Real-Time Water Quality Report

Grieg NL Nurseries Ltd Monitoring Well

Annual Deployment Period:
November 11, 2020 to November 23, 2021

Newfoundland Labrador

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

Prepared by:

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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.

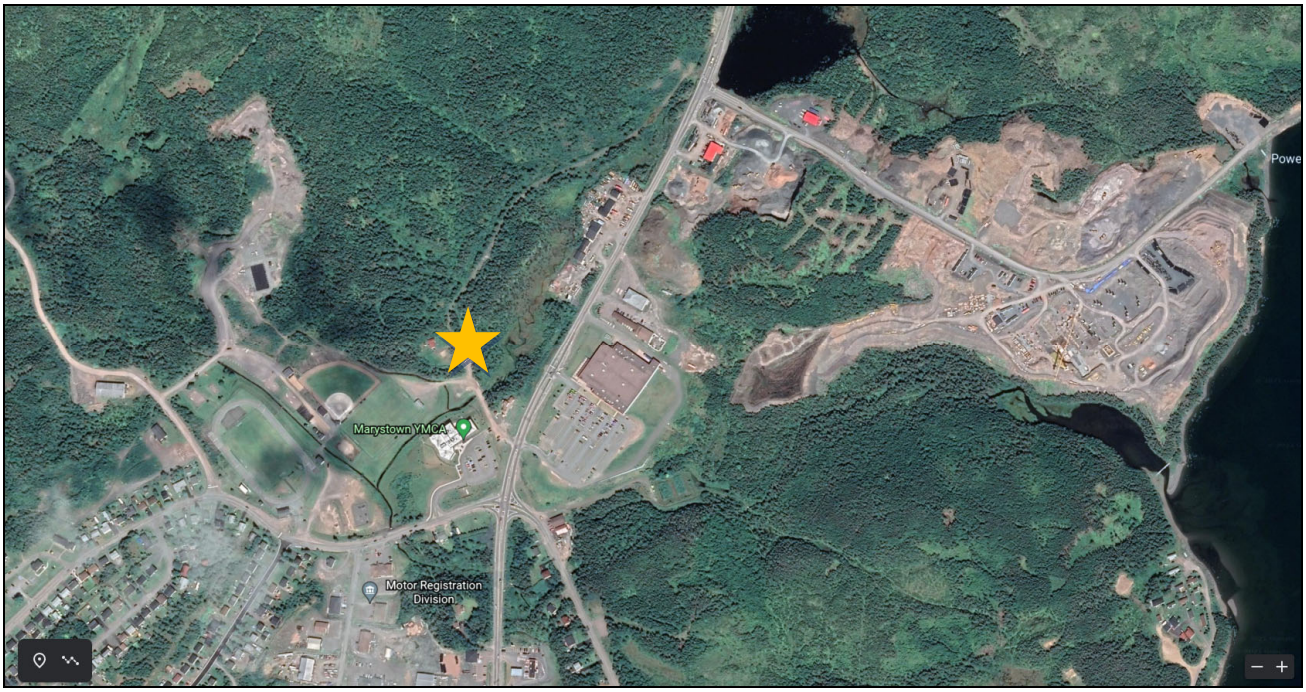

Figure 1: Location of Real-Time Groundwater Well

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 collected at the beginning of each deployment period to compare against the initial in-situ logged data. Grab samples compliment the real-time data and provide an extra source of water quality data for comparisons when monitoring changes over time at the station (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.

Status of Well

Grieg Seafood has two available wells, a main production well that provides new water to the facility as needed, and a monitoring/backup well that houses the WRMD monitoring equipment. Both wells are functioning in good condition. In the event of a catastrophic failure of the main well, the monitoring well can serve as a backup. To ensure the pump installed in the monitoring/backup well is functioning, the pump is started periodically (about once per week). The WRMD's monitoring equipment is not removed during the pump test and as a result may disrupt the water parameter recordings. Recordings can also be disrupted during routine calibration and maintenance of equipment by WRMD. 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

Date	Parameter	In-Situ Instrument	Grab Sample Result
March 25th 2021	**pH (pH units)**	7.53	8.12
	Specific Conductivity (µS/cm)	283.46	321.0
June 16th 2021	**pH (pH units)**	7.42	8.02
	Specific Conductivity (µS/cm)	293.71	290.0
August 24th 2021	**pH (pH units)**	7.46	7.94
	Specific Conductivity (µS/cm)	349.38	300.0

Grieg Monitoring Well

Water Temperature

From November 11, 2020 through to November 23, 2021 the water temperature ranged from 7.051°C to 7.394°C during the deployment period (Figure 6). The annual average water temperature was 7.25°C.

Grieg's monitoring station is a groundwater well; generally, the water temperatures will remain consistent throughout the deployment. There is very little influence from air temperatures on the water in the well therefore there isn't a large range between the minimum and maximum values.

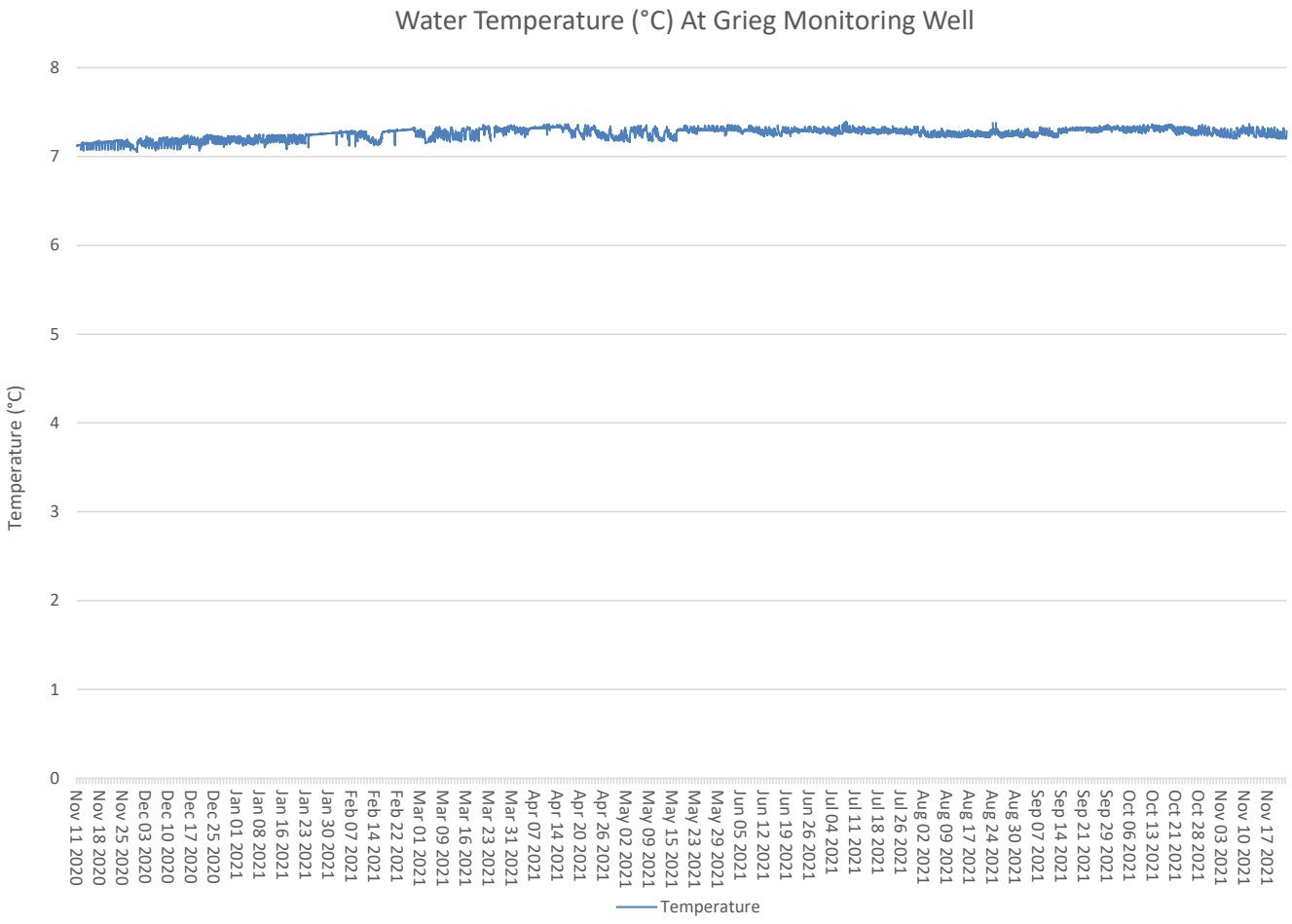

Figure 6: Water temperature (°C) values

pH

From November 2020 to November 2021, pH values ranged between 7.41 pH units and 7.93 pH units. Across the year of deployment the pH was reasonably consistent and had a median of 7.64 pH units.

Small changes in pH were likely the result of pumping within the aquifer. As the well refills and the level adjusts, there will be movement in the pH levels for a short period of time (Figure 7). There is evidence on the pH graph that there was some drifting of the data toward the end of the deployment on June 16th. After calibration on June 16th, the instrument was redeployed and the data adjusted, hence the difference in the data that is circled in red on the graph.

pH data was recording lower values toward the end of the deployment, indicating a slight possible shift in the pH range over the course of the year.

The red points on the graph represent the grab sample results for pH. Grab samples compliment the monitoring by the water quality instrument (Table 1). Slight differences between pH values of the grab sample and sonde are normal as pH from the grab sample is not analysed for several days after it is collected.

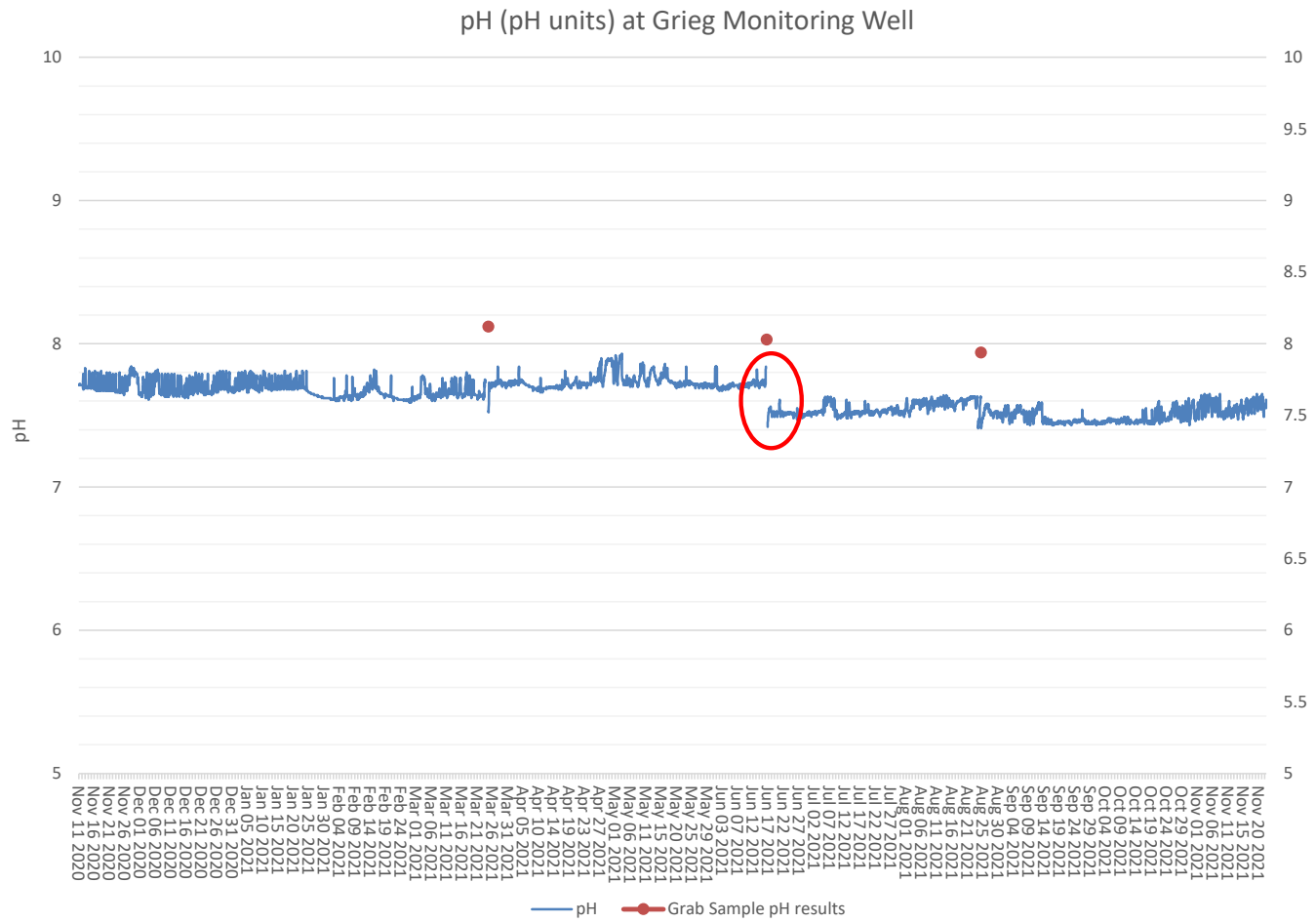

Figure 7: pH (pH units) values

Specific Conductivity & Total Dissolved Solids (TDS)

The specific conductivity probe measures the presence of diluted salts and inorganic materials in a water source. During the deployment, conductivity levels were within 264.7 µS/cm and 385.19 µS/cm (Figure 8).

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 0.17 g/L to 0.25 g/L.

The red points on the graph represent the specific conductivity results from the grab samples taken during the beginning of a deployment (Table 1). Due to the nature of this well the grab samples are taken from an inside tap within the station. It is expected that there would be some differences between the in situ data and the grab sample data.

When there is minimal or no influence from an outside source, the conductivity in the groundwater well is relatively stable and fluctuates minimally. Any significant fluctuations in the conductivity data at this site are likely due to pumping the water from the well or any movement of the equipment in the well casing.

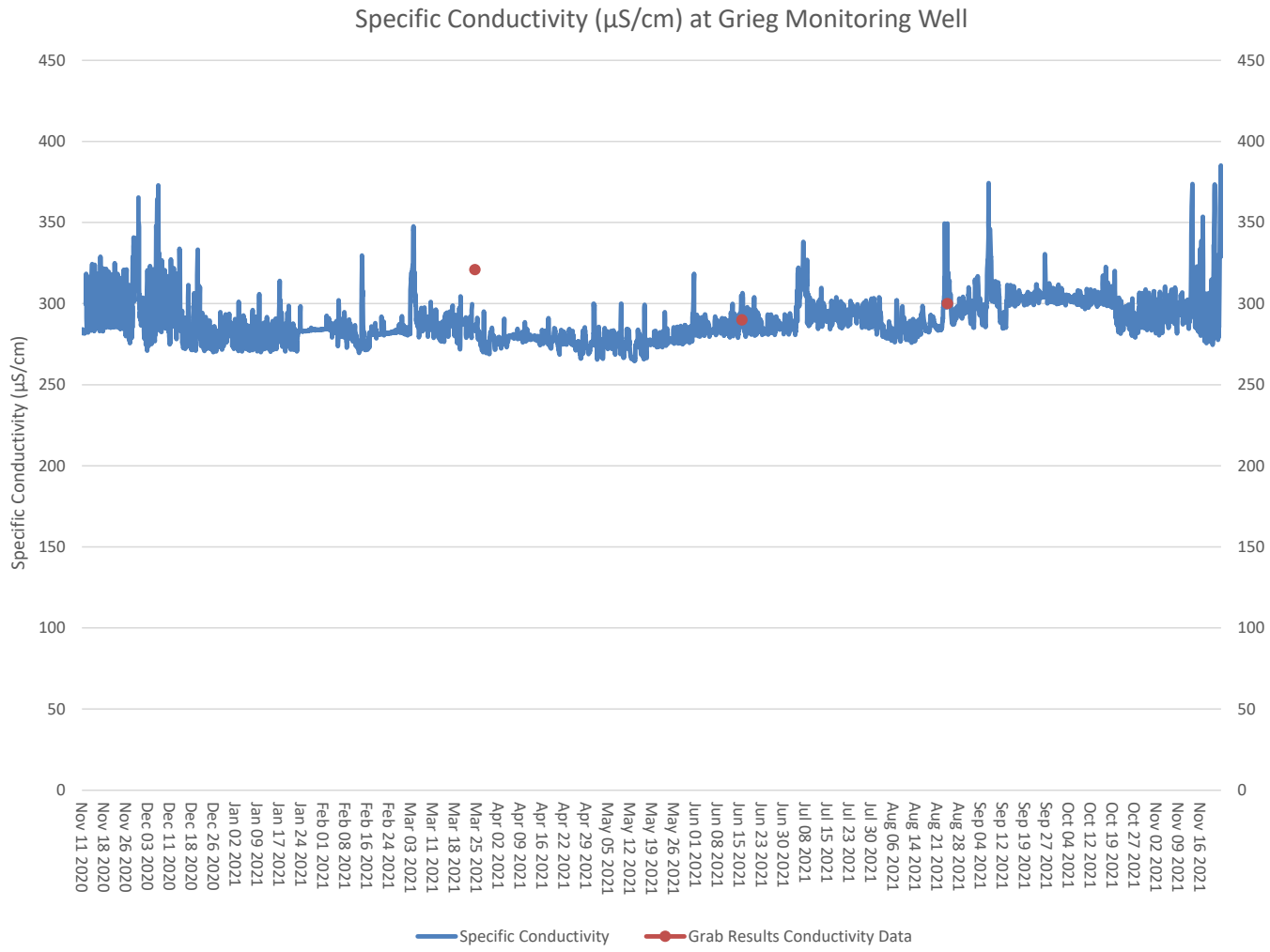

Figure 8: Specific conductivity (µS/cm) values

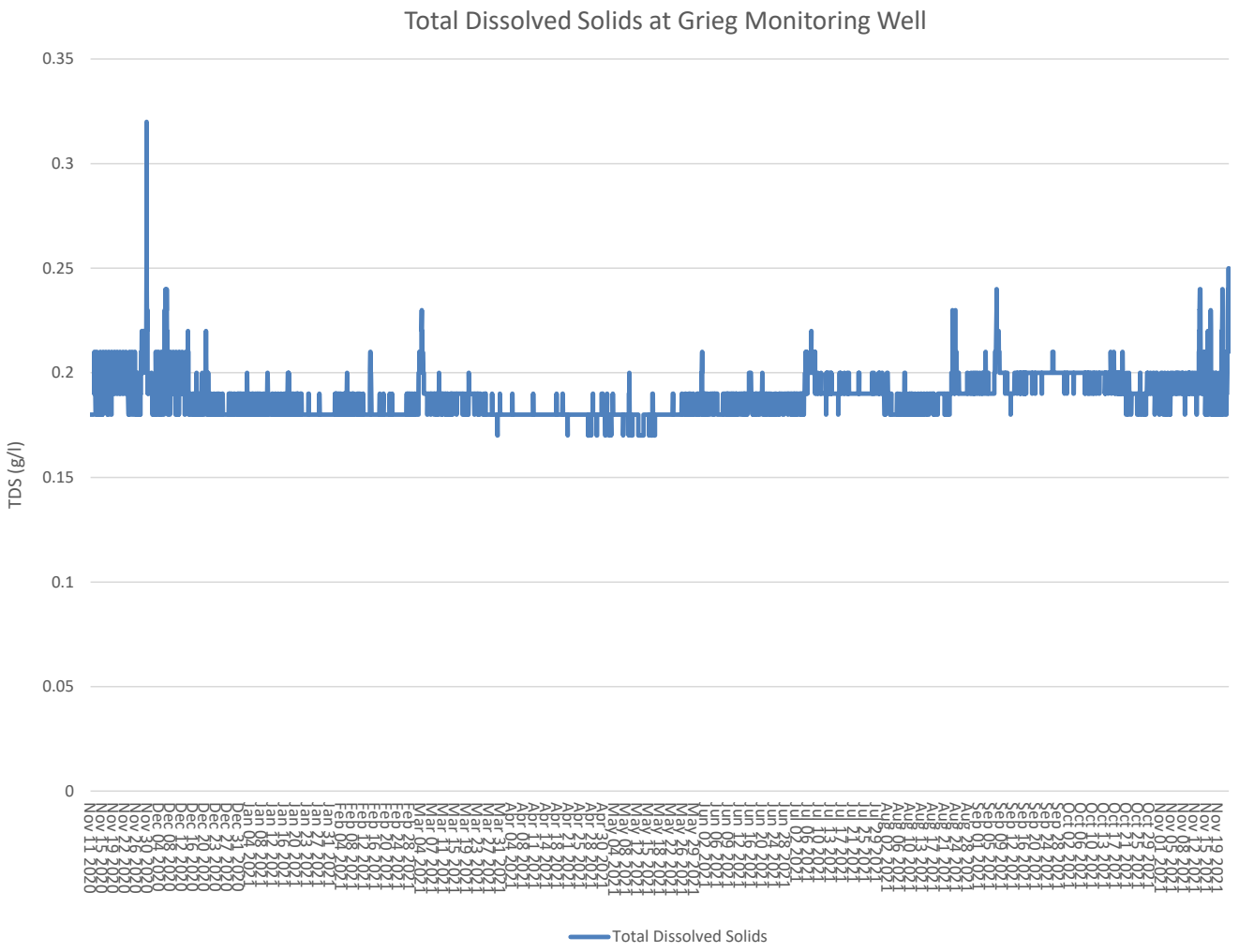

Figure 9: Total Dissolved Solids (TDS)

Oxidation-Reduction Potential (ORP)

ORP levels during the deployment ranged within -65.5 mV to 364.5 mV (Figure 10). The dataset had a median of 294.3 mV. Due to frequent pumping of the well, it was expected that the ORP would fluctuate. The changes across the deployment are evident on Figure 10, as the ORP values dip and increase.

It was determined after review of the data across the year that the ORP data recorded for the November 2020 to March 2021 deployment was inaccurate and removed from the data set.

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 represent.

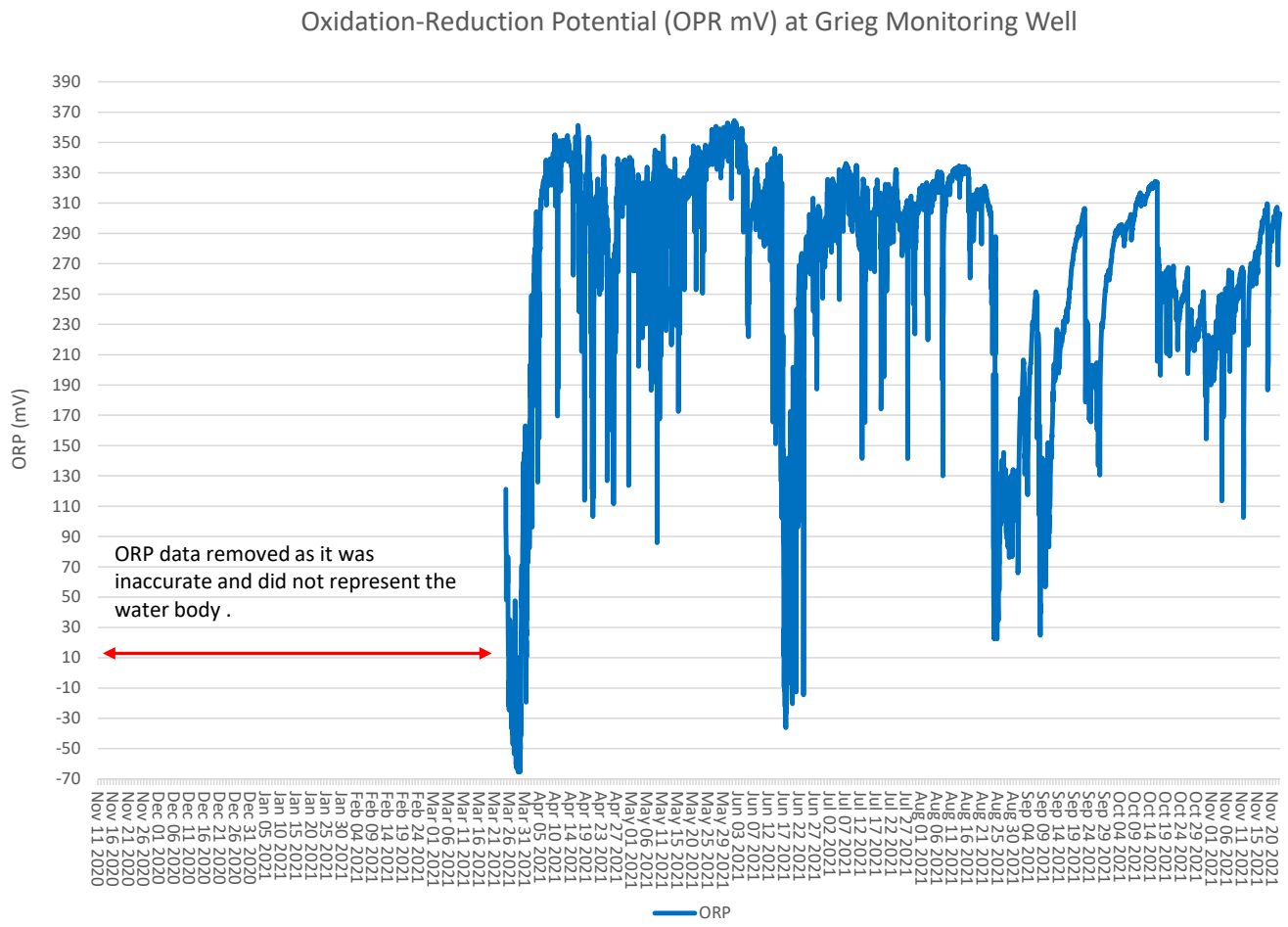

Figure 10: ORP values (mV)

Water Elevation

Water Elevation at the monitoring well, ranged within 13.17 m to 33.92 m. The data set had a median of 32.83 m and a mean of 32.16 m. Generally, water elevation within a groundwater well remains constant. This well and its aquifer are frequently accessed through pumping, therefore there are fluctuations in water level across the deployment (Figure 11).

Notwithstanding the larger dips in water elevation, the range of the elevation was reasonably consistent across deployment.

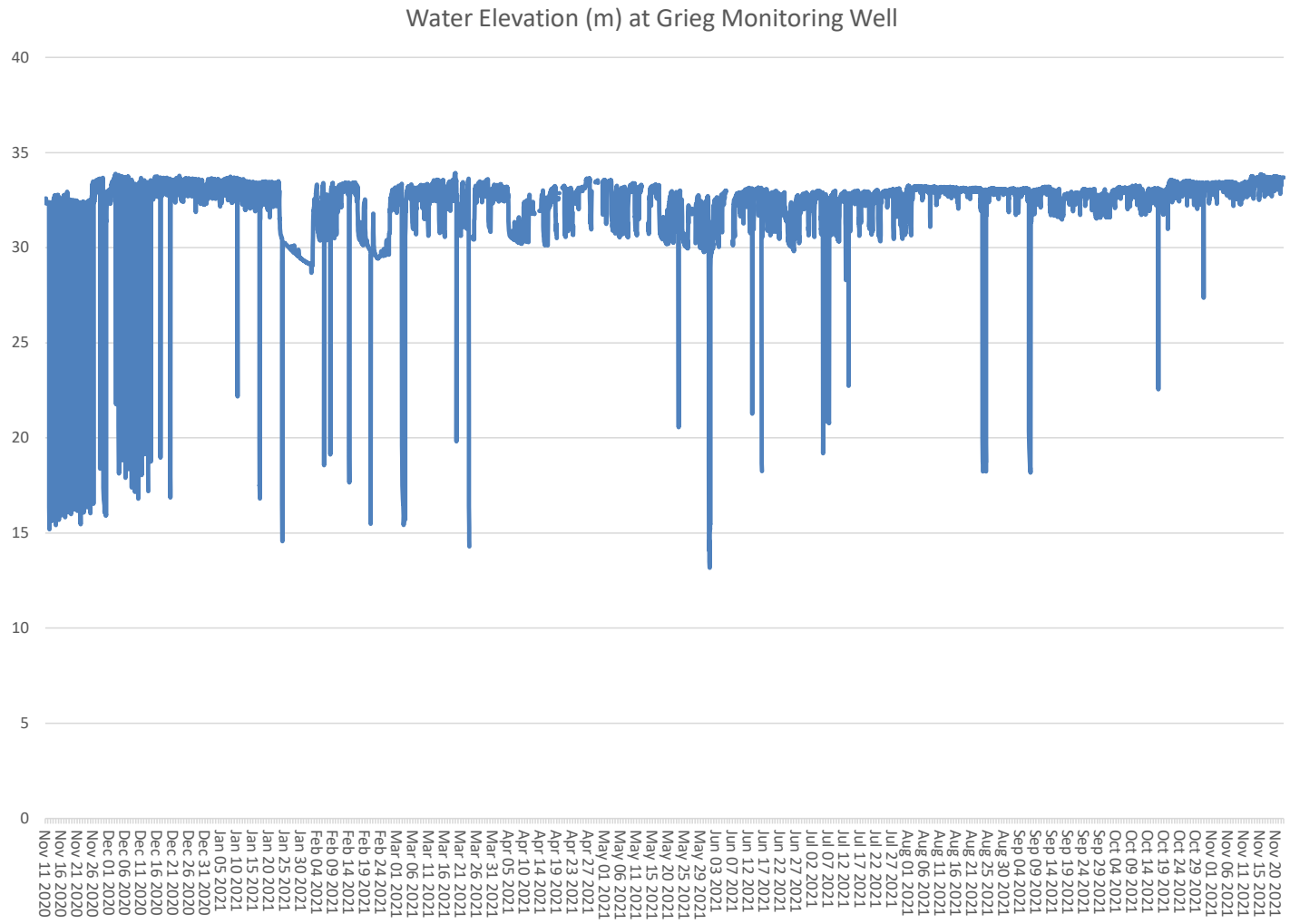

Figure 11: Water Elevation (m)

Conclusion

Background data is essential for identifying potential issues to a water body. Many water bodies have specific parameters that are natural to that areas but may seem out of the norm for others. Therefore it is so important to monitor and document the background of water bodies that are implemented in any type of anthropogenic activity.

This station is only a year old, and while there is a good range of data being recorded there is still a lot more to learn about what is normal for this site. Currently, the data provides a good indication that there is a lot of pumping from the aquifer and this use is likely the main cause for some of the changes in the parameters over the year.

Water temperature in this well remains steady throughout deployment even during the seasonal changes, which is to be expected from a groundwater aquifer. pH remains steady within a range of 7.41 to 7.93, although toward the end of the deployment the pH values do decrease to a lower range of data. Conductivity data displayed greater variation in the data, with spikes of conductivity recorded throughout deployment, before the data returned to baseline levels. The oxidizing-reduction potential (ORP) was significantly influenced by any disruption in the ground water. The large peaks and valleys in the ORP data do indicate changes in this parameter, however determining the norm for ORP of this waterbody will require more data at this point.

Other than the pumping of this aquifer and the handling of the instrumentation in the well, there was no indication of any other external factors influencing the water quality parameters of this station. As the monitoring of this site continues, a better baseline dataset for water quality parameters will be determined.

Appendix I

Water Quality Statistics of Grieg Groundwater Well

November 11, 2020 through to November 23, 2021

Parameter	Min	Max	Median	Mean
Water Temperature (°C)	7.051	7.394	7.268	7.254
pH (pH units)	7.41	7.93	7.64	7.63
Specific Conductivity (µS/cm)	264.75	385.19	285.7	288.8
Total Dissolved Solids (g/L)	0.17	0.25	0.19	0.18
ORP (mV)	-65.5	364.5	294.3	265.9
Water Elevation (m)	13.17	33.92	32.83	32.16