

Real-Time Water Quality Annual Report

Northern Harvest Smolt Ltd.

November 6th to
December 31st, 2019



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

Introduction

- The Real-Time Water Quality (RTWQ) Monitoring Network near Stephenville, NL consists of three groundwater well monitoring stations funded by Northern Harvest Smolt Ltd. The program is a joint partnership between Northern Harvest and the Newfoundland & Labrador Department of Municipal Affairs and Environment (MAE).
- Each of the three stations consists of groundwater water quality and quantity monitoring equipment (water level) which transmits data in near real-time every 2-3 hours.
- The well stations are known as: FMW10; FMW12 and MW5/6. They were installed in November 2019 by MAE staff and first deployed on November 6th 2019. The instruments remain in the monitoring wells year-round unless removed temporarily for maintenance and calibration.
- These stations measure the following water parameters: temperature, pH, specific conductivity, total dissolved solids (TDS), oxidation-reduction potential (ORP) and water quantity (depth). Parameters are recorded on an hourly basis during the deployment period and are available in real-time online:

NLGWFMW10: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW10

NLGWFMW12: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW12

NLGWMW5/6: https://www.mae.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWMW56

- FMW10 - This 50mm well is one of the five wells which make up the Northern Harvest far-field monitoring network which is set up outside the 500m radius of the hatchery. This well is relatively deep.
- FMW12 – This 50mm well is one of the thirteen wells which make up the Northern Harvest near-field monitoring well network which is within 500m of the water supply area. This well is relatively deep.
- MW5/6 – This 50mm well is one of the thirteen wells which make up the Northern Harvest near field monitoring well network within 500m of the water supply area. This is a relatively shallow well.



Figure 1: Map of Northern Harvest Smolt Ltd. Real Time Water Monitoring Network

- The purpose of this network is to monitor, process, and distribute water quality/quantity data to Northern Harvest Smolt Ltd. and MAE for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues, allowing mitigative measures to be implemented in a timely manner.
- MAE will provide Northern Harvest Smolt Ltd. with monthly and annual deployment reports in 2020. For 2019, only an annual report will be generated as there are only two months of data for analysis. Data is available in near real-time on the MAE’s website.
- Gaps in the water quality data are the result of transmission loss by the stations or the removal of inaccurate data due to ongoing station maintenance during that time period.
- The initial deployment for the 2019 season was on November 6th. The instruments were next removed for full maintenance in June 2020.
- In February 2020, MAE staff visited FMW12 to lower the instrument to a greater depth and MW5/6 to investigate frequent transmission losses. This will be discussed in the 2020 Annual Report.
- For 2019, analysis is limited to the two months the instruments were installed.



(a) FMW10



(b) FMW12



(c) MW5/6

Figure 2: Northern Harvest Real Time Monitoring Network: (a) FMW10, (b) FMW12, (c) MW5/6

Maintenance and Calibration

- To ensure accurate data collection of the real time groundwater monitoring network, maintenance and calibration of the water quality instrumentation is performed approximately every four months
- Maintenance includes a thorough cleaning of each instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, MAE staff carefully calibrate each sensor attachment for pH, specific conductivity and ORP to ensure accurate data collection.
- Installation and removal dates for the 2019 season are summarized in the table below.

Table 1: Water quality instrument deployment start and end dates for 2019

Station	Installation	Removal	Duration (days)
FMW10	November 5, 2019	June 16, 2020	221
FMW12	November 6, 2019	June 16, 2020	220
MW5/6	November 6, 2019	June 16, 2020	220

Quality Assurance and Quality Control

- 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 each deployment period. The procedure is based on the approach used by the United States Geological Survey.
- During the maintenance phase, a volume equivalent to three well casings is purged from each well prior to re-installation and the collection of grab samples. This process flushes stagnant water from the wells and ensures that the water being observed is aquifer water.
- After full purging of the well, the sonde is deployed and initial field readings are recorded. A grab sample is also taken when possible to compare the values of pH and specific conductance against the deployed sonde’s initial values.
- Three instruments are owned by Northern Harvest and will be installed in the wells on a rotating basis to ensure data accuracy.
- Deployment comparison rankings for the stations are summarized in Table 2.

Table 2: QA/QC comparison rankings for Northern Harvest Stations

Station	Date	Action	Instrument #	pH	Specific Conductivity
FMW10	5-Nov-19	Deployment	19D105281	*	*
FMW12	6-Nov-19	Deployment	19E100387	*	*
MW56	06-Nov-19	Deployment	19D105282	*	*

*Ranking not available due to issues with collecting grab sample

Data Interpretation

- The following graphs and discussion illustrate water quality and level related events from November 6th, 2019 to December 31st, 2019 at Northern Harvest Smolt.
- All data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Water Temperature

- After the initial acclimatization period, water temperature ranged from 6.71°C to 9.38°C within the well network (Table 3).
- During the 2019 deployment season, FMW10 and FMW12 temperatures varied little, maintaining relatively steady temperatures, while MW5/6 temperature was steadily decreasing (Figure 3).
- This may be related to decreasing air and water temperatures in the surrounding environment as Fall turned into Winter.

Table 3: Water Temperature (°C) Summary Statistics from the Well Network

	FMW10	FMW12	MW5/6
MIN.	7.74	6.71	4.95
MAX.	8.09	6.79	9.38
MEDIAN	7.98	6.73	6.48

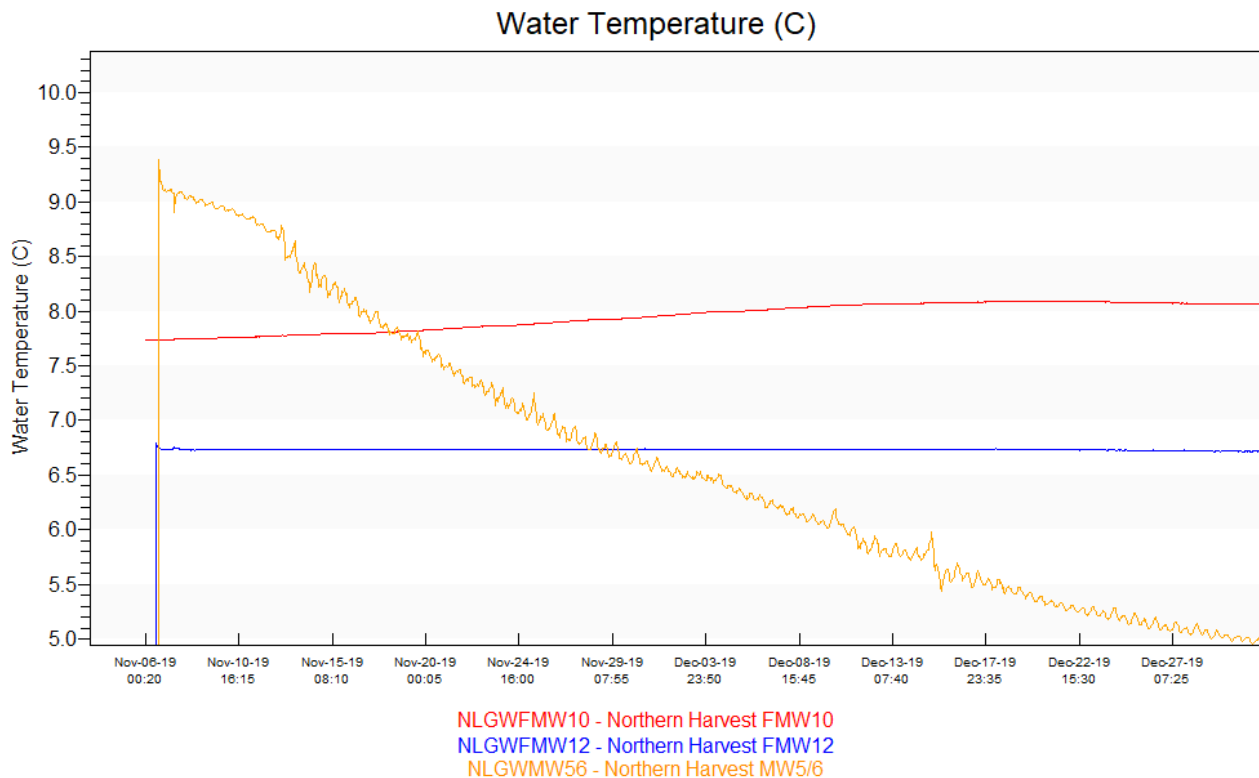


Figure 3: Water Temperature (°C) – Northern Harvest Smolt Ltd. Network

Water Depth

- From initial installation on November 6th to December 19th, water depth values did not take into account the correct water level from the surface. On December 19th, the readings were adjusted to the correct values, which are graphed below (Figure 4).
- During the deployment, FMW12 and MW5/6 were relatively stable while FMW10 showed a slight decreasing trend and a larger range (Table 4). Slight variations in level were noticeable concurrently at all wells at the same time (Figure 4).

Table 4: Water Depth from Surface (m) Summary Statistics from the Well Network

	FMW10	FMW12	MW5/6
MIN.	6.38	6.14	7.66
MAX.	8.17	6.79	8.44
RANGE	1.79	0.65	0.78
MEDIAN	7.37	6.44	8.122

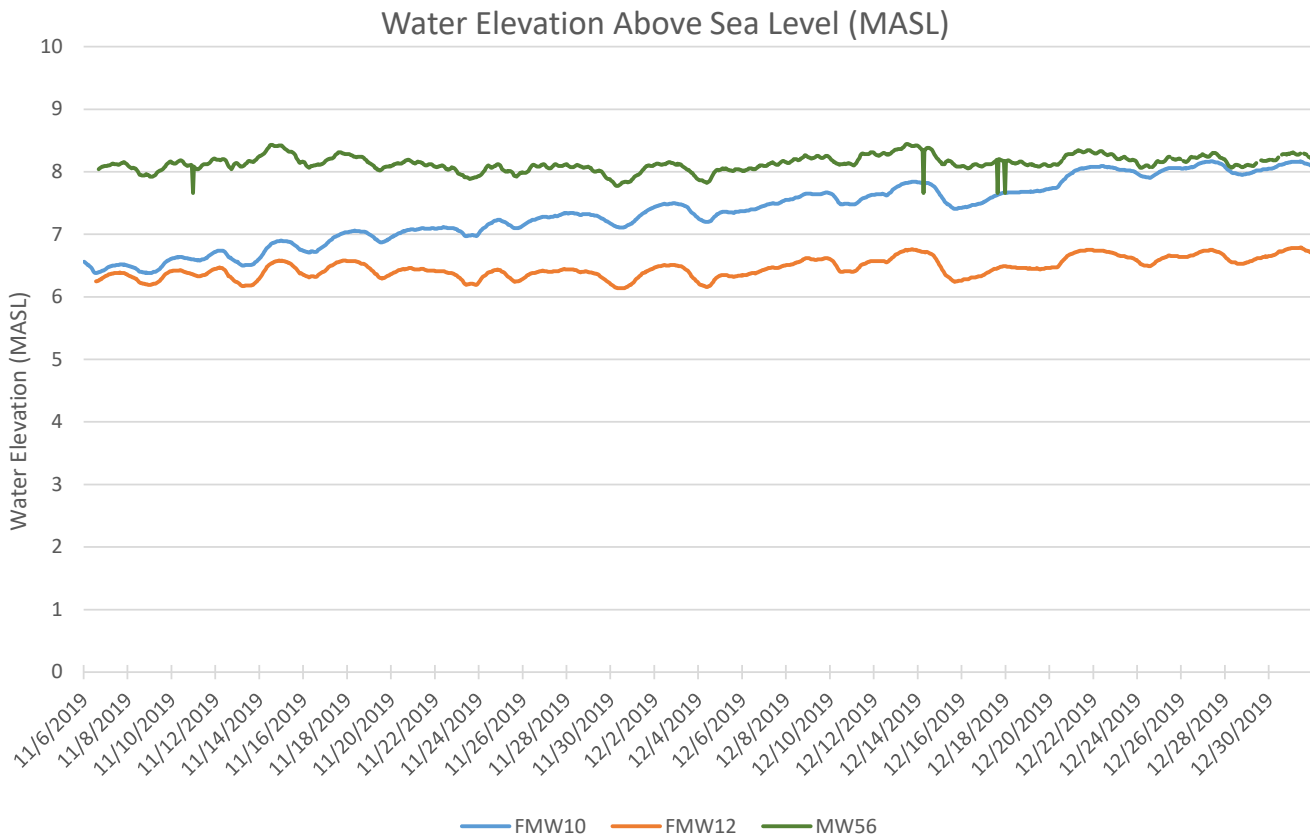


Figure 4: Water Depth (m) – Northern Harvest Smolt Ltd. Network

pH

- After the initial acclimatization period, pH ranged from 5.96 to 10.78 pH units within the well network (Table 5).
- During this time, there was an error with the pH sensor at FMW12, resulting in incorrect data during this deployment.
- The station MW5/6 remains relatively stable with daily fluctuations. FMW10 displays very little variation during this deployment (Figure 5).

Table 5: pH (pH units) Summary Statistics from the Well Network

	FMW10	FMW12	MW5/6
MIN.	7.46	7.31	5.96
MAX.	7.77	10.78	6.35
MEDIAN	7.65	10.53	6.07

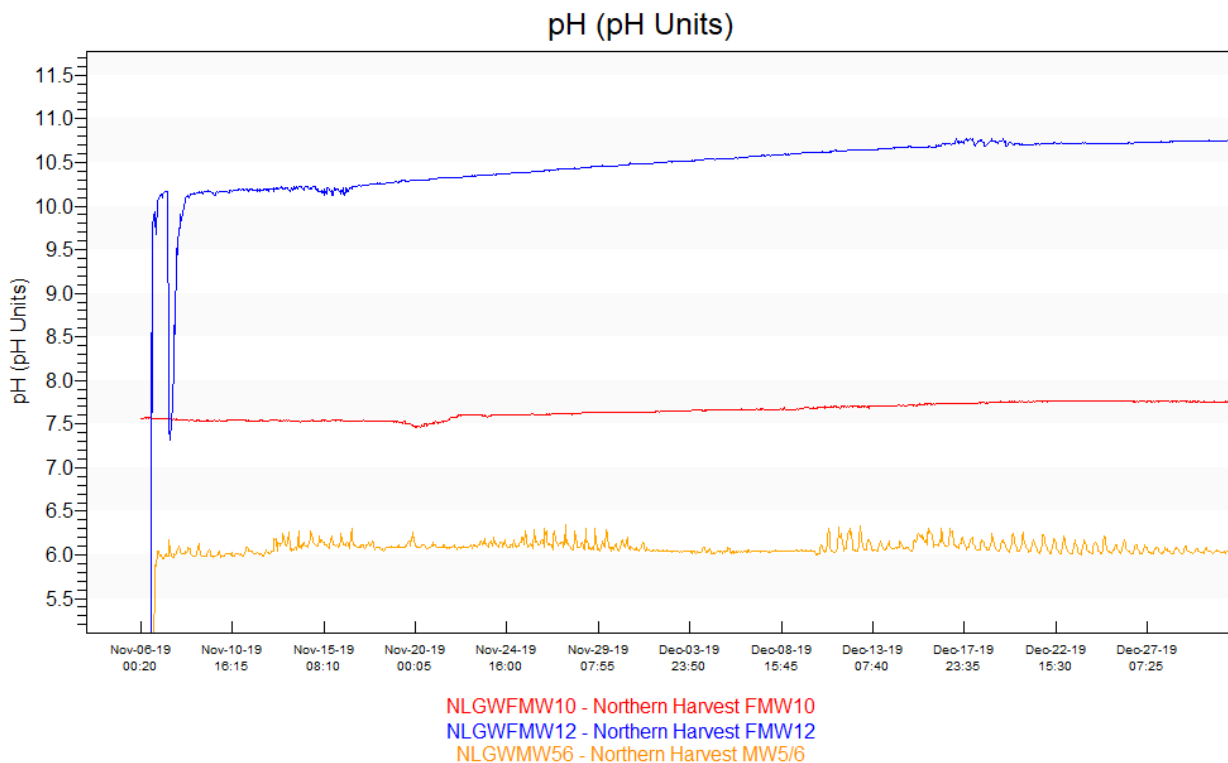


Figure 5: pH – Northern Harvest Smolt Ltd. Network

Specific Conductance and TDS

- After the initial acclimatization period, specific conductance ranged from 63.93 $\mu\text{S}/\text{cm}$ to 491.57 $\mu\text{S}/\text{cm}$ within the well network (Table 6).
- During the deployment, FMW12 displays little variation, FMW10 slowly rises before decreasing into December, and MW5/6 displays daily fluctuations (Figure 6).

Table 6: Specific Conductance ($\mu\text{S}/\text{cm}$) & TDS (g/L) Summary Statistics from the Well Network

	FMW10	FMW12	MW5/6		FMW10	FMW12	MW5/6
	SPECIFIC CONDUCTANCE				TOTAL DISSOLVED SOLIDS		
MIN.	397.78	145.16	63.93	MIN.	0.26	0.09	0.04
MAX.	491.57	172.25	135.72	MAX.	0.32	0.11	0.09
MEDIAN	464.97	153.62	90.31	MEDIAN	0.30	0.1	0.06

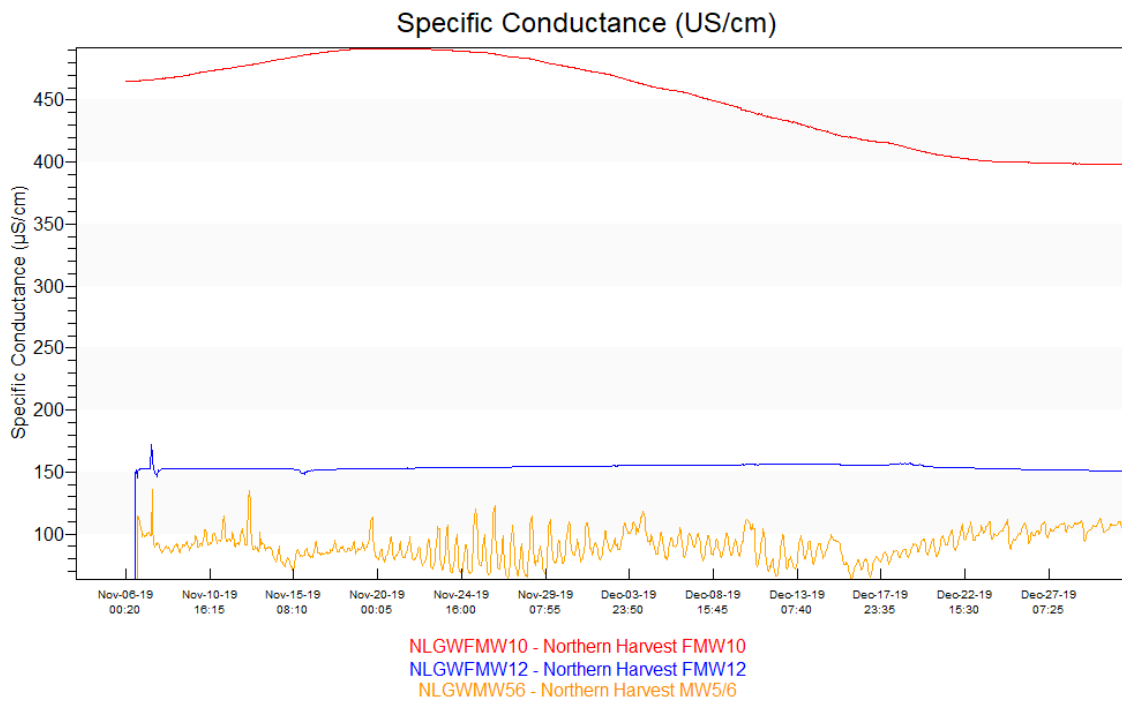


Figure 6: Specific Conductance & TDS – Northern Harvest Smolt Ltd. Network

- After the initial acclimatization period, total dissolved solids (TDS) ranged from 0.04 mg/L to 0.32 mg/L within the well network (Table 6).
- TDS varied little at FMW12. At FMW10, TDS increased into November before decreasing into December. At MW5/6 TDS was lowest and fluctuated daily (Figure 7).

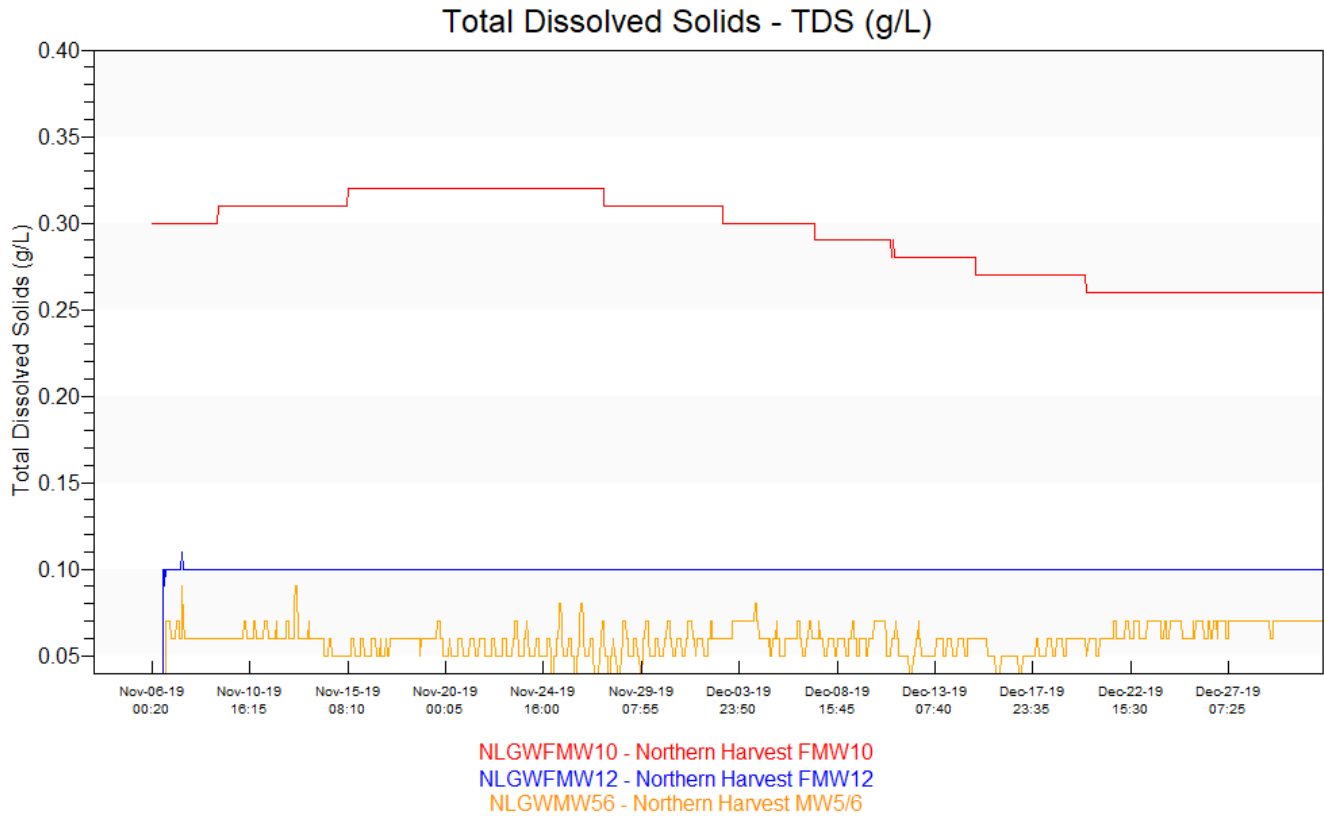


Figure 7: Total Dissolved Solids – Northern Harvest Smolt Ltd. Network

Oxidation – Reduction Potential (ORP)

- After the initial acclimatization period, oxidation-reduction potential (ORP) ranged from -711.5mV to 374.26 mV within the well network (Table 7).
- From this first deployment, both FMW10 and MW5/6 seem to be oxidative in nature, while FMW12 is reductive in nature (Figure 8).
- As there were issues with the placement of the sonde in FMW12 and this is only a first deployment to gather baseline data for all wells, the ORP values will be monitored for changes in 2020.

Table 7: Oxidation-Reduction Potential (ORP) Summary Statistics from the Well Network

	FMW10	FMW12	MW5/6
MIN.	116.15	-711.5	55.52
MAX.	374.26	-434.24	251.28
MEDIAN	280.019	-533.82	186.5

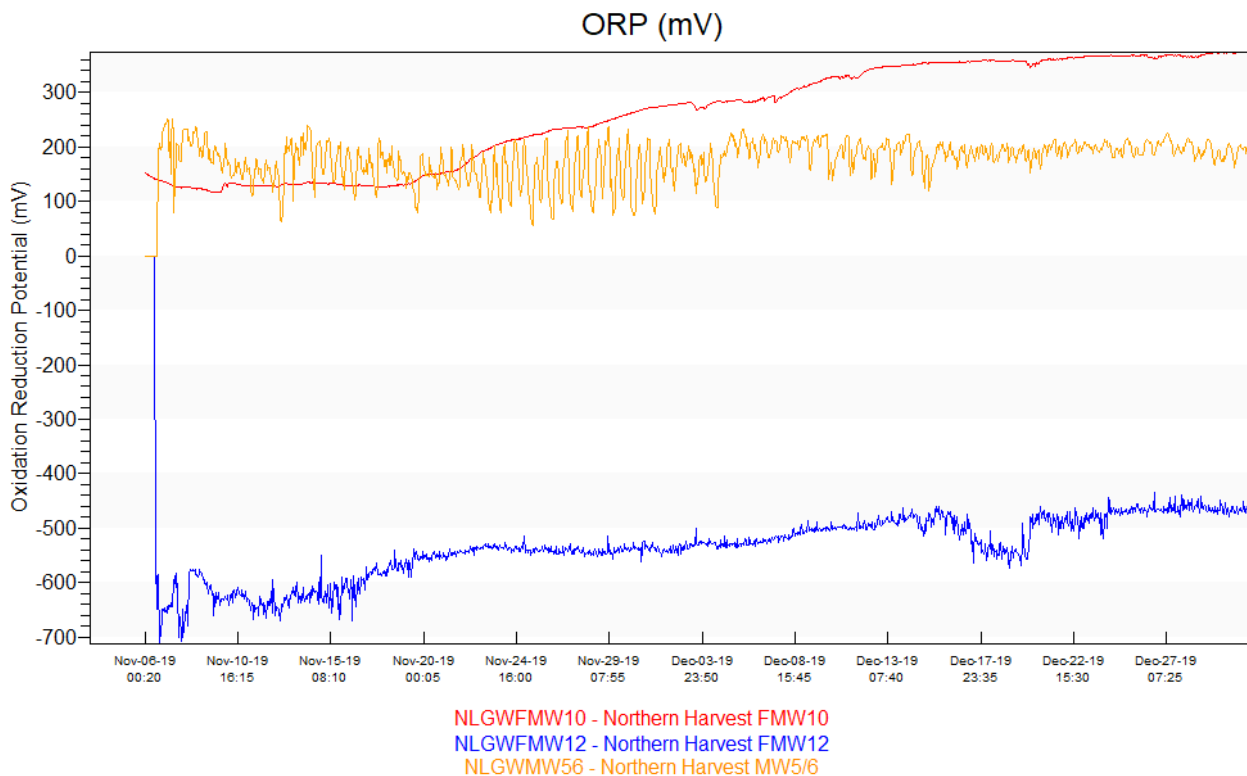


Figure 8: Oxidation-Reduction Potential (ORP) – Northern Harvest Smolt Ltd. Network

Conclusions

- The Real Time Water Quality and Quantity Monitoring Network at Northern Harvest Smolt Ltd was established on November 6, 2019 when instruments were initially deployed at each of the three wells in the network: FMW10, FMW12 and MW5/6.
- During this first deployment, data was monitored closely to determine if the instruments were accurately placed in the well casings and if there were other issues such as sensor errors.
- QAQC rankings were not obtained as grab samples were unable to be collected. Equipment will be upgraded in the future to ensure grab samples can be collected.
- On December 19th, 2019, water depth data was corrected to account for the depth of the water from the surface. This report includes the corrected data.
- Water depth was relatively stable at FMW12 and MW5/6 while FMW10 showed a slight decreasing trend.
- Water temperature at FMW10 and FMW12 were stable, while temperatures at MW5/6 steadily decreased and showed daily fluctuations.
- pH at FMW10 was slightly basic while MW5/6 was slightly acidic. It was later determined that there was an issue with FMW12 which meant the pH data was inaccurate.
- Specific conductivity hovered around 90 $\mu\text{S}/\text{cm}$ at MW5/6 and 150 $\mu\text{S}/\text{cm}$ at FMW12, while FMW10 was significantly higher with a median of 465 $\mu\text{S}/\text{cm}$.
- ORP for MW5/6 was stable while FMW10 was steadily increasing across the deployment. Both were oxidative in nature. FMW12 was reductive in nature, but increased steadily across the deployment.
- For this first deployment, the instruments performed well with few issues. The issues identified (improper placement of sonde in well and possible sensor failure) were investigated and resolved early in 2020.

Path Forward

- Staff will continue to monitor the data daily for issues.
- If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.
- MAE will continue to work on its Automatic Data Retrieval System (ADRS), to incorporate new capabilities in data management and data display.
- Open communication lines will continue to be maintained between MAE and Northern Harvest Smolt Ltd in order to respond to emerging issues on a proactive basis. Northern Harvest Smolt Ltd will receive monthly deployment reports and an annual report, summarizing the events of the deployment season.

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Appendix 1: Air Temperature and Precipitation at Stephenville, NL

