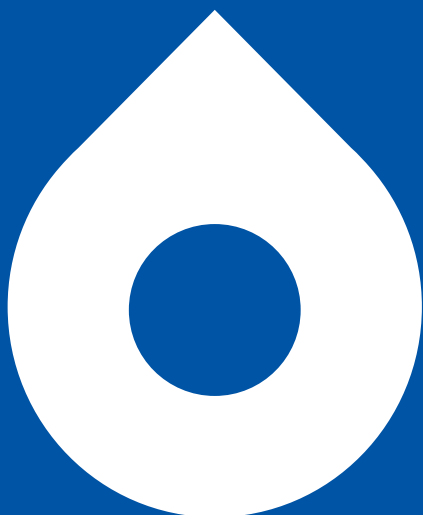


Sydney Water Aquatic Monitoring Program

Volume 2: Appendices B-H
Interpretive Report 2024-25



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B. Georges River

This Appendix mainly includes graphical presentation of all monitoring data for the Georges River catchment. Results are presented following the **Pressure, Stressor and Ecosystem Receptor (P-S-ER)** causal pathway elements.

For the pressure, trend plots are included on wastewater quantity (discharge and inflow) and quality. Trends plots on other supplementary data are also included to improve our understanding on:

- weather condition i.e. catchment specific rainfall condition for each WRRF
- wastewater reuse/ recycling volume of the relevant WRRF.

The sequence of wastewater quality and load plots are same as those described for the Hawkesbury-Nepean River WRRFs (Appendix-A).

Stressor and ecosystem receptor data for the upstream and downstream tributary monitoring sites of each WRRF zone are presented first, then the upstream and downstream monitoring site of mainstream river (if any).

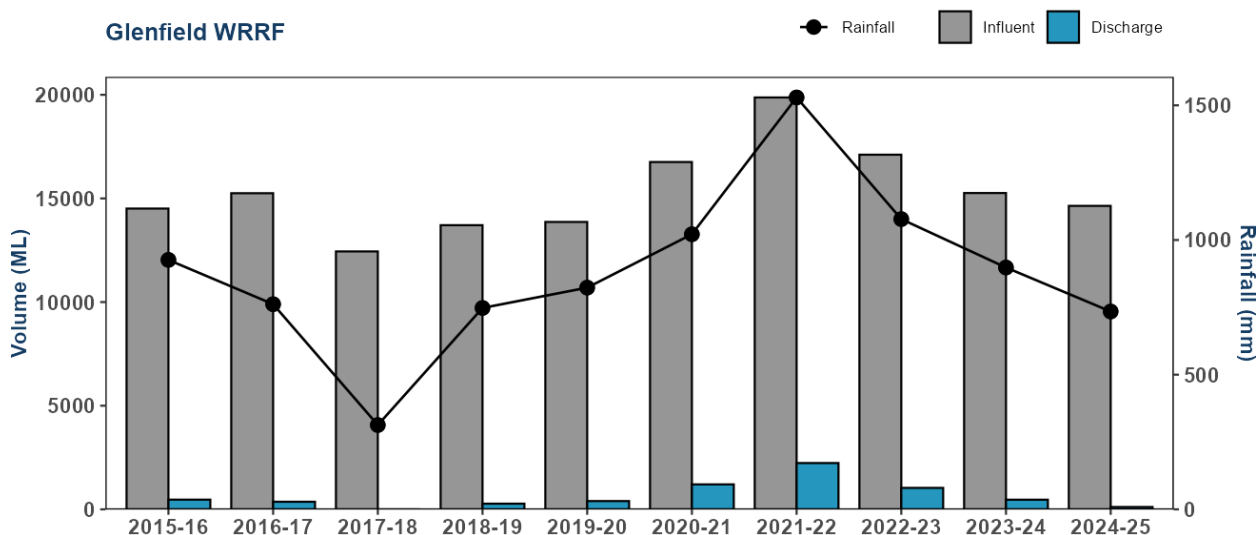
The sequence of water quality boxplots and needle plots of paired sites are same as those described for the Hawkesbury-Nepean River WRRFs (Appendix-A).

Tests conducted on wastewater are specified in the Environment Protection Licence (EPL issued by the NSW EPA for each WRRF (Appendix B-4). Data for all these measured analytes that have EPL concentration and load limits are included (where applicable).

B.1. Glenfield WRRF

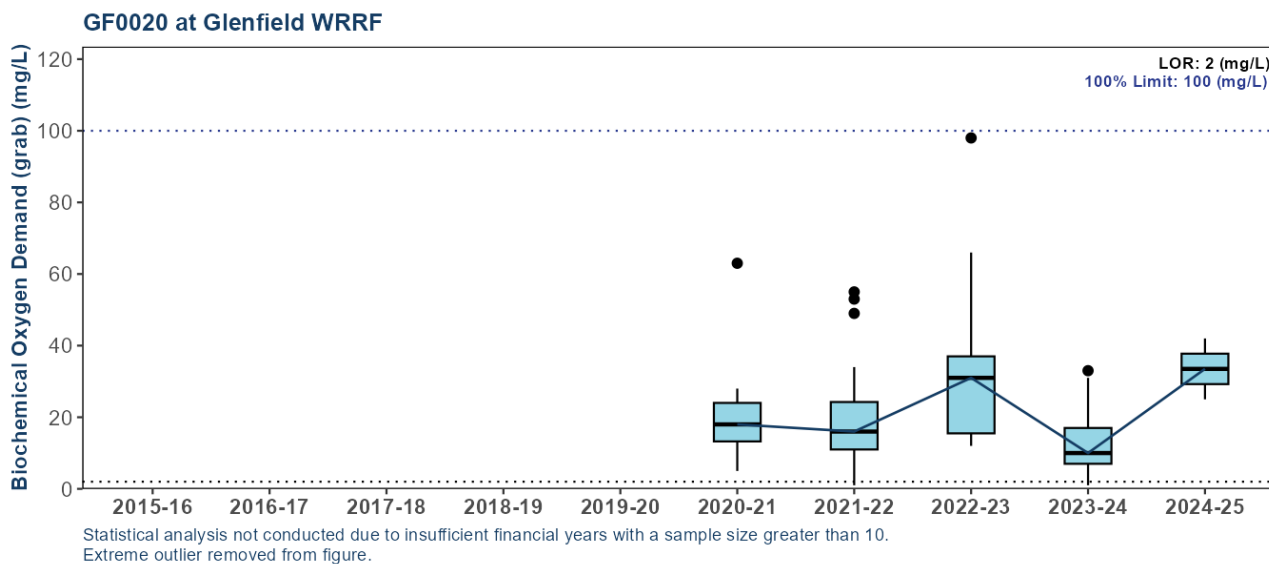
B.1.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

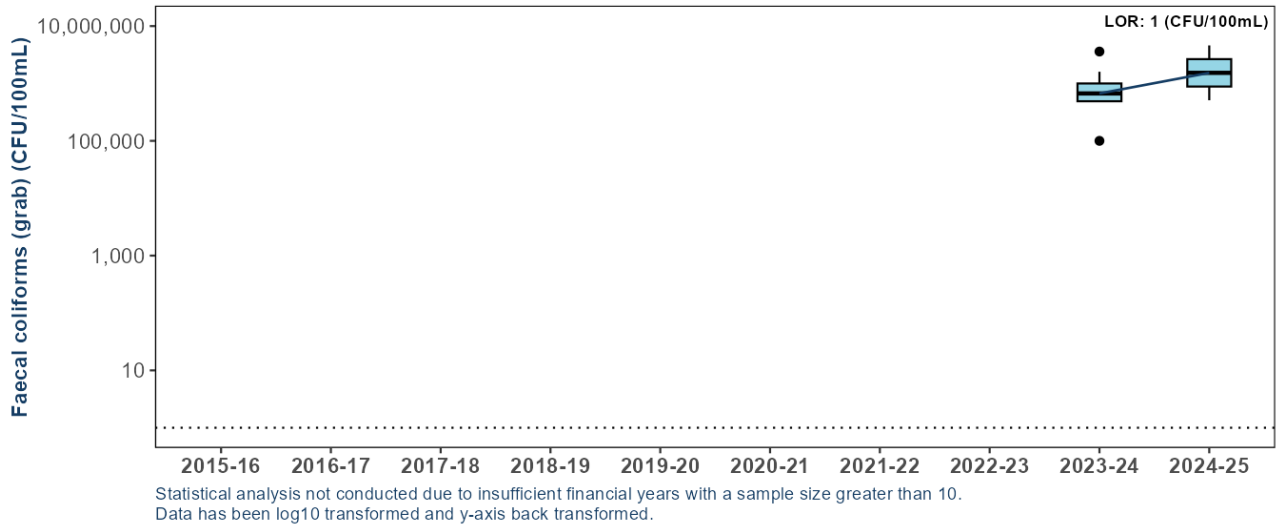


B.1.2. Pressure – Wastewater quality

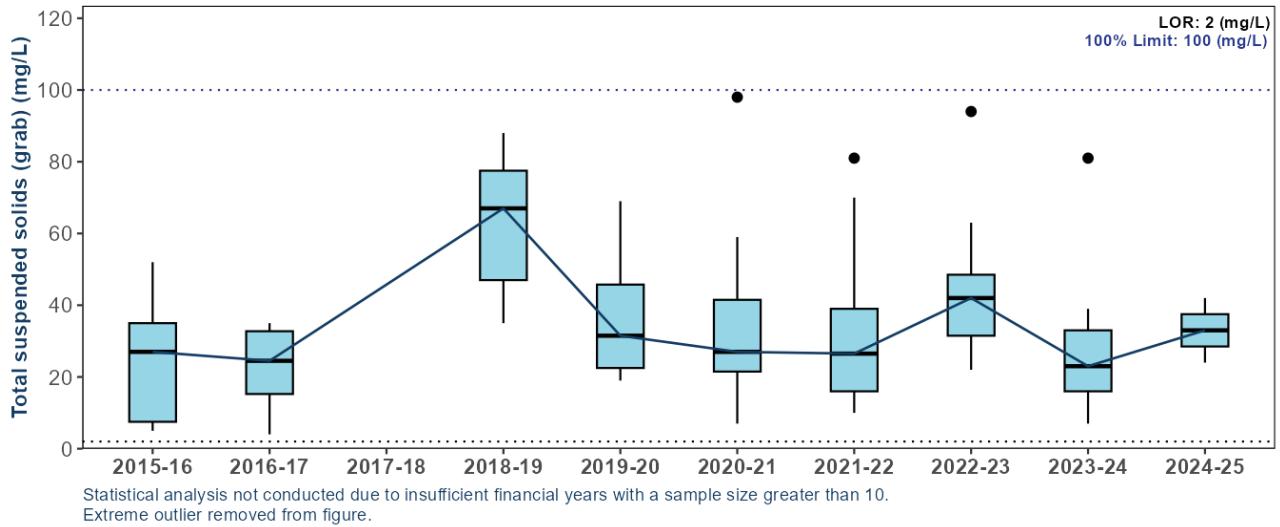
Major conventional analytes



GF0020 at Glenfield WRRF



GF0020 at Glenfield WRRF



B.1.3. Stressor – Statistical analysis outcomes

Table B-1 Upstream (Bunbury Curran Creek) vs downstream comparison (2024-25 reporting period) for the Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR231A vs GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Nutrient					
Ammonia nitrogen	0.16	0.06	64	-5.01	<0.001
Oxidised nitrogen	0.23	0.08	64	-4.11	<0.001
Total nitrogen	0.34	0.05	64	-6.93	<0.001
Soluble reactive phosphorus	0.20	0.05	64	-5.91	<0.001
Total phosphorus	0.29	0.04	64	-8.74	<0.001
Physico-chemical					
Conductivity	0.42	0.06	63	-6.07	<0.001
Dissolved oxygen	1.26	0.12	64	2.40	0.086
Dissolved oxygen saturation	15.65	4.84	63	3.24	0.010
pH	-0.19	0.08	64	-2.46	0.077
Water temperature	1.01	0.11	64	0.08	>0.999
Turbidity	0.45	0.12	64	-3.11	0.014
Trace Metals					
Filterable aluminium	2.11	0.57	64	2.77	0.036
Total aluminium	0.77	0.23	64	-0.88	0.815
Filterable cobalt	0.25	0.04	64	-7.88	<0.001
Total cobalt	0.33	0.05	64	-7.07	<0.001
Filterable copper	0.40	0.06	64	-6.16	<0.001
Total copper	0.39	0.06	64	-5.86	<0.001
Filterable nickel	0.99	0.16	64	-0.04	>0.999
Total nickel	0.87	0.14	64	-0.84	0.837
Filterable zinc	0.56	0.10	63	-3.26	0.010
Total zinc	0.47	0.10	64	-3.70	0.002

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-2 Current period (2024-25) vs previous period comparison (single site) for upstream Bunbury Curran Creek at Glenfield WRRF

Georges River at Glenfield WRRF: GR231A (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Nutrient					
Ammonia nitrogen	0.74	0.27	64	-0.82	0.843
Oxidised nitrogen	0.77	0.28	64	-0.74	0.881
Total nitrogen	0.94	0.15	64	-0.37	0.982
Soluble reactive phosphorus	1.62	0.44	64	1.77	0.297
Total phosphorus	1.12	0.16	64	0.80	0.854
Physico-chemical					
Conductivity	0.95	0.14	63	-0.38	0.982
Dissolved oxygen	1.09	0.10	64	0.88	0.814
Dissolved oxygen saturation	6.28	4.91	63	1.28	0.580
pH	-0.03	0.08	64	-0.37	0.982
Water temperature	1.03	0.12	64	0.27	0.993
Turbidity	0.84	0.21	64	-0.67	0.908
Trace Metals					
Filterable aluminium	1.48	0.40	64	1.44	0.477
Total aluminium	0.76	0.23	64	-0.92	0.792
Filterable cobalt	0.92	0.16	64	-0.45	0.970
Total cobalt	0.92	0.15	64	-0.54	0.948
Filterable copper	1.01	0.15	64	0.05	>0.999
Total copper	1.01	0.16	64	0.06	>0.999
Filterable nickel	0.70	0.11	64	-2.23	0.127
Total nickel	0.77	0.13	64	-1.61	0.379
Filterable zinc	1.30	0.23	63	1.46	0.469
Total zinc	1.16	0.24	64	0.71	0.892

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-3 Current period (2024-25) vs previous period comparison (single site) for the downstream Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Nutrient					
Ammonia nitrogen	0.61	0.14	64	-2.12	0.156
Oxidised nitrogen	0.50	0.17	64	-2.06	0.178
Total nitrogen	0.71	0.08	64	-2.96	0.022
Soluble reactive phosphorus	1.19	0.21	64	0.96	0.770
Total phosphorus	0.76	0.11	64	-1.98	0.207
Physico-chemical					
Conductivity	0.92	0.09	64	-0.84	0.833
Dissolved oxygen	1.08	0.07	64	1.17	0.647
Dissolved oxygen saturation	6.66	2.79	64	2.39	0.090
pH	-0.04	0.10	64	-0.37	0.983
Water temperature	1.03	0.12	64	0.22	0.996
Turbidity	0.89	0.20	64	-0.54	0.948
Trace Metals					
Filterable aluminium	1.40	0.48	64	0.98	0.761
Total aluminium	1.00	0.31	64	0.01	>0.999
Filterable cobalt	0.75	0.13	64	-1.66	0.351
Total cobalt	0.75	0.15	64	-1.42	0.495
Filterable copper	0.75	0.13	63	-1.65	0.360
Total copper	0.86	0.15	64	-0.91	0.801
Filterable nickel	0.74	0.13	63	-1.77	0.298
Total nickel	0.74	0.13	64	-1.70	0.333
Filterable zinc	1.13	0.21	63	0.67	0.906
Total zinc	1.14	0.22	64	0.69	0.900

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-4 Upstream vs downstream comparison (2024-25 reporting period) for the Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23B vs GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Nutrient					
Ammonia nitrogen	2.44	0.57	64	3.80	0.002
Oxidised nitrogen	3.74	1.25	64	3.96	0.001
Total nitrogen	1.52	0.17	64	3.71	0.002
Soluble reactive phosphorus	1.73	0.31	64	3.06	0.017
Total phosphorus	2.35	0.33	64	6.13	<0.001
Physico-chemical					
Conductivity	1.27	0.13	64	2.32	0.105
Dissolved oxygen	0.95	0.06	64	-0.83	0.842
Dissolved oxygen saturation	-6.34	2.79	64	-2.27	0.116
pH	-0.01	0.10	64	-0.11	>0.999
Water temperature	0.97	0.11	64	-0.23	0.995
Turbidity	2.59	0.57	64	4.29	<0.001
Trace Metals					
Filterable aluminium	0.76	0.26	64	-0.79	0.860
Total aluminium	1.81	0.56	64	1.93	0.227
Filterable cobalt	1.13	0.19	64	0.71	0.891
Total cobalt	1.78	0.37	64	2.80	0.034
Filterable copper	1.99	0.35	63	3.93	0.001
Total copper	2.21	0.38	64	4.68	<0.001
Filterable nickel	0.96	0.17	63	-0.23	0.996
Total nickel	1.00	0.17	64	-0.01	>0.999
Filterable zinc	1.64	0.31	63	2.62	0.052
Total zinc	1.98	0.38	64	3.56	0.004

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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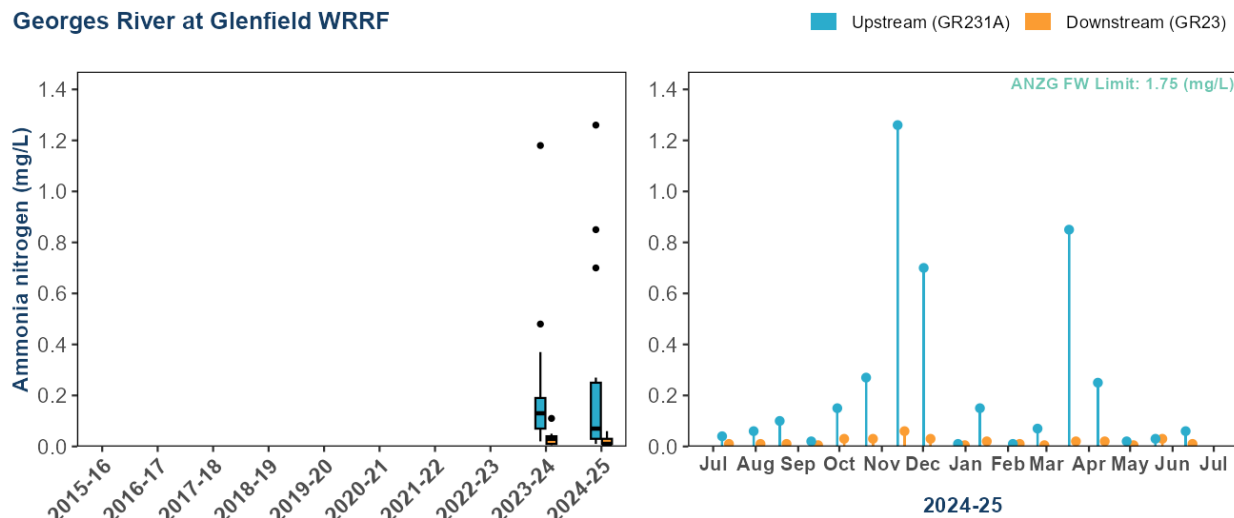
Table B-5 Current period (2024-25) vs previous period comparison (single site) for the upstream Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23B (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Nutrient					
Ammonia nitrogen	0.60	0.14	64	-2.18	0.139
Oxidised nitrogen	0.69	0.23	64	-1.12	0.678
Total nitrogen	0.83	0.09	64	-1.62	0.374
Soluble reactive phosphorus	1.21	0.22	64	1.05	0.723
Total phosphorus	0.75	0.10	64	-2.09	0.167
Physico-chemical					
Conductivity	0.98	0.10	64	-0.21	0.997
Dissolved oxygen	1.02	0.07	64	0.30	0.991
Dissolved oxygen saturation	2.91	2.79	64	1.04	0.725
pH	-0.01	0.10	64	-0.12	>0.999
Water temperature	1.01	0.12	64	0.11	>0.999
Turbidity	0.79	0.18	64	-1.04	0.729
Trace Metals					
Filterable aluminium	1.50	0.51	64	1.20	0.631
Total aluminium	0.97	0.30	64	-0.11	>0.999
Filterable cobalt	0.88	0.15	64	-0.71	0.891
Total cobalt	0.84	0.17	64	-0.85	0.829
Filterable copper	0.79	0.14	63	-1.36	0.527
Total copper	0.89	0.15	64	-0.71	0.891
Filterable nickel	0.76	0.13	63	-1.61	0.379
Total nickel	0.75	0.13	64	-1.62	0.375
Filterable zinc	1.32	0.25	63	1.45	0.476
Total zinc	1.22	0.23	64	1.02	0.738

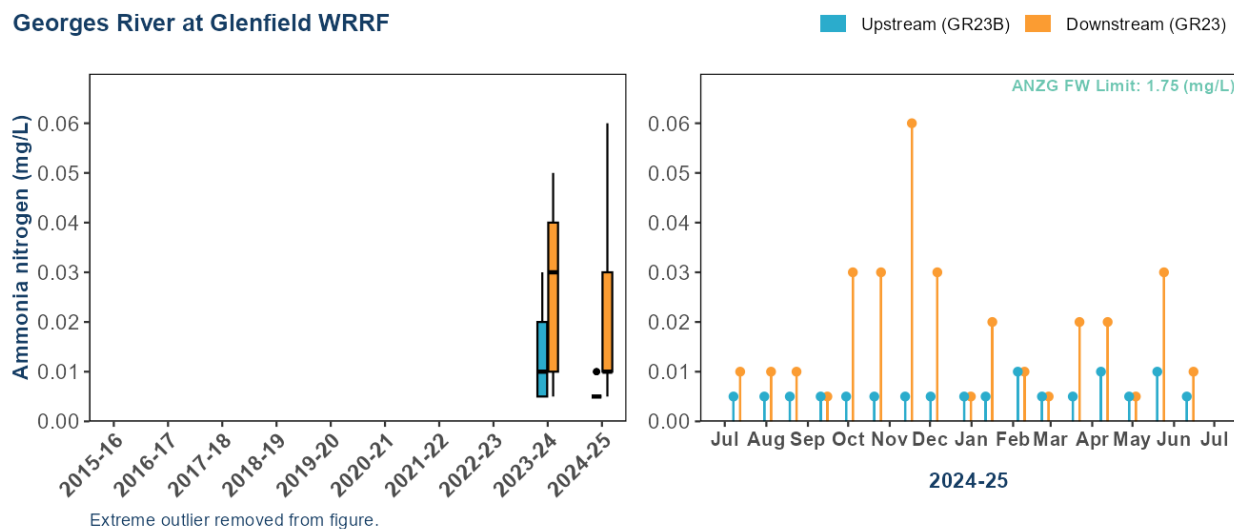
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B.1.4. Stressor – Nutrients

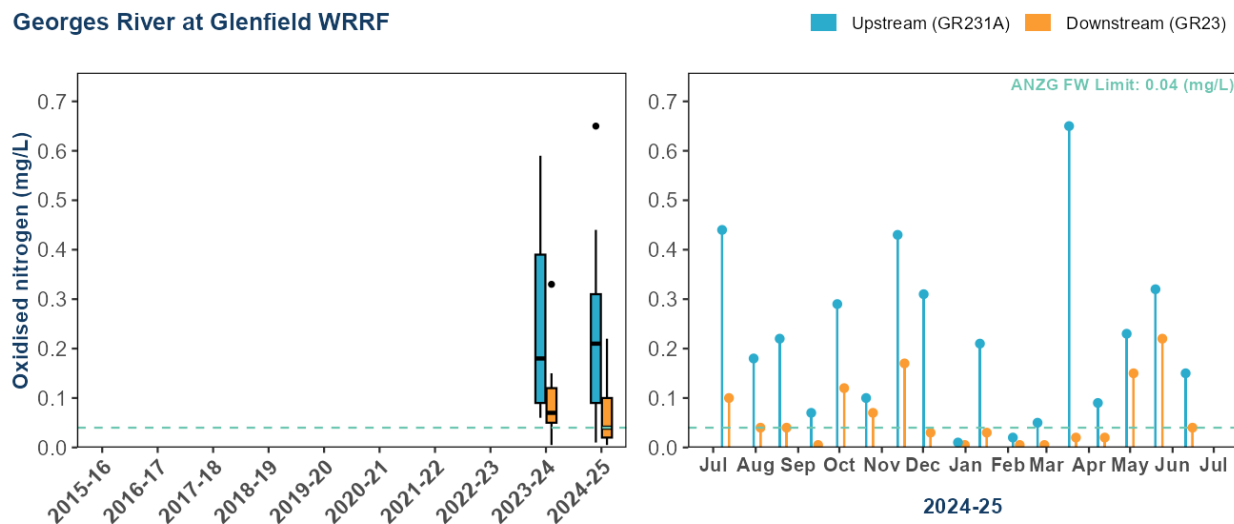
Georges River at Glenfield WRRF



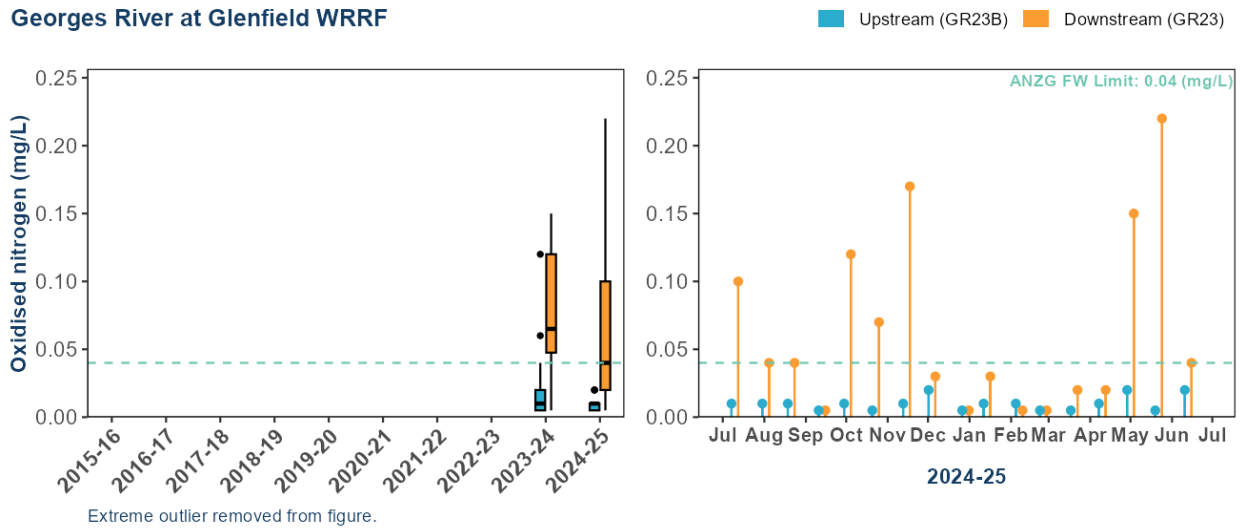
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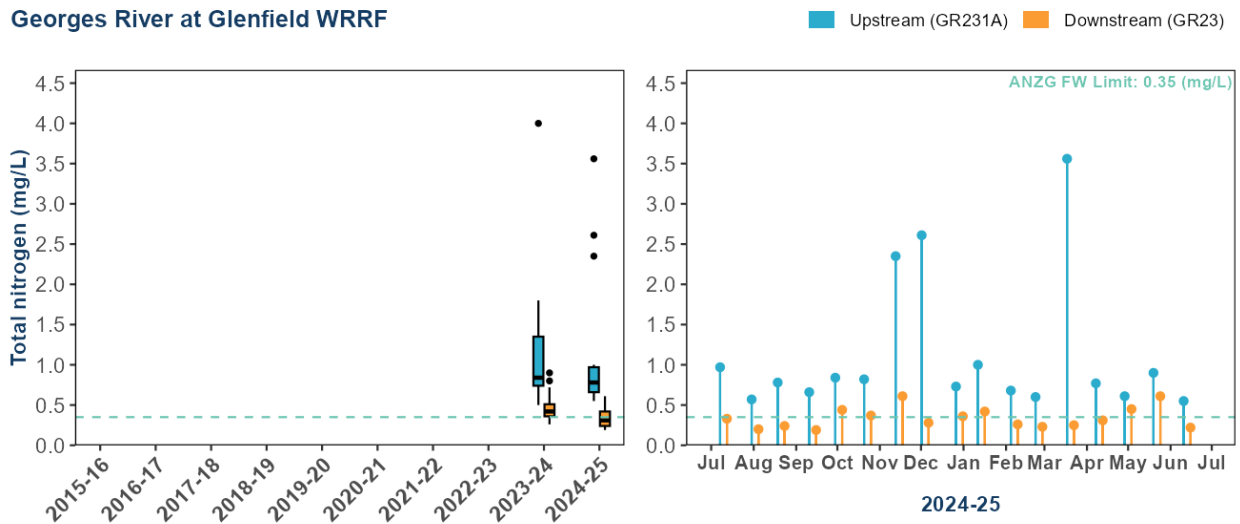
Georges River at Glenfield WRRF



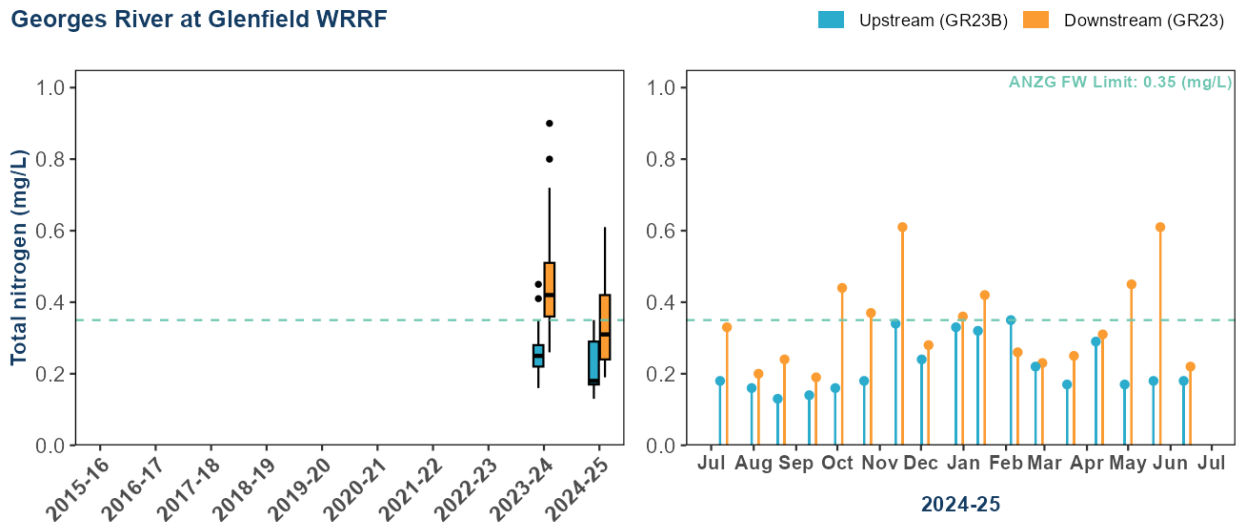
Georges River at Glenfield WRRF



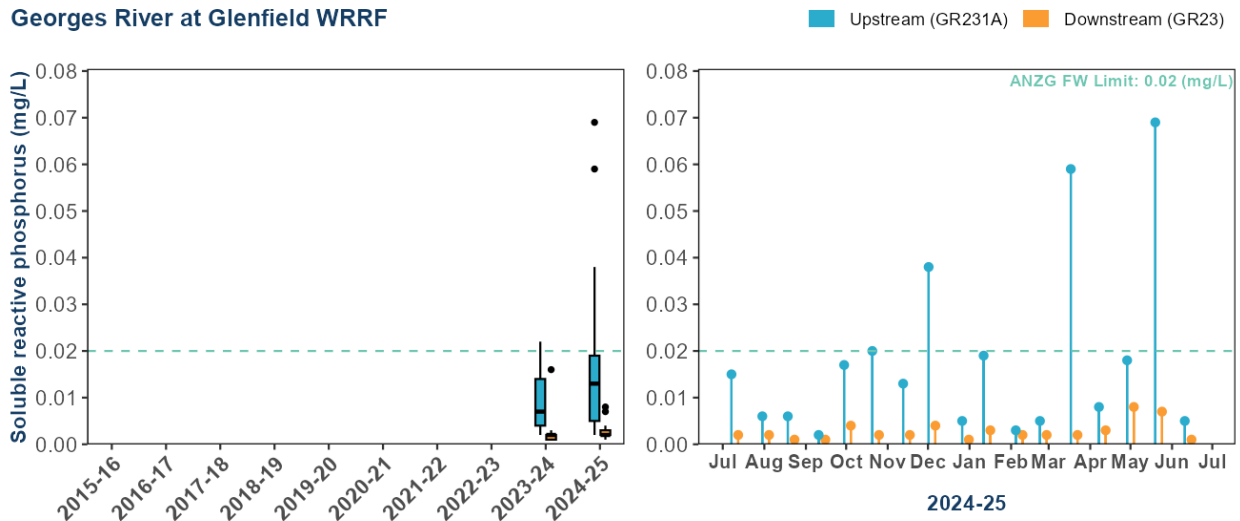
Georges River at Glenfield WRRF



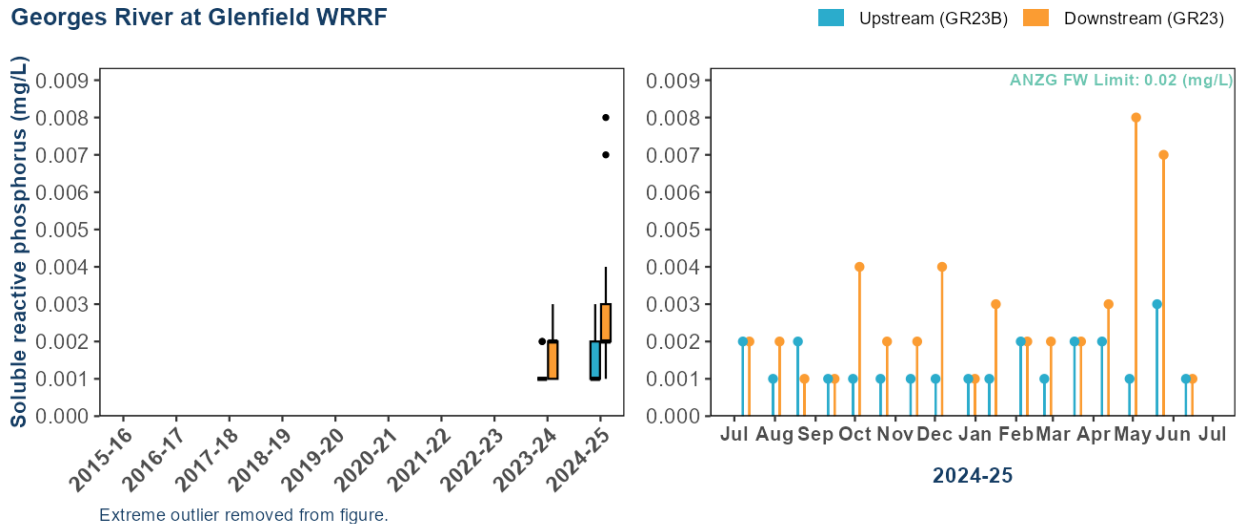
Georges River at Glenfield WRRF



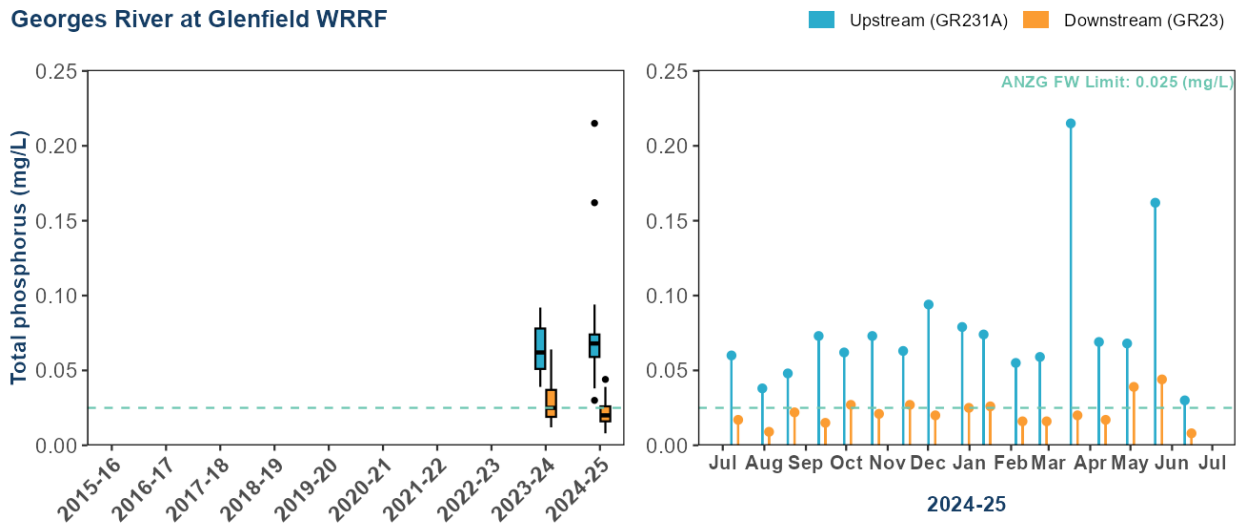
Georges River at Glenfield WRRF



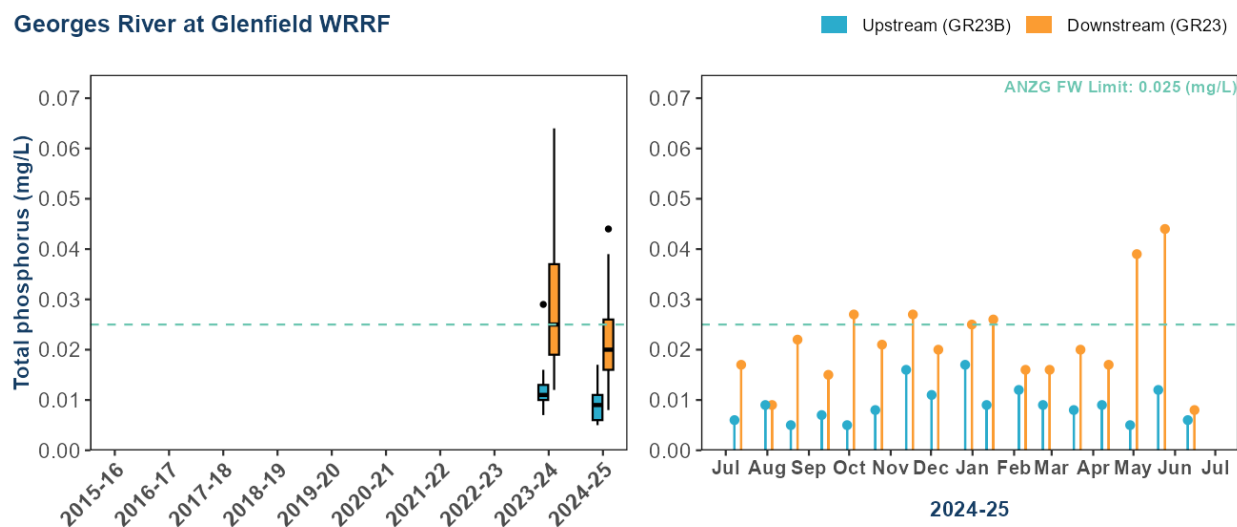
Georges River at Glenfield WRRF



Georges River at Glenfield WRRF



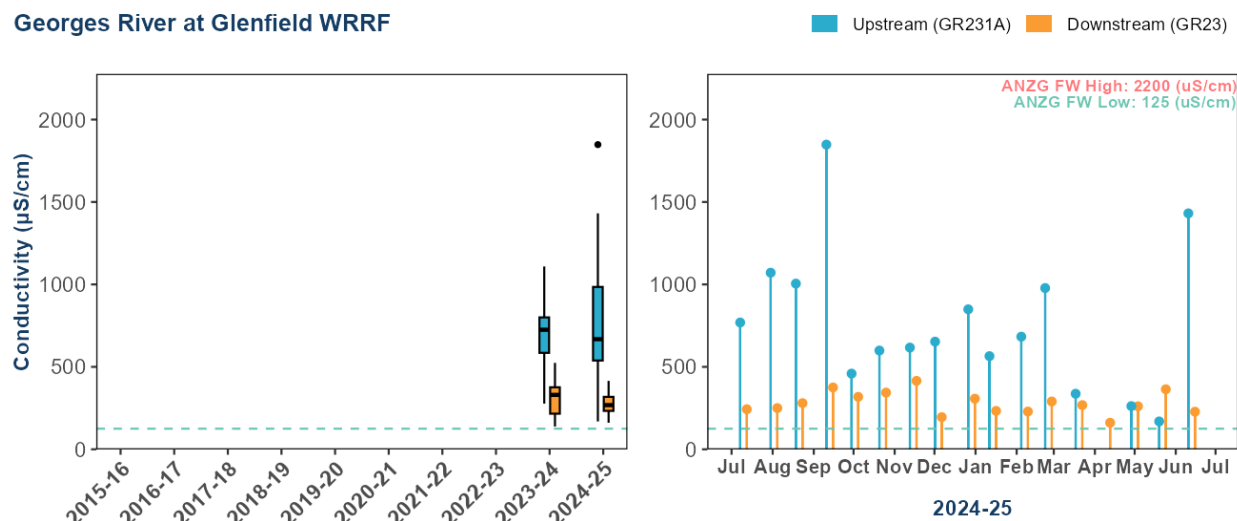
Georges River at Glenfield WRRF



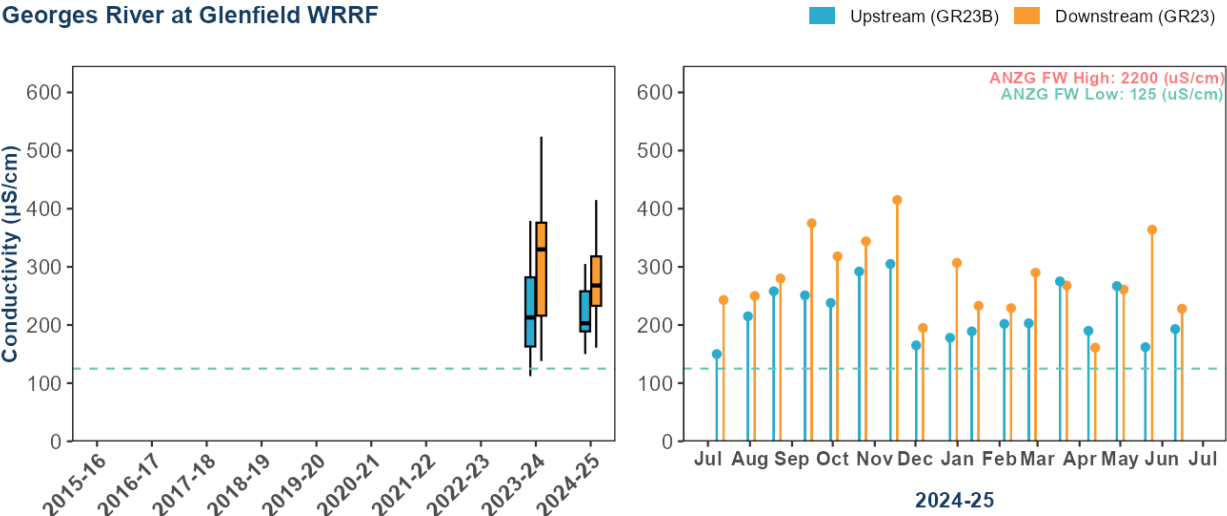
GR231A (Bunbury Curran Creek) is a tributary entering the Georges River between the Georges River upstream and downstream sites

B.1.5. Stressor – Physico-chemical water quality

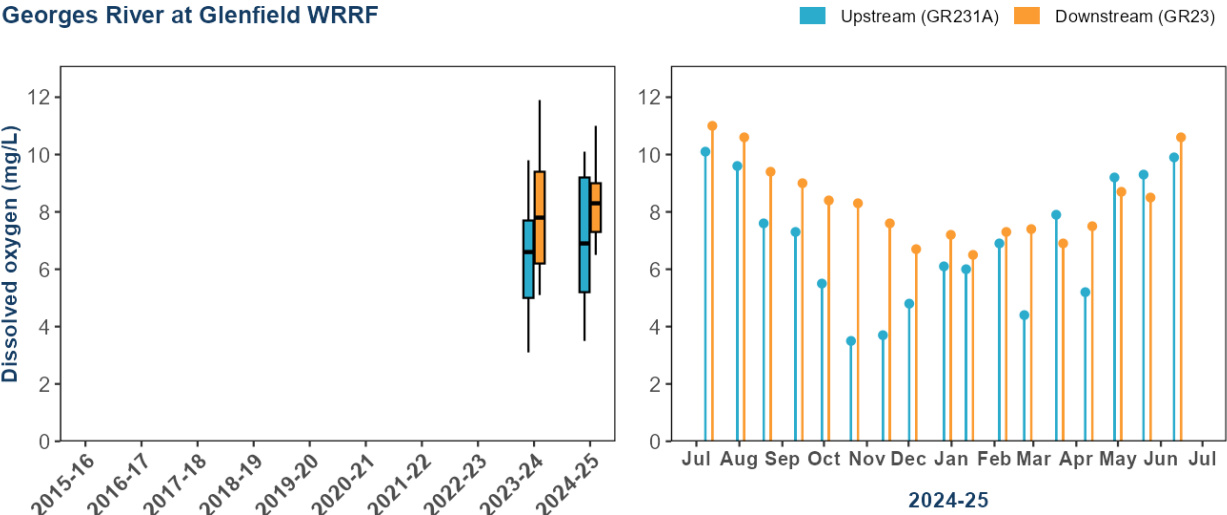
Georges River at Glenfield WRRF



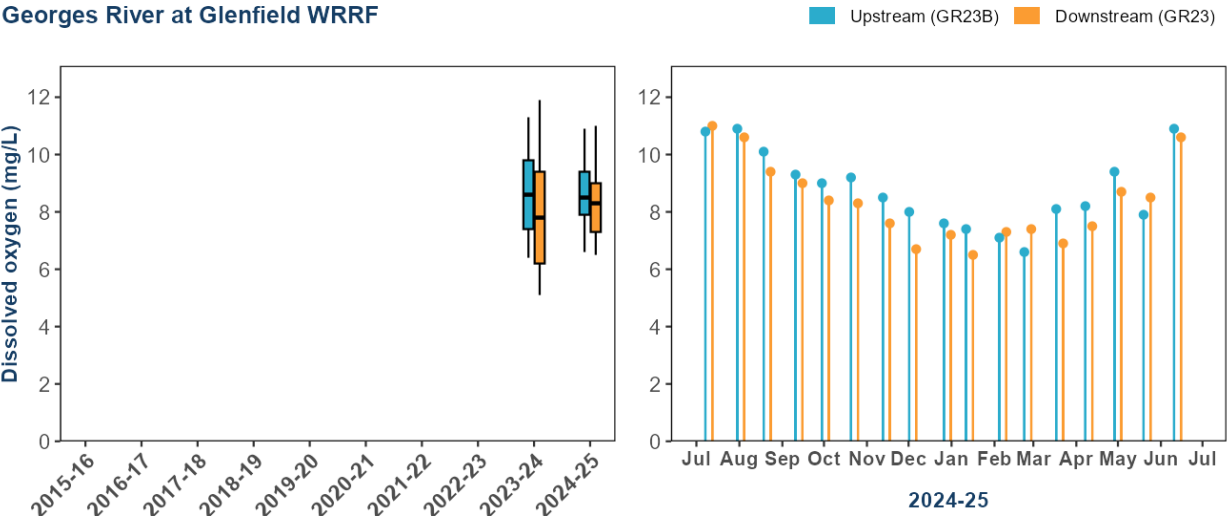
Georges River at Glenfield WRRF



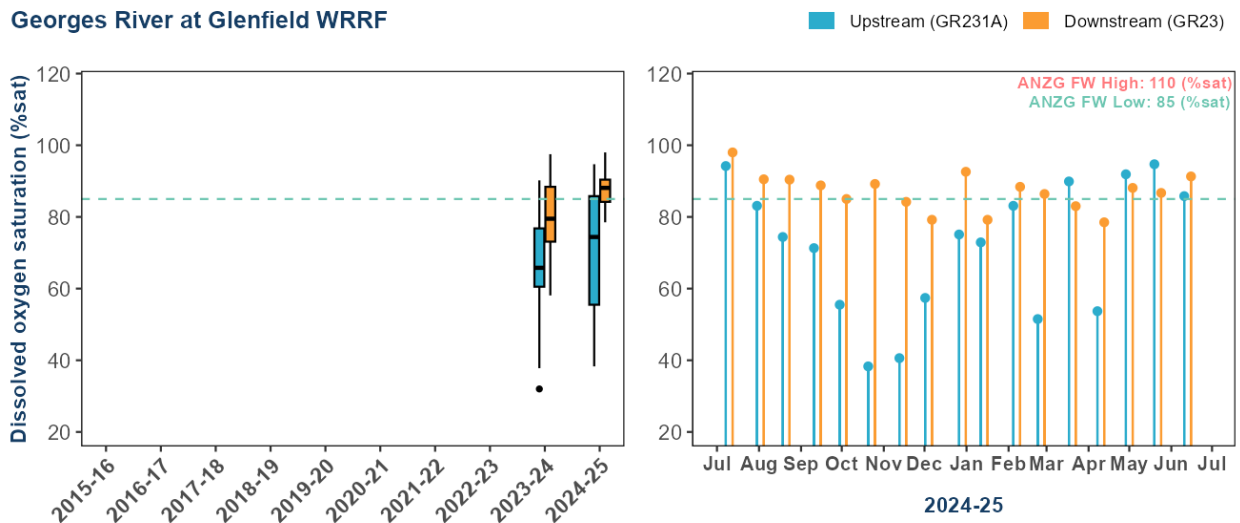
Georges River at Glenfield WRRF



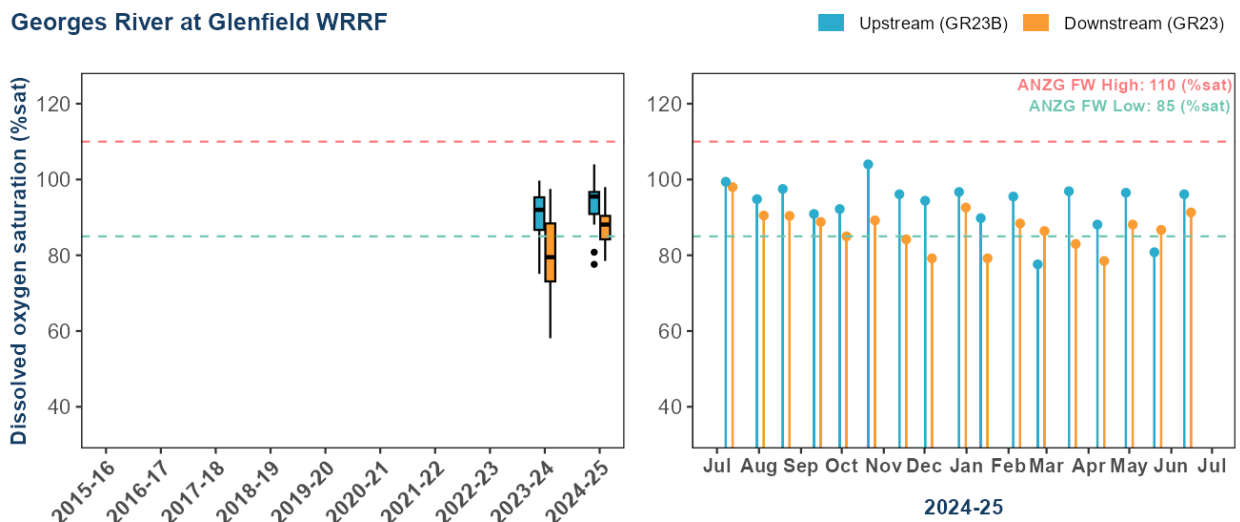
Georges River at Glenfield WRRF



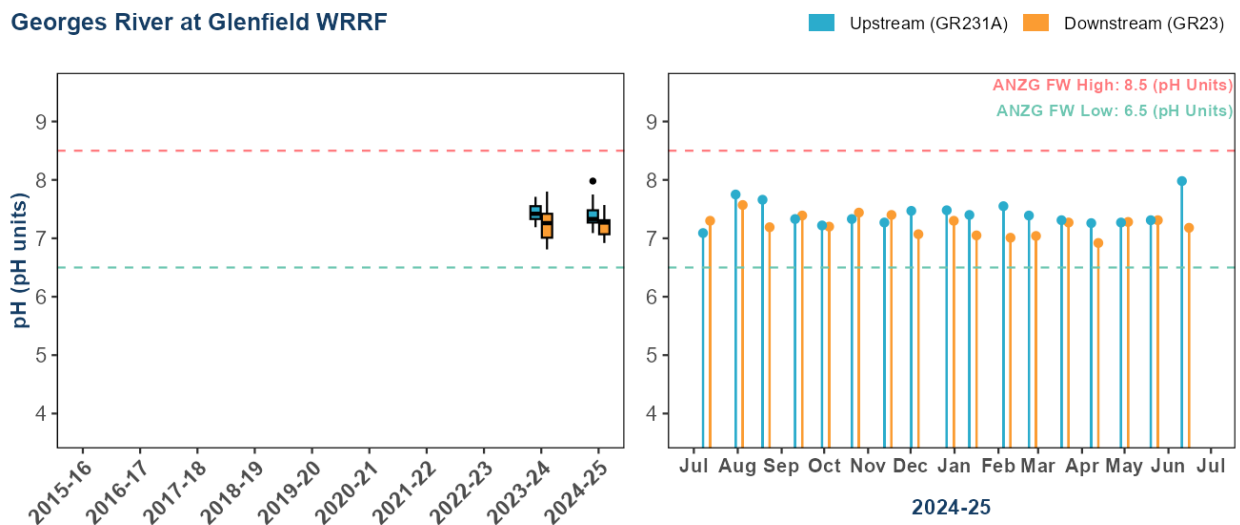
Georges River at Glenfield WRRF



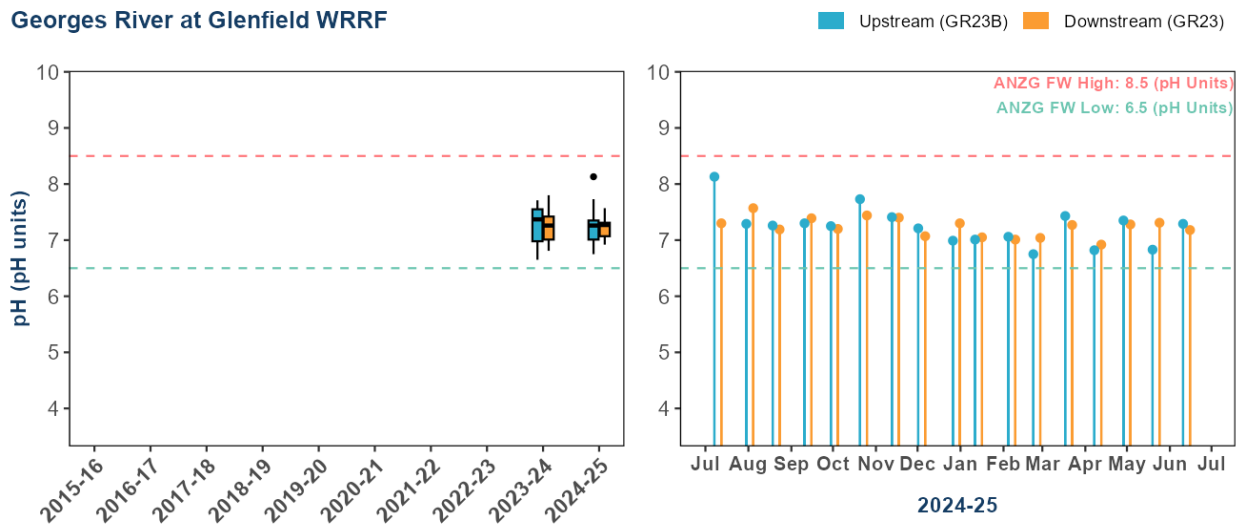
Georges River at Glenfield WRRF



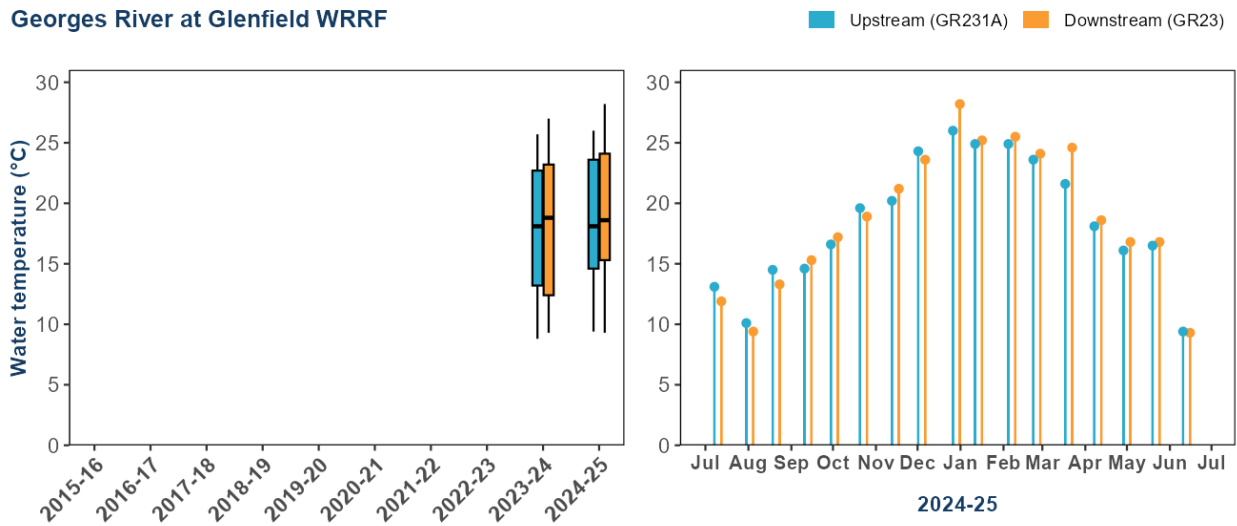
Georges River at Glenfield WRRF



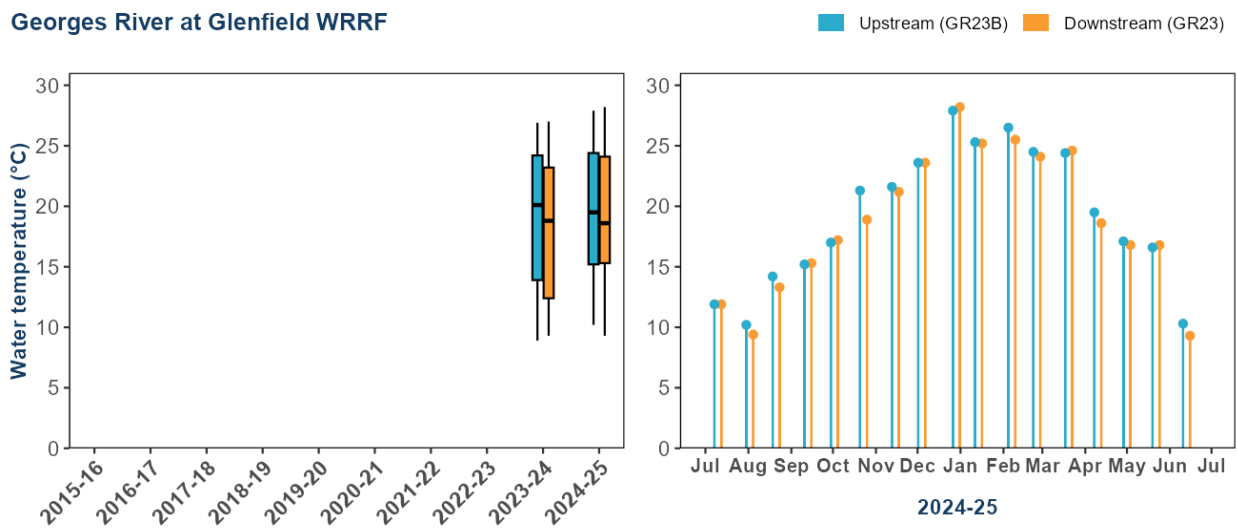
Georges River at Glenfield WRRF



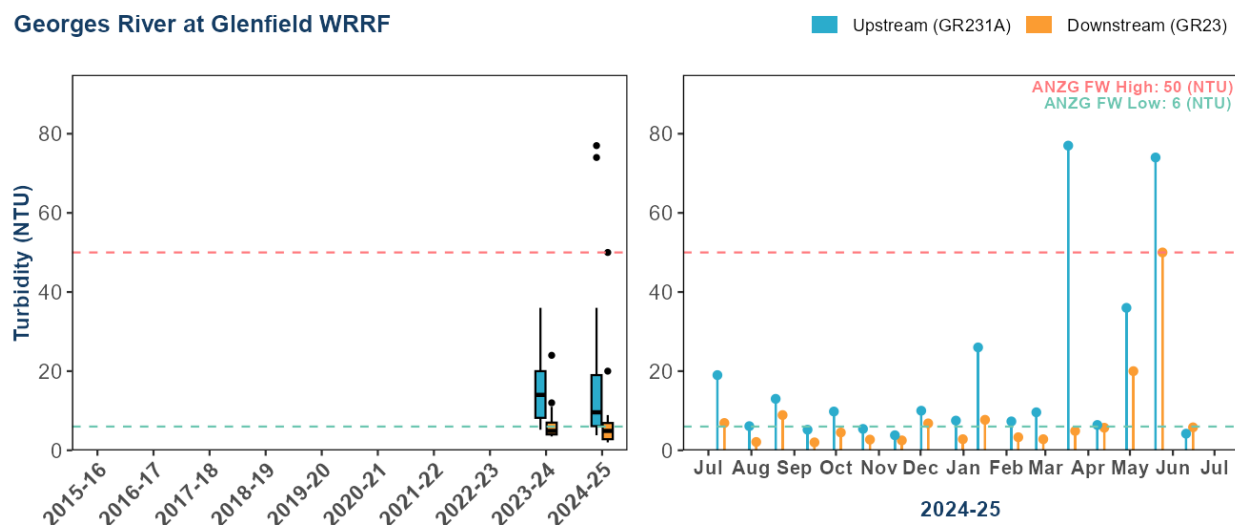
Georges River at Glenfield WRRF



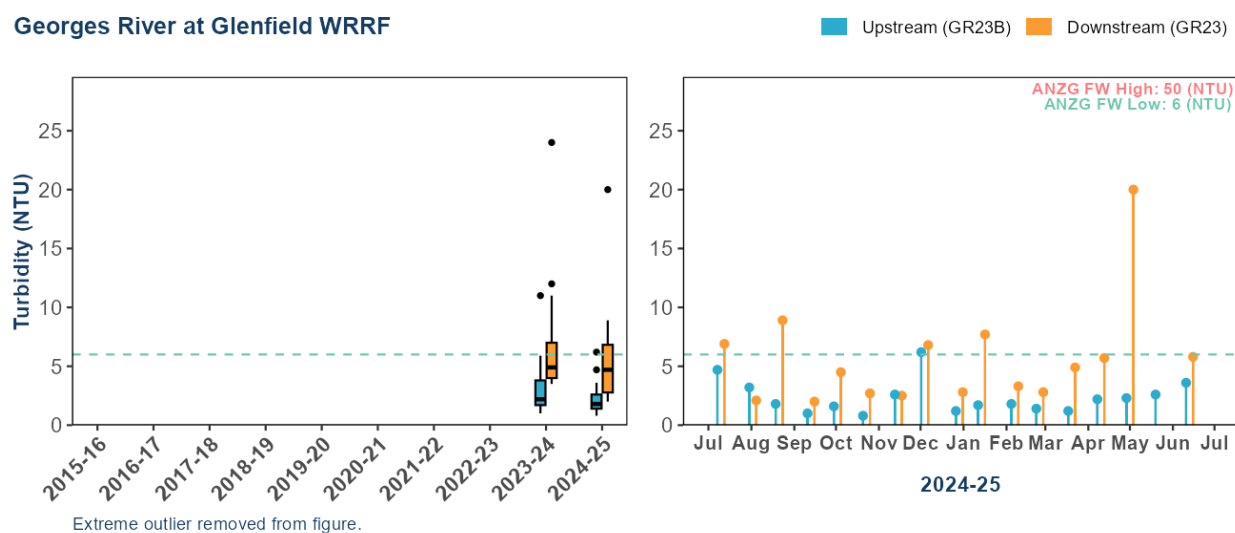
Georges River at Glenfield WRRF



Georges River at Glenfield WRRF



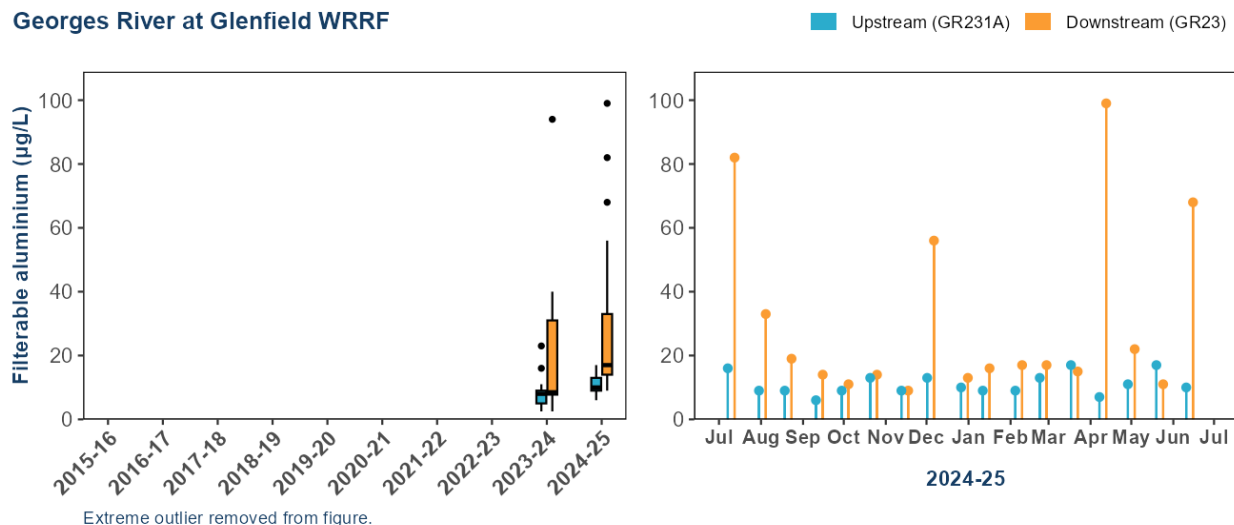
Georges River at Glenfield WRRF



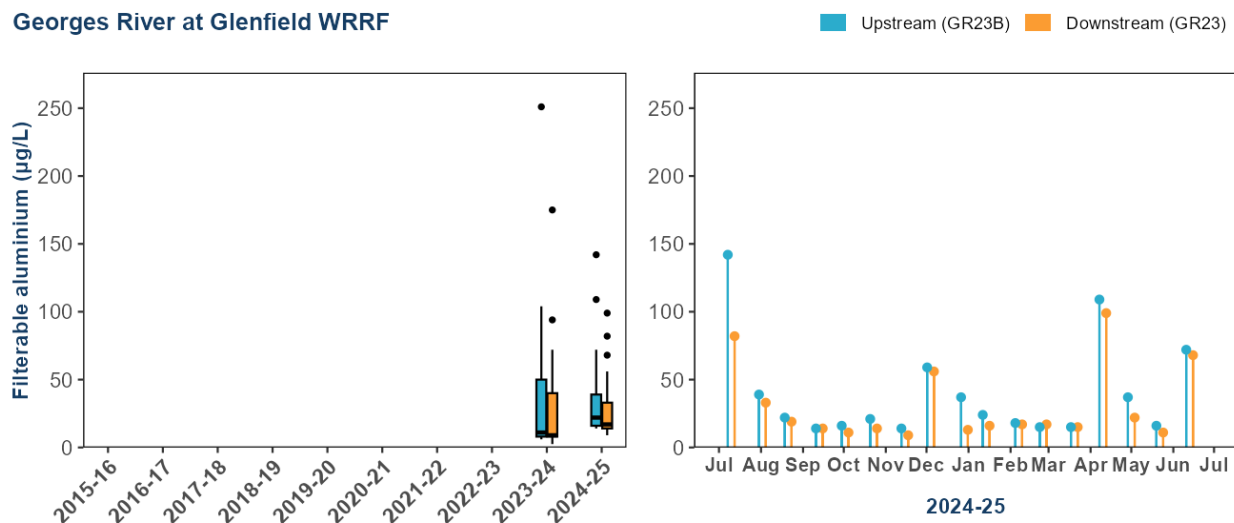
GR231A (Bunbury Curran Creek) is a tributary entering the Georges River between the Georges River upstream and downstream sites

B.1.6. Stressor – Trace metals

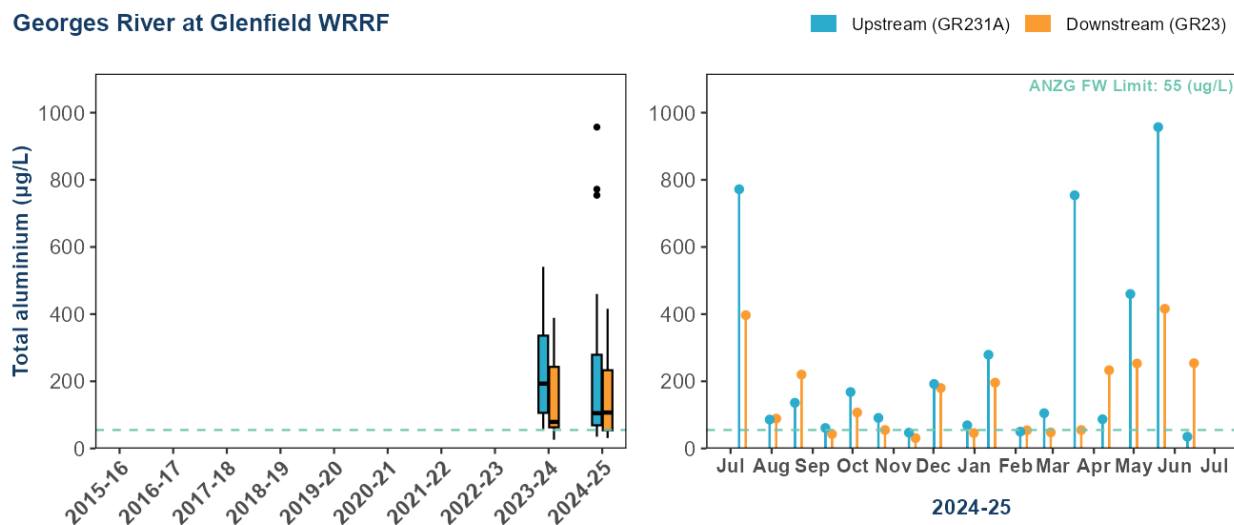
Georges River at Glenfield WRRF



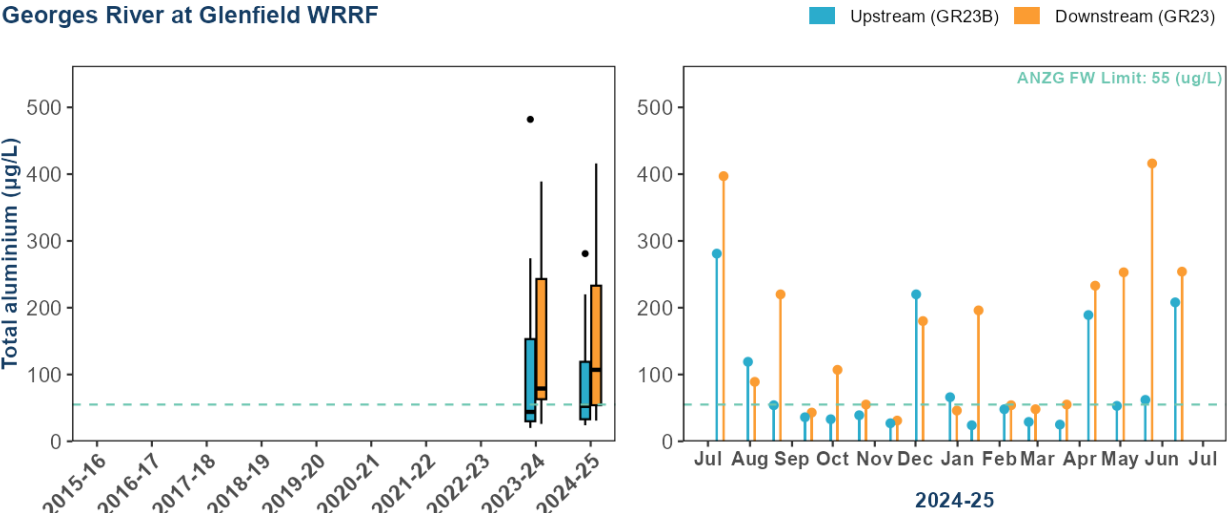
Georges River at Glenfield WRRF



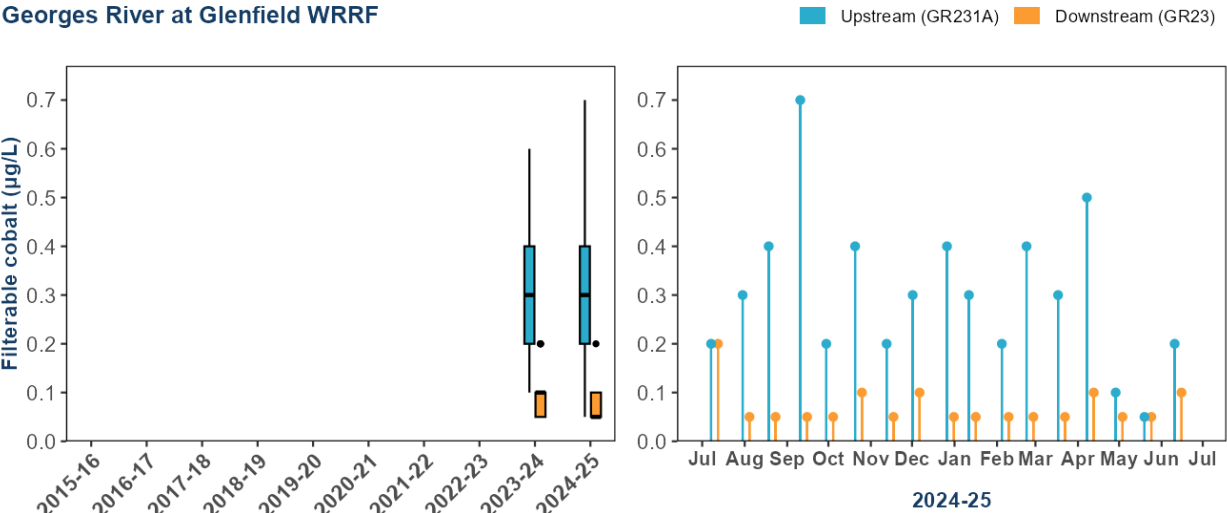
Georges River at Glenfield WRRF



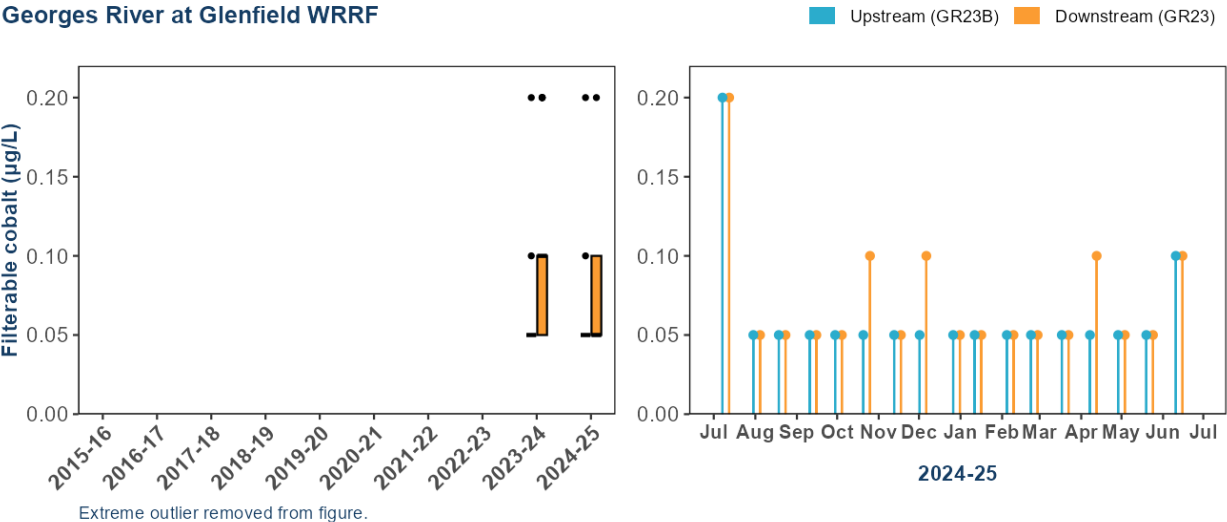
Georges River at Glenfield WRRF



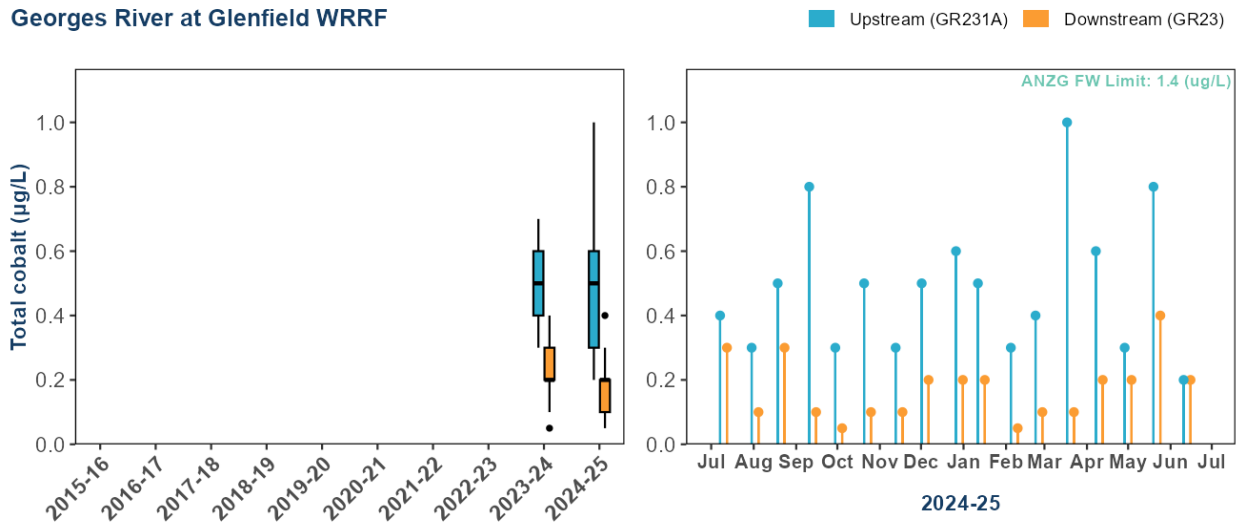
Georges River at Glenfield WRRF



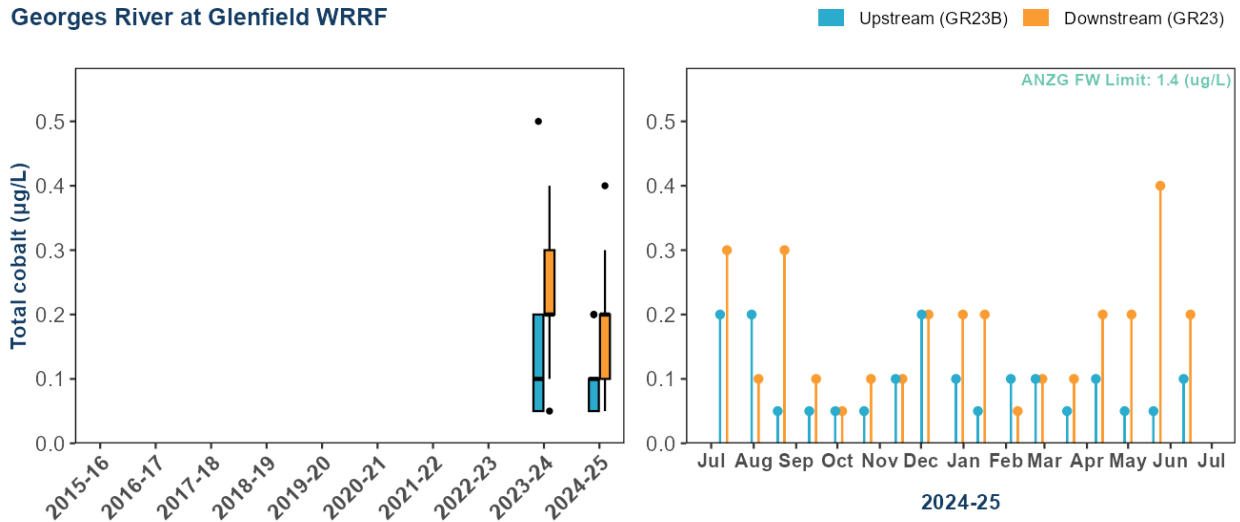
Georges River at Glenfield WRRF



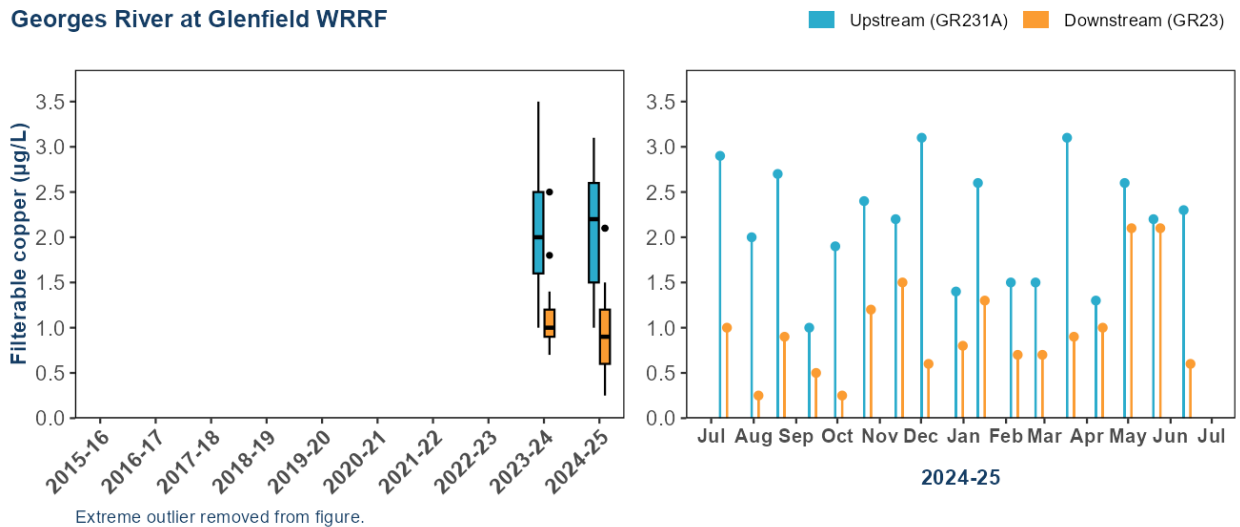
Georges River at Glenfield WRRF



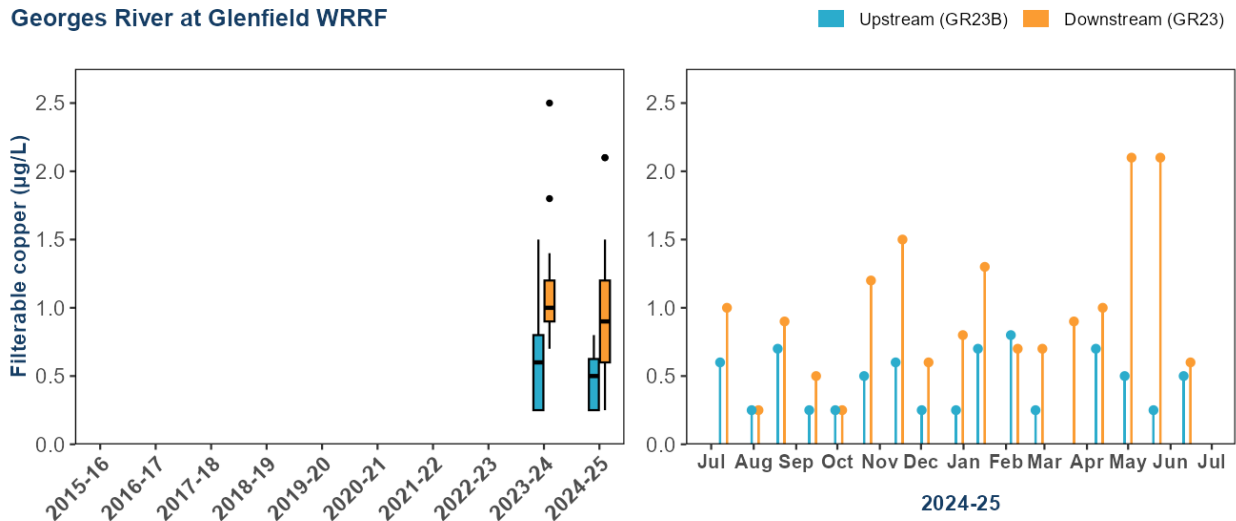
Georges River at Glenfield WRRF



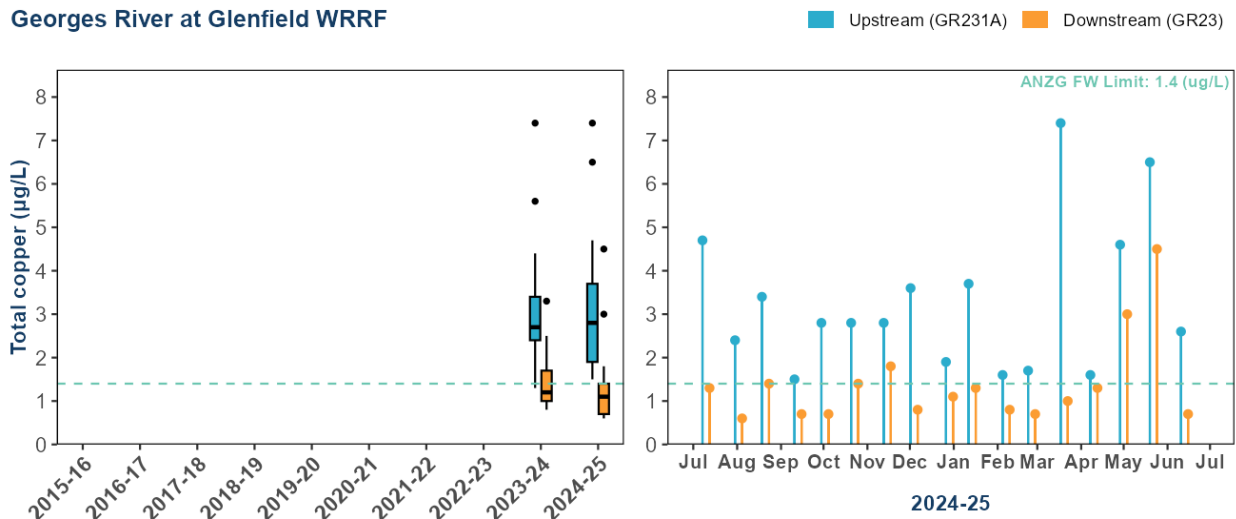
Georges River at Glenfield WRRF



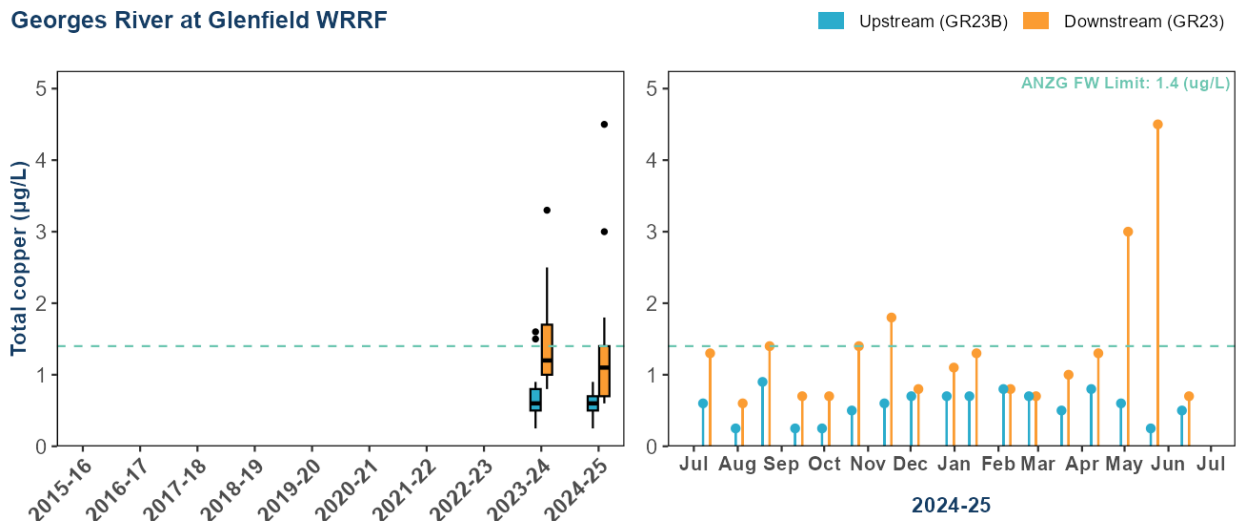
Georges River at Glenfield WRRF



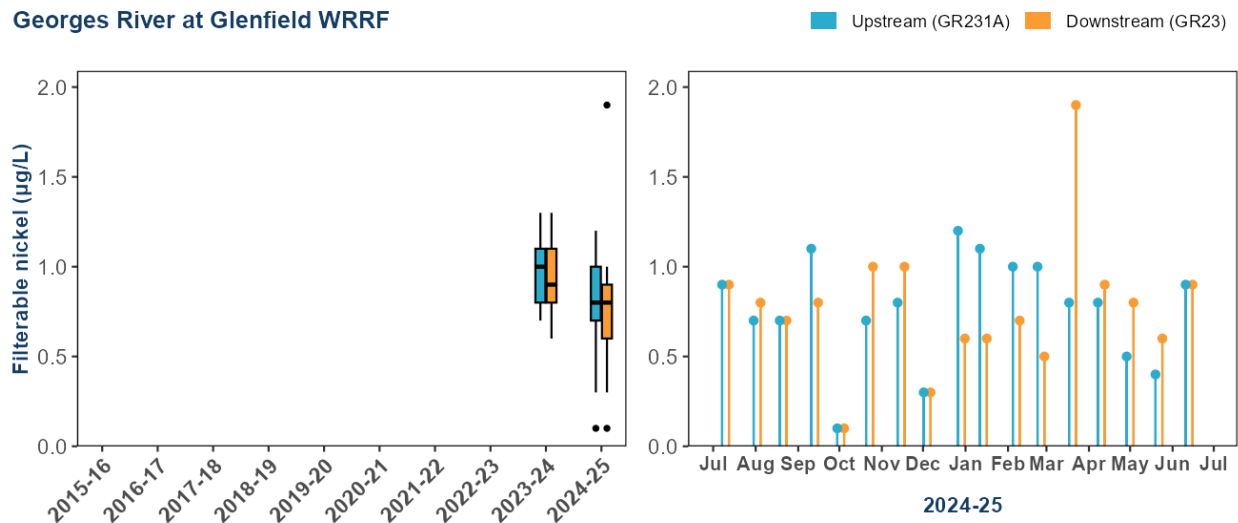
Georges River at Glenfield WRRF



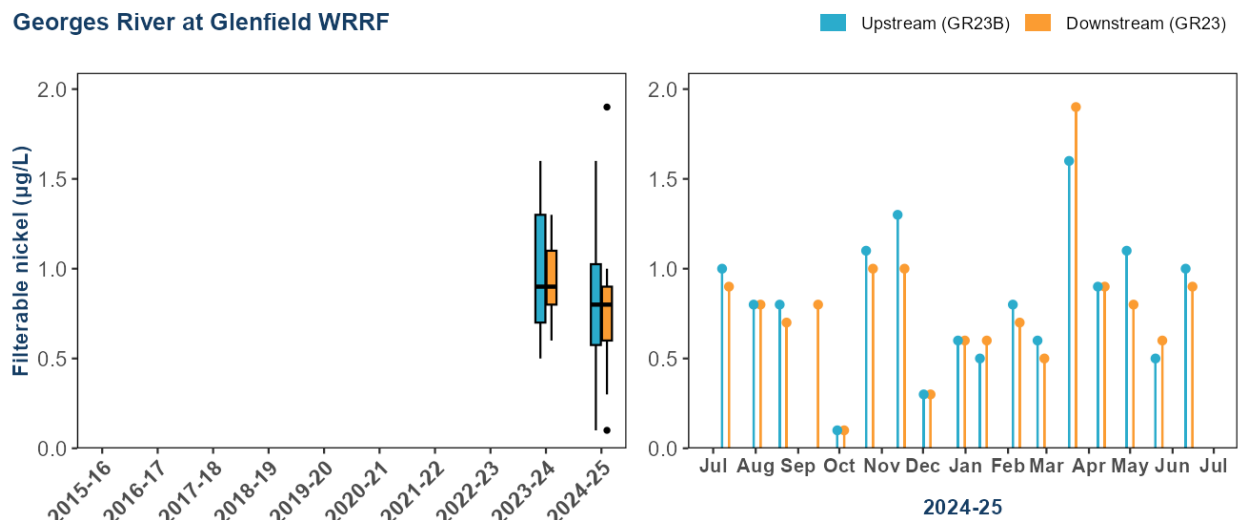
Georges River at Glenfield WRRF



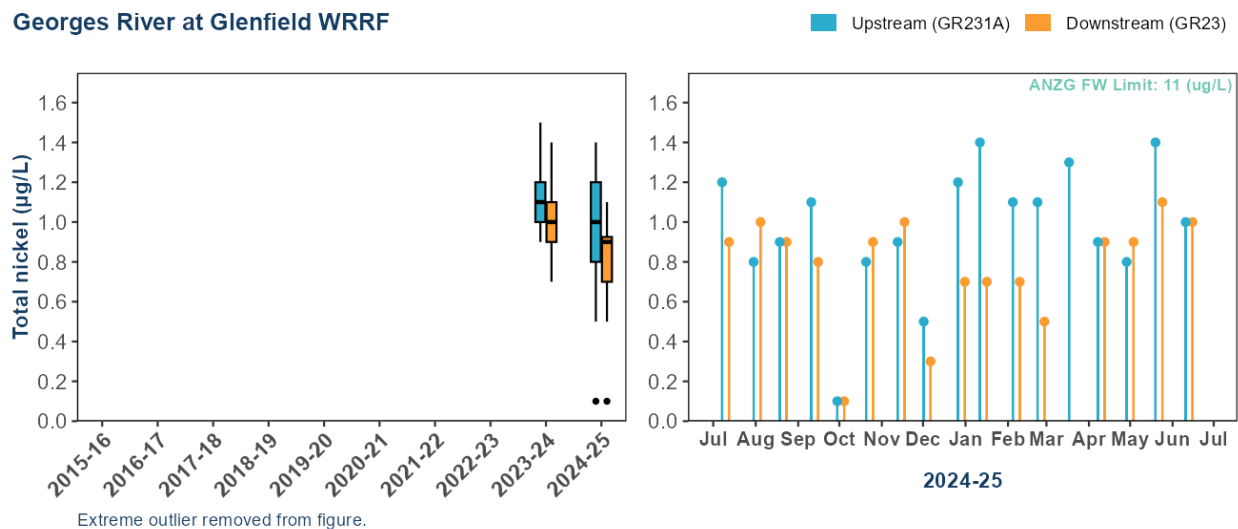
Georges River at Glenfield WRRF



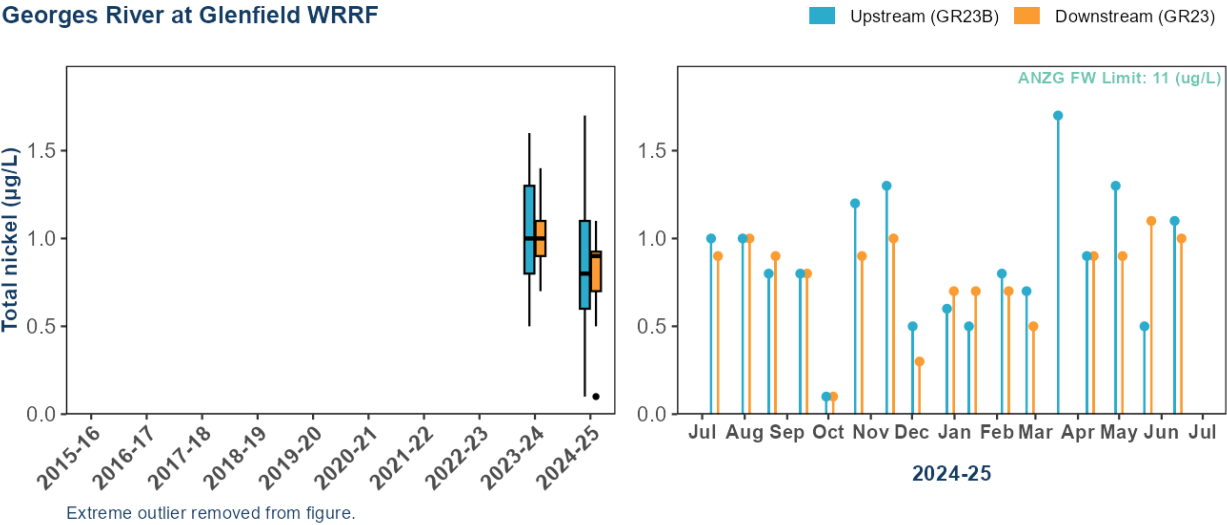
Georges River at Glenfield WRRF



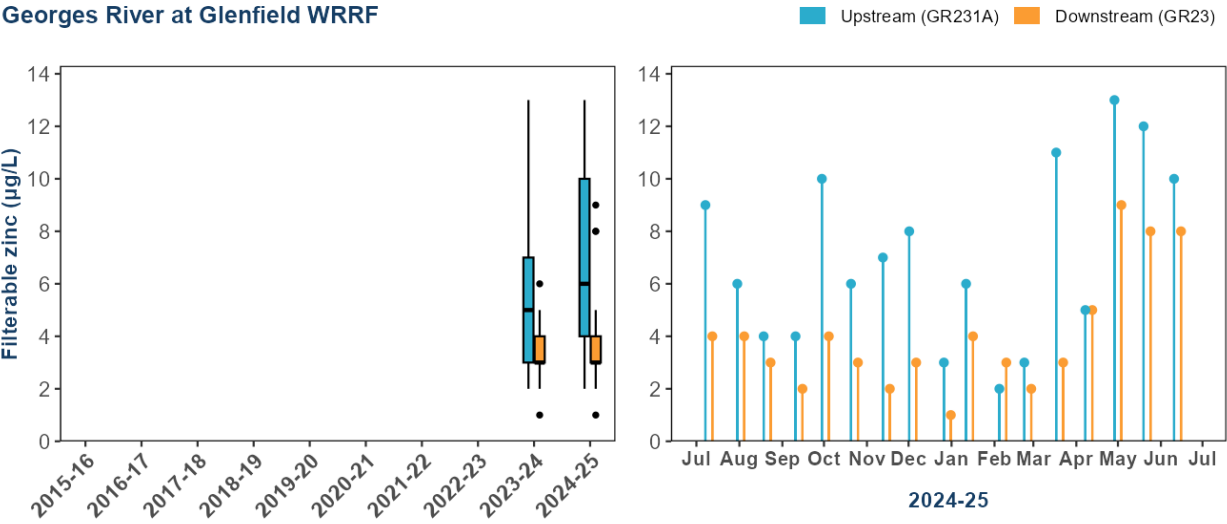
Georges River at Glenfield WRRF



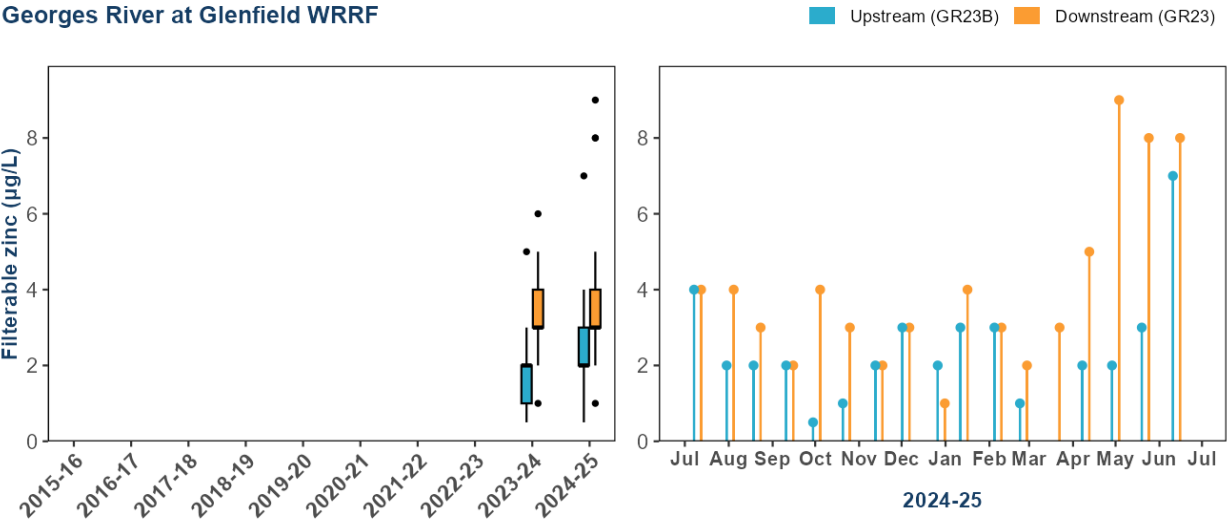
Georges River at Glenfield WRRF



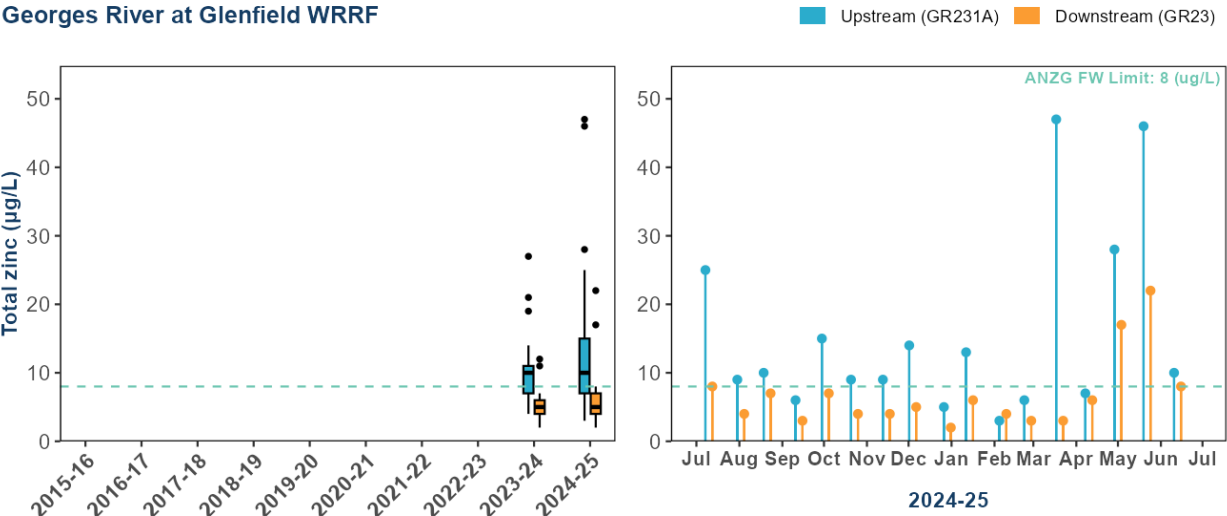
Georges River at Glenfield WRRF



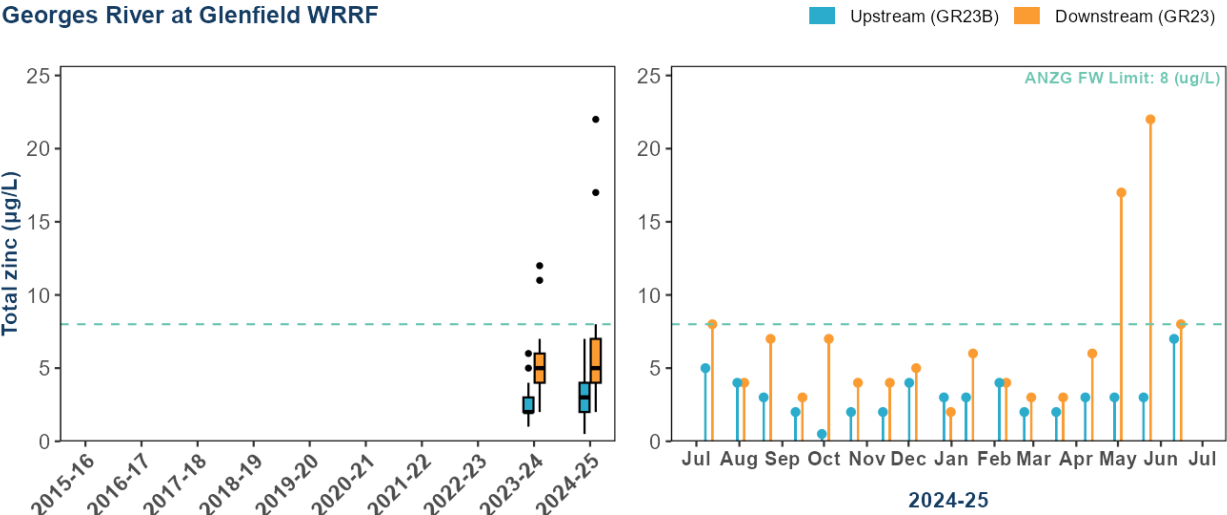
Georges River at Glenfield WRRF



Georges River at Glenfield WRRF



Georges River at Glenfield WRRF



GR231A (Bunbury Curran Creek) is a tributary entering the Georges River between the Georges River upstream and downstream sites

B.1.7. Ecosystem receptor – Statistical analysis outcomes

Table B-6 Upstream (Bunbury Curran) vs downstream comparison (2024-25 reporting period) for the Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR231A vs GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Chlorophyll-a					
Chlorophyll-a	0.50	0.20	64	-1.71	0.329

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-7 Current period (2024-25) vs previous period comparison (single site) for upstream Bunbury Curran Creek at Glenfield WRRF

Georges River at Glenfield WRRF: GR231A (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Chlorophyll-a					
Chlorophyll-a	1.05	0.43	64	0.11	>0.999

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-8 Current period (2024-25) vs previous period comparison (single site) for the downstream Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Chlorophyll-a					
Chlorophyll-a	0.76	0.32	64	-0.66	0.913

not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Table B-9 Upstream vs downstream comparison (2024-25 reporting period) for the Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23B vs GR23 (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Chlorophyll-a					
Chlorophyll-a	1.05	0.43	64	0.11	>0.999

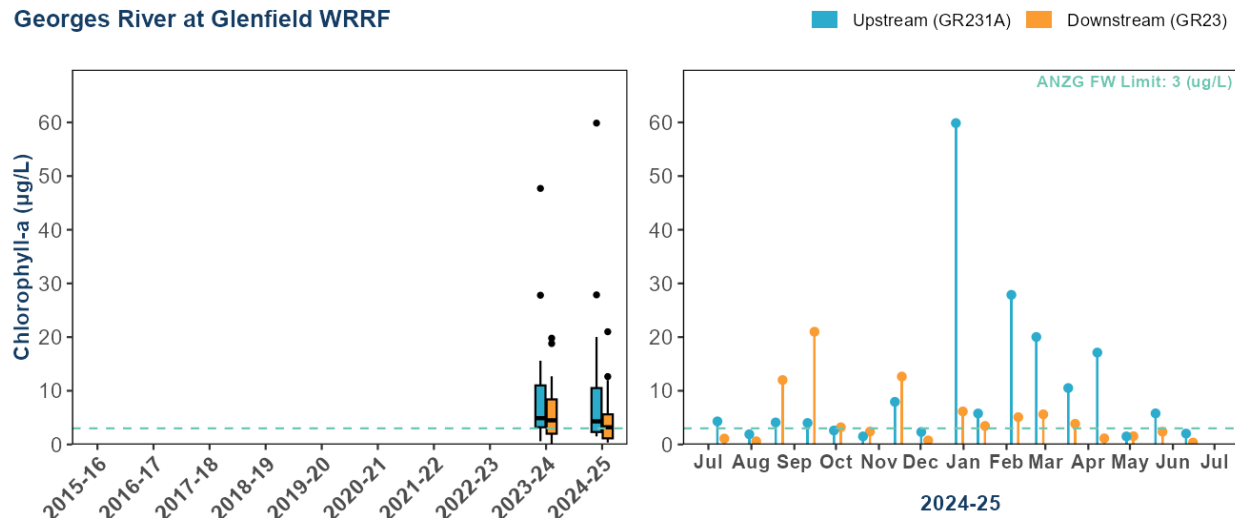
Table B-10 Current period (2024-25) vs previous period comparison (single site) contrast outcomes for the upstream Georges River at Glenfield WRRF

Georges River at Glenfield WRRF: GR23B (River)					
Analyte	Estimate	SE	df	t-ratio	p-value
Chlorophyll-a					
Chlorophyll-a	1.22	0.51	64	0.49	0.961

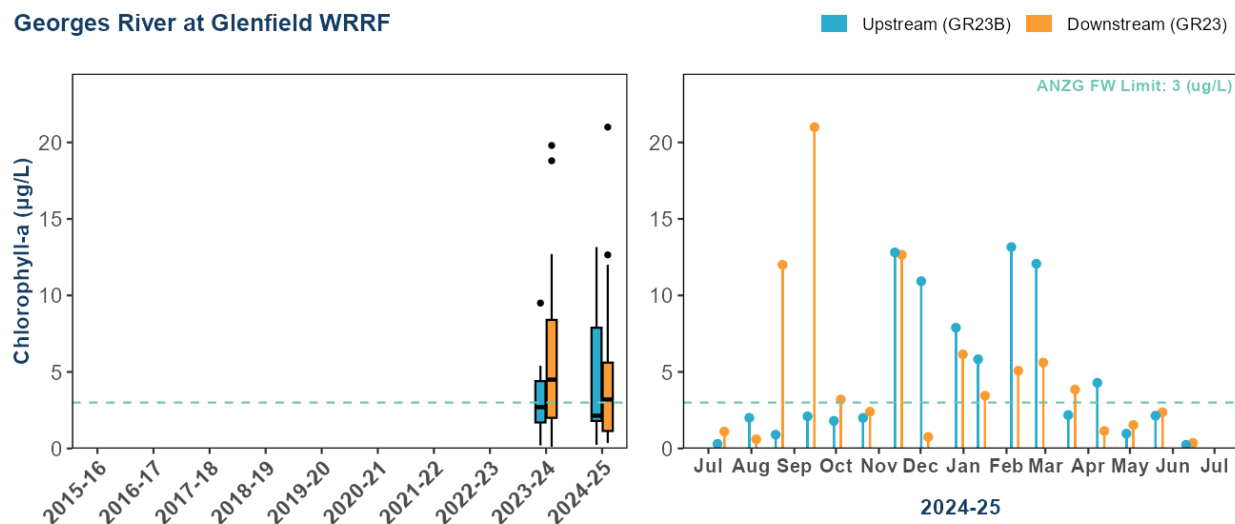
not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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B.1.8. Ecosystem receptor – Phytoplankton

Georges River at Glenfield WRRF



Georges River at Glenfield WRRF



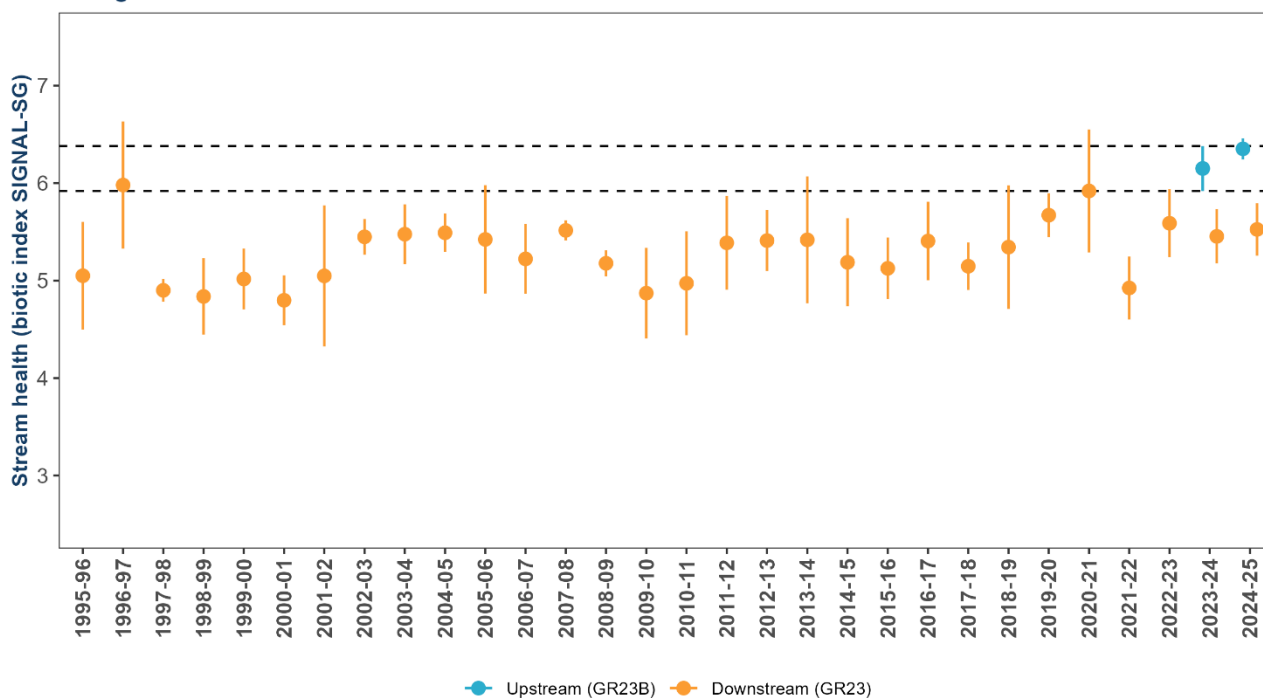
GR231A (Bunbury Curran Creek) is a tributary entering the Georges River between the Georges River upstream and downstream sites

B.1.9. Ecosystem receptor – Macroinvertebrates

Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Georges River	River (GR23B vs GR23)	Welch Two Sample t-test	0.83	6.99	6.57	<0.001
Bunbury Curran Creek	River (GR231A vs GR23)	Welch Two Sample t-test	-1.12	-6.68	9.80	<0.001

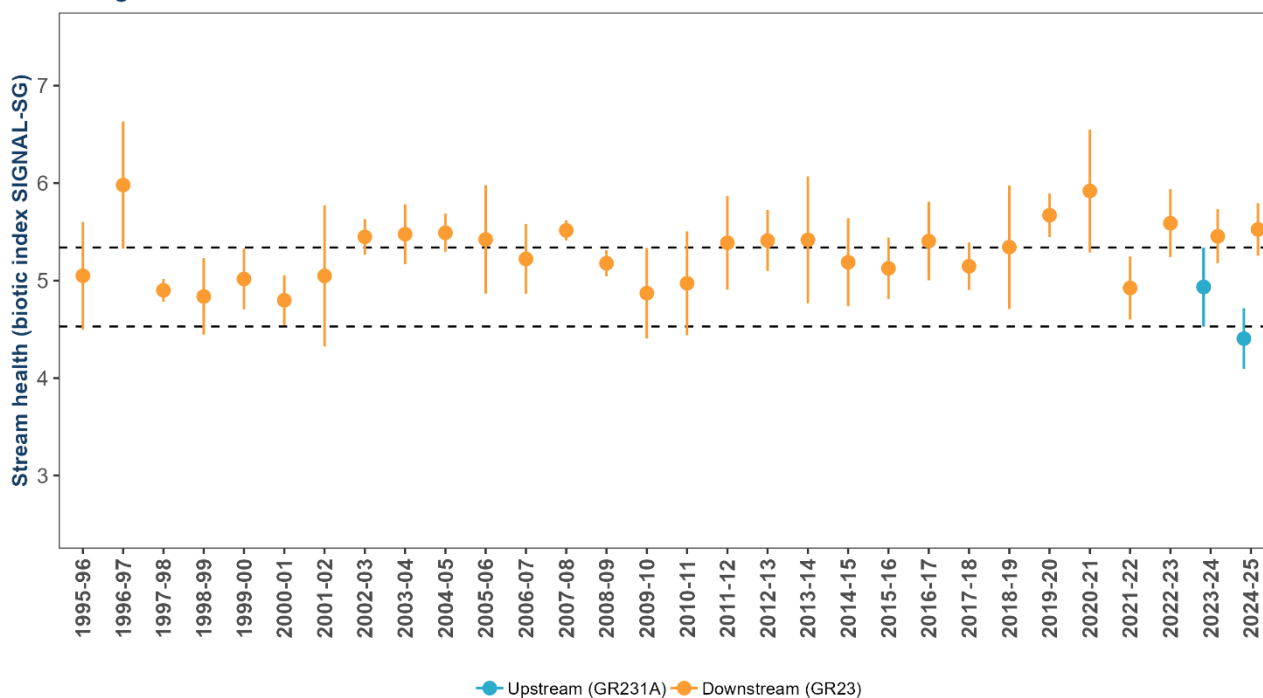
not significant ($p > 0.05$)	$p < 0.05$ and ≥ 0.01	$p < 0.01$ and ≥ 0.001	$p < 0.001$
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Georges River at Glenfield WRRF



The range of stream health recorded over each period is represented by length of line

Georges River at Glenfield WRRF



The range of stream health recorded over each period is represented by length of line

GR231A (Bunbury Curran Creek) is a tributary entering the Georges River between the Georges River upstream and downstream sites

B.1.10. Gate 3 investigation for Glenfield WRRF

An impact to the macroinvertebrate biotic index (SIGNAL-SG) score as an indicator of stream health, was presented in the gate 2 synthesis. All nutrients and a few trace metals (cobalt, copper, and zinc) were also found to be significantly higher at the downstream site (GR23). The gate 3 analysis further investigated the potential influence of these water quality parameters on the impacted stream health in the receiving water of Glenfield WRRF, as indicated by the macroinvertebrate biotic index (SIGNAL-SG) scores.

Stage 1: Multivariate analysis of macroinvertebrate community data

Multivariate analysis was limited to the main Georges River site pair due to stream habitat differences, as the macrophyte habitat was available at both Georges River sites while edge habitat samples were only available for collection in Bunbury Curran Creek. In addition, due to limited historical data (two financial years for the upstream site), a limited multivariate analysis was undertaken for the macroinvertebrate data.

Visual assessment of the ecological communities (Figure B-1 and Figure B-2) provided an initial indication of site separations. The 2D nMDS ordination suggested that while some clustering within sites and separation between sites is present, outliers may be contributing to the significant differences between these upstream-downstream sites. The first division in the cluster diagram indicated that the upstream site in 2024 may be the key contributor to differences observed. The second division in the cluster diagram does suggest some separation between upstream and downstream sites overall, however more data would be required in subsequent years to confirm these visual patterns.

Multivariate statistical results are presented in Table B-11. PERMDISP analysis resulted in a non-significant outcome, suggesting that the variability in taxonomic composition is consistent within sites. This allows interpretation of ANOSIM tests between sites without confounding variability within each site. The ANOSIM test of 'site' returned a marginally non-significant result and a mid-range R value of 0.406, suggesting that site assemblages were more similar than dissimilar. This is reinforced in the PERMANOVA outcomes, which did not indicate any statistically significant differences between sites or years. Similarly, the shade plot (Figure B-3) indicates similar diversity and abundance in assemblages, with three key species identified in the BVSTEP routine contributing to the multivariate patterns (Table B-12).

Overall, community assemblages downstream in the Georges River of Glenfield WRRF appear to be substantially different to those documented upstream on the Georges River. More data in subsequent years is required to better understand these site differences and temporal trends. A combined multivariate assessment of taxonomic data is not possible due to stream habitat differences between the larger Georges River and the Bunbury Curran Creek tributary. In this case, SIGNAL-SG provides the most effective assessment of stream health, and clearly illustrates poorer stream health in Bunbury Curran Creek. Stream health at the downstream Georges River site (GR23) lies between both Bunbury Curran Creek (GR231A) and the upstream Georges River site (GR23B). This limits our ability to conclude that stream health is solely impacted by wastewater storm discharges from the Glenfield WRRF.

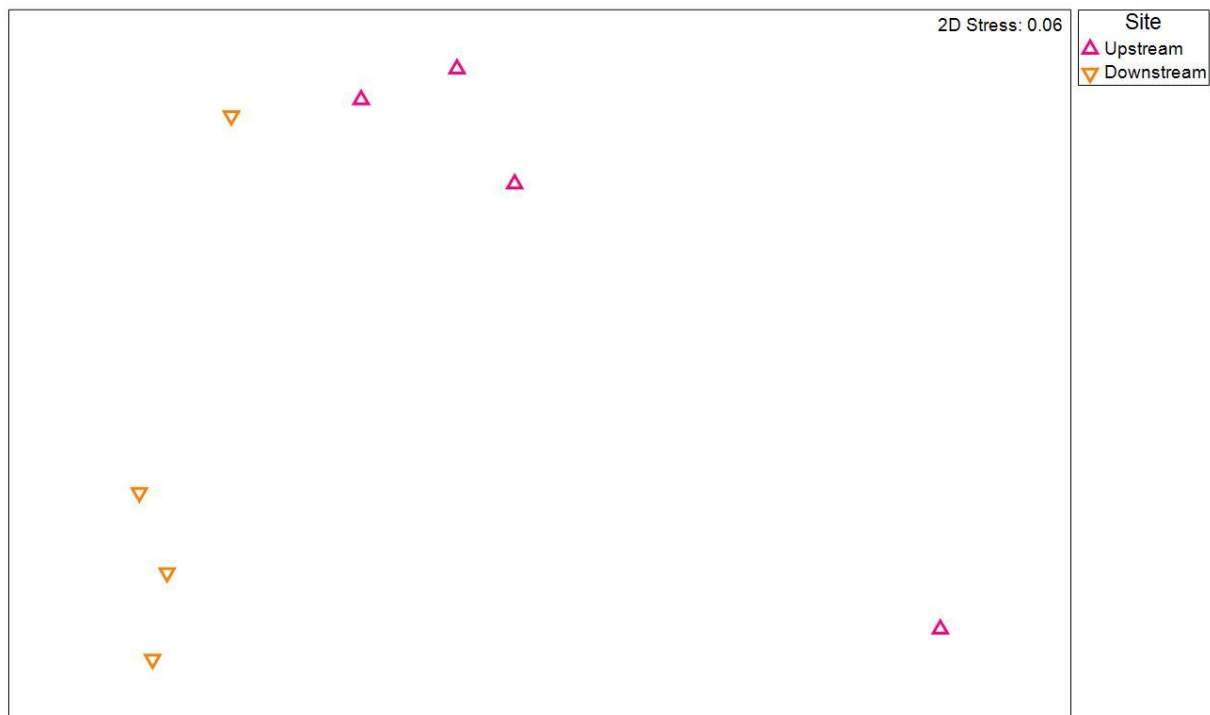


Figure B-1 Dimensions 1 and 2 of 2-dimensional ordination plot of freshwater macroinvertebrate macrophyte habitat community structure upstream and downstream sites in the Georges River near Glenfield WRRF

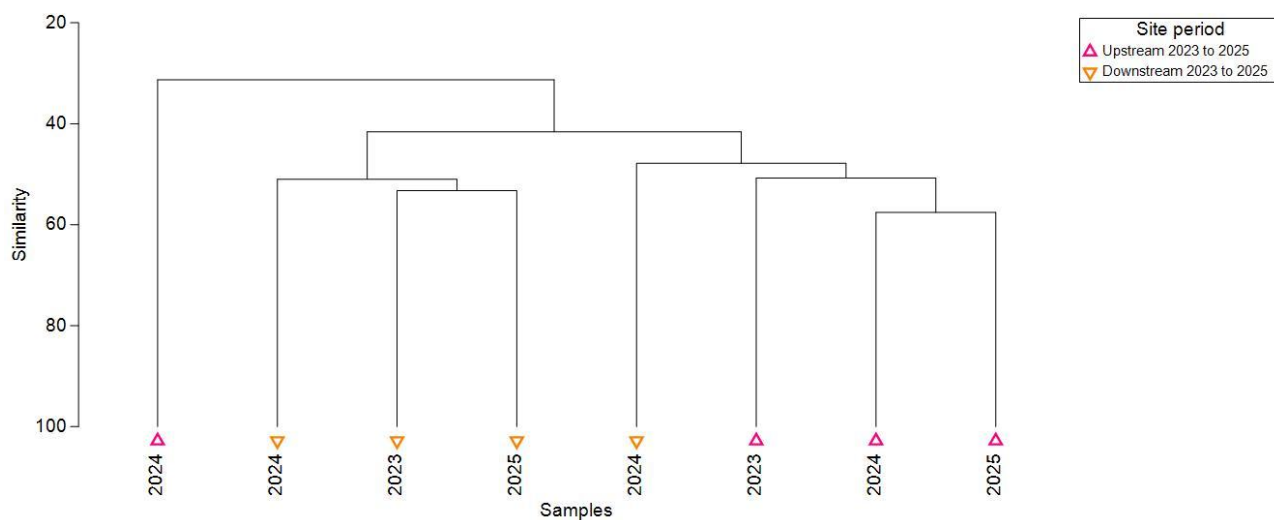


Figure B-2 Cluster diagram of freshwater macroinvertebrate macrophyte habitat community structure upstream and downstream sites in the Georges River near Glenfield WRRF

Table B-11 Macroinvertebrate multivariate statistical test summary for Glenfield WRRF

Glenfield		Macrophytes		
		df	Sample Statistic (Pseudo-F/R)	p-value
PERMDISP	Site	1(6)	0.399	0.740
ANOSIM	Site	-	0.406	0.057
	SitexPeriod	-	-	-
PERMANOVA	Site	1(7)	1.531	0.244
	Year	2(7)	0.787	0.683
	SitexYear	2(7)	0.646	0.793

	not significant ($p > 0.05$)	$p < 0.05$ and ≥ 0.01	$p < 0.01$ and ≥ 0.001	$p < 0.001$
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Table B-12 Genera subset whose multivariate pattern matches full genera set of the macrophyte habitat of the Georges River near Glenfield WRRF

Subset of 3 (correlation 0.956) genera from macrophyte habitat whose pattern matches that of the full set of 70 genera identified with the same subset found on 5 runs from 50 random start runs. Each run was based on three randomly selected genera. Genera were:

Physidae Physella, *Leptoceridae Triplectides*, *Unionicolidae Koenikea*



Figure B-3 Shade plot of freshwater macroinvertebrate macrophyte habitat community structure upstream and downstream in the Georges River near Glenfield WRRF

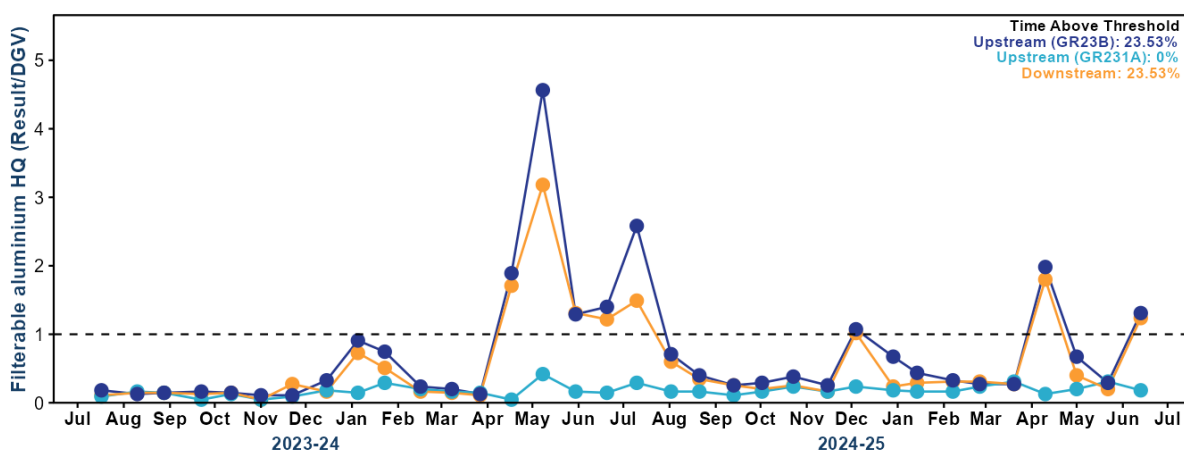
Stage 2: Multivariate regression linking water quality and ecosystem receptors

Sydney Water commenced monitoring receiving water quality upstream (GR23B and GR231A) and downstream (GR23) of Glenfield WRRF in 2023-24. The monitoring design includes multiple upstream sites to further understand the complex relationships between the multiple upstream catchments (Georges River and Bunbury Curran Creek), the additional sources of pollution (stormwater and agriculture runoff), and the downstream impacts to stream health in the receiving waters of the Glenfield WRRF. The recent addition of the Glenfield WRRF receiving water sites to the SWAM program means there is currently insufficient data to conduct a multivariate regression linking water quality to the impacted ecosystem receptors. This analysis can commence from 2025-26 once at least three financial years of data are collected at these sites.

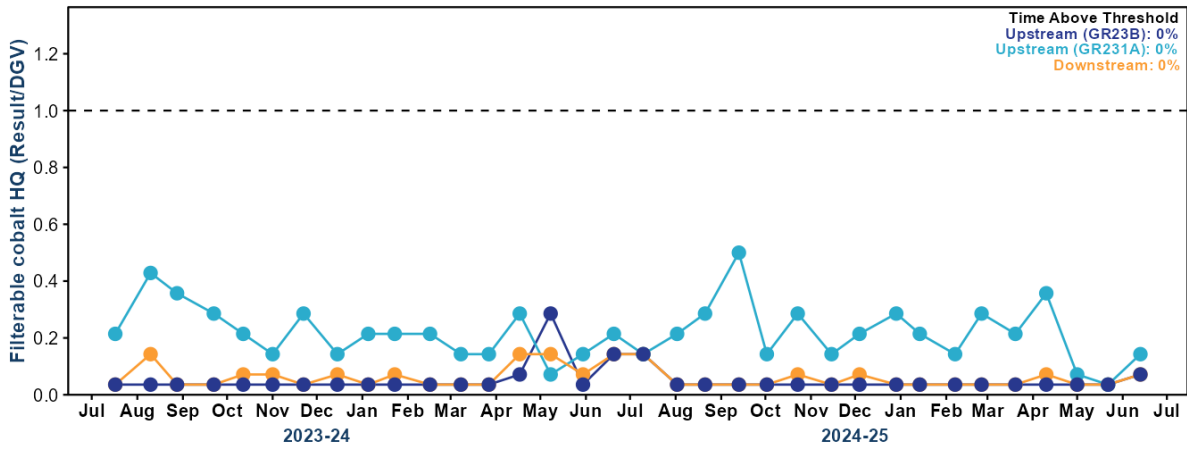
Stage 3: Hazard quotient metric to evaluate the potential risks of filterable metal exposure to organisms

Hazard quotient values for filterable cobalt in were below the hazard quotient threshold over the last two financial years for all three sites (Figure B-4). The upstream Bunbury Curran Creek site (GR231A) exceeded the hazard quotient threshold for filterable copper at 82% of the sampling events, suggesting this site experiences consistent trace metal contamination (Figure B-4). In contrast, filterable copper concentrations were infrequently above the hazard threshold at the Georges River upstream (GR23B) and downstream (GR23) sites (Figure B-4). Exceedances of the hazard quotient threshold were also found for concentrations of filterable aluminium (24% of samples) and zinc (3% of samples; Figure B-4; Table B-13). However, these occurrences were often paired with an upstream exceedance, suggesting catchment influences.

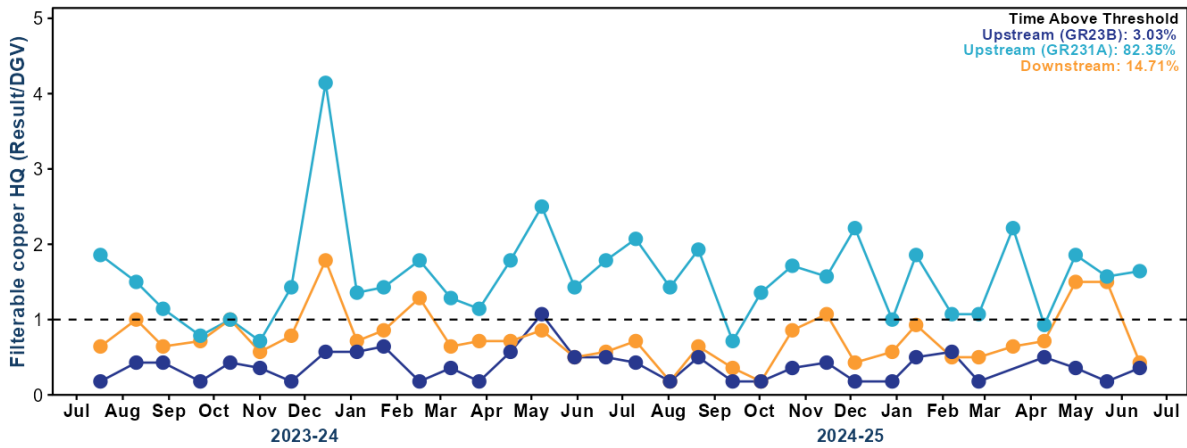
Georges River at Glenfield WRRF ■ Upstream (GR23B) ■ Upstream (GR231A) ■ Downstream (GR23) - - Hazard Threshold



Georges River at Glenfield WRRF ■ Upstream (GR23B) ■ Upstream (GR231A) ■ Downstream (GR23) - - Hazard Threshold



Georges River at Glenfield WRRF ■ Upstream (GR23B) ■ Upstream (GR231A) ■ Downstream (GR23) - - Hazard Threshold



Georges River at Glenfield WRRF ■ Upstream (GR23B) ■ Upstream (GR231A) ■ Downstream (GR23) - - Hazard Threshold

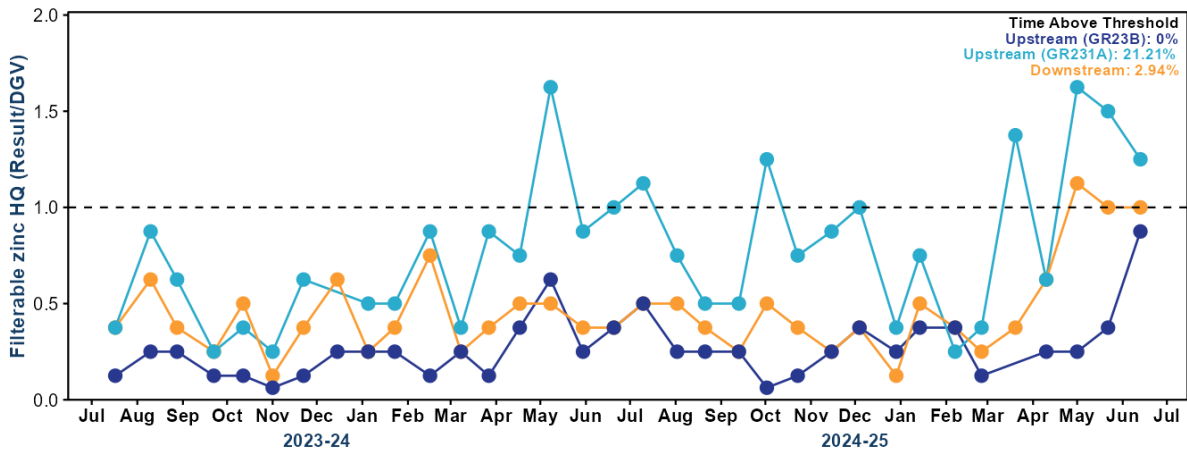


Figure B-4 Hazard quotients for filterable aluminium, cobalt, copper, and zinc between 2023 and 2025 for the Georges River and Bunbury Curran Creek, situated both upstream and downstream of the discharge from Glenfield WRR

Table B-13 Hazard quotients for metal and ammonia nitrogen concentrations between 2023 and 2025 at the Georges River and Bunbury Curran Creek, upstream and downstream of the discharge from Glenfield WRRF.

Georges River at Glenfield WRRF: Hazard Quotient (Result/DGV)																		
Collection date	Ammonia nitrogen			Filterable aluminium			Filterable cobalt			Filterable copper			Filterable nickel			Filterable zinc		
	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)
2023-07-17	0.00	0.67	0.01	0.18	0.09	0.11	0.04	0.21	0.04	0.18	1.86	0.64	0.08	0.07	0.07	0.12	0.38	0.38
2023-08-10	0.00	0.21	0.03	0.13	0.16	0.15	0.04	0.43	0.14	0.43	1.50	1.00	0.08	0.09	0.09	0.25	0.88	0.62
2023-08-28	0.00	0.27	0.02	0.15	0.15	0.15	0.04	0.36	0.04	0.43	1.14	0.64	0.15	0.10	0.12	0.25	0.62	0.38
2023-09-22	0.01	0.04	0.01	0.16	0.05	0.13	0.04	0.29	0.04	0.18	0.79	0.71	0.14	0.08	0.11	0.12	0.25	0.25
2023-10-12	0.00	0.11	0.02	0.15	0.13	0.15	0.04	0.21	0.07	0.43	1.00	1.00	0.13	0.08	0.10	0.12	0.38	0.50
2023-11-01	0.00	0.05	0.00	0.11	0.05	0.05	0.04	0.14	0.07	0.36	0.71	0.57	0.13	0.10	0.11	0.06	0.25	0.12
2023-11-22	0.01	0.08	0.01	0.11	0.09	0.27	0.04	0.29	0.04	0.18	1.43	0.79	0.06	0.10	0.07	0.12	0.62	0.38
2023-12-15	0.01	0.11	0.02	0.33	0.18	0.16	0.04	0.14	0.07	0.57	4.14	1.79	0.05	0.12	0.08	0.25	-	0.62
2024-01-05	0.02	0.03	0.03	0.91	0.15	0.73	0.04	0.21	0.04	0.57	1.36	0.71	0.07	0.09	0.06	0.25	0.50	0.25
2024-01-23	0.01	0.09	0.03	0.75	0.29	0.51	0.04	0.21	0.07	0.64	1.43	0.86	0.05	0.09	0.06	0.25	0.50	0.38
2024-02-16	0.01	0.09	0.06	0.24	0.20	0.16	0.04	0.21	0.04	0.18	1.79	1.29	0.05	0.09	0.05	0.12	0.88	0.75
2024-03-08	0.00	0.01	0.00	0.20	0.16	0.15	0.04	0.14	0.04	0.36	1.29	0.64	0.06	0.07	0.06	0.25	0.38	0.25
2024-03-27	0.01	0.03	0.02	0.13	0.15	0.11	0.04	0.14	0.04	0.18	1.14	0.71	0.12	0.07	0.11	0.12	0.88	0.38
2024-04-17	0.01	0.07	0.02	1.89	0.05	1.71	0.07	0.29	0.14	0.57	1.79	0.71	0.09	0.11	0.08	0.38	0.75	0.50
2024-05-08	0.01	0.01	0.01	4.56	0.42	3.18	0.29	0.07	0.14	1.07	2.50	0.86	0.09	0.06	0.09	0.62	1.62	0.50
2024-05-30	0.01	0.07	0.02	1.29	0.16	1.31	0.04	0.14	0.07	0.50	1.43	0.50	0.08	0.07	0.07	0.25	0.88	0.38
2024-06-20	0.00	0.05	0.01	1.40	0.15	1.22	0.14	0.21	0.14	0.50	1.79	0.57	0.07	0.09	0.08	0.38	1.00	0.38
2024-07-10	0.00	0.02	0.01	2.58	0.29	1.49	0.14	0.14	0.14	0.43	2.07	0.71	0.09	0.08	0.08	0.50	1.12	0.50
2024-08-02	0.00	0.03	0.01	0.71	0.16	0.60	0.04	0.21	0.04	0.18	1.43	0.18	0.07	0.06	0.07	0.25	0.75	0.50
2024-08-21	0.00	0.06	0.01	0.40	0.16	0.35	0.04	0.29	0.04	0.50	1.93	0.64	0.07	0.06	0.06	0.25	0.50	0.38

Georges River at Glenfield WRRF: Hazard Quotient (Result/DGV)																		
Collection date	Ammonia nitrogen			Filterable aluminium			Filterable cobalt			Filterable copper			Filterable nickel			Filterable zinc		
	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)	GR23B (US)	GR231A (US)	GR23 (DS)
2024-09-13	0.00	0.01	0.00	0.25	0.11	0.25	0.04	0.50	0.04	0.18	0.71	0.36	-	0.10	0.07	0.25	0.50	0.25
2024-10-02	0.00	0.09	0.02	0.29	0.16	0.20	0.04	0.14	0.04	0.18	1.36	0.18	0.01	0.01	0.01	0.06	1.25	0.50
2024-10-23	0.00	0.15	0.02	0.38	0.24	0.25	0.04	0.29	0.07	0.36	1.71	0.86	0.10	0.06	0.09	0.12	0.75	0.38
2024-11-15	0.00	0.72	0.03	0.25	0.16	0.16	0.04	0.14	0.04	0.43	1.57	1.07	0.12	0.07	0.09	0.25	0.88	0.25
2024-12-04	0.00	0.40	0.02	1.07	0.24	1.02	0.04	0.21	0.07	0.18	2.21	0.43	0.03	0.03	0.03	0.38	1.00	0.38
2024-12-29	0.00	0.01	0.00	0.67	0.18	0.24	0.04	0.29	0.04	0.18	1.00	0.57	0.05	0.11	0.05	0.25	0.38	0.12
2025-01-14	0.00	0.09	0.01	0.44	0.16	0.29	0.04	0.21	0.04	0.50	1.86	0.93	0.05	0.10	0.05	0.38	0.75	0.50
2025-02-07	0.01	0.01	0.01	0.33	0.16	0.31	0.04	0.14	0.04	0.57	1.07	0.50	0.07	0.09	0.06	0.38	0.25	0.38
2025-02-25	0.00	0.04	0.00	0.27	0.24	0.31	0.04	0.29	0.04	0.18	1.07	0.50	0.05	0.09	0.05	0.12	0.38	0.25
2025-03-20	0.00	0.49	0.01	0.27	0.31	0.27	0.04	0.21	0.04	-	2.21	0.64	0.15	0.07	0.17	-	1.38	0.38
2025-04-10	0.01	0.14	0.01	1.98	0.13	1.80	0.04	0.36	0.07	0.50	0.93	0.71	0.08	0.07	0.08	0.25	0.62	0.62
2025-05-01	0.00	0.01	0.00	0.67	0.20	0.40	0.04	0.07	0.04	0.36	1.86	1.50	0.10	0.05	0.07	0.25	1.62	1.12
2025-05-22	0.01	0.02	0.02	0.29	0.31	0.20	0.04	0.04	0.04	0.18	1.57	1.50	0.05	0.04	0.05	0.38	1.50	1.00
2025-06-13	0.00	0.03	0.01	1.31	0.18	1.24	0.07	0.14	0.07	0.36	1.64	0.43	0.09	0.08	0.08	0.88	1.25	1.00
% Above Threshold	0.00	0.00	0.00	23.53	0.00	23.53	0.00	0.00	0.00	3.03	82.35	14.71	0.00	0.00	0.00	0.00	21.21	2.94



Stage 4: Synthesis of gate 3 results and recommendation for future investigations

Primary and secondary effluents from the Glenfield WRRF are discharged into the Georges River (GR23). In addition, stormwater and agricultural runoff are common sources of upstream pollution that enter the Georges River and potentially influence the conditions of the downstream site.

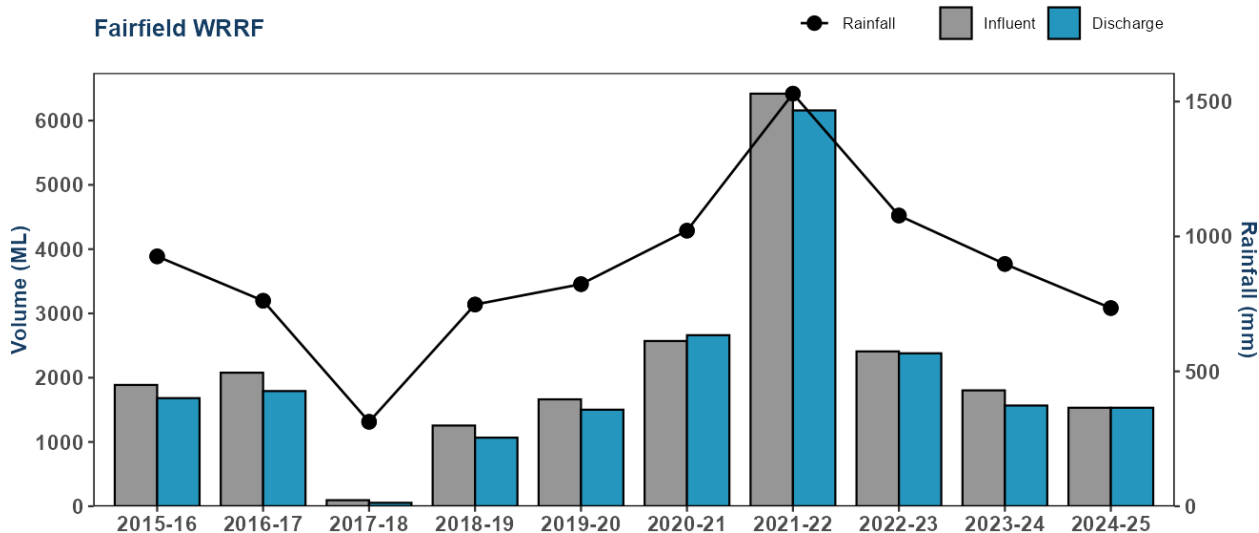
Multiple upstream sites are being monitored to capture the broad range of pollutants impacting the ecological receptors of the waterway. The downstream impacts to macroinvertebrate SIGNAL-SG score as an indicator of stream health, could therefore be attributed to discharge activity (GR23B upstream site) or the additional sources of upstream pollution (GR231A upstream site).

Multivariate analysis of the limited macroinvertebrate community data indicated that taxonomic assemblages downstream of the Glenfield WRRF appeared to have minimal differences compared to upstream in the Georges River catchment. This was further supported by hazard quotient calculations showing a reduction in filterable copper concentrations with distance downstream of the Glenfield WRRF. The Bunbury Curran Creek upstream site (GR231A) experienced consistently high concentrations of filterable copper in the waterway. Urban environments generate a significant metal load from road-derived metals particularly copper and zinc, that are transported directly to the waterways and can be a primary contributor to metal contamination in stormwater (Birch, 2024). Stormwater delivery of road derived metals at the upstream site (GR231A) is the likely source of the increased copper concentrations above the hazard quotient threshold. The contamination of trace metals was noticeably reduced at the downstream site, which could be due to recovery with distance downstream or dilution from the Georges River upstream catchment. The reduction of trace metals downstream of the waterway could be partly mitigating the impacts to stream health as indicated by the macroinvertebrate biotic index (SIGNAL-SG) score. The ongoing water quality monitoring in the Georges River and Bunbury Creek will allow for a differentiation between upstream catchment influences and provide a more comprehensive assessment of the stream health impacts downstream.

B.2. Fairfield WRRF

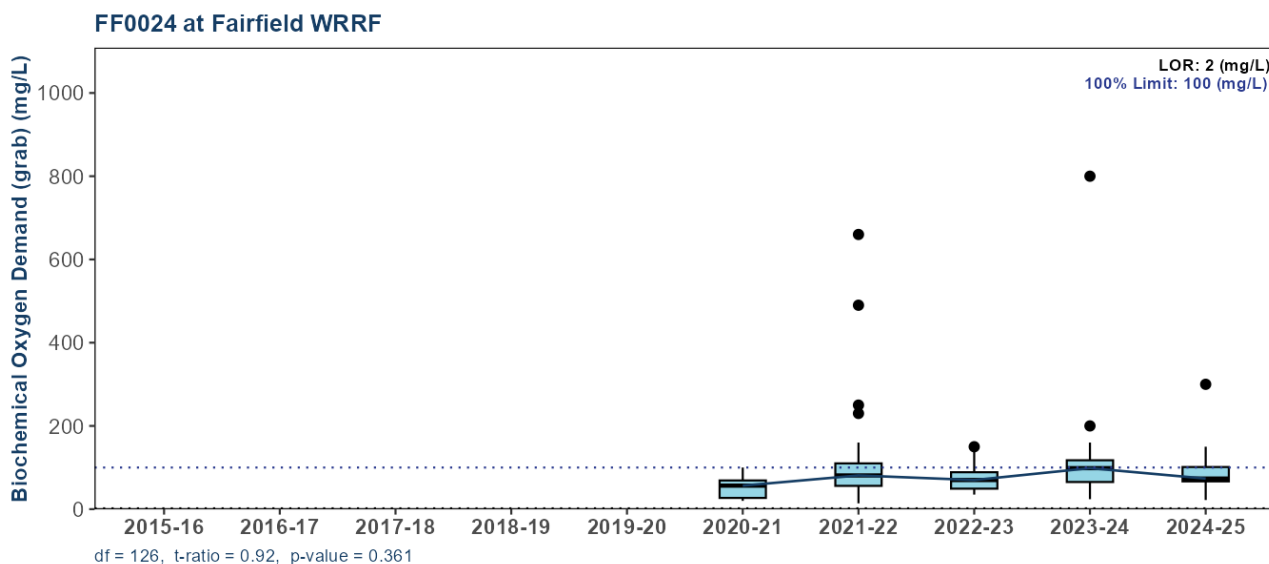
B.2.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

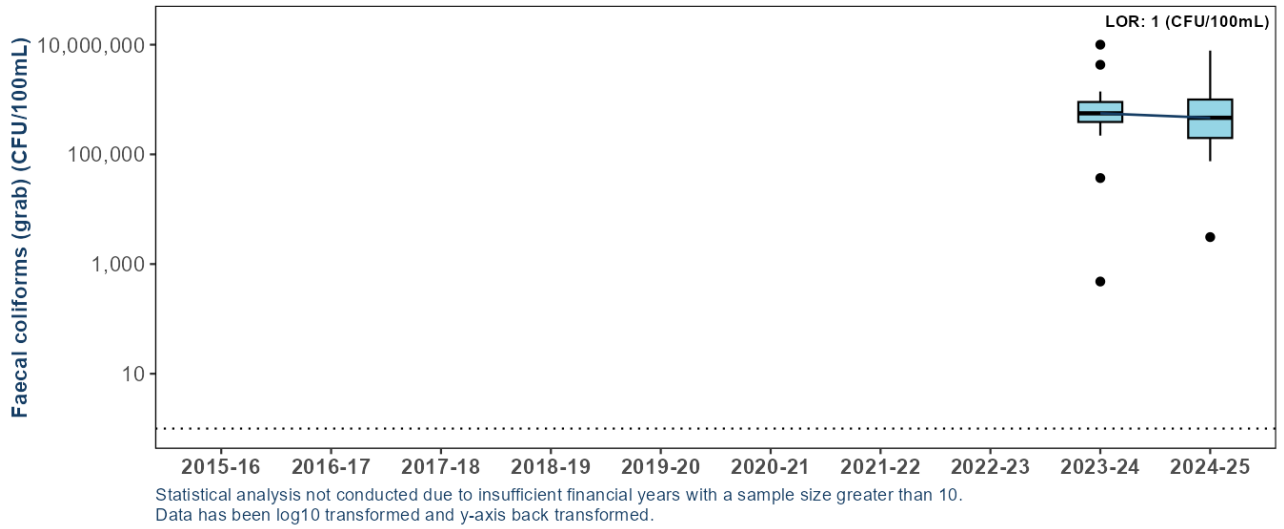


B.2.2. Pressure – Wastewater quality

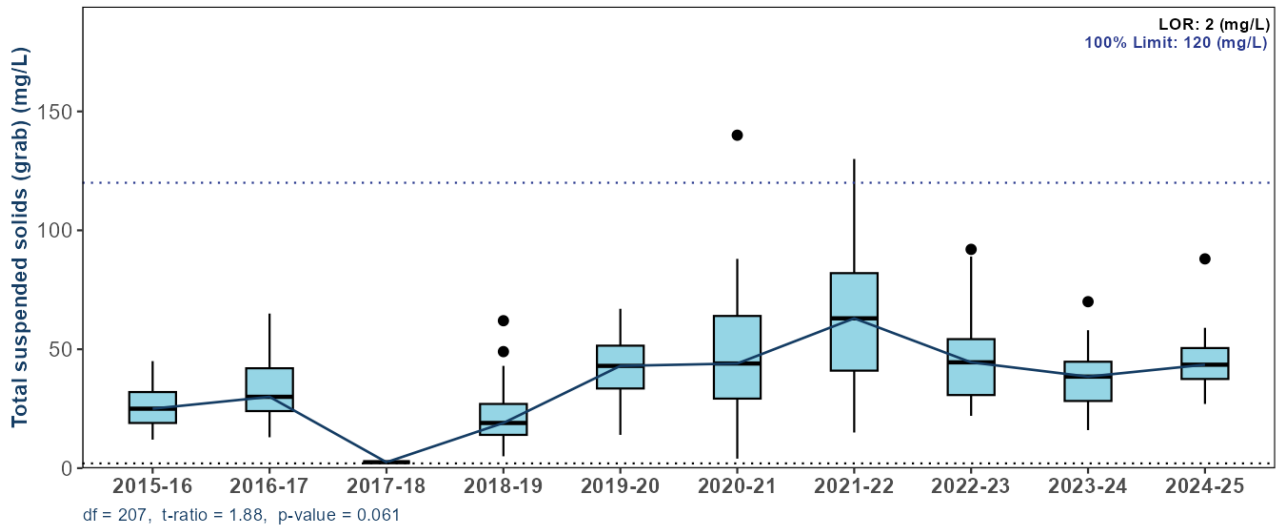
Major conventional analytes



FF0024 at Fairfield WRRF



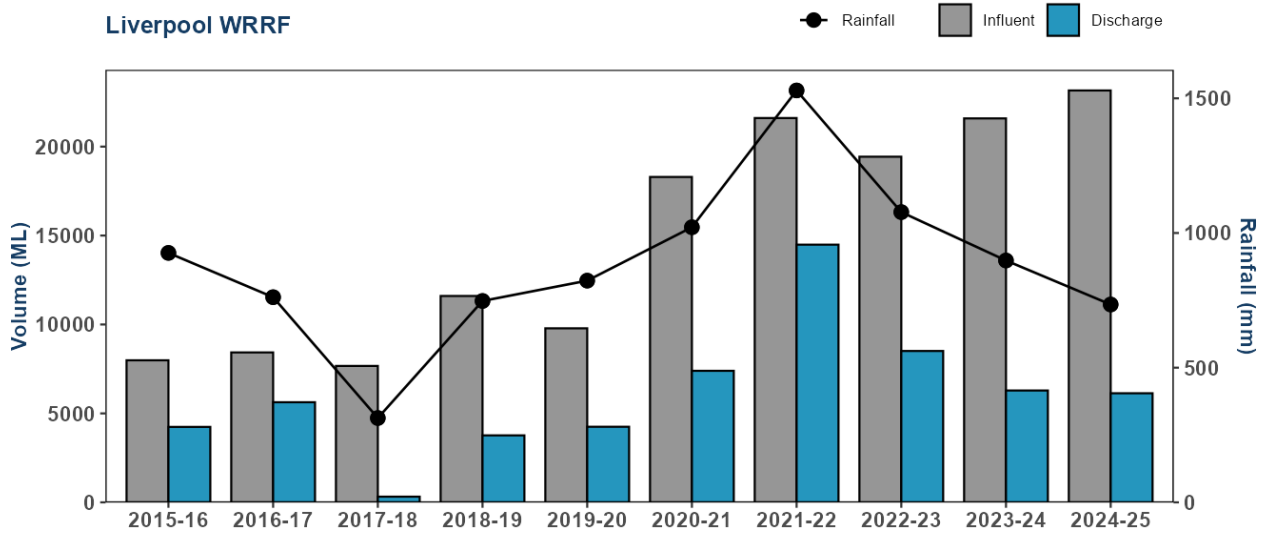
FF0024 at Fairfield WRRF



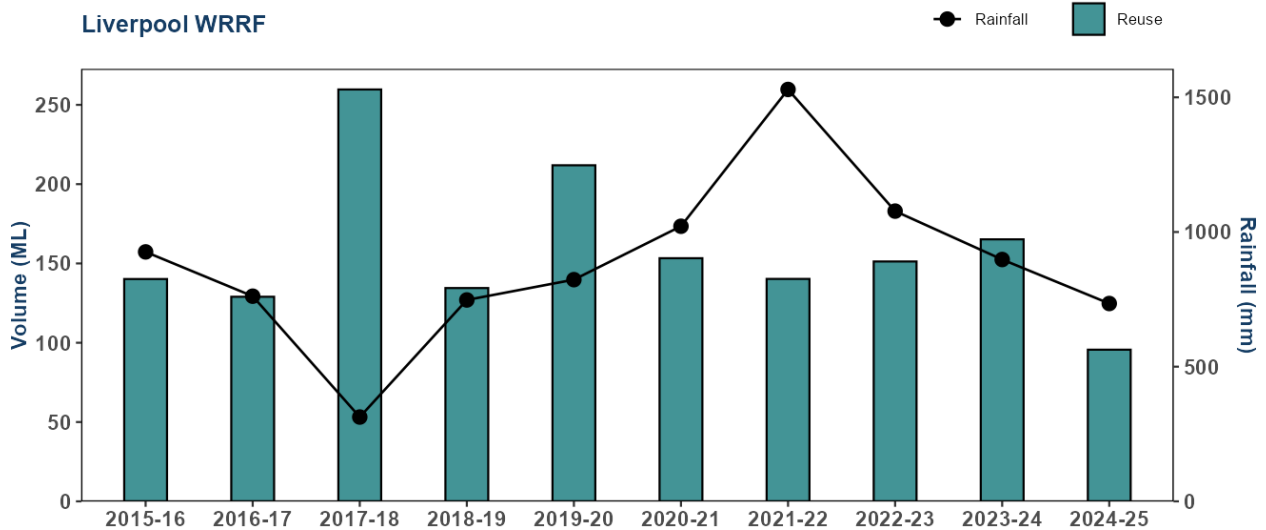
B.3. Liverpool WRRF

B.3.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

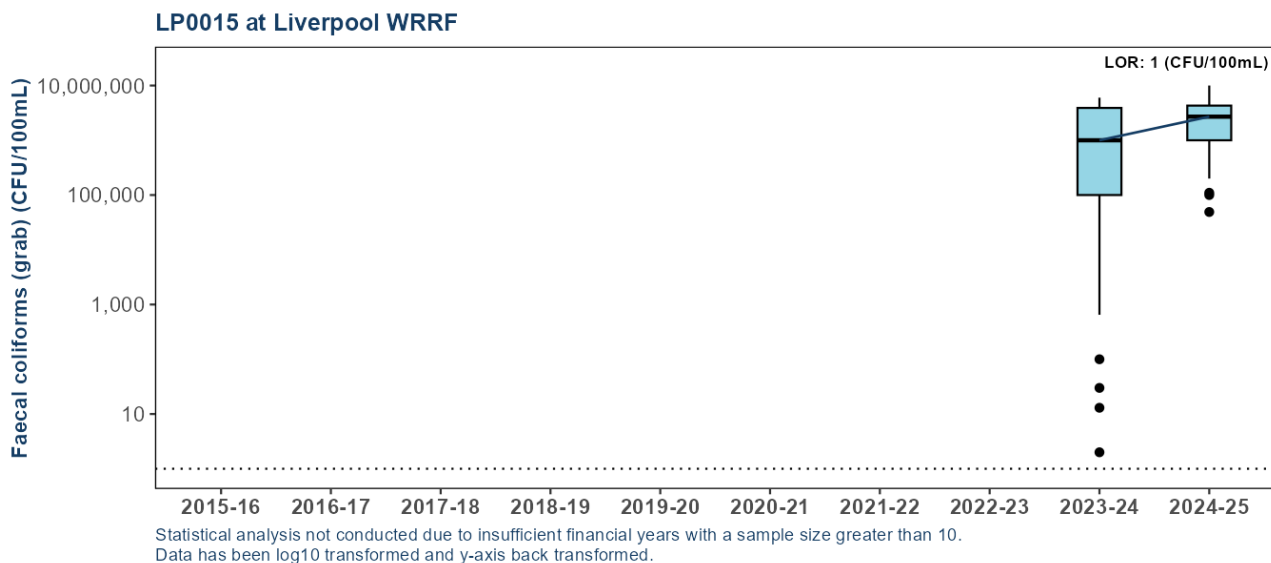
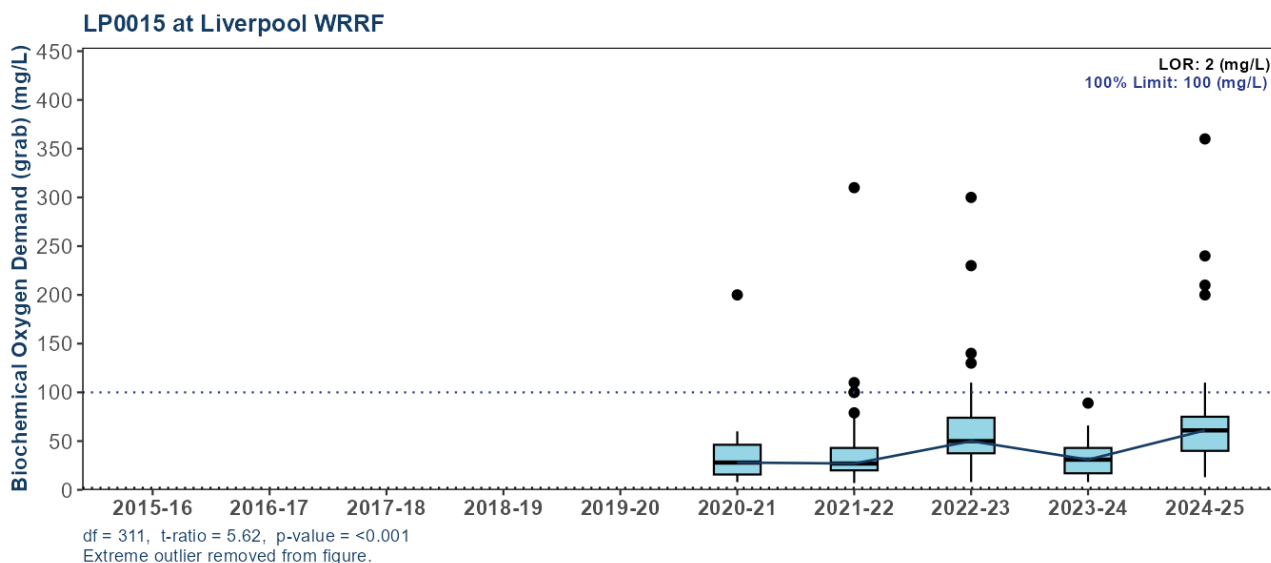


Reuse volume and rainfall

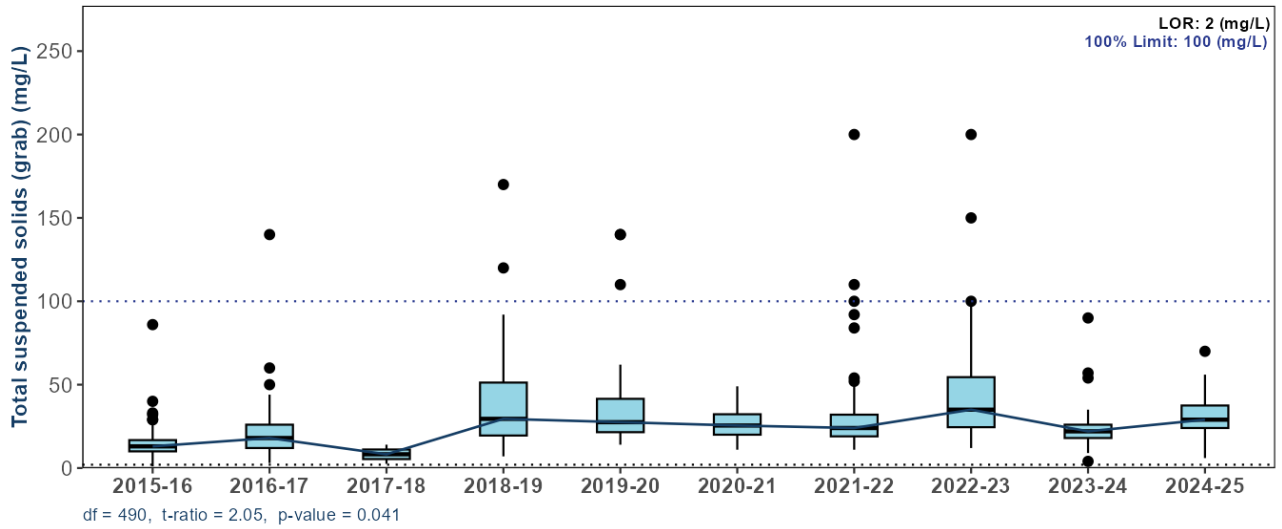


B.3.2. Pressure – Wastewater quantity

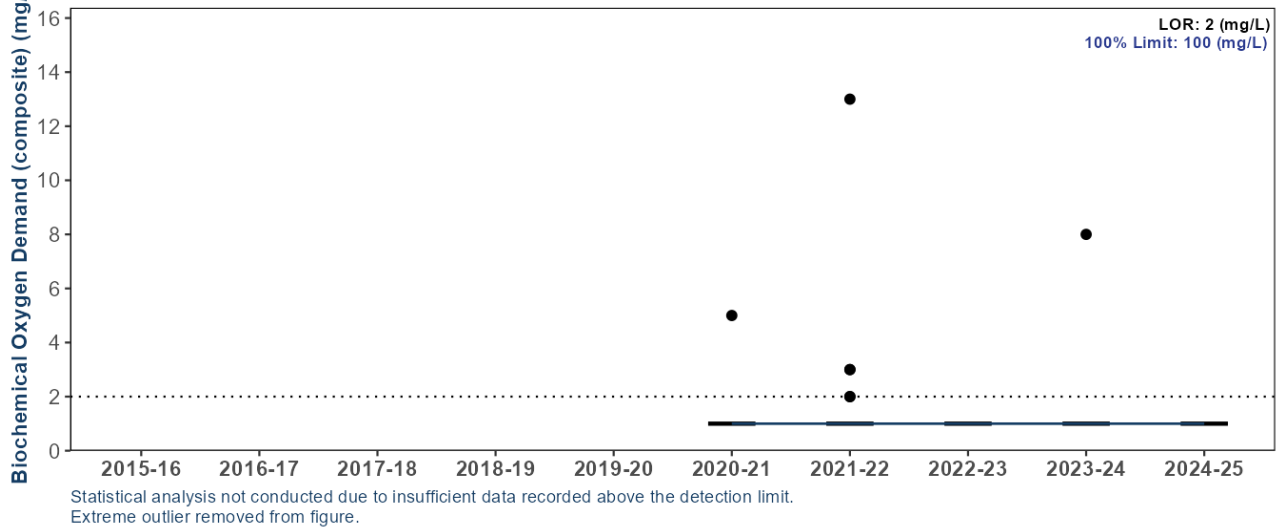
Major conventional analytes



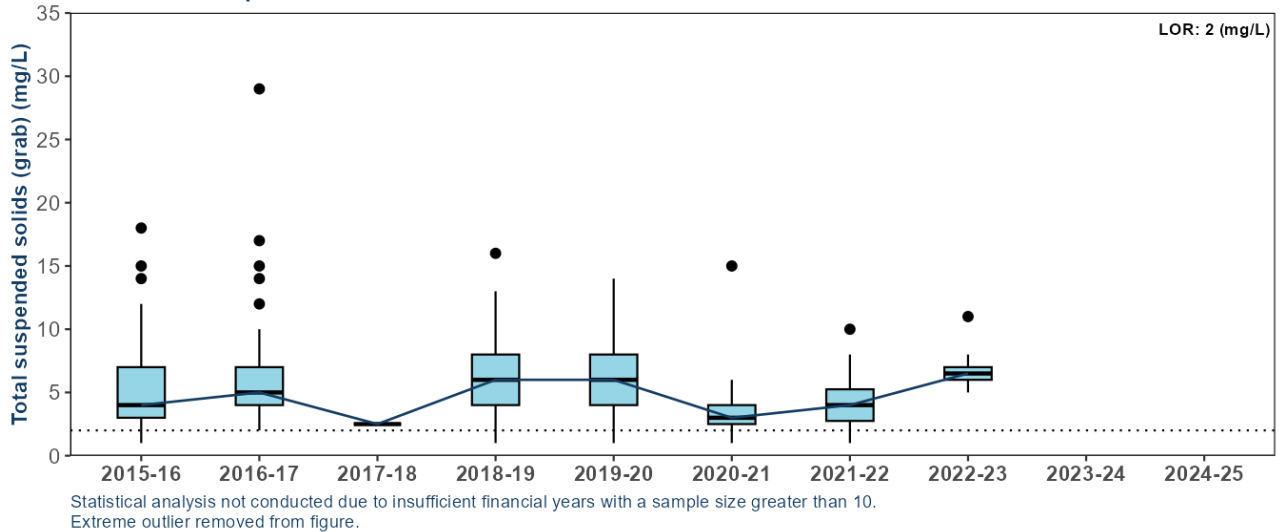
LP0015 at Liverpool WRRF



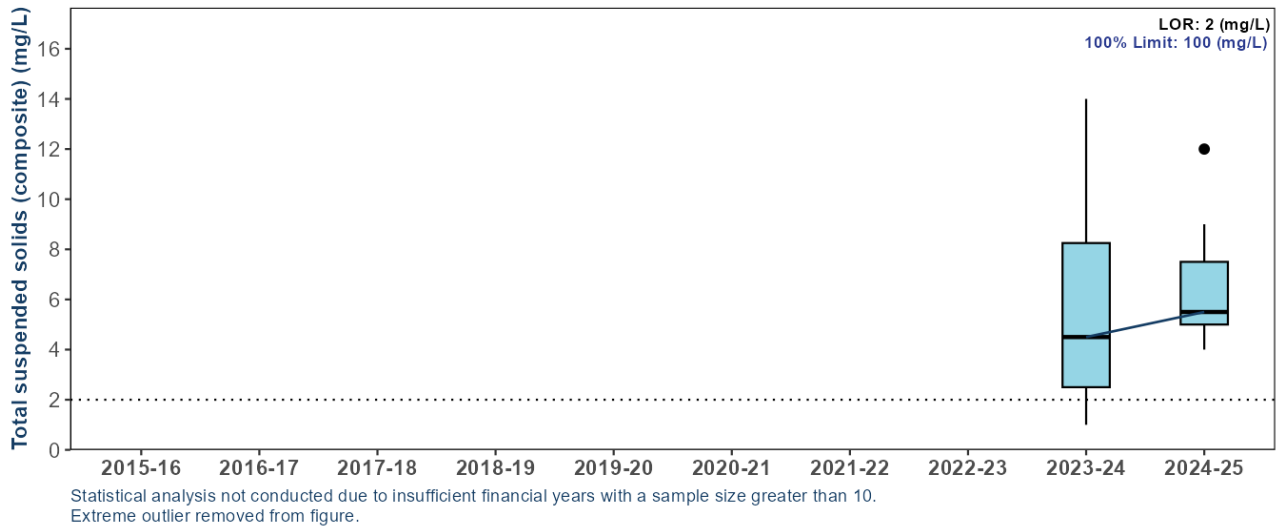
LP0076 at Liverpool WRRF



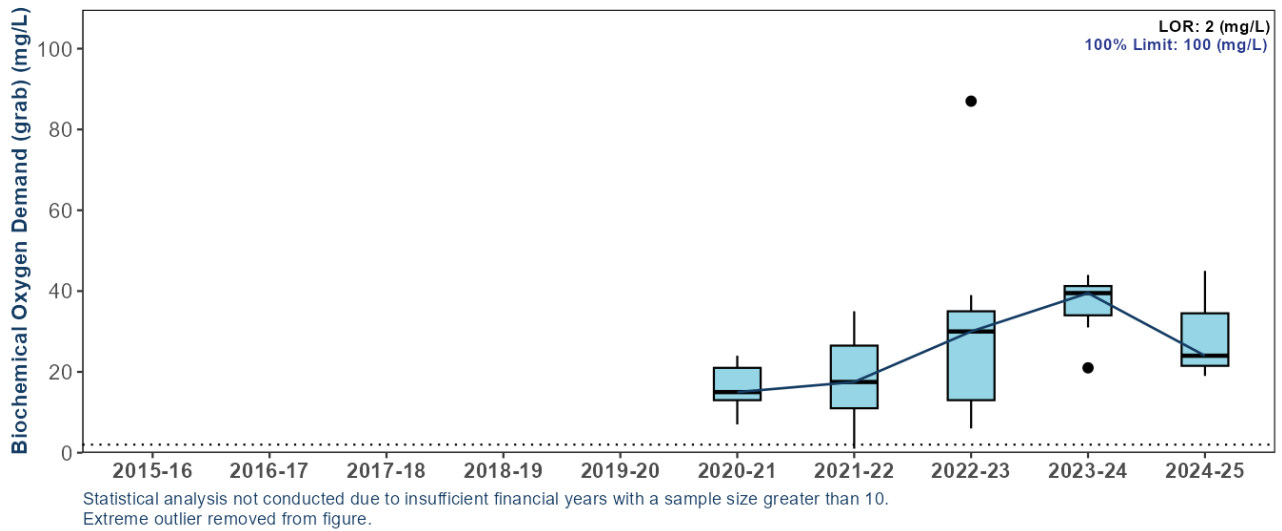
LP0076 at Liverpool WRRF



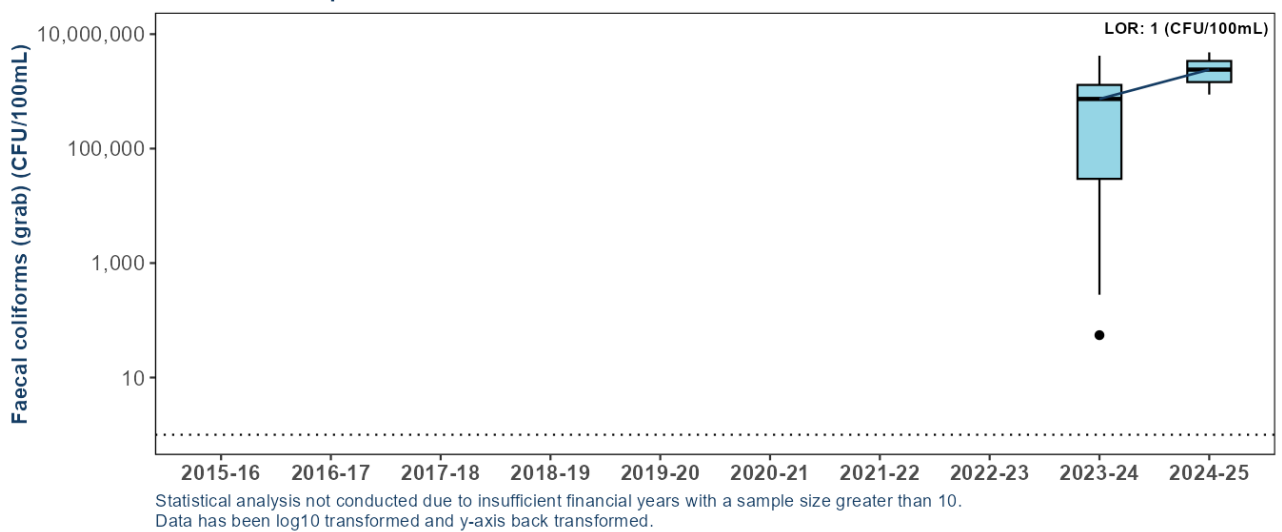
LP0076 at Liverpool WRRF



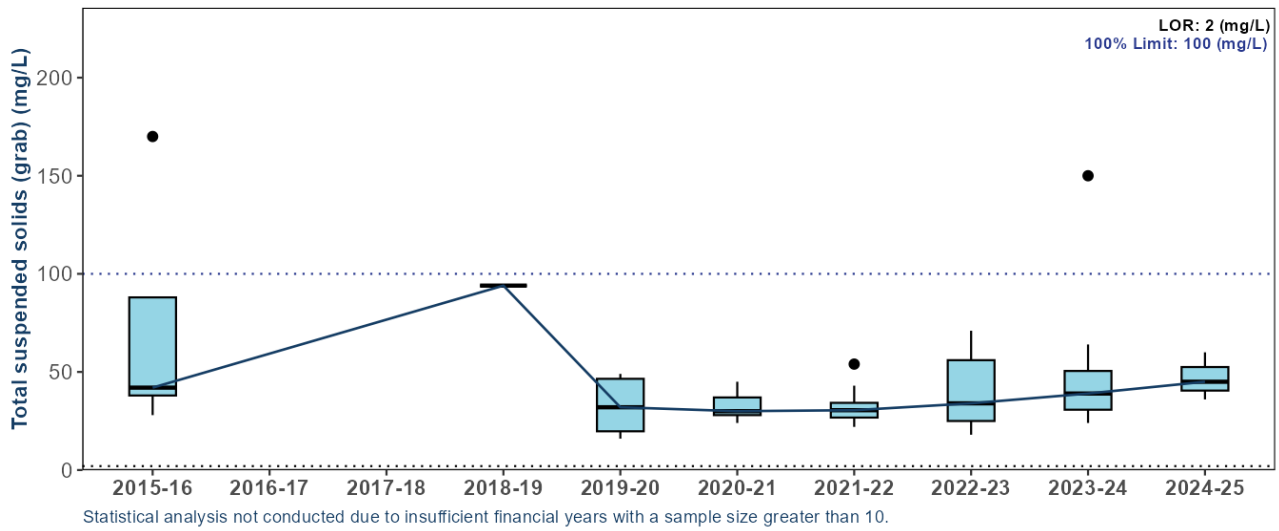
LP0081 at Liverpool WRRF



LP0081 at Liverpool WRRF



LP0081 at Liverpool WRRF



B.4. EPL limits of the Georges River WRRF

Table B-14 EPL concentration limits for the Georges River WRRFs (2024-25)

WRRF	Sampling Points	Biochemical Oxygen Demand (mg/L)	Total Suspended Solids (mg/L)
		100th %-ile	100th %-ile
Glenfield	GF0020 (G)	100	100
Fairfield	FF0024 (G)	100	120
Liverpool	LP0015 - discharge (G)	100	100
	LP0076 - irrigation (C)	100	100
	LP0081 - discharge (G)	100	100



C. Other monitoring – Freshwater

C.1. Water quality and chlorophyll-a – Other long term HN River sites (SoE)

Water quality and chlorophyll-a for the ten SoE sites are presented in the following order from upstream to downstream:

- N44: Nepean River at Yarramundi Bridge
- NS04A: Lower South Creek at Fitzroy Bridge
- N35: Hawkesbury River at Wilberforce
- NC11A: Lower Cattai Creek at Cattai Ridge Road
- N3001: Hawkesbury River off Cattai SRA
- N26: Hawkesbury River at Sackville Ferry
- N2202: Lower Colo River at Putty Road
- N18: Hawkesbury River at Leets Vale
- NB13: Berowra Creek at Calabash Bay
- NB11: Berowra Creek off Square Bay

The water quality box plots and needle plots are presented in the following groups and order of analytes:

- Nutrients
 - Ammonia nitrogen
 - Oxidised nitrogen
 - Total nitrogen
 - Soluble reactive phosphorus
 - Total phosphorus
- Physico-chemical analytes
 - Conductivity
 - Dissolved oxygen (mg/L)
 - Dissolved oxygen saturation (%)
 - pH
 - Water temperature
 - Turbidity
- Trace metals

- Filterable aluminium
- Total aluminium
- Filterable cobalt
- Total cobalt
- Filterable copper
- Total copper
- Filterable nickel
- Total nickel
- Filterable zinc
- Total zinc
- Phytoplankton (paired box plots and needle plots)
 - Chlorophyll-*a*

Statistical analysis outcome tables for SoE sites for all monitoring analytes are presented first before the plots.

Other supplementary outcomes from statistical analysis on e.g. ANOVA and estimated marginal means on SoE waterway sites are included as electronic appendices sent to the EPA.

C.1.1. Nepean River at Yarramundi Bridge (N44)

Stressors - Statistical analysis outcomes

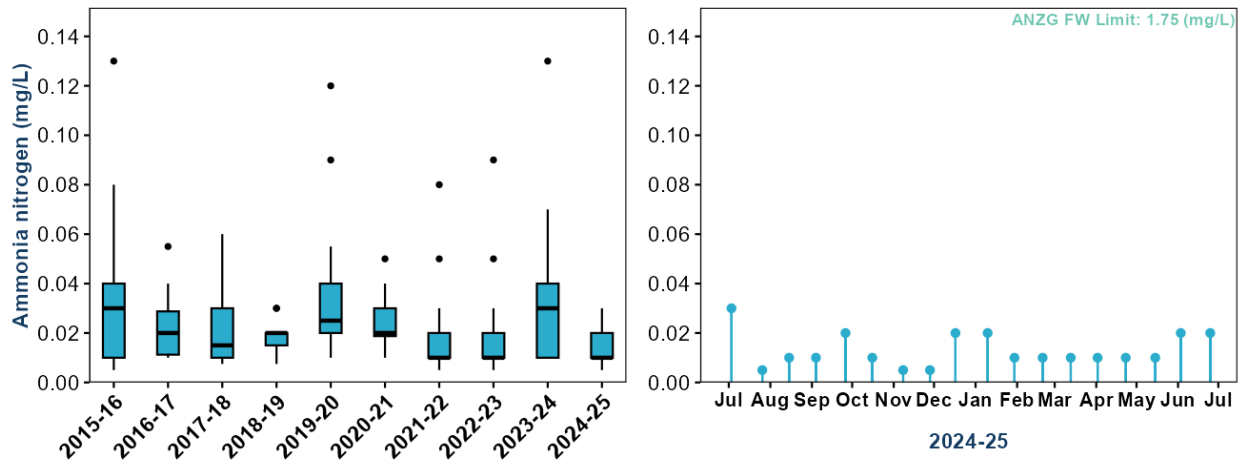
Table C-1 Current period (2024-25) vs previous period comparison for N44

Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.69	0.17	159	-1.48	0.141
Oxidised nitrogen	2.11	0.72	159	2.19	0.030
Total nitrogen	1.00	0.08	159	-0.01	0.989
Soluble reactive phosphorus	0.74	0.20	33	-1.12	0.270
Total phosphorus	0.65	0.07	159	-3.81	<0.001
Physico-chemical					
Conductivity	1.11	0.08	158	1.42	0.156
Dissolved oxygen	1.03	0.06	159	0.60	0.551
Dissolved oxygen saturation	1.61	3.42	159	0.47	0.638
pH	-0.12	0.11	159	-1.08	0.281
Water temperature	1.05	0.07	157	0.67	0.504
Turbidity	0.86	0.14	158	-0.95	0.346
Trace metals					
Filterable aluminium	0.86	0.19	33	-0.71	0.480
Total aluminium	0.65	0.18	33	-1.55	0.131
Filterable cobalt	0.82	0.20	33	-0.81	0.425
Total cobalt	0.64	0.13	33	-2.16	0.038
Filterable copper	0.94	0.07	33	-0.92	0.362
Total copper	0.74	0.09	33	-2.46	0.019
Filterable nickel	1.01	0.07	33	0.16	0.874
Total nickel	0.89	0.08	33	-1.35	0.186
Filterable zinc	1.13	0.26	32	0.53	0.603
Total zinc	0.83	0.18	33	-0.83	0.411
Chlorophyll-a					
Chlorophyll-a	0.77	0.15	159	-1.31	0.191
not significant (p>0.05) p <0.05 and >=0.01 p <0.01 and >=0.001 p <0.001					

Stressors – Nutrients

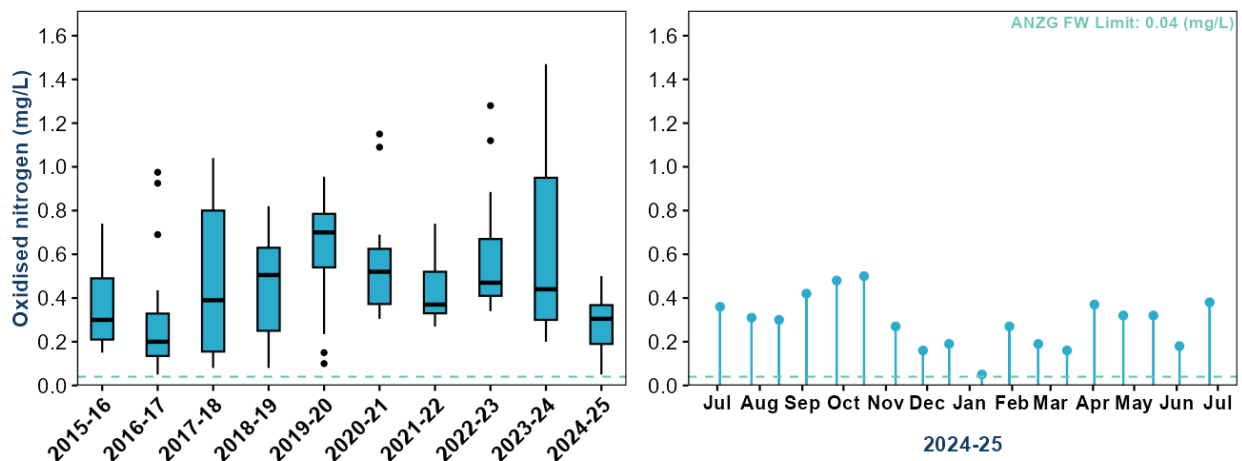
Nepean River at Yarramundi Bridge as SoE Site

N44



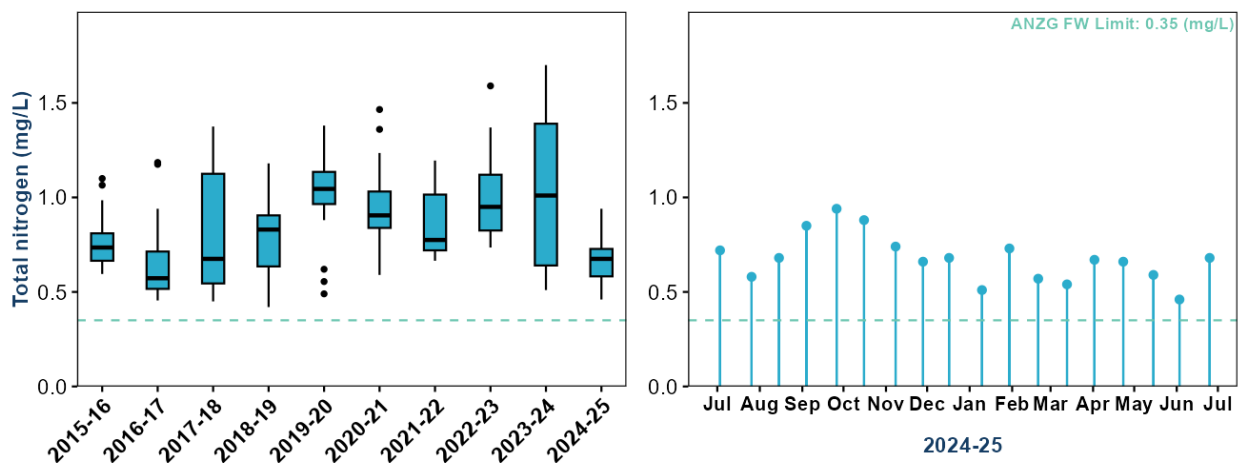
Nepean River at Yarramundi Bridge as SoE Site

N44



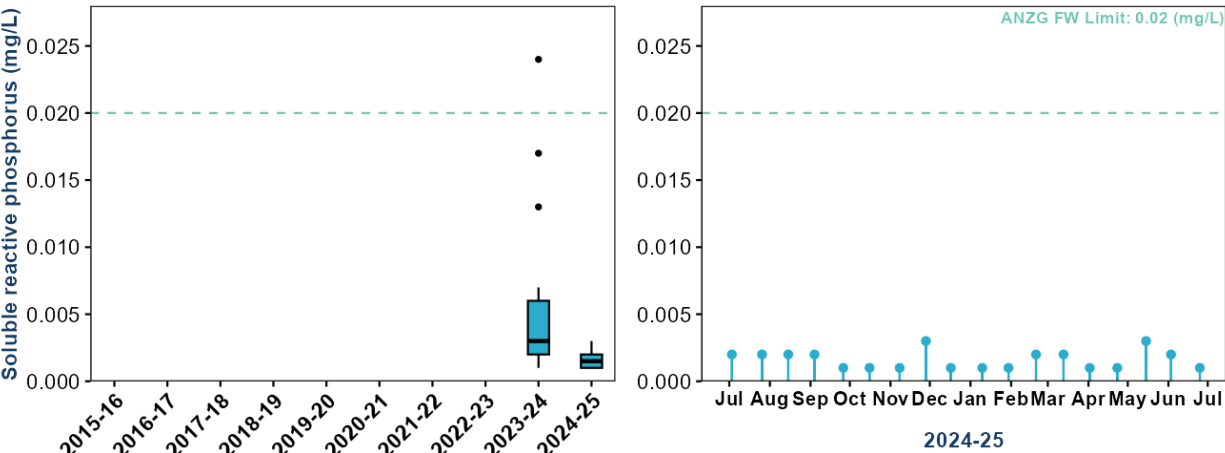
Nepean River at Yarramundi Bridge as SoE Site

N44



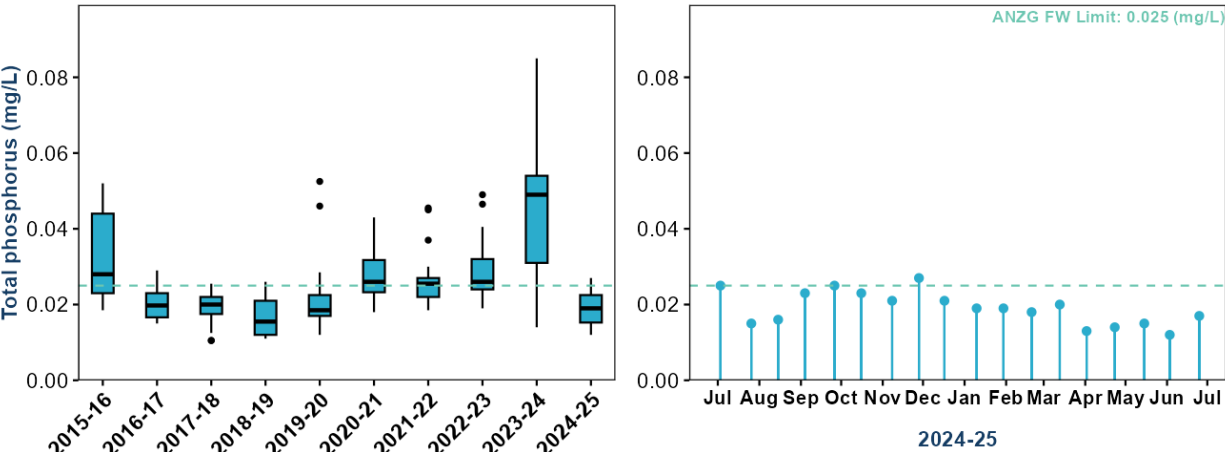
Nepean River at Yarramundi Bridge as SoE Site

N44



Nepean River at Yarramundi Bridge as SoE Site

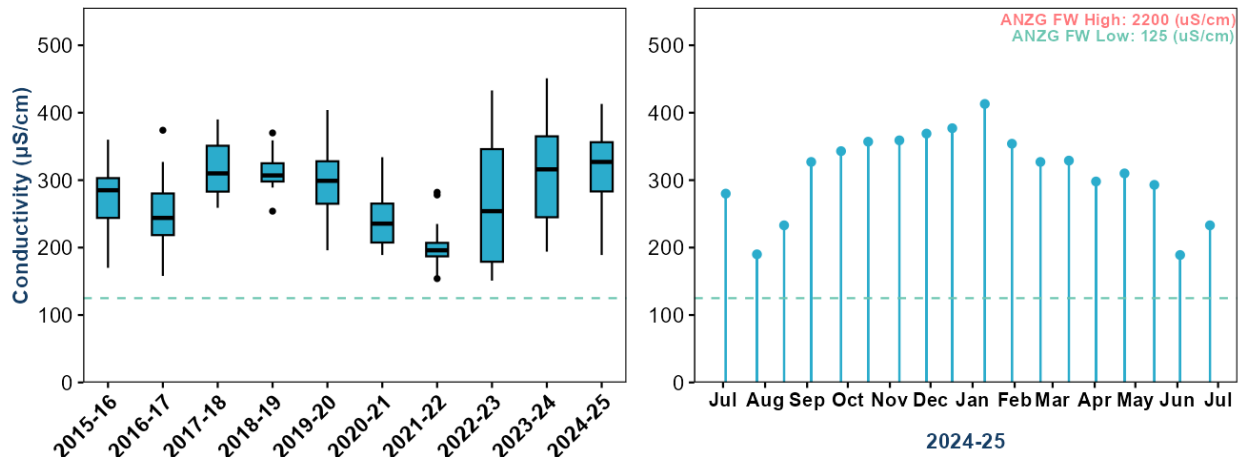
N44



Stressors – Physico-chemical water quality

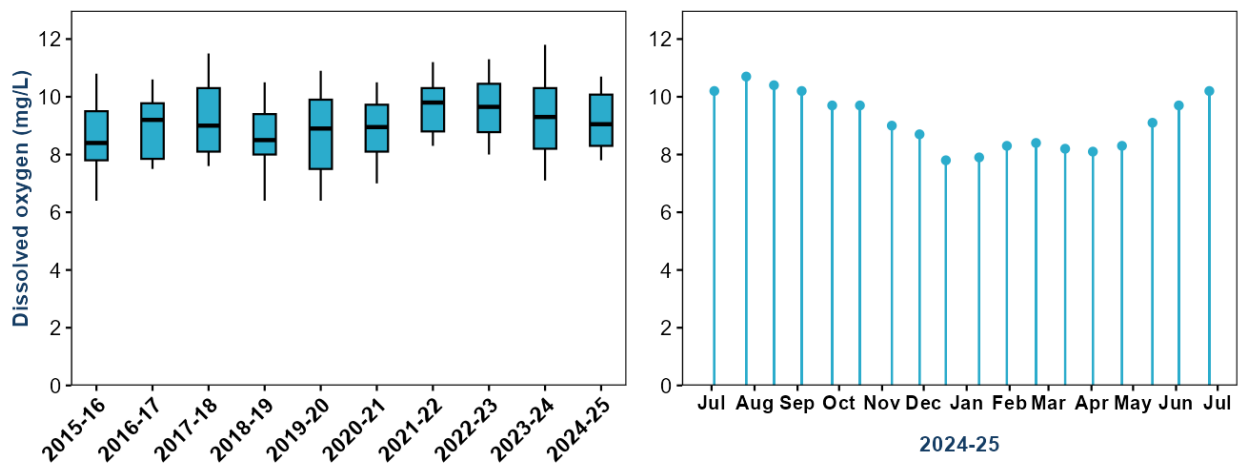
Nepean River at Yarramundi Bridge as SoE Site

N44



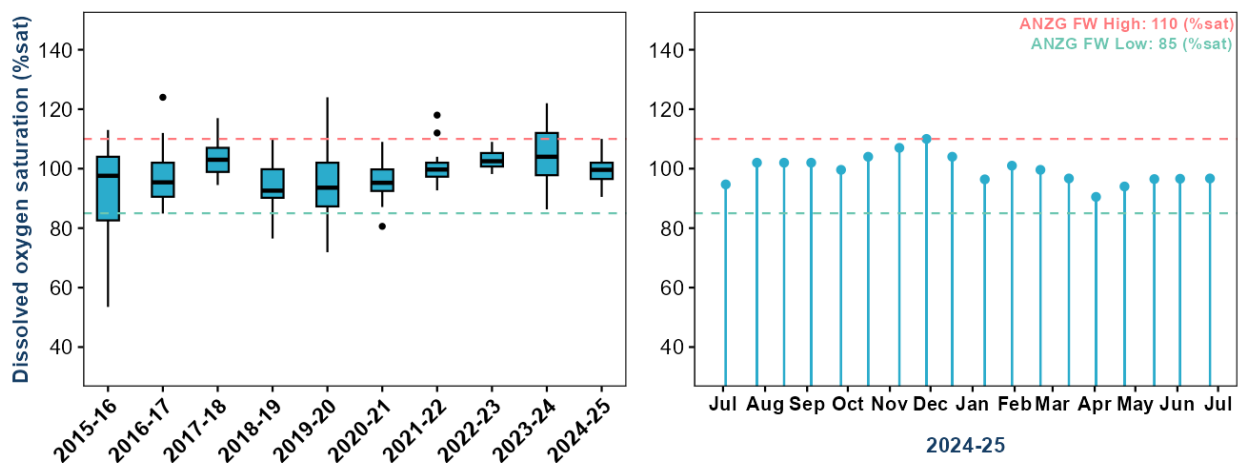
Nepean River at Yarramundi Bridge as SoE Site

N44



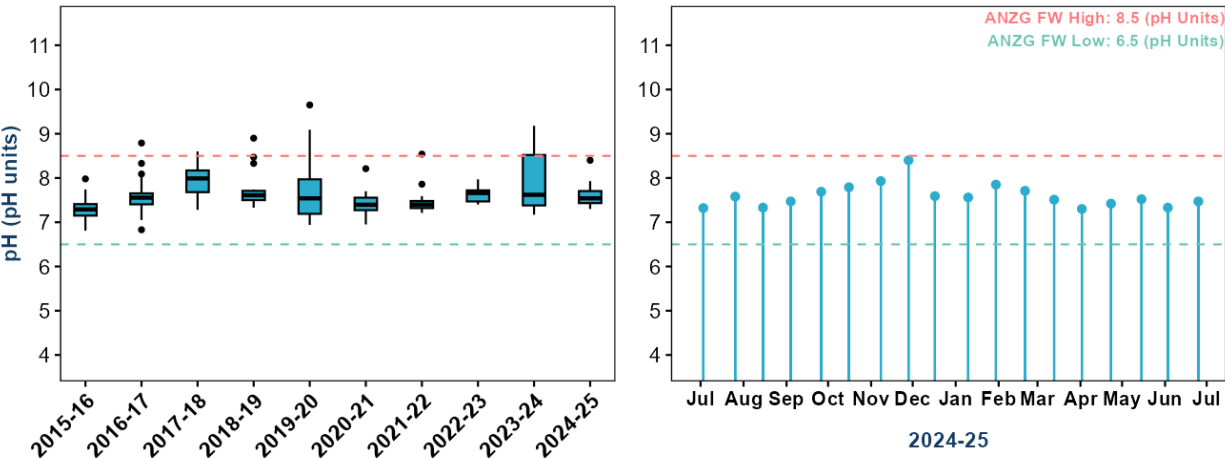
Nepean River at Yarramundi Bridge as SoE Site

N44



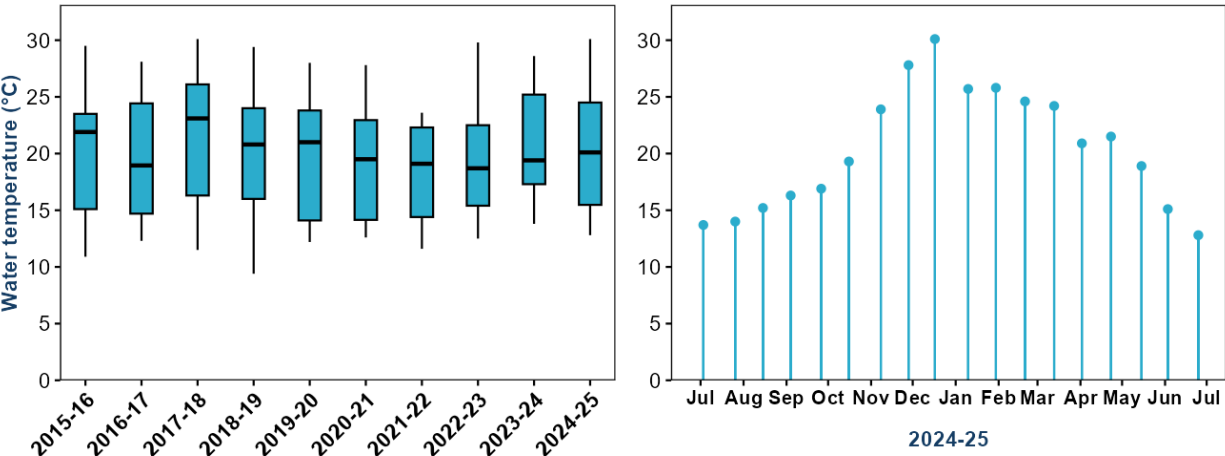
Nepean River at Yarramundi Bridge as SoE Site

N44



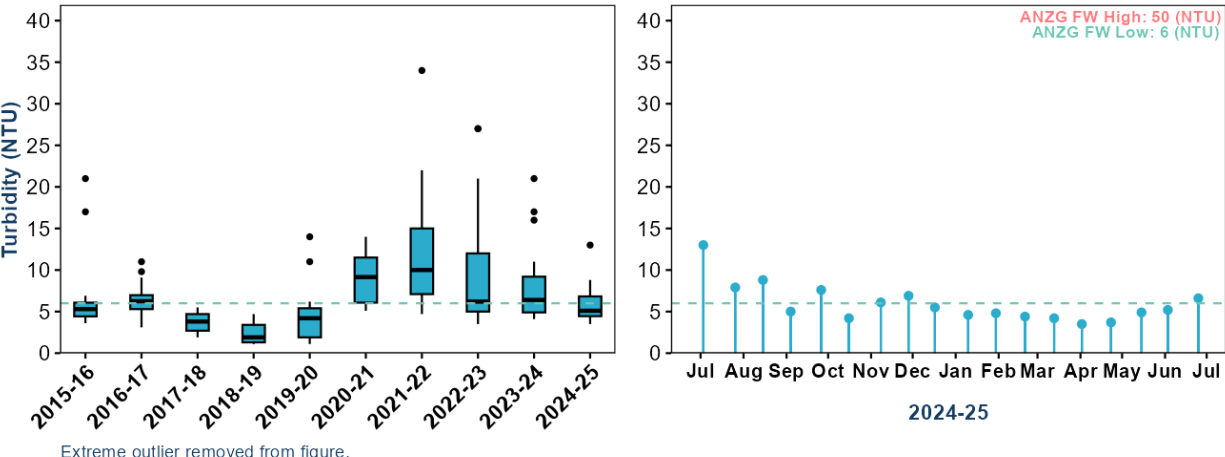
Nepean River at Yarramundi Bridge as SoE Site

N44



Nepean River at Yarramundi Bridge as SoE Site

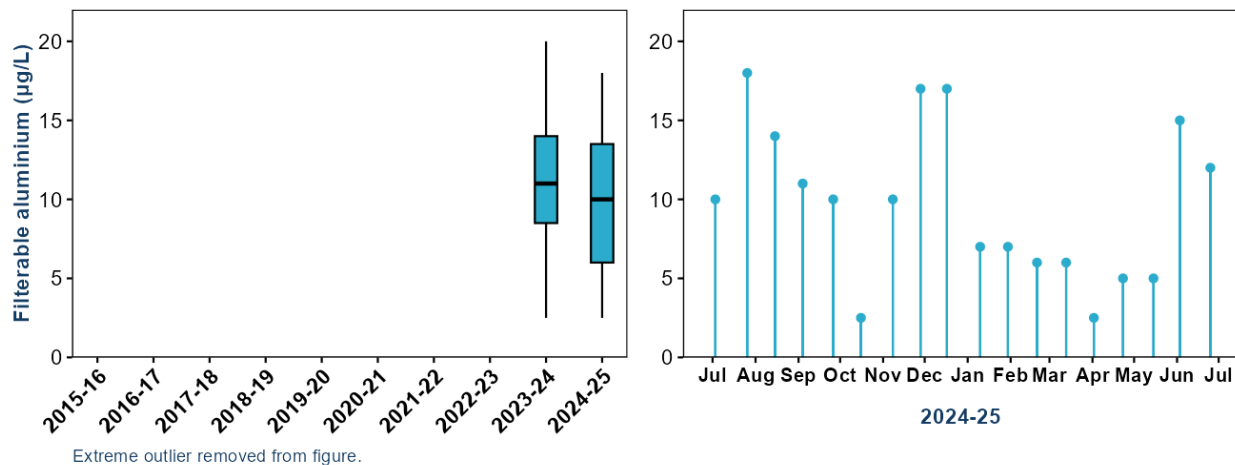
N44



Stressors – Trace metals

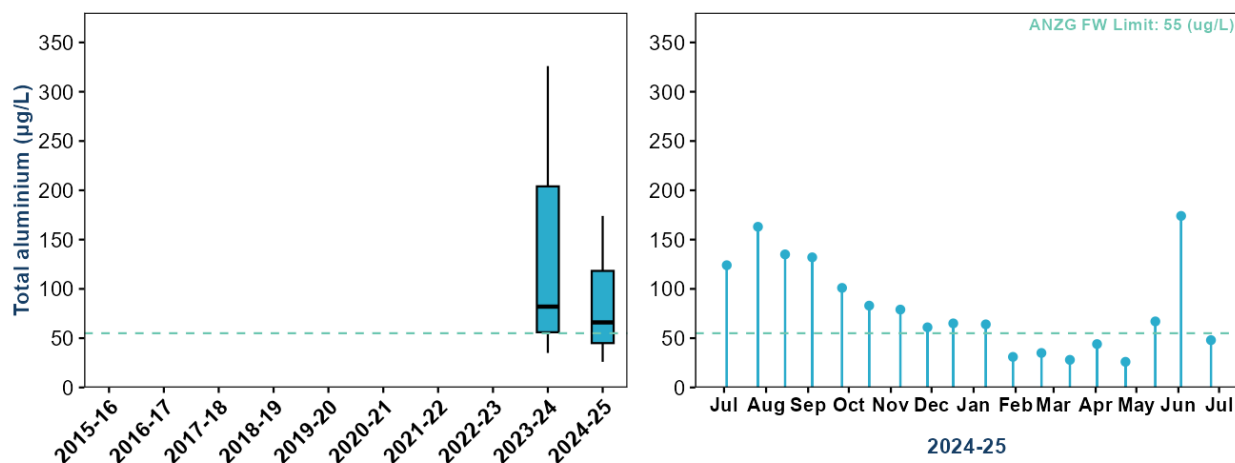
Nepean River at Yarramundi Bridge as SoE Site

N44



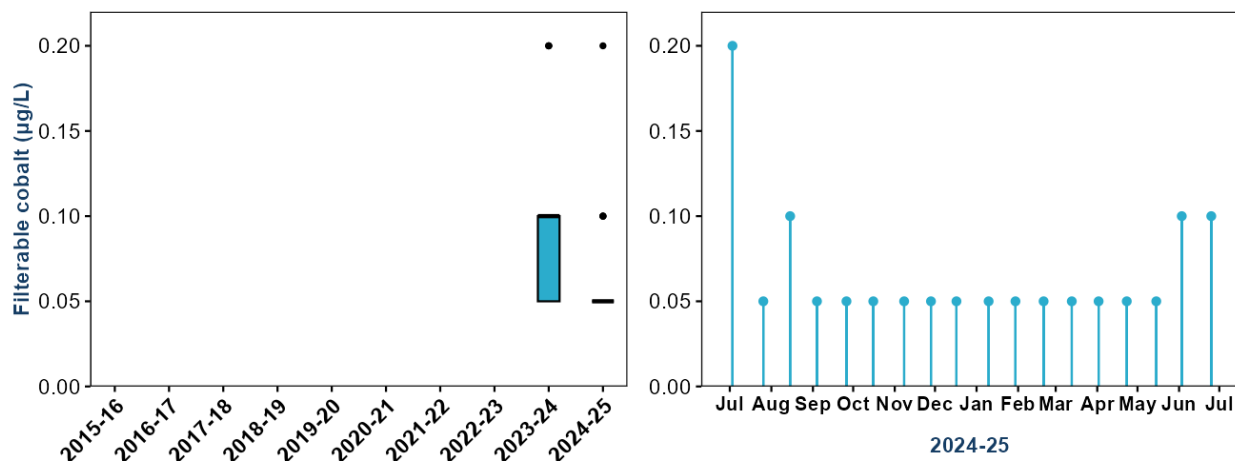
Nepean River at Yarramundi Bridge as SoE Site

N44

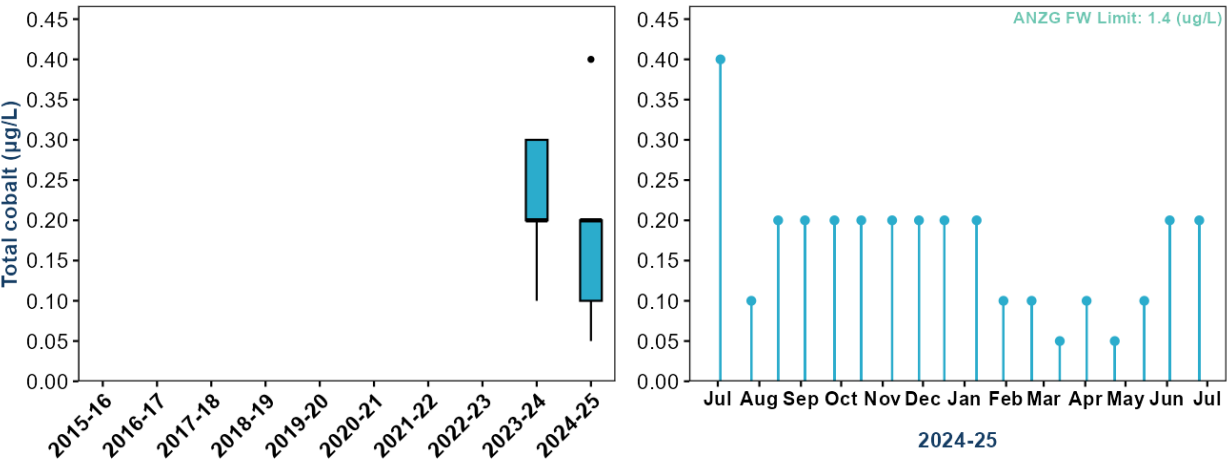


Nepean River at Yarramundi Bridge as SoE Site

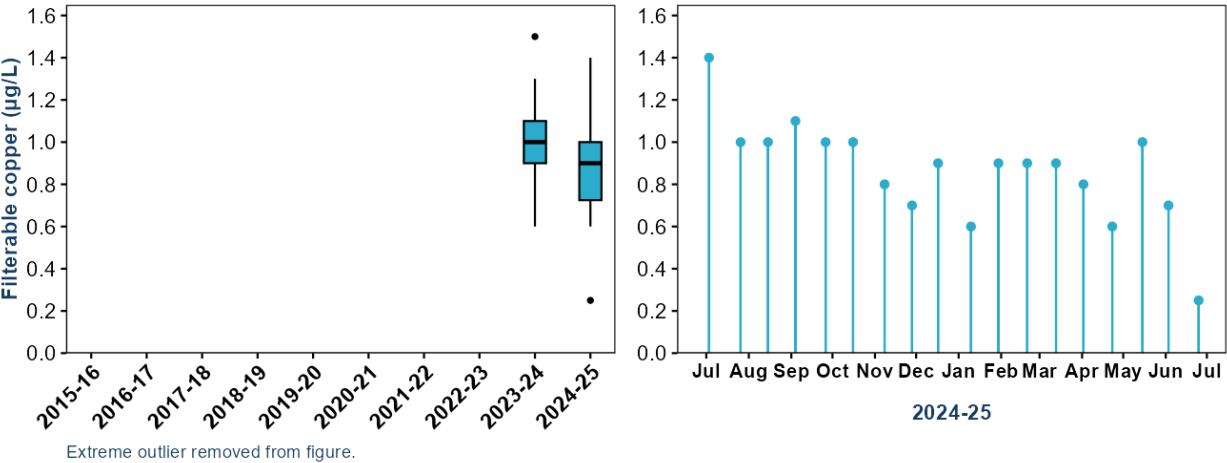
N44



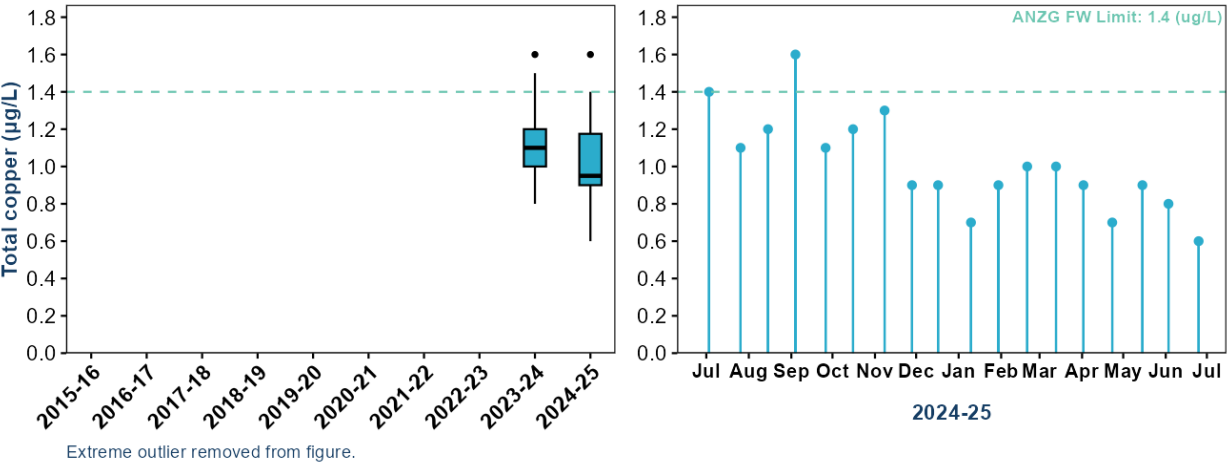
Nepean River at Yarramundi Bridge as SoE Site



Nepean River at Yarramundi Bridge as SoE Site

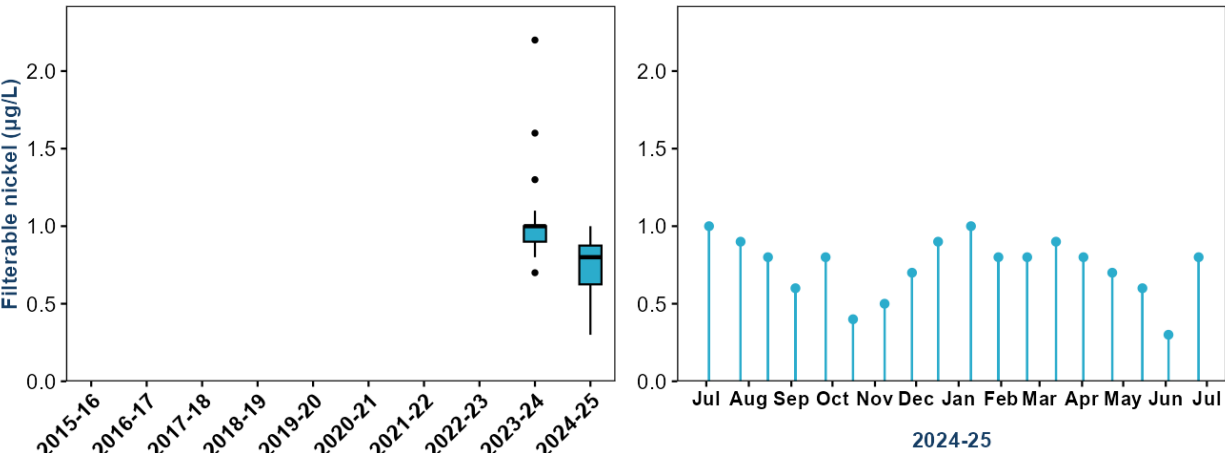


Nepean River at Yarramundi Bridge as SoE Site



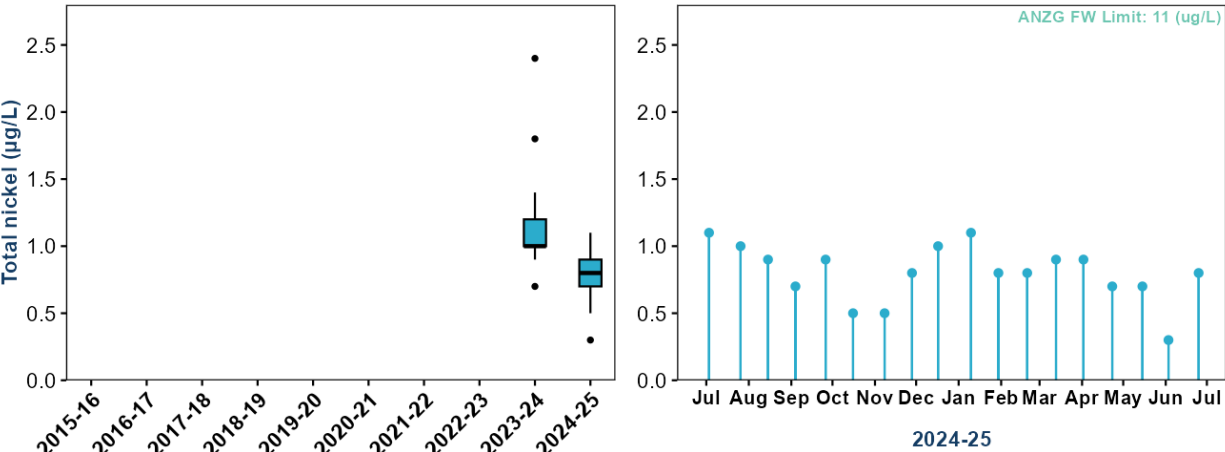
Nepean River at Yarramundi Bridge as SoE Site

N44



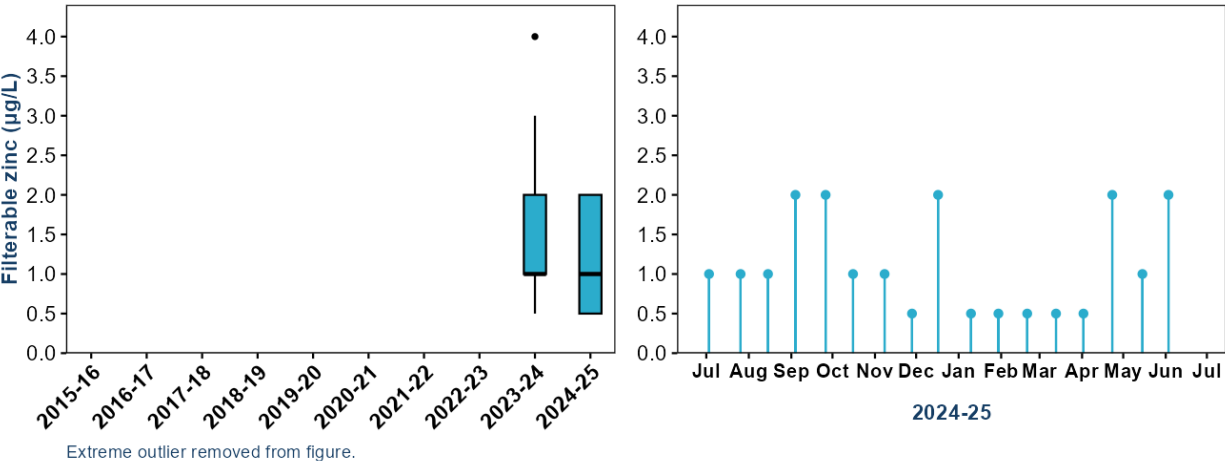
Nepean River at Yarramundi Bridge as SoE Site

N44



Nepean River at Yarramundi Bridge as SoE Site

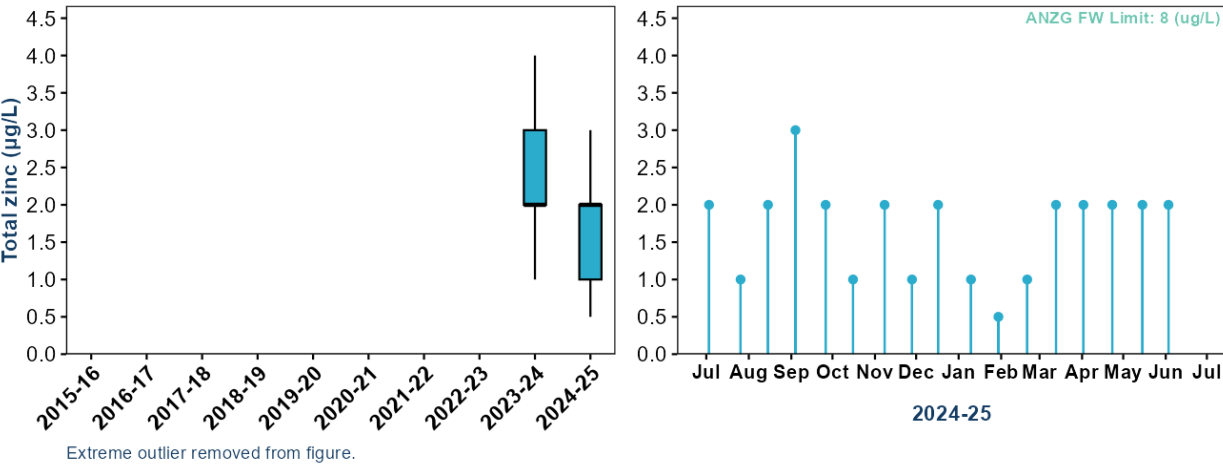
N44



Extreme outlier removed from figure.

Nepean River at Yarramundi Bridge as SoE Site

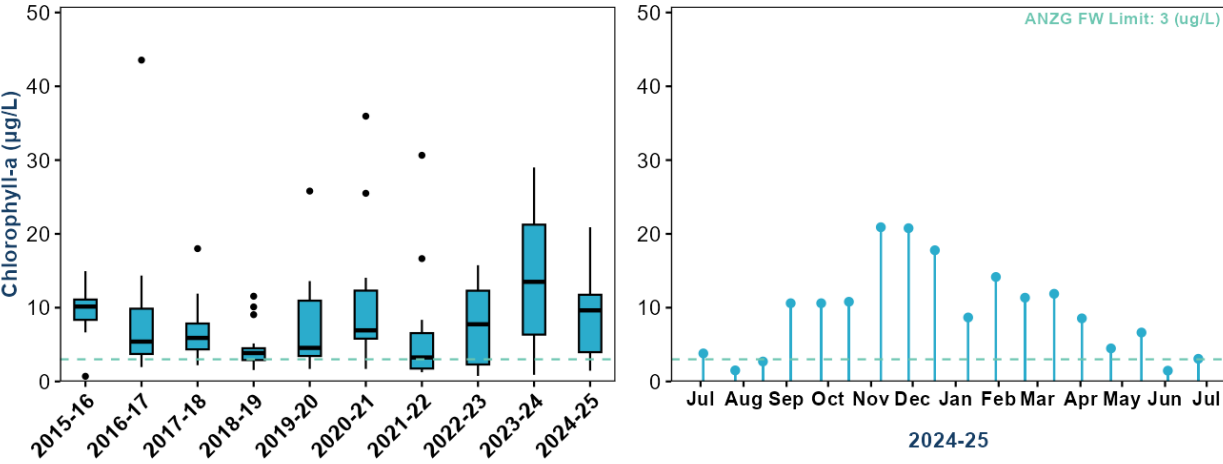
N44



Ecosystem receptor – Phytoplankton

Nepean River at Yarramundi Bridge as SoE Site

N44



C.1.2. Lower South Creek at Fitzroy bridge (NS04A)

Stressors - Statistical analysis outcomes

Table C-2 Current period (2024-25) vs previous period comparison for NS04A

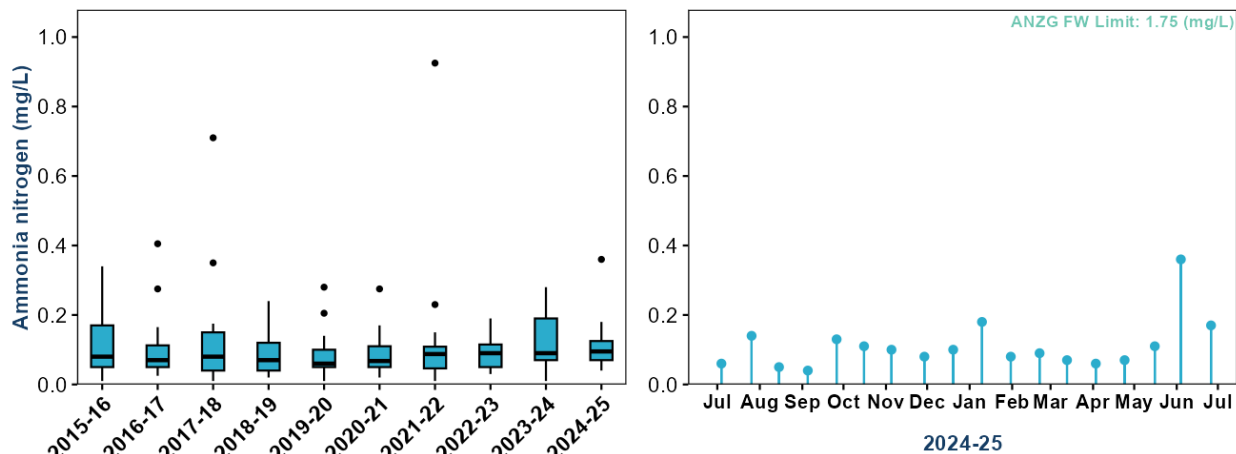
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	1.25	0.25	162	1.14	0.254
Oxidised nitrogen	1.34	0.19	162	2.14	0.034
Total nitrogen	1.24	0.09	162	2.98	0.003
Soluble reactive phosphorus	0.61	0.10	33	-2.99	0.005
Total phosphorus	0.83	0.08	162	-1.81	0.072
Physico-chemical					
Conductivity	1.16	0.09	162	1.94	0.055
Dissolved oxygen	1.07	0.06	161	1.18	0.242
Dissolved oxygen saturation	5.51	2.85	161	1.94	0.055
pH	0.06	0.04	160	1.45	0.148
Water temperature	1.04	0.07	162	0.58	0.565
Turbidity	0.86	0.11	161	-1.24	0.217
Trace metals					
Filterable aluminium	1.35	0.28	33	1.42	0.166
Total aluminium	0.61	0.1	33	-3.06	0.004
Filterable cobalt	1.25	0.11	33	2.6	0.014
Total cobalt	0.94	0.07	33	-0.83	0.41
Filterable copper	0.9	0.05	33	-1.71	0.096
Total copper	0.81	0.06	33	-3	0.005
Filterable nickel	1.13	0.08	33	1.72	0.095
Total nickel	0.98	0.06	33	-0.25	0.803
Filterable zinc	1.01	0.14	30	0.1	0.918
Total zinc	0.84	0.08	33	-1.82	0.077
Chlorophyll-a					
Chlorophyll-a	1.59	0.39	162	1.87	0.063

	not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Stressors – Nutrients

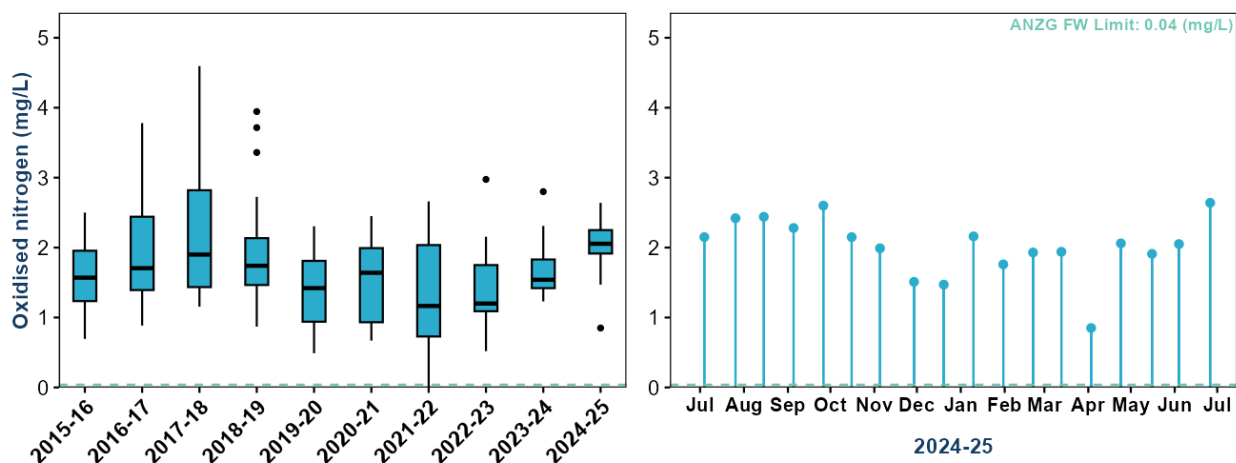
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



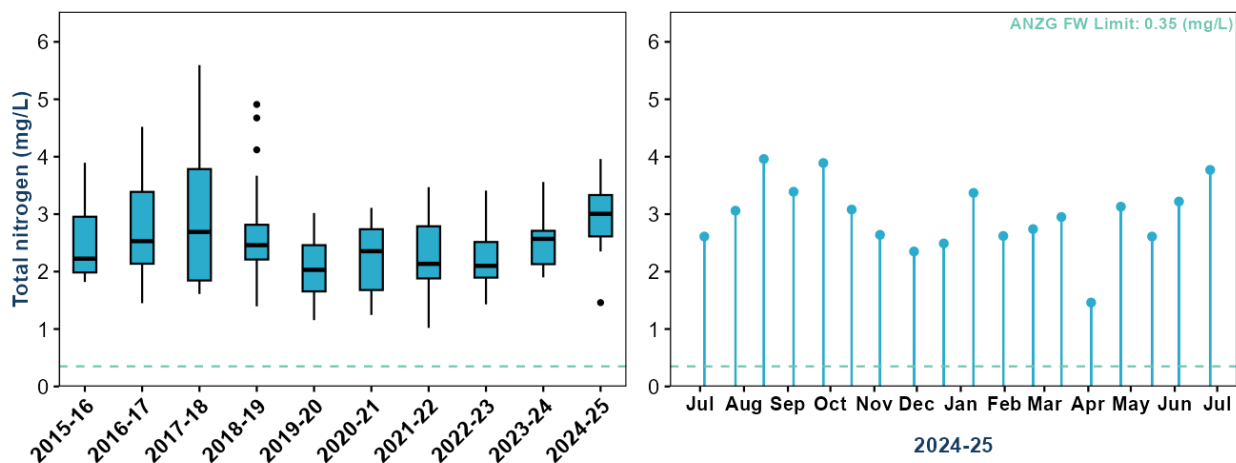
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



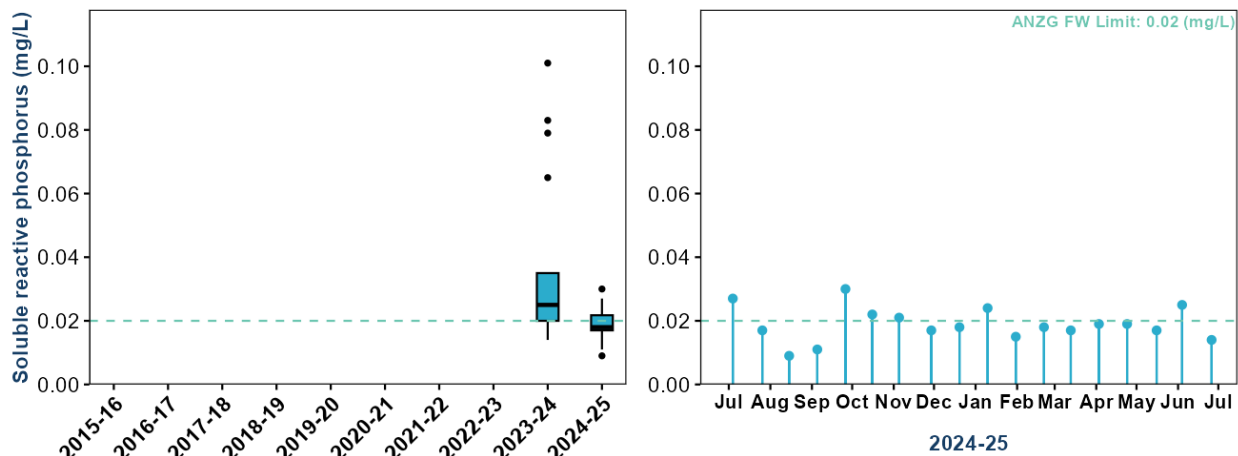
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



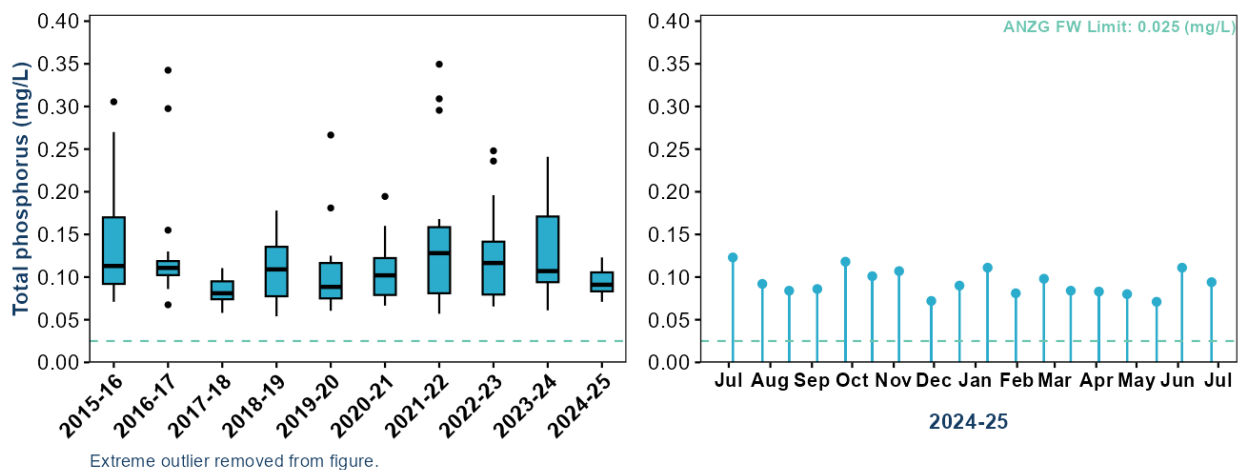
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

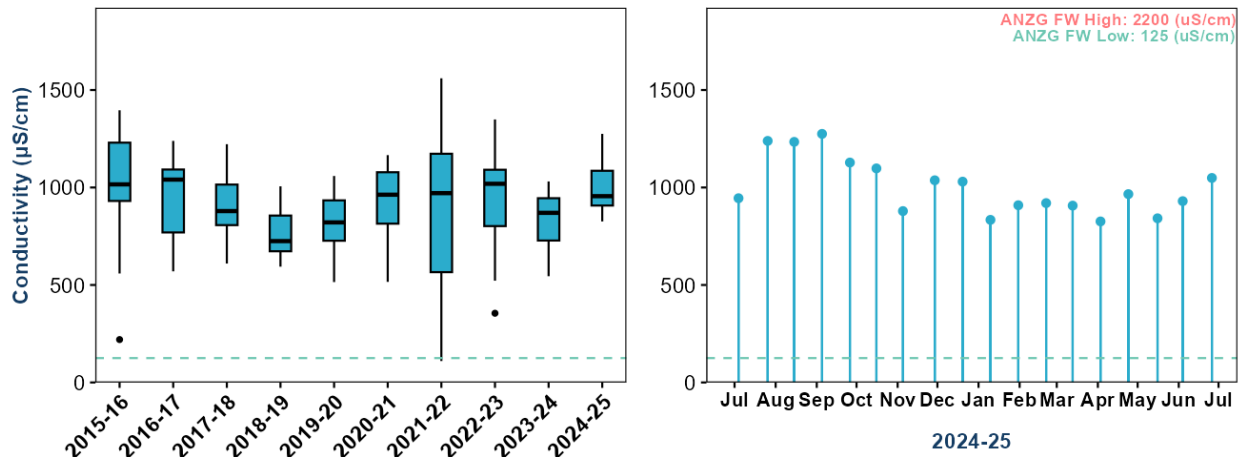
NS04A



Stressors – Physico-chemical water quality

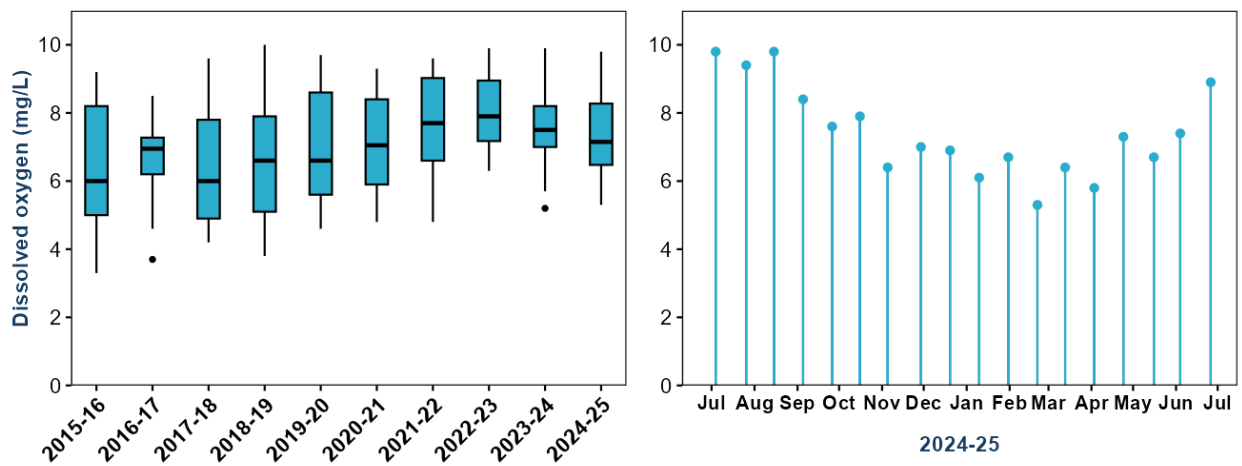
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



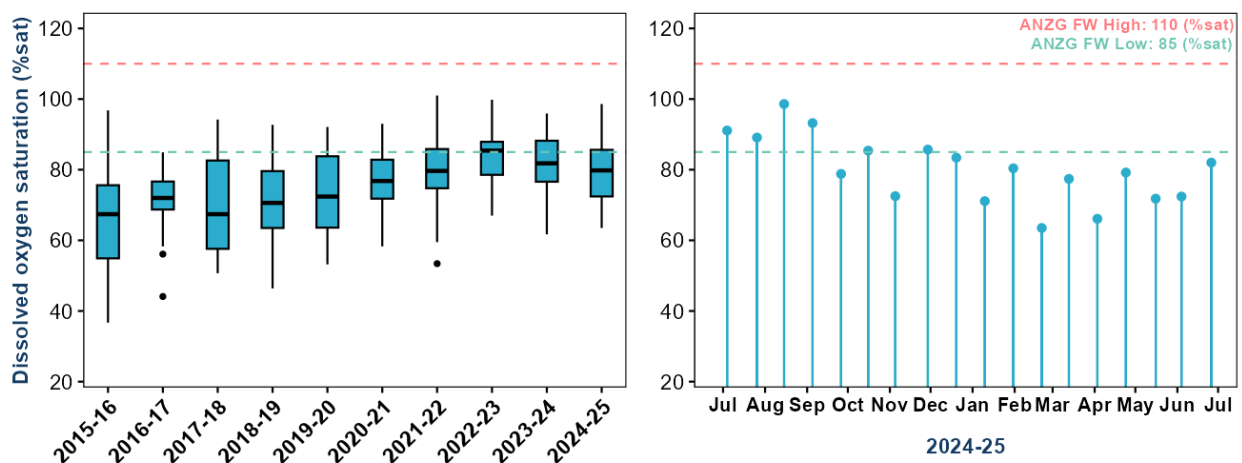
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



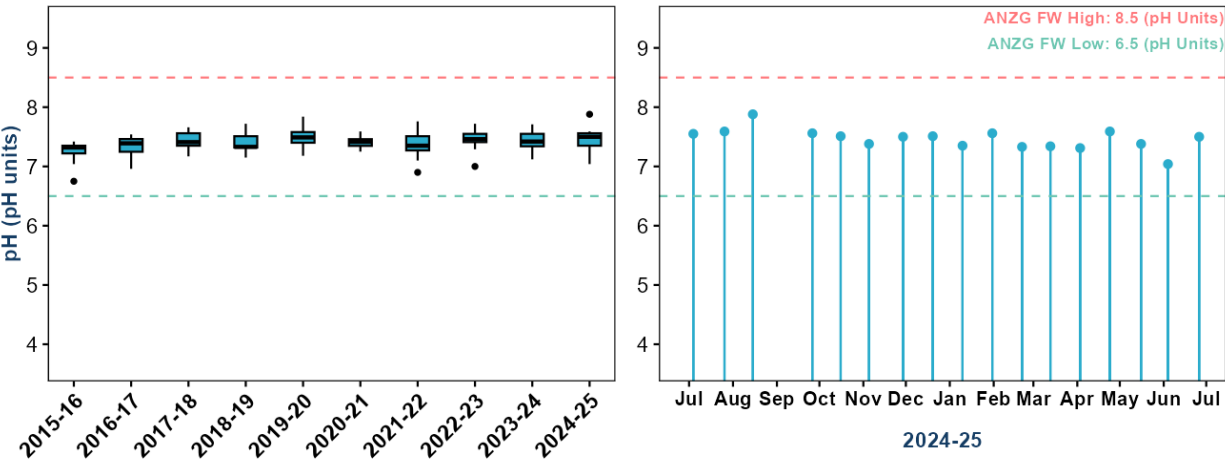
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



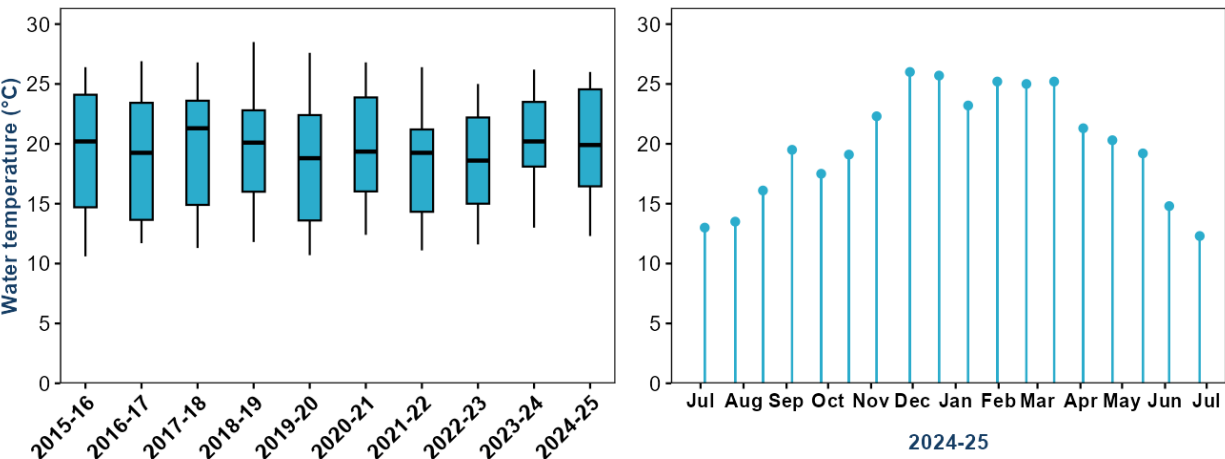
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



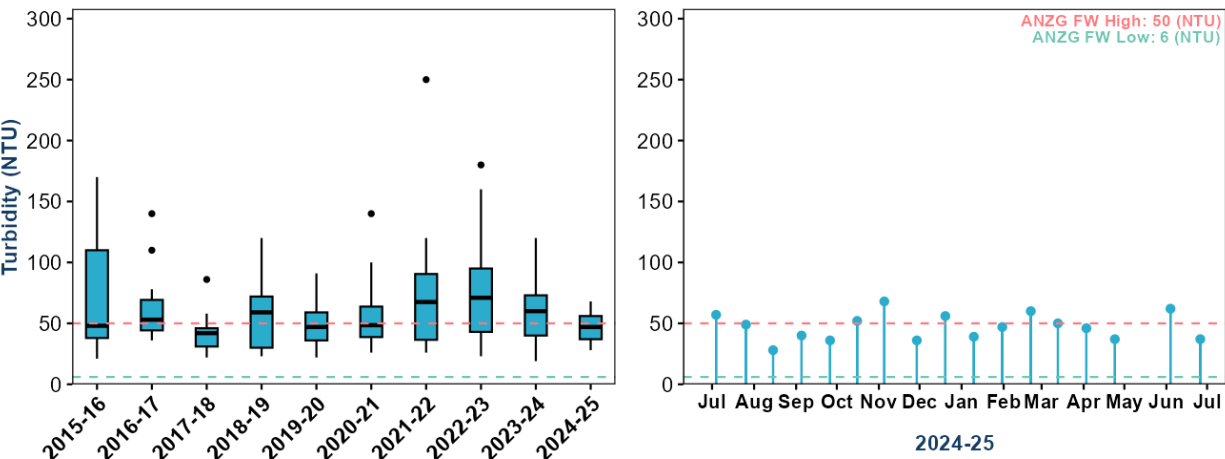
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

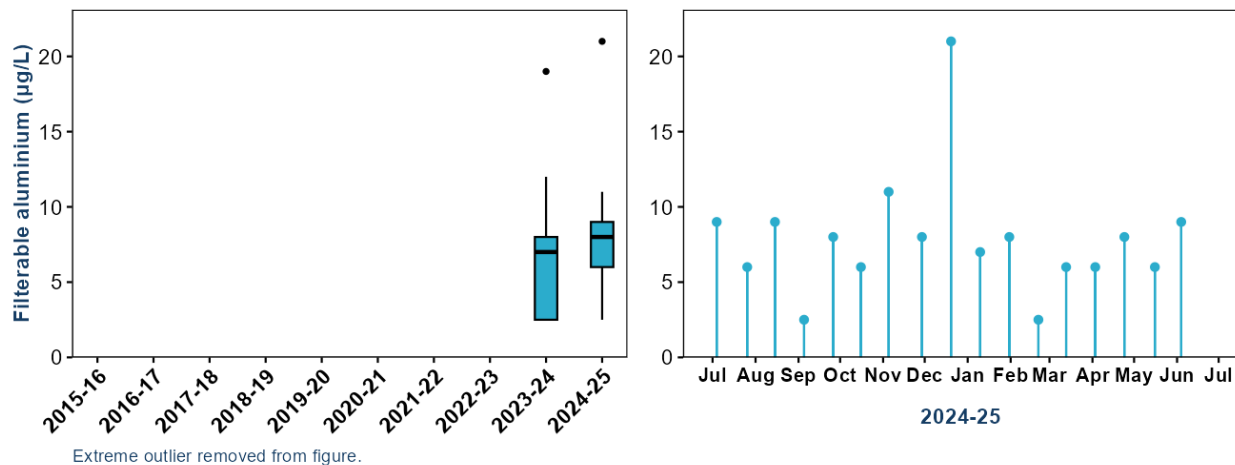
NS04A



Stressors – Trace metals

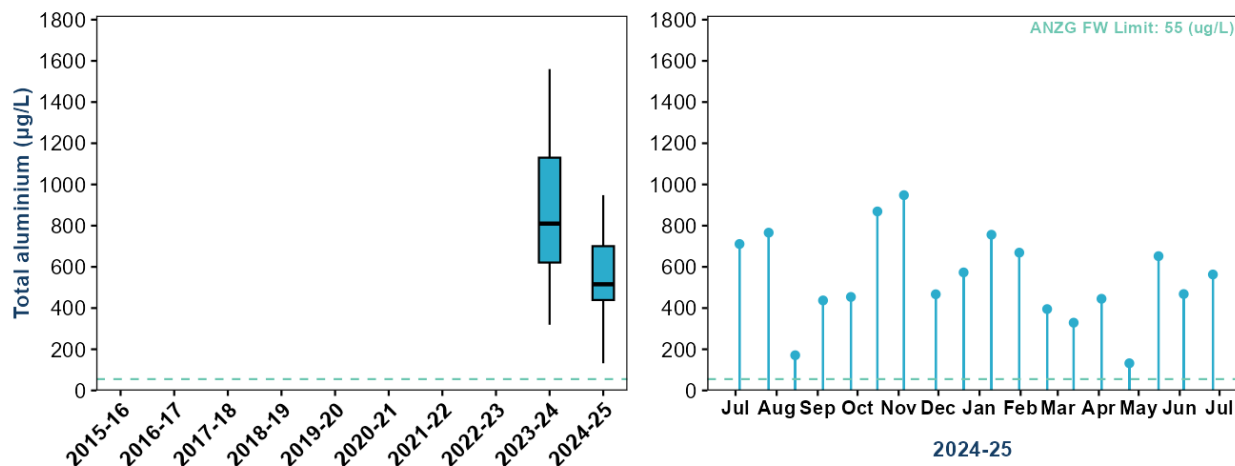
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



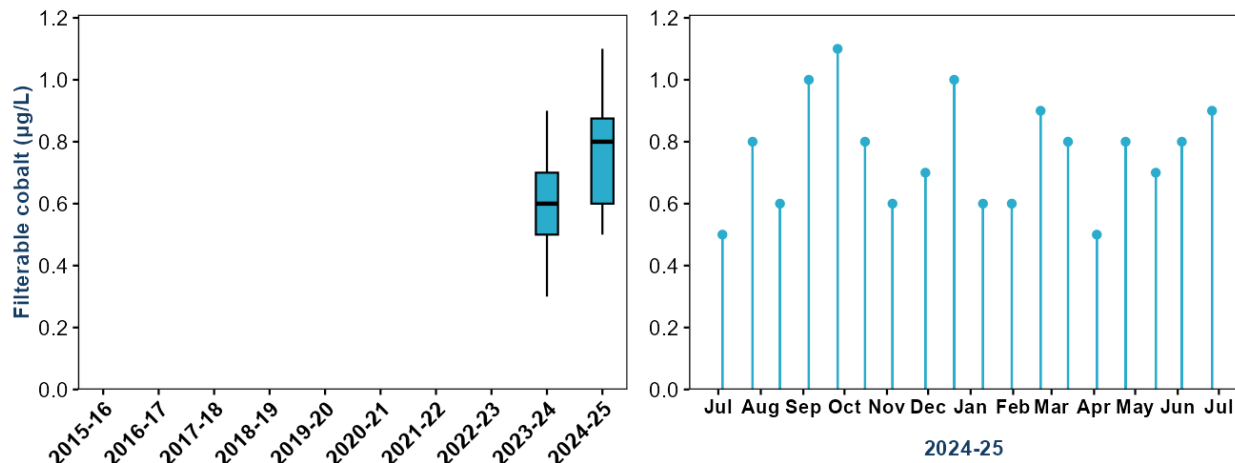
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



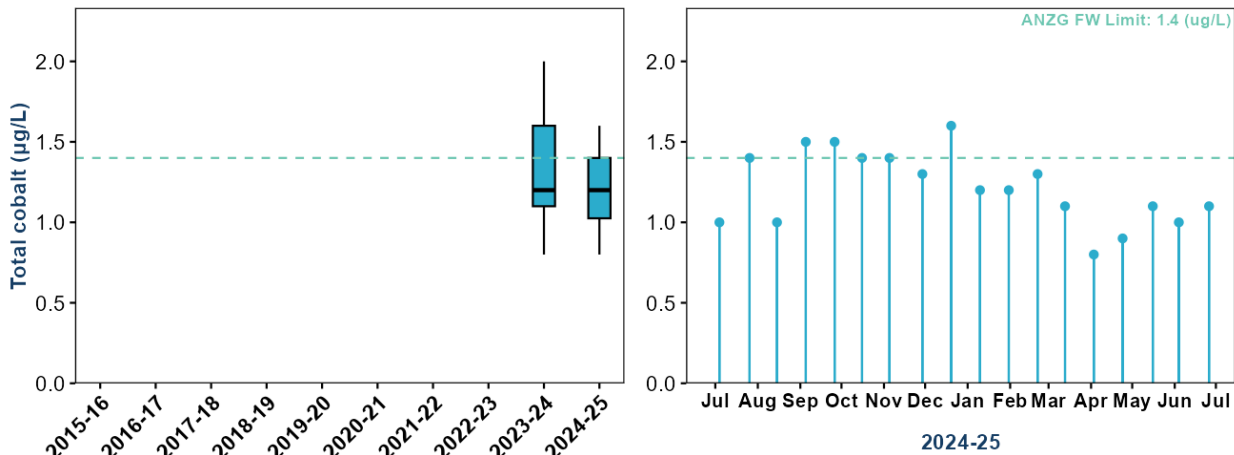
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



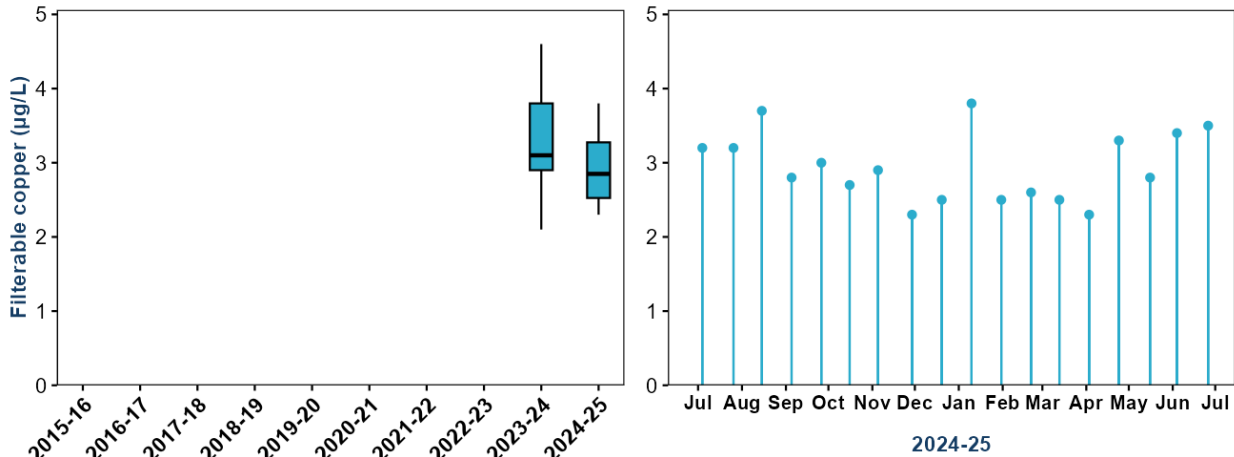
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



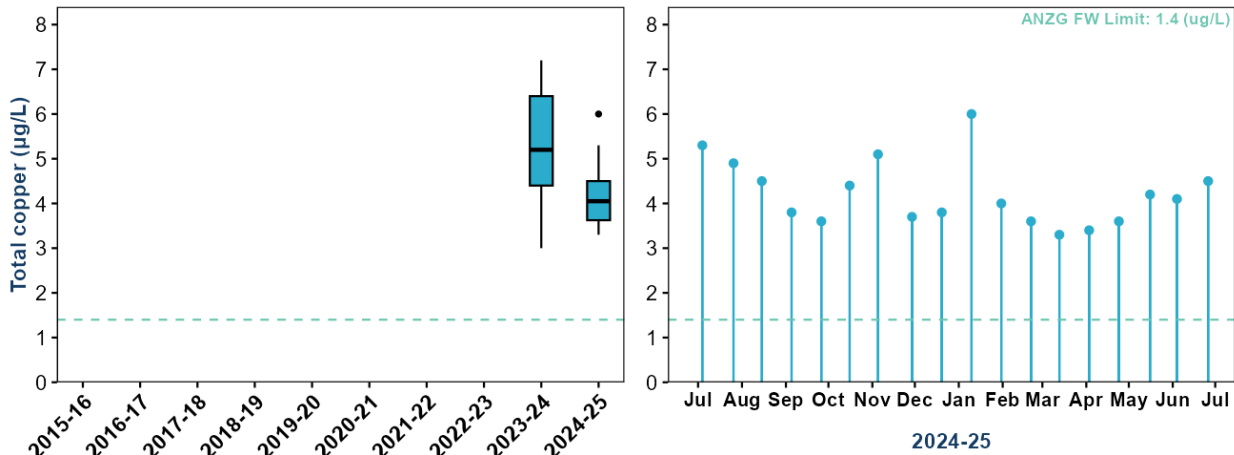
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



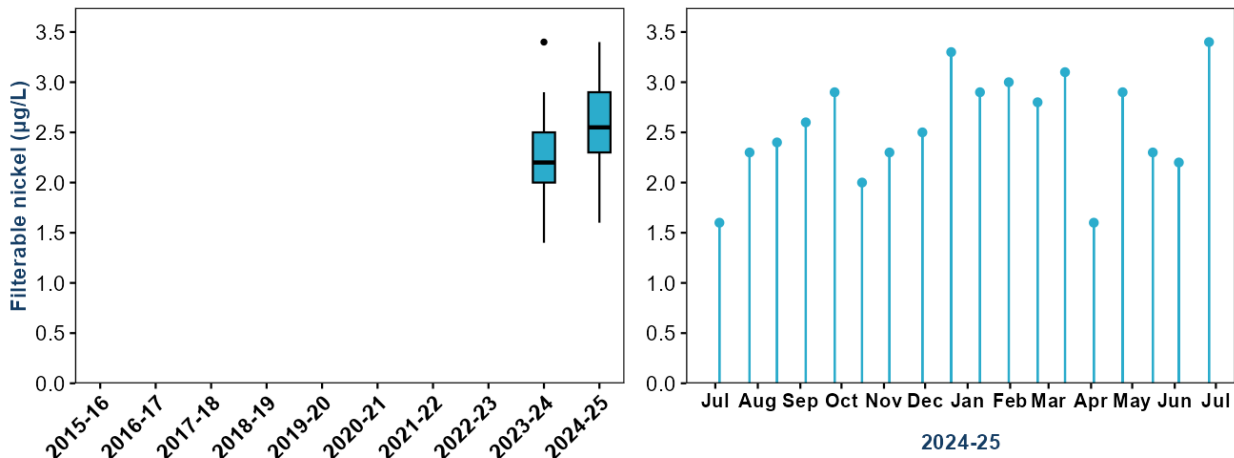
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



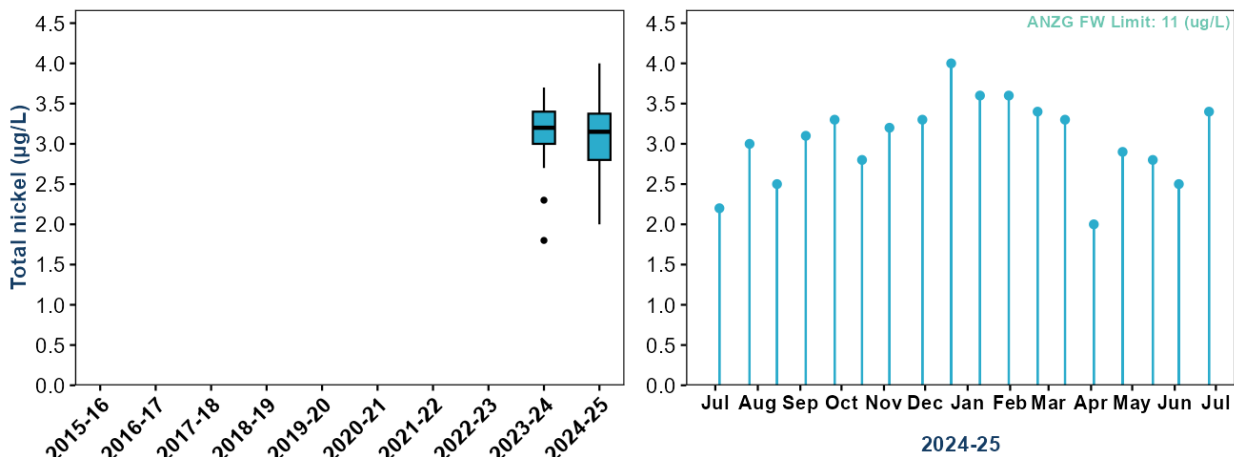
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



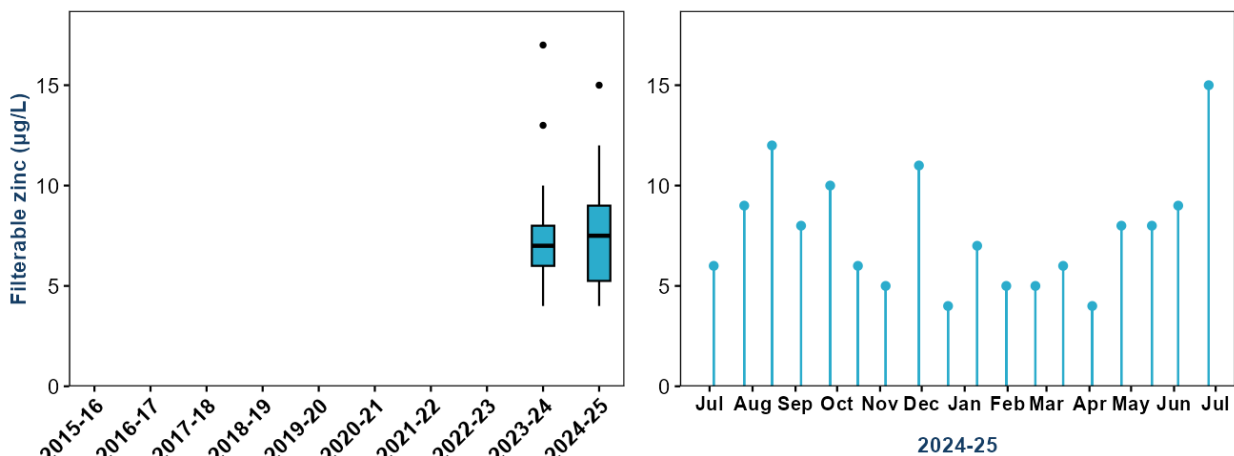
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



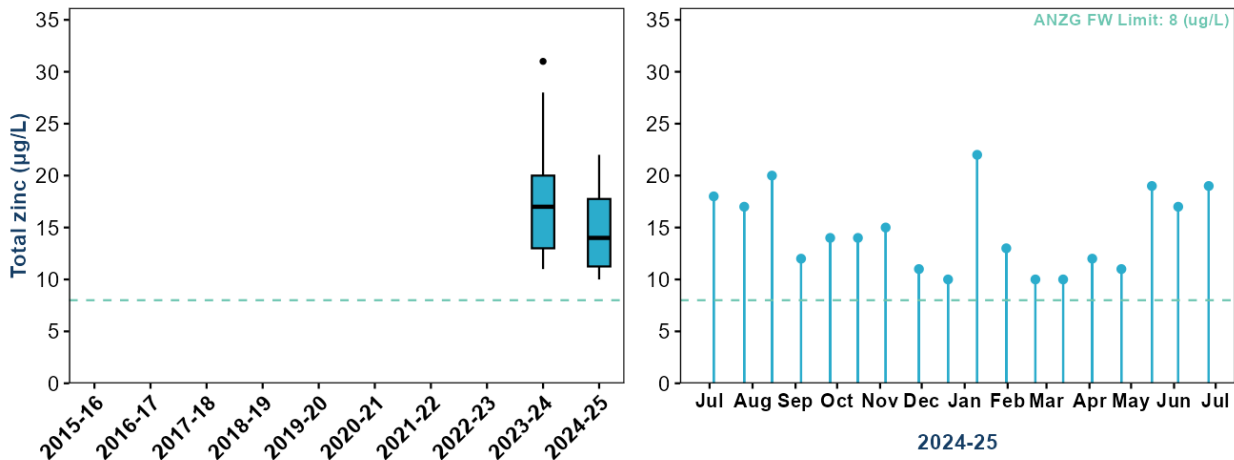
Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

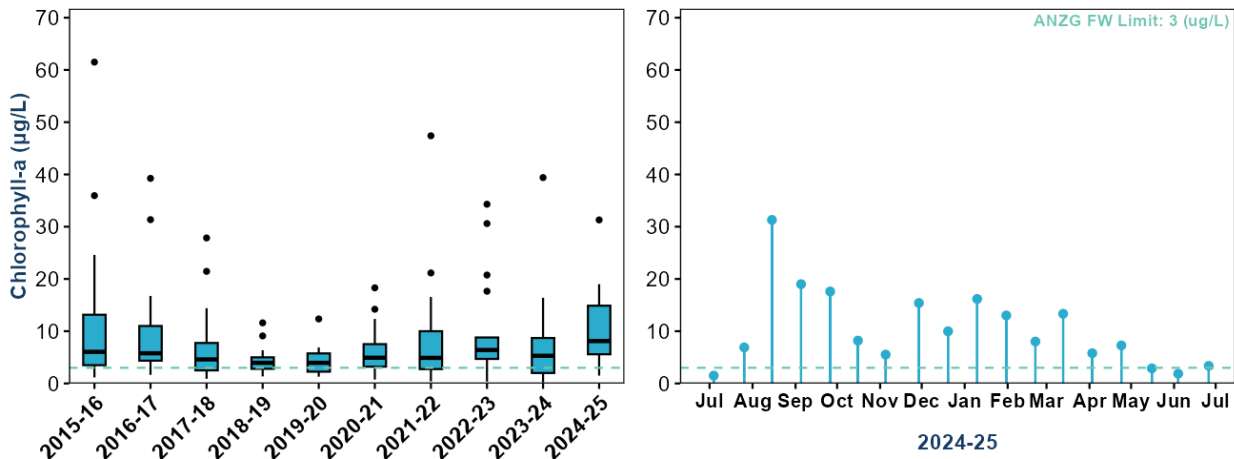
NS04A



Ecosystem receptor – Phytoplankton

Lower South Creek at Fitzroy Pedestrian Bridge as SoE Site

NS04A



C.1.3. Hawkesbury River at Wilberforce (N35)

Stressors - Statistical analysis outcomes

Table C-3 Current period (2024-25) vs previous period comparison for N35

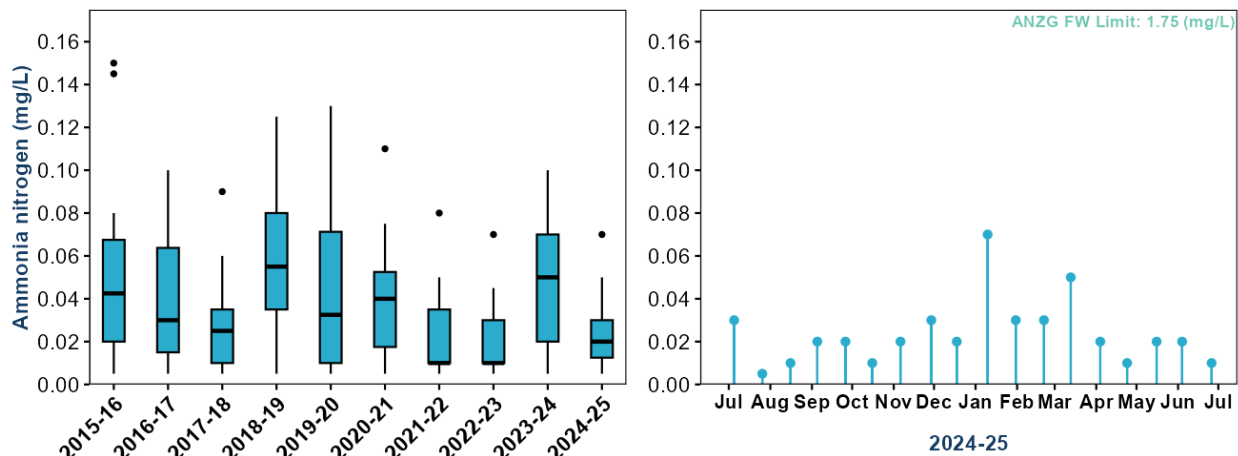
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.76	0.17	160	-1.24	0.218
Oxidised nitrogen	1.35	0.29	160	1.40	0.163
Total nitrogen	1.04	0.08	160	0.50	0.621
Soluble reactive phosphorus	0.77	0.24	33	-0.83	0.410
Total phosphorus	0.73	0.08	160	-3.00	0.003
Physico-chemical					
Conductivity	1.19	0.09	159	2.40	0.018
Dissolved oxygen	1.02	0.05	160	0.38	0.703
Dissolved oxygen saturation	1.18	2.50	160	0.47	0.637
pH	-0.04	0.06	160	-0.70	0.482
Water temperature	1.06	0.07	157	0.84	0.401
Turbidity	1.16	0.16	159	1.09	0.277
Trace metals					
Filterable aluminium	0.99	0.26	33	-0.03	0.975
Total aluminium	0.77	0.17	33	-1.20	0.239
Filterable cobalt	0.76	0.17	33	-1.22	0.231
Total cobalt	0.80	0.11	33	-1.66	0.107
Filterable copper	0.97	0.06	33	-0.58	0.567
Total copper	0.90	0.08	33	-1.07	0.293
Filterable nickel	1.01	0.09	33	0.16	0.877
Total nickel	0.95	0.10	33	-0.47	0.643
Filterable zinc	0.80	0.14	31	-1.28	0.210
Total zinc	0.90	0.13	33	-0.73	0.469
Chlorophyll-a					
Chlorophyll-a	0.75	0.17	160	-1.28	0.203

	not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Stressors – Nutrients

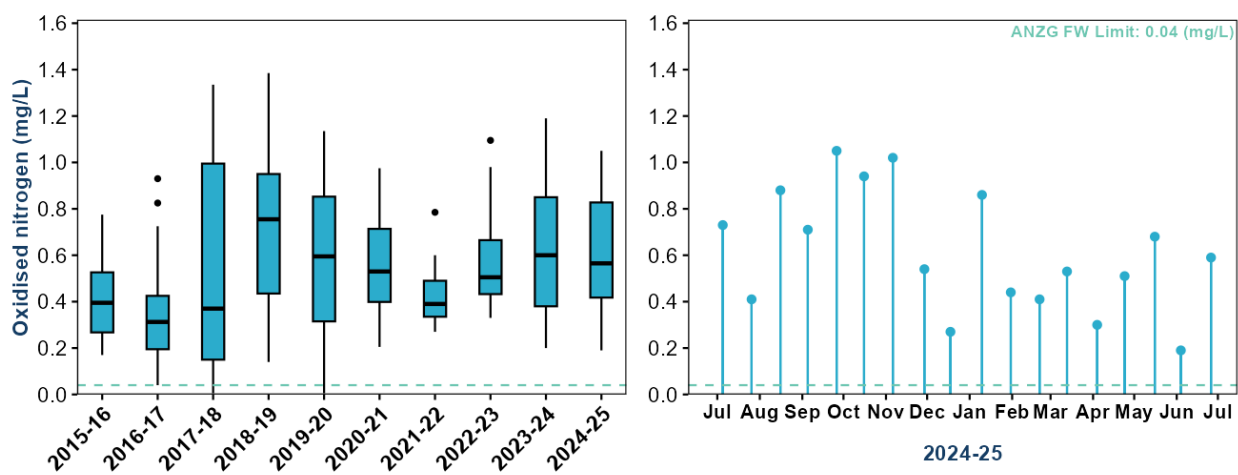
Hawkesbury River at Wilberforce as SoE Site

N35



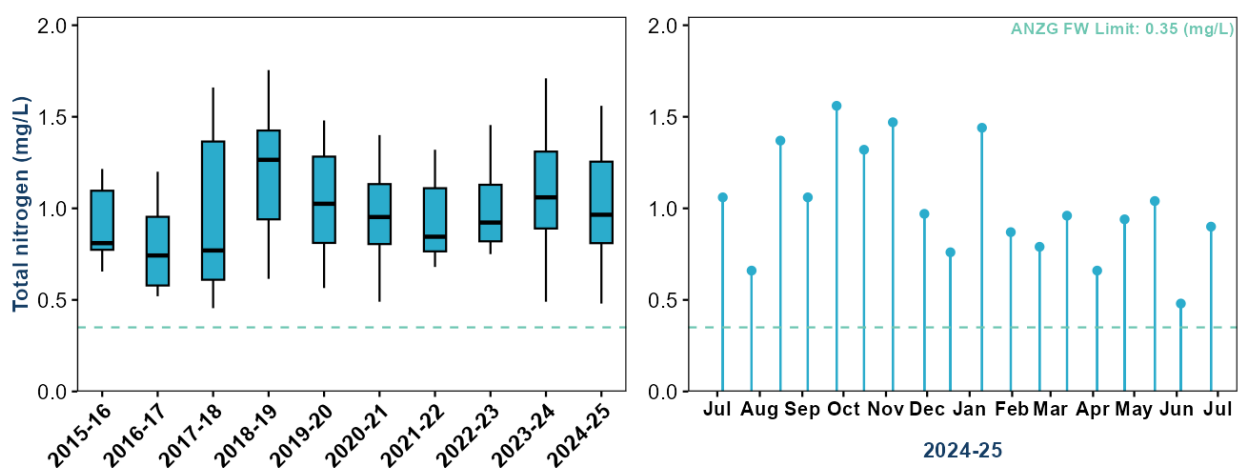
Hawkesbury River at Wilberforce as SoE Site

N35



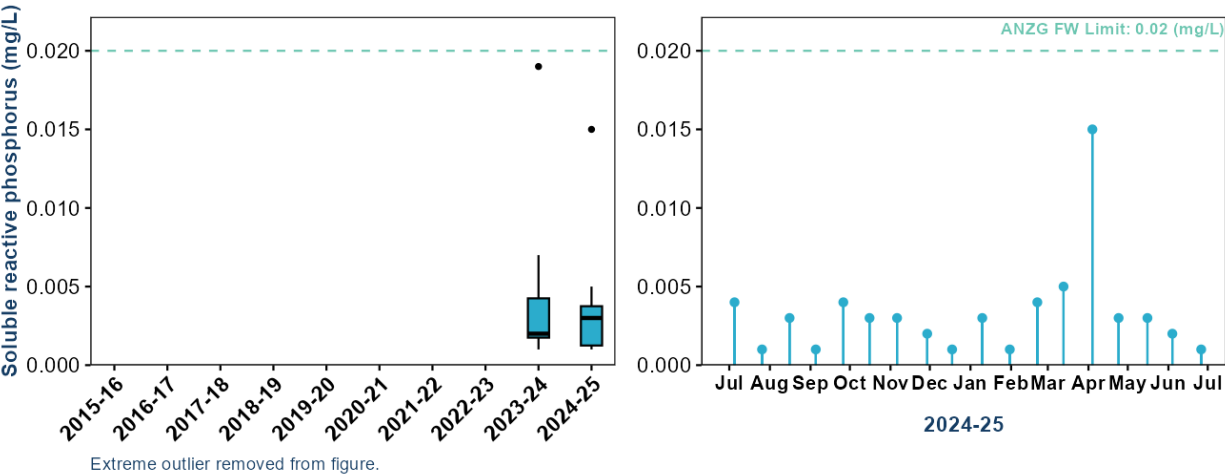
Hawkesbury River at Wilberforce as SoE Site

N35



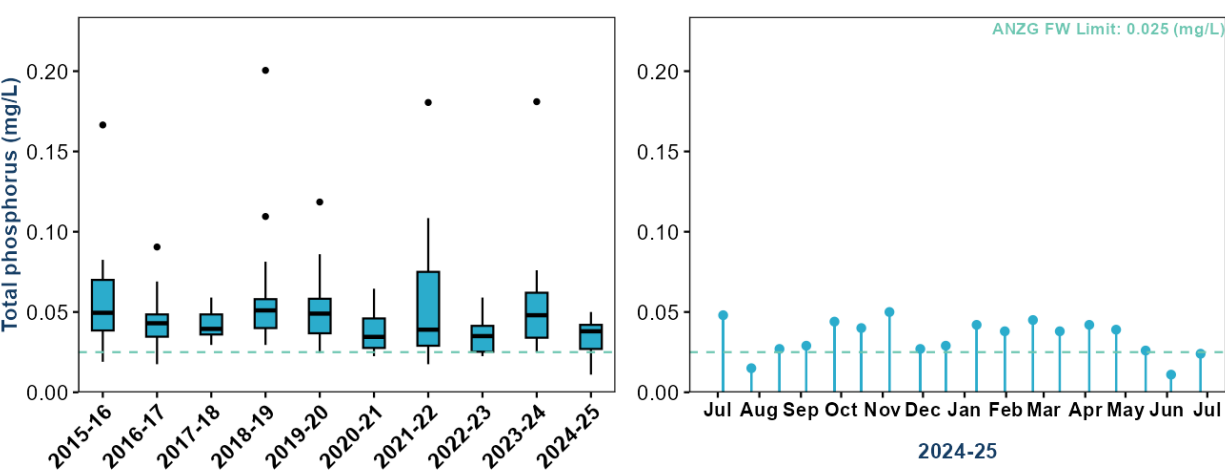
Hawkesbury River at Wilberforce as SoE Site

N35



Hawkesbury River at Wilberforce as SoE Site

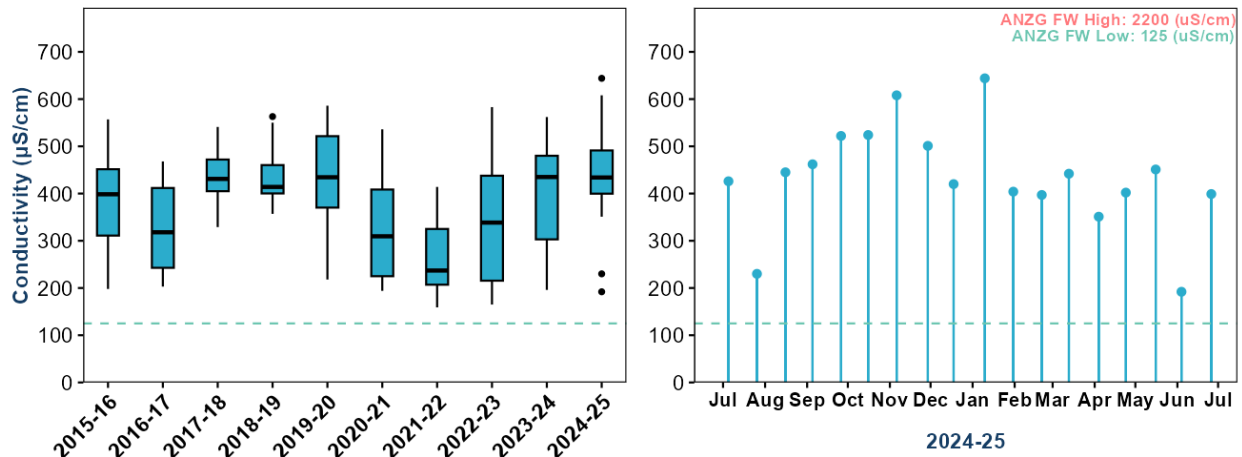
N35



Stressors – Physico-chemical water quality

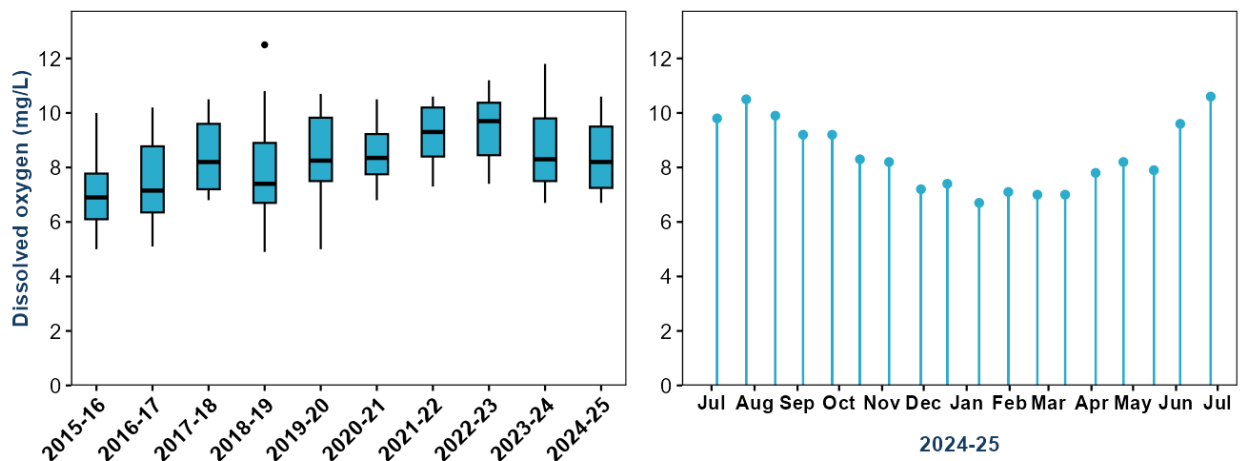
Hawkesbury River at Wilberforce as SoE Site

N35



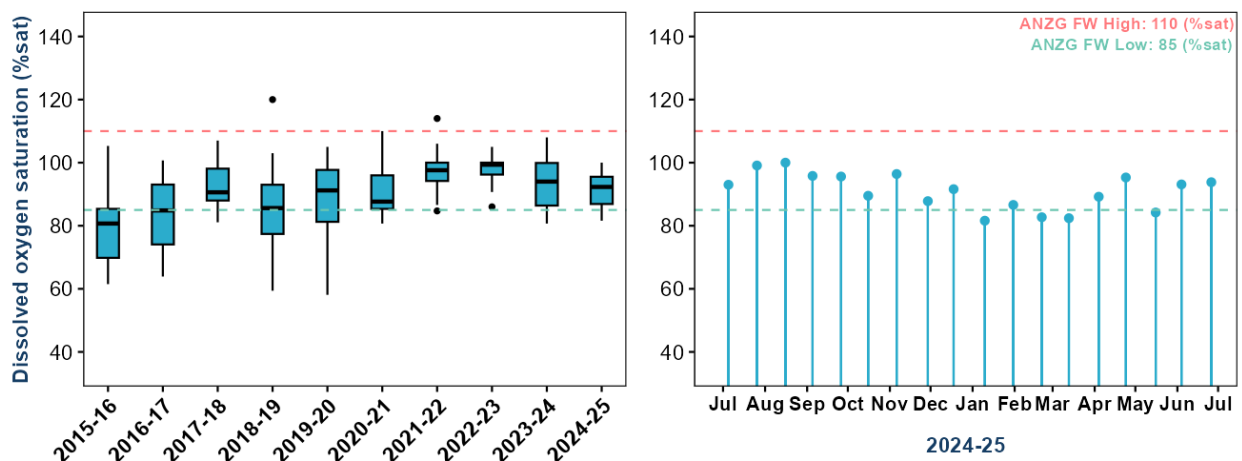
Hawkesbury River at Wilberforce as SoE Site

N35



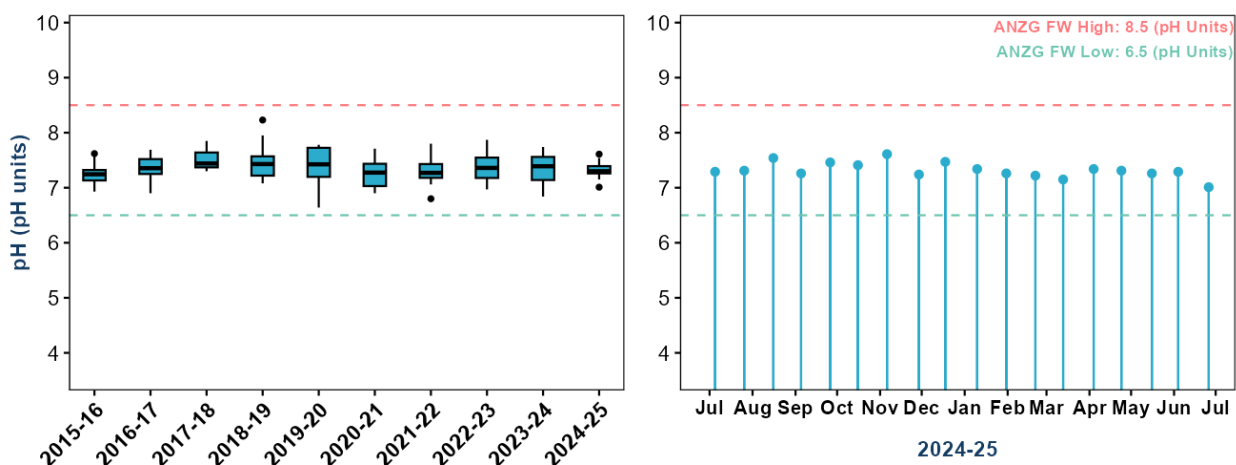
Hawkesbury River at Wilberforce as SoE Site

N35



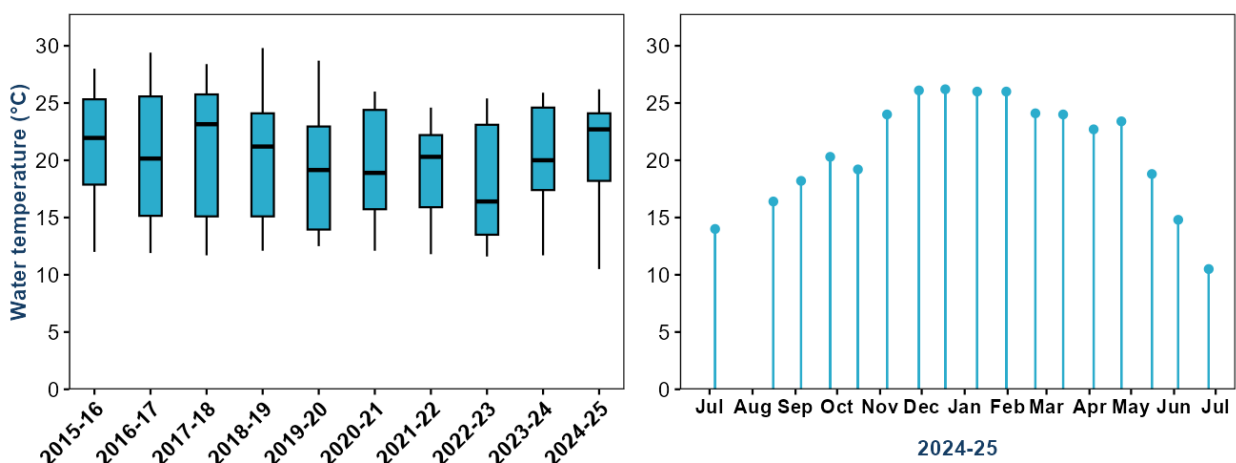
Hawkesbury River at Wilberforce as SoE Site

N35



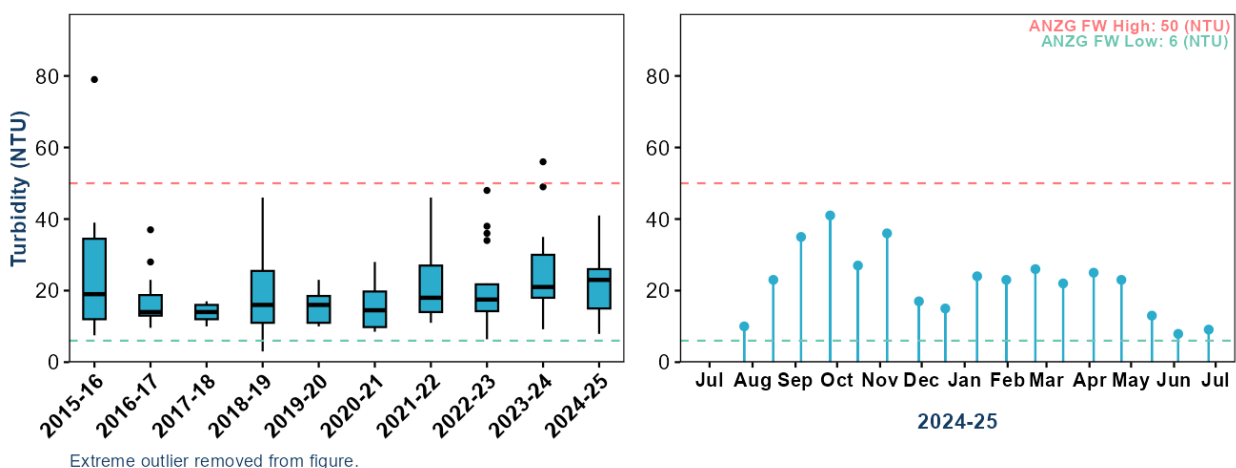
Hawkesbury River at Wilberforce as SoE Site

N35



Hawkesbury River at Wilberforce as SoE Site

N35

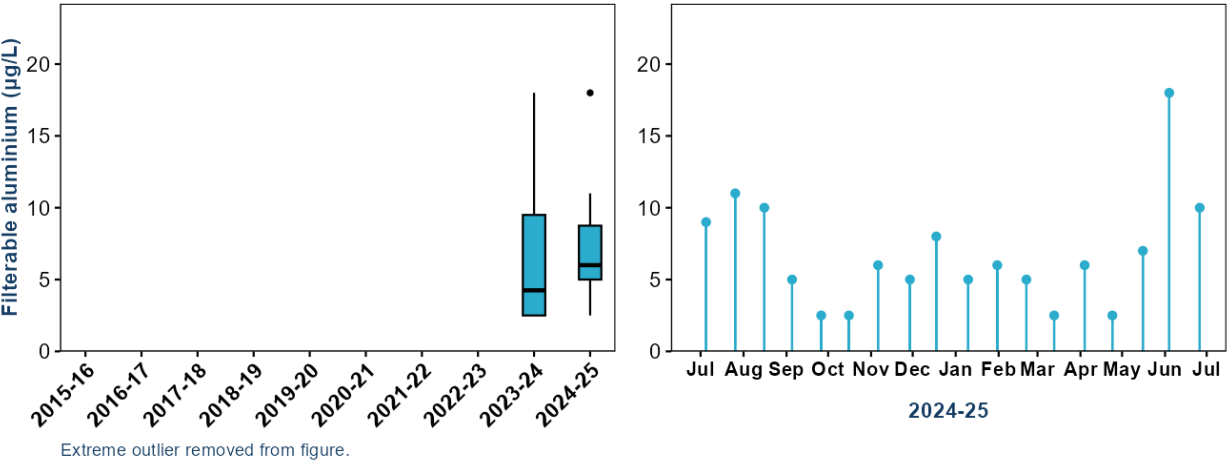


Extreme outlier removed from figure.

Stressors – Trace metals

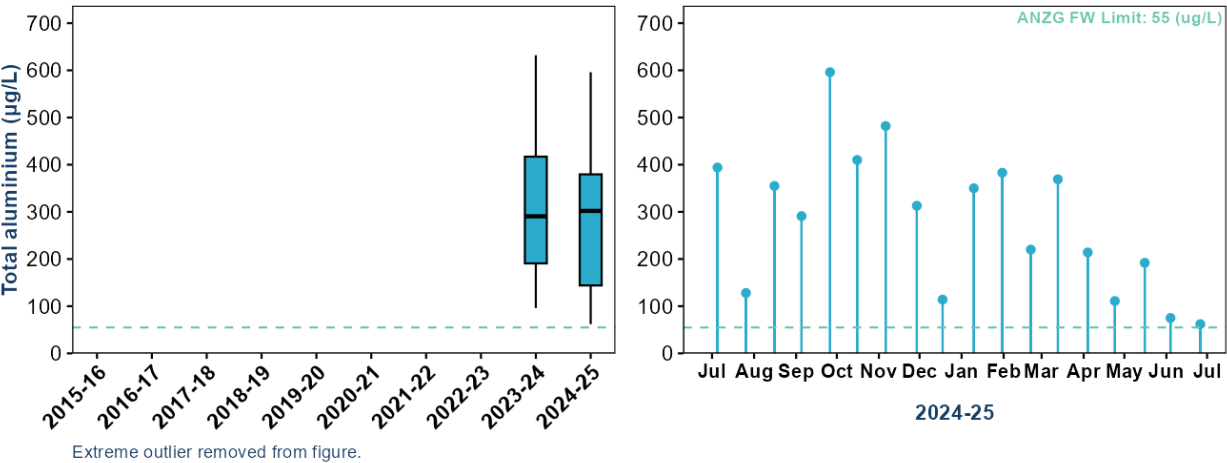
Hawkesbury River at Wilberforce as SoE Site

N35



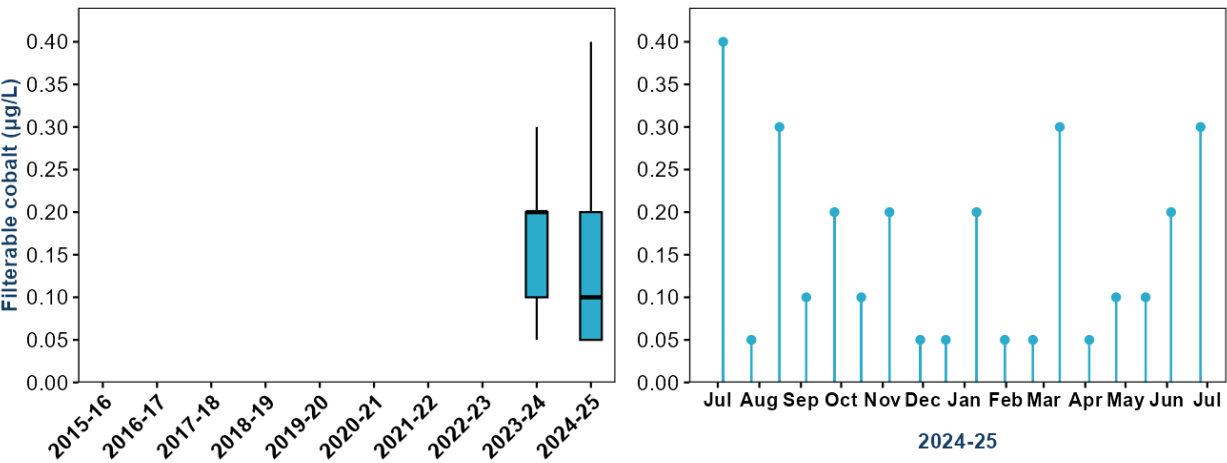
Hawkesbury River at Wilberforce as SoE Site

N35



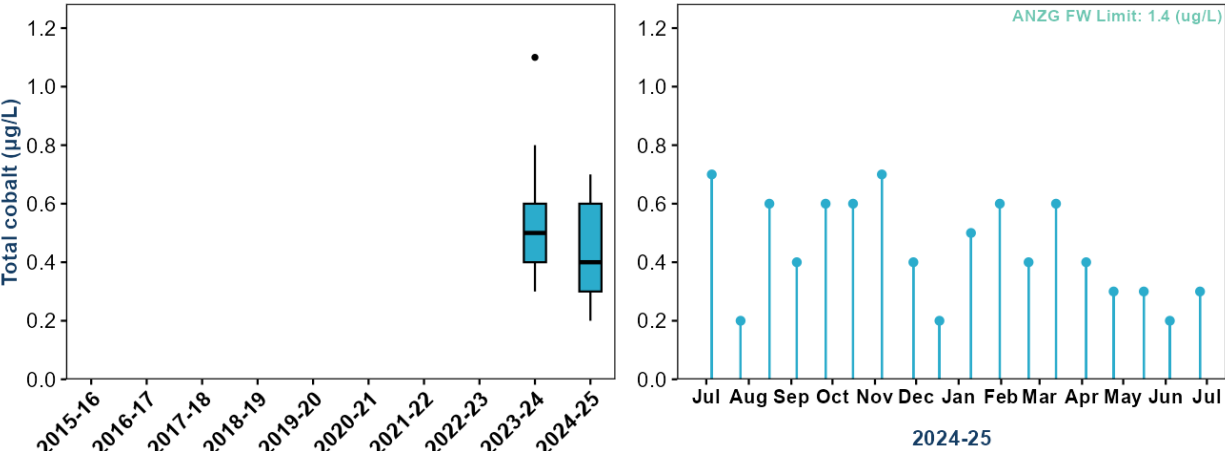
Hawkesbury River at Wilberforce as SoE Site

N35



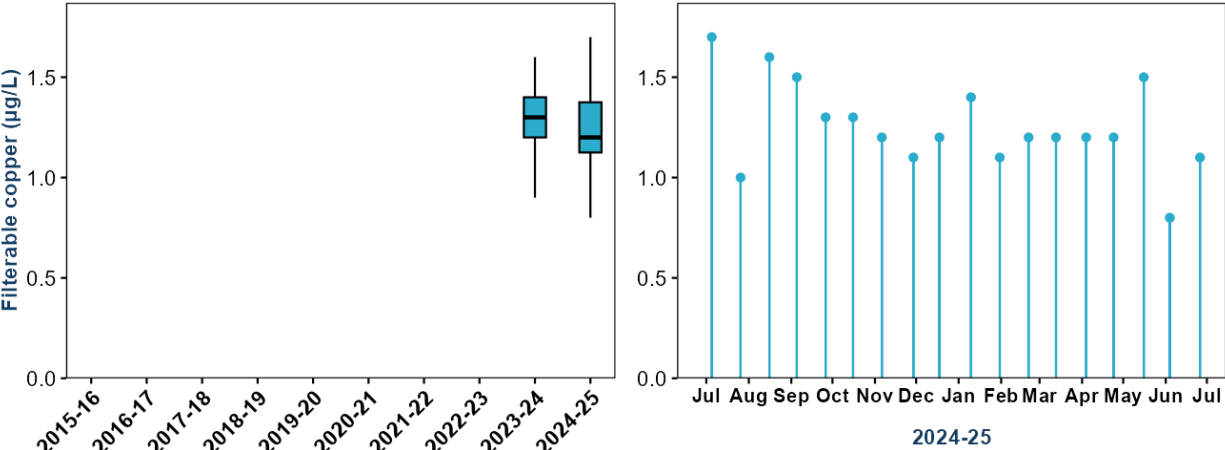
Hawkesbury River at Wilberforce as SoE Site

N35



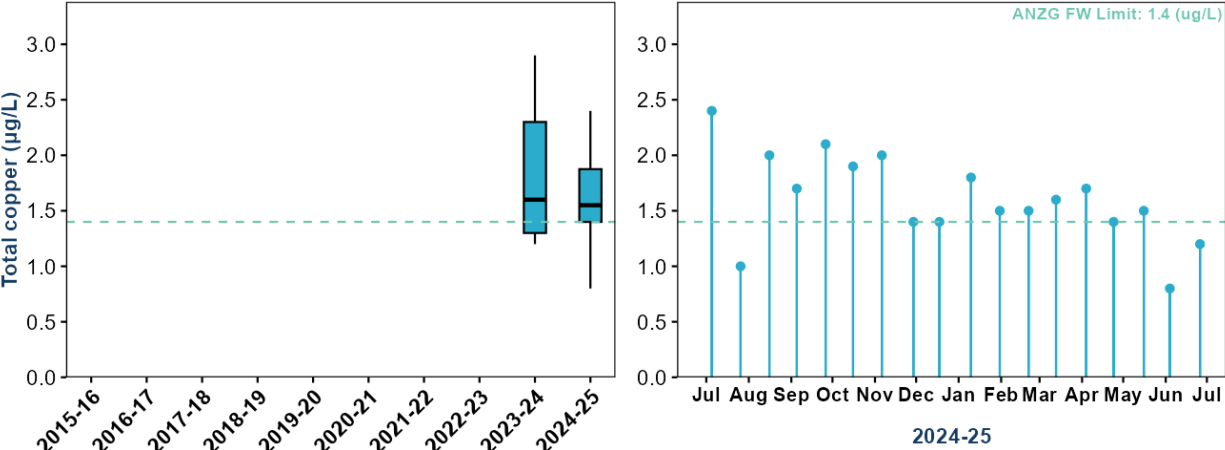
Hawkesbury River at Wilberforce as SoE Site

N35



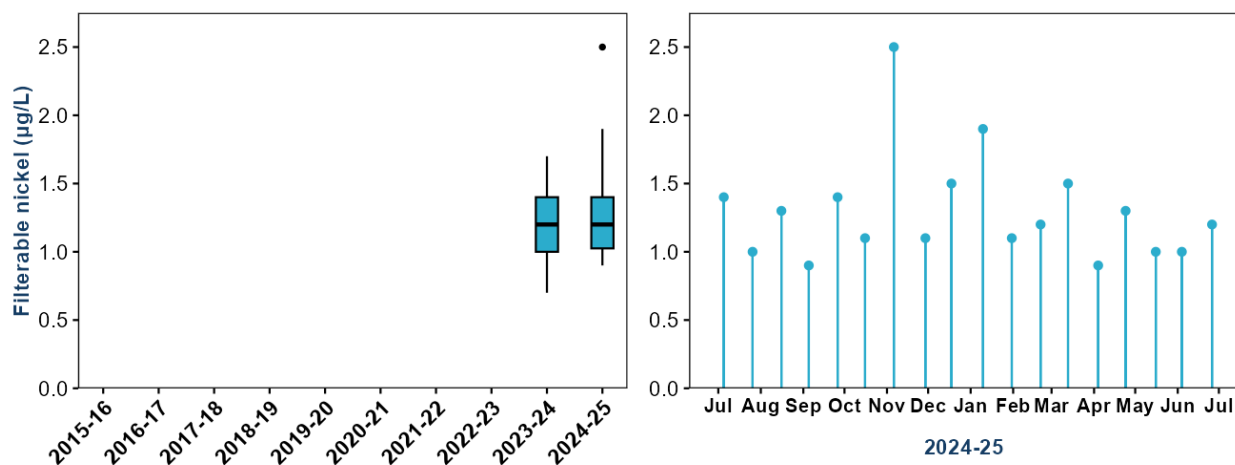
Hawkesbury River at Wilberforce as SoE Site

N35



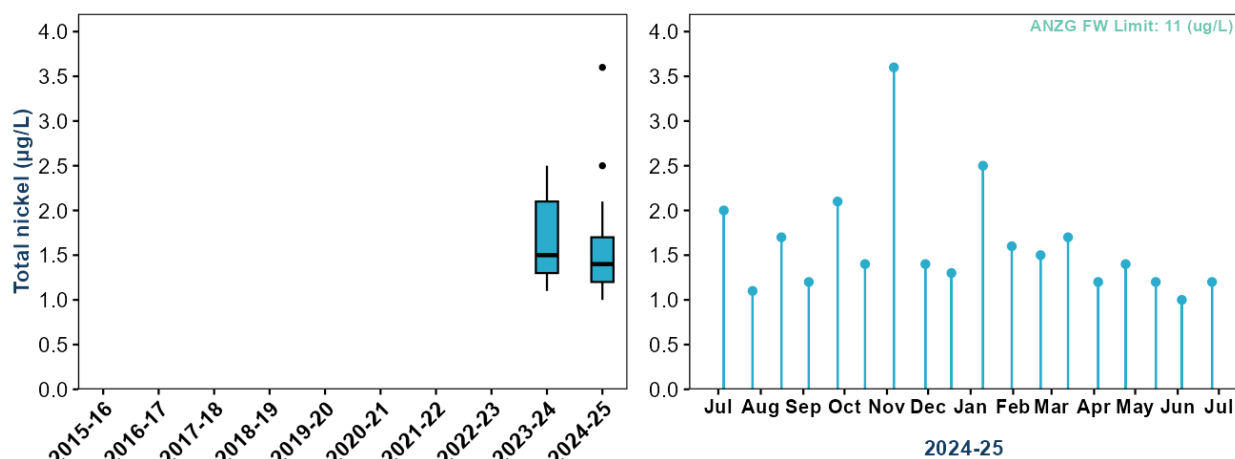
Hawkesbury River at Wilberforce as SoE Site

N35



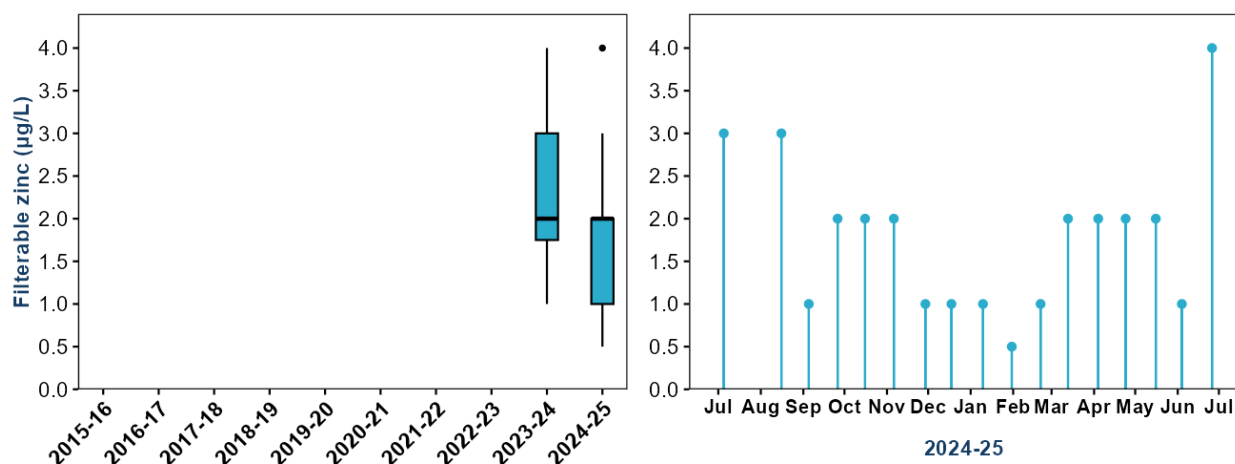
Hawkesbury River at Wilberforce as SoE Site

N35



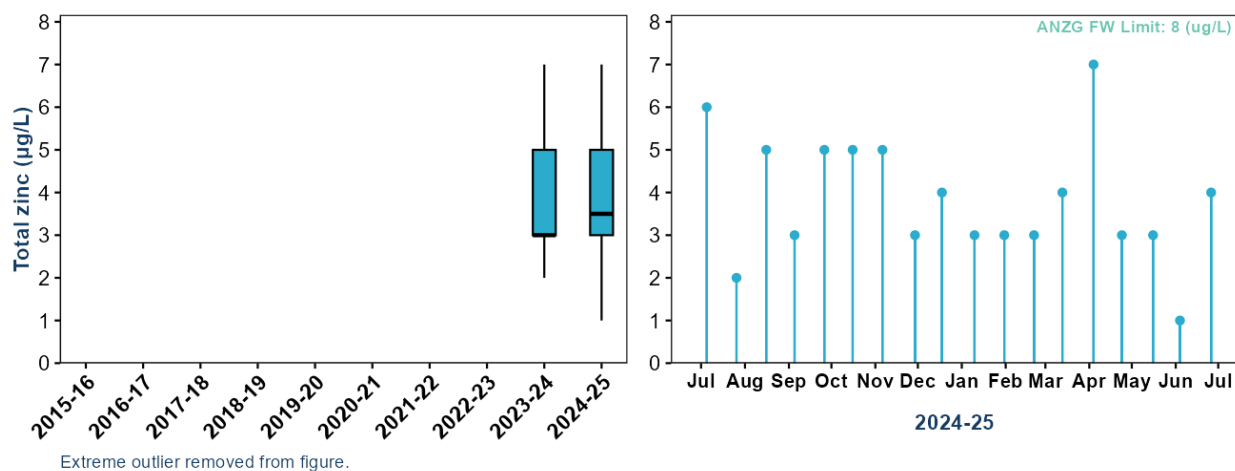
Hawkesbury River at Wilberforce as SoE Site

N35



Hawkesbury River at Wilberforce as SoE Site

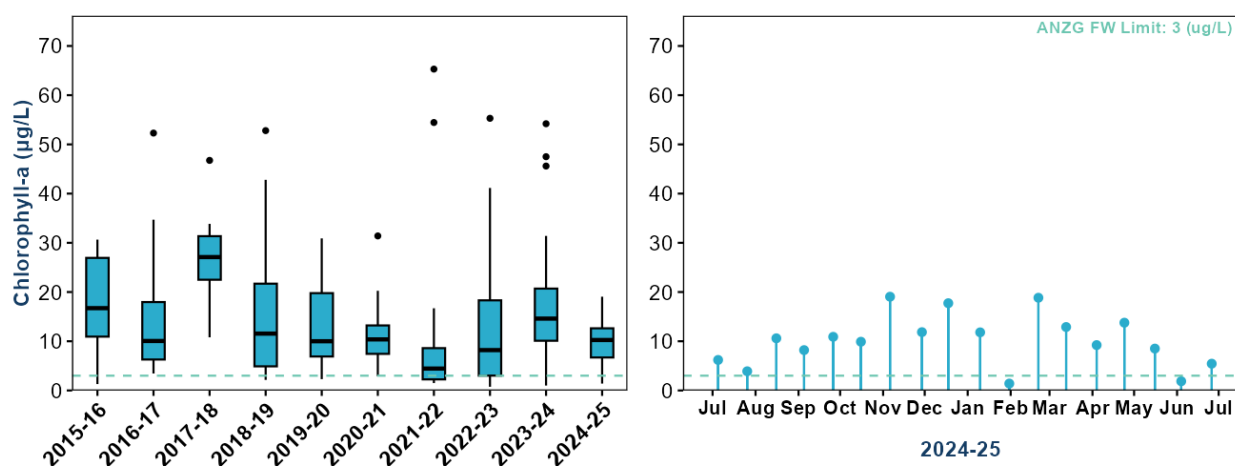
N35



Ecosystem receptor – Phytoplankton

Hawkesbury River at Wilberforce as SoE Site

N35



C.1.4. Lower Cattai Creek at Cattai Ridge Road (NC11A)

Stressors - Statistical analysis outcomes

Table C-4 Current period (2024-25) vs previous period comparison for NC11A

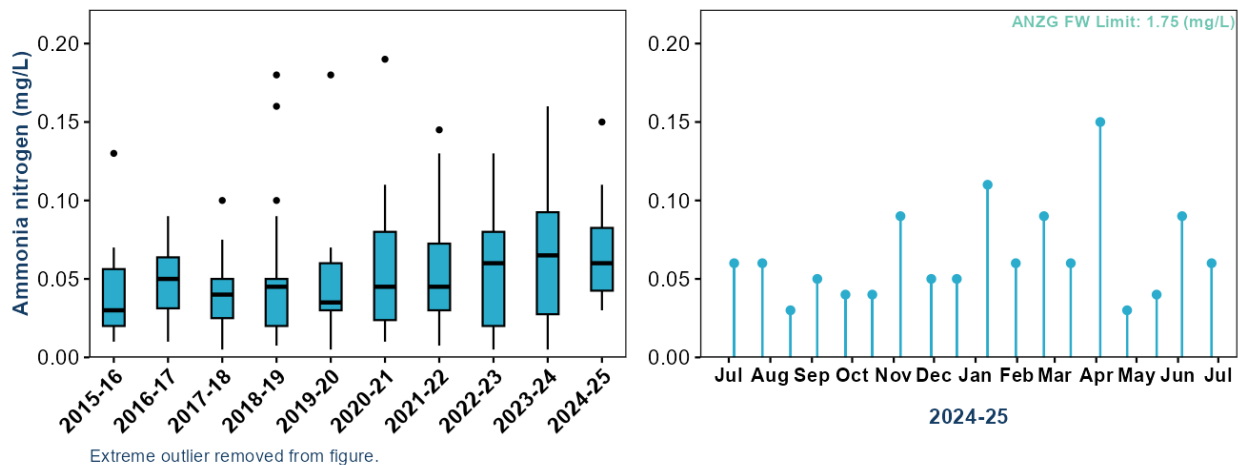
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	1.46	0.29	159	1.89	0.061
Oxidised nitrogen	1.03	0.18	159	0.17	0.867
Total nitrogen	0.96	0.10	159	-0.38	0.707
Soluble reactive phosphorus	0.81	0.18	33	-0.99	0.332
Total phosphorus	0.95	0.08	159	-0.60	0.549
Physico-chemical					
Conductivity	1.03	0.08	159	0.40	0.691
Dissolved oxygen	0.87	0.06	159	-2.10	0.037
Dissolved oxygen saturation	-8.83	3.22	159	-2.74	0.007
pH	-0.10	0.05	158	-2.07	0.040
Water temperature	1.07	0.09	158	0.84	0.404
Turbidity	1.19	0.16	158	1.29	0.198
Trace metals					
Filterable aluminium	0.81	0.24	33	-0.71	0.481
Total aluminium	0.96	0.19	33	-0.20	0.842
Filterable cobalt	0.97	0.18	33	-0.17	0.868
Total cobalt	0.99	0.15	33	-0.07	0.947
Filterable copper	0.76	0.06	33	-3.35	0.002
Total copper	0.78	0.06	33	-3.23	0.003
Filterable nickel	0.79	0.07	33	-2.68	0.012
Total nickel	0.82	0.06	33	-2.78	0.009
Filterable zinc	0.52	0.08	31	-4.01	<0.001
Total zinc	0.73	0.10	33	-2.34	0.025
Chlorophyll-a					
Chlorophyll-a	0.63	0.15	159	-1.88	0.062

	not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Stressors – Nutrients

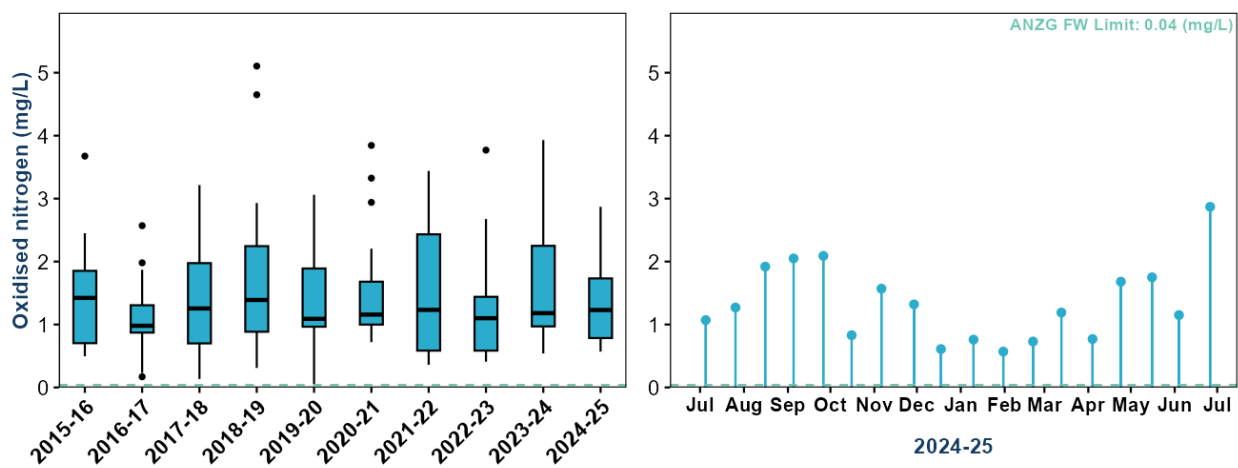
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



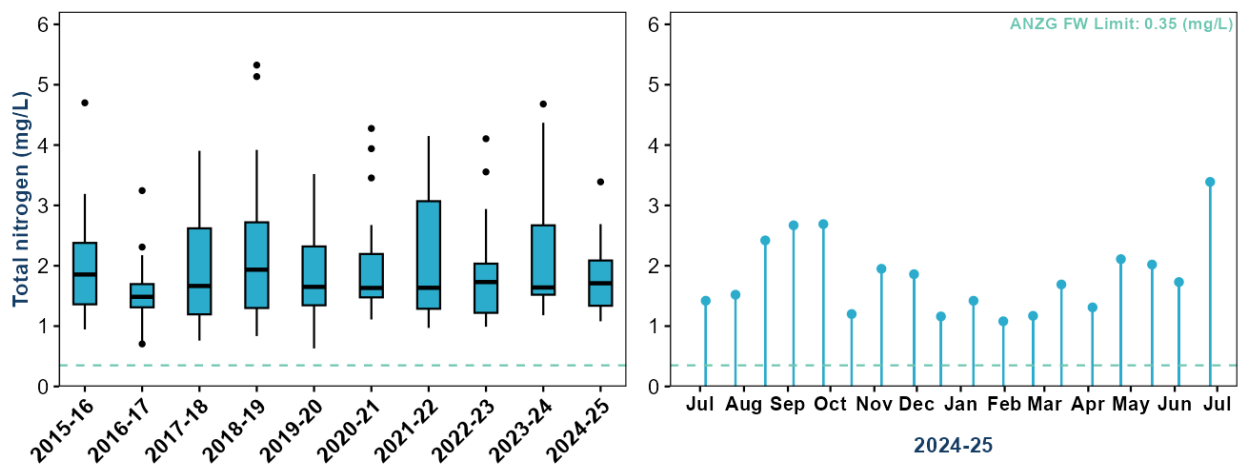
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A

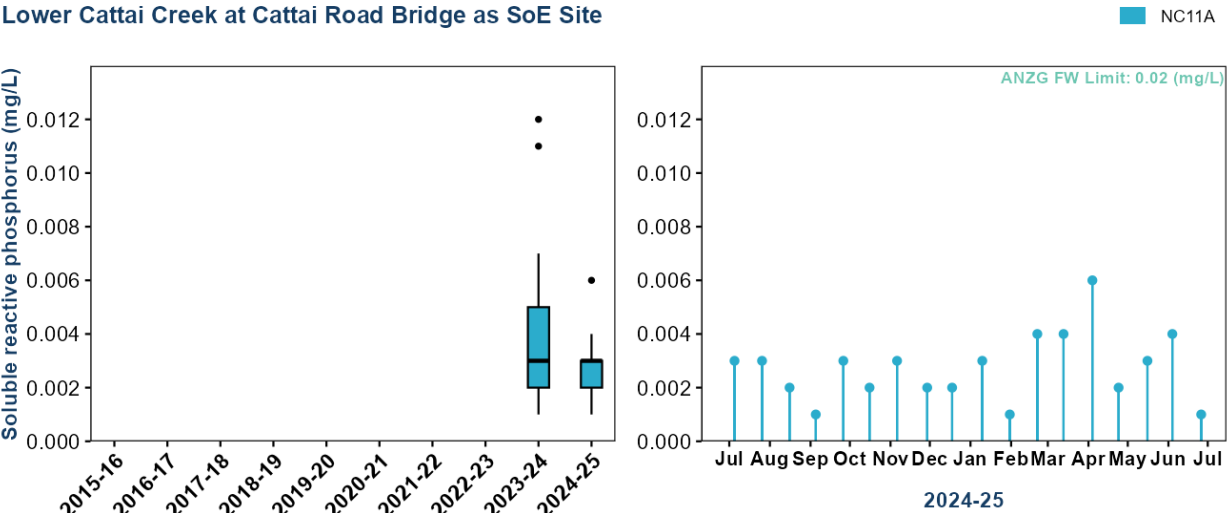


Lower Cattai Creek at Cattai Road Bridge as SoE Site

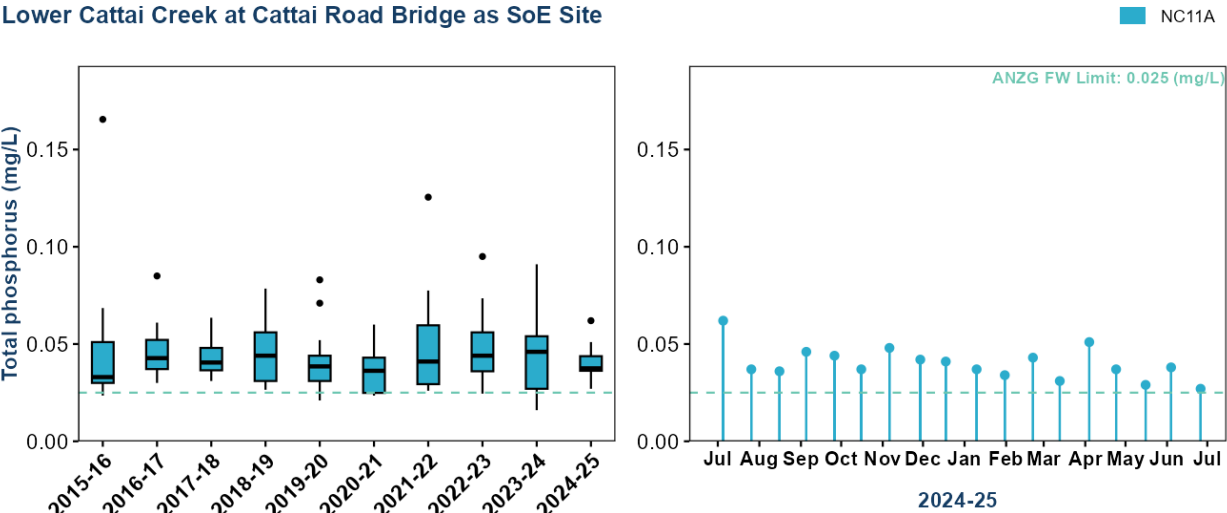
NC11A



Lower Cattai Creek at Cattai Road Bridge as SoE Site

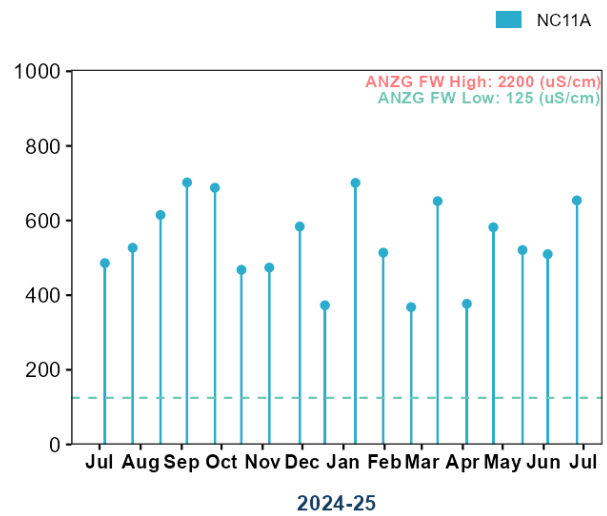
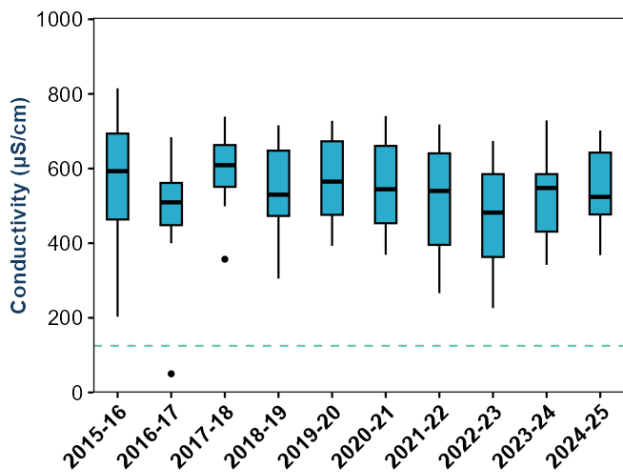


Lower Cattai Creek at Cattai Road Bridge as SoE Site

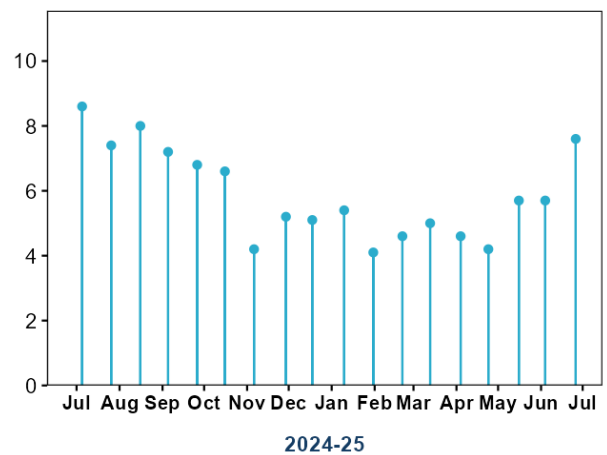
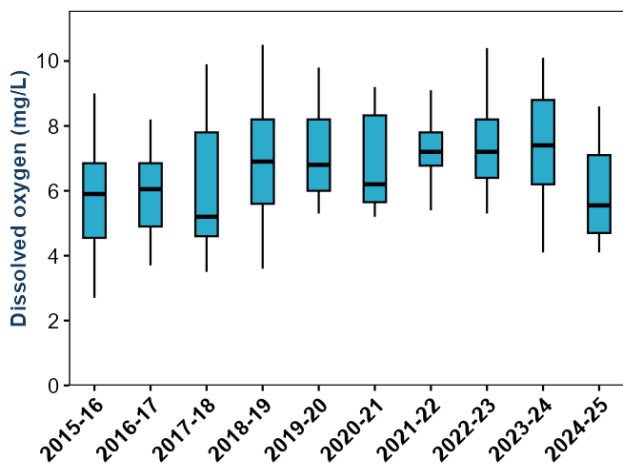


Stressors – Physico-chemical water quality

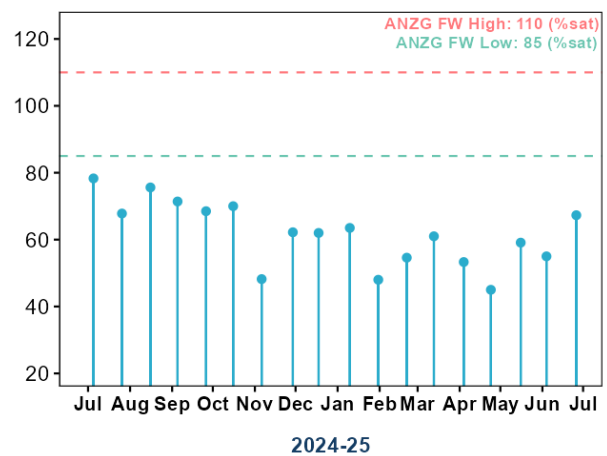
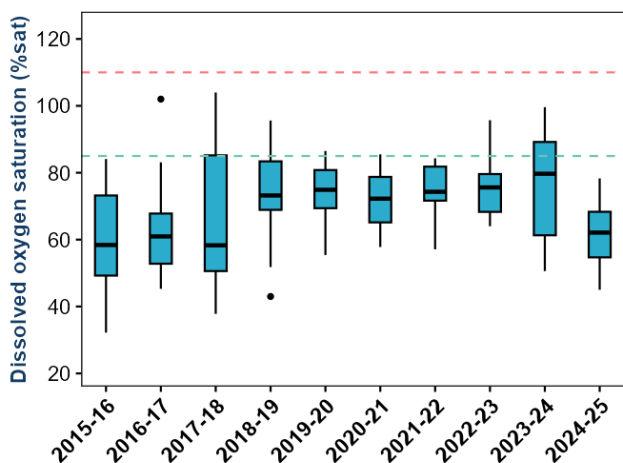
Lower Cattai Creek at Cattai Road Bridge as SoE Site



Lower Cattai Creek at Cattai Road Bridge as SoE Site

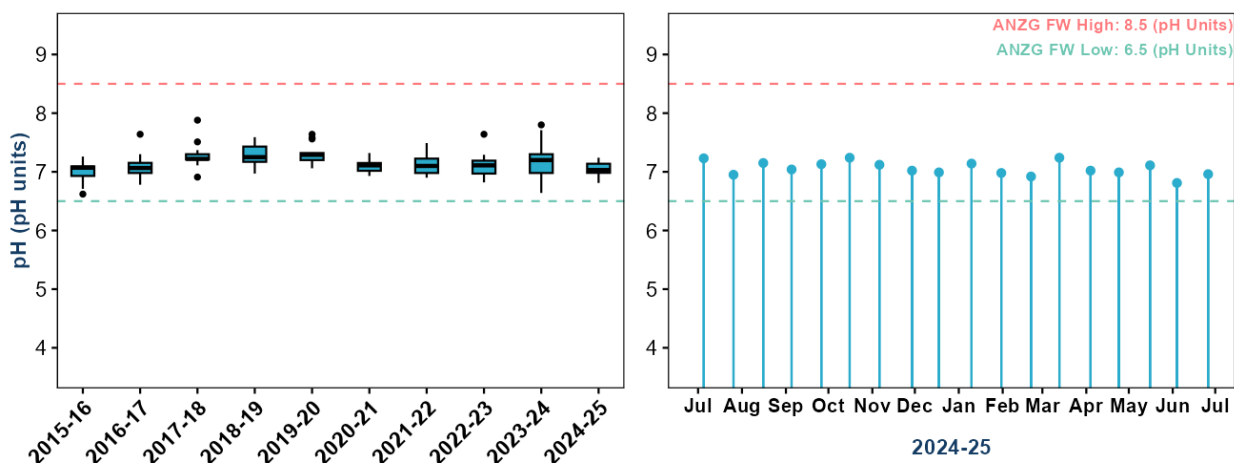


Lower Cattai Creek at Cattai Road Bridge as SoE Site



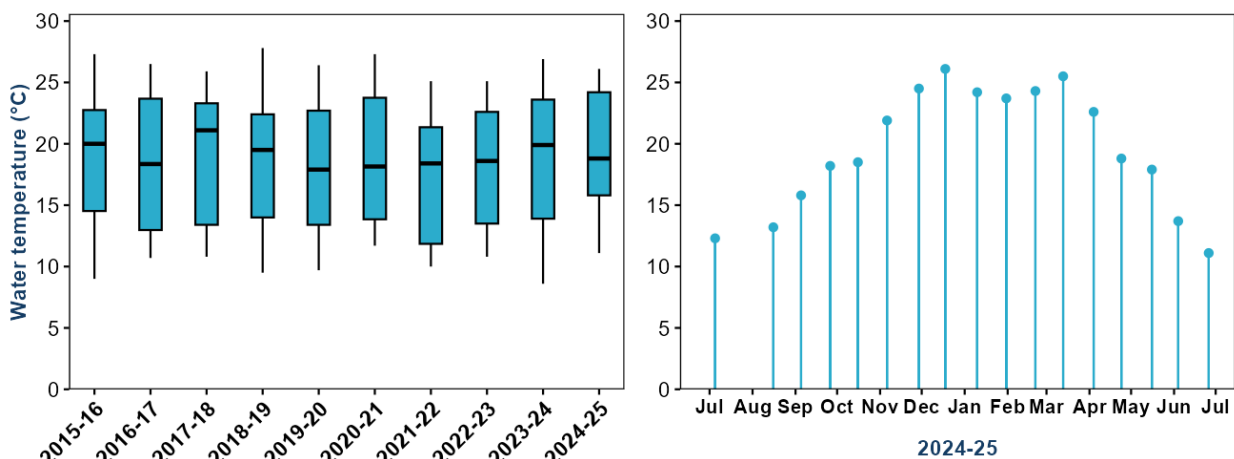
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



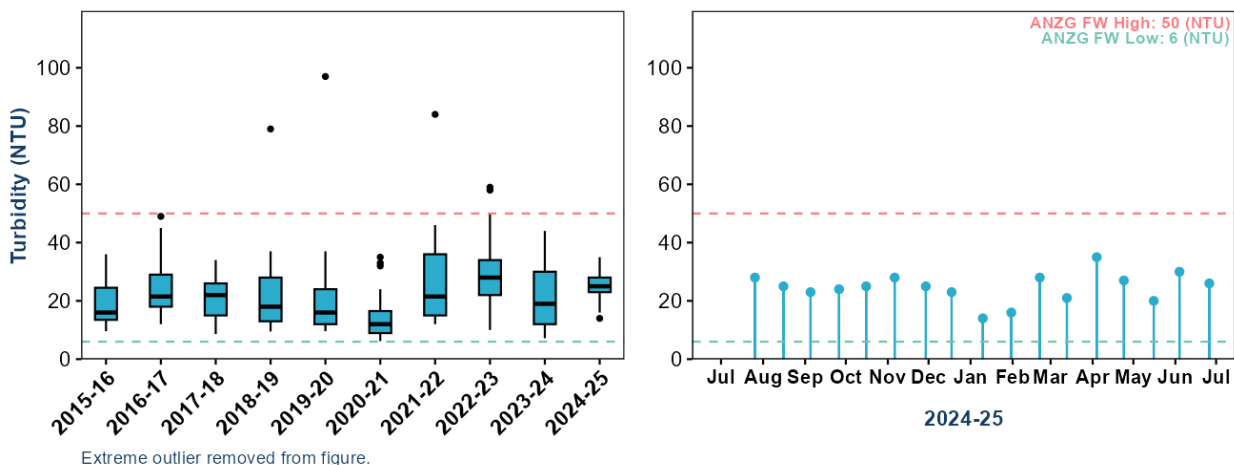
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A

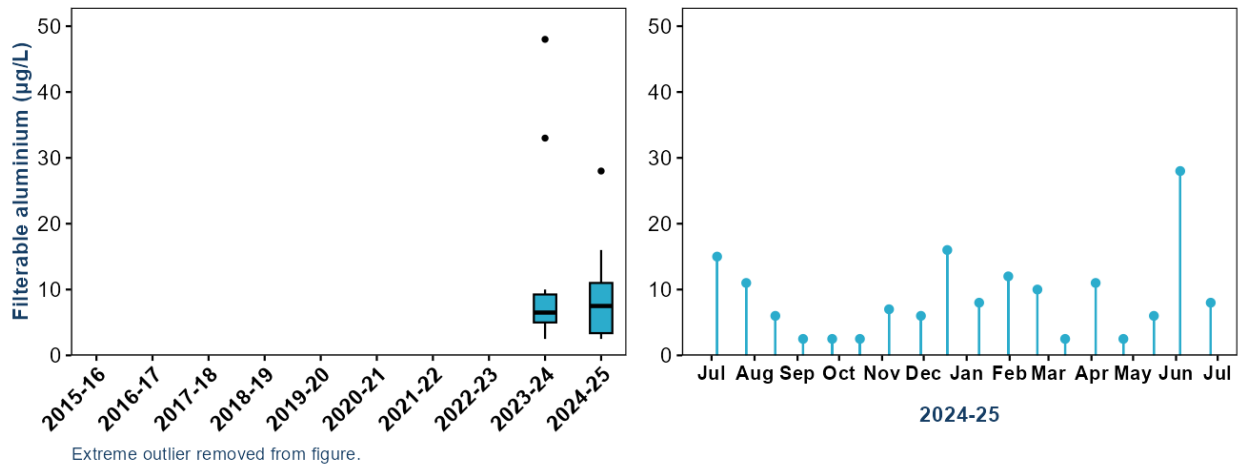


Extreme outlier removed from figure.

Stressors – Trace metals

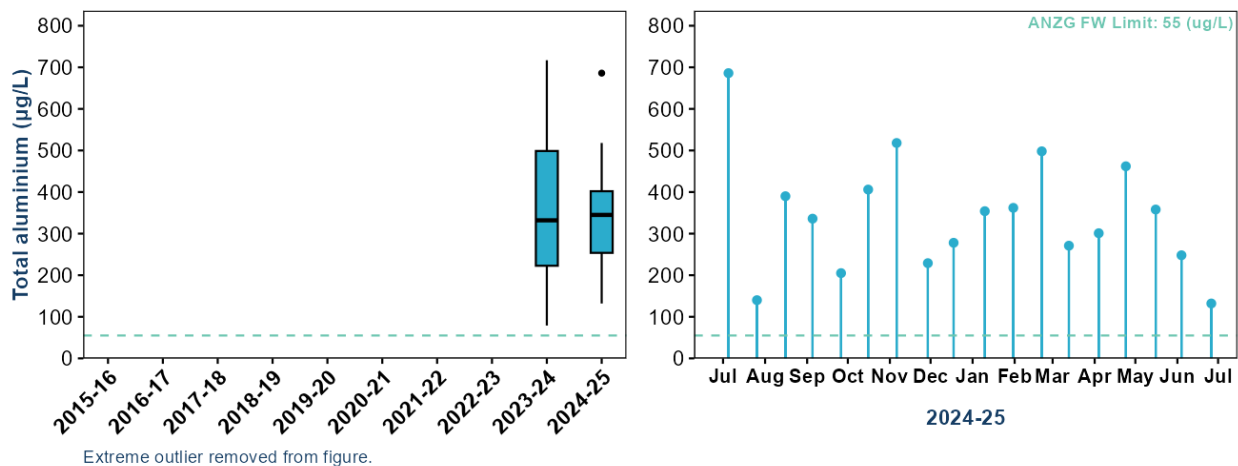
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



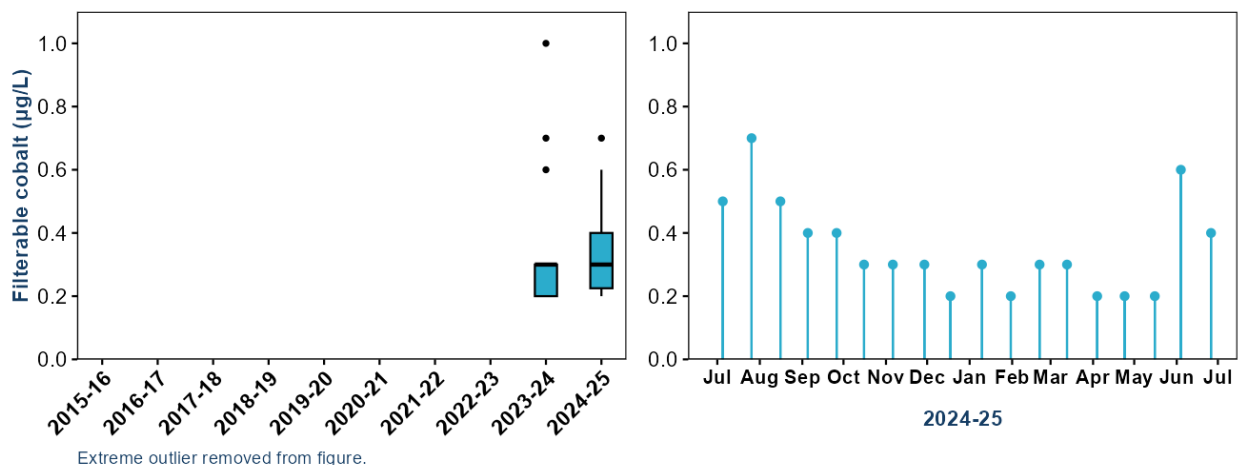
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



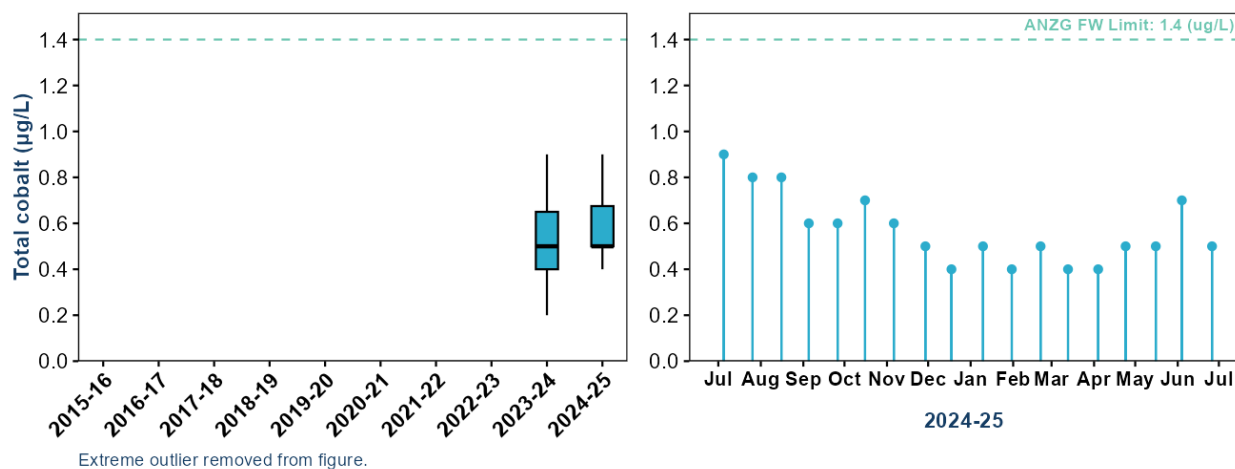
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



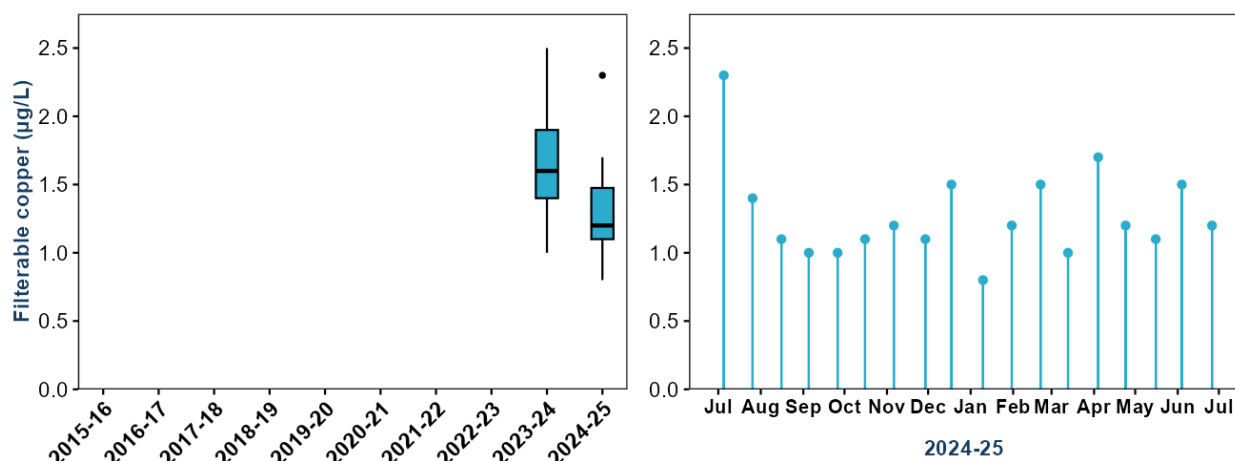
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



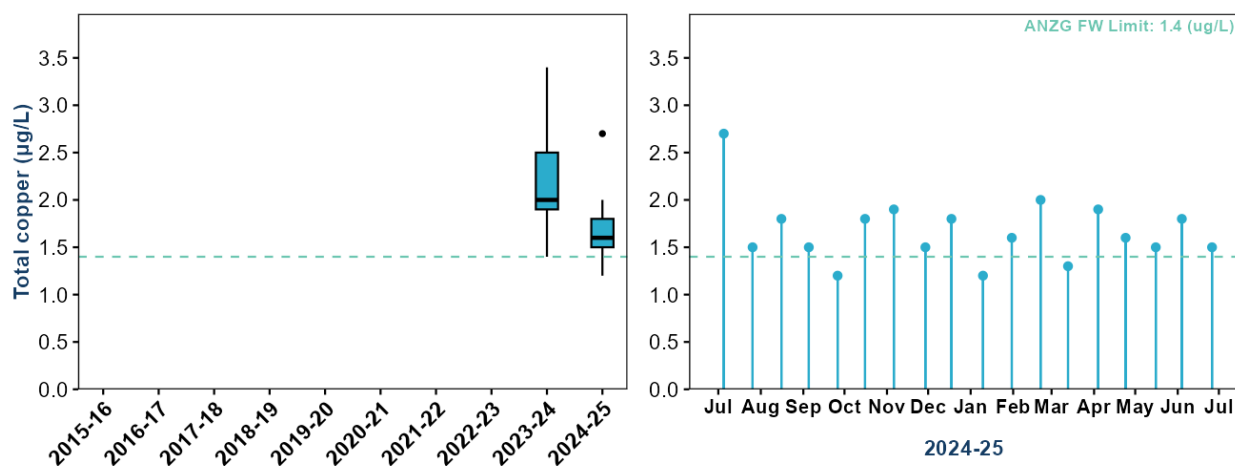
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



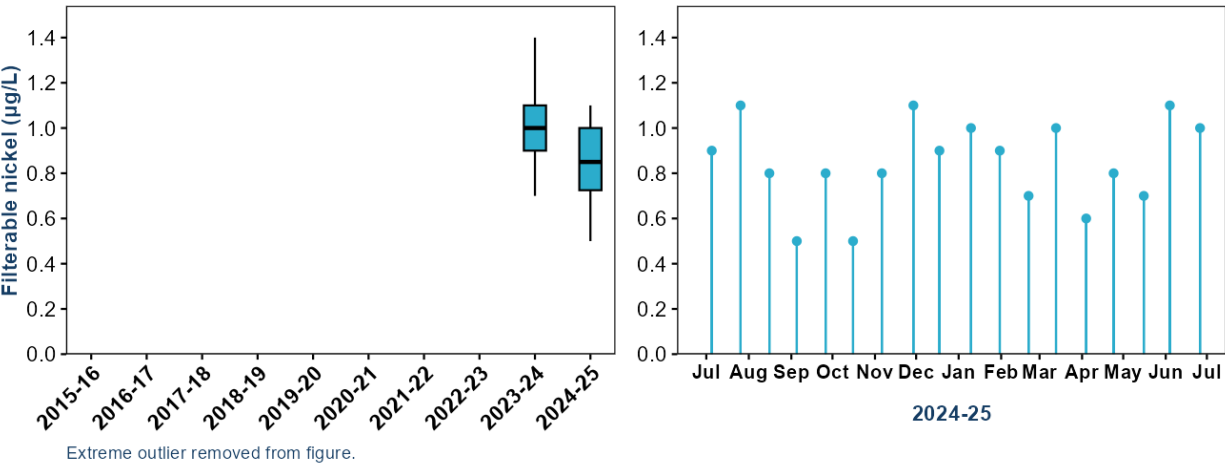
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



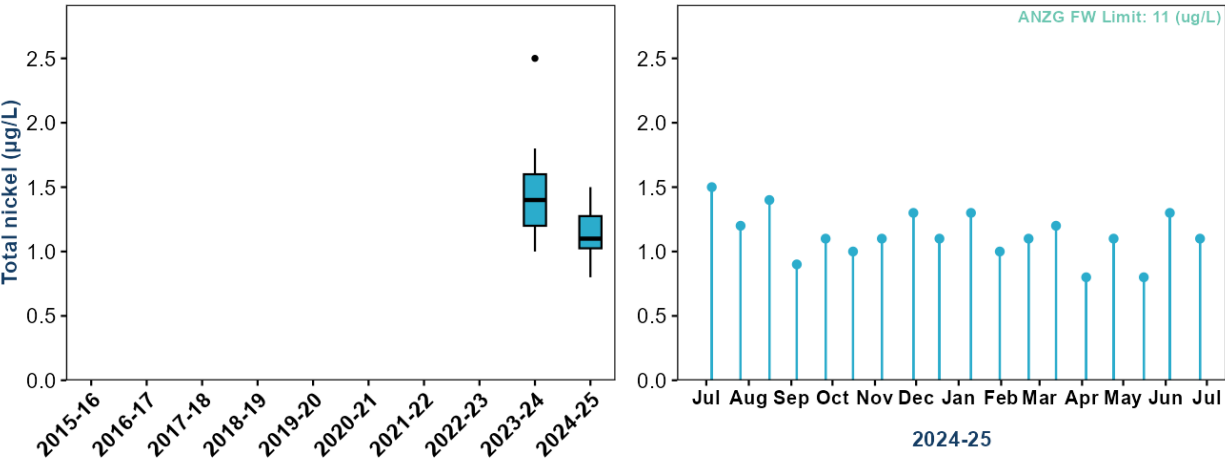
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



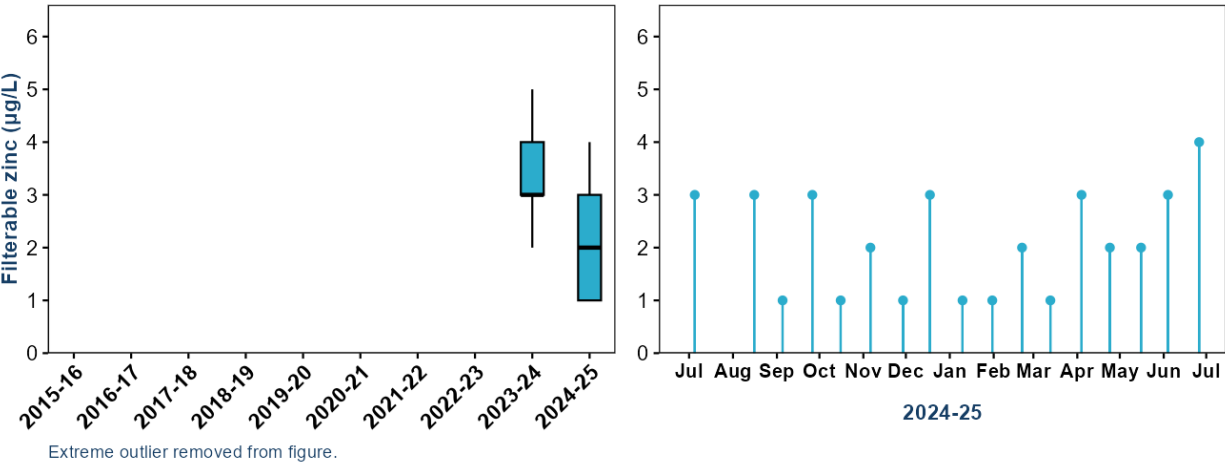
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



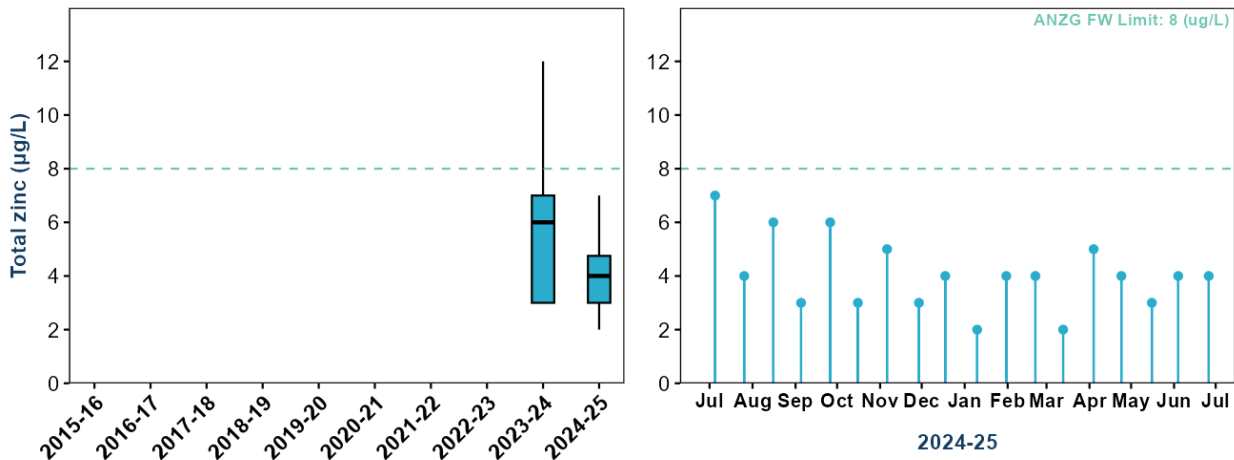
Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



Lower Cattai Creek at Cattai Road Bridge as SoE Site

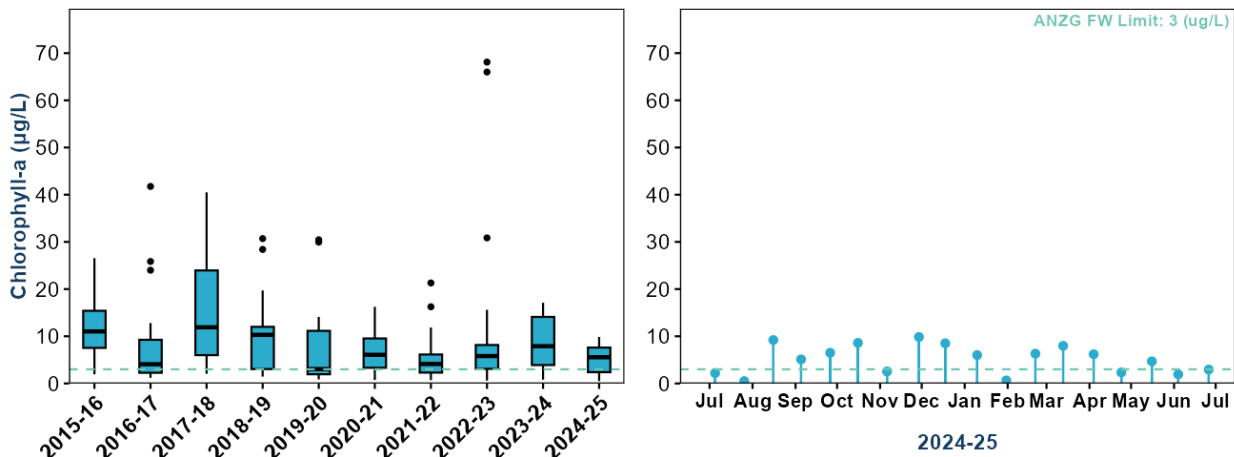
NC11A



Ecosystem receptor – Phytoplankton

Lower Cattai Creek at Cattai Road Bridge as SoE Site

NC11A



C.1.5. Hawkesbury River off Cattai SRA (N3001)

Stressors - Statistical analysis outcomes

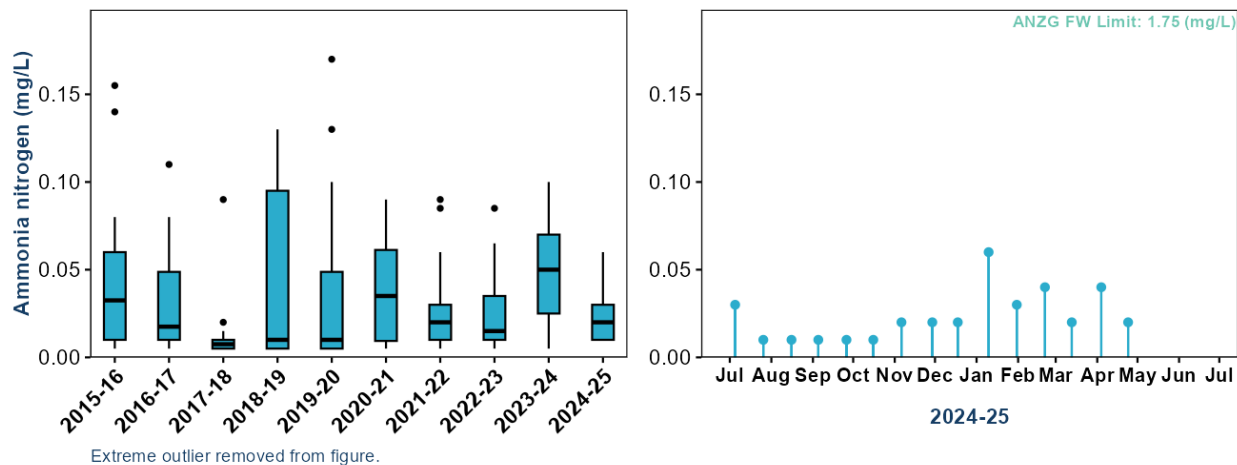
Table C-5 Current period (2024-25) vs previous period comparison for N3001

Nutrients					
Total ammonia nitrogen	0.99	0.27	156	-0.04	0.969
Oxidised nitrogen	1.48	0.46	156	1.26	0.211
Total nitrogen	1.01	0.09	156	0.14	0.886
Soluble reactive phosphorus	0.81	0.22	29	-0.79	0.437
Total phosphorus	0.76	0.08	156	-2.55	0.012
Physico-chemical					
Conductivity	1.19	0.09	155	2.30	0.023
Dissolved oxygen	1.00	0.06	156	-0.01	0.991
Dissolved oxygen saturation	0.18	3.37	155	0.05	0.956
pH	-0.05	0.09	156	-0.61	0.542
Water temperature	1.11	0.08	154	1.43	0.156
Turbidity	1.28	0.18	155	1.77	0.079
Trace metals					
Filterable aluminium	1.17	0.30	29	0.59	0.560
Total aluminium	0.82	0.18	29	-0.92	0.367
Filterable cobalt	0.80	0.20	29	-0.89	0.381
Total cobalt	0.76	0.10	29	-2.16	0.039
Filterable copper	0.90	0.06	29	-1.55	0.131
Total copper	0.88	0.08	29	-1.40	0.173
Filterable nickel	0.95	0.07	29	-0.77	0.448
Total nickel	0.97	0.09	29	-0.33	0.742
Filterable zinc	0.82	0.18	28	-0.90	0.378
Total zinc	0.75	0.10	29	-2.14	0.040
Chlorophyll-a					
Chlorophyll-a	0.68	0.16	155	-1.60	0.112
not significant (p>0.05) p <0.05 and >=0.01 p <0.01 and >=0.001 p <0.001					

Stressors – Nutrients

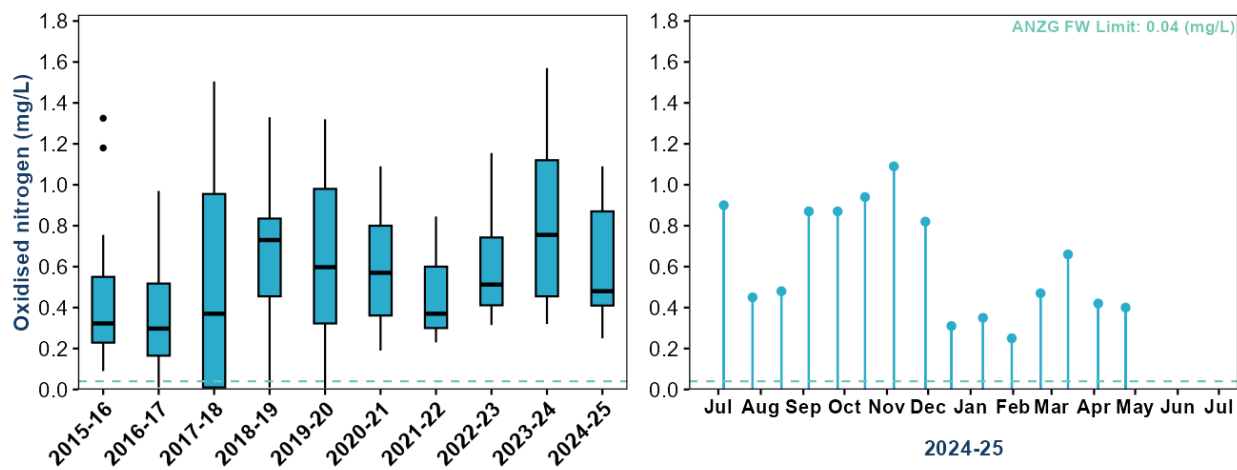
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



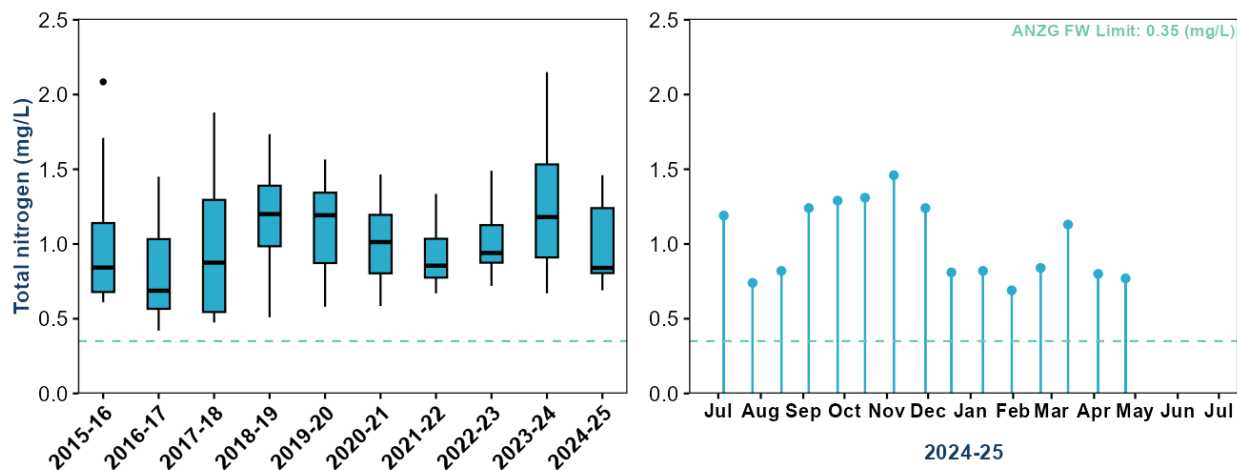
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



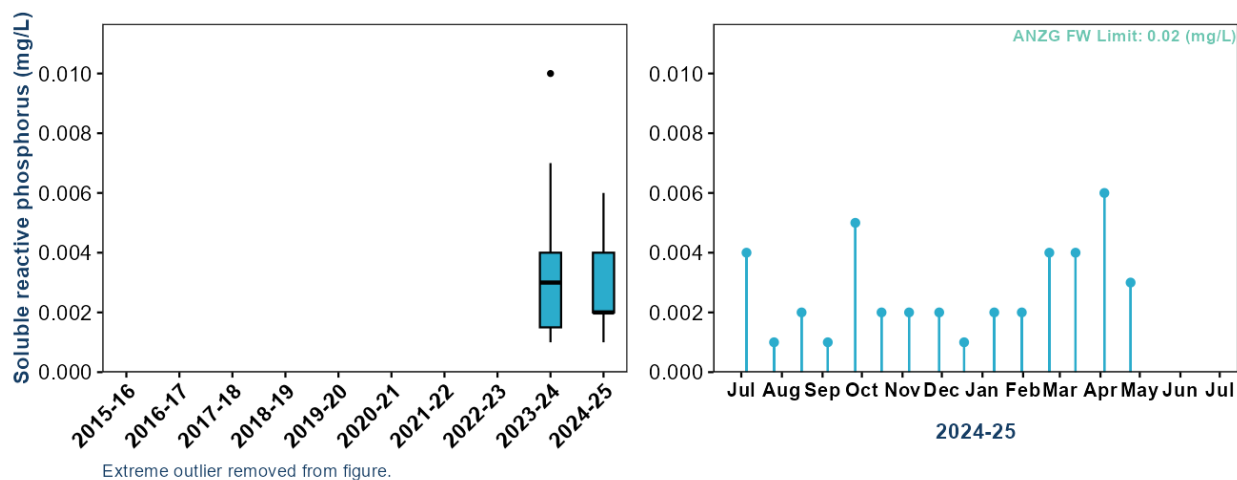
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



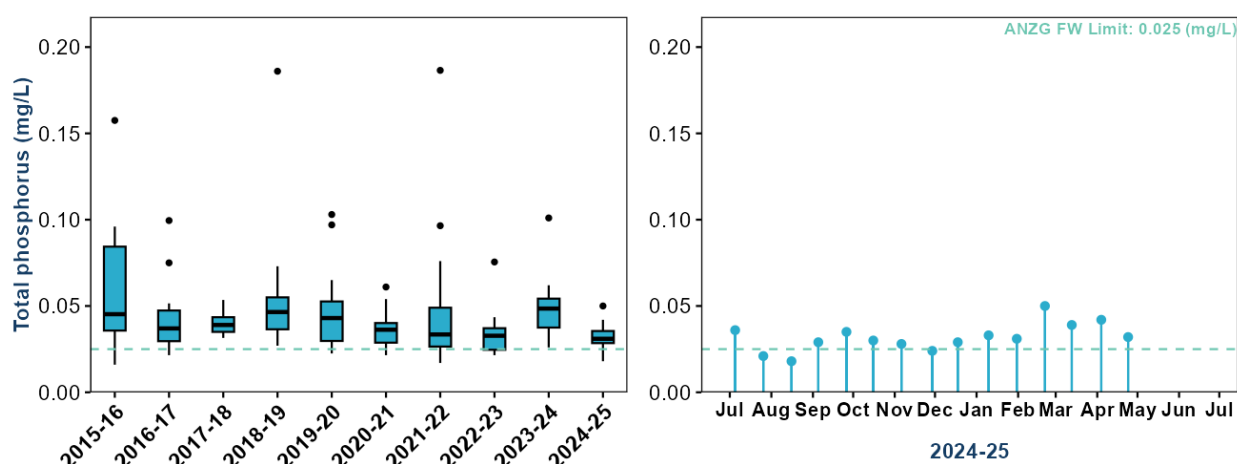
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



Hawkesbury River off Cattai State Recreation Area as SoE Site

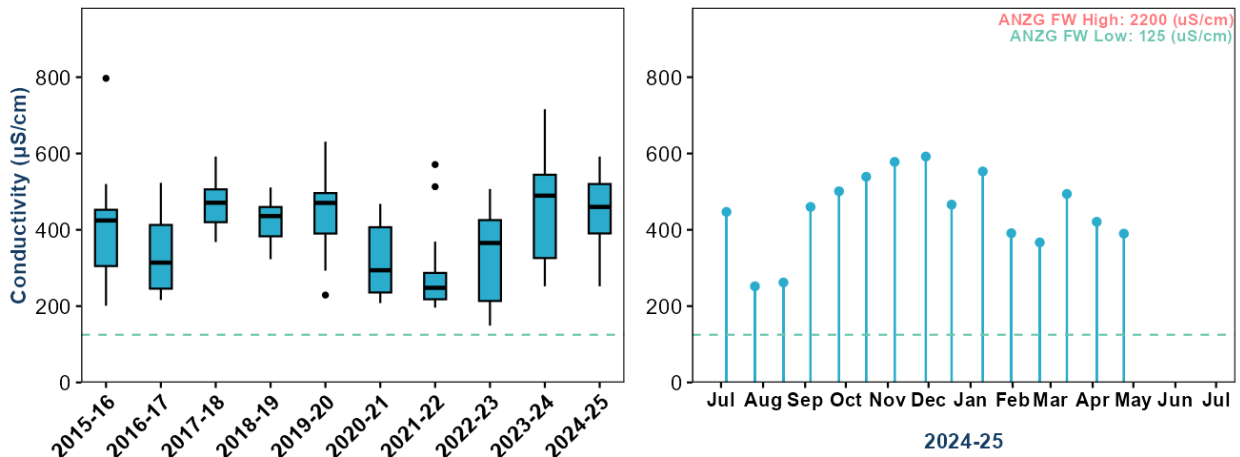
N3001



Stressors – Physico-chemical water quality

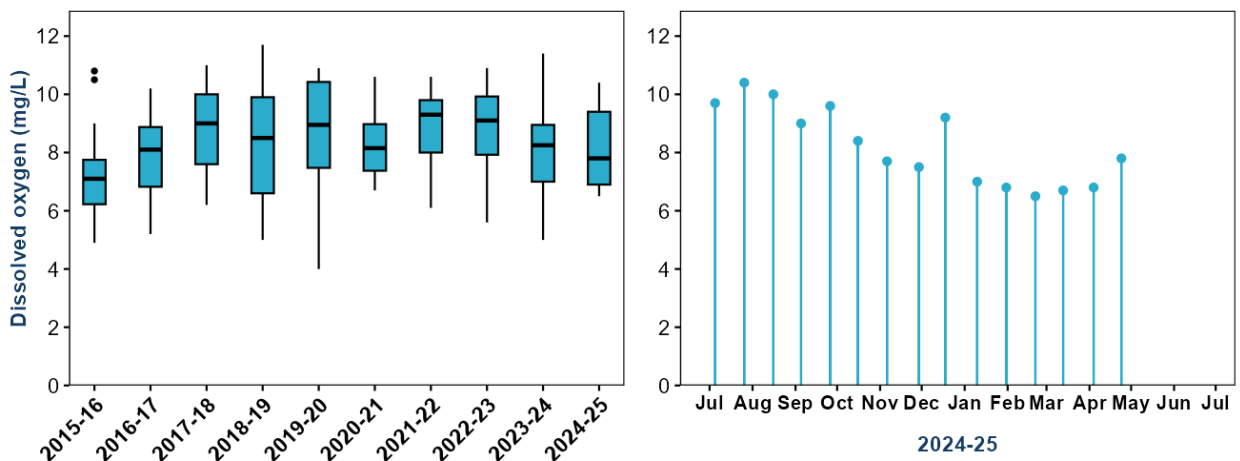
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



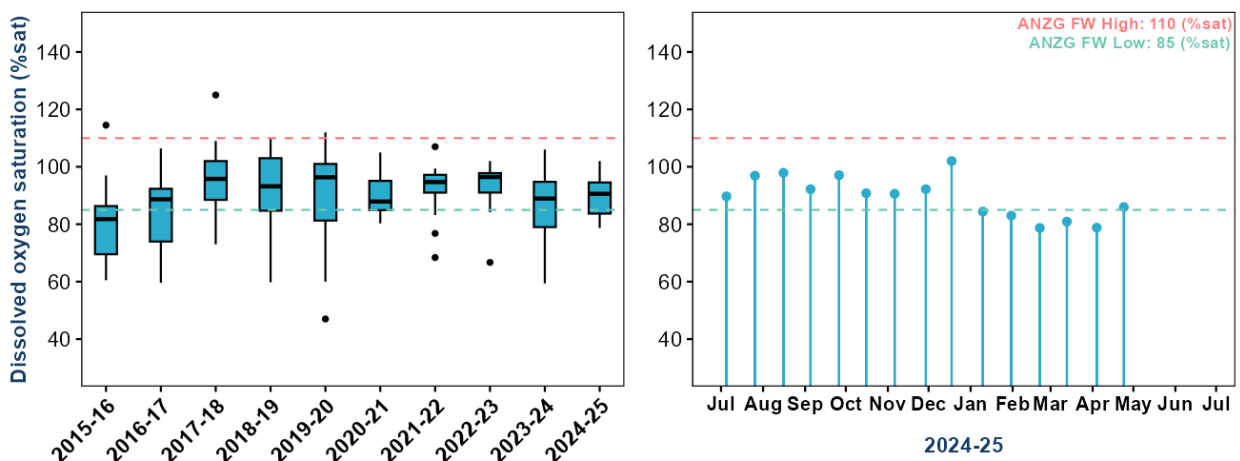
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



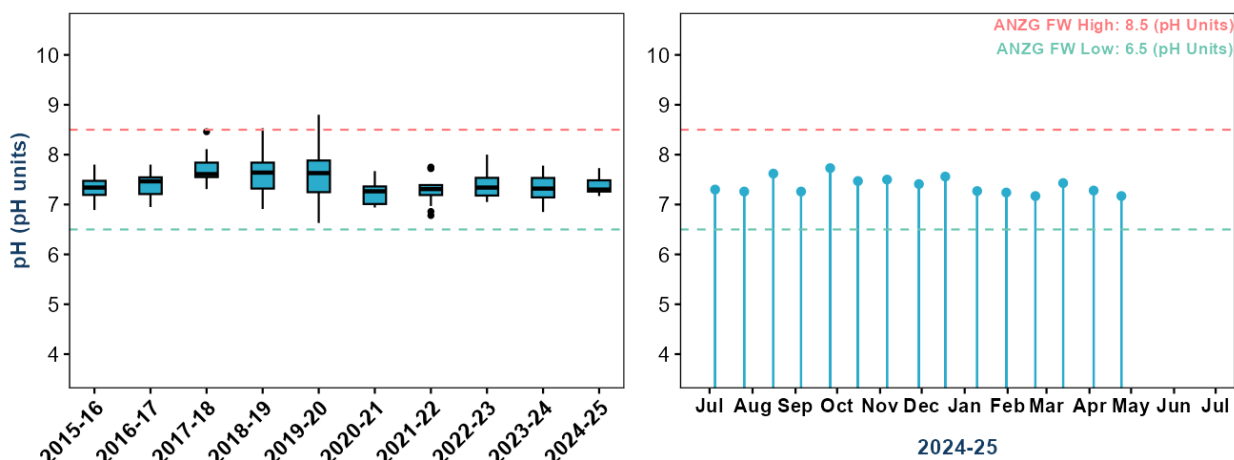
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



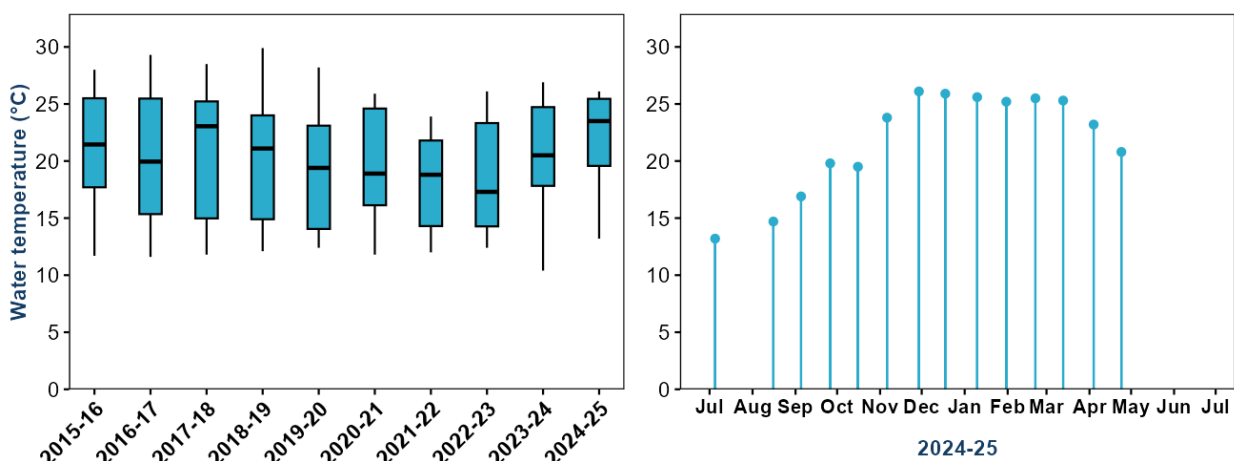
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



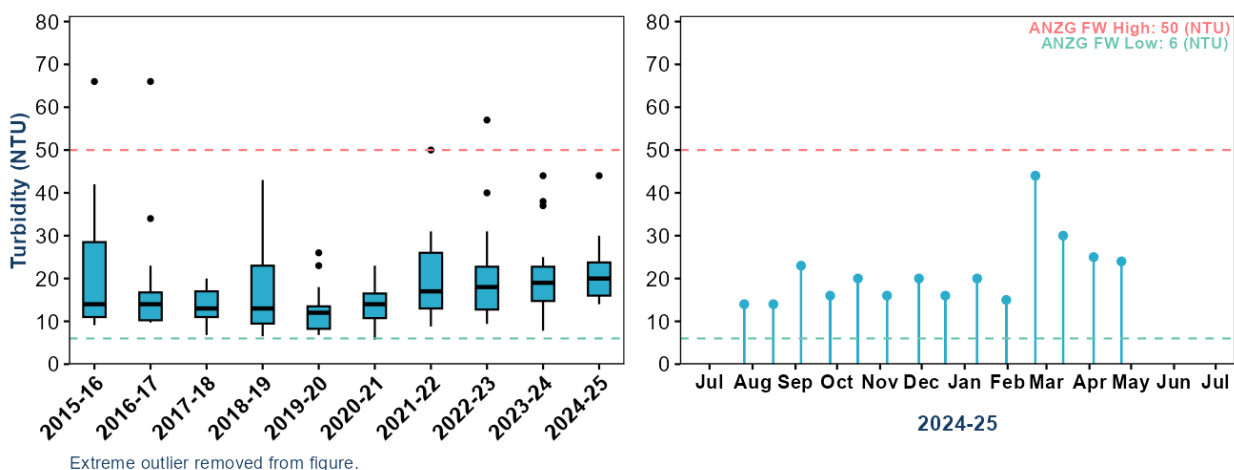
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001

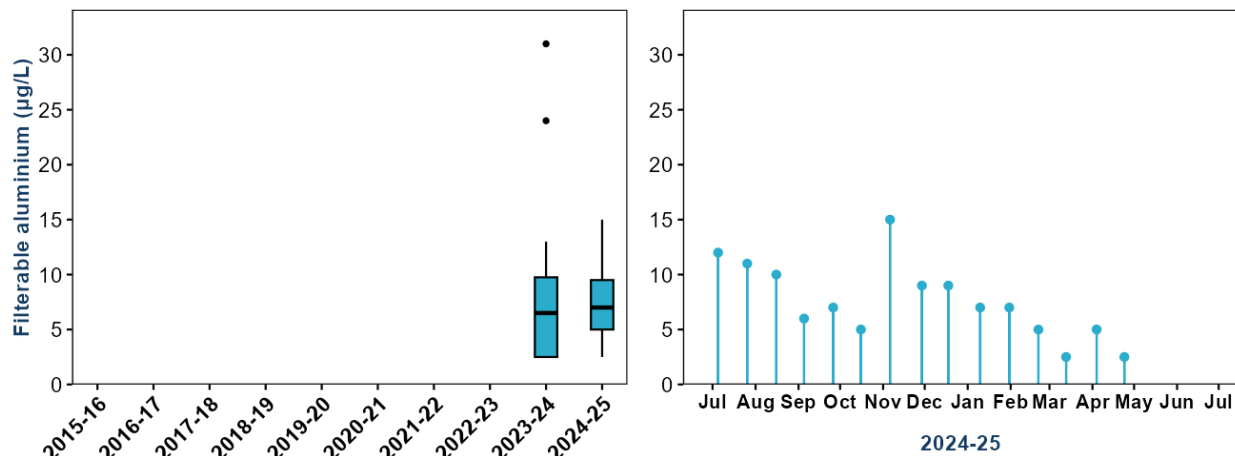


Extreme outlier removed from figure.

Stressors – Trace metals

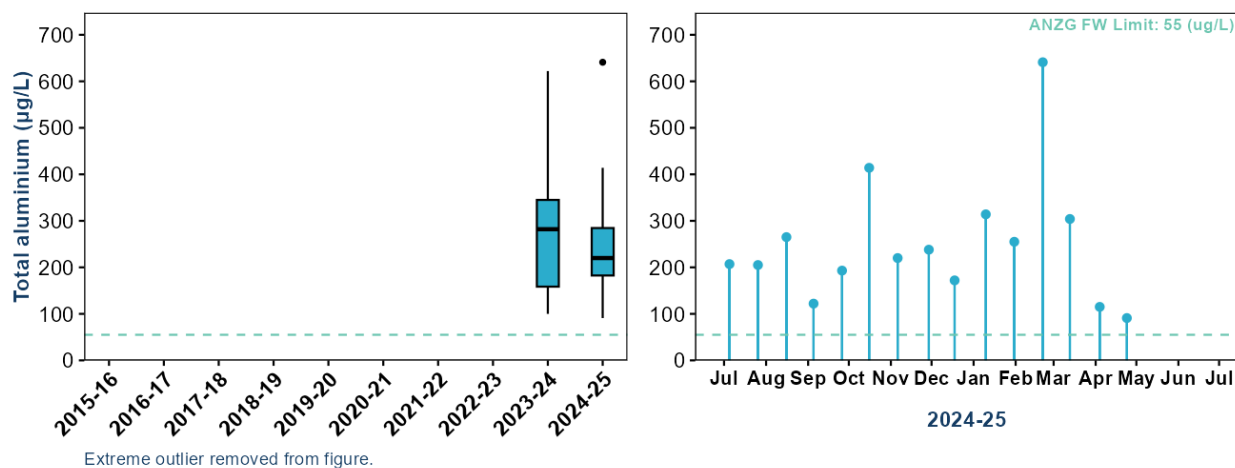
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



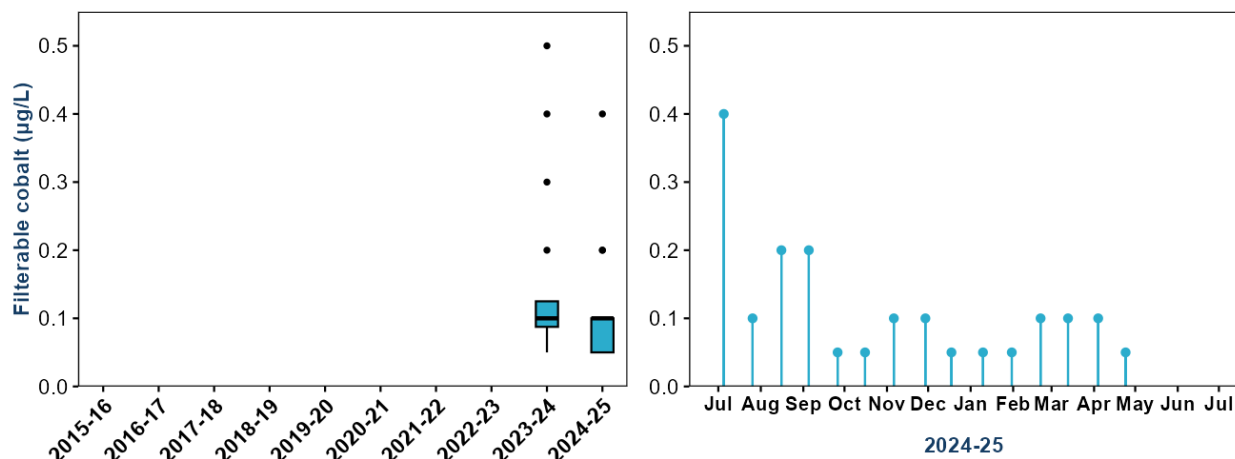
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



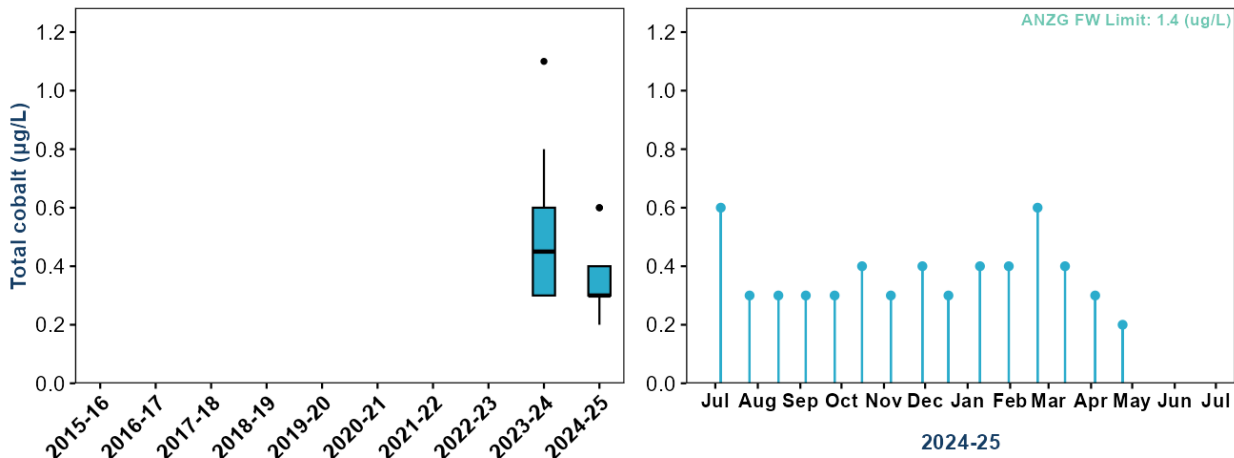
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



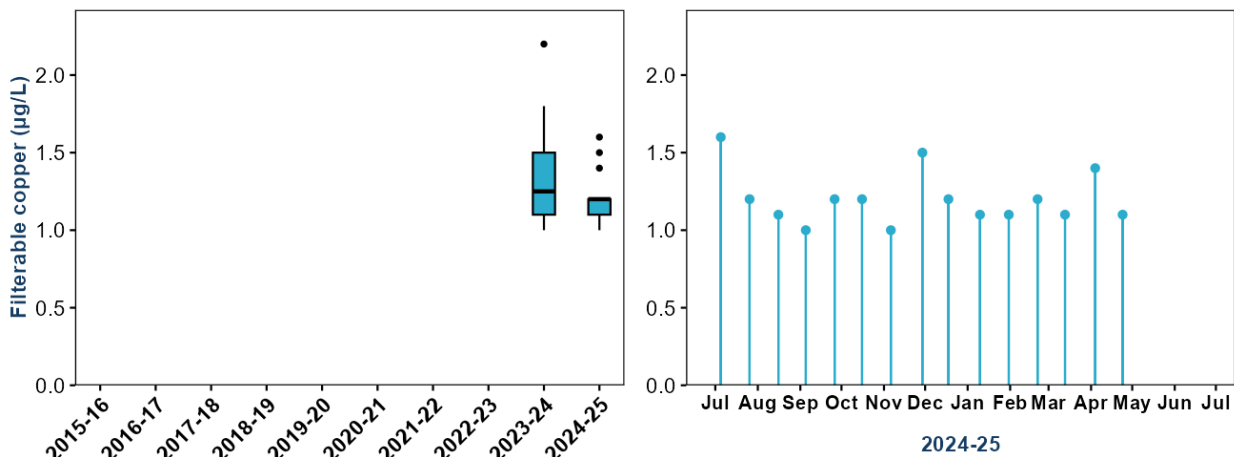
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



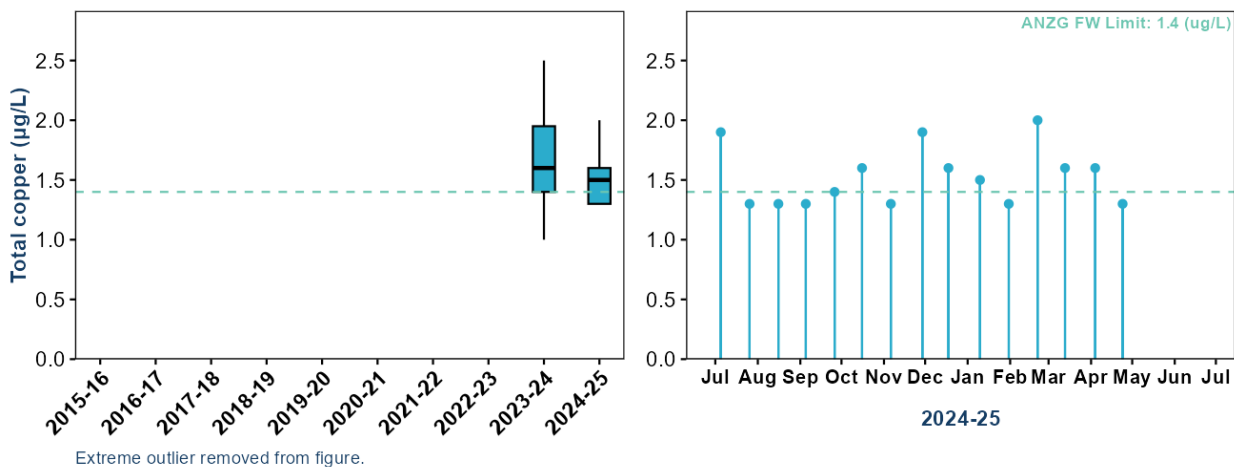
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



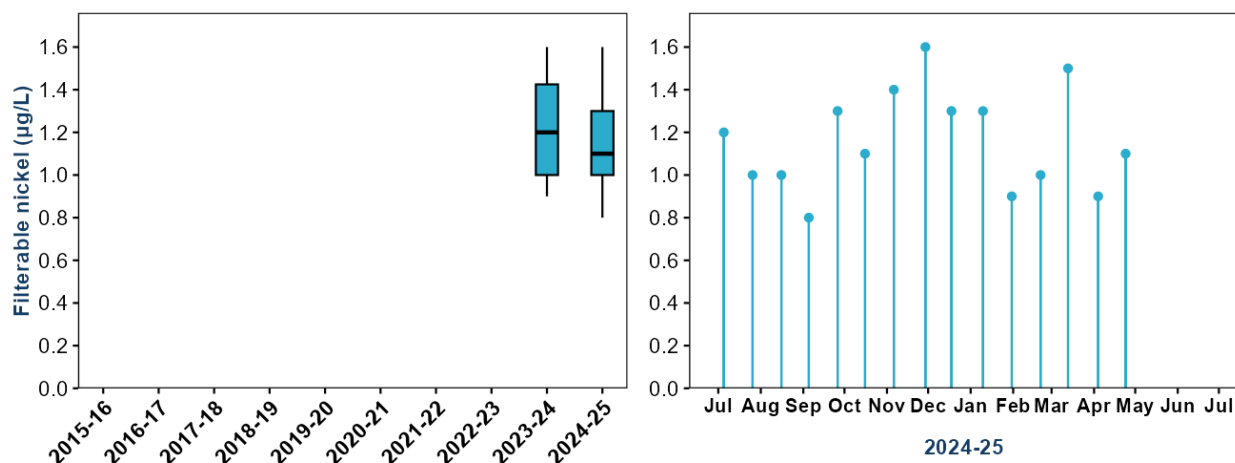
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



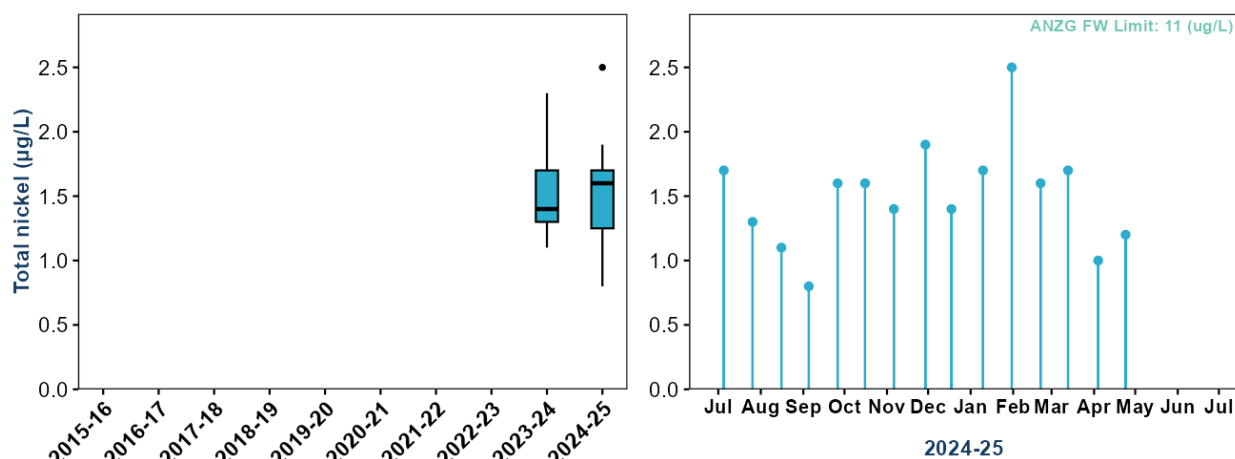
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



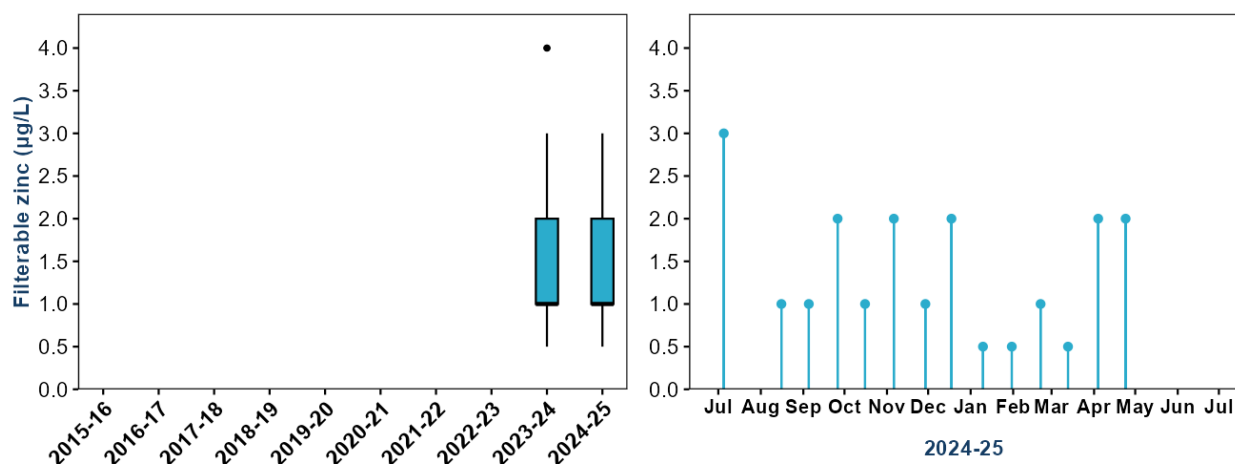
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



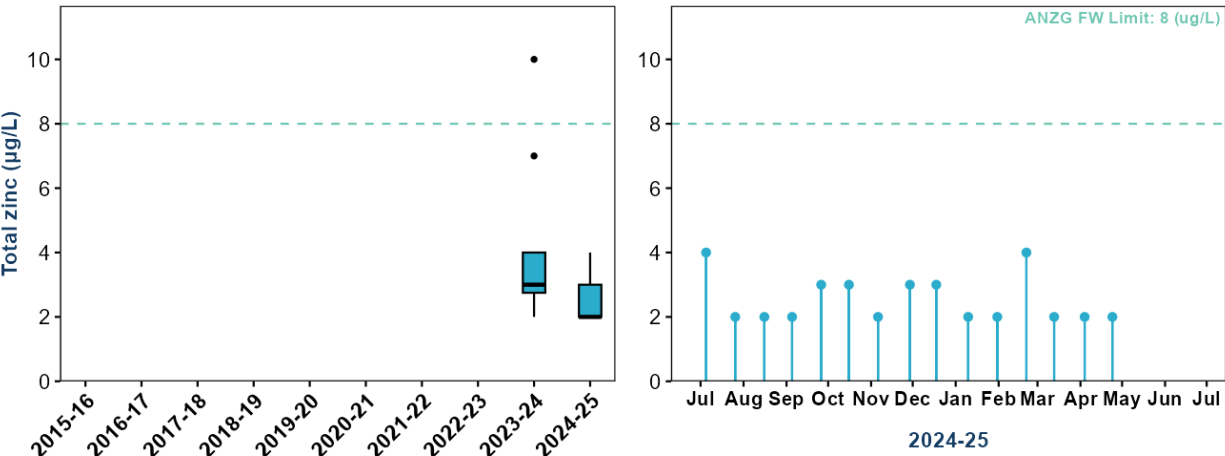
Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



Hawkesbury River off Cattai State Recreation Area as SoE Site

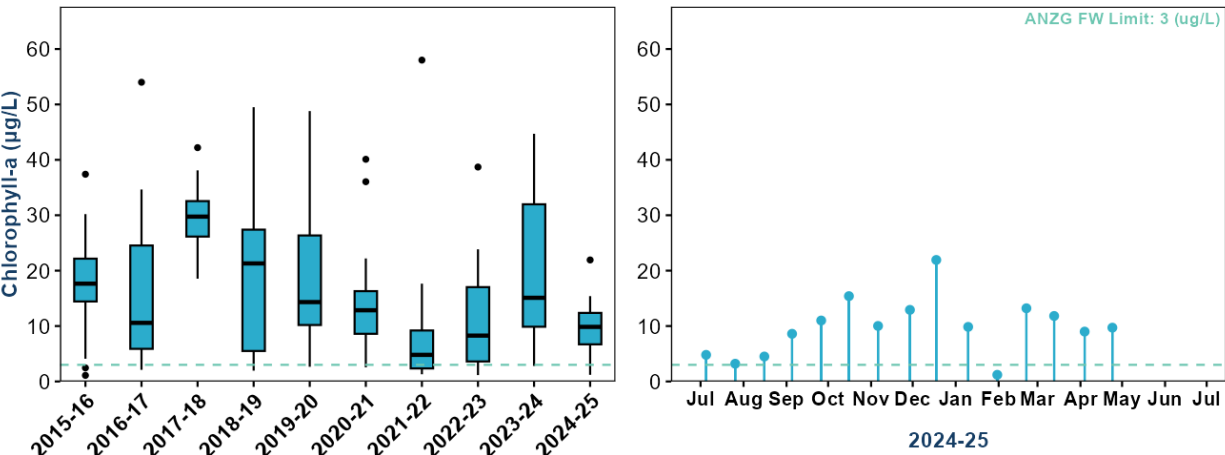
N3001



Ecosystem receptor – Phytoplankton

Hawkesbury River off Cattai State Recreation Area as SoE Site

N3001



C.1.6. Hawkesbury River at Sackville Ferry (N26)

Stressors - Statistical analysis outcomes

Table C-6 Current period (2024-25) vs previous period comparison for N26

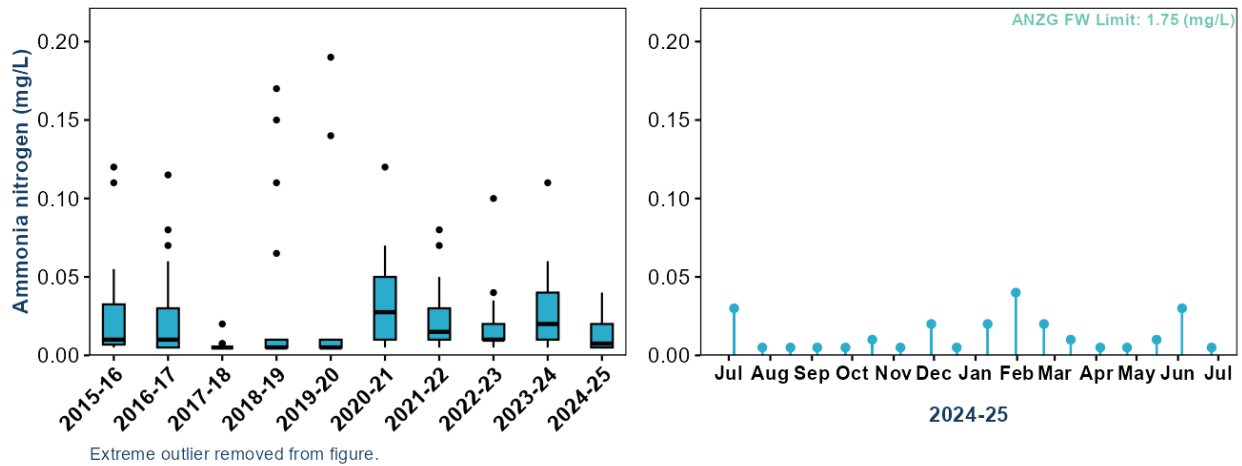
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.69	0.17	159	-1.48	0.141
Oxidised nitrogen	2.11	0.72	159	2.19	0.030
Total nitrogen	1.00	0.08	159	-0.01	0.989
Soluble reactive phosphorus	0.74	0.20	33	-1.12	0.270
Total phosphorus	0.65	0.07	159	-3.81	<0.001
Physico-chemical					
Conductivity	1.11	0.08	158	1.42	0.156
Dissolved oxygen	1.03	0.06	159	0.60	0.551
Dissolved oxygen saturation	1.61	3.42	159	0.47	0.638
pH	-0.12	0.11	159	-1.08	0.281
Water temperature	1.05	0.07	157	0.67	0.504
Turbidity	0.86	0.14	158	-0.95	0.346
Trace metals					
Filterable aluminium	0.86	0.19	33	-0.71	0.480
Total aluminium	0.65	0.18	33	-1.55	0.131
Filterable cobalt	0.82	0.20	33	-0.81	0.425
Total cobalt	0.64	0.13	33	-2.16	0.038
Filterable copper	0.94	0.07	33	-0.92	0.362
Total copper	0.74	0.09	33	-2.46	0.019
Filterable nickel	1.01	0.07	33	0.16	0.874
Total nickel	0.89	0.08	33	-1.35	0.186
Filterable zinc	1.13	0.26	32	0.53	0.603
Total zinc	0.83	0.18	33	-0.83	0.411
Chlorophyll-a					
Chlorophyll-a	0.77	0.15	159	-1.31	0.191

	not significant ($p > 0.05$)	$p < 0.05$ and ≥ 0.01	$p < 0.01$ and ≥ 0.001	$p < 0.001$
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Stressors – Nutrients

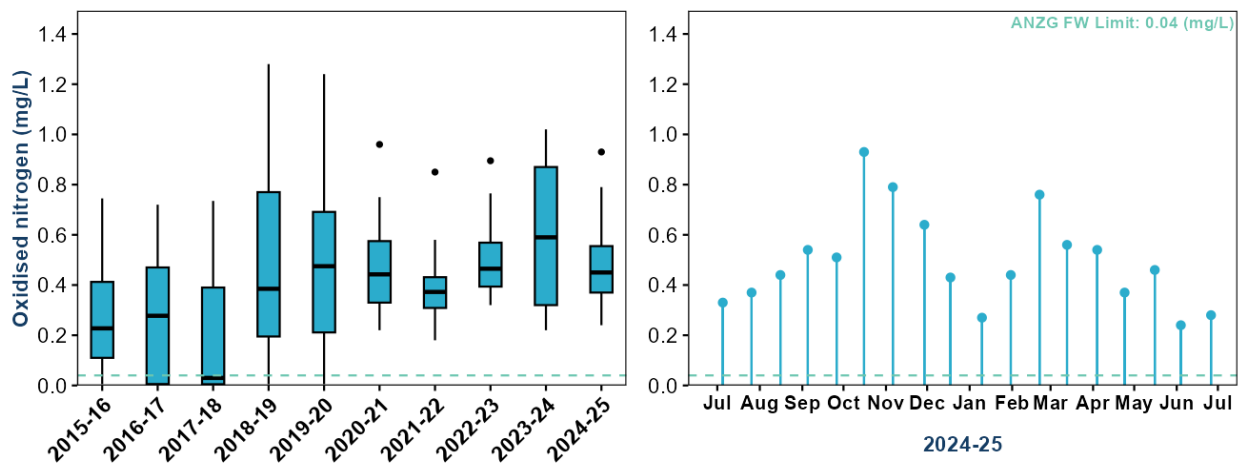
Hawkesbury River at Sackville Ferry as SoE Site

N26



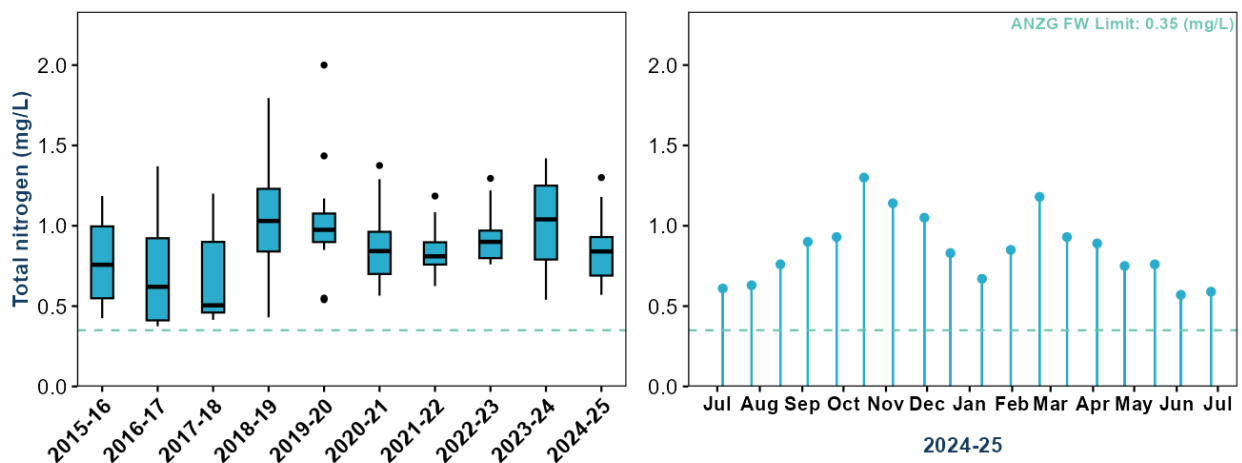
Hawkesbury River at Sackville Ferry as SoE Site

N26



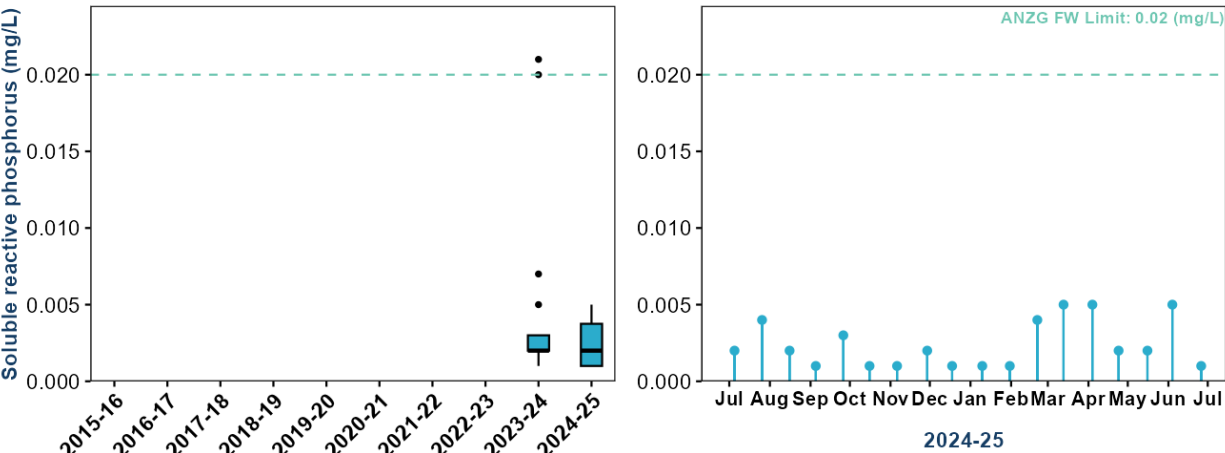
Hawkesbury River at Sackville Ferry as SoE Site

N26



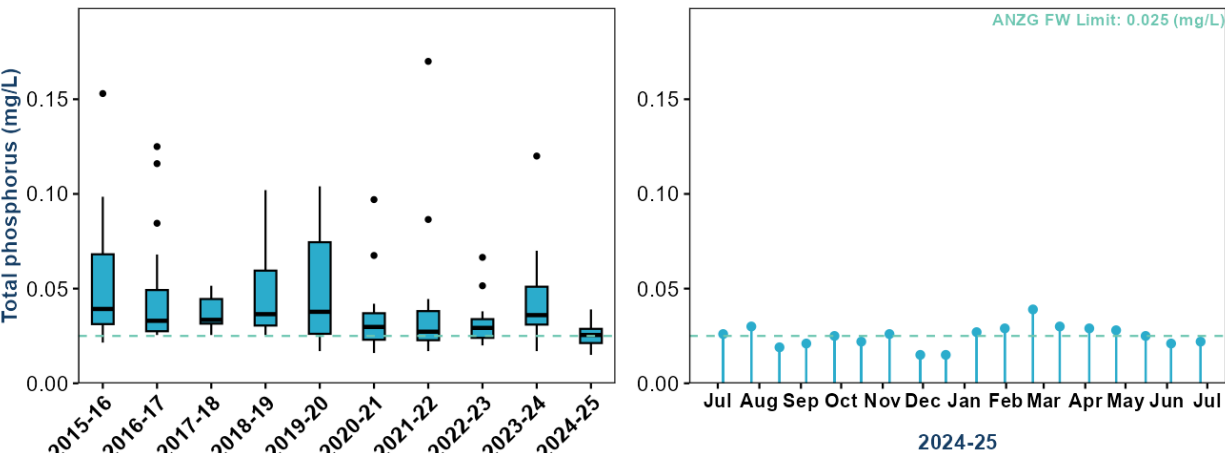
Hawkesbury River at Sackville Ferry as SoE Site

N26



Hawkesbury River at Sackville Ferry as SoE Site

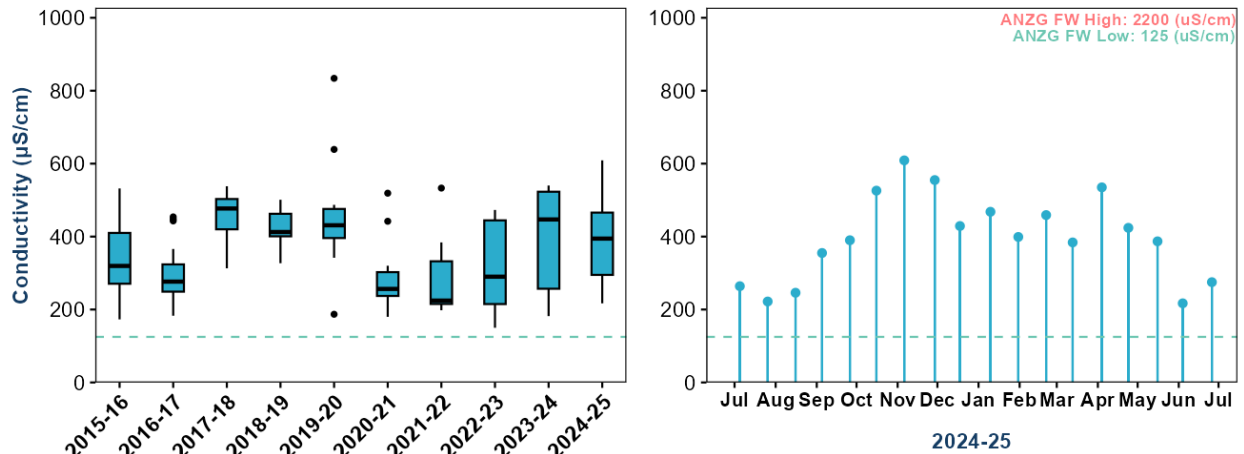
N26



Stressors - Physico-chemical water quality

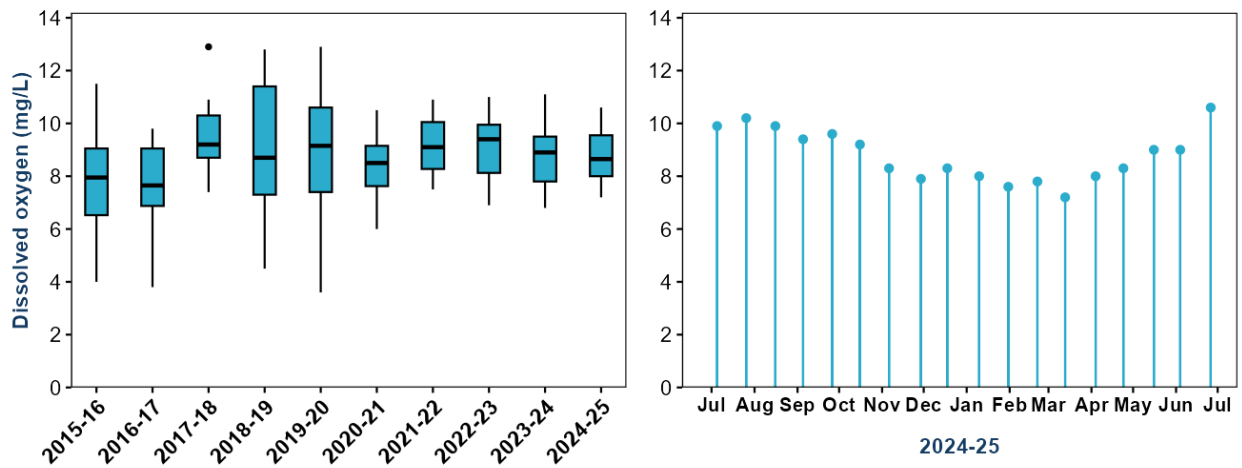
Hawkesbury River at Sackville Ferry as SoE Site

N26



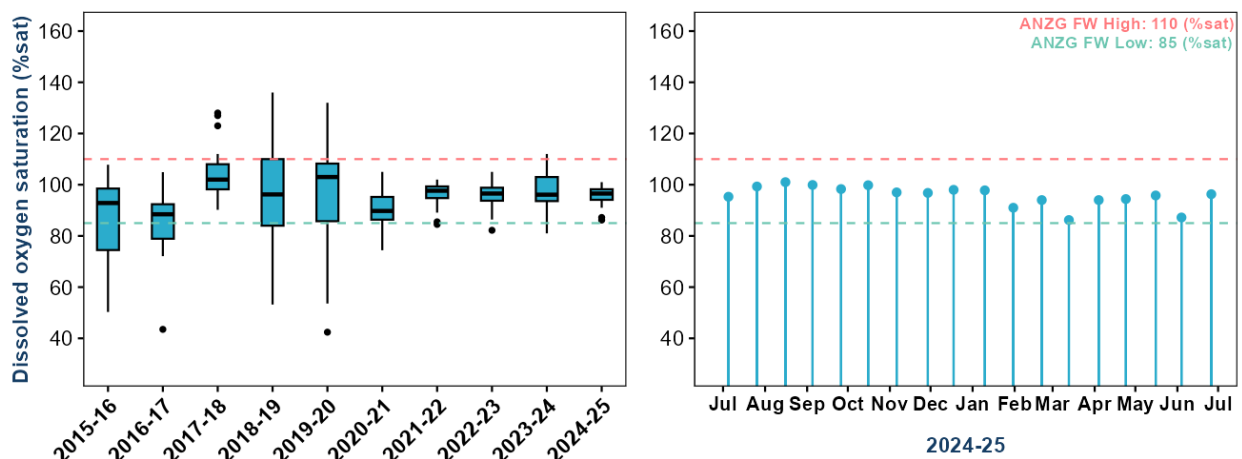
Hawkesbury River at Sackville Ferry as SoE Site

N26



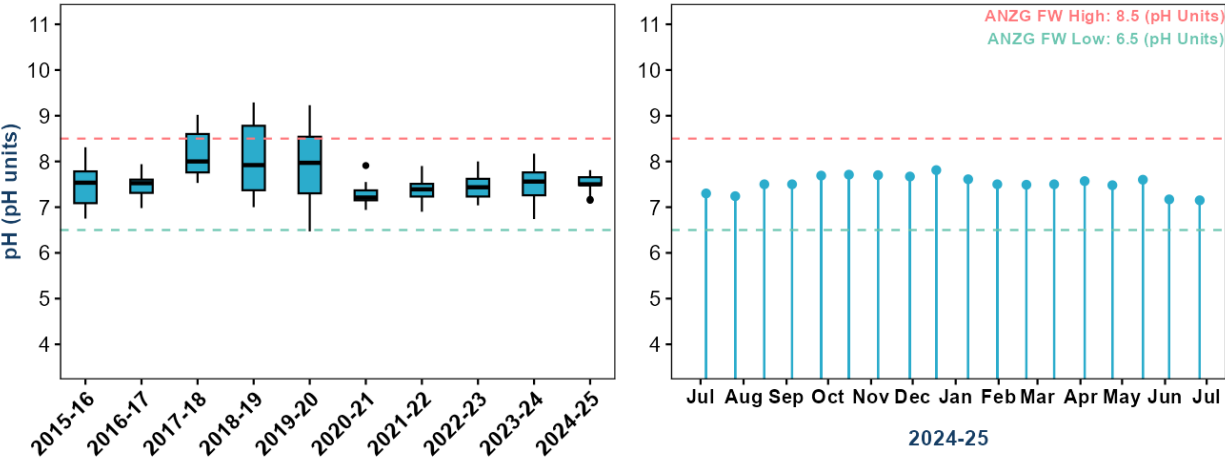
Hawkesbury River at Sackville Ferry as SoE Site

N26



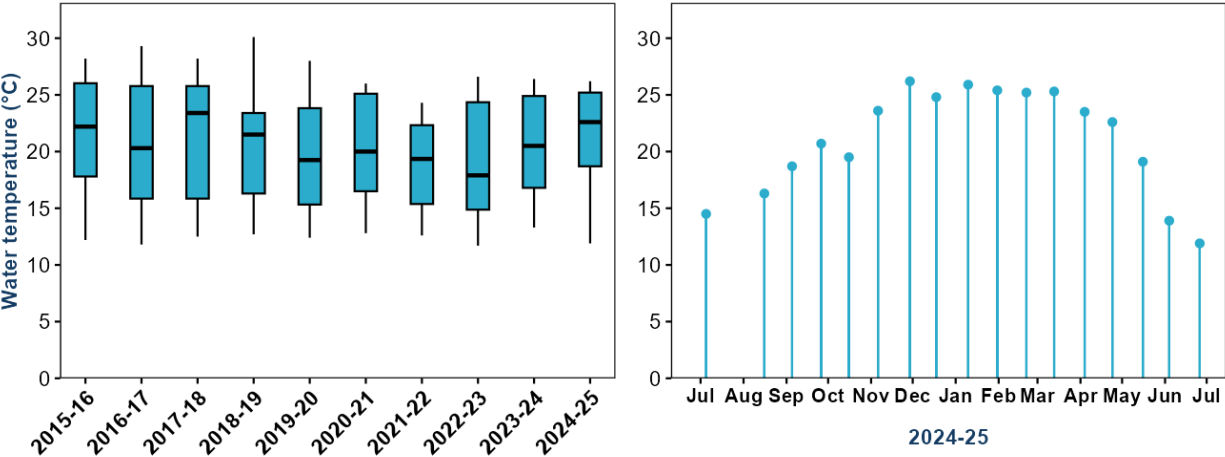
Hawkesbury River at Sackville Ferry as SoE Site

N26



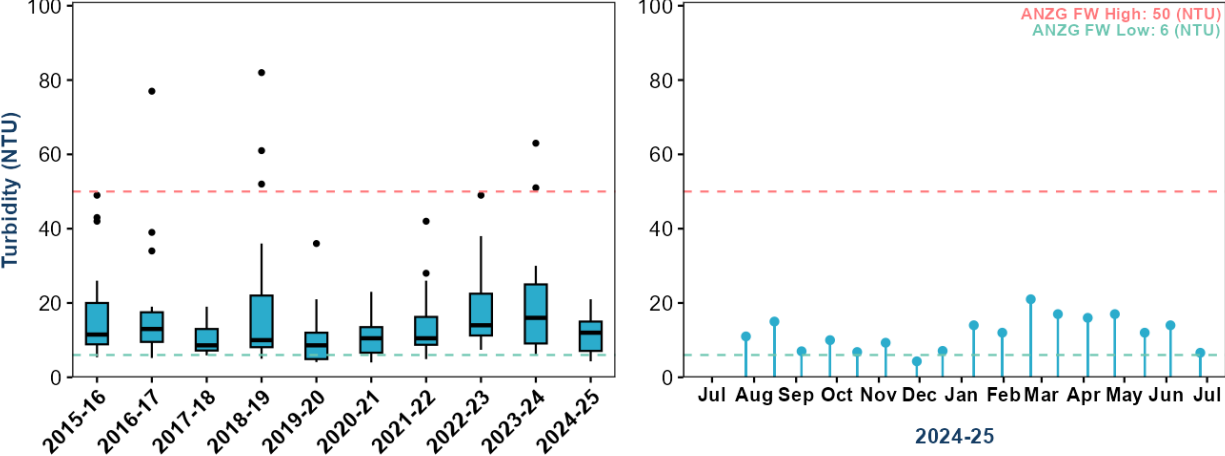
Hawkesbury River at Sackville Ferry as SoE Site

N26



Hawkesbury River at Sackville Ferry as SoE Site

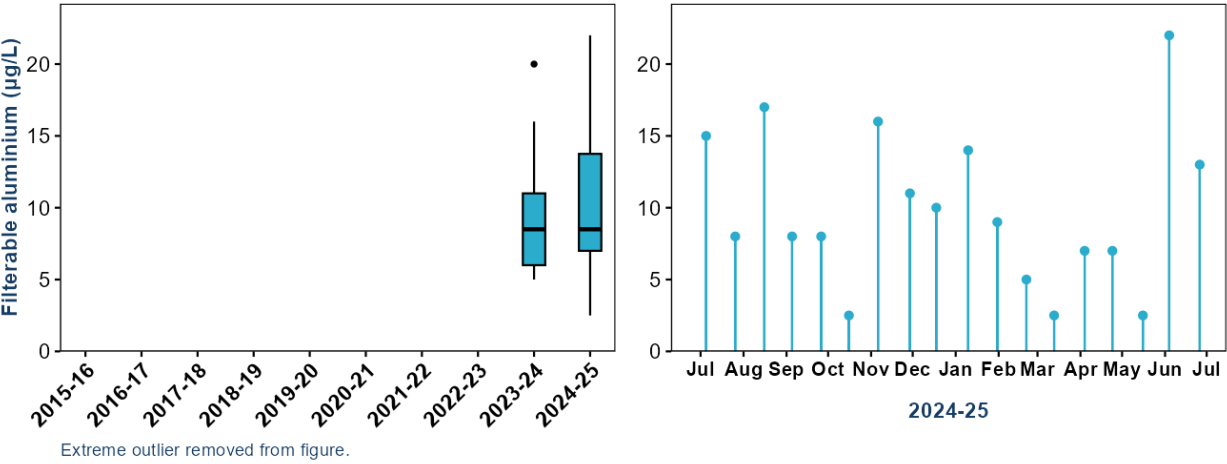
N26



Stressors - Trace metals

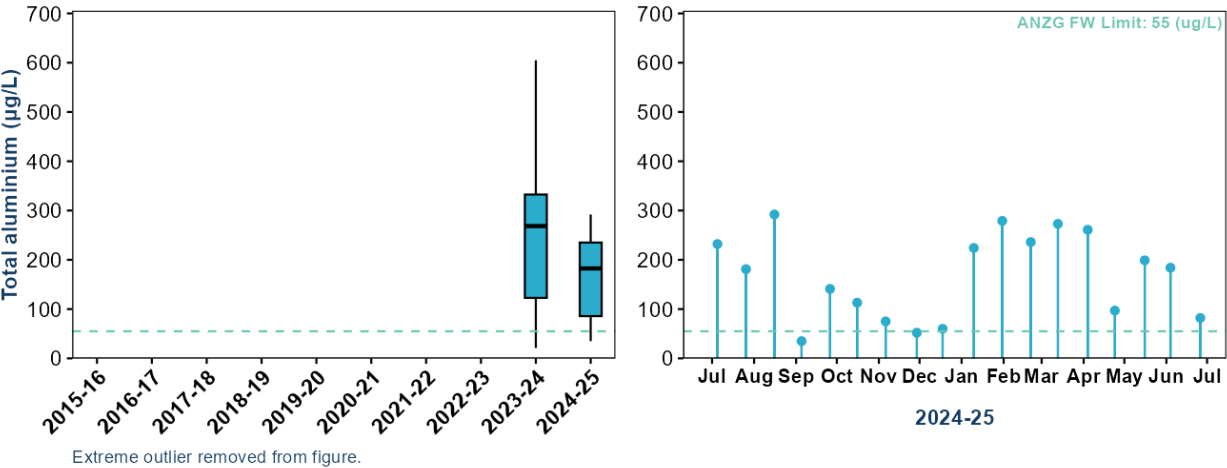
Hawkesbury River at Sackville Ferry as SoE Site

N26



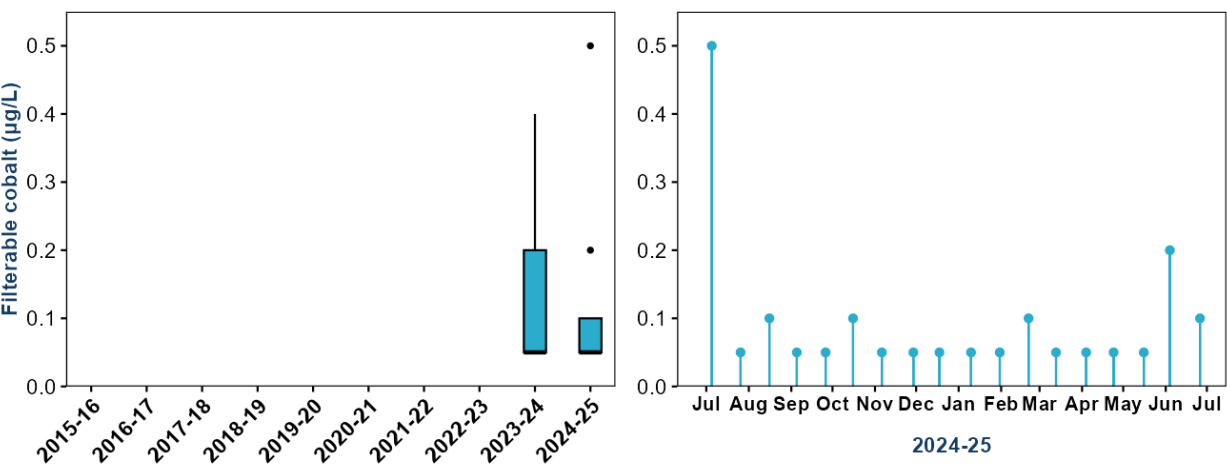
Hawkesbury River at Sackville Ferry as SoE Site

N26



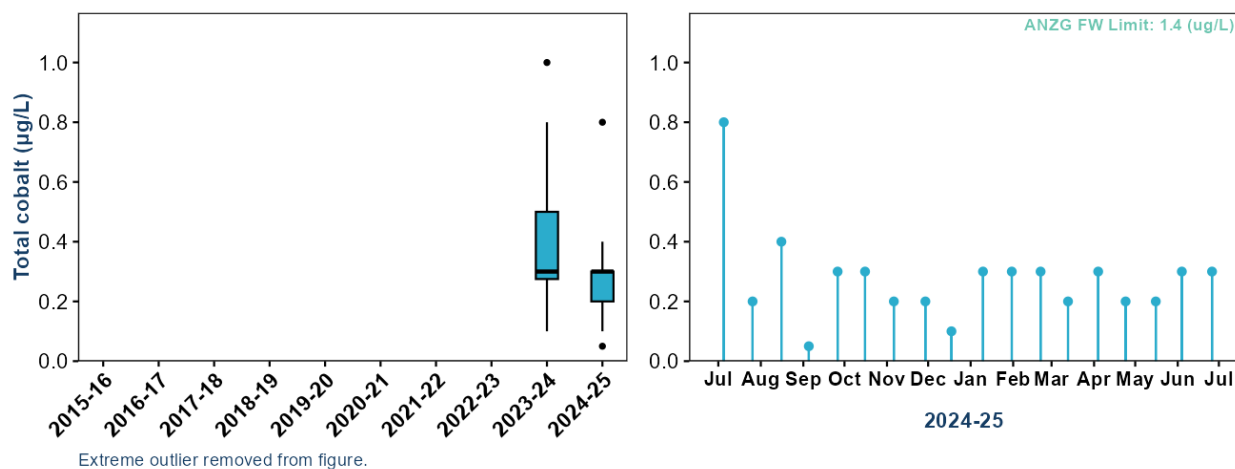
Hawkesbury River at Sackville Ferry as SoE Site

N26



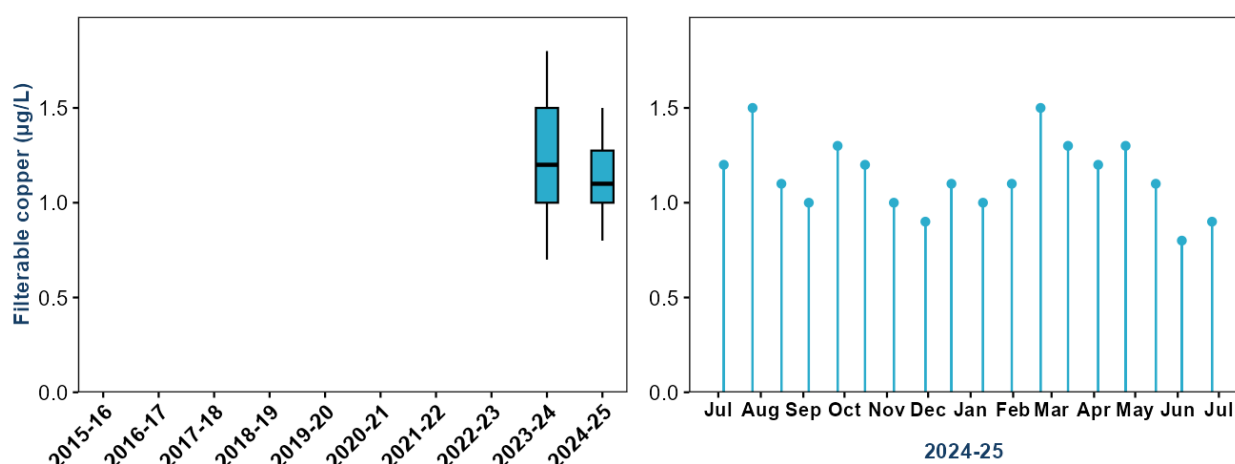
Hawkesbury River at Sackville Ferry as SoE Site

N26



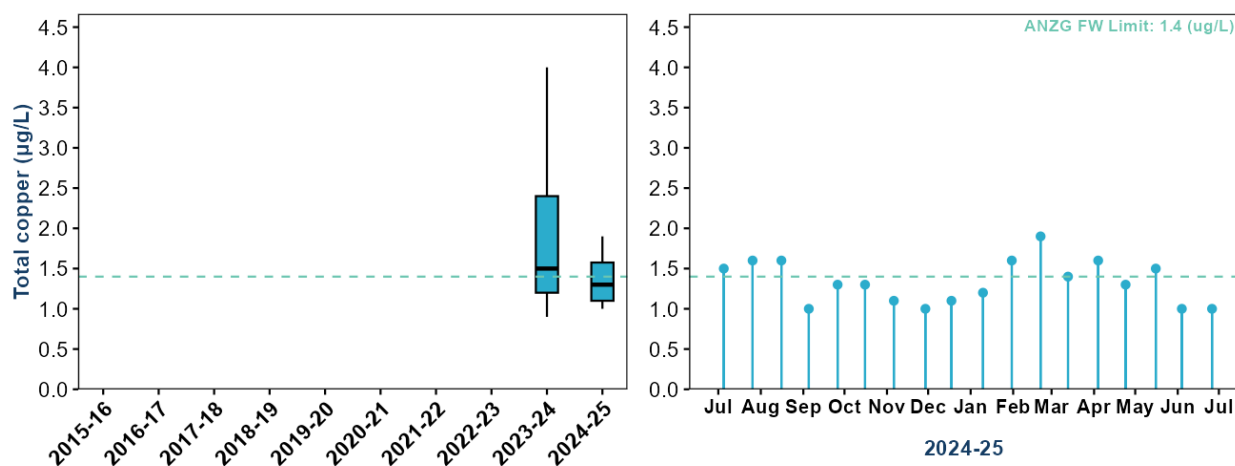
Hawkesbury River at Sackville Ferry as SoE Site

N26



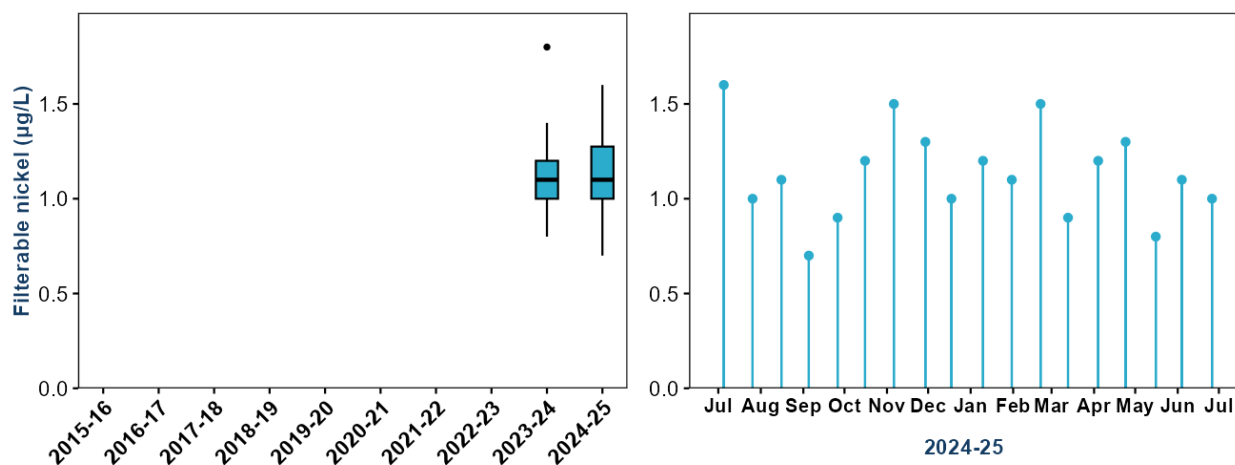
Hawkesbury River at Sackville Ferry as SoE Site

N26



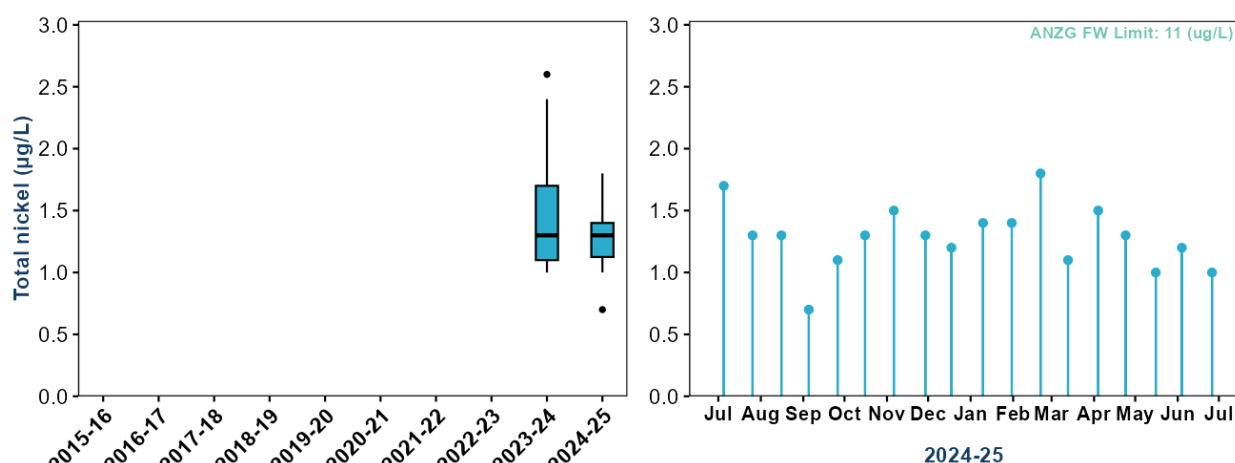
Hawkesbury River at Sackville Ferry as SoE Site

N26



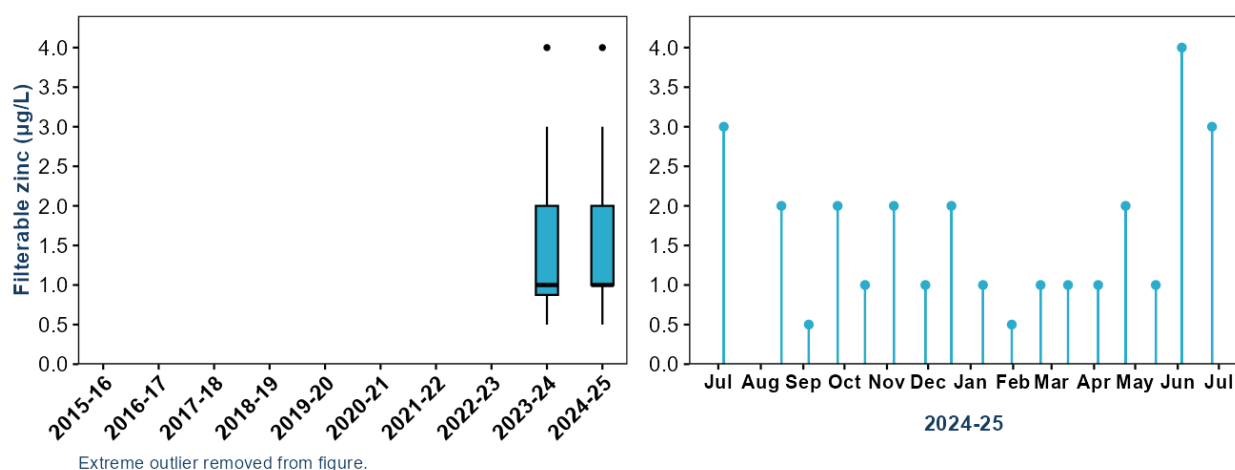
Hawkesbury River at Sackville Ferry as SoE Site

N26



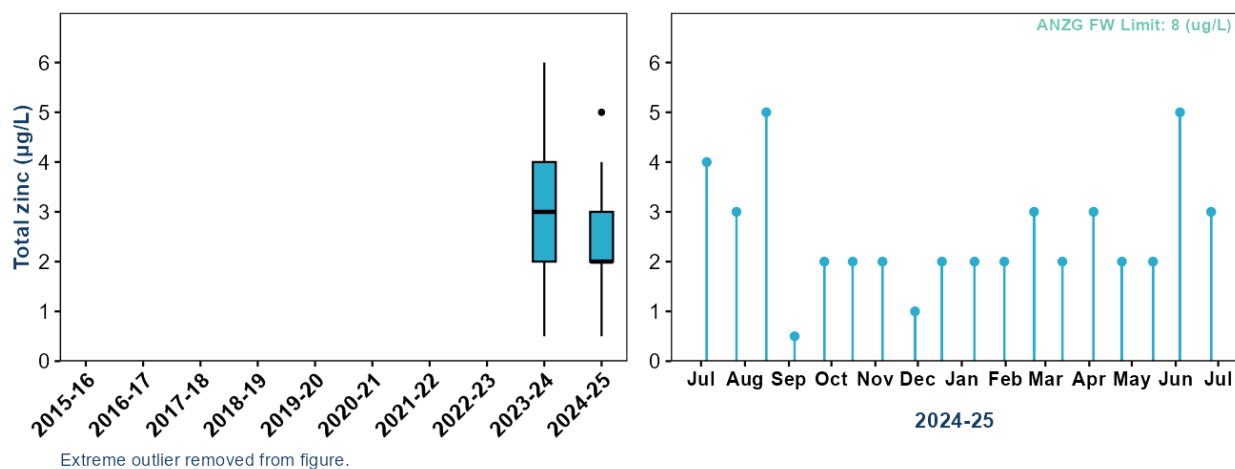
Hawkesbury River at Sackville Ferry as SoE Site

N26



Hawkesbury River at Sackville Ferry as SoE Site

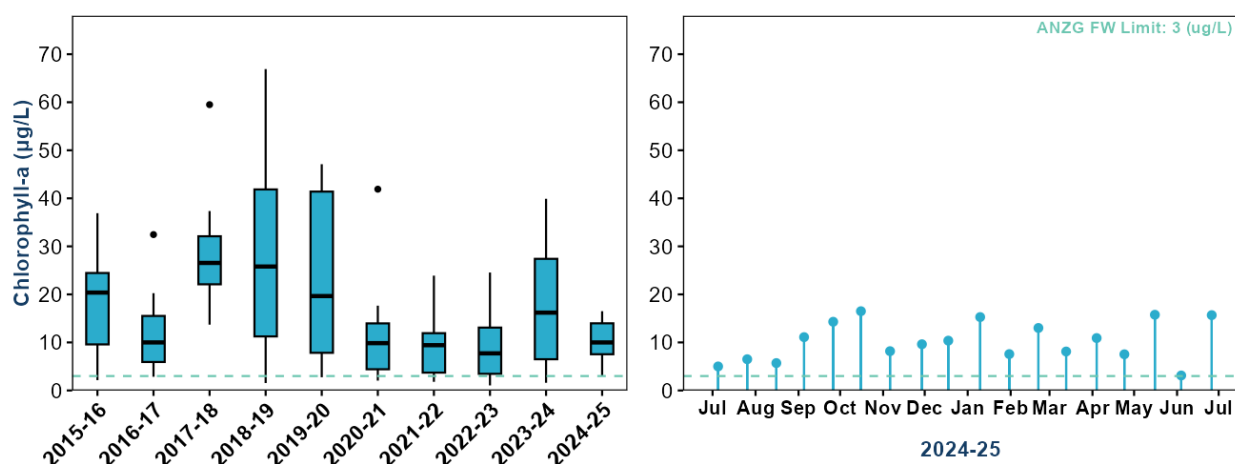
N26



Ecosystem receptor - Phytoplankton

Hawkesbury River at Sackville Ferry as SoE Site

N26



C.1.7. Lower Colo River at Putty Road (N2202)

Stressors - Statistical analysis outcomes

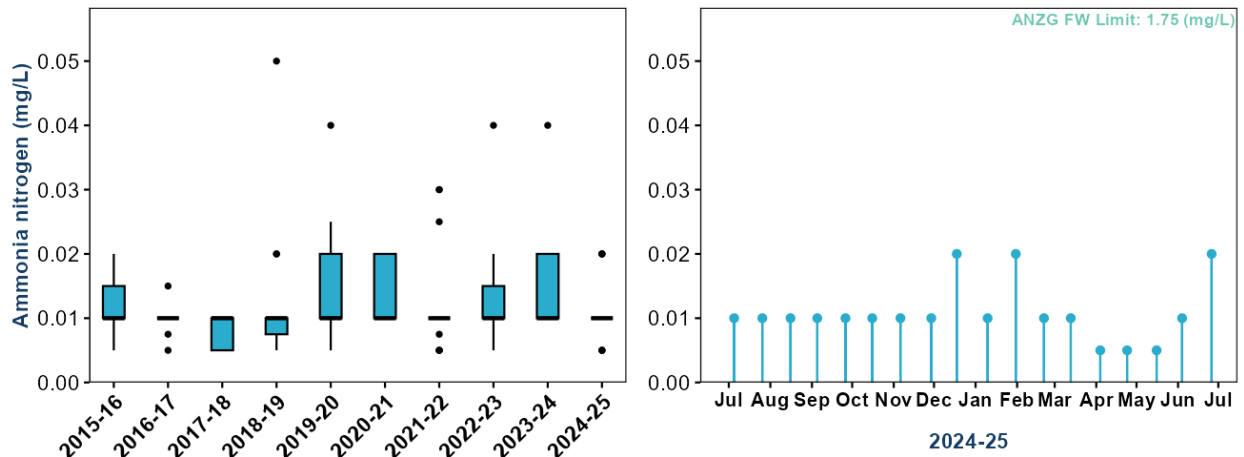
Table C-7 Current period (2024-25) vs previous period comparison for N2202

Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.90	0.10	162	-0.97	0.332
Oxidised nitrogen	1.06	0.22	162	0.29	0.775
Total nitrogen	0.77	0.09	162	-2.30	0.023
Soluble reactive phosphorus	0.95	0.11	33	-0.47	0.644
Total phosphorus	0.66	0.10	162	-2.72	0.007
Physico-chemical					
Conductivity	0.99	0.09	162	-0.16	0.876
Dissolved oxygen	1.01	0.04	162	0.33	0.741
Dissolved oxygen saturation	1.32	1.36	161	0.97	0.332
pH	-0.02	0.08	161	-0.27	0.790
Water temperature	1.06	0.09	160	0.72	0.474
Turbidity	0.78	0.18	161	-1.07	0.285
Trace metals					
Filterable aluminium	0.77	0.23	33	-0.85	0.400
Total aluminium	0.49	0.13	33	-2.59	0.014
Filterable cobalt	0.56	0.12	33	-2.71	0.011
Total cobalt	0.60	0.13	33	-2.38	0.023
Filterable copper	0.78	0.07	33	-2.62	0.013
Total copper	0.78	0.10	33	-1.82	0.077
Filterable nickel	0.66	0.11	33	-2.51	0.017
Total nickel	0.61	0.11	33	-2.88	0.007
Filterable zinc	0.79	0.17	31	-1.11	0.276
Total zinc	0.82	0.19	33	-0.87	0.392
Chlorophyll-a					
Chlorophyll-a	0.66	0.15	162	-1.77	0.079
not significant ($p > 0.05$) $p < 0.05$ and ≥ 0.01 $p < 0.01$ and ≥ 0.001 $p < 0.001$					

Stressors – Nutrients

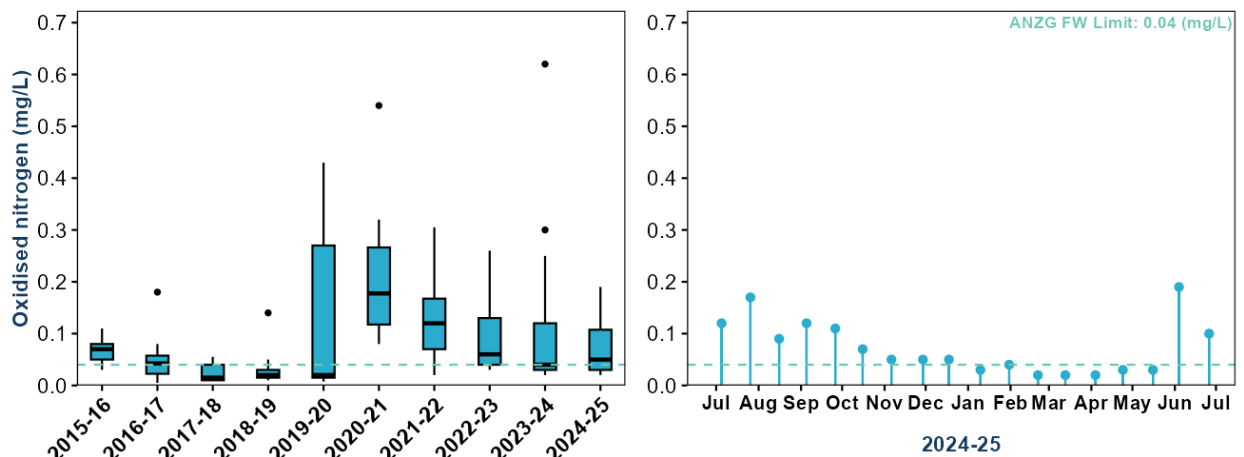
Lower Colo River at Putty Road Bridge as SoE Site

N2202



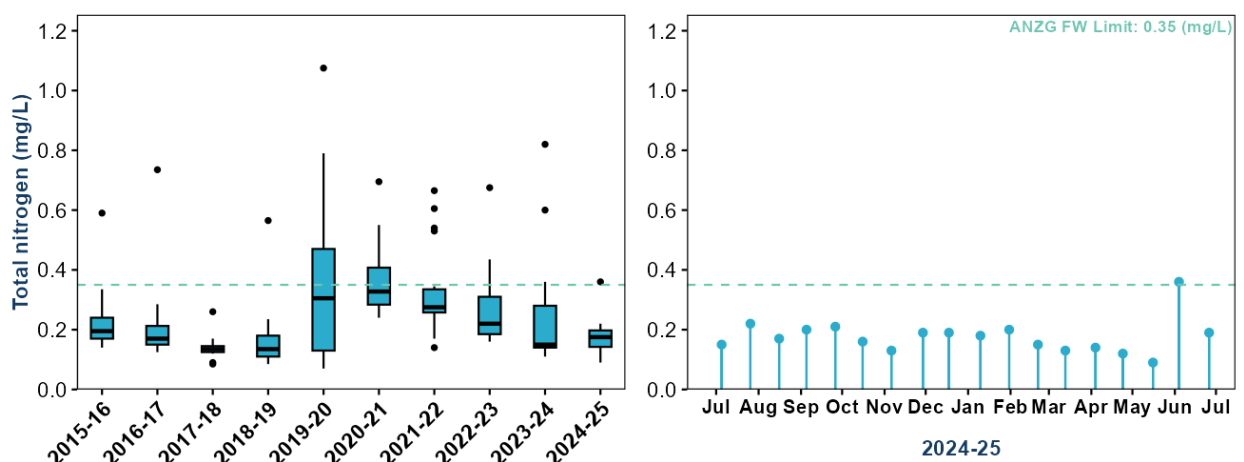
Lower Colo River at Putty Road Bridge as SoE Site

N2202

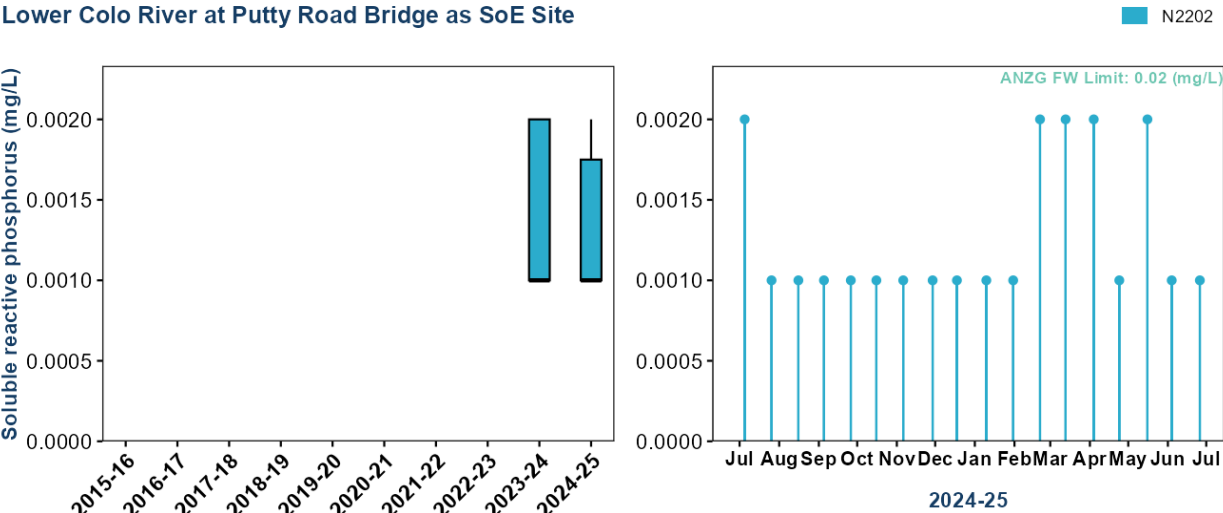


Lower Colo River at Putty Road Bridge as SoE Site

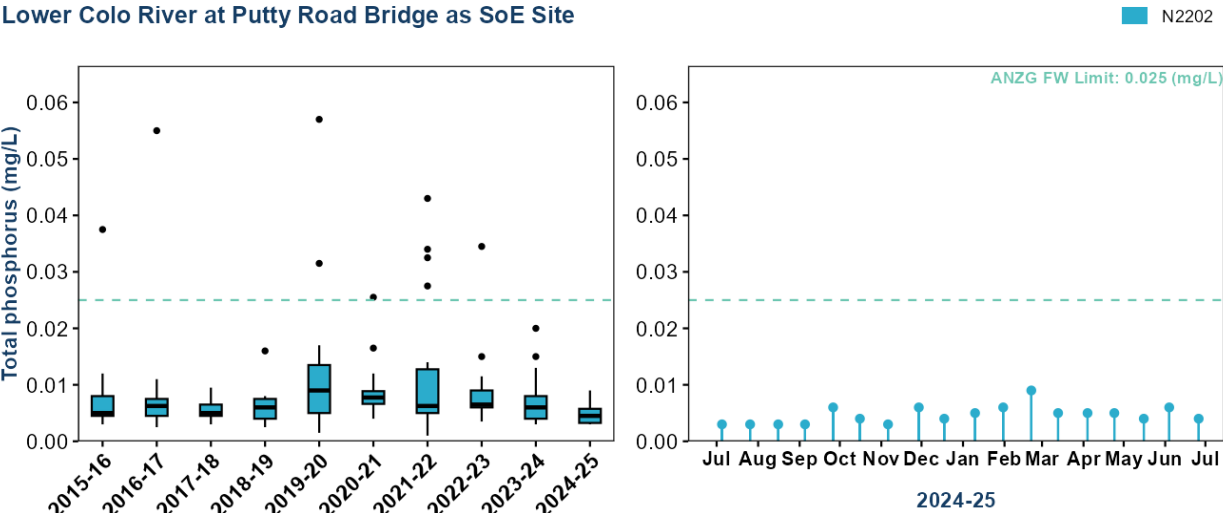
N2202



Lower Colo River at Putty Road Bridge as SoE Site



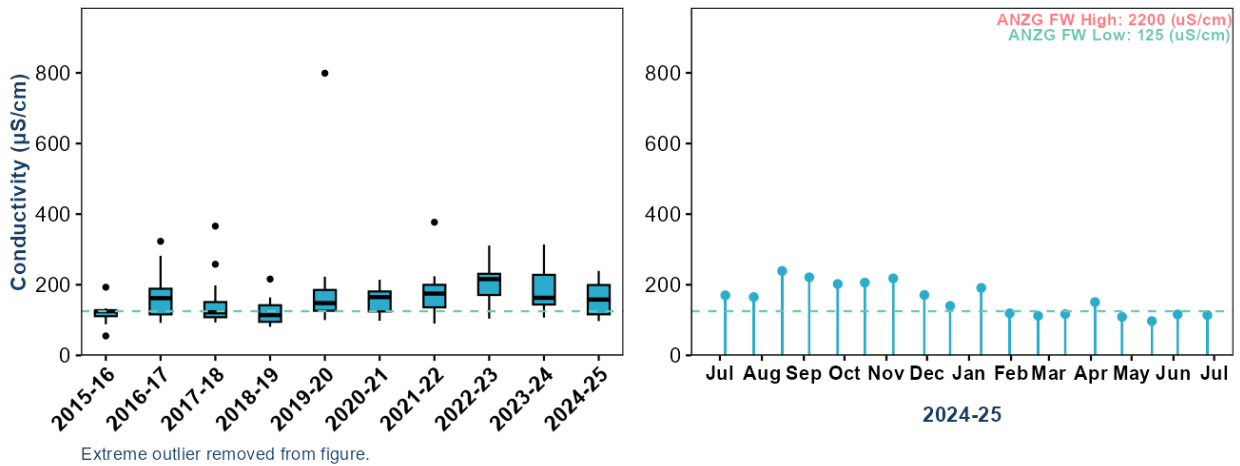
Lower Colo River at Putty Road Bridge as SoE Site



Stressors – Physico-chemical water quality

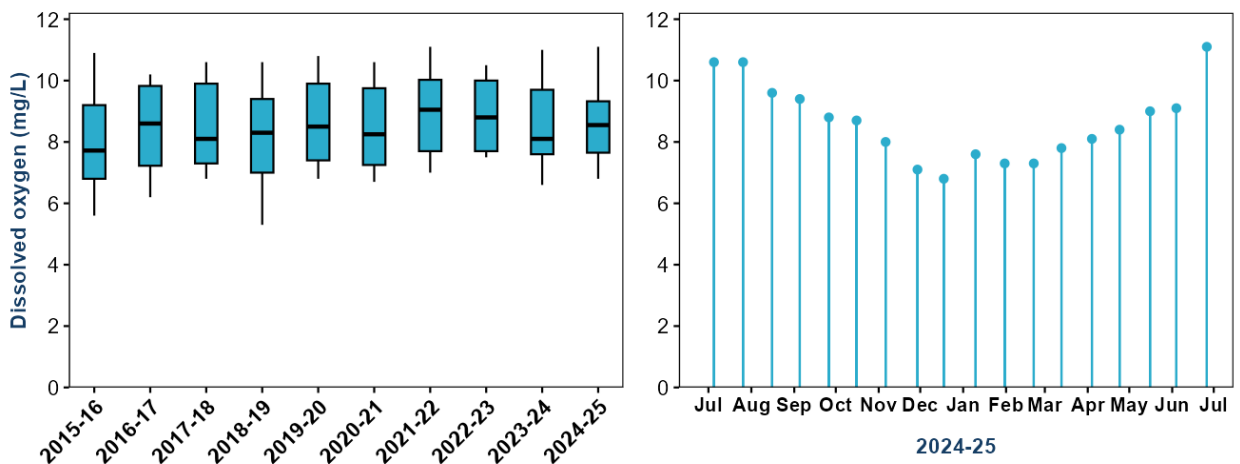
Lower Colo River at Putty Road Bridge as SoE Site

N2202



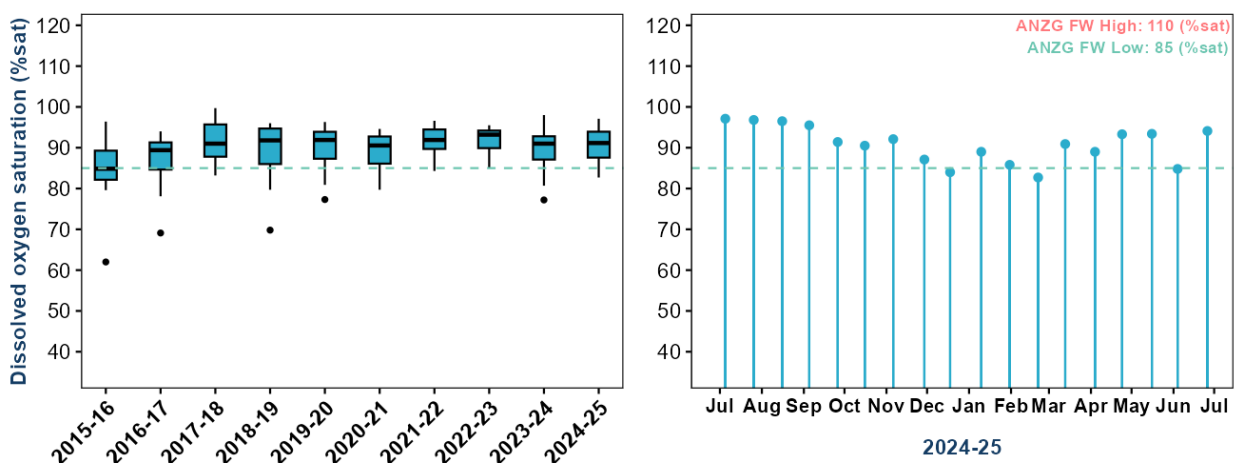
Lower Colo River at Putty Road Bridge as SoE Site

N2202



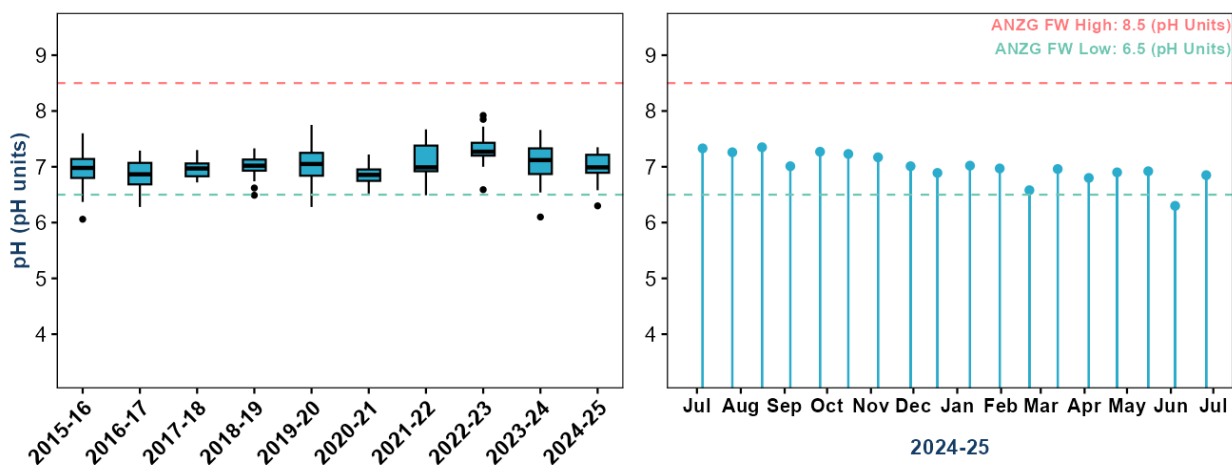
Lower Colo River at Putty Road Bridge as SoE Site

N2202



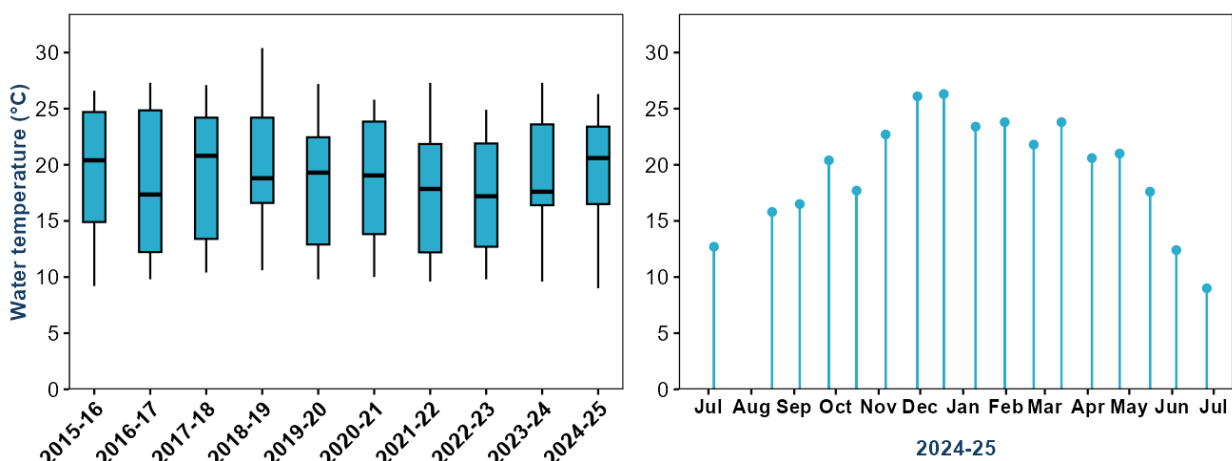
Lower Colo River at Putty Road Bridge as SoE Site

N2202



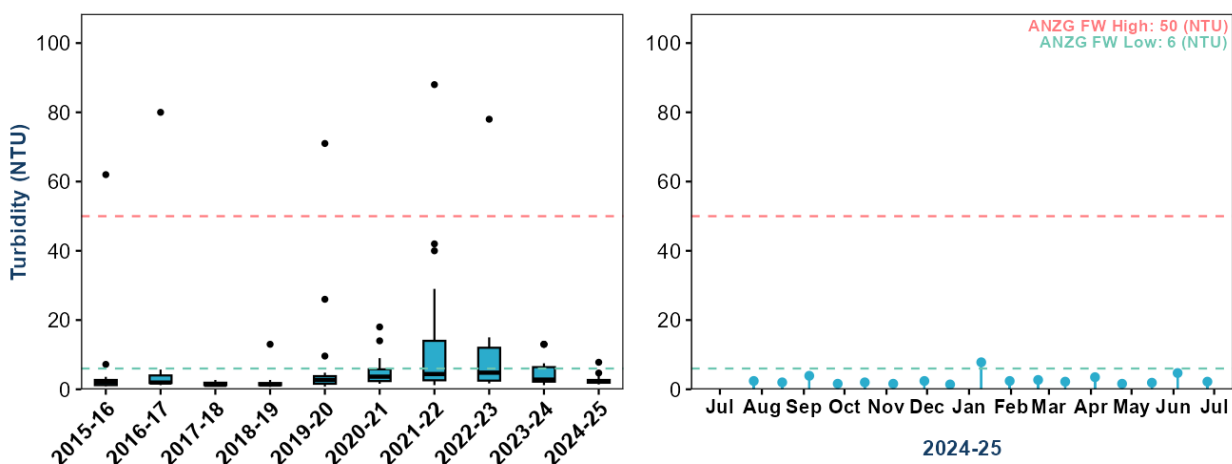
Lower Colo River at Putty Road Bridge as SoE Site

N2202



Lower Colo River at Putty Road Bridge as SoE Site

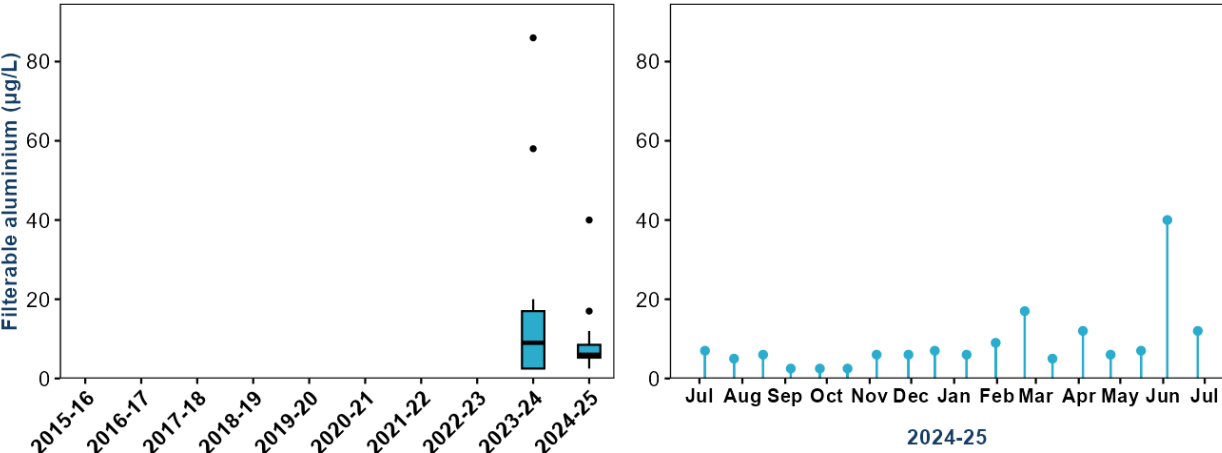
N2202



Stressors – Trace metals

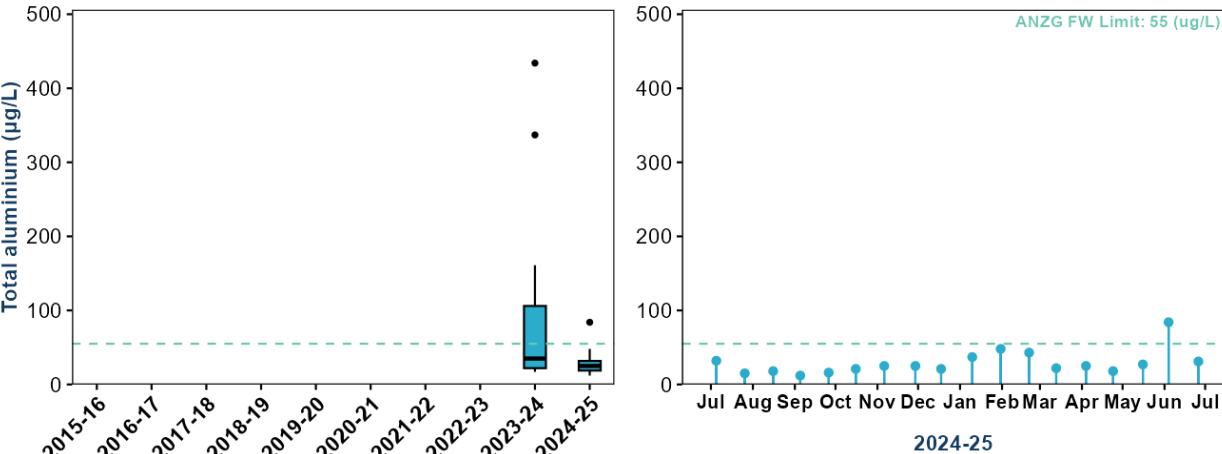
Lower Colo River at Putty Road Bridge as SoE Site

N2202



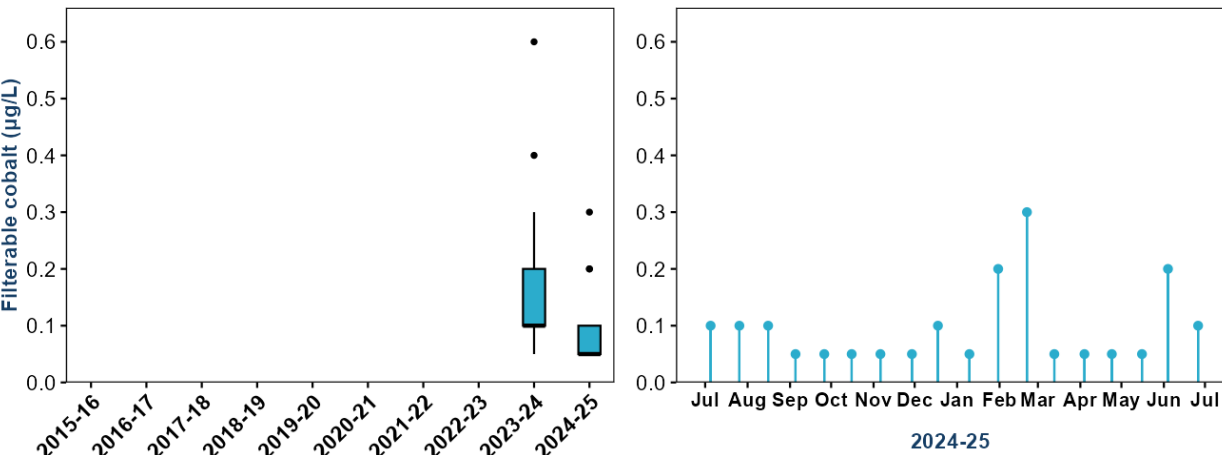
Lower Colo River at Putty Road Bridge as SoE Site

N2202



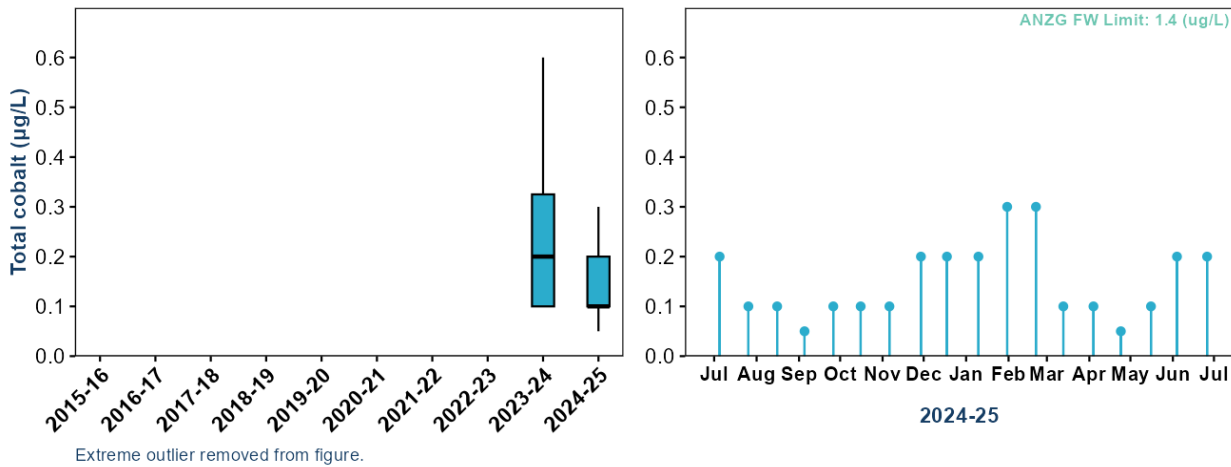
Lower Colo River at Putty Road Bridge as SoE Site

N2202



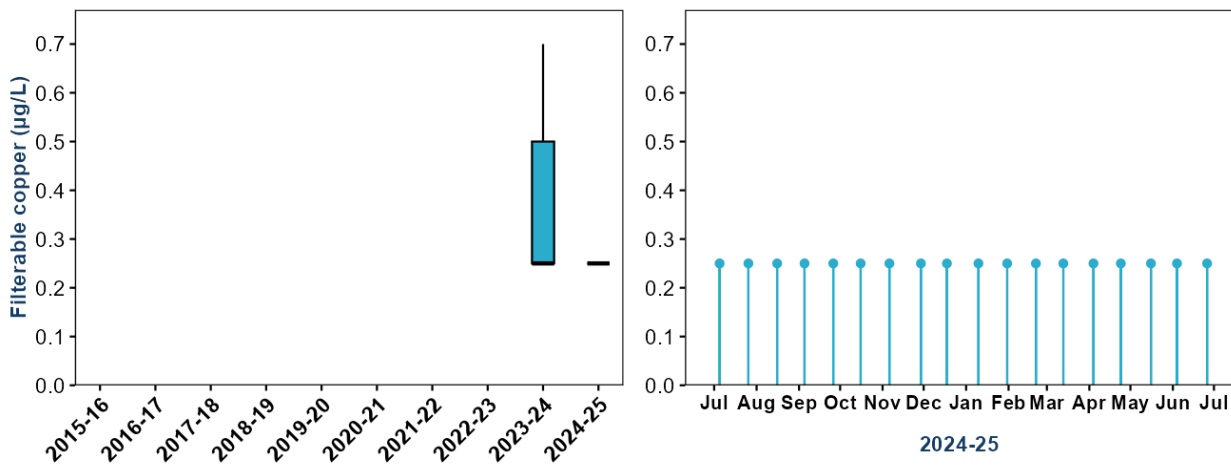
Lower Colo River at Putty Road Bridge as SoE Site

N2202



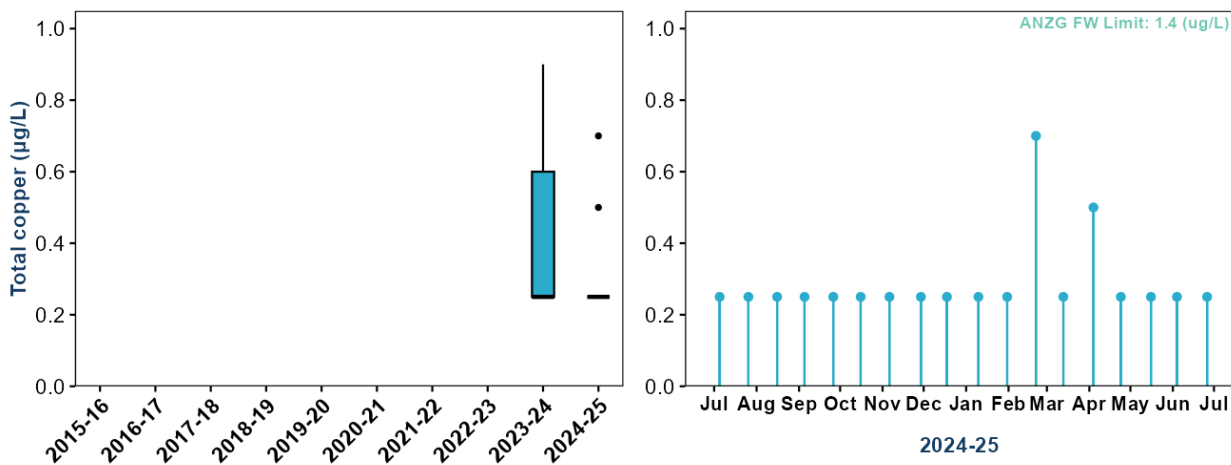
Lower Colo River at Putty Road Bridge as SoE Site

N2202



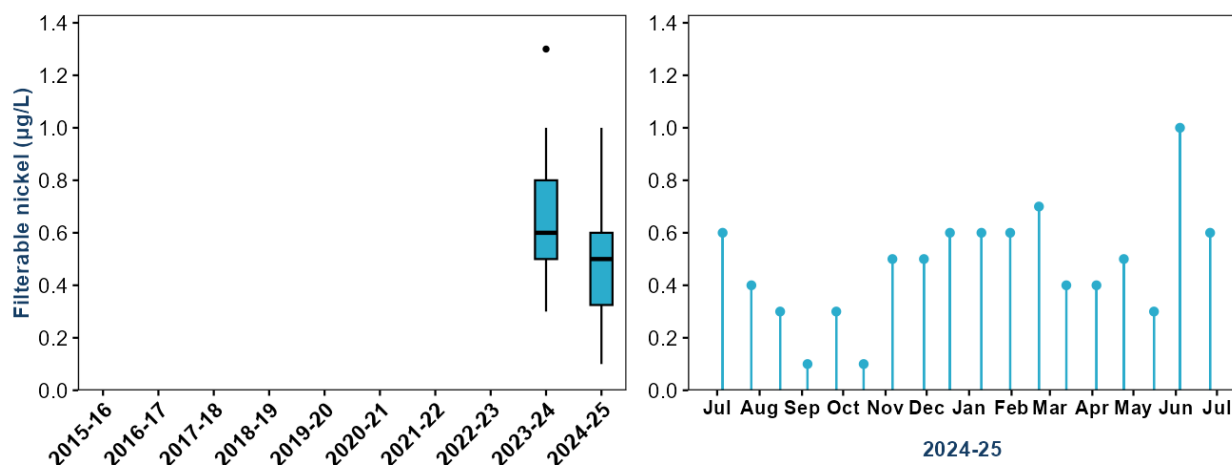
Lower Colo River at Putty Road Bridge as SoE Site

N2202



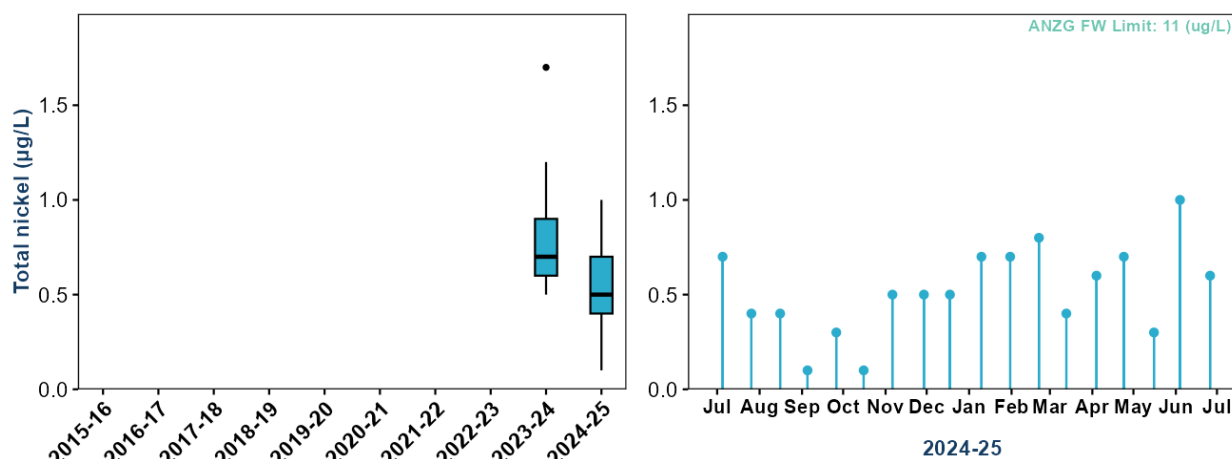
Lower Colo River at Putty Road Bridge as SoE Site

N2202



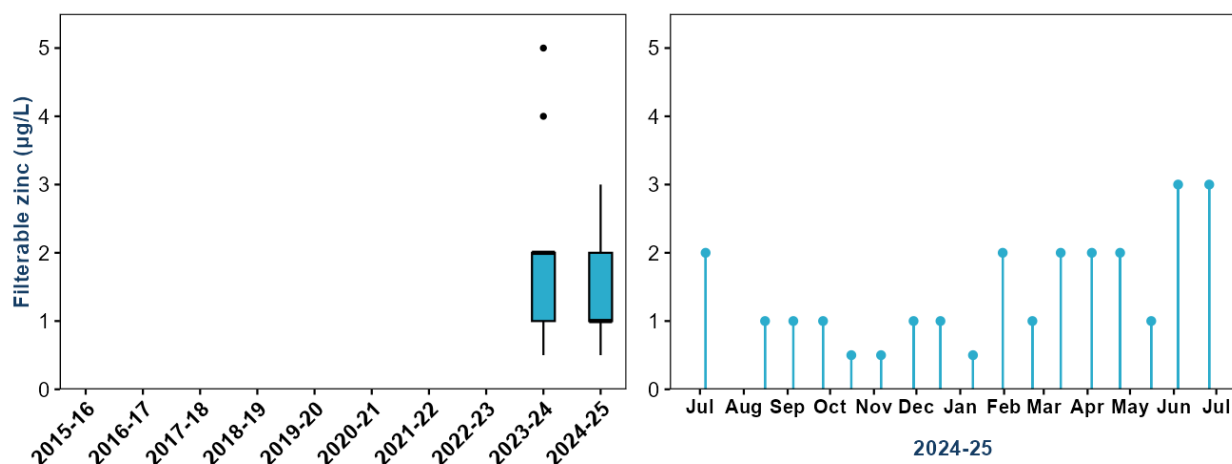
Lower Colo River at Putty Road Bridge as SoE Site

N2202



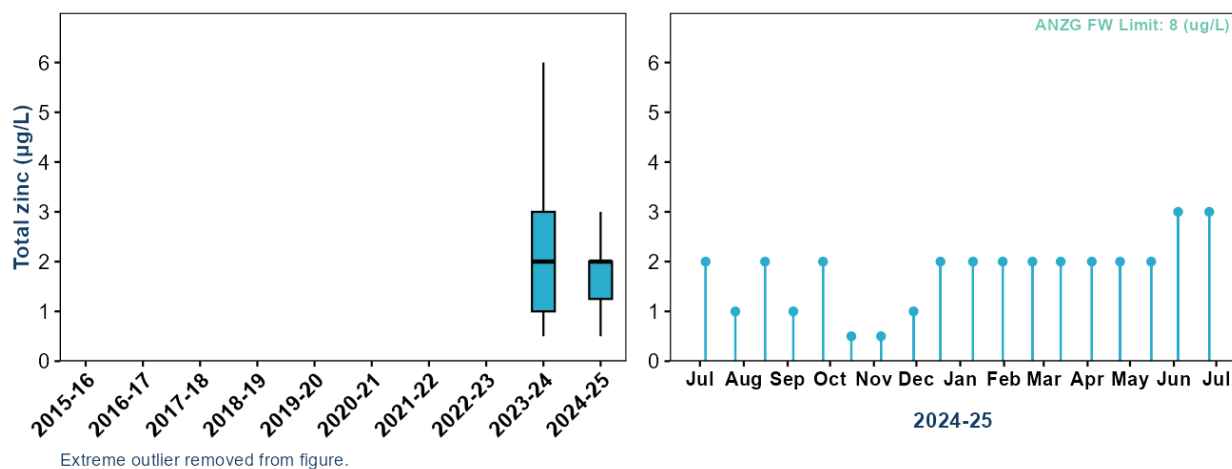
Lower Colo River at Putty Road Bridge as SoE Site

N2202



Lower Colo River at Putty Road Bridge as SoE Site

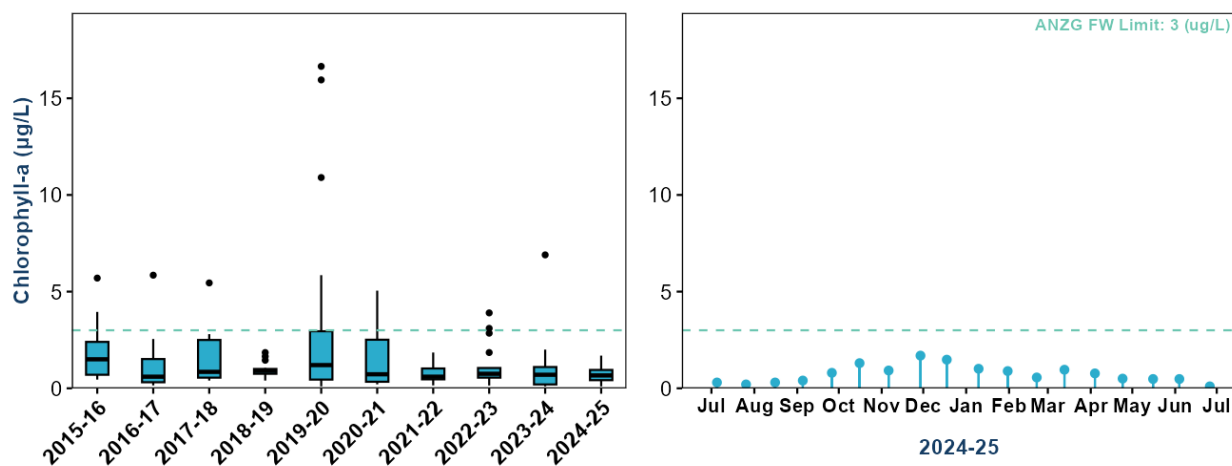
N2202



Ecosystem receptor – Phytoplankton

Lower Colo River at Putty Road Bridge as SoE Site

N2202



C.1.8. Hawkesbury River at Leets Vale (N18)

Stressors - Statistical analysis outcomes

Table C-8 Current period (2024-25) vs previous period comparison for N18

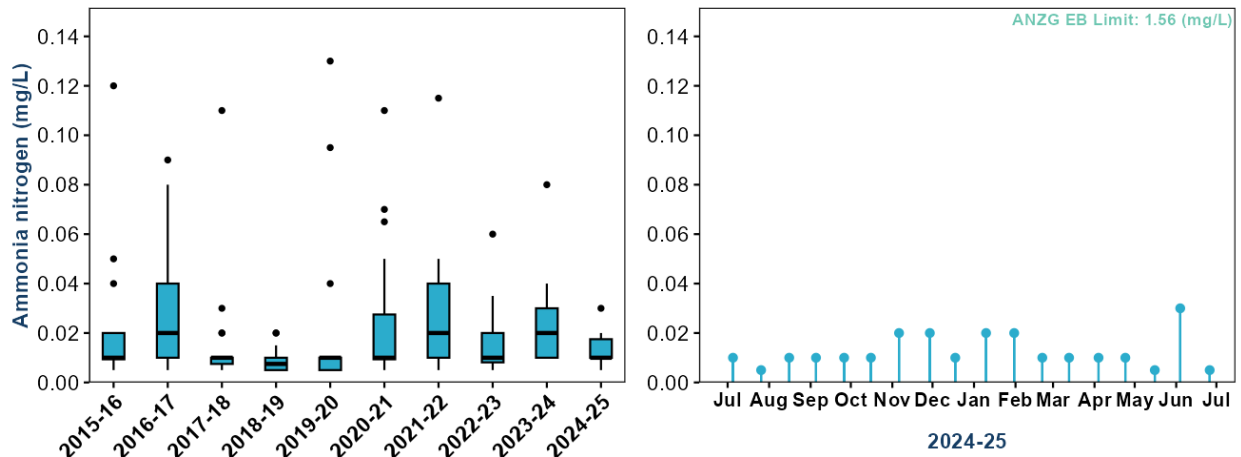
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.80	0.16	160	-1.11	0.267
Oxidised nitrogen	1.18	0.31	160	0.62	0.537
Total nitrogen	0.86	0.07	160	-1.81	0.072
Soluble reactive phosphorus	0.91	0.24	33	-0.37	0.713
Total phosphorus	0.58	0.07	160	-4.39	<0.001
Physico-chemical					
Conductivity	1.06	0.30	159	0.20	0.841
Dissolved oxygen	1.06	0.05	160	1.27	0.205
Dissolved oxygen saturation	4.47	2.60	160	1.72	0.087
pH	0.03	0.09	160	0.34	0.738
Water temperature	1.05	0.07	158	0.77	0.444
Turbidity	0.65	0.11	158	-2.57	0.011
Trace metals					
Filterable aluminium	0.91	0.25	33	-0.36	0.720
Total aluminium	0.80	0.25	33	-0.71	0.484
Filterable cobalt	1.08	0.12	33	0.68	0.503
Total cobalt	0.76	0.19	33	-1.10	0.280
Filterable copper	0.87	0.11	33	-1.07	0.290
Total copper	0.81	0.08	33	-2.15	0.039
Filterable nickel	0.85	0.09	33	-1.67	0.105
Total nickel	0.87	0.09	33	-1.35	0.186
Filterable zinc	0.87	0.20	31	-0.60	0.552
Total zinc	0.85	0.18	33	-0.75	0.462
Chlorophyll-a					
Chlorophyll-a	1.02	0.23	160	0.10	0.920

	not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Stressors – Nutrients

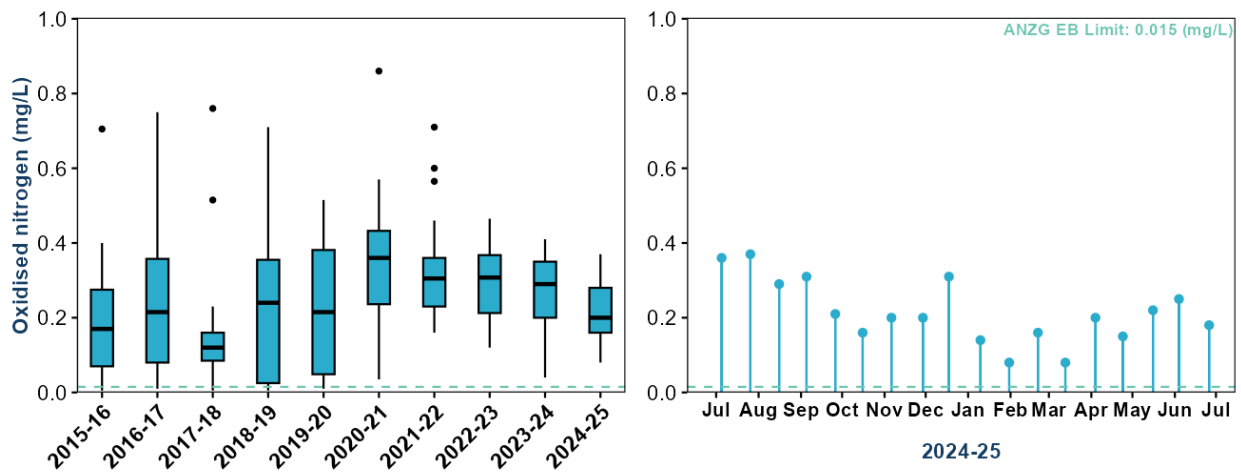
Hawkesbury River at Leets Vale as SoE Site

N18



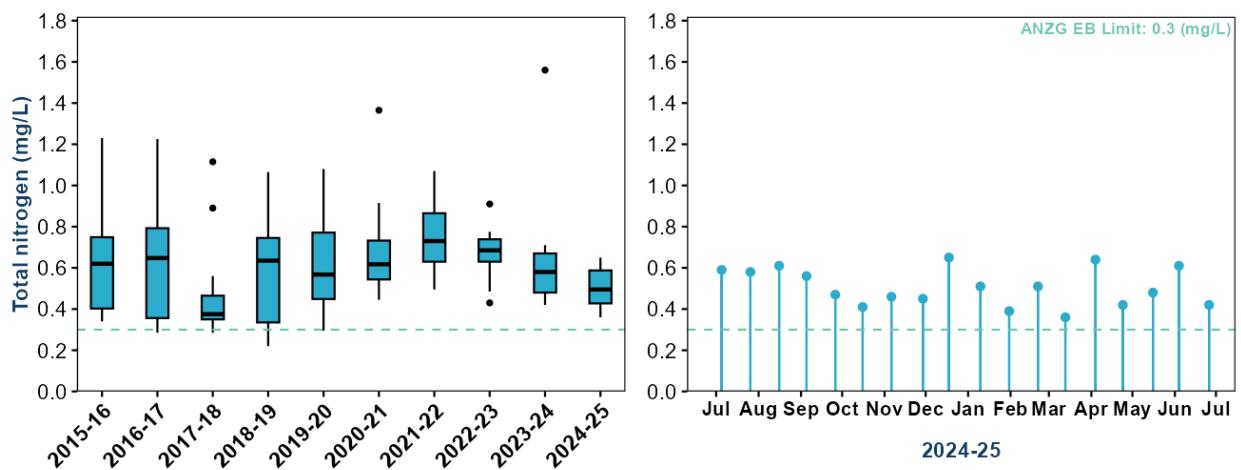
Hawkesbury River at Leets Vale as SoE Site

N18



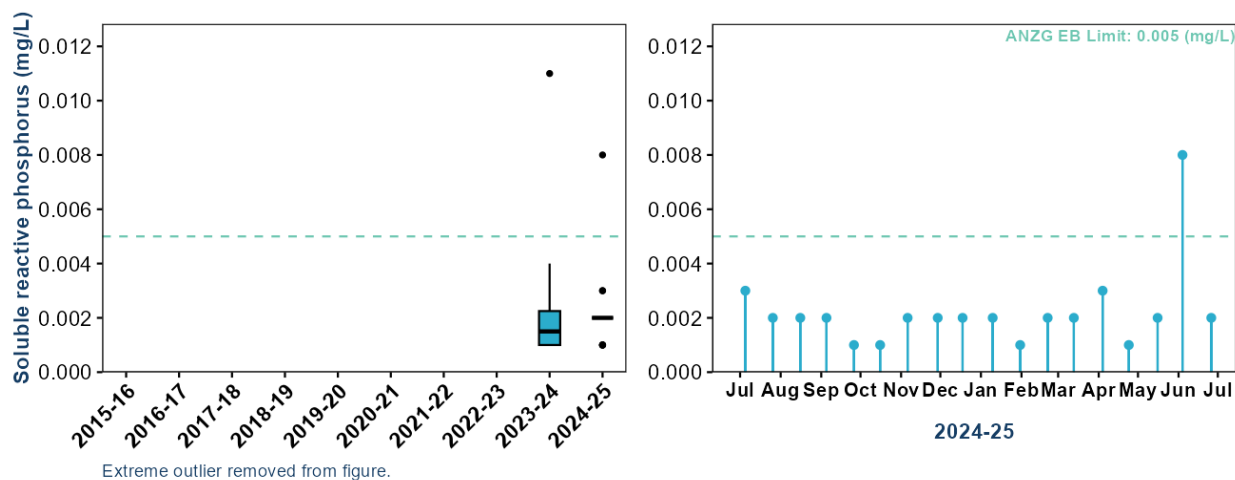
Hawkesbury River at Leets Vale as SoE Site

N18



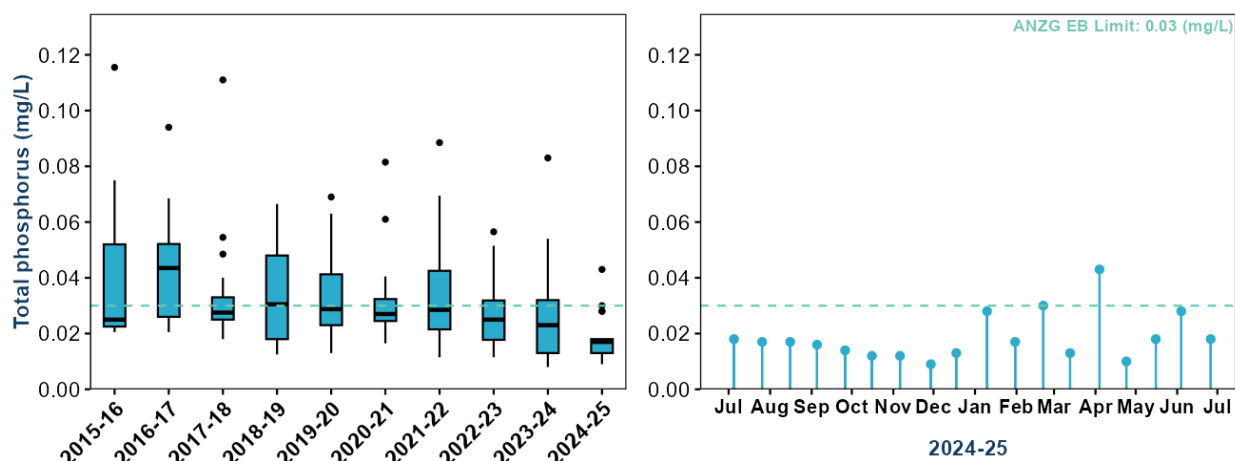
Hawkesbury River at Leets Vale as SoE Site

N18



Hawkesbury River at Leets Vale as SoE Site

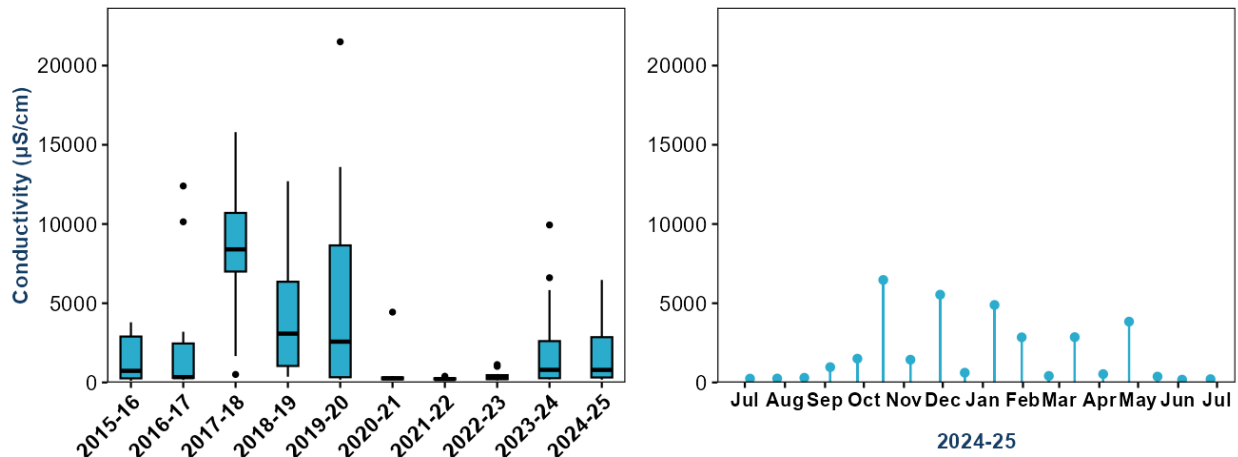
N18



Stressors – Physico-chemical water quality

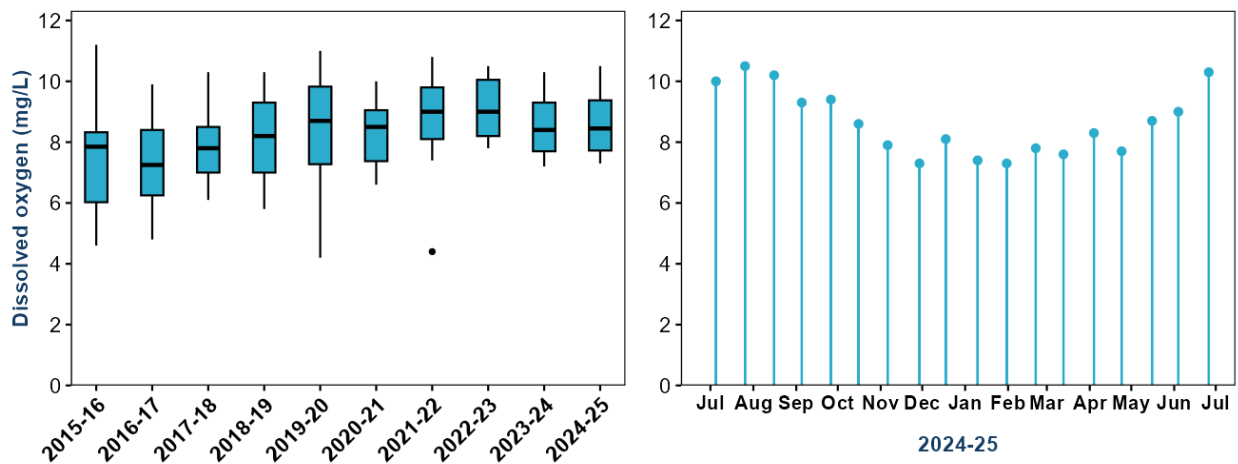
Hawkesbury River at Leets Vale as SoE Site

N18



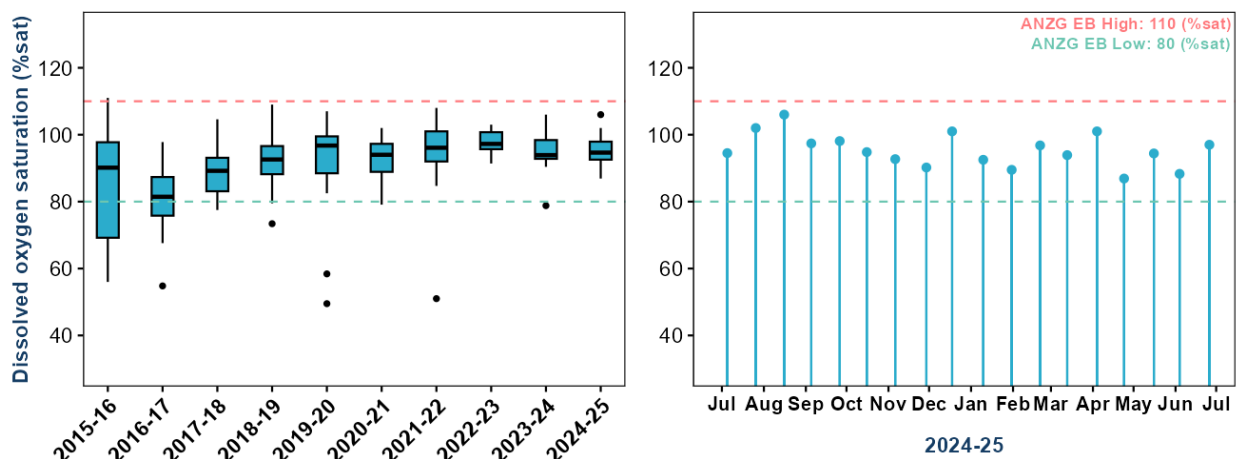
Hawkesbury River at Leets Vale as SoE Site

N18



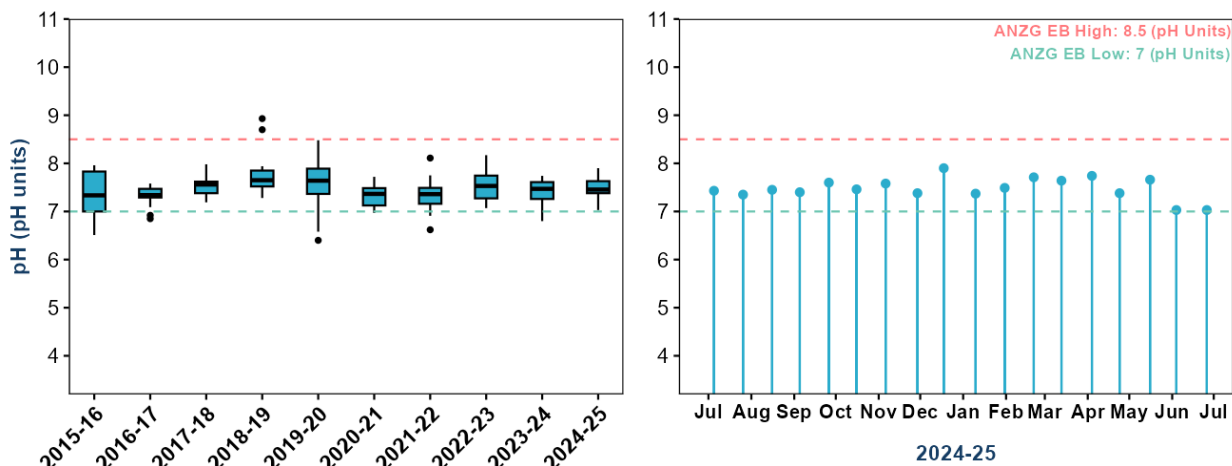
Hawkesbury River at Leets Vale as SoE Site

N18



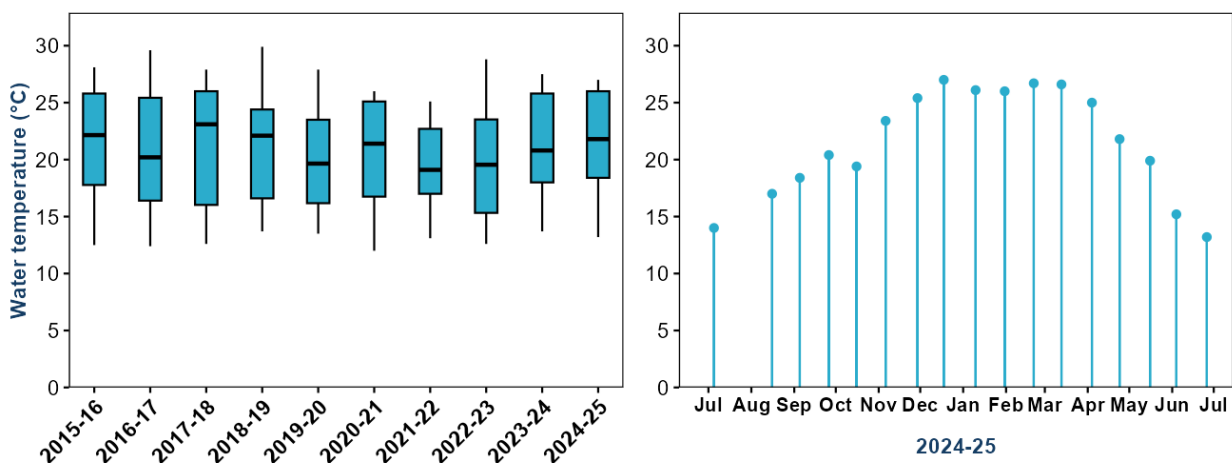
Hawkesbury River at Leets Vale as SoE Site

N18



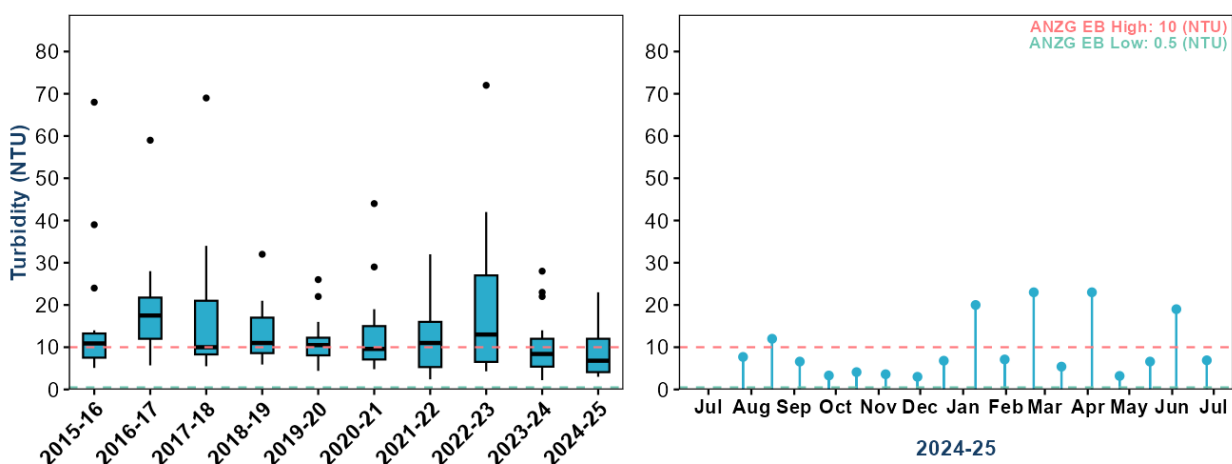
Hawkesbury River at Leets Vale as SoE Site

N18



Hawkesbury River at Leets Vale as SoE Site

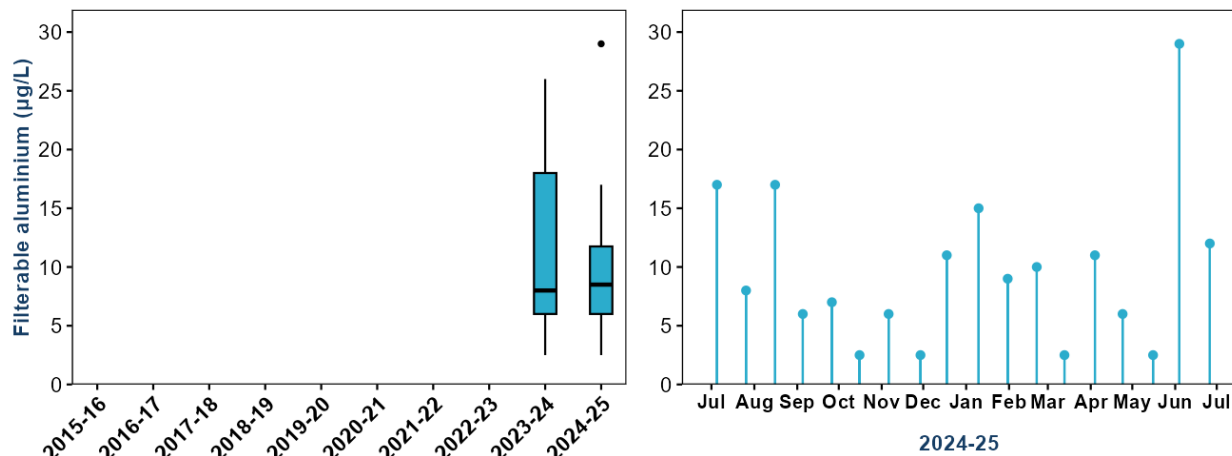
N18



Stressors – Trace metals

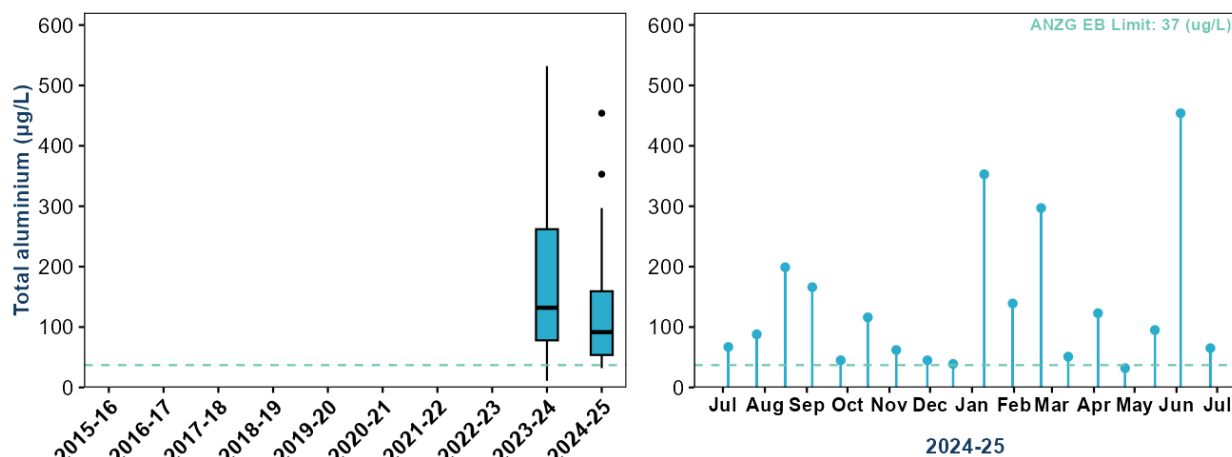
Hawkesbury River at Leets Vale as SoE Site

N18



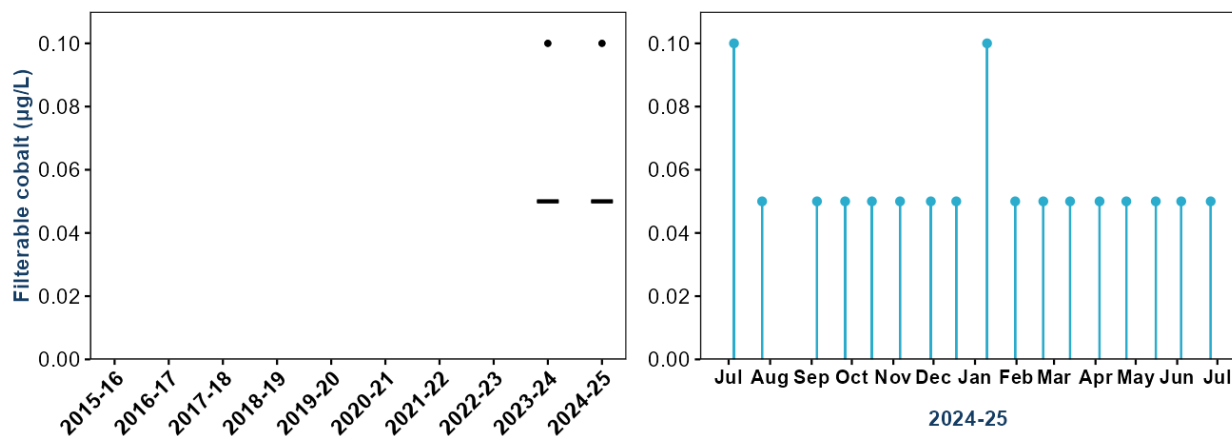
Hawkesbury River at Leets Vale as SoE Site

N18



Hawkesbury River at Leets Vale as SoE Site

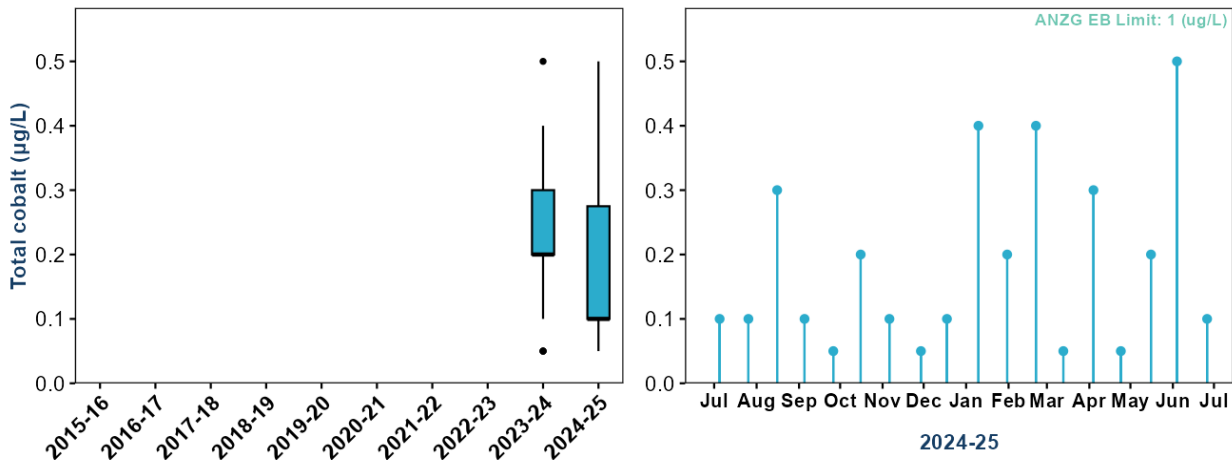
N18



Extreme outlier removed from figure.

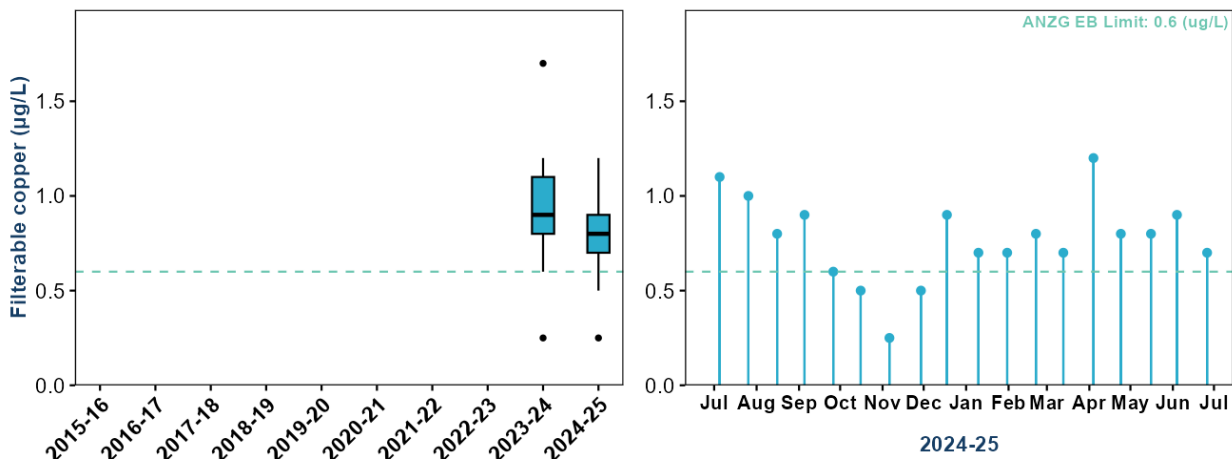
Hawkesbury River at Leets Vale as SoE Site

N18



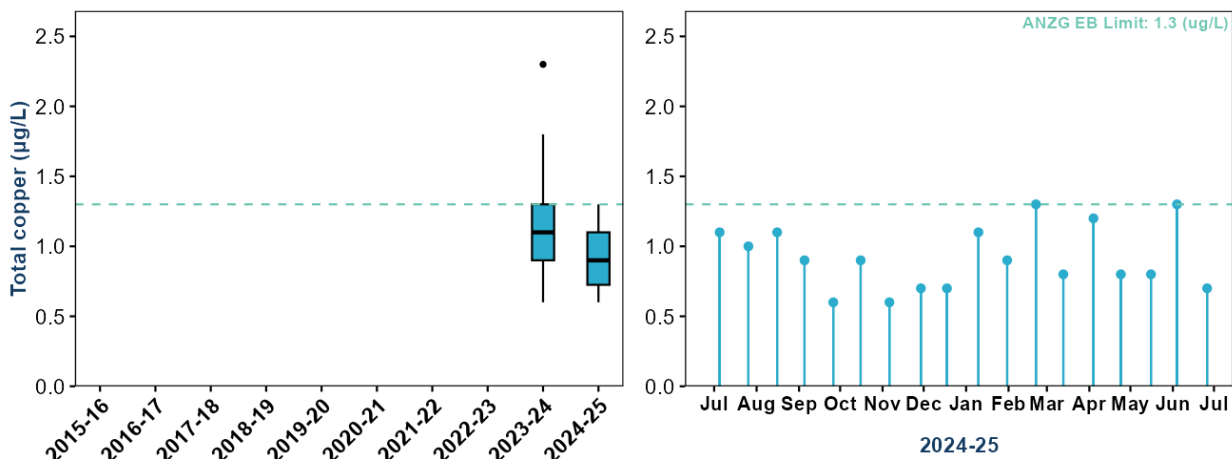
Hawkesbury River at Leets Vale as SoE Site

N18



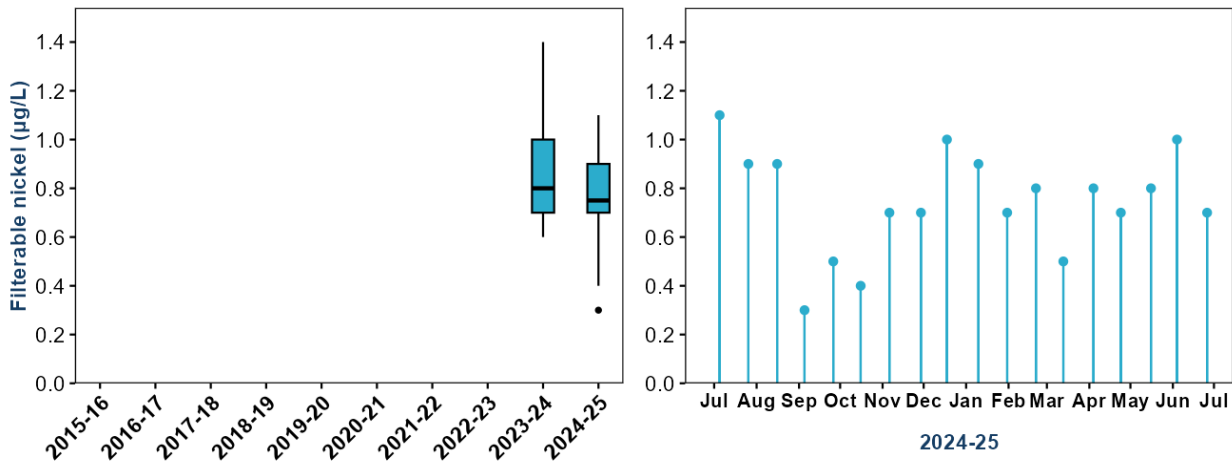
Hawkesbury River at Leets Vale as SoE Site

N18



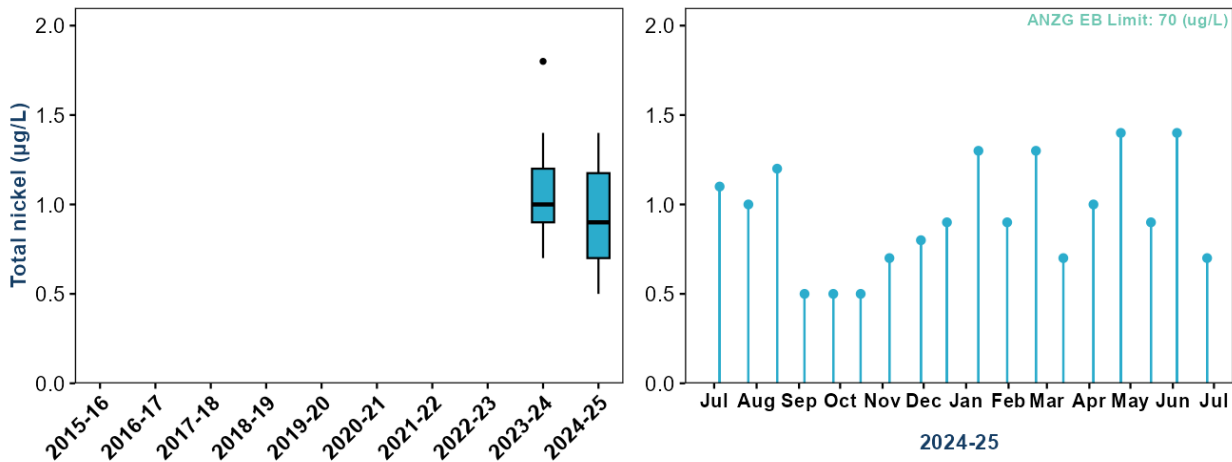
Hawkesbury River at Leets Vale as SoE Site

N18



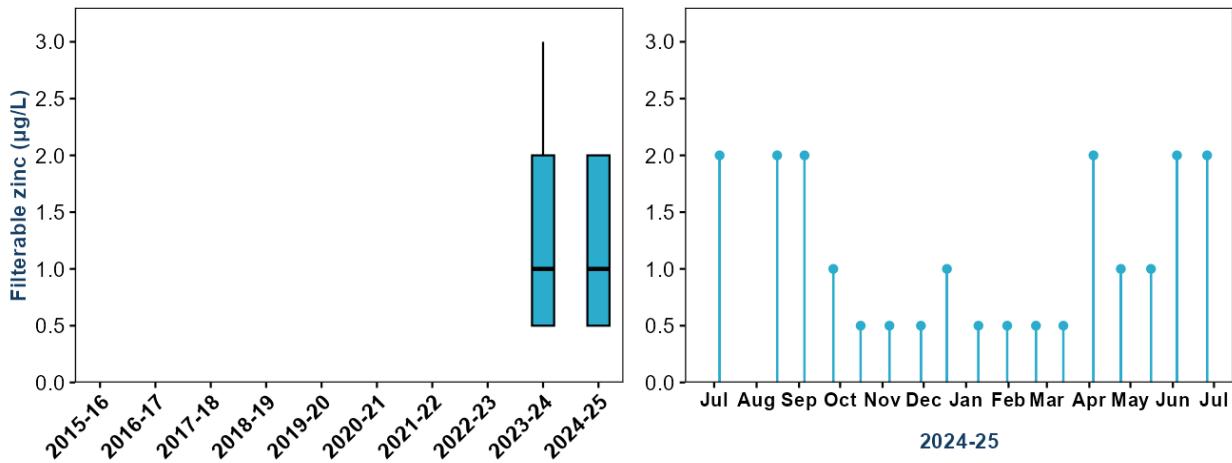
Hawkesbury River at Leets Vale as SoE Site

N18



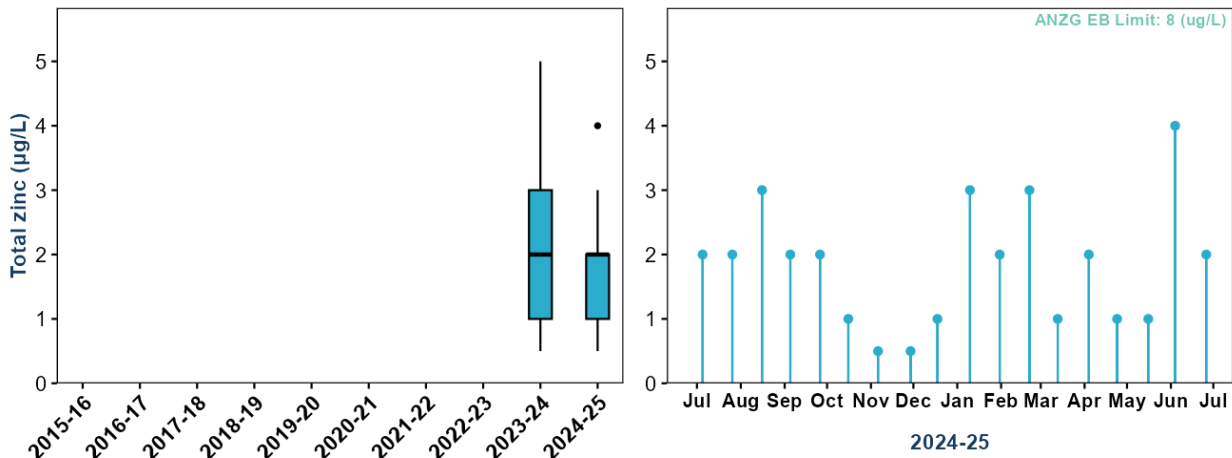
Hawkesbury River at Leets Vale as SoE Site

N18



Hawkesbury River at Leets Vale as SoE Site

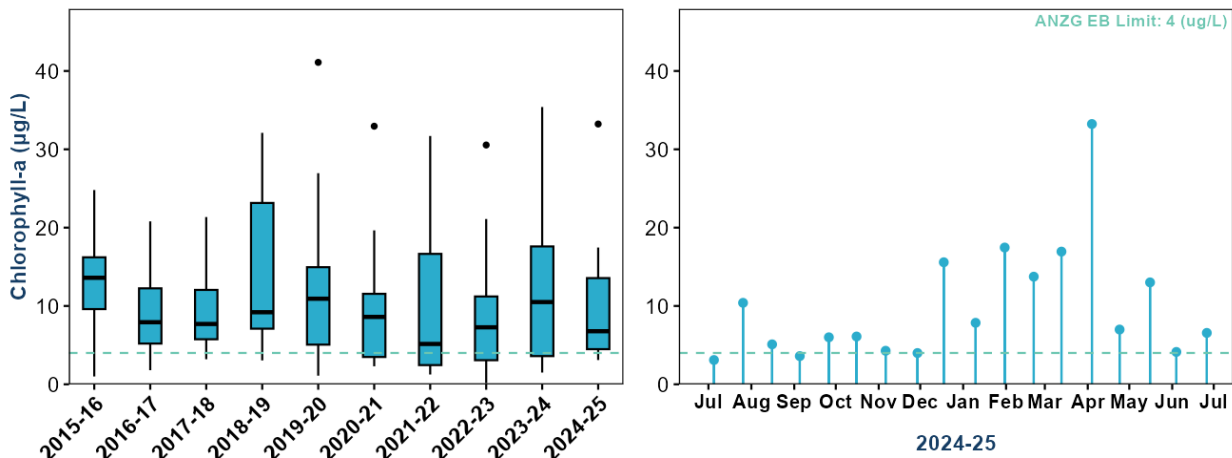
N18



Ecosystem receptor – Phytoplankton

Hawkesbury River at Leets Vale as SoE Site

N18



C.1.9. Berowra Creek at Calabash Bay (NB13)

Stressors - Statistical analysis outcomes

Table C-9 Current period (2024-25) vs previous period comparison for NB13

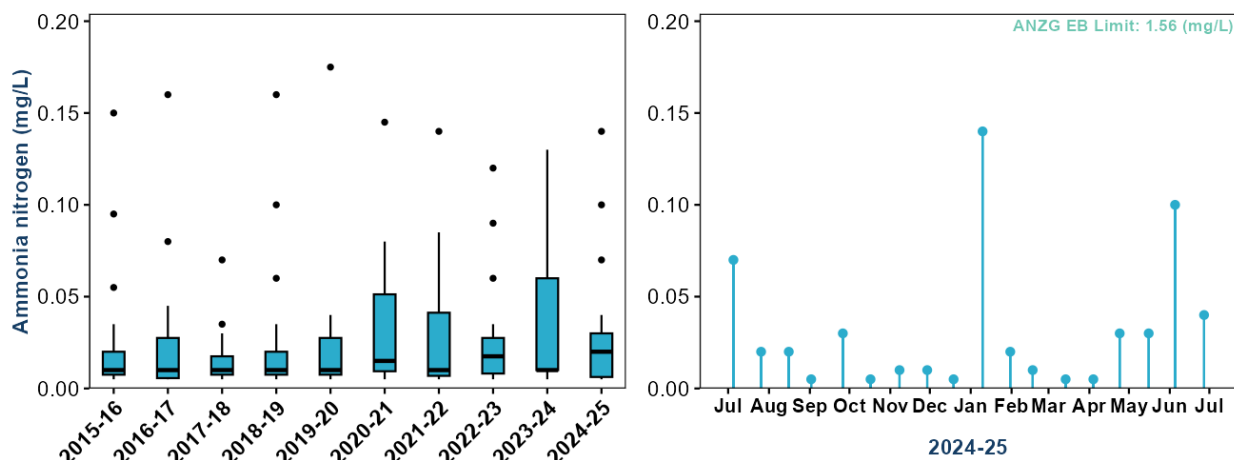
Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.84	0.15	158	-0.95	0.346
Oxidised nitrogen	1.01	0.35	158	0.04	0.970
Total nitrogen	0.94	0.08	158	-0.76	0.447
Soluble reactive phosphorus	1.36	0.39	33	1.06	0.298
Total phosphorus	1.05	0.11	158	0.49	0.621
Physico-chemical					
Conductivity	1.13	0.15	156	0.98	0.330
Dissolved oxygen	0.94	0.04	157	-1.57	0.118
Dissolved oxygen saturation	-5.01	2.96	157	-1.69	0.092
pH	-0.02	0.07	157	-0.23	0.820
Water temperature	1.00	0.06	157	0.02	0.985
Turbidity	0.96	0.13	158	-0.28	0.777
Trace metals					
Filterable aluminium	0.78	0.18	33	-1.05	0.300
Total aluminium	0.66	0.16	33	-1.68	0.102
Filterable cobalt	0.83	0.11	33	-1.49	0.146
Total cobalt	0.94	0.18	33	-0.31	0.755
Filterable copper	0.83	0.11	33	-1.43	0.163
Total copper	0.84	0.09	33	-1.58	0.124
Filterable nickel	0.64	0.13	33	-2.25	0.031
Total nickel	0.69	0.13	33	-2.03	0.051
Filterable zinc	0.67	0.14	33	-1.90	0.066
Total zinc	0.70	0.18	33	-1.40	0.171
Chlorophyll-a					
Chlorophyll-a	0.84	0.16	157	-0.94	0.349

	not significant (p>0.05)	p <0.05 and >=0.01	p <0.01 and >=0.001	p <0.001
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Stressors – Nutrients

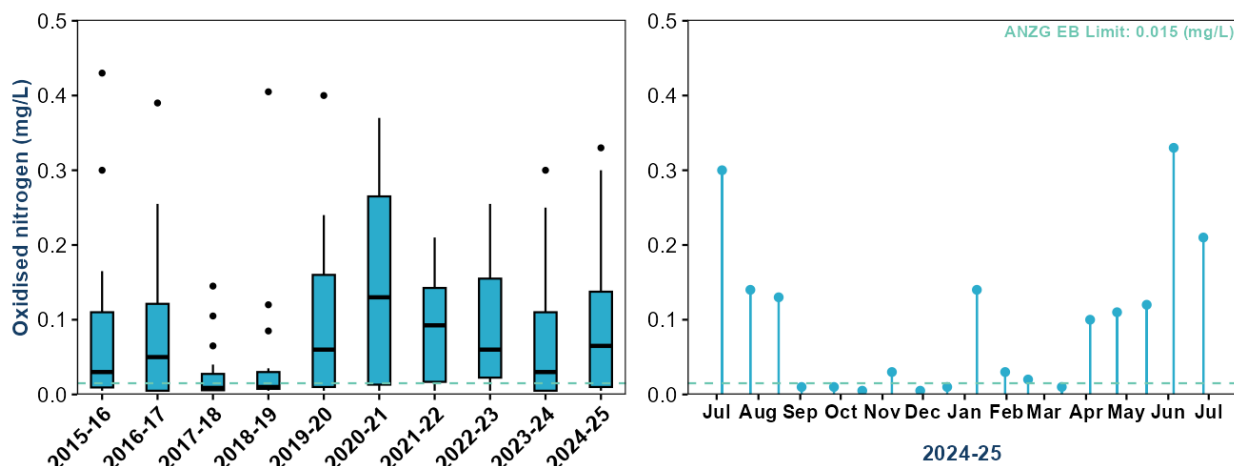
Berowra Creek at Calabash Bay as SoE Site

NB13



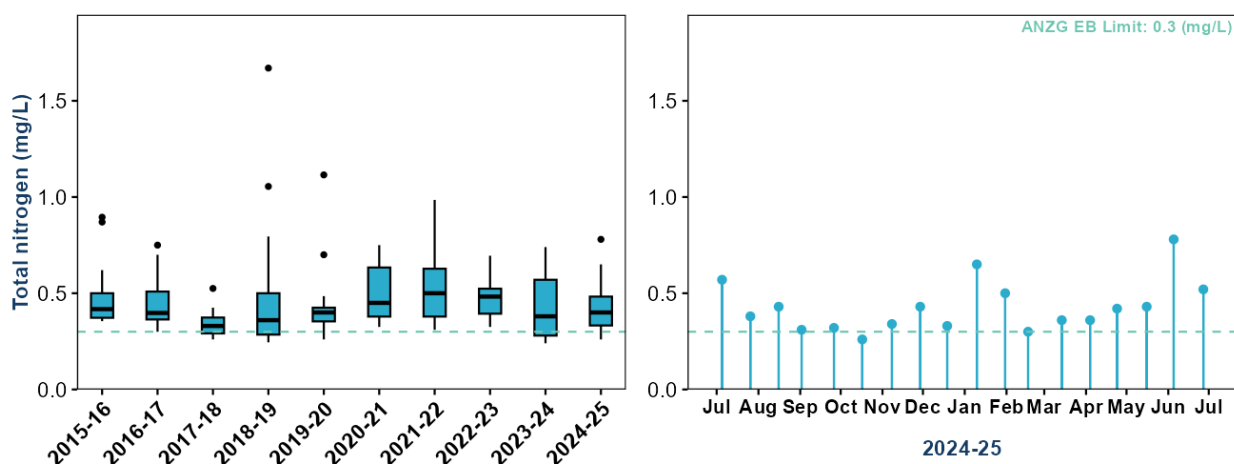
Berowra Creek at Calabash Bay as SoE Site

NB13



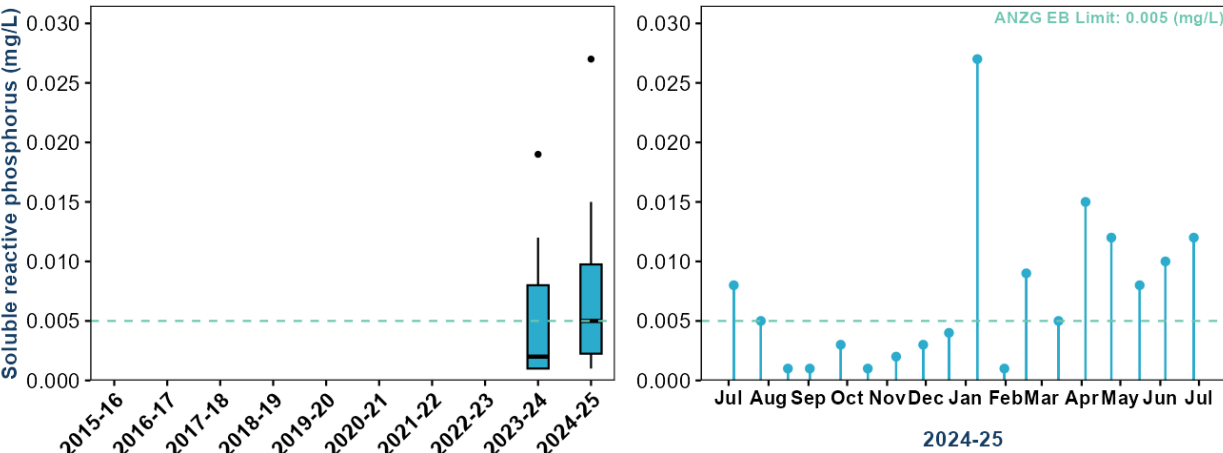
Berowra Creek at Calabash Bay as SoE Site

NB13



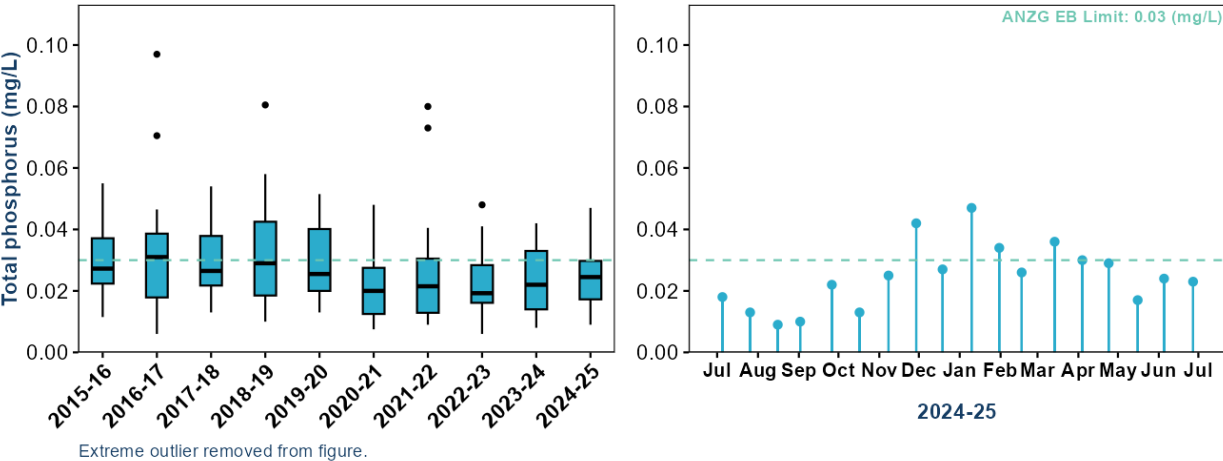
Berowra Creek at Calabash Bay as SoE Site

NB13



Berowra Creek at Calabash Bay as SoE Site

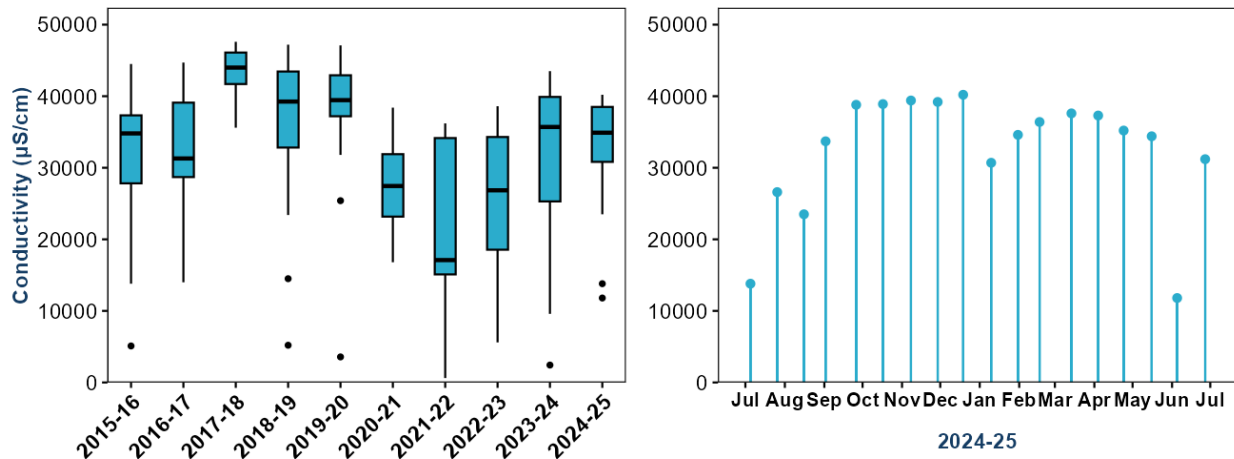
NB13



Stressors – Physico-chemical water quality

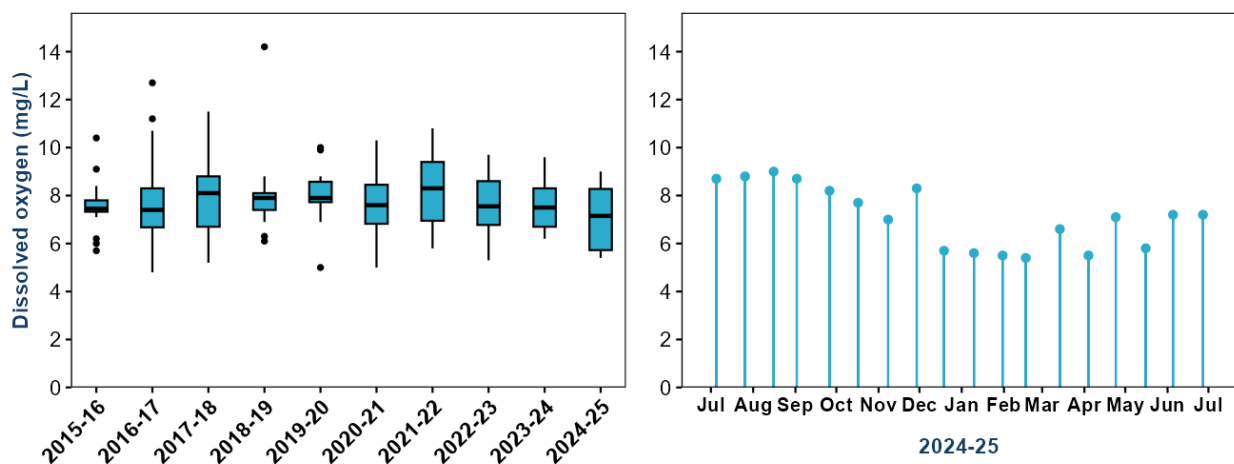
Berowra Creek at Calabash Bay as SoE Site

NB13



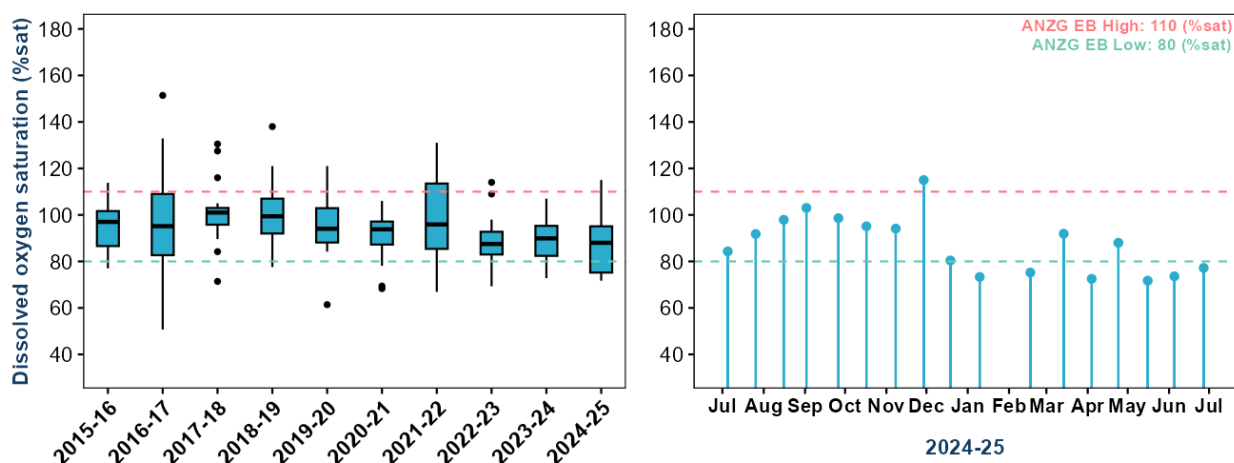
Berowra Creek at Calabash Bay as SoE Site

NB13



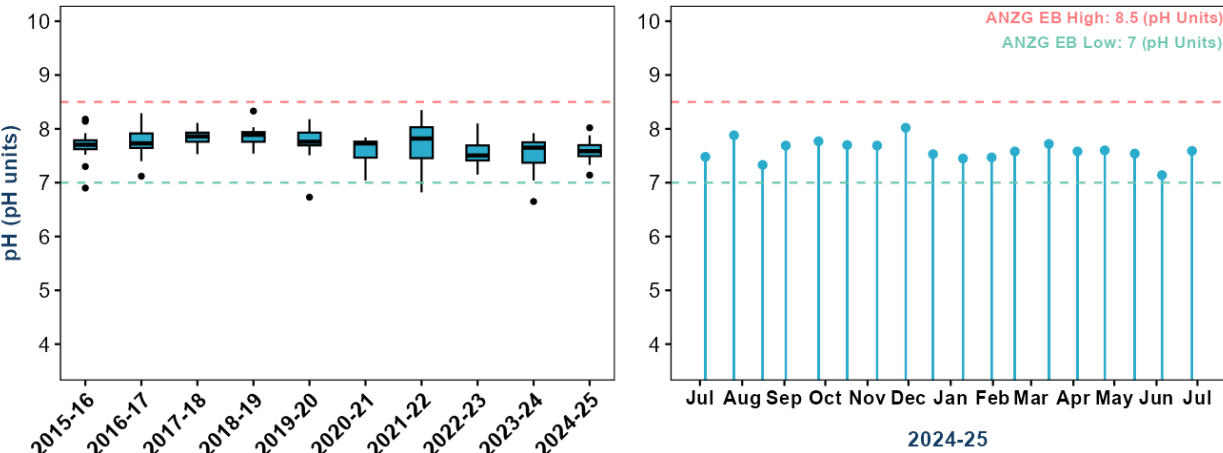
Berowra Creek at Calabash Bay as SoE Site

NB13



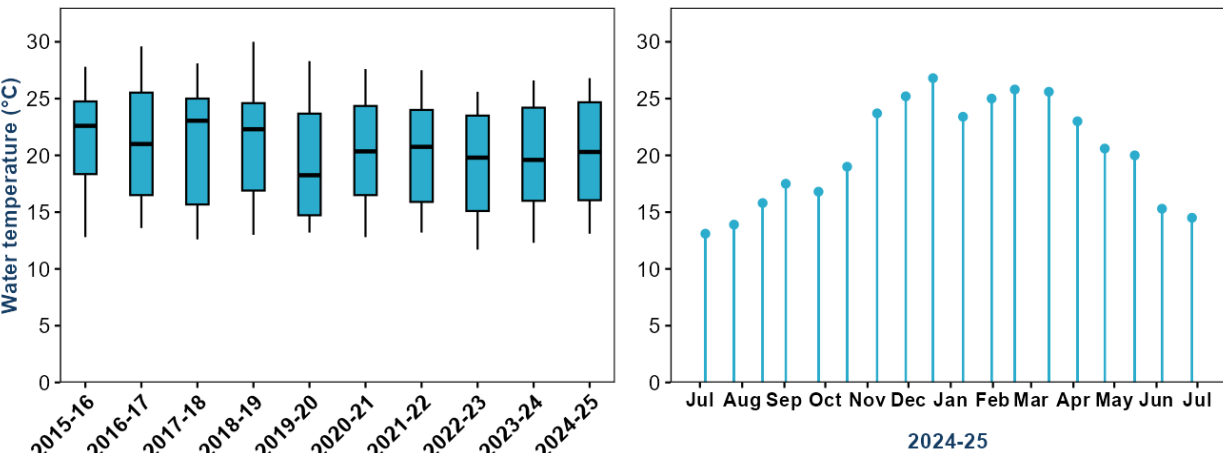
Berowra Creek at Calabash Bay as SoE Site

NB13



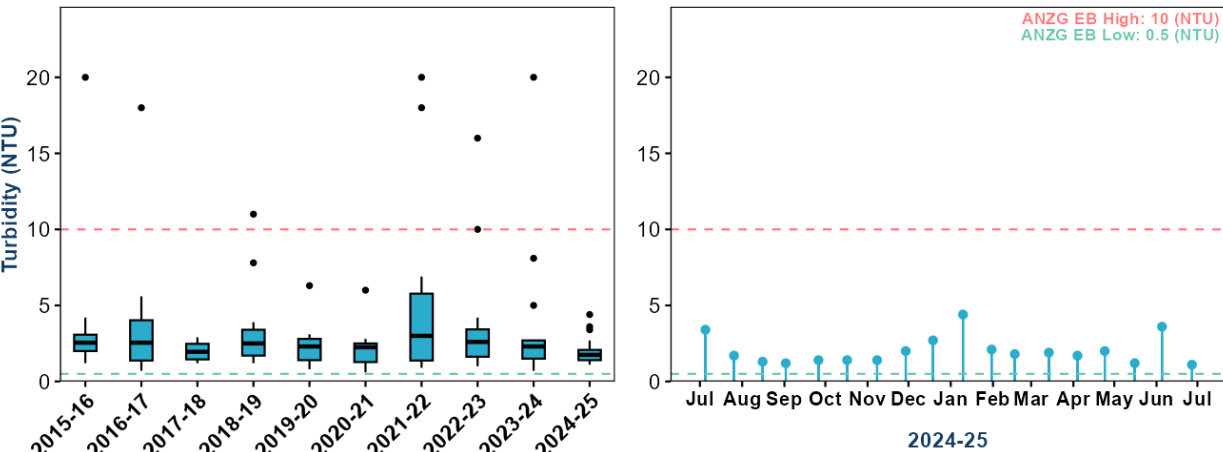
Berowra Creek at Calabash Bay as SoE Site

NB13



Berowra Creek at Calabash Bay as SoE Site

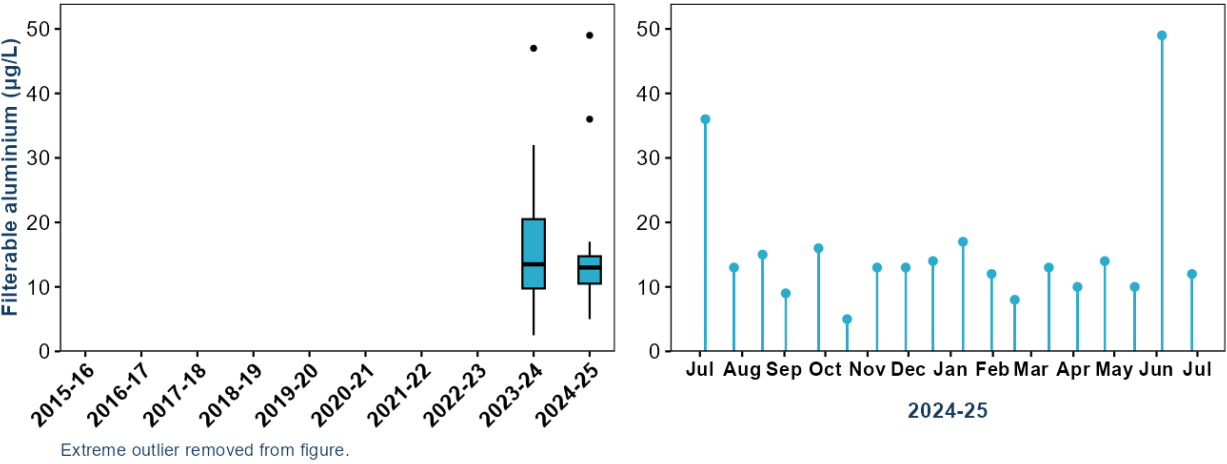
NB13



Stressors – Trace metals

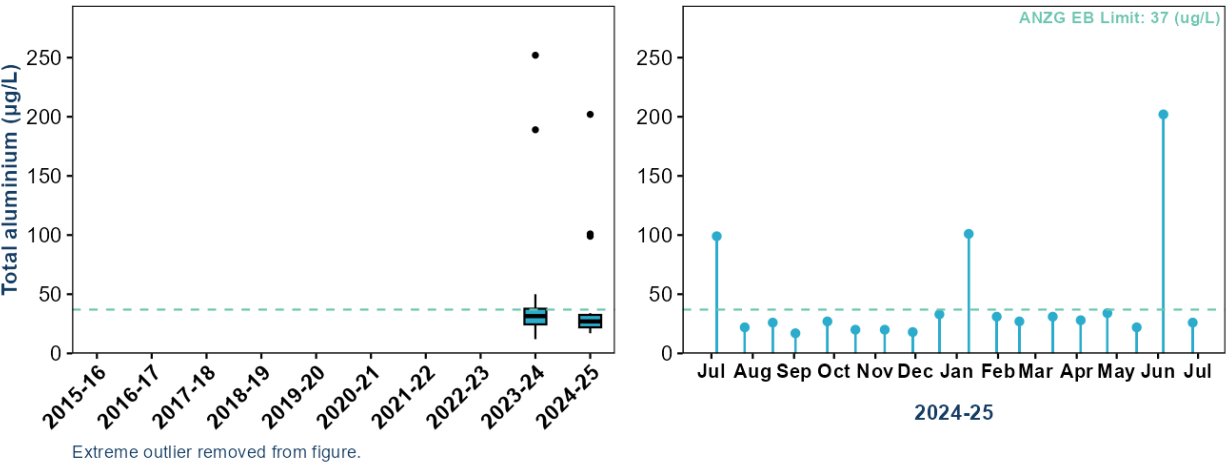
Berowra Creek at Calabash Bay as SoE Site

NB13



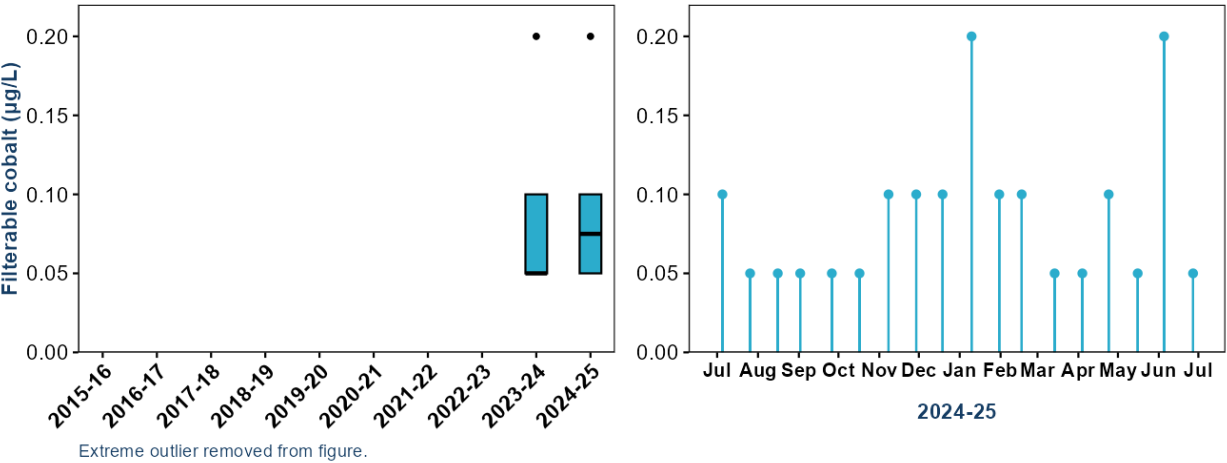
Berowra Creek at Calabash Bay as SoE Site

NB13



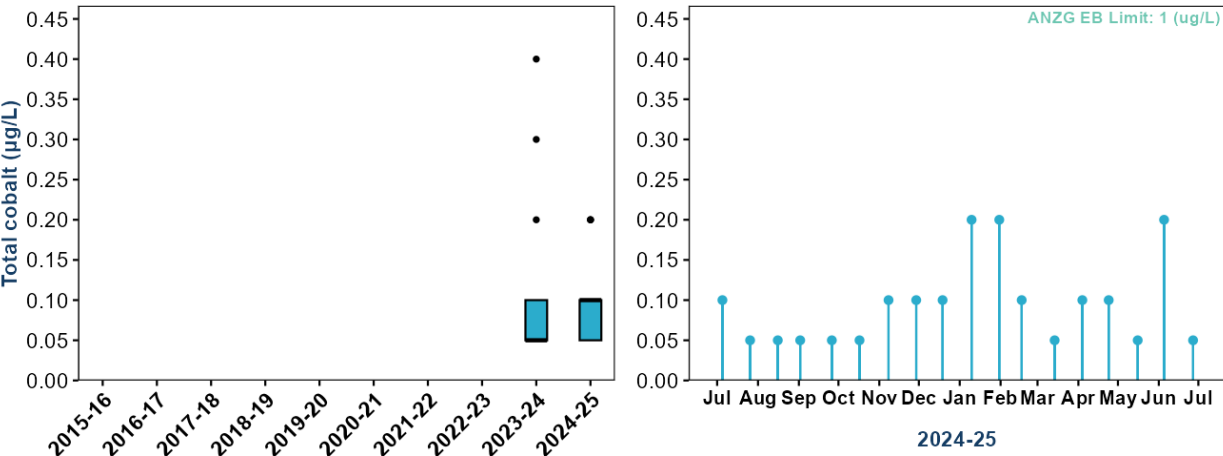
Berowra Creek at Calabash Bay as SoE Site

NB13



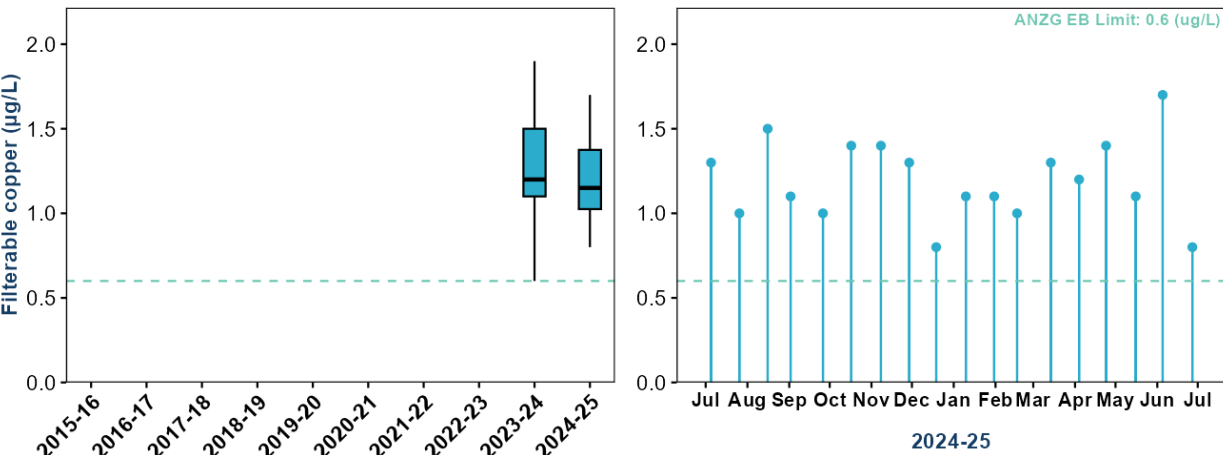
Berowra Creek at Calabash Bay as SoE Site

NB13



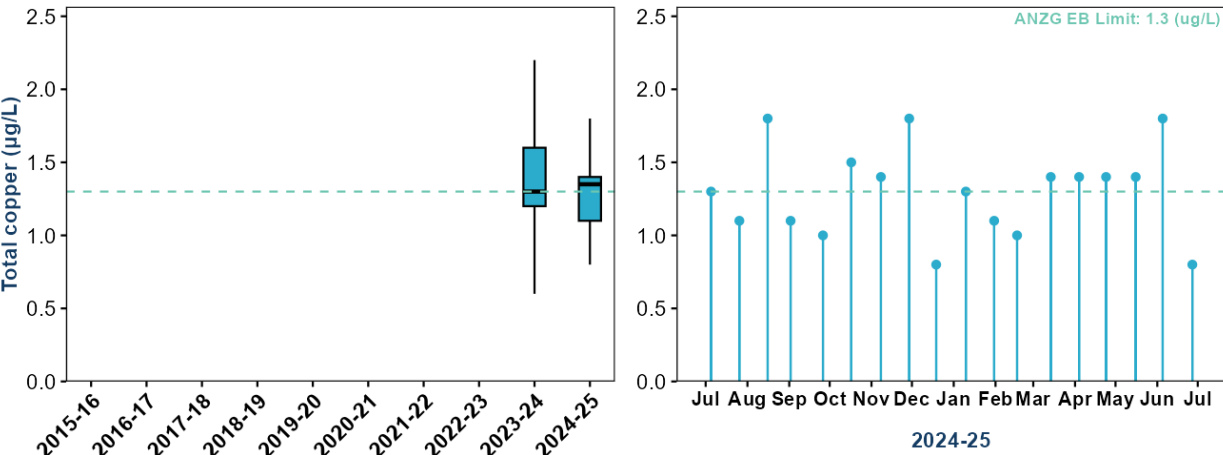
Berowra Creek at Calabash Bay as SoE Site

NB13



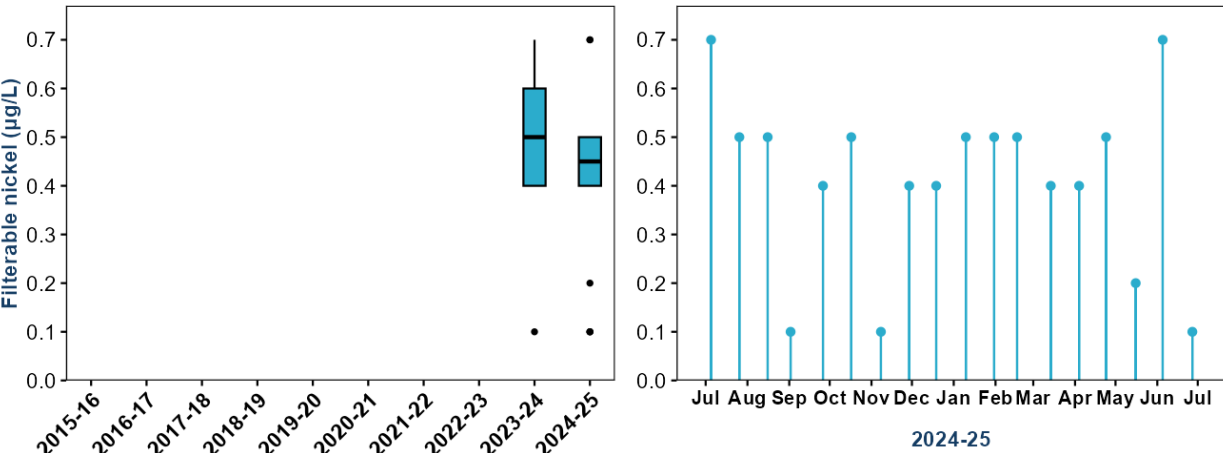
Berowra Creek at Calabash Bay as SoE Site

NB13



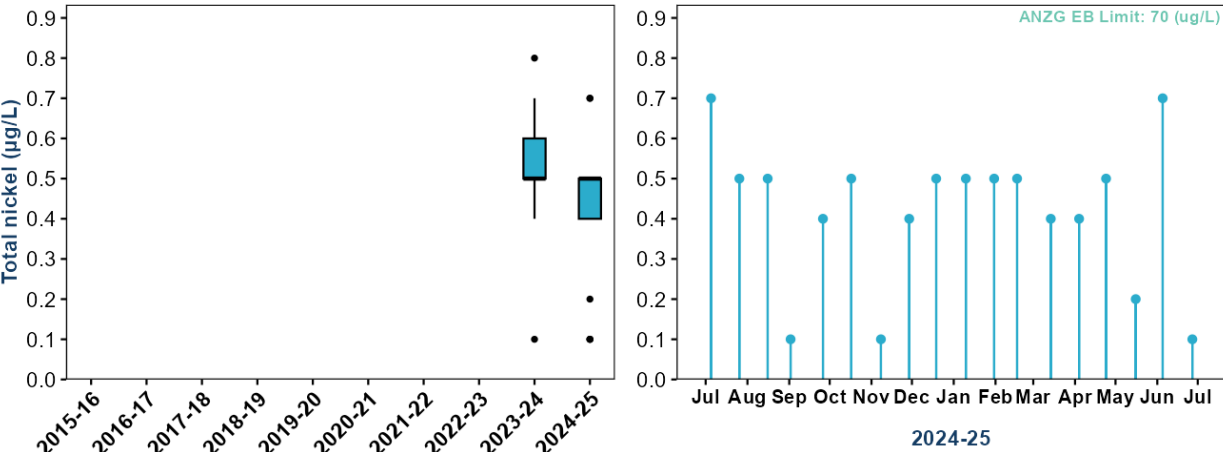
Berowra Creek at Calabash Bay as SoE Site

NB13



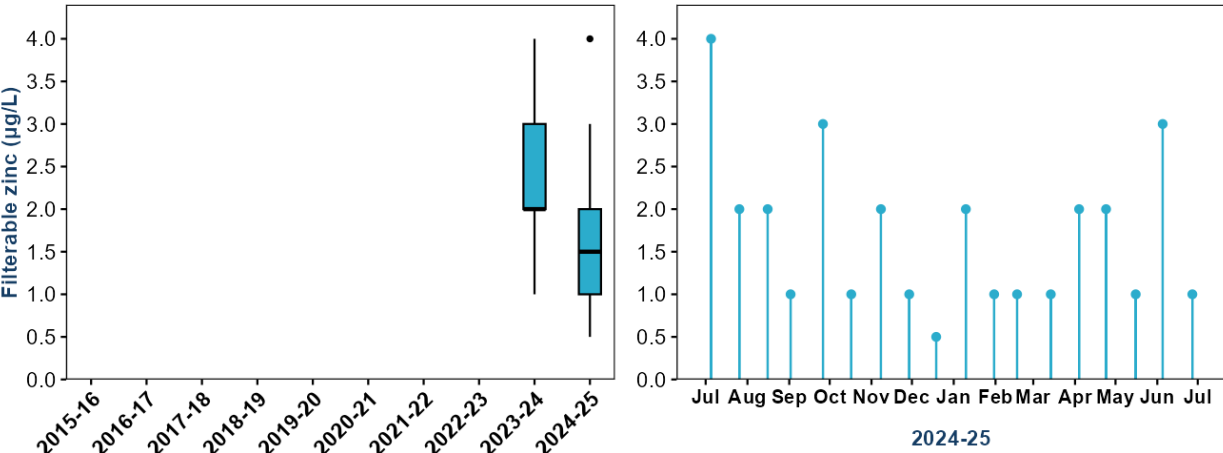
Berowra Creek at Calabash Bay as SoE Site

NB13



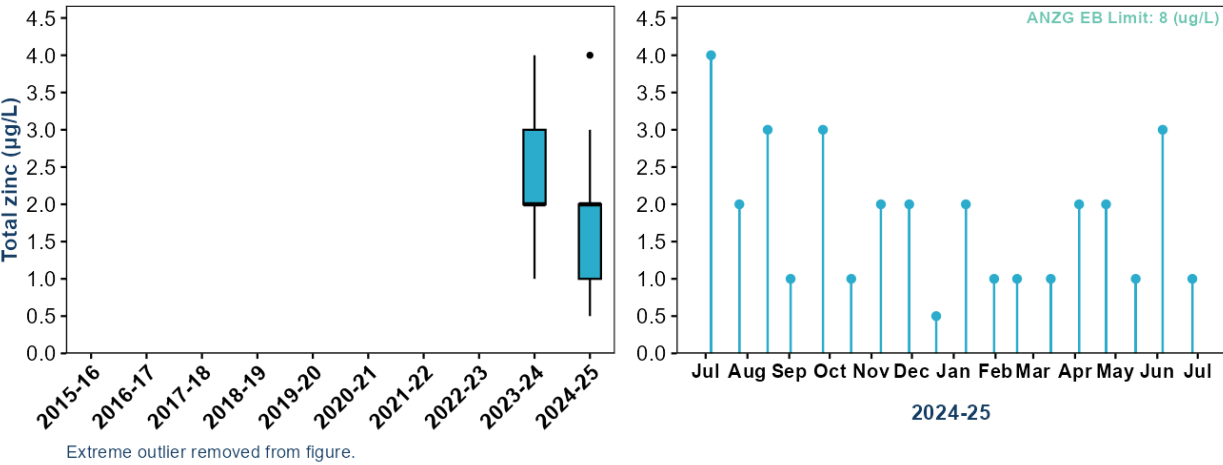
Berowra Creek at Calabash Bay as SoE Site

NB13



Berowra Creek at Calabash Bay as SoE Site

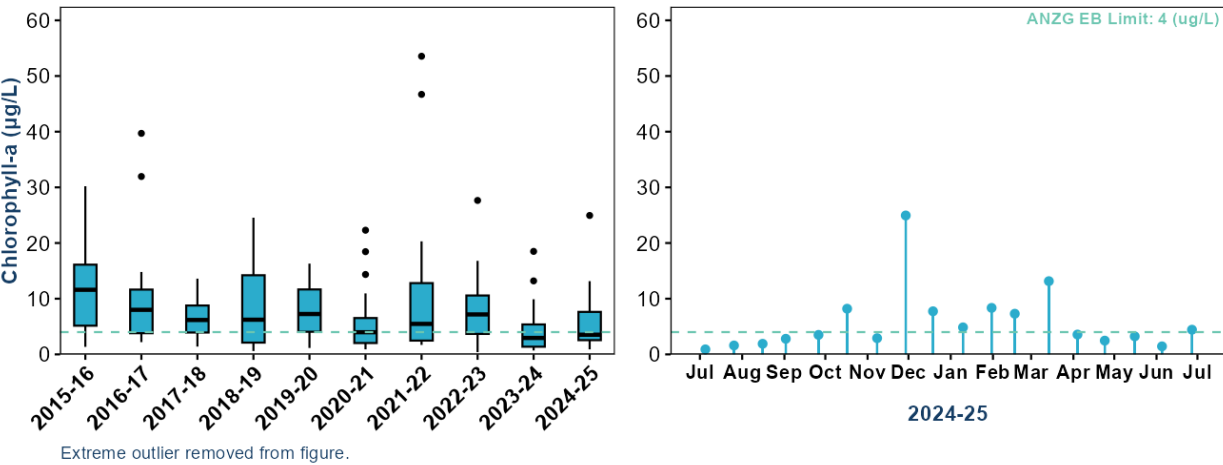
NB13



Ecosystem receptor – Phytoplankton

Berowra Creek at Calabash Bay as SoE Site

NB13



C.1.10. Berowra Creek Off Square Bay (NB11)

Stressors - Statistical analysis outcomes

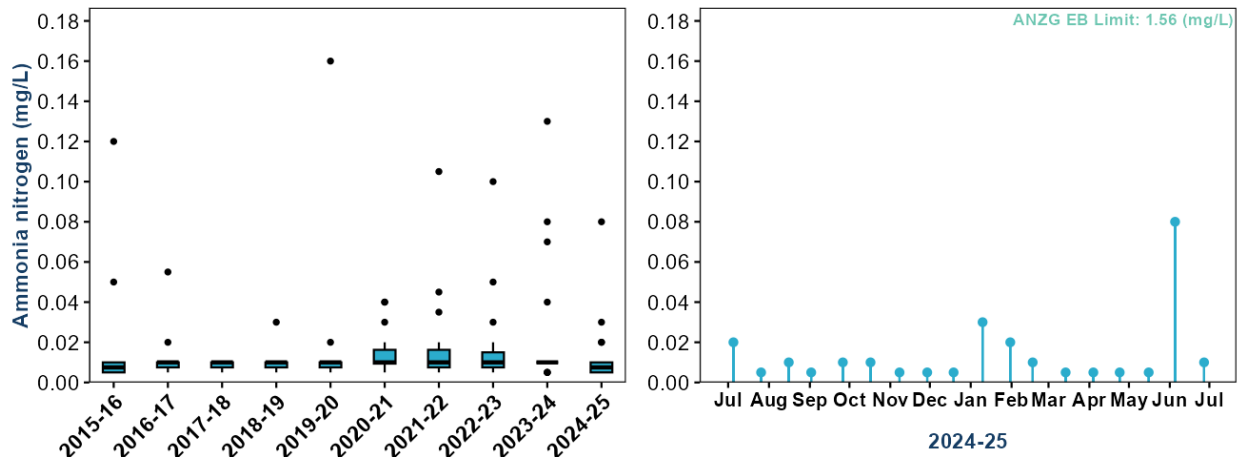
Table C-10 Current period (2024-25) vs previous period comparison for NB11

Analyte	Estimate	SE	DF	T ratio	P value
Nutrients					
Total ammonia nitrogen	0.84	0.15	158	-0.95	0.346
Oxidised nitrogen	1.01	0.35	158	0.04	0.970
Total nitrogen	0.94	0.08	158	-0.76	0.447
Soluble reactive phosphorus	1.36	0.39	33	1.06	0.298
Total phosphorus	1.05	0.11	158	0.49	0.621
Physico-chemical					
Conductivity	1.13	0.15	156	0.98	0.330
Dissolved oxygen	0.94	0.04	157	-1.57	0.118
Dissolved oxygen saturation	-5.01	2.96	157	-1.69	0.092
pH	-0.02	0.07	157	-0.23	0.820
Water temperature	1.00	0.06	157	0.02	0.985
Turbidity	0.96	0.13	158	-0.28	0.777
Trace metals					
Filterable aluminium	0.78	0.18	33	-1.05	0.300
Total aluminium	0.66	0.16	33	-1.68	0.102
Filterable cobalt	0.83	0.11	33	-1.49	0.146
Total cobalt	0.94	0.18	33	-0.31	0.755
Filterable copper	0.83	0.11	33	-1.43	0.163
Total copper	0.84	0.09	33	-1.58	0.124
Filterable nickel	0.64	0.13	33	-2.25	0.031
Total nickel	0.69	0.13	33	-2.03	0.051
Filterable zinc	0.67	0.14	33	-1.90	0.066
Total zinc	0.70	0.18	33	-1.40	0.171
Phytoplankton					
Chlorophyll - a	0.84	0.16	157	-0.94	0.349
not significant ($p > 0.05$) $p < 0.05$ and ≥ 0.01 $p < 0.01$ and ≥ 0.001 $p < 0.001$					

Stressors – Nutrients

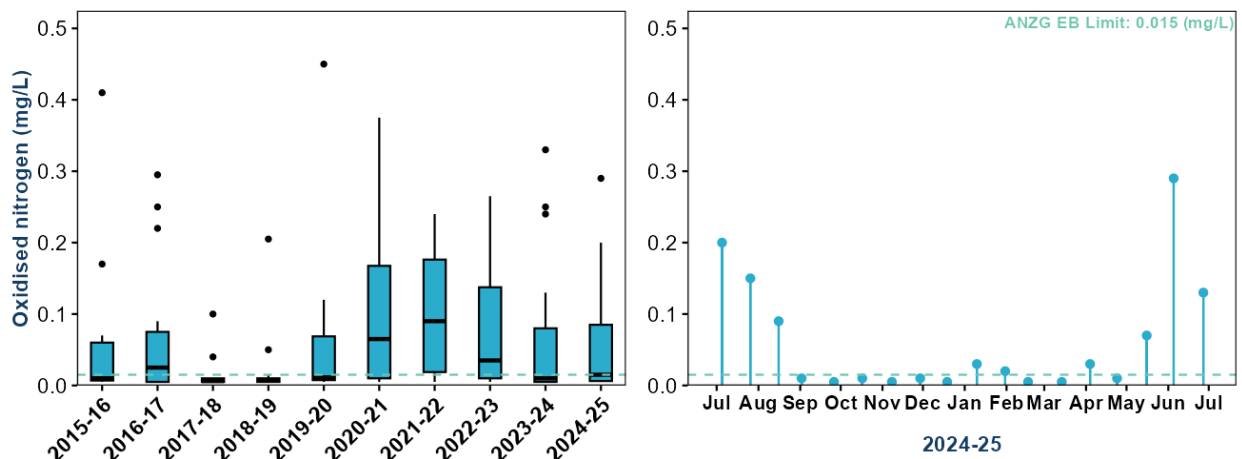
Berowra Creek off Square Bay as SoE Site

NB11



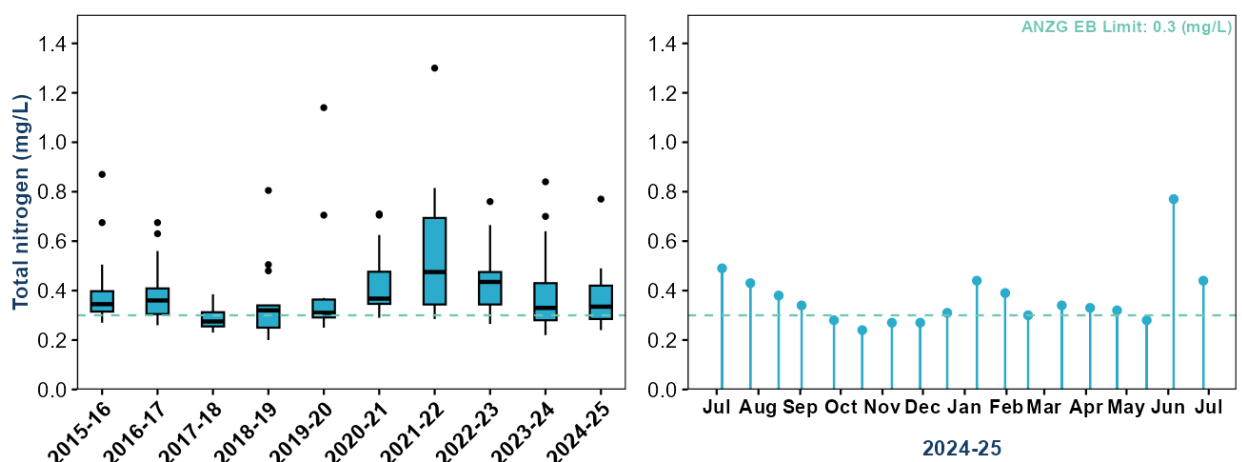
Berowra Creek off Square Bay as SoE Site

NB11



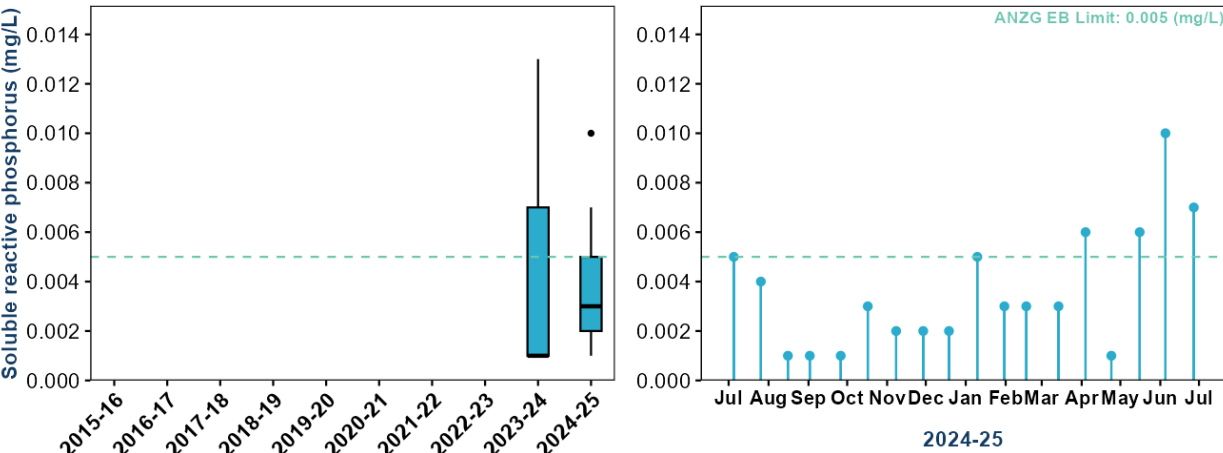
Berowra Creek off Square Bay as SoE Site

NB11



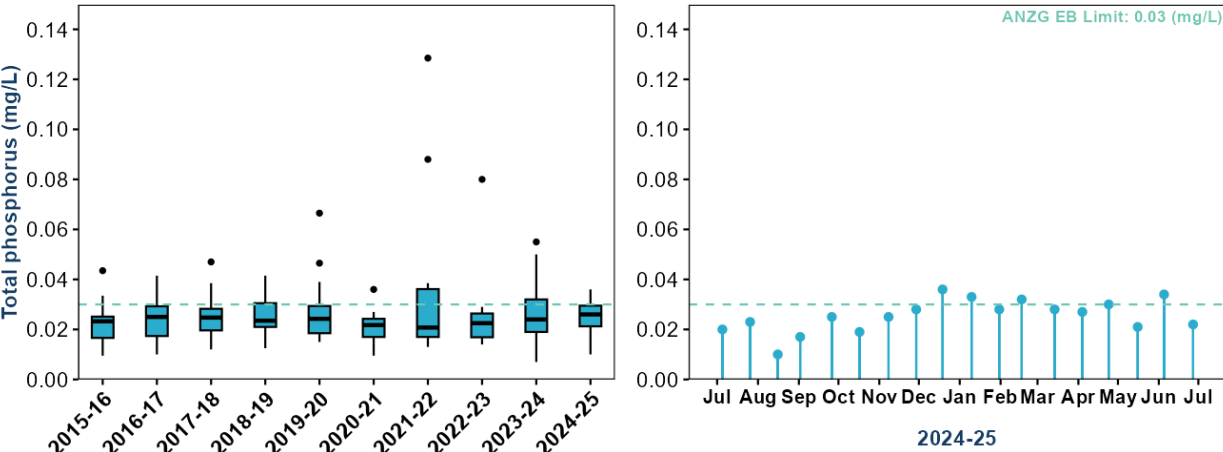
Berowra Creek off Square Bay as SoE Site

NB11



Berowra Creek off Square Bay as SoE Site

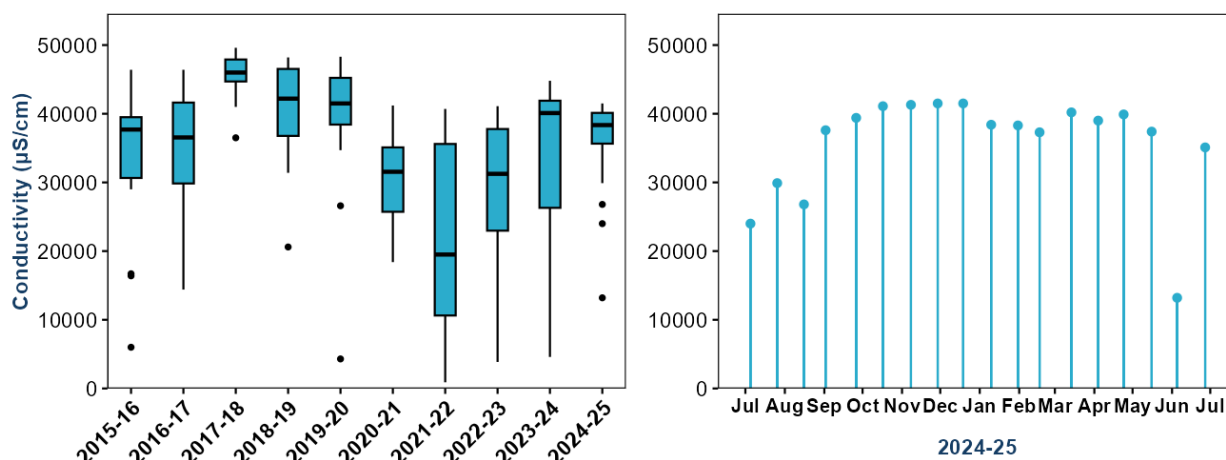
NB11



Stressors – Physico-chemical water quality

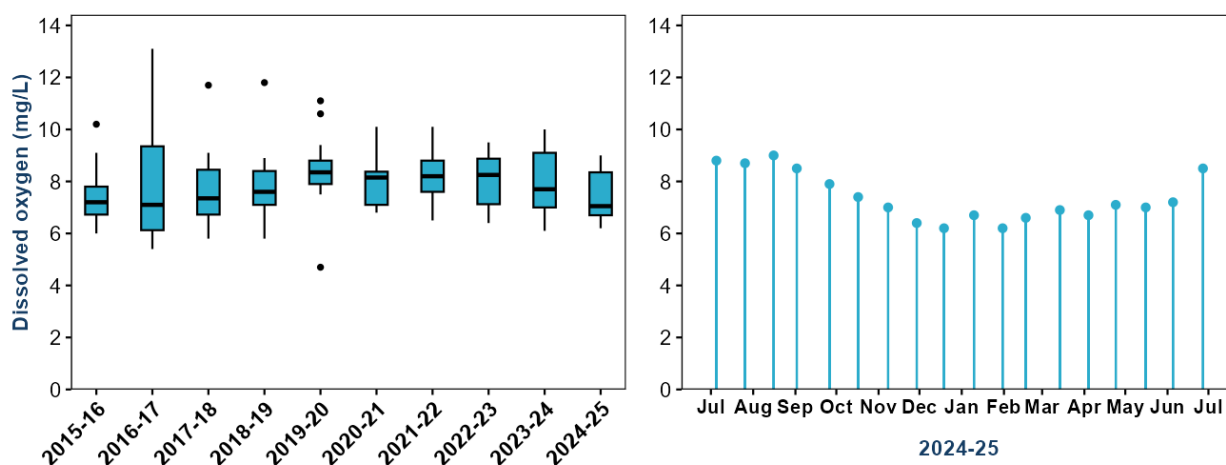
Berowra Creek off Square Bay as SoE Site

NB11



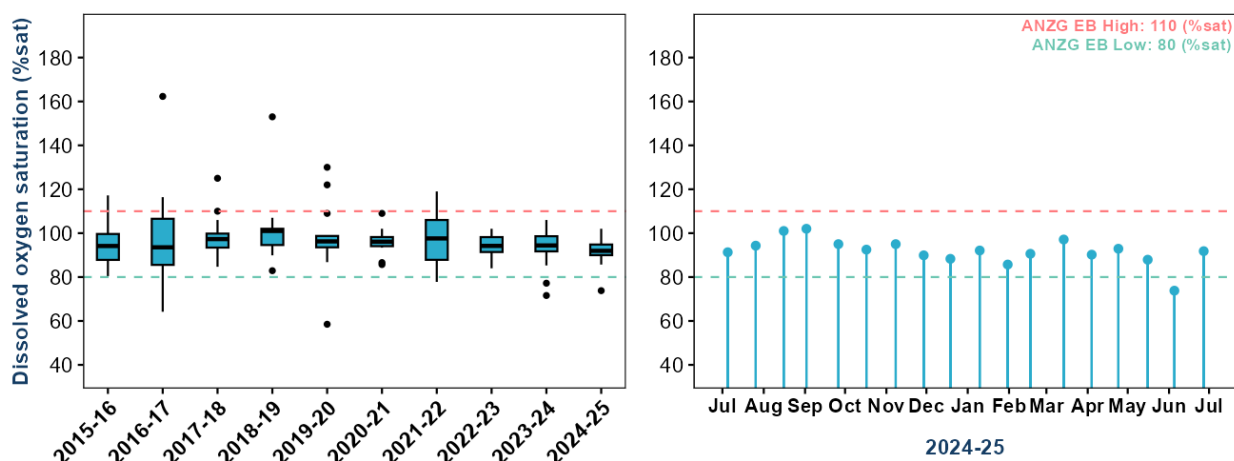
Berowra Creek off Square Bay as SoE Site

NB11



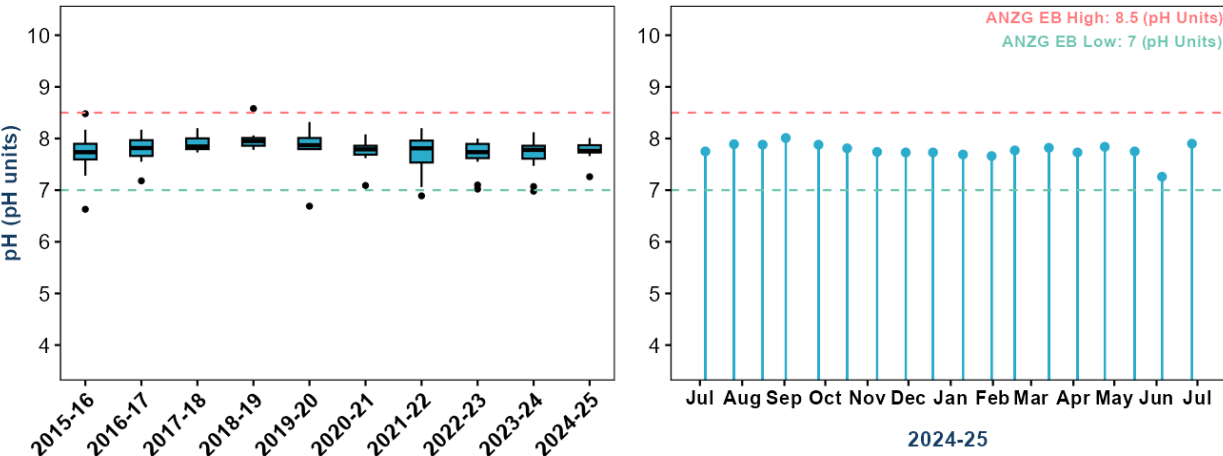
Berowra Creek off Square Bay as SoE Site

NB11



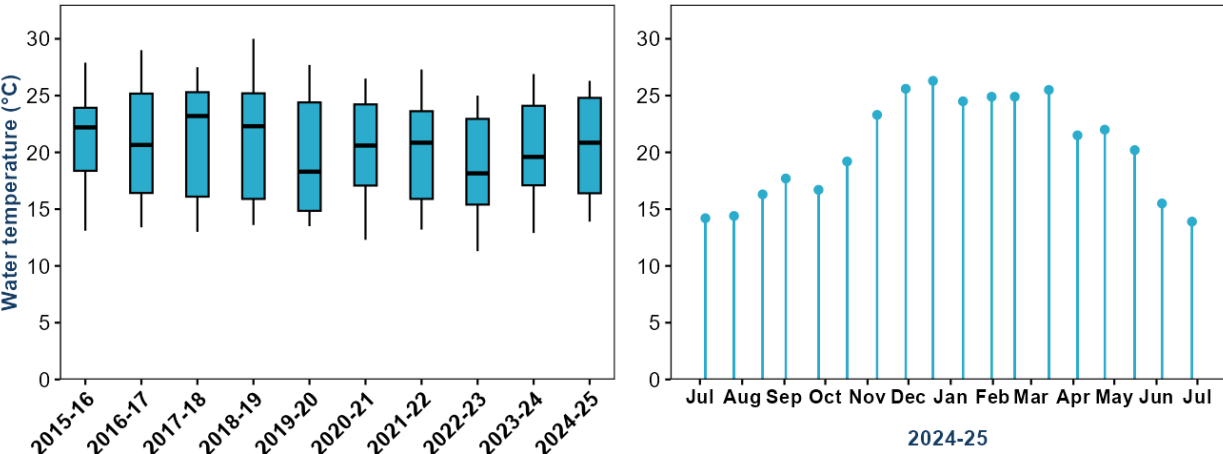
Berowra Creek off Square Bay as SoE Site

NB11



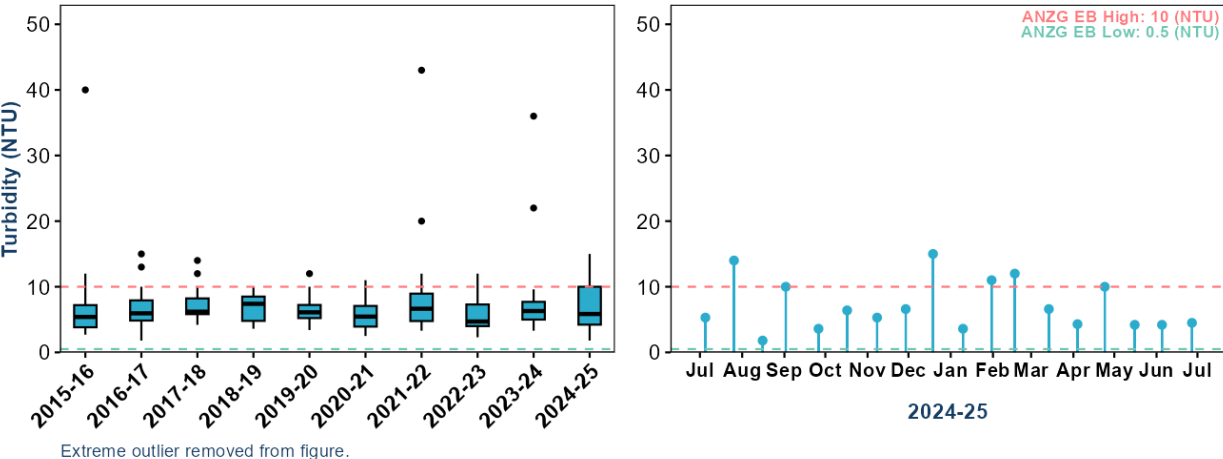
Berowra Creek off Square Bay as SoE Site

NB11



Berowra Creek off Square Bay as SoE Site

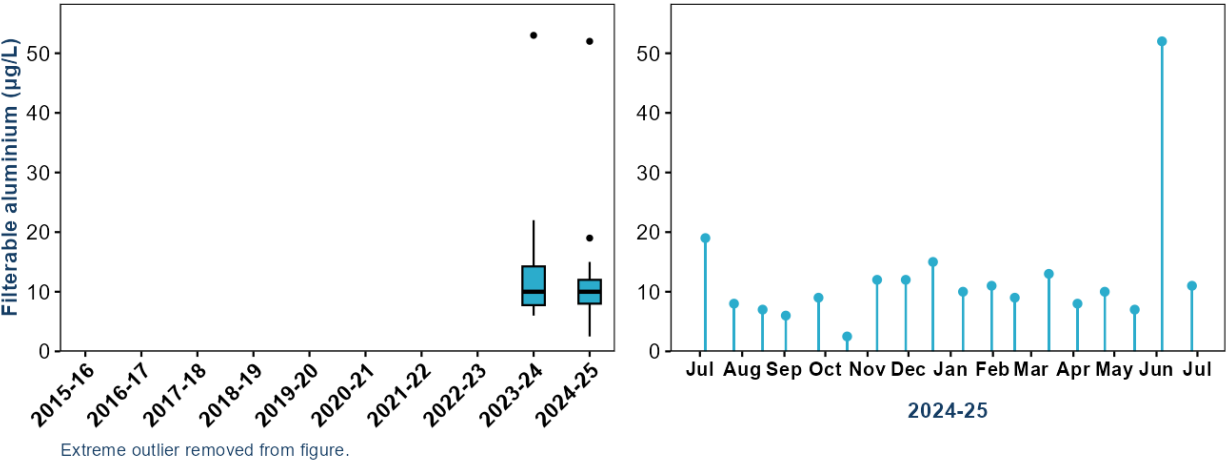
NB11



Stressors – Trace metals

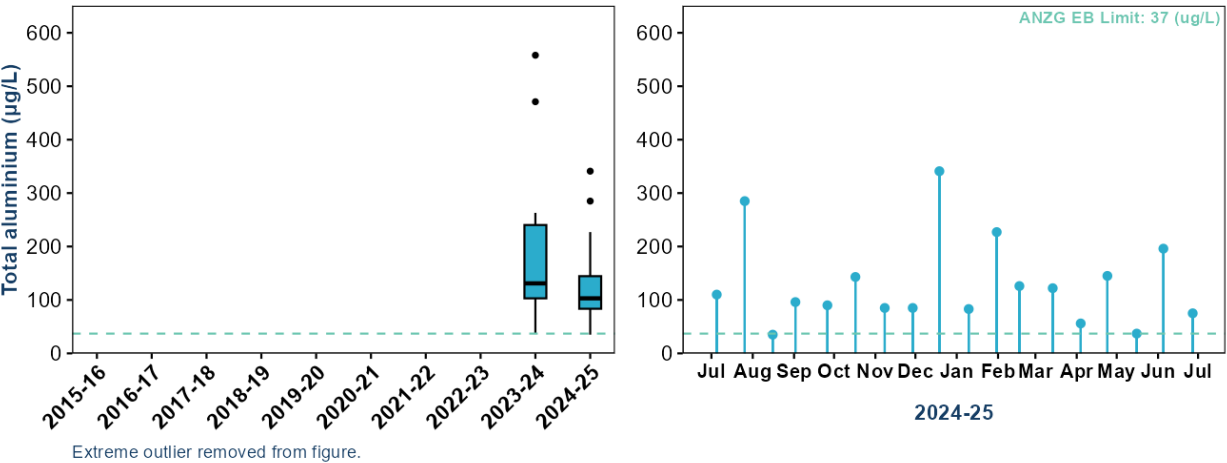
Berowra Creek off Square Bay as SoE Site

NB11



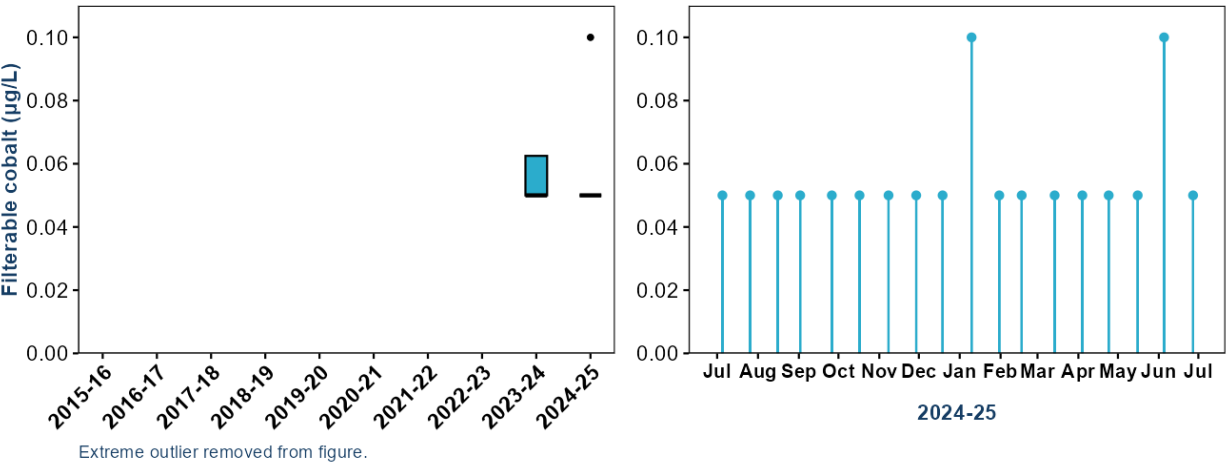
Berowra Creek off Square Bay as SoE Site

NB11



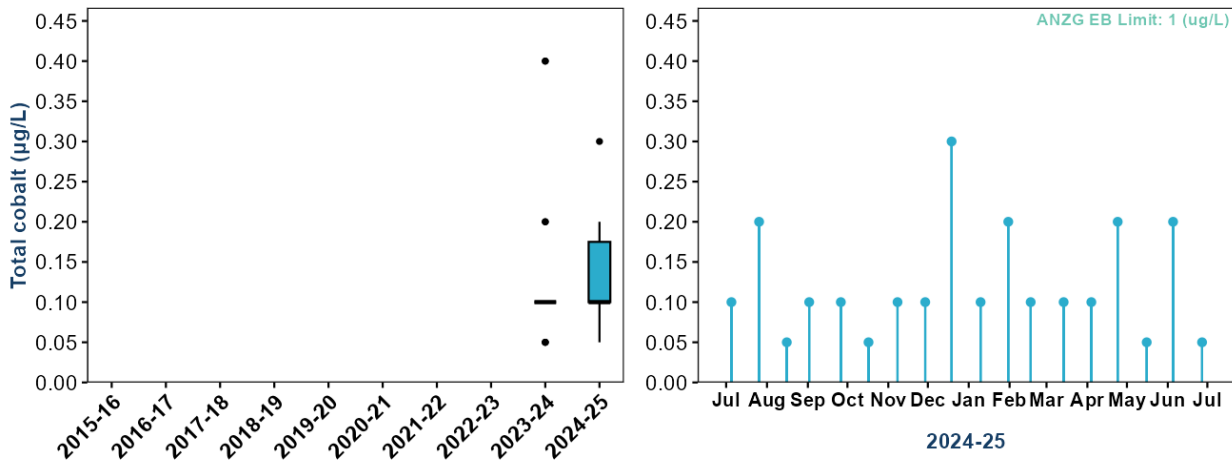
Berowra Creek off Square Bay as SoE Site

NB11



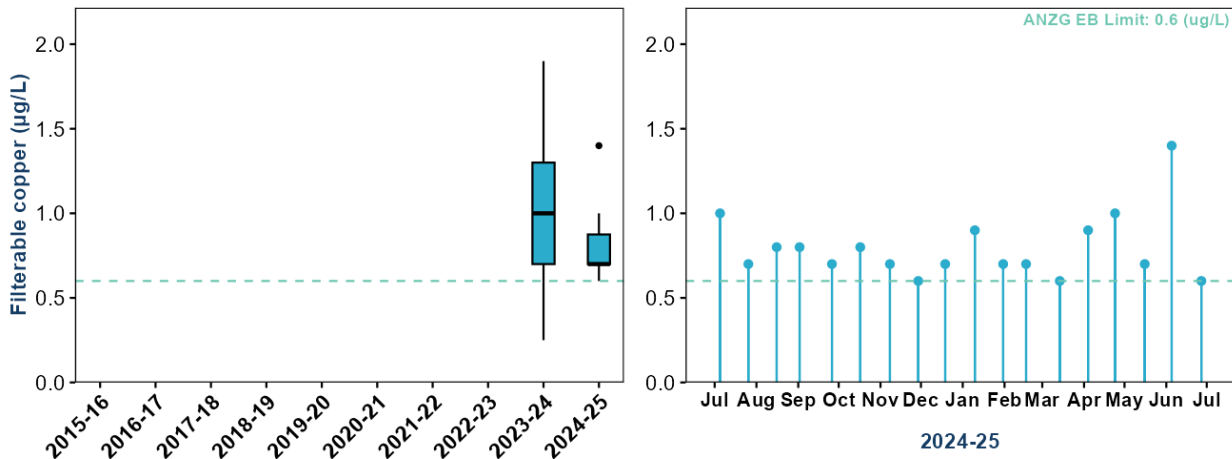
Berowra Creek off Square Bay as SoE Site

NB11



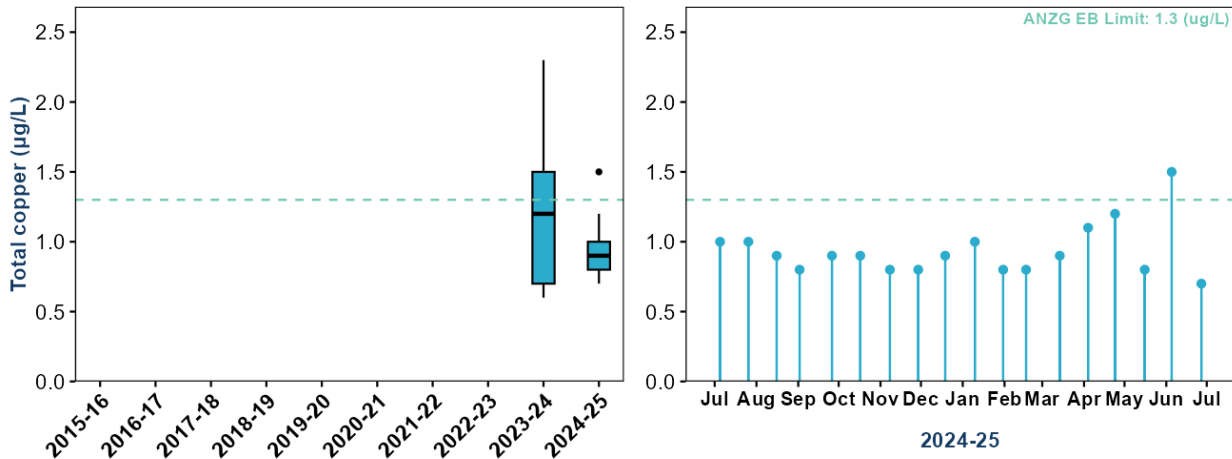
Berowra Creek off Square Bay as SoE Site

NB11



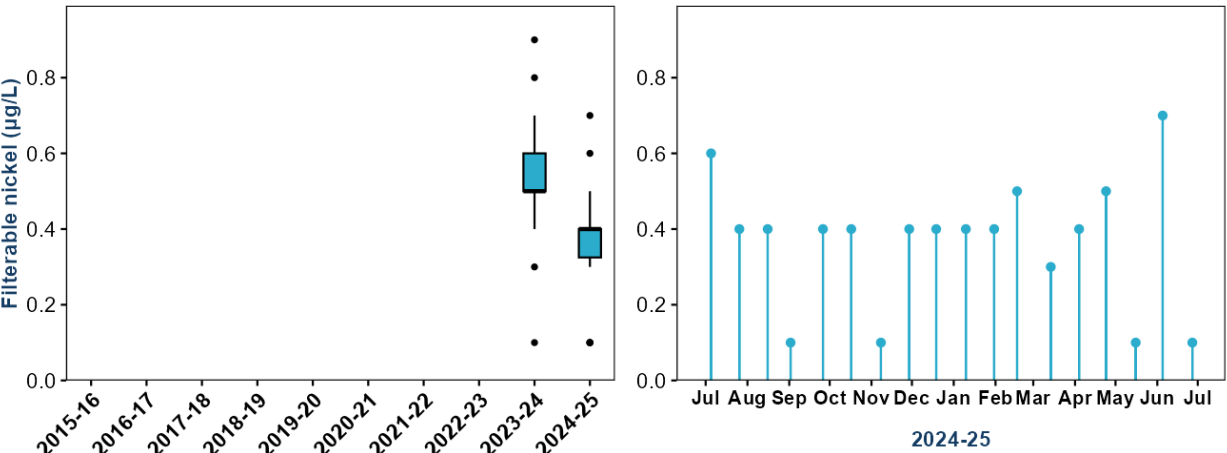
Berowra Creek off Square Bay as SoE Site

NB11



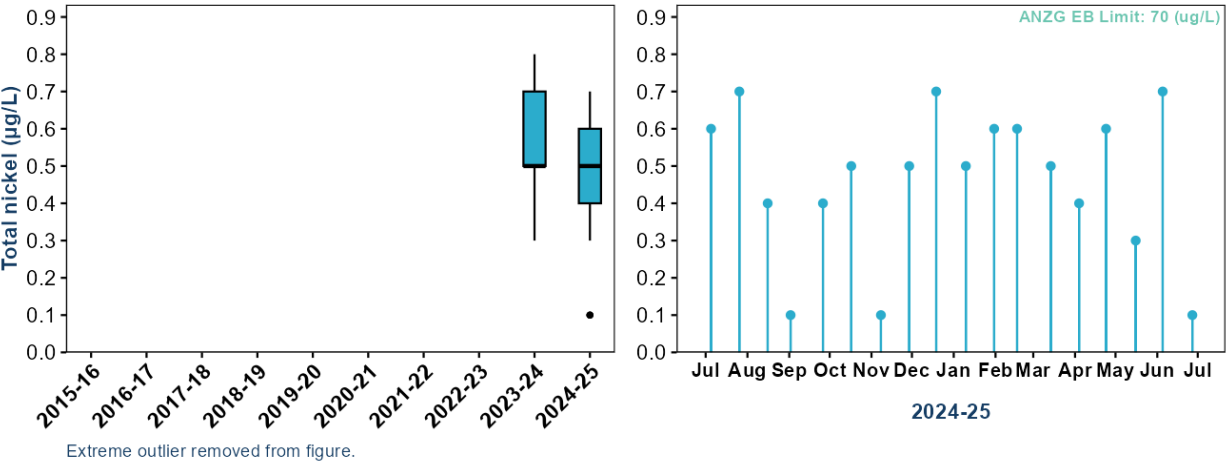
Berowra Creek off Square Bay as SoE Site

NB11



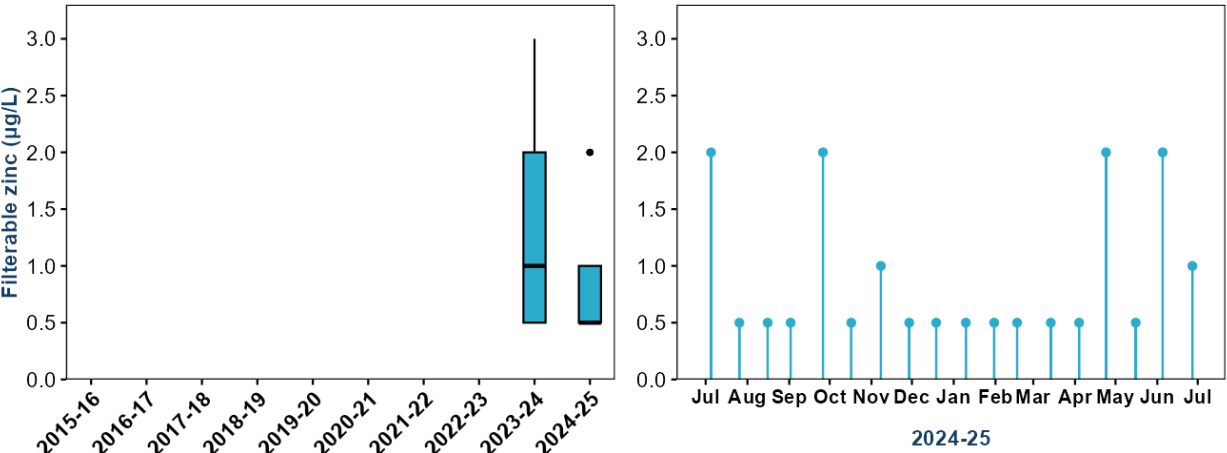
Berowra Creek off Square Bay as SoE Site

NB11



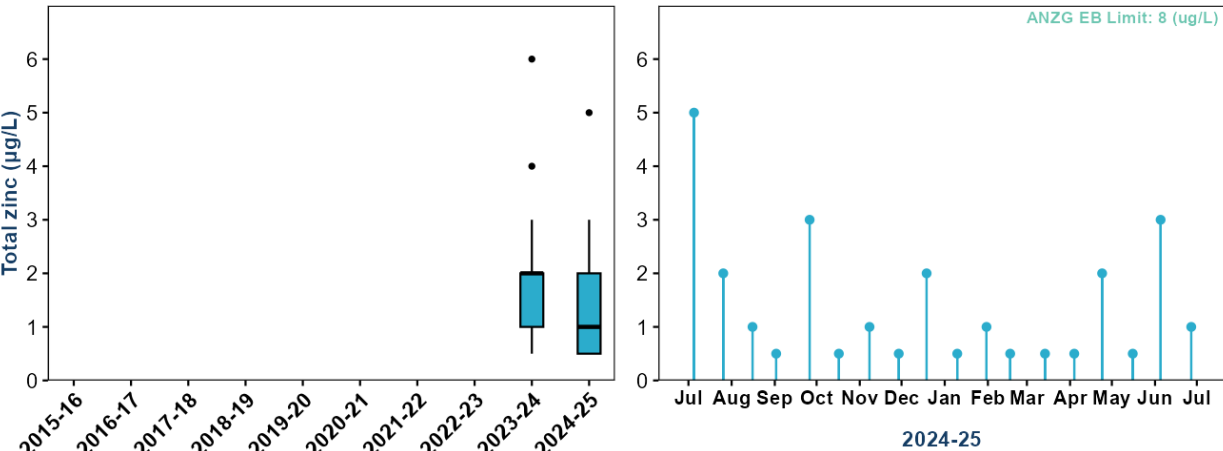
Berowra Creek off Square Bay as SoE Site

NB11



Berowra Creek off Square Bay as SoE Site

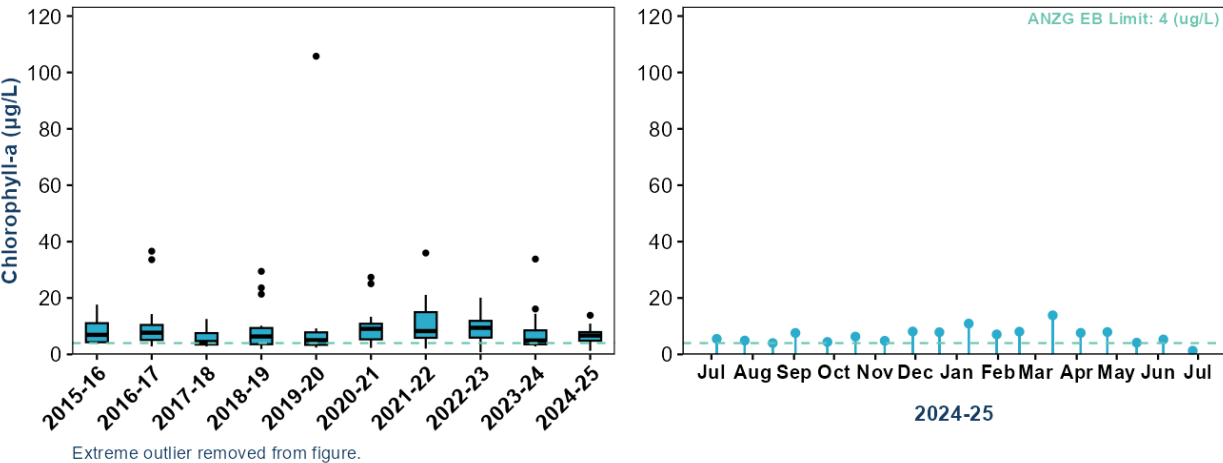
NB11



Ecosystem receptor – Phytoplankton

Berowra Creek off Square Bay as SoE Site

NB11



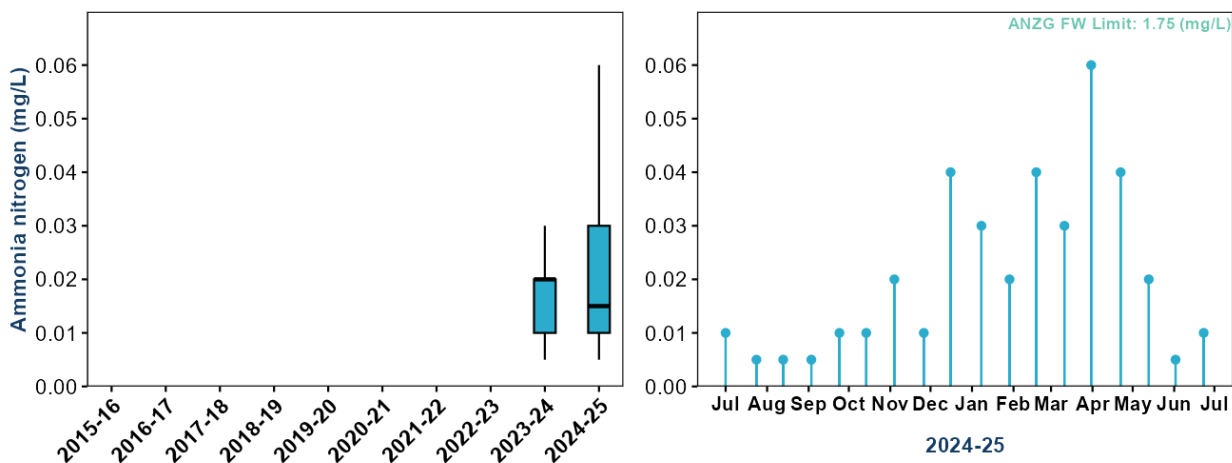
C.2. Water quality – Other HN River sites

C.2.1. N92A Nepean River downstream of Maldon Weir

Stressors – Nutrients

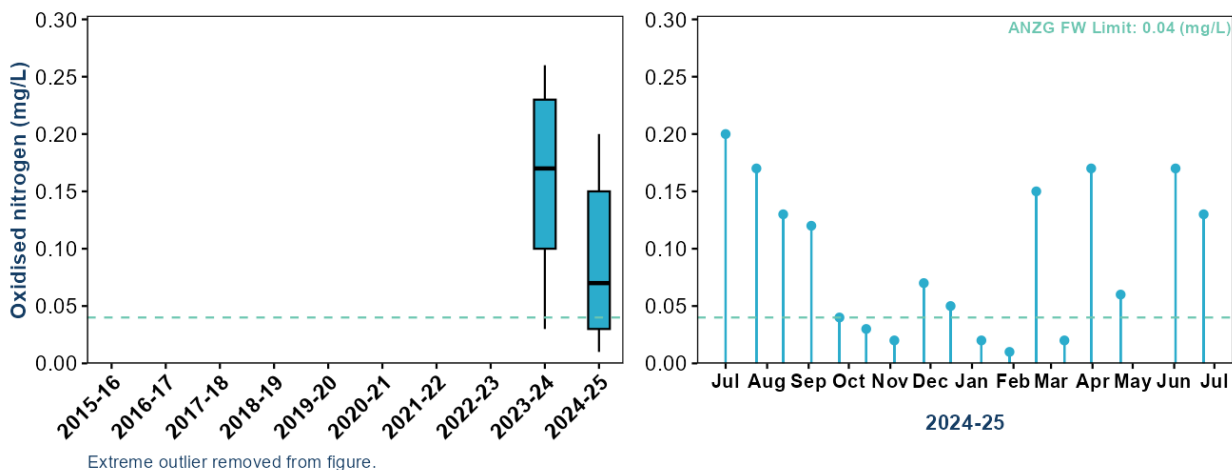
Nepean River Downstream of Maldon Weir as SoE Site

■ N92A



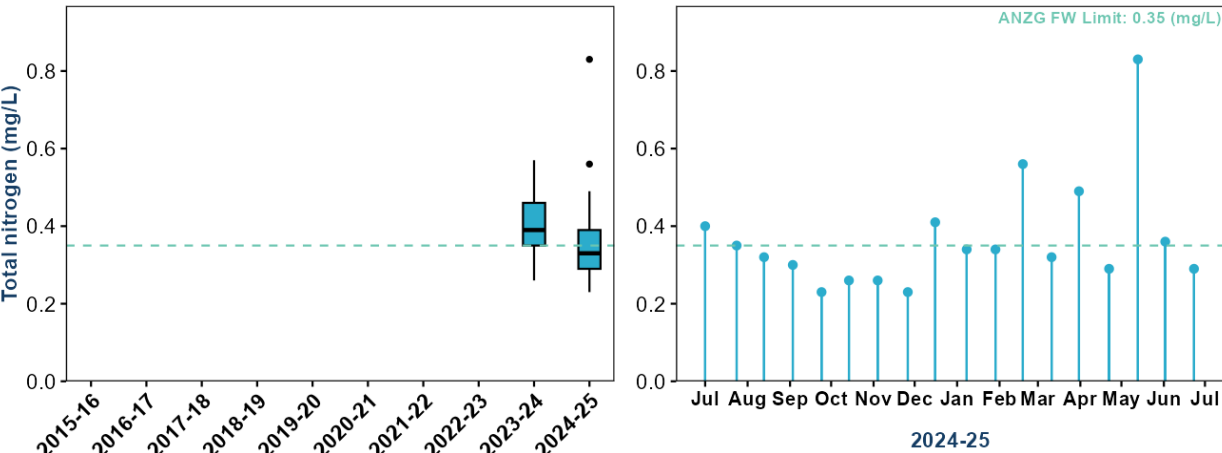
Nepean River Downstream of Maldon Weir as SoE Site

■ N92A



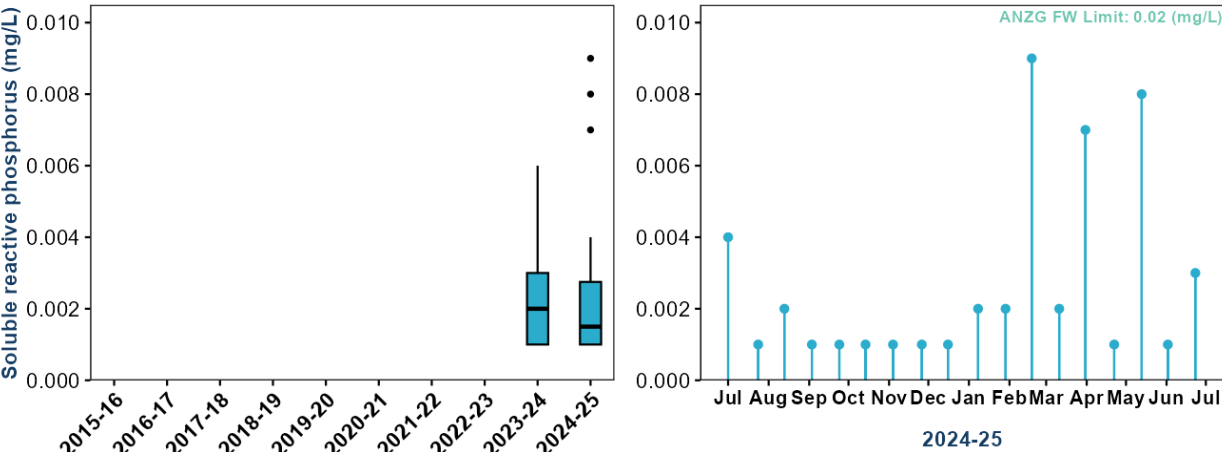
Nepean River Downstream of Maldon Weir as SoE Site

N92A



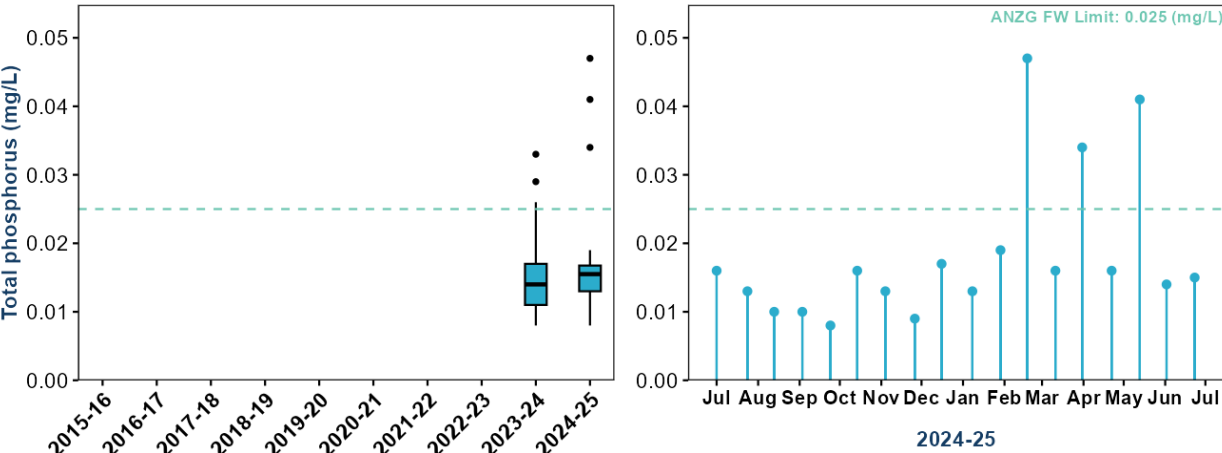
Nepean River Downstream of Maldon Weir as SoE Site

N92A



Nepean River Downstream of Maldon Weir as SoE Site

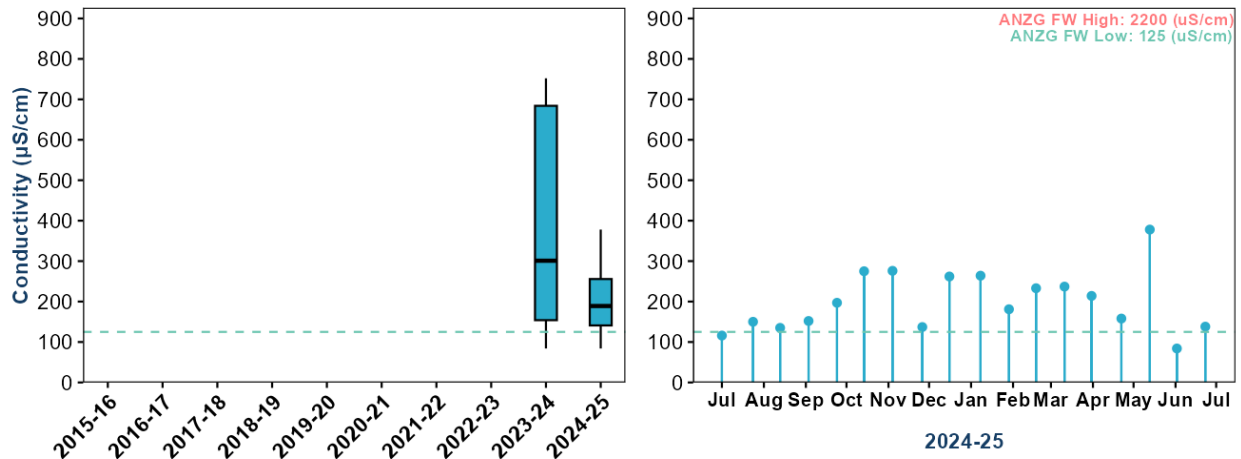
N92A



Stressors – Physico-chemical water quality

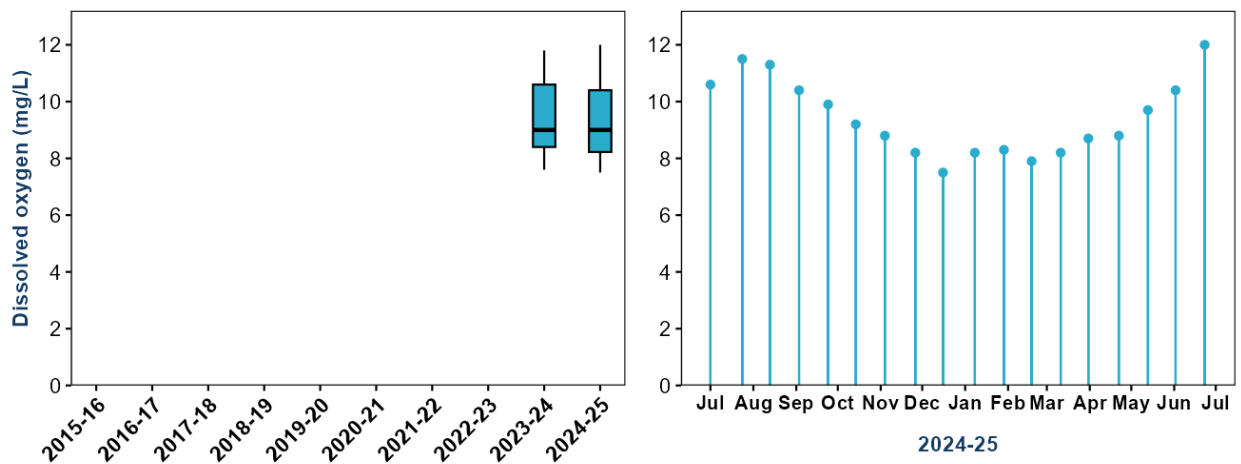
Nepean River Downstream of Maldon Weir as SoE Site

N92A



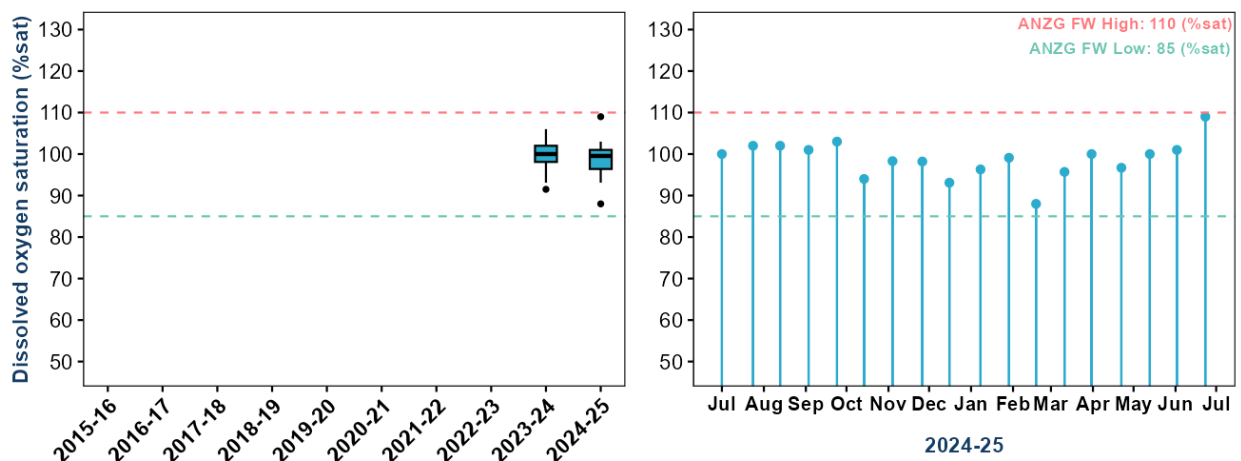
Nepean River Downstream of Maldon Weir as SoE Site

N92A



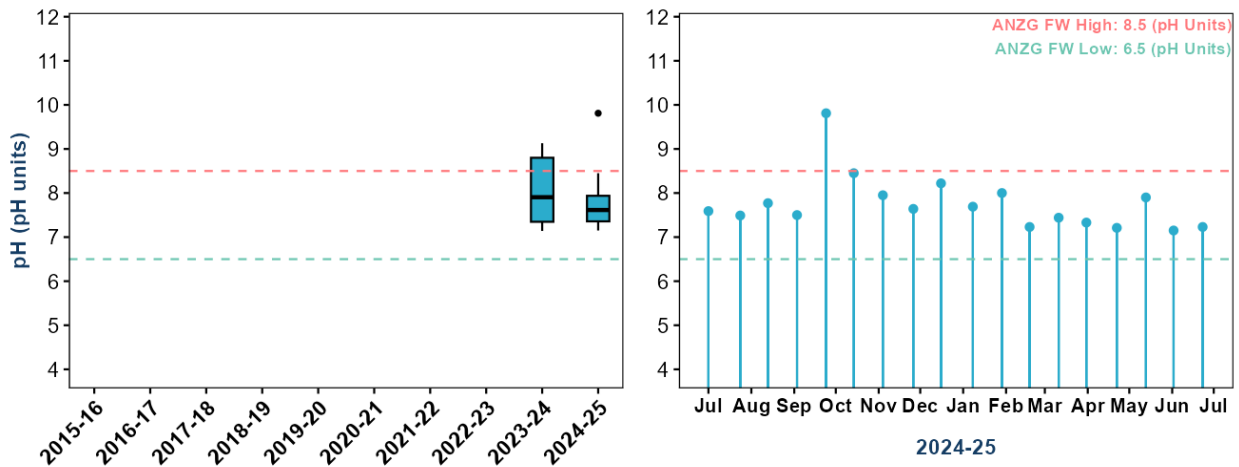
Nepean River Downstream of Maldon Weir as SoE Site

N92A



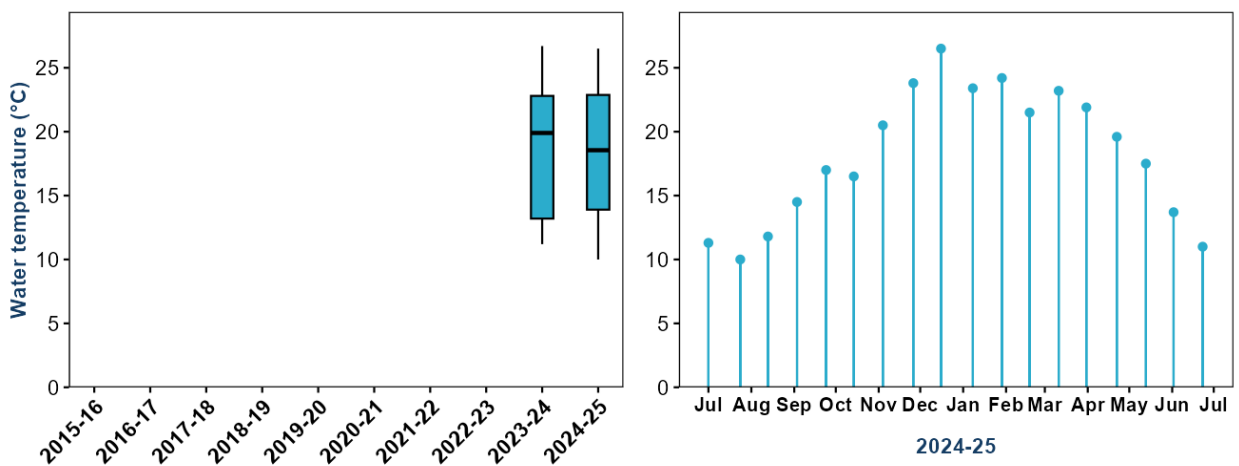
Nepean River Downstream of Maldon Weir as SoE Site

N92A



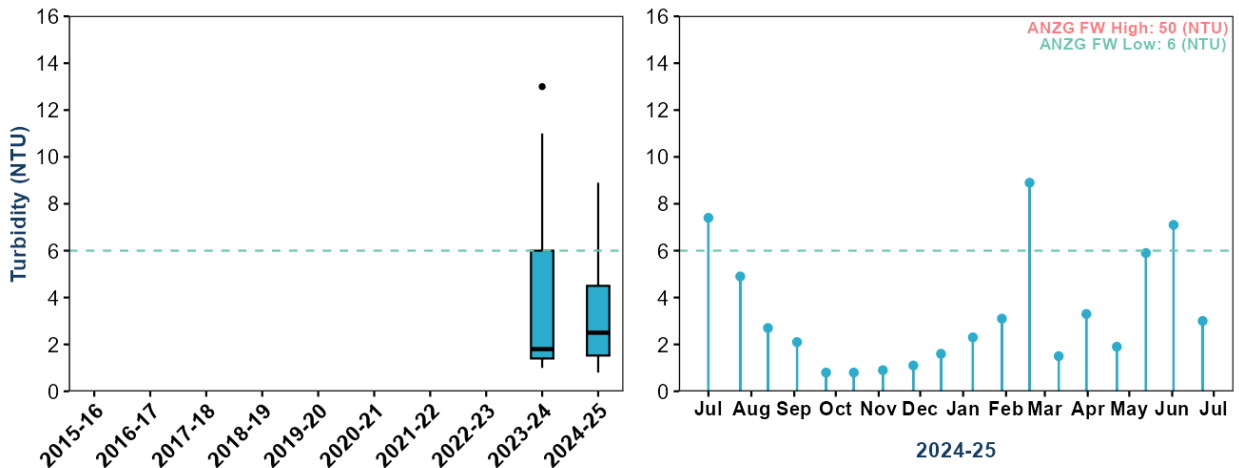
Nepean River Downstream of Maldon Weir as SoE Site

N92A



Nepean River Downstream of Maldon Weir as SoE Site

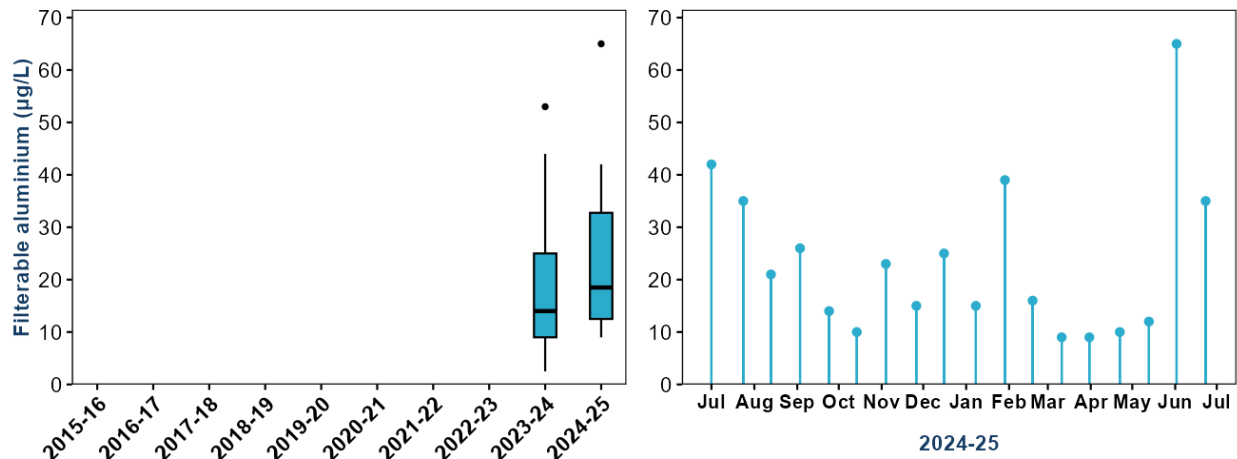
N92A



Stressors – Trace metals

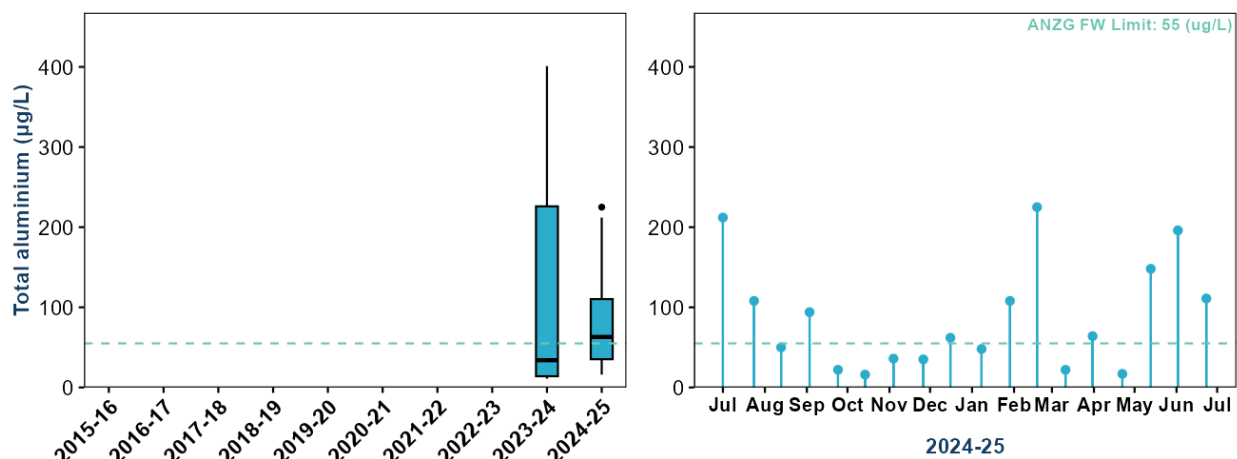
Nepean River Downstream of Maldon Weir as SoE Site

N92A



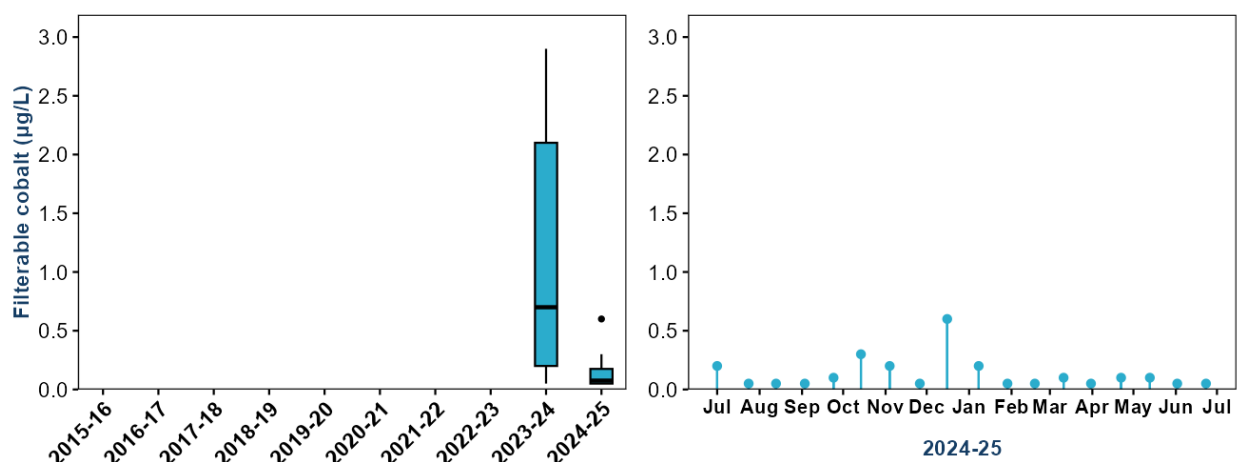
Nepean River Downstream of Maldon Weir as SoE Site

N92A



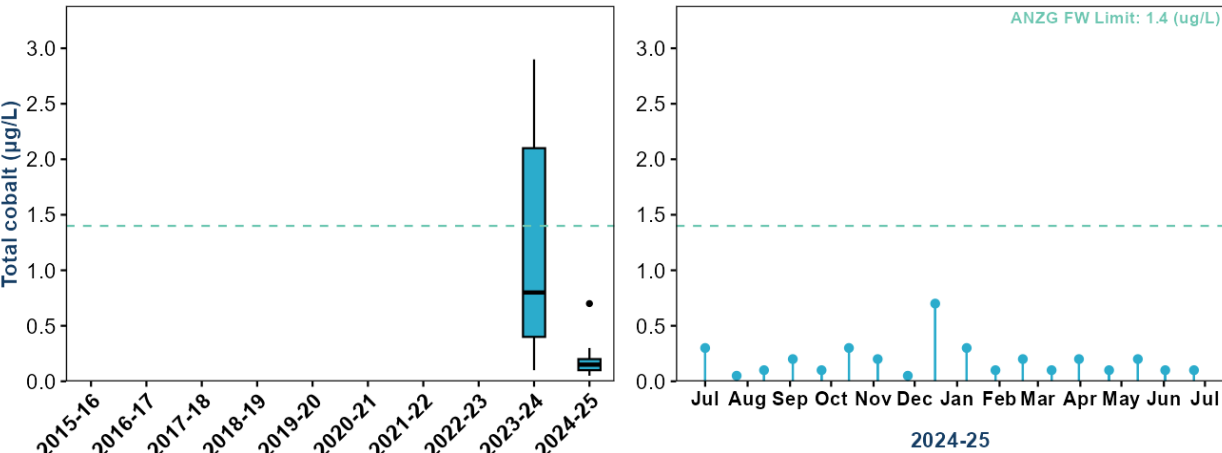
Nepean River Downstream of Maldon Weir as SoE Site

N92A



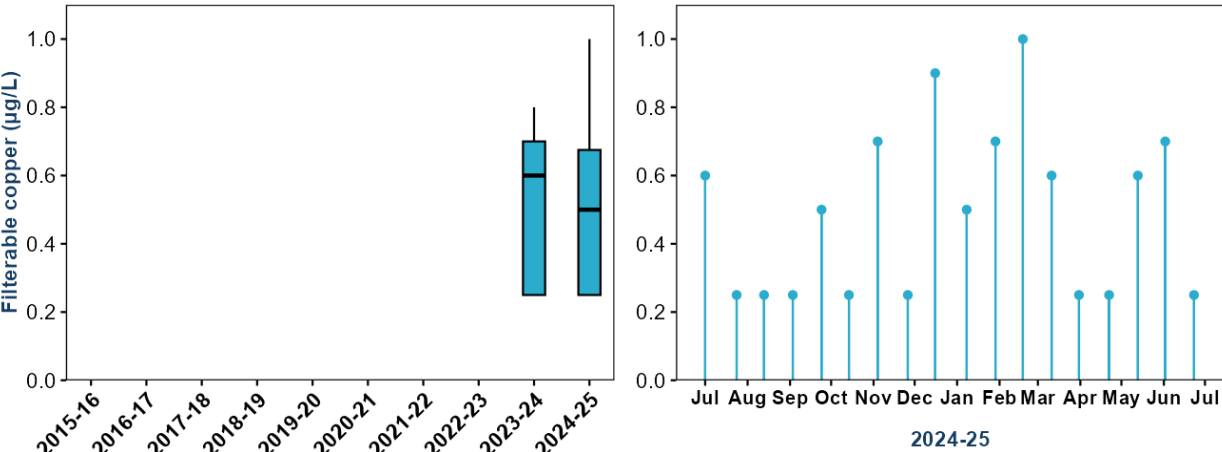
Nepean River Downstream of Maldon Weir as SoE Site

N92A



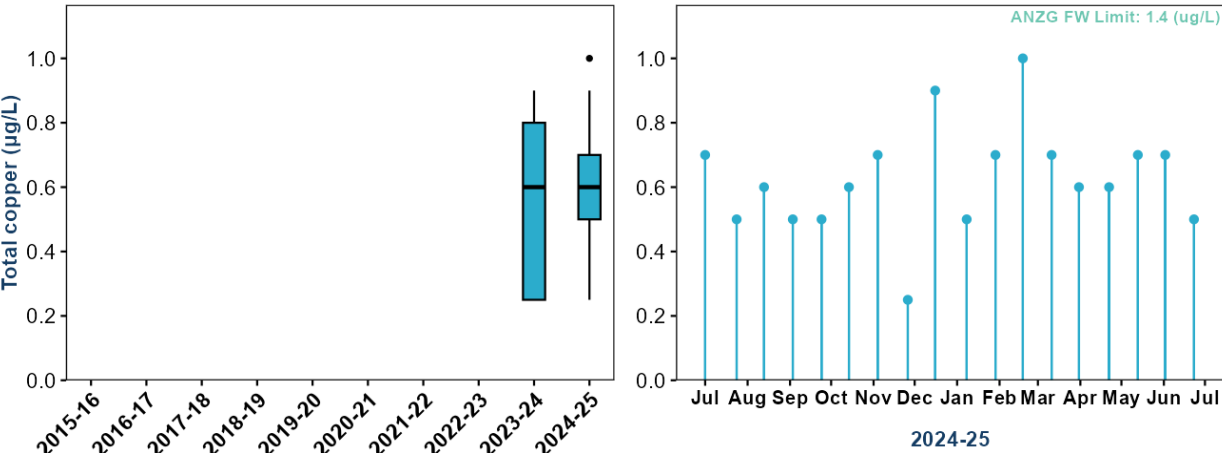
Nepean River Downstream of Maldon Weir as SoE Site

N92A



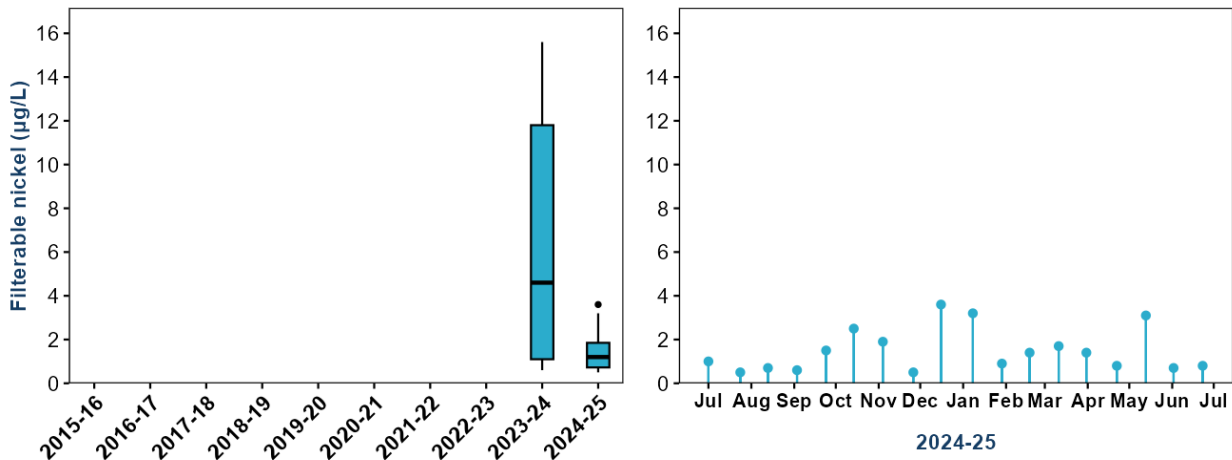
Nepean River Downstream of Maldon Weir as SoE Site

N92A



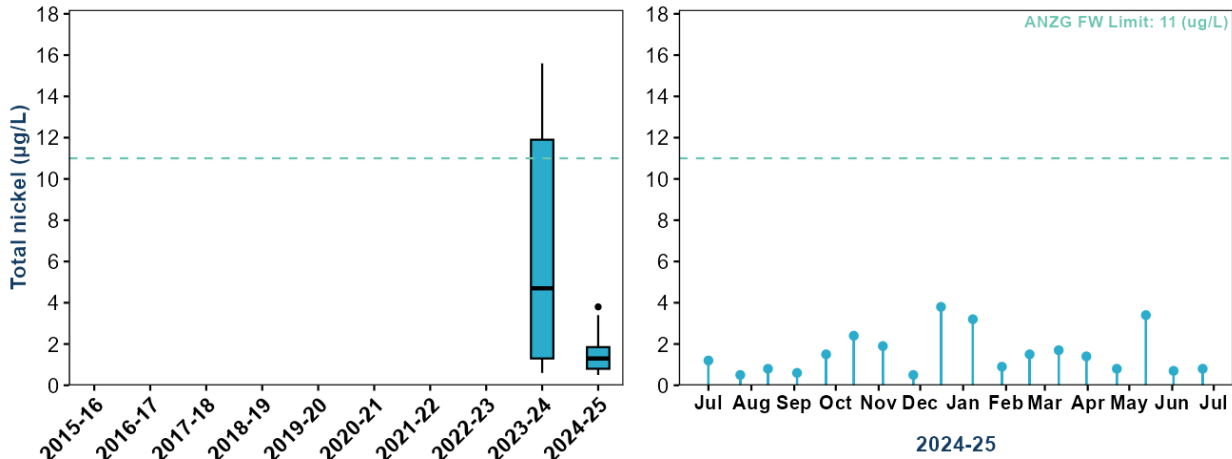
Nepean River Downstream of Maldon Weir as SoE Site

N92A



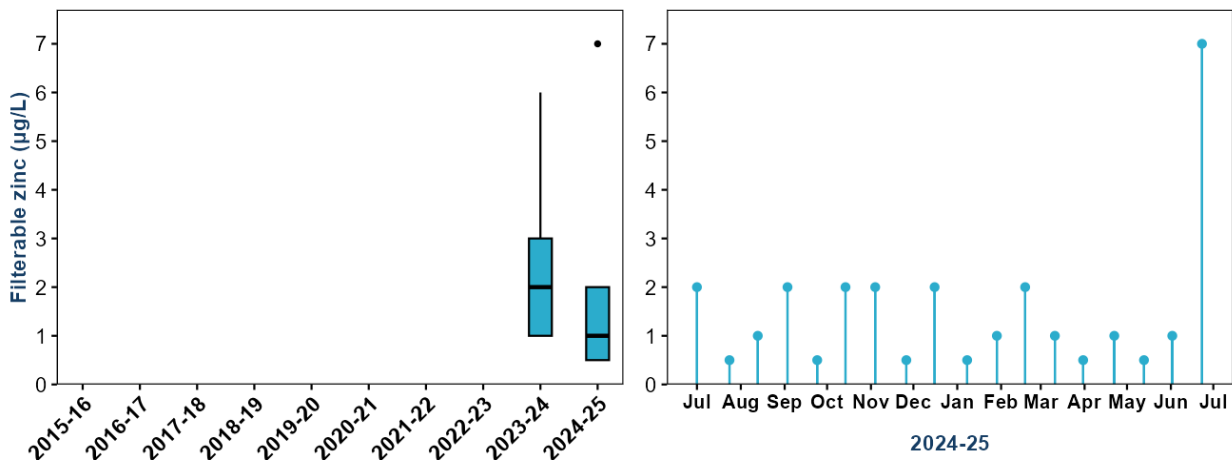
Nepean River Downstream of Maldon Weir as SoE Site

N92A



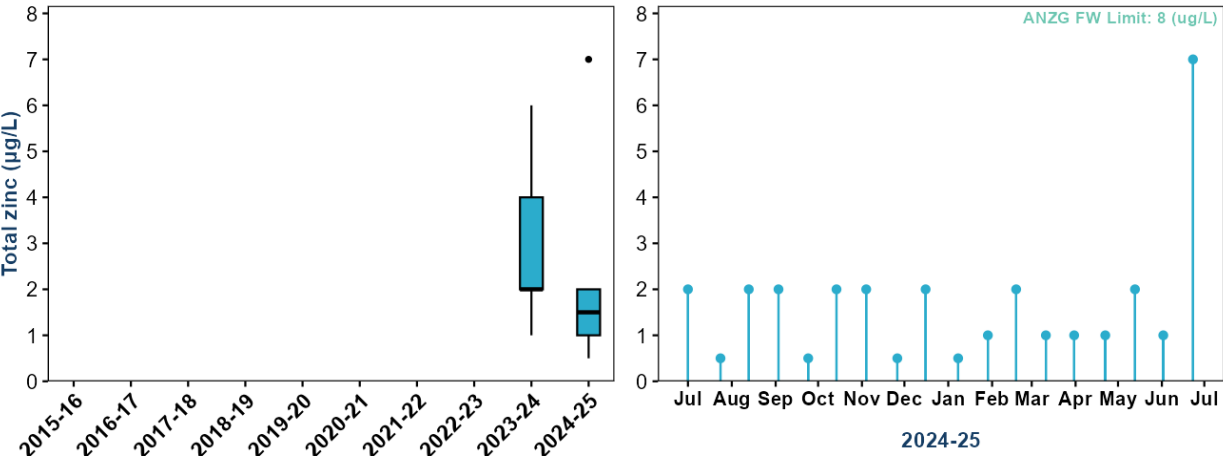
Nepean River Downstream of Maldon Weir as SoE Site

N92A



Nepean River Downstream of Maldon Weir as SoE Site

N92A

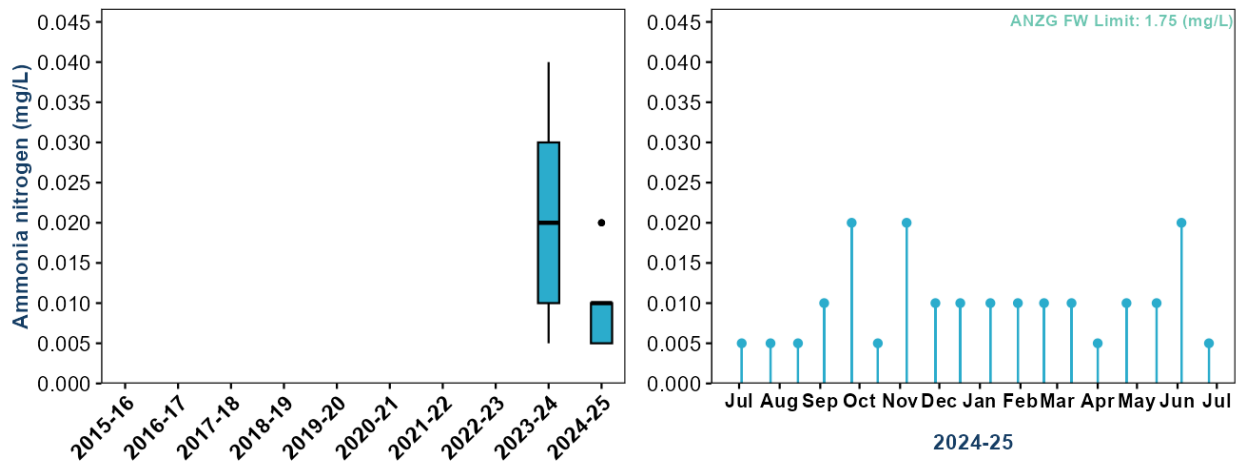


C.2.2. N57A Nepean River downstream of Penrith Weir

Stressors – nutrients

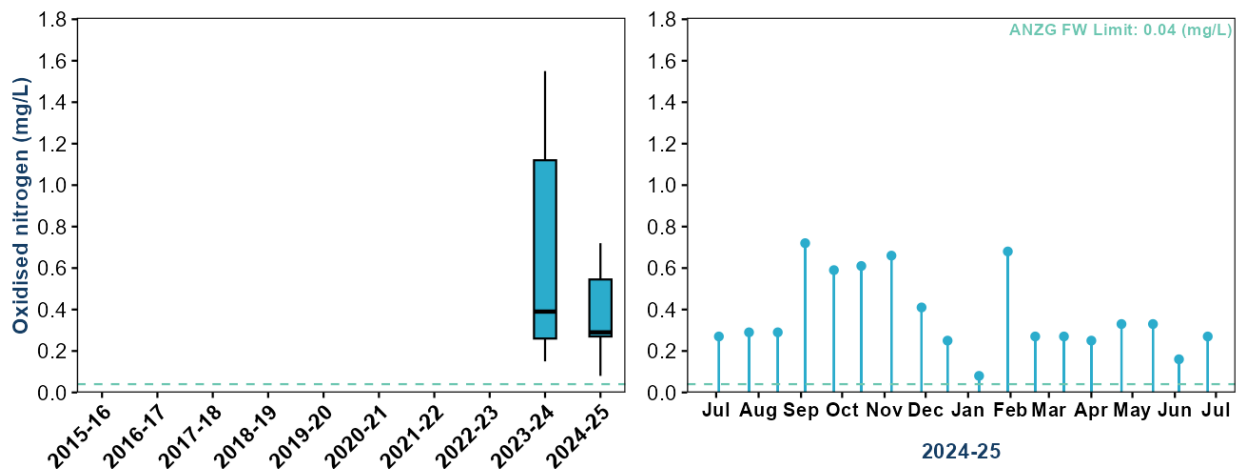
Nepean River Downstream of Penrith Weir as SoE Site

■ N57A



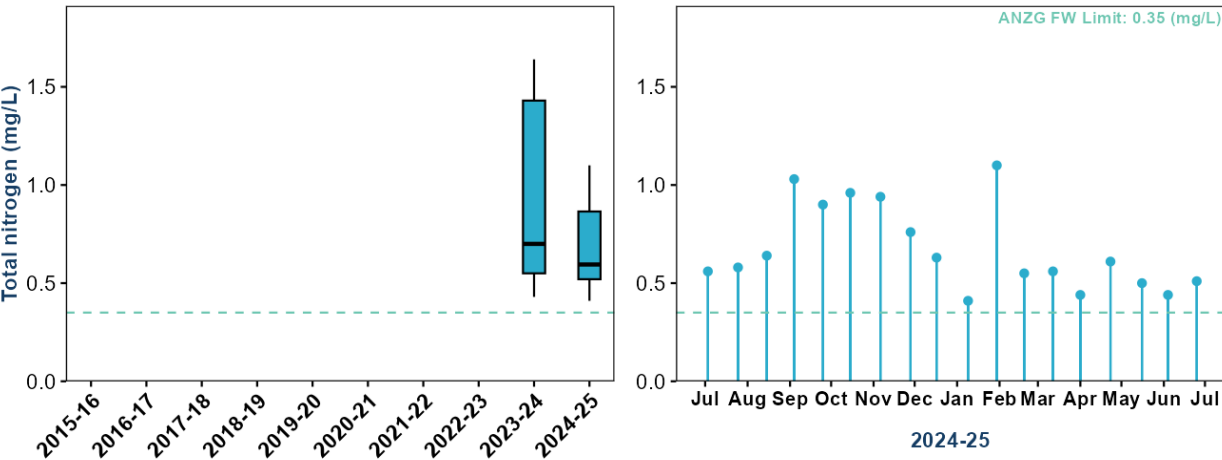
Nepean River Downstream of Penrith Weir as SoE Site

■ N57A



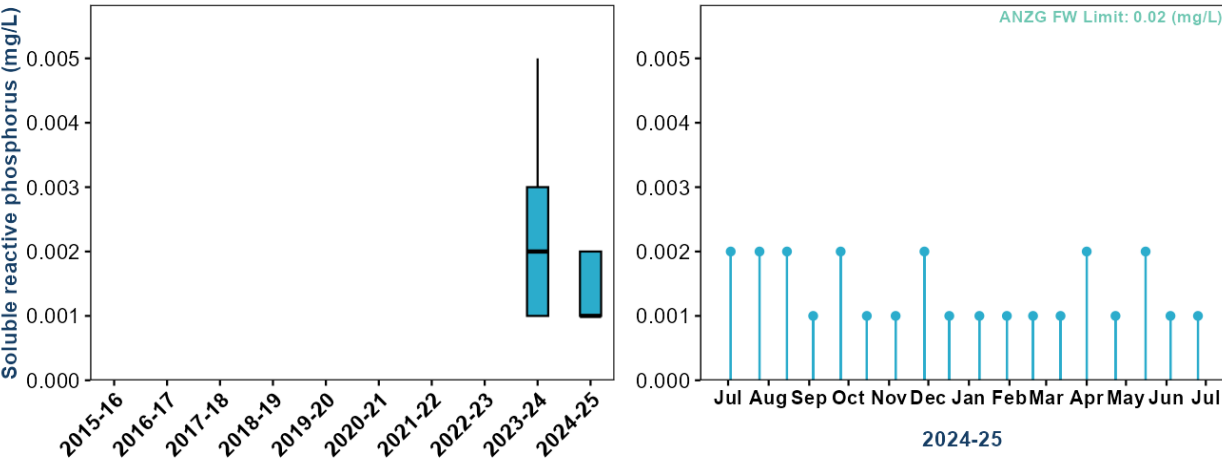
Nepean River Downstream of Penrith Weir as SoE Site

N57A



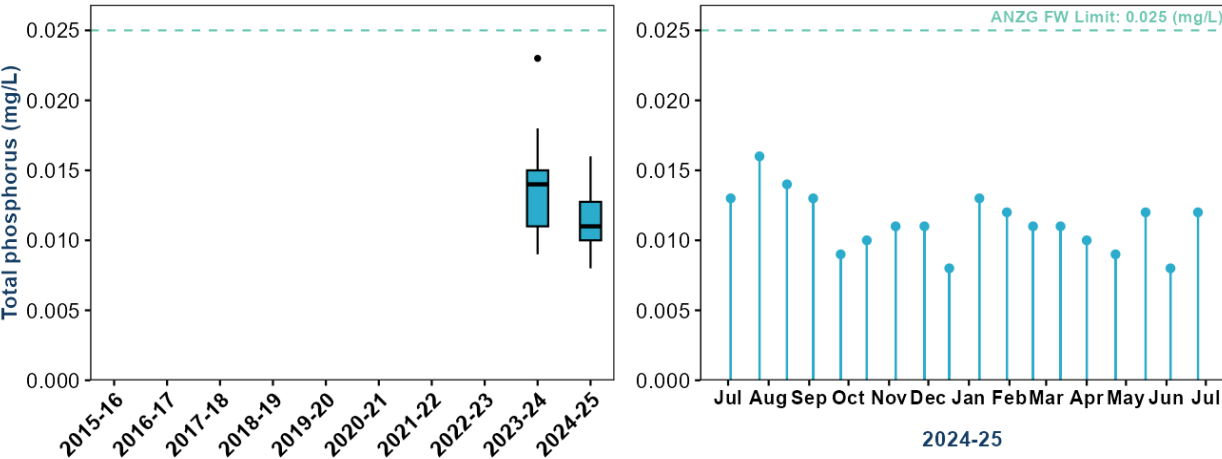
Nepean River Downstream of Penrith Weir as SoE Site

N57A



Nepean River Downstream of Penrith Weir as SoE Site

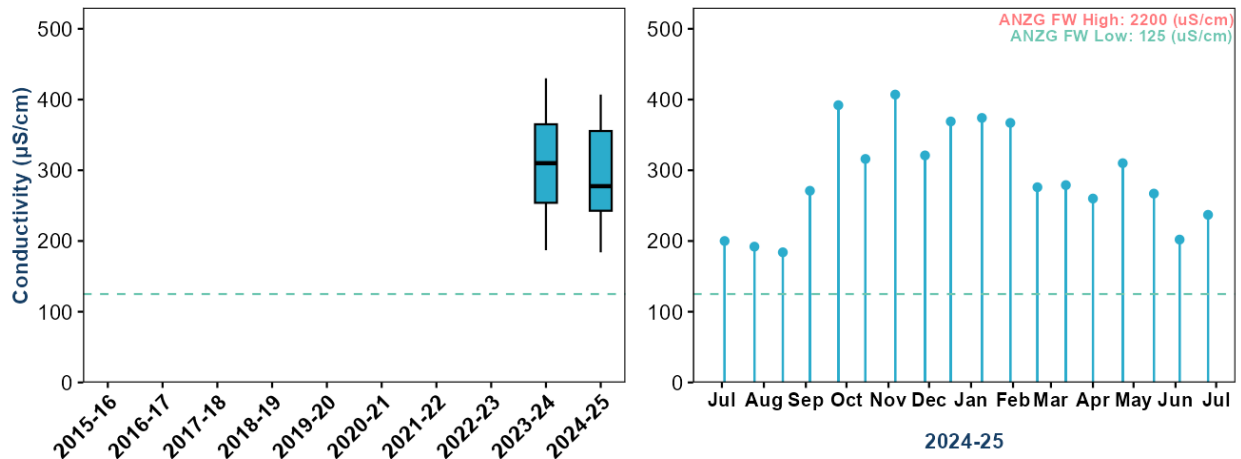
N57A



Stressors – Physico-chemical water quality

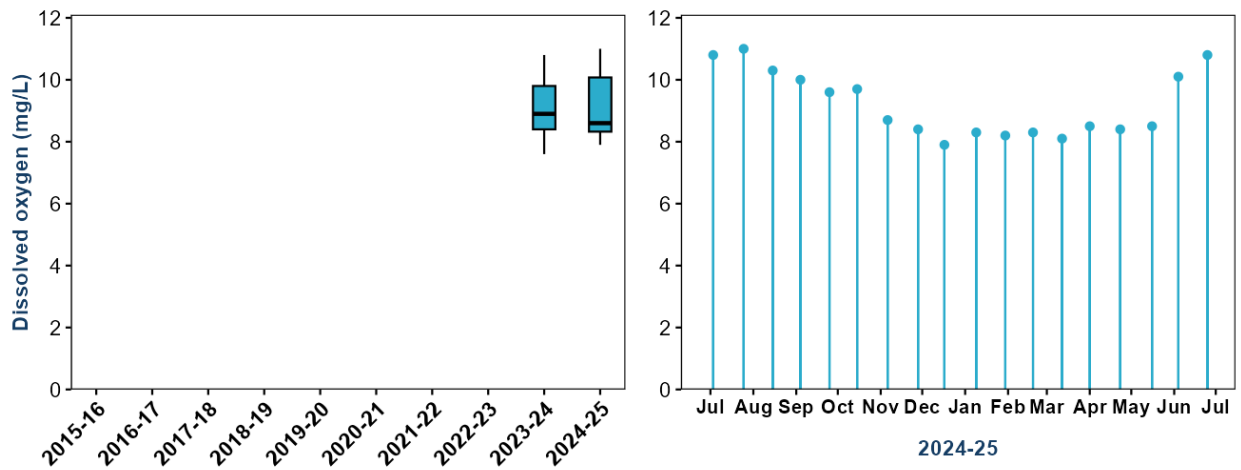
Nepean River Downstream of Penrith Weir as SoE Site

N57A



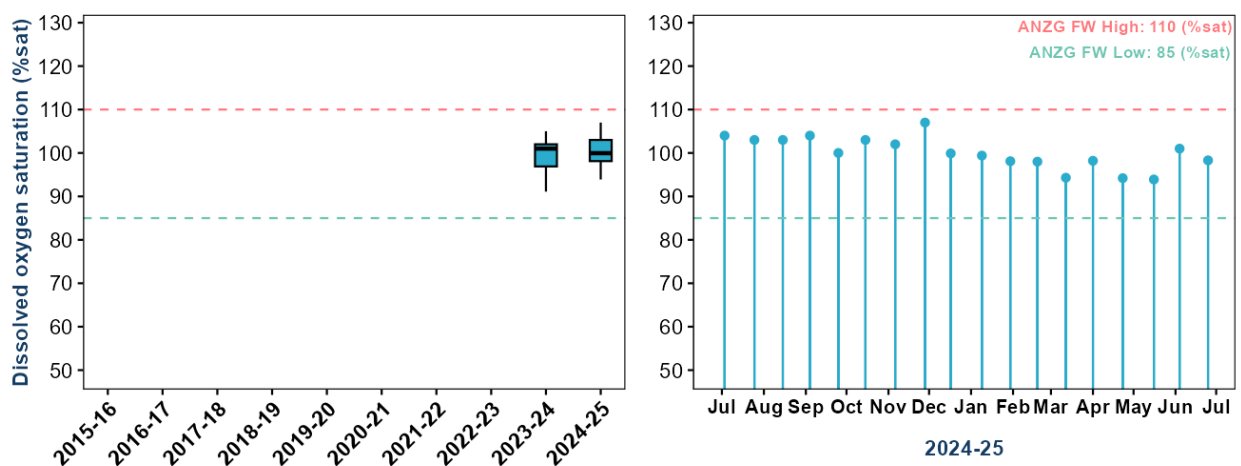
Nepean River Downstream of Penrith Weir as SoE Site

N57A



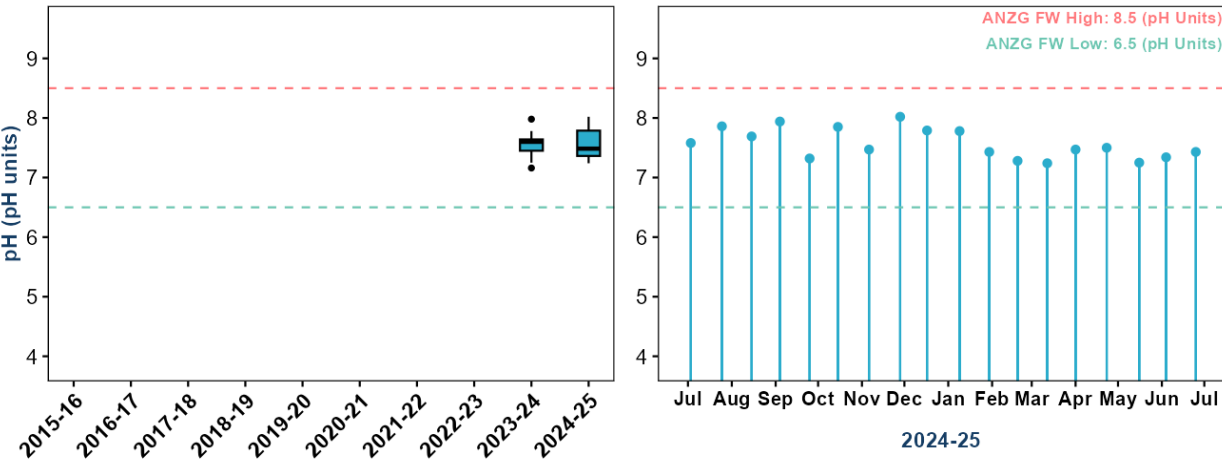
Nepean River Downstream of Penrith Weir as SoE Site

N57A



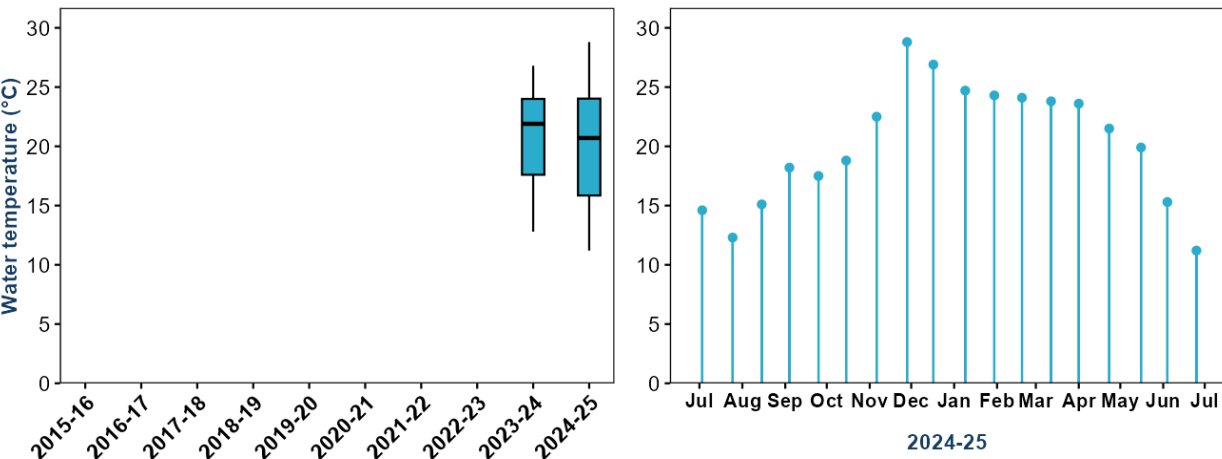
Nepean River Downstream of Penrith Weir as SoE Site

N57A



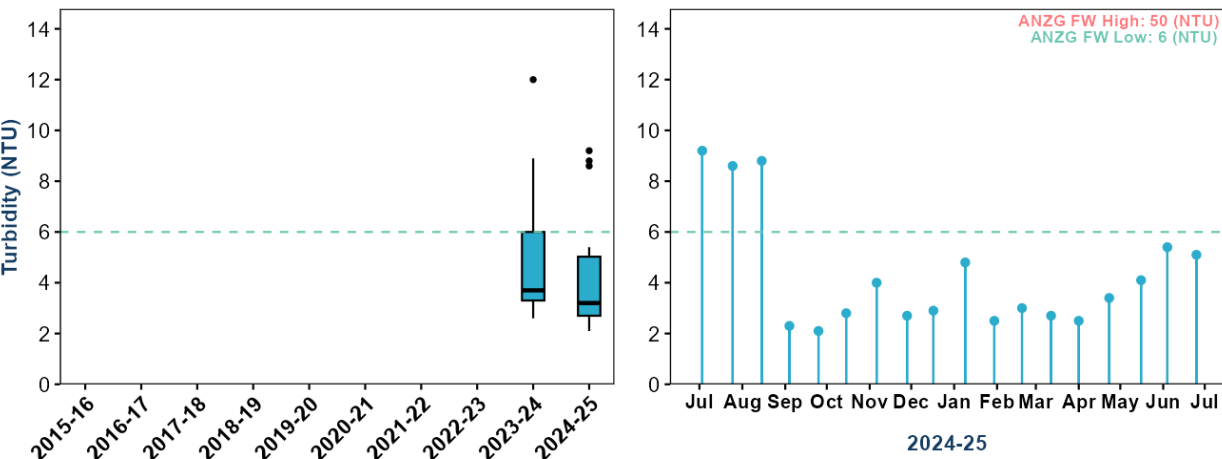
Nepean River Downstream of Penrith Weir as SoE Site

N57A



Nepean River Downstream of Penrith Weir as SoE Site

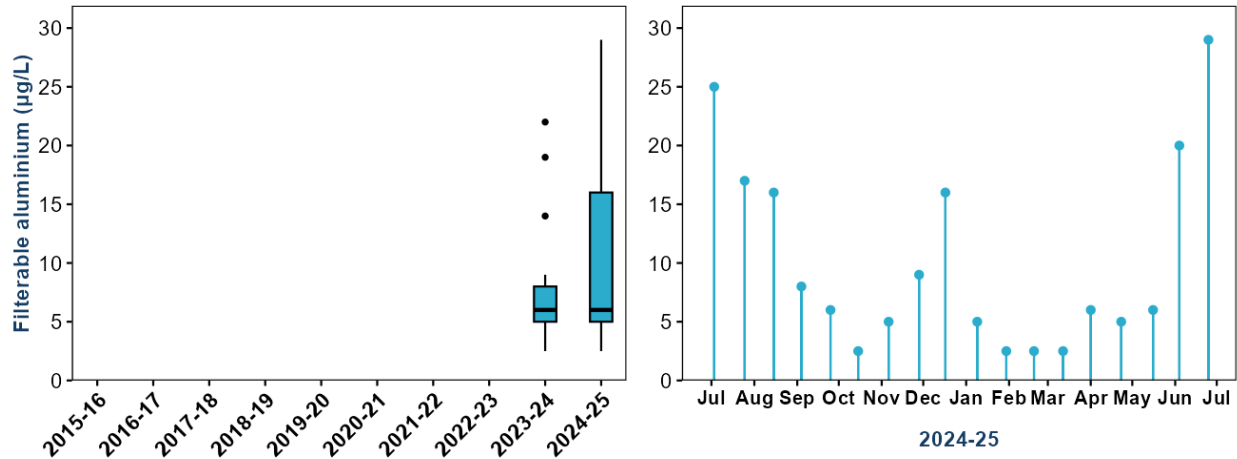
N57A



Stressors – Trace metals

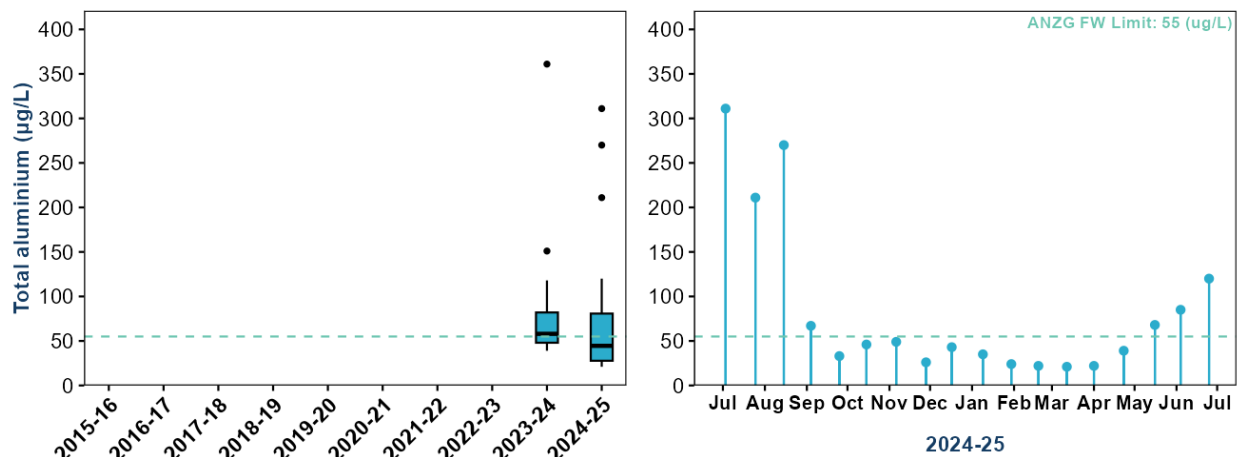
Nepean River Downstream of Penrith Weir as SoE Site

N57A



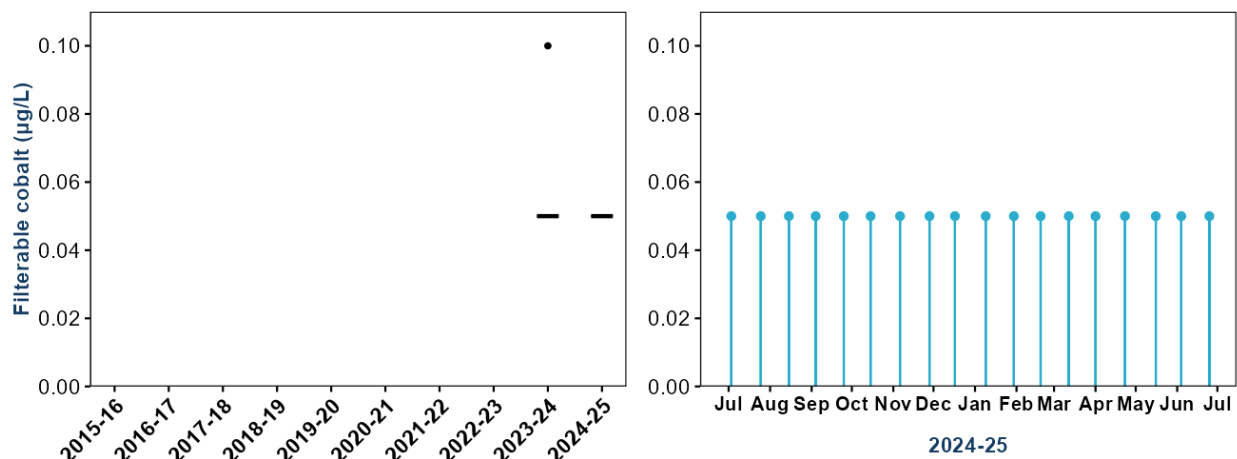
Nepean River Downstream of Penrith Weir as SoE Site

N57A

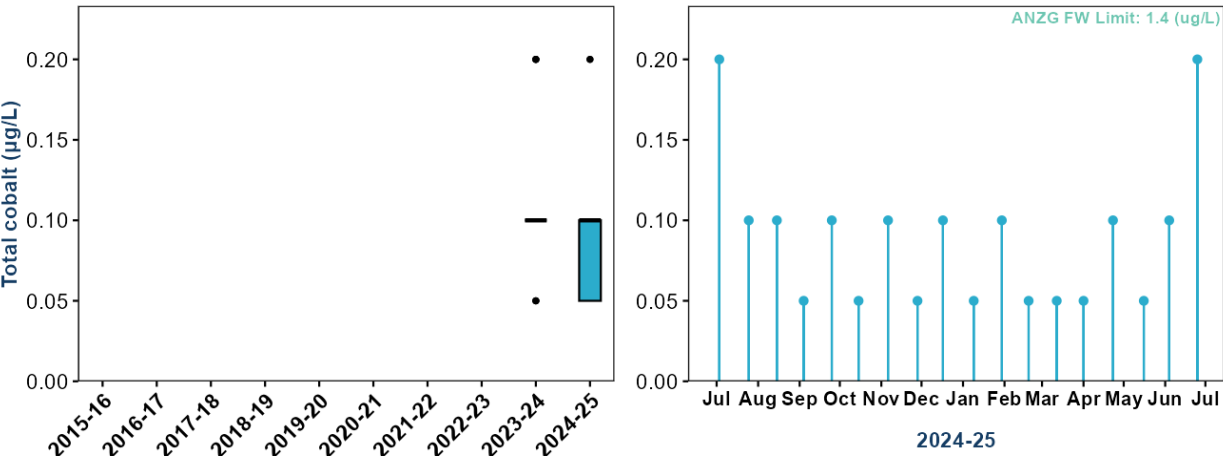


Nepean River Downstream of Penrith Weir as SoE Site

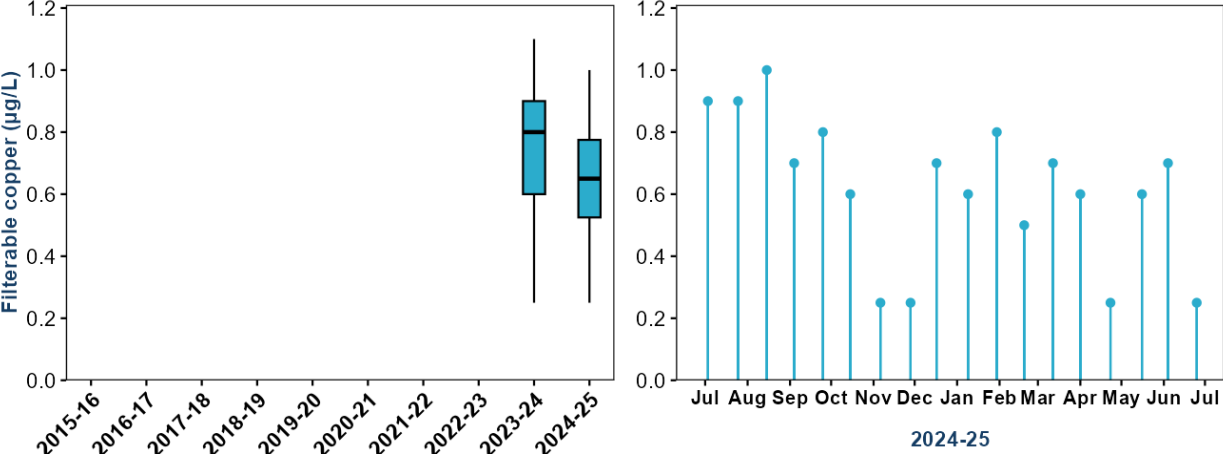
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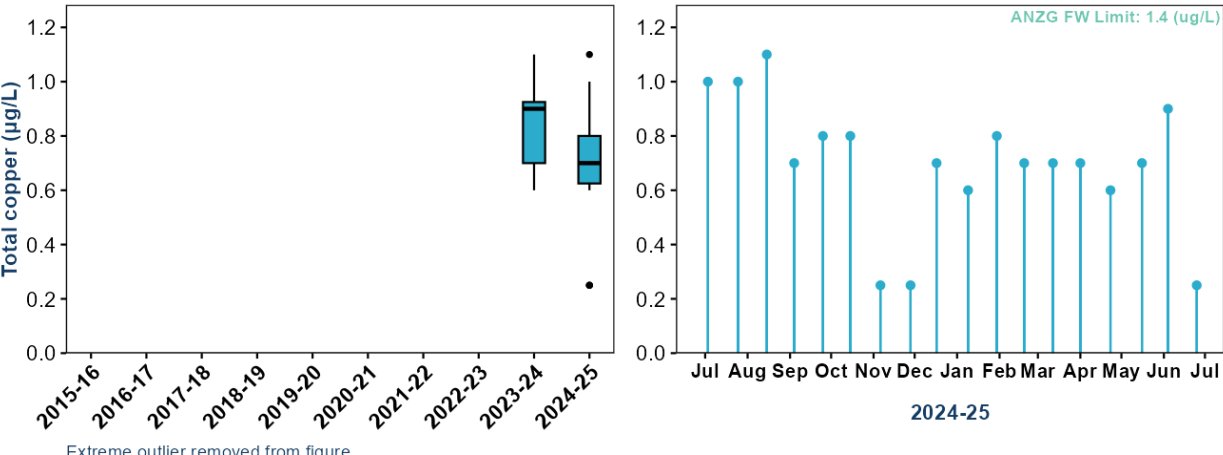
Nepean River Downstream of Penrith Weir as SoE Site



Nepean River Downstream of Penrith Weir as SoE Site



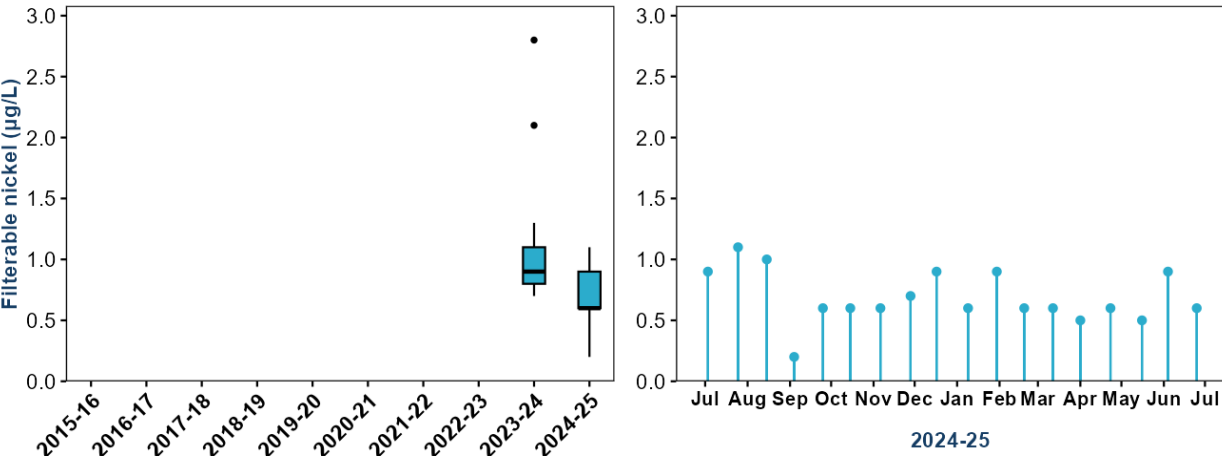
Nepean River Downstream of Penrith Weir as SoE Site



Extreme outlier removed from figure.

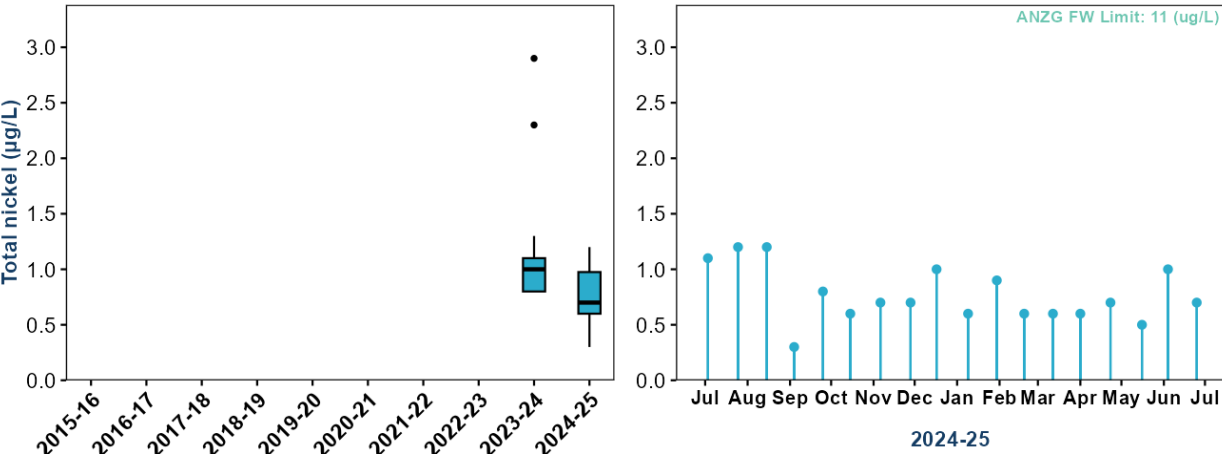
Nepean River Downstream of Penrith Weir as SoE Site

N57A



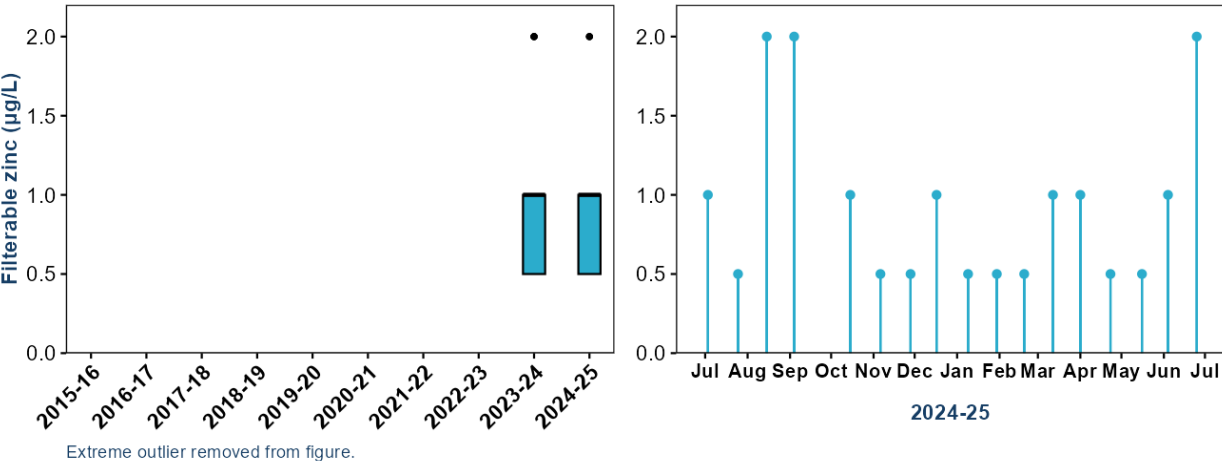
Nepean River Downstream of Penrith Weir as SoE Site

N57A



Nepean River Downstream of Penrith Weir as SoE Site

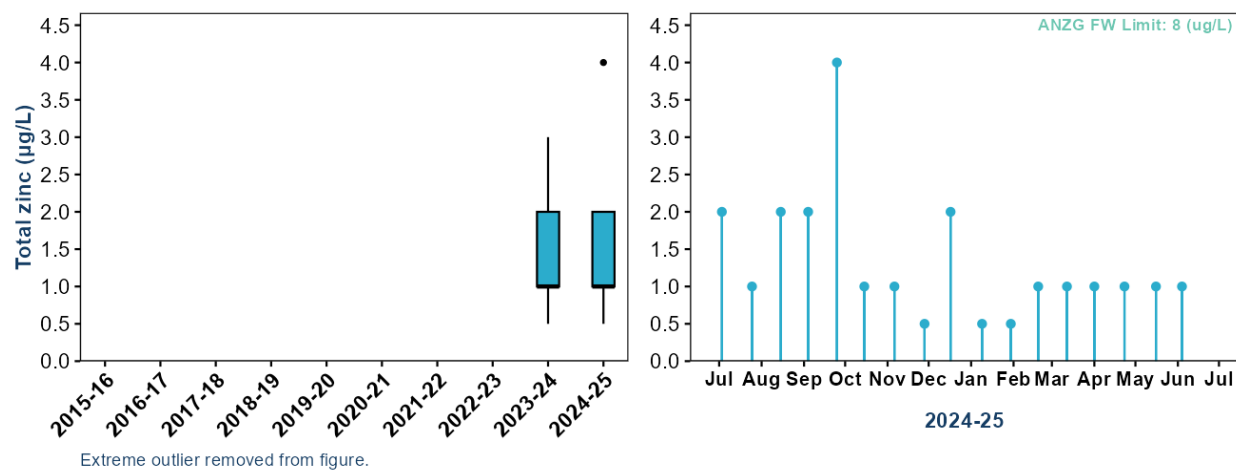
N57A



Extreme outlier removed from figure.

Nepean River Downstream of Penrith Weir as SoE Site

N57A

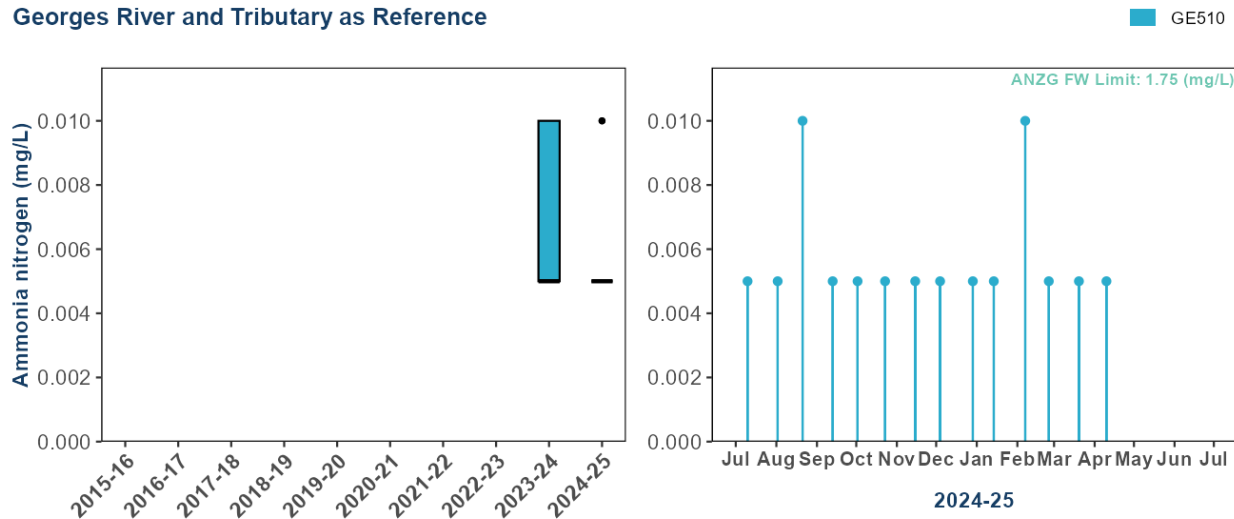


C.3. Water quality – freshwater reference sites

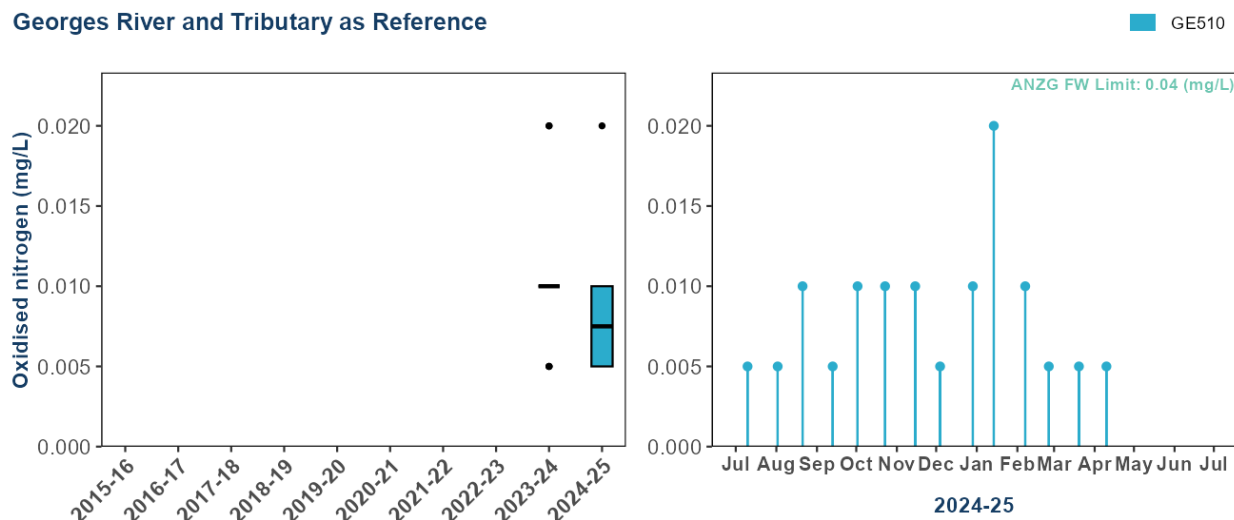
C.3.1. GE510 O'Hares Creek u/s confluence with Georges River

Stressors – Nutrients

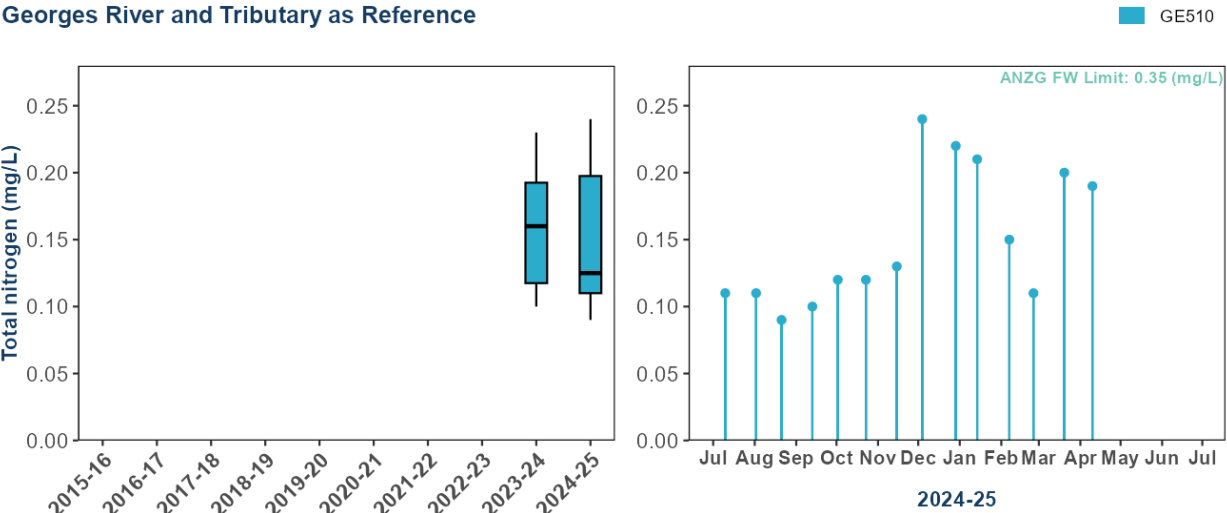
Georges River and Tributary as Reference



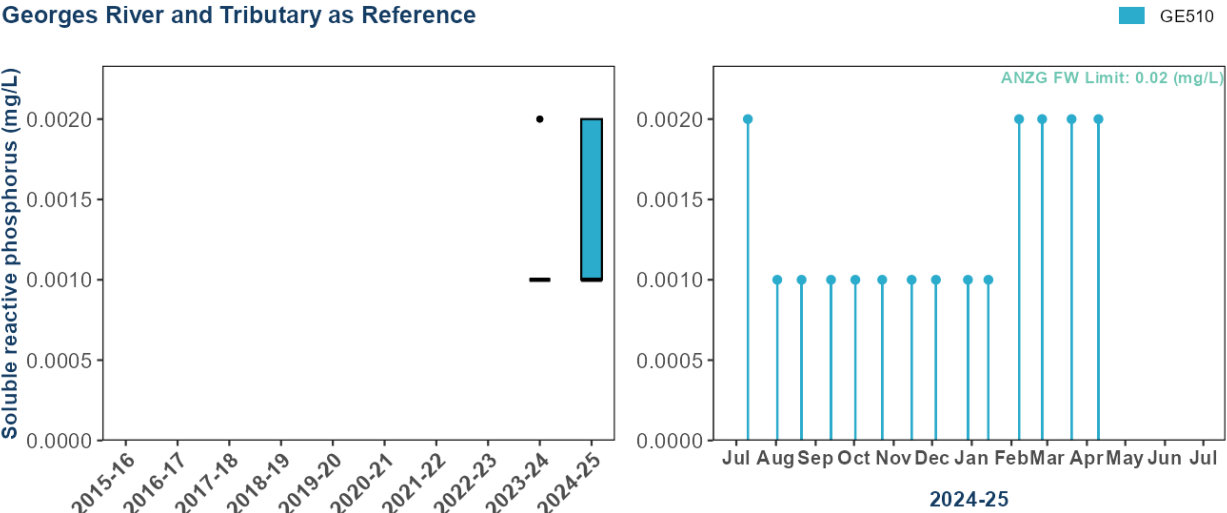
Georges River and Tributary as Reference



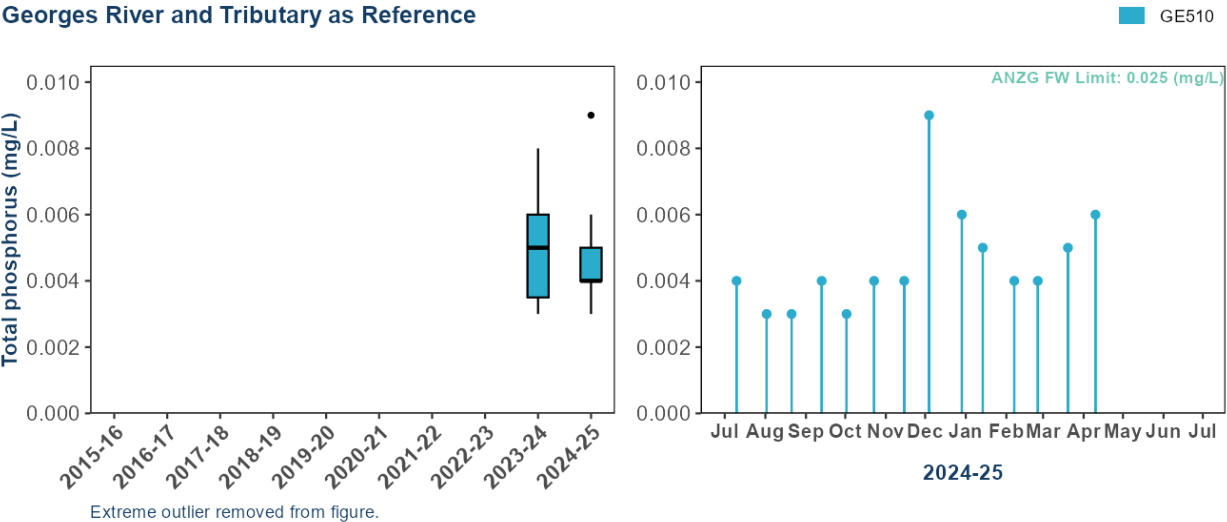
Georges River and Tributary as Reference



Georges River and Tributary as Reference

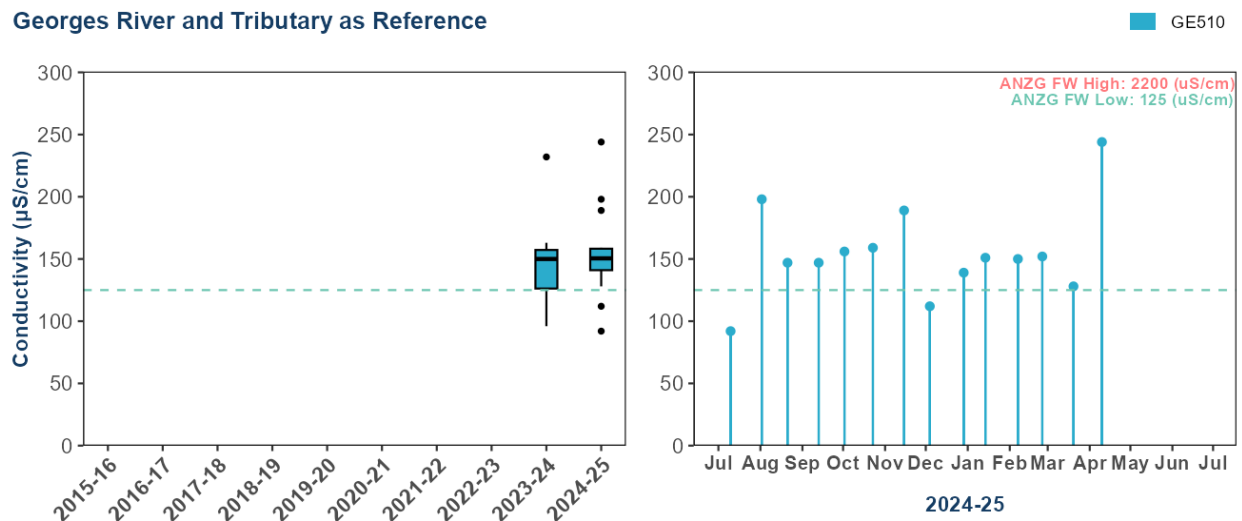


Georges River and Tributary as Reference

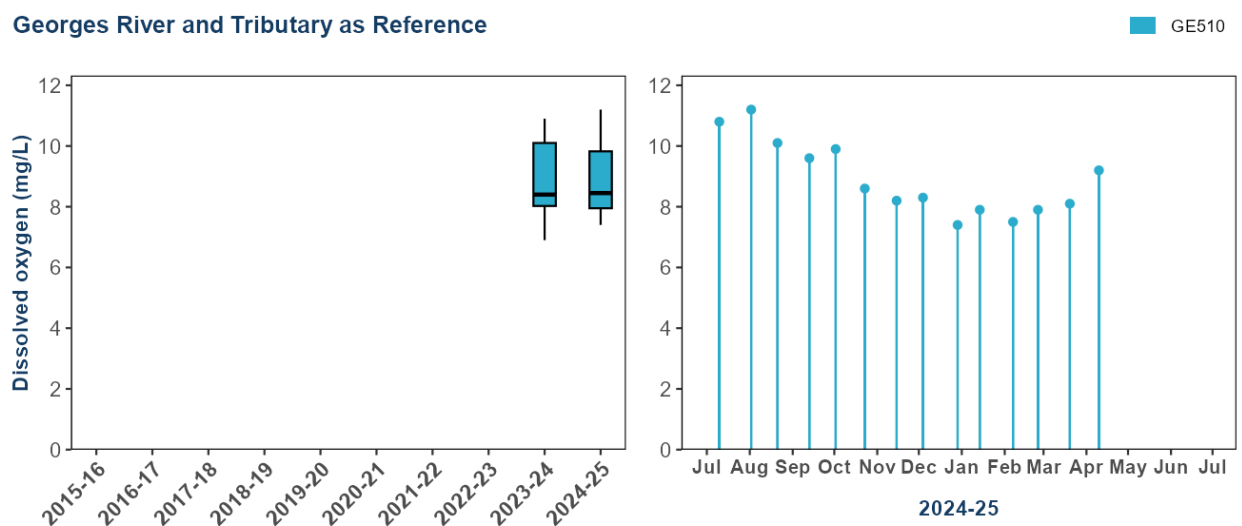


Stressors – Physico-chemical water quality

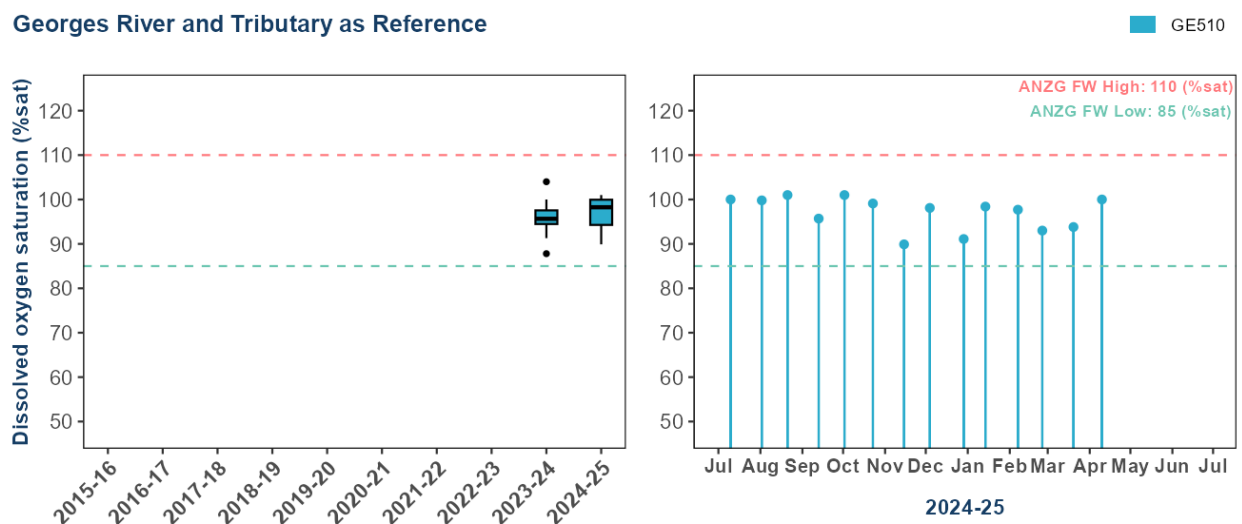
Georges River and Tributary as Reference



Georges River and Tributary as Reference

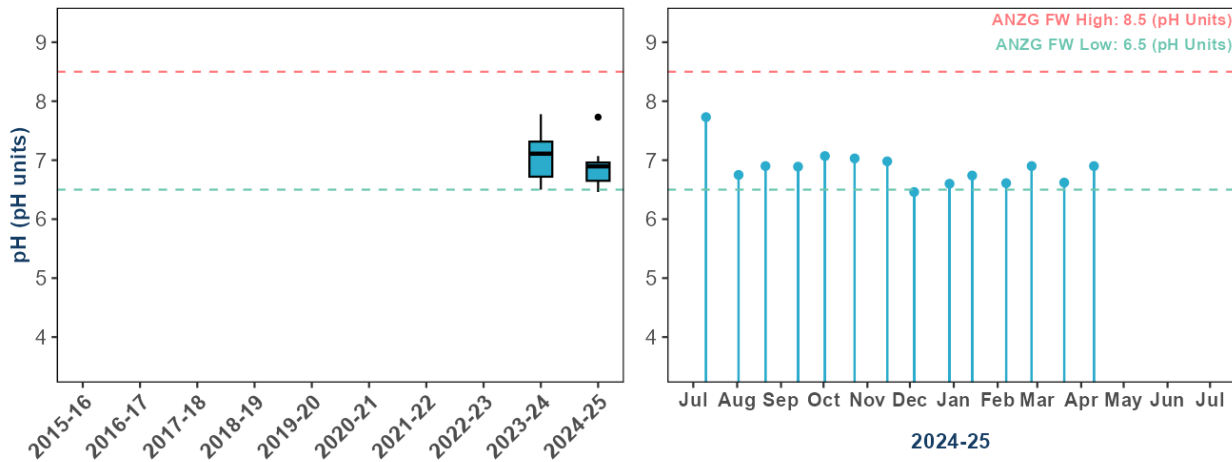


Georges River and Tributary as Reference



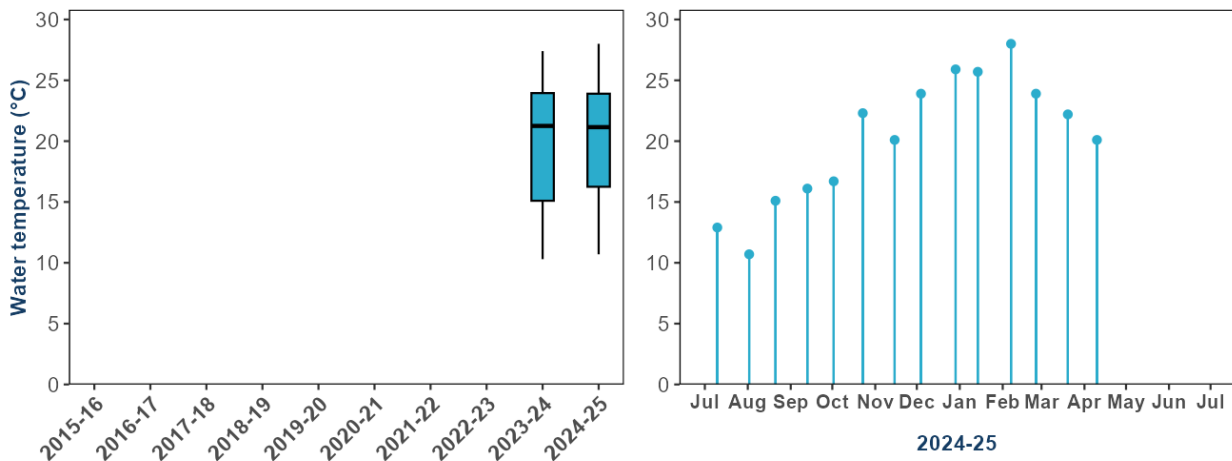
Georges River and Tributary as Reference

GE510



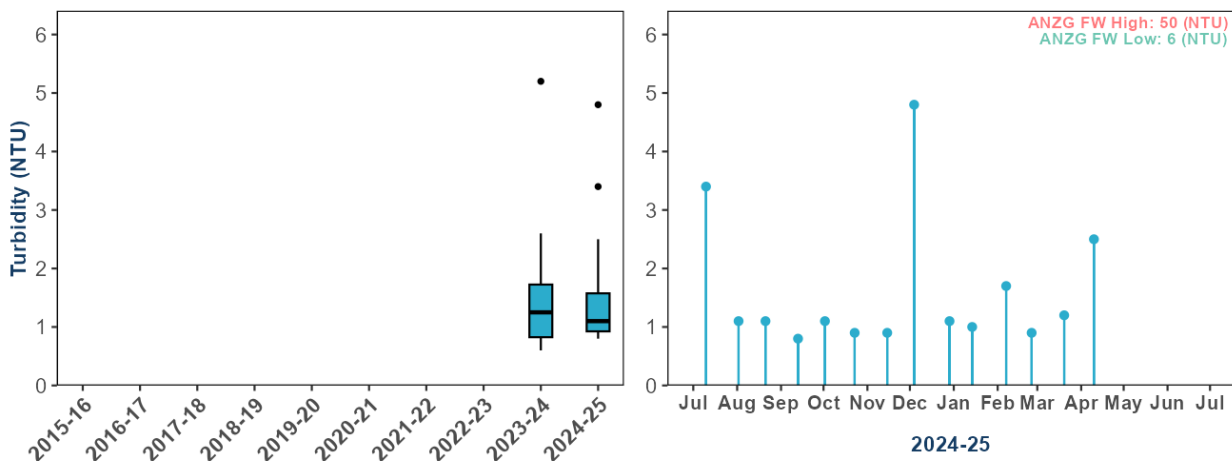
Georges River and Tributary as Reference

GE510



Georges River and Tributary as Reference

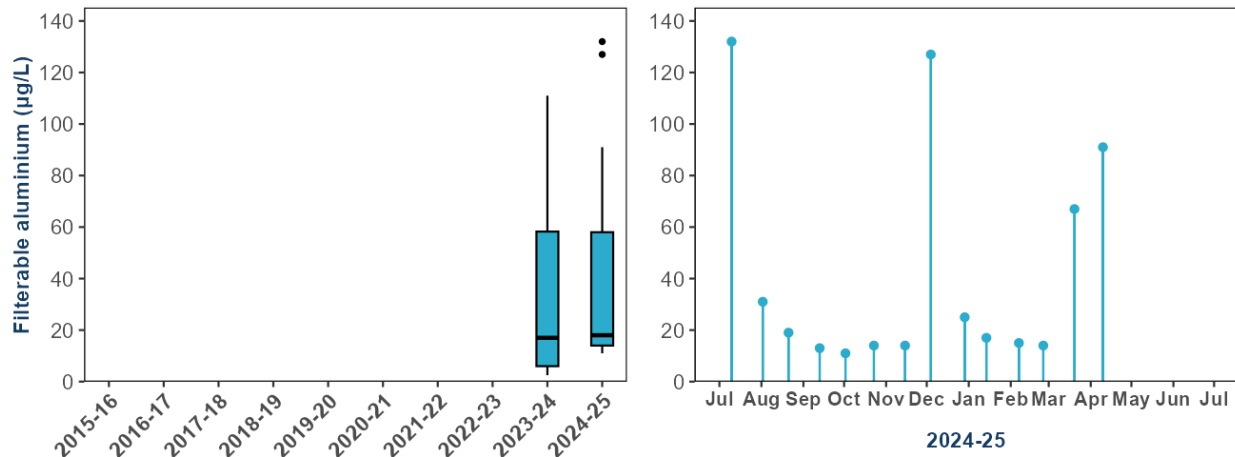
GE510



Stressors – Trace metals

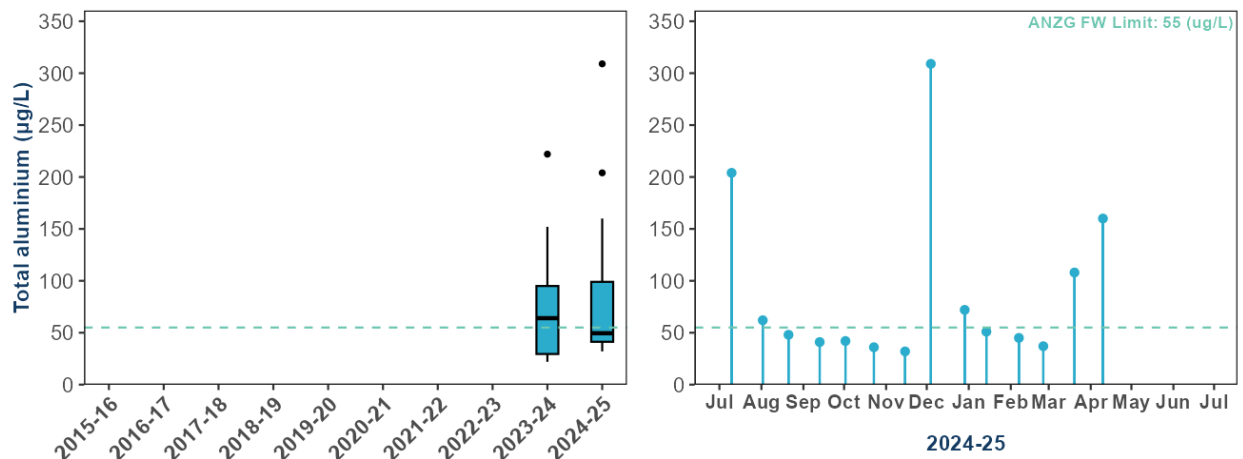
Georges River and Tributary as Reference

GE510



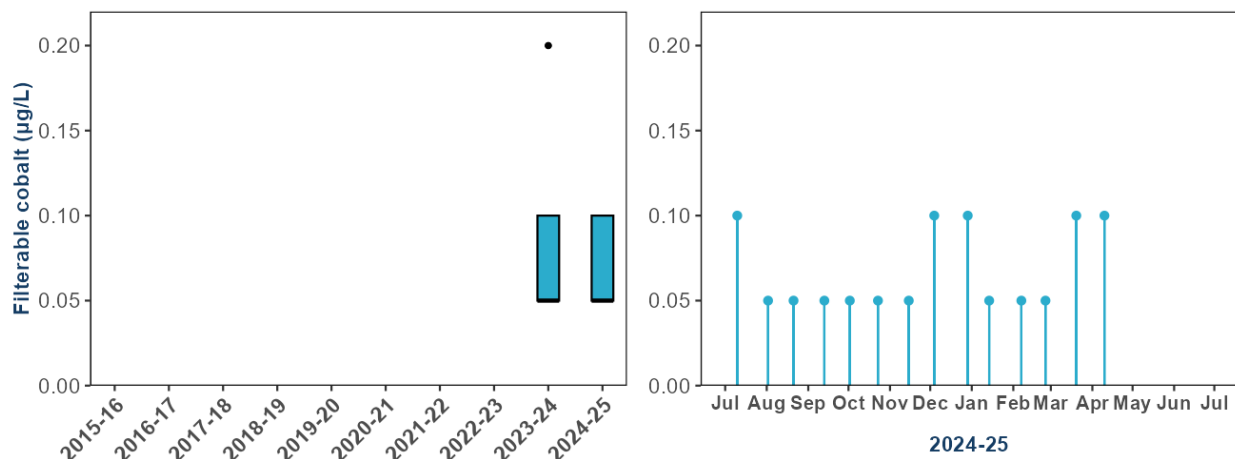
Georges River and Tributary as Reference

GE510

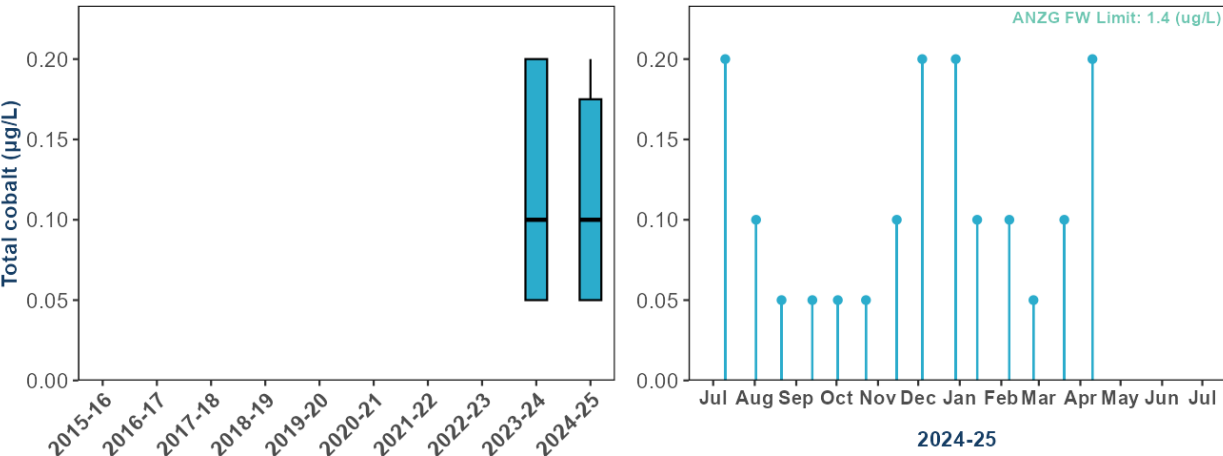


Georges River and Tributary as Reference

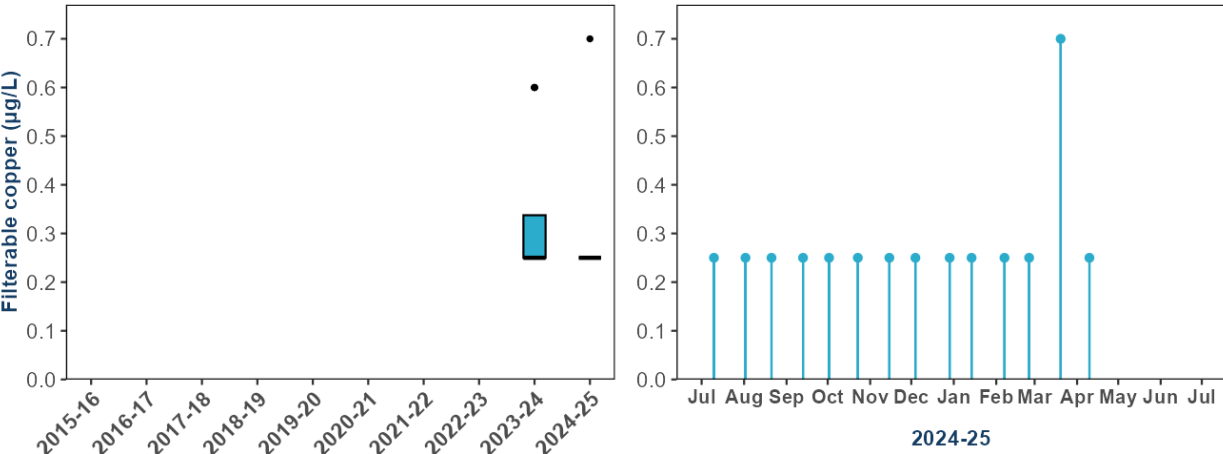
GE510



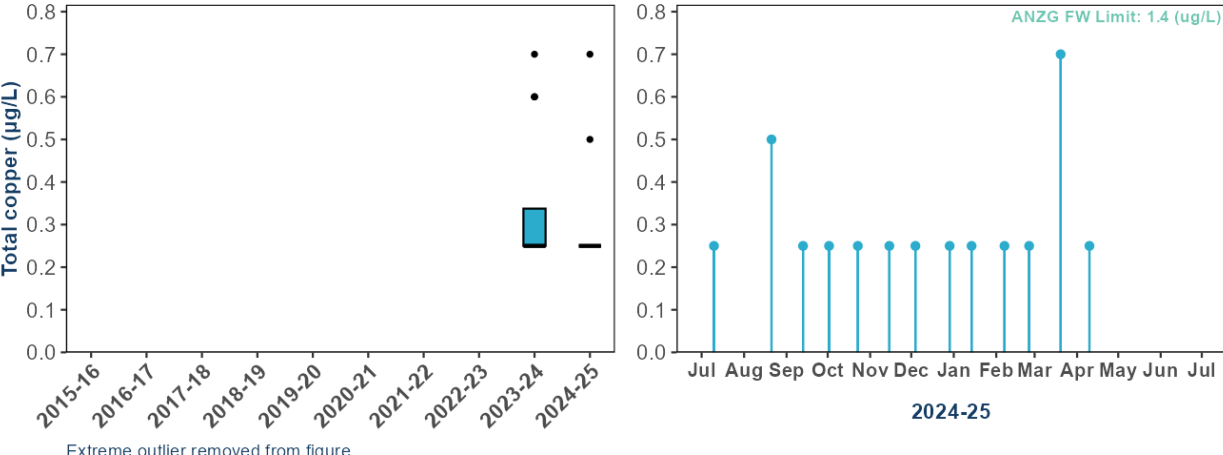
Georges River and Tributary as Reference



Georges River and Tributary as Reference



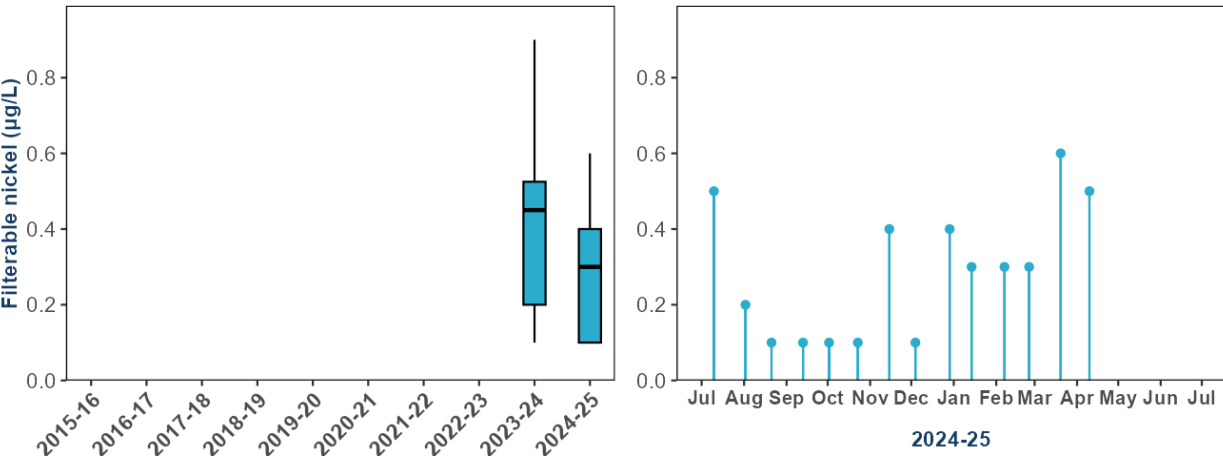
Georges River and Tributary as Reference



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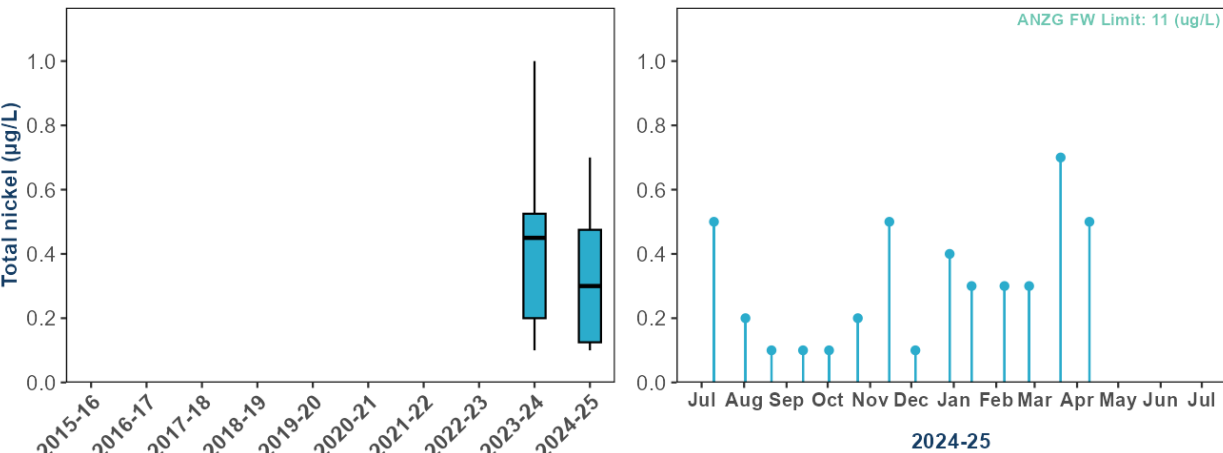
Georges River and Tributary as Reference

GE510



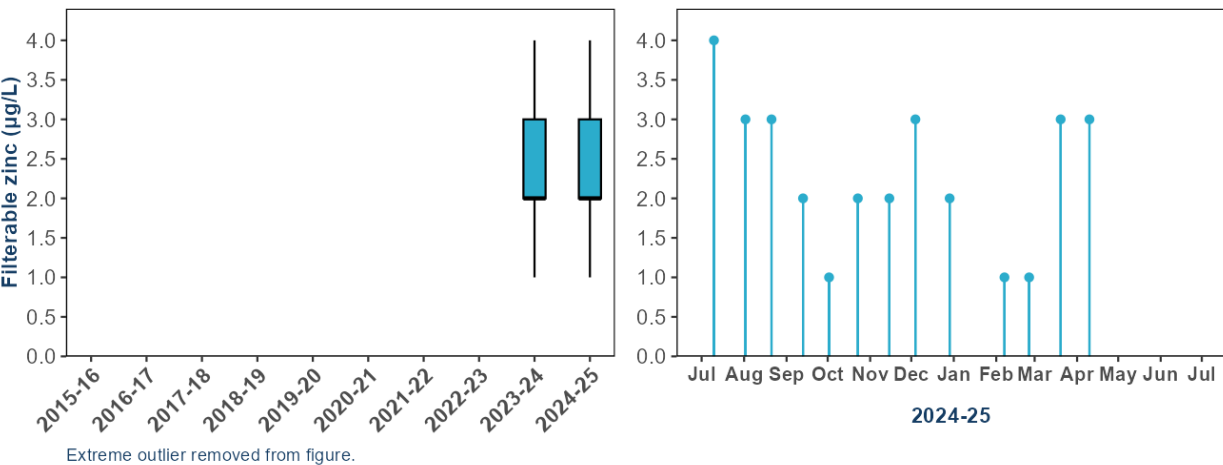
Georges River and Tributary as Reference

GE510



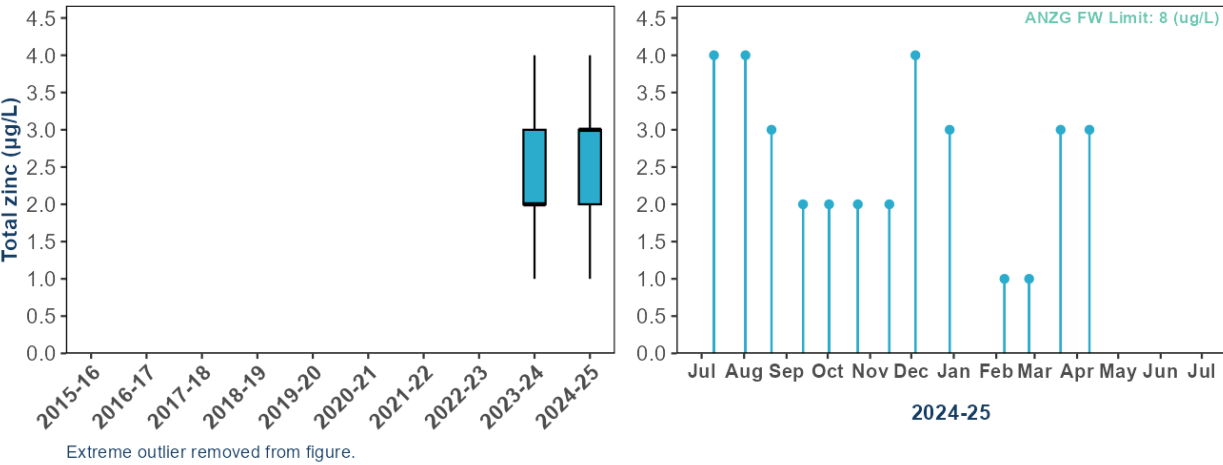
Georges River and Tributary as Reference

GE510



Georges River and Tributary as Reference

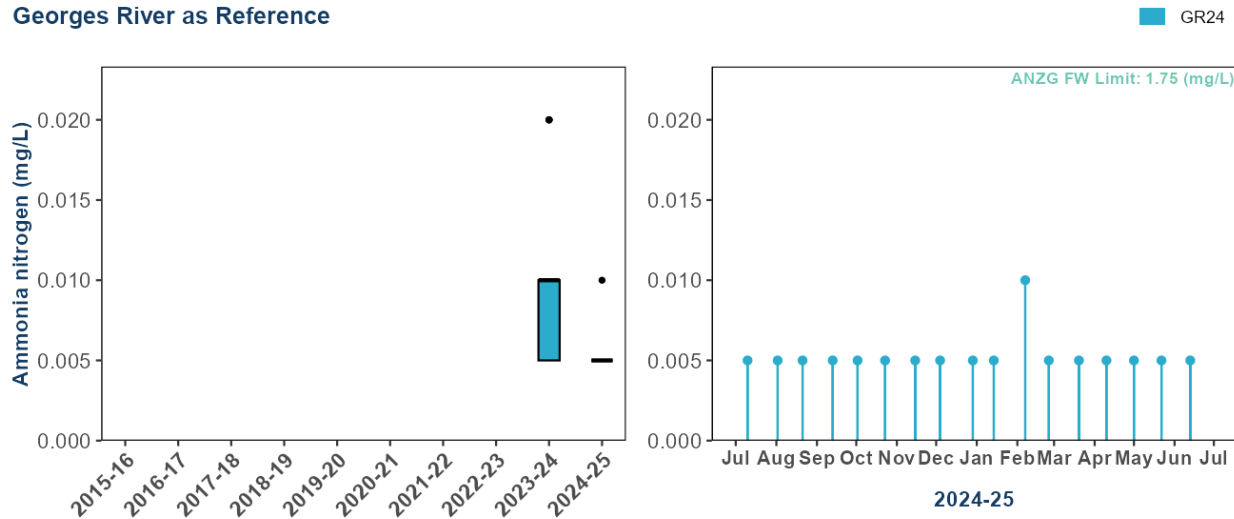
GE510



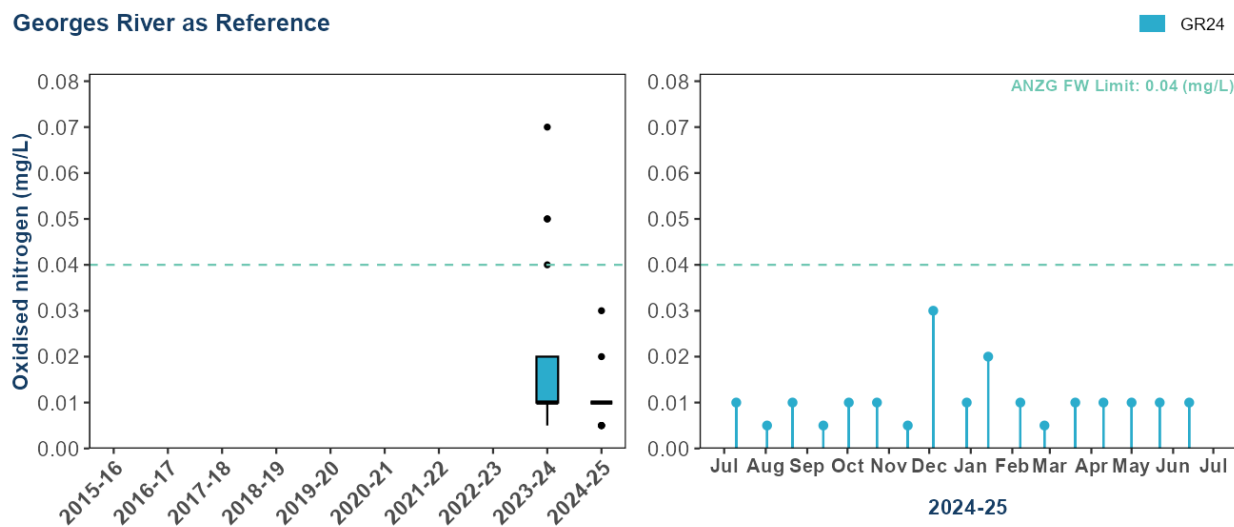
C.3.2. GR24 Georges River at Ingleburn Reserve Weir

Stressors – Nutrients

Georges River as Reference

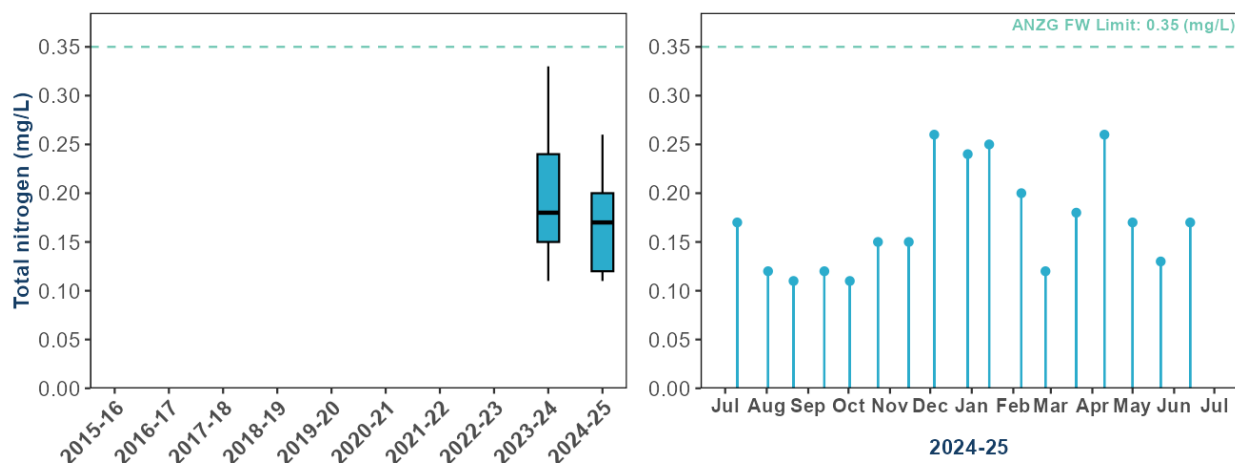


Georges River as Reference



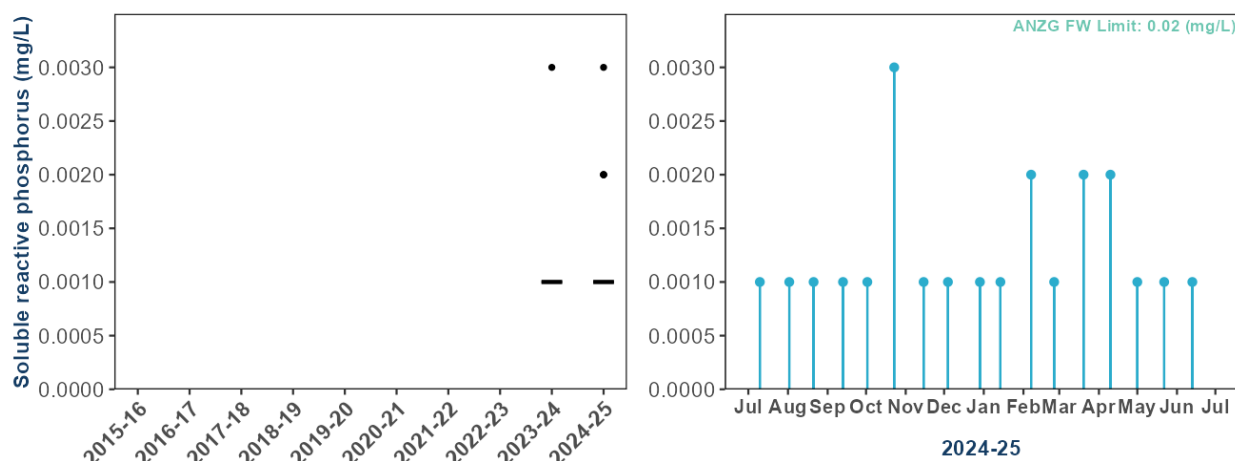
Georges River as Reference

GR24



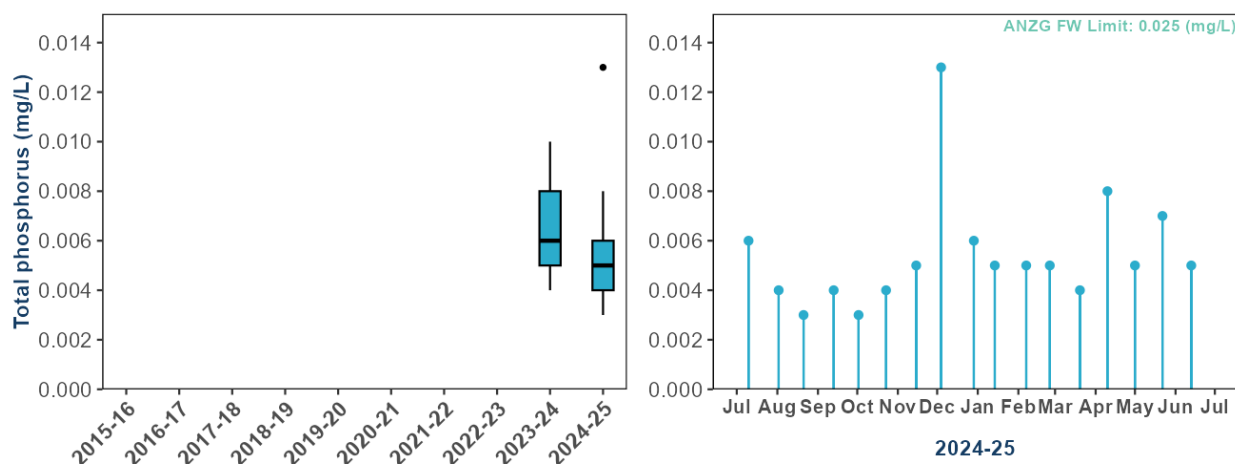
Georges River as Reference

GR24



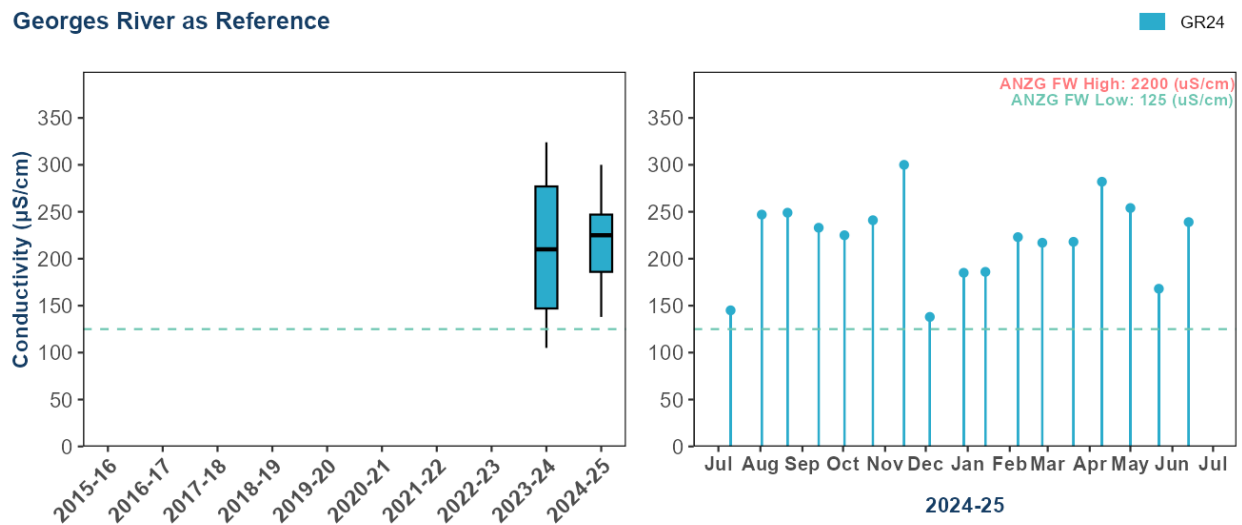
Georges River as Reference

GR24

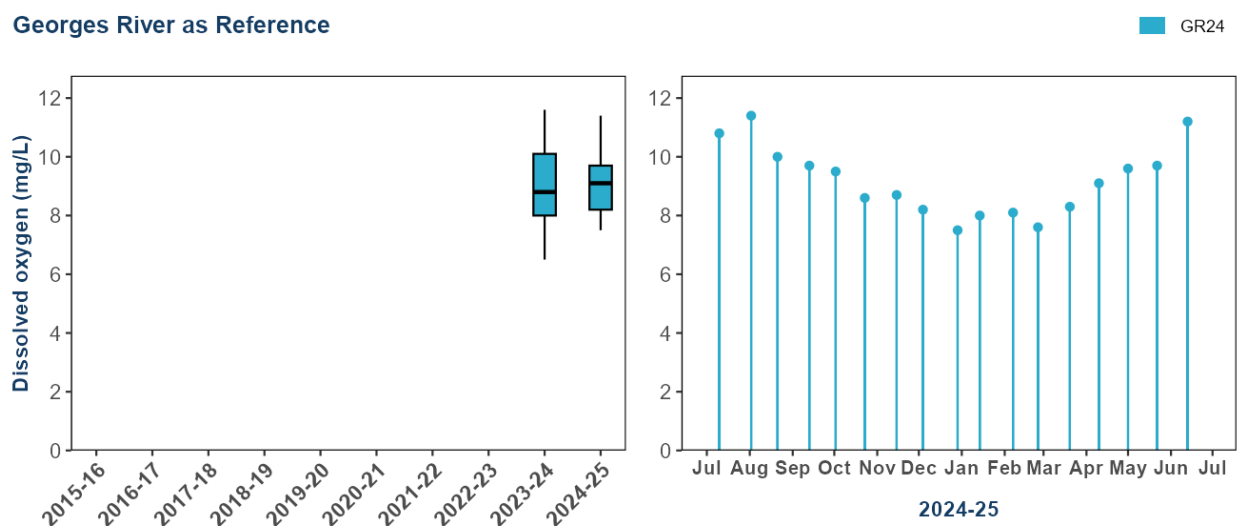


Stressors – Physico-chemical water quality

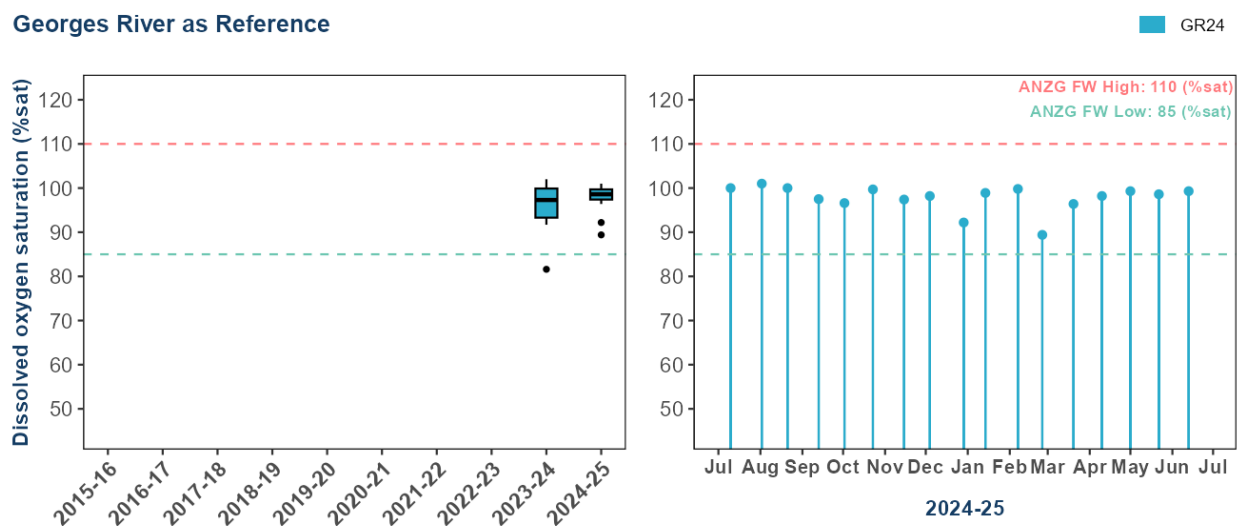
Georges River as Reference



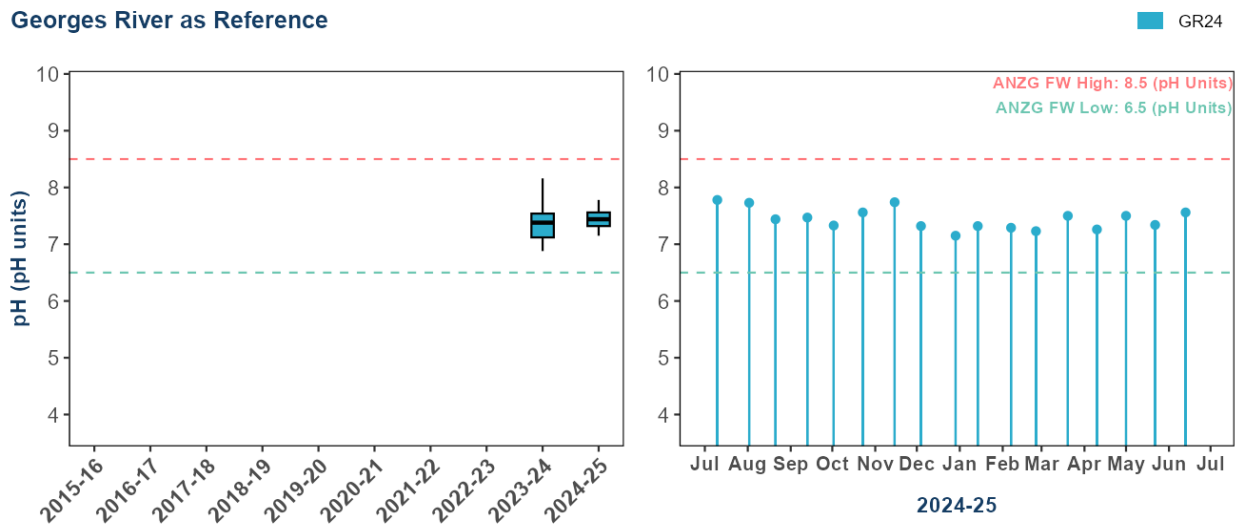
Georges River as Reference



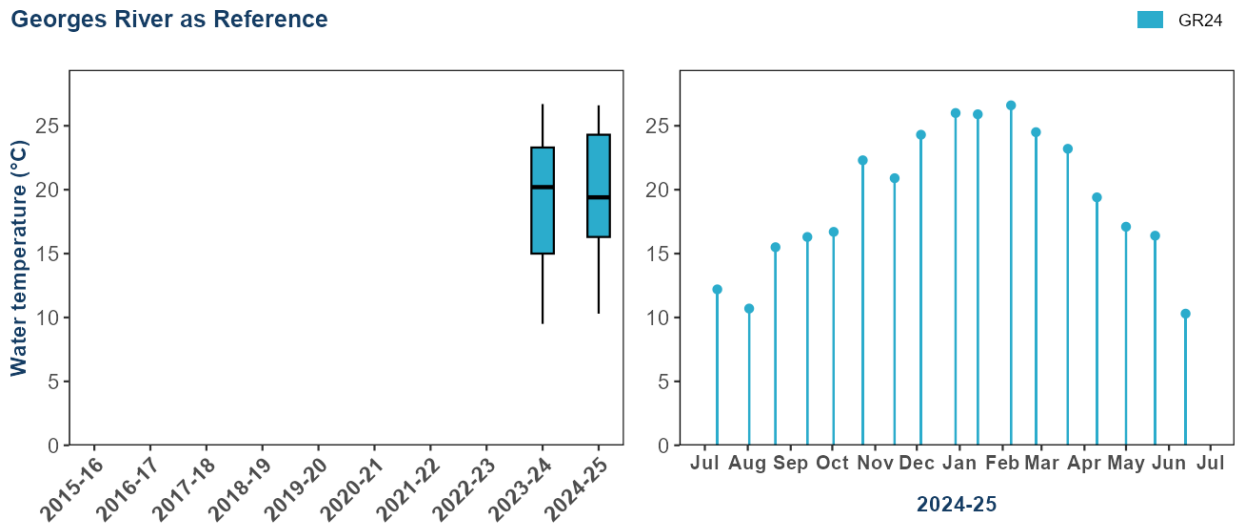
Georges River as Reference



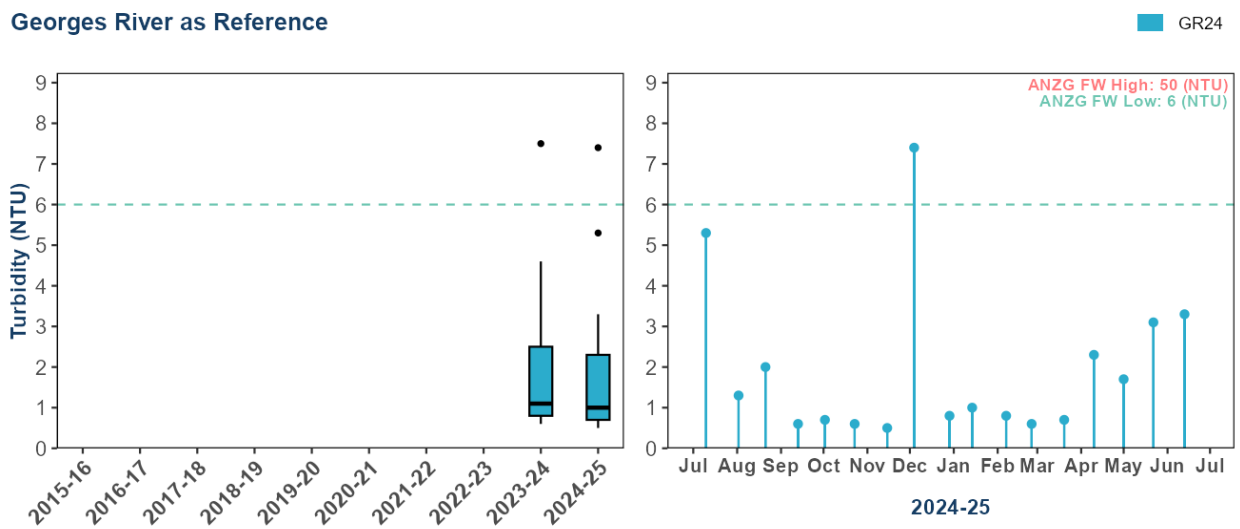
Georges River as Reference



Georges River as Reference



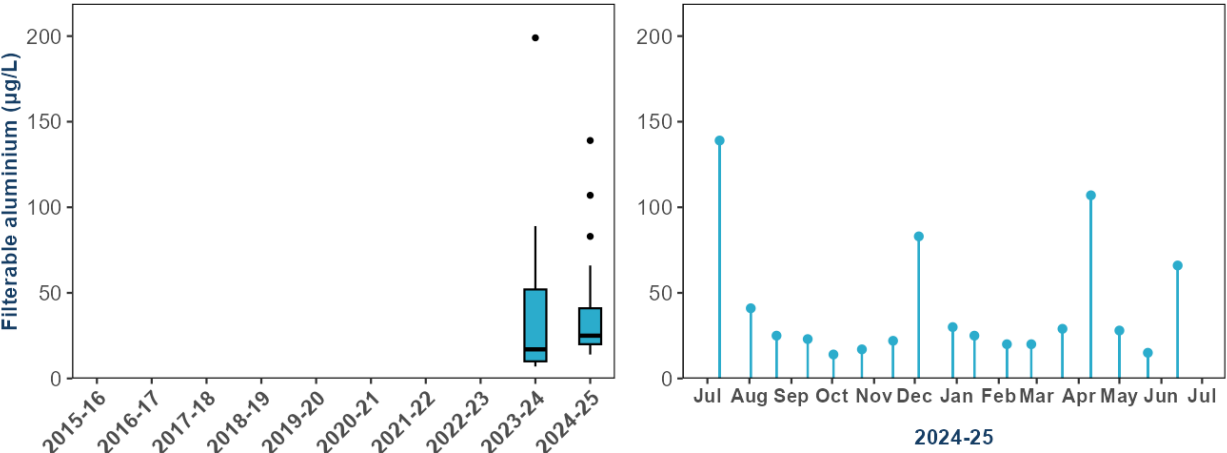
Georges River as Reference



Stressors – Trace metals

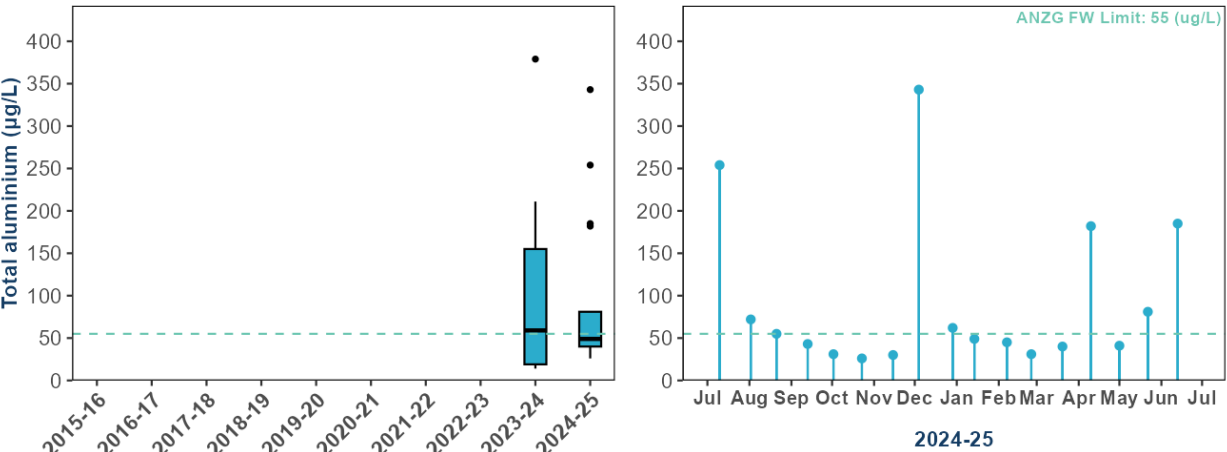
Georges River as Reference

GR24



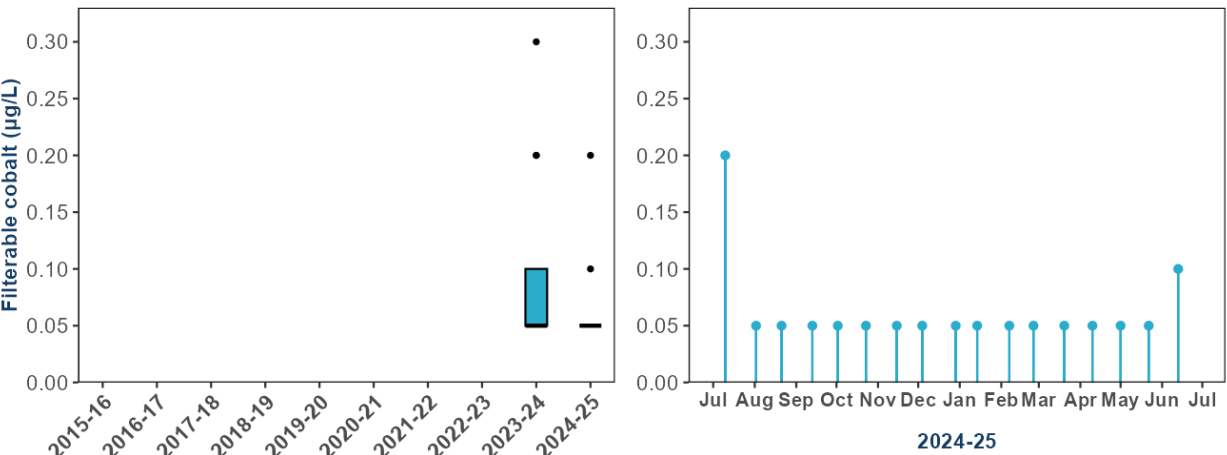
Georges River as Reference

GR24

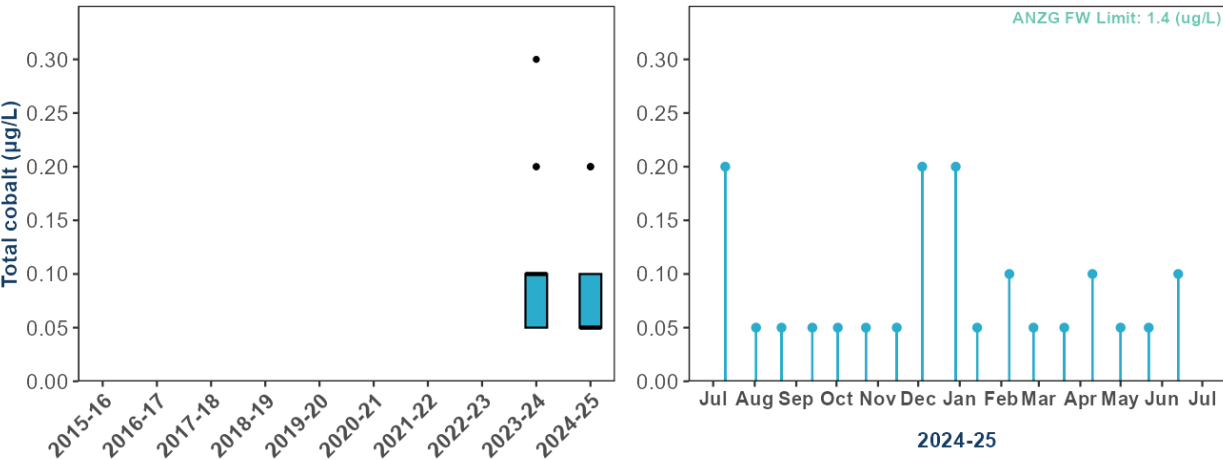


Georges River as Reference

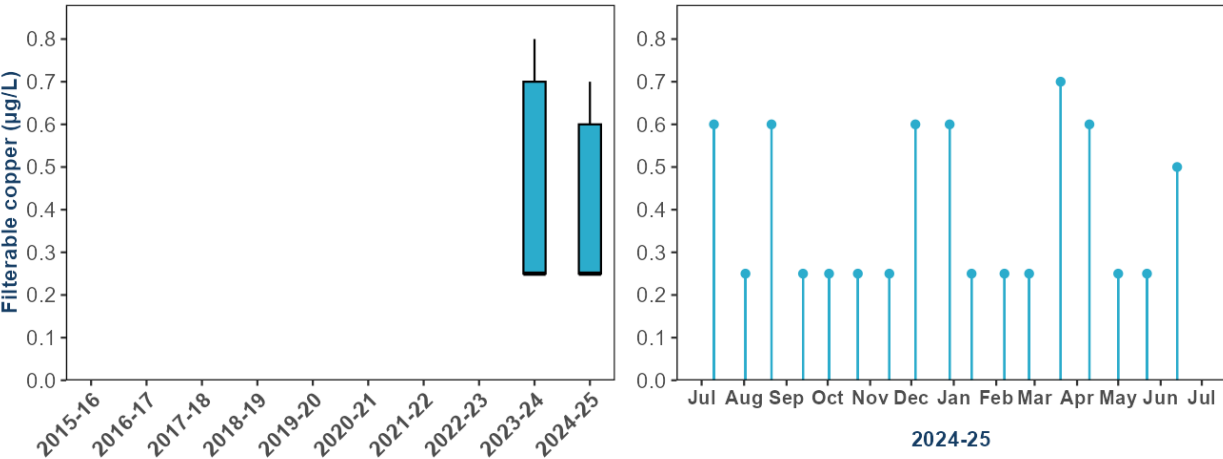
GR24



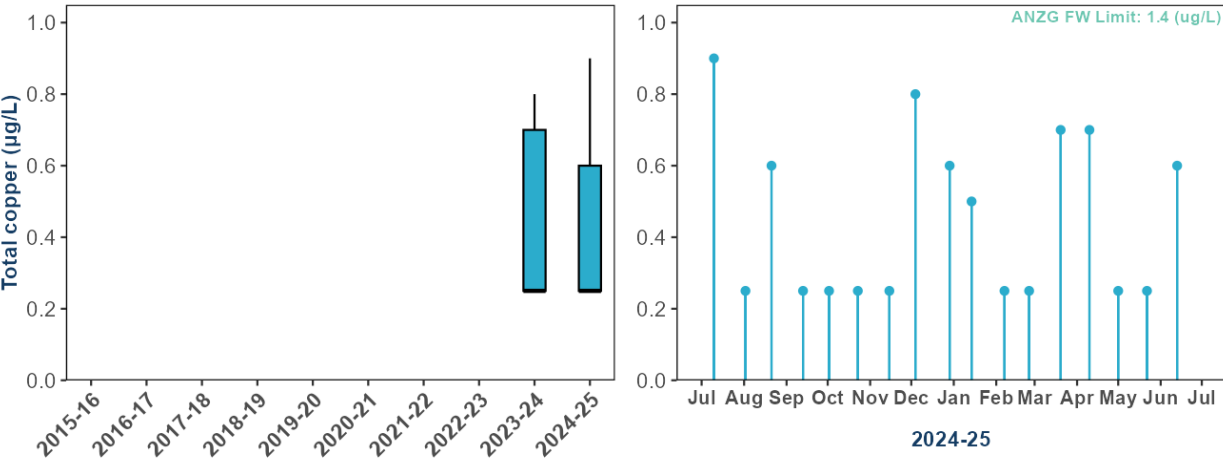
Georges River as Reference



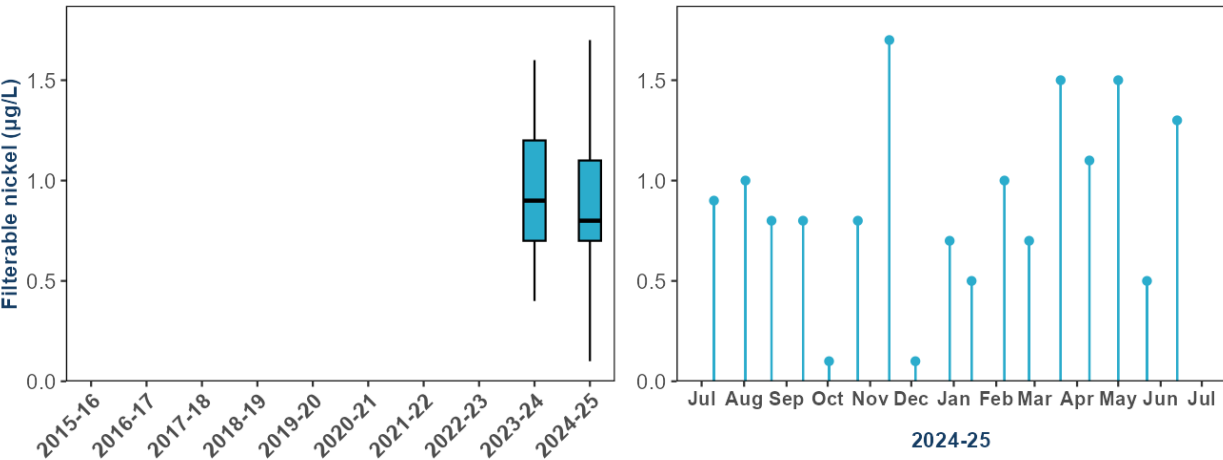
Georges River as Reference



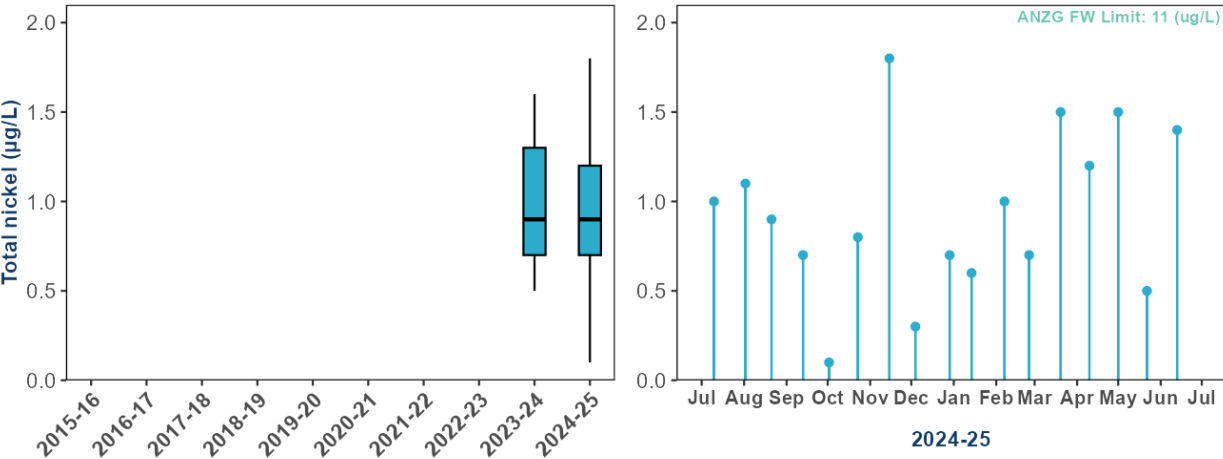
Georges River as Reference



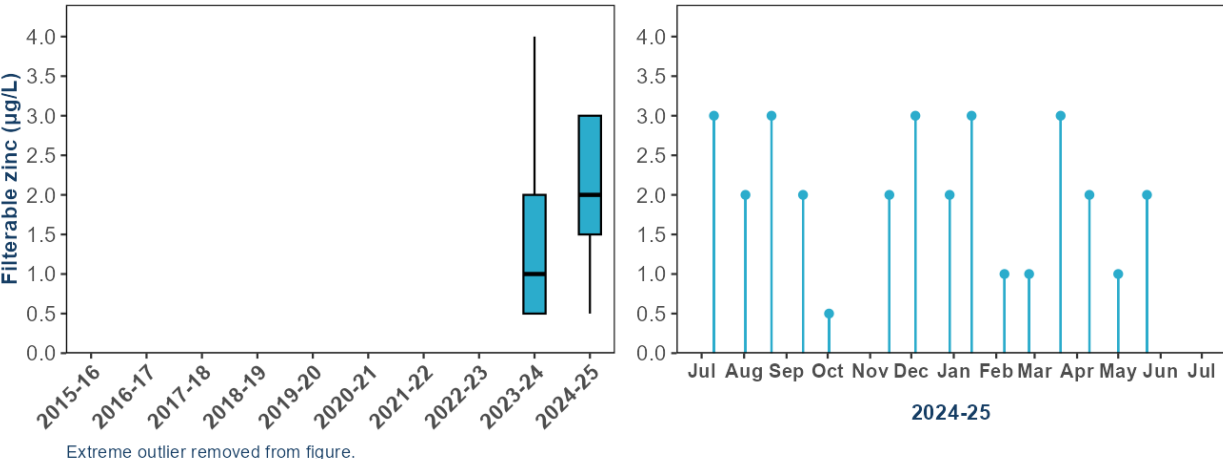
Georges River as Reference



Georges River as Reference



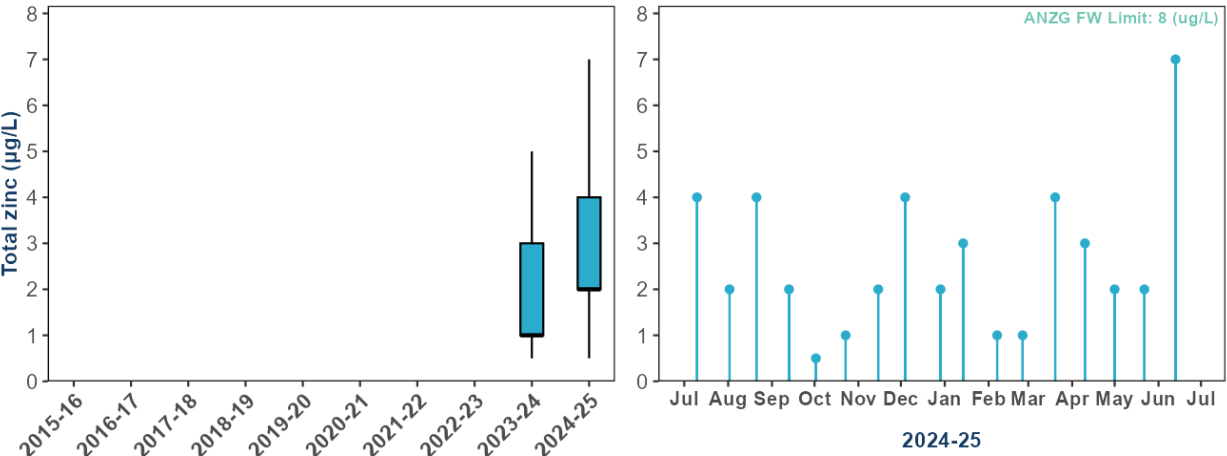
Georges River as Reference



Extreme outlier removed from figure.

Georges River as Reference

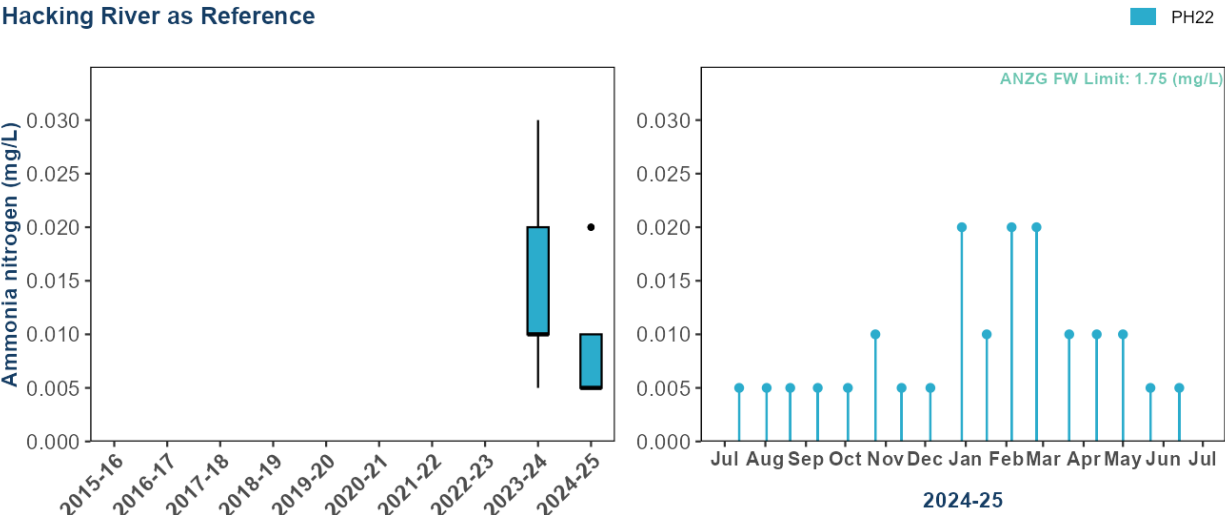
GR24



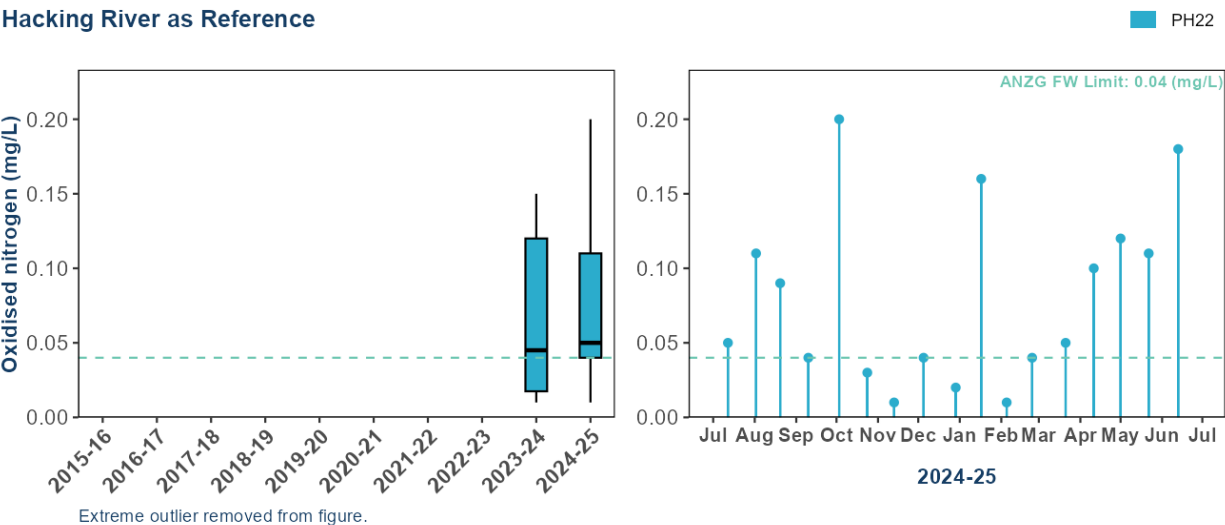
C.3.3. PH22 Hacking River at McKell Avenue

Stressors – Nutrients

Hacking River as Reference

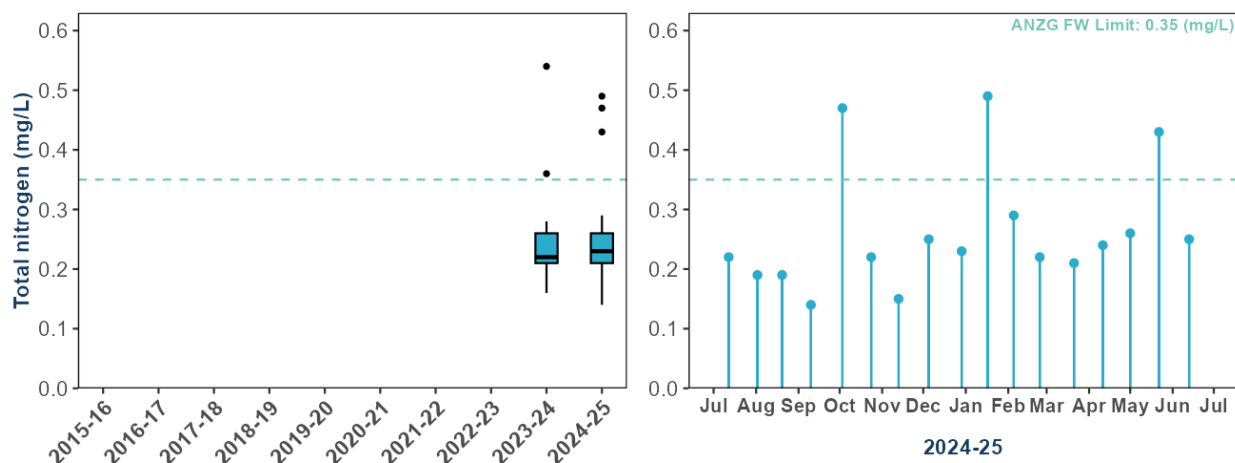


Hacking River as Reference



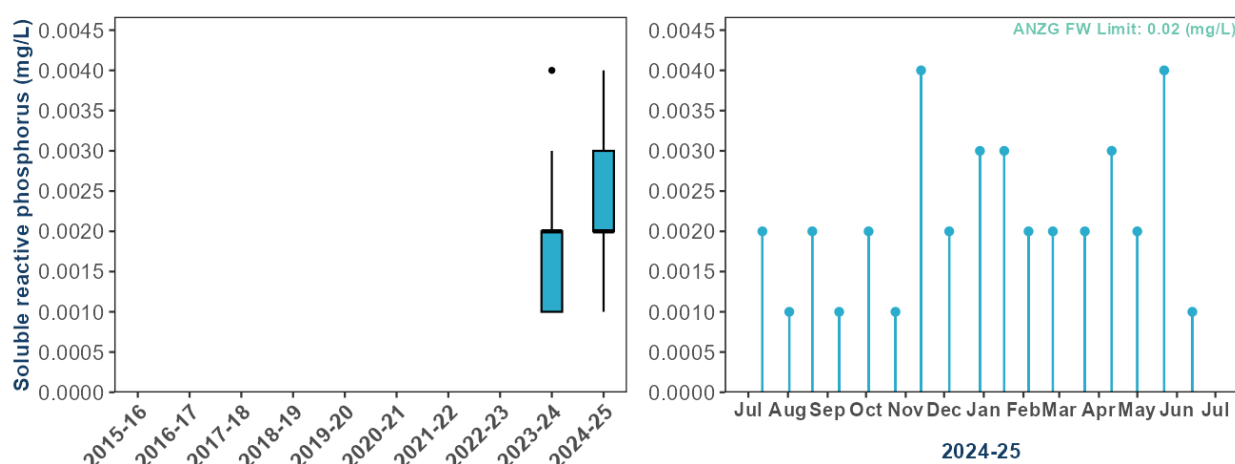
Hacking River as Reference

PH22



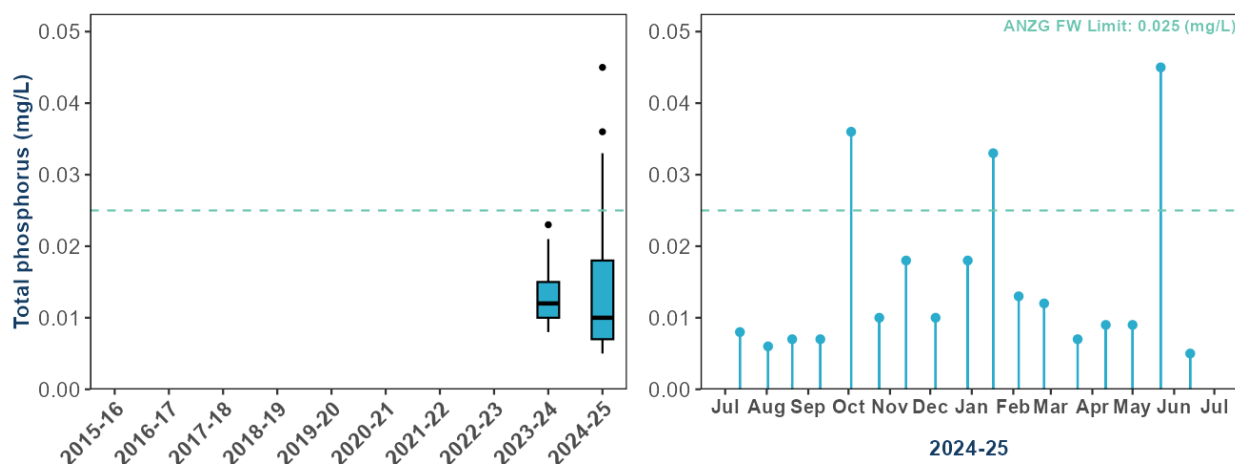
Hacking River as Reference

PH22



Hacking River as Reference

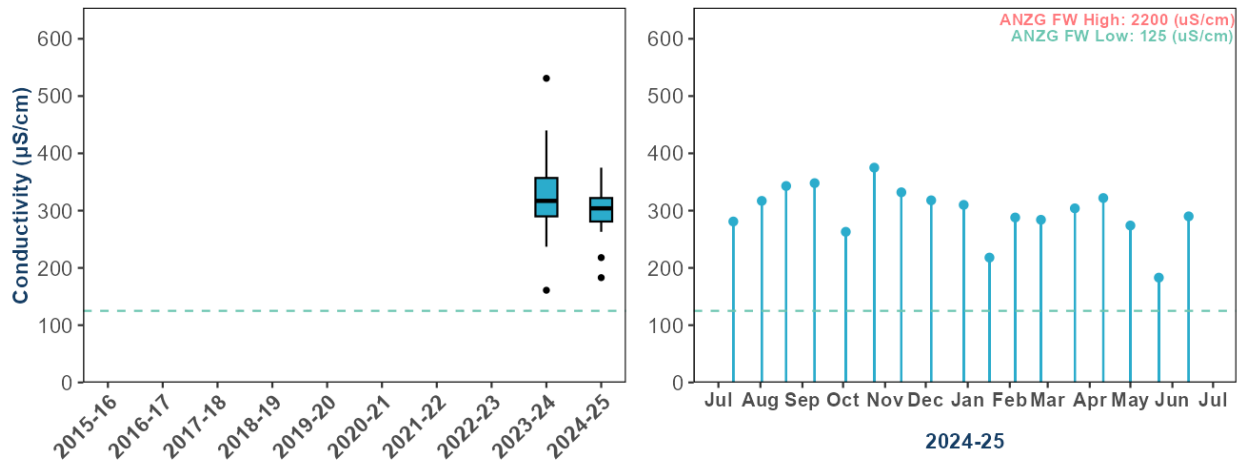
PH22



Stressors – Physico-chemical water quality

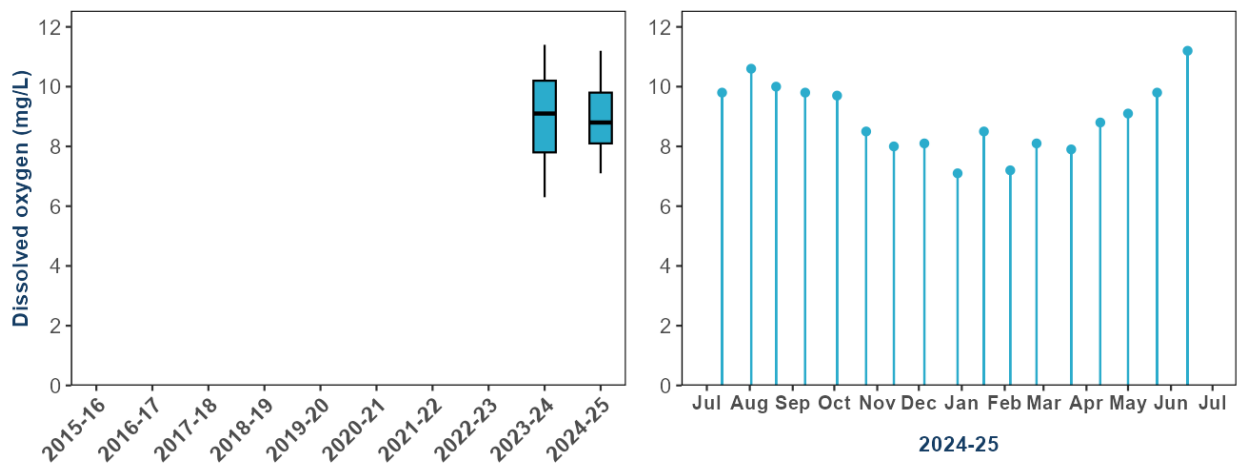
Hacking River as Reference

PH22



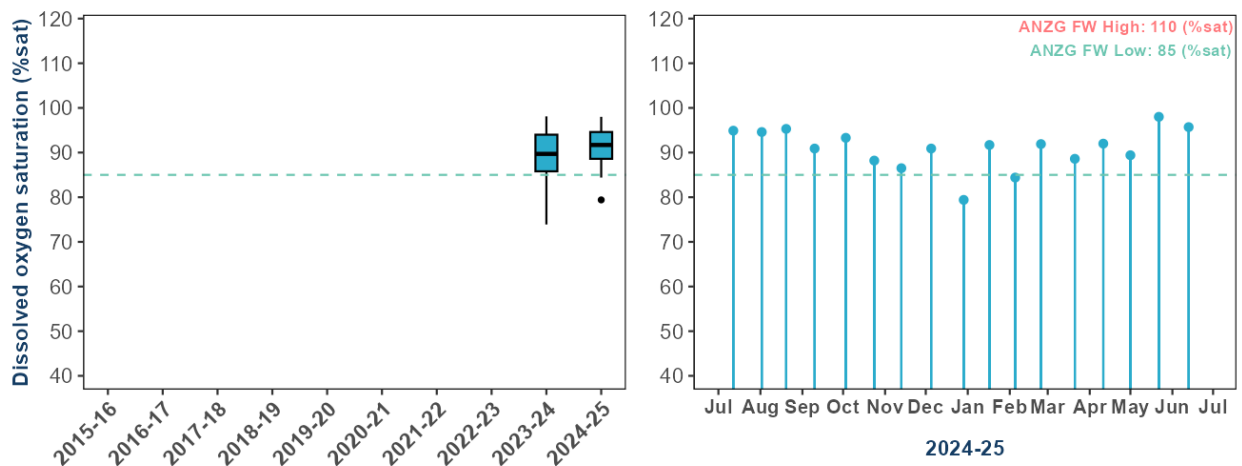
Hacking River as Reference

PH22



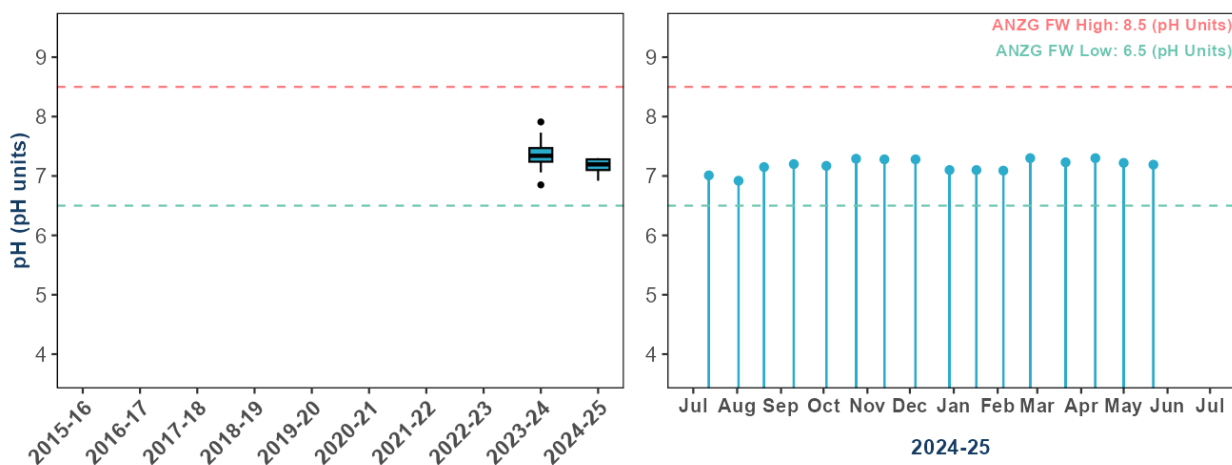
Hacking River as Reference

PH22



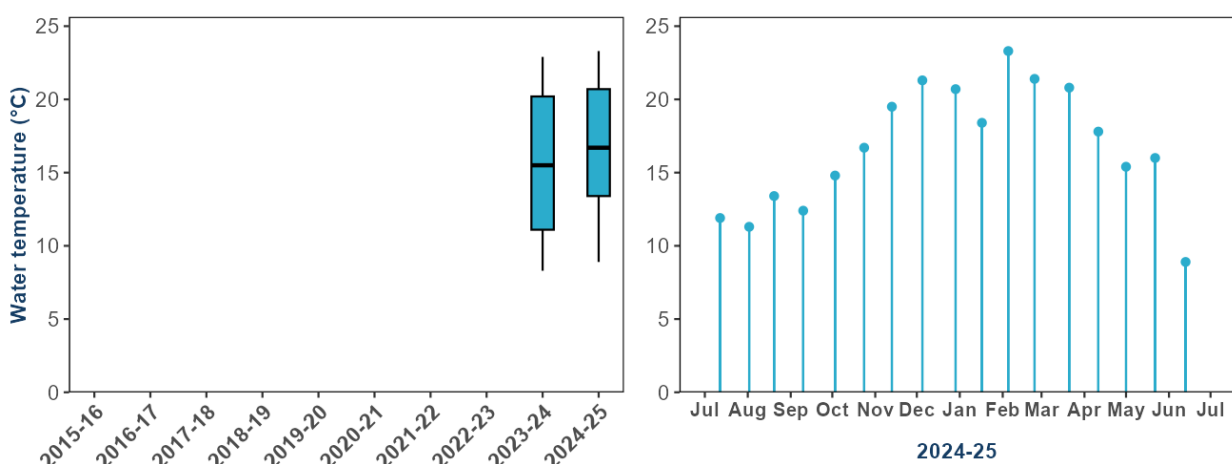
Hacking River as Reference

PH22



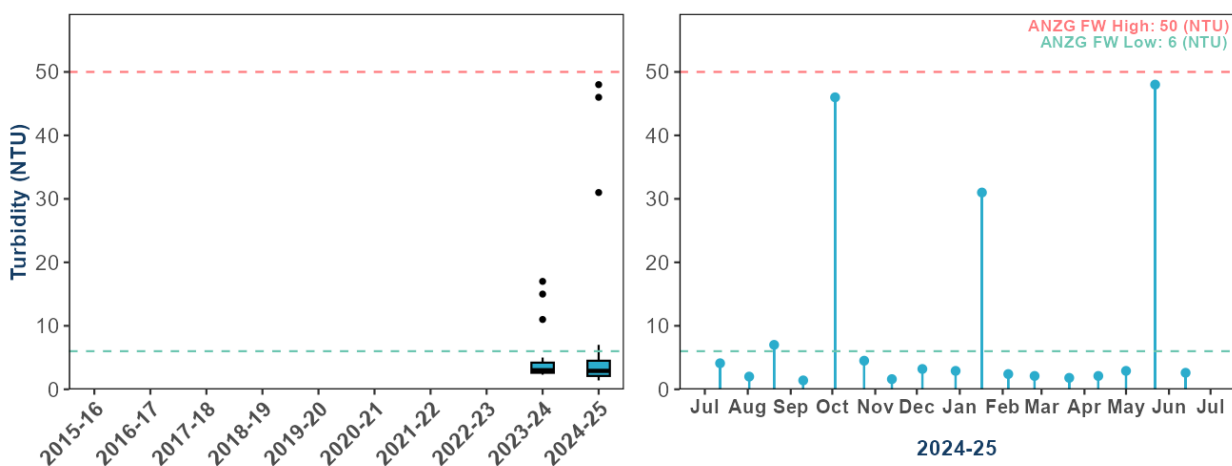
Hacking River as Reference

PH22



Hacking River as Reference

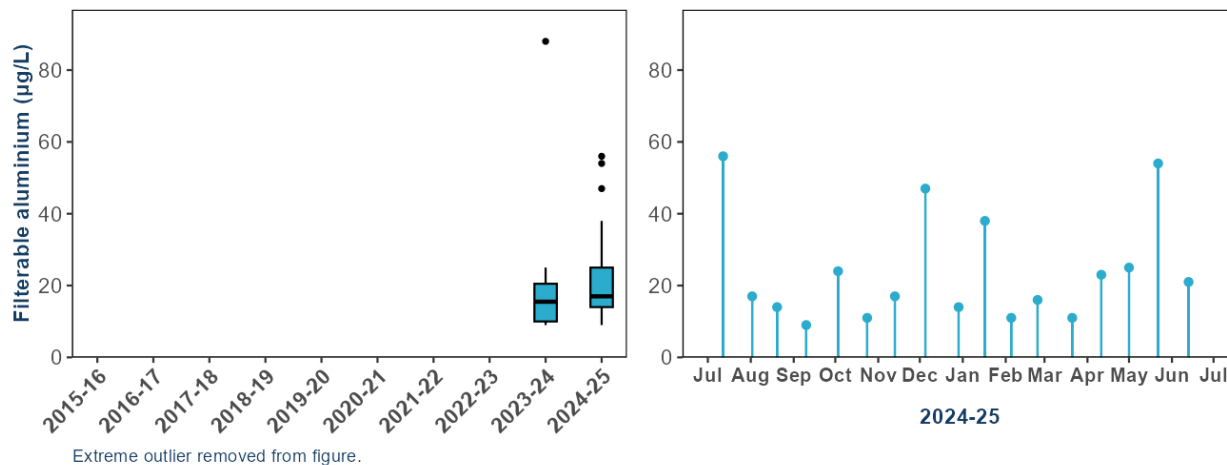
PH22



Stressors – Trace metals

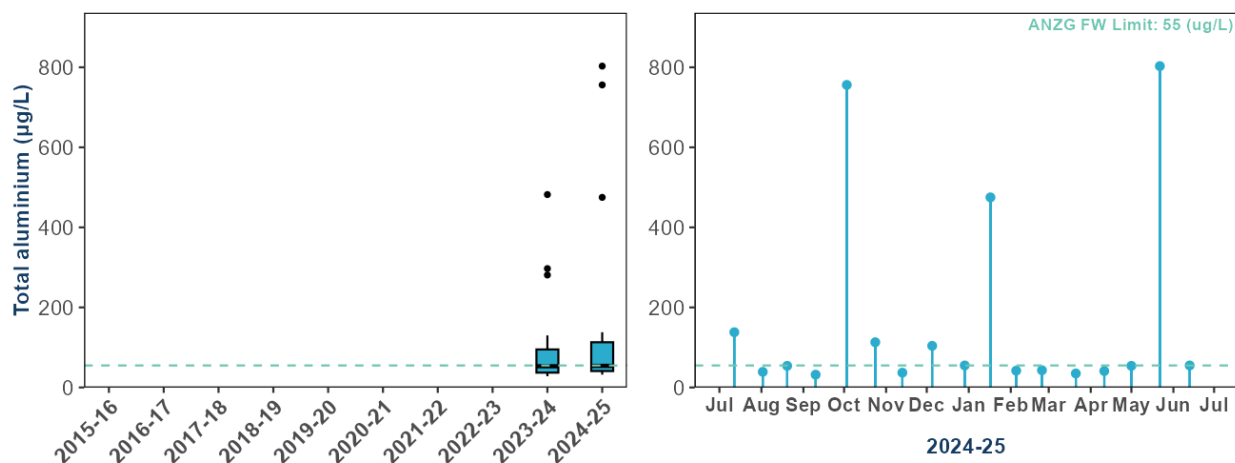
Hacking River as Reference

PH22



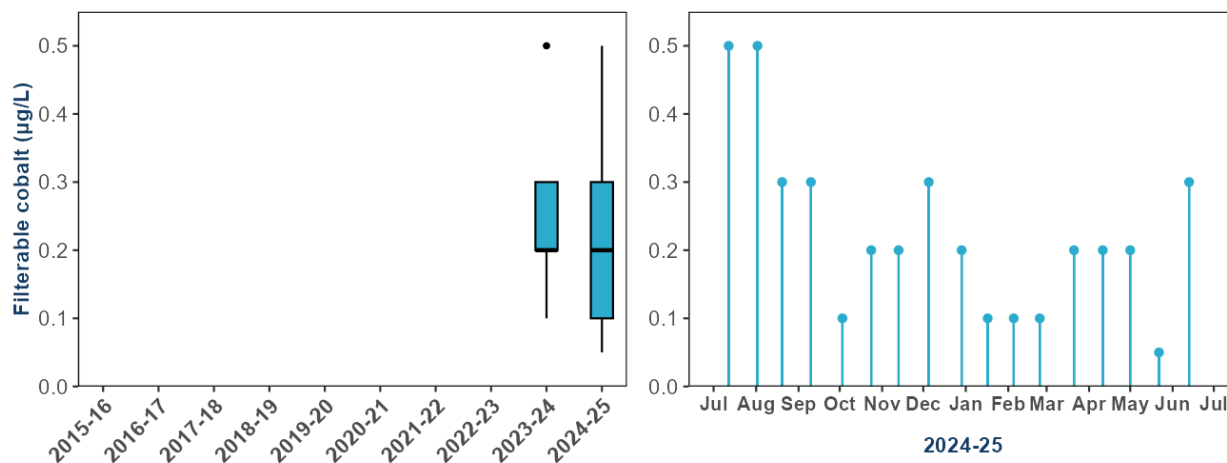
Hacking River as Reference

PH22

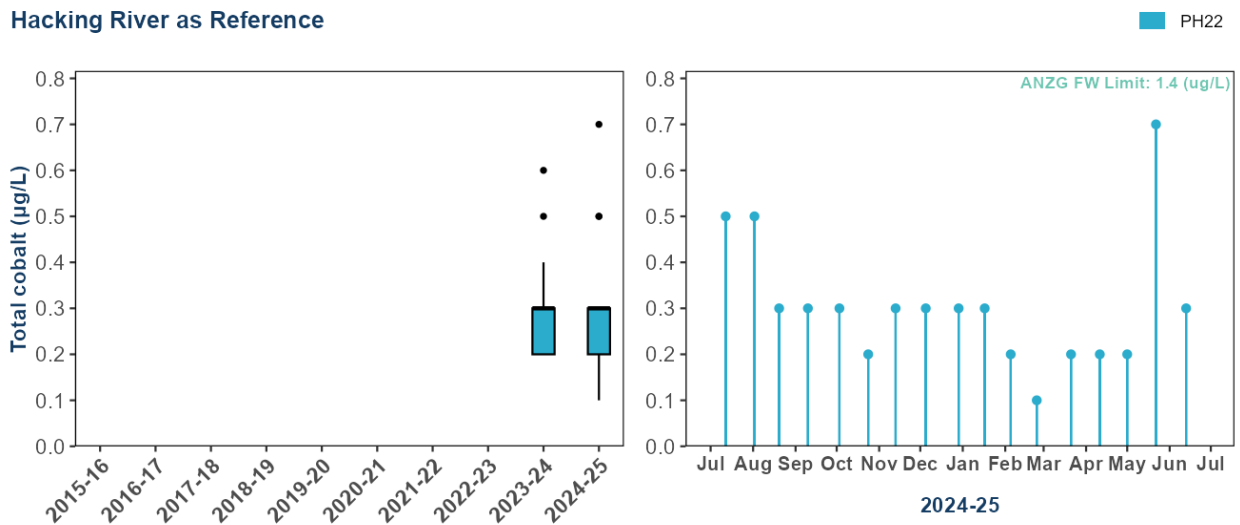


Hacking River as Reference

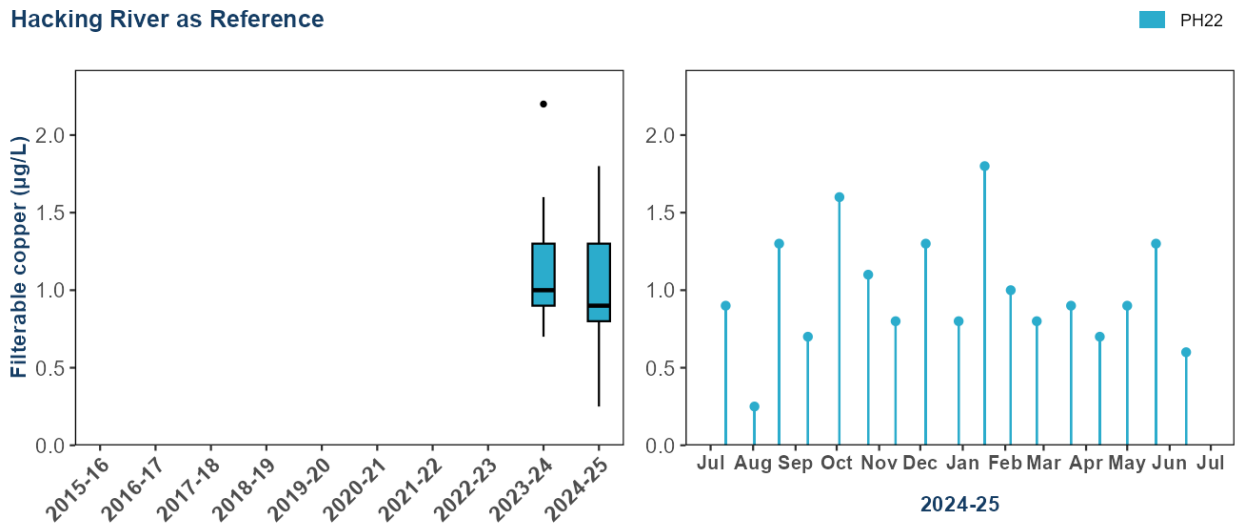
PH22



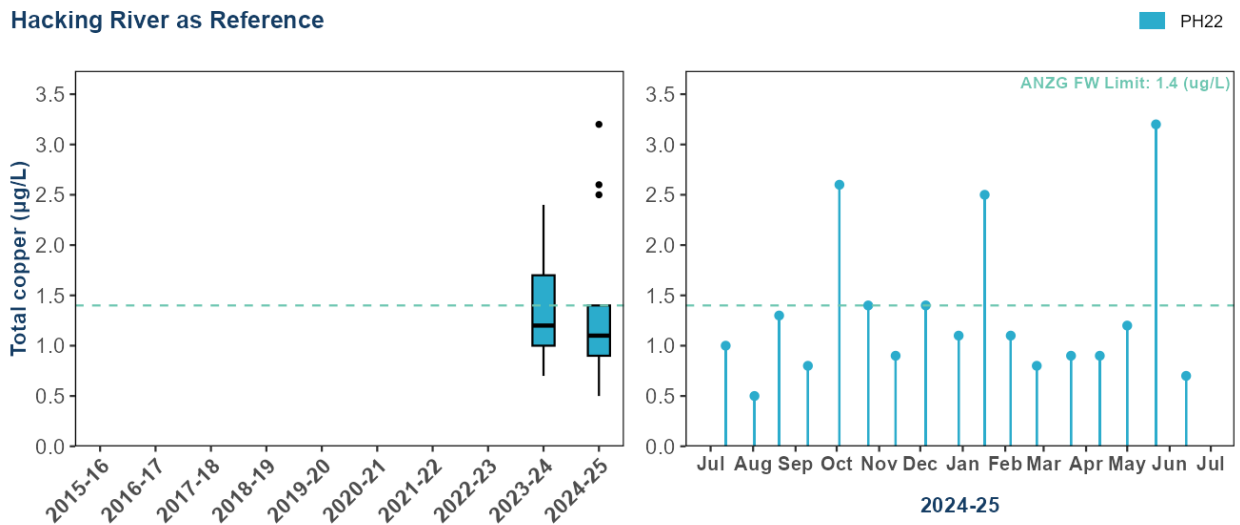
Hacking River as Reference



Hacking River as Reference

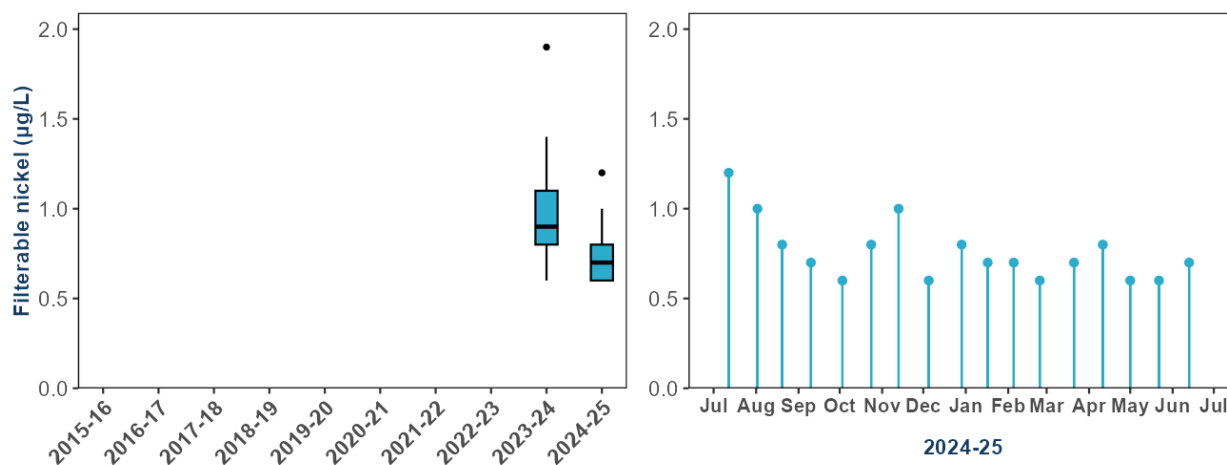


Hacking River as Reference



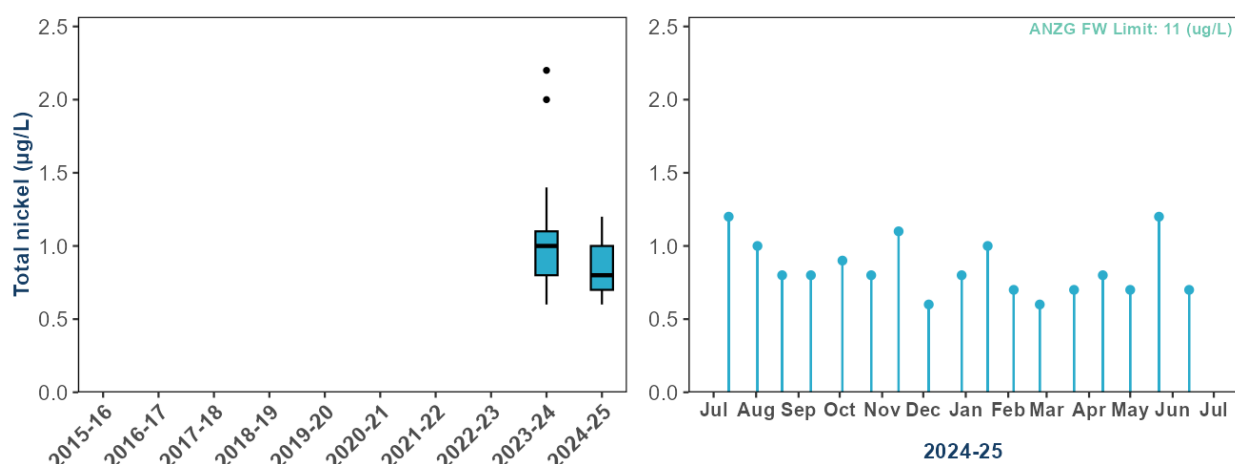
Hacking River as Reference

PH22



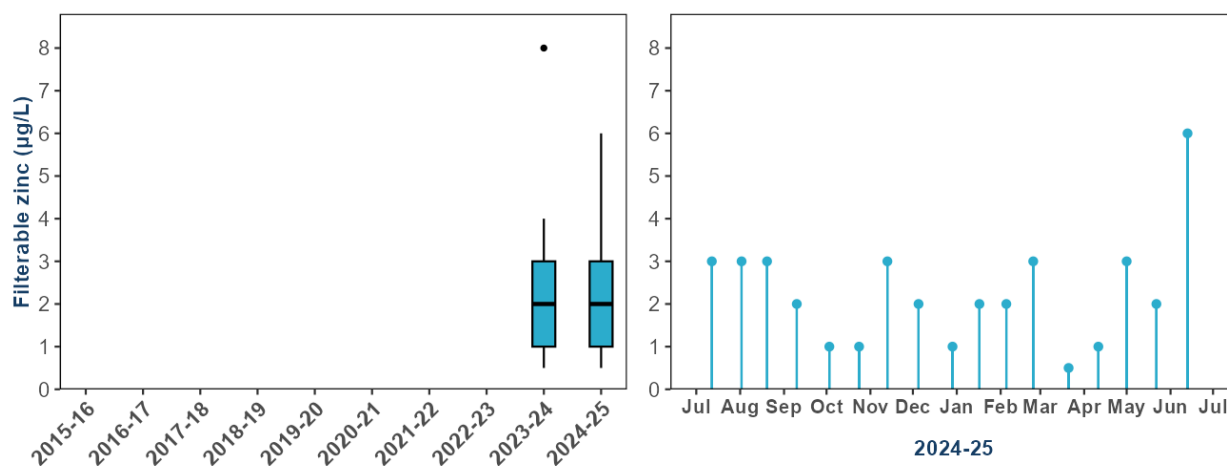
Hacking River as Reference

PH22



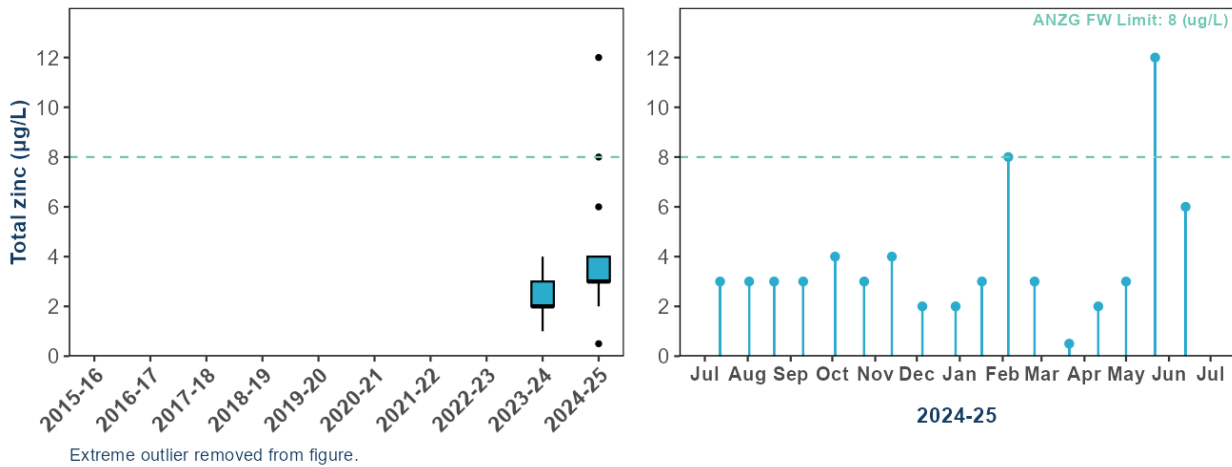
Hacking River as Reference

PH22



Hacking River as Reference

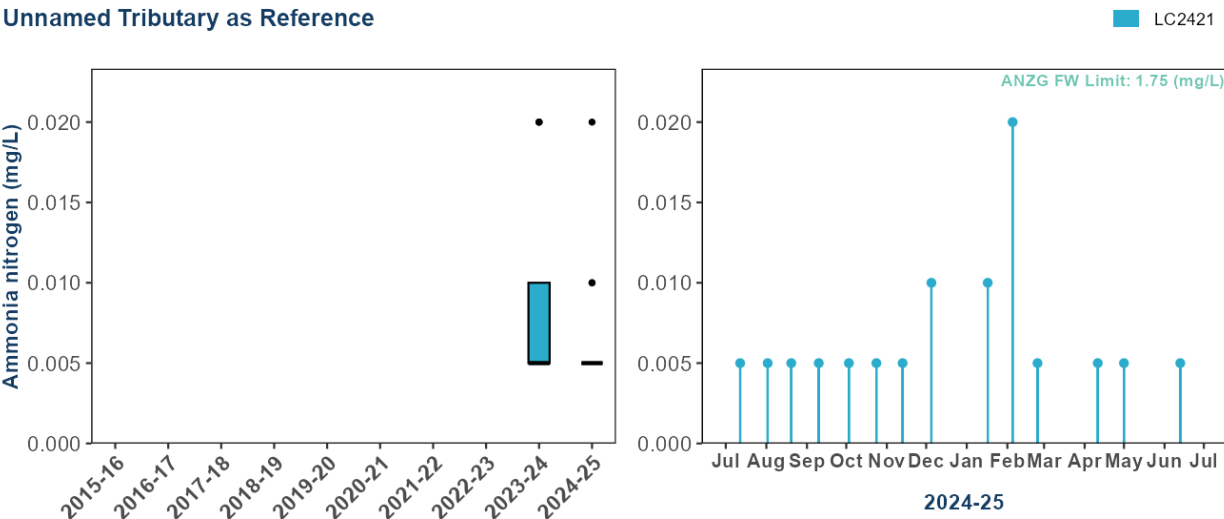
PH22



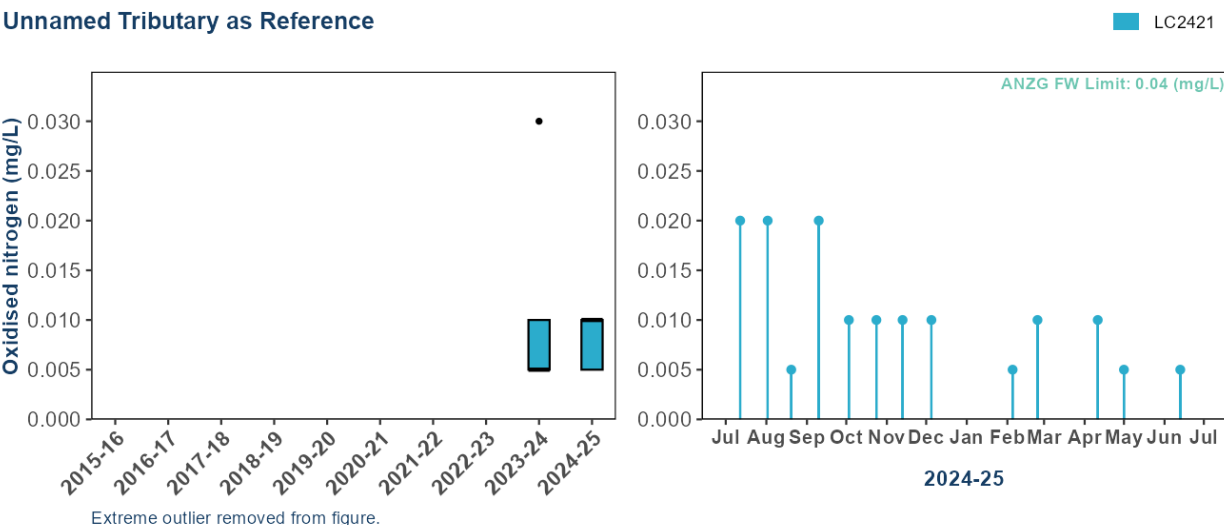
C.3.4. LC2421 Unnamed tributary of Devlin's Creek, Lane Cove River

Stressors – Nutrients

Unnamed Tributary as Reference

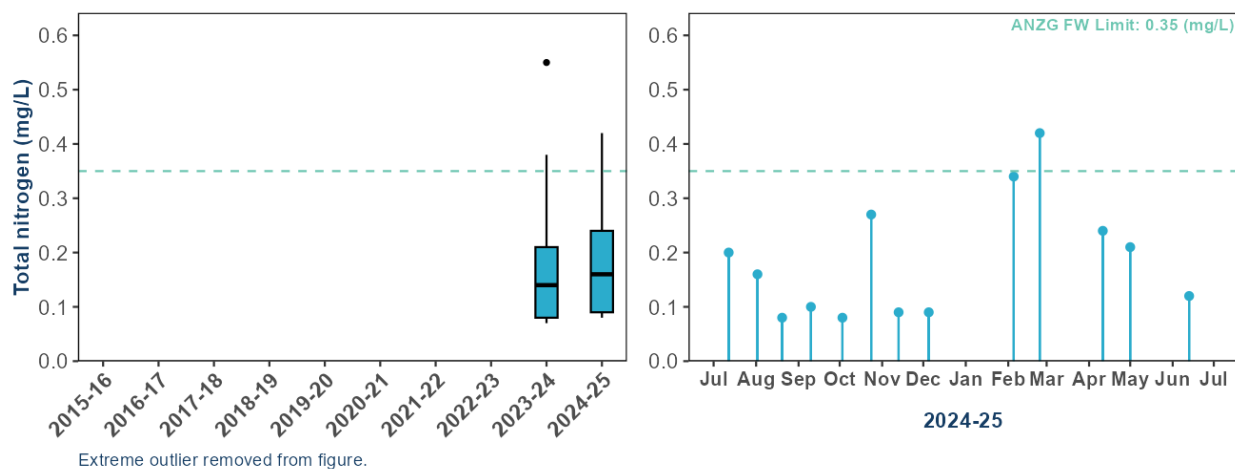


Unnamed Tributary as Reference



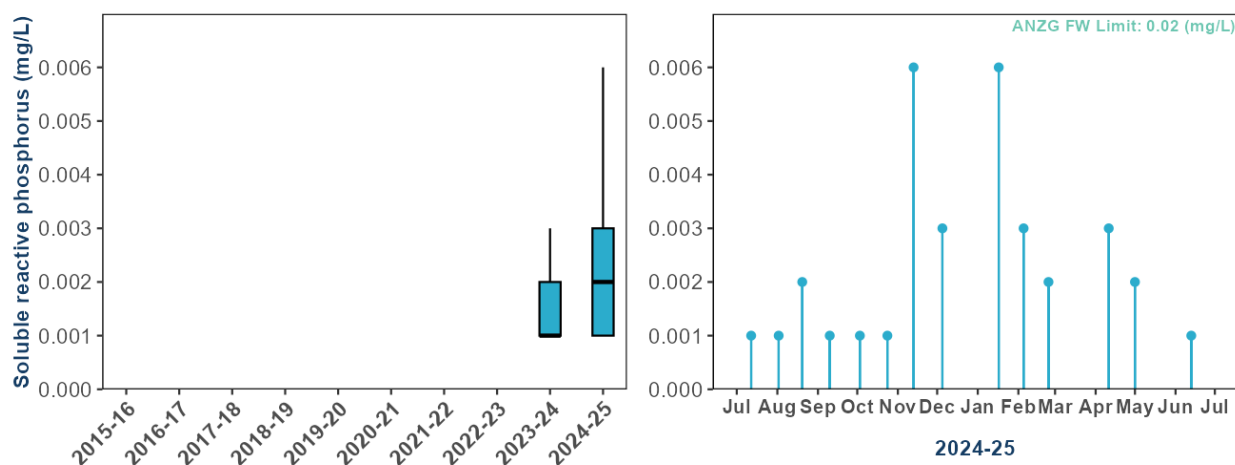
Unnamed Tributary as Reference

LC2421



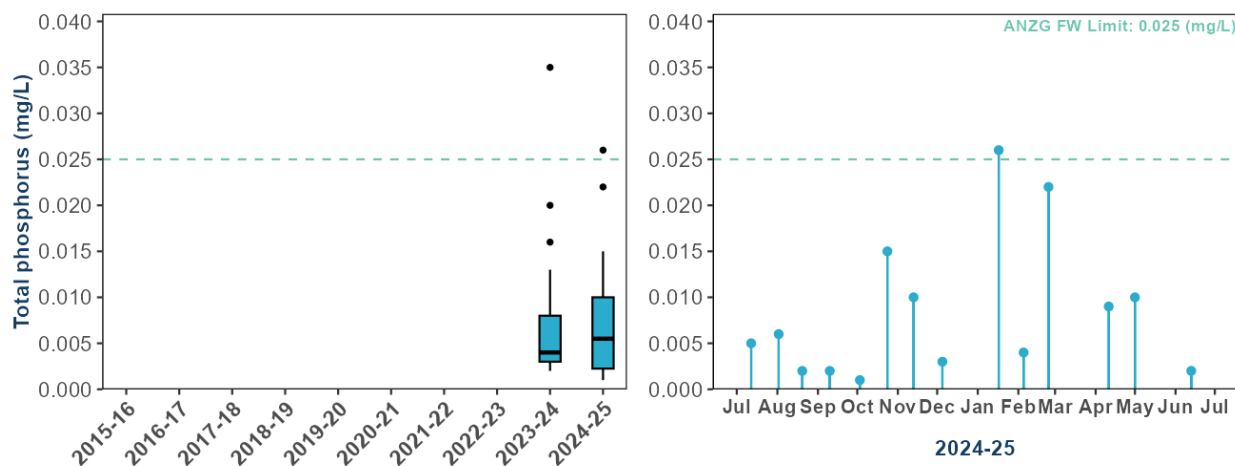
Unnamed Tributary as Reference

LC2421



Unnamed Tributary as Reference

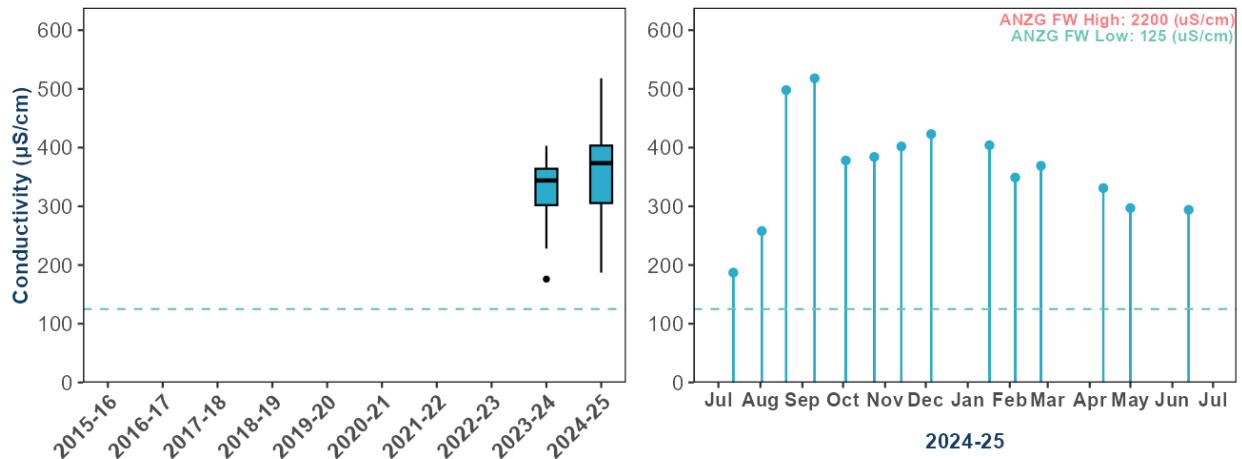
LC2421



Stressors – Physico-chemical water quality

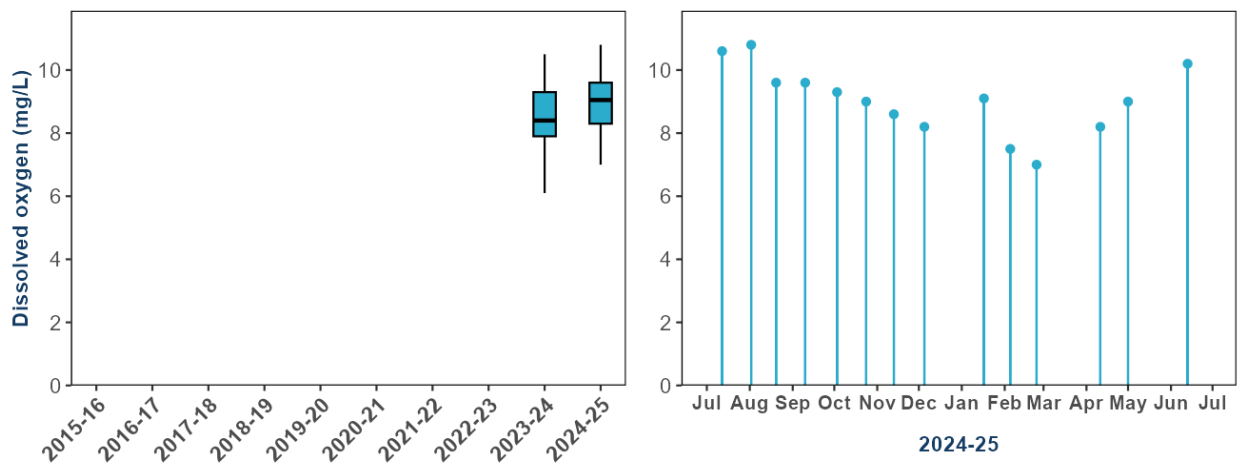
Unnamed Tributary as Reference

LC2421



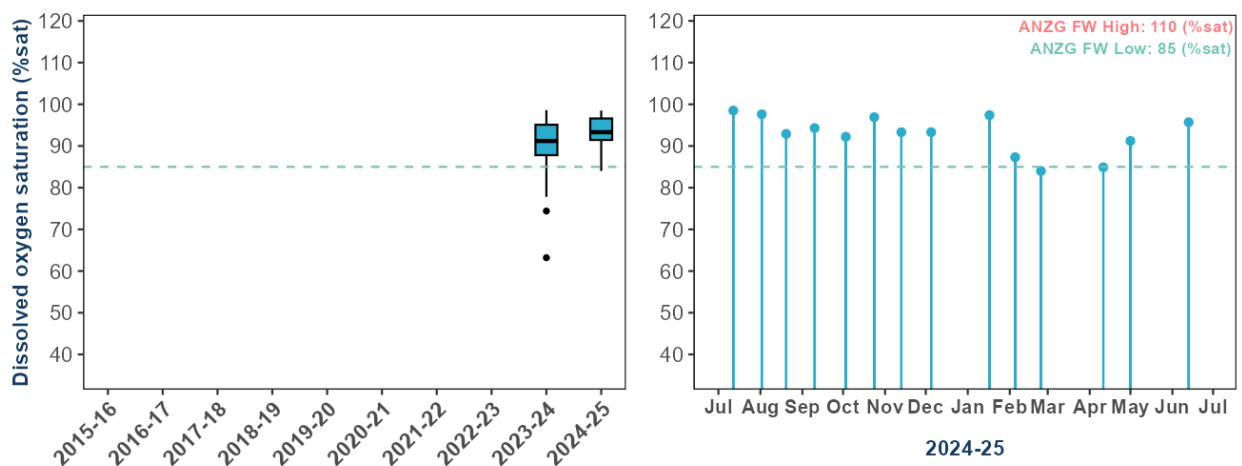
Unnamed Tributary as Reference

LC2421



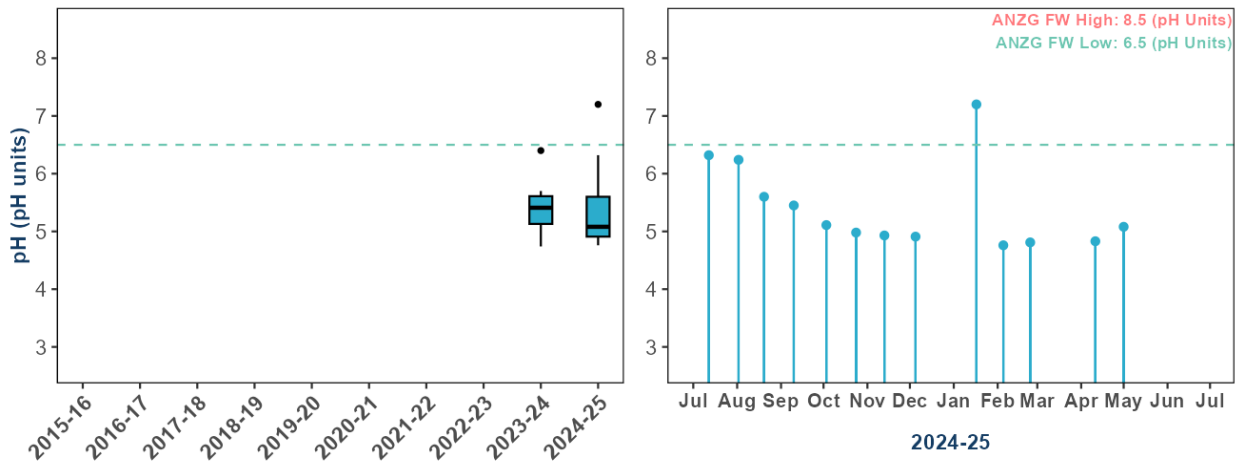
Unnamed Tributary as Reference

LC2421



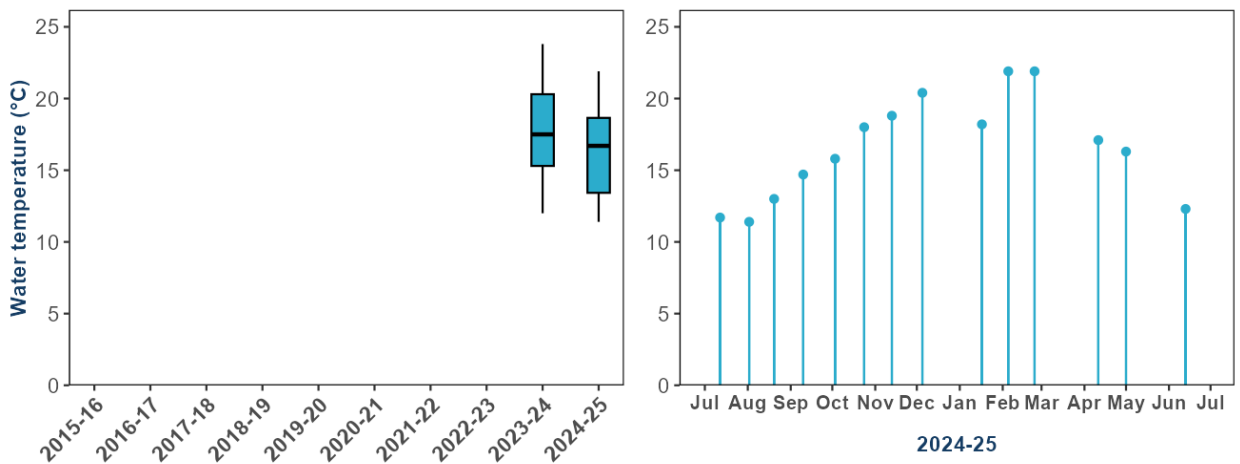
Unnamed Tributary as Reference

LC2421



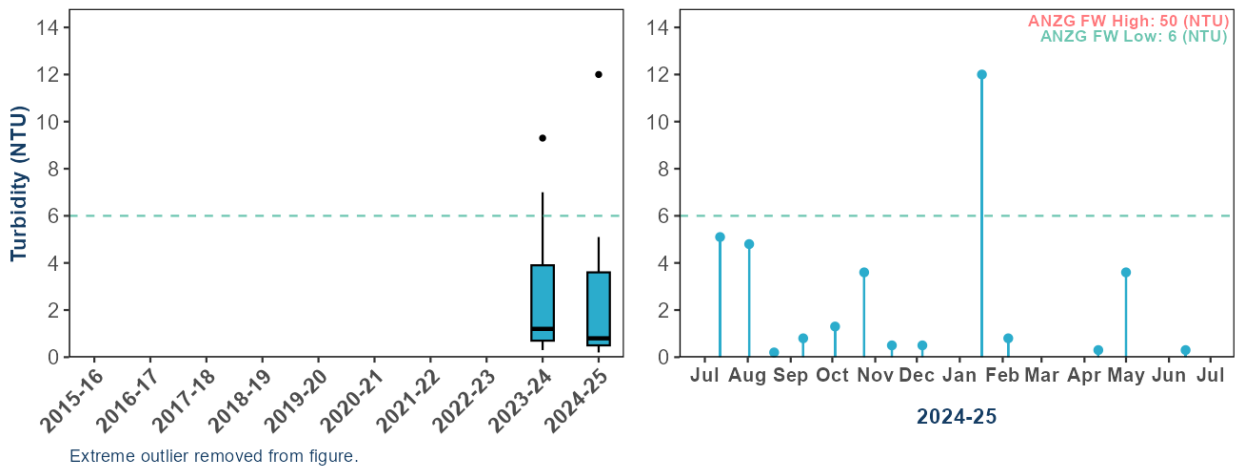
Unnamed Tributary as Reference

LC2421



Unnamed Tributary as Reference

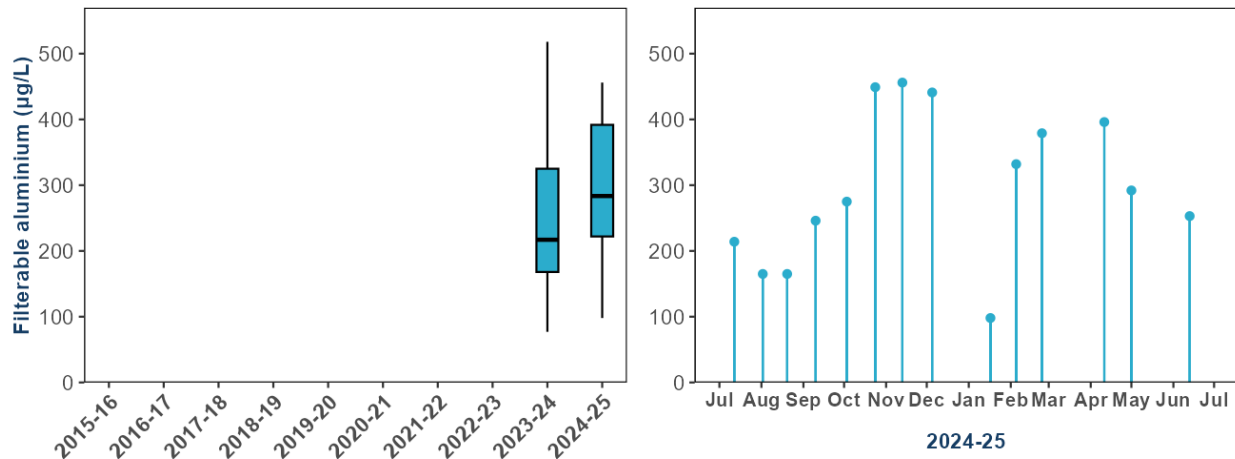
LC2421



Stressors – Trace metals

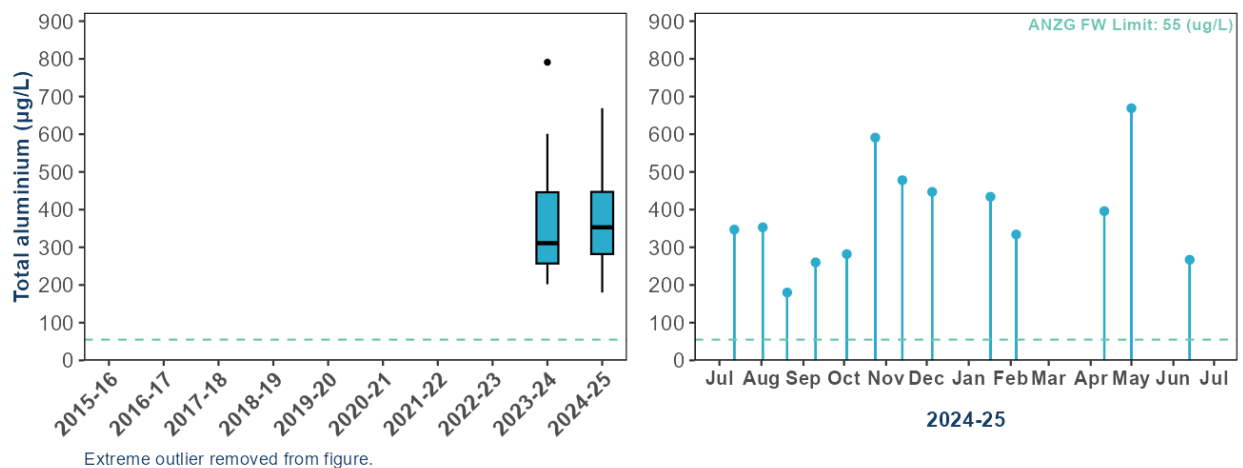
Unnamed Tributary as Reference

LC2421



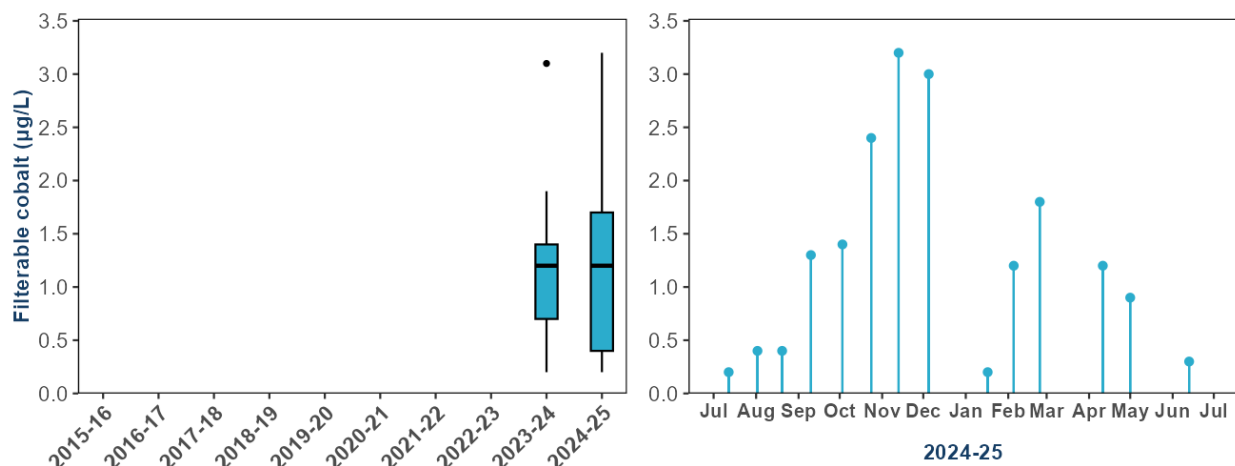
Unnamed Tributary as Reference

LC2421



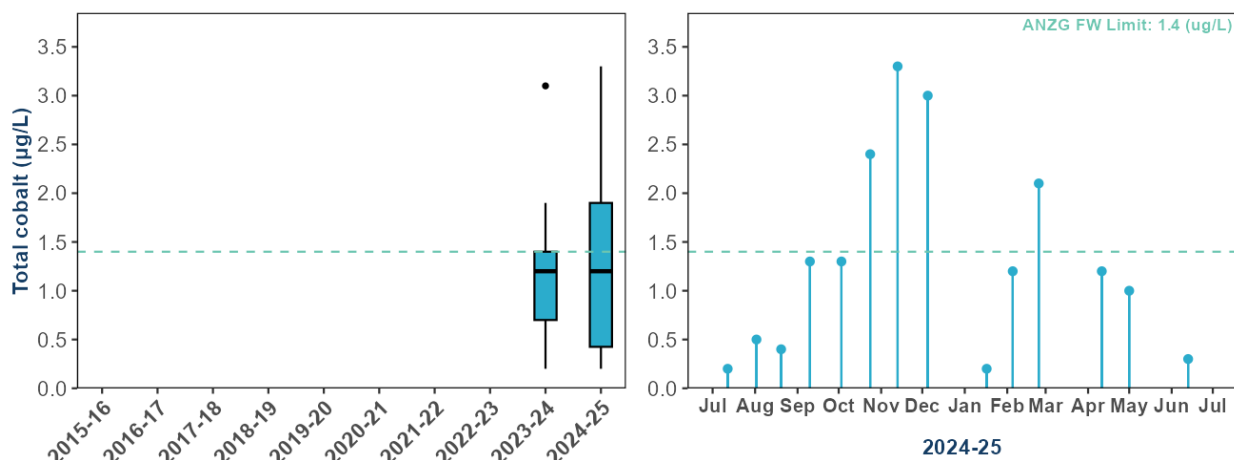
Unnamed Tributary as Reference

LC2421



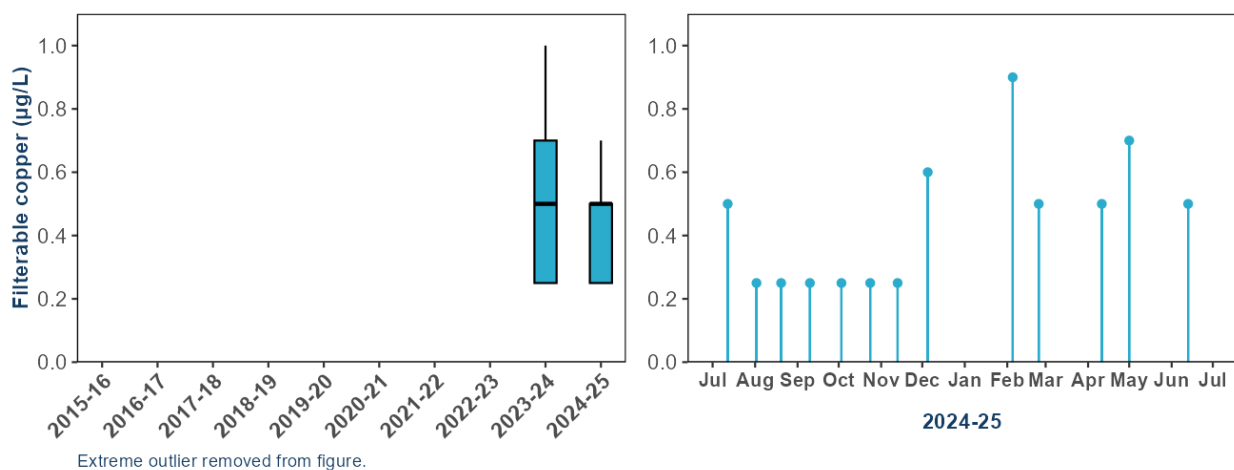
Unnamed Tributary as Reference

LC2421



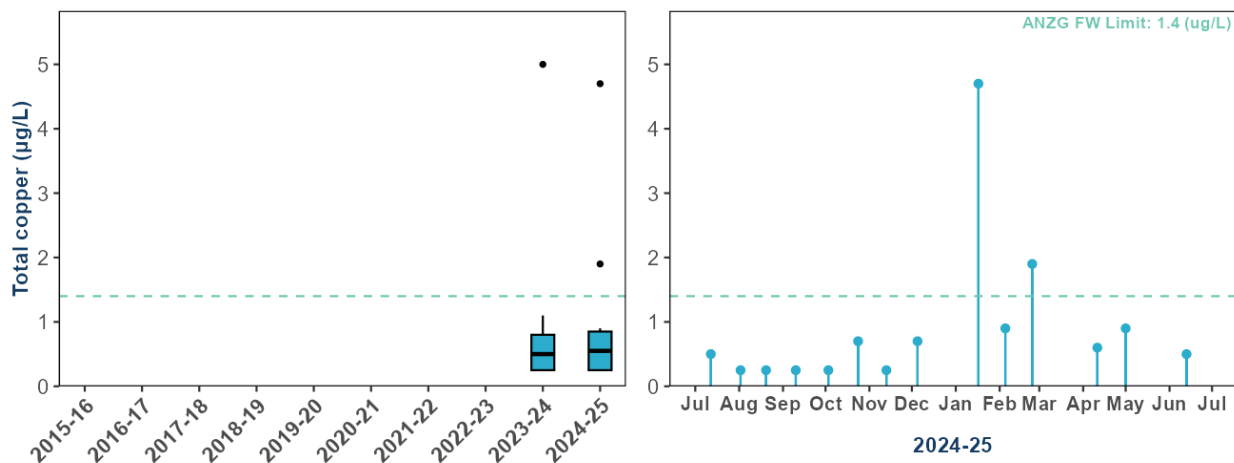
Unnamed Tributary as Reference

LC2421



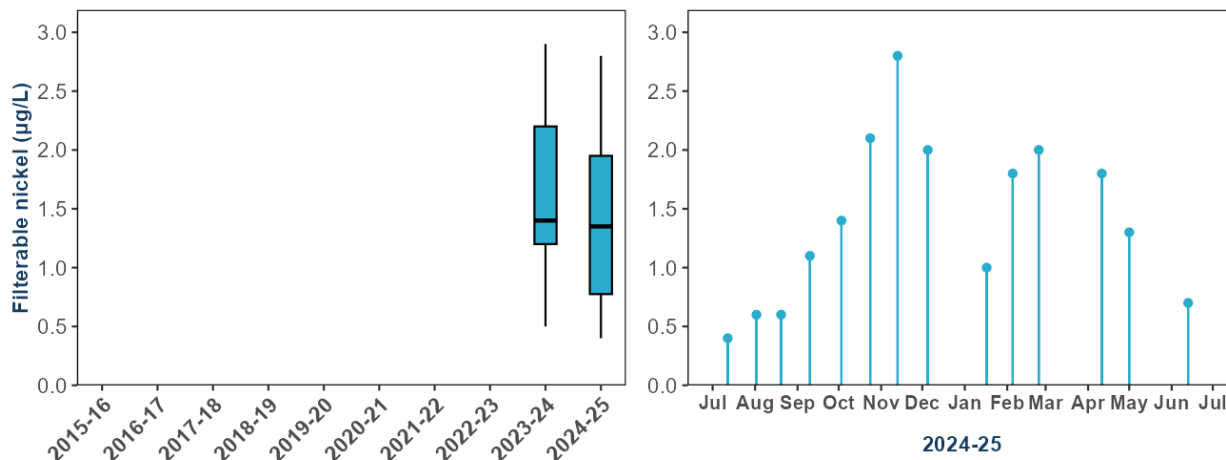
Unnamed Tributary as Reference

LC2421



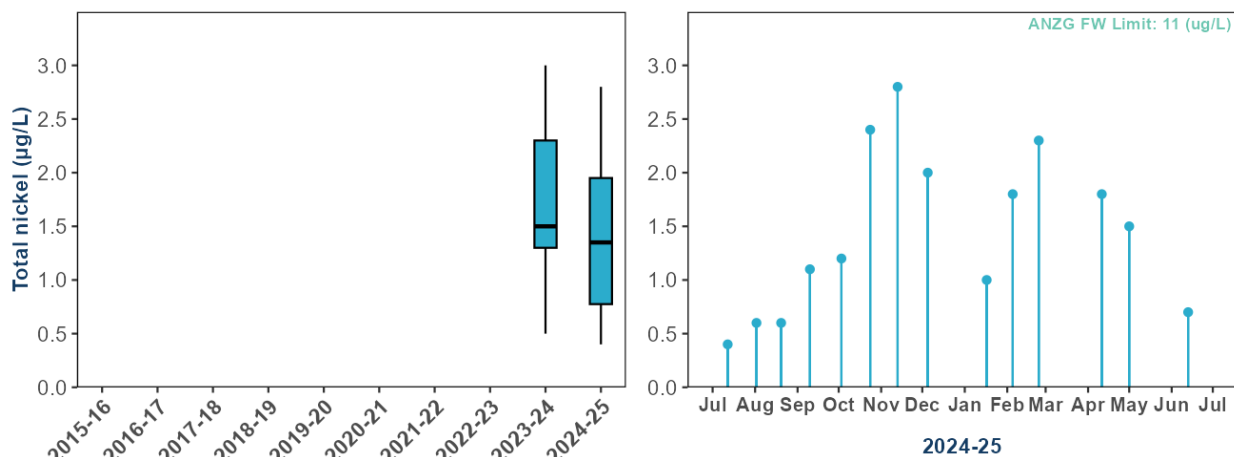
Unnamed Tributary as Reference

LC2421



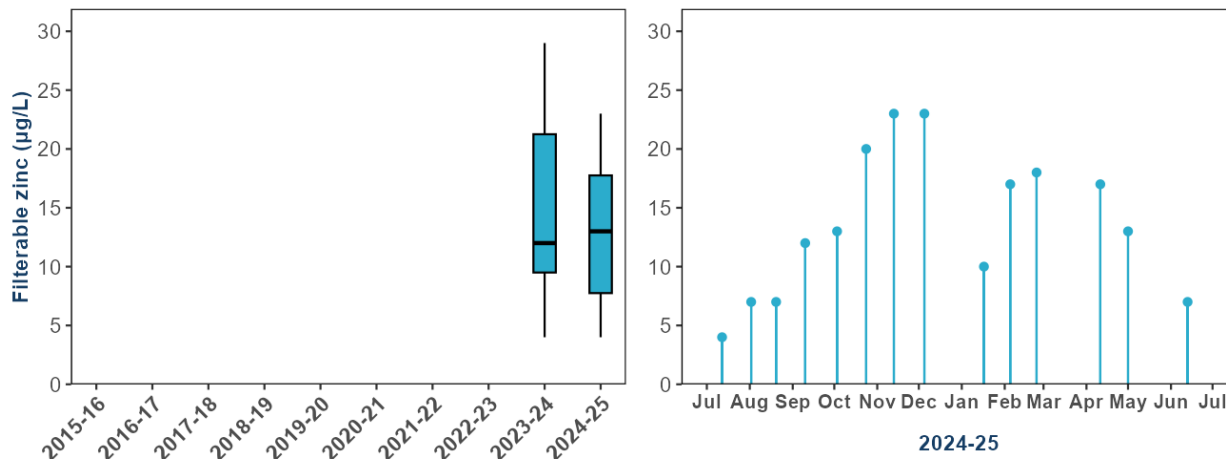
Unnamed Tributary as Reference

LC2421



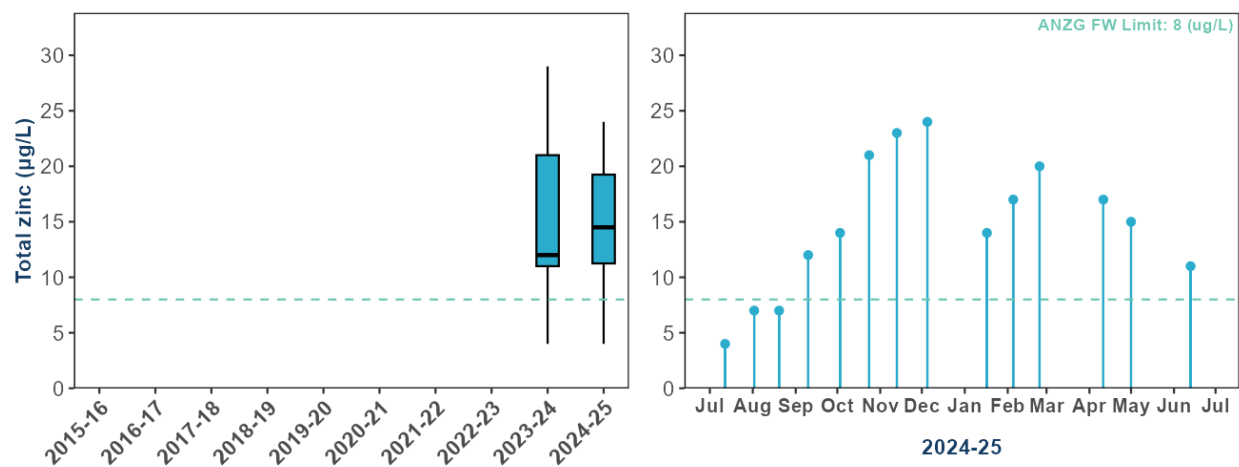
Unnamed Tributary as Reference

LC2421



Unnamed Tributary as Reference

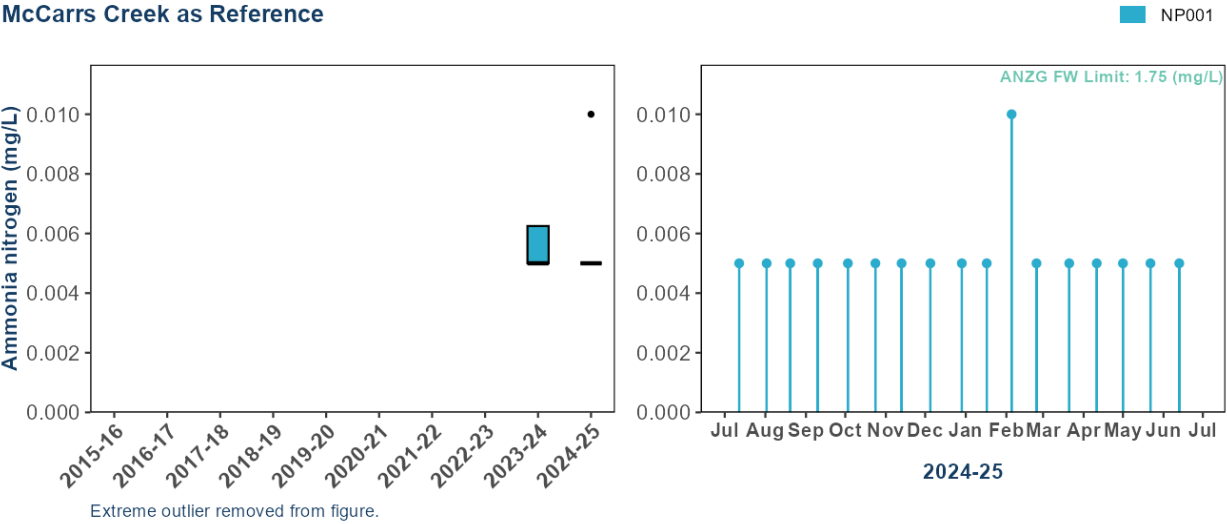
LC2421



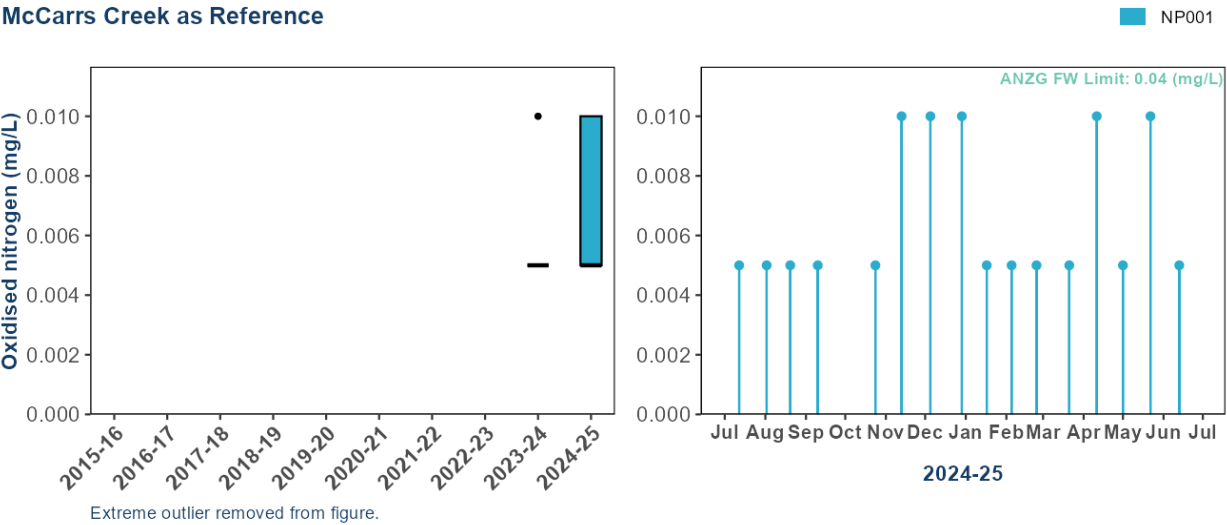
C.3.5. NP001 McCarrs Creek

Stressors – Nutrients

McCarrs Creek as Reference

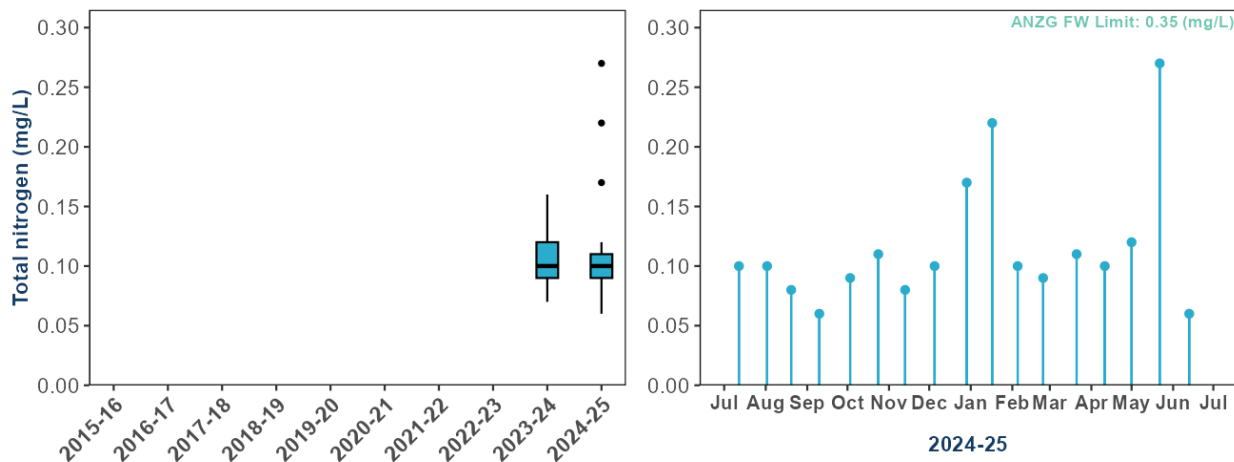


McCarrs Creek as Reference



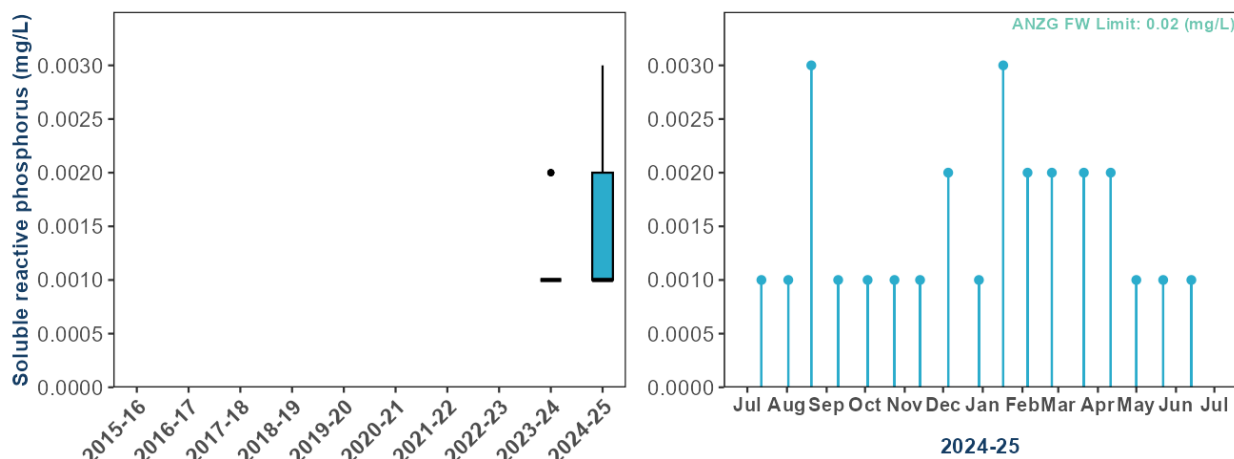
McCarrs Creek as Reference

NP001



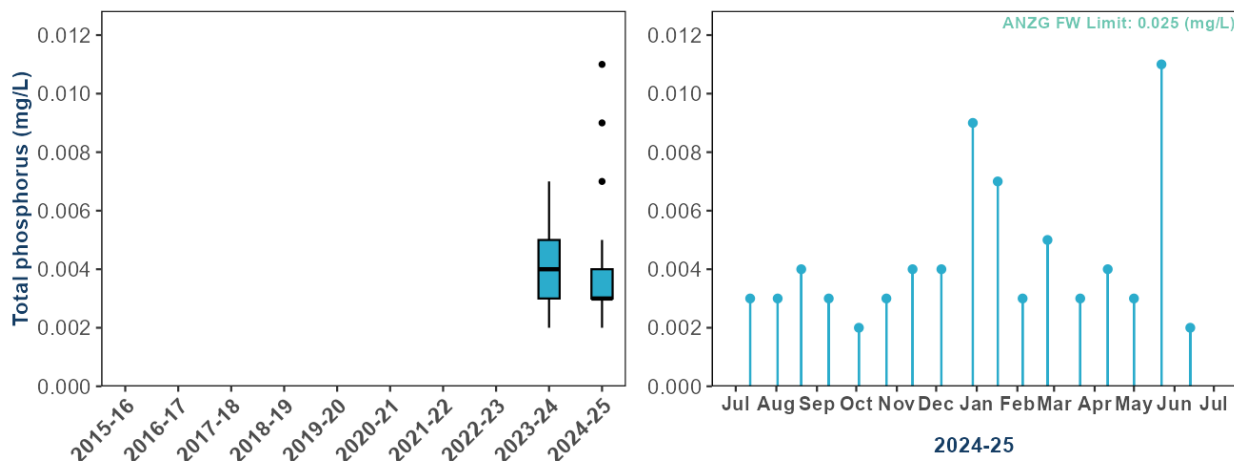
McCarrs Creek as Reference

NP001



McCarrs Creek as Reference

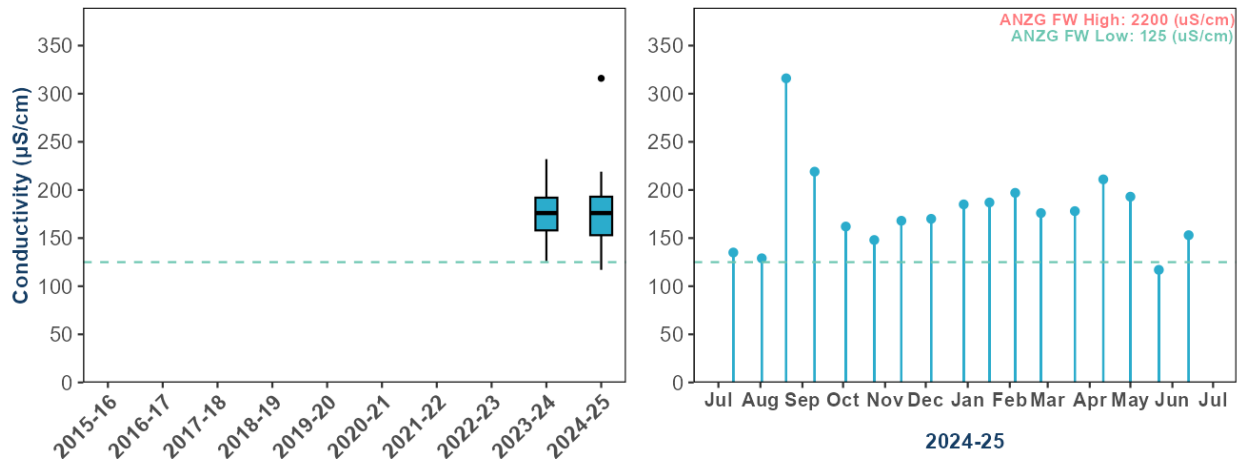
NP001



Stressors – Physico-chemical water quality

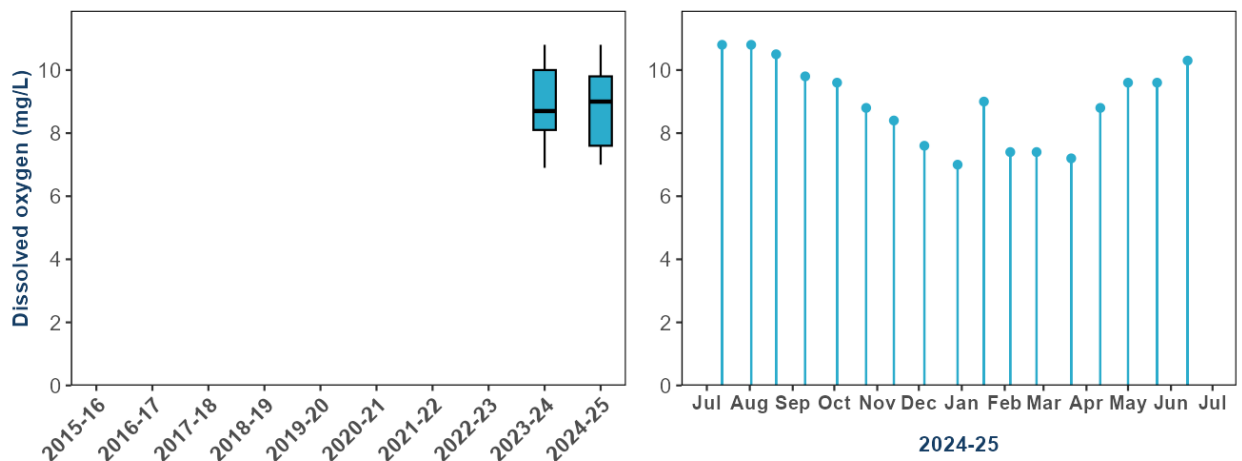
McCarrs Creek as Reference

NP001



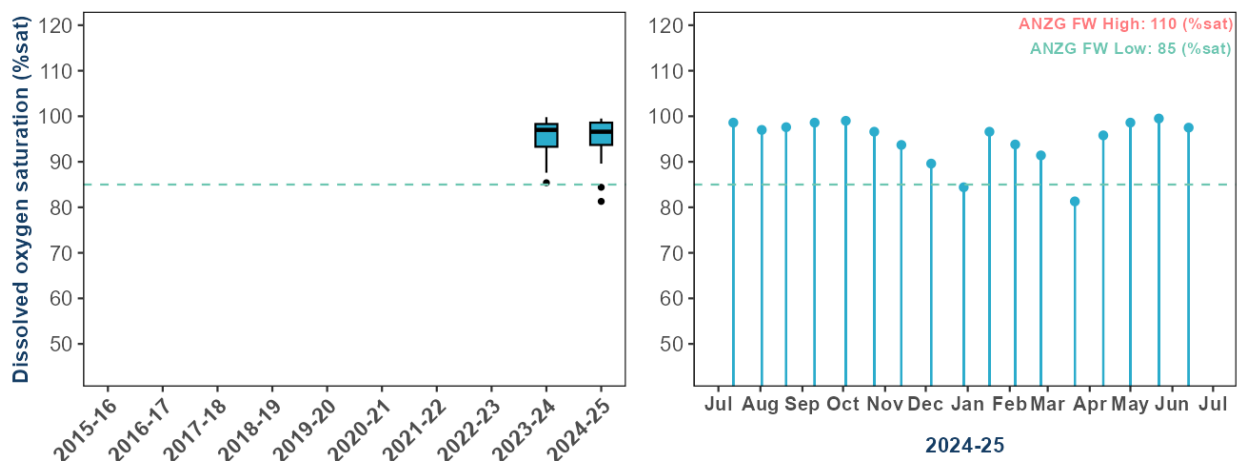
McCarrs Creek as Reference

NP001



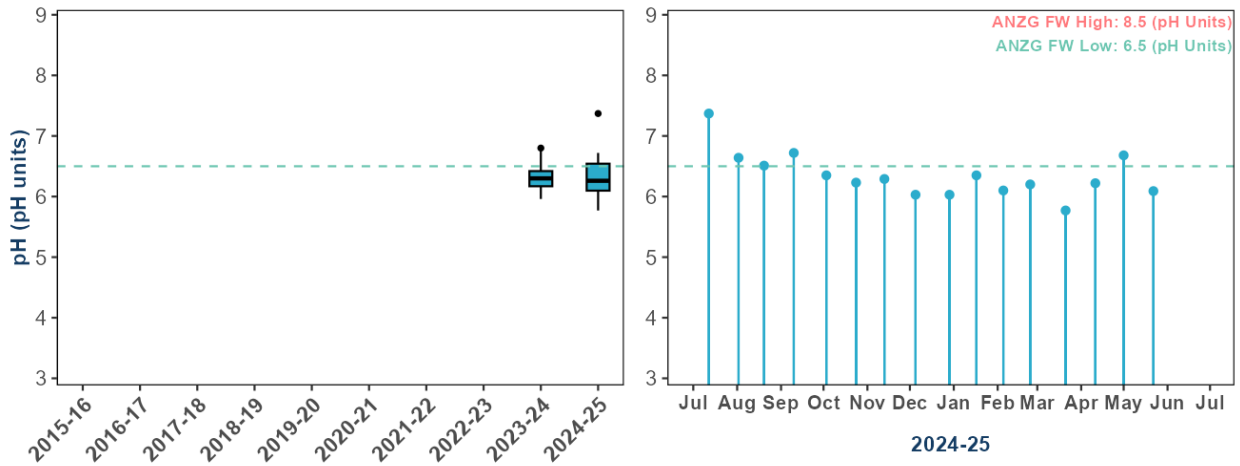
McCarrs Creek as Reference

NP001



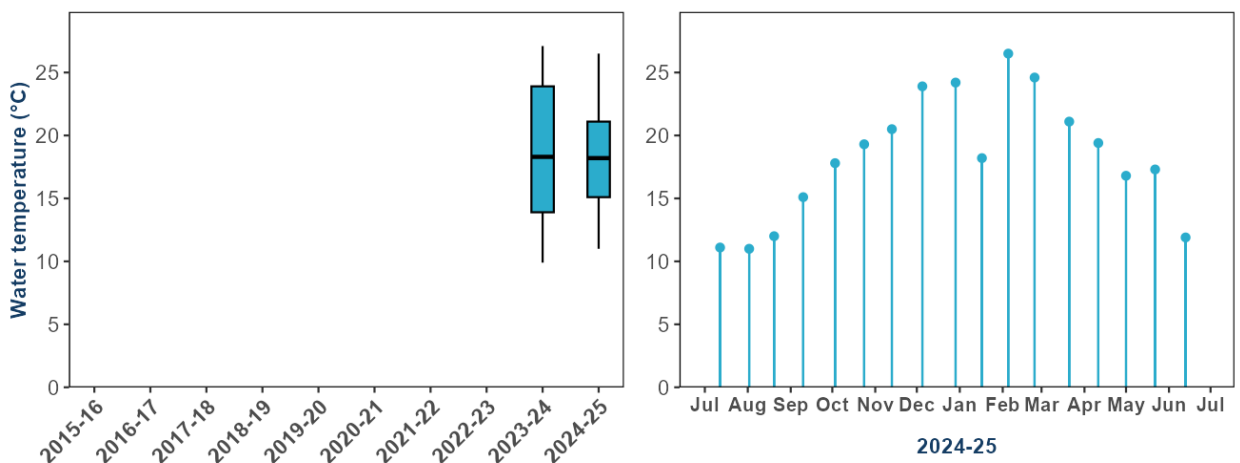
McCarrs Creek as Reference

NP001



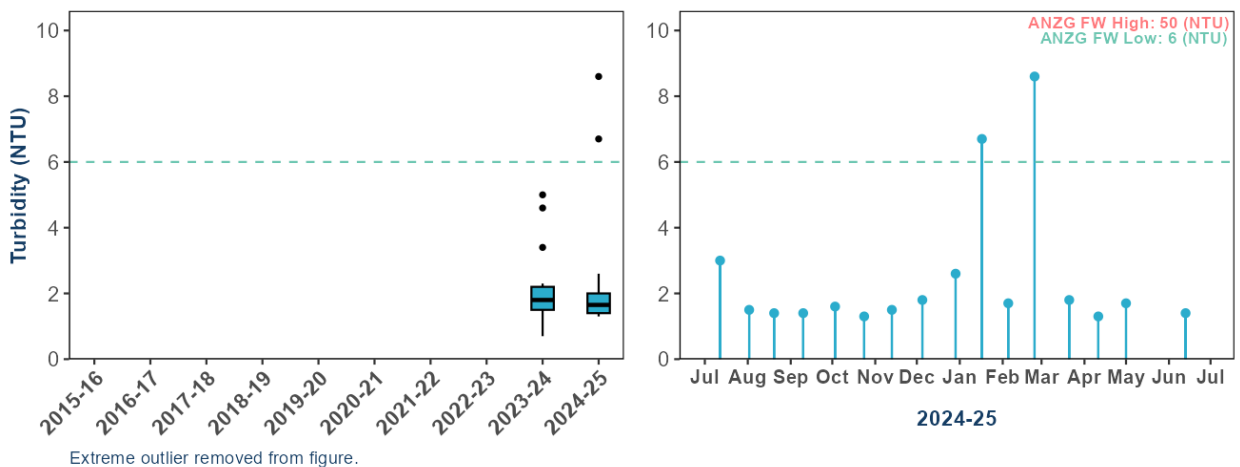
McCarrs Creek as Reference

NP001



McCarrs Creek as Reference

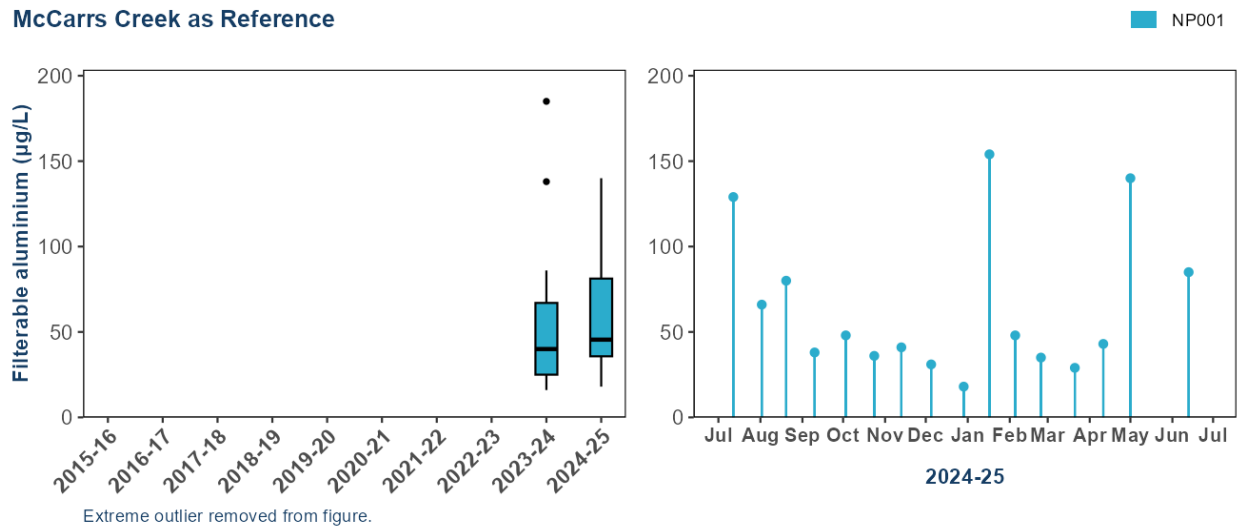
NP001



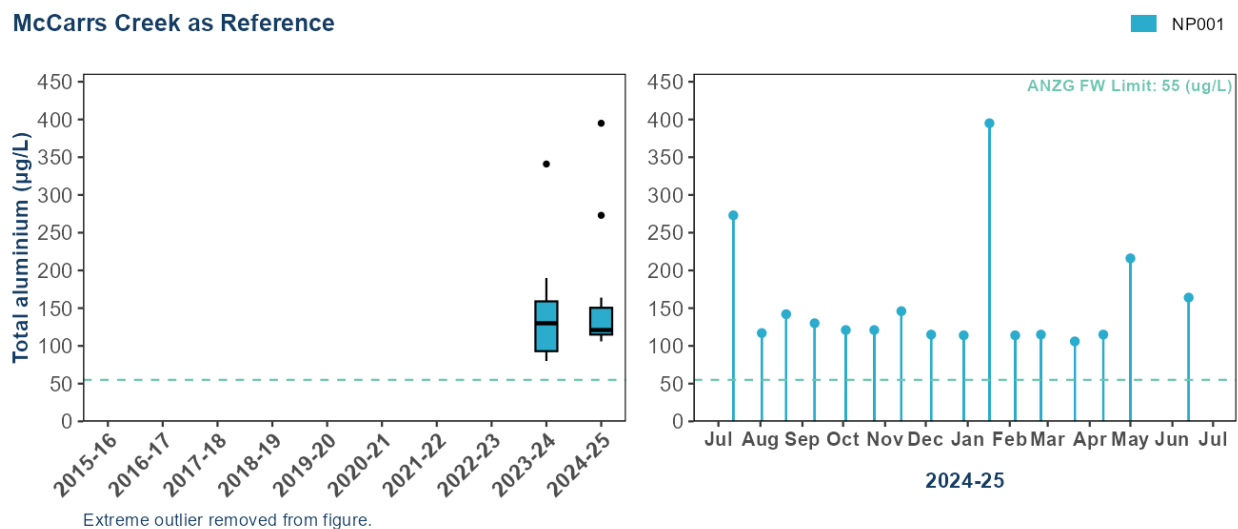
Extreme outlier removed from figure.

Stressors – Trace metals

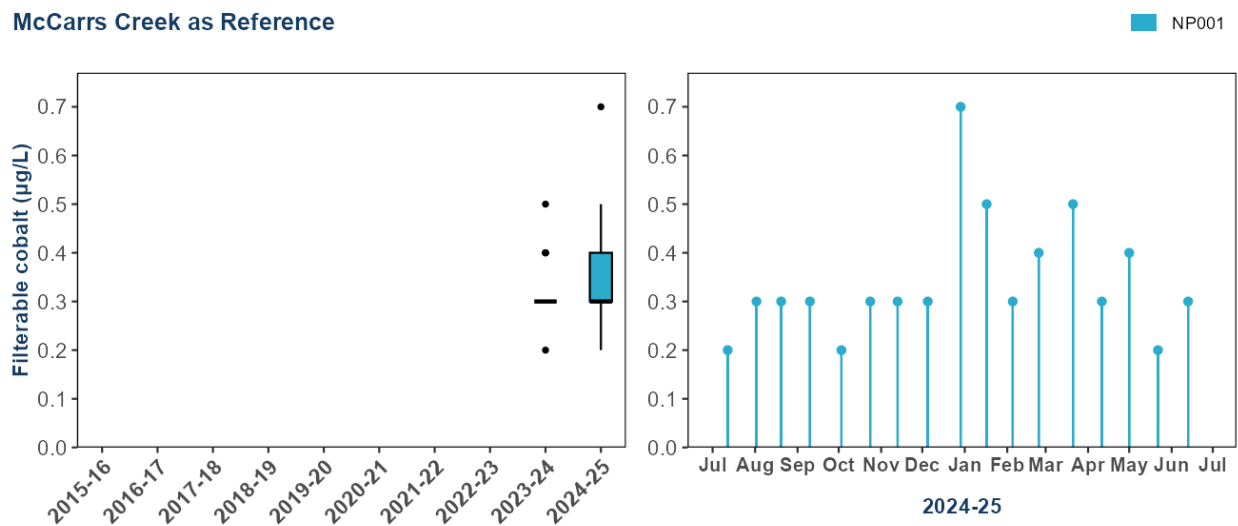
McCarrs Creek as Reference



McCarrs Creek as Reference

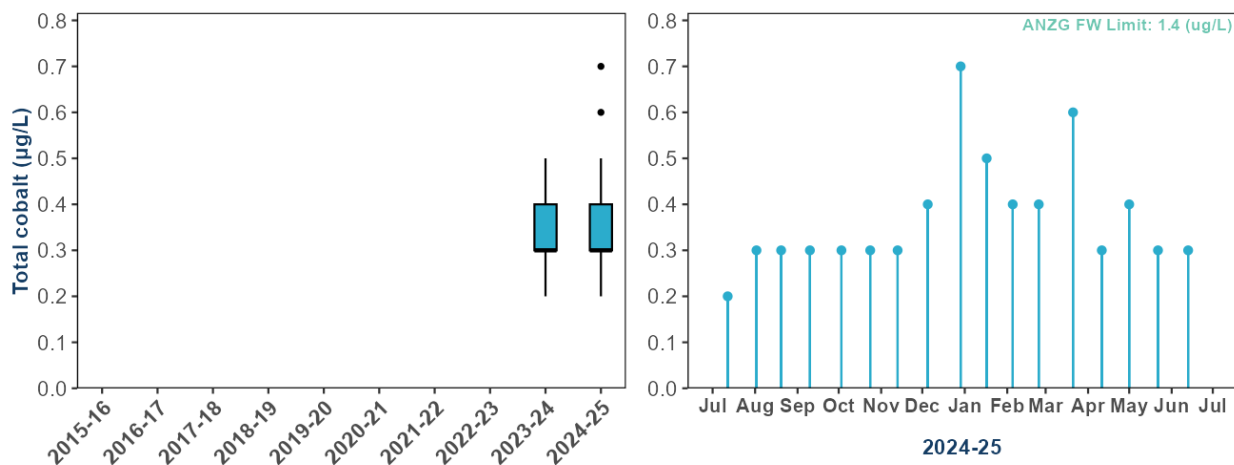


McCarrs Creek as Reference



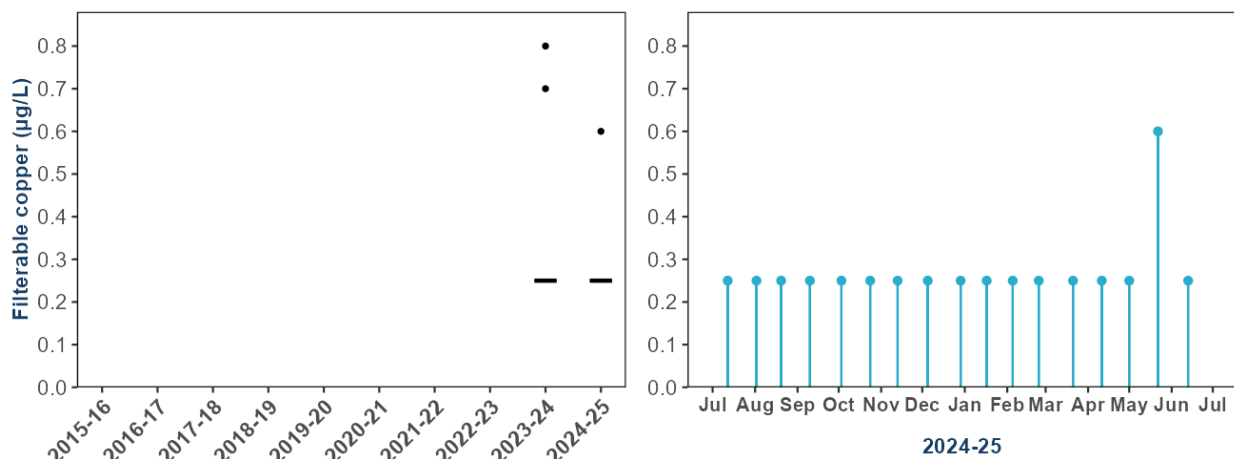
McCarrs Creek as Reference

NP001



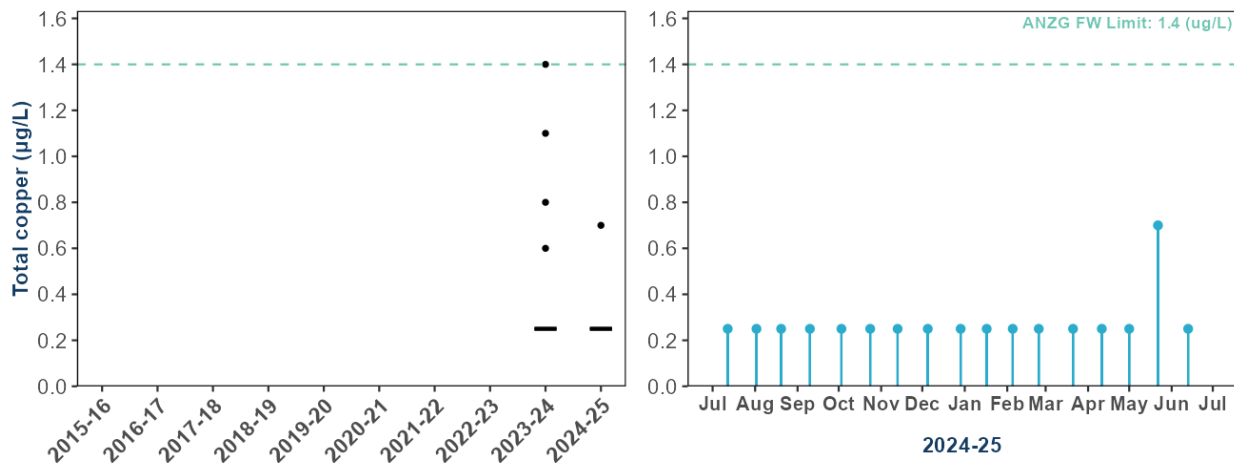
McCarrs Creek as Reference

NP001



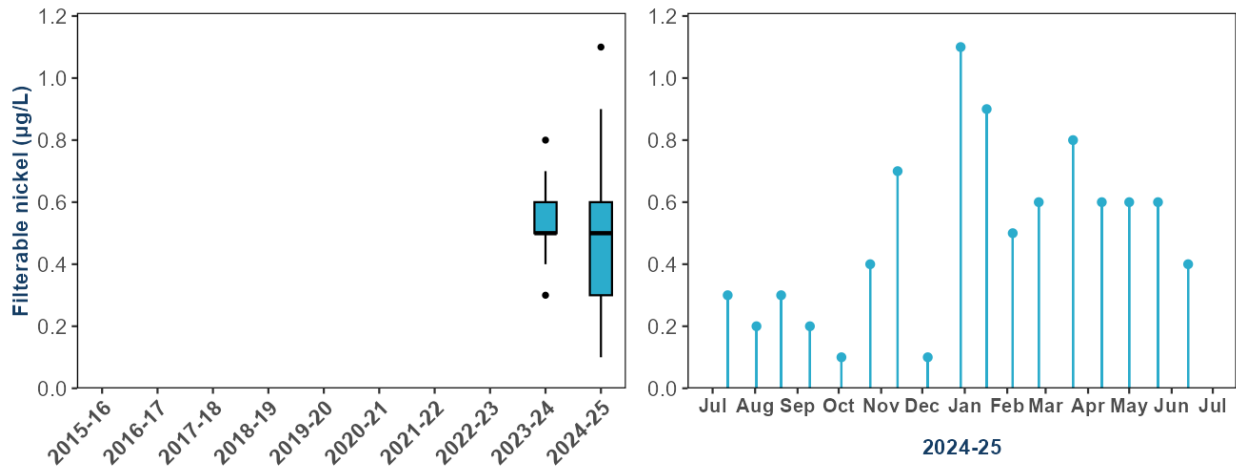
McCarrs Creek as Reference

NP001



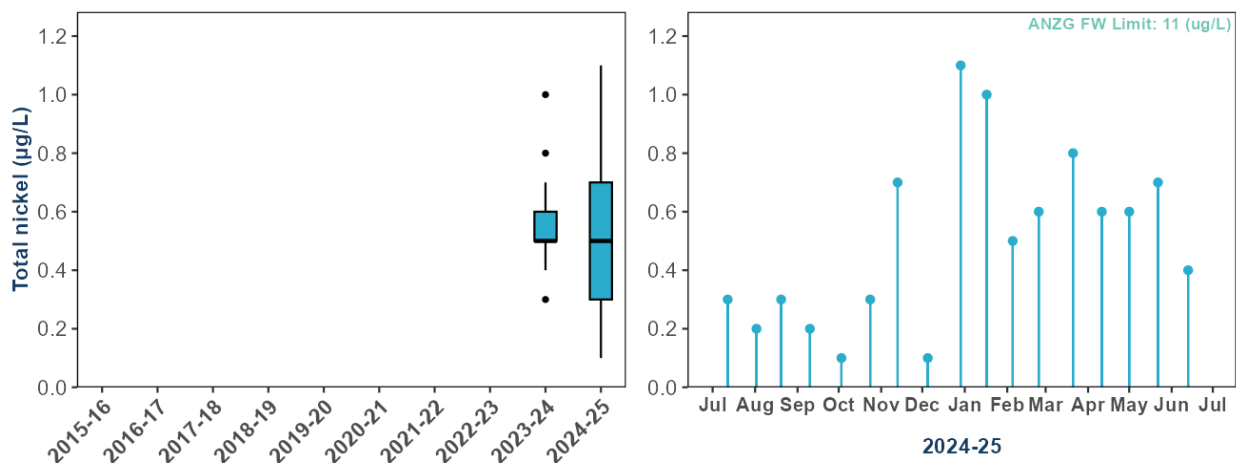
McCarrs Creek as Reference

NP001



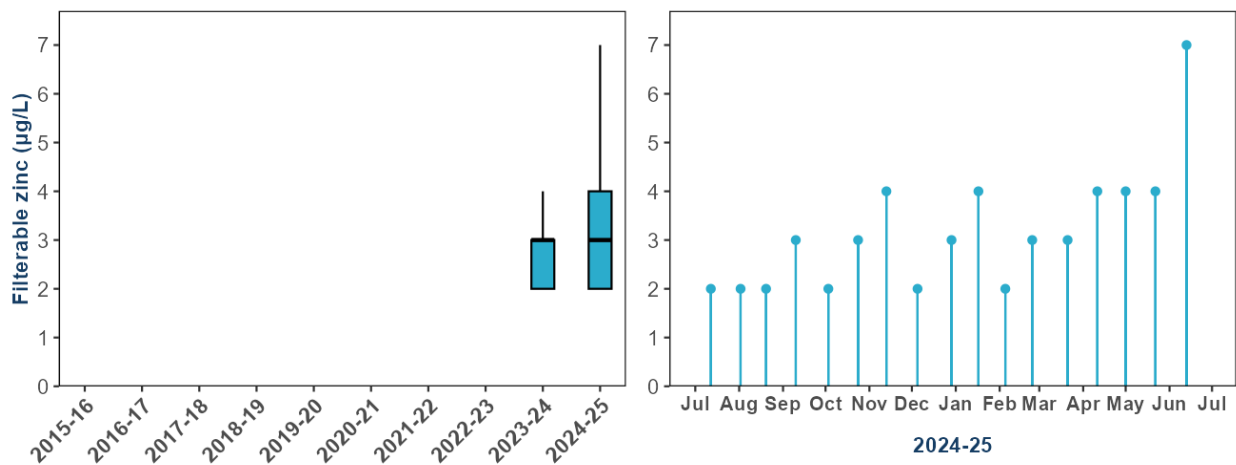
McCarrs Creek as Reference

NP001



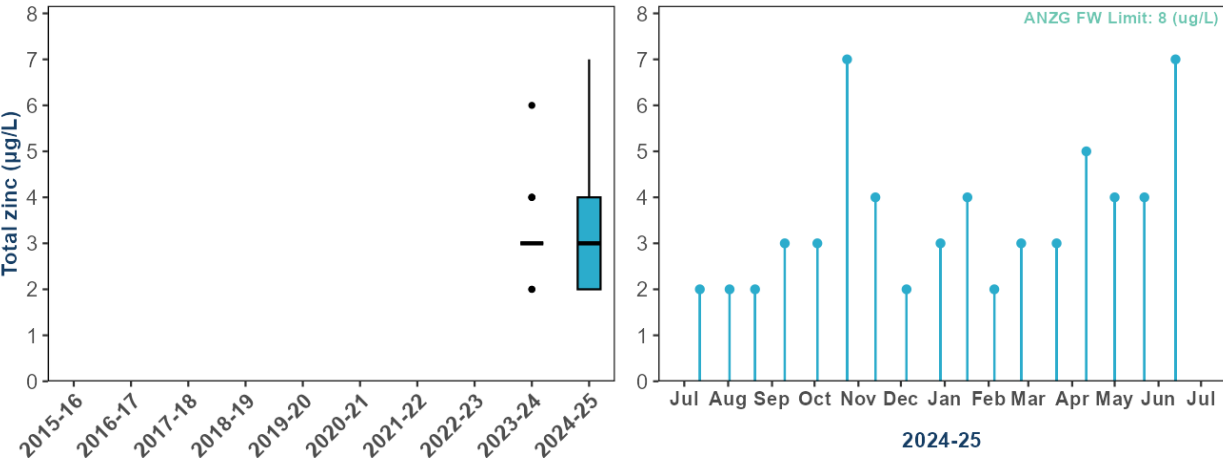
McCarrs Creek as Reference

NP001



McCarrs Creek as Reference

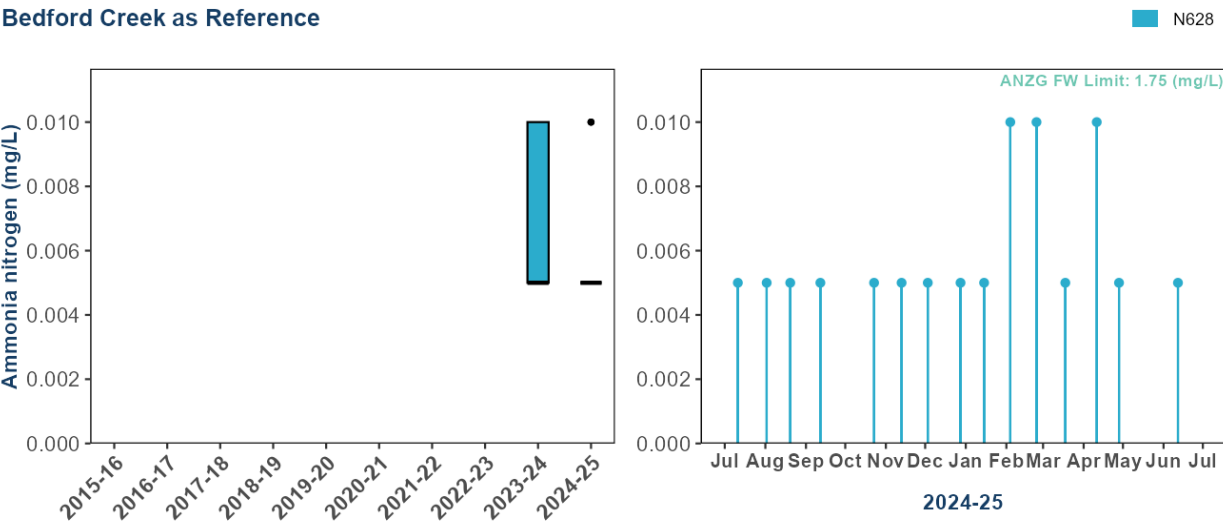
NP001



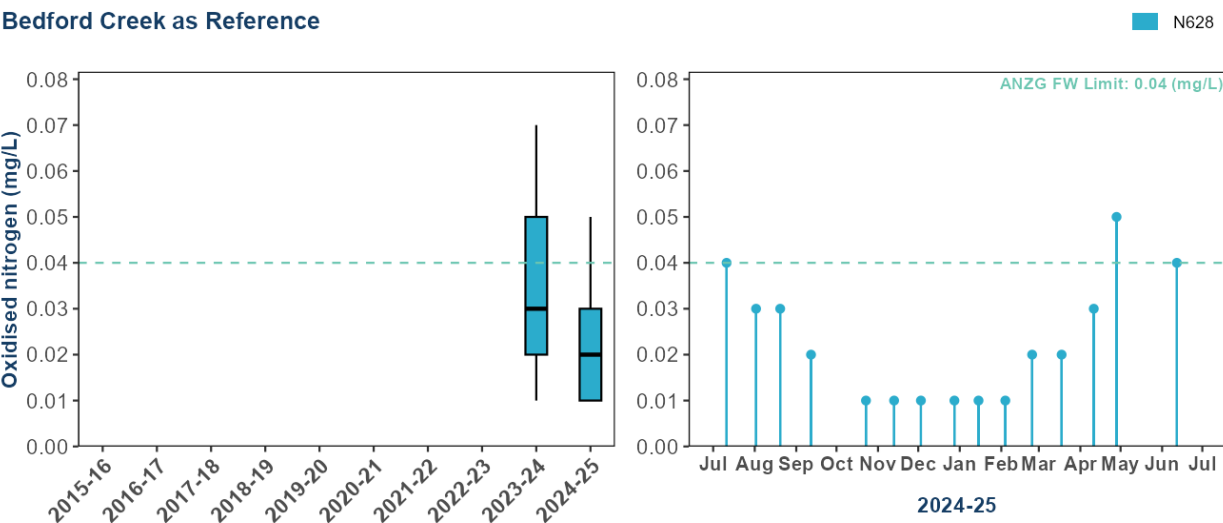
C.3.6. N628 Bedford Creek

Stressors – Nutrients

Bedford Creek as Reference

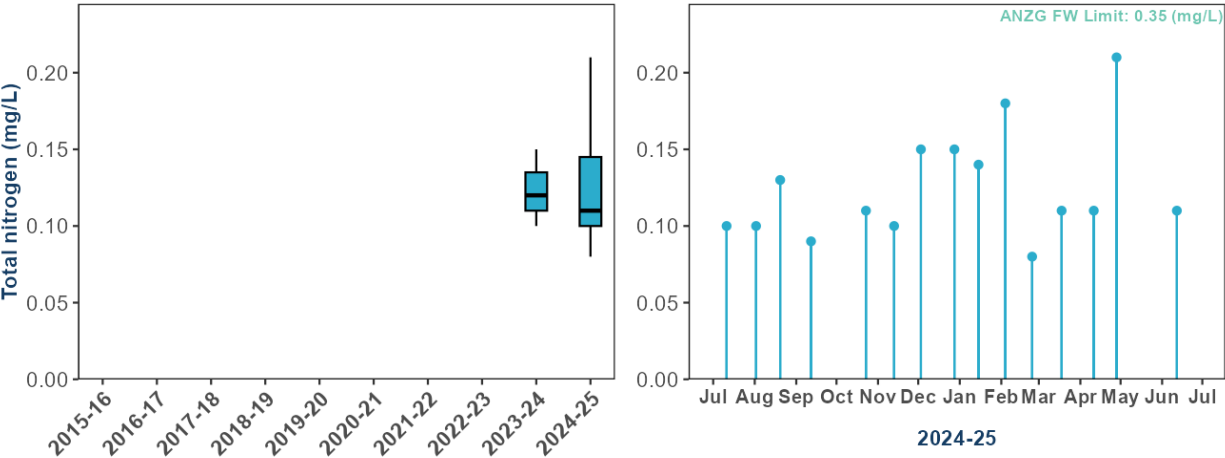


Bedford Creek as Reference



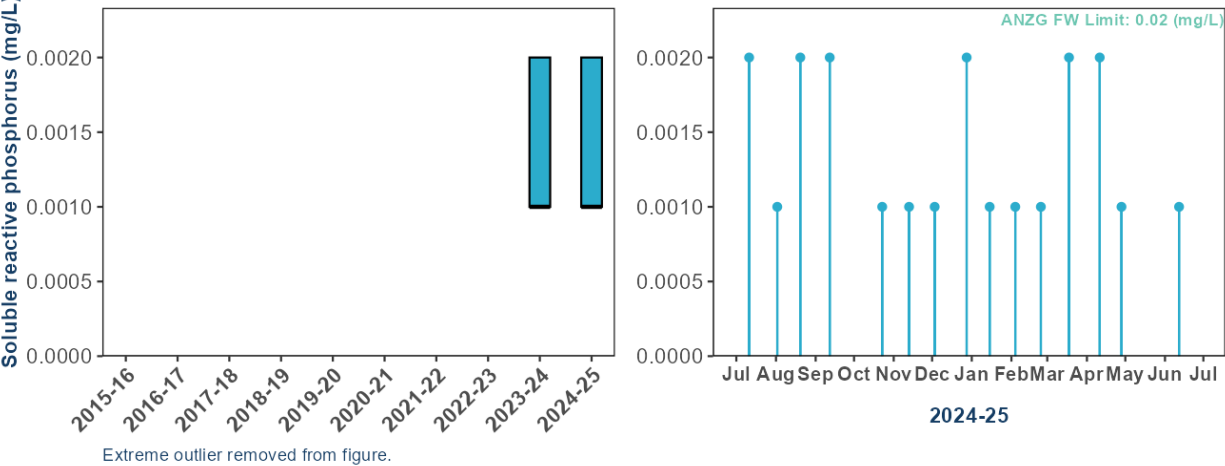
Bedford Creek as Reference

N628



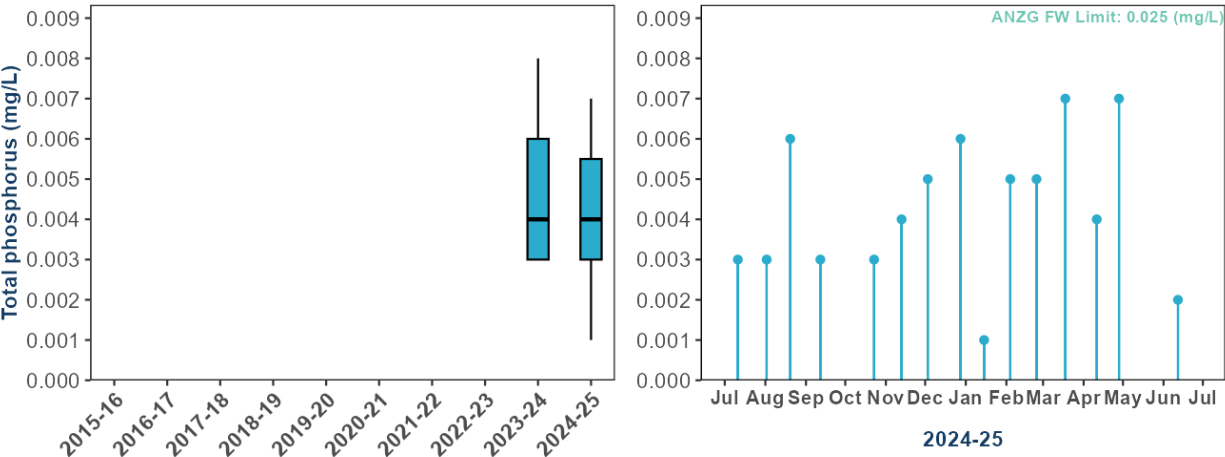
Bedford Creek as Reference

N628



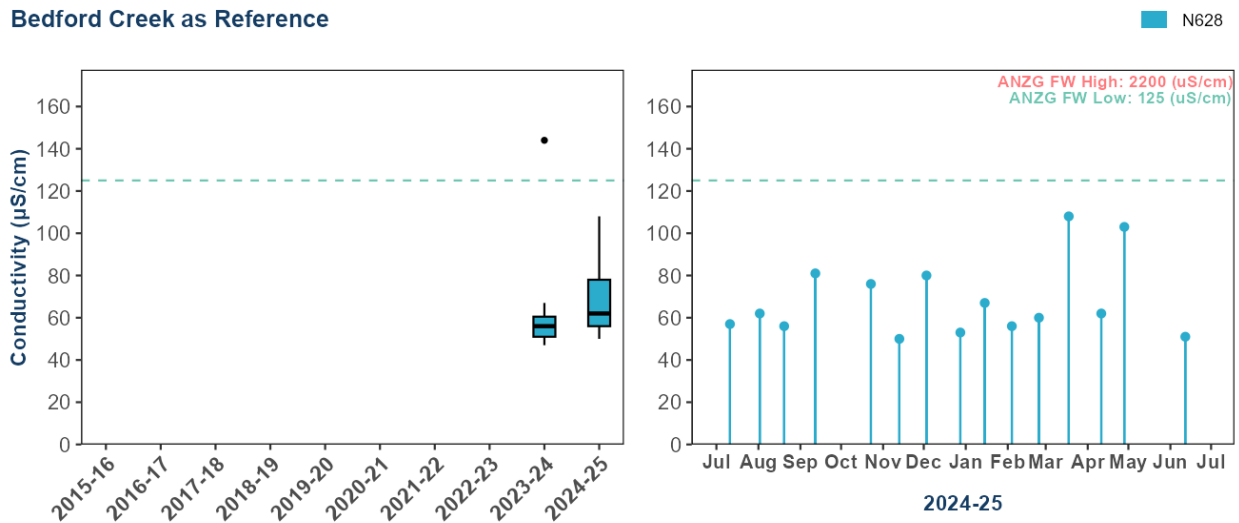
Bedford Creek as Reference

N628

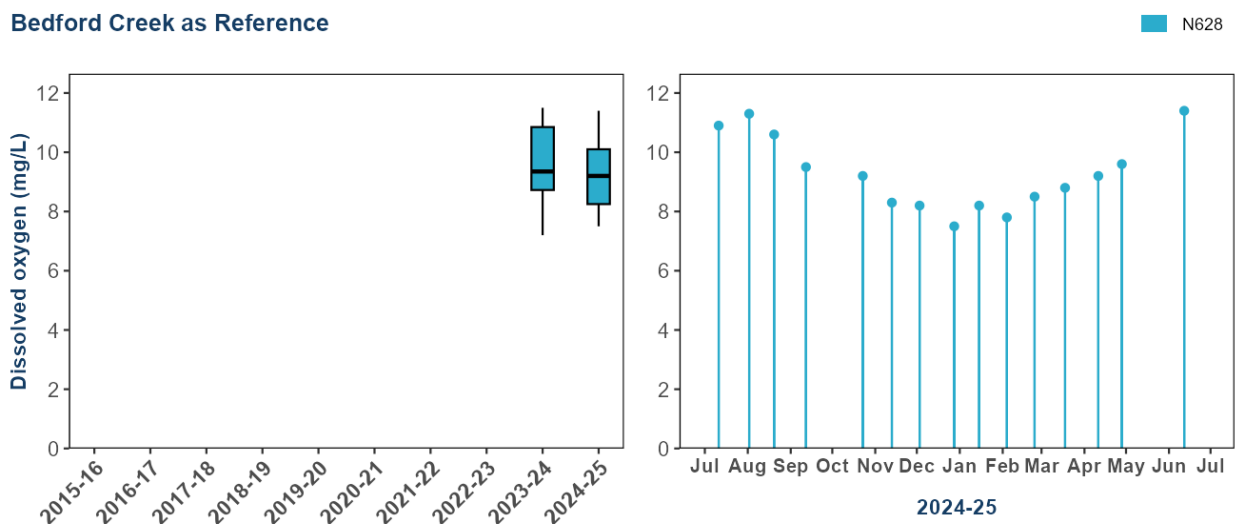


Stressors – Physico-chemical water quality

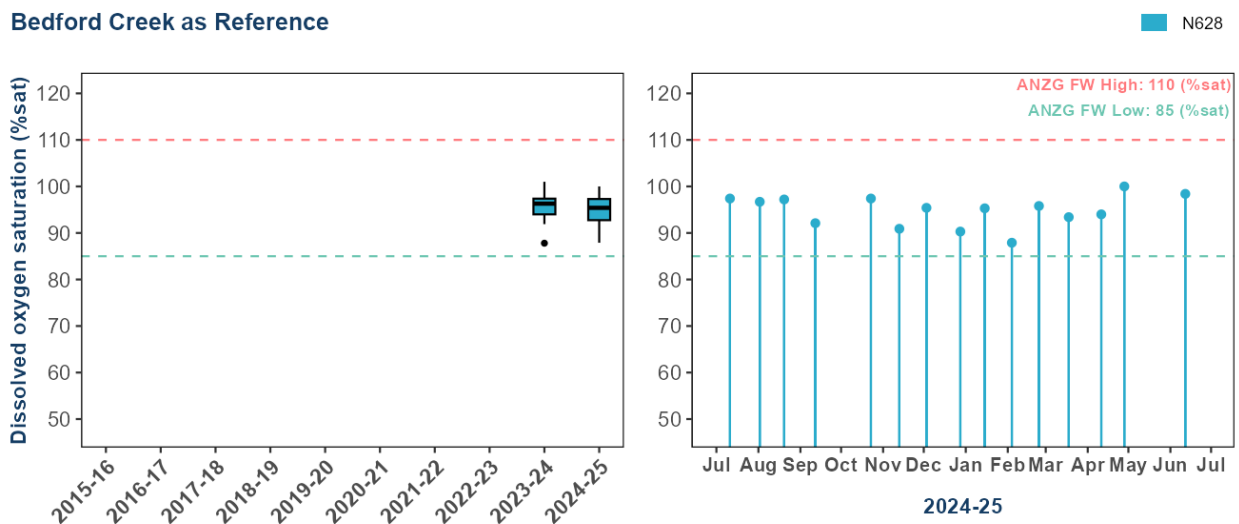
Bedford Creek as Reference



Bedford Creek as Reference

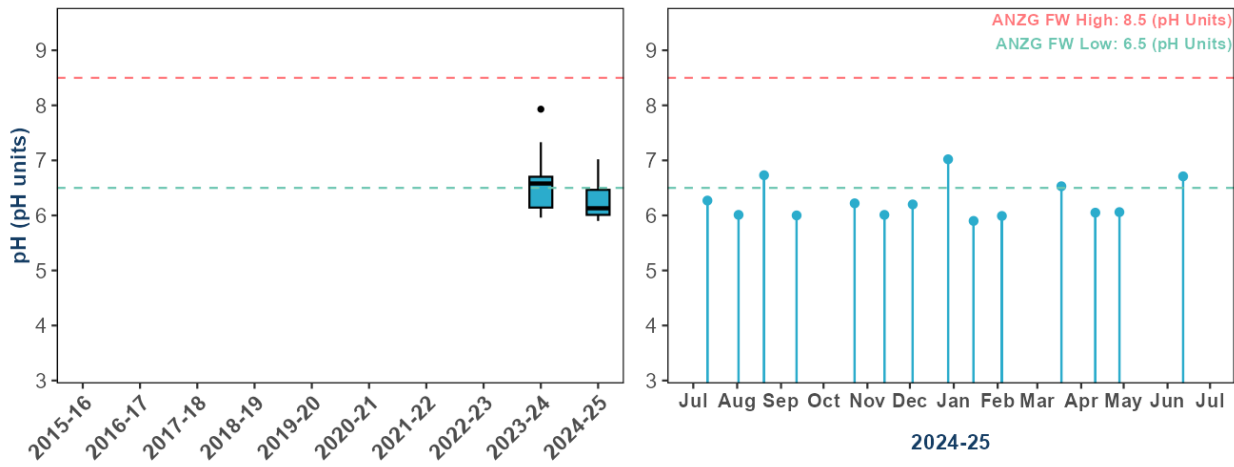


Bedford Creek as Reference



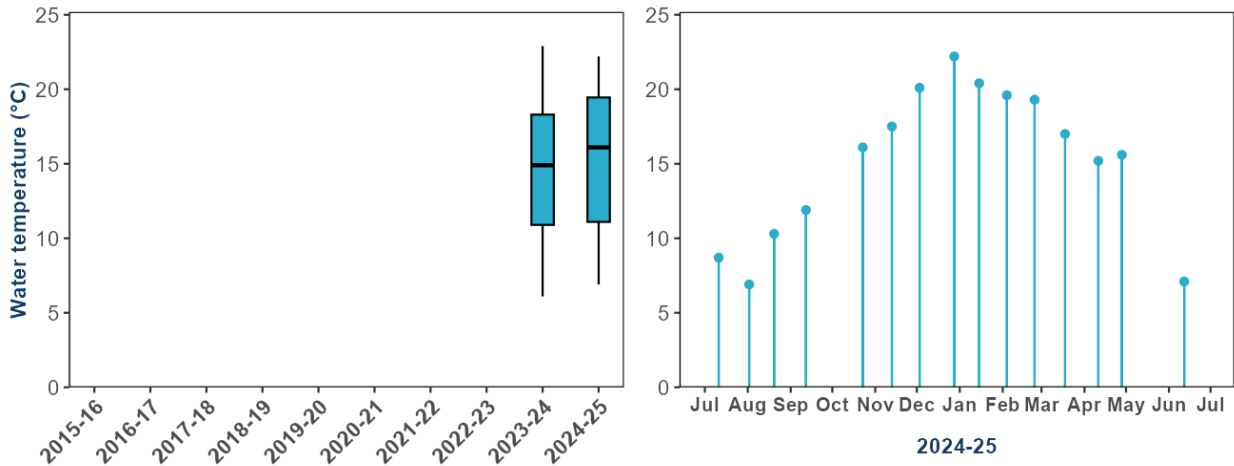
Bedford Creek as Reference

N628



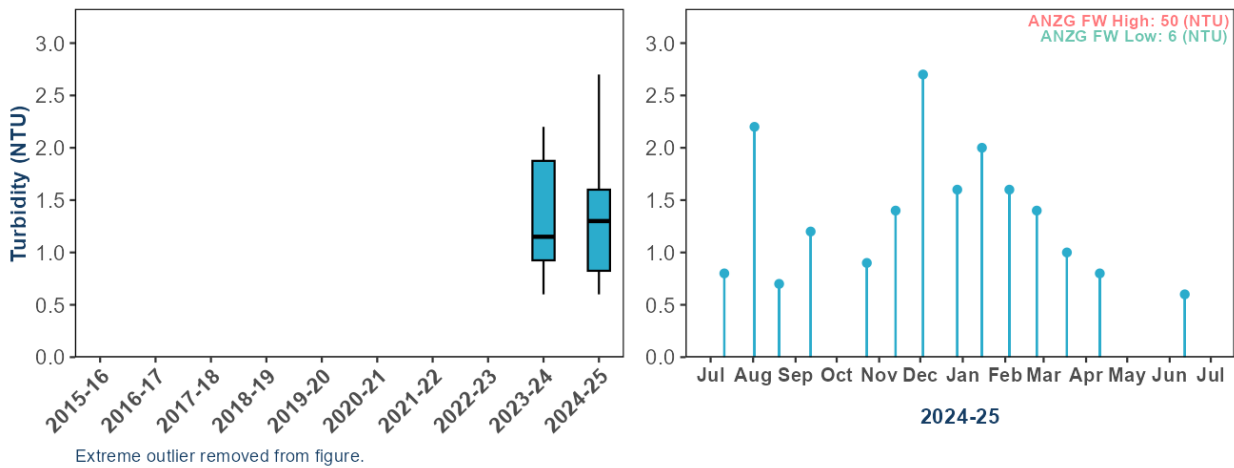
Bedford Creek as Reference

N628



Bedford Creek as Reference

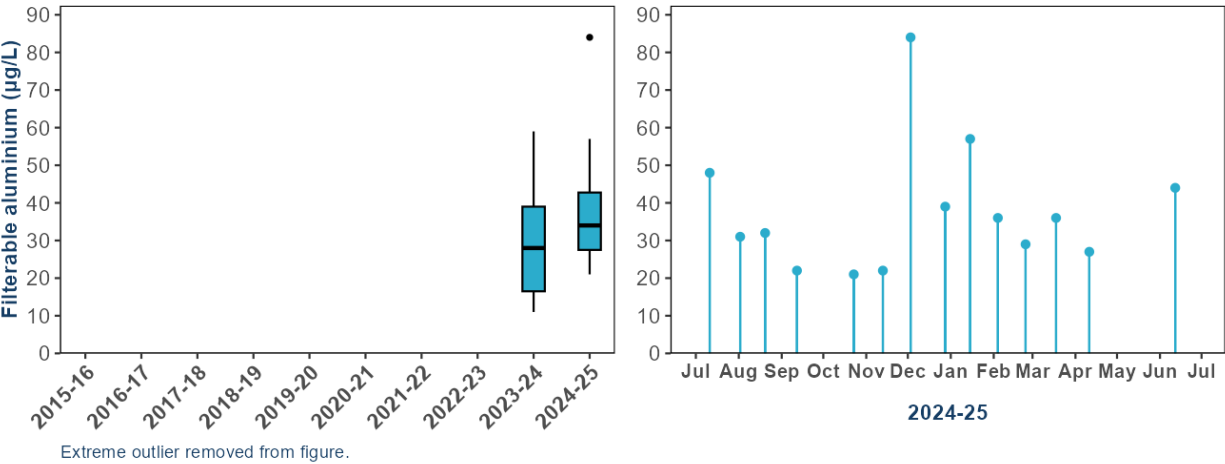
N628



Stressors – Trace metals

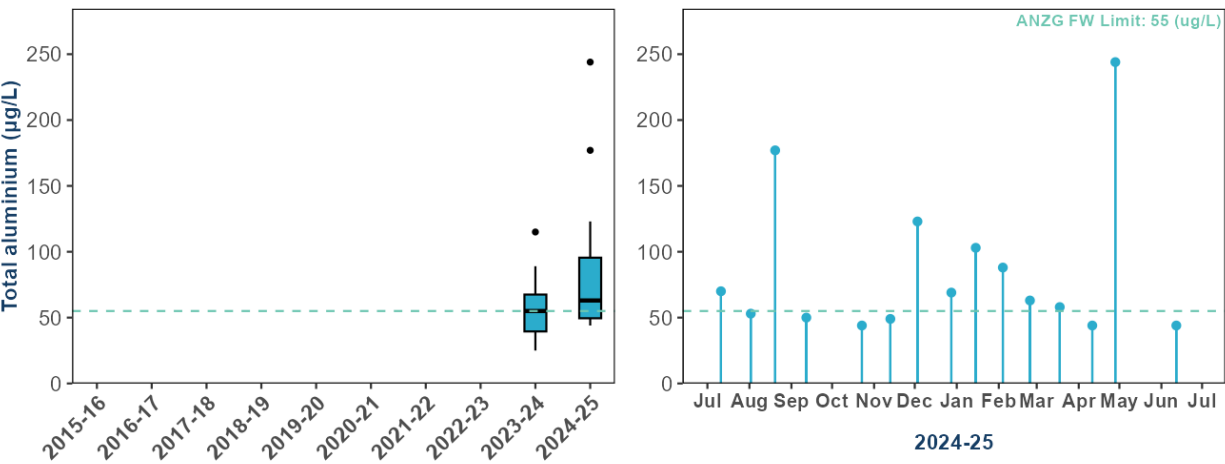
Bedford Creek as Reference

N628



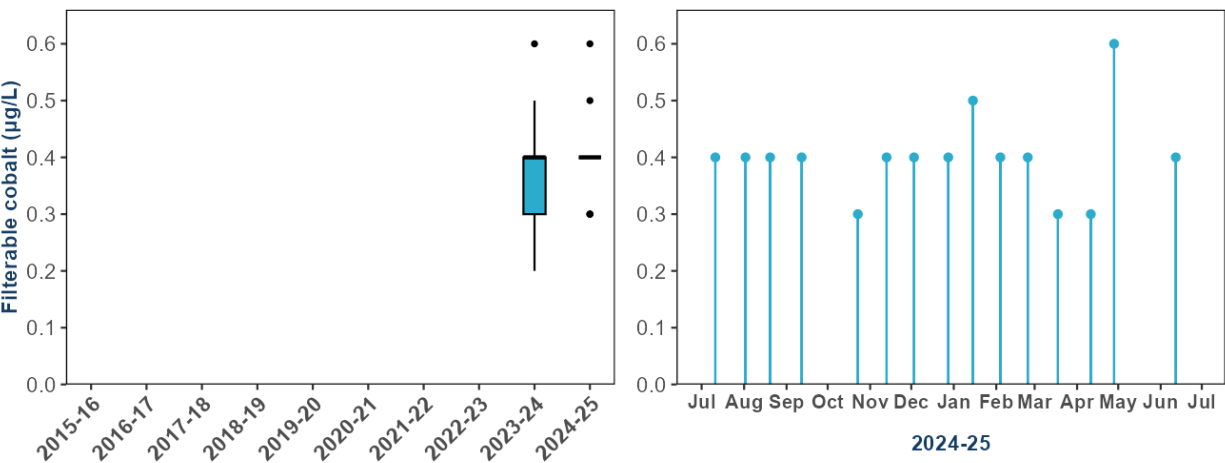
Bedford Creek as Reference

N628



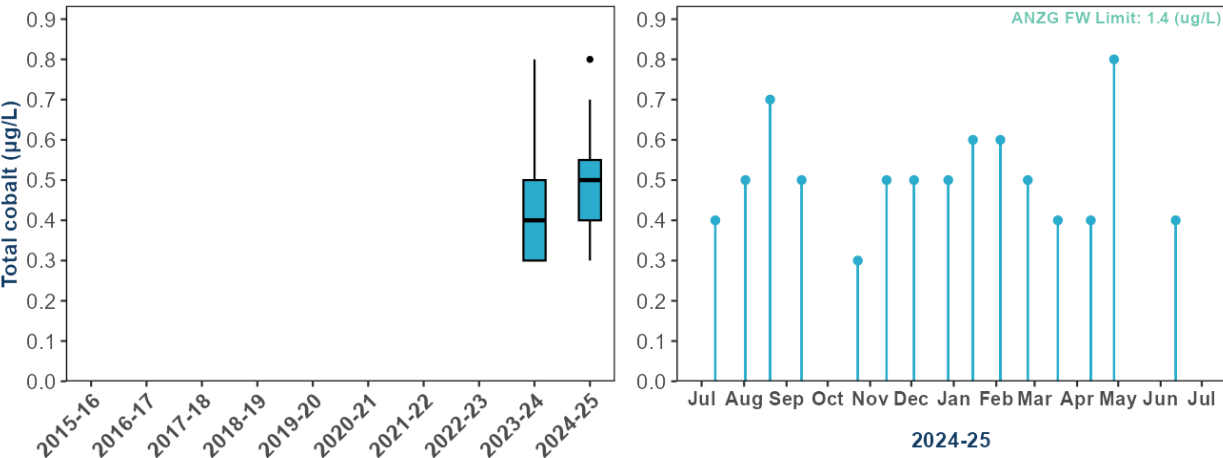
Bedford Creek as Reference

N628



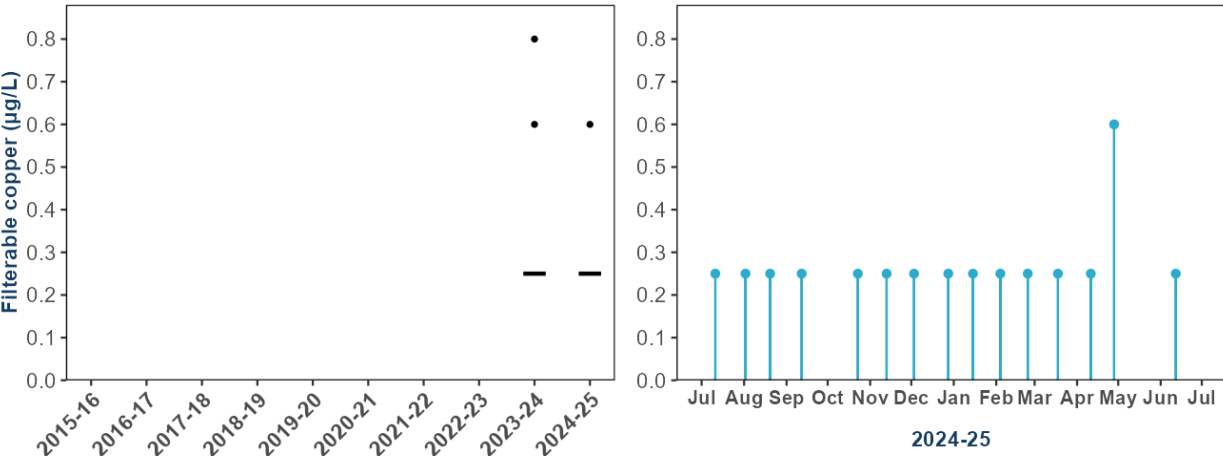
Bedford Creek as Reference

N628



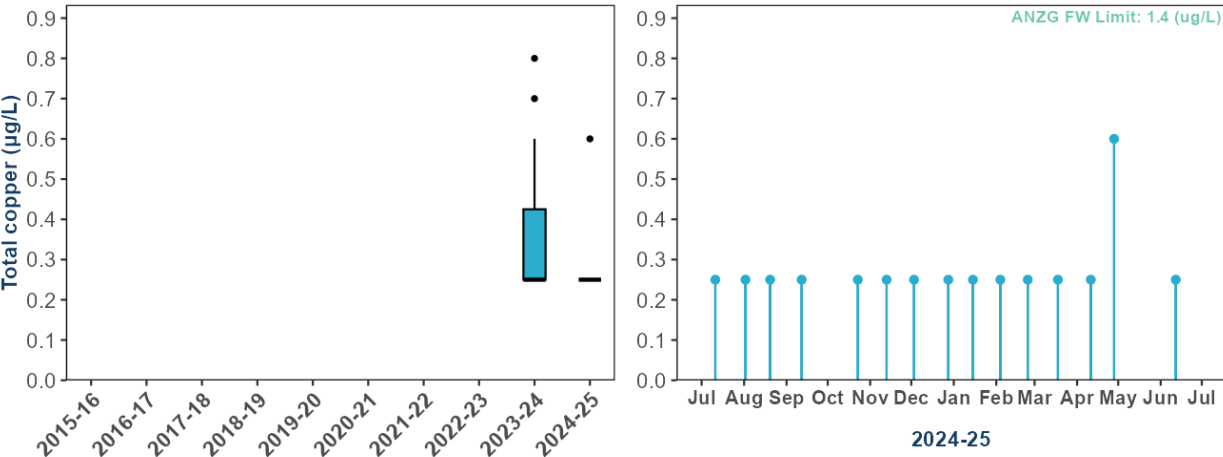
Bedford Creek as Reference

N628



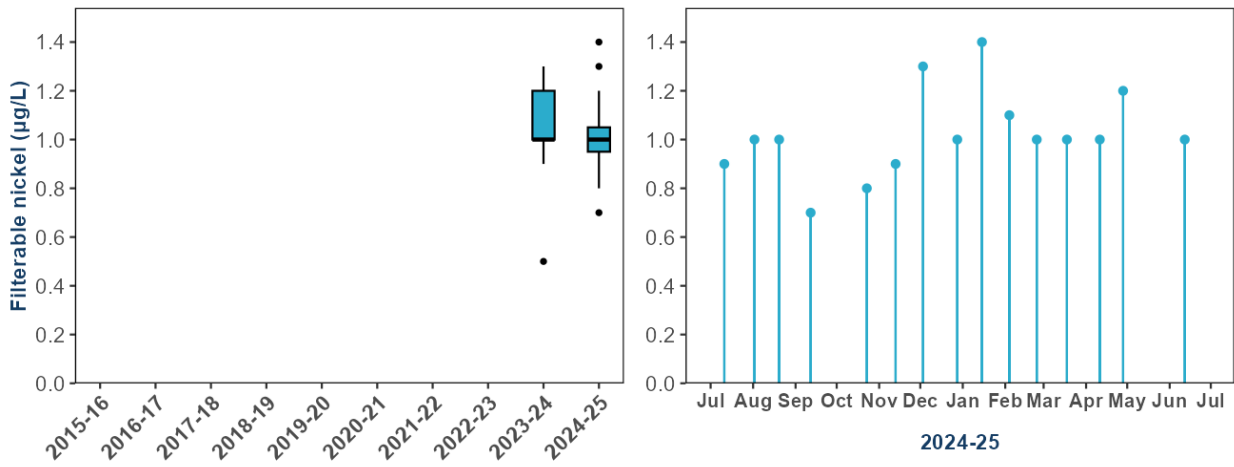
Bedford Creek as Reference

N628



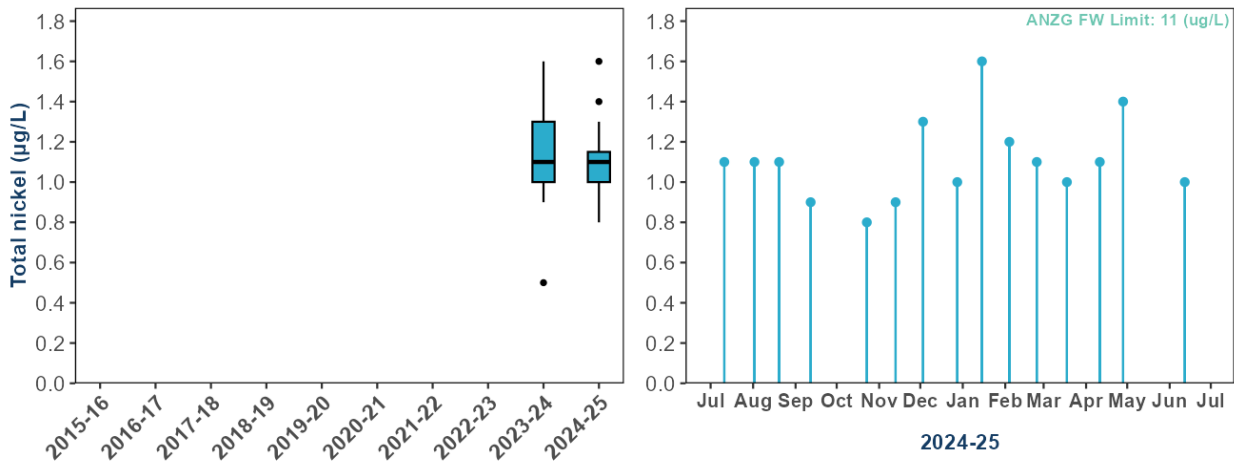
Bedford Creek as Reference

N628



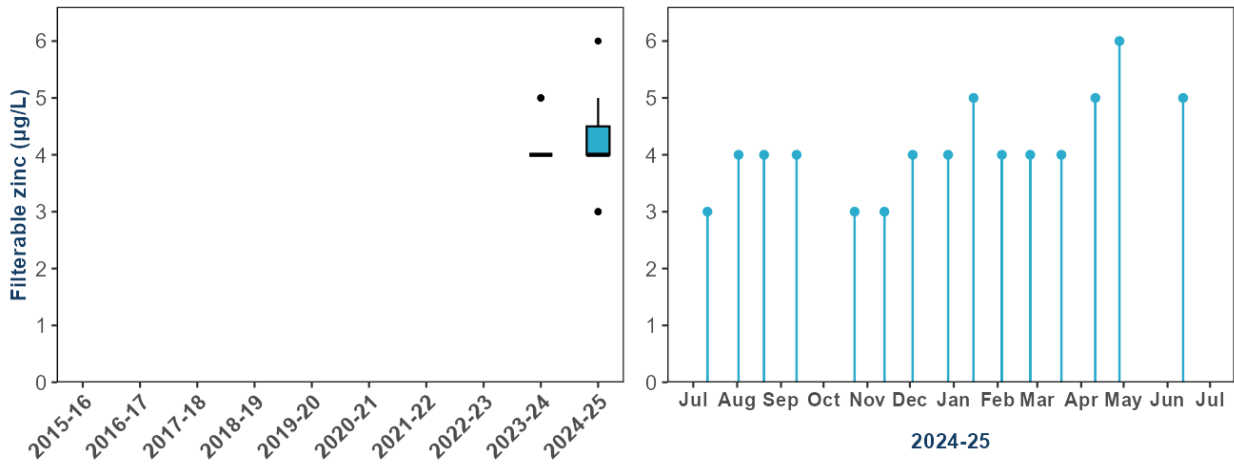
Bedford Creek as Reference

N628



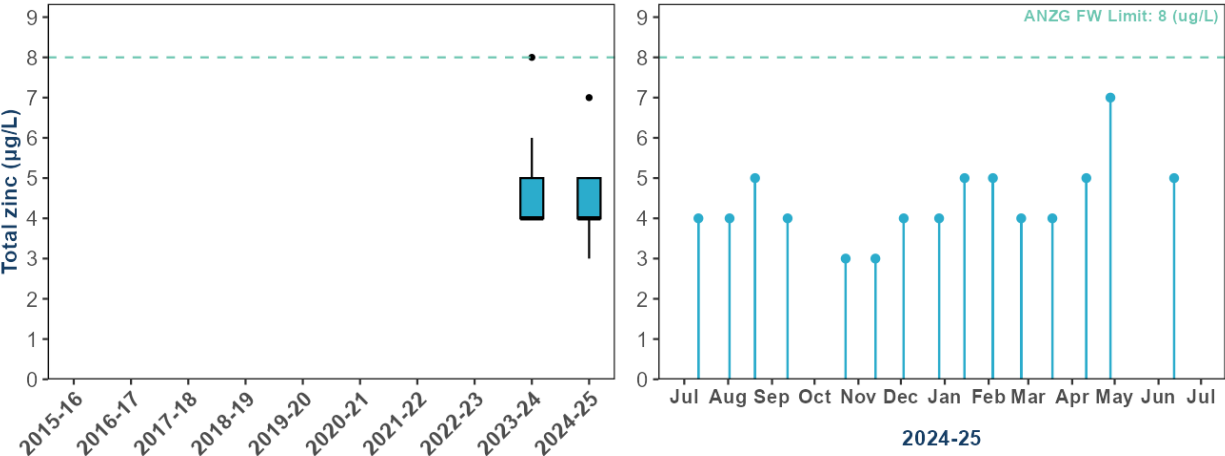
Bedford Creek as Reference

N628



Bedford Creek as Reference

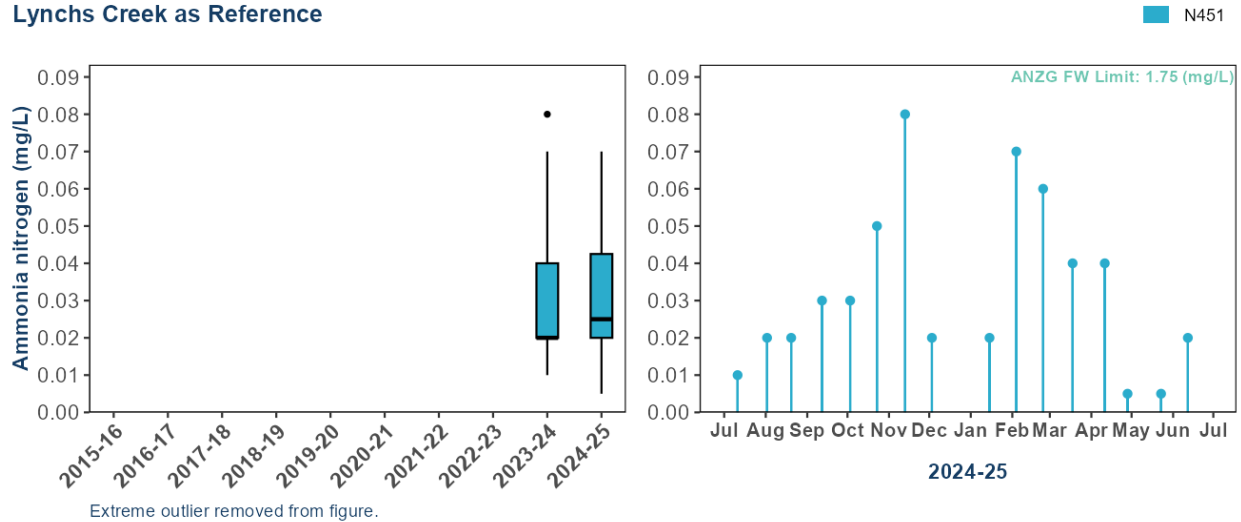
N628



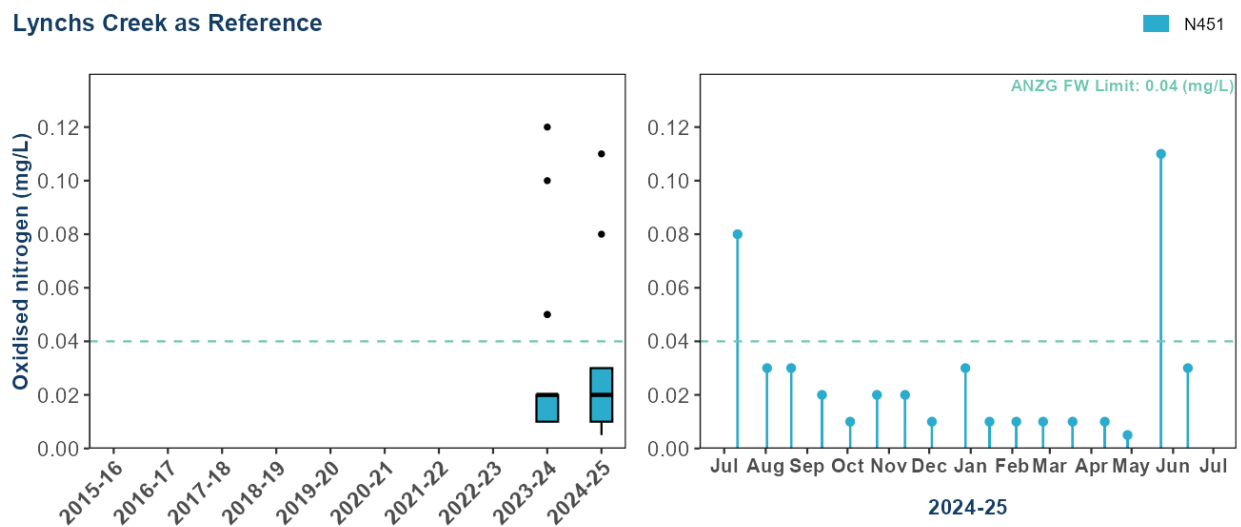
C.3.7. N451 Lynchs Creek

Stressors – Nutrients

Lynchs Creek as Reference

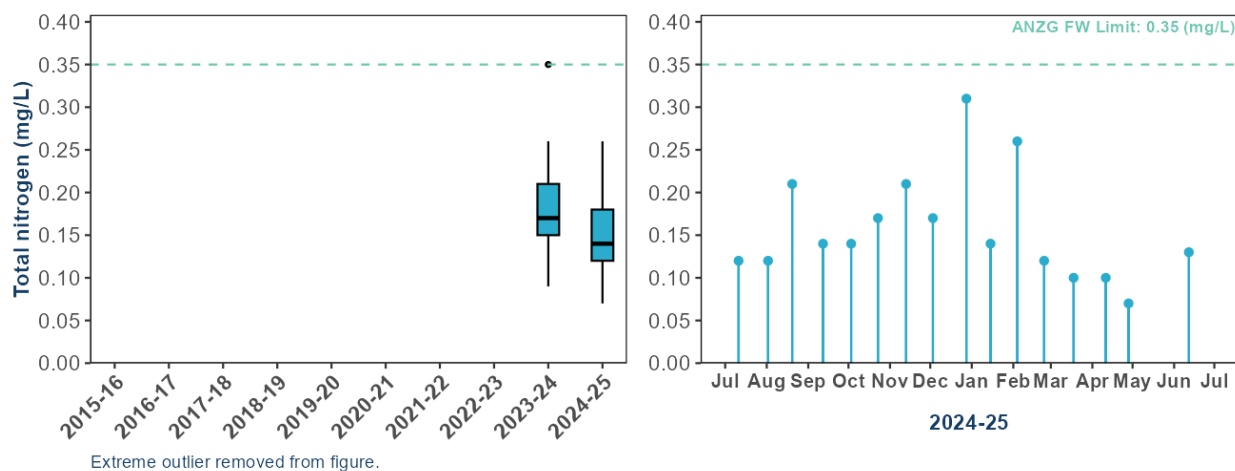


Lynchs Creek as Reference



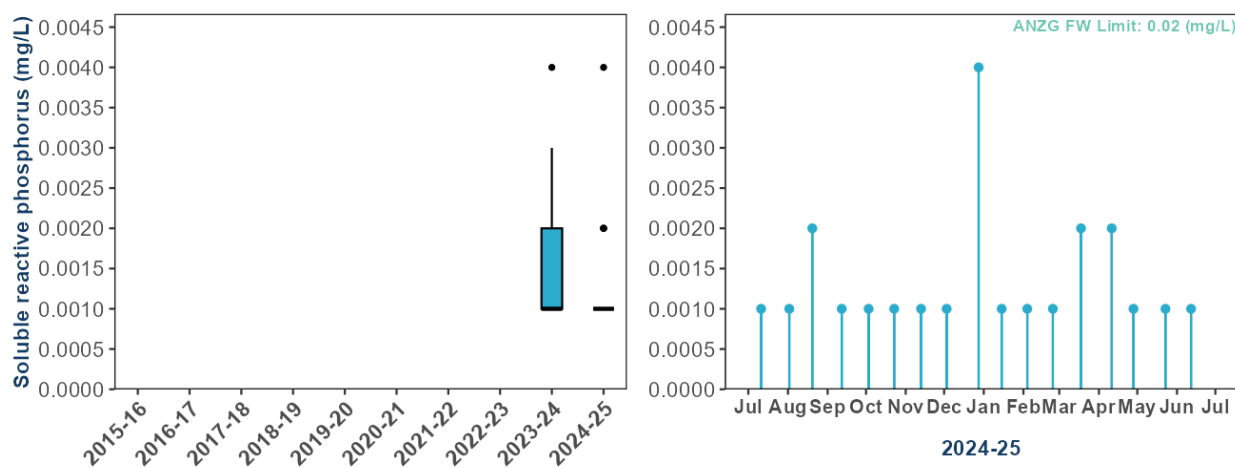
Lynchs Creek as Reference

N451



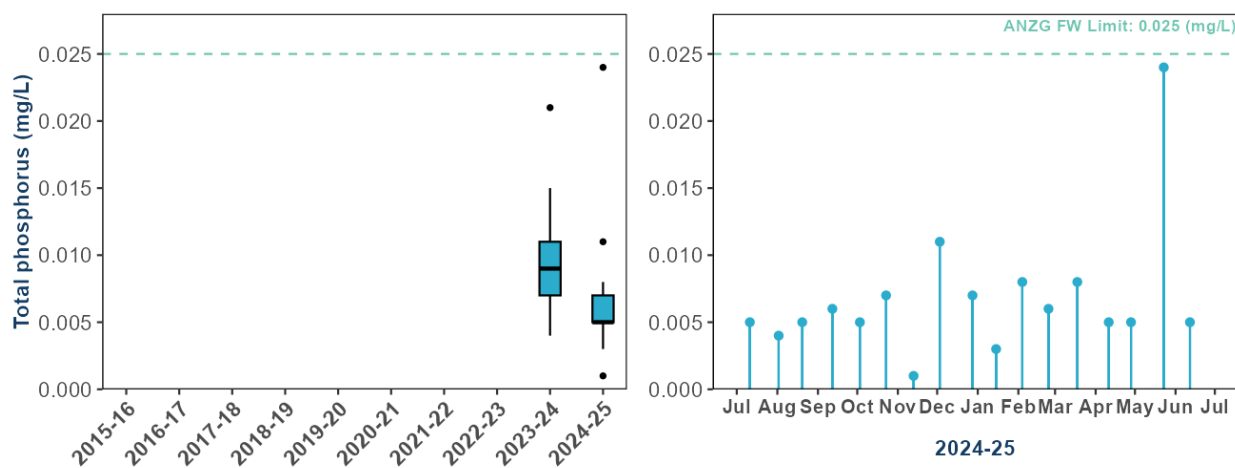
Lynchs Creek as Reference

N451



Lynchs Creek as Reference

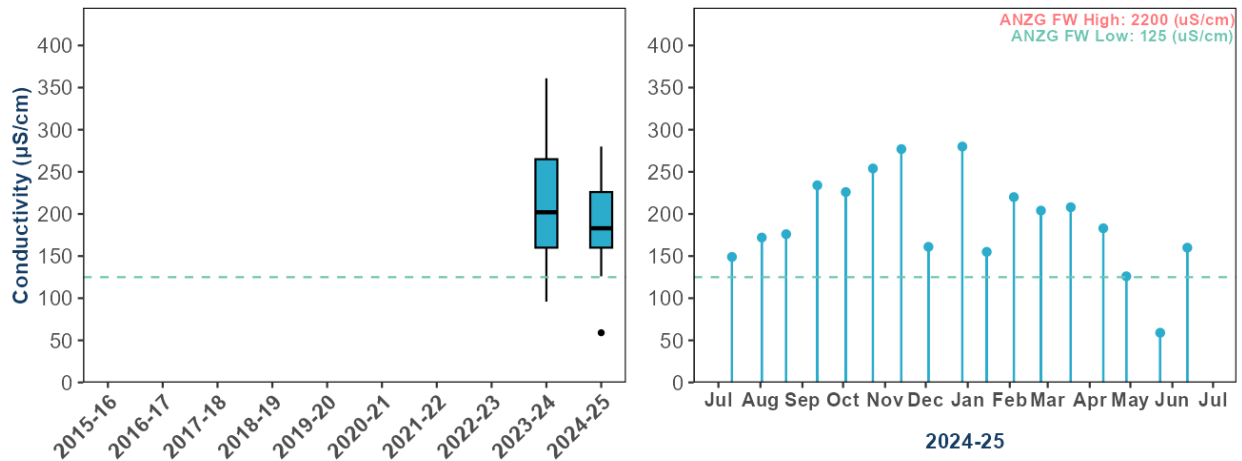
N451



Stressors – Physico-chemical water quality

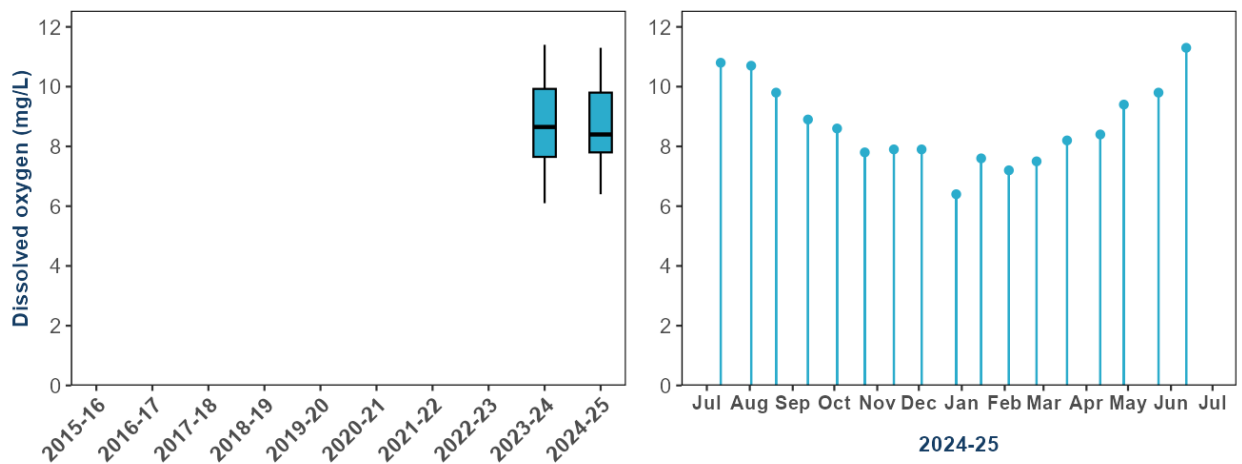
Lynchs Creek as Reference

N451



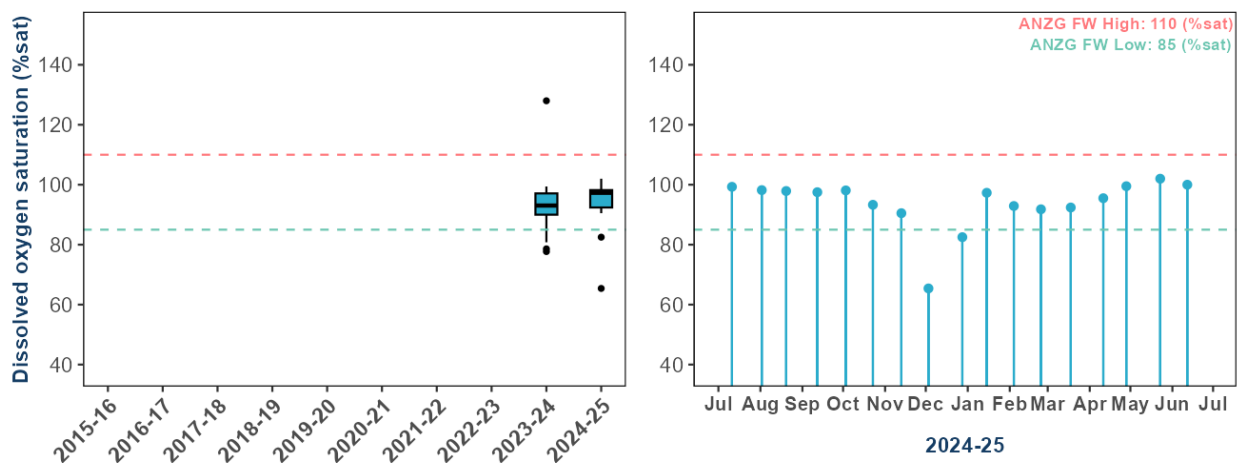
Lynchs Creek as Reference

N451



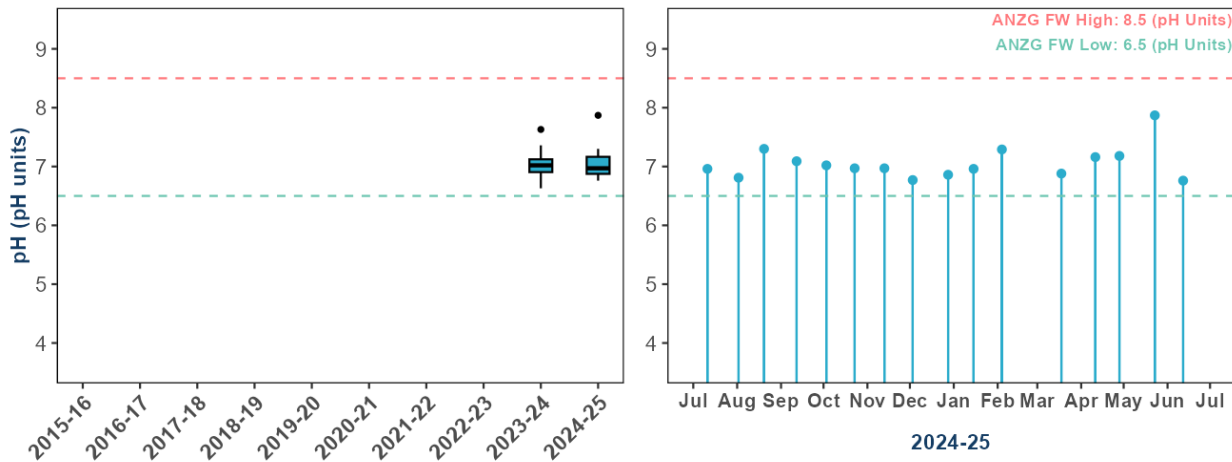
Lynchs Creek as Reference

N451



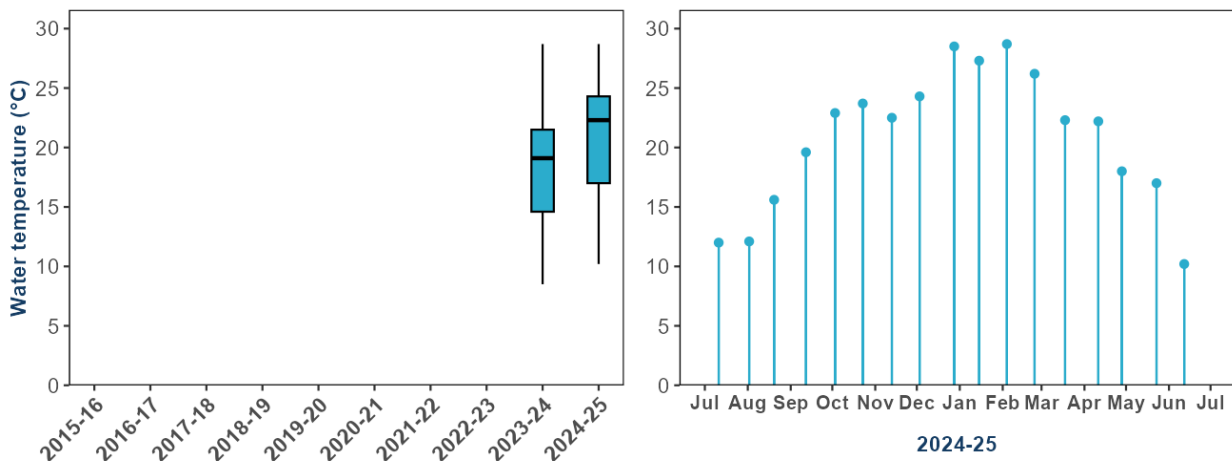
Lynchs Creek as Reference

N451



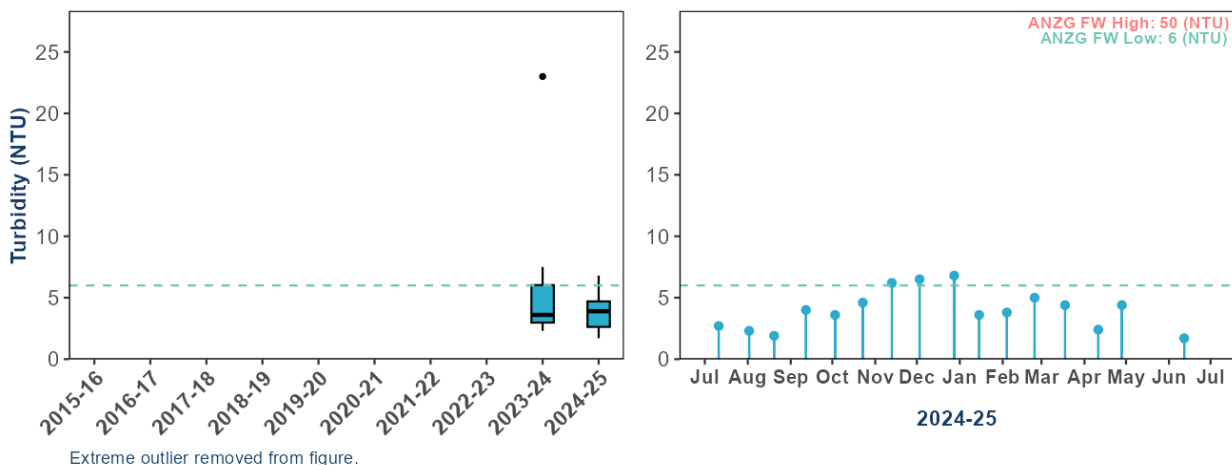
Lynchs Creek as Reference

N451



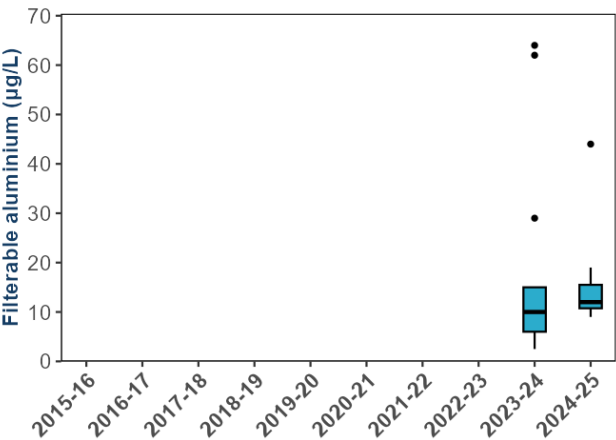
Lynchs Creek as Reference

N451

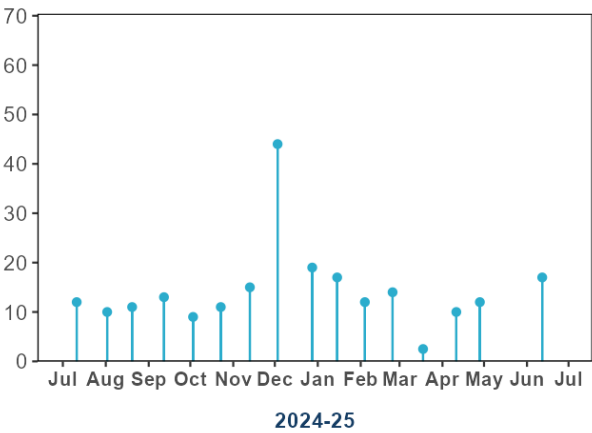


Stressors – Trace metals

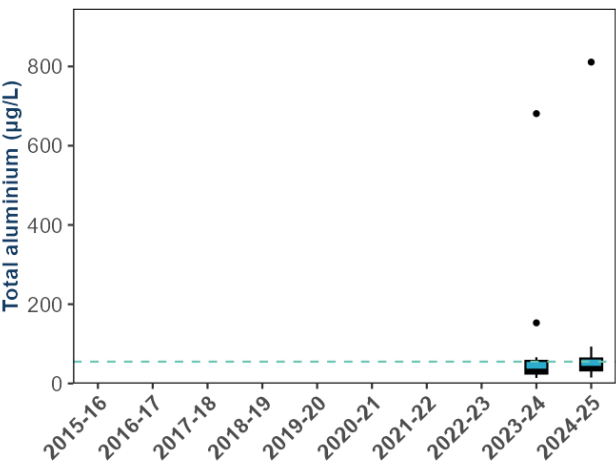
Lynchs Creek as Reference



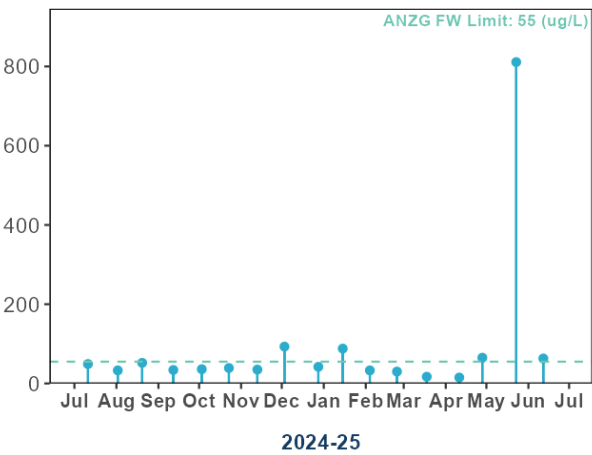
N451



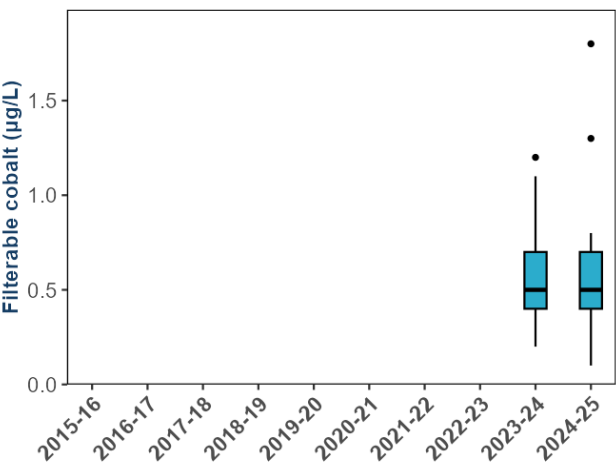
Lynchs Creek as Reference



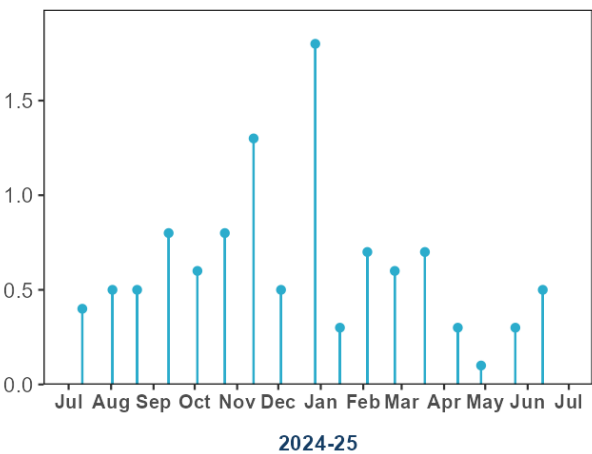
N451



Lynchs Creek as Reference

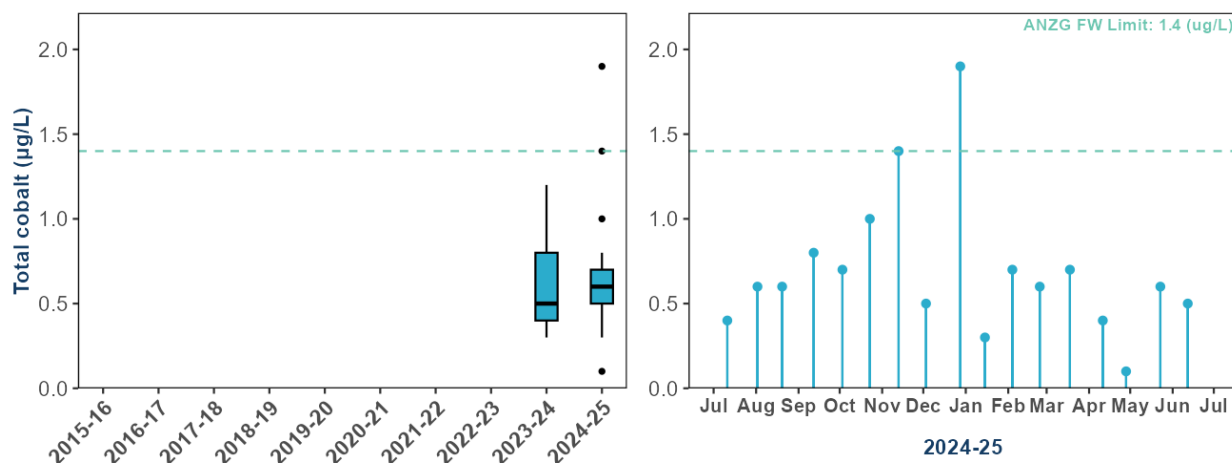


N451



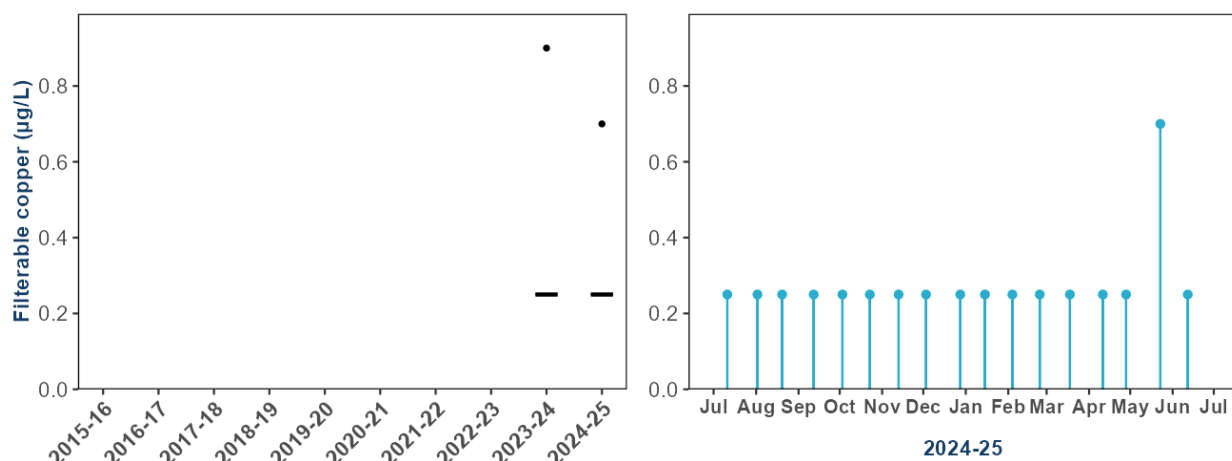
Lynchs Creek as Reference

N451



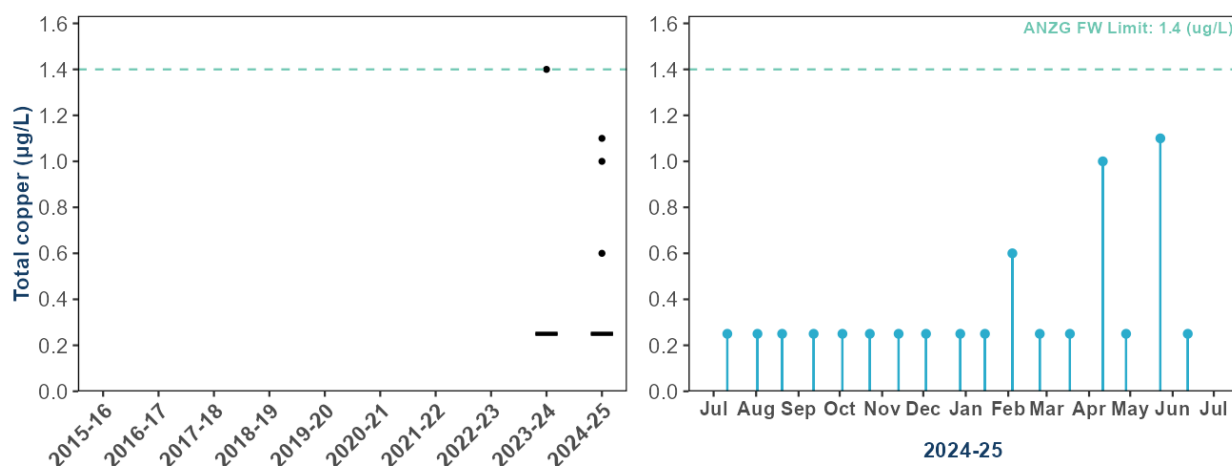
Lynchs Creek as Reference

N451



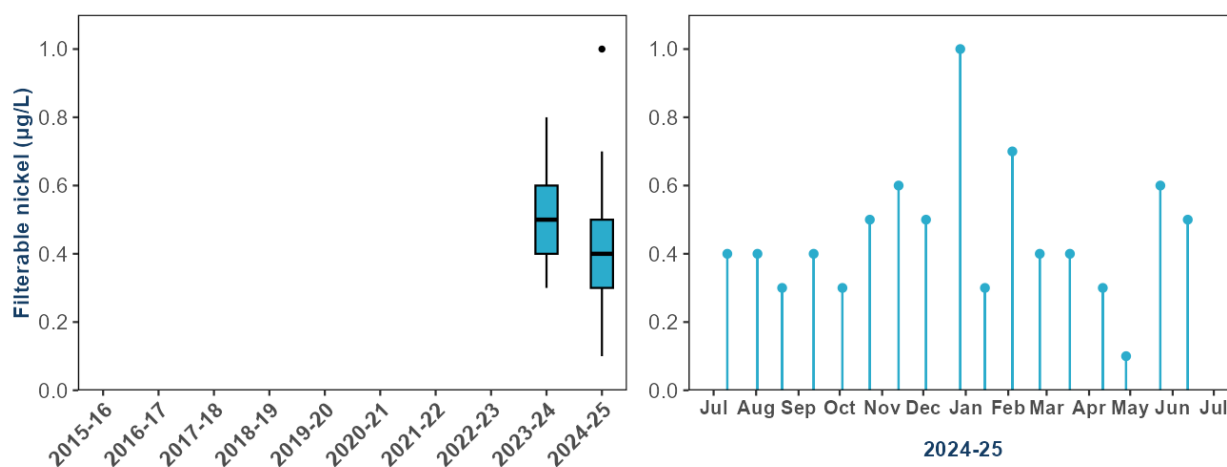
Lynchs Creek as Reference

N451



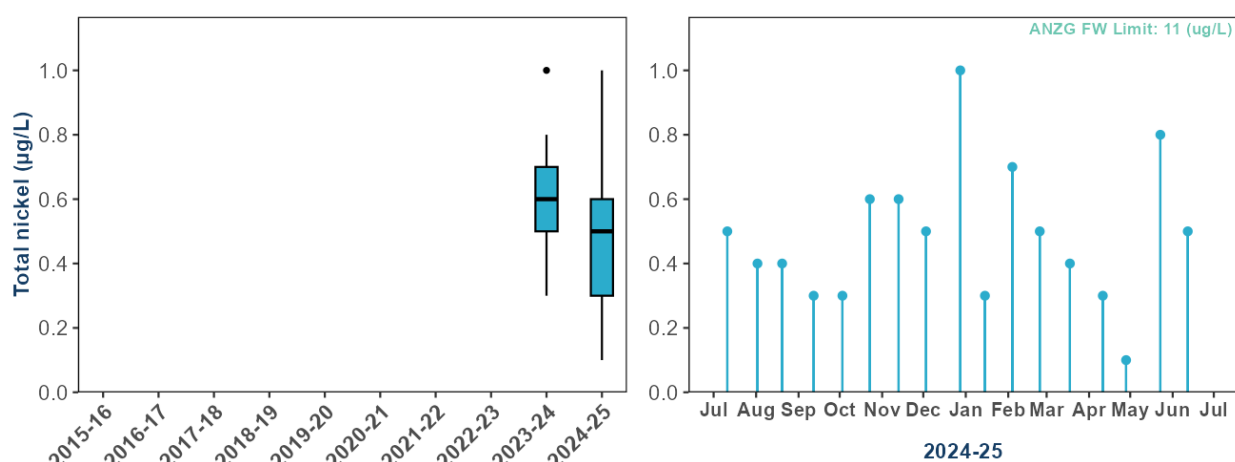
Lynchs Creek as Reference

N451



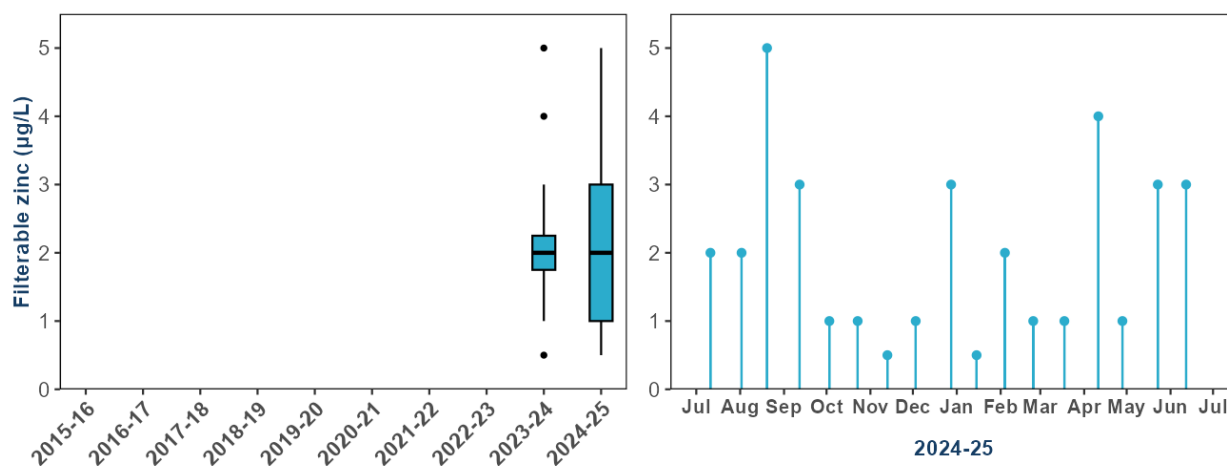
Lynchs Creek as Reference

N451

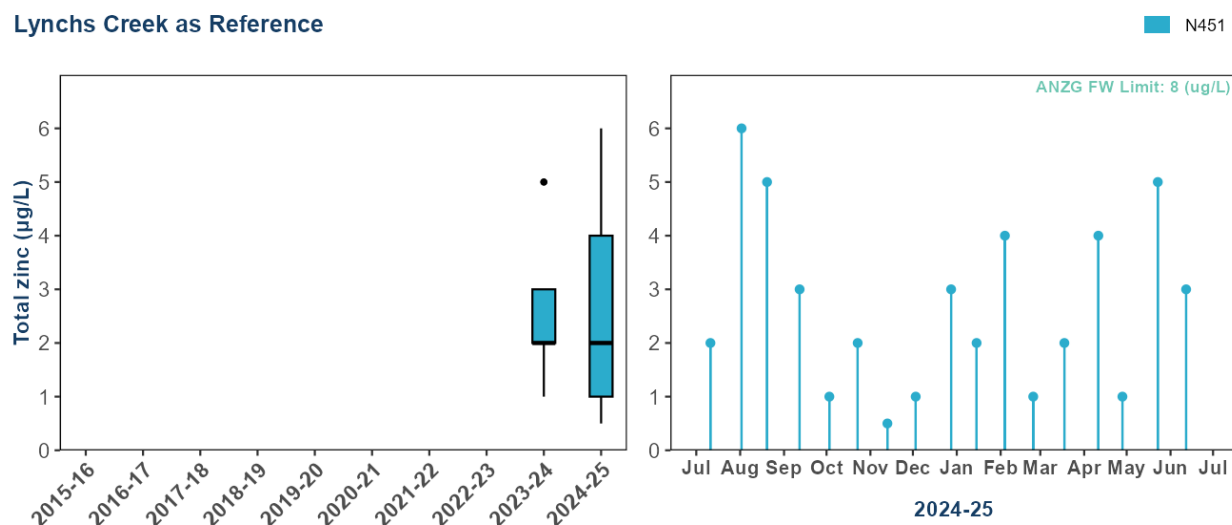


Lynchs Creek as Reference

N451



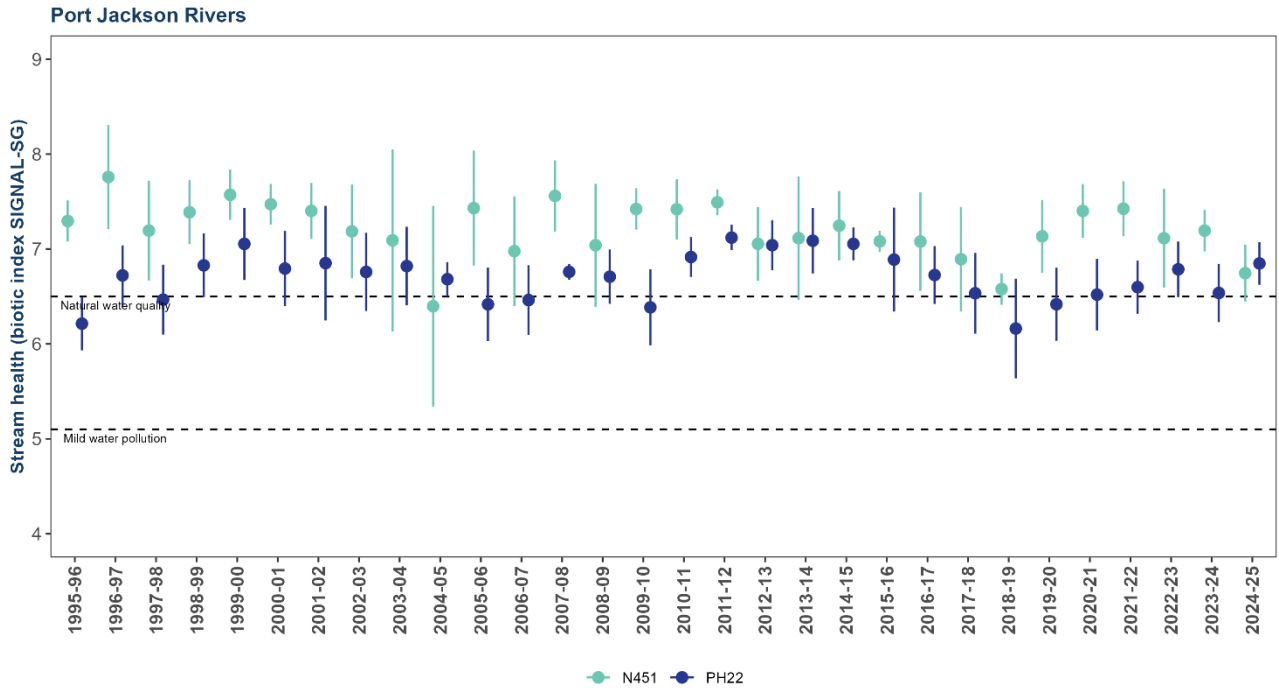
Lynchs Creek as Reference



C.4. Freshwater reference sites – Ecosystem health

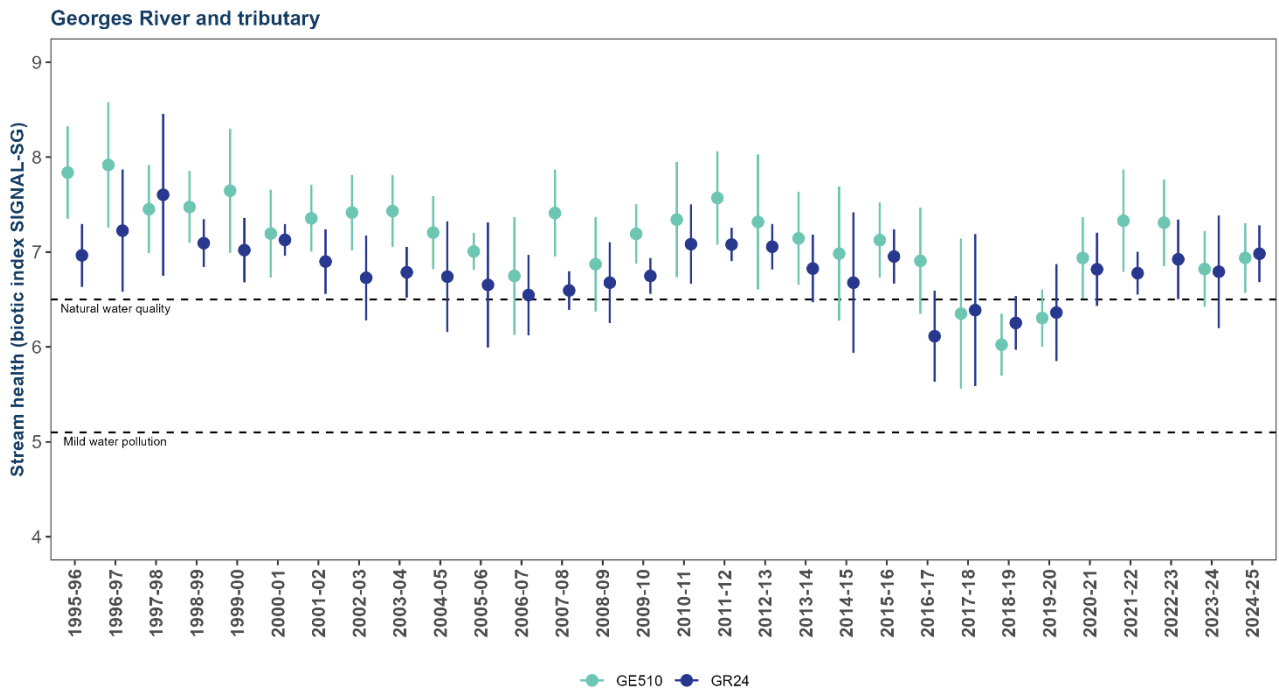
Seven sites are monitored for the macroinvertebrate indicator in freshwater streams to assess the general ambient condition of freshwater sites in the other major rivers flowing into the estuaries of the Sydney region. These waterways may be impacted by wastewater overflows and stormwater. Among these, four are control sites located upstream of any likely impact from urban areas. The control sites include Lynch's Creek (N451) a tributary of Hawkesbury-Nepean River, Hacking River at McKell Avenue in Royal National Park (PH22), the upper Georges River system at O'Hares Creek (GE510) and Georges River at Ingleburn Reserve (GR24). The remaining three sites are reference sites, which can also be used in future re-calibration of SIGNAL-SG – an unnamed tributary of Devlin's Creek (LC2421), McCarrs Creek (NP001) and Bedford Creek (N628).

Results from 2024-25 indicate stream health for all of the four control sites (N451, PH22, GE510 and GR24) was typical of natural water quality in bushland areas that do not receive urban stormwater runoff or sewer overflows, and are consistent with results observed in previous years (Figure C-1 and Figure C-2). Results from these test sites represent the ambient condition of the combined impact of urban stormwater runoff and sewer overflows. These two influences cannot be teased apart.



The range of stream health recorded over each period is represented by length of line

Figure C-1 Stream health of control sites in Lynchs Creek and Hacking River



The range of stream health recorded over each period is represented by length of line

Figure C-2 Stream health of control sites in the upper Georges River system

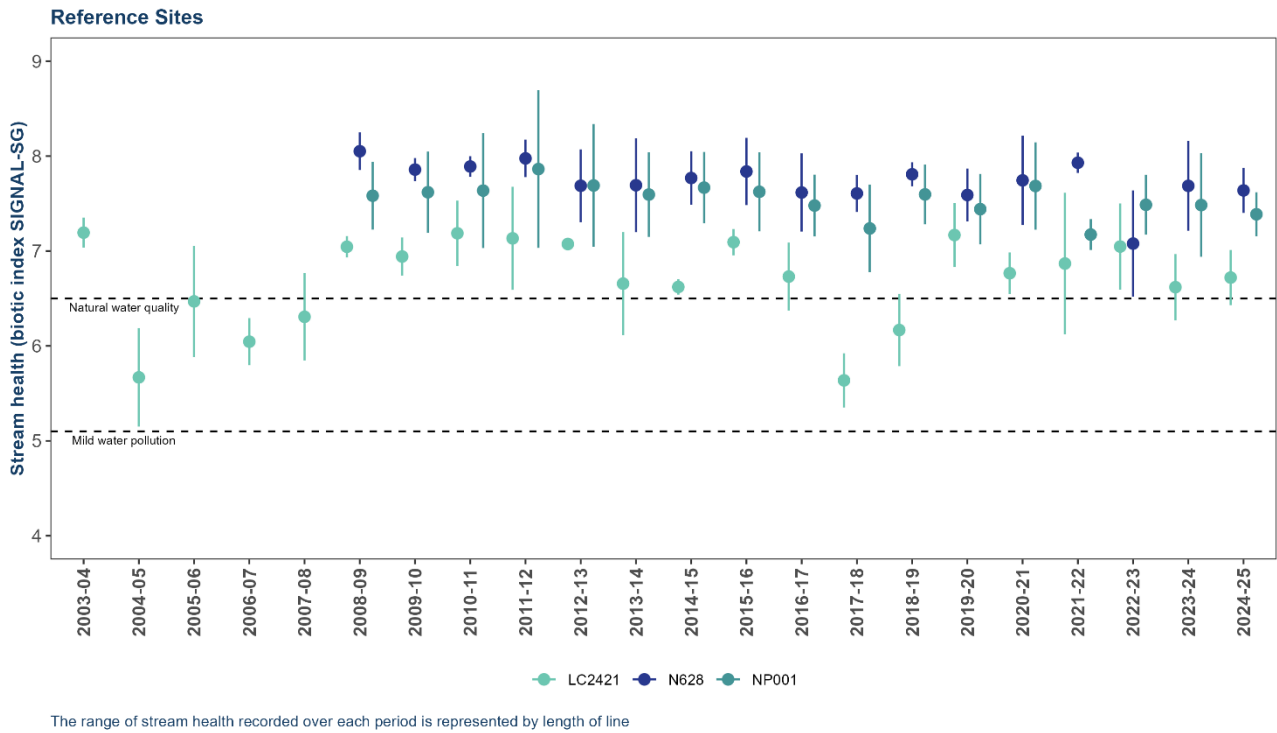


Figure C-3 Stream health of other freshwater reference sites



D. Nearshore marine environment

This Appendix includes graphical presentation of all monitoring data for the Nearshore Marine catchment.

The Water Resource Recovery Facilities (WRRFs) that are discharging into this catchment are ordered from North (Warriewood) to South (Bombo).

Under each WRRF (Appendix D.1 to D.6), the results are presented following the **Pressure, Stressor** and **Ecosystem Receptor (P-S-ER)** causal pathway elements.

For the pressure, trend plots are included on wastewater quantity (discharge and inflow), quality, toxicity and discharge loads. Trend plots on other supplementary data are also included to improve our understanding on:

- weather condition i.e. catchment specific rainfall condition for each WRRF
- wastewater reuse/ recycling volume of the relevant WRRF.

Wastewater quality and load plots are included in the following four sub-groups, and then within each sub-group, analytes presented in alphabetical order:

- nutrients
- major conventional analytes
- trace metals
- other chemicals and organics (including pesticides)

Tests conducted on wastewater are specified in the EPL issued by the NSW EPA for each WRRF (Appendix D.7). Data for all these measured analytes that have EPL concentration and load limits are included. Summary statistics are included as electronic appendices sent to the EPA.

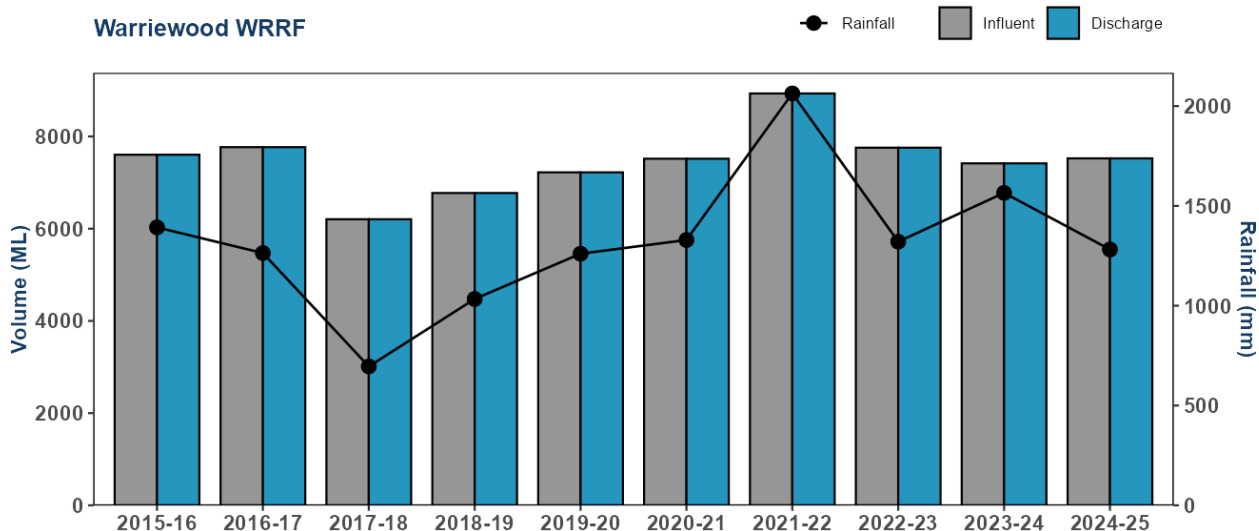
Stressor data for the Nearshore environment is not currently collected due to access and safety concerns. A pilot program commenced in 2024-25 trialling using drones to monitor receiving water quality 10 intertidal sites. The outcomes of this pilot are discussed in Volume 4.

Ecosystem receptor data (macroalgae and invertebrates) are only available for the three Shellharbour sites. Data summaries, plots, statistical analyses outcomes, including detailed commentaries are included in Appendix D.5.5.

D.1. Warriewood WRRF

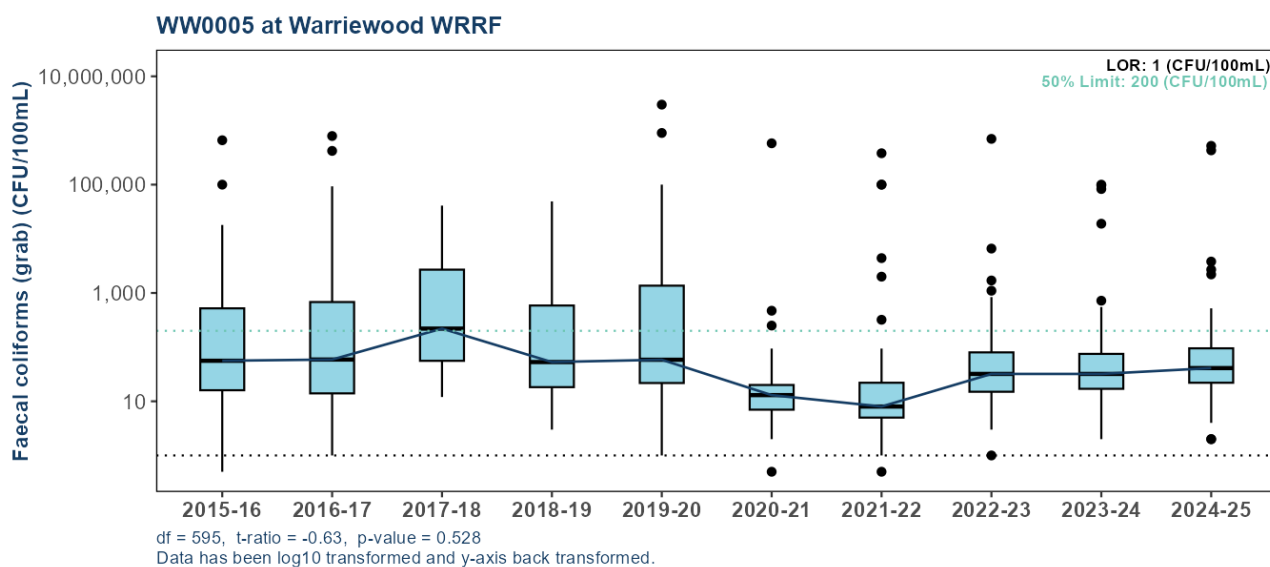
D.1.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

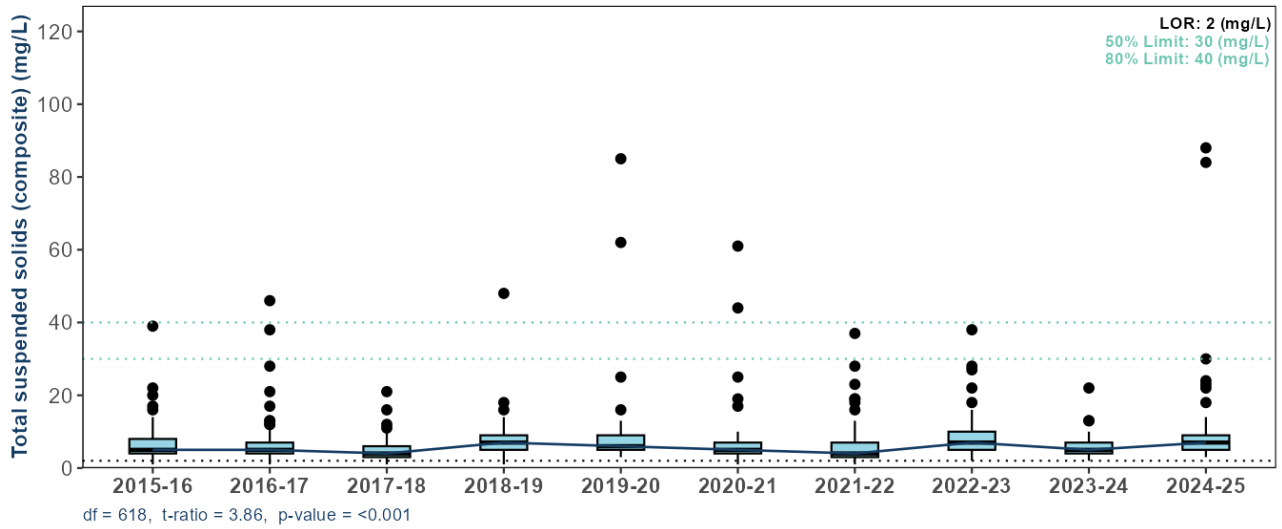


D.1.2. Pressure – Wastewater quality

Major conventional analytes

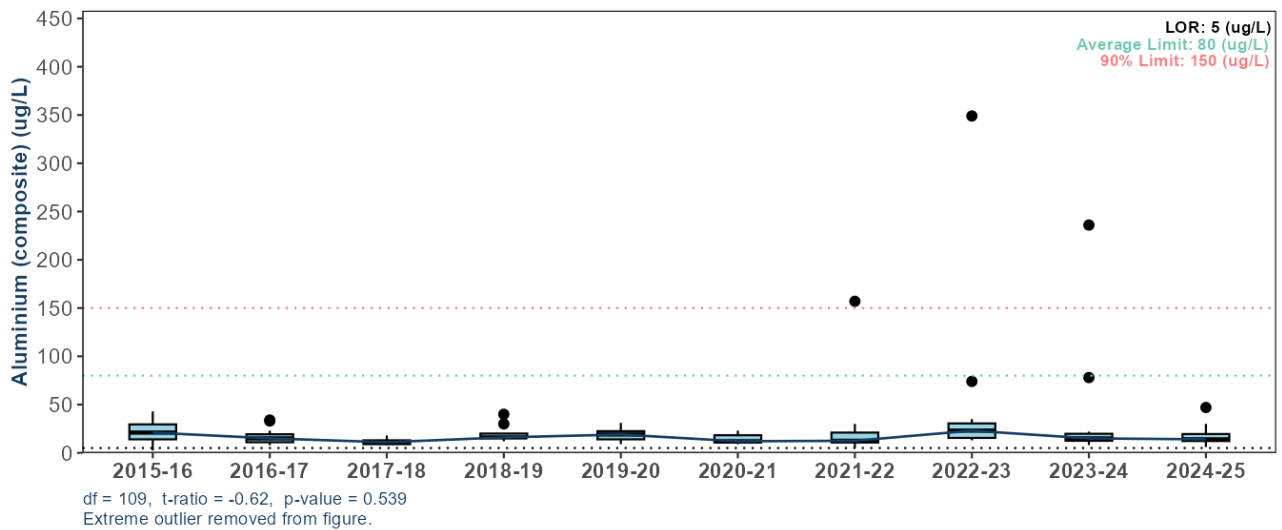


WW0005 at Warriewood WRRF

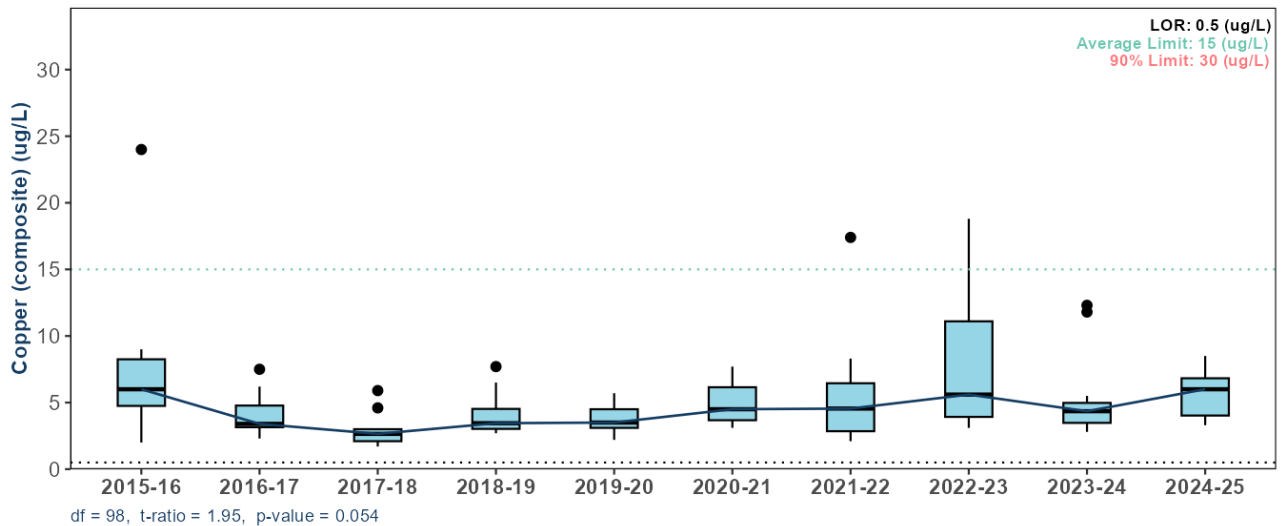


Trace metals

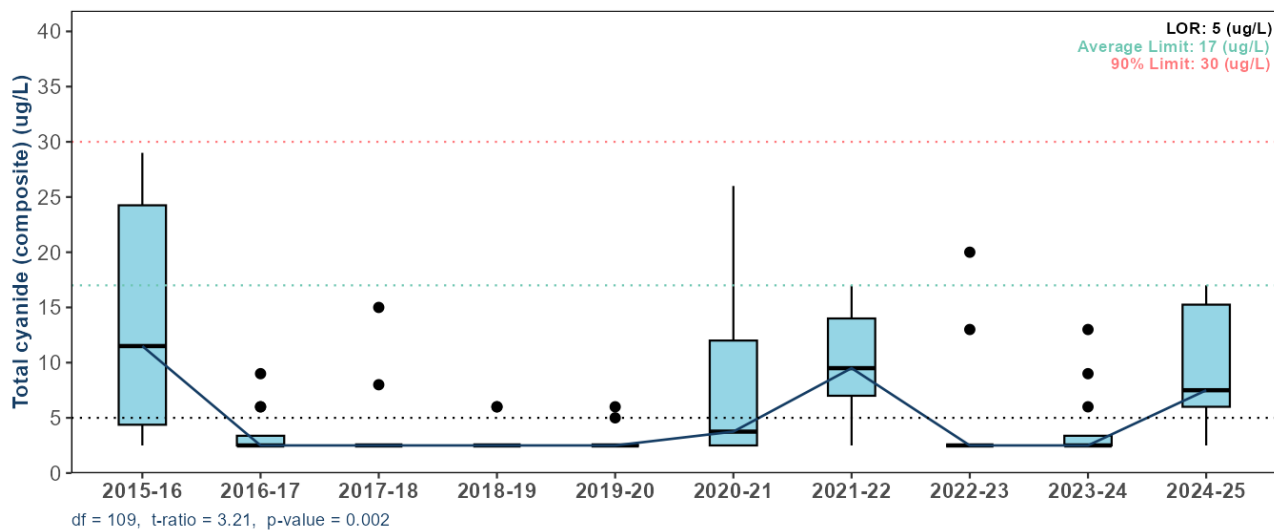
WW0005 at Warriewood WRRF



WW0005 at Warriewood WRRF

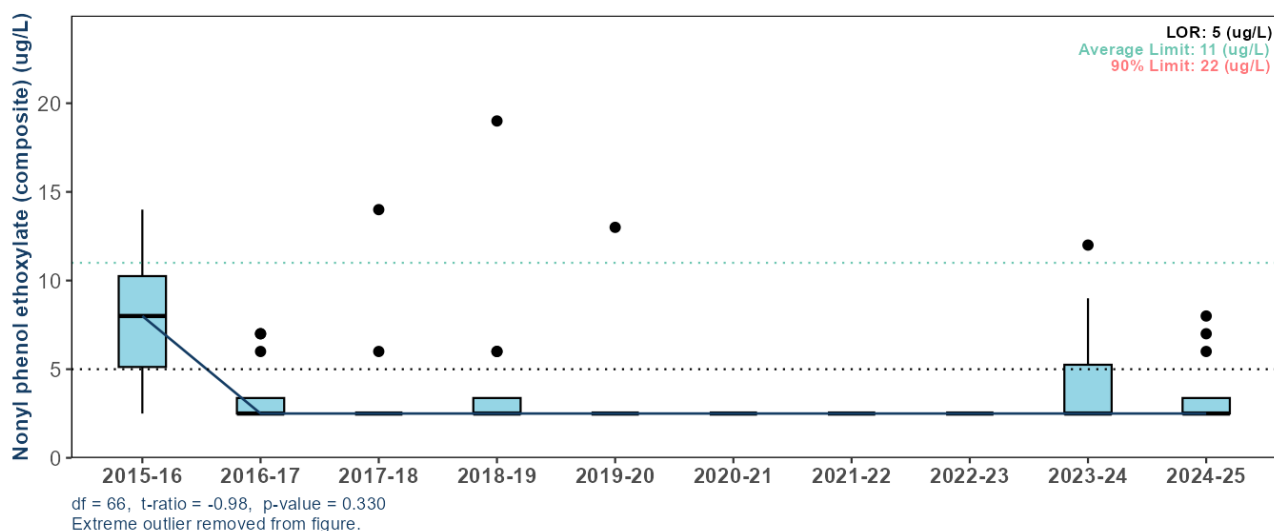


WW0005 at Warriewood WRRF

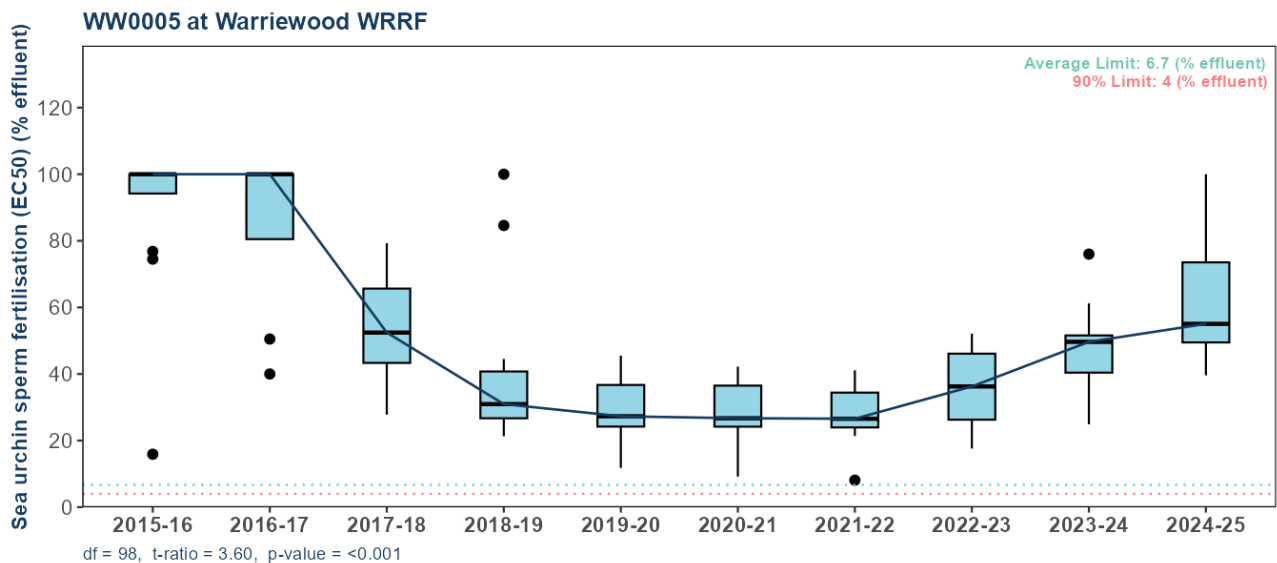


Other chemicals and organics (including pesticides)

WW0005 at Warriewood WRRF

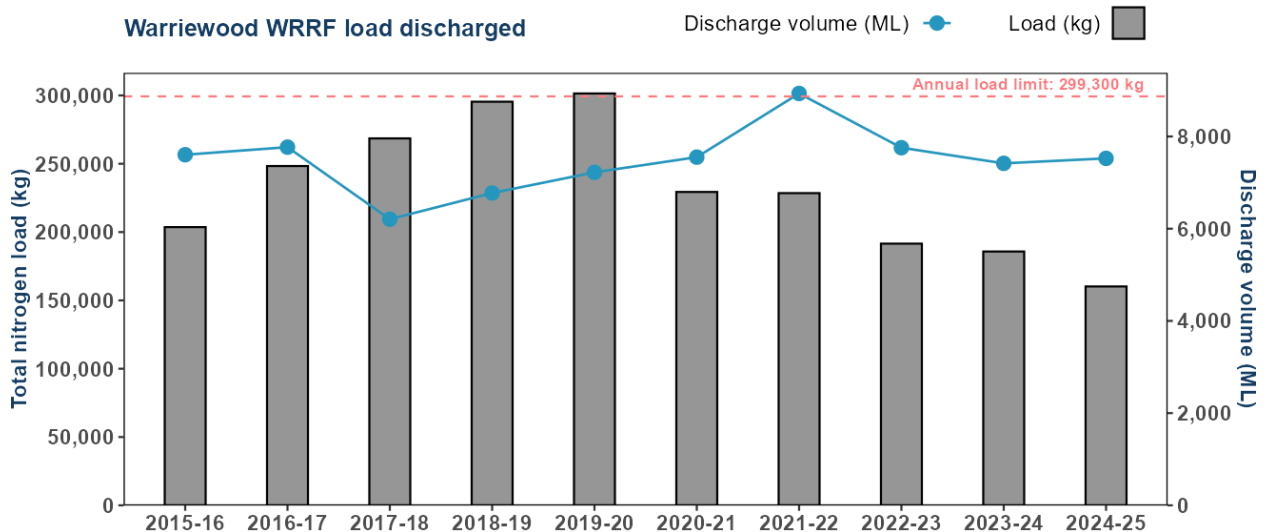


D.1.3. Pressure – Wastewater toxicity

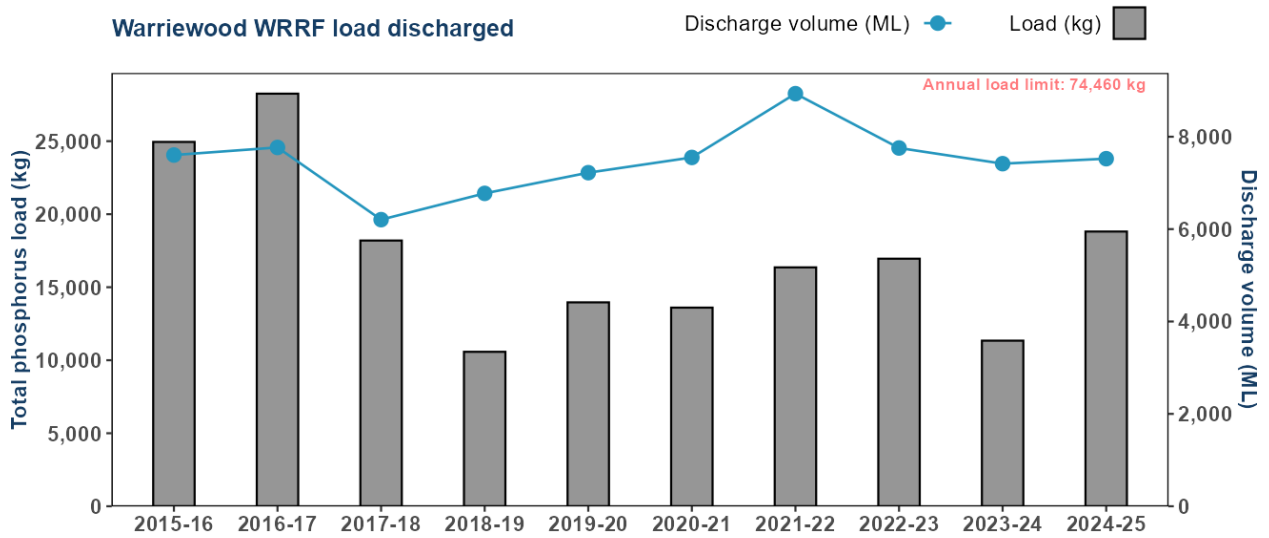


D.1.4. Pressure – Wastewater discharge load

Nutrients

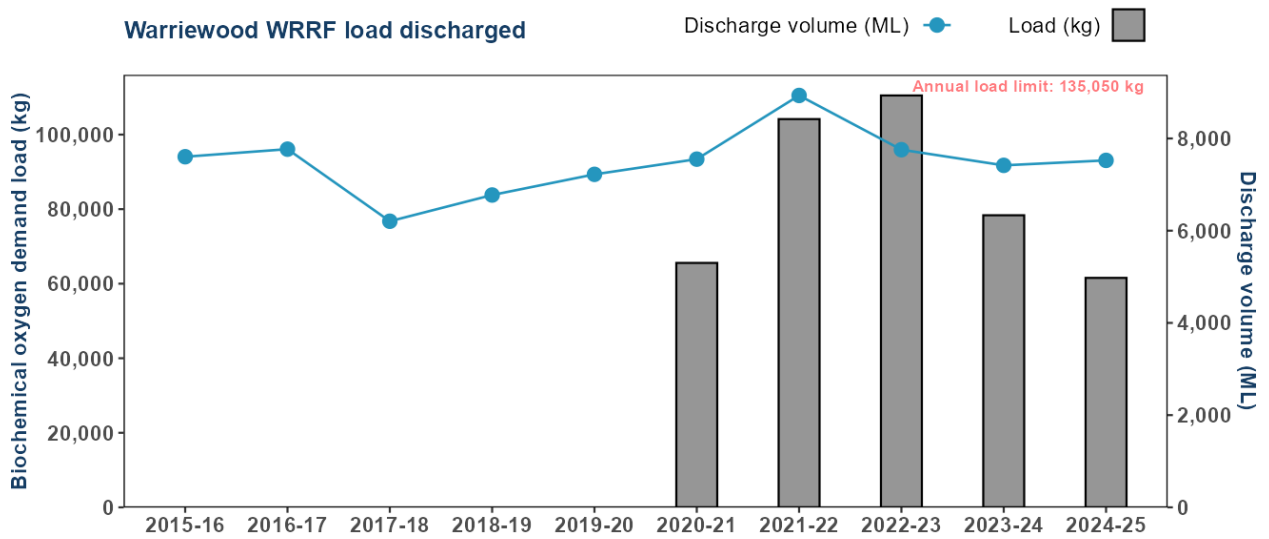


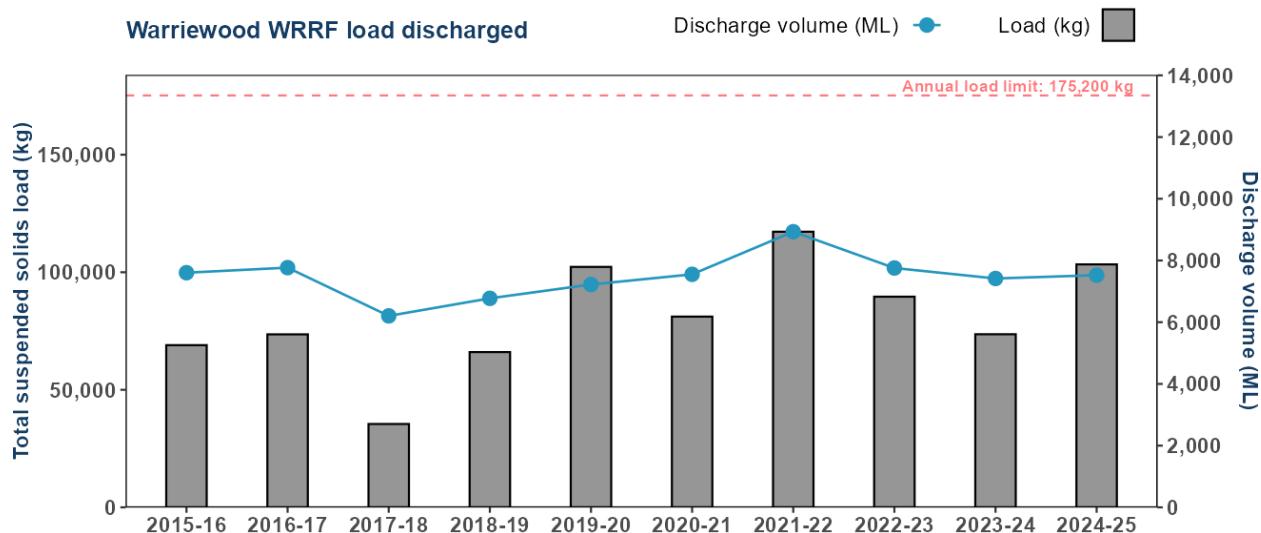
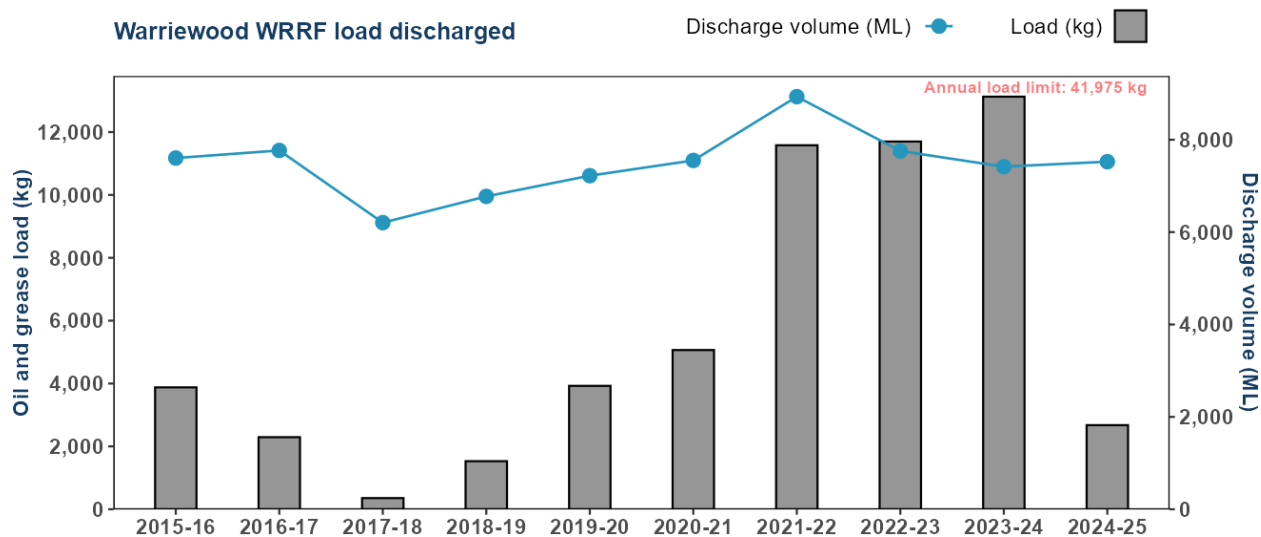
Warriewood WRRF load discharged



Major conventional analytes

Warriewood WRRF load discharged

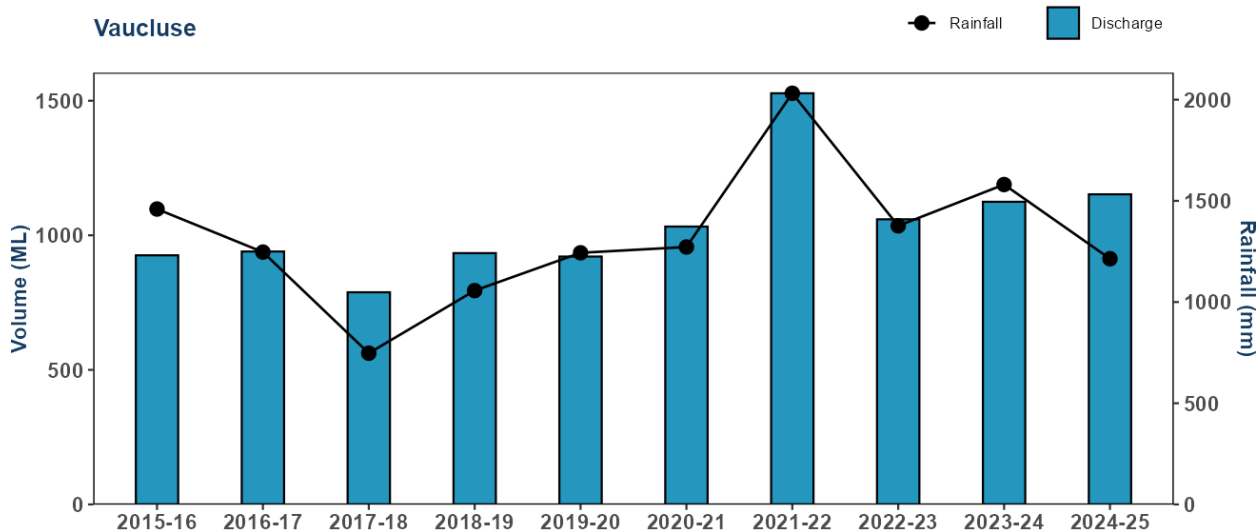
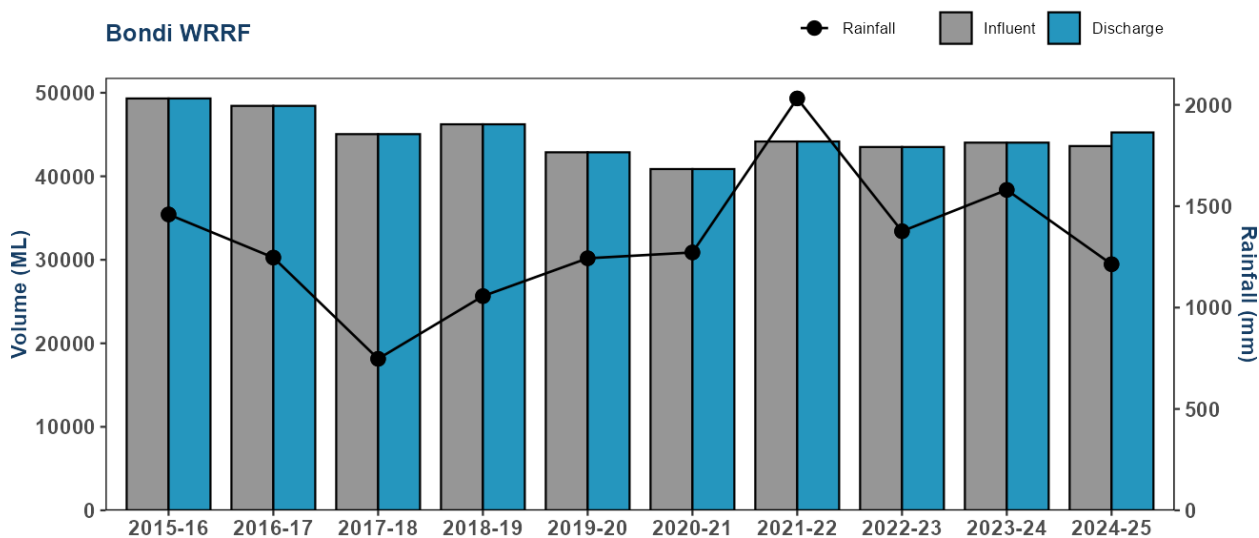




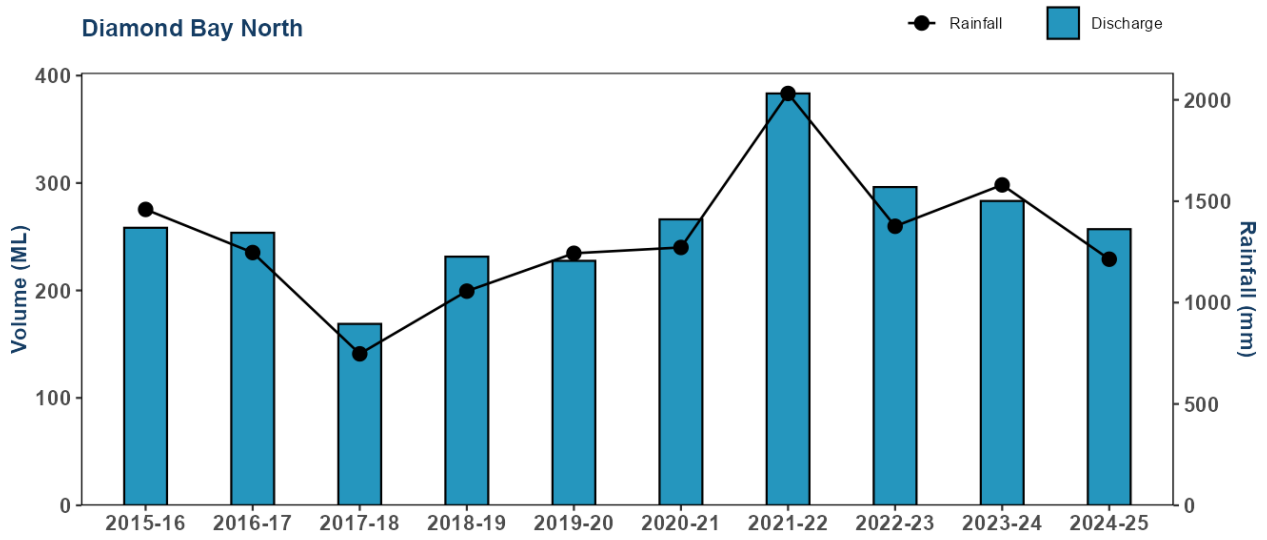
D.2. Bondi WRRF (Nearshore discharges, Vaucluse and Diamond Bay)

D.2.1. Pressure – Wastewater quantity

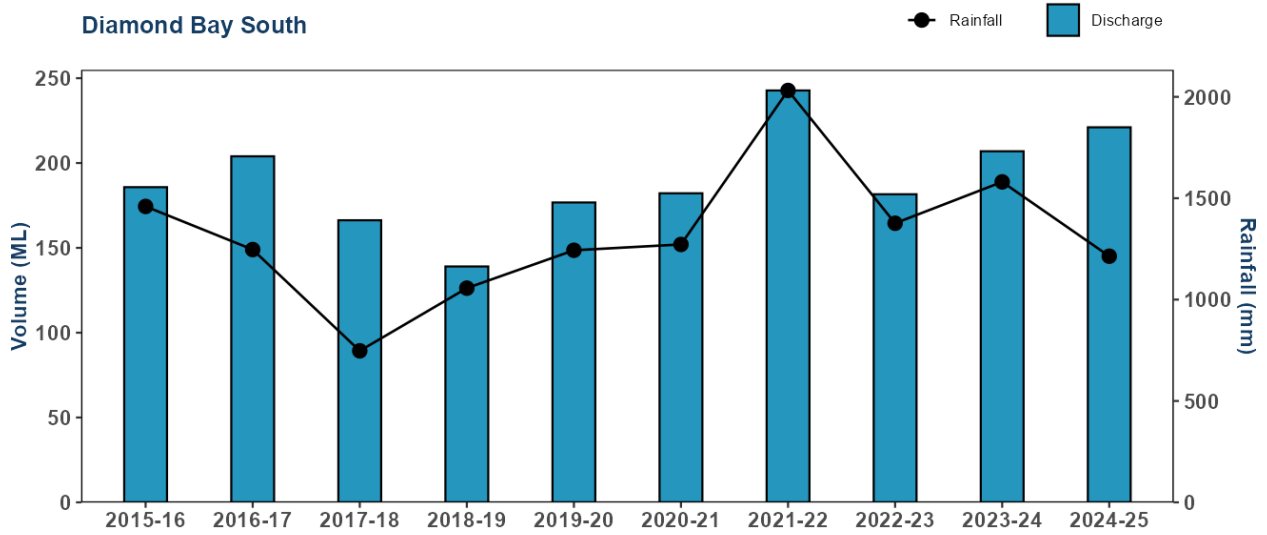
Inflow/ Discharge volume and rainfall



Diamond Bay North



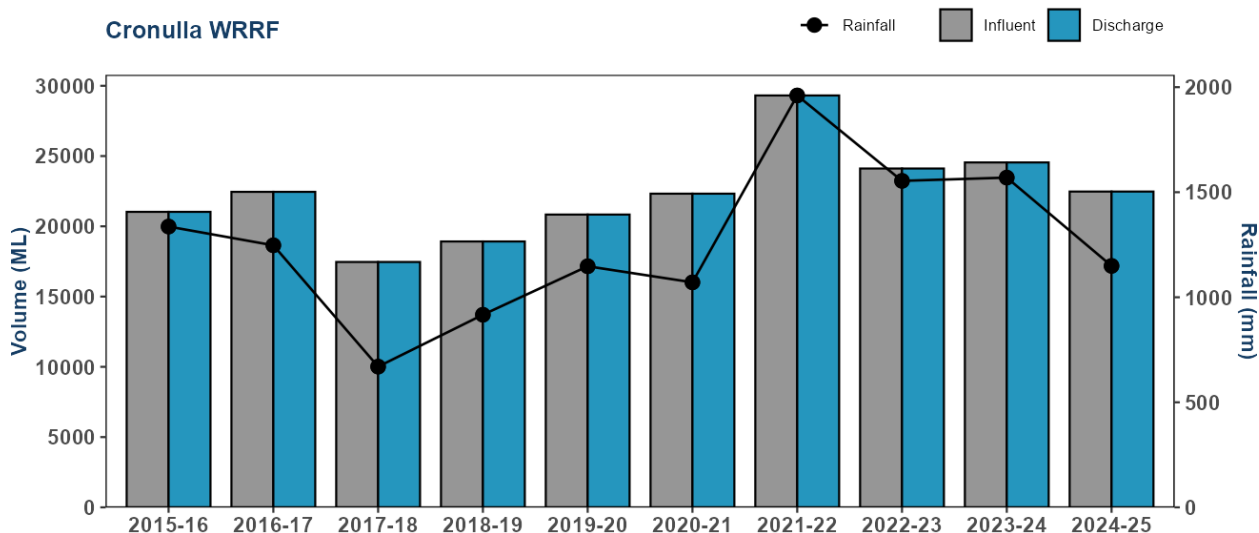
Diamond Bay South



D.3. Cronulla WRRF

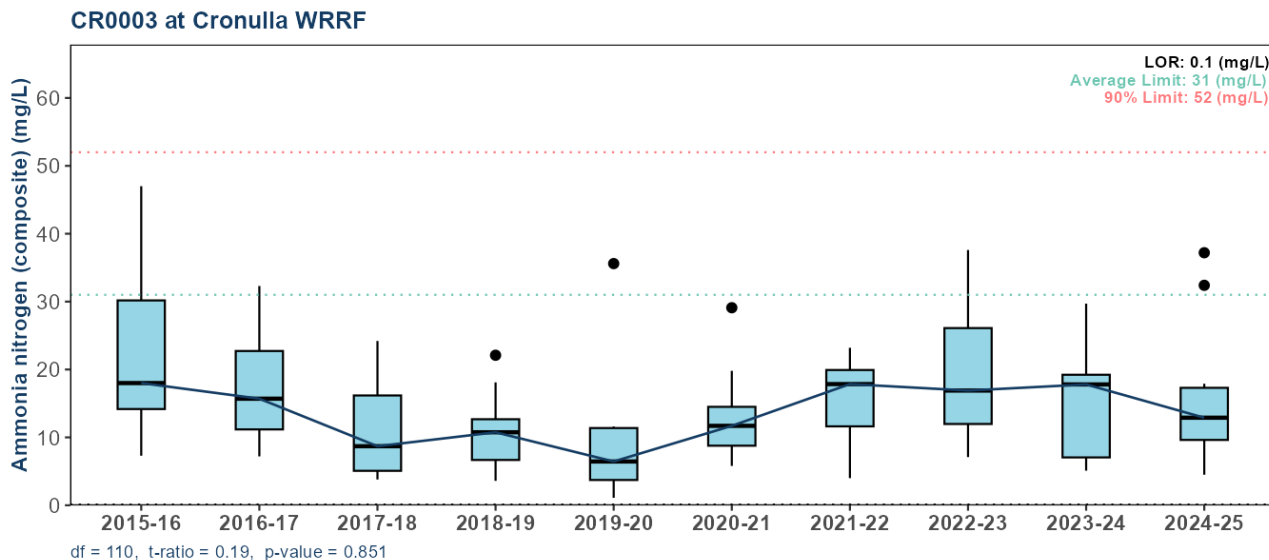
D.3.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

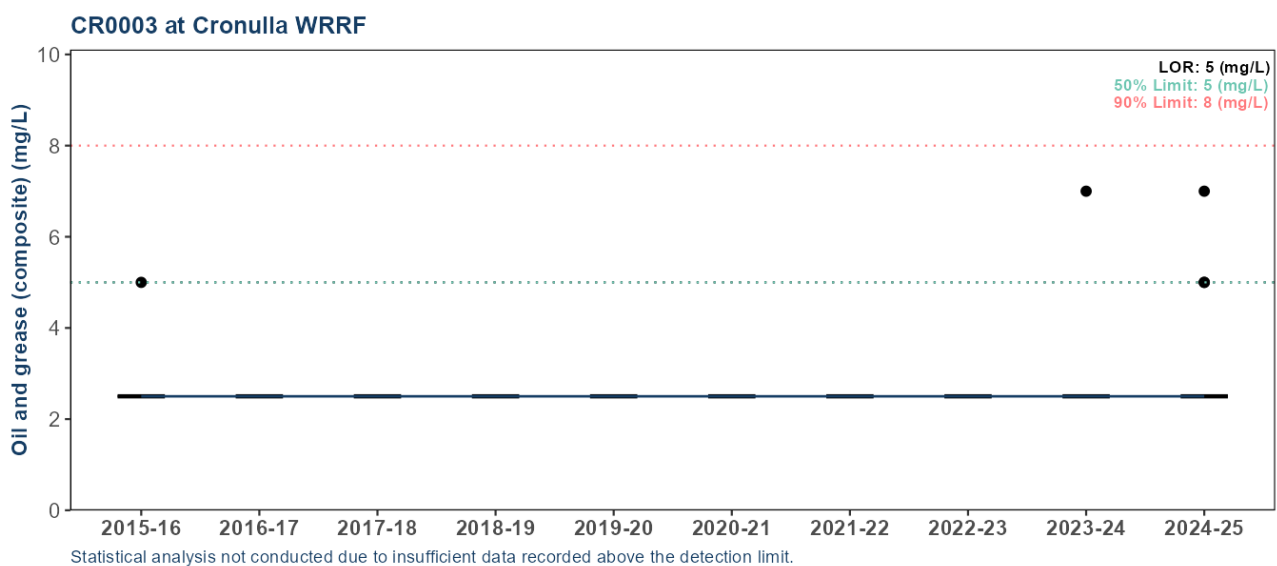
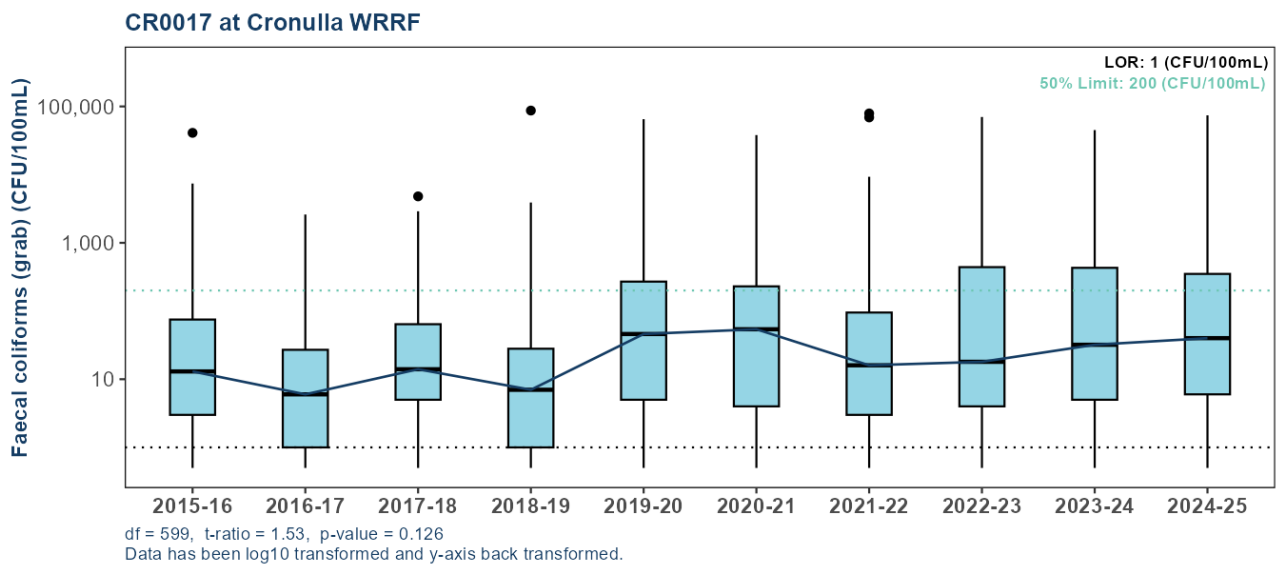
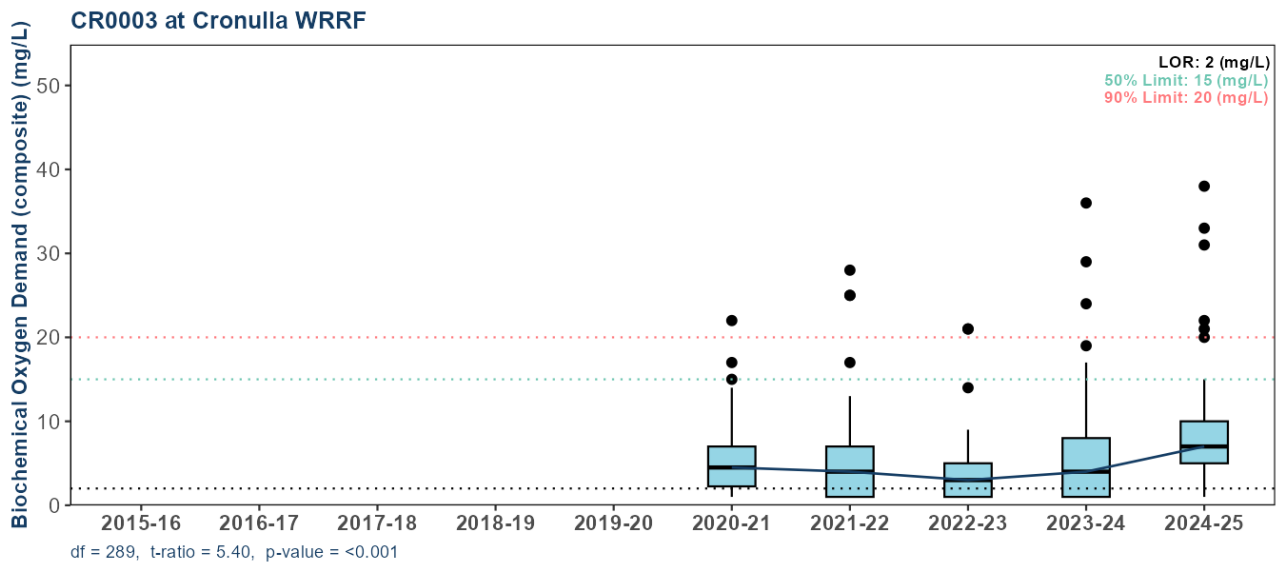


D.3.2. Pressure – Wastewater quality

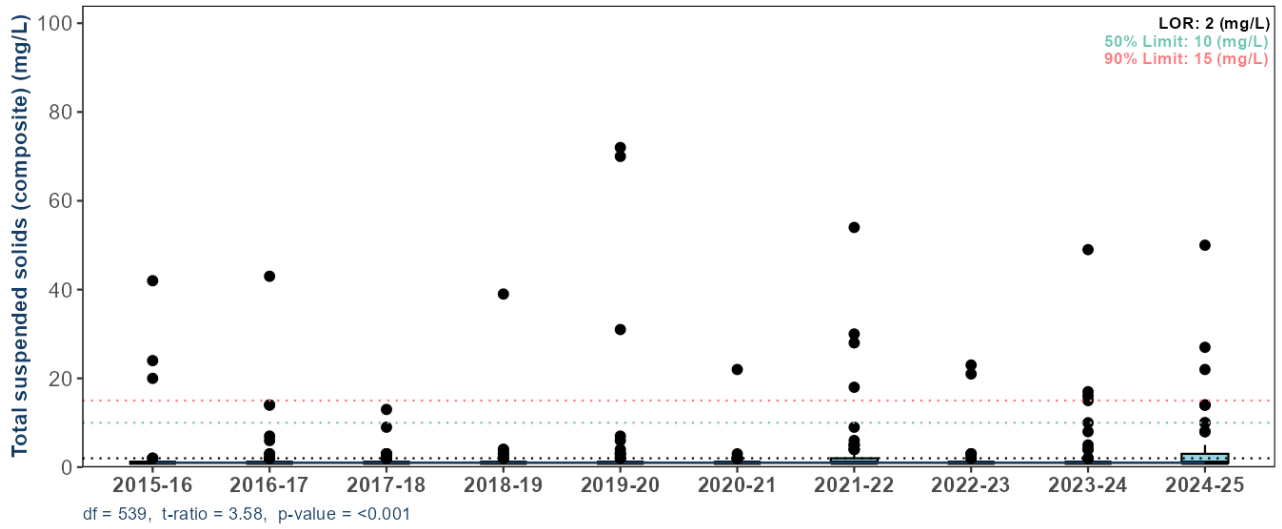
Nutrients



Major conventional analytes

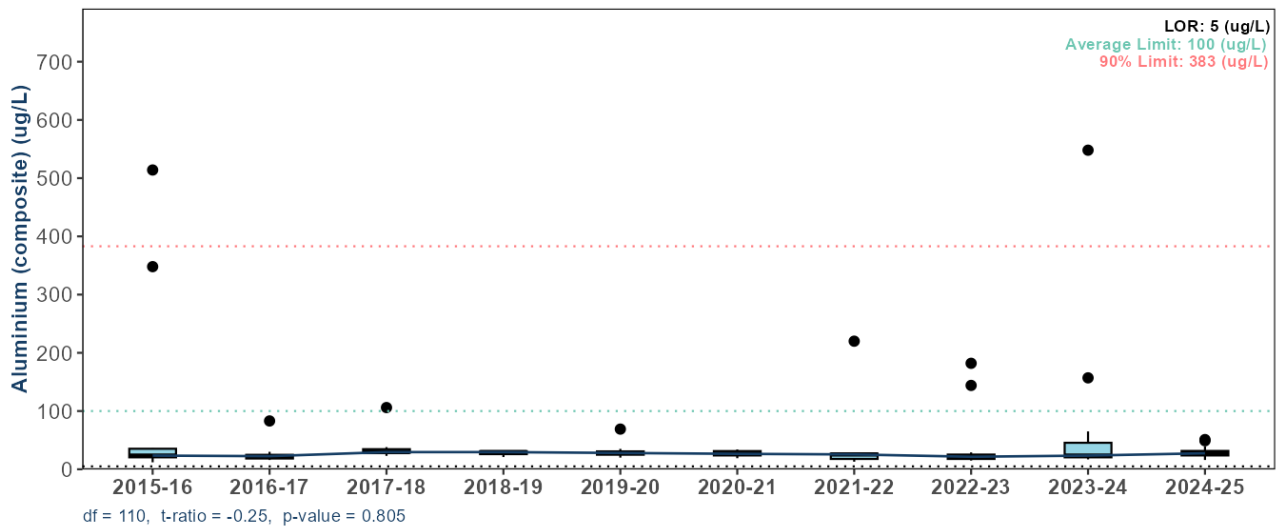


CR0003 at Cronulla WRRF

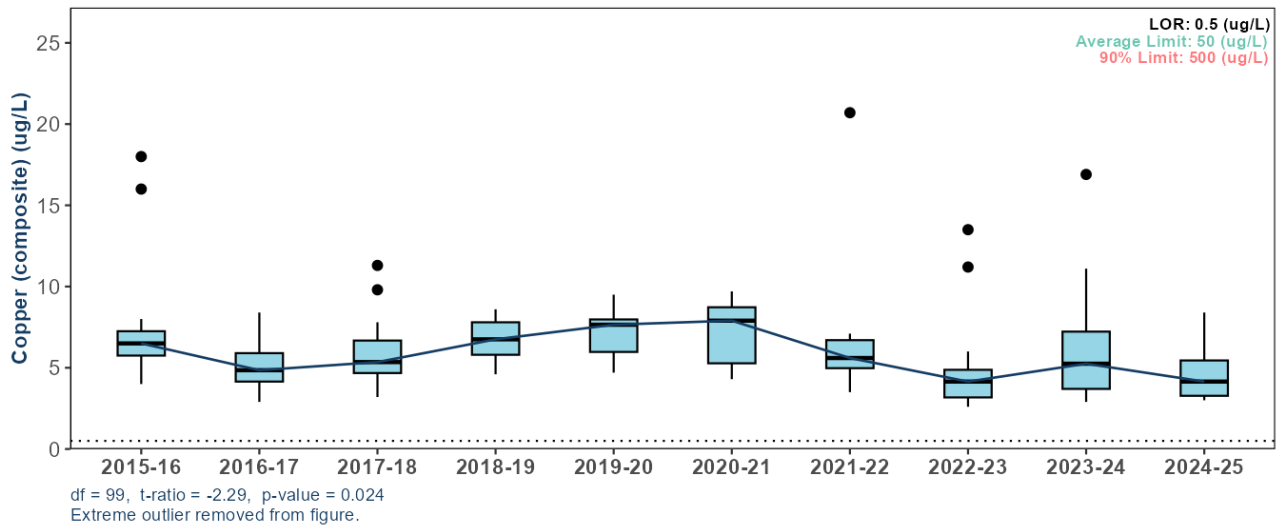


Trace metals

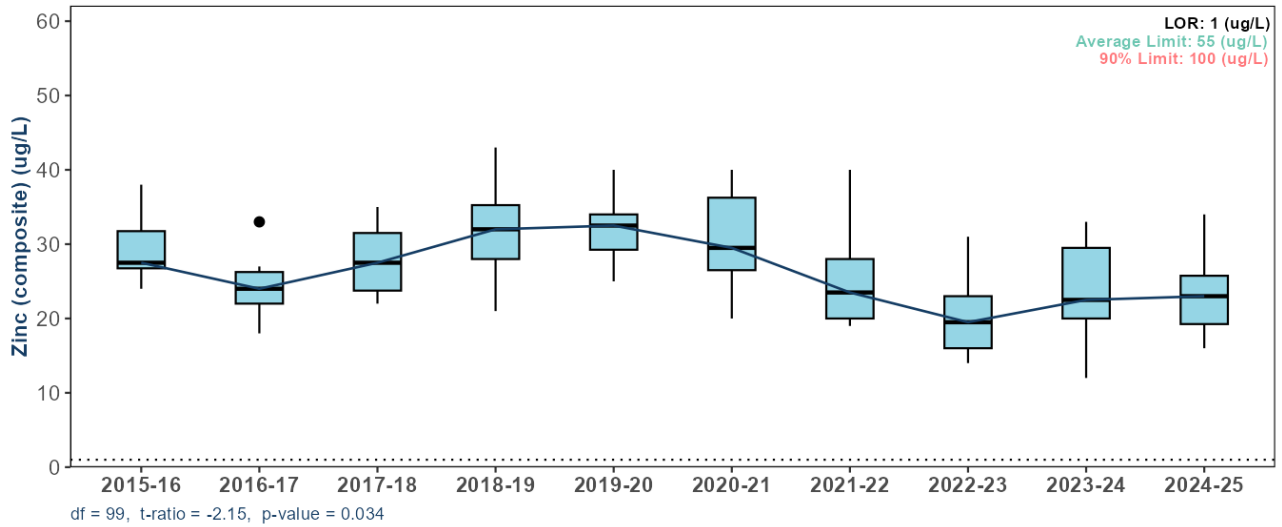
CR0003 at Cronulla WRRF



CR0003 at Cronulla WRRF

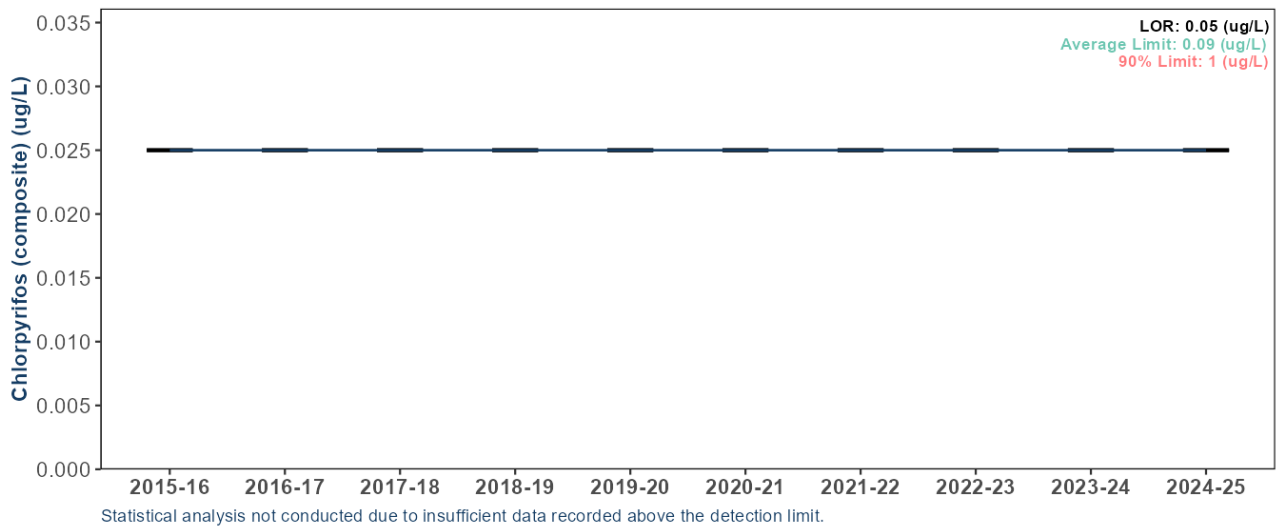


CR0003 at Cronulla WRRF

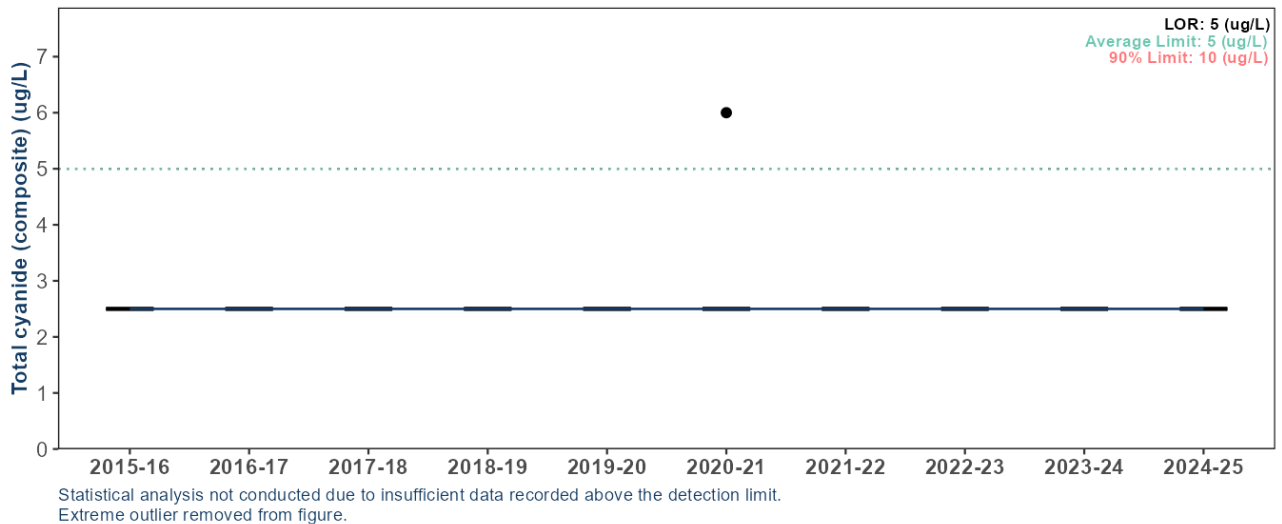


Other chemicals and organics (including pesticides)

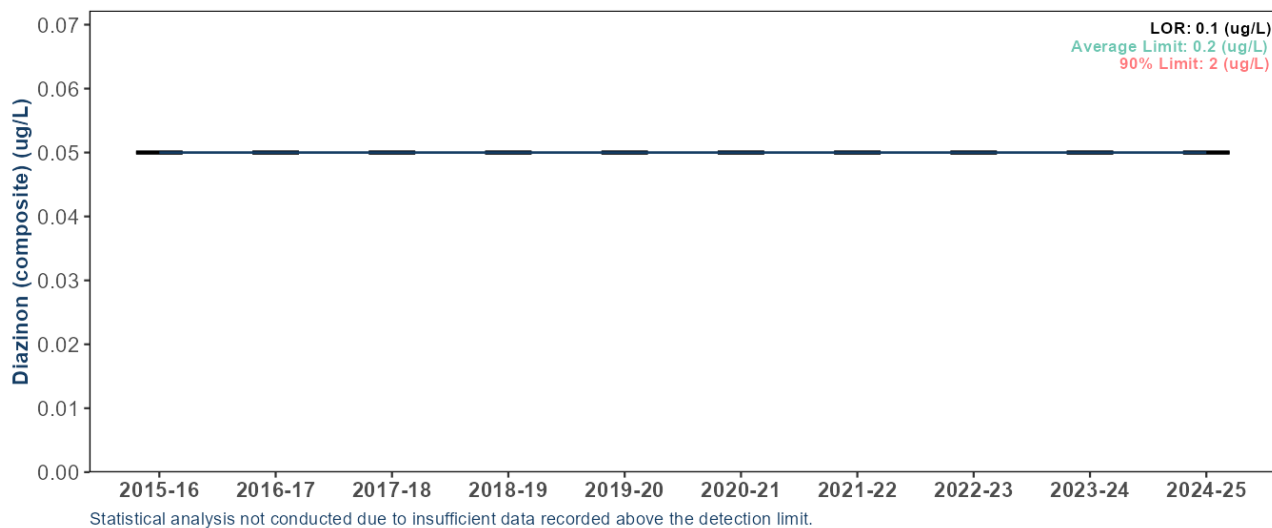
CR0003 at Cronulla WRRF



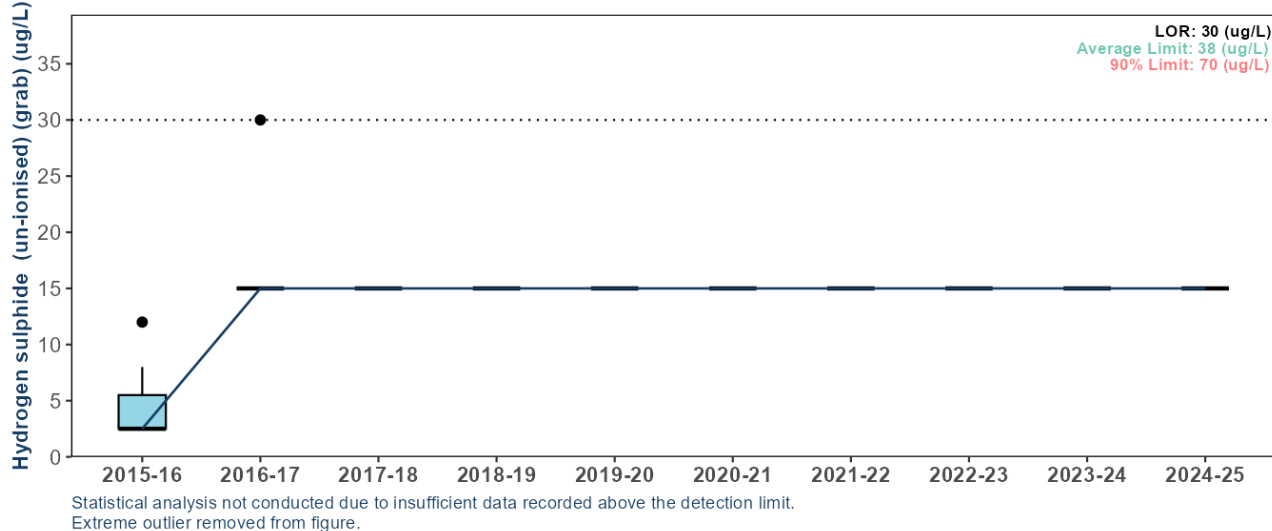
CR0003 at Cronulla WRRF



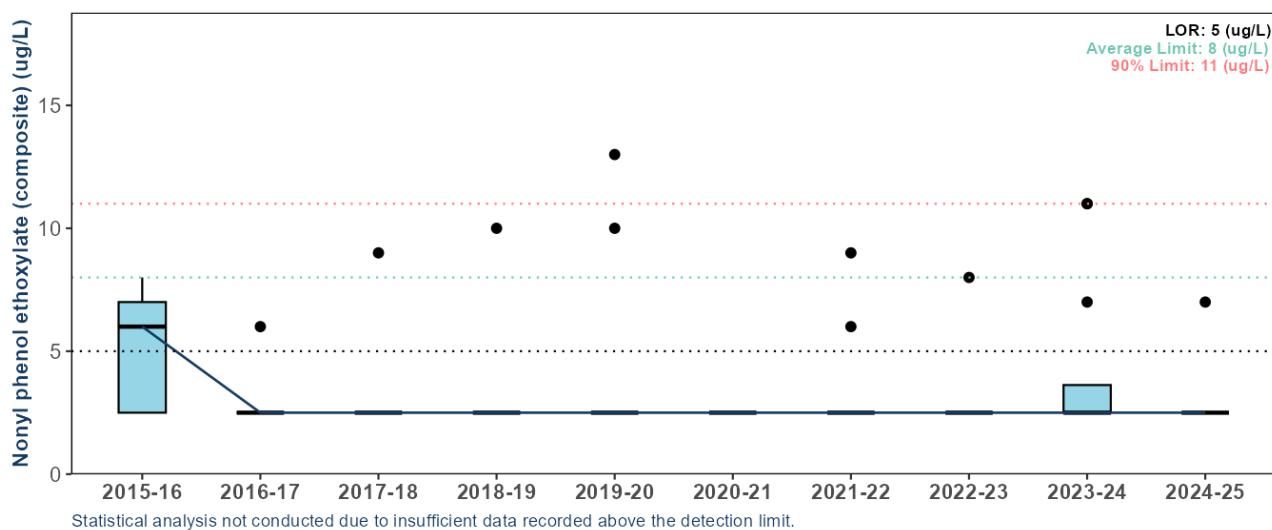
CR0003 at Cronulla WRRF



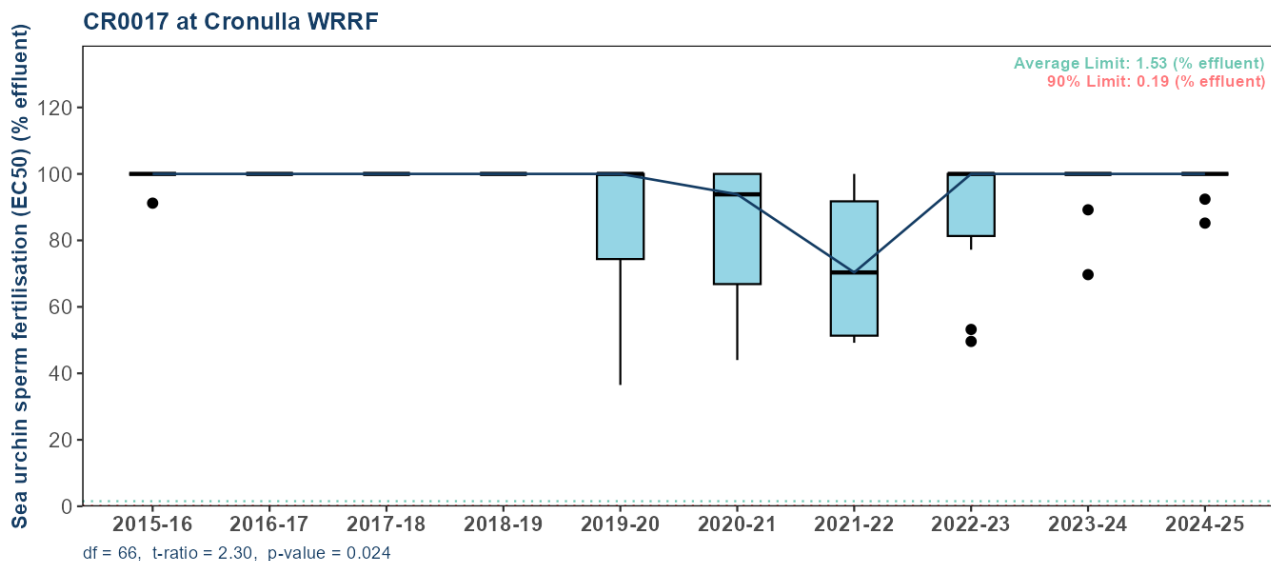
CR0017 at Cronulla WRRF



CR0003 at Cronulla WRRF

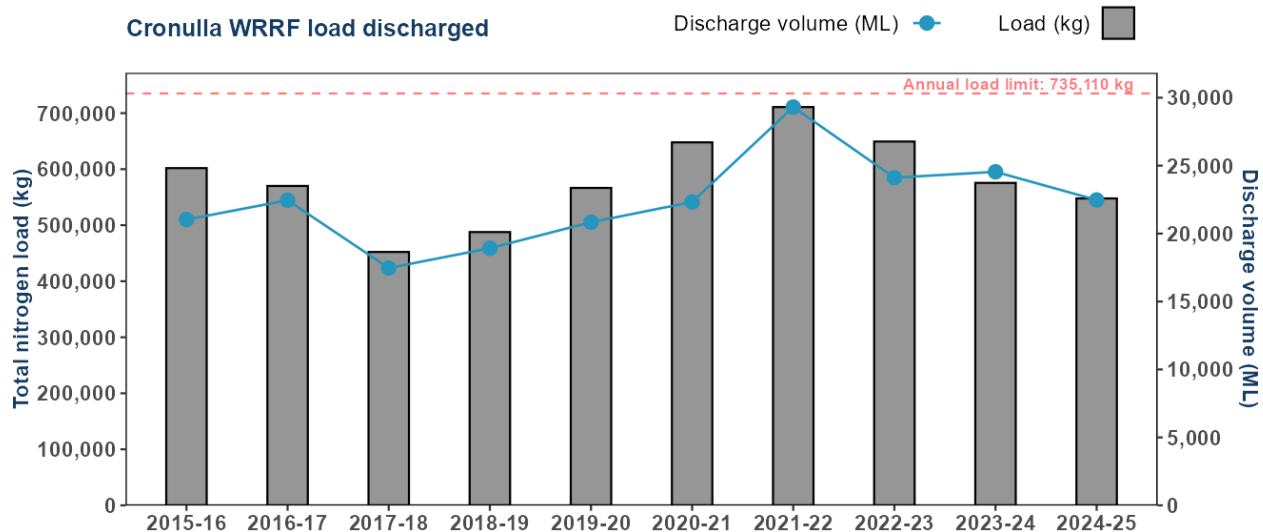


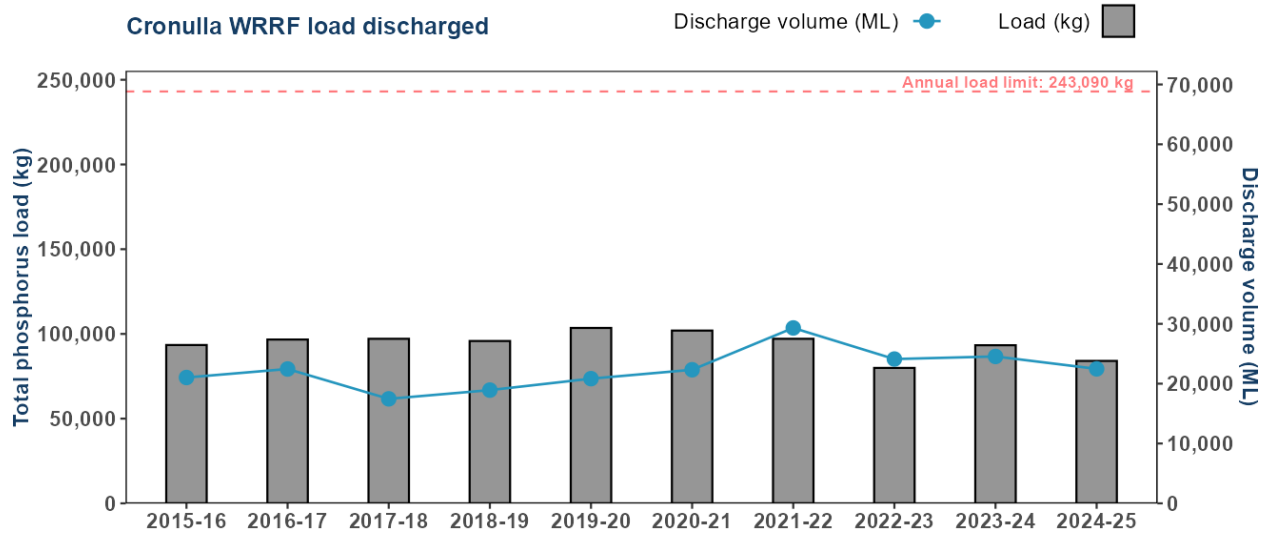
D.3.3. Pressure – Wastewater toxicity



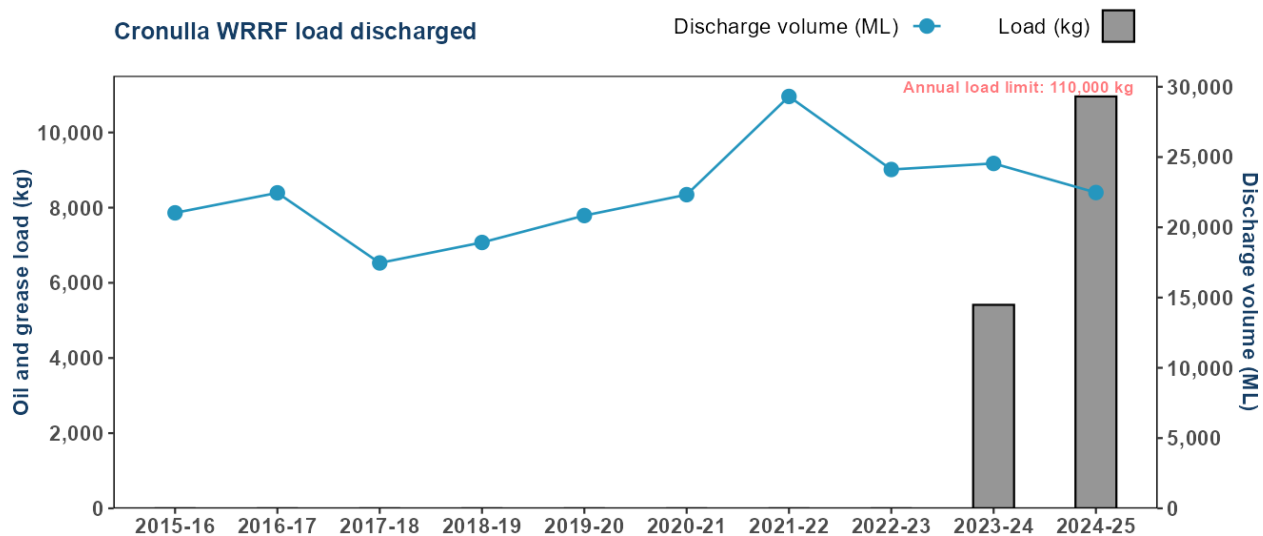
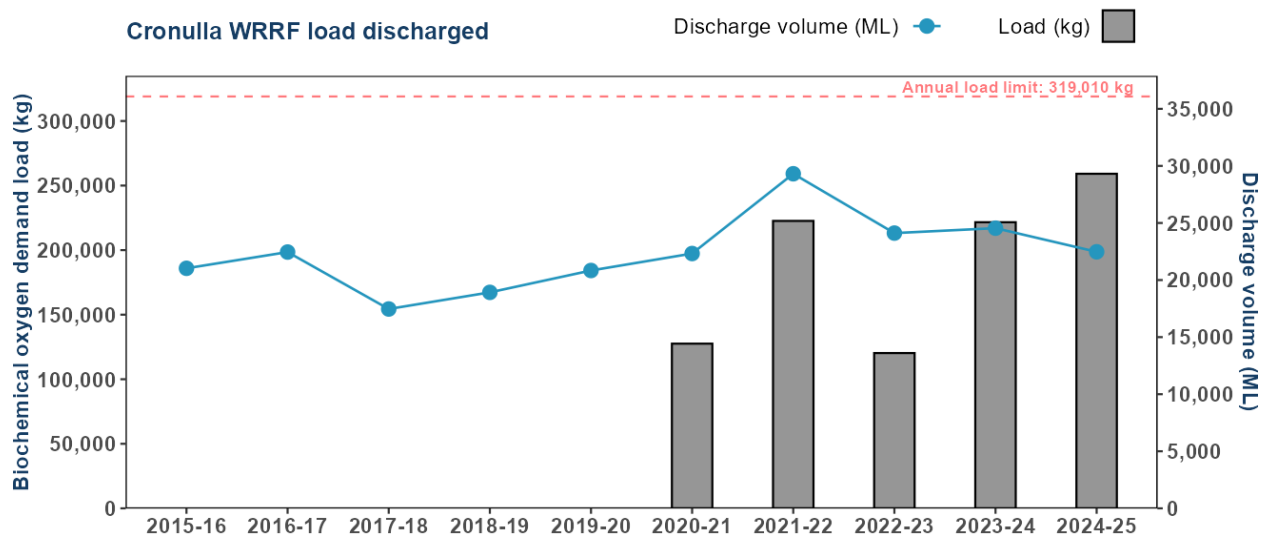
D.3.4. Pressure – Wastewater discharge load

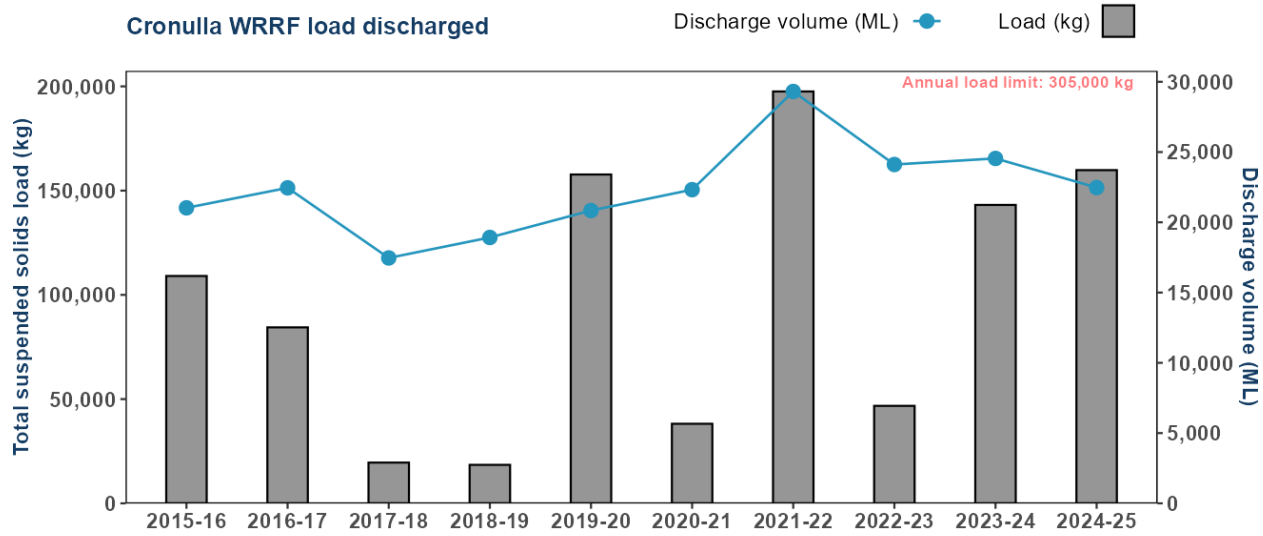
Nutrients



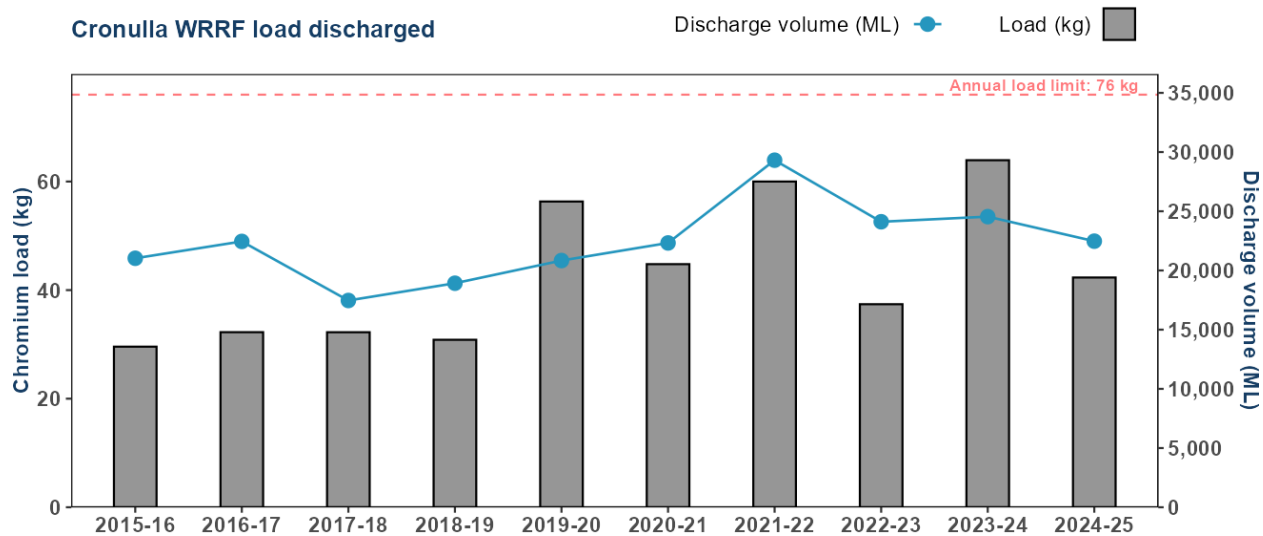
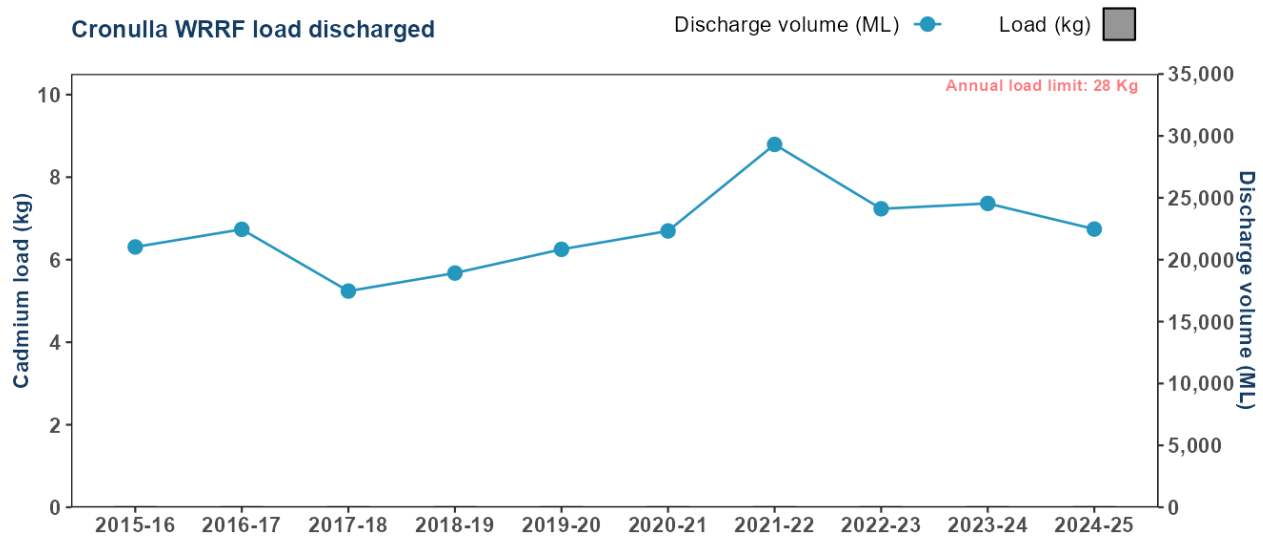


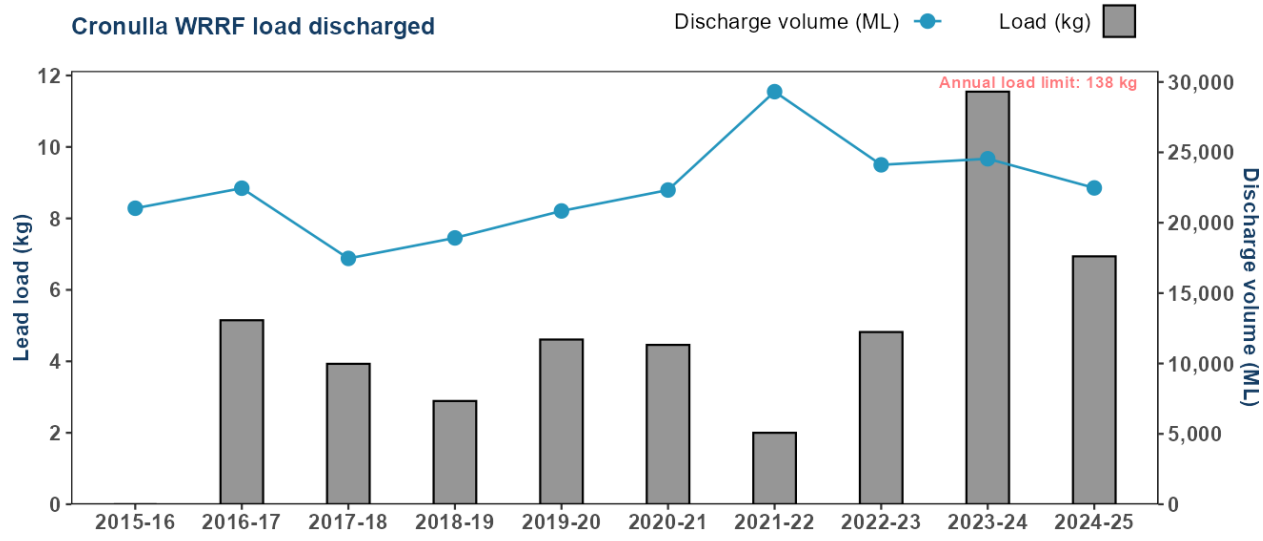
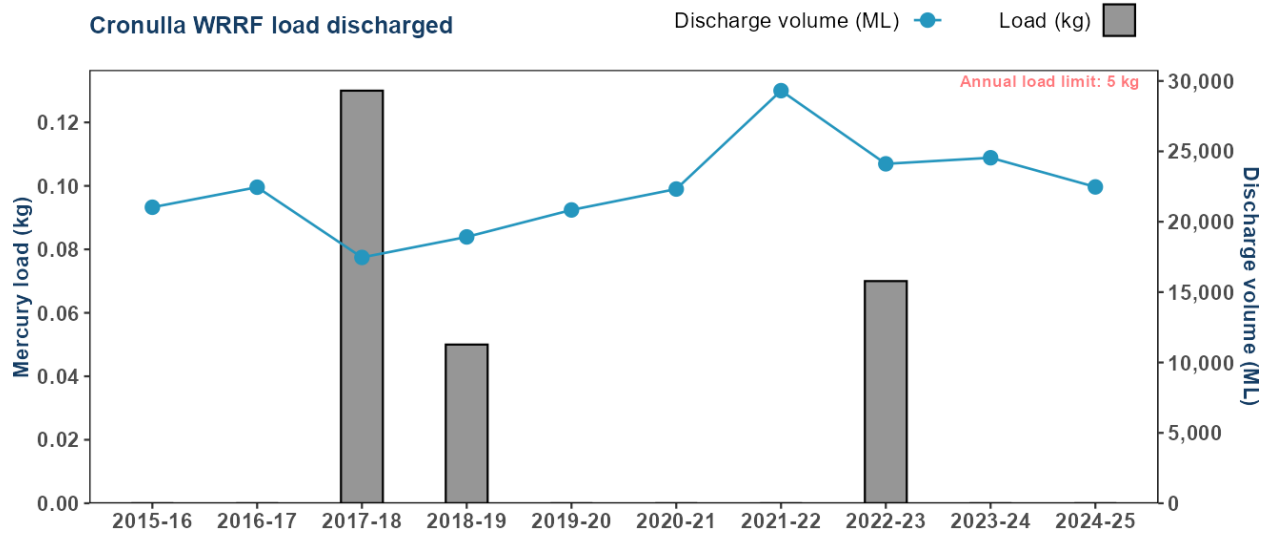
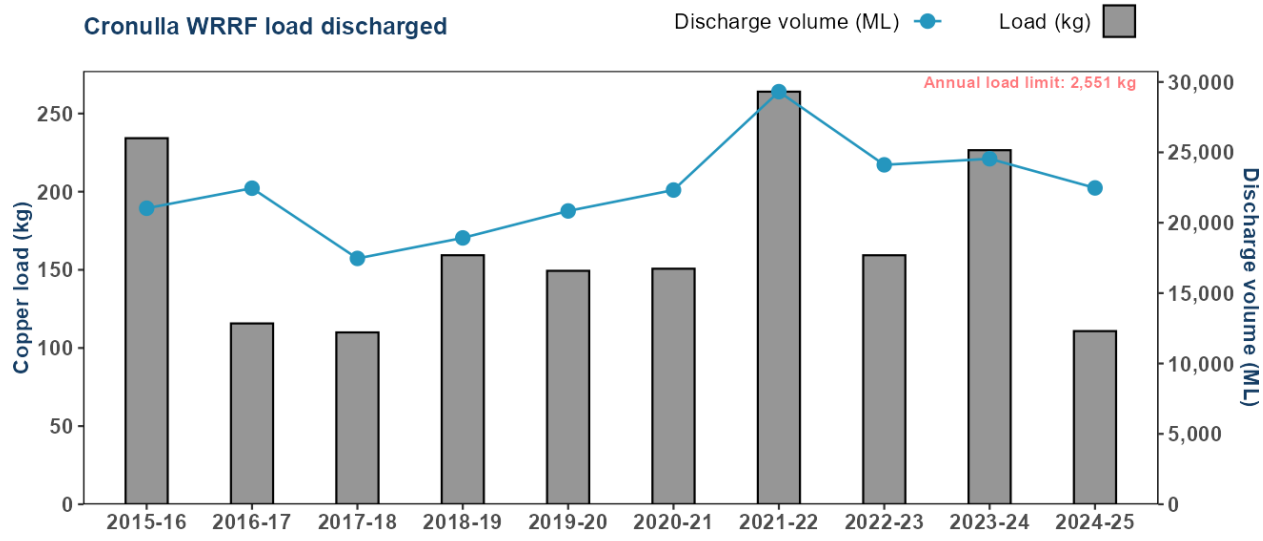
Major conventional analytes



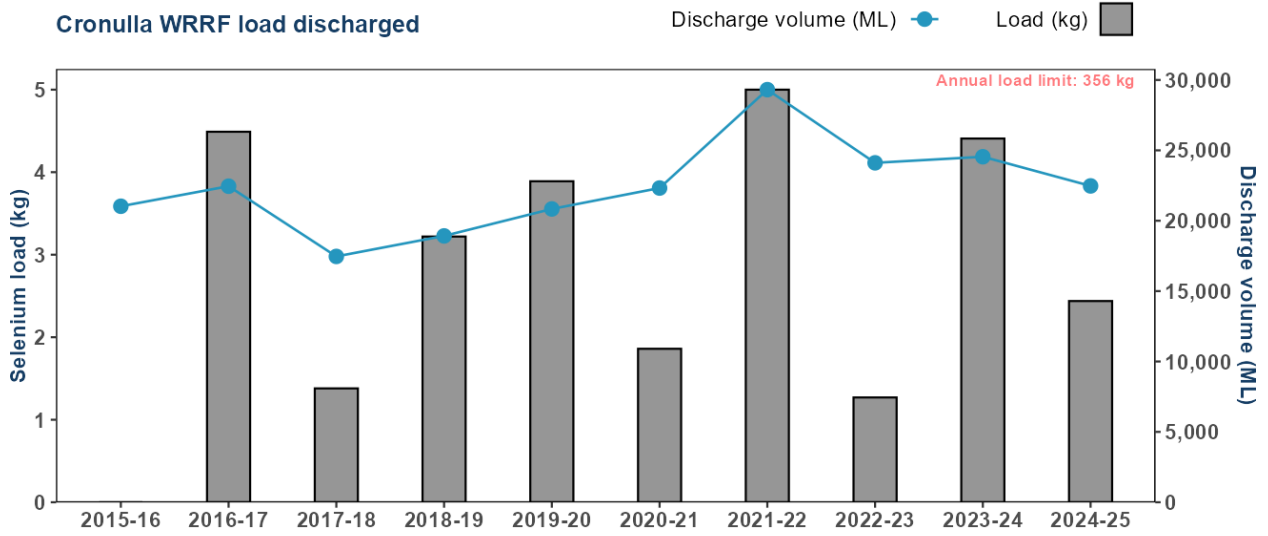


Trace metals

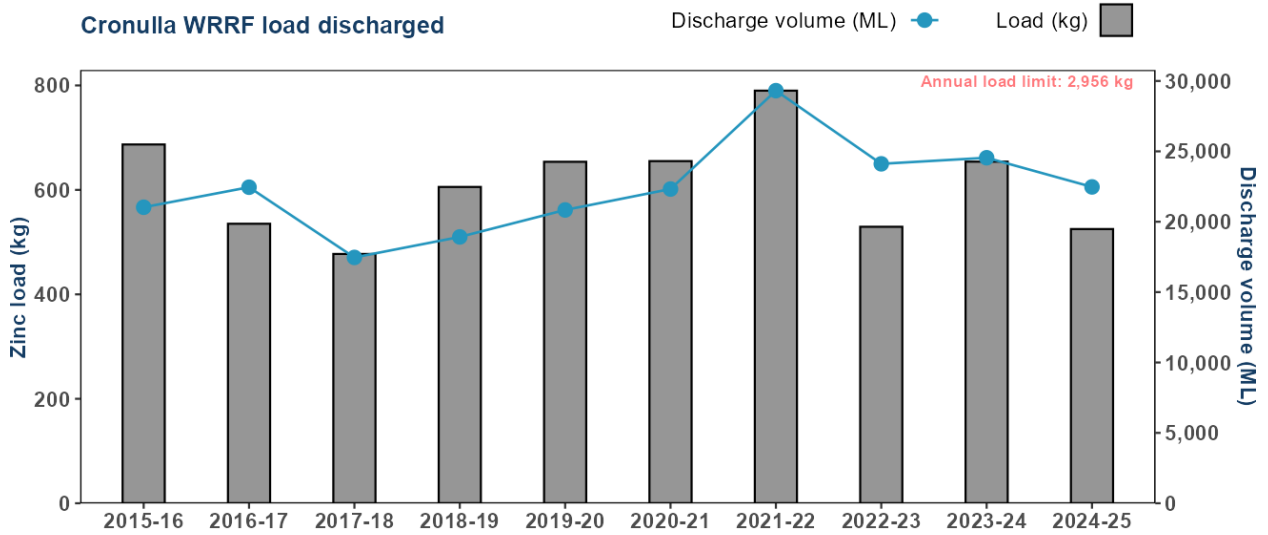




Cronulla WRRF load discharged

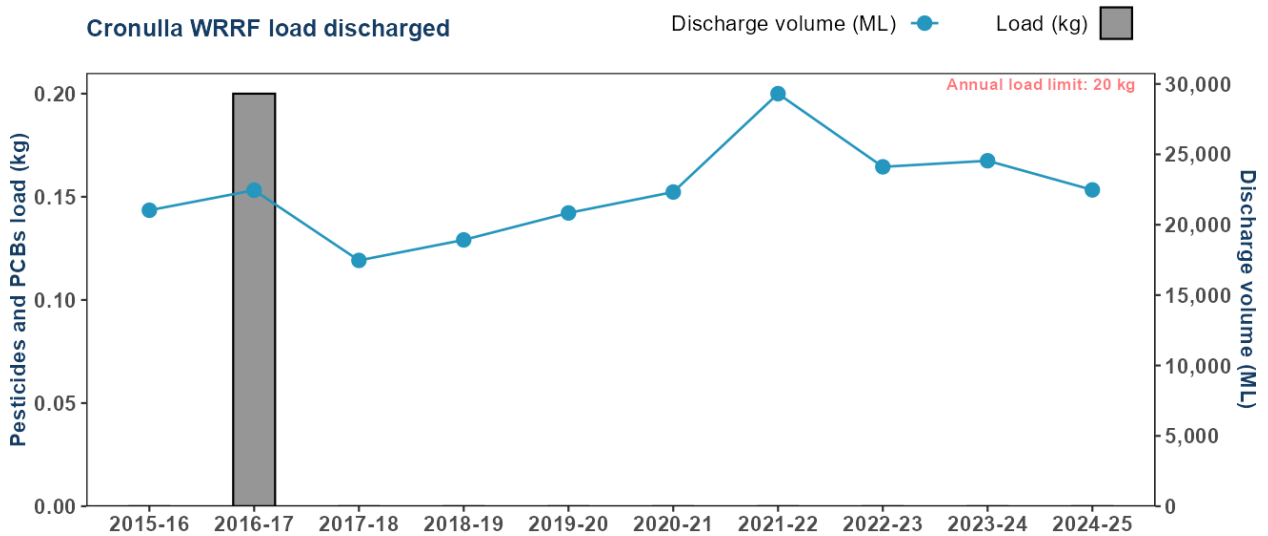


Cronulla WRRF load discharged



Other chemicals and organics (including pesticides)

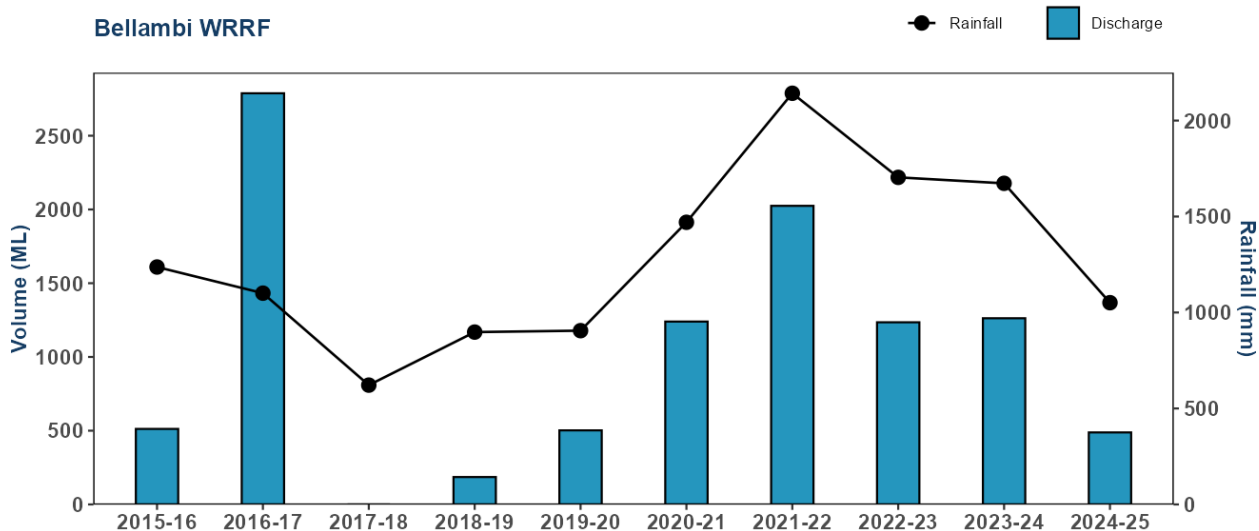
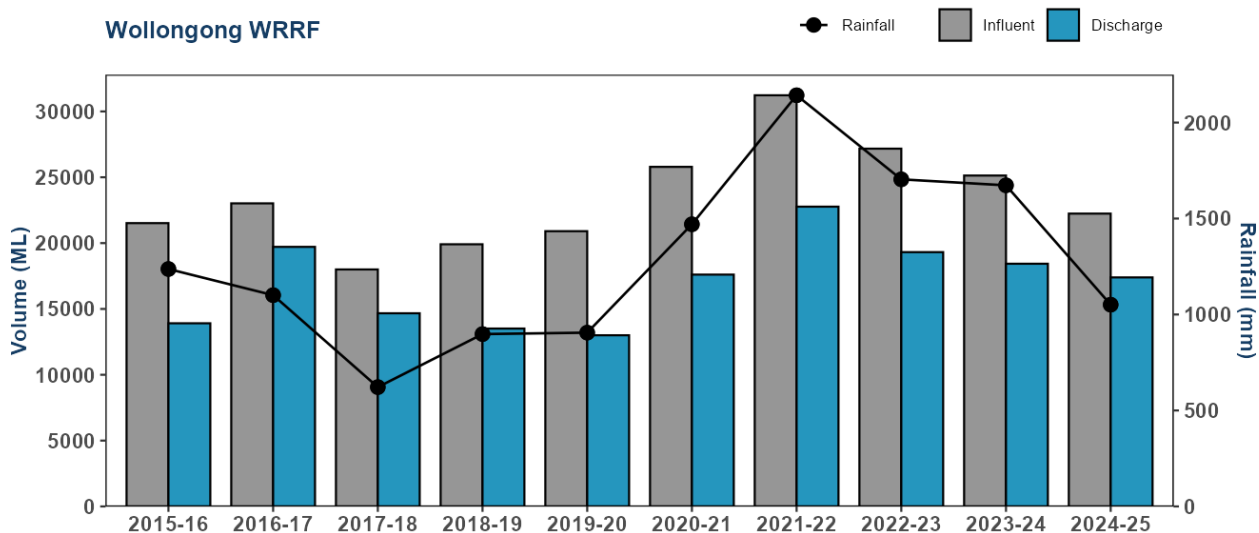
Cronulla WRRF load discharged



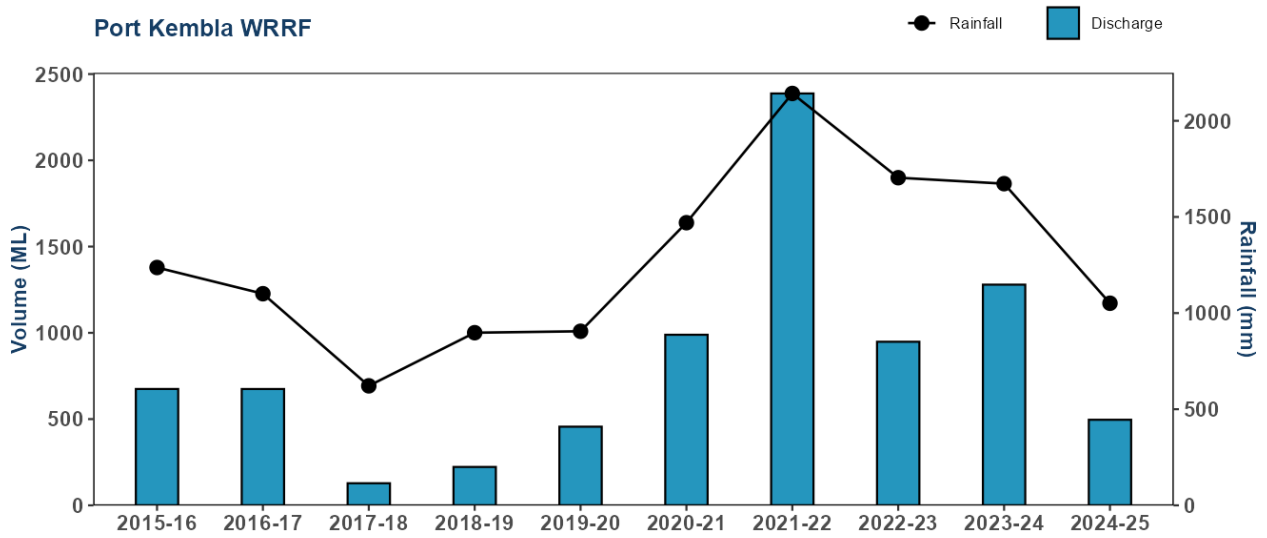
D.4. Wollongong WRRF

D.4.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

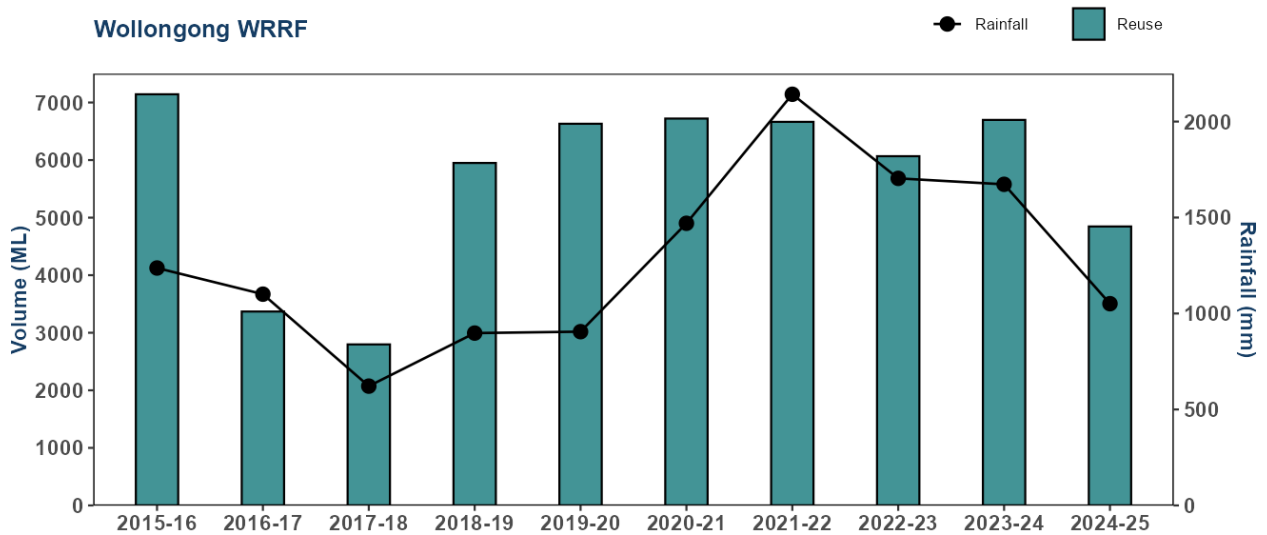


Port Kembla WRRF



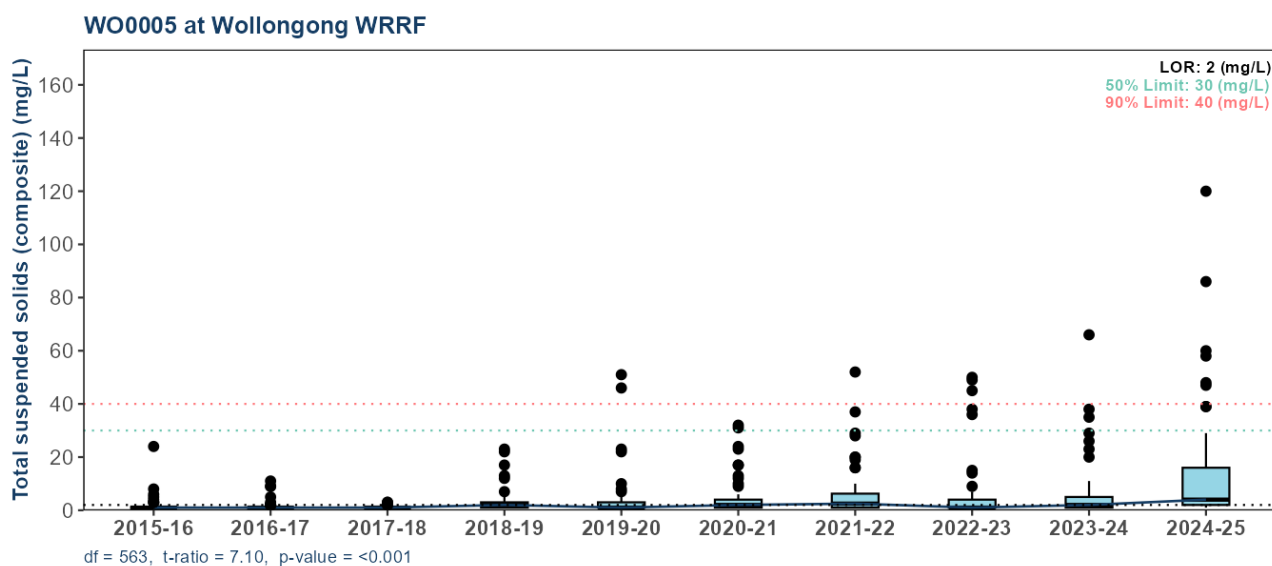
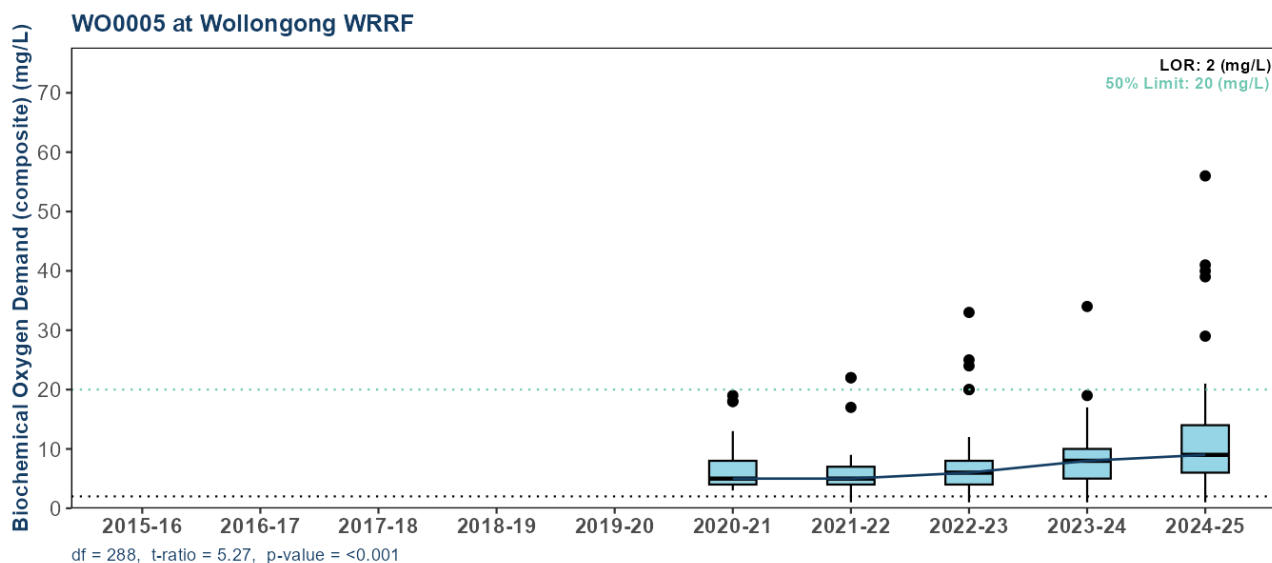
Reuse volume and rainfall

Wollongong WRRF



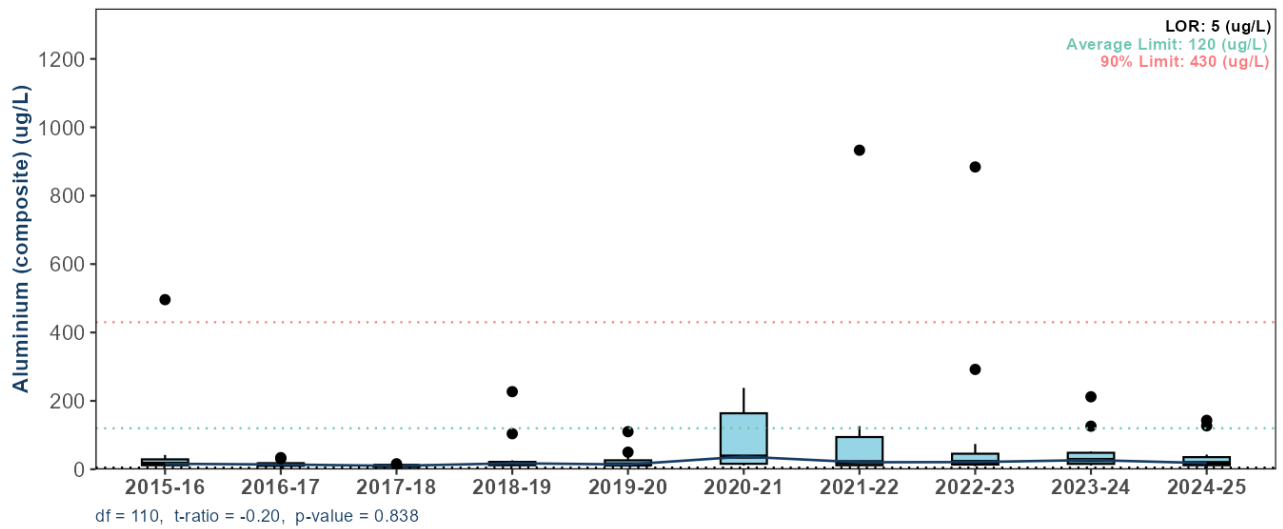
D.4.2. Pressure – Wastewater quality

Major conventional analytes

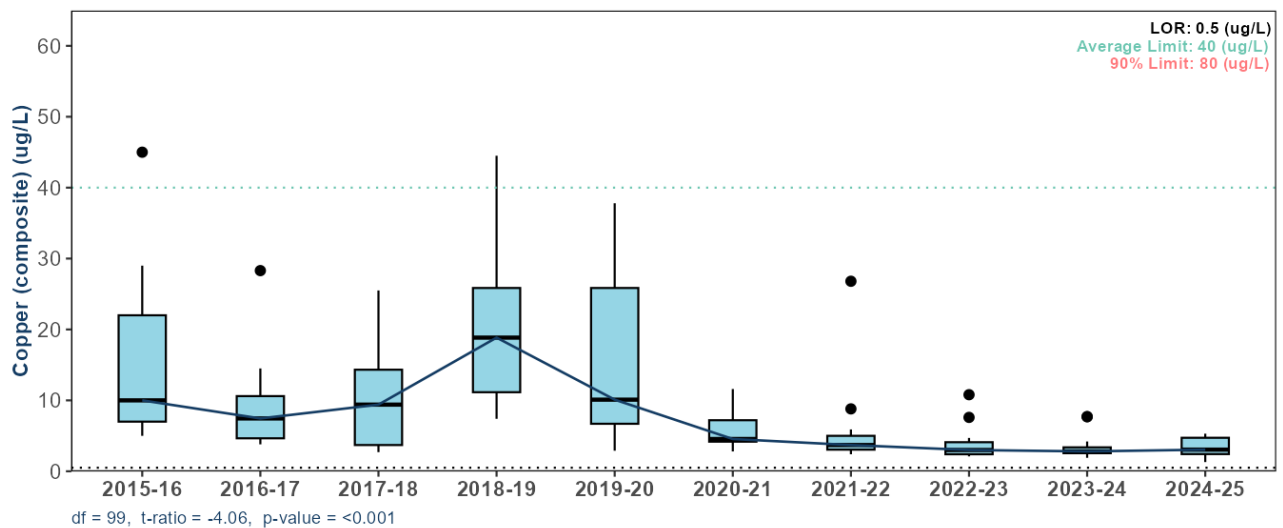


Trace metals

WO0005 at Wollongong WRRF

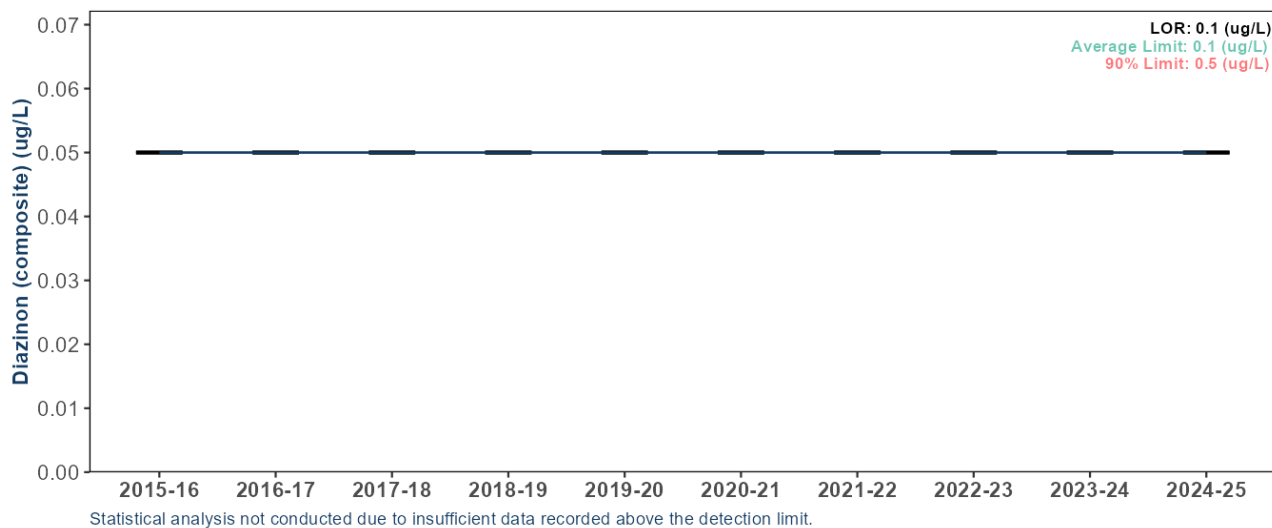


WO0005 at Wollongong WRRF

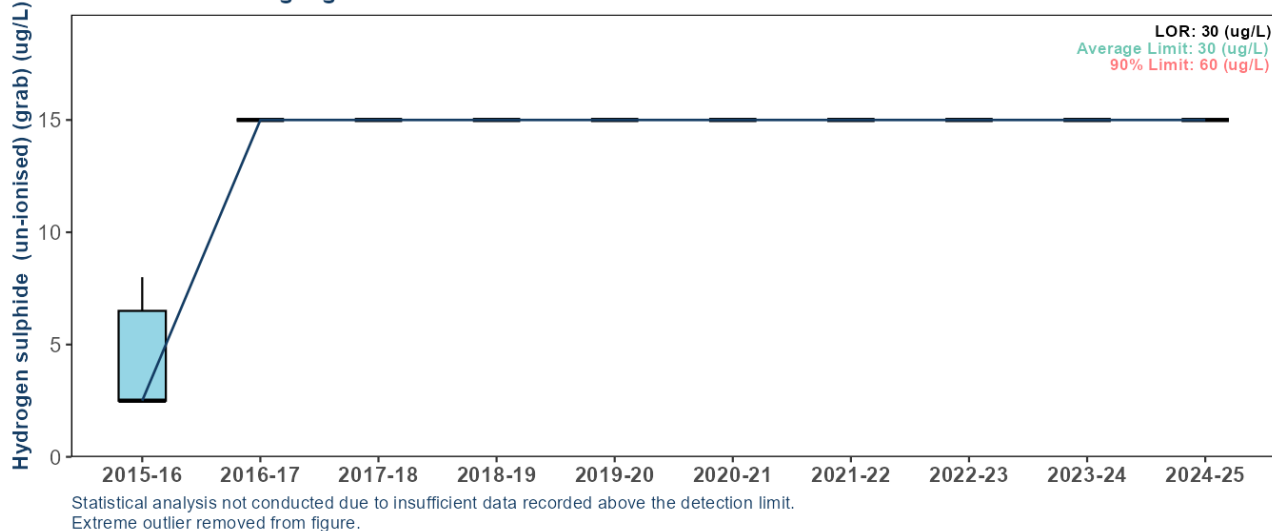


Other chemicals and organics (including pesticides)

WO0005 at Wollongong WRRF



WO0005 at Wollongong WRRF

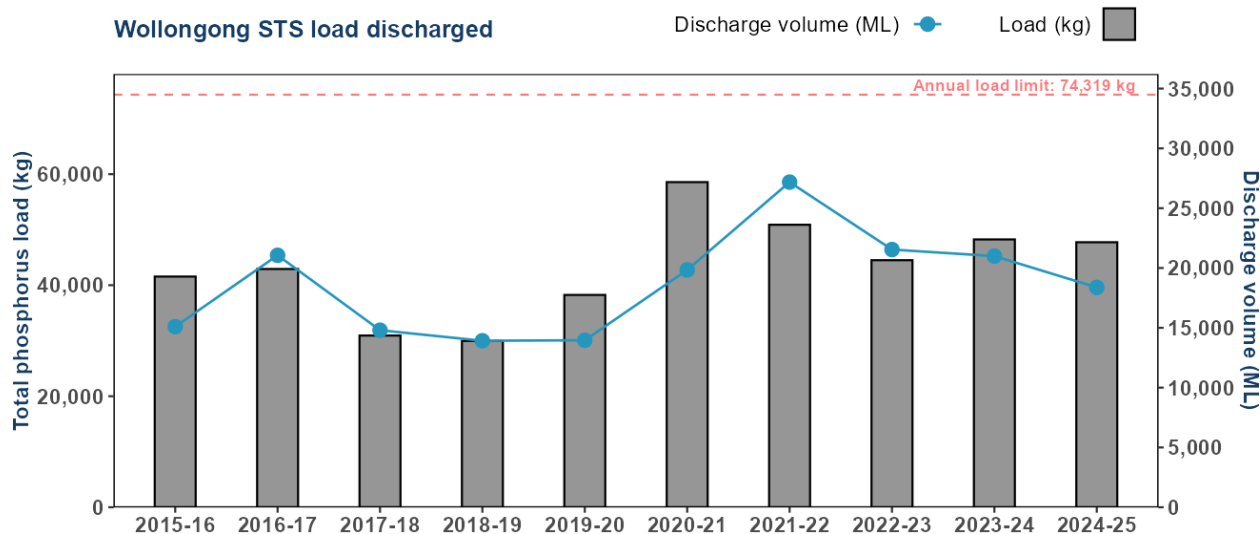
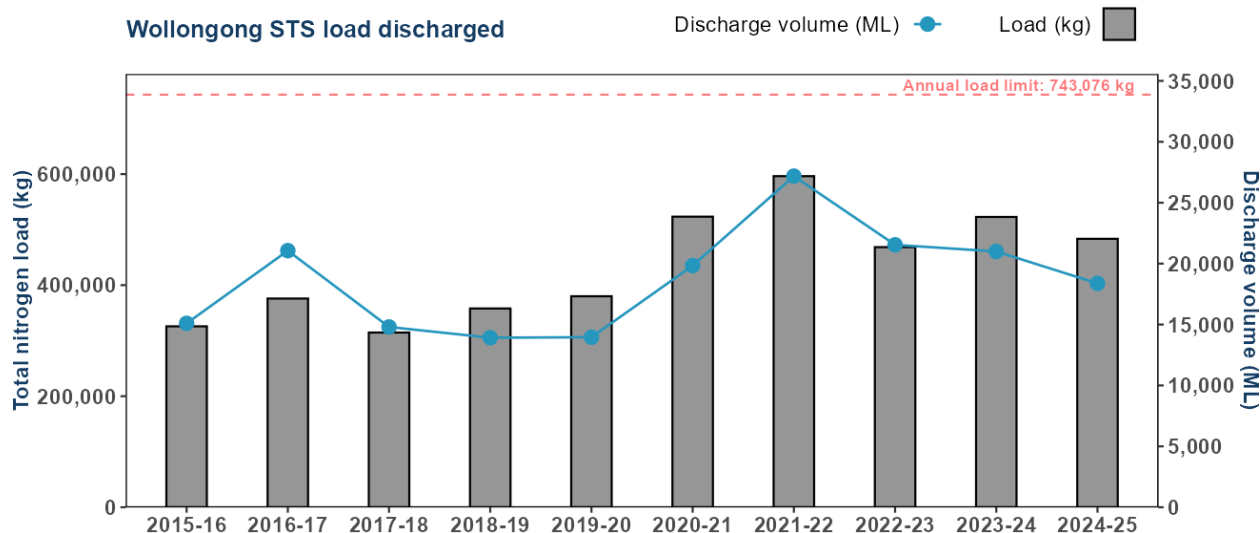


D.4.3. Pressure – Wastewater toxicity

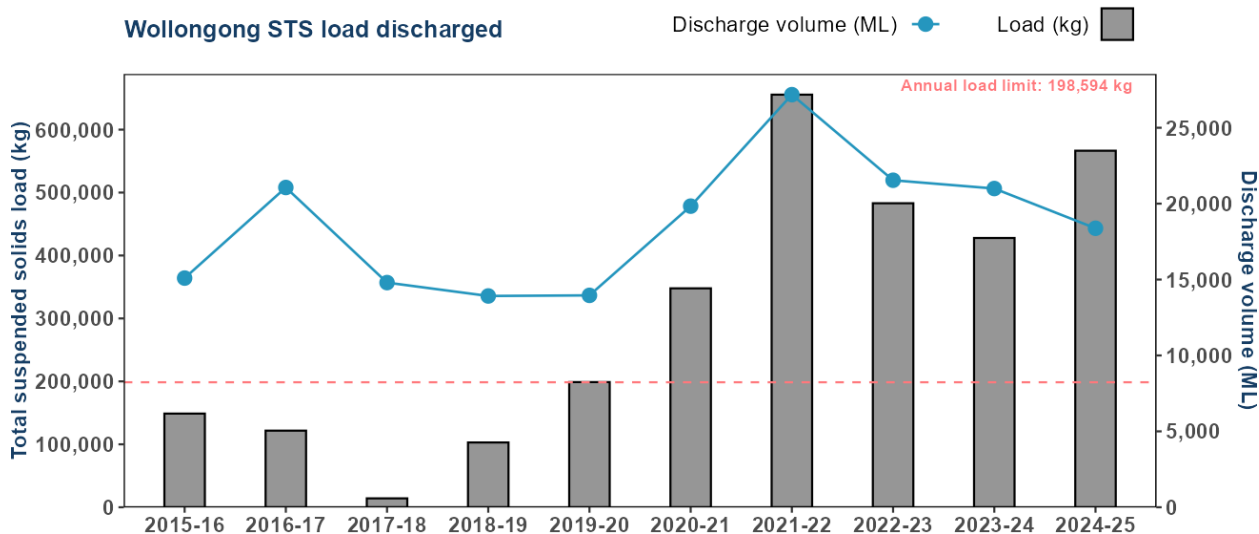
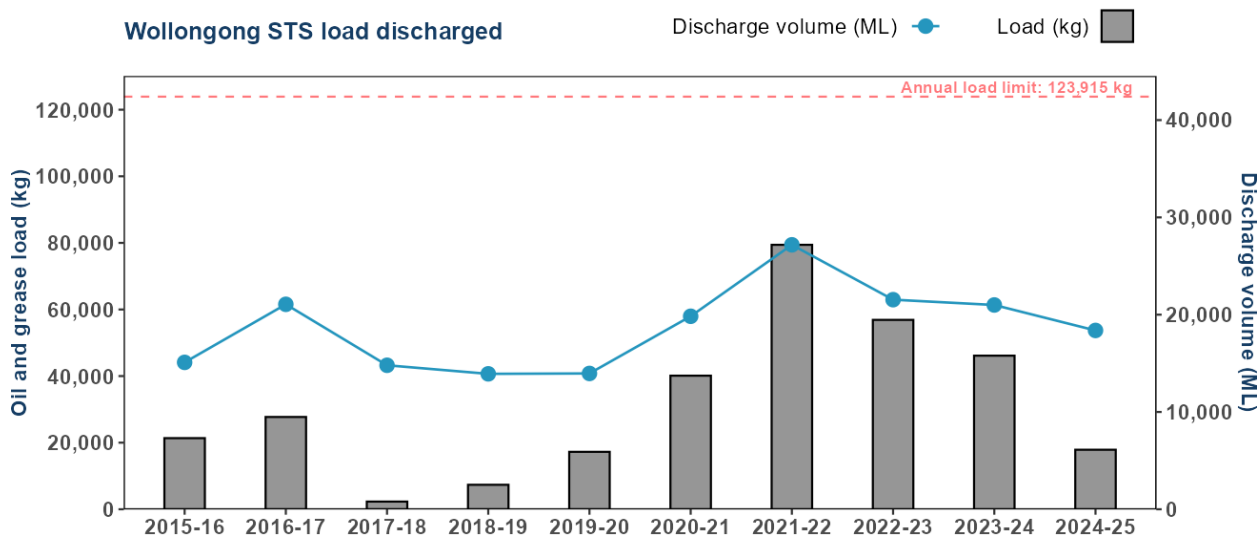
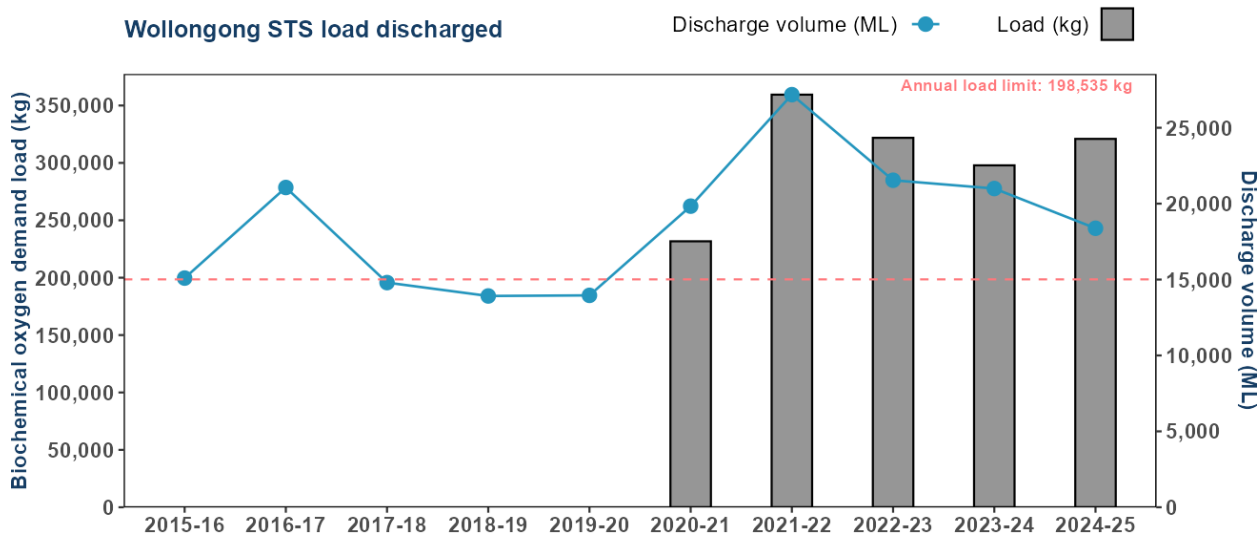
No toxicity monitoring requirement at Wollongong WRRF.

D.4.4. Pressure – Wastewater discharge load

Nutrients



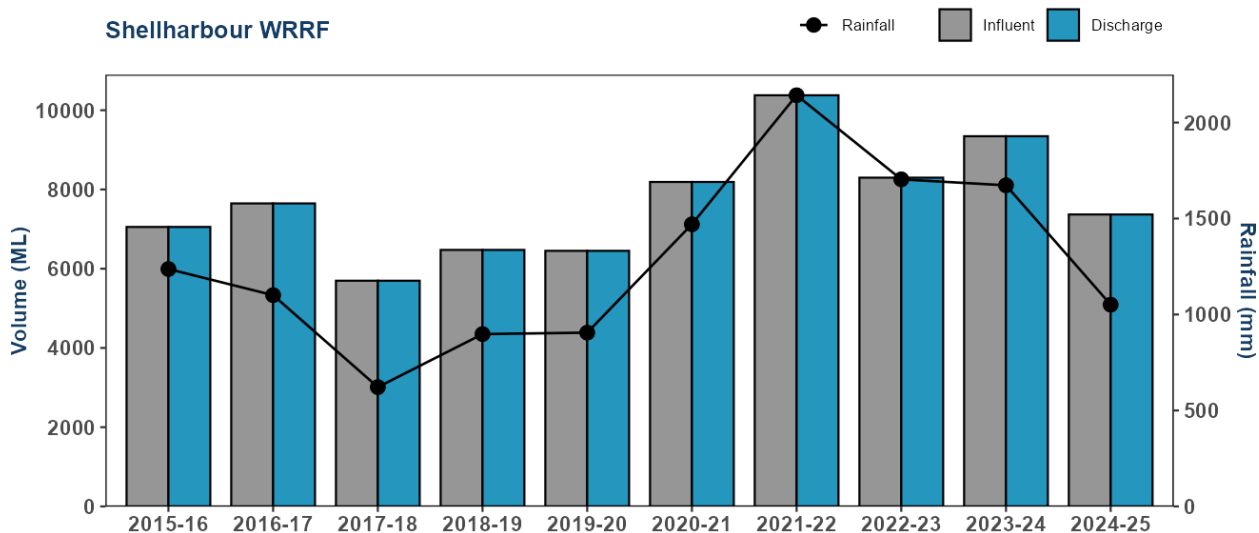
Major conventional analytes



D.5. Shellharbour WRRF

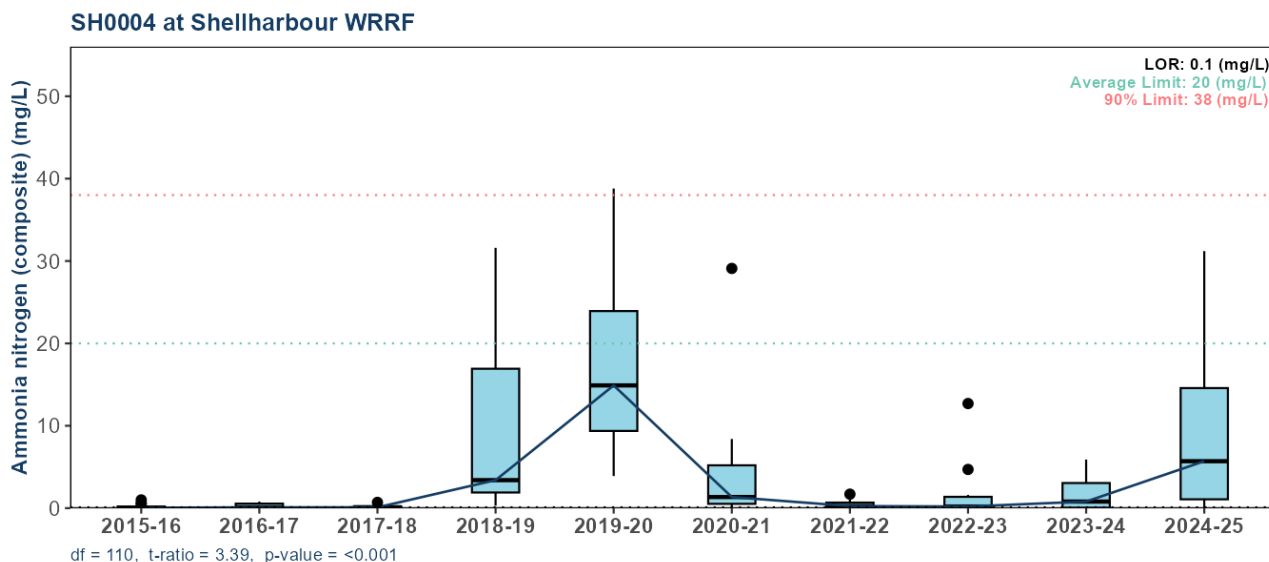
D.5.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall



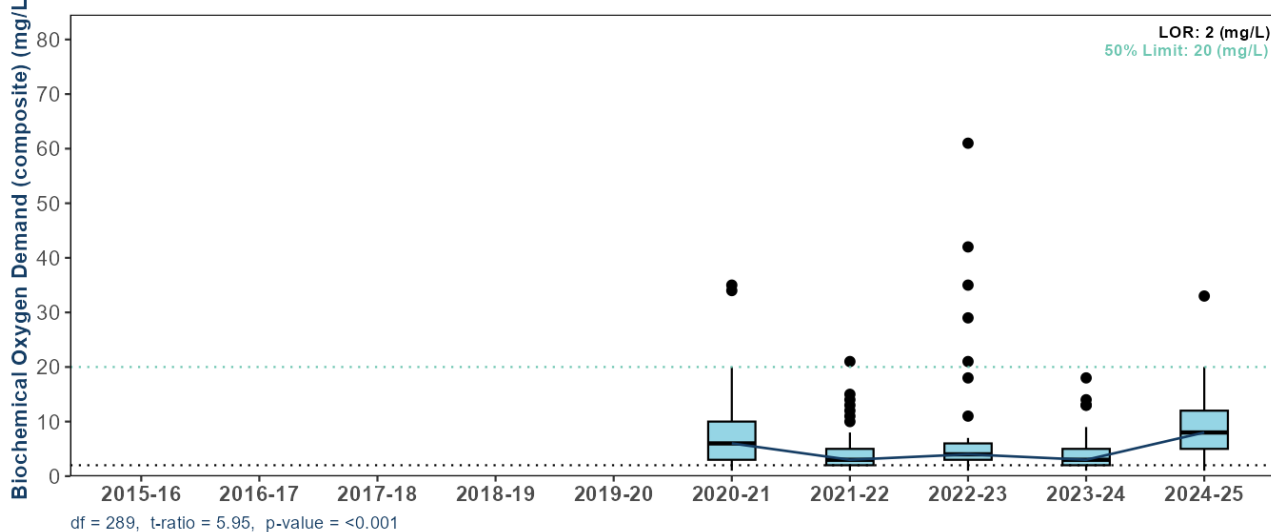
D.5.2. Pressure – Wastewater quality

Nutrients

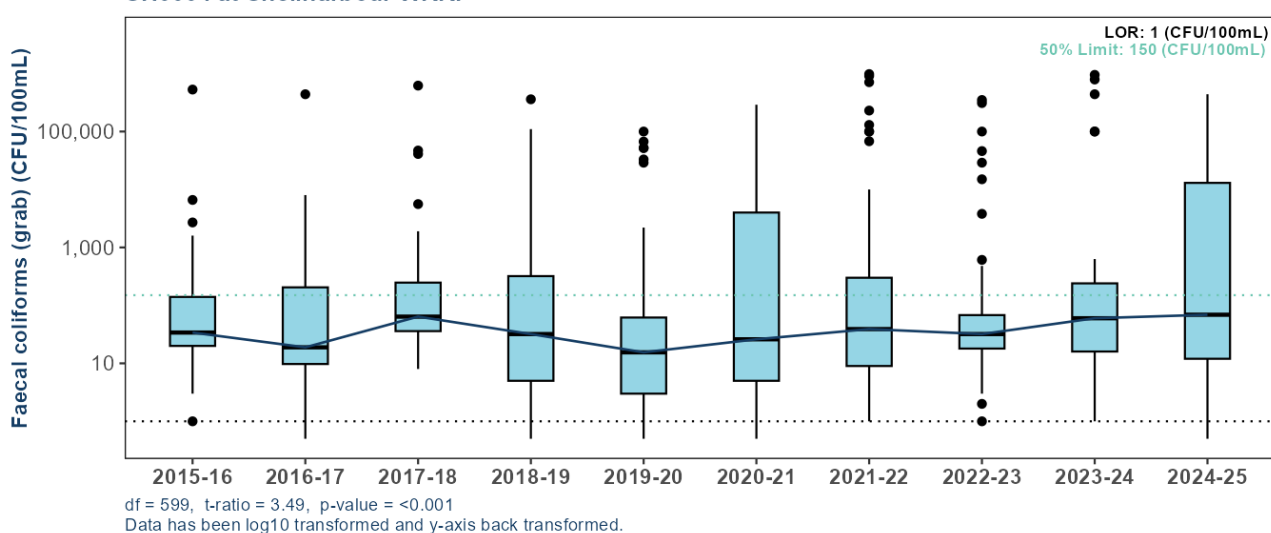


Major conventional analytes

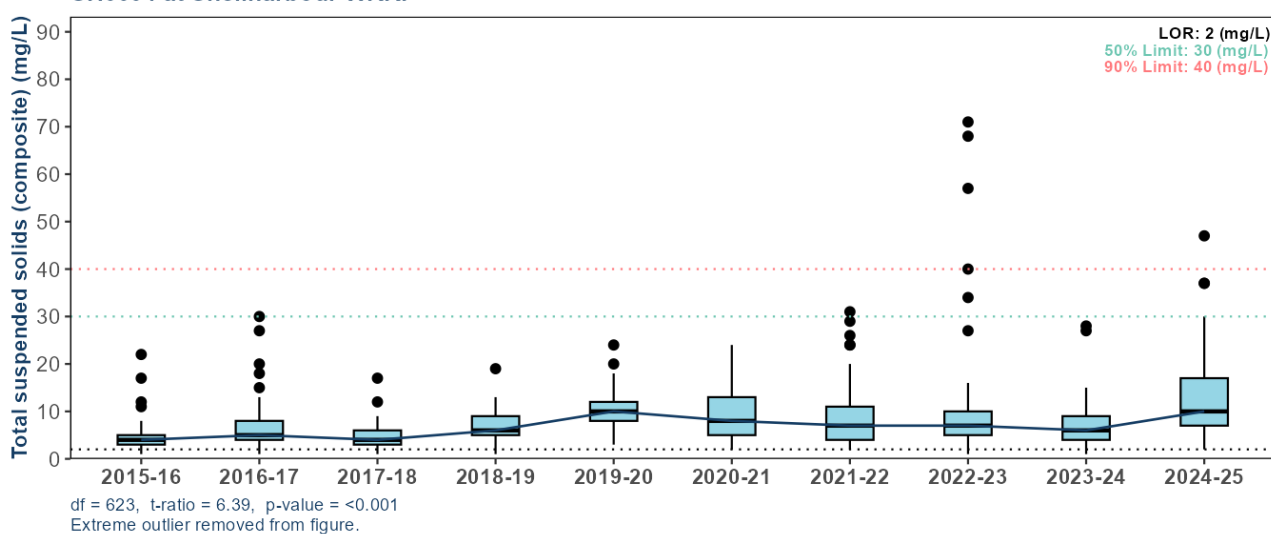
SH0004 at Shellharbour WRRF



SH0004 at Shellharbour WRRF

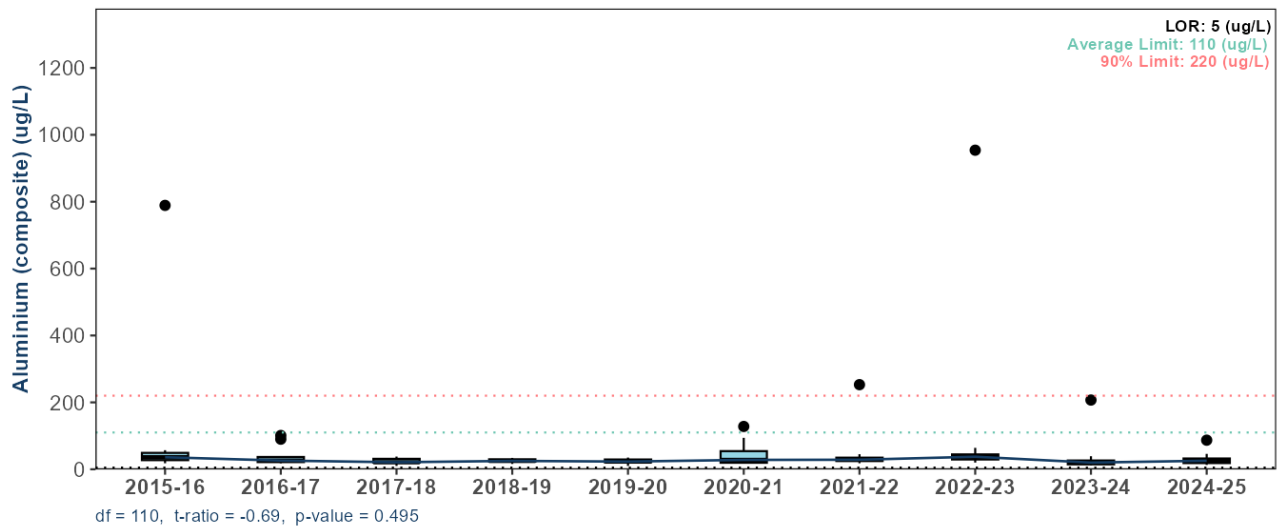


SH0004 at Shellharbour WRRF

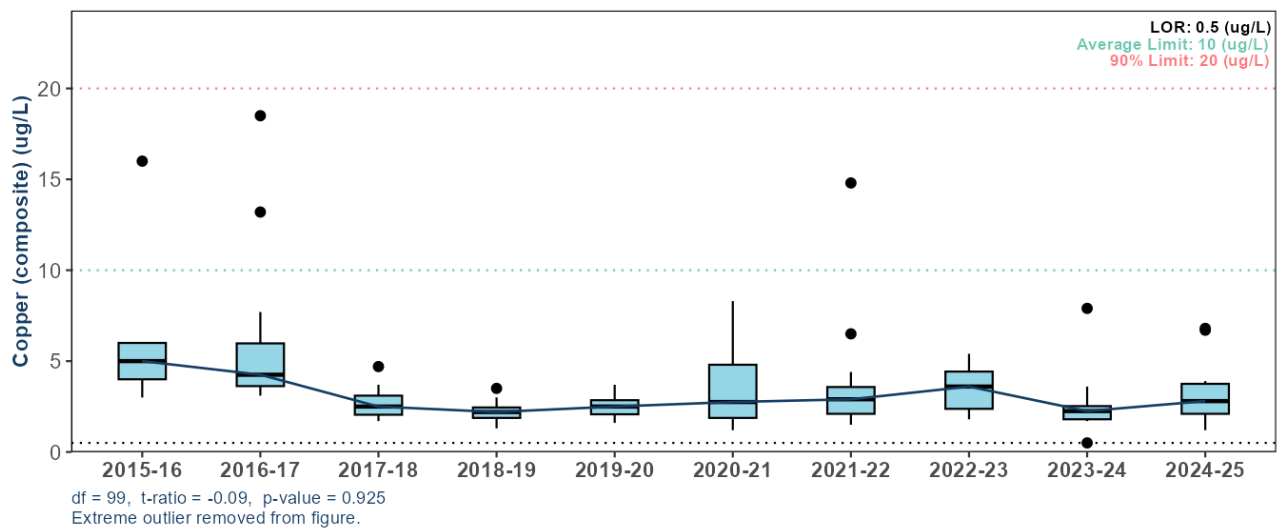


Trace metals

SH0004 at Shellharbour WRRF

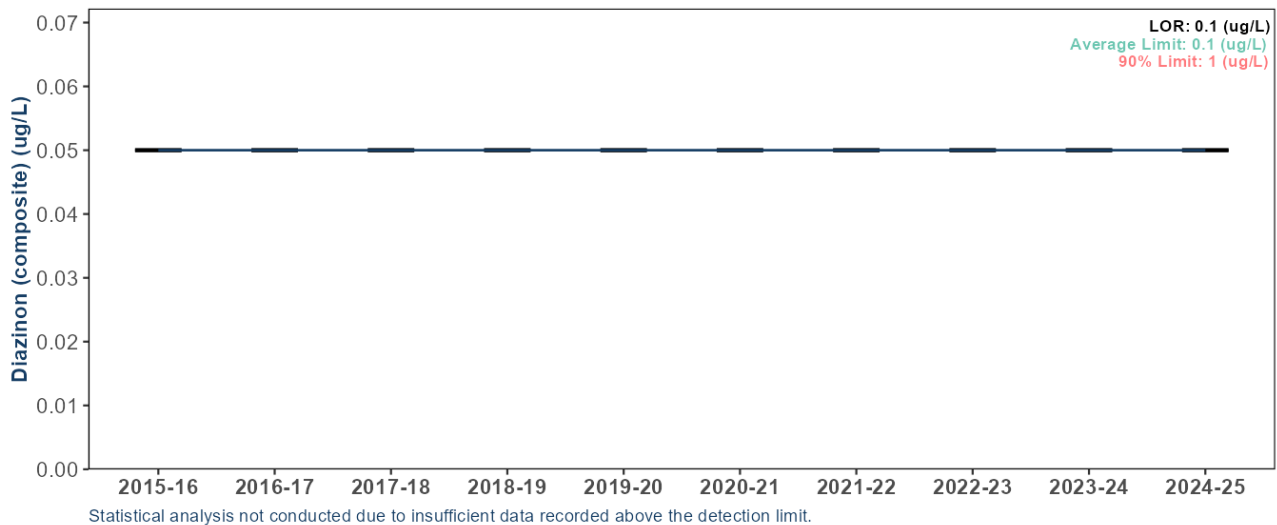


SH0004 at Shellharbour WRRF

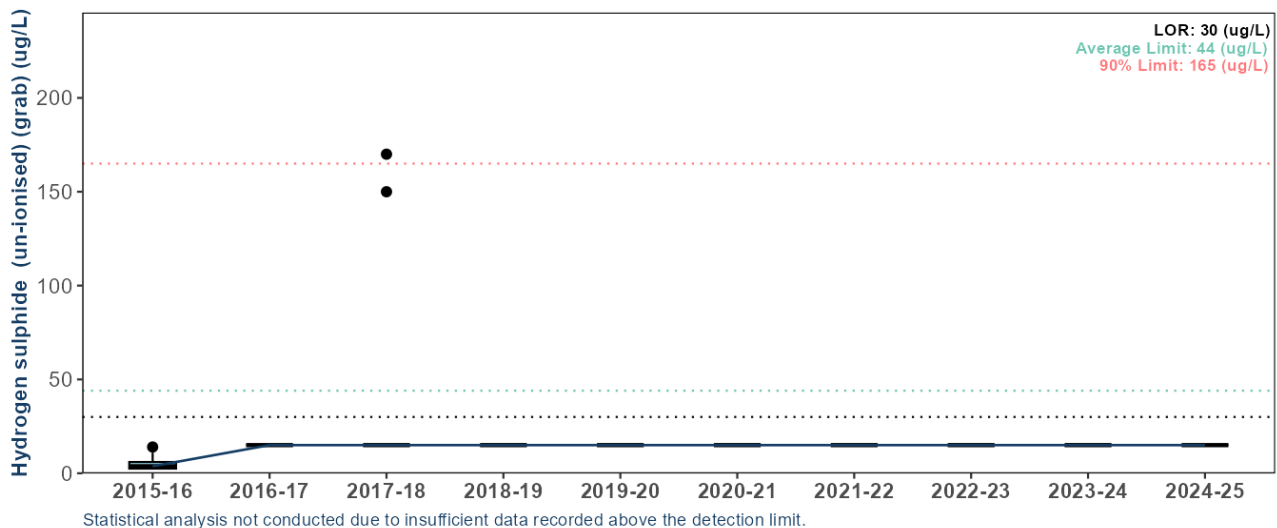


Other chemicals and organics (including pesticides)

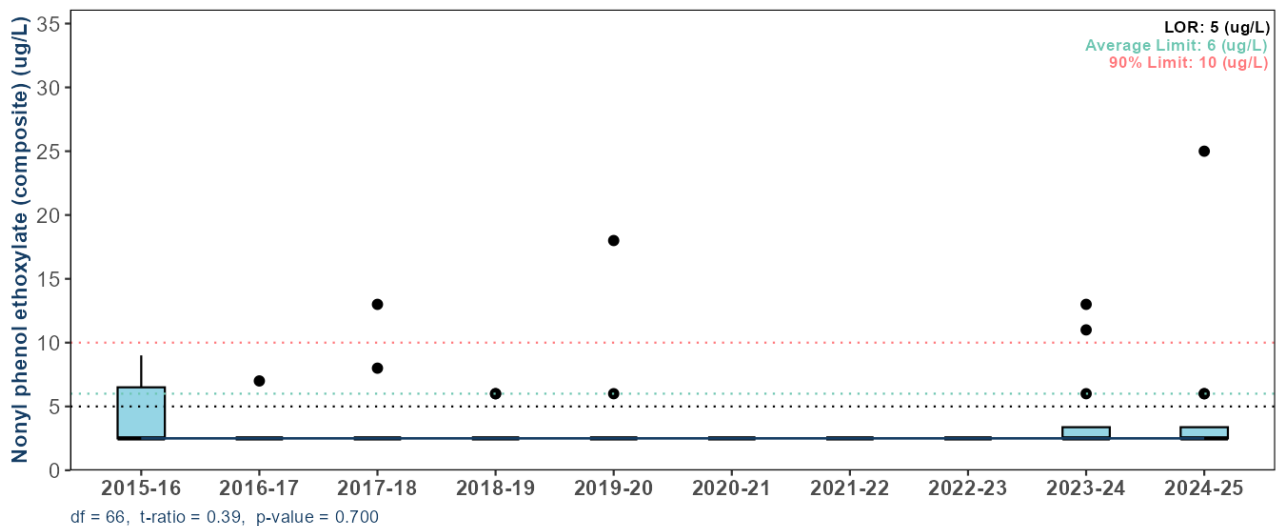
SH0004 at Shellharbour WRRF



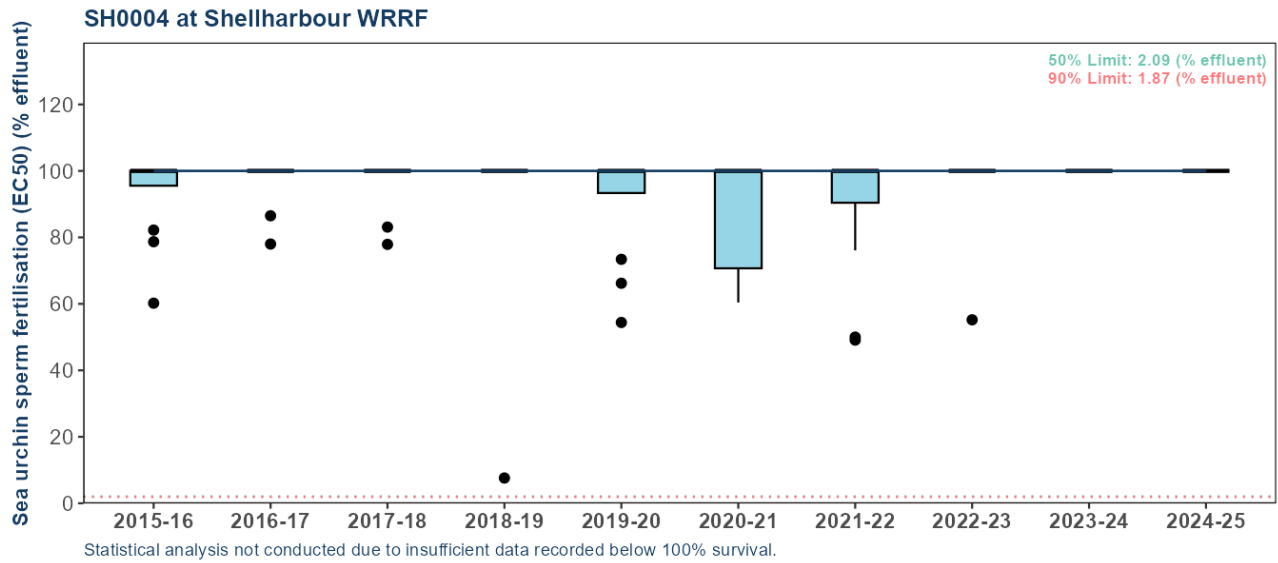
SH0004 at Shellharbour WRRF



SH0004 at Shellharbour WRRF

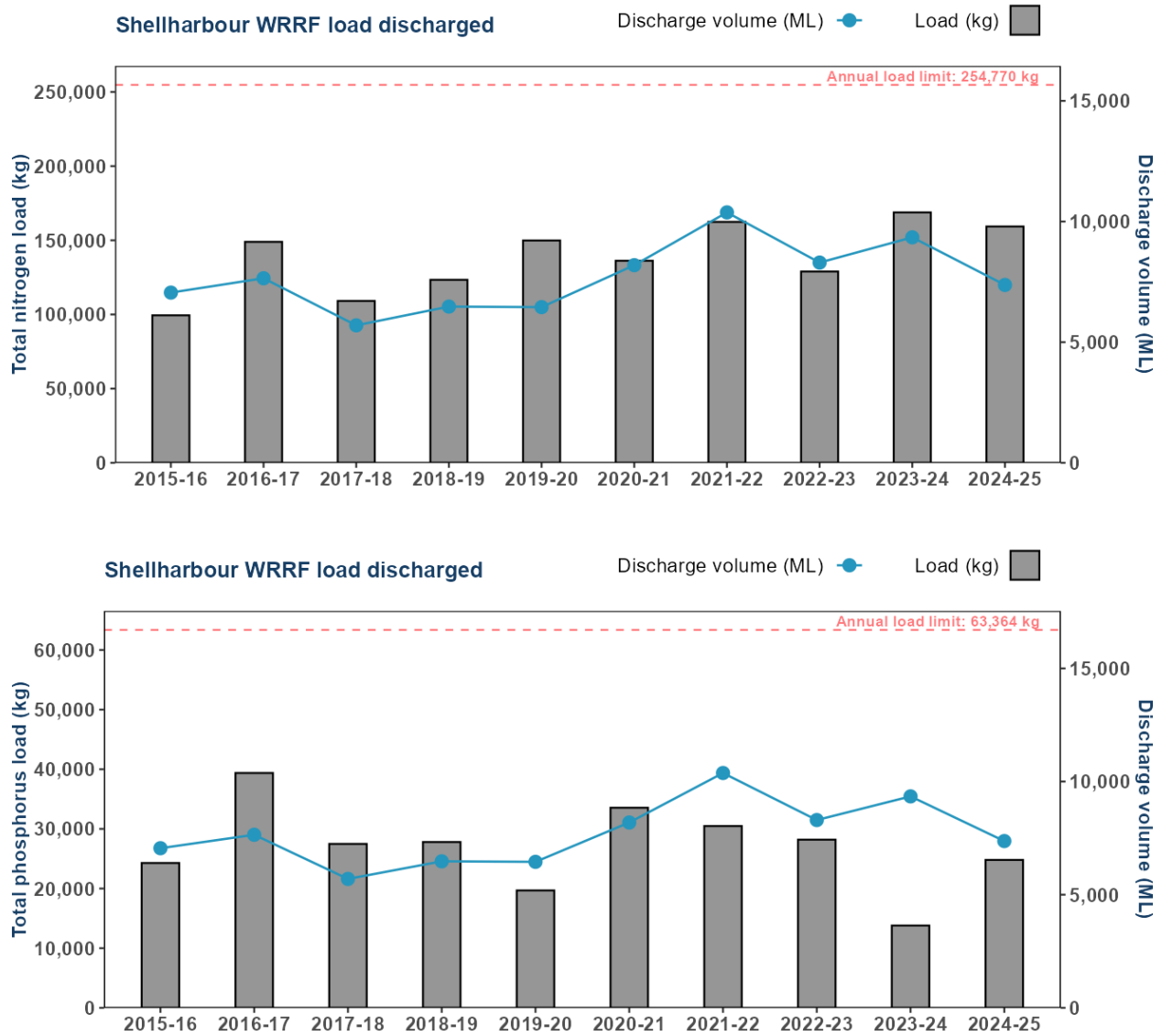


D.5.3. Pressure – Wastewater toxicity

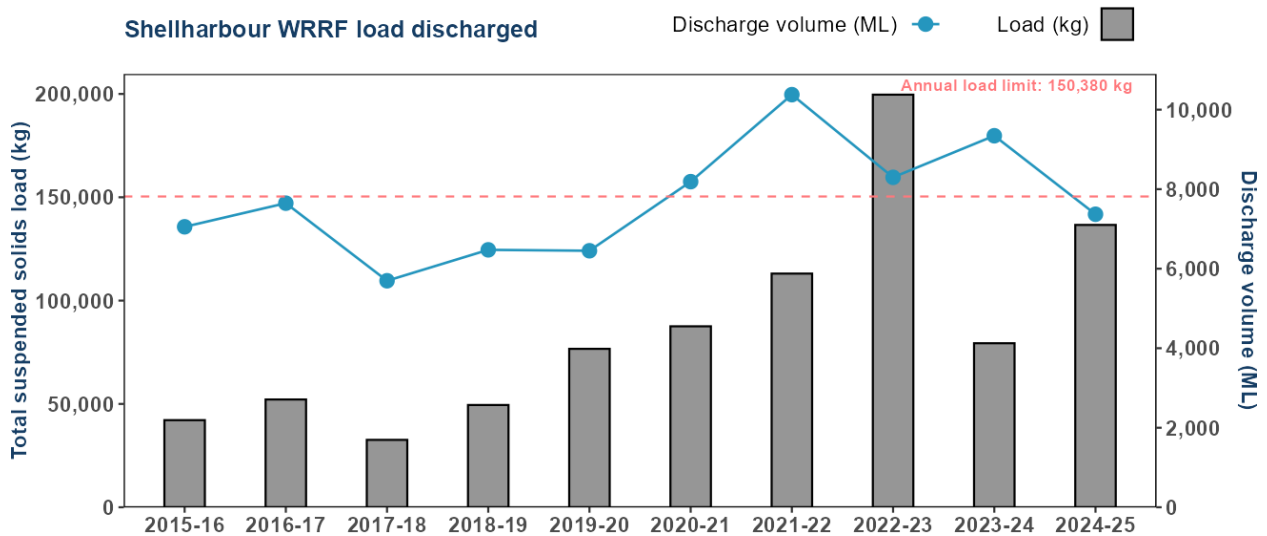
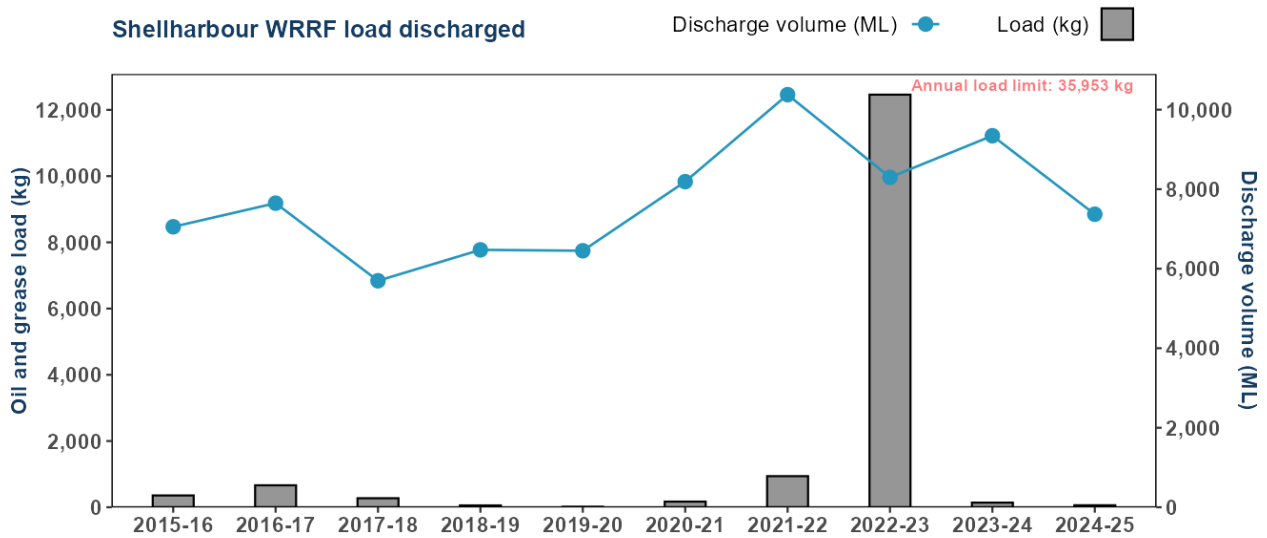
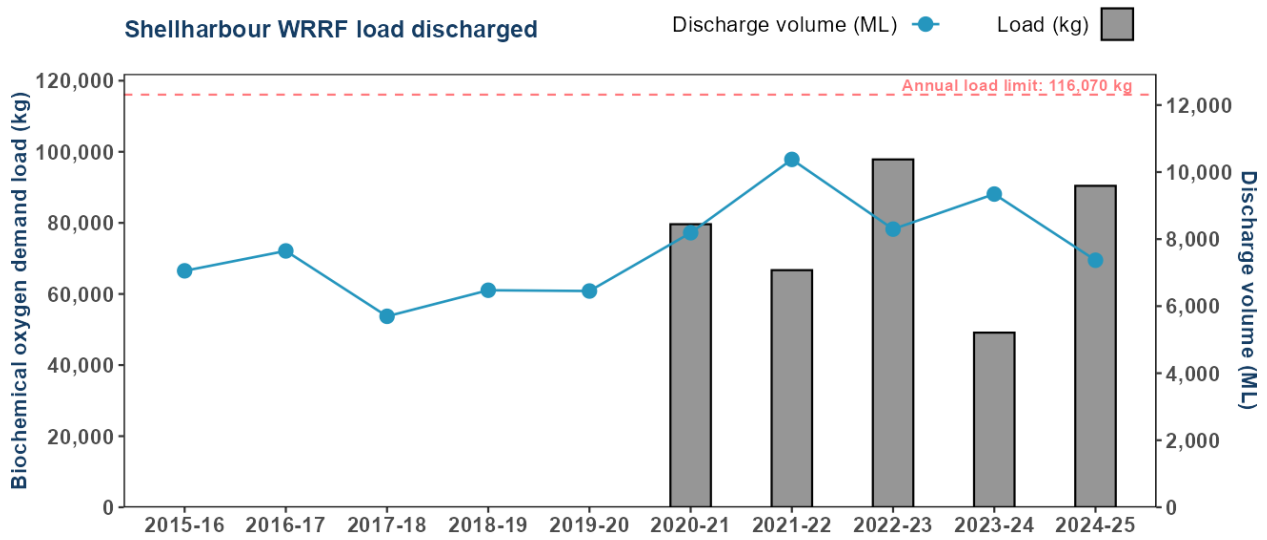


D.5.4. Pressure – Wastewater discharge load

Nutrients



Major conventional analytes



D.5.5. Ecosystem receptor – Macroalgae and invertebrates

Monitoring of the nearshore marine environment is currently limited to three sites for determining the impact of the Shellharbour WRRF outfall. No stressor indicators are monitored, only ecosystem receptor indicators are currently included. A pilot program commenced in 2024-25 to monitor water quality using drones. Long term inclusion in the SWAM program is pending the outcomes of this pilot study.

Monitoring of rocky-intertidal communities under the shoreline outfall program assesses the potential ecological impact from the Shellharbour WRRF which discharges to the nearshore ocean environment. The structures of natural communities (without anthropogenic impacts) from two control sites were used in assessment of the Shellharbour outfall (impact) site. The Shellharbour outfall site is situated about 2 km north of the two control sites. The control sites are situated about 400 m apart.

The taxonomic level recorded was based on morphological characteristics that could be seen with the naked eye and the level recorded is shown in the SIMPER 2024-25 output. Identification of macroinvertebrate taxa and macroalgae was checked against taxonomic works of Edgar (1997) and Dakin (1987).

Shoreline outfall discharges with documented measurable impacts on intertidal community structure are typically limited in spatial extent from 100 to 300 m (Fairweather 1990). These intertidal community structures were dominated by extensive covers of green macroalgae. A pictorial example of a localised spatial impact of about 50 m² (Figure D-2) was formerly seen at Barrack Point outfall in 2001. At that time, an extensive cover of green macroalgae occurred with few invertebrates (EP Consulting 2003). This was prior to upgrade works conducted at the Shellharbour WRRF in the early to mid-2000's.

An asymmetrical permutational multivariate analysis of variance test (PERMANOVA) was conducted with 'Control and Impact' locations treated as a fixed factor. 'Sites' were nested within 'Control and Impact', with 'Sites' treated as a random factor. The outfall site was the only site under the Impact location and the two sites were under the Control locations. A fourth root transformation was applied to the data prior to a Bray-Curtis dissimilarity matrix being constructed. This matrix was the basis for PERMANOVA testing with 9999 permutations run under a reduced model, with conservative Type III sums of squares inspected to base hypothesis decisions upon.

Asymmetrical PERMANOVA indicated there was a significant difference between 'Control and Impact' locations for the 2024-25 survey.

SIMPER analysis for the 2024-25 period shows *Bembicium* to be the dominate taxa at the outfall location, contributing 26.0%. The remaining majority composition of the outfall site is made up of a community structure dominated by invertebrates. Control sites 1 similarly reflected a community structure dominated by brown and green algae, contributing 35.8% and 23.9% respectively. The rest of the community composition was dominated by invertebrates. Control site 2 was also dominated by algae, with brown, green and red algae types contributing the highest contribution percentages, 37.6%, 22.3% and 14.3% respectively, and accounting for 74.2% of the cumulative contribution percentage. The rest of the community composition was dominated by invertebrates. The picture of the outfall site in 2024-25 (Figure D-1) reflects these SIMPER results, which is

different to the green algal dominance and low number of invertebrates recorded in 2001 prior to WRRF upgrade works (Figure D-2).

In summary the multivariate analyses of community structure of 2024-25 morphologically based intertidal rock platform community data suggests differences between the intertidal communities at Barrack Point and nearby reference sites, being driven by a higher representation of algal taxa at nearby reference sites. The ecological make up of Barrack Point is dominated by gastropods with little contribution from green algae, although 2023-24 green algae were the dominant taxa contributing 22.7%. It is important to view this outcome in the context of historical data as differences may occur as natural variation and not necessarily impacts from the Shellharbour WRRF. Context of 2024-25 data to the broader data collected back to 2008 is provided under the 2008 to 2024-25 data analysis below.

Permutational MANOVA
Sums of squares type: Type III (partial)
Fixed effects sum to zero for mixed terms
Permutation method: Permutation of residuals under a reduced model
Number of permutations: 9999

Factors

Name	Type	Levels
Control / Impact	Fixed	2
Site	Random	3

PERMANOVA table of results

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms	P(MC)
Control / Impact	1	22710	22710	18.575	0.3304	3	0.0156
Site(Control / Impact)	1	1222.6	1222.6	1.6136	0.1944	9963	0.1961
Res	39	29550	757.7	-	-	-	-
Total	41	53483	-	-	-	-	-

Estimates of components of variation

Source	Estimate	Sq.root
S(Control / Impact)	1151.1	33.928
V(Site(Control / Impact))	33.208	5.7627
V(Res)	757.7	27.526

Control site-1 – 2024-25 Average sample similarity: 49.04%

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Brown algae (Phaeophyta)	2.14	17.55	1.49	35.78	35.78
Green Algae (Chlorophyta)	1.83	11.73	0.70	23.92	59.70
False limpets & rock limpets (Patellogastropoda)	1.08	11.04	1.42	22.51	82.21
Red Algae (Rhodophyta)	1.18	4.74	0.52	9.67	91.87
Zebra top shell (Trochidae Austrocochlea)	0.50	2.03	0.43	4.14	96.01
Oyster Borer (Muricidae Morula marginalba)	0.37	1.26	0.35	2.57	98.58
Conniwinks (Lottorinidae Bembicium)	0.31	0.56	0.18	1.14	99.72
Barnacles (Cirripedia)	0.14	0.14	0.10	0.28	100.00

Control site-2 – 2024-25 Average sample similarity: 68.94%

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Brown algae (Phaeophyta)	3.21	25.89	4.20	37.56	37.56
Green Algae (Chlorophyta)	2.13	15.38	1.99	22.30	59.86
Red Algae (Rhodophyta)	1.71	9.88	1.18	14.33	74.19
Zebra top shell (Trochidae Austrocochlea)	1.22	8.17	1.49	11.85	86.04
False limpets & rock limpets (Patellogastropoda)	1.04	6.29	1.17	9.12	95.16
Oyster Borer (Muricidae Morula marginalba)	0.51	1.50	0.43	2.17	97.33
Barnacles (Cirripedia)	0.58	1.24	0.33	1.81	99.13
Conniwinks (Lottorinidae Bembicium)	0.31	0.60	0.26	0.87	100.00
Nerite (Nertidae Nerita)	0.00	0.00	SD=0!	0.00	100.00
Periwinkles (Littorinidae Nodilittorina)	0.00	0.00	SD=0!	0.00	100.00
Encrusting tube worm (Serpilidae <i>Galeolaria caespitosa</i>)	0.00	0.00	SD=0!	0.00	100.00

SD=0!: Sim/SD ratio could not be calculated due to low occurrence of taxa within site samples.

Outfall site – 2024-25 Average sample similarity: 63.82%

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Conniwinks (Littorinidae Bembicium)	2.26	16.57	4.21	25.96	25.96
Periwinkles (Littorinidae Nodilittorina)	2.28	15.77	1.81	24.71	50.67
Zebra top shell (Trochidae Austrocochlea)	2.15	13.85	2.20	21.70	72.36
False limpets & rock limpets (Patellogastropoda)	1.23	7.31	1.54	11.45	83.81
Red Algae (Rhodophyta)	1.09	2.80	0.61	4.39	88.20
Oyster Borer (Muricidae Morula marginalba)	0.73	2.50	0.66	3.92	92.12
Barnacles (Cirripedia)	0.71	2.41	0.53	3.77	95.89
Green Algae (Chlorophyta)	0.75	1.60	0.41	2.51	98.41
Brown algae (Phaeophyta)	0.40	0.52	0.26	0.82	99.22
Nerite (Neritidae Nerita)	0.34	0.38	0.18	0.59	99.81
Serpilidae Encrusting tube worm (Serpilidae Galeolaria caespitosa)	0.16	0.12	0.10	0.19	100.00



Figure D-1 Barrack Point with a healthy intertidal rock platform community in 2024-25



Figure D-2 Barrack Point (in 2001) with an unhealthy intertidal rock platform community impacted by wastewater discharges from the Shellharbour WRRF prior to upgrade in the early to mid-2000's

Intertidal communities Shellharbour 2008-09 to 2024-25

Inclusion of yearly replicate samples from 2008-09 to 2024-25 allowed the factor 'Time' to be included in the above asymmetrical permutational analysis of variance test (PERMANOVA). Time was comprised of 2008-09, 2009-10, 2010-11, 2011-12, 2012-13, 2013-14, 2014-15, 2015-16, 2016-17, 2017-18, 2018-19, 2019-20, 2020-21, 2021-22, 2022-23, 2023-24 and 2024-25 surveys, which were conducted at varying times through late winter to late spring.

Asymmetrical PERMANOVA indicated there was no significant difference between 'Control and Impact' locations for the 2008-09 to 2024-25 period. However, differences between sites through time were indicated as significant results were returned for the 'Site (Control / Impact)' and 'Site (Control / Impact) x Time' factors.

The non-metric multidimensional scaling (nMDS) ordination routine of PRIMER was used to produce a 3-dimensional ordination plot. In this plot the relative distance between samples is proportional to the relative similarity in taxonomic composition and abundance – the closer the points on the graph the more similar the community (Clarke 1993). That is, site samples with similar taxa lay closer together and site samples with a differing taxon composition lie farther apart. An unconstrained ordination procedure such as nMDS inevitably introduces distortion when trying to simultaneously represent the similarities between large numbers of samples in a few dimensions. The success of the procedure is measured by a stress value, which indicates the degree of distortion imposed. In the PRIMER software package, a stress value of below 0.2 indicates an acceptable representation of the original data, although lower values are desirable. Where stress values are just above 0.2, the patterns displayed should be confirmed with other techniques such as PERMANOVA. The returned 2-dimensional stress value was 0.23 and an improved lower stress value of 0.15 was observed for the 3-dimensional ordination plot.

To understand the context of 2024-25 site data to that of previous years (2008-09 to 2023-24), site sample data were colour coded as shown in Figure D-3. Data patterns displayed in this 3-dimensional nMDS ordination plot indicated widely dispersed 2008-09 to 2023-24 Control site-1 samples overlapped with 2008-09 to 2023-24 outfall site samples. The 2024-25 outfall samples also overlaid this mass of samples while 2024-25 Control site-1 samples had little overlap with previous outfall samples but good overlap with previous Control site-1 samples and some Control site-2 samples. While the Control site-1 and Control site-2 samples from 2024-25 were positioned on the edge of their agglomeration of their 2008-09 to 2023-24 samples reflecting significant 'Site (Control / Impact) x Time' term of PERMANOVA model outlined above.

Under the nMDS routine, due to rank ordering of dissimilarities some detail can be hidden. This detail may be seen using a Principal Coordinates Analysis (PCO) routine as PCO is based upon original dissimilarities being projected onto axes in the space of the chosen resemblance measure (Anderson et al. 2008). As a check for any additional dimensionality in the multivariate data cloud, a PCO ordination plot was raised based on a fourth root transformation of the data and a Bray-Curtis resemblance measure. No additional dimensionality was indicated as the patterns between nMDS (Figure D-3) and PCO ordination (Figure D-4) plots were very similar.

A Canonical Analysis of Principal Coordinates (CAP) ordination plot was also produced. The CAP routine is designed to ask, 'Are there axes in the multivariate space that separate groups?' CAP is designed to purposely seek out and find groups even if differences occur in obscure directions and



may not have been apparent from nMDS or PCO plots that provide views of the multivariate data cloud as a whole (Anderson et al. 2008). A similar pattern to that in the nMDS (Figure D-3) and PCO (Figure D-4) ordination plots was displayed. This also suggested no hidden dimensionality, with good agreement between the nMDS, PCO and CAP ordination plots.

An additional run of the CAP routine was undertaken with placement of 2024-25 outfall samples onto the canonical axes of the existing CAP model from the initial run. Output from the second run indicated 2024-25 outfall samples were most similar to either the Outfall 2008-09 to 2023-24 samples or Control site 1 2008-09 to 2024-25 samples (Figure D-5). This result also reflected patterns displayed in the nMDS and PCO ordination plots (Figure D-3 and Figure D-4).

The trend of taxonomic differences between sites situated close together on shorelines is known to occur and accounts for the differences between Control site-1 that is only 400 m from Control site-2 on the shoreline. It is mentioned by Underwood and Chapman (1995) who cite Underwood (1981) who states, 'on exposed shores in New South Wales there are great differences in patterns of occupancy of space from one place to another not many metres away, even though these are not a function of gradients in wave action.'

In summary, a relatively stable equilibrium in rocky-intertidal community structure was indicated from these assessments of the 2008-09 to 2024-25 monitoring data at the three Shellharbour WRRF sites studied. These results also suggest over the 2008-09 to 2024-25 period, no measurable impact had developed in the intertidal rock platform community near the outfall at Barrack Point from wastewater discharges from the Shellharbour WRRF as the community assemblage of the outfall site was very similar to Control site-1 for the 2008-09 to 2024-25 period. Results from Control site-2 represent natural variation in rocky-intertidal community structure that has been demonstrated to occur for closely spaced shoreline sites.

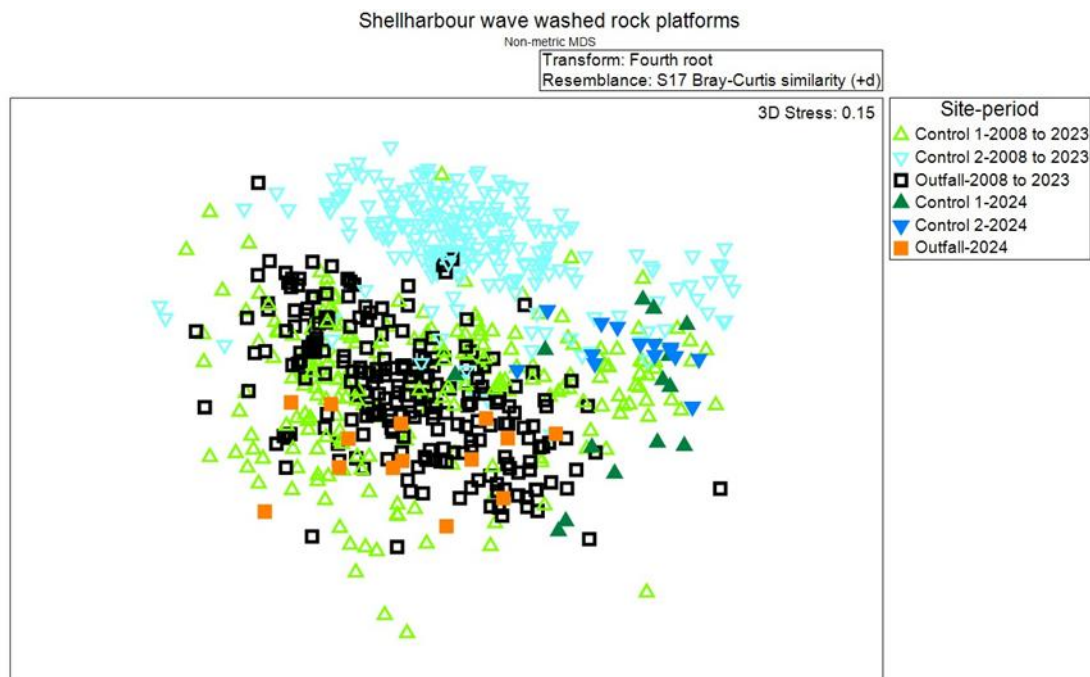


Figure D-3 Dimensions 1 and 2 of 3-dimensional nMDS ordination plot of 2008-09 to 2024-25 intertidal rock platform community

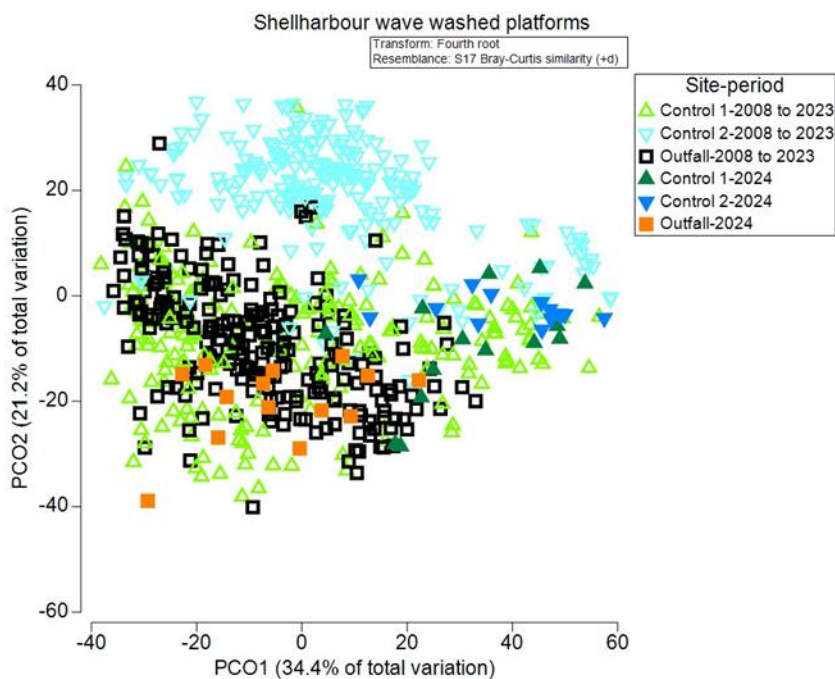


Figure D-4: PCO ordination plot of 2008-09 to 2024-25 intertidal rock platform community data - dimensional

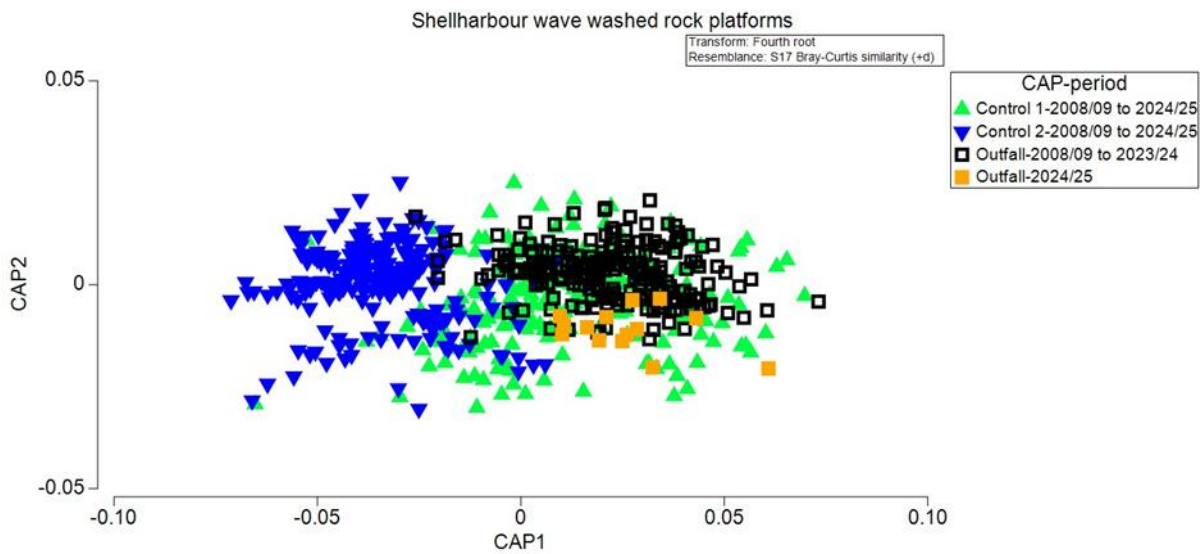


Figure D-5: CAP ordination plot of intertidal rock platform community data (2008-09 to 2024-25 for Control site-1 and Control site-2 and 2008-09 to 2023-24 outfall site) with 2024-25 outfall samples (orange squares) predicted

Sums of squares type: Type III (partial)
Fixed effects sum to zero for mixed terms
Permutation method: Permutation of residuals under a reduced model
Number of permutations: 9999

Factors

Name	Type	Levels
Control / Impact	Fixed	2
Time	Fixed	17
Site	Random	3

PERMANOVA table of results

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms	P(MC)
Control/Impact	1	86987	86987	0.87906	0.6697	3	0.5384
Time	16	1.3498E+05	8436.1	1.5391	0.0404	9893	0.0524
Site(Control/Impact)	1	97718	97718	138.63	0.0001	9954	0.0001
Control/ImpactxTime	16	87155	5447.2	0.99432	0.5086	9898	0.5048
TimexSite(Control/Impact)	16	86774	5423.4	7.6941	0.0001	9849	0.0001
Res	661	4.6593E+05	704.88				

Source	df	SS	MS	Pseudo-F	P(perm)	Unique perms	P(MC)
Total	711	9.8322E+05					

Estimates of components of variation

Source	Estimate	Sq.root
S(Control / Impact)	-37.681	-6.1385
S(Time)	79.096	8.8936
V(Site(Control / Impact))	412.41	20.308
S(Control / ImpactxTime)	-1.6655	-1.2906
V(TimexSite(Control / Impact))	340.41	18.45
V(Res)	704.88	26.55

Factor for groups: CAP-period
Factor level for new samples group: Outfall-2024/25
Number of samples: 698
Choice of m: 3

CANONICAL ANALYSIS

Correlations

Eigenvalue	Correlation	Corr.Sq.
1	0.8063	0.6502
2	0.2477	0.0614

DIAGNOSTICS

m	prop.G	ssres	d_1^2	d_2^2	%correct
3	0.7125	1.3008	0.6502	0.0614	67.335

Cross Validation

Leave-one-out Allocation of Observations to Groups (for the choice of m:3)

	Classified				
Orig. group	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25	Outfall-2008/09 to 2023/24	Total	%correct
Control 1-2008/09 to 2024/25	106	30	102	238	44.538
Control 2-2008/09 to 2024/25	18	216	0	234	92.308

	Classified				
Orig. group	Control 1- 2008/09 to 2024/25	Control 2- 2008/09 to 2024/25	Outfall- 2008/09 to 2023/24	Total	%correct
Outfall-2008/09 to 2023/24	72	6	148	226	65.487
Total Correct: 470/698 (67.335%)					
Misclassification error: 32.665%					

Individual samples that were mis-classified

Sample	Orig.group	Class.group
Control 1-2018-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2018-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2018-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2018-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2018-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2018-11	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2018-12	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2018-13	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2018-14	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2008-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2008-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24




Sample	Orig.group	Class.group
Control 1-2009-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-13	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2009-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-5	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2010-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-9	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2010-11	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2010-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2011-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2011-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2011-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2011-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-11	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2012-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2013-5	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2013-7	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2013-9	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2013-10	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2013-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2013-13	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24






Sample	Orig.group	Class.group
Control 1-2014-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-11	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-13	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2014-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2015-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2015-5	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2015-8	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2015-10	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2015-11	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2015-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2015-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2016-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2016-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2016-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2016-12	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2017-1	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2017-5	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2017-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2017-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2017-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2017-11	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2017-12	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2017-14	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2019-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-6	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2019-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2019-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24






Sample	Orig.group	Class.group
Control 1-2019-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
control 1-2020-2	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
control 1-2020-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
control 1-2020-5	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
control 1-2020-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
control 1-2020-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
control 1-2020-13	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2021-1	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-2	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-4	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-7	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-11	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-12	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-13	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2021-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2022-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2022-9	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2022-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2022-12	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2023/24-2	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2023/24-3	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2023/24-6	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2023/24-8	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2023/24-10	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2023/24-13	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2024/25-1	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2024/25-3	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2024/25-5	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 1-2024/25-7	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2024/25-9	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24



Sample	Orig.group	Class.group
Control 1-2024/25-13	Control 1-2008/09 to 2024/25	Control 2-2008/09 to 2024/25
Control 1-2024/25-14	Control 1-2008/09 to 2024/25	Outfall-2008/09 to 2023/24
Control 2-2008-2	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2008-6	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2008-10	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2008-13	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2008-14	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-1	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-2	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-3	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-4	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-7	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-8	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2019-9	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2023/24-11	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2023/24-14	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2024/25-3	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2024/25-4	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2024/25-10	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Control 2-2024/25-14	Control 2-2008/09 to 2024/25	Control 1-2008/09 to 2024/25
Outfall-2018-1	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-2	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-3	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-6	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-7	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-13	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2018-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2010-7	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-1	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25
Outfall-2011-2	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25
Outfall-2011-3	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25




Sample	Orig.group	Class.group
Outfall-2011-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-7	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25
Outfall-2011-8	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-10	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-13	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2011-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2012-2	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2012-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2012-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2013-3	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25
Outfall-2013-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-1	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-8	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-10	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2014-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2015-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2015-6	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2015-8	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2015-13	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2015-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-1	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-3	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-6	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-13	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2016-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-2	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25



Sample	Orig.group	Class.group
Outfall-2017-3	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-6	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-8	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-10	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2017-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2019-1	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2019-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2019-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2019-6	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2019-7	Outfall-2008/09 to 2023/24	Control 2-2008/09 to 2024/25
Outfall-2019-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-5	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-7	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-10	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-12	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2020-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2021-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2021-11	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2021-13	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2021-14	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2022-8	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2022-9	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25
Outfall-2023/24-4	Outfall-2008/09 to 2023/24	Control 1-2008/09 to 2024/25

PERMUTATION TEST

trace statistic = (tr(Q_m'HQ_m))
first squared canonical correlation = (delta_1^2)
tr(Q_m'HQ_m): 0.71156 P: 0.0001
delta_1^2: 0.65019 P: 0.0001
No. of permutations used: 9999

NEW SAMPLE

Canonical coordinate scores for New Samples

Sample	CAP1	CAP2
Outfall-2024/25-1	0.0342	-0.0035
Outfall-2024/25-2	0.021	-0.008
Outfall-2024/25-3	0.0274	-0.0038
Outfall-2024/25-4	0.0431	-0.0082
Outfall-2024/25-5	0.0261	-0.0123
Outfall-2024/25-6	0.0609	-0.0205
Outfall-2024/25-7	0.0285	-0.0109
Outfall-2024/25-8	0.0324	-0.0203
Outfall-2024/25-9	0.0106	-0.0098
Outfall-2024/25-10	0.0096	-0.0077
Outfall-2024/25-11	0.0163	-0.0105
Outfall-2024/25-12	0.0101	-0.0122
Outfall-2024/25-13	0.0249	-0.0138
Outfall-2024/25-14	0.0192	-0.0136

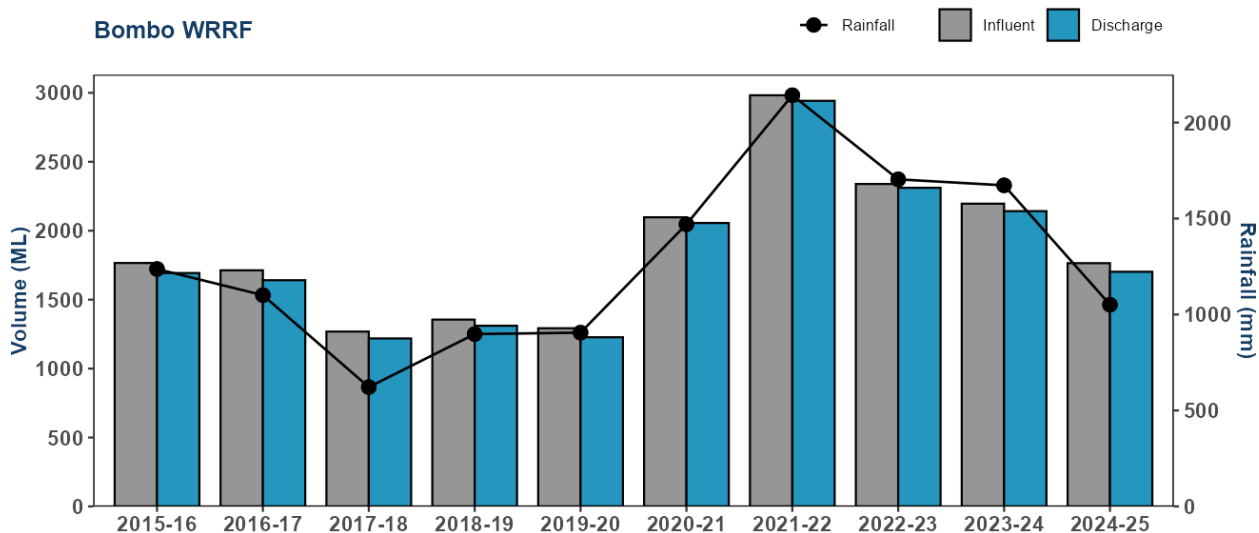
New sample classification

Sample	Group
Outfall-2024/25-1	Outfall-2008/09 to 2023/24
Outfall-2024/25-2	Control 1-2008/09 to 2024/25
Outfall-2024/25-3	Outfall-2008/09 to 2023/24
Outfall-2024/25-4	Outfall-2008/09 to 2023/24
Outfall-2024/25-5	Outfall-2008/09 to 2023/24
Outfall-2024/25-6	Outfall-2008/09 to 2023/24
Outfall-2024/25-7	Outfall-2008/09 to 2023/24
Outfall-2024/25-8	Outfall-2008/09 to 2023/24
Outfall-2024/25-9	Control 1-2008/09 to 2024/25
Outfall-2024/25-10	Control 1-2008/09 to 2024/25
Outfall-2024/25-11	Control 1-2008/09 to 2024/25
Outfall-2024/25-12	Control 1-2008/09 to 2024/25
Outfall-2024/25-13	Control 1-2008/09 to 2024/25
Outfall-2024/25-14	Control 1-2008/09 to 2024/25

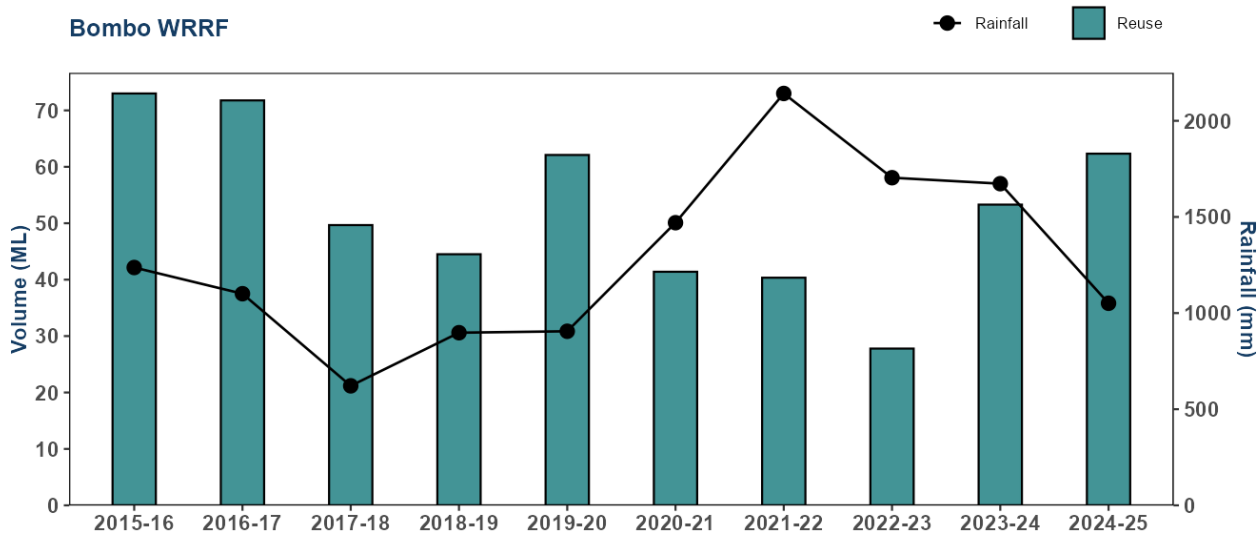
D.6. Bombo WRRF

D.6.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

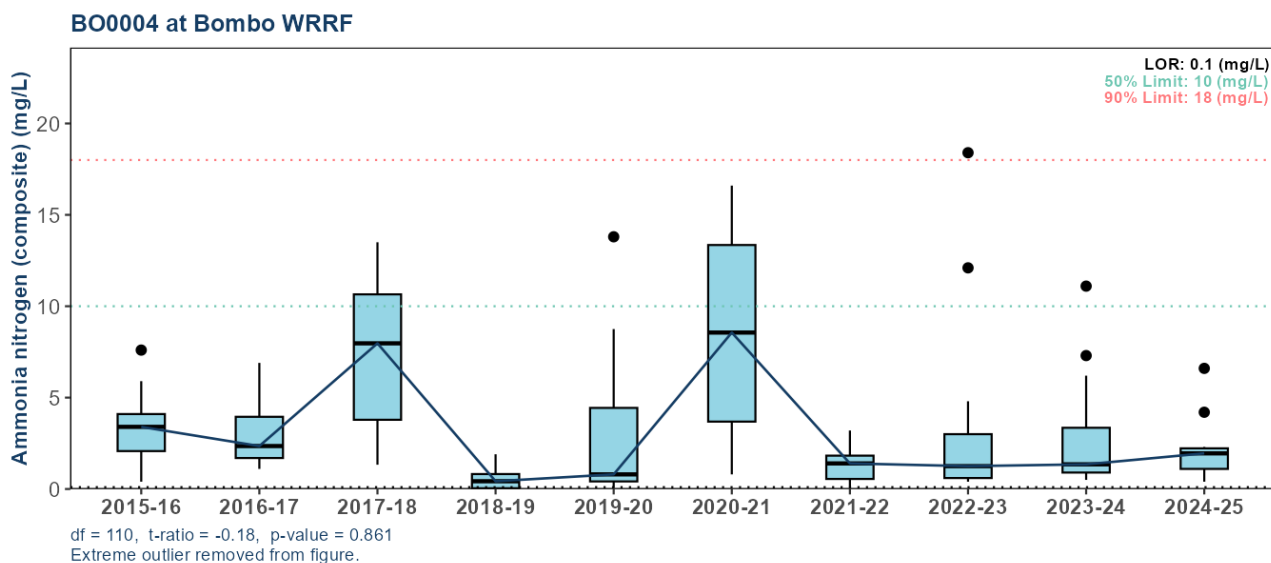


Reuse volume and rainfall

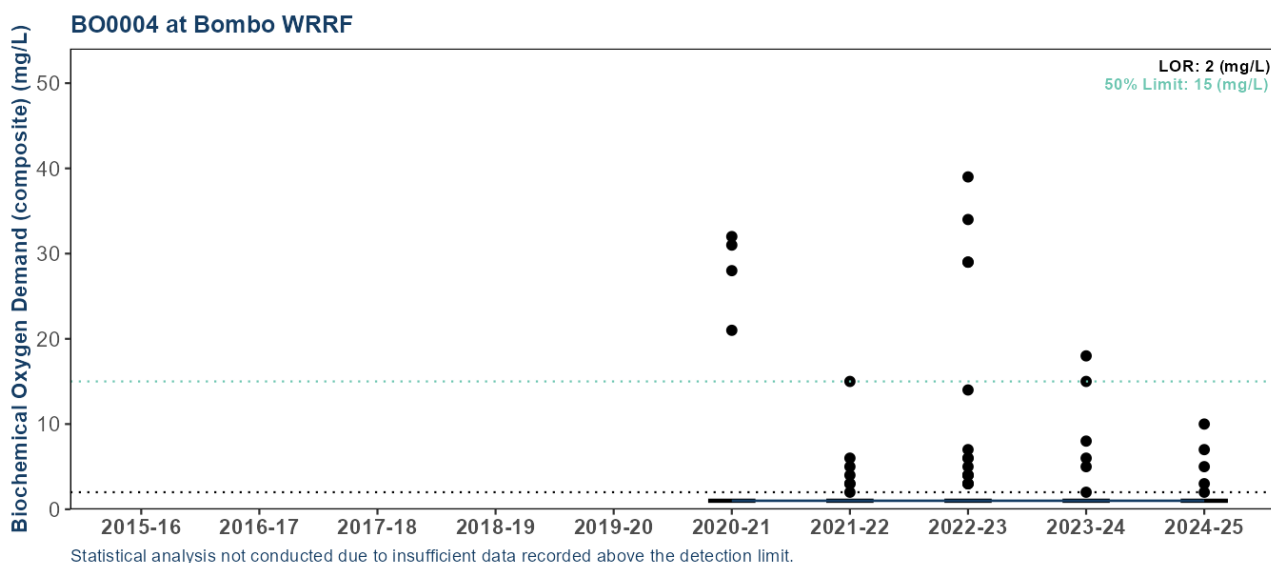


D.6.2. Pressure – Wastewater quality

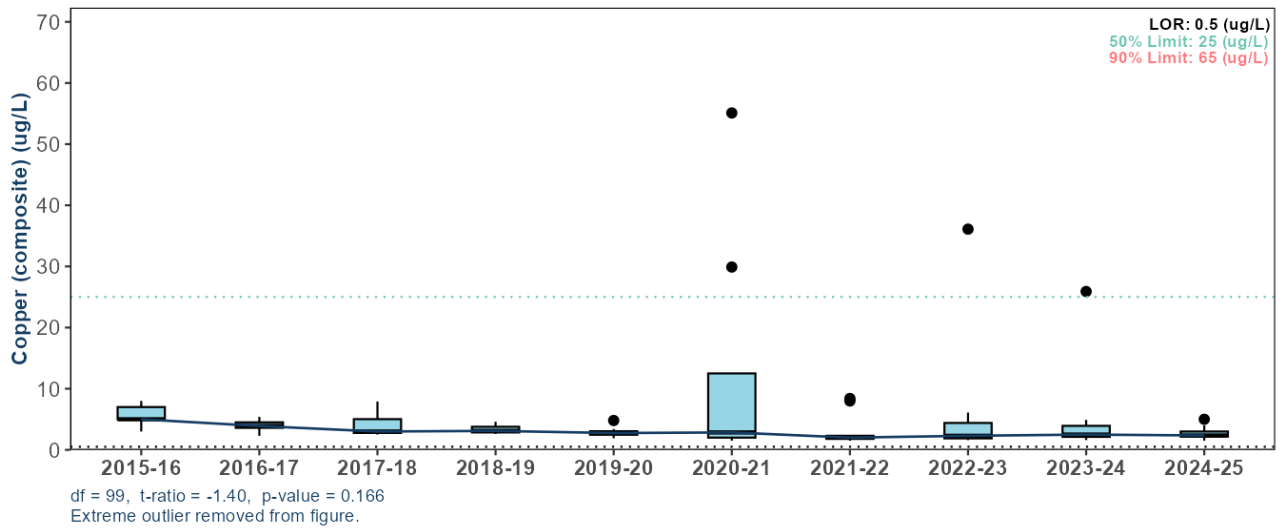
Nutrients



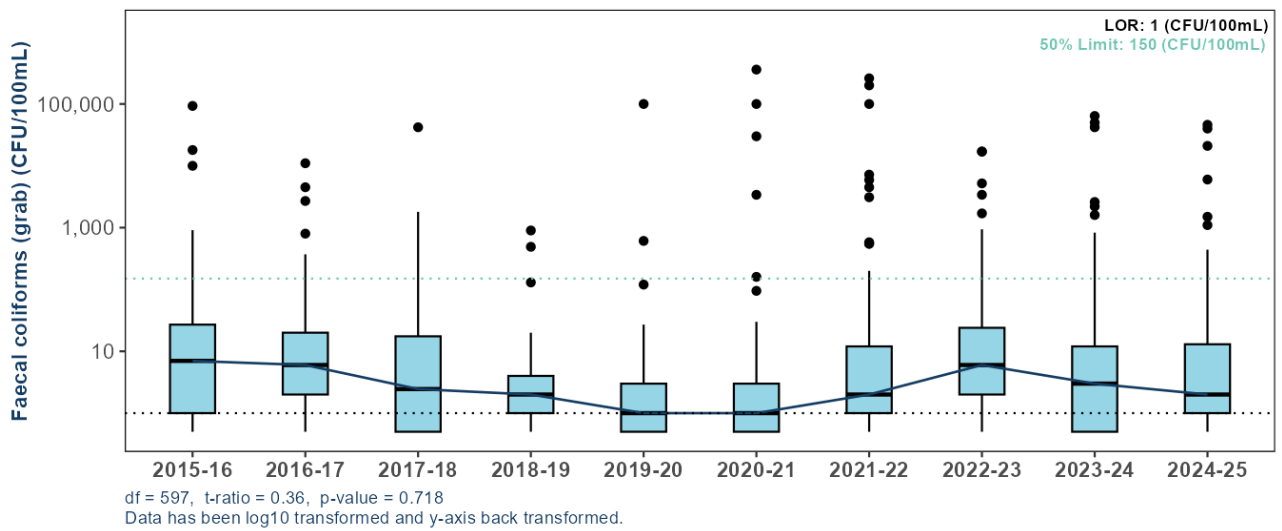
Major conventional analytes



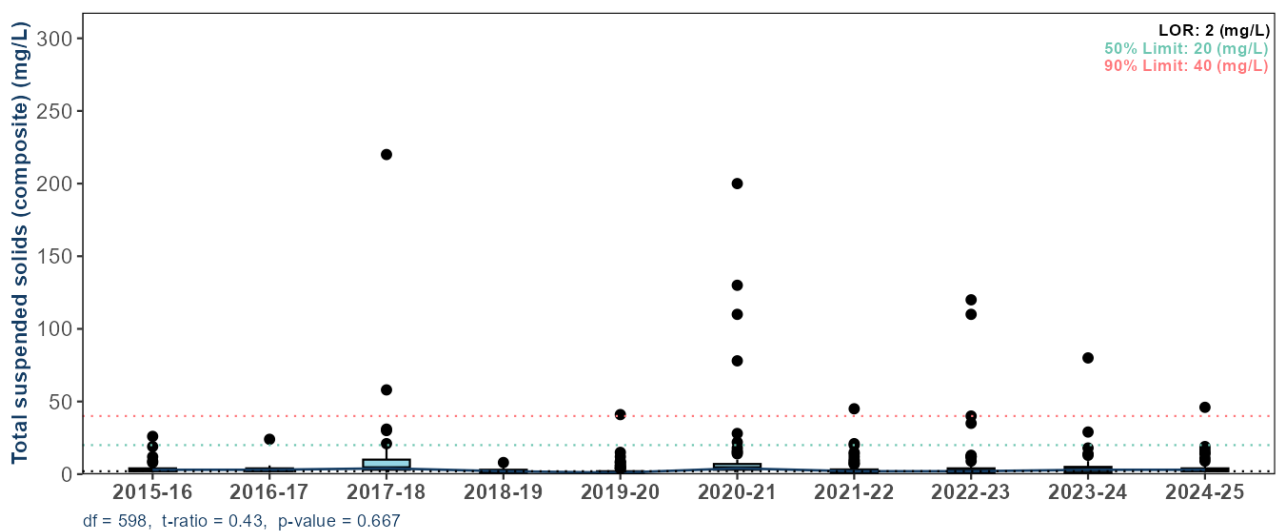
BO0004 at Bombo WRRF



BO0013 at Bombo WRRF

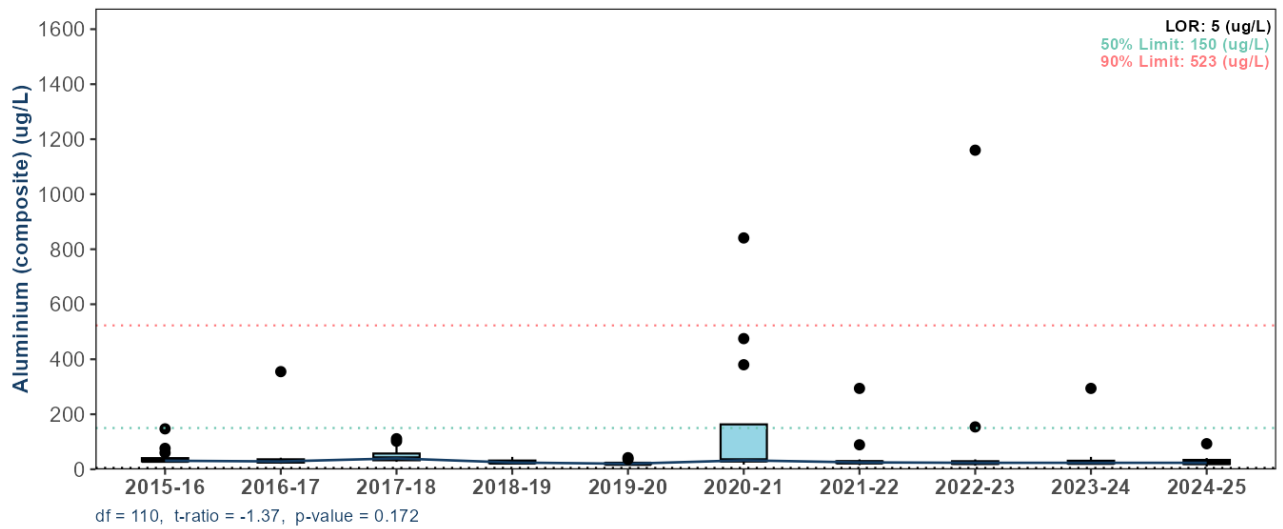


BO0004 at Bombo WRRF

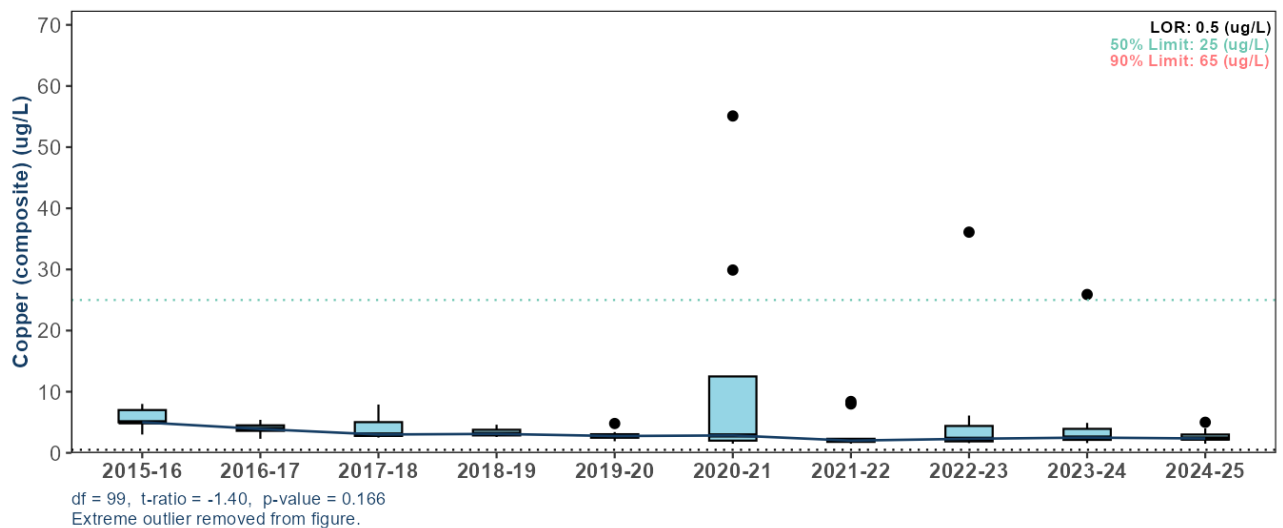


Trace metals

BO0004 at Bombo WRRF

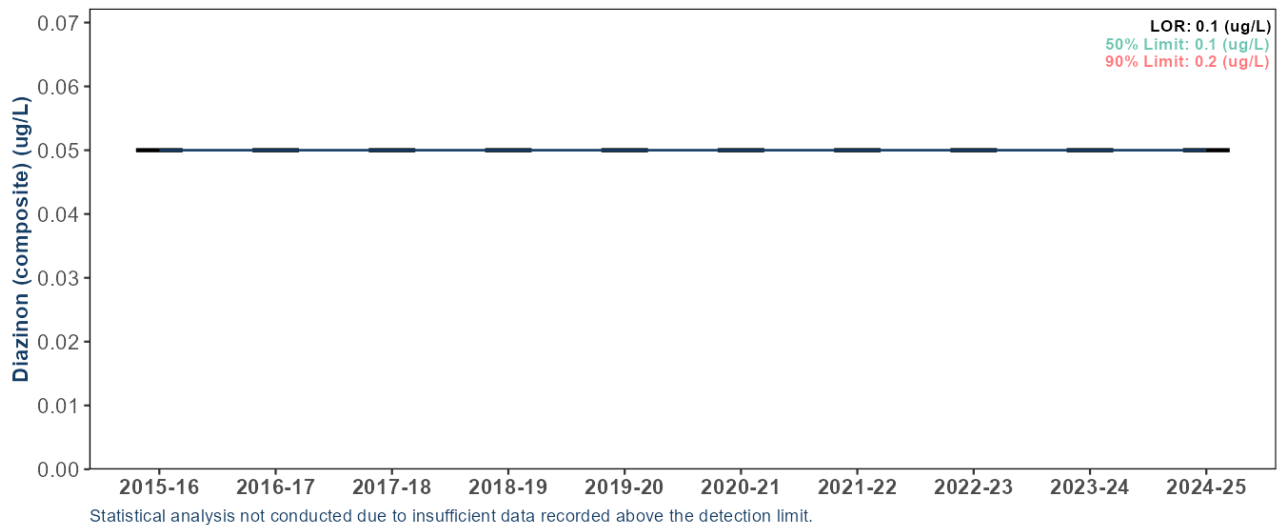


BO0004 at Bombo WRRF

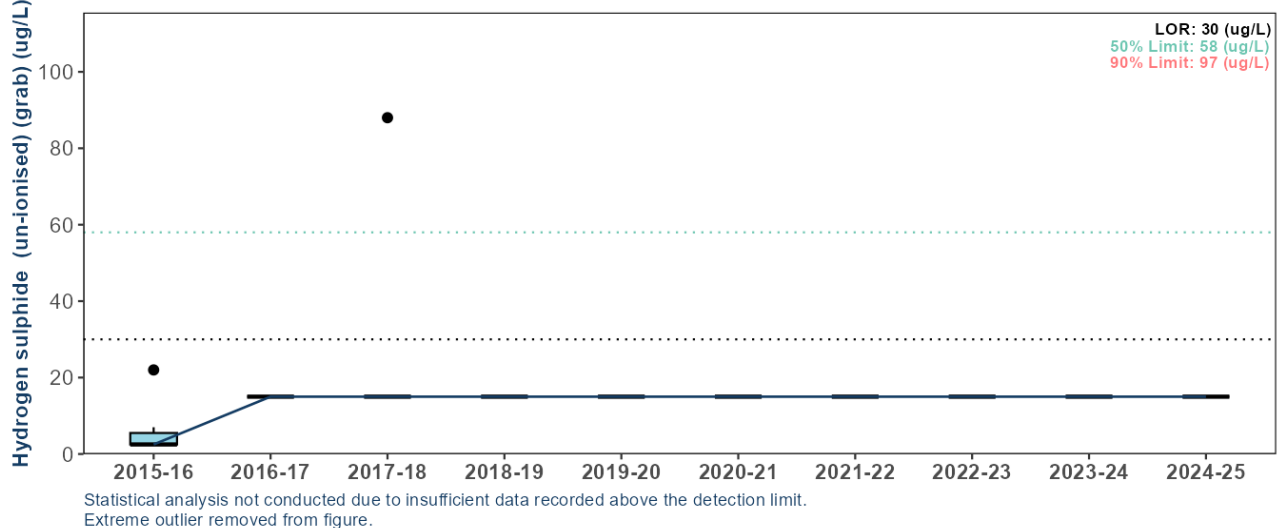


Other chemicals and organics (including pesticides)

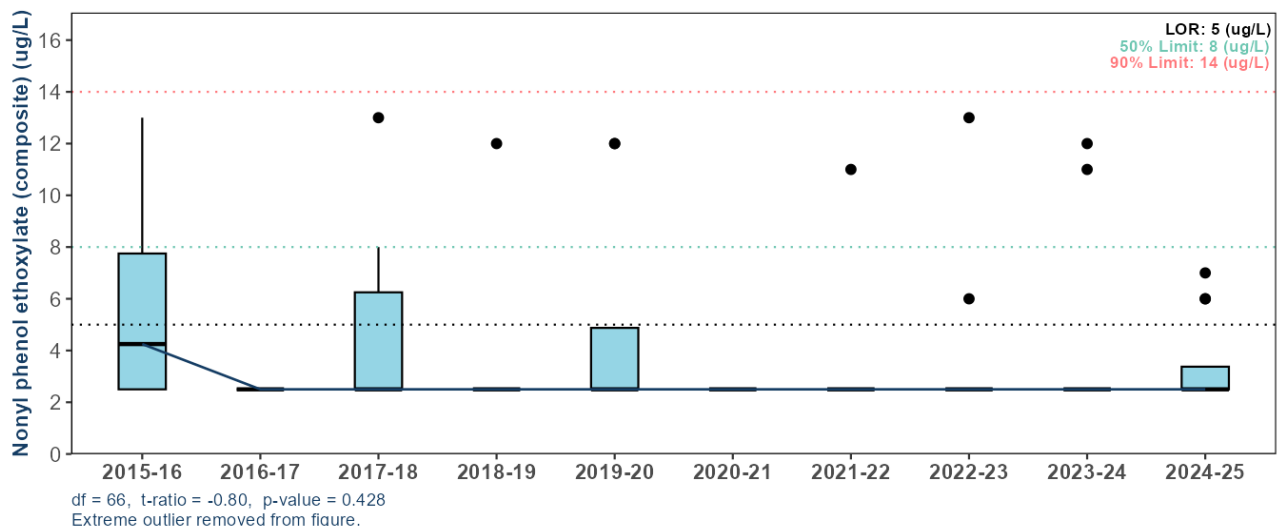
BO0004 at Bombo WRRF



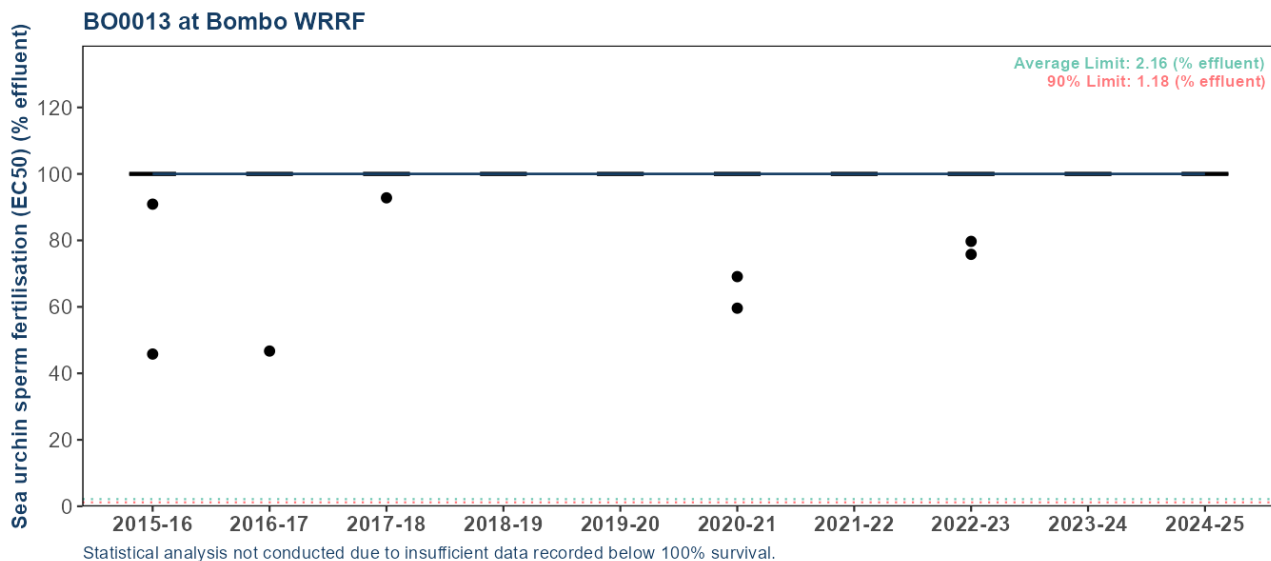
BO0013 at Bombo WRRF



BO0004 at Bombo WRRF

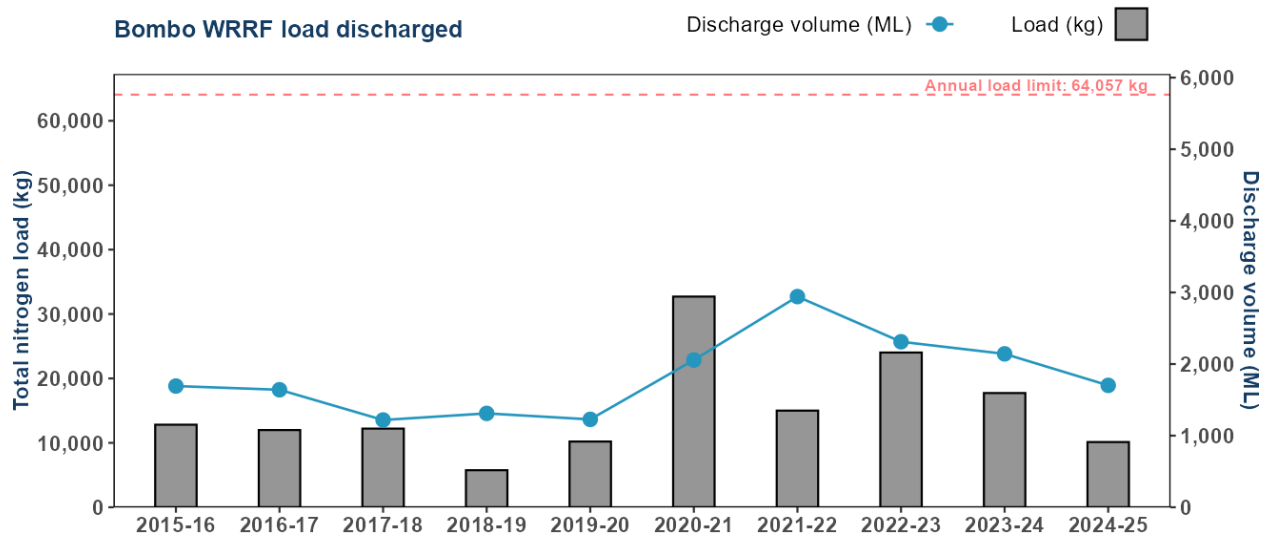


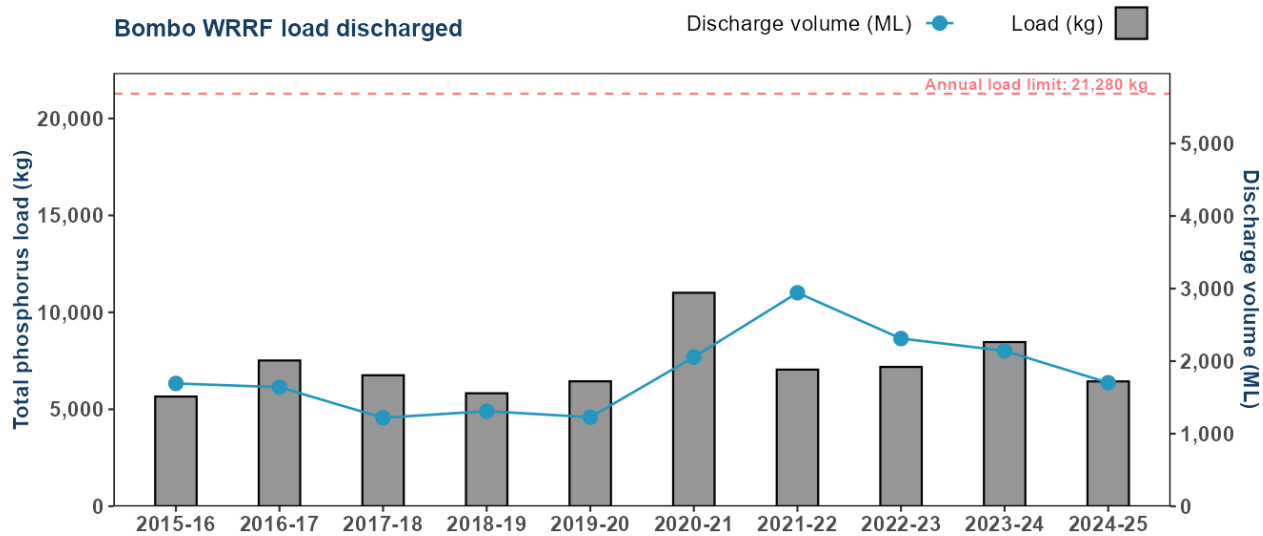
D.6.3. Pressure – Wastewater toxicity



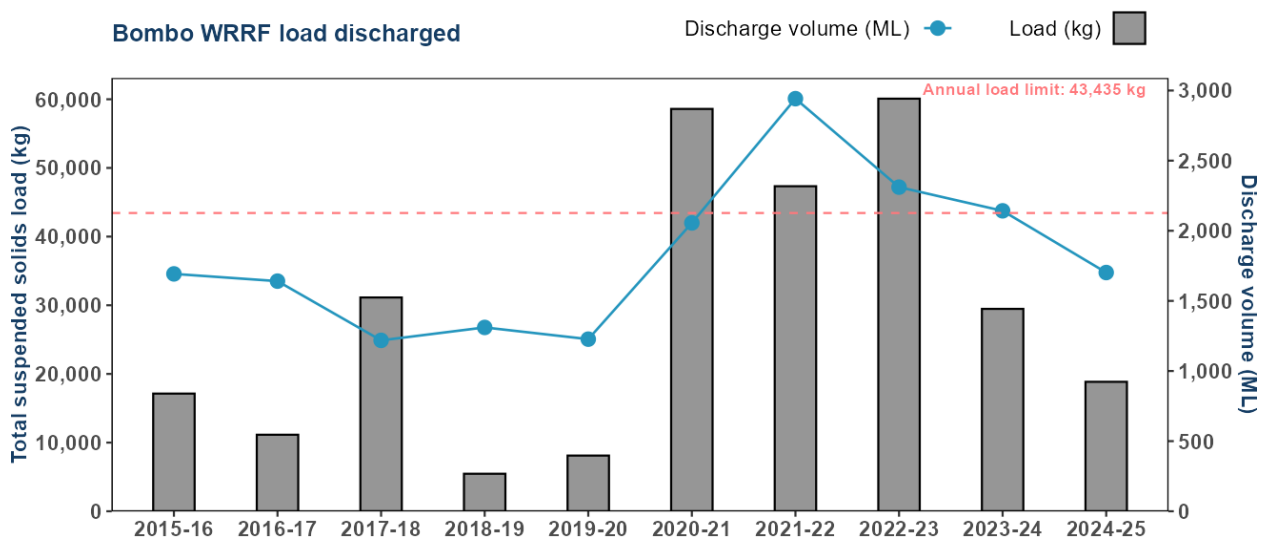
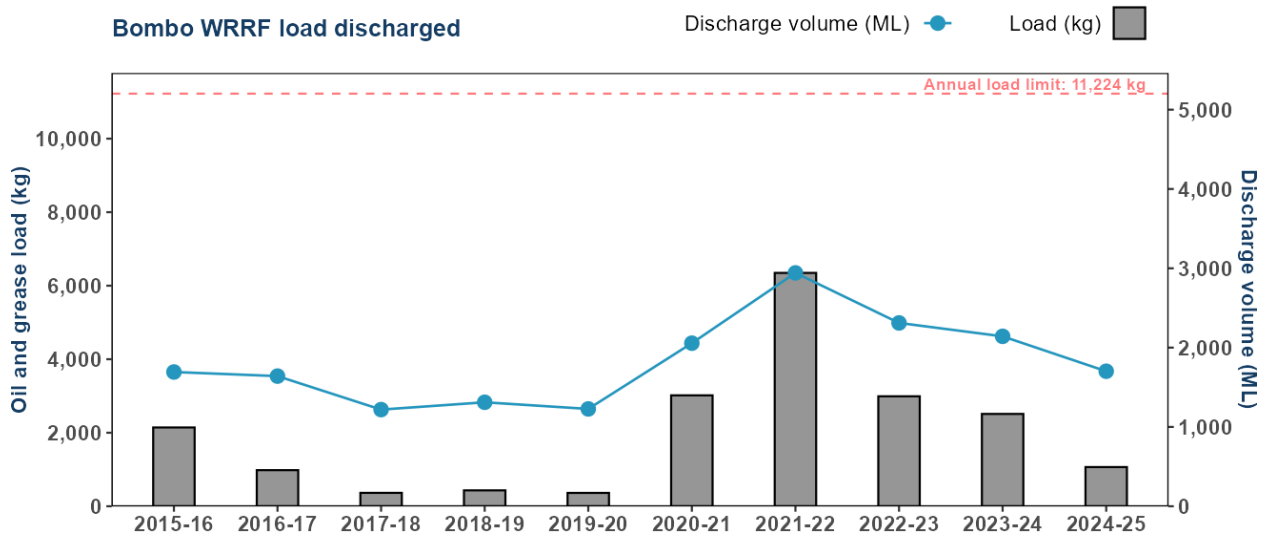
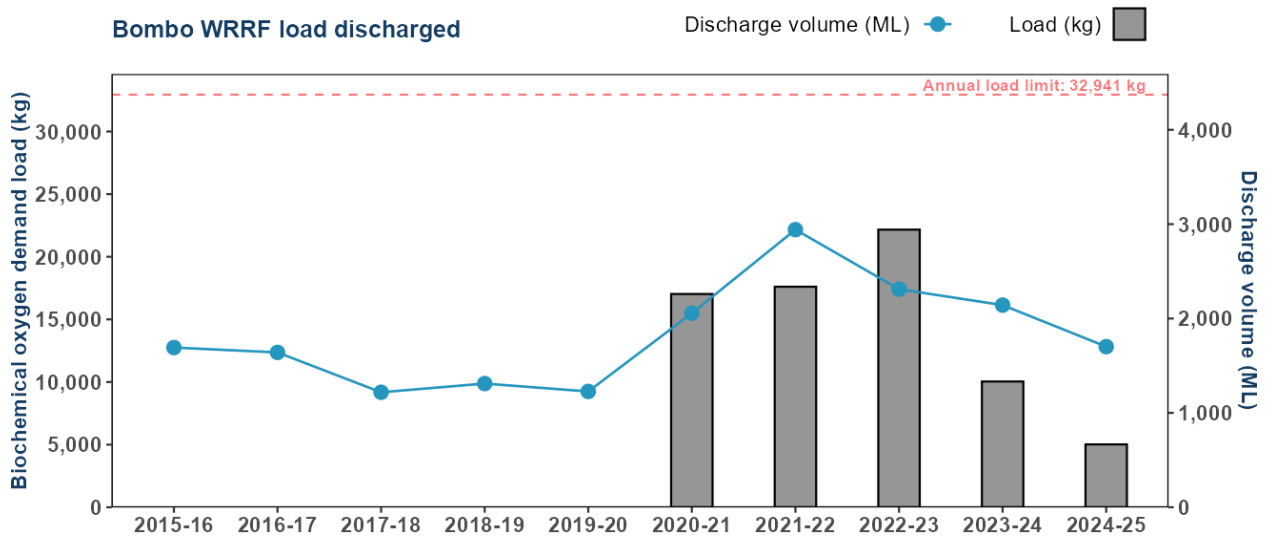
D.6.4. Pressure – Wastewater discharge load

Nutrients





Major conventional analytes



D.7. EPL limits of Nearshore discharging WRRFs

Table D-1 EPL concentration limits for the nearshore discharging WRRFs (2024-25)

WRRF	Sampling Points	Ammonia Nitrogen (mg/L)			Biochemical Oxygen Demand (mg/L)			Faecal Coliform (cfu/100mL)	Oil and Grease (mg/L)		Total Suspended Solids (mg/L)				Sea urchin fertilisation (EC 50)		
		Average	50th %-ile	90th %-ile	50th %-ile	90th %-ile	100th %-ile	50th %-ile	50th %-ile	90th %-ile	50th %-ile	80th %-ile	90th %-ile	100th %-ile	Average	50th %-ile	90th %-ile
Warriewood	WW0005 (C), (G)							200			30	40			6.7		4
Cronulla	CR0003 (C), CR0017 (G)	31		52	15	20		200	5	8	10		15		1.53		0.19
Wollongong	WO0005 (C), (G)				20						30		40				
Shellharbour	SH0004 (C), (G)	20		38	20			150			30		40			2.09	1.87
Bombo	BO0004 (C), BO0013 (G)		10	18	15			150			20		40		2.16		1.18

WRRF	Sampling Points	Aluminium (µg/L)			Copper (µg/L)			Zinc (µg/L)		Chlorpyrifos (µg/L)		Cyanide (µg/L)		Diazinon (µg/L)			Nonylphenol ethoxylate (µg/L)			Unionised H ₂ S (µg/L)		
		Average	50th %ile	90th %ile	Average	50th %ile	90th %ile	Average	90th %ile	Average	90th %ile	Average	90th %ile	Average	50th %ile	90th %ile	Average	50th %ile	90th %ile	Average	50th %ile	90th %ile
Warriewood	WW0005 (C), (G)	80		150	15		30					17	30				11		22			
Cronulla	CR0003 (C), CR0017 (G)	100		383	50		500	55	100	0.09	1	5	10	0.2		2	8		11	38		70
Wollongong	WO0005 (C), (G)	120		430	40		80							0.1		0.5			30		60	
Shellharbour	SH0004 (C), (G)	110		220	10		20							0.1		1	6		10	44		165
Bombo	BO0004 (C), BO0013 (G)		150	523		25	65							0.1	0.2		8	14		58		97

Table D-2 EPL load limits for the nearshore discharging WRRFs (2024-25)

Load limits (kg)	Warriewood	Cronulla	Wollongong	Shellharbour	Bombo
Total Nitrogen	299,300	735,110	743,076	254,770	64,057
Total Phosphorus	74,460	243,090	74,319	63,364	21,280
Biological Oxygen Demand	135,050	319,010	198,535	116,070	32,941
Total Suspended Solids	175,200	305,000	198,594	150,380	43,435
Oil & Grease	41,975	110,000	123,915	35,953	11,224
Cadmium		28			
Chromium		76			
Copper		2,551			
Lead		138			
Mercury		5			
Selenium		356			
Zinc		2,956			
Pesticides		20			



E. Offshore marine environment

This Appendix includes graphical presentation of all monitoring data for the Offshore Marine catchment.

The Water Resource Recovery Facilities (WRRFs) that are discharging into the offshore marine environment are ordered from North (North Head) to South (Malabar).

Under each Offshore WRRF, pressure indicator results are presented first following the **Pressure, Stressor** and **Ecosystem Receptor (P-S-ER)** causal pathway elements (Appendices E-1 to E-3).

Trend plots are included on wastewater quantity (discharge and inflow), quality, toxicity and discharge loads. Trend plots on other supplementary data are also included to improve our understanding on:

- weather condition i.e. catchment specific rainfall condition for each WRRF
- wastewater reuse/ recycling volume of the relevant WRRF.

Wastewater quality and load plots are included in following four sub-groups, and then within each sub-group, analytes presented in alphabetical order:

- nutrients
- major conventional analytes
- trace metals
- other chemicals and organics (including pesticides)

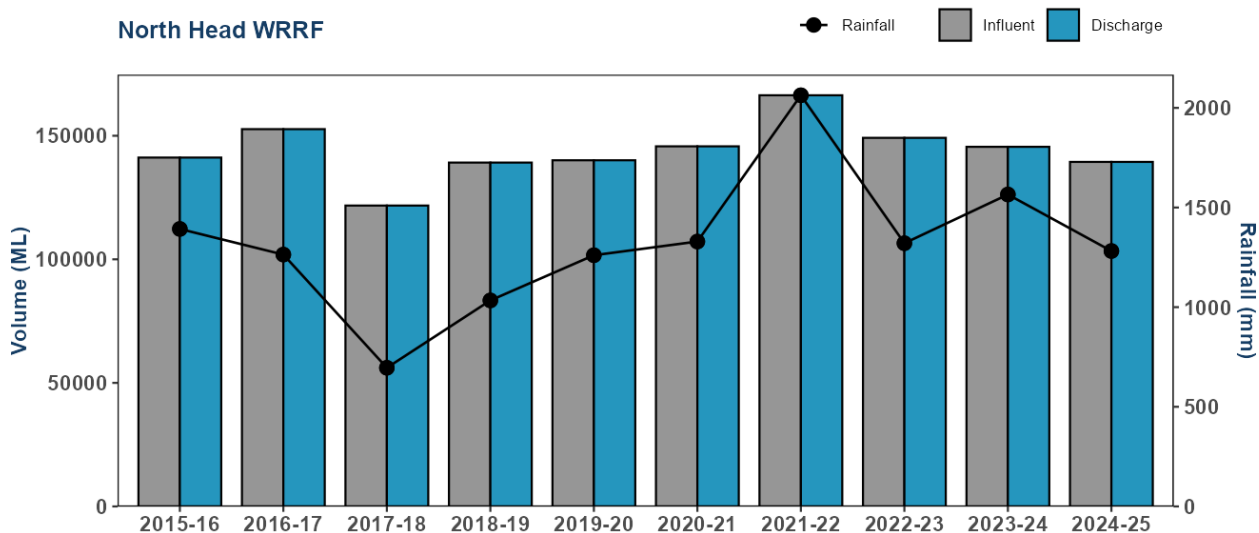
Tests conducted on wastewater are specified in the EPL issued by the NSW EPA for each WRRF (Appendix E.4). Data for all these measured analytes that have EPL concentration and load limits are included. Summary statistics are included as electronic appendices sent to the EPA.

All outcomes from offshore marine stressors and ecosystem receptor data analyses are presented in Volume 3 of this 2024-25 SWAM Interpretive Report.

E.1. North Head WRRF

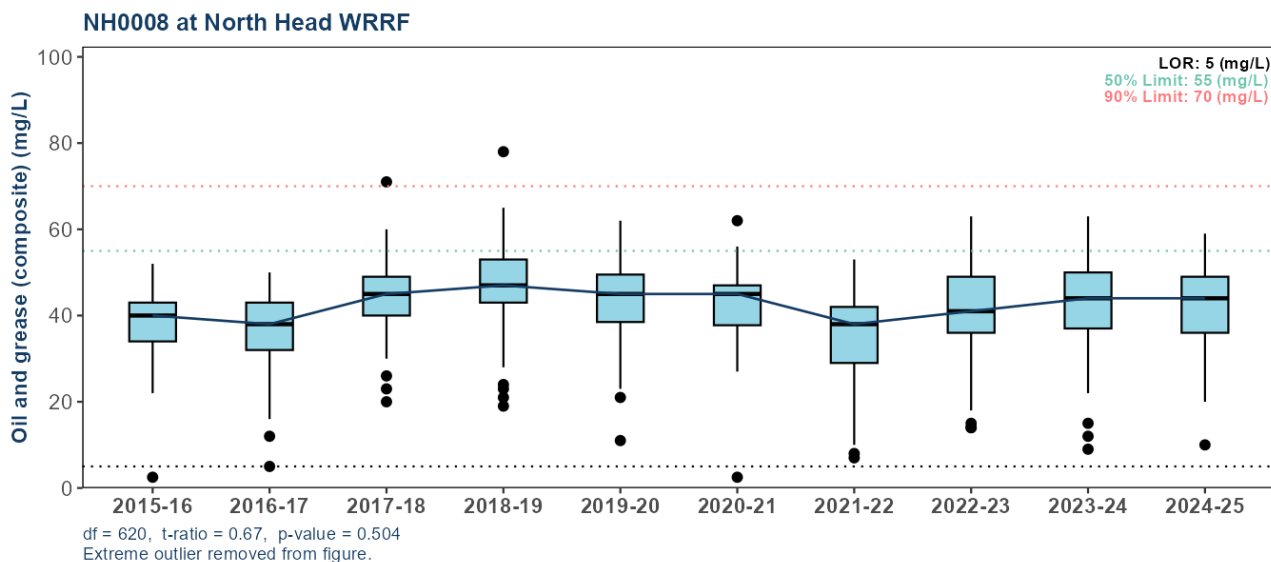
E.1.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

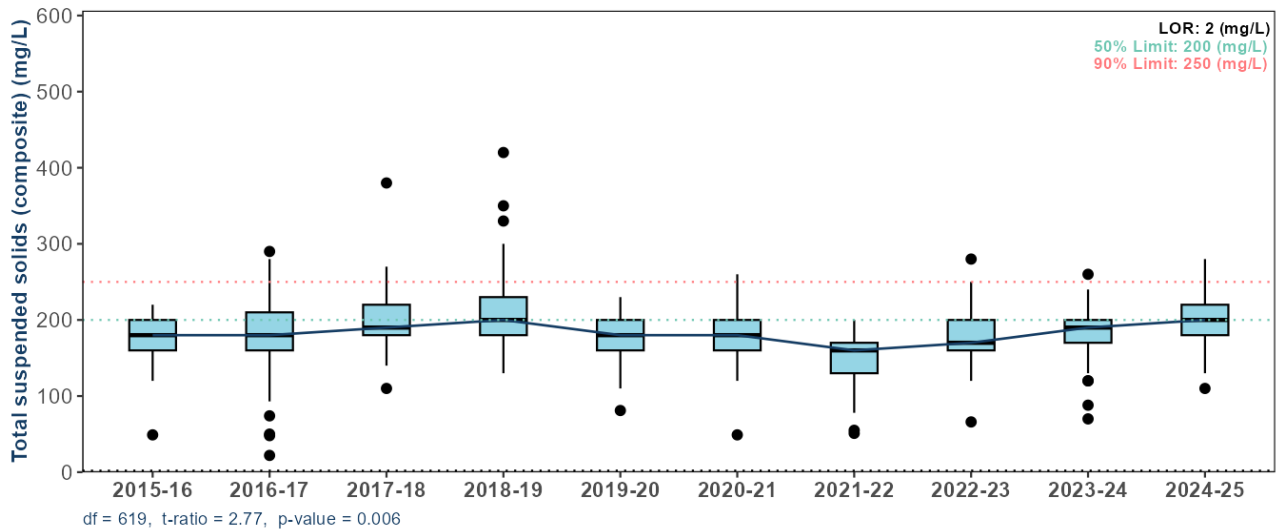


E.1.2. Pressure – Wastewater quality

Major conventional analytes

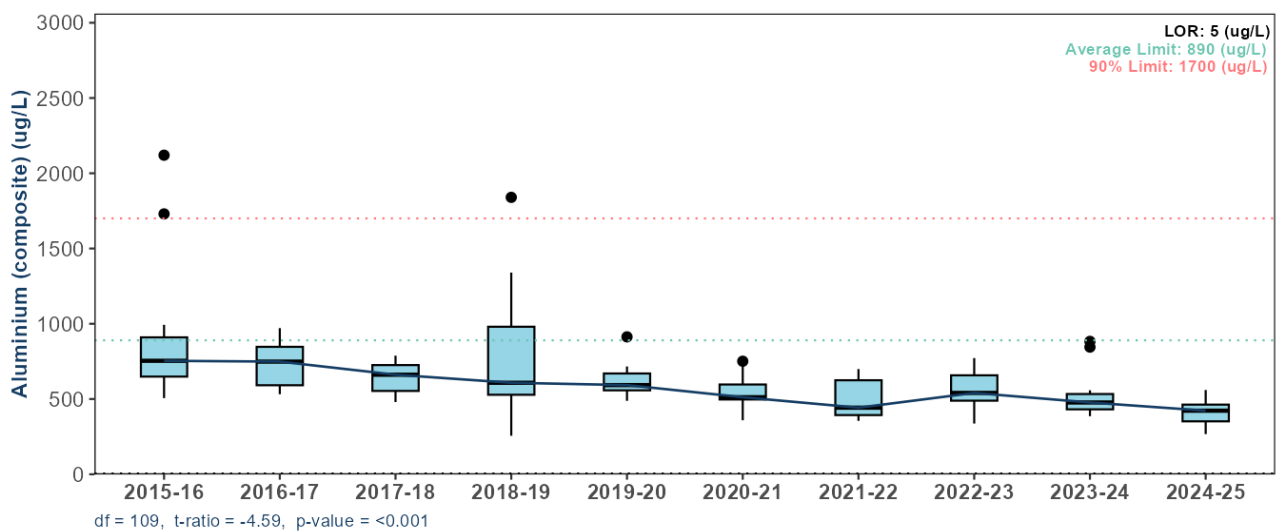


NH0008 at North Head WRRF

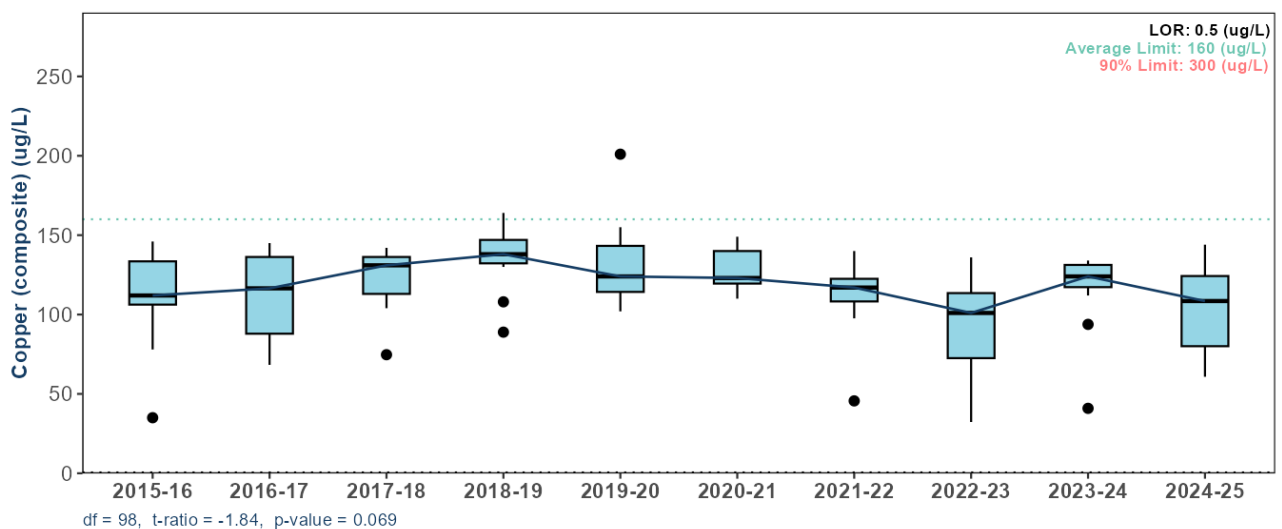


Trace metals

NH0008 at North Head WRRF

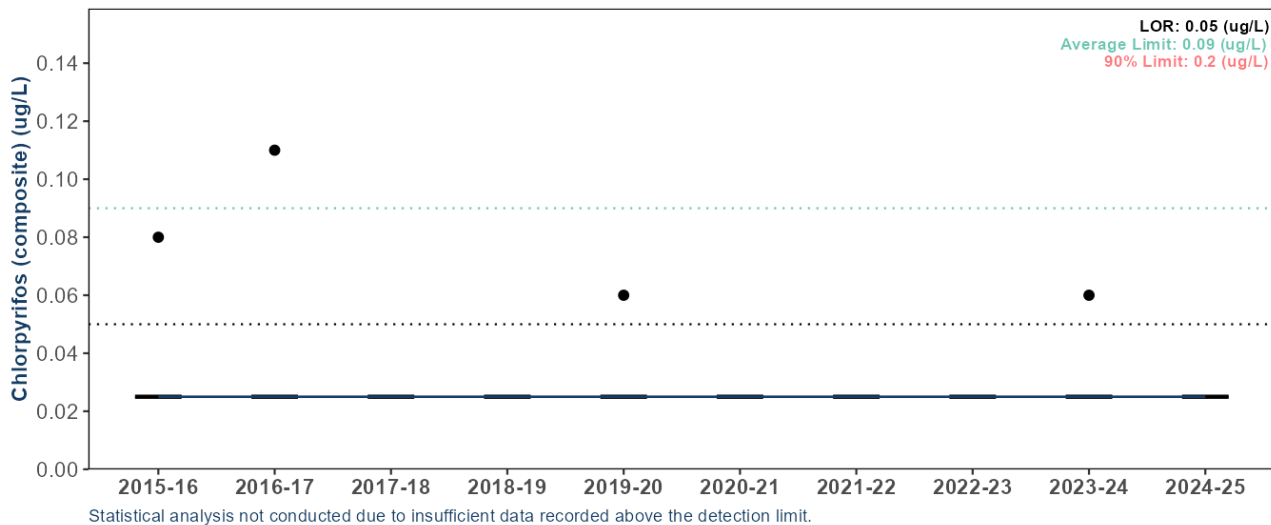


NH0008 at North Head WRRF

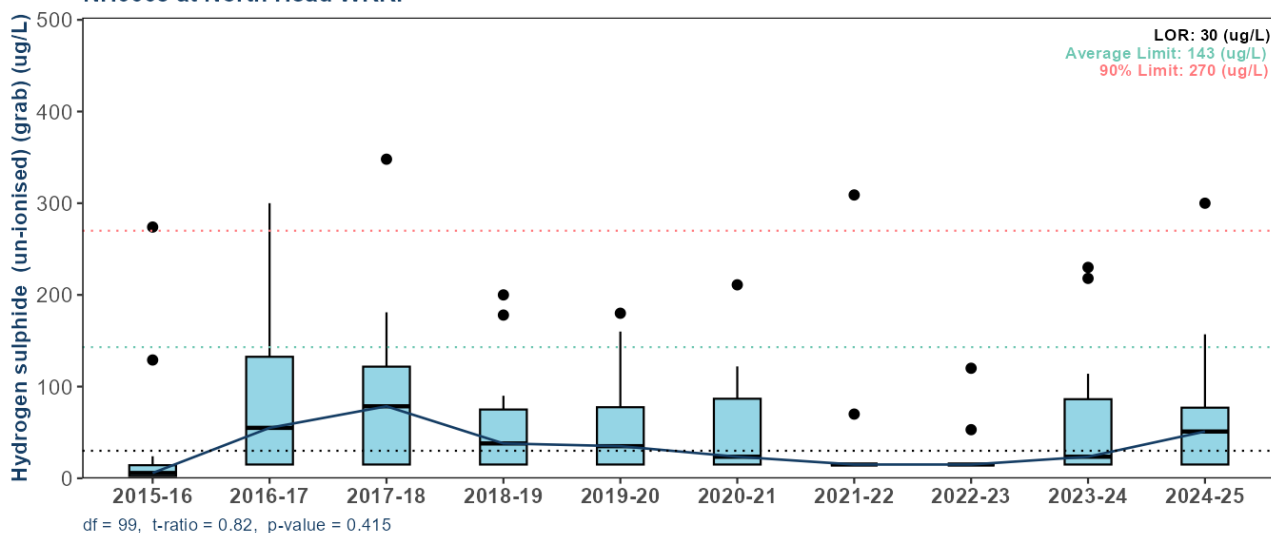


Other chemicals and organics (including pesticides)

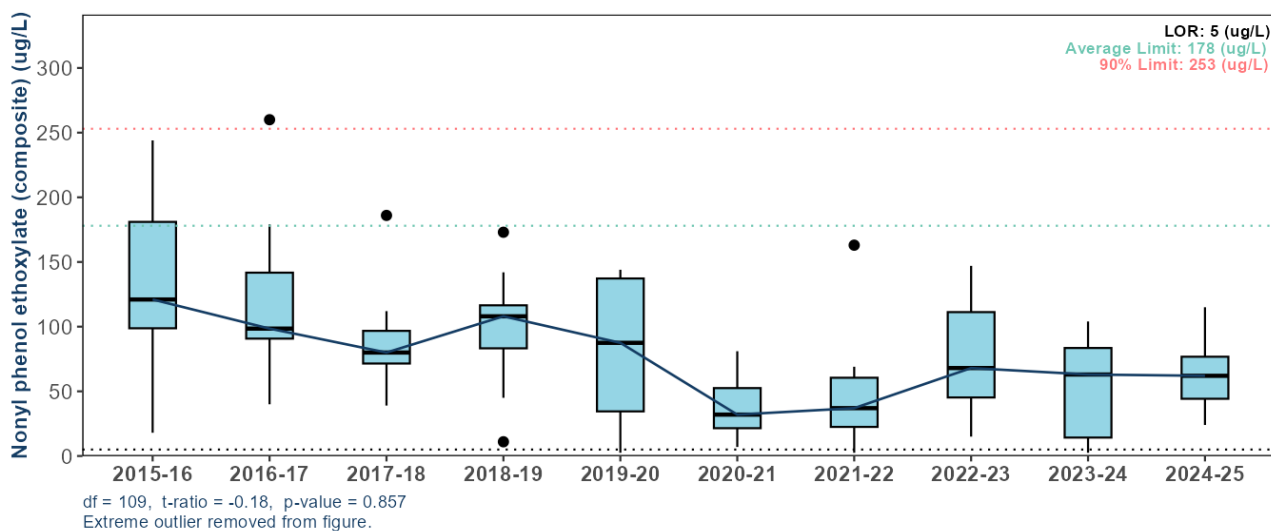
NH0008 at North Head WRRF



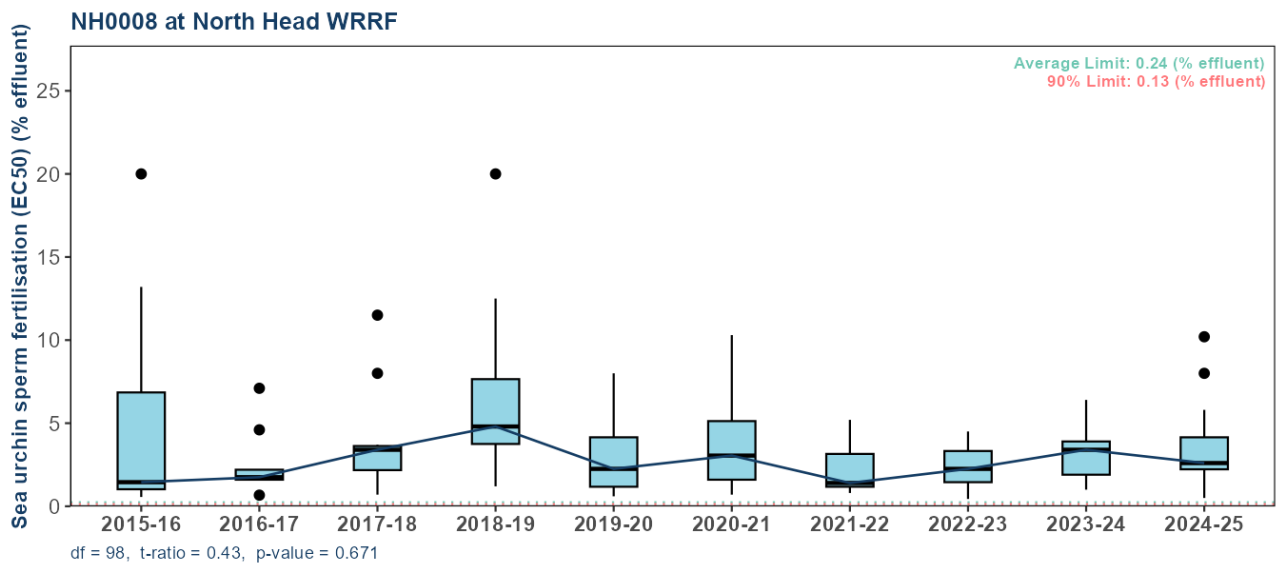
NH0008 at North Head WRRF



NH0008 at North Head WRRF

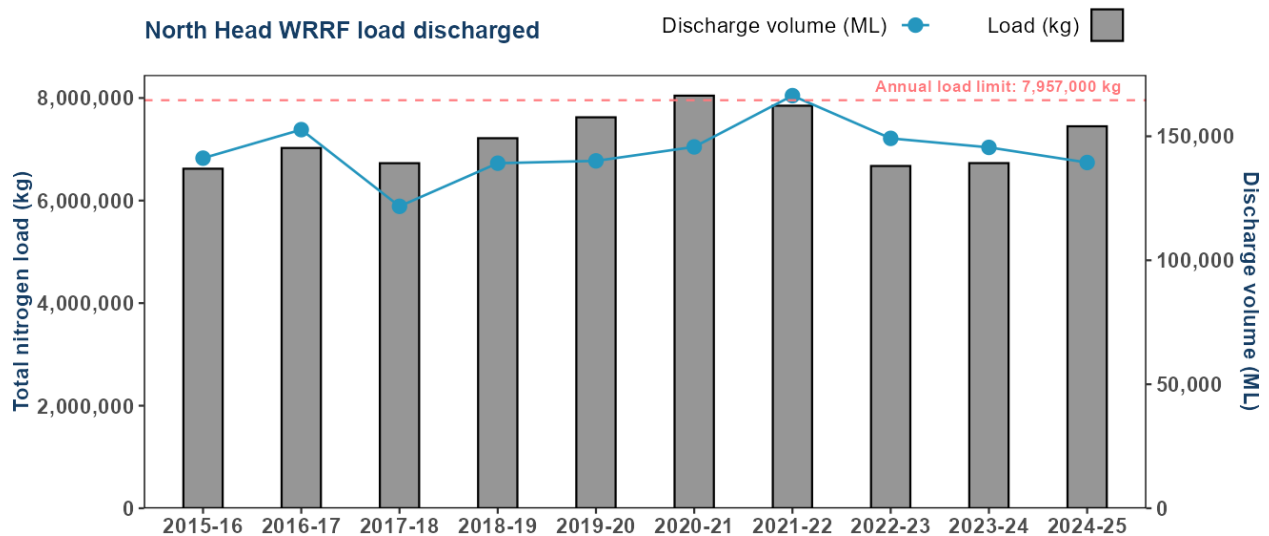


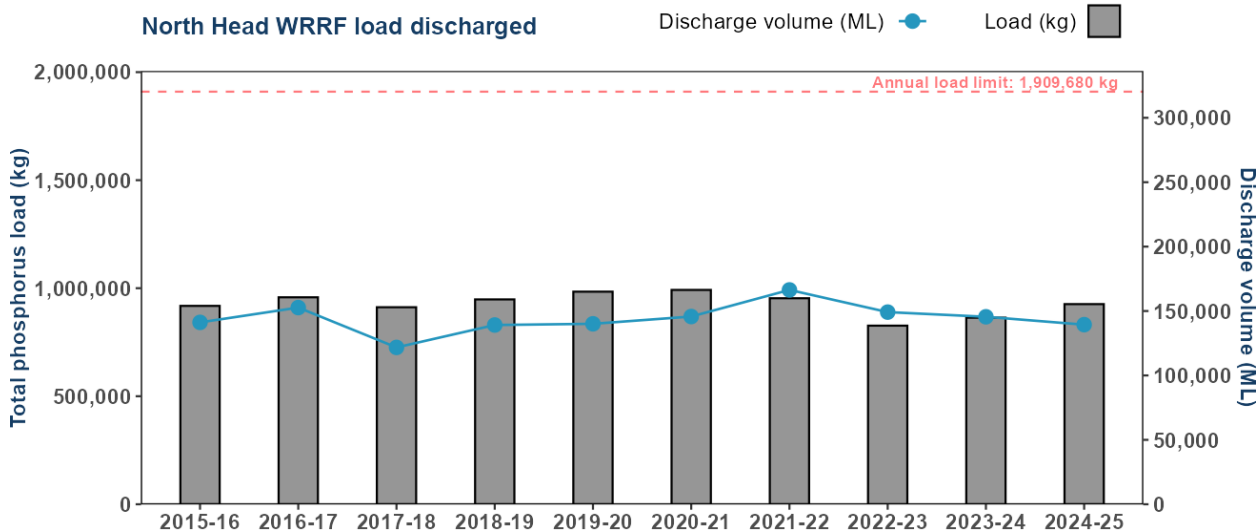
E.1.3. Pressure – Wastewater toxicity



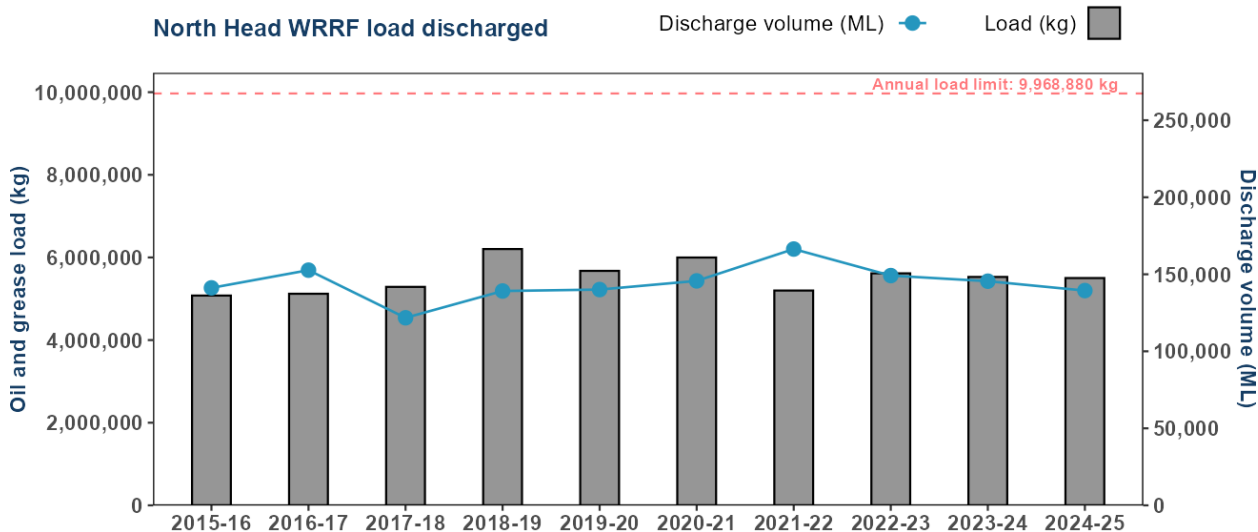
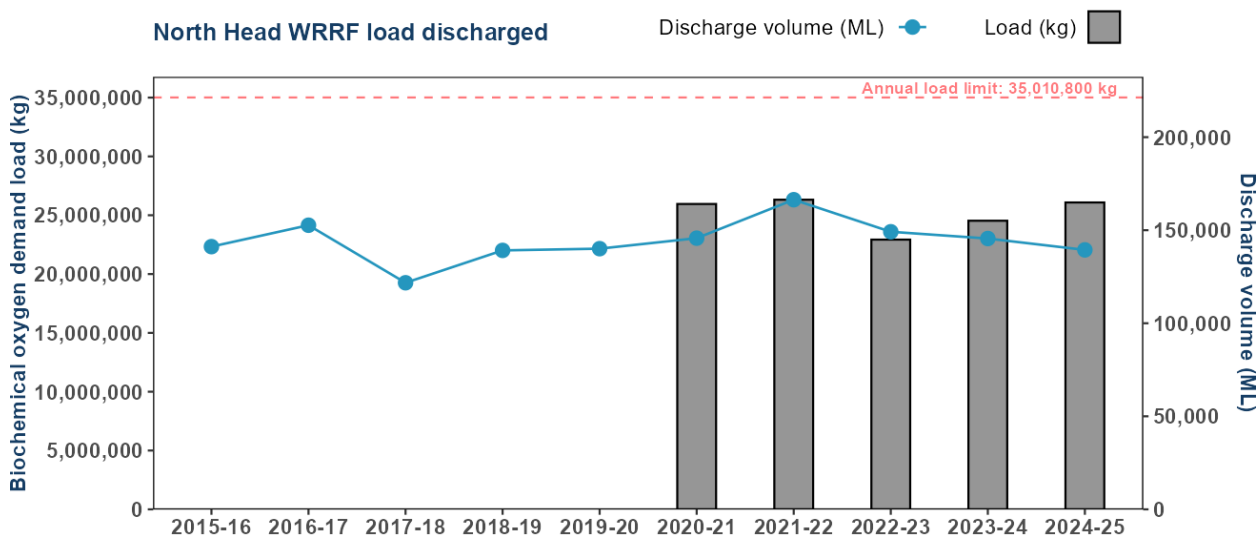
E.1.4. Pressure – Wastewater discharge load

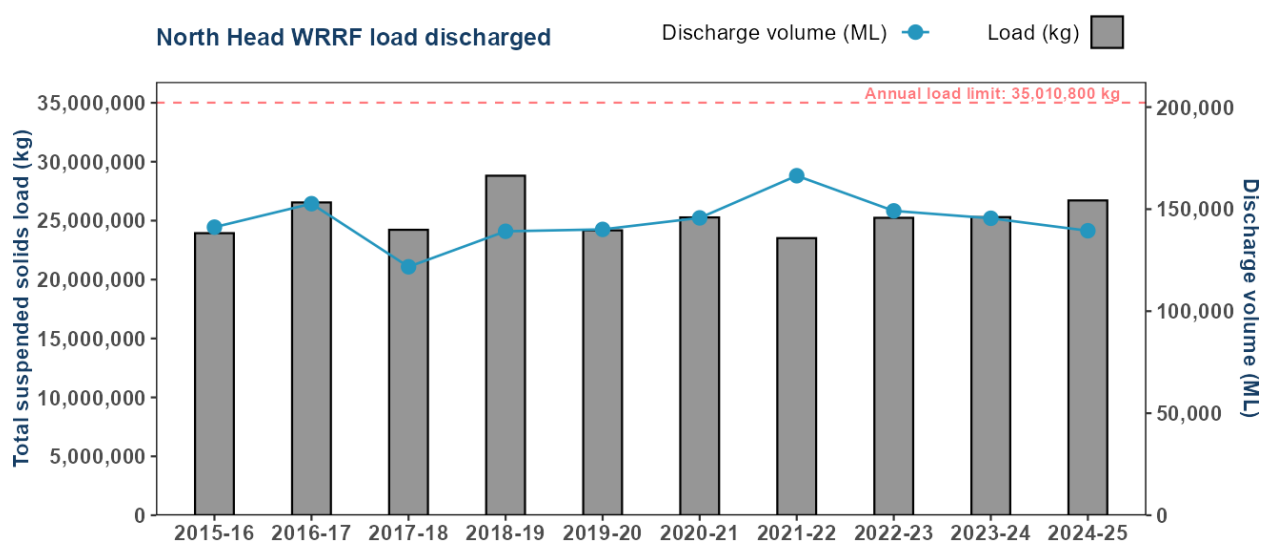
Nutrients



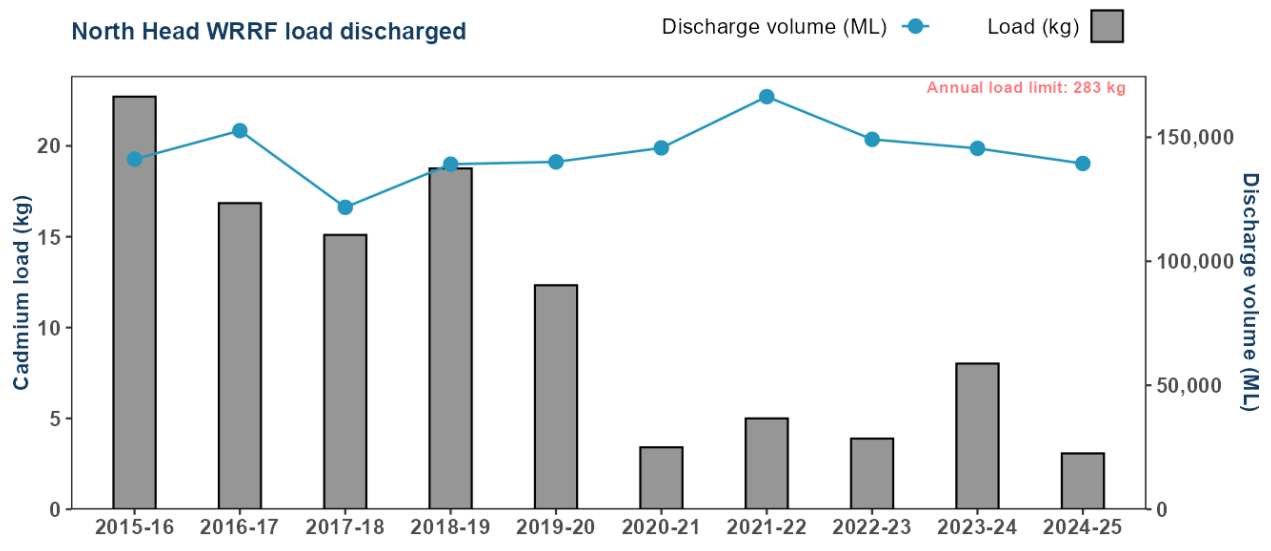


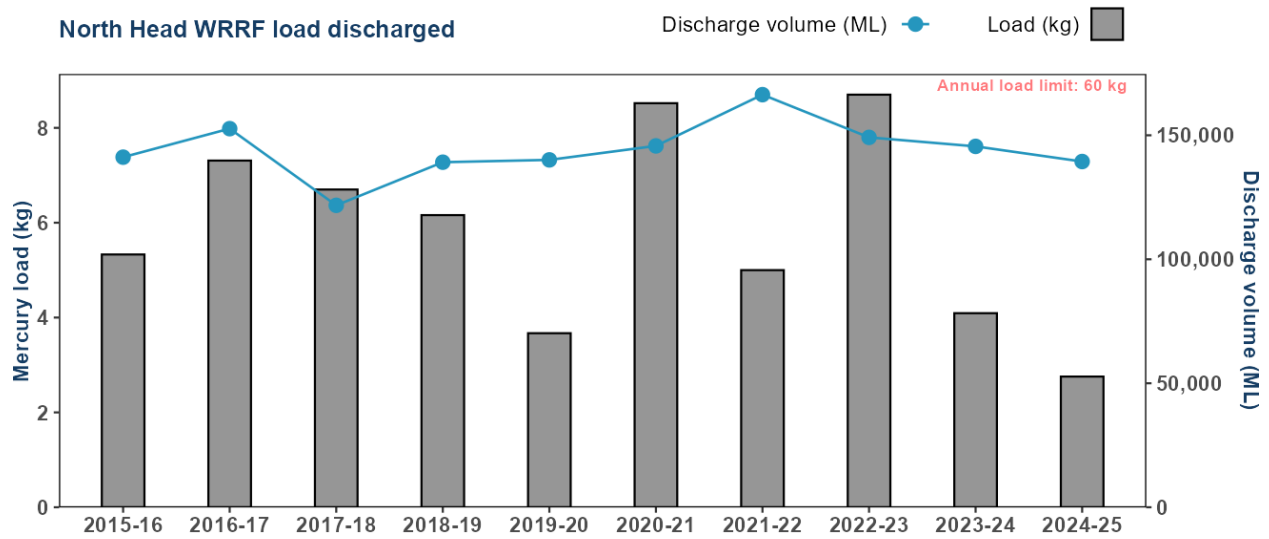
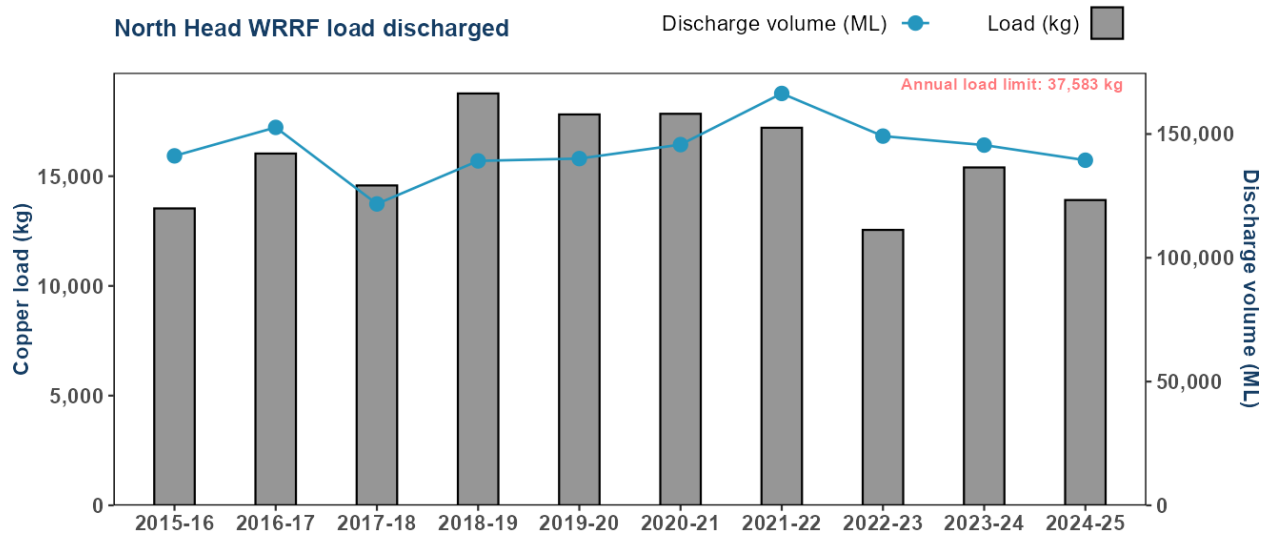
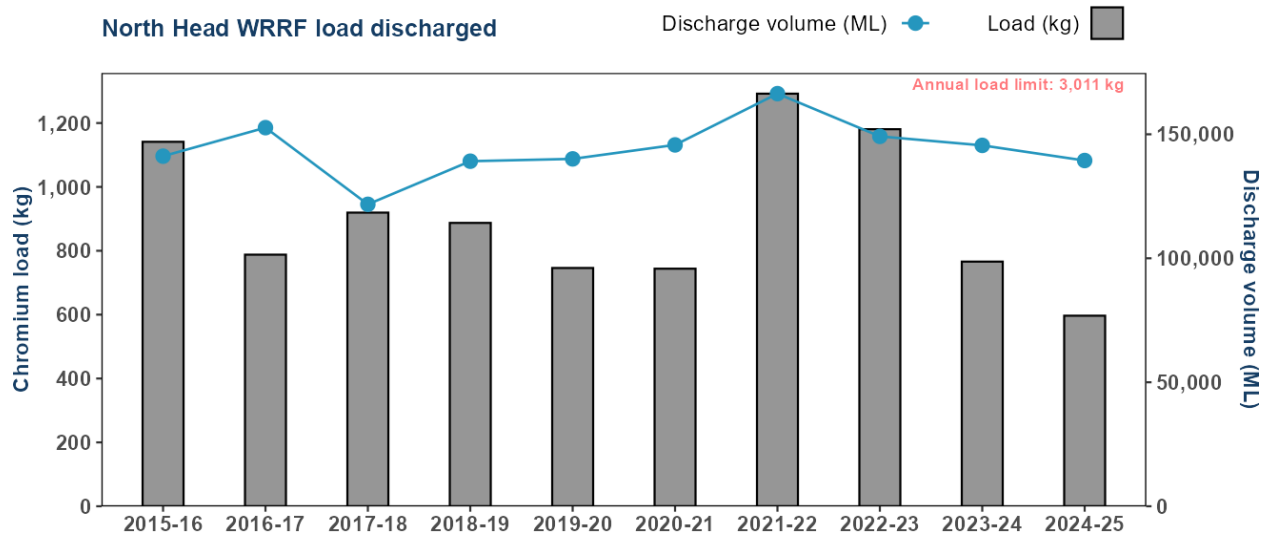
E.1.5. Major conventional analytes

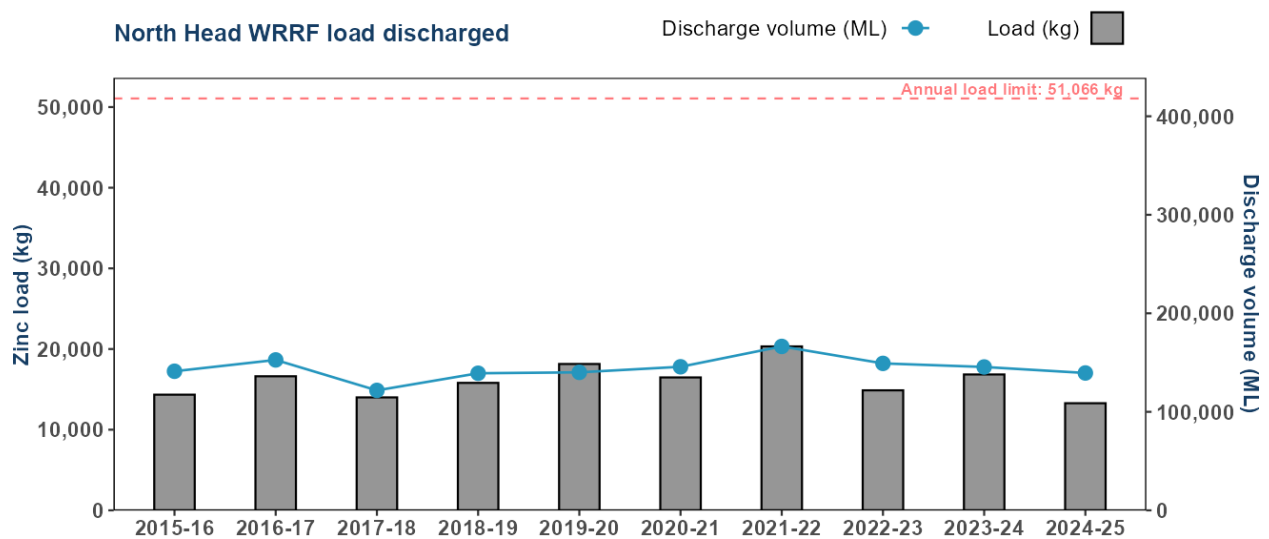
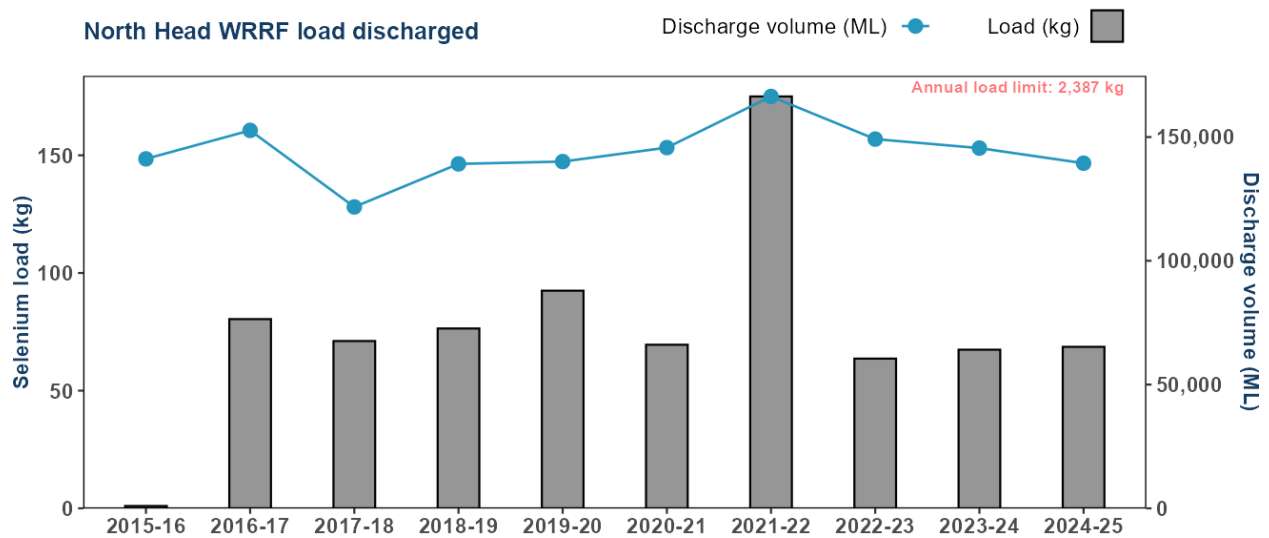
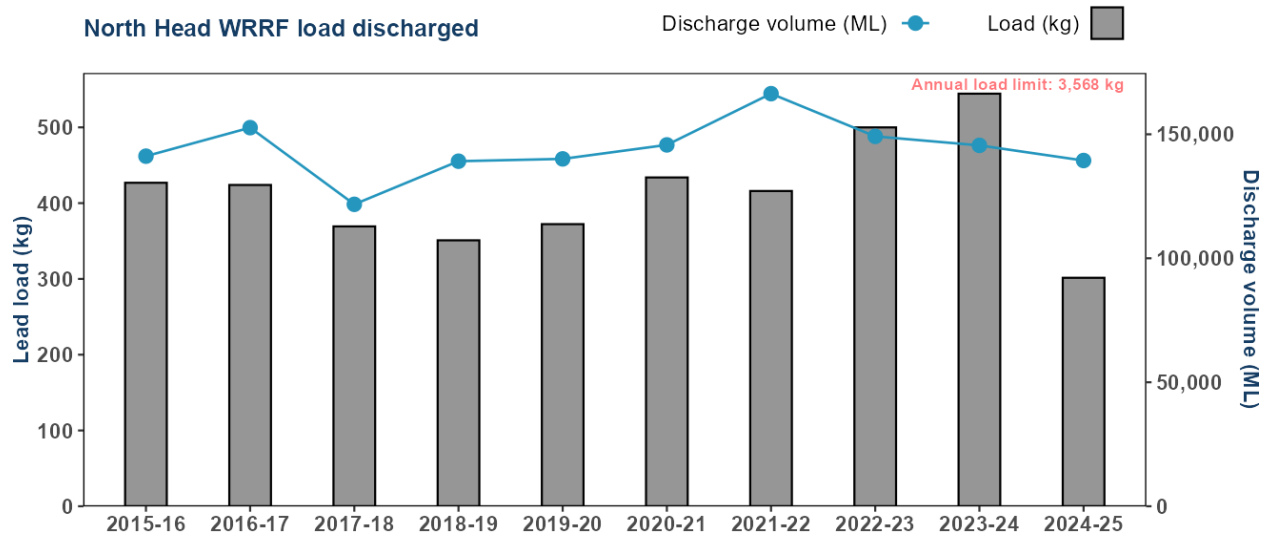




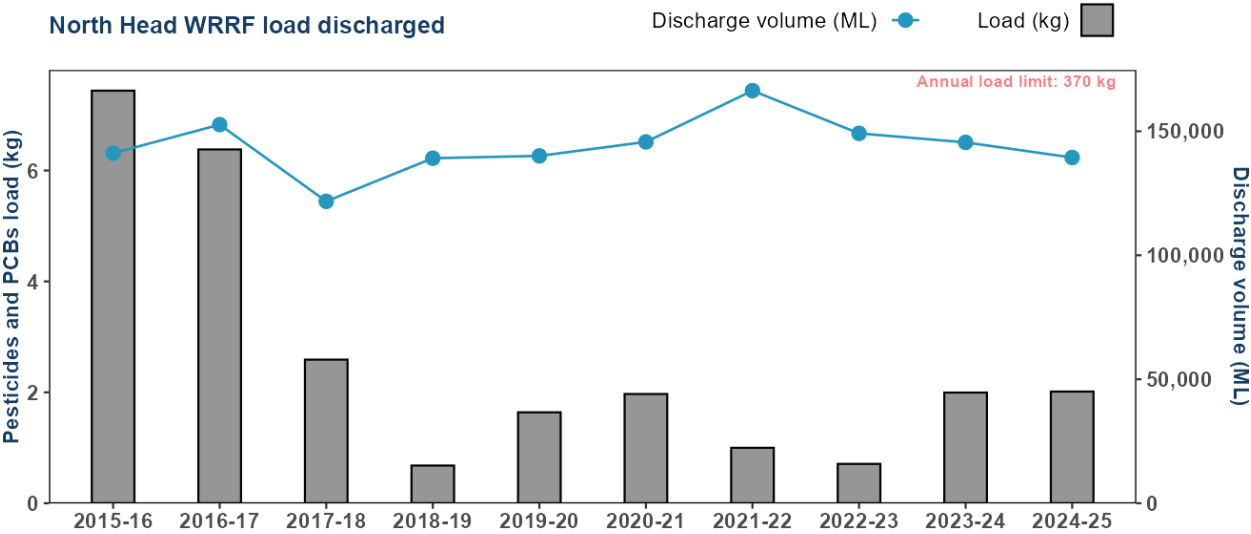
Trace metals







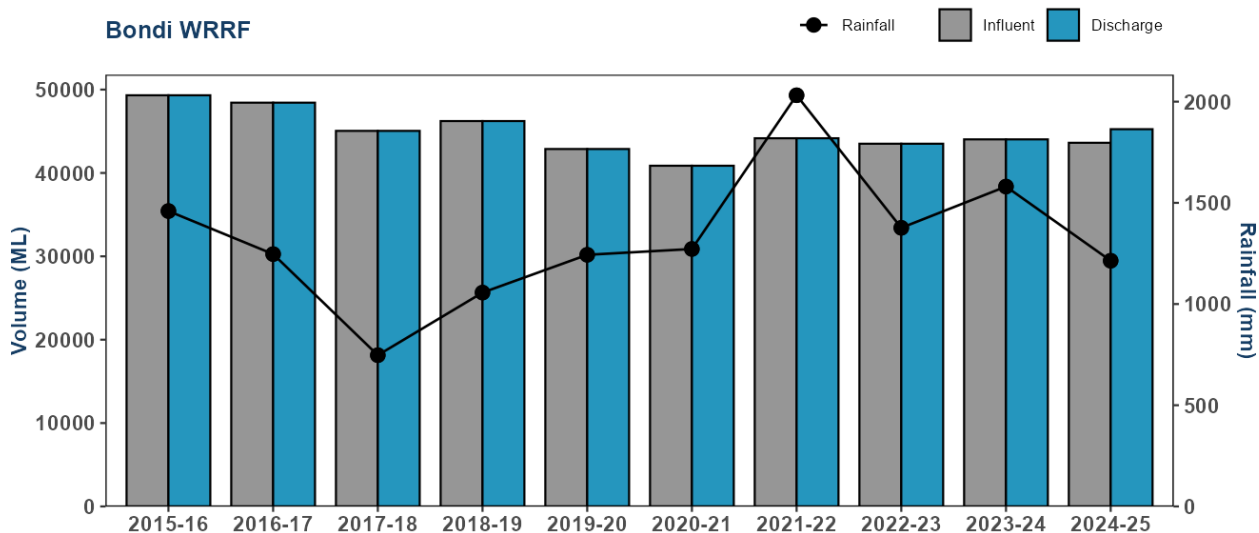
Other chemicals and organics (including pesticides)



E.2. Bondi WRRF

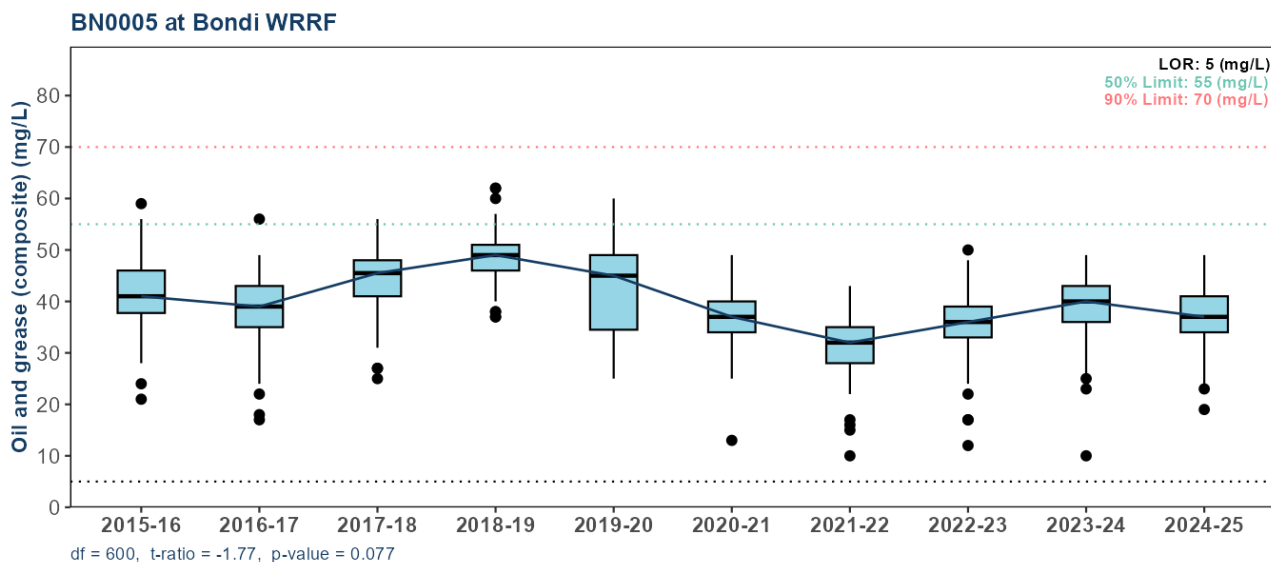
E.2.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

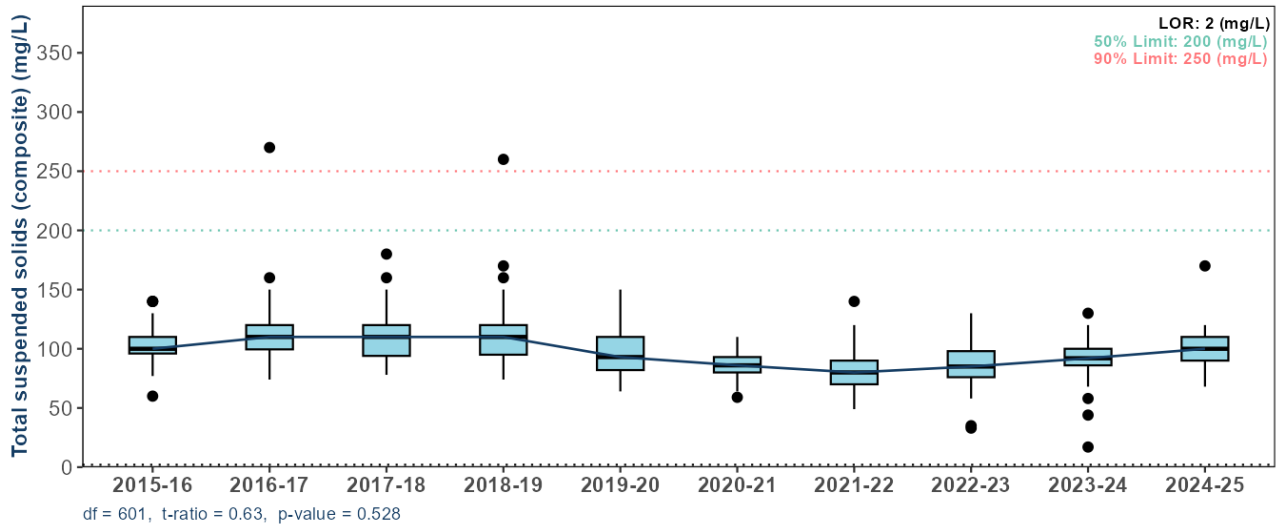


E.2.2. Pressure – Wastewater quality

Major conventional analytes

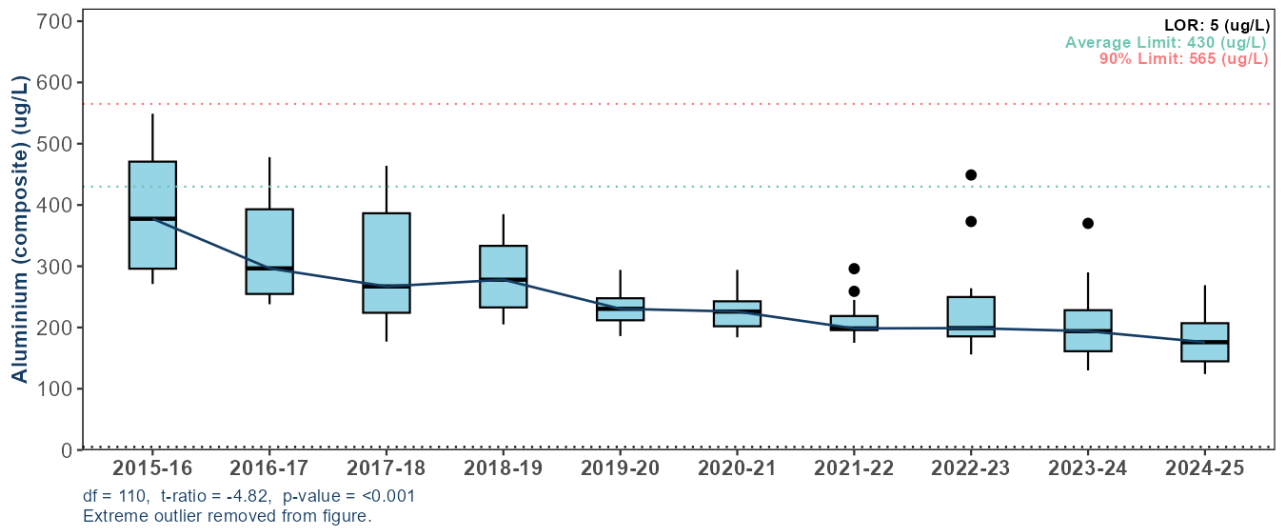


BN0005 at Bondi WRRF

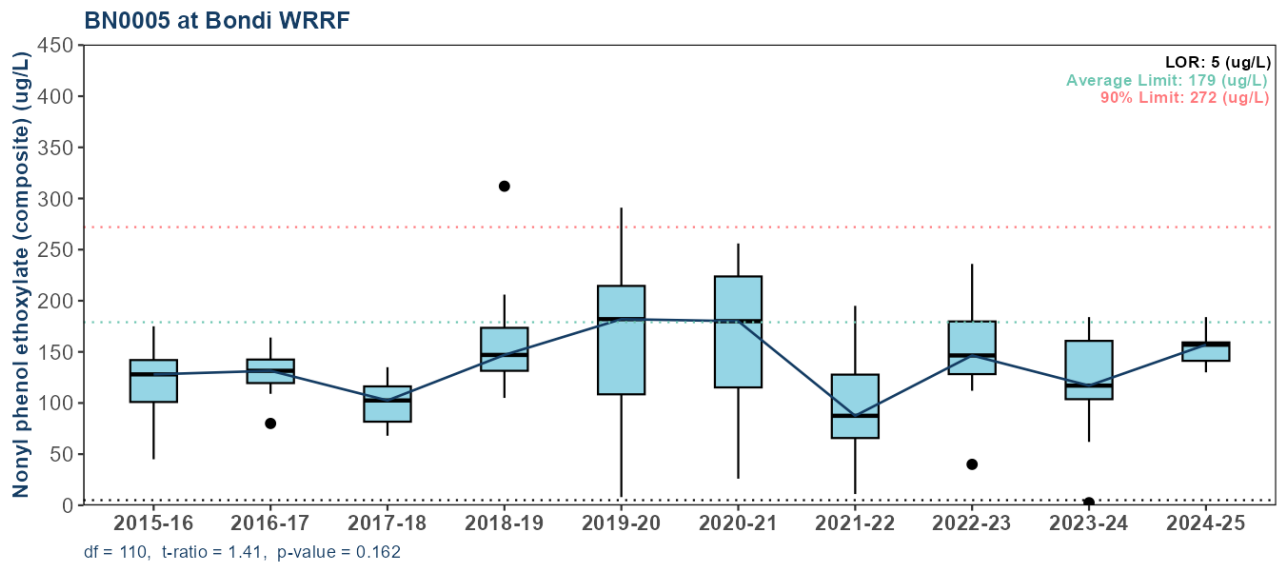
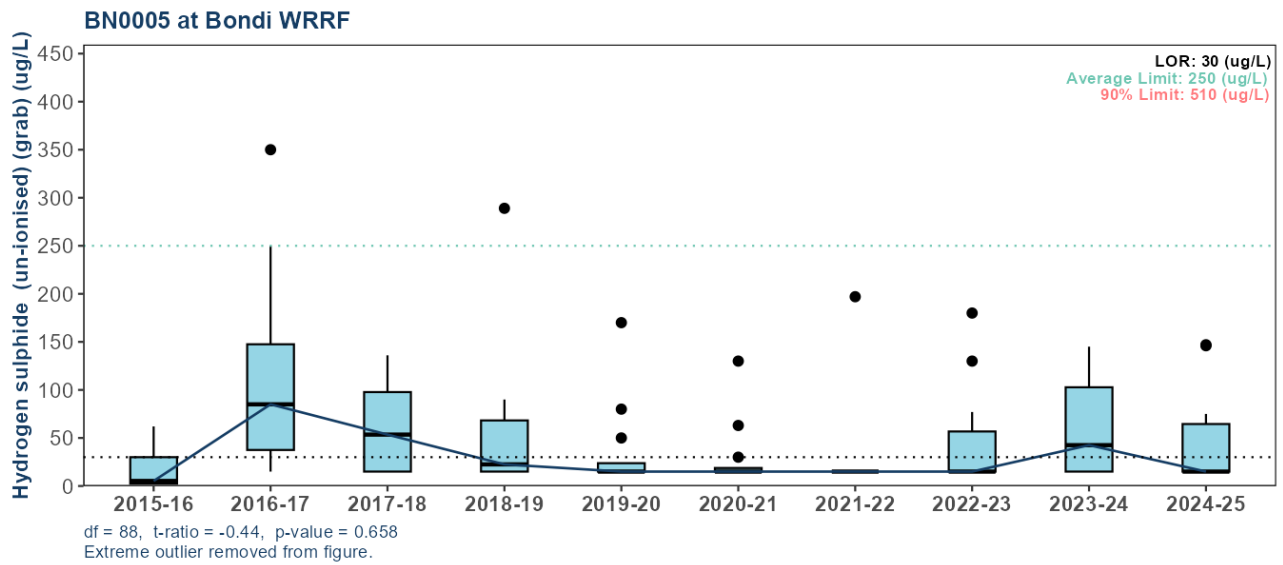


Trace metals

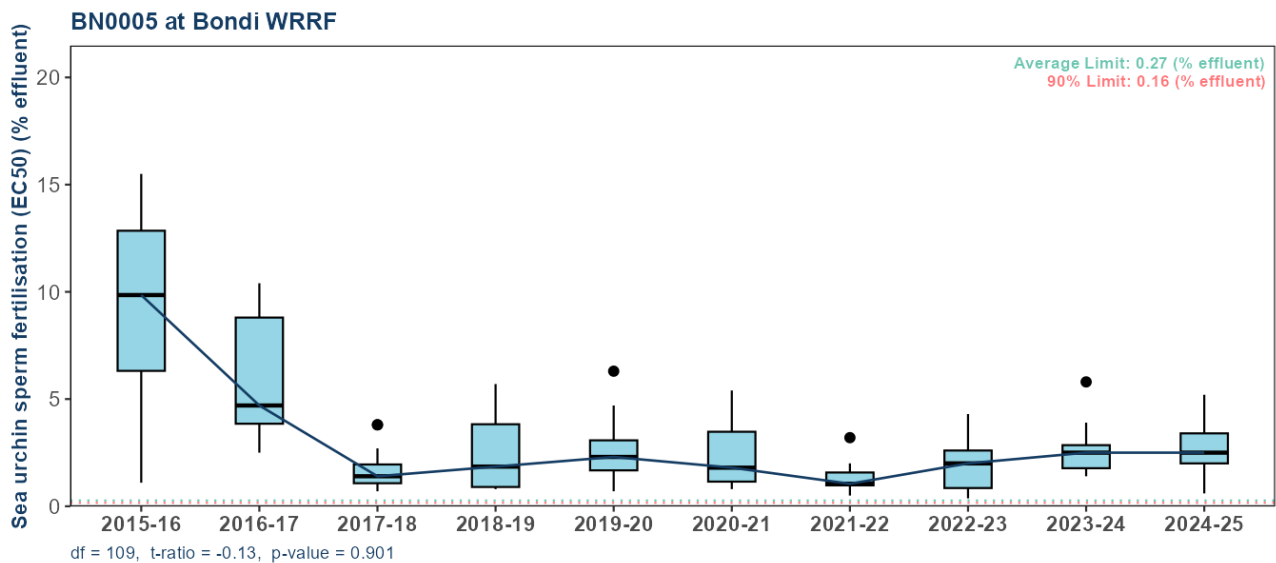
BN0005 at Bondi WRRF



Other chemicals and organics (including pesticides)

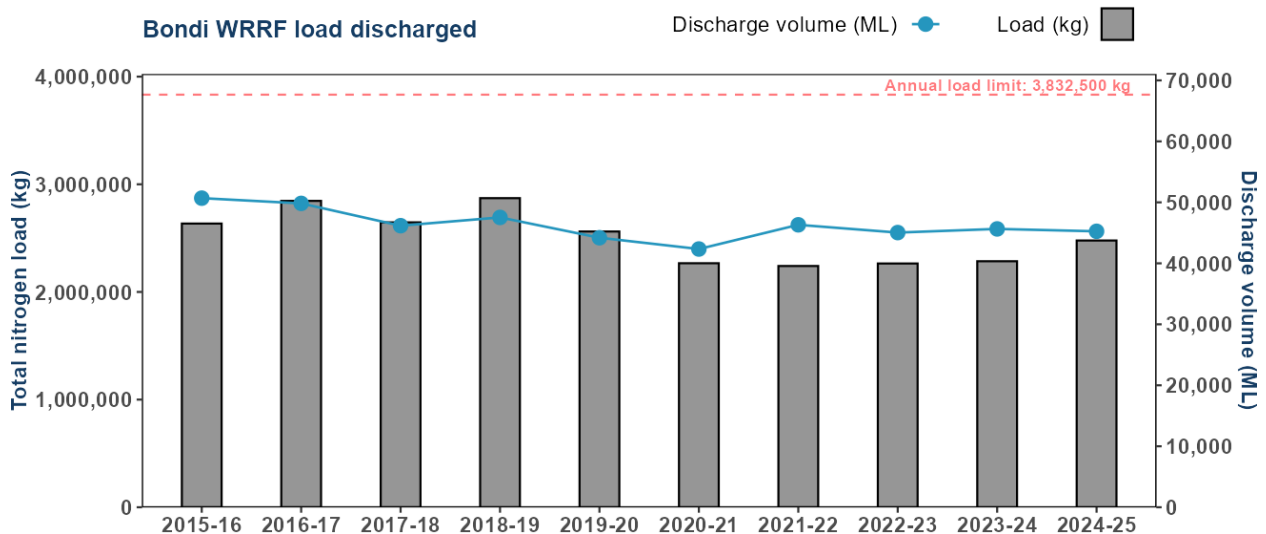


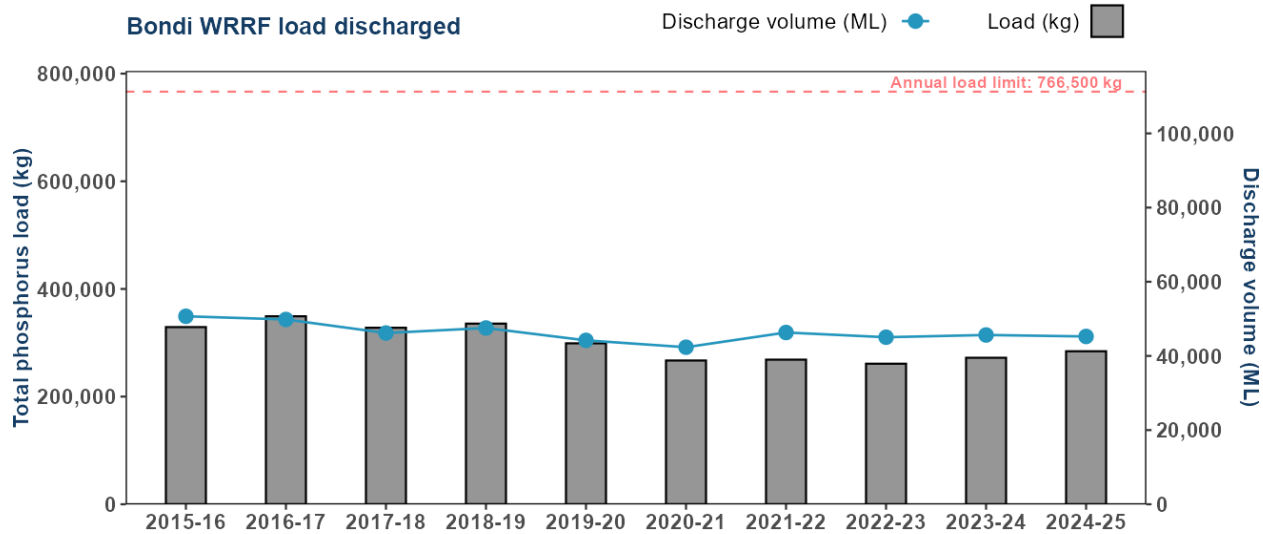
E.2.3. Pressure – Wastewater toxicity



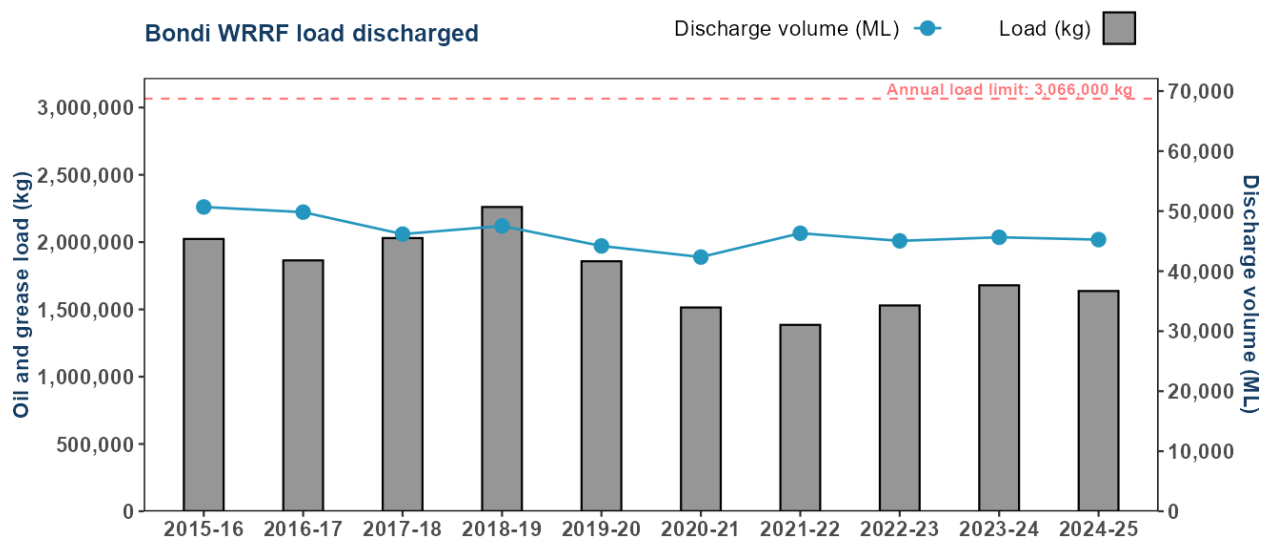
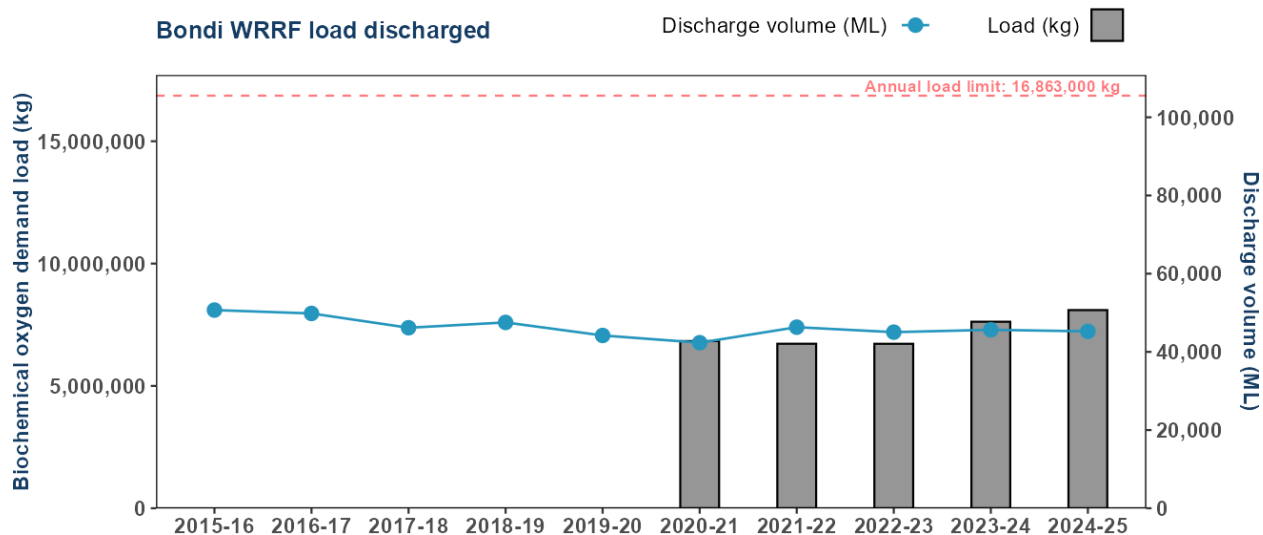
E.2.4. Pressure – Wastewater discharge load

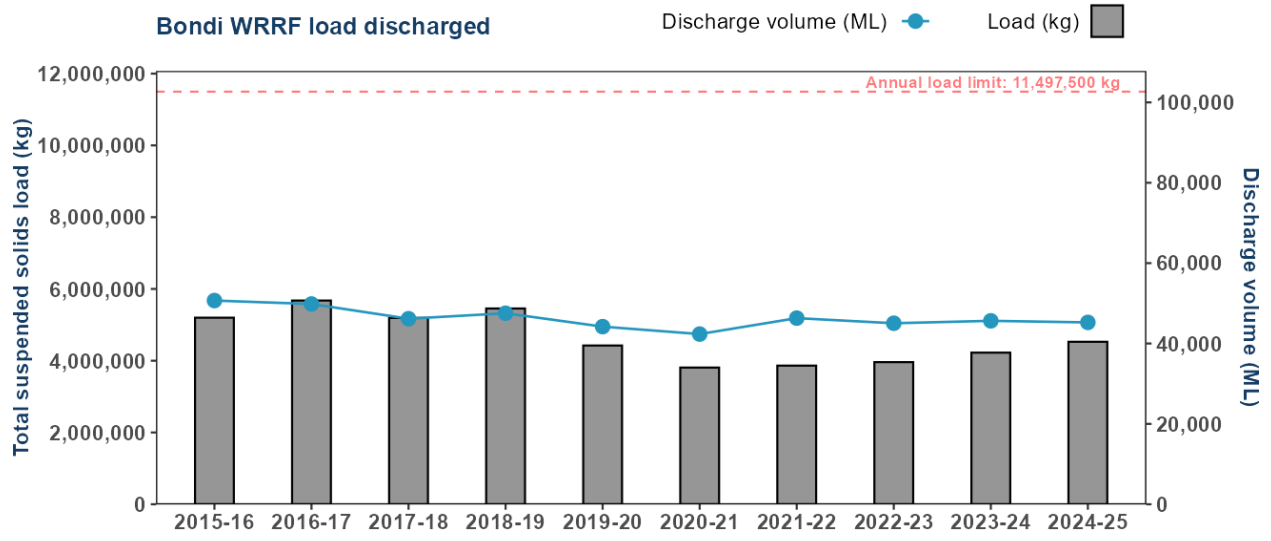
Nutrients



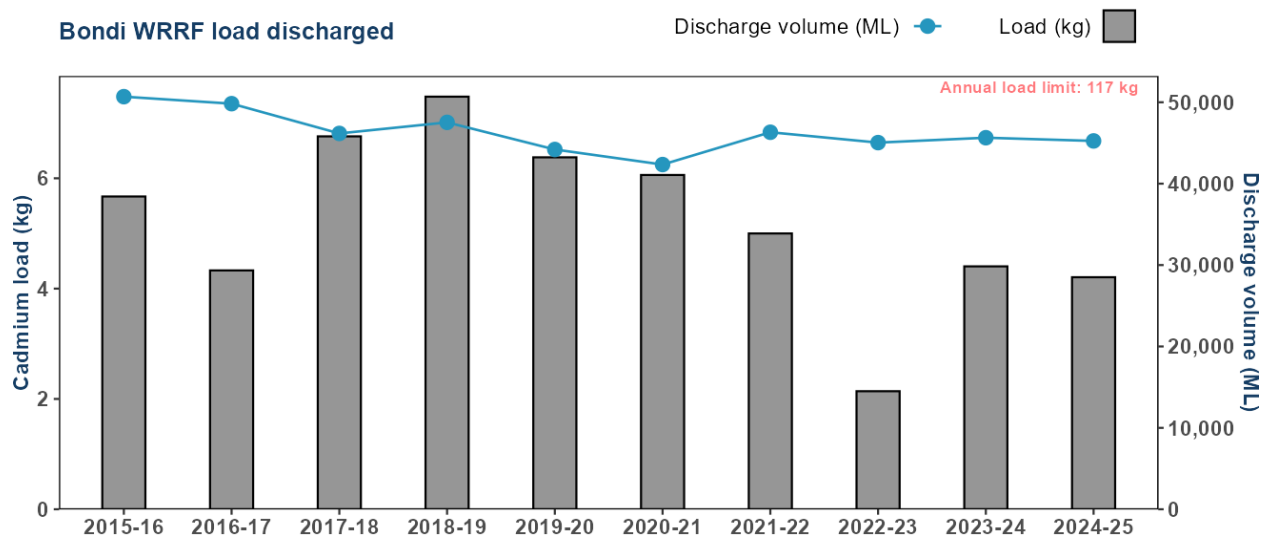


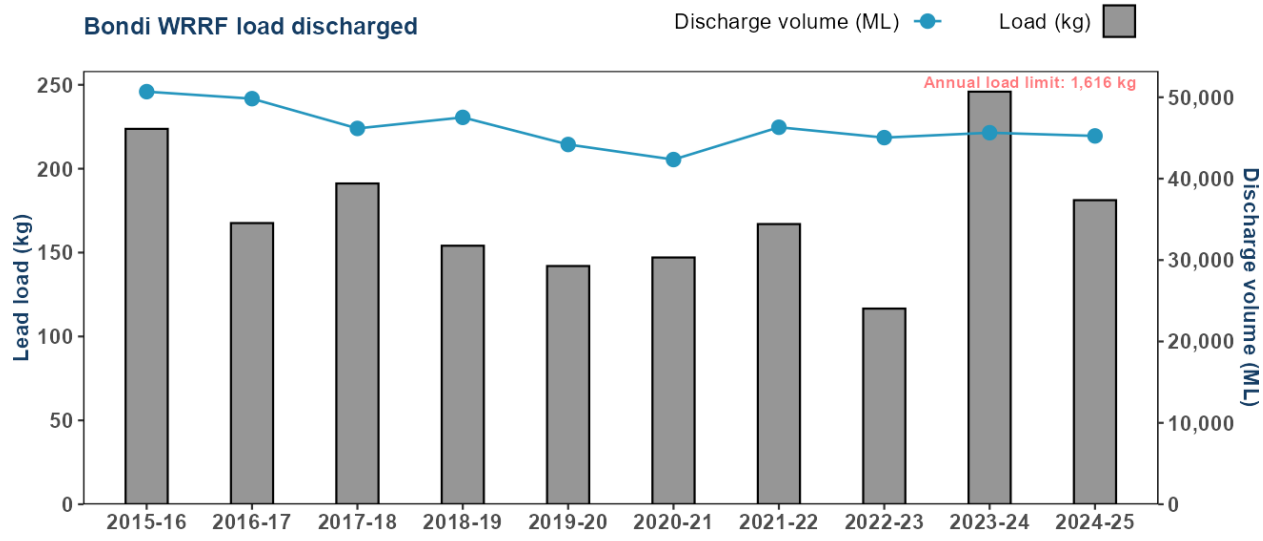
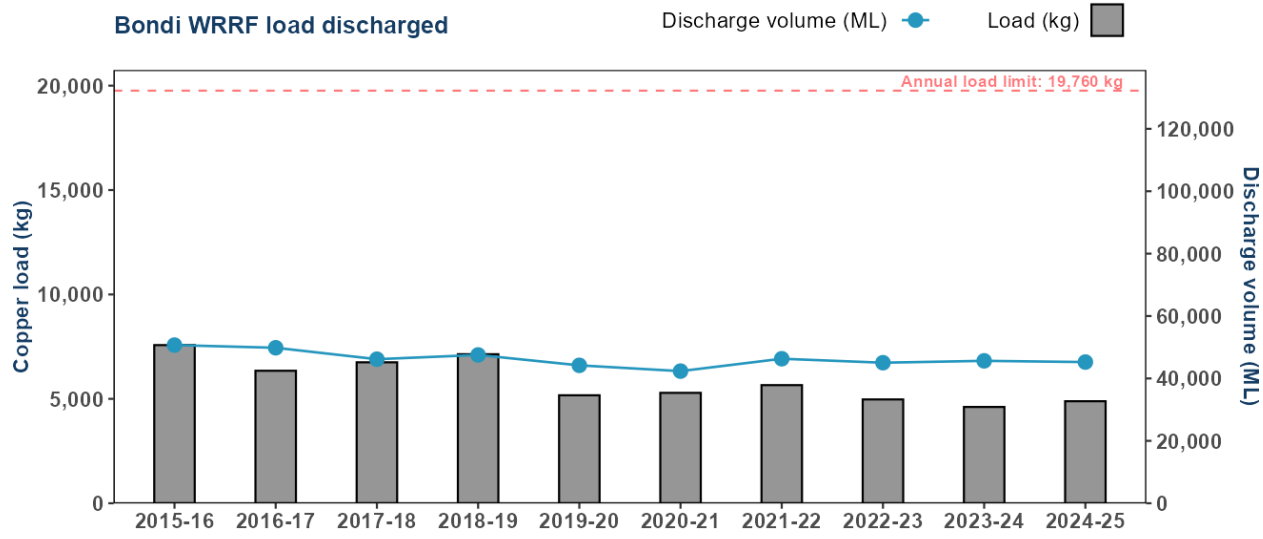
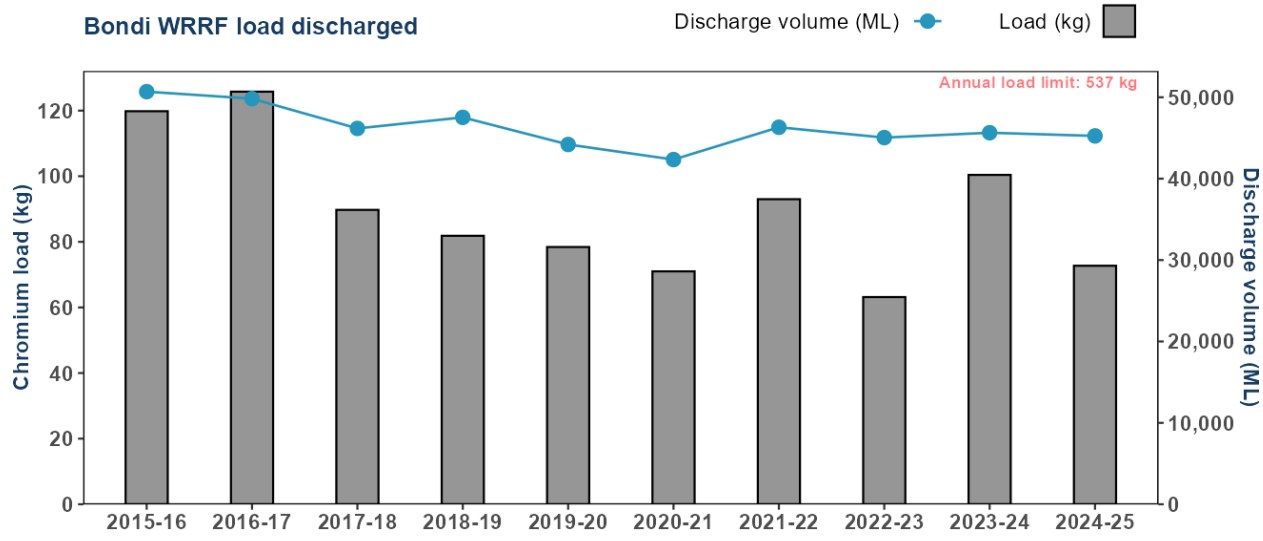
Major conventional analytes

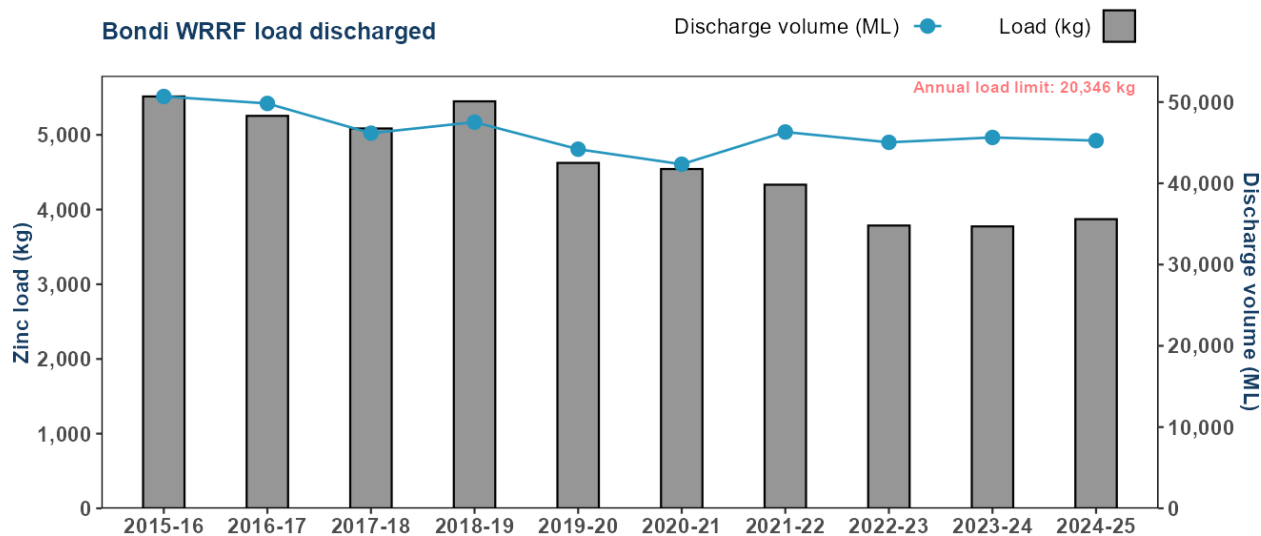
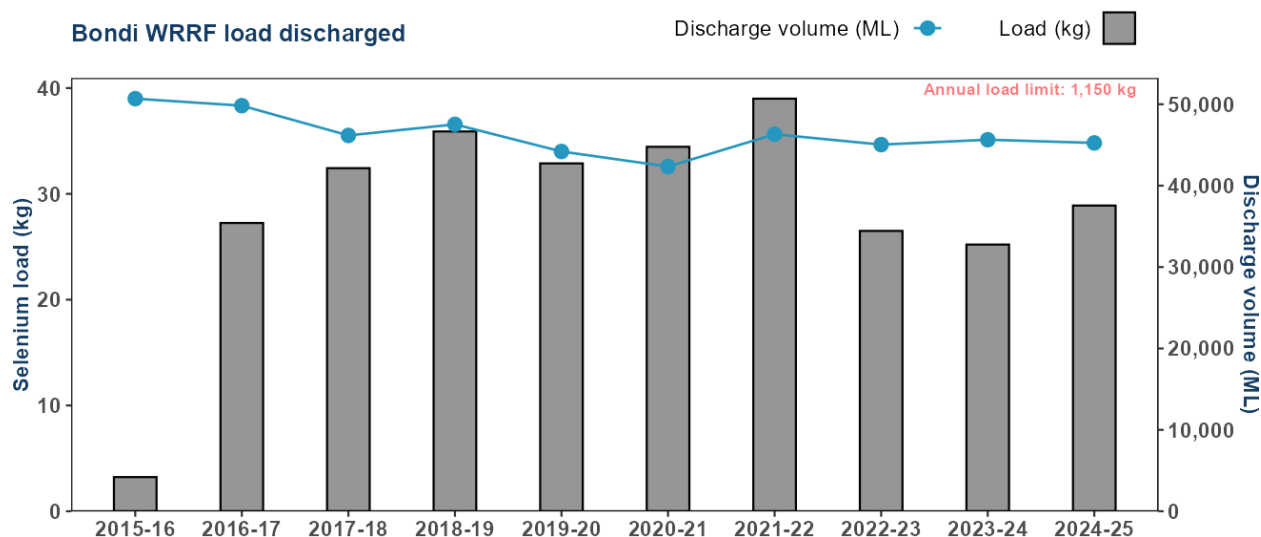
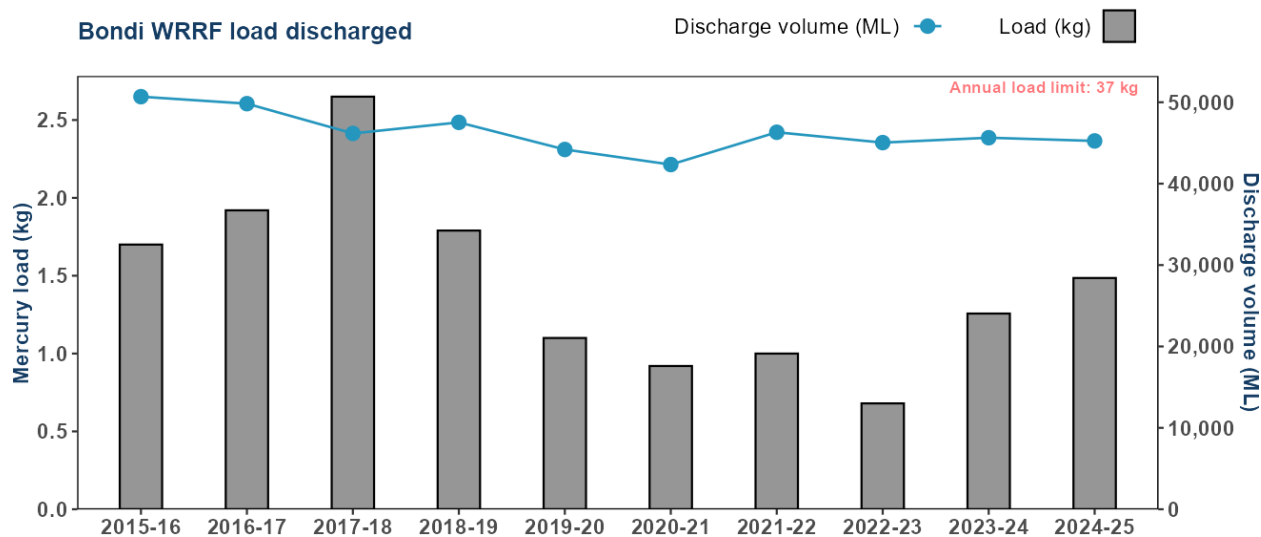




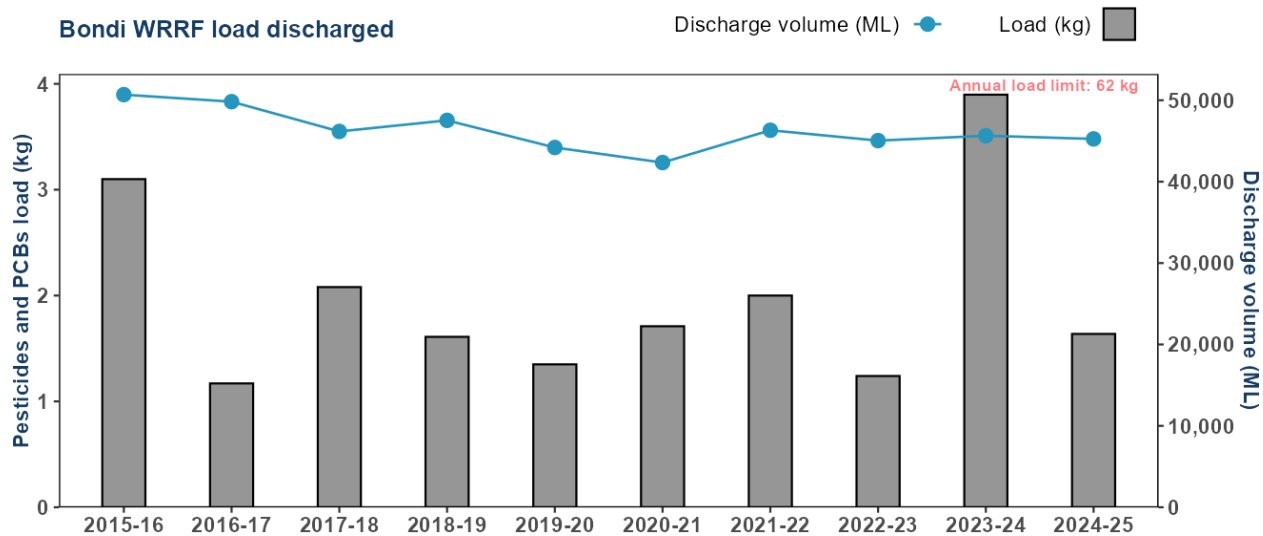
Trace metals







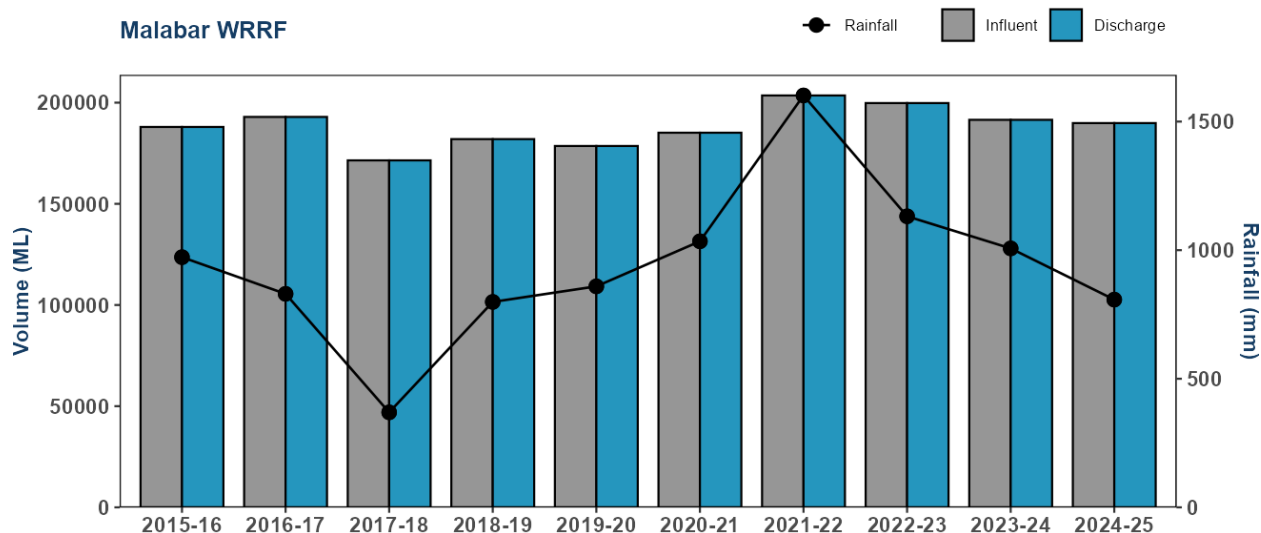
Other chemicals and organics (including pesticides)



E.3. Malabar WRRF

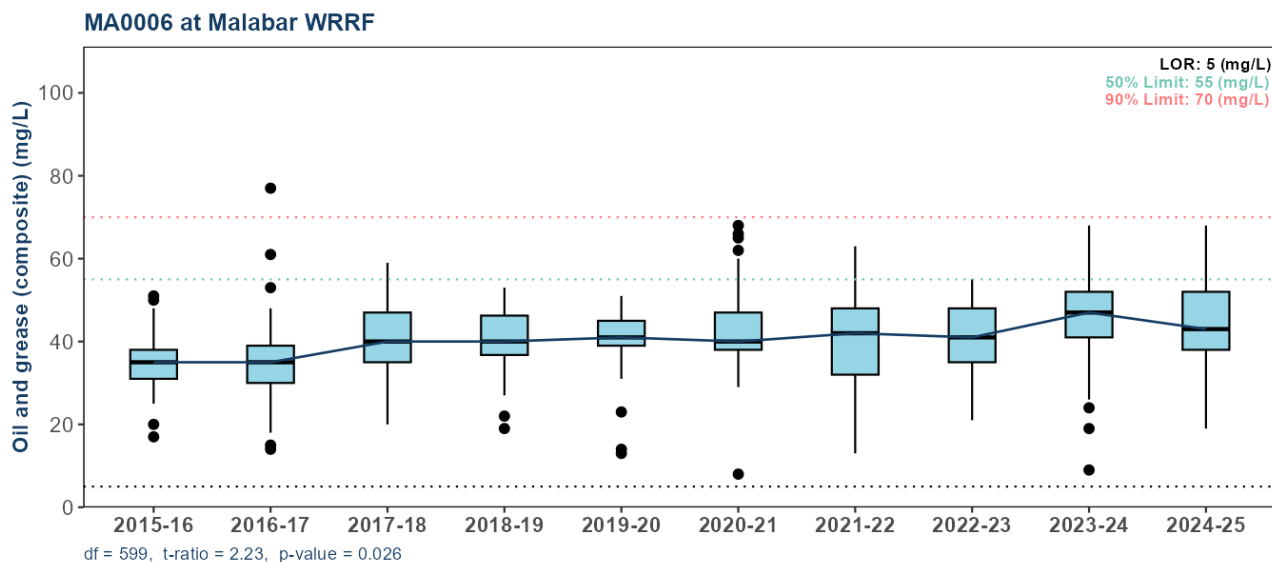
E.3.1. Pressure – Wastewater quantity

Inflow/ Discharge volume and rainfall

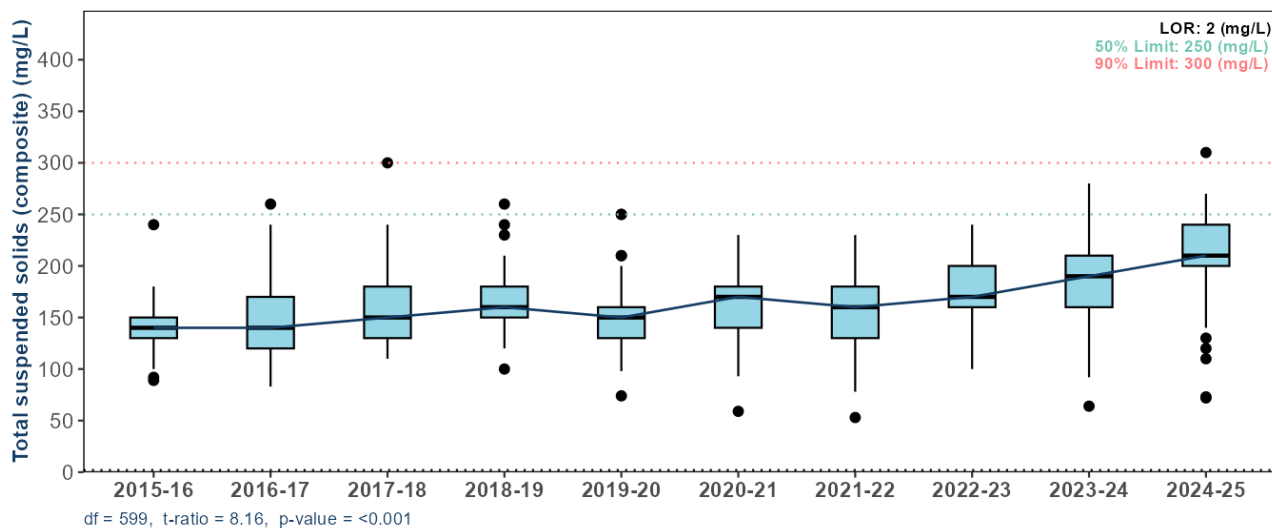


E.3.2. Pressure – Wastewater quality

Major conventional analytes

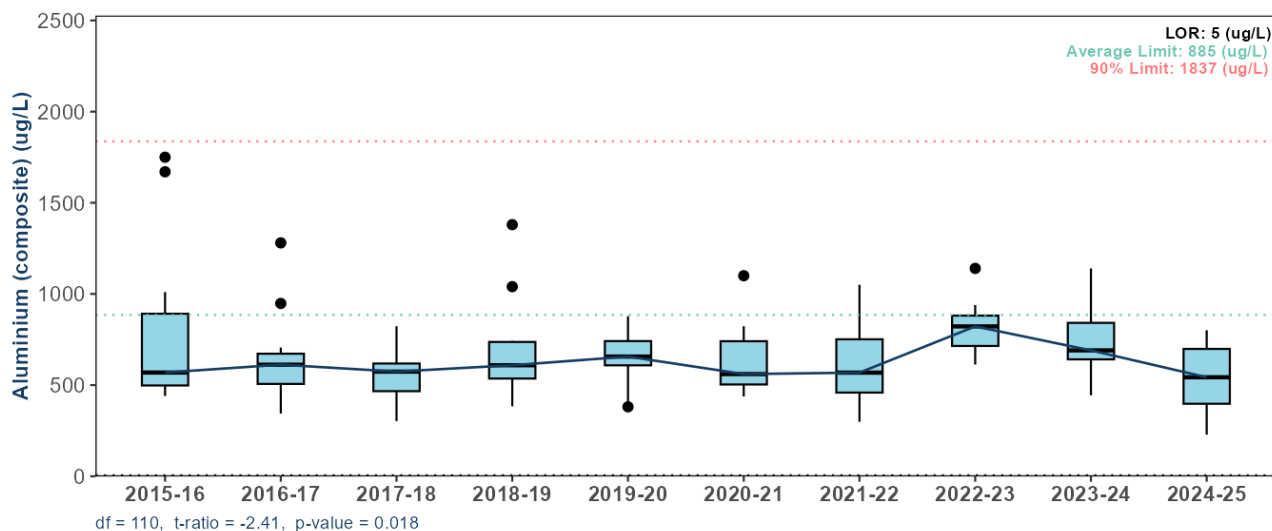


MA0006 at Malabar WRRF



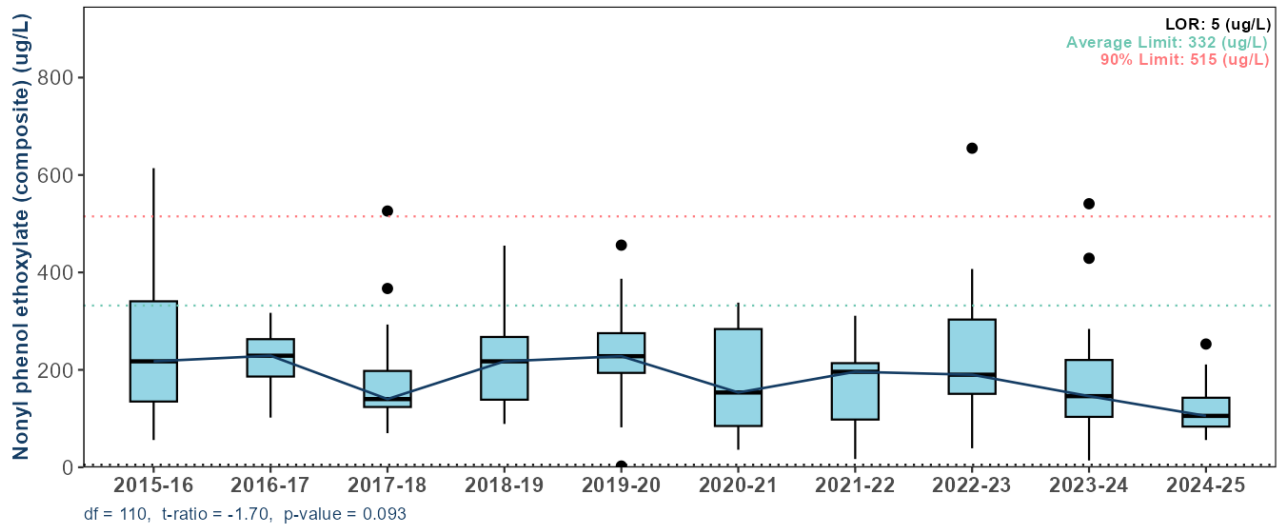
Trace metals

MA0006 at Malabar WRRF

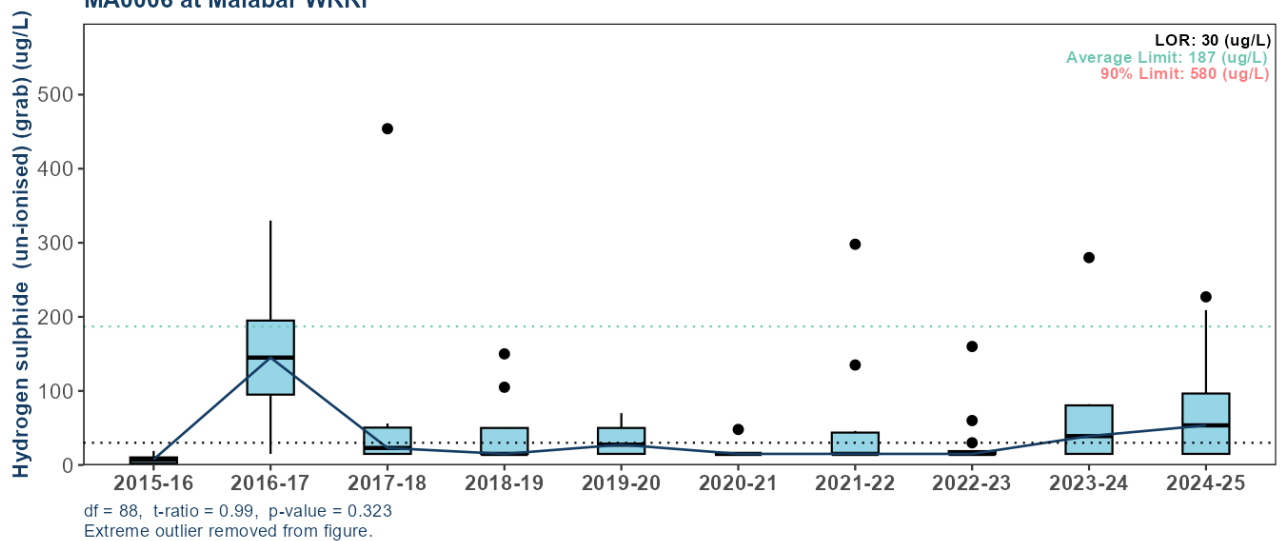


Other chemicals and organics (including pesticides)

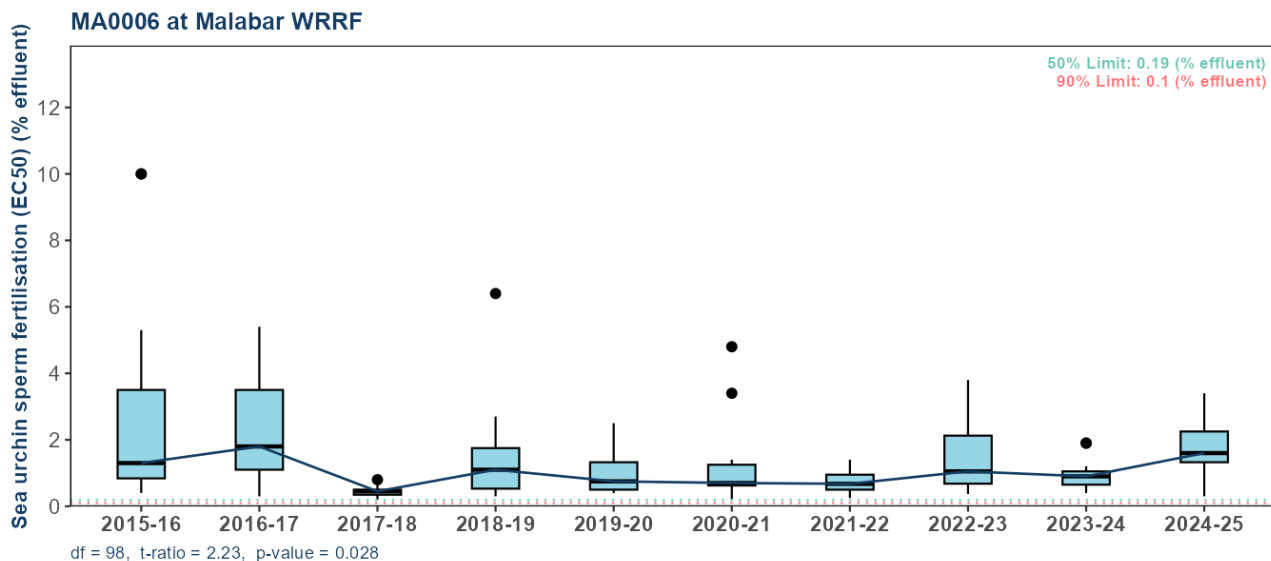
MA0006 at Malabar WRRF



MA0006 at Malabar WRRF

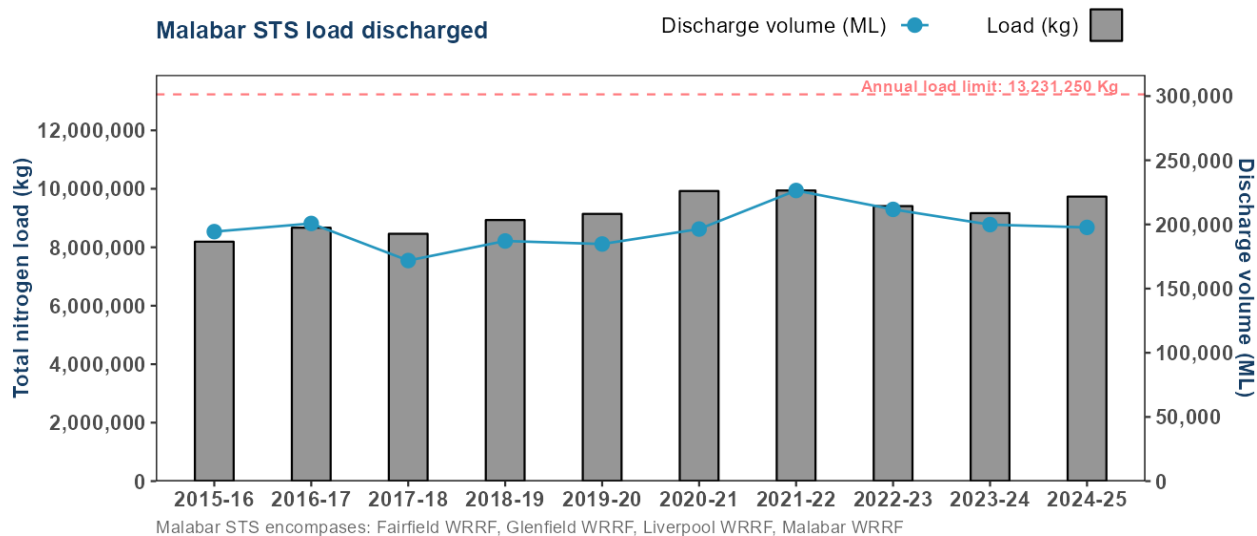


E.3.3. Pressure – Wastewater toxicity

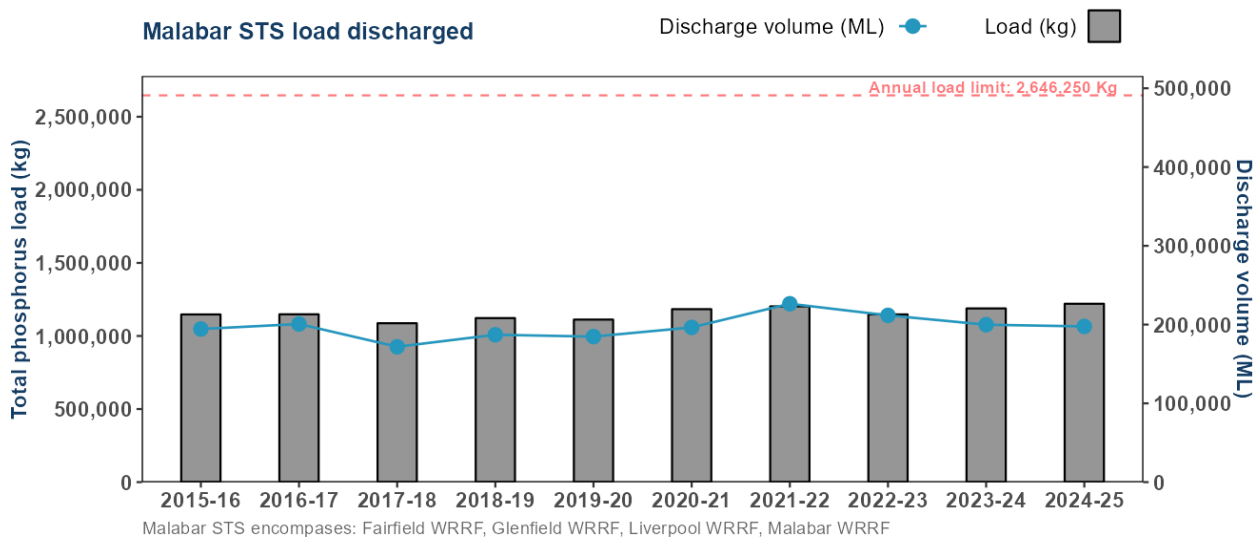


E.3.4. Pressure – Wastewater discharge load

Nutrients

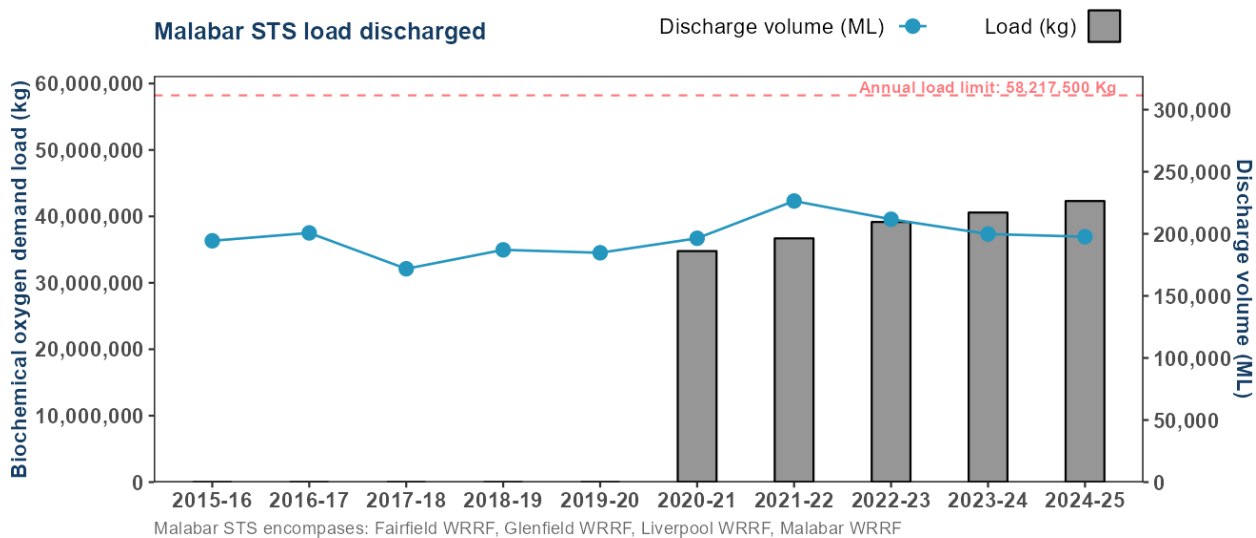


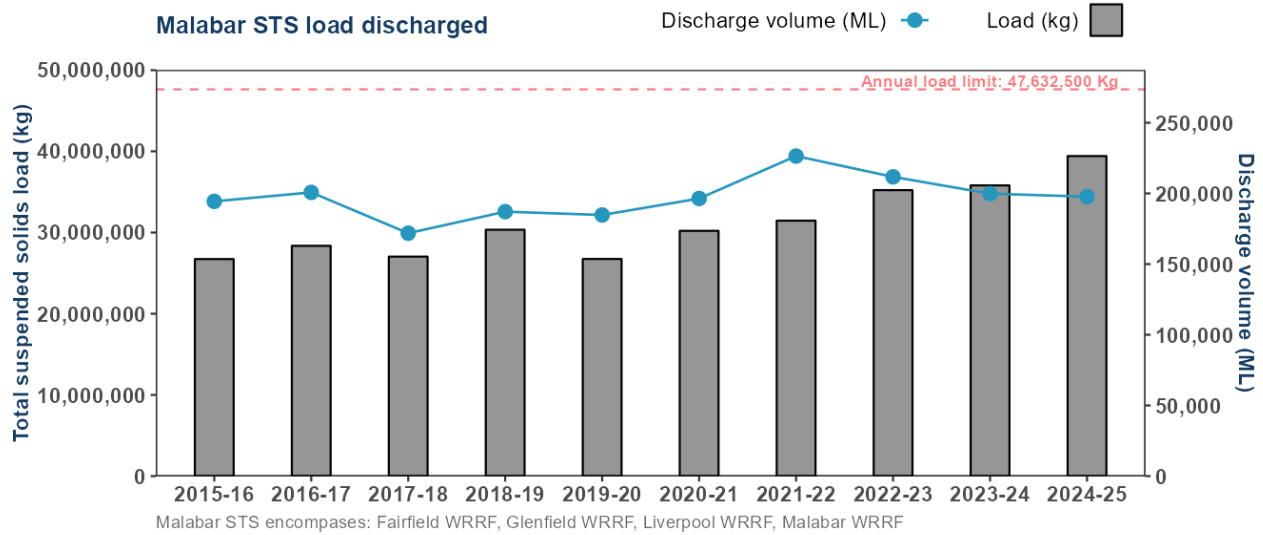
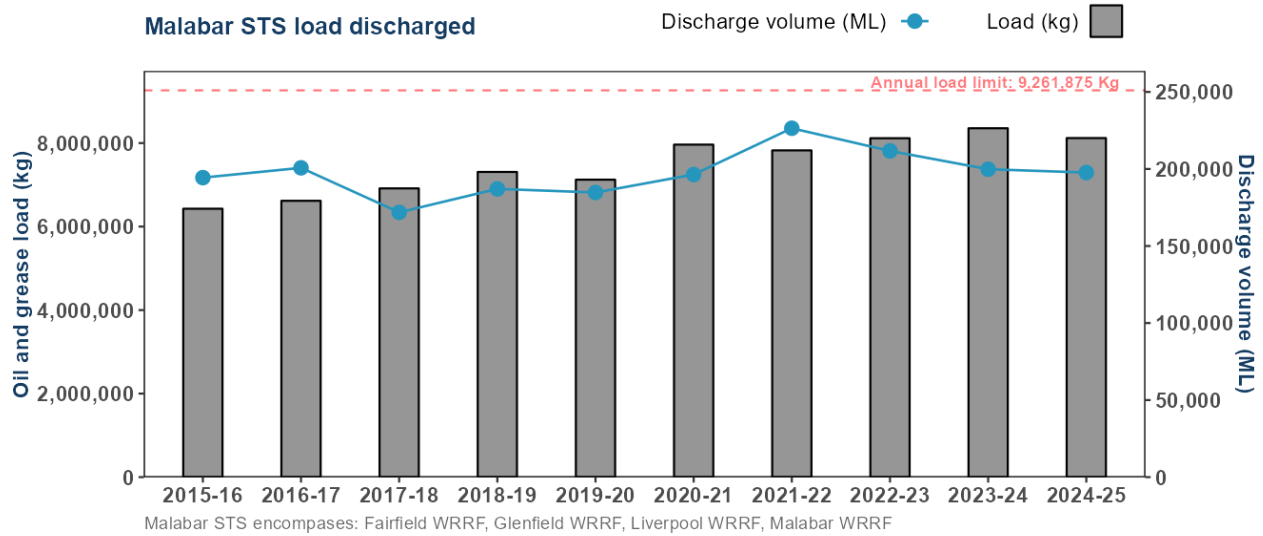
Malabar STS load discharged



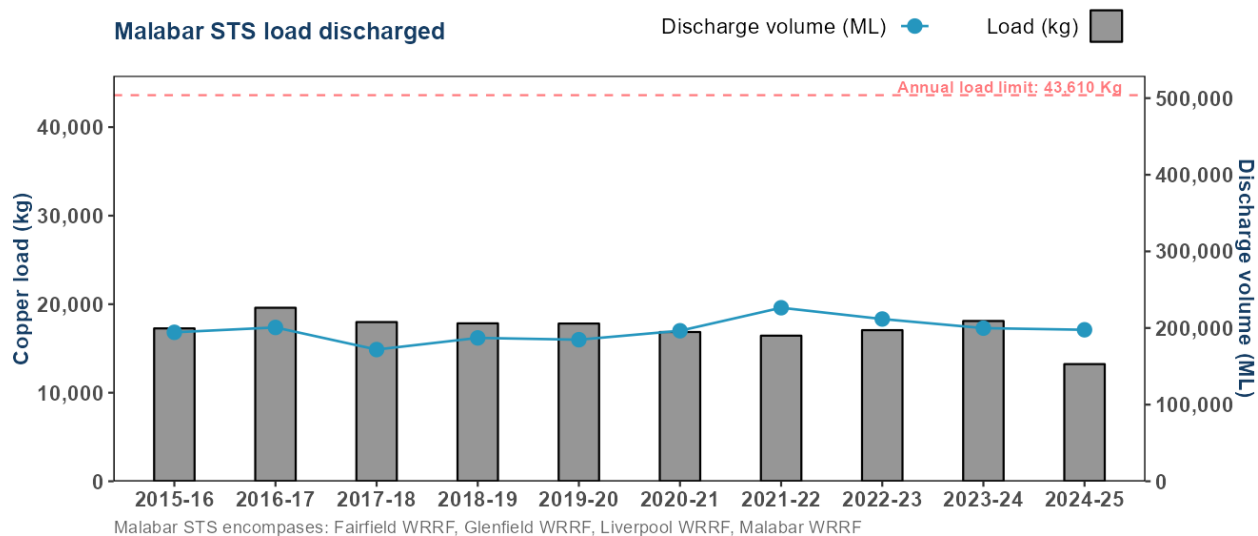
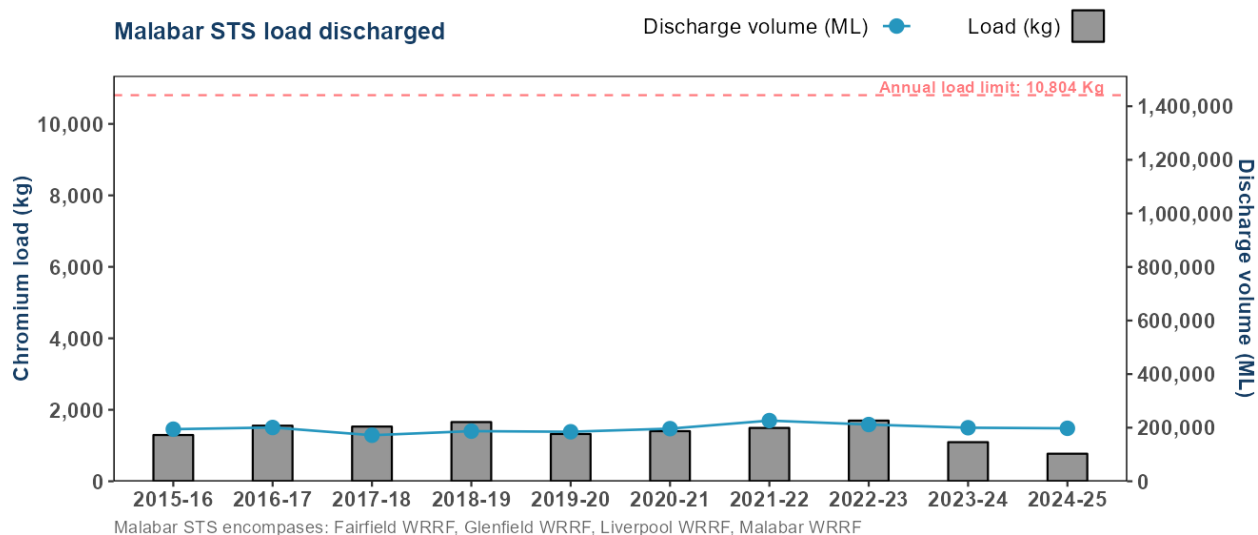
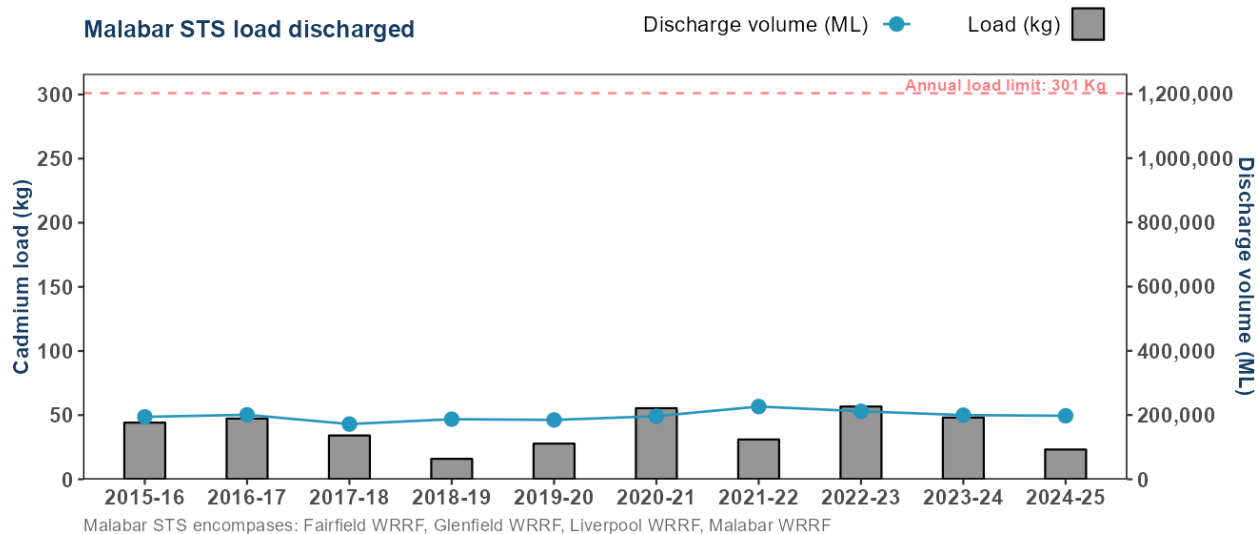
Major conventional analytes

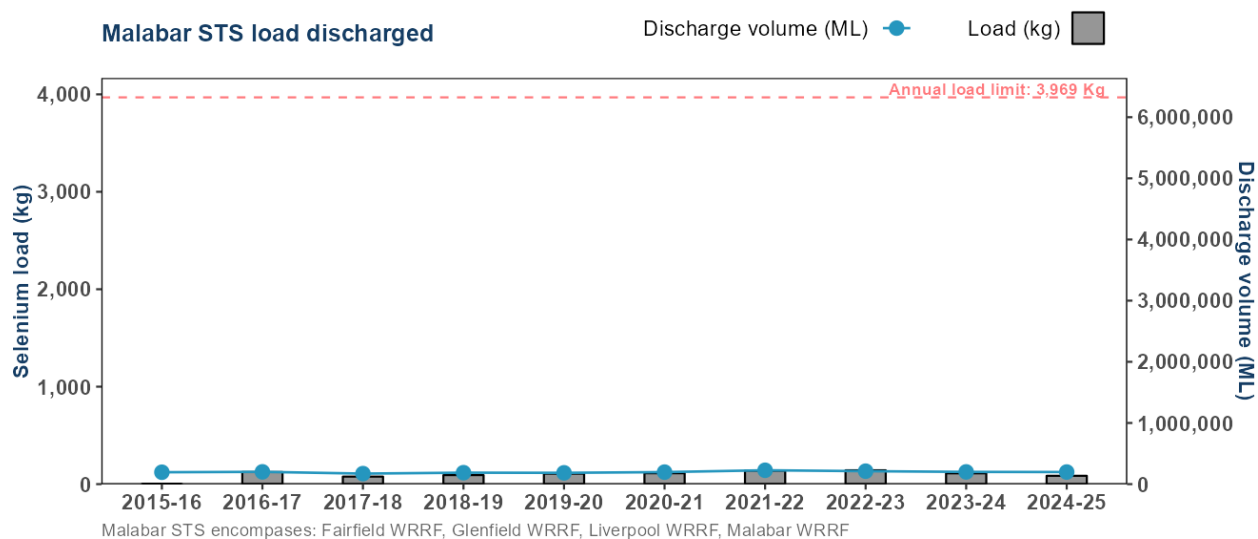
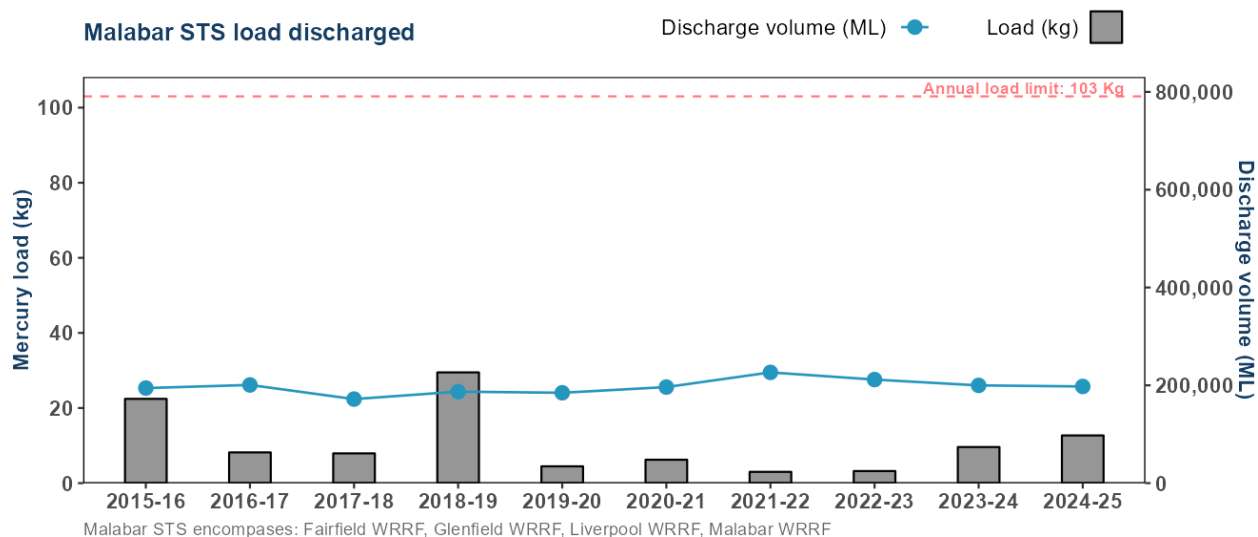
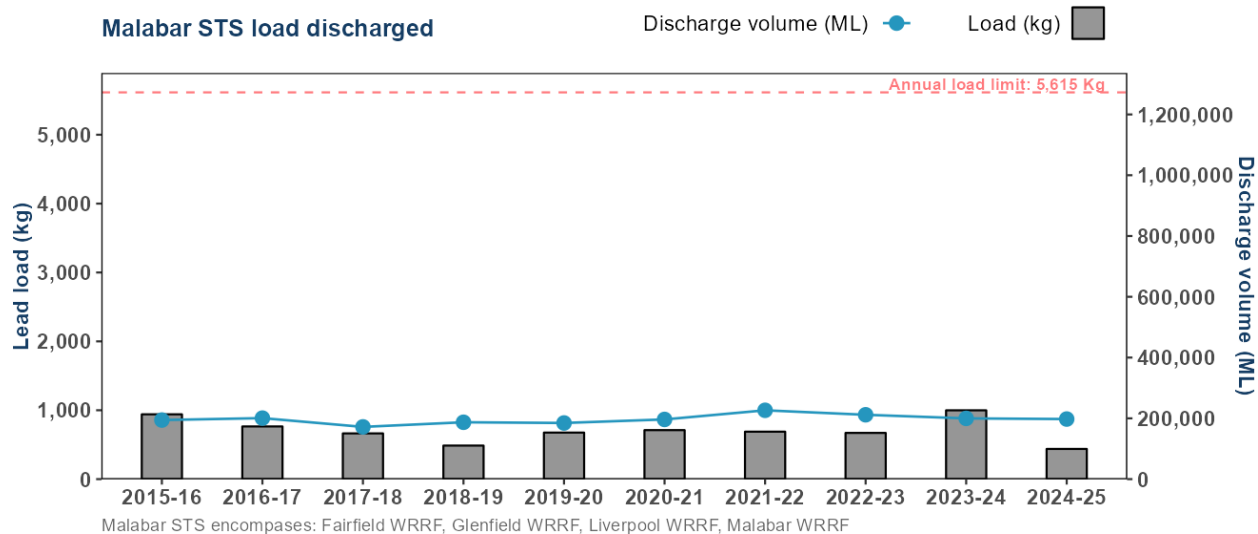
Malabar STS load discharged



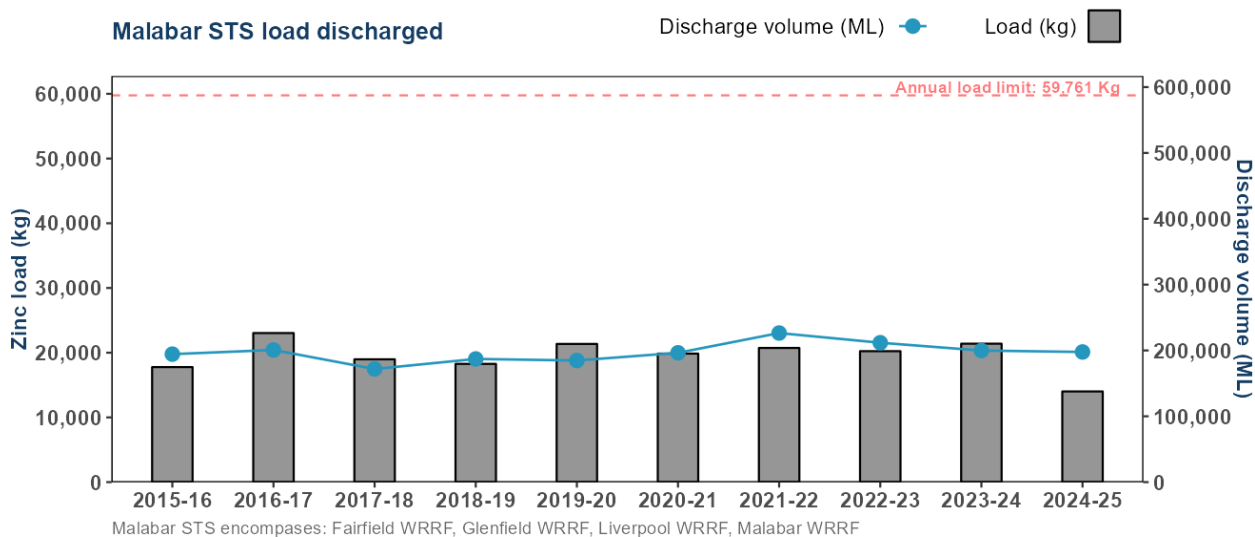


Trace metals



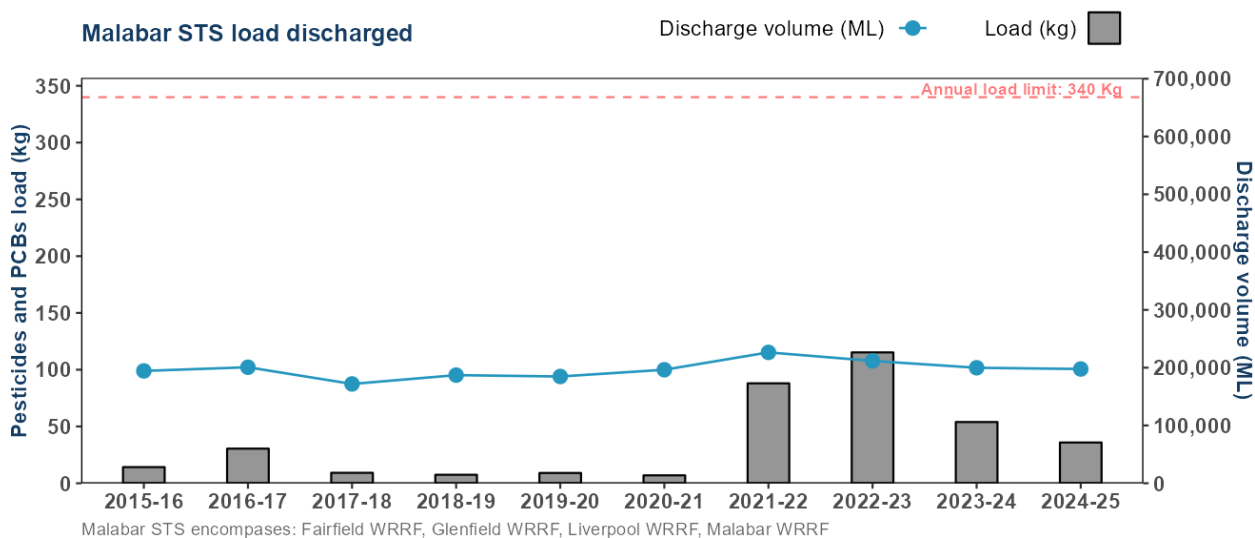


Malabar STS load discharged



Other chemicals and organics (including pesticides)

Malabar STS load discharged



E.4. EPL limits of Offshore discharging WRRFs

Table E-1 EPL concentration limits for the offshore discharging WRRFs (2024-25)

WRRF	Sampling Points	Oil and Grease (mg/L)		Total Suspended (mg/L)		Sea urchin fertilisation (EC50)			Aluminium (µg/L)		Copper (µg/L)		Chlorpyrifos (µg/L)		Nonylphenol ethoxylate (µg/L)		Unionised H ₂ S (µg/L)	
		50th %-ile	90th %-ile	50th %-ile	90th %-ile	50th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile
North Head	NH0008 (C), (G)	55	70	200	250		0.24	0.13	890	1700	160	300	0.09	0.2	178	253	143	270
Bondi	BN0005 (C), (G)	55	70	200	250		0.27	0.16	430	565					179	272	250	510
Malabar	MA0006 (C), (G)	55	70	250	300	0.19		0.1	885	1837					332	515	187	580

Table E-2 EPL load limits for the offshore discharging WRRFs (2024-25)

Load limits (kg)	North Head	Bondi	Malabar
Total Nitrogen	7,957,000	3,832,500	13,231,250
Total Phosphorus	1,909,680	766,500	2,646,250
Biological Oxygen Demand	35,010,800	16,863,000	58,217,500
Total Suspended Solids	35,010,800	11,497,500	47,632,500
Oil & Grease	9,968,880	3,066,000	9,261,875
Cadmium	283	117	301
Chromium	3,011	537	10,804
Copper	37,583	19,760	43,610
Lead	3,568	1,616	5,615
Mercury	60	37	103
Selenium	2,387	1,150	3,969
Zinc	51,066	20,346	59,761
Pesticides	370	62	340

E.5. Offshore marine – stressors and ecosystem receptors

All outcomes from offshore marine stressors and ecosystem receptor data analyses are presented in Volume 3 of this 2024-25 SWAM Interpretive Report.

F. Wastewater overflows

F.1. Wet weather overflows

Table F-1 Trend in wet weather wastewater overflow frequency and volumes for inland WWTPs wastewater system (2018-19 to 2024-25)

Wastewater system	2018-19		2019-20		2020-21		2021-22		2022-23		2023-24		2024-25	
	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)
Picton	0	0	1	7.5	3	1	4	18.4	7	16.2	3	13.1	2	0.1
West Camden	2	1.0	1	65.1	4	105	5	287.2	6	128.6	4	114.3	3	23.1
Wallacia	3	2.2	4	28.6	9	34	7	69.3	2	15.8	3	10.6	1	2.3
Penrith	4	12.2	6	173.0	5	126	11	241.6	8	88.9	5	78.7	5	19.7
Winmalee	1	0.1	2	98.0	1	35	3	15.6	2	16.7	1	19.9	1	3.9
North Richmond	2	0.4	3	15.6	3	37	2	42.5	2	9.8	4	30.0	2	10.3
Richmond	0	0	1	2.1	1	0	3	10.6	1	0	2	5.5	1	0.43
St Marys	10	71.7	6	399.7	6	445	11	864.5	5	473.1	7	240.2	3	19.9
Quakers Hill	8	280.0	4	538.2	8	853	11	1378.0	7	487.4	11	383.4	3	93.9
Riverstone	2	0.5	1	34.9	3	142	5	235.8	5	95.5	9	87.3	2	30.3
Castle Hill	4	4.6	2	75.5	3	63	4	124.8	3	40.3	6	29.4	2	0.1
Rouse Hill	2	8.1	1	111.9	0	124	4	242.0	1	72.0	5	51.0	2	0.7
Hornsby Heights	0	0	1	1.1	1	0	4	0.4	0	0	1	0	0	0.0
West Hornsby	8	42.9	2	91.8	3	60	5	103.0	2	34.0	3	33.2	1	7.2
Brooklyn-Dangar Island	0	0	0	0.0	0	0	0	0.0	0	0	0	0	0	0



Wastewater system	2018-19		2019-20		2020-21		2021-22		2022-23		2023-24		2024-25	
	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)
All inland systems	46	423.7	15	1643	50	2025	79	3633.6	51	1478.3	64	1096.5	28	212.2

MOF: Maximum overflow frequency, SOV: System overflow volume

Table F-2 Trend in wet weather wastewater overflow frequency and volumes for ocean WWTPs wastewater system (2018-19 to 2024-25)

Wastewater system	2018-19		2019-20		2020-21		2021-22		2022-23		2023-24		2024-25	
	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)	MOF	SOV (ML)
Warriewood	2	4.8	5	157.7	2	95	6	247.4	5	23.1	4	43.1	4	3.5
North Head / Northern suburbs	23	3,801.0	16	9,861.0	26	9,300	29	21,127.9	38	3,697.8	31	7,305.4	34	2655.8
Bondi	10	179.5	12	489.1	14	302	18	693.0	20	281.3	21	540.2	18	98.2
Malabar/Southern suburbs	28	6,586.5	18	15,593.2	38	13,207	47	37973.0	41	16,866.8	37	15,297.9	42	4415.5
Cronulla	8	28.0	9	659.7	7	361	15	1281.0	12	1,147.2	13	587.5	9	102.4
Wollongong	5	25.0	2	59.3	6	34	10	189.3	8	217.9	11	198.5	5	11.3
Bellambi	19	46.2	4	159.8	8	70	10	340.5	23	1,387.7	17	1,278.3	9	104.4
Port Kembla	4	6.7	2	142.4	9	113	13	348.7	19	475.6	16	224.1	8	33.6
Shellharbour	4	2.6	1	106.3	7	167	16	302.1	9	561.8	9	484.5	2	134.8
Kiama/Bombo	6	4.1	2	3.0	9	173	13	452.7	14	288.7	13	256.4	9	69.1
All ocean systems	109	10,684.4	71	27,232	126	23,821	177	62,955.6	189	26,426.2	172	26,215.9	140	7628.5

MOF: Maximum overflow frequency, SOV: System overflow volume

F.2. Dry weather overflows that reach waterways

Table F-3 Trend in dry weather wastewater overflow that reach waterways, frequency and volumes for inland wastewater systems (2018-19 to 2024-25)

Wastewater system	2018-19		2019-20		2020-21		2021-22		2022-23		2023-24		2024-25	
	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)
Picton	3	45	4	28	0	0	1	1	2	3	0	0	2	30
West Camden	1	7	3	35	4	29	9	287	4	41	4	95	12	500
Wallacia	1	9	0	0	1	21	0	0	0	0	0	0	1	0
Penrith	3	73	10	180	4	210	7	303	4	86	16	357	12	510
Winmalee	8	180	5	99	23	364	9	304	4	66	10	128	17	440
North Richmond	2	14	1	6	0	0	0	0	0	0	0	0	0	0
Richmond	0	0	0	0	0	0	1	5	1	1	1	1	0	0
St Marys	4	170	8	192	4	111	4	45	6	59	6	336	13	850
Quakers Hill	10	866	4	130	5	85	12	167	1	14	9	186	16	840
Riverstone	1	57	2	36	0	0	2	60	2	3	2	54	0	0
Castle Hill	8	213	2	20	3	61	8	235	2	16	12	241	7	100
Rouse Hill	9	318	8	163	8	78	3	51	3	33	17	499	4	60
Hornsby Heights	4	37	9	147	12	99	10	35	4	38	15	94	9	60
West Hornsby	9	391	5	100	9	319	11	292	8	517	17	217	9	120
Brooklyn	0	0	0	0	0	0	0	0	1	1	0	0	0	0
All inland systems	63	2,380	61	1,138	73	1,377	77	1,785	42	878	109	2,208	102	3,510

Table F-4 Trend in dry weather wastewater overflow that reach waterways, frequency and volumes for coastal WWTPs wastewater system (2018-19 to 2024-25)

Wastewater system	2018-19		2019-20		2020-21		2021-22		2022-23		2023-24		2024-25	
	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)	Frequency	Volume (KL)
Warriewood	3	27	7	55	9	87	16	189	9	47	21	143	10	100
North Head / Northern suburbs	170	16,151	176	7,948	155	6,215	103	2,850	88	2,958	167	5,477	149	48,430
Bondi	30	1,424	22	1,480	28	2,599	26	1,223	28	2,752	21	1,031	31	1,400
Malabar/Southern suburbs	79	6,853	133	9,530	133	11,072	82	7,614	80	7,033	103	13,417	99	5,670
Cronulla	54	2,279	41	693	29	311	26	522	18	334	36	573	38	2,400
Wollongong	28	551	27	649	26	276	23	1,011	14	163	21	360	25	200
Port Kembla	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shellharbour	3	42	4	172	5	527	5	51	5	28	8	118	6	120
Kiama/Bombo	2	34	2	39	3	39	4	99	0	0	1	70	3	20
All ocean systems	369	27,361	412	20,567	388	21,126	285	13,559	242	13,315	378	21,190	361	58,340



G. Recreational water quality – Harbour and beaches

The analysis of the Beachwatch data has been designed to identify potential wastewater overflows or leakage under dry weather conditions. Overflows or leakage reaching the waterways during dry weather conditions pose a risk to public health. The public health risk for recreational activities in waterways (harbour and beaches) following wet weather is well known.

Assumptions behind the data for Beachwatch analysis:

- *Enterococci* results without a respective conductivity value were excluded. Conductivity results for various sites were not available mainly due to instrument failures at the time of collecting samples. Conductivity data is required to separate dry weather data from wet weather data.
- Only dry weather results were included in these plots. *Enterococci* results associated with conductivity below 30,000 $\mu\text{S}/\text{cm}$ were considered wet weather and not included in these plots.
- Data labels: Maximum *Enterococci* values for each financial year were labelled where *Enterococci* values ≥ 35 cfu/100mL, which is the primary contact recreation guideline (ANZG 2018).
- Bubble colour: Bubbles where *Enterococci* values < 35 cfu/100mL are blue, bubbles where *Enterococci* values ≥ 35 cfu/100mL are orange and bubbles where *Enterococci* values ≥ 230 cfu/100mL are orange with a red outer ring.
- Bubble size: Bubble sizes are comparable between sites. Actual bubble size is in the range of 0 to 70 which reflect *Enterococci* counts of 0 cfu/100mL to 70,000 cfu/100mL (min to max *Enterococci* count for last 10-year period).

The Beachwatch results are presented in the following order, similar to monitoring programs and sub-catchments as stated in the method section of Volume 1:

Sydney Beaches

- Northern Sydney
- Central Sydney
- Southern Sydney

Illawarra Beaches

- Wollongong
- Shellharbour
- Bombo

Harbours

- Botany Bay and Georges River
- Port Hackings

- 
- 
- Port Jackson
 - Middle Harbour
 - Pittwater

The sites under each sub-catchment are presented in the order from north coast to south coast. When the sub-catchment is a harbour with sites on both coasts then sites on south coasts were stated first and then following clockwise direction to the north coast.

Table G-1 Investigated dry weather *Enterococci* exceptions data (≥ 35 cfu/100mL) based on catchment rainfall condition (2024-25) (72hr rain ≤ 2 mm)

Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (μ S/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
Sydney Coastal Beaches						
Bondi Beach	28/11/2024	81	53400	0	66098	Rose Bay (Royal Sydney Golf Club)
	16/12/2024	60	53200	0		
	24/01/2025	62	54500	0.6		
	25/02/2025	120	55000	0		
Bronte Beach	5/12/2024	44	54100	0.4	66052	Randwick (Randwick St)
Clovelly Beach	16/12/2024	72	54200	0	66052	Randwick (Randwick St)
	27/06/2025	100	52900	1.8		
Coogee Beach	28/11/2024	41	53400	0	66052	Randwick (Randwick St)
	5/12/2024	80	54000	0.4		
	14/01/2025	45	53300	0		
	25/02/2025	50	54400	0		
Gordons Bay (East)	12/11/2024	42	54000	0.8	66052	Randwick (Randwick St)
	24/01/2025	42	54300	0.8		
Little Bay Beach	5/12/2024	140	54108	0	66037	Sydney Airport AMO
	14/01/2025	180	53500	0.2		
	25/02/2025	120	54300	0		
	8/05/2025	44	51500	0.4		
	27/06/2025	39	53300	1.4		
Malabar Beach	28/11/2024	60	54100	0	66052	Randwick (Randwick St)




Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
	5/12/2024	68	54600	0.4		
	16/12/2024	96	54000	0		
	14/01/2025	190	54200	0		
	24/01/2025	36	53600	0.8		
	25/02/2025	52	54200	0		
	8/05/2025	160	52000	0.4		
Maroubra Beach	14/01/2025	40	54600	0	66052	Randwick (Randwick St)
South Maroubra Rockpool	6/08/2024	35	53600	0	66052	Randwick (Randwick St)
Tamarama Beach	11/06/2025	450	53100	1.6	66098	Rose Bay (Royal Sydney Golf Club)
Bilarong Reserve	15/07/2024	40	39750	0	66126	Collaroy (Long Reef Golf Club)
	5/11/2024	190	47600	0		
	13/12/2024	120	46800	0		
	27/02/2025	55	46400	0		
	24/06/2025	3200	46000	0		
Bungan Beach	13/12/2024	59	54800	0	66141	Mona Vale Golf Club
	17/03/2025	43	54200	0	66059	Terrey Hills AWS
Collaroy Beach	5/11/2024	52	54200	0	66126	Collaroy (Long Reef Golf Club)
	13/12/2024	56	54400	0		
Freshwater Beach	13/12/2024	140	54300	0	66126	Collaroy (Long Reef Golf Club)
	27/02/2025	85	54100	0		
Long Reef Beach	3/04/2025	46	52400	1.4	66126	Collaroy (Long Reef Golf Club)

Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
Mona Vale Beach	13/12/2024	100	54400	0	66141	Mona Vale Golf Club
	27/02/2025	130	54200	0.2	66059	Terrey Hills AWS
Narrabeen Lagoon (Birdwood Park)	30/10/2024	42	54200	0	66141	Mona Vale Golf Club
	13/12/2024	190	54700	0		
Queenscliff Beach	13/12/2024	110	55200	0	66126	Collaroy (Long Reef Golf Club)
	3/04/2025	150	46500	1.4		
Shelly Beach (Manly)	13/12/2024	200	54700	0	66126	Collaroy (Long Reef Golf Club)
	27/02/2025	240	54200	0		
South Steyne Beach	13/12/2024	270	54200	0	66126	Collaroy (Long Reef Golf Club)
Boat Harbour	12/11/2024	36	52600	0	66058	Sans Souci (Public School)
	28/11/2024	120	54700	2		
	20/12/2024	70	52900	0		
	27/06/2025	140	53900	1		
South Cronulla Beach	14/01/2025	150	54300	1	66058	Sans Souci (Public School)
Sydney Harbour and Estuaries						
Brighton Le Sands Baths	4/11/2024	46	52300	0.6	66037	Sydney Airport AMO
	22/01/2025	290	50000	0		
Congwong Bay	31/10/2024	78	54400	0	66037	Sydney Airport AMO
	25/02/2025	35	54100	0		
Foreshores Beach	23/10/2024	41	52000	0	66037	Sydney Airport AMO
	30/12/2024	130	54200	0.8		




Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
	22/01/2025	52	49600	0		
	20/02/2025	46	50400	0		
Frenchmans Bay	18/09/2024	55	52400	0	66037	Sydney Airport AMO
	20/02/2025	41	54100	0		
Kyeemagh Baths	30/12/2024	130	52600	0.8	66037	Sydney Airport AMO
	05/02/2025	42	53200	0		
Monterey Baths	11/12/2024	62	51400	0	66058	Sans Souci (Public School)
Ramsgate Baths	18/12/2024	210	51100	0	66058	Sans Souci (Public School)
	30/12/2024	150	53500	2		
Yarra Bay	18/09/2024	55	52400	0	66037	Sydney Airport AMO
	30/12/2024	47	55200	0.8		
	05/02/2025	42	54100	0		
	26/02/2025	37	53500	0		
	19/06/2025	39	50800	0.2		
Carss Point Baths	23/10/2024	55	50800	0	66058	Sans Souci (Public School)
	29/10/2024	46	46500	0		
	4/11/2024	410	51000	1		
	30/12/2024	35	52400	2		
	7/04/2025	52	50100	0		
Como Baths	19/03/2025	120	48000	0	66148	Peakhurst Golf Club
Dolls Point Baths	22/01/2025	72	47100	1	66058	Sans Souci (Public School)

Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
	13/05/2025	54	47410	1		
Jew Fish Bay Baths	29/10/2024	37	47200	0	66148	Peakhurst Golf Club
Oatley Bay Baths	13/05/2025	110	42130	1	66058	Sans Souci (Public School)
Sandringham Baths	20/02/2025	120	49400	0	66058	Sans Souci (Public School)
Clontarf Pool	19/03/2025	46	53400	0	66011	Chatswood Bowling Club
Davidson Reserve	28/01/2025	46	44240	1.2	66188	Belrose (Evelyn Place)
	03/03/2025	35	49500	0.8		
Fairlight Beach	27/03/2025	820	49100	0	66188	Belrose (Evelyn Place)
Gurney Crescent Baths	24/09/2024	40	53400	0	66011	Chatswood Bowling Club
	19/03/2025	36	52400	0		
Little Manly Cove	1/11/2024	160	53000	0	66126	Collaroy (Long Reef Golf Club)
	19/02/2025	50	53700	0		
	27/03/2025	760	49700	1.6		
Manly Cove	1/11/2024	81	53000	0	66126	Collaroy (Long Reef Golf Club)
	15/01/2025	46	53700	0		
	27/03/2025	38	49200	1.6		
Northbridge Baths	7/11/2024	320	52100	1	66011	Chatswood Bowling Club
	27/12/2024	320	53400	1		
Bayview Baths	8/10/2024	41	53400	1.6	66141	Mona Vale Golf Club
	21/11/2024	35	53100	0.2		
	23/01/2025	60	53200	1		




Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
	04/02/2025	80	53300	0.2		
	17/02/2025	120	53600	0.6		
	2/06/2025	350	48700	0	66059	Terrey Hills AWS
Elvina Bay	13/12/2024	36	54100	0	66141	Mona Vale Golf Club
Gunnamatta Bay Baths	18/09/2024	43	53500	0	66058	Sans Souci (Public School)
	30/12/2024	38	54500	2		
	22/01/2025	42	52100	1		
Gymea Bay Baths	11/10/2024	60	52400	0	66176	Audley (Royal National Park)
	5/12/2024	100	40170	0		
	22/01/2025	76	47500	0		
	05/02/2025	64	53000	0		
	20/02/2025	80	53400	0		
	7/04/2025	43	47500	0		
Lilli Pilli Baths	05/02/2025	58	53700	0	66176	Audley (Royal National Park)
Chiswick Baths	24/09/2024	170	52200	0	66034	Abbotsford (Blackwall Point Rd)
Dawn Fraser Pool	27/03/2025	70	49600	1	66214	Sydney (Observatory Hill)
Greenwich Baths	7/05/2025	44	52400	1.6	66214	Sydney (Observatory Hill)
Parsley Bay	16/07/2024	93	43610	0	66098	Rose Bay (Royal Sydney Golf Club)
	24/09/2024	190	52500	0		
Parsley Bay	19/03/2025	68	53600	0	66098	Rose Bay (Royal Sydney Golf Club)
Woodford Bay	16/07/2024	67	49000	0	66214	Sydney (Observatory Hill)



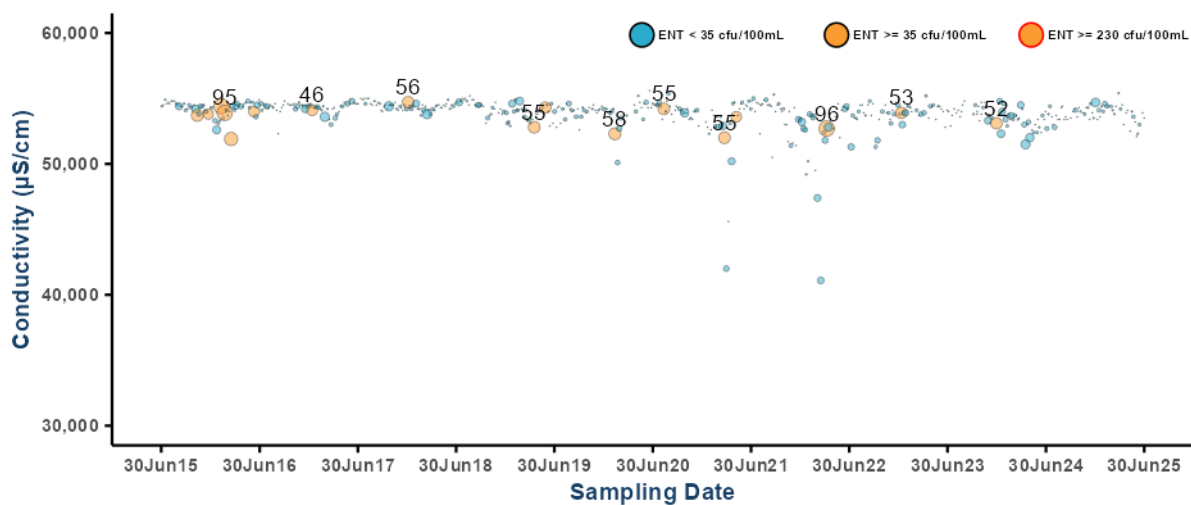
Name	Date	Enterococci (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
	2/10/2024	48	48500	0	66011	Chatswood Bowling Club
Woolwich Baths	16/07/2024	52	49100	0	66034	Abbotsford (Blackwall Point Rd)
	20/08/2024	70	50900	0		
	03/03/2025	58	51000	0		
Illawarra Beaches						
Boyds Jones Beach	01/02/2025	360	54000	0	68242	Kiama (Bombo Headland)
	25/02/2025	44	54600	0.8		
	15/03/2025	57	54000	0.2		
Surf Beach Kiama	02/01/2025	130	54400	1.2	68252	Kiama (Brighton St)
	01/02/2025	360	54000	0		
Entrance Lagoon Beach	9/11/2024	190	52000	1	68246	Blackbutt (Tammar Place)
	01/02/2025	130	53600	0		
	03/03/2025	46	54400	0		
	2/04/2025	680	50500	0.6		
Bellambi Beach	25/02/2025	58	54200	1.4	68228	Bellambi AWS
	14/04/2025	41	53500	0		
Bulli Beach	8/04/2025	330	53800	0	68228	Bellambi AWS
Coniston Beach	24/07/2024	59	54600	0	68228	Bellambi AWS
	20/04/2025	39	53600	0		
Fishermans Beach	27/03/2025	490	53700	0	68246	Blackbutt (Tammar Place)
North Wollongong Beach	27/03/2025	38	53700	1.8	68228	Bellambi AWS



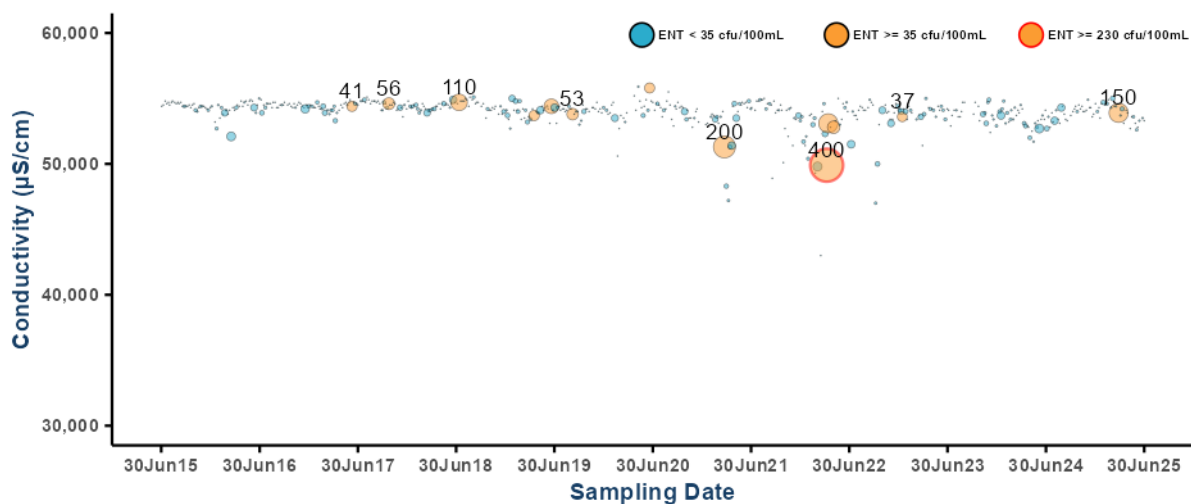
Name	Date	<i>Enterococci</i> (cfu/100mL)	Conductivity (µS/cm)	72 hours Rain (mm)	Station Number	Rainfall Station Name
Port Kembla Beach	02/01/2025	35	54400	0	68246	Blackbutt (Tammar Place)
Wollongong City Beach	03/03/2025	120	54000	0	68228	Bellambi AWS

G.1. Sydney Beaches: Northern Sydney

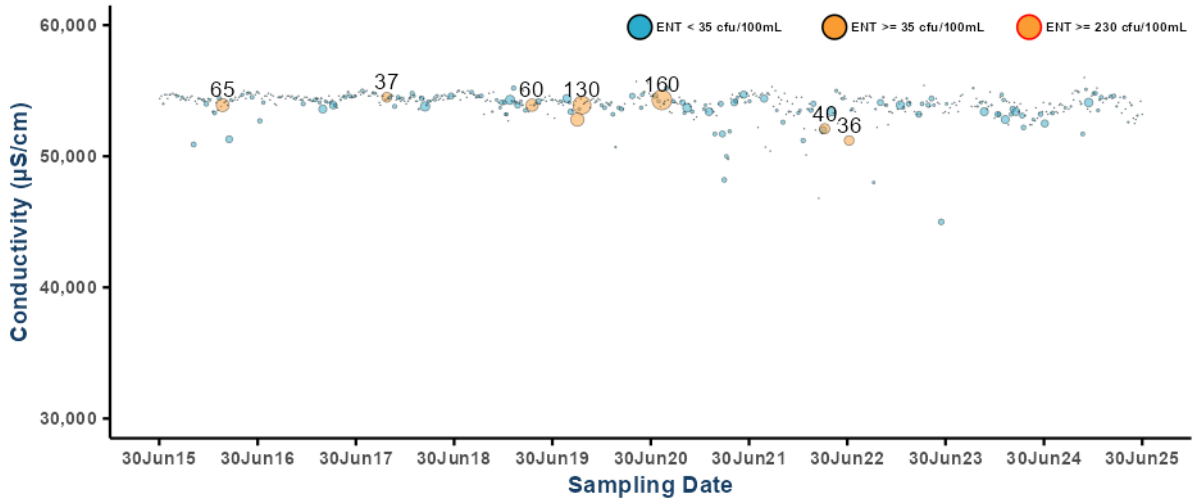
Palm Beach: Enterococci (cfu/100mL)



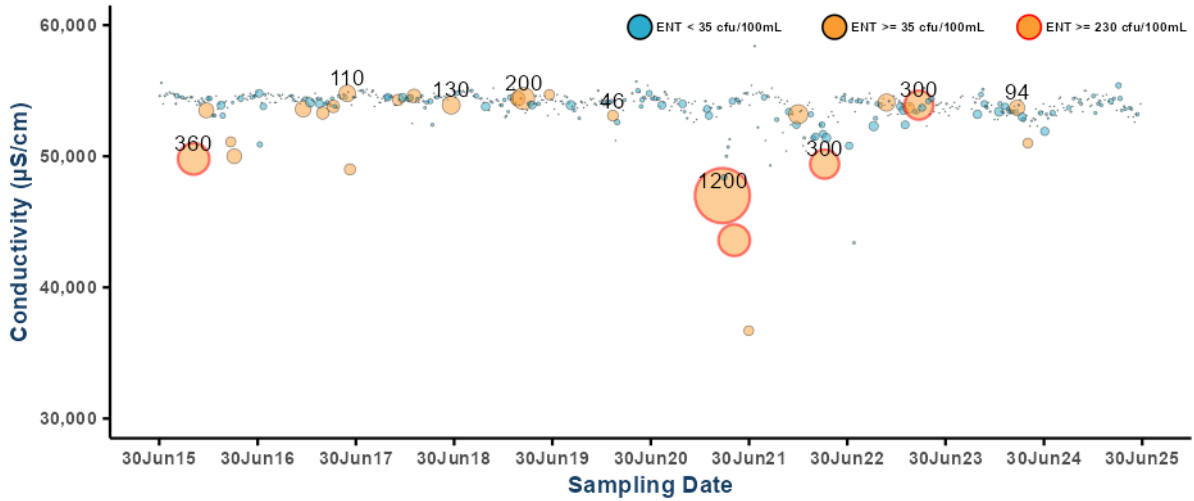
Whale Beach: Enterococci (cfu/100mL)



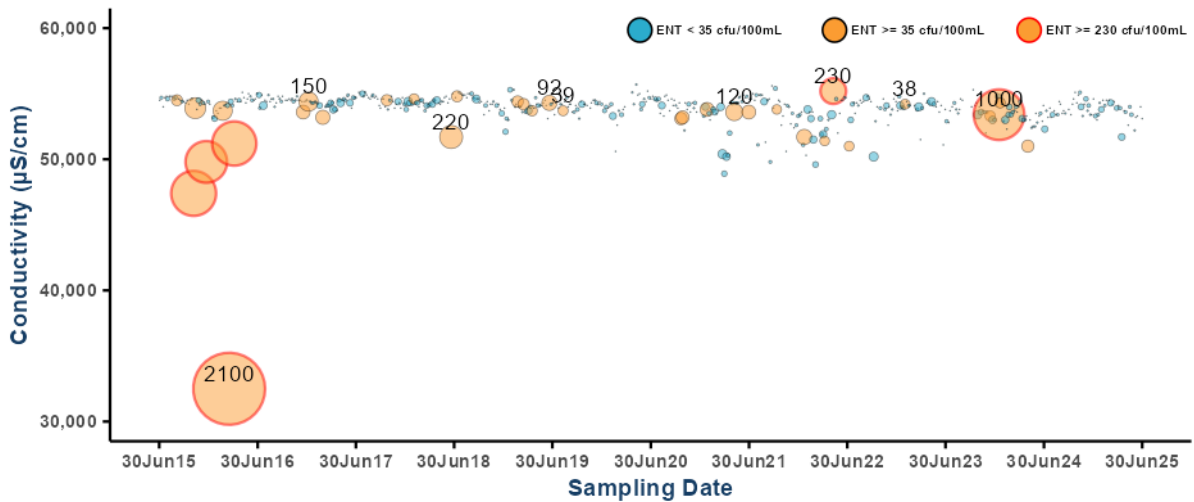
Avalon Beach: Enterococci (cfu/100mL)



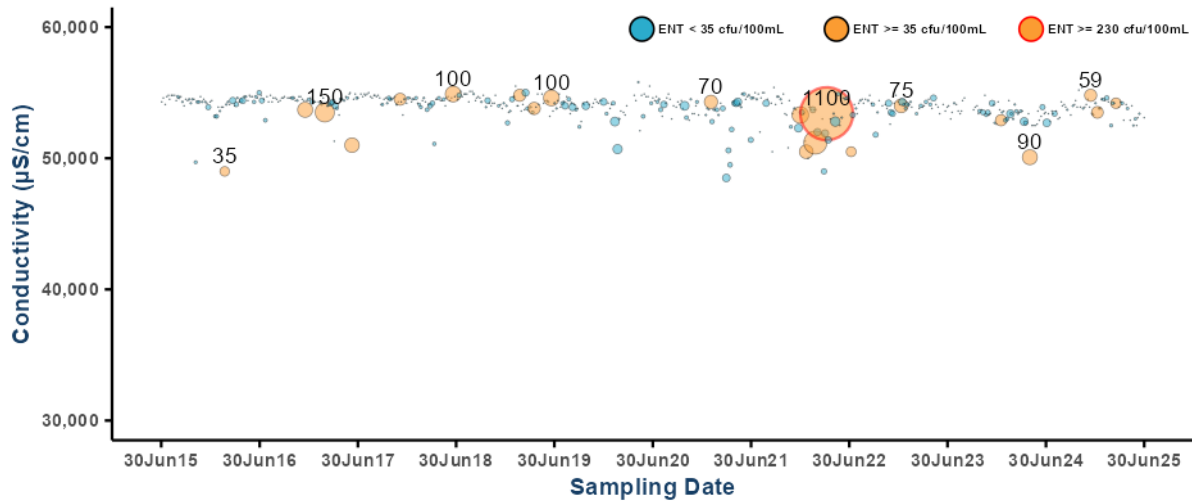
Bilgola Beach: Enterococci (cfu/100mL)



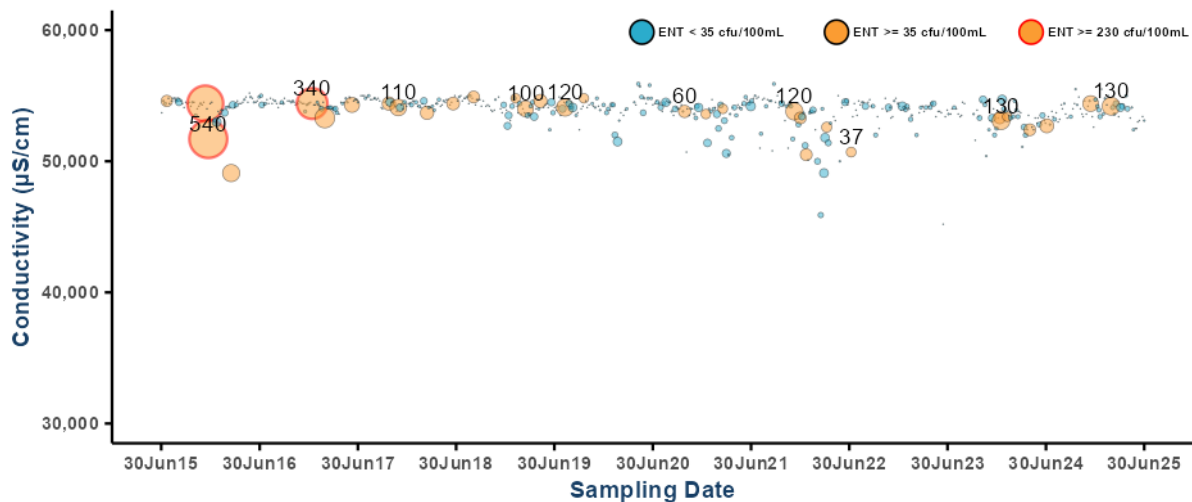
Newport Beach: Enterococci (cfu/100mL)



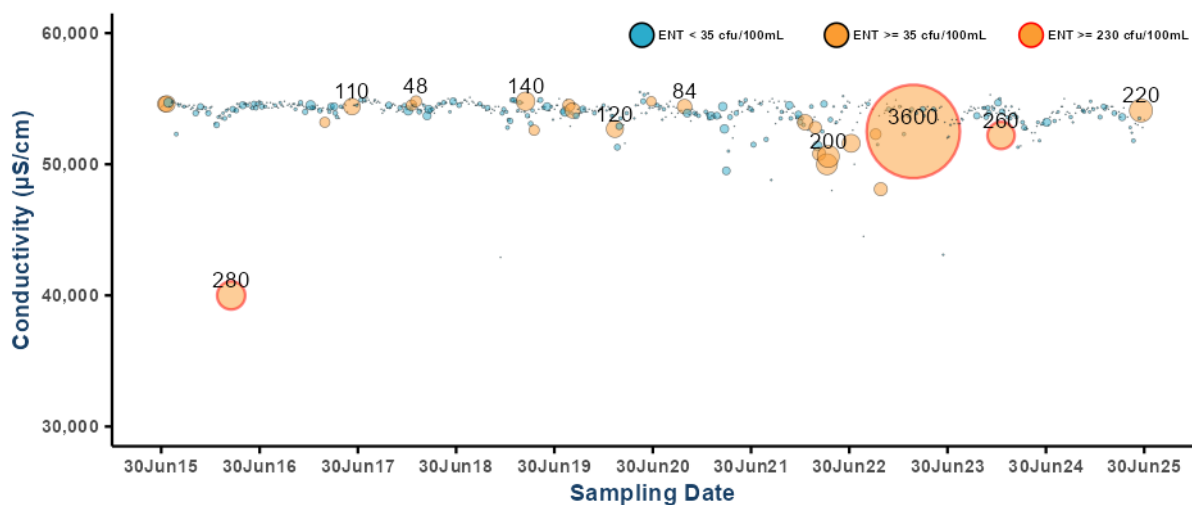
Bungan Beach: Enterococci (cfu/100mL)



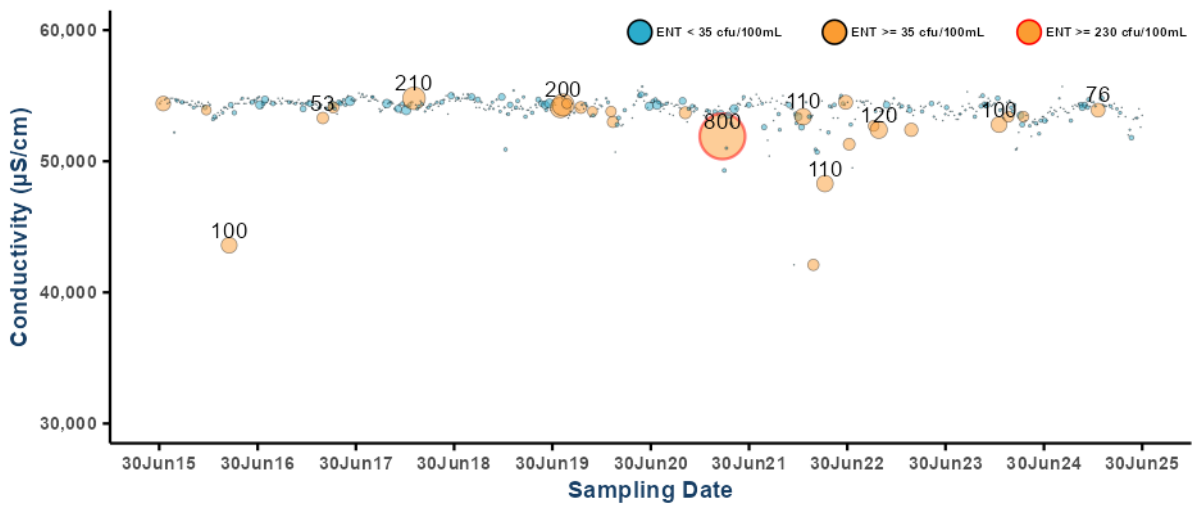
Mona Vale Beach: Enterococci (cfu/100mL)



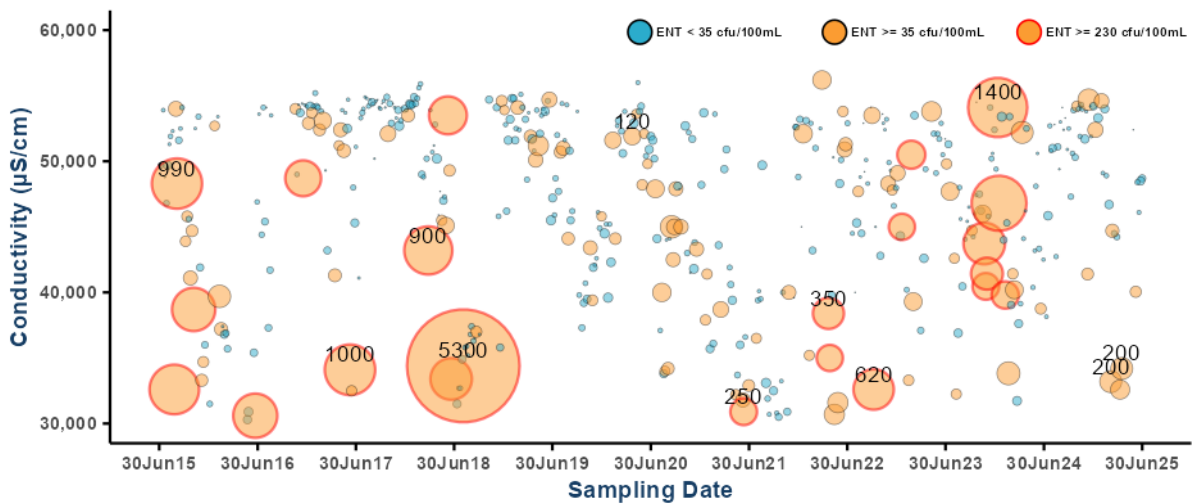
Warriewood Beach: Enterococci (cfu/100mL)



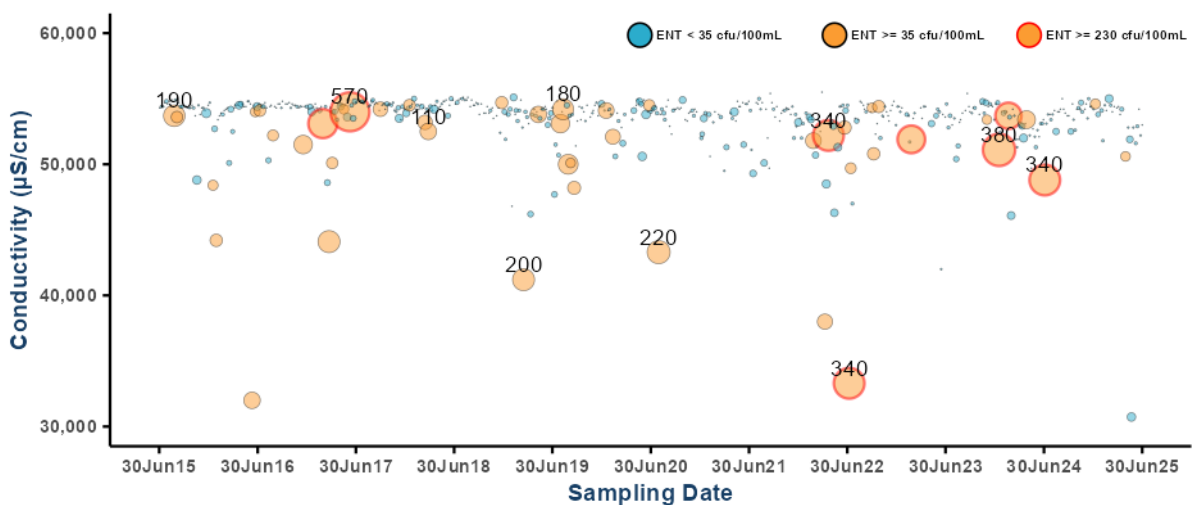
Turimetta Beach: Enterococci (cfu/100mL)



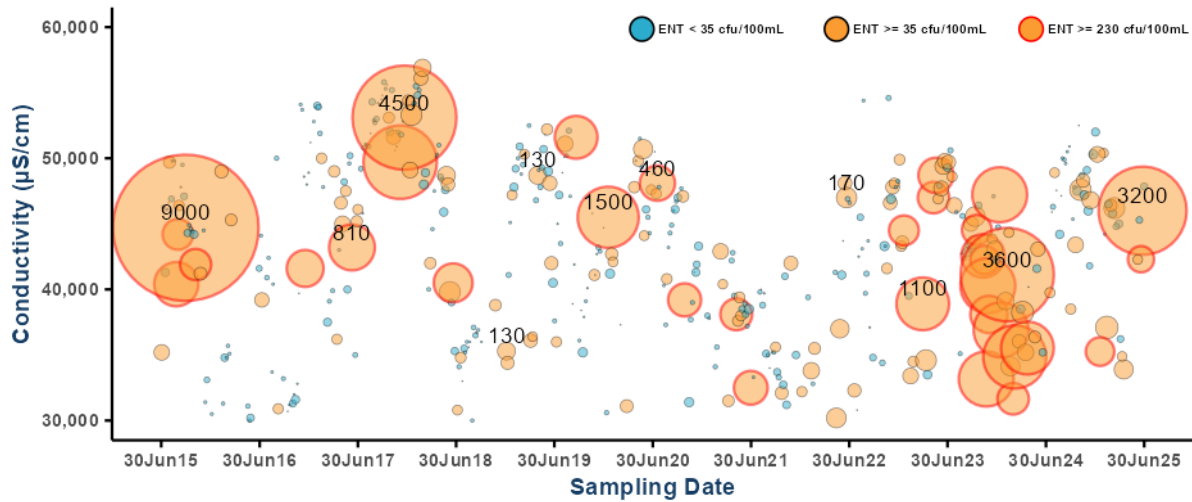
Narrabeen Lagoon (Birdwood Park): Enterococci (cfu/100mL)



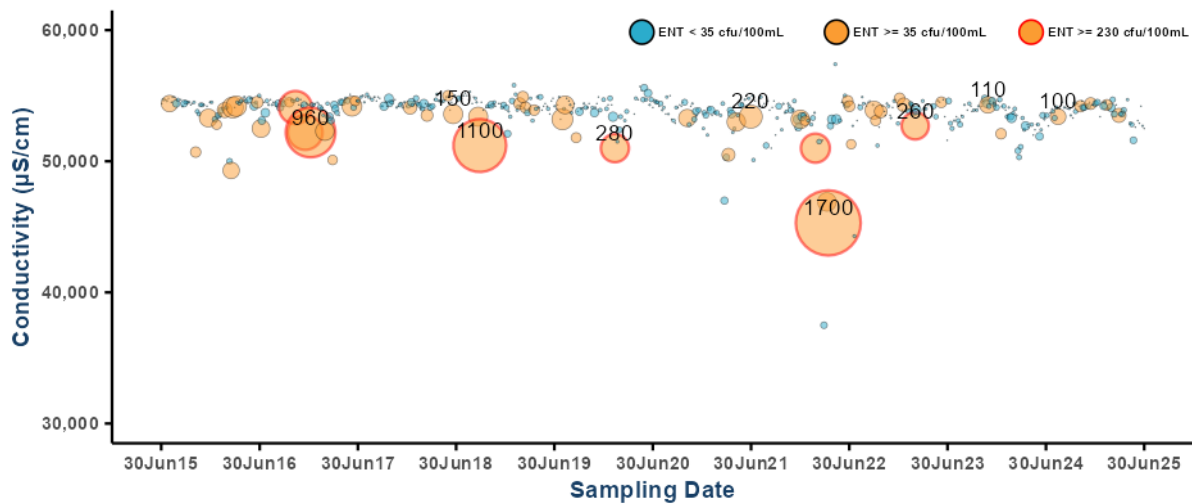
North Narrabeen Beach: Enterococci (cfu/100mL)



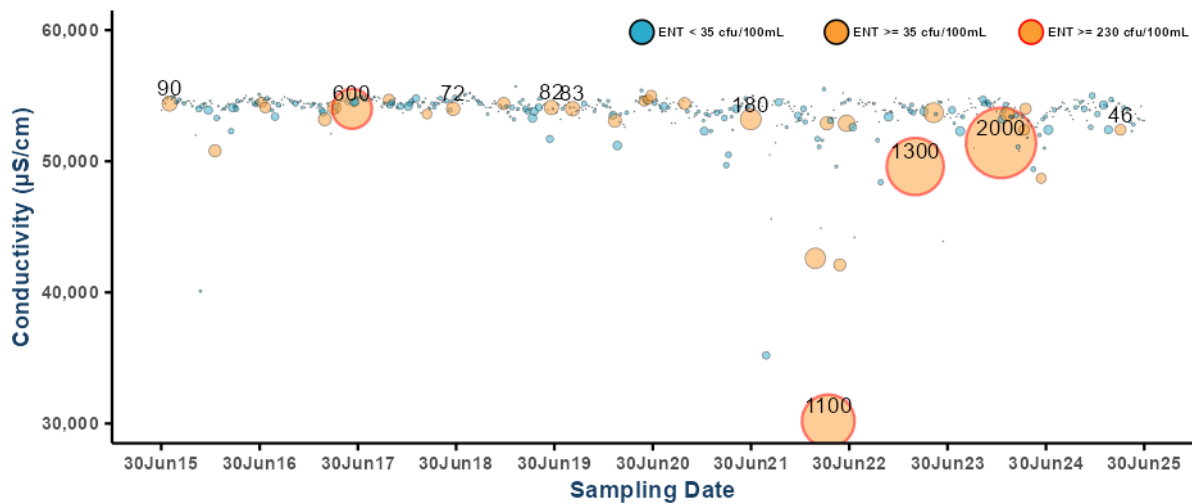
Bilarong Reserve: Enterococci (cfu/100mL)



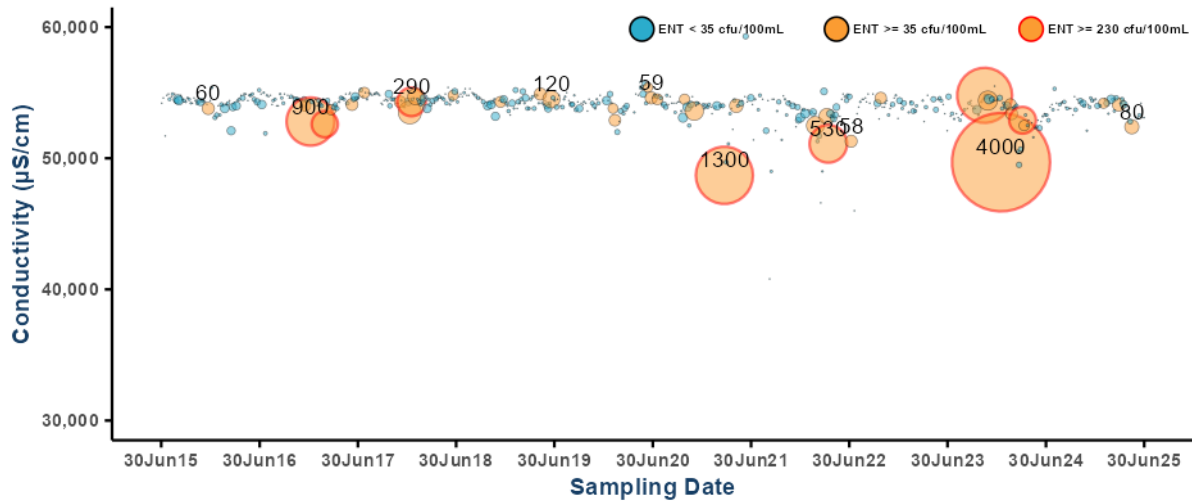
Collaroy Beach: Enterococci (cfu/100mL)



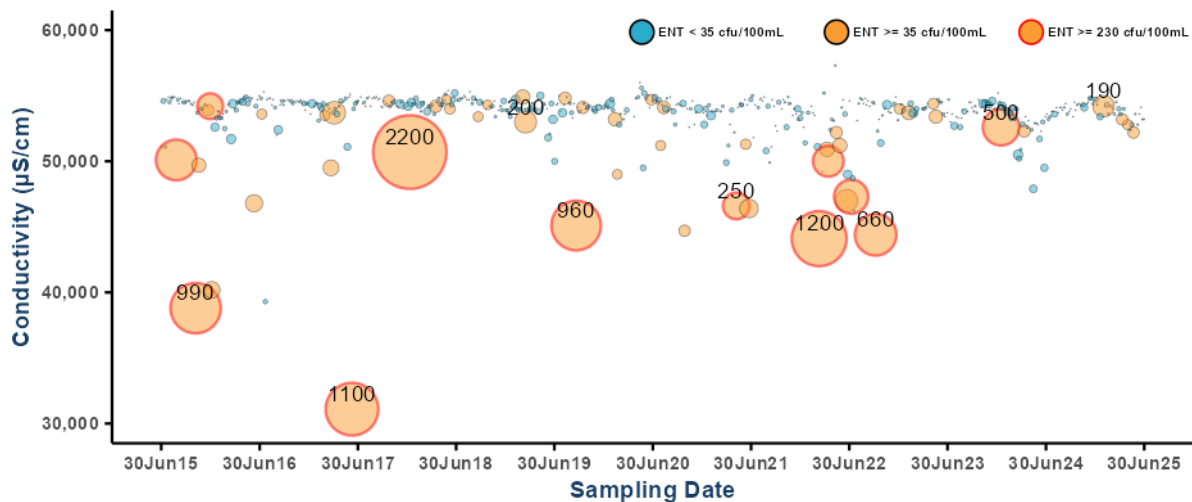
Long Reef Beach: Enterococci (cfu/100mL)



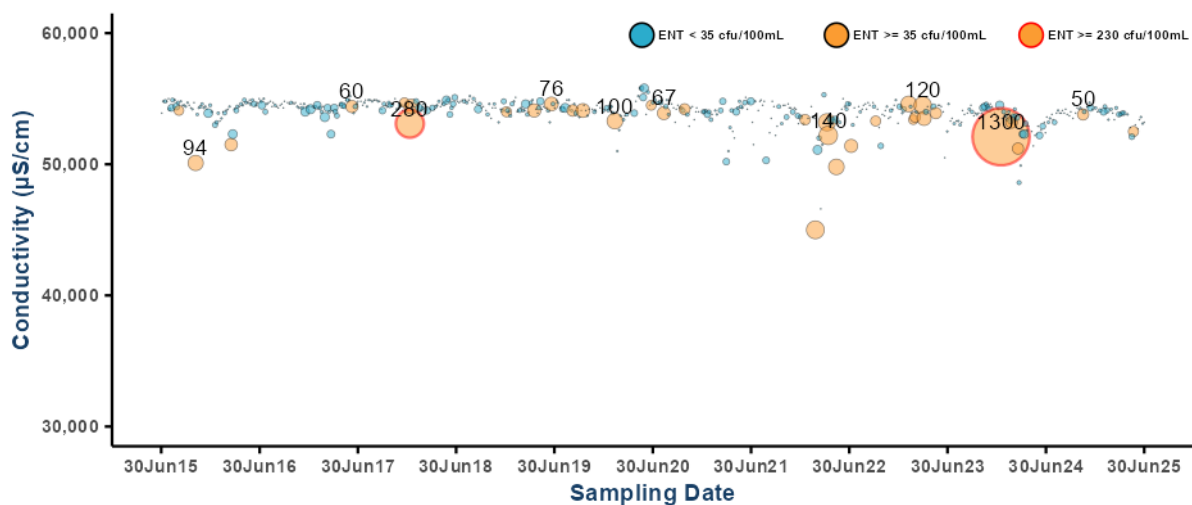
Dee Why Beach: Enterococci (cfu/100mL)



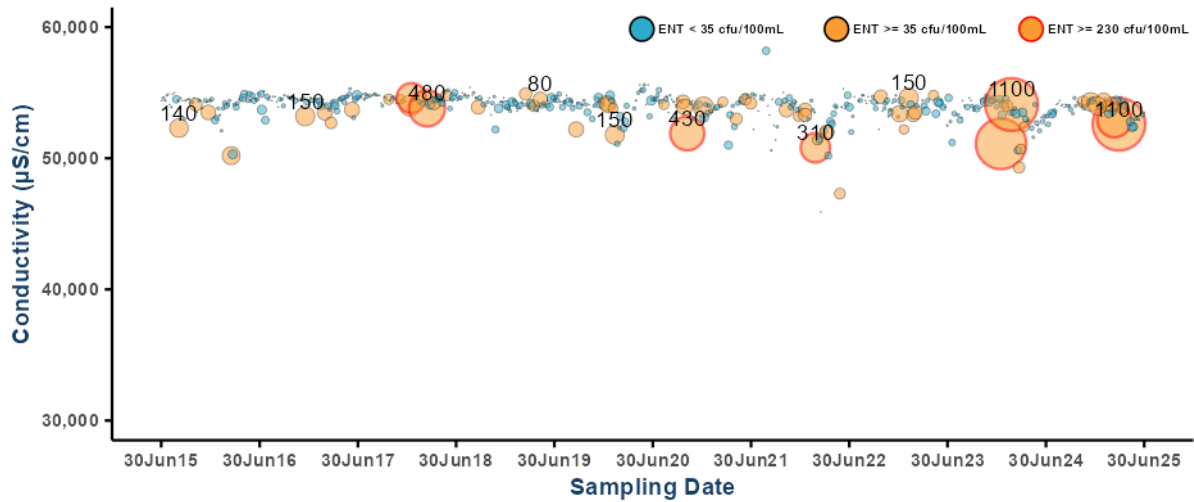
North Curl Curl Beach: Enterococci (cfu/100mL)



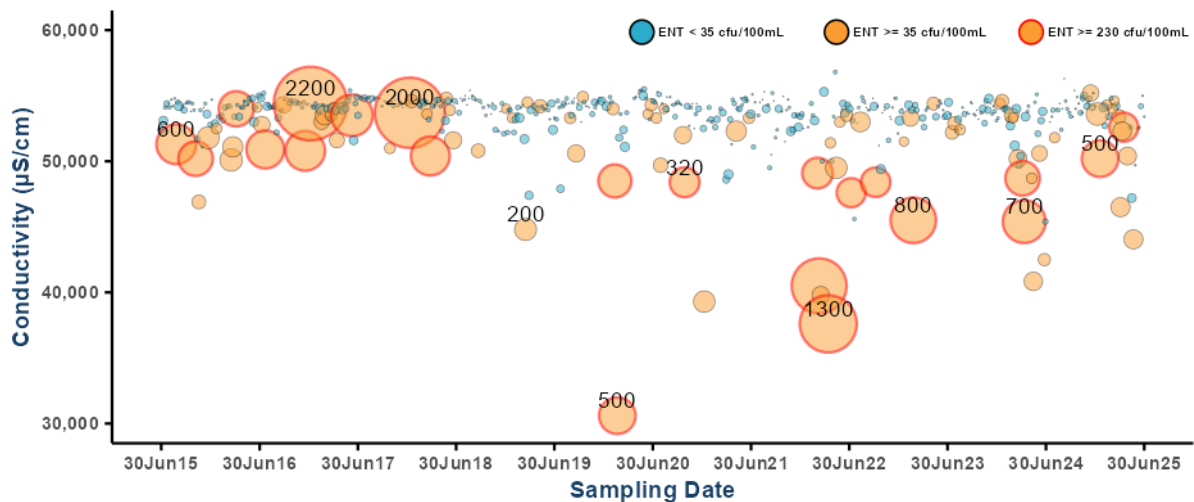
South Curl Curl Beach: Enterococci (cfu/100mL)



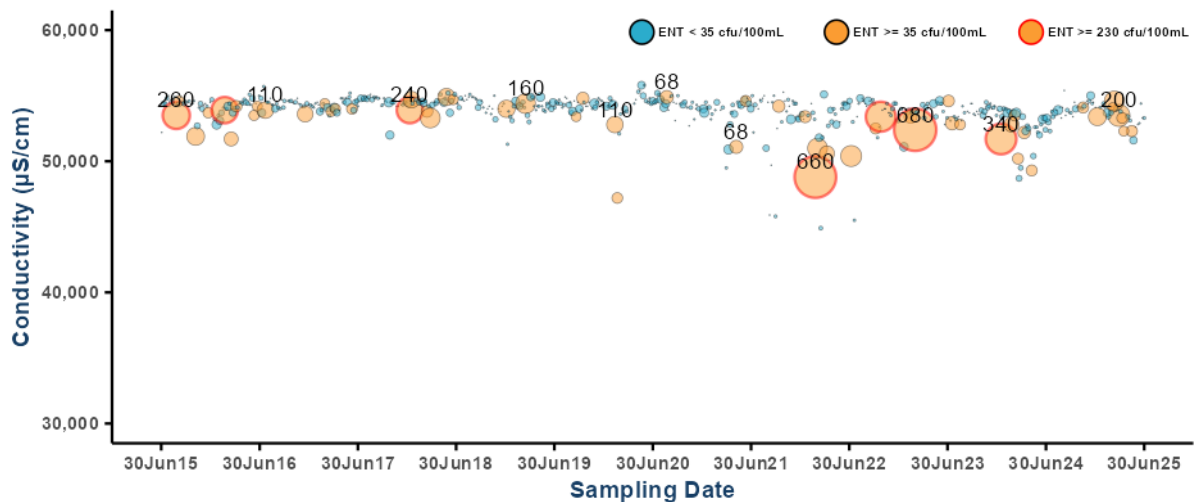
Freshwater Beach: Enterococci (cfu/100mL)



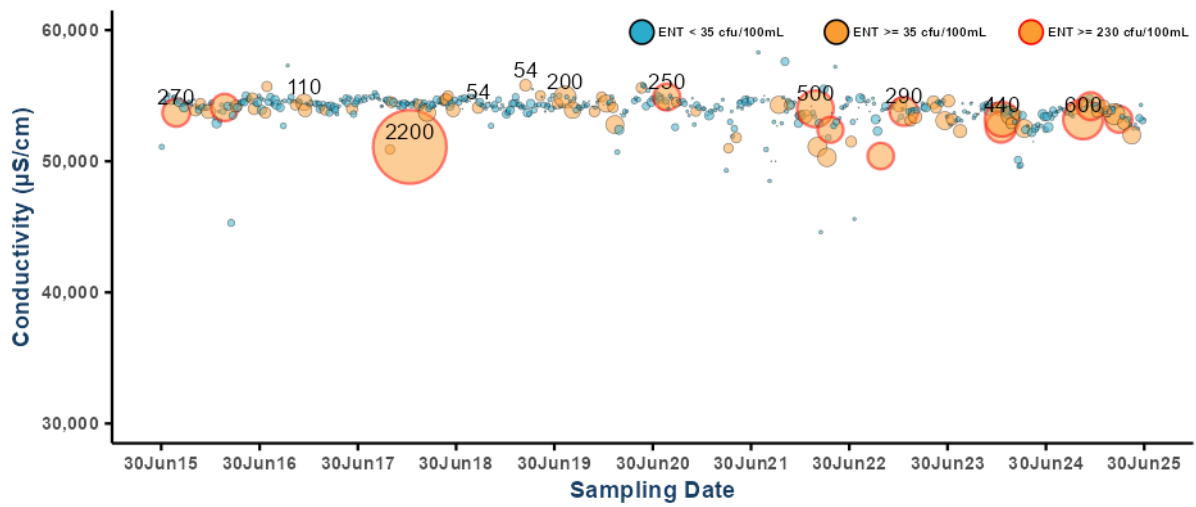
Queenscliff Beach: Enterococci (cfu/100mL)



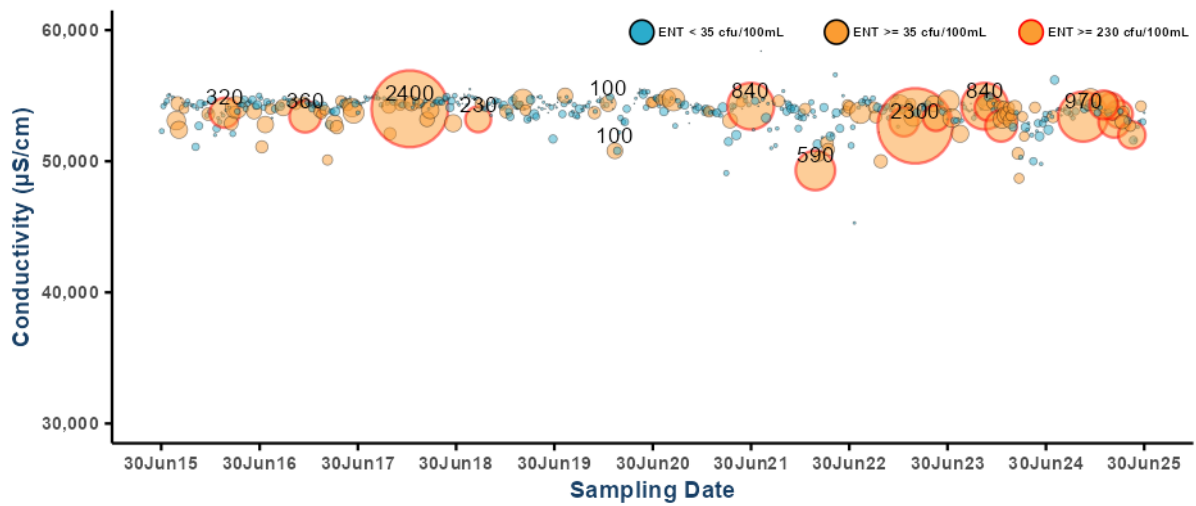
North Steyne Beach: Enterococci (cfu/100mL)



South Steyne Beach: Enterococci (cfu/100mL)

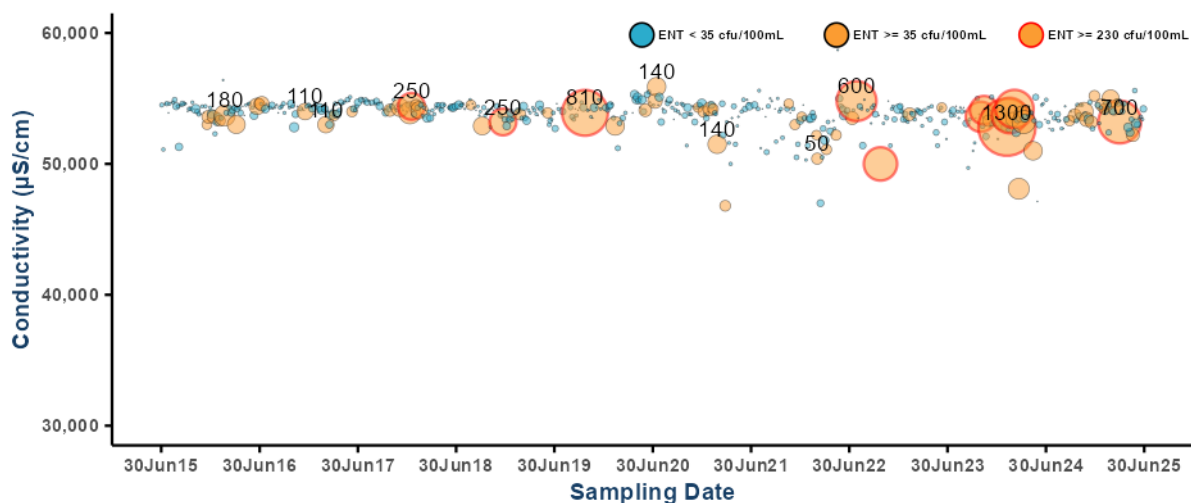


Shelly Beach (Manly): Enterococci (cfu/100mL)

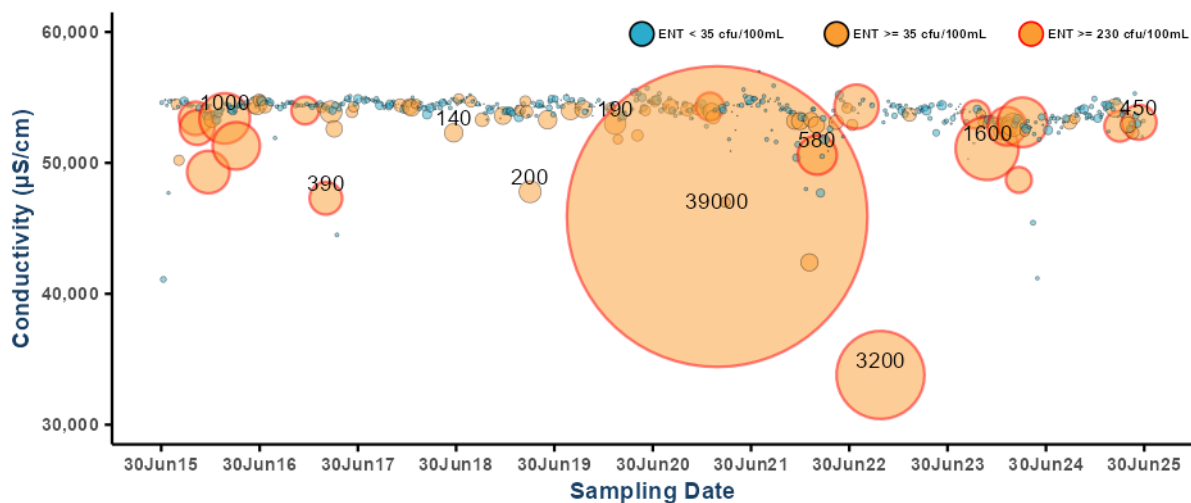


G.2. Sydney Beaches: Central Sydney

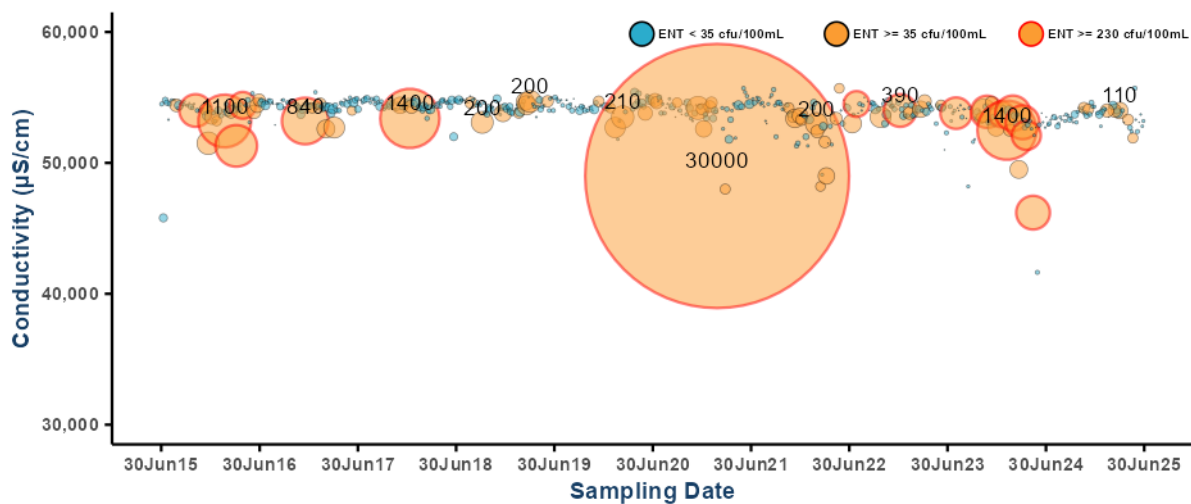
Bondi Beach: Enterococci (cfu/100mL)



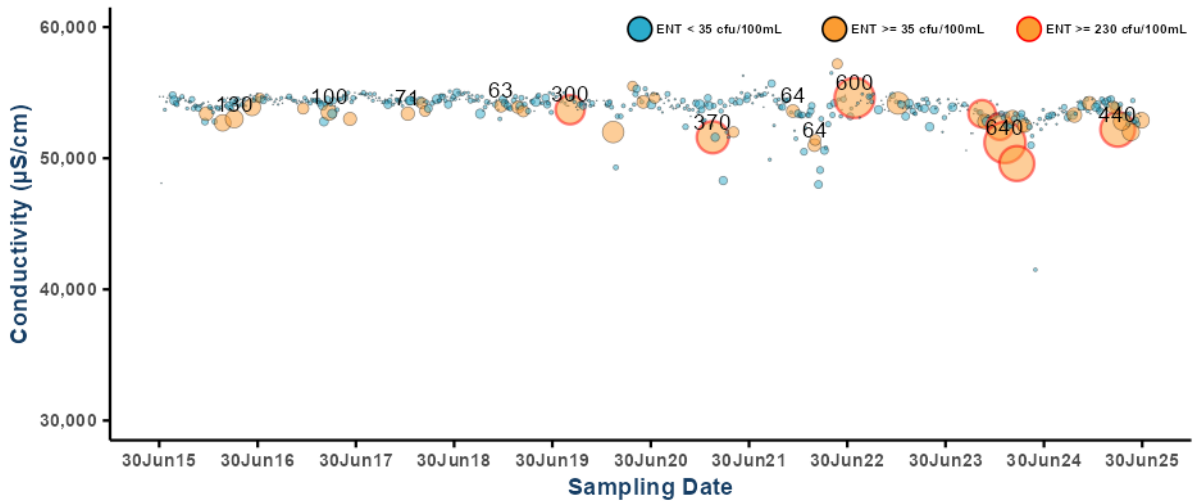
Tamarama Beach: Enterococci (cfu/100mL)



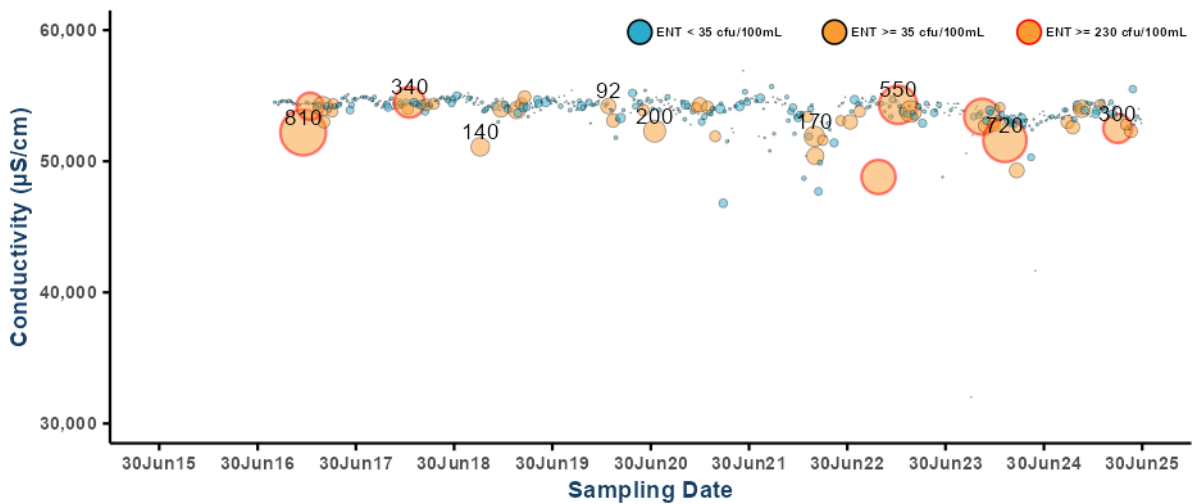
Bronte Beach: Enterococci (cfu/100mL)



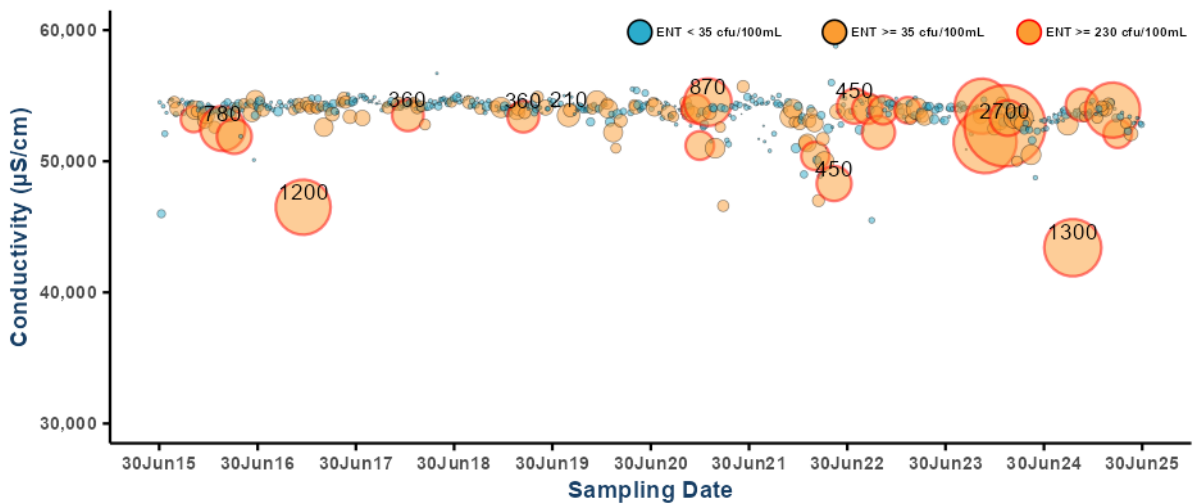
Clovelly Beach: Enterococci (cfu/100mL)



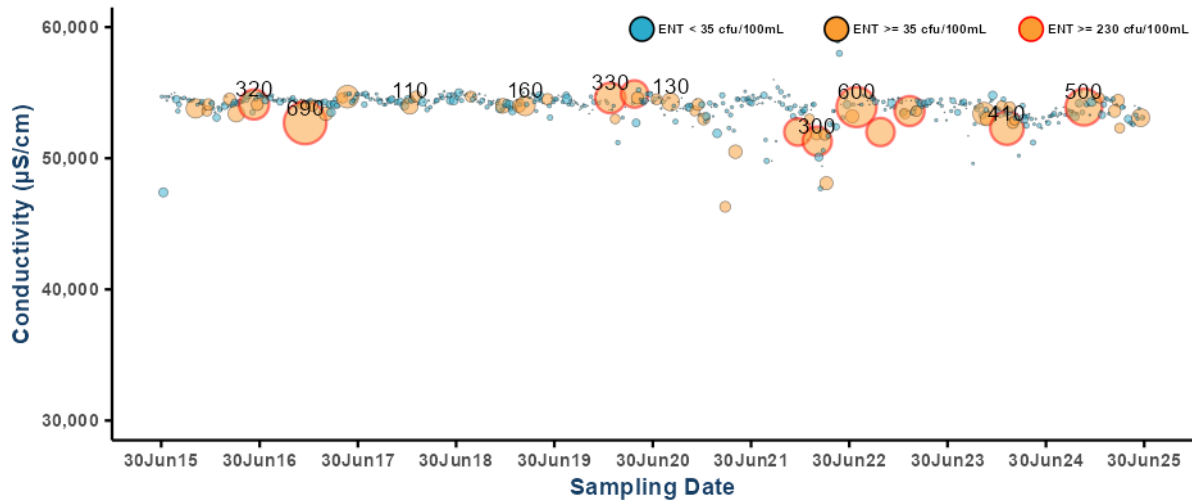
Gordons Bay (East): Enterococci (cfu/100mL)



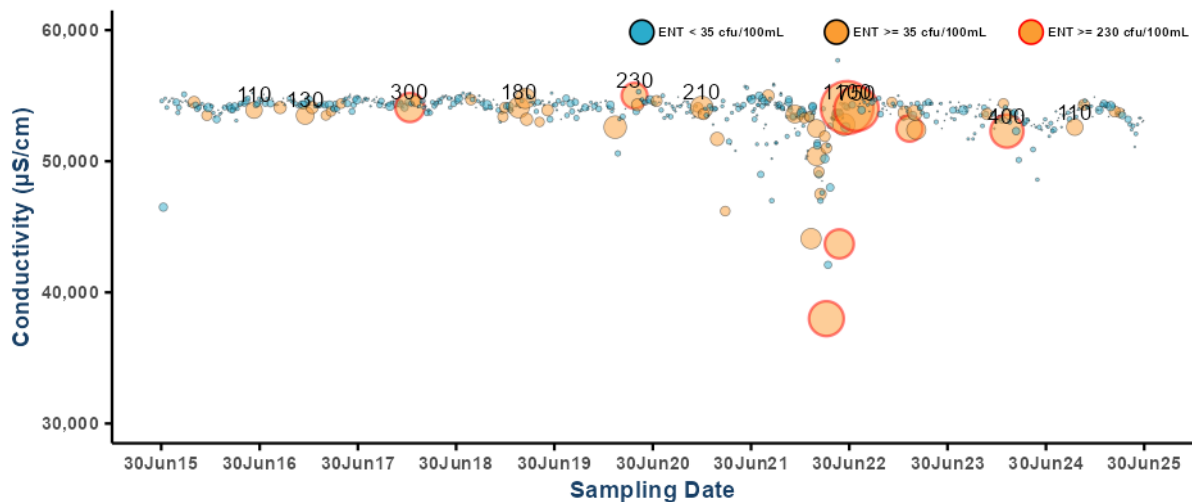
Coogee Beach: Enterococci (cfu/100mL)



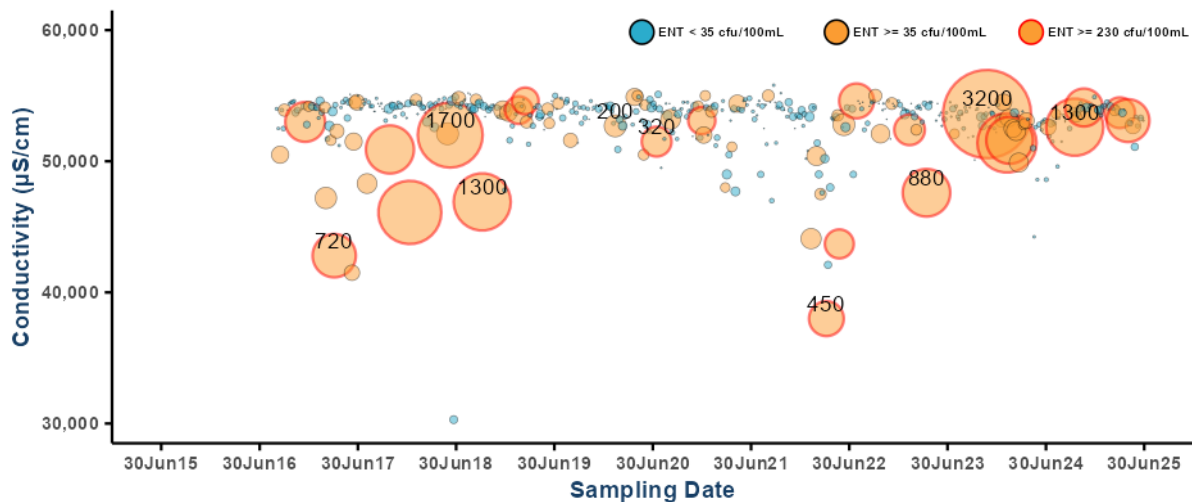
Maroubra Beach: Enterococci (cfu/100mL)



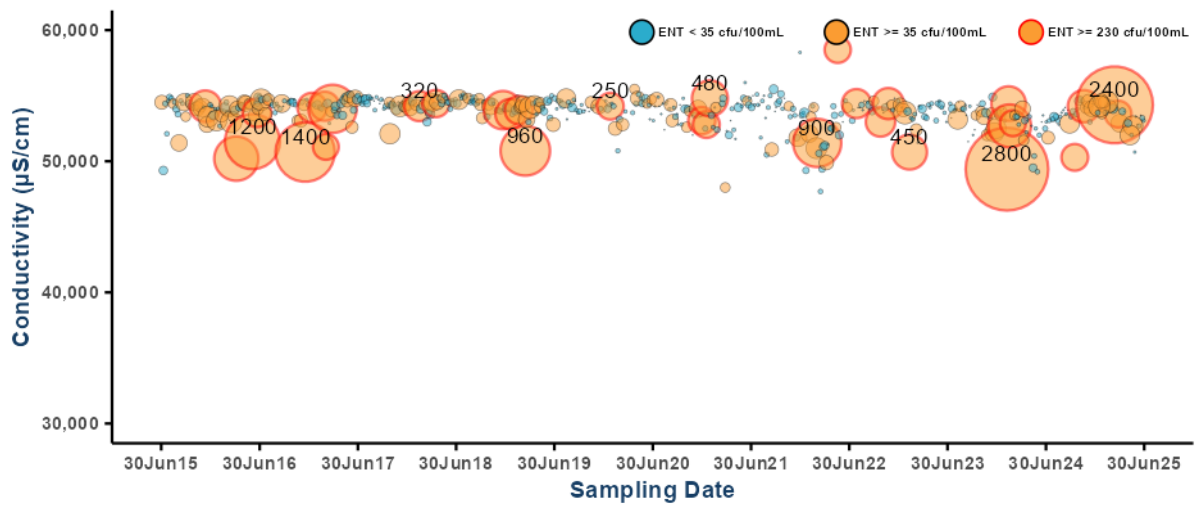
South Maroubra Beach: Enterococci (cfu/100mL)



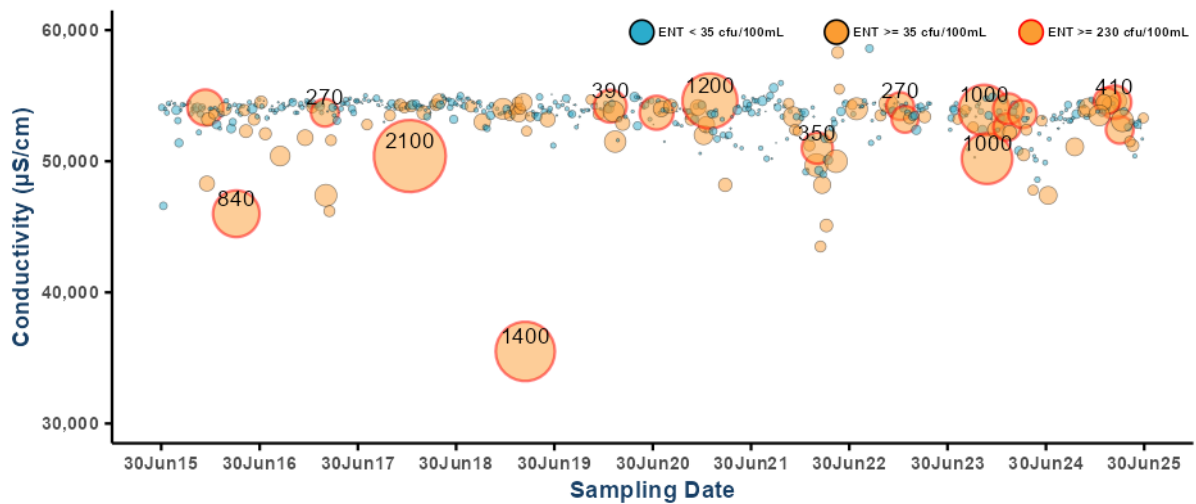
South Maroubra Rockpool: Enterococci (cfu/100mL)



Malabar Beach: Enterococci (cfu/100mL)

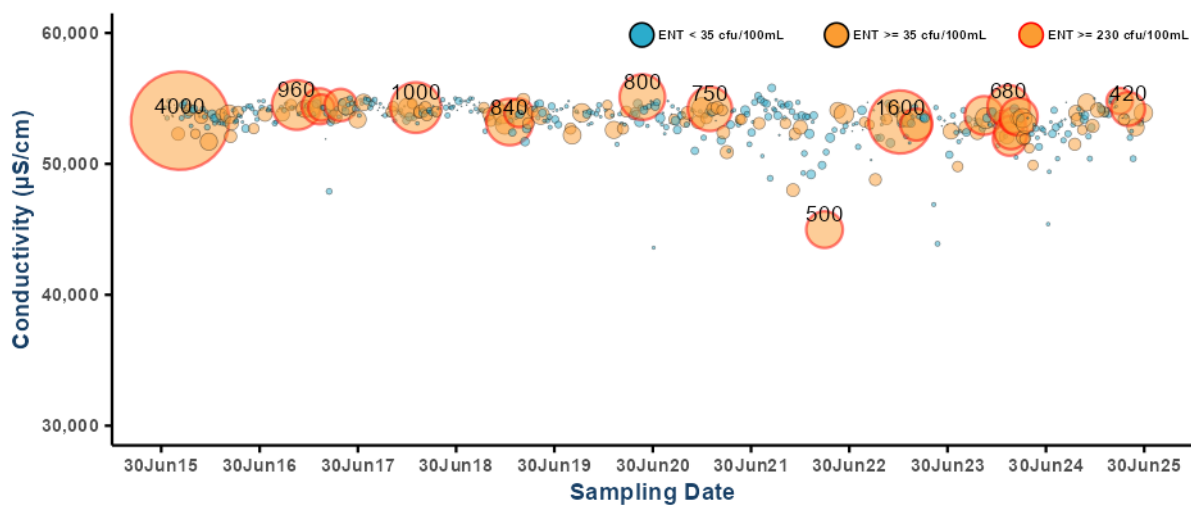


Little Bay Beach: Enterococci (cfu/100mL)

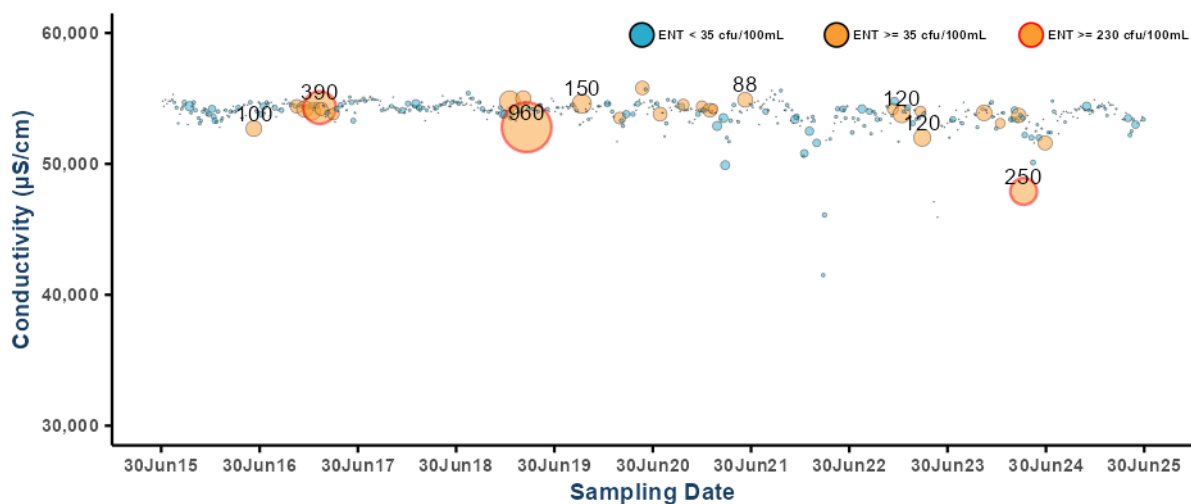


G.3. Sydney Beaches: Southern Sydney

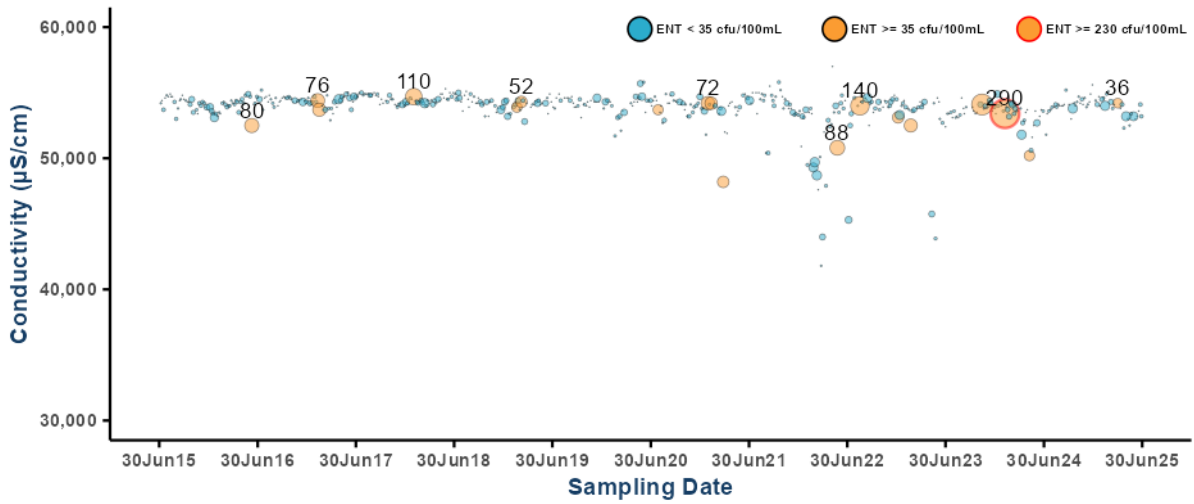
Boat Harbour: Enterococci (cfu/100mL)



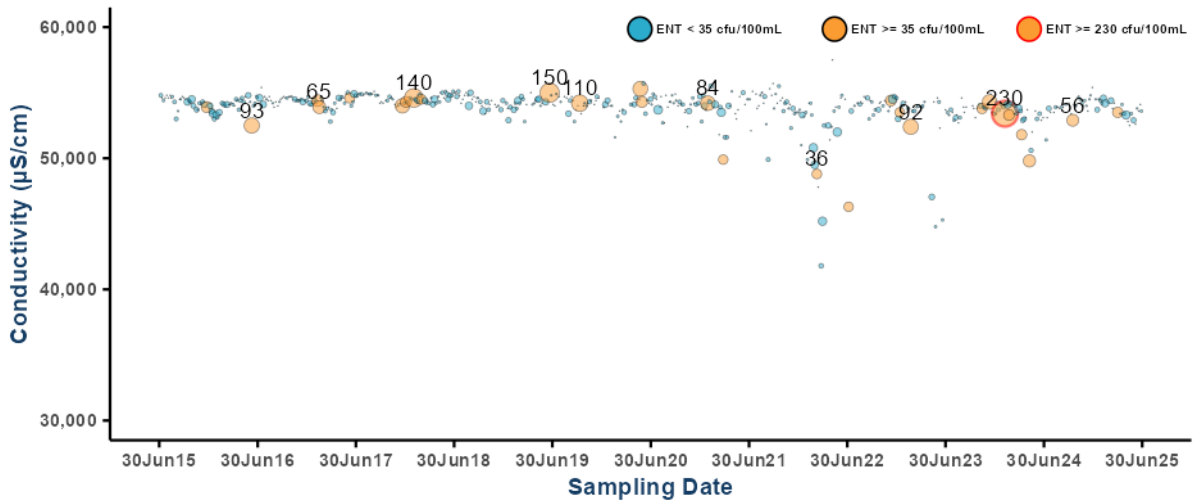
Greenhills Beach: Enterococci (cfu/100mL)



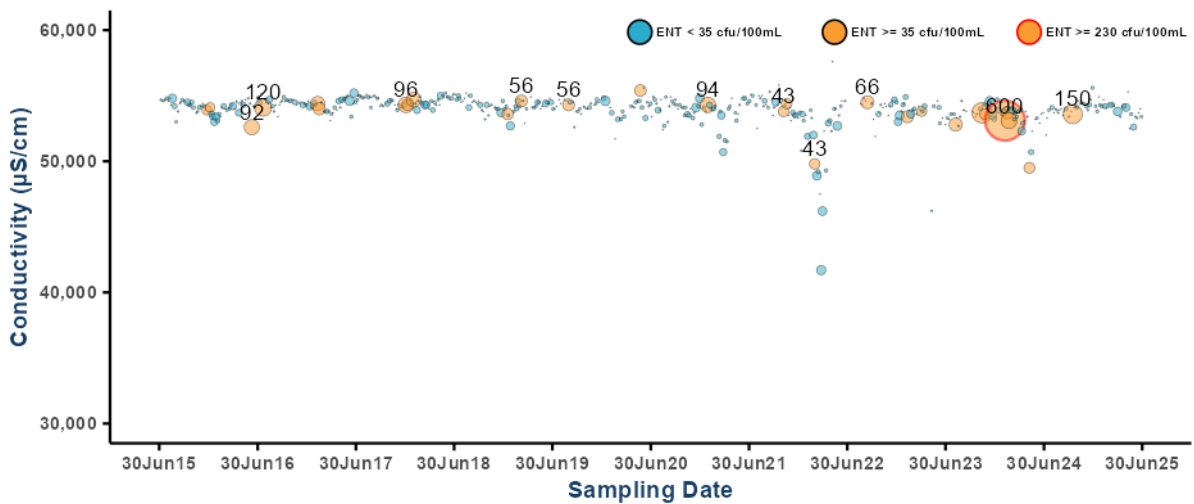
Wanda Beach: Enterococci (cfu/100mL)



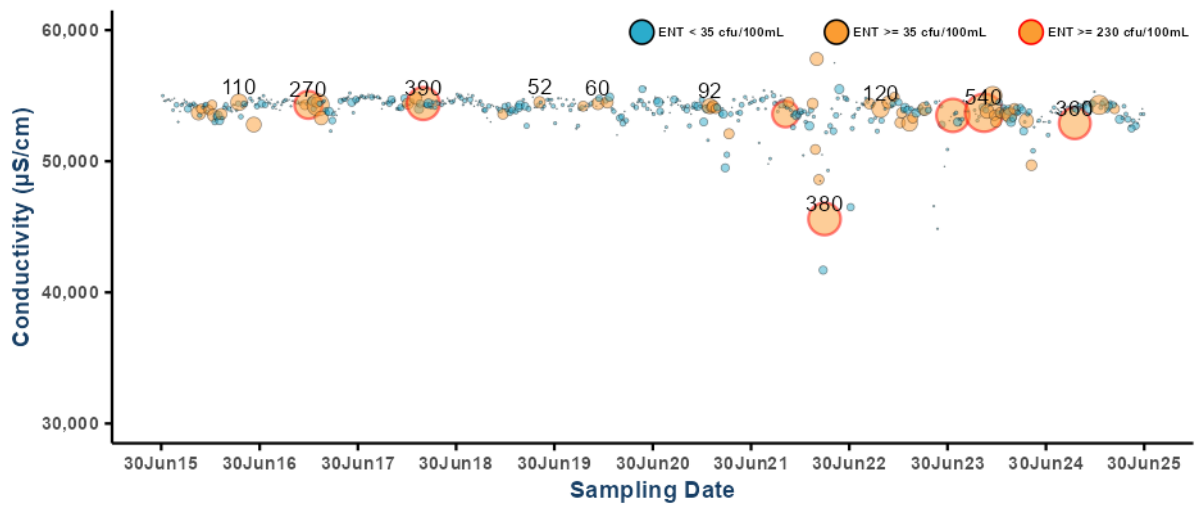
Elouera Beach: Enterococci (cfu/100mL)



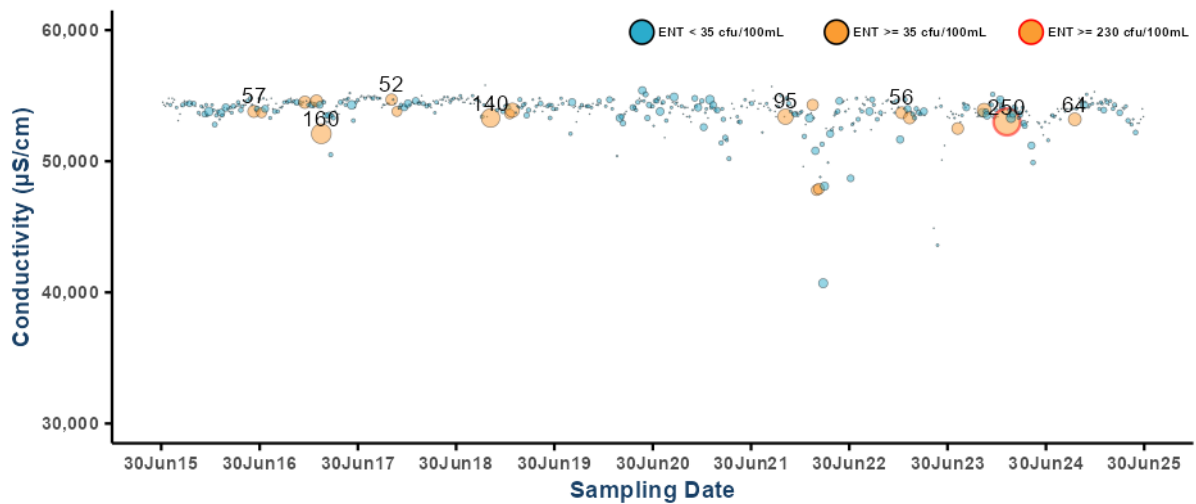
North Cronulla Beach: Enterococci (cfu/100mL)



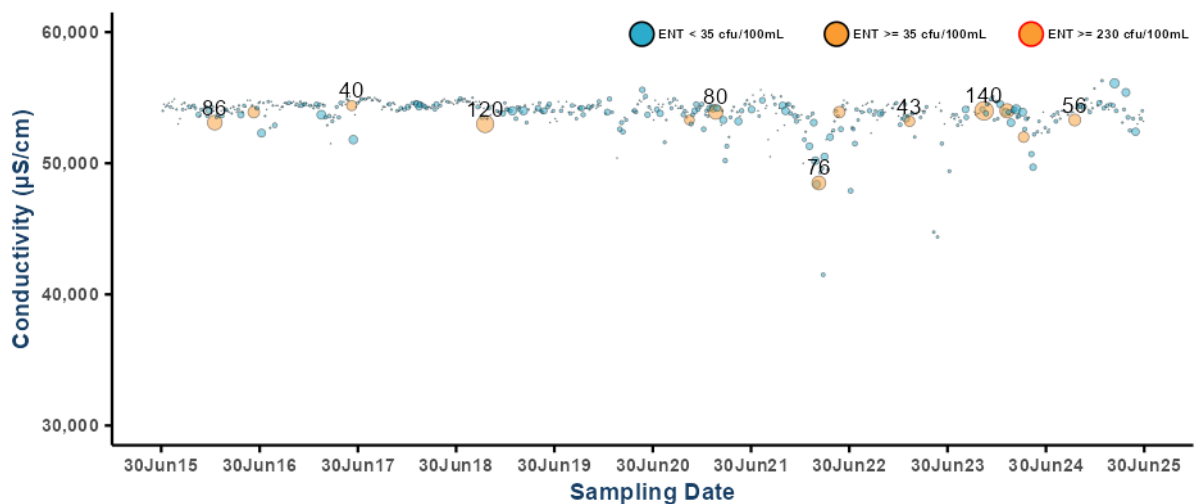
South Cronulla Beach: Enterococci (cfu/100mL)



Shelly Beach (Sutherland): Enterococci (cfu/100mL)

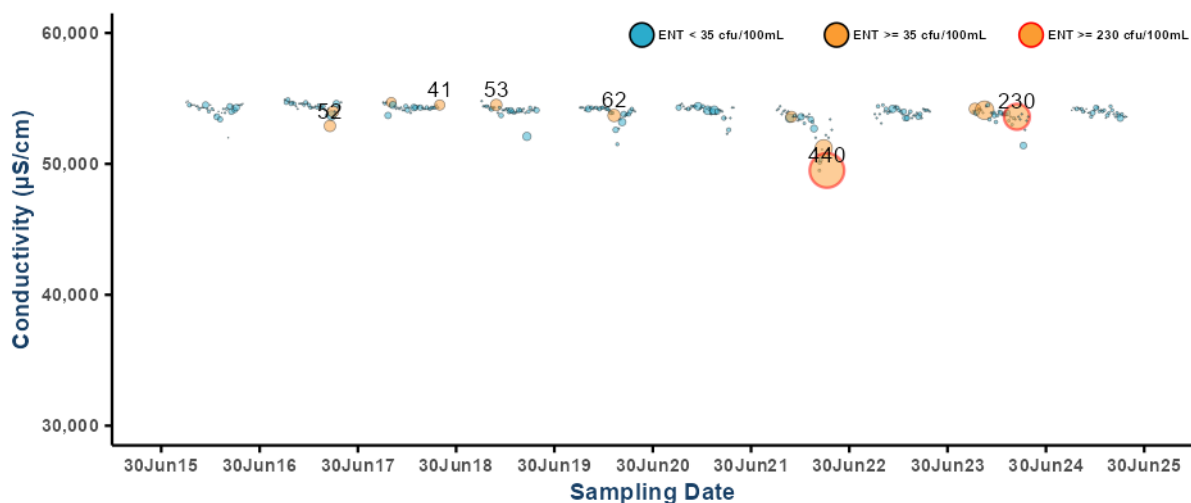


Oak Park Beach: Enterococci (cfu/100mL)

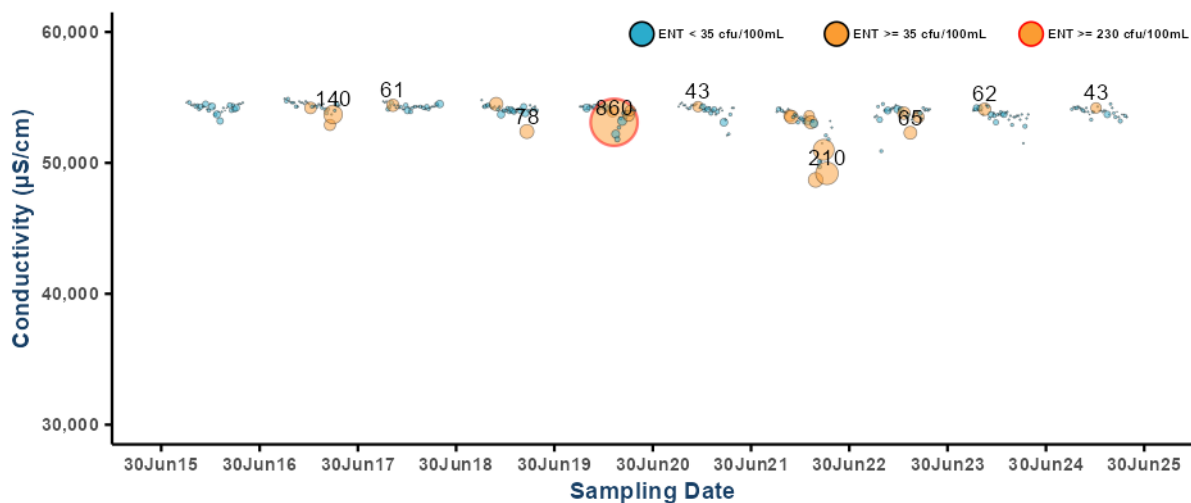


G.4. Illawarra Beaches: Wollongong

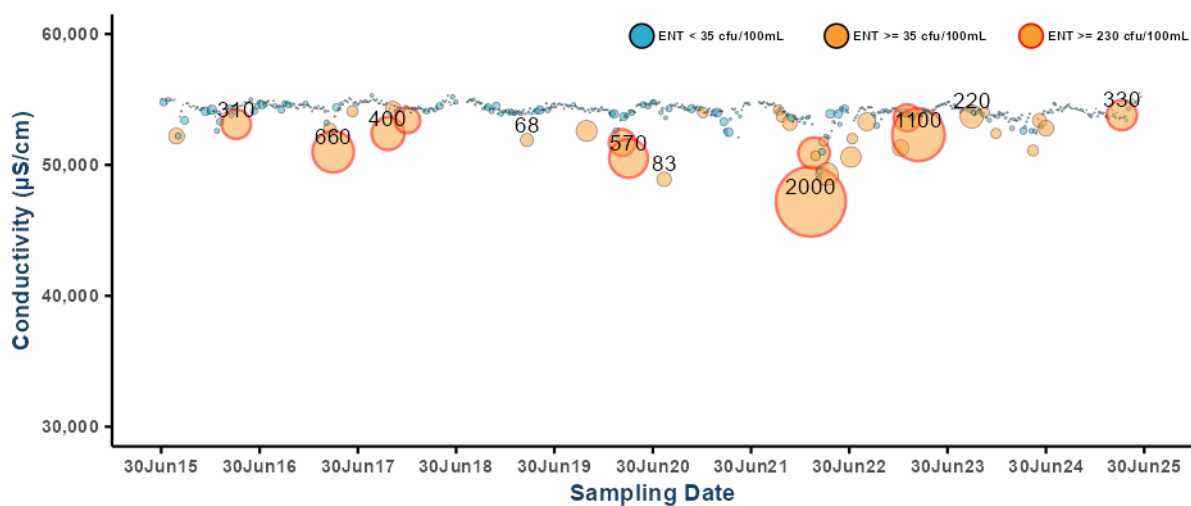
Austinmer Beach: Enterococci (cfu/100mL)



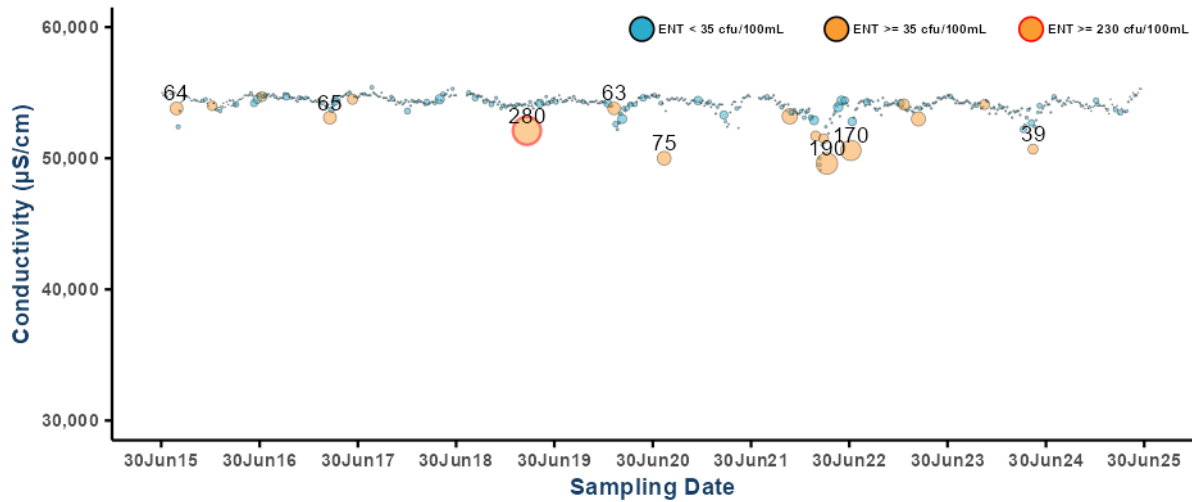
Thirroul Beach: Enterococci (cfu/100mL)



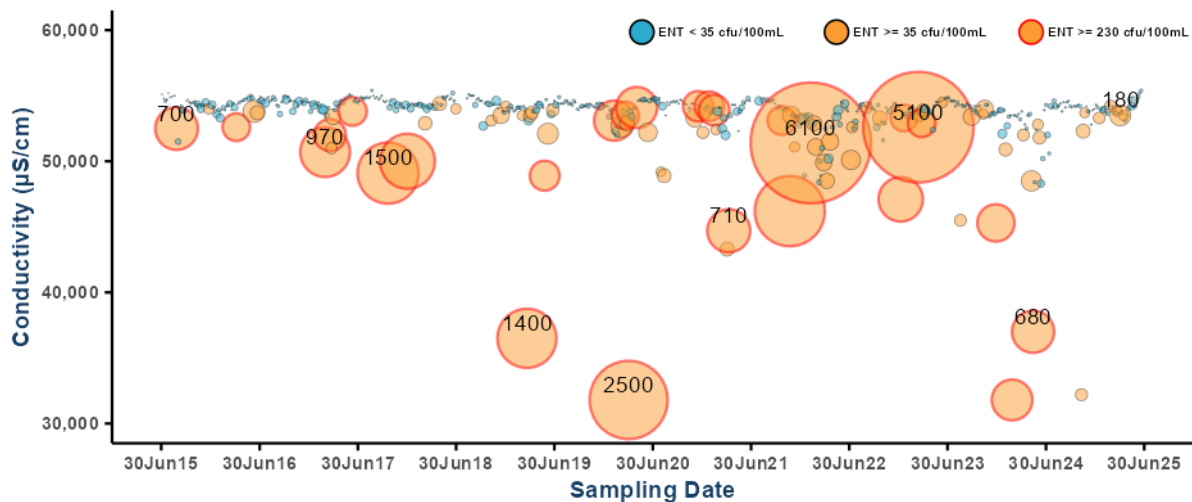
Bulli Beach: Enterococci (cfu/100mL)



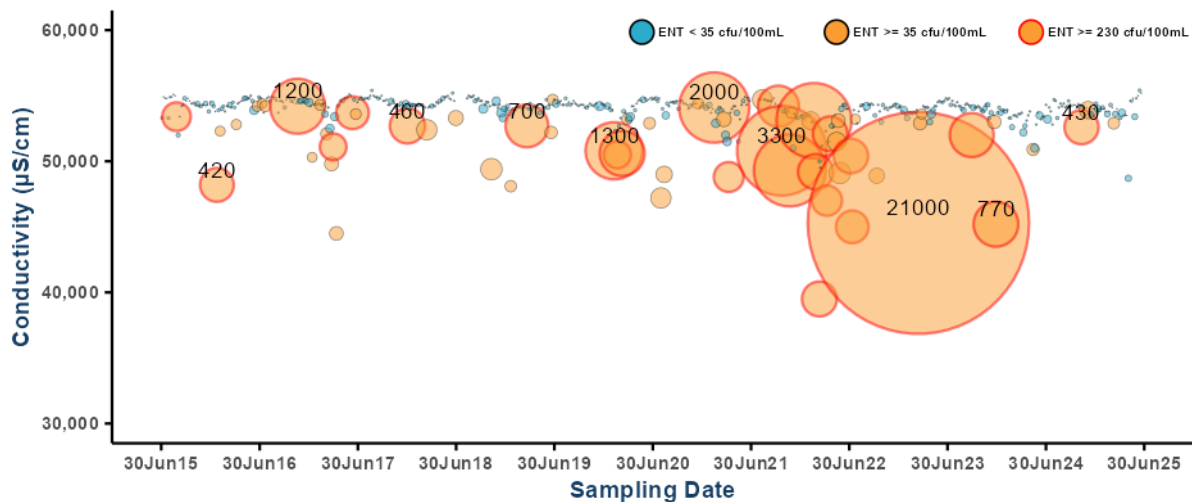
Woonona Beach: Enterococci (cfu/100mL)



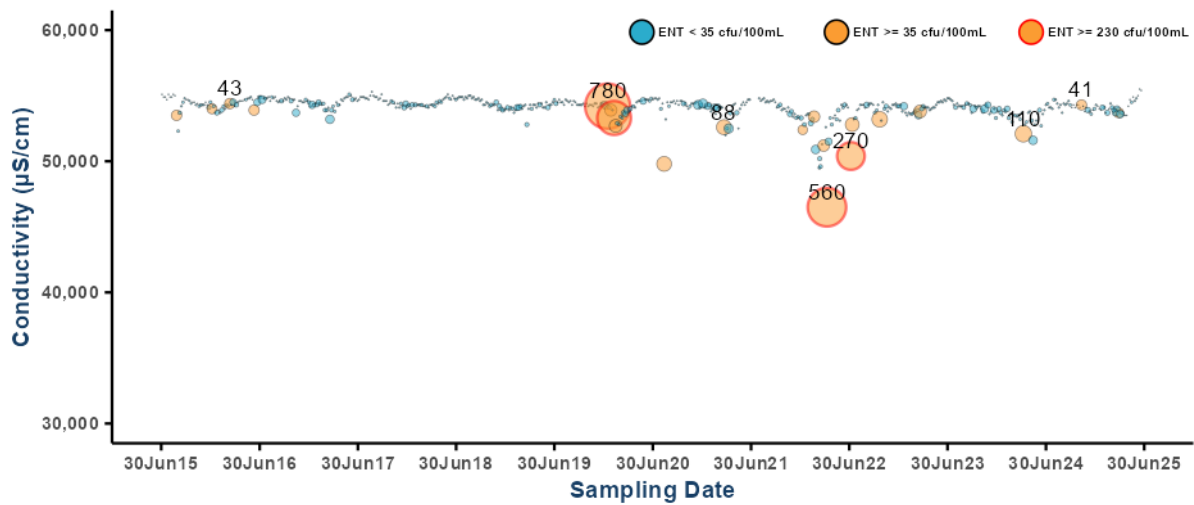
Bellambi Beach: Enterococci (cfu/100mL)



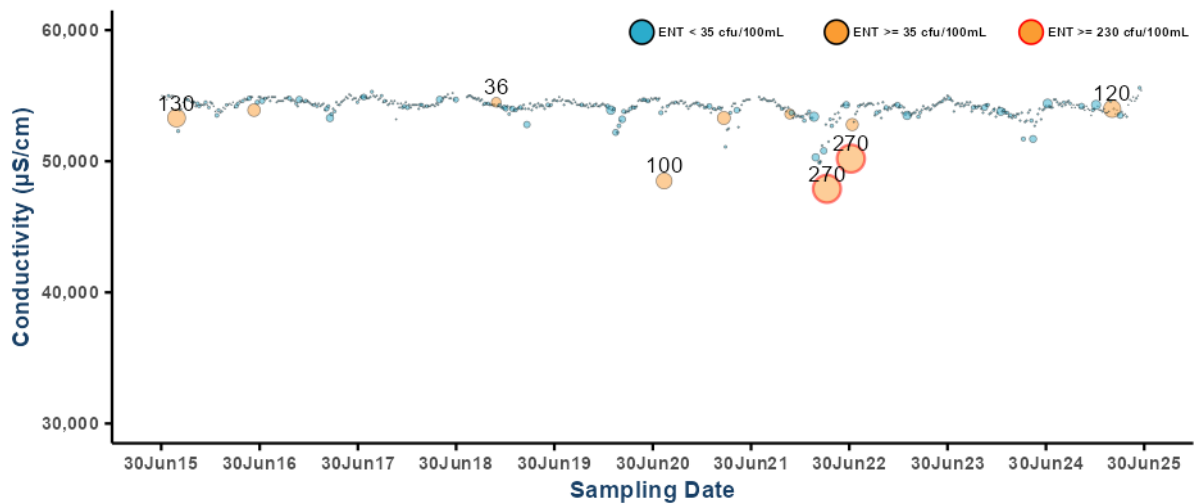
Corrimal Beach: Enterococci (cfu/100mL)



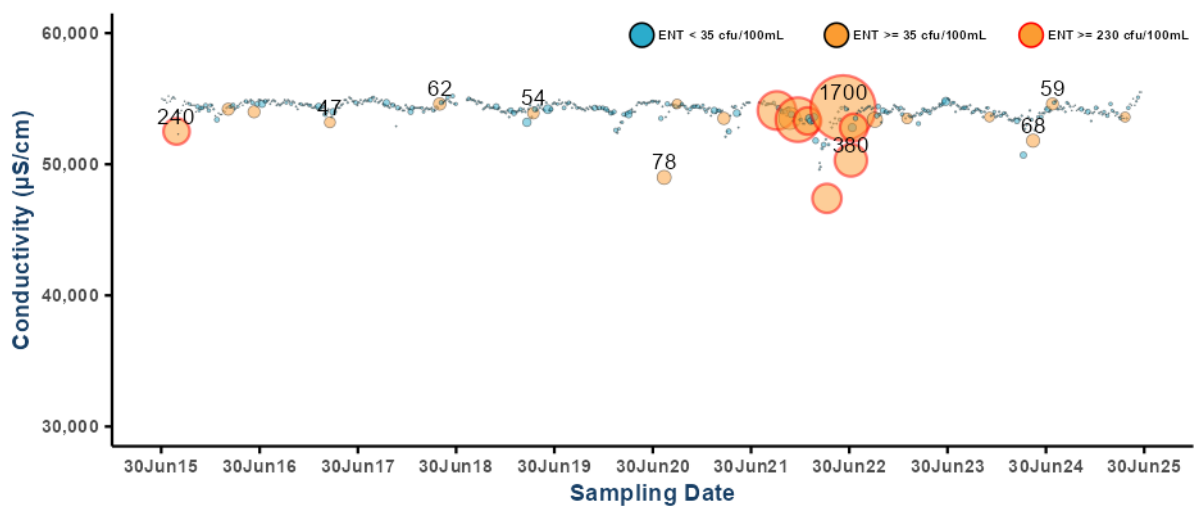
North Wollongong Beach: Enterococci (cfu/100mL)



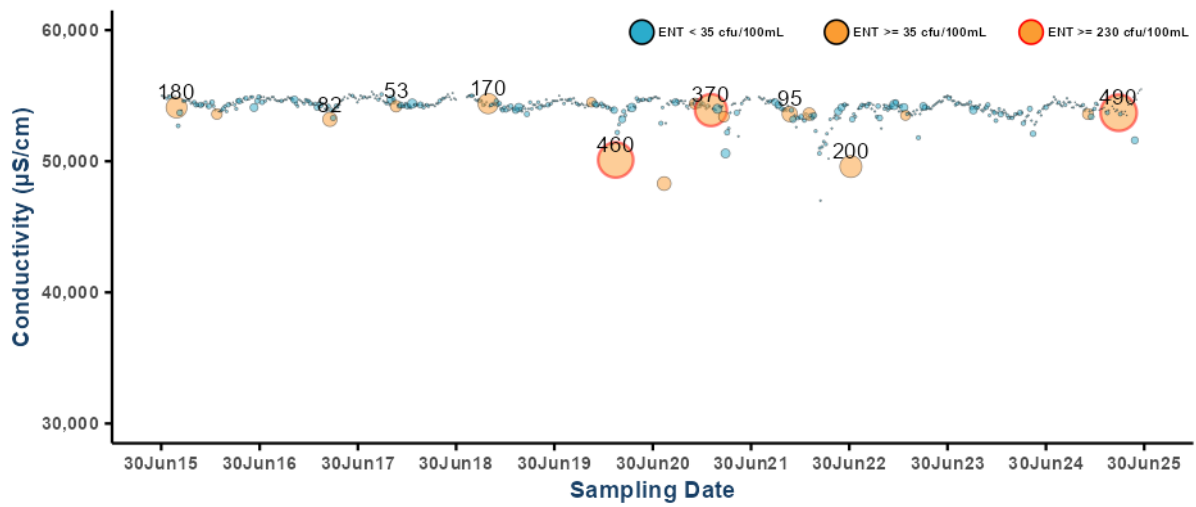
Wollongong City Beach: Enterococci (cfu/100mL)



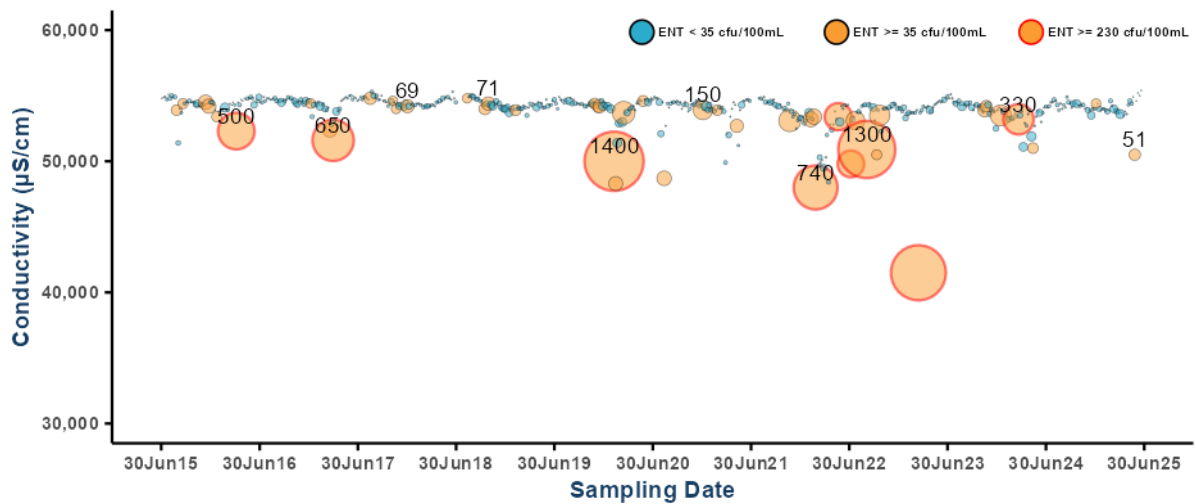
Coniston Beach: Enterococci (cfu/100mL)



Fishermans Beach: Enterococci (cfu/100mL)

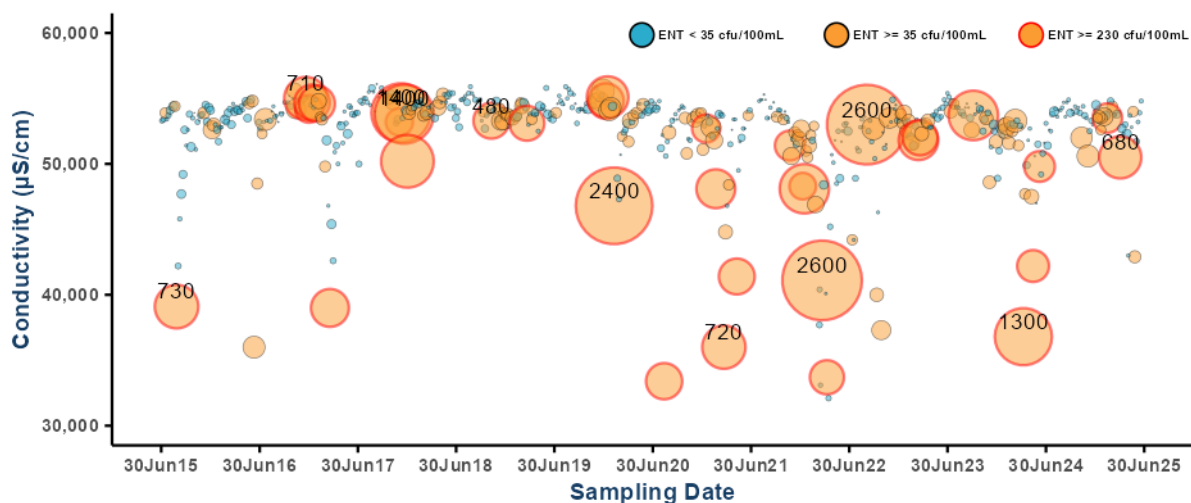


Port Kembla Beach: Enterococci (cfu/100mL)

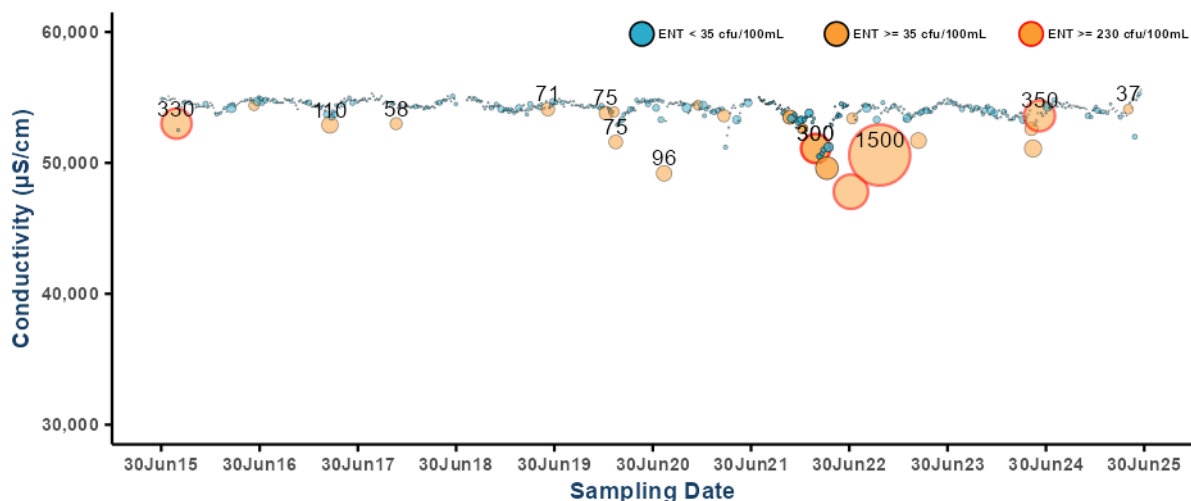


G.5. Illawarra Beaches: Shellharbour

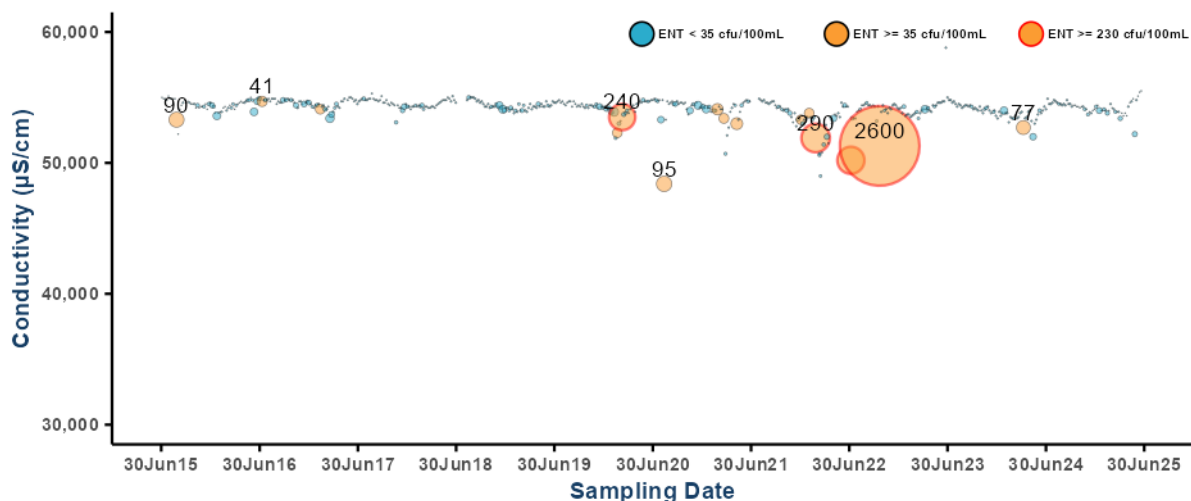
Entrance Lagoon Beach: Enterococci (cfu/100mL)



Warilla Beach: Enterococci (cfu/100mL)

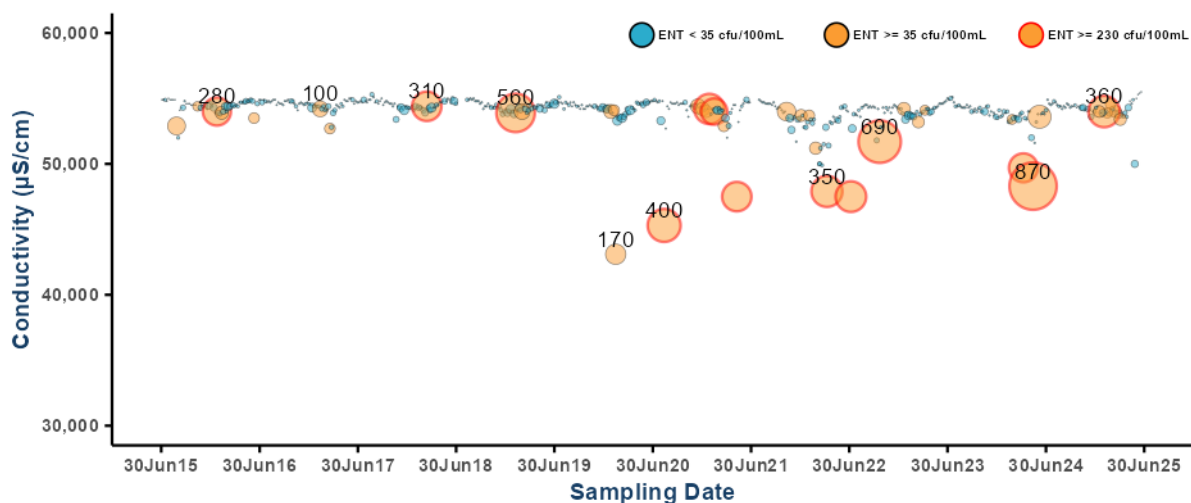


Shellharbour Beach: Enterococci (cfu/100mL)

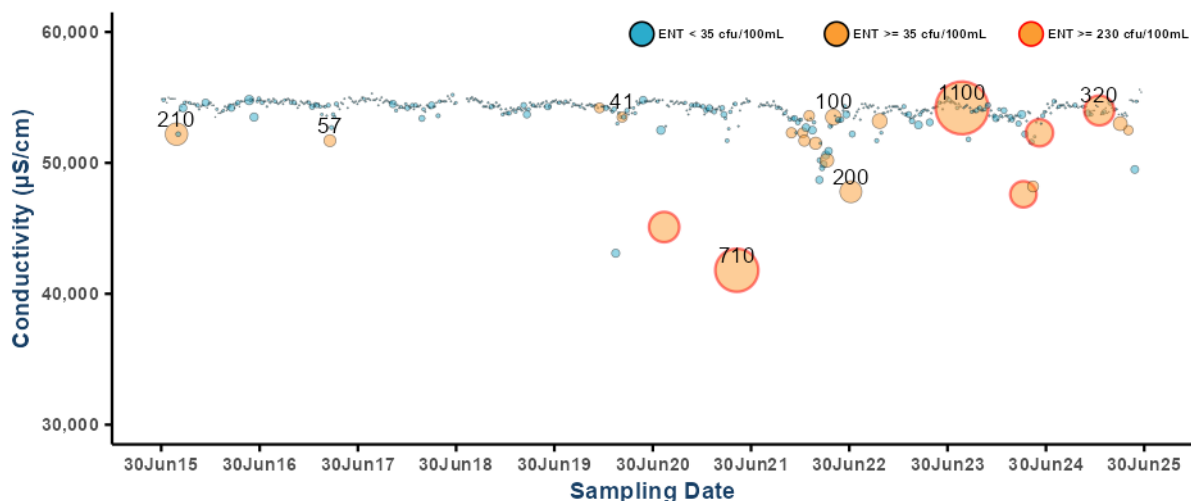


G.6. Illawarra Beaches: Bombo

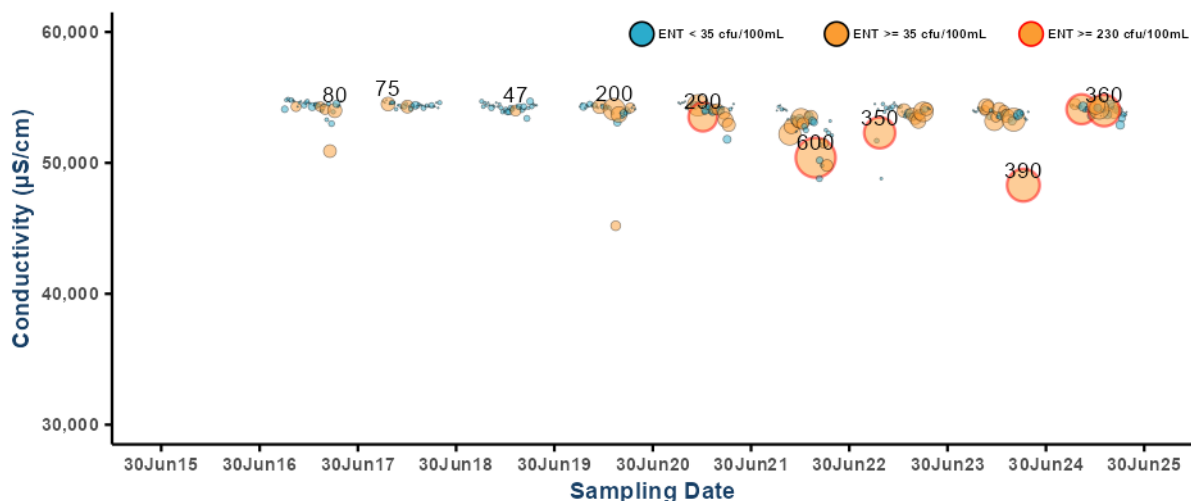
Boyd's Jones Beach: Enterococci (cfu/100mL)



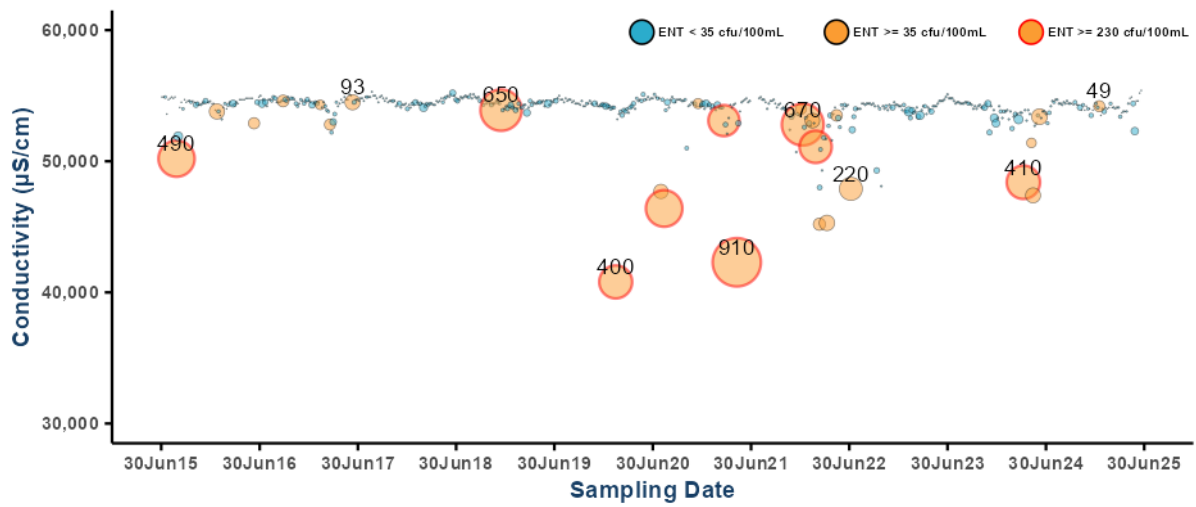
Bombo Beach: Enterococci (cfu/100mL)



Surf Beach Kiama: Enterococci (cfu/100mL)

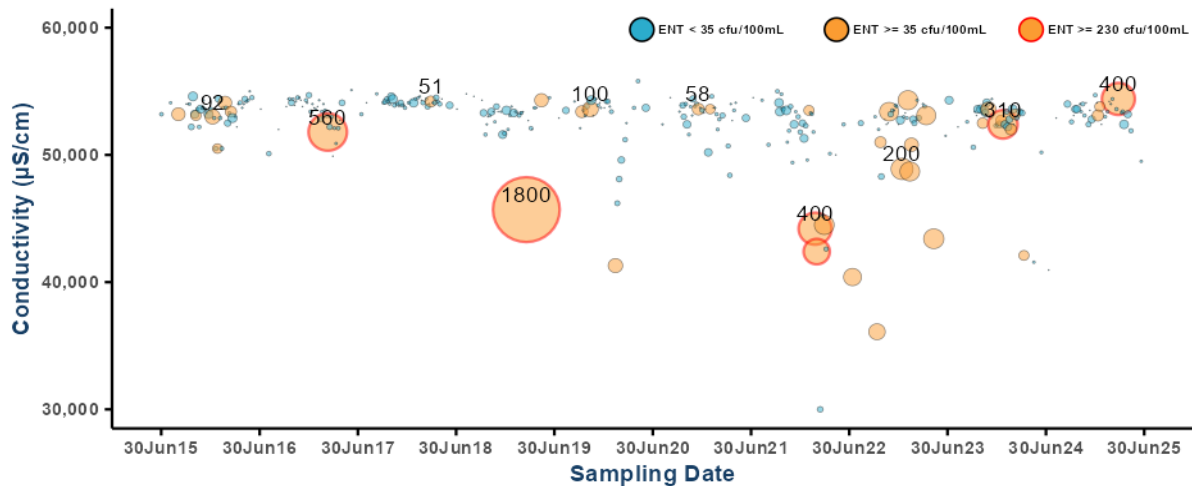


Werri Beach: Enterococci (cfu/100mL)

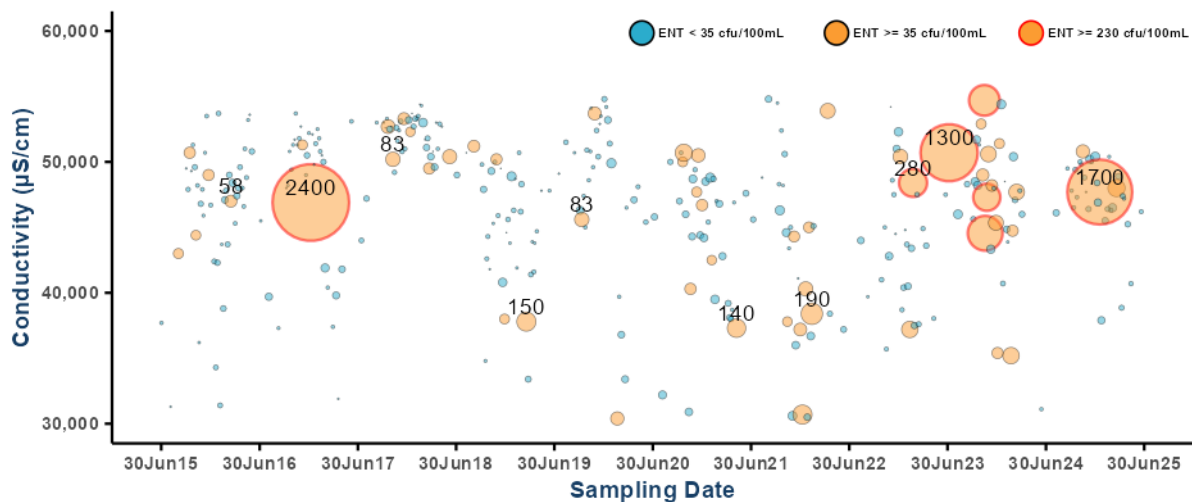


G.7. Sydney Harbour and Estuaries: Botany Bay and Georges River

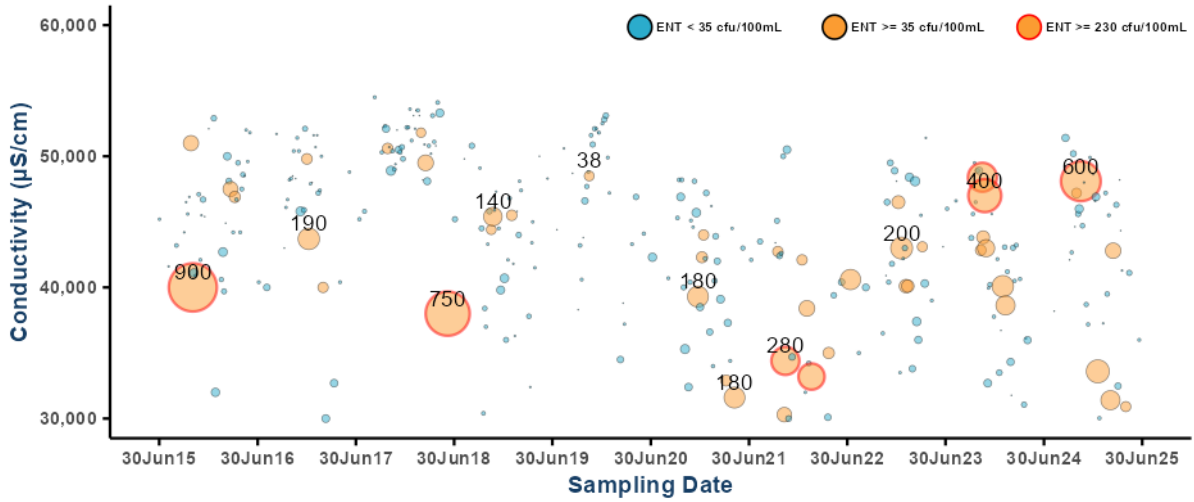
Silver Beach: Enterococci (cfu/100mL)



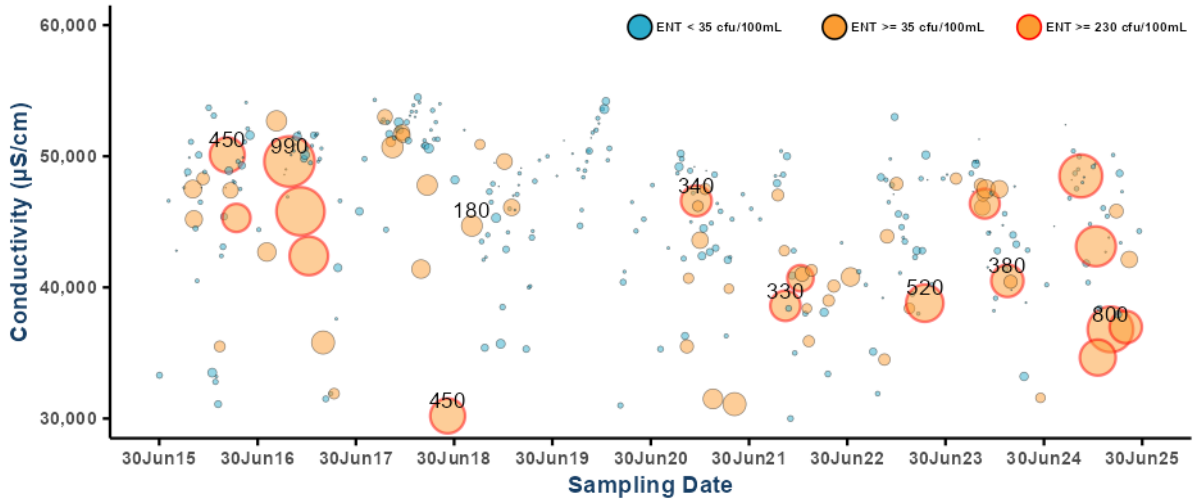
Como Baths: Enterococci (cfu/100mL)



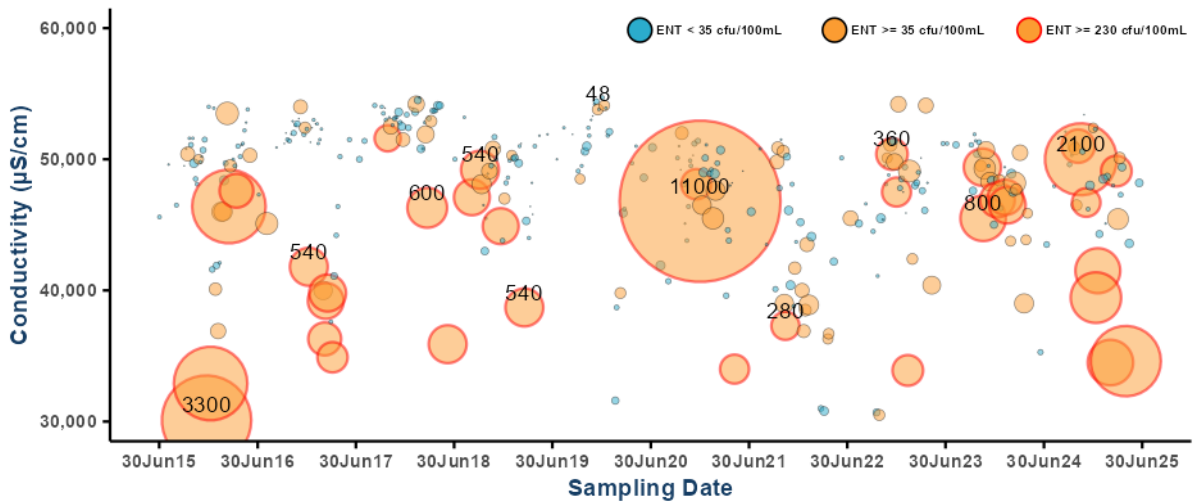
Jew Fish Bay Baths: Enterococci (cfu/100mL)



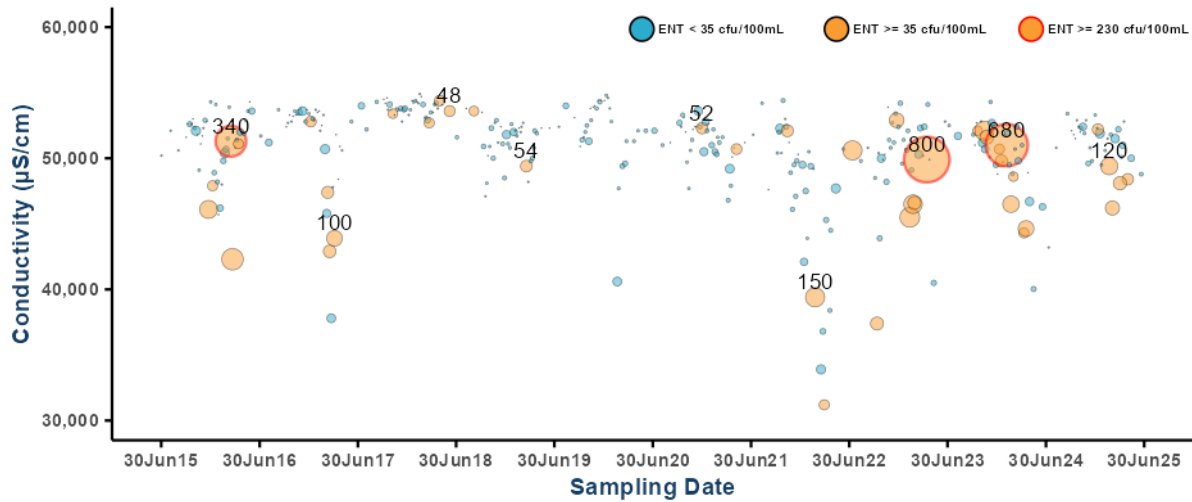
Oatley Bay Baths: Enterococci (cfu/100mL)



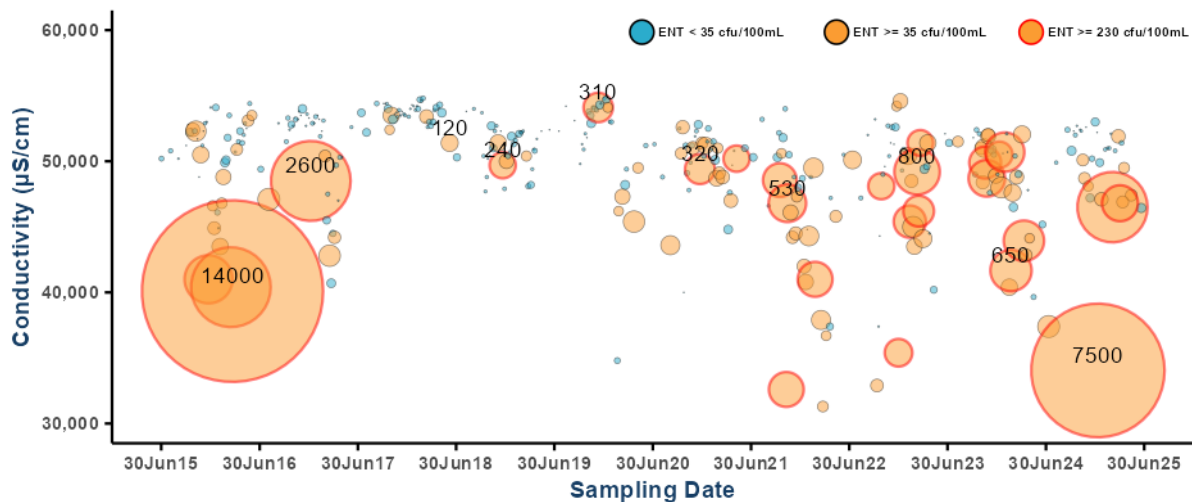
Carss Point Baths: Enterococci (cfu/100mL)



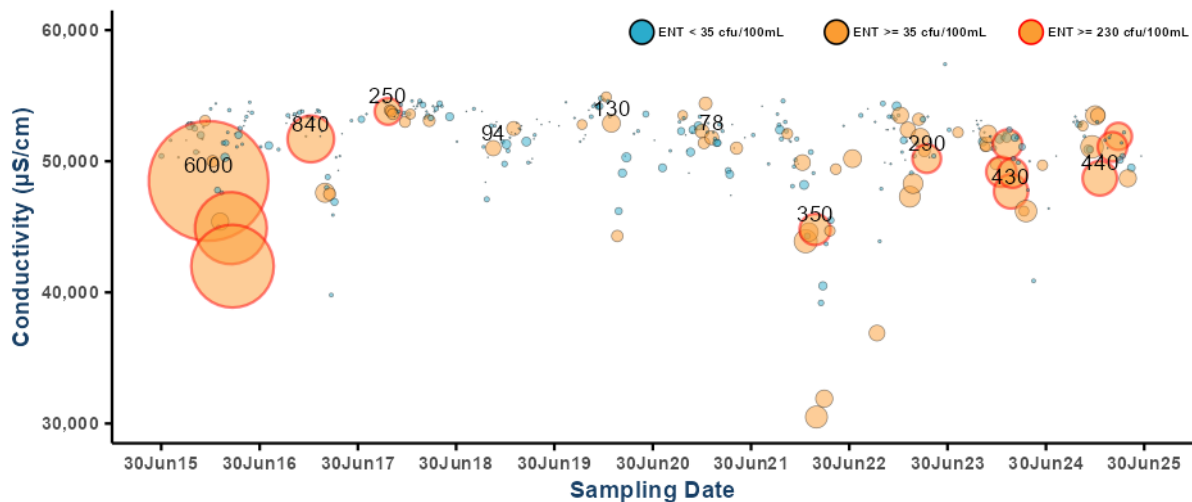
Sandringham Baths: Enterococci (cfu/100mL)



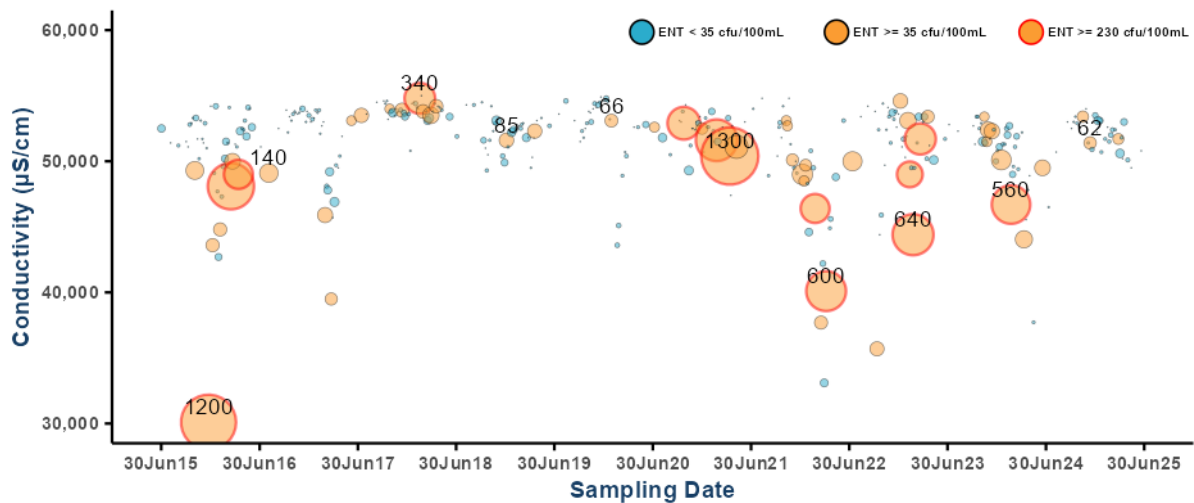
Dolls Point Baths: Enterococci (cfu/100mL)



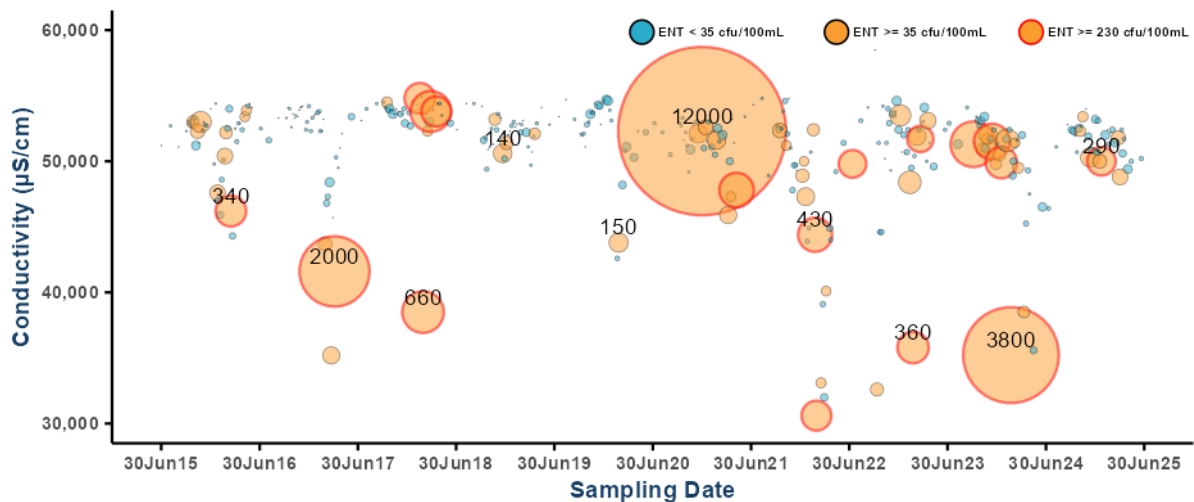
Ramsgate Baths: Enterococci (cfu/100mL)



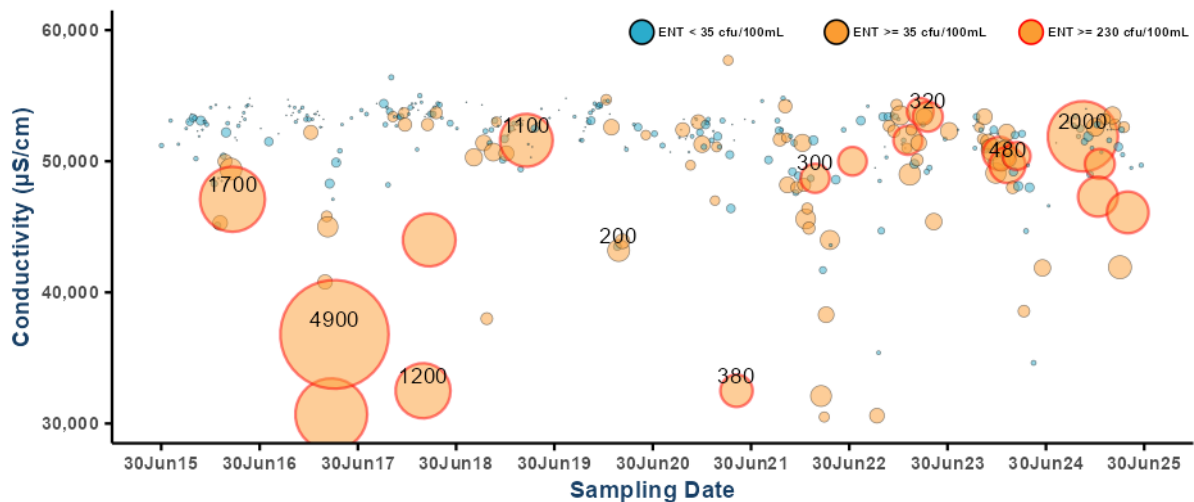
Monterey Baths: Enterococci (cfu/100mL)



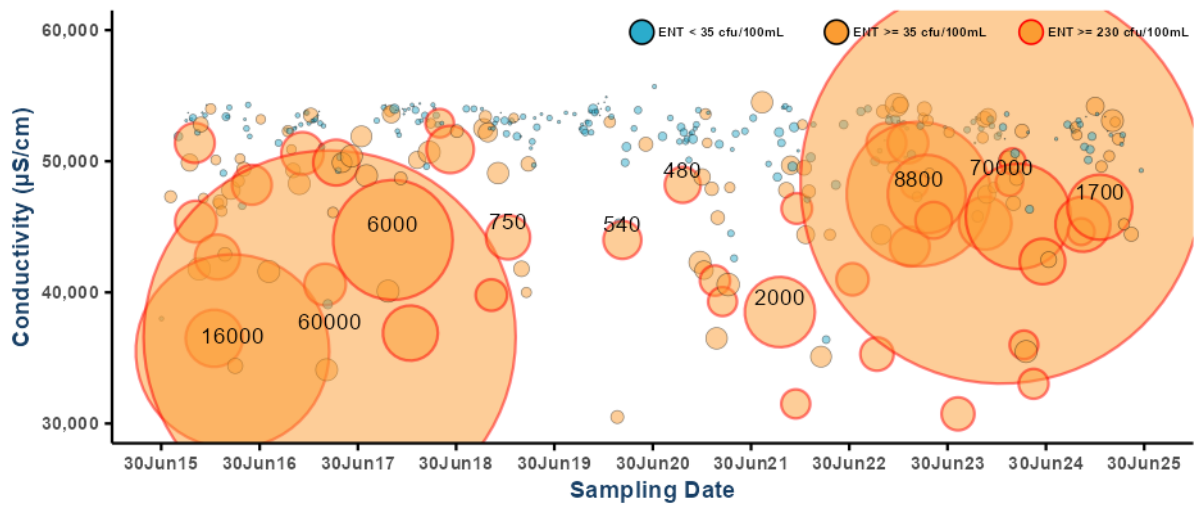
Brighton Le Sands Baths: Enterococci (cfu/100mL)



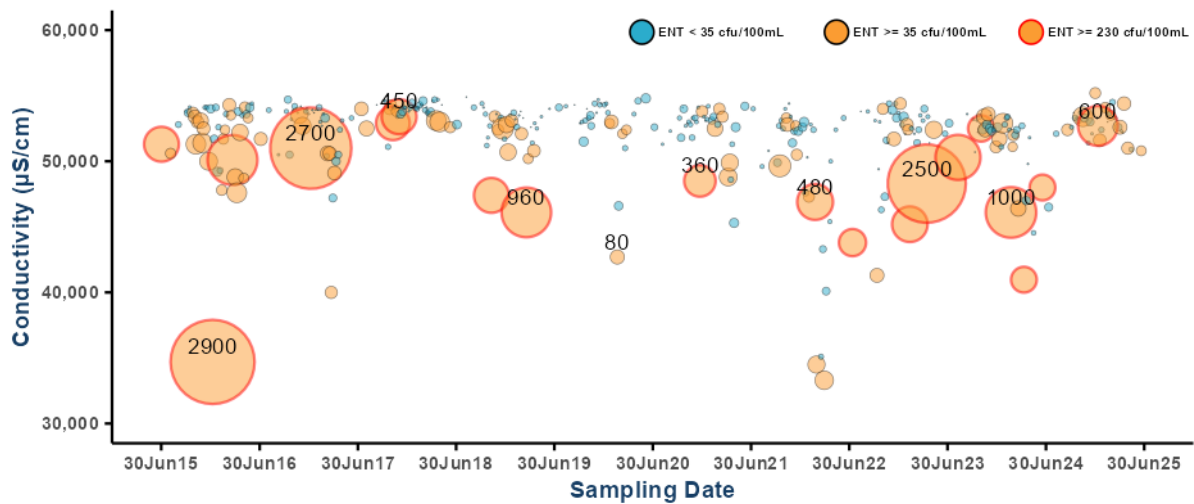
Kyeemagh Baths: Enterococci (cfu/100mL)



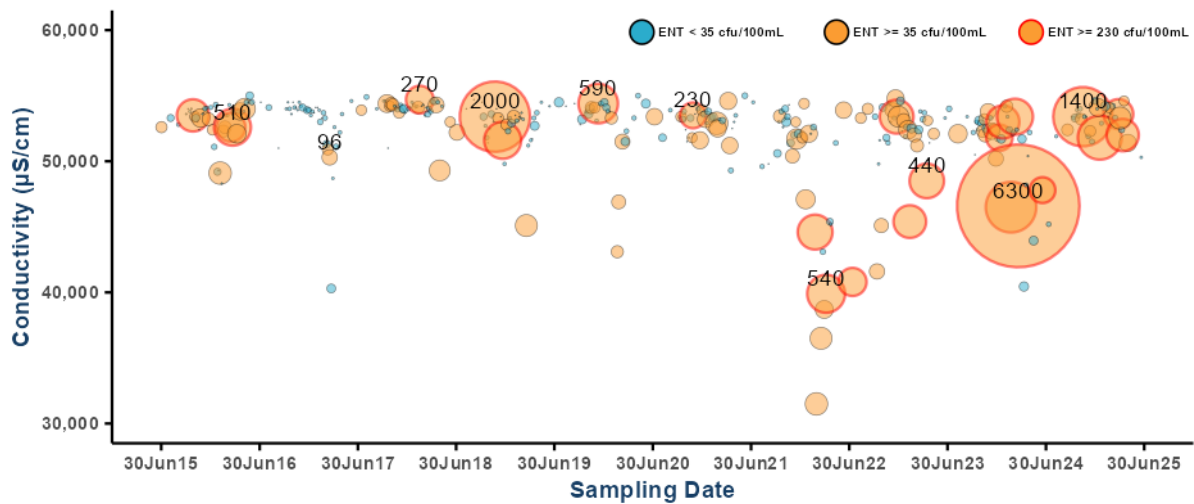
Foreshores Beach: Enterococci (cfu/100mL)



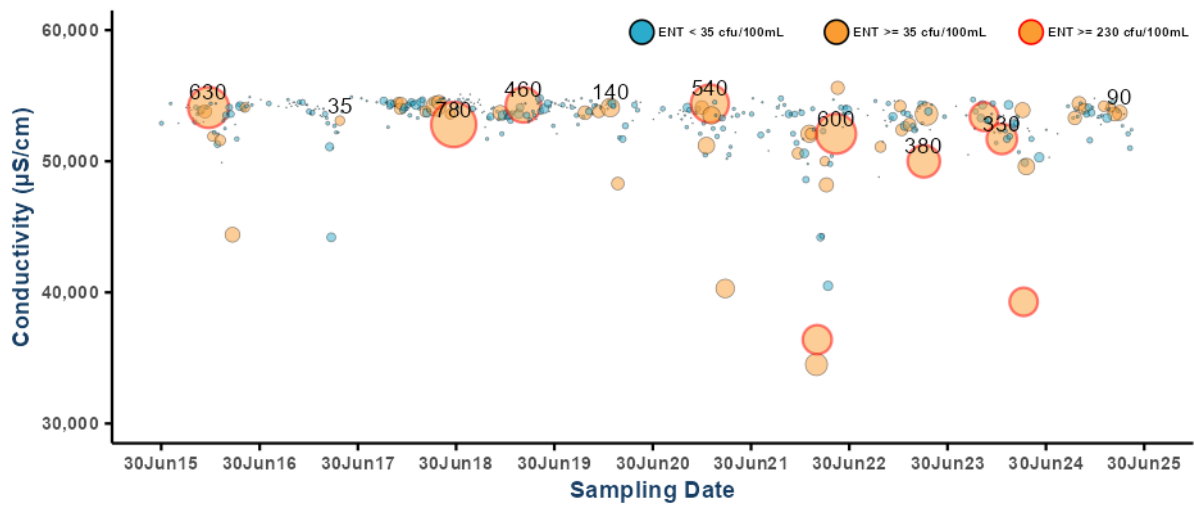
Yarra Bay: Enterococci (cfu/100mL)



Frenchmans Bay: Enterococci (cfu/100mL)

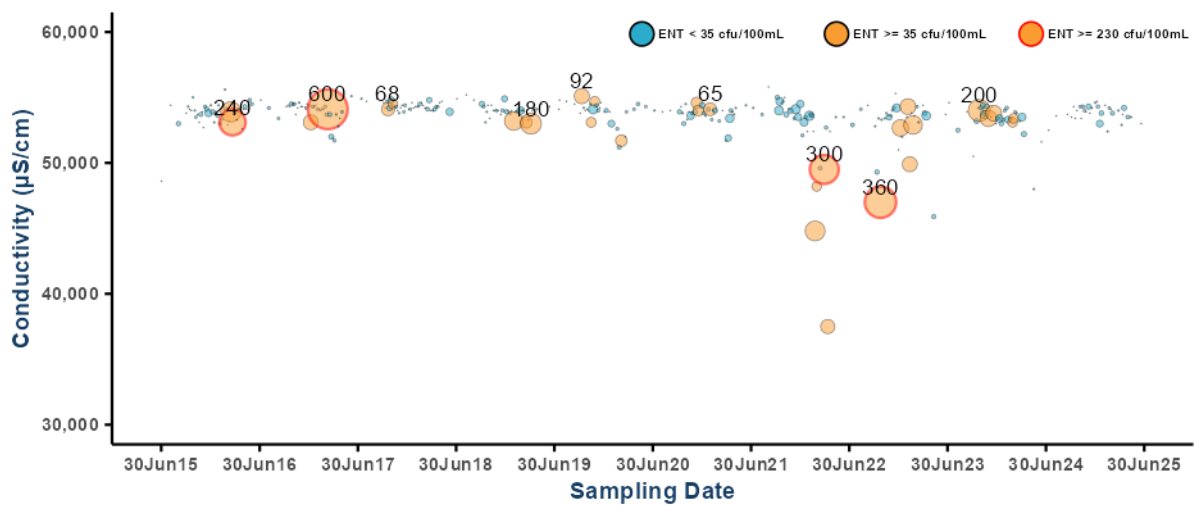


Congwong Bay: Enterococci (cfu/100mL)

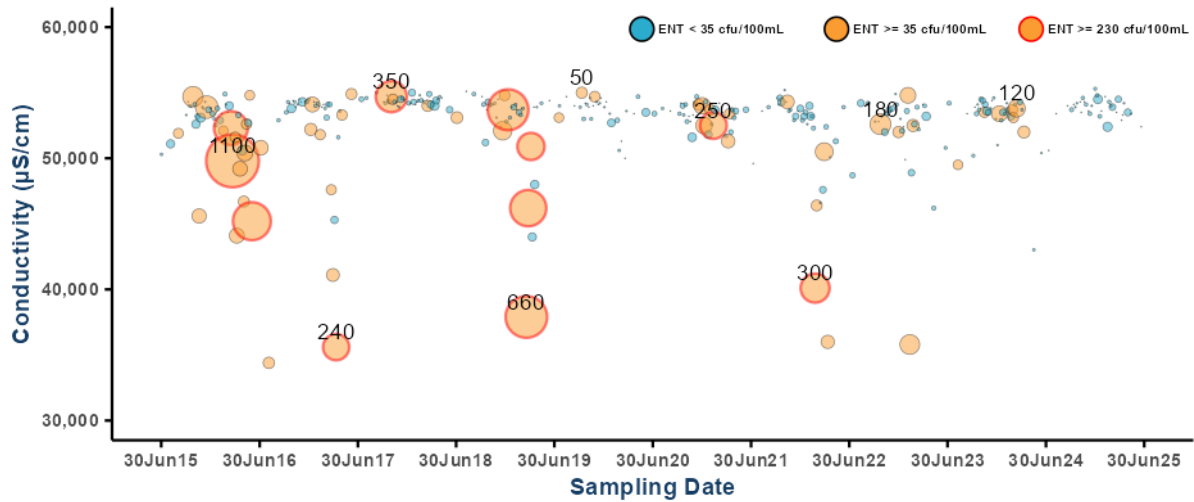


G.8. Sydney Harbour and Estuaries: Port Hacking

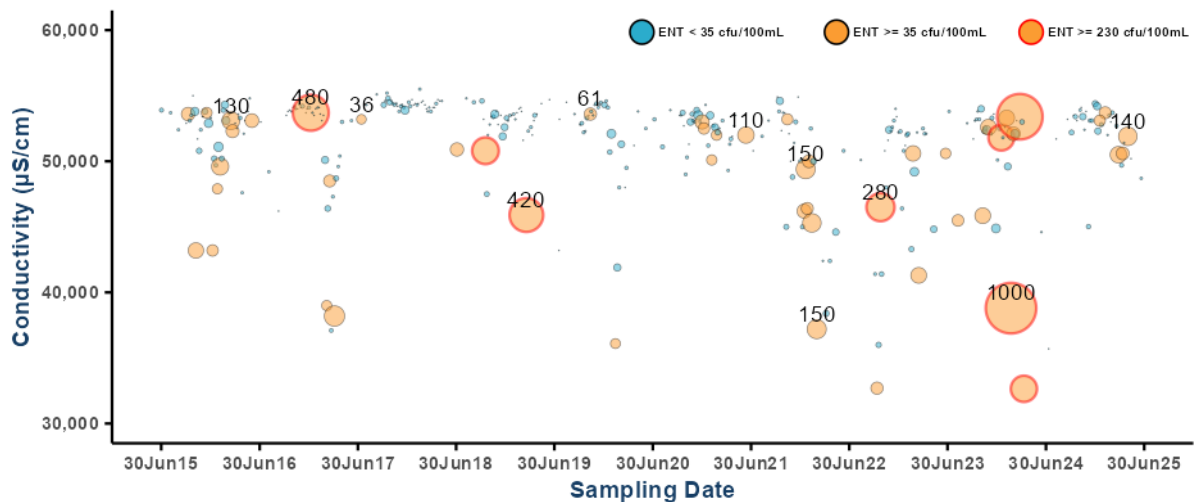
Jibbon Beach: Enterococci (cfu/100mL)



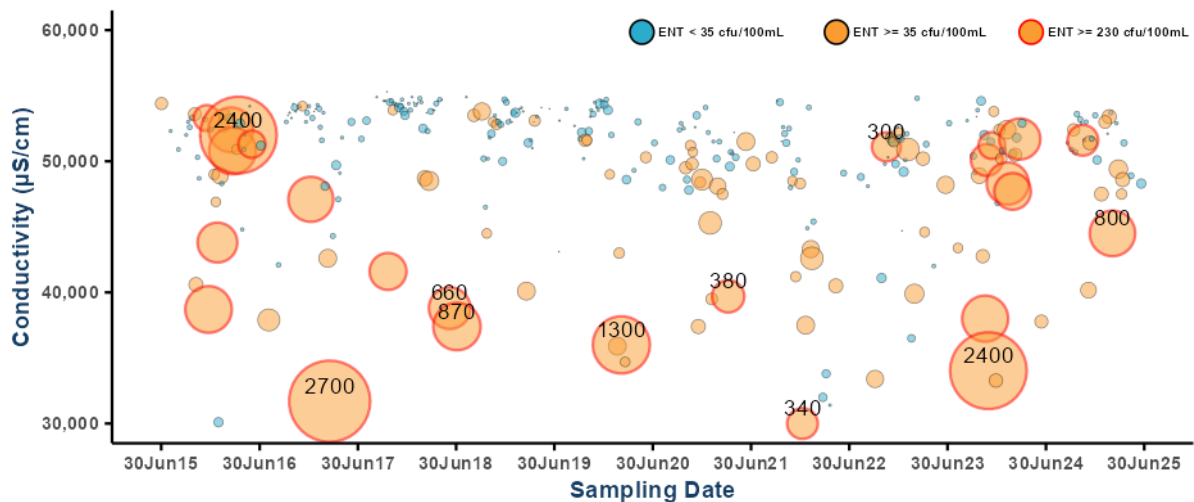
Horderns Beach: Enterococci (cfu/100mL)



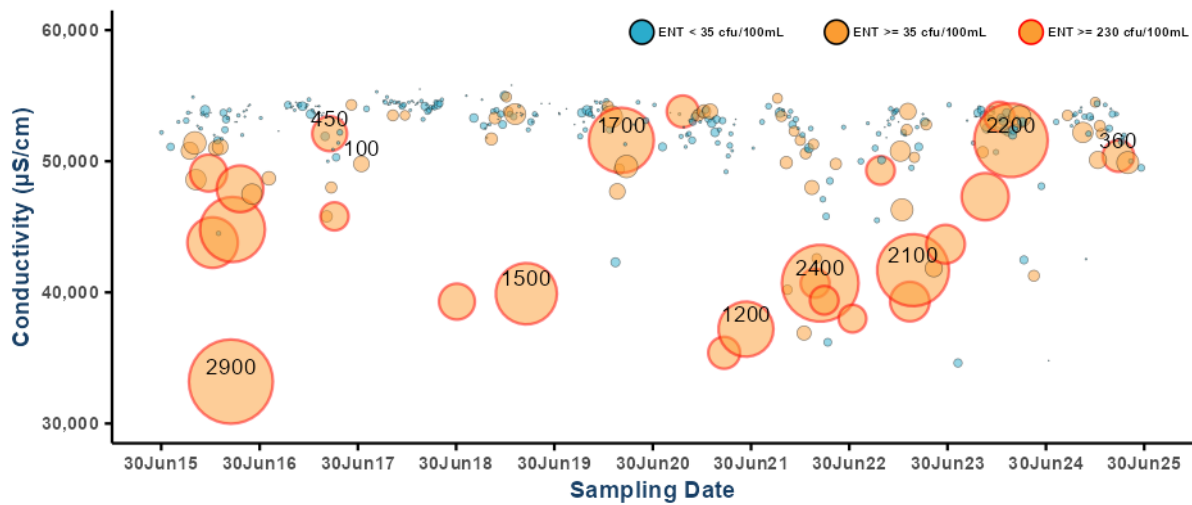
Lilli Pilli Baths: Enterococci (cfu/100mL)



GyMEA Bay Baths: Enterococci (cfu/100mL)

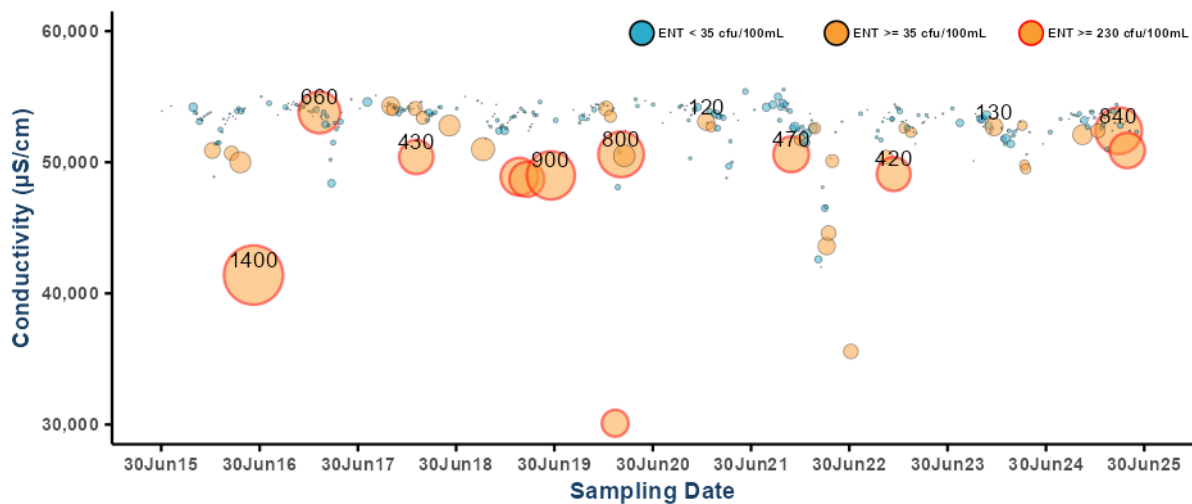


Gunnamatta Bay Baths: Enterococci (cfu/100mL)

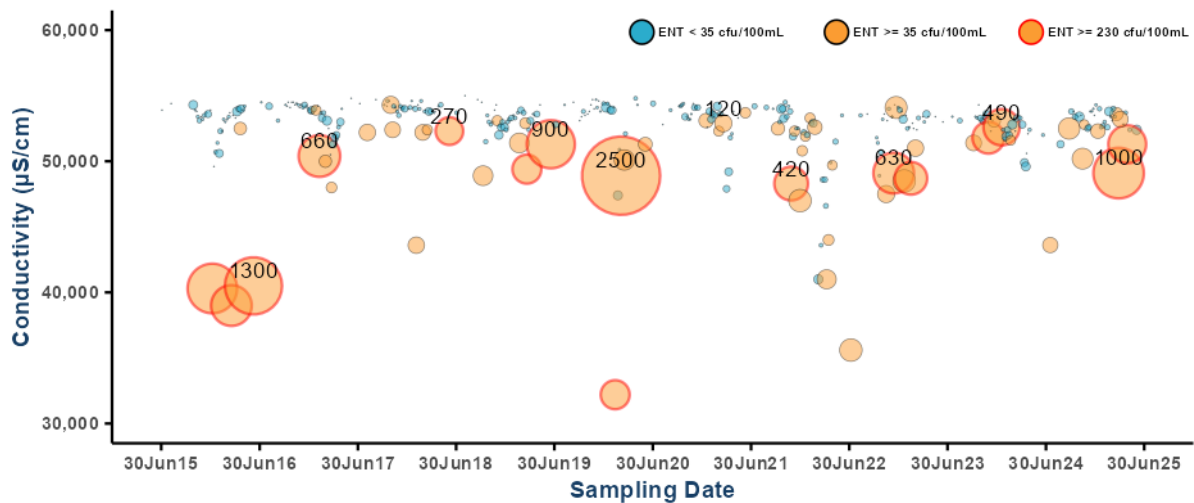


G.9. Sydney Harbour and Estuaries: Port Jackson

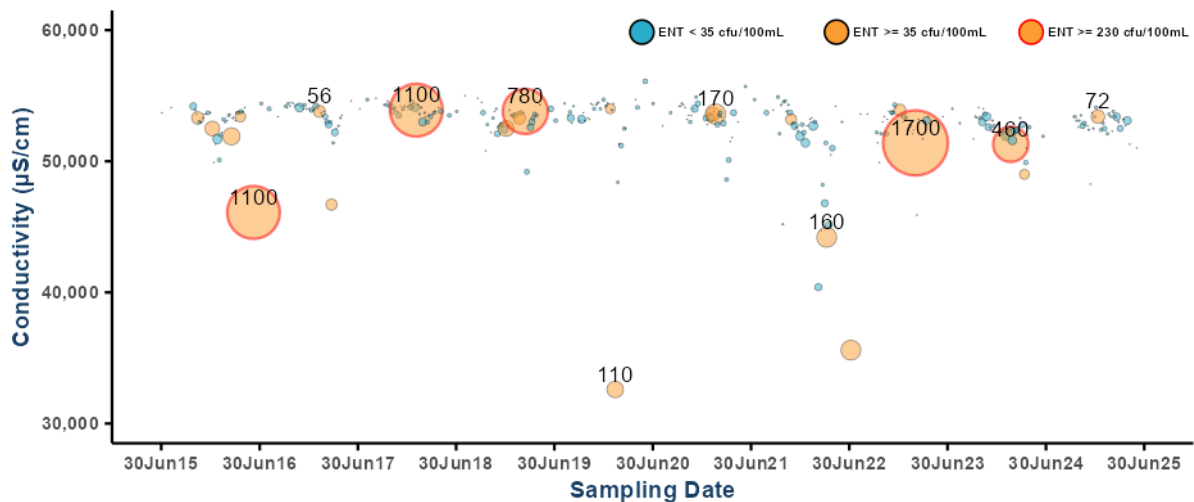
Watsons Bay: Enterococci (cfu/100mL)



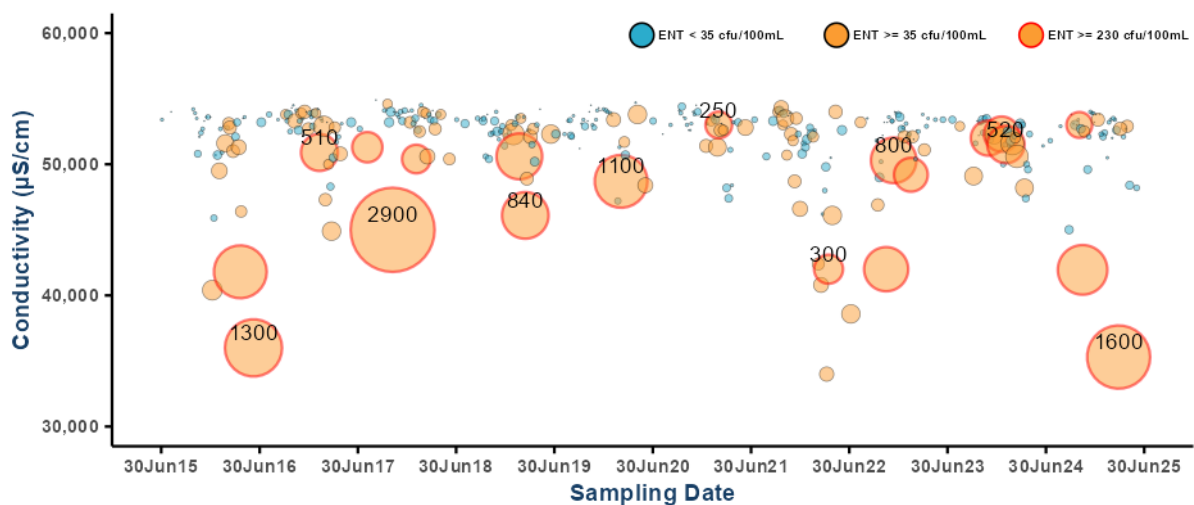
Parsley Bay: Enterococci (cfu/100mL)



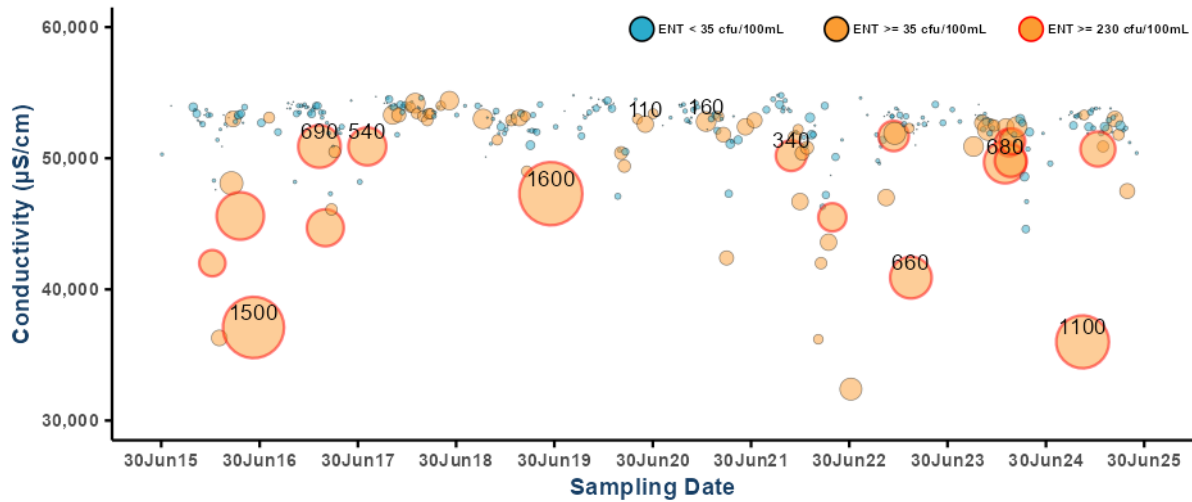
Nielsen Park: Enterococci (cfu/100mL)



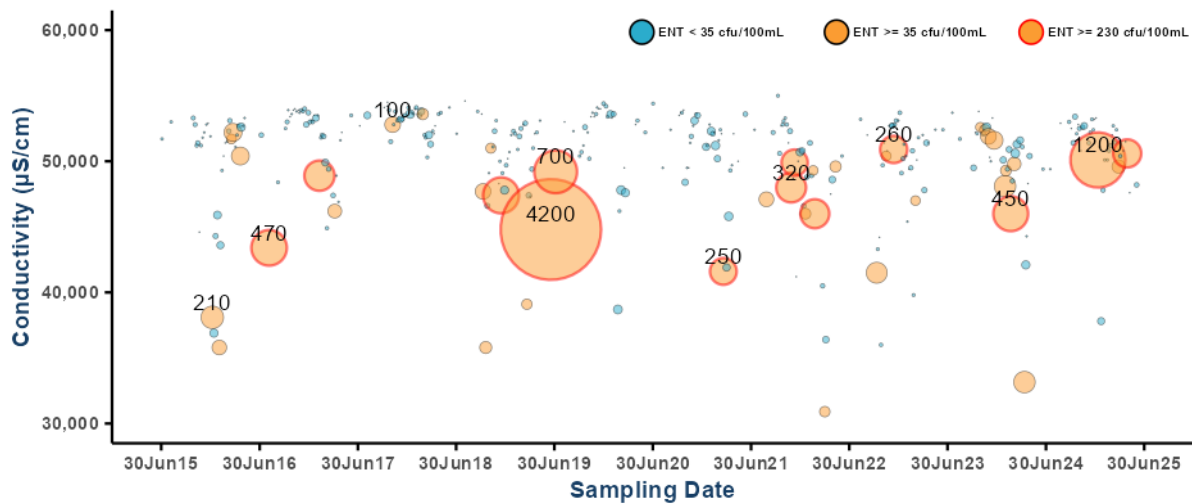
Rose Bay Beach: Enterococci (cfu/100mL)



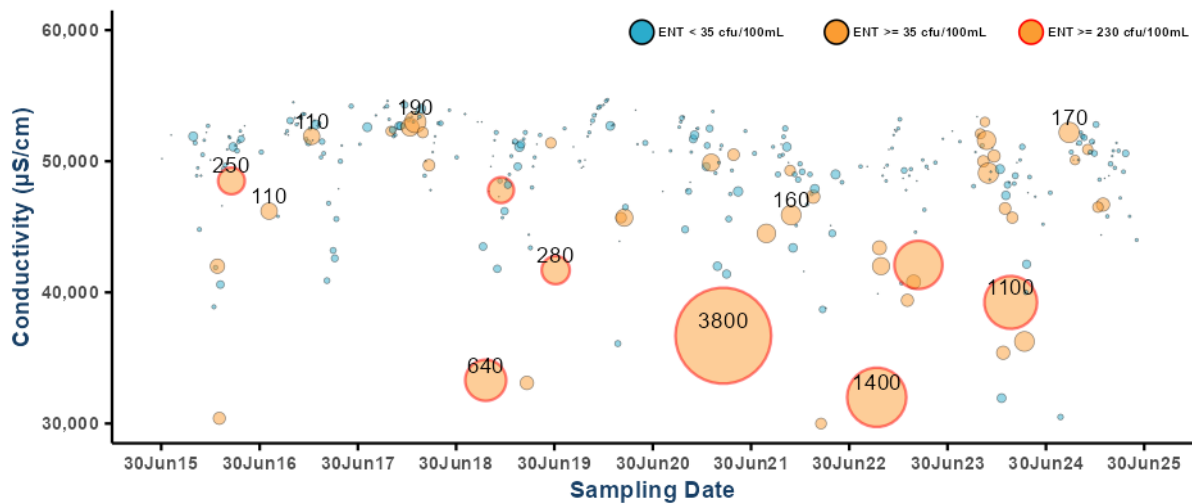
Murray Rose Pool: Enterococci (cfu/100mL)



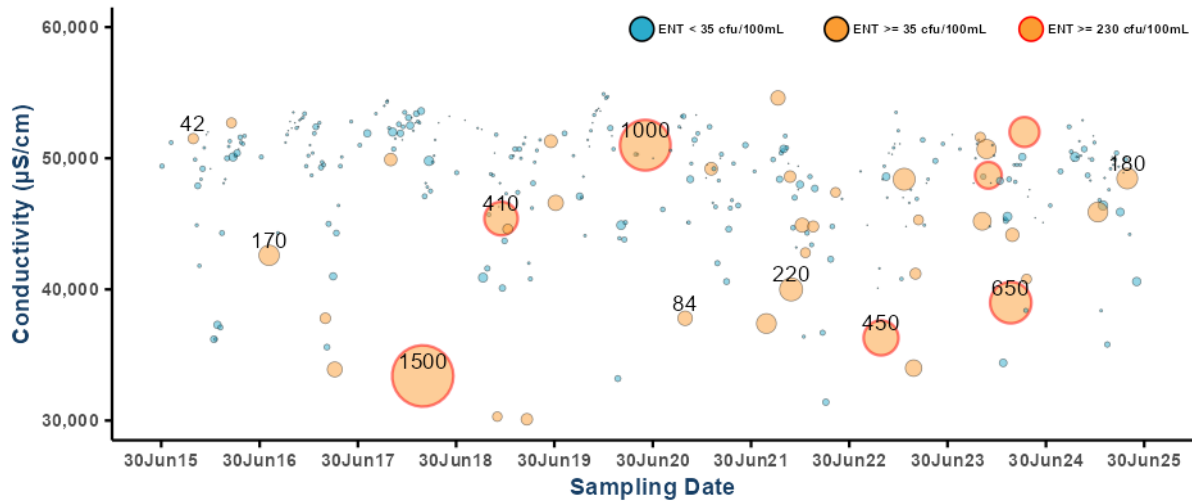
Dawn Fraser Pool: Enterococci (cfu/100mL)



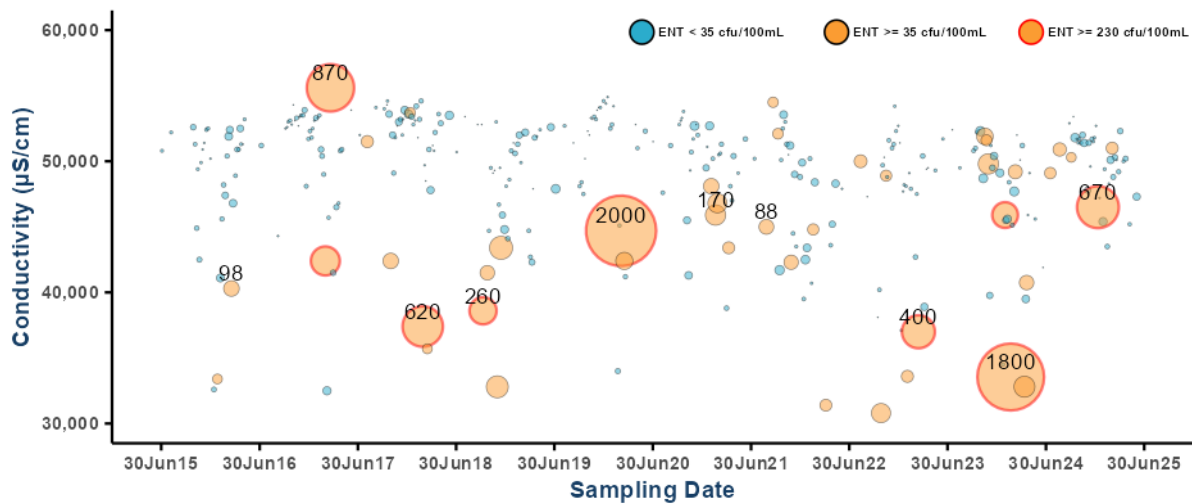
Chiswick Baths: Enterococci (cfu/100mL)



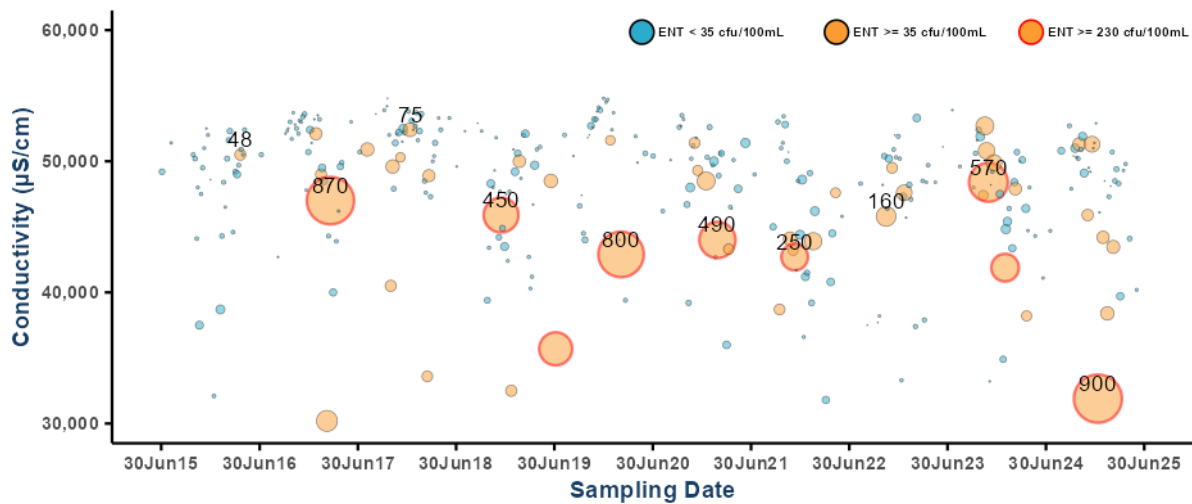
Cabarita Beach: Enterococci (cfu/100mL)



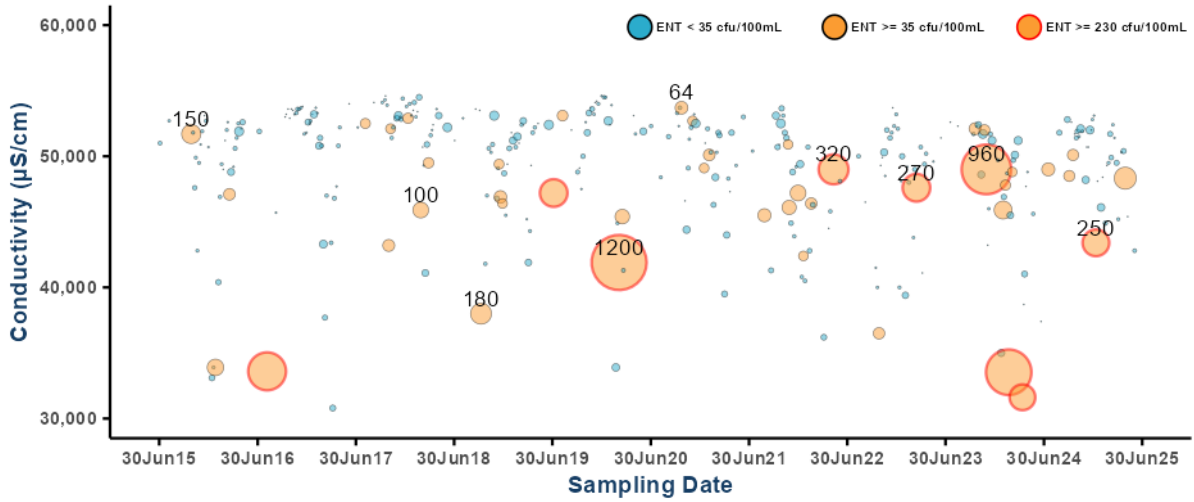
Woolwich Baths: Enterococci (cfu/100mL)



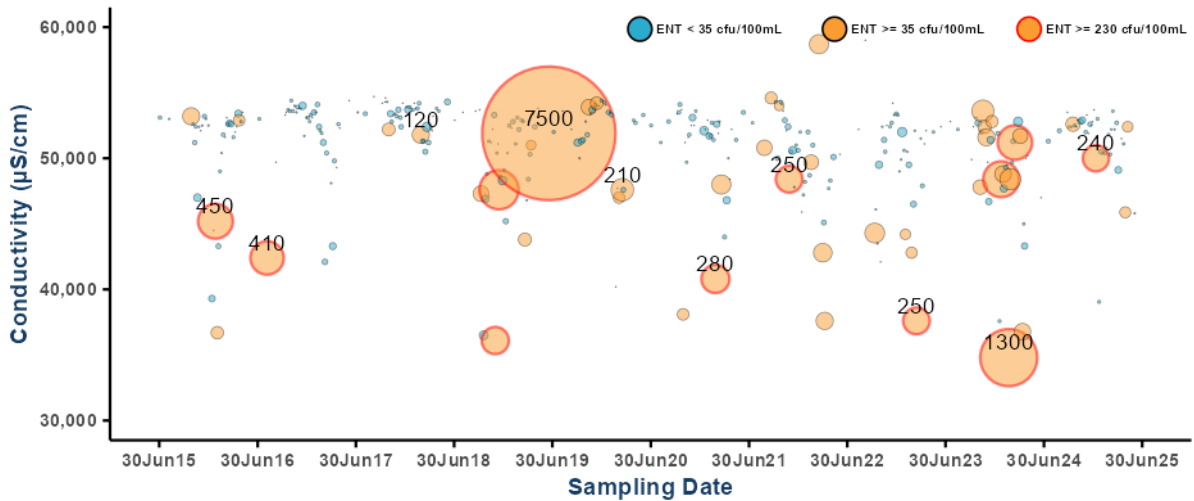
Tambourine Bay: Enterococci (cfu/100mL)



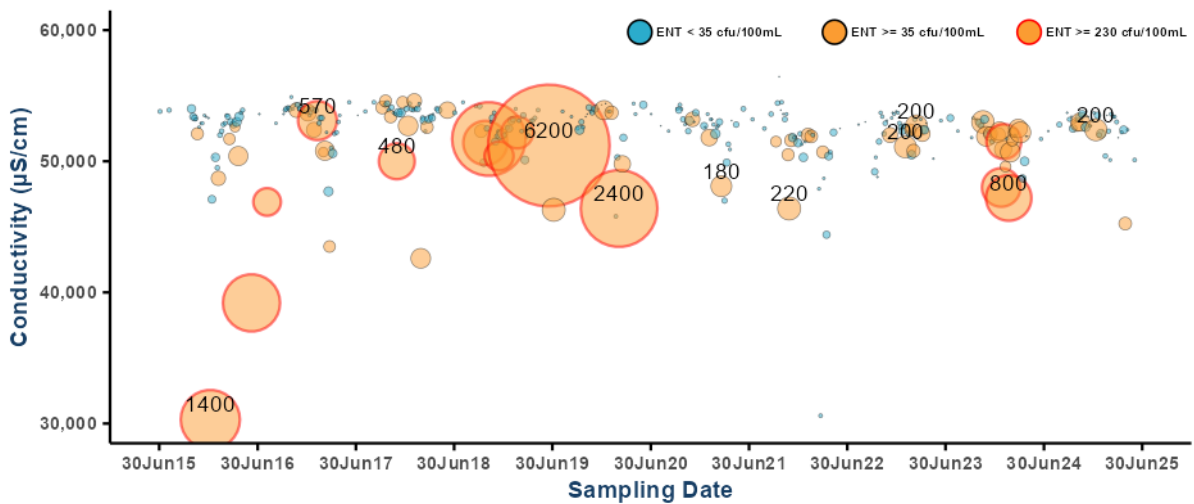
Woodford Bay: Enterococci (cfu/100mL)



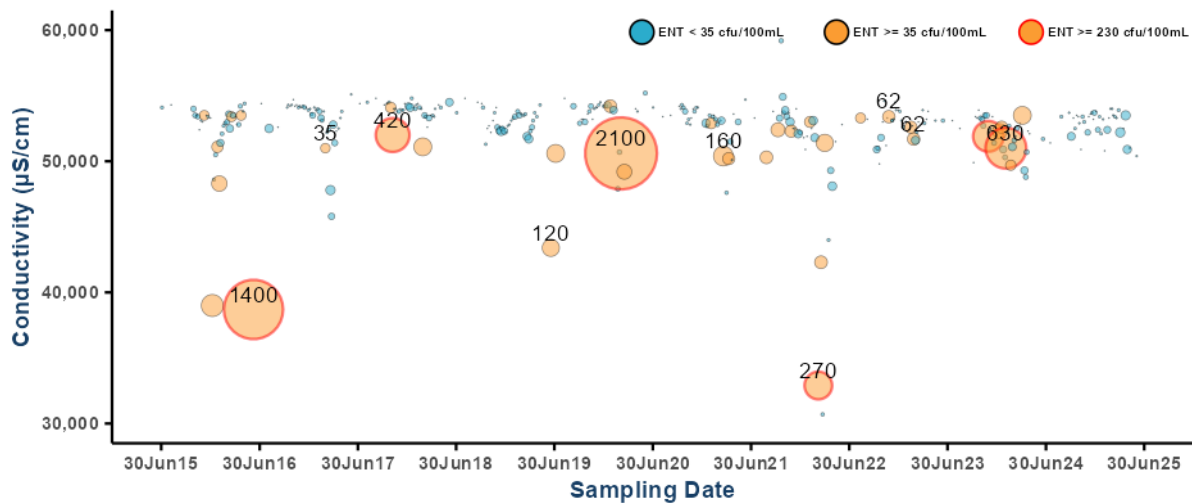
Greenwich Baths: Enterococci (cfu/100mL)



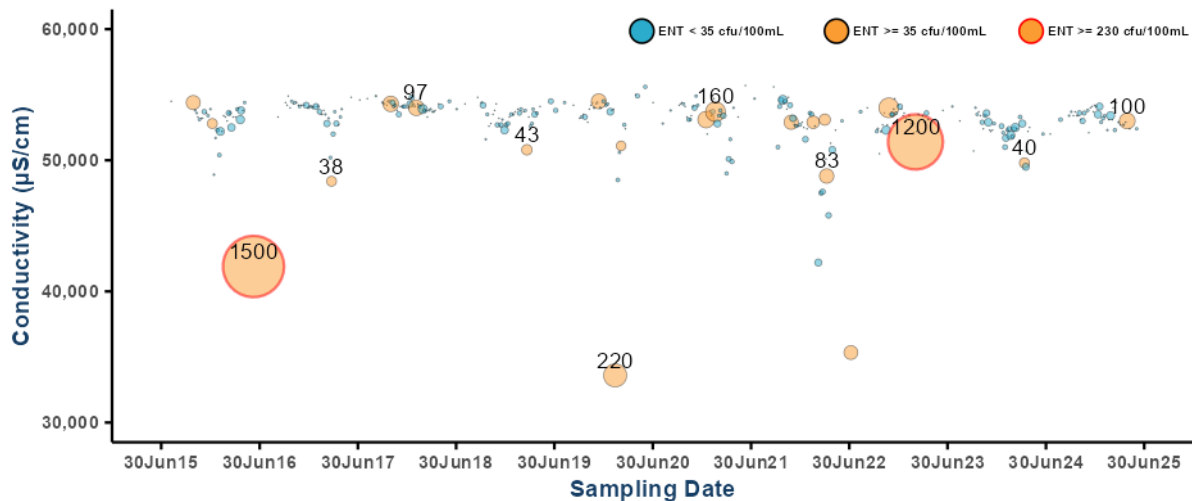
Hayes Street Beach: Enterococci (cfu/100mL)



Clifton Gardens: Enterococci (cfu/100mL)

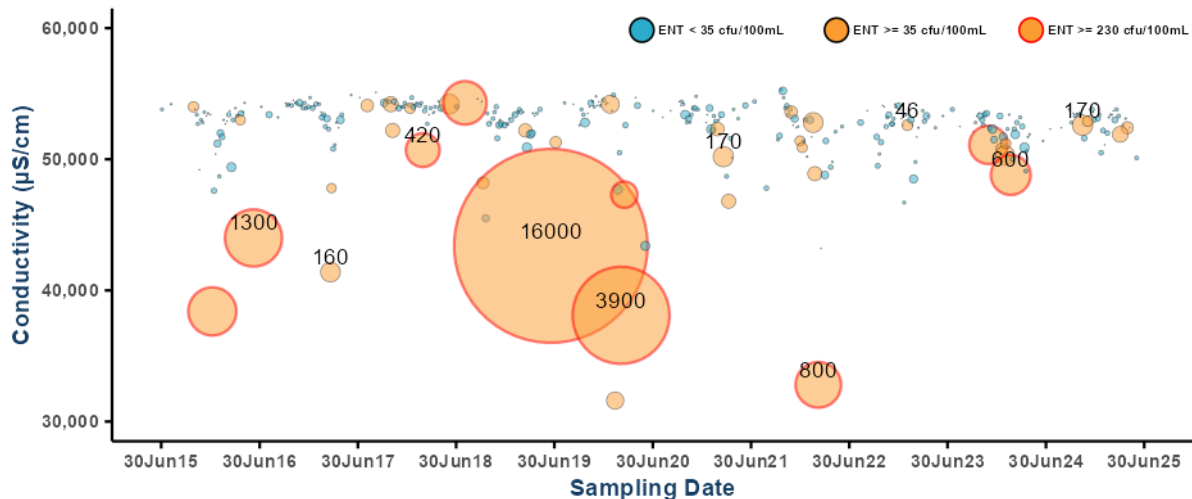


Camp Cove: Enterococci (cfu/100mL)

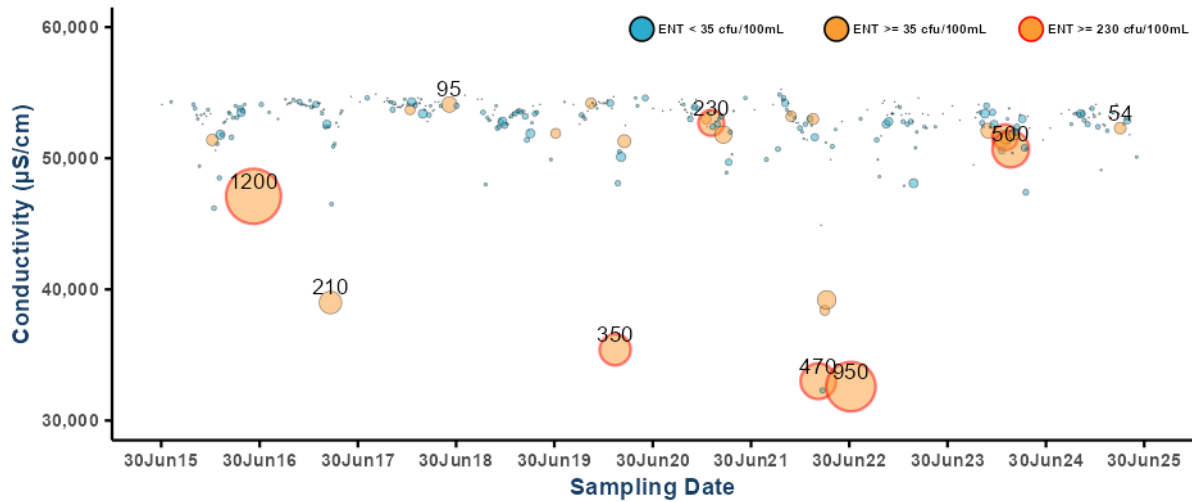


G.10. Sydney Harbour and Estuaries: Middle Harbour

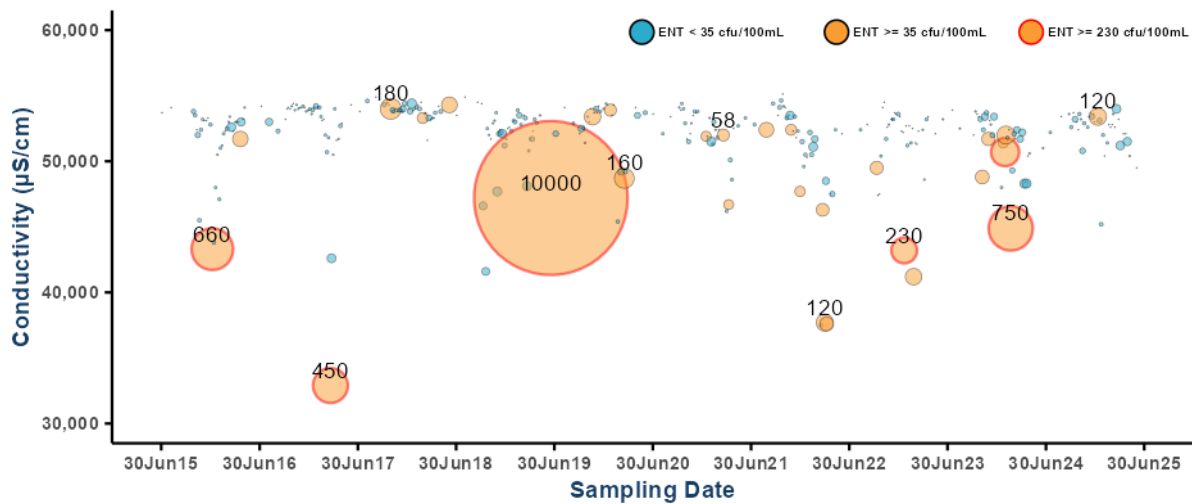
Balmoral Baths: Enterococci (cfu/100mL)



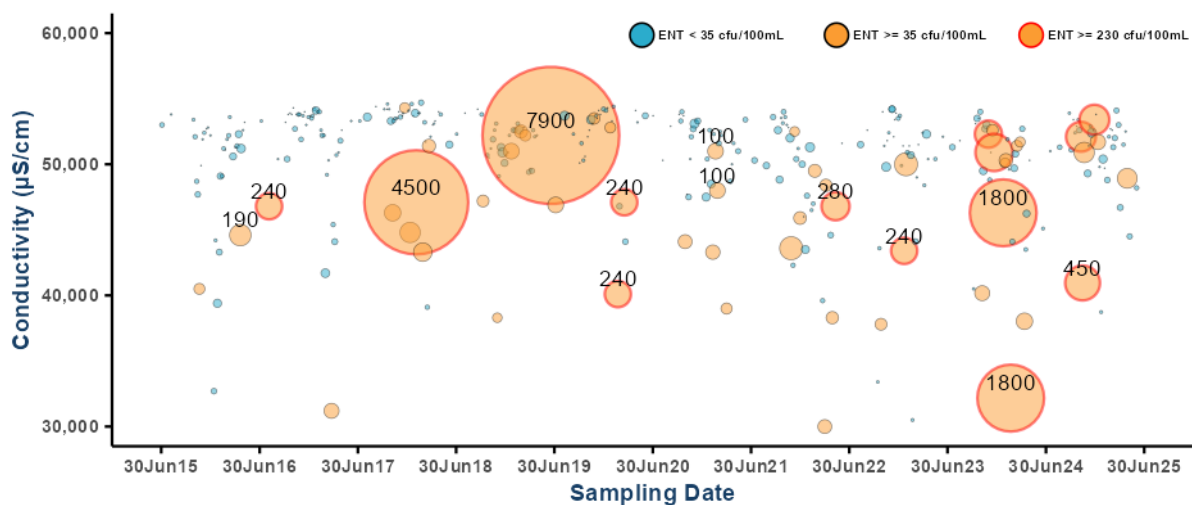
Edwards Beach: Enterococci (cfu/100mL)



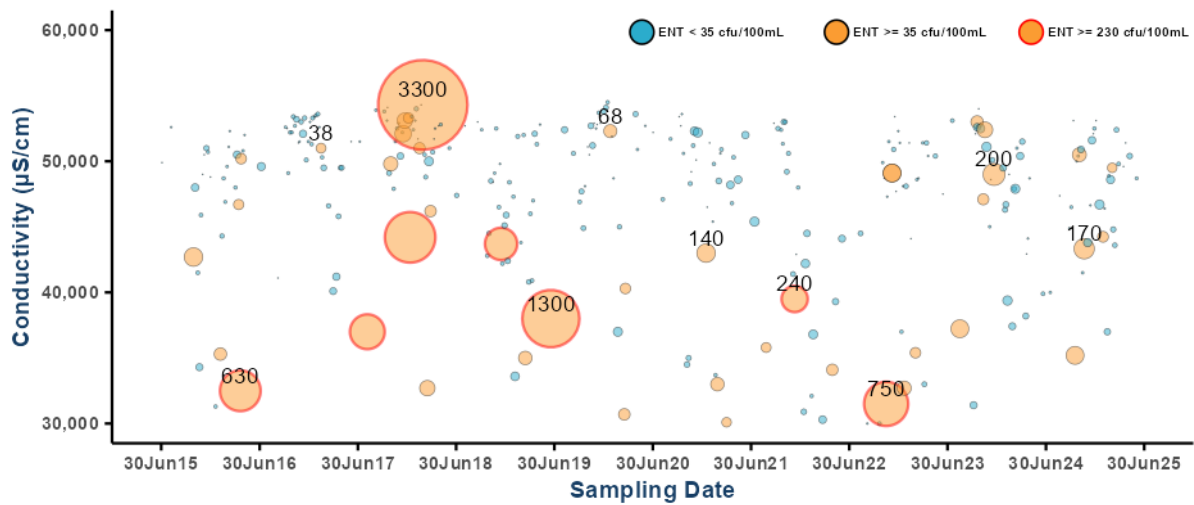
Chinamans Beach: Enterococci (cfu/100mL)



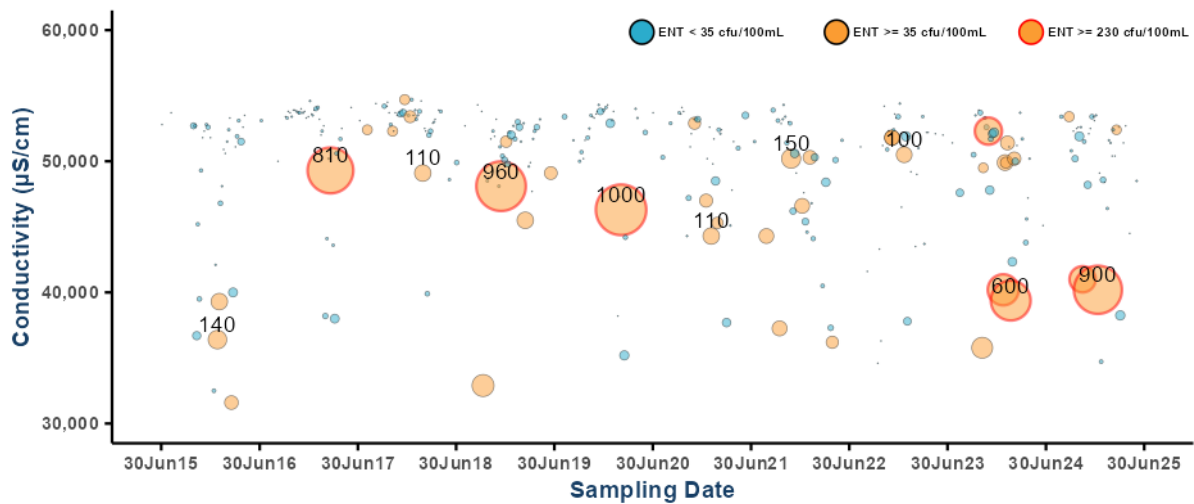
Northbridge Baths: Enterococci (cfu/100mL)



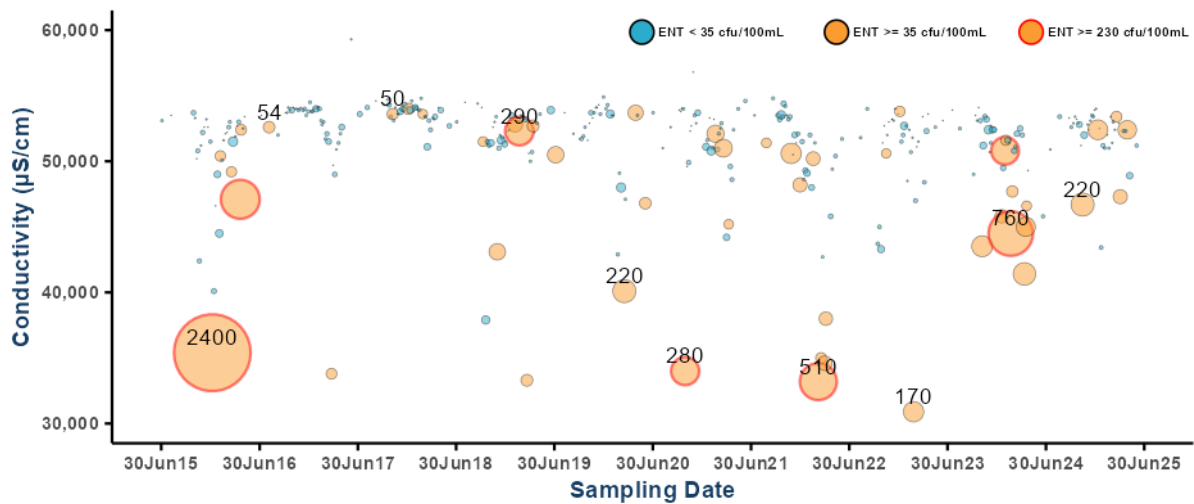
Davidson Reserve: Enterococci (cfu/100mL)



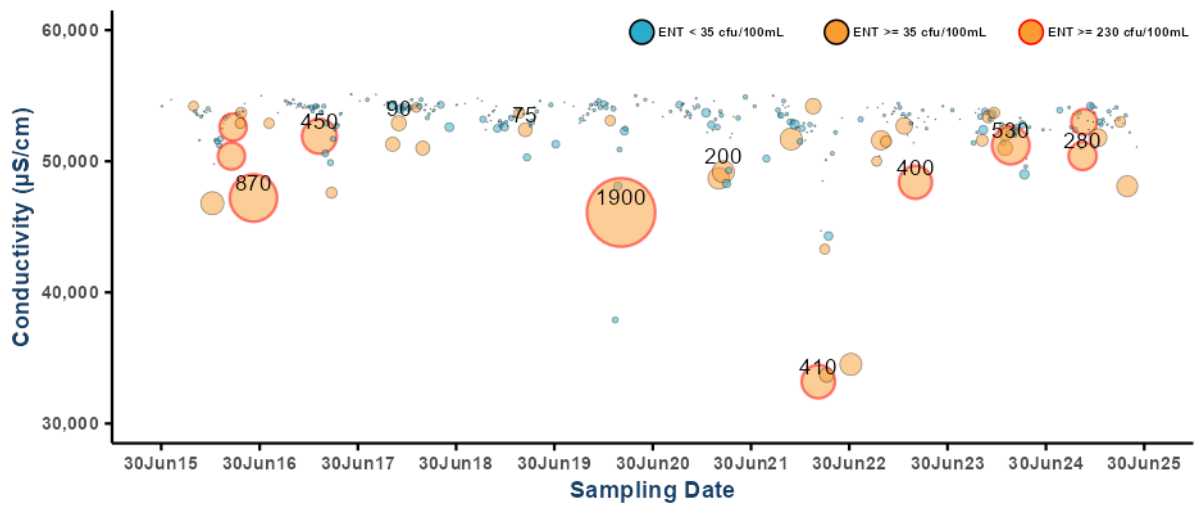
Gurney Crescent Baths: Enterococci (cfu/100mL)



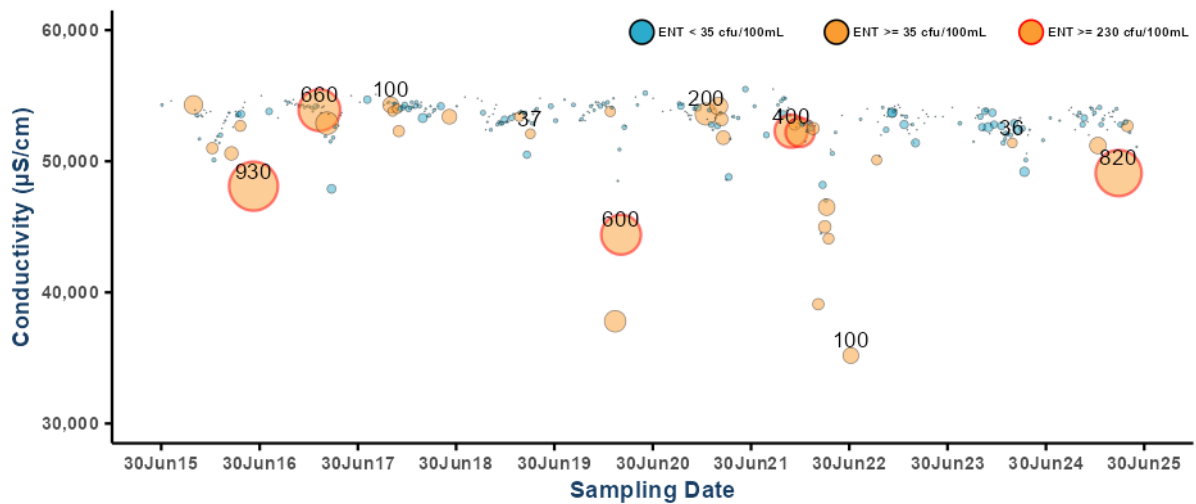
Clontarf Pool: Enterococci (cfu/100mL)



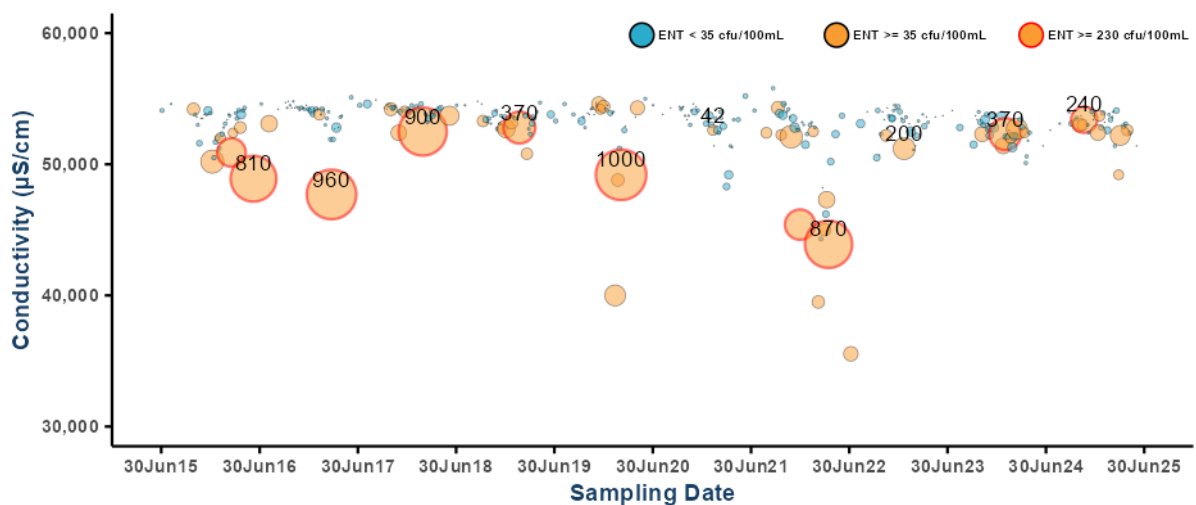
Forty Baskets Pool: Enterococci (cfu/100mL)



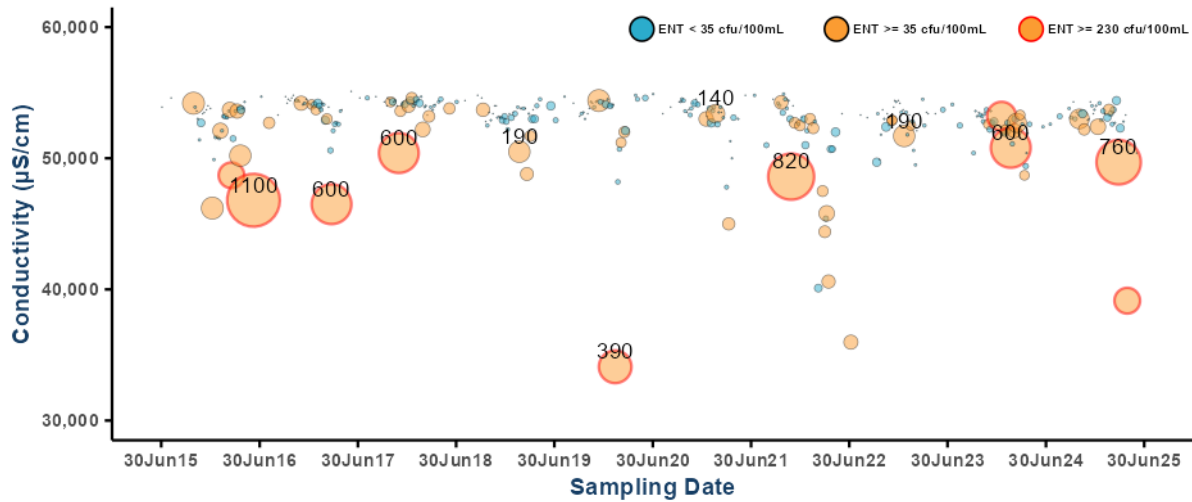
Fairlight Beach: Enterococci (cfu/100mL)



Manly Cove: Enterococci (cfu/100mL)

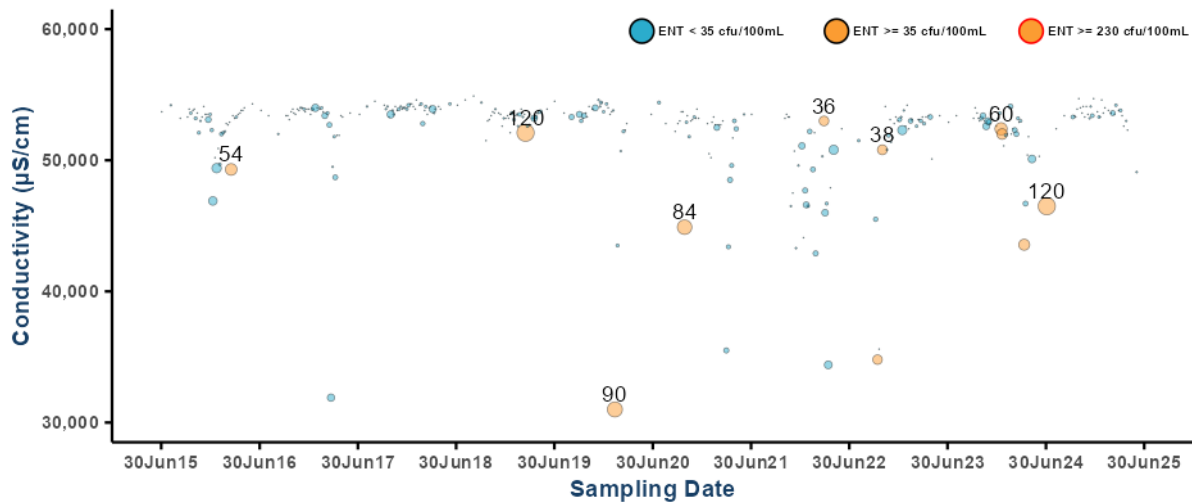


Little Manly Cove: Enterococci (cfu/100mL)

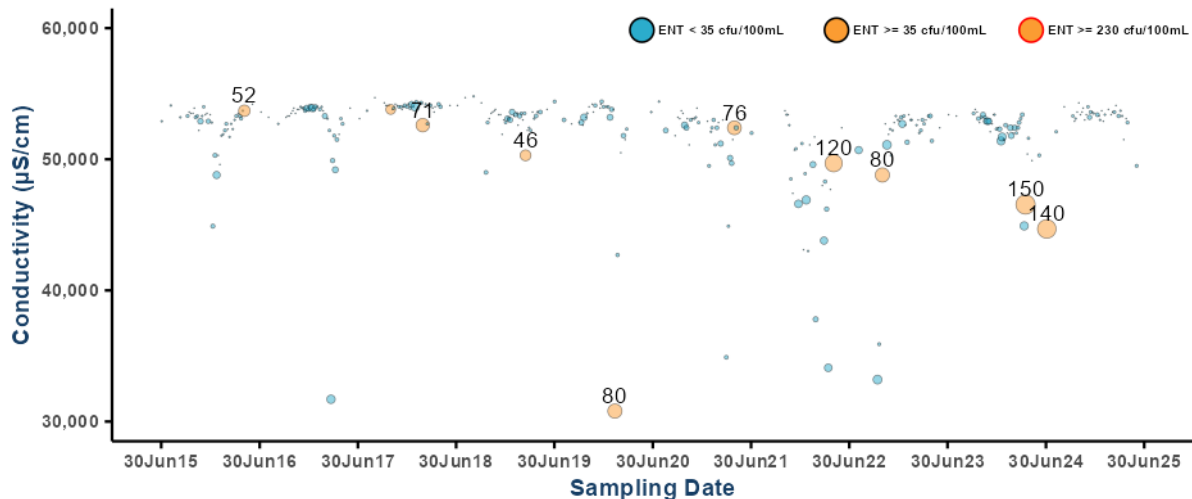


G.11. Sydney Harbour and Estuaries: Pittwater

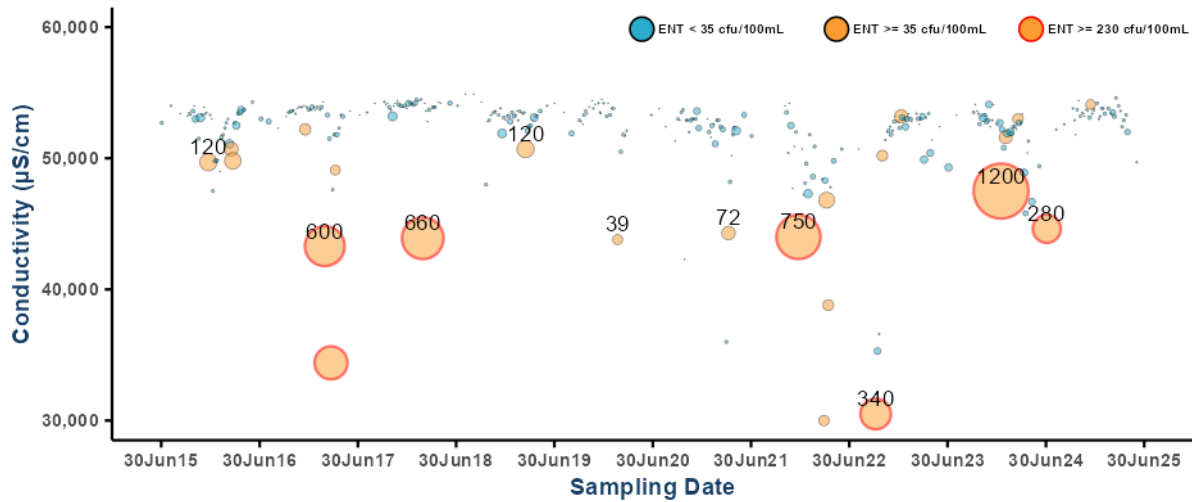
Great Mackerel Beach: Enterococci (cfu/100mL)



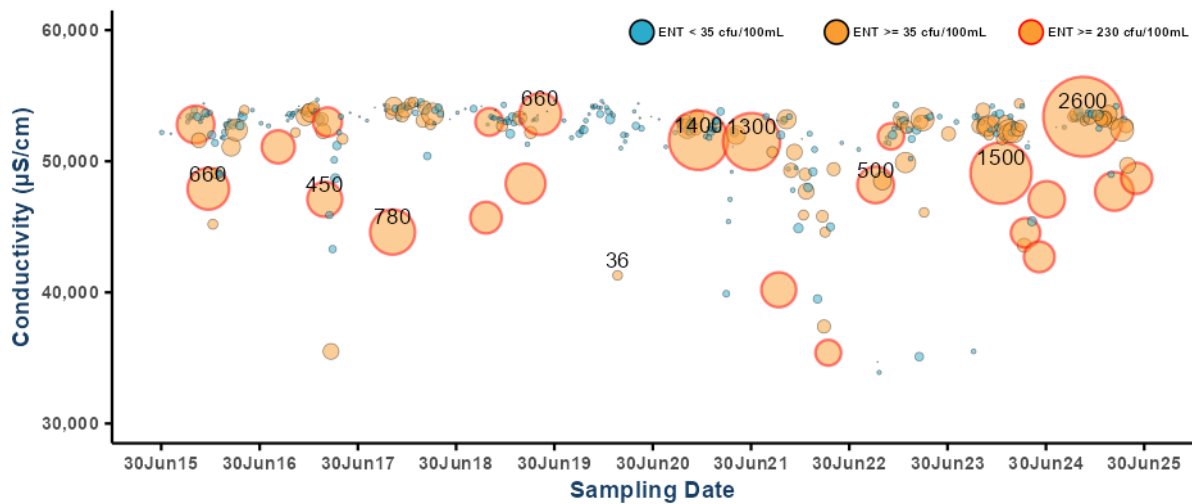
The Basin: Enterococci (cfu/100mL)



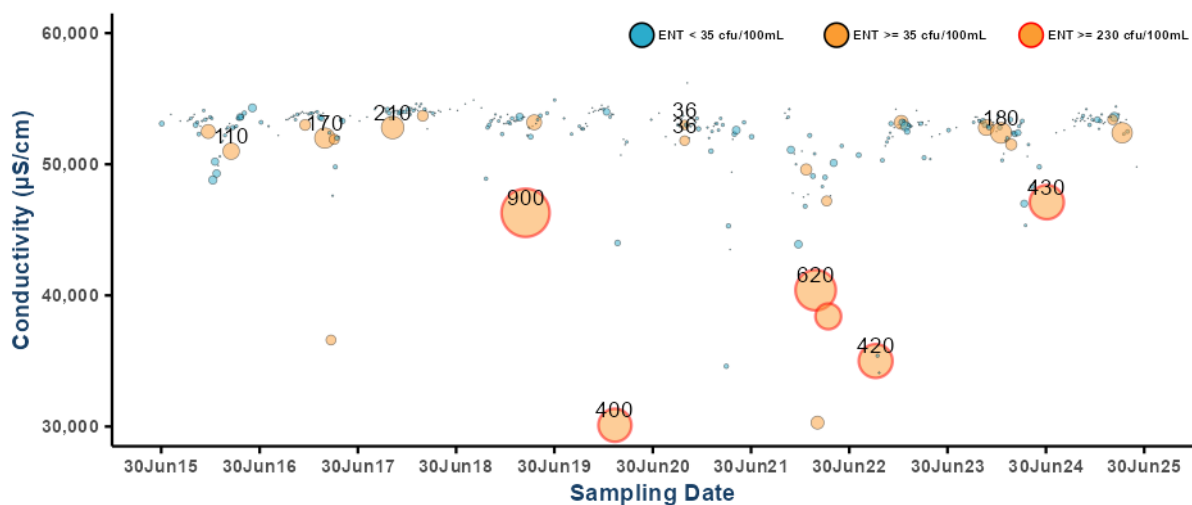
Elvina Bay: Enterococci (cfu/100mL)



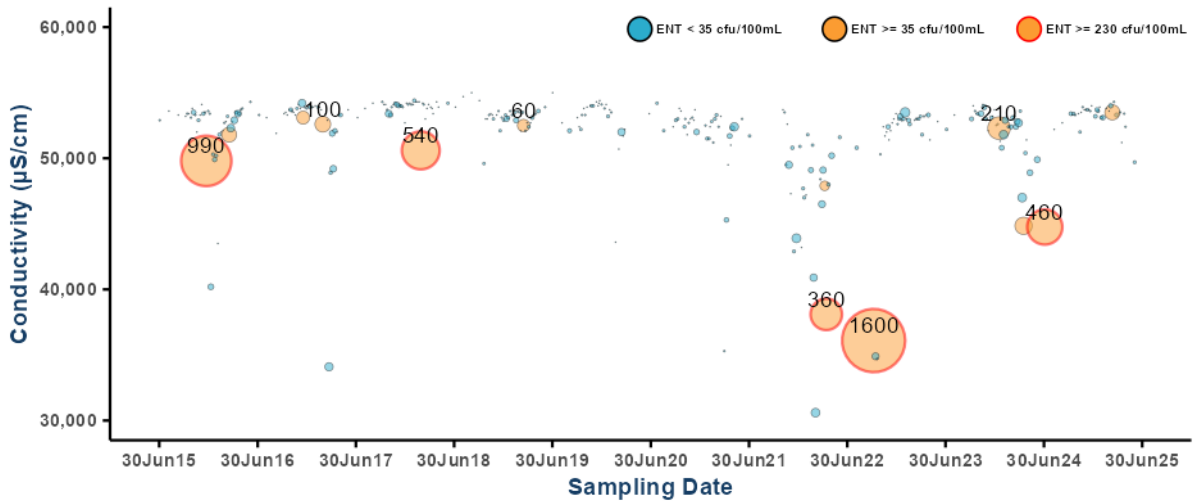
Bayview Baths: Enterococci (cfu/100mL)



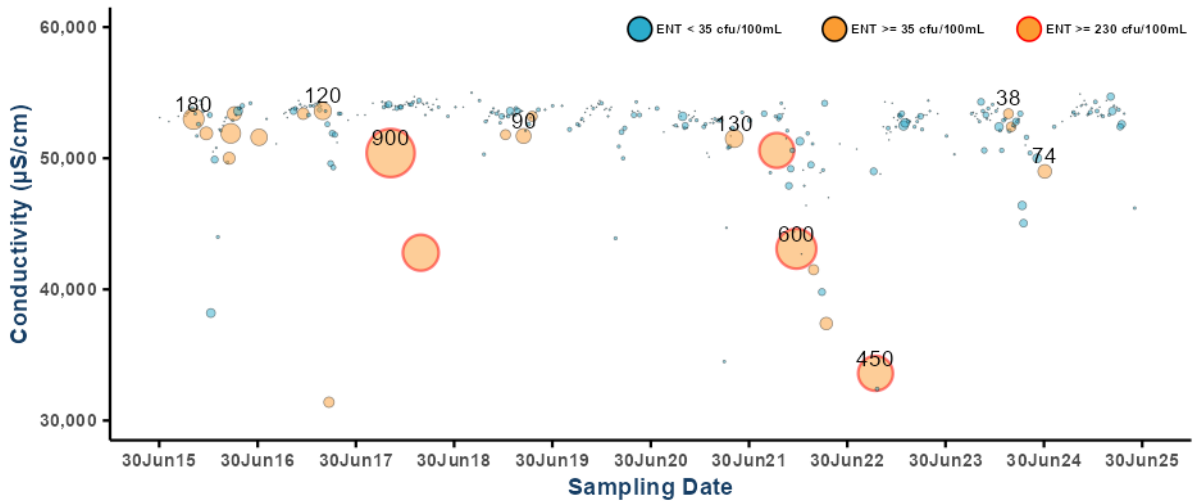
South Scotland Island: Enterococci (cfu/100mL)



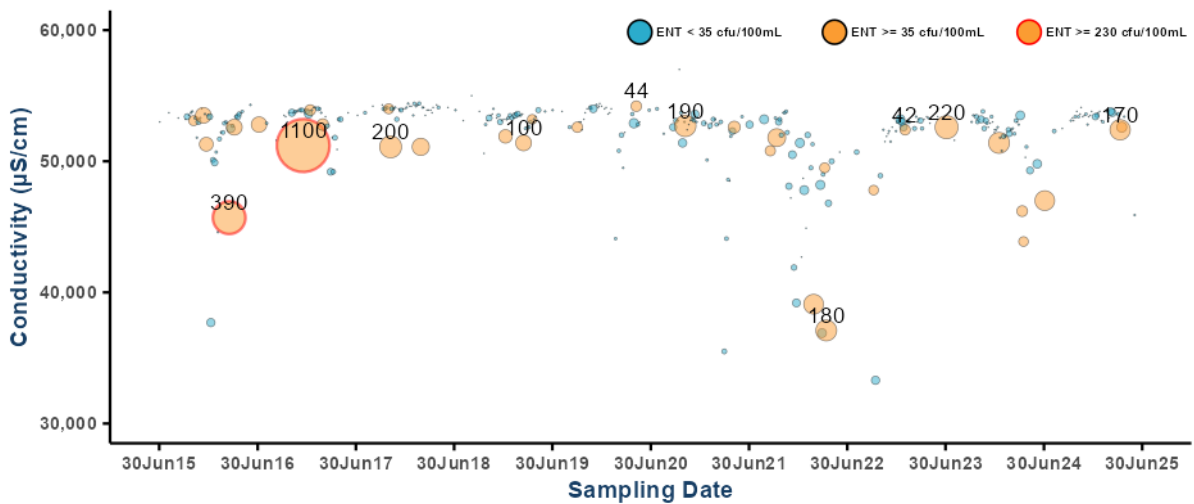
North Scotland Island: Enterococci (cfu/100mL)



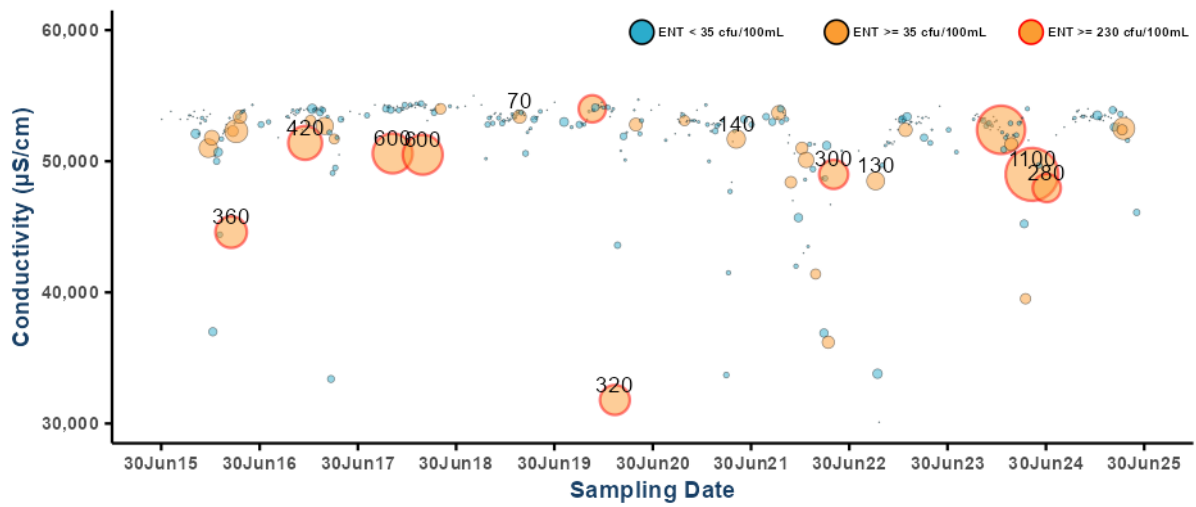
Taylors Point Baths: Enterococci (cfu/100mL)



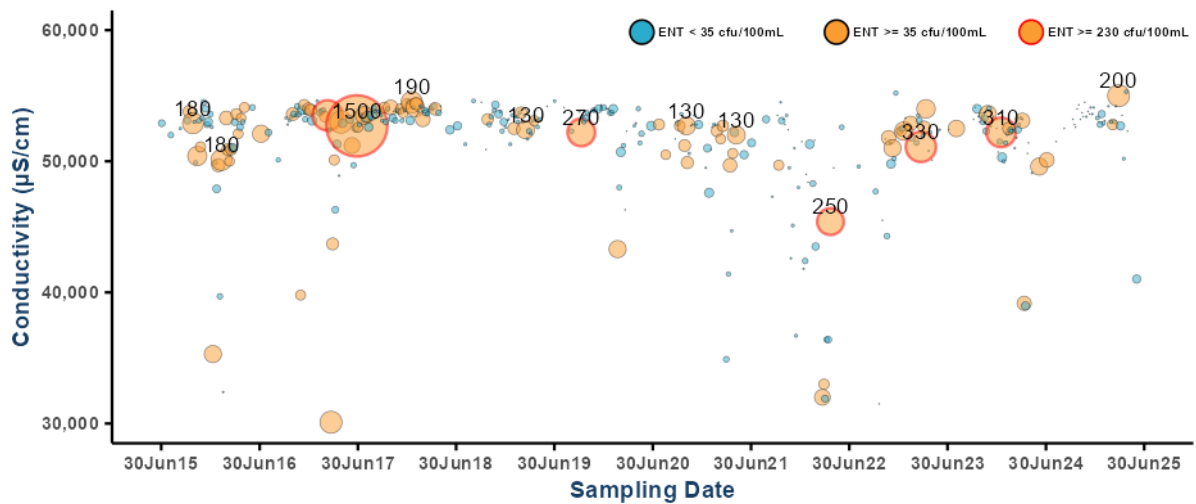
Clareville Beach: Enterococci (cfu/100mL)



Paradise Beach Baths: Enterococci (cfu/100mL)



Barrenjoey Beach: Enterococci (cfu/100mL)



H. Electronic appendices

Multiple data and data summary files are provided to the EPA as electronic appendices under the following three categories and type of data/ monitoring programs. Further details on this data and any other supporting data (historical) including metadata can be provided on request.

H.1. Descriptive statistics

Data summaries on descriptive statistics for all metrics for the key monitoring programs are provided in electronic appendices as Microsoft excel files. The criteria to prepare the files includes:

- Presenting each summary statistic within a column to the same level of precision (i.e. with the same number of decimal places) - easier to compare.
- Presenting the percentiles, minimum and maximum summary statistics with the precision of the scale of measurement.

The number of variables presented in these summary statistics files varied by the type of data analysed and their significance to improve our understanding. List of files provided as electronic appendices by each type of data/ monitoring programs are provided below.

Table H-1 List of electronic appendix files on descriptive statistics

Data	File name
Wastewater	EA_WW_01 Yearly WWRF catchment rainfall, wastewater inflow, discharge, reuse volume (2015-25)
	EA_WW_02 Yearly WWRF LBL flow and load summary
	EA_WW_03 Yearly WWRF discharge concentration summary
Wastewater overflows	EA_WWO_01 DWLP SCAMPs results for each EPL (2024-25)
Receiving water quality and ecosystem health (phytoplankton)	EA_WQ&EH_01 Yearly Hawkesbury-Nepean River – water quality and chlorophyll-a data summary (2024-25)
	EA_WQ&EH_02 Yearly Georges River – water quality and chlorophyll-a data summary (2024-25)
	EA_WQ&EH_03 Yearly SoE sites – water quality and chlorophyll-a data summary (2024-25)
	EA_WQ_01 Yearly reference sites – water quality data summary (2024-25)

H.2. Statistical model details and outputs

Statistical analysis outcome tables for the Hawkesbury-Nepean River, Georges River, Freshwater reference and SoE sites are provided as four separate electronic appendices (H-2).

Table H-2 List of electronic appendix files on analysis datasets

Data	File name
Receiving water quality and ecosystem health (phytoplankton)	EA_WQ&EH_04 ANOVA and EMMEANS outcomes for Hawkesbury-Nepean sites (2024-25)
	EA_WQ&EH_05 ANOVA and EMMEANS outcomes for SoE sites (2024-25)
	EA_WQ&EH_06 ANOVA and EMMEANS outcomes for Georges River sites (2024-25)
	EA_WQ_02 ANOVA and EMMEANS outcomes for Reference sites (2024-25)

H.3. Analysis datasets

Analysis datasets for the key monitoring programs are provided in electronic appendices as Microsoft excel files. List of files provided as electronic appendices for each type of data are provided below.

Table H-3 List of electronic appendix files on analysis datasets

Data	File name
Receiving water quality, ecosystem health and ocean sediment data	EA_WQ&EH_07 Hawkesbury-Nepean River – water quality and chlorophyll-a data (2024-25)
	EA_WQ&EH_08 Georges River – water quality and chlorophyll-a data (2024-25)
	EA_WQ&EH_09 SoE sites – water quality and chlorophyll-a data (2024-25)
	EA_WQ_03 Reference sites – water quality data (2024-25)
	EA_EH_01 Hawkesbury-Nepean River – Phytoplankton biovolume data (SoE sites) by all group (2024-25)
	EA_EH_02 Hawkesbury-Nepean River – Phytoplankton counts (SoE sites) (2024-25)
	EA_EH_03 Freshwater macroinvertebrate indicator data (2024-25)
	EA_EH_04 Shellharbour macroinvertebrate community data (2024-25)
	EA_WQ&EH_10 Offshore marine waters assessment year data (2024-25)