Real-Time Water Quality 10 Year Report

Voisey's Bay Network

2003-2013

Government of Newfoundland & Labrador
Department of Environment and Conservation
Water Resources Management Division

Table of Contents

Table of Contents	2
List of Figures	3
List of Tables	5
Acknowledgements	6
Abbreviations	8
Introduction	9
RTWQ Partnership and Agreement	10
Instrumentation	11
Station Network	11
RTWQ Station Profiles	14
Reid Brook at Outlet of Reid Pond	15
Camp Pond Brook below Camp Pond	17
Tributary to Lower Reid Brook	19
Lower Reid Brook below Tributary	21
QAQC	23
Quality Assurance	23
Quality Control	24
Quality Assessment	24
Maintenance and Calibration	25
Data Interpretation	26
RTWQ Data Review 2003-2013	27
Water Temperature	27
pH	31
Specific Conductance	36
Dissolved Oxygen	41
Turbidity	46
Grab Sample Result Trends	51
Conclusion	61
References	63
Appendix A Deployment and Removal Dates	i
Appendix B Comparison Ranking Tables	iv
Appendix C Summary Statistics by Year	xiii
Appendix D Trend Analysis for Monthly Medians	xxiv

List of Figures

Figure 1	Partnership & Agreements	10
Figure 2	Voisey's Bay RTWQ Monitoring Network	13
Figure 3	Map of RTWQ Stations and Watershed for Reid Brook at Outlet of Reid Pond Station	15
Figure 4	Picture of Reid Brook at Outlet of Reid Pond	16
Figure 5	Picture of Reid Pond and Station Hut	16
Figure 6	Picture of Reid Pond looking West	16
Figure 7	Map of RTWQ stations and watershed for Camp Pond Brook below Camp Pond Station	17
Figure 8	Shelter at Camp Pond Brook below Camp Pond	18
Figure 9	Voisey's Bay Environmental Staff at Camp Pond Brook	18
Figure 10	Camp Pond, Drinking Water Intake	18
Figure 11	Map of RTWQ Stations and watershed for Tributary to Lower Reid Brook Station	19
Figure 12	Tributary to Lower Reid Brook	20
Figure 13	Station hut at Tributary to Lower Reid Brook	20
Figure 14	Aerial view of Lower Reid Brook	20
Figure 15	Map of RTWQ Stations and Watershed for Lower Reid Brook station	21
Figure 16	Lower Reid Brook	22
Figure 17	Tributary meets Lower Reid Brook	22
Figure 18	Station hut at Lower Reid Brook below Tributary	22
Figure 19	Maintenance and Calibration Flowchart	26
Figure 20	Water Temperatures at Reid Brook graphed over the ten year period	29
Figure 21	Boxplot of Water Temperature at Reid Brook	29
Figure 22	Water Temperature at Camp Pond Brook graphed over the ten year period	29
Figure 23	Boxplot of Water Temperature at Camp Pond Brook	29
Figure 24	Water Temperature at Tributary to Lower Reid Brook graphed over the ten year period	30
Figure 25	Boxplot of Water Temperature at Tributary to Lower Reid Brook	30
Figure 26	Water Temperature at Lower Reid Brook below Tributary graph over the ten year period	30
Figure 27	Boxplot of Water Temperature at Lower Reid Brook below Tributary	30
Figure 28	pH at Reid Brook below Reid Pond graphed over the ten year period	34
Figure 29	Boxplot of pH at Reid Brook below Reid Pond	34
Figure 30	pH at Camp Pond Brook graphed over the ten year period	34
Figure 31	Boxplot of pH at Camp Pond Brook	34
Figure 32	pH at Tributary to Lower Reid brook graphed over the ten year period	35
Figure 33	Boxplot of pH at Tributary to Lower Reid Brook	35
Figure 34	pH at Lower Reid Brook below Tributary graphed over the ten year period	35
Figure 35	Boxplot of pH at Lower Reid Brook below Tributary	35

Figure 36	Specific Conductivity at Reid Brook graphed over the ten year period	39
Figure 37	Boxplot of Specific Conductivity at Reid Brook	39
Figure 38	Specific Conductivity at Camp Pond Brook graphed over the ten year period	39
Figure 39	Boxplot of Specific Conductivity at Camp Pond Brook	39
Figure 40	Specific Conductivity at Tributary to Lower Reid Brook graphed over the ten year period	40
Figure 41	Boxplot of Specific Conductivity at Tributary to Lower Reid Brook	40
Figure 42	Specific Conductivity at Lower Reid Brook graphed over the ten year period	40
Figure 43	Boxplot of Specific Conductivity at Lower Reid Brook	40
Figure 44	Dissolved Oxygen at Reid Brook graphed over the ten year period	44
Figure 45	Boxplot of Dissolved Oxygen at Reid Brook	44
Figure 46	Dissolved Oxygen at Camp Pond Brook graphed over the ten year period	44
Figure 47	Boxplot of Dissolved Oxygen at Camp Pond Brook	44
Figure 48	Dissolved Oxygen at Tributary to Lower Reid Brook over the ten year period	45
Figure 49	Boxplot of Dissolved Oxygen at Tributary to Lower Reid Brook	45
Figure 50	Dissolved Oxygen at Lower Reid Brook	45
Figure 51	Boxplot of Dissolved Oxygen at Lower Reid Brook	45
Figure 52	Turbidity at Reid Brook graphed over the ten year period	49
Figure 53	Boxplot of Turbidity at Reid Brook	49
Figure 54	Turbidity at Camp Pond Brook graphed over the ten year period	49
Figure 55	Boxplot of Turbidity at Camp Pond Brook	49
Figure 56	Turbidity at Tributary to Lower Reid brook graphed over the ten year period	50
Figure 57	Boxplot of Turbidity at Tributary to Lower Reid Brook	50
Figure 58	Turbidity at Lower Reid Brook graphed over the ten year period	50
Figure 59	Boxplot of Turbidity at Lower Reid Brook	50
Figure 60	Grab Sample results of Specific Conductivity trends for all stations	53
Figure 61	Grab Sample results of Hardness, TDS, Calcium and Sulphate trends for Camp Pond	54
Figure 62	Grab Sample results of Sulphate trends for all stations	55
Figure 63	Grab Sample results of Turbidity trends for all stations	56
Figure 64	Grab Sample results of Total Aluminum trends for all stations	57
Figure 65	Grab Sample results of Alkalinity and Iron trends for Reid Brook	58
Figure 66	Grab Sample results of Alkalinity and Iron trends for all stations	59
Figure 67	Grab Sample results of Nickel trends for all stations	60

List of Tables

Table 1	Analysis of Water Temperature for Construction Phase 2003-2005	28
Table 2	Analysis of Water Temperature for Operational Phase 2006-2013	28
Table 3	Analysis of pH for Construction Phase 2003-2005	33
Table 4	Analysis of pH for Operational Phase 2006-2013	33
Table 5	Analysis of Specific Conductivity for Construction Phase 2003-2005	38
Table 6	Analysis of Specific Conductivity for Operational Phase 2006-2013	38
Table 7	Analysis of Dissolved Oxygen for Constructional Phase 2003-2005	43
Table 8	Analysis of Dissolved Oxygen for Operational Phase 2006-2013	43
Table 9	Analysis of Turbidity for Constructional Phase 2003-2005	48
Table 10	Analysis of Turbidity for Operational Phase 2006-2013	48
Table 11	Summary of QAQC Grab Sample data trends	52

Acknowledgements

The Real-Time Water Quality Monitoring (RTWQ) Network in Voisey's Bay is successful in tracking emerging water quality issues due to the hard work and diligence of certain individuals. The management and staff of Vale Newfoundland and Labrador (referred to as Vale NL throughout the report) work in cooperation with the management and staff of the Department of Environment and Conservation (ENVC) Water Resources Management Division (WRMD) as well as Environment Canada (EC) to ensure the protection of ambient water resources in Voisey's Bay, Labrador.

Vale NL Environmental Coordinators are acknowledged for their hard work and ensuring the Real-Time Water Quality Monitoring Network is operating to the standards set by ENVC. It is only through their dedication to properly maintain and calibrate the equipment and perform acceptable quality control measures, that the data can be viewed as reliable and accurate.

Various individuals from WRMD have been integral in ensuring the smooth operation of such a technologically advanced network. WRMD staff in Goose Bay play the lead role in coordinating and liaising between the major agencies involved, thus, ensuring open communication lines at all times. In addition, WRMD is responsible for the data management/reporting, troubleshooting, along with ensuring the quality assurance/quality control measures are satisfactory. WRMD were responsible for the communication aspects of the network ensuring the data is being provided to the general public on a near real-time basis through the departmental web page.

Environment Canada staff of the Meteorological Service of Canada: Water Survey Canada play an essential role in the data logging/communication aspect of the network. These individuals visit the site often to ensure the data logging equipment is operating properly and transmitting the data efficiently. They play the lead role in dealing with hydrological quantity and flow issues.

The managers ENVC (Renée Paterson), EC (Howie Wills) and Vale NL (Perry Blanchard) are fully committed to improving this network and ensuring it provides meaningful and accurate water quality/quantity data that can be used in the decision-making process. This network is only successful due to the cooperation of all three agencies involved. This report is a reflection on the vast amount of water quality data collected over the past ten years. It is a testament to the benefits of partnership and collaboration between industry and government.

The preparation of this report involved numerous individuals who should be acknowledged for their contribution. This report was a joint effort initially started by Grace deBeer, the Environmental Scientist whom worked for ENVC in the Happy Valley – Goose Bay office. The document was passed onto Tara Clinton (ENVC St. John's Offices) for reformatting and technical editing. Shibly Rahman completed the statistical analysis of the data. The final review was completed by Vale NL Environmental staff.

Abbreviations

EC	Environment Canada
ECW&S	Environmental Control Water and Sewage Regulations
ENVC	Department of Environment and Conservation
DO	Dissolved Oxygen
NL	Newfoundland and Labrador
QAQC	Quality Assurance and Quality Control
RTWQ	Real-time Water Quality
WRMD	Water Resources Management Division
%Sat	Percent Saturation

Introduction

The Real-Time Water Quality (RTWQ) network in Voisey's Bay was successfully established by the Department of Environment and Conservation (ENVC) and Environment Canada (EC) in cooperation with Vale Newfoundland and Labrador in 2003 and further expanded in 2006. The objective of the network is to identify and track emerging water quality or quantity management issues and ensure 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, 1) Reid Brook at Outlet of Reid Pond, 2) Camp Pond Brook below Camp Pond, 3) Tributary to Lower Reid Brook, and 4) Lower Reid Brook below Tributary. These stations measure water quality parameters including water temperature, pH, specific conductivity, dissolved oxygen, and turbidity in near real-time. Two additional parameters, total dissolved solids and percent saturation, are calculated from measured parameters.

These stations also record continuous stage level and flow rate data. These parameters and the data collected are the responsibility of EC. WRMD have access to water quantity information to better understand and explain water quality fluctuations occurring during the deployment seasons.

This ten year report illustrates, discusses and summarizes water quality related events from 2003 through to 2013. Over the years the deployment season has extended from June through to November, with the instruments removed in the winter due to freezing of the water bodies. Instruments were deployed for month long intervals referred to as deployment periods (Appendix A, Table A1).

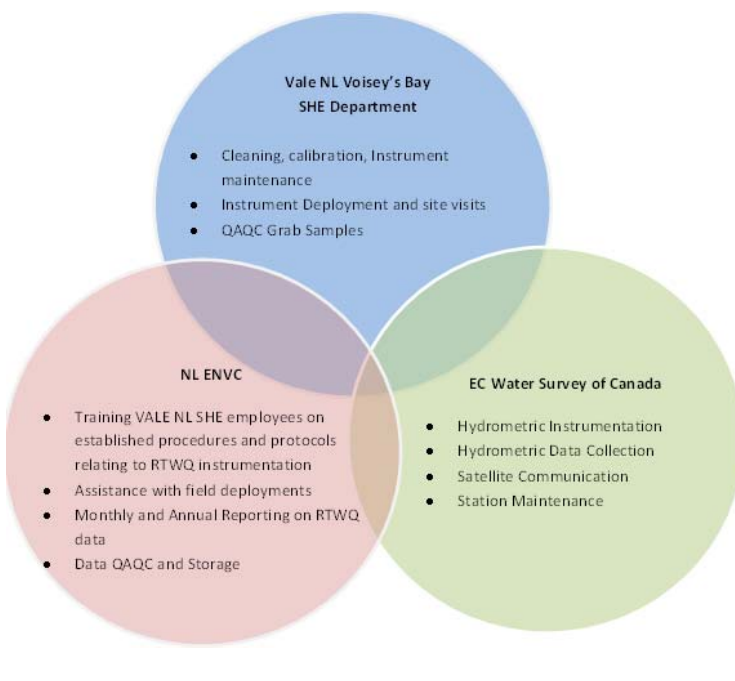
RTWQ Partnership and Agreement

The RTWQ and hydrometric monitoring program at Voisey's Bay Mine site was successfully established by ENVC and EC in cooperation with Vale NL in 2003. The original agreement included five hydrometric monitoring stations, three of which also featured RTWQ monitoring. These stations were installed and became operational in summer 2003. In summer 2006, RTWQ monitoring was added to a fourth existing hydrometric monitoring station. The original agreement signed in 2002, has been extended four times (2005, 2009, 2012, 2015). The current agreement is valid until March 31, 2020. The agreement was amended in 2012 to include two additional hydrometric monitoring stations which have since been discontinued.

The objective of the network is to identify and track emerging water quality or quantity management issues and ensure protection of ambient water resources in and around the Voisey's Bay mining operations. RTWQ monitoring can be a useful tool in many aspects of water resources management. The natural environment is constantly changing and water quality can fluctuate quickly and dramatically with potentially adverse effects to aquatic life, their habitats and the surrounding environment. With RTWQ instrumentation, in situ sensors measure water quality data continuously. This information is transmitted through communication systems and made available to the end user in near real time. This allows the end user to identify, understand, follow and potentially mitigate harmful water quality events should they occur in a water body.

EC personnel are responsible for the functioning of all hydrometric monitoring equipment, satellite communication, and hydrometric data collection and correction. ENVC personnel are responsible for training and assisting Vale NL Environment staff on all procedures related to RTWQ monitoring instrumentation, and water quality data collection, as well as monthly and annual reporting on water quality data, and data QAQC. Vale NL Environment personnel are responsible for cleaning, calibrating and deployment of RTWQ monitoring instrumentation on a monthly schedule when environmental conditions permit during the ice-free months (see Figure 1).

Figure 1: Partnerships and Agreement



Instrumentation

The three original RTWQ stations each had a designated Hach DataSonde 4 (DS4) Hydrolab which featured a temperature thermistor, a two part pH reference electrode and sensor, an integrated conductivity sensor and circulator, a Clark cell dissolved oxygen sensor, and a self-cleaning turbidity sensor. For QAQC measurements, a Hach MiniSonde 4a (MS4a) was used at all stations in the network to collect in situ measurements during site visits. The MS4a instrument featured a temperature thermistor, a two part pH reference electrode and sensor, an integrated conductivity sensor and circulator, and a Clark cell dissolved oxygen sensor. The instrumentation also included a handheld computer display unit (Surveyor 4a) which connects to the water quality sonde to view data while in the field.

When the fourth RTWQ station was installed in 2006, newer technology was available and a Hach DataSonde 5X Hydrolab (DS5X) was designated for the station. The DS5X instrument featured a temperature thermistor, a two part pH reference electrode and sensor, a conductivity sensor, a luminescent dissolved oxygen sensor, a self-cleaning turbidity sensor. The instrument was equipped with a self-cleaning brush that would rotate and wipe the pH and dissolved oxygen sensors prior to taking a reading.

Vale NL made an additional investment in the water quality monitoring on site in Spring 2012, and purchased four new Hach DataSonde 5X (DS5X) Hydrolab instruments. As well as a new Hach Minisonde 5 Hydrolab (MS5) for QAQC measurements and a new hand held computer display unit (Archer).

Despite some changes in the instrumentation over the ten year period the water quality parameters that were being recorded remained the same allowing for data continuity.

Station Network

The original RTWQ network in 2003, consisted of three RTWQ monitoring stations. These stations were installed at Upper Reid Brook (Outlet from Reid Pond), Camp Pond Brook below Camp Pond, and Lower Reid Brook below Tributary. These stations measure water quality parameters including water temperature, pH, specific conductivity, dissolved oxygen, and turbidity. Two additional parameters, total dissolved solids and percent saturation are calculated from measured parameters. In 2006, RTWQ monitoring was added to an existing hydrometric monitoring station on Tributary to Lower Reid Brook.

Also in 2006, a RTWQ groundwater monitoring station was installed at the dam between the Headwater Pond (tailing management area) and Otter Pond. This station was proposed to monitor the operation of the dam structure. This station was only active for one deployment season (July – November 2006 and data from this station is not included in this summary analysis). The groundwater monitoring station was crushed by snow fall during its first winter season. It was decided to suspend the station at that time.

In 2003, the hydrometric monitoring network originally consisted of five stations located at: Reid Brook at outlet to Reid Pond, Camp Pond Brook below Camp Pond, Lower Reid Brook below Tributary, Tributary to Lower Reid Brook and Camp Pond at Southwest End.

Water level has been recorded at all four RTWQ stations and at Camp Pond since July 2003. Flow is calculated for stations at Reid Brook at Outlet from Reid Pond, Camp Pond Brook below Camp Pond, Lower Reid Brook below Tributary, and Tributary to Lower Reid Brook. Stage and stream flow (quantity) data are not examined in this report; these parameters are the responsibility of EC.

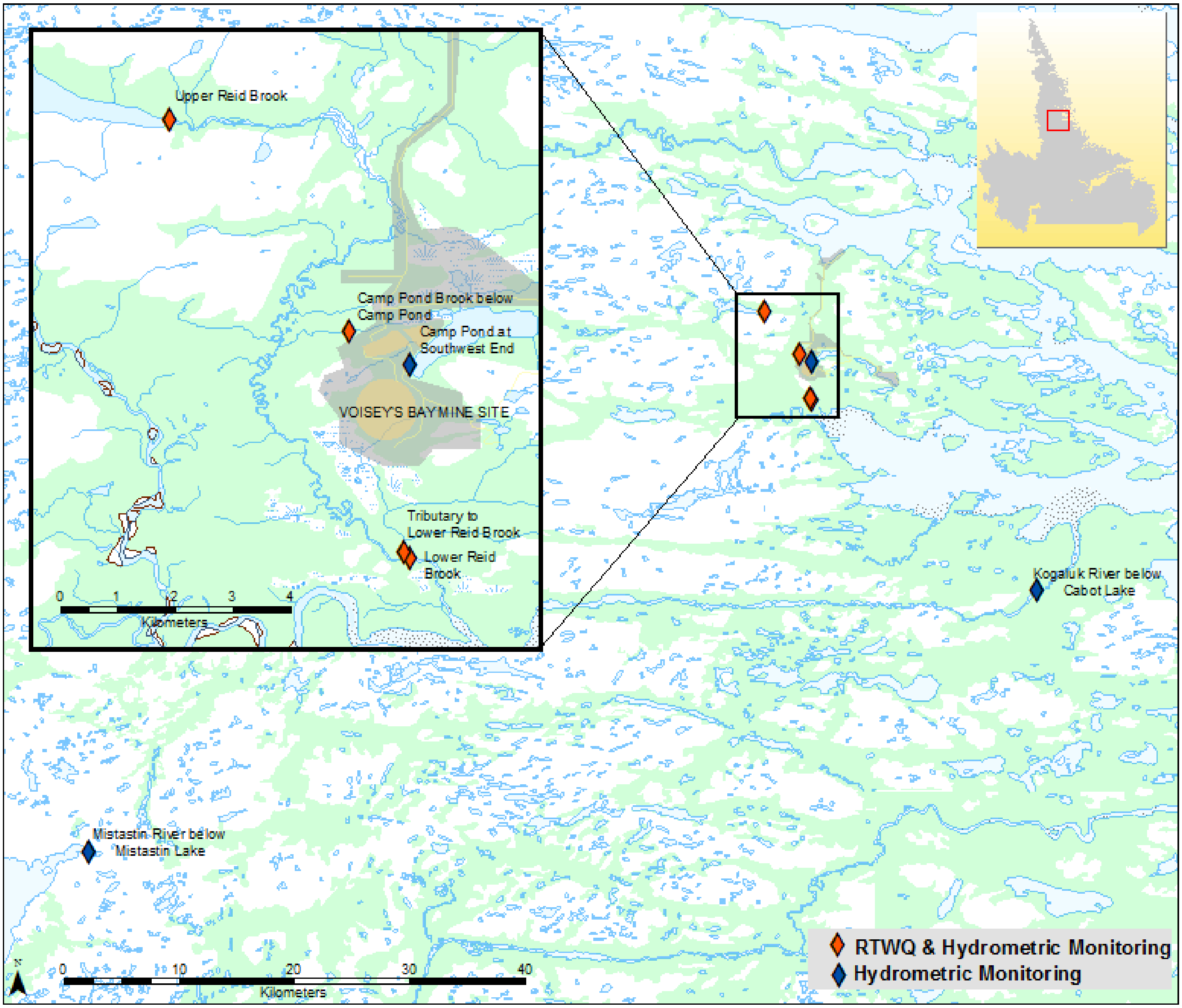


Figure 2: Voisey's Bay RTWQ Monitoring Network

RTWQ Station Profiles

Site selection is important to the quality of data being captured. The goal is to ensure the real-time stations capture the natural water quality as well as any changes or disturbances that may occur due to the mine site.

The location for the four RTWQ stations were selected based on proximity to operations of the Voisey's Bay mine site. As development of a mine site commences the natural environments around that site are subjected to several anthropogenic impacts. It is expected to see changes in the water quality as the site development moves through the stages of construction into operation (Figure 2: Voisey's Bay RTWQ Monitoring Network).

Between 2003 and 2005 the project was considered to be in a construction phase with focus on the building of mine facilities including the mill, concentrator, and the personnel camp. There was some testing of the concentrate in 2005 however it was in 2006 that the production commenced at the mine. The project has remained in an operational phase since 2006.

The real-time water quality stations surrounding the mine do not directly measure mine effluent or direct discharges from the facility. The stations are monitoring the potential for runoff and other anthropogenic disturbances coinciding with the development and operation of the mine.

The watersheds where the stations are placed are located in the geologic province of Nain. The real-time data is from watersheds that are located within two distinct eco-regions, as defined by the NL Department of Natural Resources. The region is generally described as high sub-arctic tundra but can also be considered in some parts as coastal barrens. High subarctic tundra is a rugged mountainous eco-region dominated by large areas of exposed rock. Vegetation is limited and restricted mainly to low lying valleys. Soils in this eco-region are generally pocketed between rock outcrops and typically consist of orthic humo-ferric podzols and orthic dystric brunisols (Department of Natural Resources, 2014). Shallow fens containing sedges, sphagnum mosses and other wetlands species are common in areas of poor drainage. Annual rainfall can be between 950-1000mm with snowfall amounts up to 4m. Mean daily temperatures range between -16°C and -22°C in February and from 9°C to 13°C in July (Environment Canada, 2013).

Reid Brook at Outlet of Reid Pond (or Upper Reid Brook)

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

The watershed is characterized largely by non-forested rocky outcrops. 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 (Figure 4: Picture of Reid Brook). 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: Picture of Reid Pond and Station hut). 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: Picture of Reid Pond looking west) (Department of Natural Resources, 2014).

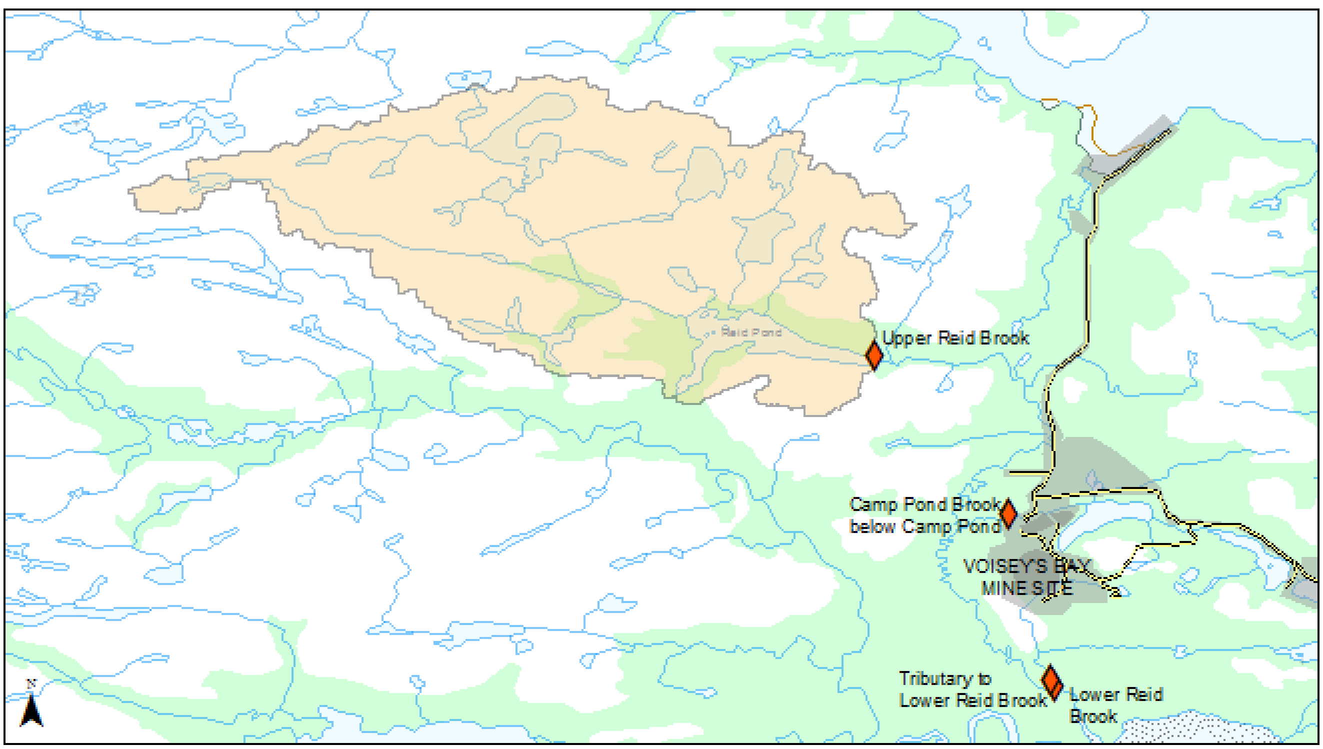


Figure 3: Map showing RTWQ stations and watershed for Reid Brook at Outlet of Reid Pond station

Figure 4: Picture of Reid Brook

Figure 5: Picture of Reid Pond and Station hut

Figure 6: Picture of Reid Pond looking west

Camp Pond Brook below Camp Pond

Camp Pond Brook station is located approximately 1.5km downstream from Camp Pond and 1.5km upstream from its confluence with Reid Brook at N56° 20' 32", W62° 06' 24". The 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. The basin drains an area of 24.0km^2 (Figure 7: Map showing RTWQ stations and watershed for Camp Pond Brook station).

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 (previously location of the 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: Camp Pond, Drinking Water Intake).

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 3km from Camp Pond to Reid Brook (Department of Natural Resources, 2014).

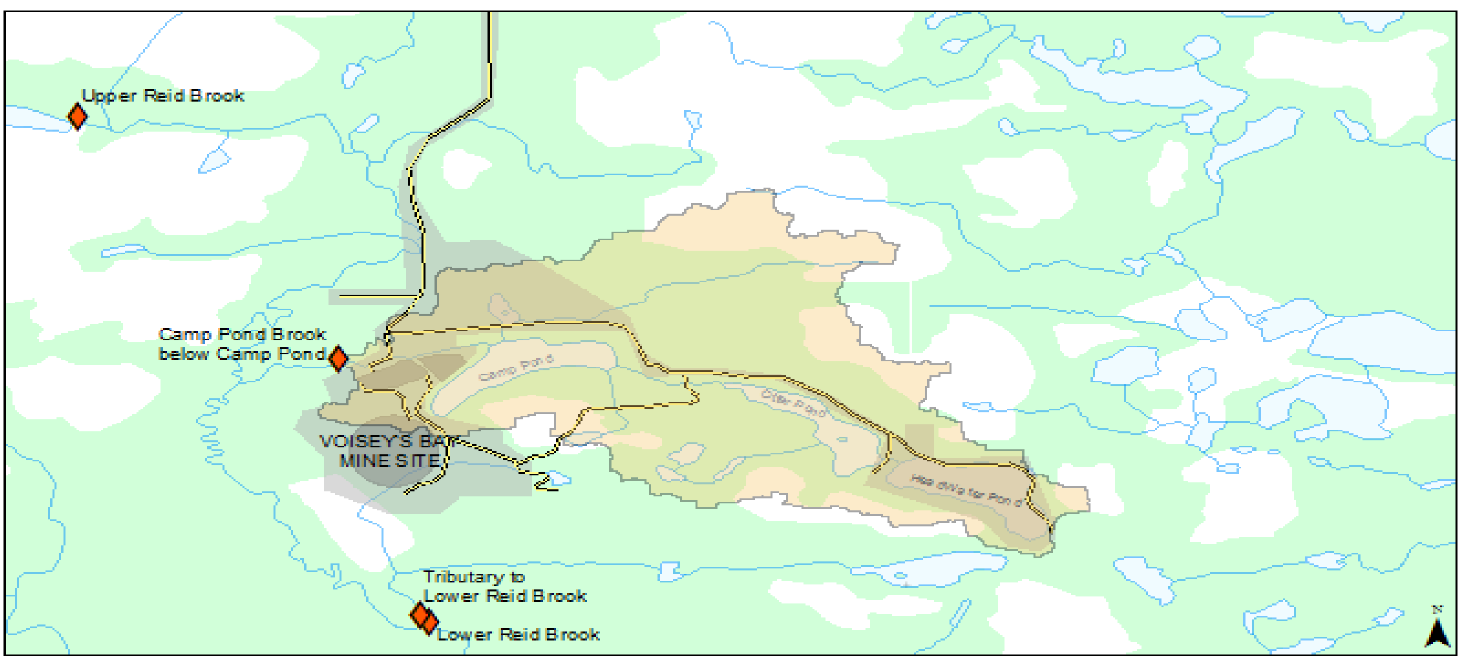


Figure 7: Map showing RTWQ stations and watershed for Camp Pond Brook station

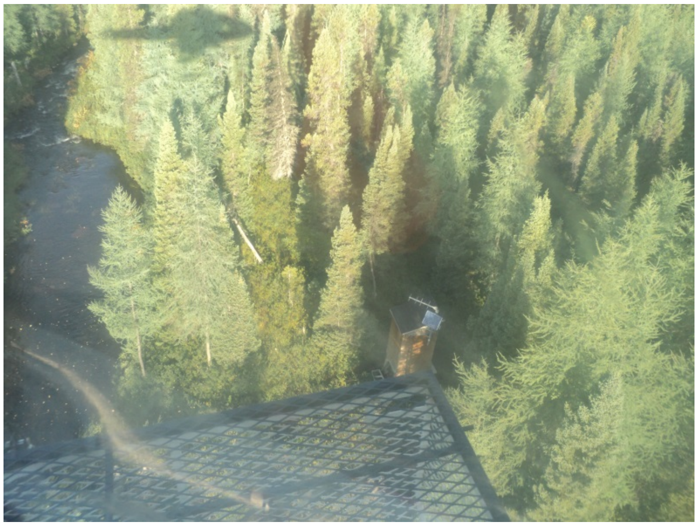


Figure 8: Shelter at Camp Pond Brook

Figure 9: Voisey's Bay Environmental Staff at Camp Pond Brook

Figure 10: Camp Pond, Drinking Water Intake

Tributary to Lower Reid Brook

The station on Tributary to Lower Reid Brook (often referred to as Tributary 1) is located about 150m upstream from its confluence with Lower Reid Brook at N56° 18' 18", W62° 05' 34". The site is accessible by helicopter. A 150m foot path north from the landing area for the helicopter at the confluence of the tributary and Lower Reid Brook has been established through the forested area adjacent to the tributary. The tributary drains an area about 15.2km^2. The headwaters for the tributary originate in the area of the ovoid (Figure 11: Map showing RTWQ stations and watershed for Tributary).

While site water controls are in place at the mine site to contain any contaminated water from entering the environment, this station was of interest to Vale NL to ensure all procedures and protocol were operating as designed and are not having an effect on the environment.

The tributary runs fast through a rocky stream bed with large substrate (Figure 12: Tributary to Lower Reid Brook). The watershed is mostly wooded with several wetland areas (see Figure 13). The geologic makeup of the watershed is a mix of granitiod rock and layered intrusions of troctolite, gabbroaorite, and anthorosite. The Tributary originates in the mine area and flows southward. The tributary combines with secondary stream system about 1km upstream of the station and another small primary stream about 200m upstream (Figure 14: Aerial view of Lower Reid Brook) (Department of Natural Resources, 2014).

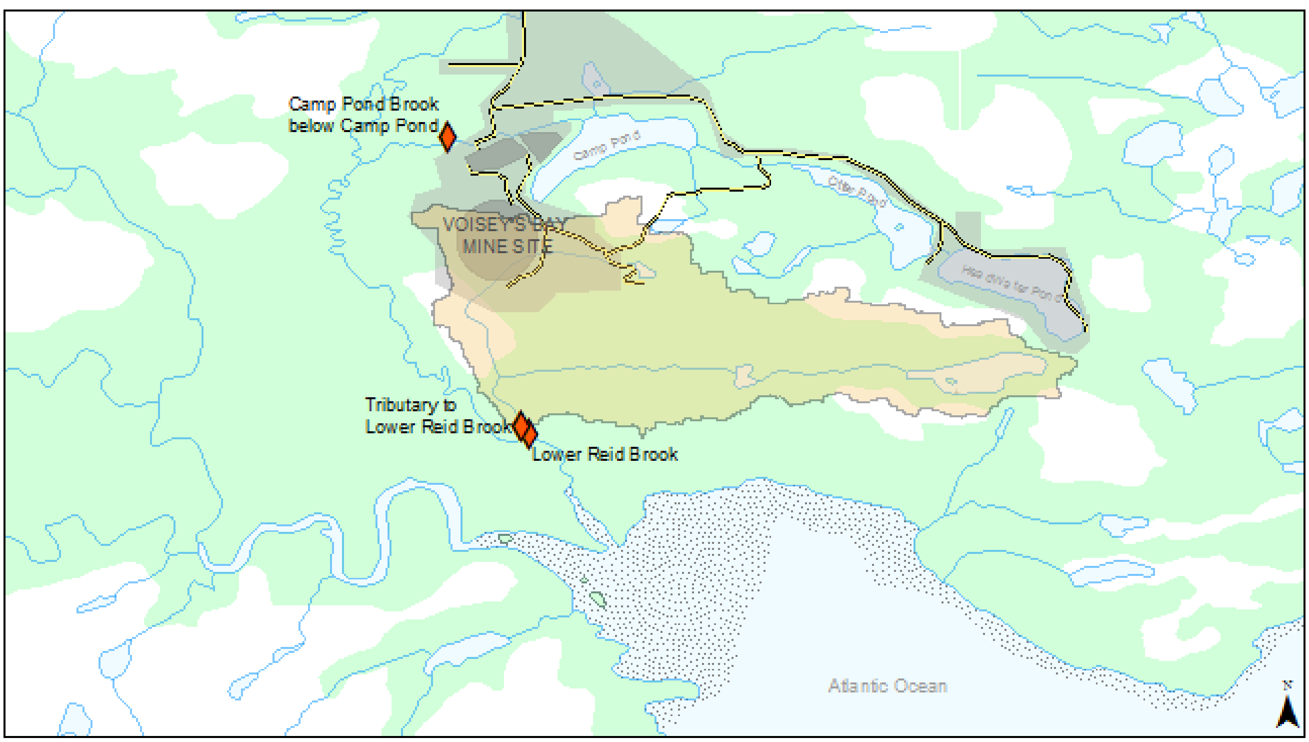


Figure 11: Map showing RTWQ stations and watershed for Tributary to Lower Reid Brook station

Figure 12: Tributary to Lower Reid Brook

Figure 13: Station Hut at Tributary to Lower Reid Brook

Figure 14: Aerial view of Lower Reid Brook

Lower Reid Brook below Tributary

The station at Lower Reid Brook is the last point of measurement before the brook empties in to Voisey's Bay, (Atlantic Ocean). 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". The station is accessible by helicopter. A 50m foot path east of the landing area for the helicopter at the confluence of the tributary and Lower Reid Brook has been established through the forested area adjacent to Lower Reid Brook. The Lower Reid Brook watershed encompasses the Reid Brook, Camp Pond Brook and the Lower Reid Brook below Tributary watersheds draining an area of 158.1km^2 (Figure 15: Map showing RTWQ stations and watershed for Lower Reid Brook below Tributary).

The watershed contains most of the mining activities at the Voisey's Bay operation. The watershed is predominantly boreal forested areas with wetlands in the lowlands with rocky barren landscape in its headwaters (Figure 16: Lower Reid Brook). 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 (Lower Reid Brook), bed material is finer and the channel is more defined when compared to Reid Brook (see Figure 17 & 18). Sand is the dominant substrate with some large boulders and riffle areas (Department of Natural Resources, 2014).

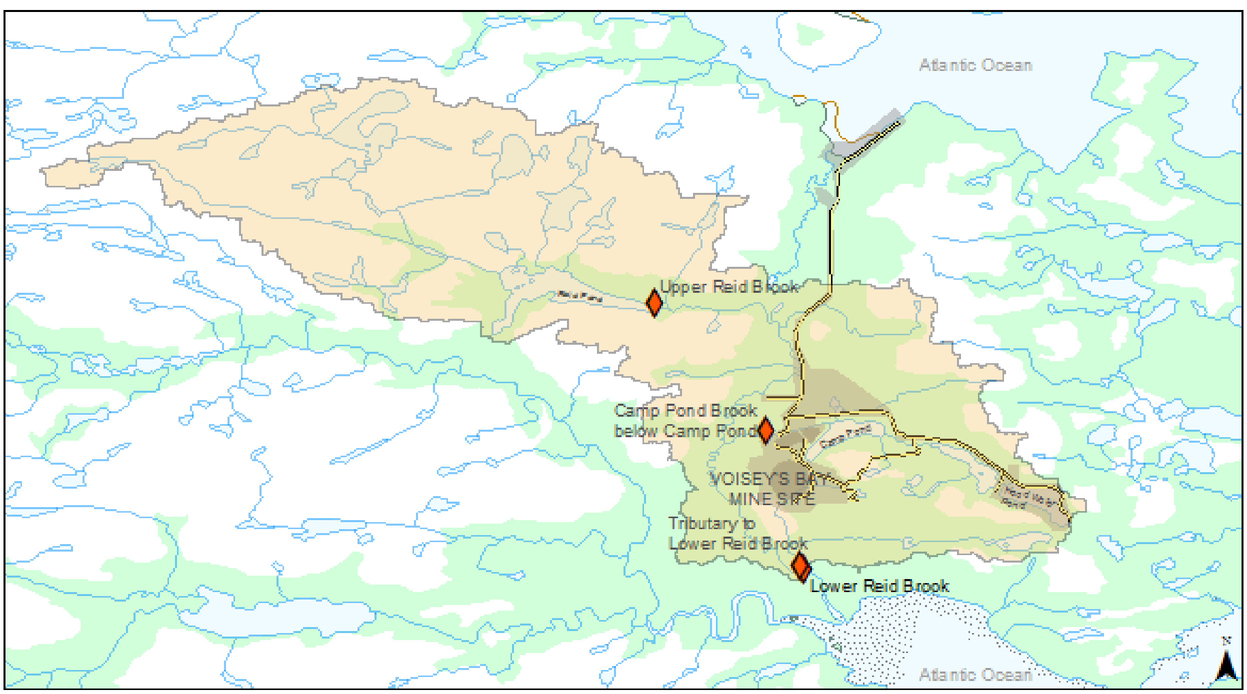


Figure 15: Map showing RTWQ stations and watershed for Lower Reid Brook station

Figure 16: Lower Reid Brook

Figure 17: (Top right photo): Tributary meets Lower Reid

Figure 18: (Bottom right photo): Station hut at Lower Reid Brook

Quality Assurance and Quality Control

To ensure the effectiveness and reliability of the RTWQ monitoring program, quality assurance (QA), quality control (QC) and quality assessment procedures have been developed. Proper procedures outlined in ENVC's *Protocols Manual for RTWQ Monitoring in NL, Calibration and Maintenance Guide for Industry Partners (http://www.env.gov.nl.ca/env/waterres/rti/rtwq/NL_RTWQ_Manual_Calibration.pdf) and Protocols Manual for RTWQ Monitoring in NL (http://www.env.gov.nl.ca/env/waterres/rti/rtwq/NL_RTWQ_Manual.pdf)* should be adhered to consistently. It is essential that all RTWQ personnel ensure that their responsibilities and tasks are completed in reference to this manual. All RTWQ personnel have the responsibility and authority to manage, perform and verify that their work follows QA, QC and quality assessment protocols. Specific components of QA, QC and quality assessment in RTWQ monitoring are summarized below.

Quality Assurance

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.

QA program elements include:

- Annual proficiency training and evaluations of instrument function
- Personnel qualifications and training
- Technical procedures for sampling and conducting field and analytical work
- Troubleshooting of instruments, recording equipment, installations, transmission of data and corrective action plans
- Record keeping including field sheet and chain on custody for grab samples, deployment field sheet, logbooks and instrument calibration records
- Implementation of QAQC procedures including data verification, validation and variance forms
- Preparation of analytical reports, data packages and RTWQ web page
- Auditing adherence to program requirements and following internal procedures
- Peer review of RTWQ program design, QAQC procedures and data analysis
- Investigation of emerging RTWQ technology, QAQC procedures, and analysis techniques
- First-hand knowledge of each RTWQ station watershed through observation and field visits

(Water Resources Management Division, 2014)

Quality Control

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.

QC program elements include:

- Monthly maintenance and calibration of the probe and its sensors
- Inspection and maintenance of RTWQ station installation
- Field readings taken at the time of removal and redeployment of the probe using a field QAQC instrument
- *In situ* validation of field and QAQC instrument readings according to comparison table and troubleshoot to determine cause if significant discrepancies occur
- Collection of a water quality grab sample at the time of redeployment of the probe to be sent to an accredited laboratory for analysis
- Updating spreadsheet with grab sample results once laboratory analysis is complete

(Water Resources Management Division, 2014)

Quality Assessment

Quality assessment activities are implemented to quantify the effectiveness of the quality control procedures.

Quality assessment program elements include:

- Calculate long-term and monthly period summary statistics
- Produce time series graphs for each parameter and evaluate for gaps, data errors, and guideline exceedance for pH, dissolved oxygen and turbidity
- Publishing near-real time updates of RTWQ data on the WRMD web page for public review
- Produce reports on the RTWQ network corresponding to deployment periods, including any problems with maintenance, calibration and QAQC procedures; any data issues; time series graphs and summary statistics for each parameter; brief explanations for observed results; and data qualification statements
- Archiving of RTWQ monitoring data records
- Identify any issues with the parameter order, sensor failure or missing data transmissions in a data variance report
- Regular updates to the calibration schedule on the web page

(Water Resources Management Division, 2014)

Maintenance and Calibration

In order to ensure reliable and accurate data is being recorded. It is recommended that regular maintenance and calibration of the instruments take place on a monthly basis. This procedure is the responsibility of the Vale NL Environment staff and is performed preferably every 30 days. To confirm real-time processes are standardized across the network, ENVC staff visit the Vale NL site twice a deployment season to ensure the procedures and processes are being followed and reliable data is being recorded (Figure 19: Flowchart on Maintenance and Calibration).

Maintenance includes a thorough cleaning of the instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, Vale NL Environment staff carefully calibrates each sensor attachment for pH, specific conductivity, dissolved oxygen and turbidity.

An extended deployment period (>30 days) can result in instrument sensor drift which may result in skewed data. The instrument sensors will still work to capture any water quality events even though the exact data values collected may be inaccurate (Appendix A, Table A1).

As part of the Quality Assurance and Quality Control protocol (QAQC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey.

At deployment and removal, a QAQC Instrument is temporarily deployed alongside the Field Instrument. Values for 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 Instrument and QAQC Instrument at deployment and at removal, a qualitative statement is made on the data quality.

Deployment and removal comparison rankings for the Voisey's Bay Network stations are summarized in Appendix B, Table D2. For additional information and explanations of rankings including "n/a" rankings, please refer to the monthly deployment reports for detailed information on the specific timeframe.

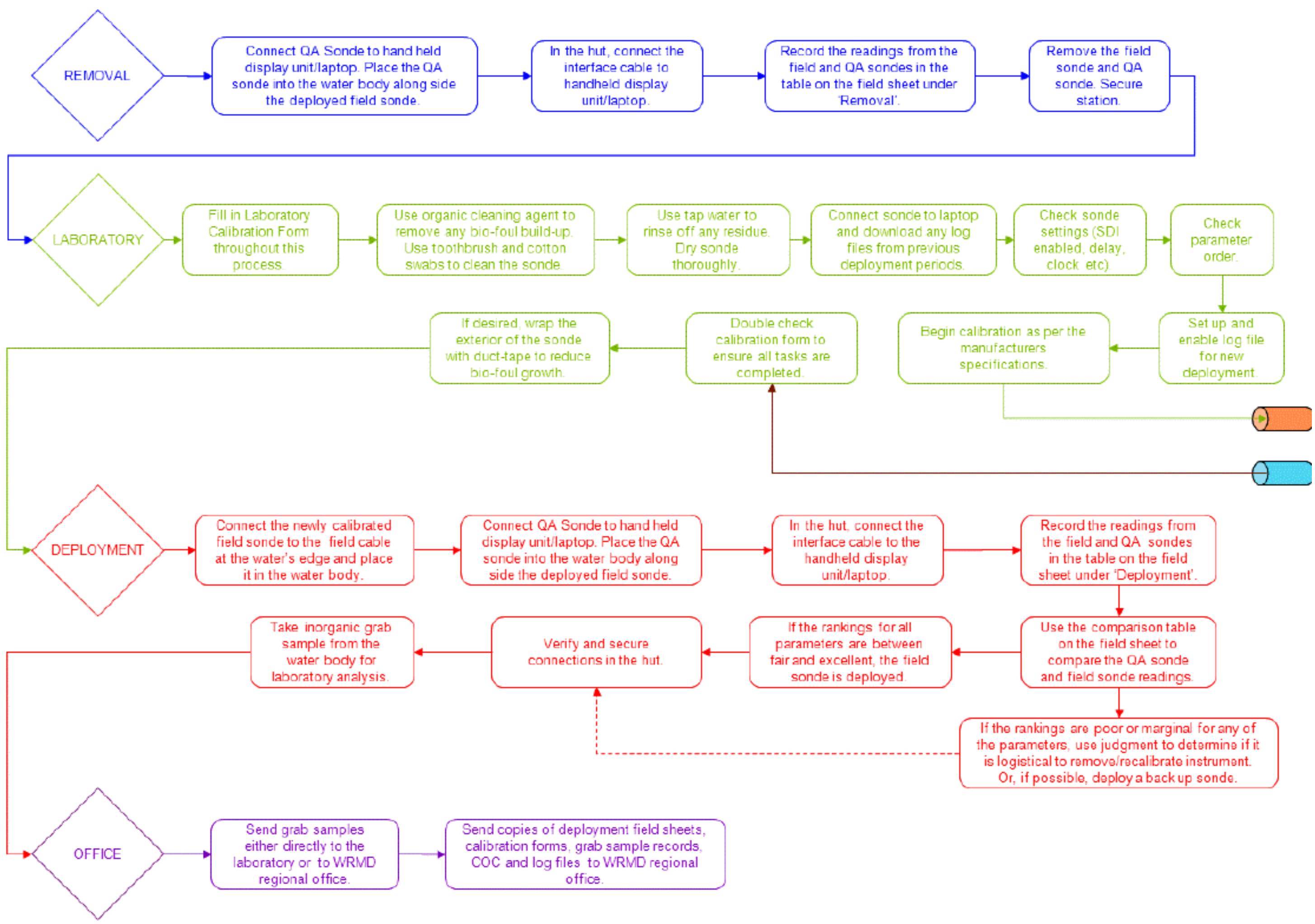


Figure 19: Maintenance and Calibration Flowchart

Data Interpretation

The following data, graphs and discussion illustrate water quality related events over the 10 year time frame from the 2003 deployment season onto the 2013 deployment season for the Voisey's Bay RTWQ Network.

With the exception of water quantity data (stage), all data used in the preparation of the graphs and subsequent discussion below adhere to WRMD stringent QAQC protocol. Water Survey of Canada is responsible for QAQC of water quantity data. Corrected data can be obtained upon request to Water Survey of Canada.

Any explicit data related issues or problems are outlined in the monthly reports for the applicable timeframe.

RTWQ Data Review 2003-2013

Water Temperature

Water Temperature is one of the most important water quality elements that can be monitored and recorded. Water temperature dictates the life cycles of aquatic organisms and ensures the correct amount of dissolved oxygen is present to maintain life in the water bodies. Over the course of ten years, the water temperatures recorded at all the Voisey's Bay real-time stations represented a natural fluctuation. Each year displays the higher summer water temperatures and then the decrease down toward the cooler water temperatures as it moves into the fall and winter season. The deployment seasons ranged from June through to November and allowed the water quality instruments an effective timeframe for capturing any changes that may have occurred in the water.

The water temperature data was analyzed several different ways, it was charted for each station from 2003-2013 (see Figure 20, 22, 24, 26), the medians were displayed in a box plot (Figures 21, 23, 25, 27), and the data was split by year into different phases of the mine's development to indicate any changes in the water temperature based on the activities around the brooks. The ten year data was divided into the construction stage from 2003 to 2005 (Tables 1) and operational phase from 2006 to 2013 (Table 2).

Over the ten years of data, the lowest median temperature recorded was 2.37^{o}C at Lower Reid Brook below Tributary in 2003. The highest median water temperature was captured at Camp Pond Brook below Camp Pond with a median of 12.70^{o}C and was calculated from the 2008 data. Of all the years of data captured, 2008 had the highest temperature medians for three out of the four stations over a ten year period (Appendix C, Table C1).

When the medians were calculated by month per year (Appendix C, Table C2) the data indicated that the highest median for all stations was during the operational phase of the mine activities. The high water temperature medians occurred in August (2010) for all four of the stations.

The trend analysis identified that there was no trend for the water temperature data at Reid Brook below Reid Pond, Lower Reid Brook below Tributary or Camp Pond Brook for the construction phase (Table 1) or the operational phase (Table 2). This indicated that there were no differences in the water temperature throughout the 10 years of data recorded at these stations. Tributary to Lower Reid Brook station was newly installed in 2006 therefore the station cannot provide a trend in the water temperatures for the construction stage, however there was no trend observed for water temperature during the operation phase, indicating no change in water temperature over the eight years the data was being monitored (Table 2).

Water Temperature; Construction Phase 2003-2005				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.290	0.162	Data	0.423
Spearman's rho	-0.263	-0.355	Not	-0.215
Parameter Count	18	17	Sufficient	16
Significant Level	0.05	0.05	At this	0.05
Trend Result	No	No	Stage	No

Table 1: Analysis of Water Temperature for Construction Phase 2003-2005

Water Temperature; Operational Phase 2006-2013				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.827	0.599	0.377	0.958
Spearman's rho	-0.036	-0.082	-0.149	-0.008
Parameter Count	39	43	37	43
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No

Table 2: Analysis of Water Temperature for Operational Phase 2006-2013

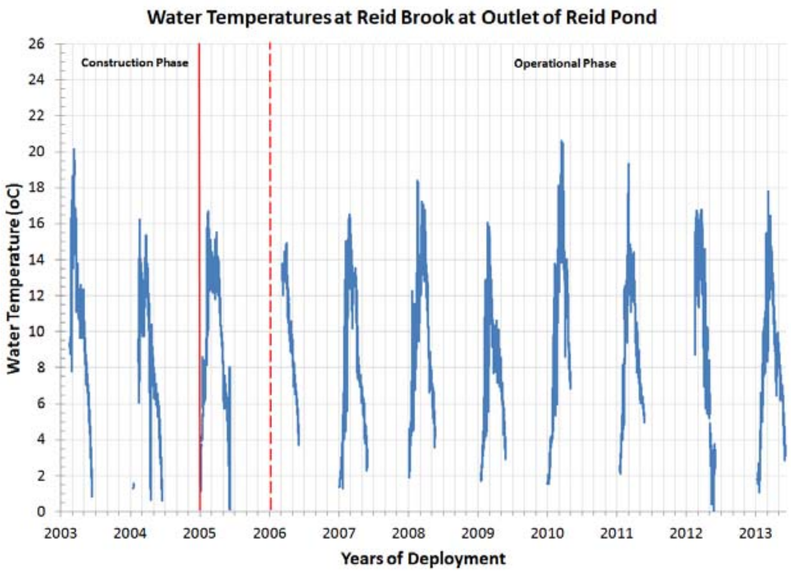


Figure 20. Water Temperature at Reid Brook graphed over the ten year period

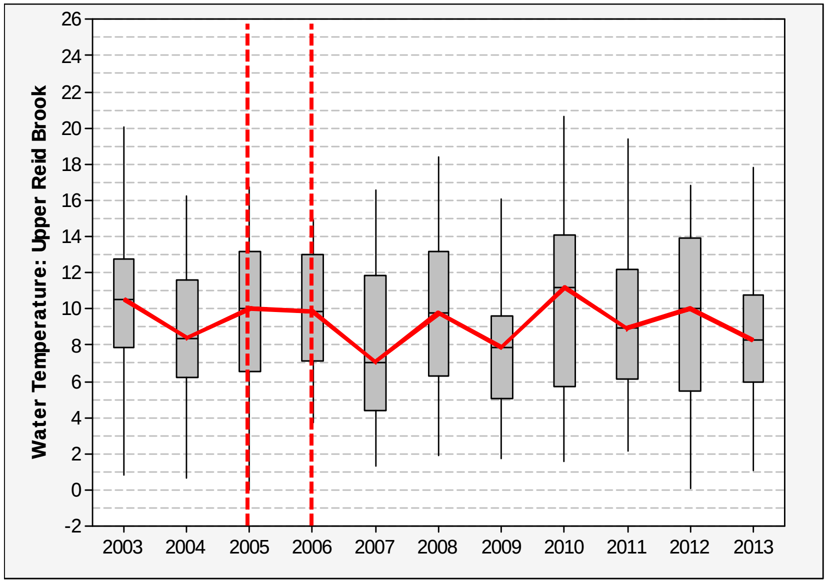


Figure 21. Boxplot of Water Temperature at Reid Brook

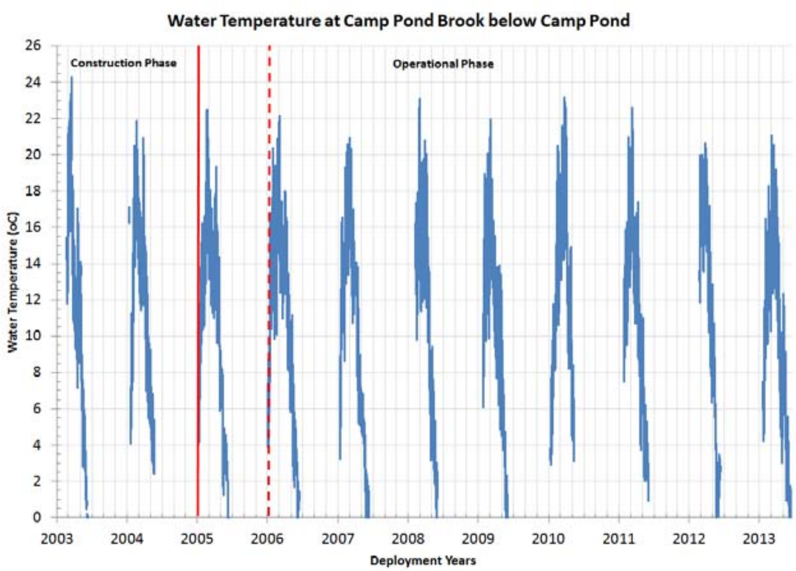


Figure 22. Water Temperature at Camp Pond Brook graphed over the ten year period

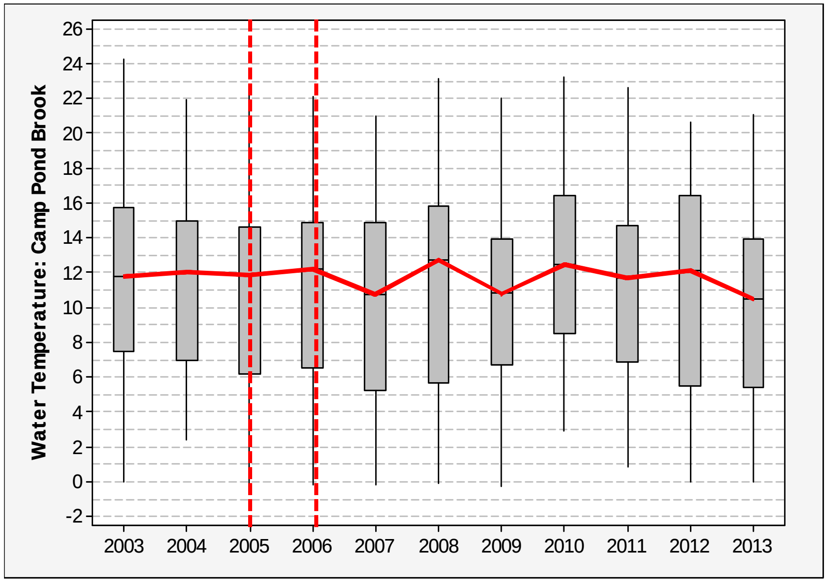


Figure 23. Boxplot of Water Temperature at Camp Pond Brook

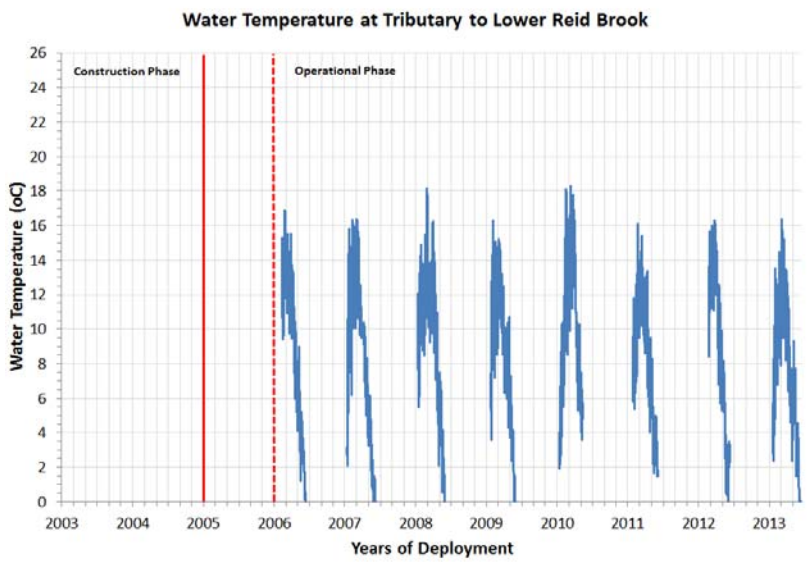


Figure 24. Water Temperature at Tributary to Lower Reid Brook graphed over the ten year period

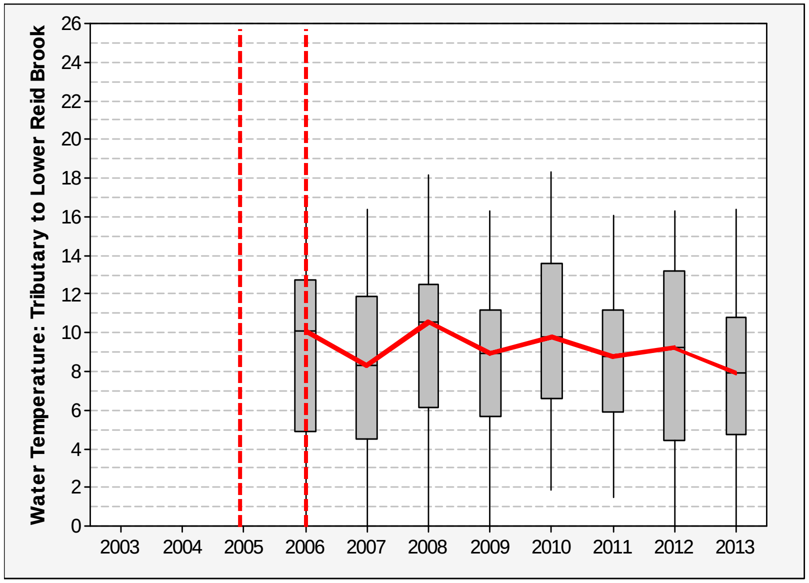


Figure 25. Boxplot of Water Temperature at Tributary to Lower Reid Brook

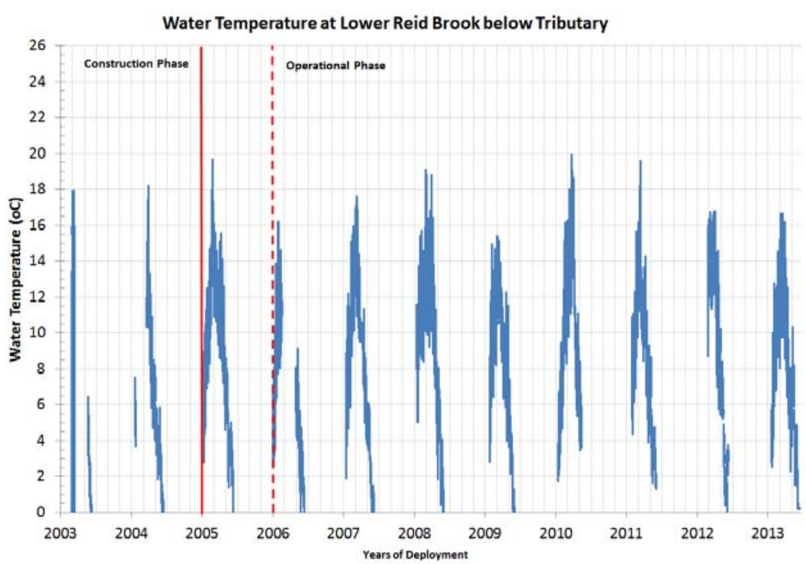


Figure 26. Water Temperature at Lower Reid Brook graphed over the ten year period

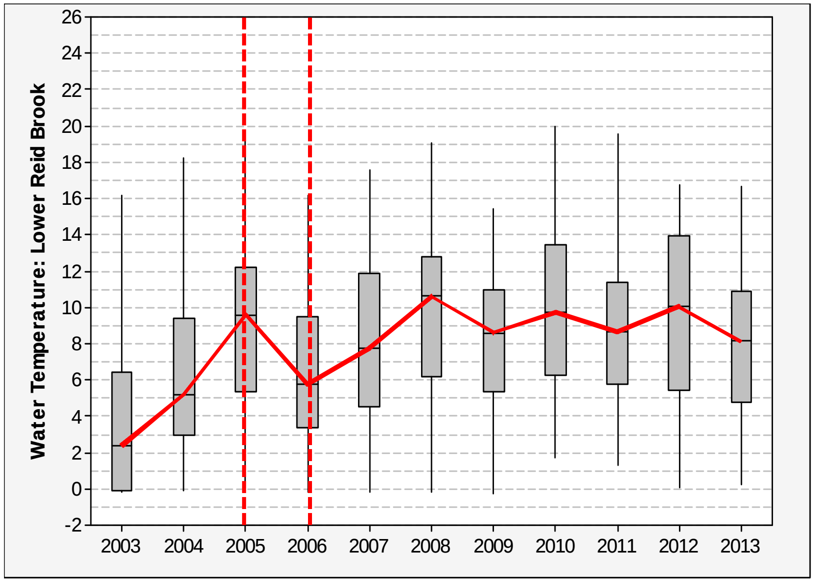


Figure 27. Boxplot of Water Temperature at Lower Reid Brook

pH

pH is the measurement of the concentration of hydrogen ions in the water body. Changes in pH values can have impacts on the aquatic environment both in stream and in riparian environments. pH is affected largely by the geologic environment but also by the activities in a watershed (urban runoff, agricultural, mining, etc.)

The Canadian Council of Ministers for the Environment (CCME) has produced a guideline for the protection of aquatic life (PAL) in cold water environments. The guideline suggests pH should remain between 6.5 and 9 pH units. Often at the stations in the Voisey's Bay network, the pH value is <6.5 however this is likely a natural adjustment over time. Values in the low end of the recommended range occur at the baseline station at Reid Brook below Reid Pond which is a consistent and pristine environment.

The pH data was analyzed several different ways, it was charted for each station from 2003-2013 (see Figures 28, 30, 32, 34), the medians were displayed in a box plot (Figure 29, 31, 33, 35), and the data was split by year into different phases of the mine's development to indicate any changes in the pH based on the activities around the brooks. The ten year data was divided into the construction stage from 2003 to 2005 (Table 3) and operational phase from 2006 to 2013 (Table 4).

The monthly medians for pH data was calculated for each year (Appendix C, see Table C4) and analysed for correlation using Spearman Rank and Mann Kendall trend analysis. The highest median for pH over the entire ten year period was found at Lower Reid Brook below Tributary at 7.3 pH units in 2007. The lowest median for pH over the ten years was in 2004 at Reid Brook below Reid Pond and calculated at 6.11 pH units. The medians were also calculated by month. The monthly median pH values revealed that the highest median by month was for Lower Reid Brook below Tributary during August in 2007 at 7.94 pH units (Appendix C, Table C4).

The construction pH dataset (from 2003 to 2005) was analysed for correlation using Spearman Rank correlation coefficient analysis (Table 3). The analysis identified no trends for Reid Brook below Reid Pond and Camp Pond Brook below Camp Pond. The analysis did indicate there was an increase in pH at Lower Reid Brook below Tributary during the construction phase with a p-value of 0.002 (significance level of 0.05). This small increase in pH at Lower Reid Brook below Tributary is most likely a natural occurrence at this time. While it is possible that the construction site runoff from mine activity and the movement of suspended materials could have contributed to the pH increase, the location of this station makes pH increases related to mining activities, highly unlikely. The boxplot (Figure 35) of the data indicates that Lower Reid Brook below Tributary quickly recovered to the pre-existing pH levels in the following year.

The data from the operational phase (2006 to 2013) was analysed for correlation using Spearman Rank correlation coefficient analysis (Table 4). The analysis indicated that Reid Brook below Reid Pond, Camp Pond Brook below Camp

Pond, Tributary to Lower Reid Brook and Lower Reid Brook below Tributary had no significant change in pH levels during this time frame. The only station that indicated a difference was Lower Reid Brook below Tributary, the pH data changed from an upward trend in the construction phase to no trend (p-value of 0.063) during the operational phase (significance level of 0.05).

pH; Construction Phase 2003-2005				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to Lower Reid**	**Lower Reid Brook**
P- Value	0.189	0.217	Data	0.002
Spearman's rho	0.324	0.316	Not	0.738
Parameter Count	18	17	Sufficient	16
Significant Level	0.05	0.05	At this	0.05
Trend Result	No	No	Stage	Up

Table 3: Analysis of pH for Construction Phase 2003-2005

pH; Operational Phase 2006-2013				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to Lower Reid**	**Lower Reid Brook**
P- Value	0.382	0.385	0.123	0.063
Spearman's rho	0.140	0.134	-0.258	-0.286
Parameter Count	41	44	37	43
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No

Table 4: Analysis of pH for Operational Phase 2006-2013

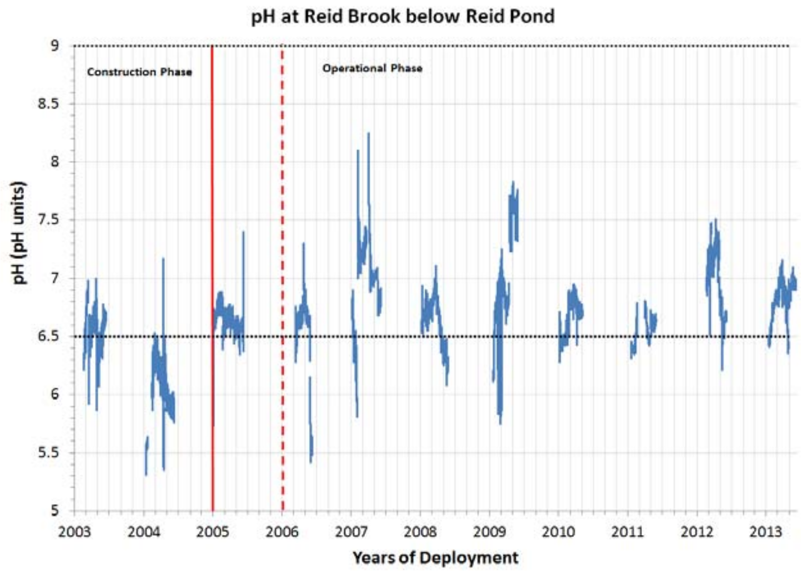


Figure 28. pH at Reid Brook below Reid Pond graphed over the ten year period

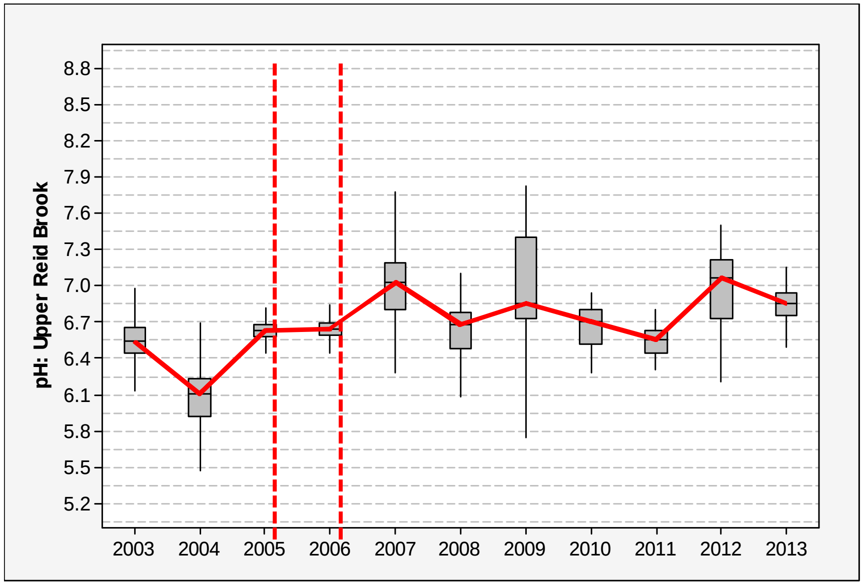


Figure 29. Boxplot of pH at Reid Brook below Reid Pond

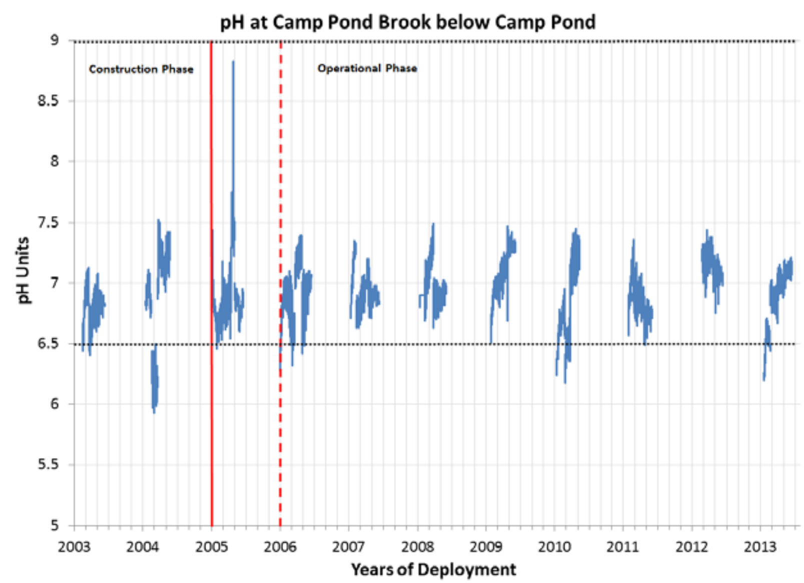


Figure 30. pH at Camp Pond Brook graphed over the ten year period

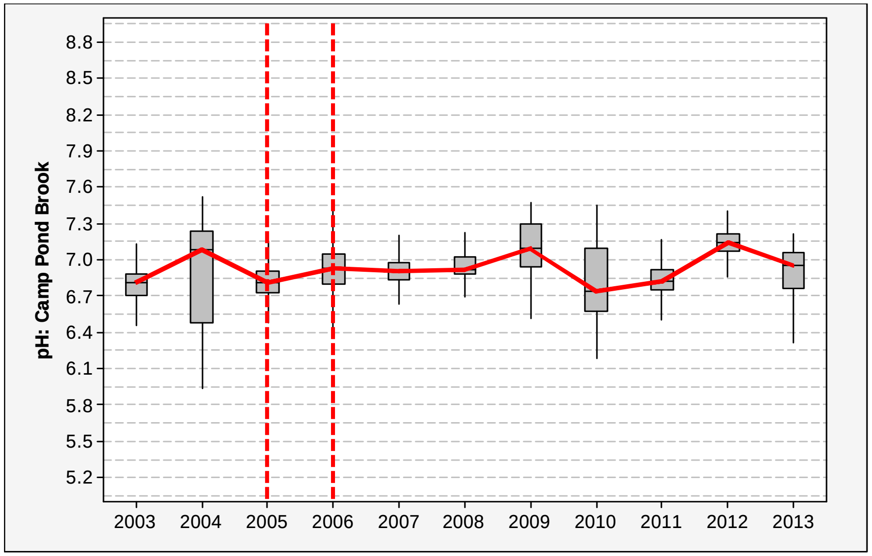


Figure 31. Boxplot of pH at Camp Pond Brook

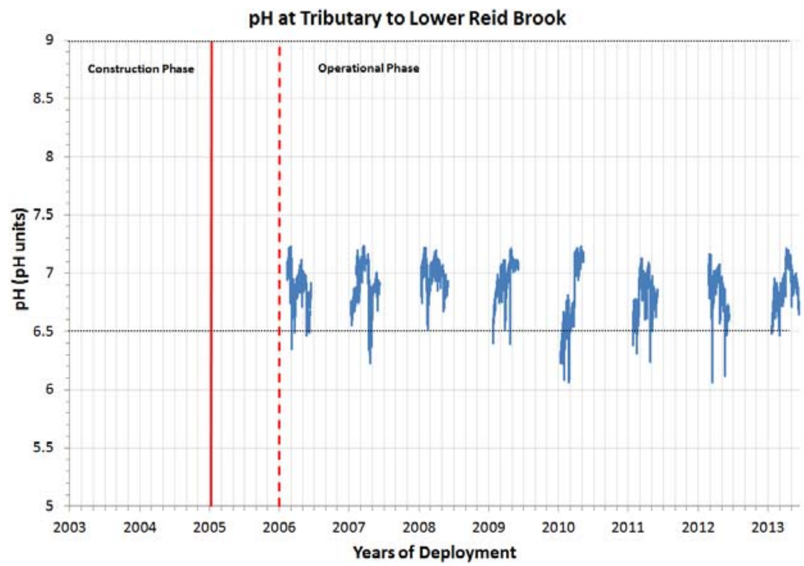


Figure 32. pH at Tributary to Lower Reid Brook graphed over the ten year period

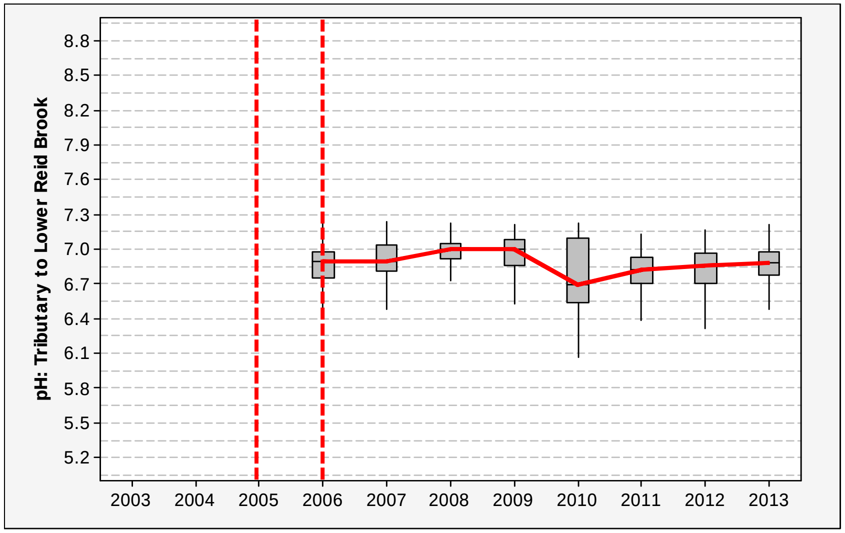


Figure 33. Boxplot of pH at Tributary to Lower Reid Brook

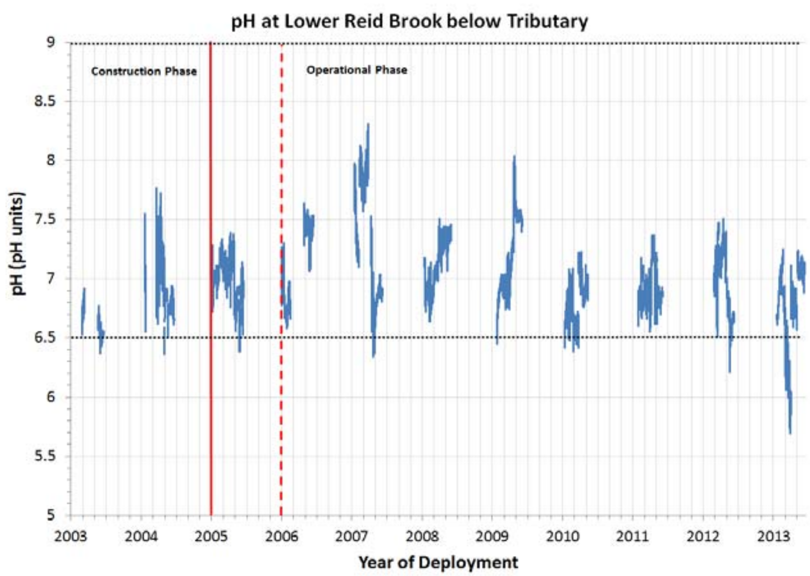


Figure 34. pH at Lower Reid Brook graphed over the ten year period

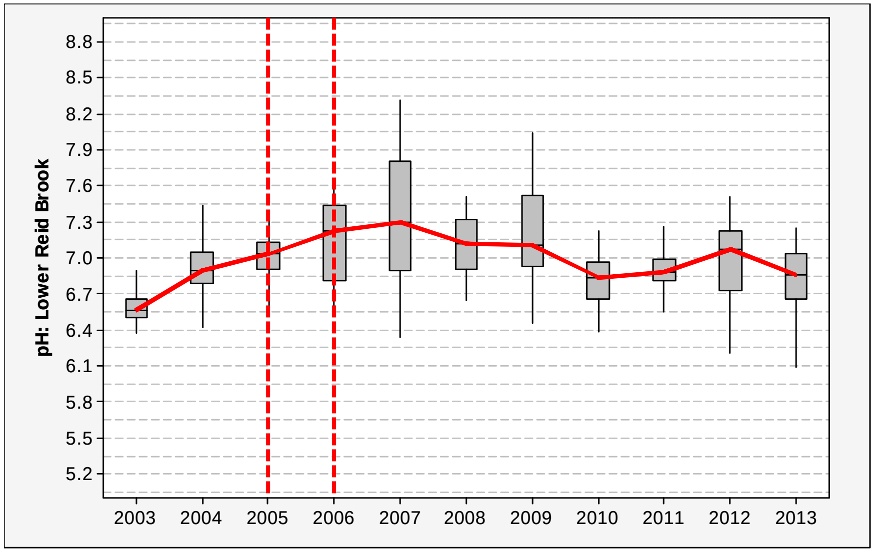


Figure 35. Boxplot of pH at Lower Reid Brook

Specific Conductance

Specific conductivity is the measurement of the ionic activity and capability of a water body to conduct electric current. High conductivity indicates there are large concentrations of minerals and ions in the water such as sodium and chloride. Specific conductivity is measured in units of microSiemens per centimeter (µS/cm) on the water quality instruments at Voisey's Bay (HACH Hydrolab 2006). Changes in specific conductivity values can impact the aquatic environment. Generally, specific conductivity is influenced by the geologic environment, although can be effected by the anthropogenic activities in a watershed (i.e. roadway runoff, land clearing, etc).

The specific conductivity data was analyzed several different ways, it was charted for each station from 2003-2013 (see Figure 36, 38, 40, 42) the conductivity medians were displayed in box plots (Figure 37, 39, 41, 43), and the data was split by years into different phases of the mine's development to indicate any changes in the conductivity based on the activities around the brooks. The ten year data was divided into the construction stage from 2003 to 2005 (Table 5) and operational phase from 2006 to 2013 (Table 6).

The highest median for specific conductivity over the ten year period was found at Tributary to Lower Reid Brook at 38.1µS/cm in 2013. The lowest median for conductivity over the ten years was in 2006 at Reid Brook at Outlet of Reid Pond and calculated at 5.9µS/cm (Appendix C, Table C5). The monthly median conductivity values revealed that the highest median by month was for Tributary to Lower Reid Brook during November in 2013 at 49.3µS/cm (Appendix C, Table C6).

Sharp increases (spikes) in specific conductivity are common among the downstream stations of Camp Pond Brook below Camp Pond, Tributary to Lower Reid Brook and Lower Reid Brook below Tributary. These 'spikes' are generally short lived and often times have been attributed to periods of low stage level. At Tributary to Lower Reid Brook and Lower Reid Brook, rainfall events often caused the specific conductivity levels to decrease as concentrations of dissolved solids are diluted by the increased water levels. At the station at Camp Pond Brook, rainfall events have the opposite effect; rainfall causes increases in specific conductivity. Materials and suspended solids flowing overland from the main camp that is adjacent to the station are deposited into the brook. Specific conductivity increases such as these are common and the data almost always returns to background levels following the events.

Monthly median specific conductivity values were calculated for the phases of development and analysed for correlation using Spearman Rank correlation coefficient. For the construction phase of the mine's development the resulting correlation was null at all stations indicating there was no significant increases (significance level of 0.05) in specific conductivity between 2003 and 2005 (Table 5). Generally, specific conductivity at the station at Reid Brook at outlet of Reid Pond is considerably lower and more stable than the downstream stations, with median values around 8.5µS/cm in

2003 and 12.6µS/cm in 2013. At the stations on Camp Pond Brook and Lower Reid Brook below Tributary, specific conductivity values had medians within 27.1µS/cm in 2003 and 56.6µS/cm in 2013.

For the operational phase of the mine's development the resulting correlation indicated that there was an upward trend (significant level 0.05) for specific conductance at all four real-time stations Reid Brook below Reid Pond, Camp Pond Brook below Camp Pond, Tributary to Lower Reid brook and Lower Reid below Tributary (Table 6). The increase is occurring at all stations in the network including the baseline station at Reid Brook at Outlet of Reid Pond indicating that this may be a natural increase in the region. The increases in specific conductivity do not appear to be related to mining operations.

Specific Conductivity; Construction Phase 2003-2005				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to Lower Reid**	**Lower Reid Brook**
P- Value	0.148	0.680	Data	0.961
Spearman's rho	0.366	0.112	Not	0.013
Parameter Count	17	16	Sufficient	16
Significant Level	0.05	0.05	At this	0.05
Trend Result	No	No	Stage	No

Table 5: Analysis of Specific Conductivity for Constructional Phase 2003-2005

Specific Conductivity ; Operational Phase 2006-2013				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to Lower Reid**	**Lower Reid Brook**
P- Value	0.000	0.000	0.00219	0.004
Spearman's rho	0.647	0.719	0.488	0.488
Parameter Count	41	43	37	37
Significant Level	0.05	0.05	0.05	0.05
Trend Result	Up	Up	Up	Up

Table 6: Analysis of Specific Conductivity for Operational Phase 2006-2013

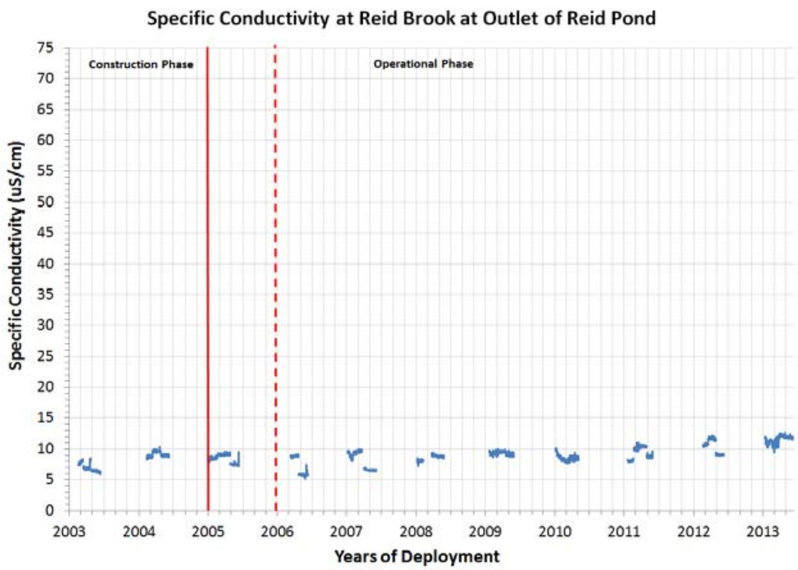


Figure 36. Specific Conductivity at Reid Brook graphed over the ten year period

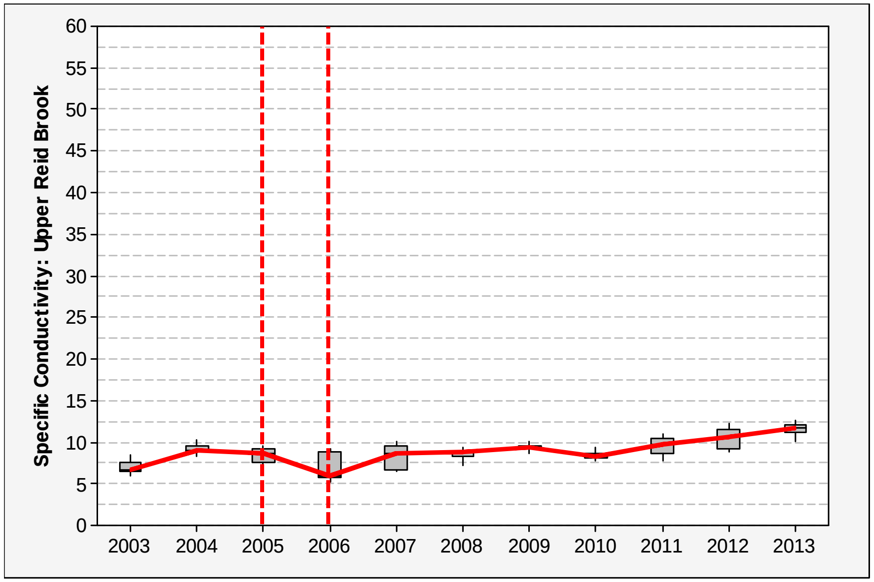


Figure 37. Boxplot of Specific Conductivity at Reid Brook

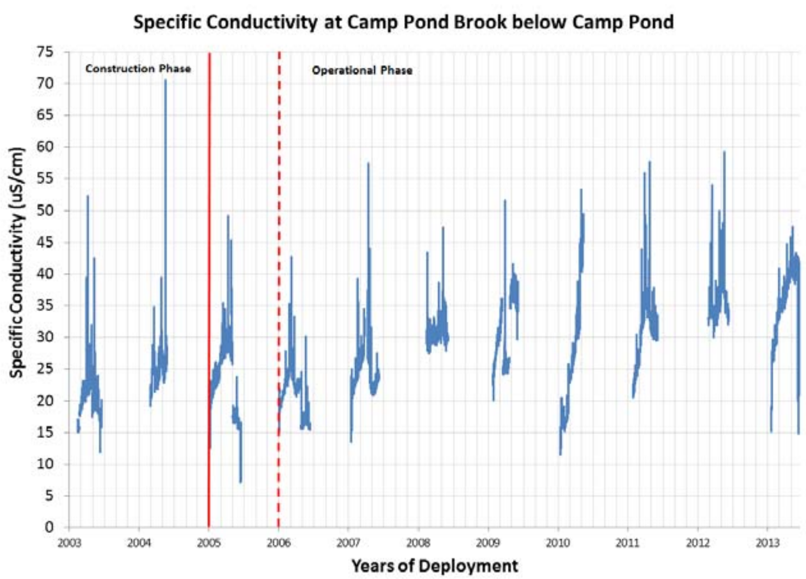


Figure 38. Specific Conductivity at Camp Pond Brook graphed over the ten year period

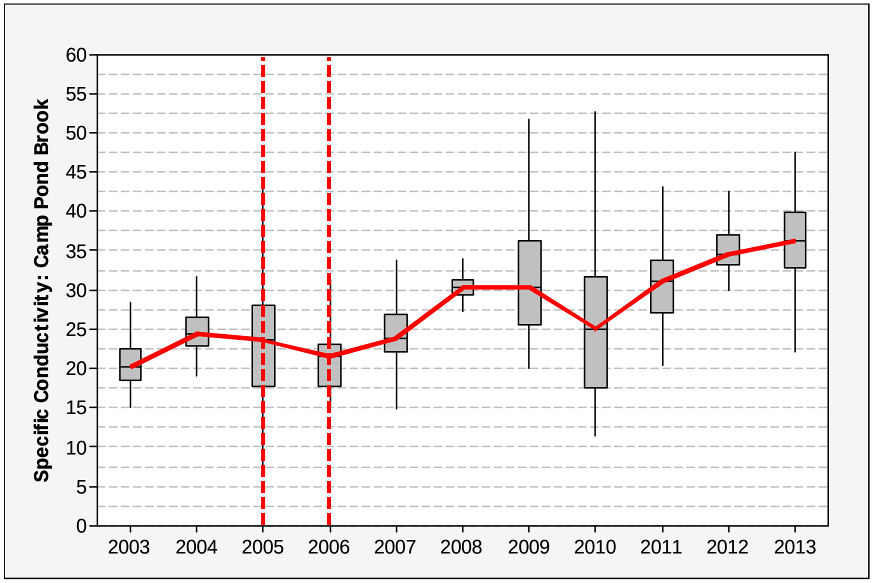


Figure 39. Boxplot of Specific Conductivity at Camp Pond Brook

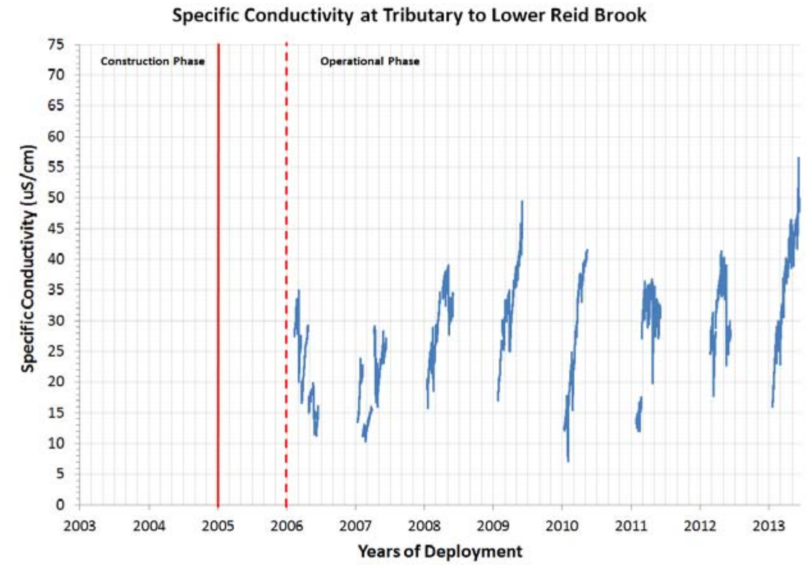


Figure 40. Specific Conductivity at Tributary to Lower Reid Brook graphed over the ten year period

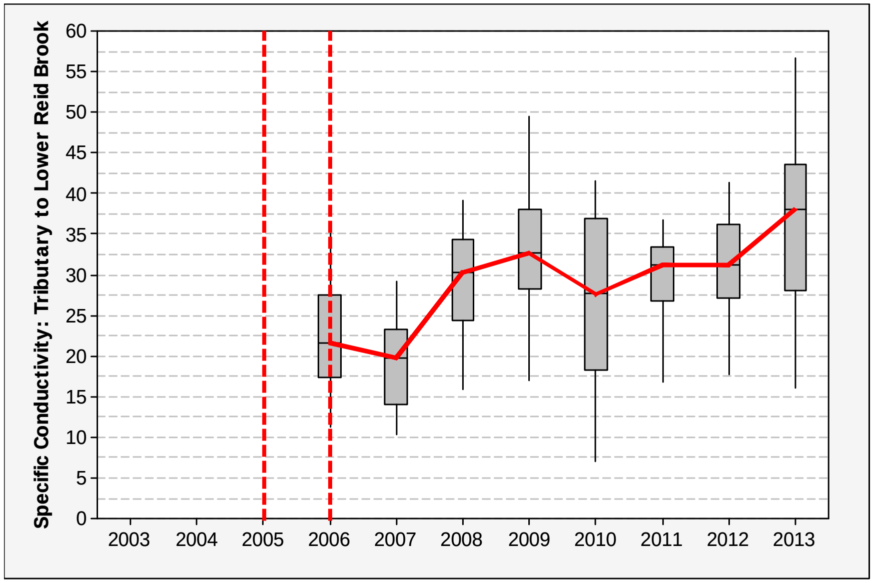


Figure 41. Boxplot of Specific Conductivity at Tributary to Lower Reid Brook

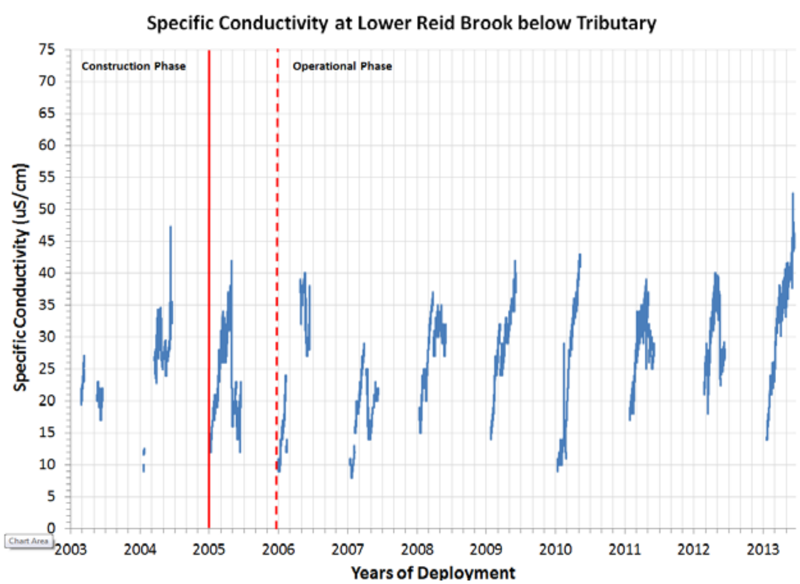


Figure 42. Specific Conductivity at Lower Reid Brook graphed over the ten year period

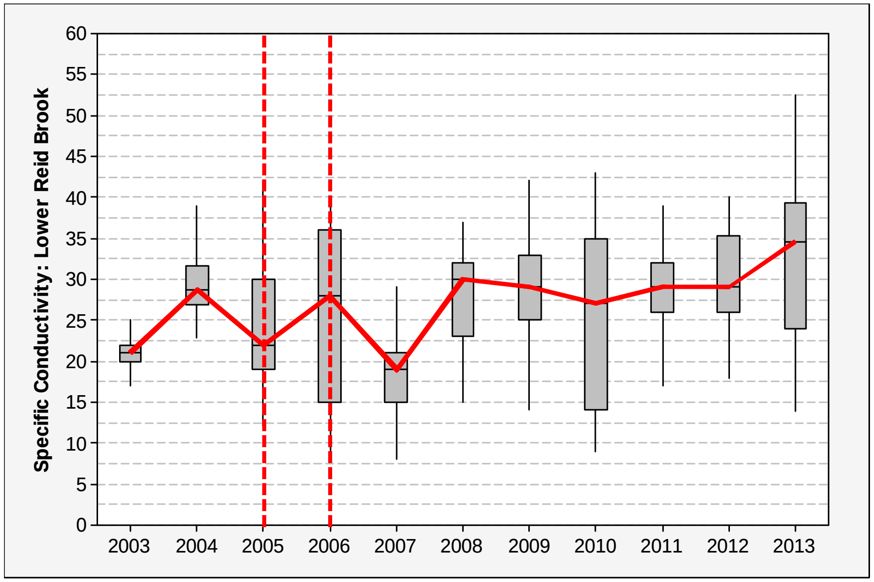


Figure 43. Boxplot of Specific Conductivity at Lower Reid Brook

Dissolved Oxygen

Dissolved oxygen is the measurement of the oxygen content in the water column. Dissolved oxygen content is necessary for most biological life to survive in the water body. The amount of dissolved oxygen in the water column is dependent upon the types of aerobic organism and plants, exposure to natural aeration (waterfalls, riffles etc.) water temperature, flow and depth (HACH Hydrolab 2006).

The CCME have produced a guideline for the protection of aquatic life in cold water environments. The guideline suggests dissolved oxygen content should remain above 9.5mg/l for early life stages and above 6.5mg/l for other life stages. Typically at the stations in the Voisey's Bay network, dissolved oxygen rarely goes below the 6.5mg/l guideline if the sensor is functioning properly. For most deployment seasons, dissolved oxygen content does drop to just below the 9.5mg/l guideline when the water temperatures are the warmest, usually in early August. This decrease below the 9.5mg/l guideline is typically short-lived between 2-4 weeks.

Dissolved oxygen content usually follows a seasonal pattern inversely related to water temperature. As water temperatures are warming in the spring and early summer months, dissolved oxygen content is typically decreasing. In the late summer and into the fall months, water temperatures are decreasing and dissolved oxygen content is increasing.

The dissolved oxygen data was analyzed several different ways, it was graphed for each station from 2003-2013 (see Figures 44, 46, 48, 50), the conductivity medians were displayed in box plots, boxplots were created to display the range of the majority of the data and the yearly median values are connected to visually display any increase or decrease between years (Figure 45, 47, 49, 51). Yearly summary statistics were calculated from the dissolved oxygen data collected (Appendix C, Table C8) and the data was split by years into different phases of the mine's development to indicate any changes in the dissolved oxygen based on the activities around the brooks. The ten year data was divided into the construction stage from 2003 to 2005 (Table 7) and operational phase from 2006 to 2013 (Table 8).

The highest median for dissolved oxygen over the ten year period was found at Reid Brook below Reid Pond at 12.53mg/L in 2007. The lowest median for dissolved oxygen over the ten years was in 2010 at Lower Reid Brook below Tributary and calculated at 8.54mg/L. The monthly dissolved oxygen medians revealed that the highest median by month was for Reid Brook at Outlet of Reid Pond during November in 2007 at 15.65mg/L (Appendix C, Table C9).

Monthly median dissolved oxygen values were calculated for the phases of development and analysed for correlation using Spearman Rank and Mann Kendall correlation coefficient. For the construction phase of the mine's development the resulting correlation was null at Reid Brook below Reid Pond and Lower Reid Brook below Tributary indicating there was no significant changes (significance level of 0.05) in dissolved oxygen between 2003 and 2005. For Camp Pond Brook below Camp Pond the analysis indicated that there was an upward trend (significant value of 0.05) in the dissolved oxygen during the construction phase of the mine (Table 7).

For the operational phase of the mine's development the resulting correlation indicated that there was no trend (significant level 0.05) for dissolved oxygen at Reid Brook below Reid Pond, Camp Pond Brook below Camp Pond, Tributary to Lower Reid brook, and Lower Reid below Tributary (Table 8).

Dissolved Oxygen; Construction Phase 2003-2005				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.431	0.030	Data	0.114
Spearman's rho	0.197	0.550	Not	0.412
Parameter Count	18	16	Sufficient	16
Significant Level	0.05	0.05	At this	0.05
Trend Result	No	Up	Station	No

Table 7. Analysis of Dissolved Oxygen for Constructional Phase 2003-2005

Dissolved Oxygen; Operational Phase 2006-2013				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.399	0.171	0.715	0.386
Spearman's rho	0.149	0.212	0.0618	0.149
Parameter Count	34	43	37	36
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	No	No	No

Table 8. Analysis of Dissolved Oxygen for Operational Phase 2006-2013

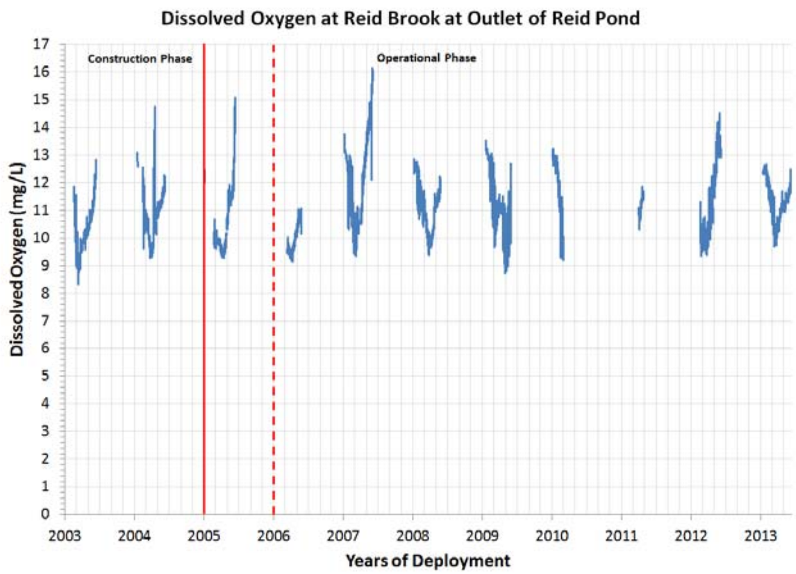


Figure 44. Dissolved Oxygen at Reid Brook graphed over the ten year period

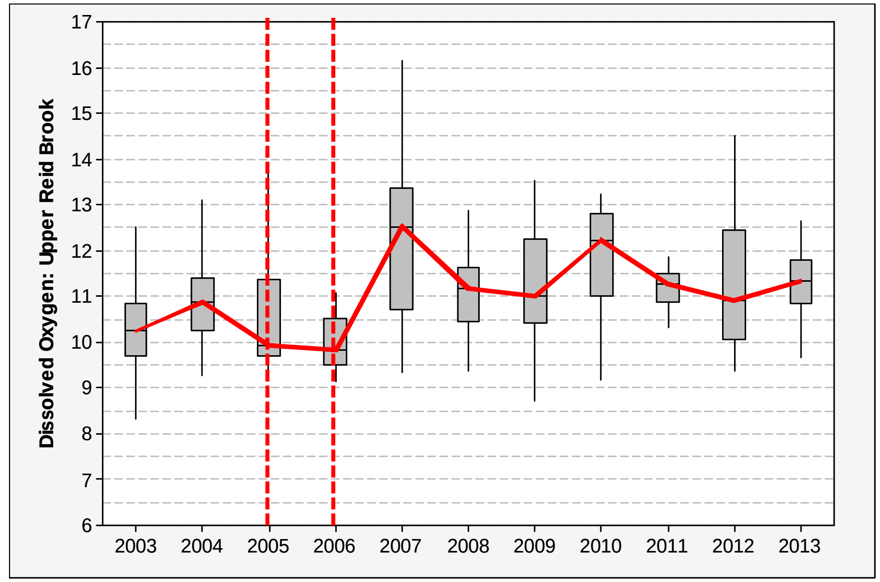


Figure 45. Boxplot of Dissolved Oxygen at Reid Brook

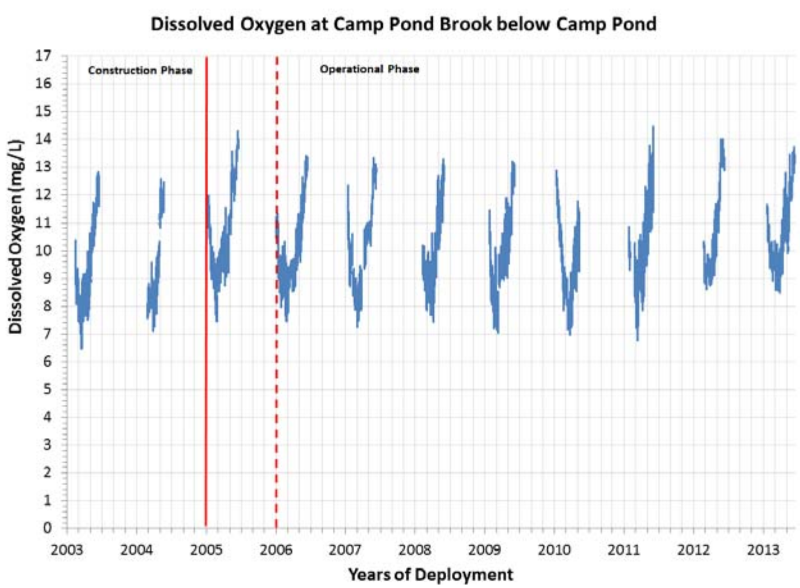


Figure 46. Dissolved Oxygen at Camp Pond Brook graphed over the ten year period

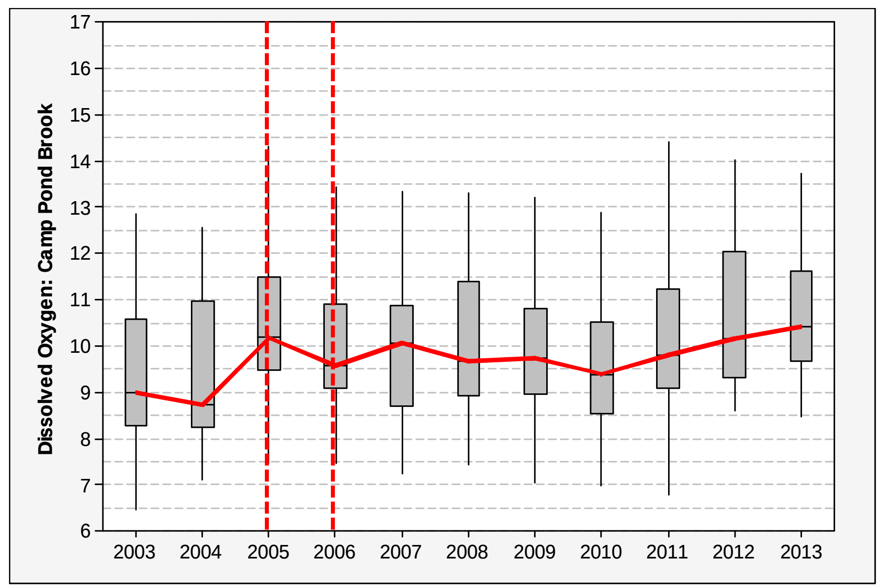


Figure 47. Boxplot of Dissolved Oxygen at Camp Pond Brook

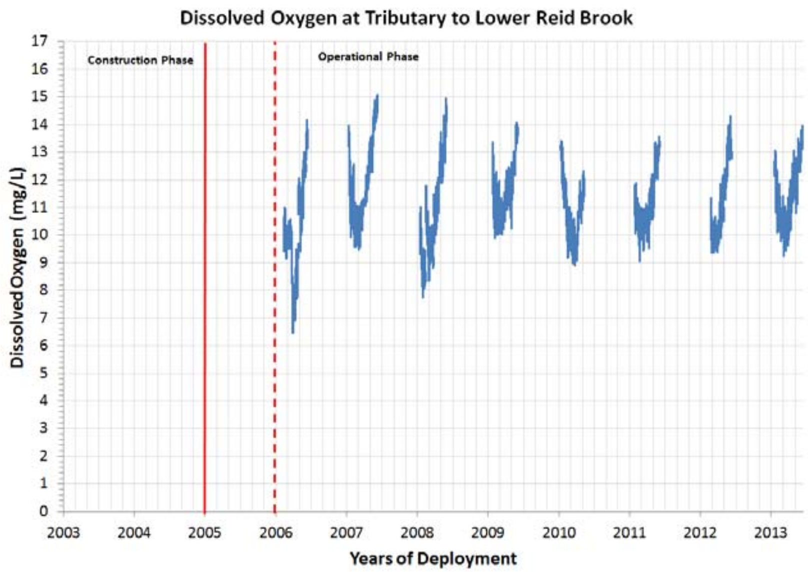


Figure 48. Dissolved Oxygen at Tributary to Lower Reid Brook graphed over the ten year period

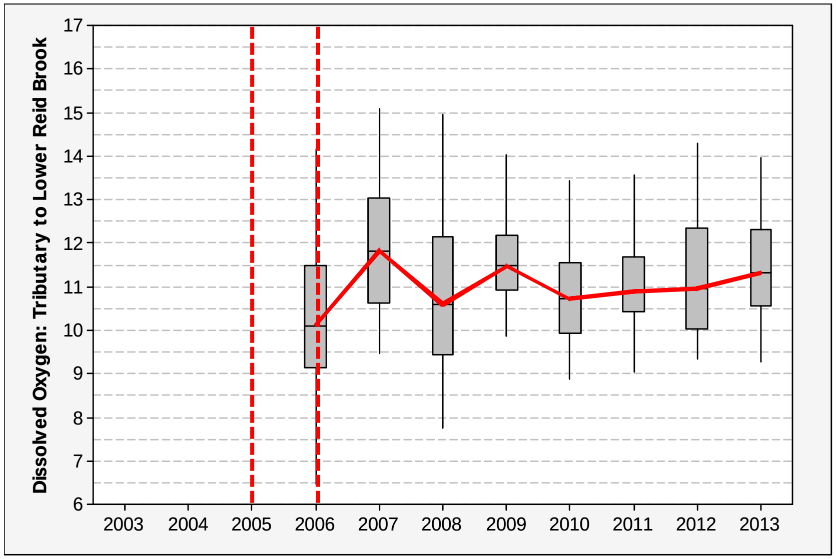


Figure 49. Boxplot of Dissolved Oxygen at Tributary to Lower Reid Brook

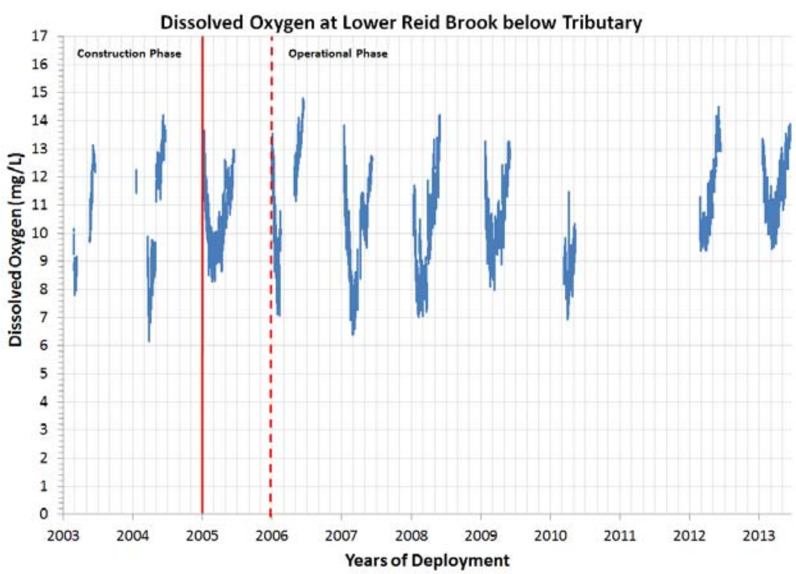


Figure 50. Dissolved Oxygen at Lower Reid Brook graphed over the ten year period

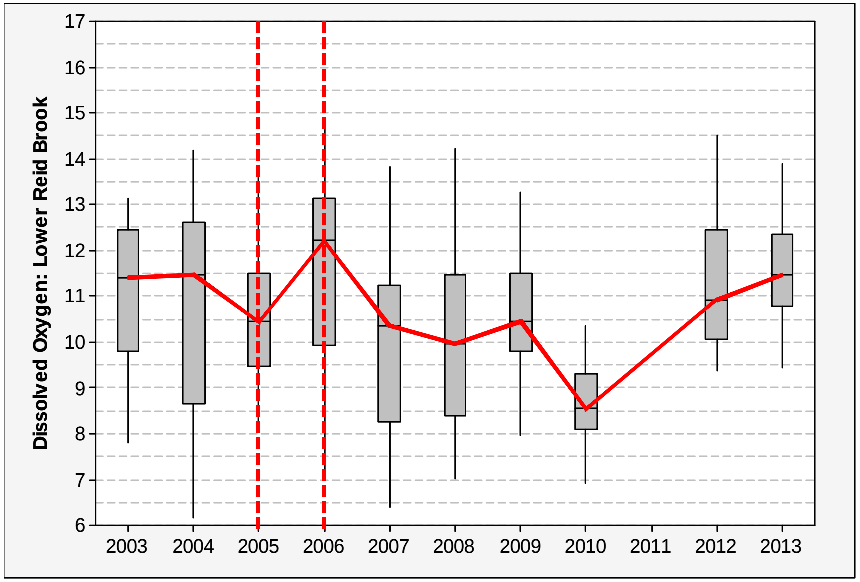


Figure 51. Boxplot of Dissolved Oxygen at Lower Reid Brook

Turbidity

Turbidity is the measurement of the translucence of water and is related to the amount of suspended material in the water column. Turbidity is measured in nephlometric turbidity units (NTU). High levels of turbidity can affect the diversity of aquatic life and the distribution of heat throughout the water column (HACH Hydrolab 2006).

The turbidity data was analyzed several different ways, it was graphed for each station from 2003-2013 (see Figures 52, 54, 56, 58), the medians were displayed in box plots, boxplots were created to display the range of the majority of the data and the yearly median values are connected to visually display any increase or decrease between years (see Figures 53, 55, 57, 59). Yearly summary statistics were calculated from the turbidity data collected and the data was split by years into different phases of the Voisey's Bay development to indicate any changes in the turbidity based on the activities around the brooks. The 10 year data was divided into the construction stage from 2003 to 2005 (See Table 9) and operational phase from 2006 to 2013 (See Table 10).

Monthly median turbidity values were calculated for each year and analysed for correlation using Spearman Rank and Mann Kendall trend analysis (Appendix D, Table D5). The results from the construction phase of the trend analysis identified that there was no change in turbidity (with a significance level of 0.05) at Reid Brook below Reid Pond. There was no significant increase or decrease in turbidity between 2003 and 2005. This correlation would be expected at Reid Brook given that there was no background turbidity at the station and there are no construction activities in the Reid Brook watershed (Table 9).

Camp Pond Brook below Camp Pond showed a downward trend in the turbidity data during the construction phase of the mine development. This trend continued in the operational phase (2006-2013). In 2003, there were a number of significant spikes in turbidity recorded at Camp Pond Brook below Camp Pond. The turbidity spikes where mostly concentrated in September. It was identified through investigation by Voisey's Bay Environmental Coordinators that there was a failure in the sedimentation screens and the material in the water was not being removed before being released into Camp Pond Brook below Camp Pond. This was amended shortly after being identified by Vale NL (Renee Paterson, September Monthly Report 2003).

It was actually Lower Reid Brook below Tributary that had the highest median over the ten year period of 94 NTU during the month of June in 2004 (Appendix C, Table C11). It was determined in 2004 that due to the sandy stream bed in Lower Reid Brook below Tributary the instrument was recording inconsistent turbidity readings; this is evident on Figure 59 with the large spread of data for 2004. To rectify this, a metal frame was built to place the instrument up off the stream bed. Despite these turbidity challenges at Lower Reid Brook below Tributary, there was no trend in the turbidity data during both construction and operational phases at Voisey's Bay.

Reid Brook below Reid Pond and Tributary to Lower Reid Brook indicated no significant change in turbidity during the operational phase of the mine's development. No significant change is a good finding. The RTWQ monitoring stations captured that the construction and operational activities occurring on site did not contribute to an increase in turbidity in the surrounding water bodies (Table 10).

The large range in data at Reid Brook below Reid Pond for 2010 is likely a result of turbidity sensor failure. This incident was captured in the annual report for 2010. Figure 53 displays the large spread of data for Reid Pond in 2010 (Grace deBeer, 2010).

The results from the Spearman Rank and Mann Kendall trend analysis indicate that the environmental mitigations and protection measures against siltation around the mining operations are working to prevent degradation of water quality in the water bodies surrounding the mine.

Turbidity; Construction Phase 2003-2005				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.102	0.000	Dataset	0.118
Spearman's rho	-0.456	-0.858	Not	-0.406
Parameter Count	14	16	Sufficient	16
Significant Level	0.05	0.05	For this	0.05
Trend Result	No	Down	Stage	No

Table 9. Analysis of Turbidity for Constructional Phase 2003-2005

Turbidity; Operational Phase 2006-2013				
Test Performed	**Reid Brook**	**Camp Pond Brook**	**Tributary to LR Brook**	**Lower Reid Brook**
P- Value	0.547	0.037	0.165	0.146
Spearman's rho	-0.105	-0.323	-0.286	-0.240
Parameter Count	35	42	25	38
Significant Level	0.05	0.05	0.05	0.05
Trend Result	No	Down	No	No

Table 10. Analysis of Turbidity for Operational Phase 2006-2013

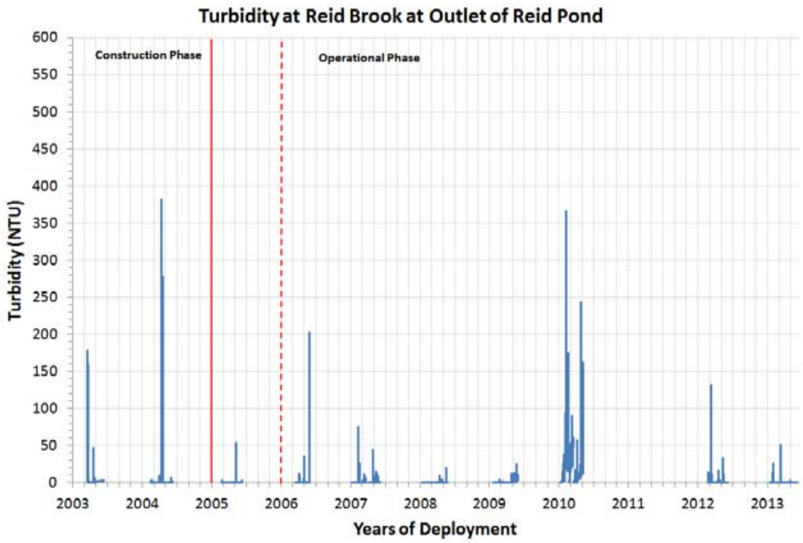


Figure 52. Turbidity at Reid Brook graphed over the ten year period

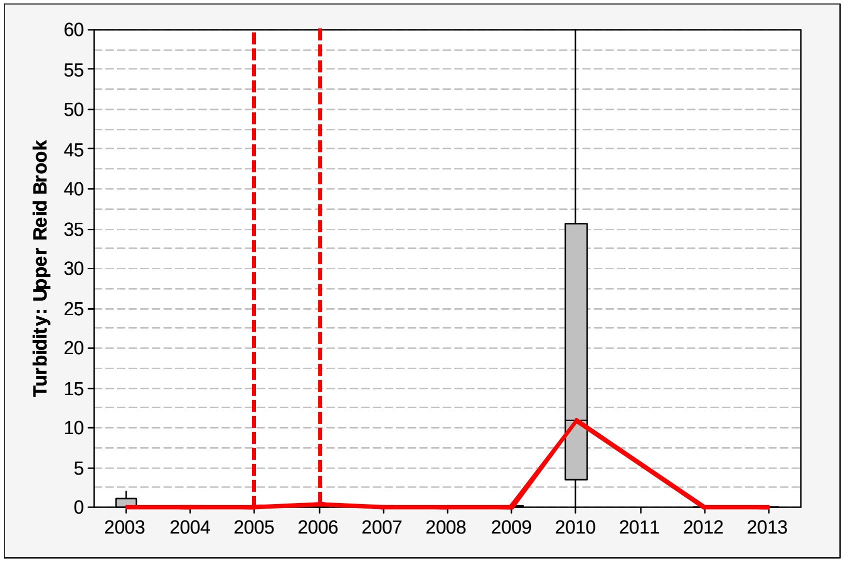


Figure 53. Boxplot of Turbidity at Reid Brook

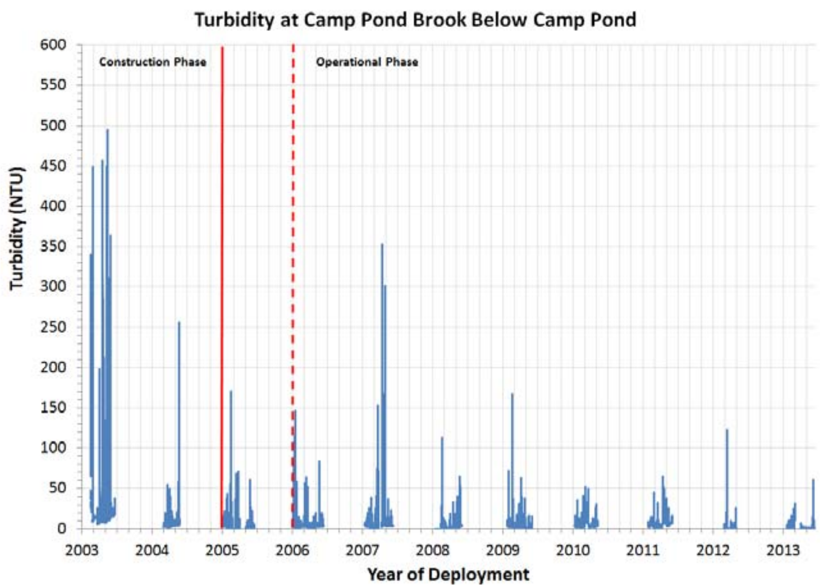


Figure 54. Turbidity at Camp Pond Brook graphed over the ten year period

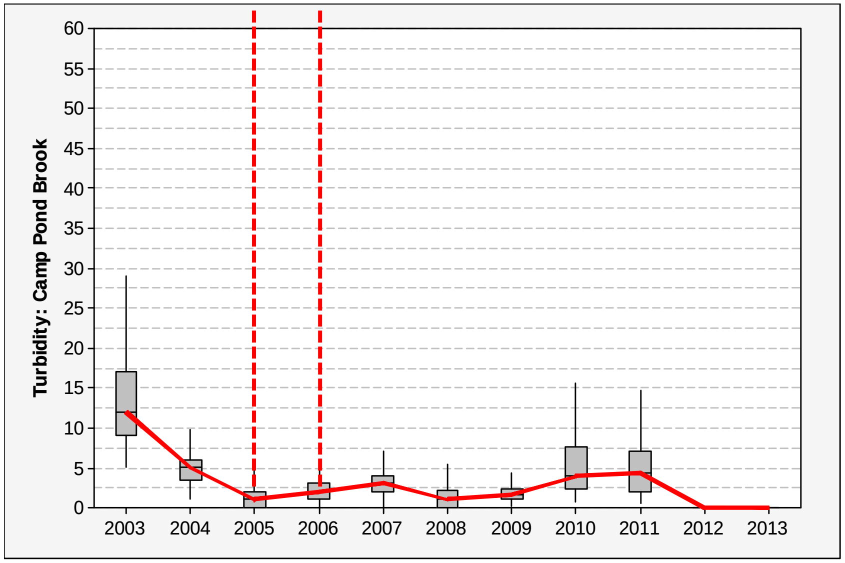


Figure 55. Boxplot of Turbidity at Camp Pond Brook

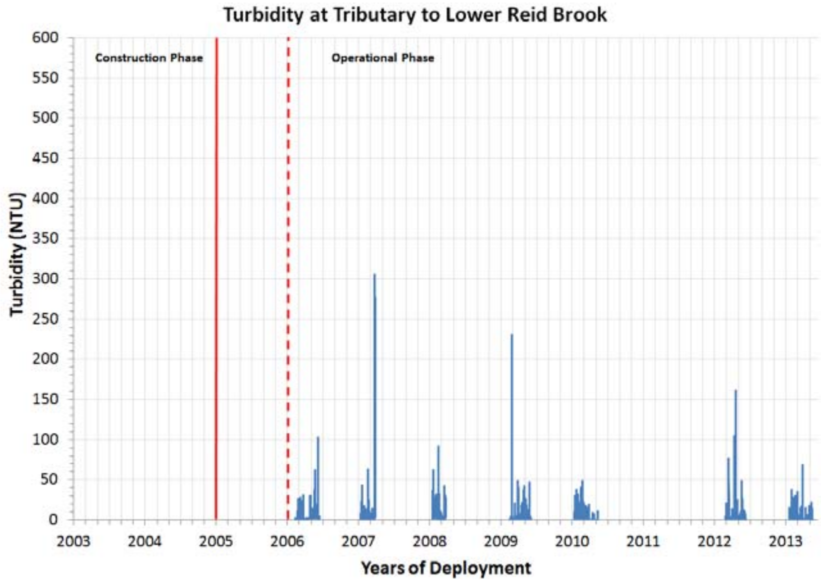


Figure 56. Turbidity at Tributary to Lower Reid Brook graphed over the ten year period

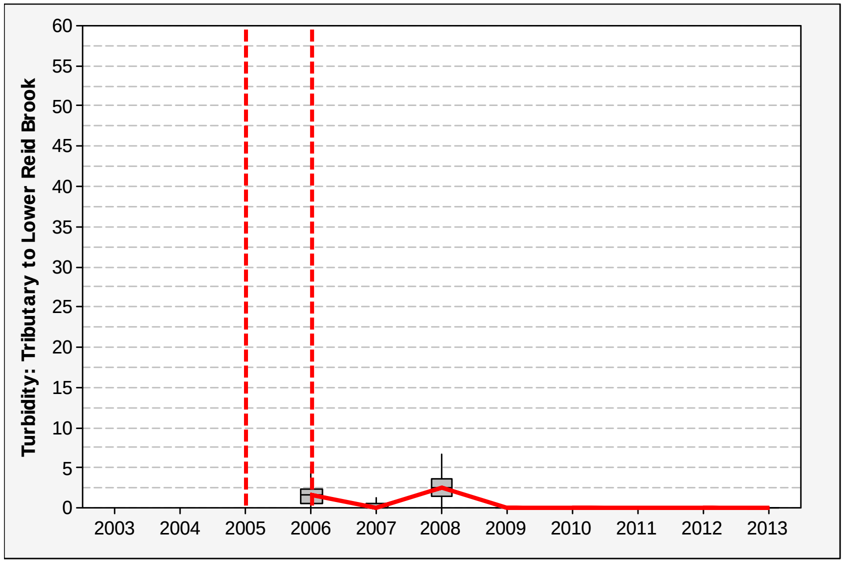


Figure 57. Boxplot of Turbidity at Tributary to Lower Reid Brook

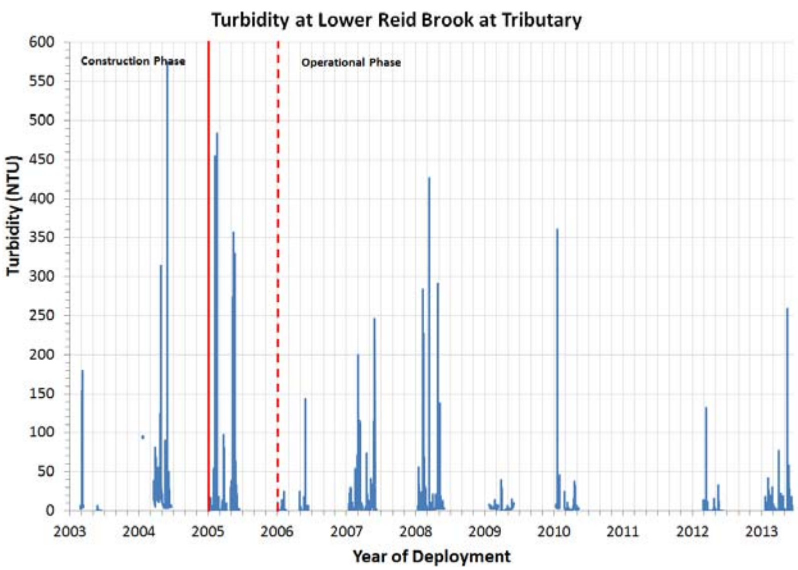


Figure 58. Turbidity at Lower Reid Brook graphed over the ten year period

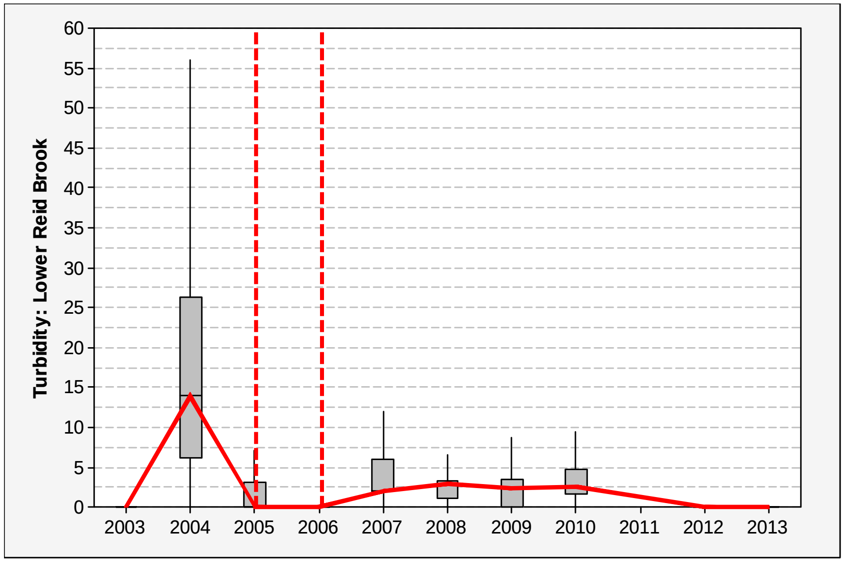


Figure 59. Boxplot of Turbidity at Lower Reid Brook

Grab Sample Result Trends

QAQC grab samples were taken at each instrument deployment. A total of 138 grab samples have been taken within the station network: 40 at Upper Reid Brook, 36 at Camp Pond Brook, 27 at Tributary to Lower Reid Brook and 35 at Lower Reid Brook.

Each parameter for each station was analyzed for correlation using the Spearman Rank and Mann Kendall trend analysis (Appendix D). For the majority of parameters measured in the QAQC grab samples, no trend was detectable at a level of significance of 0.05.

No trend was detected at any of the stations for: pH, colour, boron, bromide, chloride, fluoride, potassium, sodium, ammonia, dissolved organic carbon, nitrate(ite), Kjeldahl nitrogen, total phosphorus, antimony, arsenic, barium, cadmium, chromium, copper, lead, magnesium, manganese, mercury, selenium, uranium, and zinc. Insufficient sample size for TSS, total organic carbon, and strontium failed to produce a trend at any station.

Trends were revealed in the following parameters: conductivity, TDS, hardness, calcium, sulphate, turbidity, aluminum iron, alkalinity and nickel. Table 11 summarizes the trends detected in the grab sample data. Each of the identified trends is discussed briefly in the following sections.

Table 11: Summary of QAQC Grab Sample data trends

QAQC GRAB SAMPLE PARAMETER	Reid Brook	Camp Pond	Tributary LRB	Lower Reid
Alkalinity (mg/l CaCO3)	Down	No	No	No
Color (TCU)	No	No	No	No
Conductivity (uS/cm)	No	Up	No	No
Hardness (mg/l CaCO3)	No	Up	No	No
pH	No	No	No	No
TDS (mg/l)	No	Up	No	No
TSS	n/a	n/a	n/a	n/a
Turbidity (NTU)	No	Down	No	Down
Boron (mg/l)	No	No	No	No
Bromide (mg/l)	No	No	No	No
Calcium (mg/l)	No	Up	No	No
Chloride (mg/l)	No	No	No	No
Flouride (mg/l)	No	No	No	No
Potassium (mg/l)	No	No	No	No
Sodium (mg/l)	No	No	No	No
Sulphate (mg/l)	Down	Up	Up	No
Ammonia (mg/l)	No	No	No	No
DOC	No	No	No	No
Nitrate(ite) (mg/l)	No	No	No	No
KjeldahlNitrogen (mg/l)	No	No	No	No
TotalPhosphorus (mg/l)	No	No	No	No
Aluminium (mg/l)	Down	Down	No	Down
Antimony(mg/l)	No	No	No	No
Arsenic (mg/l)	No	No	No	No
Barium (mg/l)	No	No	No	No
Cadmium (mg/l)	No	No	No	No
Chromium (mg/l)	No	No	No	No
Copper (mg/l)	No	No	No	No
Iron (mg/l)	Down	No	No	No
Lead (mg/l)	No	No	No	No
Magnesium (mg/l)	No	No	No	No
Manganese (mg/l)	No	No	No	No
Mercury (mg/l)	No	No	No	No
Nickel (mg/l)	No	Up	No	No
Selenium (mg/l)	No	No	No	No
Uranium (mg/l)	No	No	No	No
Zinc (mg/l)	No	No	No	No
TOC (mg/L)	n/a	n/a	n/a	n/a
Sr (mg/L)	n/a	n/a	n/a	n/a

Increasing Trend: Specific Conductivity

Grab samples results for specific conductivity indicated an increasing trend at the station on Camp Pond Brook. This result corresponds with the trend identified by the RTWQ data for specific conductivity. The RTWQ data also suggested increasing trends in specific conductivity for Reid Brook at Outlet of Reid Pond, Tributary to Lower Reid Brook and Lower Reid Brook; however the grab sample data showed no conductivity trend for these stations (see Figure 60).

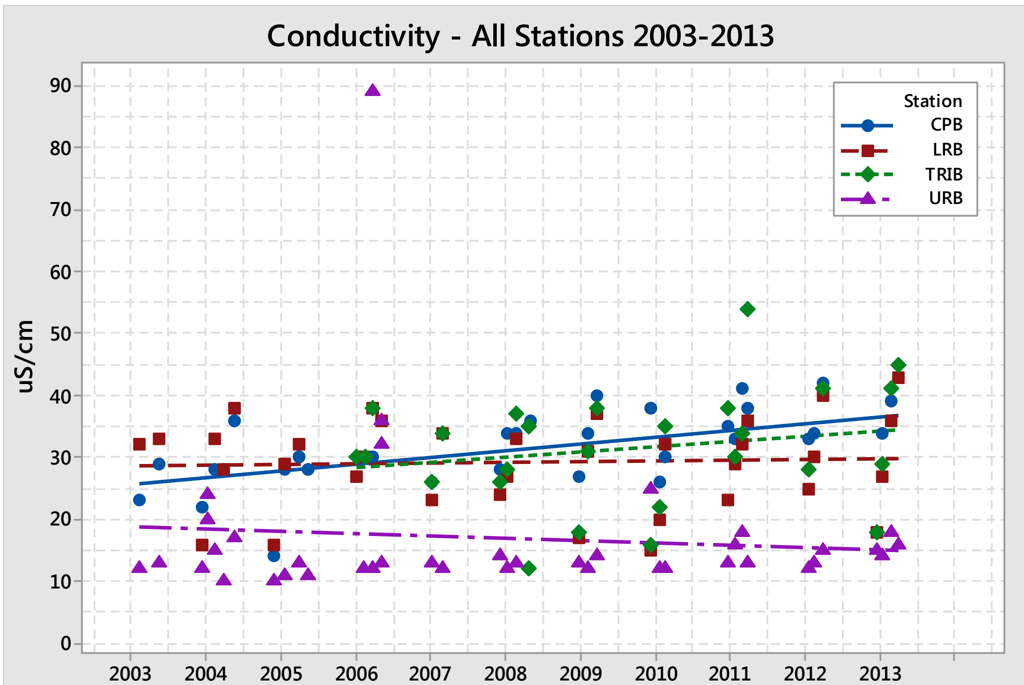


Figure 60: Grab sample results of Specific Conductivity trends for all stations

Increasing Trend: TDS, Hardness, Calcium and Sulphate

The grab sample data for Camp Pond Brook station indicated increasing trends for hardness and TDS. Calcium and sulphate also showed increasing trends at this station which could be the parameters that contributed to the increasing specific conductivity (see Figure 61).

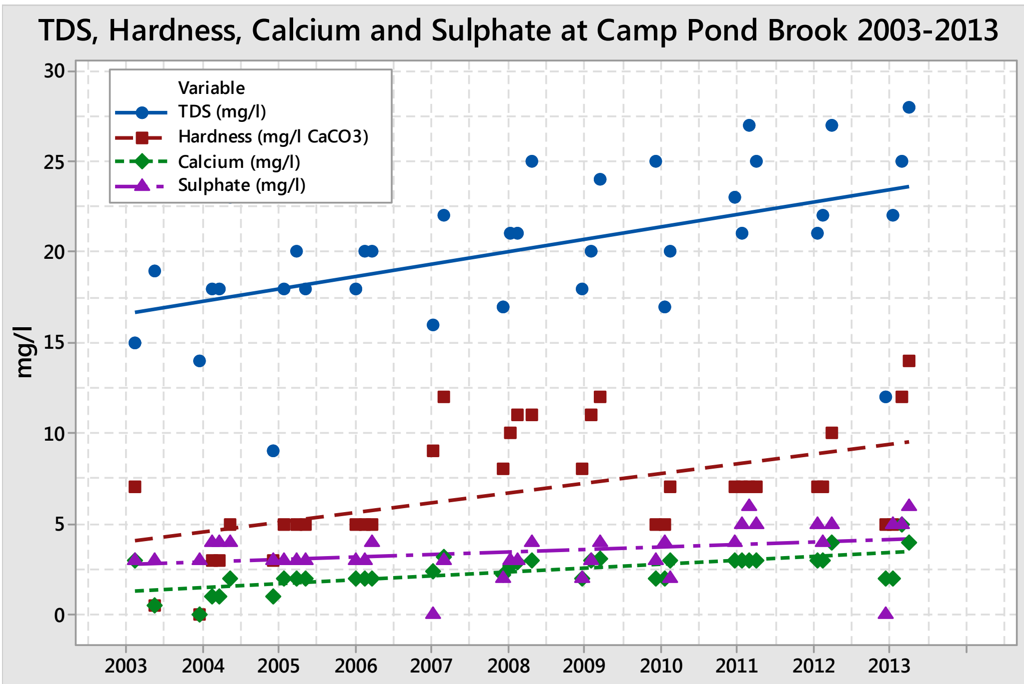


Figure 61: Grab sample results of Hardness, TDS, Calcium and Sulphate trends for Camp Pond Brook

Increasing and Decreasing Trends: Sulphate

Sulphate was shown to be increasing at Camp Pond Brook below Camp Pond and Tributary to Lower Reid Brook. The increase at Tributary to Lower Reid Brook and Camp Pond may in part be caused by the mining activities in each of the watersheds. Camp Pond Brook below Camp Pond is in close proximity to the mill and all the activity associated with the mine. Sulphate is a component of mining the ore and is a part of the treatment process occurring at the mine. Sulphate indicated a decreasing trend at Reid Brook at Outlet of Reid Pond, it is likely a natural occurrence as this station represents the baseline and there are no mining activities in the watershed (see Figure 62).

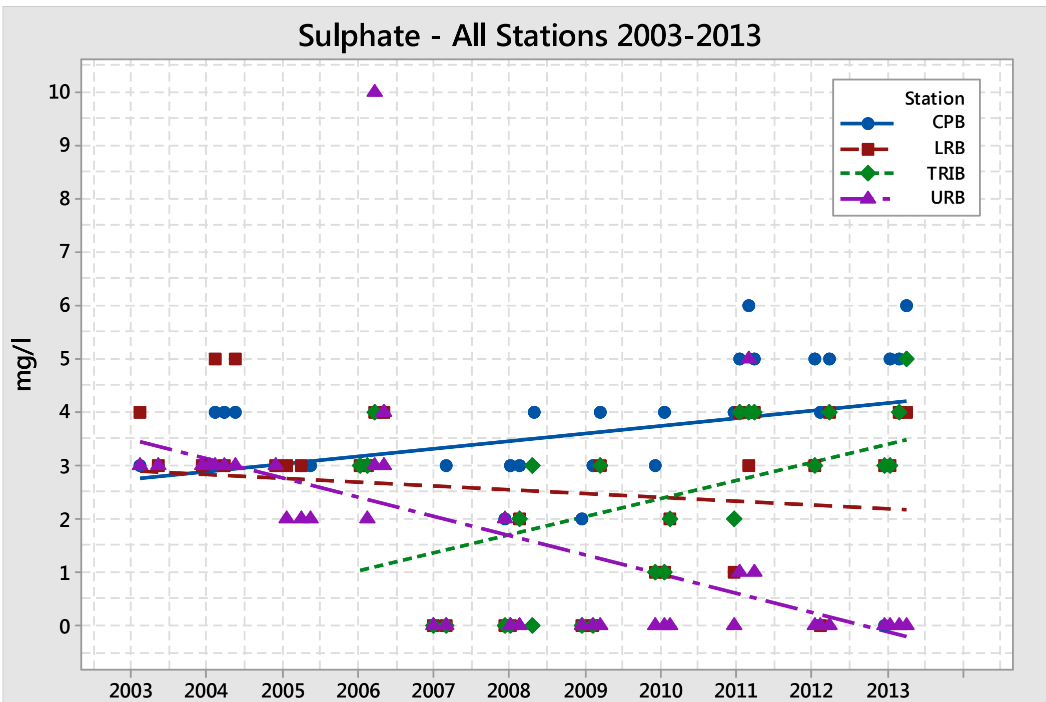


Figure 62: Grab sample results of Sulphate trends for all stations

Decreasing Trend: Turbidity

Grab sample results for turbidity showed decreasing trends at Camp Pond Brook below Camp Pond and Lower Reid Brook below Tributary stations. These grab sample results correspond with trends shown by the RTWQ data. Although the RTWQ data suggested decreasing trends in turbidity at the Tributary to Lower Reid Brook station, the grab samples indicated no trend. There was no trend in the grab sample data at the Reid Brook at Outlet of Reid Pond station which resembles the RTWQ data analysis. As the site moved from the construction to the operational stages the decreasing trend in turbidity was evident over the ten year timeframe. The reduced turbidity values indicate that the environmental mitigations and protection measures within the mining operations are effective in preventing degradation of water quality (see Figure 63).

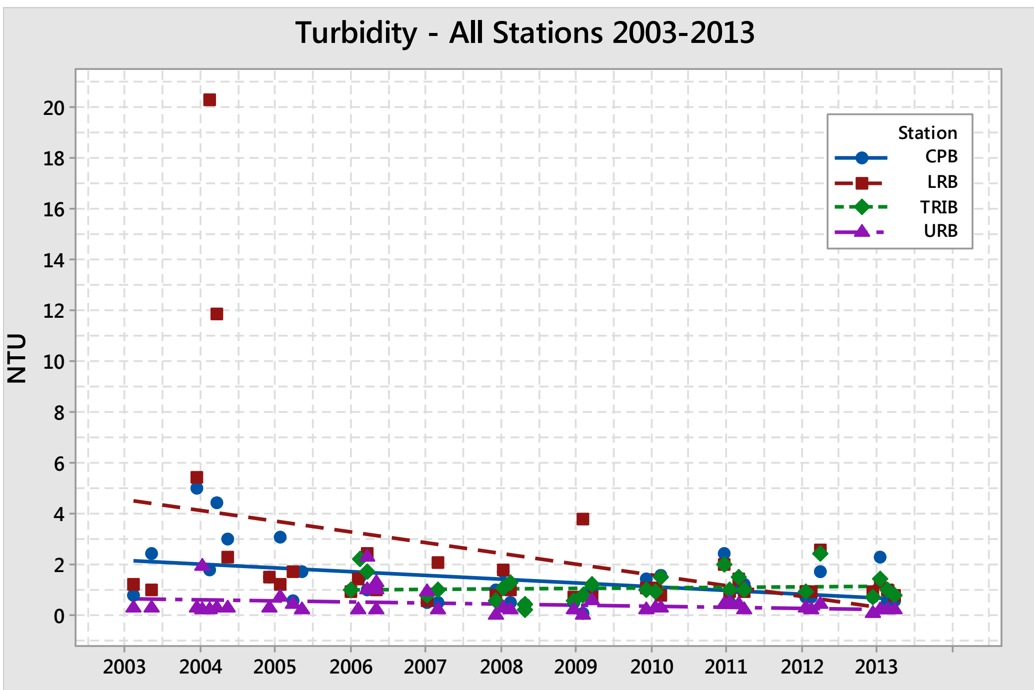


Figure 63: Grab sample results of Turbidity trends for all stations

Decreasing Trend: Aluminum

Total aluminum was shown to be decreasing at Reid Brook at Outlet of Reid Pond, Camp Pond Brook below Camp Pond and Lower Reid Brook below Tributary. This trend is likely to be a natural occurrence as it is occurring in three out of four stations including the baseline station at Reid Brook at Outlet of Reid Pond (see Figure 64).

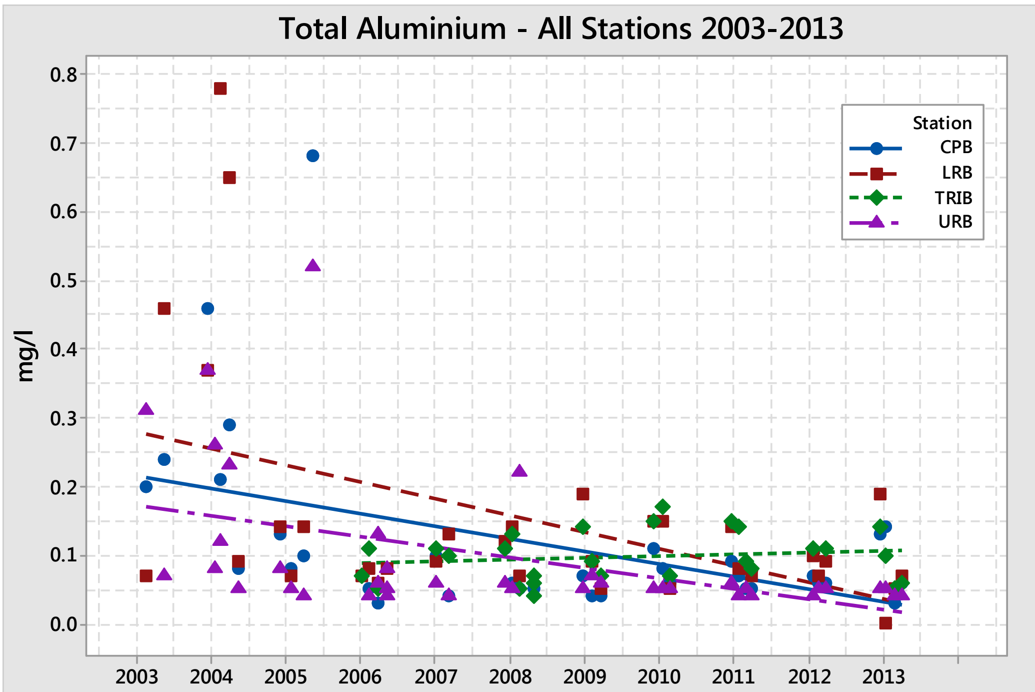


Figure 64: Grab sample results of Total Aluminium trends for all stations

Decreasing Trend: Alkalinity and Iron

Other results observed at Reid Brook at Outlet of Reid Pond include decreasing trends in alkalinity and iron. These decreasing trends are not seen at other stations in the network and are most likely attributed to natural causes (see Figure 65).

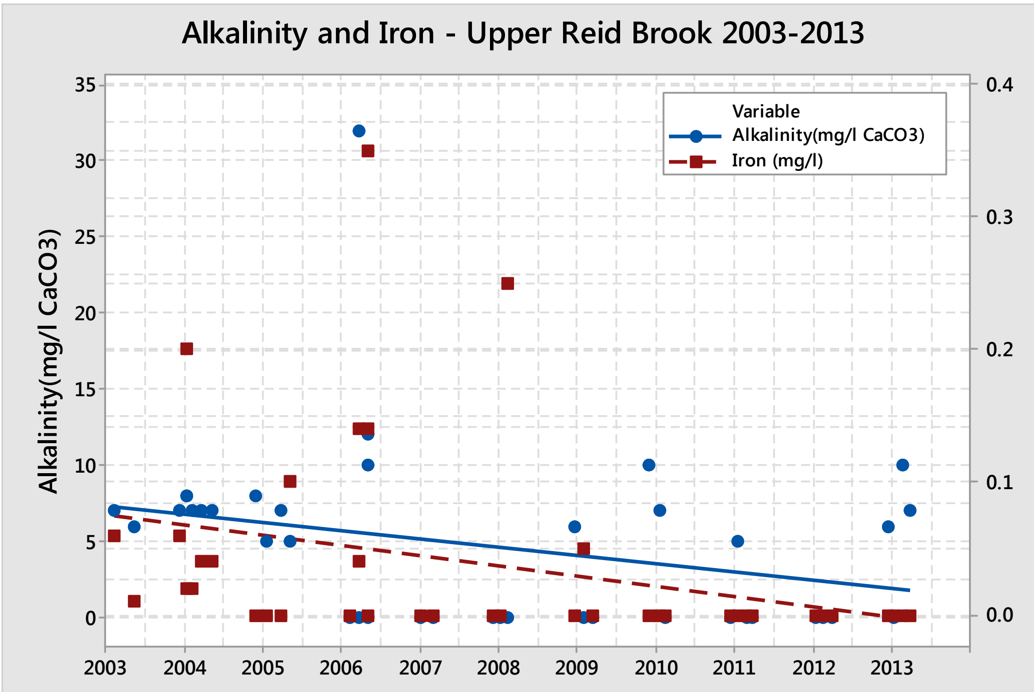


Figure 65: Grab sample results of Alkalinity and Iron trends for Reid Brook

Iron Exceedances

Although the only trend detected for iron was a declining trend at Reid Brook at Outlet of Reid Pond, iron regularly exceeds the CCME guideline for the Protection of Aquatic Life of 0.3mg/l at stations on Tributary to Lower Reid Brook and Lower Reid Brook below Tributary. Camp Pond Brook below Camp Pond and periodically Reid Brook below Reid Pond (see Figure 66) had iron values that exceeded the iron CCME guideline during the years from 2003 to 2007.

Due to Newfoundland and Labrador's topography and soil chemistry the CCME iron guideline is commonly exceeded. This is a mineral that naturally resides in the landscape of this province and is regularly identified as exceeding the CCME guideline. This is not generally considered a negative occurrence.

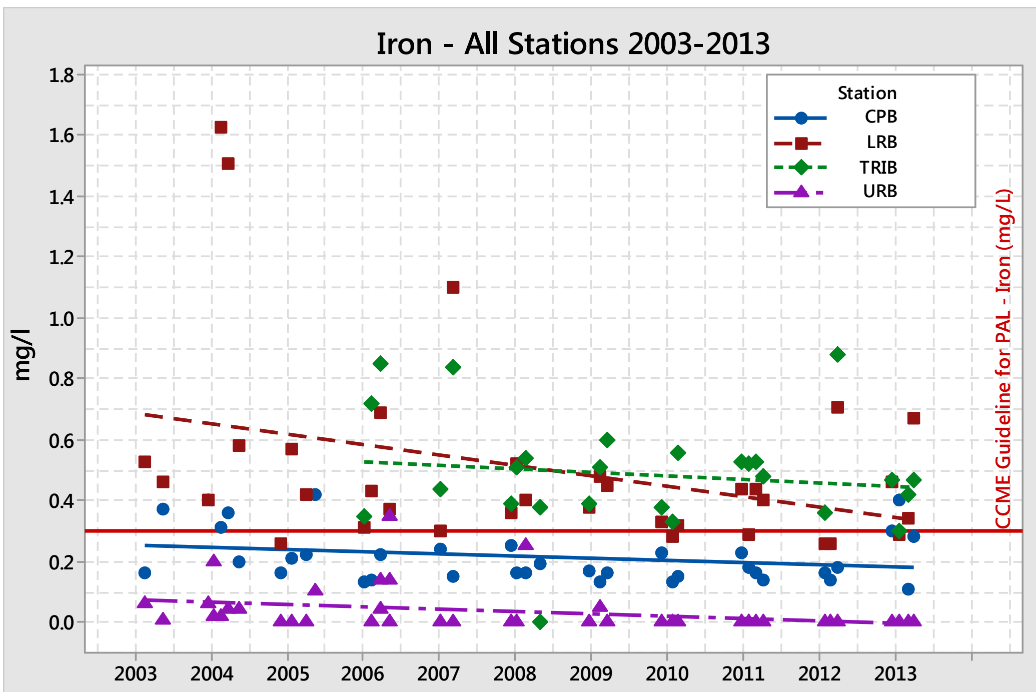


Figure 66: Grab sample results of Alkalinity and Iron trends for all stations

Increasing Trend: Nickel

At the station at Camp Pond Brook below Camp Pond, nickel content is showing an increasing trend. This trend is likely due to the location of the watershed for this station (Figure 67). The watershed for this station is in close proximity to the milling operations at the mine site, and nickel is a product of the milling. At its peak, the amount of nickel in the water column is just below the CCME water quality guideline for the Protection of Aquatic life of 0.025mg/l. The ECW&S regulations is for 0.5mg/L, therefore the amount of nickel that was present in Camp Pond Brook below Camp Pond is much lower than that of the ECW&S regulations.

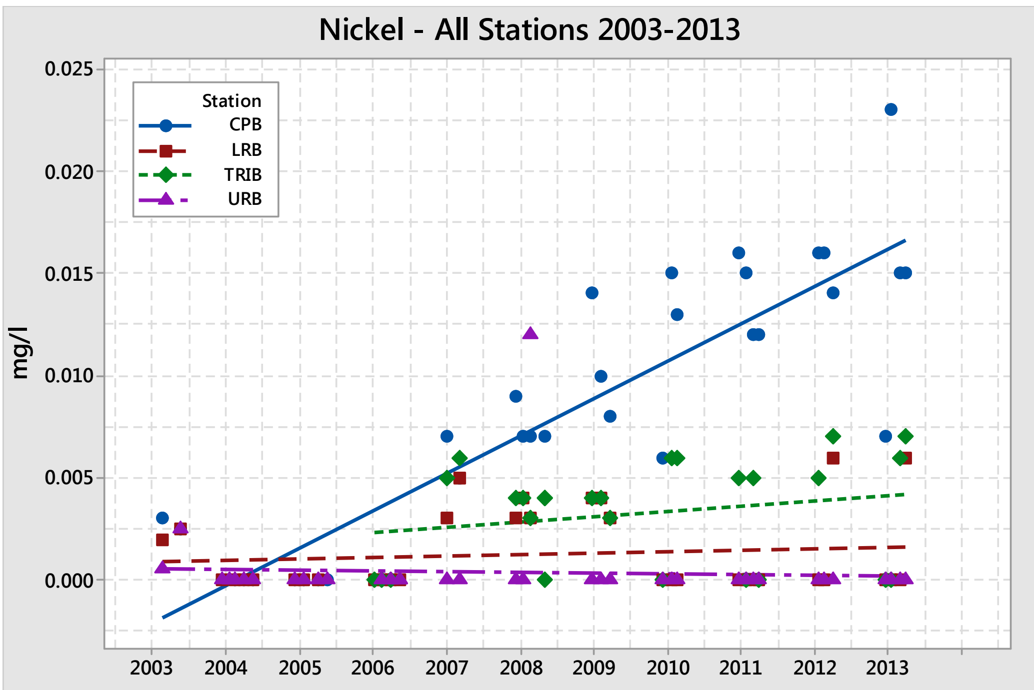


Figure 67: Grab sample results of Nickel trends for all stations

Conclusion

RTWQ has established a concrete picture; even though some trends are evident it is obvious from the data that Vale NL Voisey's Bay operations have not significantly impaired the environment that has been monitored under this program. Water temperatures and pH water quality data did not implicate any significant changes in the water parameters data over the ten year period.

For the operational phase of the mine's development the resulting correlation indicated that there was an upward trend (significant level 0.05) for specific conductance at all four real-time stations Reid Brook below Reid Pond, Camp Pond Brook below Camp Pond, Tributary to Lower Reid brook and Lower Reid below Tributary (Table 6). The increase is occurring at all stations in the network including the baseline station at Reid Brook at Outlet of Reid Pond indicating that this may be a natural increase in the region. The increases in specific conductivity do not appear to be related to mining operations.

During the construction phase of the mines development there was evidence of independent turbidity increases, however in the two brooks where the sites activities are most likely to impact, Camp Pond Brook below Camp Pond displayed a downward trend for turbidity and Lower Reid Brook below Tributary turbidity data indicated no significant trend. Indicating that the mitigation measures and environmental conditions Voisey's Bay had placed on site were working to control the runoff of material into the waterways. The turbidity data from the operational phase indicated that turbidity continued to display a downward trend over the period of time at Camp Pond Brook below Camp Pond, with no significant change at Reid Brook at Outlet of Reid Pond, Tributary to Lower Reid Brook and Lower Reid Brook below Tributary.

Logistically any waterway within a close proximity to mining activities will be influenced by the disruption. Camp Pond Brook below Camp Pond is the greater impacted station from the other RTWQ monitoring stations. The station is in the vicinity of the mill activities, the site airport and the main road ways throughout the mine site. Camp Pond Brook below Camp Pond is usually the first station to capture road side runoff during a spring thaw or any high precipitation event. However over the ten year period there was no significant change to Camp Pond Brook below Camp Pond's water quality. Although noted for increases in conductivity, hardness, total dissolved solids, calcium, and nickel in the grab sample results, the station did not have any alarmingly high data for these parameters and the data was not outside the applicable CCME guidelines.

Overall the grab sample trends indicate that there is no substantial increase in metals in the brooks over the span of the ten years. For the magnitude and size of this project this is a considerable achievement for Vale NL Voisey's Bay. The watersheds for the RTWQ monitoring stations remain comparatively consistent and undisturbed by the mine's activities. The RTWQ monitoring data does capture water quality events such as runoff during spring thaw and turbidity events however the water quality data also attests to how quickly the brooks recover to pre-existing levels in the following days or weeks.

Vale NL Voisey's Bay diligence and accountability with the RTWQ program has provided an excellent surveillance on the health of the surrounding waterbodies over the span of ten years. The Vale NL Voisey's Bay operations have actively demonstrated that they are committed to ensuring environmental sustainability, respect and stewardship in the health of the surrounding waterways. Great pride and achievement can be expressed by Vale NL Voisey's Bay by the conclusion of the data collected and analyzed in this report.

References

HACH Hydrolab (February 2006*) Hydrolab DS 5X, DS 5 and MS 5 Water Quality Multiprobes*, User Manual: Edition 3. Retrieved July 8, 2014 from HACH Hydromet website: http://www.hachhydromet.com

Environment Canada (July 2013) *Climate: Daily Data Report for Nain Newfoundland*. Retrieved data July 2013 from Government of Canada, Environment Canada Website: http://climate.weather.gc.ca/climateData/dailydata_e.html?timeframe=2&Prov=&StationID=10813&dlyRange=2004-09-27|2014-08-25&Year=2014&Month=6&Day=1

Water Resources Management Division (April 2014) *Protocols Manual for Real-Time Water Quality Monitoring in NL, Calibration and Maintenance Guide for Industry Partners,* Department of Environment and Conservation, Real Time Water Quality Monitoring Program.

The Canadian Council of Ministers for the Environment (2014) *Canadian Water Quality Guidelines for the Protection of Aquatic Life*, Canadian Environmental Quality Guidelines. Retrieved April 2014 from CCME website: http://documents.ccme.ca/?config=ccme&thesite=ceqg&words=pH&image.x=0&image.y=0

Department of Natural Resources (July 2014) *GeoScience OnLine Portal,* Mines Division of Department of Natural Resources. Retrieved April 2014 from GeoScience Online website: http://gis.geosurv.gov.nl.ca/

Newfoundland and Labrador Regulation 65/03 *Environmental Control Water and Sewage Regulations, 2003* under the *Water Resources Act*. Retrieved June 2015 from the House of Assembly website: http://www.assembly.nl.ca/legislation/sr/regulations/rc030065.htm

APPENDIX A

Deployment & Removal Date at Stations

Table A1: Deployment/ Removal dates and deployment periods for each station

Reid Brook at Outlet of Reid Pond			Camp Pond Brook			Lower Reid Brook below Tributary			Tributary to Lower Reid Brook		
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**

Reid Brook at Outlet of Reid Pond			Camp Pond Brook below Camp Pond			Lower Reid Brook below Tributary			Tributary to Lower Reid Brook		
Install	**Remove**	**Days**	**Install**	**Remove**	**Days**	**Install**	**Remove**	**Days**	**Install**	**Remove**	**Days**
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-Sept-09	35	8-Aug-09	12-Sept-09	35	9-Aug-09	12-Sept-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**
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**

APPENDIX B

Comparison Ranking Tables

Table B1: Comparison Ranking Criteria

	Rank				
Parameter	Excellent	Good	Fair	Marginal	Poor
Temperature (oC)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	<+/-1
pH (unit)	<=+/-0.2	>+/-0.2 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Sp. Conductance (µS/cm)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Sp. Conductance > 35 µS/cm (%)	<=+/-3	>+/-3 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20
Dissolved Oxygen (mg/l) (% Sat)	<=+/-0.3	>+/-0.3 to 0.5	>+/-0.5 to 0.8	>+/-0.8 to 1	>+/-1
Turbidity <40 NTU (NTU)	<=+/-2	>+/-2 to 5	>+/-5 to 8	>+/-8 to 10	>+/-10
Turbidity > 40 NTU (%)	<=+/-5	>+/-5 to 10	>+/-10 to 15	>+/-15 to 20	>+/-20

Table B2: Rankings of the water parameter data over the ten year period

Year	Station	Date	Action	Comparison Ranking				
				Temperature	pH	Specific Conductivity	Dissolved Oxygen	Turbidity
2003	**No ranking conducted at this time**							
2004	**No ranking conducted at this time**							
2005	Reid Brook	May 31 2005	Deployment	*	*	*	*	*
		July 20 2005	Removal	*	*	*	*	*
		July 21 2005	Deployment	Excellent	Good	Good	Excellent	*
		Sept 25 2005	Removal	*	*	*	*	*
		Sept 26 2005	Deployment	Poor	Excellent	Poor	Good	*
		Nov 9 2005	Removal	*	*	*	*	*
	Camp Pond Brook	May 31 2005	Deployment	*	*	*	*	*
		July 20 2005	Removal	*	*	*	*	*
		July 21 2005	Deployment	Excellent	Good	Excellent	Marginal	*
		Sept 25 2005	Removal	*	*	*	*	*
		Sept 26 2005	Deployment	Fair	Good	Fair	Fair	*
		Nov 9 2005	Removal	*	*	*	*	*
	Tributary to Lower Reid Brook	**No station installed at this time**						
	Lower Reid Brook	May 31 2005	Deployment	*	*	*	*	*
		July 20 2005	Removal	*	*	*	*	*
		July 21 2005	Deployment	Good	Good	Excellent	Marginal	*
		Sept 25 2005	Removal	*	*	*	*	*
		Sept 26 2005	Deployment	Poor	Excellent	Poor	Poor	*
		Nov 9 2005	Removal	*	*	*	*	*
2006	Reid Brook	May 26 2006	*	*	*	*	*	*
		Jul 5 2006	*	*	*	*	*	*
		Aug 11 2006	Deployment	Excellent	Excellent	*	Marginal	*
		Sept 18 2006	Removal	*	*	*	*	*
		Sept 20 2006	Deployment	Good	Good	*	Excellent	*
		Nov 7 2006	Removal	*	*	*	*	*

	Camp Pond Brook	May 26 2006	Deployment	*	*	*	*	*
		Jul 5 2006	Removal	*	*	*	*	*
		Jul 6 2006	Deployment	Good	Excellent	Good	Fair	*
		Aug 11 2006	Removal	*	*	*	*	*
		Aug 12 2006	Deployment	Excellent	Good	*	Excellent	*
		Sept 18 2006	Removal	*	*	*	*	*
		Sept 19 2006	Deployment	Good	Fair	*	Excellent	*
		Nov 7 2006	Removal	*	*	*	*	*
	Tributary to Lower Reid Brook	May 26 2006	*	*	*	*	*	*
		Jul 5 2006	*	*	*	*	*	*
		Jul 6 2006	Deployment	Excellent	Good	Good	Excellent	*
		Aug 11 2006	Removal	*	*	*	*	*
		Aug 12 2006	Deployment	Excellent	Good	*	Poor	*
		Sept 18 2006	Removal	*	*	*	*	*
		Sept 20 2006	Deployment	Excellent	Excellent	*	Excellent	*
		Nov 7 2006	Removal	*	*	*	*	*
	Lower Reid Brook	May 26 2006	Deployment	*	*	*	*	*
		Jul 5 2006	Removal	*	*	*	*	*
		Jul 6 2006	Deployment	Excellent	Good	Poor	Fair	*
		Aug 11 2006	Removal	*	*	*	*	*
		Aug 11 2006	Deployment	*	*	*	*	*
		Sept 18 2006	Removal	*	*	*	*	*
		Sept 20 2006	Deployment	Excellent	Good	*	Fair	*
		Nov 7 2006	Removal	*	*	*	*	*
2007	Reid Brook	Jun 7 2007	Deployment	Excellent	Fair	*	Good	*
		July 2 2007	Removal	*	*	*	*	*
		July 4 2007	Deployment	Poor	Poor	*	Fair	*
		August 20 2007	Removal	*	*	*	*	*
		Sept 1 2007	Deployment	Excellent	Poor	*	Poor	*
		Nov 3 2007	Removal	*	*	*	*	*
	Camp Pond Brook	Jun 7 2007	Deployment	Excellent	Fair	*	Marginal	*
		July 2 2007	Removal	*	*	*	*	*
		July 4 2007	Deployment	Excellent	Good	*	Good	*
		August 20 2007	Removal	*	*	*	*	*
		Sept 1 2007	Deployment	Good	Excellent	*	Fair	*

		Nov 3 2007	Removal	*	*	*	*	*
	Tributary to Lower Reid Brook	Jun 7 2007	Deployment	Excellent	Fair	*	Poor	*
		July 2 2007	Removal	*	*	*	*	*
		July 4 2007	Deployment	Fair	Good	*	Excellent	*
		August 20 2007	Removal	*	*	*	*	*
		Sept 1 2007	Deployment	Excellent	Excellent	*	Excellent	*
		Nov 3 2007	Removal	*	*	*	*	*
	Lower Reid Brook	Jun 7 2007	Deployment	Excellent	Poor	*	Marginal	*
		July 2 2007	Removal	*	*	*	*	*
		July 4 2007	Deployment	Good	Poor	*	Marginal	*
		August 20 2007	Removal	*	*	*	*	*
		Sept 1 2007	Deployment	Excellent	Excellent	*	Good	*
		Nov 3 2007	Removal	*	*	*	*	*
2008	Reid Brook	Jun 7 2008	Deployment	*	*	*	*	*
		Jul 7 2008	Removal	*	*	*	*	*
		Jul 8 2008	Deployment	*	*	*	*	*
		Aug 17 2008	Removal	*	*	*	*	*
		Aug 20 2008	Deployment	Good	Good	*	Good	*
		Oct 24 2008	Removal	*	*	*	*	*
	Camp Pond Brook	Jun 7 2008	Deployment	*	*	*	*	*
		Jul 7 2008	Removal	*	*	*	*	*
		Jul 8 2008	Deployment	*	*	*	*	*
		Aug 17 2008	Removal	*	*	*	*	*
		Aug 20 2008	Deployment	Good	Excellent	*	Excellent	*
		Oct 26 2008	Removal	*	*	*	*	*
	Tributary to Lower Reid Brook	Jun 7 2008	Deployment	*	*	*	*	*
		Jul 7 2008	Removal	*	*	*	*	*
		Jul 8 2008	Deployment	*	*	*	*	*
		Aug 17 2008	Removal	*	*	*	*	*
		Aug 20 2008	Deployment	Excellent	Excellent	*	Excellent	*
		Oct 24 2008	Removal	*	*	*	*	*
	Lower Reid Brook	Jun 7 2008	Deployment	*	*	*	*	*
		Jul 7 2008	Removal	*	*	*	*	*
		Jul 8 2008	Deployment	*	*	*	*	*
		Aug 17 2008	Removal	*	*	*	*	*

		Aug 20 2008	Deployment	Marginal	Good	*	Poor	*
		Oct 24 2008	Removal	*	*	*	*	*
2009	Reid Brook	Jun 19 2009	Deployment	Excellent	Good	Excellent	Good	*
		Aug 6 2009	Removal	Excellent	Good	Excellent	Excellent	*
		Aug 8 2009	Deployment	*	*	*	*	*
		Sept 12 2009	Removal	Excellent	Excellent	Excellent	Excellent	*
		Sept 15 2009	Deployment	Excellent	Fair	Excellent	Good	*
		Oct 27 2009	Removal	Good	Poor	Excellent	Fair	*
	Camp Pond Brook	Jun 20 2009	Deployment	Good	Good	Good	Fair	*
		Aug 5 2009	Removal	Excellent	Excellent	Excellent	Poor	*
		Aug 8 2009	Deployment	*	*	*	*	*
		Sept 12 2009	Removal	Excellent	Excellent	Good	Good	*
		Sept 15 2009	Deployment	Excellent	Good	Good	Excellent	*
		Oct 27 2009	Removal	Excellent	Fair	Good	Marginal	*
	Tributary to Lower Reid Brook	Jun 19 2009	Deployment	Good	Excellent	Excellent	Fair	*
		Aug 6 2009	Removal	Good	Excellent	Excellent	Fair	*
		Aug 8 2009	Deployment	*	*	*	*	*
		Sept 12 2009	Removal	Excellent	Excellent	Good	Good	*
		Sept 15 2009	Deployment	Excellent	Excellent	Good	Excellent	*
		Oct 27 2009	Removal	Excellent	Marginal	Fair	Good	*
	Lower Reid Brook	Jun 19 2009	Deployment	Excellent	Excellent	Excellent	Excellent	*
		Aug 6 2009	Removal	Excellent	Excellent	Good	Good	*
		Aug 8 2009	Deployment	*	*	*	*	*
		Sept 12 2009	Removal	Good	Excellent	Excellent	Marginal	*
		Sept 15 2009	Deployment	Excellent	Good	Excellent	Excellent	*
		Oct 27 2009	Removal	Excellent	Poor	Excellent	Marginal	*
2010	Reid Brook	Jun 5 2010	Deployment	Good	Poor	Excellent	Excellent	*
		Jul 20 2010	Removal	GOod	Excellent	Excellent	Fair	*
		Jul 21 2010	Deployment	Good	Excellent	Excellent	Excellent	*
		Aug 16 2010	Removal	Excellent	Good	Excellent	Poor	Poor
		Aug 17 2010	Deployment	Excellent	Excellent	Excellent	Poor	Excellent
		Oct 11 2010	Removal	Excellent	Good	Excellent	*	Fair
	Camp Pond Brook	Jun 5 2010	Deployment	Excellent	Good	Good	Good	*
		Jul 20 2010	Removal	Excellent	Good	Good	Marginal	*
		Jul 21 2010	Deployment	Excellent	Good	Excellent	Excellent	*

		Aug 16 2010	Removal	Excellent	Excellent	Excellent	Poor	Excellent
		Aug 17 2010	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
		Oct 11 2010	Removal	Fair	Good	Good	*	Excellent
	Tributary to Lower Reid Brook	Jun 5 2010	Deployment	Good	Excellent	Excellent	Excellent	*
		Jul 20 2010	Removal	Good	Excellent	Excellent	Good	*
		Jul 21 2010	Deployment	Excellent	Poor	Excellent	Good	*
		Aug 16 2010	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
		Aug 17 2010	Deployment	Excellent	Fair	Excellent	Excellent	Excellent
		Oct 11 2010	Removal	Good	Good	Good	*	*
	Lower Reid Brook	Jun 5 2010	Deployment	Good	Excellent	Excellent	Marginal	*
		Jul 20 2010	Removal	Excellent	Fair	Good	Poor	*
		Jul 21 2010	Deployment	Good	Good	Excellent	Excellent	*
		Aug 16 2010	Removal	Excellent	Good	Excellent	Marginal	Excellent
		Aug 17 2010	Deployment	Excellent	Excellent	Excellent	Good	Excellent
		Oct 11 2010	Removal	Marginal	Fair	Good	*	*
2011	Reid Brook	Jun 19 2011	Deployment	Poor	Good	Excellent	Poor	*
		Jul 20 2011	Removal	*	*	*	*	*
		Jul 21 2011	Deployment	Good	Good	Excellent	Excellent	*
		Aug 30 2011	Removal	Excellent	Fair	Excellent	Poor	*
		Aug 31 2011	Deployment	Good	Good	Excellent	Fair	*
		Sept 27 2011	Removal	Excellent	Poor	Excellent	Fair	*
		Sept 28 2011	Deployment	Good	Marginal	Excellent	Fair	*
		Oct 28 2011	Removal	Excellent	Excellent	Excellent	Fair	*
	Camp Pond Brook	Jun 22 2011	Deployment	Excellent	Excellent	Excellent	Fair	*
		Jul 20 2011	Removal	Good	Good	Good	Poor	Fair
		Jul 21 2011	Deployment	Good	Good	Good	Good	Excellent
		Aug 30 2011	Removal	Excellent	Good	Fair	Excellent	*
		Aug 31 2011	Deployment	Excellent	Fair	Excellent	Excellent	*
		Sept 27 2011	Removal	Excellent	Fair	Excellent	Fair	*
		Sept 28 2011	Deployment	Excellent	Good	Excellent	Excellent	*
		Oct 28 2011	Removal	Excellent	Fair	Excellent	Fair	*
	Tributary to Lower Reid Brook	Jun 22 2011	Deployment	Good	Good	Excellent	*	*
		Jul 20 2011	Removal	Excellent	Excellent	Fair	Fair	Excellent
		Jul 21 2011	Deployment	Excellent	Marginal	Excellent	Good	Excellent
		Aug 30 2011	Removal	Excellent	Fair	Good	Excellent	*

		Aug 31 2011	Deployment	Good	Fair	Excellent	*	*
		Sept 27 2011	Removal	Good	Poor	Excellent	*	*
		Sept 28 2011	Deployment	Good	Good	Good	*	*
		Oct 28 2011	Removal	Good	Good	Good	*	*
	Lower Reid Brook	Jun 22 2011	Deployment	Good	Good	Good	Excellent	*
		Jul 20 2011	Removal	Good	Excellent	Excellent	Poor	Poor
		Jul 21 2011	Deployment	Good	Excellent	Good	Poor	Excellent
		Aug 30 2011	Removal	Excellent	Fair	Good	Poor	*
		Aug 31 2011	Deployment	Excellent	Excellent	Good	Good	*
		Sept 27 2011	Removal	Excellent	Fair	Good	Excellent	*
		Sept 28 2011	Deployment	Excellent	Excellent	Good	Excellent	*
		Oct 28 2011	Removal	Excellent	Good	Excellent	Fair	*
2012	Reid Brook	Jul 19 2012	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
		Aug 15 2012	Removal	Excellent	Good	Excellent	Good	Excellent
		Aug 15 2012	Deployment	Excellent	N	Excellent	Excellent	Excellent
		Sept 24 2012	Removal	Excellent	Good	Excellent	Excellent	Excellent
		Sept 26 2012	Deployment	Excellent	Good	Excellent	Excellent	Excellent
		Nov 4 2012	Removal	Excellent	Good	Excellent	*	*
	Camp Pond Brook	Jul 19 2012	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
		Aug 15 2012	Removal	Excellent	Good	Excellent	Excellent	Excellent
		Aug 15 2012	Deployment	Excellent	*	Excellent	Excellent	Excellent
		Sept 24 2012	Removal	Good	Good	Excellent	*	Poor
		Sept 26 2012	Deployment	Excellent	Fair	Good	Excellent	Excellent
		Nov 4 2012	Removal	Excellent	Excellent	Good	*	*
	Tributary to Lower Reid Brook	Jul 19 2012	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
		Aug 15 2012	Removal	Excellent	Excellent	Excellent	Good	Excellent
		Aug 15 2012	Deployment	Excellent	*	Excellent	Excellent	Excellent
		Sept 24 2012	Removal	Excellent	Excellent	Good	Good	Excellent
		Sept 26 2012	Deployment	Excellent	Fair	Good	Excellent	Excellent
		Nov 4 2012	Removal	Excellent	Good	Good	*	*
	Lower Reid Brook	Jul 19 2012	Deployment	Excellent	Excellent	Excellent	Excellent	Excellent
		Aug 15 2012	Removal	Good	Good	Excellent	Excellent	Excellent
		Aug 15 2012	Deployment	Excellent	*	Excellent	Excellent	Excellent
		Sept 24 2012	Removal	Excellent	Excellent	Good	Good	Excellent
		Sept 26 2012	Deployment	Excellent	Fair	Good	Excellent	Excellent

		Nov 4 2012	Removal	Excellent	Excellent	Excellent	*	*
2013	Reid Brook	Jun 13 2012	Deployment	Excellent	Good	Excellent	Excellent	Excellent
		Jul 15 2013	Removal	Good	Good	Excellent	Good	Excellent
		Jul 16 2013	Deployment	Fair	Good	Excellent	Fair	Excellent
		Aug 24 2013	Removal	Excellent	Marginal	Excellent	*	*
		Aug 25 2013	Deployment	Excellent	Excellent	Excellent	*	Excellent
		Sept 26 2013	Removal	Marginal	Good	Excellent	*	*
		Sept 27 2013	Deployment	Good	Fair	Excellent	*	*
		Nov 6 2013	Removal	Poor	Poor	Excellent	*	*
	Camp Pond Brook	Jun 13 2012	Deployment	Excellent	Marginal	Excellent	Excellent	Excellent
		Jul 15 2013	Removal	Excellent	Fair	Excellent	Good	Excellent
		Jul 16 2013	Deployment	Excellent	Poor	Excellent	Good	Excellent
		Aug 24 2013	Removal	Excellent	Good	Excellent	*	*
		Aug 25 2013	Deployment	Excellent	Good	Good	*	Excellent
		Sept 26 2013	Removal	Excellent	Good	Good	*	*
		Sept 27 2013	Deployment	Excellent	Good	Excellent	*	*
		Nov 6 2013	Removal	Excellent	Poor	Good	*	*
	Tributary to Lower Reid Brook	Jun 13 2012	Deployment	Excellent	Excellent	Excellent	Fair	Excellent
		Jul 15 2013	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
		Jul 16 2013	Deployment	Excellent	Poor	Excellent	Excellent	Excellent
		Aug 24 2013	Removal	Excellent	Poor	Excellent	*	*
		Aug 25 2013	Deployment	Good	Excellent	Good	*	Excellent
		Sept 26 2013	Removal	Good	Fair	Good	*	*
		Sept 27 2013	Deployment	Excellent	Fair	Excellent	*	*
		Nov 5 2013	Removal	Excellent	Poor	Excellent	*	*
	Lower Reid Brook	Jun 13 2012	Deployment	Excellent	Excellent	Excellent	Fair	Excellent
		Jul 15 2013	Removal	Excellent	Excellent	Excellent	Excellent	Excellent
		Jul 16 2013	Deployment	Excellent	Poor	Excellent	Excellent	Excellent
		Aug 24 2013	Removal	Excellent	Poor	Excellent	*	*
		Aug 25 2013	Deployment	Good	Excellent	Good	*	Excellent
		Sept 26 2013	Removal	Good	Fair	Good	*	*
		Sept 27 2013	Deployment	Excellent	Fair	Excellent	*	*
		Nov 5 2013	Removal	Excellent	Poor	Excellent	*	*

APPENDIX C

Summary Statistics for All Stations

Table C1: Water Temperature Summary Statistics by year for all stations

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook below Reid Pond	2003	2688	10.48	0.84	20.13	10.52
	2004	2919	8.60	0.64	16.23	8.39
	2005	3401	9.64	0	16.71	10.03
	2006	2039	9.86	3.7	14.93	9.86
	2007	3187	7.90	1.31	16.53	7.06
	2008	3247	9.68	1.93	18.40	9.75
	2009	2997	7.63	1.72	16.08	7.89
	2010	2809	10.10	1.53	20.59	11.18
	2011	2991	9.11	2.11	19.34	8.90
	2012	2436	9.37	0.04	16.79	10.03
	2013	3431	8.29	1.10	17.83	8.26
	2003-13	32145	9.10	0.00	20.59	9.02
Camp Pond Brook	2003	2409	11.65	0.00	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	0.00	20.67	12.13
	2013	3451	9.89	0.03	21.06	10.48
	2003-13	33276	10.84	-0.24	24.27	11.69
Tributary to Lower Reid Brook	2003					
	2004					
	2005					
	2006	2796	8.88	0.00	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	0.00	16.30	9.20
	2013	3413	7.65	0.00	16.40	7.90
	2003-13	23996	9.64	-0.17	18.30	9.15
Lower Reid Brook	2003	886	4.90	-0.16	17.94	2.37
	2004	2208	6.07	-0.10	18.2	5.22
	2005	3778	8.85	-0.20	19.66	9.60
	2006	2182	6.40	-0.21	16.21	5.77
	2007	3194	7.85	-0.18	17.6	7.73
	2008	3232	9.58	-0.20	19.09	10.60
	2009	2805	7.94	-0.24	15.41	8.61
	2010	2872	9.88	1.75	19.96	9.74
	2011	2905	8.60	1.30	19.59	8.67
	2012	2436	9.37	0.04	16.79	10.03
	2013	3398	7.88	0.19	16.68	8.12
	2003-13	29898	8.24	-0.24	19.96	8.43

Table C2: Water Temperature Monthly Median Values for all stations

Station	Month/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Reid Brook at Outlet of Reid Pond	May	*	*	1.759	*	*	*	*	1.559	*	*	*
	June	*	1.419	6.269	*	2.94	4.579	2.604	2.915	3.23	*	2.35
	July	12.46	11.61	13.785	*	12.56	11.59	8.149	10.85	11.08	14.39	8.61
	August	15.28	12.1	13.19	13.3	12.54	13.98	10	15.42	13.14	13.82	13.045
	September	10.8	8.3745	10.94	10.18	7.739	8.825	8.119	11.43	8.699	7.975	8.85
	October	7.57	6.36	6.2345	6.829	4.639	5.8945	5.57	*	6.17	2.56	6.77
	November	3.069	3.235	1.159	4.2595	*	*	*	*	*	*	3.43
Camp Pond Brook below Camp Pond	May	*	*	8.1	5.14	*	*	*	*	*	*	*
	June	*	8.95	11.1	12.86	11.285	*	12.28	7.7	11.75	*	8.87
	July	16.92	16.7	16.18	16.115	16.7	15.47	15.07	14.9	15	17.11	13.57
	August	16.13	13.74	14.155	14.63	14.32	15.76	12.53	17.7	14.4	16.92	14.92
	September	11.585	7.59	10.49	9.99	7.52	9.06	9.1	10.3	9	10.5	8.385
	October	4.96	4.26	3.76	3.42	2.89	3.055	2.9	5.7	3.7	2.32	4.35
	November	0.085	*	-0.16	1.04	1.17	*	*	*	*	2.565	0.28
Tributary to Lower Reid Brook	May	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	8.61	10.89	10.06	5.8	8.6	*	7.1
	July	*	*	*	13.54	13.25	12.36	11.66	12.5	11	13.6	10.47
	August	*	*	*	12.27	11.29	11.9	10.7	14.4	11.1	13.8	11.5
	September	*	*	*	7.8	6.52	7.35	7.1	7.9	7.3	8.4	6.1
	October	*	*	*	3.11	1.44	2.22	2.6	5.5	3.3	2.6	3.5
	November	*	*	*	0.695	-0.12	*	*	*	*	2.7	0
Lower Reid Brook below Tributary	May	*	*	8.11	4.36	*	*	*	*	*	*	*
	June	*	4.51	8.79	9.47	7.43	10.86	8.52	5.3	8	*	6.69
	July	15.41	*	13.66	11.5	13.305	12.39	11.1	12.09	11.37	14.43	10.53
	August	15.055	12.21	11.93	*	12.07	12.77	10.7	14.615	11.32	14.17	11.98
	September	*	6.91	8.34	5.88	6.8	7.47	7.315	8.12	7.31	8.93	6.46
	October	2.515	3.35	3.72	3.37	1.45	2.15	2.565	5.395	3.065	2.72	3.71
	November	-0.12	-0.08	-0.16	-0.04	-0.16	*	*	*	*	2.91	0.22

* No data, value not calculated

Table C3: Summary Statistics by Year for 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
	2003-13	30926	6.69	5.31	8.25	6.68
Camp Pond Brook	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	6.97	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
	2003-13	33949	6.92	5.93	12.19	6.91
Tributary to Lower Reid Brook	2003					
	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	6.83	6.06	7.17	6.86
	2013	3406	6.88	6.46	7.21	6.88
	2003-13	24066	6.88	7.25	6.06	6.90
Lower Reid Brook	2003	886	6.5862	6.37	6.92	6.56
	2004	2207	6.9332	6.36	7.77	6.89
	2005	3778	7.0087	6.39	7.39	7.03
	2006	2179	7.1237	6.58	7.64	7.22
	2007	3194	7.3375	6.34	8.31	7.3
	2008	3232	7.1184	6.64	7.51	7.12
	2009	2801	7.2006	6.45	8.04	7.11
	2010	2875	6.8273	6.39	7.23	6.84
	2011	2895	6.9203	6	7.37	6.88
	2012	2439	6.9981	6.21	7.51	7.07
	2013	3394	6.78	5.69	7.25	6.86
	2003-13	29882	7.01	5.69	8.31	6.96

Table C4: Monthly Median pH Values

Station	Month/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003-13
Reid Brook at Outlet of Reid Pond	May	*	*	6.50	*	*	*	*	*	*	*	*	6.50
	June	*	5.57	6.66	*	6.45	6.67	6.54	6.47	6.40	*	6.54	6.54
	July	6.49	6.25	6.73	*	7.18	6.75	6.73	6.61	6.42	7.02	6.79	6.73
	August	6.57	6.23	6.66	6.62	7.28	6.83	6.84	6.83	6.79	7.16	6.95	6.81
	September	6.63	6.13	6.62	6.71	7.01	6.55	7.26	6.72	6.54	7.23	6.83	6.71
	October	6.42	5.91	6.58	6.65	7.00	6.31	7.62	6.71	6.62	6.66	6.93	6.62
	November	6.64	5.88	6.58	5.58	6.82	*	*	*	*	6.68	6.94	6.62
Camp Pond Brook	May	*	*	7.10	6.50	*	*	*	*	*	*	*	6.51
	June	*	7.01	6.74	6.86	7.15	6.90	6.73	6.60	6.86	*	6.53	6.84
	July	6.83	6.29	6.73	6.79	6.77	7.03	6.94	6.68	7.02	7.12	6.77	6.83
	August	6.72	7.21	6.82	7.09	6.90	7.17	7.06	6.69	6.87	7.19	6.87	6.94
	September	6.80	7.17	7.36	7.14	6.90	6.86	7.25	7.14	6.78	7.15	7.00	7.03
	October	6.82	7.28	6.83	6.96	6.90	6.94	7.31	7.19	6.75	7.09	7.09	6.94
	November	6.82	*	6.83	7.01	6.85	*	*	*	*	7.04	7.15	7.00
Tributary to Lower Reid Brook	May	*	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	6.75	7.07	6.71	6.42	6.71	*	6.71	6.72
	July	*	*	*	7.05	7.02	6.94	6.87	6.60	6.70	7.00	6.79	6.87
	August	*	*	*	6.83	7.11	7.04	6.93	6.73	6.91	6.90	6.87	6.93
	September	*	*	*	6.95	6.81	7.02	7.07	7.12	6.89	6.95	7.10	7.00
	October	*	*	*	6.77	6.89	6.88	7.08	7.13	6.79	6.69	6.91	6.87
	November	*	*	*	6.71	6.92	*	*	*	*	6.62	6.72	6.71
Lower Reid Brook	May	*	*	6.92	6.86	*	*	*	*	*	*	*	6.86
	June	*	6.84	6.99	6.74	7.38	6.89	6.81	6.76	6.85	*	6.82	6.87
	July	6.68	*	7.15	6.83	7.82	6.86	6.94	6.79	6.86	7.02	6.89	6.94
	August	6.79	6.95	7.08	*	7.94	7.12	7.04	6.70	6.82	7.16	6.31	7.03
	September	*	7.07	7.10	7.43	6.76	7.32	7.53	6.91	7.19	7.23	6.81	7.14
	October	6.58	6.82	6.89	7.43	6.89	7.34	7.53	6.95	6.86	6.66	7.06	6.91
	November	6.50	6.85	6.96	7.46	6.90	*	*	*	*	6.68	7.07	6.88

* No data, value not calculated

Table C5: Summary Statistics by Year for Specific 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
	2003-13	30959	9.0	5.2	12.6	8.9
Camp Pond Brook	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
	2003-13	32856	27.5	7.1	70.6	26.9
Tributary to Lower Reid Brook	2003					
	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
	2003-13	23865	28.3	7.1	56.6	28.5
Lower Reid Brook	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
	2003-13	29908	26.5	8.0	52.5	27.0

Table C6: Monthly Median Specific Conductivity Values

Station	Month/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003-13
Reid Brook at Outlet of Reid Pond	May	*	*	8.9	*	*	*	*	*	*	*	*	8.9
	June	*	*	8.5	*	9	8.1	9.3	9.0	8.1	*	11.1	8.8
	July	7.6	8.7	8.8	*	9.4	8.1	9.4	8.2	8.2	10.5	11.2	9.1
	August	6.9	9.6	9.1	8.8	9.6	9.0	9.5	8.2	10.2	11.4	11.6	9.5
	September	6.8	9.5	9.2	8.8	6.6	8.9	9.3	8.3	10.5	11.7	12.1	9.0
	October	6.4	8.9	7.5	5.8	6.5	8.8	9.0	8.5	8.7	9.1	11.9	8.7
	November	6.2	8.9	7.4	5.9	6.5	*	*	*	*	9.1	11.7	7.4
Camp Pond Brook	May	*	*	14.4	20.4	*	*	*	*	*	*	*	20.4
	June	*	*	21.4	20.8	22.1	*	25.1	16.9	22.0	*	27.4	21.3
	July	18.2	21.2	24.6	24.6	25.4	29.0	30.2	18.1	25.7	34.0	32.7	26.0
	August	21.4	23.7	28.5	22.6	28.2	30.0	25.3	27.1	33.2	34.0	35.5	28.6
	September	22.9	25.7	28.6	22.0	26.1	31.2	35.5	36.4	34.6	35.0	39.7	30.9
	October	19.9	25.2	16.8	16.8	22.4	30.0	36.9	44.4	30.8	35.6	40.4	29.5
	November	18.2	*	15.7	15.8	23.8	*	*	*	*	33.1	41.6	18.0
Tributary to Lower Reid Brook	May	*	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	19.7	22.0	20.3	14.1	14.0	*	21.4	18.9
	July	*	*	*	30.7	12.3	25.2	28.4	21.2	16.3	27.9	27.3	25.4
	August	*	*	*	22.4	14.7	31.6	31.6	33.0	33.5	30.5	36.1	31.4
	September	*	*	*	26.0	21.2	36.6	36.2	38.1	33.7	37.0	42.6	35.9
	October	*	*	*	15.2	24.4	32.1	41.3	40.8	31.1	28.7	45.3	31.1
	November	*	*	*	13.8	25.8	*	*	*	*	27.6	49.3	26.3
Lower Reid Brook	May	*	*	12.0	10.0	*	*	*	*	*	*	*	10.0
	June	*	12.1	18.0	15.0	10.0	19.0	16.0	11.0	19.0	*	17.0	16.0
	July	21.8	*	24.0	13.0	19.0	24.0	25.0	14.0	23.0	25.0	24.0	23.0
	August	24.8	28.5	30.0	*	25.0	32.0	27.0	29.0	32.0	28.0	33.6	30.0
	September	*	30.5	34.0	37.0	16.0	32.0	32.0	36.0	33.0	36.5	37.9	33.0
	October	21.0	27.8	19.0	35.0	20.0	30.0	35.0	42.0	28.0	27.7	40.4	28.6
	November	21.0	33.7	20.	31.0	22.0	*	*	*	*	27.2	45.3	27.3

* No data, value not calculated

Table C7: Summary Statistics by Year for Dissolved Oxygen

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
	2003-13	27078	11.11	8.31	16.15	10.97
Camp Pond Brook	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
	2003-13	32395	10.09	6.46	14.47	9.80
Tributary to Lower Reid Brook	2003					
	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
	2003-13	24079	11.18	6.46	15.09	11.02
Lower Reid Brook	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
	2003-13	25593	10.62	6.38	14.81	10.62

Table C8: Monthly Median Dissolved Oxygen Values

Station	Month/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003-13
Reid Brook at Outlet of Reid Pond	May	*	*	12.70	*	*	*	*	*	*	*	*	12.70
	June	*	12.69	12.40	*	12.90	12.59	13.10	12.82	*	*	12.47	12.68
	July	10.80	10.69	9.84	*	10.85	11.31	12.60	11.08	*	9.95	11.75	11.26
	August	9.36	9.95	9.86	9.52	10.10	10.26	10.85	*	10.93	10.00	10.32	9.96
	September	10.03	10.82	9.57	9.71	12.23	10.31	10.93	*	11.28	11.21	10.96	10.64
	October	10.70	11.22	11.41	10.68	14.26	11.43	10.14	*	*	13.24	11.36	11.34
	November	11.97	11.77	12.89	*	15.65	*	*	*	*	13.13	11.88	12.11
Camp Pond Brook	May	*	*	11.50	10.85	*	*	*	*	*	*	*	10.86
	June	*	*	10.59	9.40	9.80	*	9.50	11.39	9.88	*	10.71	10.38
	July	8.76	8.32	8.98	8.87	8.45	9.13	8.42	8.86	8.83	9.24	9.68	8.89
	August	8.12	8.25	9.78	9.15	8.52	8.78	9.51	8.03	9.08	9.25	9.49	8.98
	September	8.85	9.47	10.32	10.12	10.61	10.45	10.18	9.80	10.07	10.49	11.01	10.17
	October	10.85	11.77	12.57	11.83	12.11	12.22	11.84	10.23	12.07	13.17	12.13	11.99
	November	12.58	*	13.76	13.04	12.41	*	*	*	*	13.11	13.25	13.02
Tributary to Lower Reid Brook	May	*	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	11.83	9.21	11.40	12.07	10.99	*	11.69	11.48
	July	*	*	*	9.96	10.29	9.62	11.00	10.24	10.46	9.97	10.62	10.34
	August	*	*	*	9.49	10.68	10.02	11.02	9.70	10.49	9.96	10.36	10.19
	September	*	*	*	8.83	12.24	11.93	11.55	11.10	11.26	11.18	11.78	11.42
	October	*	*	*	12.09	14.11	13.73	12.84	11.66	12.78	13.07	12.59	12.84
	November	*	*	*	13.45	14.59	*	*	*	*	12.96	13.50	13.45
Lower Reid Brook	May	*	*	11.94	12.77	*	*	*	*	*	*	*	12.71
	June	*	0.01	11.17	9.64	10.92	9.04	10.99	*	*	*	12.03	10.70
	July	8.39	*	9.24	9.39	7.97	8.24	9.69	*	*	9.95	10.86	9.34
	August	8.49	7.61	9.55	*	7.89	8.62	10.04	8.32	*	10.00	10.48	9.53
	September	*	9.04	10.68	12.18	10.63	11.21	10.52	8.56	*	11.21	11.80	10.74
	October	11.29	12.46	11.42	13.16	11.63	12.68	12.06	9.56	*	13.24	12.58	12.31
	November	12.49	13.65	12.63	14.41	12.36	*	*	*	*	13.13	13.42	13.09

* No data, value not calculated

Table C9: Summary Statistics by Year for Turbidity

Station	Year	N	Mean	Minimum	Maximum	Median
Reid Brook at Outlet of Reid Pond	2003	2040	1.886	0.0	177.9	
	2004	2717	0.876	0.0	381.5	0.0
	2005	2616	0.0234	0.0	54.0	0.0
	2006	1741	0.821	0.0	274.2	0.3
	2007	3186	0.6693	0.0	75.3	0.0
	2008	3246	0.02	0.0	20.29	0.0
	2009	2997	0.7647	0.0	25.59	0.0
	2010	2799	23.405	0.0	366.5	10.89
	2011	0	*	*	*	*
	2012	2440	0.36	0.0	132.5	0.0
	2013	3426	0.0279	0.0	51.1	0.0
	2003-13	27208	2.9	0.0	381.5	10.89
Camp Pond Brook	2003	2801	19.0	5.0	494.9	12
	2004	1960	5.6	1.0	256.3	5
	2005	2998	2.3	0.0	171	1
	2006	3841	3.0	0.0	146	2
	2007	3195	7.0	0.0	353	3
	2008	3173	2.1	0.0	113	1
	2009	2865	2.1	0.1.0	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
	2003-13	30958	5.1	0.0		
Tributary to Lower Reid Brook	2003					
	2004					
	2005					
	2006	2879	2.726	0.0	102.1	1.7
	2007	1718	4.74	0.0	305.5	0.0
	2008	1691	3.696	0.0	91.9	2.6
	2009	2473	0.545	0.0	230.7	0.0
	2010	2876	0.8916	0.0	48.6	0.0
	2011	0	*	*	*	*
	2012	2528	1.211	0.0	160.6	0.0
	2013	2797	0.6633	0.0	68.6	0.0
	2003-13	16962	1.8	0.0	0.0	305.5
Lower Reid Brook	2003	886	2.2	0.0	179.9	0
	2004	2211	24.4	0.0	575	13.9
	2005	3322	5.8	0.0	484	0
	2006	2179	0.5	0.0	143	0
	2007	3194	10.0	0.0	246	2
	2008	3194	3.9	0.0	426	2.9
	2009	2792	2.6	0.0	38.9	2.4
	2010	2294	5.4	0.0	360.2	2.6
	2011	0	*	*	*	
	2012	2440	0.4	0.0	132.5	0
	2013	3396	0.5	0.0	258.7	0
	2003-13	25910	5.5	0.0		

Table C10: Monthly Median Turbidity Values

Station	Month/Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2003-13
Reid Brook at Outlet of Reid Pond	May	*	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	0.0	0.0	0.0	2.5	*	*	0.0	0.0
	July	*	0.2	0.0	*	0.0	0.0	0.0	33.6	*	0.0	0.0	0.0
	August	0.0	0.0	0.0	0.3	0.0	0.0	0.0	20.7	*	0.0	0.0	0.0
	September	0.0	0.0	0.0	0.3	0.0	0.0	0.0	10.6	*	0.0	0.0	0.0
	October	1.0	0.0	0.0	0.0	1.0	0.0	3.0	15.2	*	0.0	0.0	0.0
	November	2.0	0.0	0.0	*	0.0	*	*	*	*	0.0	0.0	0.0
Camp Pond Brook	May	*	*	2.0	2.0	*	*	*	*	*	*	*	2.0
	June	*	*	3.0	1.0	3.0	0.0	2.9	3.1	2.7	*	0.0	2.3
	July	13.0	4.2	0.0	3.0	1.0	1.0	2.2	2.4	4.1	0.0	0.0	2.0
	August	11.0	3.1	0.0	2.0	7.0	1.0	1.7	6.4	1.9	0.0	0.0	1.8
	September	9.0	5.5	1.0	1.0	4.0	2.0	1.3	4.9	15.5	0.0	0.0	2.8
	October	15.0	5.3	2.0	3.0	4.0	3.4	1.0	5.3	5.9	*	0.0	3.0
	November	18.0	*	2.0	3.0	3.0	*	*	*	*	*	0.0	3.0
Tributary to Lower Reid Brook	May	*	*	*	*	*	*	*	*	*	*	*	*
	June	*	*	*	*	0.0	2.9	*	0.1	*	*	0.1	0.9
	July	*	*	*	0.0	0.0	1.9	0.0	0.0	*	0.0	0.0	0.0
	August	*	*	*	0.7	0.0	1.7	0.0	0.0	*	0.0	0.0	0.0
	September	*	*	*	1.9	*	*	0.0	0.0	*	0.0	0.0	0.0
	October	*	*	*	2.6	*	*	0.0	0.0	*	0.0	0.0	0.0
	November	*	*	*	2.1	*	*	*	*	*	0.0	*	2.0
Lower Reid Brook	May	*	*	9.0	0.0	*	*	*	*	*	*	*	0.0
	June	*	94.0	2.0	0.0	1.0	1.0	4.0	4.8	*	*	0.0	1.0
	July	4.0	*	4.0	1.0	3.0	1.0	2.8	1.8	*	0.0	0.0	2.0
	August	6.0	23.5	0.0	*	2.0	1.0	0.0	1.5	*	0.0	0.0	0.0
	September	*	20.9	0.0	0.0	2.0	3.1	1.8	3.3	*	0.0	0.0	2.0
	October	0.0	6.0	0.0	0.0	8.0	3.0	3.1	2.7	*	0.0	0.0	0.0
	November	0.0	6.0	0.0	0.0	2.0	*	*	*	*	0.0	0.0	0.0

* No data, value not calculated

APPENDIX D

Trend Analysis for Monthly Medians

Table D1: Trend Results for Monthly Median Water Temperatures

	Station	Reid Brook at Outlet	Camp Pond Brook	Tributary to Lower Reid	Lower Reid Brook
Rank Spearmann	P-Value	0.875808	0.658634	0.453032	0.932426
	Spearman's rho	-0.021130	-0.058212	-0.118963	0.011280
	Parameter Count	57	60	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	No	No	No
Mann Kendall	P-Value	0.777761	0.578961	0.410088	0.953066
	Kendall's tau	-0.026316	-0.049746	-0.089535	0.005846
	Parameter Count	57	60	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	No	No	No

Table D2: Trend Results for Monthly Median pH

	Station	Reid Brook at Outlet	Camp Pond Brook	Tributary to Lower Reid	Lower Reid Brook
Rank Spearmann	P-Value	0.000079	0.213865	0.222170	0.958287
	Spearman's rho	0.491049	0.161444	-0.192411	0.006958
	Parameter Count	59	61	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	Up	No	No	No
Mann Kendall	P-Value	0.000214	0.163074	0.307921	0.854629
	Kendall's tau	0.332358	0.123868	-0.111114	0.017059
	Parameter Count	59	61	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	Up	No	No	No

Table D3: Trend Results for Monthly Median Specific Conductivity

	Station	Reid Brook at Outlet	Camp Pond Brook	Tributary to Lower Reid	Lower Reid Brook
Rank Spearmann	P-Value	0.000005	0.000000	0.000485	0.006304
	Spearman's rho	0.558521	0.718611	0.514911	0.351699
	Parameter Count	58	59	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	Up	Up	Up	Up
Mann Kendall	P-Value	0.000008	0.000000	0.000779	0.005639
	Kendall's tau	0.408461	0.541888	0.361628	0.249639
	Parameter Count	58	59	42	59
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	Up	Up	Up	Up

Table D4: Trend Results for Monthly Median Dissolved Oxygen

	Station	Reid Brook at Outlet	Camp Pond Brook	Tributary to Lower Reid	Lower Reid Brook
Rank Spearmann	P-Value	0.090093	0.142259	0.322373	0.206515
	Spearman's rho	0.237439	0.193372	0.156477	0.178100
	Parameter Count	52	59	42	52
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	No	No	No
Mann Kendall	P-Value	0.083943	0.125941	0.293126	0.157776
	Kendall's tau	0.166038	0.137427	0.113887	0.135849
	Parameter Count	52	59	42	52
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	No	No	No

Table D5: Trend Results for Monthly Median Turbidity

	Station	Reid Brook at Outlet	Camp Pond Brook	Tributary to Lower Reid	Lower Reid Brook
Rank Spearmann	P-Value	0.936813	0.000604	0.005522	0.004686
	Spearman's rho	-0.011625	-0.437017	-0.494056	-0.379209
	Parameter Count	49	58	30	54
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	Down	Down	Down
Mann Kendall	P-Value	0.973354	0.000977	0.009037	0.006134
	Kendall's tau	-0.005001	-0.307186	-0.382076	-0.274815
	Parameter Count	49	58	30	54
	Significance Level	0.05	0.05	0.05	0.05
	Trend Result	No	Down	Down	Down