Real-Time Water Quality Monitoring Network

Outer Cove Brook at Clovelly Golf Course - NF02ZM0365

Audit Report
March 30th, 2015

Newfoundland Labrador

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

Prepared by:
Leona Hyde
Environmental Monitoring Specialist
Water Resources Management Division
Department of Environment & Conservation
4th Floor, Confederation Building, West Block
PO Box 8700, St. John's NL A1B 4J6
Ph. No.: (709) 729 - 3597
Fax No.: (709) 729 - 0320
leonahyde@gov.nl.ca

Contents

Overview

The Water Resources Management Division (Department of Environment and Conservation) operates and maintains a real-time water quality monitoring network across the province. Reliable water quality data is needed to support water resources management decisions. The network currently consists of over 30 stations maintained by Environmental Scientists across the province.

Purpose

The purpose of this audit is to provide an objective independent examination of the monitoring station to ensure appropriate methods are utilized to generate high quality data. This audit will increase the value and reliability of the data by recommending station improvements as needed.

This audit is necessary to ensure ongoing program reliability, effectiveness, and delivery of high quality results for the existing real-time water quality network. It is also intended to document all methods and protocols so that continuity of delivery can be ensured across the network.

The Water Resources Management Division, in partnership with the City of St. John's and Environment Canada, maintain two real-time water quality and water quantity monitoring stations along Outer Cove Brook. For the purpose of this report, only the Outer Cove Brook at Clovelly Golf Course station in St. John's will be discussed.

Methods

For the purpose of this audit, a generic rating system of Poor, Fair, Good and Excellent is used (See Table 1).

Table 1: Rating Table Overall

Excellent	No issues Occur
Good	Minor issues with structure occur
Fair	Multiple issues with structure and sensors
Poor	Multiple issues with structure, sensors, and transmissions

Technical Audit and Assessment

Under the real-time water quality program, there is an extensive Quality Assurance, Control and Assessment (QA/QC) program documented in the "Protocols Manual for Real-Time Water Quality Monitoring in Newfoundland and Labrador" accessible on the departmental webpage. All components of the QA/QC program work together to ensure the program is generating high quality and accurate data. The station auditing process is identified as one component of the overall QA/QC program.

This technical audit and follow up report will focus on the following:

1. Condition of station structure/hut/shelter
2. Condition of grounds/surrounding area
3. Deployment technique utilized
4. Reliability of communication system
5. Data Integrity/Reporting

The audit does not cover maintenance and calibration procedures.

Background Information

Outer Cove Brook at Clovelly Golf Course - NF02ZM0365

Figure 1: Outer Cove Brook at Clovelly Golf Course looking upstream of station

Station Details

- Station Identification: NF02ZM0365
- Water Survey Canada Station Identification: 02ZM023
- Station Installed: April 6th, 2012
- Water Level (Quantity) collected every five minutes and Quality data collected every fifteen minutes. Parameters:
    - Water Temperature
    - pH
    - Specific Conductance
    - Dissolved Oxygen
    - Percent Saturation
    - Turbidity
    - Total Dissolved Oxygen
    - Stage

- Site Selection Rational: To monitor, process and publish hydrometric (water quantity) and real-time water quality data along Outer Cove Brook, which is in the vicinity of the Torbay Road North Commercial Development Area. The real-time stations allow for assessment and management of this water body.
- Date of Audit: March 30th, 2015 at approximately 10:15am NDT
- Location: N 47° 37’ 36.7” W 52° 42’ 32.1”
- Elevation: 332 ft

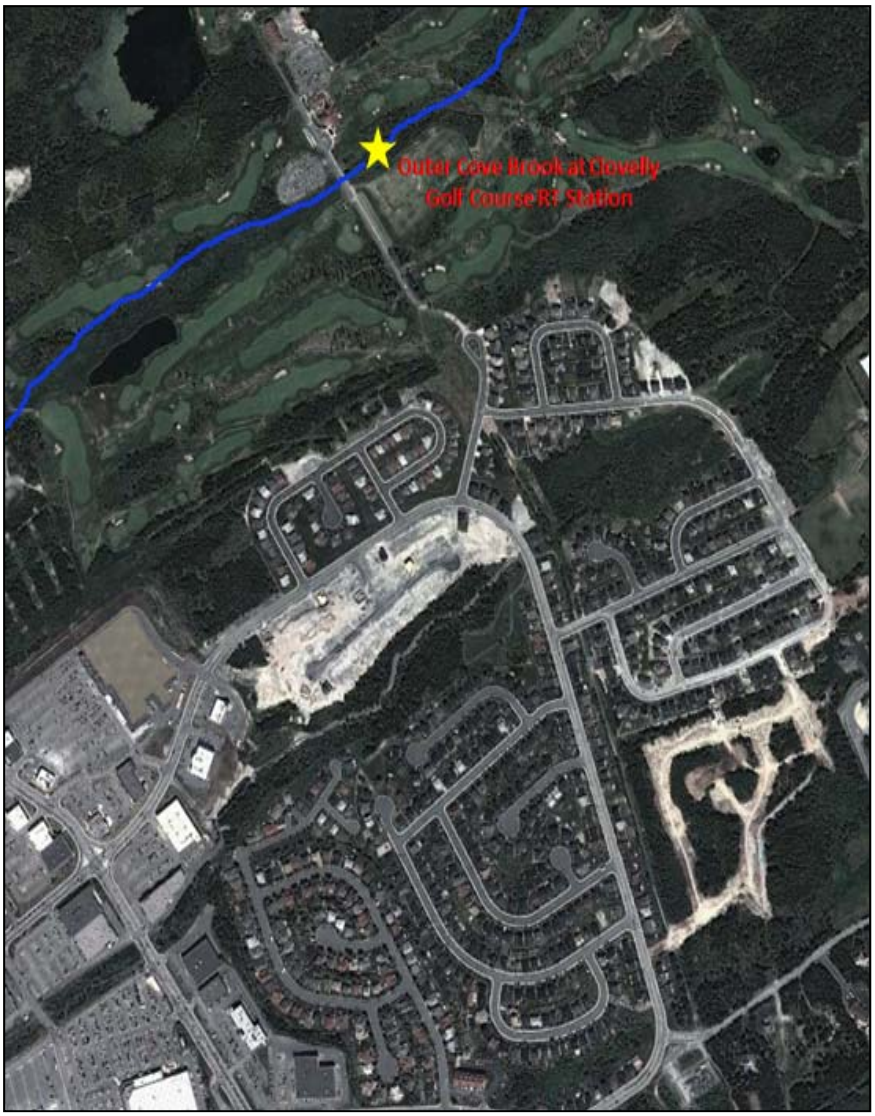


Figure 2: Location of Outer Cove Brook at Clovelly Golf Course Real-Time Water Quality and Quantity Station

Figure 3 – Outer Cove Brook at Clovelly Golf Course Station

Equipment in Use

Water Quality (single Hydrolab used at this site)

- Hydrolab, Datasonde 5X #62278
- Parameter Order: Temperature (°C), pH (pH Units), Specific Conductance (µS/cm), Dissolved Oxygen (mg/L) and Turbidity (NTU) – 15 minute measurements
- Protected by a 4 inch steel pipe anchored to the hut via aircraft cable
- Performance Testing and Evaluation last completed Summer 2014
- Cable (encased in conduit) replaced December 2014

Figure 4 – Conduit protecting the cable

Figure 5 – Aircraft cable attached to the hut

Water Quantity

- Sutron Model Satlink SL2 datalogger transmitting via GOES, PLID: 481A635C
- Level Sensor:
    - Sutron Accubar Bubbler (Bubble Gauge) – 5 minute measurements
    - Orifice and tube to river

Personal Protection Equipment (PPE) Required

- Hip or Chest Waders
- PFD with whistle
- Long waterproof gloves (if taking water samples)
- Reflective safety vest
- First Aid Kit
- Safety Glasses
- Note: The above PPE is required for every site visit, no exception. The Golf course also recommends full helmet due to short distance to the driving range

Audit Observations

Condition of grounds/surrounding area

Observations:

1. During the first year of installation the station has immersed into the marsh a depth of about 2ft from the initial installation height as can be seen in Figures 6 and 7.

Figure 6: April 6, 2012 Installation

Figure 7: March 30, 2015 – during audit

2. The station enclosure is a metal LookIn Shelter. The enclosure was originally not fully sealed from the elements which caused rust to form, resulting in pin holes in the wall and floor (See Figures 8 and 9).

Figure 8: Rust and pin holes inside of enclosure

Figure 9: Rust and pin holes

3. There is currently no signage on the enclosure of the station.

Figure 10: Real-time Station Signage Example

4. The solar panel and antenna are within reach at the site without the need of a ladder. This could be problematic and lead to vandalism or theft. There has been proper maintenance on the antenna by Water Survey Canada staff as it was noted that some of the directors on the antenna have been

replaced. Due to the plant and tree overburden, there may be a need for landscaping to ensure there is enough direct sun exposure for the battery to charge. The solar panel should be deployed with the cabling from the panel pointing to the ground with a dew loop so that if any precipitation (rain, ice) runoff occurs it will be directed away from the junction box that houses the connection and diodes.

5. The water quality sonde is deployed from the shore line. The sonde itself is housed inside a four inch diameter stainless steel casing approximately 30 inches long. The cabling is housed in a flexible protective conduit to protect it from damage (Figure 11).

Figure 11: Protective conduit at Clovelly Golf Course

Recommendations:

1. Monitor settling events and note any changes that will require stabilizing the structure.
2. In order to address the issue of rust due to moisture, the recommendation is to seal and treat the rust with a common spray from a hardware store. Once it is treated with spray, the pin holes will have to be treated with plumber's putty. A humidity indicator card should be added inside the enclosure and the desiccant that is currently depleted should be replaced. In the future when the card indicates the relative humidity is exceeded, the desiccant will need to be replaced.
3. Install proper signage on the enclosure, as can be seen in Figure 10. With proper signage, the public is notified of any safety concerns and who to call for more information as needed.
4. Extend the deployment pipe that houses the solar panel and antenna at least another 2-3 feet so that it is out of reach and landscape as necessary
5. Bury the flexible conduit between enclosure and riverbank for safety purposes as it is a tripping hazard and prone to vandals.
6. If the industry partner has at least two stations with the same sensors installed, the sondes should be rotated for validity, consistency and accuracy of data. This would also be beneficial if at one station the instrument is getting an unusual amount of wear due to turbulent tidal action. Rotating the instruments between stations would ensure even wear and usage on all instruments. Rotating the instrument would also help in conformance testing - testing to determine whether the station and

instrument is working efficiently and effectively. Presently at this station, the same instrument is utilized for each deployment period.

Quality Assurance and Quality Control

Technical staff are very familiar with the sonde and its operation. There are manuals in place: (1) Protocols Manual for Real-Time Water Quality Monitoring in NL whose purpose is to document the components from the conception and production stages through to data management and reporting; and a (2) Calibration and Maintenance Guide providing detailed instructions and tips for cleaning, maintaining and calibrating RTWQ instrumentation. This documentation ensures that all technical staff are following the same protocols at all stations and thus ensuring compliance. Following written protocols ensures the programs reliability, effectiveness and delivery of high quality results for the existing real-time water quality network. Regular Performance Testing and Evaluations and the capacity for in house servicing allows for quick repairs and functioning equipment.

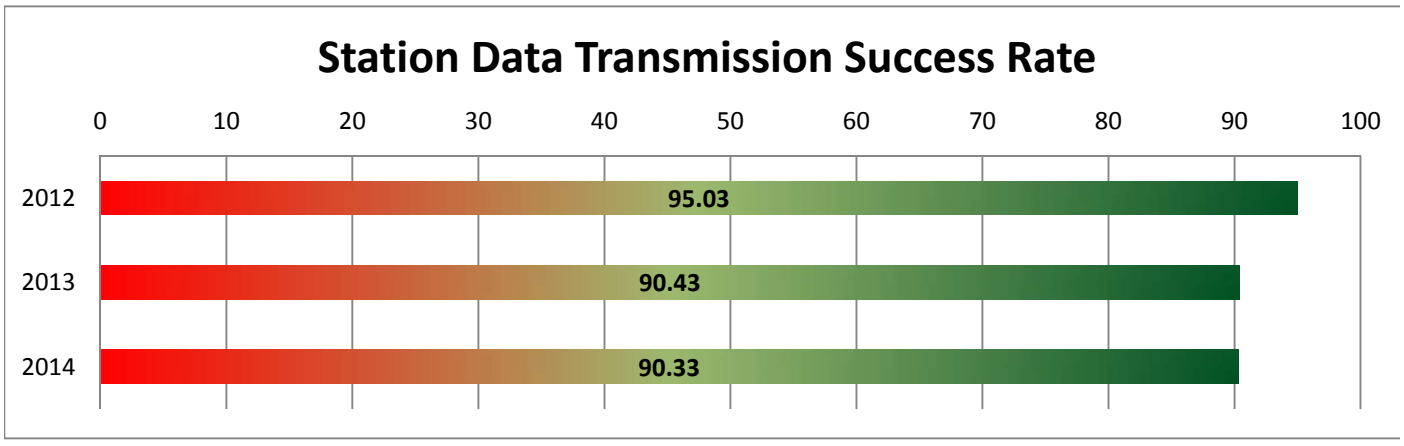
As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of the deployment period. The procedure is based on the approach used by the United States Geological Survey (USGS).

Data Integrity/Reporting

Observations: There is proper protocol in place to store data on the water quality sonde internally. In the event that transmissions fail at the station, the data from the log file is used as a back up to supplement transmitted data.

The station statistics are based on the station transmissions which are hourly via GOES with measurements every 15 minutes, 365 days a year (Figure 12). Based on the statistics (refer to Appendix A), the station has over 90% successful transmissions. Maintenance and calibration days (one day per month) account for 3.29% of missed transmissions.

Figure 12:



Full versions of the individual charts can be found in Appendix B.

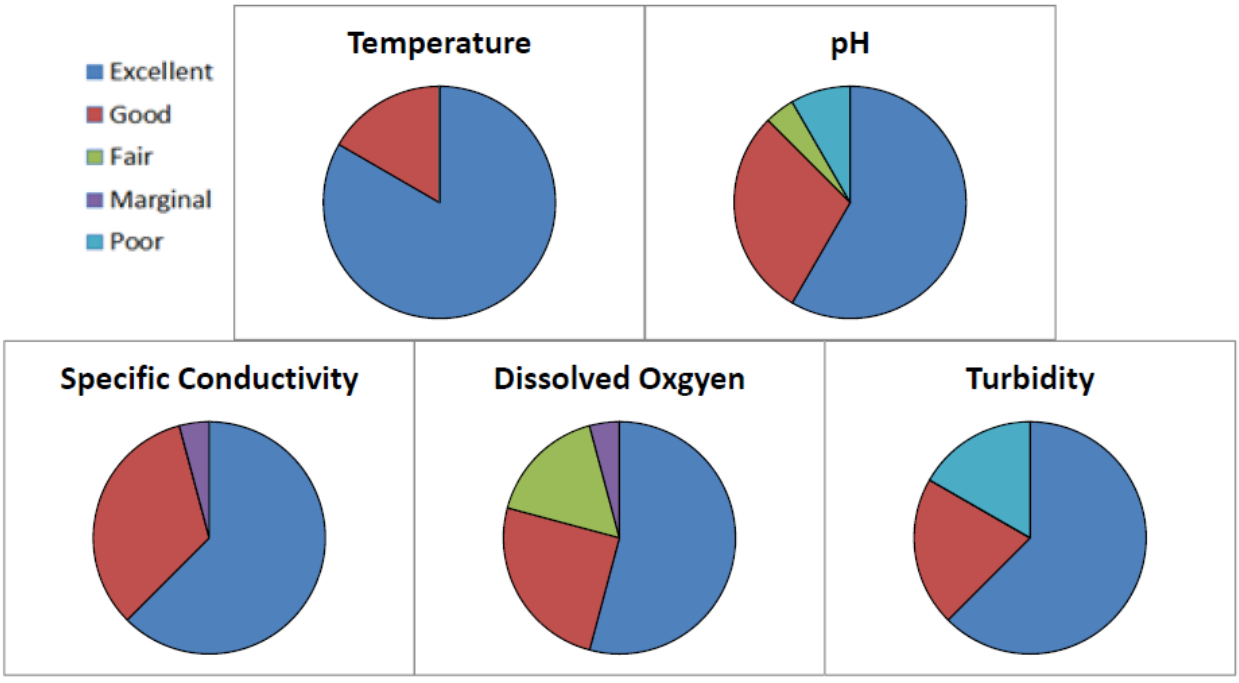
At both deployment and removal site visits, the QAQC instrument values and the field instrument values are recorded on the RTWQ field sheet for comparison. The comparison chart (see Table 2) was developed statistically to provide a range that water parameters and water data can be evaluated against to indicate the accuracy of the readings.

The comparison figure below is featured on the NL RTWQ field sheet and can be used as a quick reference to ensure all parameters are ideally yielding positive rankings based on the difference between the field and QAQC instrument readings (see Figure 13).

Table 2: Comparision Table

Parameter		Rank				
		Excellent	Good	Fair	Marginal	Poor
Temperature (°C)		± 0.2	± 0.2 – 0.5	± 0.5 – 0.8	± 0.8 – 1.0	± 1.0
pH (units)		±0.2	± 0.2 – 0.5	± 0.5 – 0.8	± 0.8 – 1.0	± 1.0
Specific Conductivity	< 35 µS/cm	± 3	± 3 - 10	± 10 – 15	± 15 – 20	± 20
	> 35 µS/cm	± 3 %	± 3 – 10 %	± 10 – 15 %	± 15 – 20 %	± 20 %
Dissolved Oxygen (mg/l)		± 0.3	± 0.3 – 0.5	± 0.5 – 0.8	± 0.8 – 1.0	± 1.0
Turbidity	< 40 NTU	± 2	± 2 – 5	± 5 – 8	± 8 – 10	± 10
	> 40 NTU	± 5 %	± 5 – 10 %	± 10 – 15 %	± 15 – 20 %	± 20 %

Figure 13: Station sensor comparison rankings over the 2014-15 deployment years



Conclusions and Path Forward

The rating of the station based on condition of all the equipment and data is 'Good' (see Table 1); there are some structural issues that need to be resolved.

Path forward for this station

- Complete a follow-up visit once all suggestive corrective action is completed to ensure all stations are in good working order.
- Improve and build on the internal auditing process to provide assurance to the stakeholders and top management that NL Real Time section is compiling reliable real-time data.

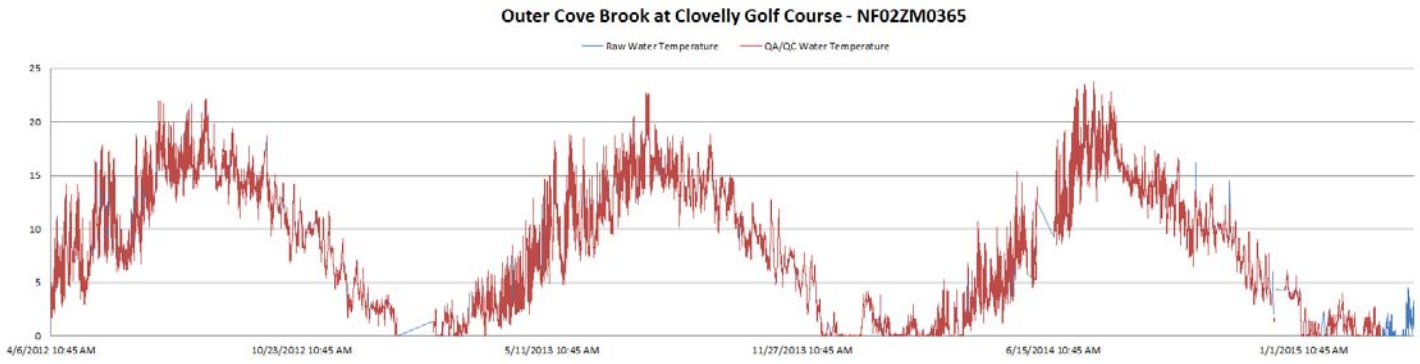
Appendix A

Summary statistics calculating station transmissions.

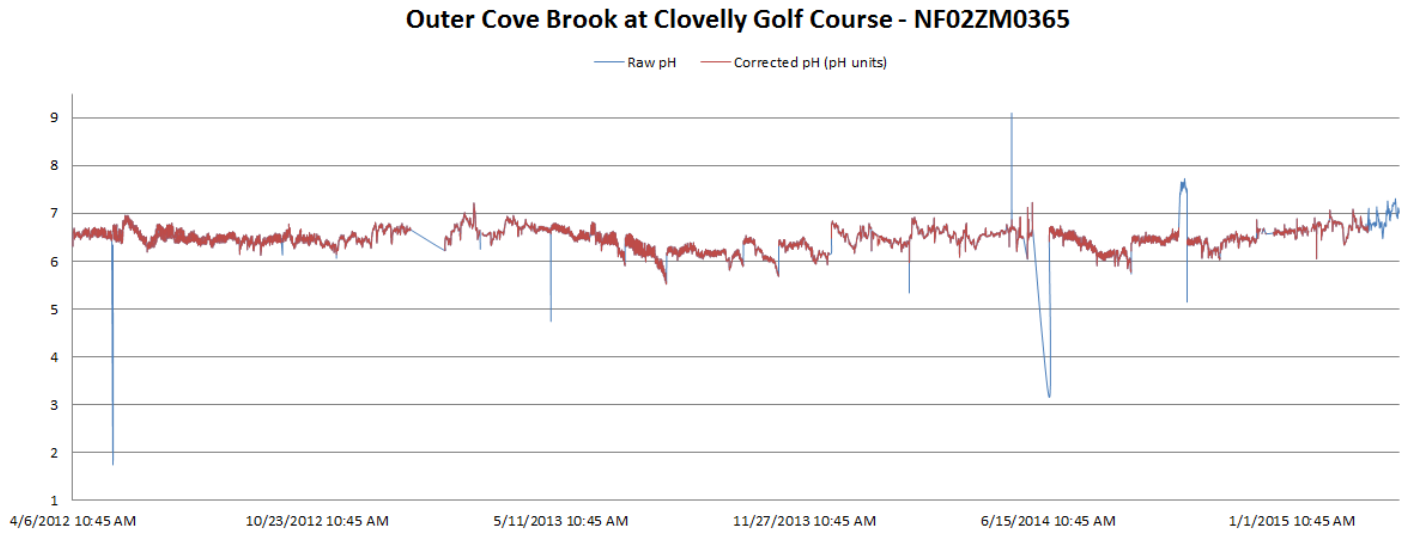
Outer Cove Brook at Clovelly Golf Course - NF02ZM0365				
	2012	2013	2014	Up to March 30th, 2015
Station Installed April 6th, 2012				
Percentage successful real-time transmissions	95.03%	90.43%	90.33%	94.54%
Transmission Error Percentage Rate per Parameter				
Water Temperature	0.08%	0.003%	0.06%	0
pH	1.75%	0.003%	0.028%	0.10%
Specific Conductance	3.41%	0.02%	0.08%	0.32%
DO	7.30%	0.038%	0.71%	0.35%
Percent Saturation	6.22%	0.03%	0.02%	0.30%
Turbidity	8.15%	0.04%	0.71%	0.42%
TDS	5.01%	0.03%	0.03%	0.24%
Sensor Errors Percentage				
Turbidity	0	2.48%	0.93%	0
Dissolved Oxgyen	12.52%	0.016%	0	0.01%

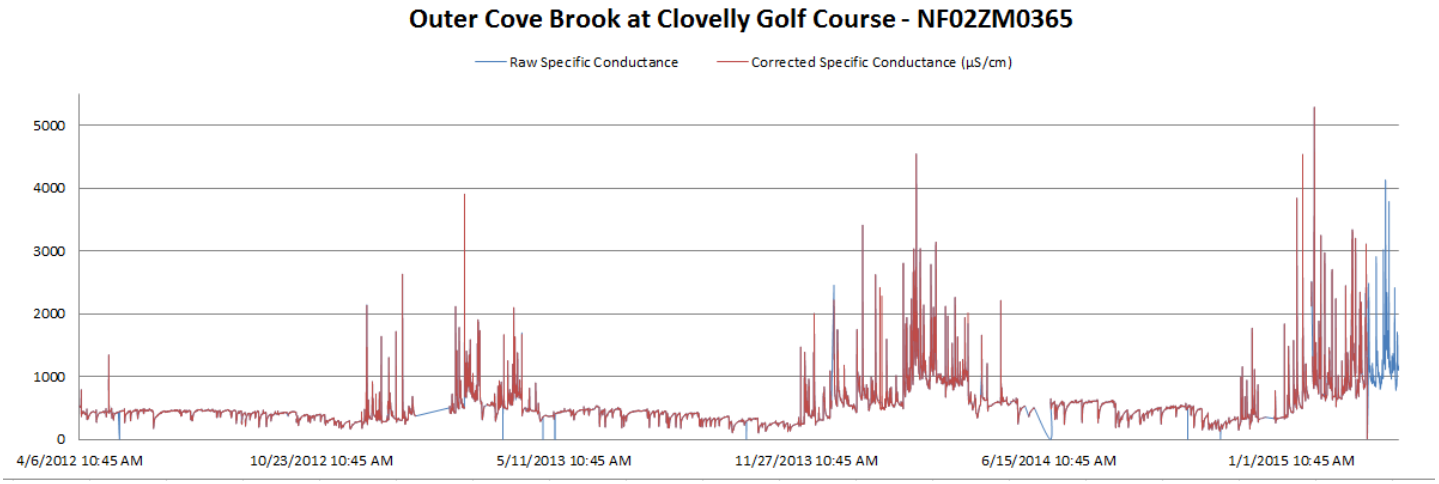
Appendix B

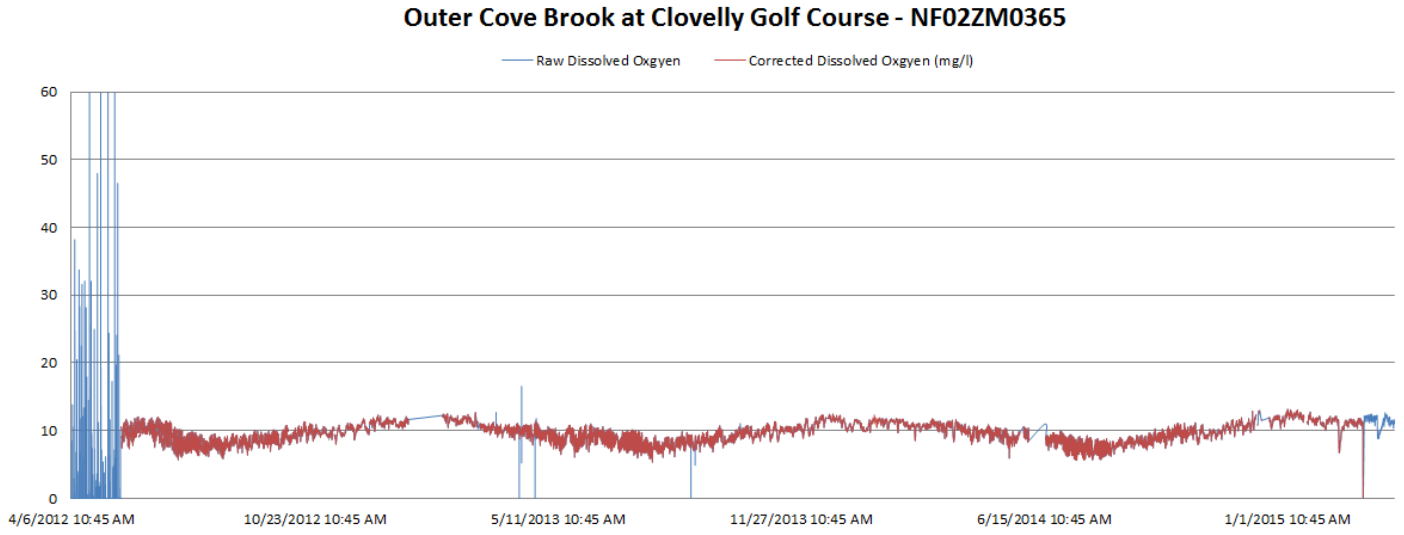
Graphical depiction of individual parameters raw data versus QA/QC data since station installation on April 6th, 2012 to March 30th, 2015.



Outer Cove Brook at Clovelly Golf Course, Newfoundland and Labrador







Outer Cove Brook at Clovelly Golf Course, Newfoundland and Labrador