

# MONITORING REPORT 2025

Remote Community Waste Discharge Licences  
Waste Stabilisation Ponds  
Reporting period: 1 July 2024 – 30 June 2025

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# Document History

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# Glossary

Abbreviation	Definition
<b>ANZECC</b>	Australian and New Zealand Environment and Conservation Council
<b>BOD</b>	Biochemical oxygen demand
<b>Chl-a</b>	Chlorophyll-a, a photosynthetic pigment present in plants, algae and cyanobacteria that is used in oxygenic photosynthesis. It can be used as a measure of algal biomass and subsequently primary production
<b>DEPWS</b>	Department of Environment, Parks and Water Security
<b>DHWQO(s)</b>	Darwin Harbour water quality objective(s)
<b>DO</b>	Dissolved oxygen
<b>EC</b>	Electrical conductivity
<b><i>E. coli</i></b>	<i>Escherichia coli</i>
<b>EP</b>	Equivalent population
<b>ET</b>	Equivalent tenement - calculation utilised in remote communities for an average residential dwelling or house (Indigenous Community Engineering Guidelines 2017)
<b>ERA</b>	Environmental risk assessment
<b>FRP</b>	Filterable reactive phosphorous (orthophosphate)
<b>KL</b>	Kilolitres
<b>LOR</b>	Limit of reporting for chemical analysis
<b>µg</b>	Micrograms
<b>mg</b>	Milligrams
<b>ML</b>	Mega litres
<b>N</b>	Nitrogen
<b>NH<sub>3</sub>-N</b>	Total ammonia as N (NH <sub>3</sub> and NH <sub>4</sub> <sup>+</sup> as N) as per ANZECC and ARMCANZ (2000)
<b>NO<sub>x</sub>-N</b>	Oxidised nitrogen as N – the sum of nitrate and nitrite
<b>NT</b>	Northern Territory
<b>NT EPA</b>	Northern Territory Environment Protection Authority
<b>NTU</b>	Nephelometric Turbidity Unit
<b>PWC</b>	Power and Water Corporation

<b>Abbreviation</b>	<b>Definition</b>
<b>RL(s)</b>	Reporting Limit(s)
<b>RM</b>	Rolling Median – of all years of available data; utilised in absence of adequate datasets.
<b>SSTV</b>	Site Specific Trigger Values
<b>TN</b>	Total nitrogen
<b>TP</b>	Total phosphorous
<b>TSS</b>	Total suspended solids
<b>WDL(s)</b>	Waste discharge licence(s)
<b>WSP(s)</b>	Waste stabilisation pond(s)
<b>WwTP(s)</b>	Wastewater Treatment Plant(s)

# Executive Summary

The 2024-2025 Monitoring Report for Remote Community Waste Discharge Licences (WDLs) by the Power and Water Corporation presents an overview of compliance and environmental impact assessments for 22 remote Indigenous communities. The report adheres to NT EPA guidelines, providing a comprehensive analysis of water quality monitoring data, discharge volumes, and environmental impacts from 2021 to 2025.

Water quality parameters monitored include chlorophyll-a, *E. coli*, *Enterococci*, Total Suspended Solids (TSS), Filterable Reactive Phosphorus (FRP), Total Phosphorus (TP), Biochemical Oxygen Demand (BOD), Dissolved Oxygen Percentage (DO%), Total Nitrogen (TN), and turbidity. Elevated nutrient levels typically correlate with higher chlorophyll-a concentrations, promoting algal growth. High TSS results in elevated turbidity, affecting light penetration and potentially increasing BOD and reducing DO%.

Low discharge volumes from WSPs align with the low equivalent populations (EP) of remote Indigenous communities. Monitoring results indicate that the discharge from these ponds has a minimal impact on the receiving environment due to intermittent discharges and dilution during high flow events. Each community shows varying levels of water quality parameters. The Belyuen WSP summary shows low pollutant levels at SBLEP01, while SBL090 exhibits minimal impact due to its intermittent and diluted discharge.

Visual observations during site visits and routine site inspections this reporting period have not shown any immediate deleterious effects from wastewater discharge to the receiving waterways i.e. no algal blooms or fish kills observed. The results show some elevated parameters at sites, however, the environmental impact is considered to be low, considering volumes and dilution factors, as further outlined in individual Environmental Risk Assessments for each community.

This report concludes that WSPs in remote Indigenous communities effectively manage wastewater discharge, ensuring minimal environmental impact. Continuous monitoring and data analysis is valuable in evaluating pond performance and identifying improvement opportunities and provides a valuable reference for future environmental risk assessments and performance improvement planning.

# Regulatory Requirements

Power and Water Corporation operates 57 Waste Stabilisation Ponds (WSPs) across the Northern Territory (NT). Under the Water Act 1992 (NT), discharging waste into water is prohibited unless specifically authorised through Waste Discharge Licences (WDLs) issued under Section 74 of the Act. These licences permit Power and Water to discharge secondary treated sewage effluent into designated waterways.

Currently, Power and Water holds WDLs for 22 remote communities. The corporation is required to submit an annual Monitoring Report for all remote WDLs, meeting specific conditions:

- Adherence to the Administrating Agency’s ‘Guideline for Reporting on Environmental Monitoring.’
- Inclusion of all required monitoring data.
- Long-term trend analysis of data over a minimum three years.
- Assessment of environmental impact from the activity.
- Summary of Investigations for the preceding 12 months (Only a requirement under Round 2 WDLs (*Condition 39.5*))

This report presents initial findings from treated effluent monitoring in remote communities, providing a foundation for future environmental risk assessments.

## Monitoring Report Requirements

Table 1 Monitoring Report Requirements

Provision
This Monitoring Report has been prepared in accordance with the NT EPA ‘Guideline for Reporting on environmental Monitoring’ (Version 1.0) where practicable and applicable.
A tabulated summary of all monitoring data for remote community WDLs is completed and provided as Appendix D – Tabulation of Monitoring Results – Treated Effluent. Also, Attachment A – Remote Community WDL Summary Data - 2021 to 2025.
Trend analysis and interpretation of the results is provided in Monitoring Results and Discussion section. Monitoring data included in this report covers a period of 5 years of data.
An assessment of environmental impacts from the activity is included in Environmental Impacts Summary section. Further specific information is available in individual Environmental Risk Assessments for each community.
A summary of investigations undertaken at Round 2 sites has been included and non-compliances have been reported in individual Annual Returns.

# Background and Objective

## Program Overview

- Commencement and Scope: The program began in 2015 and now includes 22 remote facilities, complying with WDL (Waste Discharge Licence) requirements.

## Wastewater Stabilisation Ponds (WSPs)

- Characteristics: WSPs are low input, cost-effective, and suitable for high-temperature environments with available land.
- Suitability: Ideal for remote communities due to low maintenance

## Licensing and Risk Ranking

- Issued by DLPE: Licenses are based on discharge risk:
  - Round 1: 7 highest risk sites with higher discharge volumes.
  - Round 2: 9 medium risk sites with lower discharge volumes.
  - Round 3: 6 low risk sites with intermittent or seasonal discharge.

## Monitoring and Compliance

- Frequency and Methods: Monitoring frequency is based on license conditions.
- External Monitoring: An external contractor monitors the Woods Inlet environment at Belyuen WSP during specific tidal conditions to capture near-worst-case scenarios.
- Logistics and Constraints: Monitoring may be affected by logistical and laboratory constraints.

## Objectives and Data

- Objectives:
  - Ensure regulatory compliance.
  - Minimise environmental impact and public health risks.
  - Understand operational performance for maintenance and improvements.
- Data Coverage: Data from July 2021 to June 2025.
- Sample Collection: Samples are collected as specified, with discharge points outlined in WDLs.
- Samples are preserved and analysed by NATA-accredited laboratories.

## Rainfall Data

- Regional Records: Rainfall data from Darwin, Katherine, Maningrida, and Wagait Beach stations were used as references.

Table 2. Annual Average Rainfall Data (BOM, 2025)

Region	Weather Station Number	Total annual rainfall per year (mm)					Annual Average
		2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	All years
Darwin	14163	1833	1648.4	1811	1534.4	1771.4	1719.6
Katherine	14902	1207.3	686.5	955.8	815.3	992.8	931.5
Maningrida	14405	1381	1276.4	1476	889.4	1244.8	1255.7
Wagait	14238	1840.4	1318.4	1231.4	1830.9	1848.2	1613.9

# QA/QC Protocols and Data Limitations

The assessment and interpretation of water quality data employ QA/QC protocols to enhance the reliability and accuracy of the findings. These protocols incorporate the use of annual median values to mitigate the impact of outliers, ensuring a more representative analysis of environmental data. Additionally, Z-scores are utilised for quality control, identifying outliers which, while flagged, are retained within the dataset to uphold the integrity of the median-based statistical approach. Despite these comprehensive measures, several challenges and inherent limitations persist that can affect the quality of data. The following points detail these challenges and describe the specific QA/QC processes involved:

## 1. Climate Influence on Treatment Processes:

- The effectiveness of sewage treatment is highly sensitive to climatic factors such as temperature, precipitation, and evaporation. These directly impact the biological and chemical processes within the treatment facilities.
- Extreme weather events, such as heavy rainfall or drought, can dramatically alter the concentration of pollutants and affect the efficacy of pollutant removal, complicating the interpretation of effluent quality.

## 2. Data Completeness and Accuracy:

- Small sample sizes and infrequent monitoring pose significant challenges in capturing a comprehensive dataset that accurately represents water quality conditions over time.
- An investigation is being undertaken into the non-compliance with the monitoring program required under *Condition 27 (Item 11)* of WDL206-04 Ramingining WwTP; where Physio-chemical, biological and nutrient samples were not collected during this reporting period. Follow up samples have been taken and are awaiting laboratory analysis.
- Despite adherence to standards by NATA accredited laboratories, limitations in sampling and analytical methods can impact data accuracy and completeness.

## 3. Logistical Challenges in Data Collection:

- Remote locations, adverse weather conditions, equipment malfunctions, and community unrest can delay or complicate data collection efforts. These logistical challenges can lead to gaps in data or deviations from the planned monitoring schedule.
- **QA/QC Process:** Timestamping for sample collection ensures data validity and traceability.

## 4. Standardisation of Data Presentation:

- Data is typically presented as annual median values to align with ANZECC Guidelines and provide a consistent basis for evaluating long-term trends.
- Outliers and data anomalies are assessed to ensure they do not skew the overall data interpretation, with thorough investigations conducted to ascertain their causes.
- **QA/QC Process:** Statistical methods such as z-score analysis are employed to identify and evaluate outliers, ensuring that reported data is reliable and reflective of true environmental conditions.

## 5. Variability in Treatment Facility Design:

- Variations in the design and operation of wastewater stabilisation ponds, such as differences in size, depth, and inflow characteristics, can lead to significant discrepancies in treatment performance across sites.

These QA/QC protocols and the awareness of data limitations assist in a nuanced interpretation of the monitoring results. They help maintain the integrity of the environmental monitoring process and ensure that conclusions drawn from the data are robust and well-founded.

# Monitoring Results and Discussion

The Remote WDL Monitoring Report, covering July 2021 to June 2025, presents analyte monitoring results grouped by discharge risk levels: Round 1, Round 2, Round 3, and Belyuen WSP. Key points include:

### 1. Data Presentation:

- Results are presented over a 5-year range to allow comparisons and analysis.

### 2. Analysis:

- Seasonal variations are considered in the interpretation of monitoring results.
- This helps in understanding environmental conditions and the effectiveness of wastewater treatment and management practices.

This approach ensures a detailed and contextualised understanding of the monitoring data, emphasising the influence of seasonal and environmental factors on wastewater treatment performance.

## Discharge Volumes

The report observes that relatively low discharge volumes from licensed remote Indigenous community Wastewater Stabilisation Ponds (WSPs) align with the low equivalent populations (EP) or equivalent tenements at these sites. Key points include:

### 1. Equivalent Population discharge flows:

- EP discharge flows refer to the estimated discharge based on the number of individuals, calculated from household size, water usage, wastewater generation rates, as well as factors such as evapotranspiration and sewage pond water volume capacity and area.
- Remote Indigenous communities typically have smaller populations compared to urban areas, resulting in lower EP or equivalent tenements.
- Nil discharge was estimated to have occurred at Acacia Larrakia and Kalkarindji during the reporting period.

Table 3. Estimated/Recorded Daily Discharge KL/Day (Population data - BushTel)

Community	Population (BushTel)	Daily Discharge KL/Day
Acacia Larrakia	35	0
Barunga	396	125.8
Belyuen	175	47
Beswick (Wugularr)	636	156.5
Daly River (Naiiyu)	411	112.9
Galiwinku	2582	823.8
Gapuwiyak	828	251.5
Gunbalunya (Oenpelli)	1354	436.7
Kalkarindji	10	0
Maningrida	2956	1354
Milikapiti	486	158.8
Milingimbi	1288	419.4
Minjilang	311	81.9
Ngukurr	1277	349.3
Numbulwar	799	226.4
Peppimenarti	223	66.2
Pirlangimpi	372	119.8
Ramingining	956	361.1
Wadeye East	2259	606.3
Waruwi	507	157.4
Wurrumiyanga (Nguui)	1668	516.4
Yirrkala	771	194.4

## 2. Design and Capacity:

- The design and capacity of WSPs in remote areas are tailored to accommodate the specific wastewater needs of the local population.
- This tailoring contributes to the relatively low discharge volumes observed in these communities.

## 3. Management and Operation:

- Wastewater treatment systems are managed and operated to meet local population needs while considering environmental impact and sustainability.
- Aligning the capacity of treatment facilities with the equivalent population ensures effective treatment and minimises environmental impact.

#### 4. Measured and Estimated Flow Volume:

##### Flow Measurement Techniques:

- **Direct Measurement:** Flow volumes are typically measured directly via instruments that record inflow and outflow at various points within the water system.

##### Challenges with Data Reliability:

- **Sites with Unreliable Data:** Certain locations may have inconsistent or unreliable flow data due to manual reading human error, or environmental factors. In these cases, alternative estimation methods are used. Flow data has been tabulated despite accuracy and the larger number between estimations and real flow data was selected to provide a worst-case scenario to better assess environmental effects. Sites that lack measured flow data (\*\*) are considered defiant to any conditions requiring measured flow data.

##### Estimation Methods:

- **EP/ET Discharge Volume Estimates:** For sites lacking reliable measured data (\*), flow volumes are estimated based on Equivalent Population (EP) and Equivalent Tenement (ET) calculations. This method utilises established norms for:
  1. **Average Dry Weather Flow (ADWF):** Calculated for 320 days to represent non-peak conditions.
  2. **Peak Wet Weather Flow (PWWF):** Designated for 45 days to account for higher flow volumes during rainy periods.
- **Flow Factors by Region:**
  1. **Tropical Northern Region:** This area, located north of the Adelaide River, experiences an annual rainfall generally above 1500 mm. A wet flow factor of 6 is used here to accommodate the significant increase in water flow during the wet season.
  2. **Victoria/Daly and Roper/Gulf Regions:** Situated between Tennant Creek and Adelaide River, these regions receive annual rainfall between 500 mm and 1500 mm. A flow factor of 5 is applied.
  3. **Arid Region:** South of Tennant Creek, this region sees less than 500 mm of rainfall annually, leading to a lower wet flow factor of 4, reflecting the minimal impact of wet weather on flow volumes.

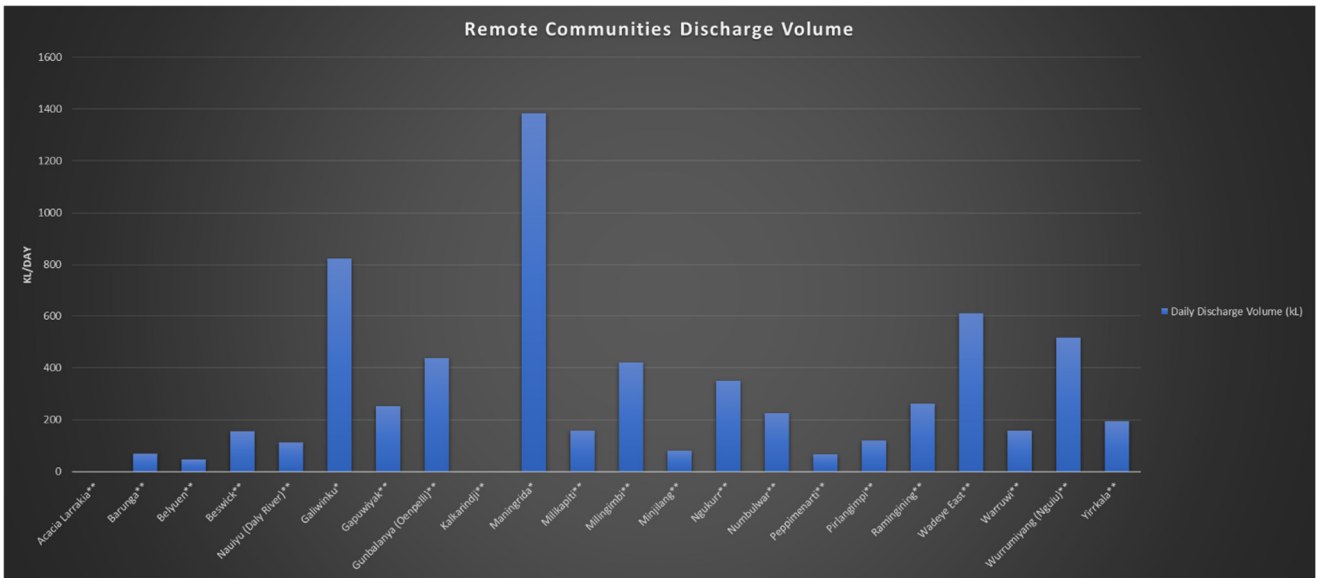


Figure 1. Remote Communities Discharge Volume (\* - Estimated and flow data recorded, \*\* – Estimated and no recorded flow data).

## Water Quality Data

The graphs in Appendix A illustrate various water quality parameters across multiple locations for the period from 2021 to 2025. The parameters include chlorophyll-a, *E. coli*, total suspended solids (TSS), filtered reactive phosphorus (FRP), total phosphorus (TP), biochemical oxygen demand (BOD), dissolved oxygen percentage (DO%), total nitrogen (TN), and turbidity.

### *E. coli*

Log10 transformation converts data to a logarithmic scale, which is particularly useful for handling highly variable datasets like *E. coli* counts. It normalises the data, making skewed distributions more symmetric and easier to analyse. This transformation compresses data ranges, reducing the impact of outliers and highlighting proportional differences, which is beneficial for understanding trends and making comparisons across locations and time periods. In the provided graphs, using log10 for *E. coli* counts improves clarity and interpretability, allowing for better visualisation of significant differences and patterns that might be obscured on a linear scale from nutrient-rich inputs.

### Total Suspended Solids (TSS)

TSS measures the particles suspended in water. Elevated TSS can reduce light penetration, affecting photosynthesis and consequently, chlorophyll-a levels. Locations with elevated TSS might also see elevated BOD due to the decomposition of organic matter.

### Chlorophyll-a

Chlorophyll-a levels are an indicator of algae and phytoplankton. Elevated levels suggest increased nutrient inputs, potentially from wastewater discharge.

### Filtered Reactive Phosphorus (FRP) and Total Phosphorus (TP)

Both FRP and TP indicate the presence of phosphorus in the water, a key nutrient that can promote algal growth. Elevated levels of phosphorus can correlate with elevated chlorophyll-a levels.

## Biochemical Oxygen Demand (BOD)

BOD measures the amount of oxygen required to decompose organic matter. Elevated BOD indicates significant organic presence. Elevated BOD can reduce dissolved oxygen (DO%) levels.

## Dissolved Oxygen Percent Saturation (DO%)

DO% indicates the oxygen available in water. Low DO% can result from elevated BOD, as decomposing organic matter consumes oxygen. Inversely related to BOD and potentially chlorophyll-a, as excessive algal growth can lead to oxygen depletion.

## Total Nitrogen (TN)

TN measures nitrogen levels, another nutrient that promotes algal growth. Elevated TN can correlate with elevated chlorophyll-a levels and BOD, as more nutrients lead to more organic matter.

## Turbidity

Turbidity measures the clarity of water. Elevated turbidity often correlates with elevated TSS and can affect photosynthesis, indirectly impacting chlorophyll-a levels.

## Correlations

- **Nutrient Levels (FRP, TP, TN) and Chlorophyll-a:** Elevated nutrient levels typically lead to elevated chlorophyll-a concentrations, promoting algal growth.
- **TSS and Turbidity:** Elevated TSS often results in elevated turbidity, affecting light penetration and potentially impacting algal growth.
- **BOD and DO%:** Elevated BOD correlates with lower DO%, as decomposing organic matter consumes oxygen.
- ***E. coli* and Nutrient Levels:** Locations with elevated *E. coli* may also exhibit elevated nutrient levels.
- **Chlorophyll-a and BOD:** Elevated chlorophyll-a can lead to increased organic matter and thus elevated BOD, reducing dissolved oxygen saturation and concentration.

## Monitoring Results Discussion

Each observation for every round involves comparing results from locations within that specific round. It is important to note that all results are from the discharge point or the final pond before or near the outlet of the sewage ponds. Belyuen WSP is the only site where the receiving environment (Woods Inlet) is monitored; hence, the discussion of monitoring results is presented separately in this section.

### Round 1

(figure 2 - figure 13)

- **Galiwinku:** Shows moderate levels across most parameters, with a decrease in DO% and Total Nitrogen and an increase in chlorophyll-a.
- **Milingimbi:** Shows an increase in Ammonia, BOD, Enterococci and FRP, while all other parameters show a slight decrease or little change to previous years.

- **Maningrida:** Displays relatively stable nutrient levels, with a decrease in total Nitrogen, TSS and Turbidity have decreased over this reporting period.
- **Naiyu:** Shows a decrease in nutrients to the previous year and slight fluctuations of other parameters, no obvious change in trend from previous years.
- **Ramingining:** Pathogen indicators remain consistent with previous years (no general chemistry data available during the reporting period).
- **Wadeye:** Shows a decrease in total Nitrogen and Phosphorus and Chlorophyll-a and a slight increase in TSS and turbidity.
- **Yirrkala:** Shows elevated and consistent nutrient levels, with the exception of decreased Nitrogen, corresponding with elevated chlorophyll-a and BOD and a decrease in TSS and turbidity.

## Round 2

(figure 14 – figure 27)

- **Barunga:** Shows elevated TSS and BOD levels, with fluctuations in DO%. Nitrogen discharge loads decreased, while Phosphorous remained consistent with previous years.
- **Peppimenarti:** BOD, DO, and Chlorophyll-a levels increased (2024-25 medians higher than previous year). Two outliers for DO were discovered in this year's data and were omitted. Nutrient levels remained moderate except nitrogen which the discharge loads decreased overall.
- **Wurrumiyanga:** Shows a decrease in Nitrogen loads discharged, while Phosphorus loads remain consistent with the previous year. DO levels increased from previous years.
- **Numbulwar:** Nitrogen loads appear to have decreased this reporting period and a slight increase in Phosphorus, along with, slight increases in TSS and turbidity.
- **Gunbalanya:** Parameters remain consistent with previous years, with the exception of an increase in BOD and decreased Nitrogen load.
- **Pirlangimpi:** Shows a decrease in nutrient levels, Chlorophyll-a, TSS and turbidity.
- **Waruwi:** Displays elevated TP, FRP and a decrease in Nitrogen loads, DO, BOD and Chlorophyll-a show fluctuation.
- **Milikapiti:** Shows a decrease in nutrient loads and Chlorophyll-a over this reporting period, though still at moderate levels.

## Round 3

(figure 28 – figure 39)

- **Acacia Larrakia:** Shows low nutrient levels, with a slight increase in DO.
- **Beswick:** Exhibits decreased TN, TP and Ammonia and Chlorophyll-a levels, with a slight increase in BOD and DO.
- **Kalkarindji:** Displays a decrease across pathogen indicators, Chlorophyll-a and TN. DO has increased moderately over this reporting period.
- **Minjilang:** Shows elevated chlorophyll-a, TSS, and BOD levels, indicating potential nutrient and organic pollution.

- **Ngukurr:** Displays elevated DO and TP, with moderate levels of other parameters.
- **Gapuwiyak:** Exhibits stable but elevated levels across most parameters, indicating persistent nutrient and organic pollution.

## Belyuen WSP Summary of Water Quality Monitoring Data

This section presents analysis of water quality parameters at two monitoring sites: **SBLEP01** – Woods Inlet and **SBL090** – Final Pond/Discharge Point. The analysis spans multiple years, from 2021 to 2025, and the findings are summarised below:

### **Chlorophyll-a** (figure 40)

- **SBLEP01:** Consistently low levels across all years 2021 – 2025.
- **SBL090:** High levels in 2021/2022, with a decreasing trend in subsequent years.

### ***E. coli*** (figure 41)

- **SBLEP01:** Low levels, showing minor fluctuations across the years.
- **SBL090:** Elevated levels in all years, with a slight increase in 2024/2025.

### ***Enterococci*** (figure 42)

- **SBLEP01:** Levels fluctuate moderately, potentially indicating variable inputs from non-point sources.
- **SBL090:** levels fluctuate over the years with an increase being shown for the 2024/2025 reporting period; though, the same spike is not seen in the receiving environment.

### **Total Suspended Solids (TSS)** (figure 43)

- **SBLEP01:** Low levels, with minor increases.
- **SBL090:** Elevated levels, peaking in 2021/2022, but still relatively low impact on the receiving environment.

### **pH** (figure 44)

- **SBLEP01:** An increase in alkalinity can be seen during the 2024/2025 reporting period.
- **SBL090:** pH levels have also increased at the final discharge point over 2024/2025.

Both monitoring points are within the default trigger values for pH range of 7.0 – 8.5 (ANZECC, 2000: table 3.3.4).

### **Biochemical Oxygen Demand (DO%)** (figure 45)

- **SBLEP01:** Stable levels across all years, no correlating fluctuations to the discharge point.
- **SBL090:** A decrease can be seen from the previous year, though still moderate.

### **Dissolved Oxygen (DO%)** (figure 46)

- **SBLEP01:** Stable levels across all years, indicating good oxygenation.
- **SBL090:** A reduction can be seen in 2024/2025; however, this has shown minimal impact to the receiving environment.

### **Ammonia (NH<sub>3</sub>-N)** (figure 47)

- **SBLEP01:** Consistently low levels, indicating minimal ammonia impact in the receiving environment.

- **SBL090:** Higher levels, peaking in 2023/2024. This suggests significant ammonia presence in the final pond, which does not impact the receiving environment due to the low and intermittent discharge, levels have decreased over this reporting period.

#### **NOx-N** (figure 48)

- **SBLEP01:** Consistently low levels across 2021-2025.
- **SBL090:** Elevated in 2022/2023, followed by a reduction, pointing to intermittent issues possibly linked to specific discharges or treatment variations.

#### **Total Nitrogen (TN)** (figure 49)

- **SBLEP01:** Low levels, with minor increases over the years.
- **SBL090:** High levels, with the highest in 2022/2023, but showing a reduction from 2023-2025.

#### **Filterable Reactive Phosphorus (FRP)** (figure 50)

- **SBLEP01:** Negligible levels.
- **SBL090:** Elevated in 2022/2023 and reduced in 2023-2025, demonstrating high phosphorus in the final pond, but low impact on the receiving environment.

#### **Total Phosphorus (TP)** (figure 51)

- **SBLEP01:** Minimal levels.
- **SBL090:** Consistent across all years, with the highest in 2021/2022. Indicates substantial phosphorus content in the final pond, yet minimal influence on the receiving environment.

#### **Turbidity** (figure 52)

- **SBLEP01:** Turbidity showed a decrease over this reporting period.
- **SBL090:** Turbidity spiked during the 2024/2025 reporting period, however, appears to have had minimal impact on the receiving environment, as a decrease was shown at the environmental monitoring point.

#### **Analysis**

- **Receiving Environment Impact:** The monitoring point (SBLEP01) consistently shows low levels of pollutants, indicating negligible impact from the final pond discharge (SBL090). This is likely due to the intermittent and low flow of discharge, which primarily occurs during high flow events or the wet season, diluting potential contaminants.
- **Bacteriological Analysis:** While levels are significant at the receiving environment, they can be correlated with non-point sources like wild animals and stormwater runoff, rather than solely from the final pond discharge.
- **Nutrient and Turbidity:** Nutrient levels and Chlorophyll-a remain low at the receiving environment monitoring point. An increase in turbidity at the pond outlet during the reporting period has not shown a carry-over effect at the environmental monitoring point.
- **Year-to-Year Variability:** Median values of results show fluctuations, with some parameters peaking in specific years, in some cases, likely due to seasonal variation.

The data highlights that the discharge from the final pond has a low impact on the receiving environment due to the intermittent nature of the discharge and the dilution during high flow events. Monitoring

continues to be essential to identify and manage potential sources of pollutants, ensuring the protection of the receiving environment.

## Environmental Impacts Summary

Environmental Risk Assessments (ERAs) evaluate and manage potential environmental risks from wastewater discharge at remote community wastewater treatment facilities. These assessments consider the characteristics of the wastewater, the receiving environment, and the sensitivity of surrounding ecosystems, identifying potential risks such as pollutant presence or excessive nutrient loads.

Site visits have been conducted by the Assurance team during this reporting period at Gapuwiyak, Beswick (Wugularr), Barunga, Acacia Larrakia and Wurrumiyanga. Visual observations of the receiving waterways onsite did not indicate deleterious effects from wastewater discharges, though access issues prevented access to the Wurrumiyanga discharge point, the ponds appeared to be operating effectively. Monitoring data remains within historical range for Gapuwiyak WwTP apart from slight increases in ammonia, phosphorus, and BOD. As environmental risk stressors are low/negligible with low volume irrigation (VIC EPA, 2023) and several site inspections by Utility Support Contract Workers (USCWs) and the PWC assurance team discovered no evidence of deleterious effects from the discharge in the receiving environment, it was deemed that the environmental effect of the discharge is minimal. Despite minimal environmental effects, improvements at Gapuwiyak have been recommended to remain proactive. No deleterious effects in receiving waterways have been reported from Utility Support Contract Workers (USCWs) during routine site inspections during this reporting period at any of the other remote WwTPs.

## Summary of Investigations

*Condition 39.5* of the Round 2 WDLs requires a summary of investigations undertaken by the licensee within the reporting period.

During this reporting period 6 investigations were conducted for the following Round 2 remote WwTPs:

On 10 June 2025, during the annual compliance audit for Annual Return submission, 4 non-compliances were found where discharge flow meter devices were non-operational at the following sites:

WDL216-03 Gunbalanya

WDL217-03 Milikapiti

WDL220-03 Peppimenarti

WDL221-03 Pirlangimpi

The investigation outcomes included an action to ensure all remote discharge flow meters are on annual preventative maintenance programs to ensure they are operational, maintained/calibrated and replaced/repared were required in accordance with WDL requirements.

The compliance audit also identified that two land-based sample monitoring point signs were missing from the following sites:

WDL218-03 Numbulwar

WDL220-03 Peppimenarti

The investigation outcomes included an action to replace and install new signage, replacement signs have been ordered and awaiting delivery to install the signs. Additionally, an action has been included to ensure missing/damaged signage is reported as soon as possible, as per USCW contracts.

# Declaration of Accuracy

I, **Tahlia Kemp** (Manager Assurance, Performance Reporting & Improvement Water Services, Power and Water Corporation), have reviewed this report and I confirm that to the best of my knowledge and ability, all the information provided in the report is true and accurate.

A handwritten signature in black ink, appearing to read 'Tahlia Kemp', written in a cursive style.

Signature:

Date: 29/07/2025

# References

ANZECC and ARMCANZ (2000) Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy. Australian and New Zealand Environment and Conservation Council and Agriculture Resource Management Council of Australia and New Zealand, Chapters 1 and 2.

BOM (2025) Bureau of Meteorology. Climate Data Online. Australian Government. Accessed 17 June 2025. <http://www.bom.gov.au/climate/data/>

Fortune, J., Butler, E. & Gibb K. (2020) A decade of nitrogen inputs to a tropical macrotidal estuary of Northern Australia, Darwin Harbour. *Regional Studies in Marine Science*, 36 (2020), pg. 101275.

Jacobs Engineering Group (2021) Jacobs Engineering Group. Waste Stabilisation Ponds; Assessment Report; Power and Water Corporation.

Water Futures (2020) Water Futures Pty Ltd, Conversations on site with Dr. Daniel Deere, Technical Wastewater Specialist, at remote community waste stabilisation ponds conducted during fieldwork in 2020.

Environment Protection Authority Victoria (2023) *Guidance for risk assessment of wastewater discharges to surface waters*, Publication 1287.2, EPA Victoria, Southbank.

# Appendix A - Monitoring Results Graph

## Round 1

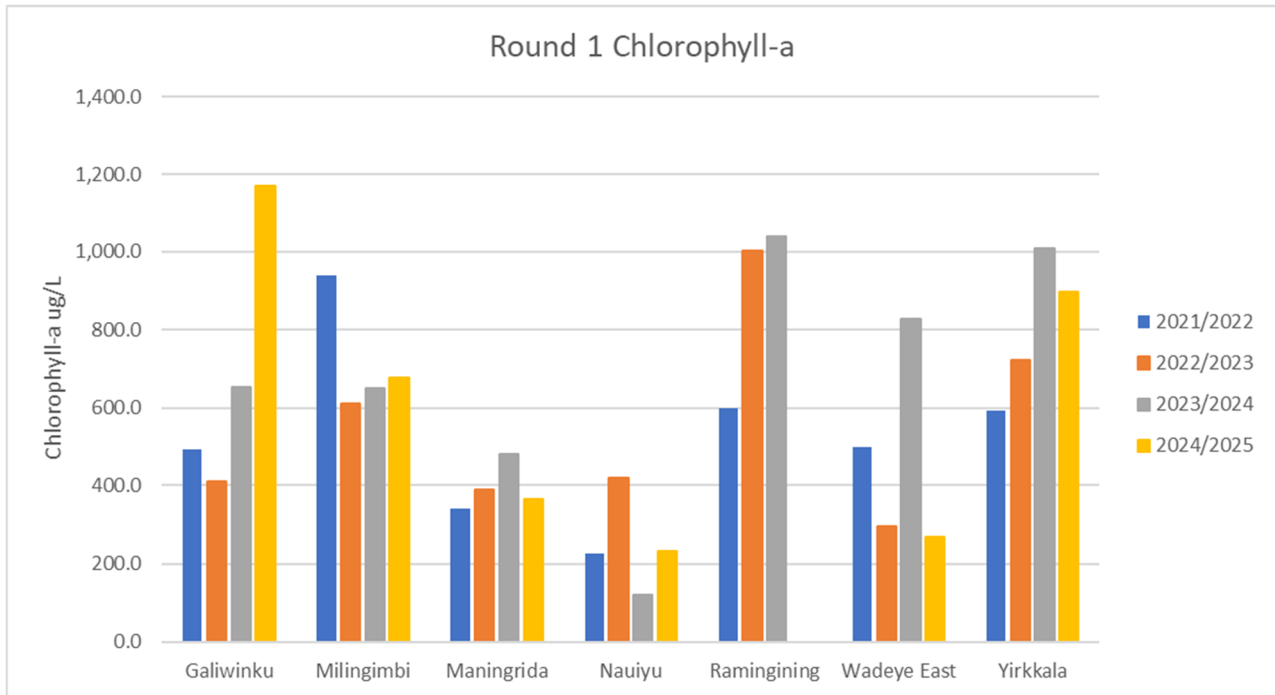


Figure 2. Round 1 Median Chlorophyll-a (2021-2025).

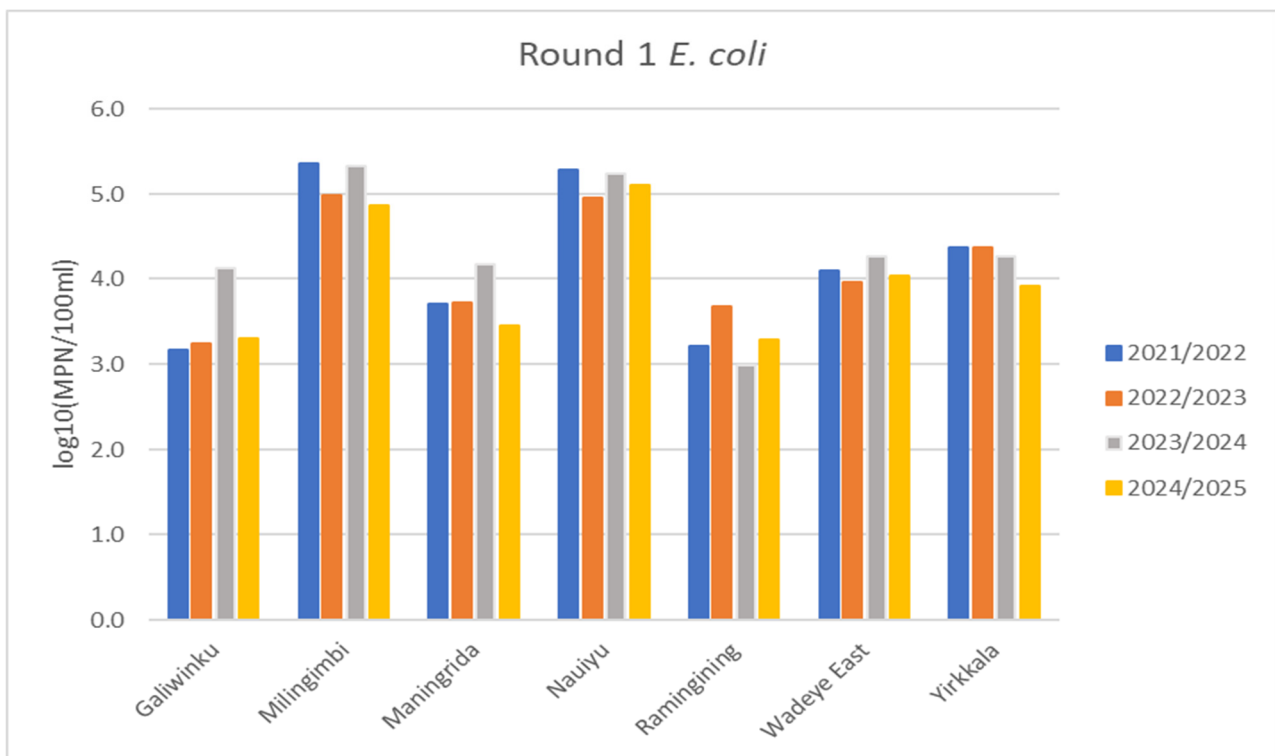


Figure 3. Round 1 *E. coli* log<sub>10</sub>(MPN/100ml) (2021-2025).

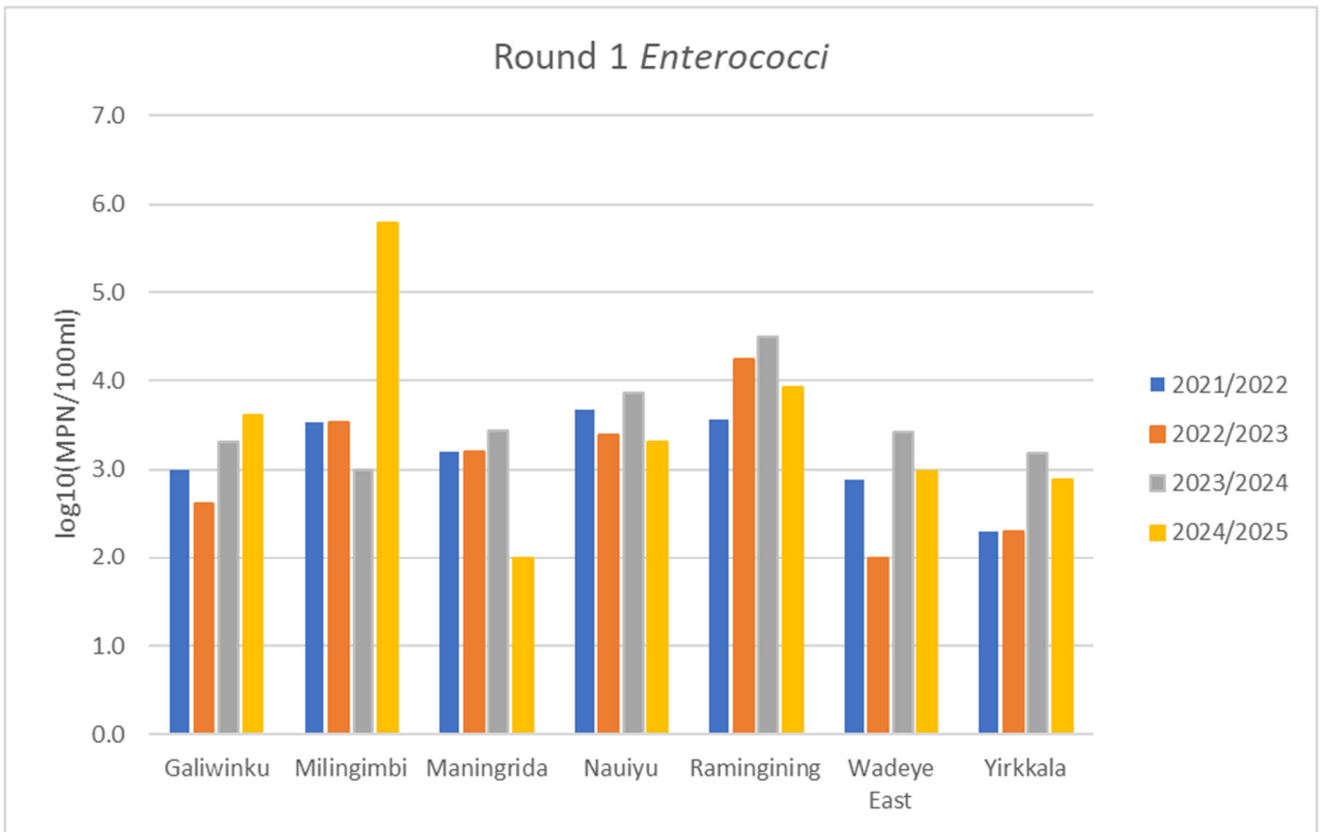


Figure 4. Round 1 Enterococci log<sub>10</sub>(MPN/100ml) (2021-2025).

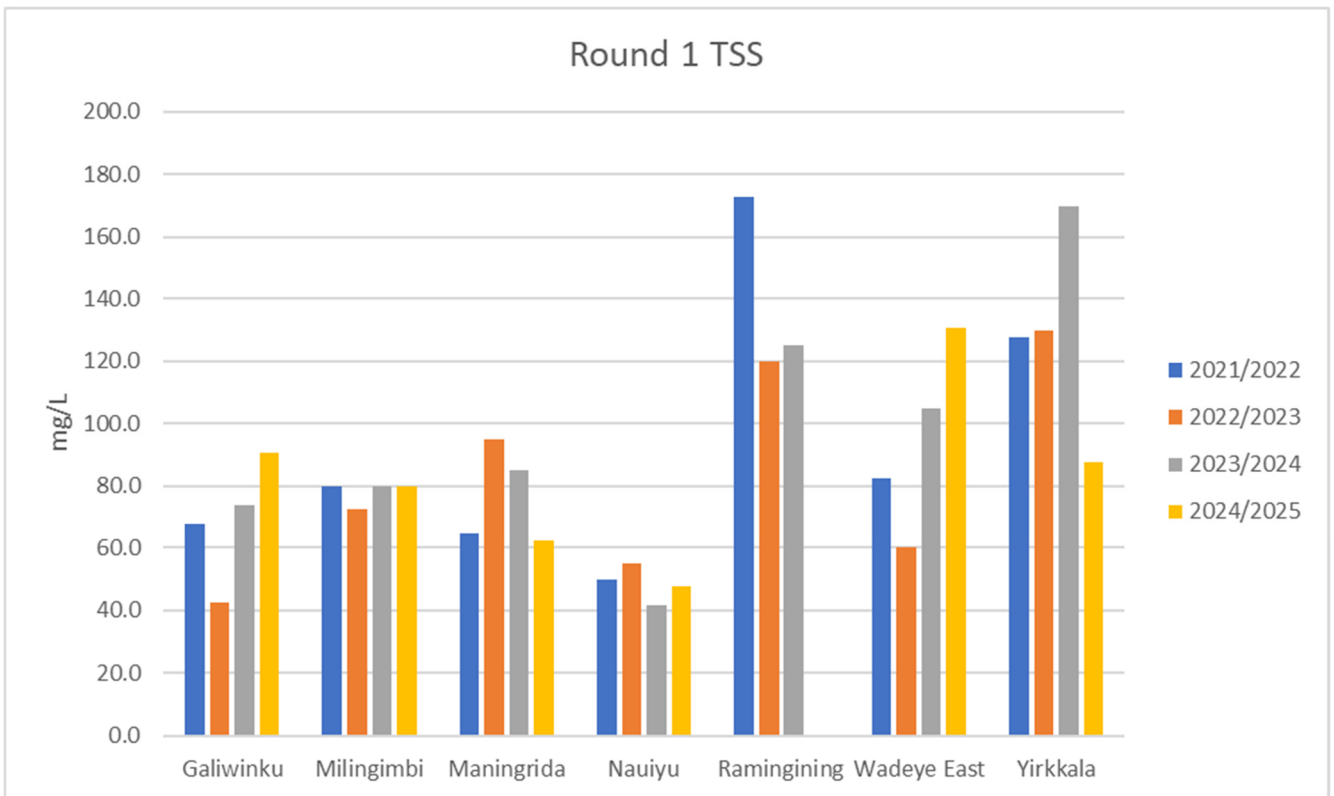


Figure 5. Round 1 Median Total Suspended Solids (2021-2025).

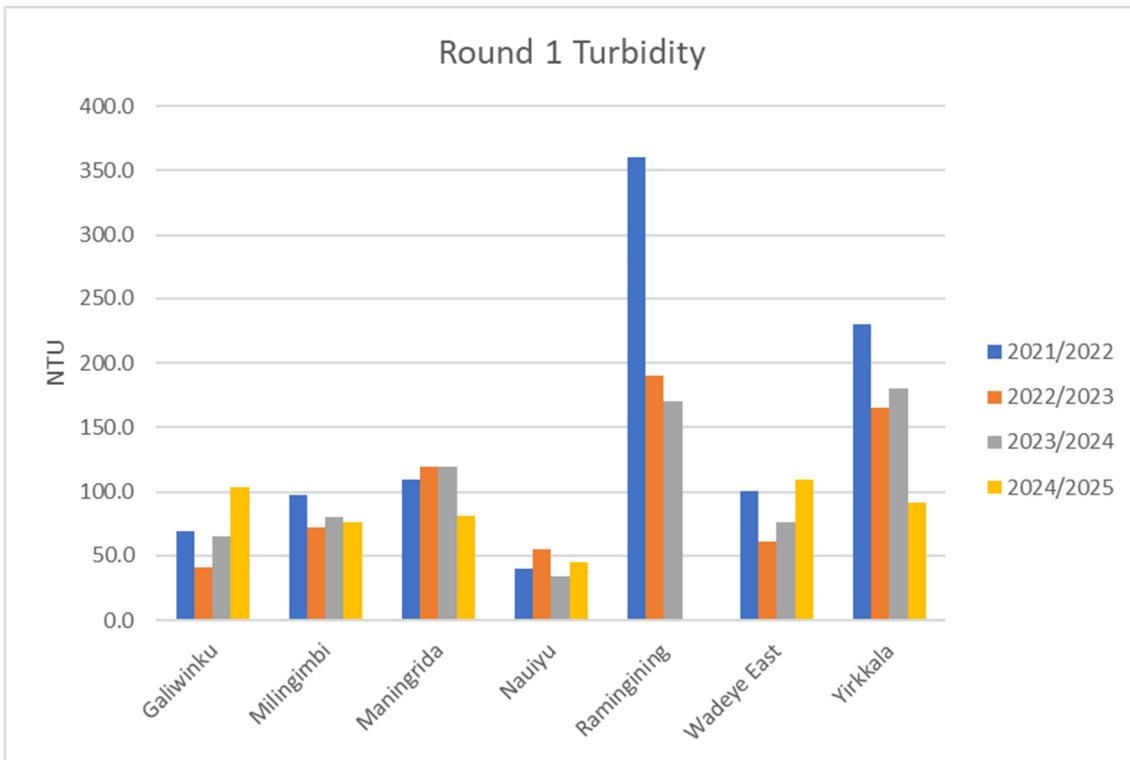


Figure 6. Round 1 Median Turbidity (NTU) (2021-2025).

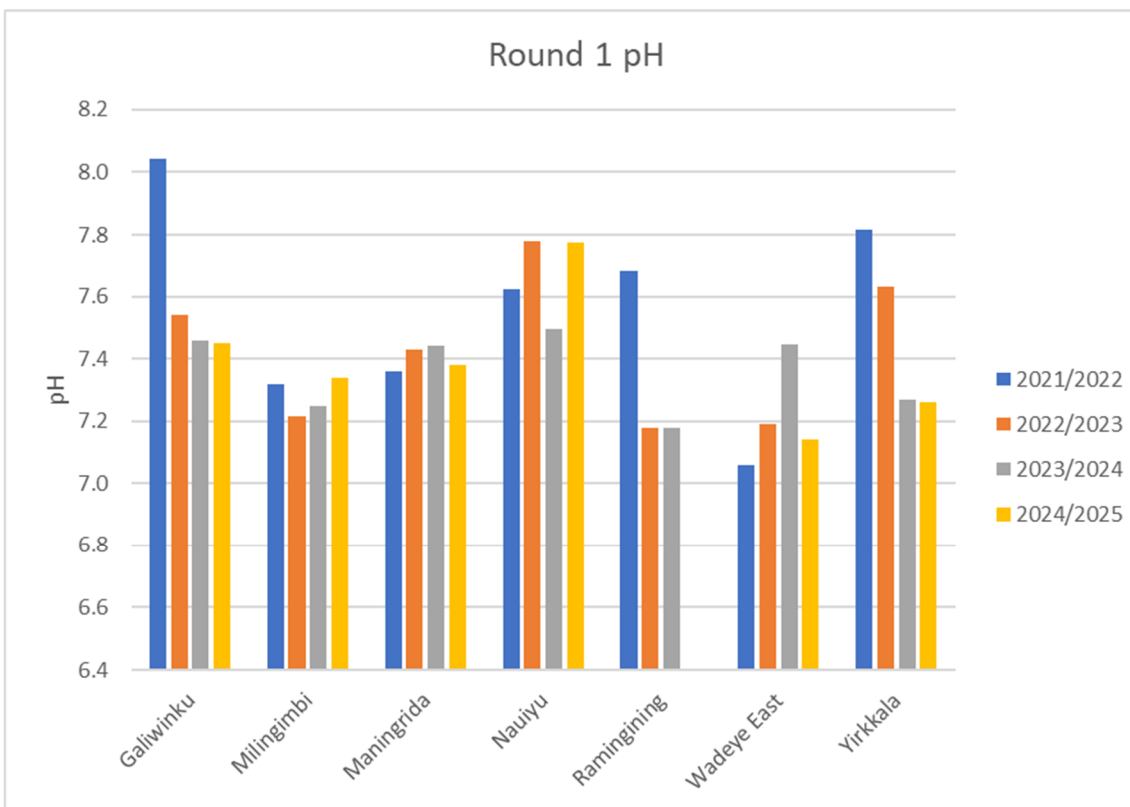


Figure 7. Round 1 Median pH (2021-2025).

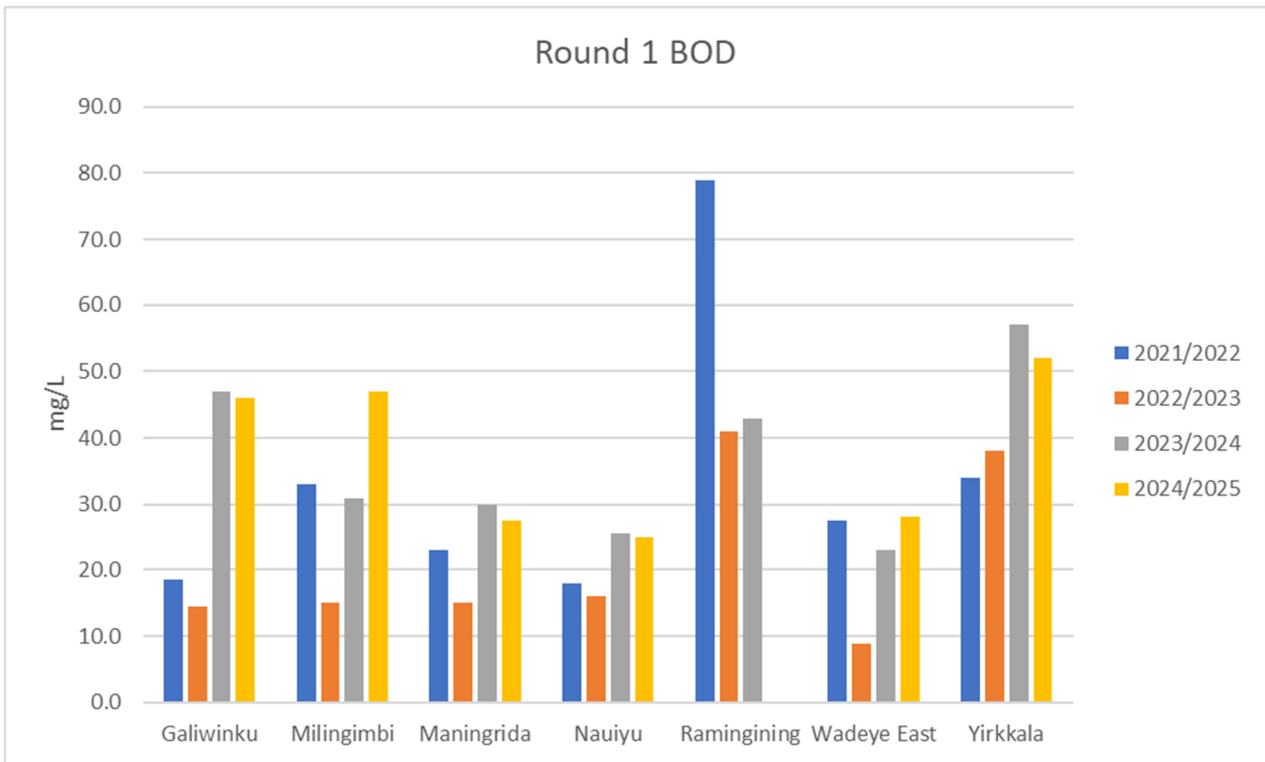


Figure 8. Round 1 Median Biochemical Oxygen Demand (2021-2025).

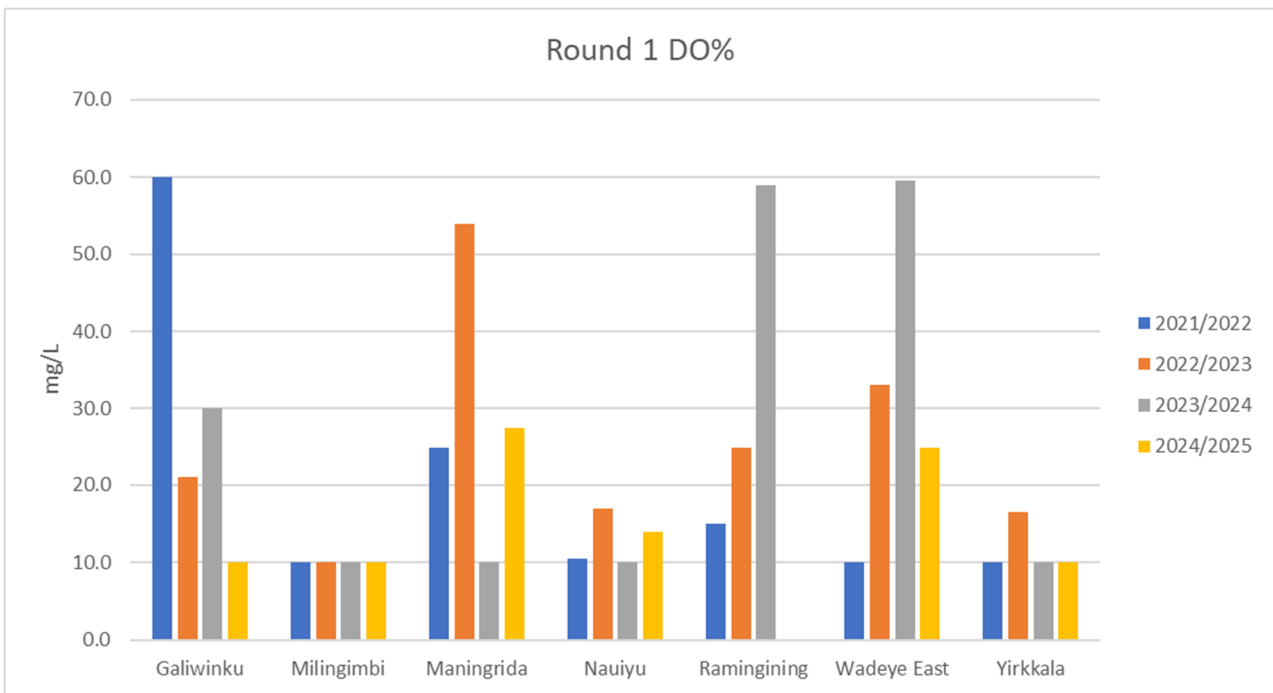


Figure 9. Dissolved Oxygen Saturation (DO%) (2021-2025).

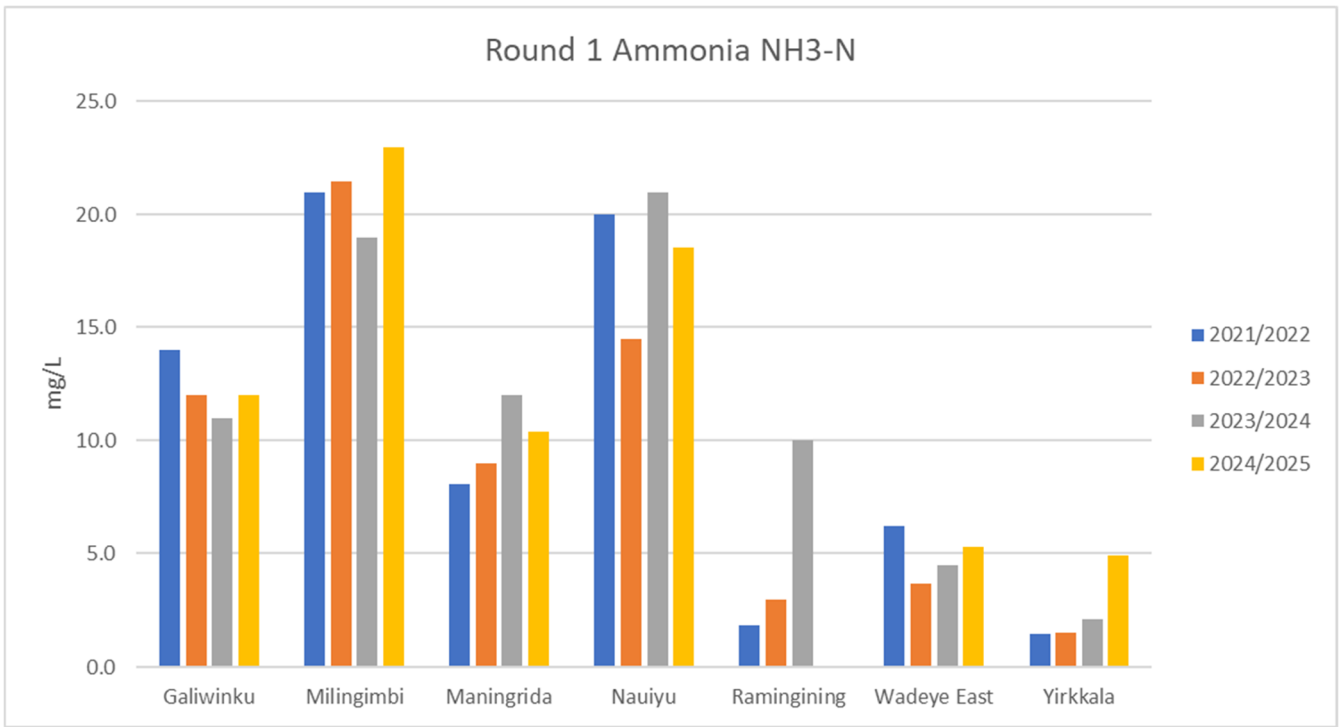


Figure 10. Round 1 Median Ammonia (NH<sub>3</sub>-N) (2021-2025).

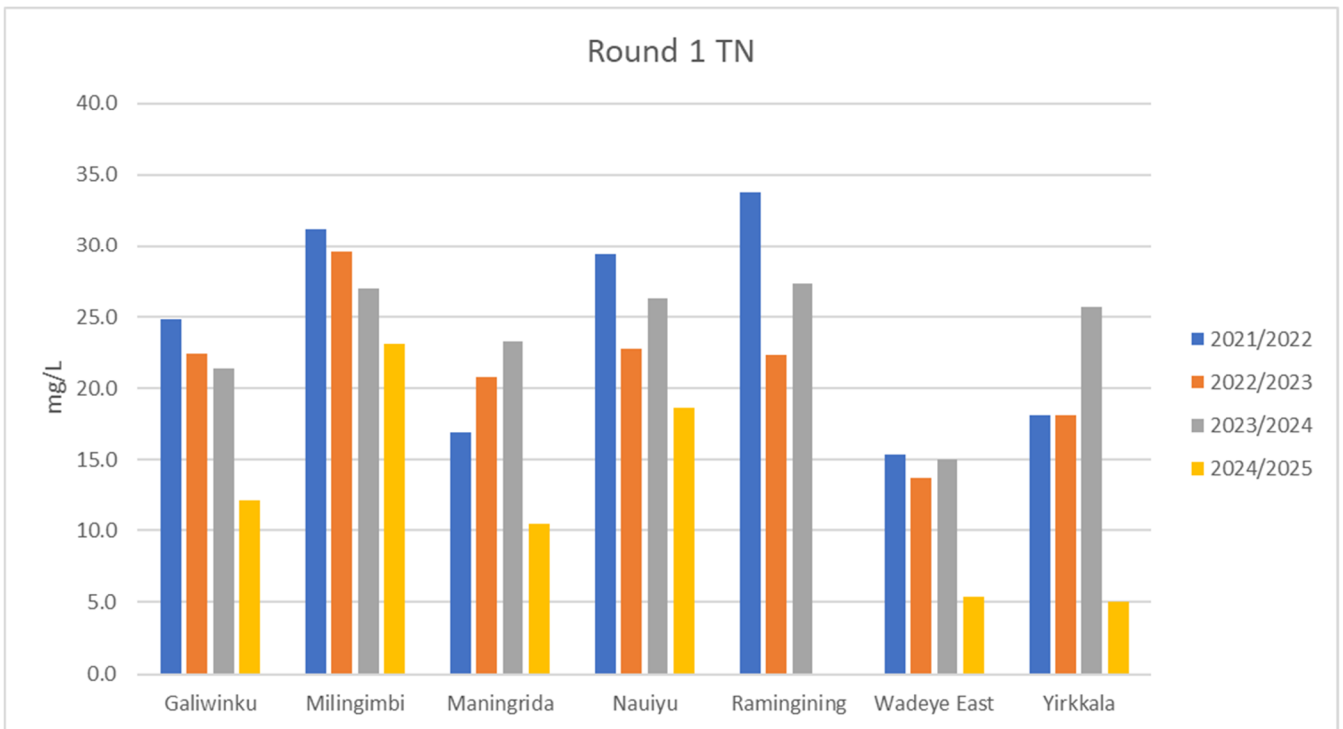


Figure 11. Round 1 Median Total Nitrogen (2021-2025).

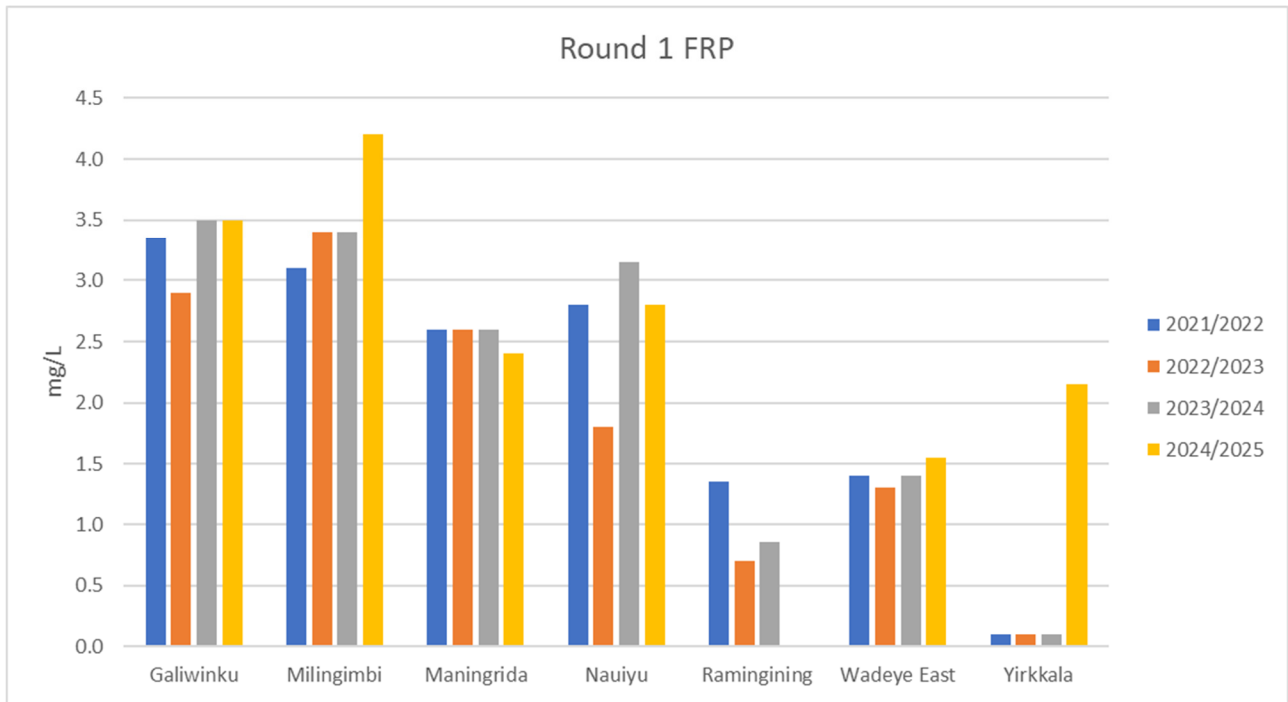


Figure 12. Round 1 Median Filterable Reactive Phosphorus (2021-2025).

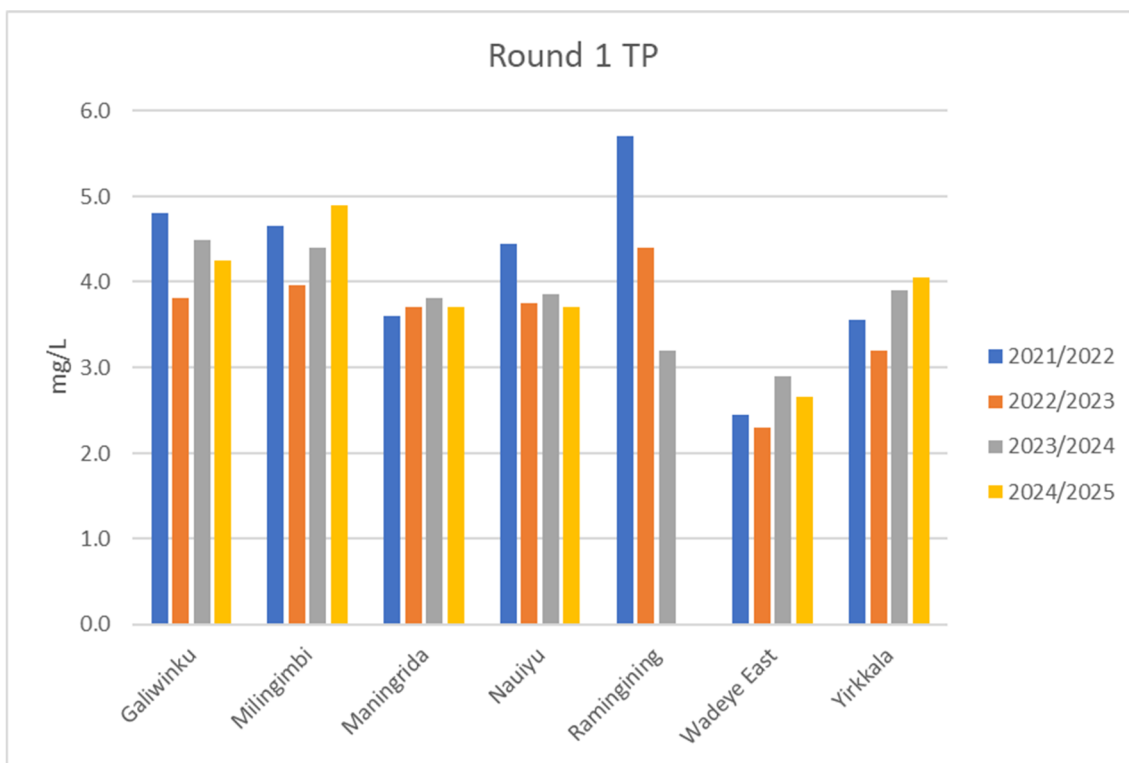


Figure 13. Round 1 Median Total Phosphorus (2021-2025).

## Round 2

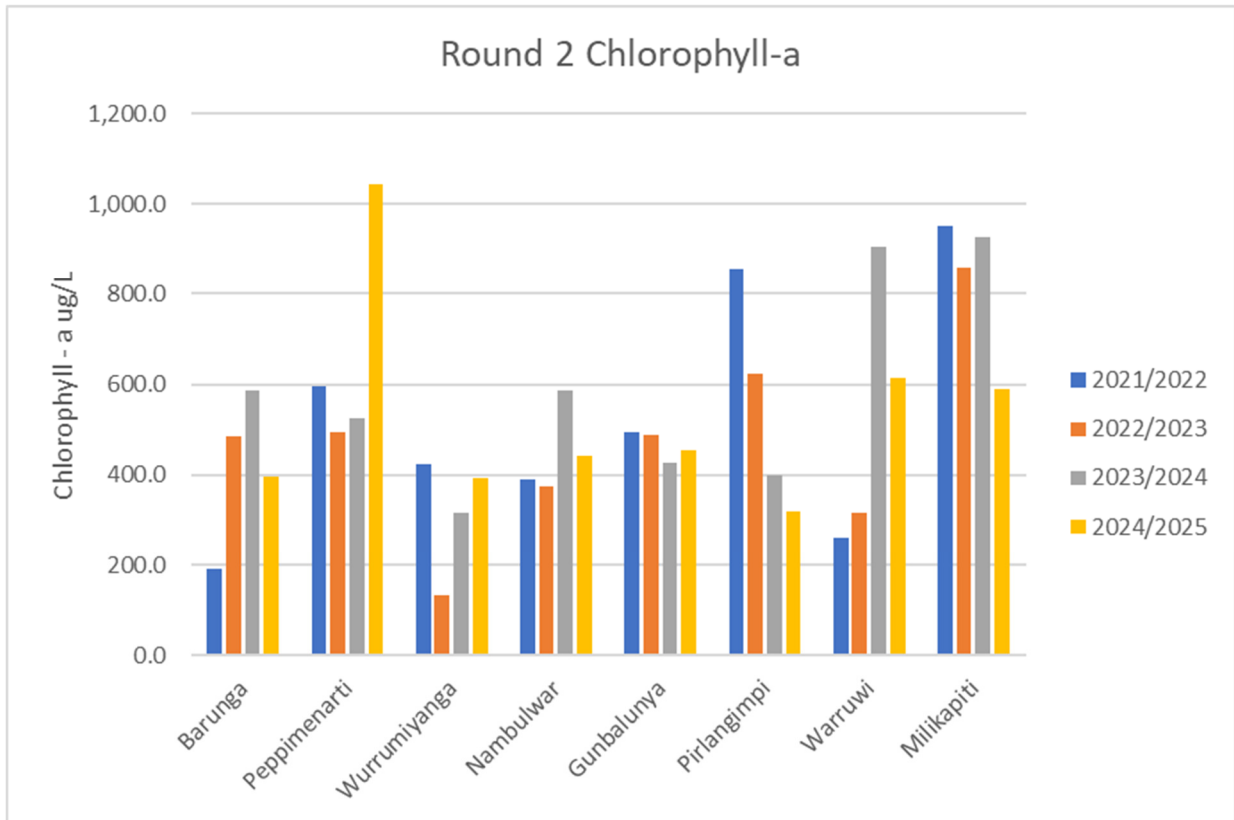


Figure 14. Round 2 Median Chlorophyll-a (2021-2025).

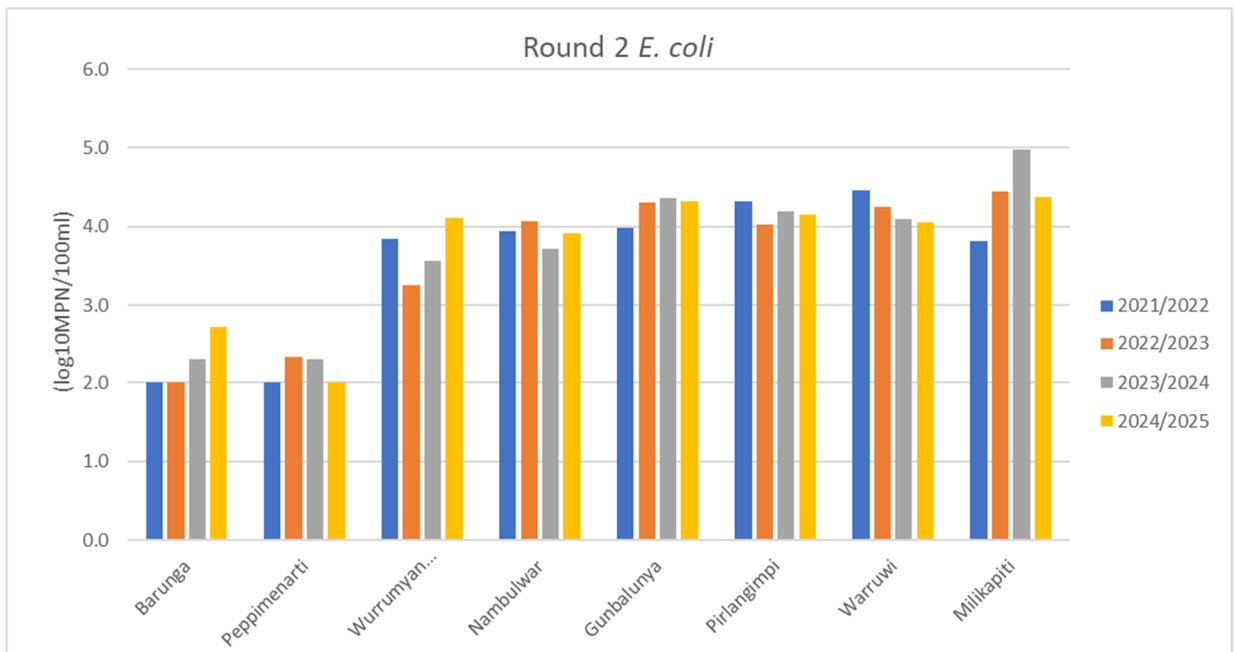


Figure 15. Round 2 E. coli Log<sub>10</sub>(MPN/100ml) (2021-2025).

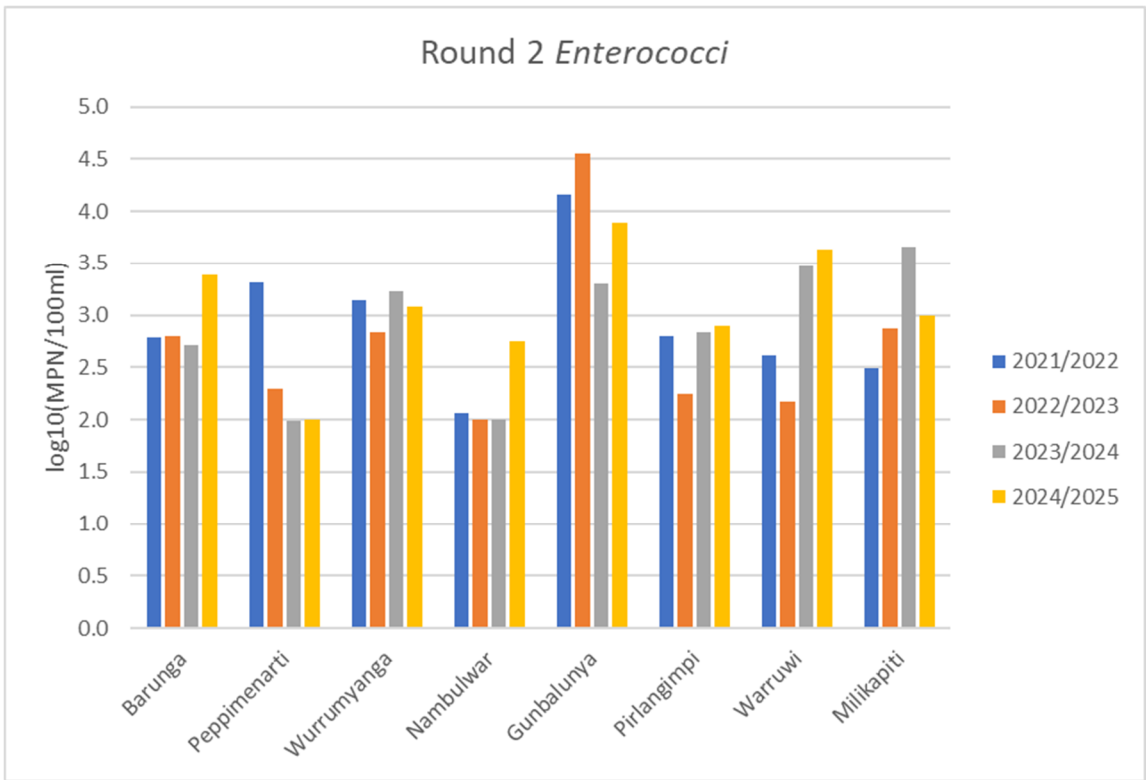


Figure 16. Round 2 Enterococci log<sub>10</sub>(MPN/100ml) (2021-2025).

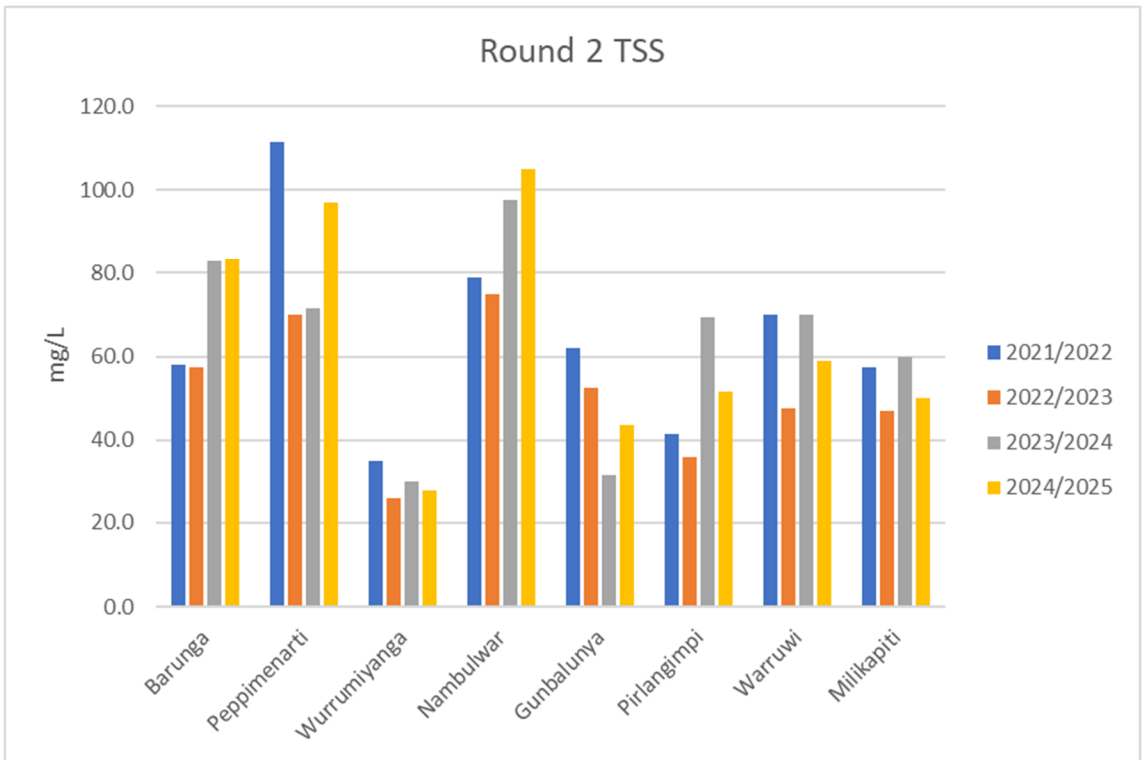


Figure 17. Round 2 Median Total Suspended Solids (2021-2025).

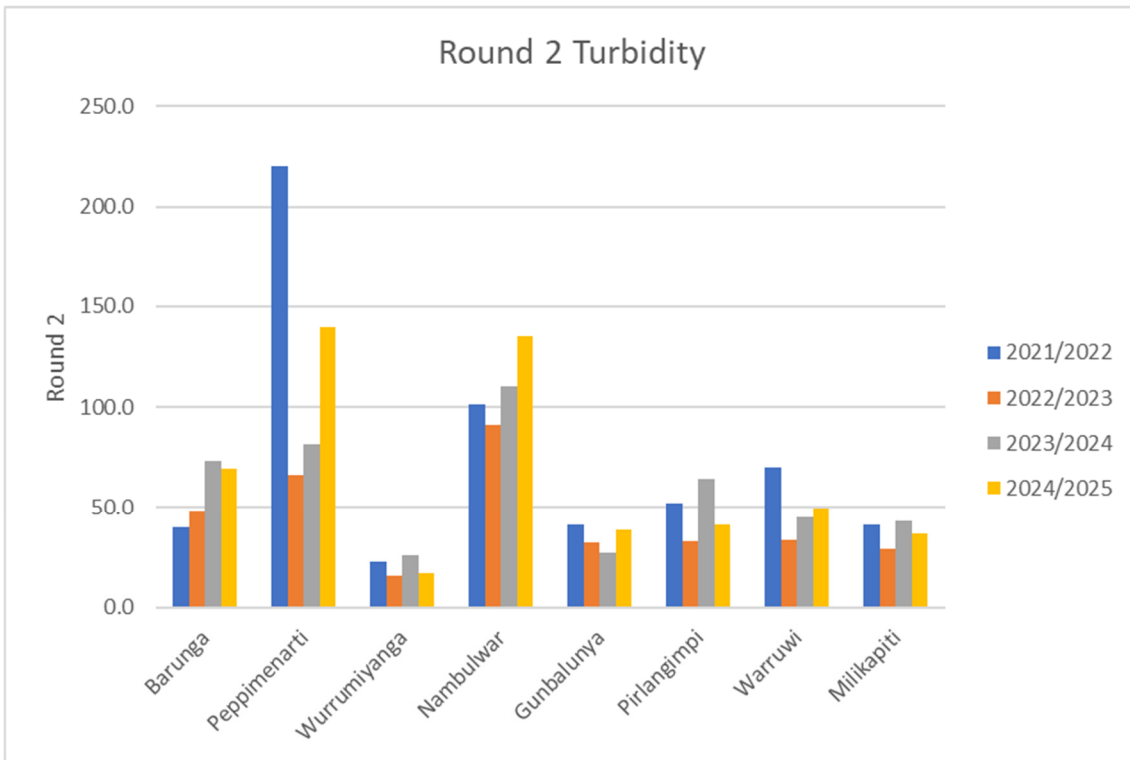


Figure 18. Round 2 Median Turbidity (NTU) (2021-2025).

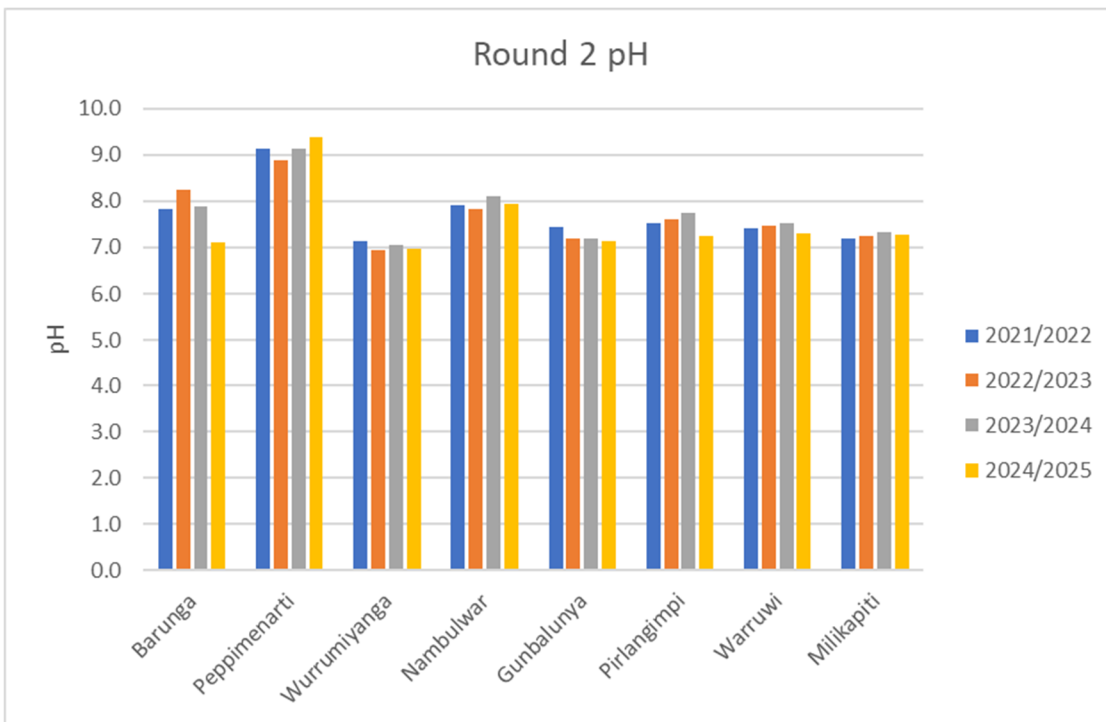


Figure 19. Round 2 Median pH (2021-2025).

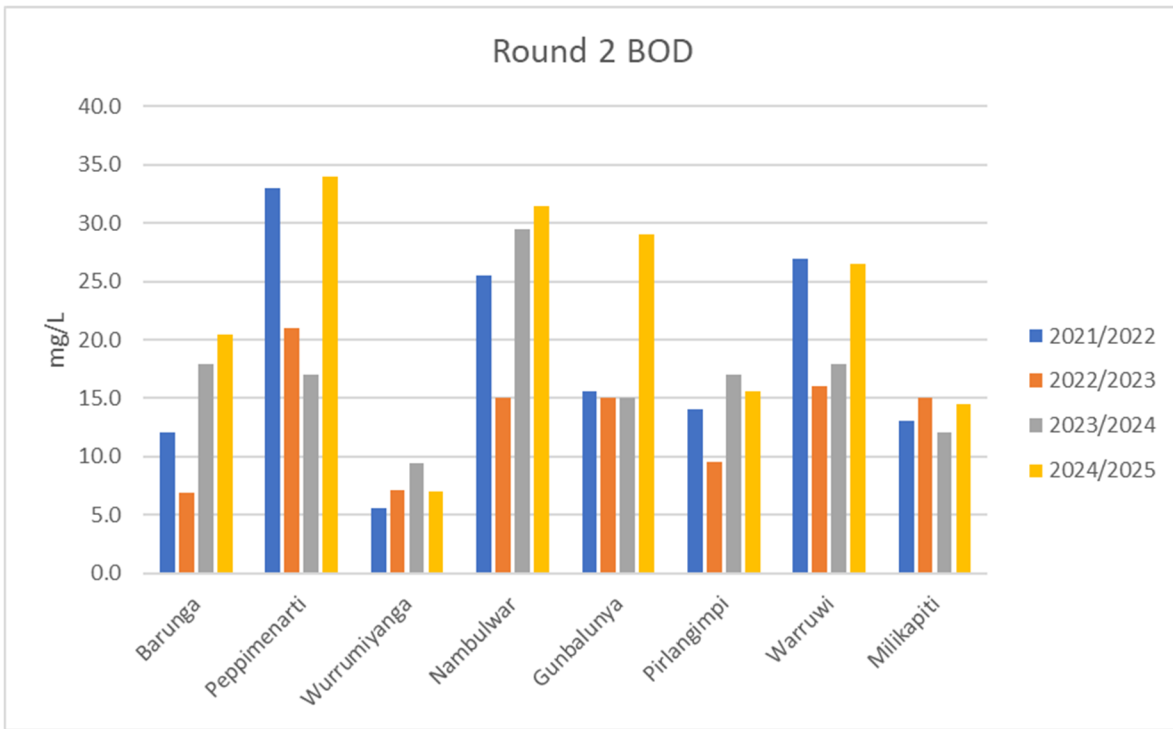


Figure 20. Round 2 Median Biochemical Oxygen Demand (2021-2025).

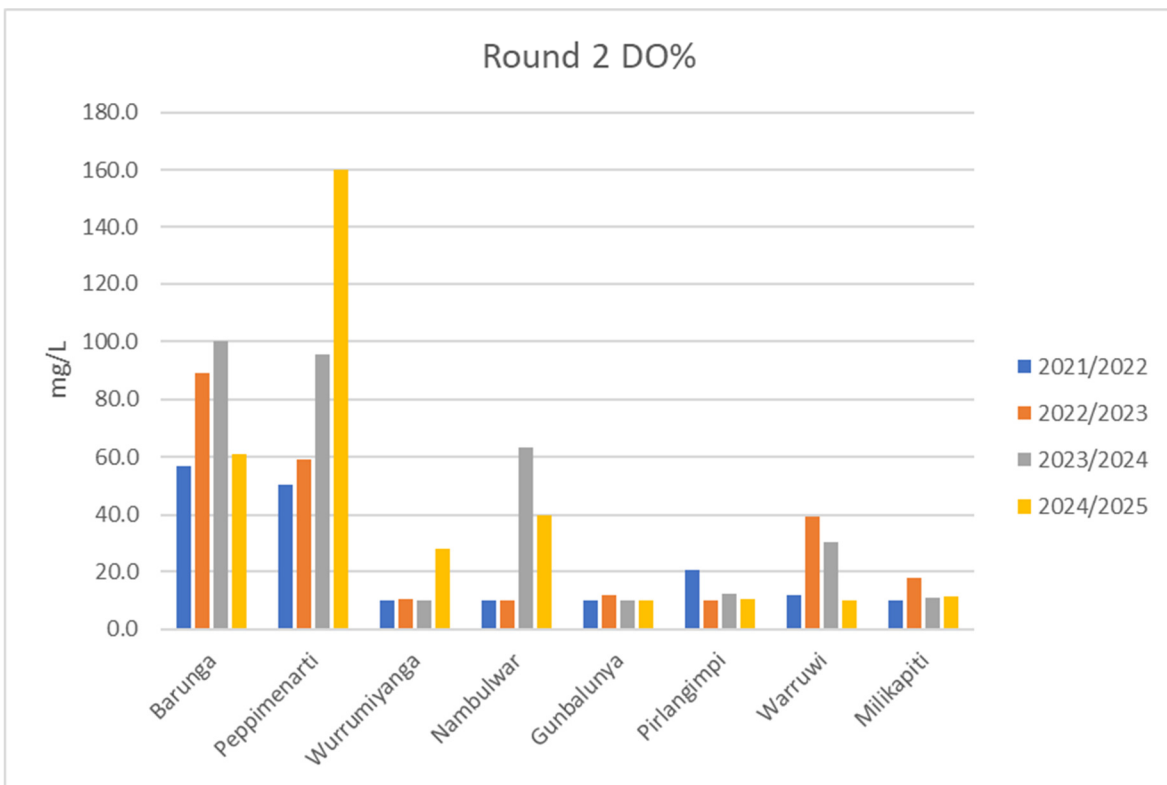


Figure 21. Round 2 Median Dissolved Oxygen Percent Saturation (2021-2025).

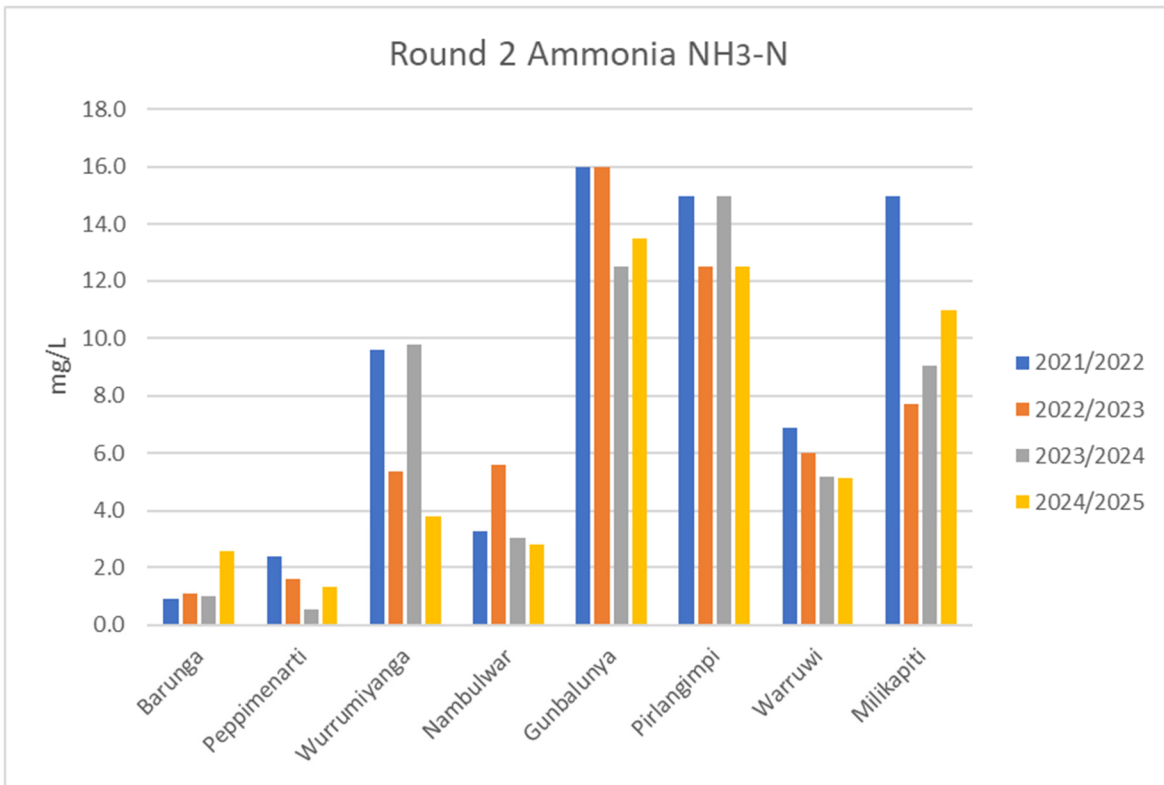


Figure 22. Round 2 Median Ammonia (NH<sub>3</sub>-N) (2021-2025).

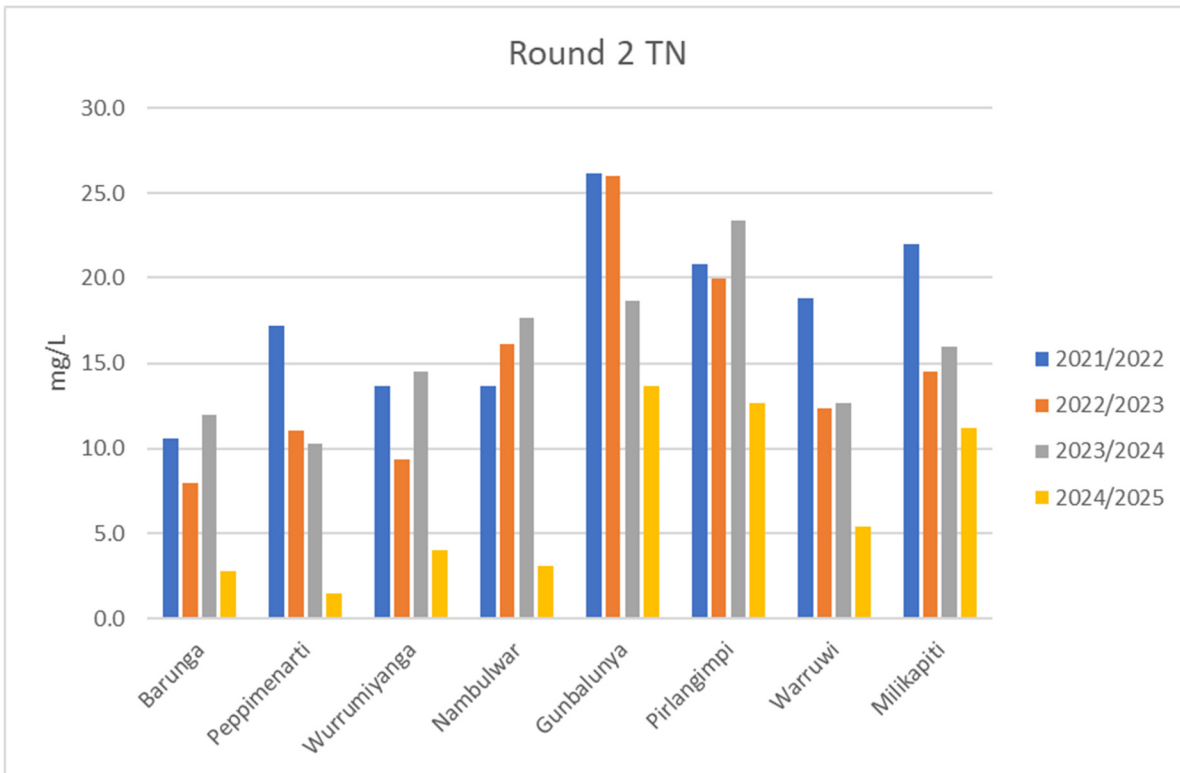


Figure 23. Round 2 Median Total Nitrogen (2021-2025).

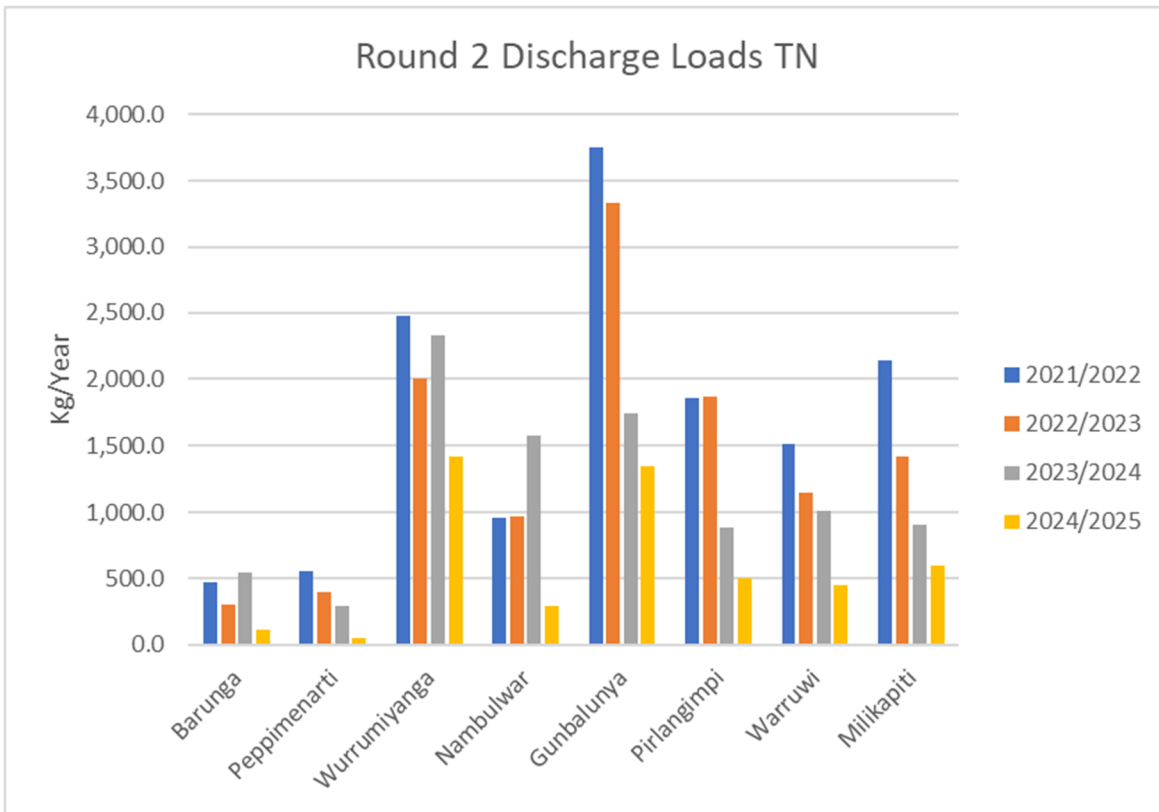


Figure 24. Round 2 Median Total Nitrogen Discharge Loads (2021-2025).

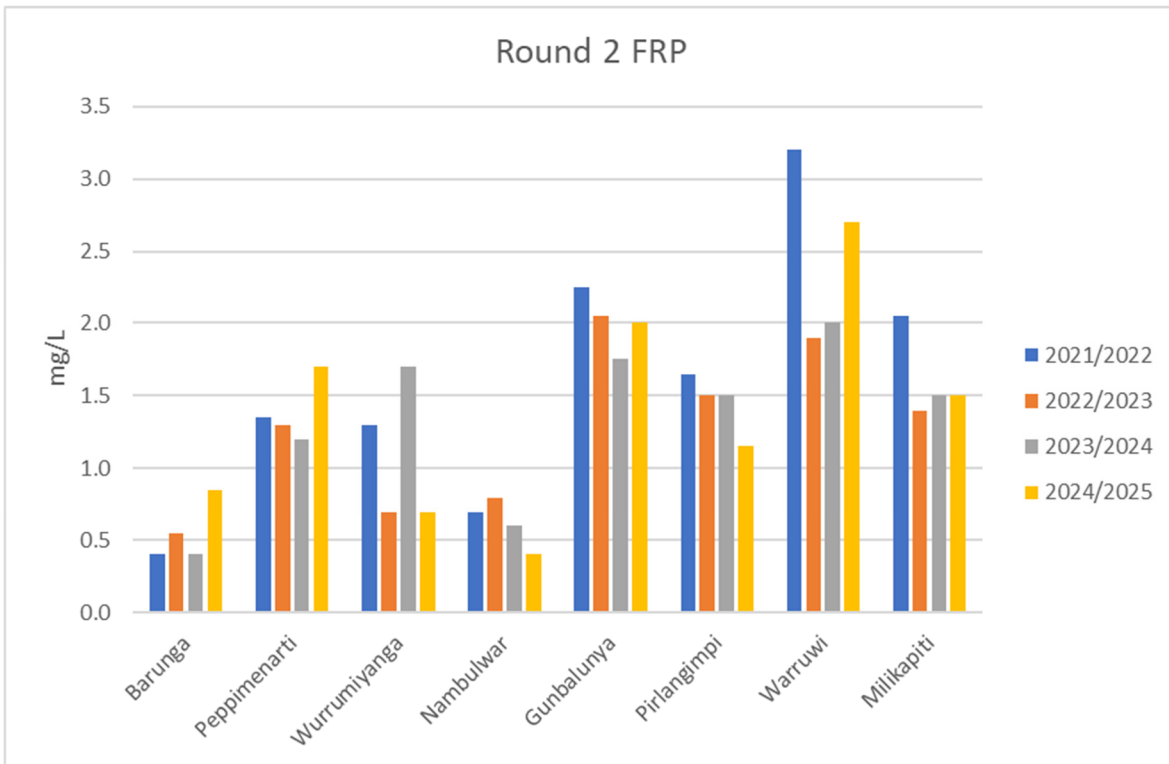


Figure 25. Round 2 Median Filterable Reactive Phosphorus (2021-2025).

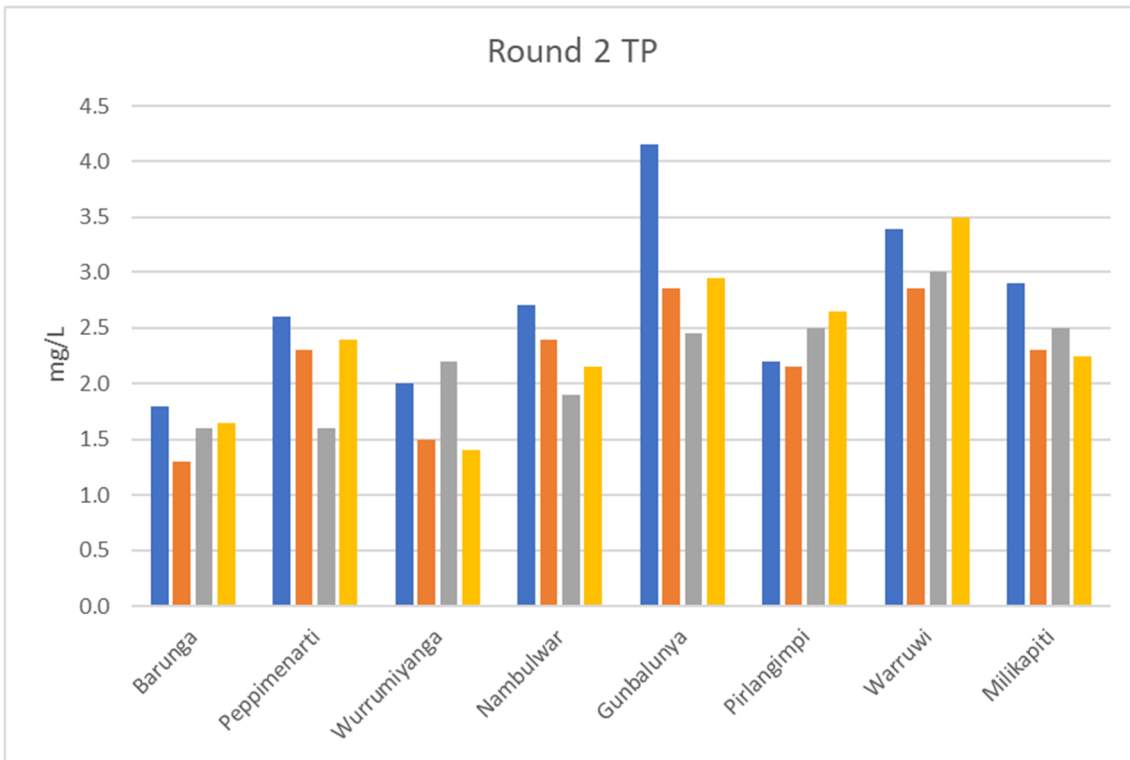


Figure 26. Round 2 Median Total Phosphorus (2021-2025).

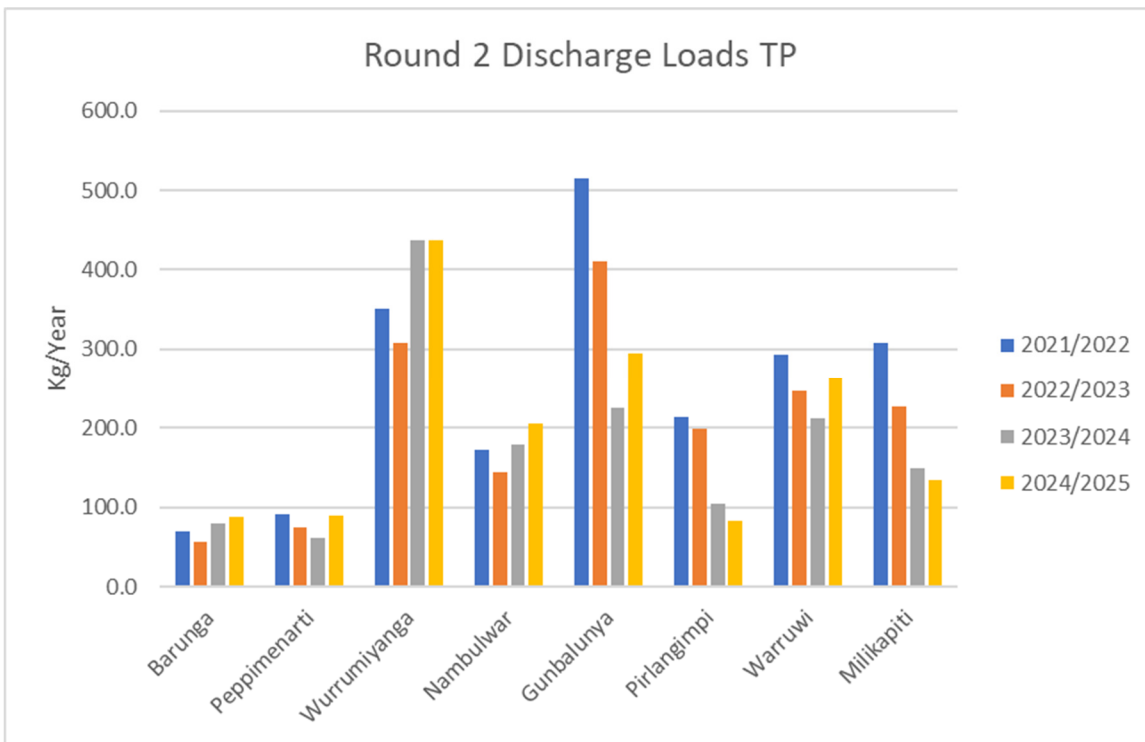


Figure 27. Round 2 Total Phosphorus Discharge Loads (2021-2025).

## Round 3

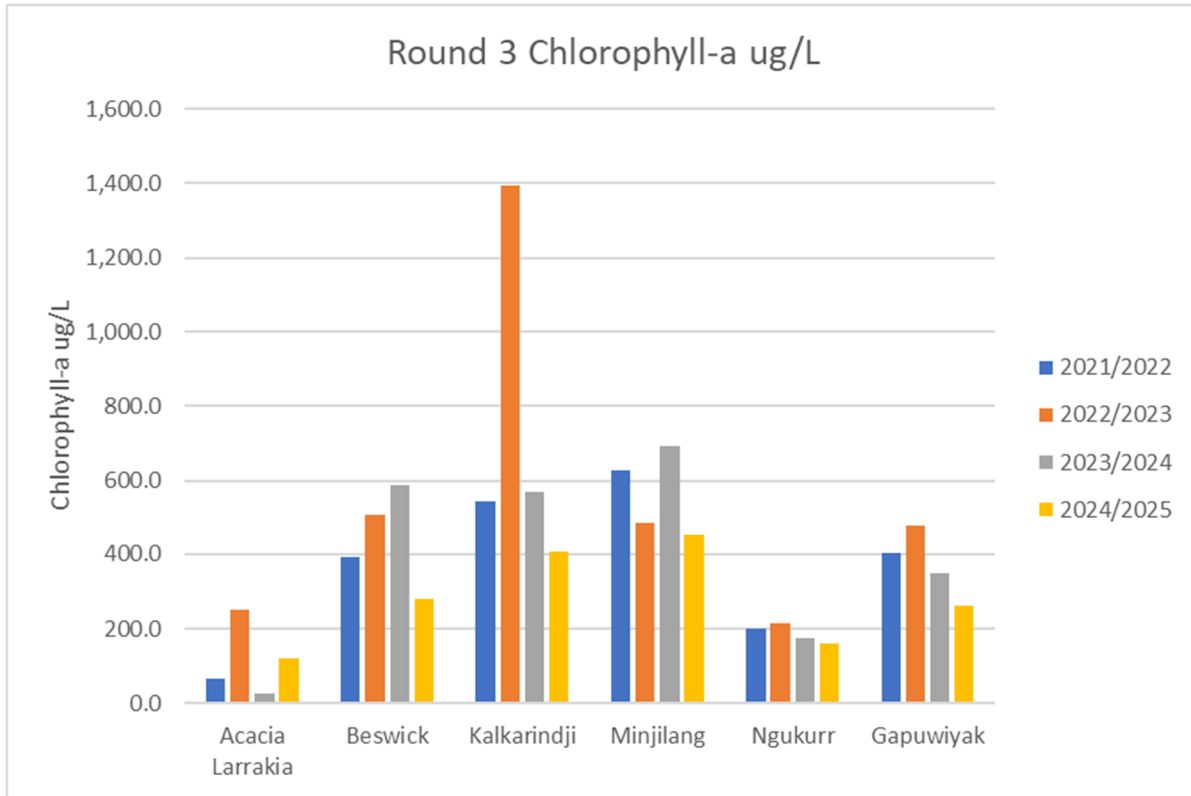


Figure 28. Round 3 Median Chlorophyll-a (2021-2025).

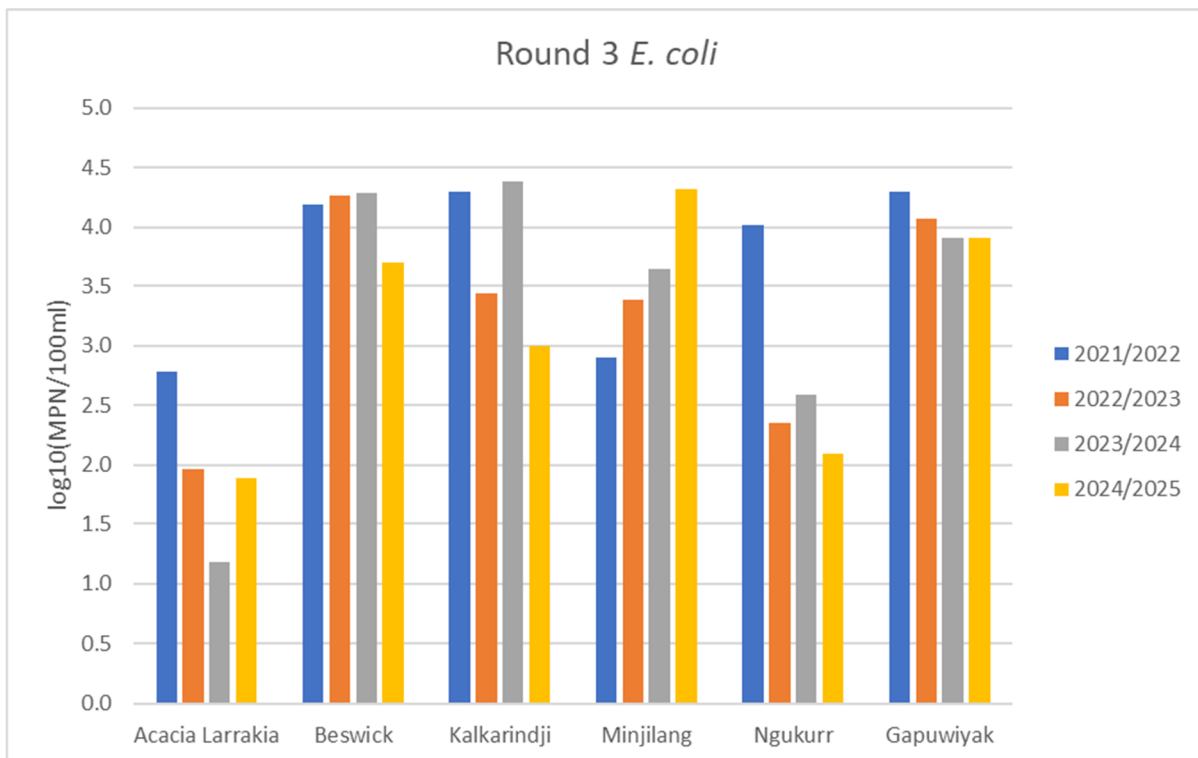


Figure 29. Round 3 *E. coli* log<sub>10</sub>(MPN/100ml) (2021-2025).

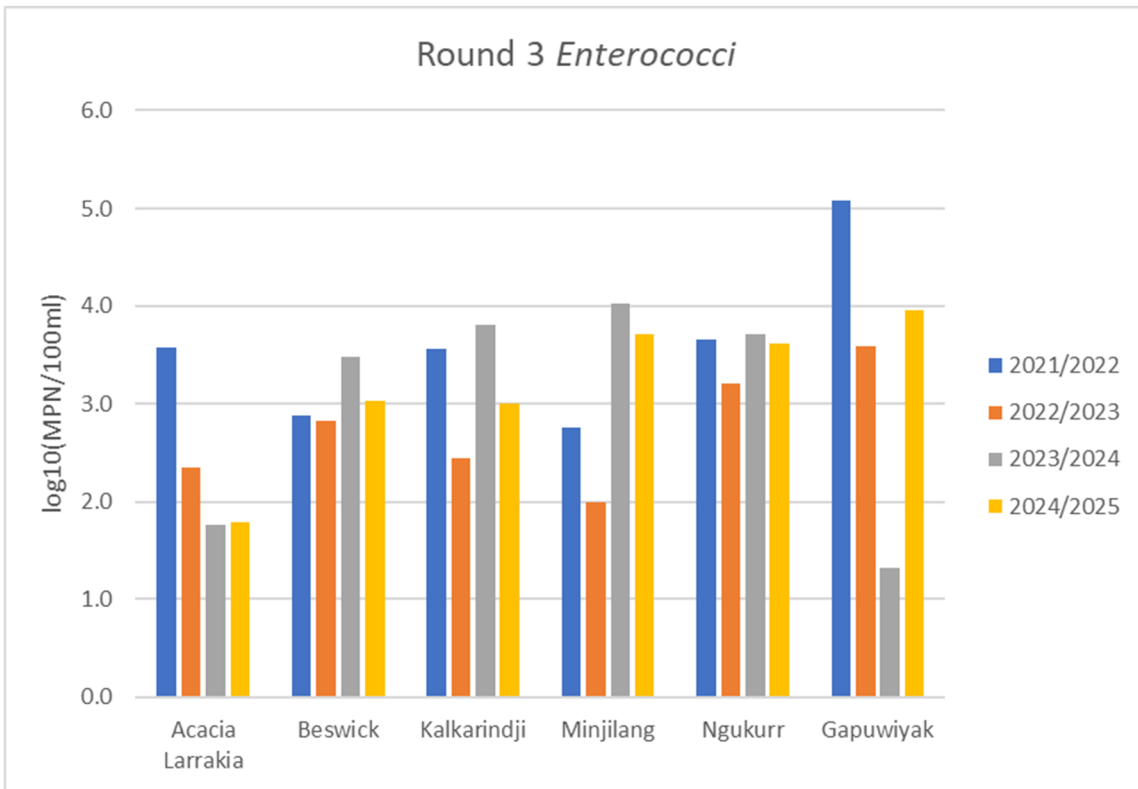


Figure 30. Round 3 Enterococci log10(MPN/100ml) (2021-2025).

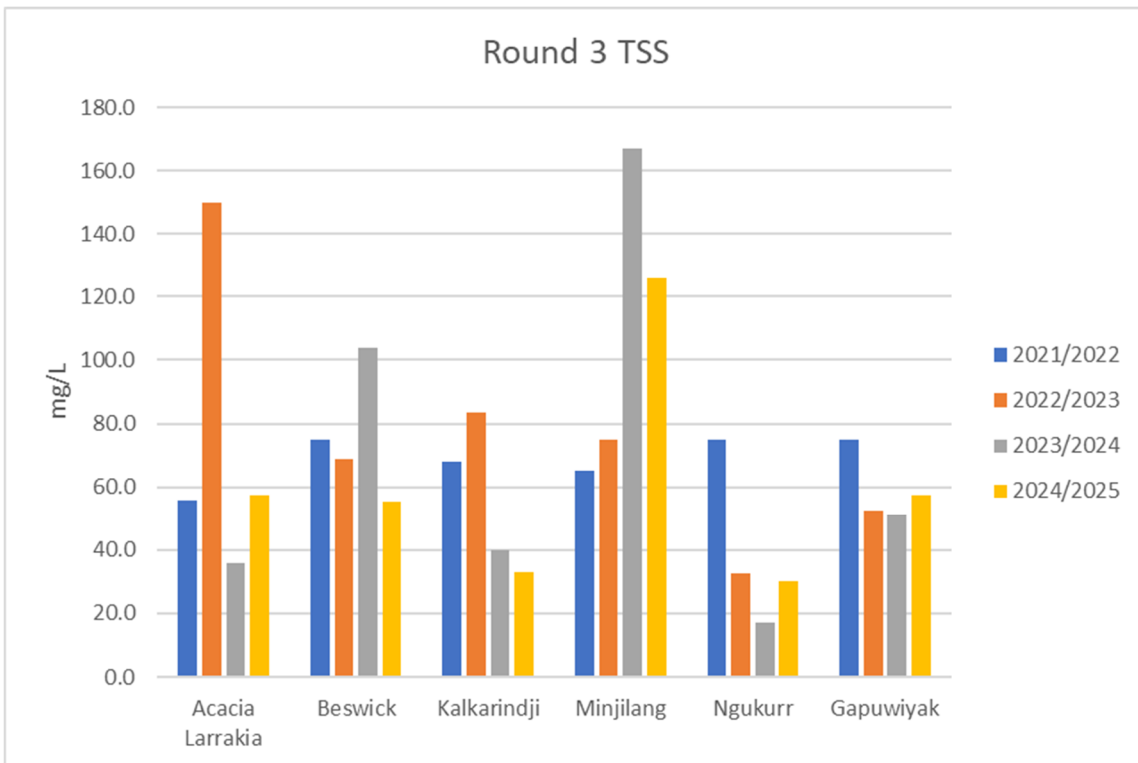


Figure 31. Round 3 Median Total Suspended Solids (2021-2025).

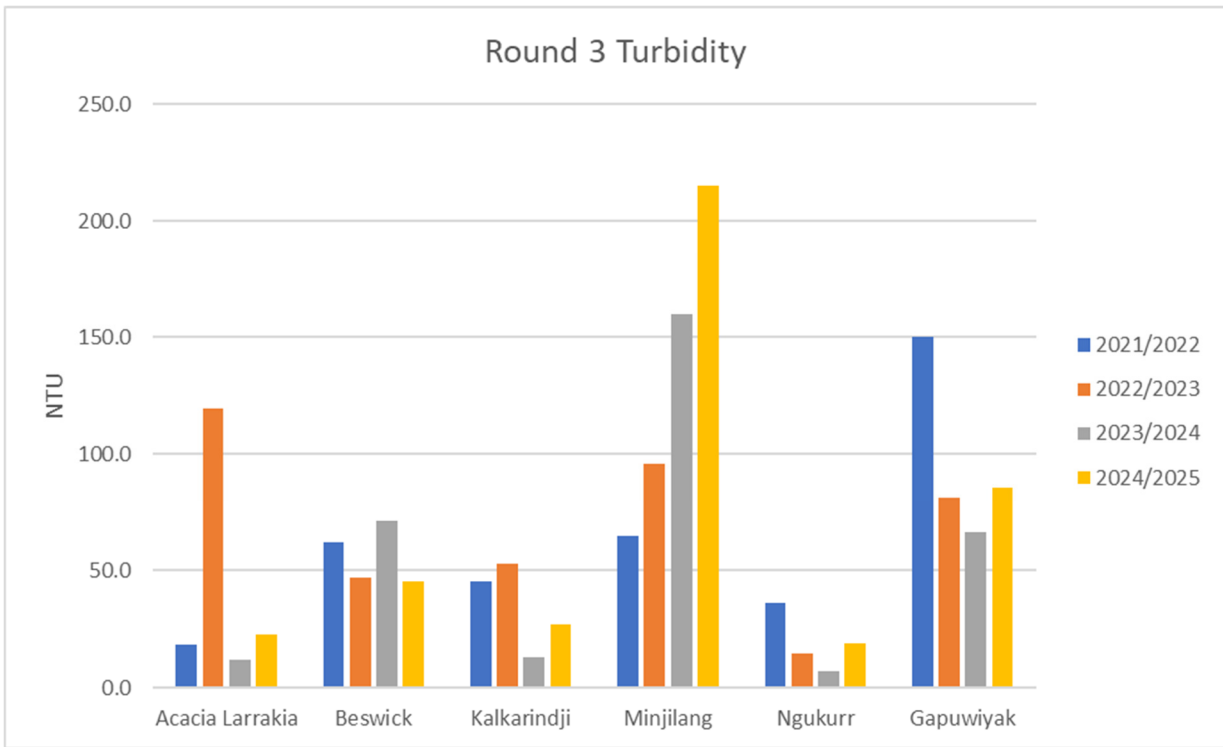


Figure 32. Round 3 Median Turbidity (NTU) (2021-2025).

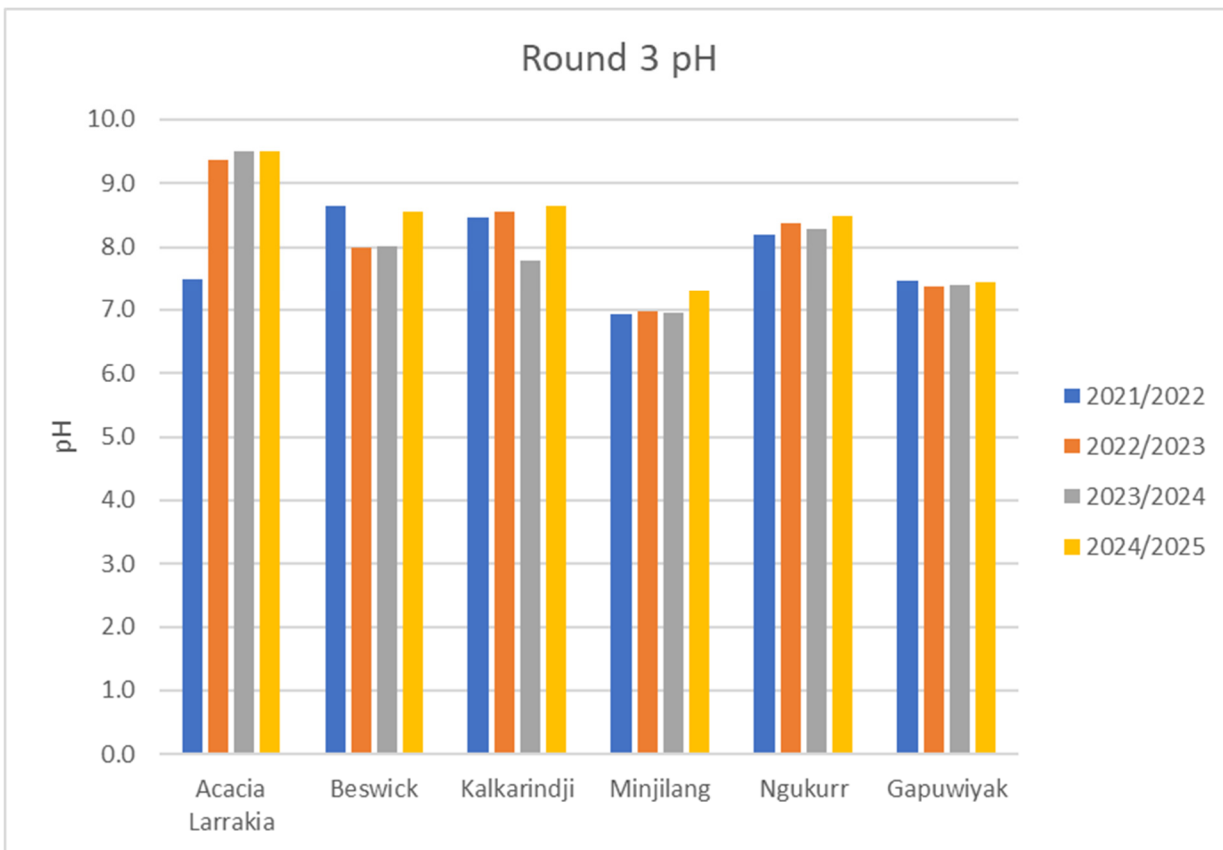


Figure 33. Round 3 Median pH (2021-2025).

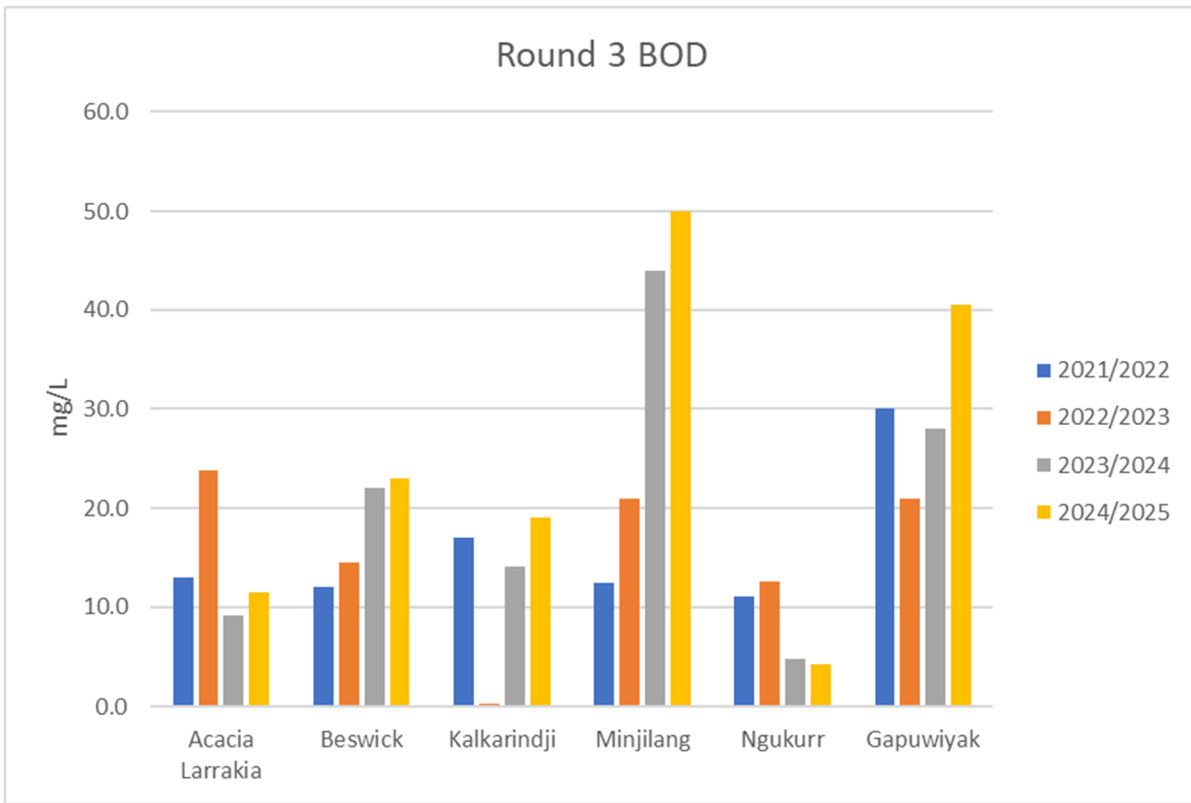


Figure 34. Round 3 Median Biochemical Oxygen Demand (2021-2025).

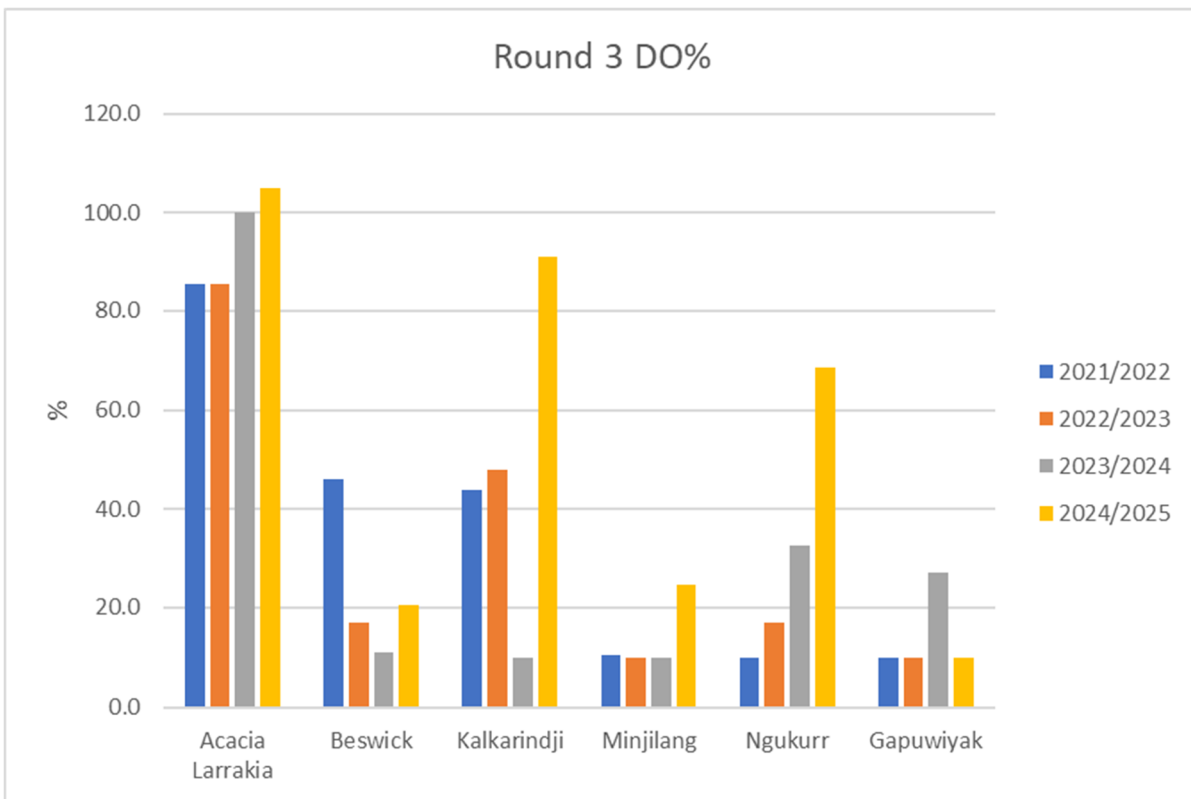


Figure 35. Round 3 Dissolved Oxygen Saturation (DO%) (2021-2025).

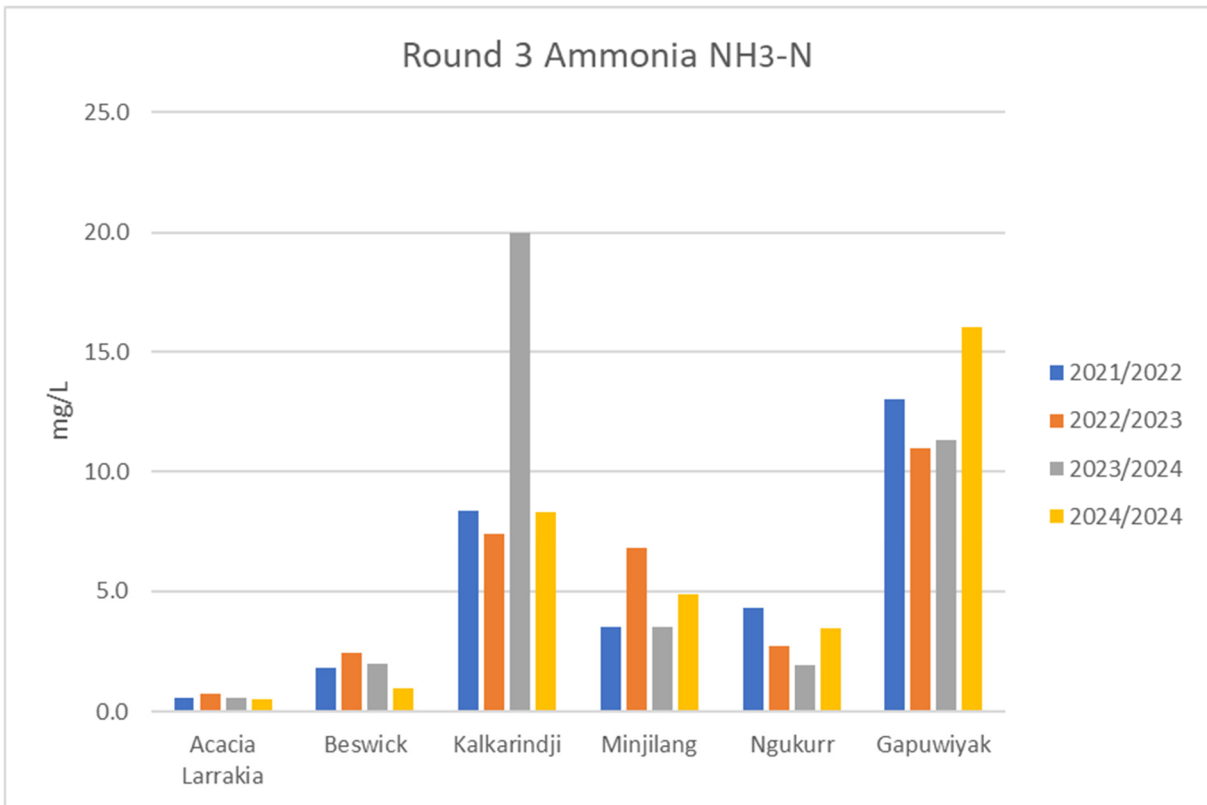


Figure 36. Round 3 Median Ammonia (NH<sub>3</sub>-N) (2021-2025).

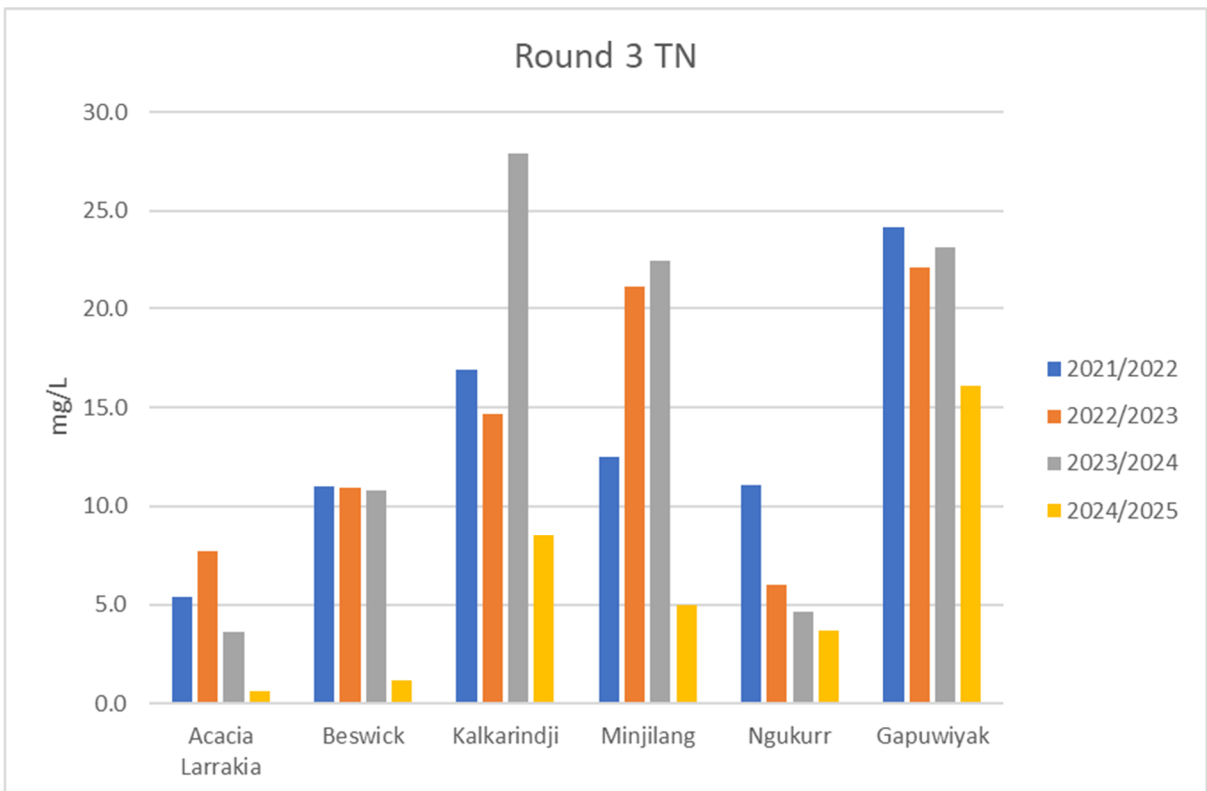


Figure 37. Round 3 Median Total Nitrogen (2021-2025).

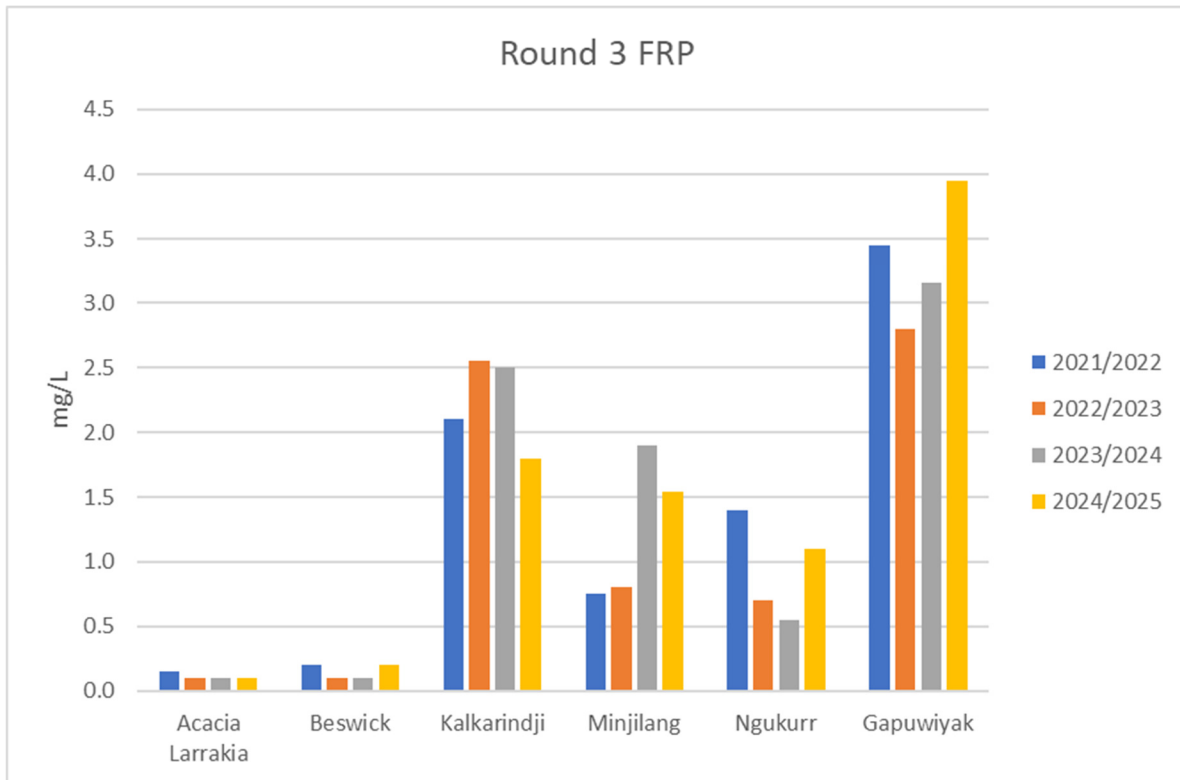


Figure 38. Round 3 Median Filterable Reactive Phosphorus (2021-2025).

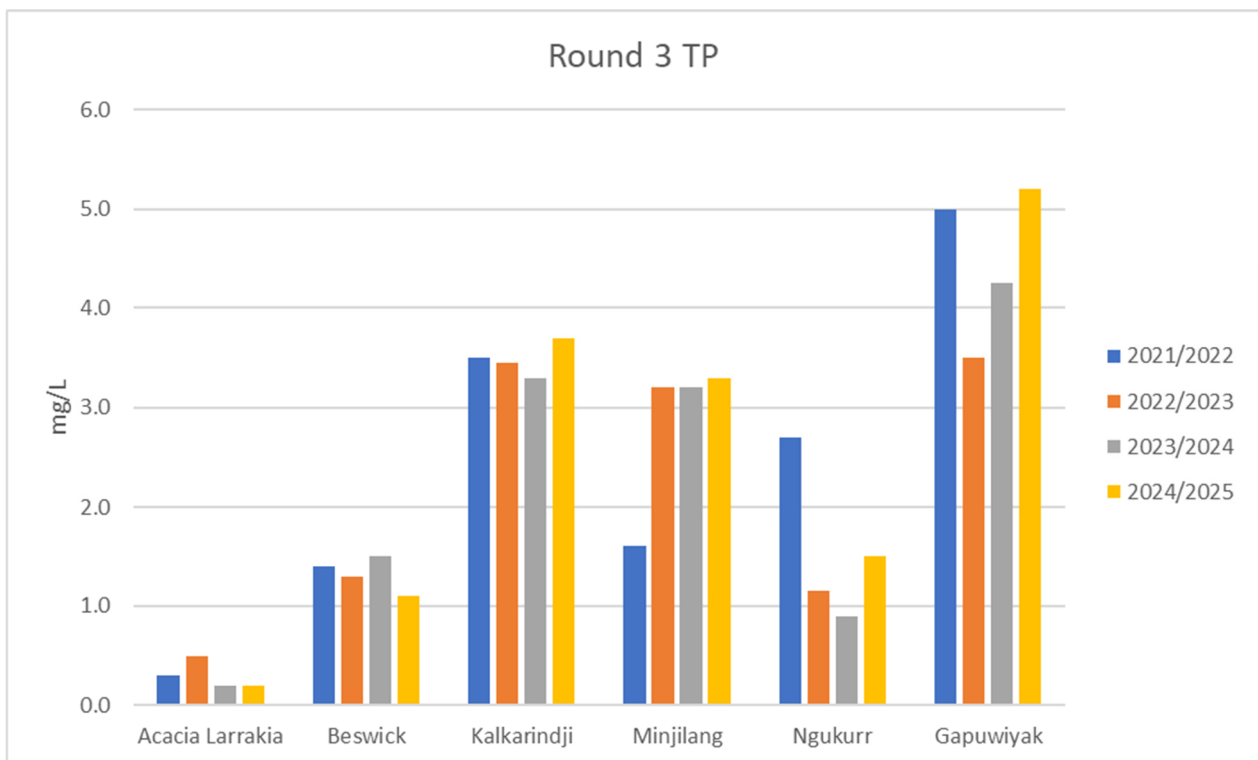


Figure 39. Round 3 Median Total Phosphorus (2021-2025).

# Appendix B – Belyuen Monitoring Results Graphs

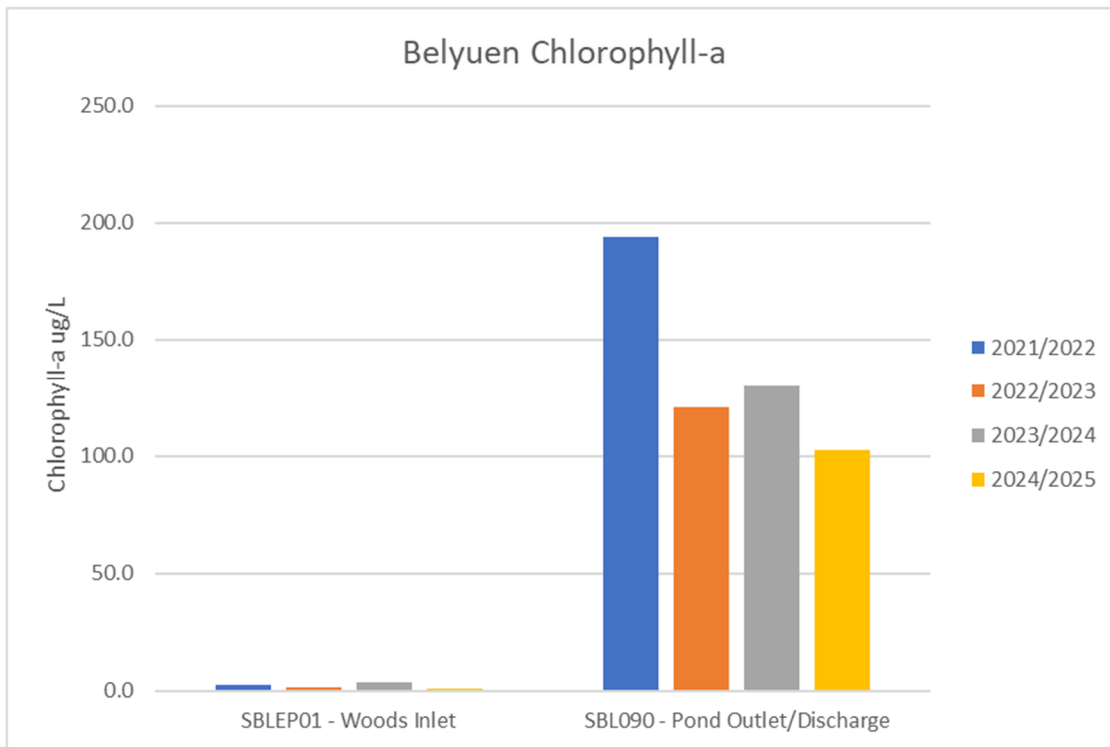


Figure 40. Belyuen Median Chlorophyll-a (2021-2025).

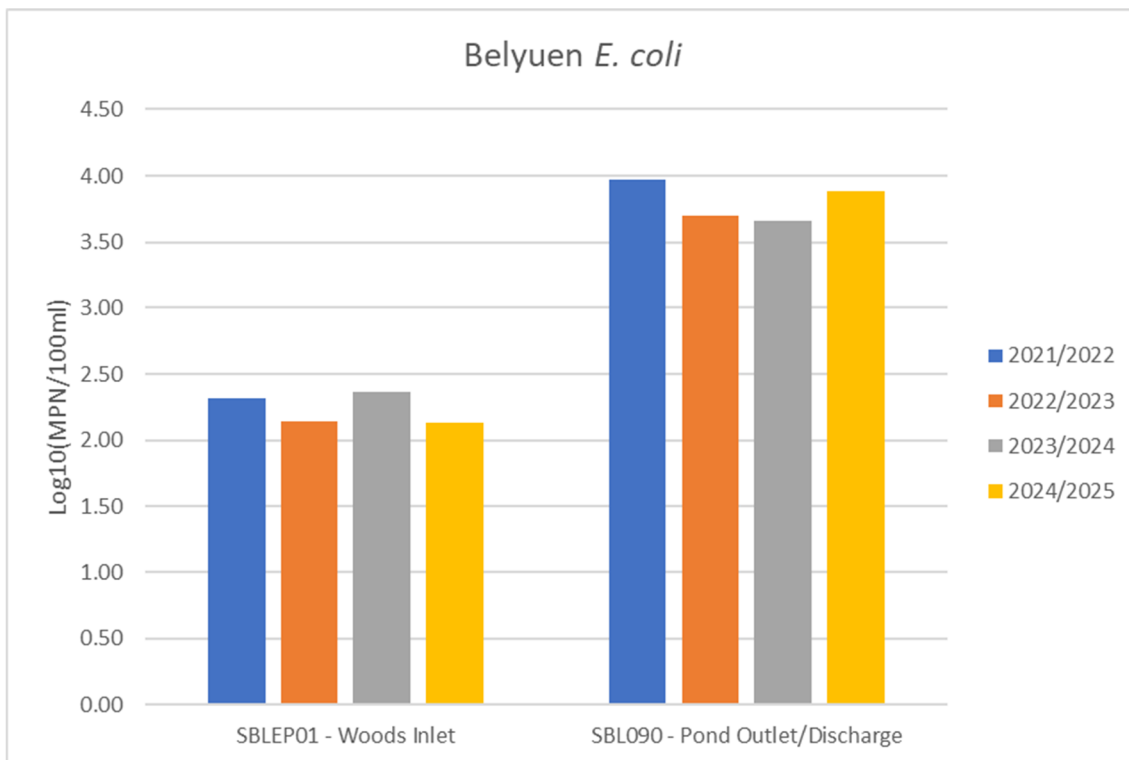


Figure 41. Belyuen E. Coli Log10(MPN/100ml) (2021-2025).

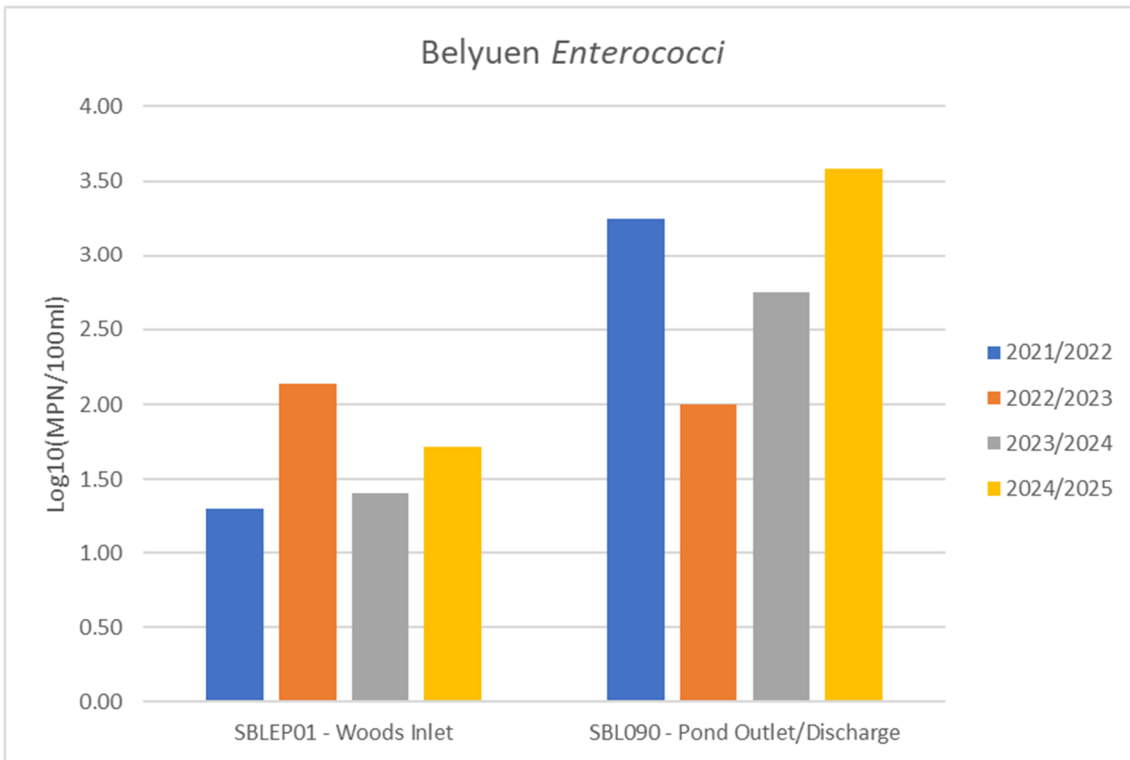


Figure 42. Belyuen Enterococci Log10(MPN/100ml) (2021-2025).

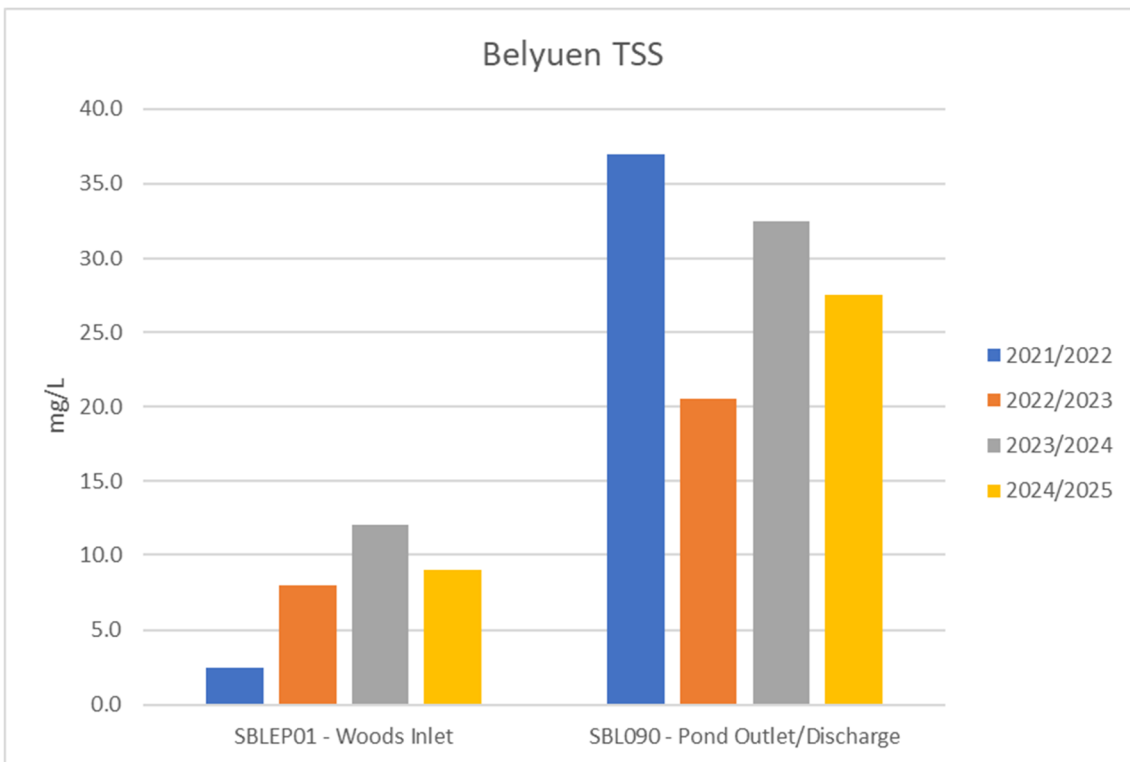


Figure 43. Belyuen Median Total Suspended Solids (2021-2025).

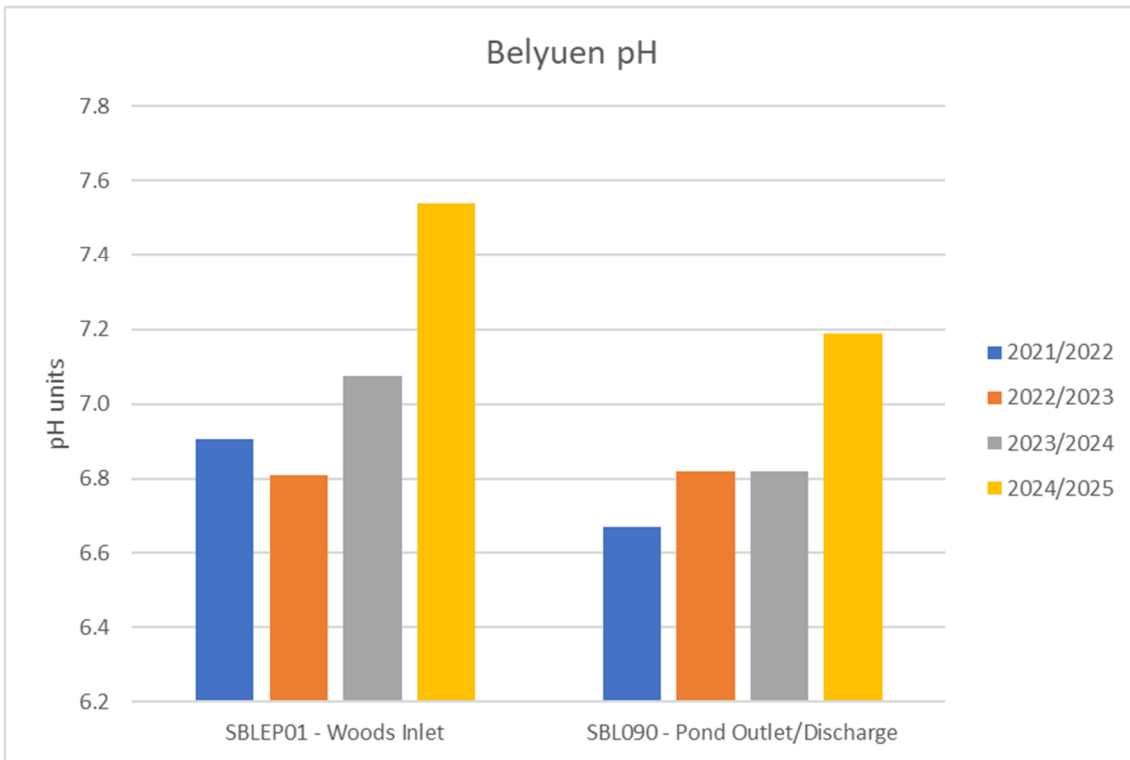


Figure 44. Belyuen Median pH units (2021-2025).

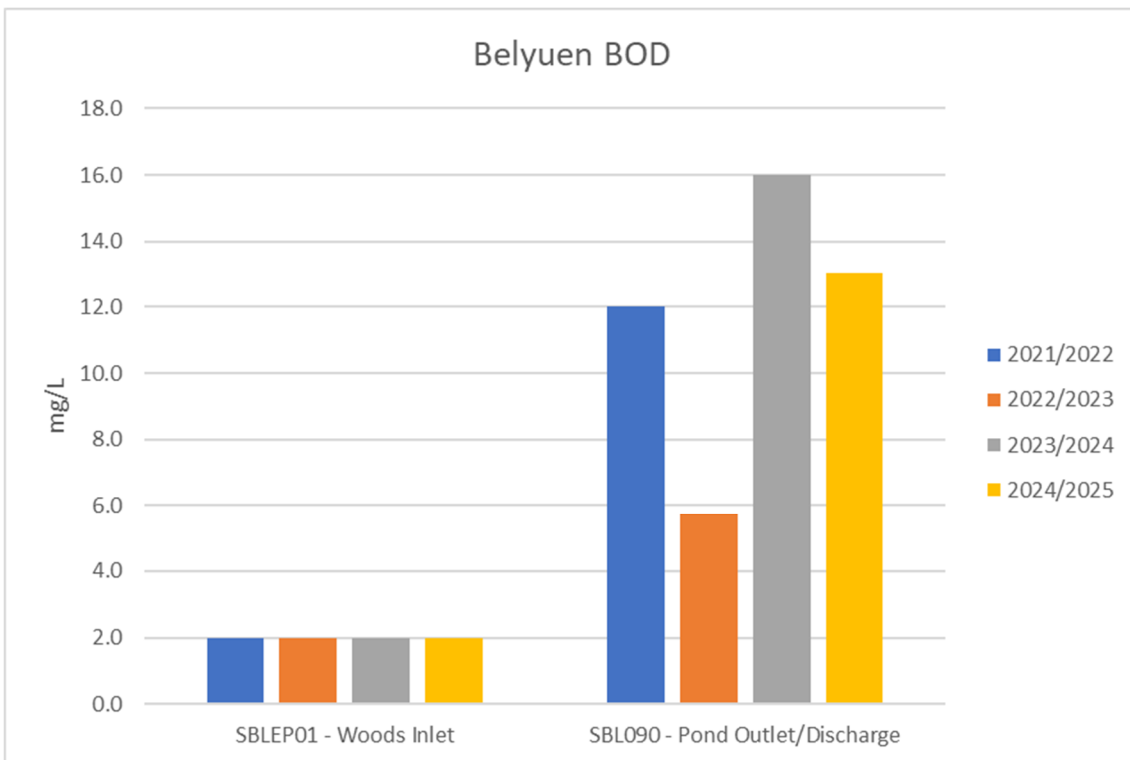


Figure 45. Belyuen Median Biochemical Oxygen Demand (2021-2025).

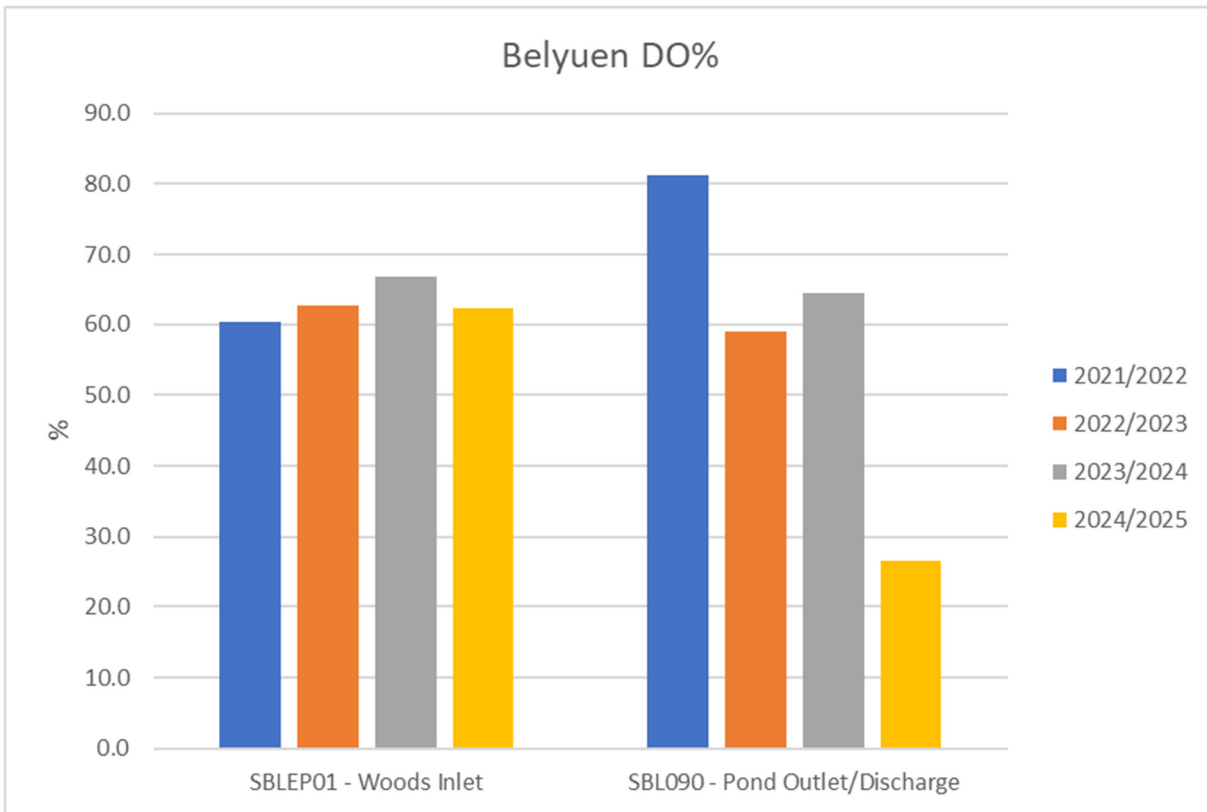


Figure 46. Dissolved Oxygen Saturation (DO%) (2021-2025).

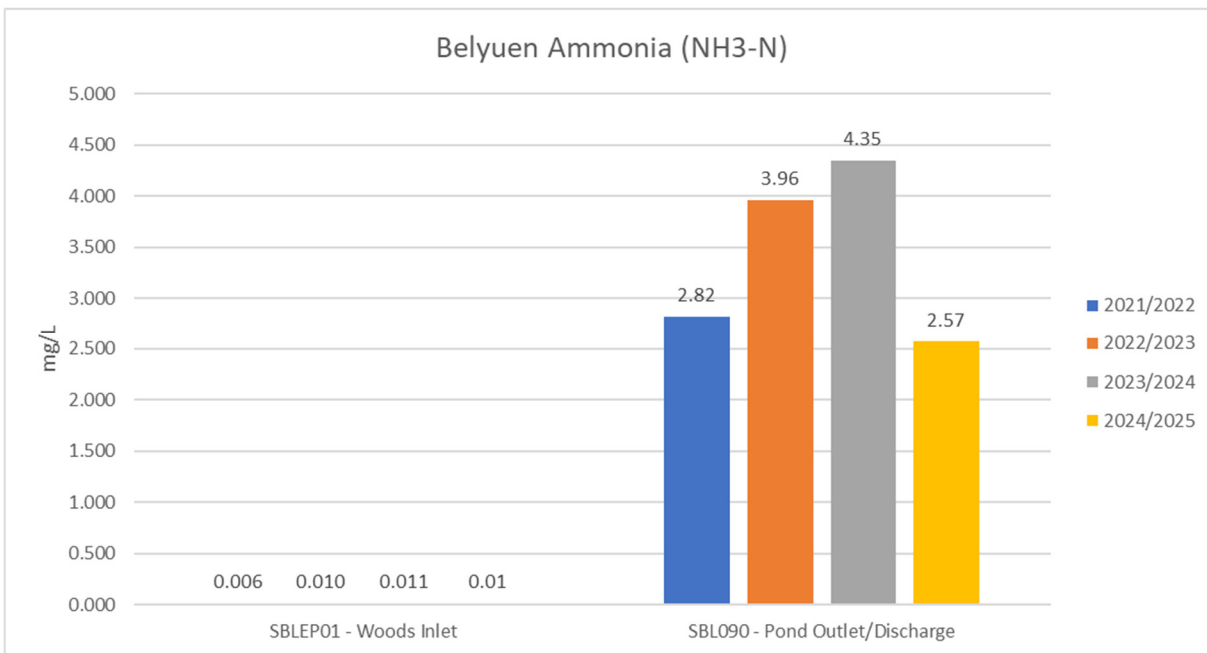


Figure 47. Belyuen Median Ammonia (NH<sub>3</sub>-N) (2021-2025).

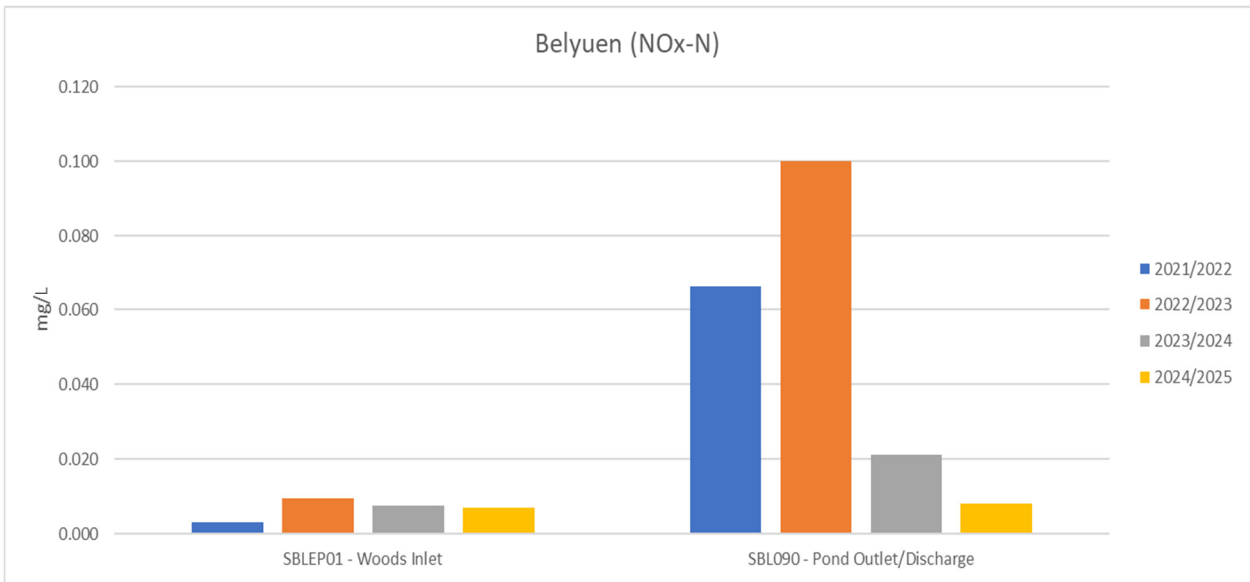


Figure 48. Belyuen Median Oxidised Nitrogen (NOx-N) (2021-2025).

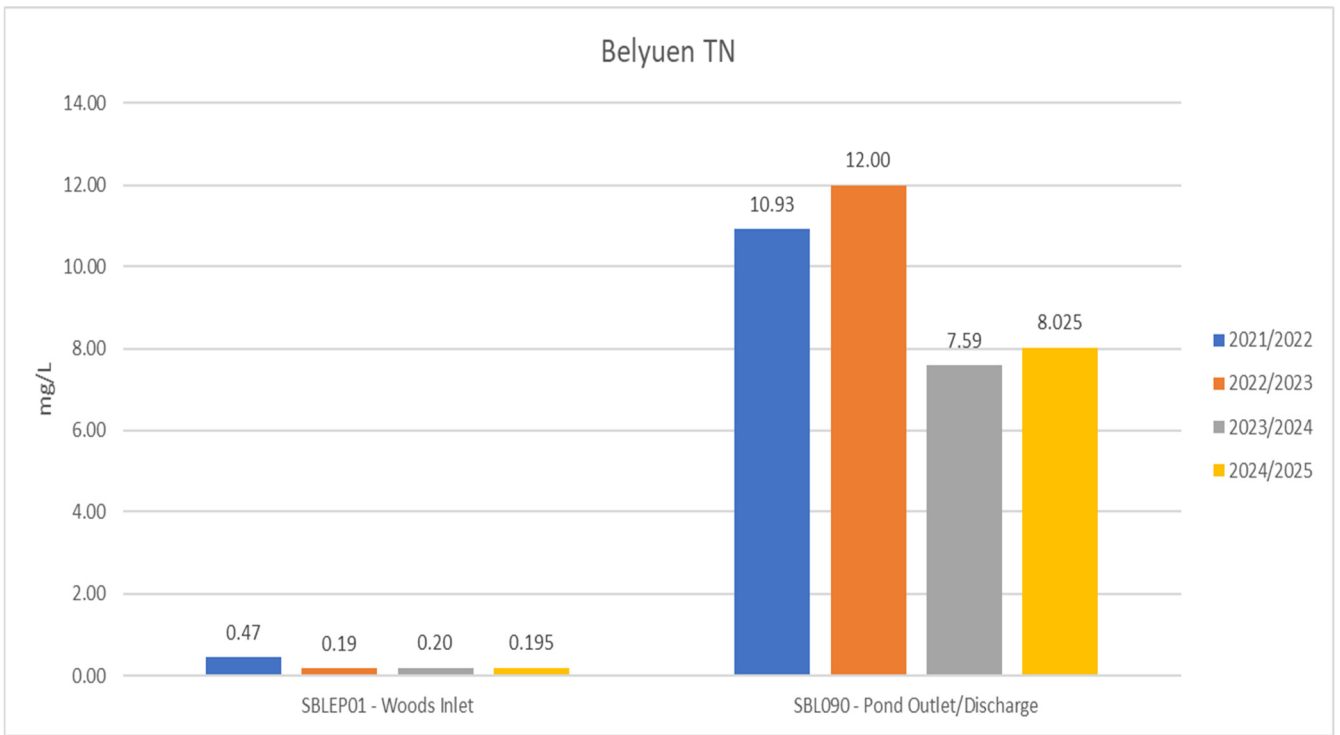


Figure 49. Belyuen Median Total Nitrogen (2021-2025).

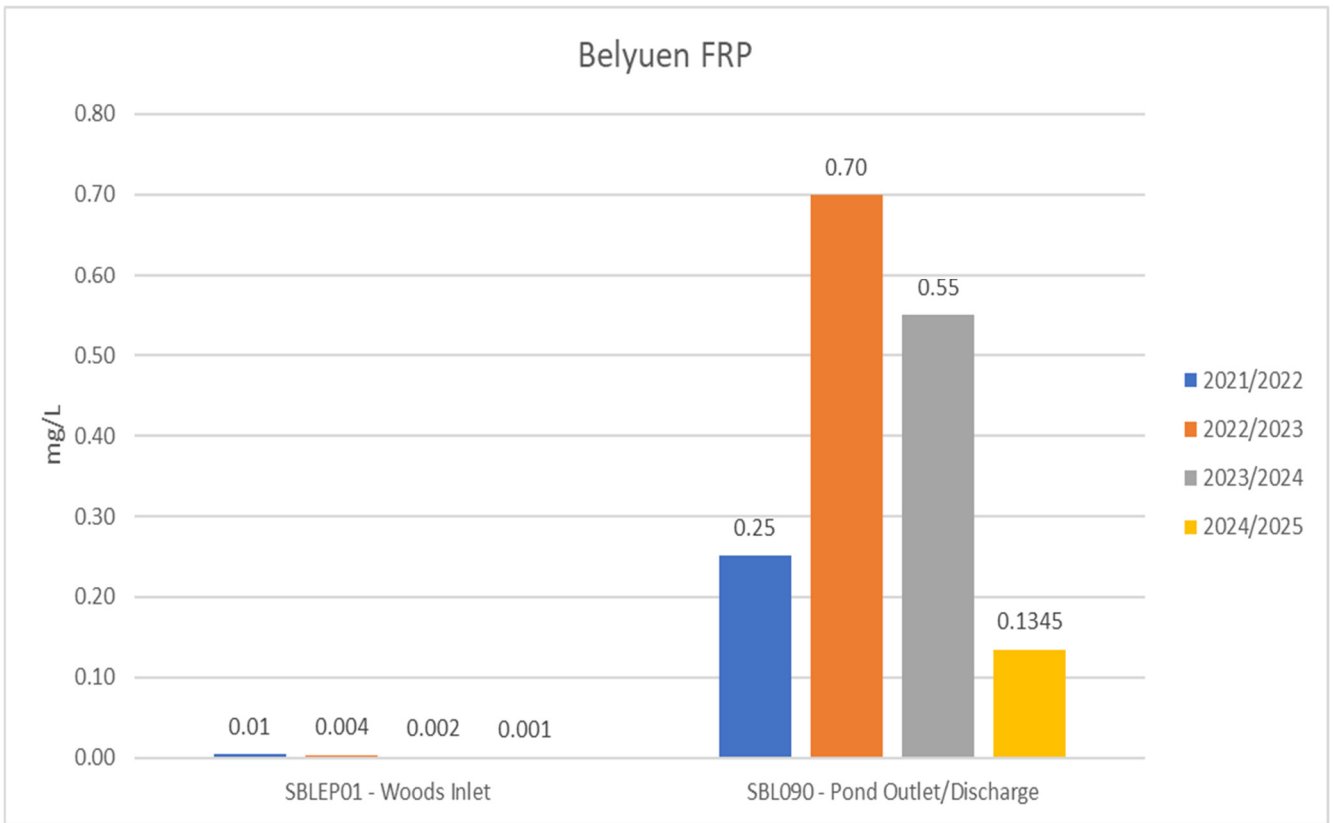


Figure 50. Belyuen Median Filterable Reactive Phosphorus (2021-2025).

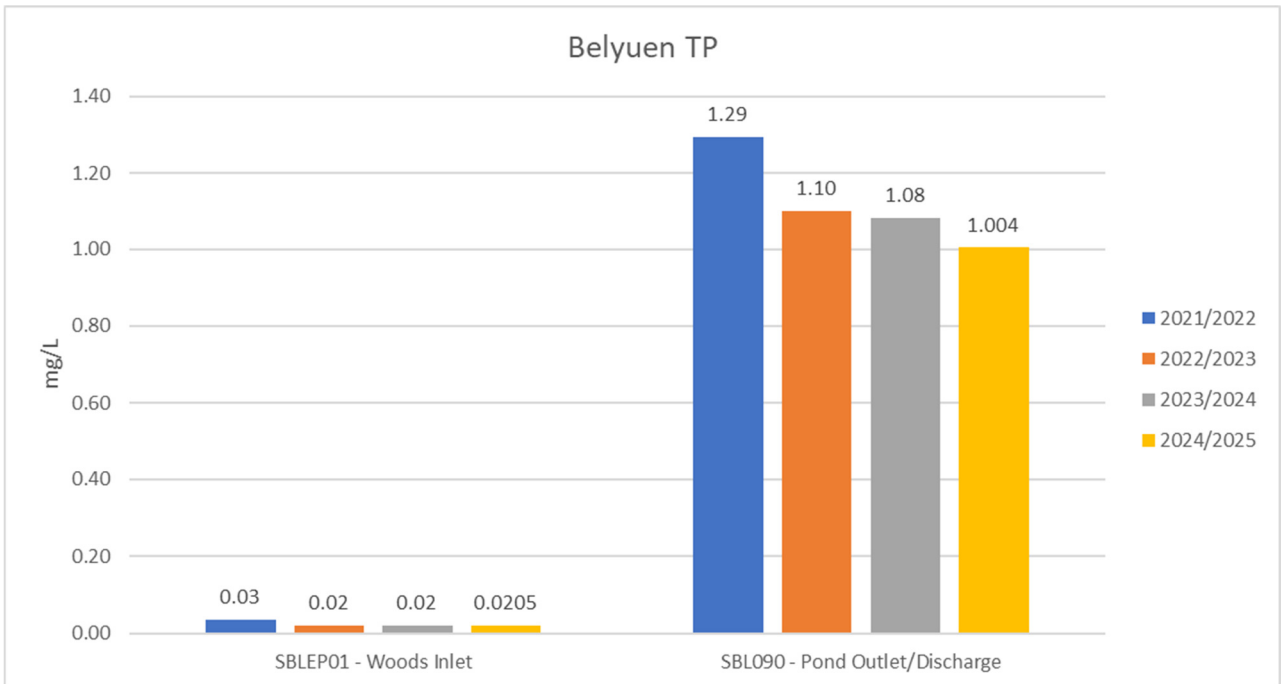


Figure 51. Belyuen Median Total Phosphorus (2021-2025).

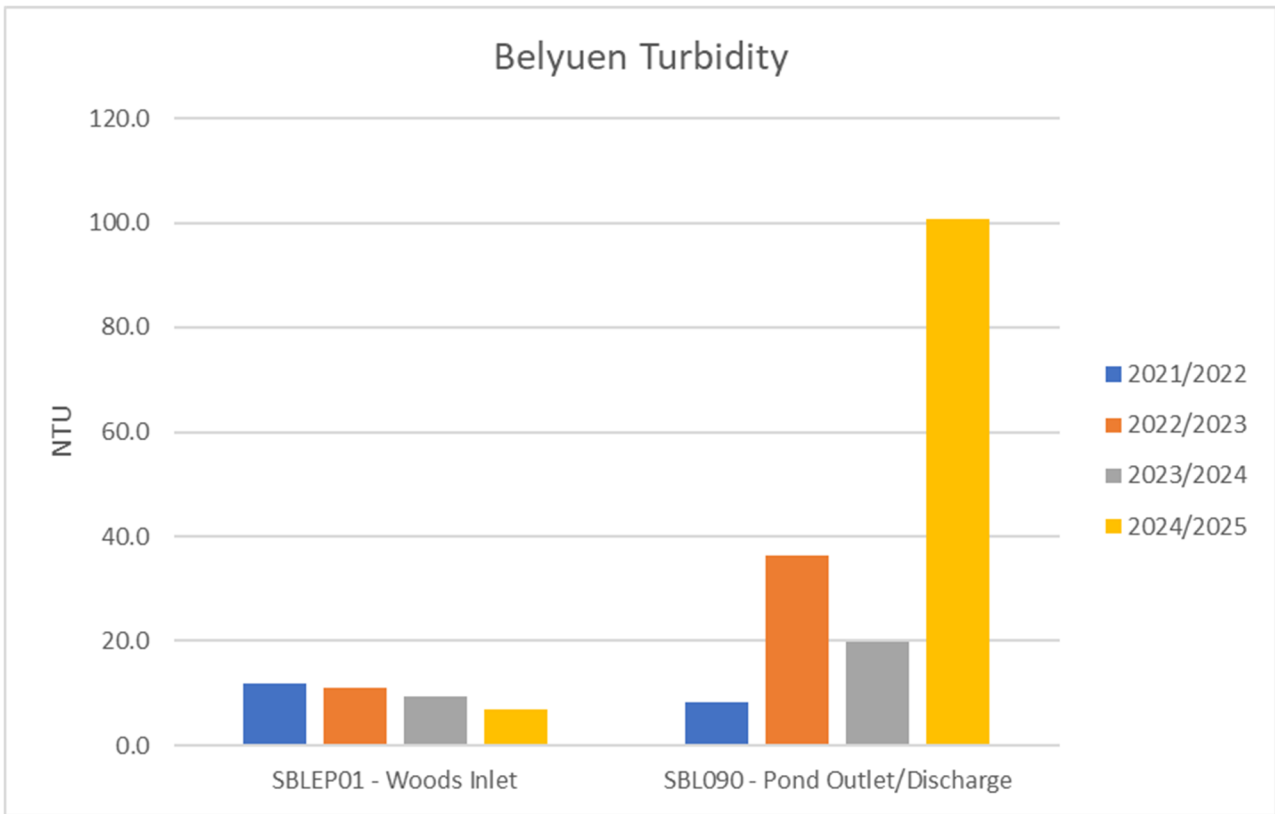


Figure 52. Belyuen Median Turbidity (2021-2025).

# Appendix C – List of Remote Communities with WDL

Table 4. List of Remote Communities with Waste Discharge Licences.

Remote Community	WDL	Monitoring Point Site	Licence Expiry
<b>Round 1</b>			
Galiwinku	202	SGA090	11/07/2028
Maningrida	203	SMN090	11/07/2028
Yirrkala	204	SYI090	11/07/2028
Wadeye East	205	SWA090	11/07/2028
Ramingining	206	SRA090	11/07/2028
Naiyu	207	SNN090	11/07/2028
Milingimbi	208	SML090	11/07/2028
<b>Round 2</b>			
Barunga	214	SBR090	30/05/2034
Belyuen	215	SBLEP01/SBL090	30/05/2034
Gunbalunya	216	SOE090	30/05/2034
Milikapiti	217	SMI090	30/05/2034
Numbulwar	218	SNU090	30/05/2034
Peppimenarti	220	SPE090	30/05/2034
Pirlangimpi	221	SPI090	30/05/2034
Waruwi	222	SWR090	30/05/2034
Wurrumiyanga	223	SNG090	30/05/2034
<b>Round 3</b>			
Acacia Larrakia	225	SAK090	11/12/2031
Beswick (Wugularr)	228	SBW090	11/12/2031
Gapuwiyak	230	SGW090	11/12/2031
Kalkarindji	231	SKJ090	11/12/2031
Minjilang	233	SMJ090	11/12/2031
Ngukurr	234	SNK090	18/12/2031

# Appendix D – Tabulation of Monitoring Results – Treated Effluent

Table 5. Remote Community WDL Summary of Data.

POWER AND WATER CORPORATION WDL Monitoring Report – Remote Community WDLs		
<b>Remote Community WDL Summary Data Sheet</b>	<p>All samples collected are in accordance with the conditions of the WDL's.</p> <p>Data is extracted from the PWC water quality database for assessment and filed on the PWC records management system.</p> <p>A tabulated summary of all year's wastewater monitoring data for remote community WDLs is completed and provided as Appendix D, attached as an Excel file format to the submission of this annual monitoring report.</p>	<p>Internal document number</p> <p>D2025/174226</p>

## Contact

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**PowerWater** 