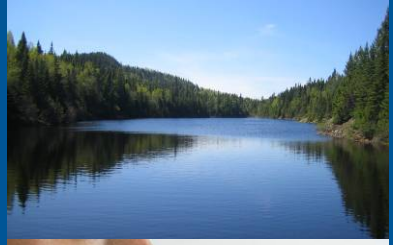







Real-Time Water Quality Report

Grieg NL Nurseries Ltd Monitoring Well

Deployment Period:
November 11, 2020 – March 24, 2021

Newfoundland Labrador

Government of Newfoundland & Labrador
Department of Environment & Climate Change
Water Resources Management Division

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General

The Water Resources Management Division (WRMD) in partnership with Grieg NL Nurseries Ltd, maintain a real-time water quality groundwater monitoring station. The station is located near the Marystown YMCA and Track and Field Complex.

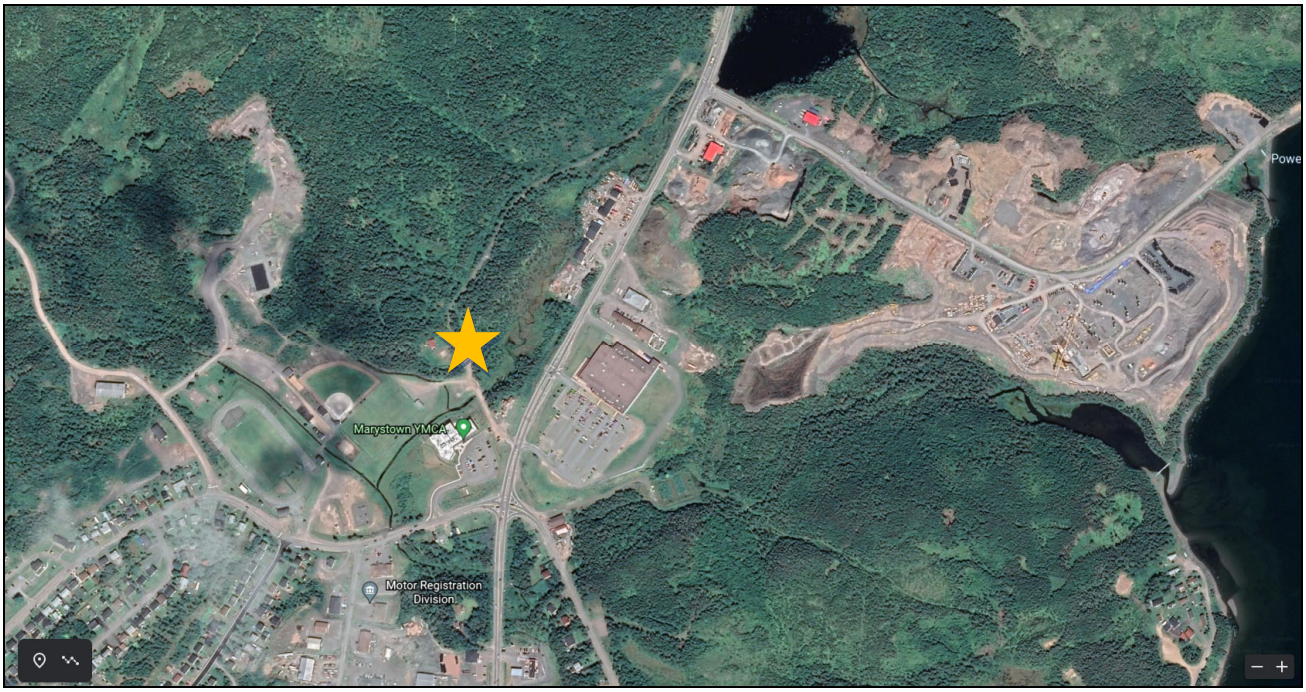

Figure 1: Location of Real-Time Groundwater Well

Figure 2: Hut Structure for groundwater well

Figure 3. View standing in front of well looking toward main road in Marystown, NL

Figure 4: Well Casing in the hut

Figure 5: View looking into well

Quality Assurance and Quality Control

WRMD staff (Environment & Climate Change (ECC)) are responsible for maintenance of the real-time water quality monitoring equipment, as well as recording and managing the water quality data. Tara Clinton is ECC's main contact regarding the instrumentation or the functionality of the monitoring well operation. Tara is responsible for maintaining and calibrating the water quality instrument, as well as grooming, analyzing and reporting on water quality data recorded at the station.

Grab samples are taken at the beginning of each deployment period to compare against the initial in-situ data that is logged. Grab samples also compliment the real-time data and provide an extra check when monitoring changes over the long term (Table 1).

It should be noted that the temperature sensor on any sonde is the most important. All other parameters can be divided into subgroups of: temperature dependent temperature compensated and temperature independent. Due to the temperature sensor's location on the sonde, the entire sonde must be at a constant temperature before the temperature sensor will stabilize. The values may take some time to climb to the appropriate reading.

Concerns or Issues during the Deployment Period

Real time water monitoring well equipment was installed in the back-up production well in November 2020, which was to be used only when the main well went off line. However after installation of the groundwater instrument it was determined that water will be intermittently pumped from this well, requiring intermittently removing the real-time water quality instrument. The removal of the instrument and the pumping of the water will disturb the water within the column of the well.

This groundwater well shares its aquifer with the main pumping well for the hatchery and variations in the water parameters could be a result of pumping from either well.

Table 1: Comparison of the In-Situ instrument vs. Grab Sample Results

Parameter of Comparison	In-Situ Instrument	Grab Sample Result
pH (pH units)	7.52	8.15
Specific Conductivity (µS/cm)	279.2	281.0

Grieg Monitoring Well

Water Temperature

Water temperature ranged from 7.05°C to 7.36°C during the deployment period (Figure 6). The average water temperature across deployment is 7.21°C.

Grieg's monitoring station is a groundwater well, and the water temperatures will remain consistent throughout the deployment. The trend line does indicate a slight increase in water temperature across this deployment.

The dips in water temperature are likely a result of the change in the water column during the pumping processes.

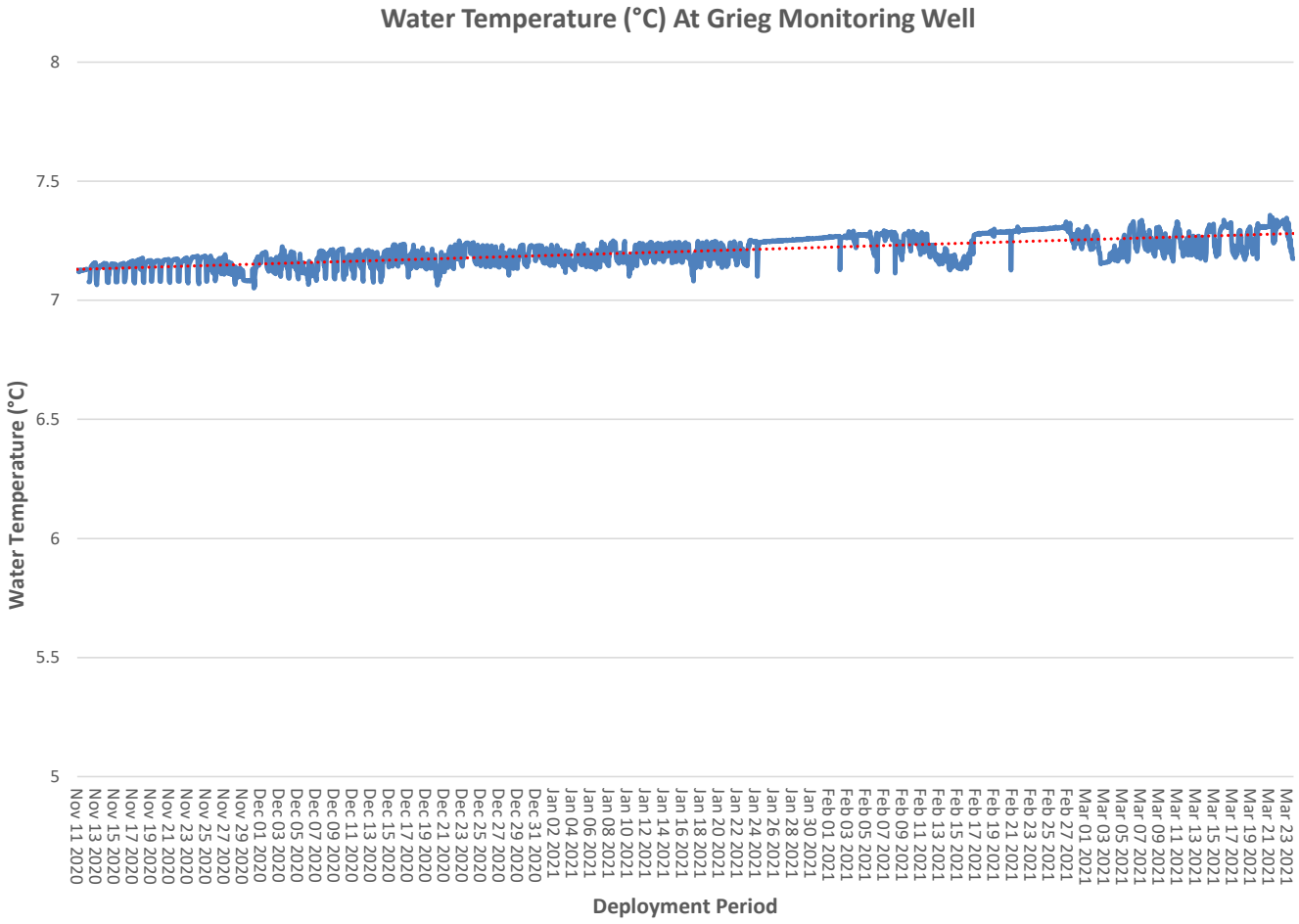

Figure 6: Water temperature (°C) values

pH

Throughout the deployment period, pH values ranged between 7.59 pH units and 7.84 pH units. The pH data remained consistent for the duration of the deployment, with a median of 7.68 pH units.

Small changes in pH were likely the result of pumping. As the well refills and the level adjusts, there will be movement in the pH levels for a short period of time (Figure 7).

Comparison of the grab sample data for pH indicated that the pH in the grab sample of 8.15 pH units, was slightly higher than what was recorded in-situ at 7.52 pH units. To obtain the grab sample the water had to be pumped from the well for a determined period before the sample was taken. The in-situ reading was recorded after the pumping of the well had stopped and the water column allowed to settle.

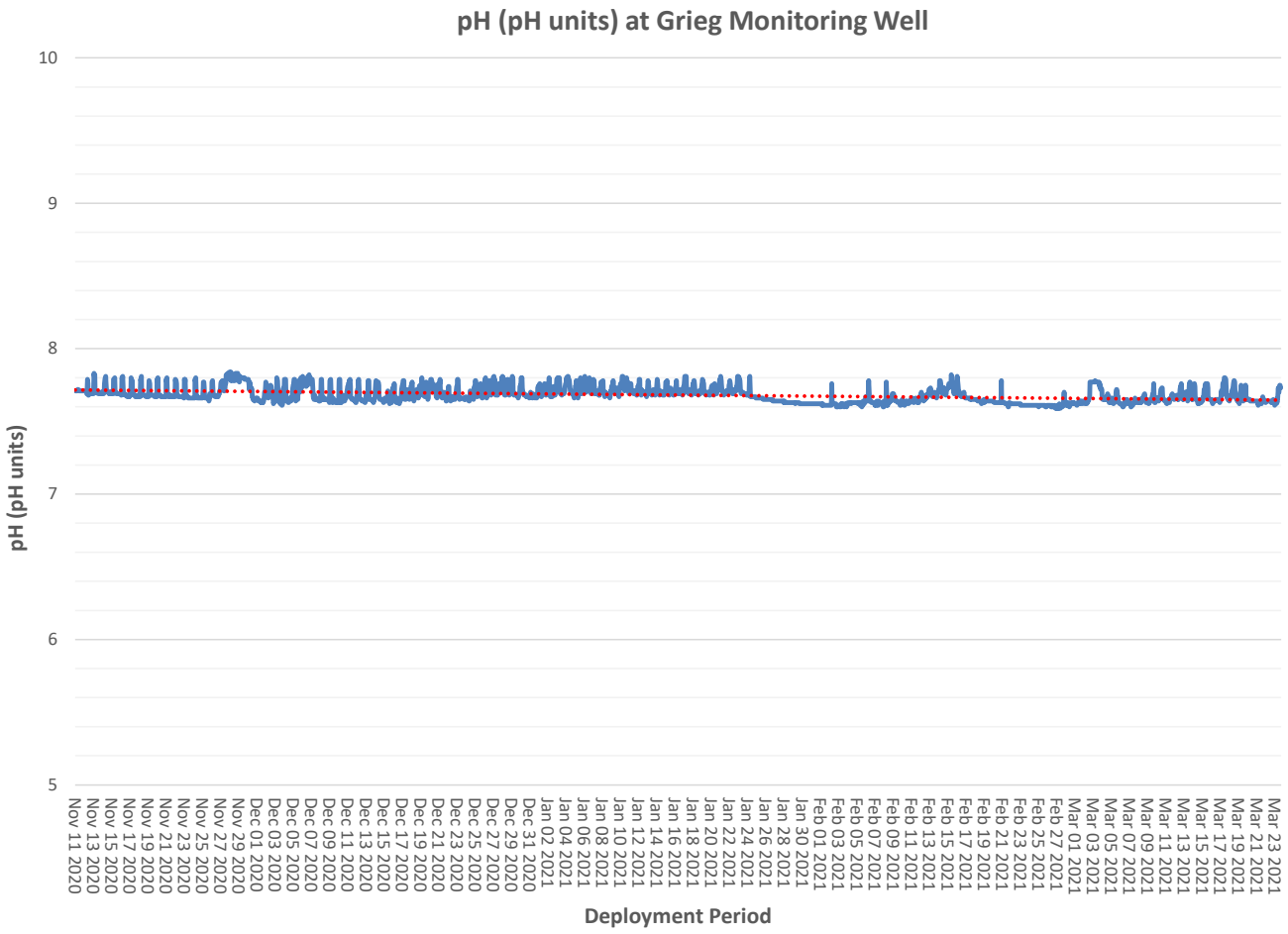

Figure 7: pH (pH units) values

Specific Conductivity & Total Dissolved Solids (TDS)

The conductivity levels were within 269.56 µS/cm and 456 µS/cm during this deployment period (Figure 8). The highest spike in conductivity was a result of the pump being turned on and the instrument being disturbed during use of the pump. The specific conductivity probe measures the presence of diluted salts and inorganic materials in a water source.

TDS data is derived from the specific conductivity data. The water quality instrument is programmed to calculate an estimated TDS value from a conductivity value. TDS data will mirror the movement of the specific conductivity data, however the TDS is calculated in g/L (Figure 9). For the deployment period, TDS ranged within 0.18 g/L to 0.32 g/L.

Due to minimal or no influence from an outside source, the conductivity in the groundwater well is low. The spikes in specific conductivity are likely a result of the pump being used and associated disturbance of the aquifer. The trendline displayed on the graph does not indicate significate changes in Specific Conductivity during deployment.

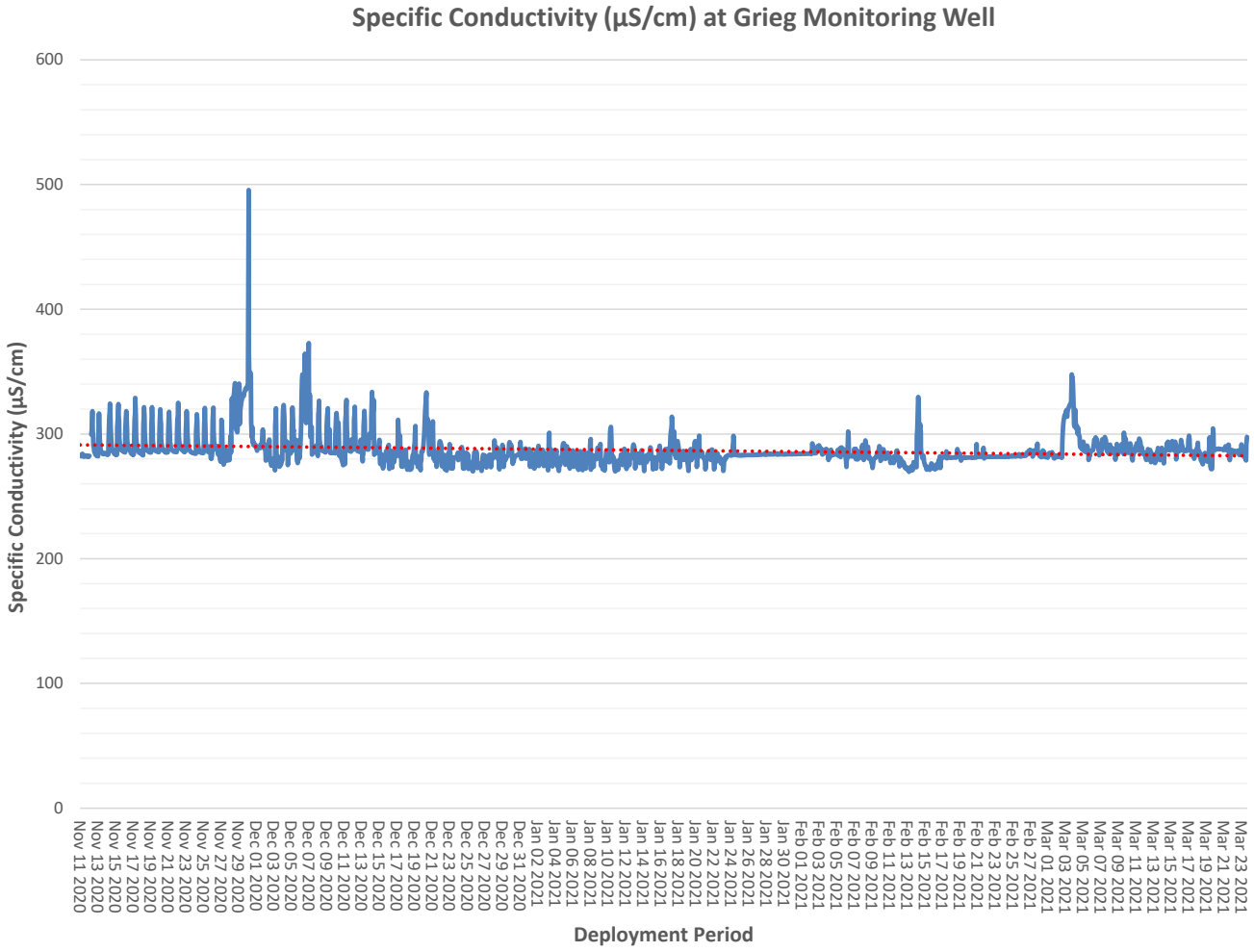

Figure 8: Specific conductivity (µS/cm) values

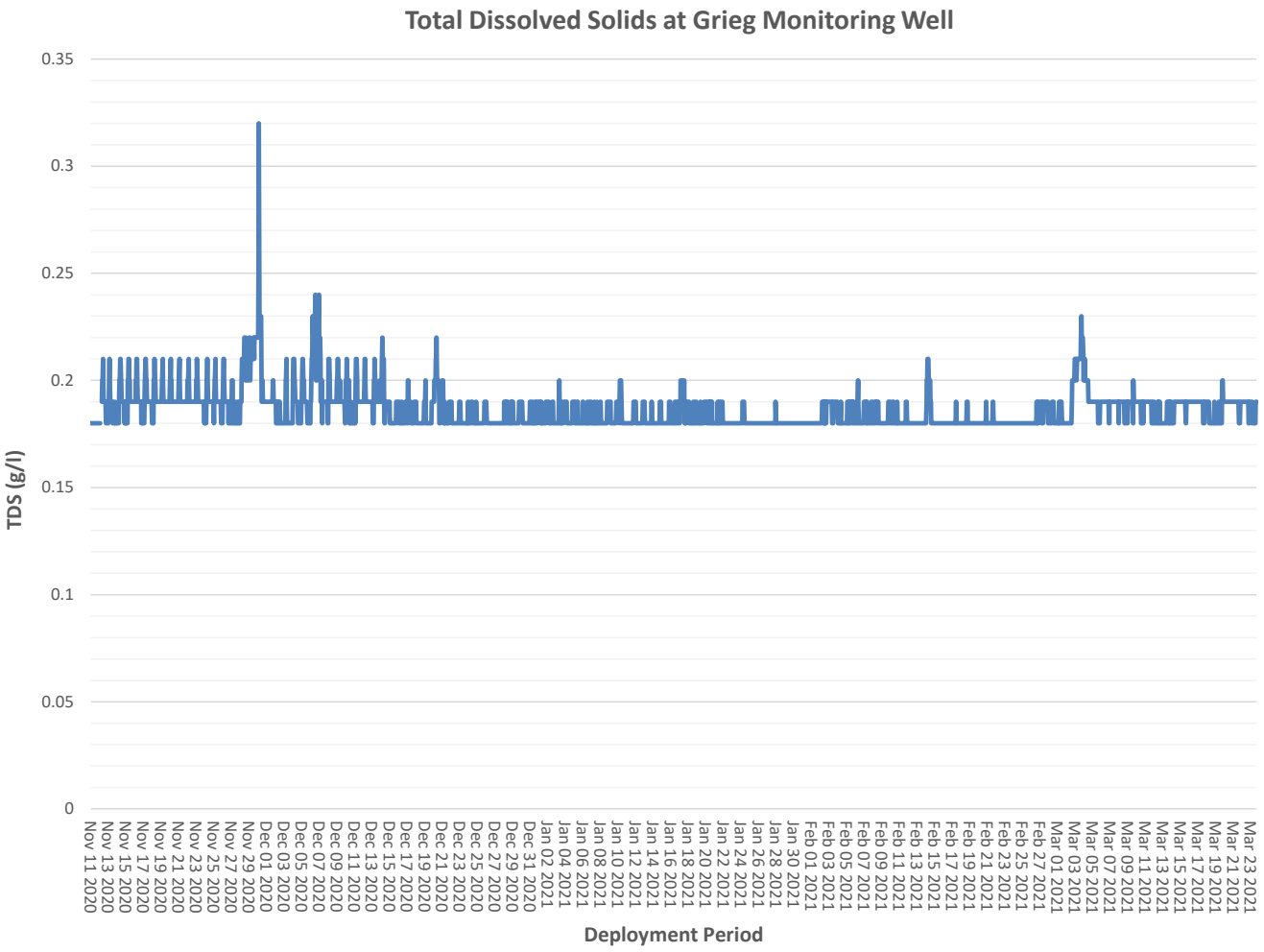

Figure 9: Total Dissolved Solids (TDS)

Oxidation-Reduction Potential (ORP)

ORP levels during the deployment ranged within -3.80 mV to 0.7 mV (Figure 10). The dataset had a median of 0.01 mV.

Oxidation-Reduction Potential is used to determine the oxidizing-reduction potential of the groundwater. The 'redox potential' of the groundwater can indicate the presence of agents that may contaminate groundwater. ORP is individual and specific to each water body and gathering background data is essential in understanding what the changes in the data mean. During this deployment period, ORP values are generally below 0 mV, indicating a predominantly reductive environment.

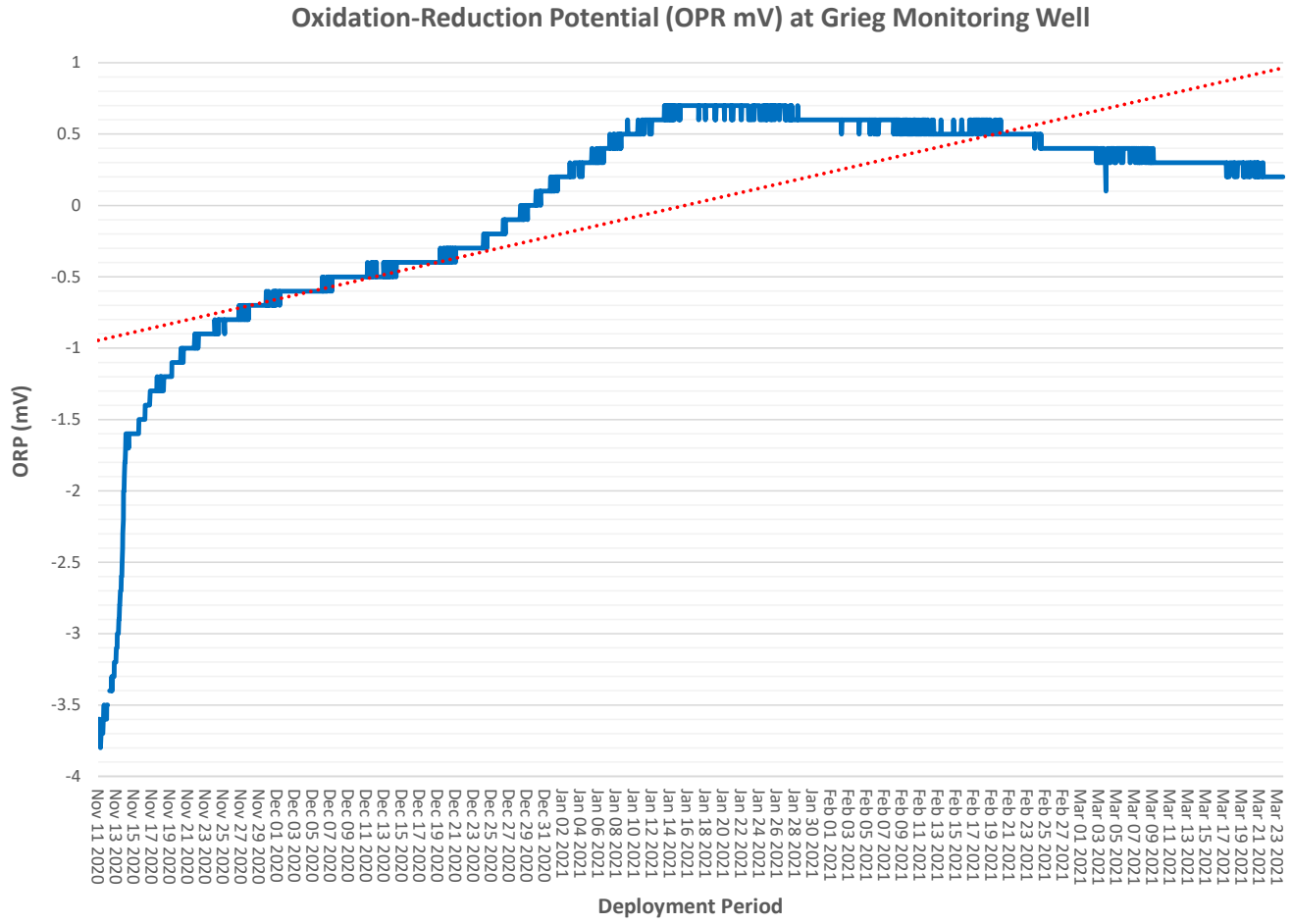

Figure 10: ORP values (mV)

Water Elevation

Water Elevation at the monitoring well, ranged within 14.55 m to 34.14 m. The instrument recorded a median of 32.83 m.

Water elevation at the well would remain consistent until the pump is put into use. As shown below on the graph, water elevation decreases when water is pumped from the well (Figure 11), it then returns to background levels after a short duration.

The red arrows indicate the routine pumping occurring at this well. The other dips in elevation are likely a result of pumping occurring at another well site that shares the aquifer.

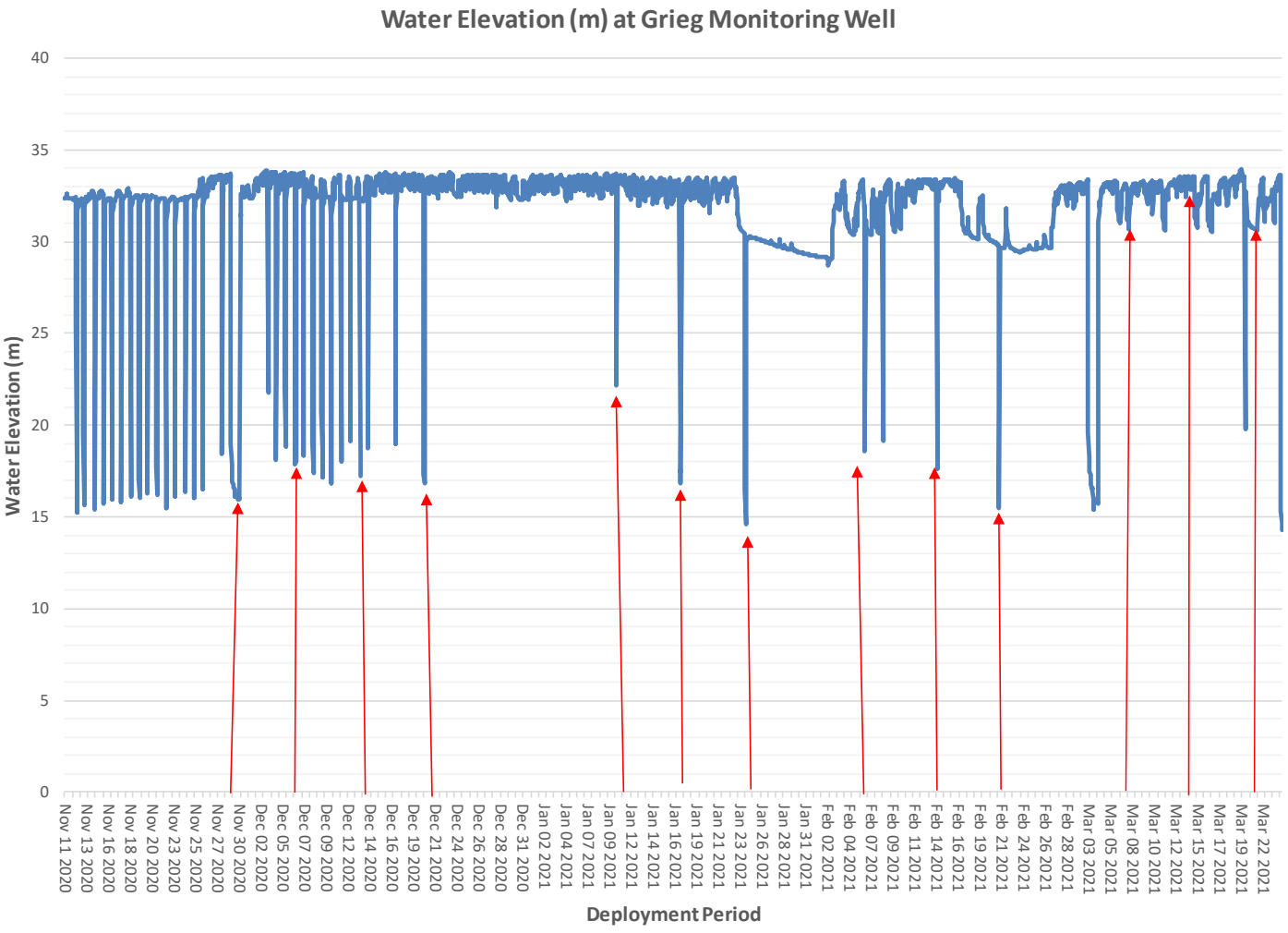

Figure 11: Water Elevation (m)

Appendix I

Water Quality Statistics of Grieg Groundwater Well

Parameter	Min	Max	Median	Mean
Water Temperature (°C)	7.05	7.36	7.20	7.21
pH (pH units)	7.59	7.84	7.67	7.68
Specific Conductivity (µS/cm)	269.6	495.6	284.0	286.8
Total Dissolved Solids (g/L)	0.1800	0.3200	0.1800	0.1861
ORP (mV)	-3.8	0.70	0.3	0.01
Water Elevation (m)	14.55	34.14	32.83	31.90