Palmerston Wastewater Treatment Plant Monitoring Report WDL 148-08

Reporting Period: 1 September 2023 to 31 August 2024

PowerWater

Document Details and History

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Abbreviations and Glossary

Abbreviation	Definition
Al	Aluminium
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BOD	Biochemical oxygen demand
BWSP	Berrimah Waste Stabilisation Ponds
Cfu	Colony forming units (expressed per unit of a specified volume of sample)
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
Cu	Copper
Cu-B	Bioavailable copper in sediment (estimated by dilute acid extraction)
Cu-F	Copper filtered (dissolved fraction)
Cu:Al	Total copper in sediment normalised to total aluminium content of the sediment
Cu-T	Total copper in sediment
DHWQO(s)	Darwin Harbour water quality objective(s)
DO	Dissolved oxygen
EC	Electrical conductivity
E. coli	*Escherichia coli*
EP	Equivalent population
ERA	Environmental risk assessment
FRP	Filterable reactive phosphorous (orthophosphate)
ISQG	Interim sediment quality guidelines

Kg	Kilograms
kL	Kilolitres
L	Litres
LOP	Level of species protection (%)
LOR	Limit of reporting for chemical analysis
µg	Micrograms
mg	Milligrams
ML	Mega-litres
N	Nitrogen
NATA	National Association of Testing Authorities in Australia
NH_3-N	Total ammonia as N (NH_3 and NH_4^+ as N) as per ANZECC and ARMCANZ (2000) and ANZG (2018)
NHMRC	National Health and Medical Research Council
NO_X-N	Oxidised of nitrogen as N – the sum of nitrate and nitrite
NRETAS	Department of Natural Resources, Environment, The Arts and Sports, Northern Territory
NT	Northern Territory
NT DOH	Northern Territory Department of Health
NT EPA	Northern Territory Environment Protection Authority
NTU	Nephelometric turbidity units
Phaeo-a	Phaeophytin-a, a degradation product of chlorophyll-a
PWC	Power and Water Corporation
QA/QC	Quality assurance and quality control
SMD	A slightly-moderately disturbed aquatic ecosystem. This reflects both the management intent and subsequently the level of protection (ANZECC 95% Species Protection).
SMDZ	Slightly to moderately disturbed zone

SSTV(s)	Site specific trigger value(s)
TN	Total nitrogen
TN:TOC	Total nitrogen to total organic carbon ratio in sediment
TOC	Total organic carbon
TP	Total phosphorous
TSS	Total suspended solids
TV(s)	Trigger value(s)
WDL(s)	Waste discharge licence(s)
WQO(s)	Water quality objective(s)
WSP(s)	Waste stabilisation pond(s)
Zn	Zinc
Zn-B	Bioavailable zinc in sediment (estimated by dilute acid extraction)
Zn-F	Zinc filtered (dissolved fraction)
Zn:Al	Total zinc in sediment normalised to total aluminium content in sediment
Zn-T	Total zinc in sediment
ZOI	Zone of influence of the discharge (disturbed zone 90% species protection level or less)

Executive Summary

This report summarises the monitoring results and analysis of sampling undertaken in accordance with Waste Discharge Licence (WDL) 148-08 and fulfils the reporting requirements to the Department of Environment, Parks and Water Security (DEPWS) for the period of September 2023 – August 2024.

Data collected within the reporting period adhered to the prescribed schedules and Quality Assurance/Quality Control (QA/QC) criteria to ensure the accuracy and reliability of water quality monitoring data. The report offers a comprehensive summary of monitoring data and assessments, emphasising the importance of trigger values in the assessment framework.

Analysis of Palmerston WWTP effluent and receiving water quality monitoring data indicates the following:

- **Wastewater discharge and mass loading -** Mass load estimates are provided using data from inflow and discharge points.

- **Physio-chemical parameters –** Physio-chemical parameters at all monitoring sites met the requirements of Site Specific Trigger Values (SSTV) with the exception of one exceedance of Total Dissolved Solids at SPAMY06.

- **Nutrient parameters -** Some nutrient levels (Ammonia, Total Nitrogen, Oxidised Nitrogen and Total Phosphorous) exceeded the prescribed SSTVs. However, as the corresponding Chlorophyll-a values were below the SSTV, the elevated nutrient levels are not a reportable exceedance.

- **Metals -** Several contamination events were identified which commenced when Power and Water Corporation entered a contract with a new laboratory service in October 2022. These events resulted in elevated filtered/soluble zinc levels which were higher than the corresponding total zinc levels. When these events are excluded, the concentration of filtered zinc consistently remains well below both the surface water assessment criteria and the SSTV for the 2023-24 reporting period and the preceding five years.

- **Pathogen indicators -** The Microbial Water Quality Assessment Category of all monitoring sites has been determined in accordance with the National Health and Medical Research Council (MHMRC) Guidelines for Managing Risks in Recreational Waters, as required by WDL148-08. This process assesses Enterococci levels within the water and the corresponding health implications to bathers.

- **Sediments -** Assessment of sediment data at some Myrmidon Creek sites has shown elevated levels for some parameters in comparison to reference site values. However, there were no exceedances of the recommended guidelines over the reporting period.

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1. Monitoring Objective

This report presents the results of the September 2023 to August 2024 data collection and assessment required for Waste Discharge Licence (WDL) 148-08 for surface water, sediment and biological monitoring.

This report is prepared in accordance with conditions in WDL 148-08 issued to Power and Water Corporation, pursuant to section 74 of the Water Act 1992. WDL 148-08 commenced on 1st November 2021. The licence can be accessed via the NT EPA website via the following link; https://ntepa.nt.gov.au/your-business/public-registers/licences-and-approvals-register/waste-discharge-licences/sewerage/power-and-water-palmerston

This report has been prepared as per the following conditions in WDL148-08:

39. *The licensee must complete and provide to the Administering Agency a Monitoring Report, not less than 30 business days prior to the anniversary date of this licence, for each year of this licence, by emailing waste@nt.gov.com.*

40. *The licensee must ensure that each Monitoring Report:*

    40.1. *is prepared in accordance with the requirements of the NT EPA 'Guideline for Reporting on Environmental Monitoring';*

    40.2. *includes a tabulation of all monitoring data required as a condition of this licence and any additional data used as part of the analysis undertaken in the report, to be submitted in electronic Microsoft Excel format.*

    40.3. *includes long-term trend analysis of monitoring data to demonstrate any environmental impact associated with the Licenced activity over a minimum period of six years (where the data is available);*

    40.4. *Includes an assessment of Surface Water Quality in accordance with Appendix 1, Table 1-3 and sediment quality in accordance with Appendix 2, Table 2-1.*

    40.5. *Reports on the progress of the Palmerston Waste Stabilisation Pond Improvement Plan.*

    40.6. *Includes and assessment of environmental impacts from the Activity*

    40.7. *Reports on the following parameters associated with wastewater discharge:*

        Total discharge (ML/year)

        Total biochemical oxygen demand (tonnes/year)

        Total Phosphorus (tonnes/year)

        Total Nitrogen (tonnes/year)

2. Monitoring Objectives and Methods

The monitoring conducted in this reporting period, including Licence Limits, Site Specific Threshold Values (SSTVs) and site locations, are specified in the approved monitoring plans (Appendixes 1, 2, 3, and 4 of WDL 148-08). All site maps and other relevant information can also be found in the licence document.

Specific licence conditions related to monitoring in WDL 148-08 include:

25 The Licensee must conduct water monitoring in accordance with Appendix 1 table 1.1

26 The Licensee must conduct sediment monitoring in accordance with Appendix 2, table 2.1

27 The licensee must ensure that all samples and field environmental data are representative of the conditions at the time of sampling.

28 The licensee must ensure that all samples and field environmental data are collected in accordance with recognised Australian Standards and guidelines (such as AS/NZS 5667, ANZG 2018).

29 The licensee must ensure that all monitoring samples are analysed at a laboratory with current NATA accreditation or equivalent, for the parameters to be measured.

30 The licensee must for all land based monitoring points specified in this licence

30.1. Install, maintain and provide appropriate identification signage so that they are easily identifiable at all times; and

30.2. Maintain safe access and egress, as is reasonably practicable

31 The licensee must ensure any samples collected in accordance with Appendix 1, 2 and 3 of this licence or in connection with the Licenced activity or this licence, are obtained by, or under the supervision of, a qualified sampler

32 The licensee must ensure that, for each sample collected in accordance with this licence or in connection with the activity or this licence, the following information must be recorded and retained:

32.1. the date on which the sample was collected;

32.2. the time at which the sample was collected;

32.3. the location at which the sample was collected;

32.4. the name of the person who collected the sample;

32.5. the chain of custody forms relating to the sample;

32.6. the field measurements (if any) and analytical results relating to the sample; and

32.7. laboratory quality assurance and quality control documentation.

2.1 Assessment criteria

WDL 148 compliance monitoring assesses results against SSTVs relevant to the protection of the declared Beneficial Uses under the *Water Act* (NT) and the Darwin Harbour Water Quality Objectives (DHWQO) (NRTEAS 2010). These SSTV values have been developed and refined from previous versions of WDL 148 in partnership between the NT EPA and the Power and Water Corporation.

2.2 Surface Water

During the reporting period, the assessment of each parameter was conducted in accordance with either a assessment criteria value or a SSTV as required in Appendixes 1, 2, and 3 of WDL 148-08.

Data from the Outer or Mid Estuary was assessed against the DHWQO guidelines, the ANZG 95% level of species protection (ANZG 2018), and the NHMRC (2008) Guidelines for Recreational Water.

This assessment includes a long term trend analysis of monitoring data to demonstrate potential environmental impact associated with the activity of Palmerston WwTP over the last six years.

For exceedance reporting within the reporting period, individual spot values were compared to guideline values, or where specified in the WDL, a six-monthly rolling median was calculated for assessing compliance.

2.3 Sediment

As specified in the WDL sediment monitoring plan, sediment quality was assessed against either Sediment Quality Guideline (SQG) ANZG (2018) values, water quality SSTVs for the relevant zone, or against 2 x 80th percentile of reference site data from Short Creek, which was considered an appropriate reference as it is unaffected by waste discharge, providing a reliable baseline for comparative analysis.

3.Monitoring Results

All collected data associated with WDL 148-08 and referred to in this report is summarised and presented in an Excel spreadsheet which has been provided to DEPWS ("Palmerston WwTP Monitoring Report Data" - D2024/362592).

3.1 Wastewater Discharge and Mass Loading

Mass load estimates are provided using data from inflow and discharge points (Table 1). It should be noted that reported values are subject to uncertainty due to laboratory analysis reporting limits. The method for calculating discharge loads was to multiply the reported analyte concentrations by inflow and discharge volumes. In the event that reported analyte concentrations were below the limits of reporting (LOR), half the LOR value was used for the calculation. below presents mass loads for selected parameters for the 2023 – 2024 financial year.

Table 1. Mass Loading Discharged to Myrmidon Creek for the 2023 – 2024 Reporting Period.

Parameter	Discharge to Myrmidon Creek (tonnes/year)
Biochemical Oxygen Demand	148.61
Total Phosphorus	25.04
Total Nitrogen	190.11
Total Flow volume ML/year	**4935.107**

3.2 Physico-chemical parameters

Physio-chemical parameters at all monitoring sites met the requirements of SSTVs (Figure 1), with the exception of one exceedance of Total Dissolved Solids at SPAMY06.

SPAMY06 recorded a TSS of 20mg/L on 04/10/2023, exceeding the SSTV of 15mg/L. On 04/10/2023, SPAMYDP recorded a TSS reading of 104.0mg/L and TSS decreased significantly to 18.0g/L at SPAMY01, increasing to 19.0mg/L at SPAMY03 and decreasing to 13.0mg/L at SPAMY05. As such, it appears that the increase to 20.0mg/L at SPAMY06 is likely due to sources other than the discharge point.

TSS levels returned to within SSTV limits during the following sampling event and further exceedances were not detected until the 2024 Wet season (i.e. March and April 2024), during which trigger values developed from the Water Quality Objectives for the Darwin Harbour Region (NRETAS 2010) do not apply. In accordance with condition 36 of the WDL, the exceedance on 04/10/2023 is not recognised as a non-compliance.

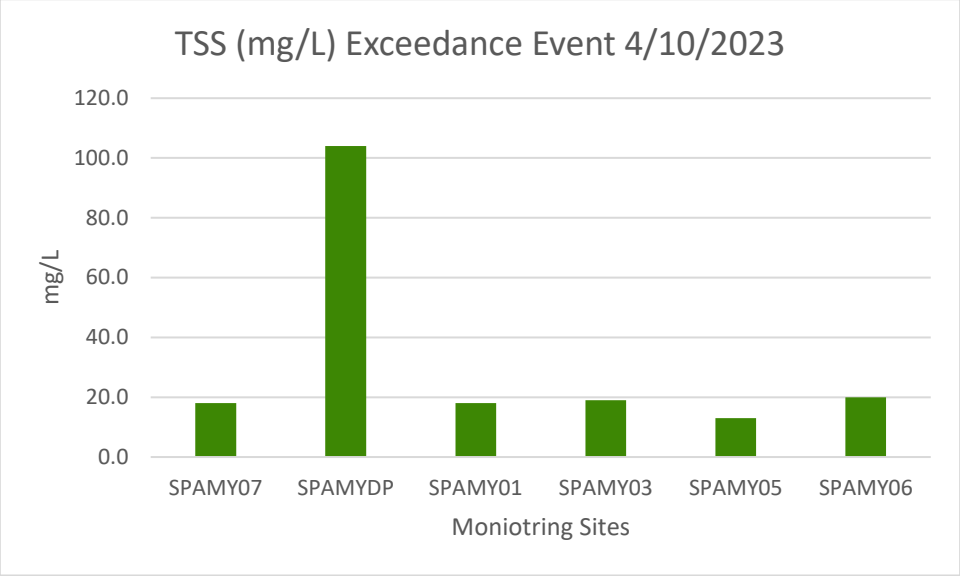

Figure 1. Total suspended solids results from all sampling sites during the exceedance event on 04/10/2023.

3.3 Biological parameters

There were no exceedances for Chlorophyll-a within the 2023-2024 reporting period.

3.4 Nutrient parameters

The assessment of nutrient levels within Myrmidon creek identified several instances that exceeded the prescribed SSTV at the SMDZ monitoring points. However, while some Ammonia, Total Nitrogen, Oxidised Nitrogen and Total Phosphorous levels were greater than the SSTV, as the corresponding Chlorophyll-a values were below the SSTV, the elevated nutrient levels are not a reportable exceedance.

Chlorophyll-a is considered the primary indicator of the environmental effect of nutrient loads, providing a measure of algal abundance and eutrophication. As such, while there may have been occasional nutrient exceedances, the overall nutrient load in the creek was not sufficient to trigger eutrophication—a process characterised by excessive nutrient levels leading to harmful algal blooms and water quality degradation.

All nutrient levels remained within the surface water assessment criteria limits for the 2023-24 reporting period for ZOI and SMDZ sites.

3.5 Metal parameters

In October 2022, Power and Water Corporation entered a contract with a new laboratory service provider. This contract covered laboratory services and the provision of materials used for collecting environmental samples as per WDL monitoring requirements. However, as we received the results of our analysis, we noted a significant increase in filtered zinc concentrations, and that the filtered zinc levels exceeded total zinc levels.

Following this, the contractor responsible for collecting water samples initiated an investigation which continued until the contamination source was identified, which occurred approximately five months after the initial detection of the anomaly. For further details, please refer to the 2022-2023 Palmerston WwTP Monitoring Report.

To conduct an accurate assessment of the monitoring data for the purpose of this report, the contamination events have been removed from the dataset and are listed in the tabulated data. When these instances are excluded, the concentration of filtered zinc consistently remains well below both the surface water assessment criteria limit and the SSTV for the 2023-24 reporting period and the preceding five years.

Filtered copper levels did not exceed the prescribed SSTV within the 2023-24 reporting period, however, there was a slight exceedance of the surface water assessment criteria (1.3µg/L) at SPAMY01 attributed to a sample collected during the Wet season.

3.6 Pathogen indicators

The Microbial Water Quality Assessment Category of each of the Myrmidon Creek monitoring sites has been determined in accordance with the National Health and Medical Research Council (MHMRC) Guidelines for Managing Risks in Recreational Waters (Table 2), as required by WDL148-08. This process assesses Enterococci levels within the water and the corresponding health implications to bathers.

Monitoring site SPAMY01 was determined as a category D due to Enterococci levels within the 2023-2024 reporting period. Within this category, the NHMRC guidelines estimate the probability of the following health implications per exposure:

- >10% risk of gastrointestinal (GI) illness.
- >3.9% risk of AFRI (Acute Flaccid Respiratory Infection).

As SPAMY01 is closest to the discharge location in the Zone of Influence (ZOI), this level of probability regarding adverse health outcomes is expected.

Monitoring site SPAMY03 and SPAMY07 were determined as a category C, which denotes the following health implications per exposure:

- 5-10% risk of gastrointestinal (GI) illness.
- 1.9-3.9% risk of AFRI (Acute Flaccid Respiratory Infection).

SPAMY03 is located downstream of SPAMY01 within the ZOI.

SPAMY07 is located upstream of all other monitoring points, within the Slightly-Moderately Disturbed Zone (SMDZ). It's important to note that SPAMY07 receives drainage and runoff from the surrounding residential area which can introduce external factors and contaminants, especially during rain events. As such, this monitoring point can experience localized variations in water quality.

Monitoring site SPAMY05 and SPAMY06 were determined as a Category B and are subject to the following health implications per exposure:

- 1-5% risk of GI illness.
- 0.3-1.9% risk of AFRI.

SPAMY05 and SPAMY06 are located downstream of SPAMY03 within the SMDZ. SPAMY06 is located at the mouth of Myrmidon Creek.

Regarding environmental monitoring analysis and exceedance reporting, Enterococci levels exceeded the Assessment Criteria on various occasions during the Wet season (i.e. November, December, January, February and March) and in the Dry season (i.e. June). Enterococci levels exceeded the SSTVs on two

occasions during the Wet season (i.e. January and Febuary). However, the Enterococci assessment criteria and SSTVs are developed from the Water Quality Objectives for the Darwin Harbour Region (NRETAS 2010) and do not apply in Wet season months.

All results from the Dry season months of the 2023-24 reporting period consistently demonstrated Enterococci levels well below the relevant SSTVs.

Table 2. NHMRC Enterococci Category Results Table.

Monitoring Point	Enterococci Results - Long Term 95th Percentile (Hazen Method)	Category
SPAMY01	134.7	D
SPAMY03	106.7	C
SPAMY05	134.7	B
SPAMY06	106.7	B
SPAMY07	229.6	C

3.7 Sediment

All data was collected at the frequencies defined in the sediment monitoring schedule of WDL 148-08. The QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) as described in ANZG (2018) were met for sediment monitoring. **Error! Reference source not found.** and

Table 6 provide values for the sediment data collected in the 2024 dry season.

Assessment of sediment has shown that all sites remained under the recommended default guideline values (DGV) during the 2023 – 2024 reporting period.

Comparison to the site-specific assessment protocol has shown:

- SPAMY06 is slightly above the reference value for Aluminium-normalised Total Zinc; however, the sites closest to the discharge point remain below.
- Three sites (SPAMY03, SPAMY05 and SPAMY06) have shown higher ratios to Pheophytin-a in comparison to the reference site.
- Pore water samples at SPAMY06 and SPAMY07 returned results higher than the reference value for both Copper and Zinc, while the three other Myrmidon Creek sites remain under the limit of reporting (LOR) for both analytes.
- Total phosphorus at SPAMY03 and SPAMY06 are above the reference site value, with the other Myrmidon Creek sites being similar to the Short Creek reference sites.
- SPAMY03 was slightly higher than the reference value for Ammonia as N (pH adjusted), as was one of the reference sites (SPASC03).

3.8 Summary of trigger value exceedances during reporting period

Table 3: Trigger value exceedances for WDL148-08 from September 2023 to August 2024

Indicator	Site	Zone	Date	Reporting statistic	Reporting value	Reporting limit	significance
Total Dissolved Solids (TSS)	SPAMY06	SMDZ	04/10/2023	Individual Value	20mg/L	>15mg/L	Not reportable (see condition 36)
Total Dissolved Solids (TSS)	SPAMY05	SMDZ	12/03/2024	Individual Value	21.0	>15mg/L	Not reportable (SSTV does not apply in Wet season).
Total Dissolved Solids (TSS)	SPAMY06	SMDZ	12/03/2024	Individual Value	48.0	>15mg/L	As above.
Total Dissolved Solids (TSS)	SPAMY06	SMDZ	11/04/2024	Individual Value	16.0	>15mg/L	As above.
Total Dissolved Solids (TSS)	SPAMY07	SMDZ	11/04/2024	Individual Value	26.0	>20	As above.
Total Dissolved Solids (TSS)	SPAMY07	SMDZ	11/04/2024	Individual Value	24.0	>20	As above.
Enterococci	SPAMY07	SMDZ	29/01/2024	Individual Value	279.0	>200	As above.
Enterococci	SPAMY05	SMDZ	13/02/2024	Individual Value	278.0	>200	As above.

4. Monitoring Results – quality assurance/ quality control (QA/QC) evaluation

All data was collected at the frequencies defined in the Surface Water Monitoring Schedule and Sediment Monitoring Schedule of WDL 148-08 and the QA/QC criteria of sampling and data analysis (collection of blanks, duplicate and triplicate samples) were met.

The QA/QC protocol incorporates an approach that includes z-score flagging to identify potential outliers and anomalies in the data. Additionally, the protocol utilises duplicate samples and field blanks to ensure the accuracy, precision, and reliability of the monitoring results. Duplicate samples are employed to assess the consistency of the data, while field blanks are used to detect any contamination that might occur during sample collection or analysis. Together, these methods provide a framework for maintaining high data quality and integrity throughout the monitoring process.

5. Discussion

5.1 Palmerston Waste Stabilisation Ponds Improvement Plan

Actions listed in the Palmerston Waste Stabilisation Ponds Improvement Plan 2021 are ongoing. Table 4 identifies the management goals of the Palmerston Waste Stabilisation Ponds Improvement Plan.

Table 4: Management Goals – Palmerton Waste Stabilisation Ponds Improvement Plan 2021

Management Goals		**Timeframe**
Goal 1	**Comply with the conditions of WDL 148**	
Statement	Except as permitted by the Licence, the discharge will not either directly or indirectly alter the properties of the receiving waters so as to render it less fit for a prescribed beneficial use.	Ongoing

Actions	• Discharge effluent via authorised discharge point only.
	• Ongoing condition monitoring and assessment in receiving environment inclusive of the zone of influence where beneficial uses may not be protected.
	• Progress performance improvement through:
	  ○ Improvement plan actions; and
	  ○ Periodic risk assessment updates.	

Goal 2	**Improve treatment efficacy within the constraints of the existing infrastructure**	Ongoing
Statement	PWC will operate the ponds in a manner that ensures optimal treatment performance	
Actions	• Implement routine wastewater quality monitoring program across the treatment train.	
	• Routine inspections of pond condition and maintenance.	

Recent maintenance actions include:

- Surface scum removal (undertaken several times per year).
- Pond 5 desludged in 2020 (approximately 90% of sludge volume removed).
- Pond 3 sludge survey completed in October 2020.

Changes like desludging, which take ponds offline can reduce treatment efficacy short-term, but are important components of ensuring long-term capacity and treatment outcomes.

6. Conclusion

This report summarises monitoring and results of sampling undertaken in accordance with WDL 148-08 and fulfils the reporting requirements to DEPWS. A detailed summary of all results, from both this and previous years, is summarised, and presented in an Excel spreadsheet which has been provided to DEPWS ("Palmerston WwTP Monitoring Report Data" - D2024/362592).

Regarding environmental impact form the licensed activity, which has been occurring for more than 30 years, surface water analysis at monitoring sites indicate little change from previous years. As stated in the '2021 Environmental Risk Assessment for the Discharge from Palmerston Waste Stabilisation Ponds to Myrmidon Creek' (D2021/14491), "overall, the ecological health of Myrmidon Creek is considered largely intact with limited - to no indications of secondary responses such as dissolved oxygen suppression; in-situ biomass stimulation; impacts on nutrient cycling and benthic fluxes; or significant accumulation of contaminants".

Due to Enterococci levels within the 2023-2024 reporting period, monitoring site SPAMY01 was determined as a category D in accordance with the NHMRC guidelines which estimates the probability of health implications (i.e. GI illness and AFRI risk) per exposure. As SPAMY01 is closest to the discharge location in the ZOI, high probability regarding adverse health outcomes is expected. However, SPAMY01 is not a known bathing or swimming site and public warning signs are in place.

Based on chlorophyll-a concentrations, elevated levels of some nutrients at some surface water sites does not appear to be translating to eutrophication.

There were eight non-reportable exceedances of SSTVs during the 2023-2024 reporting period as highlighted in table 3, seven of which occurred within the Wet season, during which trigger values developed from the Water Quality Objectives for the Darwin Harbour Region (NRETAS 2010) do not apply.

7.Certification

I Mark Rodriquez, 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.

(*being a person authorised to legally represent the holder of the licence*)

Signature:  ..... Date:.....24/09/2024.....

Please note that:

- Significant penalties may apply where it is demonstrated that false or misleading information has been supplied to the NT EPA.

References

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Appendices

Number	Title
Appendix 1	Long-term Water Quality Graphs
Appendix 2	Sediment and Pore Water Quality Tables

Appendix 1 Long-term Water Quality Graphs

Physiochemical

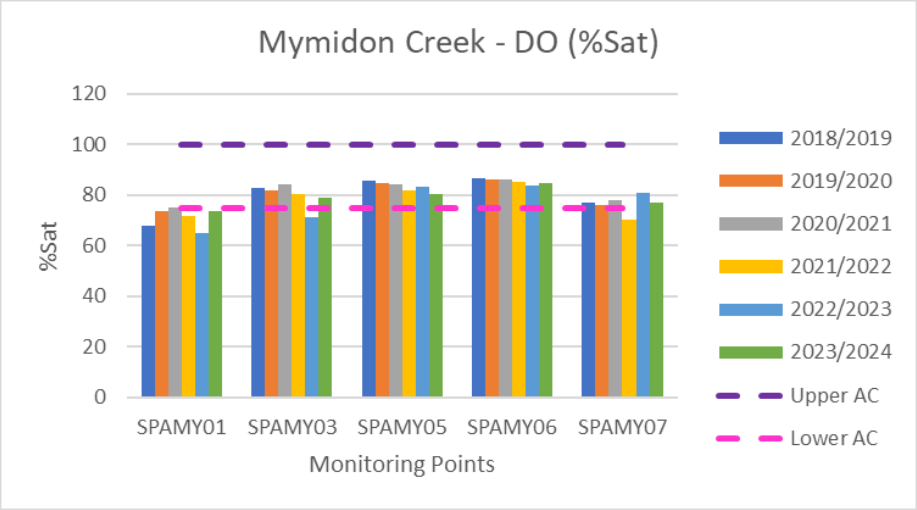

Figure 2. Median Dissolved Oxygen 2018 – 2024.

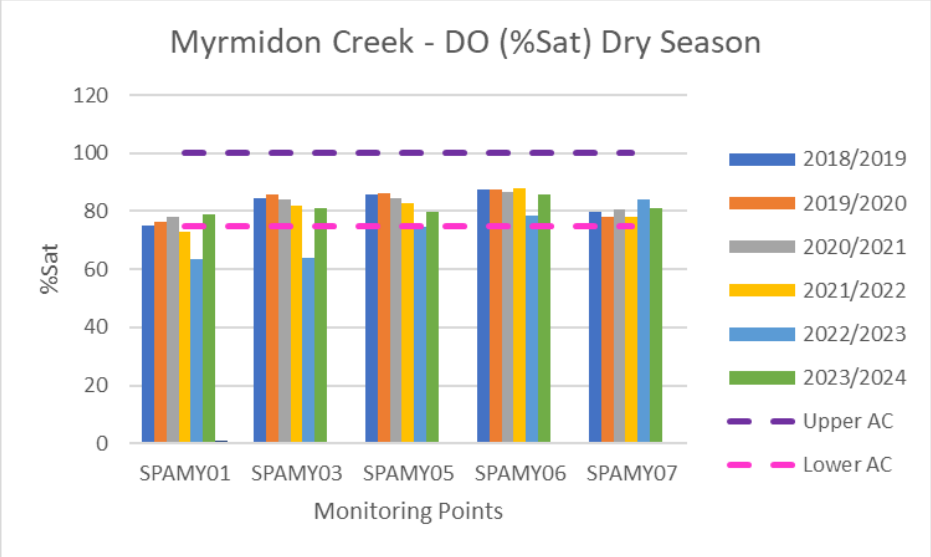

Figure 3. Median Dissolved Oxygen Dry Season 2018-2024.

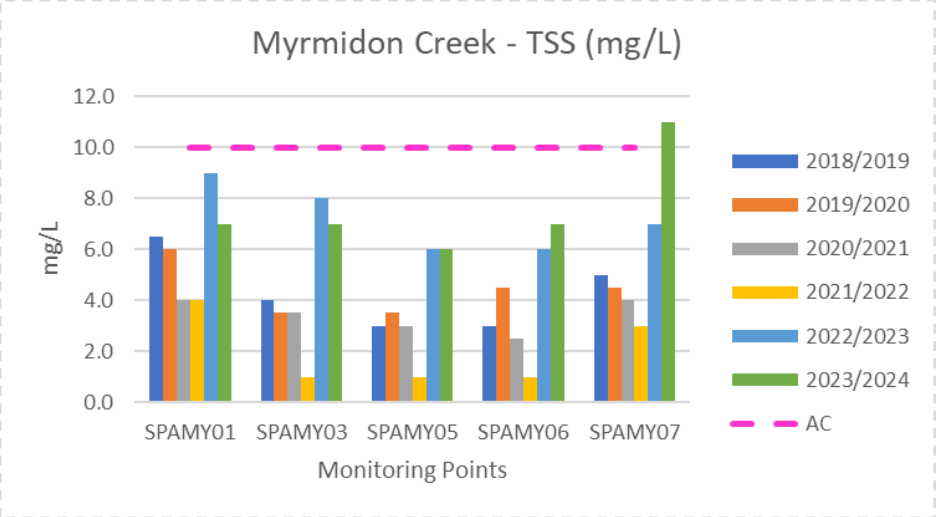

Figure 4. Median Total Suspended Solids 2018 – 2024.

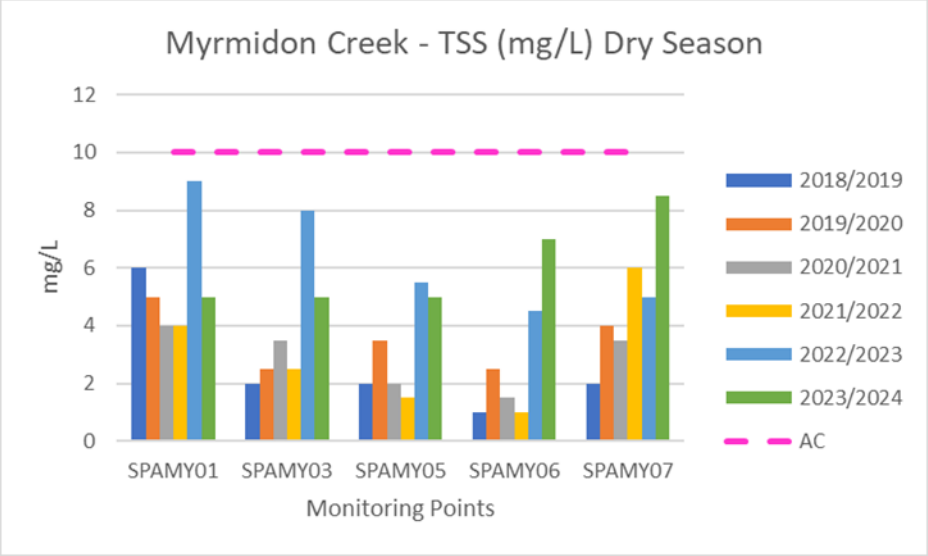

Figure 5. Median Total Suspended Solids Dry Season 2018 – 2024.

Biological

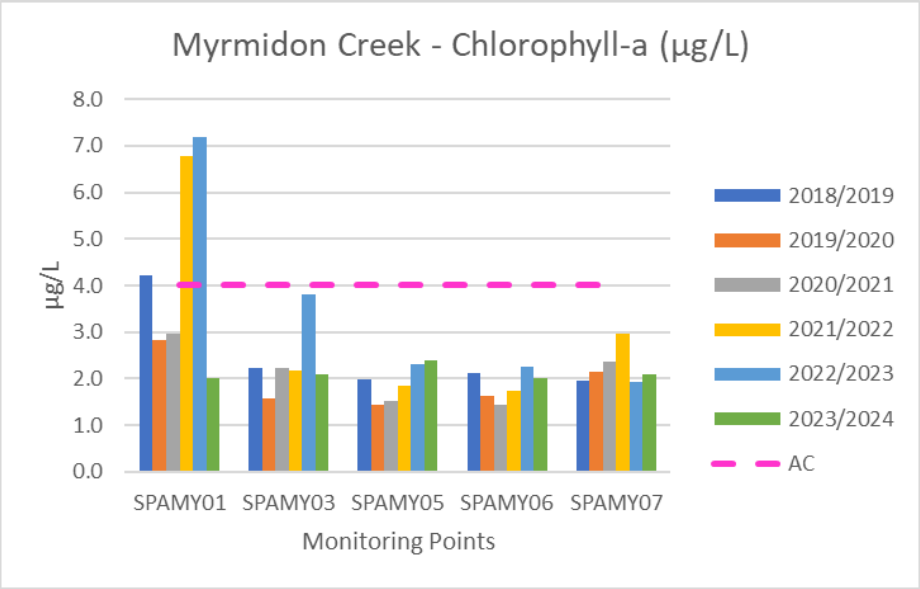

Figure 6. Median Chlorophyll-a 2018 – 2024.

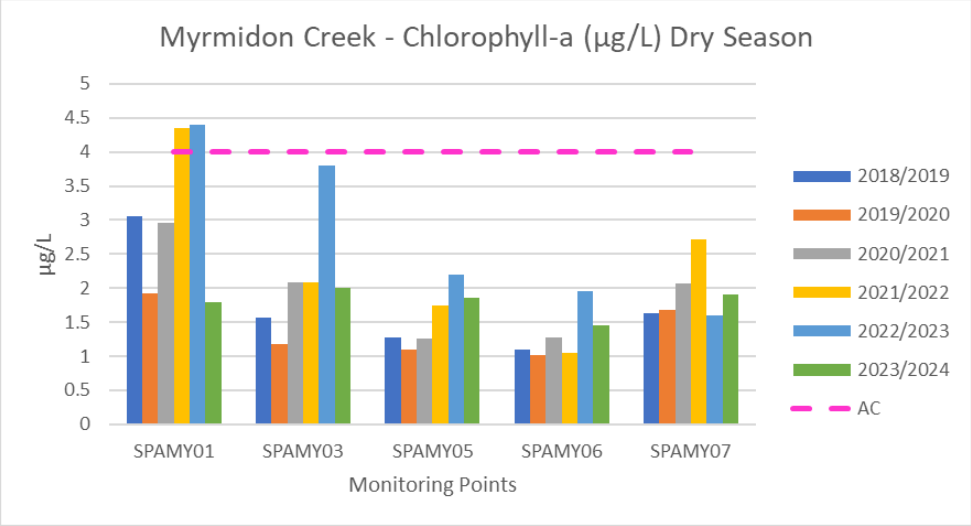

Figure 7. Median Chlorophyll-a Dry Season 2018 – 2024.

Nutrient

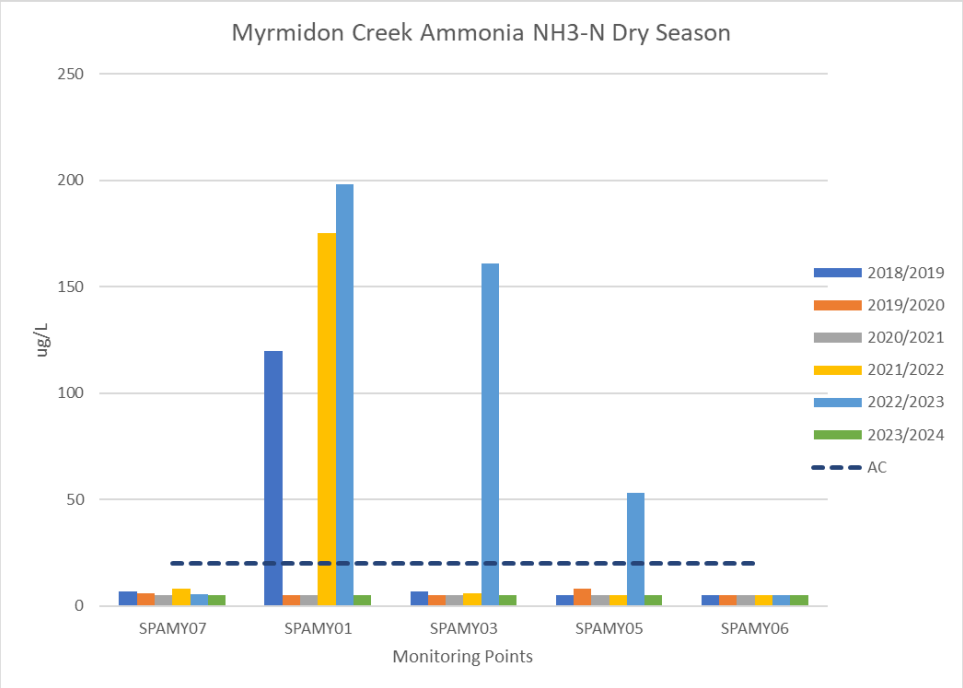

Figure 8. Median Ammonia NH3-N Dry season 2018 – 2024.

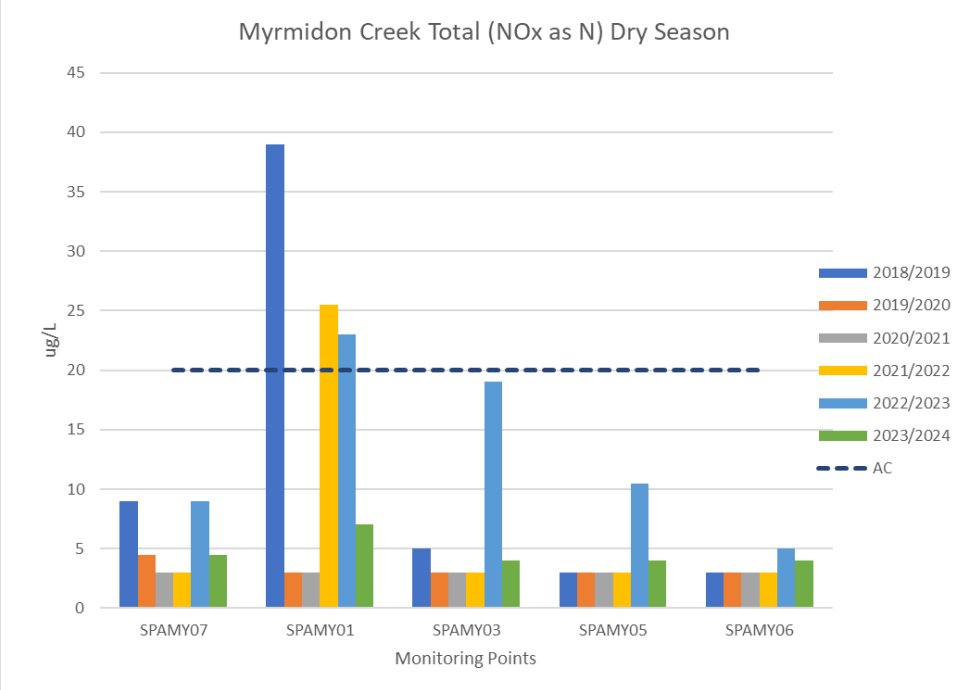

Figure 9. Median of Nitrate + Nitrite as N (NOx-N) Dry season 2018 - 2024.

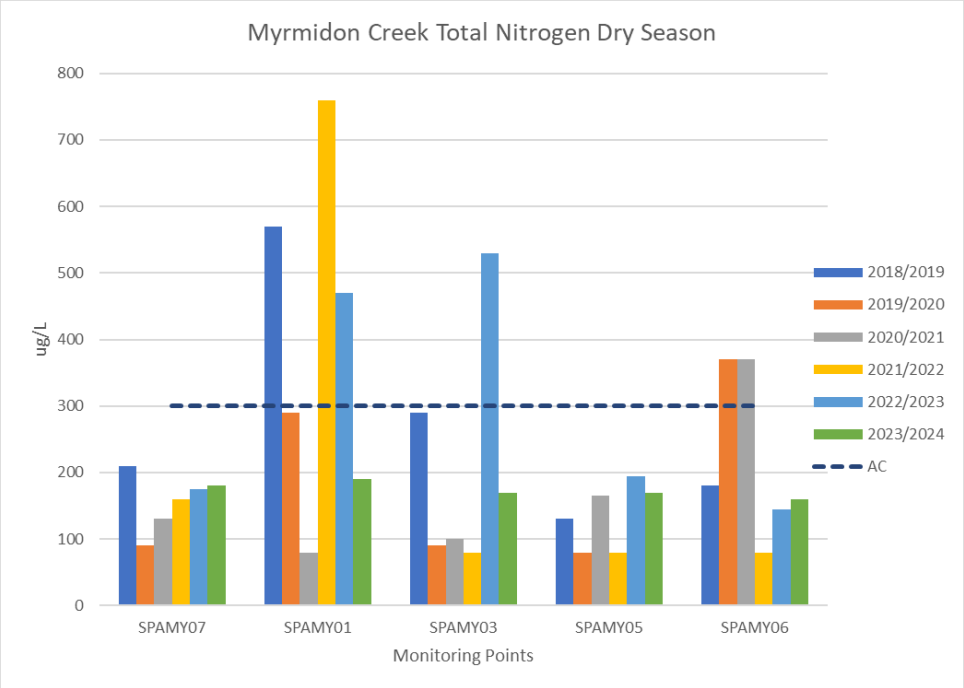

Figure 10. Median of Total Nitrogen Dry season 2018 – 2024.

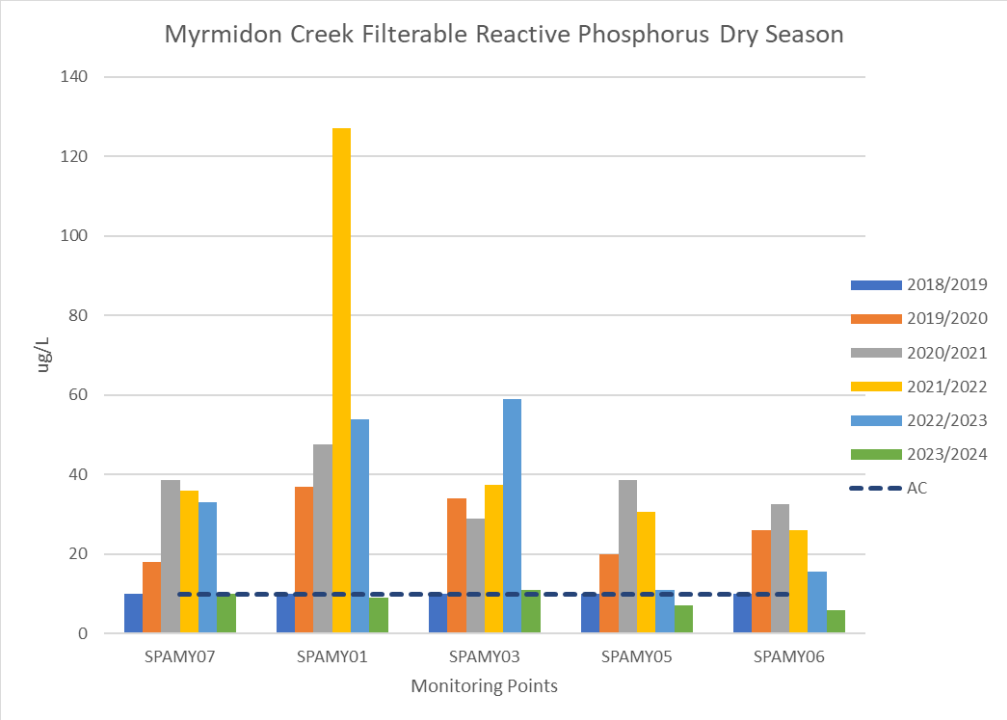

Figure 11. Median of Filterable Reactive Phosphorus Dry season 2018 – 2024.

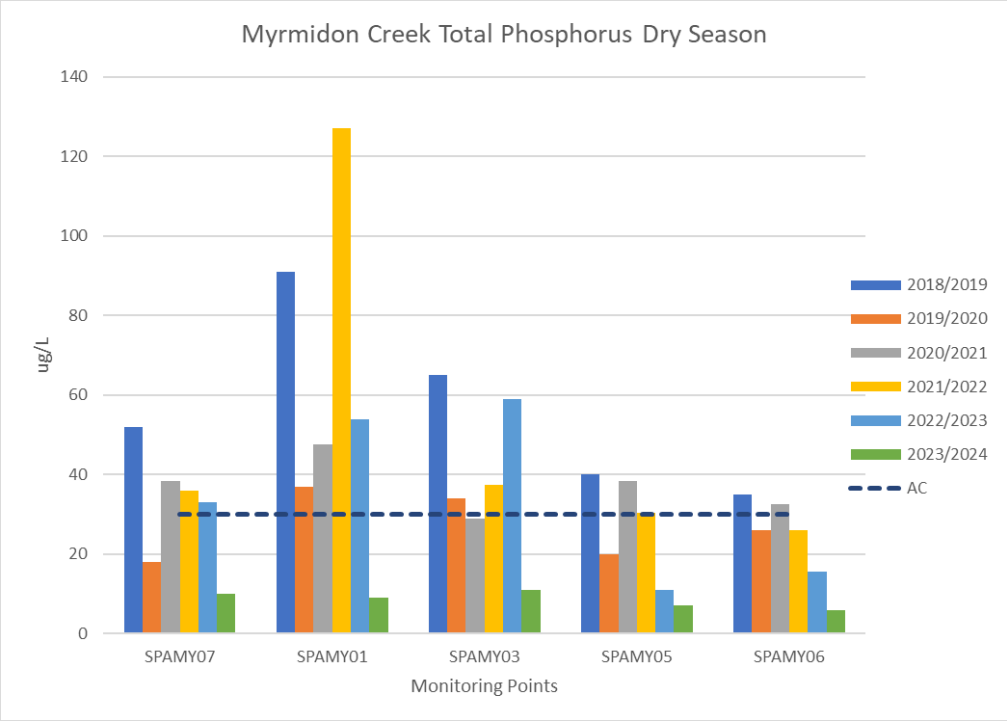

Figure 12. Median of Total Phosphorus Dry season 2018 – 2024.

Metals

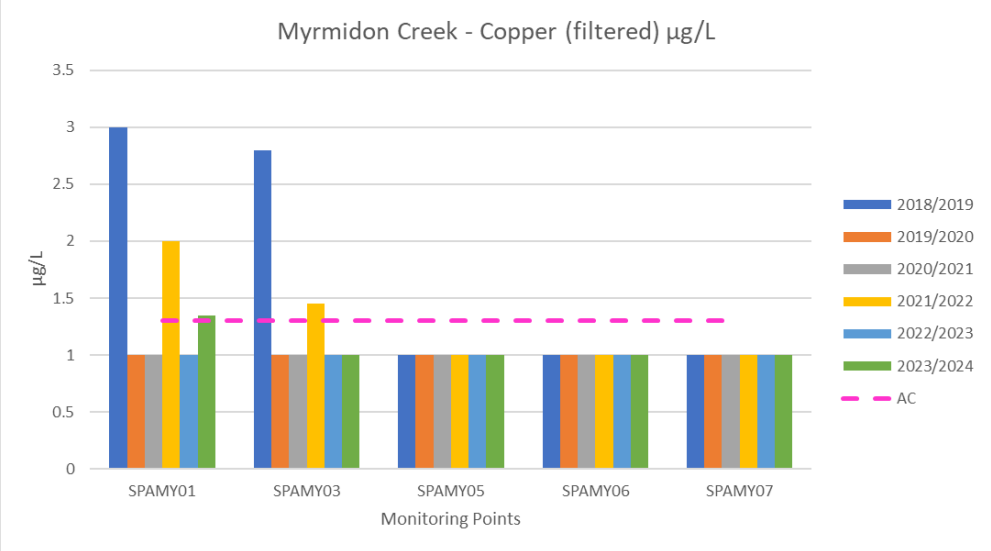

Figure 13. 95th Percentile of Copper (filtered) 2018 – 2024.

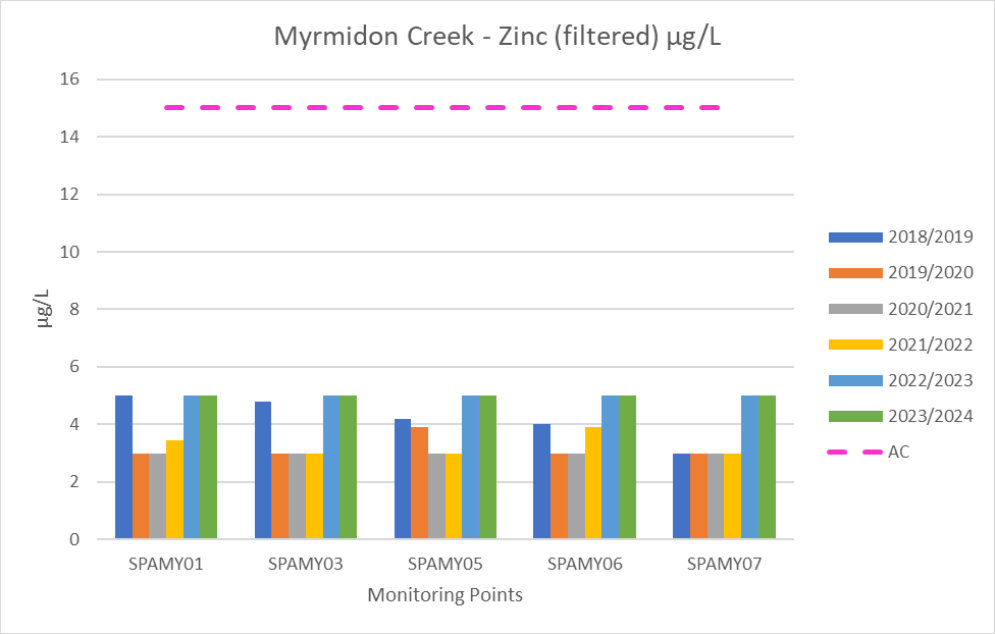

Figure 14. 95th Percentile of Zinc (filtered) 2018 – 2024.

Pathogen

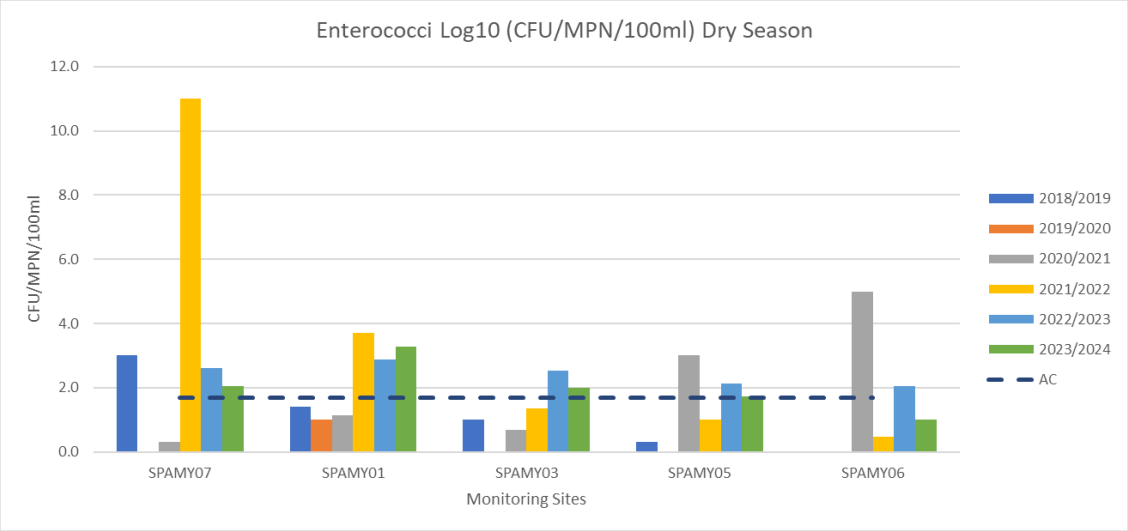

Figure 15. Maximum Enterococci levels Dry season 2018 – 2024.

Appendix 2. Sediment and Pore Water Quality Tables

Table 5. Sediment Assessment of Myrmidon Creek and comparison to Short Creek (reference site) 2024.

			Sediments													
PWC DHSWMP 2024 - Palmerston WWTP		Analyte	Moisture Content	Aluminium	Copper	Zinc	Al normalisation of Total Copper	Al normalisation of Total Zinc	Total Nitrogen as N	Total Phosphorus as P	Total Organic Carbon	C:N Ratios	Chlorophyll *a* mg/kg (dry weight)	Pheophytin *a* mg/kg (dry weight)	Ratios to Pheophytin-a
		Unit	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%				
		LOR	1.0	50	1.0	1.0			20	2	0.02				
Sample Date:	**Client sample ID (1st):**														
Myrmidon Creek															
05/06/2024	SPAMY01		62.5	13900	15.2	40.3	0.00109	0.0029	1930	636	3.16	25	0.16	19.88	0.01
05/06/2024	SPAMY03		64.5	13600	13	36.5	0.00096	0.0027	1800	449	3.39	28	1.68	7.06	0.24
05/06/2024	SPAMY05		55.5	8770	7.4	23.1	0.00084	0.0026	1560	464	3.03	29	2.24	6.06	0.37
05/06/2024	SPAMY06		47.4	6810	5.4	37.4	0.00079	0.0055	1030	320	1.4	20	1.04	0.87	1.20
05/06/2024	SPAMY07		65.9	13800	13.4	42.9	0.00097	0.0031	2530	627	3.84	23	0.1	41.69	0.00
05/06/2024	TRIPLICATE 5A		66.3	14300	12.1	35.7	0.00085	0.0025	2400	608	3.73	23	2.97	13.48	0.22
05/06/2024	TRIPLICATE 5B		65.7	15200	13.2	39	0.00087	0.0026	2460	692	3.56	22	2.54	14.65	0.17
05/06/2024	TRIPLICATE 6A		63.8	11600	9	32.5	0.00078	0.0028	2140	452	3.56	25	5.34	12.28	0.43
05/06/2024	TRIPLICATE 6B		63	13500	12.2	33.4	0.00090	0.0025	1970	546	2.83	22	0.88	0.41	2.15
Short Creek															
04/06/2024	SPASC01		60.3	12500	8.6	32	0.00069	0.0026	1550	384	2.87	28	0.71	3.40	0.10
04/06/2024	SPASC02		63.7	13500	10.2	36	0.00076	0.0027	1910	511	3.29	26	1.12	5.14	0.13
04/06/2024	SPASC03		66.8	12500	8.2	35	0.00066	0.0028	1750	480	3.33	29	2.86	9.31	0.12
04/06/2024	SPASC04		58.5	12300	7.8	29.7	0.00063	0.0024	1380	450	2.46	27	0.79	3.66	0.09
04/06/2024	TRIPLICATE 7A		61.6	11800	8.2	28.7	0.00069	0.0024	1720	452	3	26	1.44	8.25	0.11
04/06/2024	TRIPLICATE 7B		60.7	11500	8.2	29.1	0.00071	0.0025	1490	404	3.74	38	1.22	6.54	0.10
					Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile			Reference Site 2 x 80th Percentile
					17.2	70	0.0014	0.0053	3500	960	6.66	57.09			0.23
					DGV	DGV									
					65	200									
					GV-High	GV-High									
					270	410									

Above reference site
Above DGV (Default Guideline Values)
Above GV-High (Guideline Vaule High)
https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants

Table 6. Pore water Assessment of Myrmidon Creek sample sites and comparison to Short Creek (reference site) 2024.

			Analyte grouping/Analyte	pH Value		Copper		Zinc	Ammonia as N	Total Nitrogen as N	Total Phosphorus as P	Ammonia as N - pH adjusted ANZG 2018 SMD Trigger Values		Nitrite + Nitrate as N		Organic Nitrogen as N	Total Kjeldahl Nitrogen as N		Dissolved Reactive Phosphorus as P
PWC DHSMP 2024 - Myrmidon Creek			Unit	pH Unit		µg/L		µg/L	mg/L	mg/L	mg/L	mg/L		mg/L		mg/L	mg/L		mg/L
			Limit of reporting	0.01		1		5	0.01	0.1	0.01			0.01		0.1	0.1		0.01
Sample Date:	Site Code	Matrix																	
05/06/2024	SPAMY01	POREWATER		7.47	<	1	<	5	2.12	2.9	0.07	0.03		0.09		0.7	2.8		0.06
05/06/2024	SPAMY03	POREWATER		7.53	<	1	<	5	3.86	5.7	0.72	0.07	<	0.01		1.8	5.7		0.03
05/06/2024	SPAMY05	POREWATER		7.58	<	1	<	5	1.31	2.6	0.06	0.03		0.03		1.3	2.6	<	0.01
05/06/2024	SPAMY06	POREWATER		7.66		4		36	1.18	5	0.17	0.03		2.2		1.6	2.8		0.01
05/06/2024	SPAMY07	POREWATER		7.5		30		58	1.4	6.4	0.14	0.02		2.35		2.7	4.1		0.04
05/06/2024	TRIPLICATE 5A	POREWATER		7.59		2	<	5	1.46	2.9	0.09	0.03		0.14		1.3	2.8		0.02
05/06/2024	TRIPLICATE 5B	POREWATER		7.62		1	<	5	1.3	2.8	0.09	0.03		0.13		1.4	2.7		0.02
05/06/2024	TRIPLICATE 6A	POREWATER		7.72		1		16	2.38	6.9	0.1	0.07		2.47		2	4.4	<	0.01
05/06/2024	TRIPLICATE 6B	POREWATER		7.77	<	1	<	5	1.75	3.3	0.1	0.06		0.19		1.4	3.1		0.02
04/06/2024	SPASC01	POREWATER		7.67		2		11	0.9	4.3	0.08	0.02		1.38		2	2.9		0.02
04/06/2024	SPASC02	POREWATER		7.62	<	1	<	5	1.06	2.1	0.07	0.02		0.09		0.9	2		0.01
04/06/2024	SPASC03	POREWATER		7.69	<	1	<	5	3.04	3.8	0.07	0.08		0.13		0.7	3.7		0.01
04/06/2024	SPASC04	POREWATER		7.66	<	1	<	5	1.4	1.5	0.06	0.04		0.08	<	0.1	1.4	<	0.01
04/06/2024	TRIPLICATE 7A	POREWATER		7.64	<	1	<	5	1.3	1.6	0.07	0.03		0.02		0.3	1.6		0.02
04/06/2024	TRIPLICATE 7B	POREWATER		7.67	<	1	<	5	1.24	1.6	0.07	0.03		0.04		0.4	1.6	<	0.01
						Reference Site 2 x 80th Percentile		Reference Site 2 x 80th Percentile		Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile	Reference Site 2 x 80th Percentile							
						2.00		10.00		7.60	0.14	0.07							

Above reference site

https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants

The "Reference Site 2 x 80th Percentile" method is effective for environmental assessments because it accounts for natural variability at a reference site, provides a conservative threshold to identify potential contamination, and is adaptable to different sites and conditions. This approach is supported by environmental guidelines like those from ANZECC/ARMCANZ, which recommend using site-specific data to create relevant guideline values. The method acts as an early warning system, alerting managers to potential risks, making it a robust tool for protecting ecosystems.

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