Real Time Water Quality
20 Year Report

Voisey's Bay Network

2003-2023

Government of Newfoundland and Labrador
Dept. of Environment, Conservation and Climate Change
Water Resources Management Division

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Acknowledgements

The Real-Time Water Quality (RTWQ) Monitoring Network at the Vale Voisey's Bay Nickel-Copper Mine site has been successful in identifying and tracking emerging water quality issues due to the dedication and collaboration of numerous individuals and organizations. The management and staff of Vale Newfoundland and Labrador (hereafter referred to as Vale NL) work closely with the Department of Environment, Conservation and Climate Change (ECC), Water Resources Management Division (WRMD), as well as Environment and Climate Change Canada (ECCC), to ensure the protection of ambient water resources in the Voisey's Bay area of Labrador.

Vale NL, as the network owner, has supplied all station equipment and continues to provide replacement parts and instrumentation as required. The ongoing cooperation and support of Vale NL Environmental Advisors are gratefully acknowledged, as they play a key role in ensuring the RTWQ network remains fully operational. Their assistance with site access and maintenance logistics is highly valued and essential to the continued success of the program.

Staff from WRMD have played a central role in the operation of this technologically advanced monitoring network. WRMD personnel based in Happy Valley - Goose Bay lead coordination and liaison efforts among the participating agencies, ensuring consistent communication and collaboration. WRMD is responsible for instrument maintenance and calibration, troubleshooting, and the implementation of quality assurance and quality control procedures. WRMD staff also oversee data management and reporting, ensuring that water quality information is publicly available on a near real-time basis through the departmental website and is routinely assessed for data quality and integrity.

ECCC staff with Water Survey of Canada (WSC) provide essential expertise in data logging, telecommunications, and hydrometric monitoring. WSC plays a lead role in addressing water quantity and flow-related components of the network and conducts regular site visits to ensure that hydrometric and data transmission systems are functioning reliably and efficiently.

Management teams from WRMD, WSC, and Vale NL remain fully committed to the continued operation and ongoing improvement of the RTWQ monitoring network. Their shared goal is to ensure that the network consistently produces accurate, reliable water quality and quantity data to support informed environmental decision-making. The success of the RTWQ program is a direct result of the strong partnership among all three organizations. This report, reflecting two decades of water quality data collection and analysis, stands as a testament to the value of sustained collaboration between industry and government, as well as the network's effective role as an early warning system.

Abbreviations

RTWQ	Real-time Water Quality
ECC	Department of Environment, Conservation and Climate Change NL
WRMD	Water Resources Management Division
ECCC	Environment and Climate Change Canada
WSC	Water Survey Canada
DO	Dissolved Oxygen
NL	Newfoundland and Labrador
QA/QC	Quality Assurance and Quality Control
ICED	Inventory, Calibration and Evaluation Database
%Sat	Percent Saturation
PTE	Performance Testing and Evaluation
PPT	Precipitation

Background

In 1993, a large and economically significant ore deposit containing nickel, copper, and cobalt was discovered at Voisey's Bay near the community of Nain in northern Labrador. The deposit's proximity to the earth's surface and its location within a marine coastal environment created favourable conditions for an above-ground mining operation with efficient access to shipping infrastructure. Open-pit mining operations began in 2005. An underground expansion project, transitioning the site from open-pit to underground mining, completed construction and commissioning in December 2024. Since 2014, ore produced at Voisey's Bay has been transported via nearby port facilities to the Long Harbour Processing Plant in Placentia Bay, Newfoundland and Labrador

In 2001, the Water Resources Management Division (WRMD) launched the provincial Real-Time Water Quality (RTWQ) monitoring network. The program was designed to remotely monitor sensitive waterbodies using continuous water quality instrumentation and telemetry. The network enables the collection of large volumes of high-frequency data that can be used to assess aquatic ecosystem health, identify long-term trends, and establish timelines for potential adverse events. As RTWQ data are available shortly after collection, the network functions as an early warning system, allowing for rapid identification of changes in water quality and timely mitigation actions. The data are valuable to industry partners, government agencies, and the public. Transparency is a key feature of the program as all collected data are published and made publicly accessible in near real-time on the WRMD website.

The RTWQ monitoring network at Voisey's Bay was established in 2003 through a collaborative effort involving the Newfoundland and Labrador Department of Environment, Conservation and Climate Change (ECC), Environment and Climate Change Canada (ECCC), and Vale Newfoundland and Labrador (Vale NL). The network was further expanded in 2006. The primary objective of the Voisey's Bay RTWQ network is to identify and track emerging water quality and water quantity management issues, while ensuring the protection of ambient water resources in and around the Voisey's Bay Mine and Mill site operations.

The RTWQ network consists of four water quality monitoring stations (Table 1):

Table 1: Voisey's Bay Real-Time Water Quality Monitoring Network Stations

Station Name	Station Number	Measurements	Installed
Reid Brook at Outlet of Reid Pond	NF03NE0009	Water Quality/Quantity	July 2003
Camp Pond Brook below Camp Pond	NF03NE0010	Water Quality/Quantity	July 2003
Reid Brook below Tributary	NF03NE0011	Water Quality/Quantity	July 2003
Tributary to Reid Brook	NF03NE0012	Water Quality/Quantity	July 2006

Each RTWQ monitoring station measures a core suite of water quality parameters in near real-time. These parameters include water temperature, pH, specific conductivity, dissolved oxygen, and turbidity. In addition to the directly measured parameters, two derived variables—total dissolved solids (TDS) and percent oxygen saturation (% sat)—are calculated using the measured data.

RTWQ stations also record continuous water quantity data, including stage (water level) and flow rate. Responsibility for the collection, maintenance, and management of water quantity data rests with the Water Survey of Canada (WSC). WRMD regularly references hydrometric data to support interpretation of observed water quality variability, particularly in relation to flow conditions during monitoring deployment seasons.

This twenty-year review illustrates, discusses, and summarizes water quality–related events observed between 2003 and 2023. Throughout this period, water quality monitoring deployments typically occurred on a seasonal basis, generally spanning from June through October. Instruments were removed prior to the onset of freeze-up in late fall and winter to prevent damage associated with ice formation.

Monitoring equipment was typically deployed for approximately one-month intervals, referred to as deployment periods (see Appendix A, Table A-1). In contrast, water quantity monitoring equipment operated year-round, providing continuous stage and flow data regardless of seasonal conditions.

RTWQ Partnership and Agreement

The RTWQ and hydrometric monitoring program at the Voisey's Bay mine site was established in 2003 by WRMD and WSC in cooperation with Vale NL. The original agreement provided five hydrometric monitoring stations, three of which were equipped with RTWQ instrumentation. These stations were installed and became operational during the summer of 2003. In the summer of 2006, RTWQ monitoring capabilities were added to a fourth existing hydrometric station, expanding the scope of continuous water quality monitoring within the network. The original agreement, signed in 2002, has since been amended and extended on multiple occasions. The current agreement remains in effect for the duration of the Voisey's Bay mining project.

The objective of the monitoring network is to identify and track emerging water quality and water quantity management issues, while ensuring the ongoing protection of ambient water resources in and around the Voisey's Bay mining operations. RTWQ monitoring is a valuable tool that supports multiple aspects of water resource management. Water quality in natural environments is inherently dynamic and can change rapidly in response to natural processes or anthropogenic activities, potentially resulting in adverse effects on aquatic organisms, their habitats, and surrounding ecosystems. RTWQ monitoring addresses this variability by using in situ sensors to continuously measure water quality parameters.

Collected data are transmitted through communication systems and made available to end users in near real-time. This timely access enables users to identify, interpret, and track changing conditions, and to respond proactively to potential water quality concerns. As a result, RTWQ monitoring functions as an effective early warning system, supporting informed decision-making and timely mitigation when adverse water quality events occur.

WSC personnel are responsible for the operation and maintenance of all hydrometric monitoring equipment, including satellite communications, as well as the collection, validation, and correction of hydrometric data. WRMD personnel are responsible for all aspects of RTWQ monitoring. This includes the cleaning, calibration, deployment, and maintenance of RTWQ instrumentation, which is typically conducted on a monthly schedule during the ice-free season, as environmental conditions permit. WRMD is also responsible for water quality data management, including quality assurance and quality control (QA/QC), as well as the preparation of deployment and annual water quality reports. Vale NL personnel provide logistical support for the program, including on-site coordination and accommodation arrangements (Figure 1).

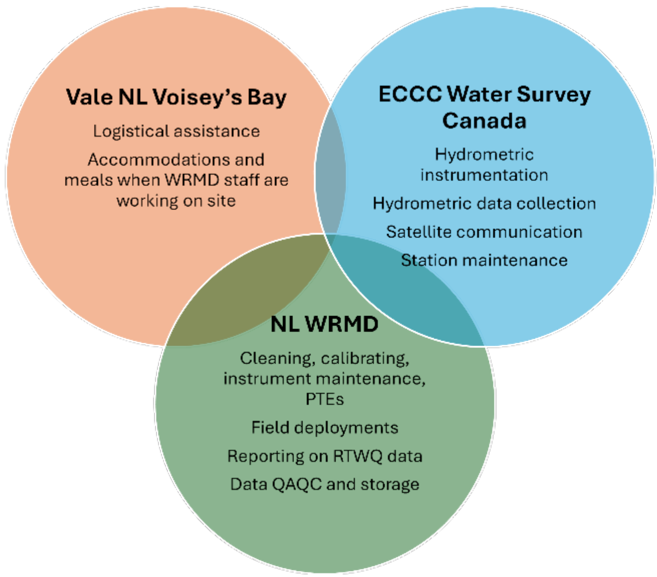


Figure 1: Real-Time Water Quality Monitoring Partnership Model

Instrumentation

The three original RTWQ stations were each equipped with a Hach DataSonde 4 (DS4) Hydrolab. The DS4 featured a temperature thermistor, a two-part pH reference electrode and sensor, an integrated conductivity sensor with circulator, a Clark cell dissolved oxygen sensor, and a self-cleaning turbidity sensor.

To support quality assurance and quality control (QA/QC), a Hach MiniSonde 4a (MS4a), configured to measure the same suite of parameters as the DS4, was used at all stations. During routine station maintenance visits, the MS4a was deployed to collect adjacent in situ measurements for comparison with the field RTWQ instrumentation. Field operations also included a handheld computer display unit (Surveyor 4a), which connected directly to the water quality sondes to allow real-time data review during site visits.

When the fourth RTWQ station (Tributary to Reid Brook) was established in 2006, advancements in instrumentation technology prompted the purchase and installation of a Hach DataSonde 5X (DS5X) Hydrolab. The DS5X measured the same parameters as the DS4 but incorporated an upgraded dissolved oxygen sensor, improving measurement performance and reliability.

In the spring of 2012, Vale NL made an additional investment to enhance on-site water quality monitoring capacity. This upgrade included the purchase of four new Hach DataSonde 5X (DS5X) Hydrolabs, a Hach MiniSonde 5 (MS5) for QA/QC measurements, and a new handheld computer display unit (Archer) for field-based data access and review.

Despite changes in monitoring instrumentation over the twenty-year period, the suite of water quality parameters measured remained consistent. This consistency has ensured strong data continuity and supports robust long-term and historical water quality analyses.

Monitoring Network

The Voisey's Bay RTWQ monitoring network expanded from the original three combined water quality and water quantity monitoring stations established in 2003 to four stations in 2006 (Figure 2). Also in 2006, a RTWQ groundwater monitoring station was installed at the dam separating the Headwater Pond (tailings management area) and Otter Pond. This station was intended to monitor dam performance and associated groundwater conditions.

The groundwater monitoring station was operational for a single deployment season, from July to November 2006, and the data collected are not included in this summary analysis. During its first winter season, the station was damaged by snow loading, and a subsequent decision was made to suspend groundwater RTWQ monitoring at that location.

At program inception in 2003, the hydrometric monitoring network consisted of five stations. Three of these stations were co-located with RTWQ monitoring, while two stations—Tributary to Reid Brook and Camp Pond at Southwest End—were dedicated solely to water quantity monitoring. Continuous water level (stage) measurements have been recorded at all five hydrometric stations since July 2003. Streamflow is calculated at all stations except Camp Pond at Southwest End.

Although water level and streamflow data provide important context for interpreting water quality conditions, these parameters are not examined in this report. Hydrometric data collection and management are the responsibility of the Water Survey of Canada (WSC) and are available from WSC upon request.

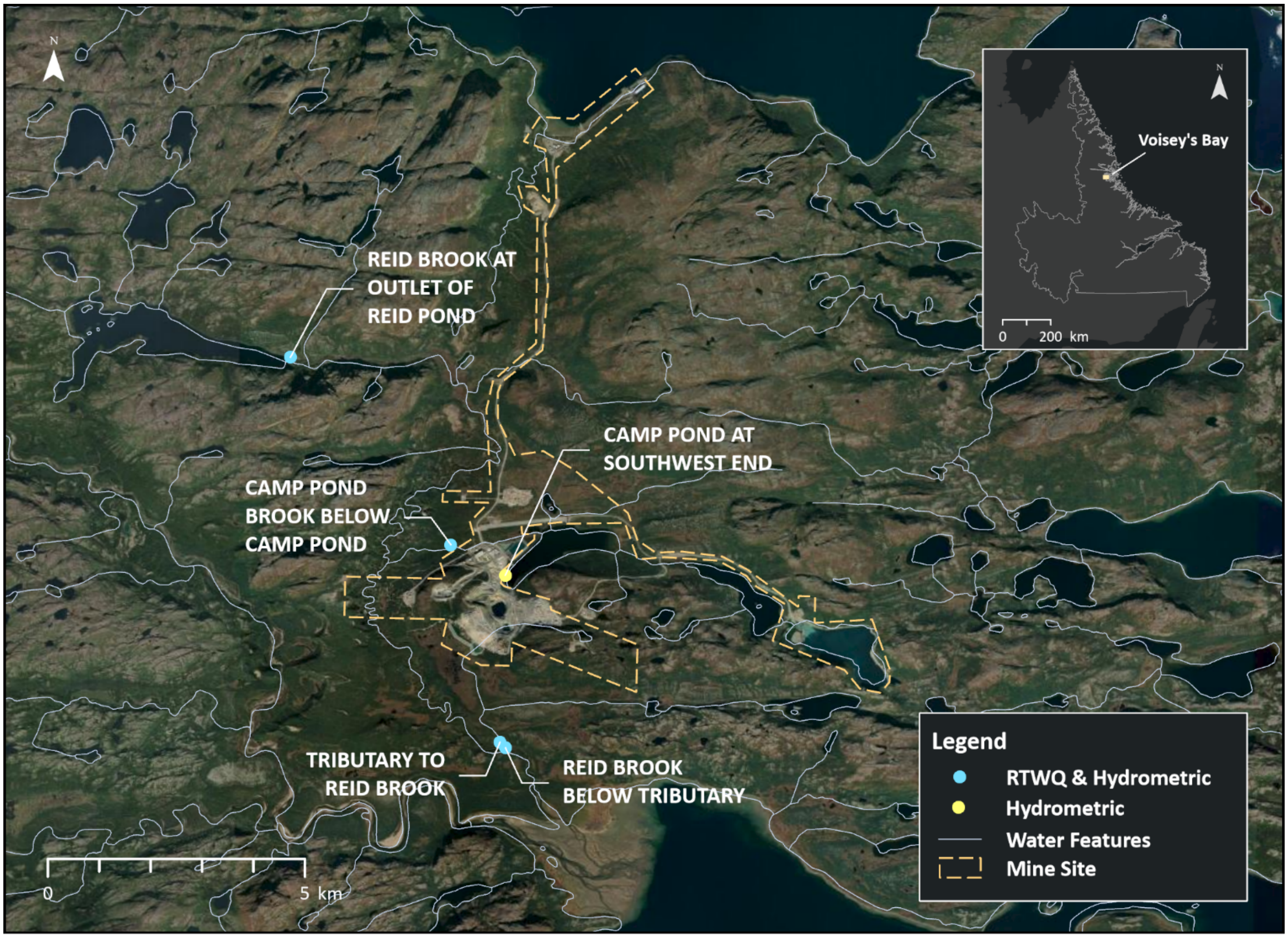


Figure 2: Voisey's Bay Real-Time Water Quality Monitoring Network

RTWQ Station Profiles

Appropriate site selection is critical to ensuring the quality and usefulness of data collected through the RTWQ monitoring program. The primary objective is to position real-time monitoring stations so they accurately characterize baseline (natural) water quality conditions, while also detecting changes or disturbances that may occur as a result of mining activities.

The four RTWQ station locations were selected based on their proximity to key components of the Voisey's Bay mine site operations. In general, as mine development progresses, the surrounding natural environment can be influenced by a range of anthropogenic factors. It is therefore anticipated that water quality conditions may change as mine projects advance through the stages of construction, commissioning, and active operation. Strategically located RTWQ stations enable the timely detection and assessment of such changes, supporting effective environmental management throughout the life of the project.

Between 2003 and 2005, the Voisey's Bay project was in the construction phase, with activities focused on the development of mine infrastructure, including the mill, concentrator, and personnel camp. Limited concentrate testing occurred in 2005; however, full production at the mine began in 2006. The project has remained in an operational phase since that time and underwent additional expansion activities through 2024.

The RTWQ stations located around the mine site do not directly monitor mine effluent or authorized point-source discharges from the facility. Rather, the stations are strategically positioned to detect potential changes in ambient water quality associated with surface runoff and other indirect anthropogenic disturbances related to mine construction, operation, and expansion activities.

The watersheds containing the RTWQ monitoring stations are located within the Nain geologic province. The real-time monitoring data are drawn from watersheds situated within two distinct ecoregions, as defined by the Newfoundland and Labrador Department of Energy and Mines. The area is generally characterized as high subarctic tundra, with some portions also described as coastal barrens.

The high subarctic tundra ecoregion is a rugged, mountainous landscape dominated by extensive areas of exposed bedrock. Vegetation cover is sparse and largely confined to low-lying valleys and protected areas. Soils are typically shallow and discontinuous, occurring in pockets between rock outcrops, and are commonly classified as orthic humo-ferric podzols and orthic dystric brunisols (Department of Energy and Mines, 2014). In areas with poor drainage, shallow fens are common and support sedges, sphagnum mosses, and other wetland species.

The regional climate is characterized by high precipitation and cold temperatures. Average annual rainfall ranges from approximately 950 to 1,000 mm, with snowfall accumulations reaching up to 4 m. Mean daily air temperatures typically range from −16 °C to −22 °C in February and from 9 °C to 13 °C in July (Environment Canada, 2013).

Reid Brook at Outlet of Reid Pond

The station Reid Brook at Outlet of Reid Pond is located at N56° 22' 22", W62° 09' 43" (Figure 3). This station is accessible only by helicopter. Upstream of the station, the watershed drains an area of 76.1km^2. This is the baseline monitoring station for the RTWQ network as there are no mining or construction activities within the Upper Reid Brook watershed. This station is pristine and represents reference point conditions in the network.

The watershed is characterized largely by non-forested rocky outcrops (Figure 4). There is some boreal forest in the lowlands. Geology in the catchment is predominantly anthorositic rock with about a quarter of the watershed classified as granitoid rock. Water flows from a main river and lake system into Reid Pond as well as from a few other smaller sub-basins. Reid Pond is about 4km long and less than 1km wide in most areas, narrowing down the lake towards the station (Figure 5). The water from Reid Pond flows out of the Pond through Reid Brook. Reid Brook is rocky and braided. Reid Brook flows east and then south towards the mine site (Figure 6) (Department of Energy and Mines, 2014).

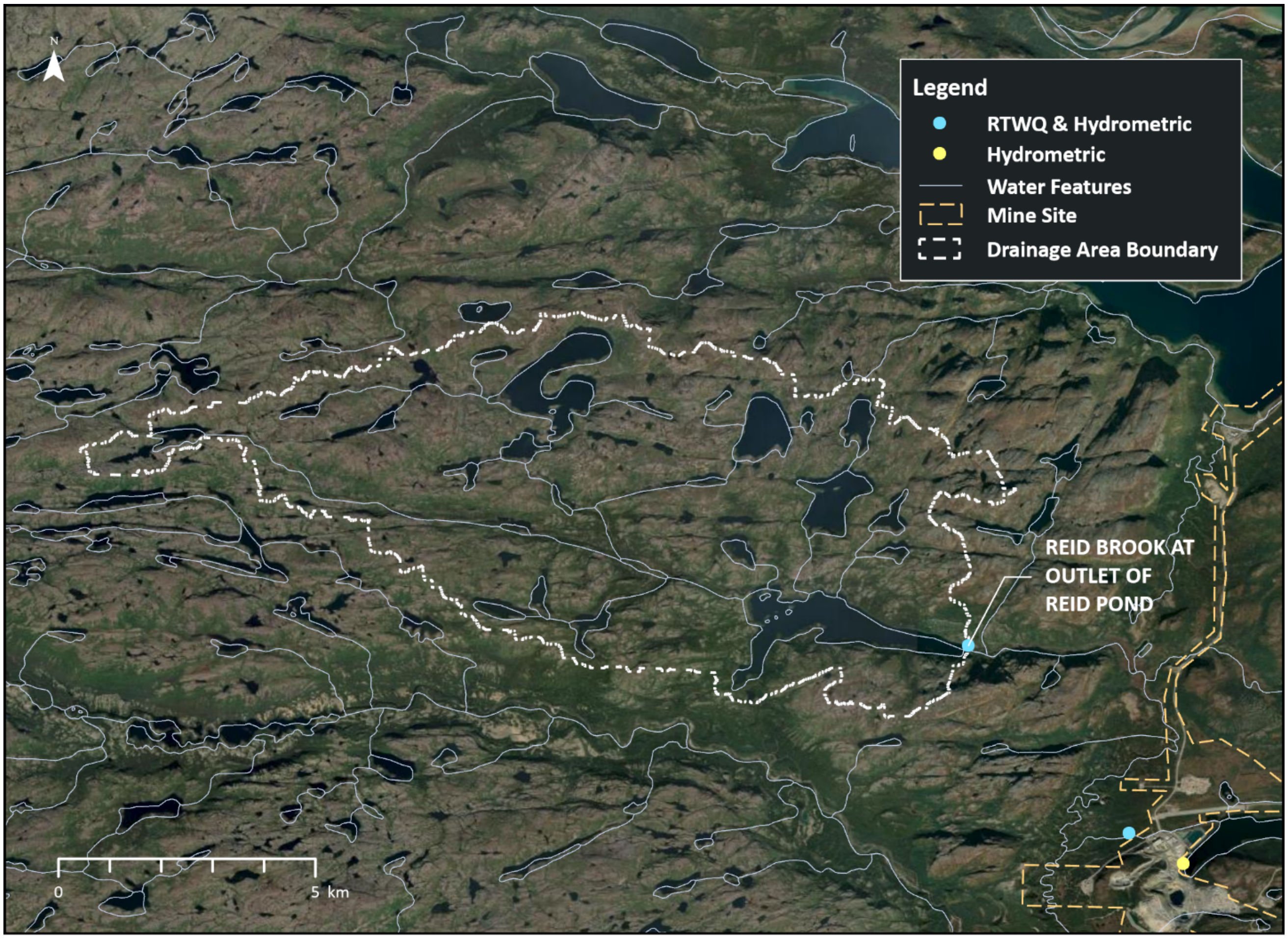


Figure 3: RTWQ station location and watershed for Reid Brook at Outlet of Reid Pond

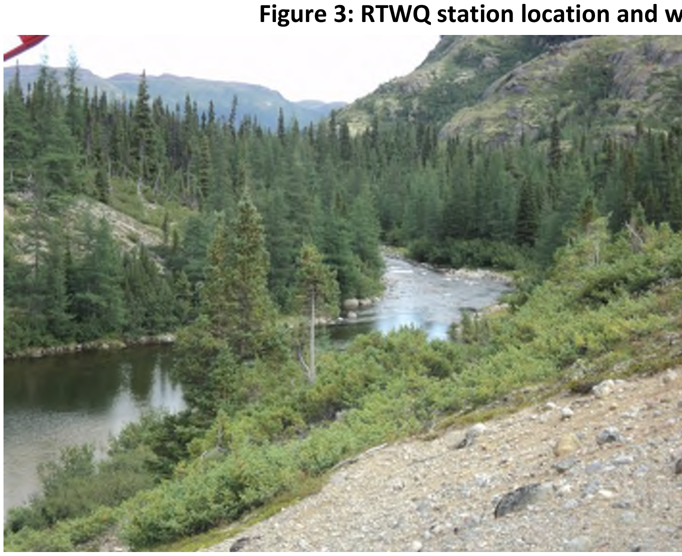


Figure 4: Outlet of Reid Pond Brook


Figure 5: Reid Pond Brook station hut (October 2024)

Figure 6: Reid Pond looking west

Camp Pond Brook below Camp Pond

The station at Camp Pond Brook below Camp Pond is located at N56° 20' 32", W62° 06' 24" (Figure 7), approximately 1.5km downstream from Camp Pond and 1.5km upstream from its confluence with Reid Brook. This station is accessible by helicopter or on foot from the Main Access Road. The foot path follows west along Camp Pond Brook from the road for about 500m through a wet, sparsely forested area. Upstream of the station, the watershed drains an area of 24.0km^2.

Water flows from Camp Pond by way of Camp Pond Brook adjacent to the airstrip and crosses the main road between the airstrip and the main camp and mill site. This is an important station in terms of its proximity to the main camp and the series of three ponds in its watershed. The first of these ponds, Headwater Pond, is the designated tailings management area for the mining operations. There is a dam located between Headwater Pond and Otter Pond (previous location of a RTWQ groundwater monitoring station). Otter Pond is the second of the three ponds in the series; Camp Pond is the third of the three ponds. There is a network of roads that run adjacent to the series of ponds as well as tailings pipes. Camp Pond is also the drinking water supply for the main camp (Figure 10).

The basin is characterized by mostly wooded and wetland areas with some exposed rock outcrops and barren landscape (Figure 8 and Figure 9). Geologic composition is a mix of granitoid rock, tonalitic to granodioritic magmatic gneisses and layered intrusions of troctolite, gabboraorite, and anthorosite. Bed material in Camp Pond Brook at the station is a mix of small and large boulders. Camp Pond Brook flows west for 1.5km from Camp Pond to Reid Brook (Department of Energy and Mines, 2014).

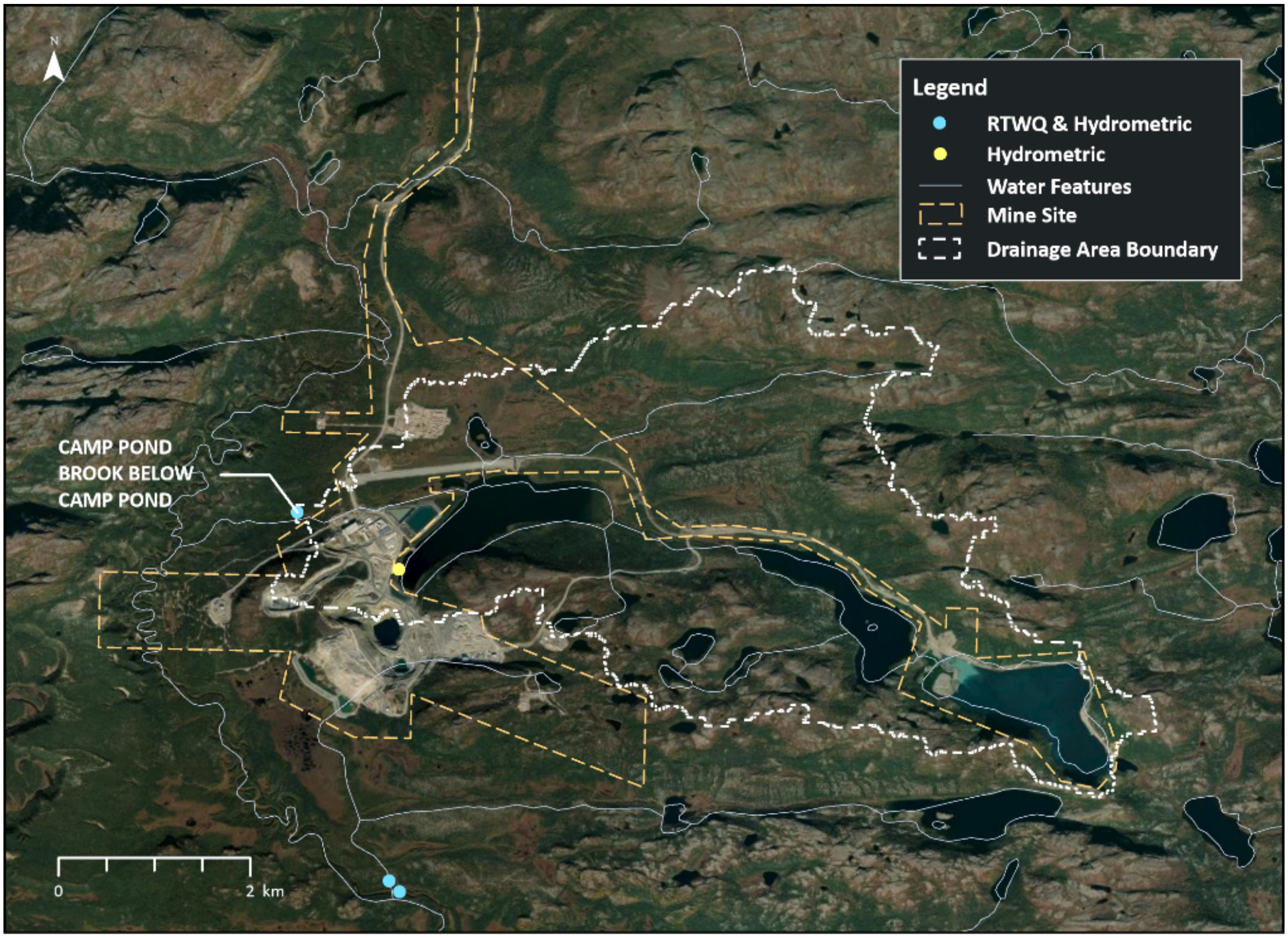


Figure 7: RTWQ station location and watershed for Camp Pond Brook below Camp Pond

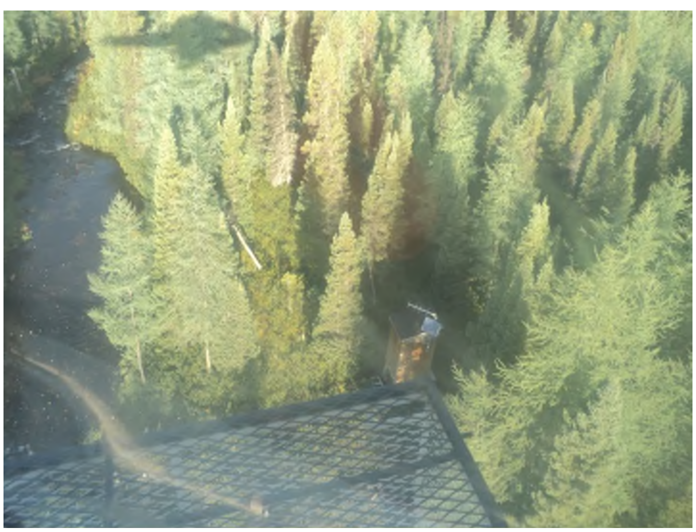


Figure 8: Camp Pond Brook station hut

Figure 9: Vale NL staff at Camp Pond Brook

Figure 10: Camp Pond, Drinking Water Intake

Tributary to Reid Brook

The station at Tributary to Reid Brook is located approximately 150m upstream from its confluence with Reid Brook at N56° 18' 18", W62° 05' 34" (Figure 11). This site is only accessible by helicopter. A 150m foot path has been established through the forested area adjacent to the tributary leading north from the helicopter landing area at the confluence of the tributary and Reid Brook. Upstream of the station, the tributary drains an area of about 15.2km^2. The headwaters for the tributary originate around the ore deposit ovoid as well as to the east near Headwater Pond.

While site water controls are in place at the mine site to contain any contaminated water from entering the freshwater environment, this station was of particular interest to Vale NL to ensure all procedures and protocols were operating as designed and were not adversely affecting the surrounding environment.

This tributary runs fast through a rocky stream bed with large substrate (Figure 12). The watershed is mostly wooded with several wetland areas (Figure 13). The geologic makeup of the watershed is a mix of granitoid rock and layered intrusions of troctolite, gabbroaorite, and anthorosite. This tributary originates in the mine area and flows southward; it combines with a secondary stream system about 1km upstream of the station and another small primary stream about 200m upstream (Figure 14) (Department of Energy and Mines, 2014).

Figure 11: RTWQ station location and watershed for Tributary to Reid Brook

Figure 12: Tributary to Reid Brook

Figure 13: RTWQ hut at Tributary to Reid Brook

Figure 14: Aerial view of Tributary to Reid Brook

Reid Brook below Tributary

The station Reid Brook below Tributary is the last point of measurement before the brook empties into the Atlantic Ocean at Voisey's Bay. The station is located about 2km from the end of the river channel; however, tidal influences and saltwater intrusion are likely experienced about 1km downstream from the station. The station is located at N56° 18' 21", W62° 05' 39" (Figure 15) and is only accessible by helicopter. A 50m foot path has been established through the forested area adjacent to Reid Brook leading east of the helicopter landing area at the confluence of the tributary and Reid Brook. This station's watershed encompasses the Reid Brook, Camp Pond Brook and Tributary to Reid Brook watersheds, draining an area of 158.1km^2.

This watershed contains most of the mining activities at the Voisey's Bay operation, including the underground expansion. The watershed is predominantly boreal forested areas with wetlands in the lowlands and rocky barren landscape in its headwaters (Figure 16). Geology in the watershed is approximately 40% granitoid rock, 40% anthorsitic rock, 20% tonalitic to granodioritic magmatic gneisses with the remainder a combination of magmatic quartz, feldspar and layered intrusions of troctolite, gabboraorite, and anthorosite.

In the lower reaches of Reid Brook, bed material is finer and the channel is more defined when compared to Upper Reid Brook (Figures 17 & 18). Sand is the dominant substrate with some large boulders and riffle areas (Department of Energy and Mines, 2014).

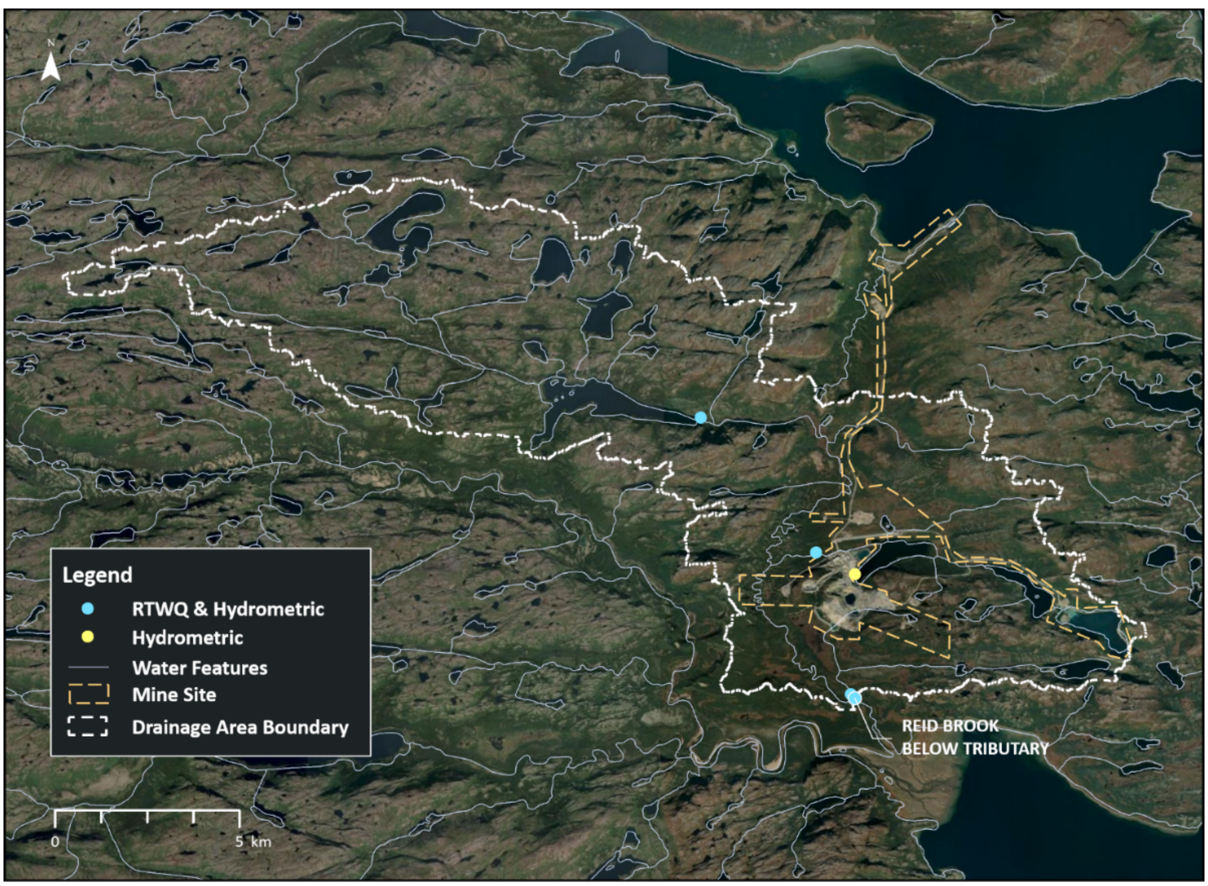


Figure 15: Map showing RTWQ stations and watershed for Reid Brook below Tributary

Figure 17: Tributary to Reid Brook meets Reid Brook below Trib

Figure 16: Reid Brook below Tributary

Figure 18: RTWQ hut at Reid Brook below Tributary

Quality Assurance and Quality Control

To ensure the effectiveness, accuracy, and reliability of the RTWQ monitoring program, comprehensive quality assurance (QA), quality control (QC), and quality assessment procedures have been established. All RTWQ activities are conducted in accordance with the procedures outlined in WRMD Protocols Manual for Real-Time Water Quality Monitoring in Newfoundland and Labrador (https://www.gov.nl.ca/eccc/files/NL_RTWQ_Manual_2023.pdf)

Consistent adherence to the protocols described in this manual is essential. All RTWQ personnel are responsible for ensuring that their duties and tasks are carried out in compliance with established QA, QC, and quality assessment requirements. Personnel are accountable for managing, performing, and verifying their work to ensure that data collection, instrumentation handling, and data management meet program standards.

Specific components of QA, QC, and quality assessment as they apply to the RTWQ monitoring program are summarized in the following sections.

Quality Assurance (QA)

QA includes all high-level activities, structures and mechanisms used to ensure and document the accuracy, precision, completeness, effectiveness and representativeness of the RTWQ monitoring program. QA ensures the overall integrity of the program design and consists of two separate but interrelated activities: QC and quality assessment (Water Resources Management, 2023).

Key elements of the QA framework for the RTWQ monitoring program include:

- **Annual performance testing and evaluation of instrumentation** (Performance Testing and Evaluation; PTE) to verify proper function and accuracy
- **Personnel qualifications and training**, ensuring staff are competent and familiar with approved protocols and procedures
- **Standardized technical procedures** for sampling, field operations, and analytical activities
- **Troubleshooting and corrective actions** for instrumentation, data loggers, station installations, data transmission issues, and identified equipment failures
- **Comprehensive record management**, including field sheets, chain-of-custody documentation for grab samples, deployment records, and instrument calibration logs
- **Implementation of QA/QC procedures**, including data verification, validation, variance documentation, and corrective action reporting
- **Preparation and dissemination of analytical results**, including routine reports, data packages, and publication of data on the RTWQ web platform
- **Auditing and internal review**, to assess adherence to program requirements and compliance with internal procedures
- **Peer review of program components**, including RTWQ network design, QA/QC procedures, and data analysis methodologies

- **Evaluation of emerging technologies and methodologies**, including advancements in RTWQ instrumentation, QA/QC practices, and analytical techniques
- **Direct field knowledge of monitored watersheds**, maintained through regular site visits and observational understanding of each RTWQ station location

Quality Control (QC)

QC refers to the use of technical activities which ensure that the data collected are adequate for quality assessment purposes. This includes feedback systems to ensure activities are occurring as planned and intended, and to verify that procedures are being carried out satisfactorily.

Key quality control (QC) activities implemented within the RTWQ monitoring program include:

- **Routine maintenance and calibration of instrumentation and sensors** to ensure accurate and reliable performance
- **Regular inspection and maintenance of RTWQ station installations**, including mounting hardware, cabling, and protective components
- **Collection of field readings at the time of sonde removal and redeployment**, using a designated field QA/QC instrument
- **In situ validation of measurements** by comparing field sonde readings with QA/QC instrument readings in accordance with established comparison criteria; investigation and troubleshooting are conducted when significant discrepancies are identified
- **Collection of water quality grab samples** at the time of sonde deployment and removal, with samples submitted to an accredited laboratory for analysis
- **Updating data records**, including entry of laboratory analytical results into program tracking spreadsheets upon receipt

Quality Assessment

Quality assessment activities are used to evaluate the completeness, reliability, and usability of RTWQ data over time.

Key elements of the quality assessment component of the RTWQ monitoring program include:

- **Calculation of long-term and deployment-period summary statistics**, including both deployment/annual and multi-year evaluations
- **Production and review of time-series graphs** for all monitored parameters, with evaluation of data gaps, data anomalies, and environmental guideline exceedances for pH and dissolved oxygen
- **Publication of near real-time RTWQ data** on the WRMD public website to support transparency and external data review

- **Preparation of deployment period monitoring reports**, documenting network performance and summarizing maintenance, calibration, and QA/QC activities; identification of data issues; presentation of time-series plots and summary statistics; interpretation of observed trends or events; and inclusion of data qualification statements
- **Archiving RTWQ monitoring data and associated records**, ensuring long-term data accessibility and traceability
- **Identification and documentation of data issues**, including incorrect parameter order, sensor malfunction, or missing data transmissions, through completion of data variance reports
- **Regular updates to instrument calibration schedules** and related documentation on the WRMD website

Maintenance and Calibration

To ensure the collection of reliable and accurate data, routine instrument maintenance and calibration are conducted in accordance with manufacturer specifications. RTWQ monitoring procedures are standardized across the provincial network, with maintenance activities carried out by WRMD staff to ensure that established protocols are consistently followed and that high-quality data are recorded (Figure 19).

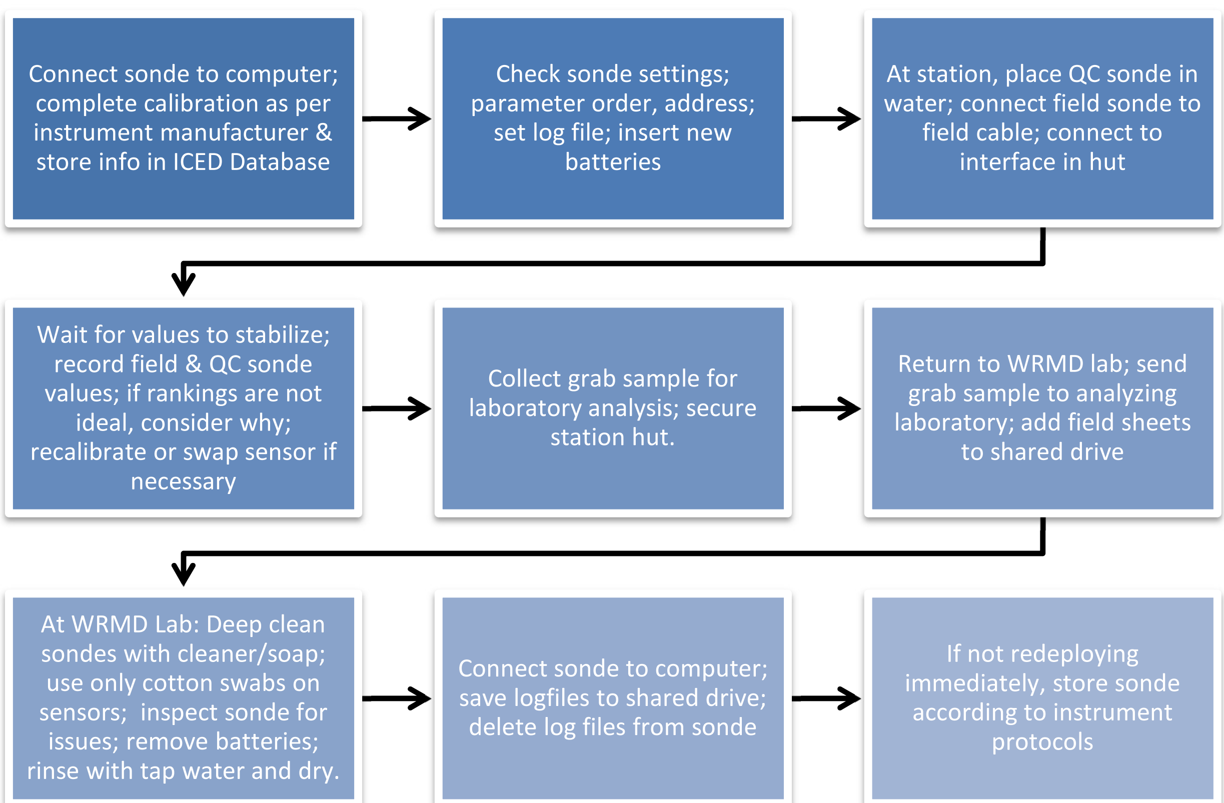


Figure 19: RTWQ Maintenance and Calibration Flowchart

Maintenance activities include thorough cleaning of the instrument and replacement of any sensor components that are damaged or unsuitable for reuse. Following cleaning, each sensor is carefully calibrated in accordance with the manufacturer's specifications.

Extended deployment periods can result in biofouling or sediment accumulation, which may cause sensor drift and lead to biased or inaccurate data. Although sensor performance may be affected, the instruments remain capable of detecting water quality events; however, the precise values recorded during these periods may be unreliable (Appendix A, Table A-1).

As part of the QA/QC protocol, the reliability of data recorded by each instrument is assessed at both the beginning and end of the deployment period. At deployment and retrieval, a QA/QC instrument is temporarily deployed adjacent to the field instrument, and measurements of temperature, pH, conductivity, dissolved oxygen, and turbidity are compared between the two instruments. Based on the degree of difference between parameters recorded by the field and QA/QC instruments at deployment and removal, a qualitative assessment of data quality is assigned. This procedure is based on an approach developed by the United States Geological Survey.

For deployment and removal comparison rankings, additional information and explanations of rankings, refer to the deployment reports available on the WRMD website (https://www.gov.nl.ca/eccc/waterres/watermonitoring/rtwq/csdr/#vale)

Analysis and Data Interpretation

The following data, figures, and discussion summarize water quality–related events observed over the twenty-year period spanning from the initial 2003 deployment season through the end of the 2023 deployment season for the Voisey's Bay RTWQ Network.

Except for water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to WRMD stringent QA/QC protocols. Water Survey Canada is responsible for QA/QC of water quantity data using national established QA/QC protocols. Corrected data can be obtained from Water Survey Canada online: https://wateroffice.ec.gc.ca/search/historical_e.html

Any explicit data related issues or problems are detailed in the deployment reports for the applicable timeframe and are available on the WRMD website: https://www.gov.nl.ca/ecc/waterres/watermonitoring/rtwq/csdr/#vale

RTWQ data collected between 2003 and 2023 were first screened for obvious errors, which were removed from the dataset prior to analysis. The remaining data were then grouped into construction (2003–2006) and operational (2006–2023) phases for analytical purposes. It should be noted that it is standard practice for RTWQ data collection to occur only during ice-free months, generally from May through November, to prevent instrument damage from ice and freezing temperatures in northern climates. This seasonal sampling constraint is reflected in the dataset, figures, and analysis.

Methodology

Data were analyzed using several complementary approaches:

1. **Time-series analysis:** Time-series graphs (2003–2023) were generated for each RTWQ parameter at all monitoring stations to illustrate variation over time, allowing seasonal patterns, short-term variability and longer-term changes to be visually assessed across the full monitoring period.
2. **Annual summary series analysis:** To compare typical water quality conditions over the years. Annual median values were used to reduce the influence of short-term variability, supporting consistent year-to-year comparisons and identification of atypical values.
3. **Trend analysis of continuous real-time data:** To evaluate whether sustained changes in water quality are evident over the approximately 20-year construction and operational period. Monthly median values were used to represent typical conditions and to assess potential long-term influences associated with mining activity.
4. **Trend analysis (grab samples):** To evaluate accredited laboratory-analyzed samples collected during routine program maintenance. These data include parameters not measured by real-time sensors (eg. major ions, nutrients, metals) and provide an independent interpretation of long-term water quality trends.

Time-series graphs (2003–2023) were generated in R Studio using R Programming version 4.53 ggplot2 package for each RTWQ parameter at all monitoring stations.

The annual summary series analysis is displayed as boxplots generated in R Studio using R Programming version 4.53 ggplot2 package with outliers identified by red dots.

Trend analysis was conducted using the Spearman rank correlation method to evaluate monotonic changes over time. For RTWQ data, monthly median values were first calculated for each parameter to reduce short-term variability and the influence of high-frequency observations. Trend analysis was then applied to the resulting monthly median dataset. For grab sample data, trend analysis was performed directly on individual measured values using their corresponding sampling dates.

Trend direction and statistical significance were determined using Spearman's rank correlation coefficient (Spearman's rho) and its associated *p*-value. A positive rho value indicates an increasing (Up) trend, while a negative rho value indicates a decreasing (Down) trend. Trends were considered statistically significant only when the *p*-value was less than the specified significance threshold ($\alpha = 0.05$). In cases where the *p*-value exceeded this threshold, results were classified as "No trend," regardless of the direction of rho, indicating that observed variations were not statistically distinguishable from natural variability.

The following section of the report discuss analysis and data interpretation of each parameter.

RTWQ Data Review 2003-2023

Water Temperature

Water temperature is one of the most important water quality parameters monitored in freshwater systems. It strongly influences the life cycles of aquatic organisms and regulates the solubility and availability of dissolved oxygen necessary to sustain aquatic life. Over the twenty-year monitoring period, water temperatures recorded at all Voisey's Bay real-time stations displayed clear seasonal patterns, with temperatures increasing through the spring to peak in mid-summer, followed by a gradual decline during late summer and early fall (Figure 20).

Over the twenty-year monitoring period, the lowest annual median water temperature recorded was 2.37°C at Reid Brook below Tributary in 2003. In contrast, the highest annual median water temperature, 14.27°C, was recorded at Reid Brook at Outlet of Reid Pond in 2023. Notably, the highest annual median water temperatures for three of the four monitoring stations occurred in 2023, reflecting a notable warm year across the monitoring network (Figure 21; Appendix B, Table B-1).

Trend analysis indicated no statistically significant trends in water temperature at Reid Brook at Outlet of Reid Pond, Reid Brook below Tributary, or Camp Pond Brook below Camp Pond during either the construction phase (Table 2) or the operational phase (Table 3). These results indicate that water temperatures at these stations remained generally stable over the twenty-year monitoring period.

The Tributary to Reid Brook monitoring station was installed in 2006; therefore, water temperature data are unavailable for the construction phase at this location. During the operational phase, no trend was identified for water temperature at Tributary to Reid Brook, indicating no measurable change in water temperature over the monitoring period (Table 3).

Table 2: Trend Analysis of Water Temperature for Construction Phase 2003-2005

Water Temperature: Construction Phase 2003-2005				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.290	0.162	Data not sufficient at this stage	0.423
Spearman's rho	-0.263	-0.355		-0.215
Parameter Count	18	17		16
Significant Level	0.05	0.05		0.05
Trend Result	No	No		No

Table 3: Trend Analysis of Water Temperature for Operational Phase 2006-2023

Water Temperature: Operational Phase 2006-2023				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.165	0.964	0.934	0.336
Spearman's rho	0.158	-0.0049	-0.0107	0.11
Parameter Count	78	78	78	78
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No

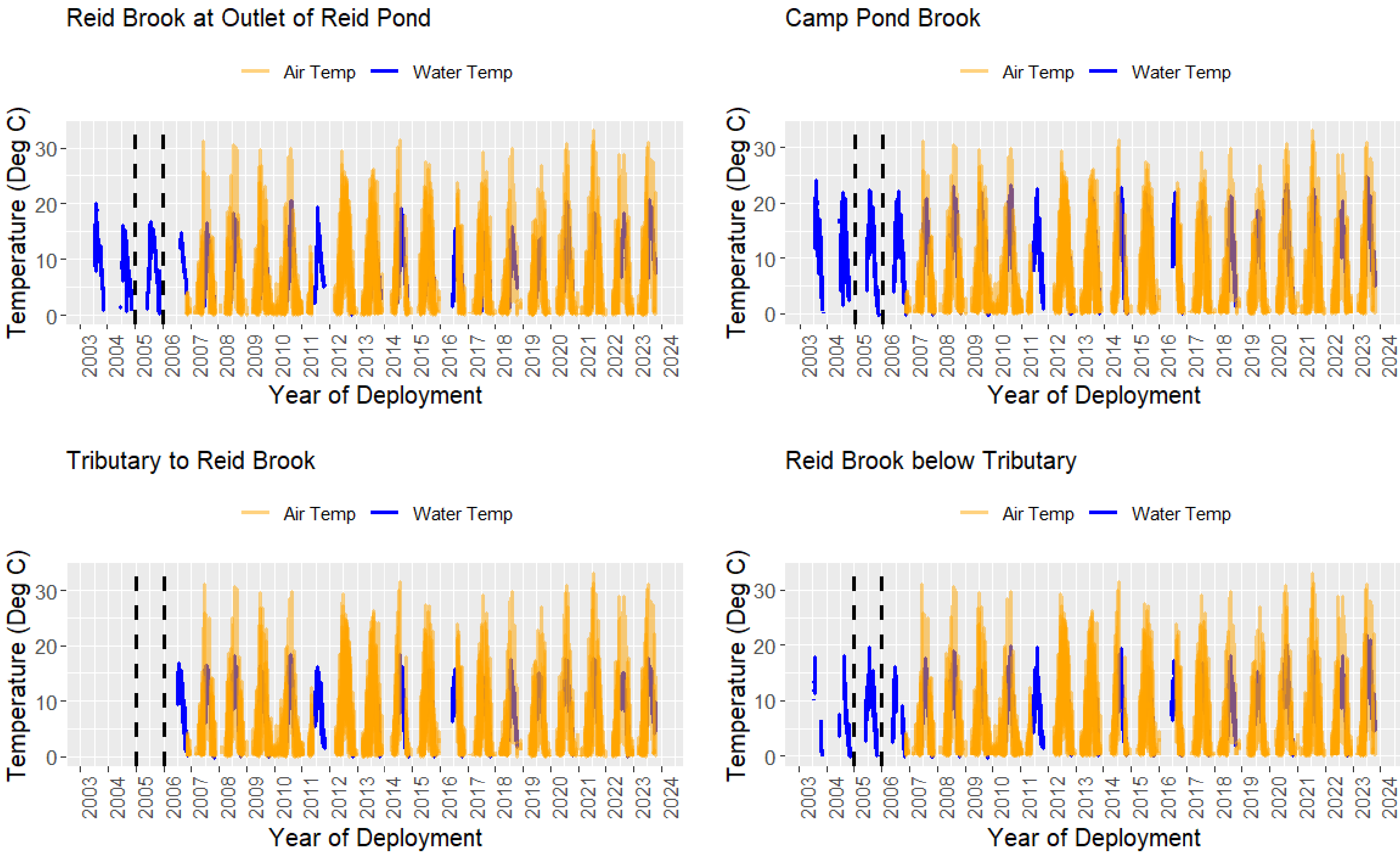


Figure 20: Voisey's Bay Real-Time Water Quality Monitoring Network: Water Temperature 2003-2023

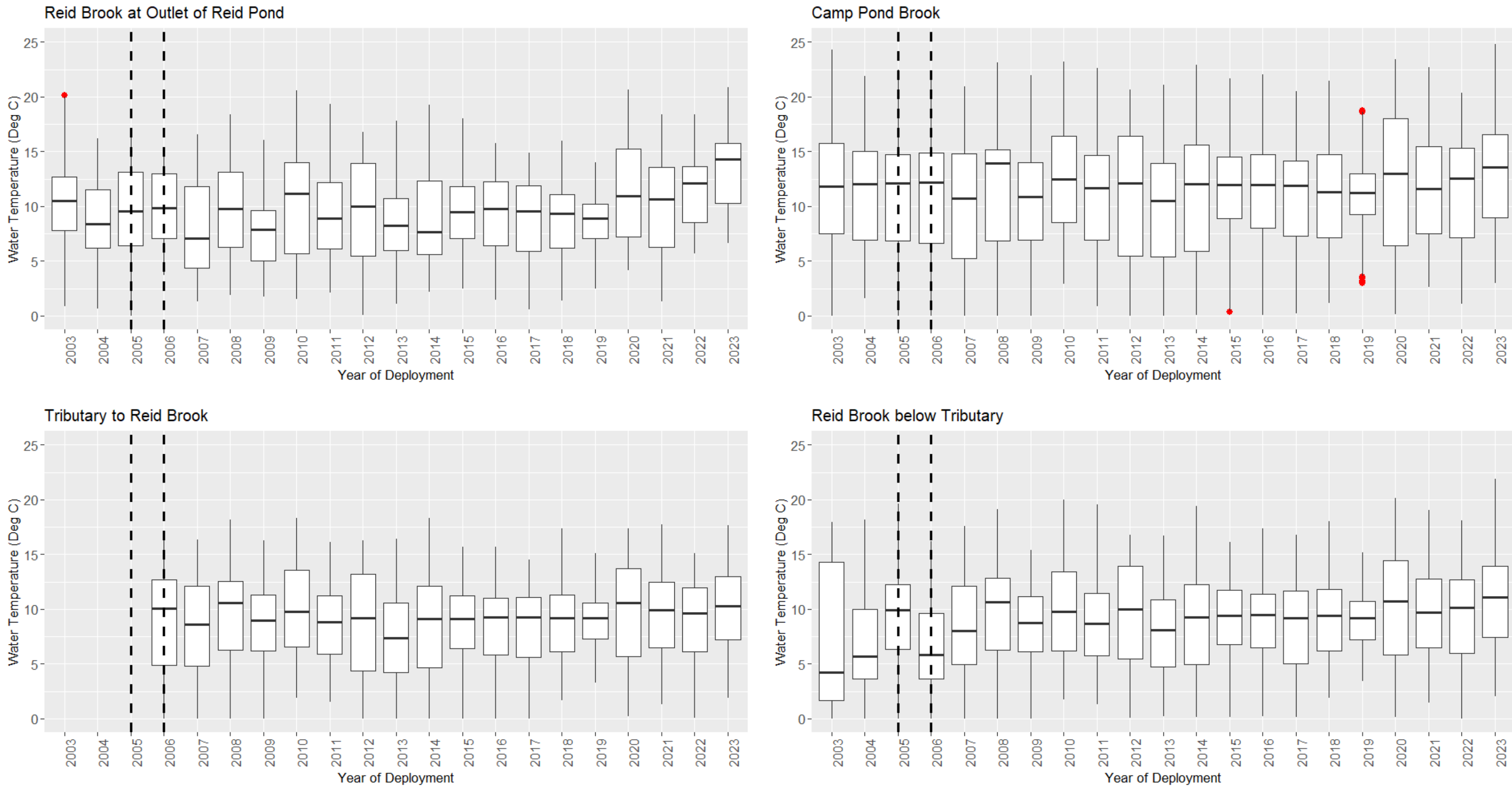


Figure 21: Voisey's Bay Real-Time Water Quality Monitoring Network: Water Temperature Boxplots 2003-2023

pH

pH is a measure of the concentration of hydrogen ions in a water body and is a key indicator of water quality. Variations in pH can significantly affect aquatic organisms and ecosystem processes in both stream and riparian environments. Although pH is largely influenced by the underlying geology of a watershed, it can also be altered by human activities such as urban runoff, agricultural practices, and mining.

The Canadian Council of Ministers of the Environment (CCME) has established guidelines for the protection of aquatic life in freshwater cold-water environments (CCME, 2014). These guidelines recommend that pH values remain within the range of 6.5 to 9.0. At several monitoring stations within the Voisey's Bay network, recorded pH values are frequently below 6.5. However, these values are considered to reflect natural background conditions associated with the local geology and surrounding physical environment rather than anthropogenic disturbance. Notably, pH values near the lower end of the recommended range are also observed at the baseline station at Reid Brook at outlet of Reid Pond, which represents a pristine reference site. Figures 22 and 23 illustrate the lower guideline limit (6.5 pH units) as a red line.

Over the twenty-year monitoring period, the highest annual median pH was 7.33, recorded at Reid Brook below Tributary in 2018. In contrast, the lowest annual median pH was observed in 2015 at Reid Brook at outlet of Reid Pond, with a value of 6.05 pH units (Figure 23).

Trend analysis of pH during the construction phase (Table 4) identified no statistically significant trends at the Reid Brook at Outlet of Reid Pond or Camp Pond Brook below Camp Pond stations. However, a statistically significant increase in pH was detected at Reid Brook below Tributary during construction, with a p-value of 0.002 ($\alpha = 0.05$). This modest increase in pH may be attributed to construction-related runoff and the mobilization of suspended materials which have the potential to influence pH. Furthermore, boxplot analysis (Figure 23) indicates that pH values at Reid Brook below Tributary returned to pre-construction levels in the year following construction, suggesting a rapid recovery to baseline conditions following potential influence from activities upstream.

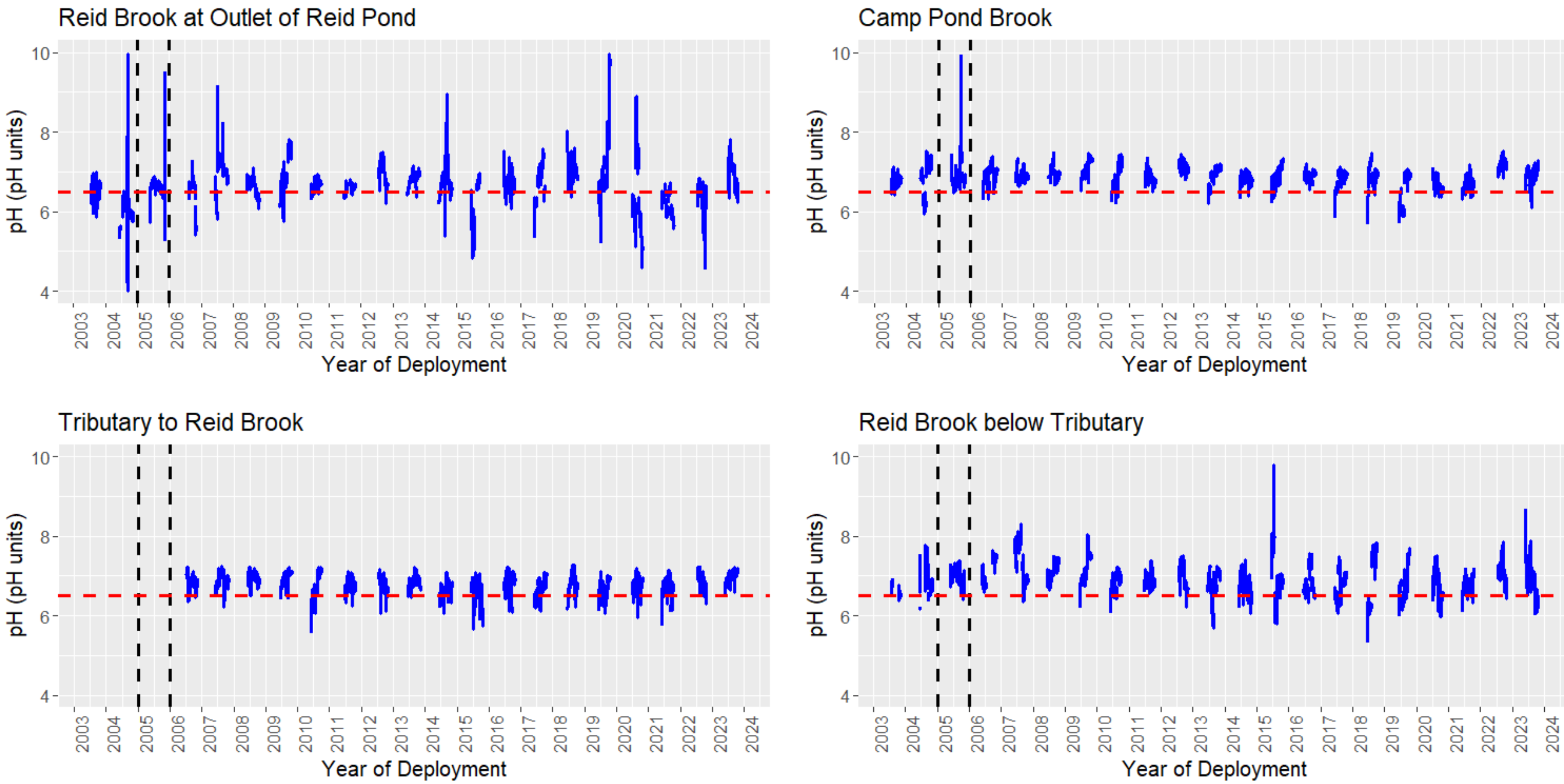
pH data collected during the operational phase (2006 to 2023) were also analyzed for temporal trends (Table 5). The analysis indicated that none of the four monitoring stations exhibited a statistically significant change in pH over this period. The only station that showed a difference between the construction and operational phases was Reid Brook below Tributary, where pH values shifted from a significant increasing trend during construction to no detectable trend during operations (p-value = 0.063, $\alpha = 0.05$).

Table 4: Trend Analysis of pH for Construction Phase 2003-2005

pH; Construction Phase 2003-2005				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.189	0.217	Data not sufficient at this stage	0.002
Spearman's rho	0.324	0.316		0.738
Parameter Count	18	17		16
Significant Level	0.05	0.05		0.05
Trend Result	No	No		Up

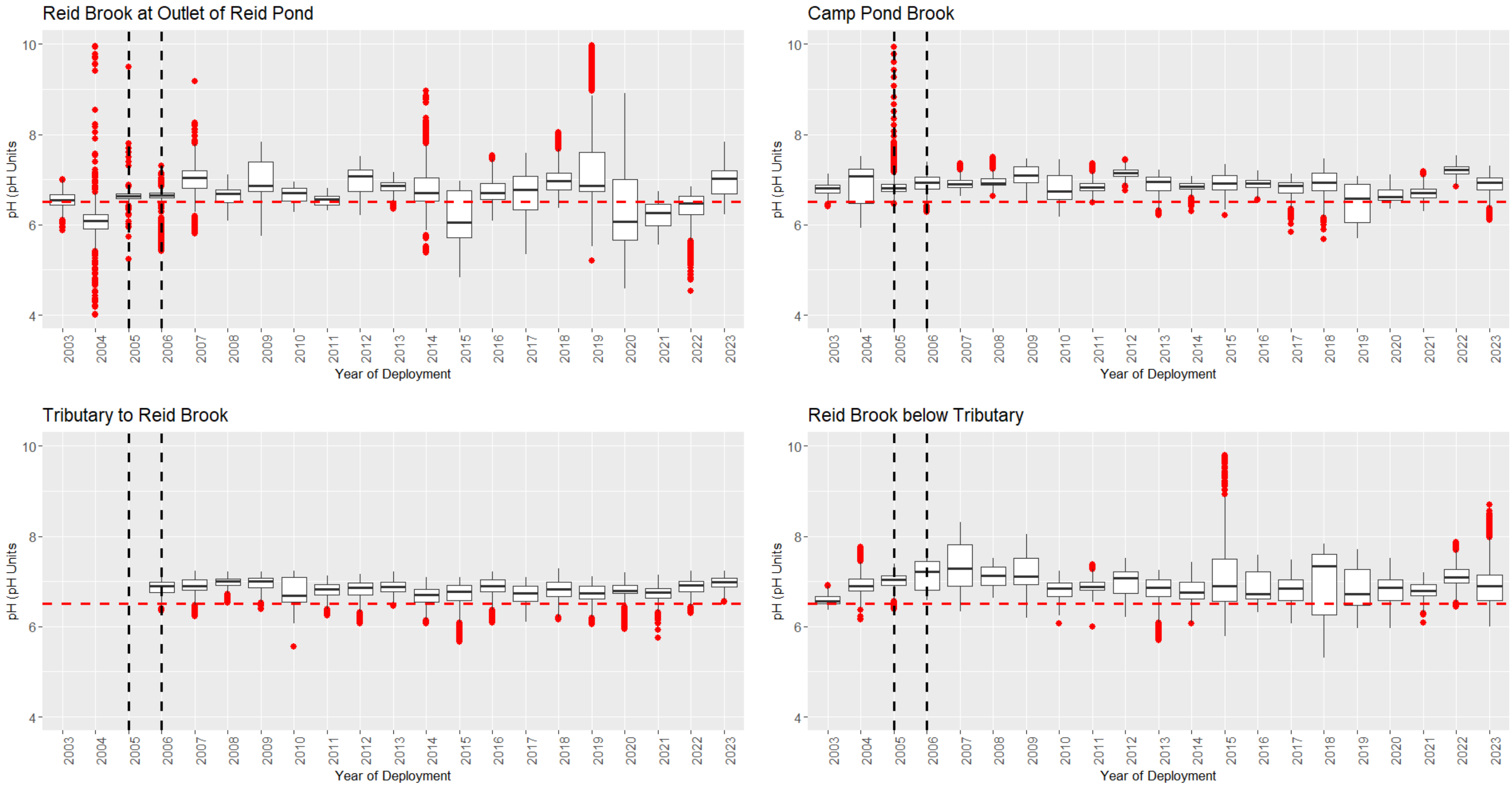
Table 5: Trend Analysis of pH for Operational Phase 2006-2023

pH; Operational Phase 2006-2023				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.236	0.066	0.851	0.153
Spearman's rho	-0.135	-0.198	0.024	-0.163
Parameter Count	78	78	78	78
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No



Note: *Red line is CCME Freshwater Aquatic Life for Cold Water Species minimum guideline value of 6.50 pH units

Figure 22: Voisey's Bay Real-Time Water Quality Monitoring Network: pH 2003-2023



Note: *Red line is CCME Freshwater Aquatic Life for Cold Water Species minimum guideline value of 6.50 pH units

Figure 23: Voisey's Bay Real-Time Water Quality Monitoring Network: pH Boxplots 2003-2023

Specific Conductivity

Specific conductivity is a measure of the ionic activity in a water body and reflects its capacity to conduct an electrical current. Elevated specific conductivity values indicate higher concentrations of dissolved minerals and ions, such as sodium and chloride. Specific conductivity is typically measured in microSiemens per centimeter (µS/cm) using standard water quality instrumentation. Changes in specific conductivity can influence aquatic ecosystems by altering water chemistry and habitat suitability. While specific conductivity is primarily governed by the underlying geologic conditions of a watershed, it can also be affected by anthropogenic activities, including roadway runoff, land clearing, and other land-use disturbances.

Over the twenty-year monitoring period, the highest annual median for specific conductivity was recorded at Camp Pond Brook below Camp Pond, with a value of 53.0 µS/cm in 2023. In contrast, the lowest annual median for specific conductivity was observed in 2006 at Reid Brook at outlet of Reid Pond, with a value of 5.9 µS/cm (Figure 25; Appendix B, Table B-1).

Reid Brook at the outlet of Reid Pond generally exhibited minimal variation in specific conductivity, including during precipitation events. At Tributary to Reid Brook and Reid Brook below Tributary, rainfall events commonly resulted in decreases in specific conductivity, likely due to dilution of dissolved solids associated with increased streamflow. In contrast, rainfall events at Camp Pond Brook below Camp Pond were often associated with short-term increases in specific conductivity. This response is attributed to overland flow transporting materials and suspended solids from the adjacent main camp area into the brook. Increases in specific conductivity of this nature are common at this station, and monitoring data indicate that values typically return to background levels shortly after the events (Figure 26).

During the construction phase of the mine's development (2003–2005), trend analysis of specific conductivity indicated no statistically significant correlations at any monitoring station, demonstrating that there were no significant increases over this period ($\alpha = 0.05$) (Table 6). Specific conductivity at Reid Brook at outlet of Reid Pond remained consistently low and stable during construction, with annual median values ranging from 6.7 to 8.6 µS/cm. In contrast, downstream stations exhibited higher annual median specific conductivity values during the same period. Values ranged from 20.3 to 23.6 µS/cm at Camp Pond Brook below Camp Pond and from 21.0 to 28.7 µS/cm at Reid Brook below Tributary.

During the operational phase of the mine's development, trend analysis identified a statistically significant upward trend in specific conductivity at three of the real-time monitoring stations: Reid Brook at Outlet of Reid Pond, Camp Pond Brook below Camp Pond, and Reid Brook below Tributary ($\alpha = 0.05$) (Table 7). As this increasing trend is observed across multiple stations within the monitoring network—including the baseline station at Reid Brook at Outlet of Reid Pond—it is interpreted as indicative of broader, regionally driven changes rather than site-specific effects. As such, the observed increases in specific conductivity do not appear to be attributable to mining operations.

During the operational phase of the mine's development, trend analysis identified a statistically significant downward trend in precipitation at Voisey's Bay over the period from 2007 to 2023 ($\alpha = 0.05$) (Table 8). Reduced precipitation can limit dilution of dissolved salts in the water column, which may contribute to increased specific conductivity. Accordingly, the observed decreasing precipitation trend is consistent with the concurrent increasing trends in specific conductivity identified at several monitoring stations. To further examine this relationship, specific conductivity has been plotted against precipitation for all stations (Figure 26).

Table 6: Trend Analysis of Specific Conductivity for Constructional Phase 2003-2005

Specific Conductivity: Construction Phase 2003-2005				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.148	0.680	Data not sufficient at this stage	0.961
Spearman's rho	0.366	0.112		0.013
Parameter Count	17	16		16
Significant Level	0.05	0.05		0.05
Trend Result	No	No		No

Table 7: Trend Analysis of Specific Conductivity for Operational Phase 2006-2023

Specific Conductivity: Operational Phase 2006-2023				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.0	0.0	0.093	0.0078
Spearman's rho	0.573	0.651	0.215	0.298
Parameter Count	78	78	78	78
Significant Level	0.05	0.05	0.05	0.05
Trend Result	Up	Up	No	Up

Table 8: Trend Analysis of Air Temperature and Precipitation for Operational Phase 2007-2023

Test Performed	Air Temperature	Precipitation
P- Value	0.628	0.0338
Spearman's rho	0.056	-0.238
Parameter Count	80	80
Significant Level	0.05	0.05
Trend Result	No	Down

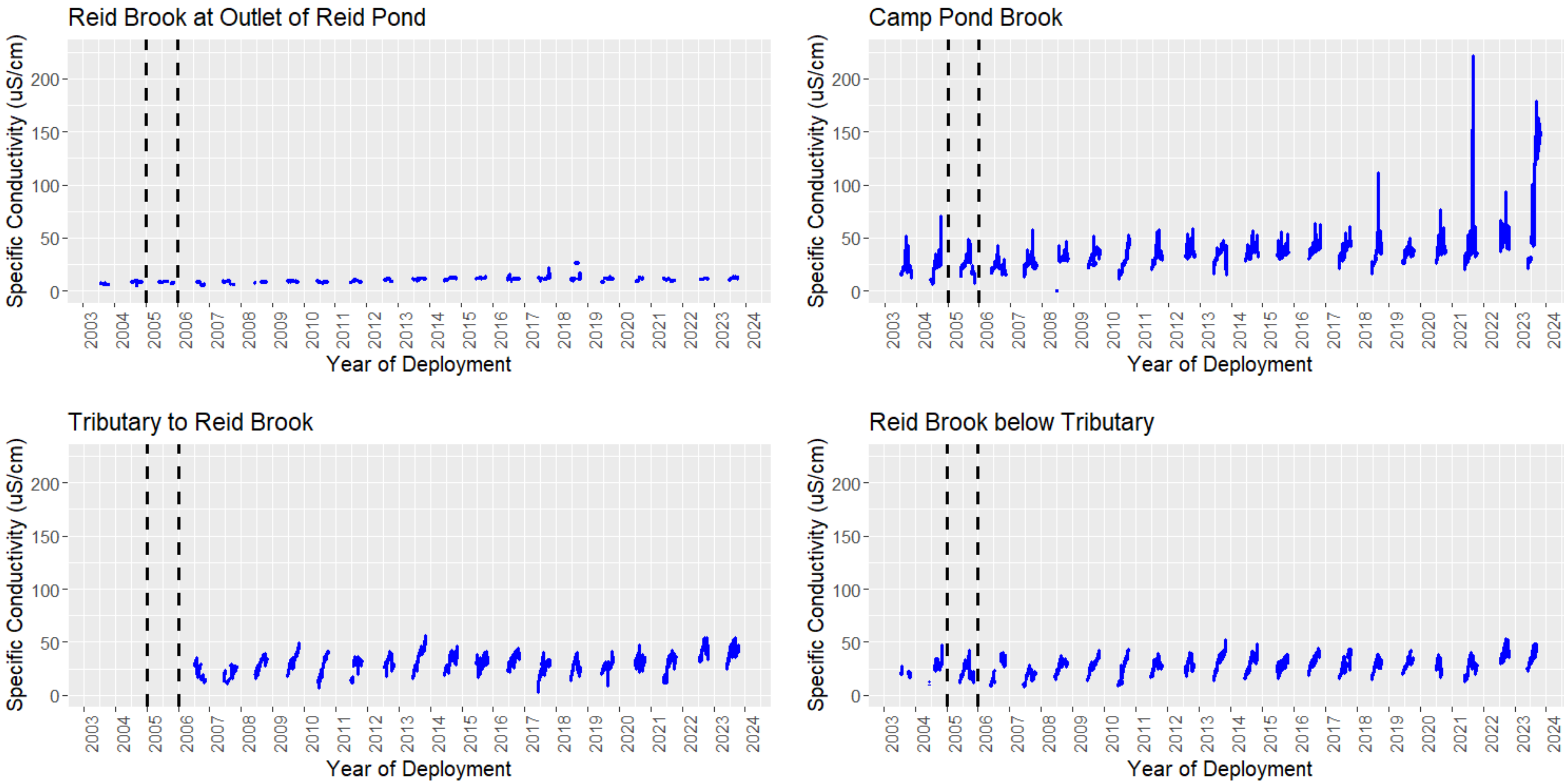


Figure 24: Voisey's Bay Real-Time Water Quality Monitoring Network: Conductivity 2003-2023

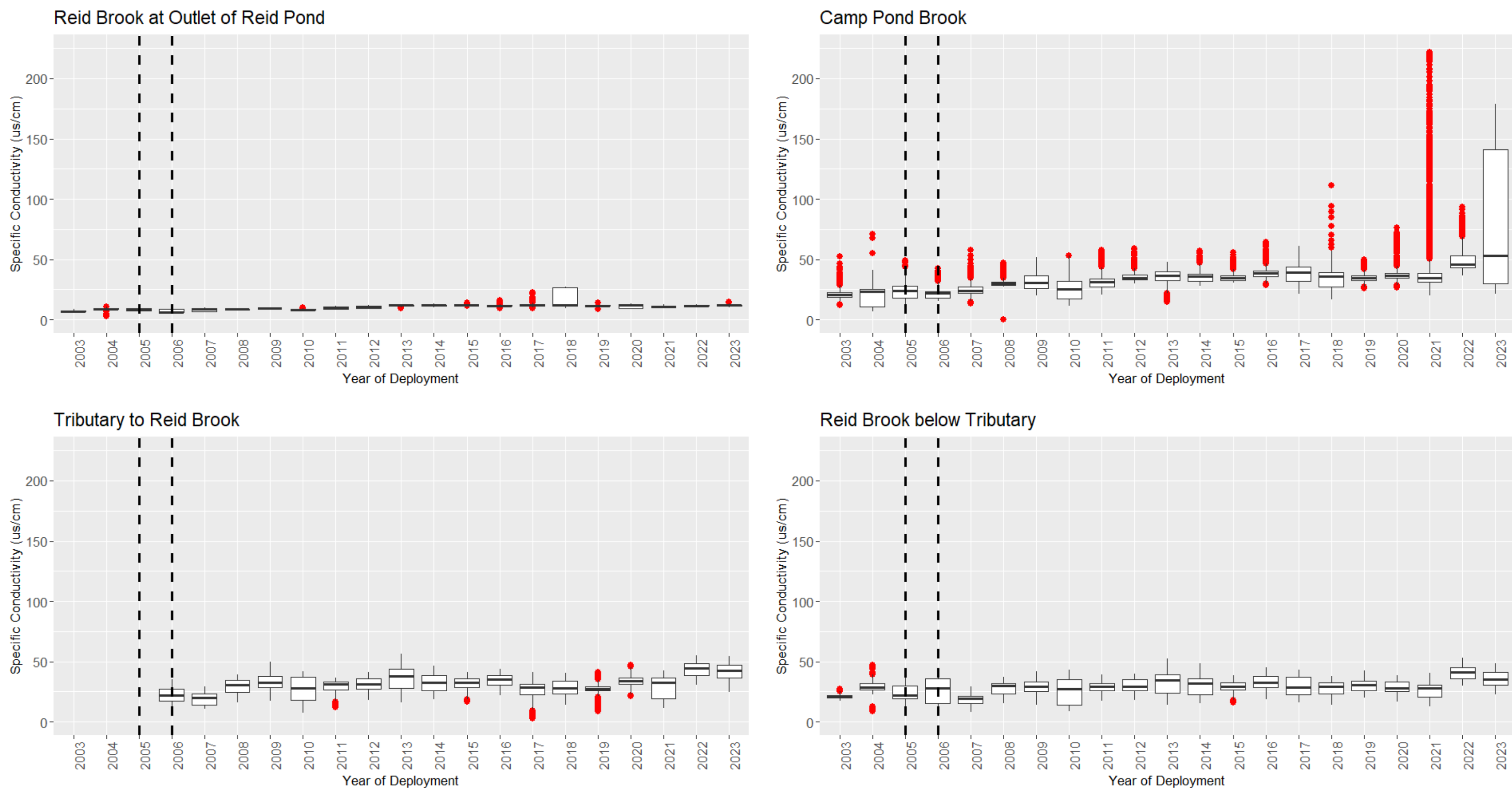


Figure 25: Voisey's Bay Real-Time Water Quality Monitoring Network: Conductivity Boxplots 2003-2023

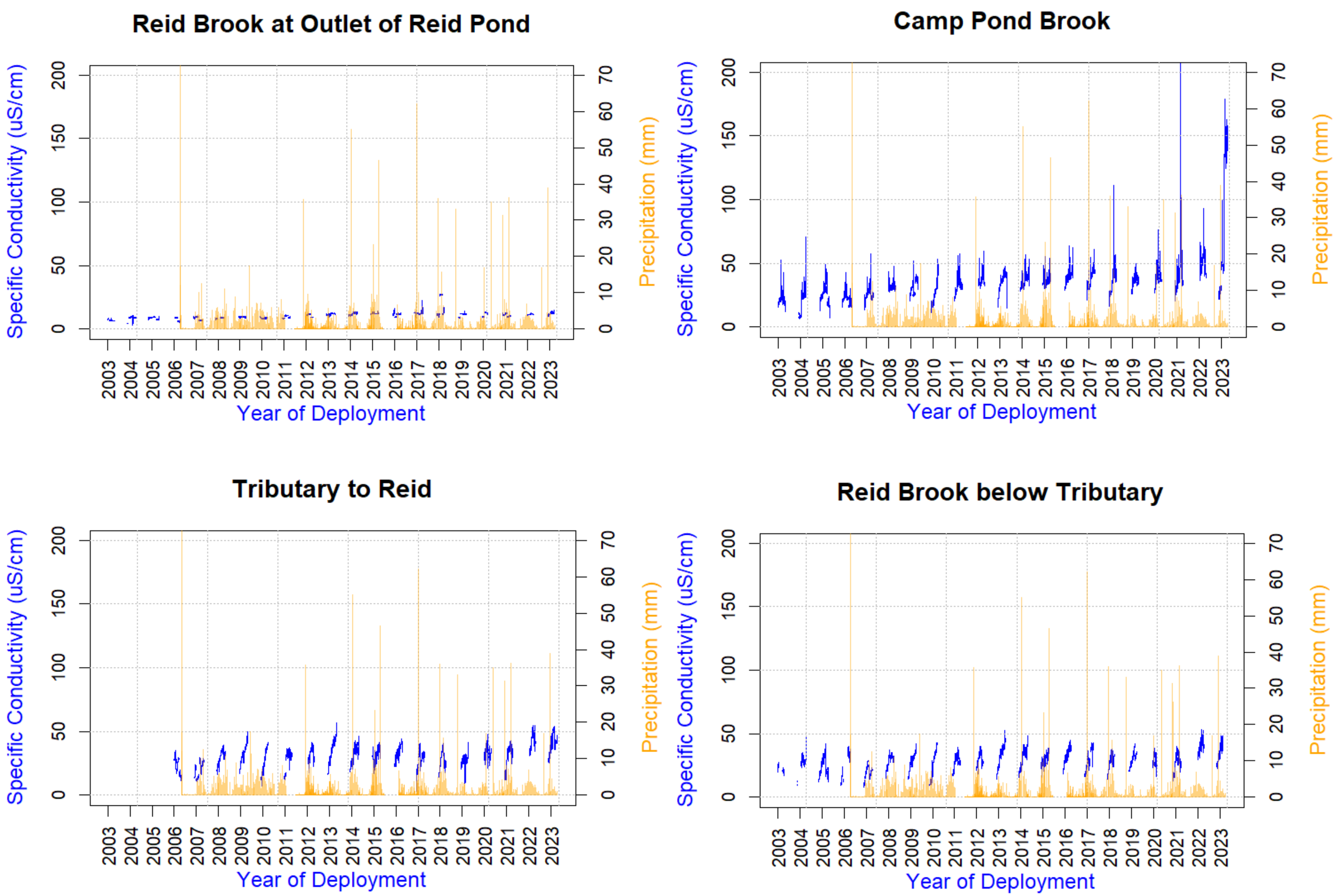


Figure 26: Voisey's Bay Real-Time Water Quality Monitoring Network: Conductivity versus Precipitation 2003-2023

Dissolved Oxygen

Dissolved oxygen (DO) is a measure of the concentration of oxygen present in the water column and is essential for the survival of most aquatic organisms in freshwater systems. Dissolved oxygen levels are influenced by several factors, including the presence and activity of aerobic organisms and aquatic plants, exposure to natural aeration processes such as waterfalls and riffles, as well as physical characteristics of the water body, including temperature, flow, and depth (HACH Hydrolab, 2006).

Dissolved oxygen concentrations typically exhibit a seasonal pattern that is inversely related to water temperature. During the spring and early summer, as water temperatures increase, dissolved oxygen concentrations generally decrease due to reduced oxygen solubility and increased biological activity. Conversely, in late Summer and into Fall, cooling water temperatures promote higher oxygen solubility, resulting in increased dissolved oxygen concentrations.

The Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life in cold-water environments specify that dissolved oxygen concentrations should remain above 9.5 mg/L for early life stages and above 6.5 mg/L for other life stages (CCME, 2014). Within the Voisey's Bay monitoring network, dissolved oxygen concentrations rarely fell below the 6.5 mg/L guideline when sensors were functioning properly. During most deployment seasons, dissolved oxygen concentrations occasionally decreased slightly below the 9.5 mg/L guideline coinciding with peak water temperatures, typically in early August (Figure 27). These short-term exceedances are generally temporary, and typical during warmer summer months, with dissolved oxygen levels returning to guideline values shortly thereafter.

Over the twenty-year monitoring period, the highest annual median dissolved oxygen concentration was recorded at Reid Brook at the outlet of Reid Pond, with a value of 12.53 mg/L in 2007. The lowest annual median dissolved oxygen concentration was observed in 2010 at Reid Brook below Tributary, with a value of 8.54 mg/L (Figure 28).

During the construction phase of the mine's development (2003–2005), trend analysis for dissolved oxygen indicated no statistically significant change at Reid Brook at the outlet of Reid Pond or at Reid Brook below Tributary ($\alpha = 0.05$). In contrast, analysis for Camp Pond Brook below Camp Pond identified a statistically significant increasing trend in dissolved oxygen concentrations during the construction phase ($\alpha = 0.05$), indicating increasing dissolved oxygen levels at this station (Table 9) which is beneficial to the waterbody.

During the operational phase of the mine's development, trend analysis for dissolved oxygen indicated no statistically significant trends at any of the monitoring stations within the Voisey's Bay network ($\alpha = 0.05$) (Table 10).

Table 9: Trend Analysis of Dissolved Oxygen for Constructional Phase 2003-2005

Dissolved Oxygen: Construction Phase 2003-2005				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.431	0.030	Data not sufficient at this stage	0.114
Spearman's rho	0.197	0.550		0.412
Parameter Count	18	16		16
Significant Level	0.05	0.05		0.05
Trend Result	No	Up		No

Table 10: Trend Analysis of Dissolved Oxygen for Operational Phase 2006-2023

Dissolved Oxygen: Operational Phase 2006-2023				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.99	0.118	0.981	0.071
Spearman's rho	-0.0014	0.169	0.0029	0.205
Parameter Count	78	78	78	78
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No

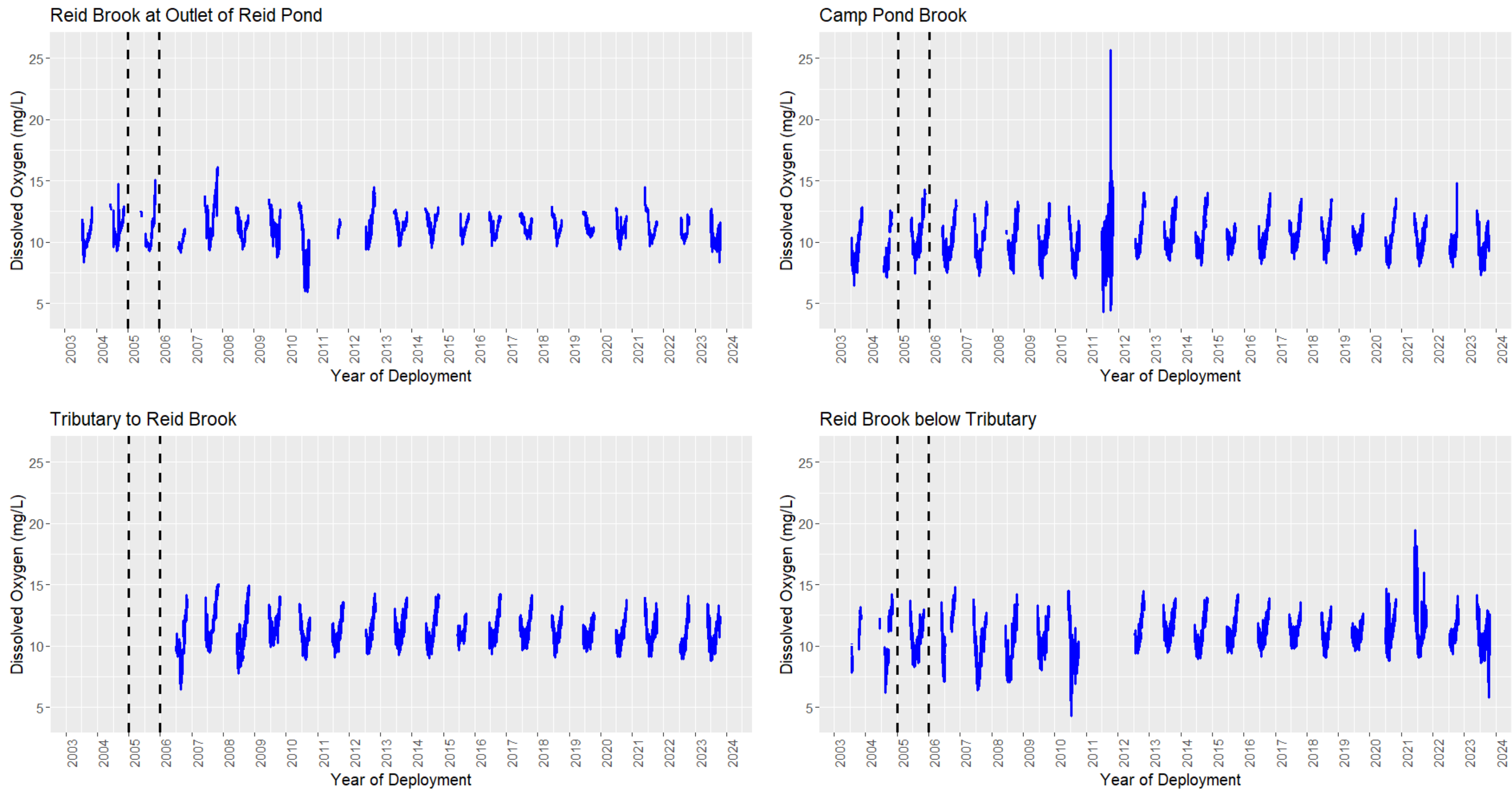


Figure 27: Voisey's Bay Real-Time Water Quality Monitoring Network: Dissolved Oxygen 2003-2023

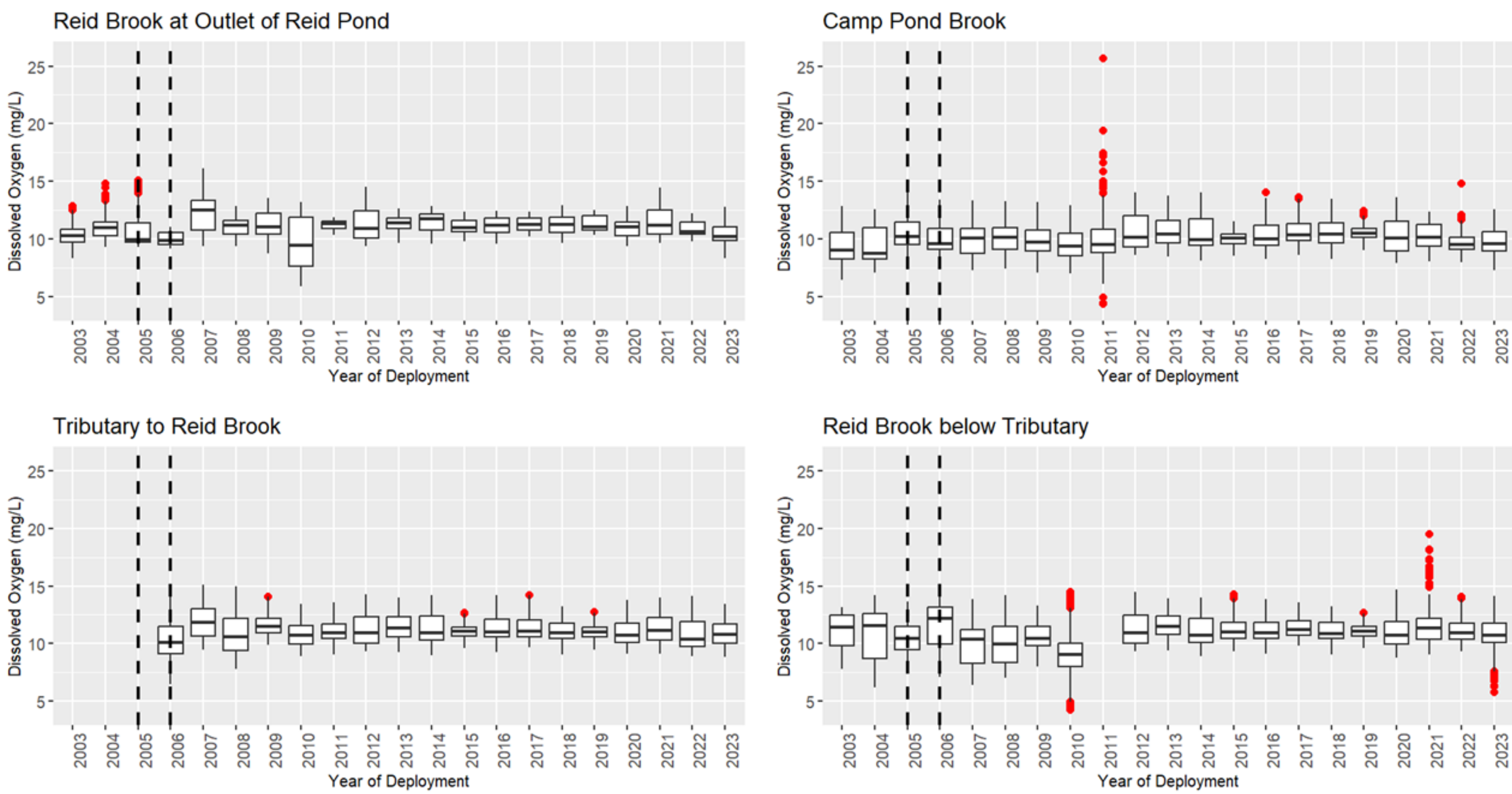


Figure 28: Voisey's Bay Real-Time Water Quality Monitoring Network: Dissolved Oxygen Boxplots 2003-2023

Turbidity

Turbidity is a measure of the clarity, or translucence, of water and reflects the concentration of suspended materials within the water column. It is commonly measured in nephelometric turbidity units (NTU). Elevated turbidity levels can adversely affect aquatic ecosystems by reducing light penetration, thereby limiting primary productivity, altering thermal structure, and impairing the diversity and distribution of aquatic organisms (HACH Hydrolab, 2006).

Results from the construction-phase trend analysis (2003–2005) indicated no statistically significant change in turbidity at Reid Brook at outlet of Reid Pond ($\alpha = 0.05$) (Table 11). This result was expected, as background turbidity at this station is minimal and no construction activities occur within the Reid Pond watershed. Similarly, no statistically significant change in turbidity was observed at this station during the operational phase of the mine's development (Table 12). Given the station's distance from the mine site, the absence of detectable turbidity changes is expected and represents a favourable outcome.

Camp Pond Brook below Camp Pond exhibited a statistically significant downward trend in turbidity during the construction phase of the mine's development, and this trend continued throughout the operational phase (2006–2023). Elevated and frequent turbidity spikes were recorded at this station in 2003, with most events occurring in September. Subsequent investigation by Voisey's Bay Environmental Coordinators determined that these exceedances were associated with a failure of sedimentation screens, which resulted in suspended materials not being adequately removed prior to discharge to Camp Pond Brook below Camp Pond. Corrective actions were implemented by Vale NL shortly after the issue was identified, and turbidity levels declined thereafter, contributing to the long-term decreasing trend observed at this station.

This incident demonstrated how the real-time monitoring network functions as an effective early warning system, providing valuable benefits to industry partners in safeguarding the surrounding aquatic environment. Without this network, the sedimentation issue may have gone undetected for a prolonged period, potentially resulting in significant adverse effects on water quality and the health of the surrounding ecosystem.

In 2004, it was determined that turbidity measurements at Reid Brook below Tributary were inconsistent due to disturbance of the sandy streambed, which affected instrument performance. To address this issue, a metal mounting frame was installed to elevate the instrument above the streambed and improve measurement reliability. Trend analysis indicated no statistically significant change in turbidity at this station during the construction phase of the mine's development. However, analysis of turbidity data collected during the operational phase (2006–2023) identified a statistically significant downward trend at Reid Brook below Tributary ($\alpha = 0.05$) (Table 12), indicating decreasing turbidity over time. This may be associated with shifting sand patterns in the area and the use of the metal frame to elevate the sonde, thereby reducing the potential for biofouling of the turbidity sensor.

Precipitation can influence waterbodies in many ways, depending on surrounding land characteristics, landscape features, geology, and streambed conditions. When rainfall occurs, water may travel considerable distances before draining into a waterbody. Along this path, it can accumulate sediment, debris, chemicals, and other materials. As a result, precipitation often increases the concentration of various substances through runoff, leading to elevated conductivity and turbidity.

In areas where surrounding vegetation limits the transport of additional materials, precipitation can instead have a diluting effect, reducing parameters such as pH and conductivity. However, precipitation is also essential for the natural "flushing" of waterbodies, helping to remove excess organic matter and sediment. During periods of low precipitation, reduced flow limits this process, allowing material to accumulate on the streambed. This buildup can smother substrates and promote biofouling and algal growth due to excess nutrients. When water levels rise again, accumulated material may become resuspended in the water column, influencing water quality parameters and monitoring results (Figure 31).

Analysis of turbidity data collected during the operational phase at Tributary to Reid Brook identified a statistically significant increasing trend, indicating that turbidity levels have increased over time at this station (α = 0.05) (Table 12). It is possible that upstream mining activity may be affecting the waterbody at this location. It is also possible that the decreasing precipitation trend during this timeframe may also be a factor. Decreasing precipitation decreases water levels in the waterbodies and prevents organic material and debris from flushing out of the system. When water levels rise due to rainfall, this material is resuspended and can increase the turbidity in the area.

Results from the Spearman Rank and Mann–Kendall trend analyses indicate that the environmental mitigation and protection measures implemented to control siltation associated with mining operations have been effective. These measures appear to be successfully preventing degradation of water quality in the surface water bodies surrounding the mine, as evidenced by stable or improving turbidity trends at most monitoring stations.

Table 11: Trend Analysis of Turbidity for Constructional Phase 2003-2005

Turbidity: Construction Phase 2003-2005				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.102	0.000	Data not sufficient at this stage	0.118
Spearman's rho	-0.456	-0.858		-0.406
Parameter Count	14	16		16
Significant Level	0.05	0.05		0.05
Trend Result	No	Down		No

Table 12: Trend Analysis of Turbidity for Operational Phase 2006-2023

Turbidity: Operational Phase 2006-2023				
Test Performed	**Reid Brook at Outlet**	**Camp Pond Brook**	**Tributary to Reid Brook**	**Reid Brook below Tributary**
P- Value	0.396	0.0083	0.0301	0.00098
Spearman's rho	-0.097	-0.282	0.275	-0.365
Parameter Count	78	78	78	78
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	Down	Up	Down

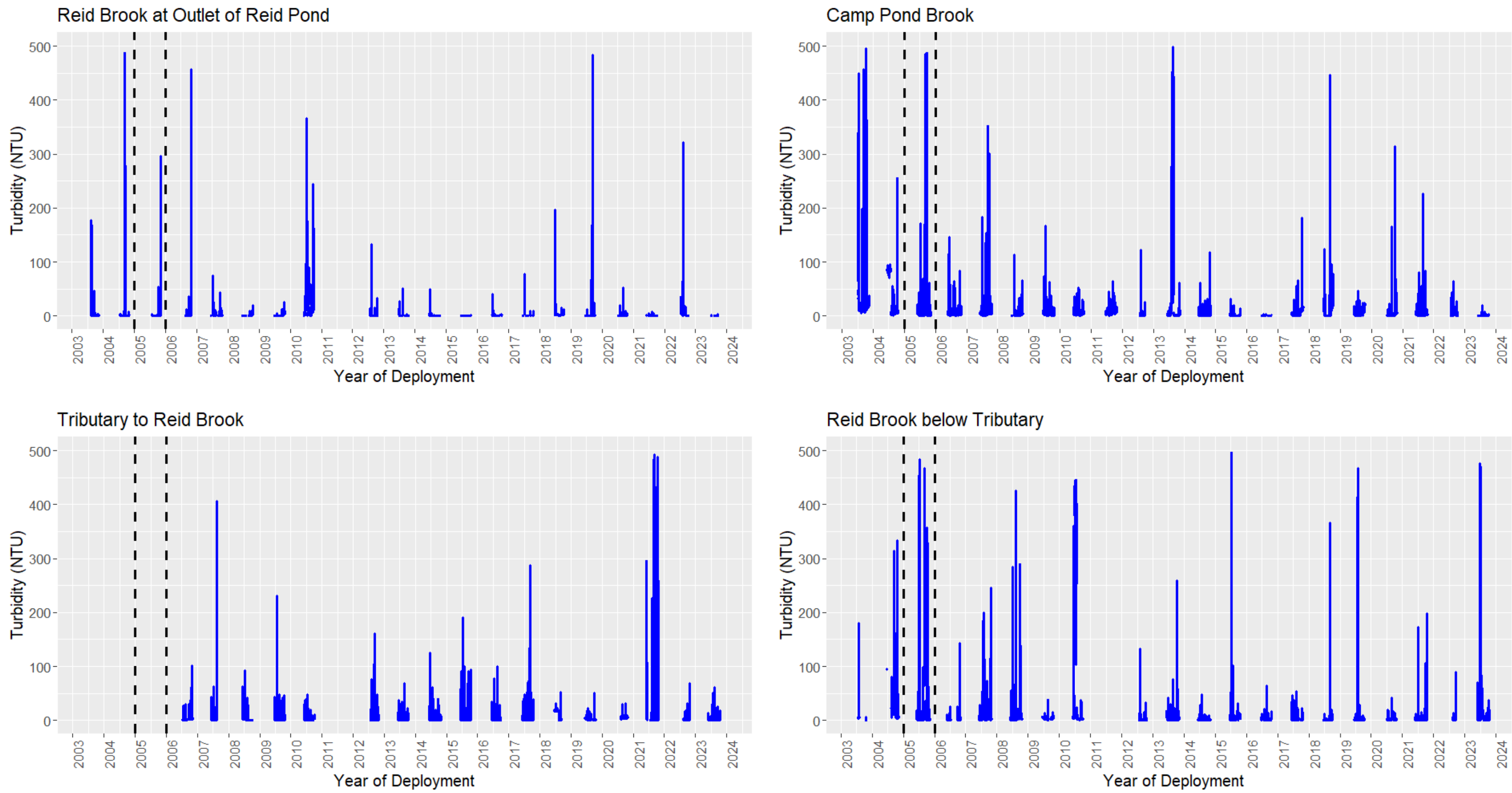


Figure 29: Voisey's Bay Real-Time Water Quality Monitoring Network: Turbidity 2003-2023

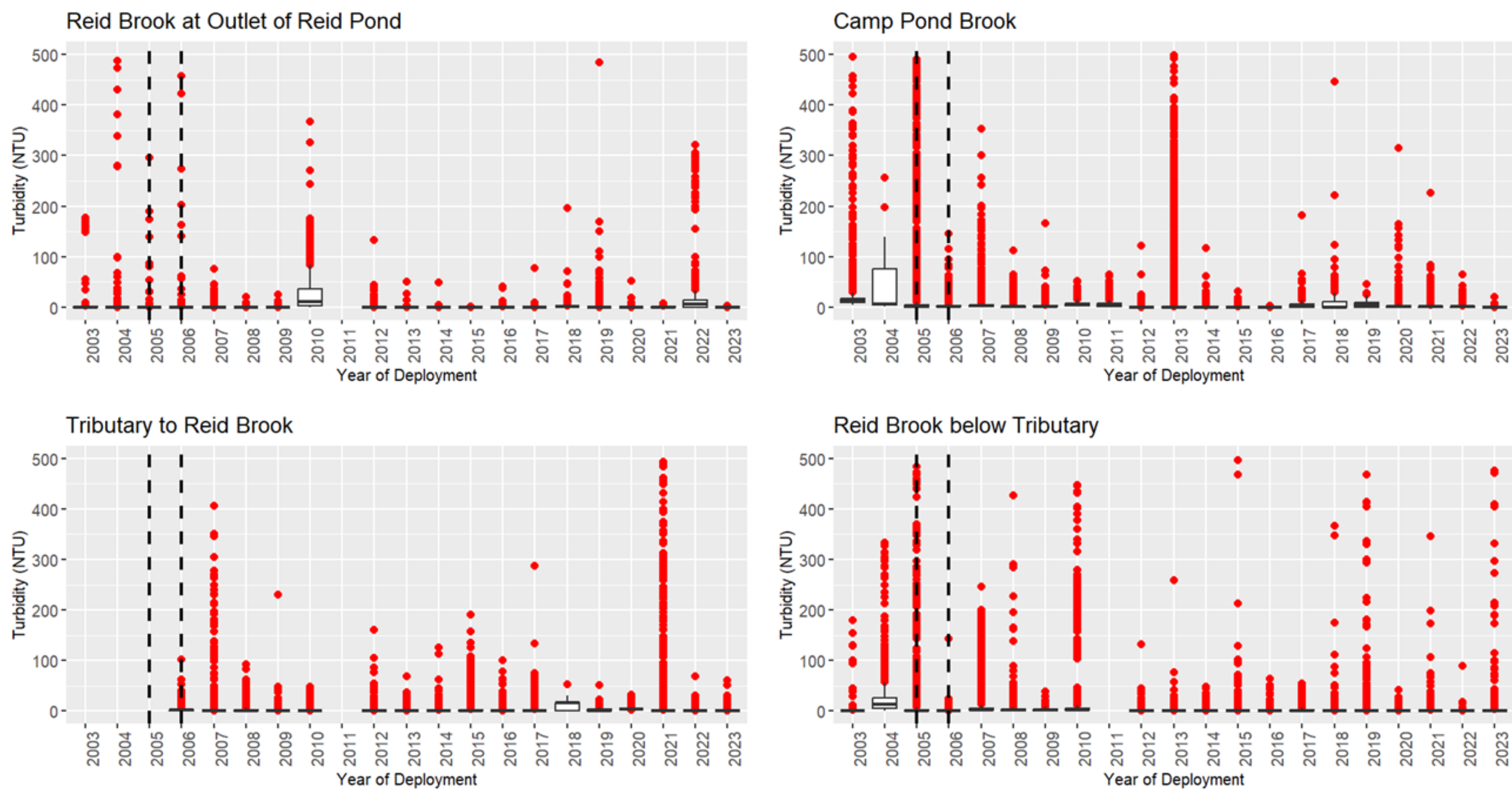


Figure 30: Voisey's Bay Real-Time Water Quality Monitoring Network: Turbidity Boxplots 2003-2023

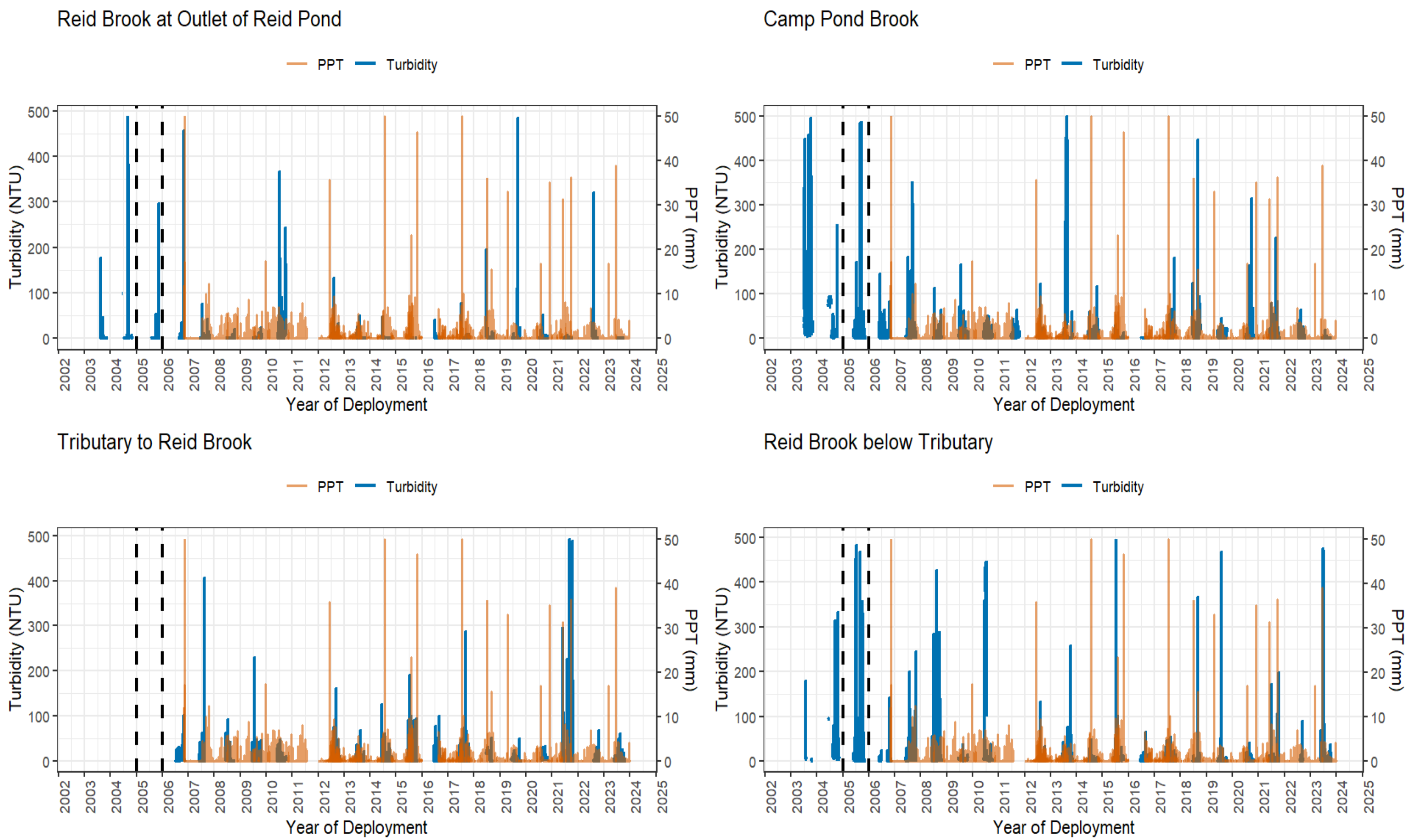


Figure 31: Voisey's Bay Real-Time Water Quality Monitoring Network: Turbidity & Precipitation 2003-2023

Grab Sample Data Review 2003-2023

Grab samples were collected during each instrument deployment as part of the RTWQ quality assurance and quality control (QA/QC) program and analyzed at an accredited laboratory. These samples were used to verify the accuracy and performance of the field and QA/QC sondes for pH, specific conductivity, and turbidity. In addition, grab samples provided analytical data for a range of physical parameters, major ions, nutrients, and metals. Over the 20-year monitoring period, a total of 309 grab samples were collected across the monitoring station network, as summarized below:

Table 13: Grab sample totals collected 2003-2023 for QA/QC of the RTWQ network at Voisey's Bay

Station	Number of Grab Samples Collected:
Reid Brook at Outlet of Reid Pond	85
Camp Pond Brook below Camp Pond	79
Tributary to Reid Brook	66
Reid Brook below Tributary	79
TOTAL:	309

Grab sample parameters at all monitoring stations were analyzed for temporal trends using Spearman Rank and Mann–Kendall trend analyses. Two timeframes were assessed: an initial period spanning 2003 to 2013 (the timeframe analyzed in the 10 year monitoring report) and the full monitoring record from 2003 to 2023. The combined results of these analyses are presented in Table 14.

Over the full 2003–2023 period, statistically significant trends (either increasing or decreasing, $\alpha = 0.05$) were detected for most parameters at one or more stations within the monitoring network. This represents a notable contrast to the 2003–2013 analysis, during which only ten parameters exhibited detectable trends. Only seven parameters—alkalinity, colour, turbidity, boron, ammonia, dissolved organic carbon (DOC), and zinc—exhibited no statistically significant trends at any of the four monitoring stations.

Seven parameters—specific conductivity, hardness, chloride, sodium, copper, nickel, and strontium—exhibited no statistically significant trends at the baseline station, Reid Brook at outlet of Reid Pond, which is located upstream of mine site activities. In contrast, these same parameters showed statistically significant increasing trends at all three downstream stations within the monitoring network. This spatial pattern suggests that conditions influencing these parameters occur downstream of the baseline station and may indicate an influence from mine-related activities at the lower stations. However, the potential contribution of other factors, such as regional geochemical variability or hydrologic processes, must also be considered when interpreting these trends.

Five parameters—pH, calcium, barium, magnesium, and uranium—exhibited consistent trends across all monitoring stations, including both upstream and downstream locations. The uniform nature of these trends throughout the monitoring network suggests that they are more likely associated with broader regional or climatic influences rather than site-specific effects related to mine activities.

Table 14 summarizes the trends identified in the grab sample data. Parameters discussed above that exhibited trends at multiple monitoring stations are examined further in the following section.

Table 14: Summary of QA/QC Grab Sample data trends: 2003-2013 and 2003-2023

QA/QC GRAB SAMPLE PARAMETER	Reid Brook at Outlet of Reid Pond		Camp Pond Brook below Camp Pond		Tributary to Reid Brook		Reid Brook below Tributary	
	2003 - 2013	2003 - 2023	2003 - 2013	2003 - 2023	2003 - 2013	2003 - 2023	2003 - 2013	2003 - 2023
Alkalinity (mg/l CaCO3)	Down	No	No	No	No	No	No	No
Color (TCU)	No	No	No	No	No	No	No	No
Conductivity (µS/cm)	No	No	Up	Up	No	Up	No	Up
Hardness (mg/l CaCO3)	No	No	Up	Up	No	Up	No	Up
pH	No	Up	No	Up	No	Up	No	Up
TDS (mg/l)	No	No	Up	Up	No	No	No	No
TSS	n/a	Down	n/a	No	n/a	No	n/a	No
Turbidity (NTU)	No	No	Down	No	No	No	Down	No
Boron (mg/l)	No	No	No	No	No	No	No	No
Bromide (mg/l)	No	No	No	No	No	Up	No	No
Calcium (mg/l)	No	Up	Up	Up	No	Up	No	Up
Chloride (mg/l)	No	No	No	Up	No	Up	No	Up
Fluoride (mg/l)	No	No	No	Down	No	No	No	No
Potassium (mg/l)	No	No	No	Up	No	No	No	Up
Sodium (mg/l)	No	No	No	Up	No	Up	No	Up
Sulphate (mg/l)	Down	Down	Up	Up	Up	Up	No	No
Ammonia (mg/l)	No	No	No	No	No	No	No	No
DOC	No	No	No	No	No	No	No	No
Nitrate(ite) (mg/l)	No	Up	No	No	No	Up	No	No
Kjeldahl Nitrogen (mg/l)	No	Down	No	No	No	No	No	No
Total Phosphorus (mg/l)	No	No	No	No	No	Up	No	No
Aluminum (mg/l)	Down	Down	Down	No	No	No	Down	No
Antimony (mg/l)	No	No	No	No	No	Up	No	No
Arsenic (mg/l)	No	No	No	No	No	Up	No	No
Barium (mg/l)	No	Up	No	Up	No	Up	No	Up
Cadmium (mg/l)	No	Down	No	No	No	Up	No	No
Chromium (mg/l)	No	No	No	Up	No	No	No	No
Copper (mg/l)	No	No	No	Up	No	Up	No	Up
Iron (mg/l)	Down	Down	No	No	No	No	No	No
Lead (mg/l)	No	No	No	No	No	Up	No	No
Magnesium (mg/l)	No	Up	No	Up	No	Up	No	Up
Manganese (mg/l)	No	Down	No	No	No	No	No	No
Nickel (mg/l)	No	No	Up	Up	No	Up	No	Up
Selenium (mg/l)	No	No	No	No	No	Up	No	No
Uranium (mg/l)	No	Up	No	Up	No	Up	No	Up
Zinc (mg/l)	No	No	No	No	No	No	No	No
TOC (mg/L)	n/a	Down	n/a	Down	n/a	Down	n/a	No
Strontium (mg/L)	n/a	No	n/a	Up	n/a	Up	n/a	Up

Increasing Trends at Lower Network Stations

Trend analysis identified a group of parameters that exhibited increasing trends exclusively at the Lower Reid monitoring stations—Camp Pond Brook below Camp Pond, Tributary to Reid Brook, and Reid Brook below Tributary—while no corresponding trends were observed at the upstream baseline station, Reid Brook at outlet of Reid Pond. These parameters include specific conductivity, hardness, chloride, sodium, copper, nickel, and strontium. The absence of trends at the Upper Reid Brook station, combined with consistent upwards trends downstream, suggests that these parameters may be influenced by mine site activities occurring within the lower portion of the monitoring network.

Increasing Trend: Specific Conductivity

Grab sample trend analysis for specific conductivity identified statistically significant increasing trends at the three lower Reid Brook monitoring stations (Figure 32). These findings are generally consistent with the increasing trends observed in the RTWQ data for Camp Pond Brook below Camp Pond and Reid Brook below Tributary. However, some discrepancies were noted between the two datasets. Specifically, Reid Brook at the outlet of Reid Pond exhibited an increasing trend in RTWQ data but no detectable trend in the grab sample data, while Tributary to Reid Brook showed no trend in RTWQ data but an increasing trend in grab sample results. Trend analysis of precipitation data (Table 8; Figure 26) identified a statistically significant decrease in precipitation over the past twenty years. Given the inverse relationship between precipitation and specific conductivity, the concurrent occurrence of decreasing precipitation and increasing specific conductivity is not unexpected and likely reflects broader hydrologic or climatic influences in the region.

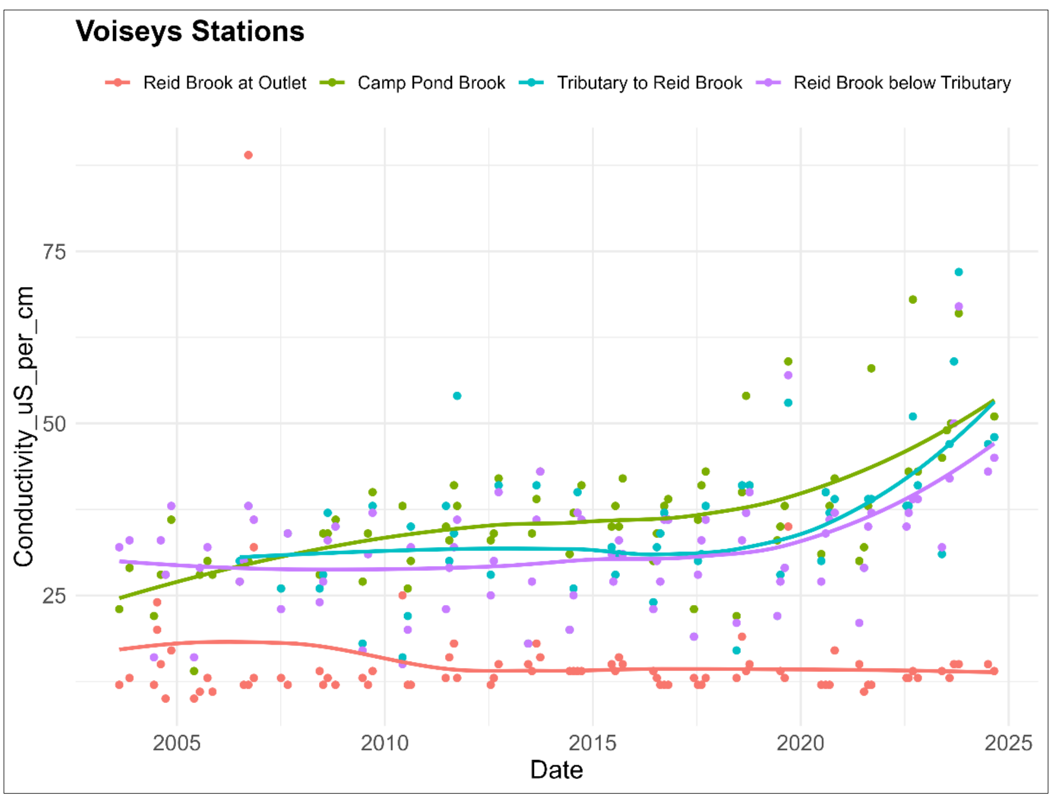


Figure 32: Grab sample results of Specific Conductivity trends for all stations, 2003-2023

Increasing Trend: Hardness (Calcium & Magnesium)

Grab sample trend analysis for hardness identified statistically significant increasing trends at the three lower Reid Brook monitoring stations (Figure 33). As water hardness is a function of calcium and magnesium concentrations, observed increases in water hardness were accompanied by increasing trends in both calcium and magnesium (Figures 34 and 35). However, calcium and magnesium exhibited increasing trends at all four monitoring stations, including the upstream baseline station. This spatially consistent pattern suggests that increases in these constituents are more likely driven by regional or climatic influences rather than anthropogenic inputs. Calcium and magnesium are naturally occurring elements that can increase in surface water through natural weathering processes, soil and groundwater inputs, and runoff under changing hydrologic conditions.

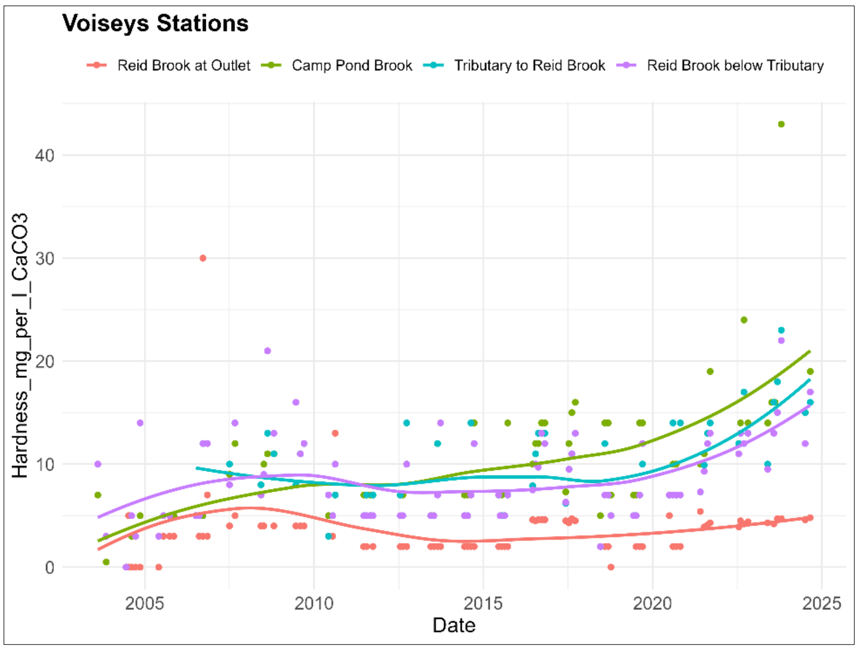


Figure 33: Grab sample results of Hardness trends for all stations, 2003-2023

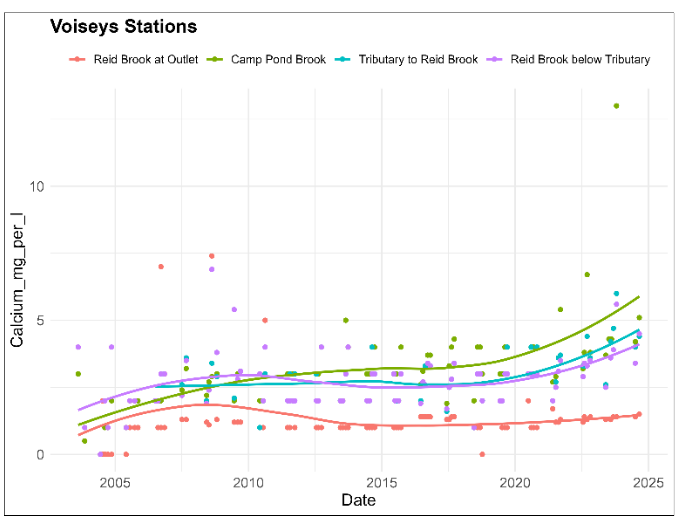


Figure 34: Grab sample results of Calcium Trends 2003-2023

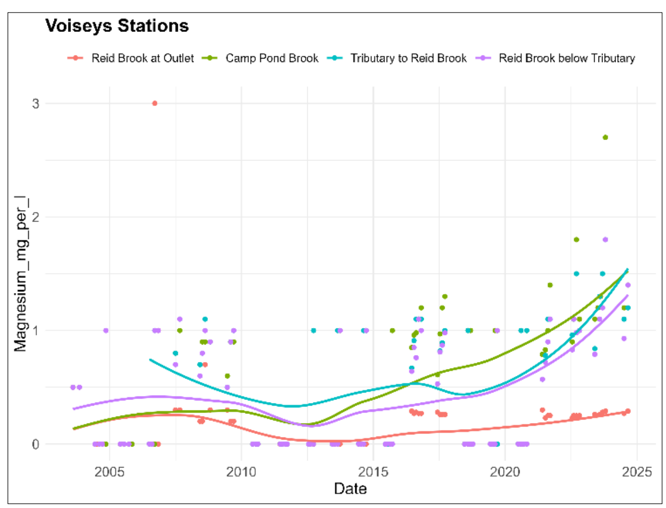


Figure 35: Grab sample results of Magnesium Trends 2003-2023

Increasing Trend: Chloride

Grab sample trend analysis for chloride identified statistically significant increasing trends at the three lower Reid Brook monitoring stations (Figure 37). In contrast, no corresponding trend was observed at the upstream baseline station, Reid Brook at outlet of Reid Pond. This spatial pattern suggests that increasing chloride concentrations may be influenced by anthropogenic sources downstream of the baseline location. Chloride is commonly associated with road salt application and wastewater inputs, both of which have the potential to affect stations located near and downstream of the Voisey's Bay mine site.

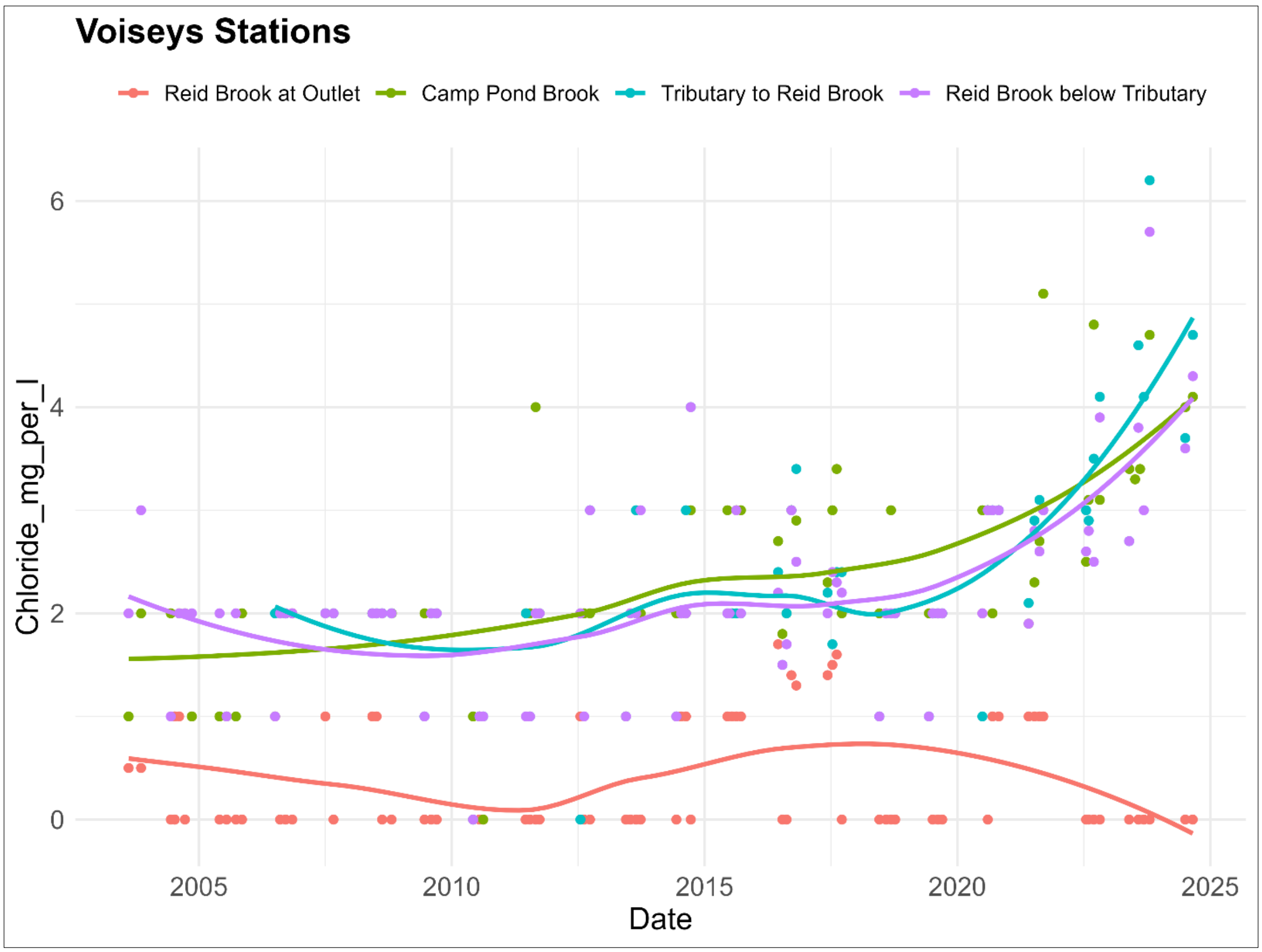


Figure 37: Grab sample results of Chloride trends for all stations, 2003-2023

Increasing Trend: Sodium

Grab sample trend analysis for sodium identified statistically significant increasing trends at the three lower Reid Brook monitoring stations (Figure 38). In contrast, no corresponding trend was observed at the upstream baseline station, Reid Brook at the outlet of Reid Pond. This spatial pattern suggests that increasing sodium concentrations may be influenced by anthropogenic sources downstream of the baseline location. Like chloride, sodium is commonly associated with road salt application and wastewater discharges, both of which have the potential to affect monitoring stations located near and downstream of the Voisey's Bay mine site.

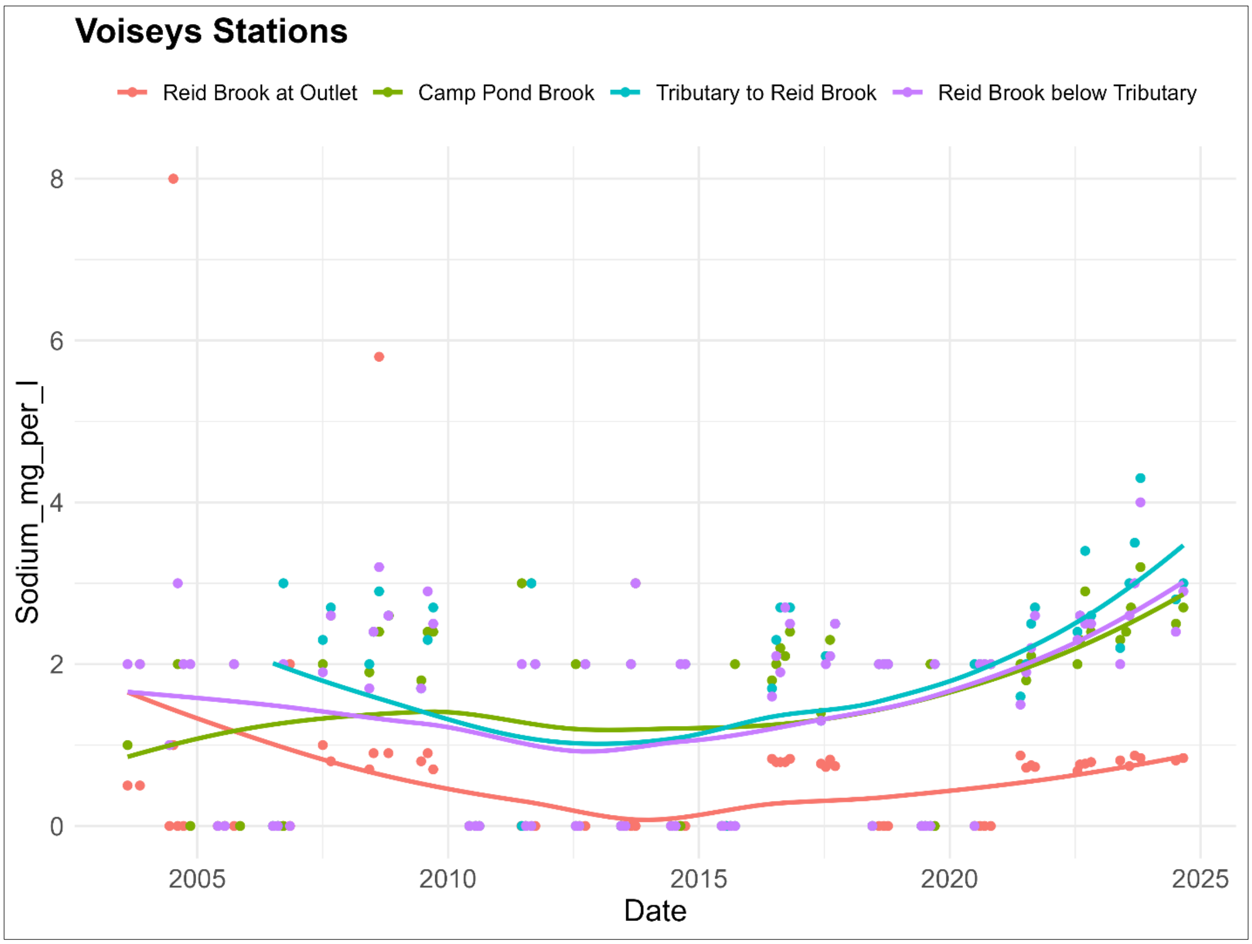


Figure 38: Grab sample results of Sodium trends for all stations, 2003-2023

Increasing Trend: Copper, Nickel, Strontium

Grab sample trend analysis identified statistically significant increasing trends for copper, nickel, and strontium at the three lower Reid Brook monitoring stations (Figure 39). Although the region is known to contain natural deposits of copper and nickel, other metals such as strontium also occur naturally in the environment. It is important to note that analytical detection limits for these metals have gradually decreased over the 20-year monitoring period, which may contribute to the apparent increasing trends observed across the monitoring network. This factor should be considered when interpreting long-term trends in trace metal concentrations.

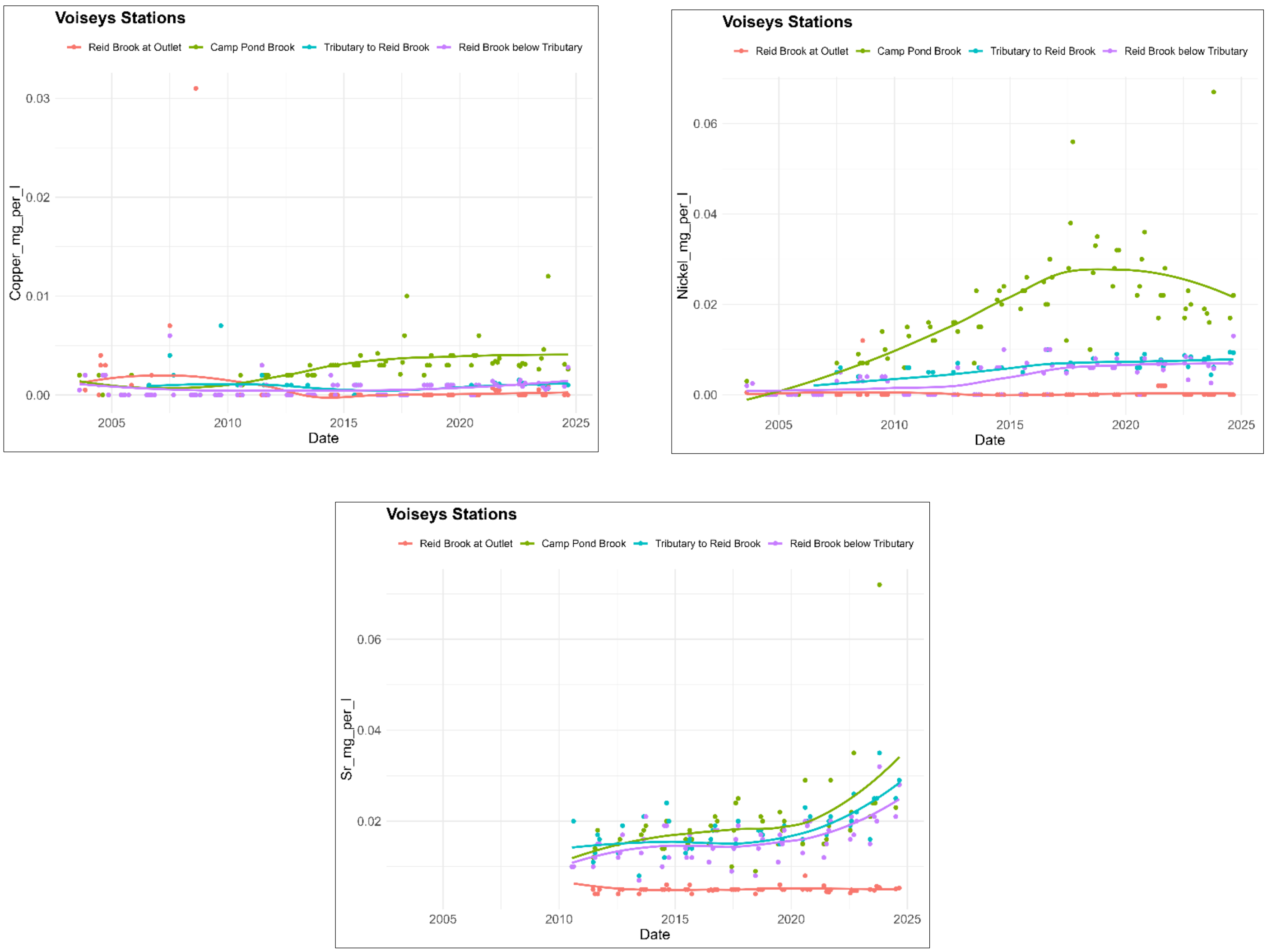


Figure 42: Grab sample results of various metal trends for all stations, 2003-2023

Increasing Trends at All Network Stations

The following parameters exhibited statistically significant increasing trends at all four monitoring stations, both upstream and downstream of the mine activity influence zone: pH, calcium, barium, magnesium, and uranium. The consistent occurrence of these trends across the entire monitoring network suggests that they are likely driven by regional or climatic factors rather than site-specific influences, particularly considering the decreasing precipitation trend identified earlier. Calcium and magnesium have been discussed previously in relation to their contribution to observed hardness trends. Analysis and interpretation of the remaining parameters are provided below.

Increasing Trend: pH

Trend analysis of grab sample data indicated statistically significant increasing trends in pH at all four monitoring stations within the Voisey's Bay network (Figure 36). This result contrasts with the RTWQ pH trend analysis, which identified no statistically significant trends at any RTWQ station (Table 5). This discrepancy is likely attributable to differences in data frequency and resolution between the two datasets, or the time-lag (up to a week) between collection and analysis for the grab samples as pH is in constant flux. Grab samples represent discrete measurements collected three to four times per year between spring and fall, whereas RTWQ monitoring records hourly pH measurements over a four- to five-month deployment period each year. As a result, RTWQ data captures a broader range of natural temporal variability in pH, which may dampen or obscure longer-term trends detected in the lower-frequency grab sample dataset.

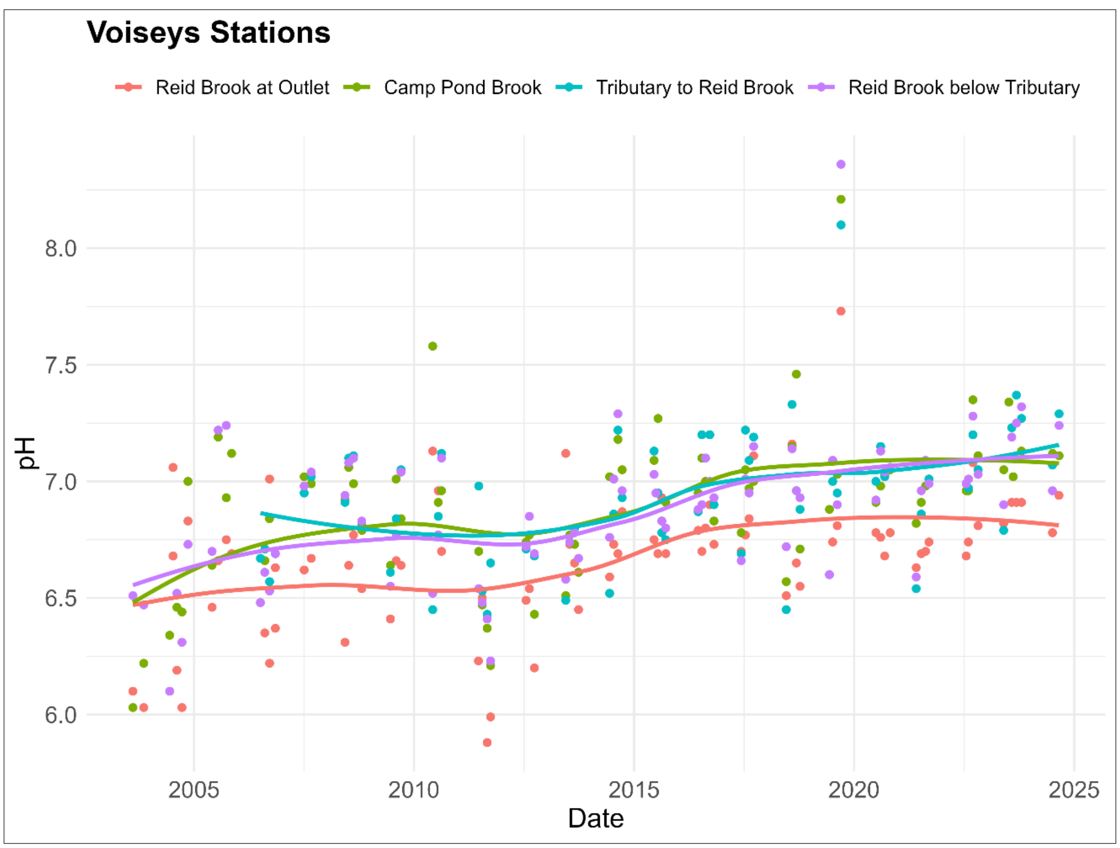


Figure 36: Grab sample results of pH trends for all stations, 2003-2023

Increasing Trend: Barium, Uranium

Like pH, trend analysis of grab sample data for barium and uranium identified statistically significant increasing trends for both parameters at all four monitoring stations (Figures 37 and 38). The presence of increasing trends at the upstream baseline station indicates that the observed increases across the network are likely driven by regional or climatic factors rather than mine-related influences. Processes such as freeze–thaw cycles, variations in precipitation, and enhanced weathering of bedrock and soils may contribute to increased mobilization and transport of naturally occurring elements, including barium and uranium, into freshwater systems. It is also important to note that analytical detection limits for these metals have progressively decreased over the 20-year monitoring period. This change may contribute to the apparent increasing trends observed across the monitoring network and should be taken into account when interpreting long-term trends in trace metal concentrations.

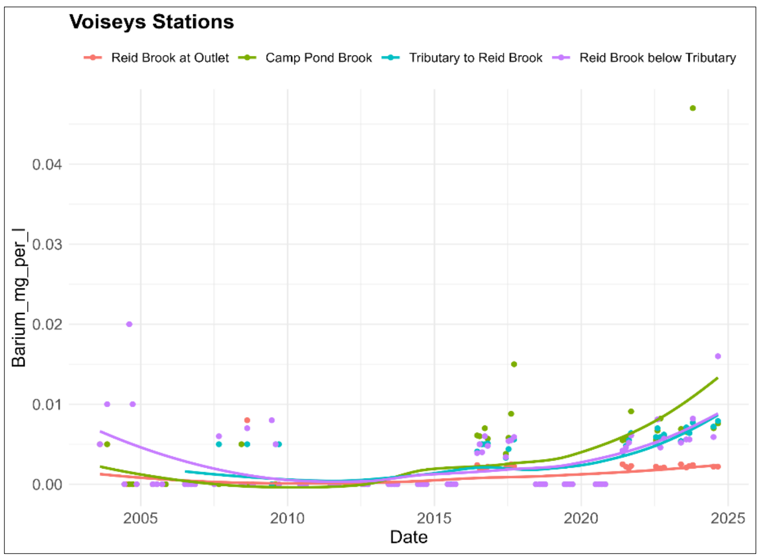


Figure 37: Grab sample results of Barium trends for all stations, 2003-2023

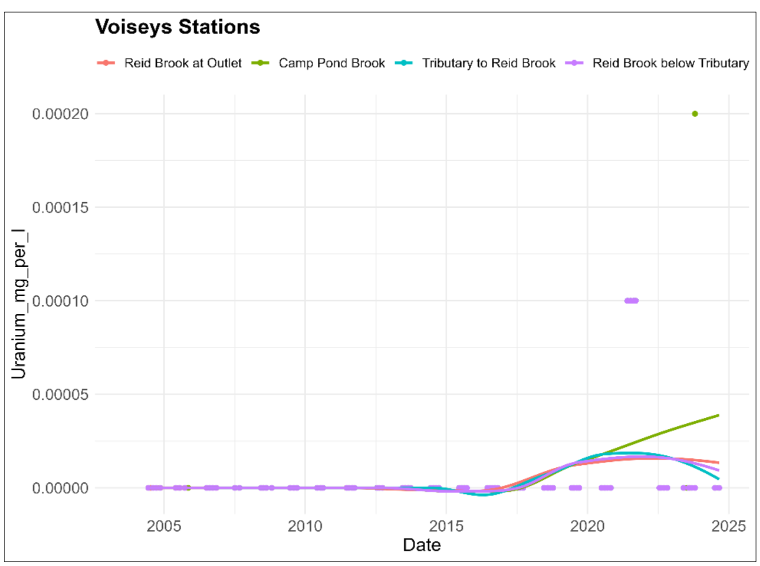


Figure 38: Grab sample results of Uranium trends for all stations, 2003-2023

Conclusions

This report represents the second long-term analysis and interpretation of real-time water quality (RTWQ) data collected through the Vale NL Voisey's Bay monitoring network since its establishment in 2003. The initial report evaluated the first ten years of monitoring data (2003–2013), while the present assessment extends the analysis to include the full 20-year data record from 2003 to 2023. The long-term datasets generated from both RTWQ in situ monitoring and associated QA/QC grab sampling have proven to be robust and effective for evaluating temporal trends and assessing changes in surface water quality over time. The monitoring network continues to support the proactive mitigation of potential impacts to the surrounding aquatic environment.

Based on statistical analyses, time-series evaluations, boxplot comparisons, and trend analyses, the results indicate that Vale NL Voisey's Bay operations have not resulted in significant adverse effects on the surface water environments monitored under this program . Although several parameters have exhibited increasing trends over the monitoring period, none can be conclusively attributed to mining activities upstream. Mineral extraction in the region occurs within a geological setting naturally enriched in metals, which can enter surface waters through natural processes such as rock weathering, freeze–thaw cycles, and erosion. In addition, observed changes in regional precipitation patterns may influence hydrologic conditions and enhance the natural transport of metals, nutrients, and other materials into surrounding watercourses. Collectively, the findings support the conclusion that observed water quality trends are primarily driven by natural and climatic factors rather than mine-related impacts.

Analysis of water temperature data indicated no statistically significant trends at either RTWQ monitoring station over the period of record. This result is somewhat unexpected given that northern climates are often cited as being particularly sensitive to climate change; however, no clear temperature-related signal is evident in the twenty-year Voisey's Bay dataset. Similarly, trend analysis of air temperature data for the 2007–2023 period did not identify any statistically significant trends. In contrast, precipitation data for the same period exhibited a statistically significant decreasing trend. These results suggest that changes in precipitation patterns, rather than temperature, may be the dominant climatic factor influencing observed changes in water quality conditions within the project area.

During the operational phase of the mine's development, trend analysis of RTWQ in situ data identified a statistically significant upward trend in specific conductivity at three of the four RTWQ stations ($\alpha = 0.05$), while no trend was detected at the remaining station (Table 7). The occurrence of increasing trends at most stations within the monitoring network, including the baseline station at Reid Brook at outlet of Reid Pond, indicates that this pattern is reflective of broader regional conditions rather than site-specific effects. In addition, the observed decrease in precipitation over the same period aligns with the well-established inverse relationship between precipitation and specific conductivity. Collectively, these findings suggest that the increasing trend in specific conductivity is more likely driven by climatic factors, particularly reduced precipitation, rather than by mining operations.

Trend analysis of RTWQ pH and dissolved oxygen data identified no statistically significant changes during the operational period (2006–2023). These results indicate that Vale NL Voisey's Bay operations have not measurably affected pH or dissolved oxygen concentrations within the monitored water bodies.

Analysis of RTWQ turbidity data indicated that Camp Pond Brook below Camp Pond was the only station to exhibit a discernible trend during the construction phase, characterized by a statistically significant downward trend. This result suggests that mitigation measures implemented at the Voisey's Bay site during construction, were effective in controlling runoff and reducing the input of suspended materials to adjacent waterways.

During the operational phase (2006–2023), turbidity at Camp Pond Brook below Camp Pond continued to exhibit a downward trend, and a similar decreasing trend was observed at Reid Brook below Tributary. In contrast, Reid Brook at outlet of Reid Pond showed no statistically significant trend, which is consistent with its location upstream of mine-related activities. Turbidity data from the Tributary to Lower Reid Brook exhibited an increasing trend during the operational phase. While this may suggest some anthropogenic influence at this location, the absence of corroborating trends at upstream and adjacent stations indicate that the increase may be related to regional or climatic factors rather than direct mining activities.

Overall, grab sample trend analyses indicate increasing metal concentrations in project-area waterways since 2003, with numerous parameters exhibiting upward trends at the three lower monitoring stations. In contrast, the upstream baseline station, Reid Brook at outlet of Reid Pond, showed relatively few increasing trends and several decreasing trends over the same period. This spatial pattern suggests that conditions affecting metal concentrations differ between the upper and lower portions of the monitoring network and may indicate some influence associated with downstream activities, including the mine site.

However, it is also plausible that the observed increases in metals reflect natural processes, such as enhanced weathering of bedrock and erosion driven by climatic or hydrologic changes. In this context, Reid Pond may be acting as a natural depositional sink for metals in the upper system, resulting in reduced concentrations in water exiting the pond at the outlet. Consequently, the combined influence of natural geochemical processes and site-specific factors should be considered when interpreting long-term metal trends within the project area.

It is notable that pH trend analyses derived from RTWQ in situ data and grab sample data yielded divergent results. Specifically, RTWQ data indicated no statistically significant pH trends at any monitoring station during the operational phase (2006–2023), whereas grab sample data showed statistically significant increasing pH trends at all four stations within the monitoring network. This discrepancy is likely attributable to differences in data volume and temporal resolution between the two monitoring approaches, or the effect of extended hold time on the grab samples which can affect the values over time. Grab samples represent discrete measurements collected only three to four times per year between spring and fall, while RTWQ monitoring provides hourly measurements over a four- to five-month deployment period annually. In addition, the hold-time for pH grab samples is short due to their state of constant flux which is affected by temperature and samples from Voisey's Bay cannot reach the accredited laboratory for a week or more, resulting in slight changes to values from when they were collected in-situ. Consequently, RTWQ data capture a more accurate, broader range of short-term natural variability in pH, which may moderate or obscure longer-term trends detected in the lower-frequency grab sample dataset. The provision of frequent, reliable data is a key benefit of the continuous real-time water quality monitoring network.

Overall, the results of the 20-year RTWQ data analysis indicate that Vale NL Voisey's Bay operations have been highly effective in preventing significant impairments to water quality within the surrounding Reid Brook watershed with the assistance of the real-time quality monitoring network. Given the scale, duration, and operational complexity of the project, this represents a considerable achievement in environmental management and stewardship. Watersheds associated with the RTWQ monitoring stations have remained relatively stable and largely unaffected by mining activities. Although the RTWQ dataset captures episodic water quality responses—such as spring freshet runoff and short-term turbidity increases—the data consistently demonstrate that water quality conditions typically recover to baseline levels within days to weeks following such events. The monitoring network will continue to provide transparency and act as an early warning system against any possible impairment to the aquatic environment in the Reid Brook watershed.

Vale NL Voisey's Bay's diligence and accountability in implementing the RTWQ program have provided an effective and robust means of tracking the health of surrounding waterbodies over a span of twenty years. Through consistent monitoring and data transparency, Vale NL Voisey's Bay operations have clearly demonstrated a strong commitment to environmental sustainability, stewardship, and the protection of local waterways. The findings presented in this report reflect a noteworthy level of environmental responsibility, and the conclusions drawn from the long-term data analysis represent a source of justified pride and achievement for Vale NL Voisey's Bay.

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APPENDIX A

Table A-1: Deployment season and period dates

Upper Reid Brook			Camp Pond			Lower Reid			Tributary		
Install	**Remove**	**days**	**Install**	**Remove**	**days**	**Install**	**Remove**	**days**	**Install**	**Remove**	**days**
16-Jul-03	11-Aug-03	26	16-Jul-03	11-Aug-03	26	16-Jul-03	11-Aug-03	26			
13-Aug-03	22-Sep-03	40	13-Aug-03	22-Sep-03	40	13-Aug-03	22-Sep-03	40			
23-Sep-03	11-Nov-03	49	23-Sep-03	11-Nov-03	49	23-Sep-03	11-Nov-03	49			
Total 2003		**115**			**115**			**115**			
13-Jun-04	18-Jun-04	5	13-Jun-04	11-Jul-04	28	13-Jun-04	18-Jun-04	5			
11-Jul-04	10-Aug-04	30	11-Jul-04	10-Aug-04	30	no deployment					
11-Aug-04	23-Sep-04	43	12-Aug-04	23-Sep-04	42	11-Aug-04	23-Sep-04	43			
24-Sep-04	12-Nov-04	49	24-Sep-04	16-Oct-04	22	24-Sep-04	12-Nov-04	49			
Total 2004		**127**			**122**			**97**			
31-May-05	20-Jul-05	50	31-May-05	20-Jul-05	50	31-May-05	20-Jul-05	50			
21-Jul-05	25-Sep-05	66	21-Jul-05	25-Sep-05	66	21-Jul-05	25-Sep-05	66			
26-Sep-05	9-Nov-05	44	26-Sep-05	9-Nov-05	44	26-Sep-05	9-Nov-05	44			
Total 2005		**160**			**160**			**160**			
no deployment			26-May-06	5-Jul-06	40	26-May-06	5-Jul-06	40			
no deployment			6-Jul-06	11-Aug-06	36	6-Jul-06	11-Aug-06	36	6-Jul-06	11-Aug-06	36
11-Aug-06	18-Sep-06	38	12-Aug-06	18-Sep-06	37	11-Aug-06	18-Sep-06	38	12-Aug-06	18-Sep-06	37
20-Sep-06	7-Nov-06	48	19-Sep-06	7-Nov-06	49	20-Sep-06	7-Nov-06	48	20-Sep-06	7-Nov-06	48
Total 2006		**86**			**162**			**162**			**121**
7-Jun-07	2-Jul-07	25	7-Jun-07	2-Jul-07	25	7-Jun-07	2-Jul-07	25	7-Jun-07	2-Jul-07	25
4-Jul-07	20-Aug-07	47	4-Jul-07	20-Aug-07	47	4-Jul-07	20-Aug-07	47	4-Jul-07	20-Aug-07	47
1-Sep-07	3-Nov-07	63	1-Sep-07	3-Nov-07	63	1-Sep-07	3-Nov-07	63	1-Sep-07	3-Nov-07	63
Total 2007		**135**			**135**			**135**			**135**
7-Jun-08	7-Jul-08	30	7-Jun-08	7-Jul-08	30	7-Jun-08	7-Jul-08	30	7-Jun-08	7-Jul-08	30
8-Jul-08	17-Aug-08	40	8-Jul-08	17-Aug-08	40	8-Jul-08	17-Aug-08	40	8-Jul-08	17-Aug-08	40
20-Aug-08	24-Oct-08	65	20-Aug-08	26-Oct-08	67	20-Aug-08	24-Oct-08	65	20-Aug-08	24-Oct-08	65
Total 2008		**135**			**137**			**135**			**135**
19-Jun-09	6-Aug-09	48	20-Jun-09	5-Aug-09	46	19-Jun-09	6-Aug-09	48	19-Jun-09	6-Aug-09	48
8-Aug-09	12-Sep-09	35	8-Aug-09	12-Sep-09	35	9-Aug-09	12-Sep-09	34	8-Aug-09	12-Sep-09	35
15-Sep-09	27-Oct-09	42	15-Sep-09	27-Oct-09	42	15-Sep-09	27-Oct-09	42	15-Sep-09	27-Oct-09	42
Total 2009		**125**			**123**			**124**			**125**
5-Jun-10	20-Jul-10	45	5-Jun-10	20-Jul-10	45	5-Jun-10	20-Jul-10	45	5-Jun-10	20-Jul-10	45
21-Jul-10	16-Aug-10	26	21-Jul-10	16-Aug-10	26	21-Jul-10	16-Aug-10	26	21-Jul-10	16-Aug-10	26
17-Aug-10	11-Oct-10	55	17-Aug-10	11-Oct-10	55	17-Aug-10	12-Oct-10	56	17-Aug-10	12-Oct-10	56
Total 2010		**126**			**126**			**127**			**127**
19-Jun-11	20-Jul-11	31	22-Jun-11	20-Jul-11	28	22-Jun-11	20-Jul-11	28	22-Jun-11	20-Jul-11	28
21-Jul-11	30-Aug-11	40	21-Jul-11	30-Aug-11	40	21-Jul-11	30-Aug-11	40	21-Jul-11	30-Aug-11	40
31-Aug-11	27-Sep-11	27	31-Aug-11	27-Sep-11	27	31-Aug-11	27-Sep-11	27	31-Aug-11	27-Sep-11	27
28-Sep-11	28-Oct-11	30	28-Sep-11	28-Oct-11	30	28-Sep-11	28-Oct-11	30	28-Sep-11	28-Oct-11	30
Total 2011		**128**			**125**			**125**			**125**

Upper Reid Brook			Camp Pond			Lower Reid			Tributary		
19-Jul-12	15-Aug-12	27	19-Jul-12	15-Aug-12	27	19-Jul-12	15-Aug-12	27	19-Jul-12	15-Aug-12	27
15-Aug-12	24-Sep-12	40	15-Aug-12	24-Sep-12	40	15-Aug-12	24-Sep-12	40	15-Aug-12	24-Sep-12	40
26-Sep-12	4-Nov-12	39	26-Sep-12	4-Nov-12	39	26-Sep-12	4-Nov-12	39	26-Sep-12	4-Nov-12	39
Total 2012		**106**			**106**			**106**			**106**
13-Jun-13	15-Jul-13	32	13-Jun-13	15-Jul-13	32	13-Jun-13	15-Jul-13	32	13-Jun-13	15-Jul-13	32
16-Jul-13	24-Aug-13	39	16-Jul-13	24-Aug-13	39	16-Jul-13	24-Aug-13	39	16-Jul-13	24-Aug-13	39
25-Aug-13	26-Sep-13	32	25-Aug-13	26-Sep-13	32	25-Aug-13	26-Sep-13	32	25-Aug-13	26-Sep-13	32
27-Sep-13	6-Nov-13	40	27-Sep-13	7-Nov-13	41	27-Sep-13	5-Nov-13	39	27-Sep-13	5-Nov-13	39
Total 2013		**143**			**144**			**142**			**142**
12-Jun-14	15-Jul-14	33	12-Jun-14	15-Jul-14	33	12-Jun-14	15-Jul-14	33	12-Jun-14	15-Jul-14	33
16-Jul-14	20-Aug-14	36	16-Jul-14	20-Aug-14	36	16-Jul-14	20-Aug-14	36	16-Jul-14	20-Aug-14	36
20-Aug-14	23-Sep-14	35	20-Aug-14	23-Sep-14	35	20-Aug-14	23-Sep-14	35	20-Aug-14	23-Sep-14	35
24-Sep-14	5-Nov-14	43	24-Sep-14	5-Nov-14	43	24-Sep-14	5-Nov-14	43	24-Sep-14	5-Nov-14	43
Total 2014		**147**			**147**			**147**			**147**
16-Jun-15	18-Jul-15	32	16-Jun-15	18-Jul-15	32	16-Jun-15	18-Jul-15	32	16-Jun-15	18-Jul-15	32
18-Jul-15	18-Aug-15	30	19-Jul-15	18-Aug-15	29	19-Jul-15	18-Aug-15	29	19-Jul-15	18-Aug-15	29
19-Aug-15	19-Sep-15	30	19-Aug-15	19-Sep-15	30	19-Aug-15	19-Sep-15	30	19-Aug-15	19-Sep-15	30
21-Sep-15	23-Oct-15	32	21-Sep-15	23-Oct-15	32	21-Sep-15	23-Oct-15	32	21-Sep-15	23-Oct-15	32
Total 2015		**124**			**123**			**123**			**123**
16-Jun-16	16-Jul-16	30	16-Jun-16	16-Jul-16	30	16-Jun-16	16-Jul-16	30	16-Jun-16	16-Jul-16	30
17-Jul-16	15-Aug-16	29	17-Jul-16	15-Aug-16	29	17-Jul-16	15-Aug-16	29	17-Jul-16	15-Aug-16	29
16-Aug-16	19-Sep-16	34	16-Aug-16	19-Sep-16	34	16-Aug-16	19-Sep-16	34	16-Aug-16	19-Sep-16	34
20-Sep-16	25-Oct-16	35	20-Sep-16	25-Oct-16	35	20-Sep-16	25-Oct-16	35	20-Sep-16	25-Oct-16	35
Total 2016		**128**			**128**			**128**			**128**
7-Jun-17	12-Jul-17	35	7-Jun-17	12-Jul-17	35	7-Jun-17	12-Jul-17	35	7-Jun-17	12-Jul-17	35
13-Jul-17	12-Aug-17	31	13-Jul-17	12-Aug-17	31	13-Jul-17	12-Aug-17	31	13-Jul-17	12-Aug-17	31
13-Aug-17	18-Sep-17	37	13-Aug-17	18-Sep-17	37	13-Aug-17	18-Sep-17	37	13-Aug-17	18-Sep-17	37
19-Sep-17	23-Oct-17	35	19-Sep-17	23-Oct-17	35	19-Sep-17	23-Oct-17	35	19-Sep-17	23-Oct-17	35
Total 2017		**138**			**138**			**138**			**138**
17-Jun-18	4-Aug-18	48	17-Jun-18	4-Aug-18	48	17-Jun-18	4-Aug-18	48	17-Jun-18	4-Aug-18	48
5-Aug-18	8-Sep-18	34	5-Aug-18	8-Sep-18	34	5-Aug-18	8-Sep-18	34	5-Aug-18	8-Sep-18	34
9-Sep-18	9-Oct-18	30	9-Sep-18	9-Oct-18	30	9-Sep-18	9-Oct-18	30	9-Sep-18	9-Oct-18	30
Total 2018		**112**			**112**			**112**			**112**
10-Jun-19	6-Jul-19	26	10-Jun-19	6-Jul-19	26	10-Jun-19	6-Jul-19	26	10-Jun-19	6-Jul-19	26
7-Jul-19	13-Aug-19	37	7-Jul-19	13-Aug-19	37	7-Jul-19	13-Aug-19	37	7-Jul-19	13-Aug-19	37
14-Aug-19	14-Sep-19	31	14-Aug-19	14-Sep-19	31	14-Aug-19	14-Sep-19	31	14-Aug-19	14-Sep-19	31
14-Sep-19	16-Oct-19	32	14-Sep-19	16-Oct-19	32	14-Sep-19	16-Oct-19	32	14-Sep-19	16-Oct-19	32
Total 2019		**126**			**126**			**126**			**126**

Upper Reid Brook			Camp Pond			Lower Reid			Tributary		
29-Jun-20	7-Aug-20	39	29-Jun-20	7-Aug-20	39	29-Jun-20	7-Aug-20	39	29-Jun-20	7-Aug-20	39
9-Aug-20	8-Sep-20	30	8-Aug-20	8-Sep-20	31	9-Aug-20	8-Sep-20	30	8-Aug-20	8-Sep-20	31
11-Sep-20	26-Oct-20	45	11-Sep-20	26-Oct-20	45	11-Sep-20	26-Oct-20	45	11-Sep-20	26-Oct-20	45
Total 2020		**114**			**115**			**114**			**115**
30-May-21	10-Jul-21	42	30-May-21	10-Jul-21	42	30-May-21	10-Jul-21	42	30-May-21	10-Jul-21	42
11-Jul-20	14-Aug-21	35	11-Jul-20	14-Aug-21	35	11-Jul-20	14-Aug-21	35	11-Jul-20	14-Aug-21	35
16-Aug-21	11-Sep-21	27	16-Aug-21	11-Sep-21	27	16-Aug-21	11-Sep-21	27	16-Aug-21	11-Sep-21	27
13-Sep-21	19-Oct-21	37	13-Sep-21	19-Oct-21	37	13-Sep-21	19-Oct-21	37	13-Sep-21	19-Oct-21	37
Total 2021		**141**			**141**			**141**			**141**
16-Jul-22	6-Aug-22	21	16-Jul-22	6-Aug-22	21	16-Jul-22	6-Aug-22	21	16-Jul-22	6-Aug-22	21
7-Aug-22	13-Sep-22	37	7-Aug-22	13-Sep-22	37	7-Aug-22	13-Sep-22	37	7-Aug-22	13-Sep-22	37
13-Sep-22	26-Oct-22	43	13-Sep-22	26-Oct-22	43	13-Sep-22	26-Oct-22	43	13-Sep-22	26-Oct-22	43
Total 2022		**101**			**101**			**101**			**101**
26-May-23	1-Aug-23	67	27-May-23	8-Jul-23	42	26-May-23	1-Aug-23	67	26-May-23	1-Aug-23	67
1-Aug-23	9-Sep-23	39	8-Jul-23	13-Aug-23	36	1-Aug-23	9-Sep-23	39	1-Aug-23	9-Sep-23	39
9-Sep-23	21-Oct-23	42	13-Aug-23	21-Oct-23	69	9-Sep-23	21-Oct-23	42	9-Sep-23	21-Oct-23	42
Total 2023		**148**			**147**			**148**			**148**

Appendix B: Summary Statistics for Voisey's Bay Network By Year

Water Temperature

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2688	10.48	0.839	20.13	10.52
	2004	2919	8.60	0.639	16.23	8.39
	2005	3401	9.64	0	16.71	10.03
	2006	2039	9.86	3.70	14.93	9.86
	2007	3187	7.90	1.309	16.53	7.06
	2008	3247	9.68	1.929	18.40	9.75
	2009	2997	7.63	1.72	16.08	7.89
	2010	2809	10.10	1.529	20.59	11.18
	2011	2991	9.11	2.109	19.34	8.90
	2012	2436	9.37	0.04	16.79	10.03
	2013	3431	8.29	1.10	17.83	8.26
	2014	3358	8.93	2.21	19.25	7.68
	2015	3002	9.31	2.51	18.01	9.49
	2016	3017	9.33	1.47	15.77	9.79
	2017	3004	8.65	0.60	14.9	9.53
	2018	2646	8.59	1.37	15.97	9.33
	2019	3014	8.34	2.49	13.99	8.90
	2020	2730	11.15	4.17	20.62	10.93
	2021	3289	9.67	1.29	18.42	10.65
	2022	2334	11.30	5.67	18.36	12.15
	2023	2563	13.42	6.63	20.84	**14.27**
	2003-2023	**61102**	**9.49**	**0**	**20.84**	**9.75**
Camp Pond Brook below Camp Pond	2003	2409	11.65	0	24.27	11.82
	2004	2727	11.33	2.40	21.90	12.07
	2005	3774	10.51	-0.23	22.49	11.84
	2006	3844	10.79	-0.15	22.12	12.18
	2007	3201	10.02	-0.17	20.95	10.72
	2008	2652	11.18	-0.08	23.12	12.70
	2009	2865	10.13	-0.24	21.98	10.80
	2010	2896	12.43	2.90	23.20	12.50
	2011	2933	11.00	0.90	22.60	11.70
	2012	2524	10.90	0	20.67	12.13
	2013	3451	9.89	0.03	21.06	10.48
	2014	3335	11.01	0.06	22.90	12.06
	2015	2981	11.31	0.38	21.70	11.95
	2016	2906	11.11	0.07	22.02	12.00
	2017	3136	10.80	0.22	20.52	11.86
	2018	2635	11.16	1.18	21.42	11.34
	2019	2995	11.09	2.99	18.76	11.22
	2020	2746	12.31	0.16	23.45	13.00
	2021	3279	11.64	2.66	22.68	11.59
	2022	2425	11.40	1.09	20.36	12.54
	2023	3523	13.33	3.01	24.80	13.57
	2003-2023	**63237**	**11.19**	**-0.24**	**24.80**	**11.95**

Station	Year	N	Mean	Minimum	Maximum	Median
Tributary to Reid Brook	2003	Station Not Installed Until 2006				
	2004					
	2005					
	2006	2796	8.88	0	16.88	10.09
	2007	3199	7.96	-0.17	16.36	8.32
	2008	3253	9.39	-0.13	18.15	10.57
	2009	2934	8.12	-0.10	16.30	8.90
	2010	2876	10.08	1.90	18.30	9.75
	2011	2997	8.42	1.50	16.10	8.80
	2012	2528	8.87	0	16.30	9.20
	2013	3413	7.65	0	16.40	7.90
	2014	3405	8.45	0	18.30	9.10
	2015	3021	8.53	0	15.70	9.10
	2016	3064	8.29	0	15.70	9.30
	2017	3230	8.39	0	14.50	9.30
	2018	2689	8.83	1.70	17.40	9.20
	2019	3013	9.01	3.30	15.10	9.20
	2020	2763	9.84	0.20	17.40	10.60
	2021	3297	9.44	1.30	17.70	9.90
	2022	2404	8.97	0.04	15.10	9.60
	2023	3544	10.27	1.88	17.63	10.29
	2003-2023	**54426**	**8.86**	**-0.17**	**18.30**	**9.25**
Reid Brook below Tributary	2003	886	4.895	-0.16	17.94	**2.37**
	2004	2208	6.0746	-0.10	18.2	5.22
	2005	3778	8.8506	-0.20	19.66	9.595
	2006	2182	6.395	-0.21	16.21	5.77
	2007	3194	7.851	-0.18	17.6	7.73
	2008	3232	9.5839	-0.20	19.09	10.6
	2009	2805	7.9383	-0.24	15.41	8.61
	2010	2872	9.8765	1.75	19.96	9.74
	2011	2905	8.5976	1.30	19.59	8.67
	2012	2436	9.3747	0.04	16.79	10.025
	2013	3398	7.8818	0.19	16.68	8.12
	2014	3423	8.77	0.15	19.44	9.26
	2015	2959	8.90	0.16	16.11	9.39
	2016	3012	8.72	0.19	17.34	9.52
	2017	2853	8.46	0.17	16.81	9.21
	2018	2687	9.13	1.86	18.02	9.39
	2019	3013	9.05	3.40	15.20	9.21
	2020	2725	10.20	0.17	20.12	10.71
	2021	3294	9.58	1.44	19.01	9.67
	2022	2405	9.39	0.01	18.06	10.15
	2023	3537	11.07	2.04	21.87	11.09
	2003-2023	**59804**	**8.60**	**-0.24**	**21.87**	**9.39**

pH

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2687	6.55	5.87	7.00	6.54
	2004	2619	6.08	5.31	7.17	6.11
	2005	3461	6.64	5.73	7.40	6.63
	2006	2039	6.53	5.42	7.30	6.65
	2007	3186	6.97	5.81	8.25	7.03
	2008	3247	6.63	6.08	7.11	6.68
	2009	2996	7.00	5.75	7.83	6.86
	2010	2809	6.68	6.28	6.95	6.71
	2011	2025	6.54	6.31	6.81	6.56
	2012	2439	7.00	6.21	7.51	7.07
	2013	3418	6.83	6.35	7.16	6.86
	2014	2781	6.79	5.38	8.96	6.70
	2015	1499	6.18	4.83	6.96	**6.05**
	2016	2967	6.76	6.08	7.54	6.71
	2017	2487	6.74	5.34	7.58	6.78
	2018	2646	6.97	6.36	8.04	6.96
	2019	3013	7.10	5.21	10.05	6.86
	2020	2730	6.25	4.59	8.91	6.06
	2021	3288	6.21	5.56	6.74	6.26
	2022	2319	6.33	4.53	6.85	6.48
	2023	2563	6.97	6.22	7.83	7.02
	2003-2023	**57219**	**6.65**	**4.53**	**10.05**	**6.70**
Camp Pond Brook below Camp Pond	2003	2566	6.79	6.41	7.13	6.81
	2004	2729	6.92	5.93	7.52	7.08
	2005	3774	6.88	6.46	12.19	6.81
	2006	3844	6.92	6.28	7.40	6.93
	2007	3201	6.92	6.63	7.35	6.90
	2008	3180	6.96	6.63	7.49	6.92
	2009	2865	7.10	6.51	7.47	7.09
	2010	2893	6.81	6.18	7.45	6.74
	2011	2931	6.85	6.49	7.36	6.82
	2012	2522	7.14	6.75	7.44	7.14
	2013	3444	6.89	6.20	7.21	6.95
	2014	3335	6.84	6.30	7.08	6.84
	2015	2981	6.92	6.21	7.33	6.92
	2016	2901	6.91	6.54	7.20	6.92
	2017	3136	6.81	5.84	7.12	6.87
	2018	2635	6.94	5.68	7.47	6.94
	2019	2995	6.52	5.70	7.07	6.58
	2020	2746	6.66	6.35	7.11	6.62
	2021	3280	6.70	6.30	7.18	6.70
	2022	2425	7.21	6.85	7.53	7.22
	2023	3522	6.86	6.11	7.30	6.93
	2003-2023	**63905**	**6.88**	**5.68**	**12.19**	**6.92**

Station	Year	N	Mean	Minimum	Maximum	Median
Tributary to Reid Brook	2003	Station Not Installed Until 2006				
	2004					
	2005					
	2006	2879	6.86	6.35	7.23	6.89
	2007	3199	6.90	6.23	7.24	6.89
	2008	3253	6.98	6.52	7.22	7.00
	2009	2934	6.96	6.39	7.21	7.00
	2010	2872	6.77	6.06	7.23	6.69
	2011	2997	6.81	6.24	7.13	6.82
	2012	2526	6.82	6.06	7.17	6.86
	2013	3406	6.88	6.46	7.21	6.88
	2014	3405	6.69	6.07	7.10	6.70
	2015	3020	6.69	5.66	7.09	6.78
	2016	3064	6.87	6.08	7.22	6.89
	2017	3227	6.72	6.11	7.09	6.74
	2018	2689	6.82	6.15	7.28	6.83
	2019	3013	6.73	6.05	7.11	6.74
	2020	2763	6.81	5.95	7.19	6.80
	2021	3297	6.75	5.75	7.15	6.75
	2022	2402	6.89	6.30	7.24	6.92
	2023	3542	6.97	6.54	7.23	6.99
	2003-2023	**54488**	**6.83**	**5.66**	**7.28**	**6.85**
Reid Brook below Tributary	2003	886	6.59	6.37	6.92	6.56
	2004	2207	6.93	6.36	7.77	6.89
	2005	3778	7.01	6.39	7.39	7.03
	2006	2179	7.12	6.58	7.64	7.22
	2007	3194	7.34	6.34	8.31	7.30
	2008	3232	7.12	6.64	7.51	7.12
	2009	2801	7.20	6.45	8.04	7.11
	2010	2875	6.83	6.39	7.23	6.84
	2011	2895	6.92	6.00	7.37	6.88
	2012	2439	7.00	6.21	7.51	7.07
	2013	3394	6.78	5.69	7.25	6.86
	2014	3423	6.77	6.07	7.42	6.76
	2015	2957	7.02	5.79	9.80	6.89
	2016	3012	6.85	6.31	7.58	6.72
	2017	2852	6.80	6.06	7.48	6.85
	2018	2687	6.99	5.31	7.84	**7.33**
	2019	3013	6.82	5.97	7.71	6.72
	2020	2725	6.85	5.97	7.52	6.86
	2021	3294	6.79	6.08	7.20	6.80
	2022	2404	7.11	6.43	7.86	7.10
	2023	3537	6.91	6.00	8.69	6.90
	2003-2023	**59784**	**6.94**	**5.31**	**9.80**	**6.89**

Conductivity

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2687	6.9	6.0	8.5	6.7
	2004	2496	9.1	8.3	10.3	9.0
	2005	3516	8.5	7.2	9.5	8.6
	2006	2039	7.2	5.2	9.2	**5.9**
	2007	3187	8.1	6.4	10.0	8.6
	2008	2280	8.6	7.2	9.4	8.8
	2009	2996	9.3	8.6	10.0	9.3
	2010	2809	8.4	7.7	10.1	8.3
	2011	2991	9.4	7.8	11.0	9.8
	2012	2527	10.5	8.8	12.2	10.7
	2013	3431	11.6	9.4	12.6	11.7
	2014	3358	11.67	9.7	13.0	12.0
	2015	2735	12.02	11.0	14.0	12.0
	2016	2994	11.34	9.1	15.9	11.6
	2017	2986	12.05	9.4	22.3	12.1
	2018	2646	16.46	9.1	27.5	11.8
	2019	3012	11.10	8.5	13.8	11.6
	2020	2730	13.16	9.1	29.7	12.1
	2021	3288	10.72	9.3	12.7	10.6
	2022	2344	11.37	10.8	12.5	11.2
	2023	2563	13.59	10.0	40.8	12.0
	2003-2023	**59615**	**10.53**	**5.2**	**40.8**	**10.7**
Camp Pond Brook below Camp Pond	2003	2854	20.8	11.9	52.3	20.3
	2004	1963	25.0	19.1	70.6	24.4
	2005	3769	23.4	7.1	49.1	23.6
	2006	3842	21.1	15.2	42.7	21.6
	2007	3201	24.7	13.5	57.4	23.9
	2008	2557	30.7	27.4	47.3	30.3
	2009	2865	30.9	20.1	51.7	30.4
	2010	2896	26.6	11.4	53.3	25.1
	2011	2933	31.0	20.5	57.6	31.2
	2012	2525	35.4	30.0	59.2	34.6
	2013	3451	35.4	14.9	47.5	36.3
	2014	3334	35.21	27.8	56.7	36.0
	2015	2981	34.88	30.3	55.5	34.8
	2016	2893	38.30	28.6	64.0	38.2
	2017	3136	37.95	21.2	61.1	39.45
	2018	2635	34.19	16.4	111.0	35.9
	2019	2995	33.99	25.6	49.7	34.8
	2020	2746	36.75	26.4	76.5	36.6
	2021	3281	43.47	20.2	222.0	34.5
	2022	2425	48.90	36.6	93.1	46.0
	2023	3523	85.86	21.4	178.7	**53.0**
	2003-2023	**62805**	**34.98**	**7.1**	**222.0**	**34.6**

Station	Year	N	Mean	Minimum	Maximum	Median
Tributary to Reid Brook	2003	Station Not Installed Until 2006				
	2004					
	2005					
	2006	2879	22.3	11.3	35.1	21.6
	2007	3199	18.9	10.4	29.2	19.8
	2008	3038	29.5	15.8	39.1	30.4
	2009	2934	32.7	17.0	49.5	32.6
	2010	2876	27.3	7.1	41.6	27.6
	2011	2997	28.0	12.0	36.8	31.2
	2012	2528	31.7	17.8	41.4	31.2
	2013	3414	36.0	16.0	56.6	38.1
	2014	3405	31.83	18.4	46.1	32.5
	2015	3020	31.88	16.6	41.4	32.2
	2016	3064	34.25	22.1	44.0	34.9
	2017	3229	26.90	2.5	40.9	28.6
	2018	2689	28.21	14.0	40.3	27.8
	2019	3013	27.74	8.8	41.1	27.5
	2020	2763	34.15	21.2	47.4	33.9
	2021	3297	29.24	11.6	42.4	32.6
	2022	2402	43.51	30.5	54.7	44.65
	2023	3543	41.98	24.9	54.2	42.2
	2003-2023	**54290**	**30.89**	**2.5**	**56.6**	**31.7**
Reid Brook below Tributary	2003	886	21.2	17.0	27.1	21.0
	2004	2211	28.9	9.0	47.3	28.7
	2005	3778	23.8	12.0	42.0	22.0
	2006	2179	25.0	9.0	40.0	28.0
	2007	3194	18.1	8.0	29.0	19.0
	2008	3232	28.0	15.0	37.0	30.0
	2009	2802	28.3	14.0	42.0	29.0
	2010	2866	24.6	9.0	43.0	27.0
	2011	2909	28.5	17.0	39.0	29.0
	2012	2452	30.4	18.0	40.0	29.0
	2013	3397	32.6	13.9	52.5	34.6
	2014	3422	29.86	15.1	48.1	32.0
	2015	2957	29.42	15.7	38.5	28.9
	2016	3011	32.73	18.5	44.9	32.2
	2017	2853	29.13	16.1	43.0	28.7
	2018	2687	27.81	14.3	38.1	29.2
	2019	3013	30.26	20.0	42.3	30.7
	2020	2725	100.64	16.3	247.0	34.1
	2021	3293	26.21	12.8	40.2	27.9
	2022	2403	40.89	29.6	53.0	41.2
	2023	3536	29.49	7.5	74.1	32.1
	2003-2023	**59806**	**31.71**	**7.5**	**247.0**	**29.0**

Dissolved Oxygen (mg/L)

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2685	10.31	8.31	12.84	10.24
	2004	2806	10.85	9.26	14.77	10.88
	2005	2668	10.51	9.26	15.06	9.94
	2006	1742	9.99	9.15	11.06	9.82
	2007	3187	12.28	9.35	16.15	**12.53**
	2008	3247	11.15	9.38	12.86	11.18
	2009	2997	11.20	8.71	13.52	11.01
	2010	1245	11.90	9.19	13.22	12.23
	2011	629	11.20	10.31	11.87	11.28
	2012	2443	11.30	9.36	14.50	10.92
	2013	3429	11.33	9.67	12.65	11.35
	2014	3358	11.43	9.54	12.82	11.72
	2015	2089	11.05	9.76	12.36	10.98
	2016	2970	11.17	9.59	12.46	11.20
	2017	2962	11.32	10.22	12.39	11.27
	2018	2646	11.18	9.63	12.92	11.23
	2019	3013	11.30	10.37	12.52	11.00
	2020	2730	10.91	9.36	12.81	11.04
	2021	3288	11.32	9.66	14.48	11.18
	2022	2343	10.85	9.81	12.25	10.61
	2023	2563	10.45	8.33	12.75	10.23
	2003-2023	**55040**	**11.10**	**8.31**	**16.15**	**11.04**
Camp Pond Brook below Camp Pond	2003	2851	9.48	6.46	12.84	8.98
	2004	1961	9.36	7.09	12.57	8.72
	2005	3774	10.57	7.45	14.32	10.17
	2006	3840	10.06	7.46	13.42	9.56
	2007	3201	10.06	7.24	13.34	10.05
	2008	2652	10.09	7.44	13.29	9.67
	2009	2862	9.89	7.04	13.21	9.72
	2010	2896	9.55	6.97	12.89	9.39
	2011	2382	10.07	6.77	14.47	9.80
	2012	2525	10.75	8.61	14.01	10.15
	2013	3451	10.69	8.47	13.72	10.40
	2014	3331	10.55	8.08	14.06	9.93
	2015	2221	9.99	8.51	11.55	10.03
	2016	2905	10.38	8.22	14.03	10.00
	2017	3136	10.65	8.61	13.60	10.37
	2018	2635	10.53	8.27	13.48	10.38
	2019	2995	10.50	9.00	12.42	10.46
	2020	2746	10.24	7.90	13.58	10.04
	2021	3283	10.26	8.01	12.37	10.11
	2022	1973	9.65	7.94	14.81	9.51
	2023	3309	9.71	7.27	12.56	9.56
	2003-2023	**60929**	**10.14**	**6.46**	**14.81**	**10.00**

Station	Year	N	Mean	Minimum	Maximum	Median
Tributary to Reid Brook	2003	Station Not Installed Until 2006				
	2004					
	2005					
	2006	2879	10.20	6.46	14.17	10.11
	2007	3199	12.00	9.46	15.09	11.83
	2008	3253	10.86	7.76	14.96	10.59
	2009	2934	11.64	9.88	14.06	11.47
	2010	2876	10.82	8.88	13.43	10.71
	2011	2996	11.14	9.04	13.58	10.90
	2012	2528	11.26	9.35	14.30	10.95
	2013	3414	11.46	9.26	13.96	11.32
	2014	3405	11.32	8.99	14.21	10.92
	2015	1532	11.07	9.63	12.65	11.05
	2016	3063	11.38	9.29	14.21	11.01
	2017	3228	11.33	9.66	14.19	11.04
	2018	2689	11.08	9.05	13.26	10.95
	2019	3013	11.04	9.50	12.73	10.99
	2020	2763	10.90	9.10	13.77	10.73
	2021	3193	11.09	6.57	13.96	10.92
	2022	2394	10.81	8.94	14.10	10.37
	2023	3542	10.82	8.81	13.41	10.78
	2003-2023	**52901**	**11.12**	**6.46**	**15.09**	**10.94**
Reid Brook below Tributary	2003	886	11.00	7.79	13.15	11.41
	2004	2211	10.46	000	14.20	11.46
	2005	3778	10.54	8.27	13.68	10.44
	2006	2179	11.63	7.07	14.81	12.21
	2007	3194	9.99	6.38	13.84	10.34
	2008	3232	10.05	7.03	14.21	9.97
	2009	2799	10.64	7.98	13.28	10.46
	2010	1473	8.66	6.93	11.49	**8.54**
	2011	0	*	*	*	*
	2012	2443	11.30	9.36	14.50	10.92
	2013	3396	11.58	9.43	13.89	11.46
	2014	3420	11.12	8.91	13.96	10.74
	2015	2954	11.26	9.36	14.25	11.00
	2016	3009	11.19	9.10	13.88	10.90
	2017	2852	11.34	9.78	13.56	11.22
	2018	2684	11.07	9.03	13.22	10.89
	2019	3013	11.07	9.58	12.68	11.05
	2020	2717	10.88	8.79	14.68	10.71
	2021	3246	11.35	9.05	19.48	11.36
	2022	2400	11.12	9.32	14.09	10.92
	2023	3534	10.85	5.76	14.13	10.72
	2003-2023	**55420**	**10.86**	**0**	**19.48**	**10.91**

Turbidity

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2040	1.89	0	177.9	0
	2004	2717	0.88	0	381.5	0
	2005	2616	0.02	0	54.0	0
	2006	1741	0.82	0	274.2	0.3
	2007	3186	0.67	0	75.3	0
	2008	3246	0.02	0	20.3	0
	2009	2997	0.76	0	25.6	0
	2010	2799	23.41	0	366.5	10.89
	2011	0	*	*	*	*
	2012	2440	0.36	0	132.5	0
	2013	3426	0.03	0	51.1	0
	2014	3358	0.03	0	49.3	0
	2015	2961	0.01	0	1.2	0
	2016	2850	0.24	0	41.3	0
	2017	2954	0.04	0	78.0	0
	2018	2646	2.01	0.7	196.4	1.8
	2019	3013	1.21	0	484.0	0
	2020	2729	0.09	0	52.8	0
	2021	3287	0.30	0	8.2	0
	2022	2271	12.92	0	320.9	5.6
	2023	2563	0.00	0	3.4	0
	2003-2023	**55840**	**2.29**	**0**	**484.0**	**0**
Camp Pond Brook below Camp Pond	2003	2801	19.0	5.0	494.9	12
	2004	1960	5.6	1.0	256.3	5
	2005	2998	2.3	0	171	1
	2006	3841	3.0	0	146	2
	2007	3195	7.0	0	353	3
	2008	3173	2.1	0	113	1
	2009	2865	2.1		166.9	1.6
	2010	2896	6.1	0.8	52.5	3.9
	2011	2848	6.9	0.6	65.1	4.3
	2012	1594	0.5	0.0	122.5	0
	2013	2787	0.7	0.0	61.4	0
	2014	3331	0.87	0	117.7	0.2
	2015	2979	0.50	0	31.5	0
	2016	2905	0.02	0	3.6	0
	2017	3029	3.98	0	182.1	1.7
	2018	2635	6.54	0	446	0
	2019	2995	5.94	0	46.5	4.7
	2020	2746	2.37	0	314.7	0.8
	2021	3284	1.91	0	226.6	1.2
	2022	2424	1.16	0	64.2	1.0
	2023	3332	0.13	0	20.4	0
	2003-2023	**60618**	**3.75**	**0**	**494.9**	**1.0**

Station	Year	N	Mean	Minimum	Maximum	Median
Tributary to Reid Brook	2003	Station Not Installed Until 2006				
	2004					
	2005					
	2006	2879	2.726	0	102.1	1.7
	2007	1718	4.74	0	305.5	0
	2008	1691	3.696	0	91.9	2.6
	2009	2473	0.545	0	230.7	0
	2010	2876	0.8916	0	48.6	0
	2011	0	*	*	*	*
	2012	2528	1.211	0	160.6	0
	2013	2797	0.6633	0	68.6	0
	2014	3405	1.13	0	125.3	0
	2015	2911	4.26	0	191.5	0
	2016	2849	1.17	0	100.2	0
	2017	3229	1.99	0	287.2	0
	2018	1964	10.36	0	52.8	**16.8**
	2019	2446	1.91	0	50.9	1.2
	2020	2763	36.63	2.1	100.0	4.5
	2021	2596	11.42	0	493.0	0
	2022	2391	20.60	0	100.0	0
	2023	3541	0.45	0	61.4	0
	2003-2023	**45057**	**6.14**	**0**	**493.0**	**0**
Reid Brook below Tributary	2003	886	2.2	0	179.9	0
	2004	2211	24.4	0	575	13.9
	2005	3322	5.8	0	484	0
	2006	2179	0.5	0	143	0
	2007	3194	10.0	0	246	2
	2008	3194	3.9	0	426	2.9
	2009	2792	2.6	0	38.9	2.4
	2010	2294	5.4	0	360.2	2.6
	2011	0	*	*	*	*
	2012	2440	0.4	0	132.5	0
	2013	3396	0.5	0	258.7	0
	2014	3420	0.46	0	48.1	0
	2015	2843	1.97	0	497.0	0
	2016	2485	0.44	0	64.5	0
	2017	2852	2.46	0	54.6	0.8
	2018	2687	0.85	0	366.1	0
	2019	3006	2.51	0	468.0	0
	2020	2725	0.42	0	41.7	0
	2021	3286	1.29	0	345.5	0.2
	2022	1249	58.8	0.1	499.0	0.6
	2023	3522	3.09	0	476.0	0
	2003-2023	**53983**	**6.40**	**0**	**575**	**0**