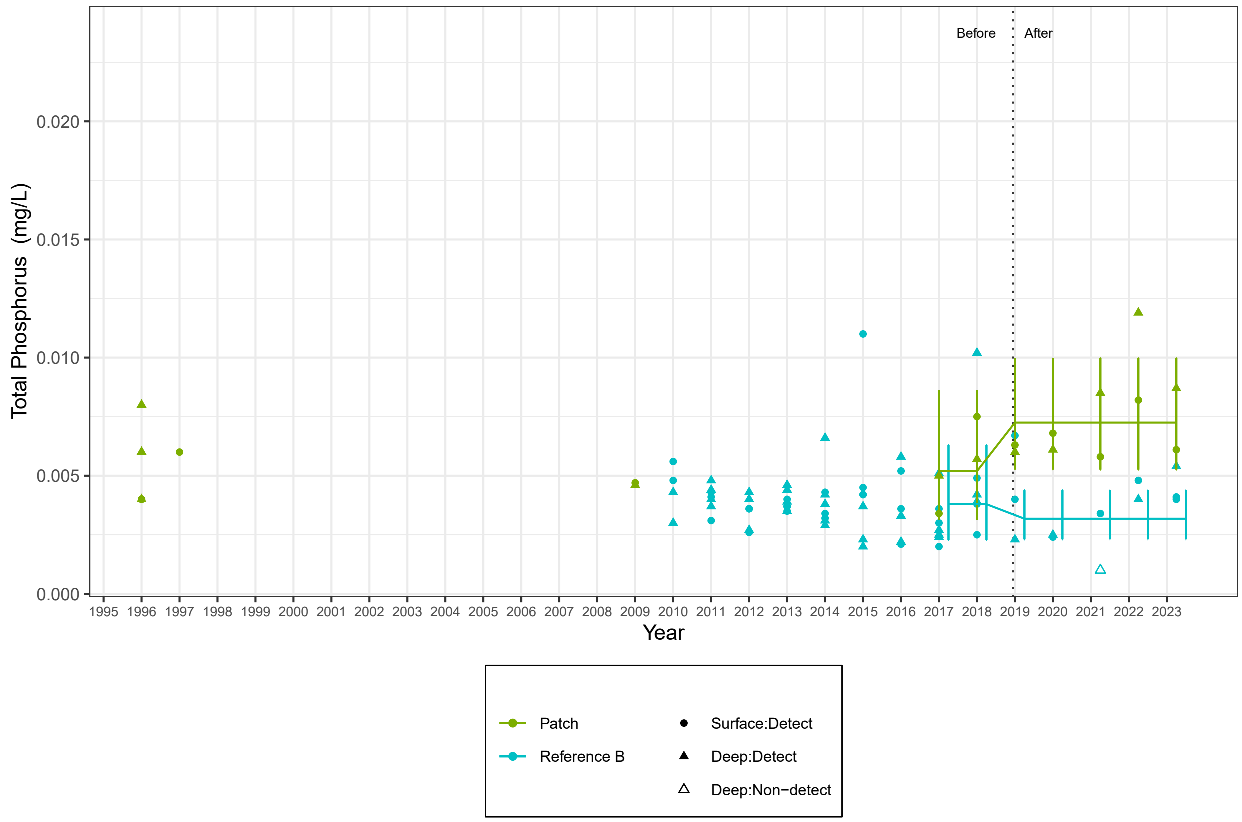
A BACI contrast is identified as *significant* if the confidence interval does not include 0.

Conclusion:

The change in Total Phosphorus concentrations at the Patch North site from before to after was not significantly (p = 0.092) different from the change at Reference Lake B, according to the test on the BACI term (*class:period*).

Observed Data and Fitted Values with Comparable Years

Depth was accounted for in the model but not evaluated since its effect is not of primary interest. Below are plots of the observed and fitted data. The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for monitored and reference sites.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

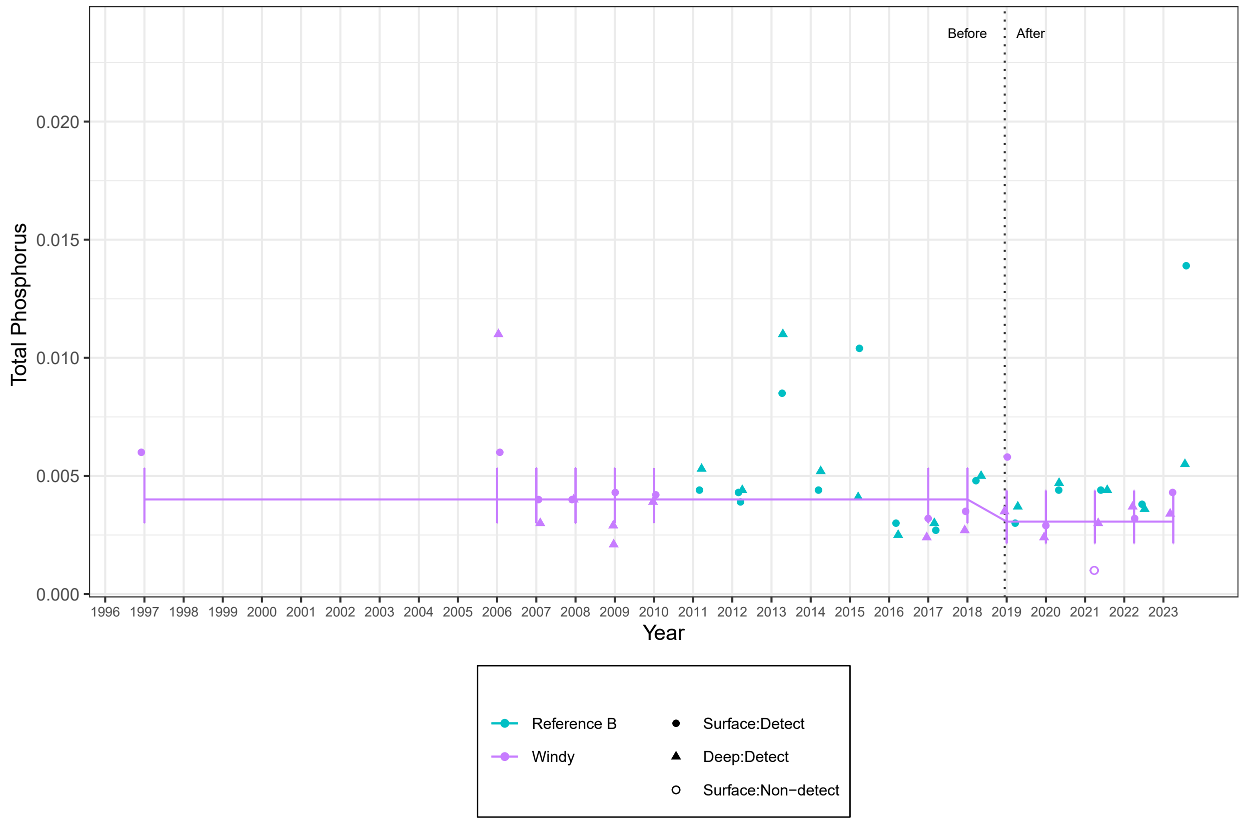
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.2672	0.2073	10.81	-1.289	0.2243	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

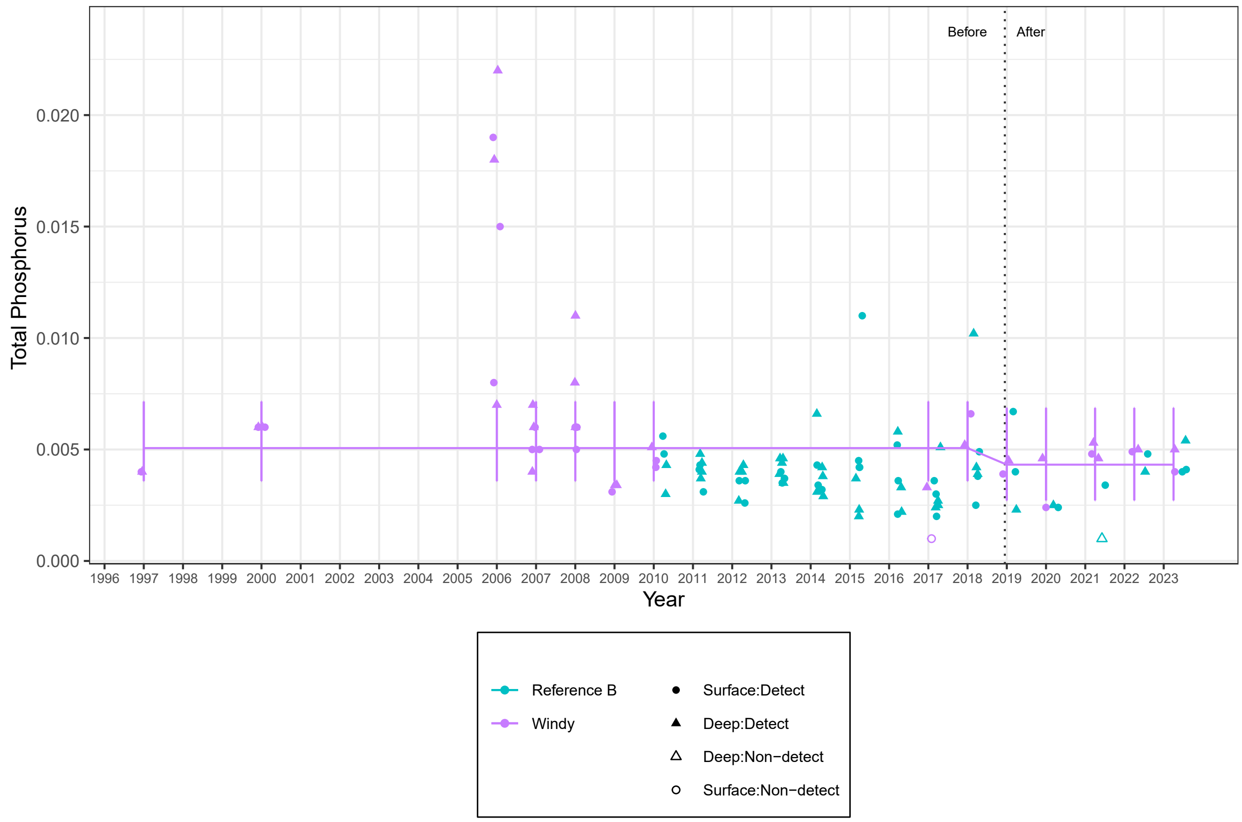
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.159	0.2653	12	-0.5993	0.5601	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

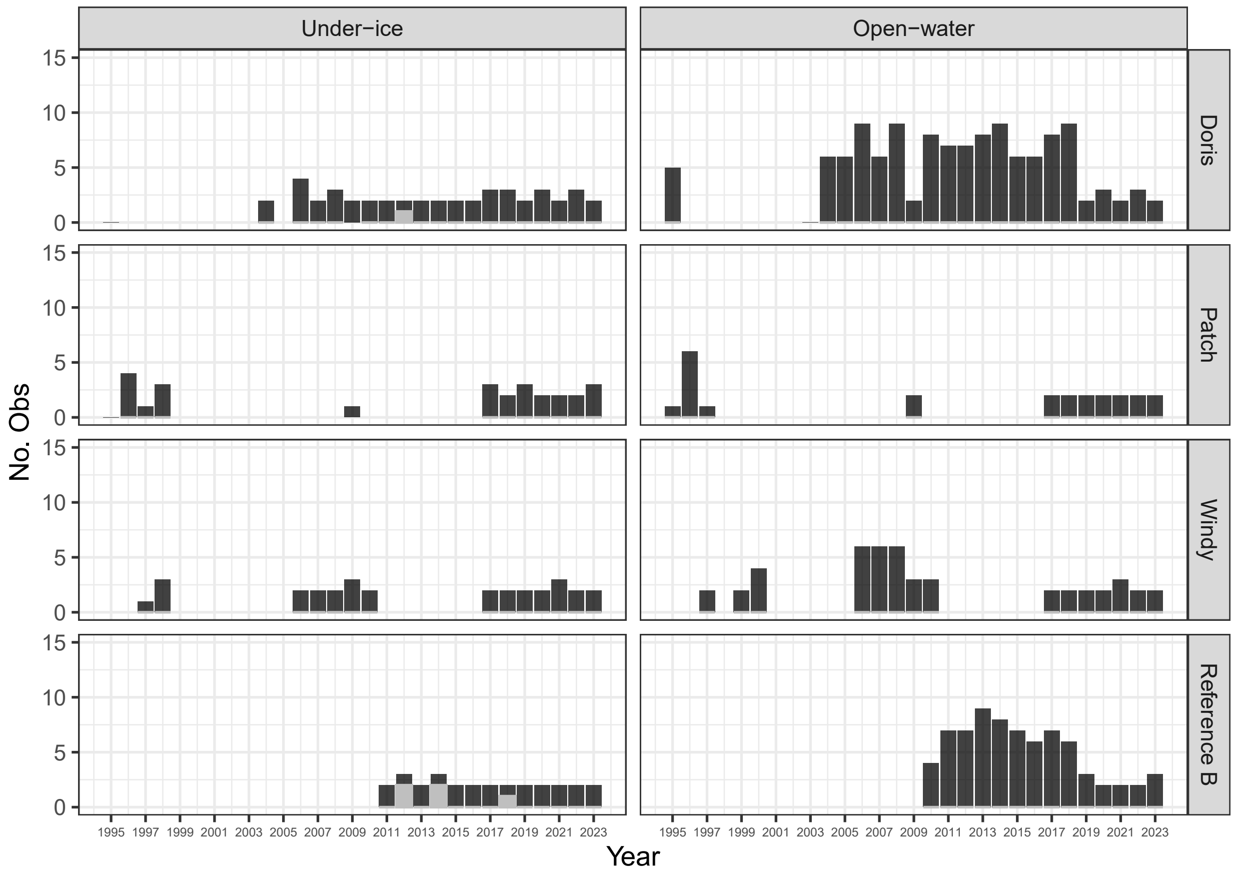
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Phosphorus
0.000
0.005
0.010
0.015
0.020
Before
After
Year
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Reference B
Windy
Surface:Detect
Deep:Detect
Deep:Non−detect
Surface:Non−detect

C.3.1.10 Total Aluminum

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

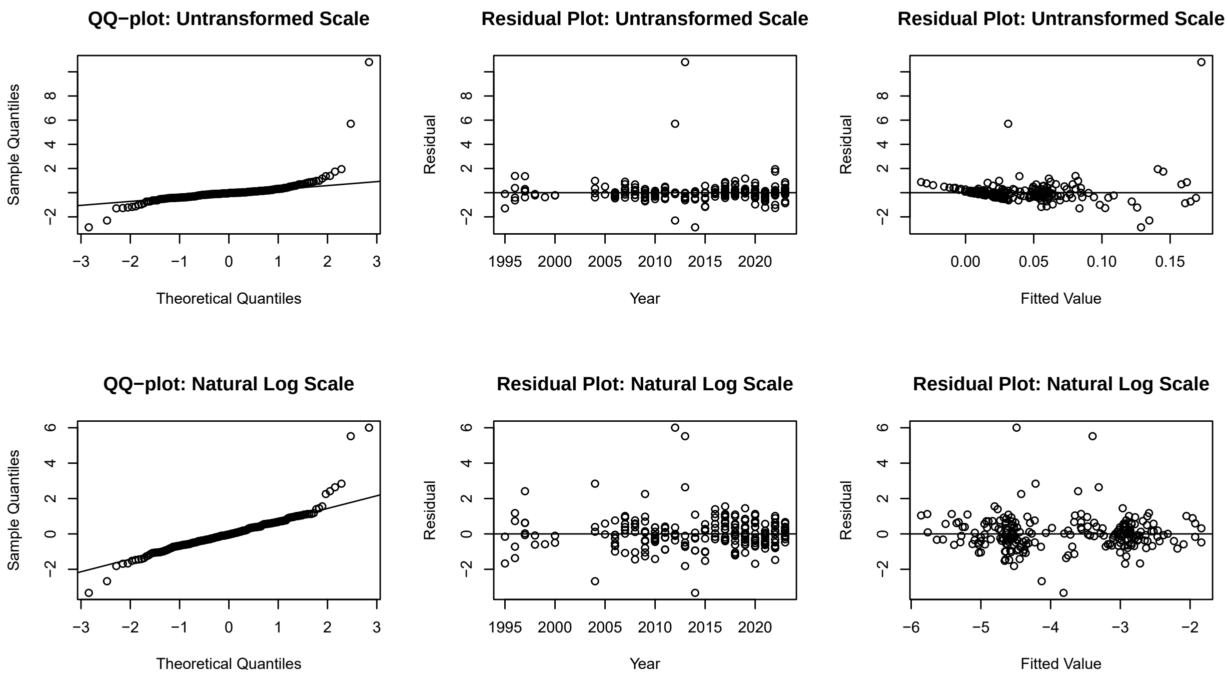
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	1	2	0
Doris	Open-water	123	0	0	0
Patch	Under-ice	26	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	28	5	18	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	30	0	0	0
Windy	Open-water	47	0	0	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
35	Doris	2012	Under-ice	Surface	0.280	0.031	5.703
133	Reference B	2013	Under-ice	Surface	0.644	0.173	10.801

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
35	Doris	2012	Under-ice	Surface	0.2800	-4.489	6.005
133	Reference B	2013	Under-ice	Surface	0.6440	-3.398	5.524
136	Reference B	2014	Under-ice	Deep	0.0037	-3.815	-3.333

There were outliers retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	6.47	3	0.09090	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

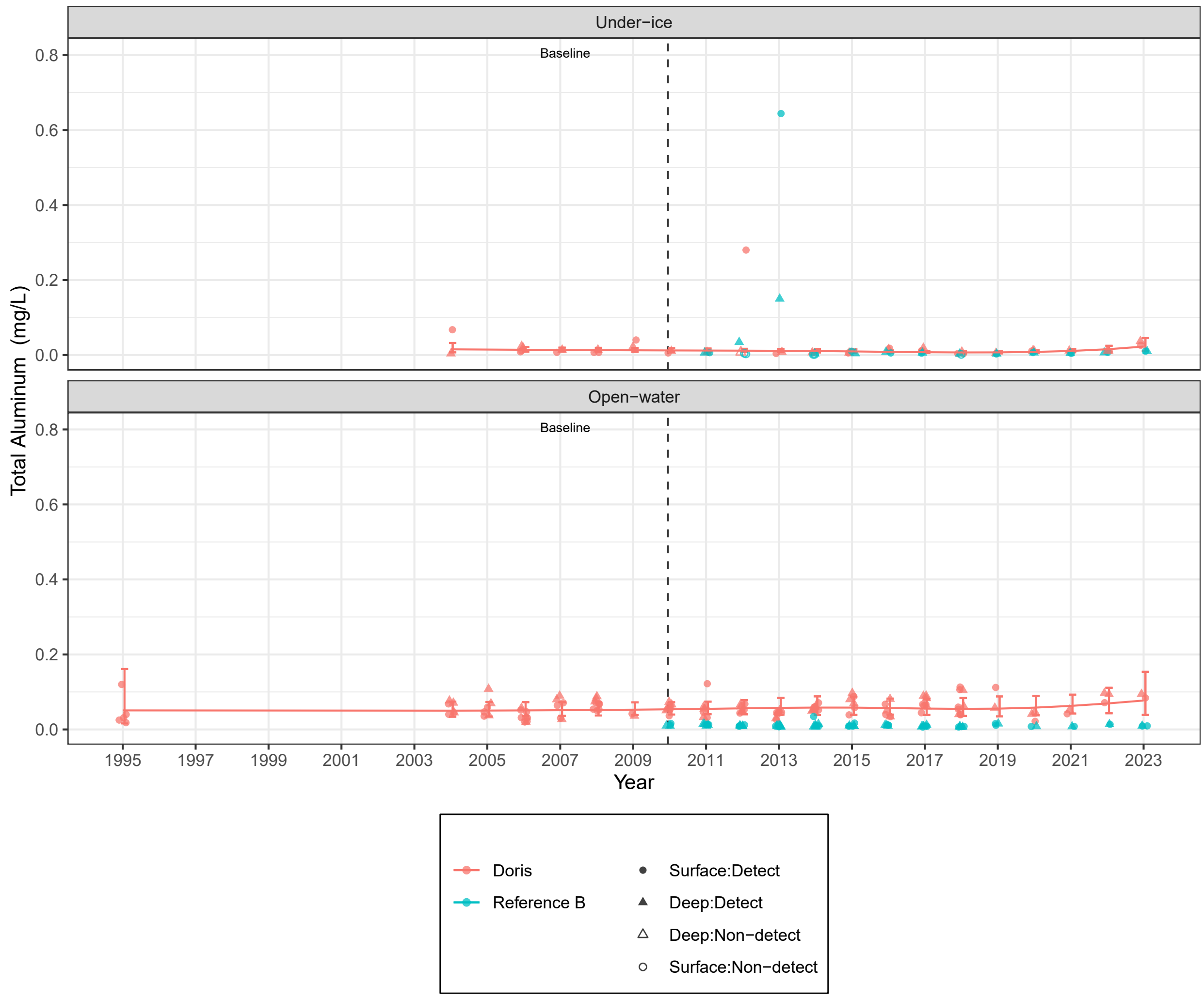
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	0.835	3	0.84100	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

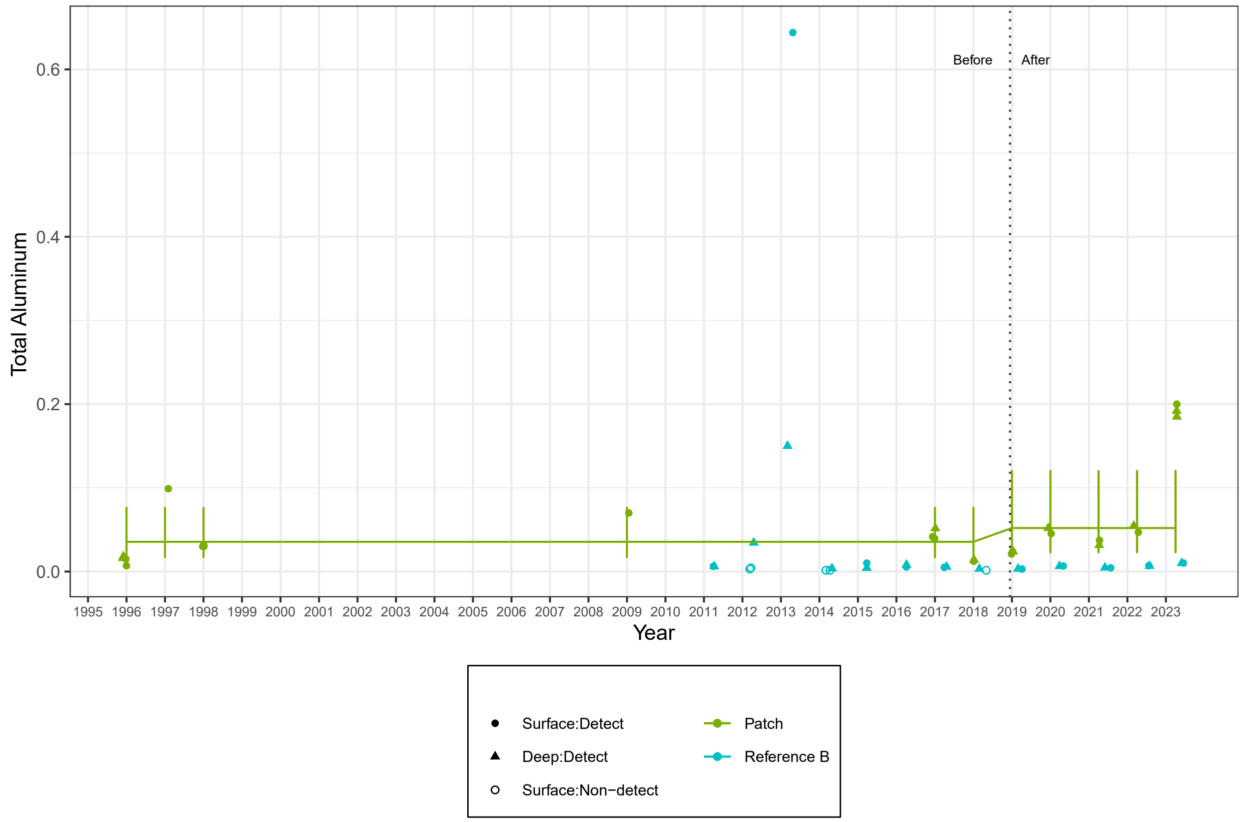
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3799	0.5048	8.996	0.7526	0.4709	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

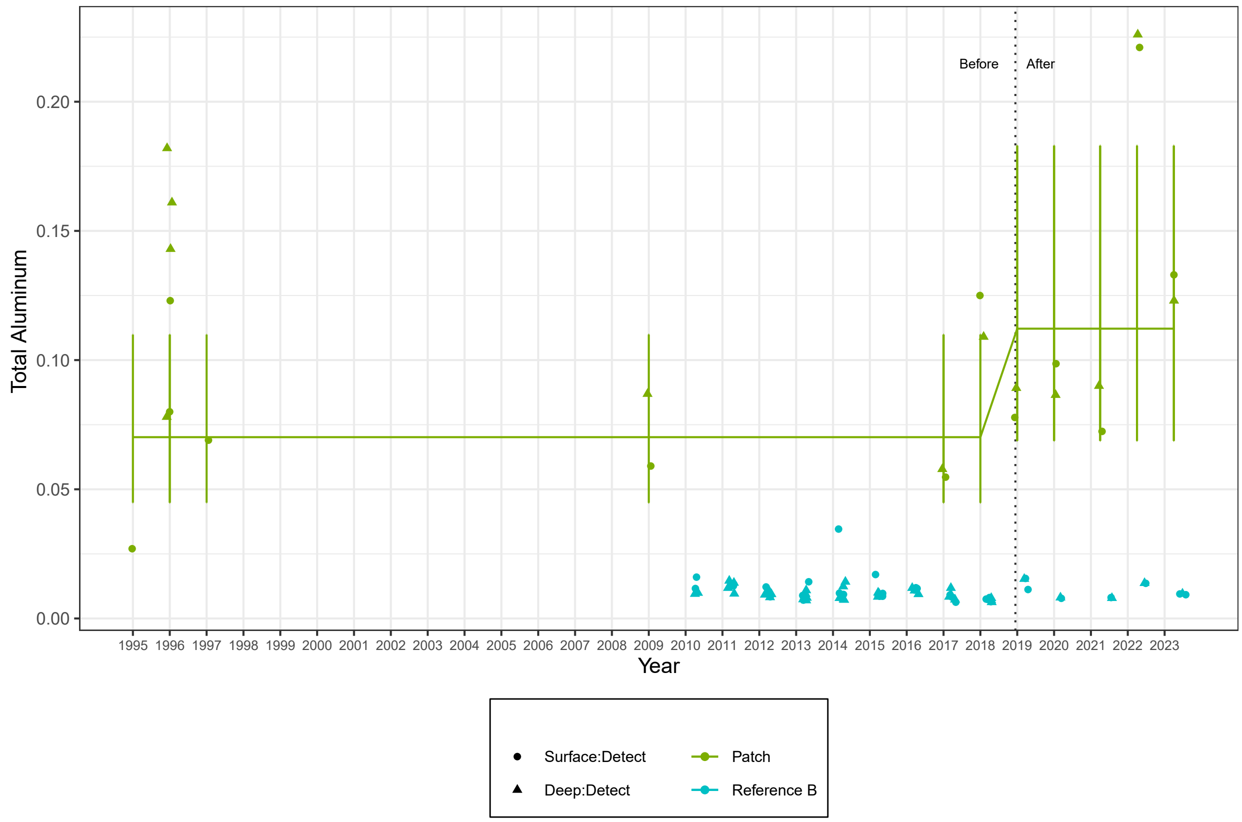
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.4691	0.2934	8.837	1.599	0.1449	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

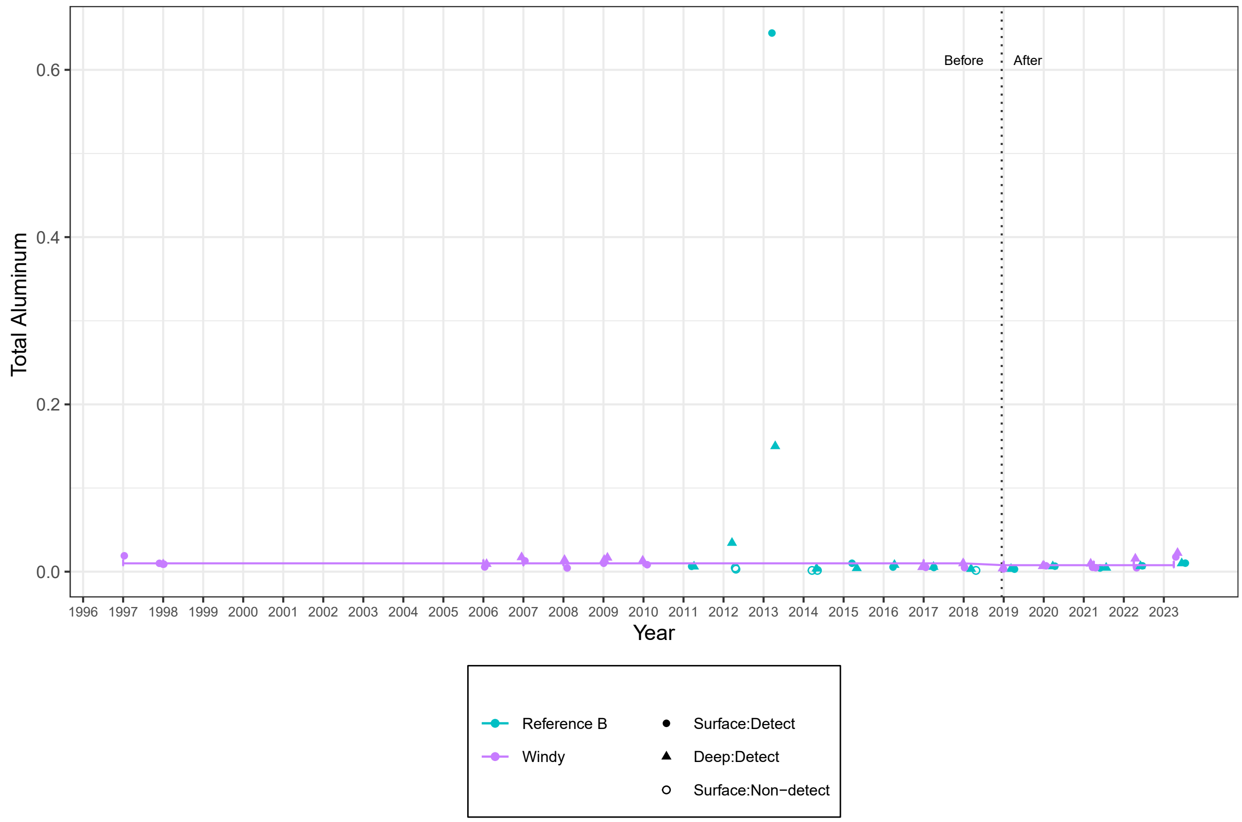
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.2503	0.2852	11.51	-0.8776	0.3981	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

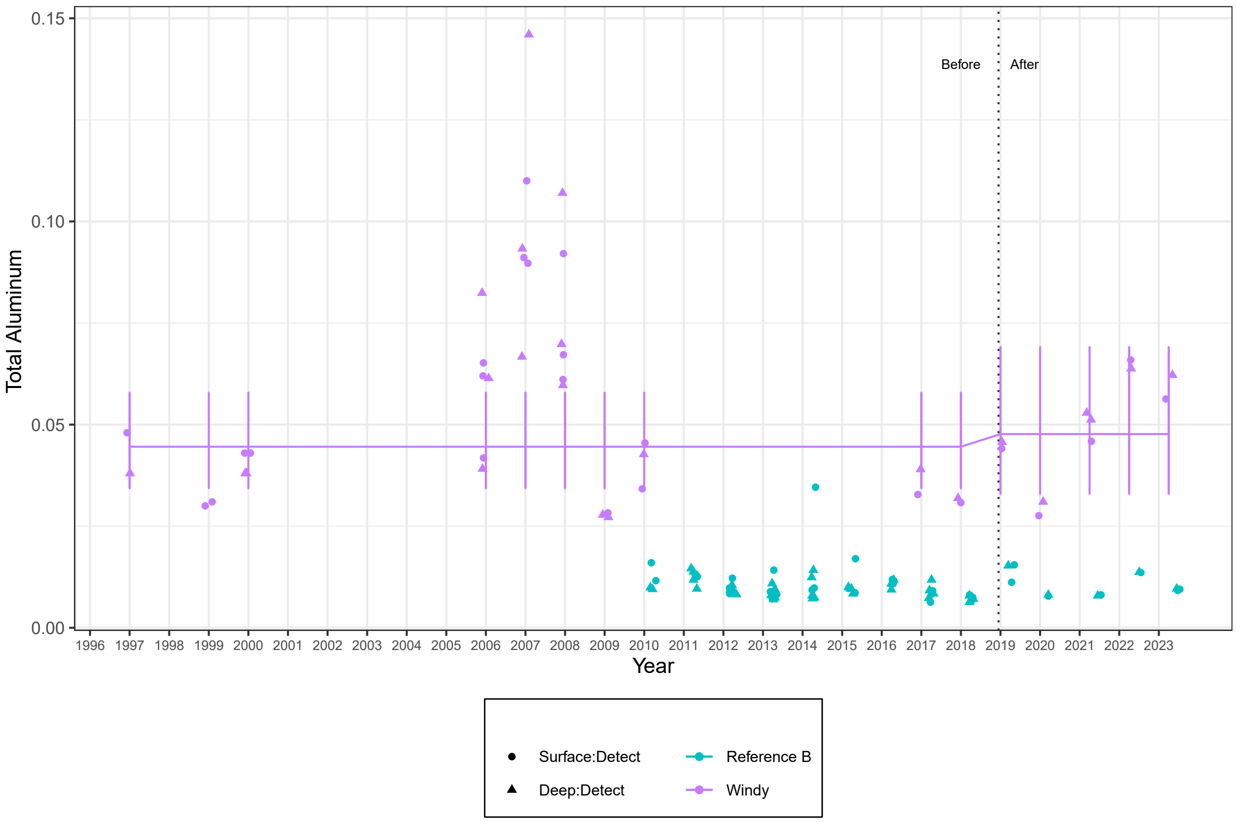
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0677	0.211	12.98	0.3208	0.7535	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

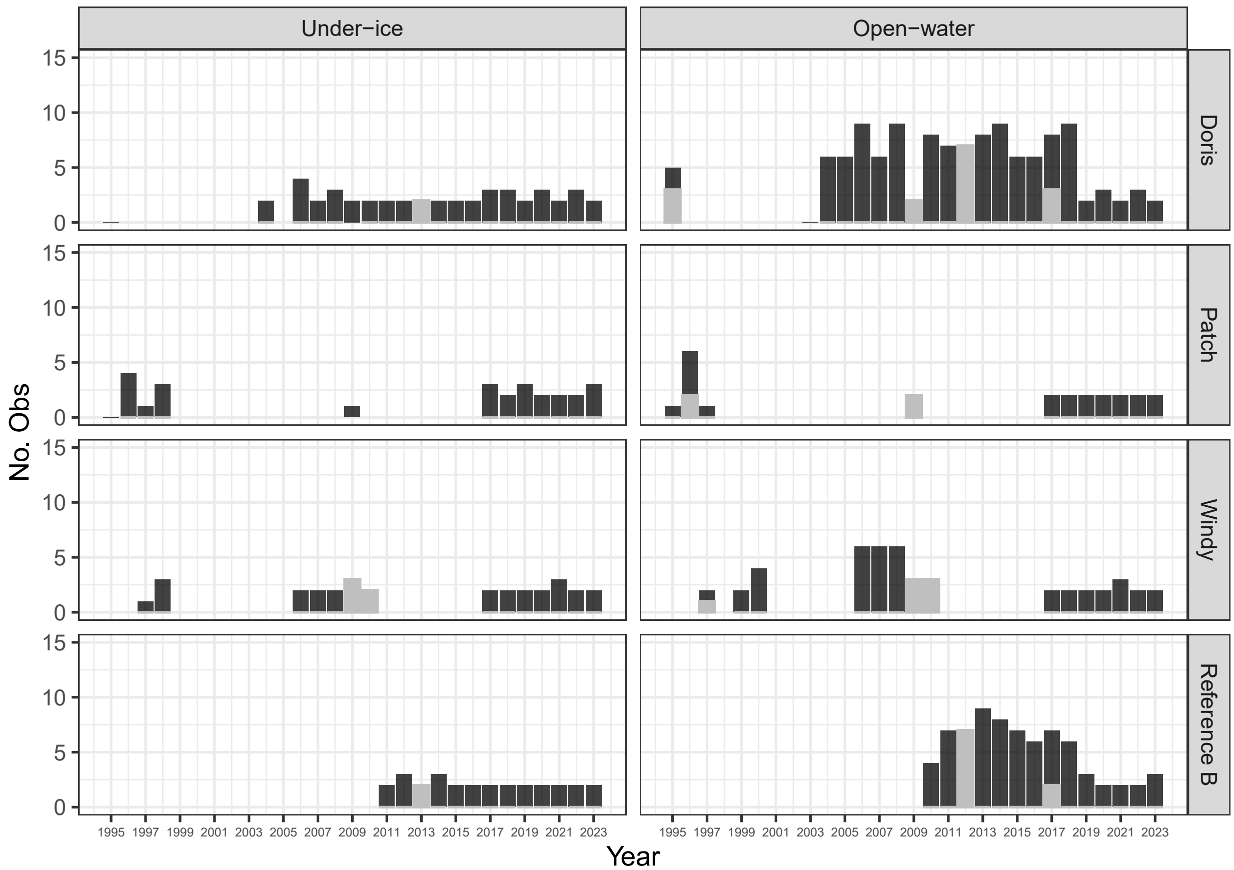
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Aluminum
0.15
0.10
0.05
0.00
Before
After
Year
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Surface:Detect
Deep:Detect
Reference B
Windy

C.3.1.11 Total Arsenic

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

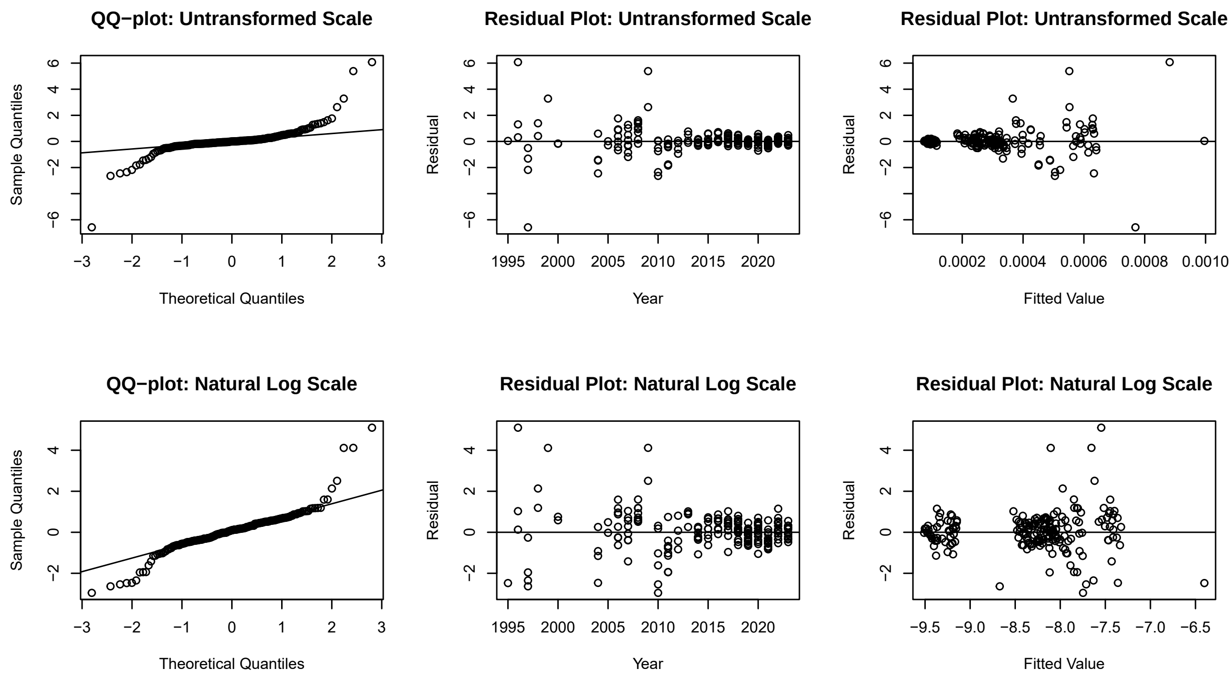
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	2	4	0
Doris	Open-water	123	15	12	0
Patch	Under-ice	26	1	4	0
Patch	Open-water	24	4	17	0
Reference B	Under-ice	28	2	7	0
Reference B	Open-water	73	9	12	0
Windy	Under-ice	30	5	17	0
Windy	Open-water	47	7	15	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression. Doris North Open-water, Patch Open-water, Reference B Open-water, Windy Under-ice, and Windy Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
22	Doris	2009	Under-ice	Deep	0.0011	0.001	5.386
87	Patch	1996	Open-water	Surface	0.0015	0.001	6.074
89	Patch	1997	Open-water	Surface	0.0001	0.001	-6.580
180	Windy	1999	Open-water	Surface	0.0007	0.000	3.282

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
22	Doris	2009	Under-ice	Deep	0.0011	-7.654	4.117
87	Patch	1996	Open-water	Surface	0.0015	-7.545	5.100
180	Windy	1999	Open-water	Surface	0.0007	-8.106	4.114

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there were outliers retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	89.95	3	<0.00001	sig.
Compare to Reference B	10.38	3	0.01560	sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake exhibited significant deviation from the trend of Reference Lake B

Doris Open-Water

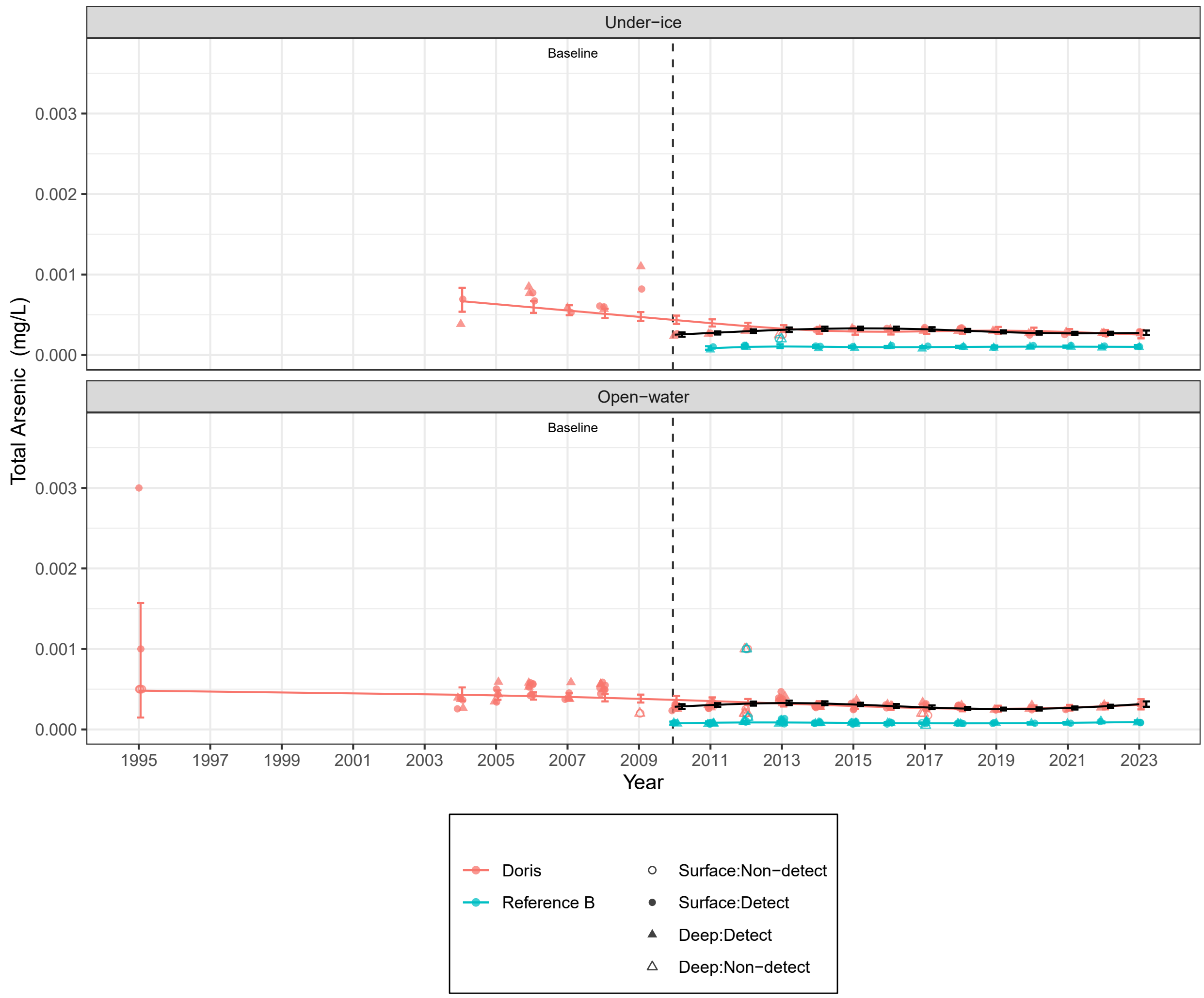
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	34.686	3	<0.00001	sig.
Compare to Reference B	5.633	3	0.13090	not sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake did not exhibit significant deviation from the trend of Reference Lake B

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

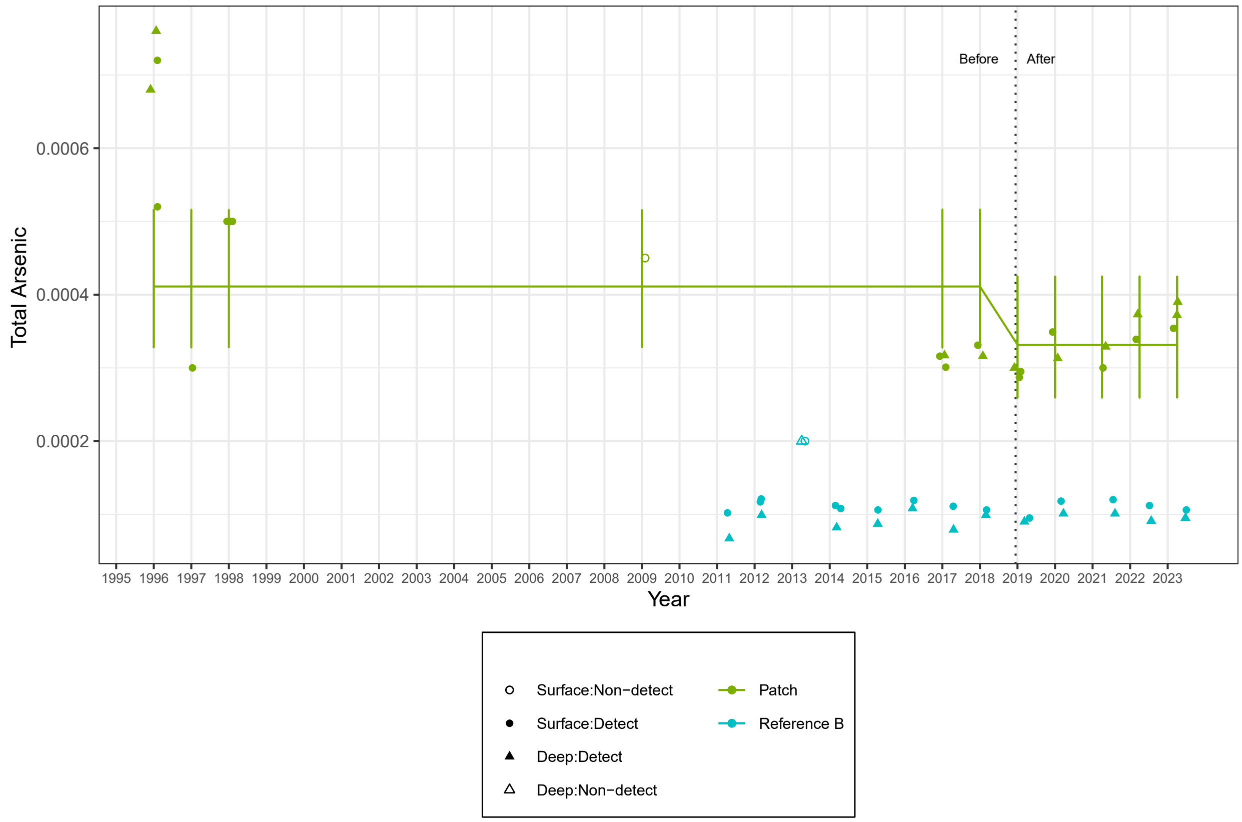
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.2152	0.1493	9.024	-1.442	0.1831	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

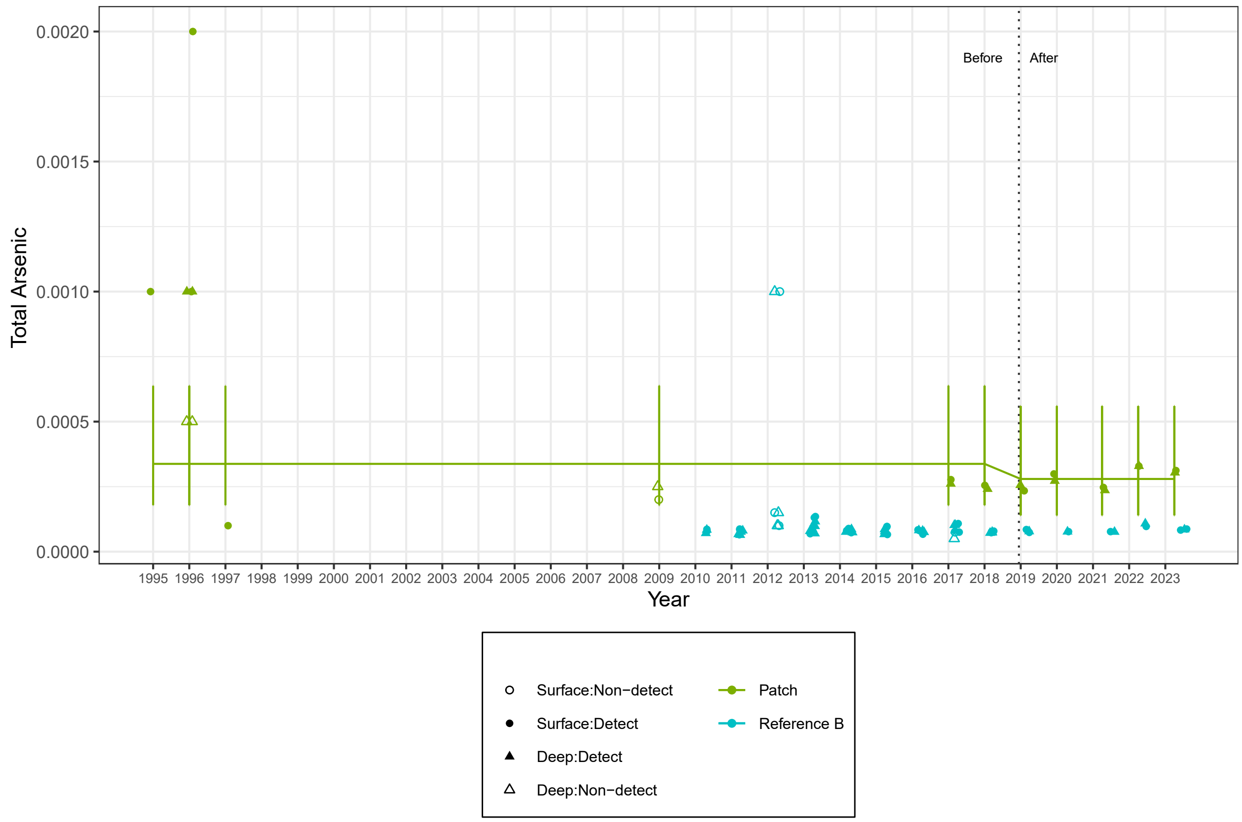
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.1887	0.4163	8.741	-0.4532	0.6614	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

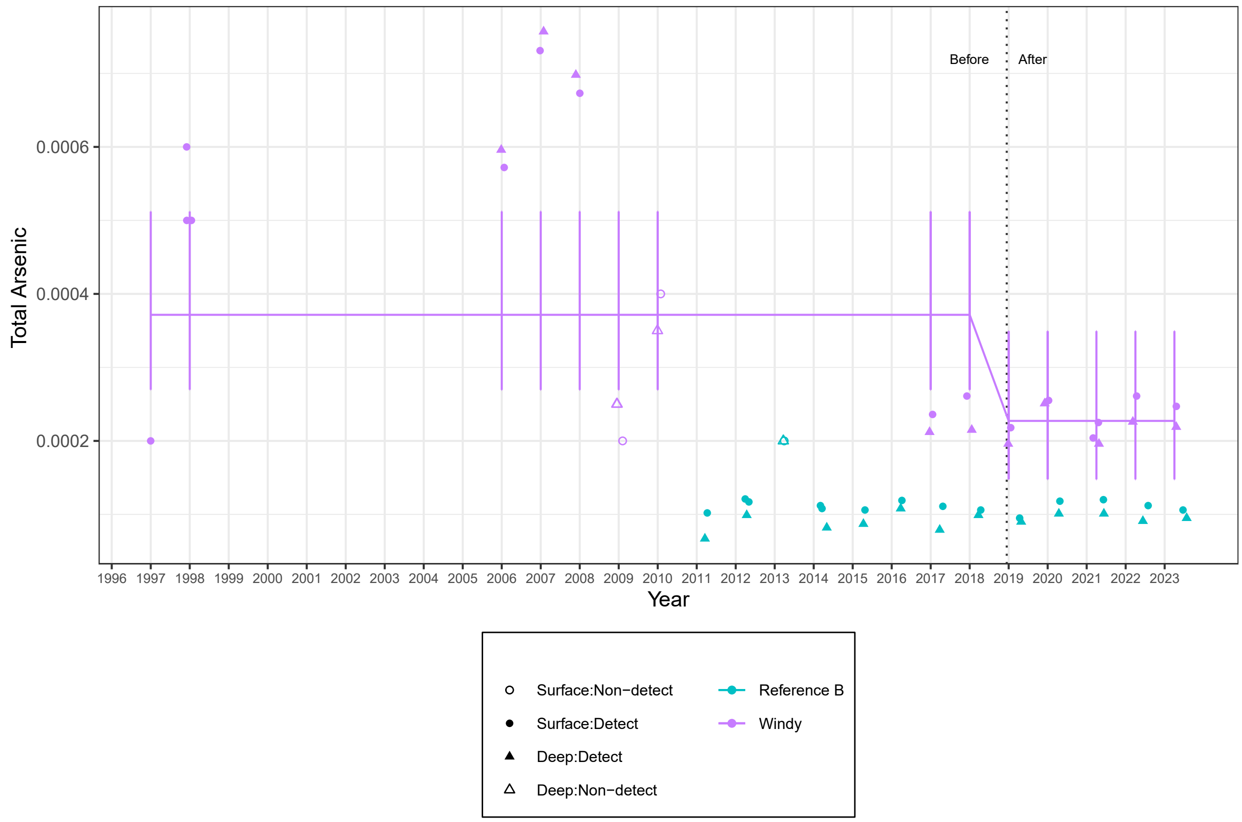
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.4918	0.246	11.95	-1.999	0.0689	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

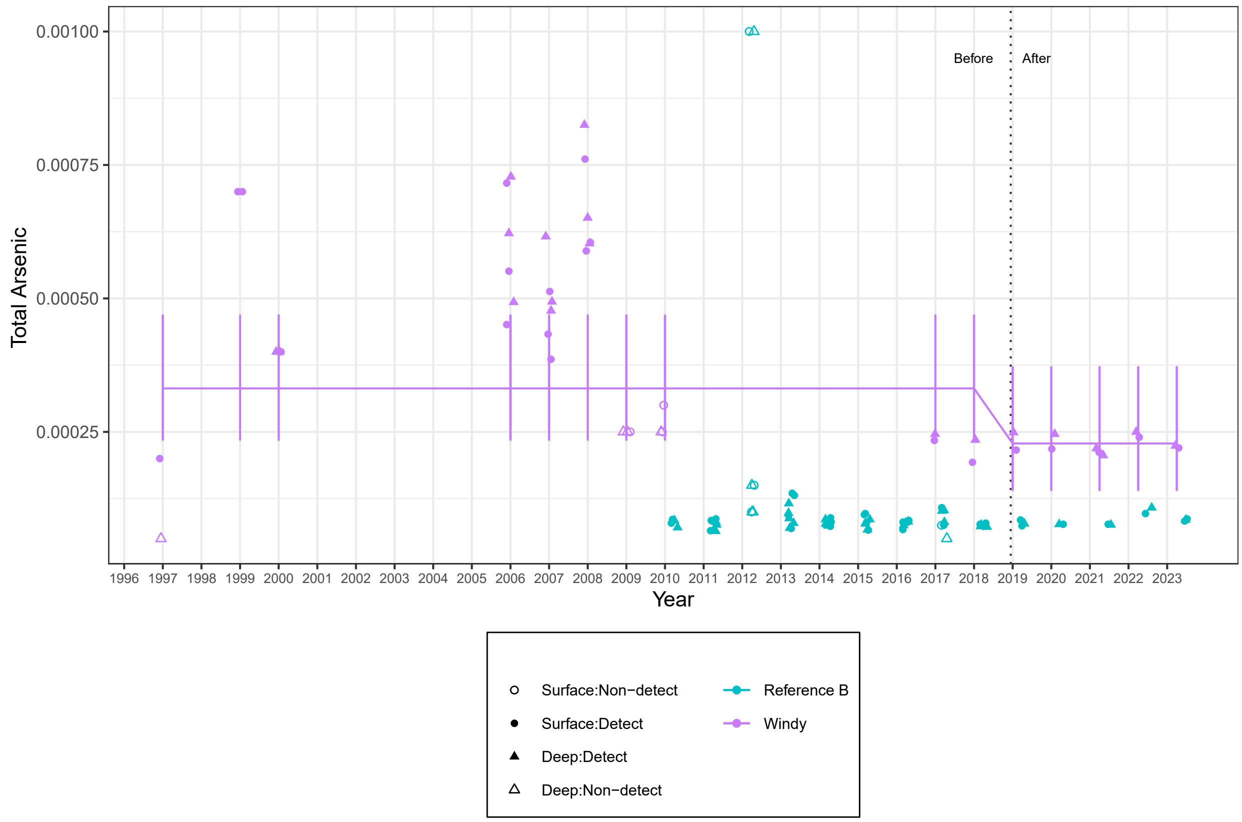
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.3729	0.2775	12.65	-1.344	0.2026	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

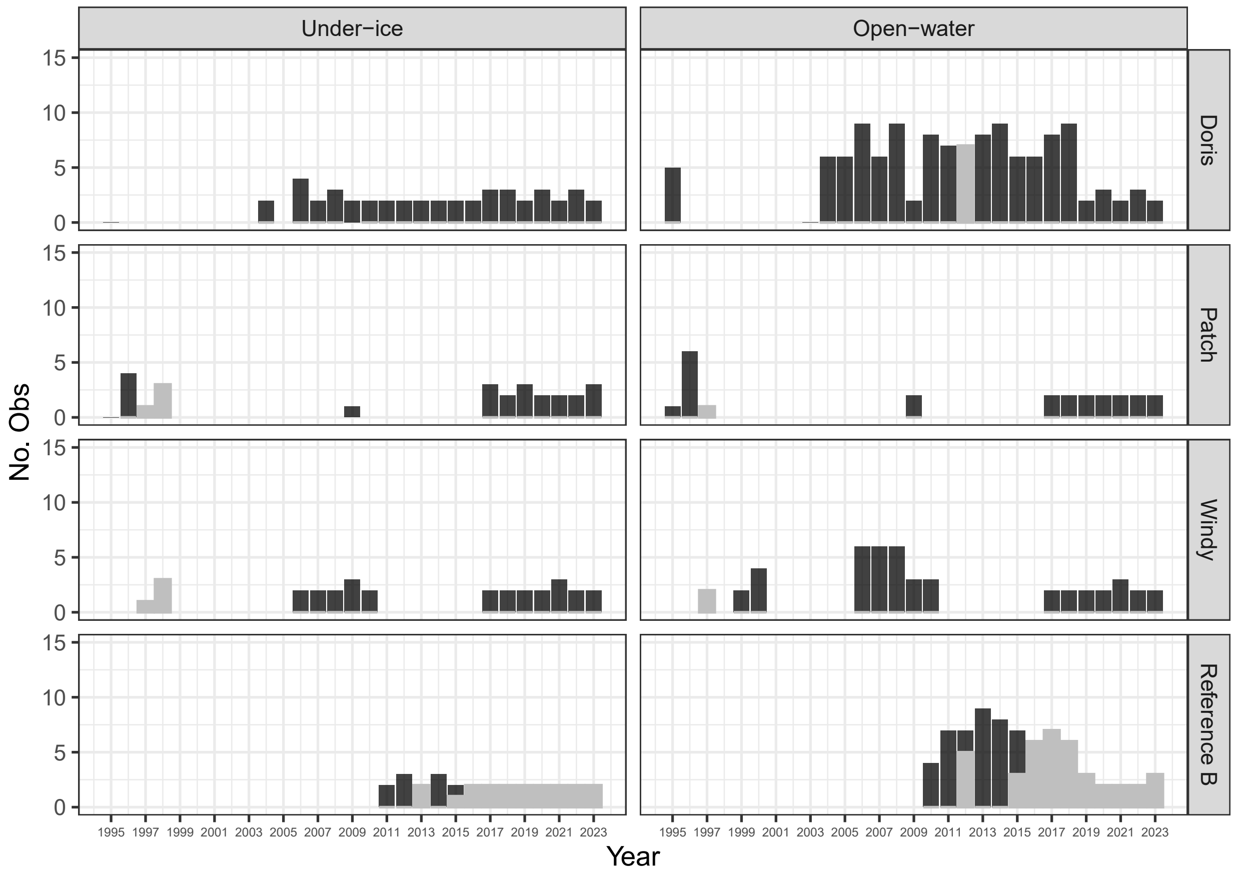
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Arsenic
0.00100
0.00075
0.00050
0.00025
Before
After
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Surface:Non−detect
Surface:Detect
Deep:Detect
Deep:Non−detect
Reference B
Windy

C.3.1.12 Total Boron

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

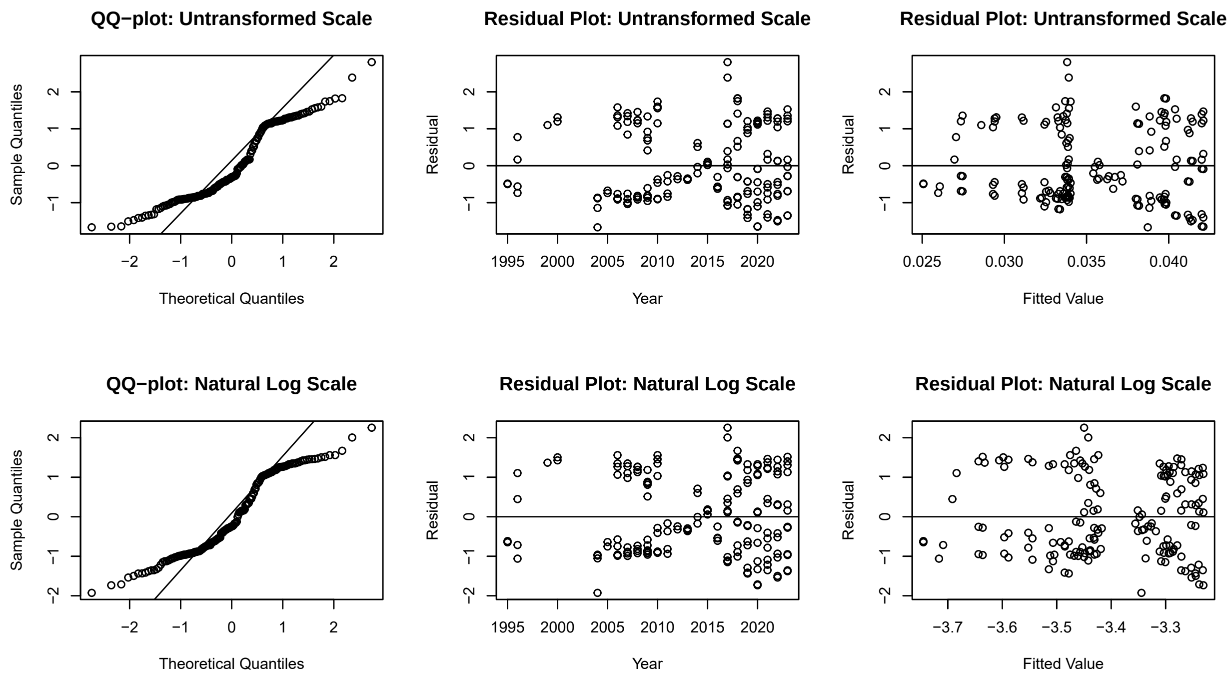
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	0	0	0
Doris	Open-water	123	7	6	0
Patch	Under-ice	26	4	15	0
Patch	Open-water	24	1	4	0
Reference B	Under-ice	28	19	68	100
Reference B	Open-water	73	39	53	100
Windy	Under-ice	30	4	13	0
Windy	Open-water	47	2	4	0

More than 50% of data under detection limit in Reference B Under-ice and Reference B Open-water. Data from those site-season groupings will be removed from the analysis.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

None

Outliers on natural log scale:

None

The untransformed and natural log-transformed model fit the data equally well. Analysis proceeds with untransformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	39.25	3	<0.00001	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

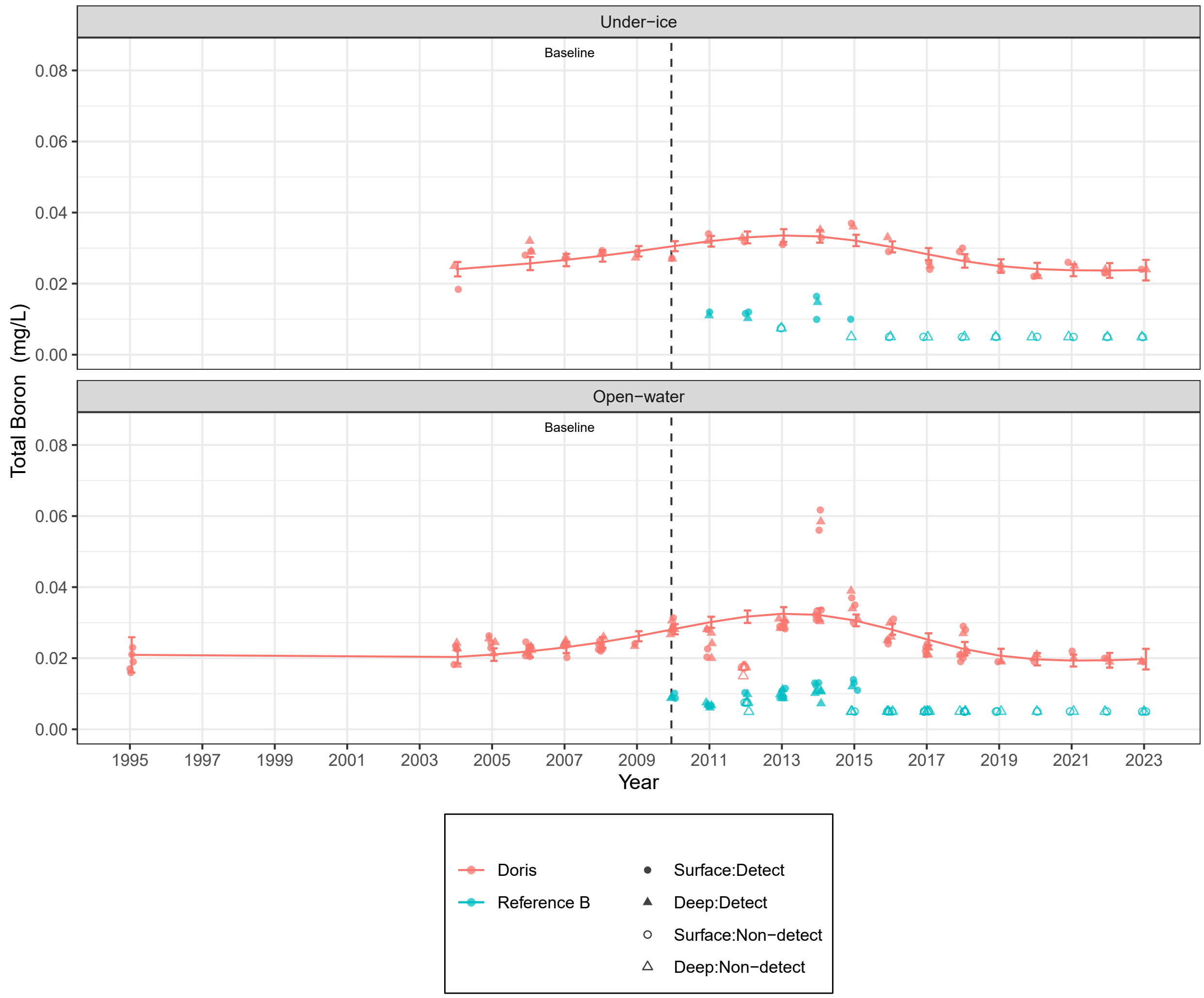
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	46.04	3	<0.00001	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

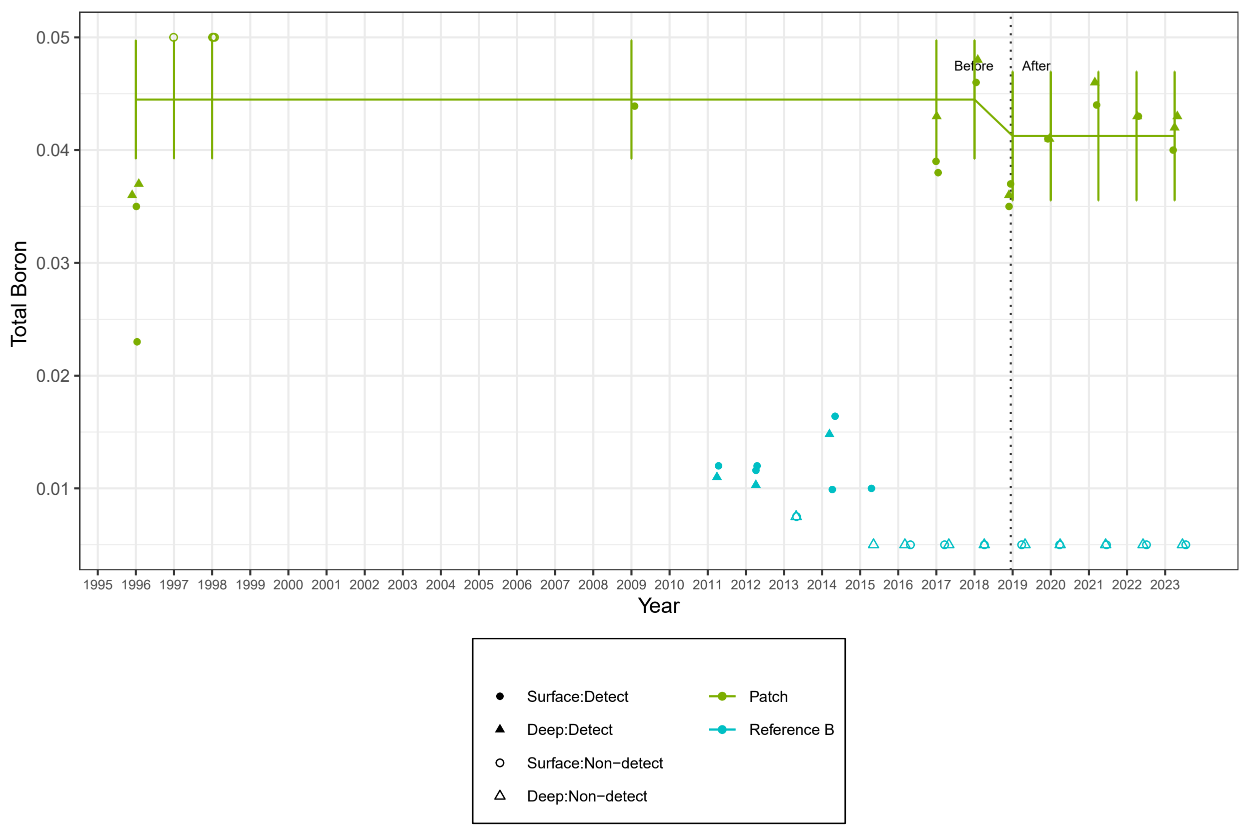
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0032	0.0034	8.942	-0.9408	0.3715	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

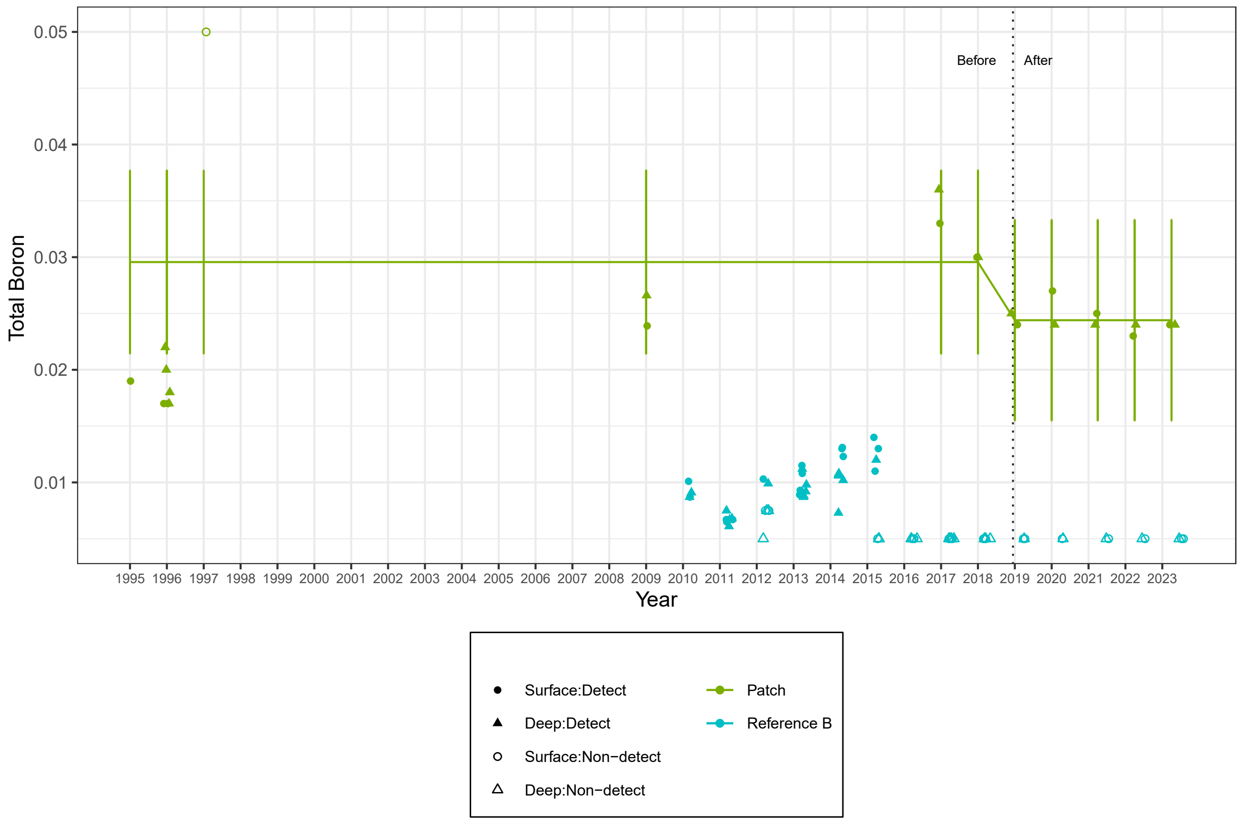
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0052	0.0054	8.875	-0.9653	0.36	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

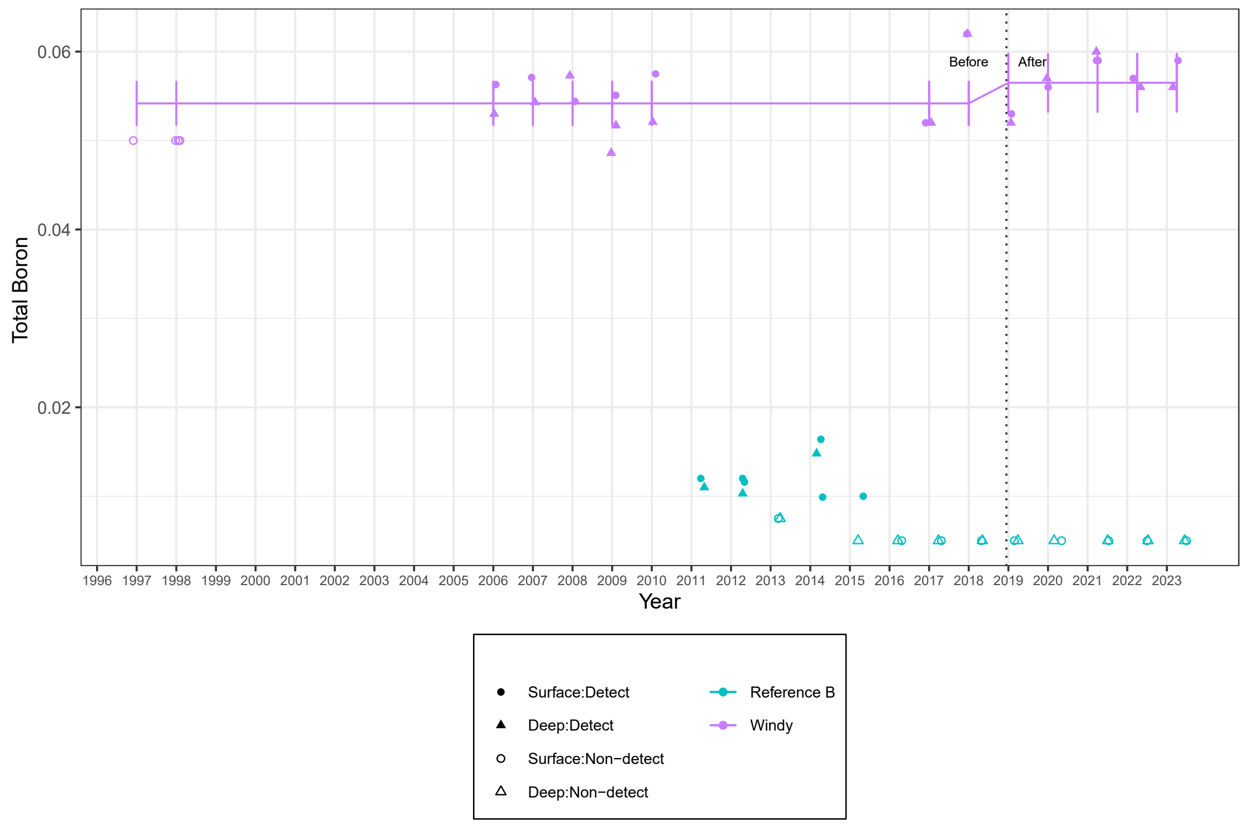
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0023	0.0019	11.27	1.22	0.2475	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

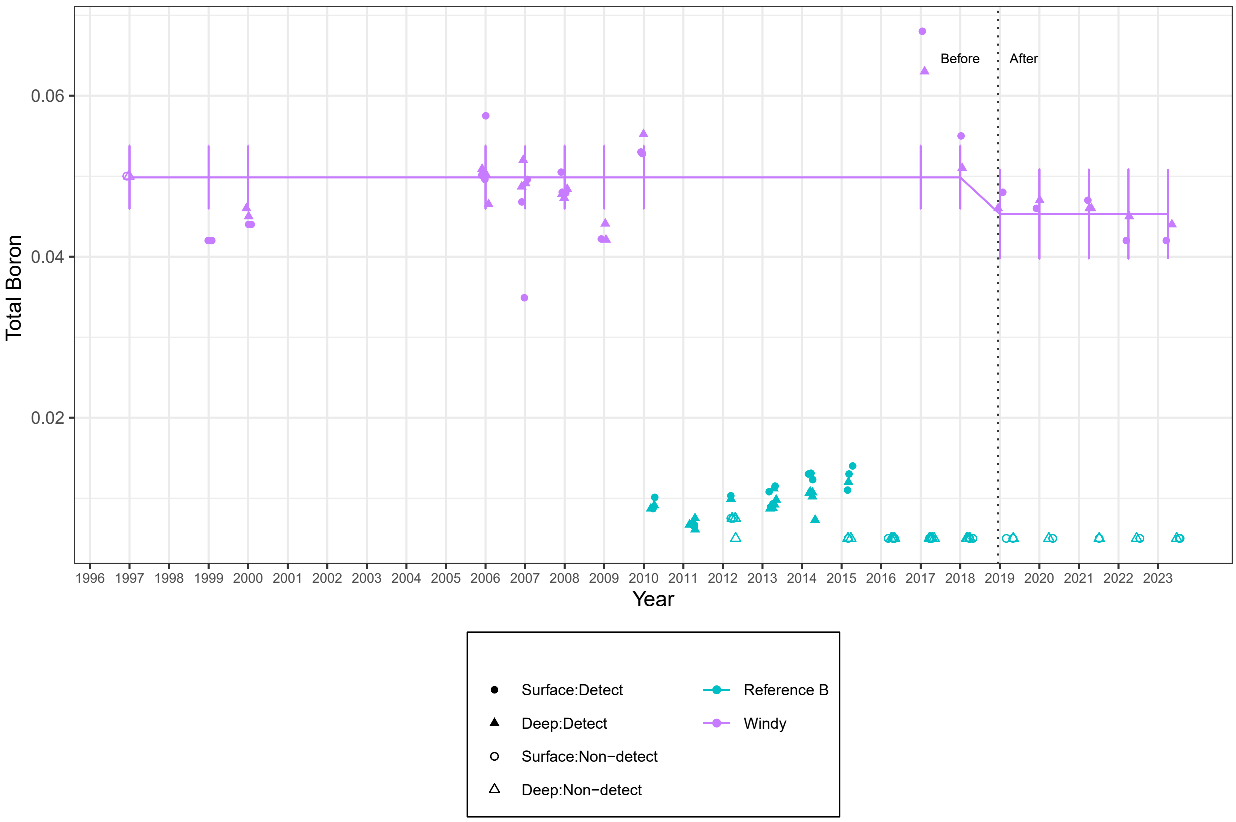
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0045	0.0032	12.83	-1.438	0.1743	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

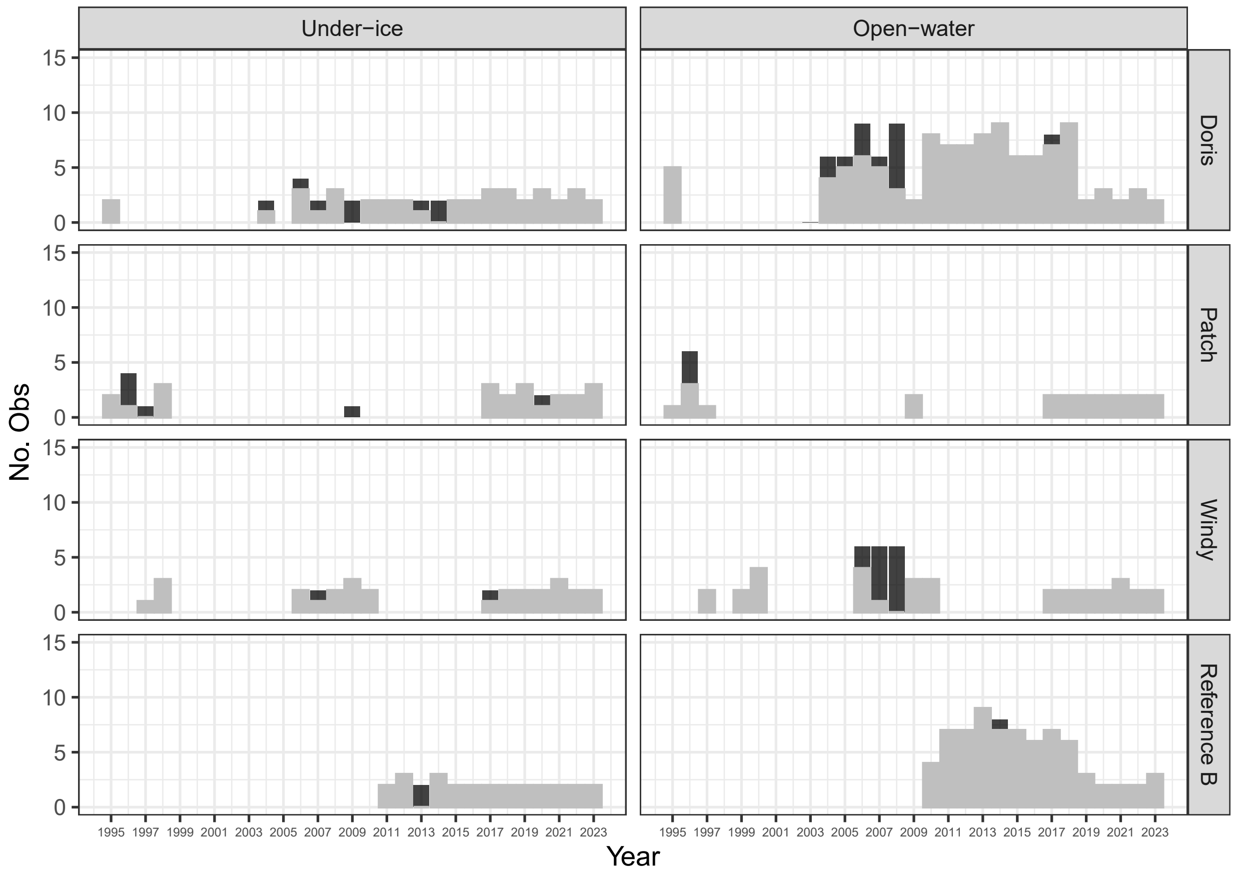
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Boron
0.06
0.04
0.02
Before
After
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Surface:Detect
Deep:Detect
Surface:Non−detect
Deep:Non−detect
Reference B
Windy

C.3.1.13 Total Cadmium

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

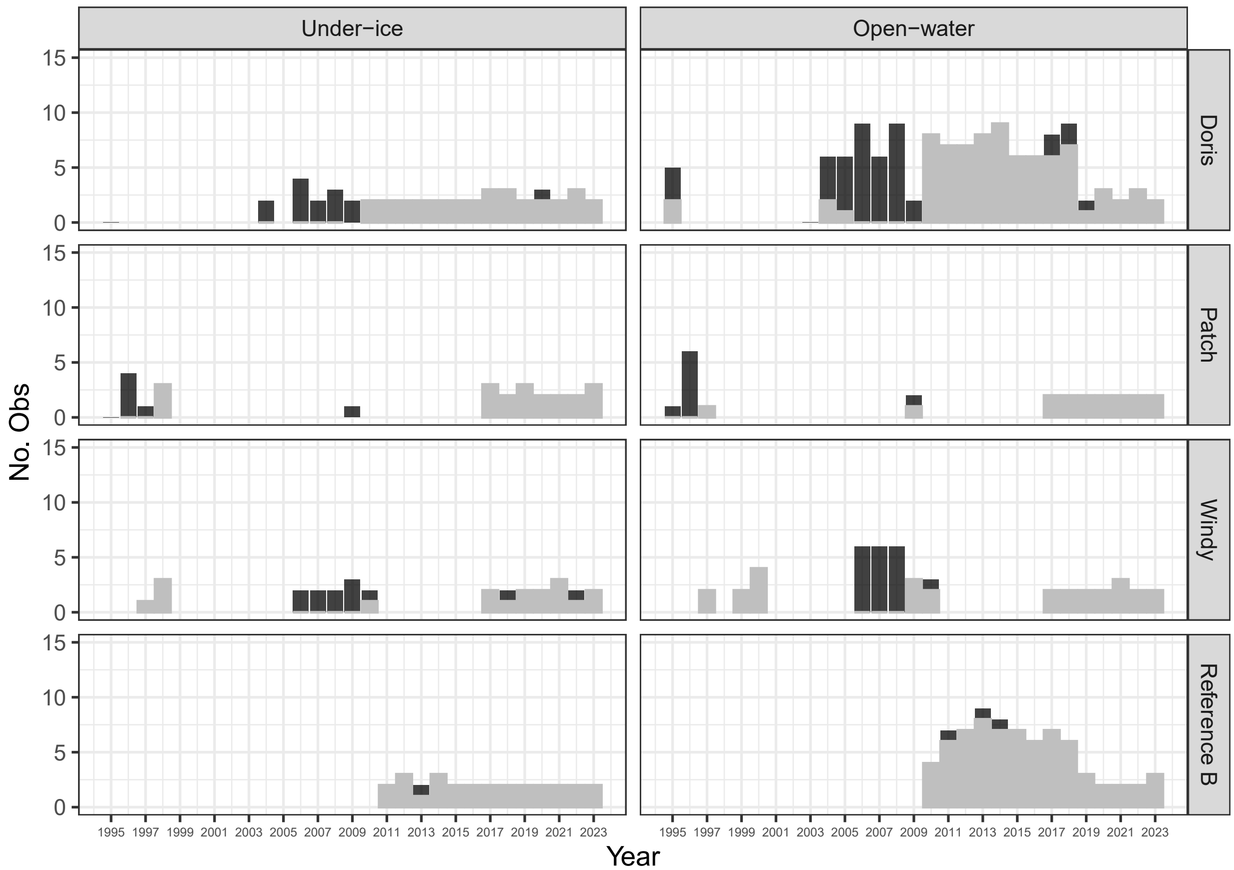
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	47	41	87	100
Doris	Open-water	123	109	89	100
Patch	Under-ice	28	23	82	100
Patch	Open-water	24	21	88	100
Reference B	Under-ice	28	26	93	100
Reference B	Open-water	73	72	99	100
Windy	Under-ice	30	28	93	100
Windy	Open-water	47	34	72	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.14 Total Chromium

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

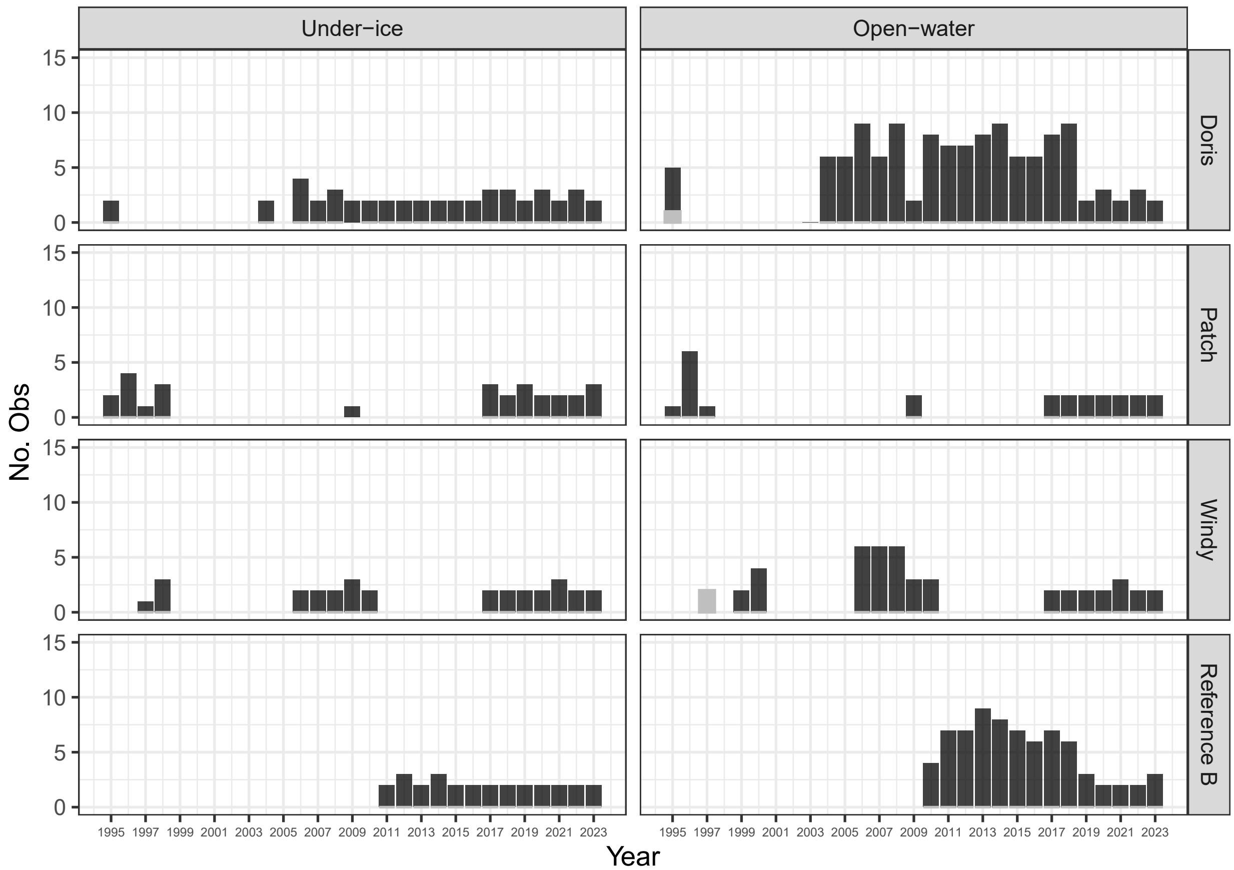
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	31	69	100
Doris	Open-water	123	80	65	100
Patch	Under-ice	26	20	77	100
Patch	Open-water	24	16	67	100
Reference B	Under-ice	28	27	96	100
Reference B	Open-water	73	70	96	100
Windy	Under-ice	30	18	60	100
Windy	Open-water	47	28	60	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.15 Total Copper

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

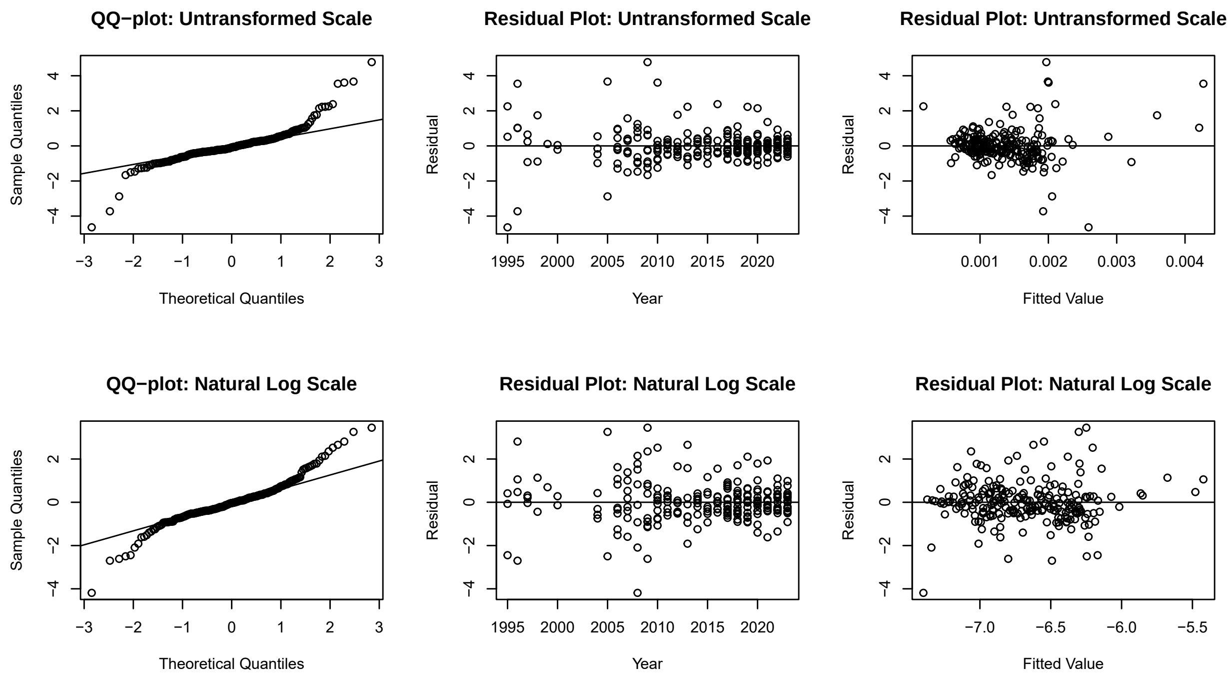
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	47	0	0	0
Doris	Open-water	123	1	1	0
Patch	Under-ice	28	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	28	0	0	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	30	0	0	0
Windy	Open-water	47	2	4	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
8	Doris	2005	Open-water	Deep	0.0029	0.002	3.668
23	Doris	2009	Under-ice	Surface	0.0031	0.002	4.775
27	Doris	2010	Under-ice	Surface	0.0029	0.002	3.609
82	Patch	1995	Under-ice	Surface	0.0015	0.003	-4.640
85	Patch	1996	Under-ice	Surface	0.0051	0.004	3.545
87	Patch	1996	Open-water	Surface	0.0011	0.002	-3.726

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
8	Doris	2005	Open-water	Deep	0.0029	-6.302	3.253
23	Doris	2009	Under-ice	Surface	0.0031	-6.249	3.448
191	Windy	2008	Under-ice	Deep	0.0003	-7.399	-4.188

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there were outliers retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	8.695	4	0.06920	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

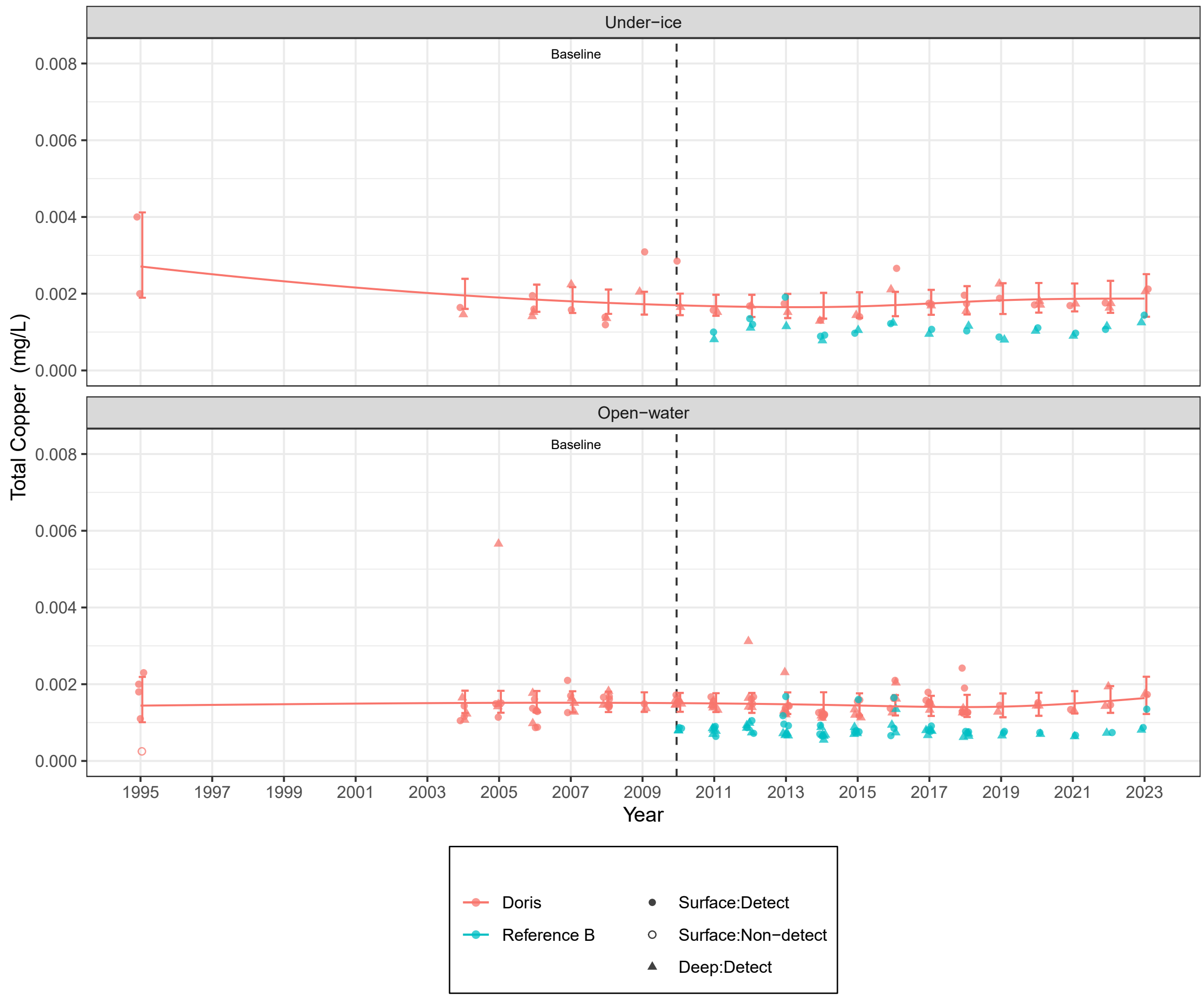
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	1.333	4	0.85580	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.2275	0.2281	9.982	-0.9974	0.3421	not sig.

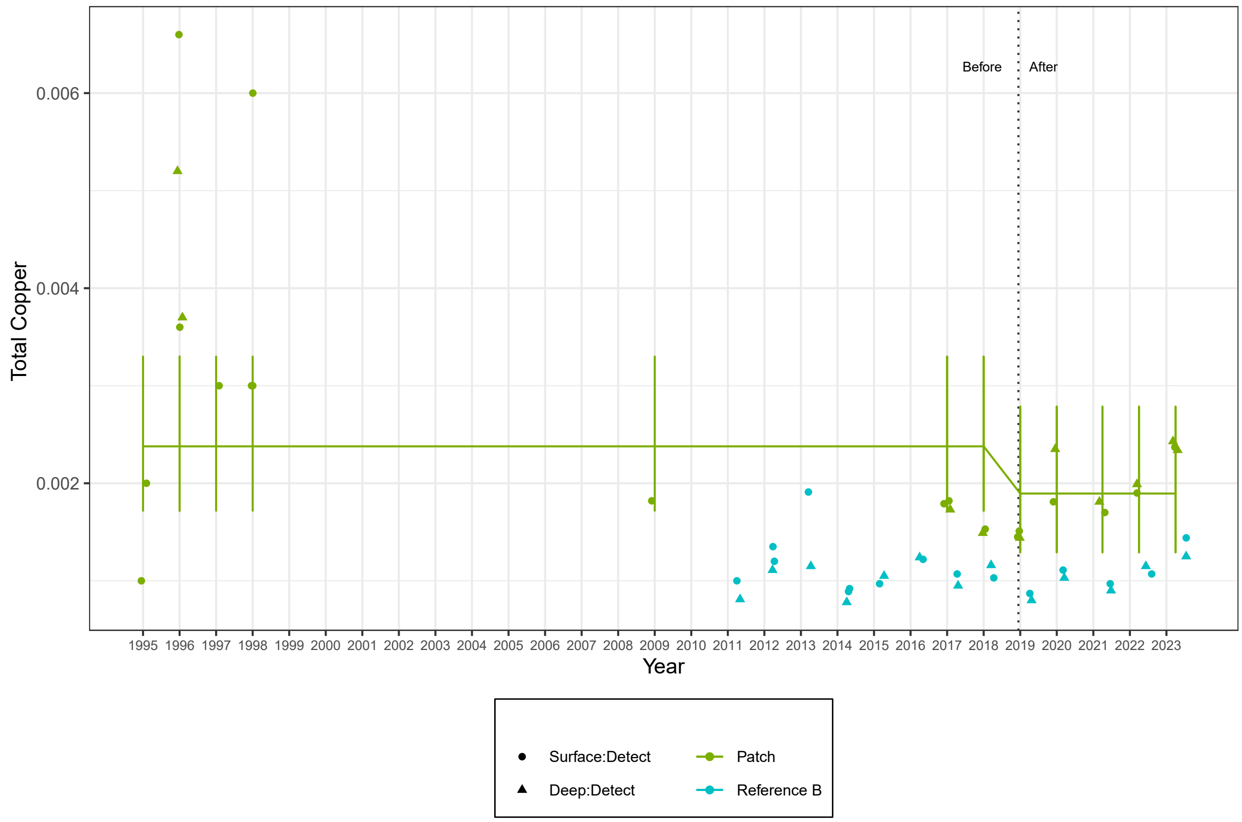
Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

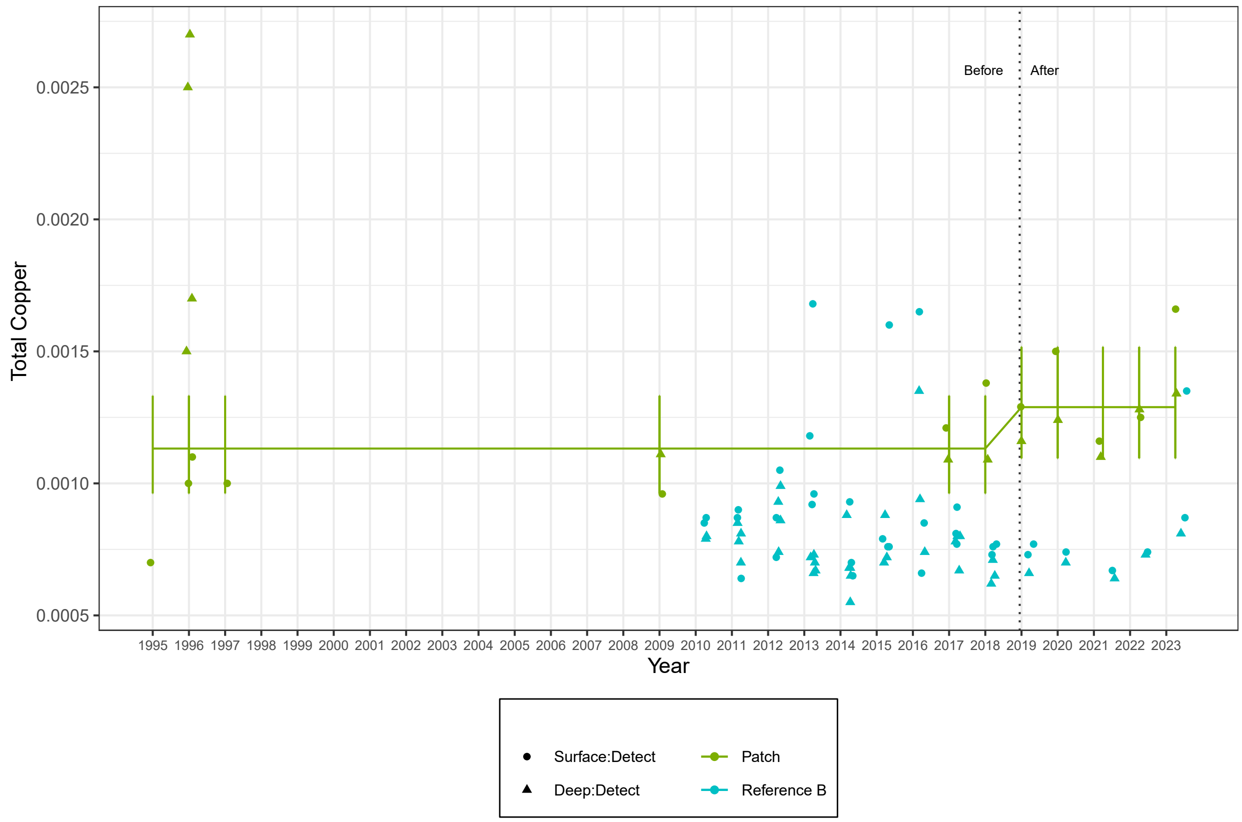
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.1298	0.0994	17	1.306	0.2088	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

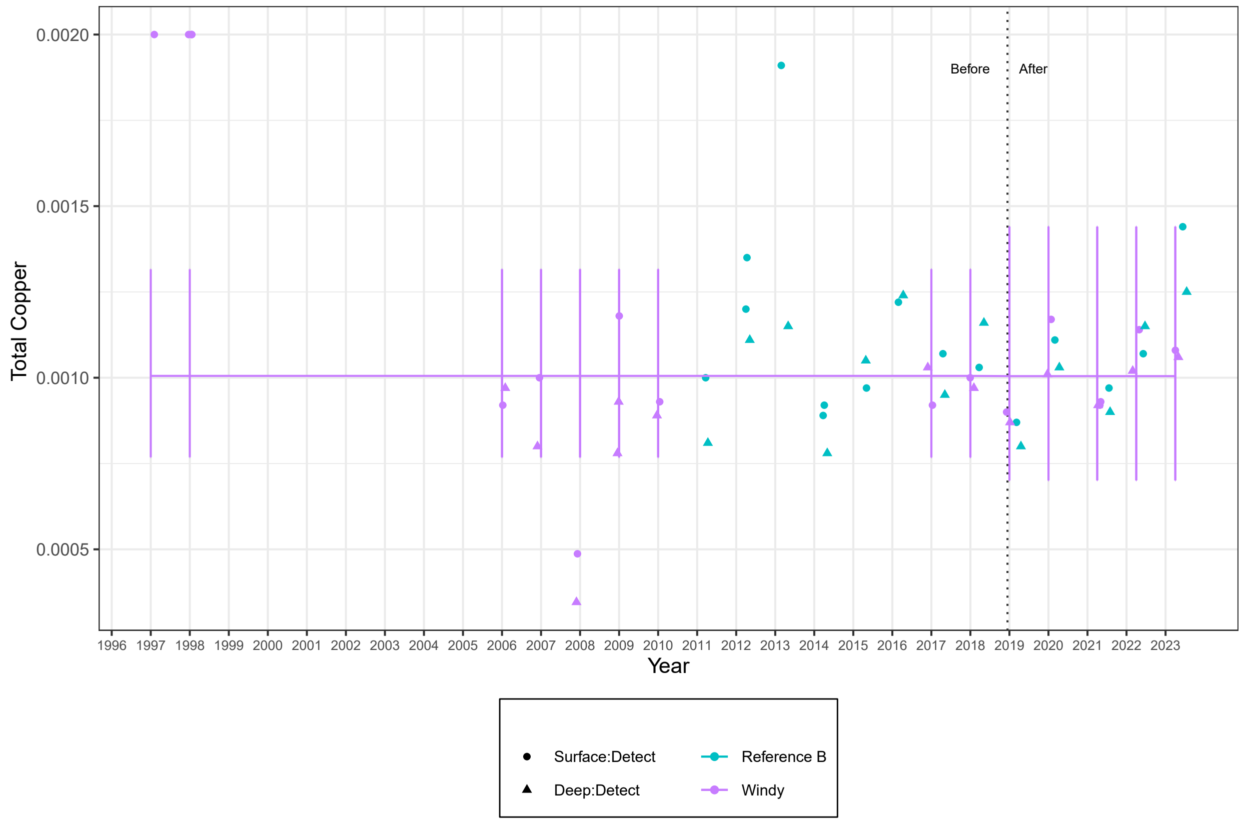
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0007	0.2062	11.59	-0.0034	0.9973	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

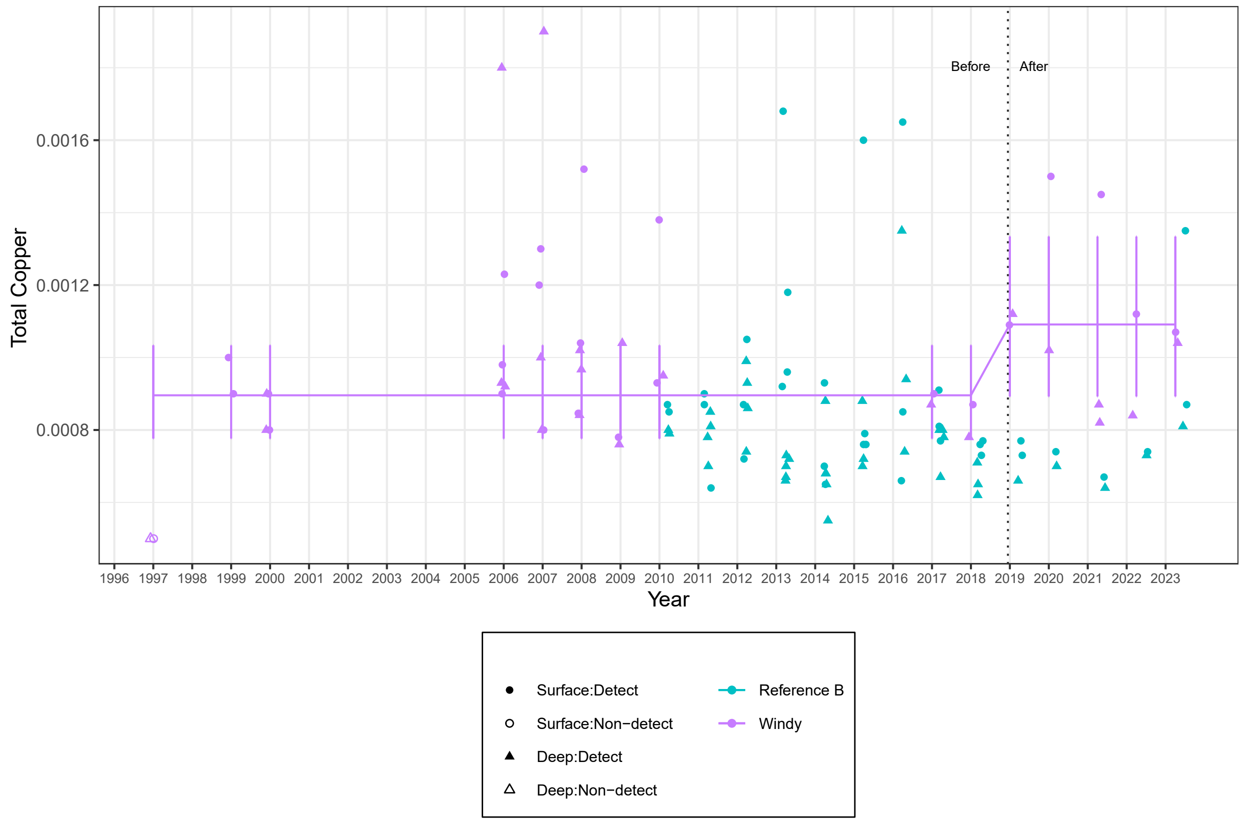
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.1974	0.114	13.11	1.732	0.1066	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

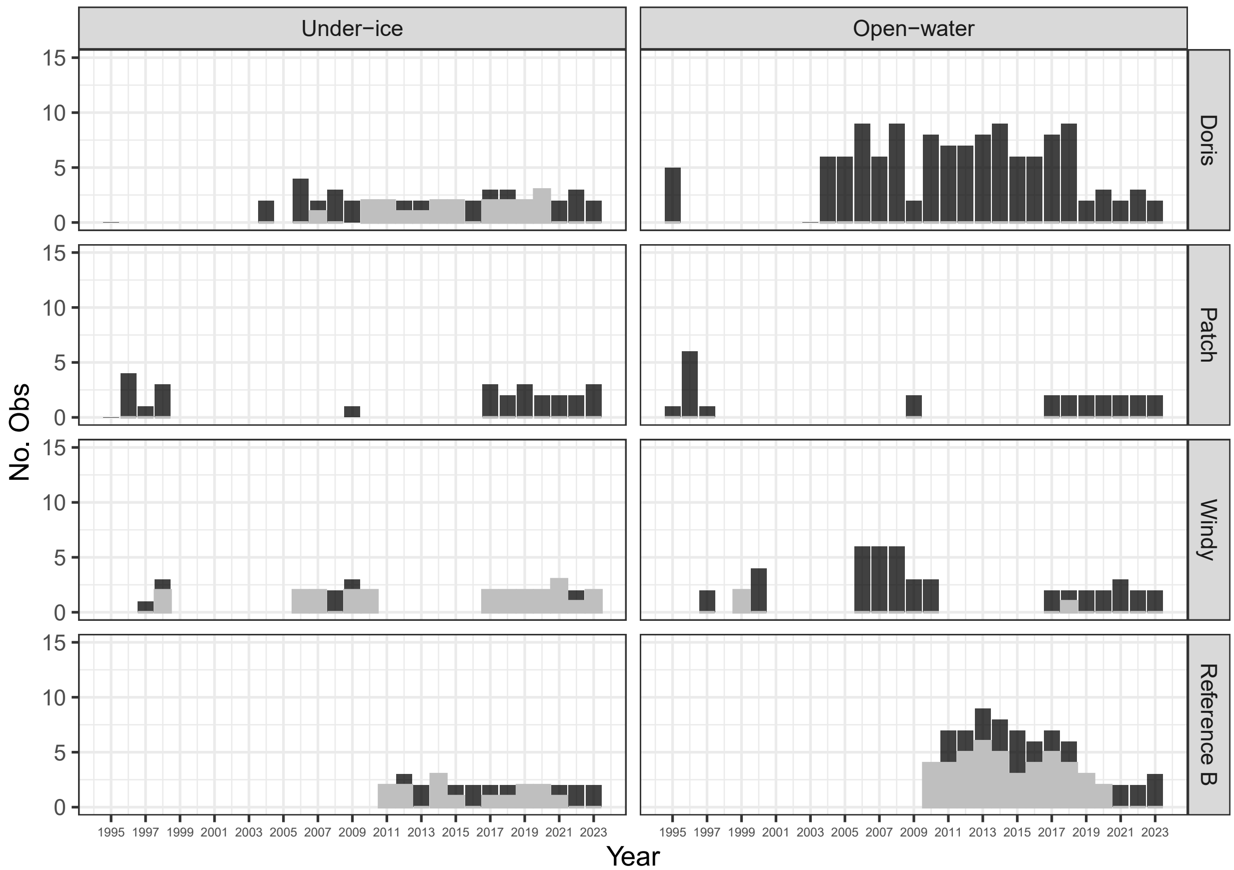
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Before
After
0.0016
0.0012
0.0008
Total Copper
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year
Surface:Detect
Surface:Non−detect
Deep:Detect
Deep:Non−detect
Reference B
Windy

C.3.1.16 Total Iron

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

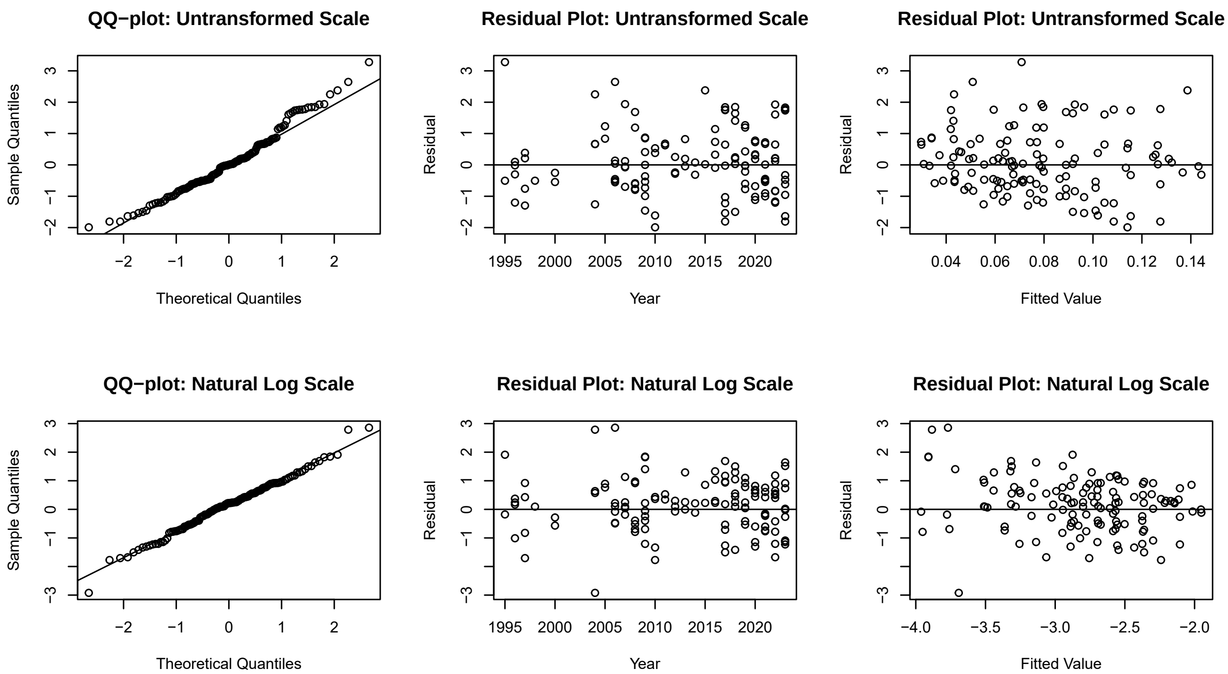
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	20	44	0
Doris	Open-water	123	0	0	0
Patch	Under-ice	26	0	0	0
Patch	Open-water	24	0	0	0
Reference B	Under-ice	28	15	54	0
Reference B	Open-water	73	45	62	0
Windy	Under-ice	30	24	80	100
Windy	Open-water	47	3	6	0

More than 50% of data under detection limit in Reference B Under-ice, Reference B Open-water, and Windy Under-ice. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
2	Doris	1995	Open-water	Surface	0.206	0.071	3.278

Outliers on natural log scale:

None

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	11.16	3	0.01090	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

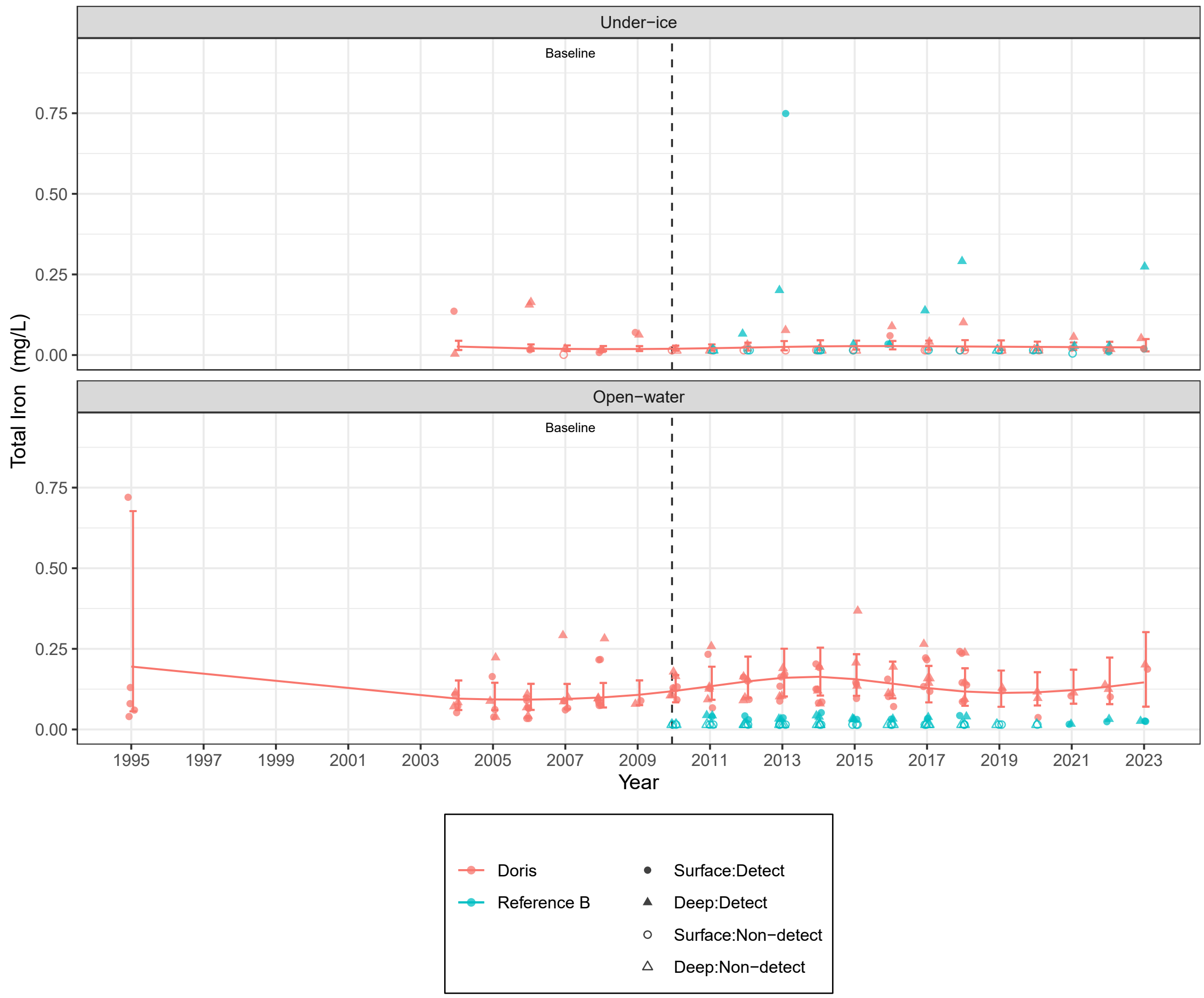
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	1.66	3	0.64590	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

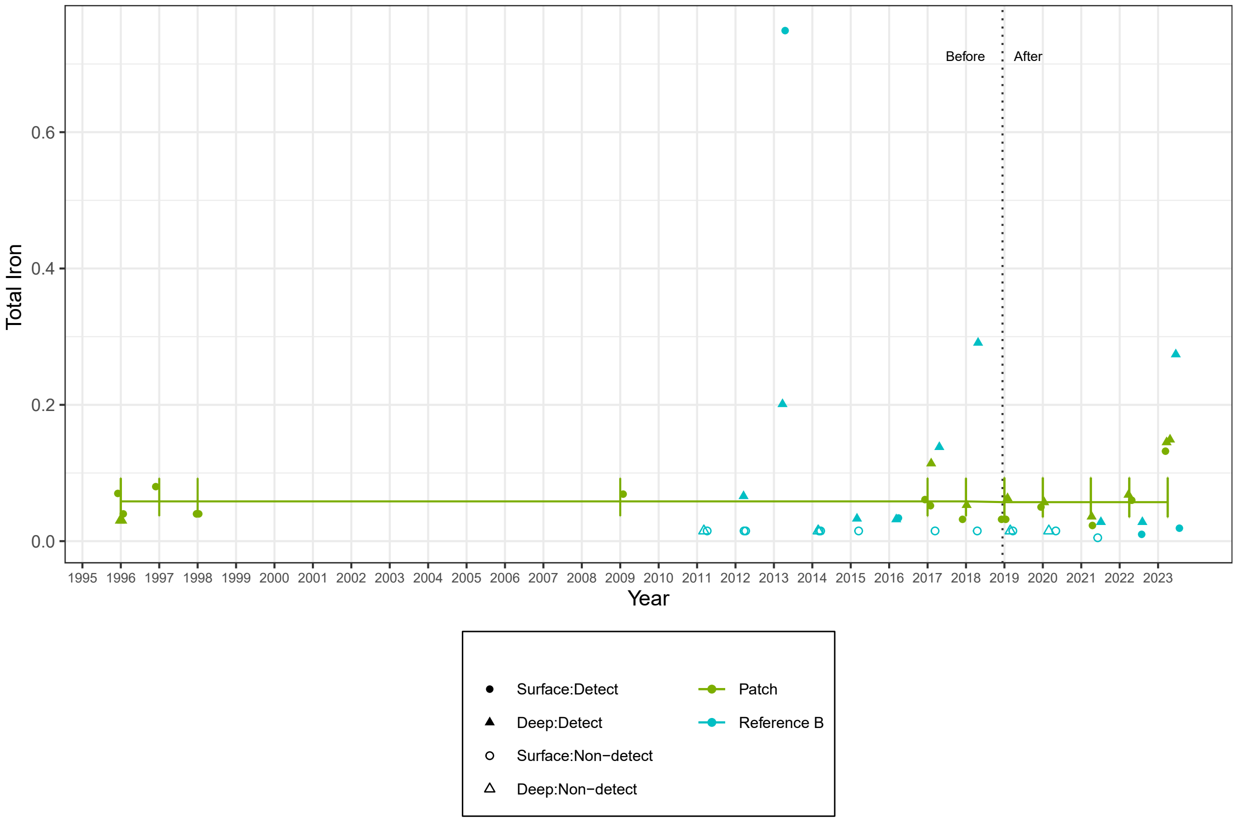
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0195	0.2954	9.357	-0.0661	0.9487	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

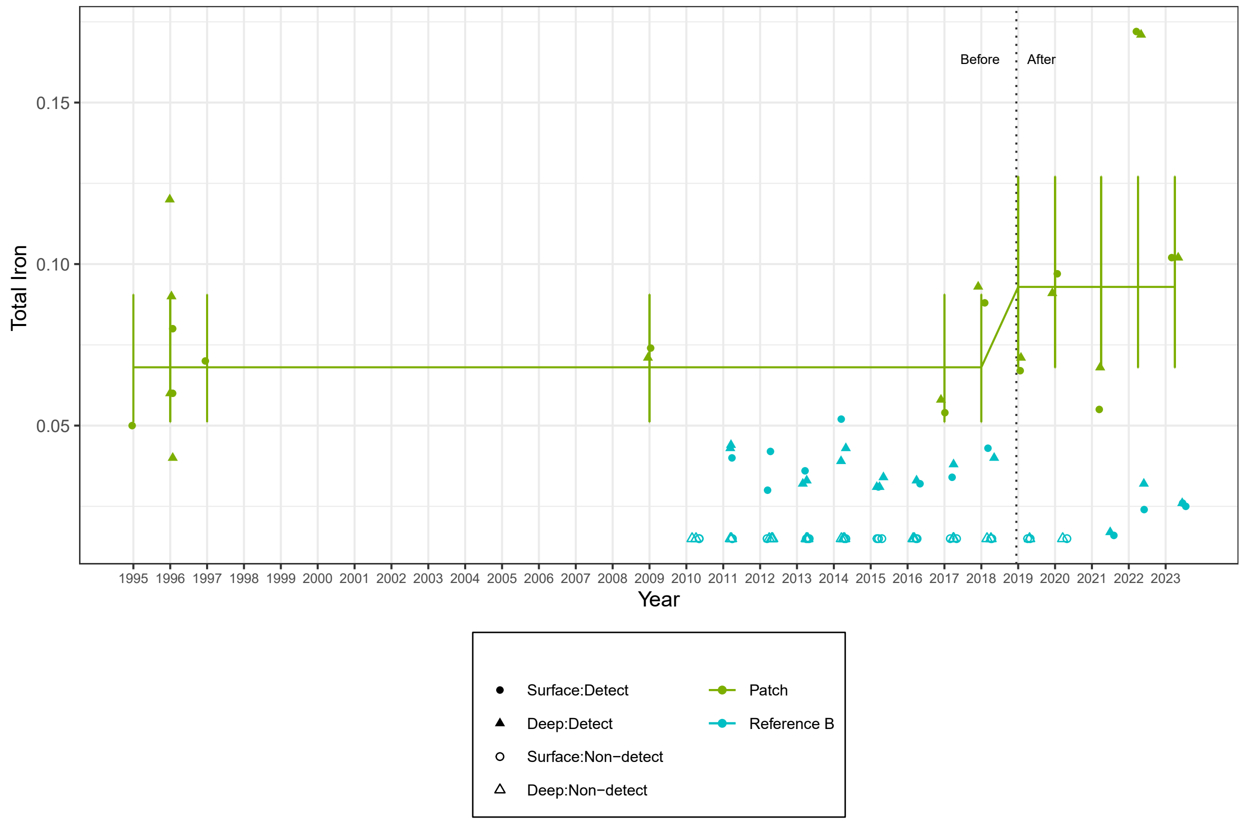
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3117	0.1877	9.025	1.66	0.1312	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis Analysis not performed.

Windy Open-water Before-After Analysis

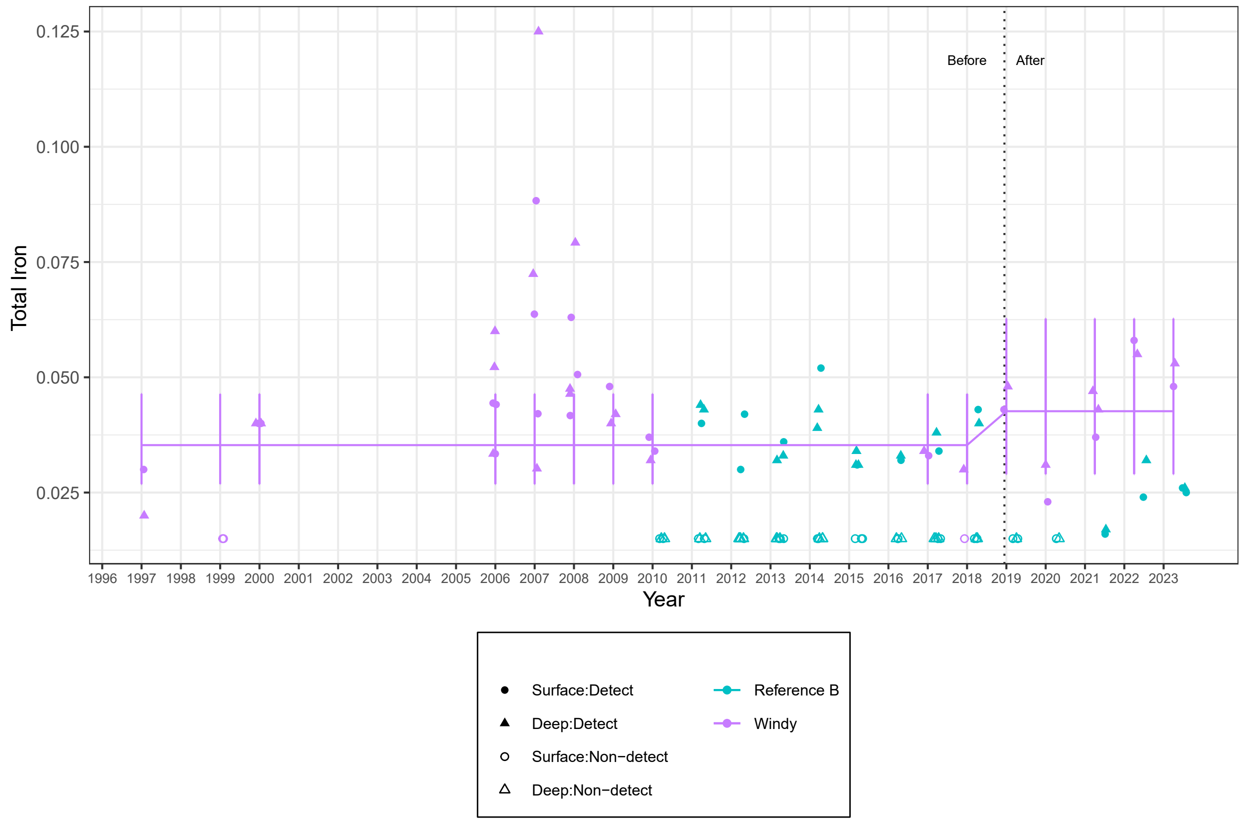
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.1894	0.2188	12.38	0.8656	0.4032	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

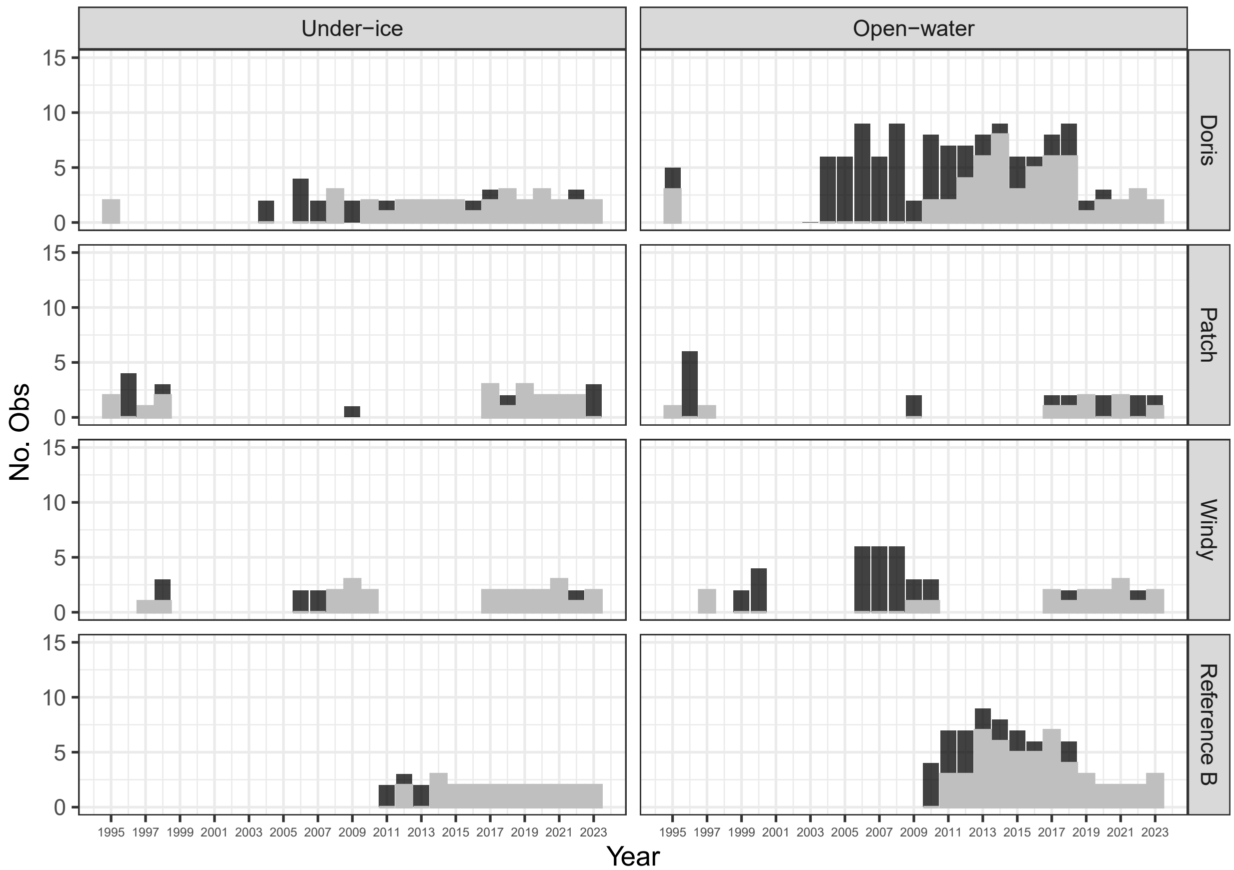
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Iron
Year
Before
After
0.125
0.100
0.075
0.050
0.025
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Surface:Detect
Deep:Detect
Surface:Non−detect
Deep:Non−detect
Reference B
Windy

C.3.1.17 Total Lead

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

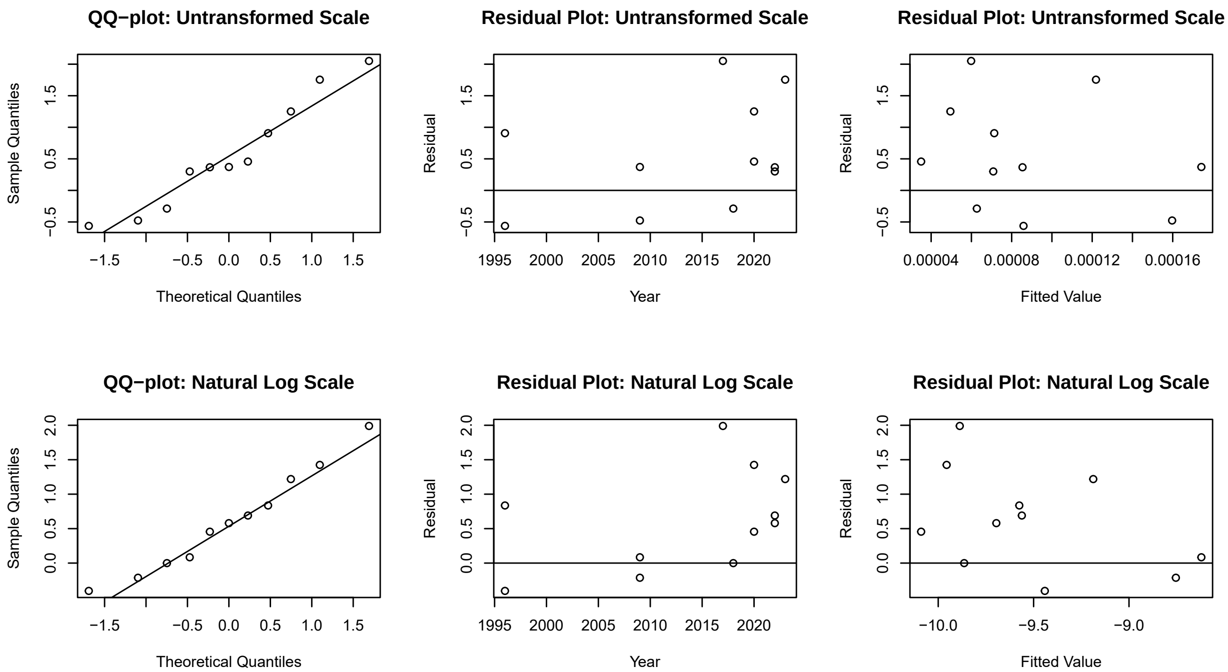
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	47	34	72	100
Doris	Open-water	123	55	45	100
Patch	Under-ice	28	18	64	0
Patch	Open-water	24	9	38	50
Reference B	Under-ice	28	23	82	100
Reference B	Open-water	73	52	71	100
Windy	Under-ice	30	23	77	100
Windy	Open-water	47	17	36	100

More than 50% of data under detection limit in Doris North Under-ice, Doris North Open-water, Patch Under-ice, Reference B Under-ice, Reference B Open-water, Windy Under-ice, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Open-water, Patch

Open-water, and Windy Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

None

Outliers on natural log scale:

None

The untransformed and natural log-transformed model fit the data equally well. Analysis proceeds with untransformed data.

Doris Lake

Doris Under-Ice

All data from Doris under-ice removed from the analysis. No analysis performed.

Doris Open-Water

All data from Doris Lake open-water removed from the analysis. No analysis performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis Analysis not performed.

Patch Open-Water Before-After Analysis

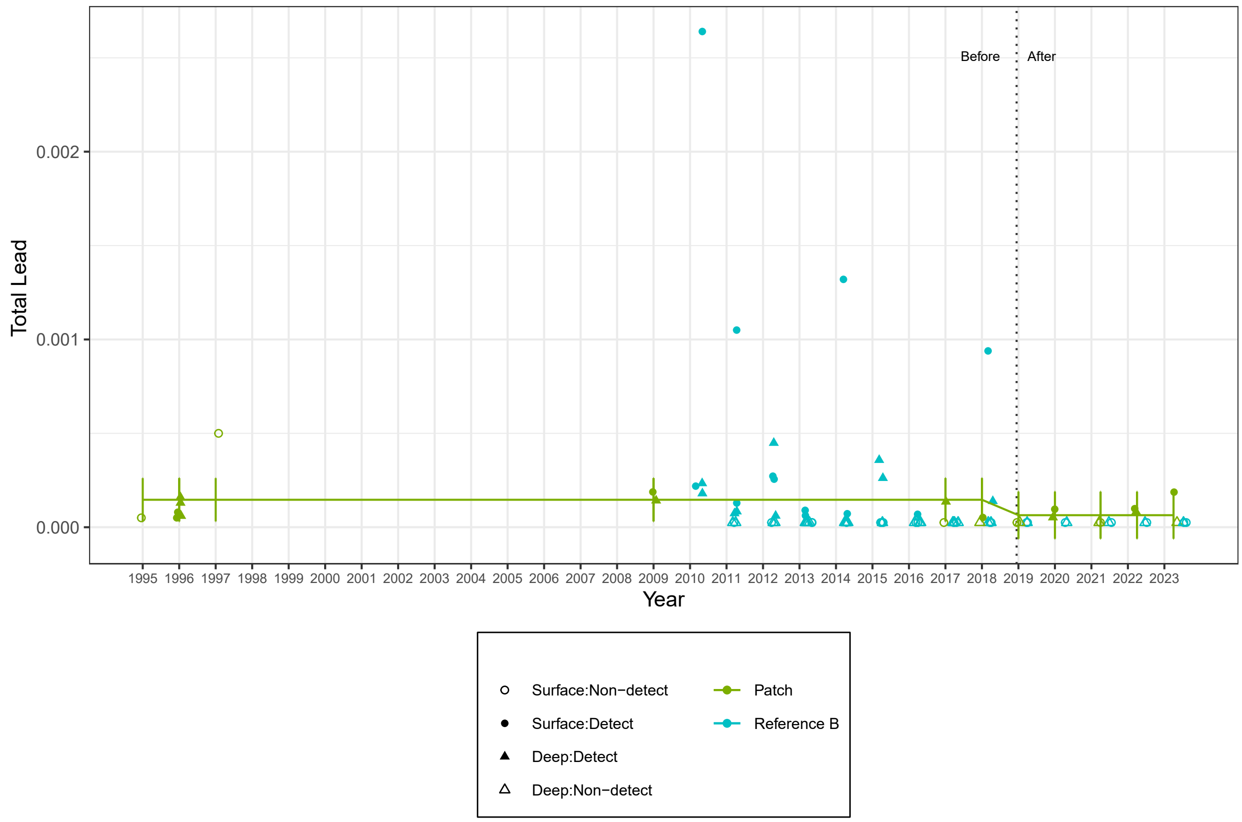
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0001	0.0001	7.75	-1.096	0.306	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

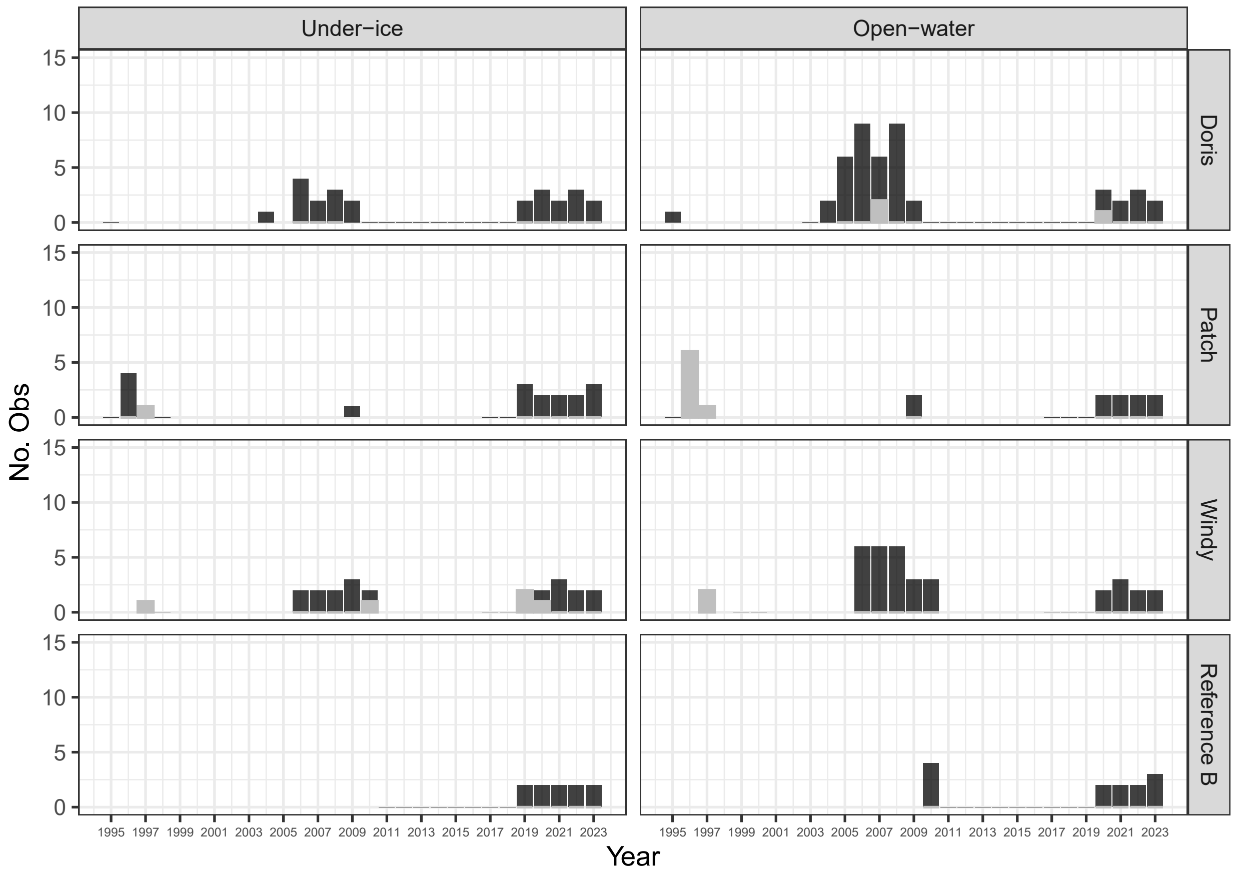
Windy Under-Ice Before-After Analysis Analysis not performed.

Windy Open-water Before-After Analysis Analysis not performed.

C.3.1.18 Dissolved Manganese

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

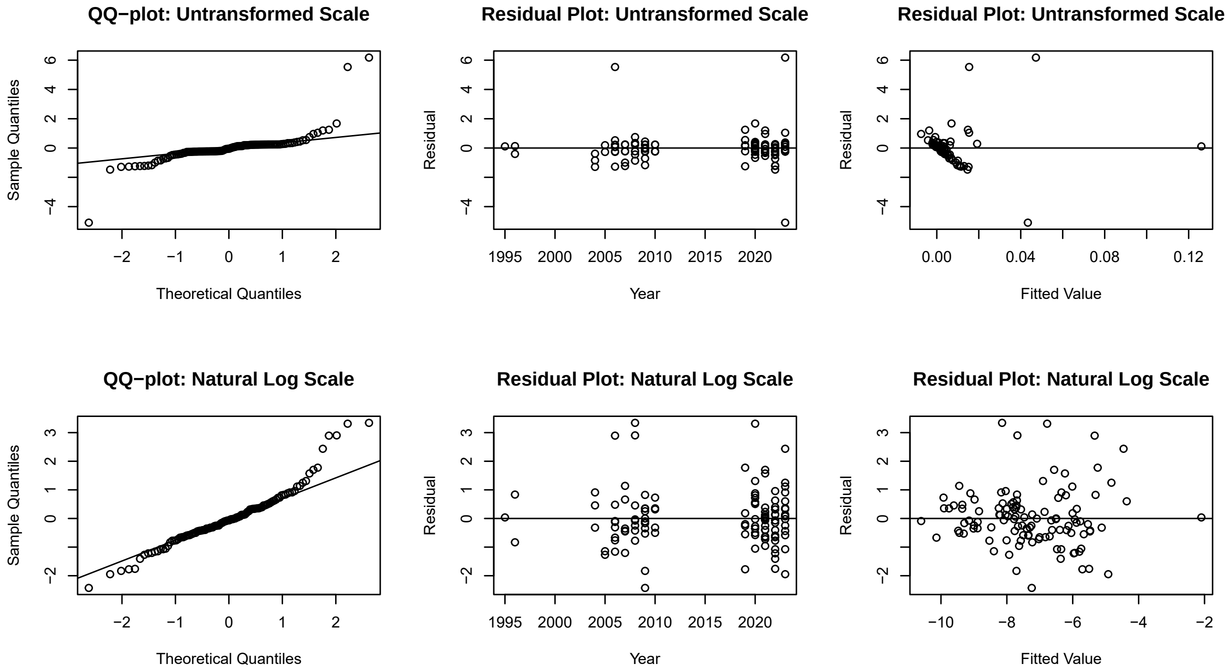
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	24	0	0	0
Doris	Open-water	45	3	7	0
Patch	Under-ice	18	1	6	0
Patch	Open-water	17	7	41	0
Reference B	Under-ice	10	0	0	0
Reference B	Open-water	13	0	0	0
Windy	Under-ice	23	5	22	0
Windy	Open-water	35	2	6	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
10	Doris	2006	Under-ice	Deep	0.0611	0.015	5.534
172	Reference B	2023	Under-ice	Deep	0.0982	0.047	6.176
173	Reference B	2023	Under-ice	Surface	0.0013	0.043	-5.096

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
21	Doris	2008	Open-water	Surface	0.0054	-8.144	3.341
68	Doris	2020	Open-water	Deep	0.0209	-6.776	3.312

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	2.239	3	0.52440	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Doris Open-Water

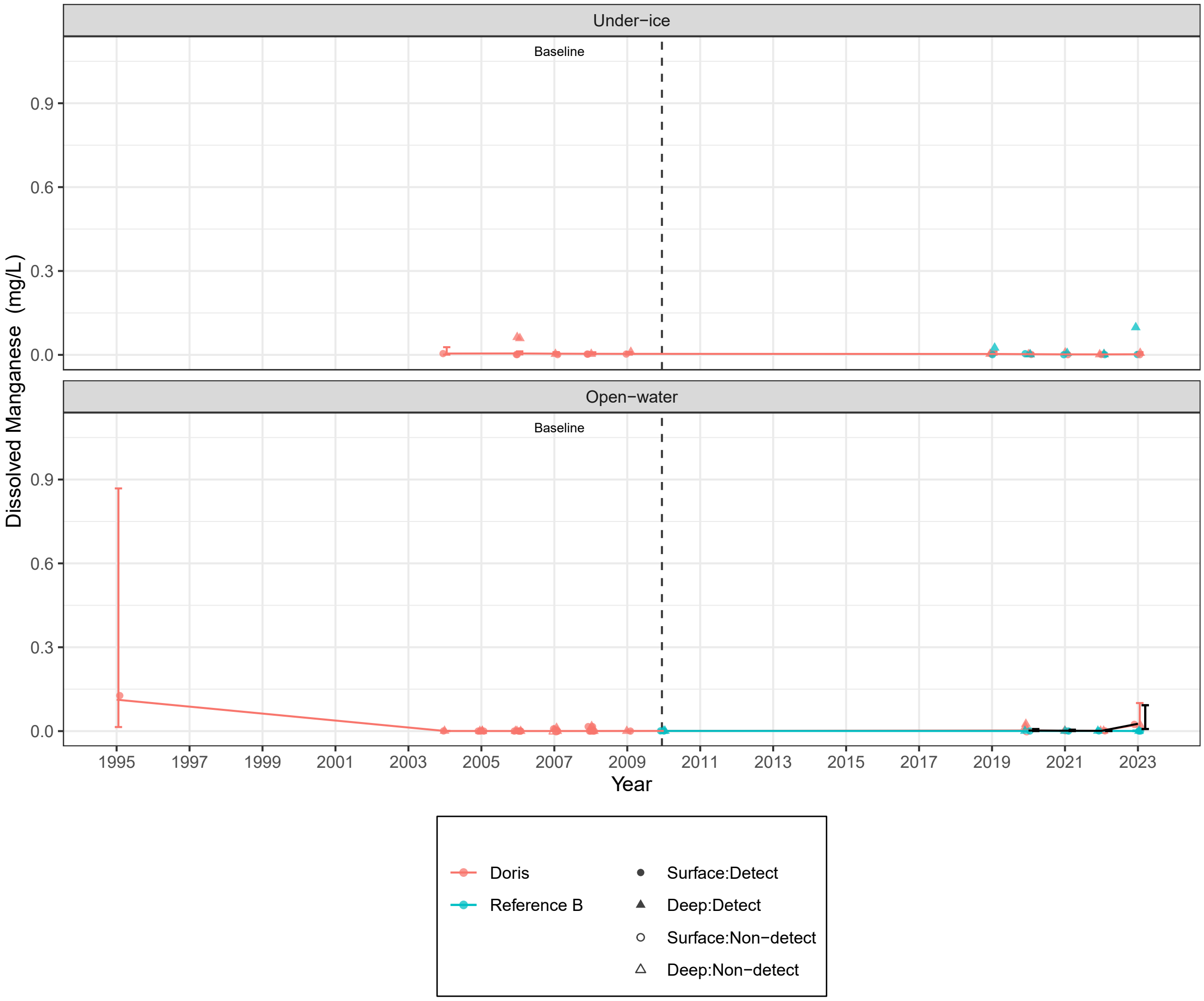
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	33.41	3	<0.00001	sig.
Compare to Reference B	10.44	3	0.01520	sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake exhibited significant deviation from the trend of Reference Lake B

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

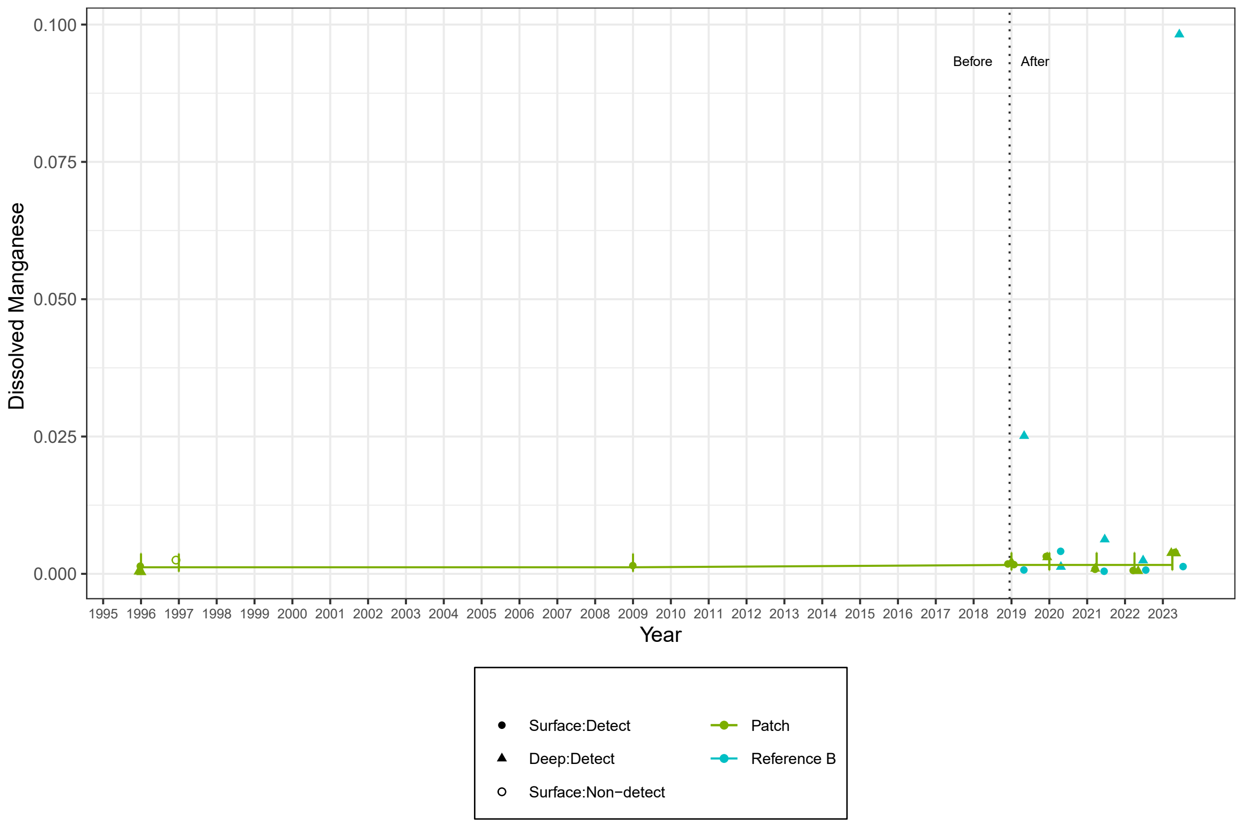
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.3024	0.5846	6.345	0.5172	0.6226	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

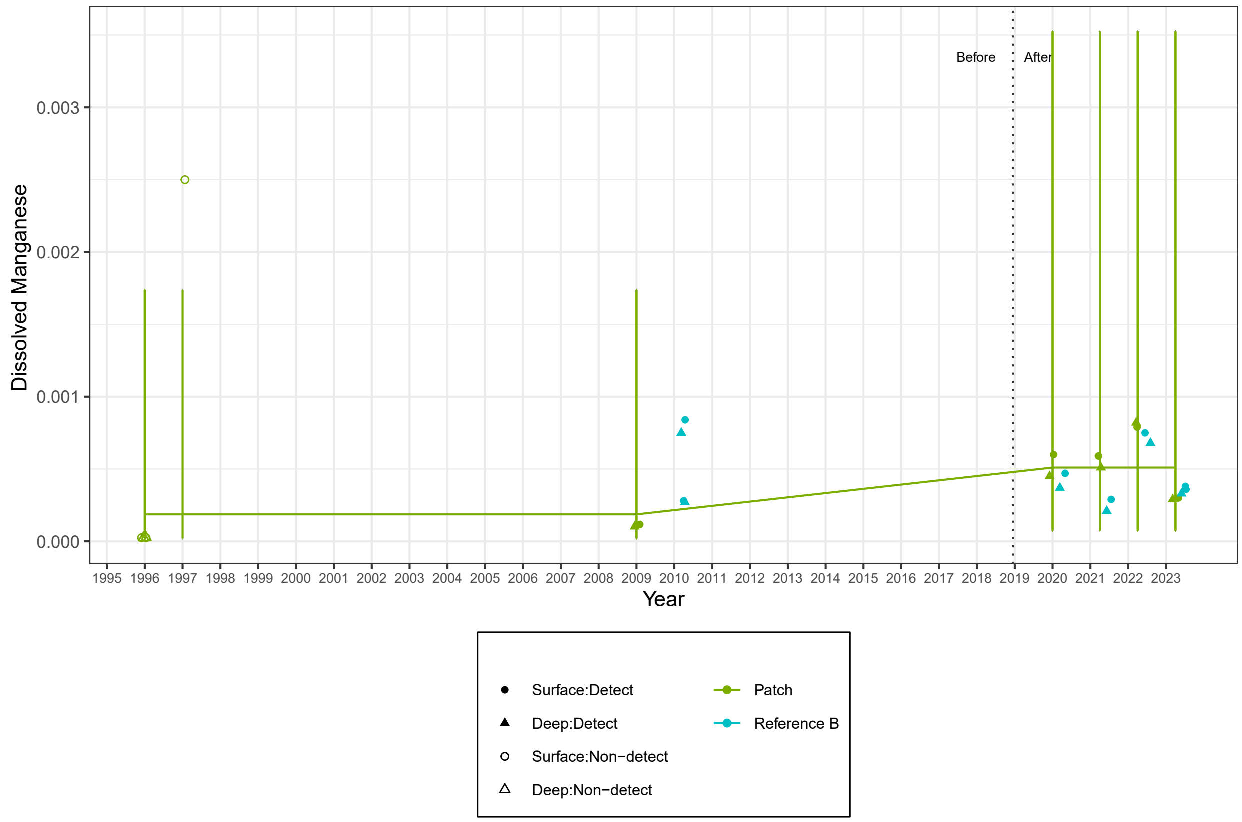
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	1.006	1.149	4.993	0.8758	0.4212	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

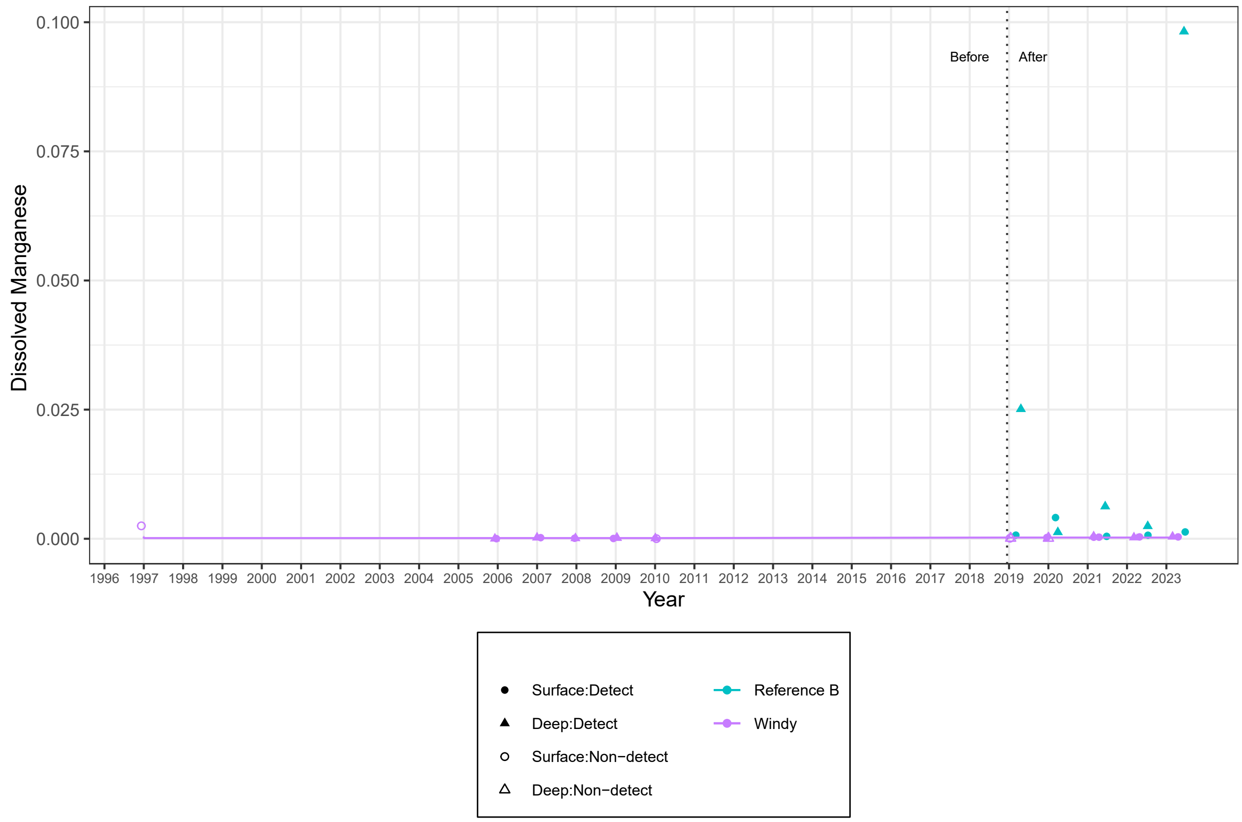
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.5659	0.7573	8.294	0.7473	0.4755	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

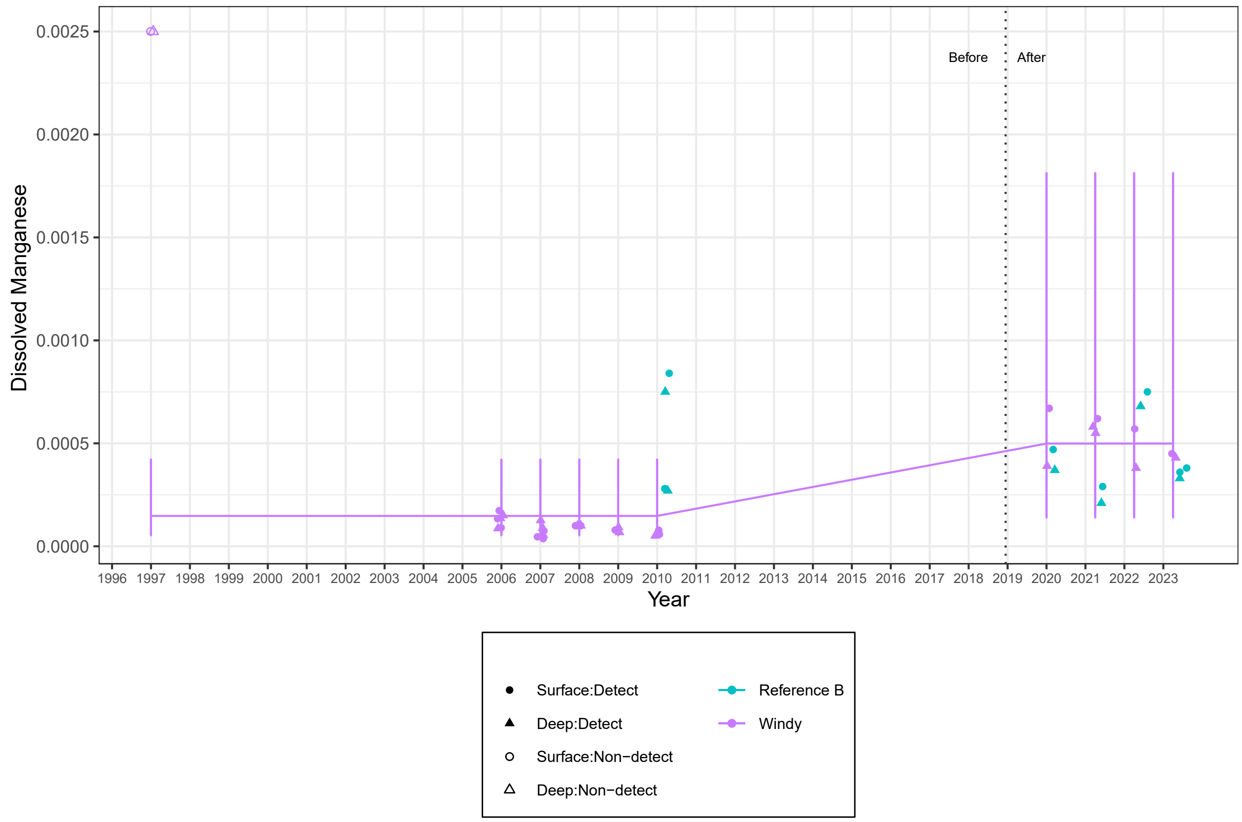
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	1.218	0.7231	8	1.685	0.1305	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

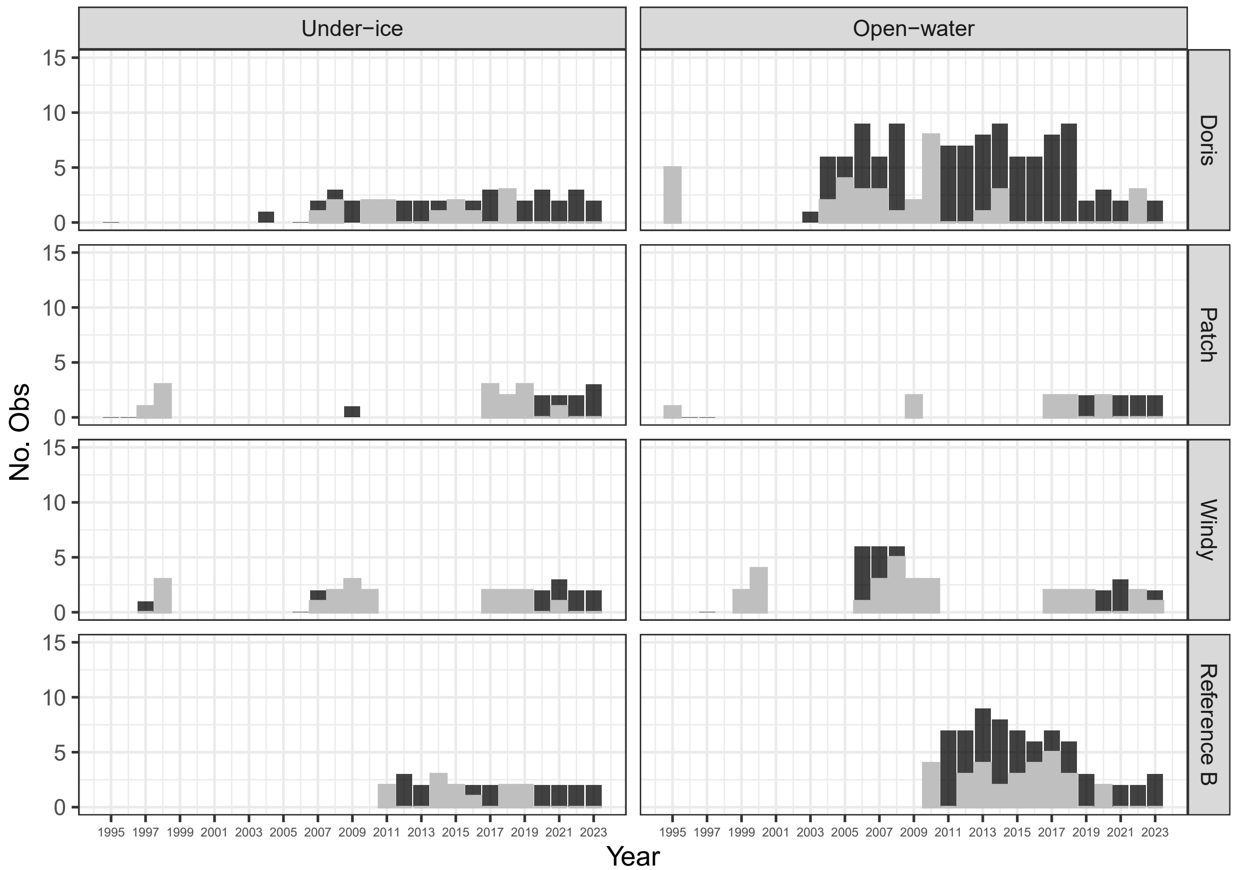
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Dissolved Manganese
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
Before
After
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year
Surface:Detect
Deep:Detect
Surface:Non−detect
Deep:Non−detect
Reference B
Windy

C.3.1.19 Total Mercury

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

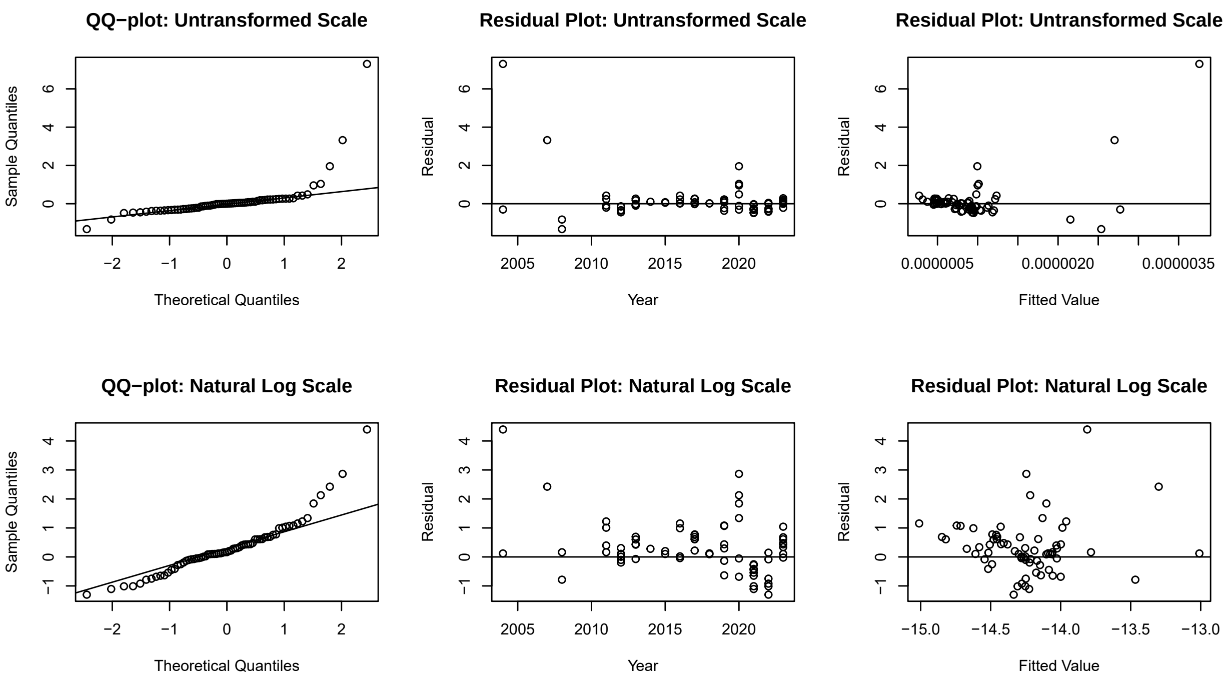
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	40	16	40	0
Doris	Open-water	124	36	29	0
Patch	Under-ice	22	14	64	0
Patch	Open-water	17	9	53	0
Reference B	Under-ice	28	12	43	0
Reference B	Open-water	73	30	41	0
Windy	Under-ice	28	18	64	0
Windy	Open-water	45	30	67	50

More than 50% of data under detection limit in Patch Under-ice, Patch Open-water, Windy Under-ice, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice, Doris North Open-water, Reference B Under-ice, and Reference B Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.

Reference Lake B exhibited close to 50% under detection limit in the open-water season. Inclusion of Reference Lake B lead to unstable results, hence Reference Lake B was removed from the analysis. The analysis proceeds with tobit regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
6	Doris	2004	Open-water	Deep	0	0	7.303
15	Doris	2007	Under-ice	Surface	0	0	3.321

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
6	Doris	2004	Open-water	Deep	0	-13.81	4.396

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	11.652	3	0.00870	sig.
Compare to Reference B	0.279	3	0.96390	not sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake did not exhibit significant deviation from the trend of Reference Lake B

Doris Open-Water

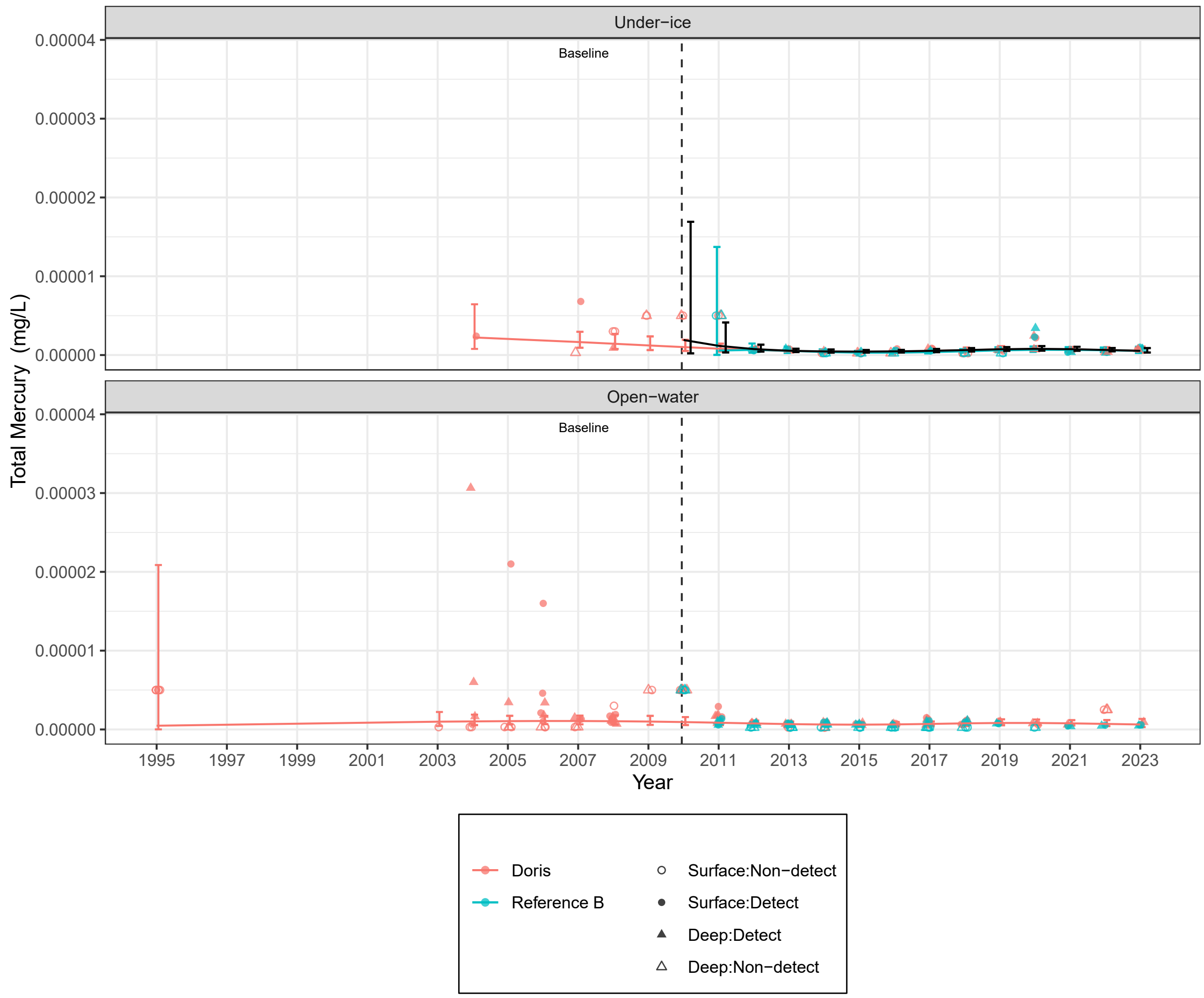
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	1.464	3	0.69070	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis Analysis not performed.

Patch Open-Water Before-After Analysis Analysis not performed.

Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

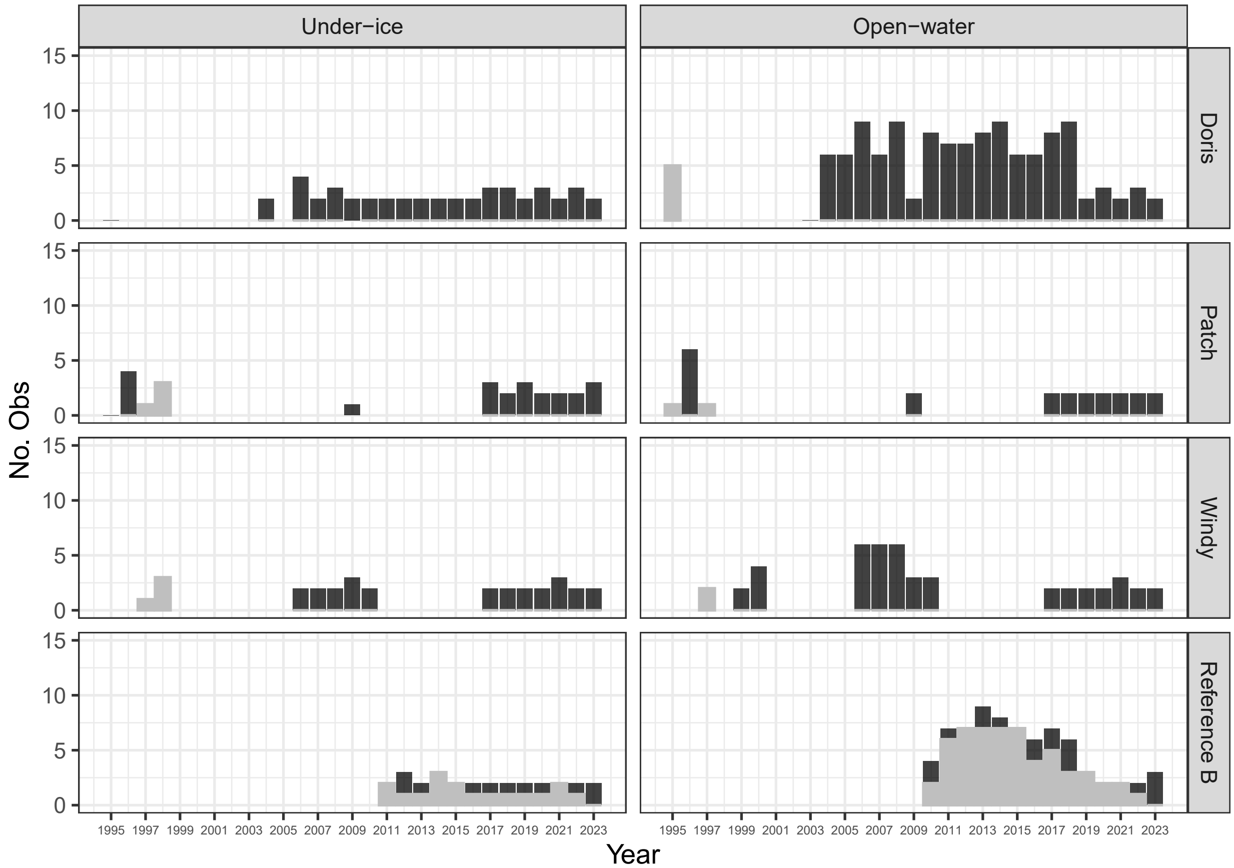
Windy Under-Ice Before-After Analysis Analysis not performed.

Windy Open-water Before-After Analysis Analysis not performed.

C.3.1.20 Total Molybdenum

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

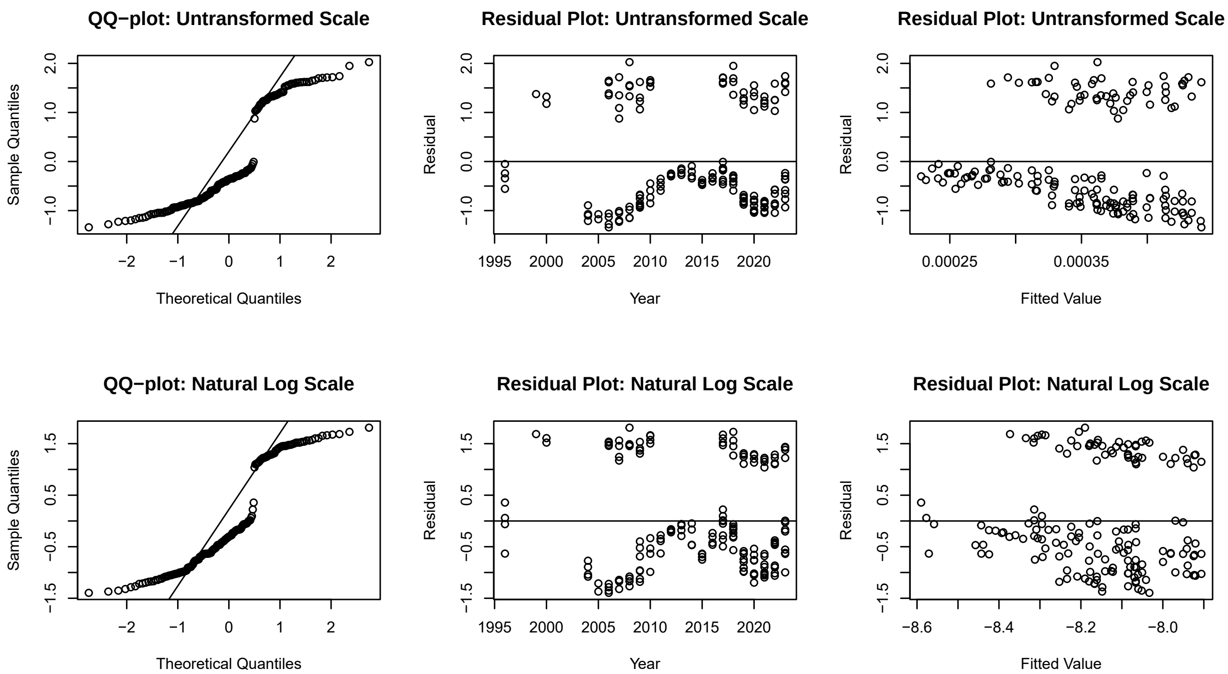
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	0	0	0
Doris	Open-water	123	5	4	0
Patch	Under-ice	26	4	15	0
Patch	Open-water	24	2	8	0
Reference B	Under-ice	28	17	61	0
Reference B	Open-water	73	56	77	0
Windy	Under-ice	30	4	13	0
Windy	Open-water	47	2	4	0

More than 50% of data under detection limit in Reference B Under-ice and Reference B Open-water. Data from those site-season groupings will be removed from the analysis.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

None

Outliers on natural log scale:

None

The untransformed and natural log-transformed model fit the data equally well. Analysis proceeds with untransformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	24.41	3	<0.00001	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

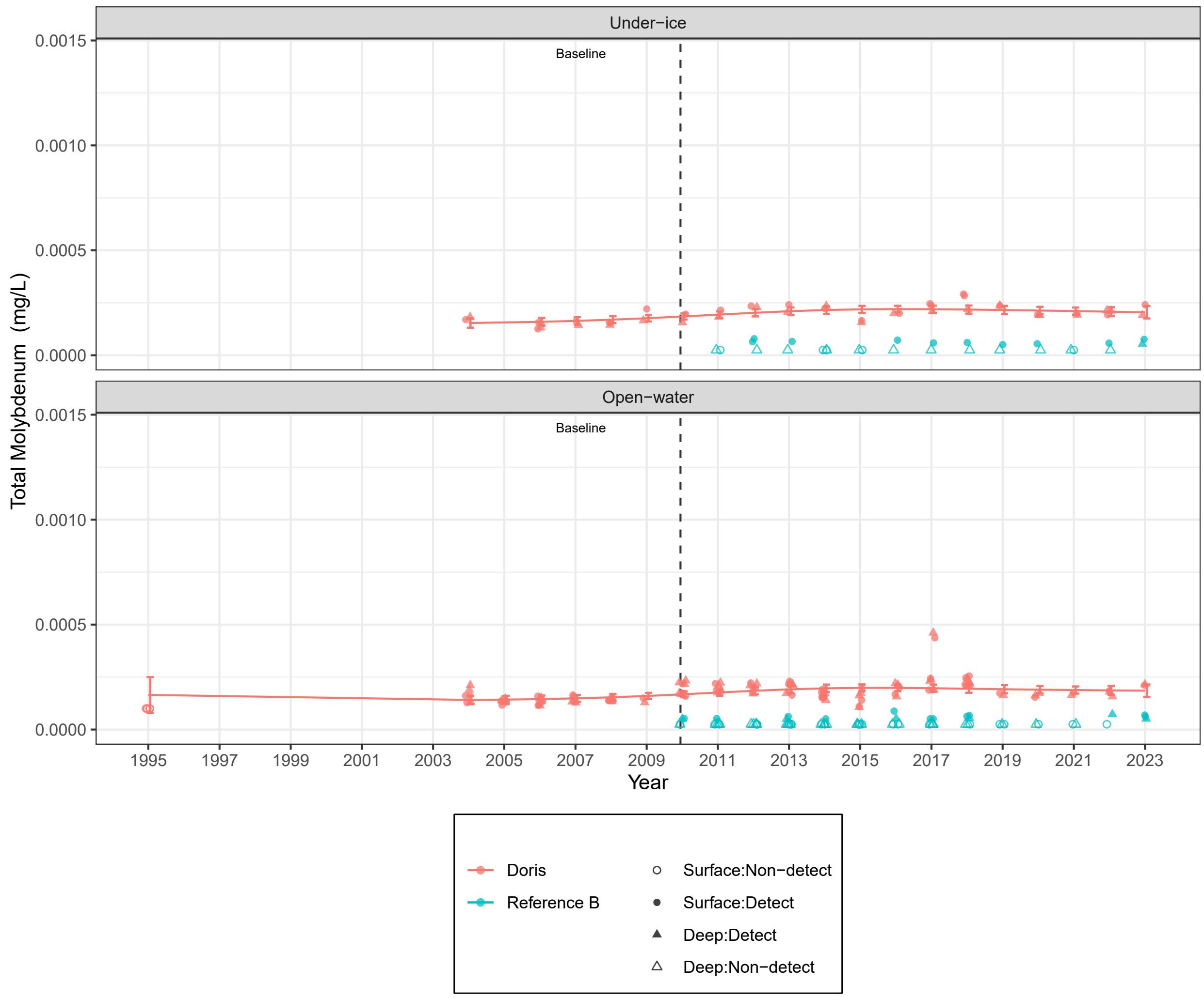
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	21.1	3	0.00010	sig.

Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

Patch Under-Ice Before-After Analysis

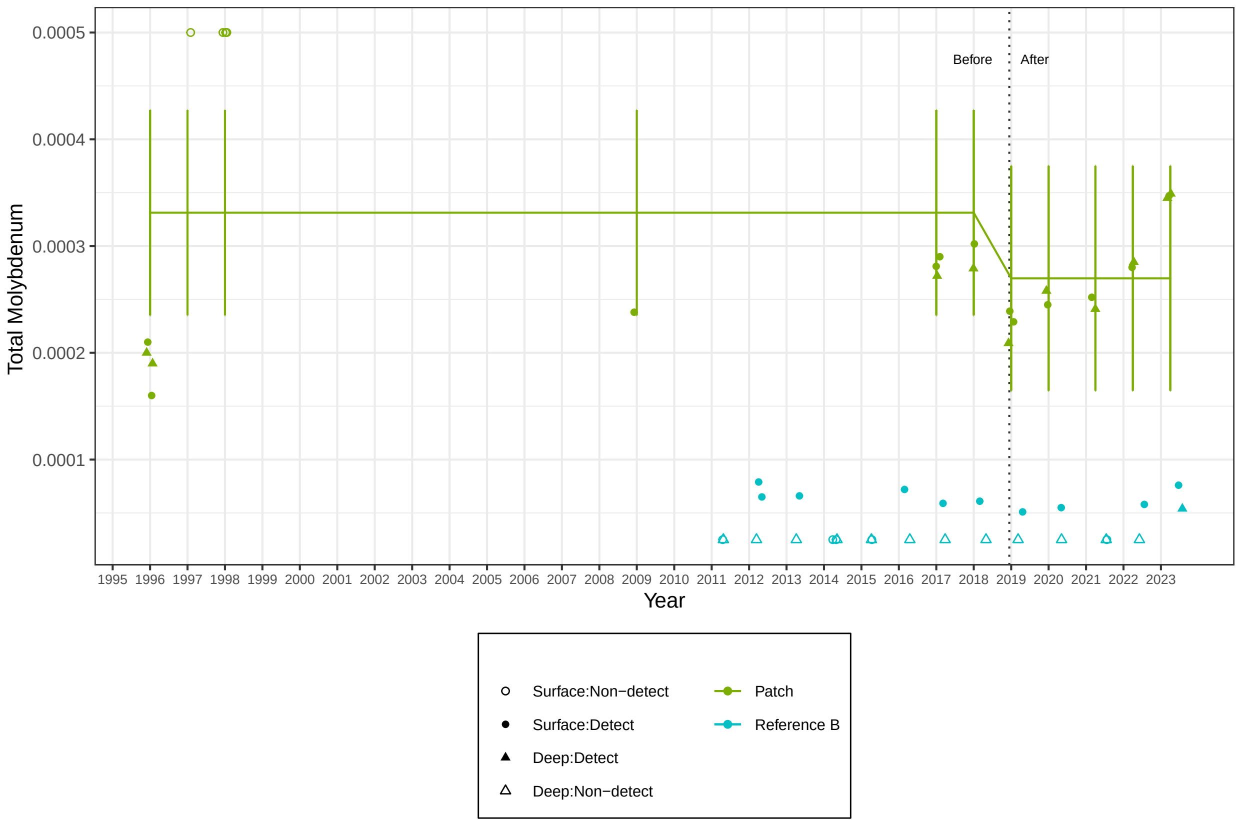
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0001	0.0001	69.62	-0.974	0.3335	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

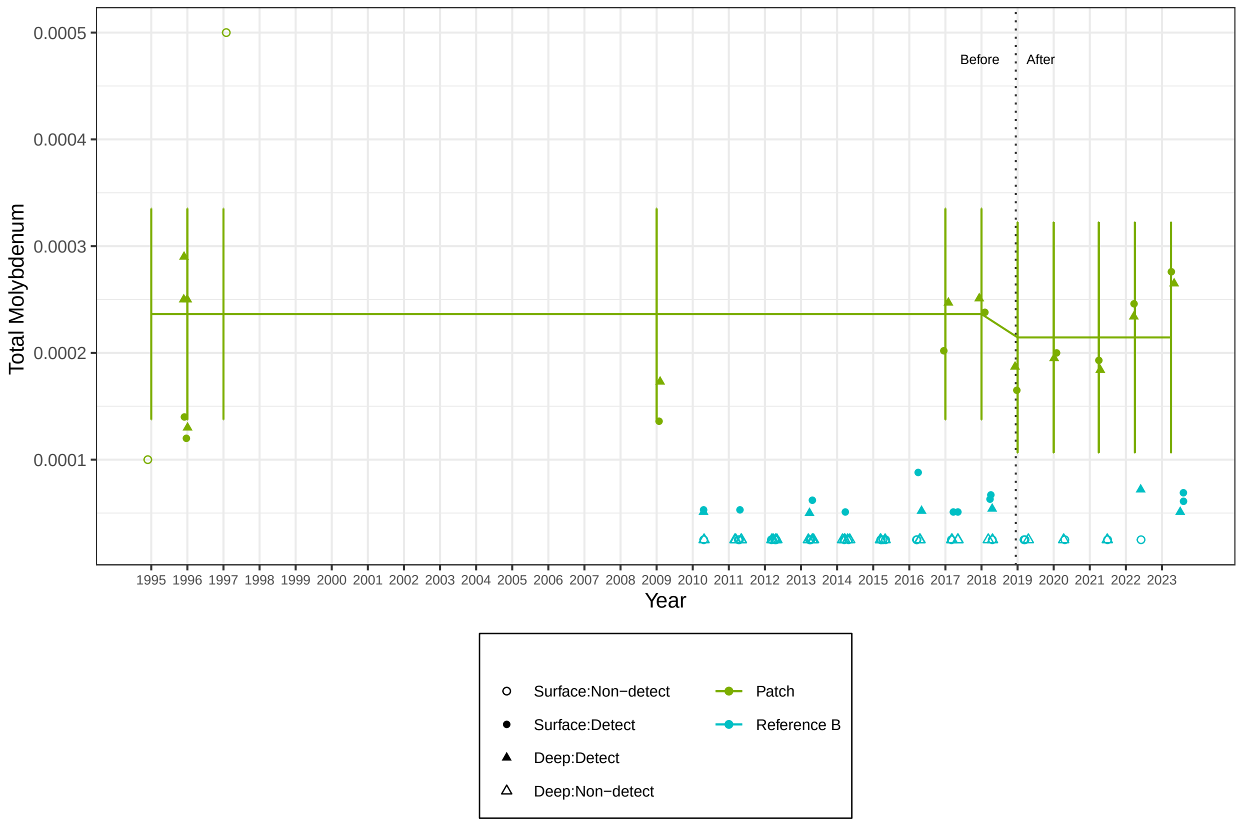
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0	0.0001	8.618	-0.3377	0.7436	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

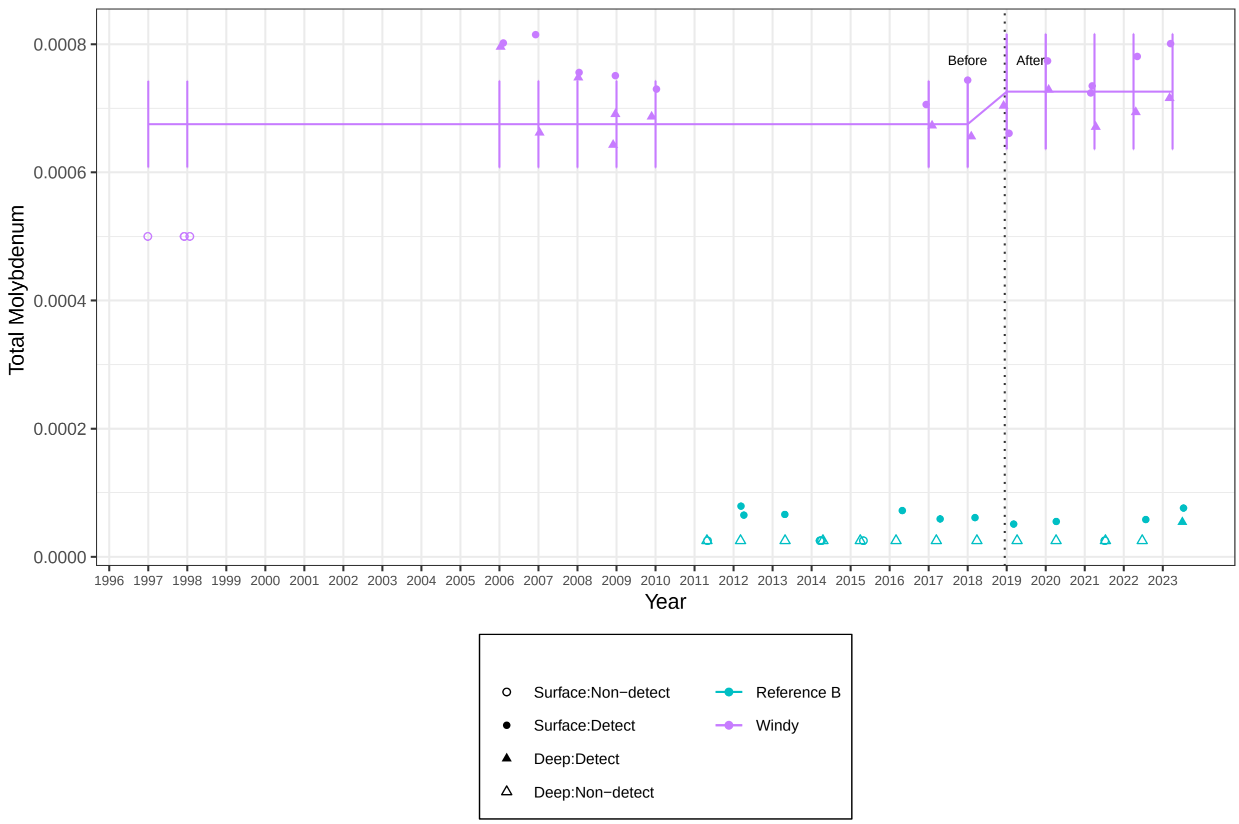
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0001	0.0001	10.58	0.9834	0.3474	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

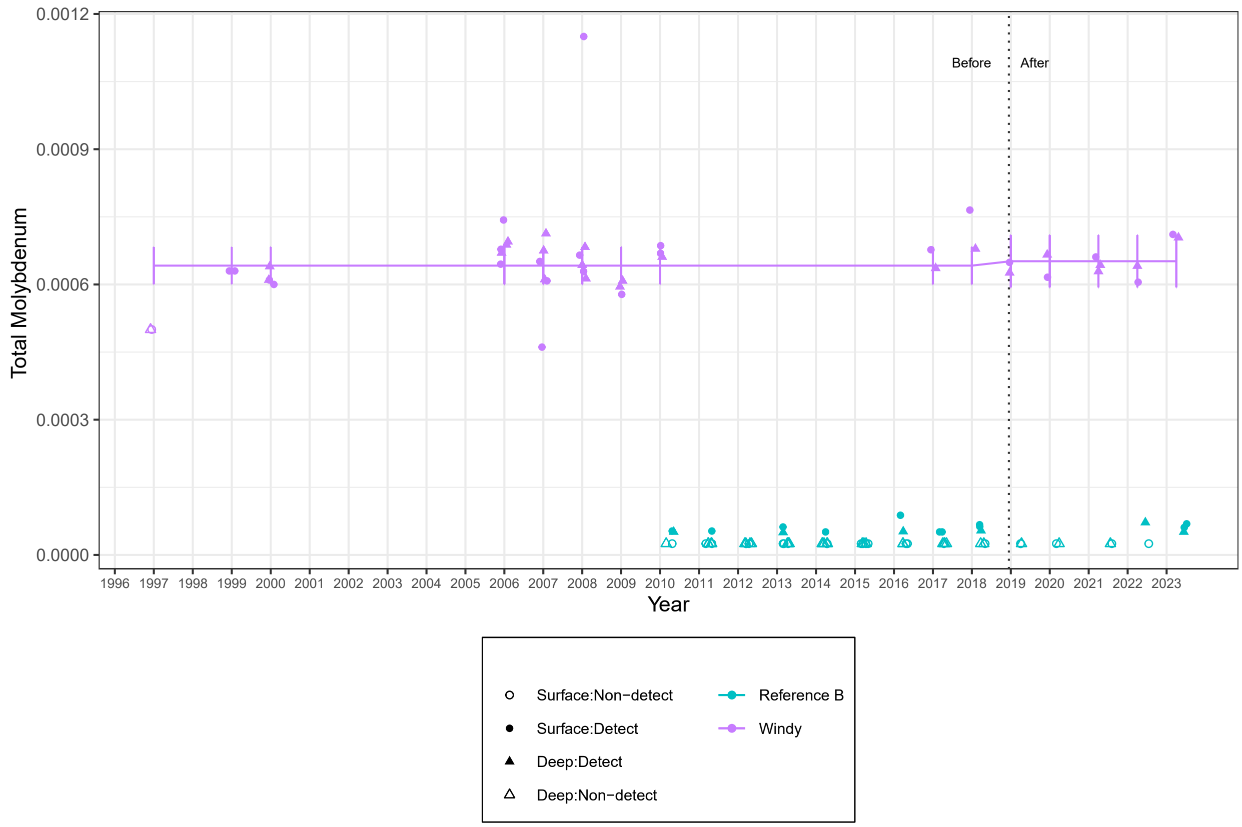
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0	0	13.09	0.2956	0.7722	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

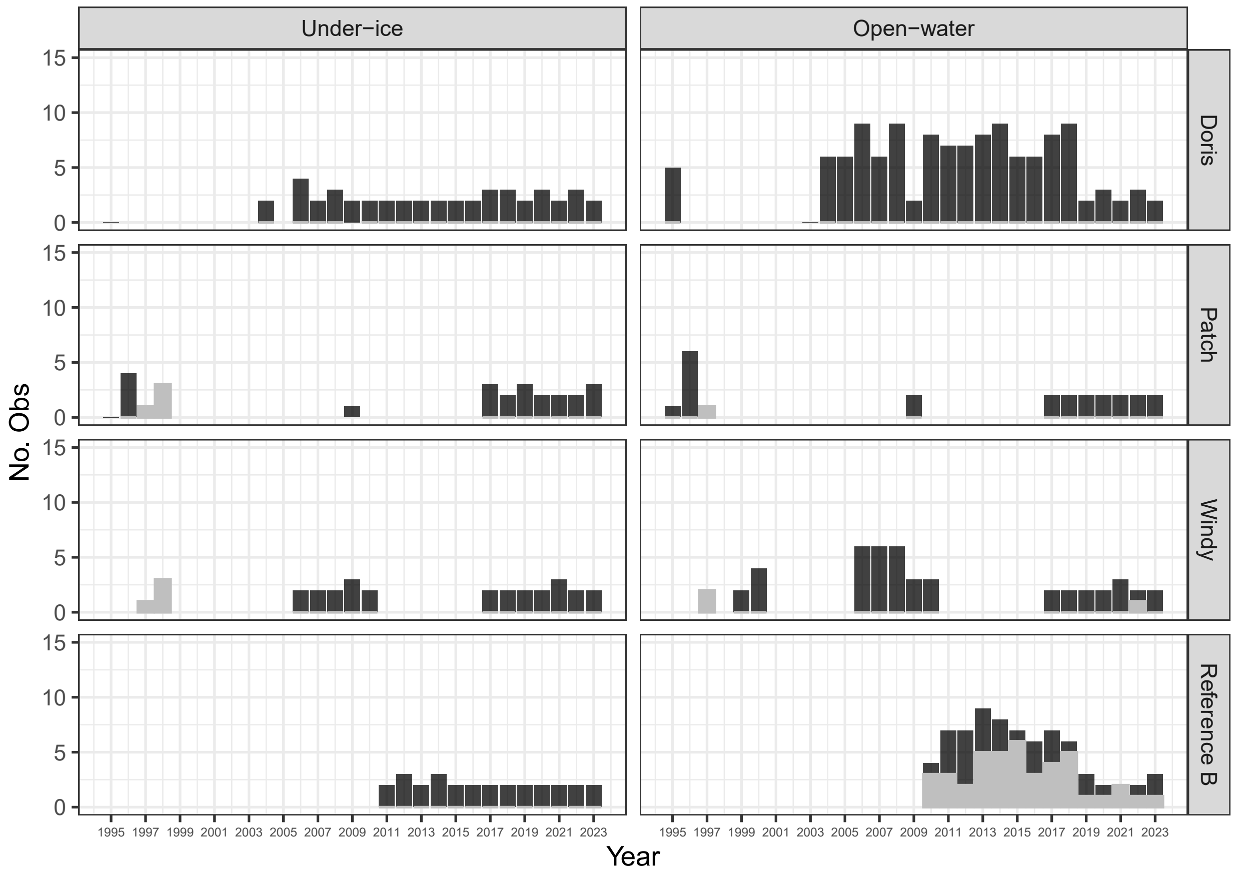
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Molybdenum
0.0012
0.0009
0.0006
0.0003
0.0000
Before
After
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Year
Surface:Non−detect
Surface:Detect
Deep:Detect
Deep:Non−detect
Reference B
Windy

C.3.1.21 Total Nickel

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

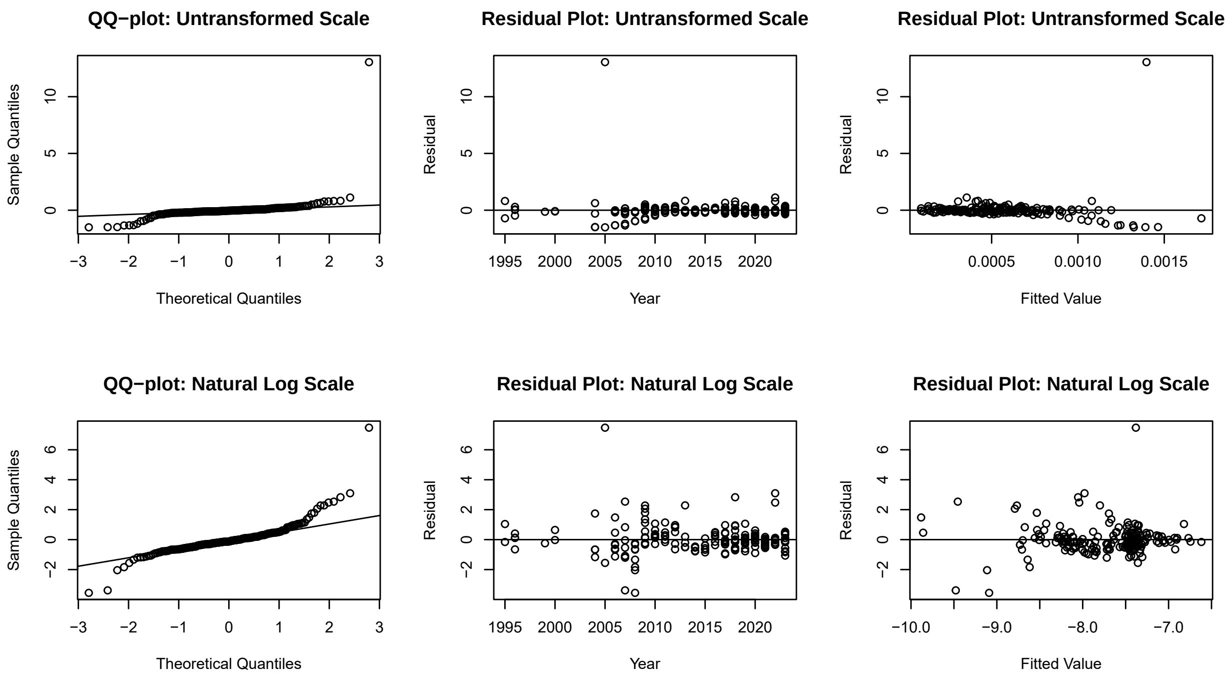
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	0	0	0
Doris	Open-water	123	0	0	0
Patch	Under-ice	26	4	15	0
Patch	Open-water	24	1	4	0
Reference B	Under-ice	28	0	0	0
Reference B	Open-water	73	42	58	33
Windy	Under-ice	30	4	13	0
Windy	Open-water	47	3	6	0

More than 50% of data under detection limit in Reference B Open-water. Data from those site-season groupings will be removed from the analysis.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
8	Doris	2005	Open-water	Deep	0.0097	0.001	13.04

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
8	Doris	2005	Open-water	Deep	0.0097	-7.381	7.476
159	Windy	2007	Under-ice	Deep	0.0000	-9.478	-3.388
164	Windy	2008	Under-ice	Surface	0.0000	-9.090	-3.556
196	Windy	2022	Under-ice	Surface	0.0011	-7.979	3.097

There were outliers retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	0.278	3	0.96420	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

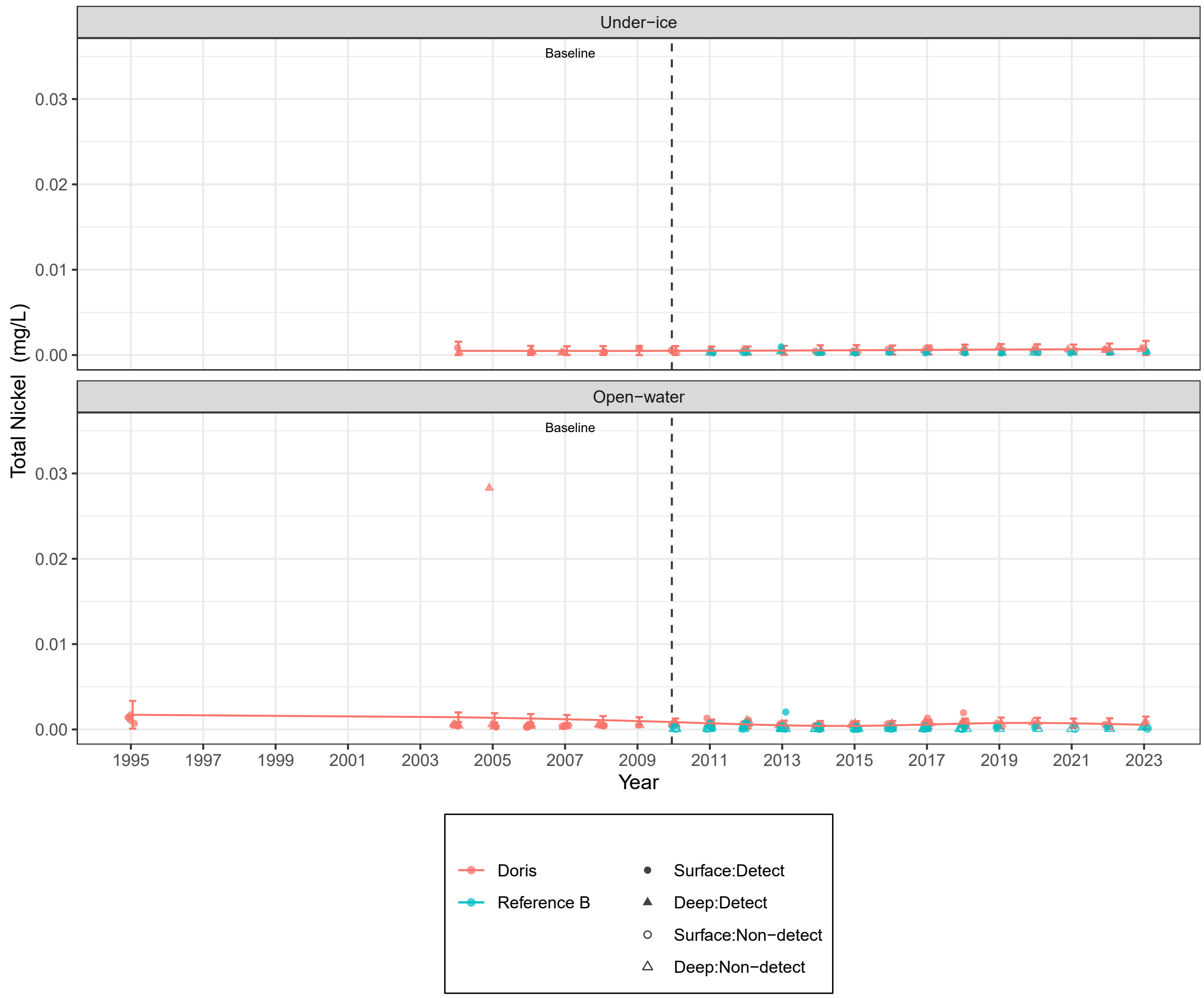
Doris Open-Water

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	5.341	3	0.14850	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

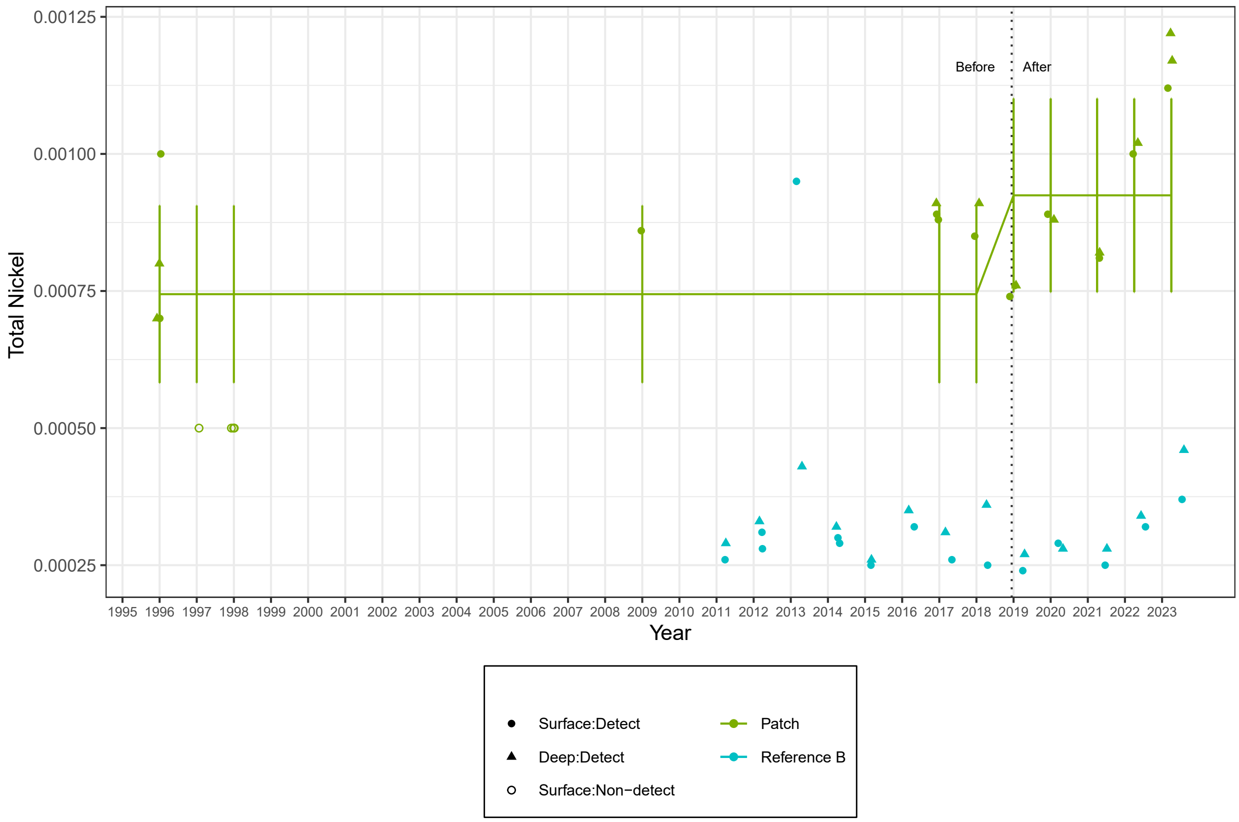
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0002	0.0001	8.916	1.704	0.123	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

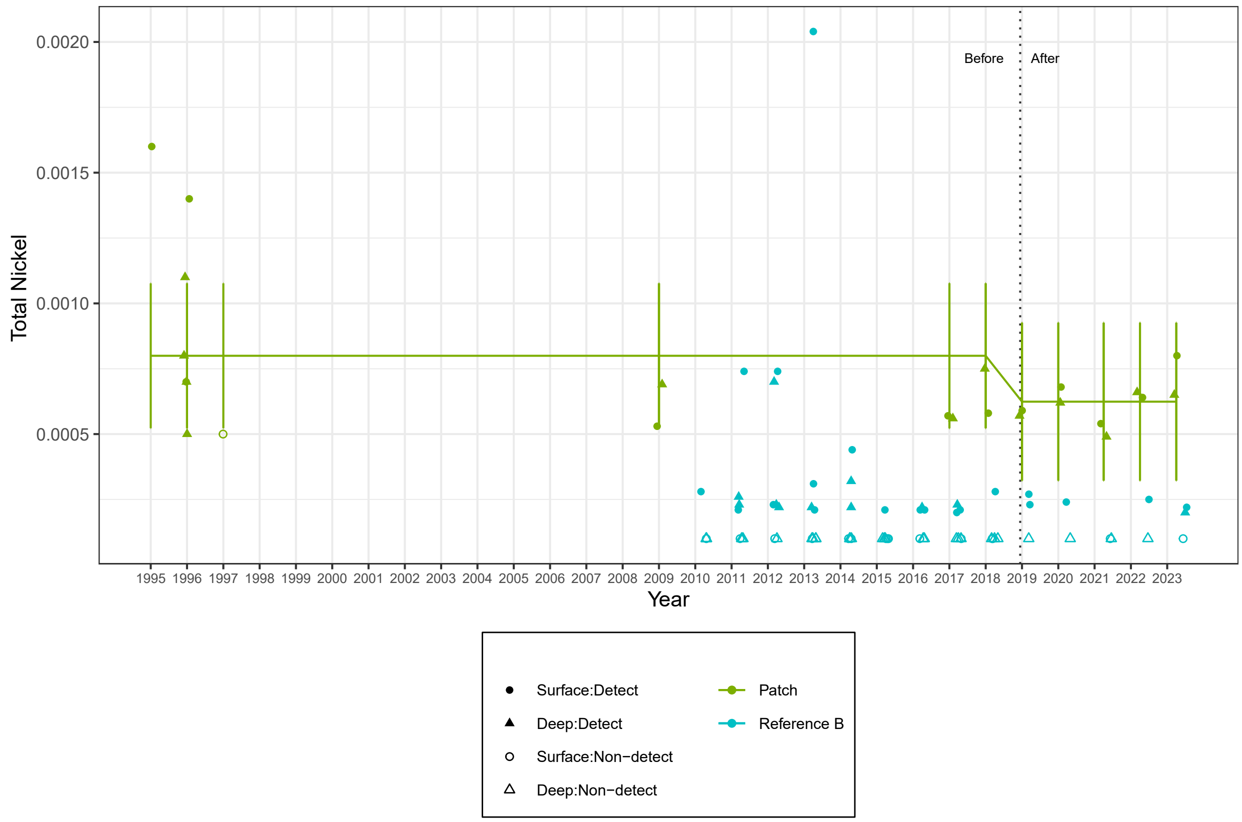
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0002	0.0002	8.29	-0.9697	0.3597	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

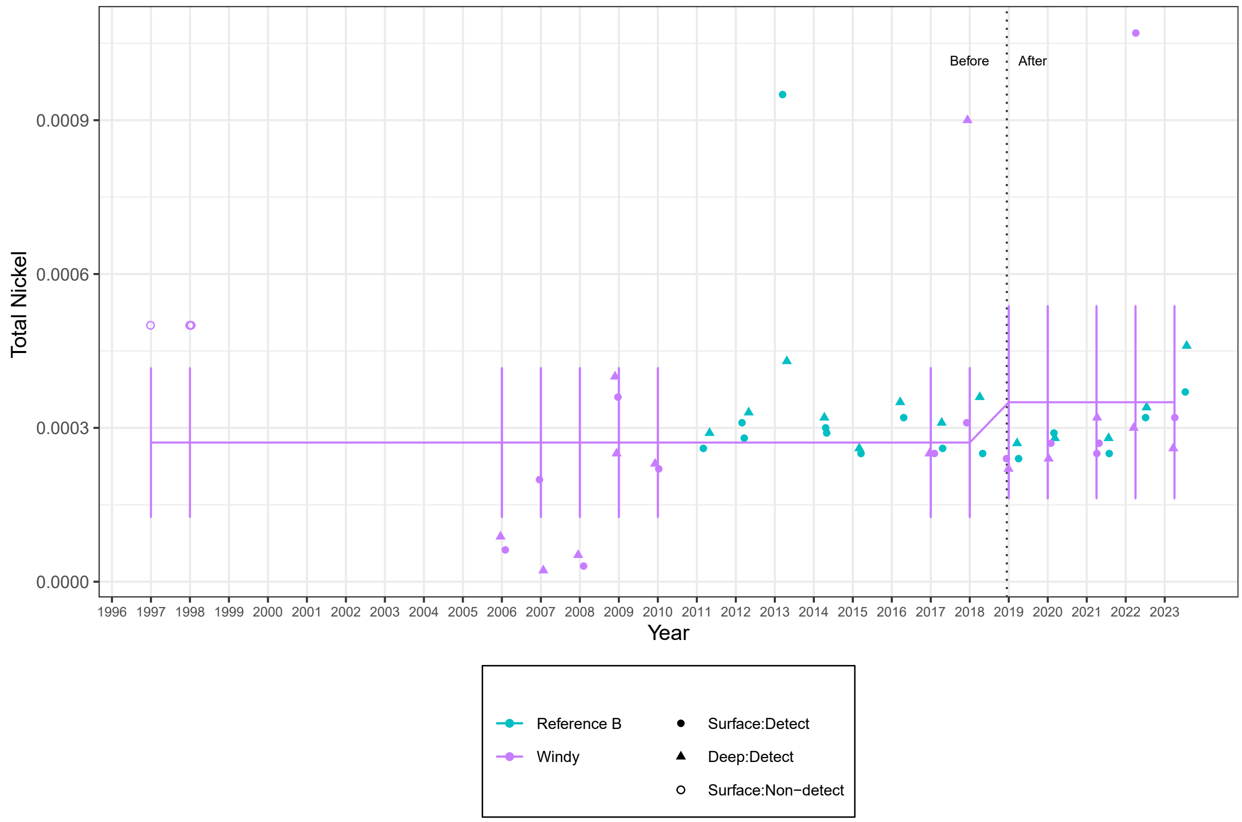
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0001	0.0001	11.47	0.7259	0.4825	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

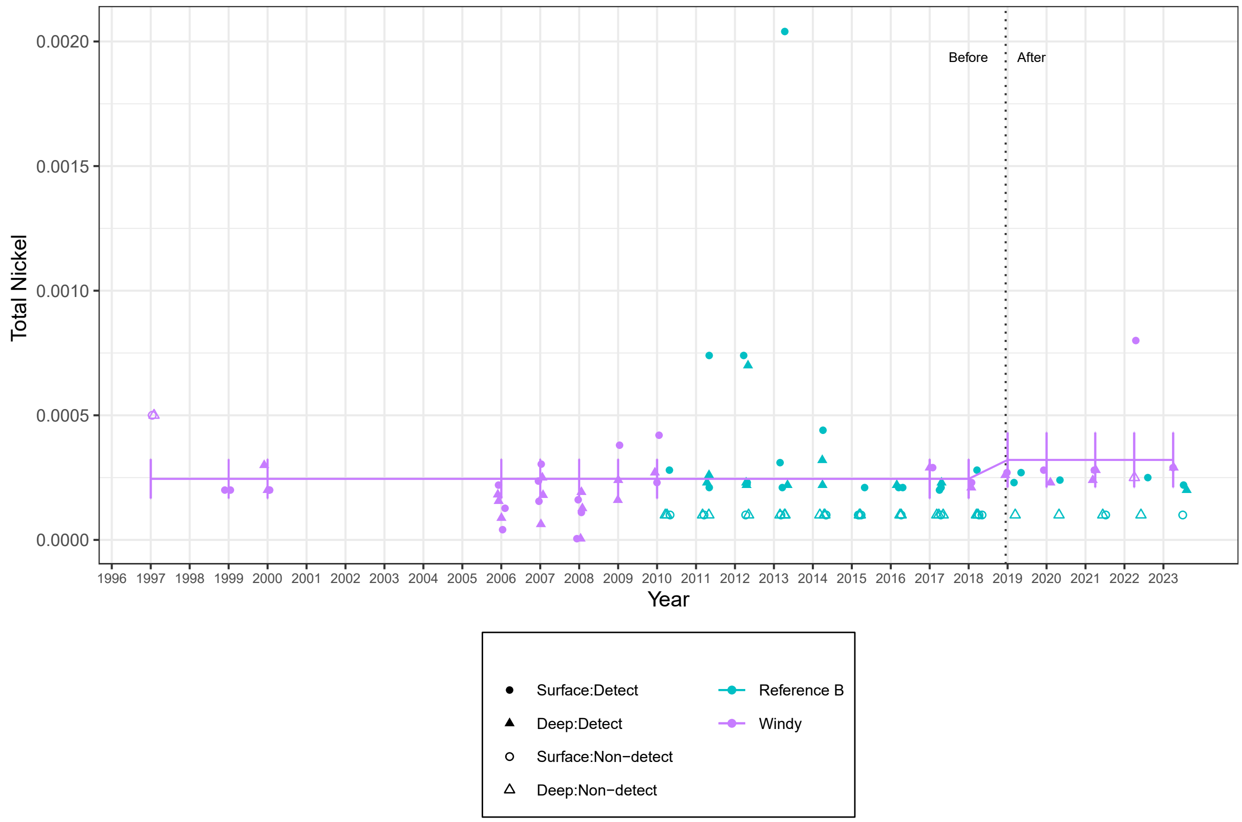
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.0001	0.0001	12.97	1.218	0.2448	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

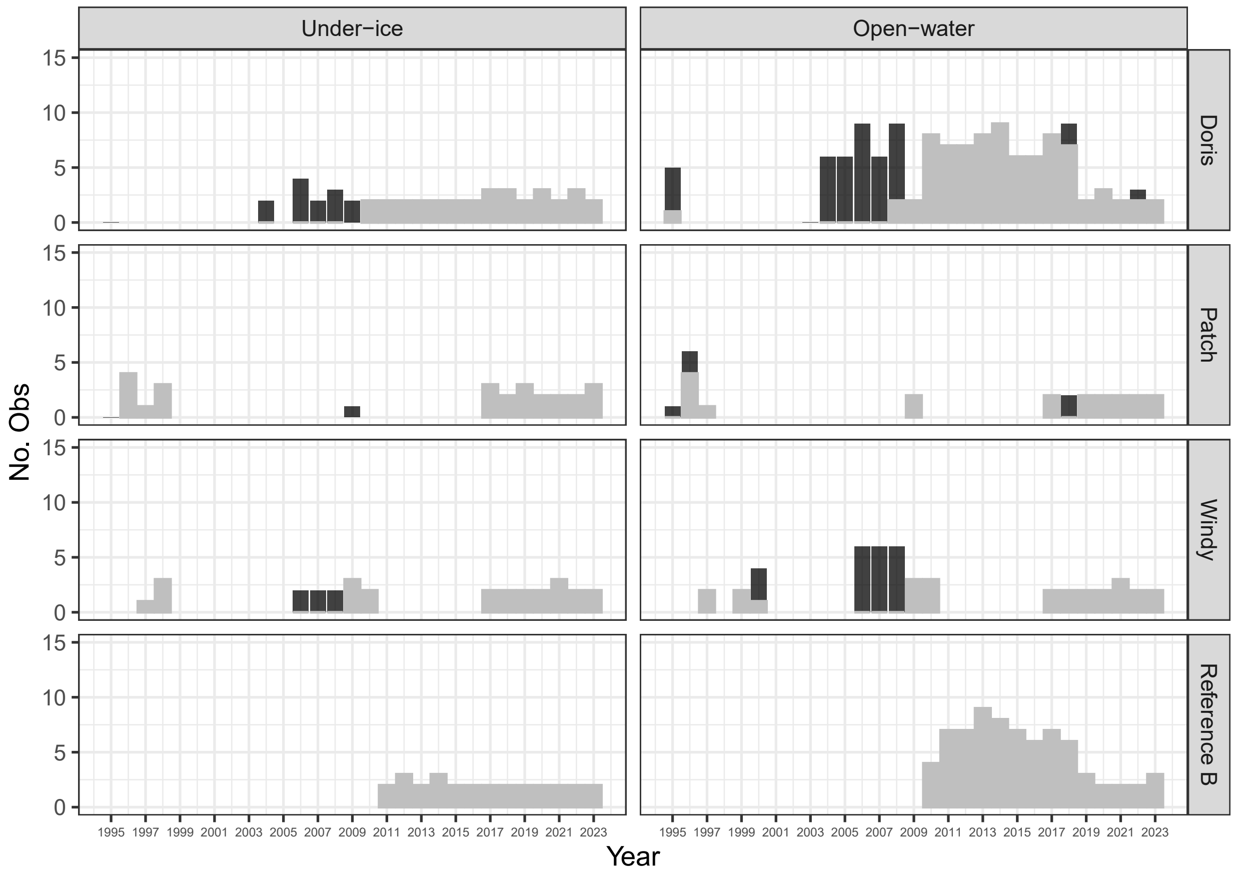
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Nickel
0.0020
0.0015
0.0010
0.0005
0.0000
Before
After
Year
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023
Surface:Detect
Deep:Detect
Surface:Non−detect
Deep:Non−detect
Reference B
Windy

C.3.1.22 Total Selenium

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

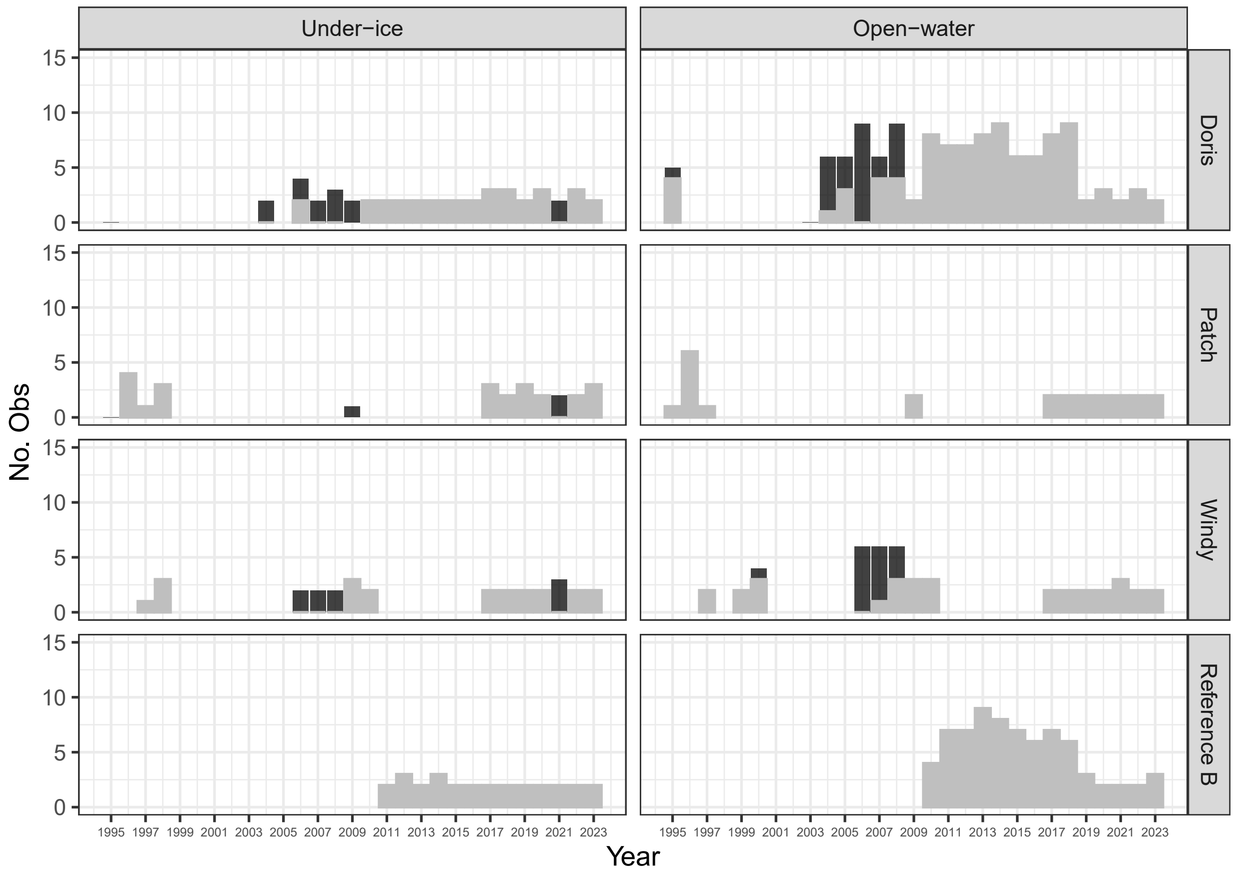
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	32	71	100
Doris	Open-water	123	82	67	100
Patch	Under-ice	26	26	100	100
Patch	Open-water	24	19	79	100
Reference B	Under-ice	28	28	100	100
Reference B	Open-water	73	73	100	100
Windy	Under-ice	30	24	80	100
Windy	Open-water	47	26	55	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.23 Total Silver

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

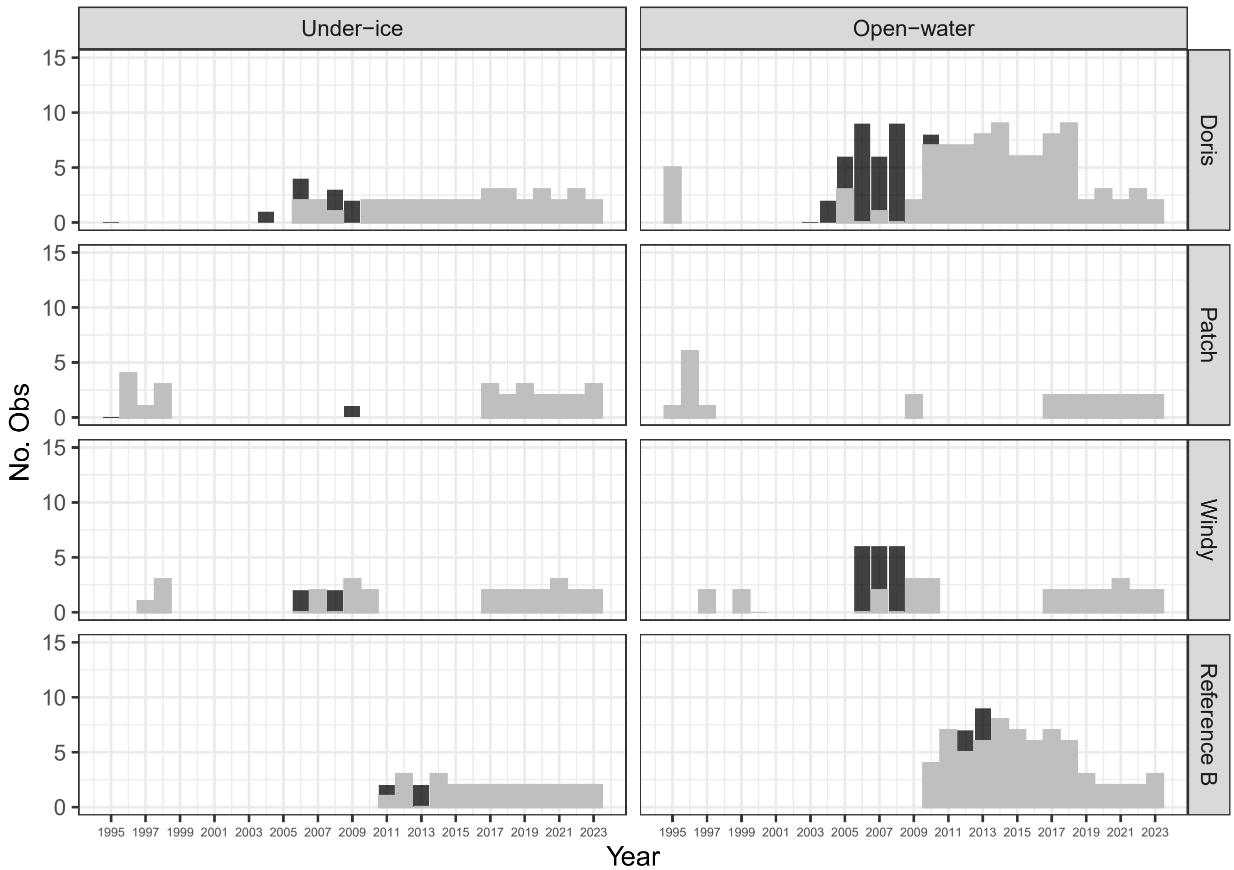
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	34	76	100
Doris	Open-water	123	98	80	100
Patch	Under-ice	26	24	92	100
Patch	Open-water	24	24	100	100
Reference B	Under-ice	28	28	100	100
Reference B	Open-water	73	73	100	100
Windy	Under-ice	30	21	70	100
Windy	Open-water	47	32	68	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.24 Total Thallium

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

The sample sizes per lake and season are summarized in the table below.

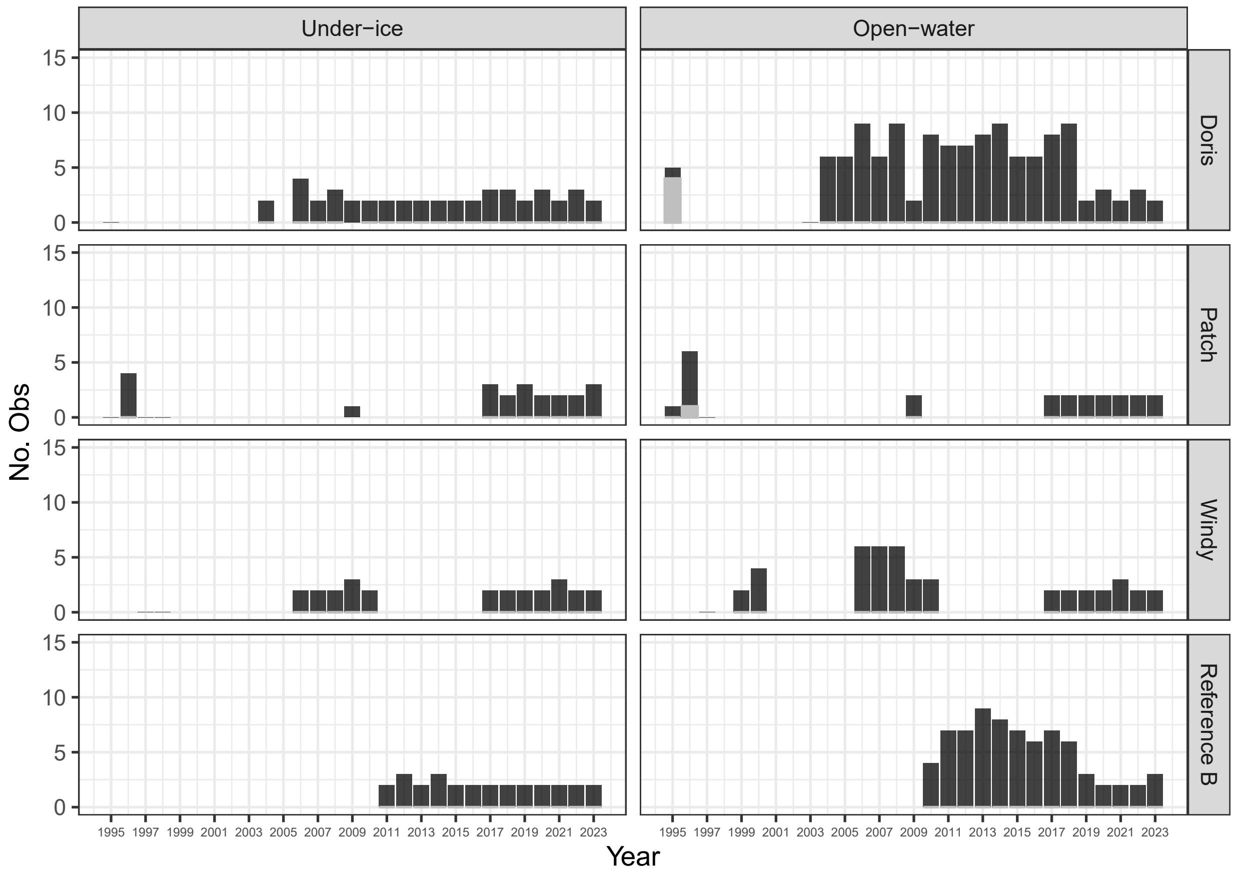
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	44	40	91	100
Doris	Open-water	119	92	77	100
Patch	Under-ice	26	26	100	100
Patch	Open-water	24	24	100	100
Reference B	Under-ice	28	25	89	100
Reference B	Open-water	73	68	93	100
Windy	Under-ice	30	26	87	100
Windy	Open-water	43	27	63	100

All data from Doris North, Patch and Windy were censored. All data removed from the analysis and no statistical analyses were performed.

C.3.1.25 Total Uranium

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

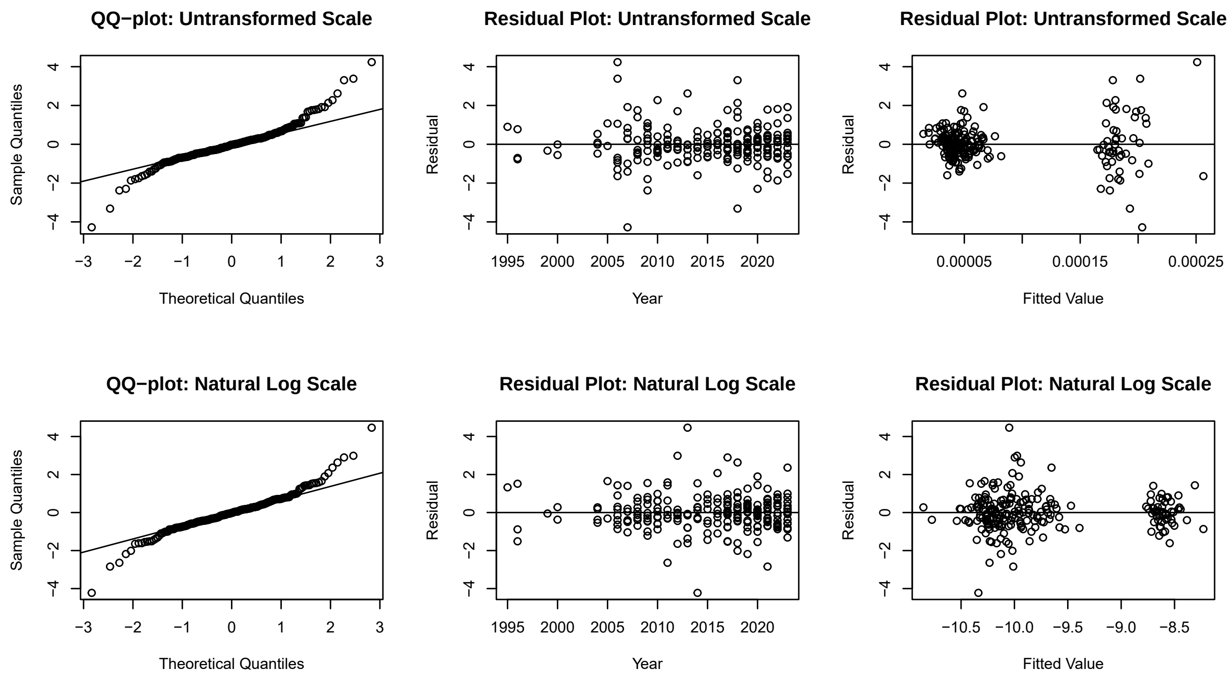
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	45	0	0	0
Doris	Open-water	123	4	3	0
Patch	Under-ice	22	0	0	0
Patch	Open-water	23	1	4	0
Reference B	Under-ice	28	0	0	0
Reference B	Open-water	73	0	0	0
Windy	Under-ice	26	0	0	0
Windy	Open-water	45	0	0	0

None of the sites exhibited greater than 50% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
183	Windy	2006	Under-ice	Deep	0.0003	0	4.234
185	Windy	2006	Open-water	Deep	0.0002	0	3.380
187	Windy	2007	Under-ice	Deep	0.0002	0	-4.280
207	Windy	2018	Under-ice	Deep	0.0002	0	-3.315
210	Windy	2018	Open-water	Surface	0.0002	0	3.303

Outliers on natural log scale:

	Lake	Year	Season	Depth.Zone	Impute	Fitted	Std. Residual
133	Reference B	2013	Under-ice	Surface	0.0001	-10.05	4.464
136	Reference B	2014	Under-ice	Deep	0.0000	-10.34	-4.226

The natural log-transformed data better meets the residual assumptions. Analysis proceeds with natural log-transformed data. However, there was an outlier retained in the analysis. Results should be interpreted with caution and along with graphical results.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	33.151	4	<0.00001	sig.
Compare to Reference B	5.662	4	0.22590	not sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake did not exhibit significant deviation from the trend of Reference Lake B

Doris Open-Water

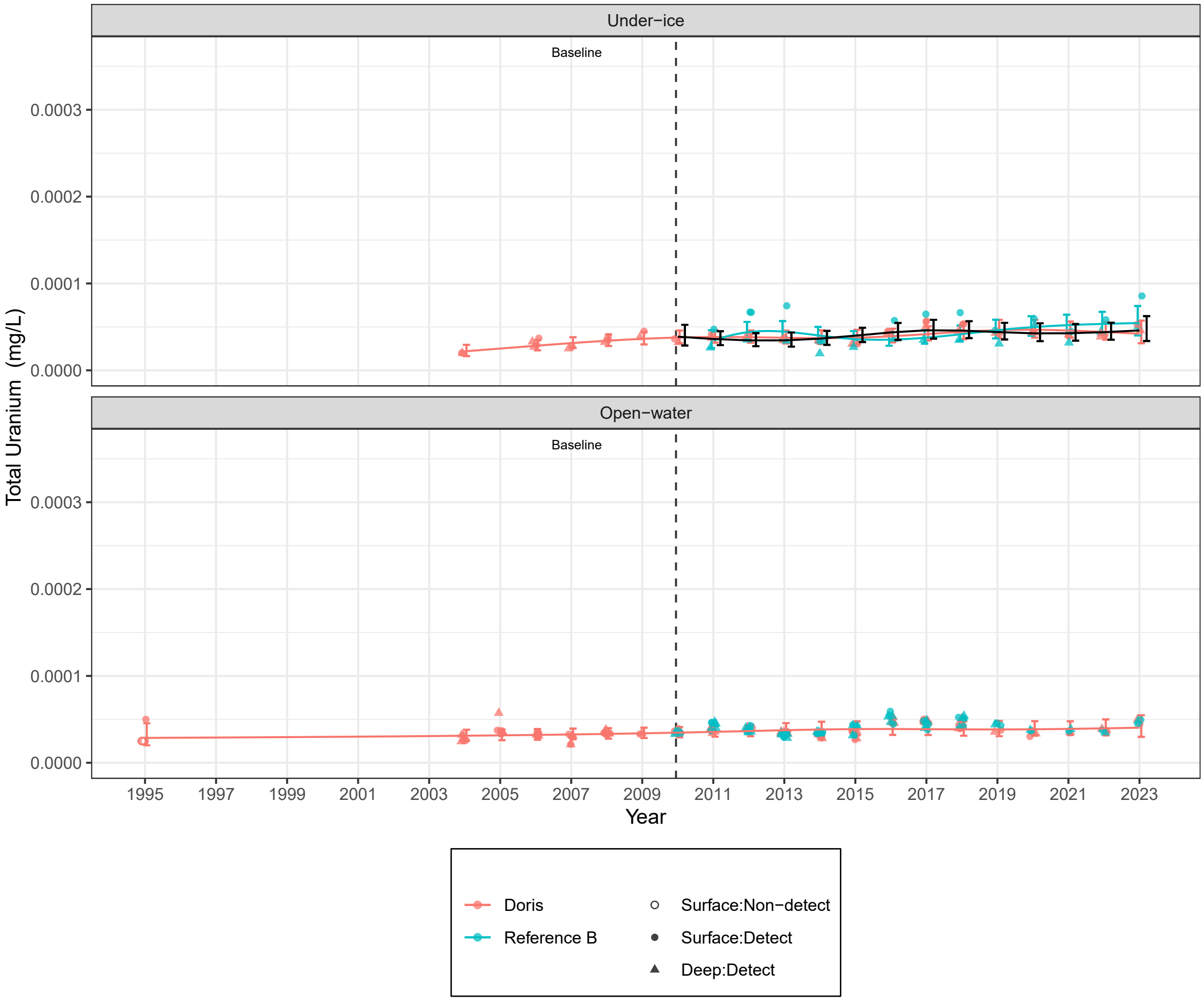
Analysis	Chi.sq	df	p	Significance
Compare to slope zero	7.87	4	0.09650	not sig.

Doris Lake did not exhibit significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.

As Doris Lake exhibited significant deviation from a slope of zero in at least one season, the black lines and error bars represent the model built with Doris Lake data from comparable sampling years with Reference Lake B only.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis

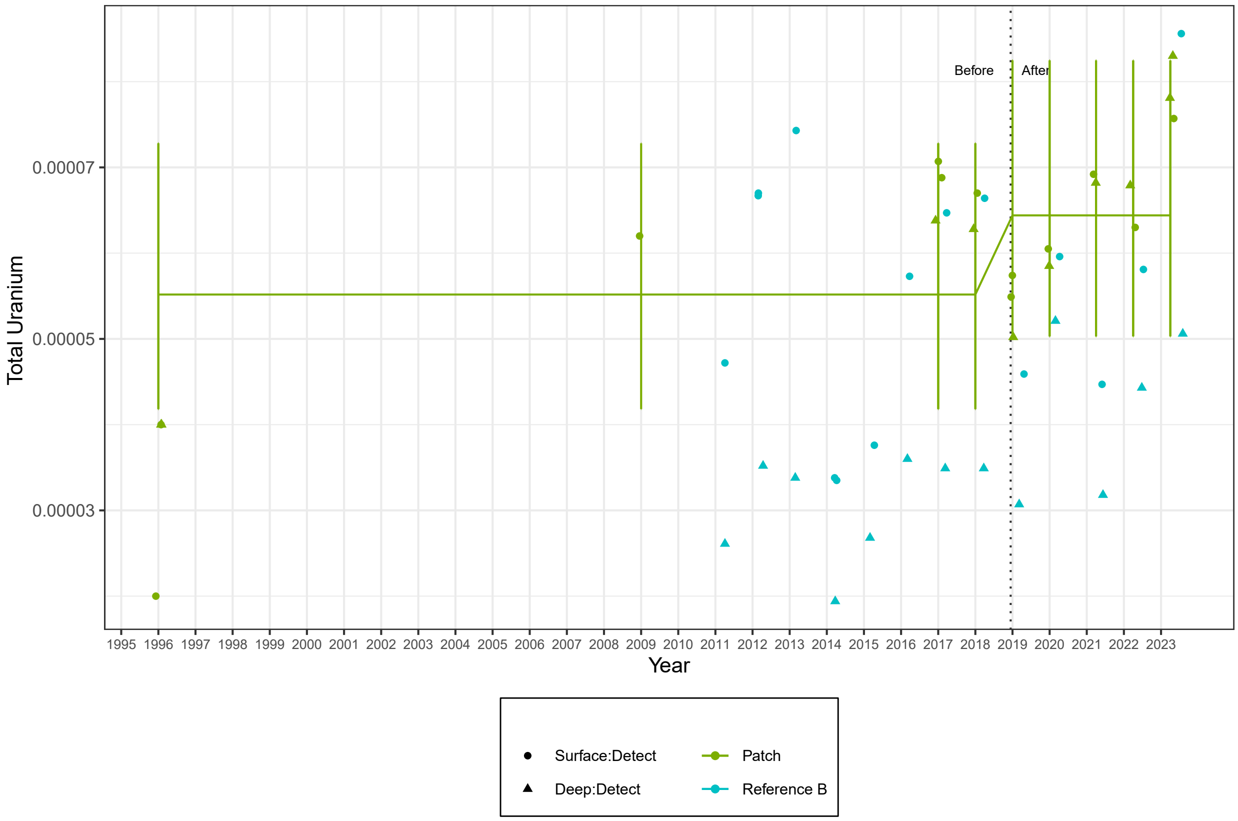
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.1547	0.1572	7.104	0.984	0.3574	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Patch Open-Water Before-After Analysis

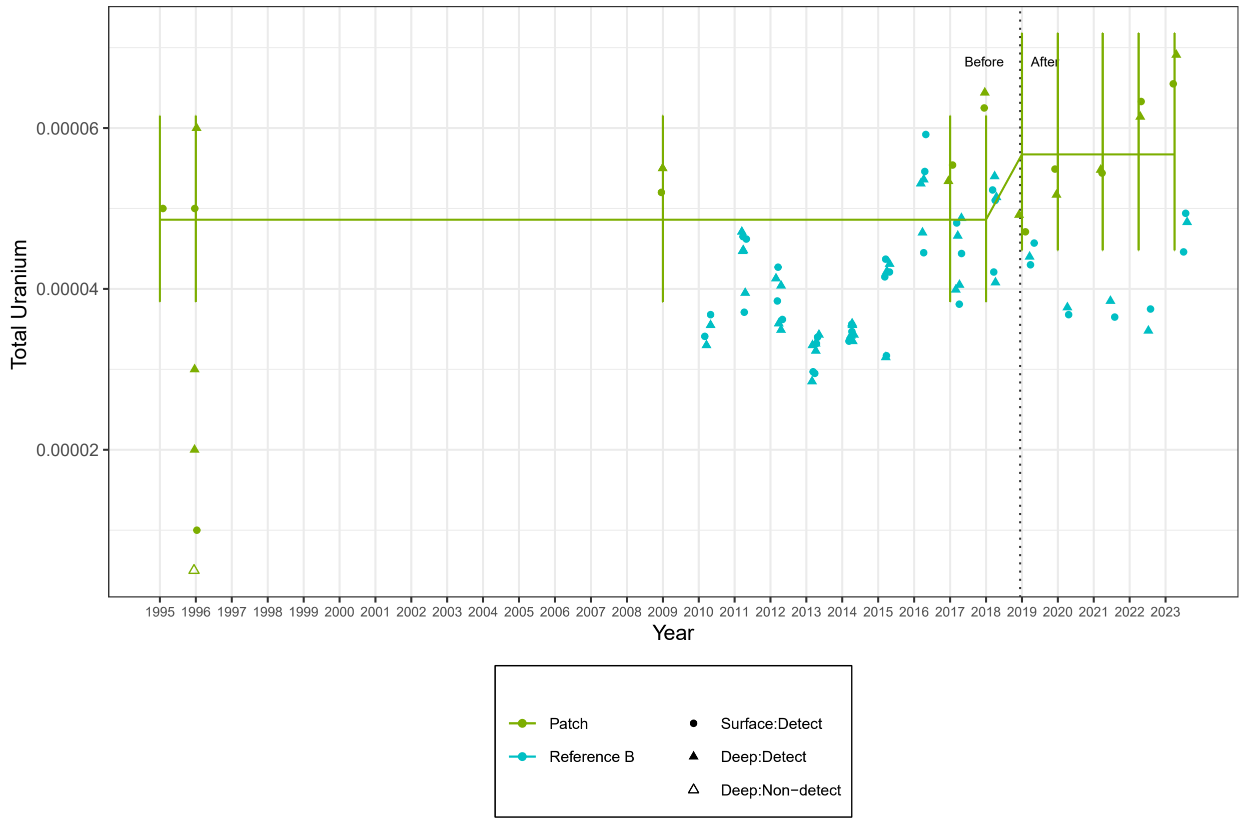
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	0.1545	0.1447	8.017	1.068	0.3166	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis

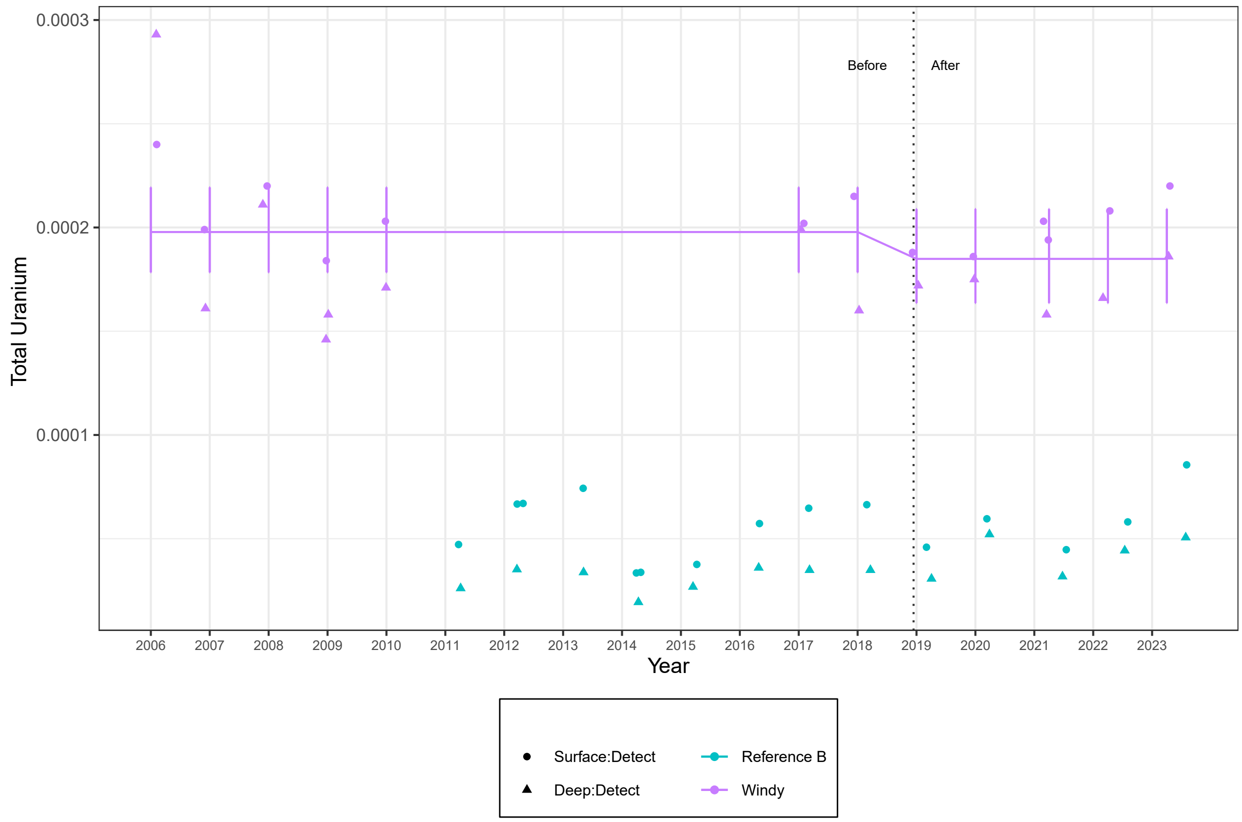
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0676	0.0719	10	-0.9409	0.369	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.



Windy Open-water Before-After Analysis

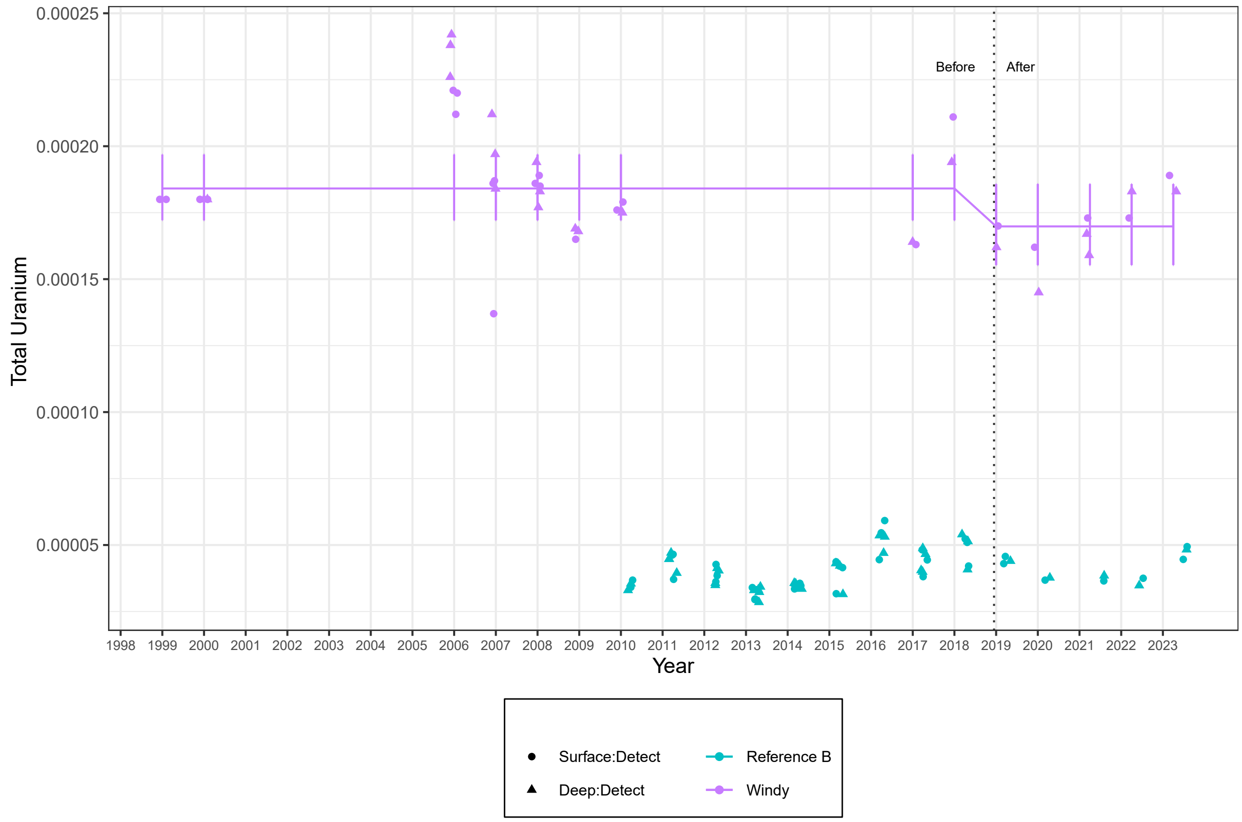
Coefficient	Estimate	Std. Error	df	t value	p	Significance
periodafter	-0.0806	0.0513	12.08	-1.571	0.142	not sig.

Conclusion:

The change from before to after was not significantly different.
BACI analysis not performed.

Observed Data and Fitted Values

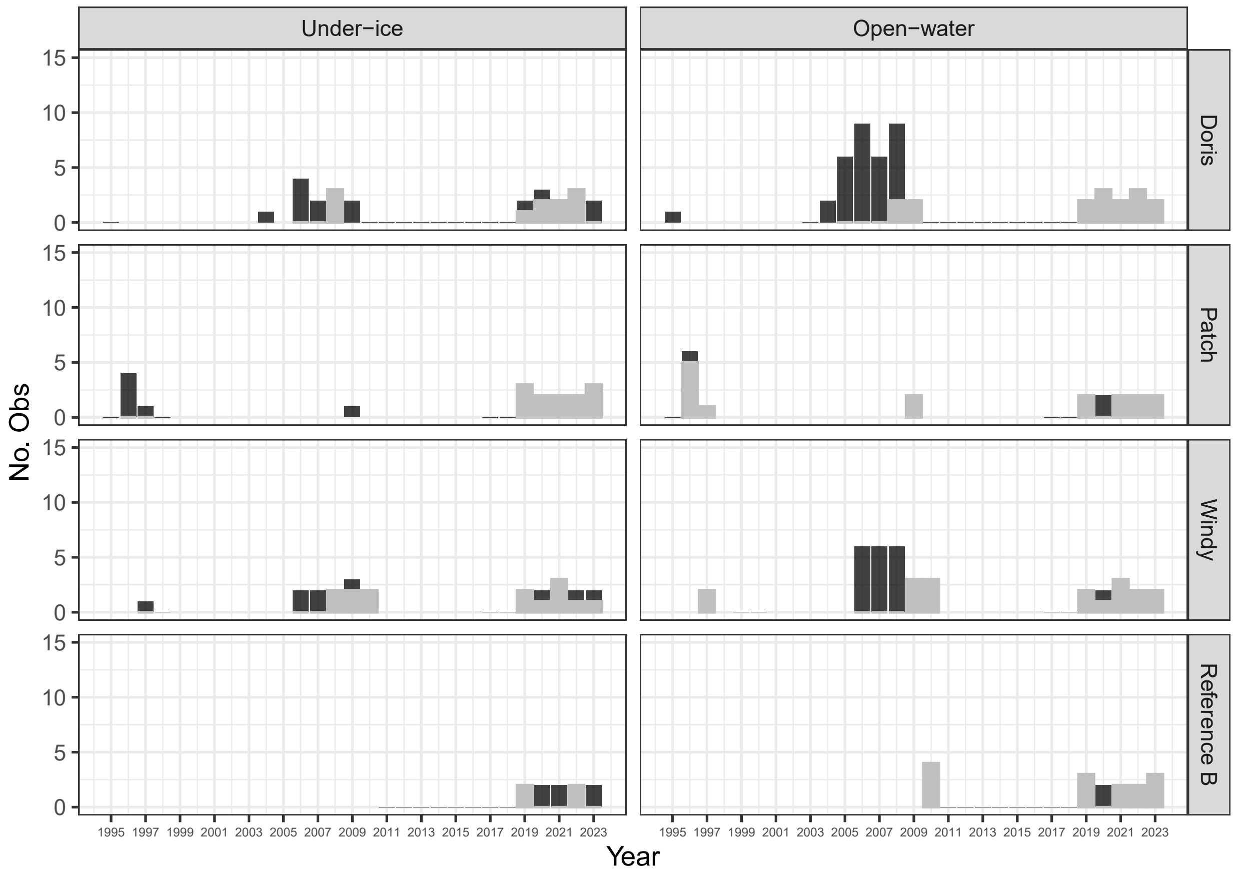
The symbols represent the observed data values and hollow symbols at half the detection limit. Solid lines represent the fitted means. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations in the before and after periods for the exposure site.


Total Uranium
0.00025
0.00020
0.00015
0.00010
0.00005
Before
After
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year
Surface:Detect
Deep:Detect
Reference B
Windy

C.3.1.26 Dissolved Zinc

Censored Values and Sample Sizes

The following plots indicate the number of observations for each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

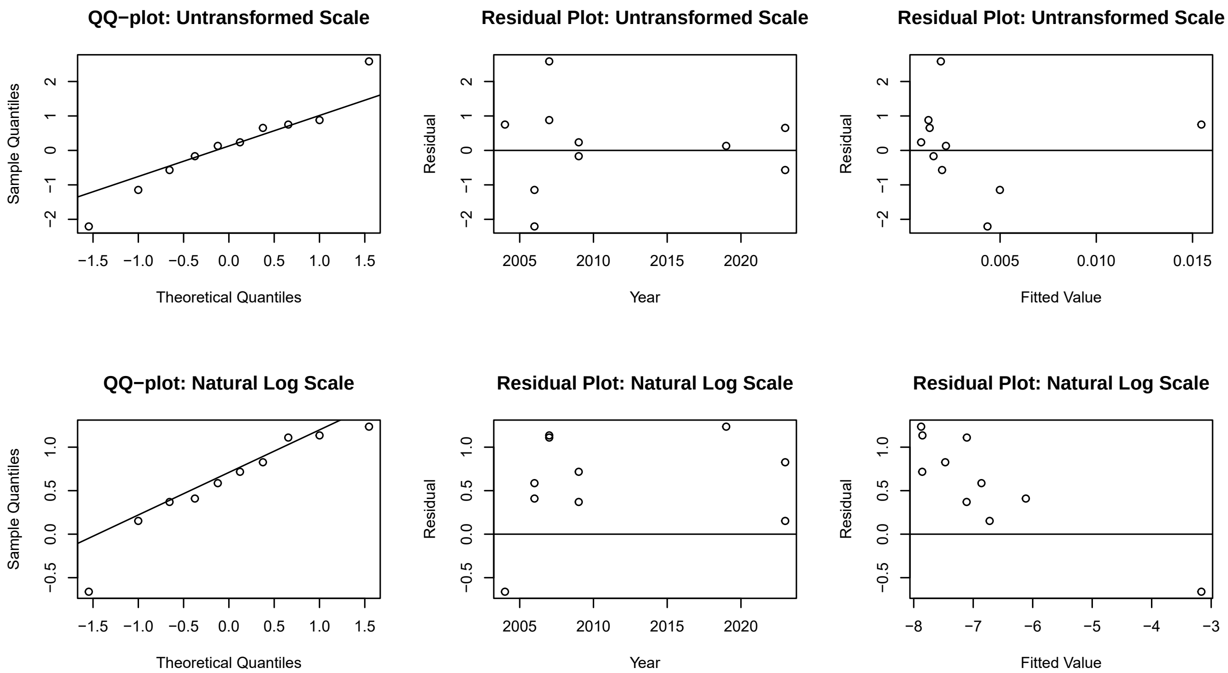
The sample sizes per lake and season are summarized in the table below.

Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Under-ice	24	11	46	0
Doris	Open-water	47	17	36	100
Patch	Under-ice	18	12	67	100
Patch	Open-water	19	16	84	100
Reference B	Under-ice	10	4	40	0
Reference B	Open-water	16	14	88	100
Windy	Under-ice	23	14	61	50
Windy	Open-water	37	18	49	100

More than 50% of data under detection limit in Doris North Open-water, Patch Under-ice, Patch Open-water, Reference B Open-water, Windy Under-ice, and Windy Open-water. Data from those site-season groupings will be removed from the analysis. Doris North Under-ice, Doris North Open-water, Reference B Under-ice, and Windy Open-water exhibited more than 10% of data under detection limit. The analysis proceeds with tobit regression for Doris Lake.Reference Lake B exhibited close to 50% under detection limit in the under-ice season. Inclusion of Reference Lake B lead to unstable results, hence Reference Lake B was removed from the analysis. The analysis proceeds with tobit regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the fitted model as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.



Outliers on untransformed scale:

None

Outliers on natural log scale:

None

The untransformed and natural log-transformed model fit the data equally well. Analysis proceeds with untransformed data.

Doris Lake

The trend for Doris Lake was compared to a slope of zero. If there was a significant trend, then the trend for Doris Lake was compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Doris Under-Ice

Analysis	Chi.sq	df	p	Significance
Compare to slope zero	70.8	3	<0.00001	sig.

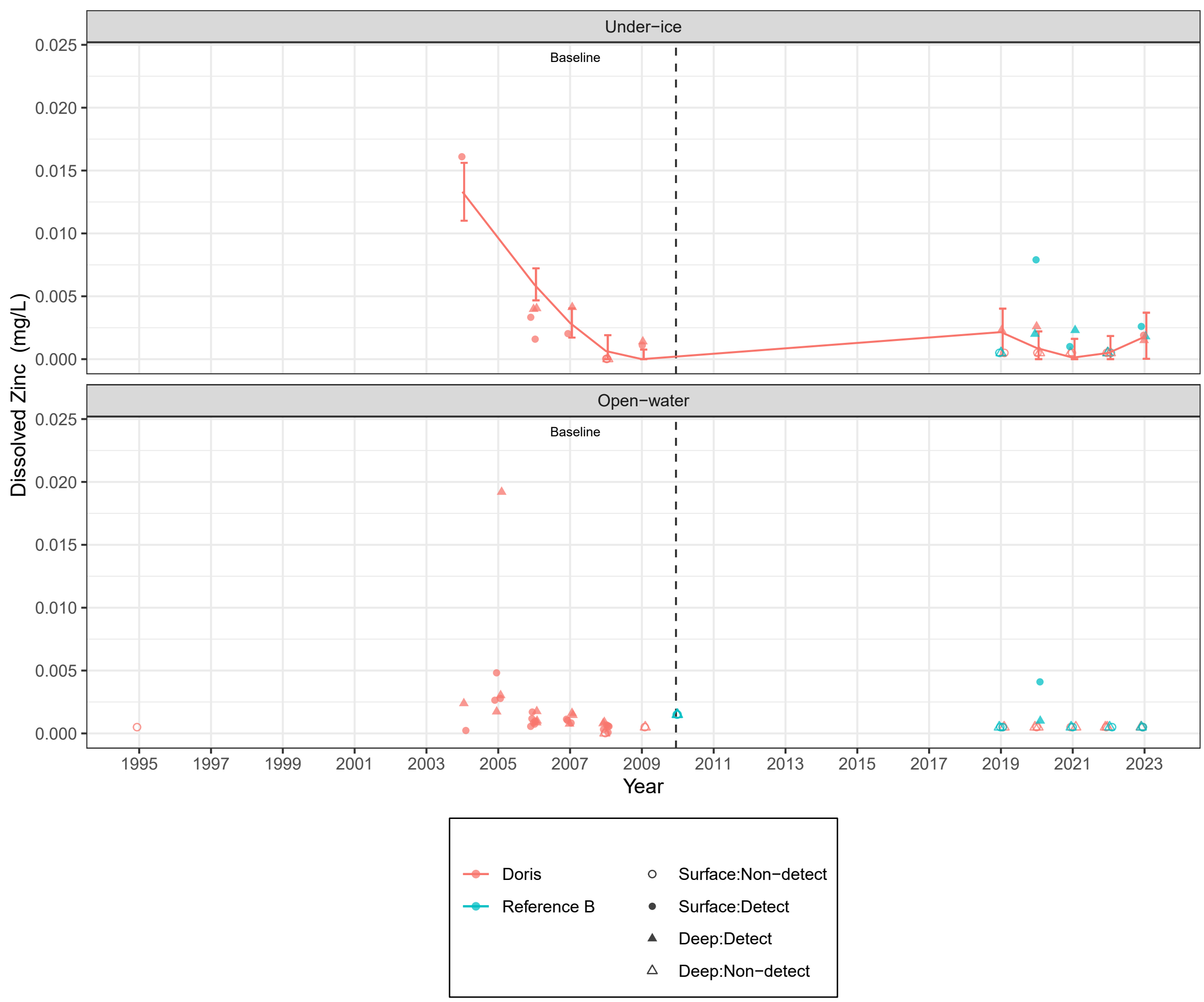
Doris Lake exhibited significant deviation from a slope of zero. Comparison to the trend in Reference Lake B was not completed due to Reference Lake B being excluded from analysis.

Doris Open-Water

All data from Doris Lake open-water removed from the analysis. No analysis performed.

Observed Data and Fitted Values

The symbols represent the observed data values and hollow symbols are values presented at half the detection limit. Solid lines represent the fitted curves. Error bars indicate the upper and lower 95% confidence intervals of the modelled concentrations.



Patch Lake

Before-after analyses were first performed to compare the change in the before and after period for the exposure site. If a change detected, then before-after-control-impact linear modelling was applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Patch Under-Ice Before-After Analysis Analysis not performed.

Patch Open-Water Before-After Analysis Analysis not performed.

Windy Lake

Before-after analyses were first performed to compare the change in the before and after period in the exposure lake. If a change was detected then before-after-control-impact linear modeling would be applied to compare the change in before and after periods relative to Reference Lake B. Models were fit separately for each season.

Windy Under-Ice Before-After Analysis Analysis not performed.

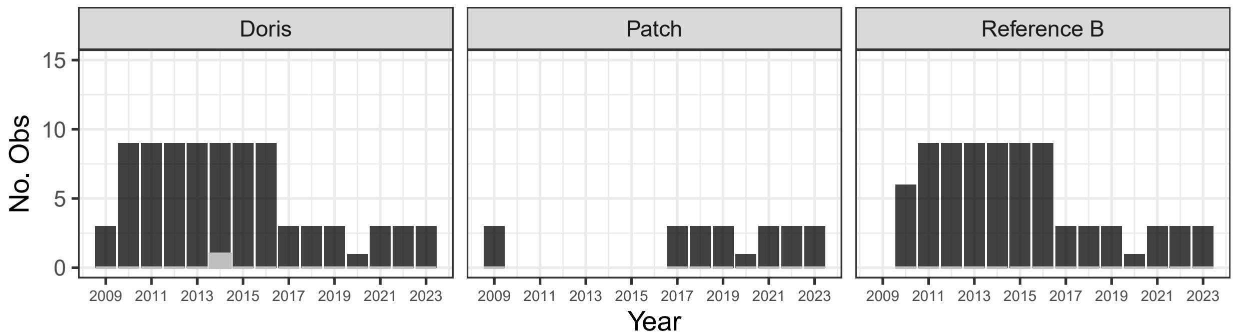
Windy Open-water Before-After Analysis Analysis not performed.

C.3.2 PHYTOPLANKTON

C.3.2.1 Phytoplankton Biomass

Censored Values and Sample Sizes

The following plots indicate the number of measurements taken in each year from each lake that were less than the detection limit (light gray) or greater than the detection limit (dark gray). Observations at or below the analytical detection limit were considered censored.



Analysis not performed if greater than 50% of observations from a site-season grouping were censored or if 100% of observations from the current assessment year (i.e., 2023) were censored.

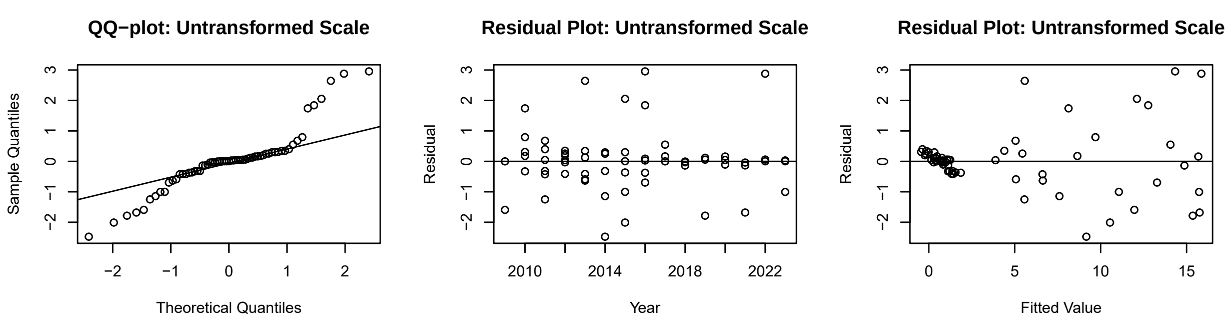
The sample sizes and median values per lake are summarized in the table below.

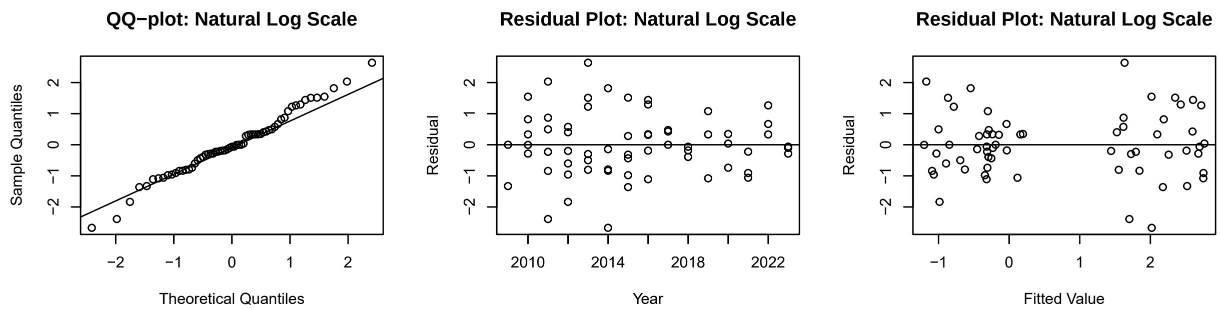
Lake	Season	# Obs (total)	# < DL (total)	% < DL (total)	% < DL (2023)
Doris	Open-water	85	1	0.01	0
Patch	Open-water	22	0	0.00	0
Reference B	Open-water	79	0	0.00	0

None of the lakes exhibited greater than 10% of data less than the detection limit. The analysis proceeds with linear mixed model regression.

Initial Model Fit

A model was fit both on the untransformed and natural log scale to assess the need for transformations. Outliers were identified from the model fit as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.





Outliers are identified from the model fit as standardized residuals greater than 3, and flagged to caution interpretation of results but not removed from the analysis.

Outliers on untransformed scale:

None

Outliers on natural log scale:

None

The natural log data better meets the residual assumptions. Analysis proceeds with natural log data.

Doris Lake

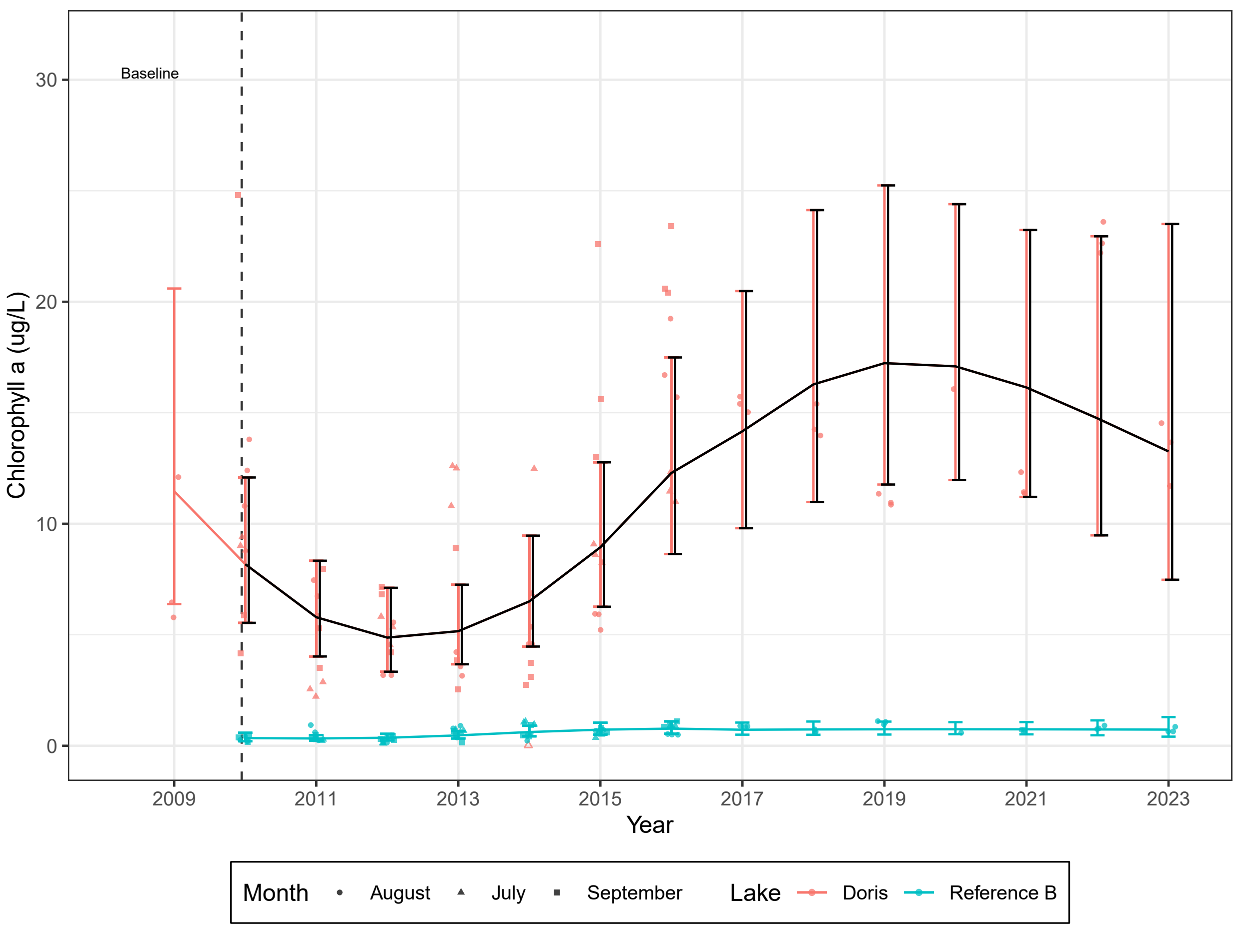
The trend of Doris Lake was compared to a slope of 0. If there is a significant trend, then the trend of Doris Lake is compared to the trend in Reference Lake B. This contrast does not test for differences in intercepts between lakes.

Analysis	Chi.sq	df	p	Significance
Compare to slope 0	47.698	4	<0.00001	sig.
Compare to Reference B	12.115	4	0.01650	sig.

Doris Lake exhibited significant deviation from a slope of zero. Doris Lake exhibited significant deviation from the trend of Reference Lake B

Observed Data and Fitted Values

Symbols represent the observed data values. Observations under detection limit are shown by hollow symbols and plotted at half the detection limit. Solid lines represent the fitted curves and the error bars indicate the upper and lower 95% confidence intervals.



Patch Lake Before-after analyses were first performed to compare the change in concentrations in the before and after period in the monitoried site. If a change has been detected then before-after-control-impact linear modeling was applied to compare the change in concentrations before and after baseline years between Reference B and Patch lakes.

Before-vs-After Analysis

Coefficient	Estimate	Std. Error	t value	p	Significance
periodafter	0.0087	0.2956	0.0295	0.9774	not sig.

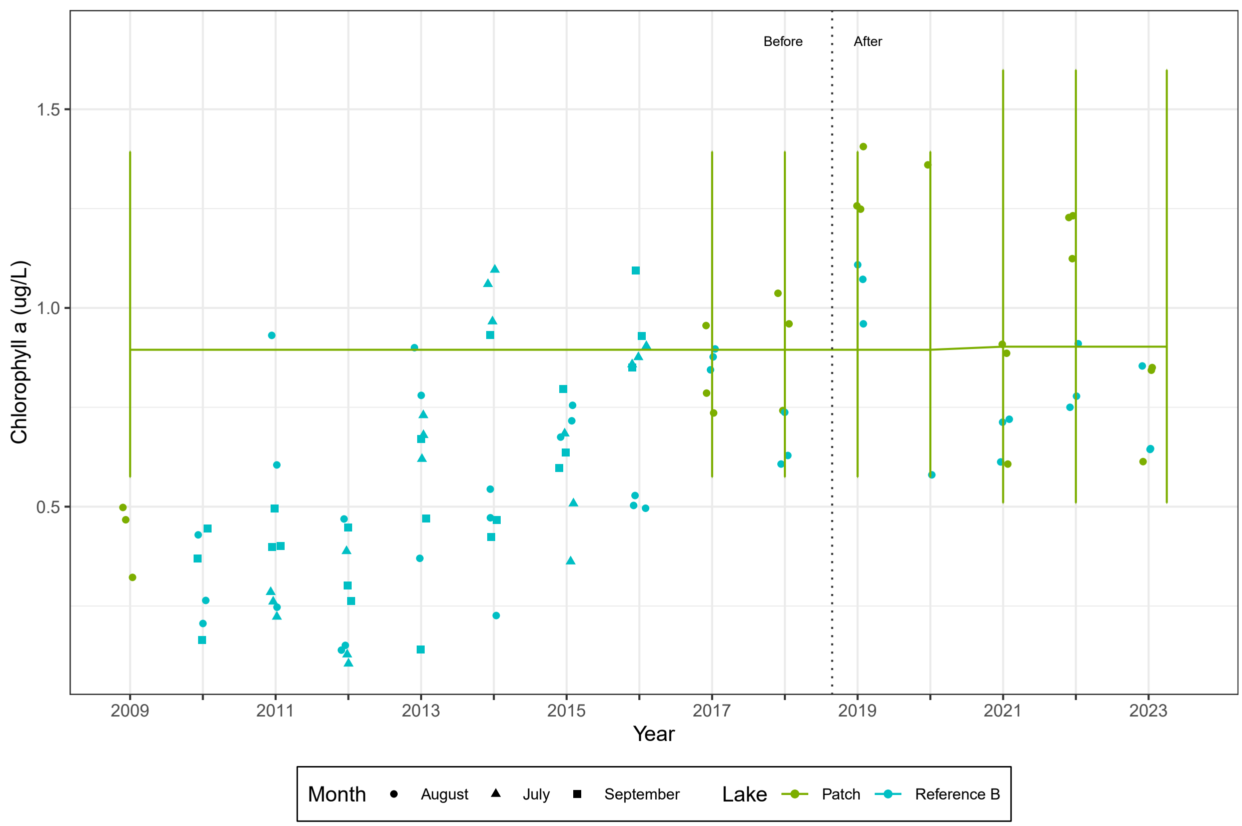
Conclusion:

The change at Patch North Lake from before to after was not significantly different.

BACI analysis not performed.

Observed data and fitted values

Below are plots of the observed and fitted data. The symbols represent the observed data values. Solid lines represent the fitted means and error bars indicate the upper and lower 95% confidence intervals.



C.4 REFERENCES

TMAC. 2018. *Hope Bay Project: Aquatic Effects Monitoring Plan*. Prepared by TMAC Resources Inc.: Toronto, ON.

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