Real-Time Water Quality Report

Grieg NL Nurseries Ltd Monitoring Well

Annual Deployment Period:
November 23, 2022 to December 12, 2023

Newfoundland Labrador

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

Prepared by:

Victoria Hollohan
Environmental Scientist
Water Resources Management Division
Department of Environment & Climate Change
4th Floor, Confederation Building, West Block
St. John's NL A1B 4J6
Ph. No.: (709) 729 - 5925
Fax No.: (709) 729 - 0320
victoriahollohan@gov.nl.ca

Grieg Monitoring Well

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.

Grieg Seafood has two 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. Due to this groundwater well sharing its aquifer with the main pumping well, variations in the water parameters could be a result of pumping from either well. The water monitoring equipment, a YSI EXO1, is not removed during the pump test and as a result, there may be disruptions to the water quality data for a short period of time. Data can also be disrupted during routine calibration and maintenance of equipment by WRMD.

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. Grab samples are collected at the beginning of each deployment period to compare against the initial in-situ logged data. The samples are collected from an internal tap located in the station hut. Grab samples complement the real-time data and provide an extra source of water quality data for comparisons when tracking changes over time at the station (Table 1). Combining both types of data can offer a more comprehensive understanding of the water quality.

Initial in-situ instrument measurements are recorded shortly after the freshly calibrated instrument is deployed. The limited time for the sonde to reach equilibrium with its surroundings can occasionally lead to variations in values between grab sample results and instrument measurements.

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

Date	Parameter	Grab Sample Result	In-Situ Instrument
November 23, 2022	**pH (pH units)**	7.93	7.3
	Specific Conductivity (µS/cm)	300	310.33
March 7, 2023	**pH (pH units)**	8.08	7.54
	Specific Conductivity (µS/cm)	340	285.62
May 10, 2023	**pH (pH units)**	8.05	7.43
	Specific Conductivity (µS/cm)	320	291.53
July 19, 2023	**pH (pH units)**	8.01	7.51
	Specific Conductivity (µS/cm)	310	299.43
August 21, 2023	**pH (pH units)**	8.06	7.58
	Specific Conductivity (µS/cm)	310	300.76
September 22, 2023	**pH (pH units)**	7.93	7.49
	Specific Conductivity (µS/cm)	290	298.98
December 12, 2023	**pH (pH units)**	7.94	7.64
	Specific Conductivity (µS/cm)	310	288.46

Issues Encountered During the 2023 Season

From November 23rd, 2022, to December 12th, 2023, the Grieg Monitoring Well faced challenges such as power issues and instrument malfunctions. Periodic gaps observed in the data can be attributed to power issues experienced at the station, such as in late February, August, and September.

On February 18th, the station stopped transmitting data. During a site visit on March 7th, the instrument was switched out and the station began transmitting once again. Due to instrument malfunctions, there was no data logfile, therefore no data was available for February 19th-March 7th.

On July 21st, 2023, the station ceased transmitting data and went offline. Due to prior commitments for field work, maintenance and troubleshooting could not be conducted until August 21st. The subsequent investigation revealed a blown fuse between the instrument and datalogger, causing a power shortage. The instrument had continued logging measurements internally until July 25th. When the instrument was pulled up from the well and inspected on August 21st, it was determined that the instrument had sustained damage resulting in a lack of power and no internal log file. After replacing the fuse and instrument, the station came back online and appeared to be operating normally. However, on August 24th, 2023, the station went offline again, ceasing data transmission. Troubleshooting and maintenance on September 21st identified a malfunction in the field cable connecting the instrument and datalogger, causing a loss of power and data collection. The instrument continued to log measurements in an internal logfile until its batteries depleted on August 24th. Following the replacement of the field cable on September 21st, the station resumed normal data transmission.

On December 12th, 2023, the station stopped transmitting data. Upon arriving to the station, the signal output adaptor displayed a slow blinking red light, indicating the sonde had gone into low power sleep mode. The instrument had continued collecting data on the internal log file throughout the deployment period. The instrument was replaced, and the station resumed normal operations.

Grieg Monitoring Well Water Quality Parameters

Water Temperature

Between November 23, 2022, and December 12, 2023, the water temperature fluctuated within the range of 7.28°C to 7.54°C throughout the deployment period, as illustrated in Figure 6. The annual average water temperature was recorded at 7.40°C.

The water temperatures remain consistent throughout the year of data. Due to the depth of the instrument in the well, there is very little influence from air temperatures on the water, therefore there is minimal variance between the minimum and maximum values.

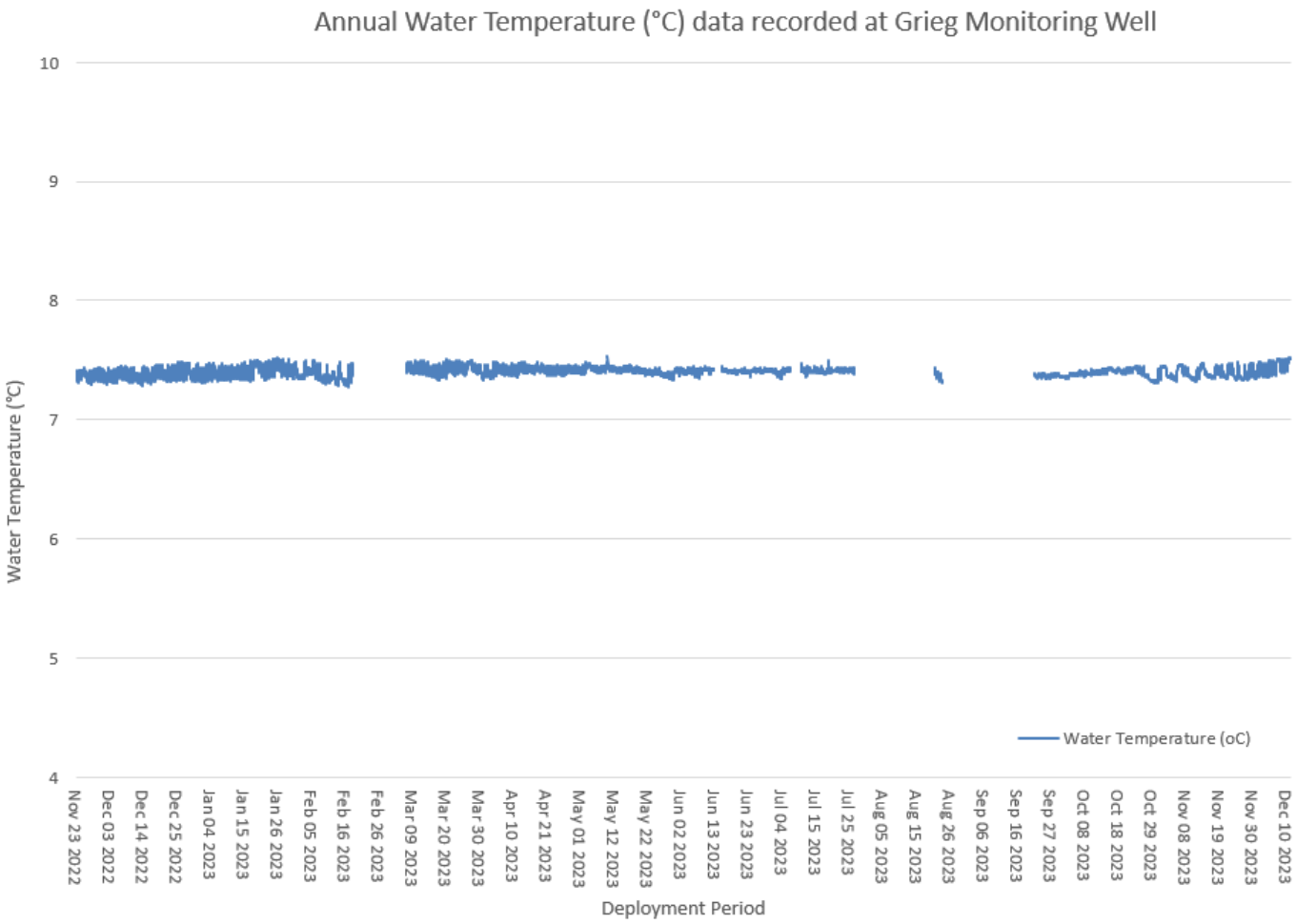

Figure 6: Water temperature (°C) values

pH

Between November 23, 2022, and December 12, 2023, pH values exhibited a range from 7.40 pH units to 7.78 pH units. Throughout the deployment year, pH remained reasonably consistent, with an average of 7.56 pH units.

A pH sensor measures the acidity or alkalinity of a water body and is a measure of the concentration of hydrogen ions (H^+) in a solution. Minor pH fluctuations were likely a consequence of aquifer pumping activities. The well's refilling process and subsequent level adjustments led to temporary variations in pH levels, as depicted in Figure 7.

The red points on the graph denote pH values derived from grab samples, offering complementary insights to the in-situ monitoring conducted by the water quality instrument (refer to Table 1). It is anticipated that there may be slight disparities between the pH values obtained from grab samples and the water quality instrument. Variations in the data could be attributed to factors such as delayed analysis of grab samples over several days and the pumping of the well before collecting grab samples, which may disturb the water column.

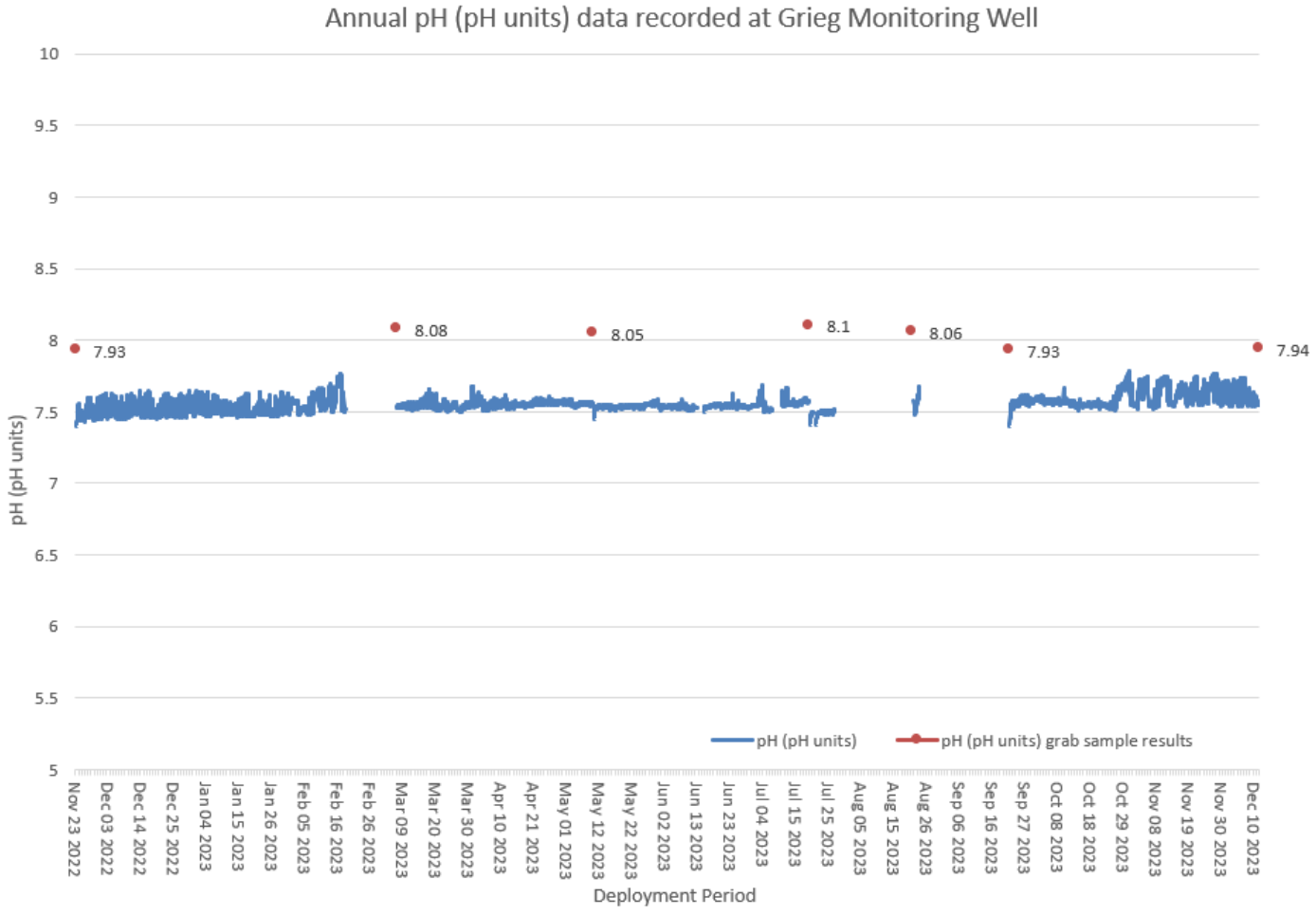

Figure 7: pH (pH units) values

Specific Conductivity & Total Dissolved Solids (TDS)

Throughout the annual deployment season, conductivity levels were within 267.94 µS/cm and 364.21 µS/cm (Figure 8), with an average of 287.60 µS/cm. The specific conductivity probe measures the presence of diluted salts and inorganic materials in a water source. In instances where there is minimal or no external influence, the conductivity in the groundwater well remains relatively stable, experiencing minimal fluctuations. Elevated spikes in conductivity are likely attributed to pumping activities and disturbances within the aquifer which can disturb the water column.

The red points on the graph represent the specific conductivity results from the grab samples collected at the beginning of a deployment (Table 1). It is expected that there would be some differences between the in-situ data and the grab sample data. Variations in the data can arise due to factors such as delayed analysis of grab samples spanning several days, as well as the pumping of the well prior to collecting grab samples.

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 10). For the deployment year, TDS ranged within 0.17 g/L to 0.24 g/L.

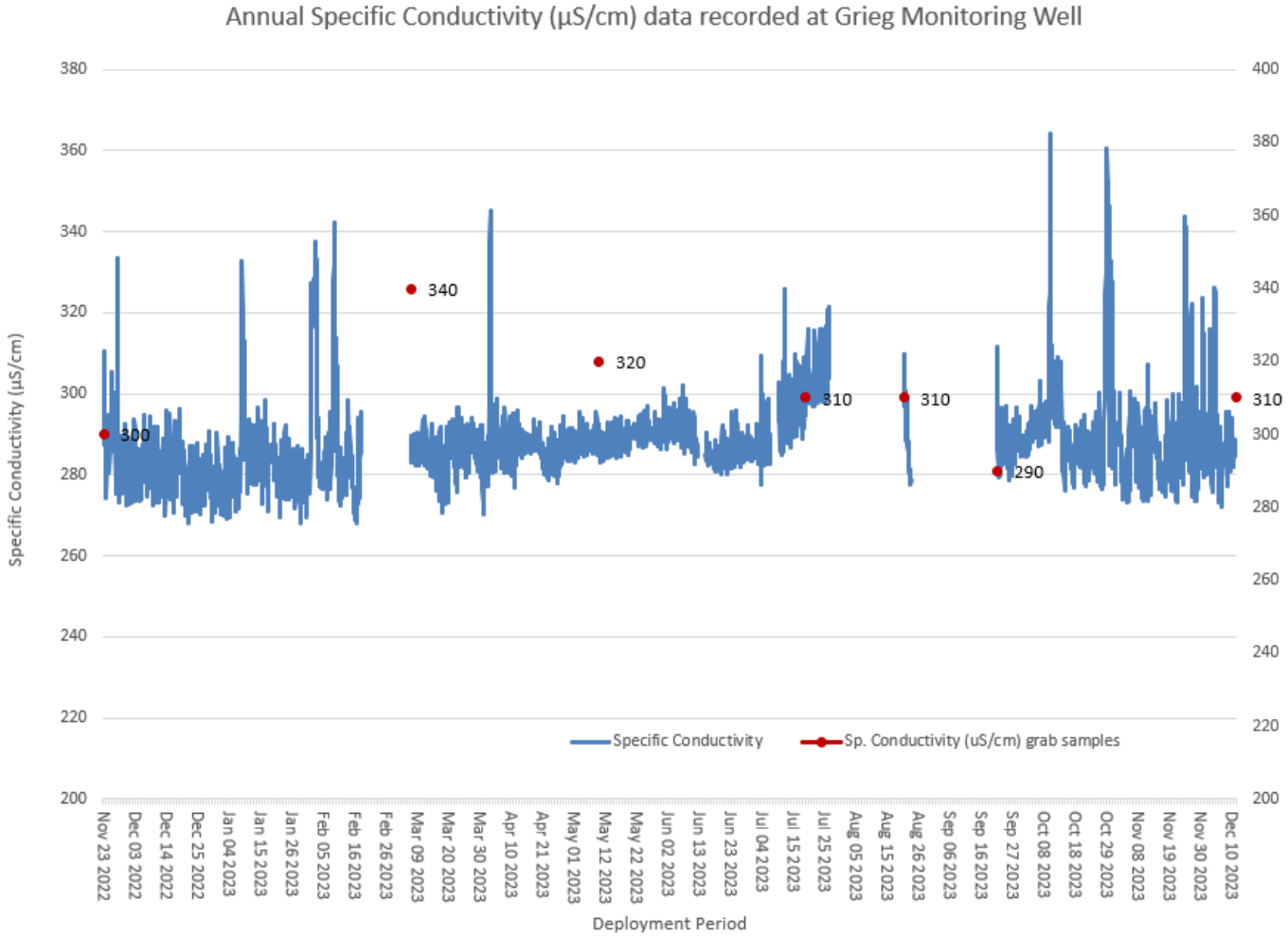

Figure 8: Specific conductivity (µS/cm) values

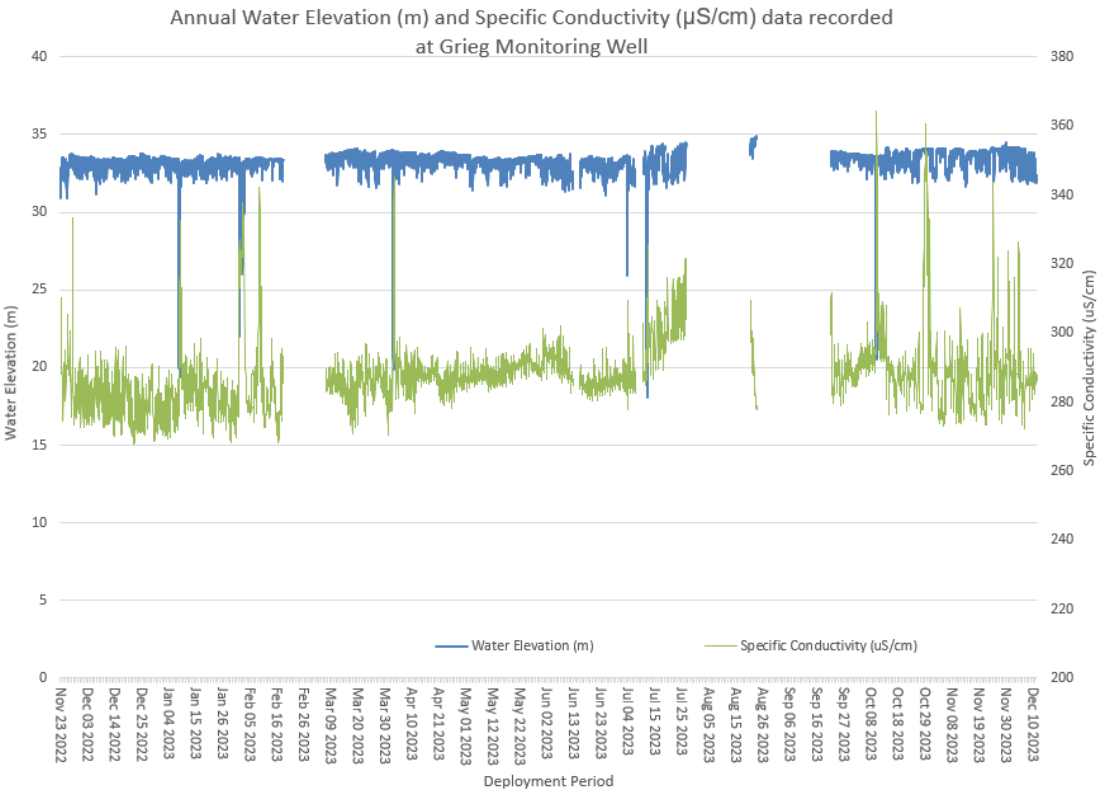

Figure 9: Annual Specific Conductivity & Water Elevation

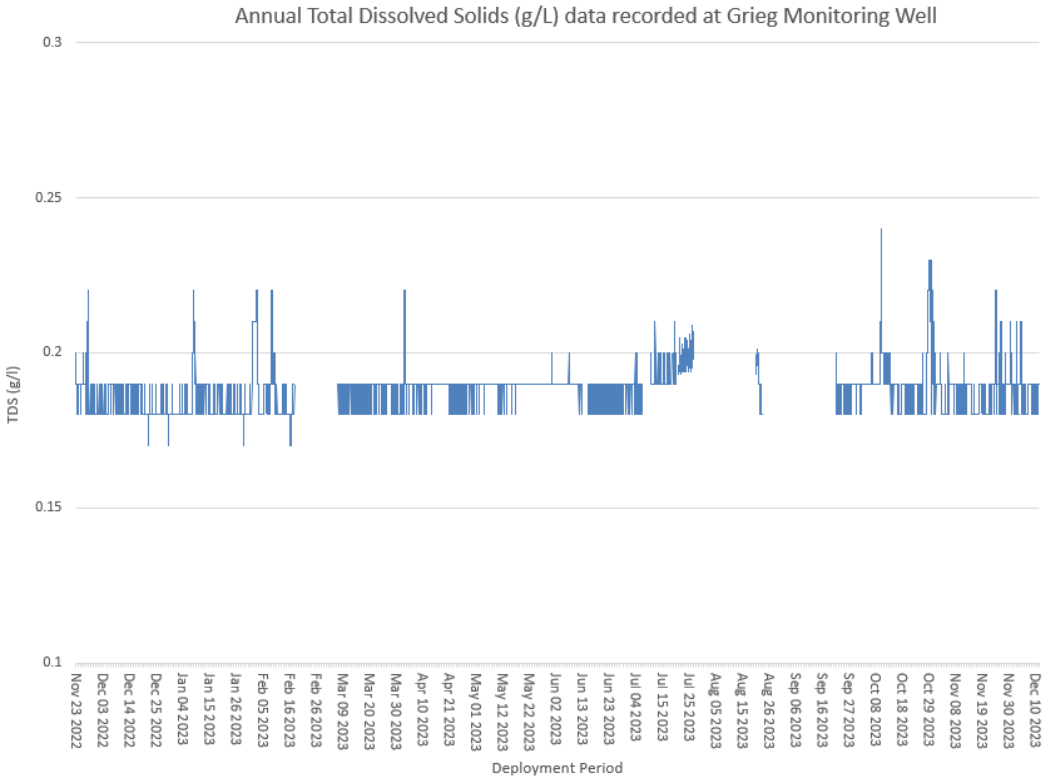

Figure 10: Total Dissolved Solids (TDS)

Oxidation-Reduction Potential (ORP)

ORP levels during the year of deployment ranged within 90.10 mV to 412.70 mV, with an average of 322.66 mV, an increase from the 2022 average of 288.7 mV (Table 3, Appendix I). As expected, due to periodic pumping of the well, fluctuations in ORP levels were observed, but values generally remained within typical ranges over the course of the year. The variations in ORP values throughout the deployment are visually evident in Figure 11, showcasing dips and increases. It's worth noting that ORP can take days to weeks to equilibrate in groundwater, which may explain the lower values observed at the beginning of each deployment period.

ORP, measuring the oxidizing-reduction potential of groundwater, plays a crucial role in identifying the mobility and persistence of contaminants that could impact water quality. The values can be influenced by local conditions, the presence of specific contaminants, and the geochemical characteristics of the aquifer. Natural aquifer materials may release specific chemicals, leading to concentration changes over time. ORP values are unique to each water body, and collecting background data is essential for understanding the significance of changes in the data and their potential implications.

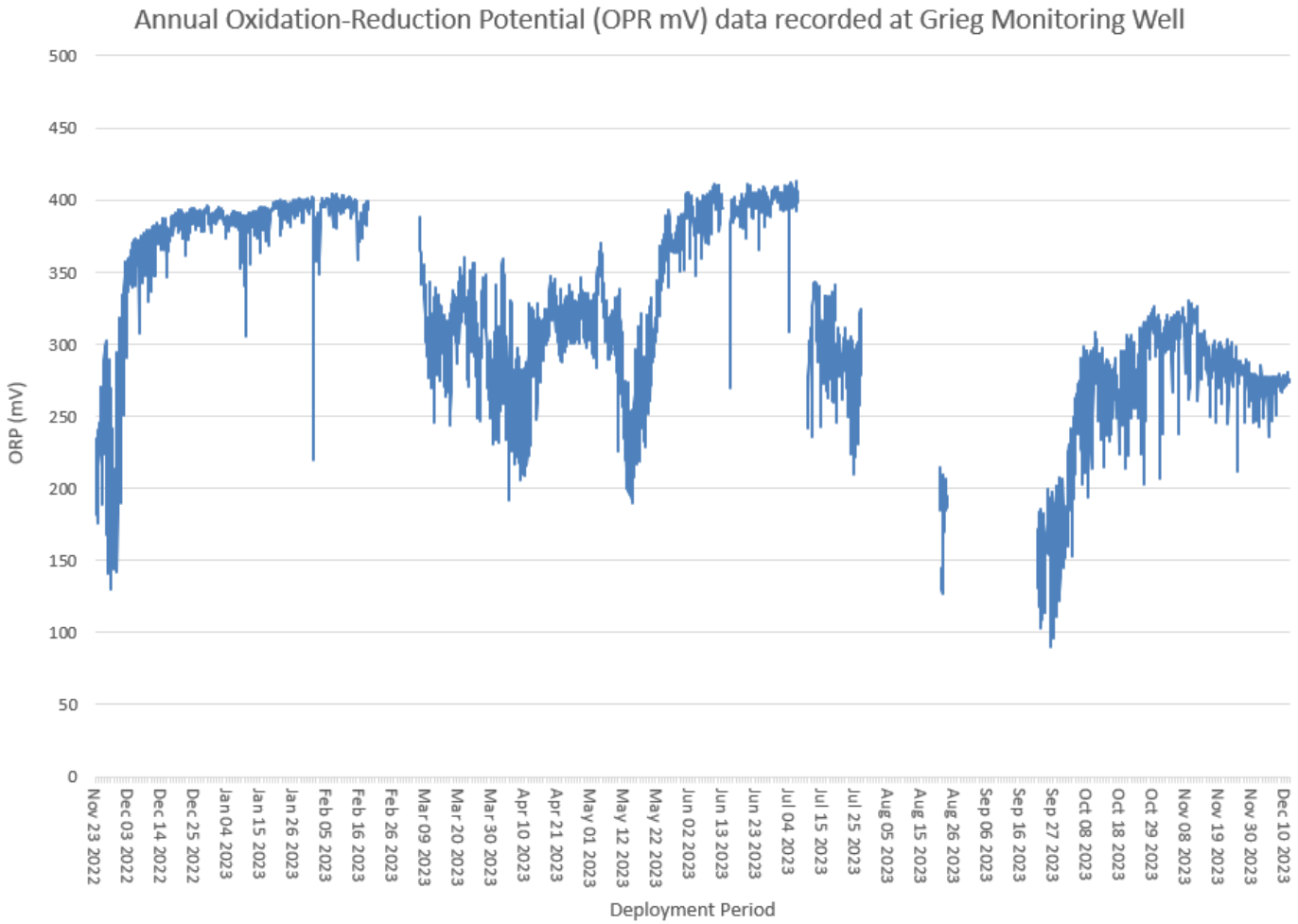

Figure 11: ORP values (mV)

Water Elevation

Water Elevation monitors the height of the water surface in the well measured to an assumed datum. Water Elevation at the monitoring well, ranged within 18.05 m to 34.88 m throughout the year of deployment, with an annual average of 33.19 m. Generally, the water elevation within this groundwater well remains constant. This well and its aquifer are intermittently accessed through pumping. There will be fluctuations in water elevation during deployment (Figure 12). Despite the larger dips in water elevation, the range of the elevation was reasonably consistent across deployment.

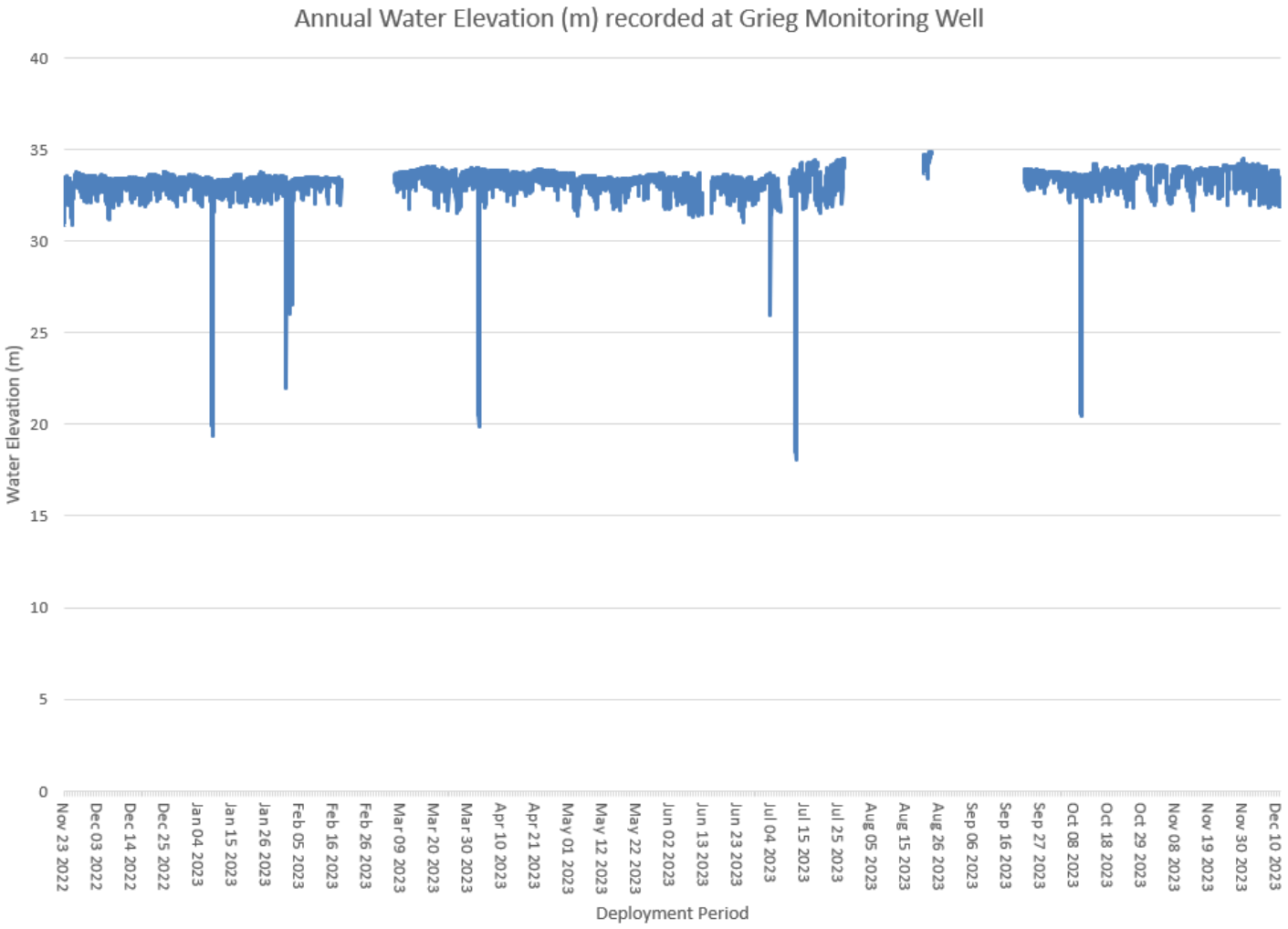

Figure 12: Water Elevation (m)

Conclusion

The comprehensive monitoring of various parameters, including pH, conductivity, Total Dissolved Solids (TDS), and Oxidation-Reduction Potential (ORP) throughout the year of deployments has provided valuable insights into the dynamic nature of the groundwater well and its aquifer. Collecting background data is crucial for recognizing potential concerns in a water body. Different areas may have specific parameters that are inherent to their natural conditions but might appear abnormal elsewhere. It is essential to monitor and document background data of water bodies that are influenced by anthropogenic activity.

The water elevation measurements consistently demonstrated stability within an expected range, even amidst sporadic pumping activities. The pH levels exhibited relative constancy with minor fluctuations, and the specific conductivity and TDS data remained consistent other than periodic elevated spikes which corresponded with pumping events. The ORP levels showcased expected variations, underscoring the importance of continued monitoring to understand contaminant mobility and persistence. The integration of grab sample data, represented by red points on the graphs, complemented the in-situ monitoring, albeit acknowledging slight differences due to factors like delayed analysis and well pumping disturbances.

Other than the pumping of the aquifer and the management of the instrumentation in the well, there was no indication of any other external factors influencing the water quality parameters of this station. Given that this station is only three years old, a better baseline dataset for water quality parameters will be determined as the monitoring of this site continues in the years to follow,

Addressing the challenges encountered in 2023, the primary objective for the 2024 season is to minimize occurrences of power issues and instrument malfunctions. The power-related problems in 2023 were attributed to a damaged field cable, which was successfully replaced in September of that year. Notably, the EXO1 instrument faced difficulties during power outages, leading to a failure to collect measurements on an internal logfile. Additionally, the low power sleep mode issue experienced in December 2023 resulted in data being recorded on the logfile but not transmitted. To prevent the recurrence of these issues, the instrument is currently undergoing testing to identify the causes of logfile failure and low power sleep mode. The aim is to implement measures that will mitigate these challenges in future operations.

Moving forward into the 2024 season, WRMD will maintain its schedule of maintenance and calibration activities approximately every 10-12 weeks, along with site visits in between when necessary to address any issues that arise.

Appendix I

Annual Water Quality Statistics of Grieg Groundwater Well

November 23, 2022 to December 12, 2023

Parameter	Min	Max	Median	Mean
Water Temperature (°C)	7.28	7.54	7.40	7.40
pH (pH units)	7.40	7.78	7.55	7.56
Specific Conductivity (µS/cm)	267.94	364.21	286.70	287.60
Total Dissolved Solids (g/L)	0.17	0.24	0.19	0.19
ORP (mV)	90.10	412.70	318.60	322.66
Water Elevation (m)	18.05	34.88	33.37	33.19

Data Comparison: Average Annual Water Quality Parameters Across Previous Deployment Years

Parameter	2021	2022	2023
Water Temperature (°C)	7.254	7.325	7.40
pH (pH units)	7.63	7.55	7.56
Specific Conductivity (µS/cm)	288.8	284.95	287.60
Total Dissolved Solids (g/L)	0.18	0.19	0.19
ORP (mV)	265.9	288.7	322.66
Water Elevation (m)	32.16	33.59	33.19