MONITORING REPORT 2023-2024

Remote Community Waste Discharge Licences Waste Stabilisation Ponds

PowerWater

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Document History

Document Title:	Monitoring Report 2024 - Remote Community Waste Discharge Licences		
TRIM Container:	F2016/1529	Document #	D2024/286051

Version:	**Date Prepared:**	**Prepared by:**	**Version reviewed by/Issued to:**
Draft 0.1	29/05/2020	Emma Fakes Power and Water Corporation	Jessica Huxley Simon Ruckenstuhl Dianne Rose Power and Water Corporation
Final 1.0	23/07/2020	Remote Water Planning	Department of Environment and Natural Resources Northern Territory Government waste@nt.gov.au
Draft 0.2	16/06/2021	Emma Fakes Power and Water Corporation	Simon Ruckenstuhl Power and Water Corporation
Final 2.0	26/07/2021	Remote Water Planning	Department of Environment, Parks and Water Security Northern Territory Government waste@nt.gov.au
Draft 0.3	29/03/2022	Emma Fakes Power and Water Corporation	Tahlia Kemp Power and Water Corporation
Final 3.0	26/07/2022	Water Services	Department of Environment, Parks and Water Security Northern Territory Government waste@nt.gov.au
Draft 0.4	19/06/2023	Lenin Villamar Power and Water Corporation	Oliver Crick & Tahlia Kemp Power and Water Corporation
Final 4.0	27/07/2023	Lenin Villamar Power and Water Corporation	Department of Environment, Parks and Water Security Northern Territory Government waste@nt.gov.au
Draft 0.5	29/07/2024	Lenin Villamar Power and Water Corporation	Ashley Beagley and Mark Rodriguez Power and Water Corporation
Final 5.0	31/07/2024	Lenin Villamar Power and Water Corporation	Department of Environment, Parks, and Water Security Northern Territory Government waste@nt.gov.au
Revised 5.1	21/08/2024	Lenin Villamar Power and Water Corporation	Department of Environment, Parks, and Water Security Northern Territory Government waste@nt.gov.au

Table 1. Document History

Glossary

Abbreviation	Definition
ANZECC	Australian and New Zealand Environment and Conservation Council
BOD	Biochemical oxygen demand
Chl-a	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
DEPWS	Department of Environment, Parks and Water Security
DHWQO(s)	Darwin Harbour water quality objective(s)
DO	Dissolved oxygen
EC	Electrical conductivity
E. coli	*Escherichia coli*
EP	Equivalent population
ET	Equivalent tenement - calculation utilised in remote communities for an average residential dwelling or house (Indigenous Community Engineering Guidelines 2017)
ERA	Environmental risk assessment
FRP	Filterable reactive phosphorous (orthophosphate)
kL	Kilolitres
LOR	Limit of reporting for chemical analysis
µg	Micrograms
mg	Milligrams
ML	Mega litres
N	Nitrogen
NH_3-N	Total ammonia as N (NH_3 and $NH4^+$ as N) as per ANZECC and ARMCANZ (2000)
NO_X-N	Oxidised nitrogen as N – the sum of nitrate and nitrite
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority

Abbreviation	Definition
NTU	Nephelometric Turbidity Unit
PWC	Power and Water Corporation
RL(s)	Reporting Limit(s)
RM	Rolling Median – of all years of available data; utilised in absence of adequate datasets.
SSTV	Site Specific Trigger Values
TN	Total nitrogen
TP	Total phosphorous
TSS	Total suspended solids
WDL(s)	Waste discharge licence(s)
WSP(s)	Waste stabilisation pond(s)

Table 2. Glossary

Executive Summary

The 2023-2024 Monitoring Report for Remote Community Waste Discharge Licences (WDLs) by the Power and Water Corporation presents an overview of compliance and environmental assessments for 22 remote Indigenous communities. The report adheres to NT EPA guidelines, providing analysis of water quality monitoring data, discharge volumes, and environmental assessment from 2021 to 2024.

Water quality parameters monitored include chlorophyll-a, E. coli, Enterococci, Total Suspended Solids (TSS), pH, 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 populations 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 indicate no immediate deleterious effects from wastewater discharges, with healthy waterways and no observed impacts on aquatic life or vegetation. The report concludes that WSPs in remote Indigenous communities effectively manage wastewater discharge, ensuring regulatory compliance and minimal environmental impact. Continuous monitoring and data analysis are essential for maintaining this balance and maintaining compliant operational performance. The report provides a useful reference for future environmental risk assessments and highlights the importance of adapting management practices to local needs and environmental conditions.

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 authorized 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 at least three years.
- Assessment of environmental impact from the activity.

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

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 2024.
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 3 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.

Table 3. Monitoring Report Requirements

Background and Objective

Program Overview

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

Wastewater Stabilization 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 minimal maintenance and solar energy reliance.

Licensing and Risk Ranking

- Issued by DEPWS: 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.
  - Minimize environmental impact and public health risks.
  - Understand operational performance for maintenance and improvements.
- Data Coverage: Data from July 2021 to June 2024.
- 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.

Region	Weather Station Number	Total annual rainfall per year (mm)				Annual Average
		2020/2021	2021/2022	2022/2023	2023/2024	All years
Darwin	14163	1833	1648.4	1811	1534.4	1706.7
Katherine	14902	1207.3	686.5	955.8	815.3	916.2
Maningrida	14405	1381	1276.4	1476	889.4	1255.7
Wagait	14238	1840.4	1318.4	1231.4	1830.9	1555.3

Table 4. Rainfall Data (BOM, 2024)

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. Furthermore, 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 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.
    - Despite adherence to rigorous 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 are typically presented as annual median values to align with ANZECC Guidelines and provide a consistent basis for evaluating long-term trends.
    - Special attention is given to outliers and data anomalies to ensure they do not skew the overall data interpretation, with 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 dependable and reflective of environmental conditions.
5. **Variability in Treatment Facility Design**:
    - Variations in the design and operation of wastewater stabilization 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 are crucial for a good interpretation of the monitoring results. They help maintain the integrity of the environmental monitoring process and ensure that conclusions drawn from the data are well-founded.

Monitoring Results and Discussion

The Remote WDL Monitoring Report, covering July 2021 to June 2024, 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 3-year range to allow meaningful comparisons and analysis.

2. **Seasonal Influence and Weather Data**:
   - The report compares Belyuen's monitoring data with the 2023-2024 monthly weather data from the Wagait Beach BOM weather station, located 13 km north of the monitoring point.
   - This integration allows examination of correlations between monitoring results and seasonal weather conditions.
3. **Analysis**:
   - By considering seasonal variations and weather data, the report offers an analysis 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 Stabilization Ponds (WSPs) align with the low equivalent populations (EP) or equivalent tenements at these sites. Key points include:

1. **Equivalent Population (discharge flows)**:
   - Equivalent Population 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.

Community	Population (BushTel)	Estimated Average Daily Discharge KL/Day
Acacia Larrakia	35	0
Barunga	396	125.8
Belyuen	175	47
Beswick	636	156.5
Daly River (Nauiyu)	411	112.9
Galiwinku	2582	823.8
Gapuwiyak	828	251.5
Gunbalunya (Oenpelli)	1354	436.7
Kalkarindji	10	0
Maningrida	2956	815.4

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
Warruwi	507	157.4
Wurrumiyanga (Nguiu)	1668	516.4
Yirrkala	771	194.4

Table 5. EP/ET - Estimated Average Daily Discharge KL/Day (Population data - BushTel)

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 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.
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 equipment malfunctions, human error, or environmental factors. In these cases, alternative estimation methods are used.

    Estimation Methods:

    - **Discharge Volume Estimates:** For sites lacking reliable measured data (*) (Figure 1), flow volumes are estimated based on Equivalent Population (EP) and Equivalent Tenement (ET) calculations. This method uses 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 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.

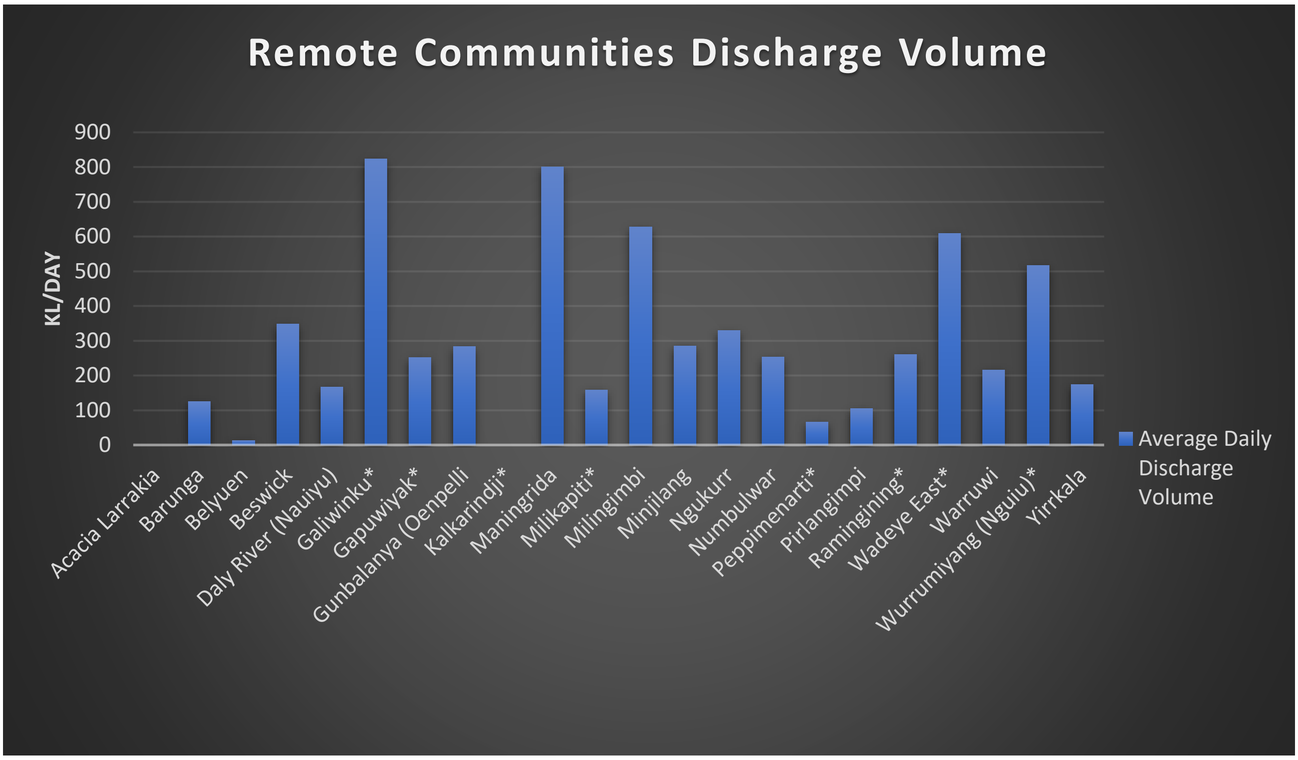

Figure 1. Remote Communities Discharge Volume (- Estimated discharge volumes).*

Water Quality Data

The graphs at Appendix A illustrate various water quality parameters across multiple locations for the period from 2021 to 2024. 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.

Here are the water quality data presentation description:

E. coli and Enterococci

Log10 transformation converts data to a logarithmic scale, which is particularly useful for handling highly variable datasets like *E. coli and Enterococci* 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 and Enterococci* counts improves clarity and interpretability, allowing for better visualization 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.

pH

pH is a key water quality parameter in sewage pond discharges, crucial for both the effectiveness of treatment processes and the protection of the receiving environment. The pH level influences microbial activity, chemical reactions, and the toxicity of various substances in the water.

Chlorophyll-a

Chlorophyll-a levels are an indicator of algae and phytoplankton. Elevated levels suggest increased nutrient inputs.

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 from this section.

Round 1

- **Galiwinku:** Shows moderate levels across most parameters, with a notable increase in DO% in 2023/2024 monitoring period.
- **Milingimbi:** Exhibits elevated chlorophyll-a and nutrient levels, with consistent BOD and *E. coli* levels.
- **Maningrida:** Displays stable nutrient levels, with slight increases in TSS and turbidity over the years.
- **Nauiyu:** Shows elevated levels of ammonia and phosphorus, which correlate with the trend in chlorophyll-a levels.
- **Ramingining:** Observable elevated chlorophyll-a and BOD levels, with corresponding nutrient concentrations trend.
- **Wadeye:** Exhibits moderate levels across most parameters, with slight increases in nutrient levels and chlorophyll-a.
- **Yirrkala:** Shows elevated and consistent nutrient levels, with corresponding elevated chlorophyll-a and BOD.

Round 2

- **Barunga:** Shows elevated TSS and BOD levels, with fluctuations in DO%.
- **Peppimenarti:** Exhibits moderate levels across most parameters, with slight increases in nutrient levels.
- **Nguiu:** Displays elevated turbidity and moderate nutrient levels.
- **Numbulwar:** Shows stable nutrient levels, with slight increases in TSS and turbidity.

- **Oenpelli:** Exhibits elevated levels across most parameters, indicating significant nutrient and organic inputs.
- **Pirlangimpi:** Shows elevated ammonia and moderate phosphorus levels.
- **Warruwi:** Displays elevated FRP, TP, and TN levels, indicating significant nutrient inputs.
- **Milikapiti:** Shows elevated TSS and moderate nutrient levels.

Round 3

- **Acacia Larrakia:** Shows elevated TSS and BOD levels, with fluctuations in DO%.
- **Beswick:** Exhibits elevated chlorophyll-a and nutrient levels, indicating significant nutrient inputs.
- **Kalkarindji:** Displays a significant spike in chlorophyll-a in 2022/2023, with consistently elevated *E. coli* and nutrient levels.
- **Minjilang:** Shows elevated chlorophyll-a, TSS, and BOD levels, indicating nutrient and organic pollution.
- **Ngukurr:** Displays elevated TN and turbidity, with moderate levels of other parameters.
- **Gapuwiyak:** Exhibits consistently 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 2024, and the findings are summarized below:

1. Chlorophyll-a (Figure 44**)**

- **SBLEP01:** Consistently low levels across all years (2021/2022, 2022/2023, and 2023/2024).
- **SBL090:** Elevated levels in 2021/2022, with a decreasing trend in subsequent years.

2. *E. coli* (Figure 45**)**

- **SBLEP01:** Low levels, showing minor fluctuations across the years.
- **SBL090:** Elevated levels in all years, although there is a slight decrease in 2023/2024.

3. *Enterococci (*Figure 46***)***

- **SBLEP01**: Levels fluctuate moderately, potentially indicating variable inputs from wildlife or human sources.
- **SBL090**: Shows a peak in 2022/2023, due to specific events, followed by a decrease, suggesting resolution or effective intervention.

4. Ammonia (NH3-N) (Figure 39**)**

- **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.

5. NOx-N (Figure 52**)**

- **SBLEP01**: Consistently low, suggesting effective nitrogen management.
- **SBL090**: Elevated in 2022/2023, followed by a reduction, pointing to intermittent issues linked to specific discharges or treatment variations.

6. Total Nitrogen (TN) (Figure 53**)**

- **SBLEP01:** Low levels, with minor increases over the years.
- **SBL090:** Elevated levels, with the highest in 2022/2023, but showing a reduction in 2023/2024.

7. Filterable Reactive Phosphorus (FRP) (Figure 54**)**

- **SBLEP01:** Negligible levels.
- **SBL090:** Elevated in 2022/2023 and reduced in 2023/2024, demonstrating high phosphorus in the final pond, but minimal impact on the receiving environment.

8. Total Phosphorus (TP) (Figure 55**)**

- **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.

9. Total Suspended Solids (TSS) (Figure 47**)**

- **SBLEP01:** Low levels, with minor increases.
- **SBL090:** Elevated levels, peaking in 2023/2024, but still relatively low impact on the receiving environment.

10. Turbidity (Figure 56**)**

- **SBLEP01**: Experiences a significant spike in turbidity in conjunction with rainfall events, indicating surface runoff impacts.
- **SBL090**: Also shows elevated turbidity during specific periods, correlating with operational activities or storm events.

11. Dissolved Oxygen (DO%) (Figure 50**)**

- **SBLEP01:** Stable levels across all years, indicating good oxygenation.
- **SBL090:** Stable, reflecting adequate oxygen levels in the final pond.

12. pH (Figure 48**)**

- **SBLEP01:** Slightly alkaline and consistent.
- **SBL090:** More variable, significantly influence by annual climatic conditions.

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 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 Increase:** The increase in nutrients and turbidity at the receiving environment during initial rainfall events after dry periods suggests that runoff significantly contributes to these parameters.
- **Year-to-Year Variability:** Median values of results show fluctuations, with some parameters peaking in specific years. These variations are within acceptable levels of change.

The data highlights that the discharge from the final pond has a minimal 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. Visual observations through on-site visits have shown no immediate deleterious effects from wastewater discharges, indicating effective management of environmental risks. Waterways at the receiving sites appear healthy, with no observed impacts on fish, aquatic invertebrates, or surrounding vegetation.

Declaration of Accuracy

I, ***Lenin Aquino Villamar*** (Water and Wastewater Quality Officer, Power and Water Corporation), have created and 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.

Signature: ___________________________

Date: 19/08/2024

Appendix A - Monitoring Results Graph

Round 1

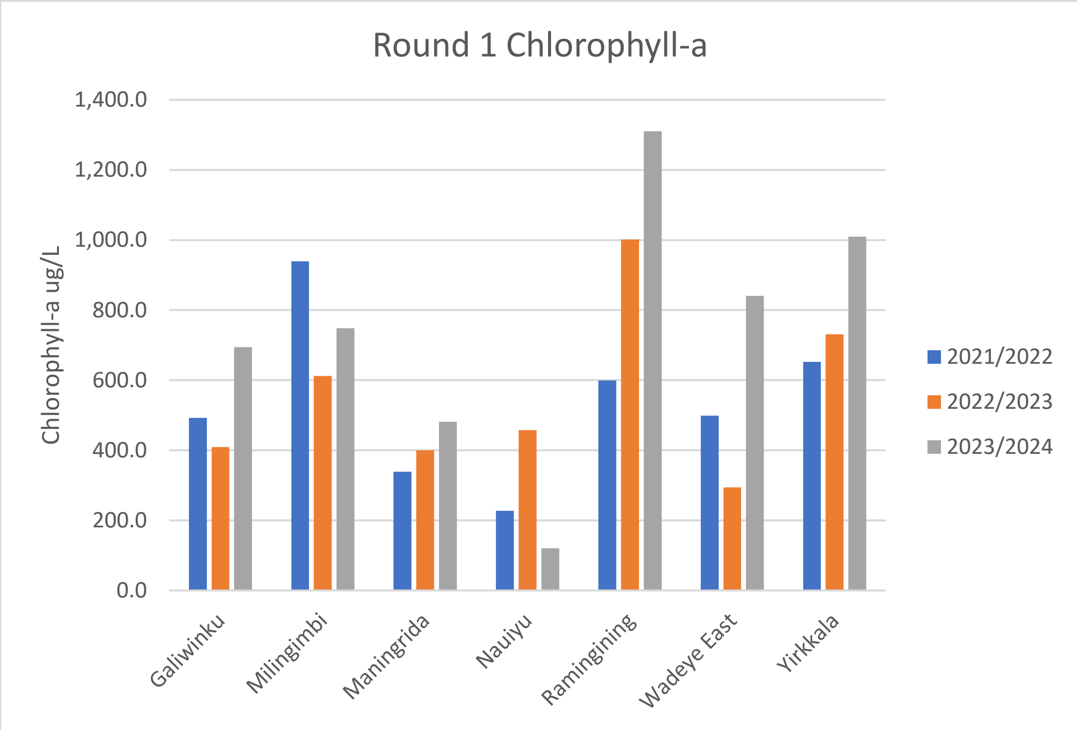

Figure 2. Round 1 Chlorophyll-a

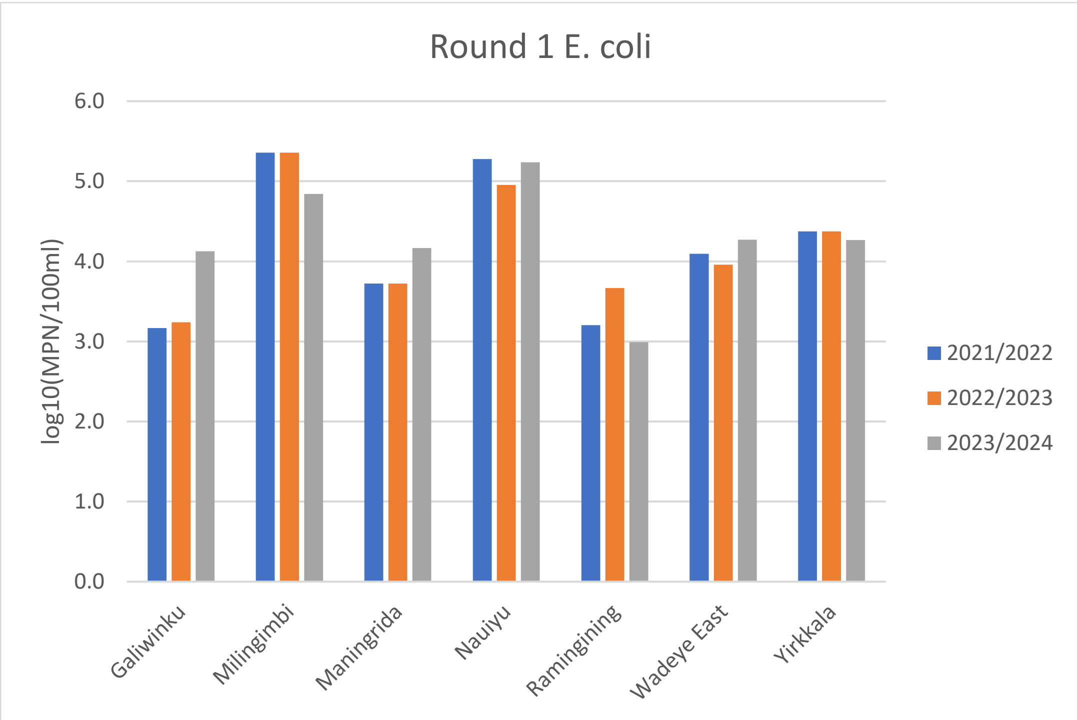

Figure 3. Round 1 E. coli $\log_{10}$(MPN/100ml)

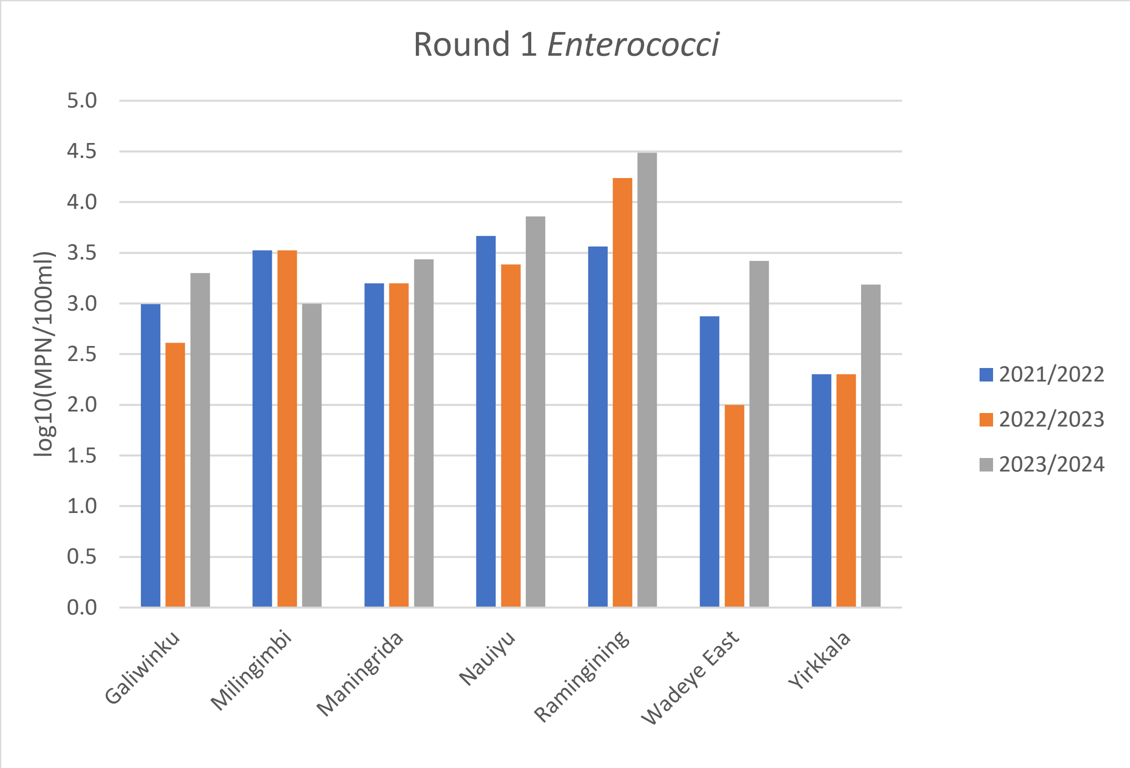

Figure 4. Round 1 Enterococci log10(MPN/100ml)

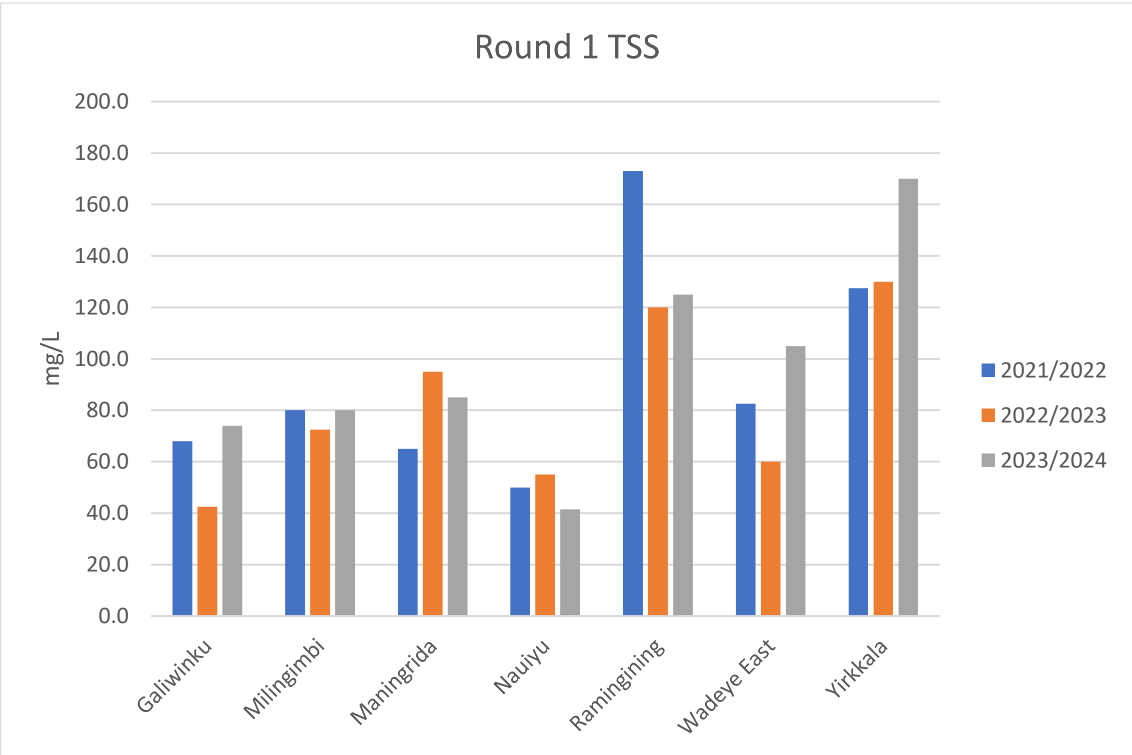

Figure 5. Round 1 Total Suspended Solids

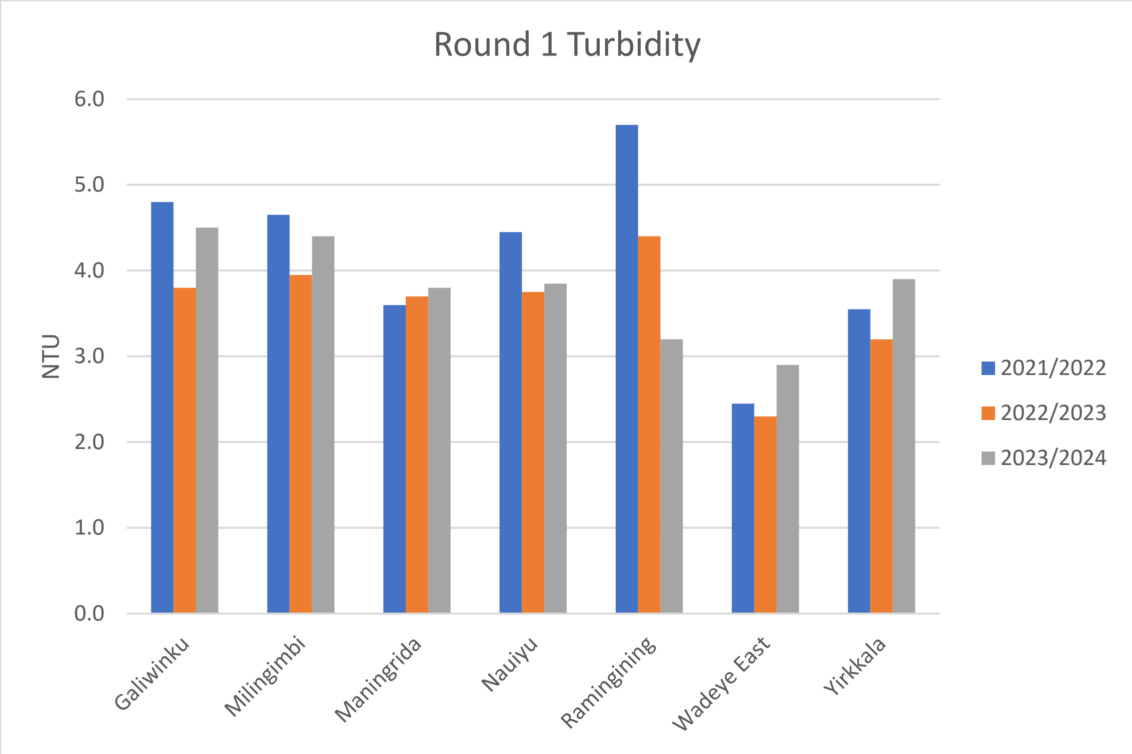

Figure 6. Round 1 Turbidity (NTU)

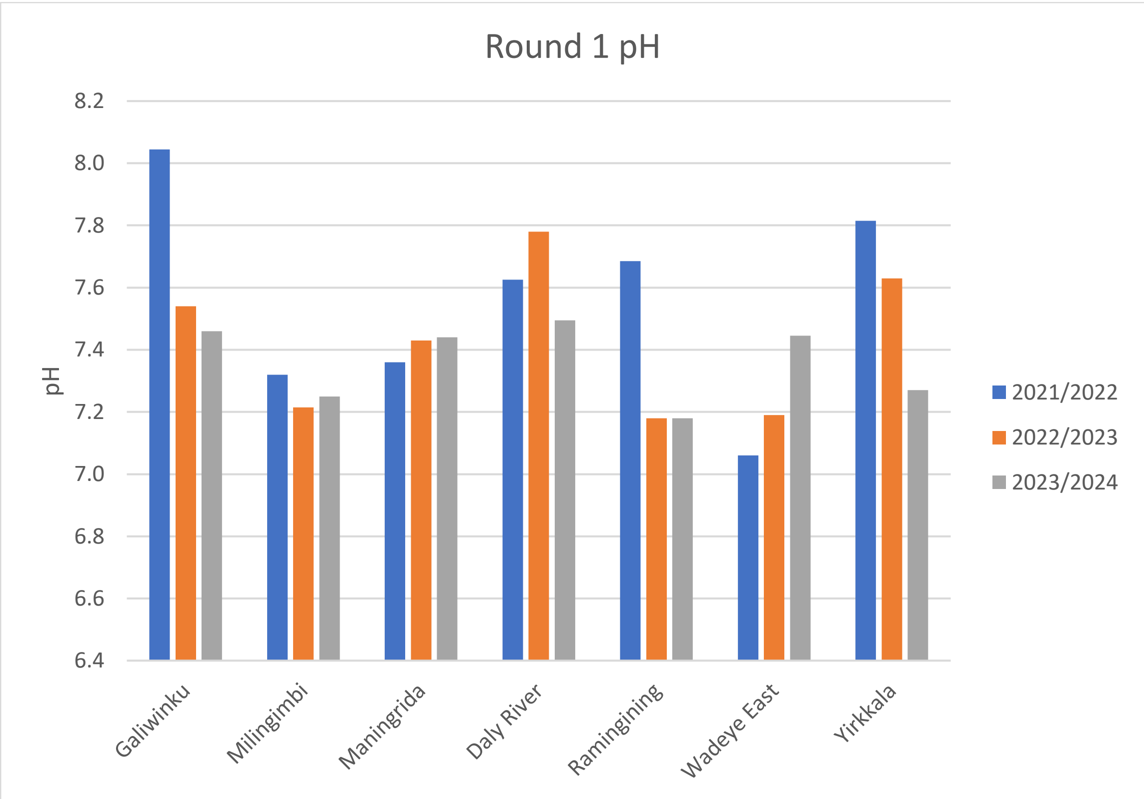

Figure 7. Round 1 pH

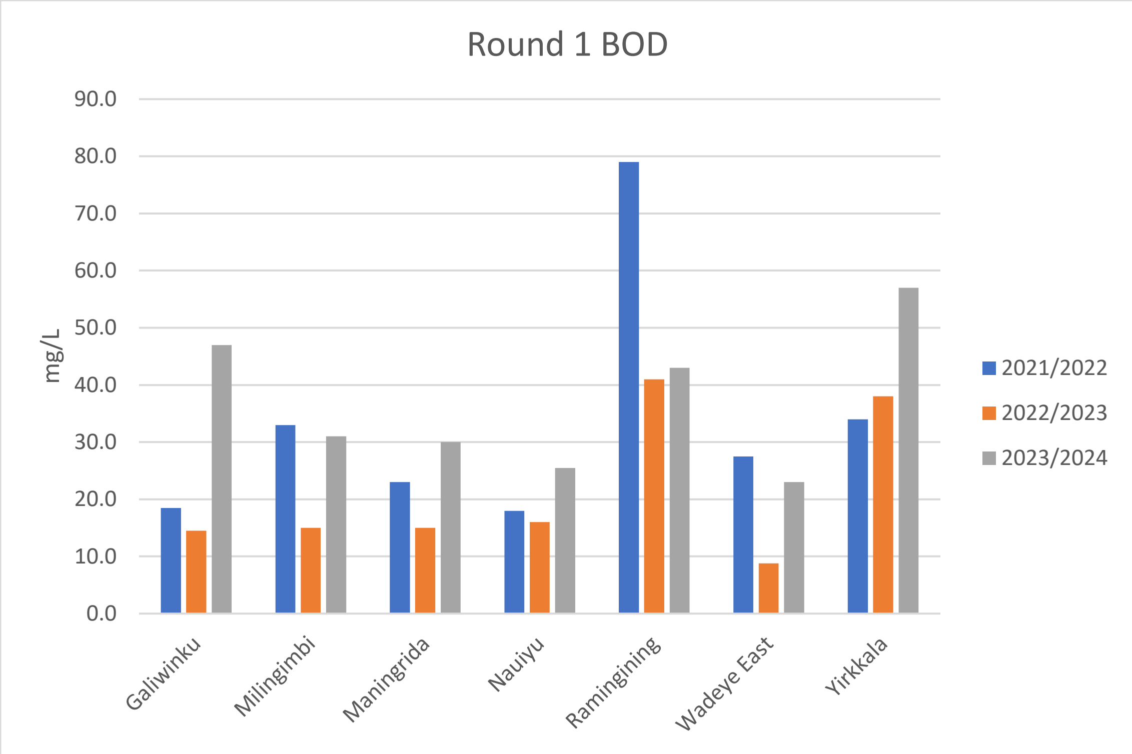

Figure 8. Round 1 Biochemical Oxygen Demand

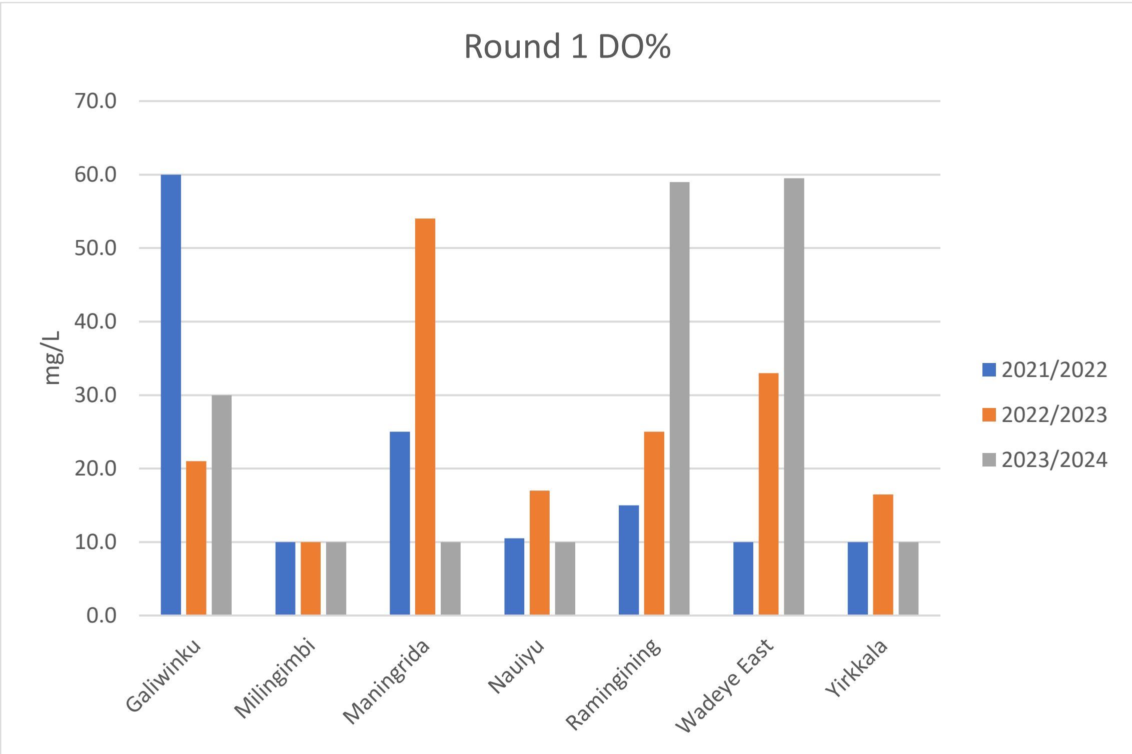

Figure 9. Dissolved Oxygen Saturation (DO%)

PowerWater

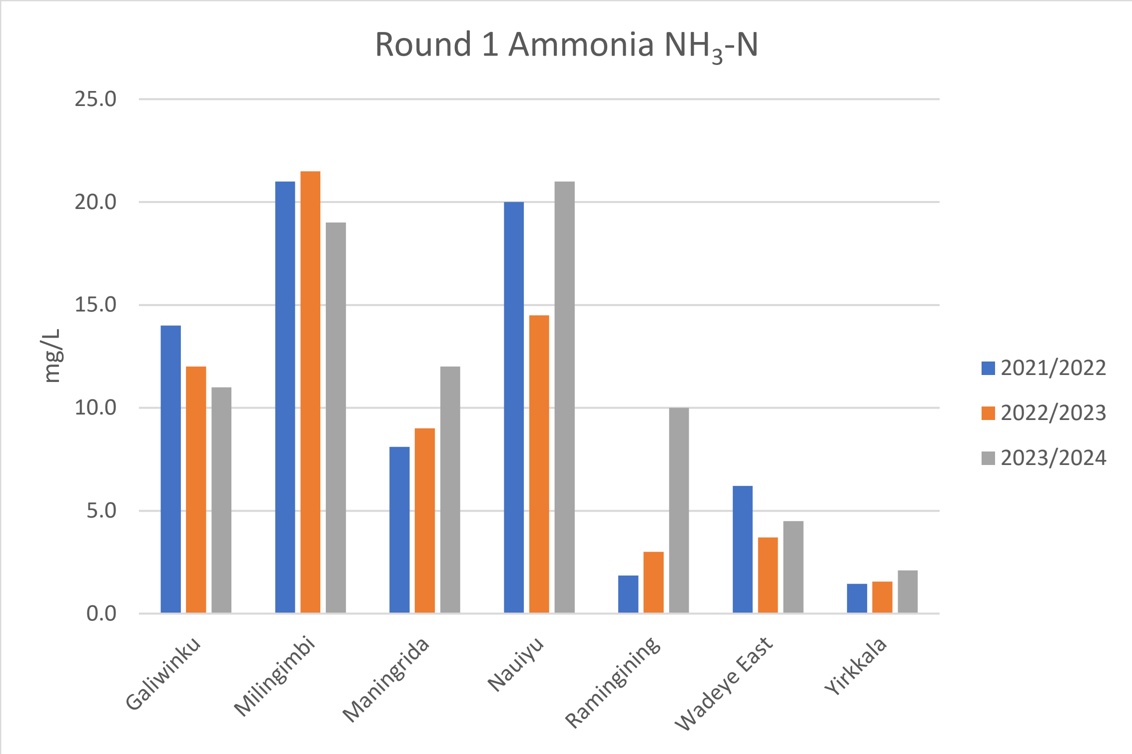

Figure 10. Round 1 Ammonia (NH_3-N)

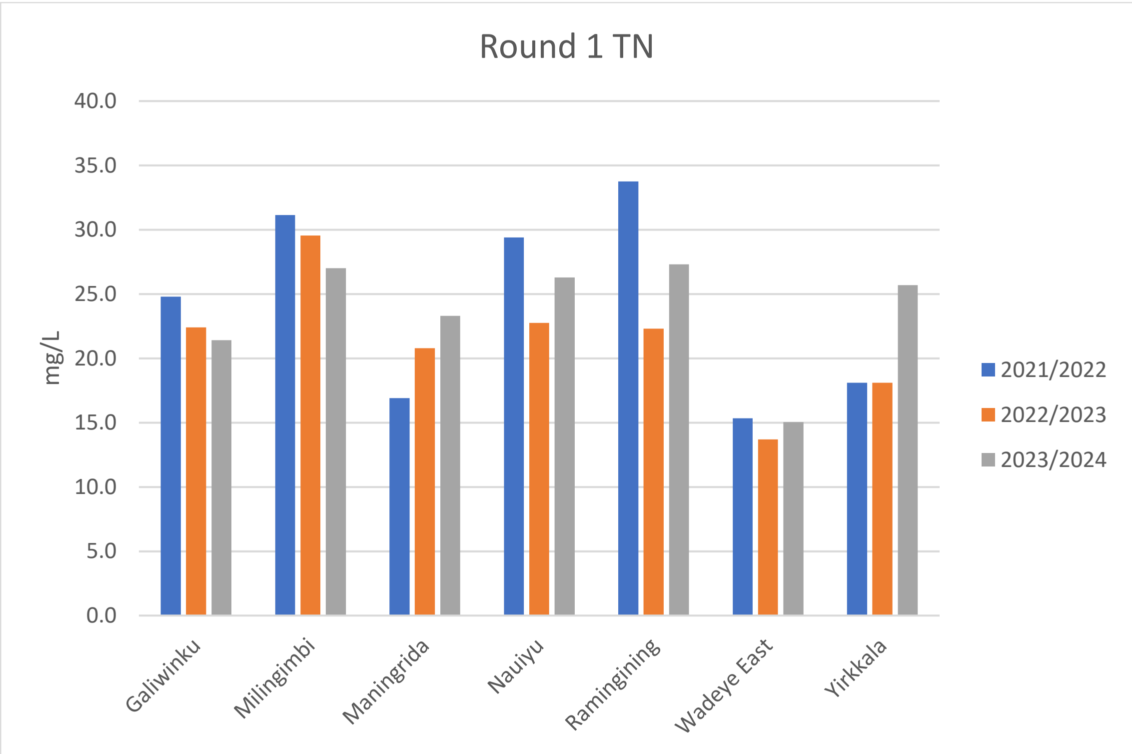

Figure 11. Round 1 Total Nitrogen

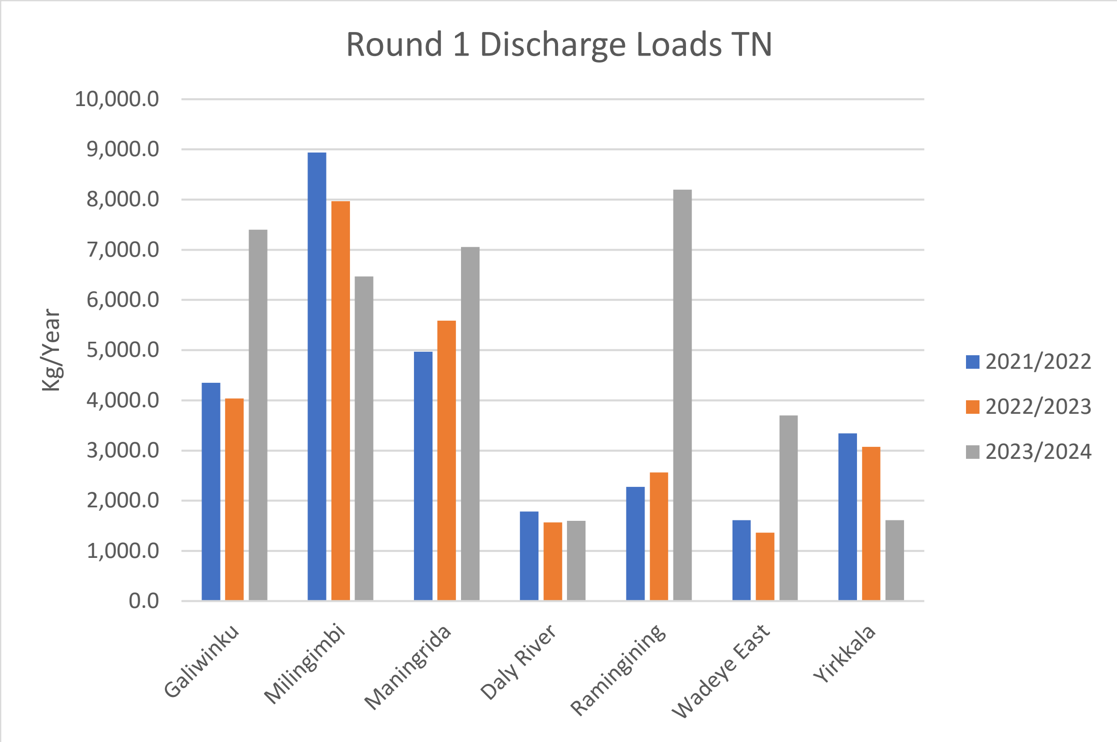

Figure 12. Round 1 Total Nitrogen Discharge Load

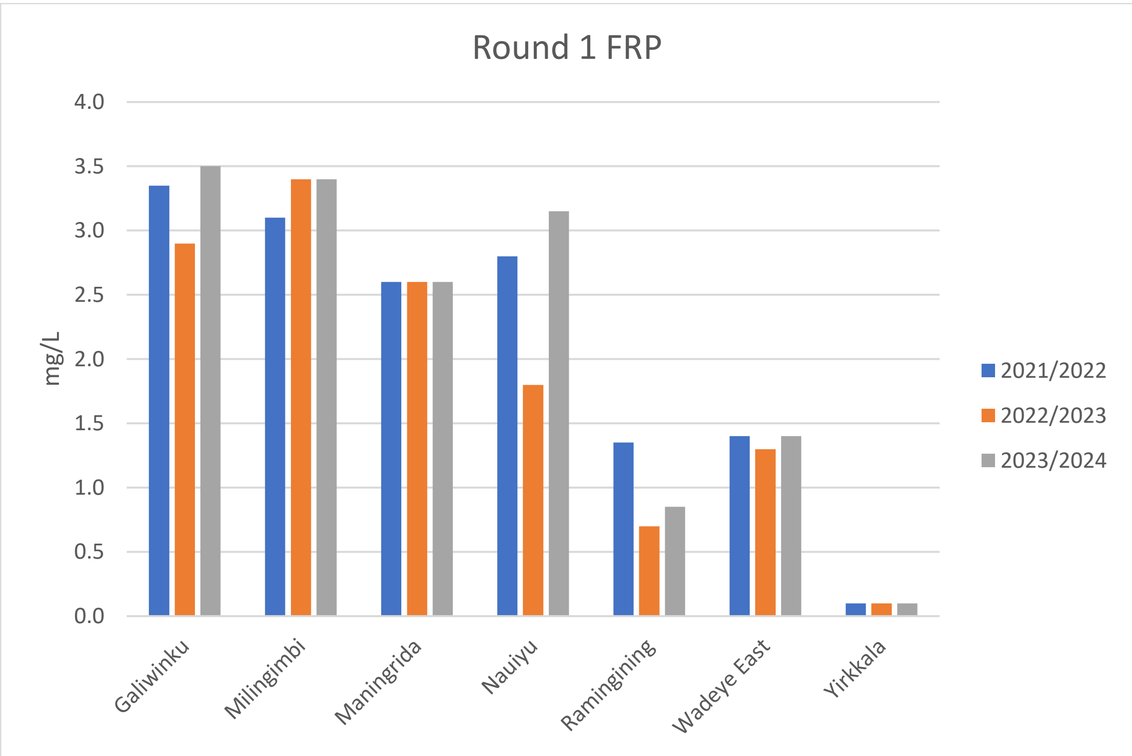

Figure 13. Round 1 Filterable Reactive Phosphorus

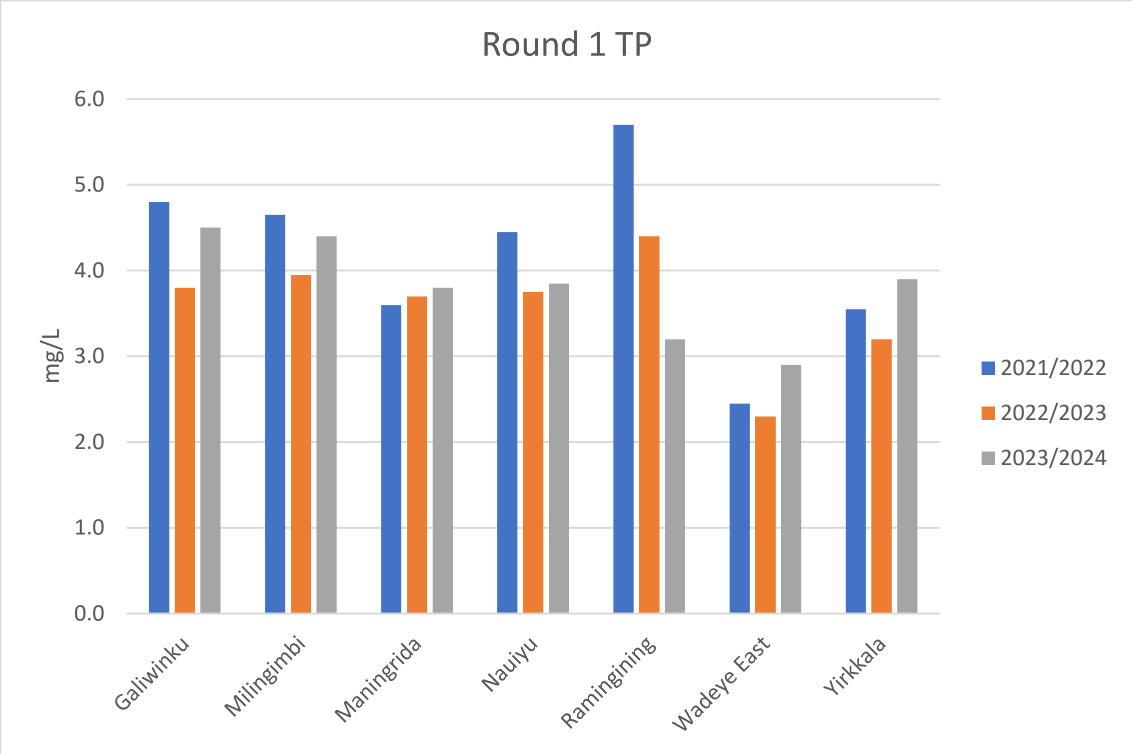

Figure 14. Round 1 Total Phosphorus

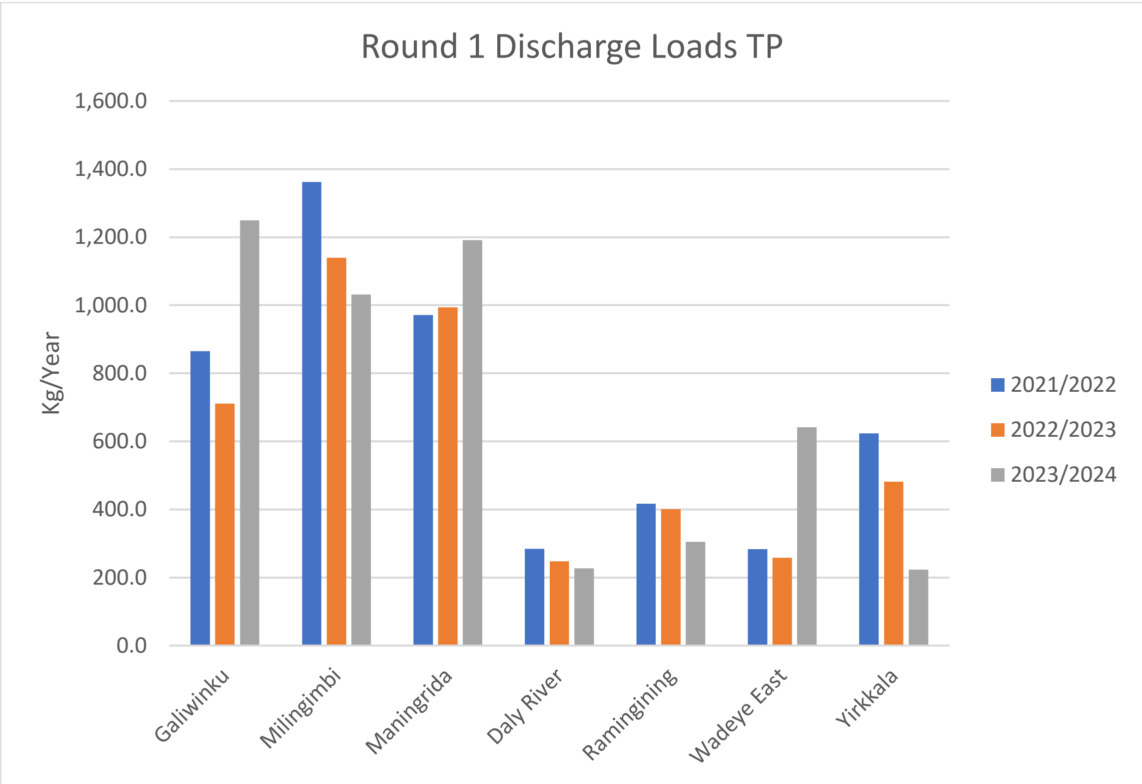

Figure 15. Round 1 Total Phosphorus Discharge Loads

Round 2

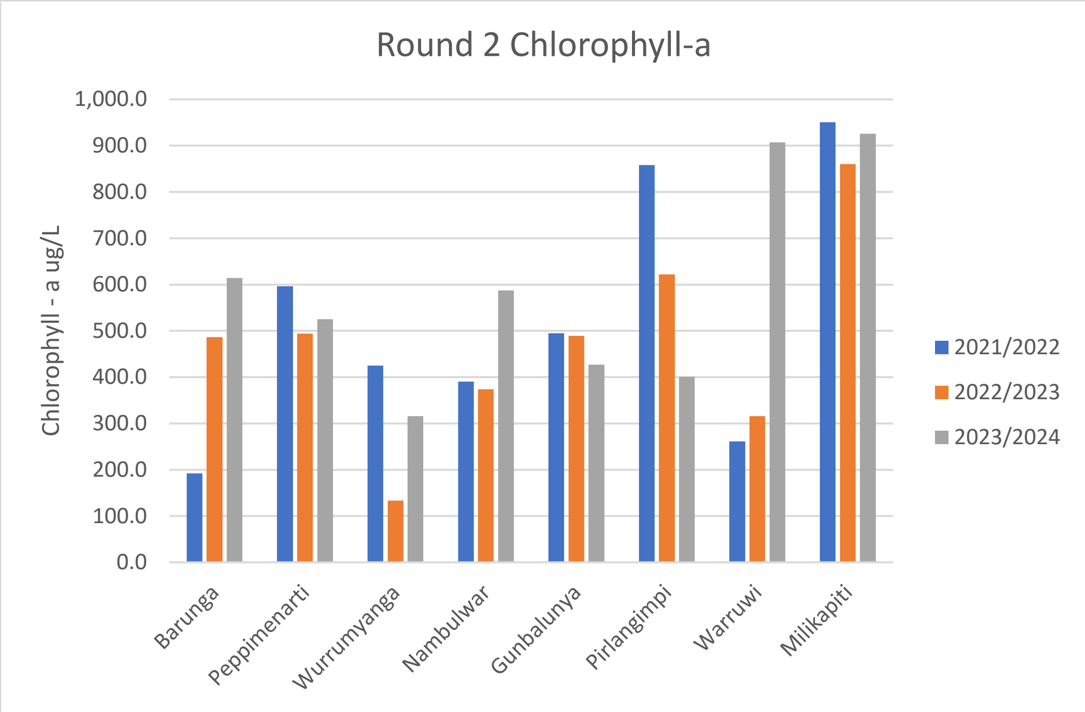

Figure 16. Round 2 Chlorophyll-a

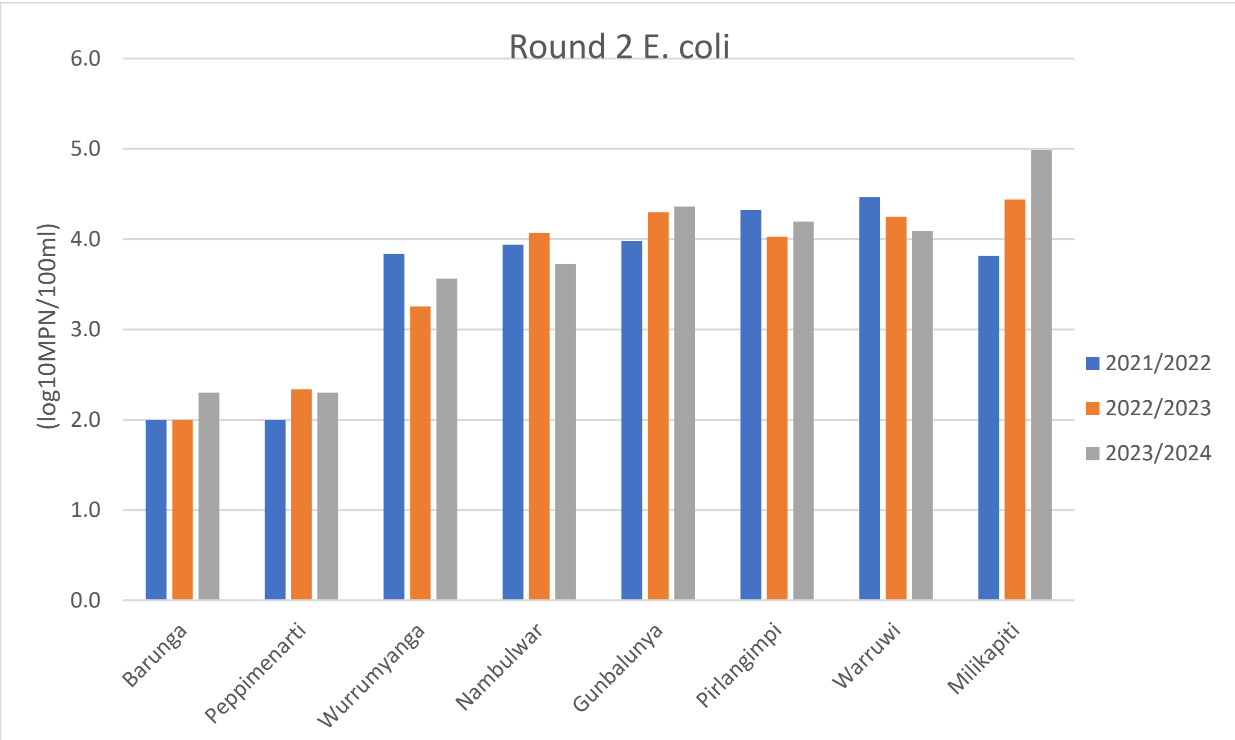

Figure 17. Round 2 E. coli

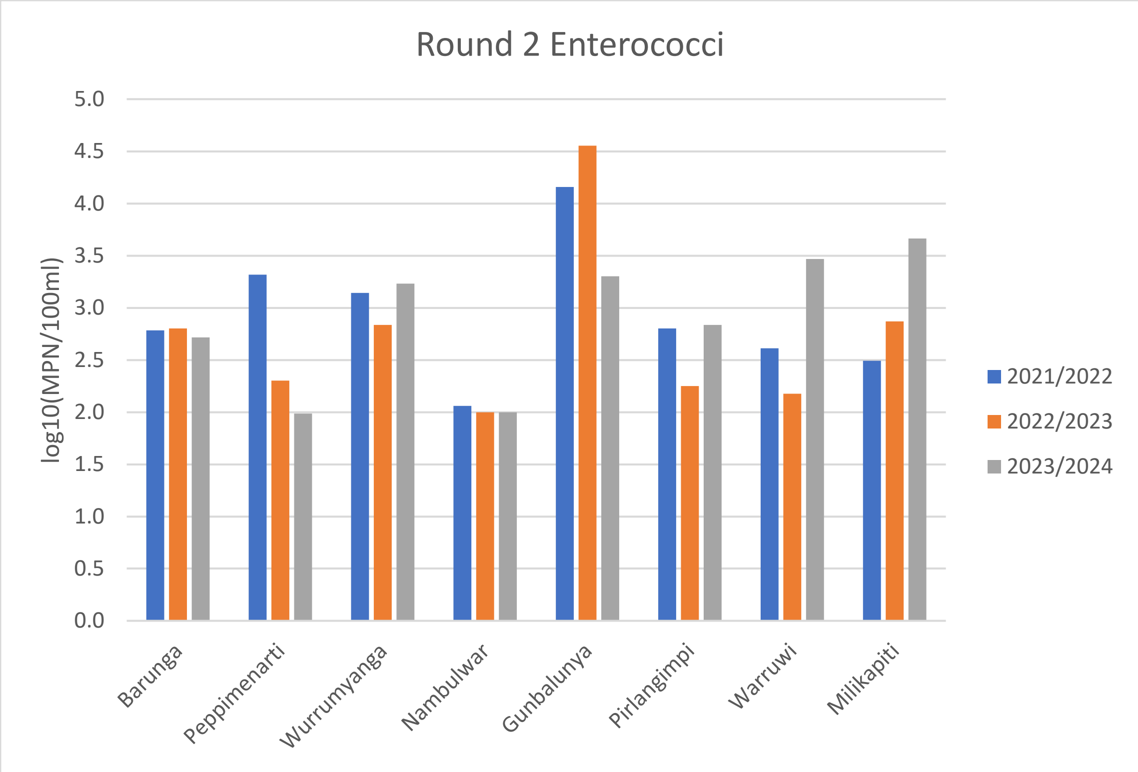

Figure 18. Round 2 Enterococci log10(MPN/100ml)

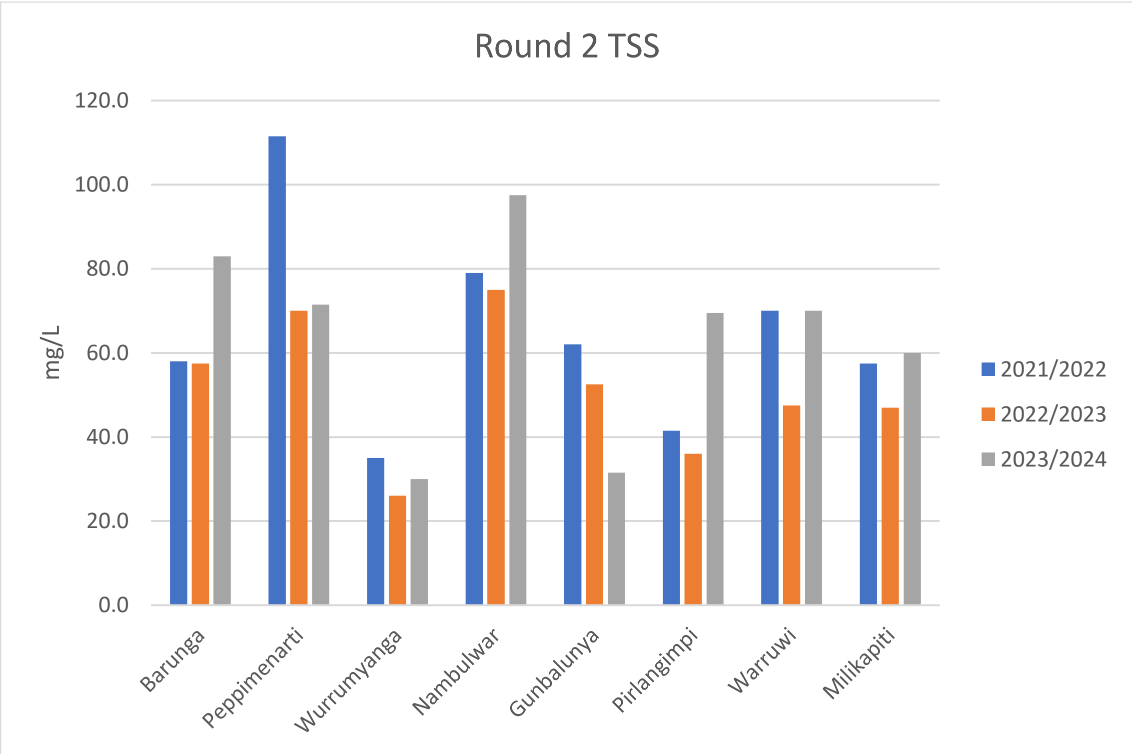

Figure 19. Round 2 Total Suspended Solids

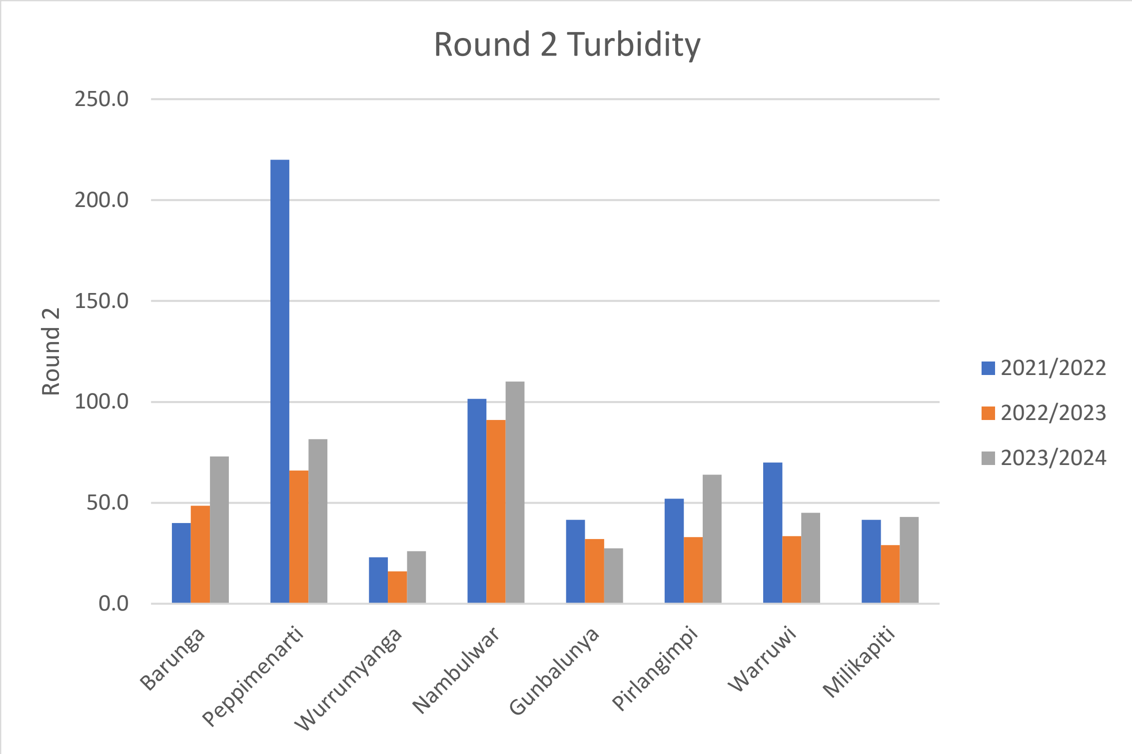

Figure 20. Round 2 Turbidity (NTU)

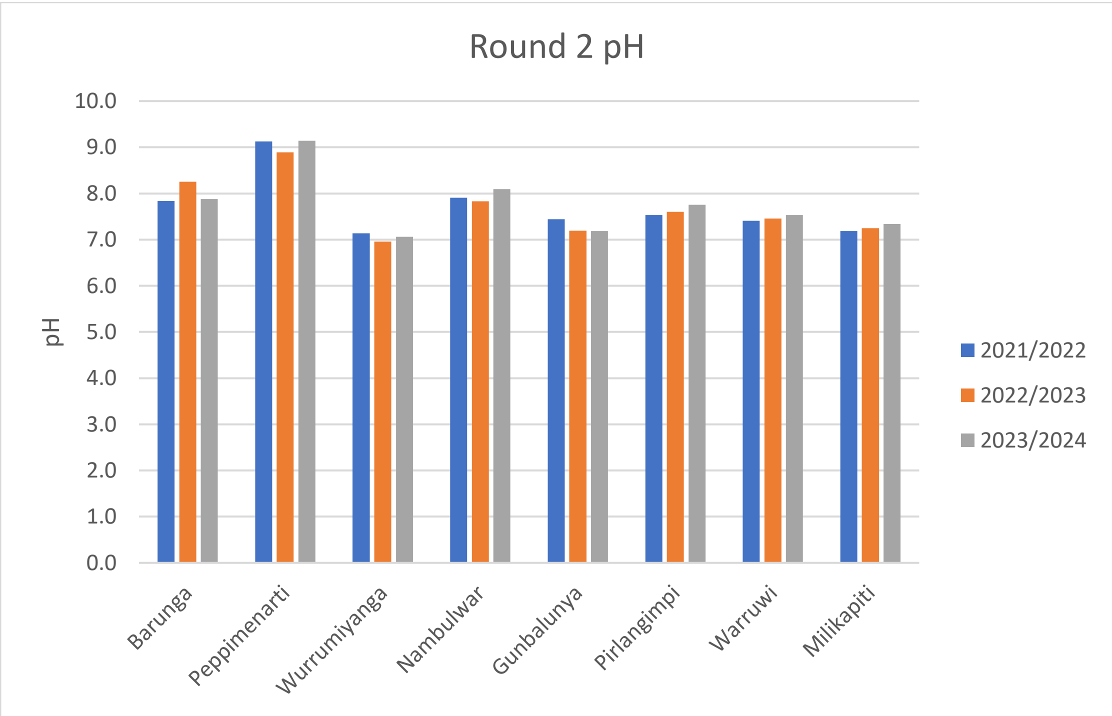

Figure 21. Round 2 pH

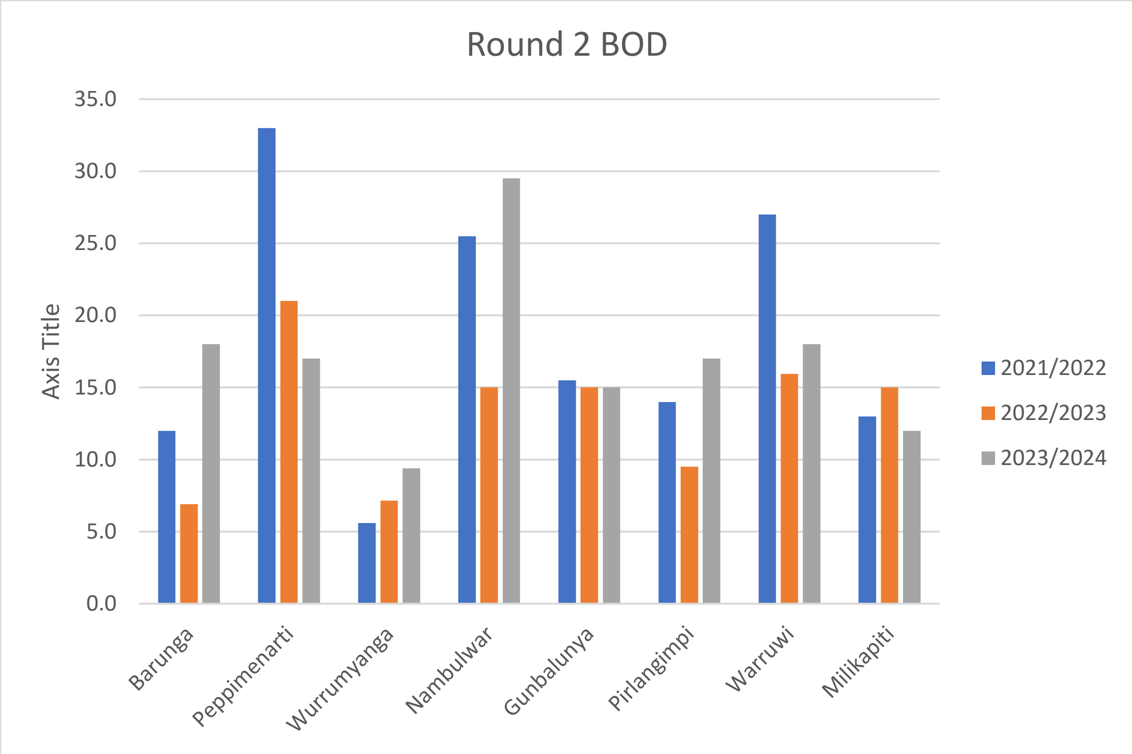

Figure 22. Round 2 Biochemical Oxygen Demand

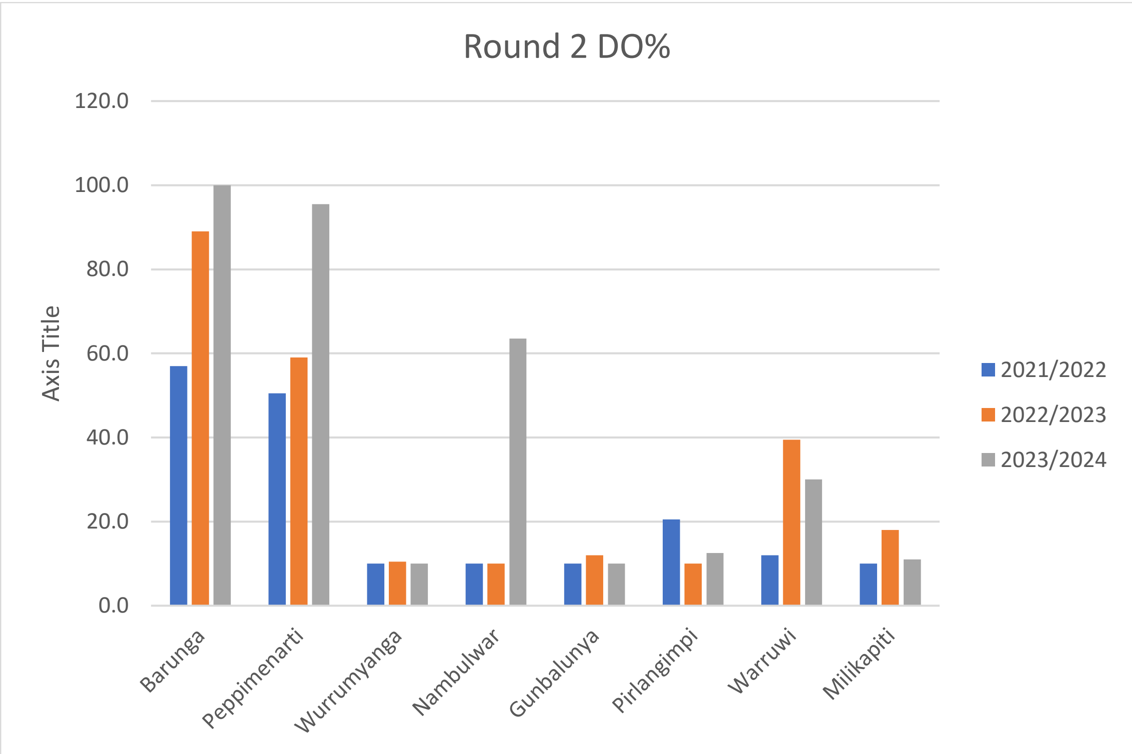

Figure 23. Round 2 Dissolved Oxygen Percent Saturation

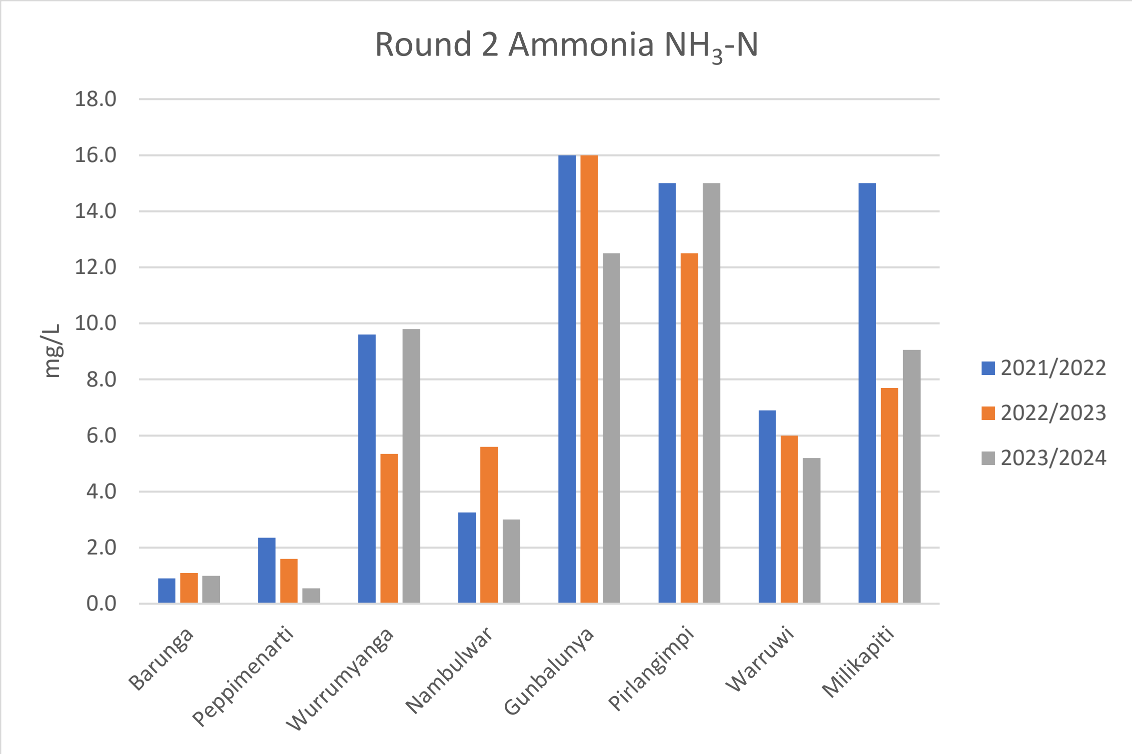

Figure 24. Round 2 Ammonia (NH_3-N)

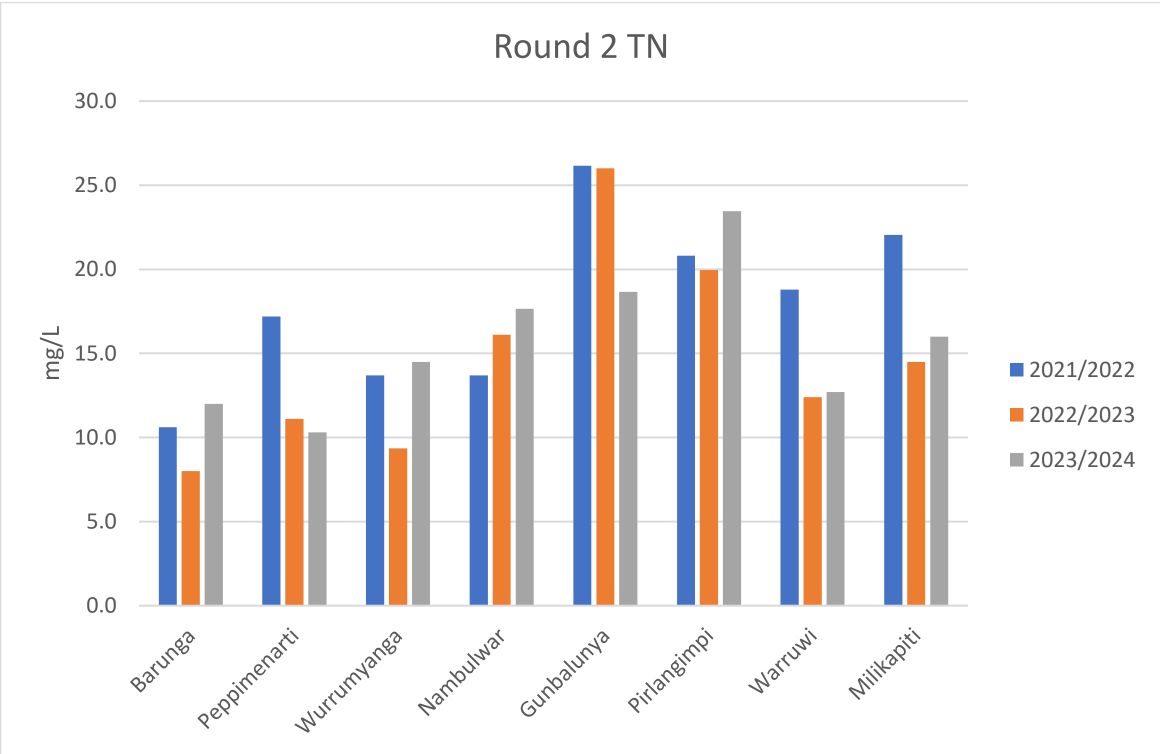

Figure 25. Round 2 Total Nitrogen

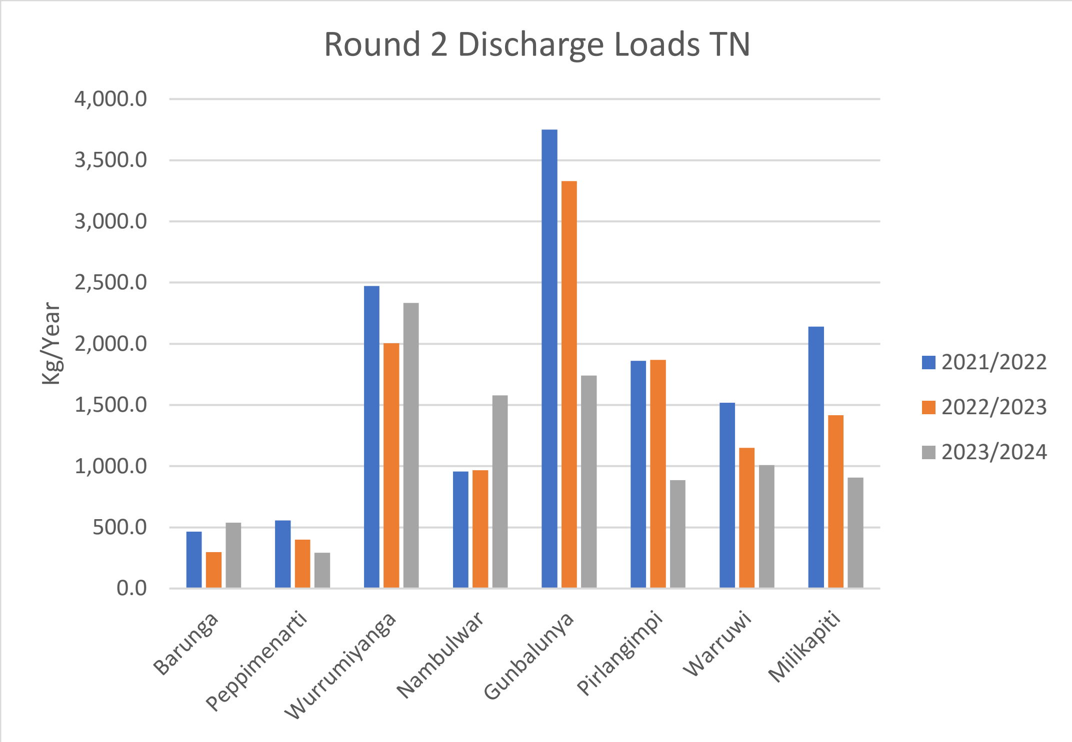

Figure 26. Round 2 Total Nitrogen Discharge Loads

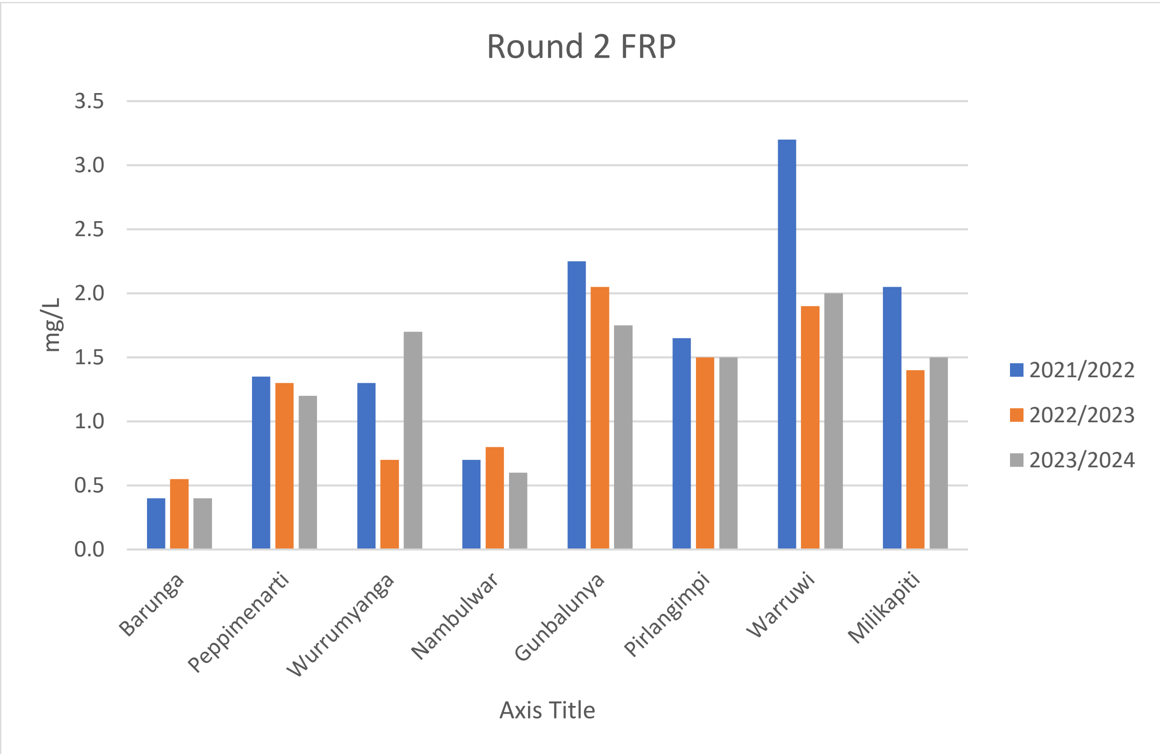

Figure 27. Round 2 Filterable Reactive Phosphorus

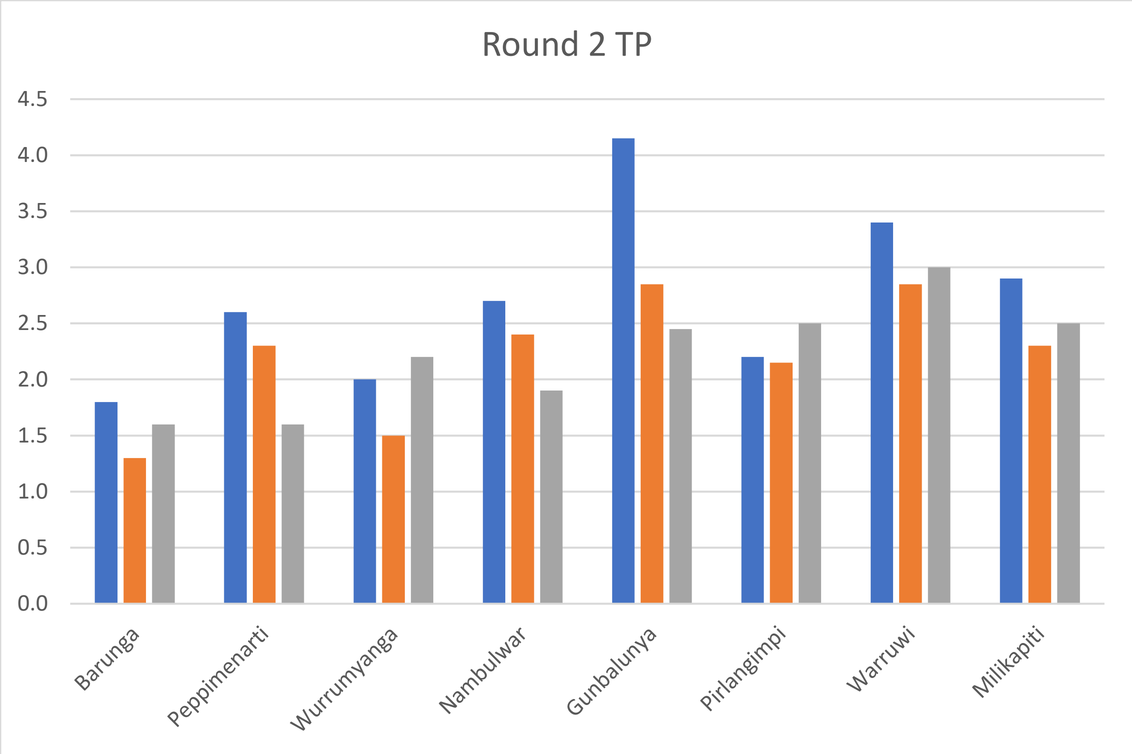

Figure 28. Round 2 Total Phosphorus

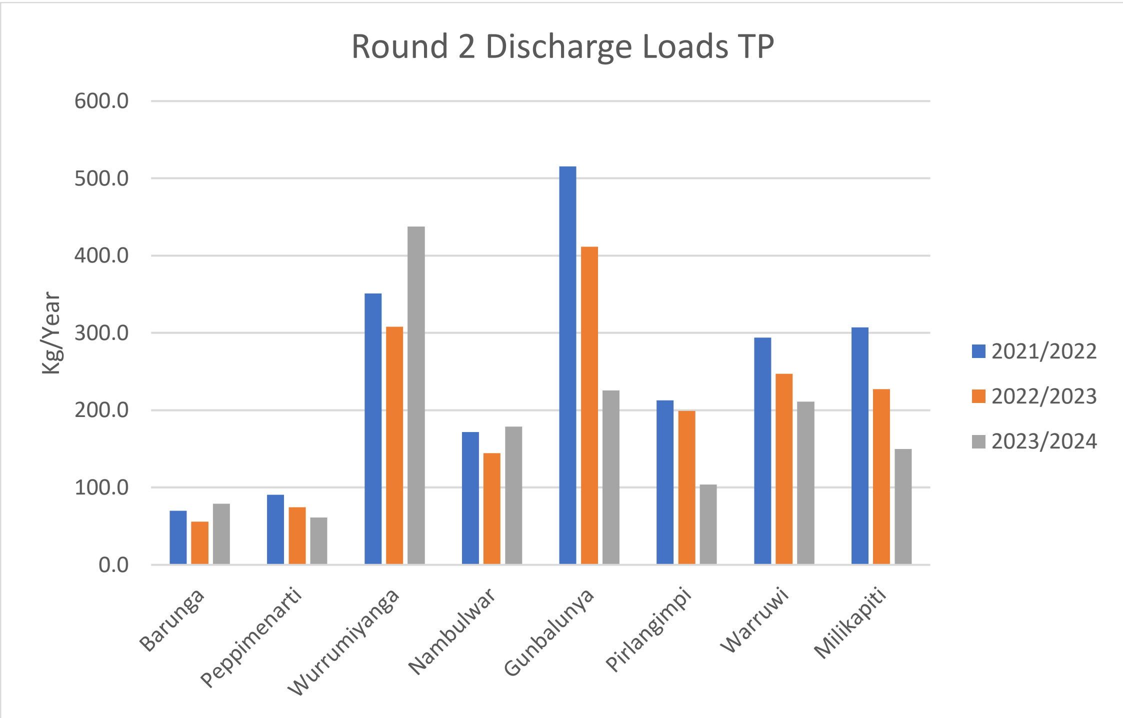

Figure 29. Round 2 Total Phosphorus Discharge Loads

Round 3

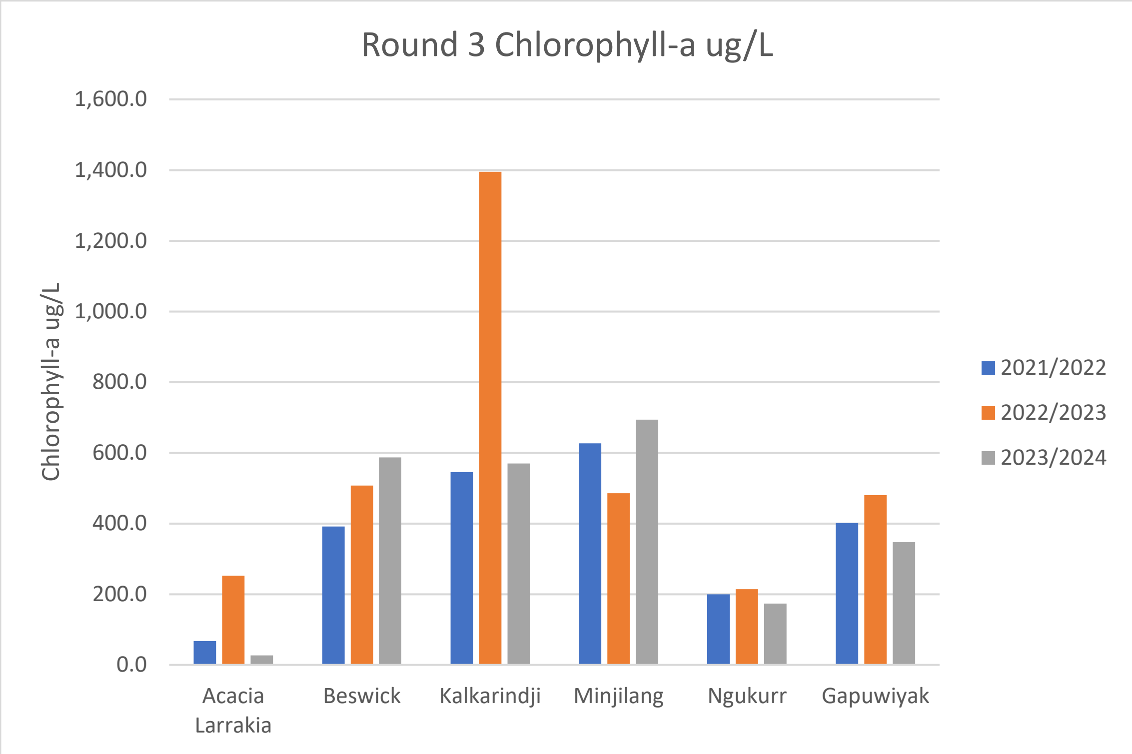

Figure 30. Round 3 Chlorophyll-a

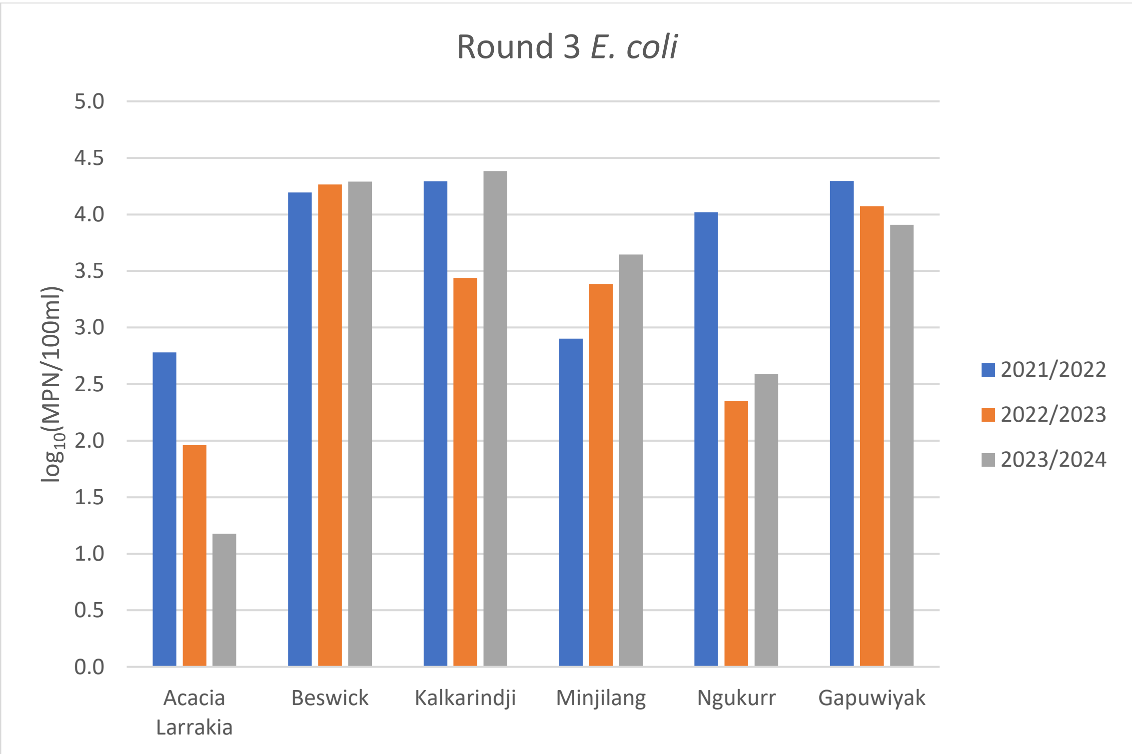

Figure 31. Round 3 E. coli

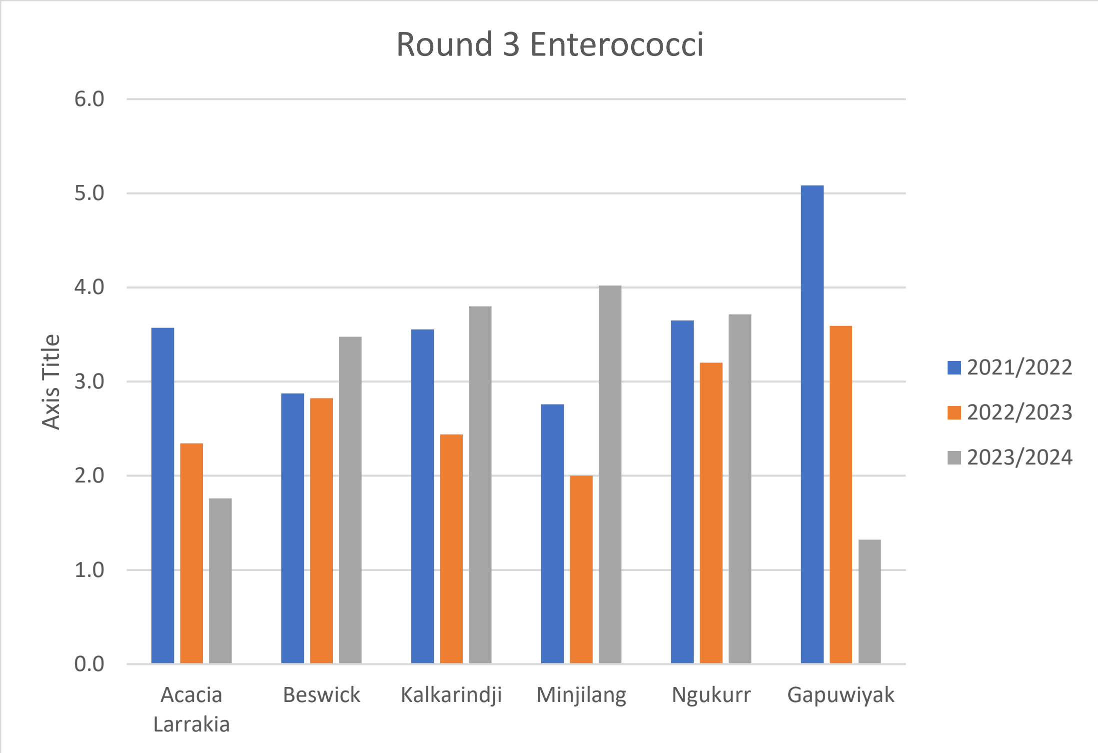

Figure 32. Round 3 Enterococci log10(MPN/100ml)

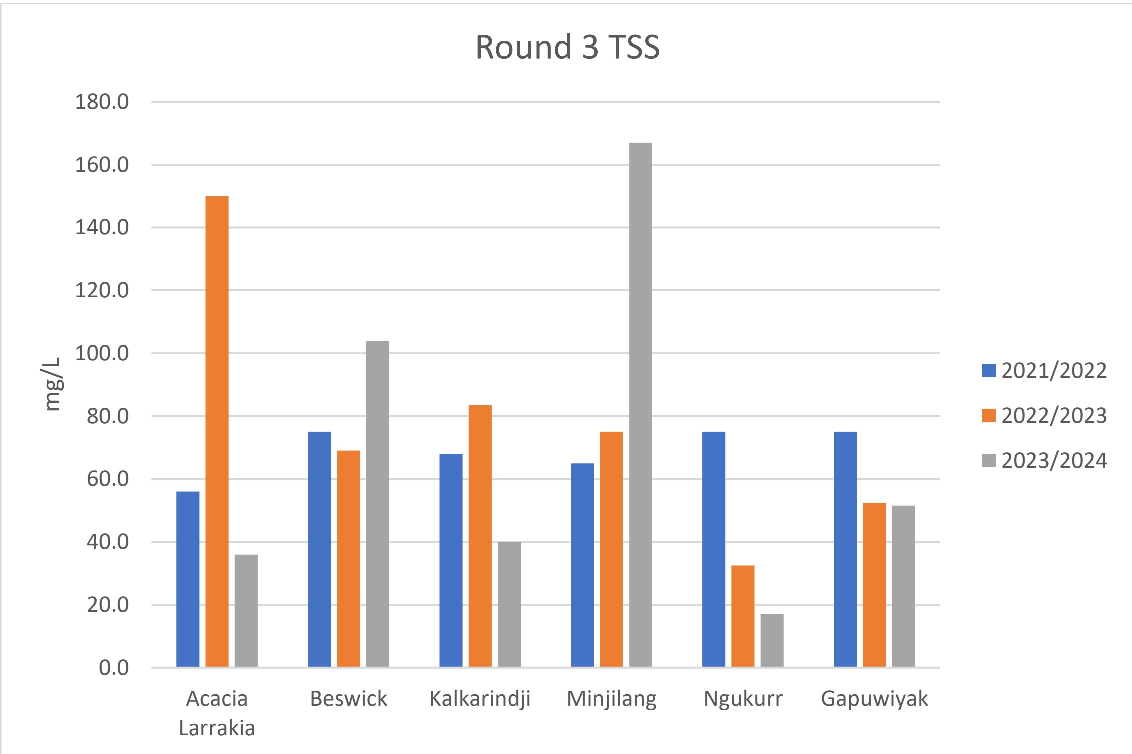

Figure 33. Round 3 Total Suspended Solids

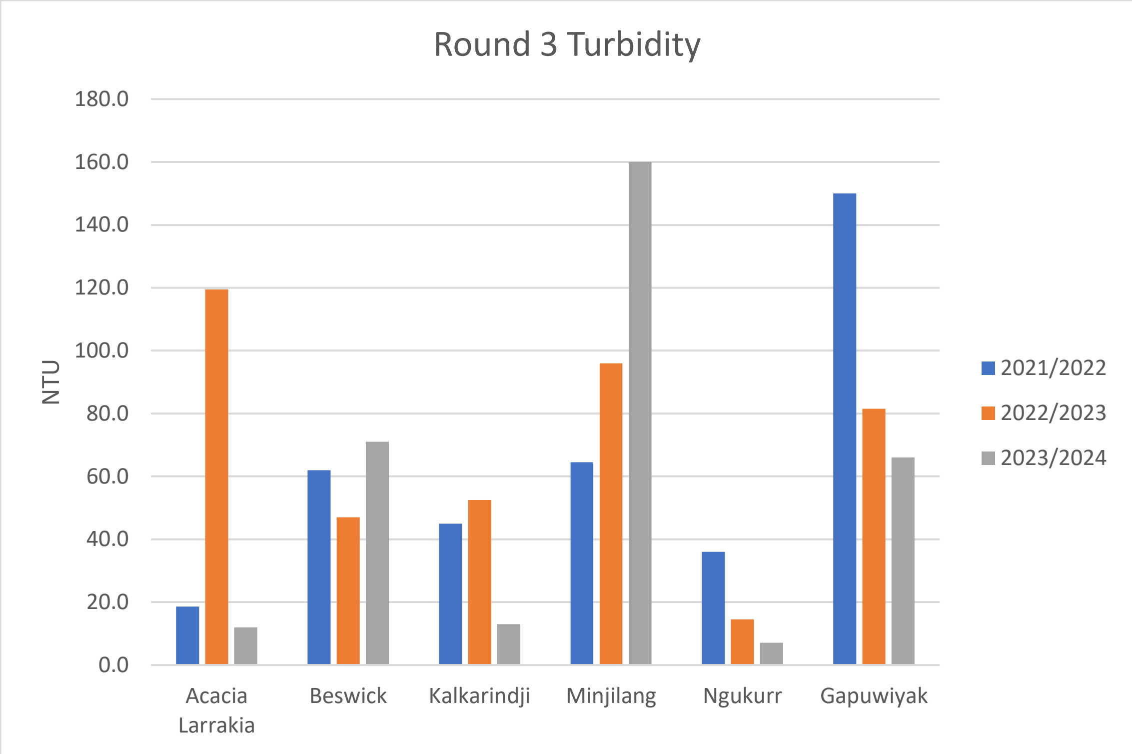

Figure 34. Round 3 Turbidity (NTU)

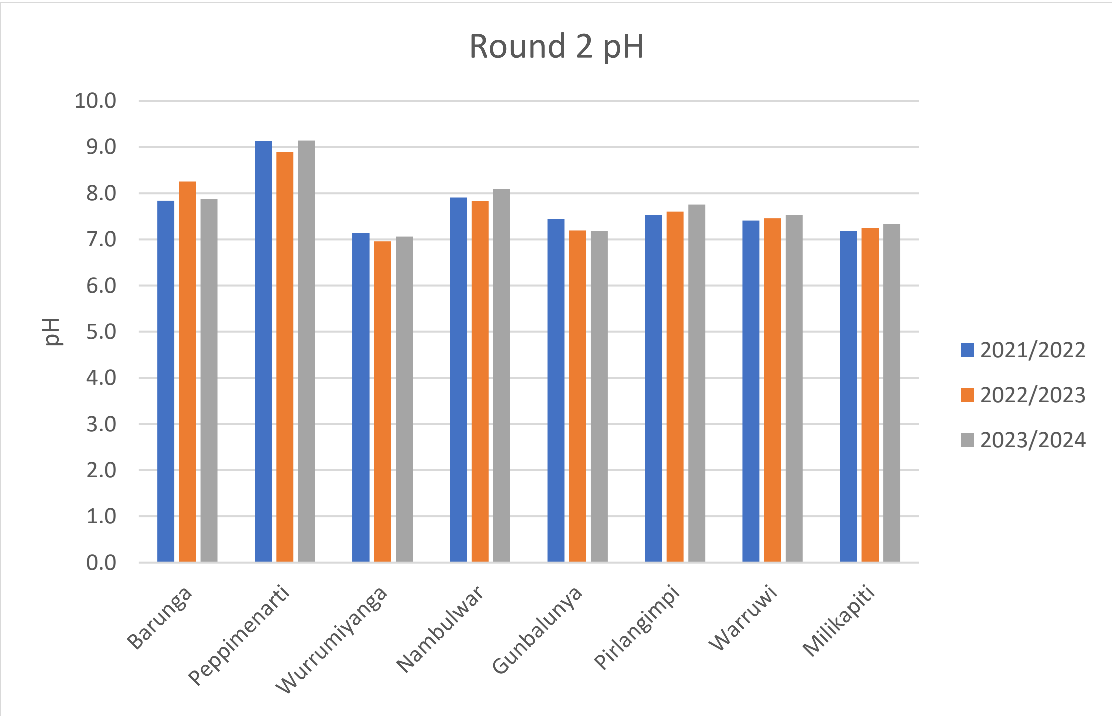

Figure 35. Round 3 pH

PowerWater

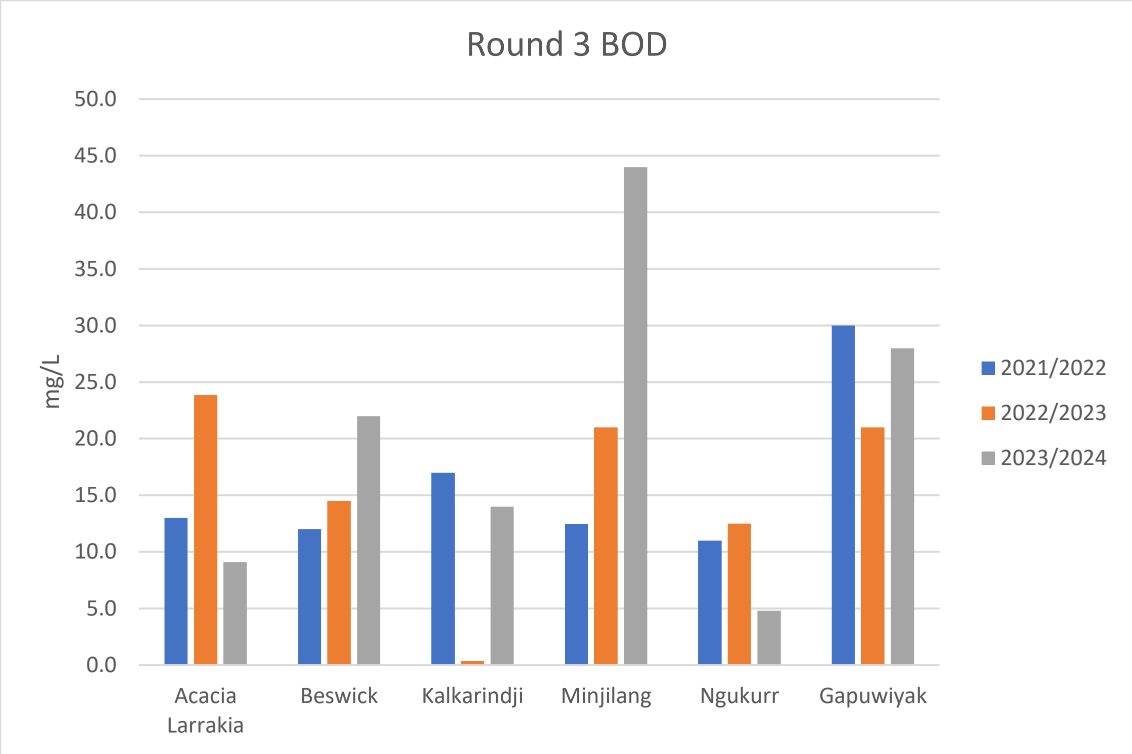

Figure 36. Round 3 Biochemical Oxygen Demand

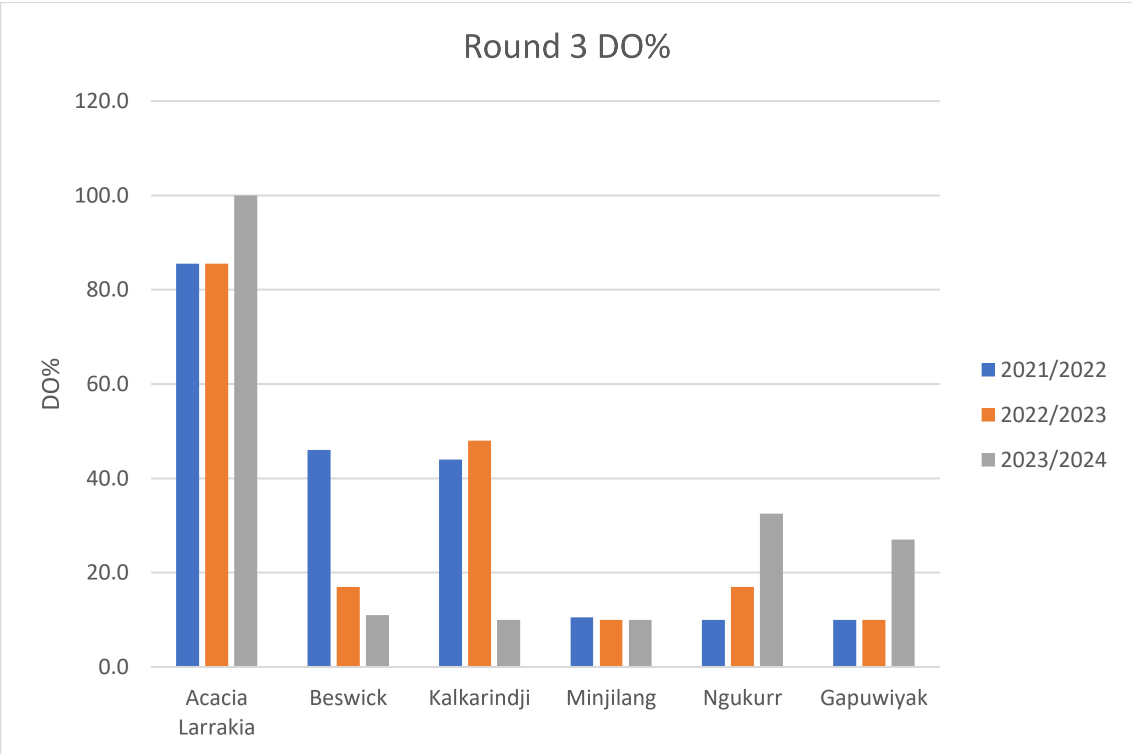

Figure 37. Round 3 Dissolved Oxygen Saturation (DO%)

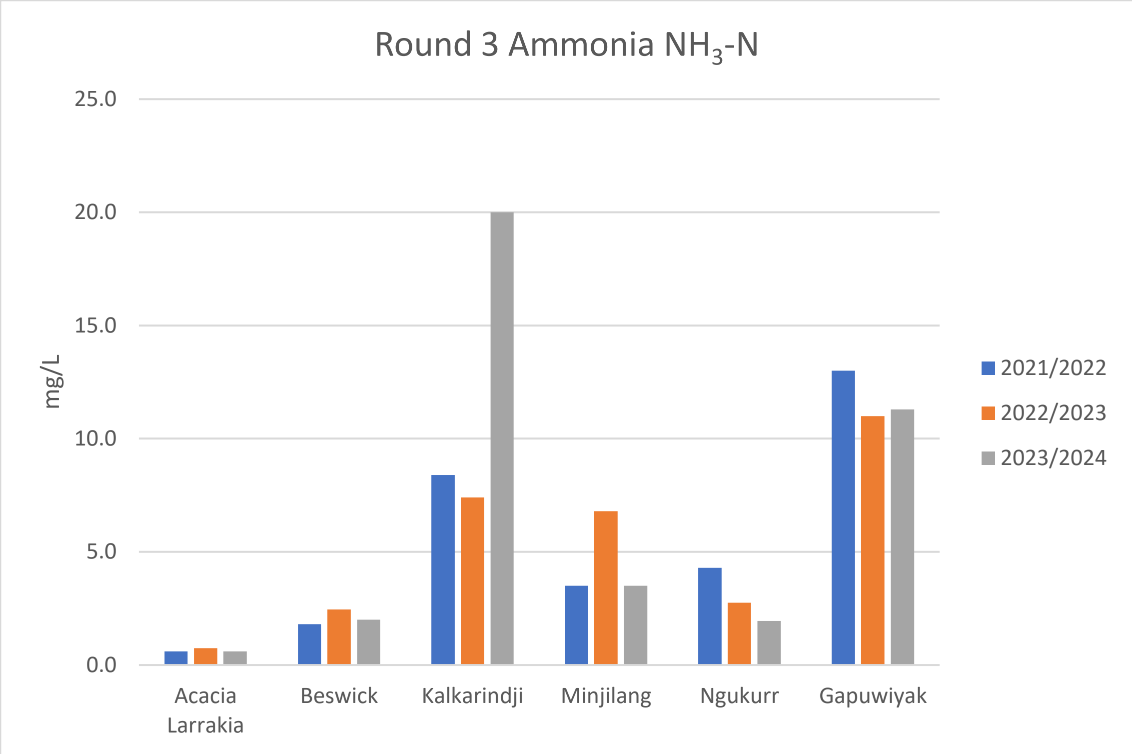

Figure 38. Round 3 Ammonia (NH_3-N)

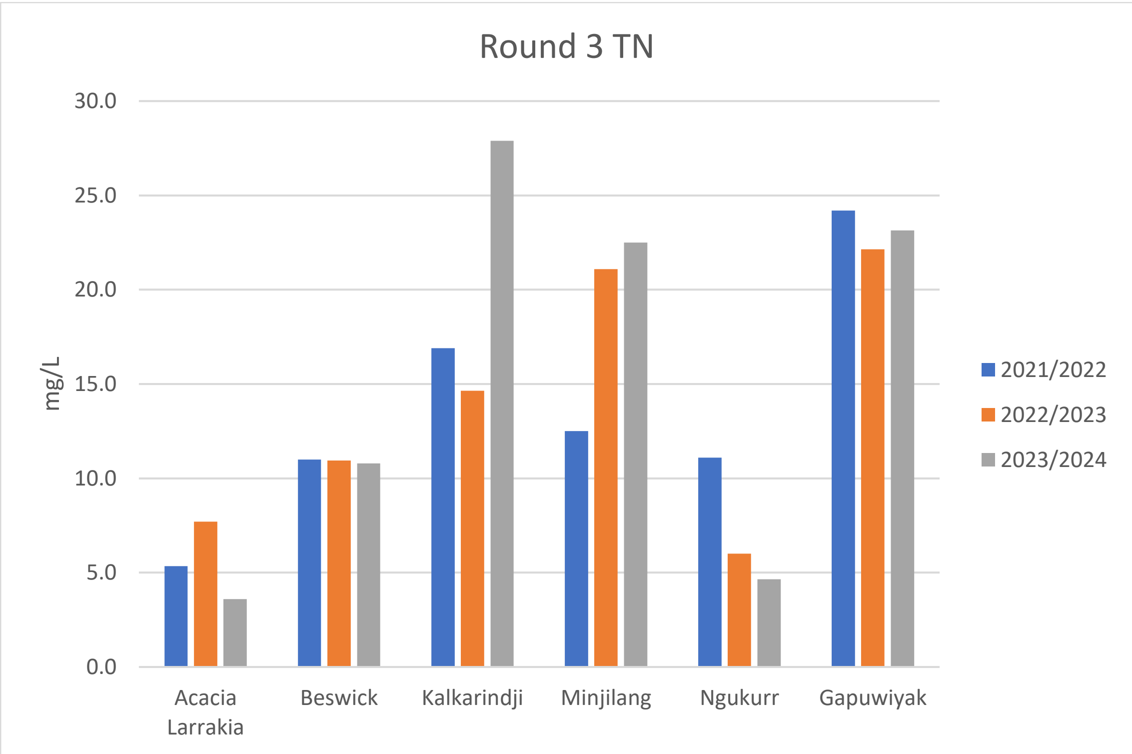

Figure 39. Round 3 Total Nitrogen

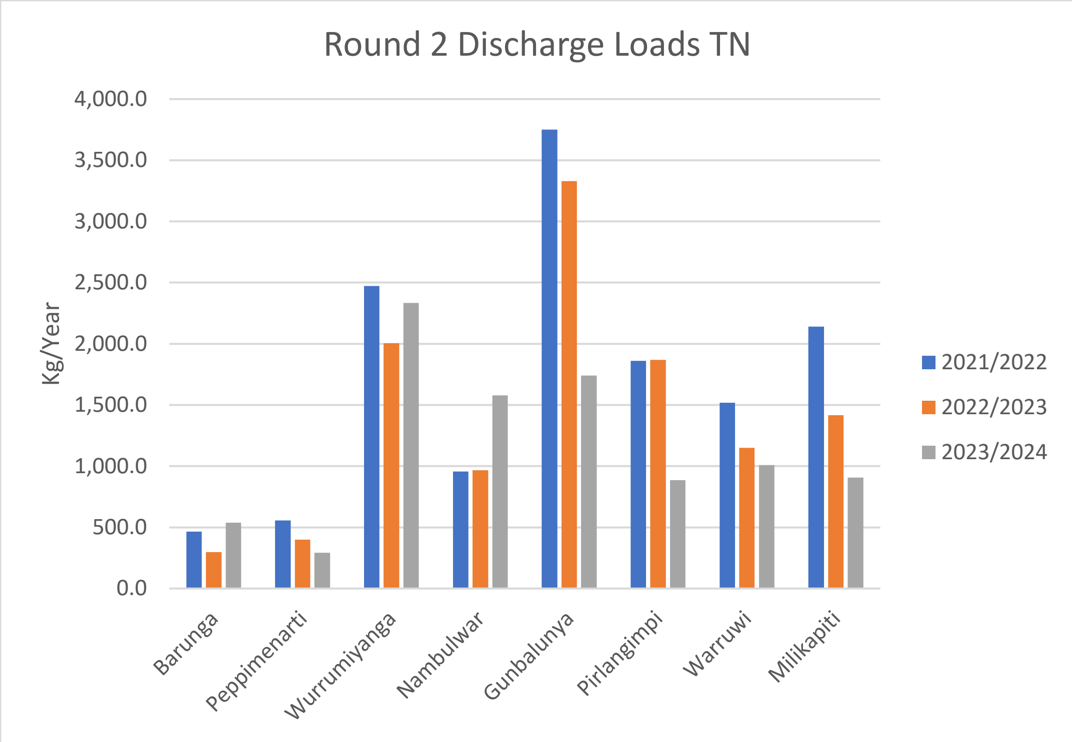

Figure 40. Round 3 Total Nitrogen Discharge Loads

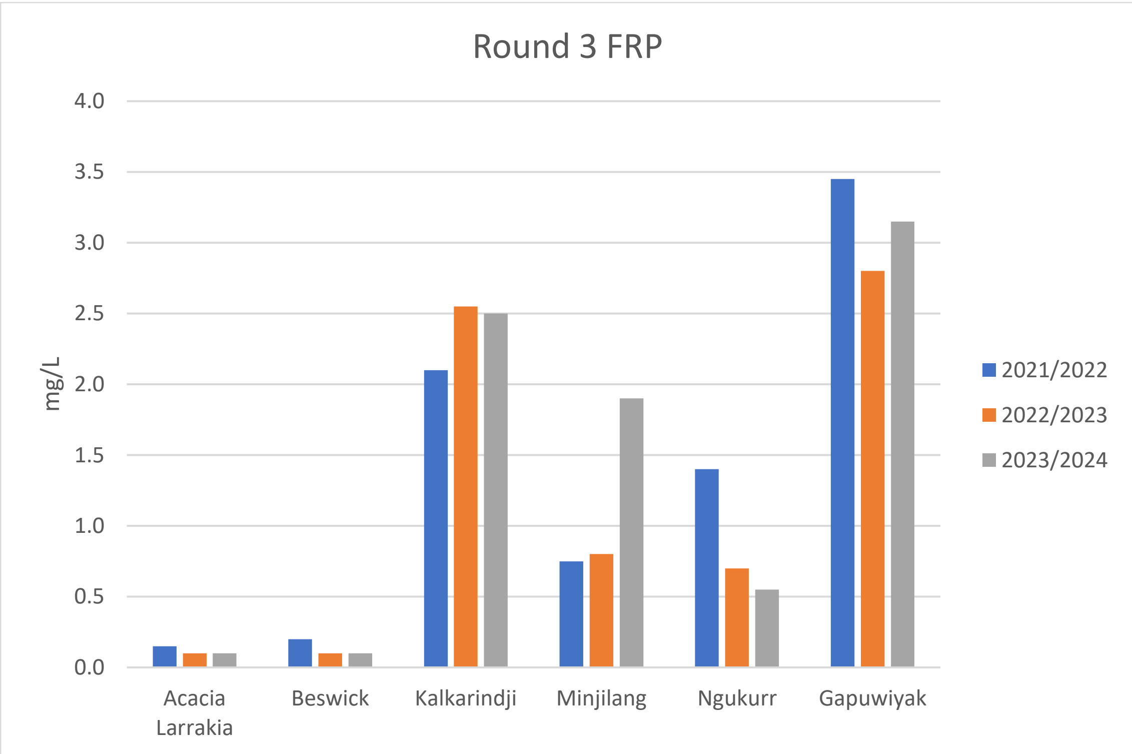

Figure 41. Round 3 Filterable Reactive Phosphorus

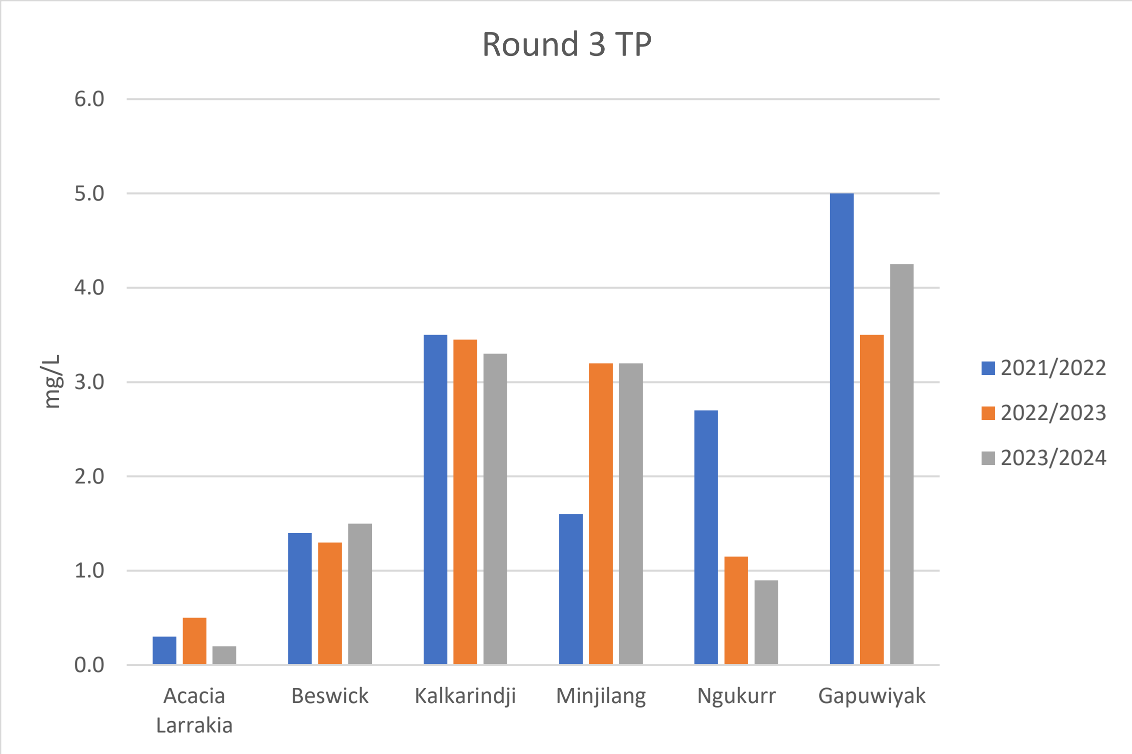

Figure 42. Round 3 Total Phosphorus

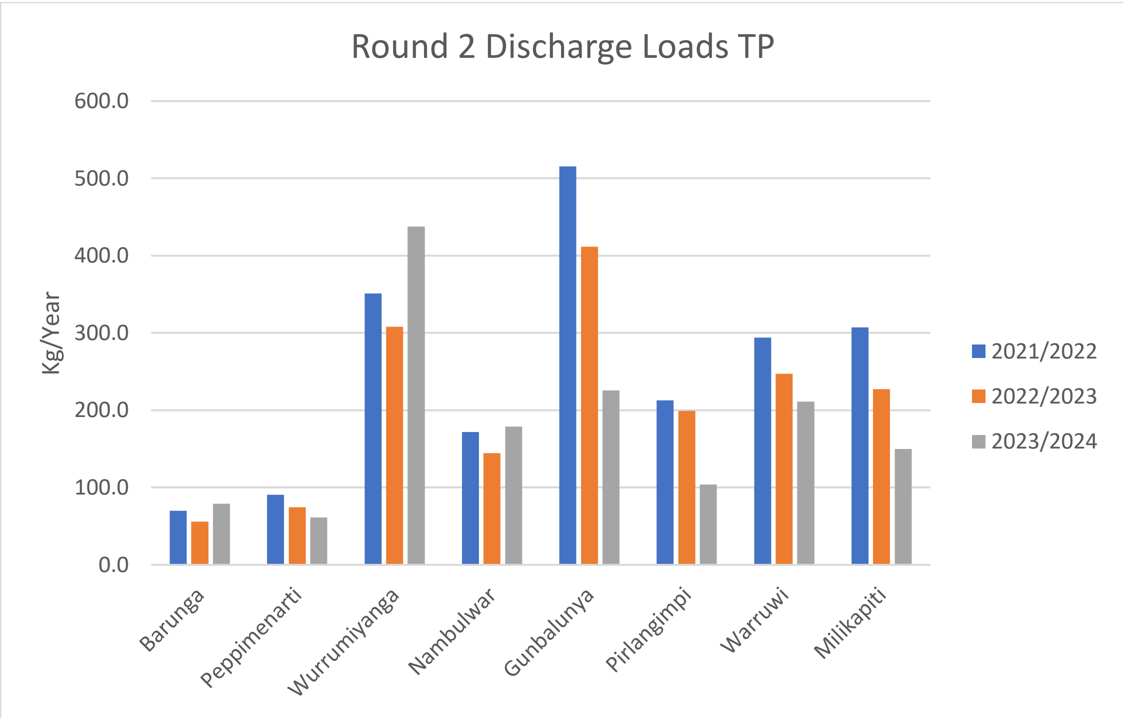

Figure 43. Round 3 Total Phosphorus Discharge Loads

Appendix B – Belyuen Monitoring Results Graphs

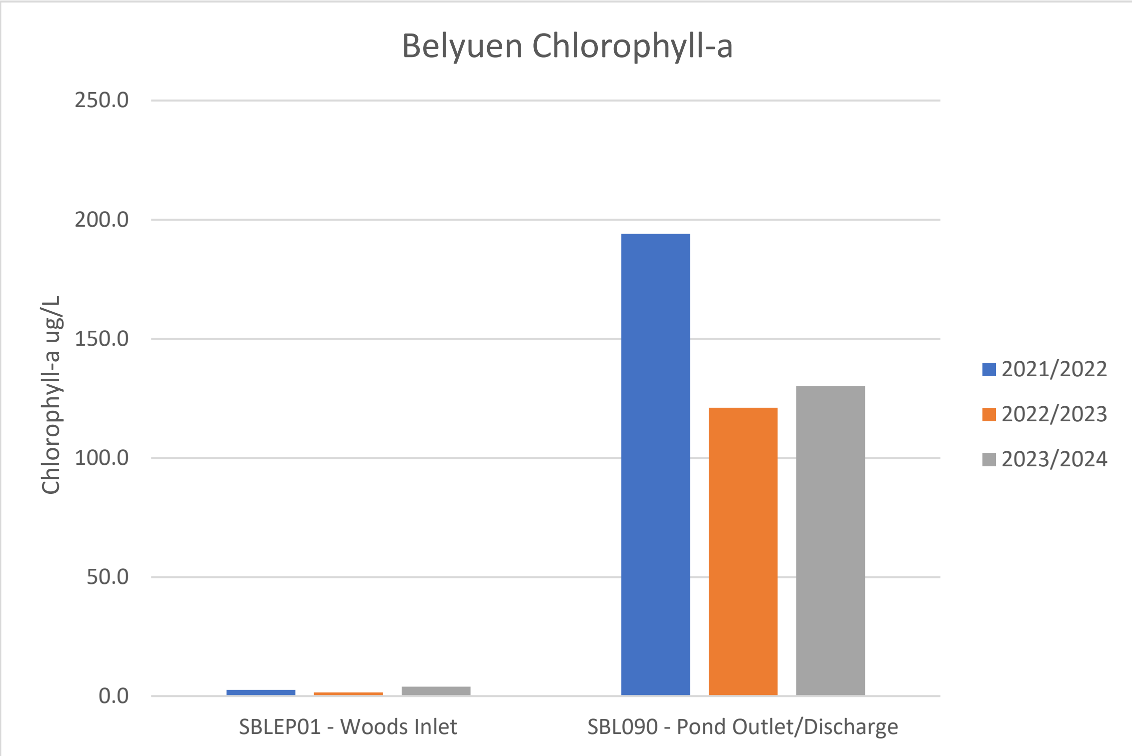

Figure 44. Belyuen Chlorophyll-a

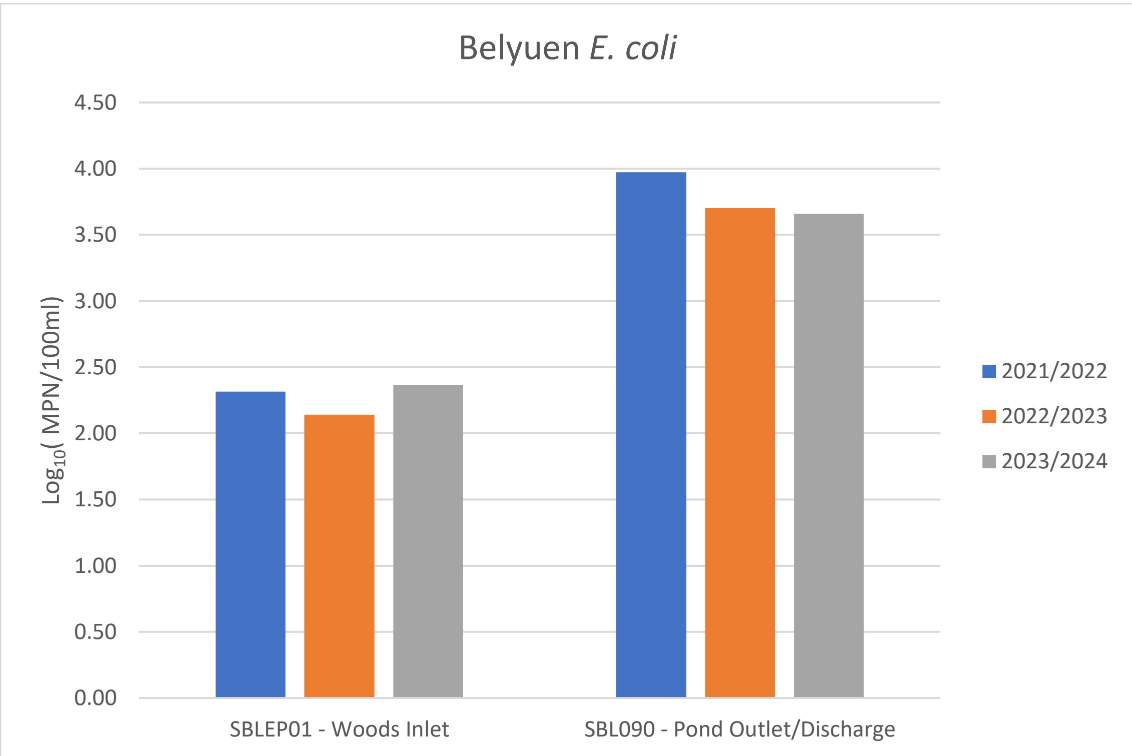

Figure 45. Belyuen E. Coli

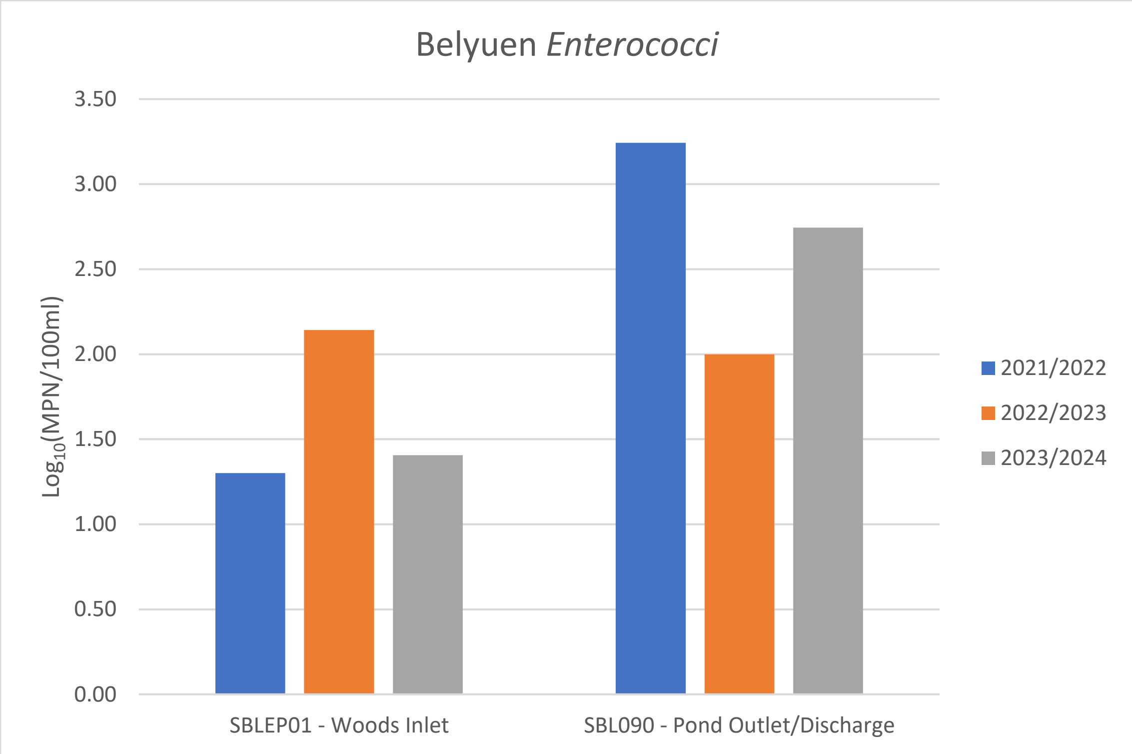

Figure 46. Belyuen Enterococci

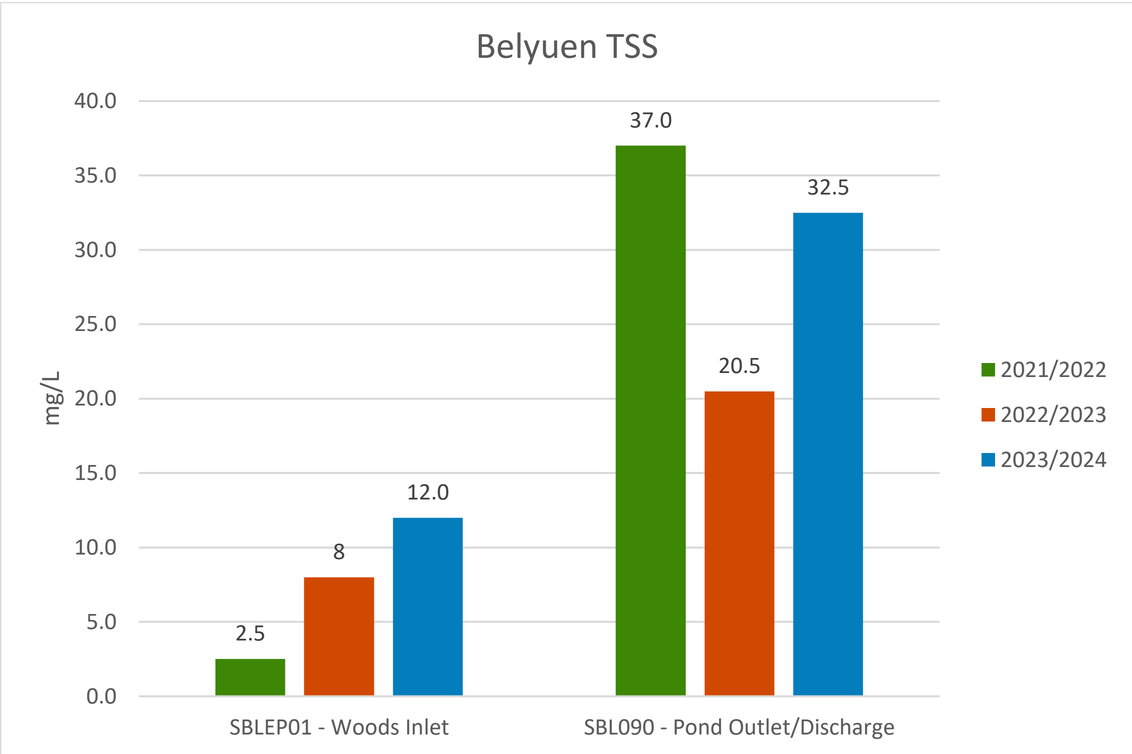

Figure 47. Belyuen Total Suspended Solids

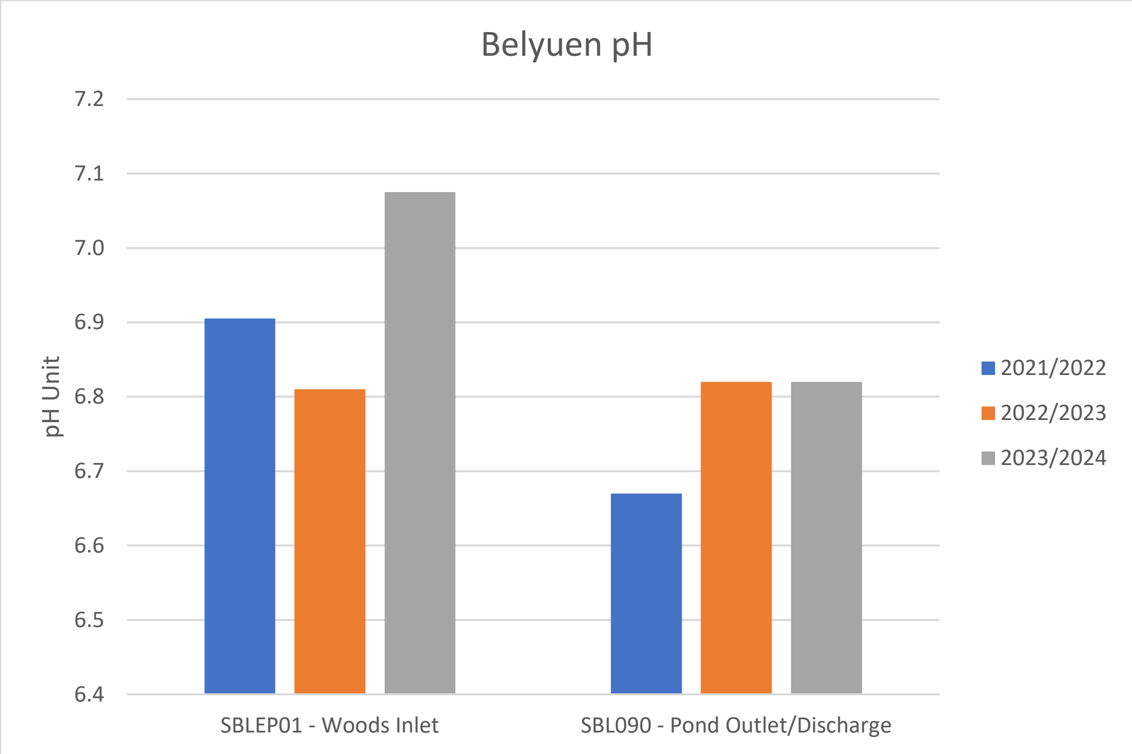

Figure 48. Belyuen pH unit.

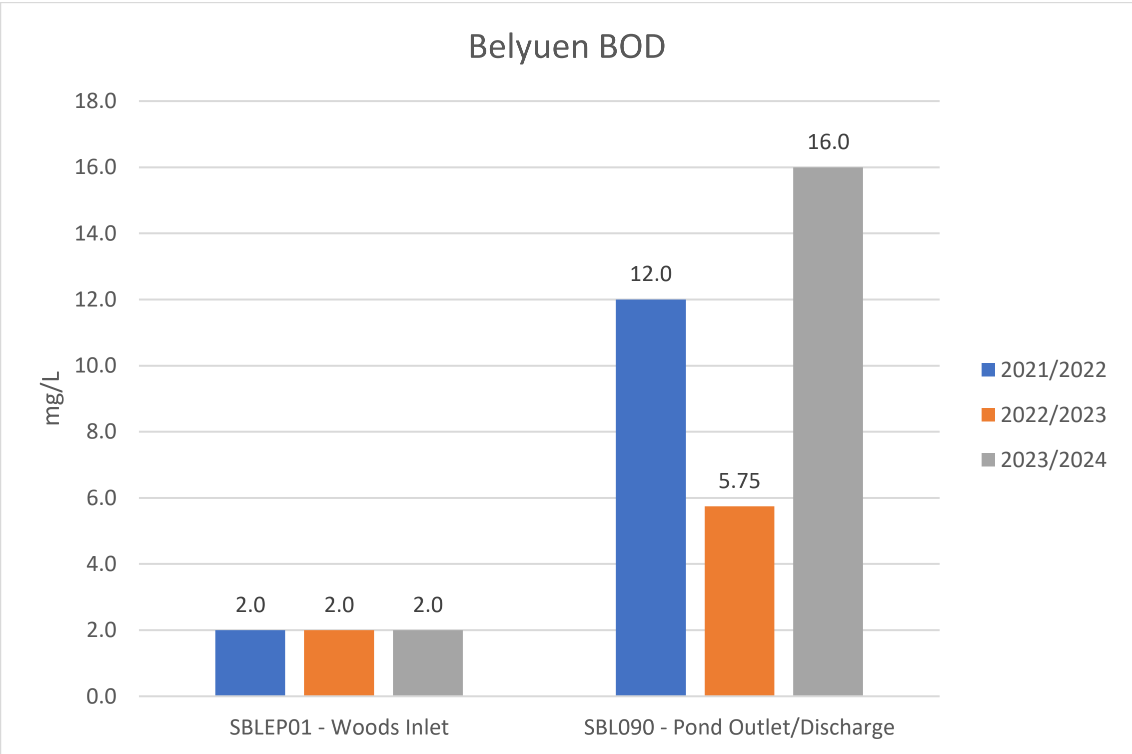

Figure 49. Belyuen Biochemical Oxygen Demand

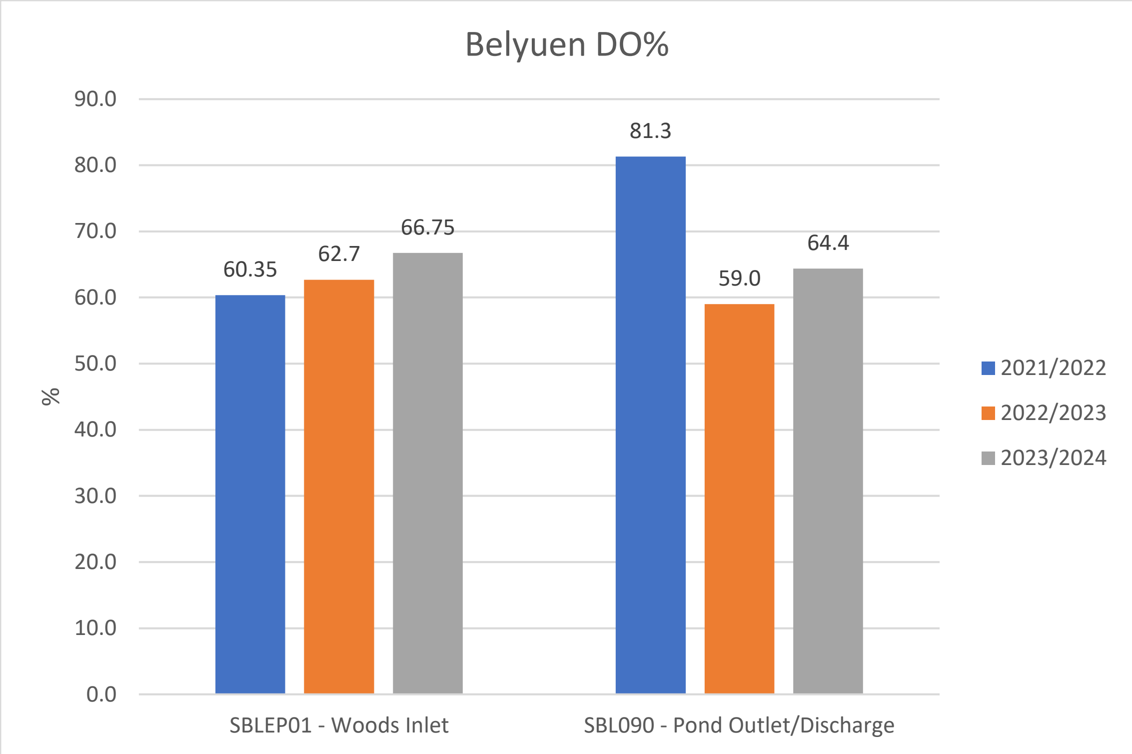

Figure 50. Dissolved Oxygen Saturation (DO%)

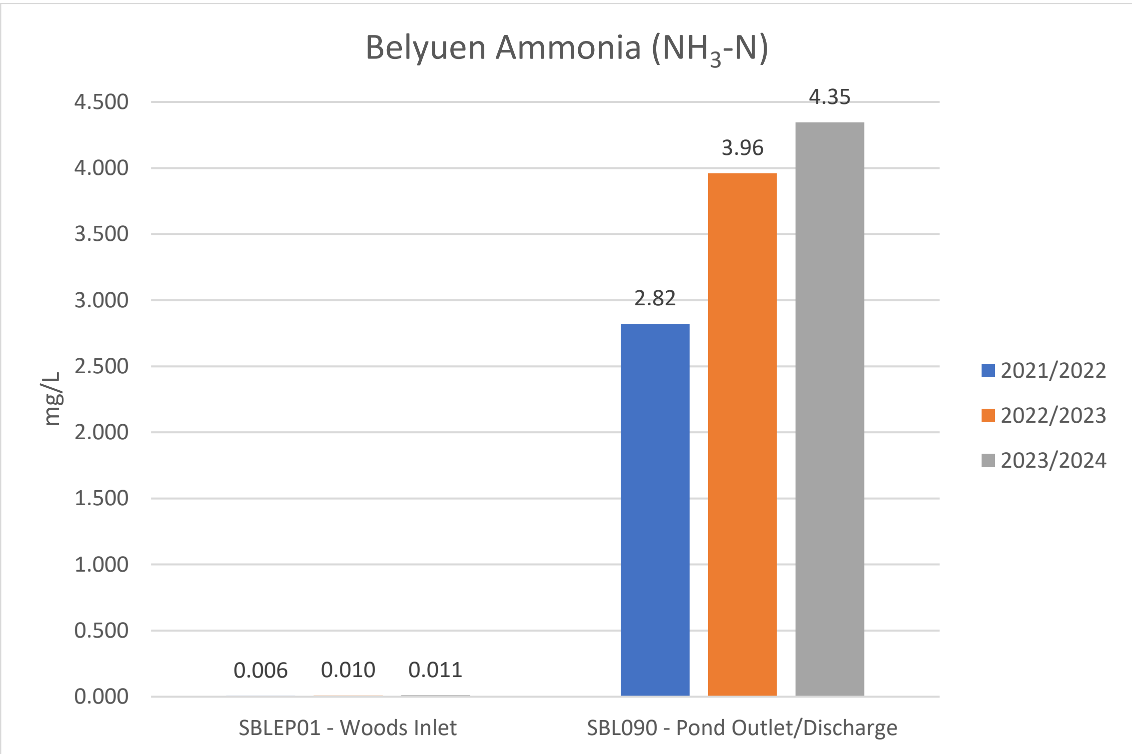

Figure 51. Belyuen Ammonia (NH_3-N)

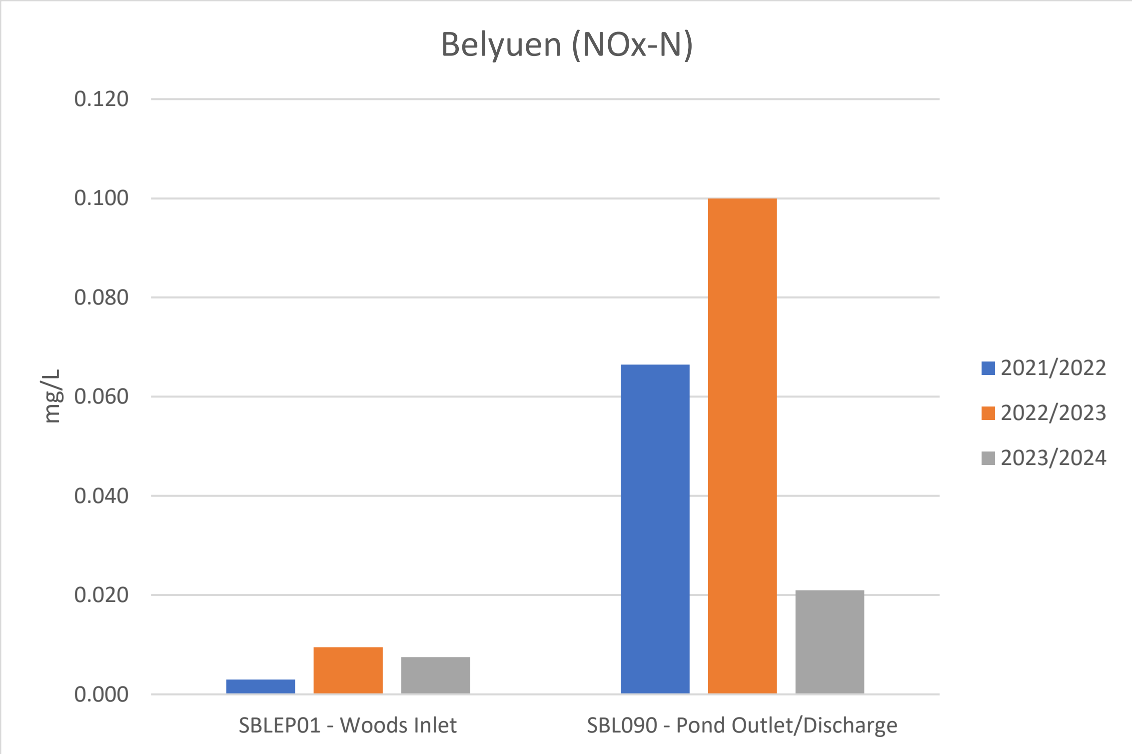

Figure 52. Belyuen Nitrate + Nitrite as N (NOx-N) (mg/L)

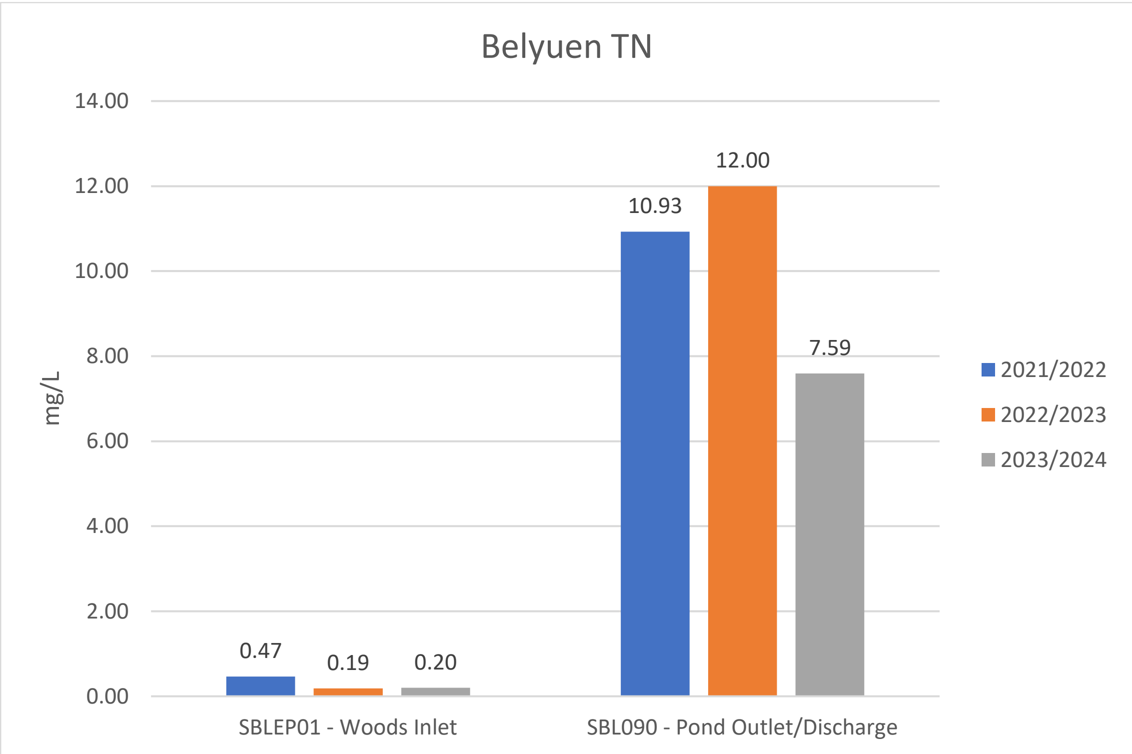

Figure 53. Belyuen Total Nitrogen

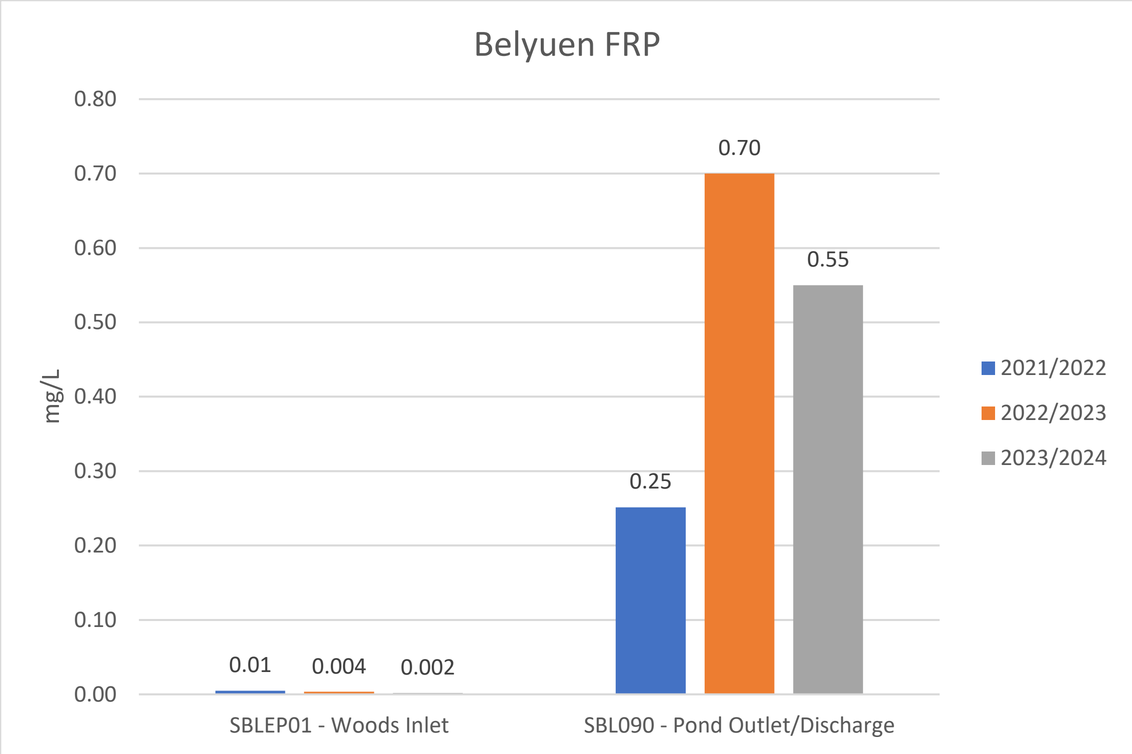

Figure 54. Belyuen Filterable Reactive Phosphorus

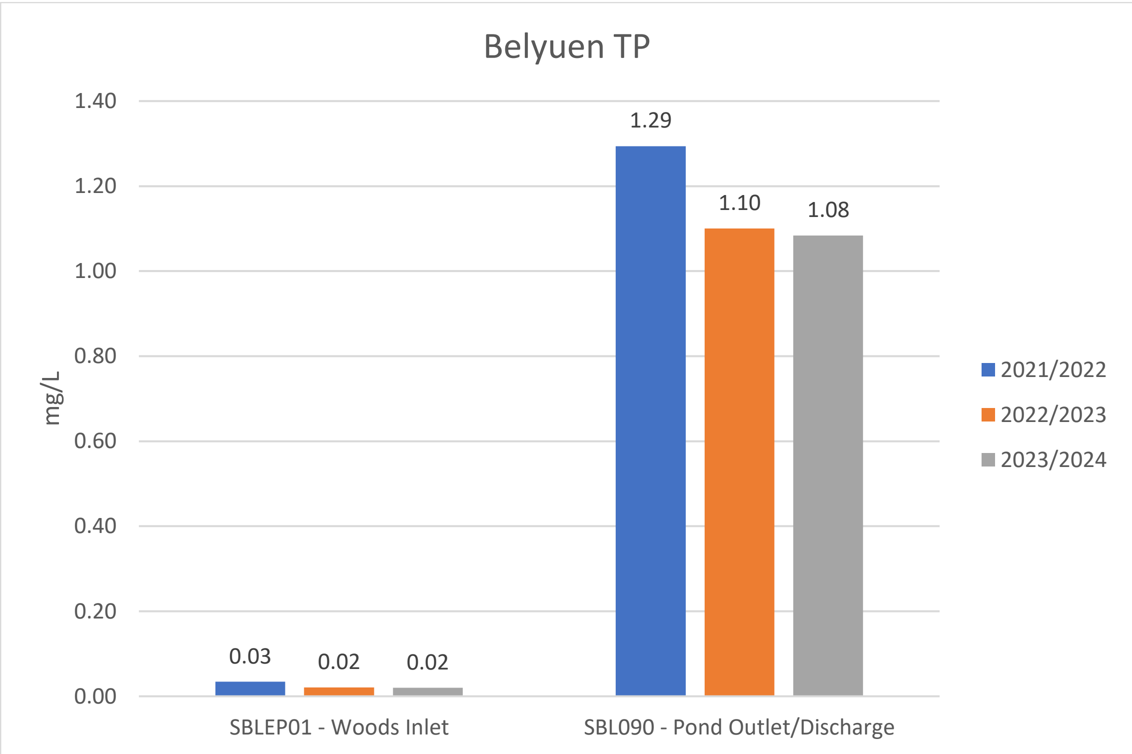

Figure 55. Belyuen Total Phosphorus

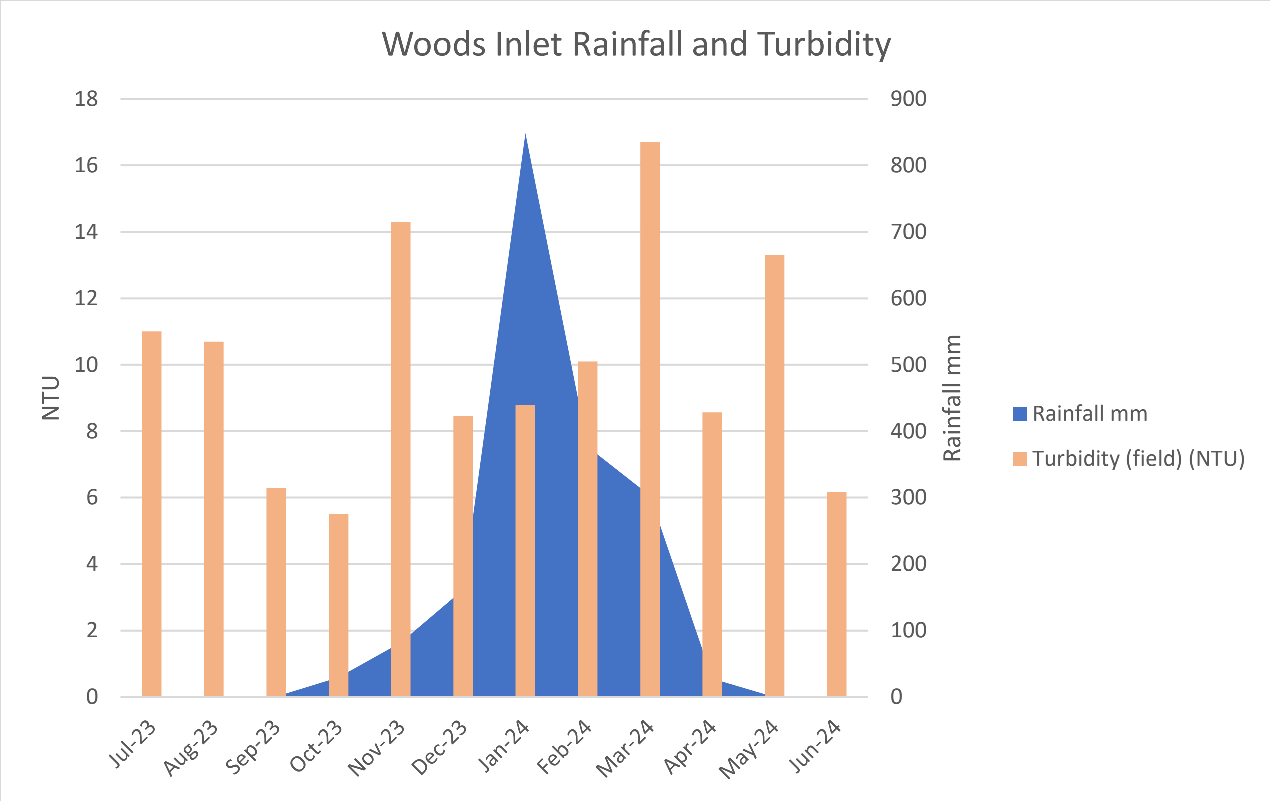

Figure 56. Woods Inlet Turbidity and Rainfall Trend 2023/2024

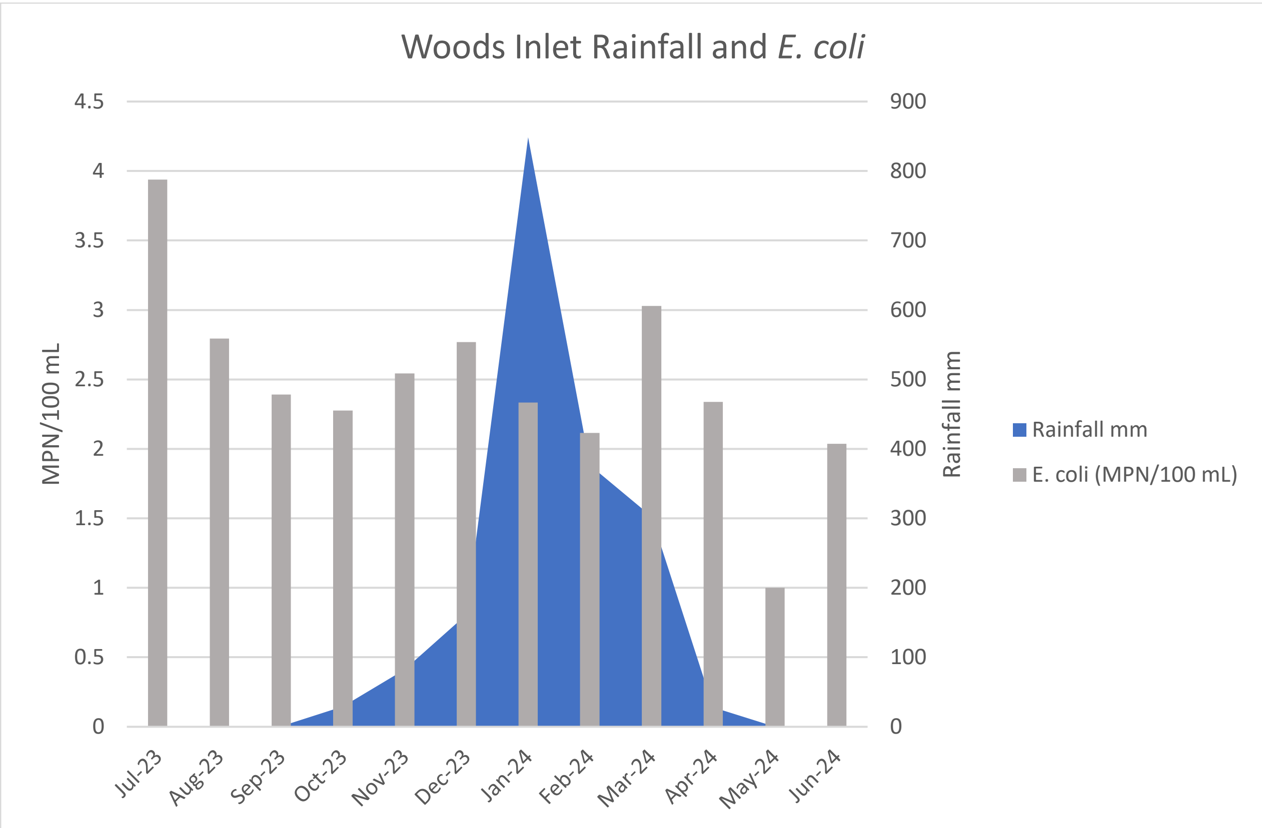

Figure 57. Woods Inlet E. coli and Rainfall Trend 2023/2024.

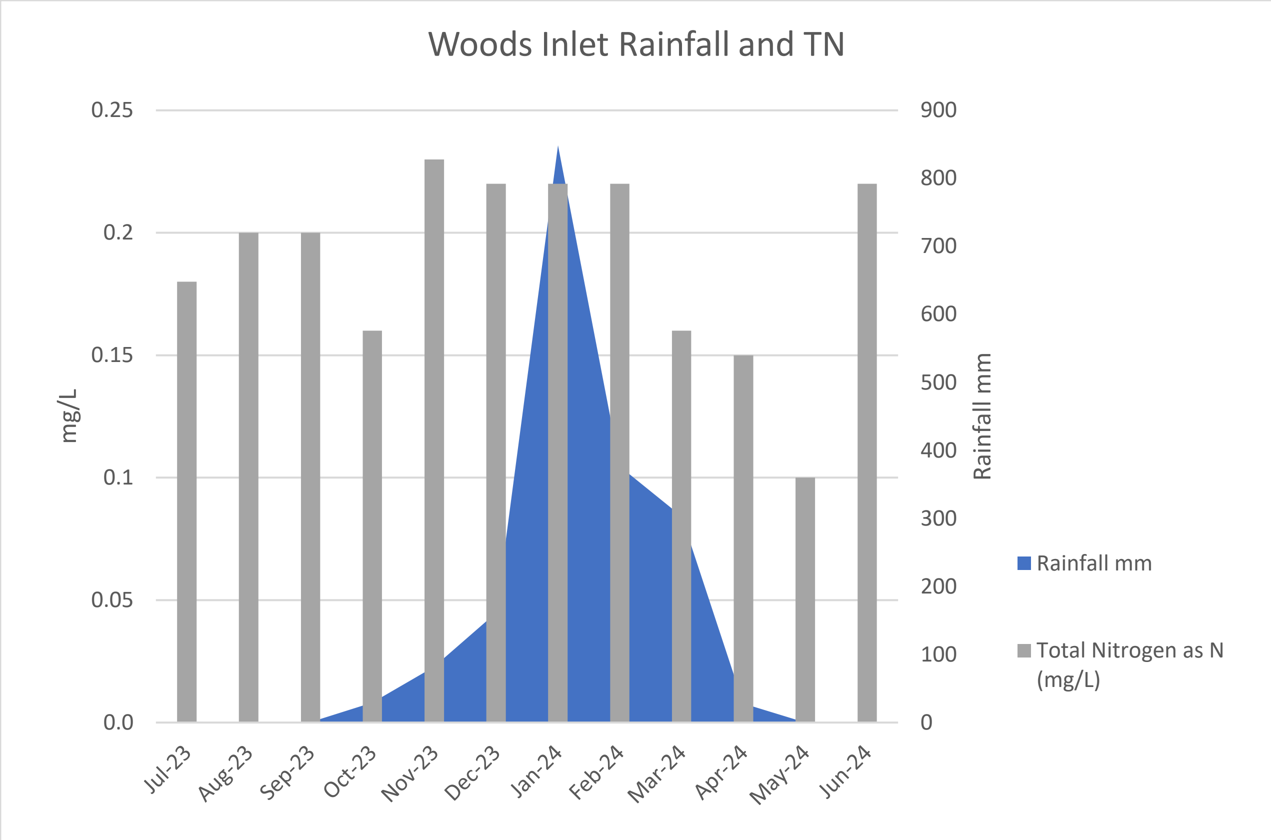

Figure 58. Woods Inlet Total Nitrogen and Rainfall Trend 2023/2024

Appendix C – List of Remote Communities with WDL

Remote Community	WDL	Monitoring Point Site	Licence Expiry
Round 1			
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
Nauiyu	207	SNN090	11/07/2028
Milingimbi	208	SML090	11/07/2028
Round 2			
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
Warruwi	222	SWR090	30/05/2034
Wurrumiyanga	223	SNG090	30/05/2034
Round 3			
Acacia Larrakia	225	SAK090	11/12/2031
Beswick	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	11/12/2031

Table 6. List of Remote Communities with Waste Discharge Licence

Appendix D – Tabulation of Monitoring Results – Treated Effluent

POWER AND WATER CORPORATION WDL Monitoring Report – Remote Community WDLs		
Remote Community WDL Summary Data Sheet	All samples collected are in accordance with the conditions of the WDL's. Data is extracted from the PWC water quality database for assessment and filed on the PWC records management system. 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.	Internal document number D2024/286063

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