Sydney Water Aquatic Monitoring Program

Volume 2: Appendices

Data Report 2023-24

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Monitoring Services

1 Smith Street, Parramatta, NSW Australia 2150

PO Box 399 Parramatta NSW 2124

Table of Contents

A. Hawkesbury-Nepean River

This Appendix includes graphical presentation of monitoring data for the Hawkesbury-Nepean River catchment that are directly linked with the assessment of WRRF impact.

The inland Water Resource Recovery Facilities (WRRFs) that are discharging into this catchment are ordered from upstream (Picton) to downstream (Brooklyn).

Under each WRRF (Sub-chapters A-1 to A-15), 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. 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.

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

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

Tests conducted on wastewater are specified in the Environment Protection Licence (EPL) issued by the NSW EPA for each WRRF (A-16). 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.

For the **Stressor** data for the upstream and downstream tributary monitoring sites of each WRRF zone are presented first, and then the upstream and downstream monitoring site of the main stream river (if any).

Statistical analysis outcome tables on paired sites for all monitoring analytes are presented first before the plots for each WRRF section e.g. A.1.5 Stressor and Ecosystem receptor – Statistical analysis outcomes for Picton WRRF. Each WRRF section contains two statistical outcome tables:

- Current period vs previous period comparison for each individual site, e.g. current period vs past period for Nepean River site N91 at Picton WRRF
- Downstream vs upstream (current period) contrast outcomes for paired tributary and/or main stream river sites, e.g. Downstream vs upstream Stonequarry Creek and Nepean River sites at Picton WRRF.

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

Paired box plots and needle plots for each site are presented in the following three sub-groups and order:

- Nutrients
  - Total ammonia nitrogen
  - Oxidised nitrogen
  - Total nitrogen
  - Soluble reactive phosphorus
  - Filterable total 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

Analytes included for the receiving water quality are in accordance with Sydney Water Aquatic Monitoring (SWAM, Sydney Water 2023).

For the **Ecosystem Receptor**, the following two approaches were taken:

- Phytoplankton (paired box plots and needle plots)
  - Chlorophyll-a
- Macroinvertebrates

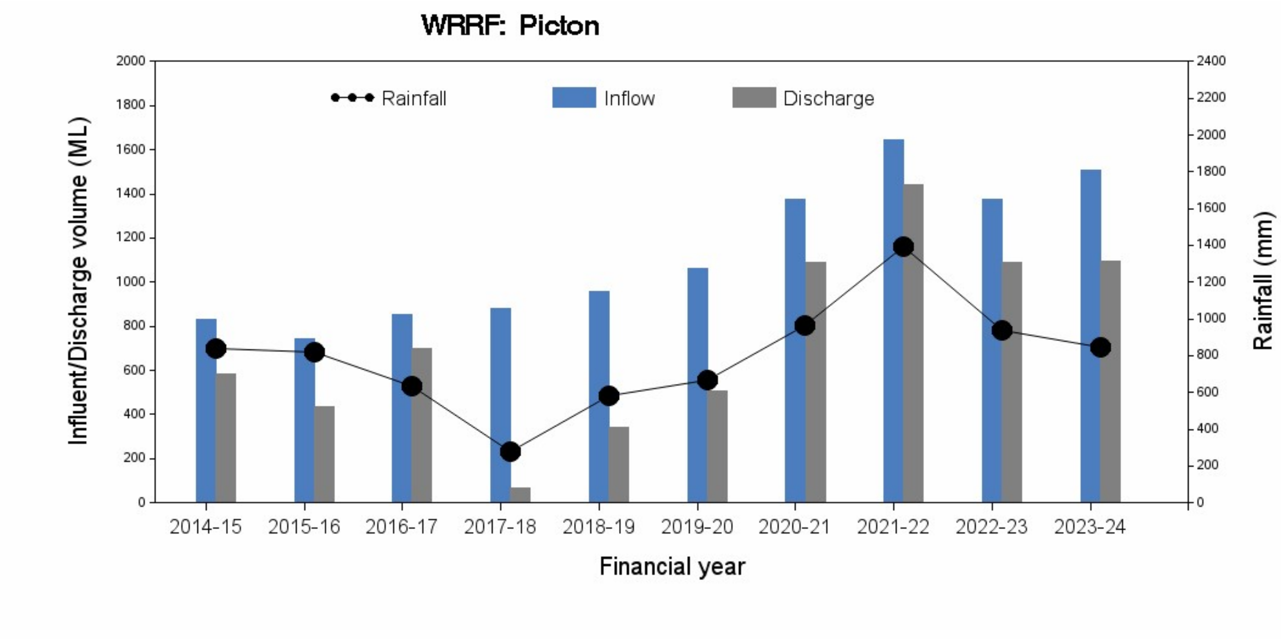
– Univariate statistical analysis outcomes

Water quality trend plots and needle plots for two macroinvertebrates monitoring sites (N92A and N57A) are presented as a separate sub-section at the end of Appendix C-2. The sequence on these box plots and needle plots of are same as those described above for the paired sites.

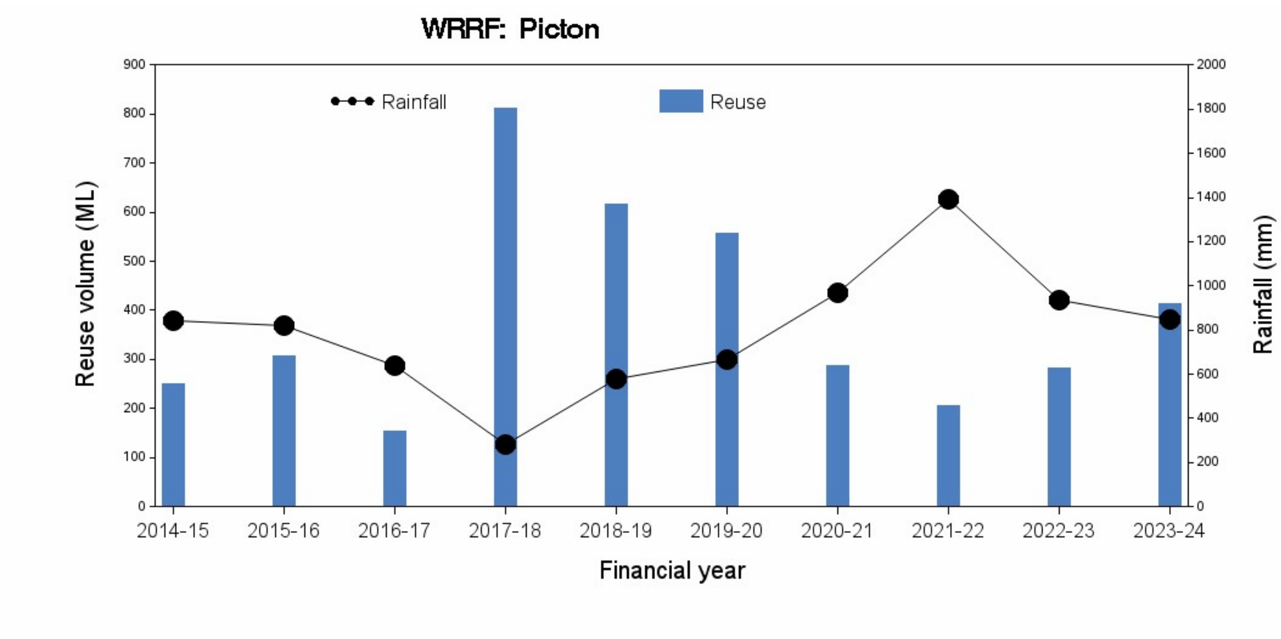
A.1. Picton WRRF

A.1.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

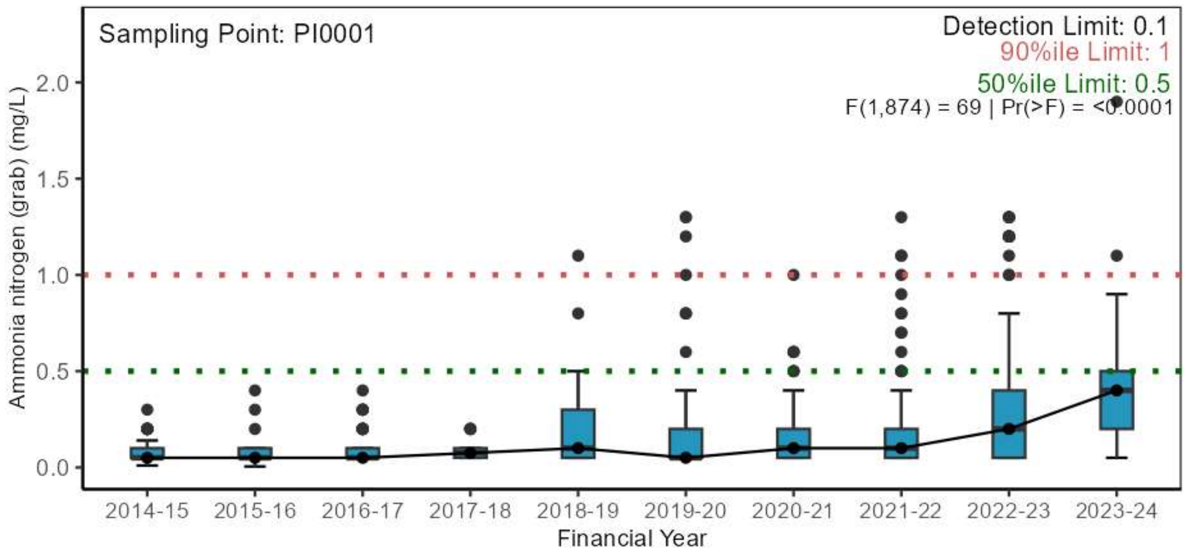


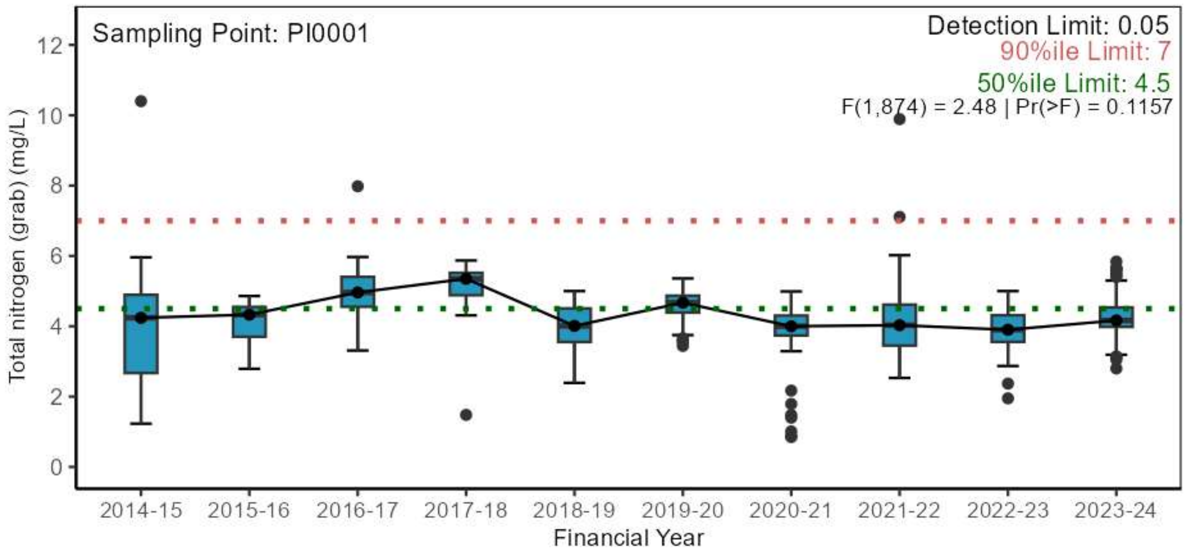
Reuse volume and rainfall

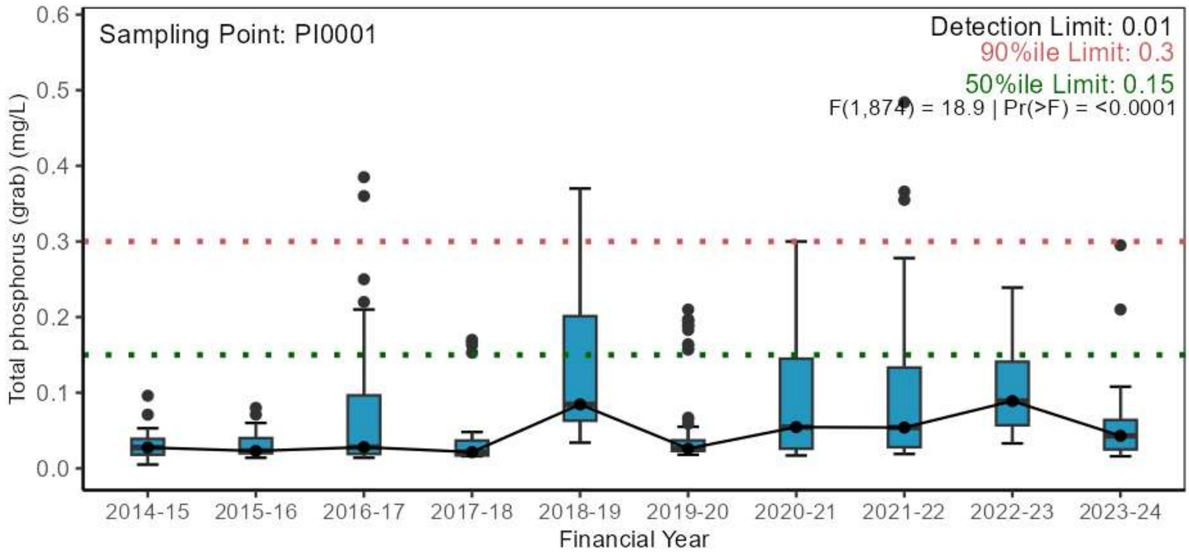


A.1.2. Pressure – Wastewater quality

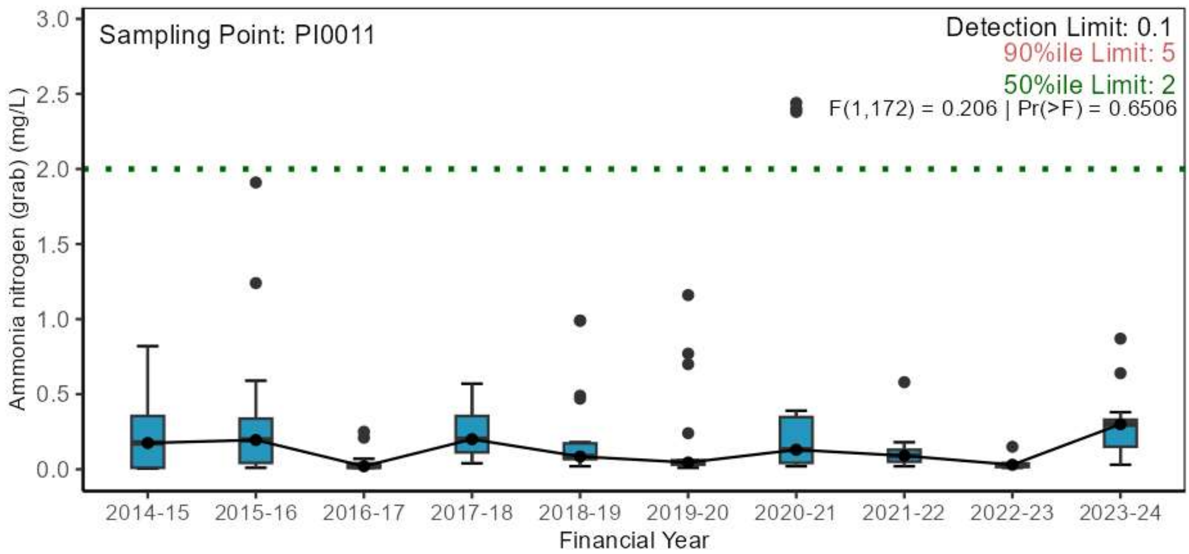
Nutrients: PI0001 Precautionary discharge

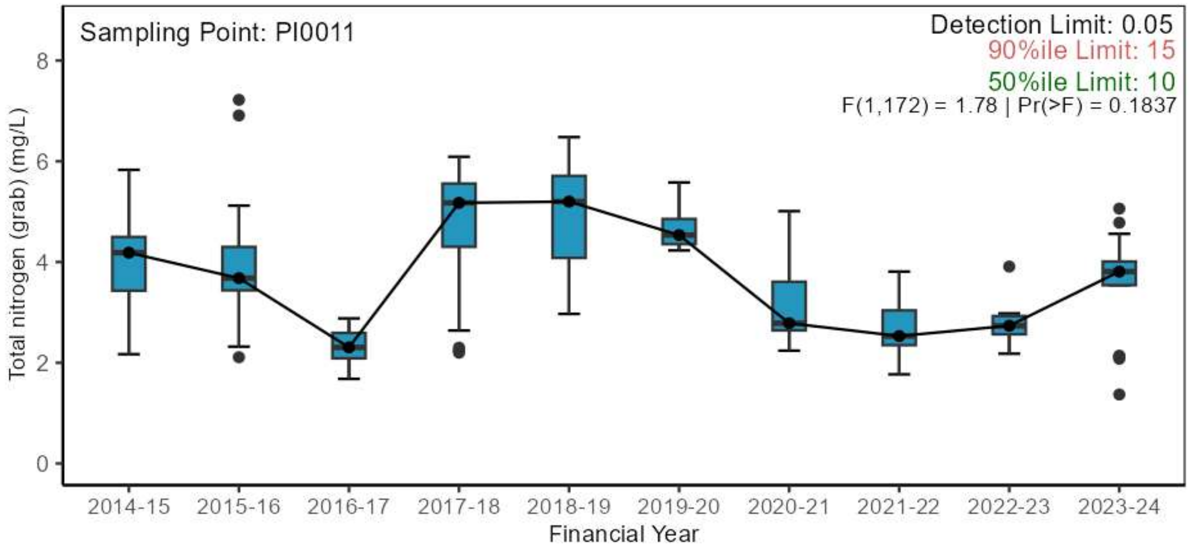


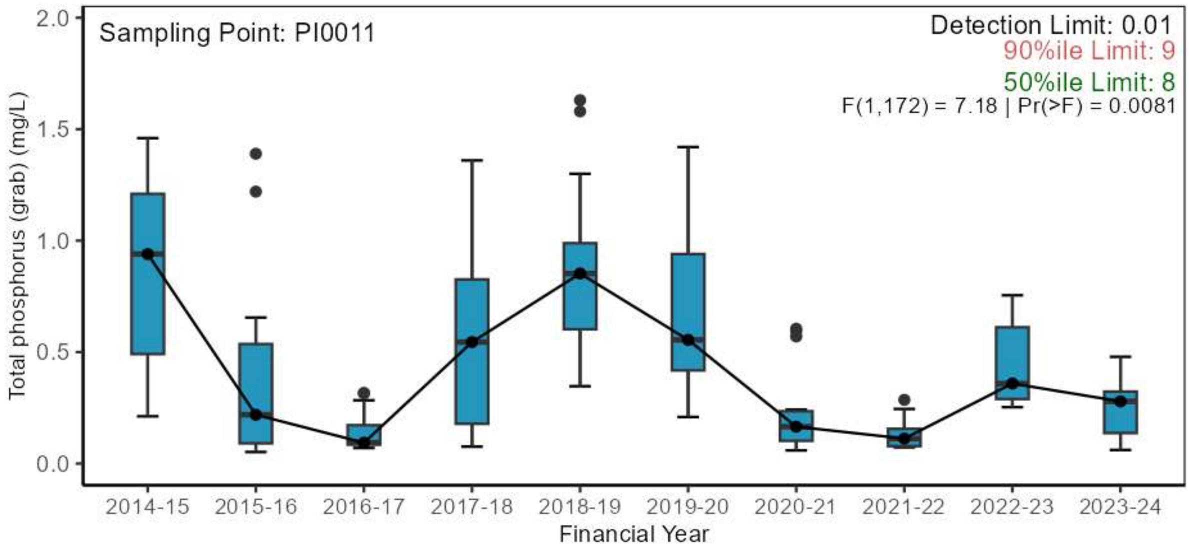




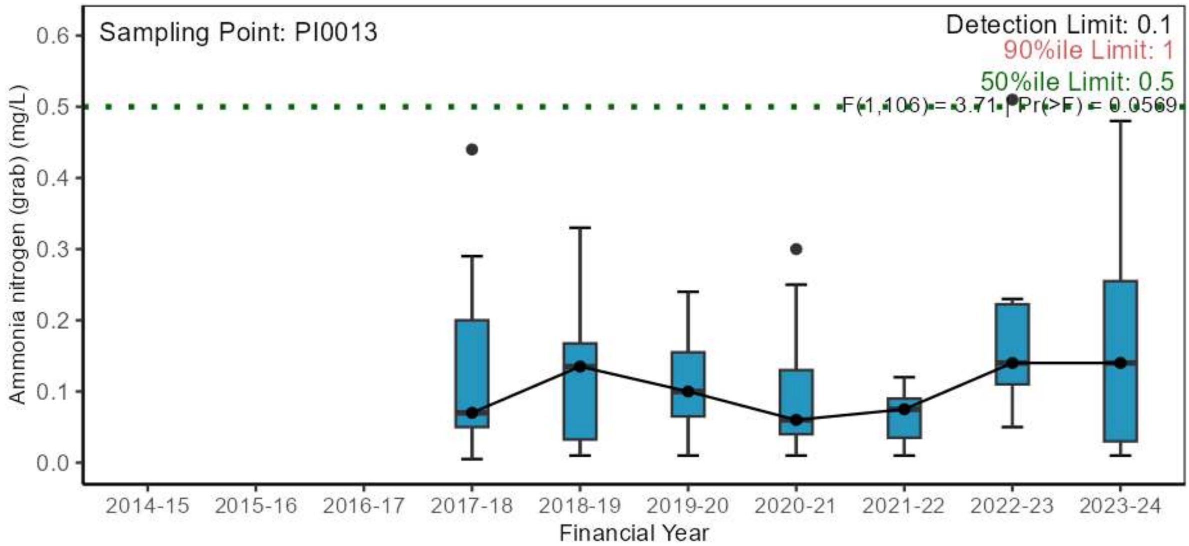
Nutrients: PI0011 Irrigation

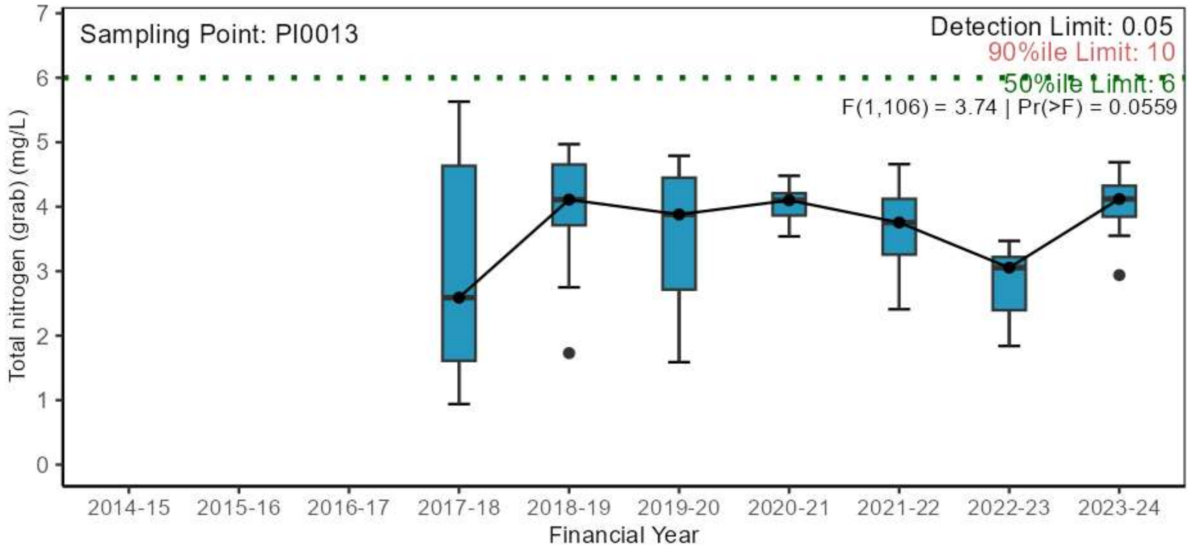


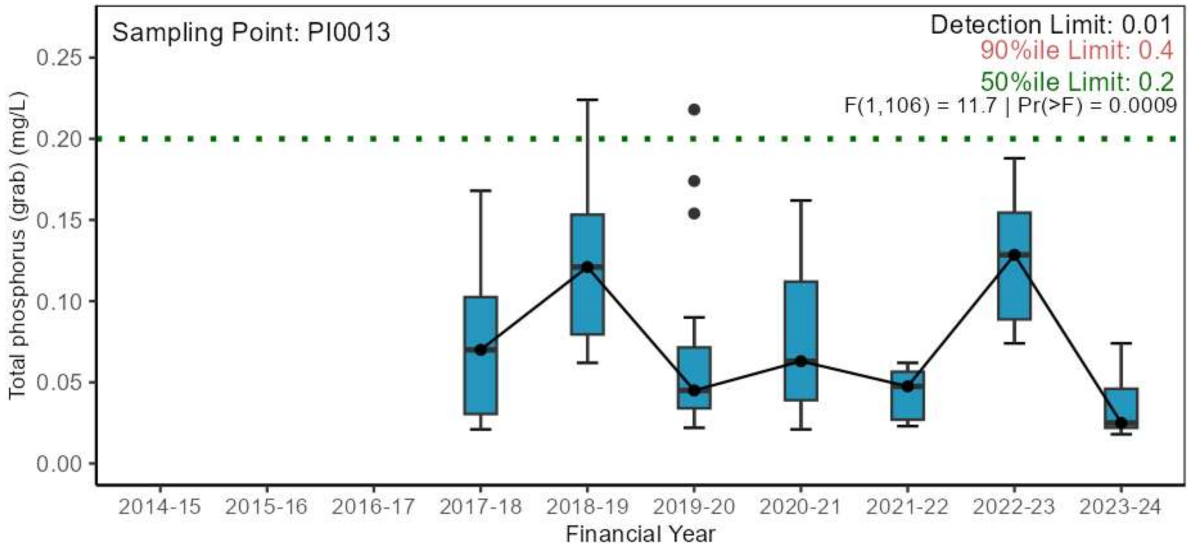

Sampling Point: PI0011
Detection Limit: 0.05
90%ile Limit: 15
50%ile Limit: 10
F(1,172) = 1.78 | Pr(>F) = 0.1837
Total nitrogen (grab) (mg/L)
0
2
4
6
8
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


Sampling Point: PI0011
Detection Limit: 0.01
90%ile Limit: 9
50%ile Limit: 8
F(1,172) = 7.18 | Pr(>F) = 0.0081
Total phosphorus (grab) (mg/L)
0.0
0.5
1.0
1.5
2.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

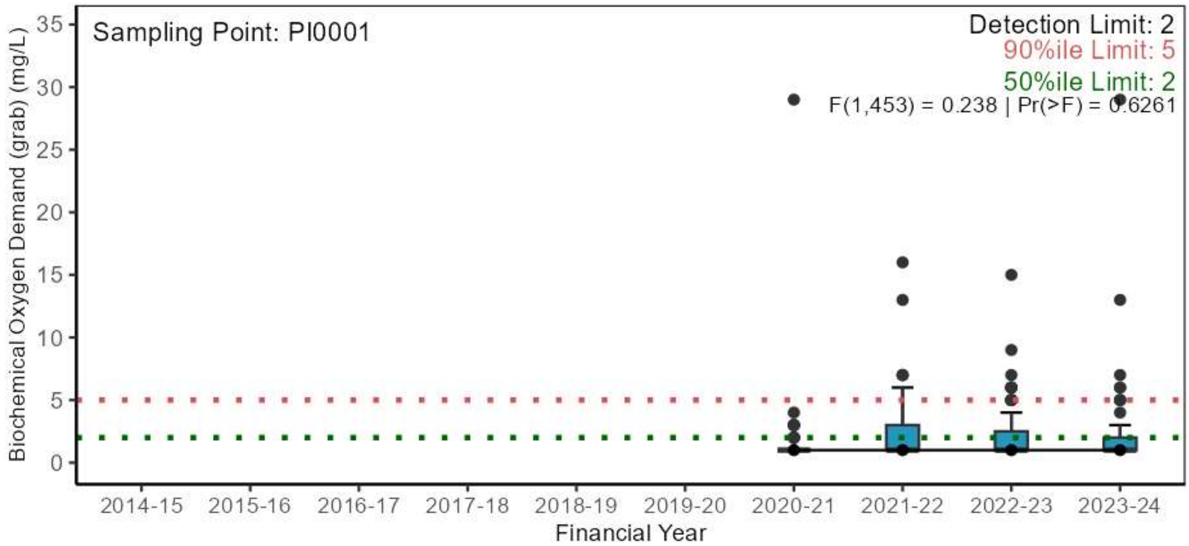
Nutrients: PI0013 Irrigation

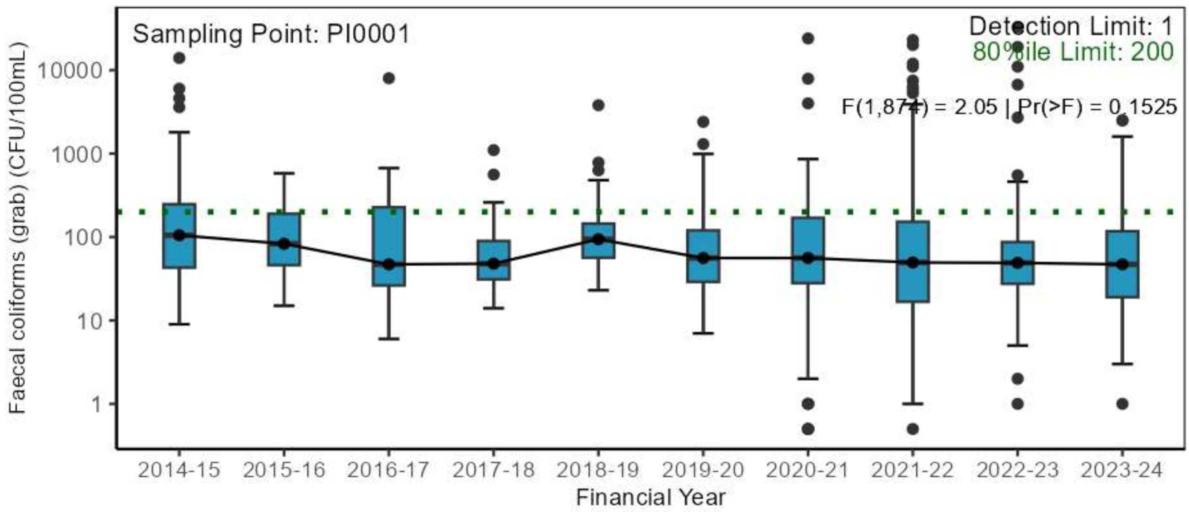




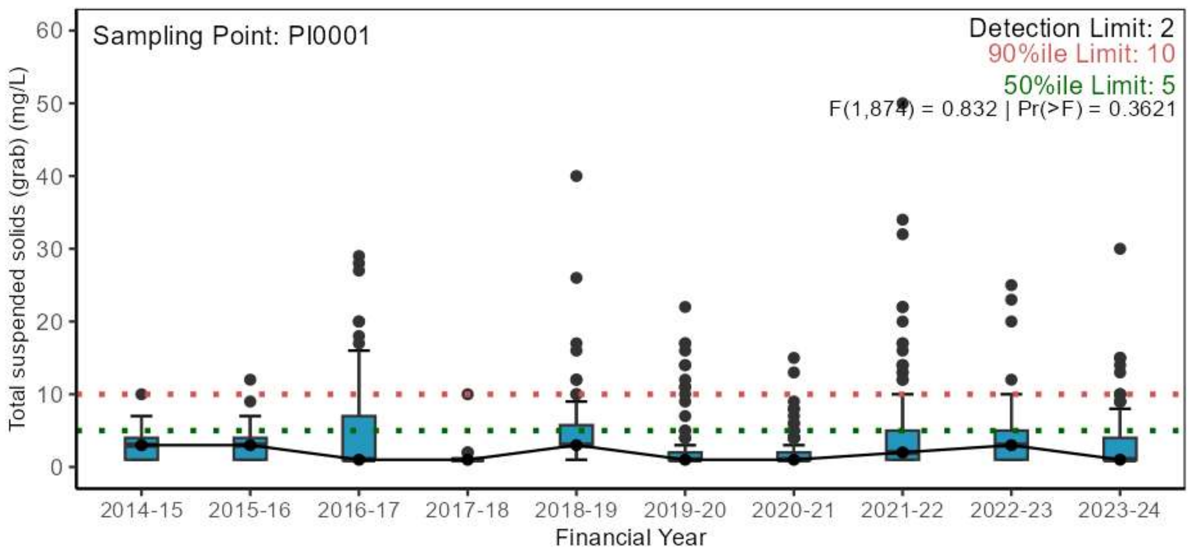


Major conventional analytes: PI0001 Precautionary discharge

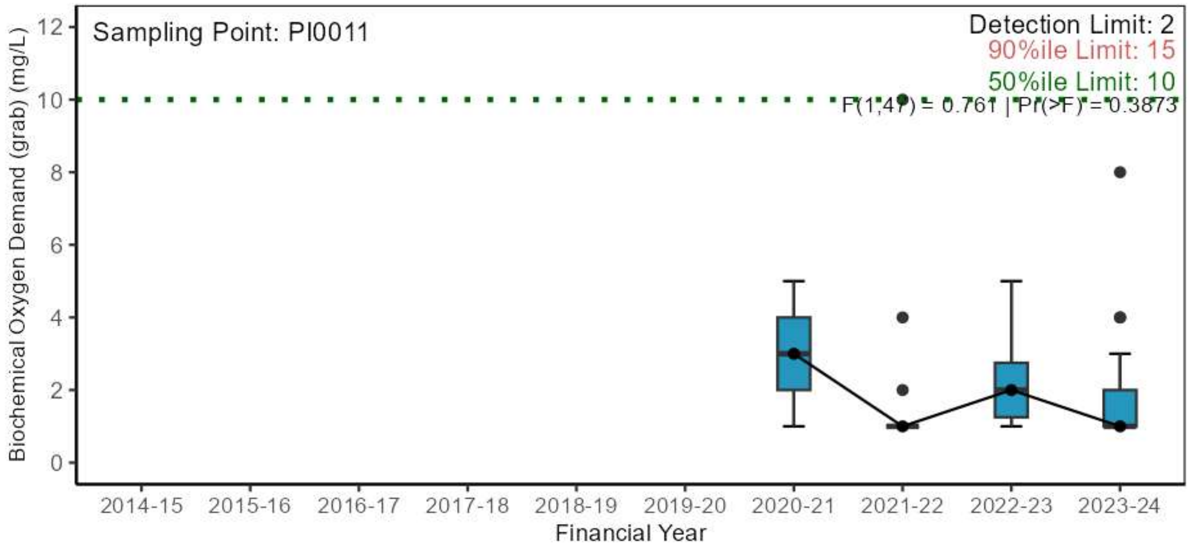


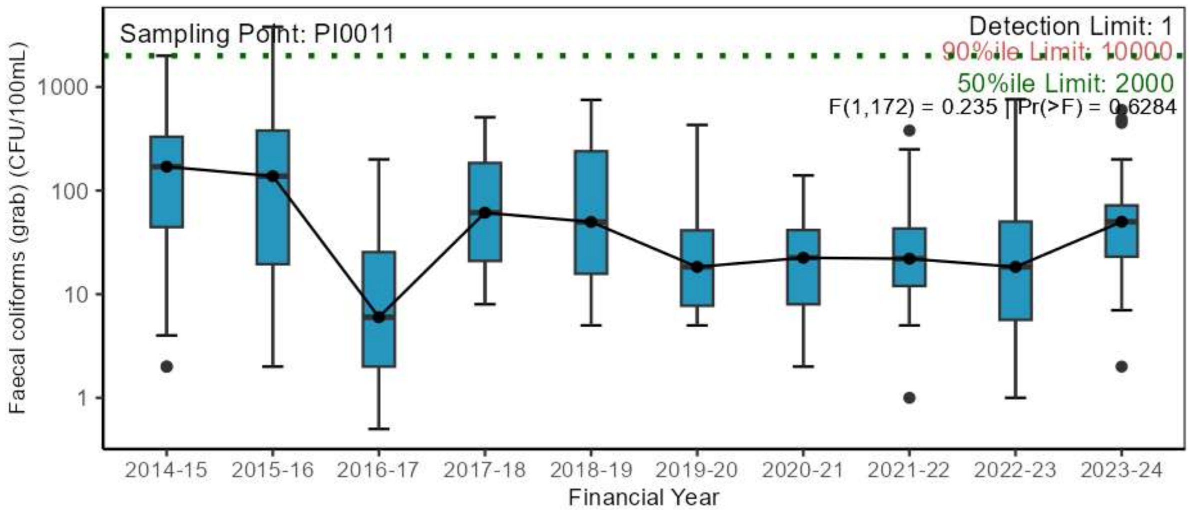


Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

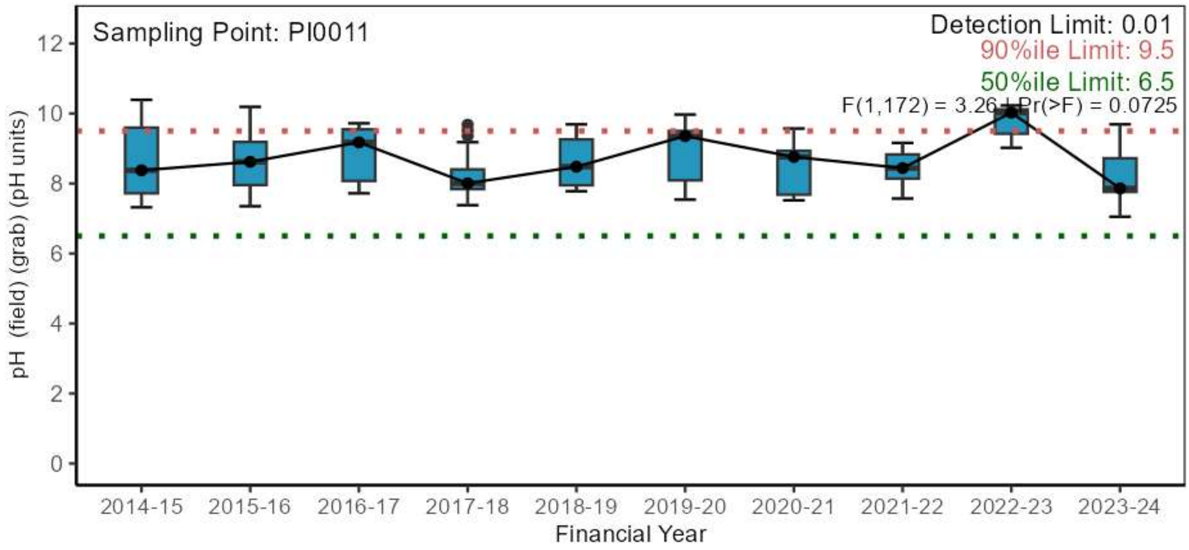


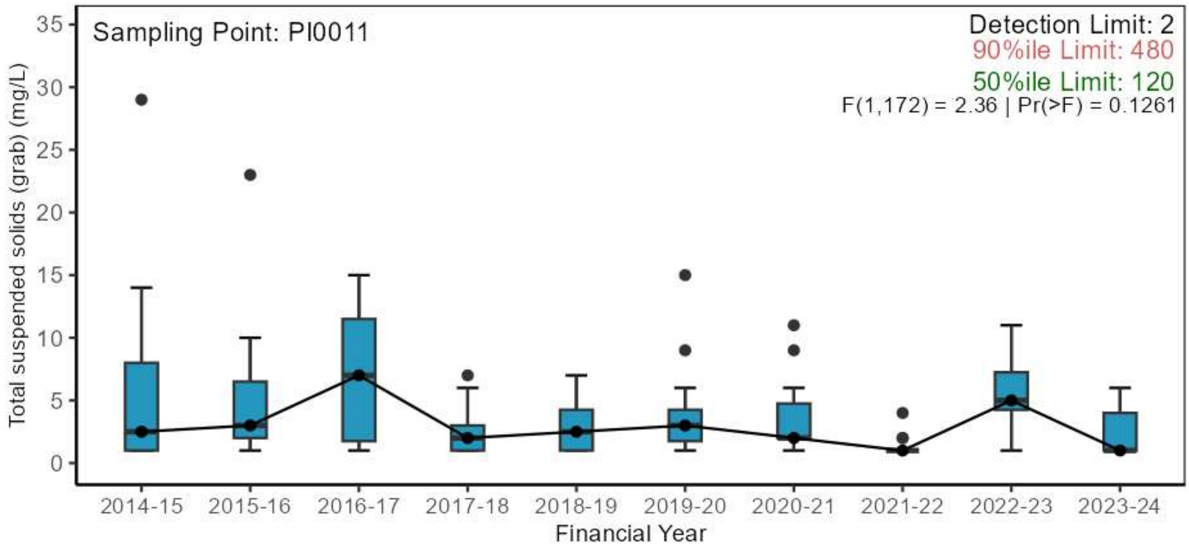
Major conventional analytes: PI0011 Irrigation



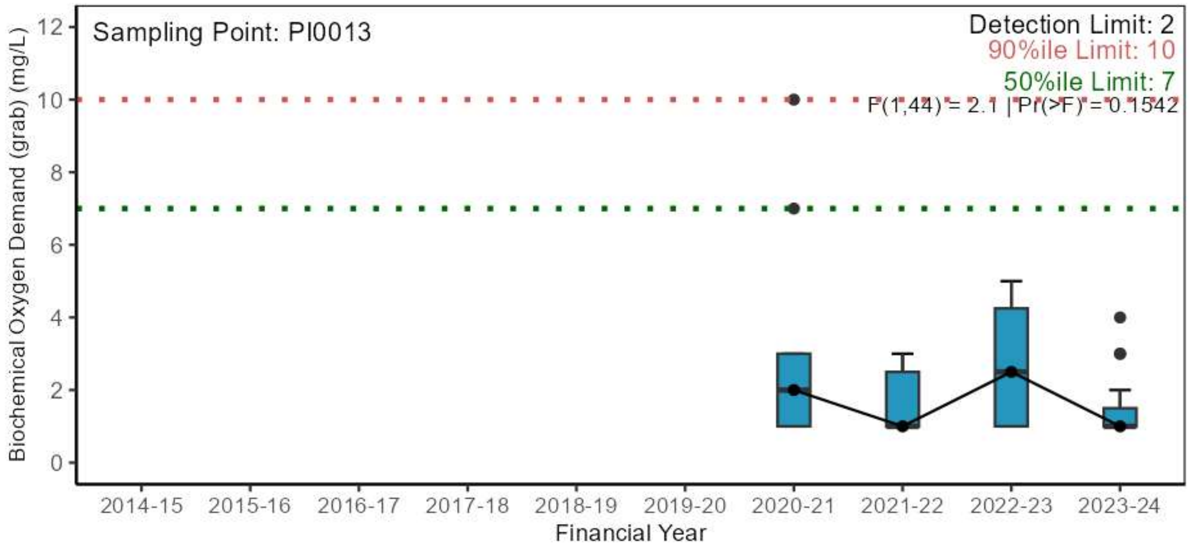


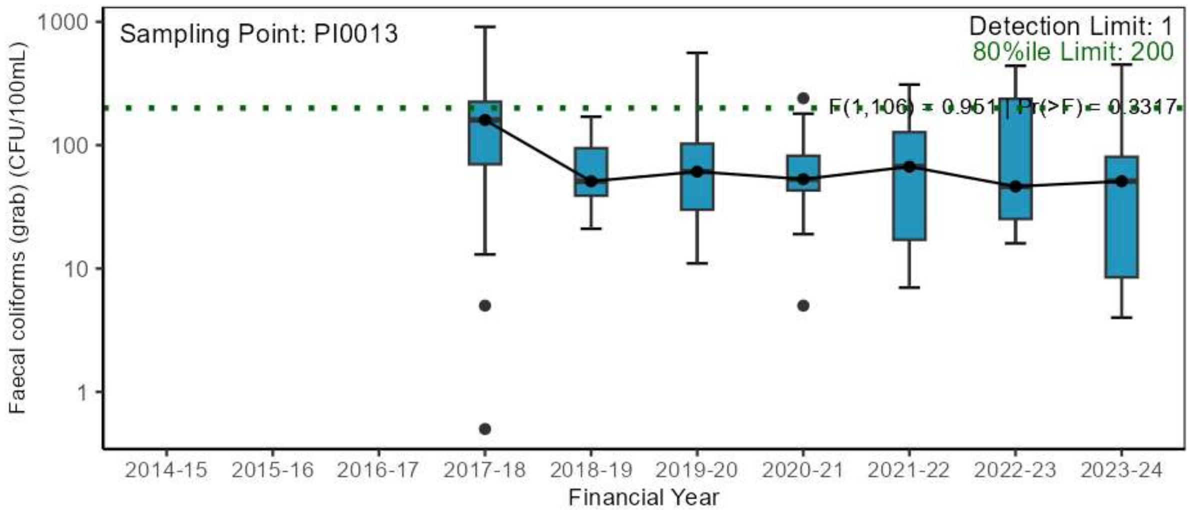
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.


Sampling Point: PI0011
Detection Limit: 0.01
90%ile Limit: 9.5
50%ile Limit: 6.5
F(1,172) = 3.26 | Pr(>F) = 0.0725
pH (field) (grab) (pH units)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

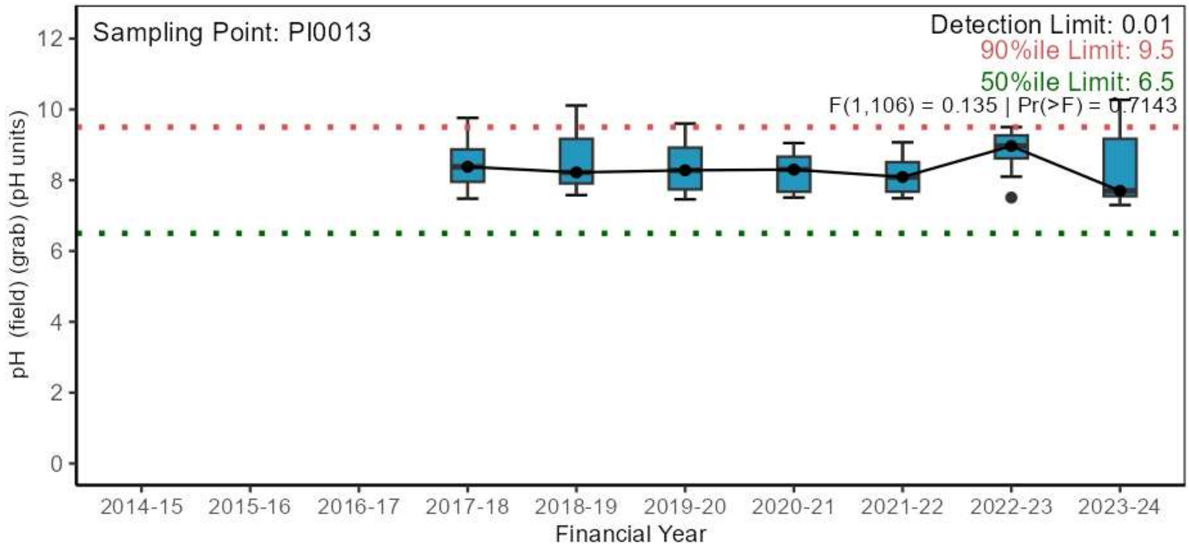

Sampling Point: PI0011
Detection Limit: 2
90%ile Limit: 480
50%ile Limit: 120
F(1,172) = 2.36 | Pr(>F) = 0.1261
Total suspended solids (grab) (mg/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

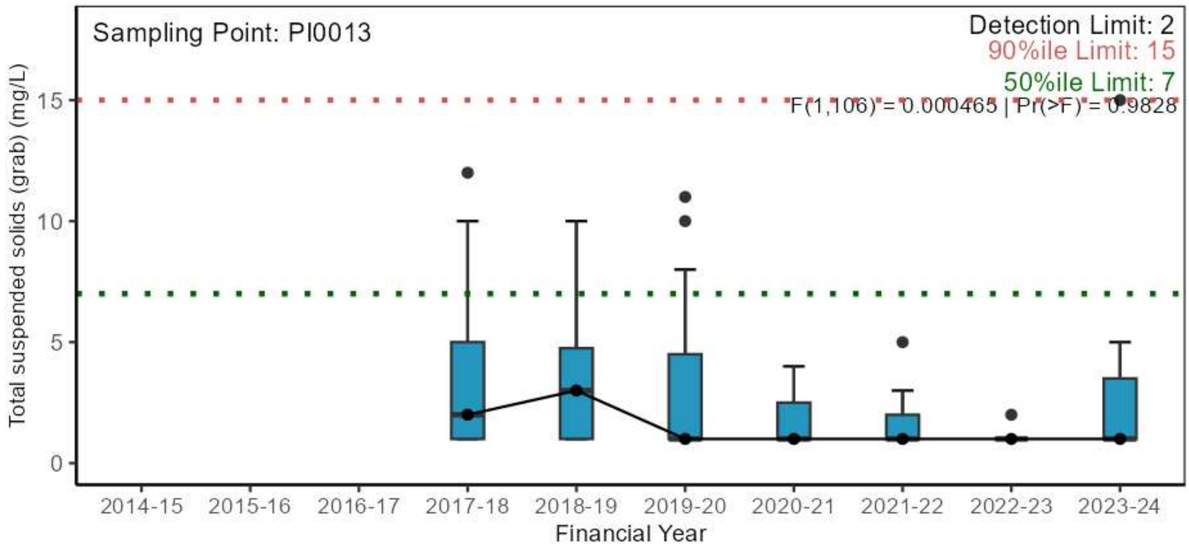
Major conventional analytes: PI0013 Irrigation





Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



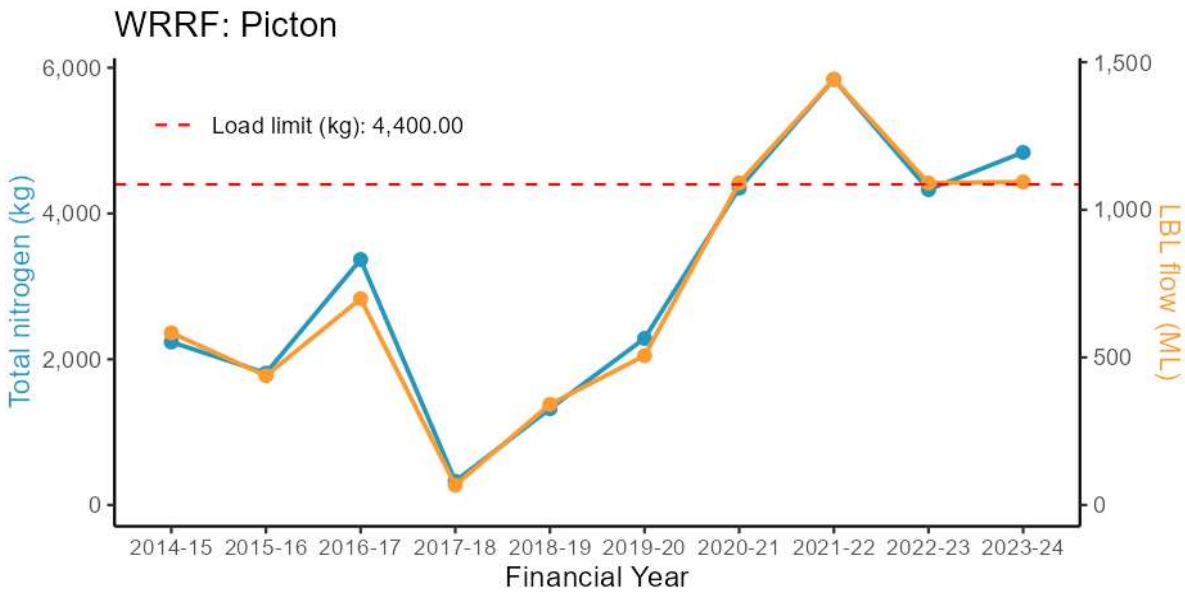


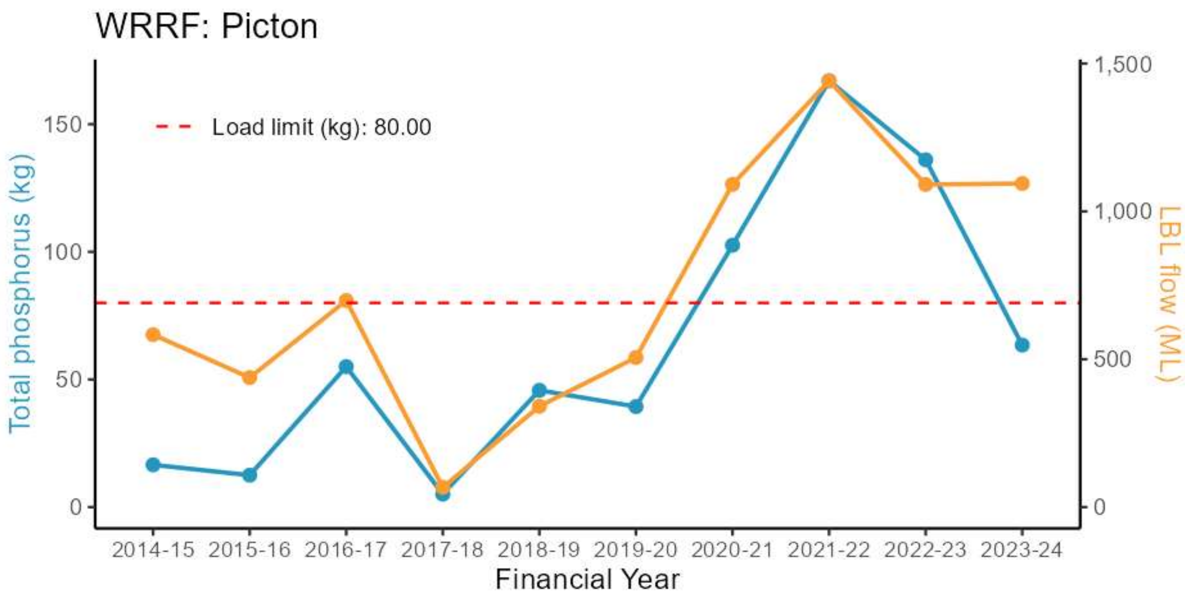
A.1.3. Pressure – Wastewater toxicity

No toxicity monitoring requirement at Picton WRRF.

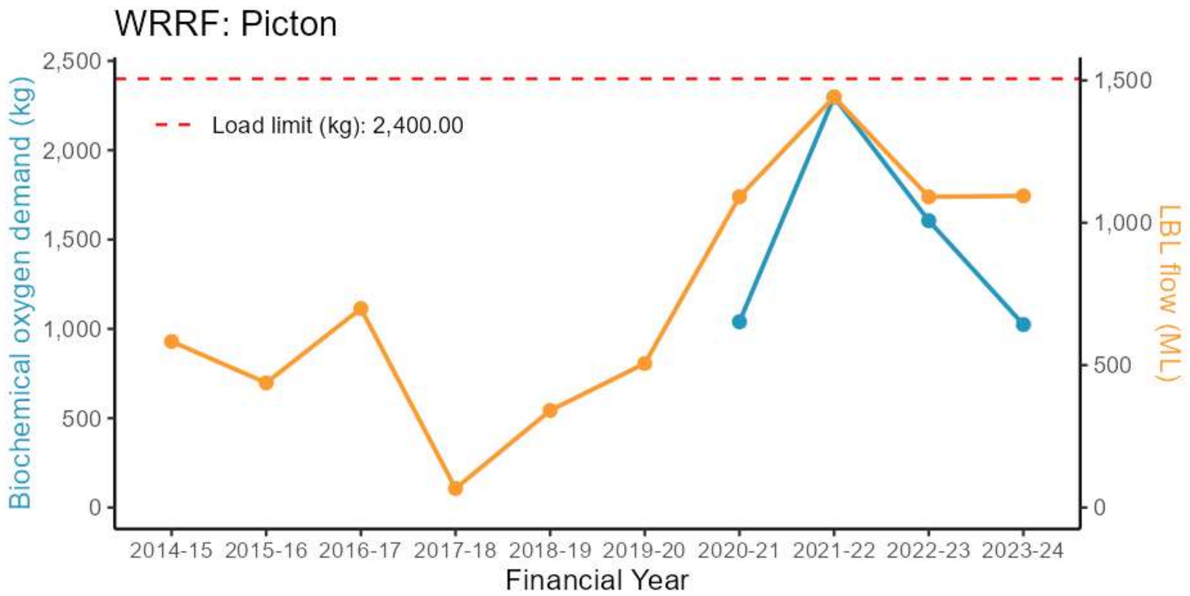
A.1.4. Pressure – Wastewater discharge load

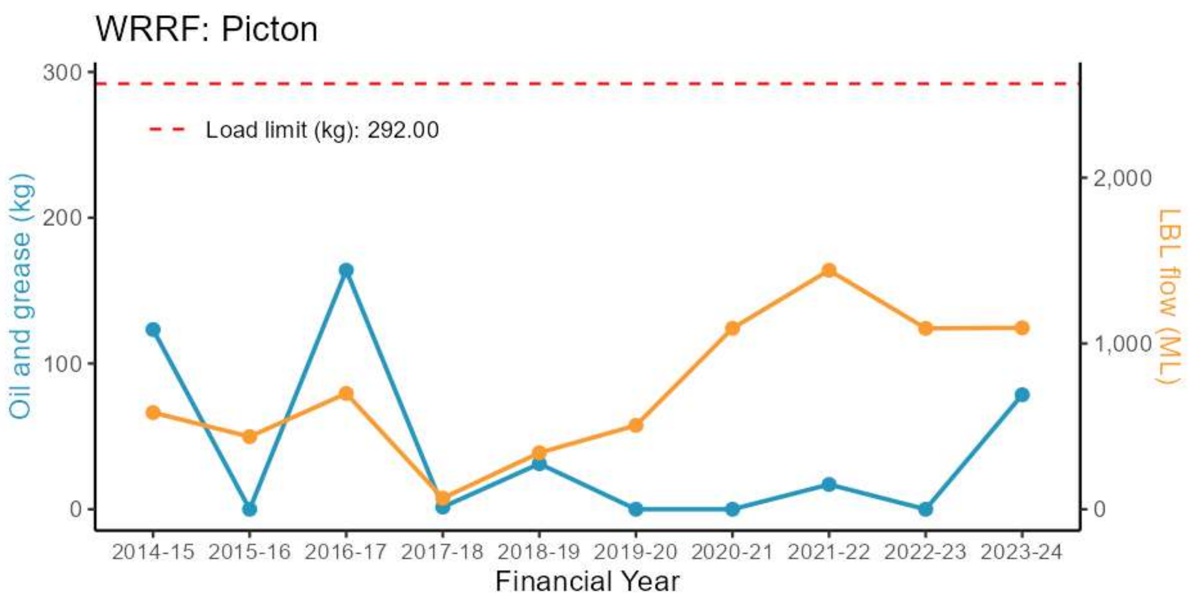
Nutrients

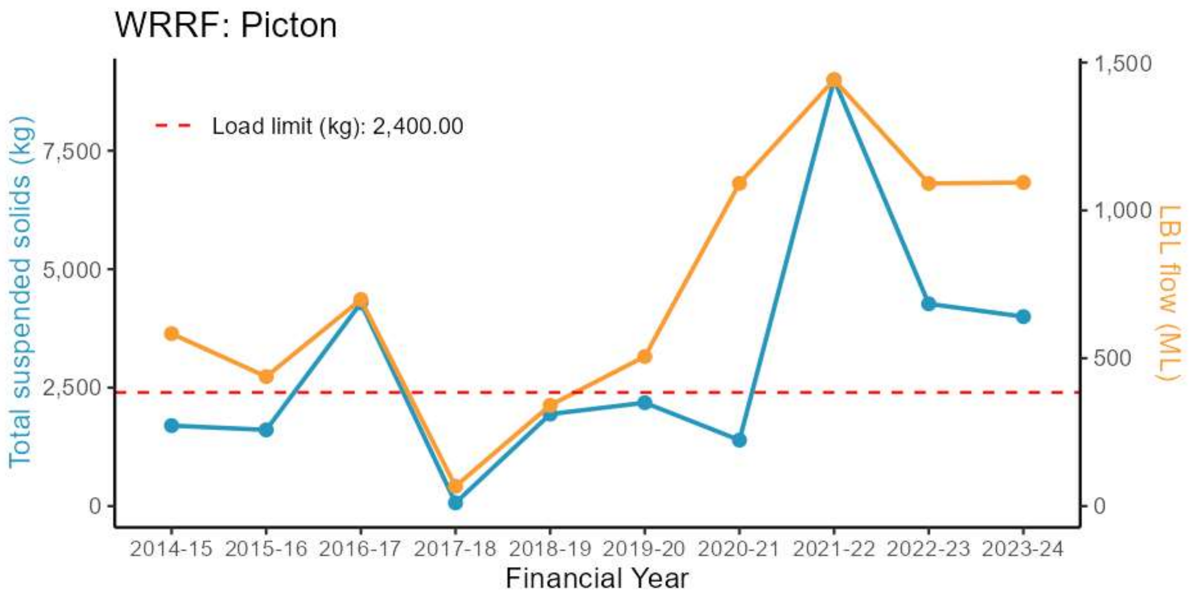




Major conventional analytes







A.1.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-1 Downstream vs upstream comparison (current period) contrast outcomes for Picton WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Stonequarry Creek	N911B vs N911	Total ammonia nitrogen	3.19	0.93	99	3.97	<0.001
Stonequarry Creek	N911B vs N911	Oxidised nitrogen	4.44	2.21	99	3.00	0.018
Stonequarry Creek	N911B vs N911	Total nitrogen	2.86	0.71	99	4.22	<0.001
Stonequarry Creek	N911B vs N911	Filterable total phosphorus	1.66	0.43	99	1.97	0.207
Stonequarry Creek	N911B vs N911	Total phosphorus	1.40	0.36	99	1.32	0.554
Stonequarry Creek	N911B vs N911	Conductivity	0.99	0.12	99	-0.06	1.000
Stonequarry Creek	N911B vs N911	Dissolved oxygen	1.01	0.05	99	0.14	0.999
Stonequarry Creek	N911B vs N911	Dissolved oxygen saturation	1.79	1.72	99	1.04	0.725
Stonequarry Creek	N911B vs N911	pH	-0.04	0.07	99	-0.56	0.945
Stonequarry Creek	N911B vs N911	Water temperature	1.05	0.13	99	0.42	0.976
Stonequarry Creek	N911B vs N911	Turbidity	0.71	0.23	99	-1.05	0.719
Stonequarry Creek	N911B vs N911	Chlorophyll - a	1.78	0.60	97	1.72	0.319
Nepean R	N92 vs N91	Total ammonia nitrogen	2.28	0.44	307	4.24	<0.001
Nepean R	N92 vs N91	Oxidised nitrogen	1.80	0.59	307	1.78	0.283
Nepean R	N92 vs N91	Total nitrogen	1.26	0.14	307	2.05	0.172
Nepean R	N92 vs N91	Filterable total phosphorus	1.64	0.30	307	2.77	0.030
Nepean R	N92 vs N91	Total phosphorus	1.53	0.24	307	2.65	0.042
Nepean R	N92 vs N91	Conductivity	1.12	0.21	305	0.59	0.934
Nepean R	N92 vs N91	Dissolved oxygen	0.94	0.05	305	-1.10	0.688
Nepean R	N92 vs N91	Dissolved oxygen saturation	-5.93	3.00	303	-1.98	0.198
Nepean R	N92 vs N91	pH	-0.03	0.16	305	-0.17	0.998
Nepean R	N92 vs N91	Water temperature	1.02	0.12	307	0.19	0.998
Nepean R	N92 vs N91	Turbidity	1.45	0.36	307	1.49	0.446
Nepean R	N92 vs N91	Chlorophyll - a	0.99	0.33	305	-0.04	1.000

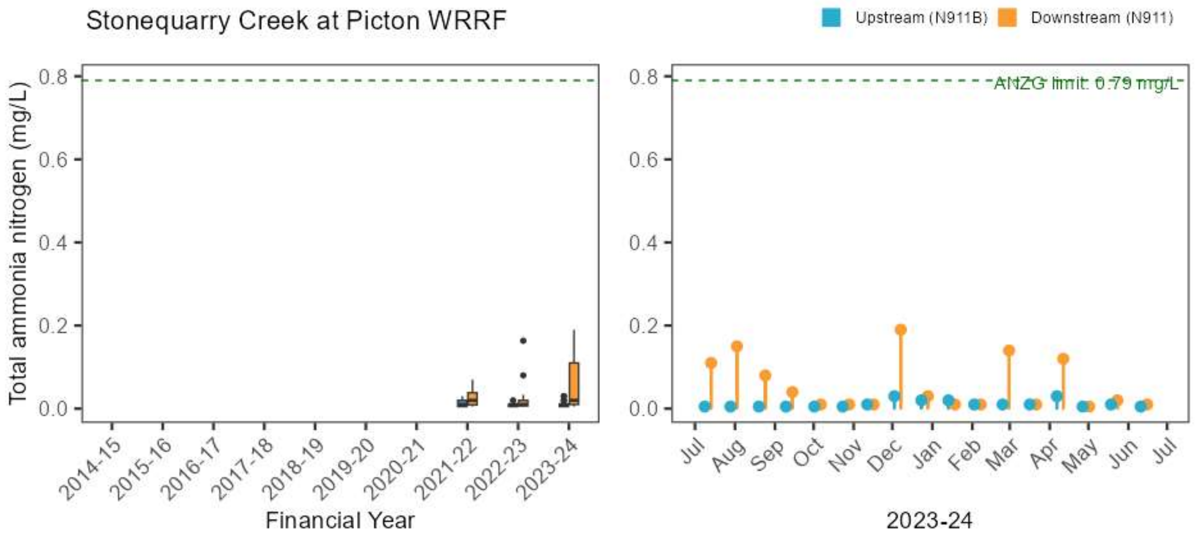
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

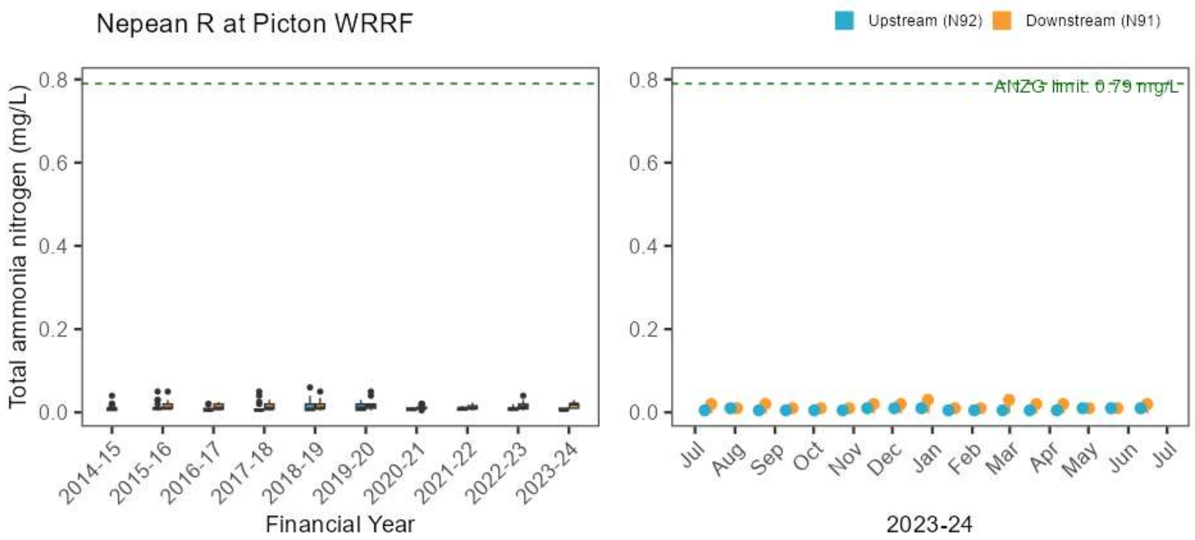
Table A-2 Current period vs previous period comparison (single site) contrast outcomes for Picton WRRF

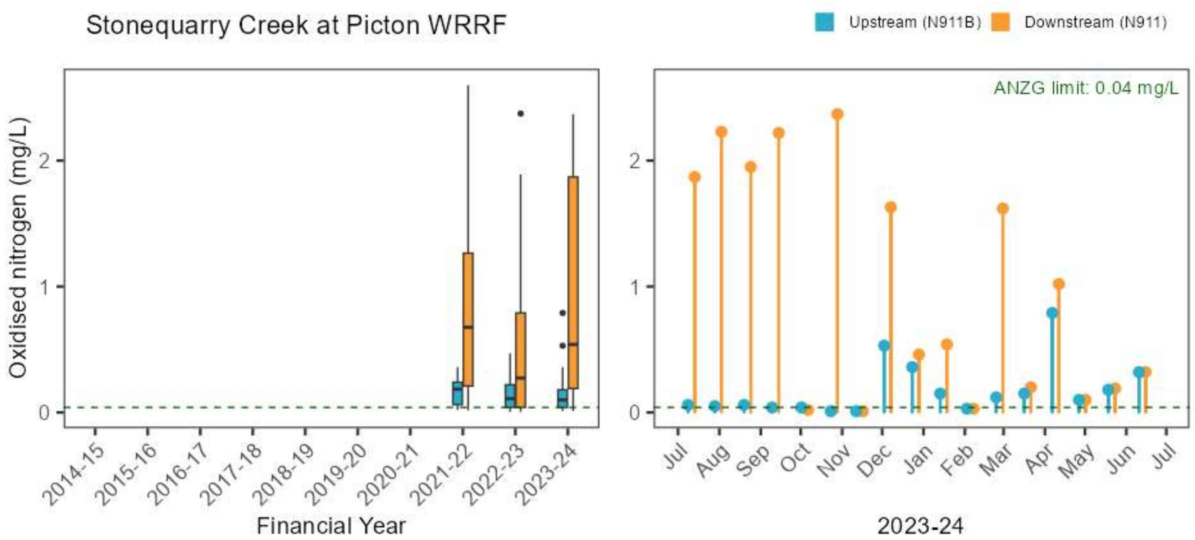
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Stonequarry Creek	N911B	Total ammonia nitrogen	0.98	0.25	99	-0.06	1.000
Stonequarry Creek	N911B	Oxidised nitrogen	0.87	0.37	99	-0.32	0.989
Stonequarry Creek	N911B	Total nitrogen	0.88	0.19	99	-0.62	0.927
Stonequarry Creek	N911B	Filterable total phosphorus	1.07	0.24	99	0.29	0.992
Stonequarry Creek	N911B	Total phosphorus	1.03	0.23	99	0.15	0.999
Stonequarry Creek	N911B	Conductivity	0.96	0.10	99	-0.43	0.973
Stonequarry Creek	N911B	Dissolved oxygen	0.99	0.04	99	-0.30	0.990
Stonequarry Creek	N911B	Dissolved oxygen saturation	-1.25	1.48	99	-0.84	0.833
Stonequarry Creek	N911B	pH	-0.12	0.06	99	-1.97	0.207
Stonequarry Creek	N911B	Water temperature	1.03	0.11	99	0.29	0.991
Stonequarry Creek	N911B	Turbidity	1.20	0.34	99	0.65	0.917
Stonequarry Creek	N911B	Chlorophyll - a	0.93	0.27	97	-0.26	0.994
Stonequarry Creek	N911	Total ammonia nitrogen	1.74	0.44	99	2.21	0.127
Stonequarry Creek	N911	Oxidised nitrogen	1.37	0.59	99	0.74	0.880
Stonequarry Creek	N911	Total nitrogen	1.21	0.26	99	0.89	0.810
Stonequarry Creek	N911	Filterable total phosphorus	0.97	0.22	99	-0.11	0.999
Stonequarry Creek	N911	Total phosphorus	1.02	0.22	99	0.08	1.000
Stonequarry Creek	N911	Conductivity	0.96	0.10	99	-0.41	0.976
Stonequarry Creek	N911	Dissolved oxygen	1.01	0.04	99	0.25	0.994
Stonequarry Creek	N911	Dissolved oxygen saturation	0.76	1.48	99	0.52	0.955
Stonequarry Creek	N911	pH	-0.15	0.06	99	-2.59	0.053
Stonequarry Creek	N911	Water temperature	1.06	0.11	99	0.50	0.960
Stonequarry Creek	N911	Turbidity	0.96	0.27	99	-0.16	0.998
Stonequarry Creek	N911	Chlorophyll - a	0.97	0.28	97	-0.09	1.000
Nepean R	N92	Total ammonia nitrogen	0.75	0.11	307	-1.99	0.194
Nepean R	N92	Oxidised nitrogen	1.25	0.31	307	0.90	0.807
Nepean R	N92	Total nitrogen	1.07	0.09	307	0.75	0.875
Nepean R	N92	Filterable total phosphorus	0.79	0.11	307	-1.72	0.317
Nepean R	N92	Total phosphorus	1.08	0.13	307	0.65	0.916
Nepean R	N92	Conductivity	1.15	0.16	305	0.96	0.774
Nepean R	N92	Dissolved oxygen	1.09	0.04	305	2.00	0.189
Nepean R	N92	Dissolved oxygen saturation	9.22	2.25	303	4.10	<0.001
Nepean R	N92	pH	0.15	0.12	305	1.27	0.581
Nepean R	N92	Water temperature	1.05	0.09	307	0.56	0.945
Nepean R	N92	Turbidity	1.15	0.22	307	0.73	0.885
Nepean R	N92	Chlorophyll - a	1.35	0.33	305	1.22	0.618
Nepean R	N91	Total ammonia nitrogen	1.20	0.17	307	1.26	0.592
Nepean R	N91	Oxidised nitrogen	1.71	0.42	307	2.16	0.136
Nepean R	N91	Total nitrogen	1.18	0.10	307	2.01	0.185
Nepean R	N91	Filterable total phosphorus	1.07	0.14	307	0.50	0.959
Nepean R	N91	Total phosphorus	1.35	0.16	307	2.53	0.058
Nepean R	N91	Conductivity	1.14	0.16	305	0.93	0.789
Nepean R	N91	Dissolved oxygen	1.01	0.04	305	0.36	0.984
Nepean R	N91	Dissolved oxygen saturation	2.33	2.25	303	1.04	0.728
Nepean R	N91	pH	0.11	0.12	305	0.88	0.816
Nepean R	N91	Water temperature	1.06	0.09	307	0.64	0.919
Nepean R	N91	Turbidity	1.29	0.24	307	1.37	0.519
Nepean R	N91	Chlorophyll - a	1.59	0.39	305	1.89	0.233

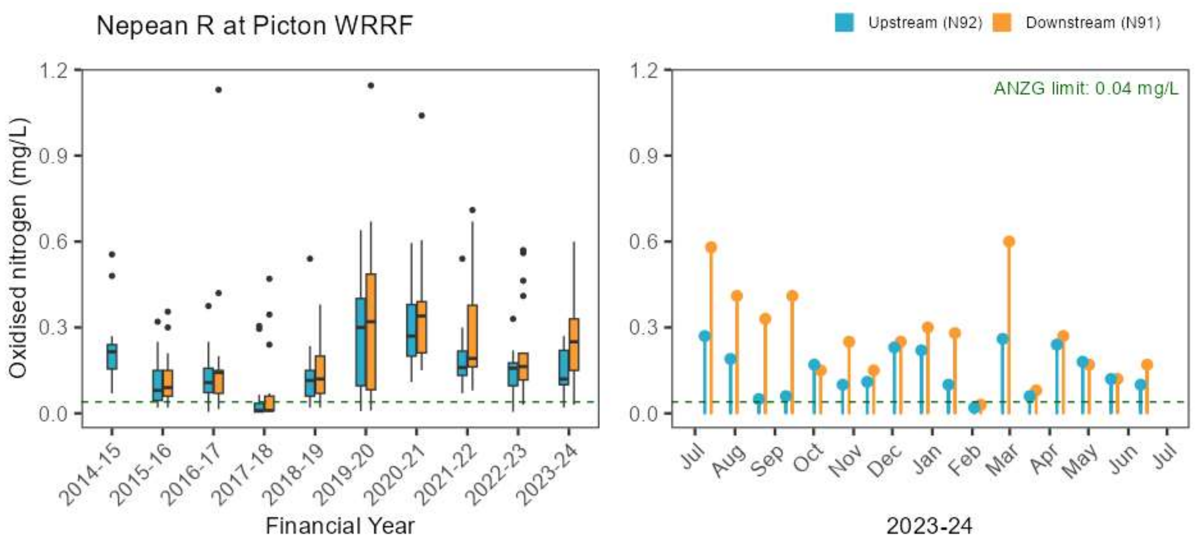
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

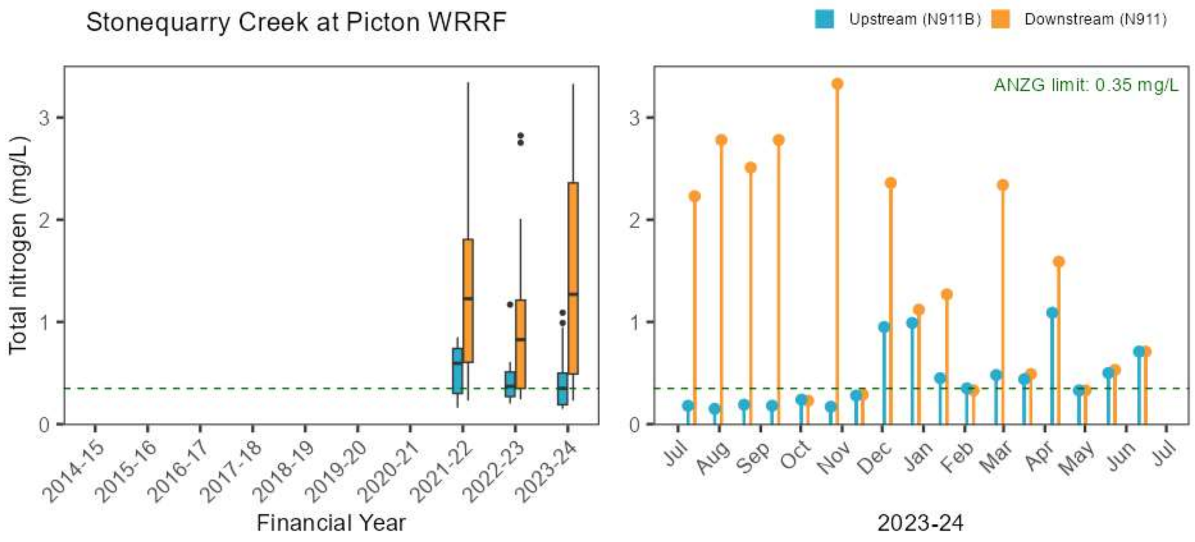
A.1.6. Stressor – Nutrients

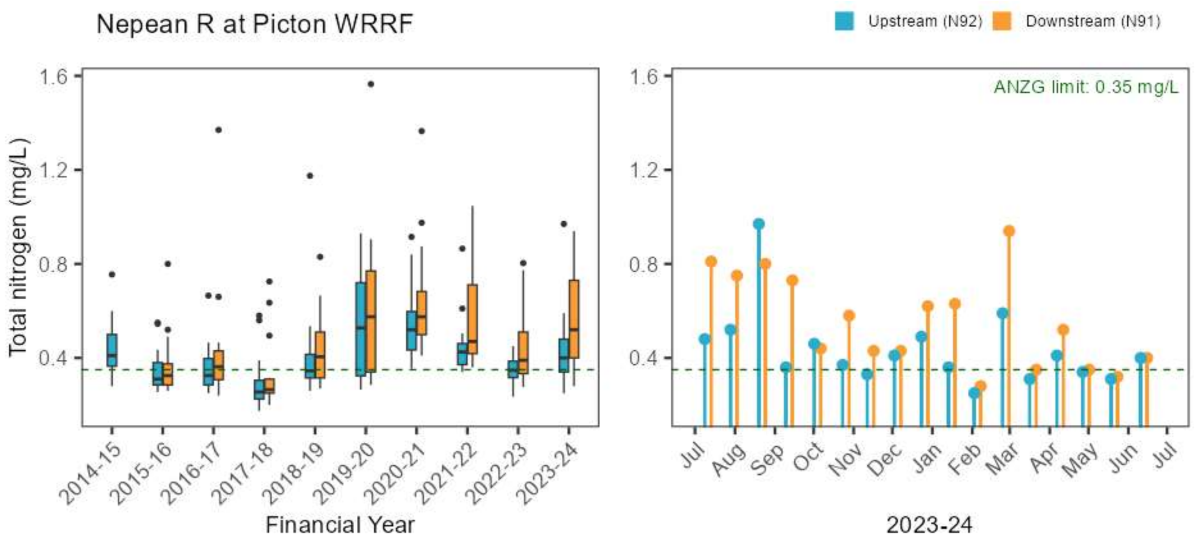


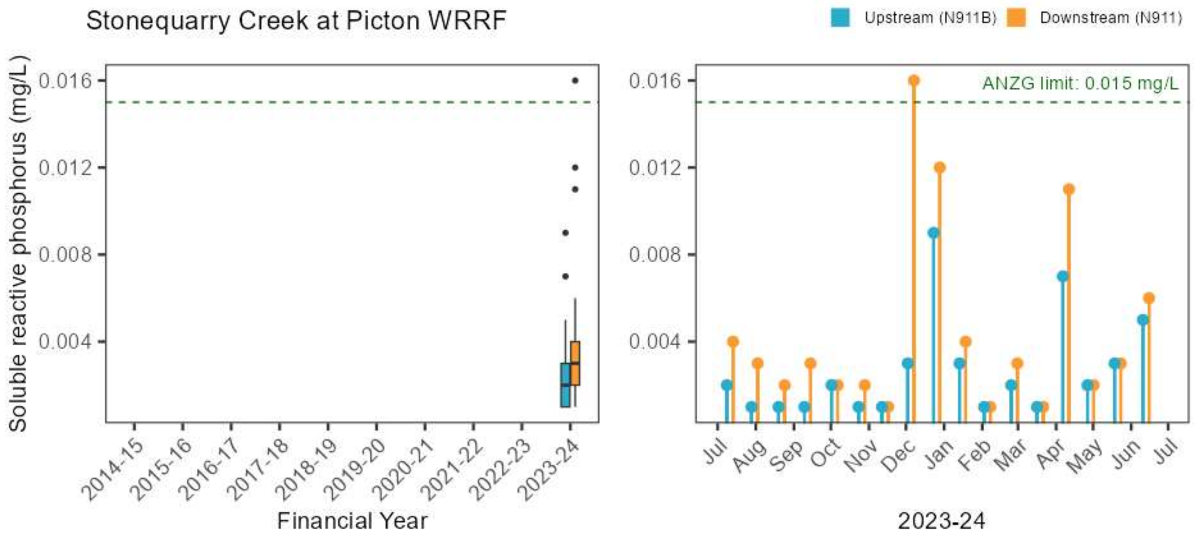


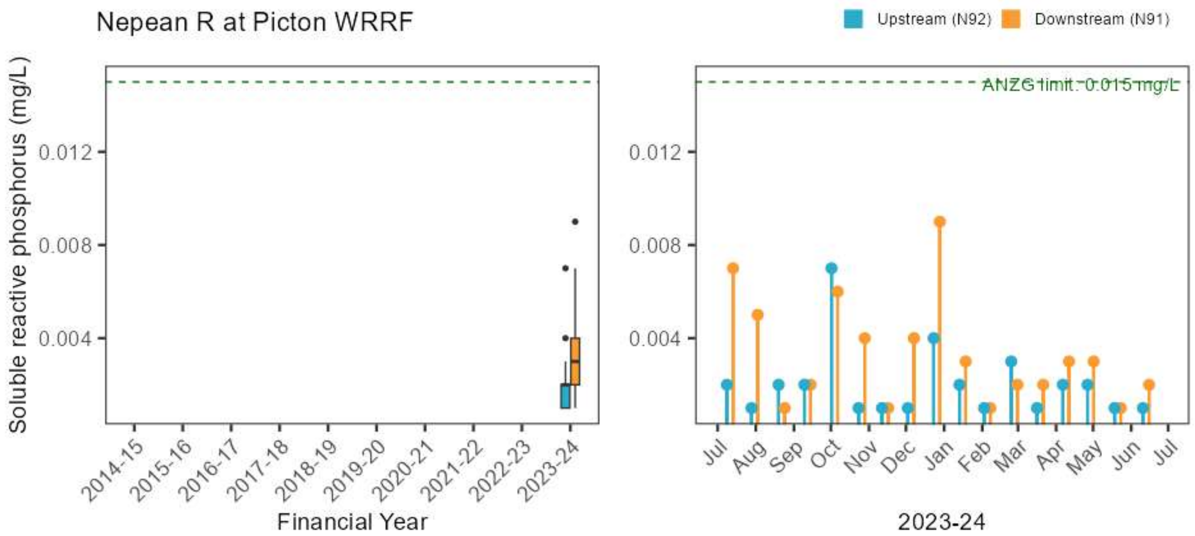


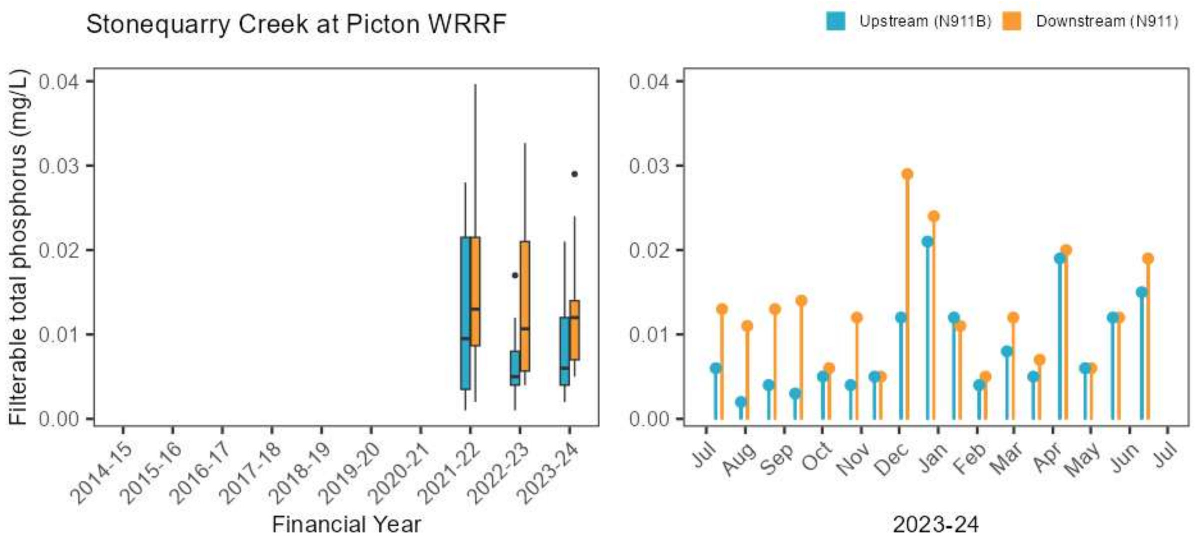

Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 0.04 mg/L
Oxidised nitrogen (mg/L)
1.2
0.9
0.6
0.3
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

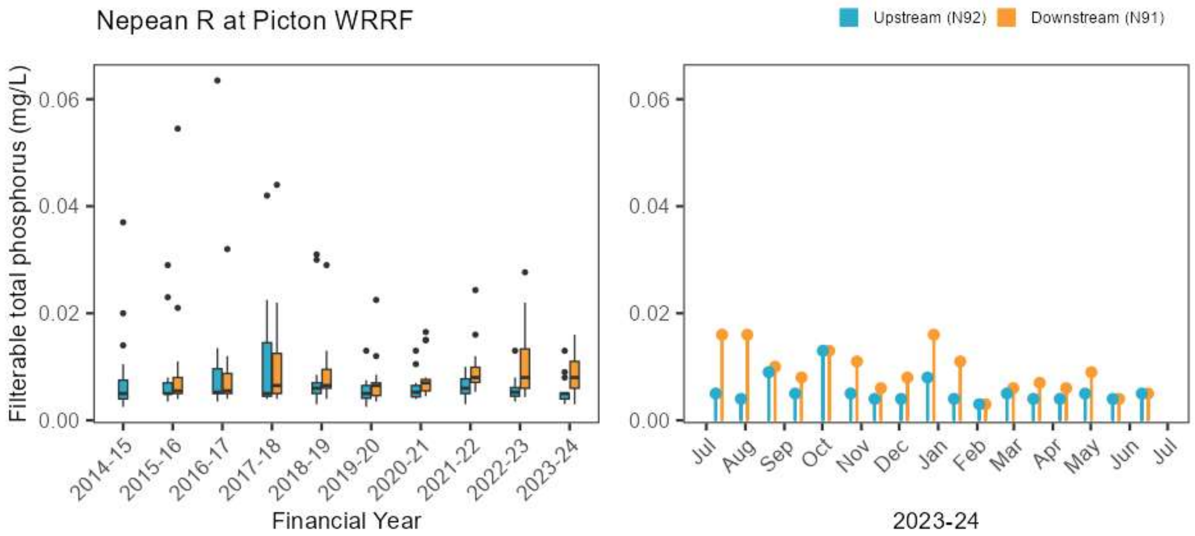

Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
ANZG limit: 0.35 mg/L
Total nitrogen (mg/L)
3
2
1
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 0.35 mg/L
Total nitrogen (mg/L)
1.6
1.2
0.8
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Filterable total phosphorus (mg/L)
Financial Year
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Filterable total phosphorus (mg/L)
0.00
0.02
0.04
0.06
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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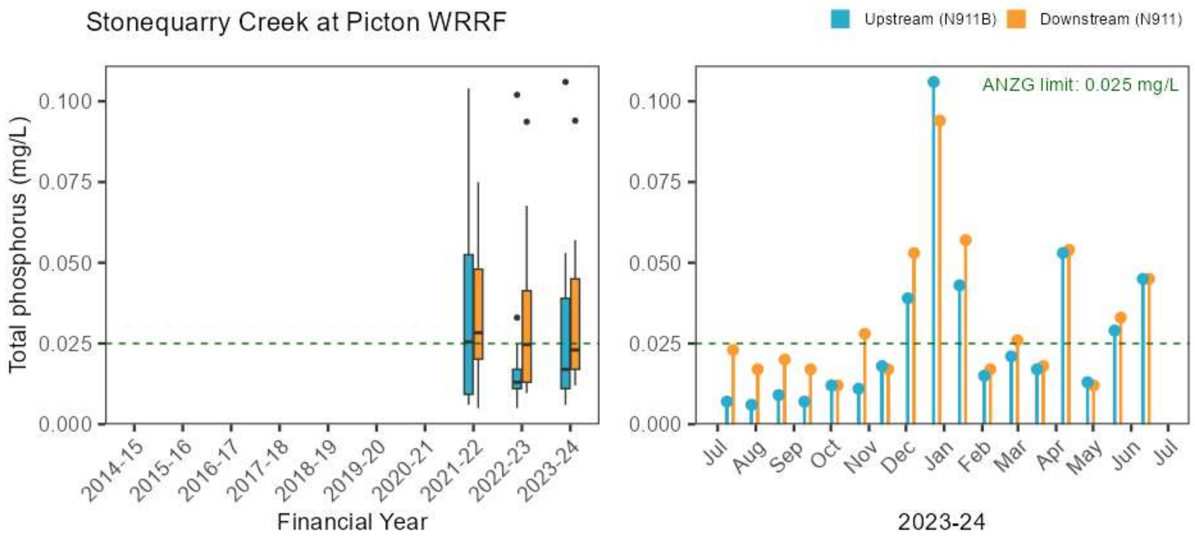
Jun
Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.000
0.025
0.050
0.075
0.100
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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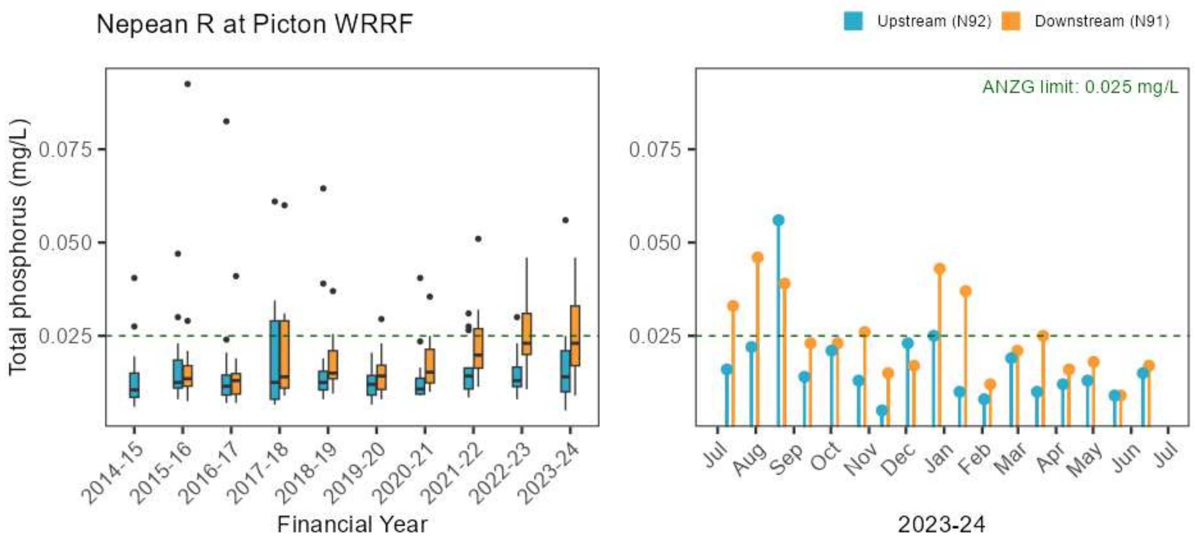
Jun
Jul
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.025
0.050
0.075
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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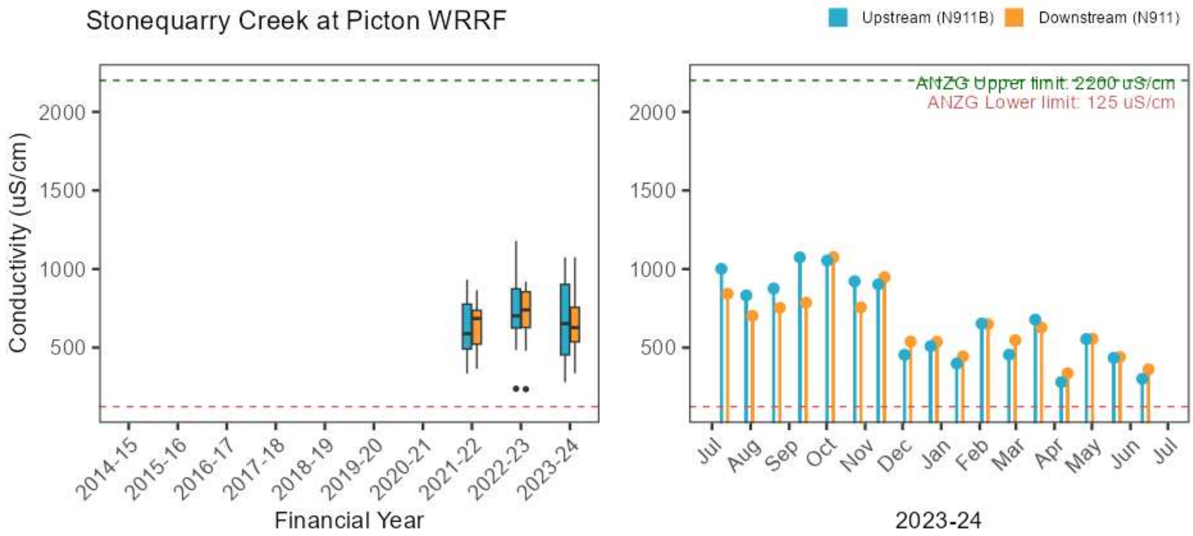
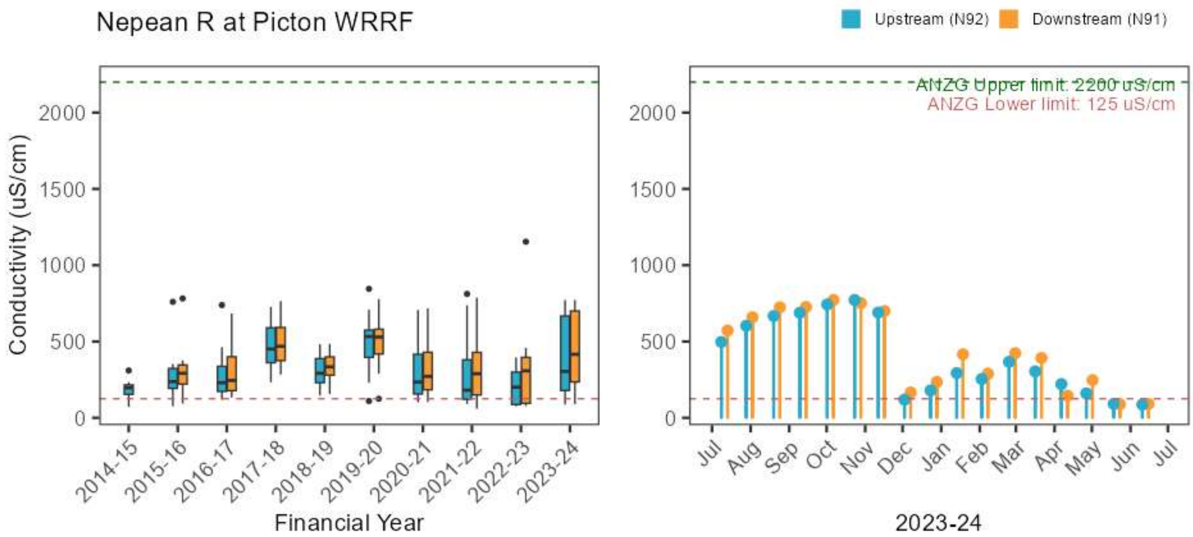
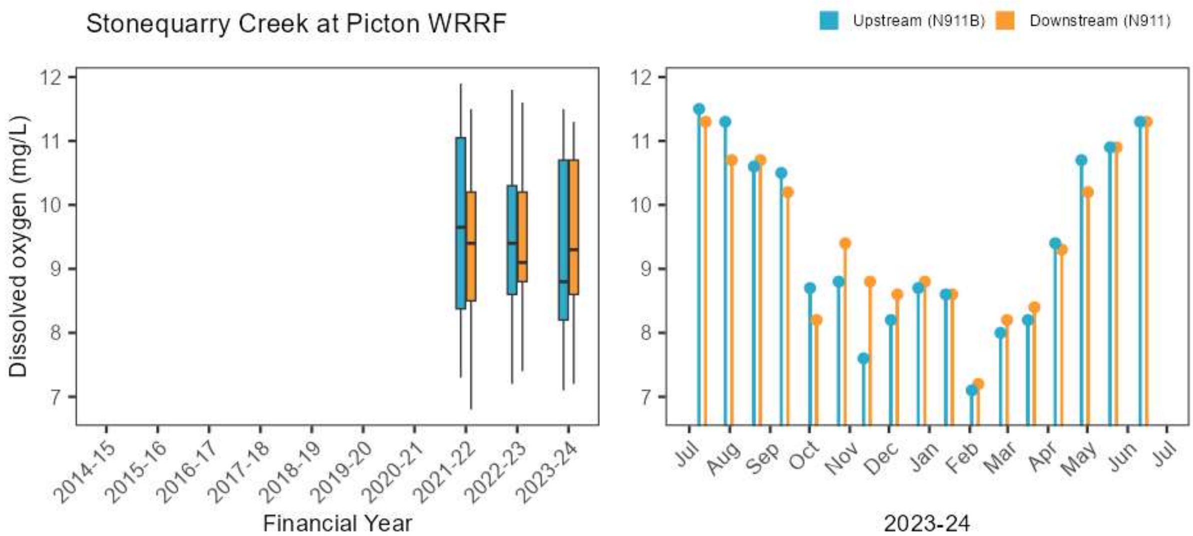
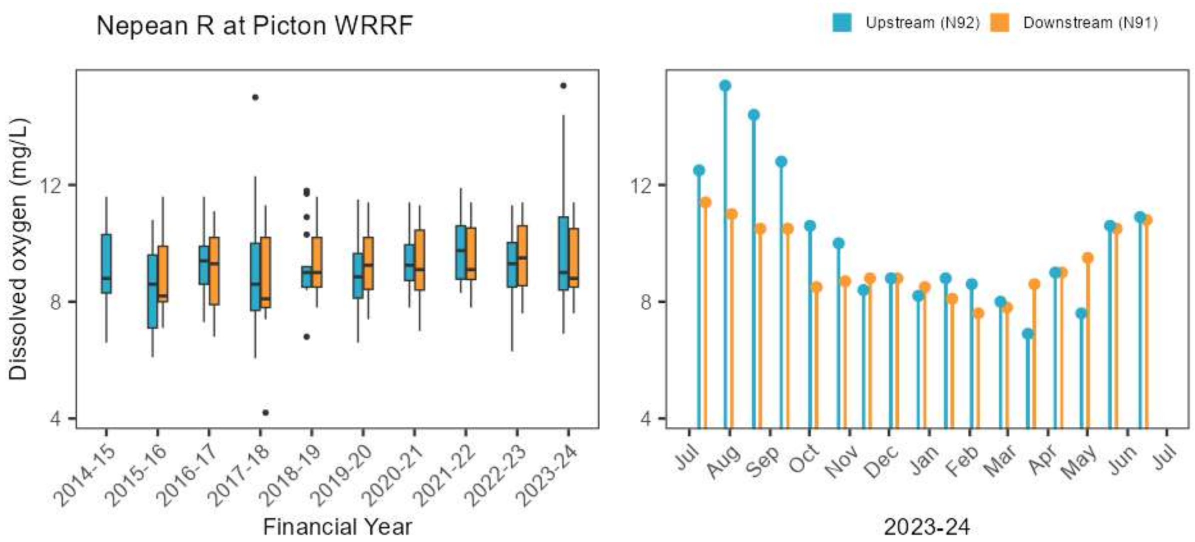
Jun
Jul
2023-24

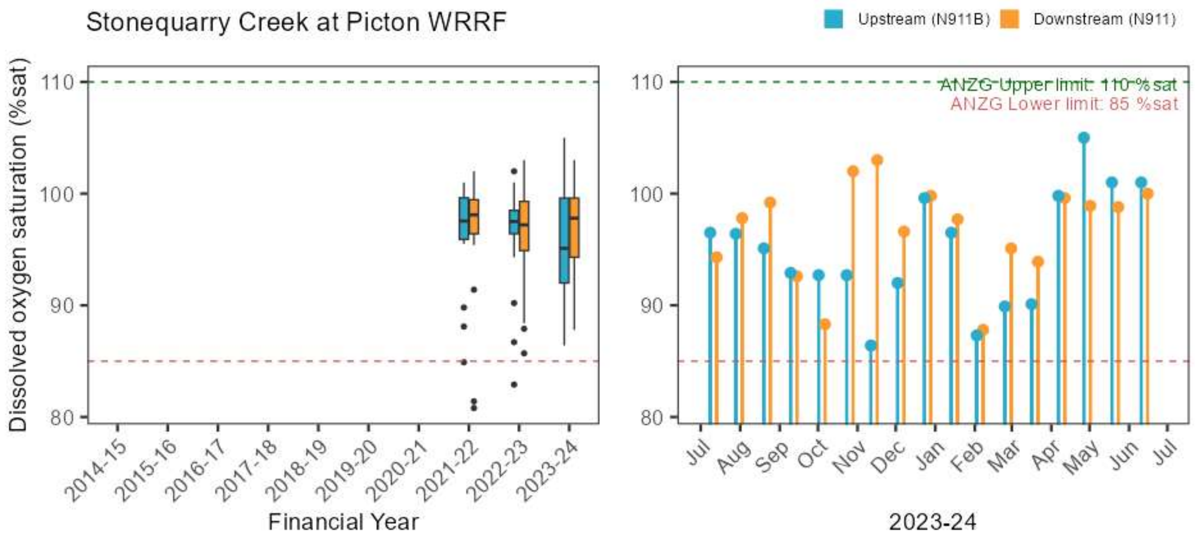
A.1.7. Stressor – Physico-chemical water quality

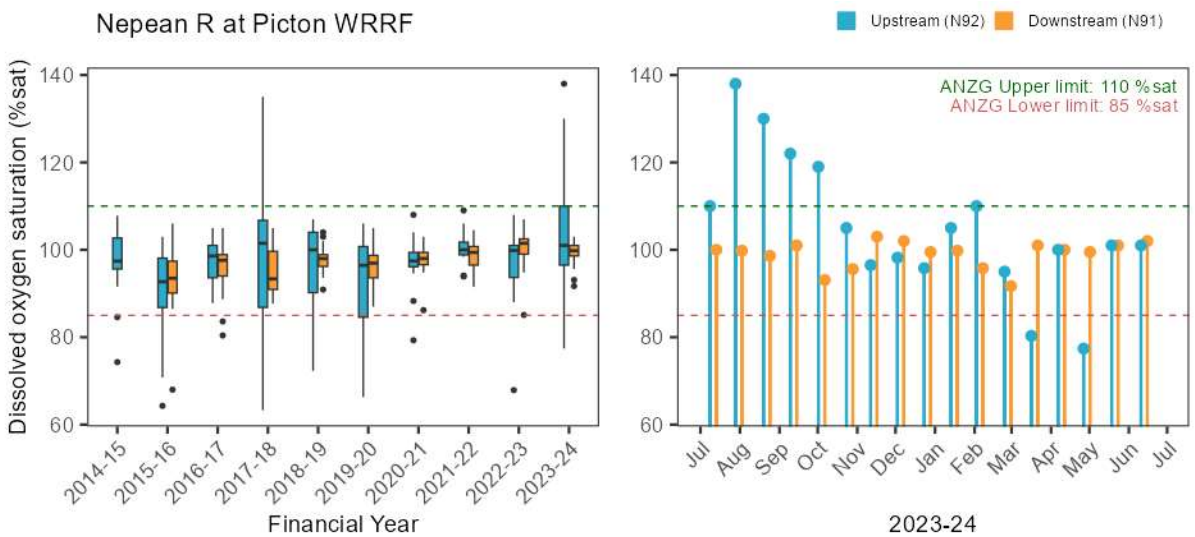


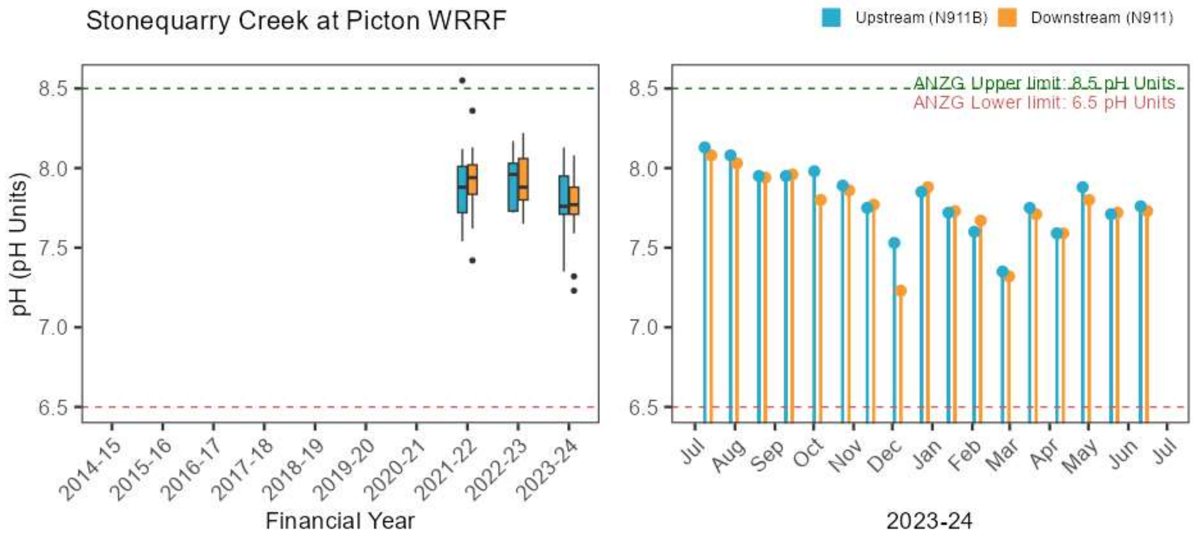


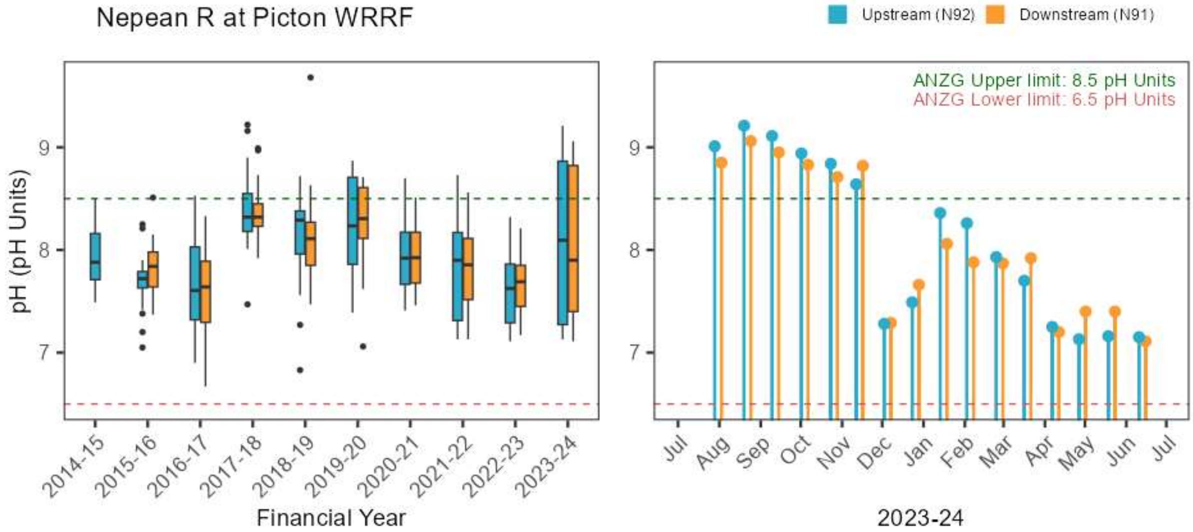


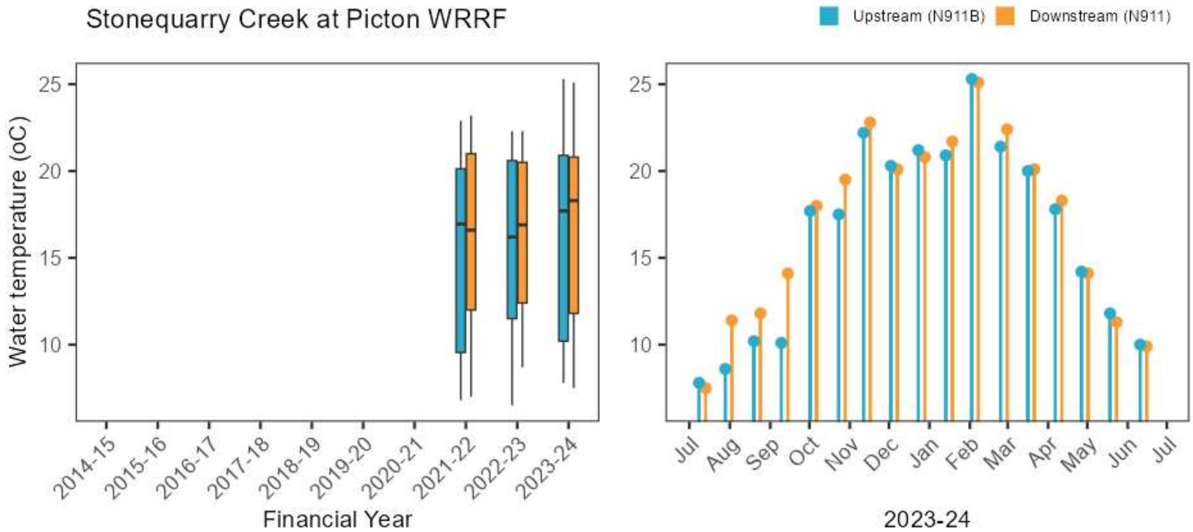

Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Dissolved oxygen (mg/L)
4
8
12
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Dissolved oxygen saturation (%sat)
80
90
100
110
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Dissolved oxygen saturation (%sat)
60
80
100
120
140
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
pH (pH Units)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
pH (pH Units)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Water temperature (oC)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
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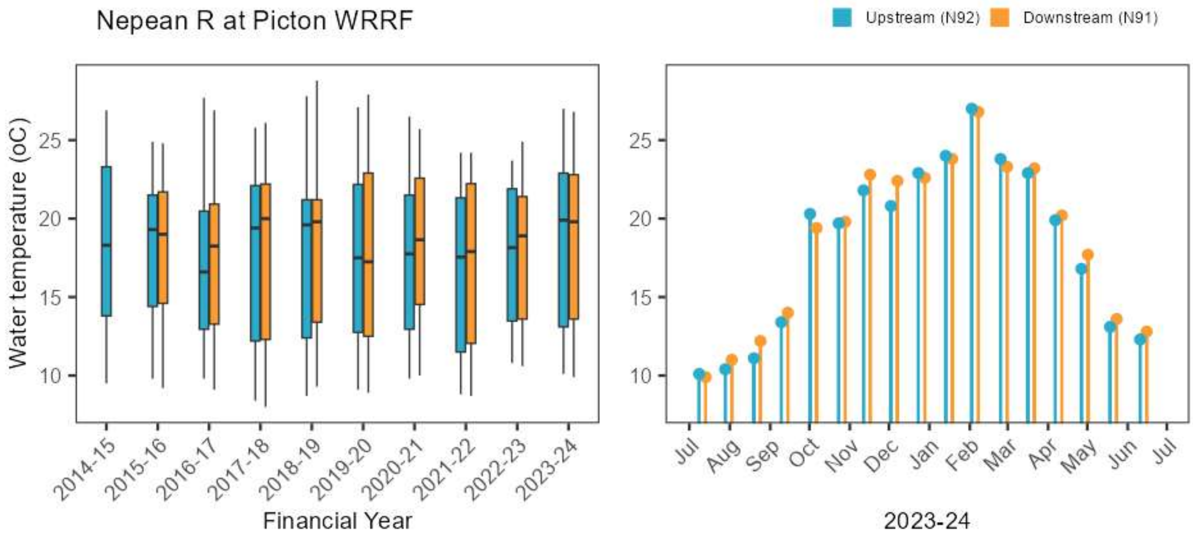
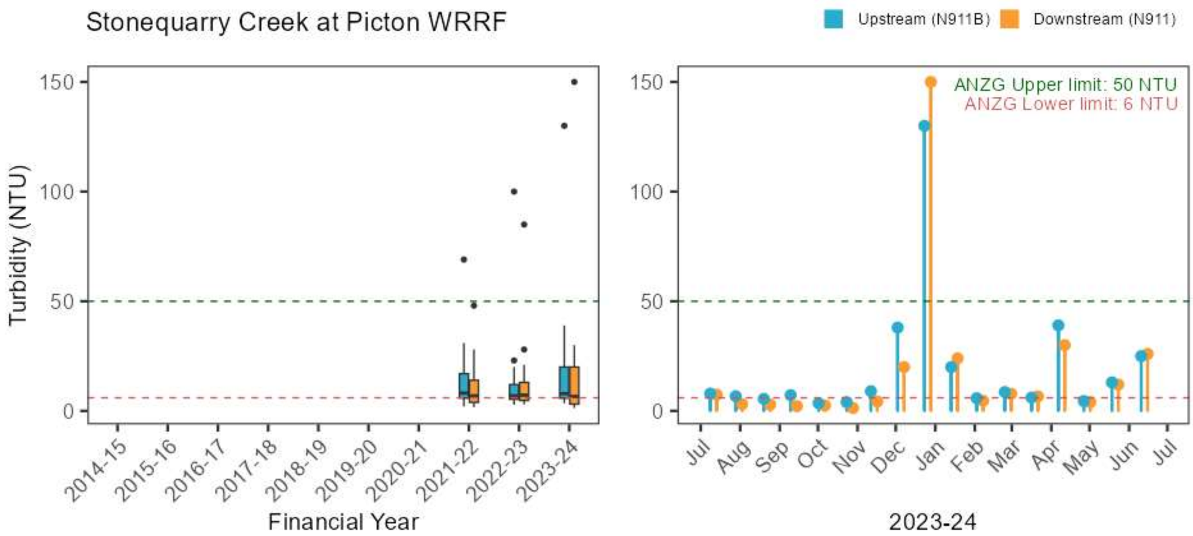
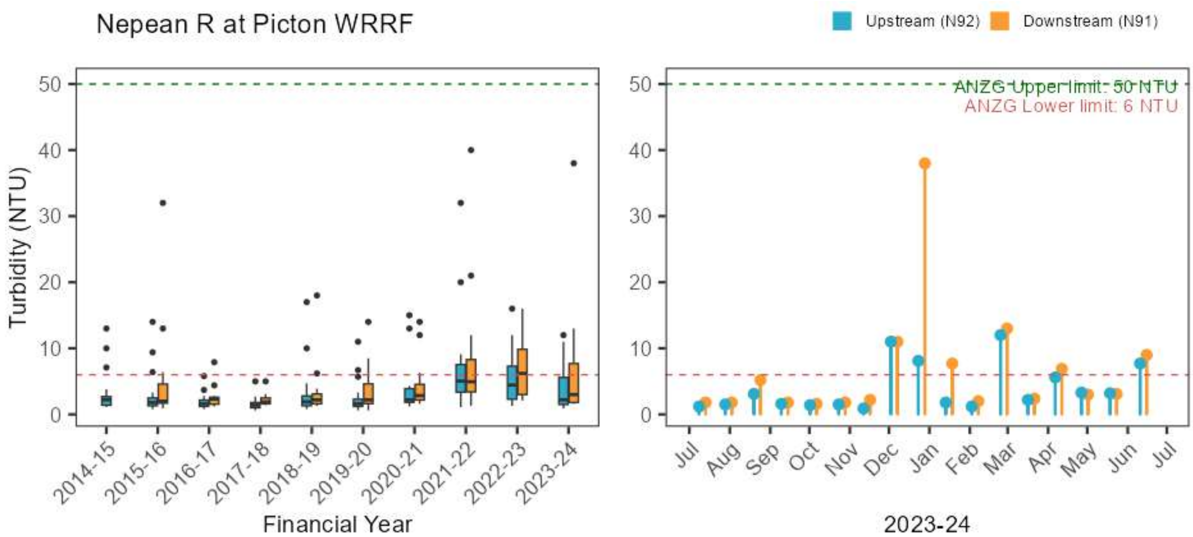
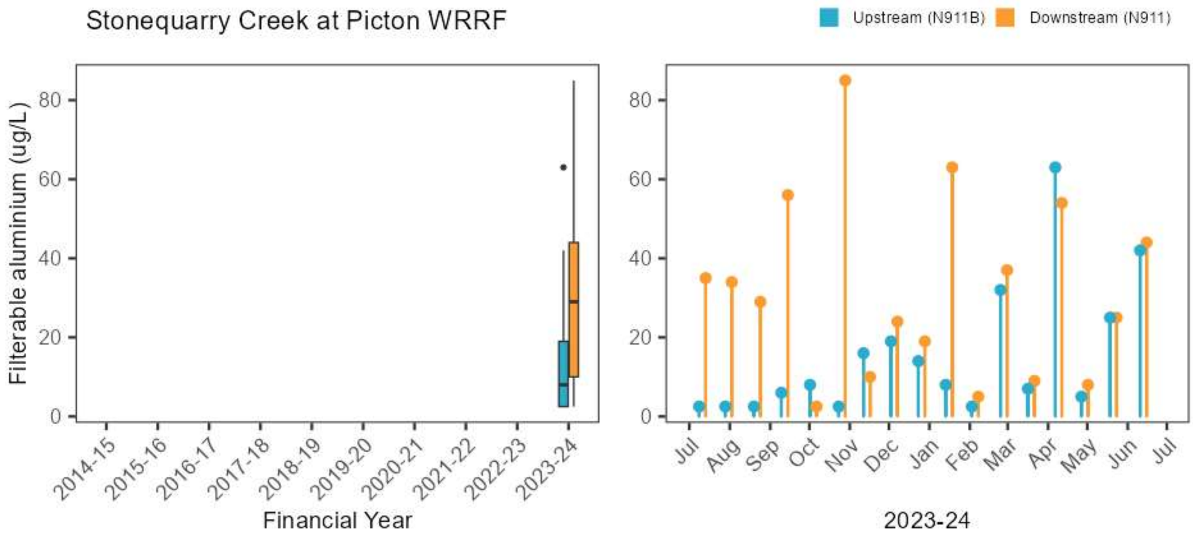
Jun
Jul
2023-24

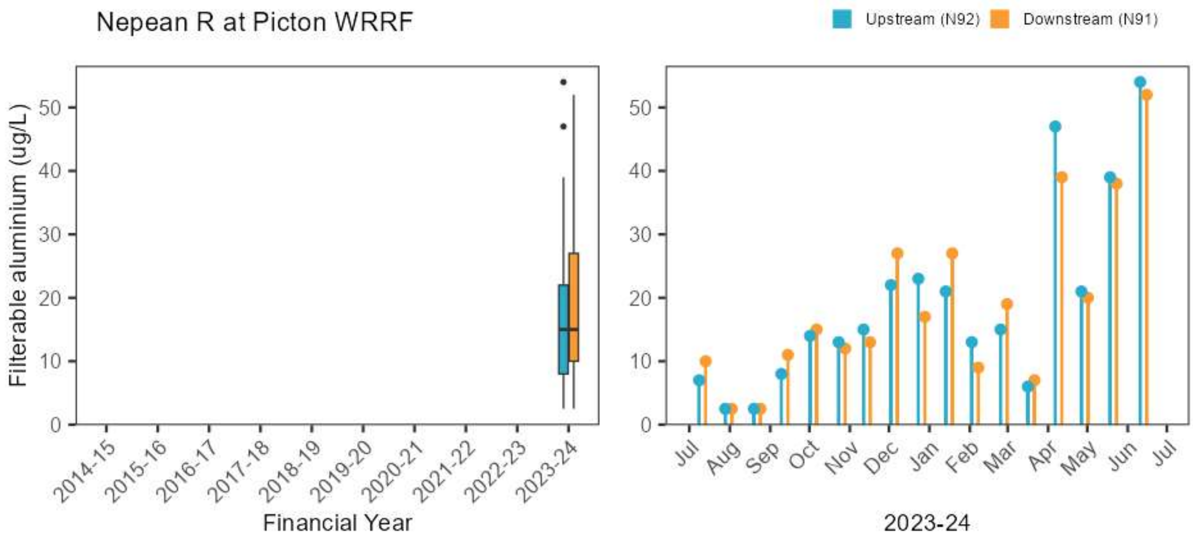

Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Water temperature (oC)
Financial Year
2023-24

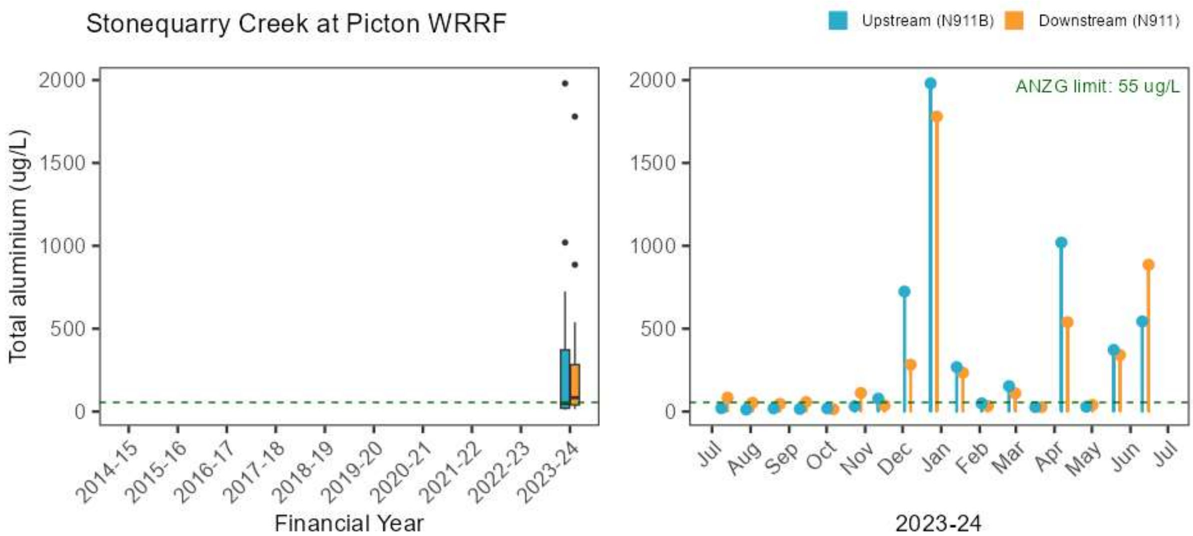

Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

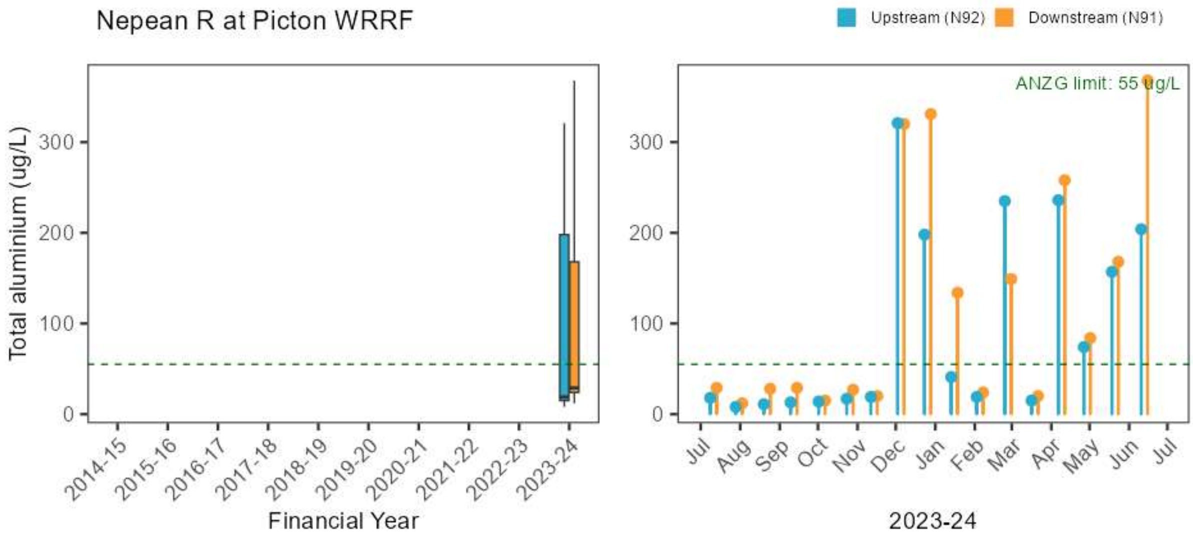

Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

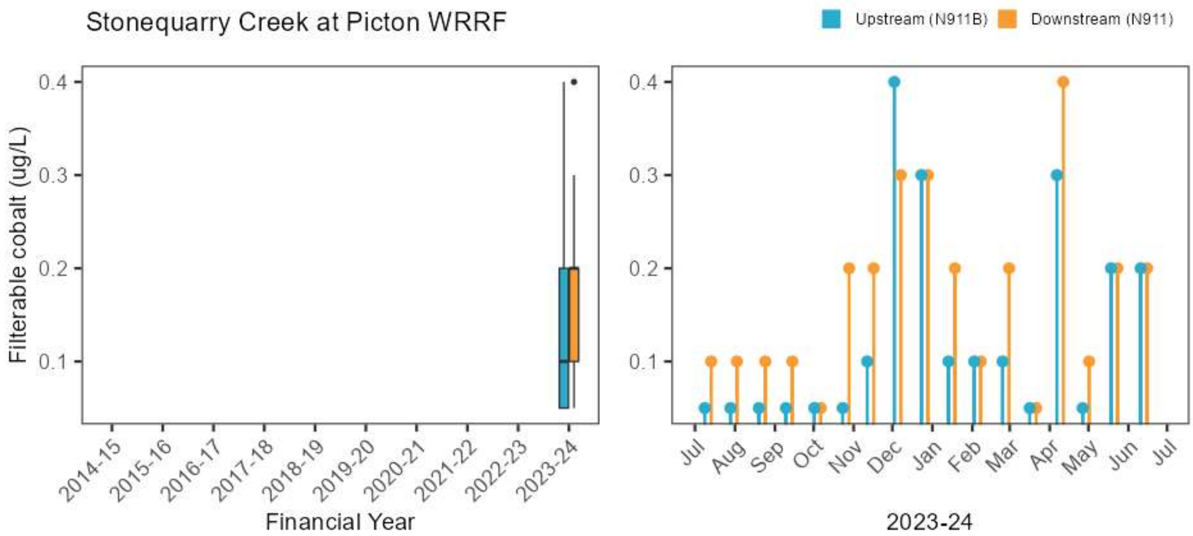
A.1.8. Stressor - Trace metals

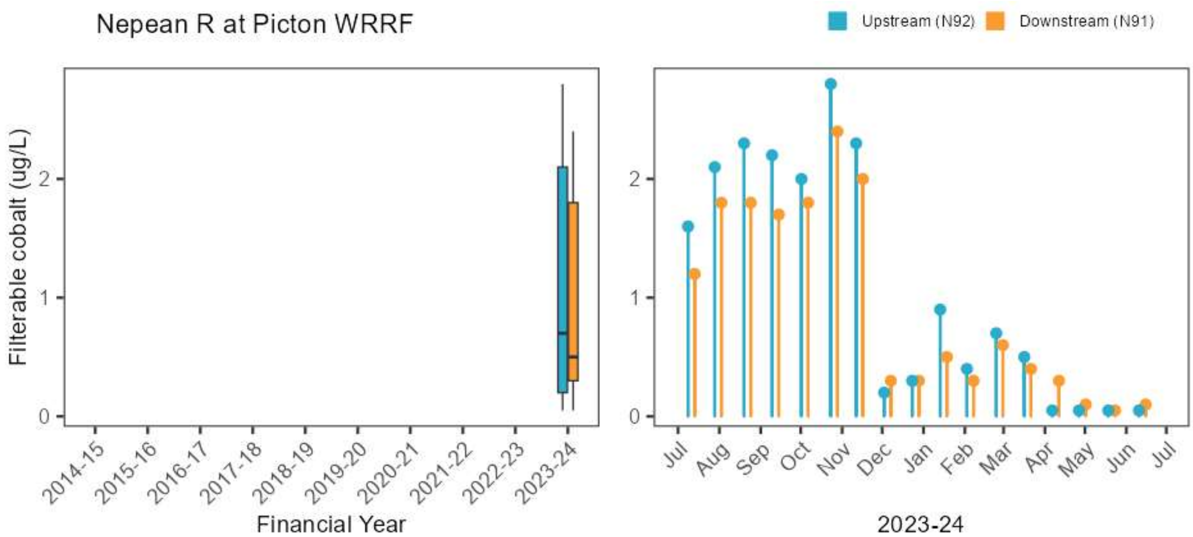


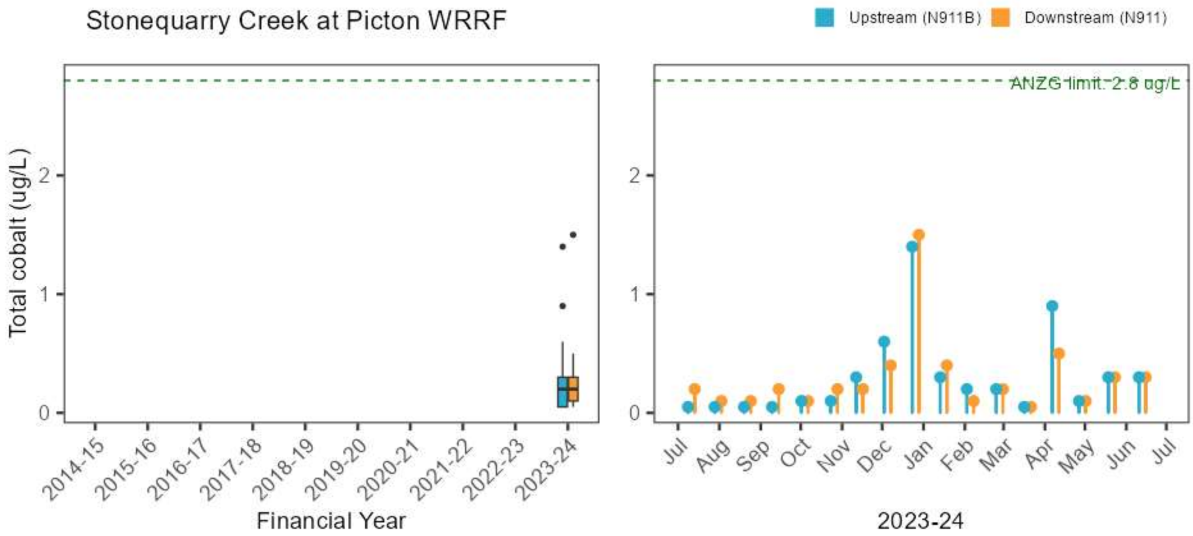





Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 55 ug/L
Total aluminium (ug/L)
Financial Year
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Filterable cobalt (ug/L)
Financial Year
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Filterable cobalt (ug/L)
Financial Year
2023-24



Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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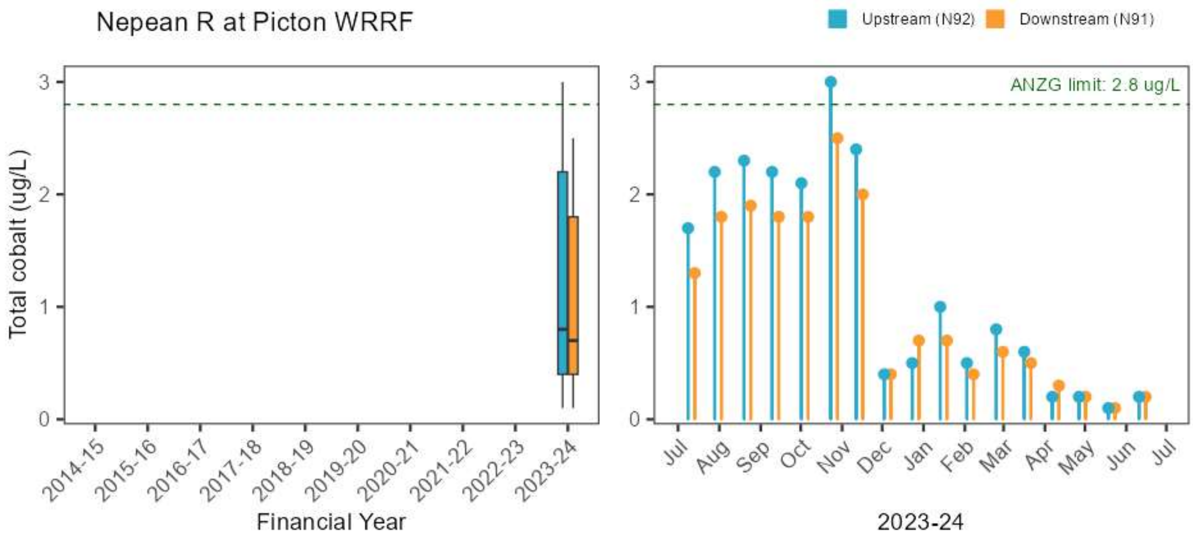
May
Jun
Jul
2023-24



Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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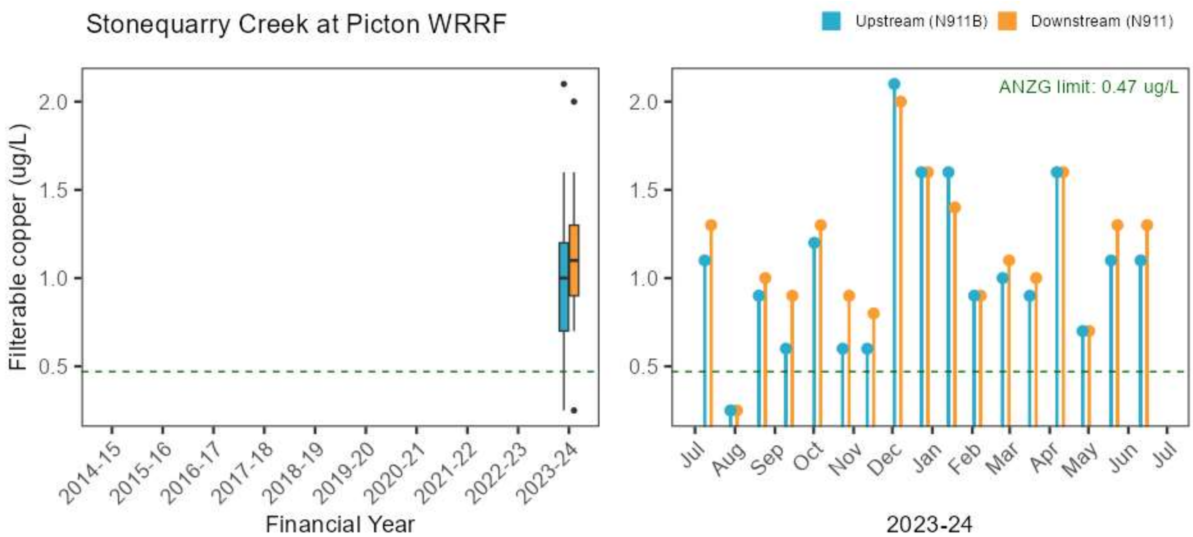
May
Jun
Jul
2023-24



Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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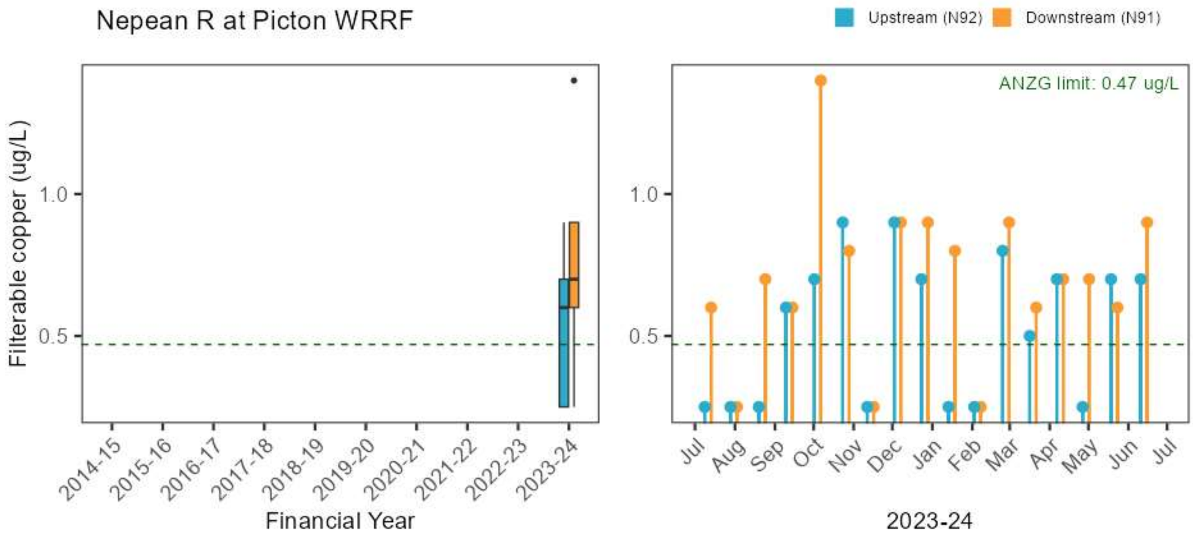
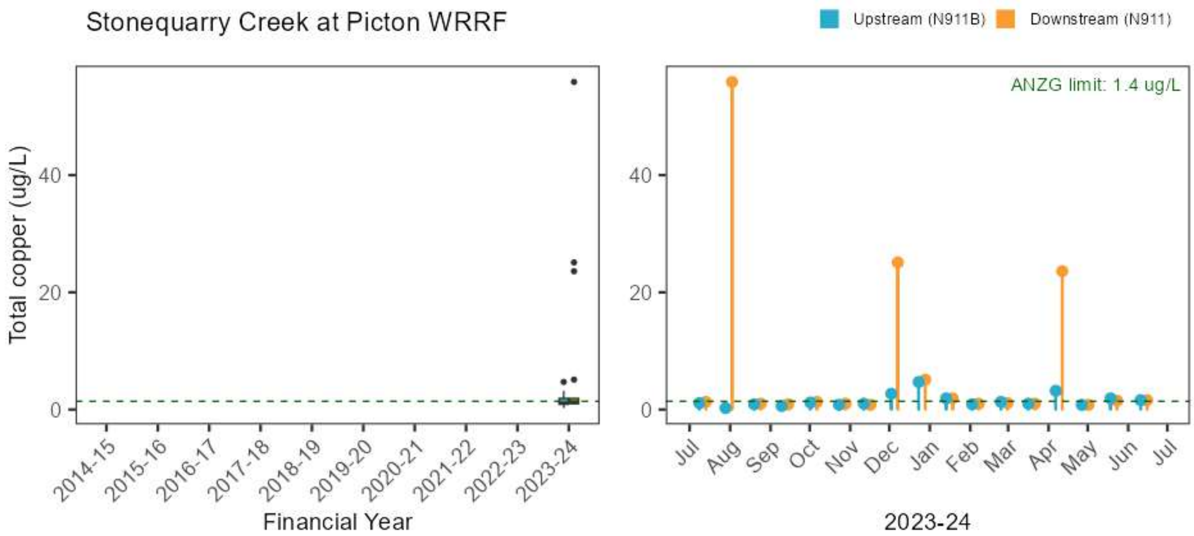
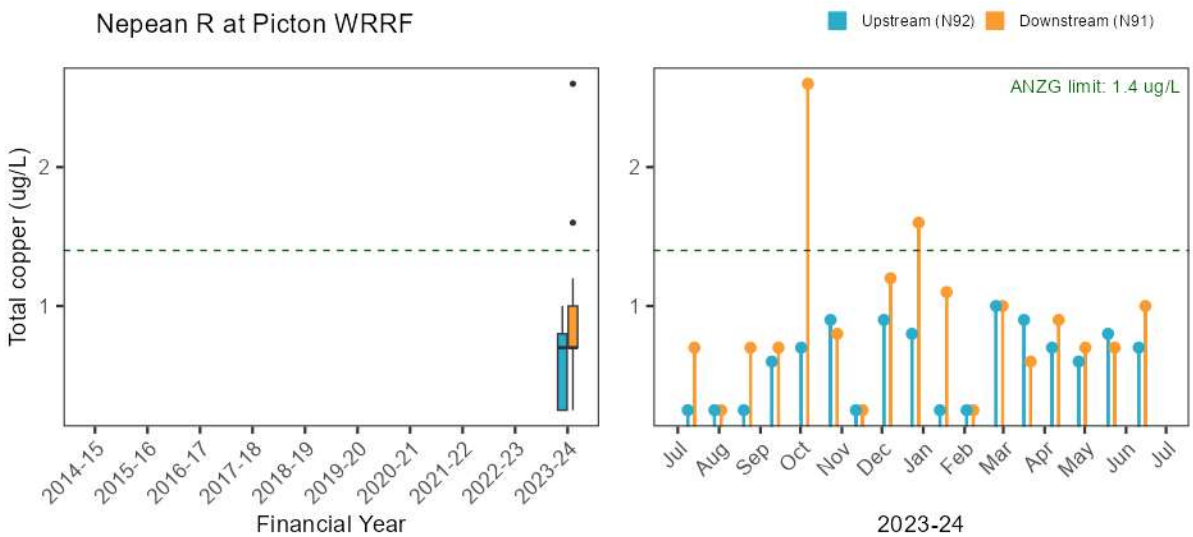
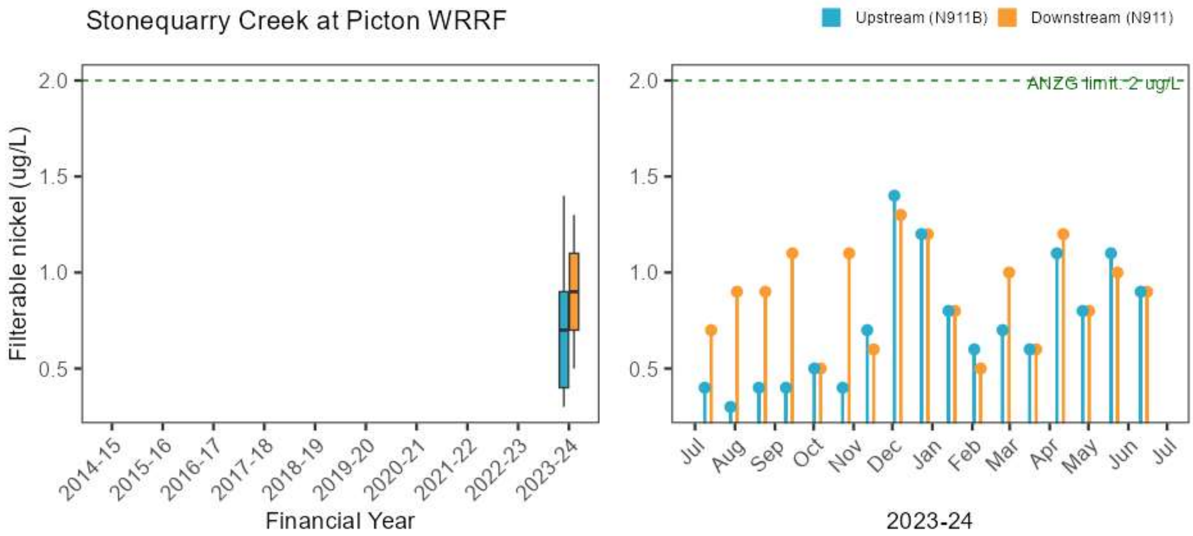
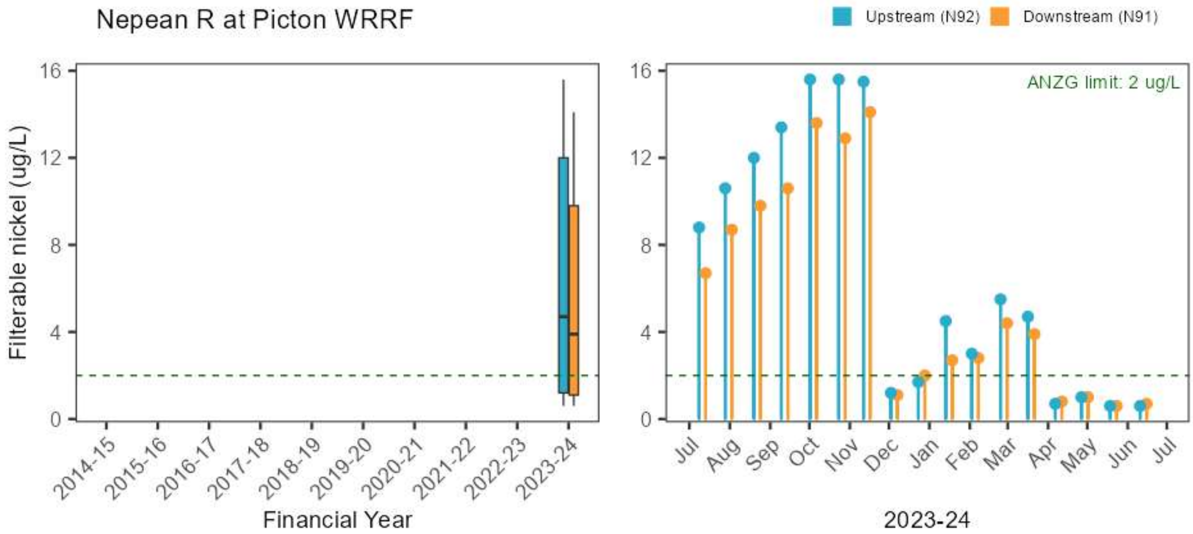
Jul
2023-24

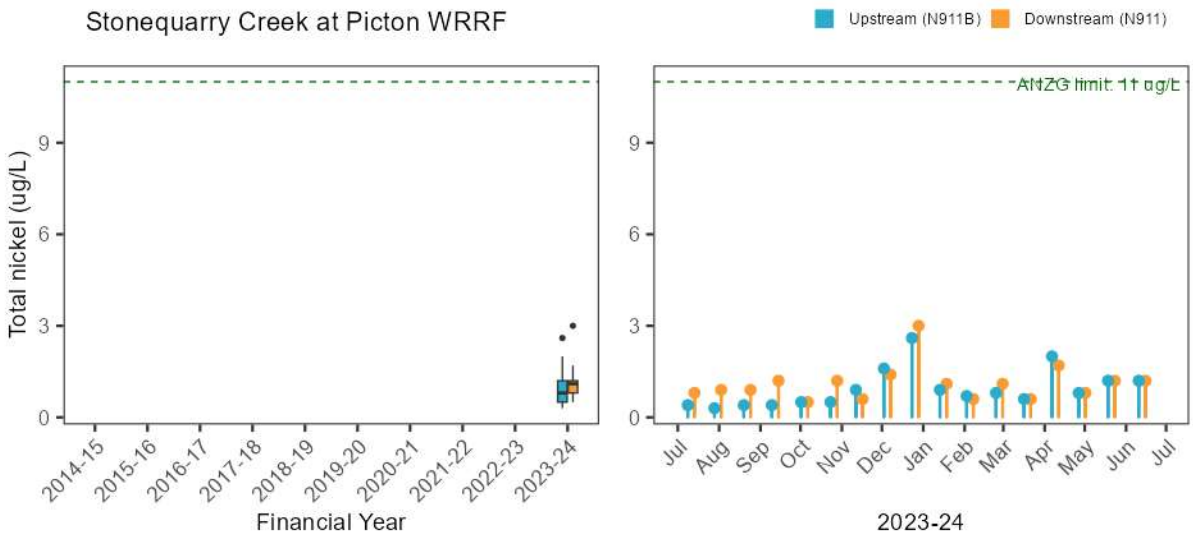

Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
Financial Year
2023-24

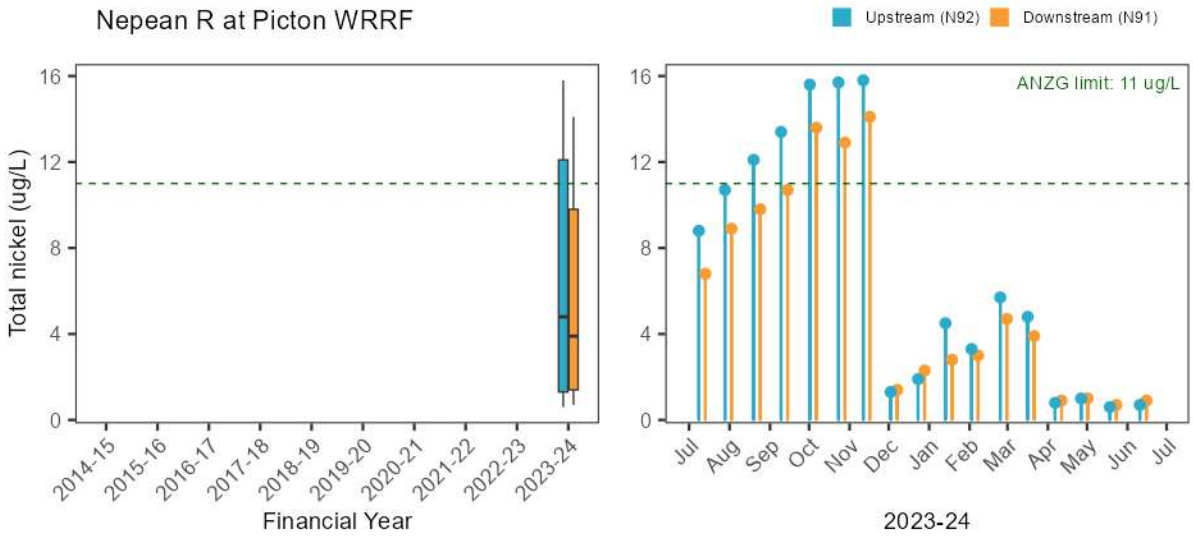

Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
Financial Year
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
Financial Year
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Filterable nickel (ug/L)
Financial Year
ANZG limit: 2 ug/L
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Filterable nickel (ug/L)
Financial Year
ANZG limit: 2 ug/L
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Total nickel (ug/L)
Financial Year
ANZG limit: 11 ug/L
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
ANZG limit: 11 ug/L
Total nickel (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
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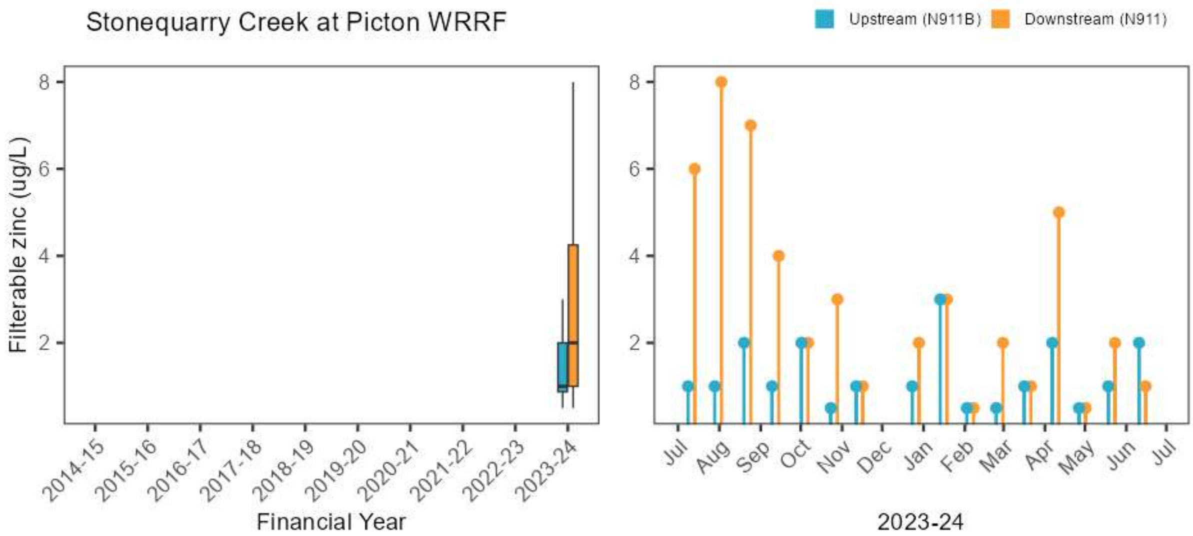
May
Jun
Jul
2023-24


Stonequarry Creek at Picton WRRF
Upstream (N911B)
Downstream (N911)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
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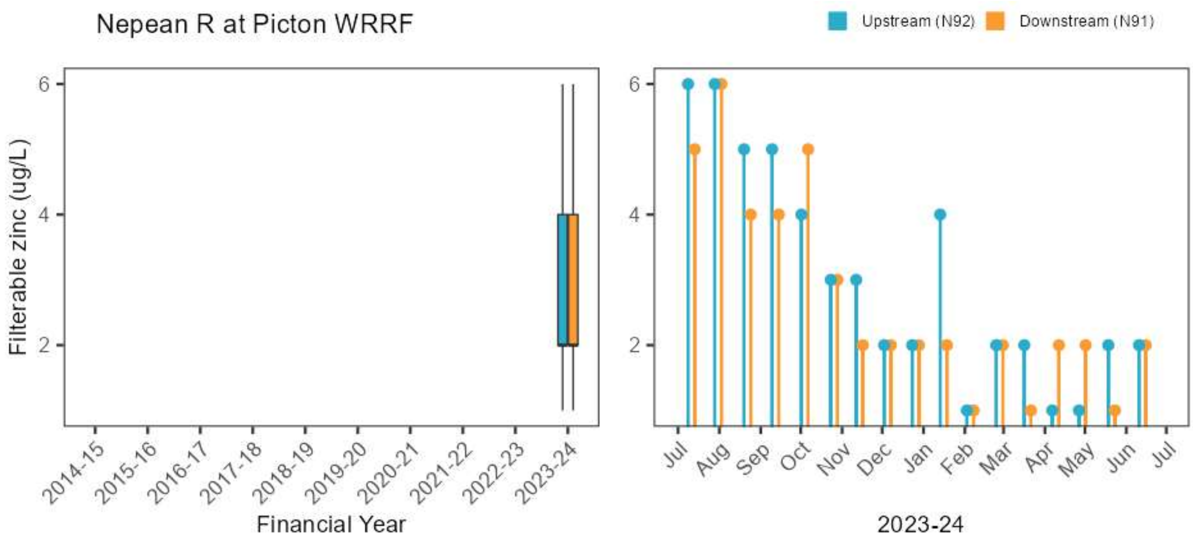
May
Jun
Jul
2023-24


Nepean R at Picton WRRF
Upstream (N92)
Downstream (N91)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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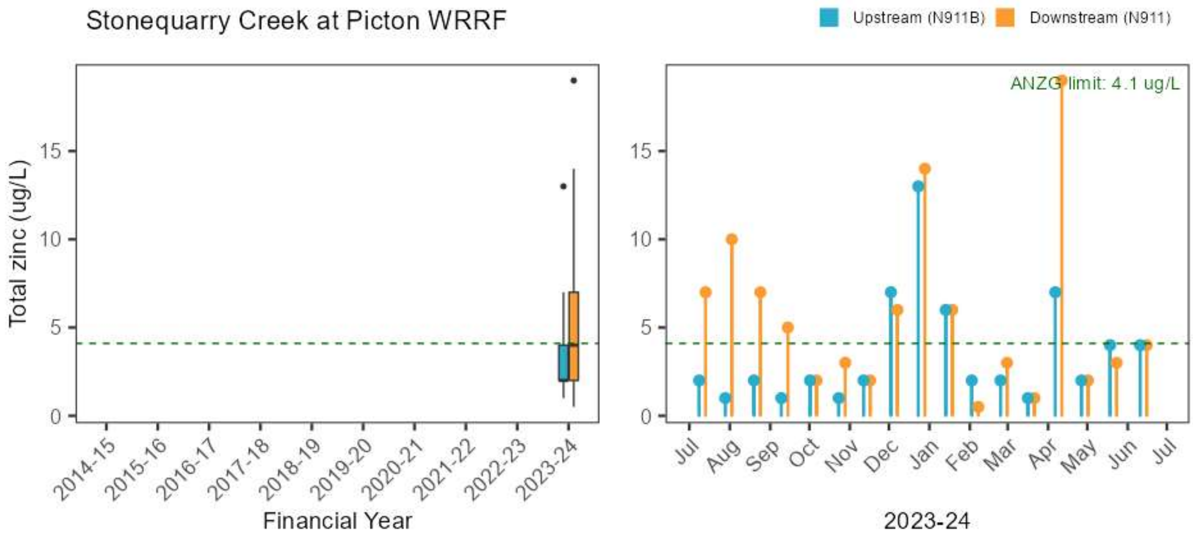
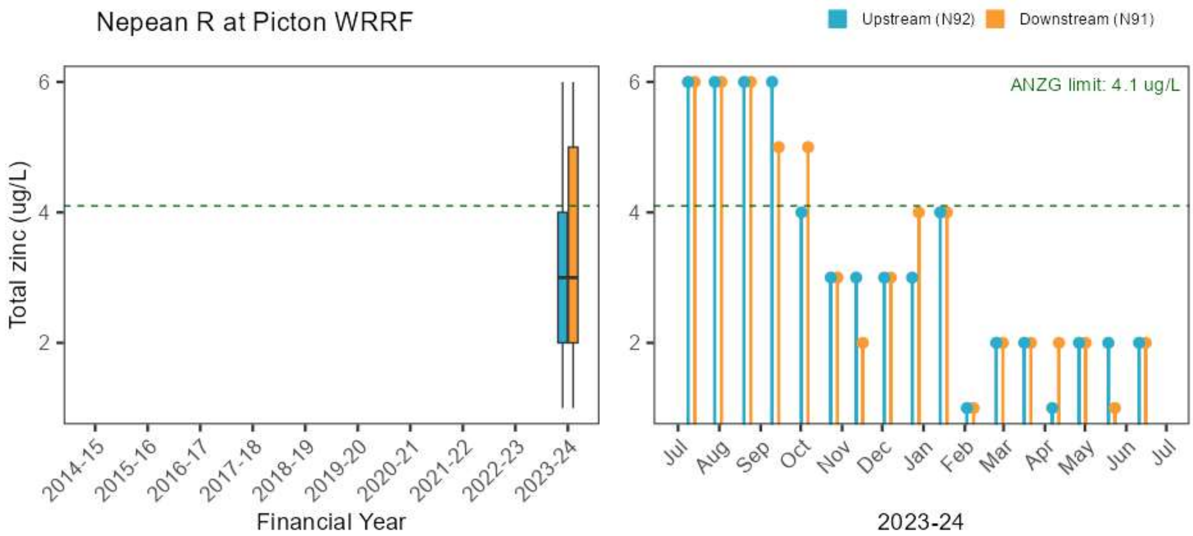
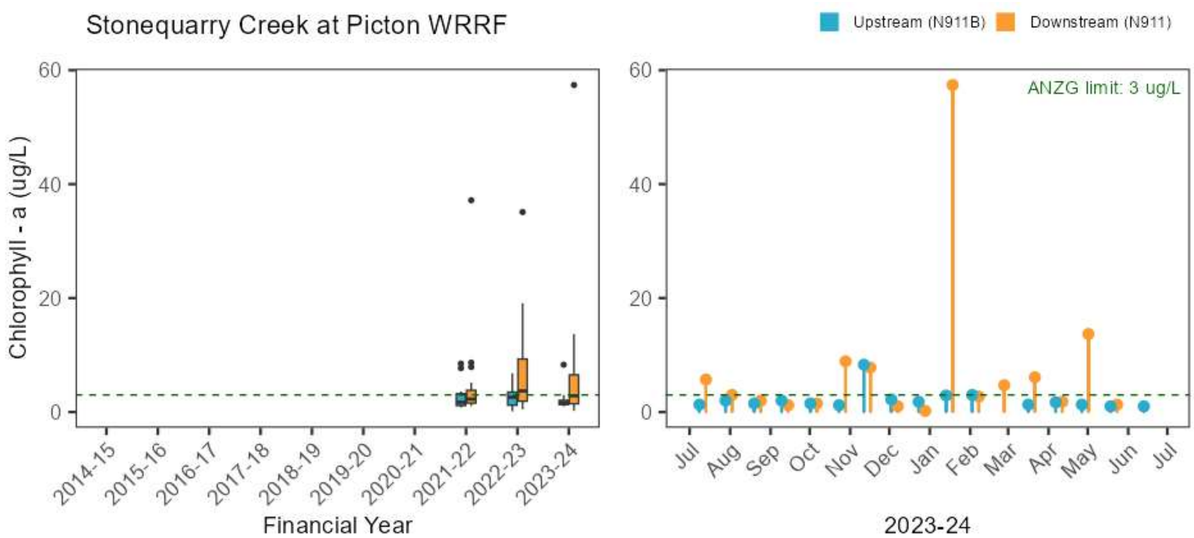
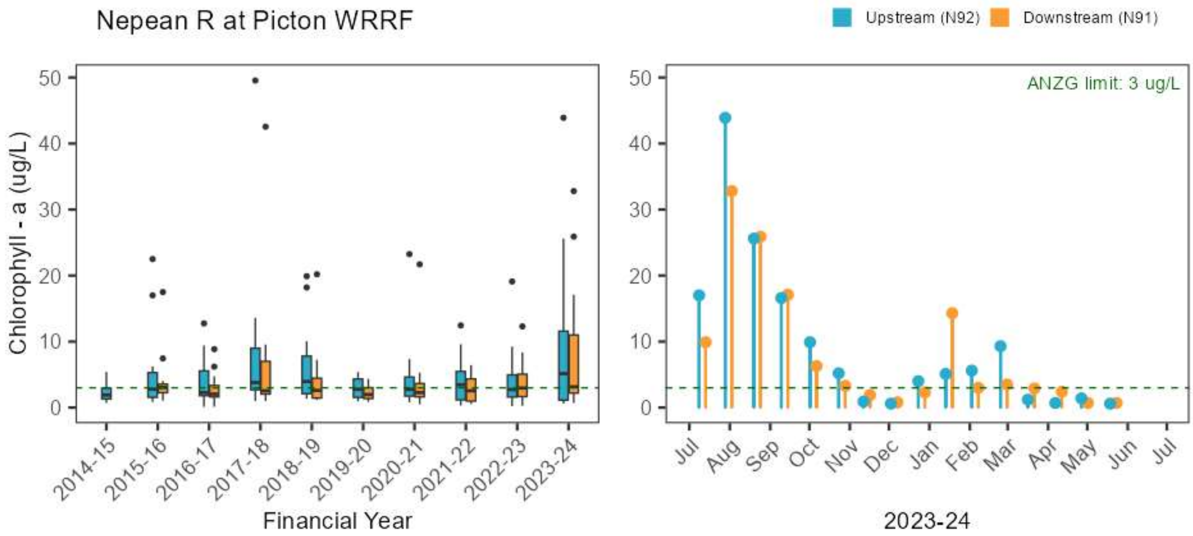
2023-24





A.1.9. Ecosystem receptor – Phytoplankton





A.1.10. Ecosystem receptor – Macroinvertebrates

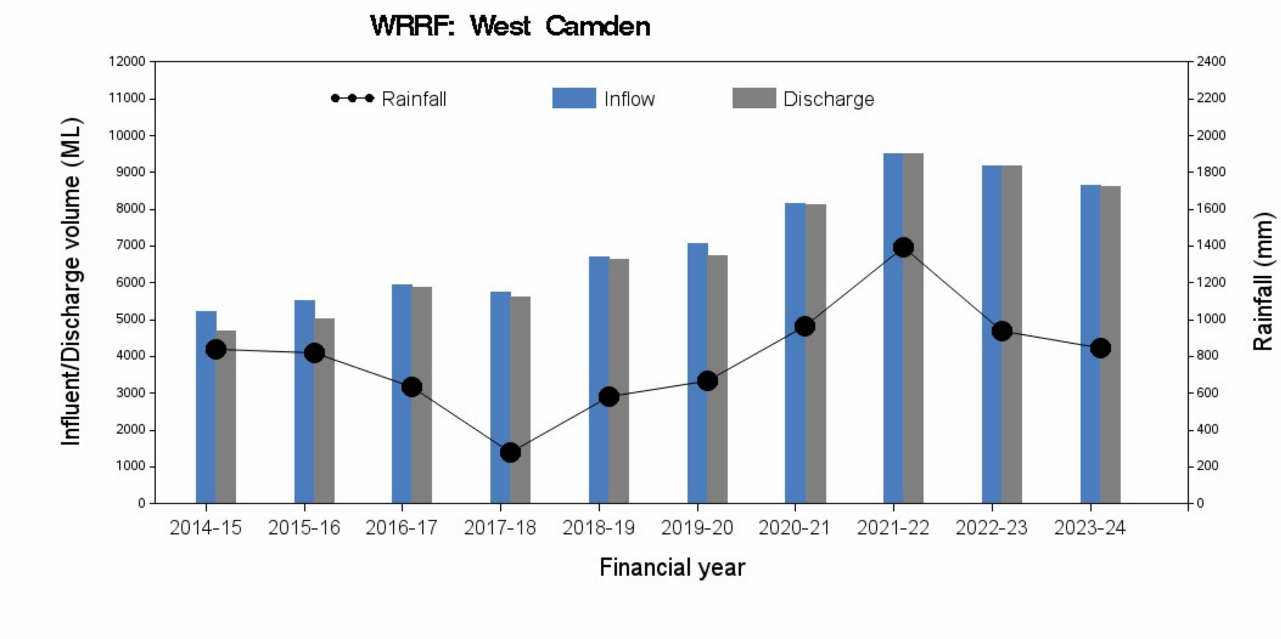
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Stonequarry Creek	Tributary (N911B vs N911)	Welch Two Sample t-test	0.34	2.64	13.7	0.02
Nepean River	River (N92A vs N91)	Welch Two Sample t-test	-0.03	-0.17	13.6	0.870

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

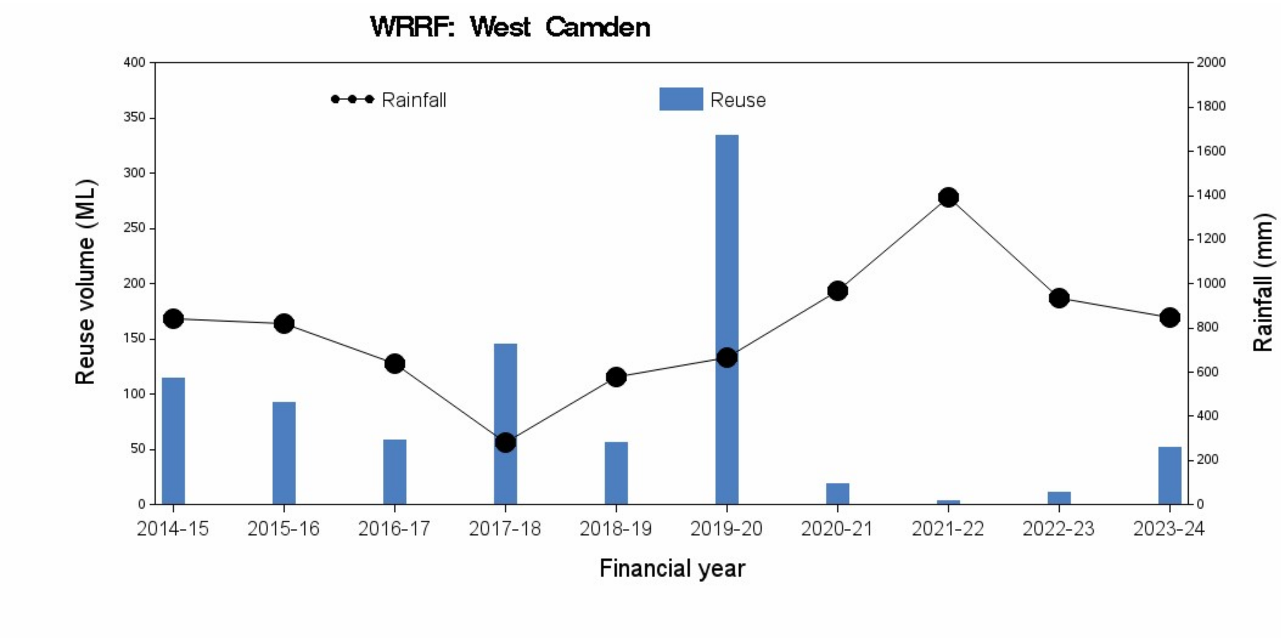
A.2. West Camden WRRF

A.2.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

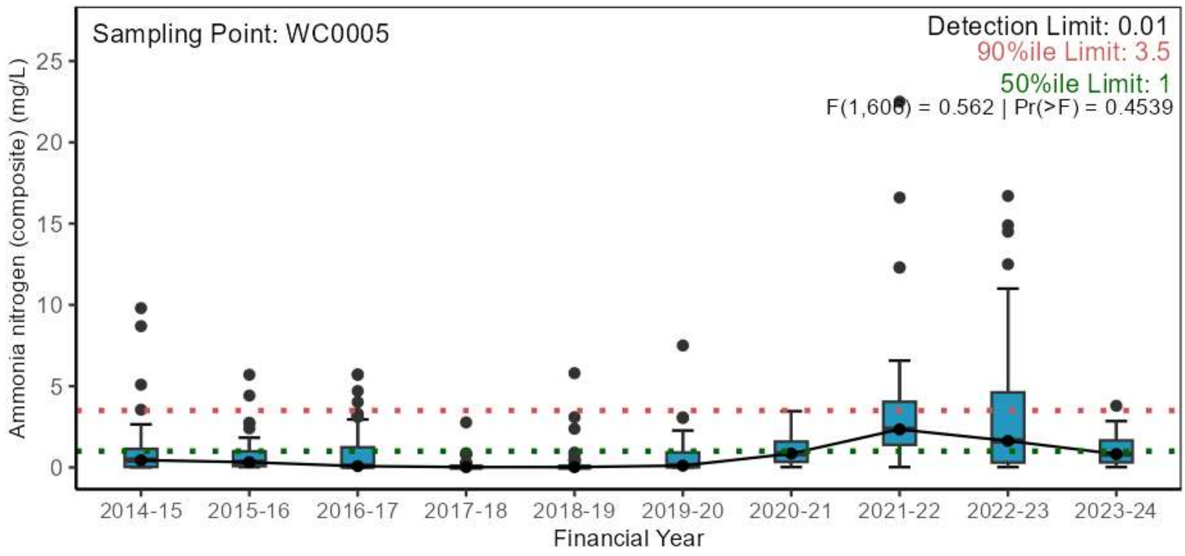


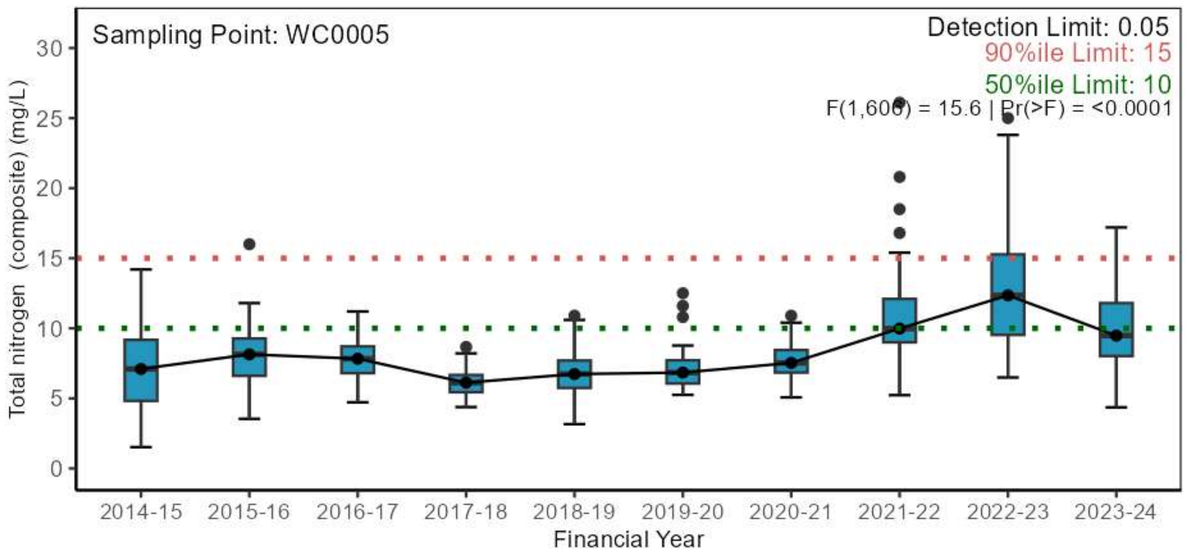
Reuse volume and rainfall

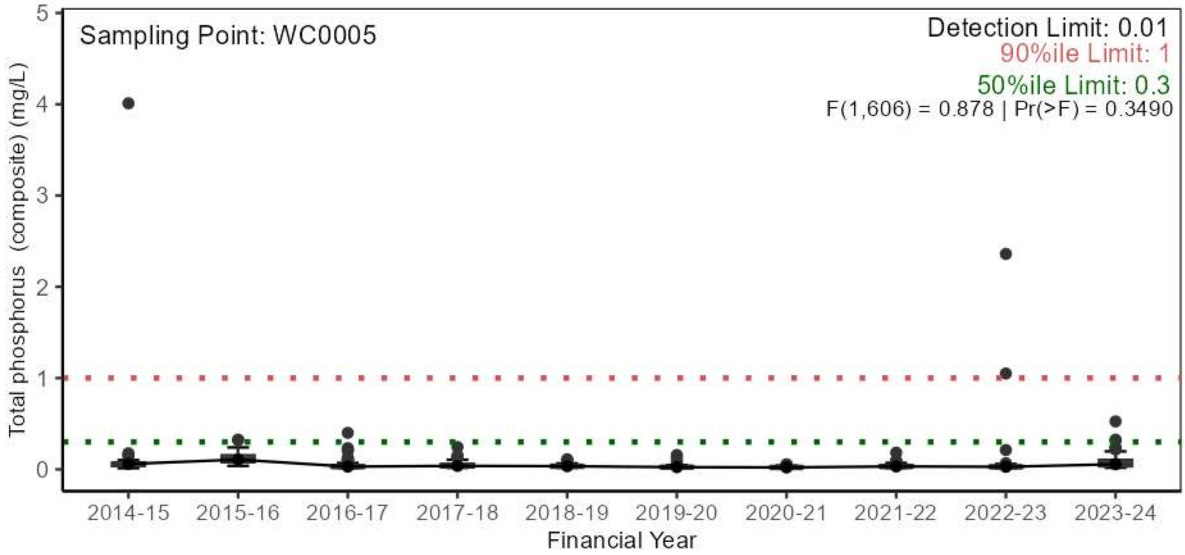


A.2.2. Pressure – Wastewater quality

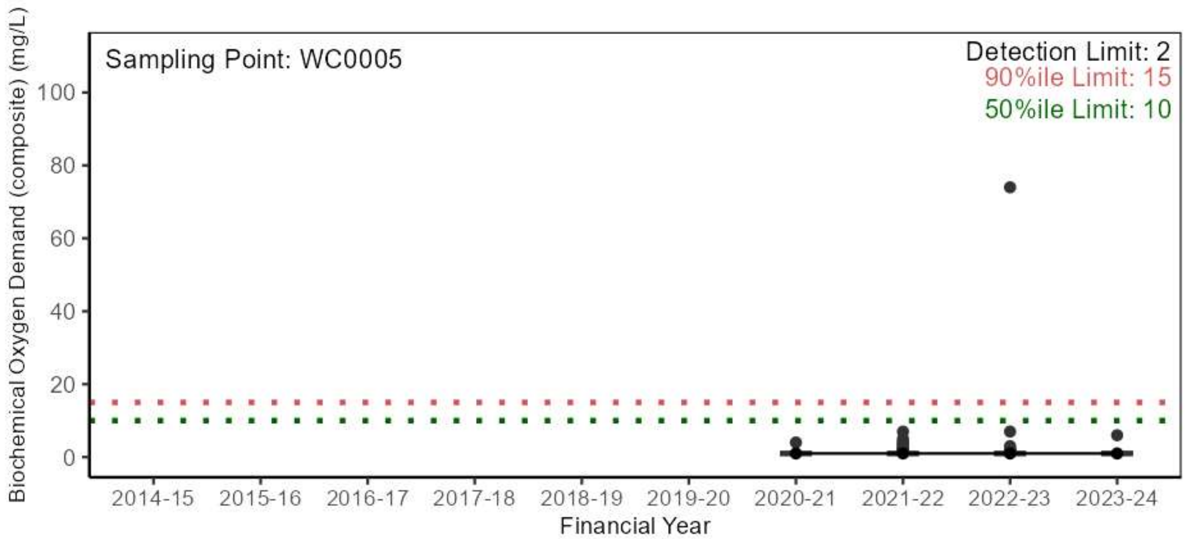
Nutrients



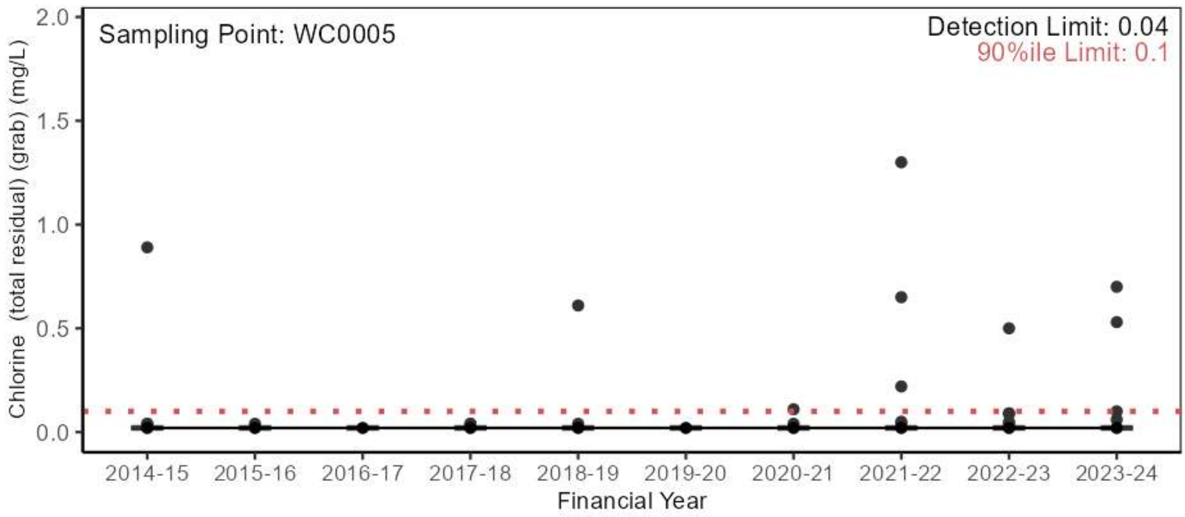




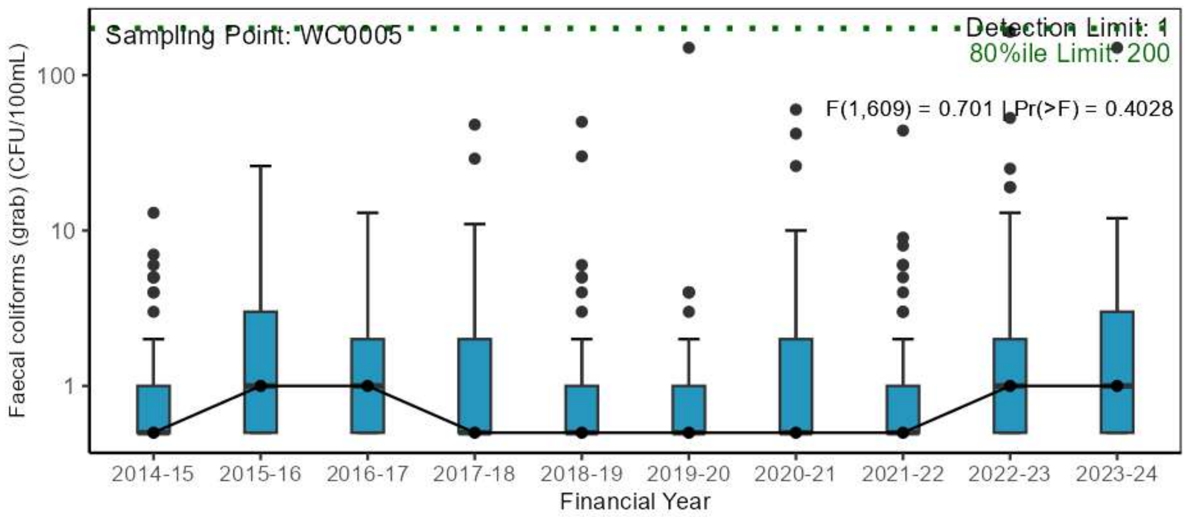
Major conventional analytes



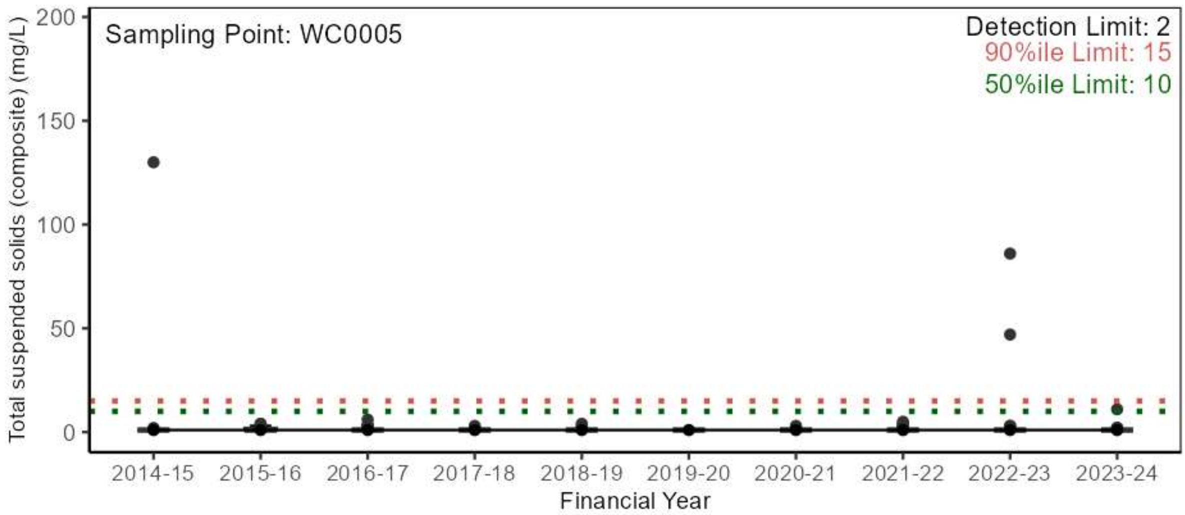
Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

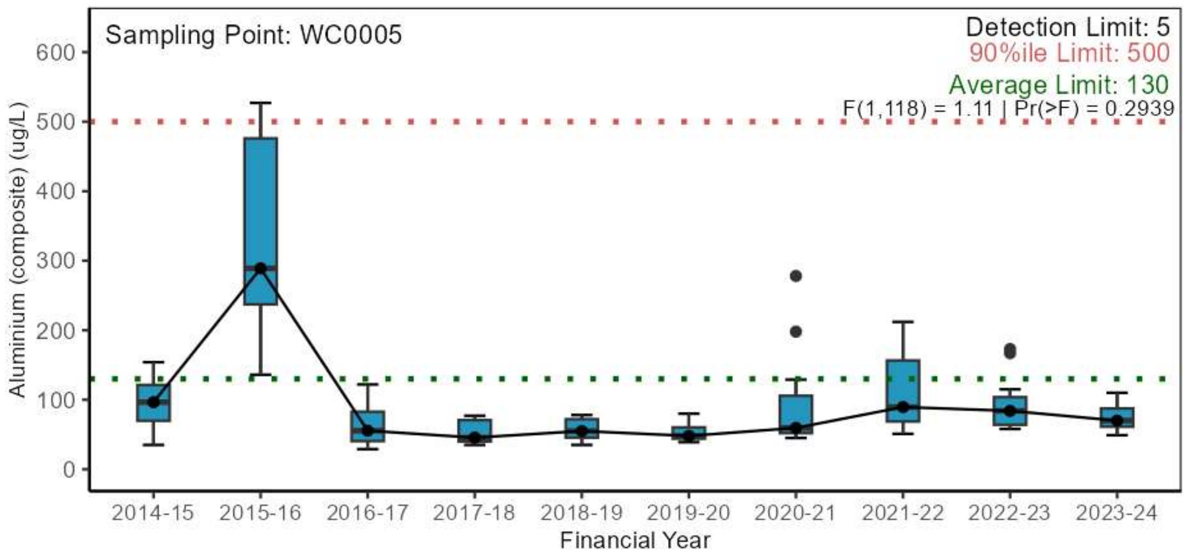


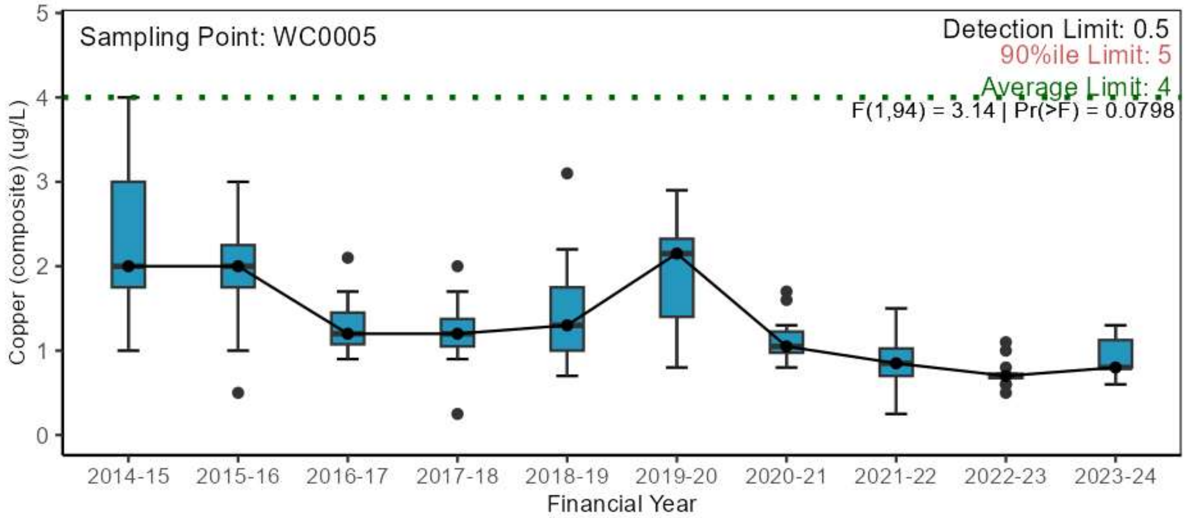
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



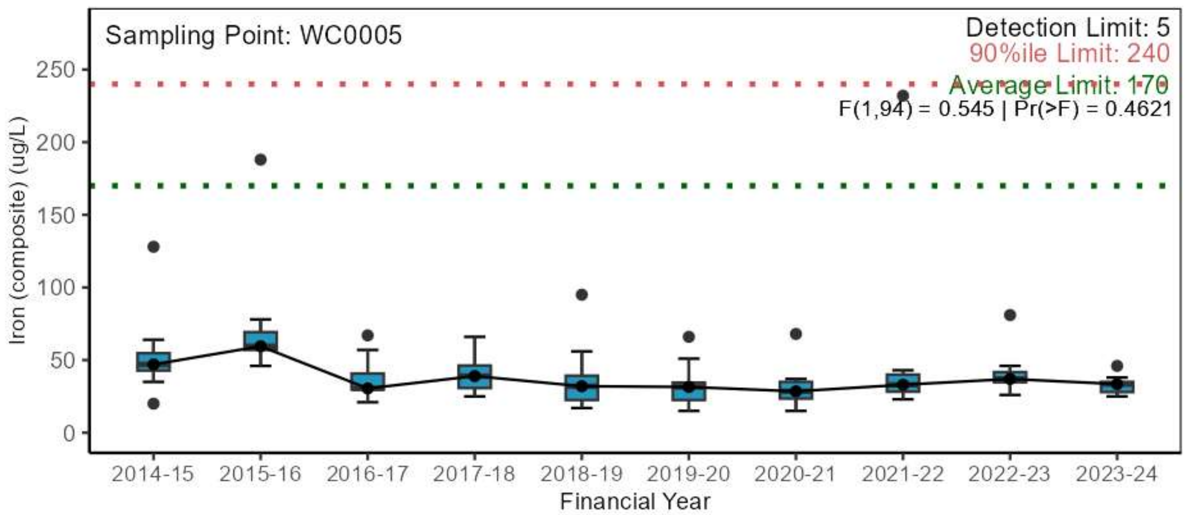
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

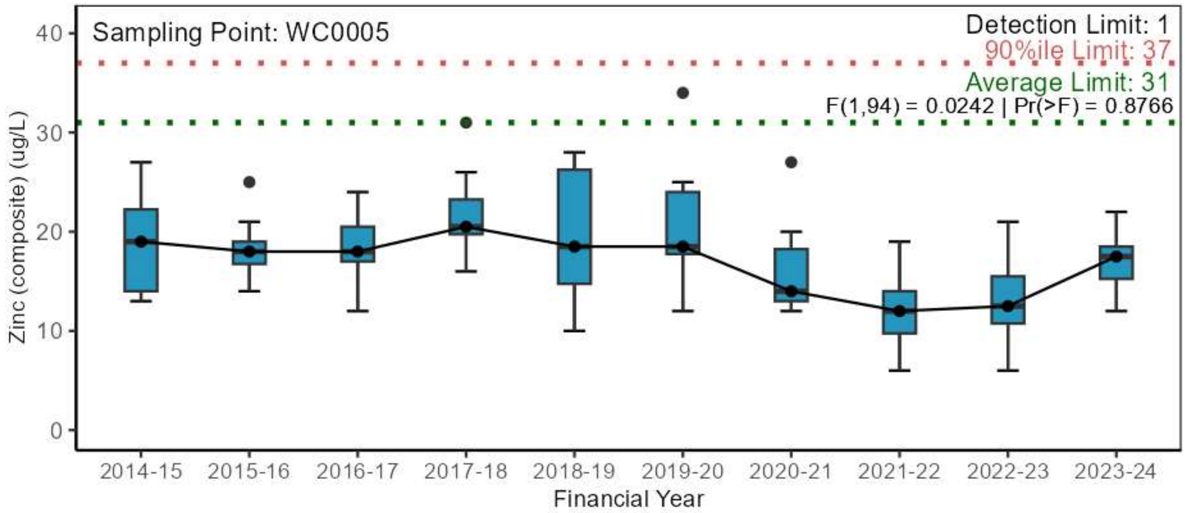




Statistical test excludes data prior to 2016-17 due to method detection limit change.

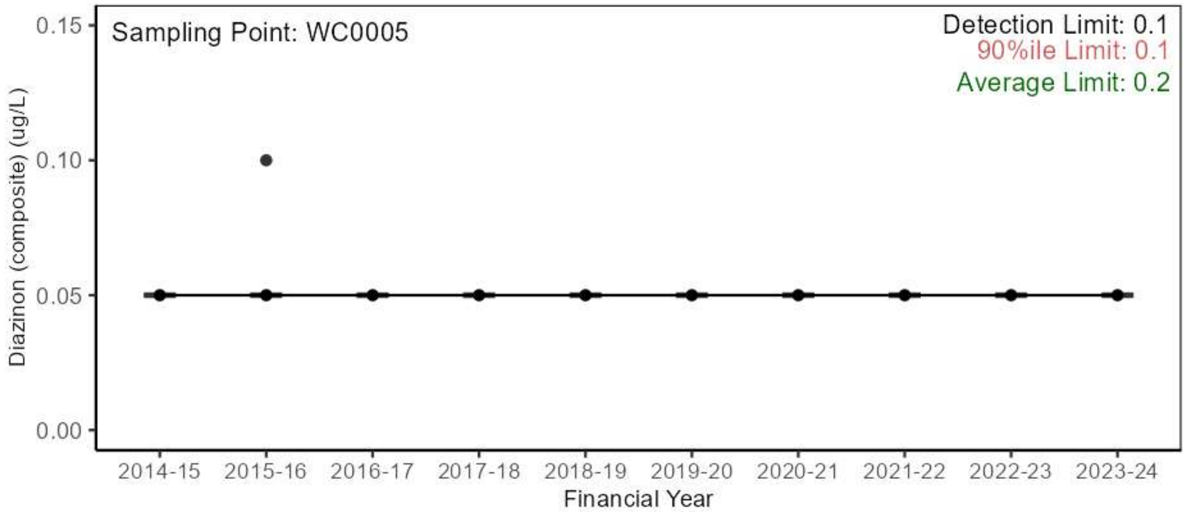


Statistical test excludes data prior to 2016-17 due to method detection limit change.

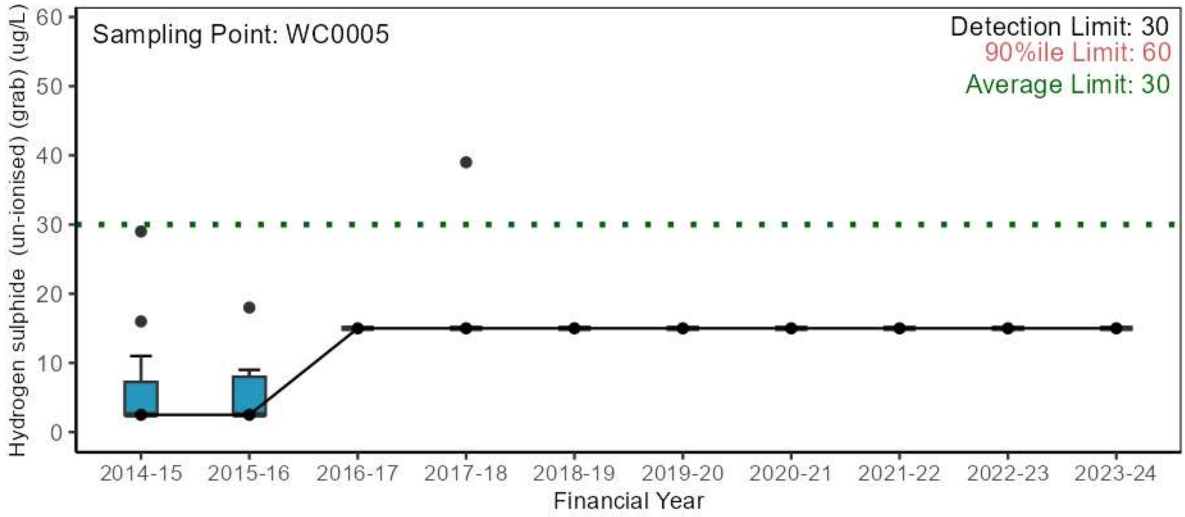


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

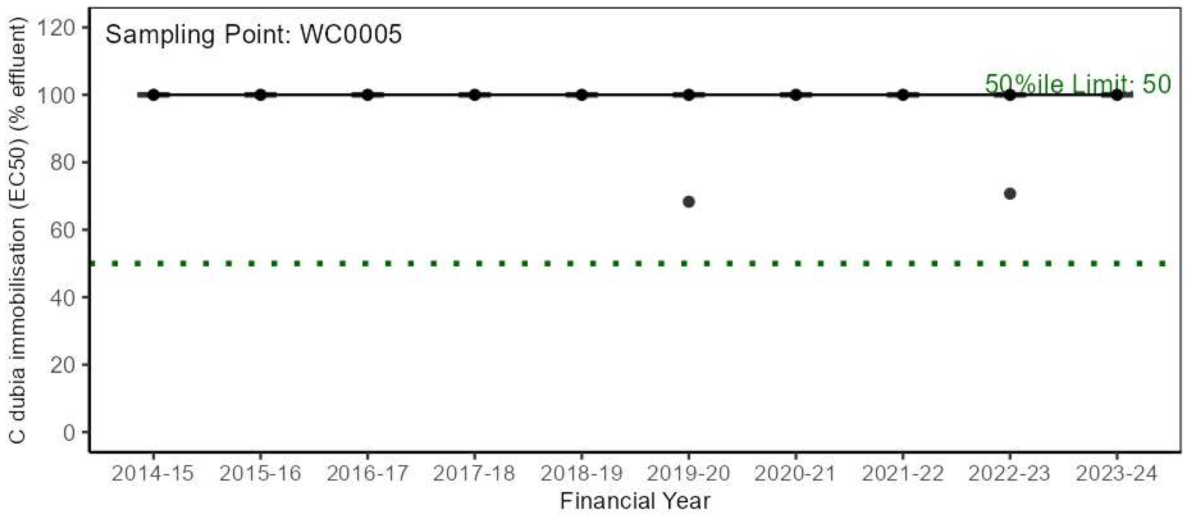


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

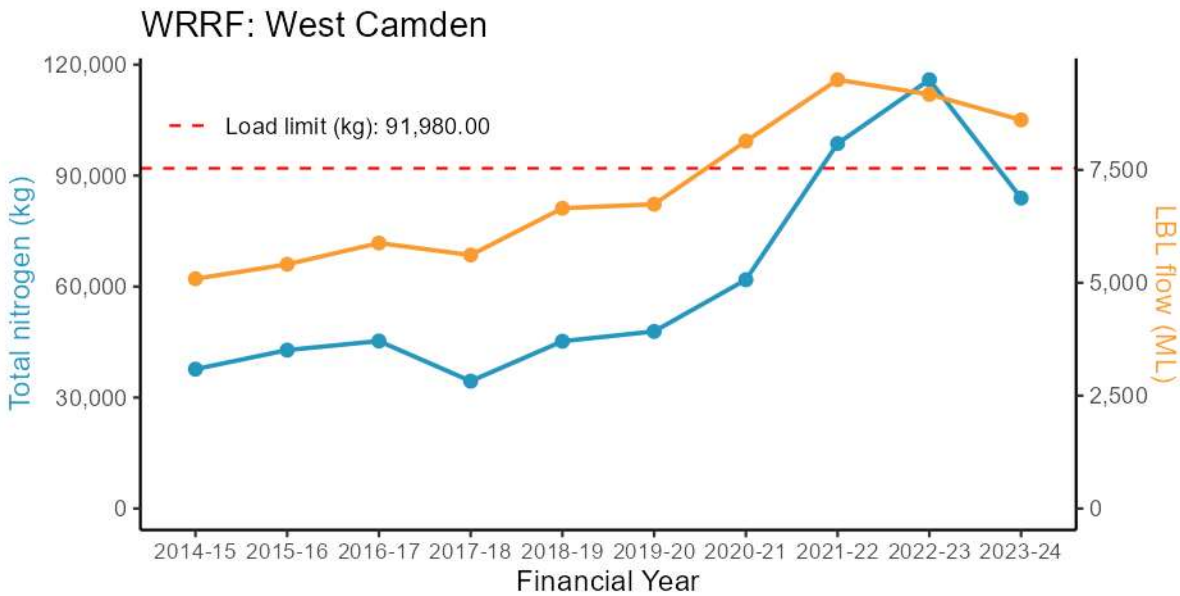
A.2.3. Pressure – Wastewater toxicity

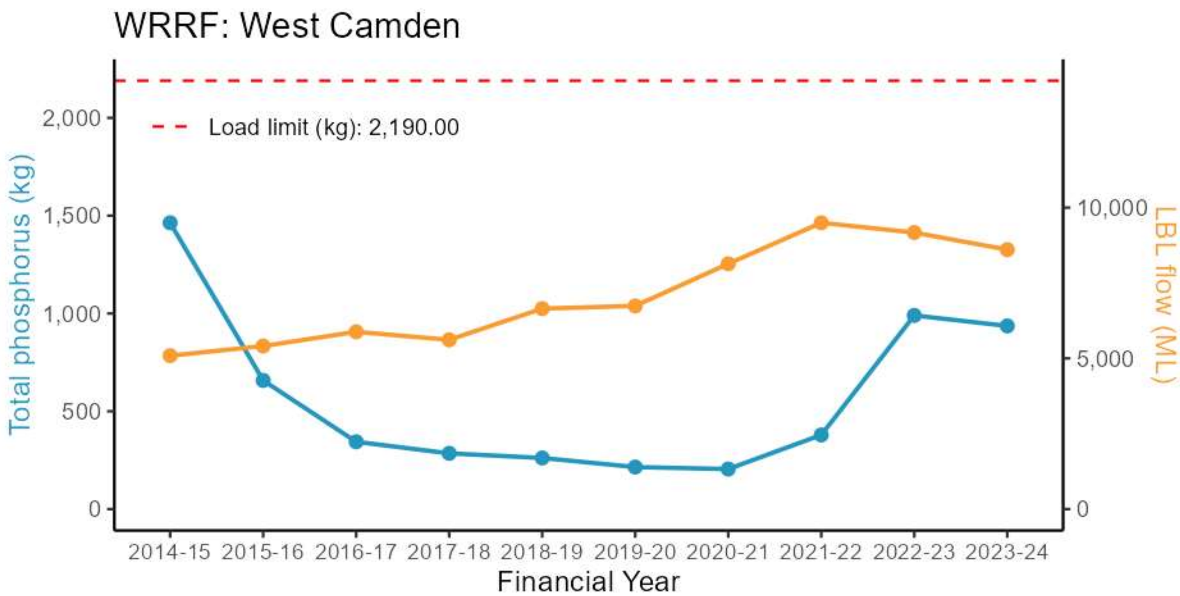


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

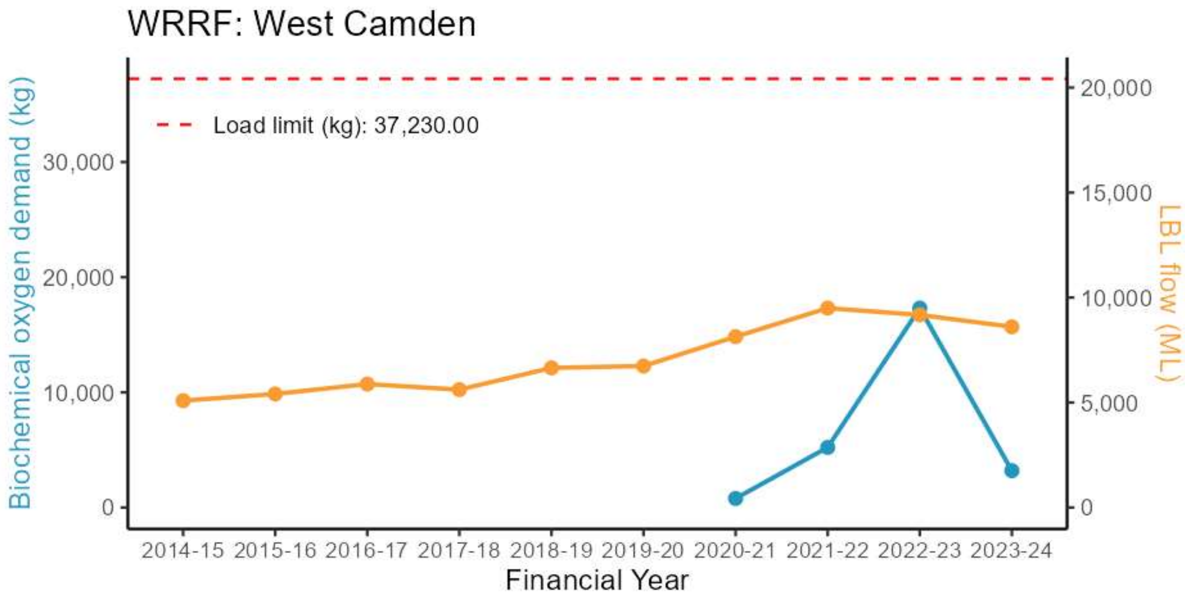
A.2.4. Pressure – Wastewater discharge load

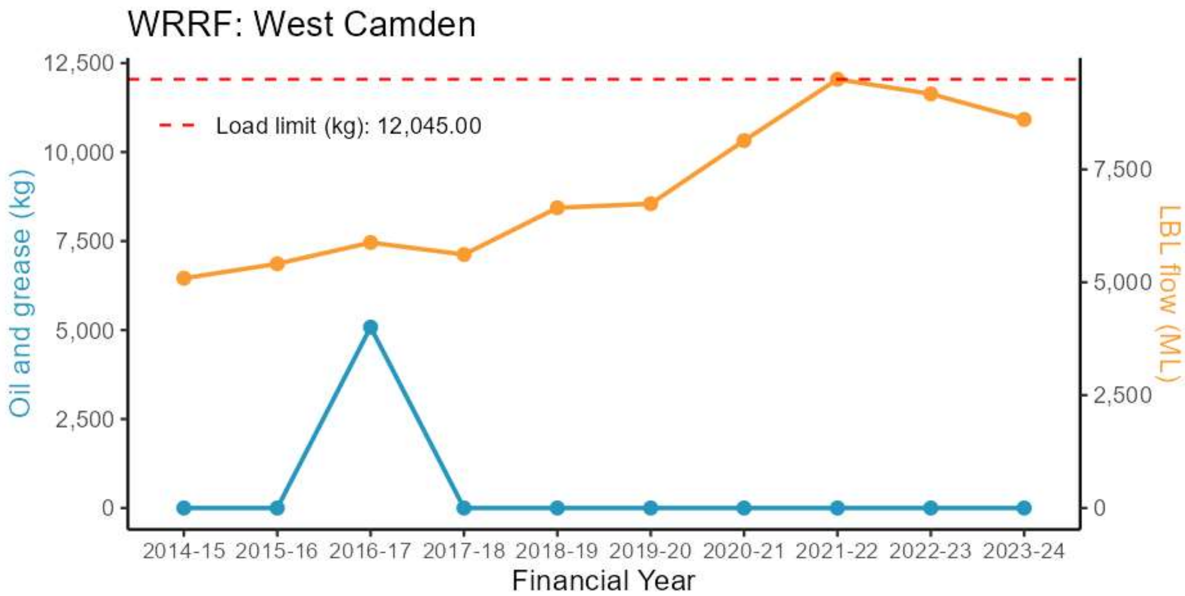
Nutrients

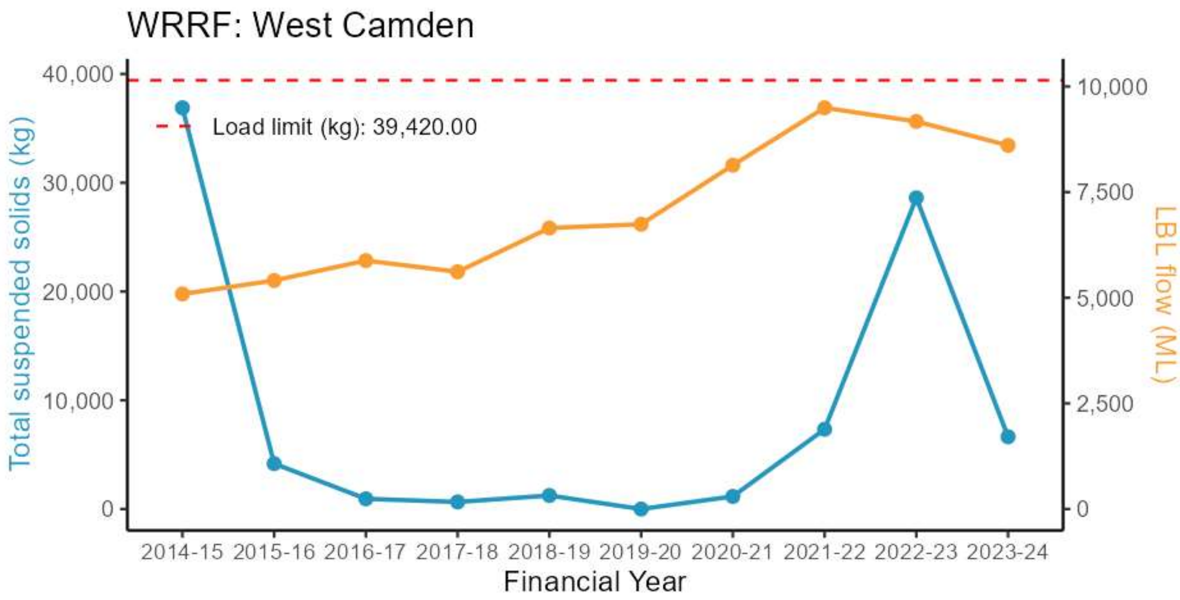




Major conventional analytes







A.2.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-3 Downstream vs upstream comparison (current period) contrast outcomes for West Camden WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Matahil Ck	N7824A vs N7824	Total ammonia nitrogen	24.78	16.77	110	4.75	<0.001
Matahil Ck	N7824A vs N7824	Oxidised nitrogen	407.50	128.31	110	19.09	<0.001
Matahil Ck	N7824A vs N7824	Total nitrogen	9.89	1.43	110	15.82	<0.001
Matahil Ck	N7824A vs N7824	Filterable total phosphorus	2.16	0.60	110	2.78	0.032
Matahil Ck	N7824A vs N7824	Total phosphorus	1.02	0.26	110	0.08	1.000
Matahil Ck	N7824A vs N7824	Conductivity	0.27	0.05	110	-7.23	<0.001
Matahil Ck	N7824A vs N7824	Dissolved oxygen	1.19	0.07	110	2.89	0.024
Matahil Ck	N7824A vs N7824	Dissolved oxygen saturation	21.86	2.83	110	7.73	<0.001
Matahil Ck	N7824A vs N7824	pH	-0.24	0.07	108	-3.29	0.007
Matahil Ck	N7824A vs N7824	Water temperature	1.36	0.13	110	3.29	0.007
Matahil Ck	N7824A vs N7824	Turbidity	0.04	0.01	110	-10.29	<0.001
Matahil Ck	N7824A vs N7824	Chlorophyll - a	0.09	0.03	108	-6.49	<0.001
Nepean R	N78 vs N75	Total ammonia nitrogen	3.48	1.23	209	3.54	0.003
Nepean R	N78 vs N75	Oxidised nitrogen	9.23	2.83	209	7.25	<0.001
Nepean R	N78 vs N75	Total nitrogen	3.41	0.46	209	9.01	<0.001
Nepean R	N78 vs N75	Filterable total phosphorus	1.50	0.17	209	3.47	0.004
Nepean R	N78 vs N75	Total phosphorus	1.41	0.18	209	2.71	0.037
Nepean R	N78 vs N75	Conductivity	1.23	0.15	209	1.69	0.333
Nepean R	N78 vs N75	Dissolved oxygen	0.99	0.04	209	-0.28	0.992
Nepean R	N78 vs N75	Dissolved oxygen saturation	-0.25	2.68	208	-0.09	1.000
Nepean R	N78 vs N75	pH	0.05	0.10	207	0.49	0.961
Nepean R	N78 vs N75	Water temperature	1.01	0.11	209	0.12	0.999
Nepean R	N78 vs N75	Turbidity	0.80	0.18	209	-0.99	0.756
Nepean R	N78 vs N75	Chlorophyll - a	1.50	0.45	208	1.34	0.539

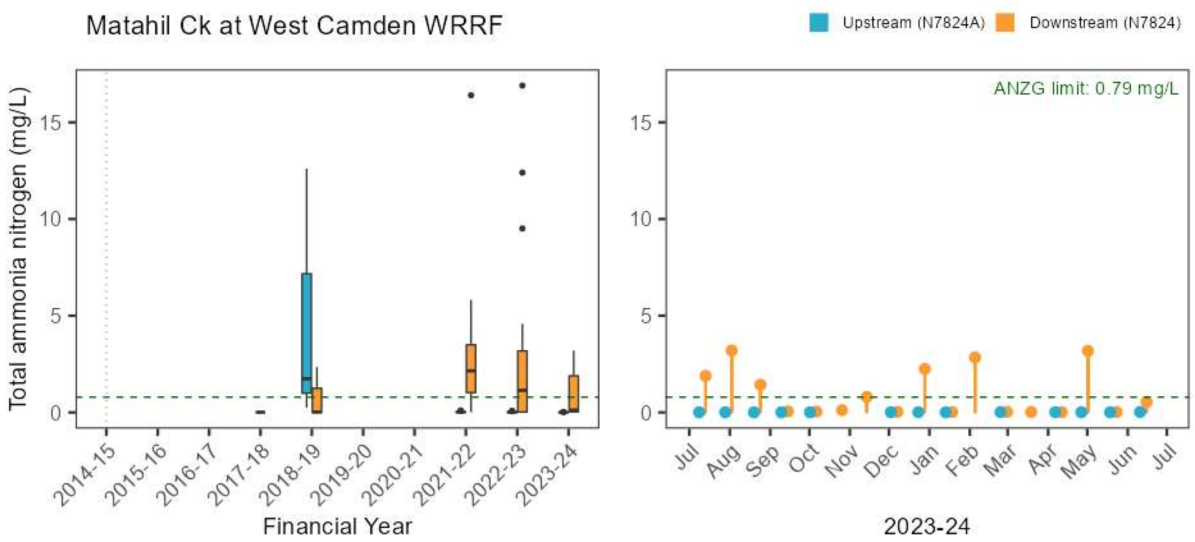
(white)	not significant (p>0.05)	(yellow)	p <0.05 and >=0.01	(orange)	p <0.01 and >=0.001	(red)	p <0.001

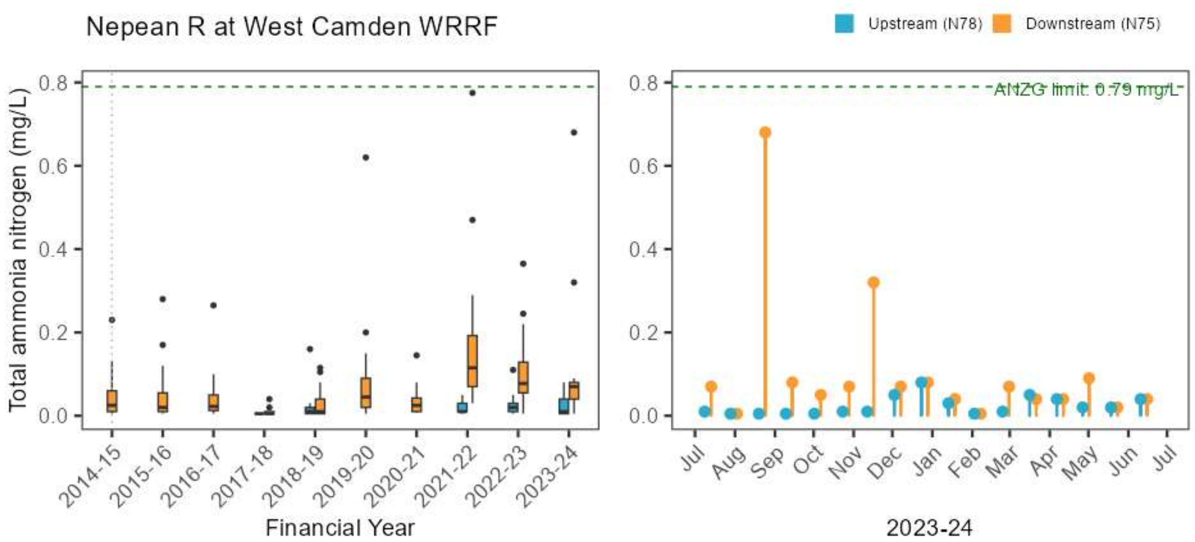
Table A-4 Current period vs previous period comparison (single site) contrast outcomes for West Camden WRRF

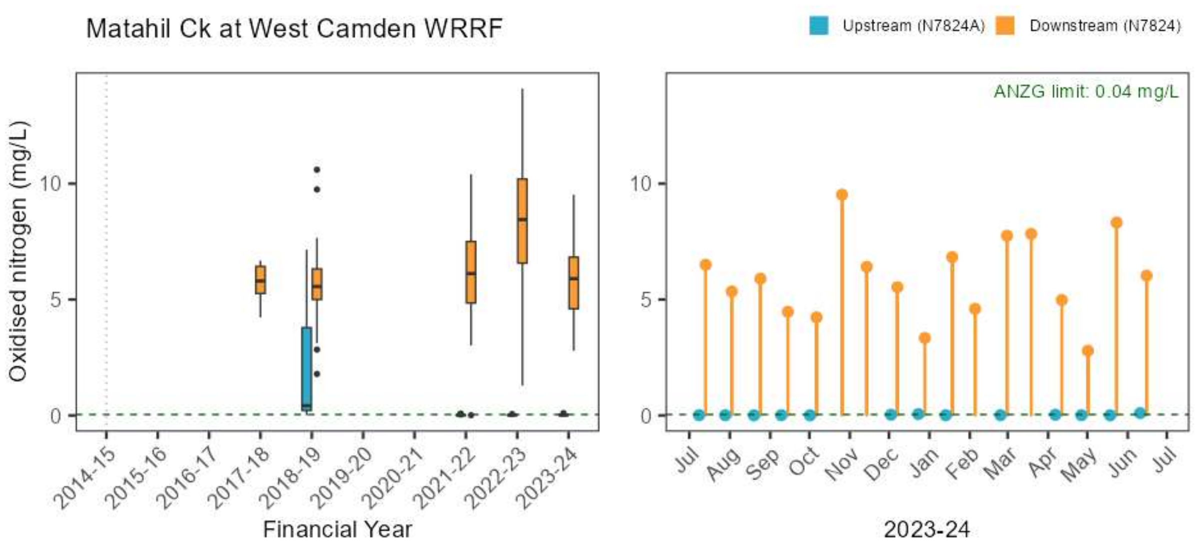
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Matahil Ck	N7824A	Total ammonia nitrogen	0.49	0.29	110	-1.20	0.629
Matahil Ck	N7824A	Oxidised nitrogen	1.06	0.30	110	0.22	0.996
Matahil Ck	N7824A	Total nitrogen	0.91	0.12	110	-0.75	0.878
Matahil Ck	N7824A	Filterable total phosphorus	0.81	0.20	110	-0.89	0.812
Matahil Ck	N7824A	Total phosphorus	0.91	0.20	110	-0.42	0.974
Matahil Ck	N7824A	Conductivity	1.02	0.16	110	0.13	0.999
Matahil Ck	N7824A	Dissolved oxygen	0.94	0.05	110	-1.12	0.680
Matahil Ck	N7824A	Dissolved oxygen saturation	-6.67	2.49	110	-2.68	0.042
Matahil Ck	N7824A	pH	-0.02	0.06	108	-0.25	0.994
Matahil Ck	N7824A	Water temperature	0.92	0.08	110	-1.05	0.718
Matahil Ck	N7824A	Turbidity	1.59	0.43	110	1.73	0.311
Matahil Ck	N7824A	Chlorophyll - a	1.47	0.47	108	1.20	0.631
Matahil Ck	N7824	Total ammonia nitrogen	0.29	0.16	110	-2.28	0.110
Matahil Ck	N7824	Oxidised nitrogen	1.05	0.27	110	0.20	0.997
Matahil Ck	N7824	Total nitrogen	0.77	0.09	110	-2.20	0.130
Matahil Ck	N7824	Filterable total phosphorus	2.22	0.49	110	3.57	0.003
Matahil Ck	N7824	Total phosphorus	1.81	0.37	110	2.91	0.023
Matahil Ck	N7824	Conductivity	0.86	0.13	110	-1.01	0.744
Matahil Ck	N7824	Dissolved oxygen	1.00	0.05	110	0.01	1.000
Matahil Ck	N7824	Dissolved oxygen saturation	1.15	2.27	110	0.51	0.958
Matahil Ck	N7824	pH	-0.03	0.06	108	-0.60	0.931
Matahil Ck	N7824	Water temperature	1.03	0.08	110	0.46	0.968
Matahil Ck	N7824	Turbidity	0.86	0.21	110	-0.60	0.932
Matahil Ck	N7824	Chlorophyll - a	1.91	0.56	108	2.24	0.120
Nepean R	N78	Total ammonia nitrogen	1.10	0.32	209	0.35	0.986
Nepean R	N78	Oxidised nitrogen	1.29	0.32	209	1.01	0.744
Nepean R	N78	Total nitrogen	0.96	0.11	209	-0.41	0.976
Nepean R	N78	Filterable total phosphorus	0.84	0.08	209	-1.86	0.247
Nepean R	N78	Total phosphorus	0.93	0.10	209	-0.71	0.892
Nepean R	N78	Conductivity	1.01	0.10	209	0.09	1.000
Nepean R	N78	Dissolved oxygen	0.98	0.03	209	-0.58	0.937
Nepean R	N78	Dissolved oxygen saturation	0.09	2.18	208	0.04	1.000
Nepean R	N78	pH	-0.10	0.08	207	-1.26	0.589
Nepean R	N78	Water temperature	1.08	0.09	209	0.92	0.794
Nepean R	N78	Turbidity	1.14	0.21	209	0.70	0.896
Nepean R	N78	Chlorophyll - a	0.78	0.19	208	-1.02	0.740
Nepean R	N75	Total ammonia nitrogen	1.08	0.31	209	0.26	0.994
Nepean R	N75	Oxidised nitrogen	1.28	0.32	209	0.99	0.753
Nepean R	N75	Total nitrogen	1.16	0.13	209	1.34	0.537
Nepean R	N75	Filterable total phosphorus	1.03	0.10	209	0.31	0.990
Nepean R	N75	Total phosphorus	1.18	0.12	209	1.60	0.383
Nepean R	N75	Conductivity	1.00	0.10	209	0.03	1.000
Nepean R	N75	Dissolved oxygen	0.98	0.03	209	-0.63	0.924
Nepean R	N75	Dissolved oxygen saturation	-0.39	2.19	208	-0.18	0.998
Nepean R	N75	pH	-0.12	0.08	207	-1.45	0.467
Nepean R	N75	Water temperature	1.07	0.09	209	0.78	0.863
Nepean R	N75	Turbidity	1.07	0.20	209	0.35	0.985
Nepean R	N75	Chlorophyll - a	0.96	0.23	208	-0.17	0.998

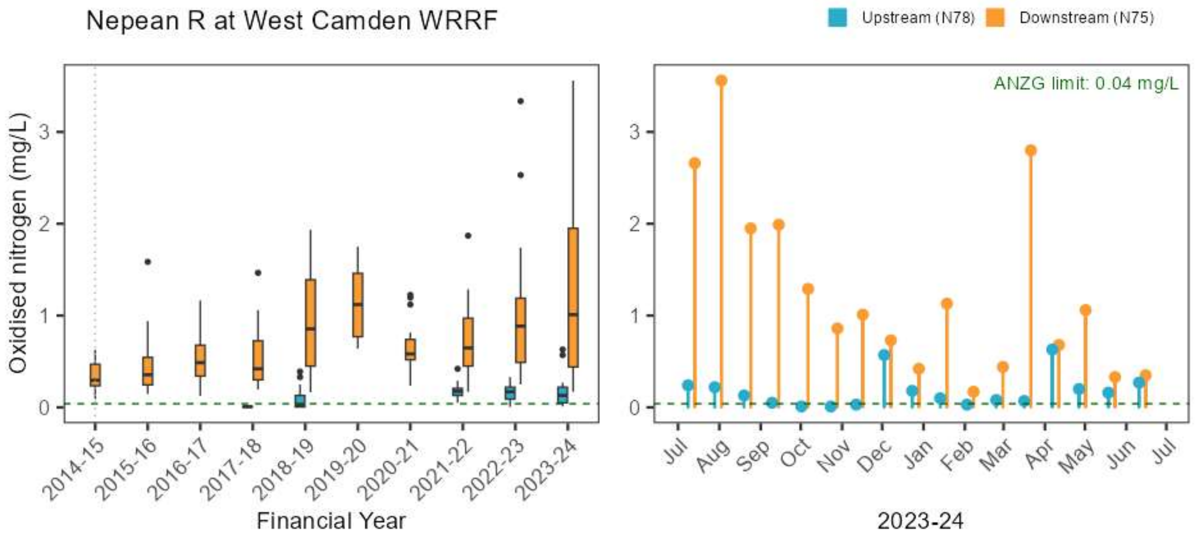
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

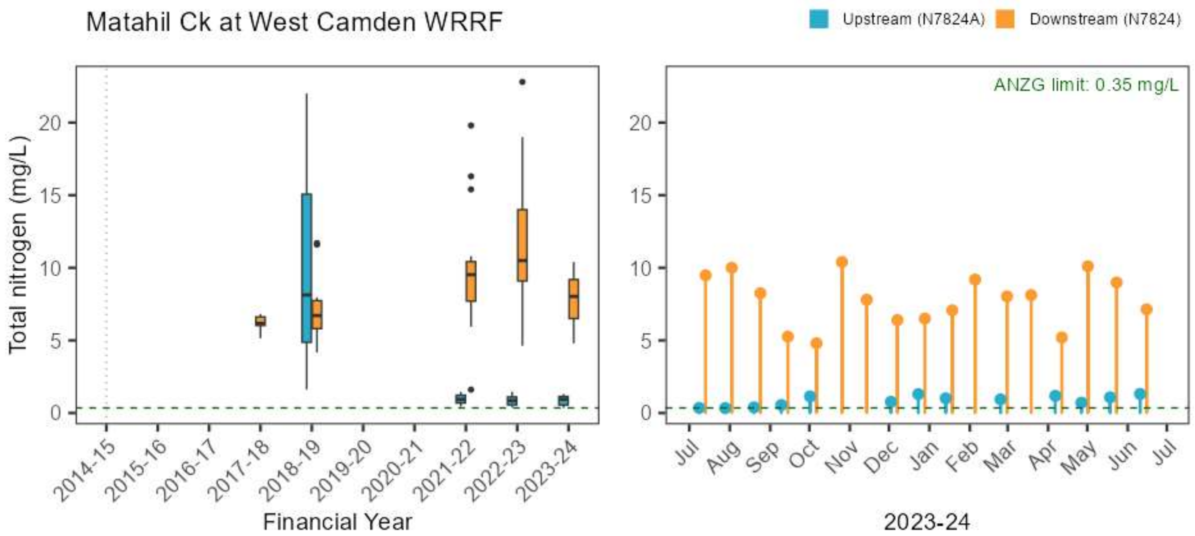
A.2.6. Stressor – Nutrients

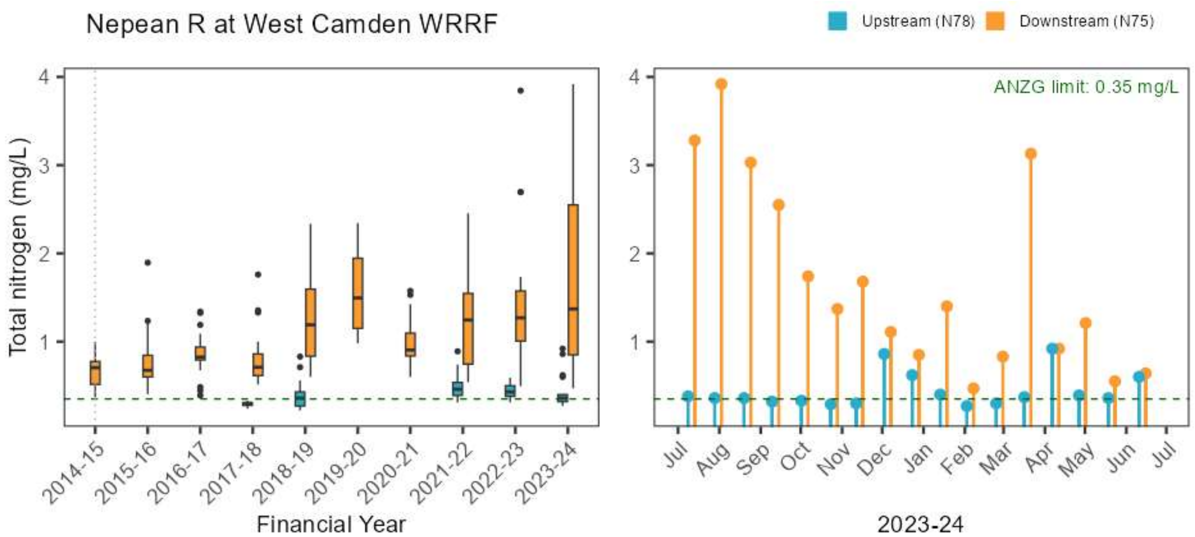


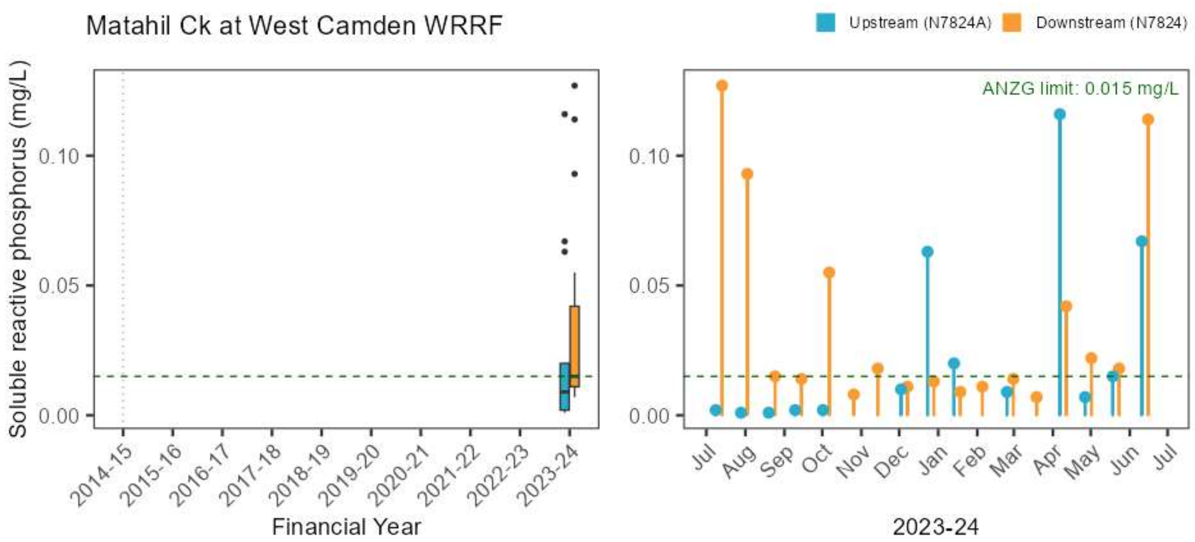


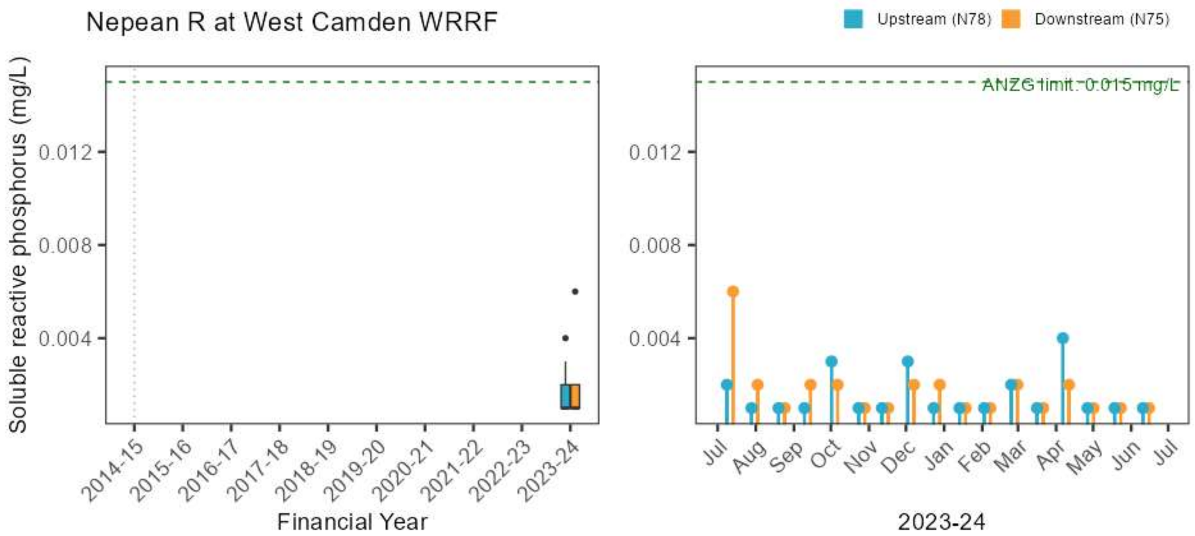


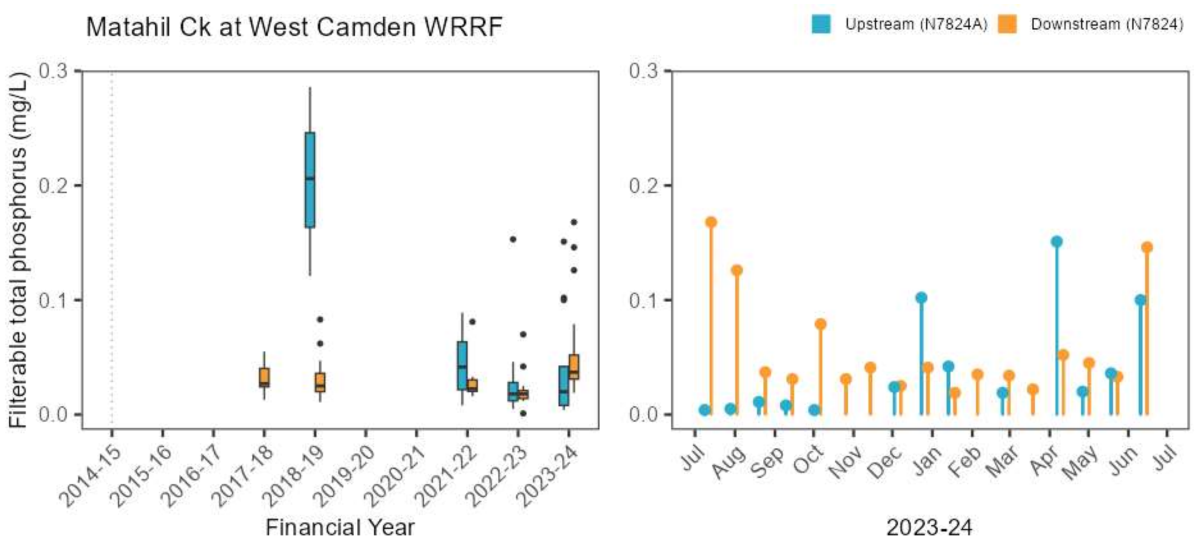

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
Financial Year
2023-24

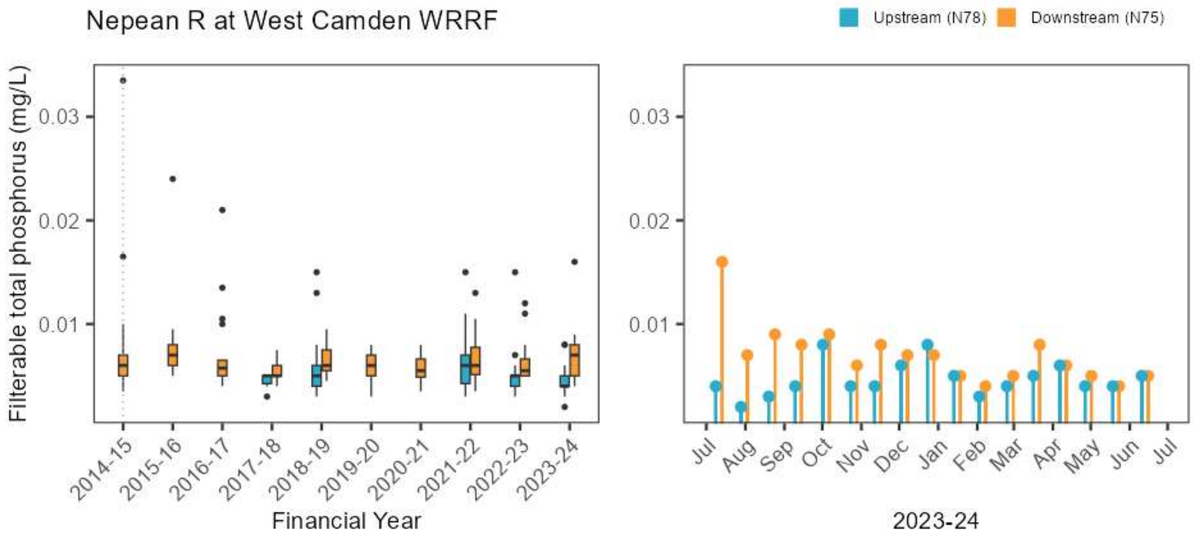

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24

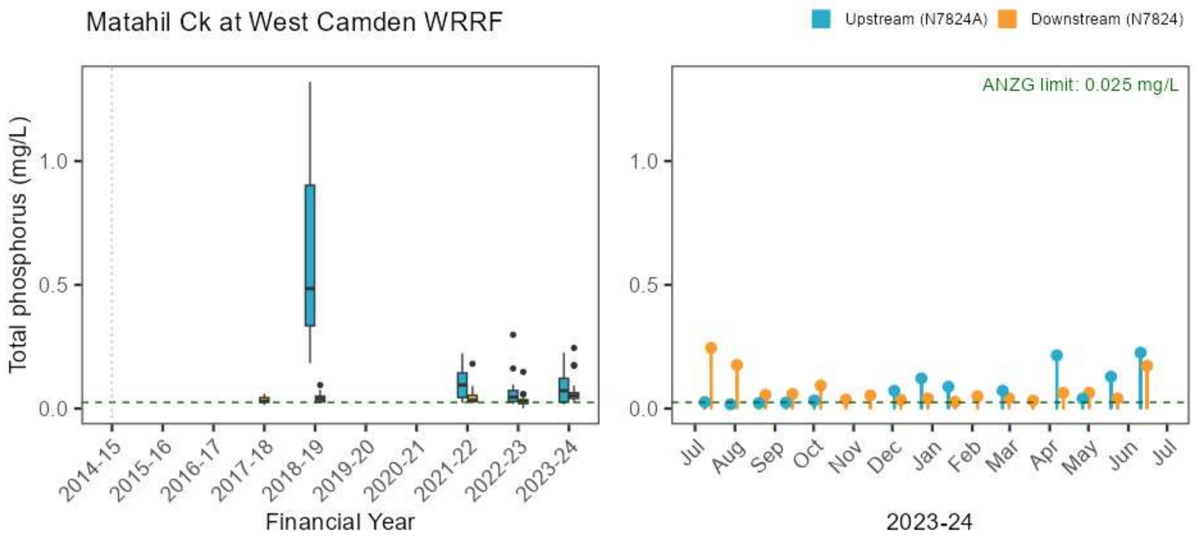

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24

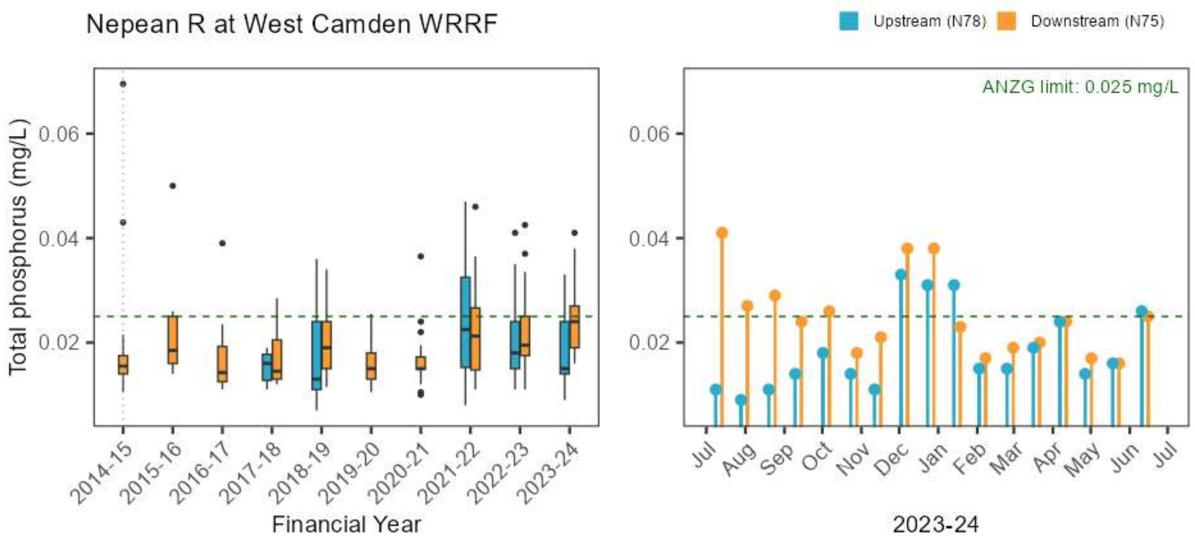

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Soluble reactive phosphorus (mg/L)
Financial Year
ANZG limit: 0.015 mg/L
2023-24


Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Soluble reactive phosphorus (mg/L)
Financial Year
ANZG limit: 0.015 mg/L
2023-24

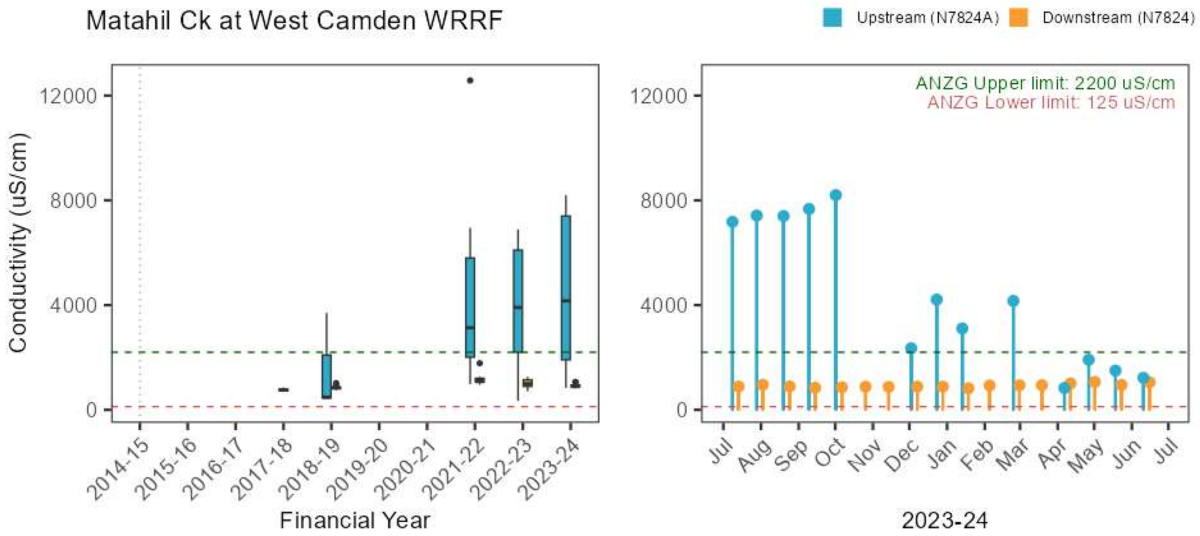

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Filterable total phosphorus (mg/L)
Financial Year
2023-24

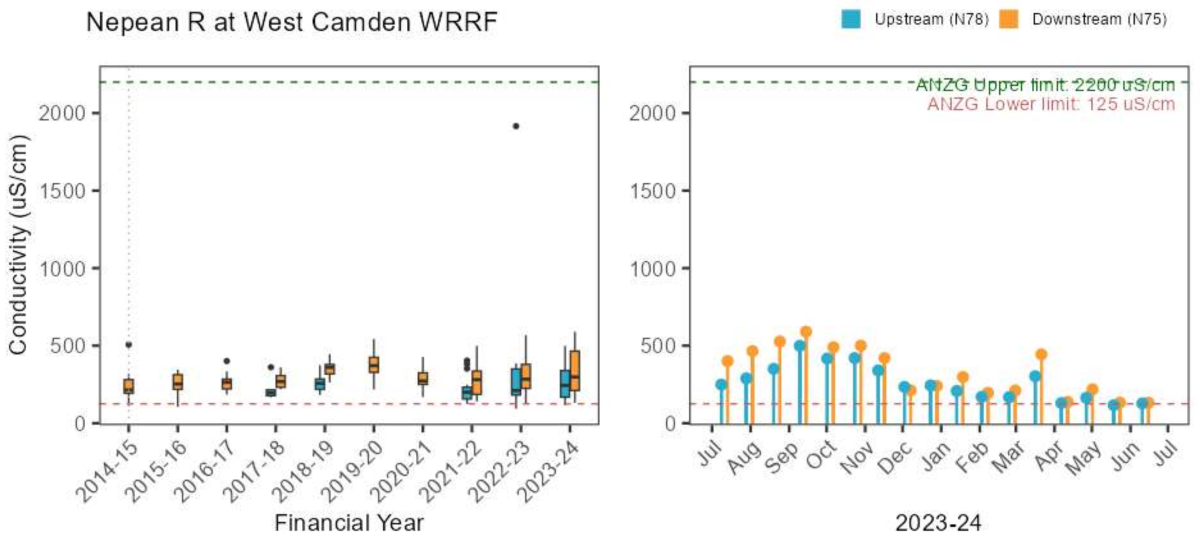

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Filterable total phosphorus (mg/L)
0.03
0.02
0.01
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

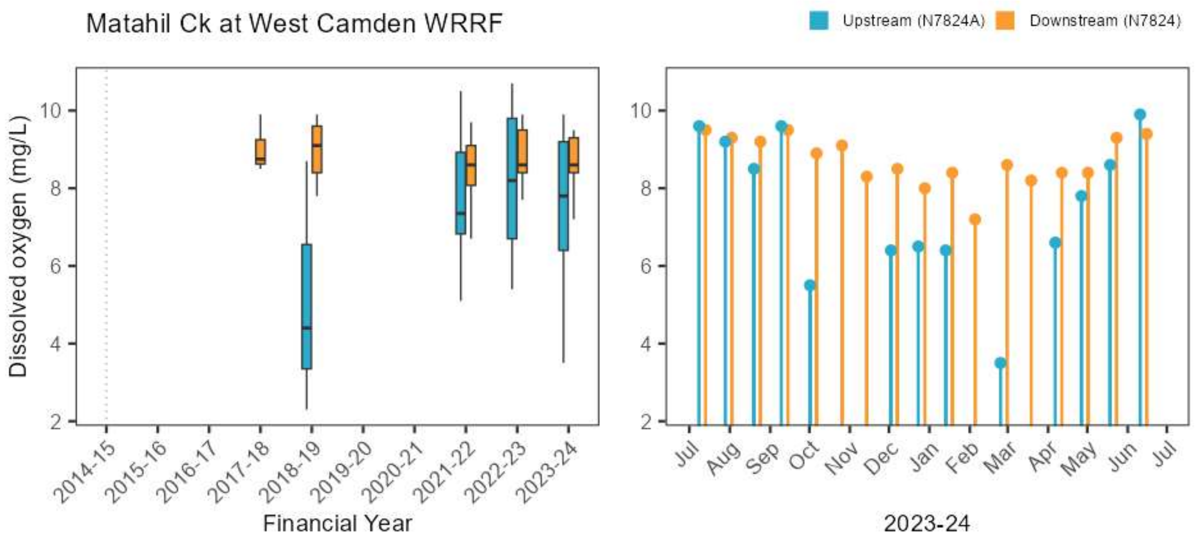

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
1.0
0.5
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

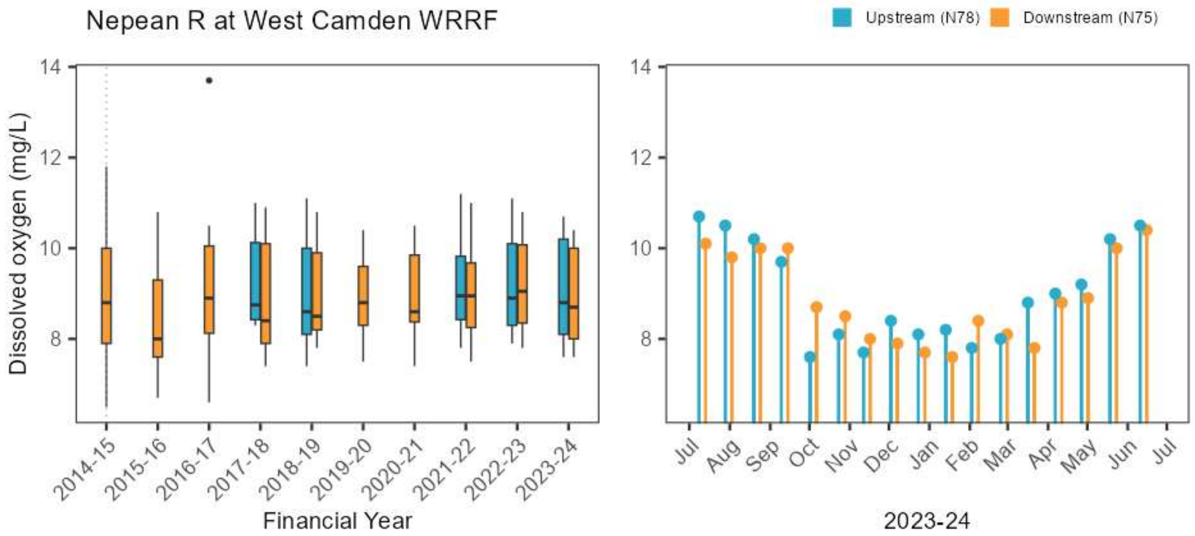

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.06
0.04
0.02
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

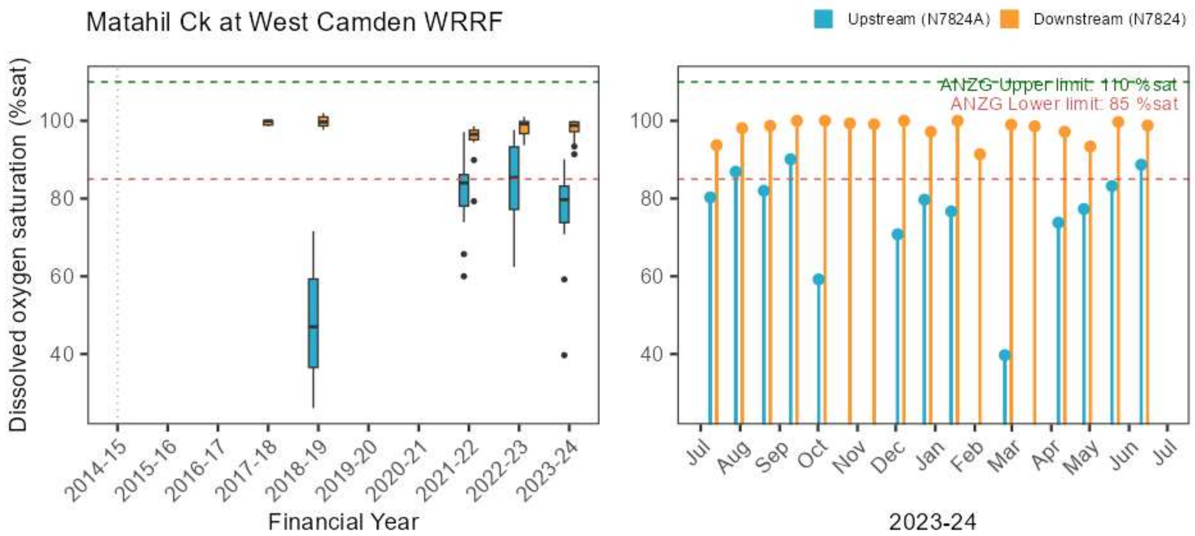
A.2.7. Stressor – Physico-chemical water quality

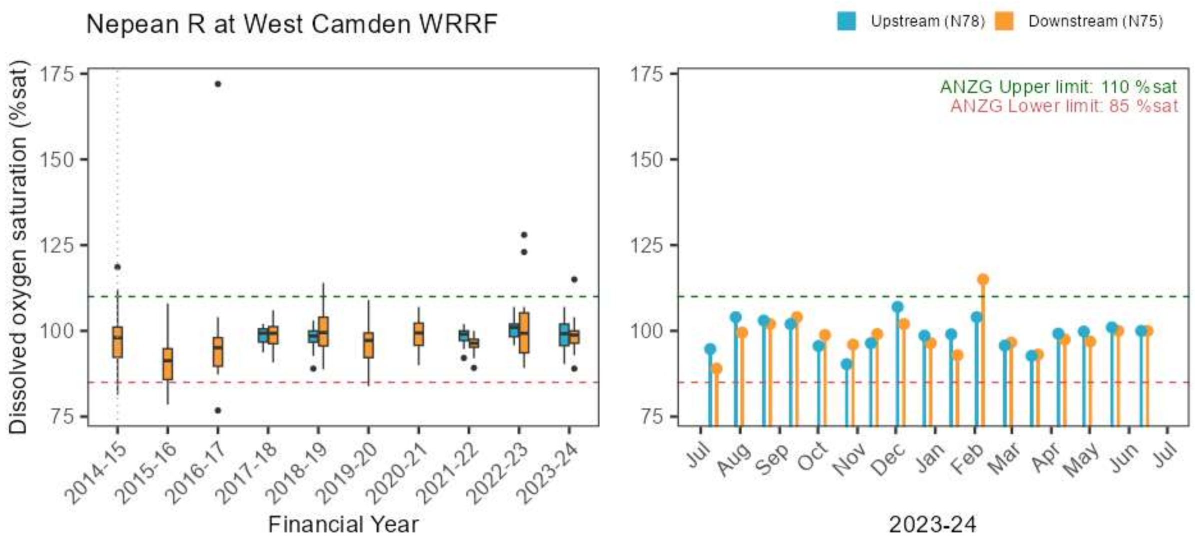


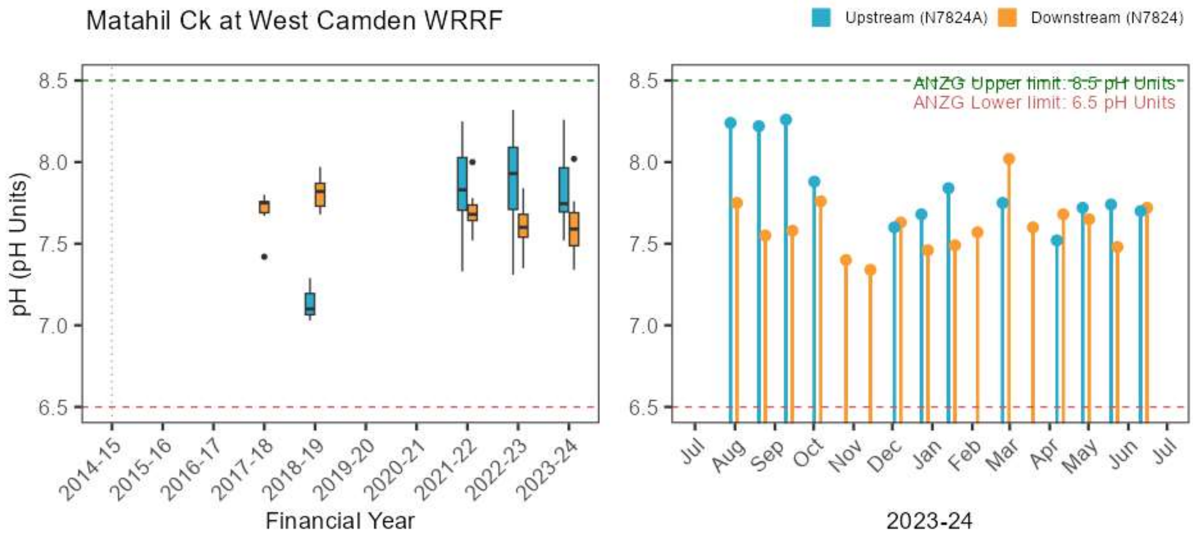


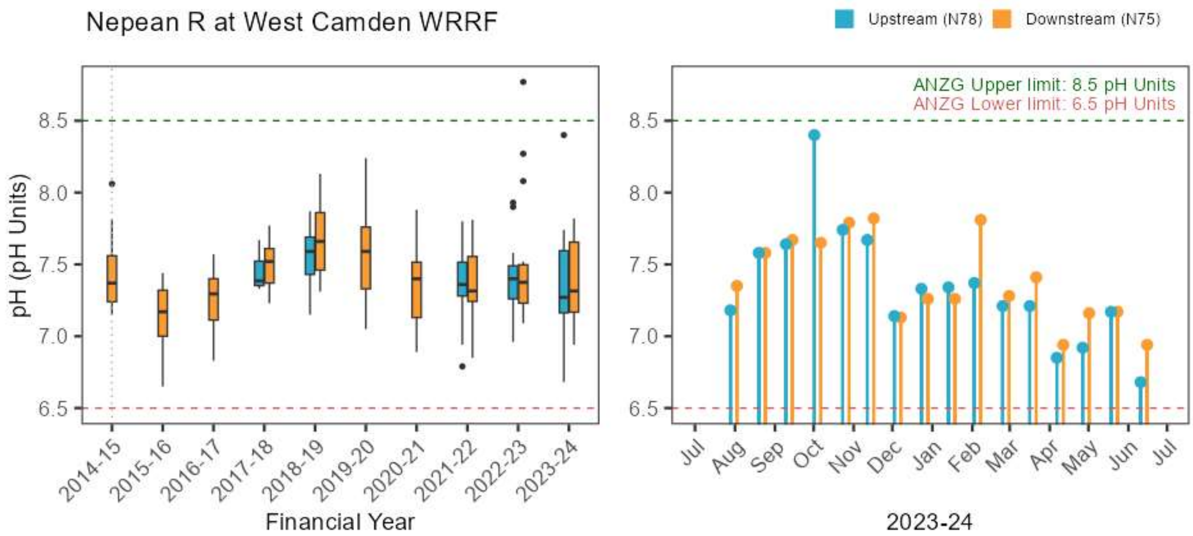


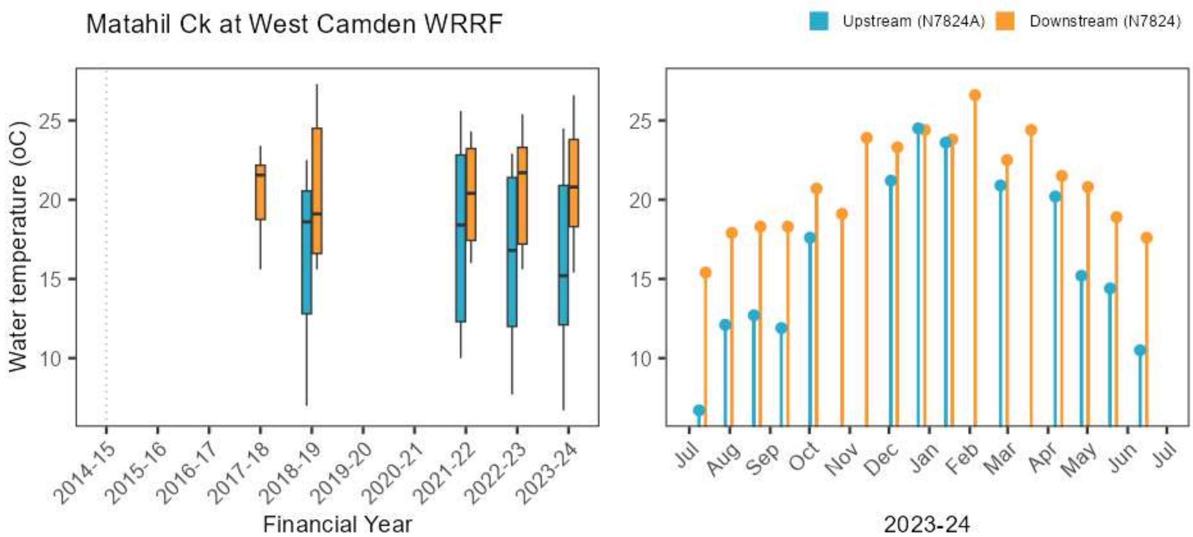

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Dissolved oxygen (mg/L)
Financial Year
2023-24

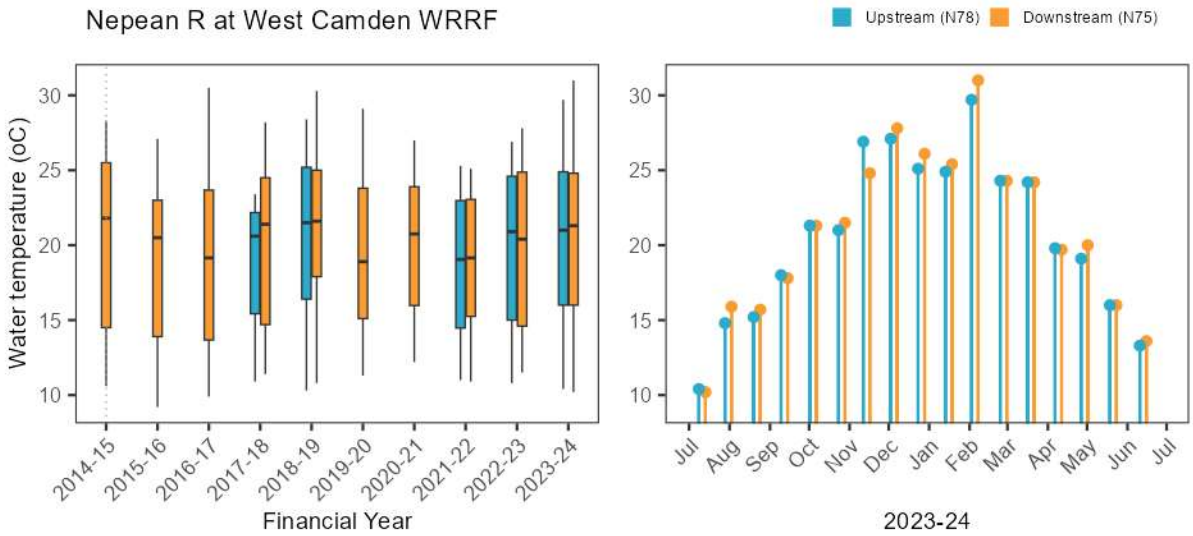

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Financial Year
2023-24

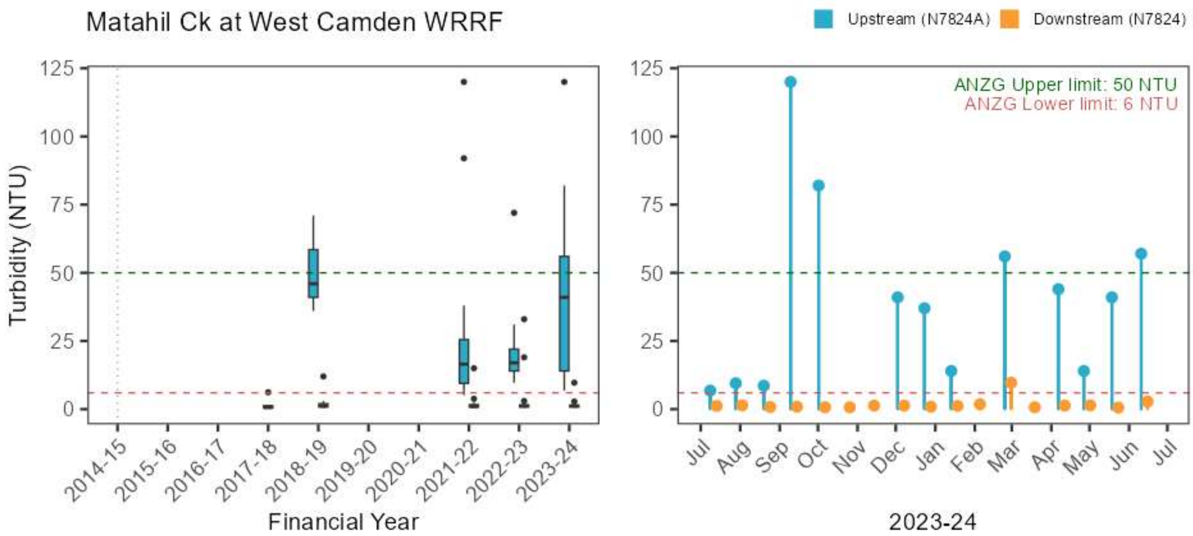

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Financial Year
2023-24

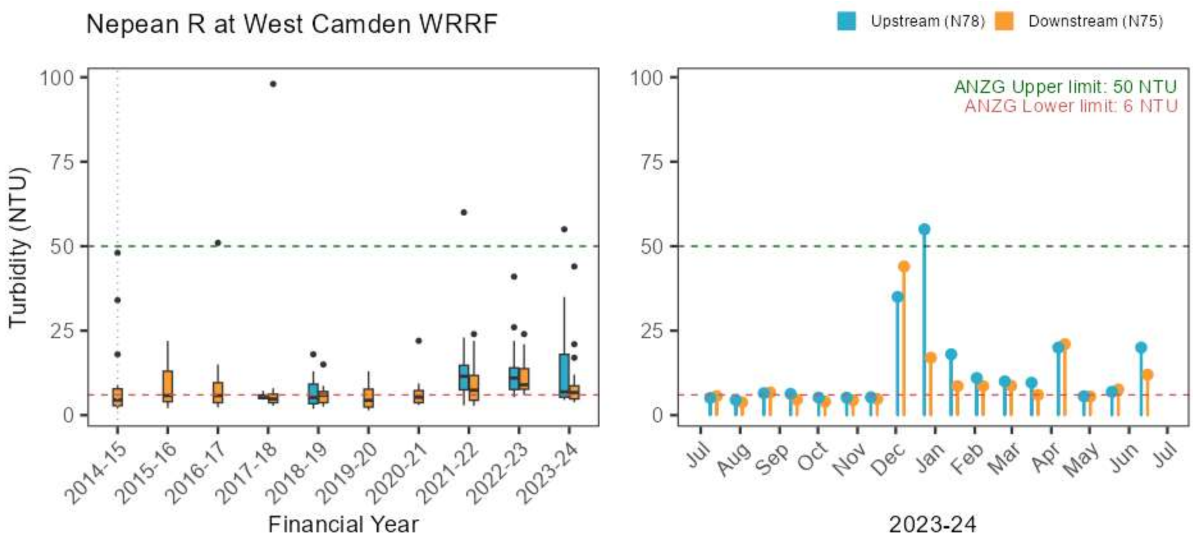

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
pH (pH Units)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
pH (pH Units)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

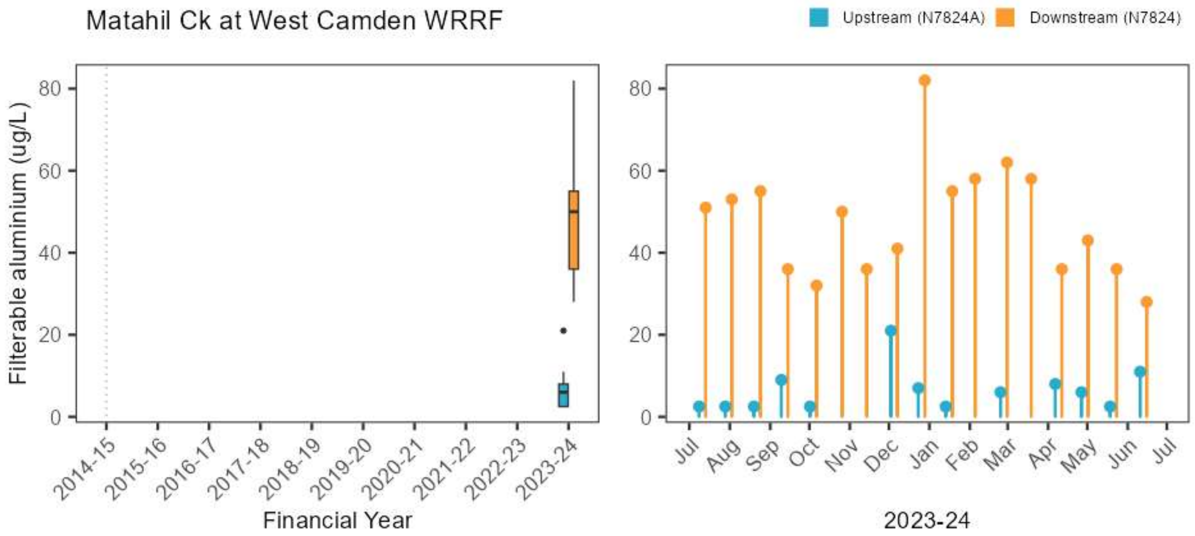

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Water temperature (oC)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

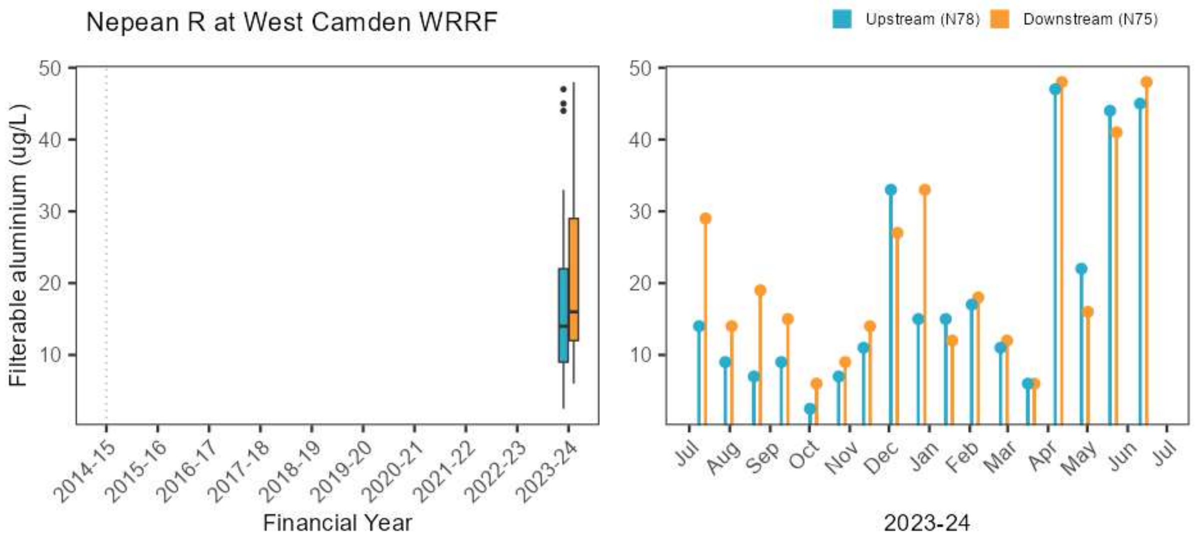

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Water temperature (oC)
Financial Year
2023-24

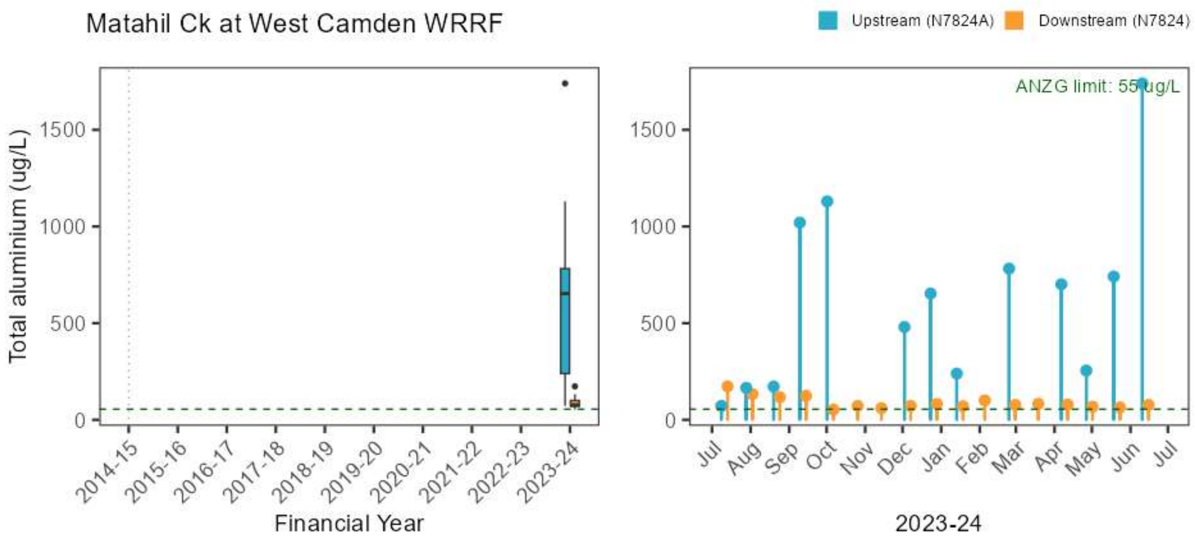

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

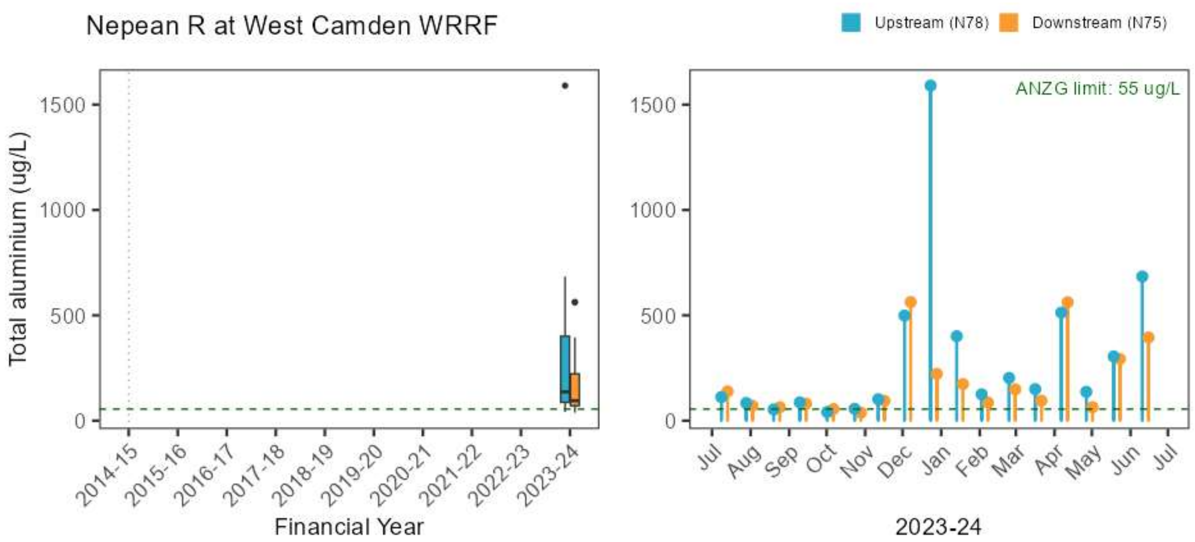

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

A.2.8. Stressor – Trace metals

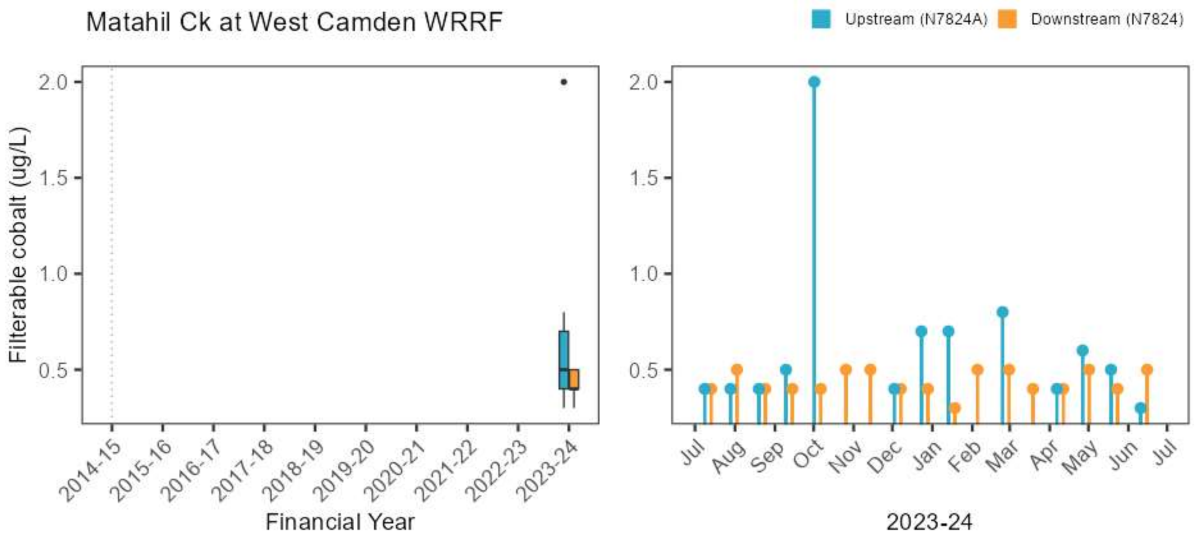




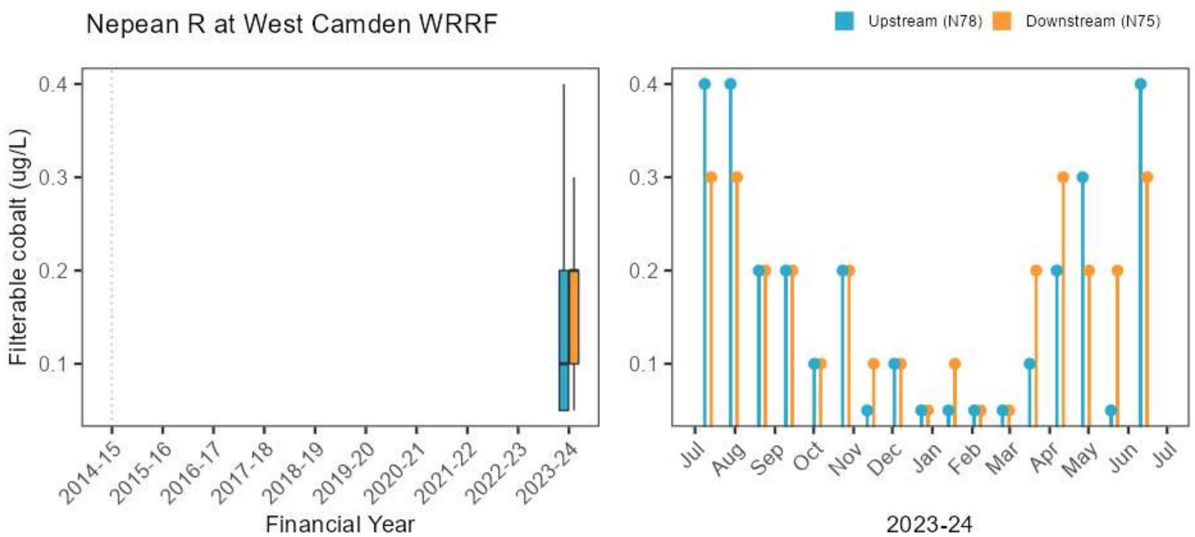




Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Total aluminium (ug/L)
ANZG limit: 55 ug/L
Financial Year
2023-24

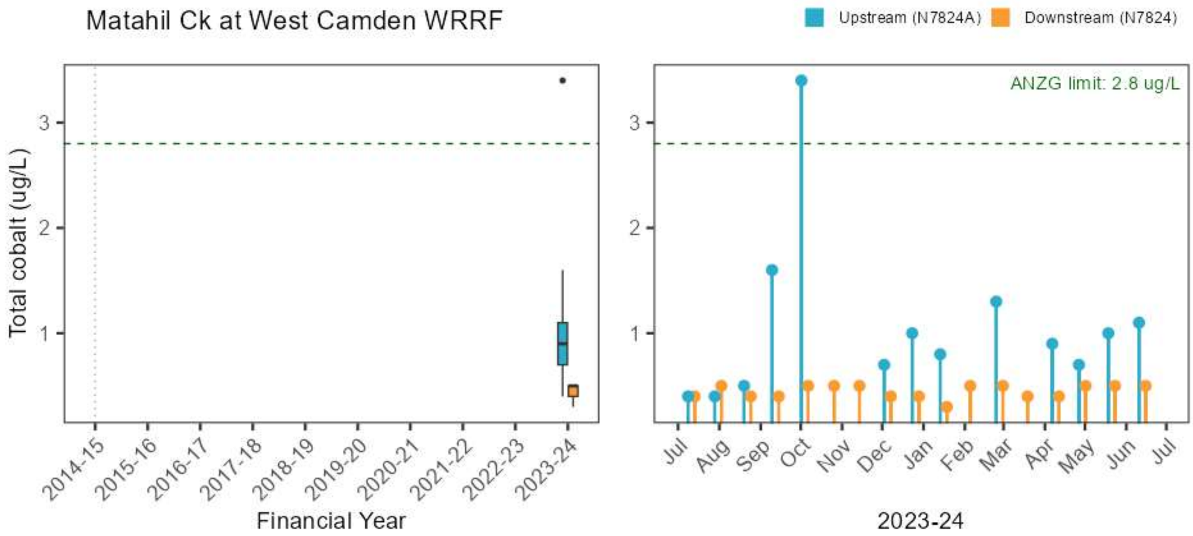


Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Filterable cobalt (ug/L)
Financial Year
2023-24

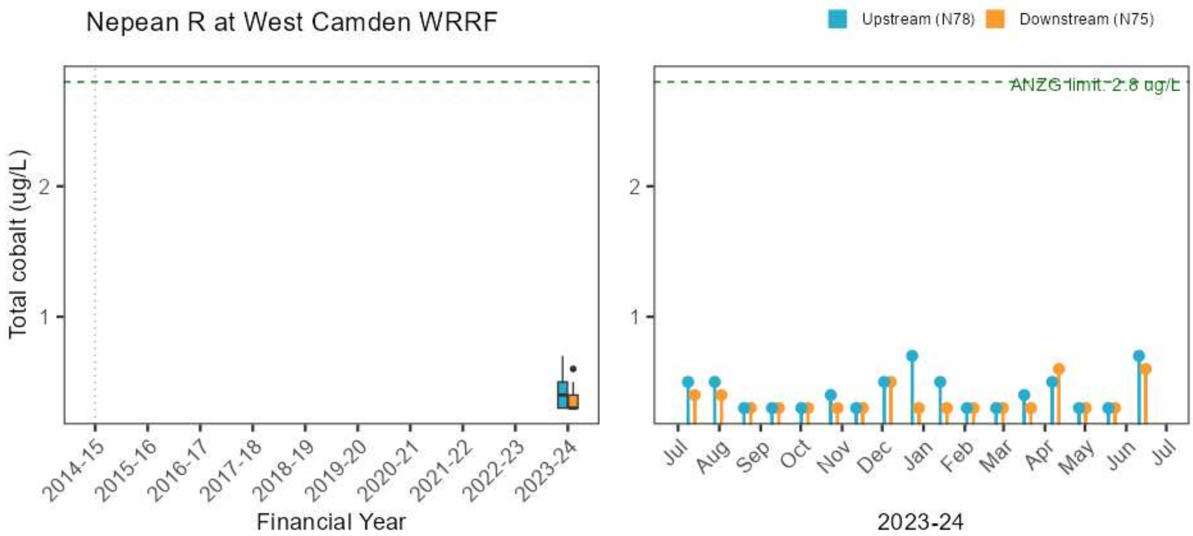


Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Filterable cobalt (ug/L)
Financial Year
2023-24

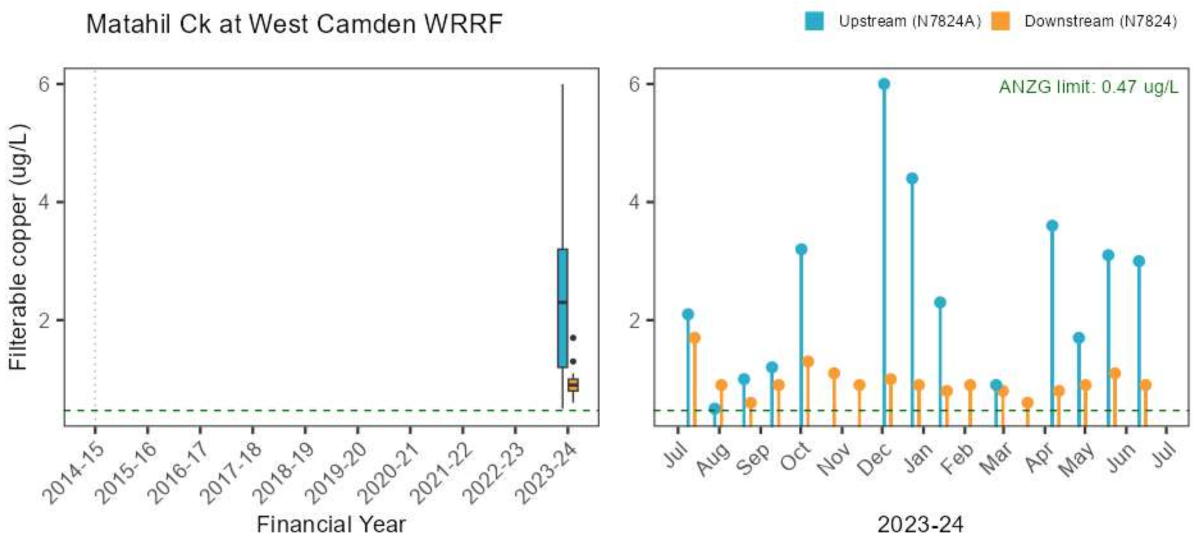
Matahil Ck at West Camden WRRF

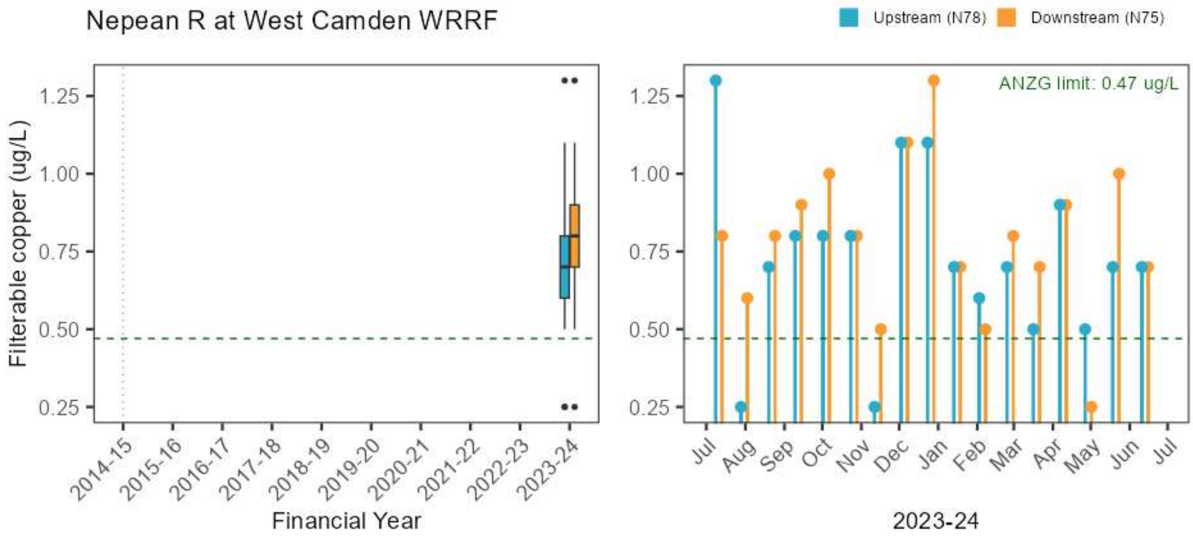


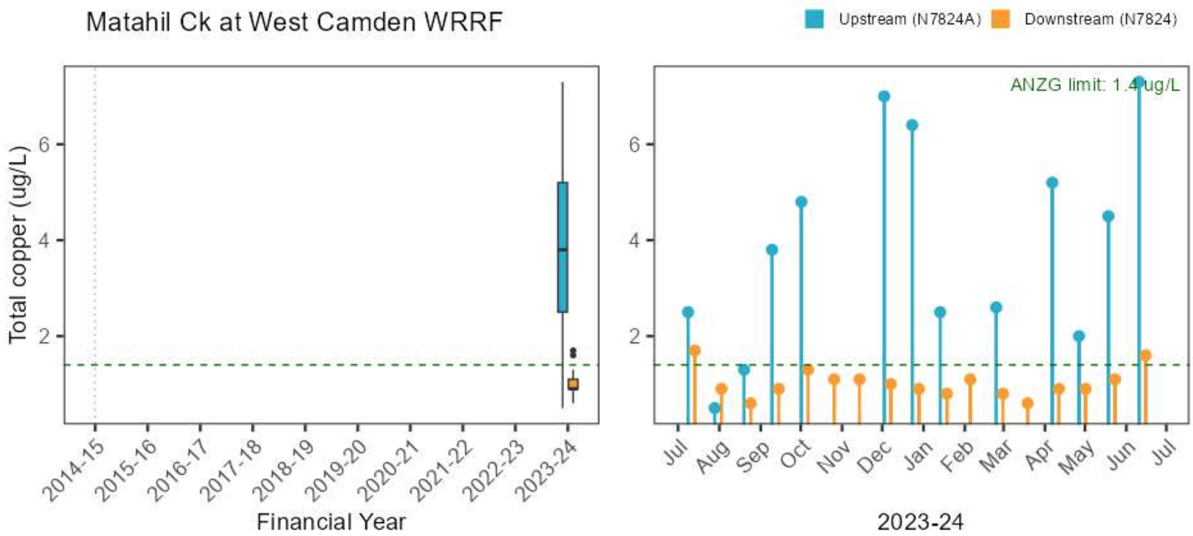
Nepean R at West Camden WRRF

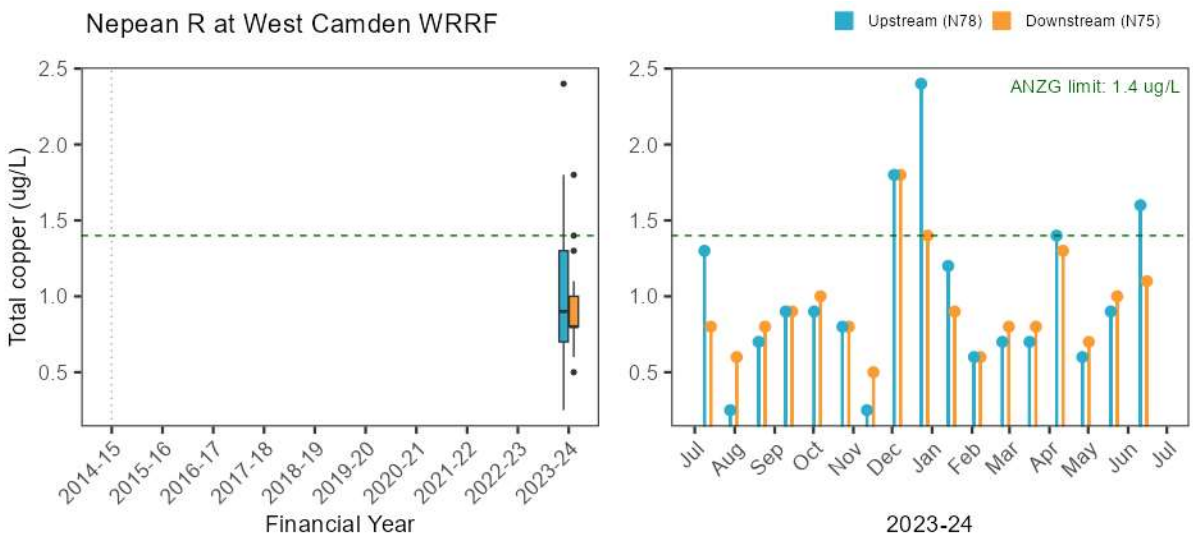


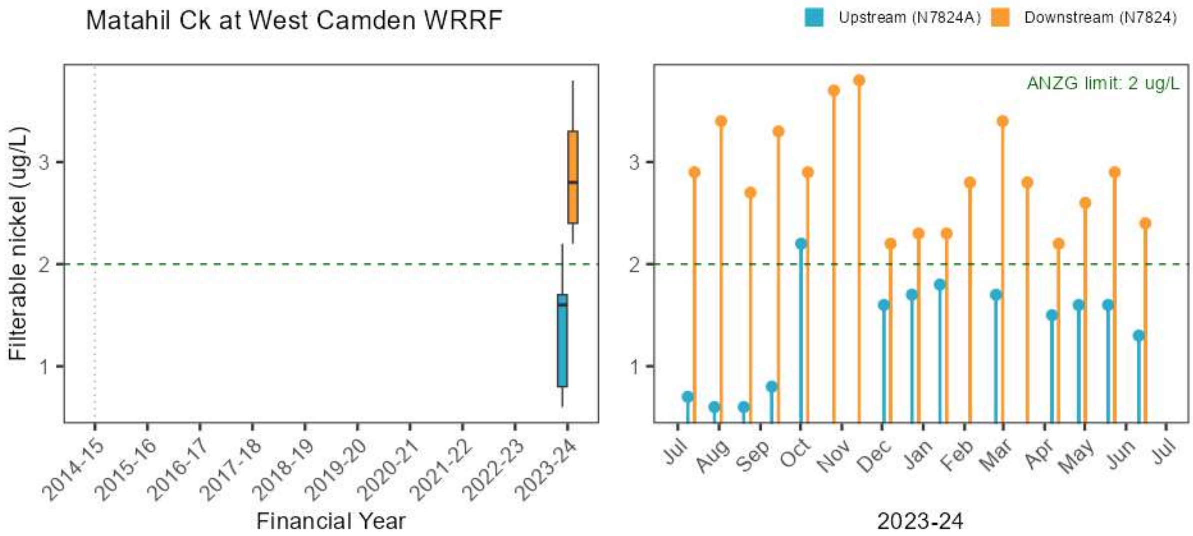
Matahil Ck at West Camden WRRF

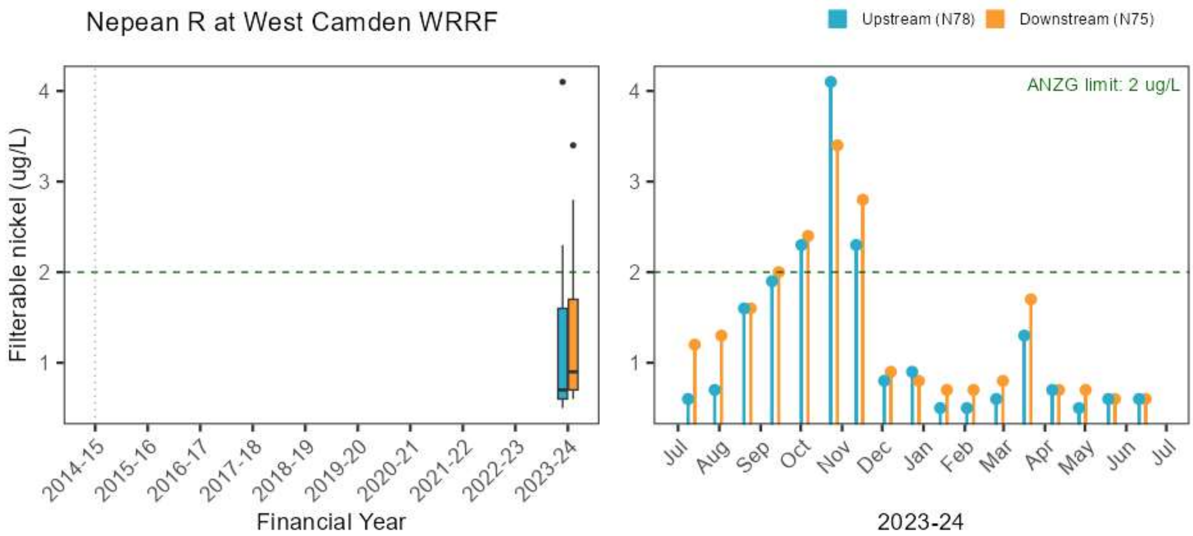


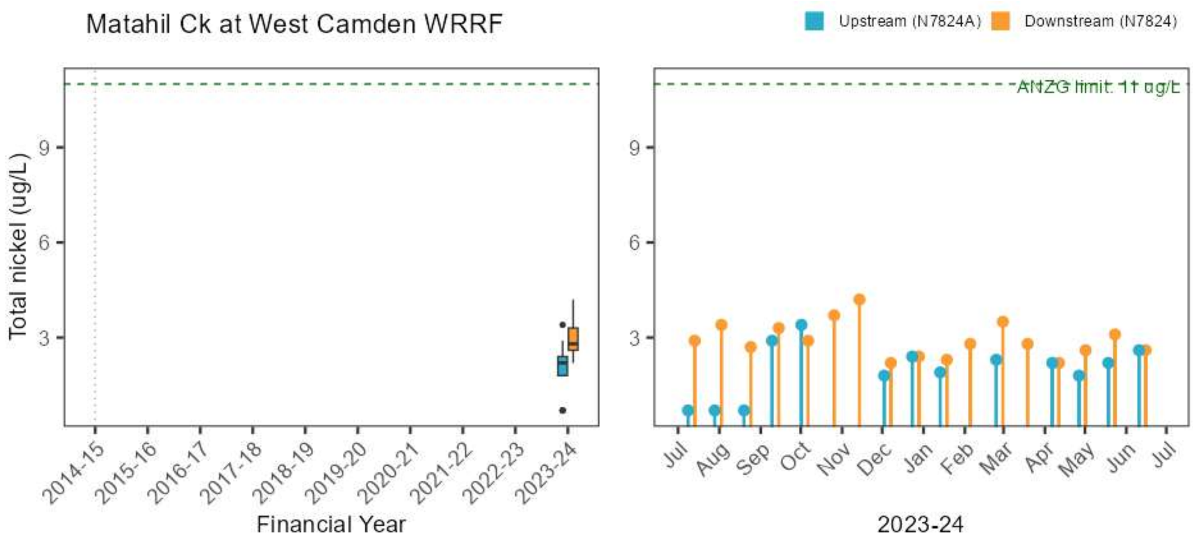

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Filterable copper (ug/L)
Financial Year
ANZG limit: 0.47 ug/L
2023-24

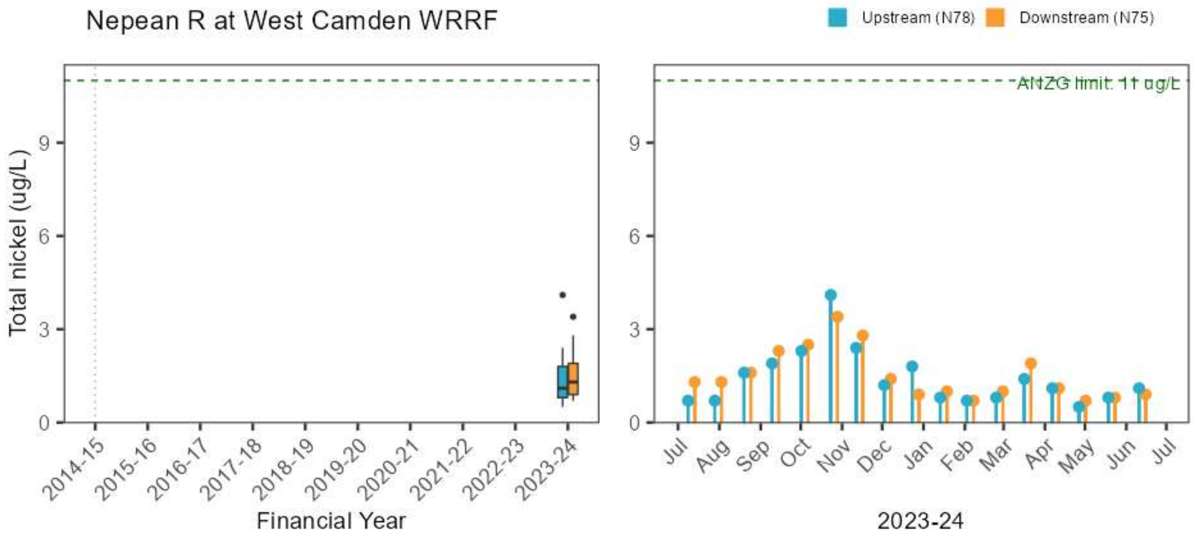

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Total copper (ug/L)
Financial Year
ANZG limit: 1.4 ug/L
2023-24

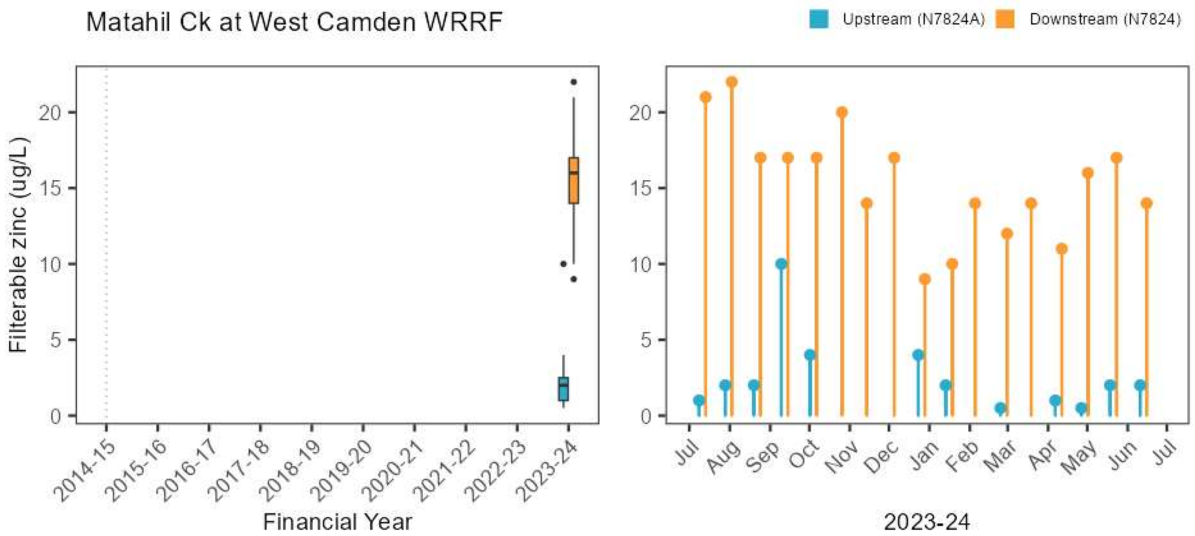

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Total copper (ug/L)
Financial Year
ANZG limit: 1.4 ug/L
2023-24

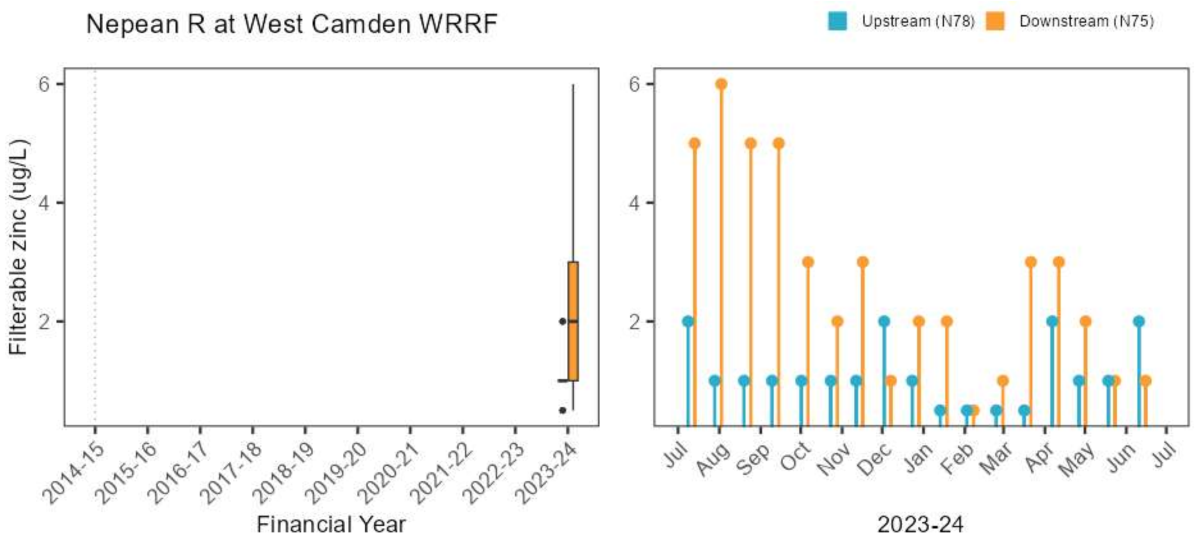

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

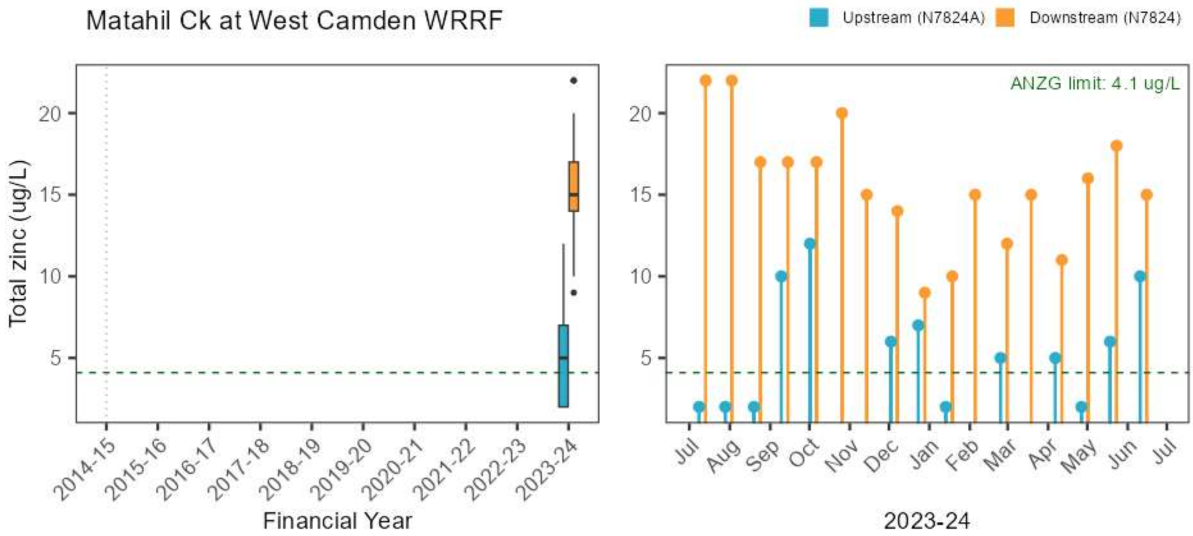

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

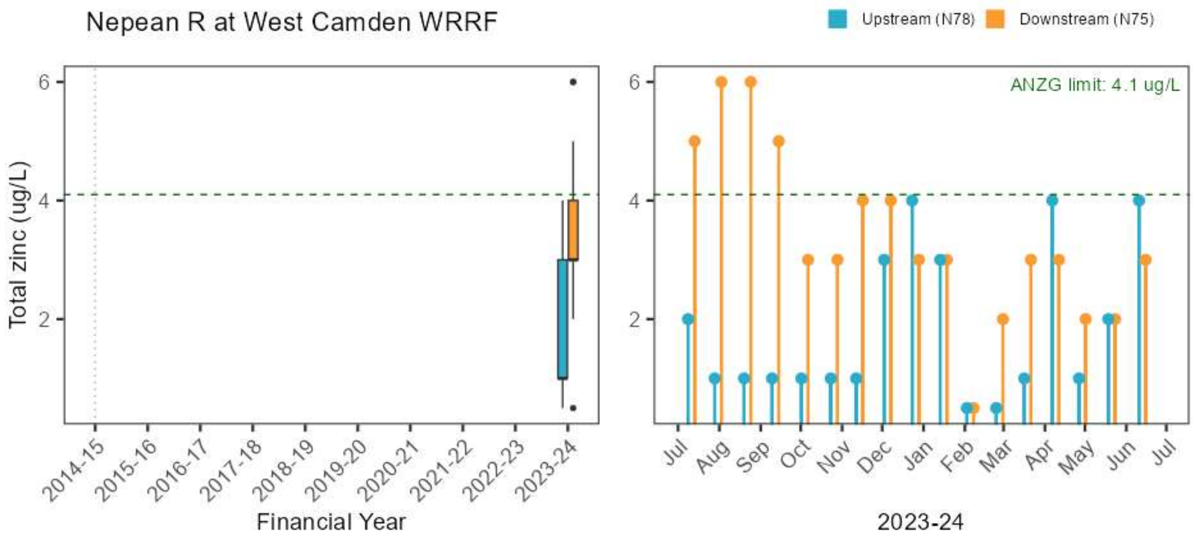

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
ANZG limit: 11 ug/L
Total nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
ANZG limit: 11 ug/L
Total nickel (ug/L)
0
3
6
9
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

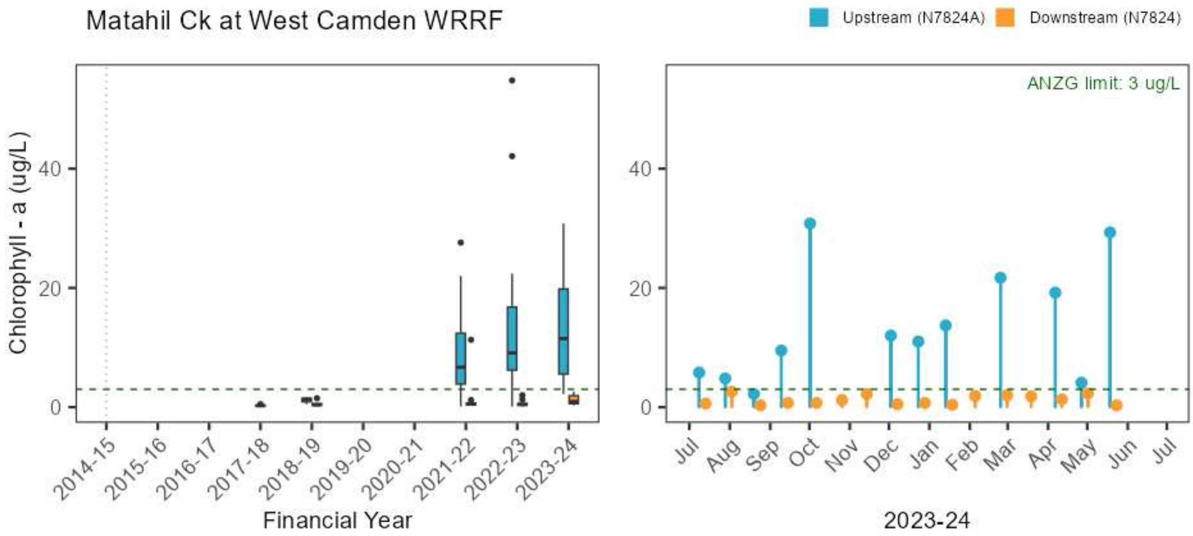

Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
Filterable zinc (ug/L)
0
5
10
15
20
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

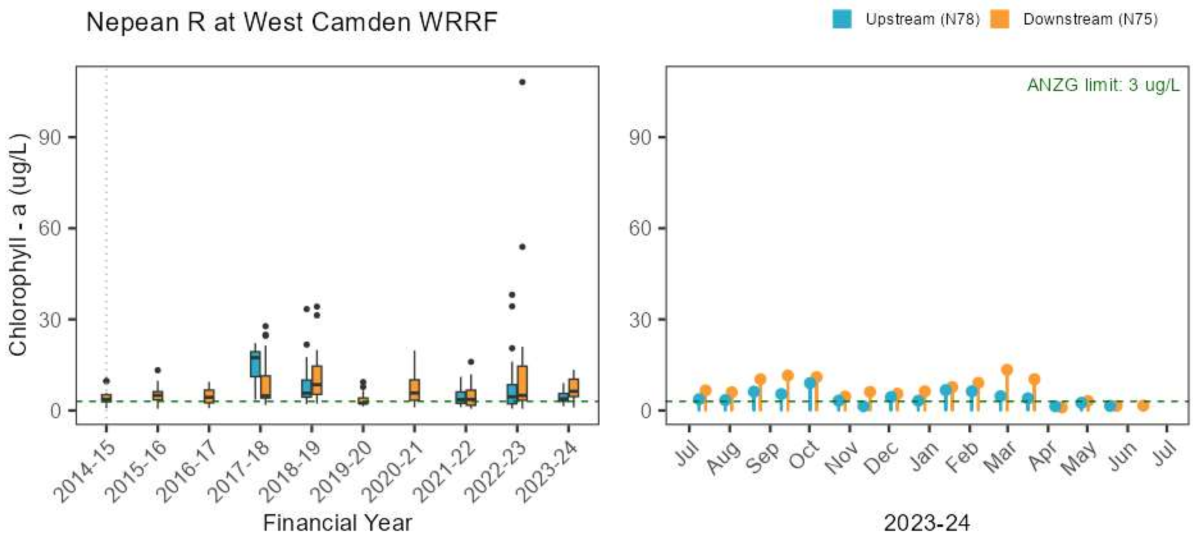

Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
Filterable zinc (ug/L)
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Matahil Ck at West Camden WRRF
Upstream (N7824A)
Downstream (N7824)
ANZG limit: 4.1 ug/L
Total zinc (ug/L)
Financial Year
2023-24
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun


Nepean R at West Camden WRRF
Upstream (N78)
Downstream (N75)
ANZG limit: 4.1 ug/L
Total zinc (ug/L)
Financial Year
2023-24
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun

A.2.9. Ecosystem receptor – Phytoplankton





A.2.10. Ecosystem receptor – Macroinvertebrates

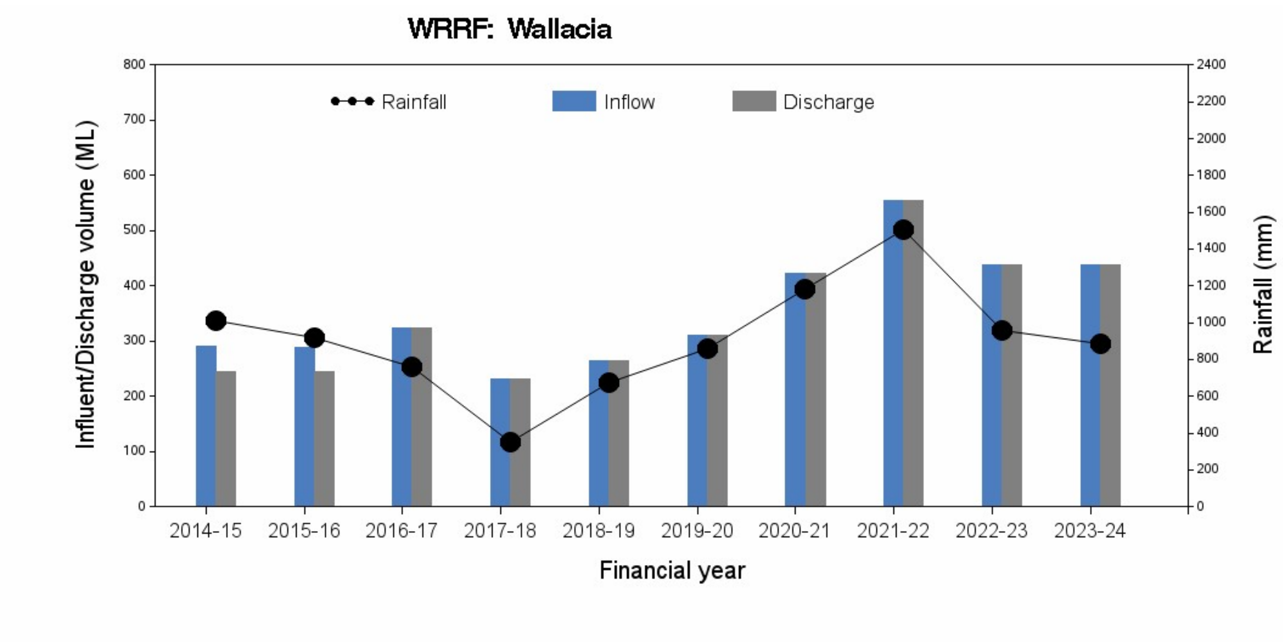
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Matahil Creek	Tributary (N7824A vs N7824)	Welch Two Sample t-test	0.77	3.79	6.3	0.0082
Nepean River	River (N78 vs N75)	Welch Two Sample t-test	0.22	1.72	9.4	0.119

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.3. Wallacia WRRF

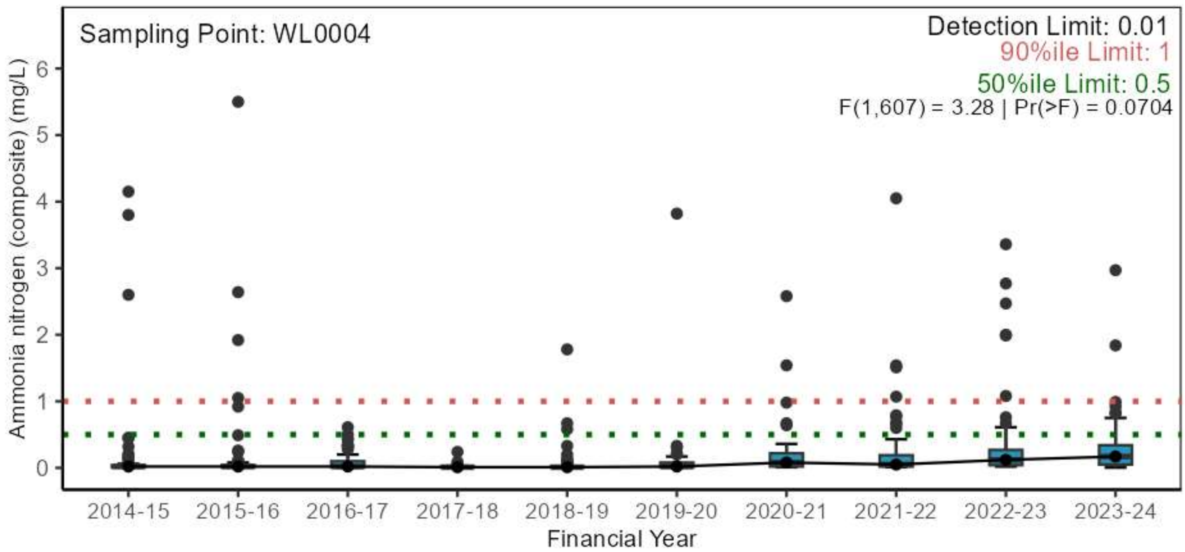
A.3.1. Pressure – Wastewater quantity

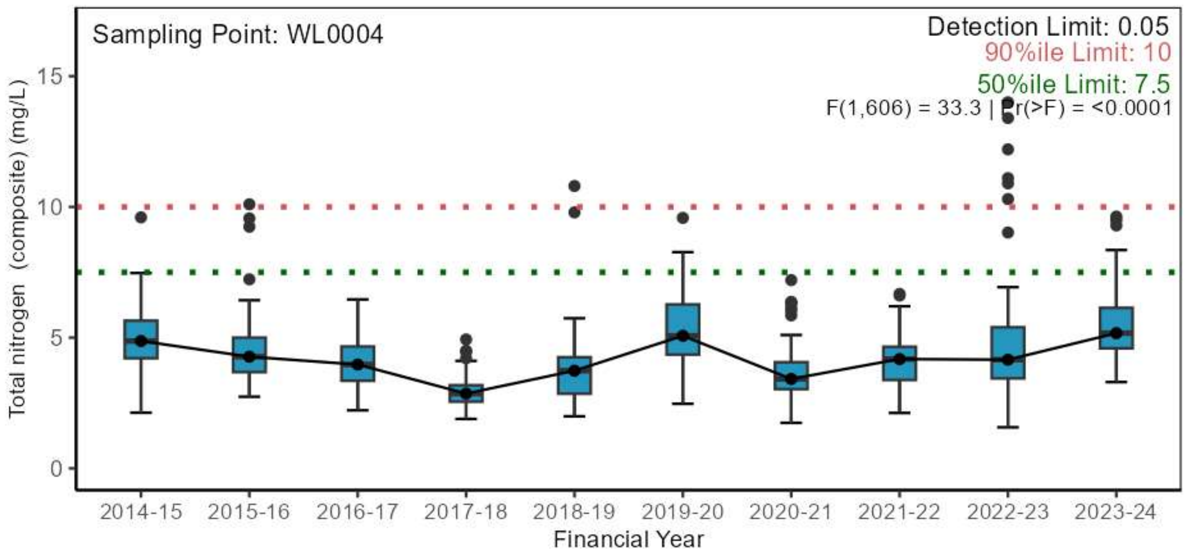
Inflow/discharge volume and rainfall

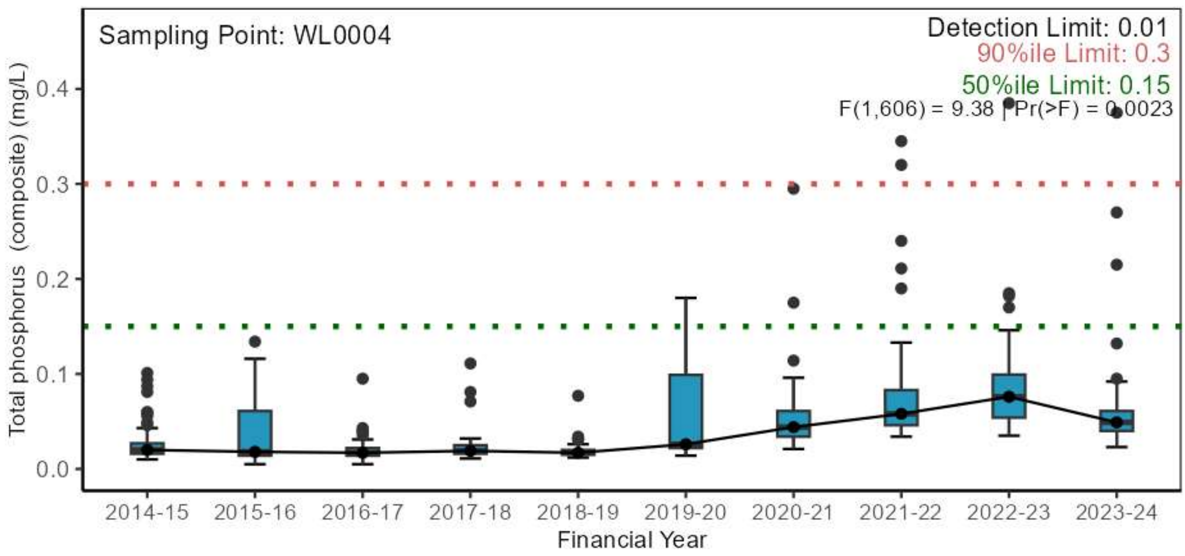


A.3.2. Pressure – Wastewater quality

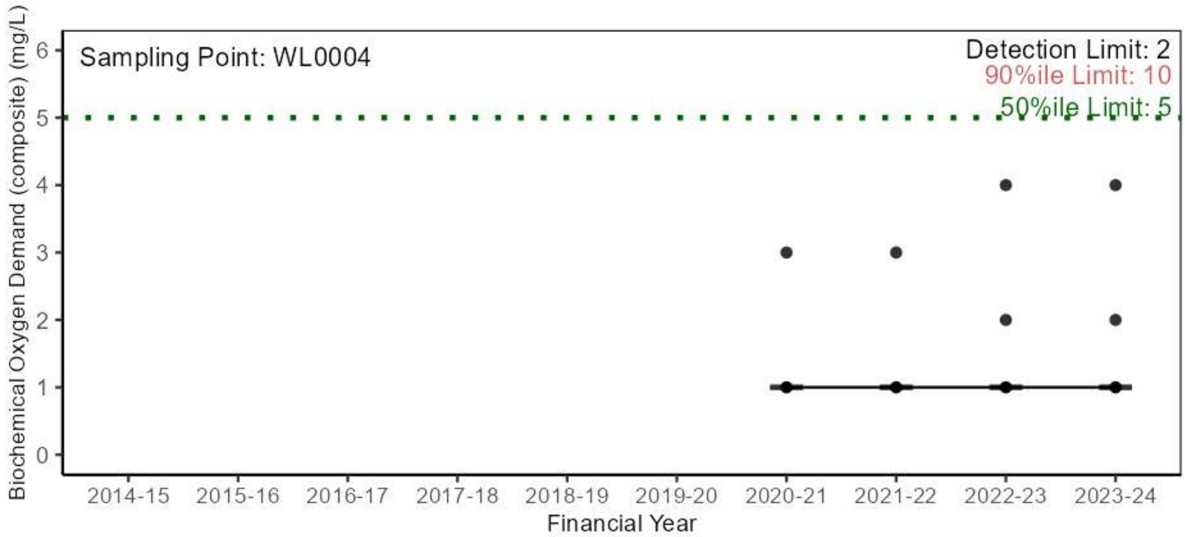
Nutrients



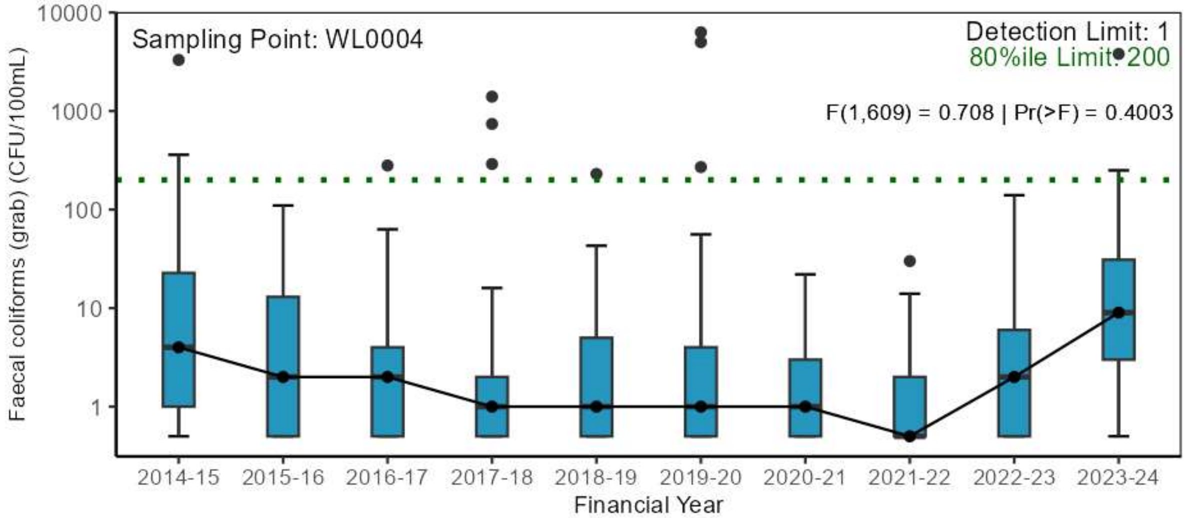

Sampling Point: WL0004
Detection Limit: 0.05
90%ile Limit: 10
50%ile Limit: 7.5
F(1,606) = 33.3 | Pr(>F) = <0.0001
Total nitrogen (composite) (mg/L)
15
10
5
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


Sampling Point: WL0004
Detection Limit: 0.01
90%ile Limit: 0.3
50%ile Limit: 0.15
F(1,606) = 9.38 | Pr(>F) = 0.0023
Total phosphorus (composite) (mg/L)
0.4
0.3
0.2
0.1
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

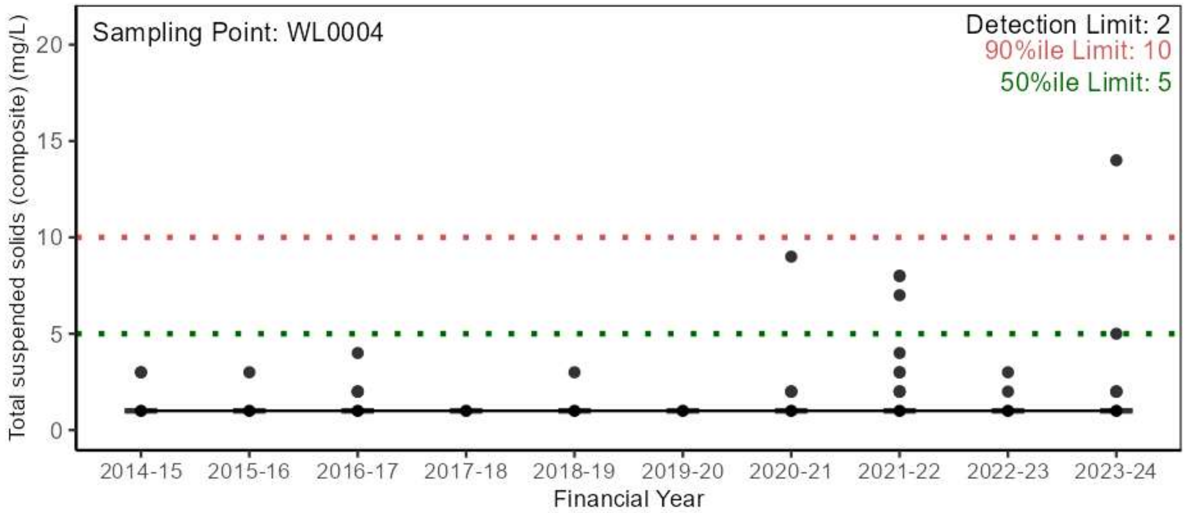
Major conventional analytes



Statistical test not conducted as >90% of results were below detection limits.

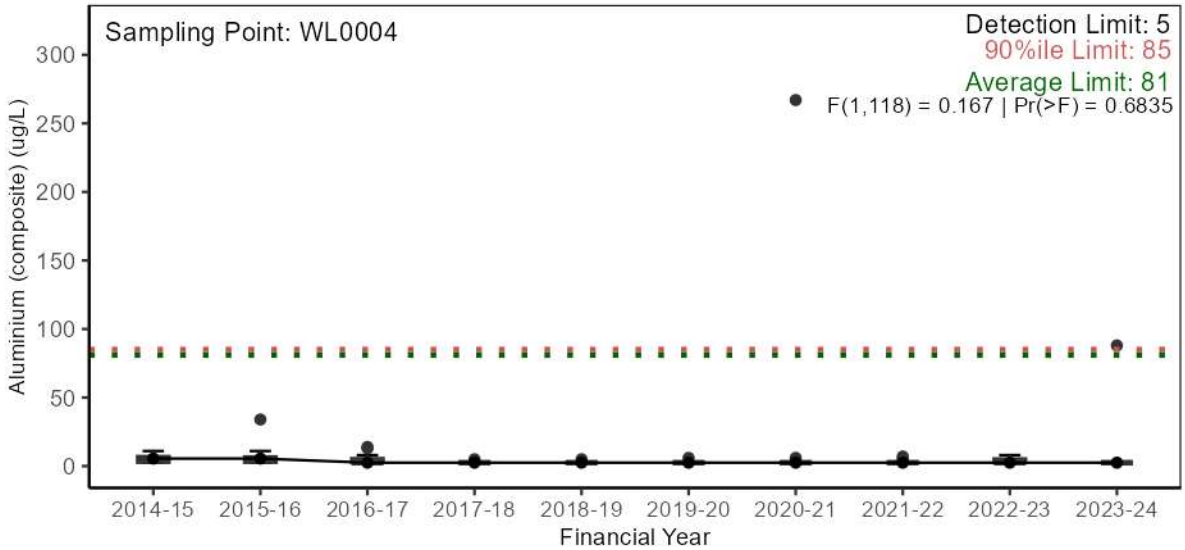


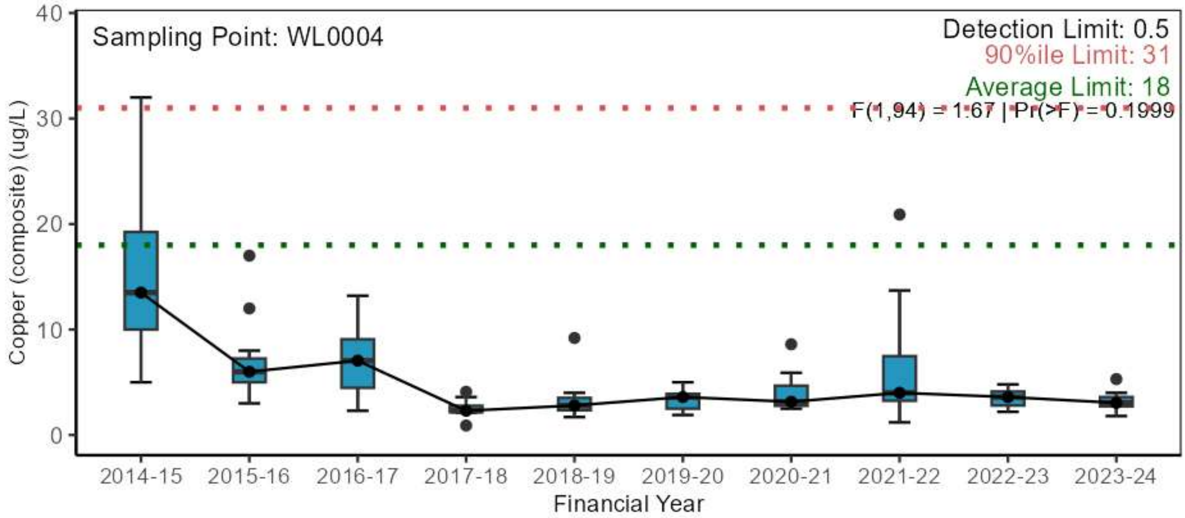
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



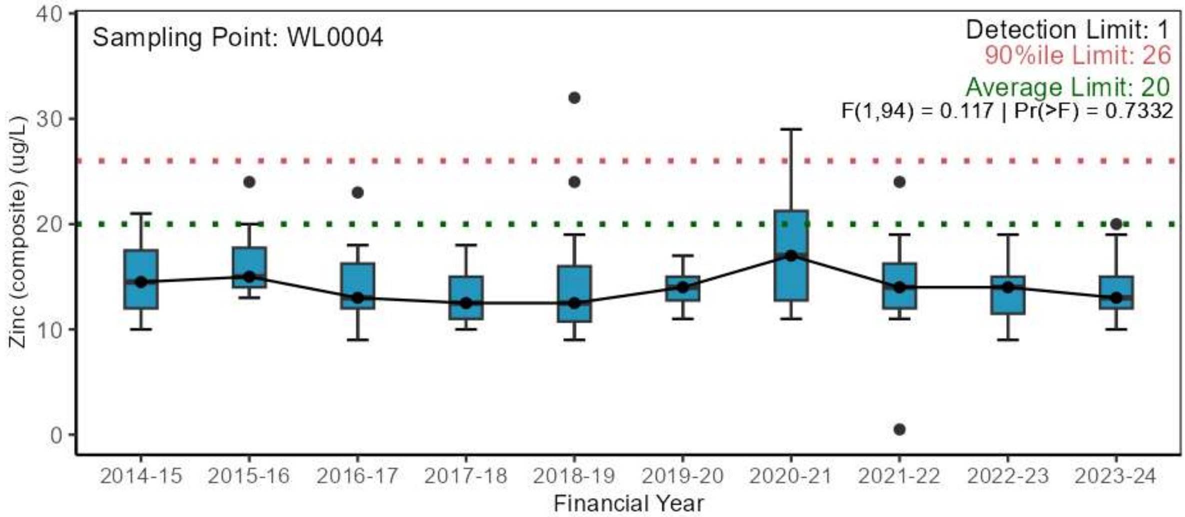
Statistical test not conducted as >90% of results were below detection limits.

Trace metals



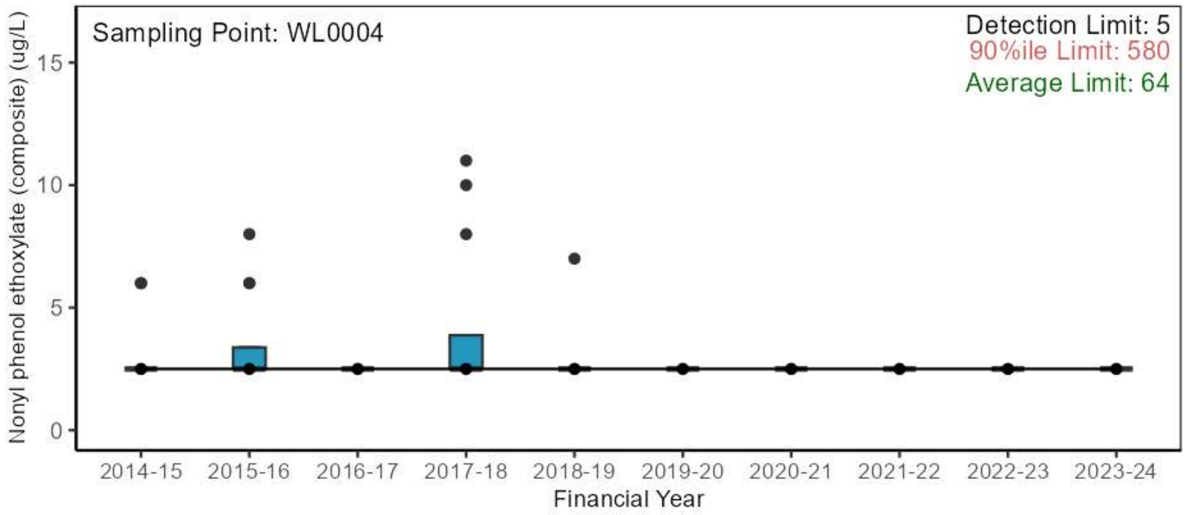


Statistical test excludes data prior to 2016-17 due to method detection limit change.

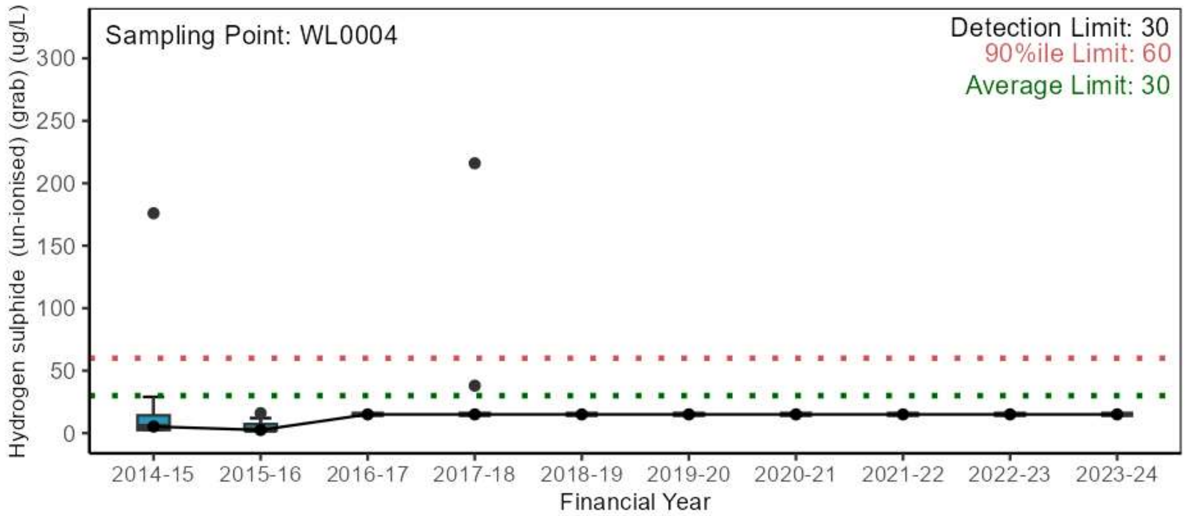


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

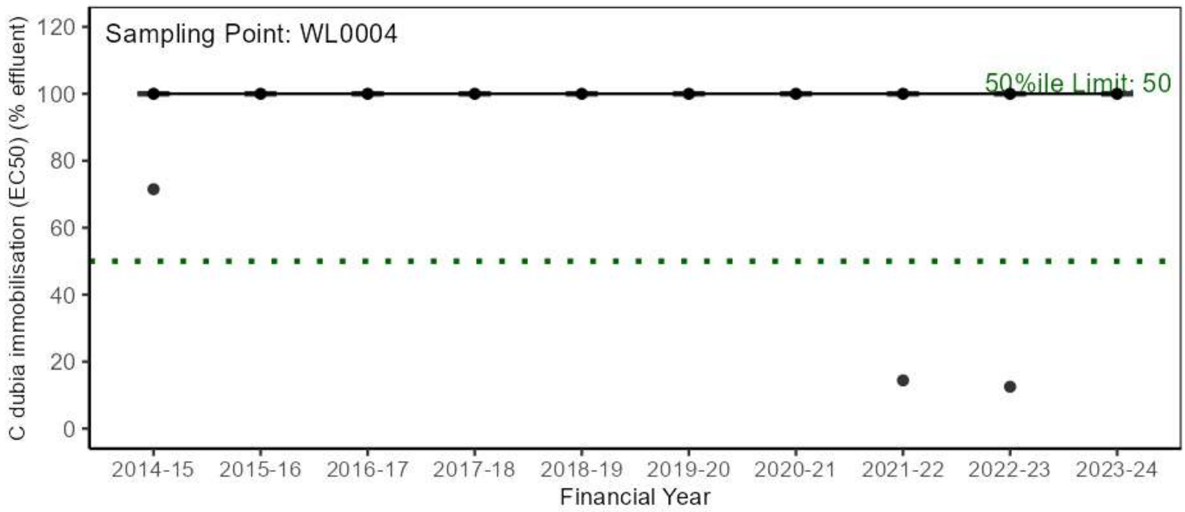


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

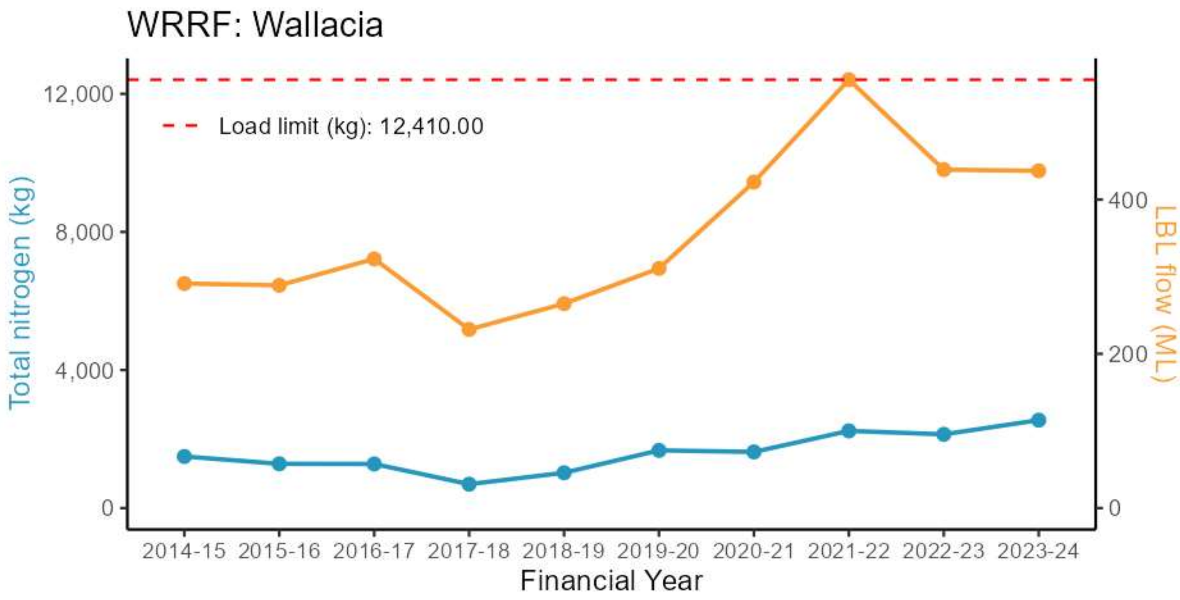
A.3.3. Pressure – Wastewater toxicity

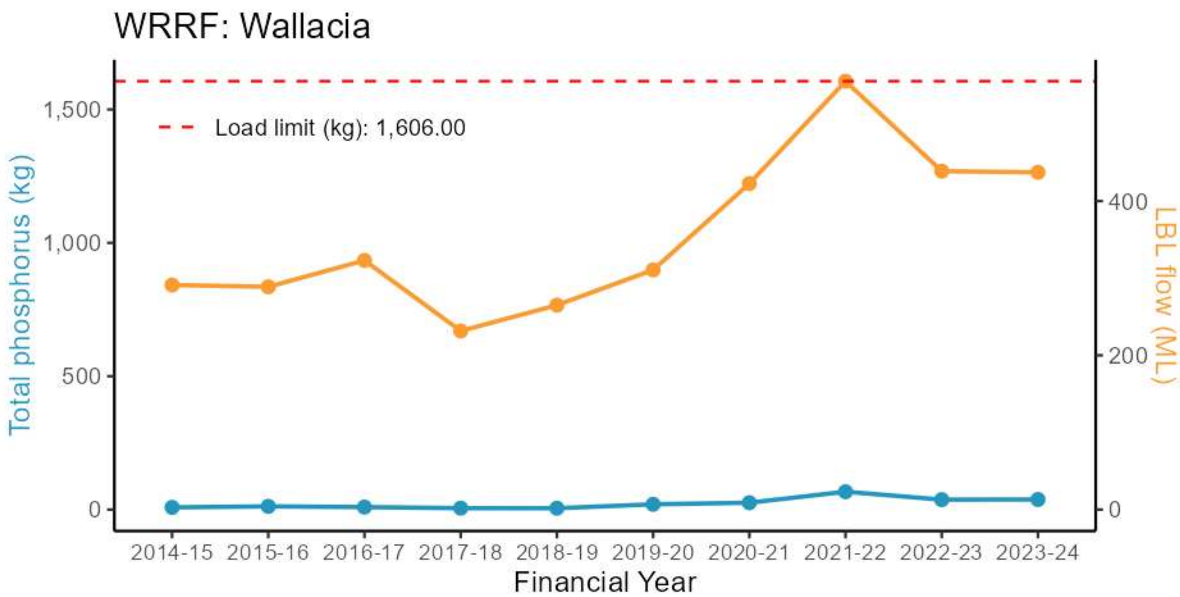


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

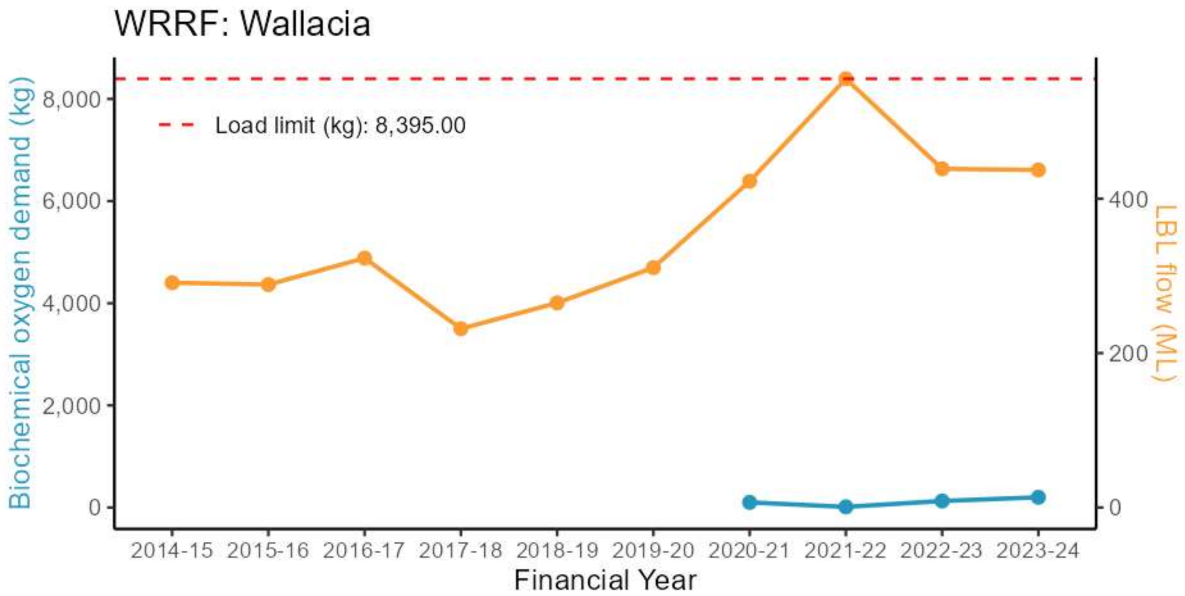
A.3.4. Pressure – Wastewater discharge load

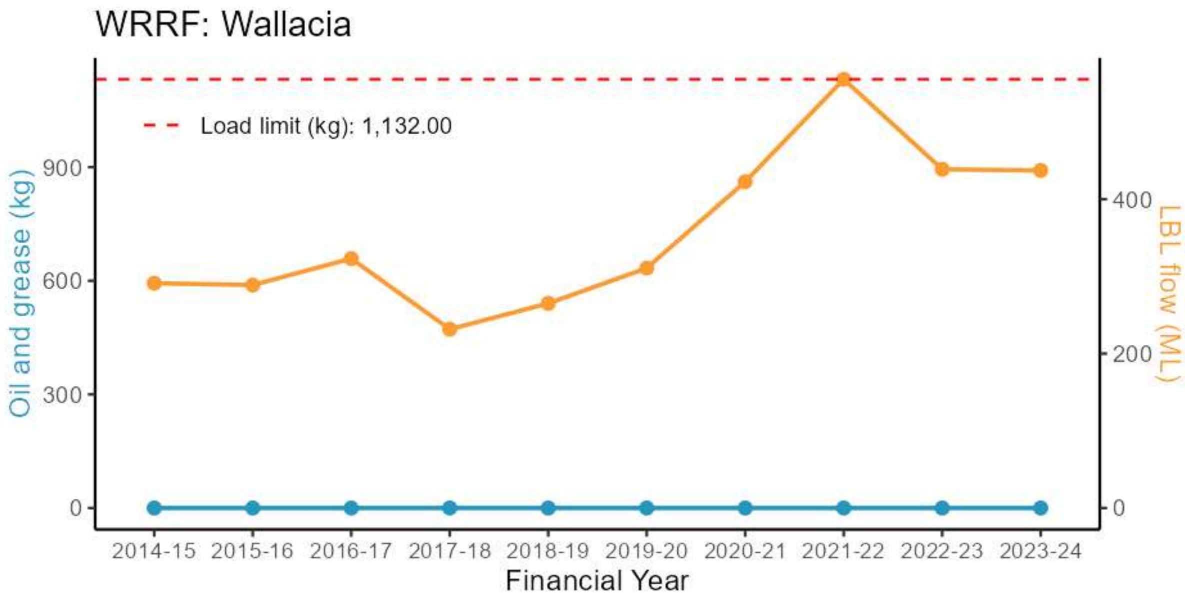
Nutrients

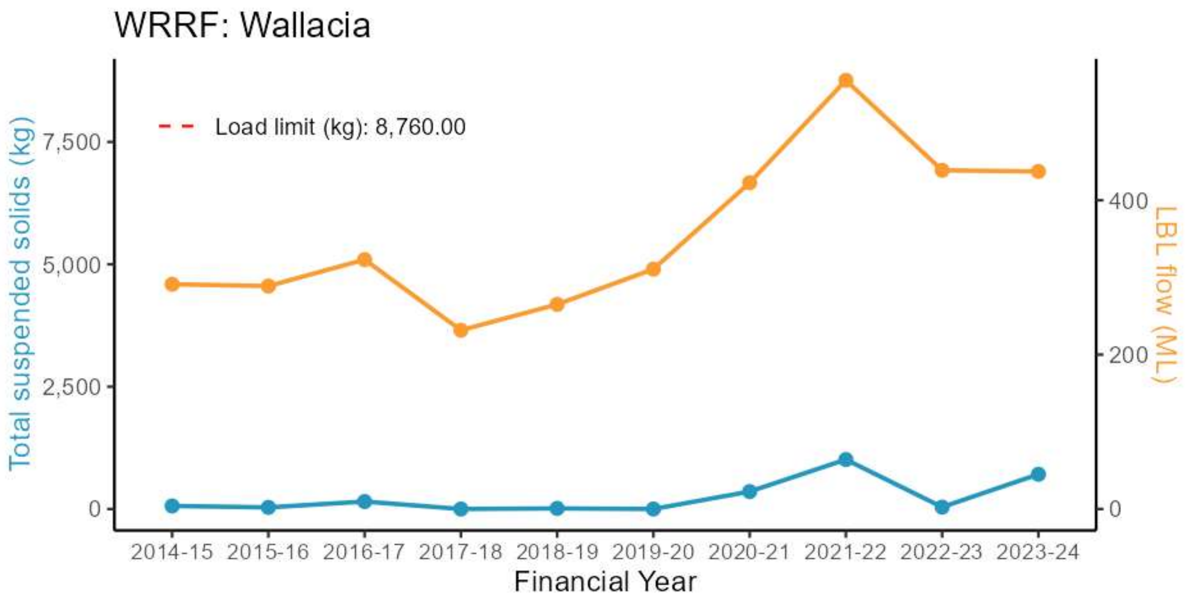




Major conventional analytes







A.3.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-5 Downstream vs upstream comparison (current period) contrast outcomes for Wallacia WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Warragamba / Nepean R	N67 vs N641	Total ammonia nitrogen	0.48	0.16	221	-2.19	0.129
Warragamba / Nepean R	N67 vs N641	Oxidised nitrogen	0.31	0.07	221	-5.42	<0.001
Warragamba / Nepean R	N67 vs N641	Total nitrogen	0.45	0.05	221	-6.95	<0.001
Warragamba / Nepean R	N67 vs N641	Filterable total phosphorus	0.59	0.14	206	-2.28	0.105
Warragamba / Nepean R	N67 vs N641	Total phosphorus	0.61	0.12	221	-2.57	0.053
Warragamba / Nepean R	N67 vs N641	Conductivity	0.72	0.07	221	-3.19	0.009
Warragamba / Nepean R	N67 vs N641	Dissolved oxygen	1.12	0.06	221	2.01	0.188
Warragamba / Nepean R	N67 vs N641	Dissolved oxygen saturation	9.10	2.99	221	3.04	0.014
Warragamba / Nepean R	N67 vs N641	pH	0.24	0.09	219	2.61	0.047
Warragamba / Nepean R	N67 vs N641	Water temperature	0.97	0.10	221	-0.32	0.989
Warragamba / Nepean R	N67 vs N641	Turbidity	0.76	0.17	221	-1.26	0.590
Warragamba / Nepean R	N67 vs N641	Chlorophyll - a	0.56	0.16	221	-2.02	0.185

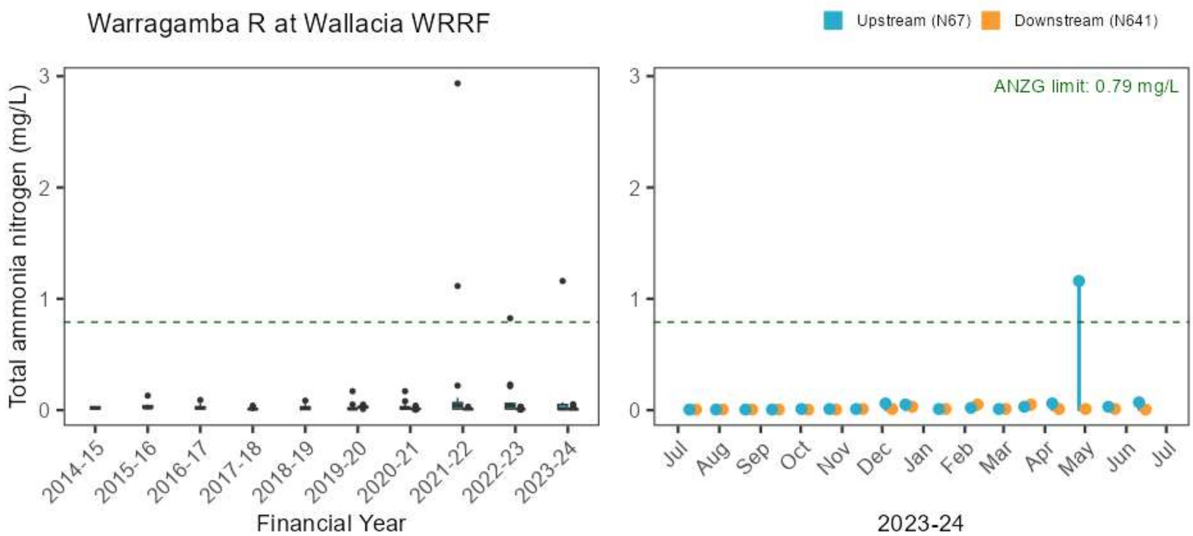
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

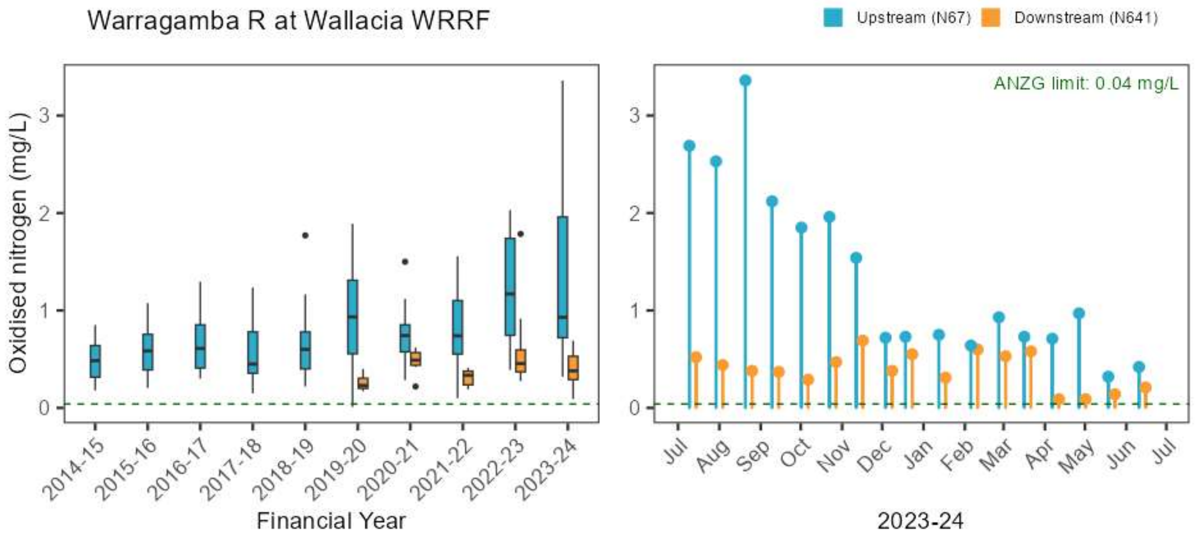
Table A-6 Current period vs previous period comparison (single site) contrast outcomes for Wallacia WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Nepean R	N67	Total ammonia nitrogen	0.71	0.19	221	-1.25	0.595
Nepean R	N67	Oxidised nitrogen	1.33	0.24	221	1.61	0.376
Nepean R	N67	Total nitrogen	1.15	0.11	221	1.53	0.423
Nepean R	N67	Filterable total phosphorus	0.79	0.16	206	-1.19	0.632
Nepean R	N67	Total phosphorus	0.93	0.15	221	-0.44	0.971
Nepean R	N67	Conductivity	1.05	0.09	221	0.59	0.935
Nepean R	N67	Dissolved oxygen	0.95	0.04	221	-1.18	0.642
Nepean R	N67	Dissolved oxygen saturation	-4.35	2.44	221	-1.78	0.284
Nepean R	N67	pH	-0.03	0.08	219	-0.46	0.968
Nepean R	N67	Water temperature	1.03	0.09	221	0.28	0.992
Nepean R	N67	Turbidity	1.07	0.19	221	0.40	0.979
Nepean R	N67	Chlorophyll - a	0.96	0.23	221	-0.16	0.999
Warragamba R	N641	Total ammonia nitrogen	0.97	0.27	221	-0.10	1.000
Warragamba R	N641	Oxidised nitrogen	0.81	0.14	221	-1.19	0.631
Warragamba R	N641	Total nitrogen	0.86	0.08	221	-1.55	0.410
Warragamba R	N641	Filterable total phosphorus	0.71	0.15	206	-1.68	0.337
Warragamba R	N641	Total phosphorus	1.00	0.16	221	0.03	1.000
Warragamba R	N641	Conductivity	1.24	0.10	221	2.57	0.052
Warragamba R	N641	Dissolved oxygen	0.99	0.05	221	-0.25	0.994
Warragamba R	N641	Dissolved oxygen saturation	-0.19	2.47	221	-0.08	1.000
Warragamba R	N641	pH	0.07	0.08	219	0.87	0.821
Warragamba R	N641	Water temperature	1.04	0.09	221	0.40	0.979
Warragamba R	N641	Turbidity	1.06	0.19	221	0.30	0.991
Warragamba R	N641	Chlorophyll - a	1.11	0.27	221	0.42	0.976

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

A.3.6. Stressor – Nutrients




Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 0.04 mg/L
Oxidised nitrogen (mg/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Oct
Nov
Dec
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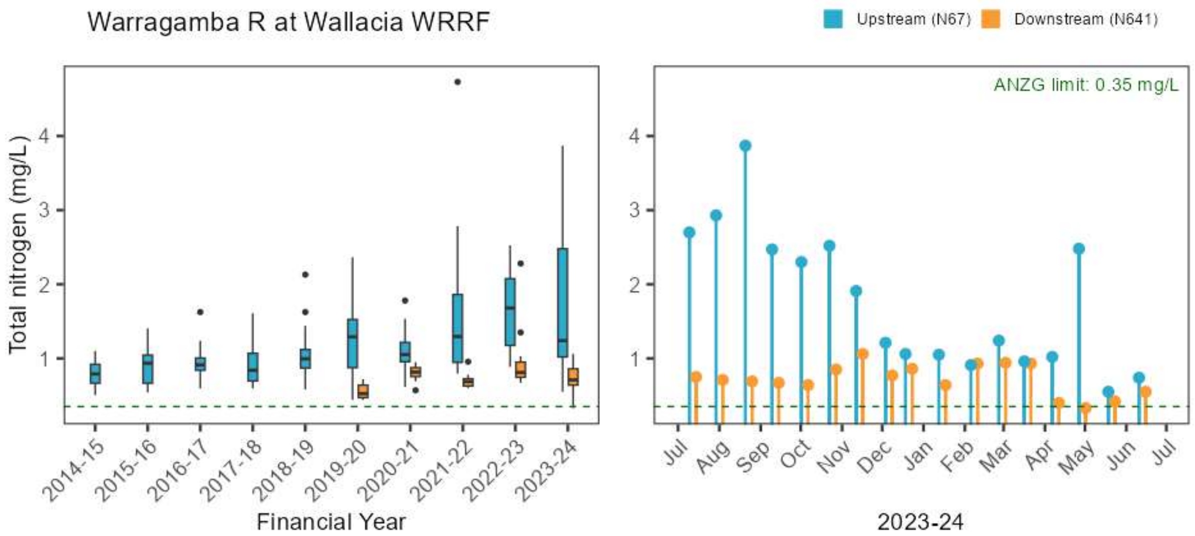
May
Jun
Jul
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 0.35 mg/L
Total nitrogen (mg/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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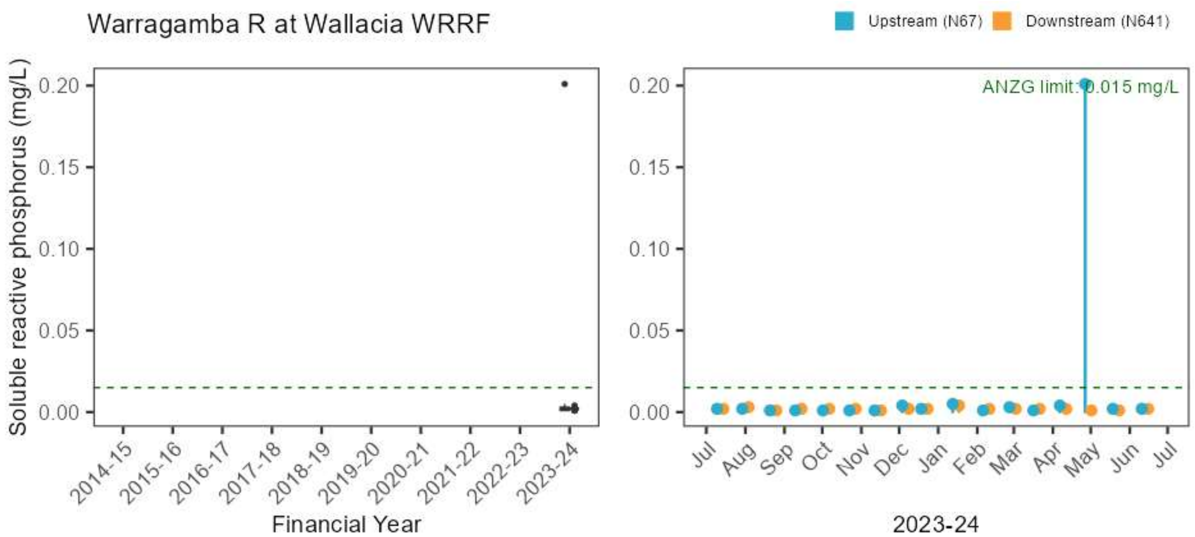
Jun
Jul
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 0.015 mg/L
Soluble reactive phosphorus (mg/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Nov
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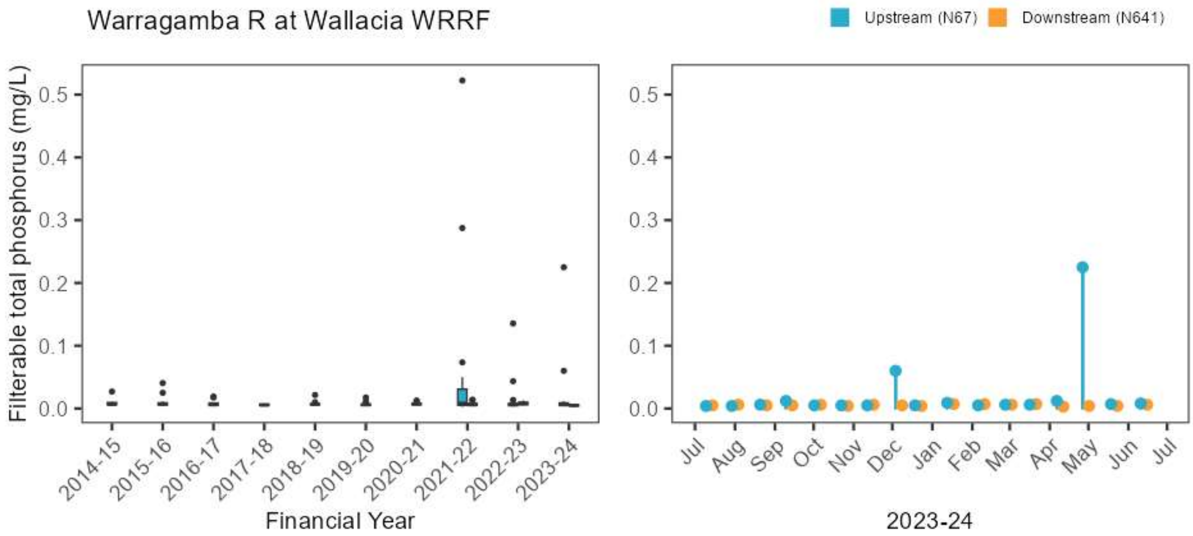
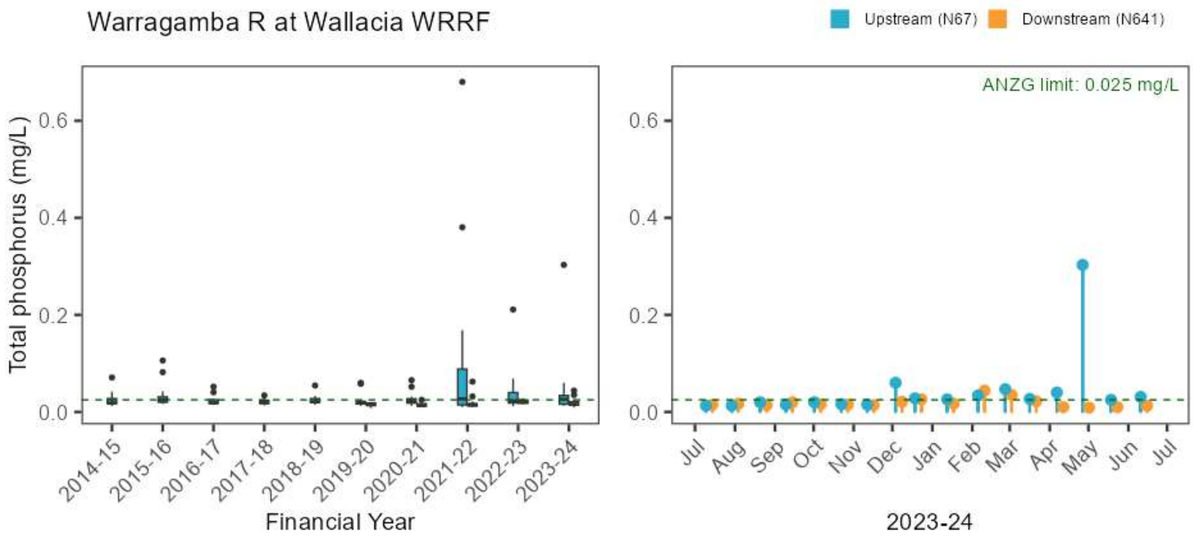
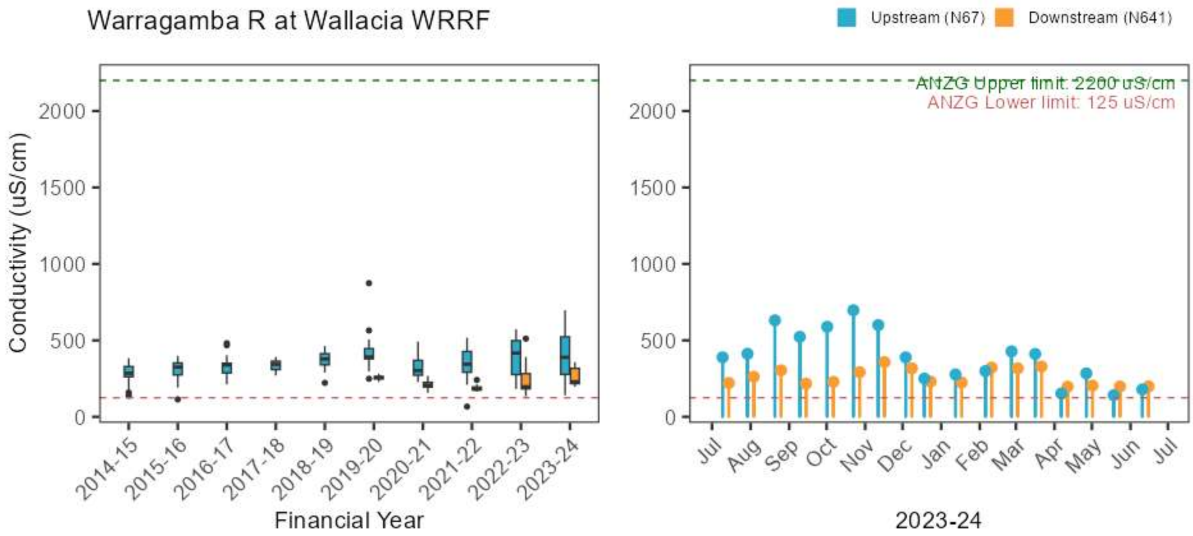
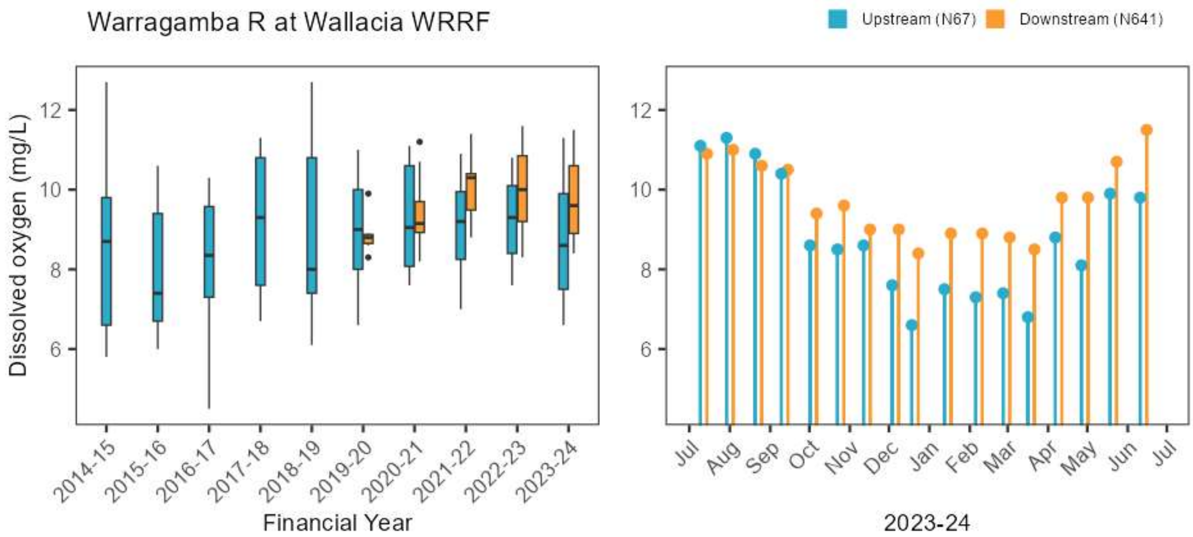
May
Jun
Jul
2023-24

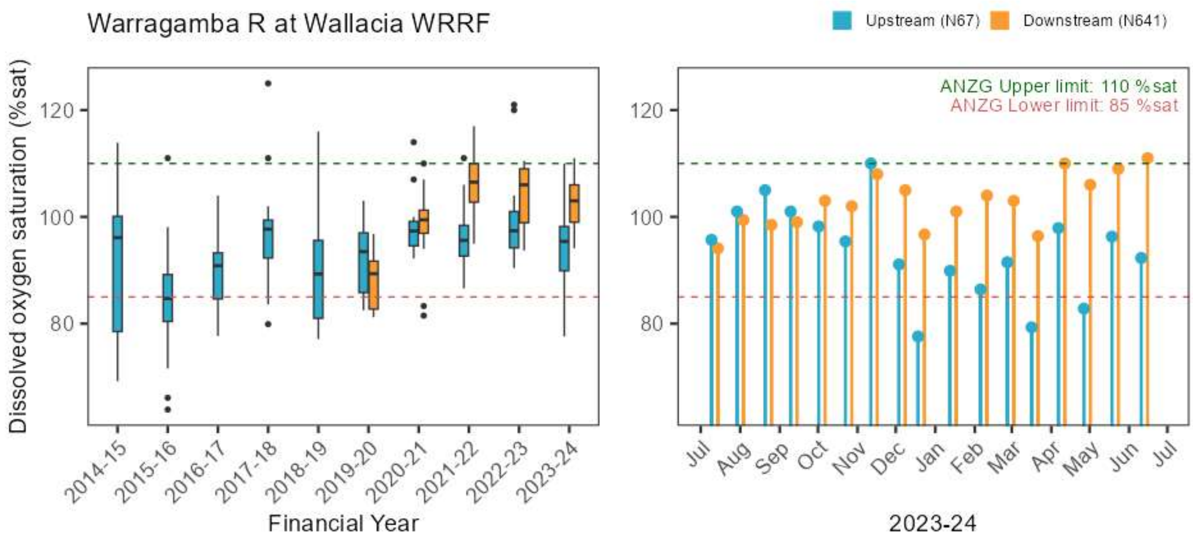

Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
Filterable total phosphorus (mg/L)
Financial Year
2023-24

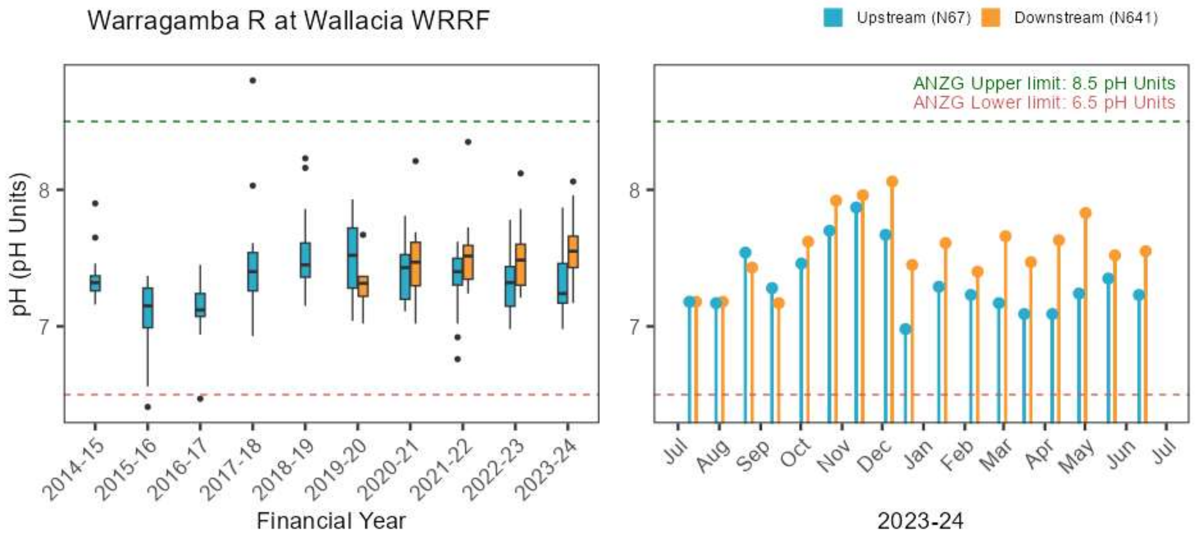

Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
Financial Year
2023-24

A.3.7. Stressor – Physico-chemical water quality








Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
pH (pH Units)
7
8
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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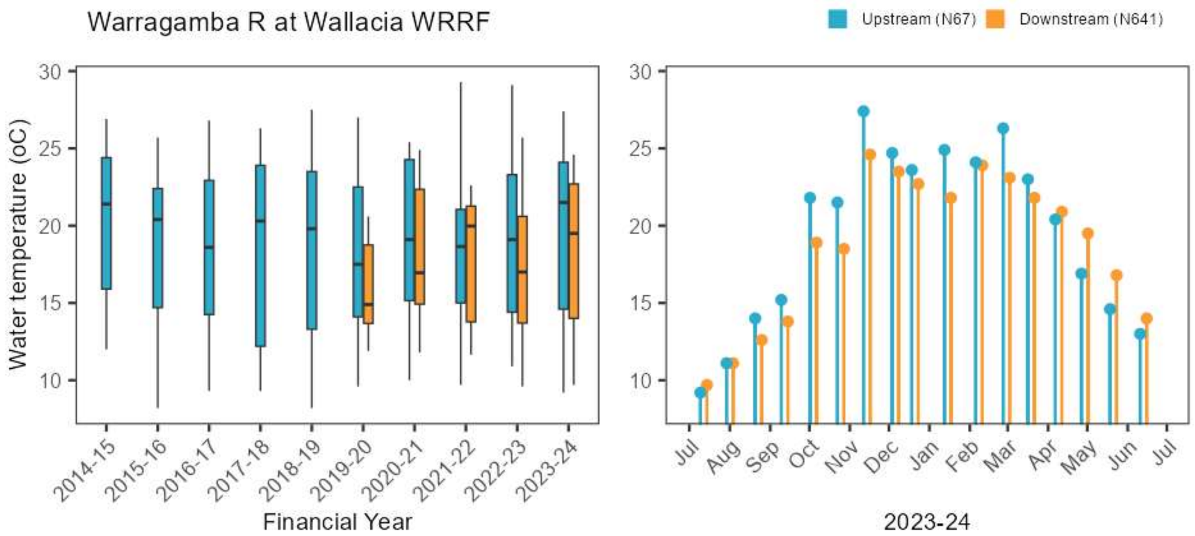
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
Water temperature (oC)
10
15
20
25
30
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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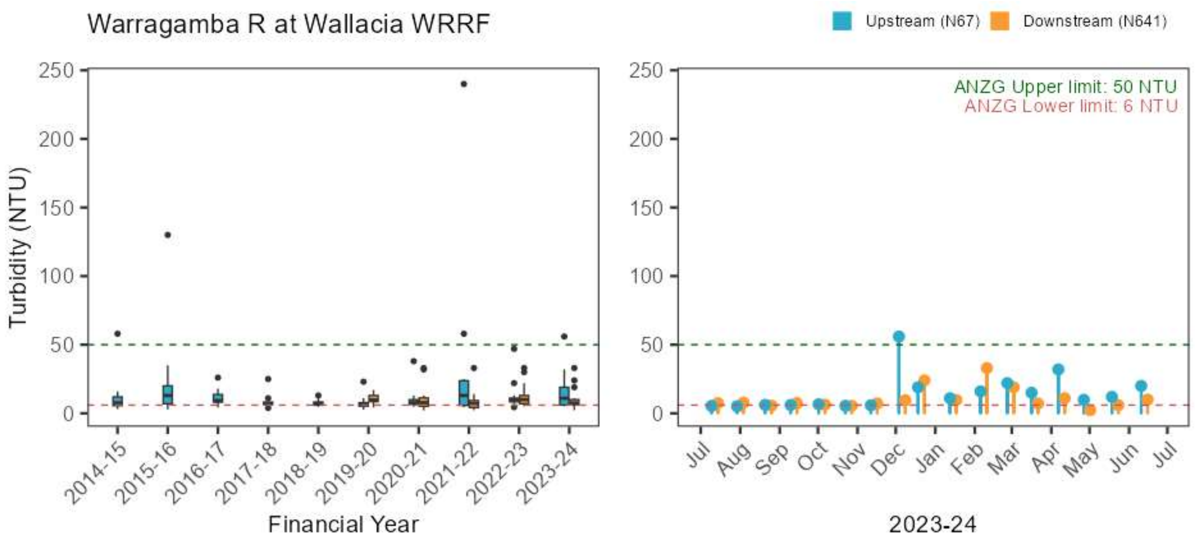
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Turbidity (NTU)
0
50
100
150
200
250
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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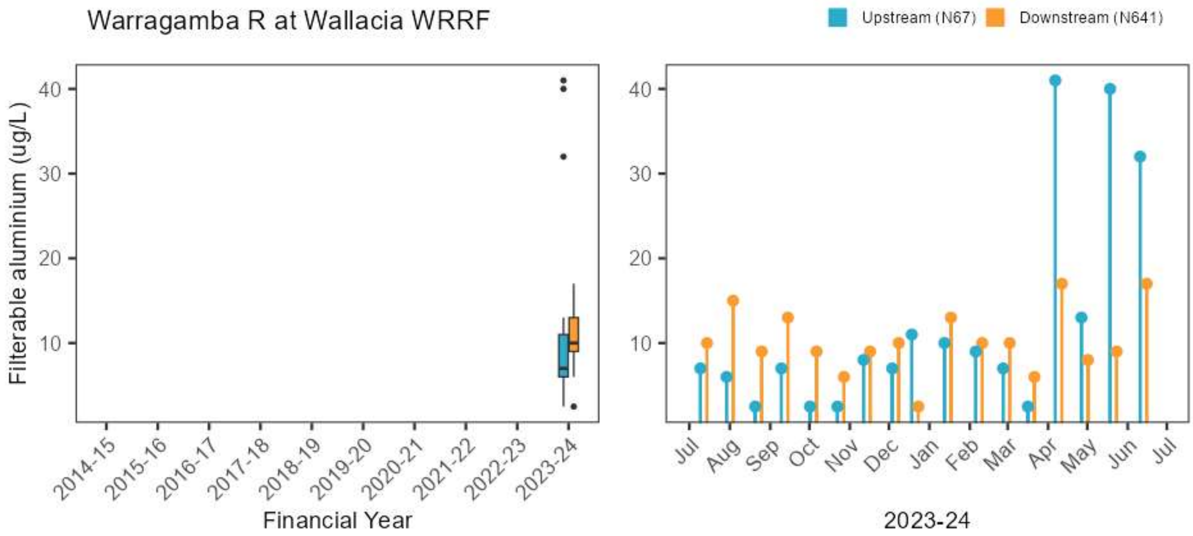
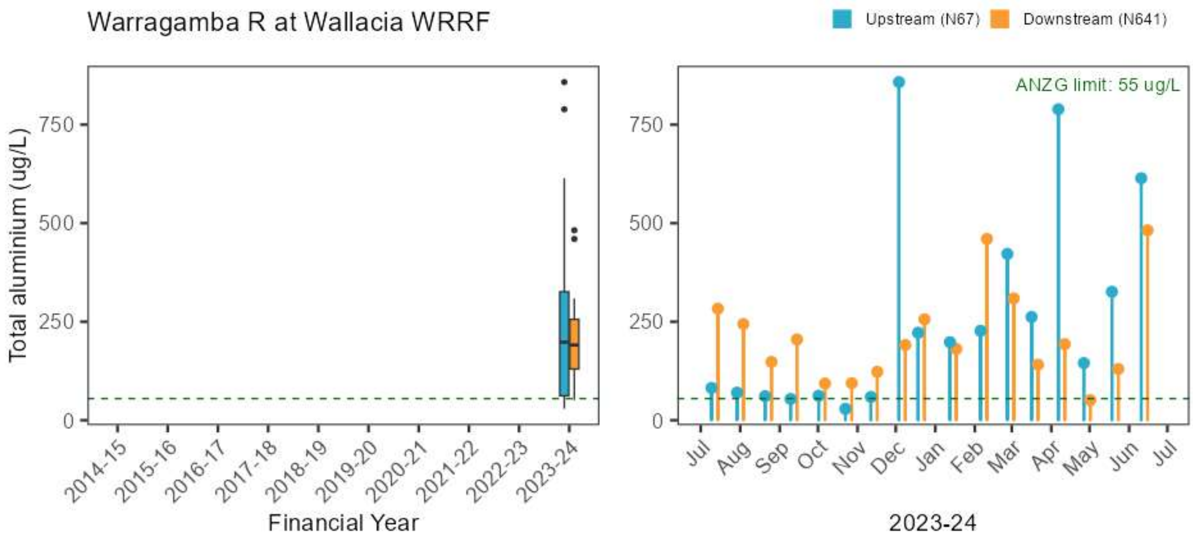
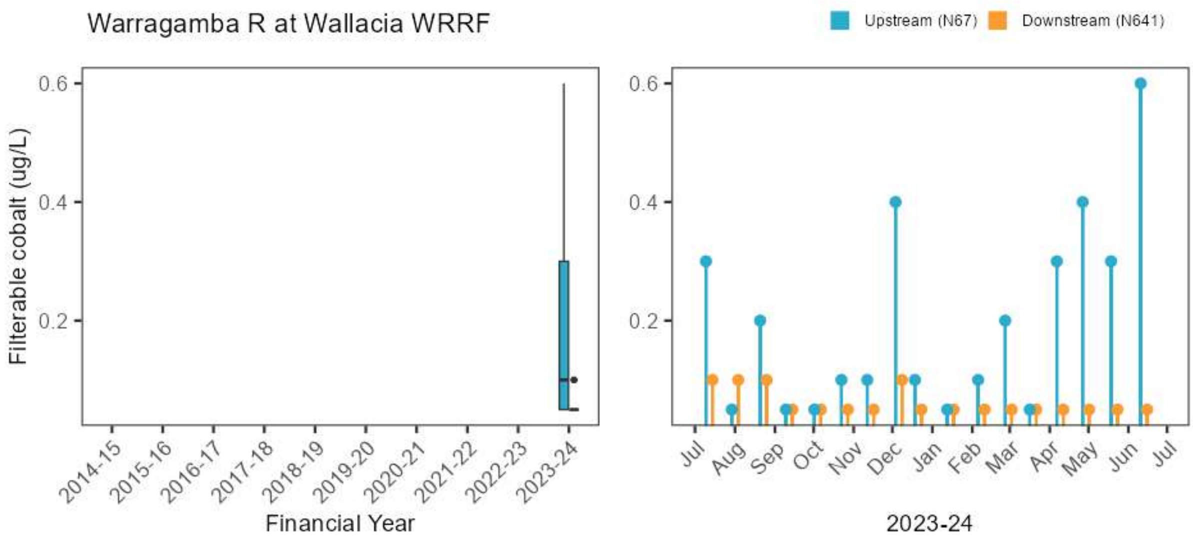
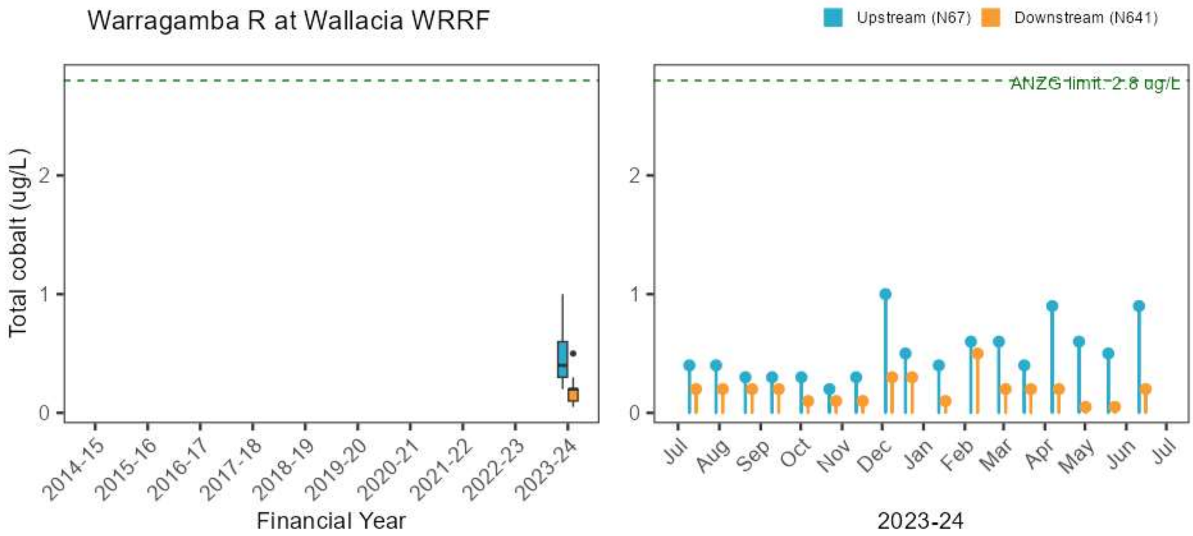
2023-24

A.3.8. Stressor – Trace metals









Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
0
1
2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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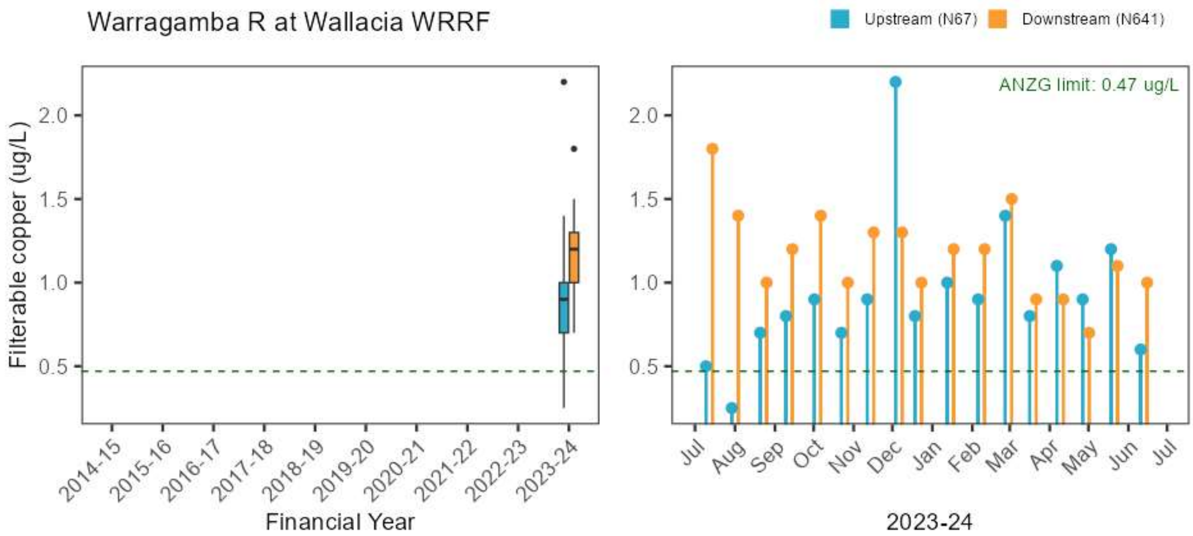
Jul
2023-24



Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
0.5
1.0
1.5
2.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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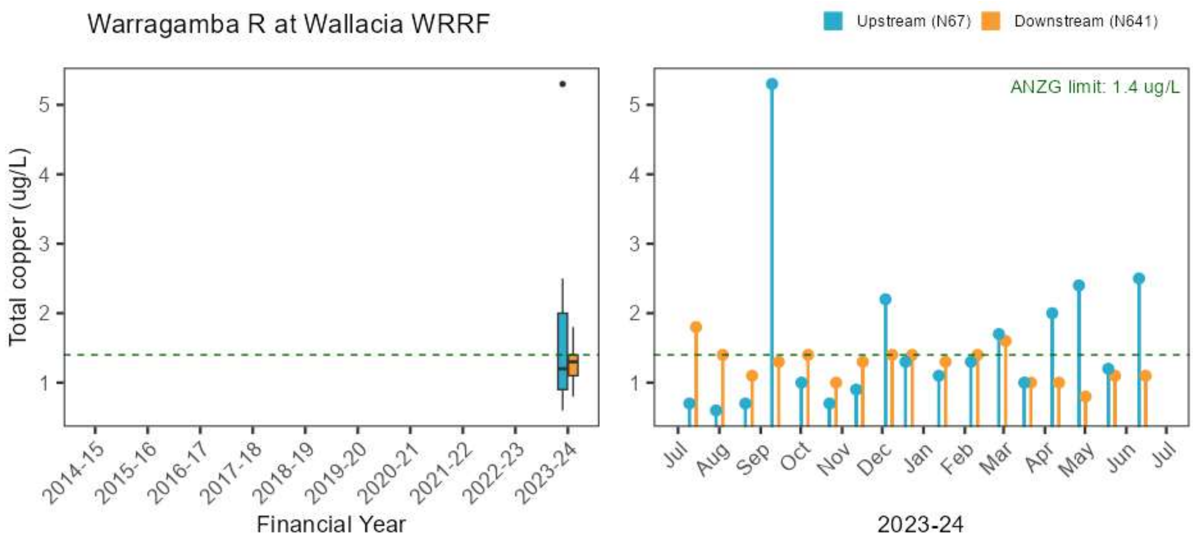
Jul
2023-24



Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
1
2
3
4
5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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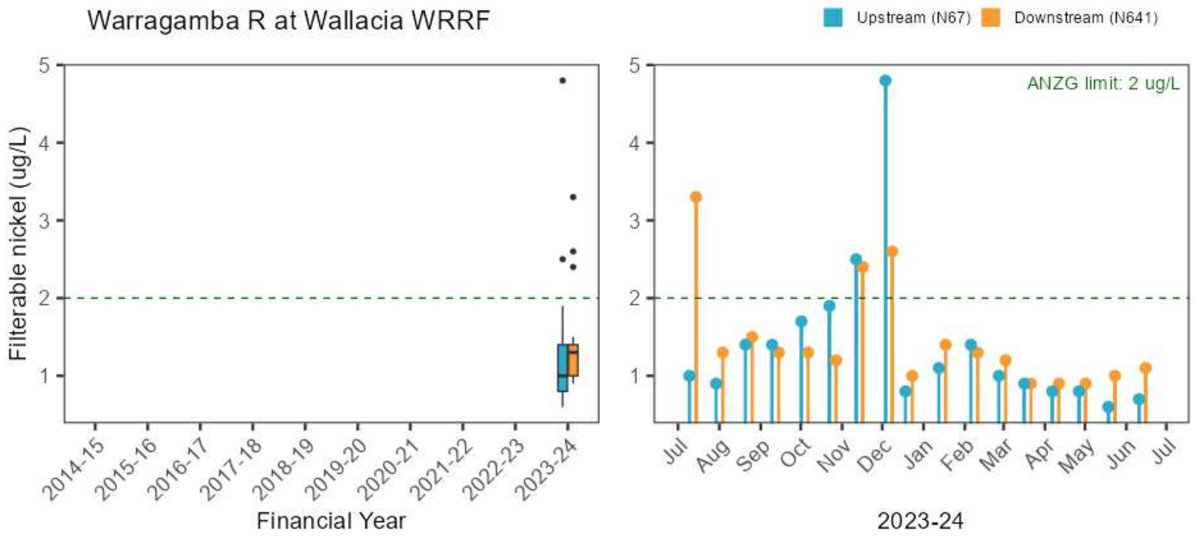
May
Jun
Jul
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
Filterable nickel (ug/L)
ANZG limit: 2 ug/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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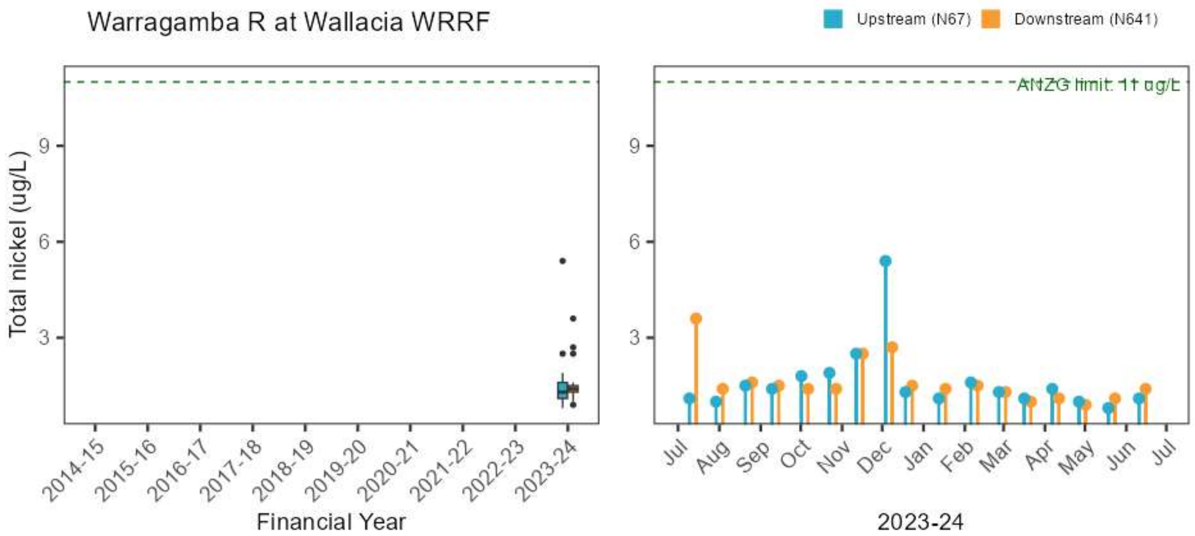
May
Jun
Jul
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
Total nickel (ug/L)
ANZG limit: 11 ug/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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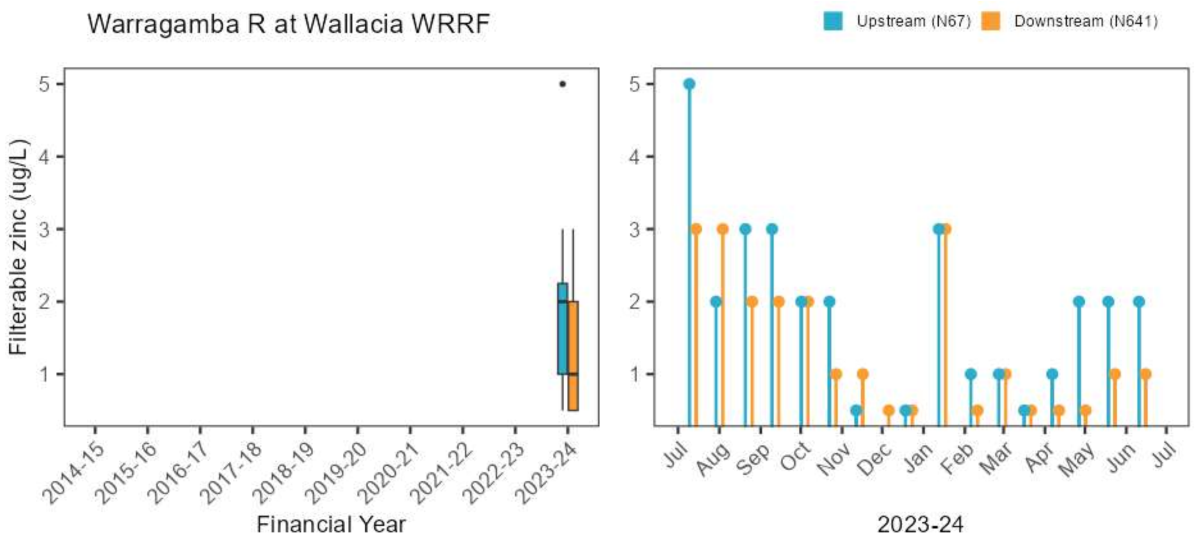
Jun
Jul
2023-24


Warragamba R at Wallacia WRRF
Upstream (N67)
Downstream (N641)
Filterable zinc (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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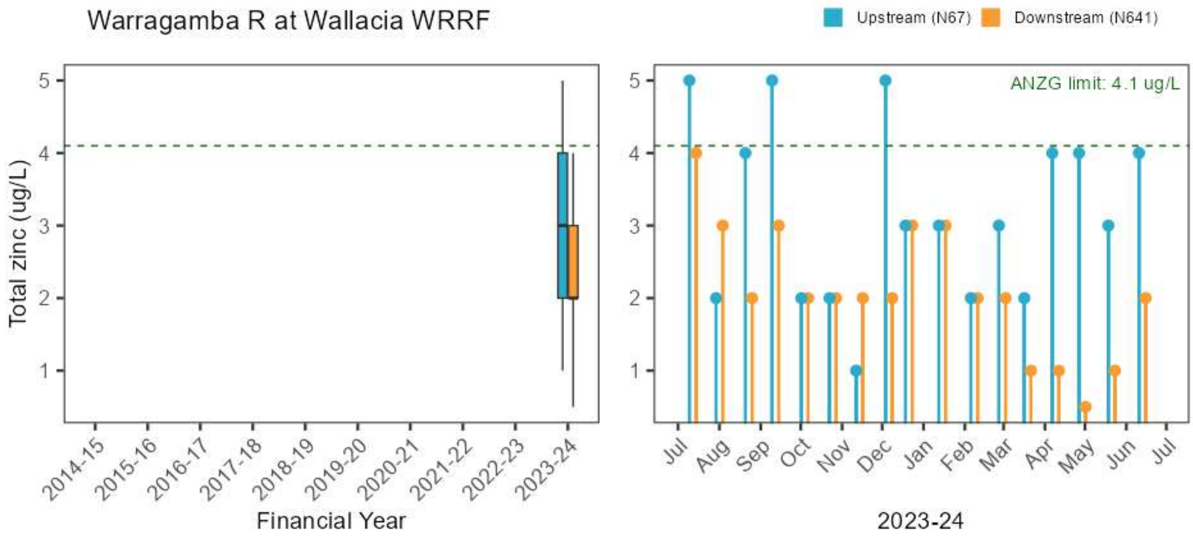
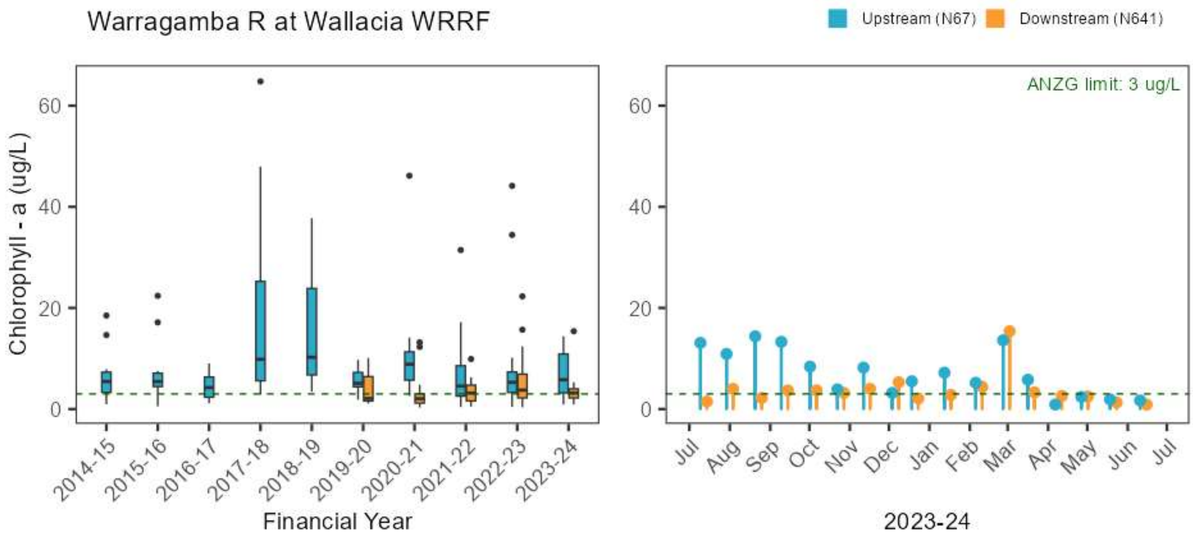
Apr
May
Jun
Jul
2023-24



A.3.9. Ecosystem receptor – Phytoplankton



A.3.10. Ecosystem receptor – Macroinvertebrates

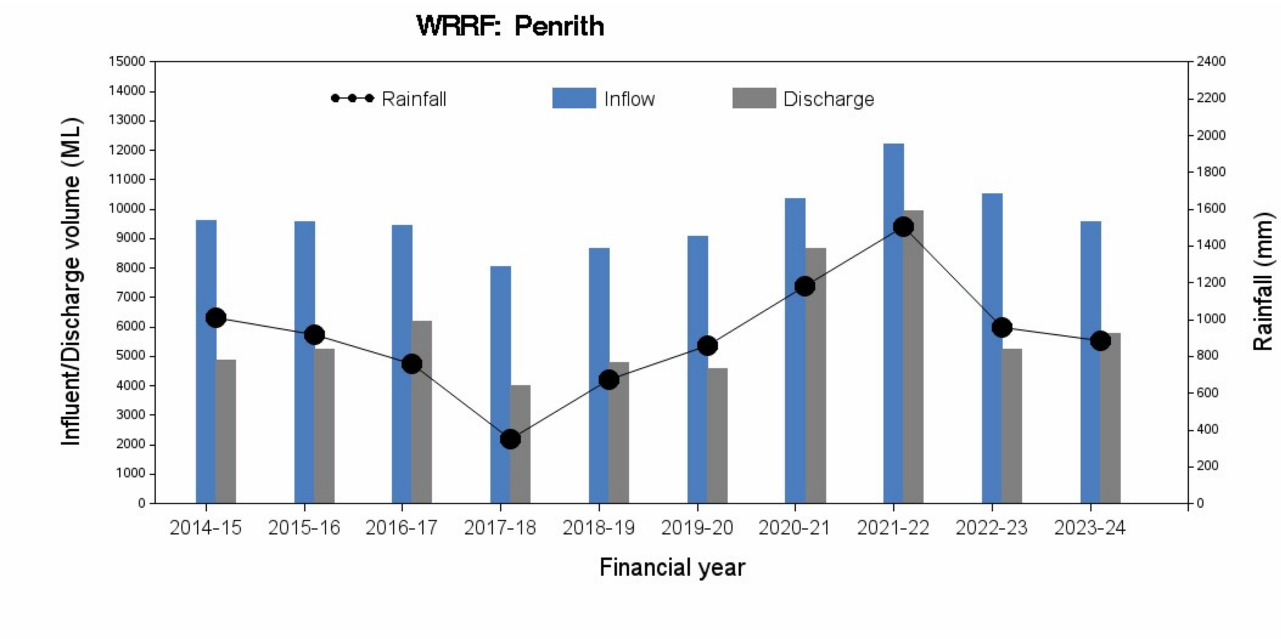
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Warragamba / Nepean Rivers	River (N67 vs N641)	Welch Two Sample t-test	0.47	2.83	13.9	0.014

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

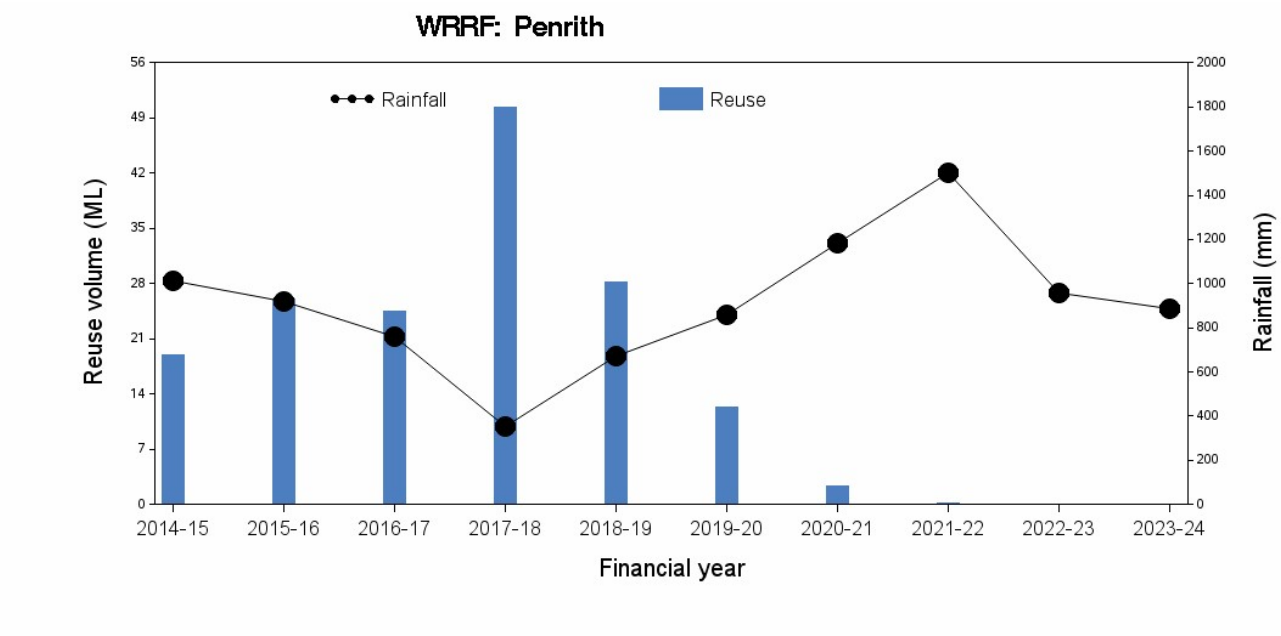
A.4. Penrith WRRF

A.4.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

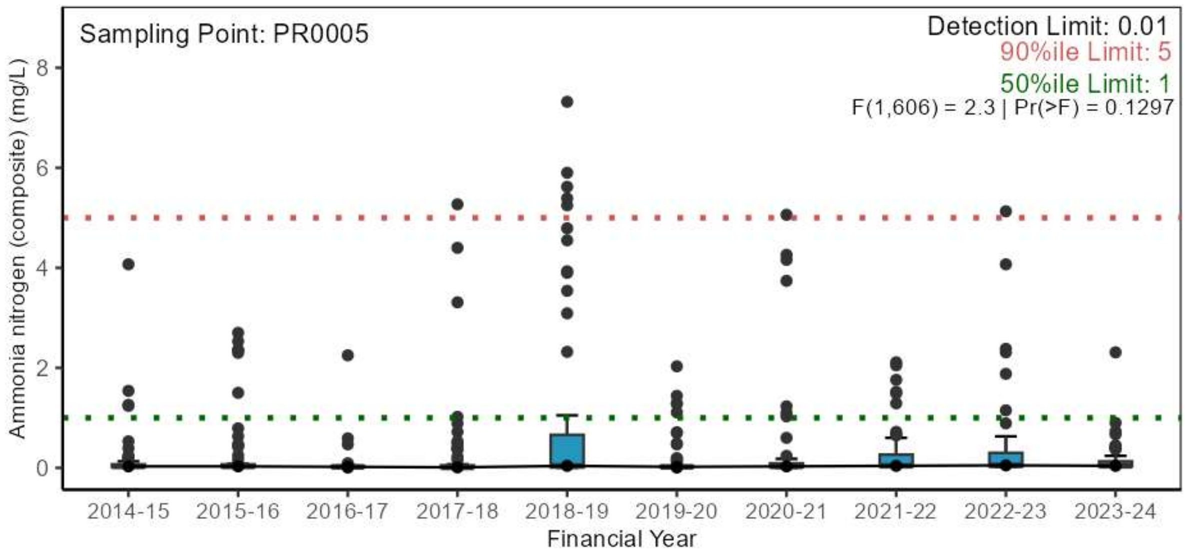


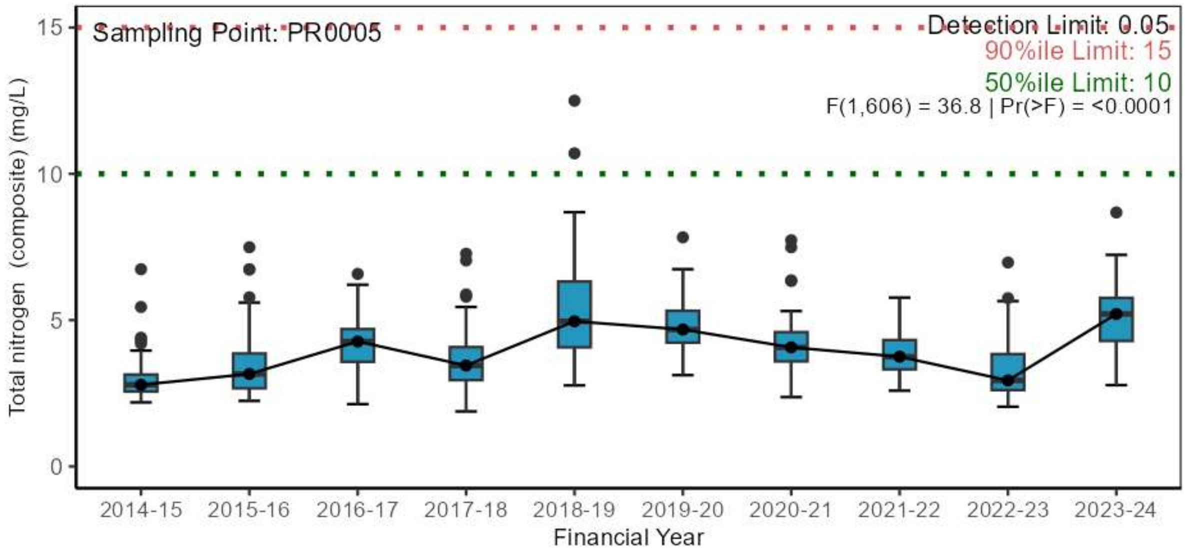
Reuse volume and rainfall

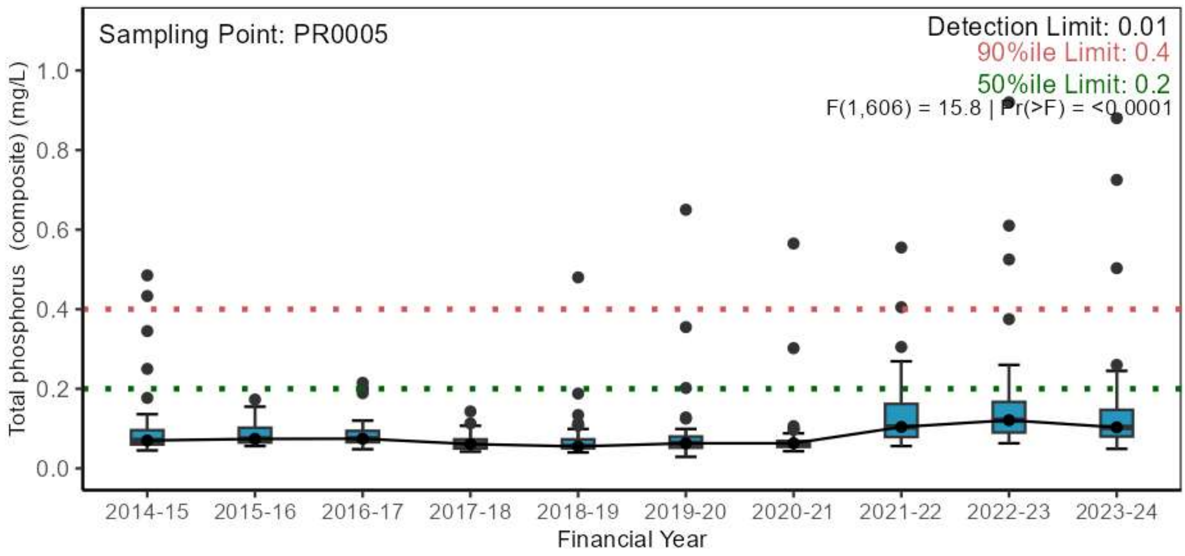


A.4.2. Pressure – Wastewater quality

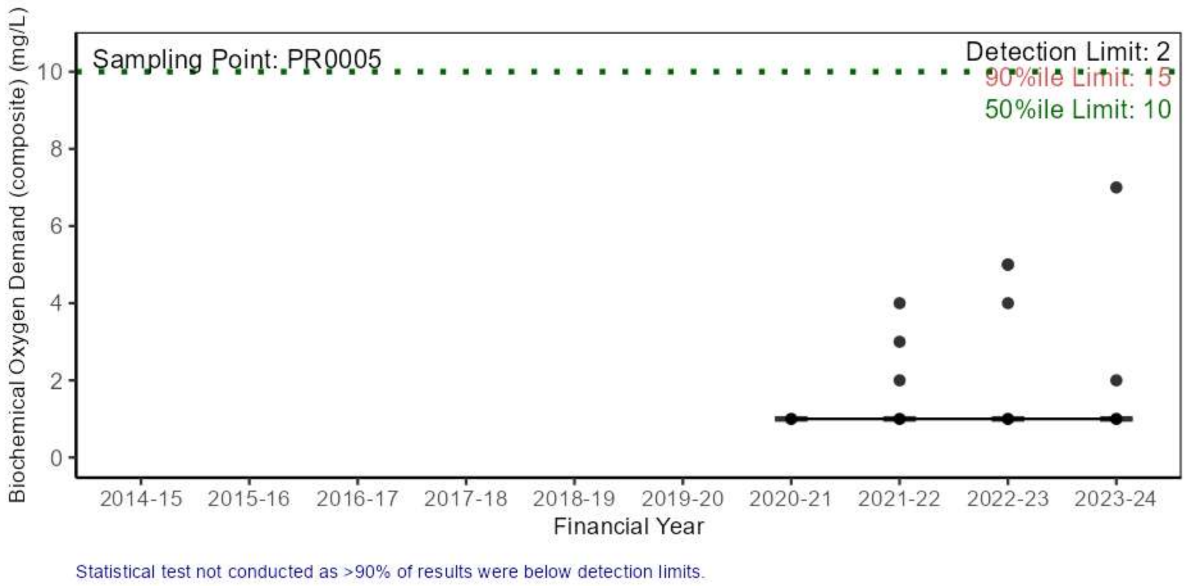
Nutrients: PR0005

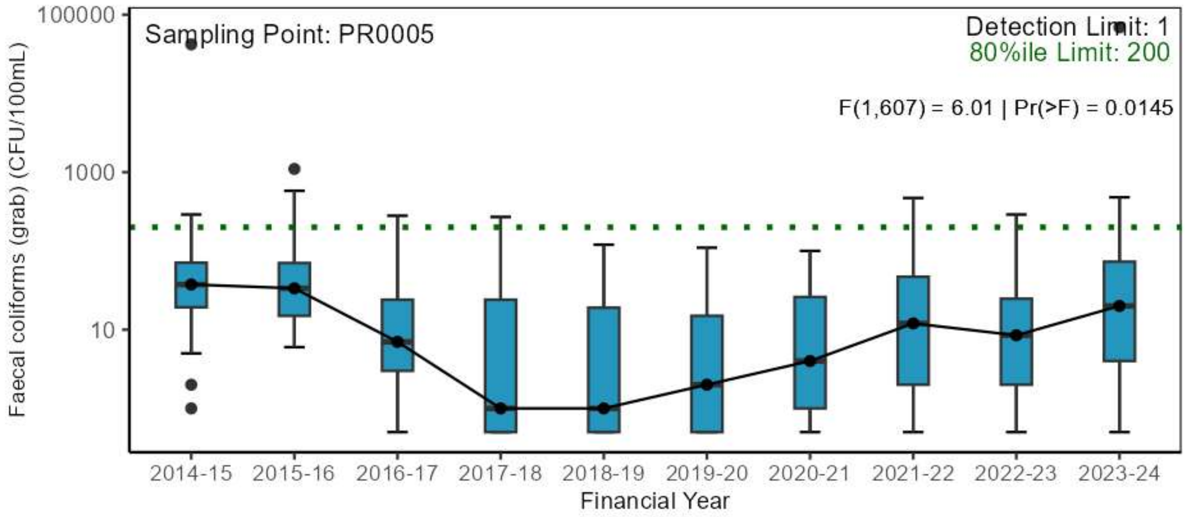




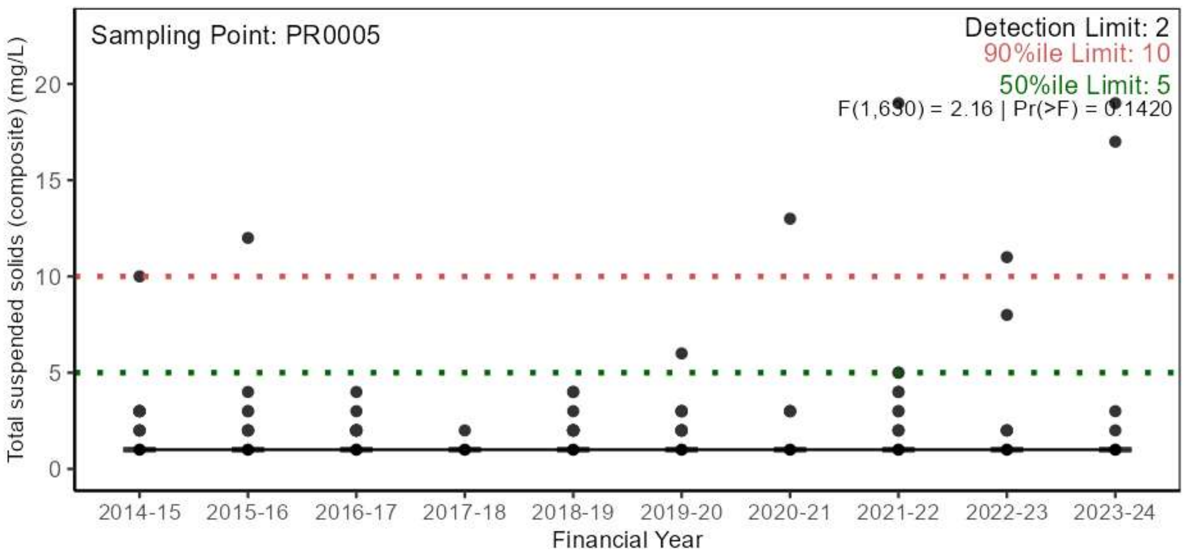


Major conventional analytes: PR0005

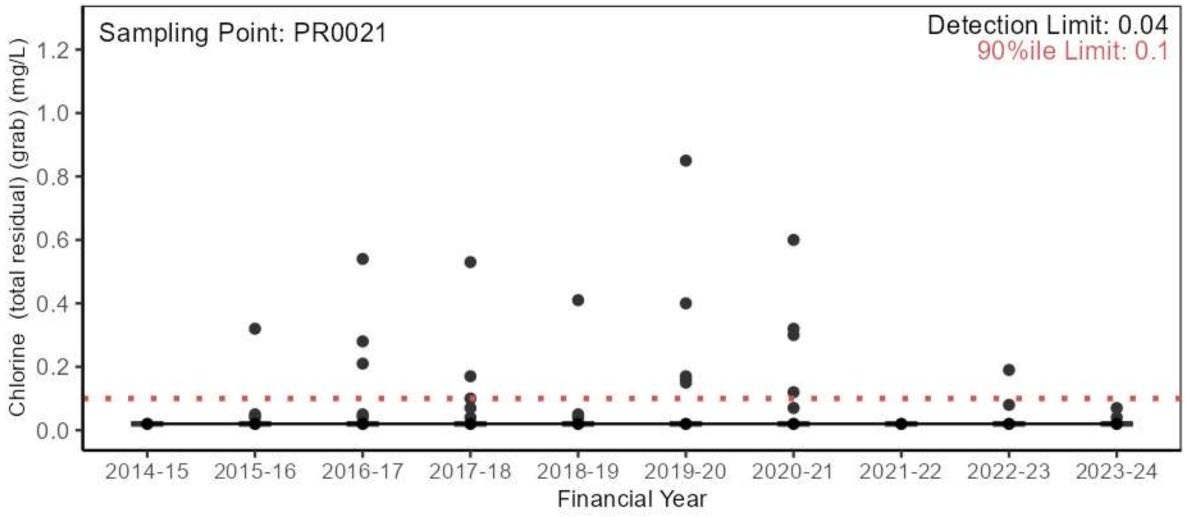




Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

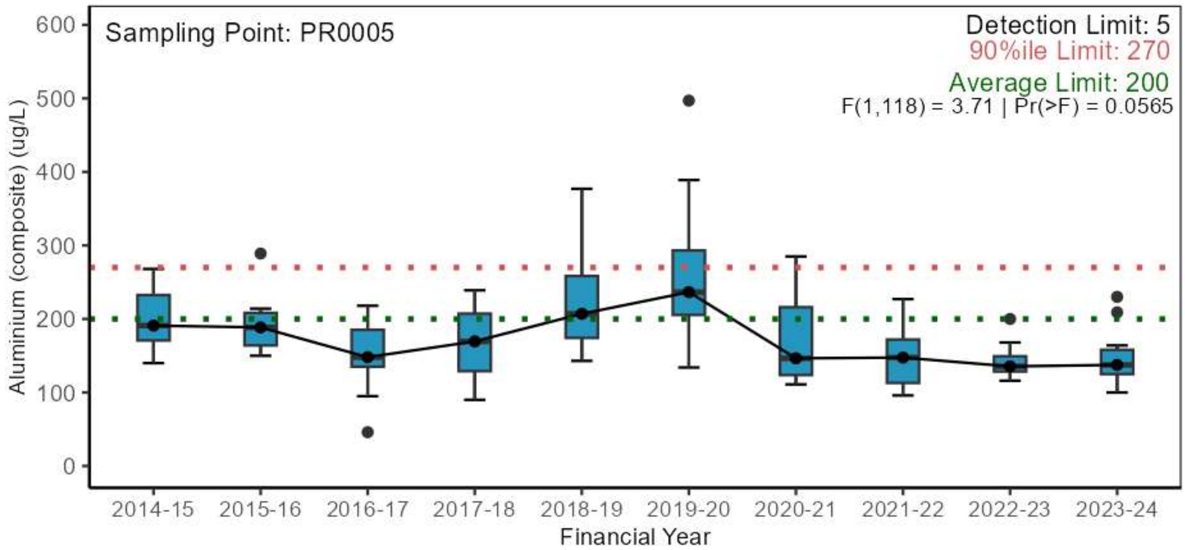


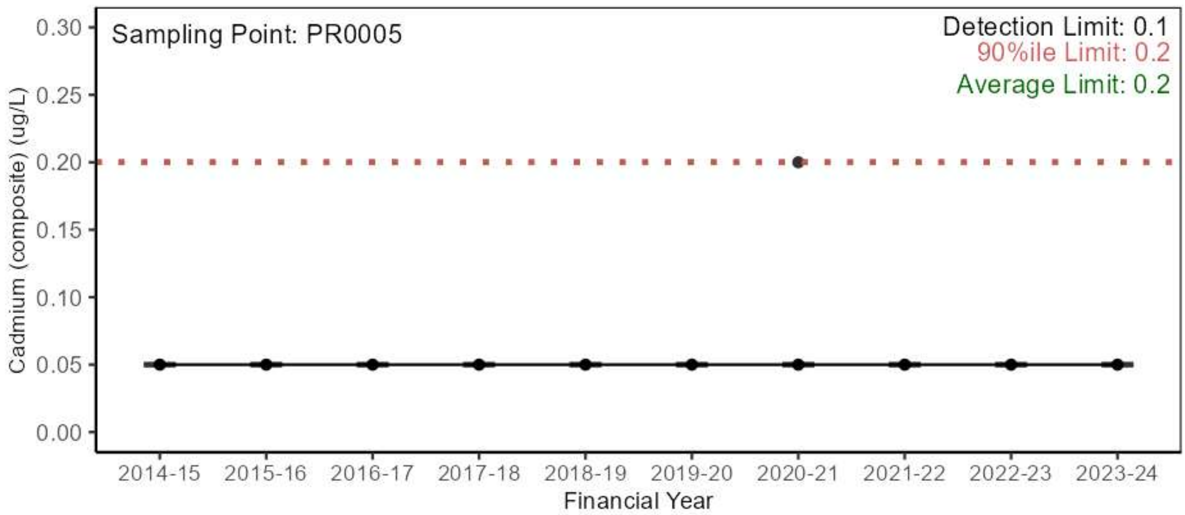
Major conventional analytes: PR0021



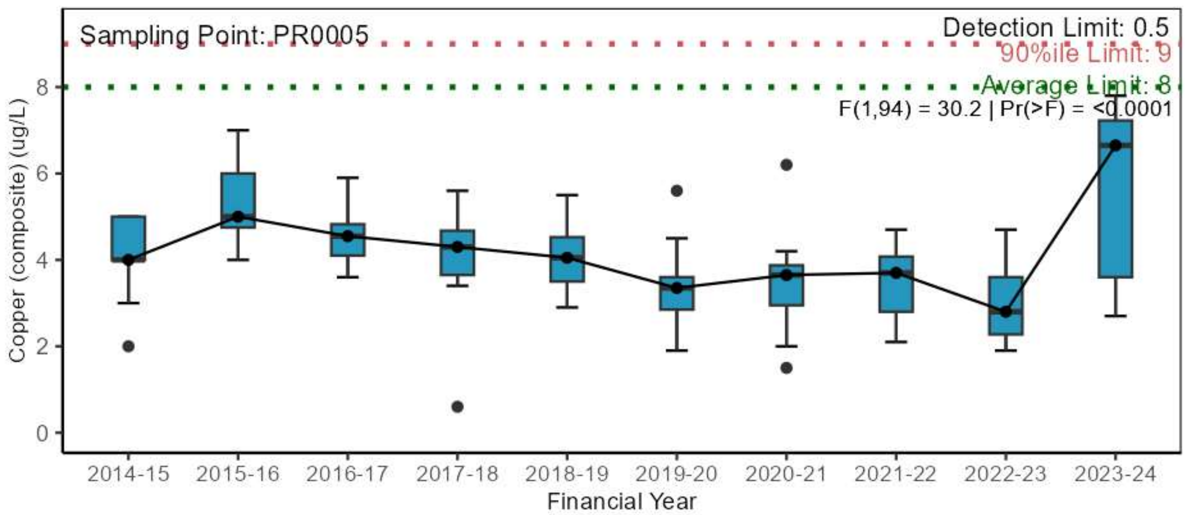
Statistical test not conducted as >90% of results were below detection limits.

Trace metals: PR0005

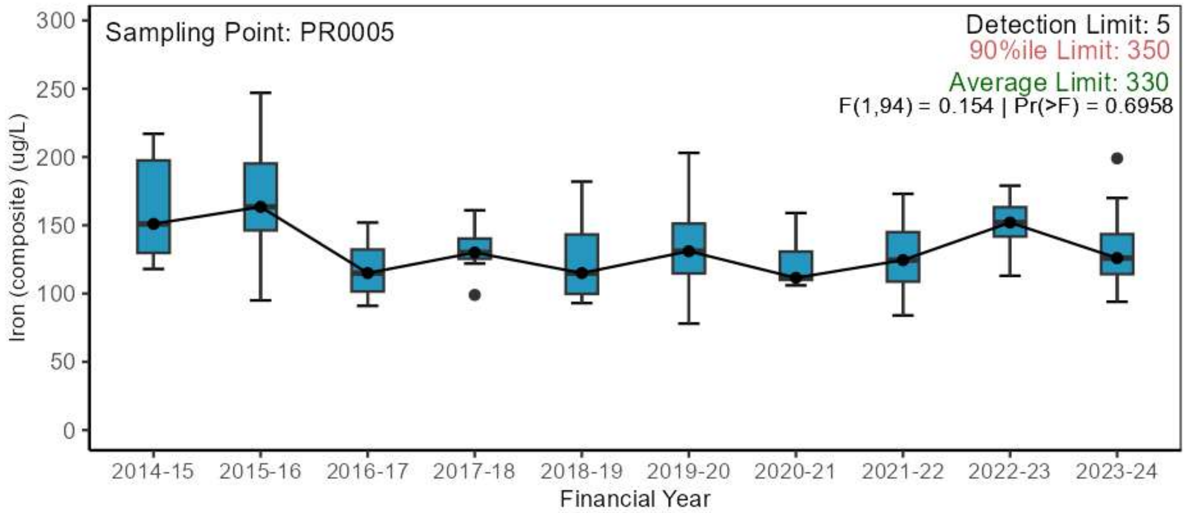




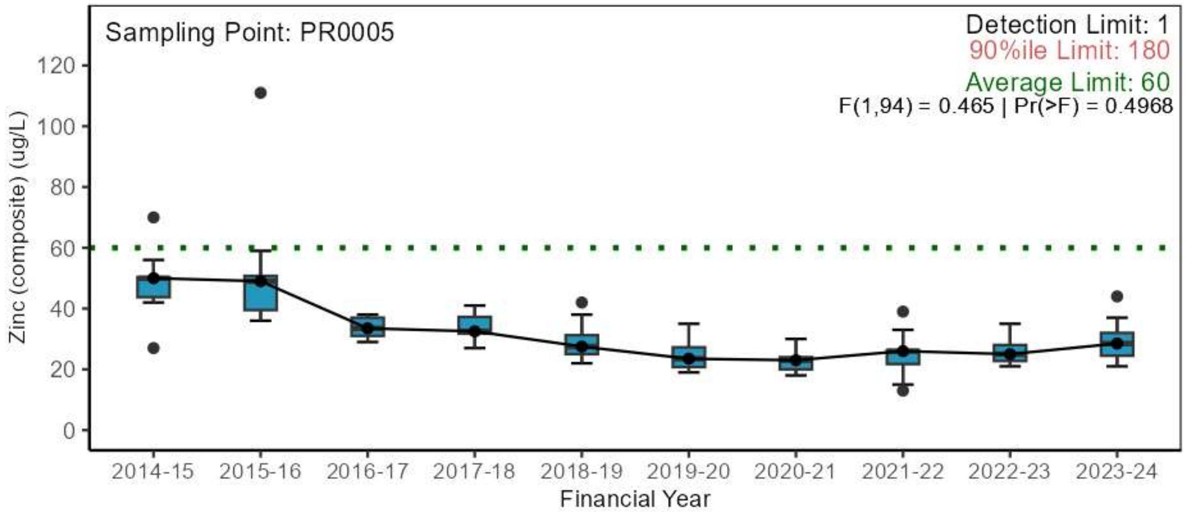
Statistical test not conducted as >90% of results were below detection limits.



Statistical test excludes data prior to 2016-17 due to method detection limit change.

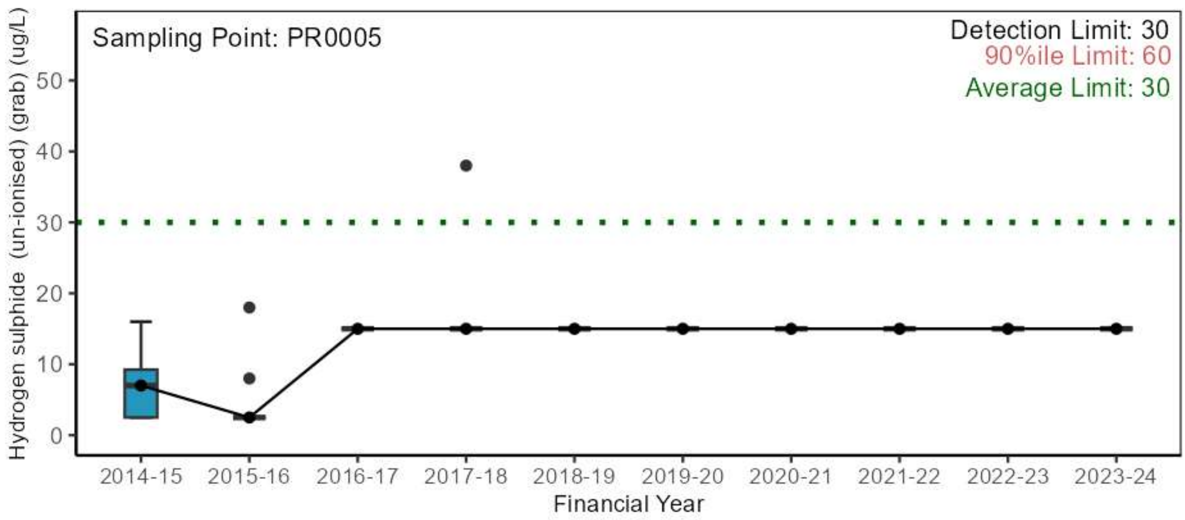


Statistical test excludes data prior to 2016-17 due to method detection limit change.



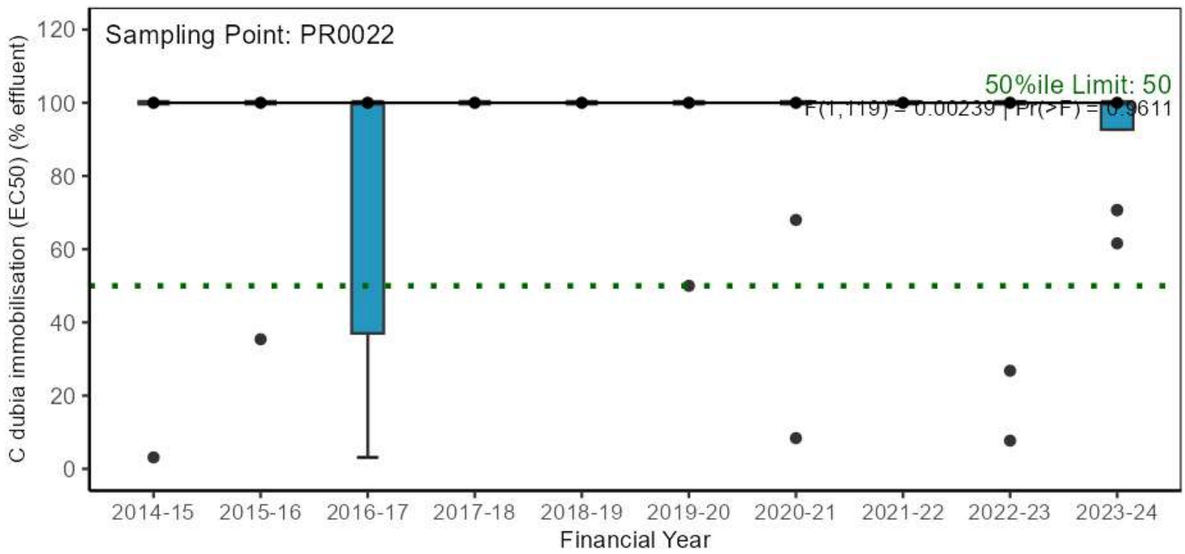
Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides): PR0005



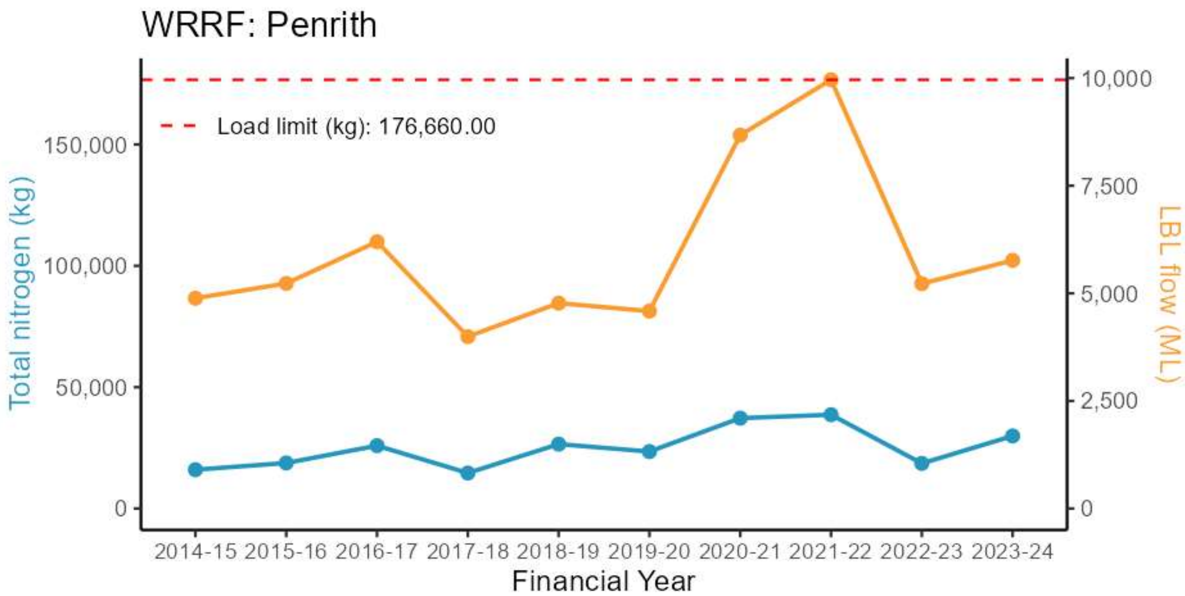
Statistical test not conducted as >90% of results were below detection limits.

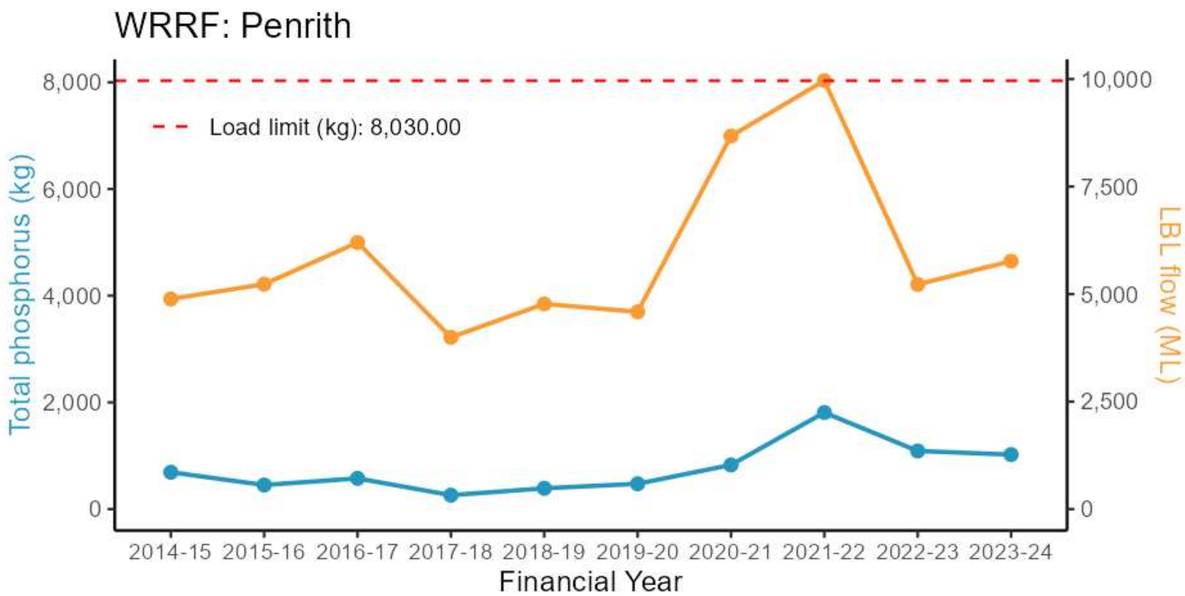
A.4.3. Pressure – Wastewater toxicity



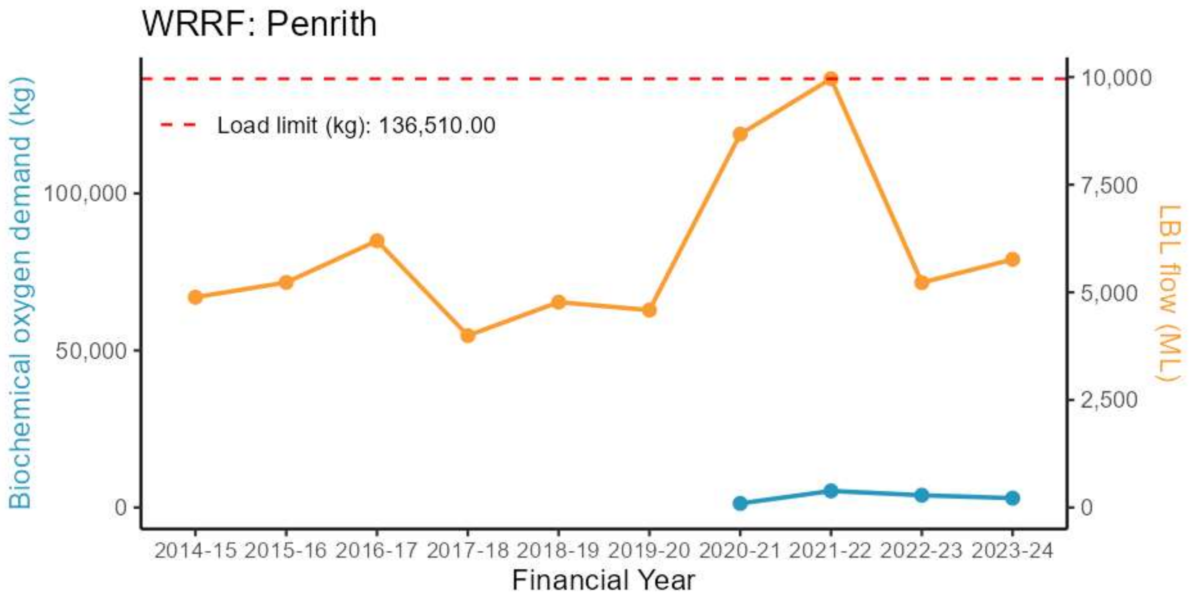
A.4.4. Pressure – Wastewater discharge load

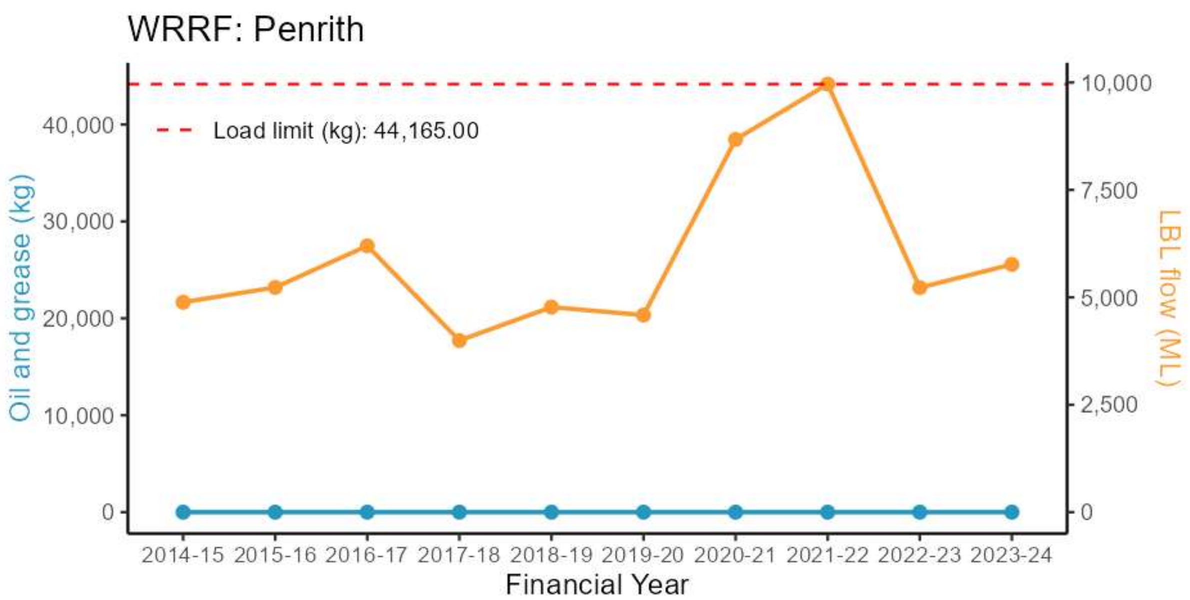
Nutrients

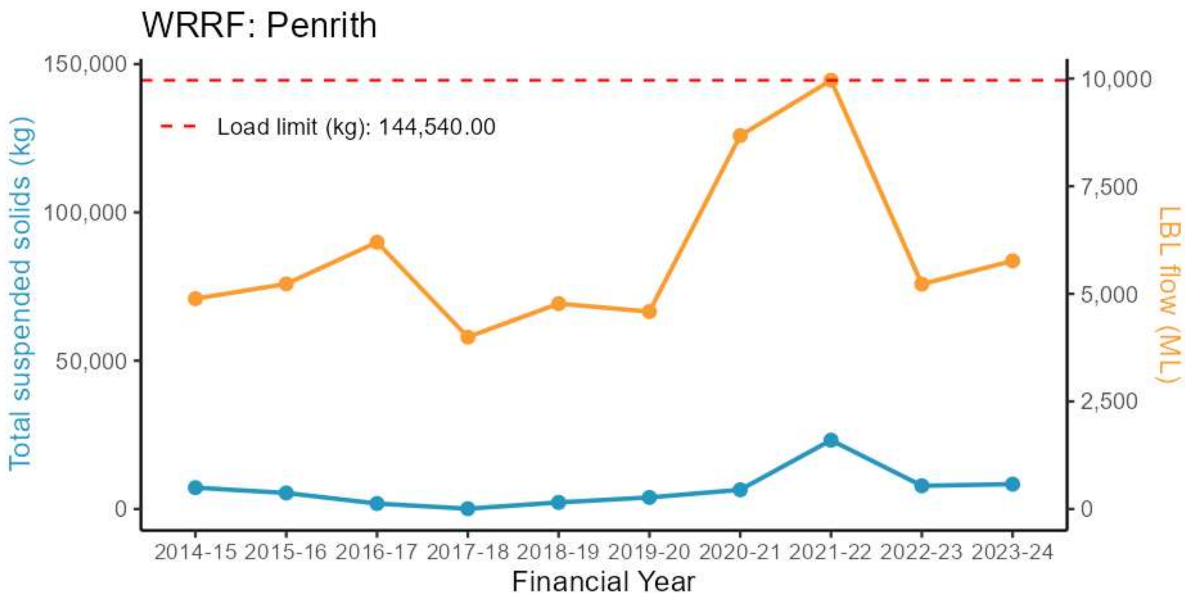




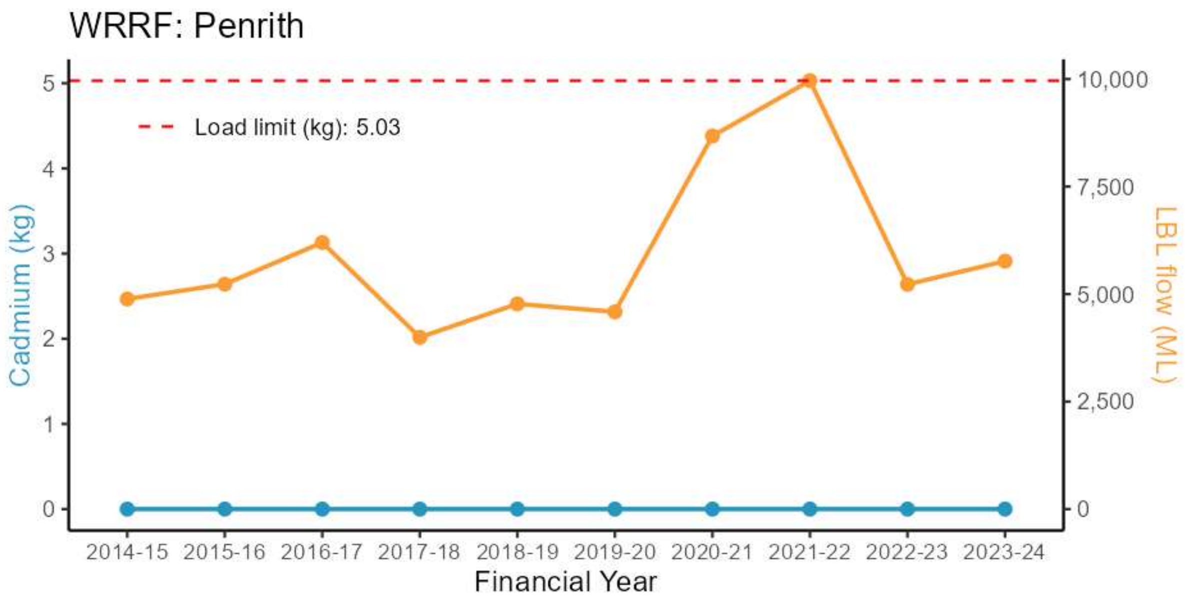
Major conventional analytes

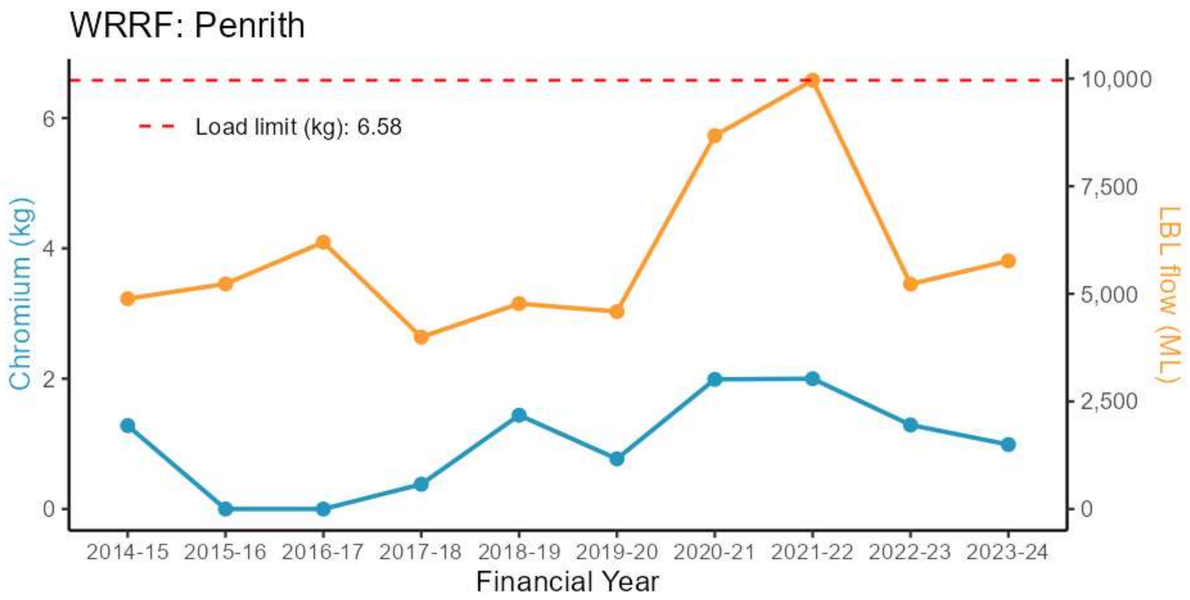


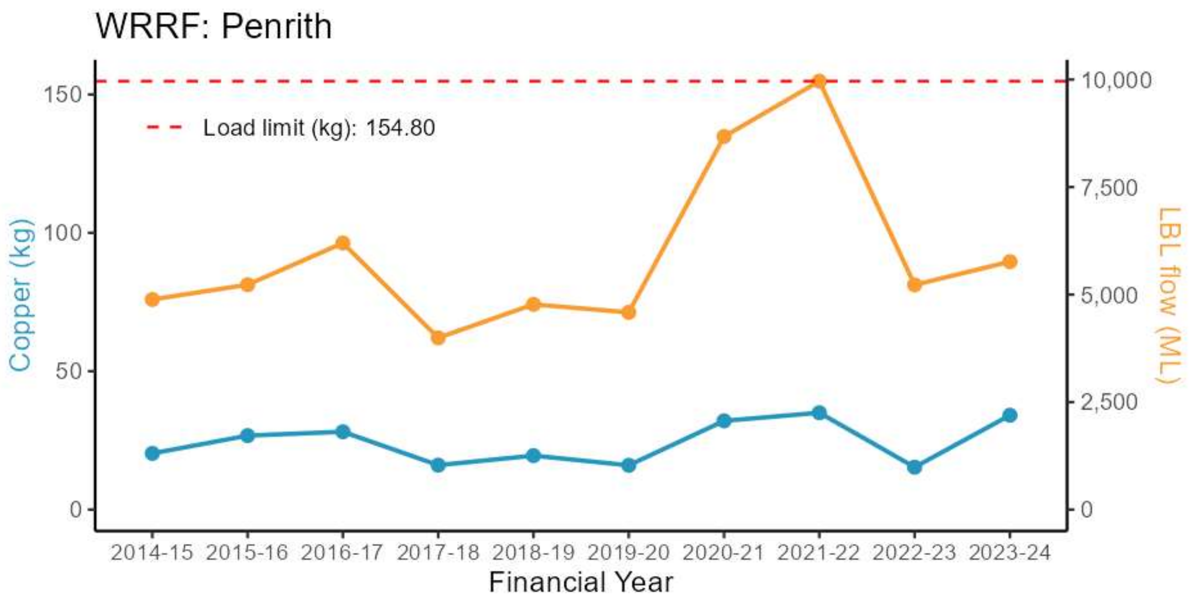


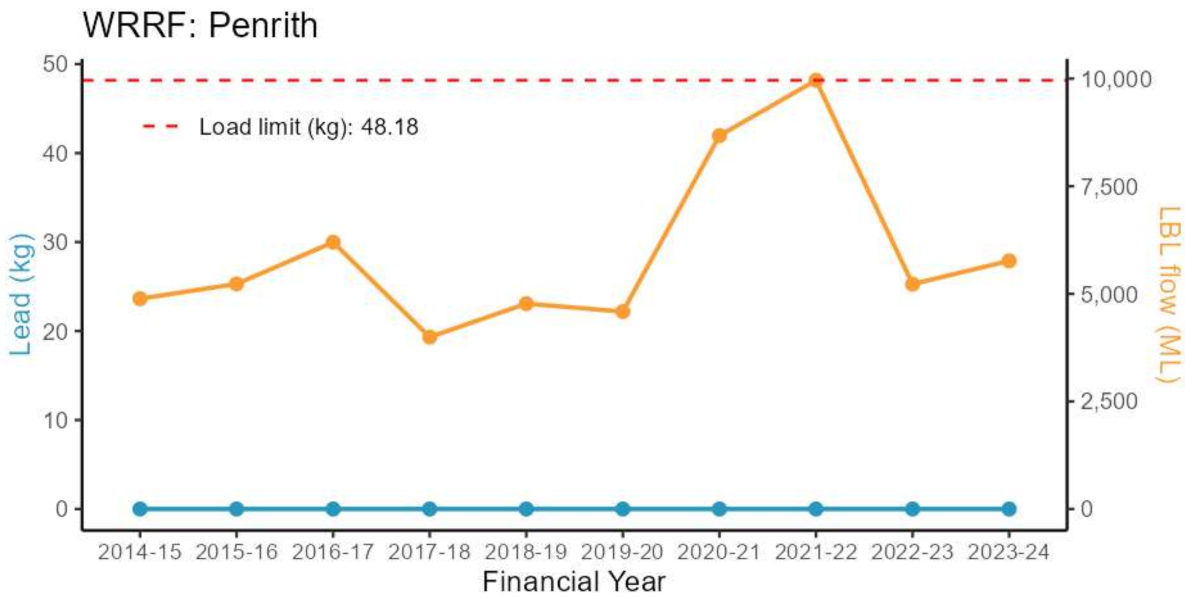


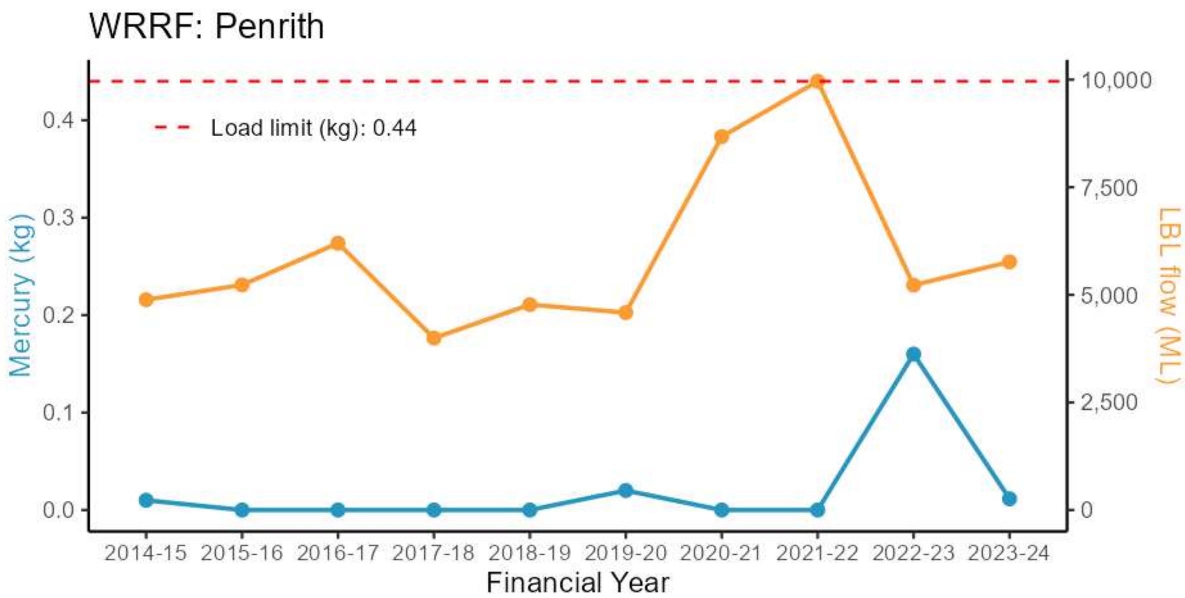
Trace metals

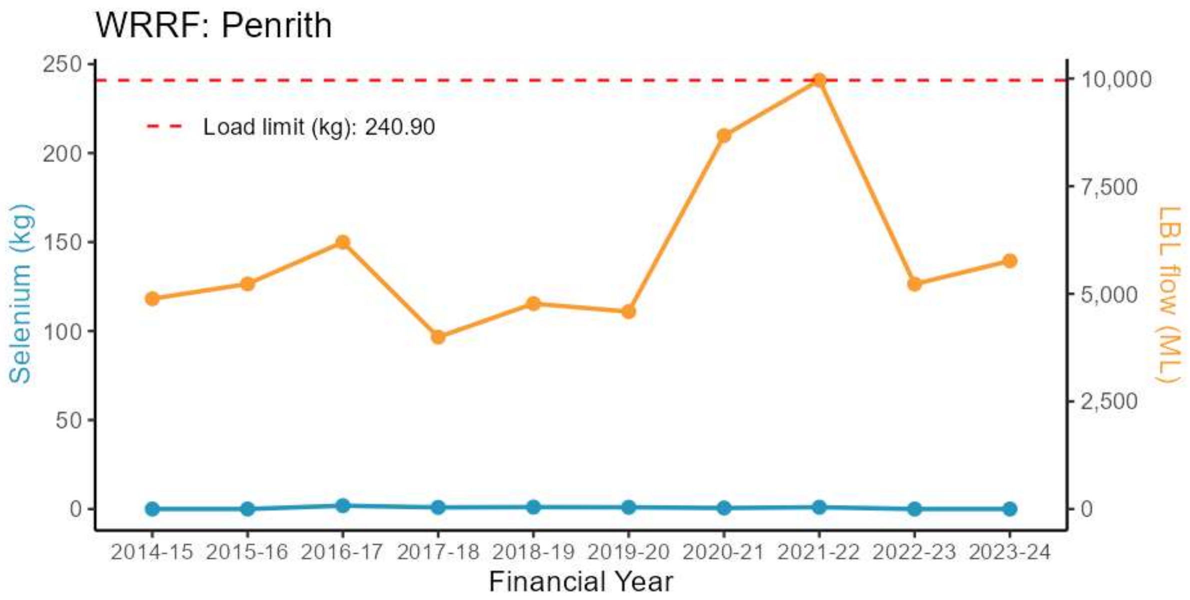



WRRF: Penrith
Load limit (kg): 6.58
Chromium (kg)
LBL flow (ML)
0
2
4
6
0
2,500
5,000
7,500
10,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: Penrith
Load limit (kg): 154.80
Copper (kg)
LBL flow (ML)
0
50
100
150
0
2,500
5,000
7,500
10,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: Penrith
Load limit (kg): 48.18
Lead (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24

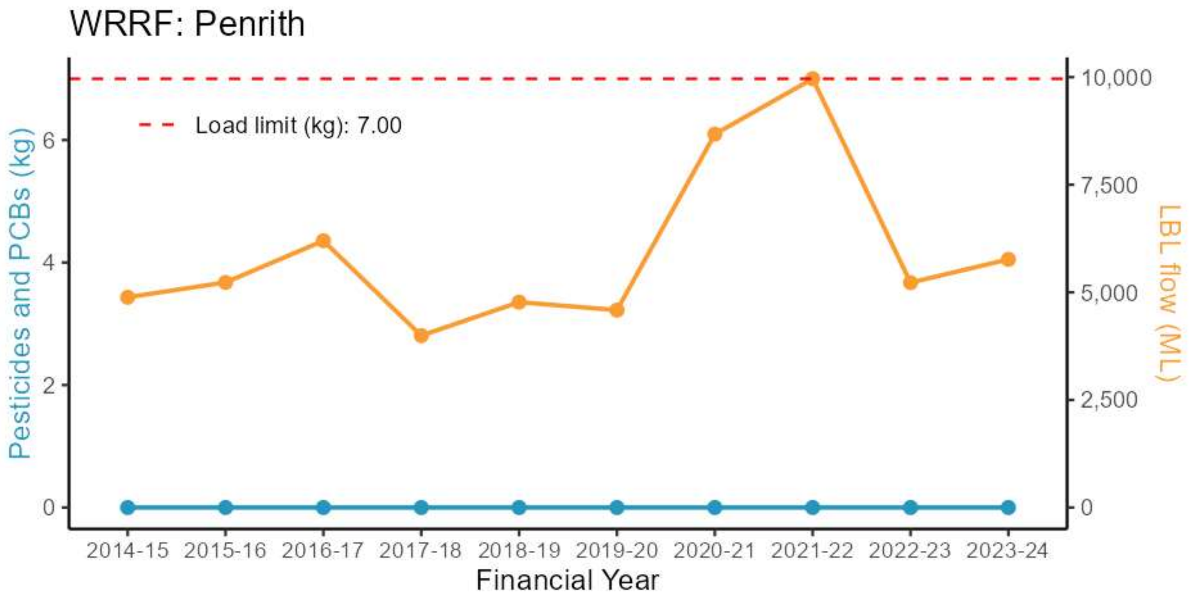

WRRF: Penrith
Load limit (kg): 0.44
Mercury (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24



WRRF: Penrith
Load limit (kg): 240.90
Selenium (kg)
LBL flow (ML)
250
200
150
100
50
0
10,000
7,500
5,000
2,500
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

WRRF: Penrith
Load limit (kg): 2,312.83
Zinc (kg)
LBL flow (ML)
2,000
1,500
1,000
500
0
10,000
7,500
5,000
2,500
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

Other chemical and organics (including pesticides)



A.4.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-7 Downstream vs upstream comparison (current period) contrast outcomes for Penrith WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Boundary Ck	N542 vs N541	Total ammonia nitrogen	0.20	0.10	130	-3.12	0.012
Boundary Ck	N542 vs N541	Oxidised nitrogen	7.94	3.74	130	4.40	<0.001
Boundary Ck	N542 vs N541	Total nitrogen	0.52	0.17	130	-2.00	0.192
Boundary Ck	N542 vs N541	Filterable total phosphorus	0.12	0.05	130	-5.46	<0.001
Boundary Ck	N542 vs N541	Total phosphorus	0.09	0.04	130	-6.28	<0.001
Boundary Ck	N542 vs N541	Conductivity	0.10	0.04	129	-6.30	<0.001
Boundary Ck	N542 vs N541	Dissolved oxygen	1.71	0.30	130	3.05	0.014
Boundary Ck	N542 vs N541	Dissolved oxygen saturation	19.90	10.81	128	1.84	0.259
Boundary Ck	N542 vs N541	pH	-0.49	0.20	130	-2.37	0.087
Boundary Ck	N542 vs N541	Water temperature	1.10	0.08	130	1.22	0.617
Boundary Ck	N542 vs N541	Turbidity	0.12	0.04	130	-6.48	<0.001
Boundary Ck	N542 vs N541	Chlorophyll - a	0.04	0.02	130	-7.93	<0.001
Nepean R	N57 vs N53	Total ammonia nitrogen	2.36	0.63	223	3.21	0.008
Nepean R	N57 vs N53	Oxidised nitrogen	1.17	0.36	223	0.50	0.958
Nepean R	N57 vs N53	Total nitrogen	1.08	0.12	223	0.74	0.882
Nepean R	N57 vs N53	Filterable total phosphorus	1.40	0.20	223	2.33	0.093
Nepean R	N57 vs N53	Total phosphorus	1.39	0.19	223	2.40	0.080
Nepean R	N57 vs N53	Conductivity	1.00	0.08	223	0.04	1.000
Nepean R	N57 vs N53	Dissolved oxygen	1.00	0.05	223	-0.01	1.000
Nepean R	N57 vs N53	Dissolved oxygen saturation	-1.61	3.24	223	-0.50	0.960
Nepean R	N57 vs N53	pH	-0.06	0.11	223	-0.48	0.963
Nepean R	N57 vs N53	Water temperature	0.96	0.09	223	-0.44	0.972
Nepean R	N57 vs N53	Turbidity	1.05	0.23	223	0.23	0.995
Nepean R	N57 vs N53	Chlorophyll - a	0.77	0.18	222	-1.10	0.692

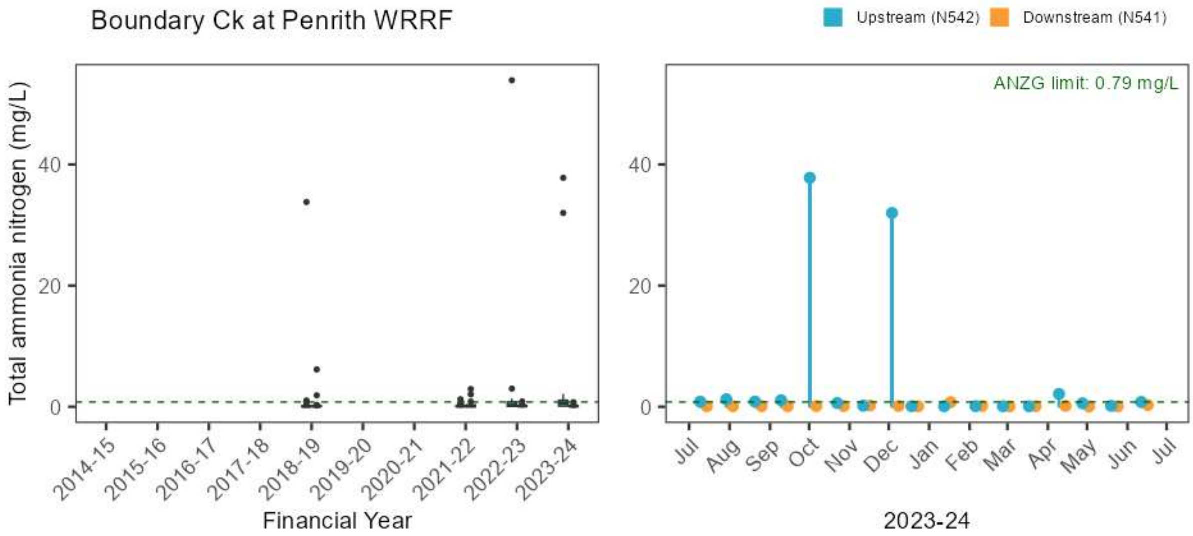
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

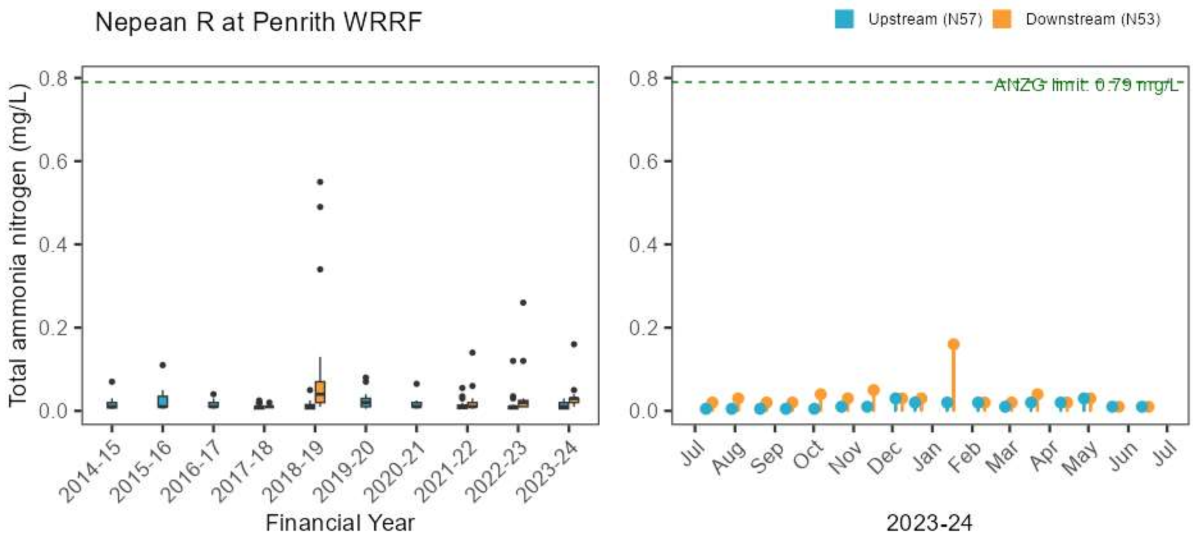
Table A-8 Current period vs previous period comparison (single site) contrast outcomes for Penrith WRRF

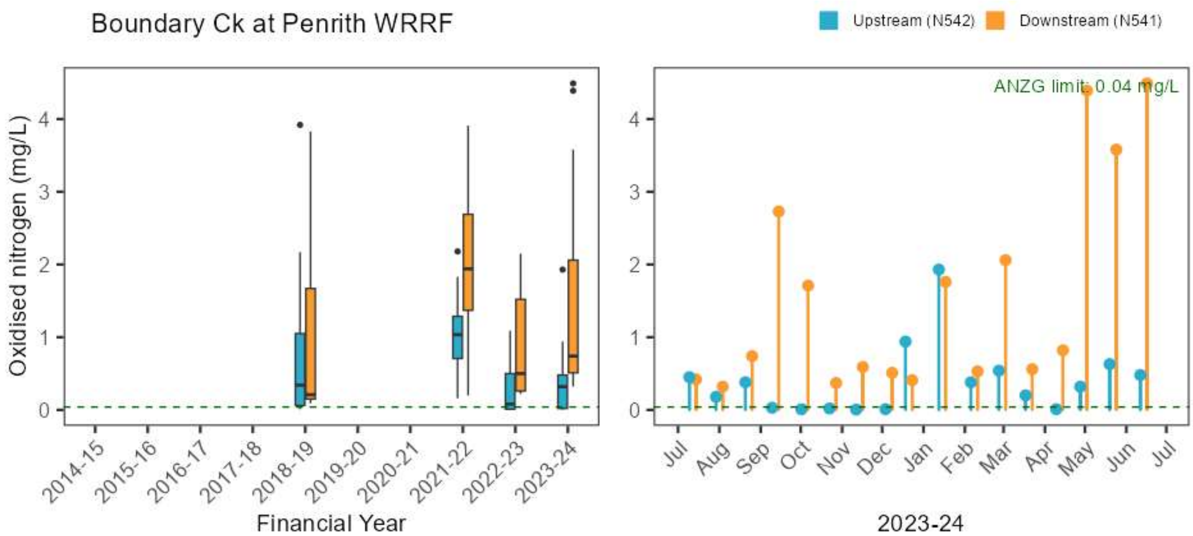
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Boundary Ck	N542	Total ammonia nitrogen	3.91	1.66	130	3.21	0.009
Boundary Ck	N542	Oxidised nitrogen	0.50	0.19	130	-1.82	0.267
Boundary Ck	N542	Total nitrogen	1.35	0.36	130	1.13	0.675
Boundary Ck	N542	Filterable total phosphorus	1.66	0.53	130	1.59	0.386
Boundary Ck	N542	Total phosphorus	1.83	0.56	130	1.98	0.202
Boundary Ck	N542	Conductivity	0.92	0.28	129	-0.26	0.994
Boundary Ck	N542	Dissolved oxygen	0.52	0.07	130	-4.58	<0.001
Boundary Ck	N542	Dissolved oxygen saturation	-36.82	8.83	128	-4.17	<0.001
Boundary Ck	N542	pH	-0.66	0.17	130	-3.96	<0.001
Boundary Ck	N542	Water temperature	1.07	0.07	130	1.08	0.702
Boundary Ck	N542	Turbidity	1.46	0.40	130	1.39	0.507
Boundary Ck	N542	Chlorophyll - a	1.01	0.32	130	0.04	1.000
Boundary Ck	N541	Total ammonia nitrogen	0.90	0.38	130	-0.25	0.994
Boundary Ck	N541	Oxidised nitrogen	1.33	0.51	130	0.75	0.878
Boundary Ck	N541	Total nitrogen	1.09	0.29	130	0.31	0.989
Boundary Ck	N541	Filterable total phosphorus	1.20	0.38	130	0.57	0.941
Boundary Ck	N541	Total phosphorus	1.08	0.33	130	0.26	0.994
Boundary Ck	N541	Conductivity	0.78	0.23	129	-0.87	0.819
Boundary Ck	N541	Dissolved oxygen	1.05	0.15	130	0.33	0.988
Boundary Ck	N541	Dissolved oxygen saturation	4.41	8.82	128	0.50	0.959
Boundary Ck	N541	pH	0.03	0.17	130	0.21	0.997
Boundary Ck	N541	Water temperature	1.04	0.06	130	0.60	0.932
Boundary Ck	N541	Turbidity	0.91	0.25	130	-0.33	0.987
Boundary Ck	N541	Chlorophyll - a	0.67	0.21	130	-1.27	0.586
Nepean R	N57	Total ammonia nitrogen	1.07	0.23	223	0.30	0.990
Nepean R	N57	Oxidised nitrogen	1.96	0.50	223	2.67	0.040
Nepean R	N57	Total nitrogen	1.27	0.11	223	2.69	0.038
Nepean R	N57	Filterable total phosphorus	0.67	0.08	223	-3.32	0.006
Nepean R	N57	Total phosphorus	0.82	0.09	223	-1.81	0.274
Nepean R	N57	Conductivity	1.20	0.08	223	2.79	0.029
Nepean R	N57	Dissolved oxygen	0.97	0.04	223	-0.78	0.862
Nepean R	N57	Dissolved oxygen saturation	-0.16	2.64	223	-0.06	1.000
Nepean R	N57	pH	-0.10	0.09	223	-1.11	0.683
Nepean R	N57	Water temperature	1.11	0.09	223	1.35	0.533
Nepean R	N57	Turbidity	0.89	0.16	223	-0.66	0.912
Nepean R	N57	Chlorophyll - a	1.19	0.23	222	0.92	0.795
Nepean R	N53	Total ammonia nitrogen	1.05	0.23	223	0.20	0.997
Nepean R	N53	Oxidised nitrogen	1.44	0.37	223	1.42	0.486
Nepean R	N53	Total nitrogen	1.12	0.10	223	1.29	0.573
Nepean R	N53	Filterable total phosphorus	0.74	0.09	223	-2.47	0.068
Nepean R	N53	Total phosphorus	0.93	0.11	223	-0.61	0.928
Nepean R	N53	Conductivity	1.14	0.07	223	2.04	0.177
Nepean R	N53	Dissolved oxygen	0.98	0.04	223	-0.55	0.946
Nepean R	N53	Dissolved oxygen saturation	0.38	2.66	223	0.14	0.999
Nepean R	N53	pH	-0.09	0.09	223	-0.93	0.791
Nepean R	N53	Water temperature	1.08	0.08	223	0.92	0.792
Nepean R	N53	Turbidity	0.86	0.16	223	-0.83	0.839
Nepean R	N53	Chlorophyll - a	0.90	0.17	222	-0.54	0.949

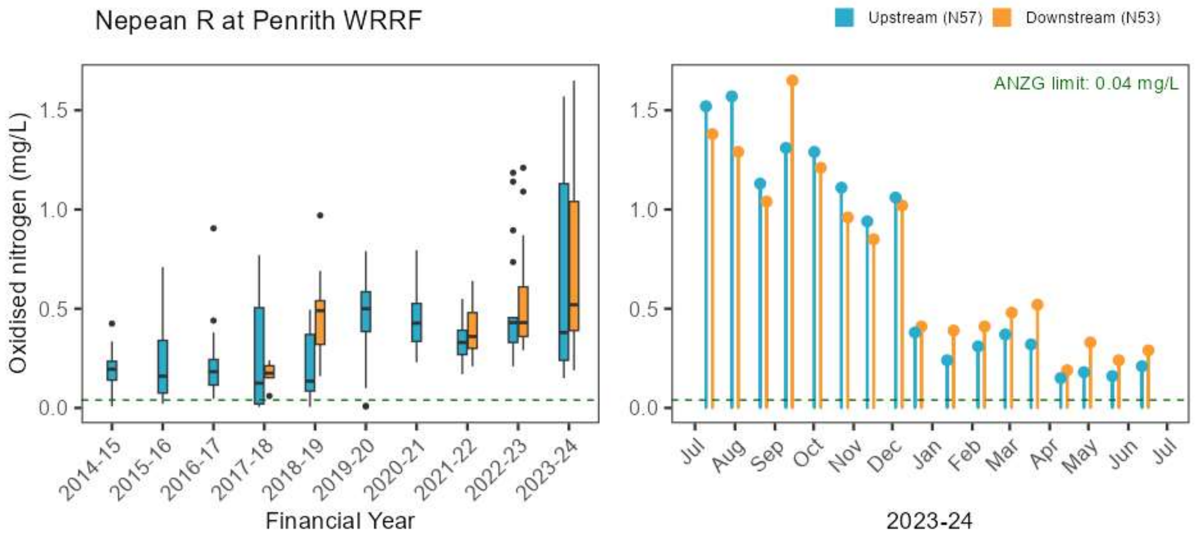
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.4.6. Stressor – Nutrients

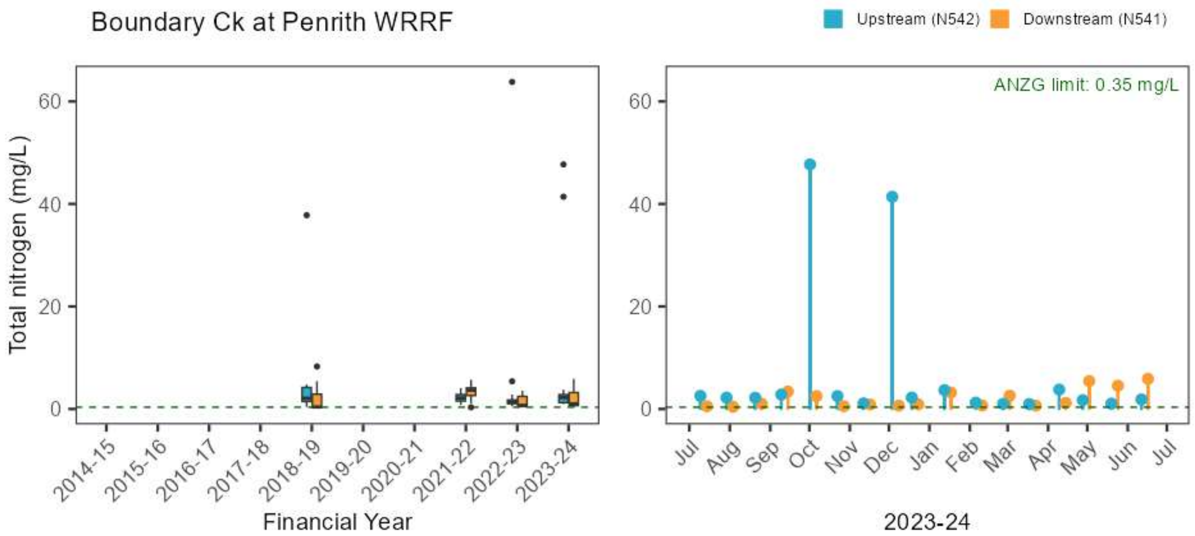




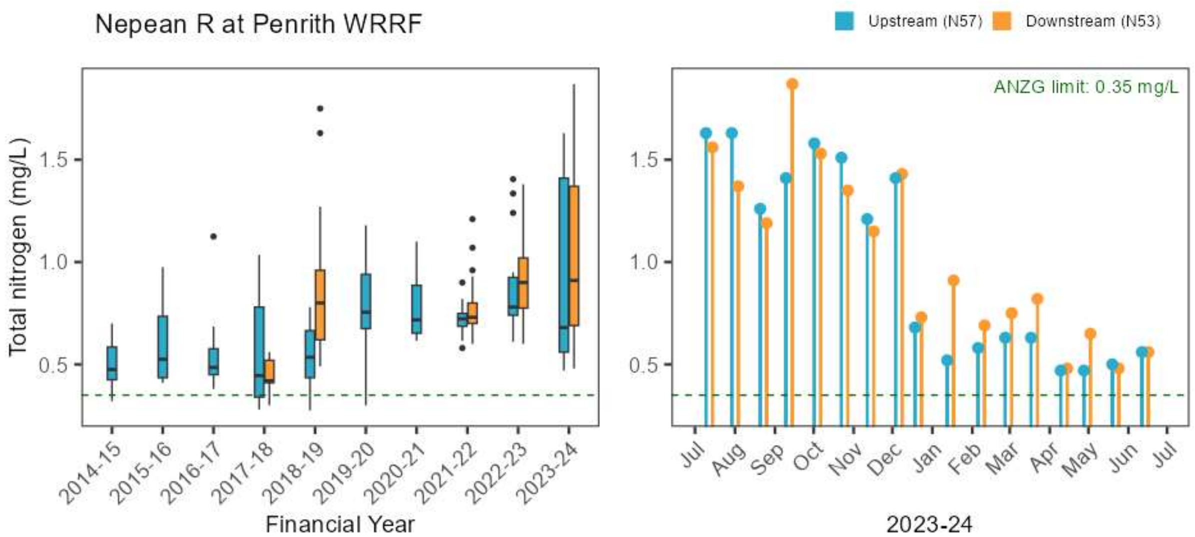




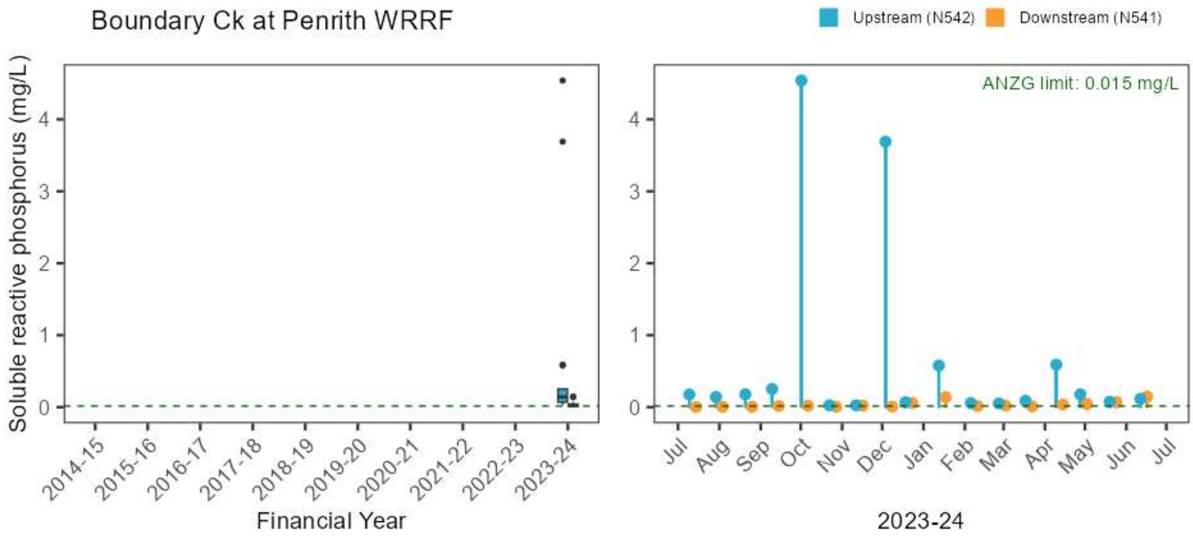
Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
Financial Year
2023-24



Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24



Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24


Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
0
1
2
3
4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Nov
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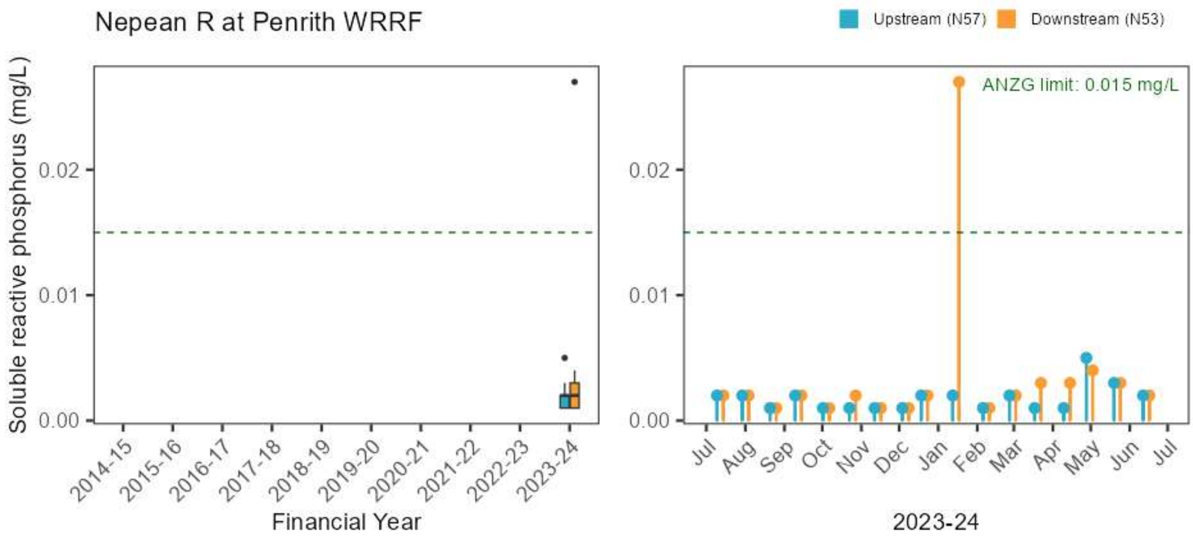
Feb
Mar
Apr
May
Jun
Jul
2023-24


Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
0.00
0.01
0.02
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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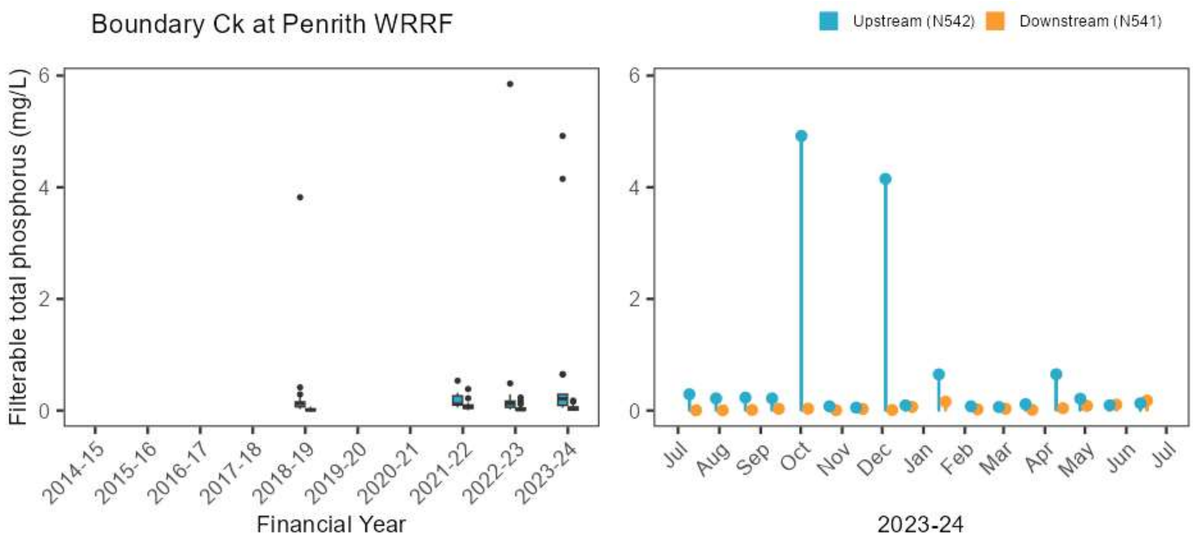
Jun
Jul
2023-24


Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Filterable total phosphorus (mg/L)
0
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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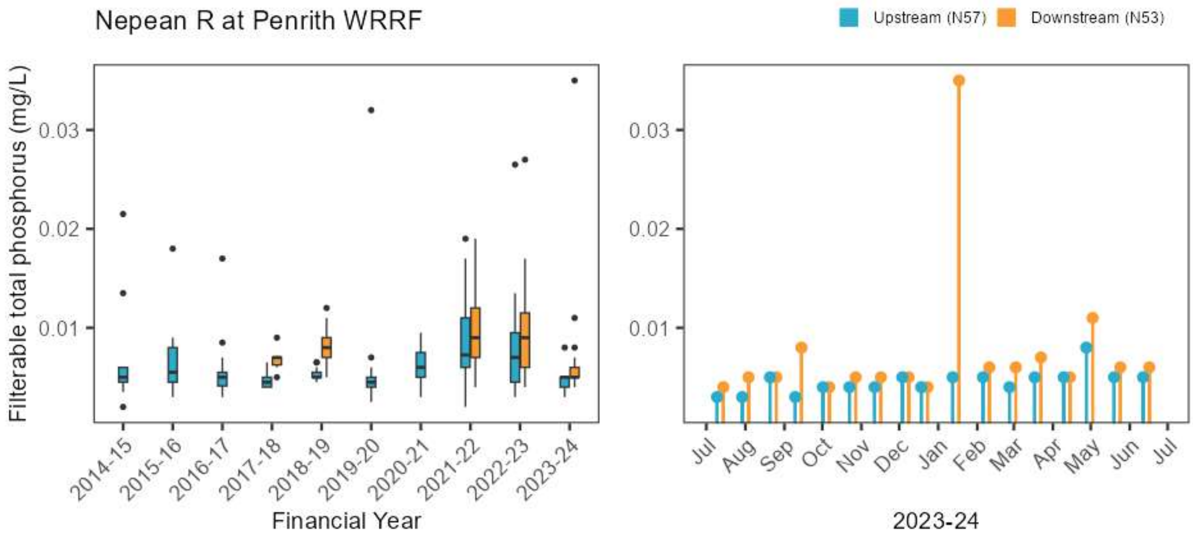
Jun
Jul
2023-24


Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Filterable total phosphorus (mg/L)
0.01
0.02
0.03
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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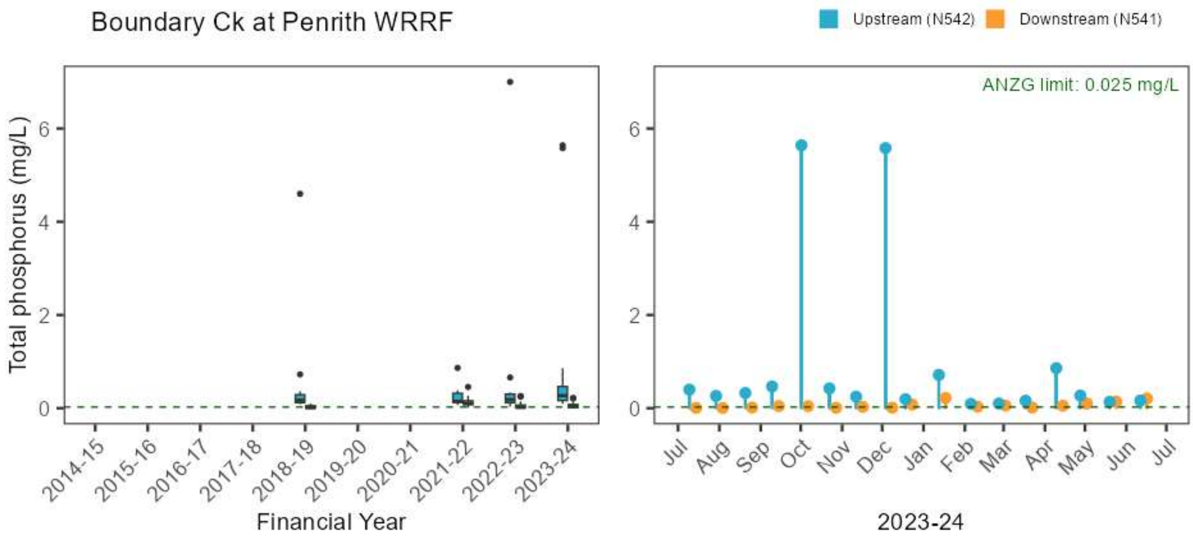
2023-24


Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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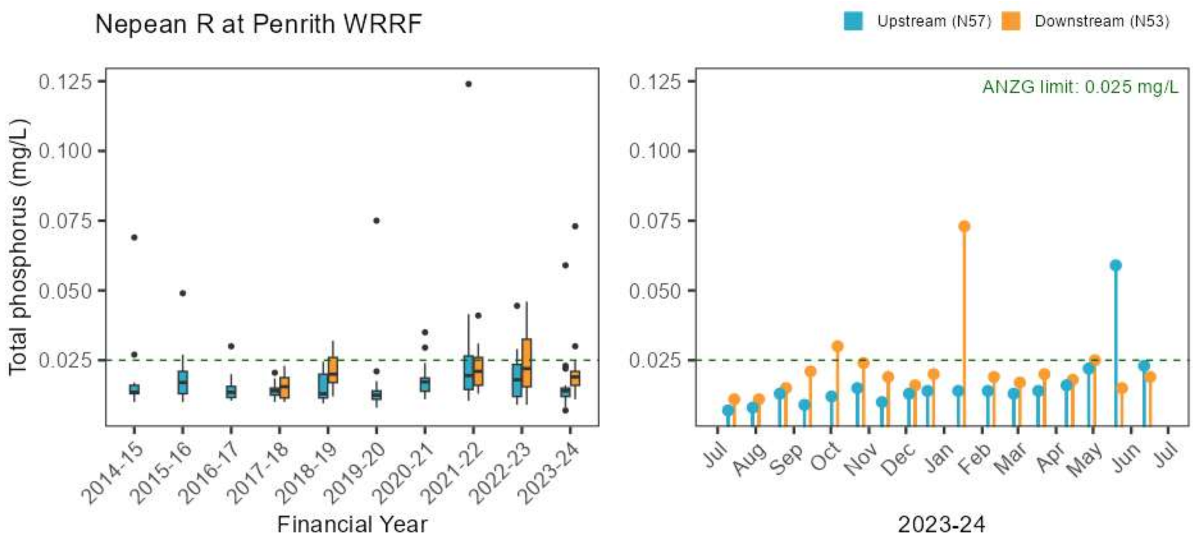
Jul
2023-24


Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.025
0.050
0.075
0.100
0.125
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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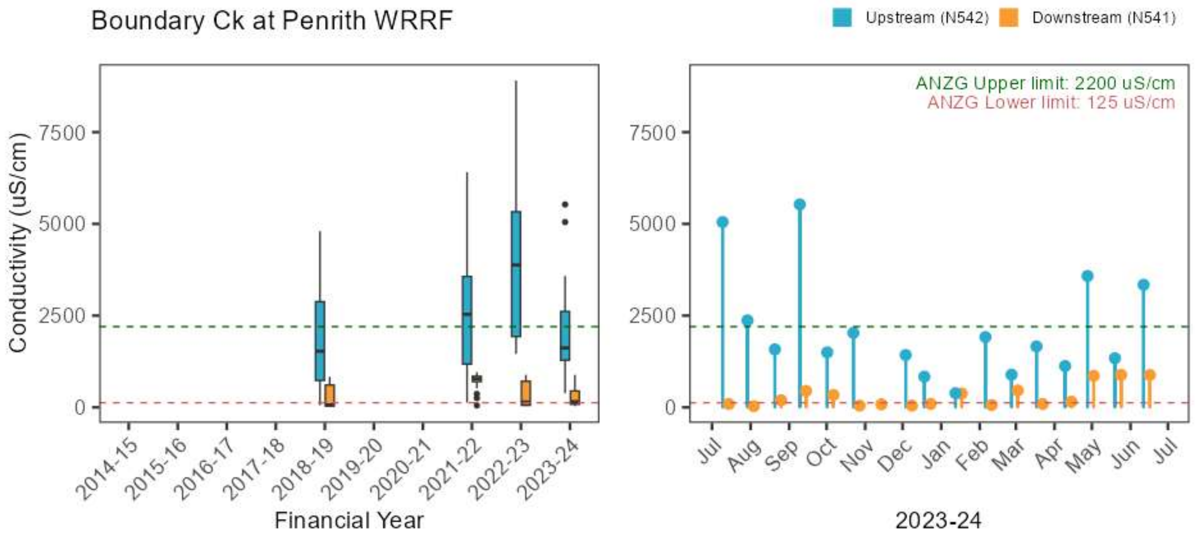
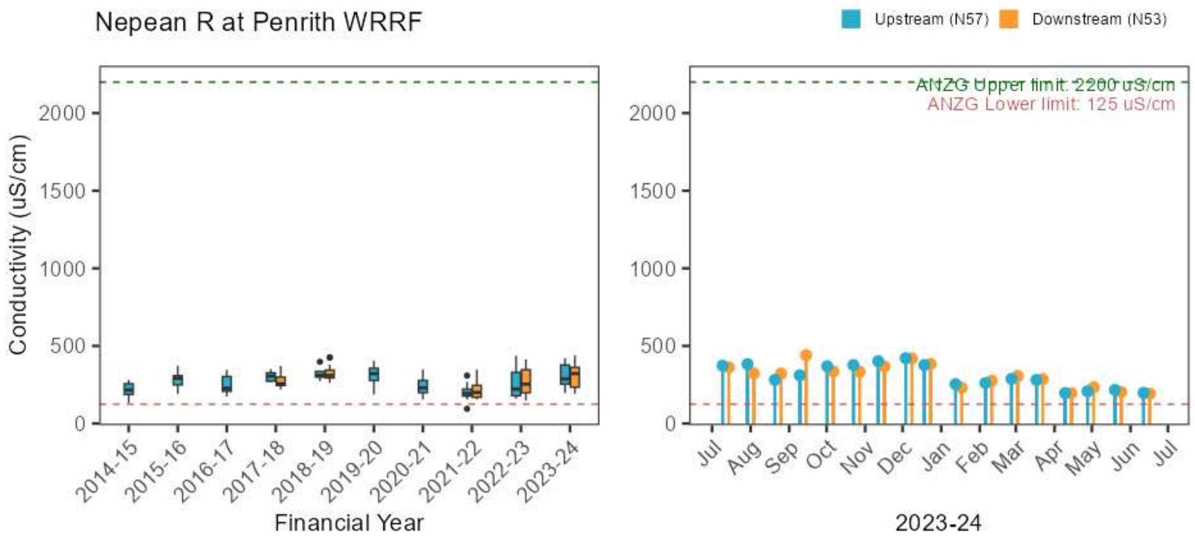
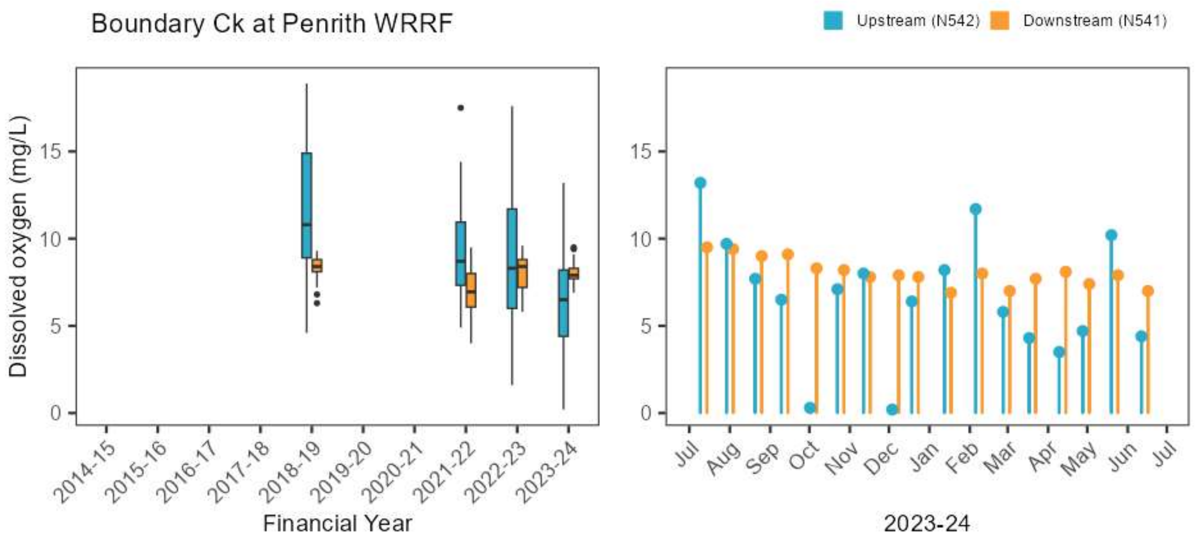
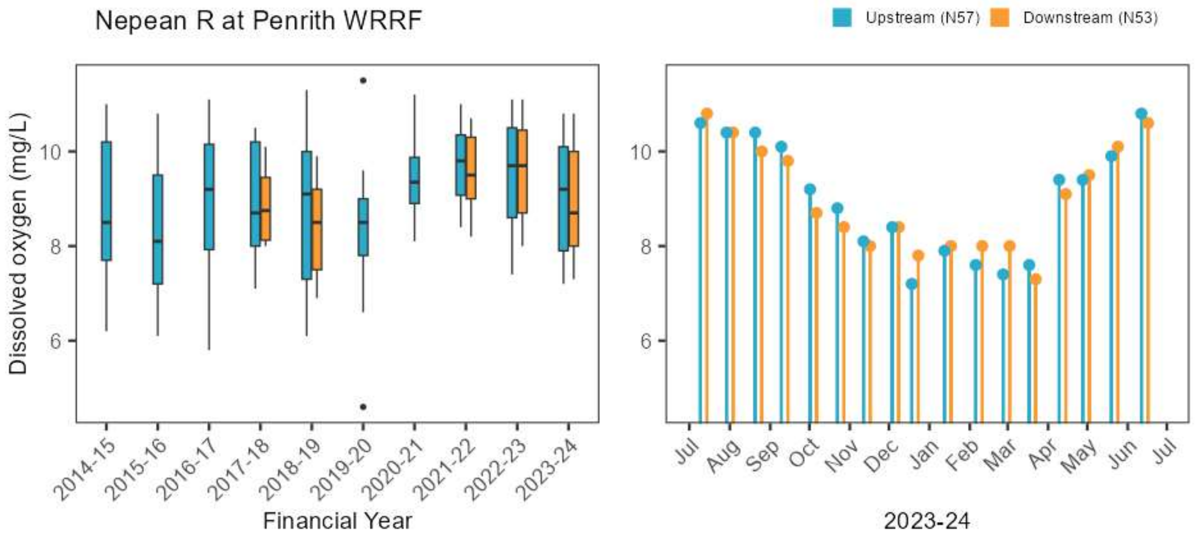
Jul
2023-24

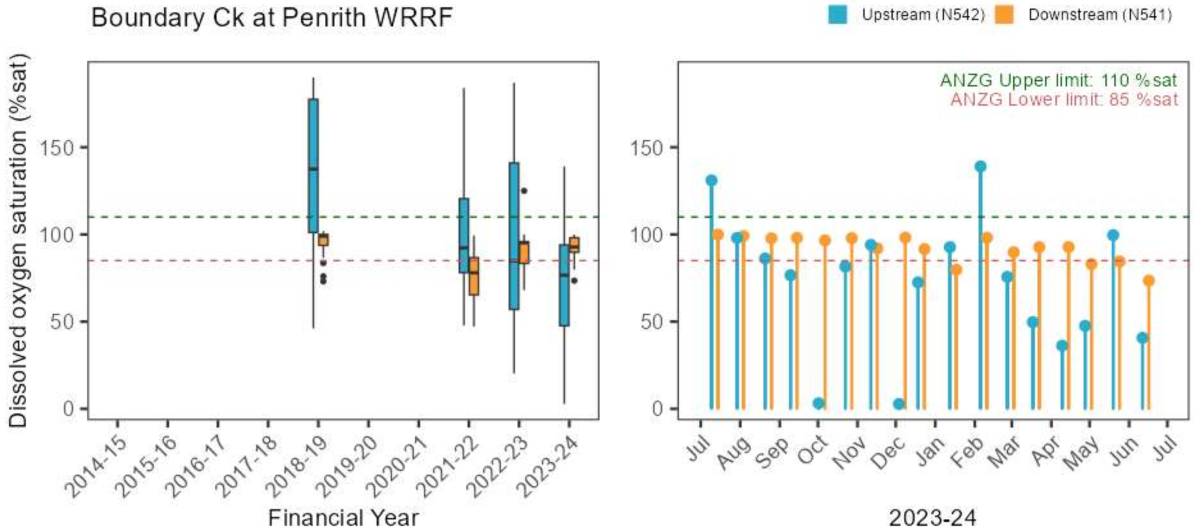
A.4.7. Stressor – Physico-chemical water quality

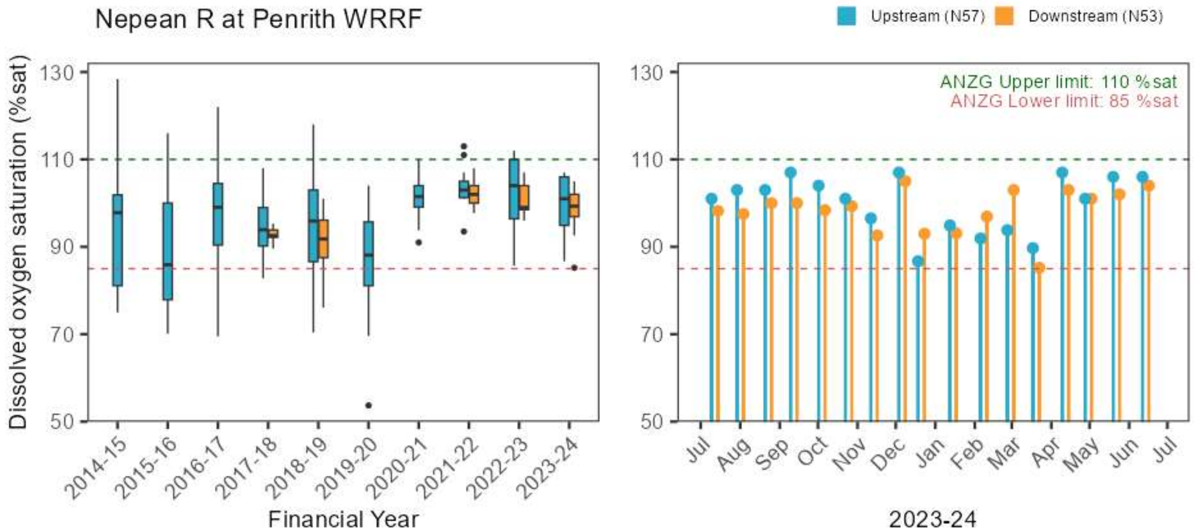


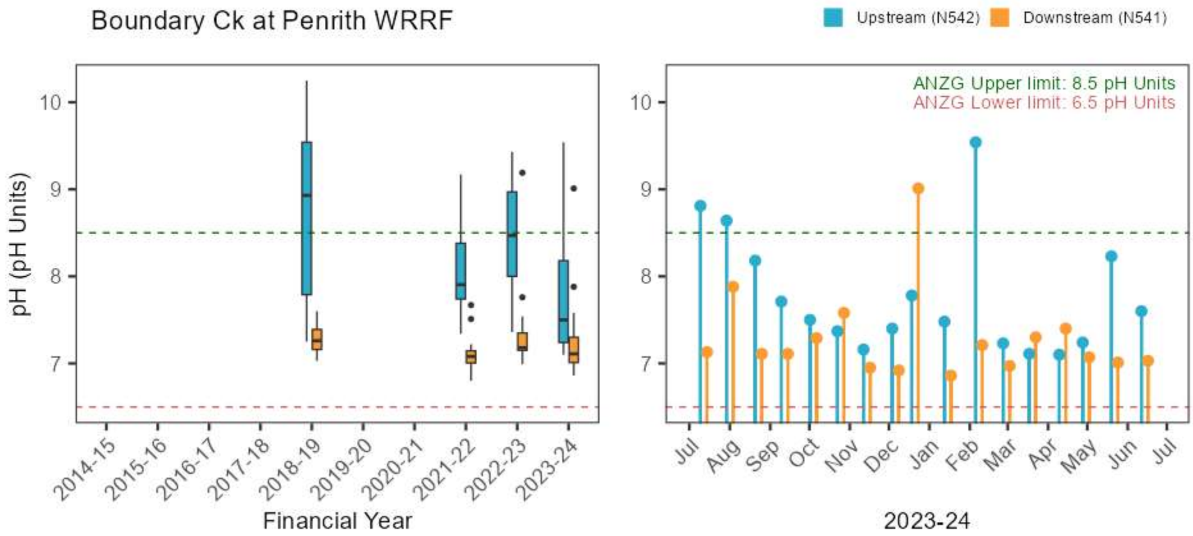




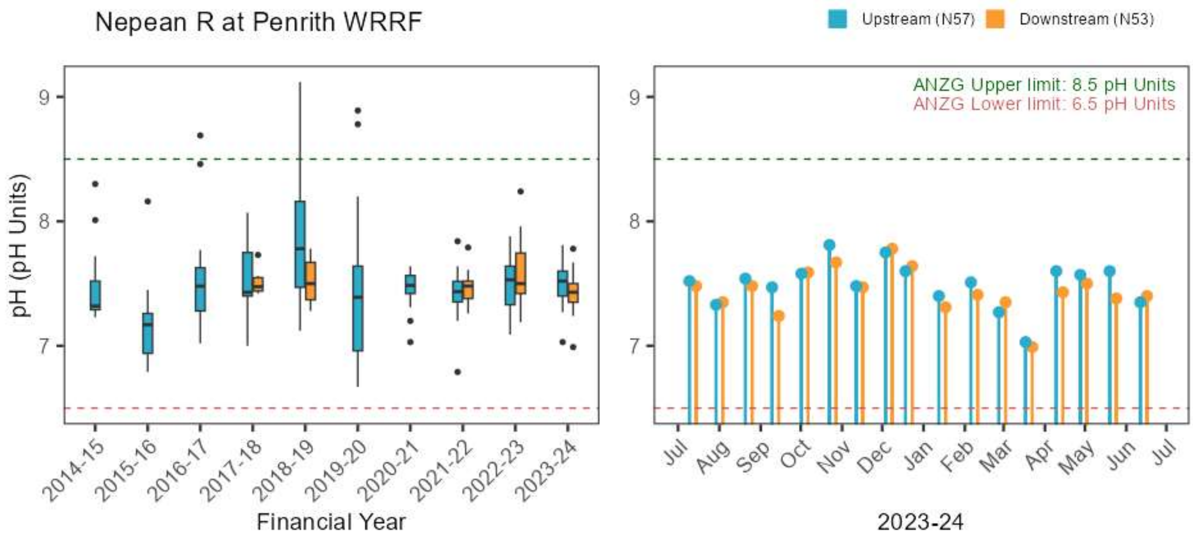

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Dissolved oxygen (mg/L)
Financial Year
2023-24


Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Dissolved oxygen saturation (%sat)
Financial Year
2023-24

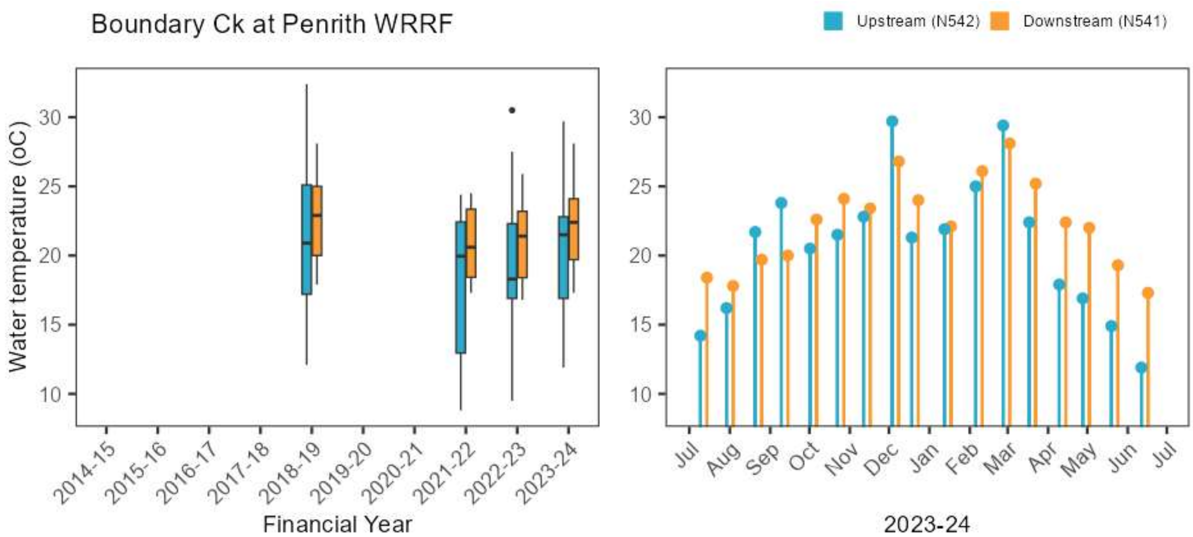

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Dissolved oxygen saturation (%sat)
Financial Year
2023-24



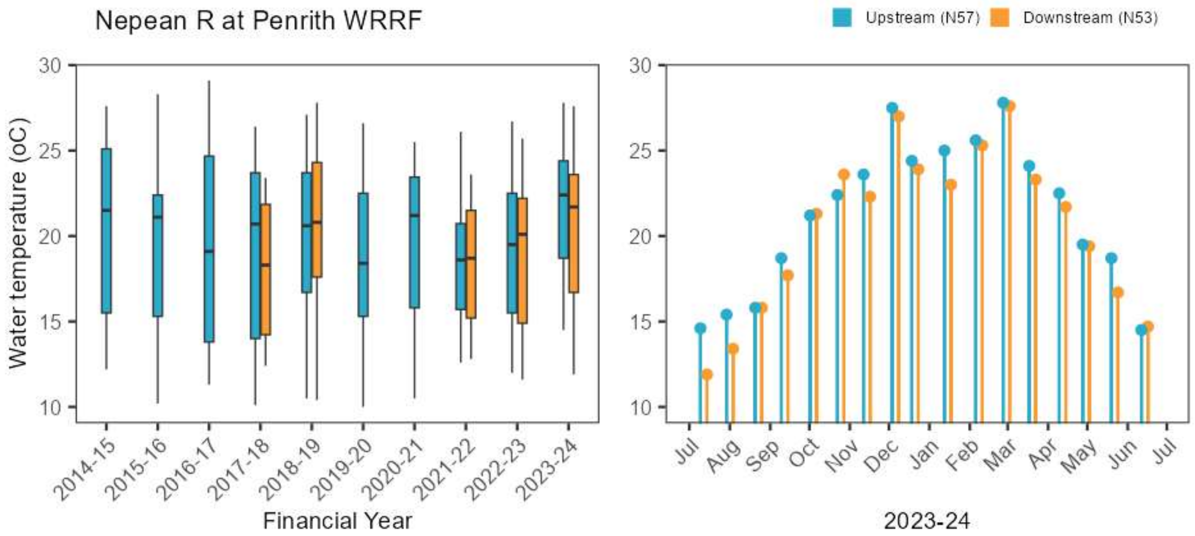
Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
pH (pH Units)
Financial Year
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
2023-24

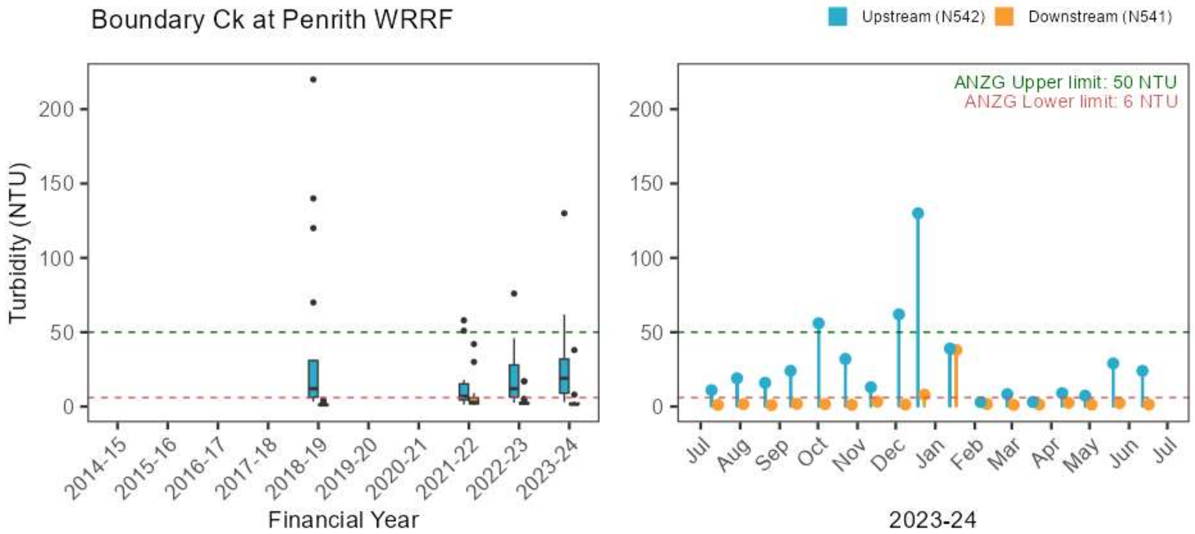


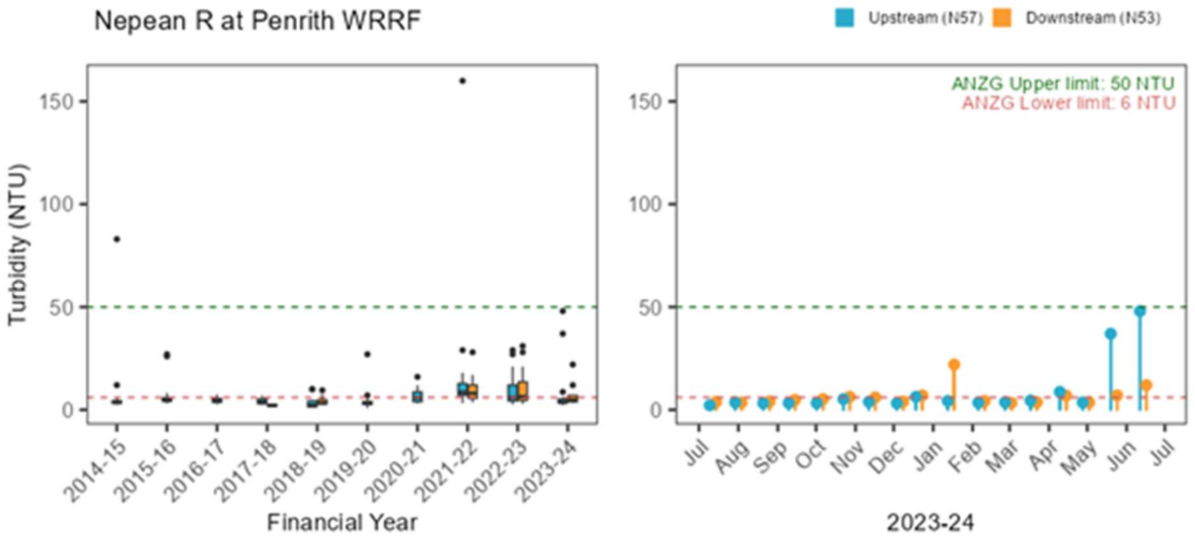
Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
pH (pH Units)
Financial Year
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
2023-24



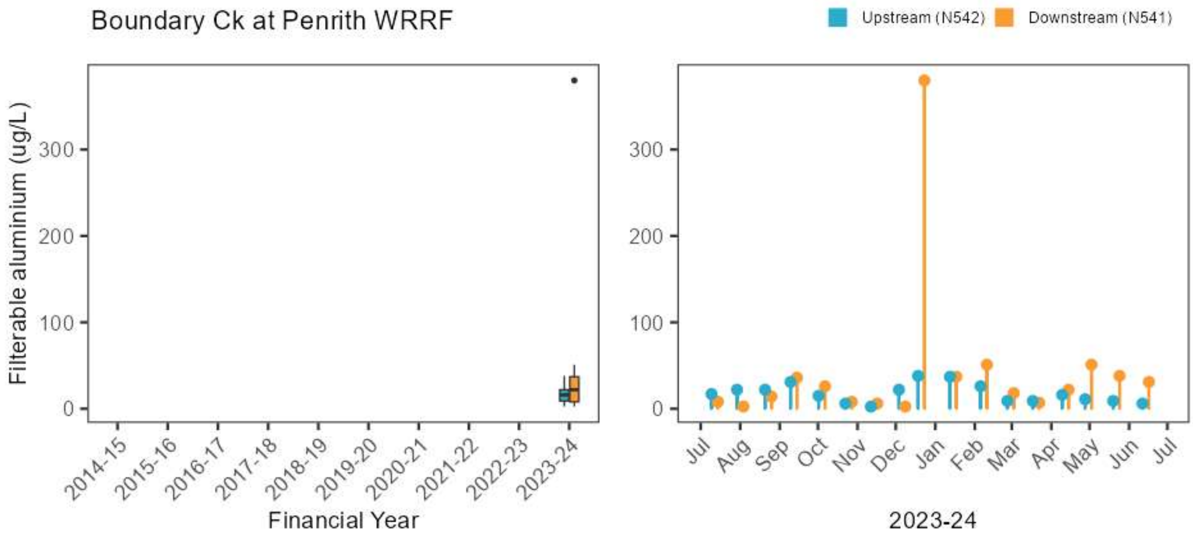
Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Water temperature (oC)
Financial Year
2023-24

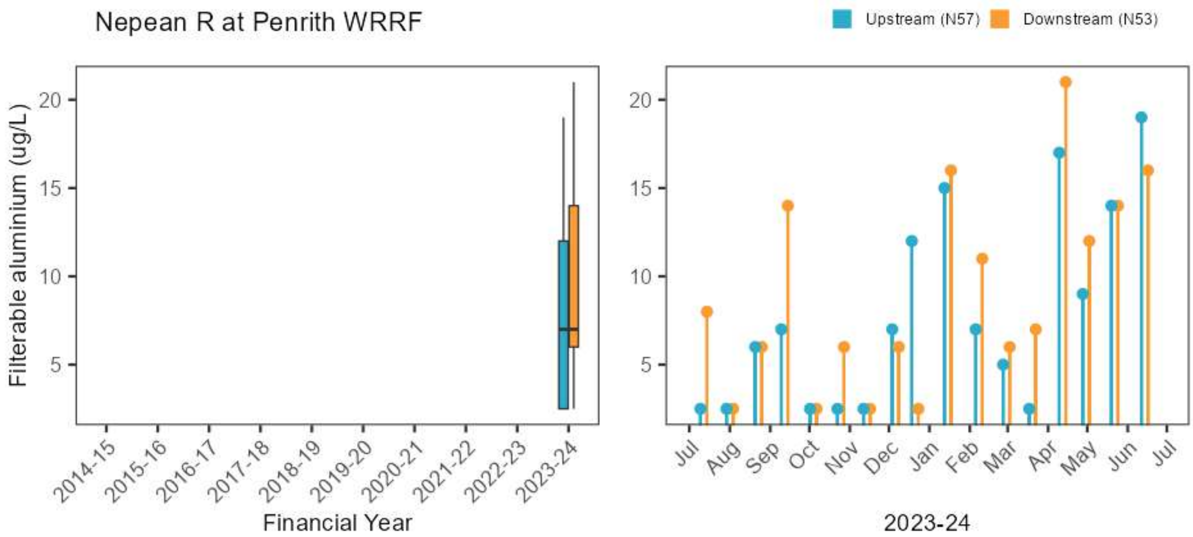

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Water temperature (oC)
Financial Year
2023-24

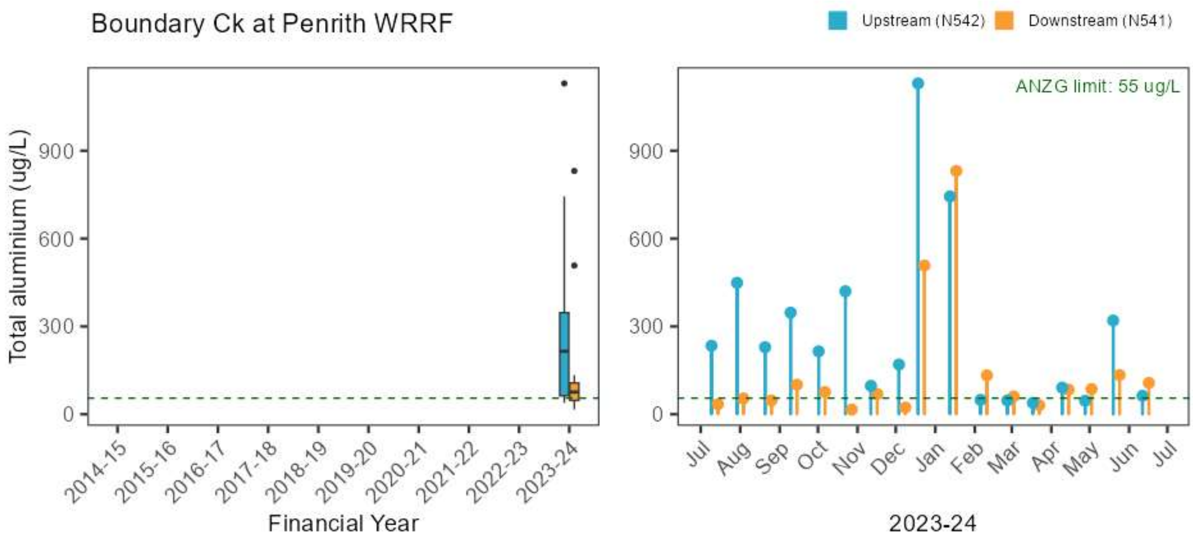

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

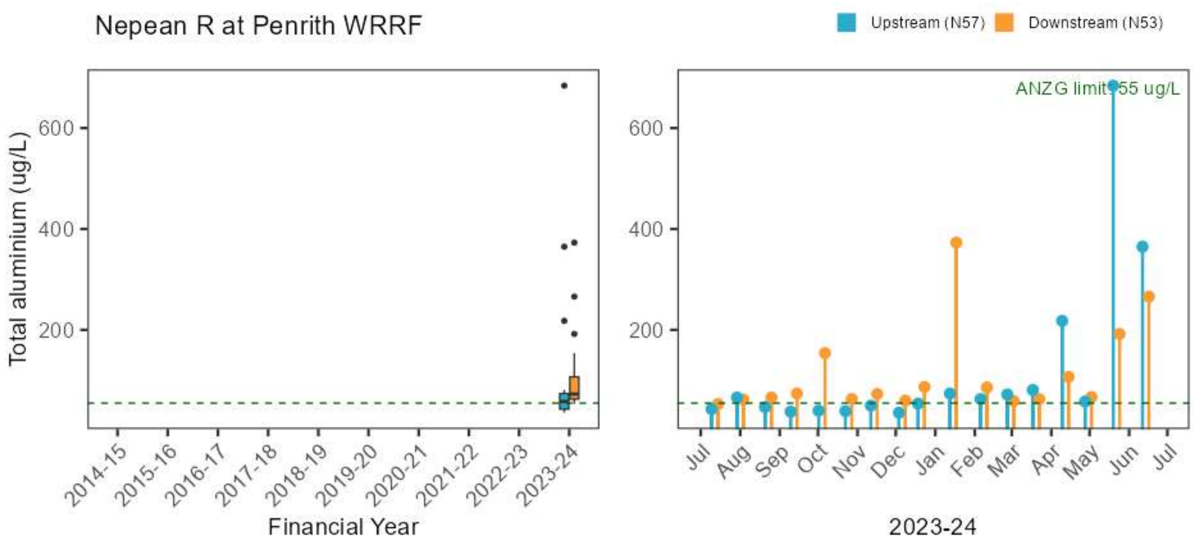

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

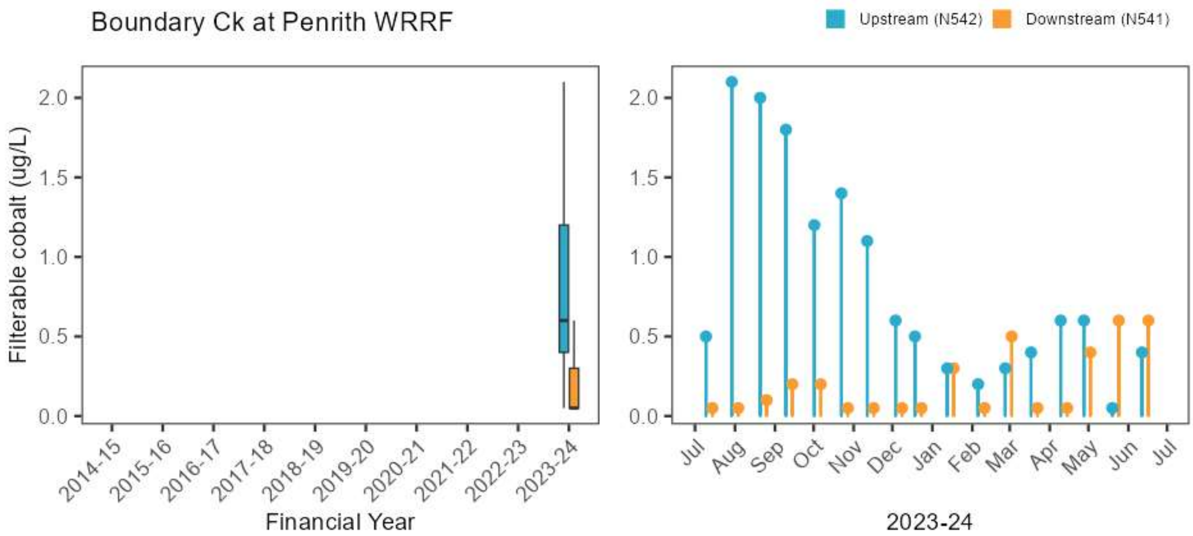
A.4.8. Stressor – Trace metals

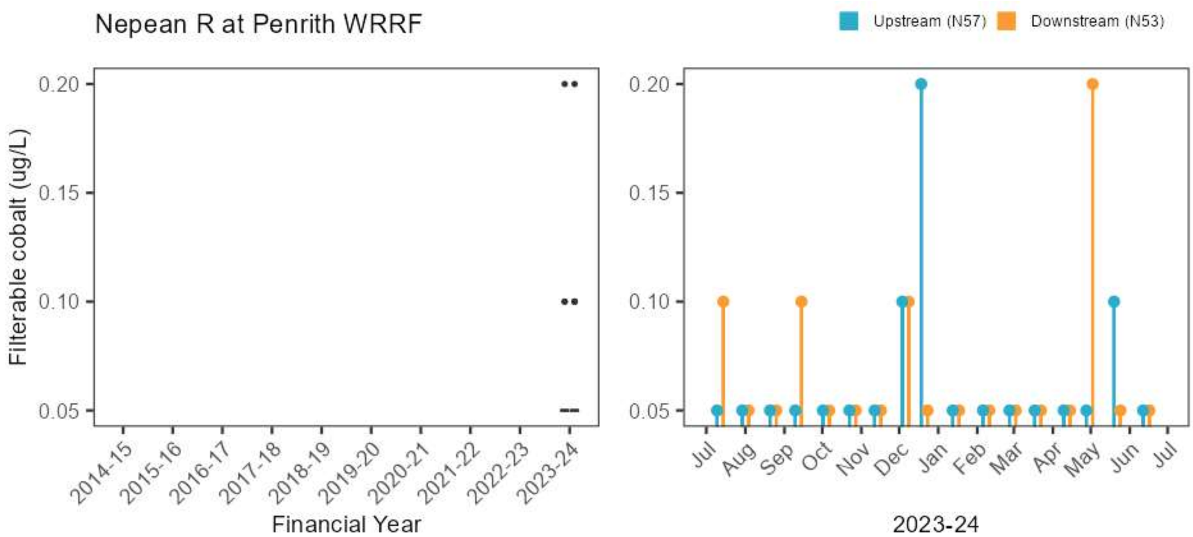


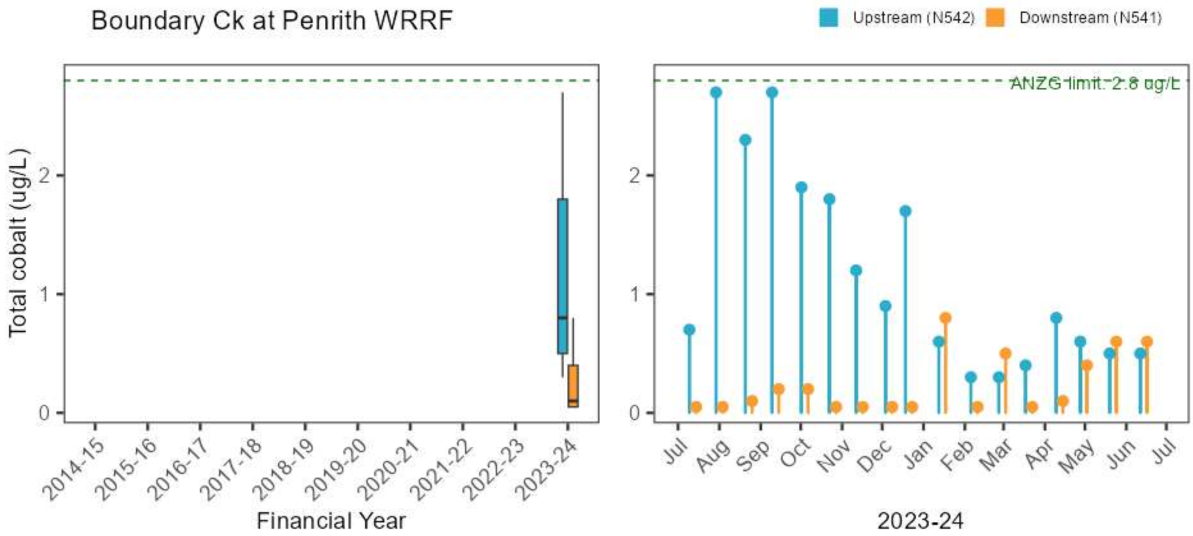


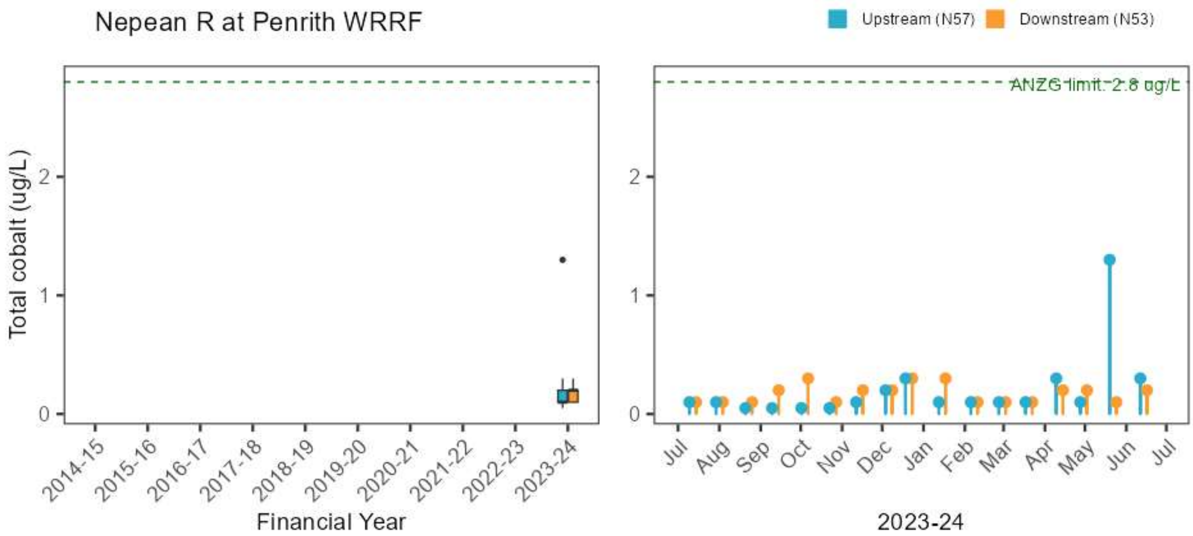


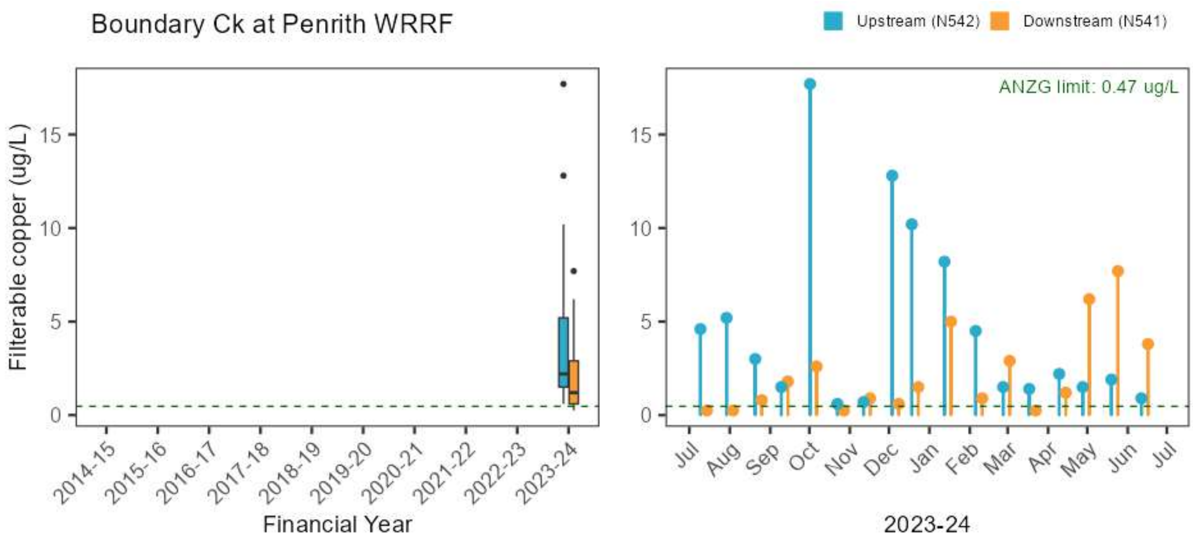

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Total aluminium (ug/L)
600
400
200
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 55 ug/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

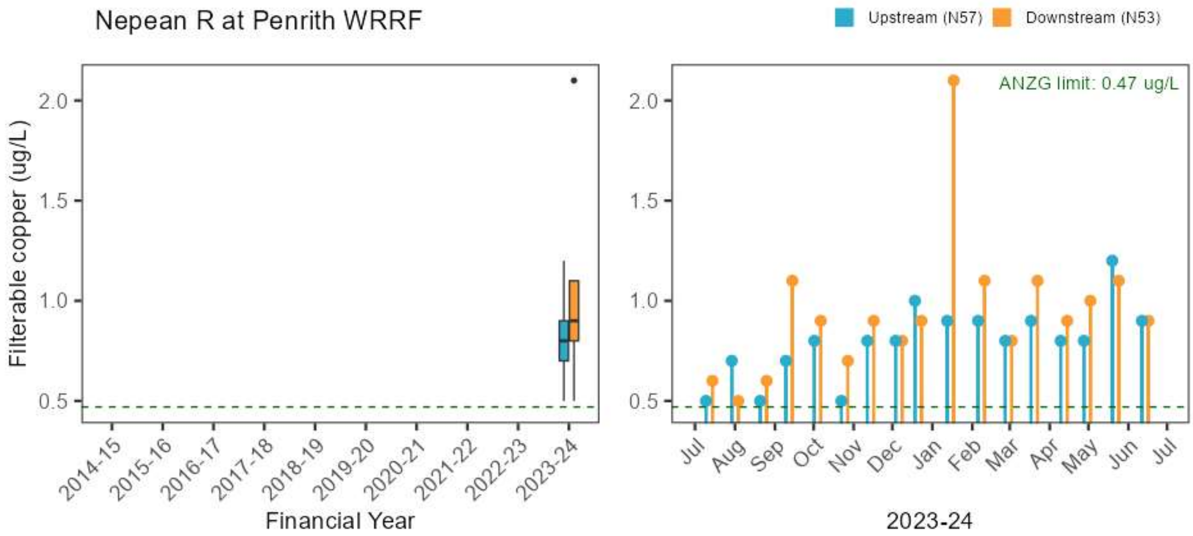

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Filterable cobalt (ug/L)
2.0
1.5
1.0
0.5
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

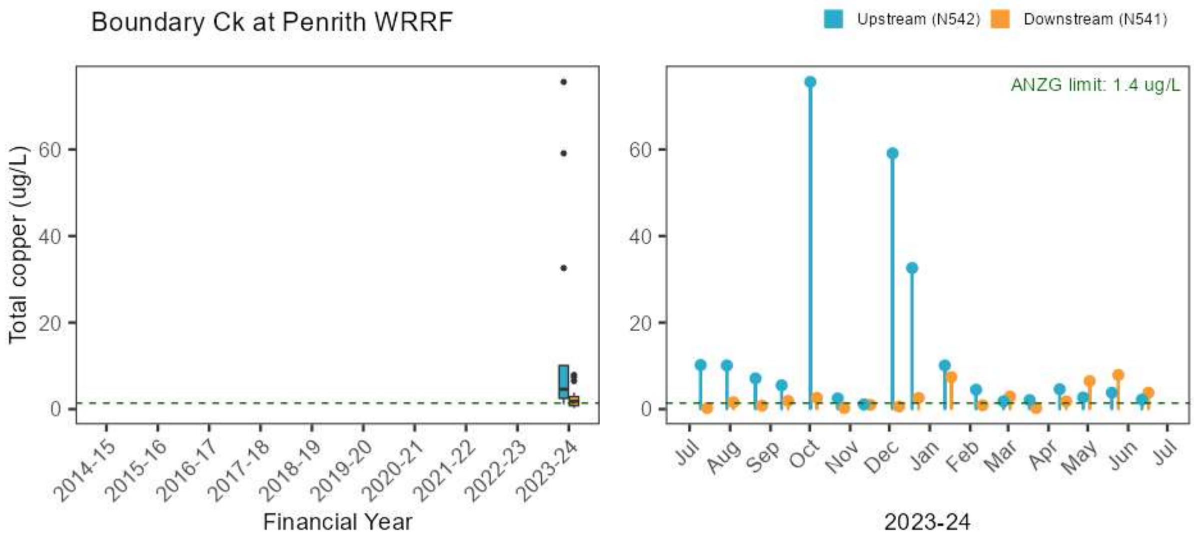

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Filterable cobalt (ug/L)
0.20
0.15
0.10
0.05
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

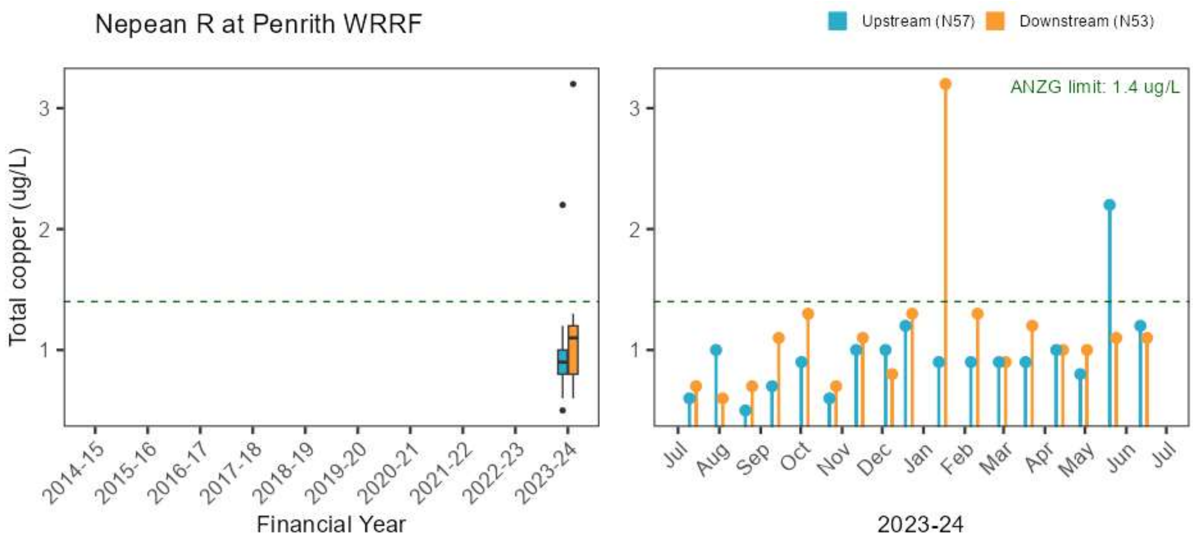

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

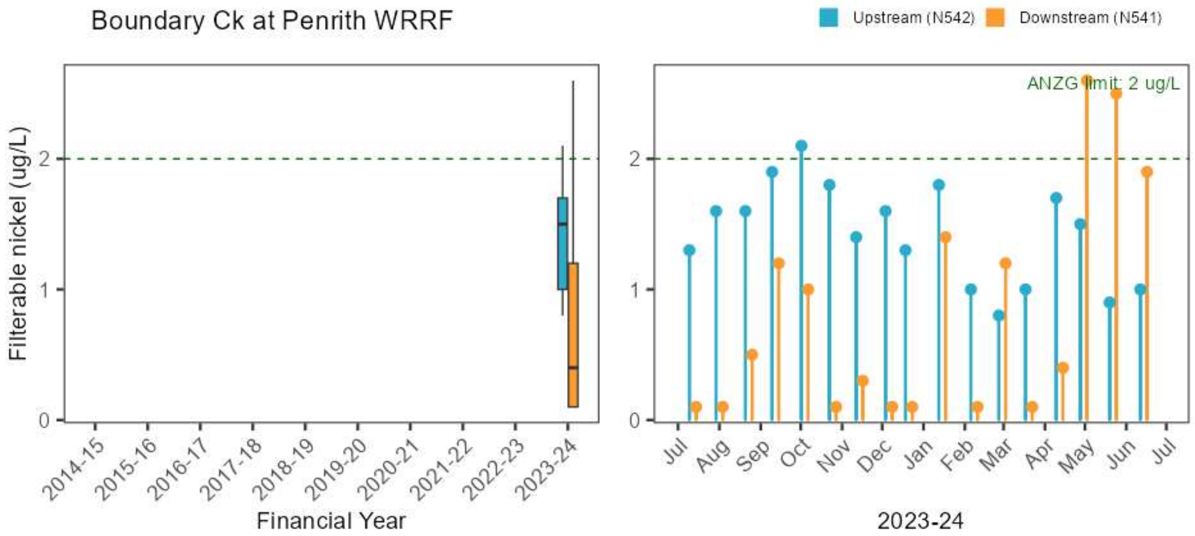

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

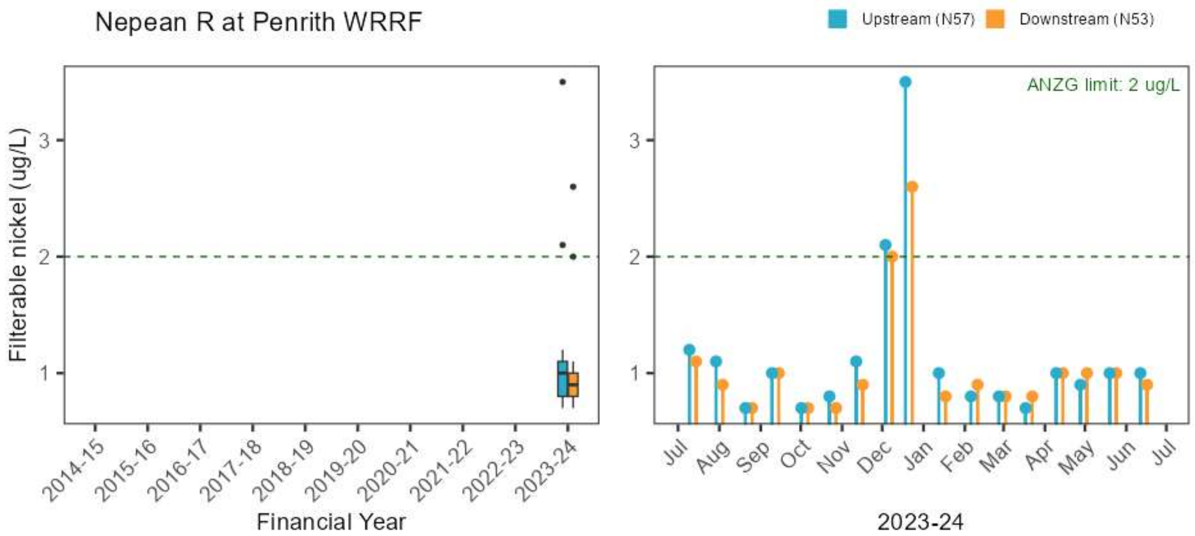

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

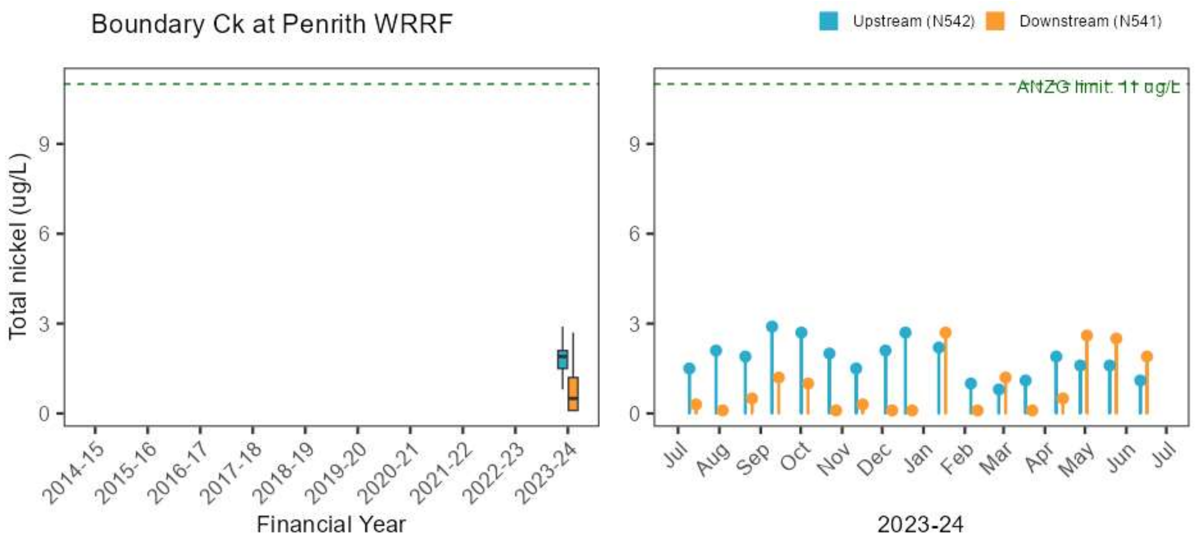

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Filterable copper (ug/L)
Financial Year
ANZG limit: 0.47 ug/L
2023-24

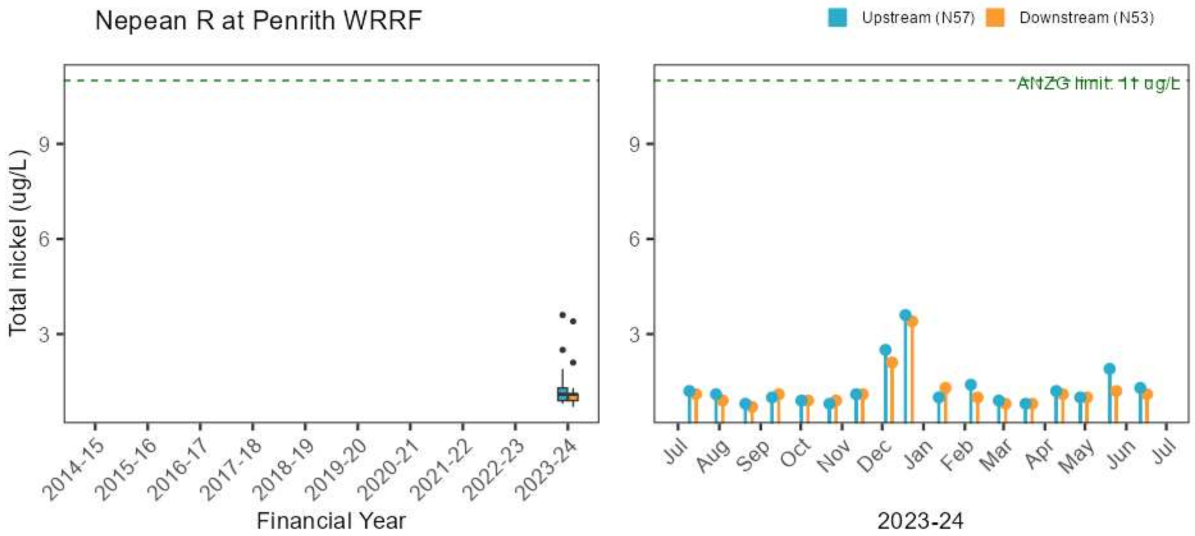

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Total copper (ug/L)
Financial Year
ANZG limit: 1.4 ug/L
2023-24

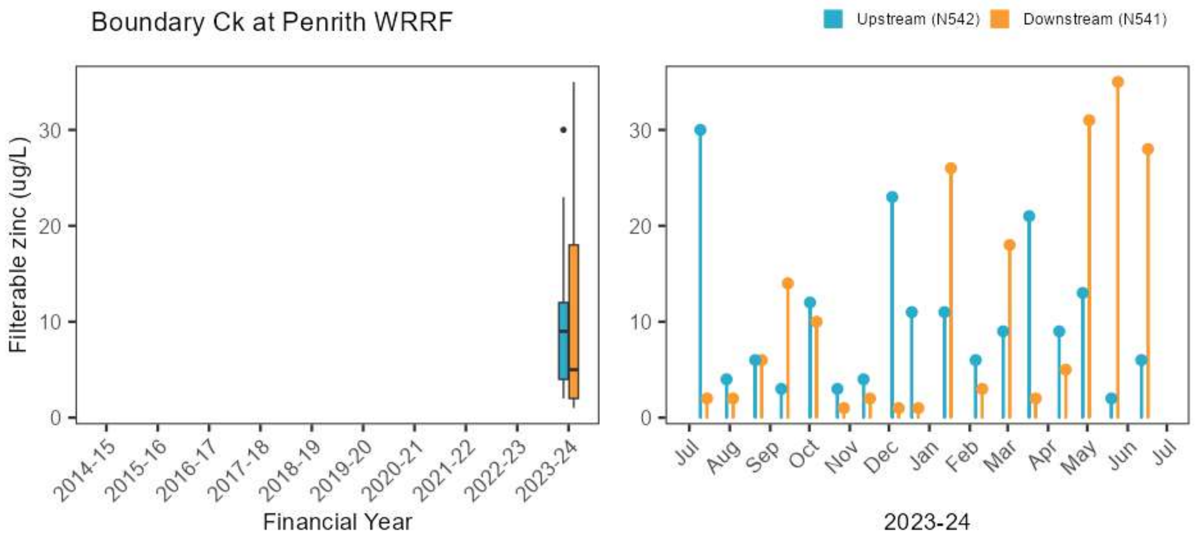

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Total copper (ug/L)
Financial Year
ANZG limit: 1.4 ug/L
2023-24

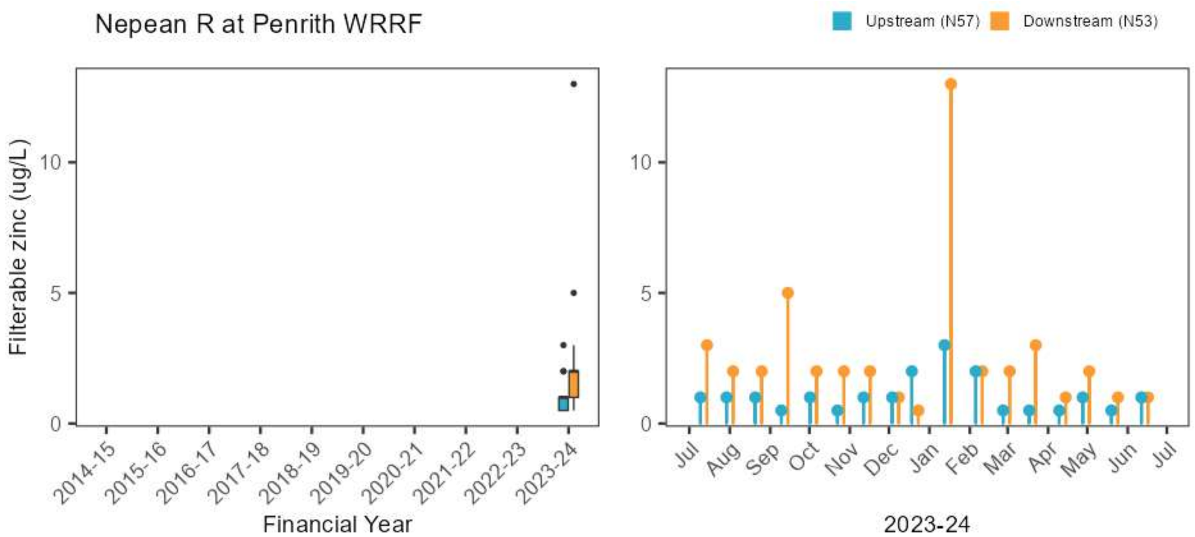

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

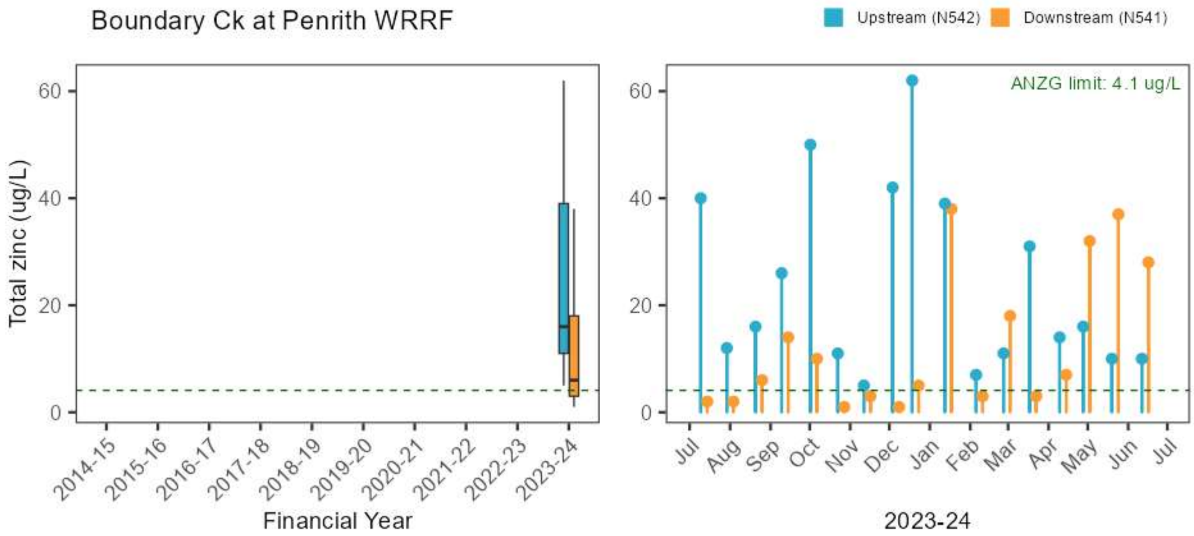

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

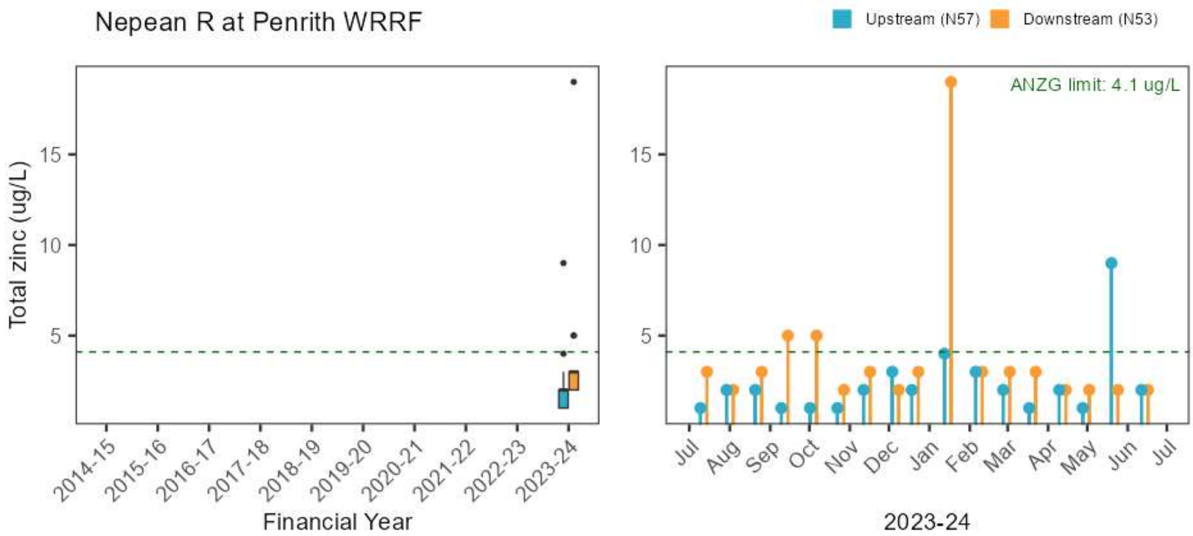

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
ANZG limit: 11 ug/L
Total nickel (ug/L)
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Financial Year
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Total nickel (ug/L)
ANZG limit: 11 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

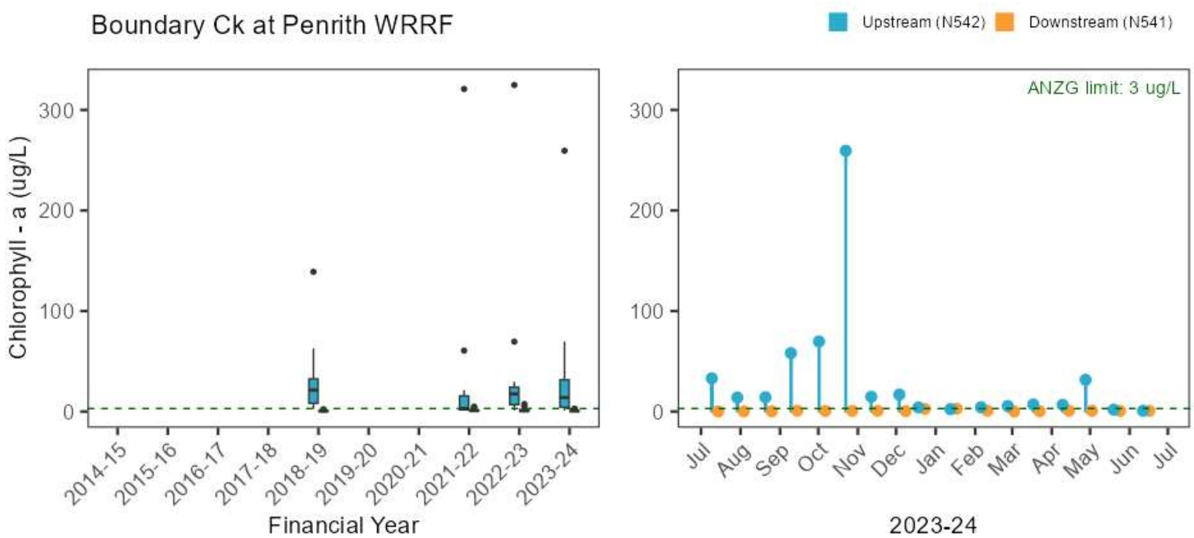

Boundary Ck at Penrith WRRF
Upstream (N542)
Downstream (N541)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

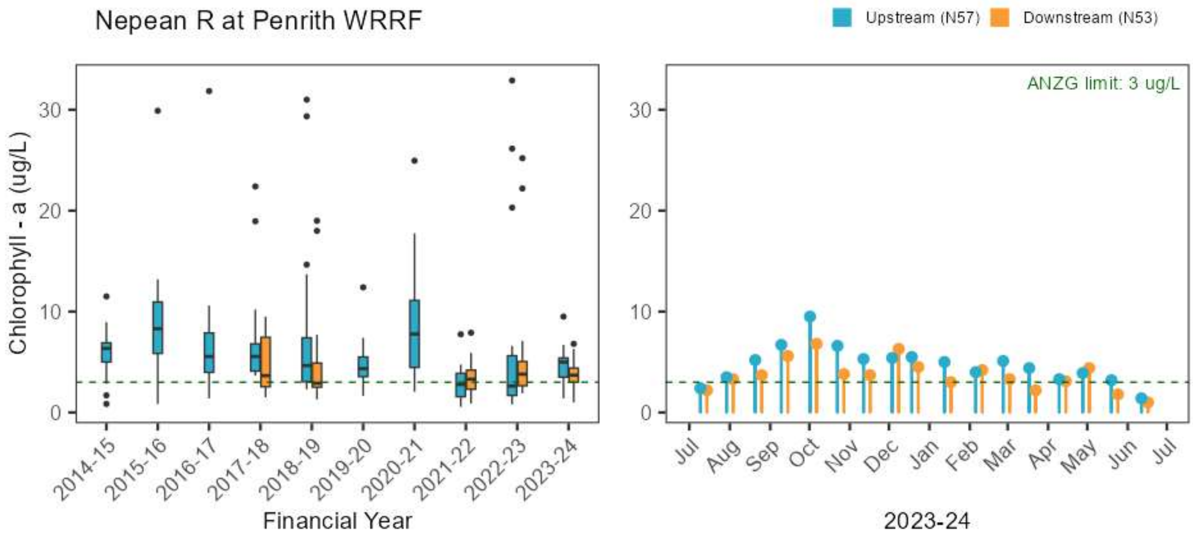

Nepean R at Penrith WRRF
Upstream (N57)
Downstream (N53)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24





A.4.9. Ecosystem receptor – Phytoplankton





A.4.10. Ecosystem receptor – Macroinvertebrates

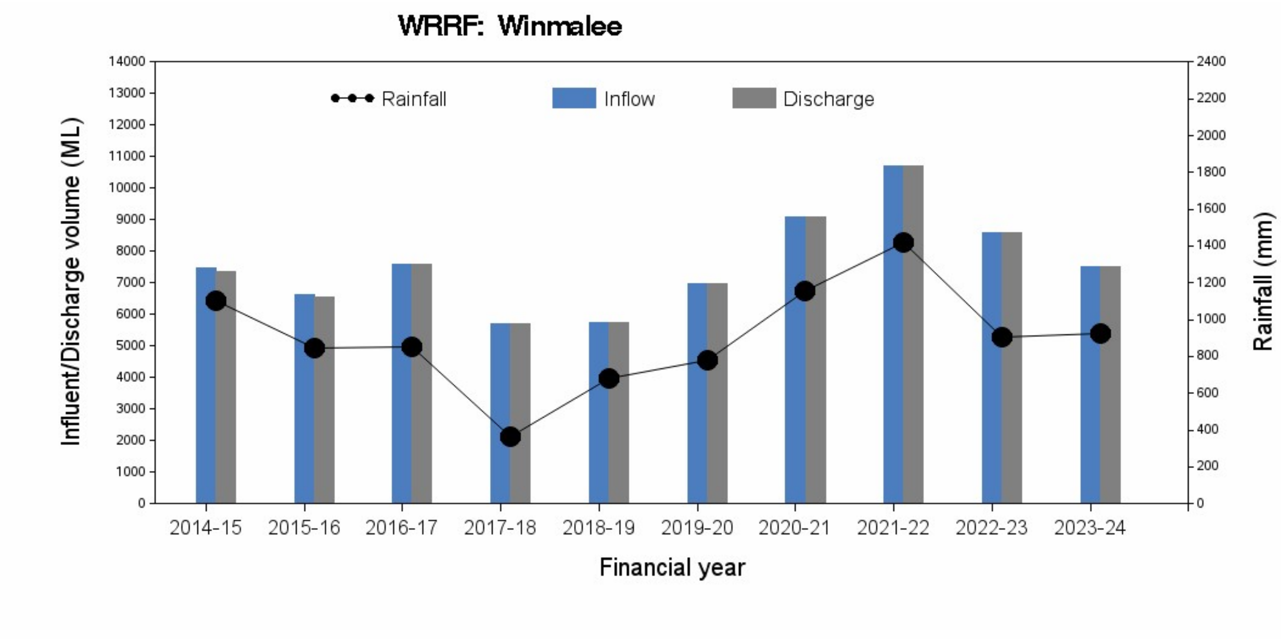
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Boundary Creek	Tributary (N542 vs N541)	Welch Two Sample t-test	-1.69	-6.77	6.6	<0.001
Nepean River	River (N57A vs N53)	Welch Two Sample t-test	0.26	0.83	7.7	0.433

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.5. Winmalee WRRF

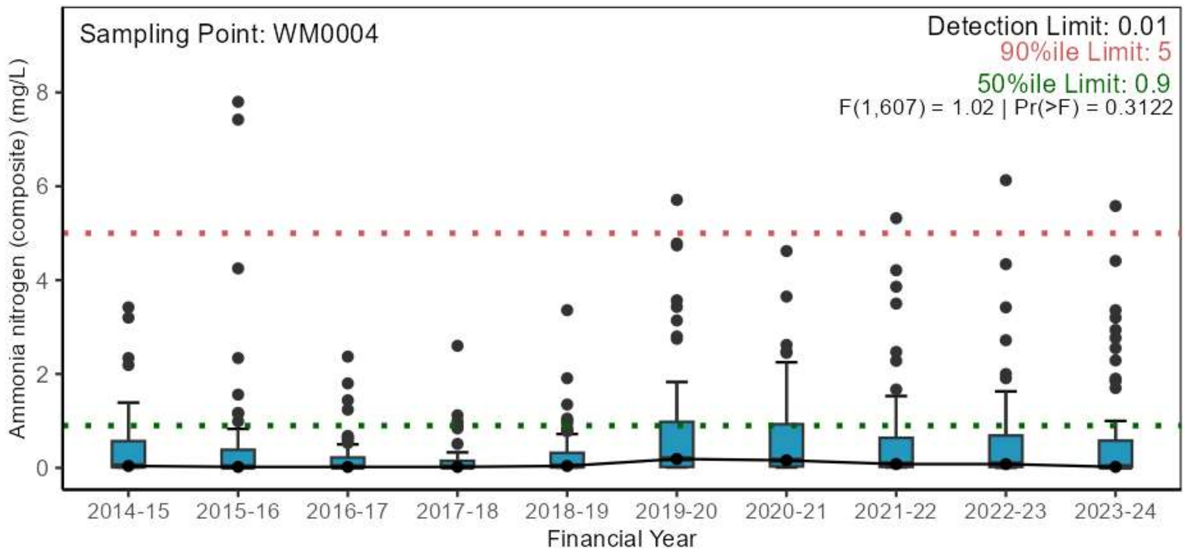
A.5.1. Pressure – Wastewater quantity

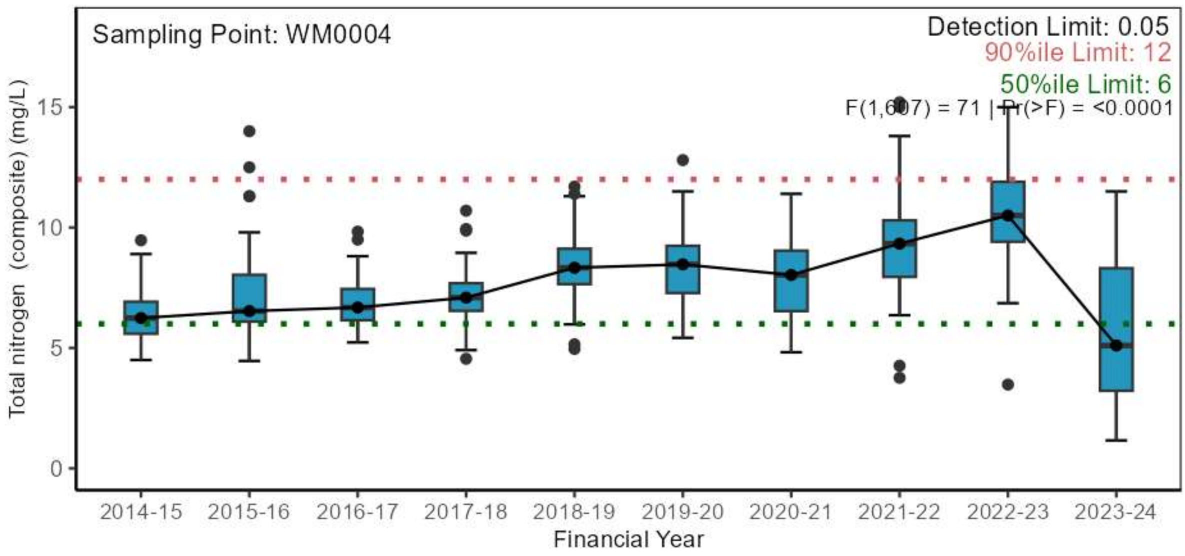
Inflow/discharge volume and rainfall

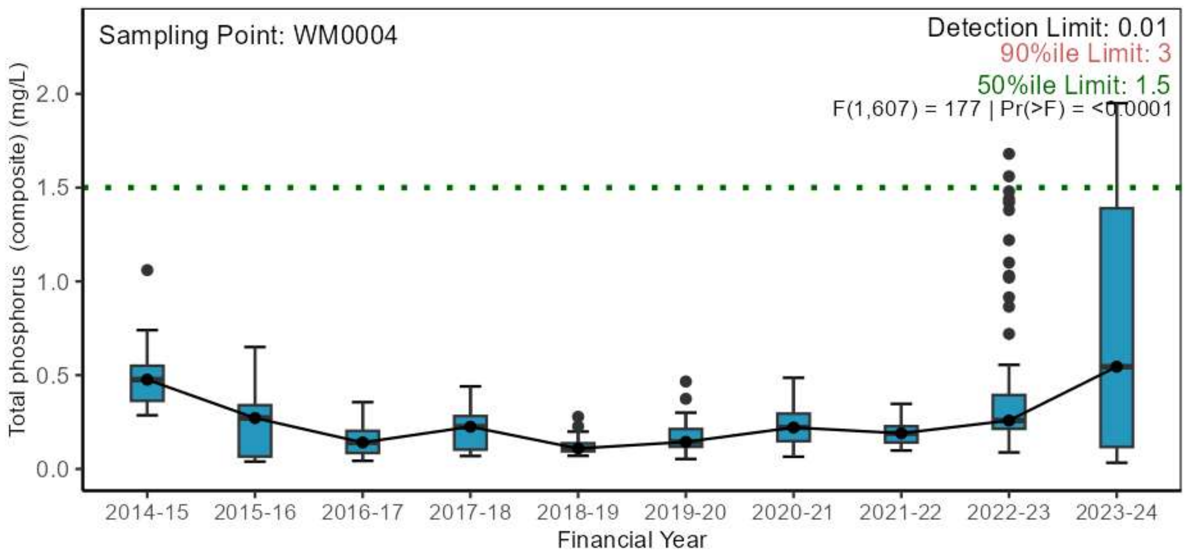


A.5.2. Pressure – Wastewater quality

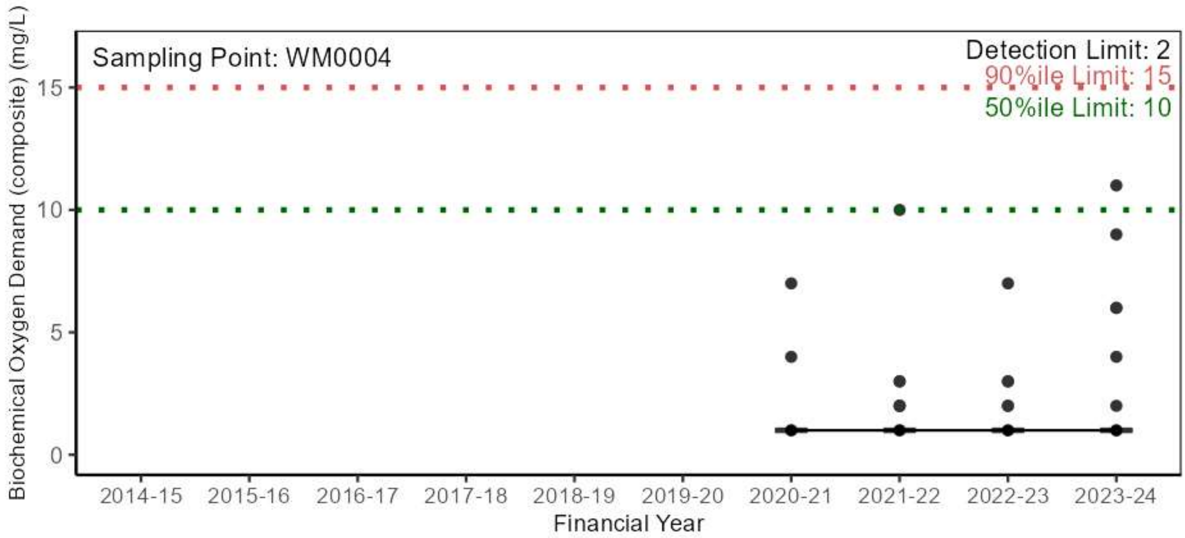
Nutrients



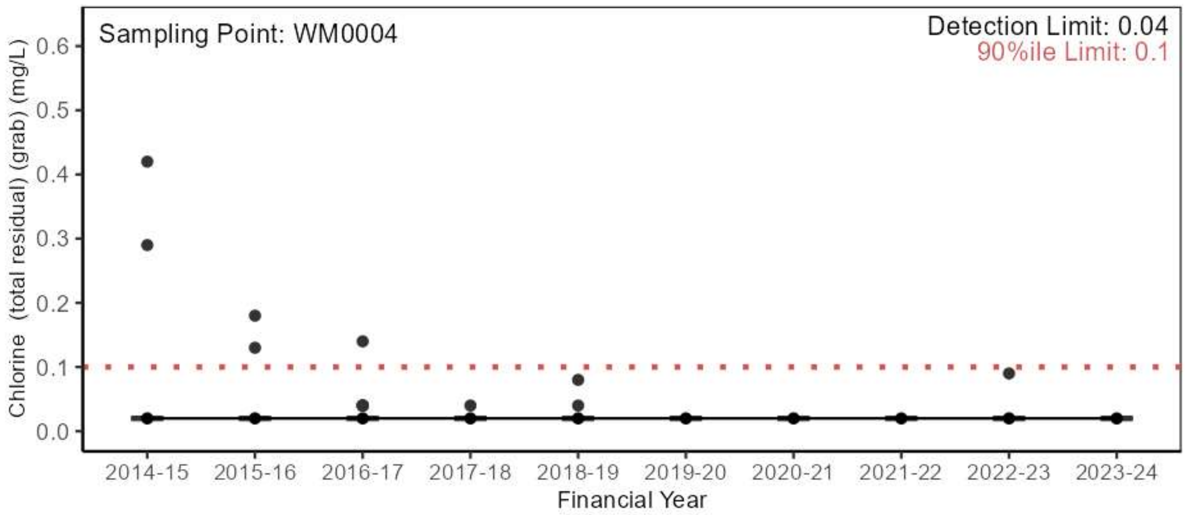

Sampling Point: WM0004
Detection Limit: 0.05
90%ile Limit: 12
50%ile Limit: 6
F(1,607) = 71 | Pr(>F) = <0.0001
Total nitrogen (composite) (mg/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24


Sampling Point: WM0004
Detection Limit: 0.01
90%ile Limit: 3
50%ile Limit: 1.5
F(1,607) = 177 | Pr(>F) = <0.0001
Total phosphorus (composite) (mg/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24

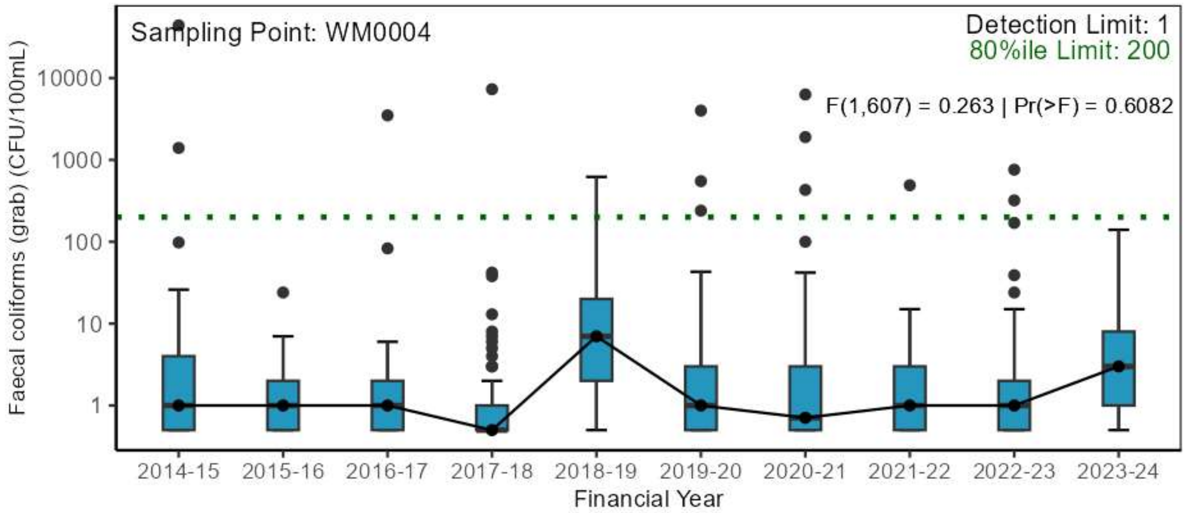
Major conventional analytes



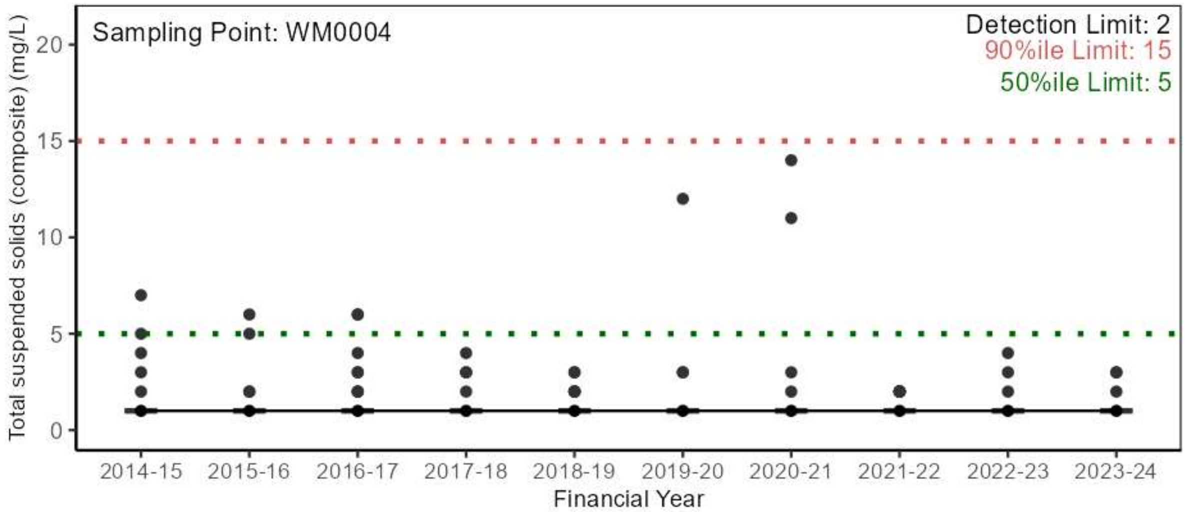
Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

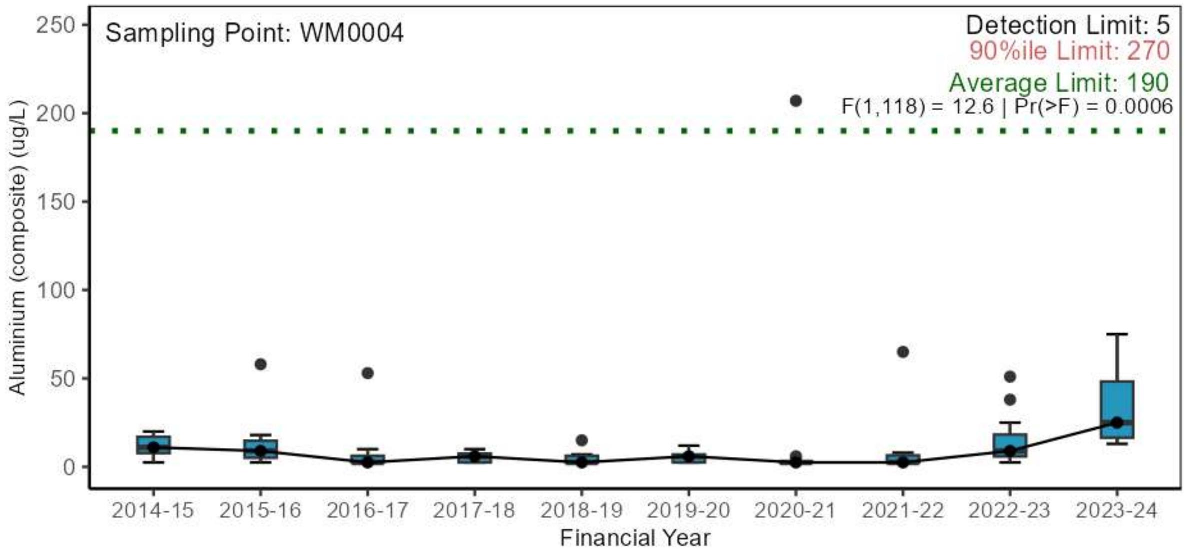


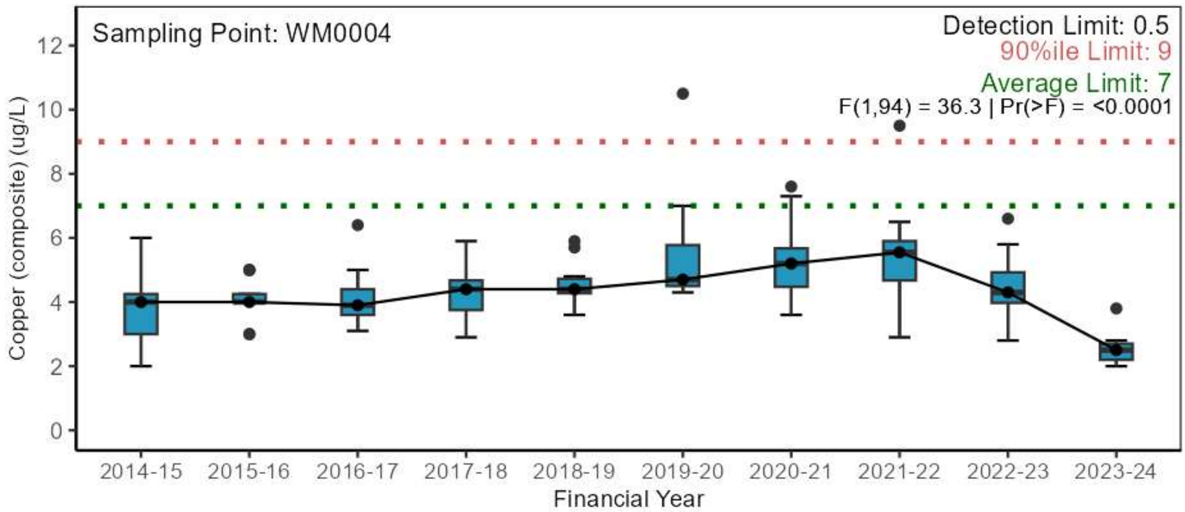
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



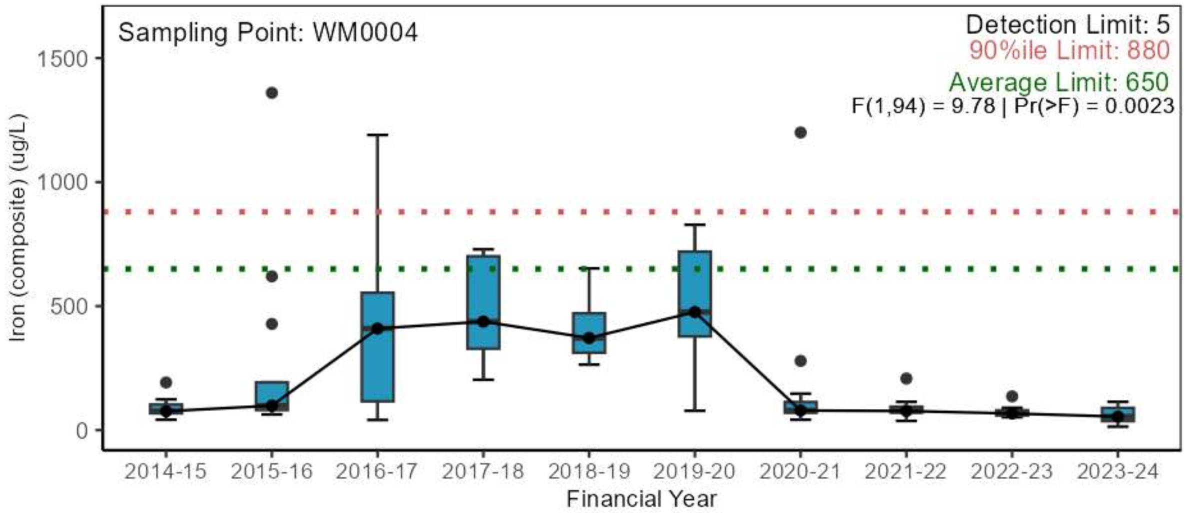
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

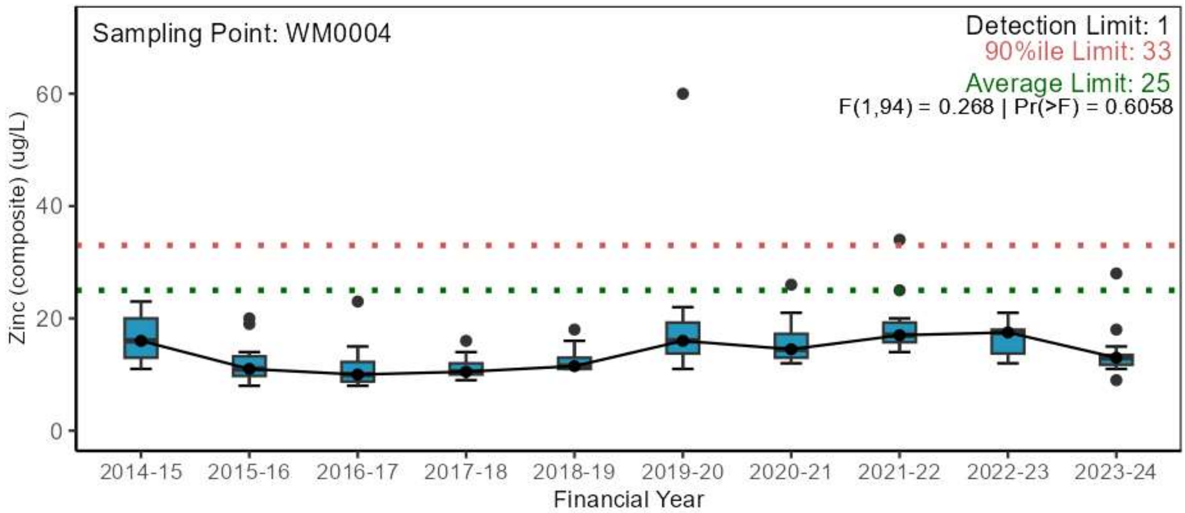




Statistical test excludes data prior to 2016-17 due to method detection limit change.

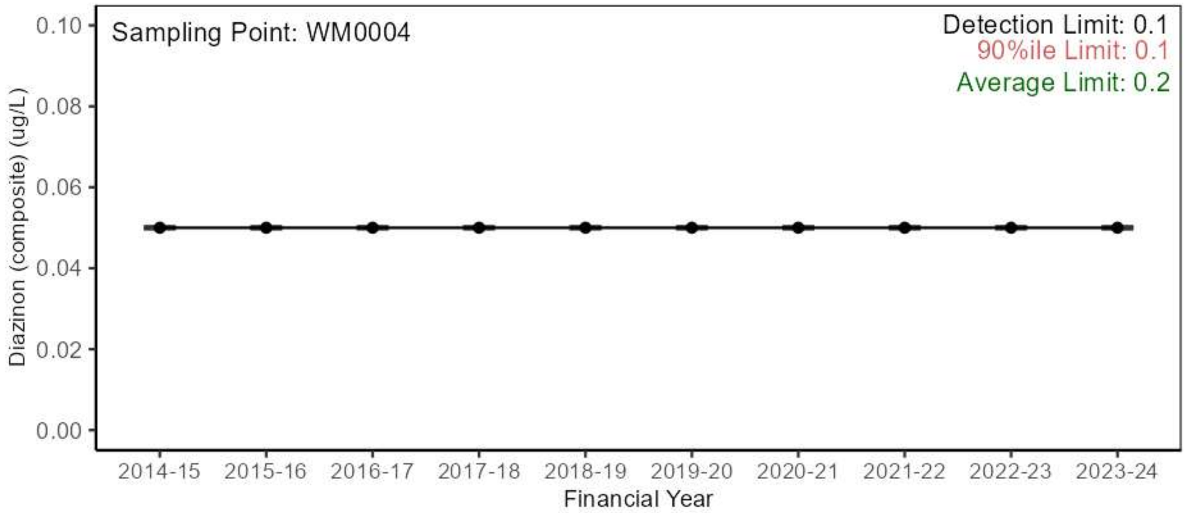


Statistical test excludes data prior to 2016-17 due to method detection limit change.



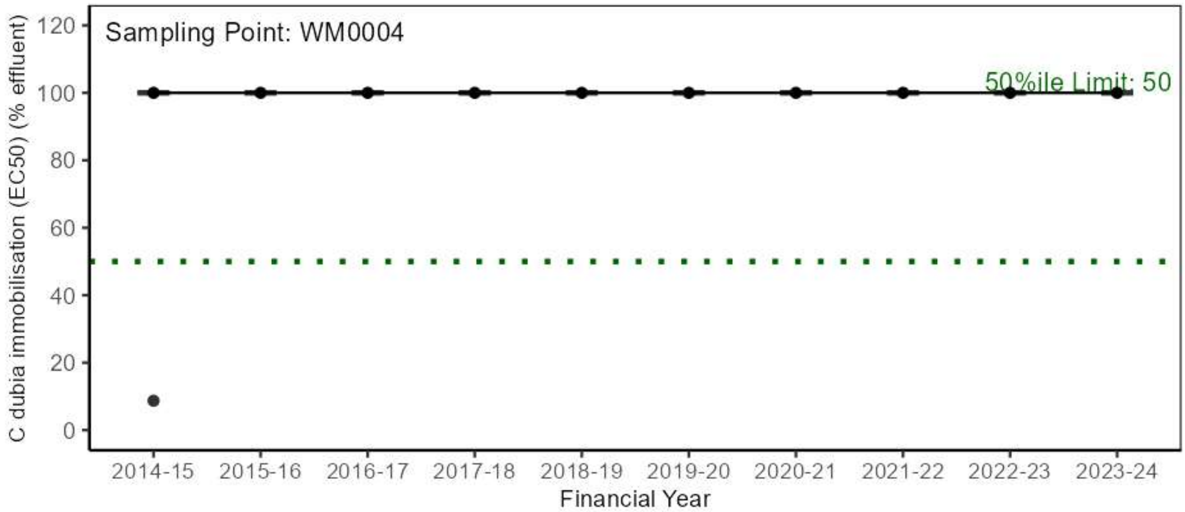
Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)



Statistical test not conducted as >90% of results were below detection limits.

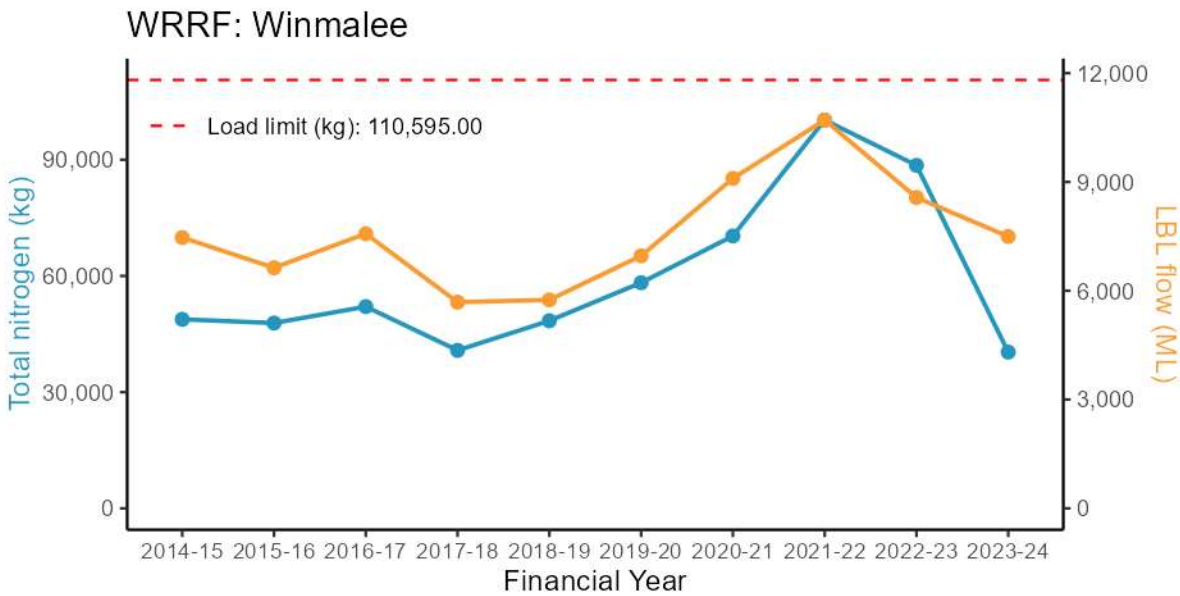
A.5.3. Pressure – Wastewater toxicity

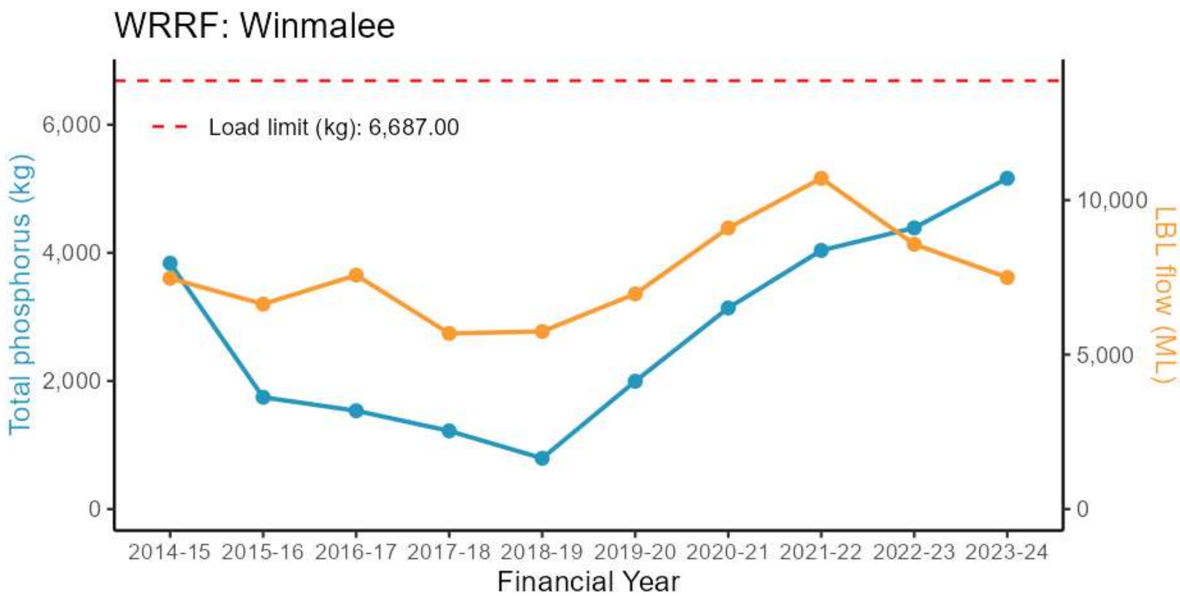


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

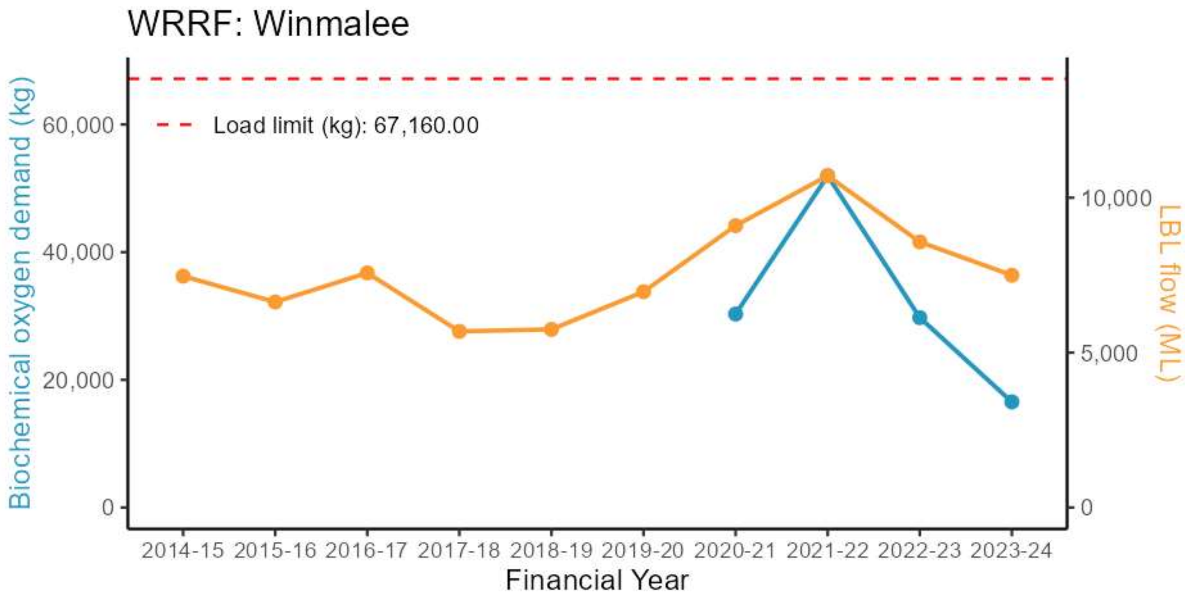
A.5.4. Pressure – Wastewater discharge load

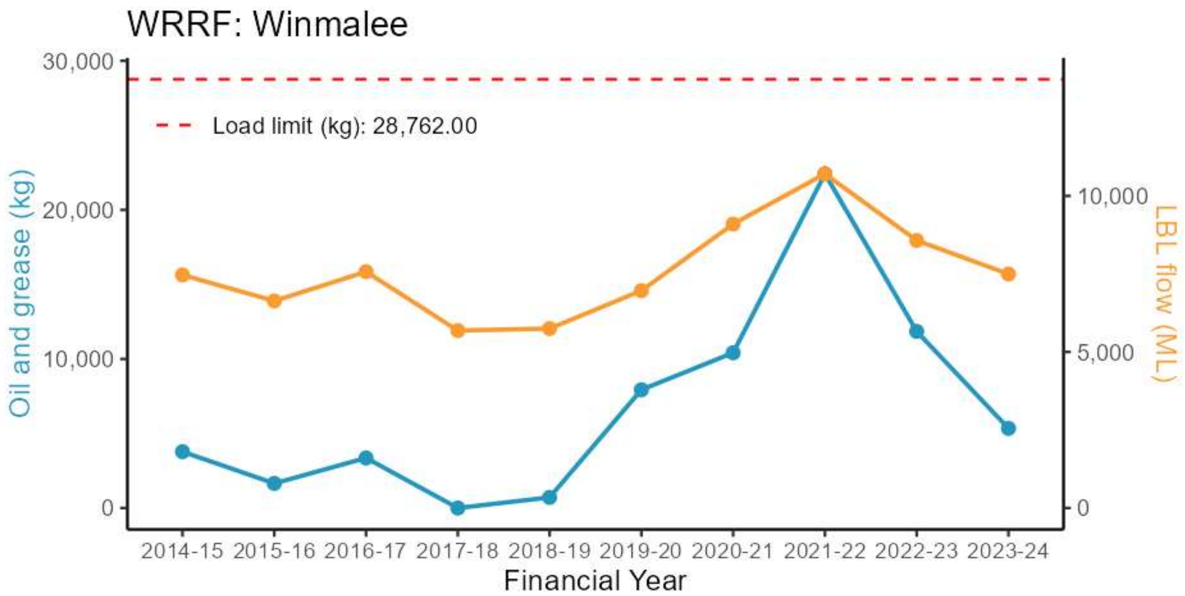
Nutrients

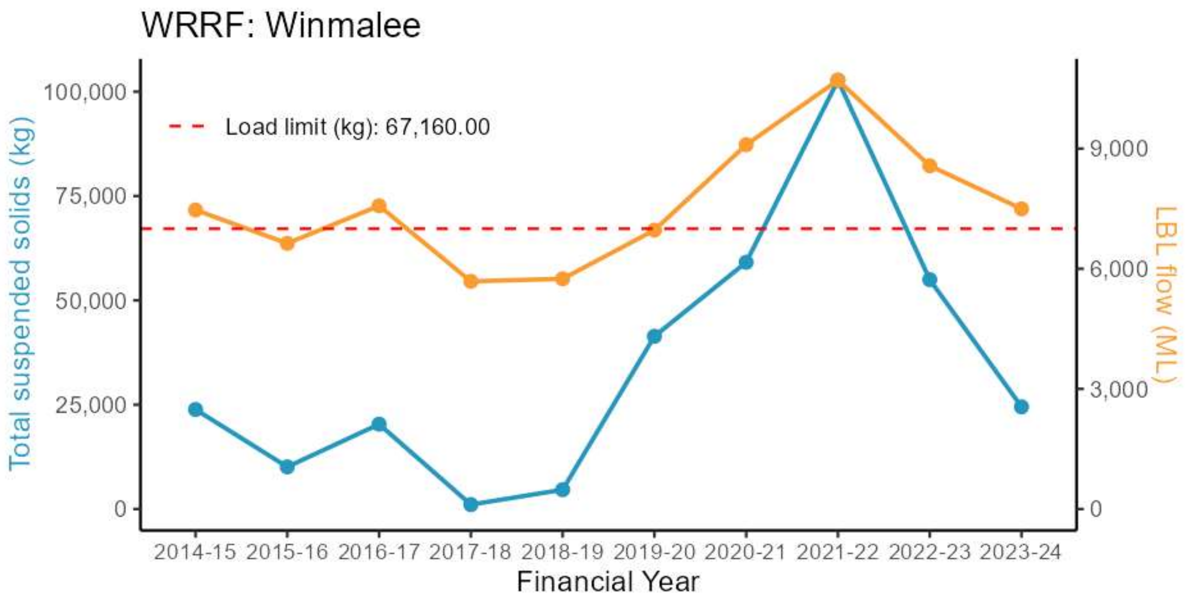




Major conventional analytes







A.5.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-9 Downstream vs upstream comparison (current period) contrast outcomes for Winmalee WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Nepean R	N48A vs N464	Total ammonia nitrogen	0.89	0.20	291	-0.51	0.957
Nepean R	N48A vs N464	Oxidised nitrogen	1.36	0.41	291	1.02	0.738
Nepean R	N48A vs N464	Total nitrogen	1.28	0.16	291	2.02	0.184
Nepean R	N48A vs N464	Filterable total phosphorus	4.20	0.75	291	8.05	<0.001
Nepean R	N48A vs N464	Total phosphorus	3.13	0.46	291	7.87	<0.001
Nepean R	N48A vs N464	Conductivity	1.04	0.08	291	0.59	0.935
Nepean R	N48A vs N464	Dissolved oxygen	1.03	0.04	290	0.72	0.890
Nepean R	N48A vs N464	Dissolved oxygen saturation	2.13	2.71	290	0.79	0.861
Nepean R	N48A vs N464	pH	0.14	0.12	291	1.21	0.619
Nepean R	N48A vs N464	Water temperature	0.98	0.09	291	-0.23	0.996
Nepean R	N48A vs N464	Turbidity	1.10	0.24	291	0.46	0.967
Nepean R	N48A vs N464	Chlorophyll - a	1.08	0.28	286	0.29	0.991

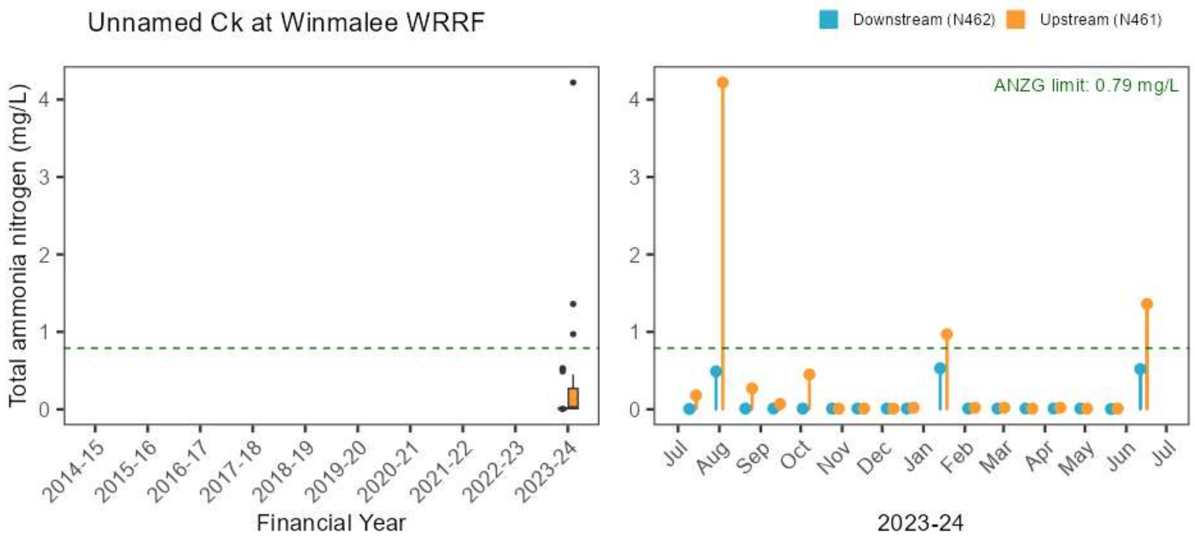
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

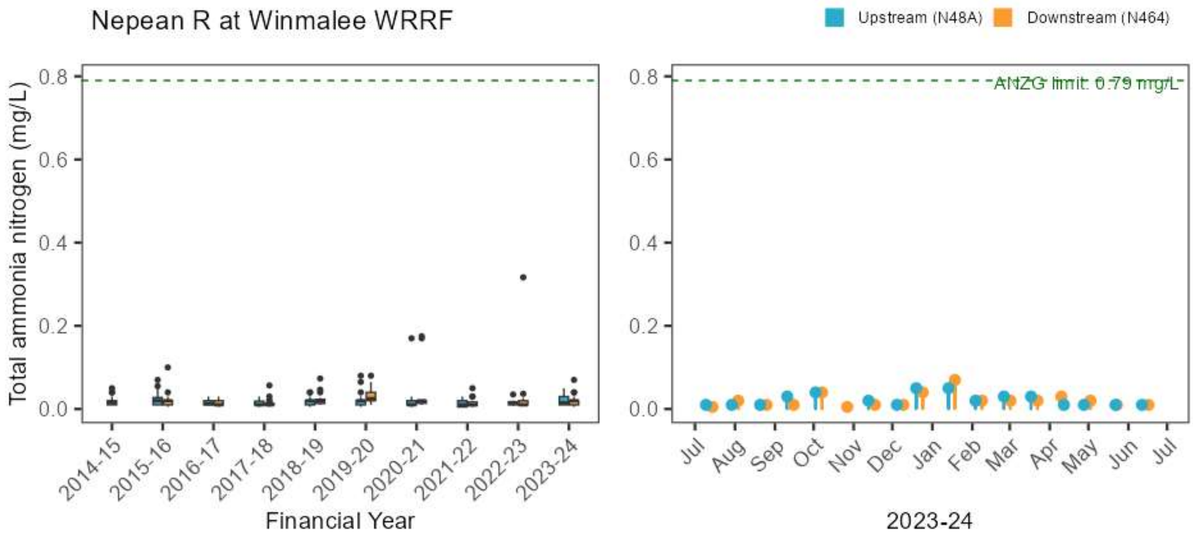
Table A-10 Current period vs previous period comparison (single site) contrast outcomes for Winmalee WRRF

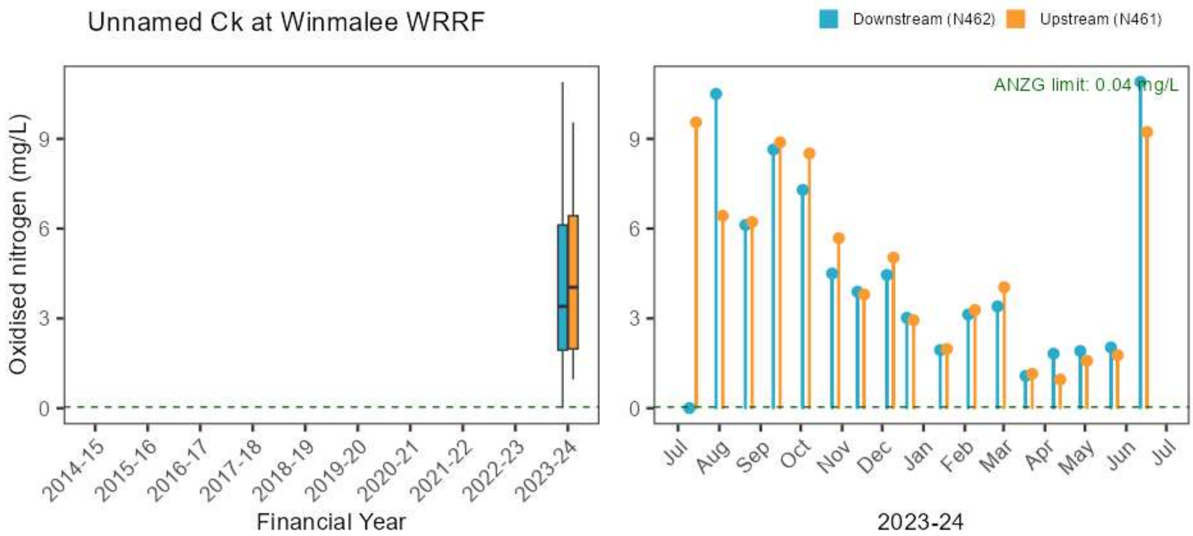
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Nepean R	N48A	Total ammonia nitrogen	1.21	0.21	291	1.10	0.689
Nepean R	N48A	Oxidised nitrogen	2.50	0.57	291	4.00	<0.001
Nepean R	N48A	Total nitrogen	1.33	0.12	291	3.03	0.014
Nepean R	N48A	Filterable total phosphorus	0.88	0.12	291	-0.92	0.793
Nepean R	N48A	Total phosphorus	1.02	0.11	291	0.15	0.999
Nepean R	N48A	Conductivity	1.13	0.06	291	2.17	0.134
Nepean R	N48A	Dissolved oxygen	1.01	0.03	290	0.29	0.991
Nepean R	N48A	Dissolved oxygen saturation	2.49	2.07	290	1.20	0.625
Nepean R	N48A	pH	-0.02	0.09	291	-0.20	0.997
Nepean R	N48A	Water temperature	1.05	0.08	291	0.68	0.905
Nepean R	N48A	Turbidity	1.13	0.18	291	0.74	0.881
Nepean R	N48A	Chlorophyll - a	0.84	0.17	286	-0.89	0.810
Nepean R	N464	Total ammonia nitrogen	0.98	0.17	291	-0.12	0.999
Nepean R	N464	Oxidised nitrogen	0.91	0.20	291	-0.42	0.974
Nepean R	N464	Total nitrogen	0.95	0.09	291	-0.57	0.940
Nepean R	N464	Filterable total phosphorus	2.25	0.30	291	6.14	<0.001
Nepean R	N464	Total phosphorus	2.04	0.22	291	6.63	<0.001
Nepean R	N464	Conductivity	1.13	0.06	291	2.25	0.113
Nepean R	N464	Dissolved oxygen	1.01	0.03	290	0.24	0.995
Nepean R	N464	Dissolved oxygen saturation	1.78	2.00	290	0.89	0.809
Nepean R	N464	pH	0.05	0.09	291	0.62	0.926
Nepean R	N464	Water temperature	1.06	0.08	291	0.85	0.830
Nepean R	N464	Turbidity	1.18	0.19	291	1.06	0.715
Nepean R	N464	Chlorophyll - a	0.96	0.18	286	-0.24	0.995

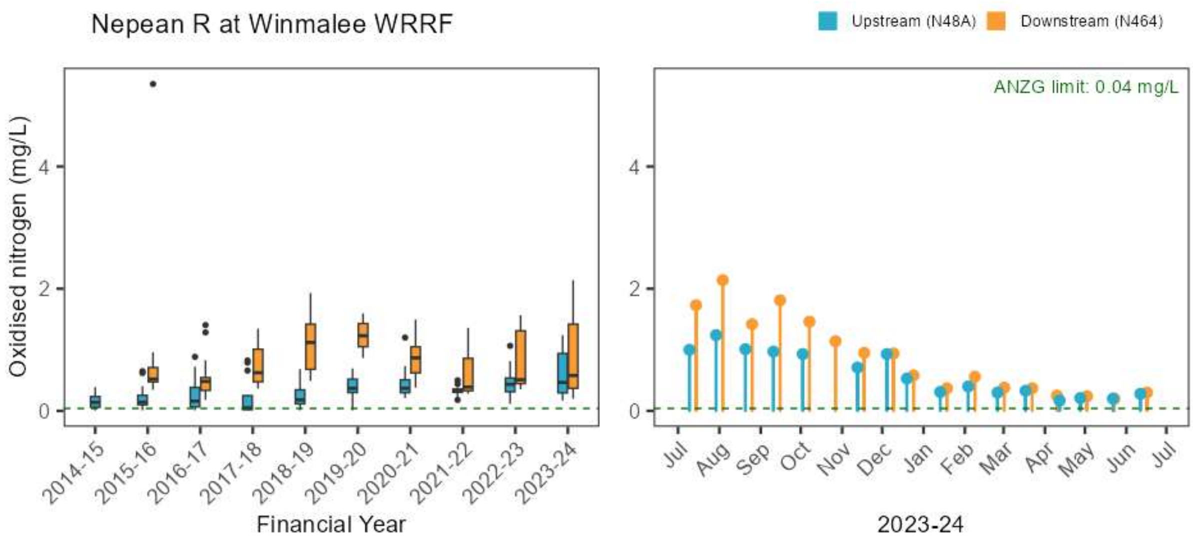
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

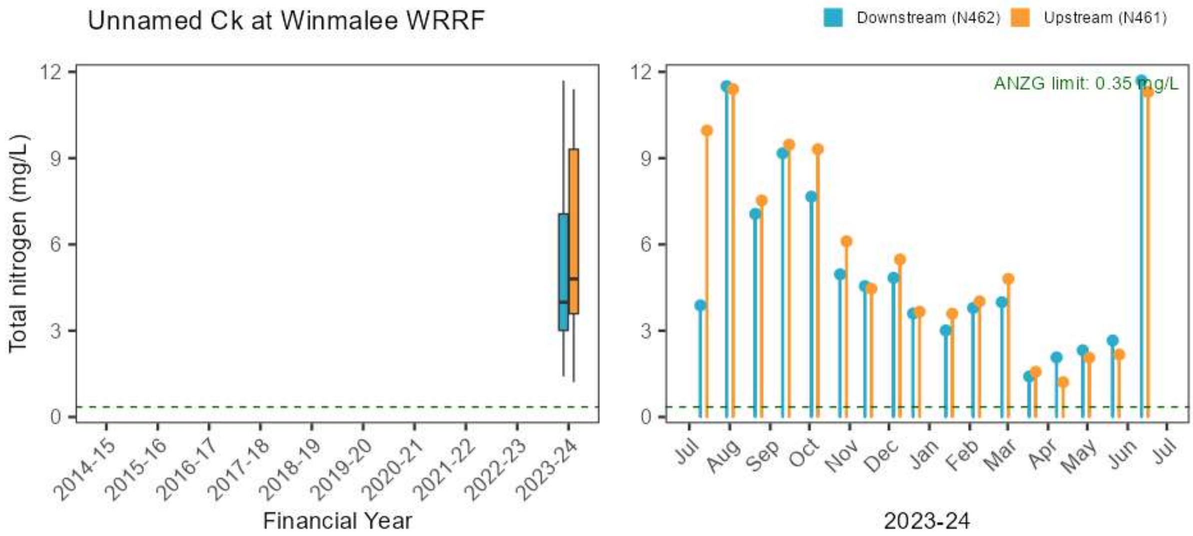
A.5.6. Stressor – Nutrients

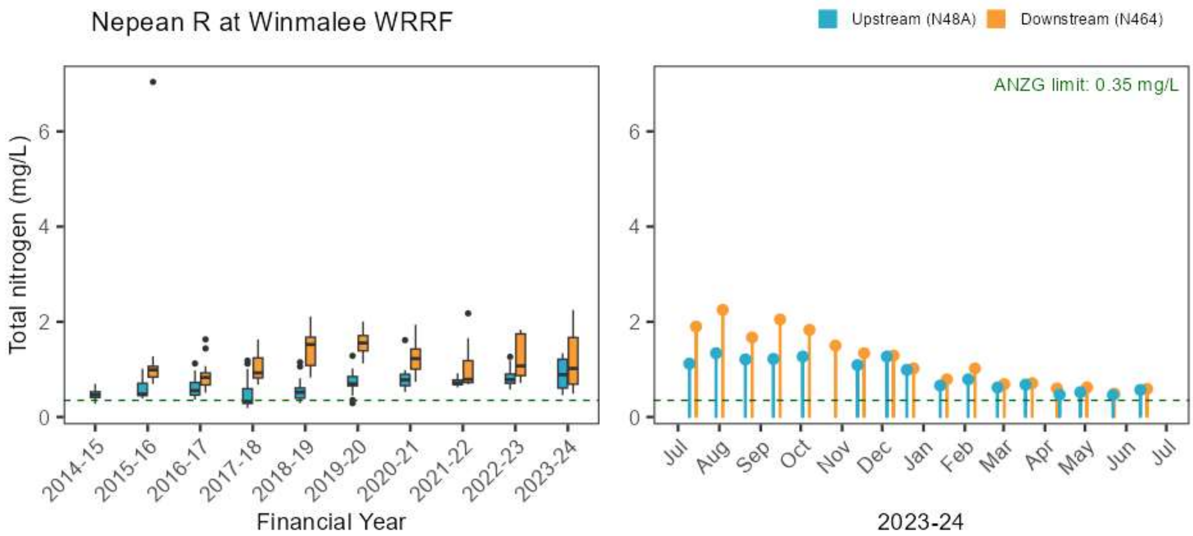


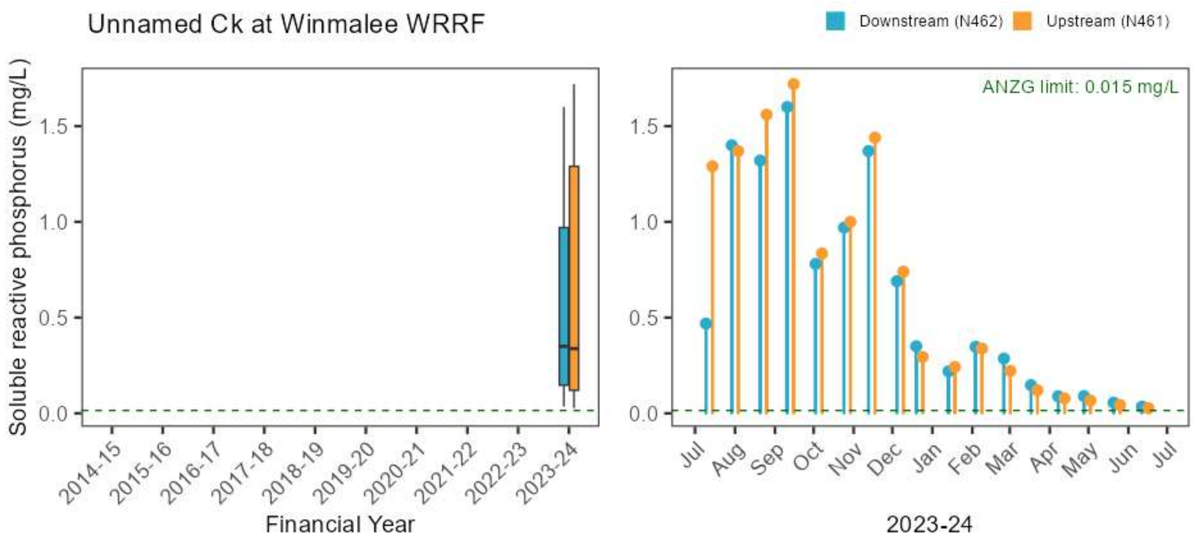

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Total ammonia nitrogen (mg/L)
0.0
0.2
0.4
0.6
0.8
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.79 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

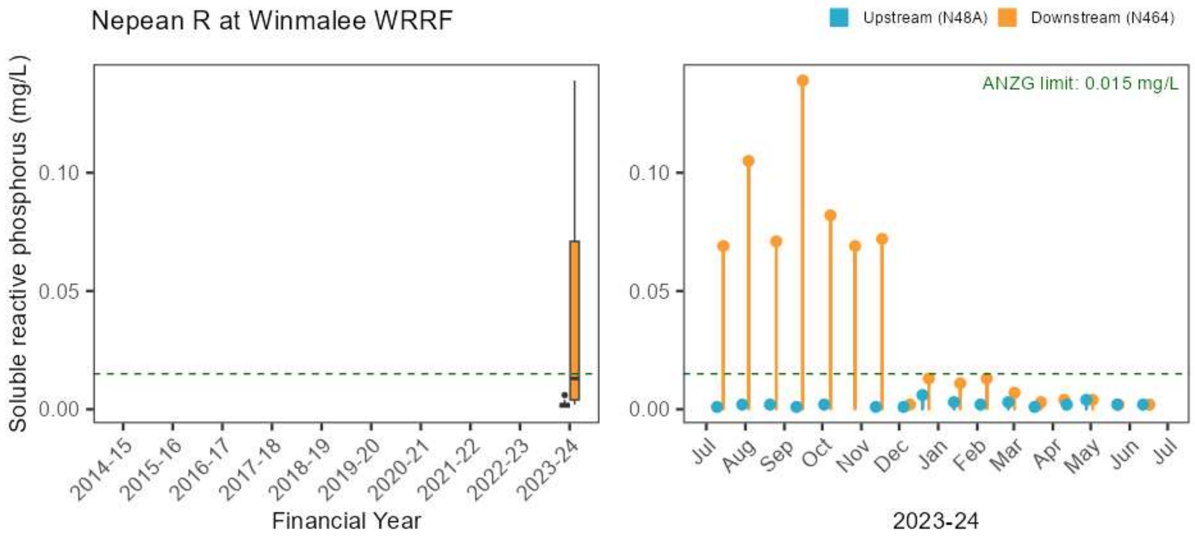

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Oxidised nitrogen (mg/L)
0
3
6
9
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.04 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

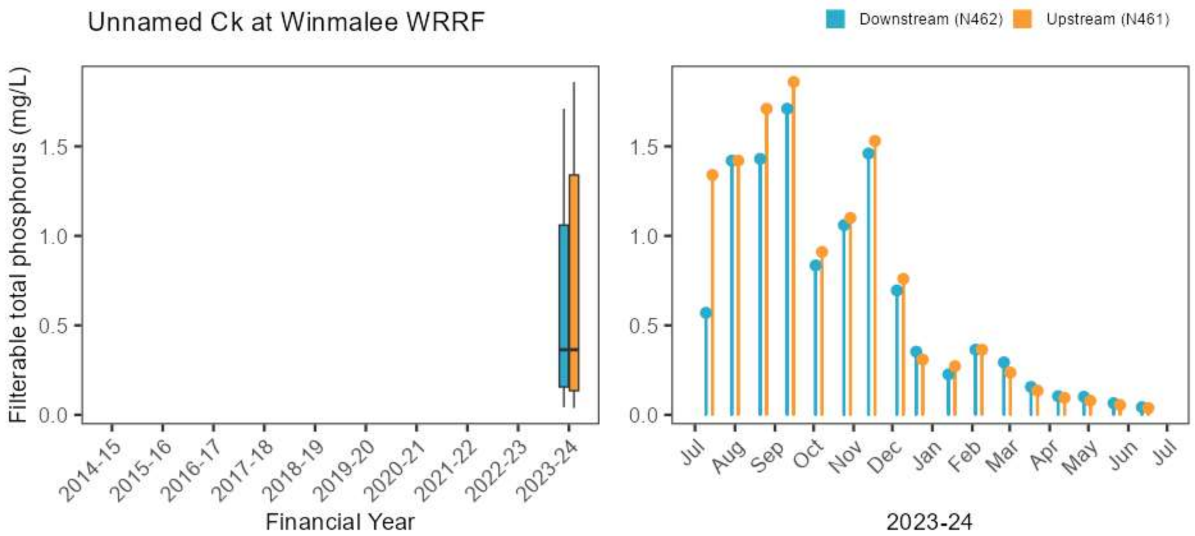

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Oxidised nitrogen (mg/L)
0
2
4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.04 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

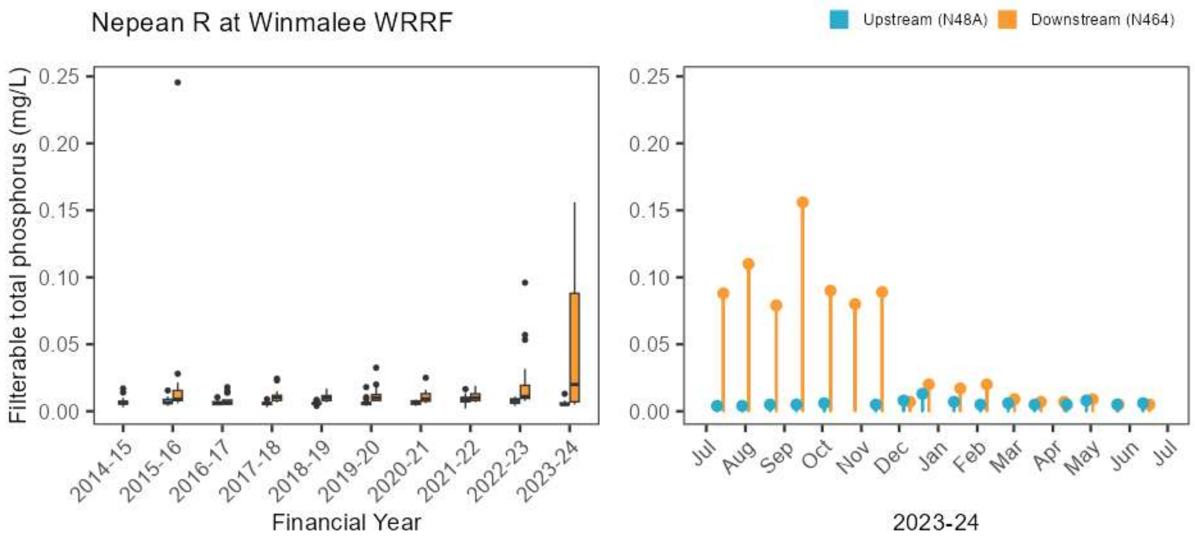

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
ANZG limit: 0.35 mg/L
Total nitrogen (mg/L)
Financial Year
2023-24

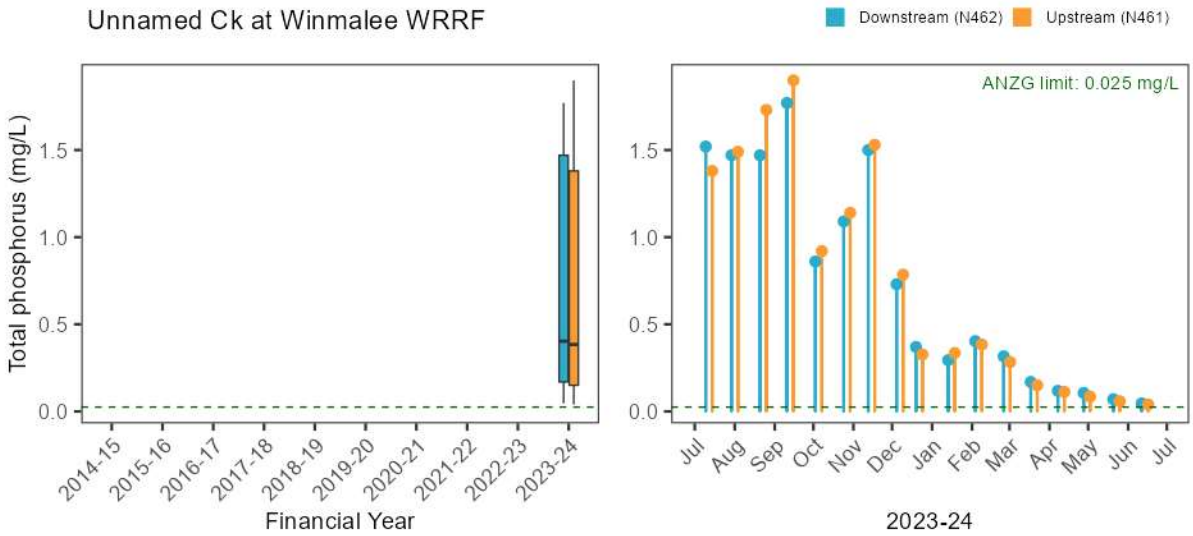

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
ANZG limit: 0.35 mg/L
Total nitrogen (mg/L)
Financial Year
2023-24

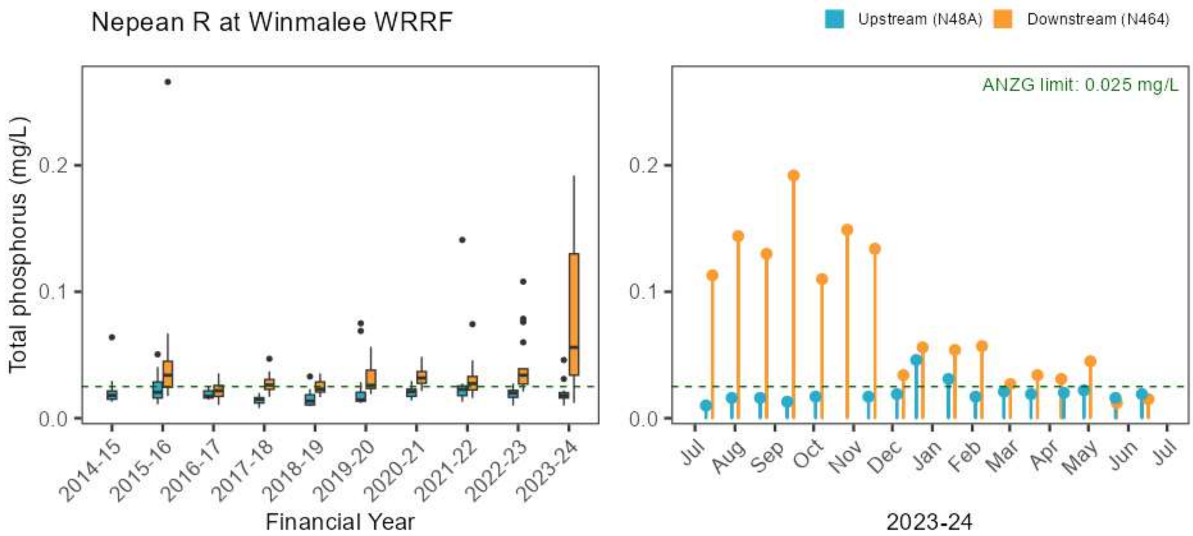

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
ANZG limit: 0.015 mg/L
Soluble reactive phosphorus (mg/L)
Financial Year
2023-24


Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
ANZG limit: 0.015 mg/L
Soluble reactive phosphorus (mg/L)
0.00
0.05
0.10
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

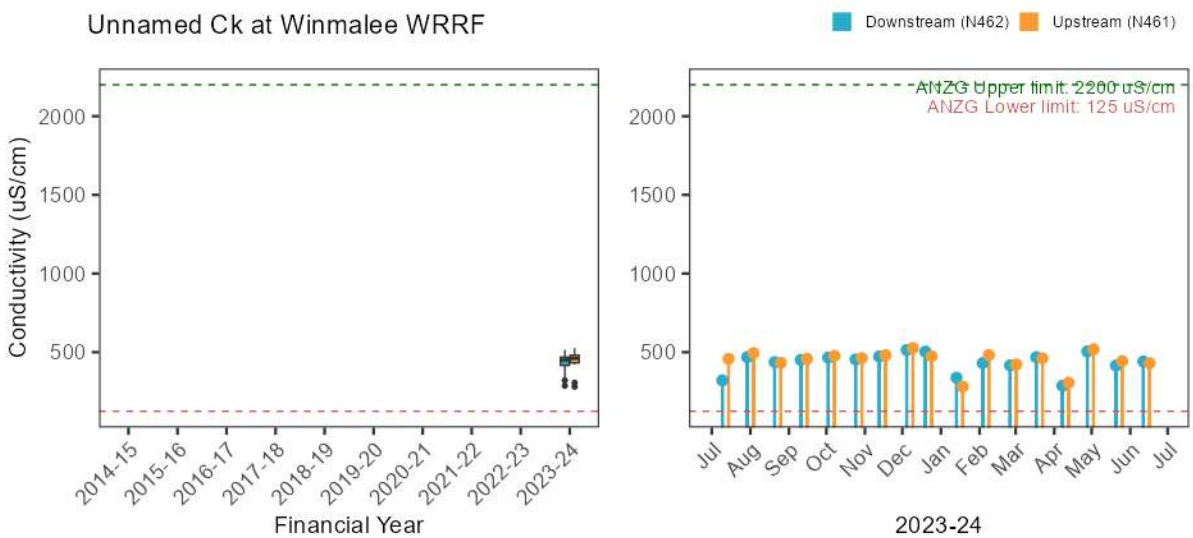

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Filterable total phosphorus (mg/L)
0.0
0.5
1.0
1.5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

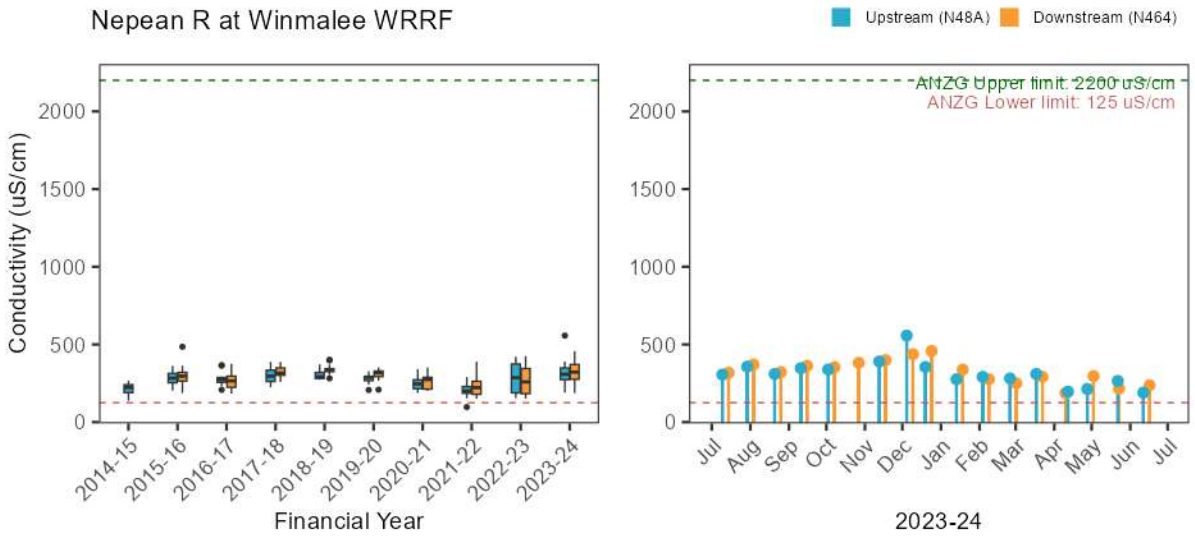

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Filterable total phosphorus (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

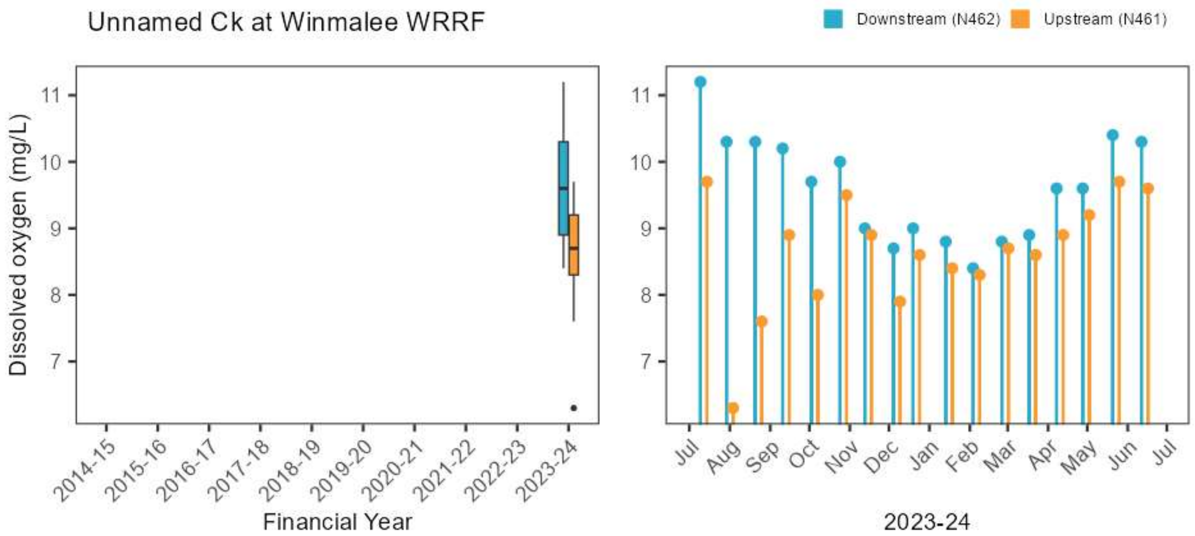


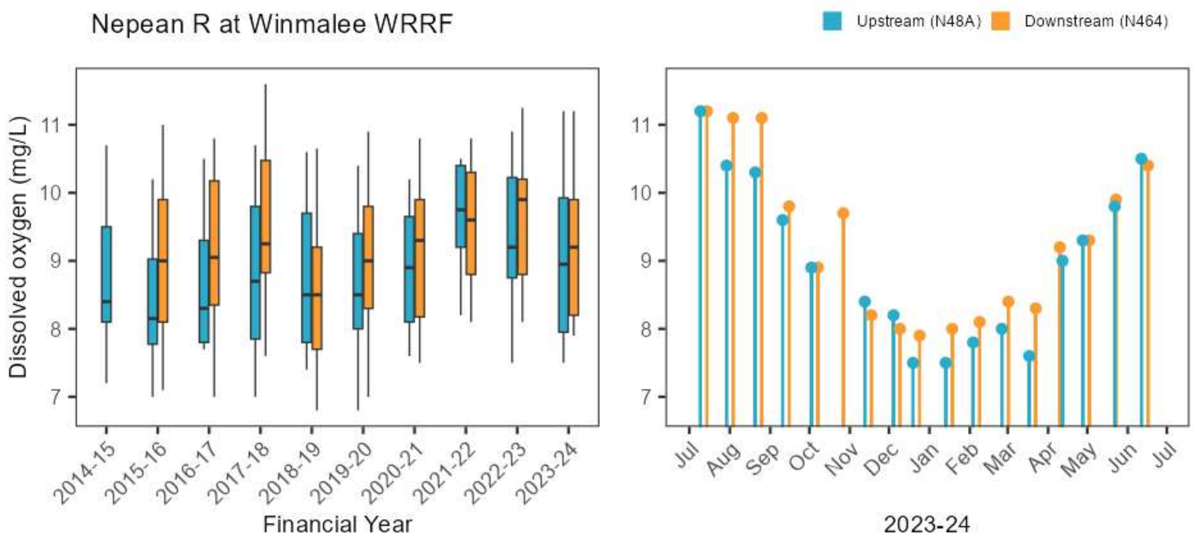


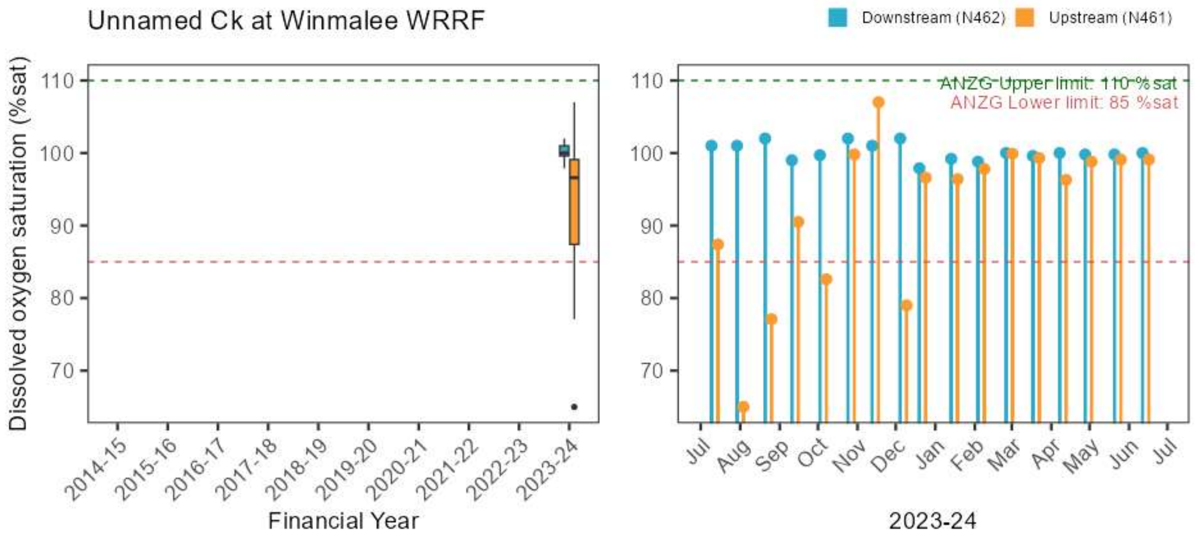
A.5.7. Stressor – Physico-chemical water quality

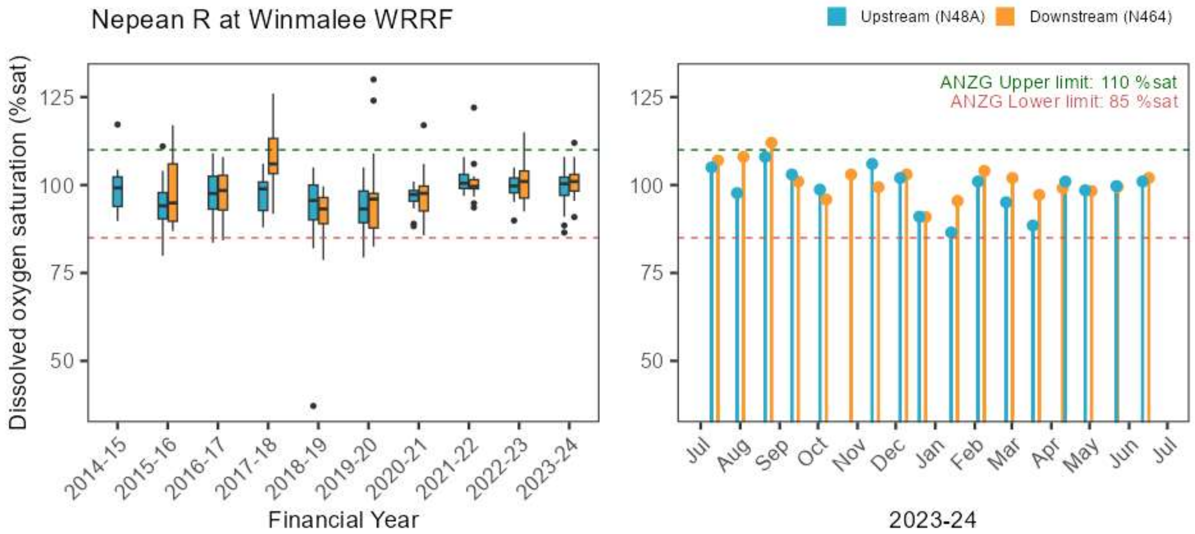


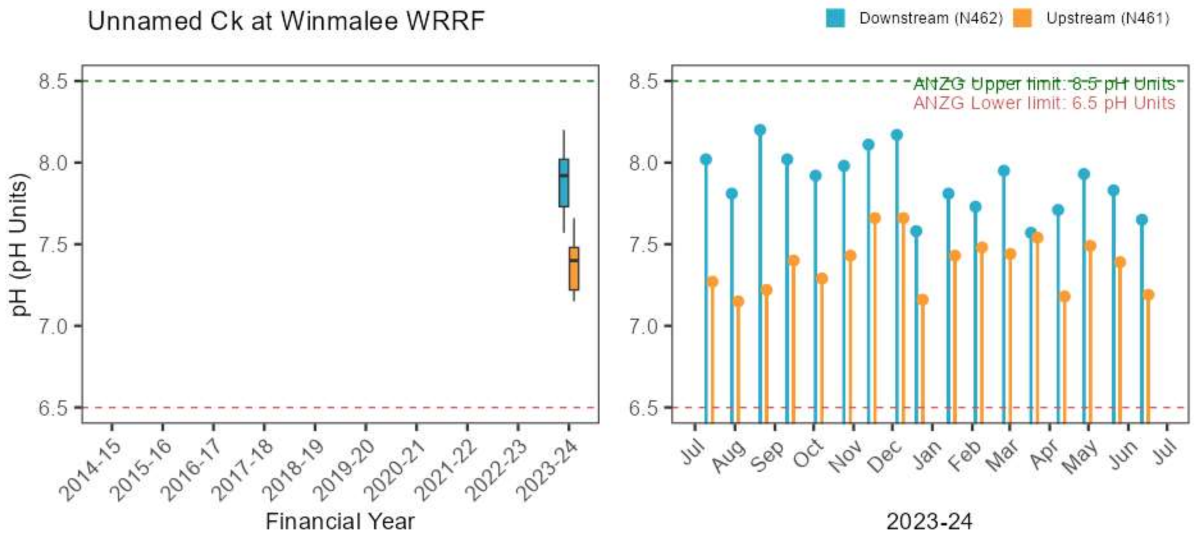

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Conductivity (uS/cm)
ANZG Upper limit: 2200 uS/cm
ANZG Lower limit: 125 uS/cm
Financial Year
2023-24

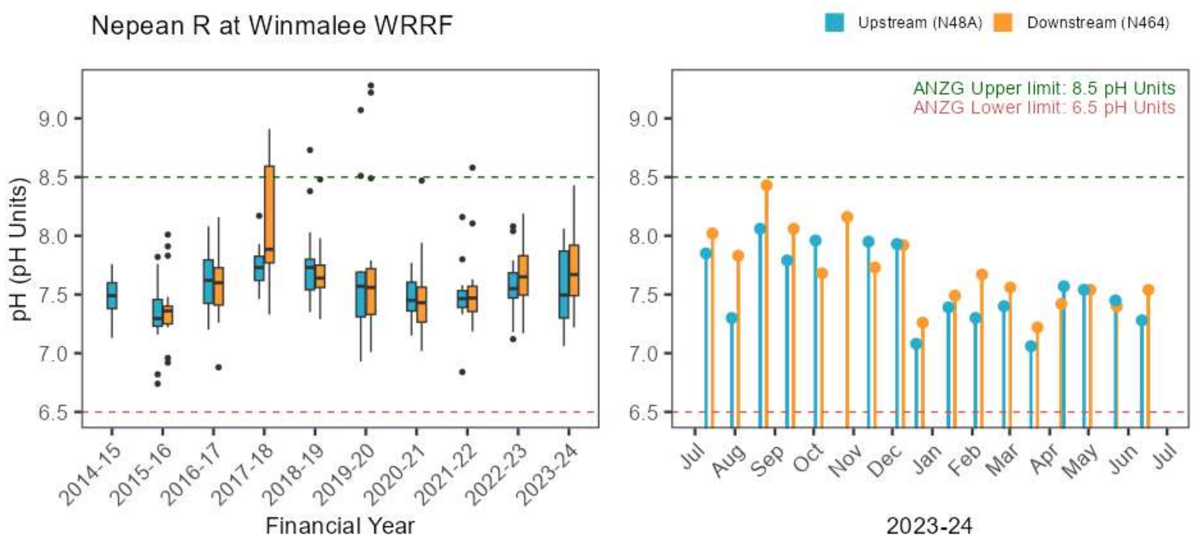

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Dissolved oxygen (mg/L)
Financial Year
2023-24

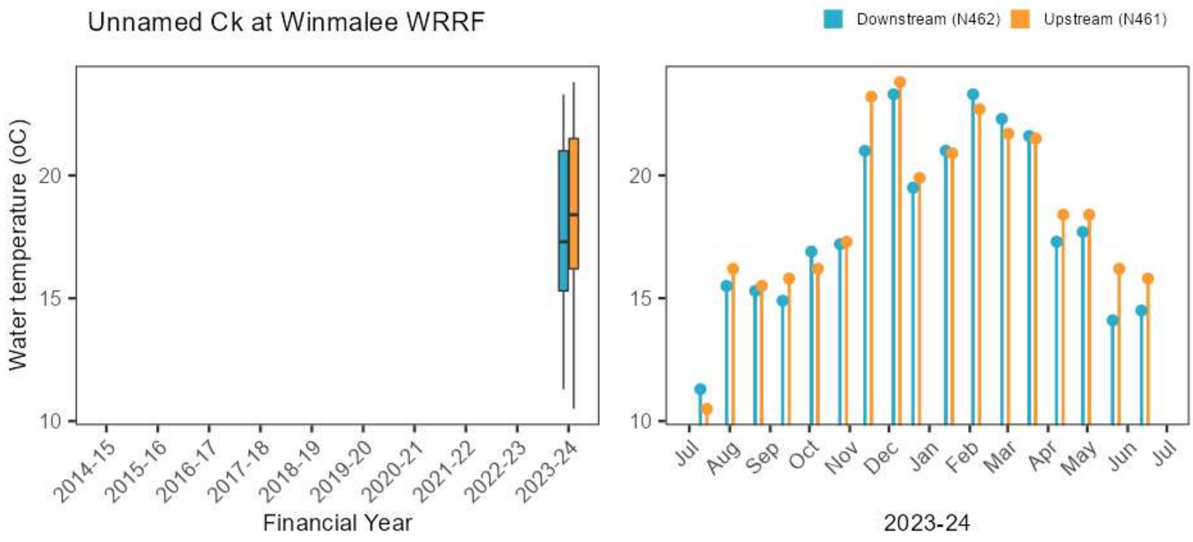

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Dissolved oxygen (mg/L)
Financial Year
2023-24

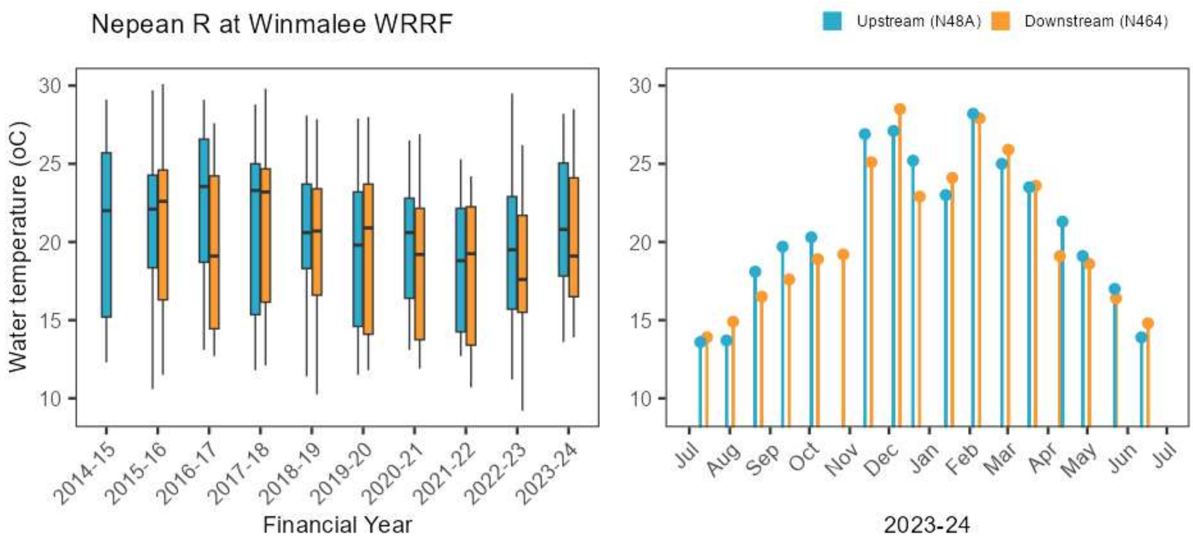

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Financial Year
2023-24

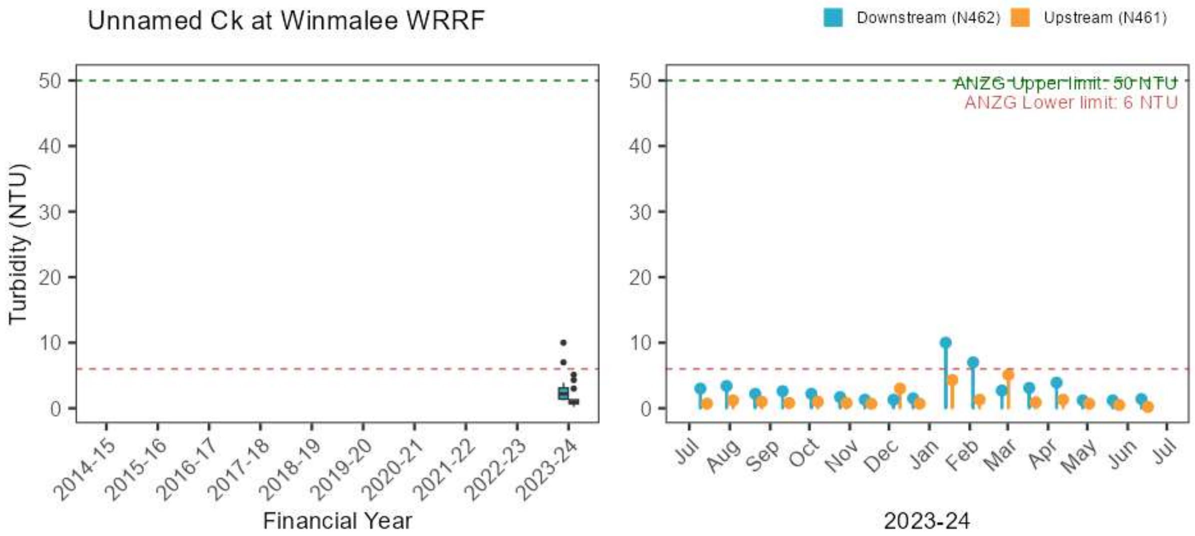

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Financial Year
2023-24

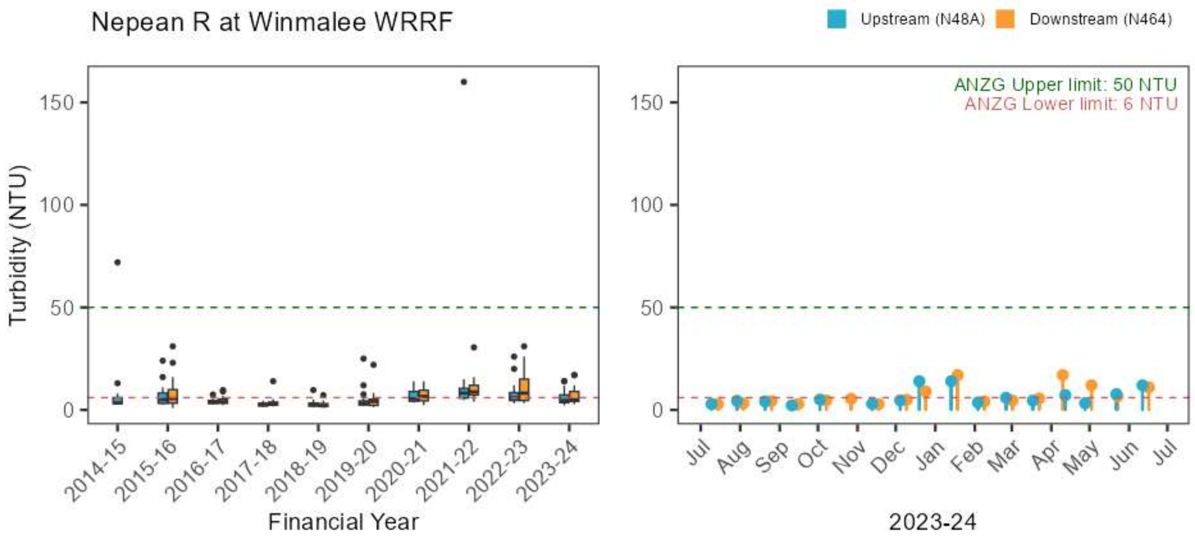

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Financial Year
2023-24


Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
pH (pH Units)
Financial Year
2023-24

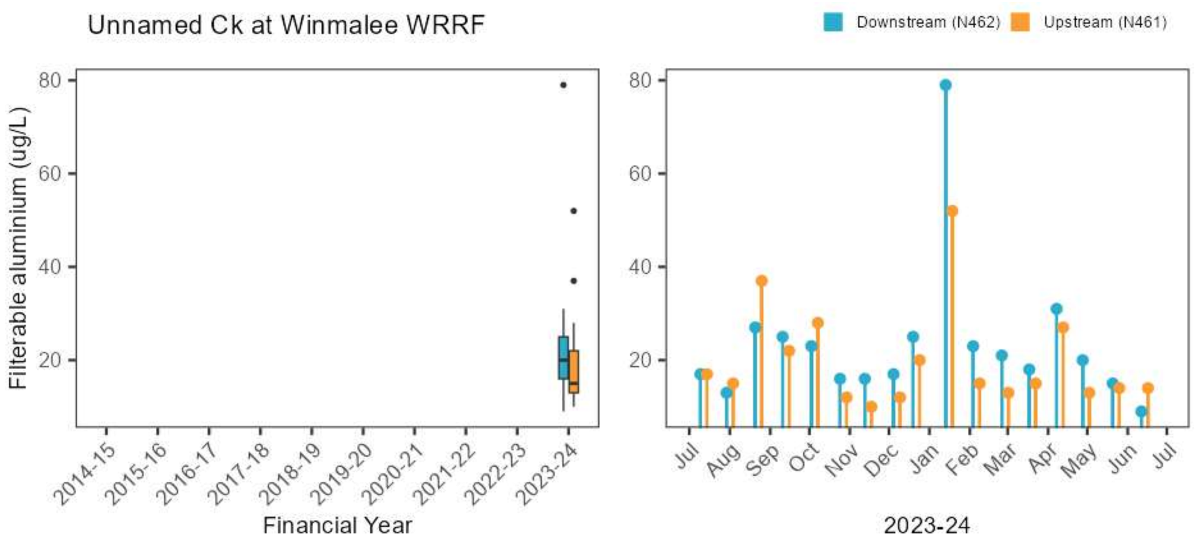

Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Water temperature (oC)
Financial Year
2023-24

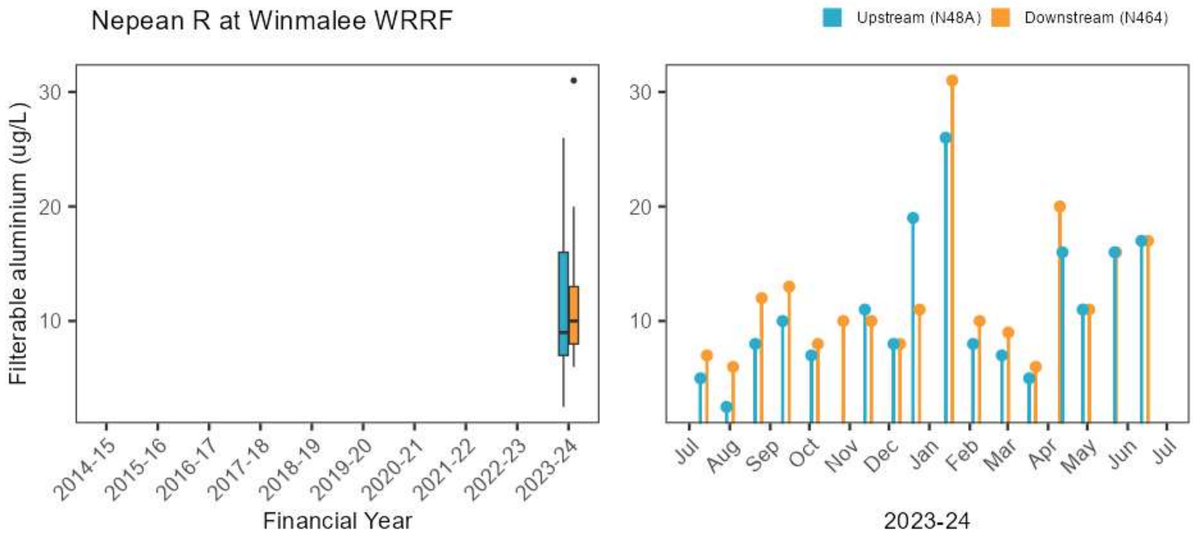

Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Water temperature (oC)
Financial Year
2023-24



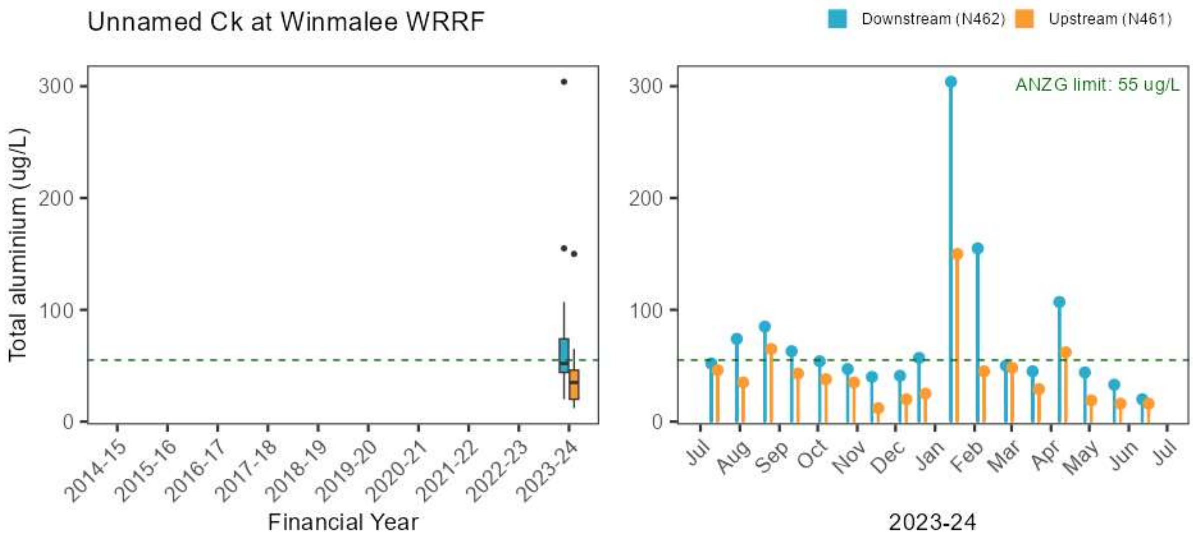


A.5.8. Stressor – Trace metals

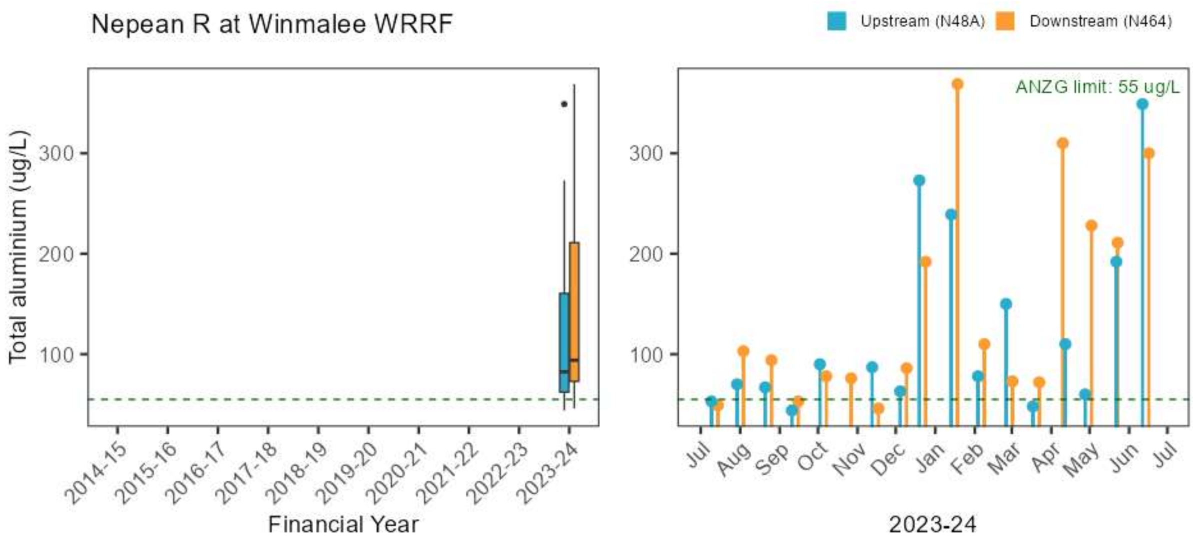




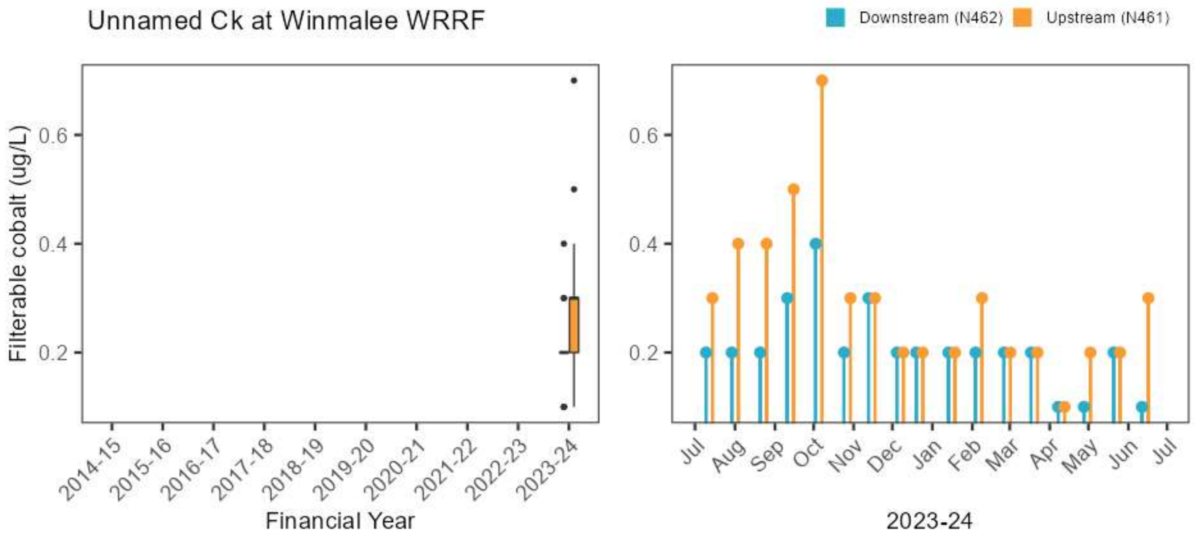
Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Filterable aluminium (ug/L)
30
20
10
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24



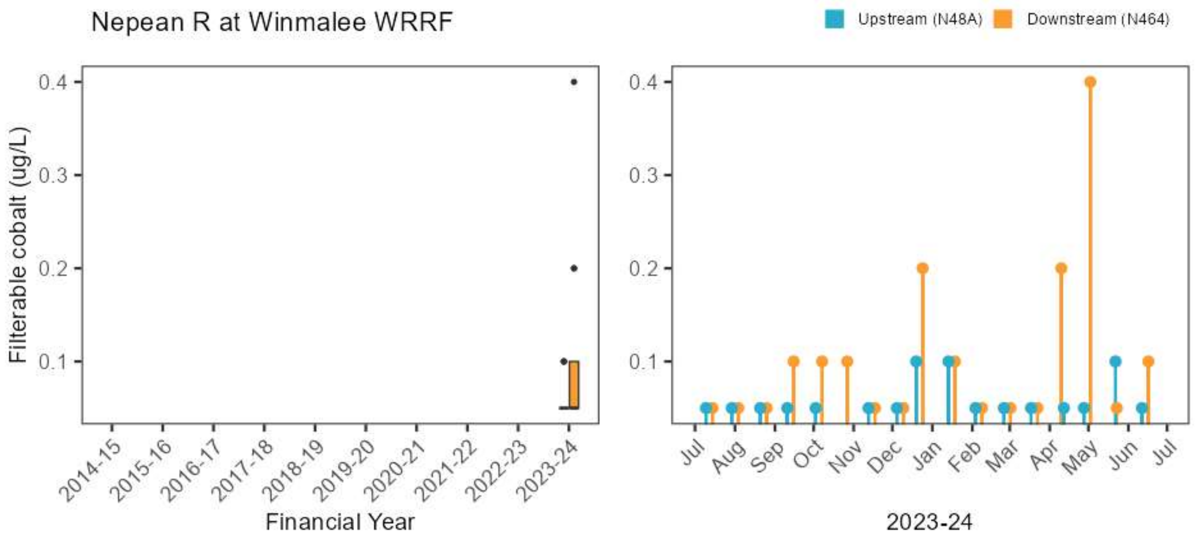
Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
ANZG limit: 55 ug/L
Total aluminium (ug/L)
300
200
100
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24



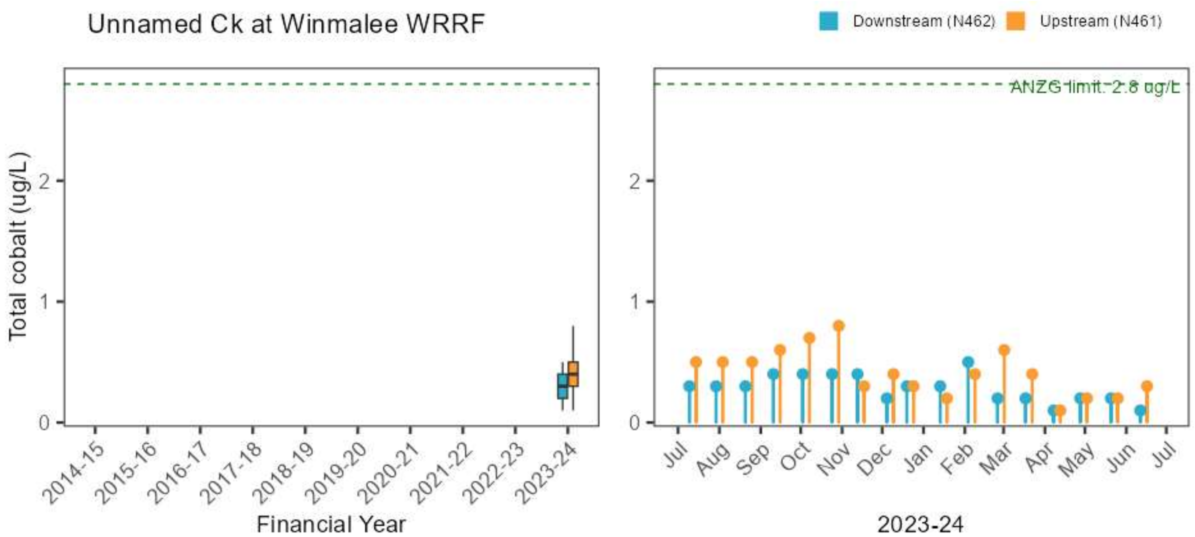
Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
ANZG limit: 55 ug/L
Total aluminium (ug/L)
300
200
100
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24



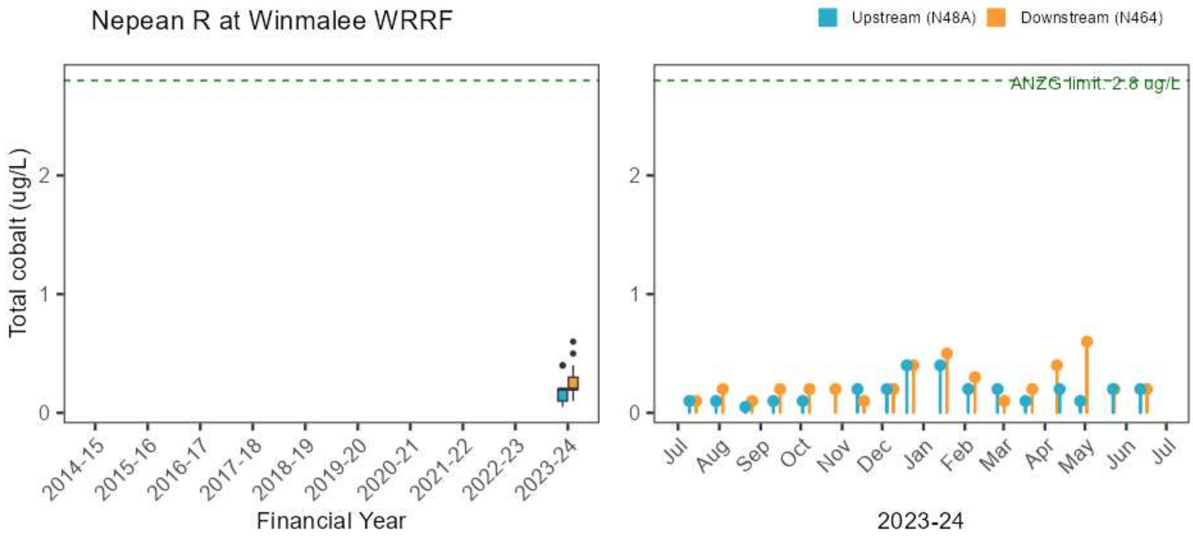
Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Filterable cobalt (ug/L)
Financial Year
2023-24



Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Filterable cobalt (ug/L)
Financial Year
2023-24



Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
Financial Year
2023-24


Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
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Dec
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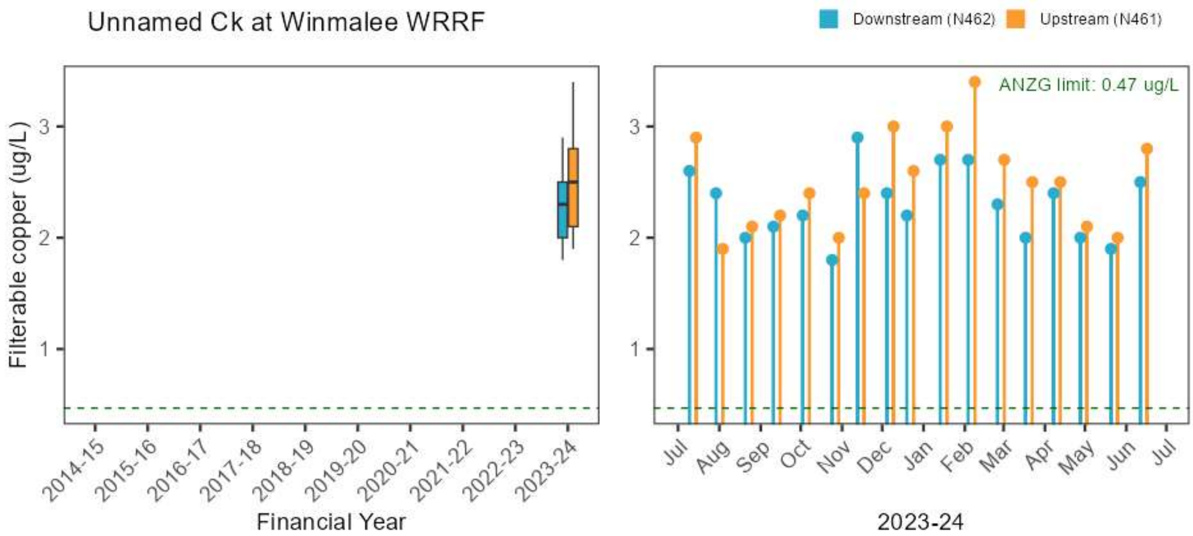
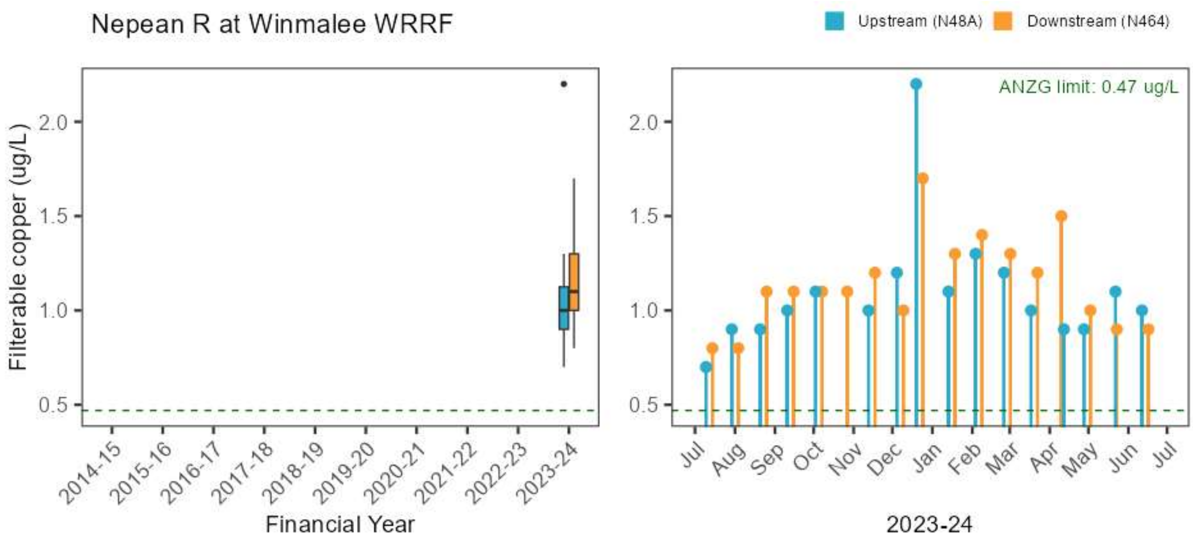
May
Jun
Jul
2023-24


Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
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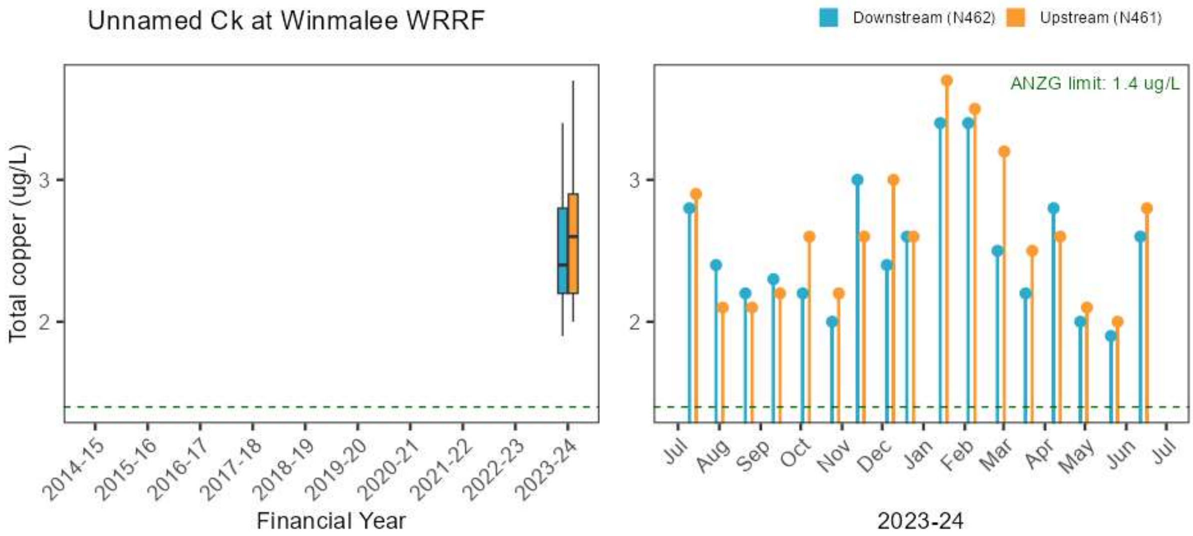
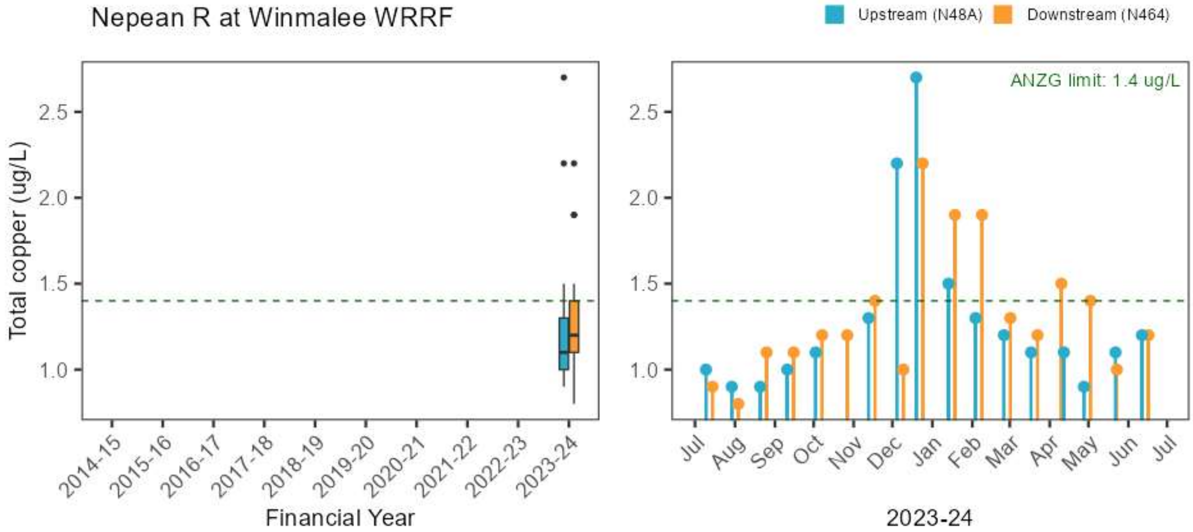
Apr
May
Jun
Jul
2023-24

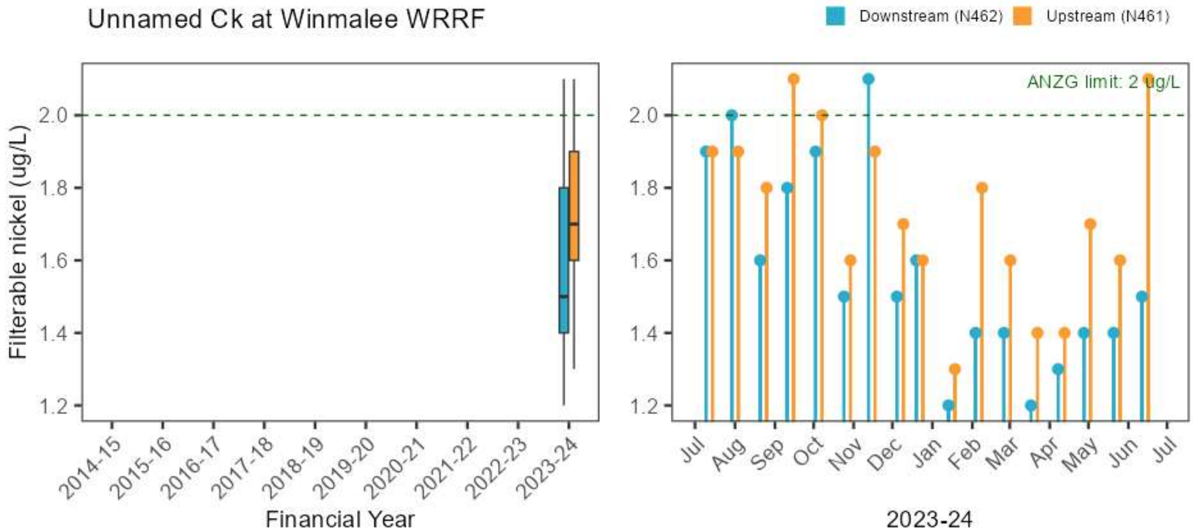
Unnamed Ck at Winmalee WRRF

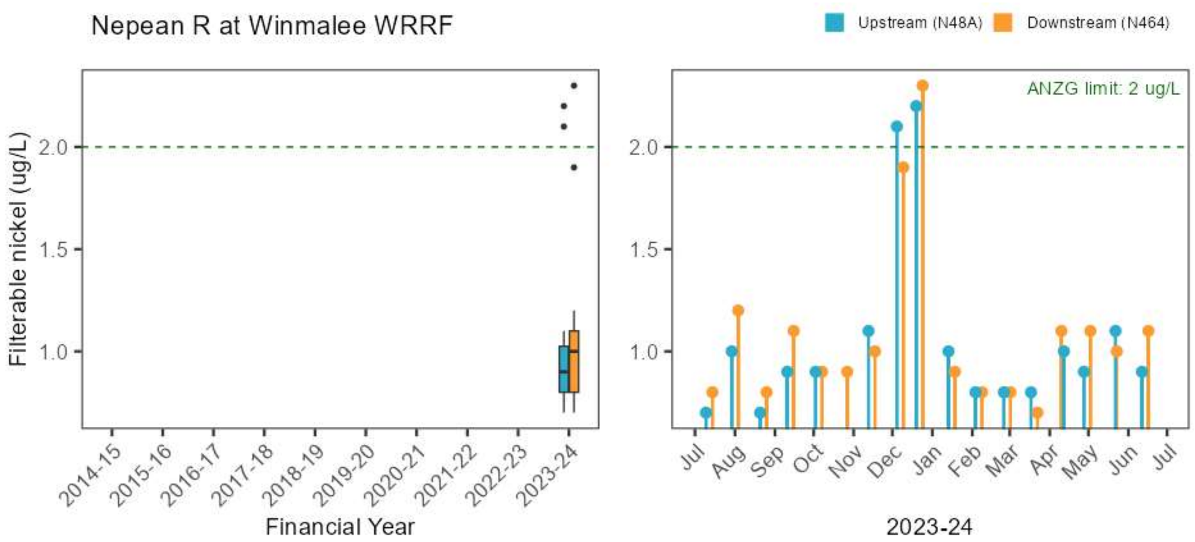


Nepean R at Winmalee WRRF



Unnamed Ck at Winmalee WRRF




Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Filterable nickel (ug/L)
ANZG limit: 2 ug/L
2.0
1.5
1.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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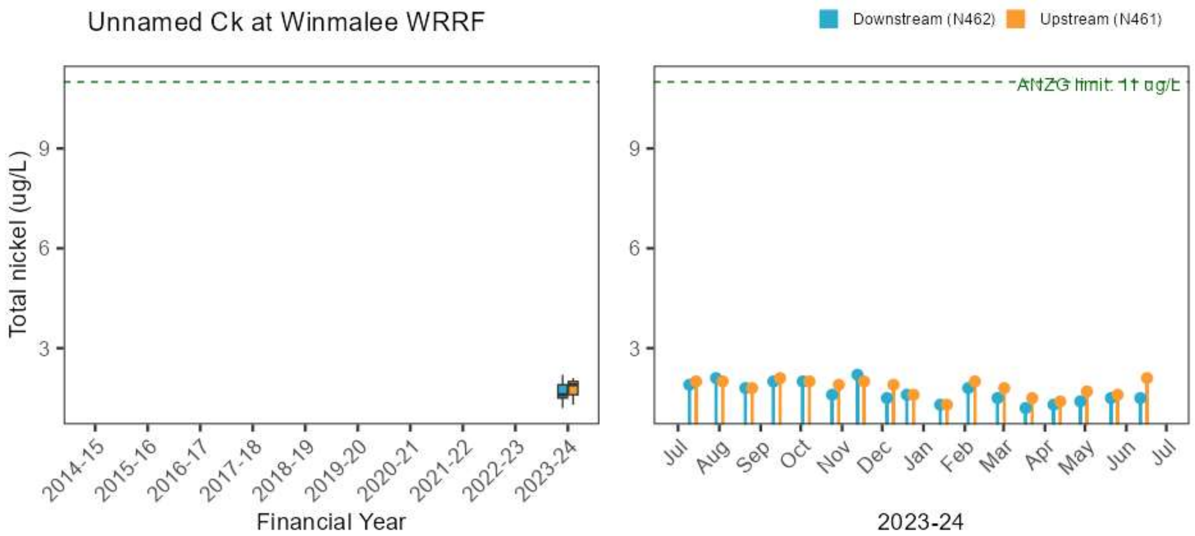
May
Jun
Jul
2023-24


Unnamed Ck at Winmalee WRRF
Downstream (N462)
Upstream (N461)
Total nickel (ug/L)
ANZG limit: 11 ug/L
9
6
3
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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Nov
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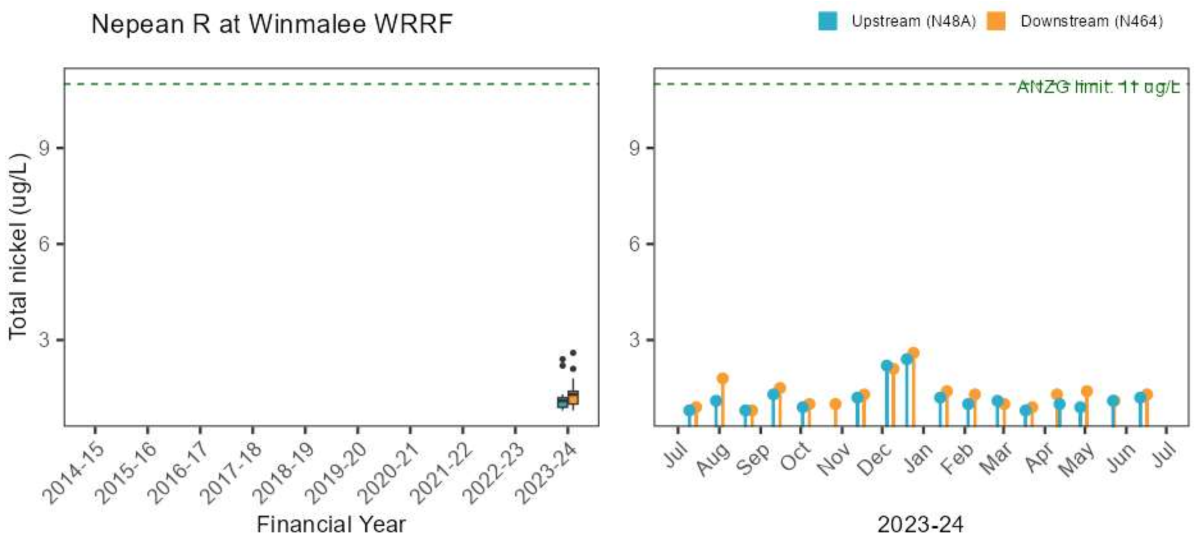
Apr
May
Jun
Jul
2023-24


Nepean R at Winmalee WRRF
Upstream (N48A)
Downstream (N464)
Total nickel (ug/L)
ANZG limit: 11 ug/L
9
6
3
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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Nov
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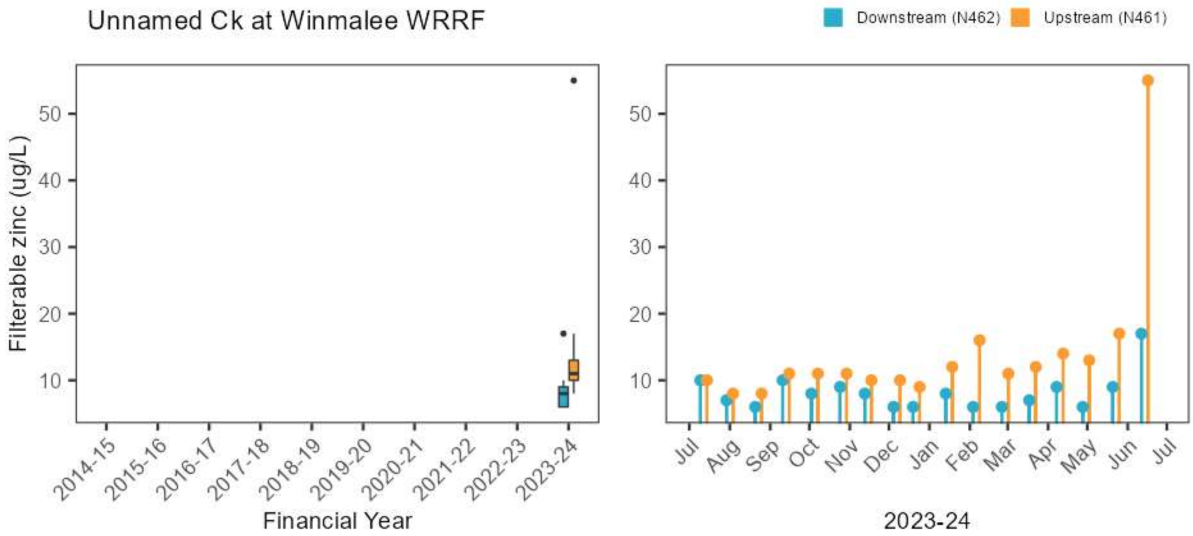
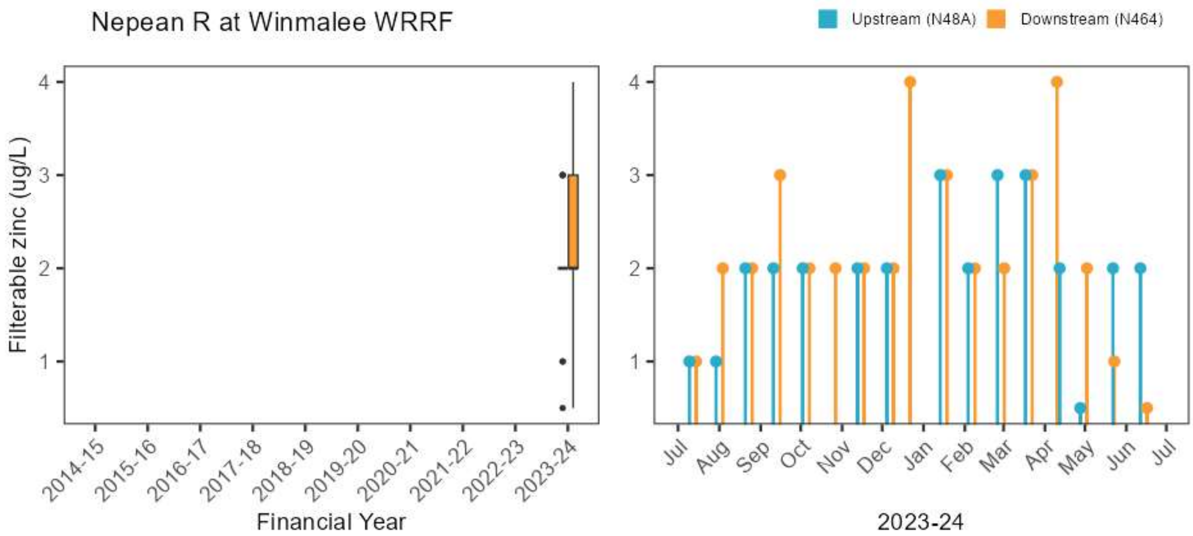
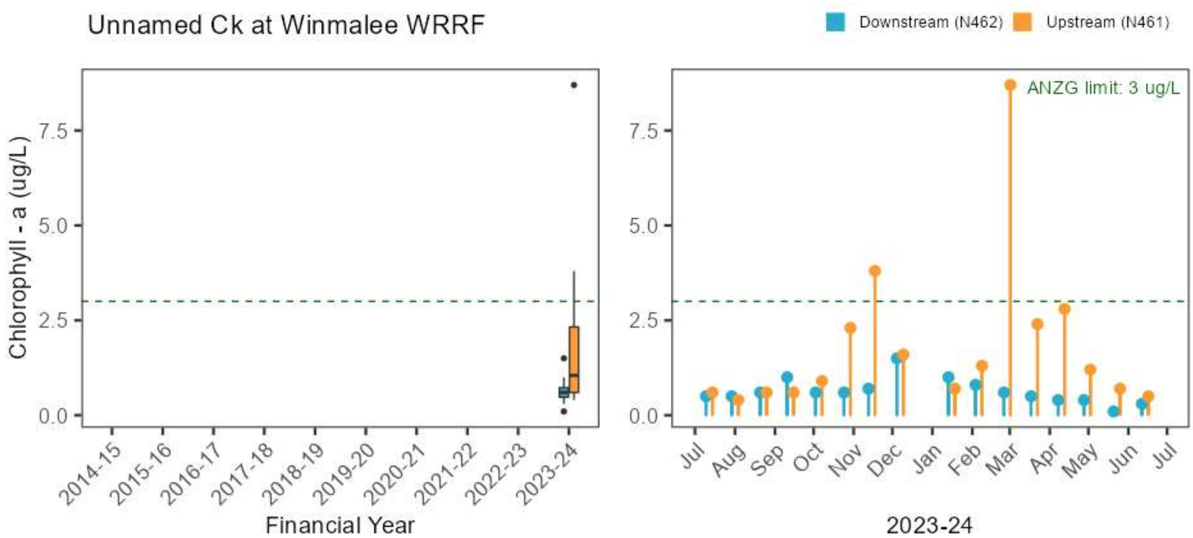
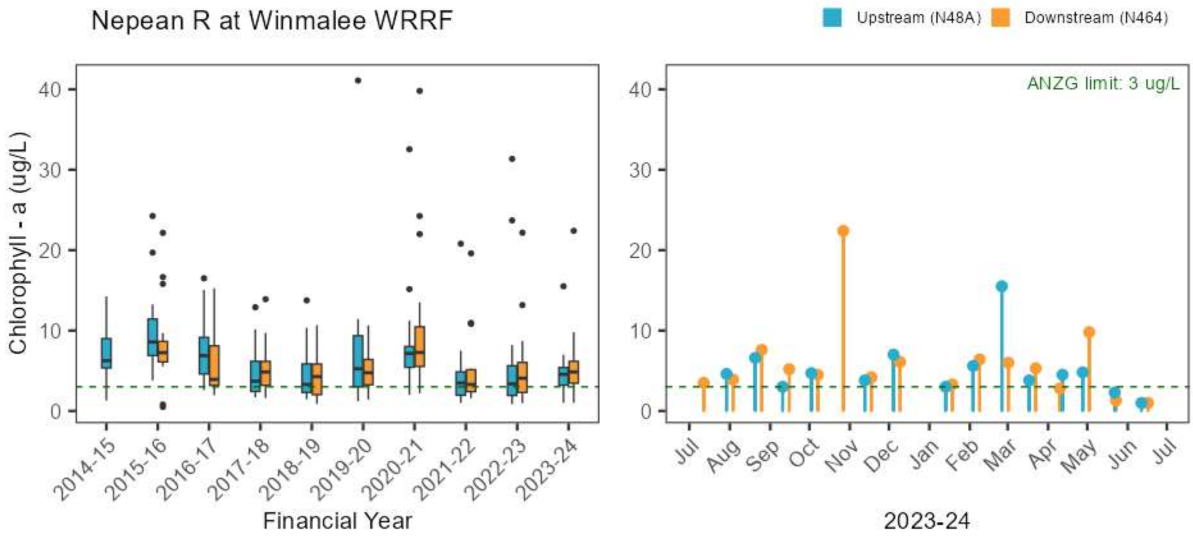
May
Jun
Jul
2023-24





A.5.9. Ecosystem receptor – Phytoplankton





A.5.10. Ecosystem receptor – Macroinvertebrates

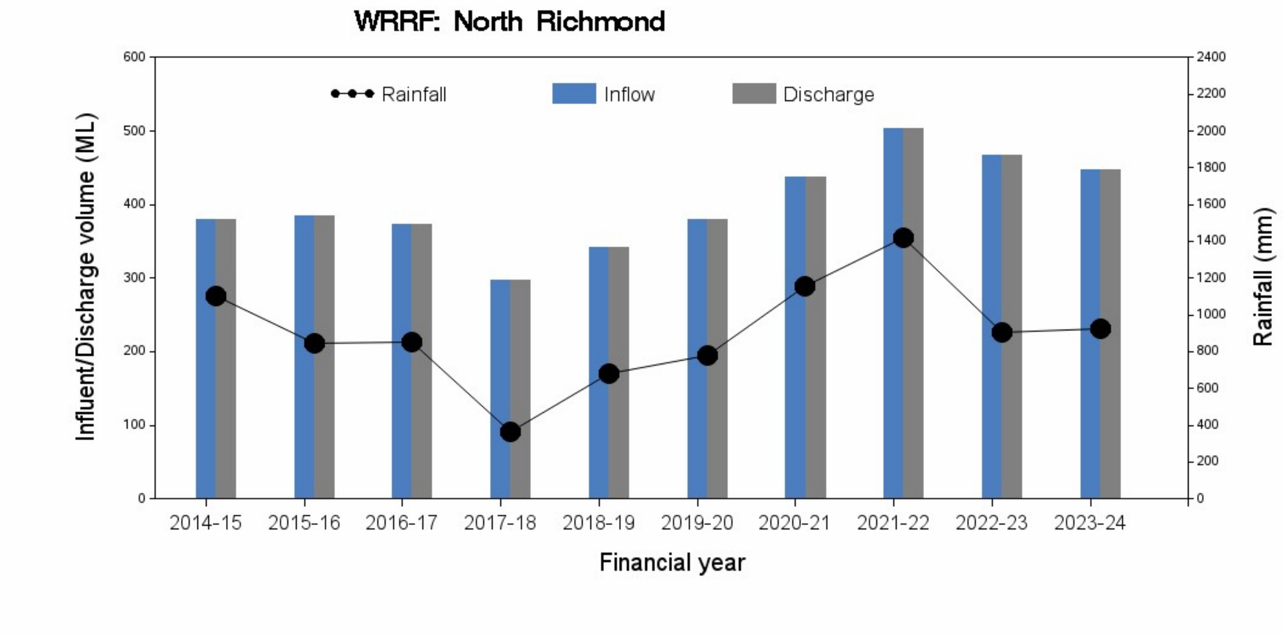
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Unnamed Creek	Tributary (N461 vs N462)	Welch Two Sample t-test	0.84	3.37	7.3	0.011
Nepean River	River (N48A vs N44)	Welch Two Sample t-test	-0.24	-1.22	12.0	0.246

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.6. North Richmond

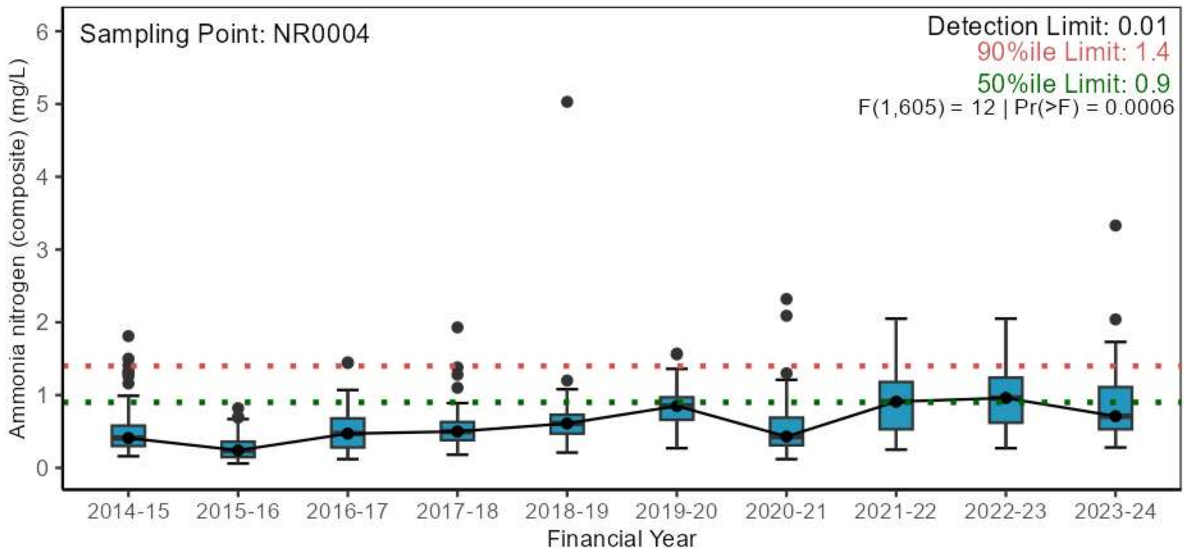
A.6.1. Pressure – Wastewater quantity

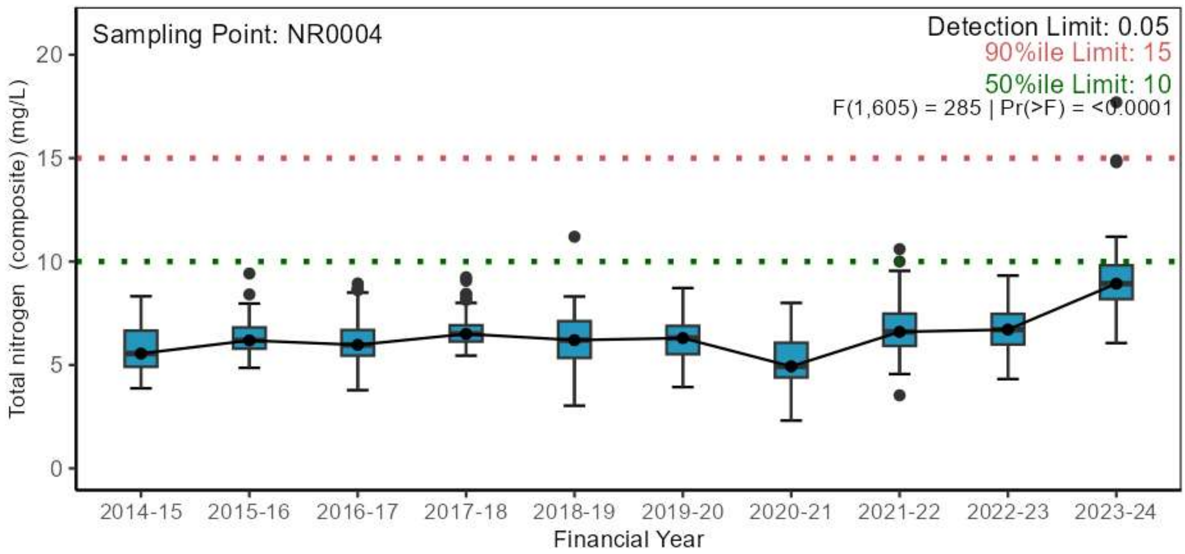
Inflow/discharge volume and rainfall

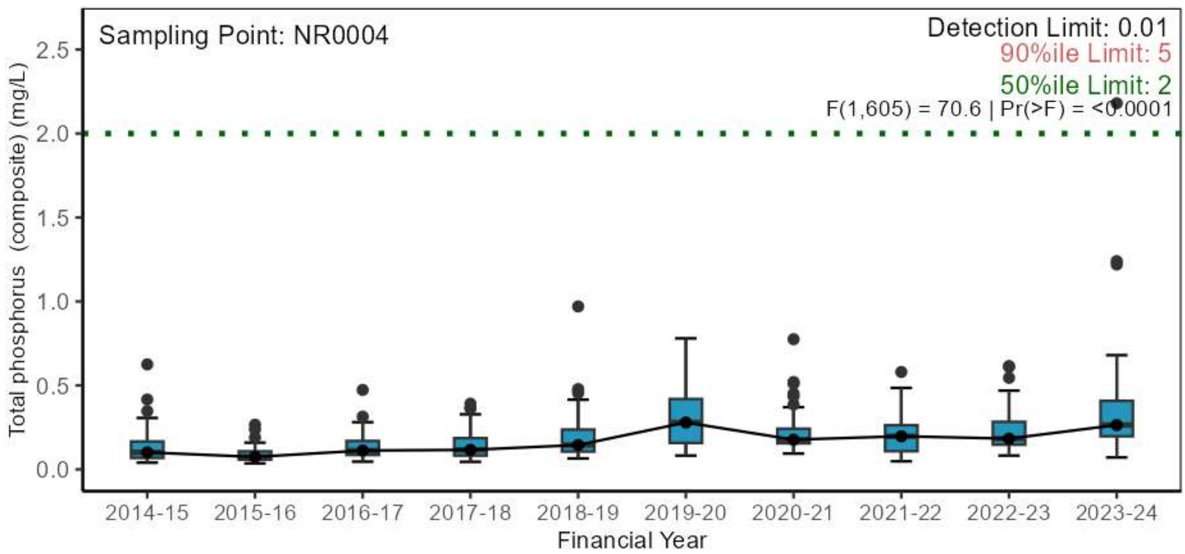


A.6.2. Pressure – Wastewater quality

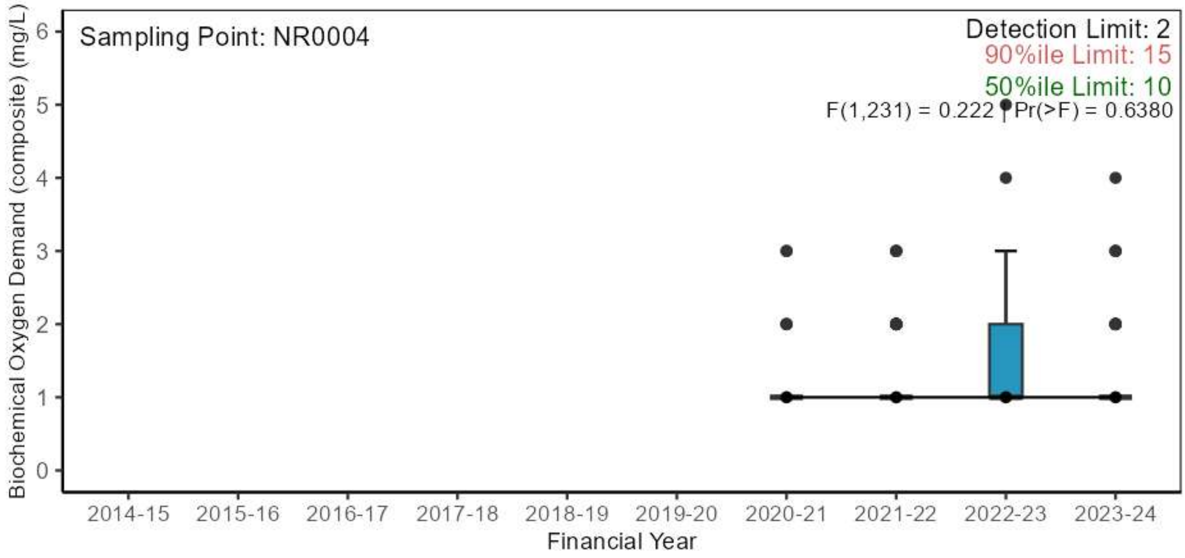
Nutrients

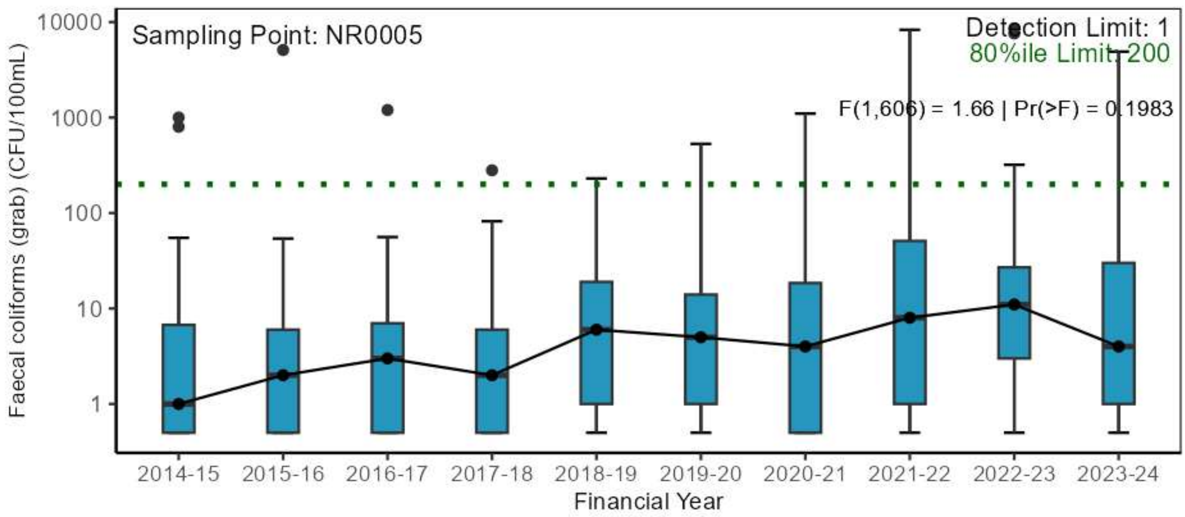




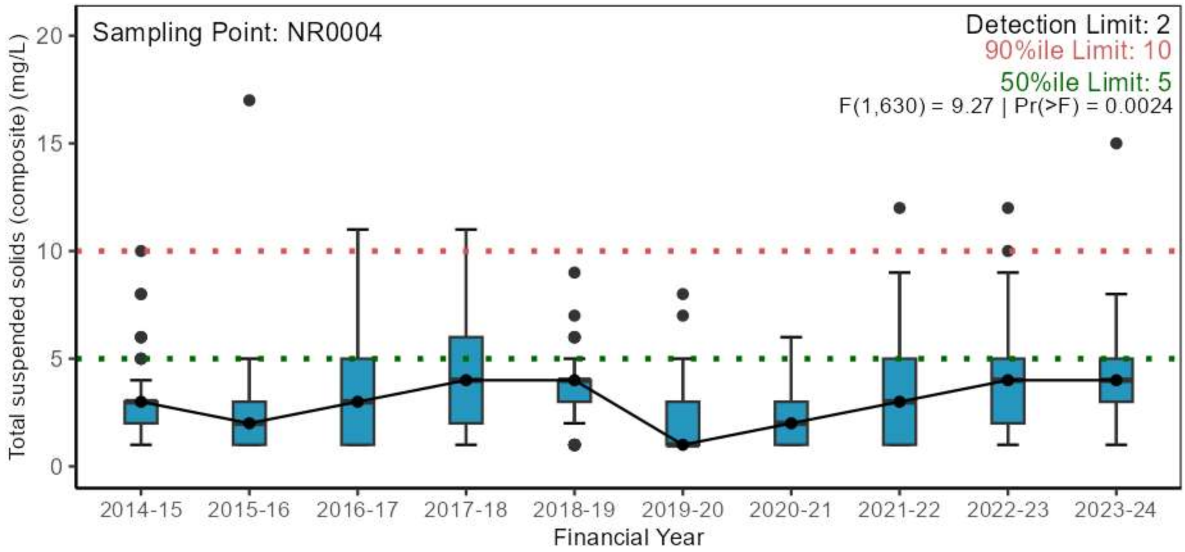


Major conventional analytes

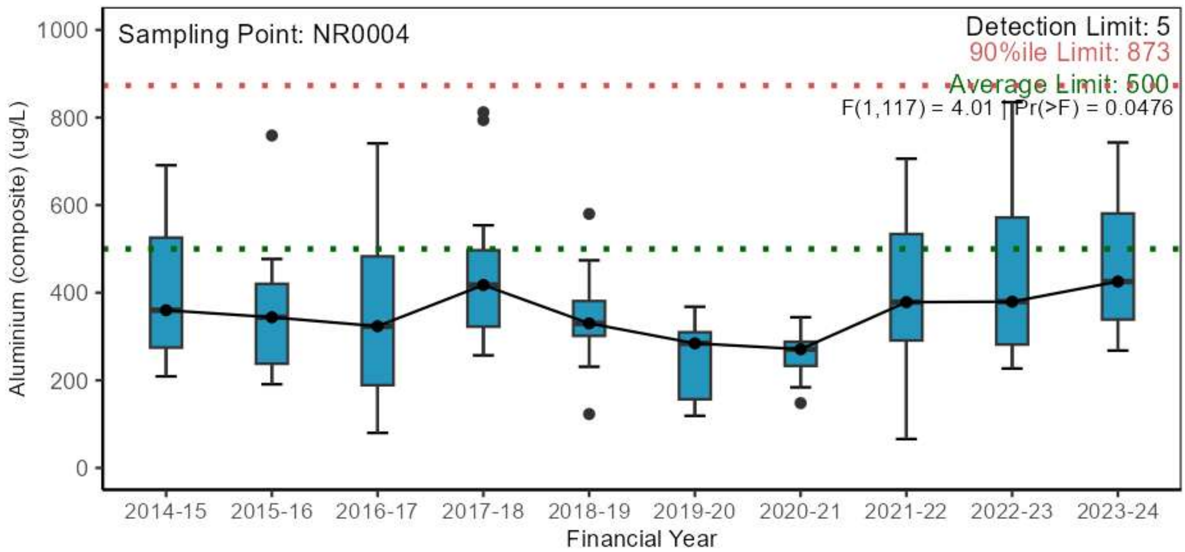


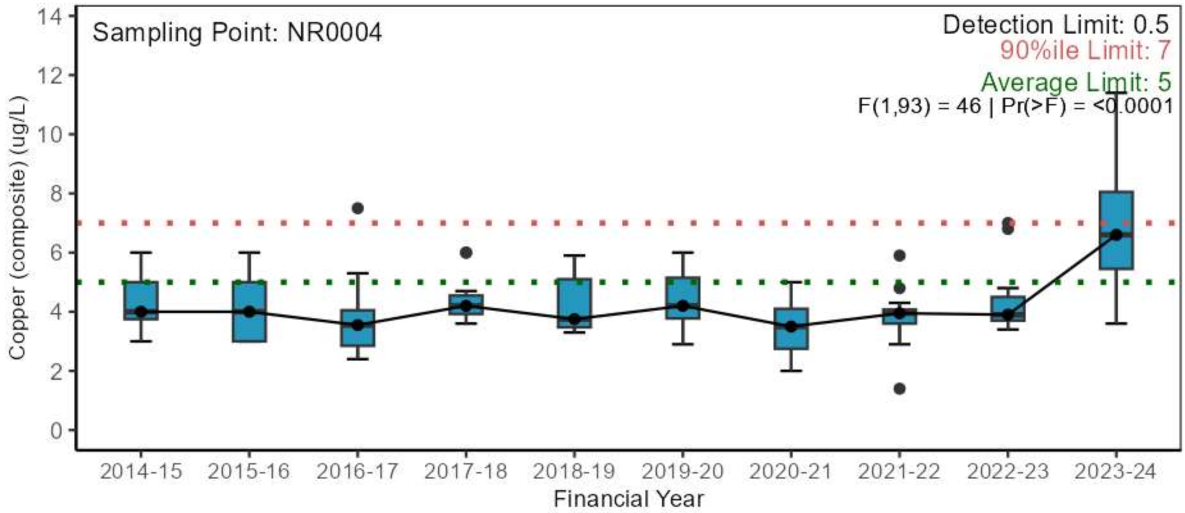


Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

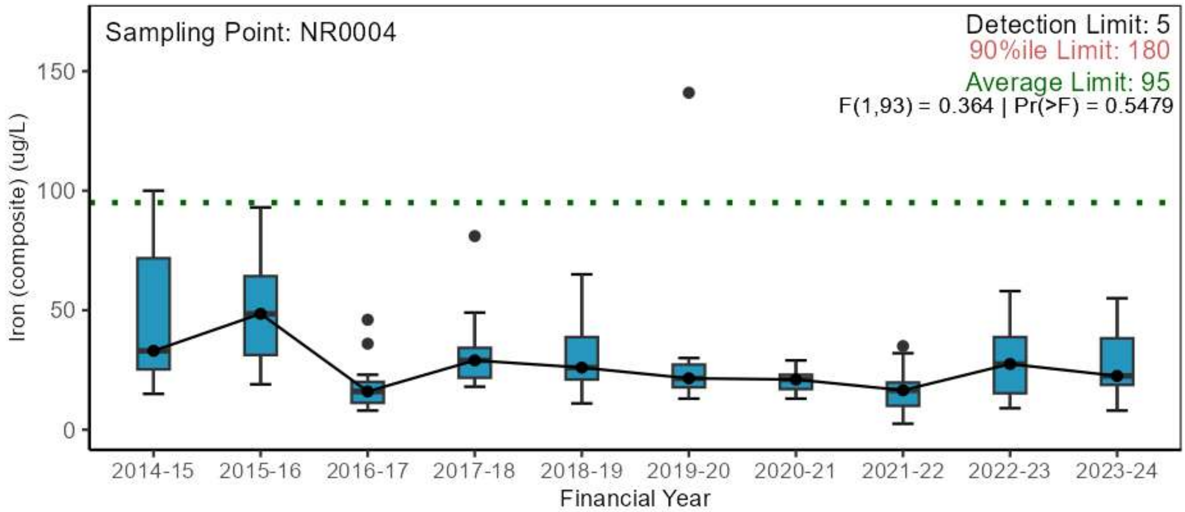


Trace metals

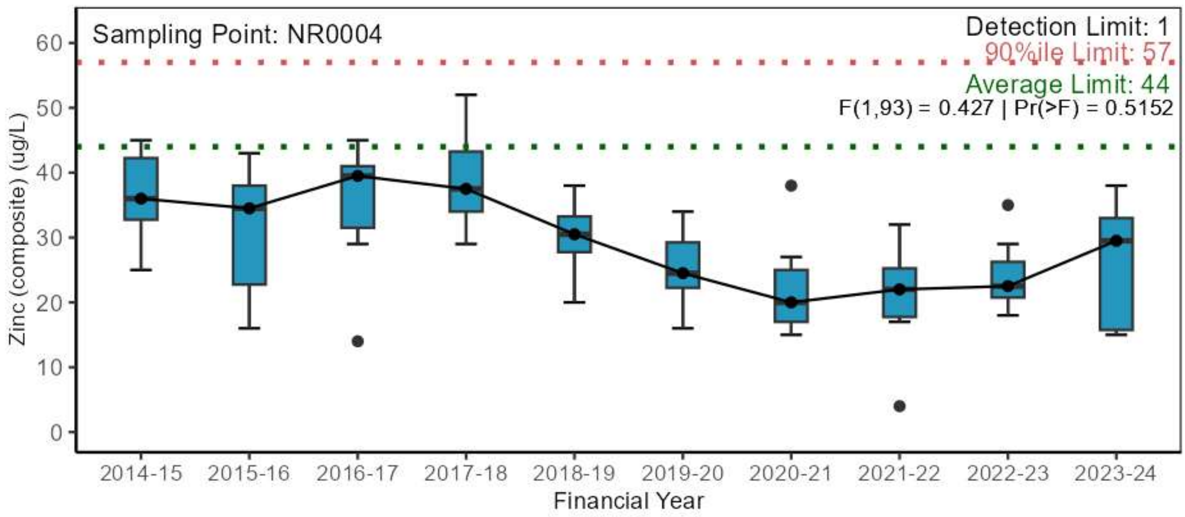




Statistical test excludes data prior to 2016-17 due to method detection limit change.

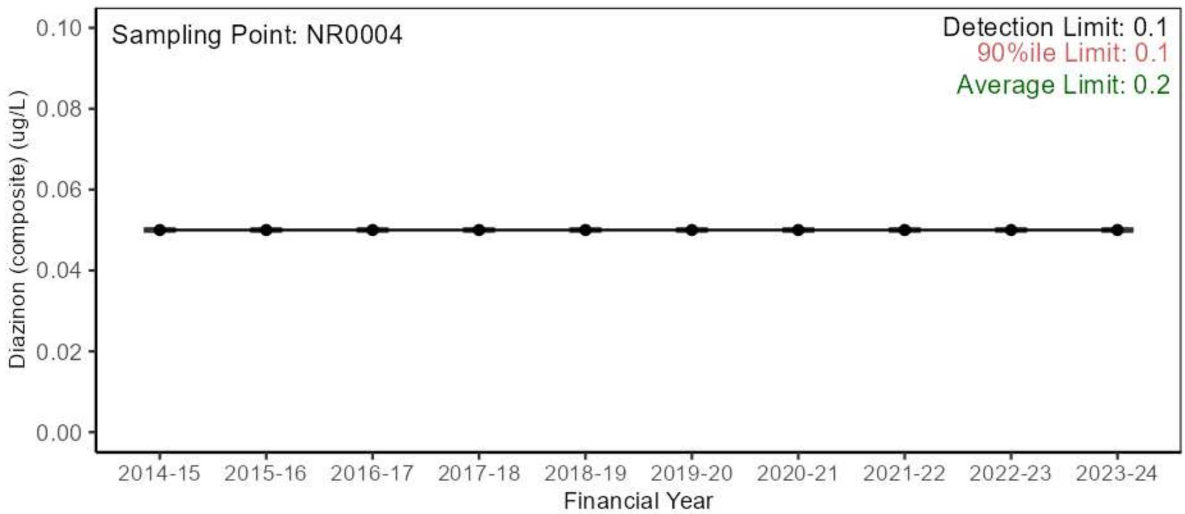


Statistical test excludes data prior to 2016-17 due to method detection limit change.

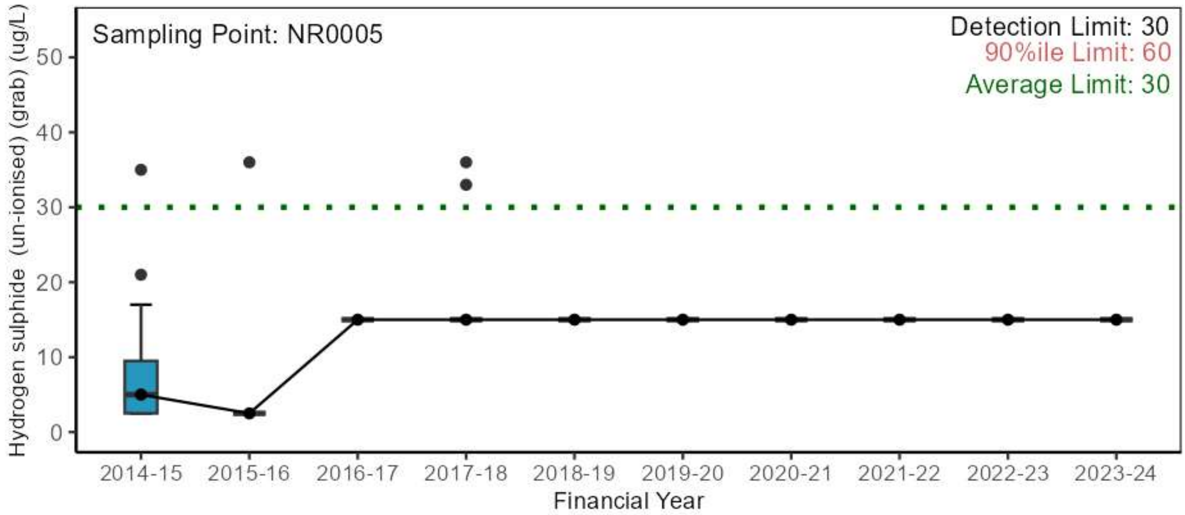


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

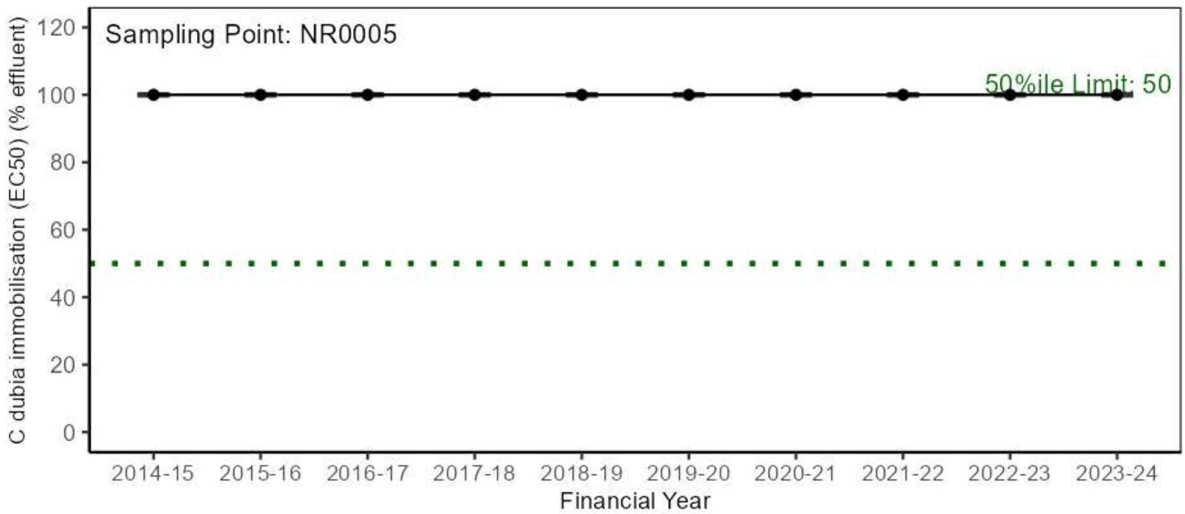


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

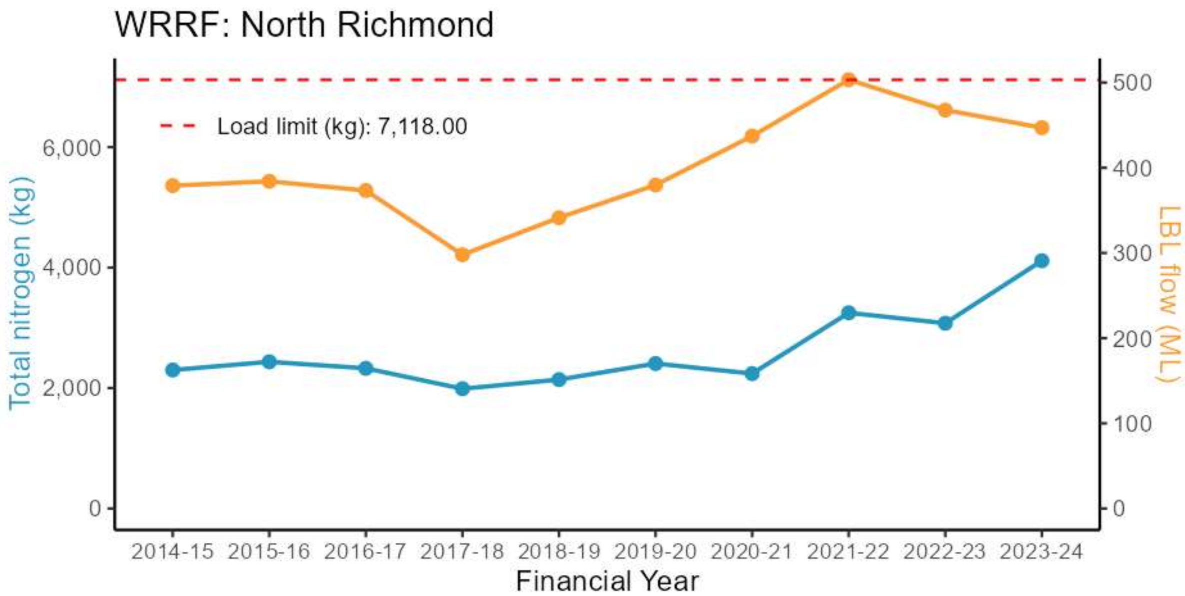
A.6.3. Pressure – Wastewater toxicity

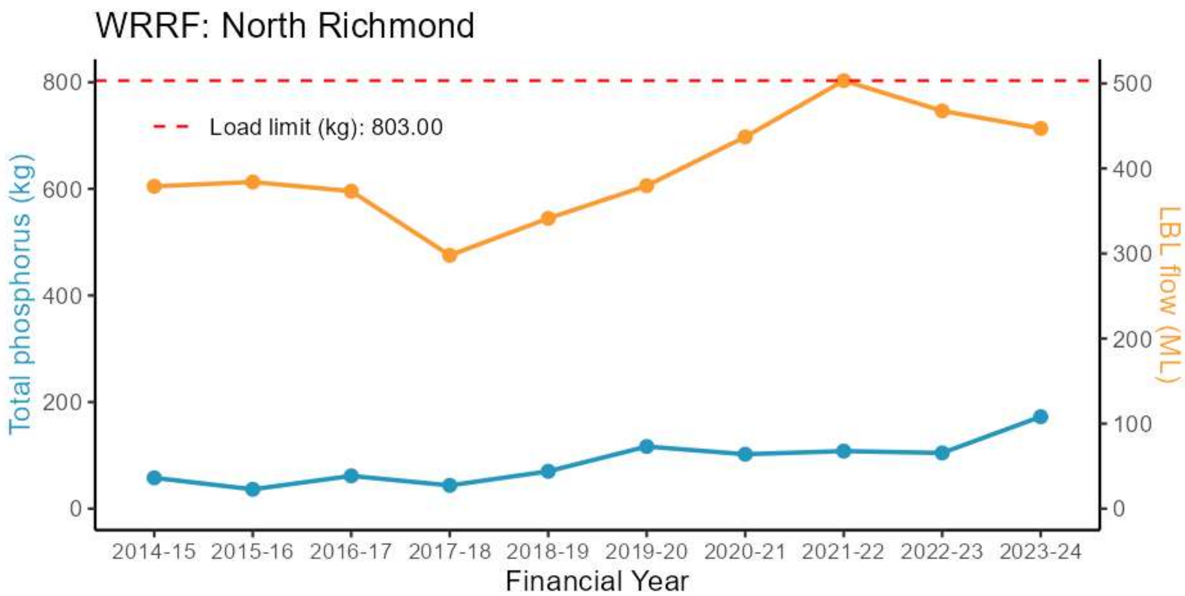


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

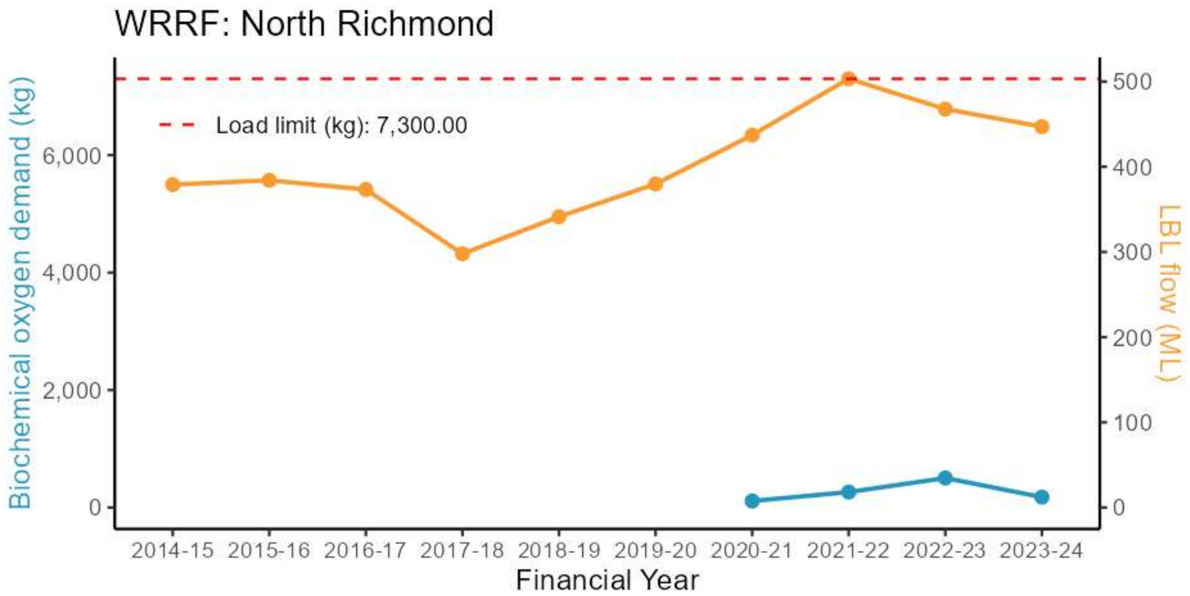
A.6.4. Pressure – Wastewater discharge load

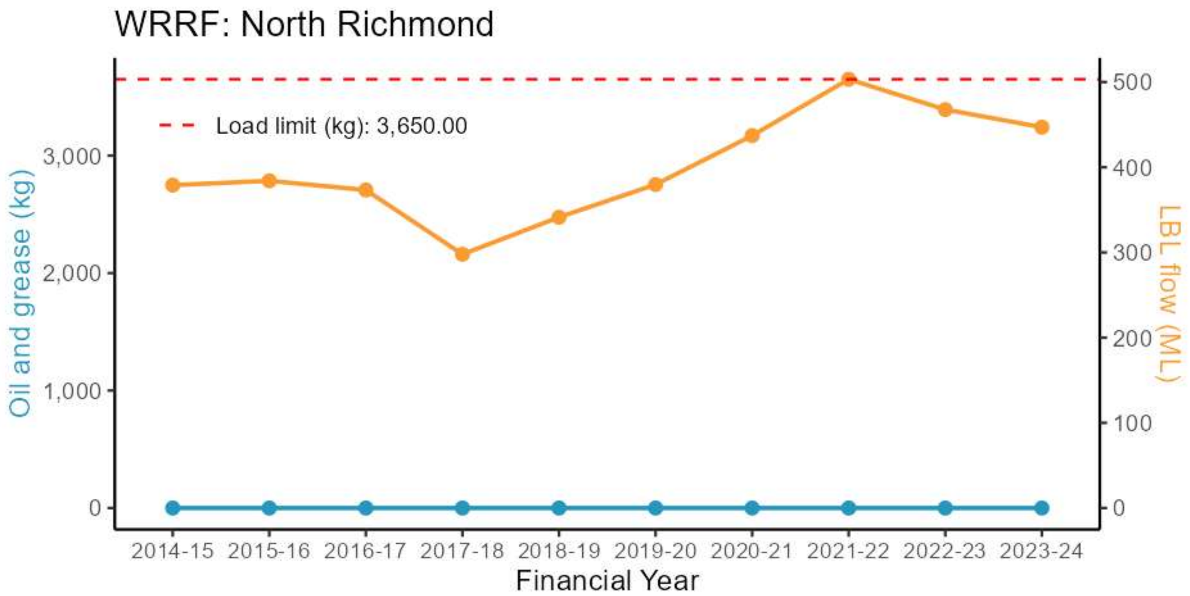
Nutrients

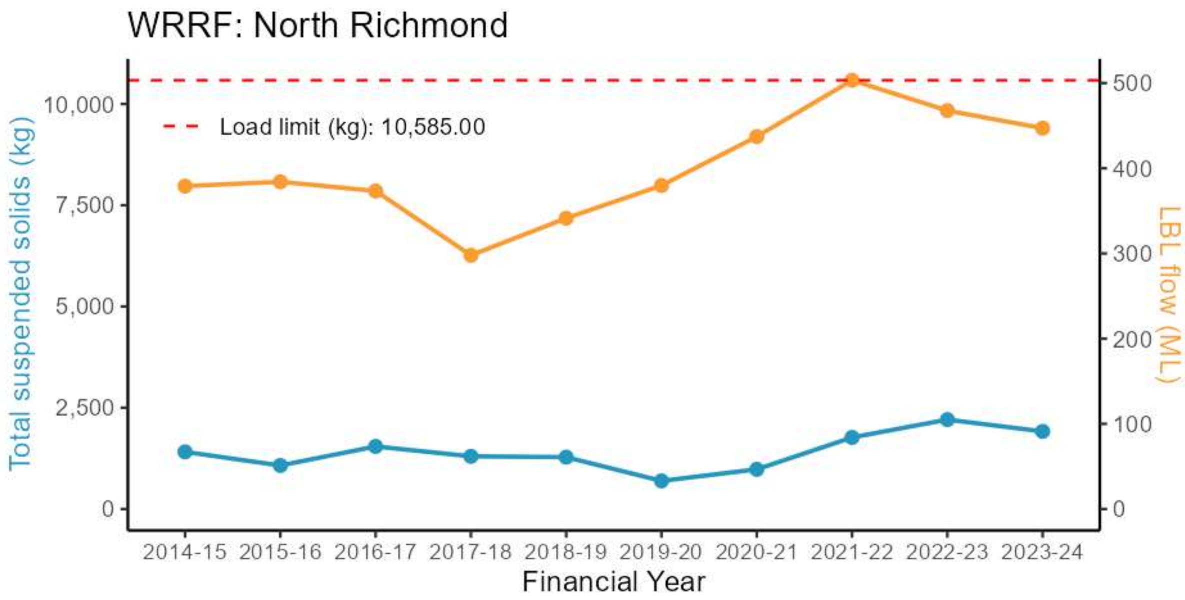




Major conventional analytes







A.6.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-11 Downstream vs upstream comparison (current period) contrast outcomes for North Richmond WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Redbank Ck	N412 vs N411	Total ammonia nitrogen	4.78	1.45	126	5.16	<0.001
Redbank Ck	N412 vs N411	Oxidised nitrogen	11.64	2.83	126	10.07	<0.001
Redbank Ck	N412 vs N411	Total nitrogen	5.17	0.78	126	10.83	<0.001
Redbank Ck	N412 vs N411	Filterable total phosphorus	4.65	1.04	126	6.88	<0.001
Redbank Ck	N412 vs N411	Total phosphorus	3.99	0.78	126	7.08	<0.001
Redbank Ck	N412 vs N411	Conductivity	1.28	0.12	126	2.70	0.039
Redbank Ck	N412 vs N411	Dissolved oxygen	1.10	0.07	124	1.51	0.433
Redbank Ck	N412 vs N411	Dissolved oxygen saturation	10.99	3.17	124	3.47	0.004
Redbank Ck	N412 vs N411	pH	-0.05	0.06	122	-0.87	0.822
Redbank Ck	N412 vs N411	Water temperature	1.10	0.11	126	0.95	0.780
Redbank Ck	N412 vs N411	Turbidity	0.99	0.41	126	-0.03	1.000
Redbank Ck	N412 vs N411	Chlorophyll - a	1.36	0.44	126	0.95	0.778
Hawkesbury R	N42 vs N39	Total ammonia nitrogen	1.43	0.36	314	1.41	0.497
Hawkesbury R	N42 vs N39	Oxidised nitrogen	1.31	0.33	314	1.07	0.707
Hawkesbury R	N42 vs N39	Total nitrogen	1.19	0.12	314	1.77	0.289
Hawkesbury R	N42 vs N39	Filterable total phosphorus	0.76	0.09	314	-2.42	0.076
Hawkesbury R	N42 vs N39	Total phosphorus	0.83	0.10	314	-1.58	0.393
Hawkesbury R	N42 vs N39	Conductivity	0.93	0.07	314	-0.98	0.761
Hawkesbury R	N42 vs N39	Dissolved oxygen	0.99	0.05	312	-0.20	0.997
Hawkesbury R	N42 vs N39	Dissolved oxygen saturation	-0.92	3.87	311	-0.24	0.995
Hawkesbury R	N42 vs N39	pH	-0.21	0.14	312	-1.46	0.460
Hawkesbury R	N42 vs N39	Water temperature	1.01	0.11	314	0.09	1.000
Hawkesbury R	N42 vs N39	Turbidity	1.19	0.28	314	0.75	0.876
Hawkesbury R	N42 vs N39	Chlorophyll - a	0.77	0.22	314	-0.94	0.784

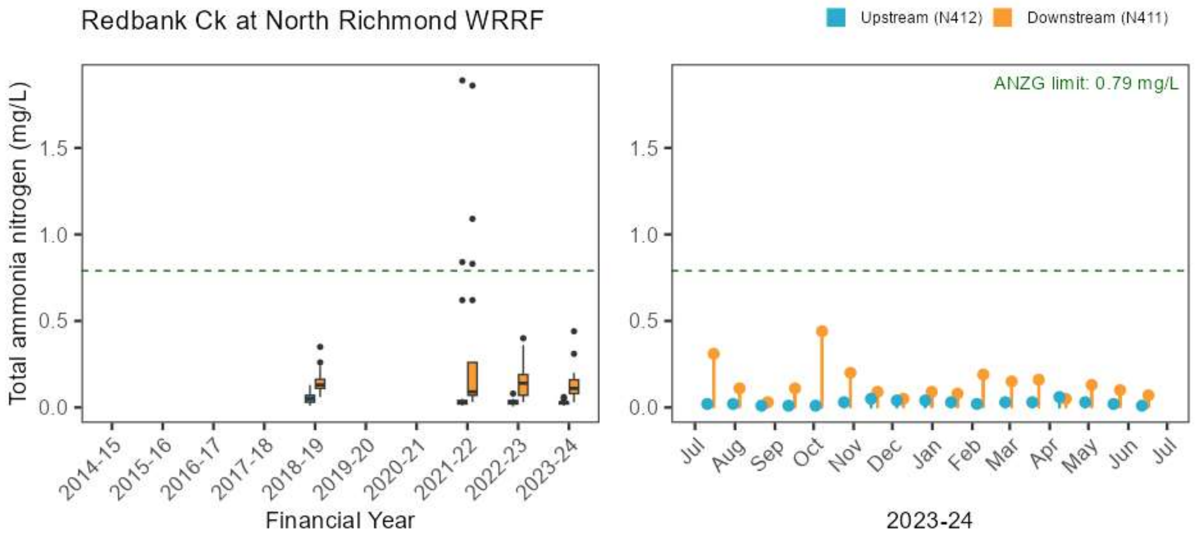
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

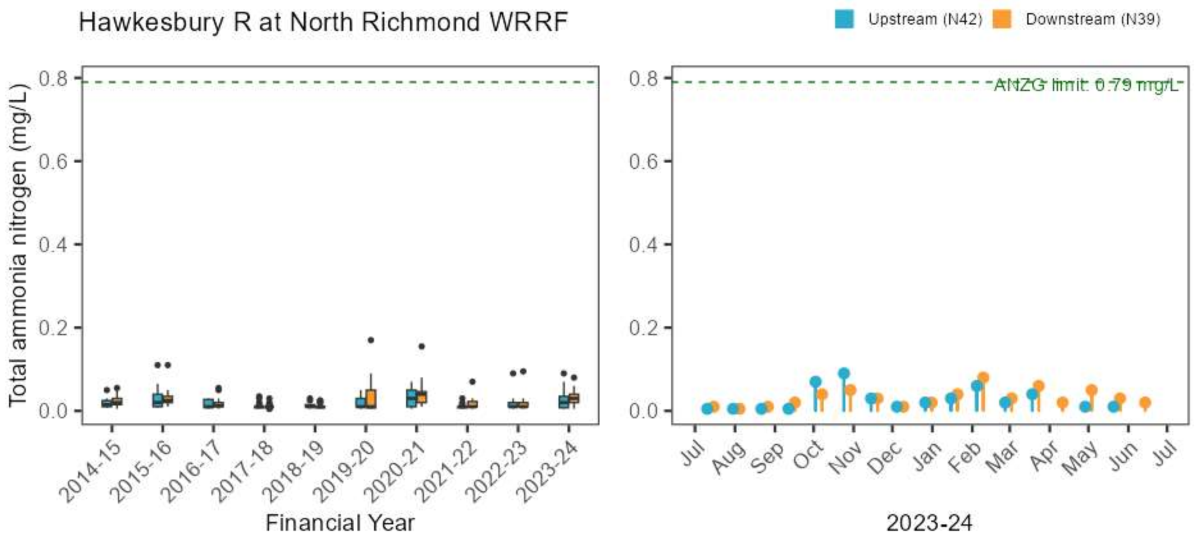
Table A-12 Current period vs previous period comparison (single site) contrast outcomes for North Richmond WRRF

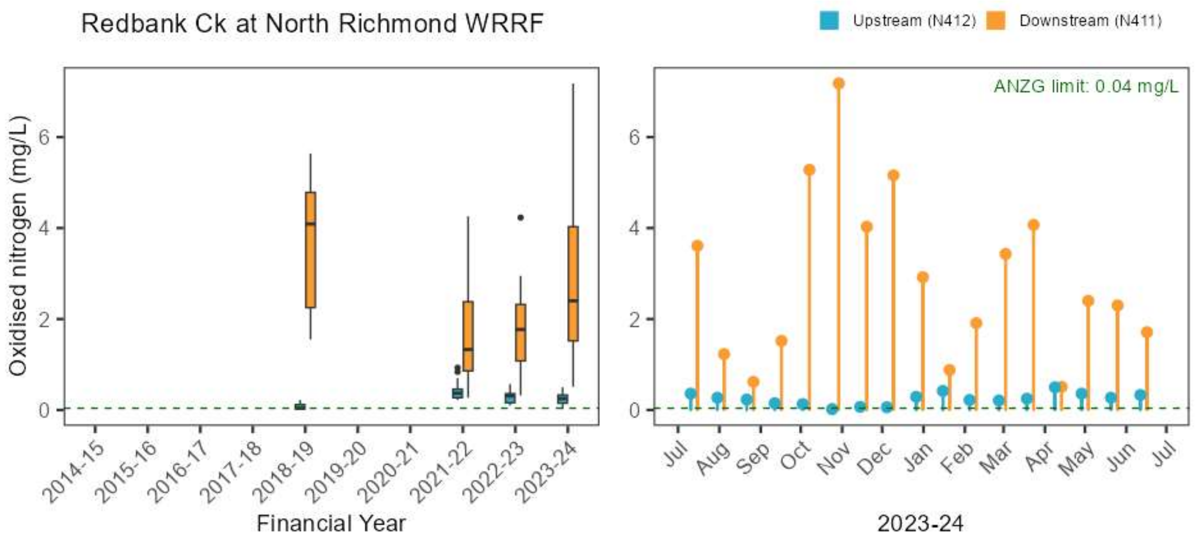
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Redbank Ck	N412	Total ammonia nitrogen	0.59	0.15	126	-2.11	0.155
Redbank Ck	N412	Oxidised nitrogen	1.16	0.23	126	0.75	0.874
Redbank Ck	N412	Total nitrogen	0.82	0.10	126	-1.59	0.385
Redbank Ck	N412	Filterable total phosphorus	0.91	0.17	126	-0.54	0.948
Redbank Ck	N412	Total phosphorus	0.80	0.13	126	-1.41	0.496
Redbank Ck	N412	Conductivity	0.97	0.07	126	-0.47	0.966
Redbank Ck	N412	Dissolved oxygen	1.15	0.06	124	2.68	0.041
Redbank Ck	N412	Dissolved oxygen saturation	8.63	2.60	124	3.32	0.006
Redbank Ck	N412	pH	0.12	0.05	122	2.36	0.091
Redbank Ck	N412	Water temperature	1.00	0.08	126	0.05	1.000
Redbank Ck	N412	Turbidity	0.53	0.18	126	-1.88	0.241
Redbank Ck	N412	Chlorophyll - a	0.95	0.25	126	-0.21	0.997
Redbank Ck	N411	Total ammonia nitrogen	0.80	0.20	126	-0.90	0.806
Redbank Ck	N411	Oxidised nitrogen	1.22	0.24	126	1.01	0.747
Redbank Ck	N411	Total nitrogen	1.05	0.13	126	0.37	0.982
Redbank Ck	N411	Filterable total phosphorus	1.10	0.20	126	0.55	0.948
Redbank Ck	N411	Total phosphorus	1.23	0.20	126	1.31	0.558
Redbank Ck	N411	Conductivity	0.96	0.07	126	-0.49	0.962
Redbank Ck	N411	Dissolved oxygen	1.07	0.05	124	1.35	0.533
Redbank Ck	N411	Dissolved oxygen saturation	4.50	2.60	124	1.73	0.311
Redbank Ck	N411	pH	-0.02	0.05	122	-0.31	0.989
Redbank Ck	N411	Water temperature	0.98	0.08	126	-0.26	0.994
Redbank Ck	N411	Turbidity	0.79	0.27	126	-0.71	0.892
Redbank Ck	N411	Chlorophyll - a	1.12	0.30	126	0.41	0.977
Hawkesbury R	N42	Total ammonia nitrogen	1.20	0.23	314	0.96	0.771
Hawkesbury R	N42	Oxidised nitrogen	1.42	0.28	314	1.79	0.282
Hawkesbury R	N42	Total nitrogen	1.17	0.09	314	2.14	0.144
Hawkesbury R	N42	Filterable total phosphorus	1.29	0.11	314	2.94	0.019
Hawkesbury R	N42	Total phosphorus	1.49	0.13	314	4.53	<0.001
Hawkesbury R	N42	Conductivity	1.20	0.07	314	3.08	0.012
Hawkesbury R	N42	Dissolved oxygen	1.04	0.04	312	1.03	0.731
Hawkesbury R	N42	Dissolved oxygen saturation	4.87	2.96	311	1.65	0.353
Hawkesbury R	N42	pH	0.10	0.11	312	0.94	0.781
Hawkesbury R	N42	Water temperature	1.05	0.08	314	0.55	0.947
Hawkesbury R	N42	Turbidity	1.03	0.18	314	0.15	0.999
Hawkesbury R	N42	Chlorophyll - a	1.96	0.42	314	3.16	0.009
Hawkesbury R	N39	Total ammonia nitrogen	1.50	0.27	314	2.21	0.122
Hawkesbury R	N39	Oxidised nitrogen	1.95	0.36	314	3.64	0.002
Hawkesbury R	N39	Total nitrogen	1.39	0.10	314	4.66	<0.001
Hawkesbury R	N39	Filterable total phosphorus	0.99	0.08	314	-0.17	0.998
Hawkesbury R	N39	Total phosphorus	1.28	0.11	314	3.03	0.014
Hawkesbury R	N39	Conductivity	1.08	0.06	314	1.37	0.516
Hawkesbury R	N39	Dissolved oxygen	1.02	0.04	312	0.52	0.955
Hawkesbury R	N39	Dissolved oxygen saturation	0.59	2.79	311	0.21	0.997
Hawkesbury R	N39	pH	-0.09	0.10	312	-0.92	0.797
Hawkesbury R	N39	Water temperature	1.00	0.08	314	0.04	1.000
Hawkesbury R	N39	Turbidity	1.21	0.20	314	1.14	0.668
Hawkesbury R	N39	Chlorophyll - a	1.40	0.28	314	1.68	0.337

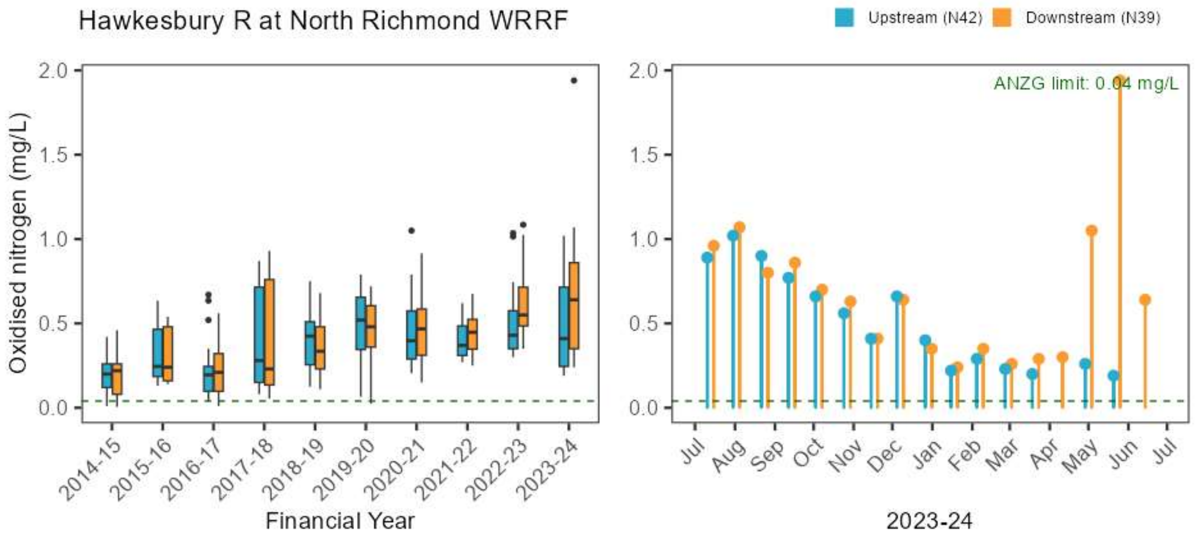
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.6.6. Stressor – Nutrients








Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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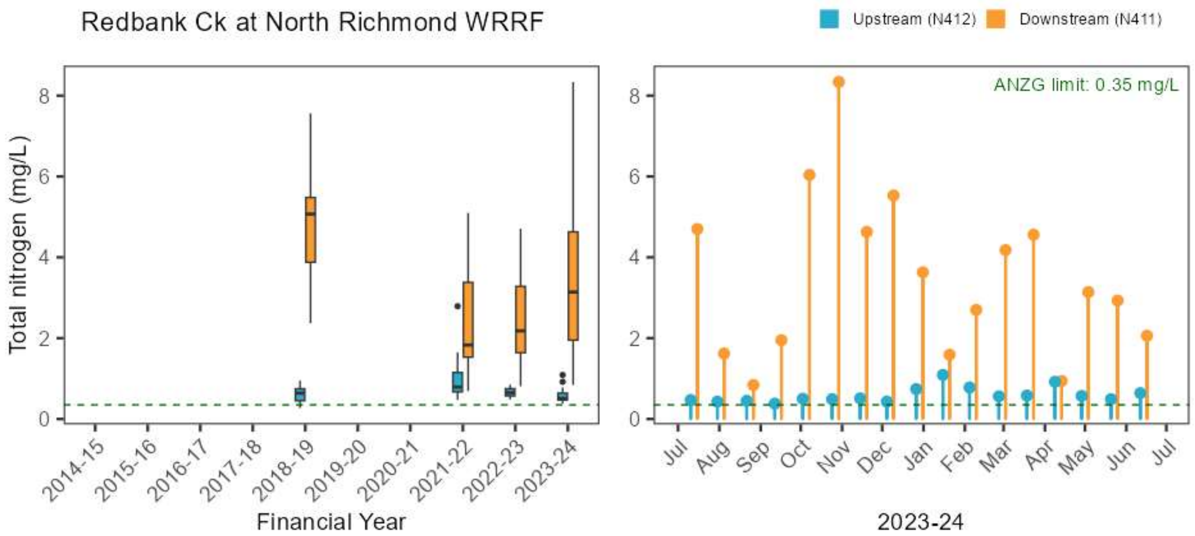
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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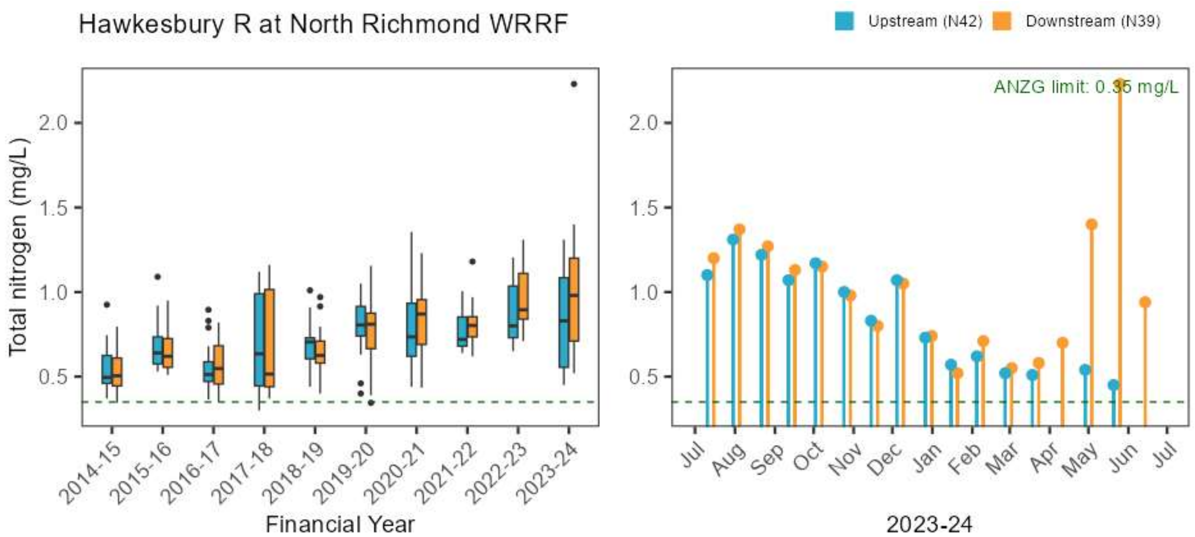
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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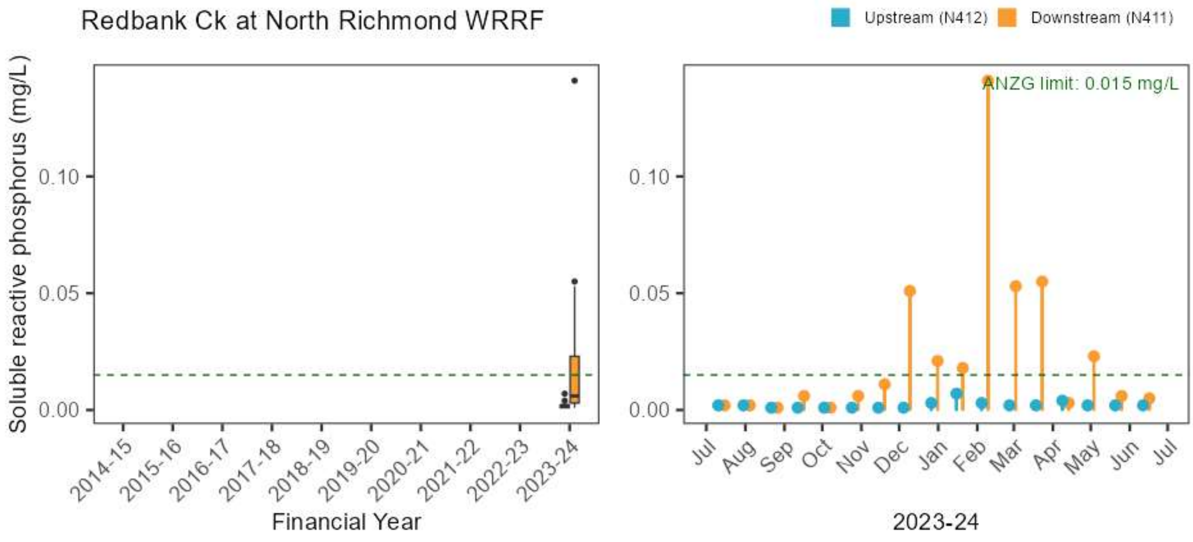
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
0.10
0.05
0.00
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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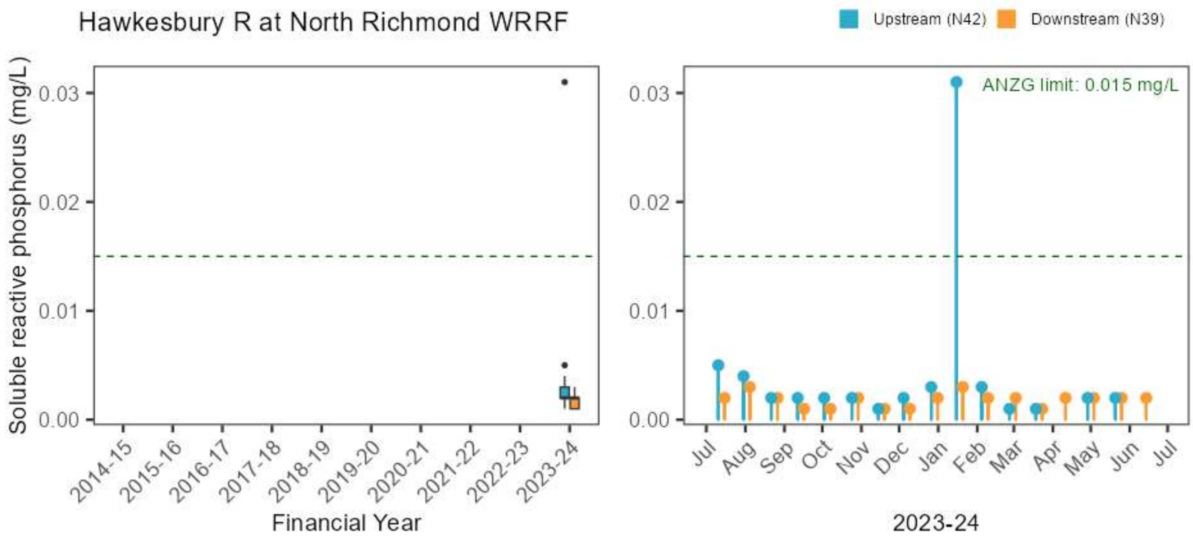
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
0.03
0.02
0.01
0.00
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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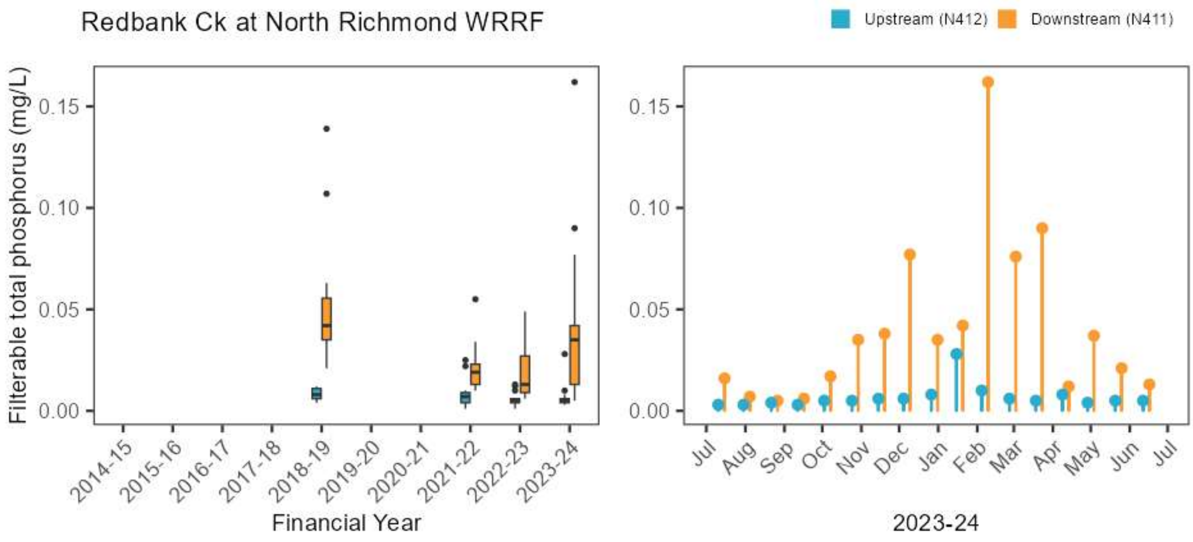
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Filterable total phosphorus (mg/L)
0.15
0.10
0.05
0.00
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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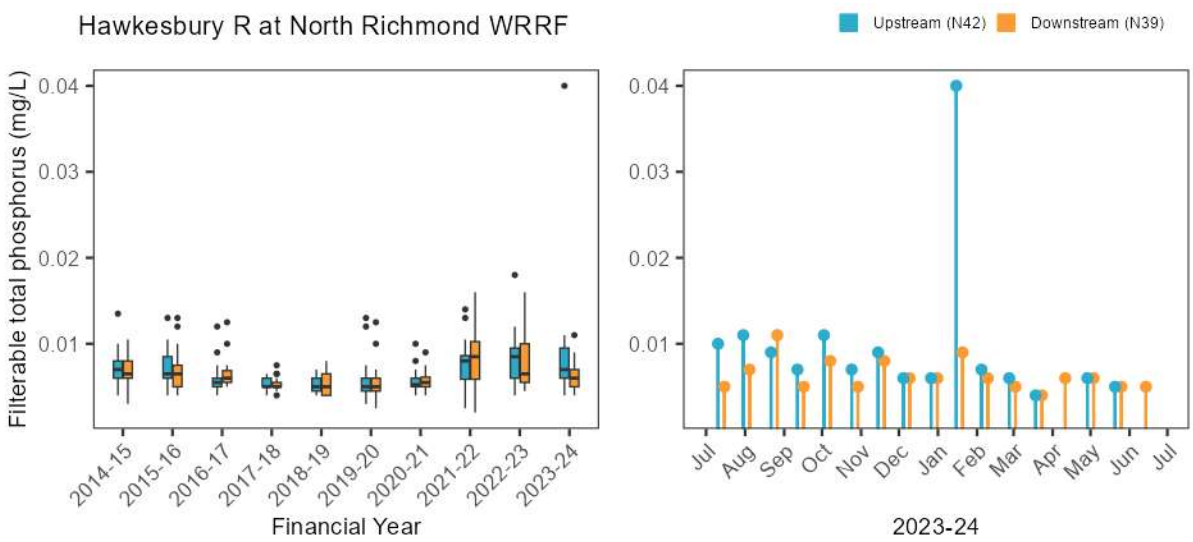
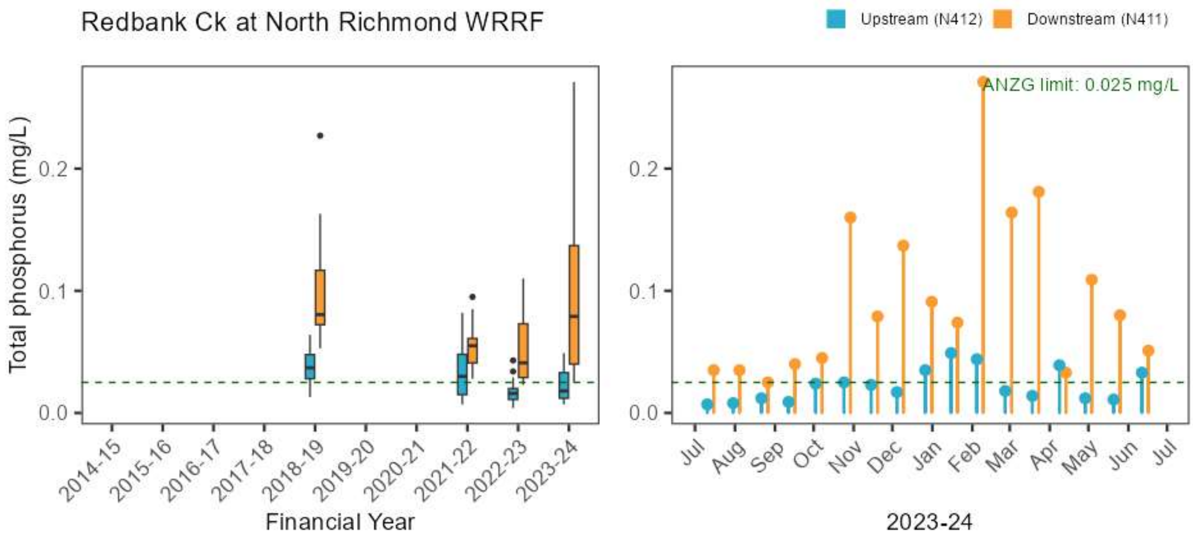
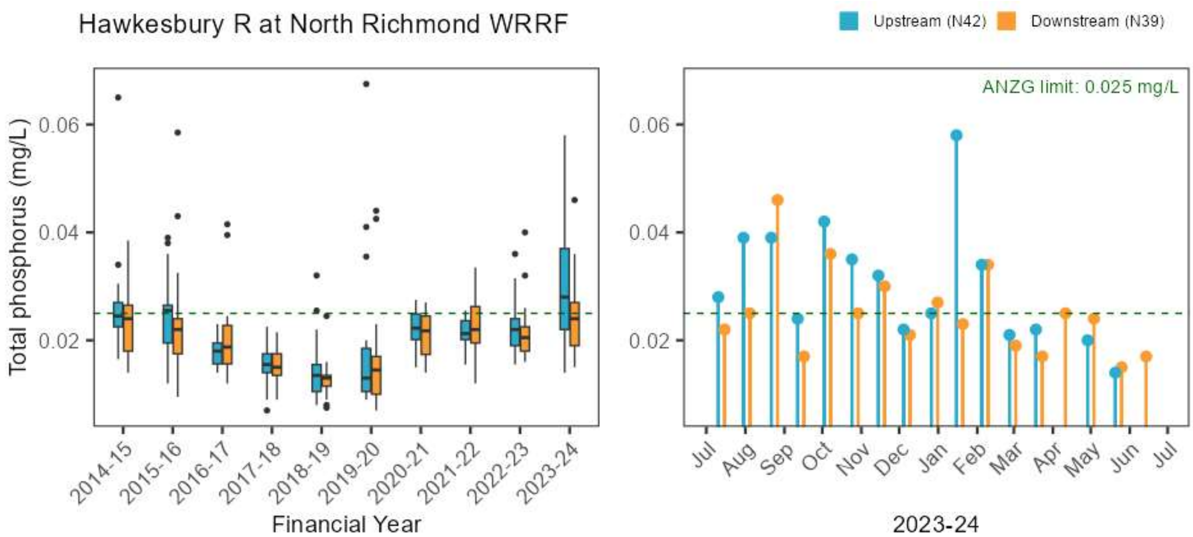
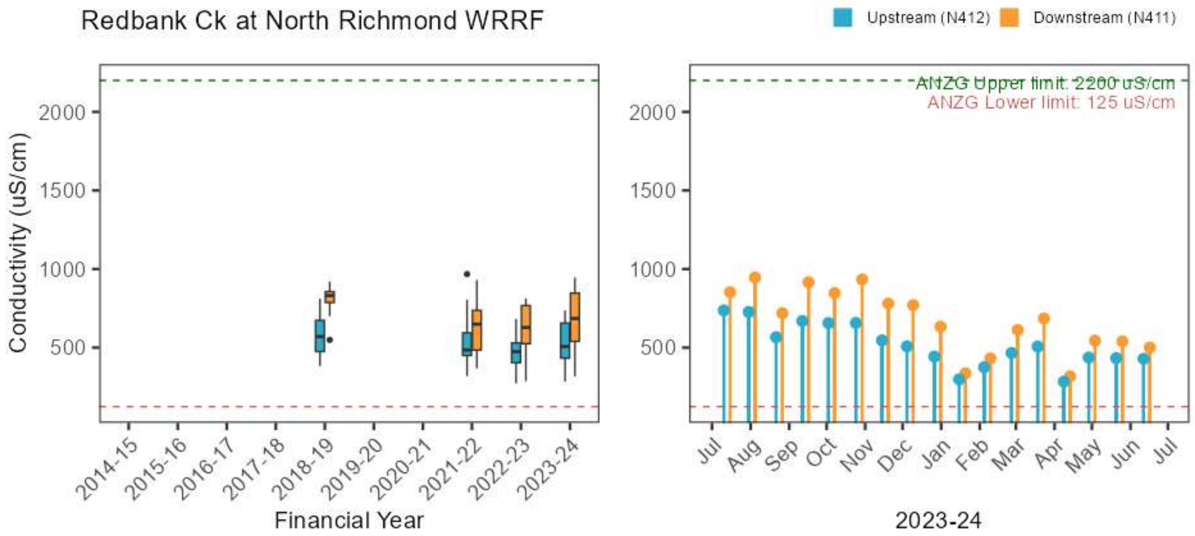
2023-24

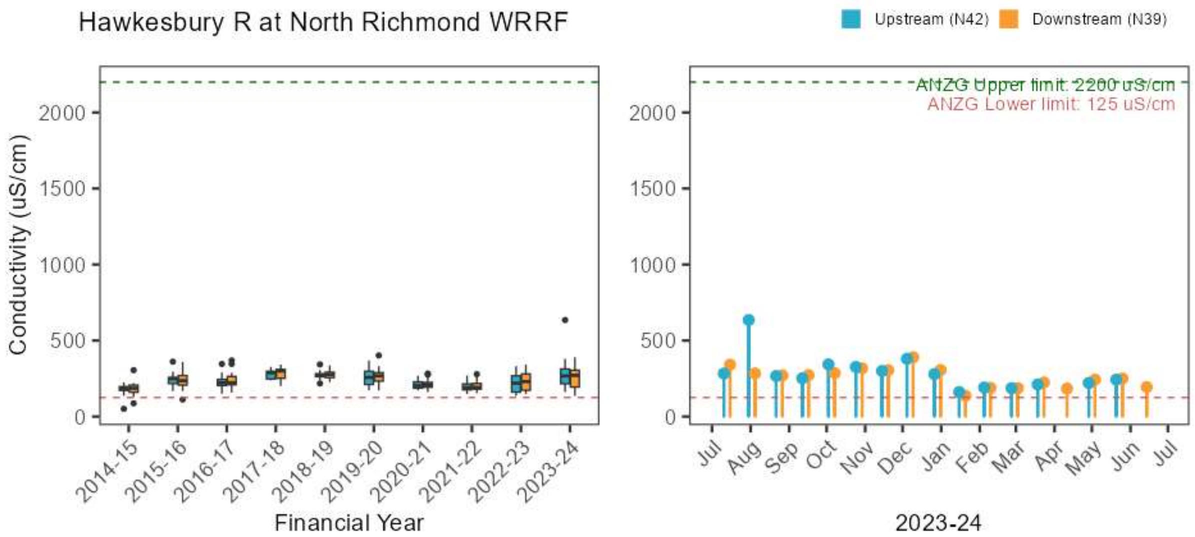

Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Filterable total phosphorus (mg/L)
Financial Year
2023-24

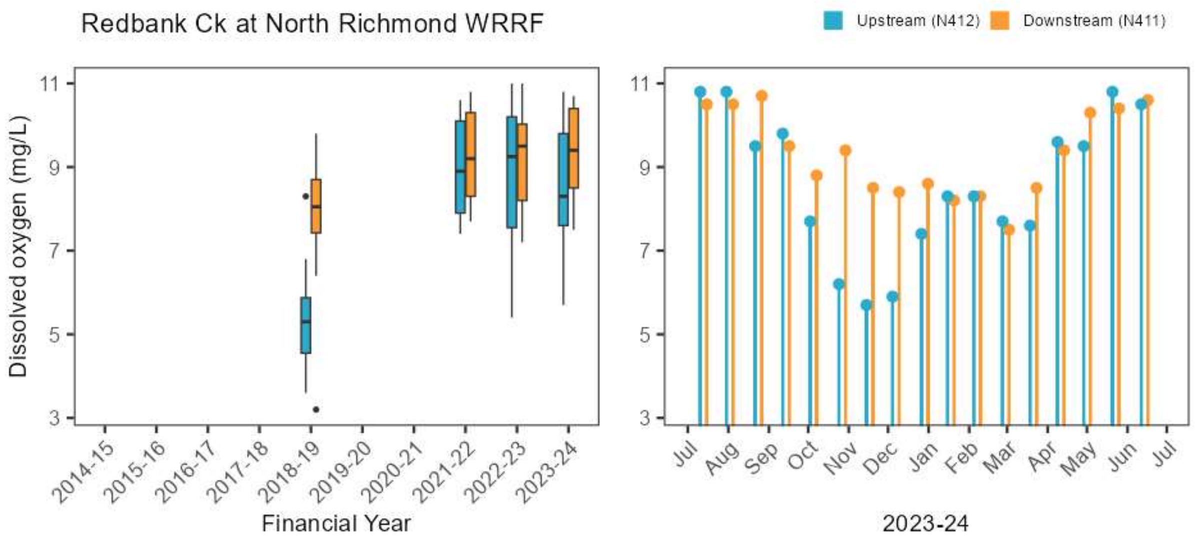

Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
Financial Year
2023-24

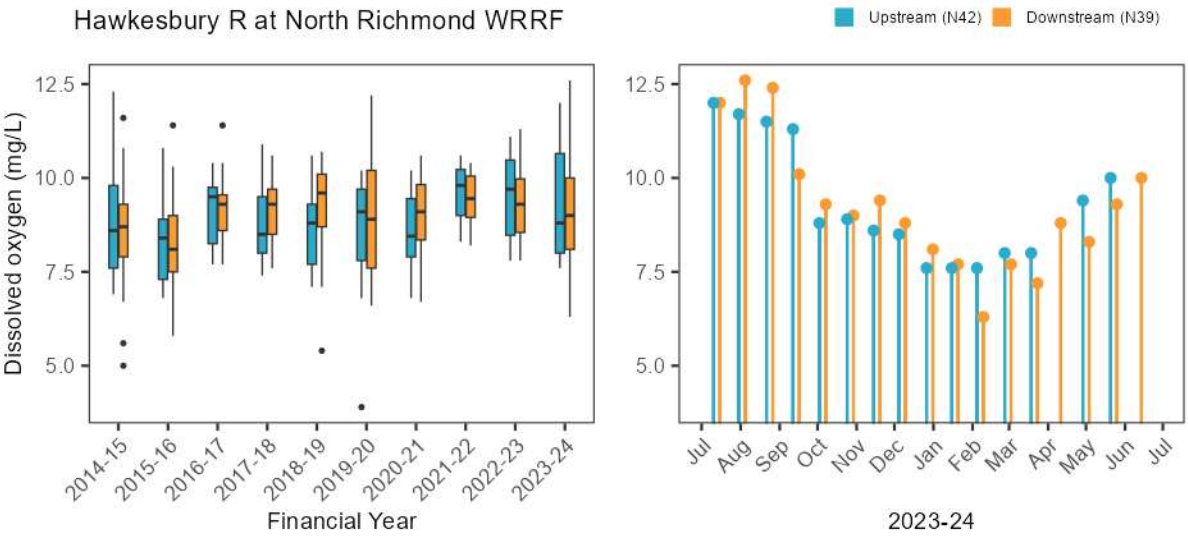

Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
Financial Year
2023-24

A.6.7. Stressor – Physico-chemical water quality








Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Dissolved oxygen (mg/L)
12.5
10.0
7.5
5.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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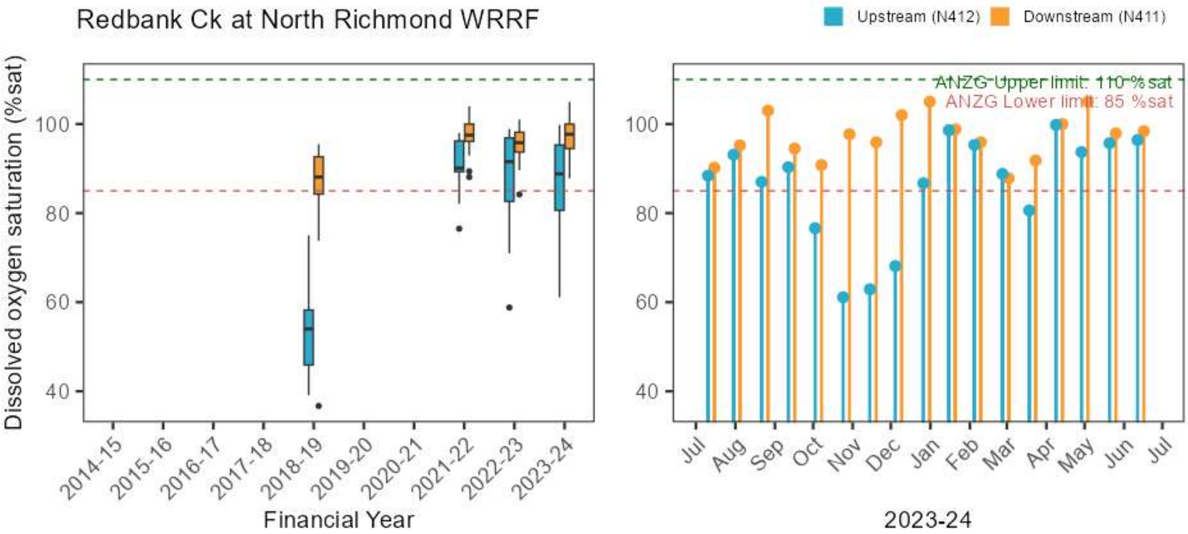
Apr
May
Jun
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Dissolved oxygen saturation (%sat)
100
80
60
40
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
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Nov
Dec
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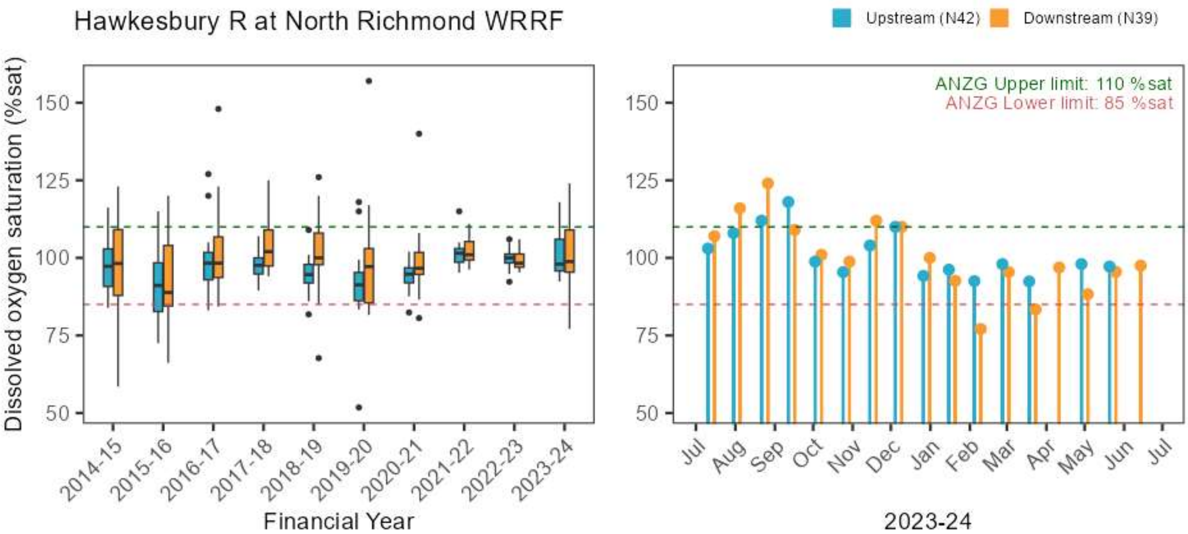
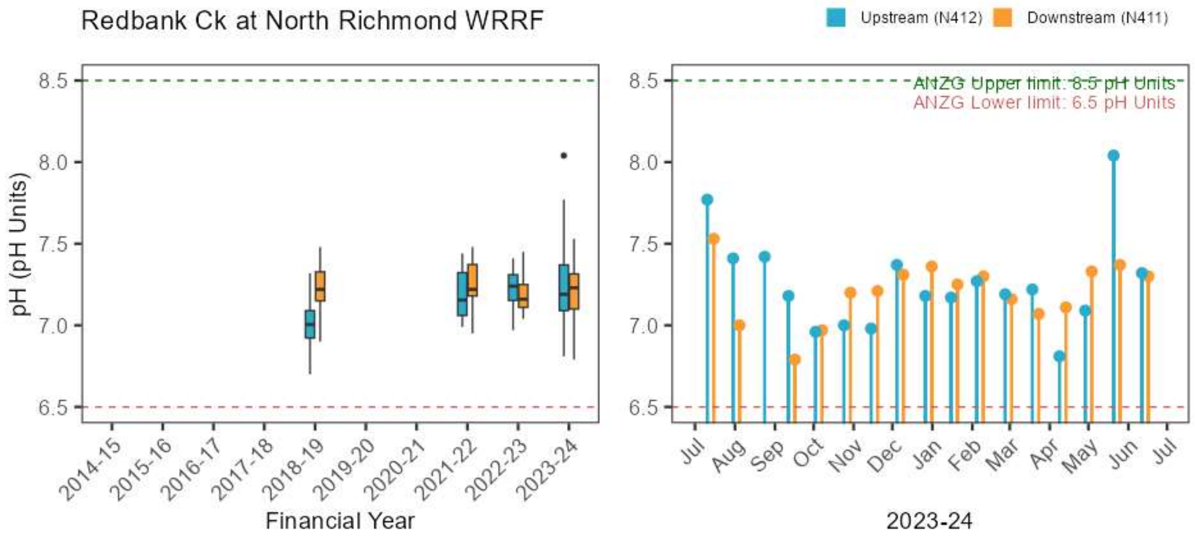
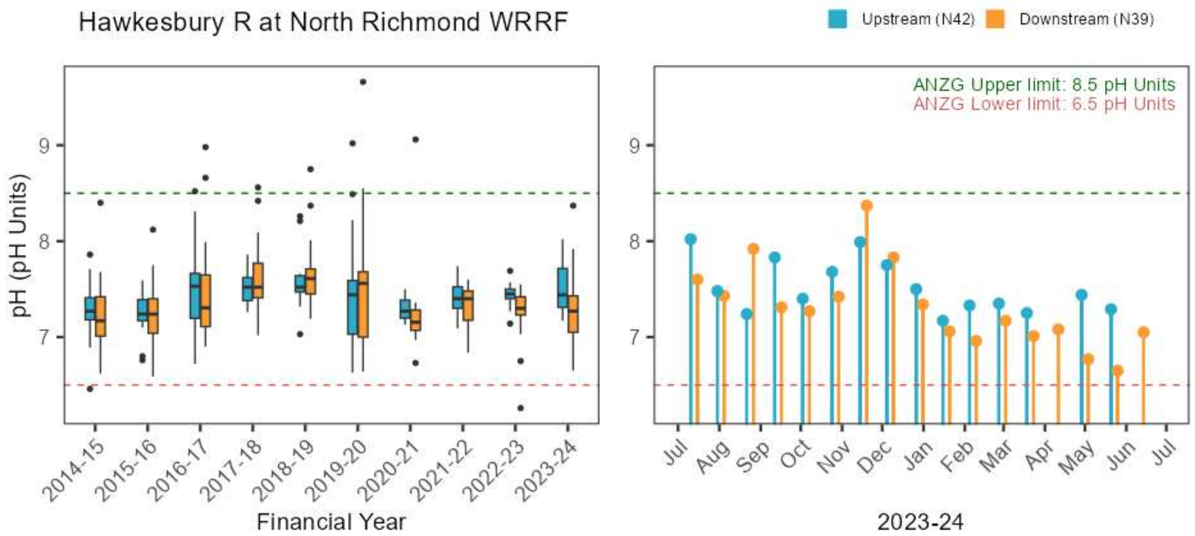
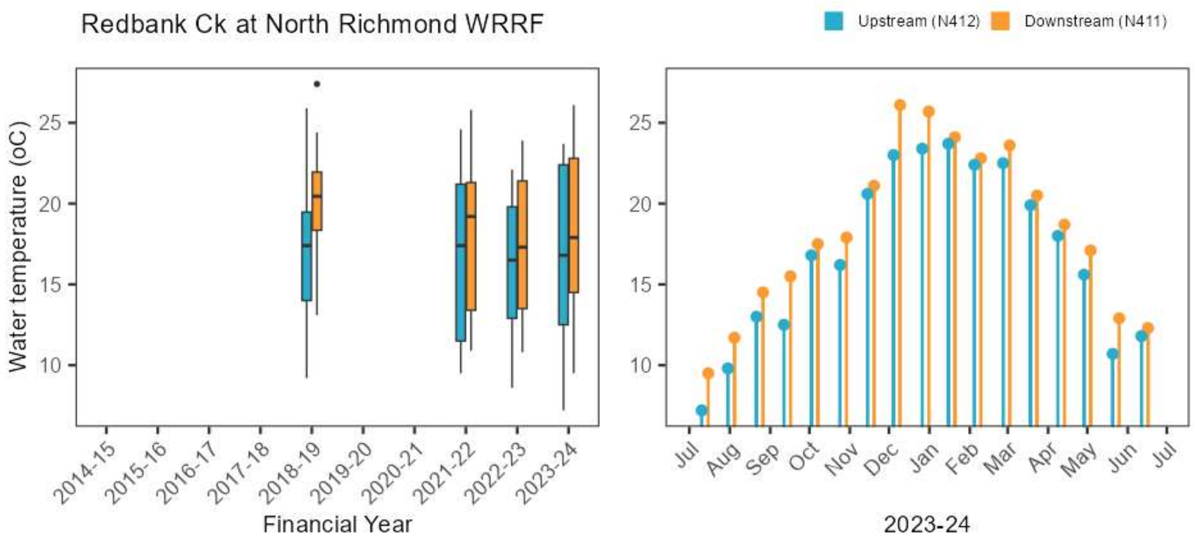
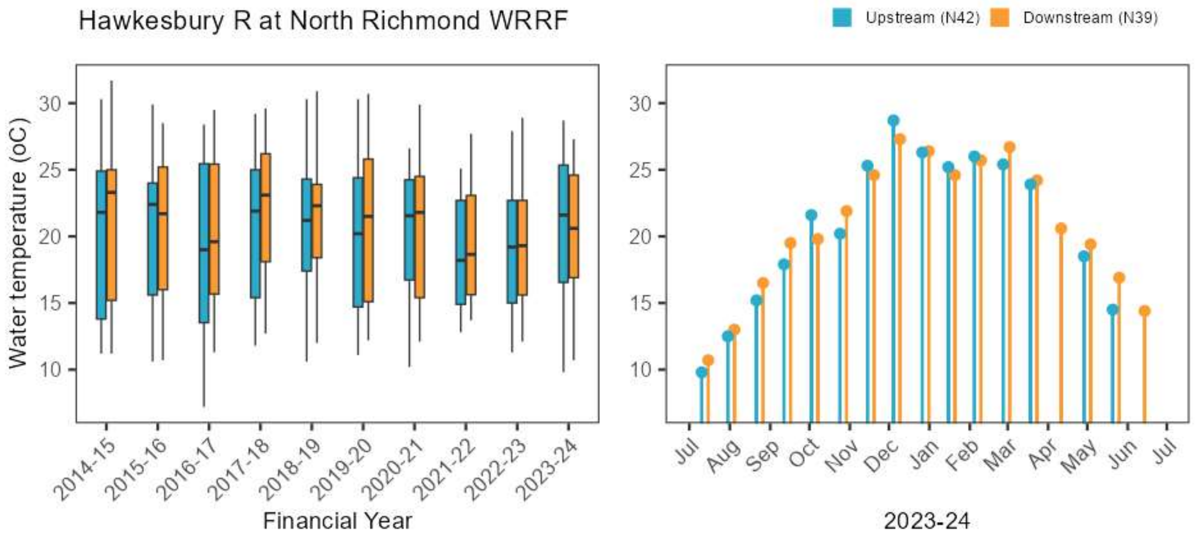
Apr
May
Jun
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Dissolved oxygen saturation (%sat)
150
125
100
75
50
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

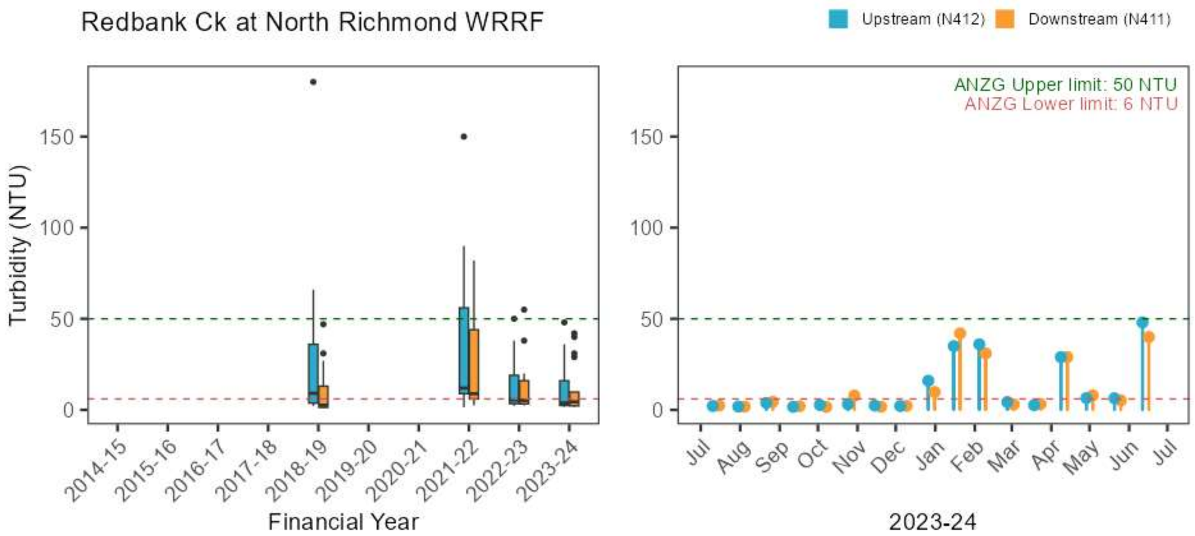

Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Financial Year
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Financial Year
2023-24

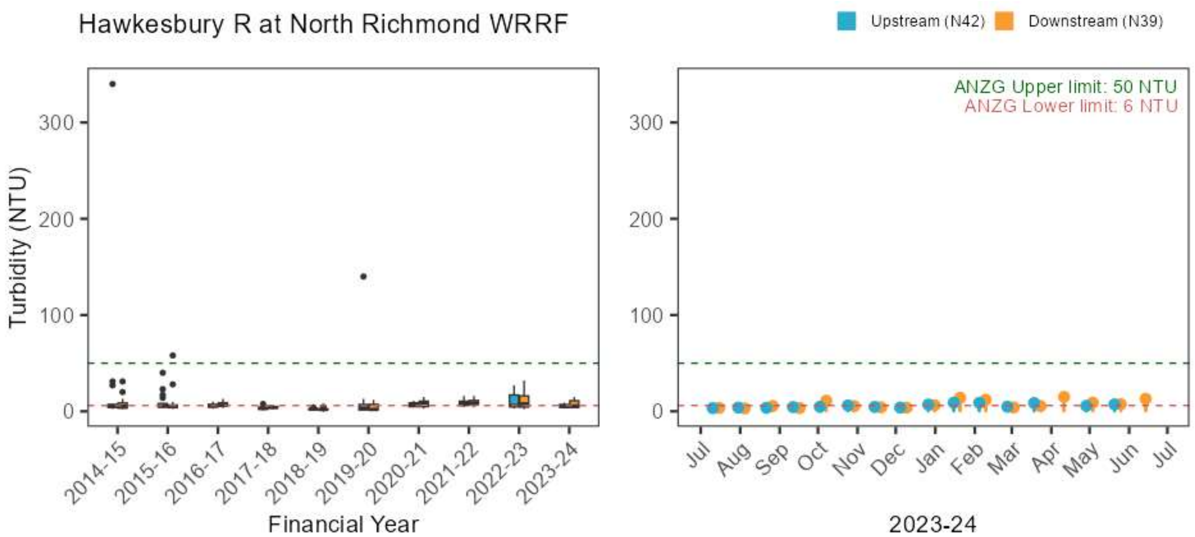

Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Water temperature (oC)
Financial Year
2023-24



Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Water temperature (oC)
Financial Year
2023-24

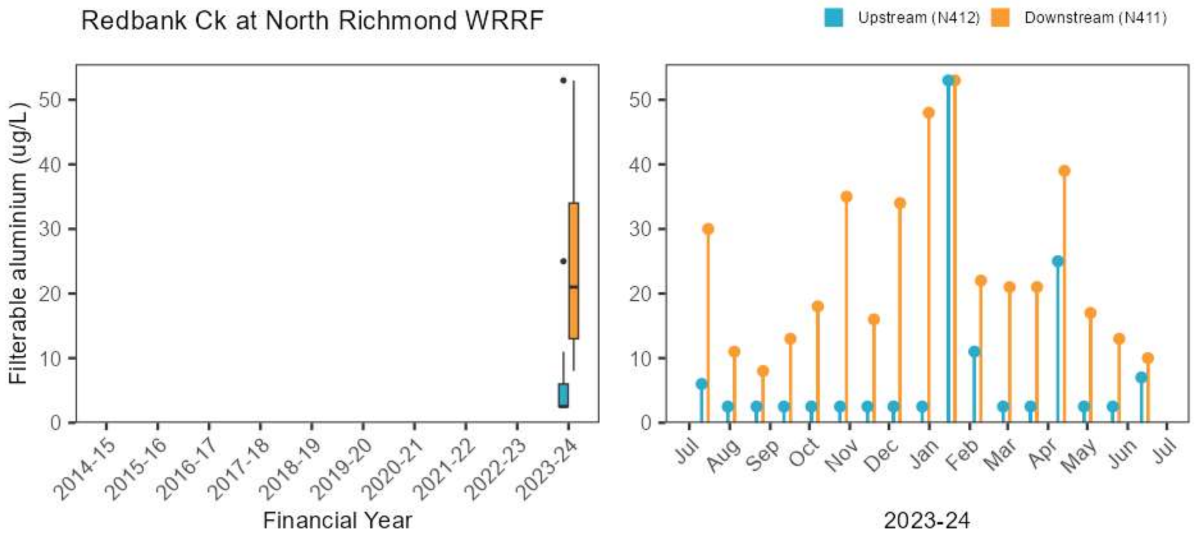


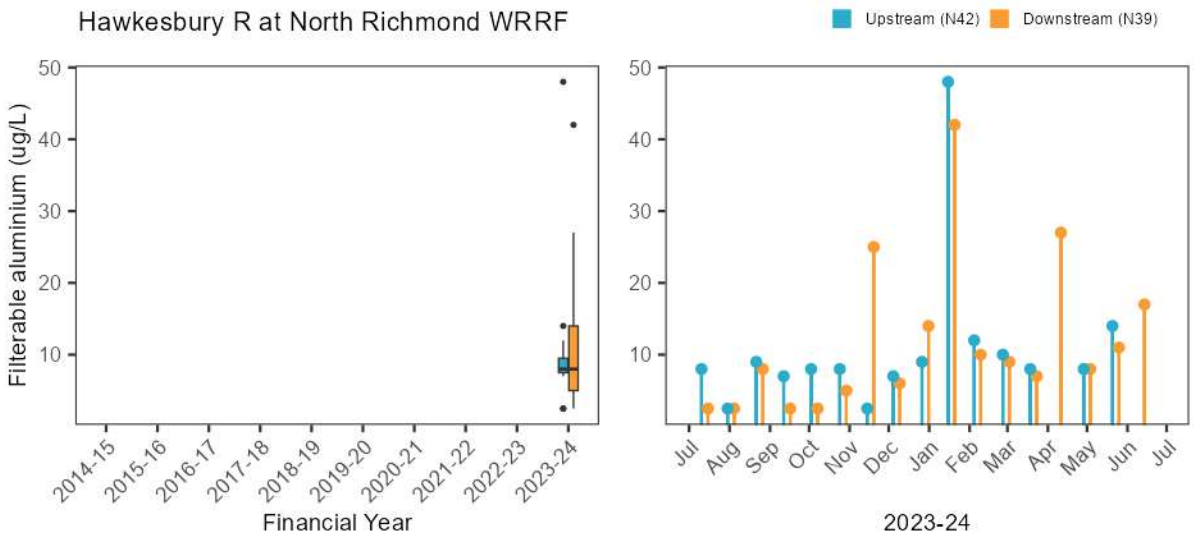
Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

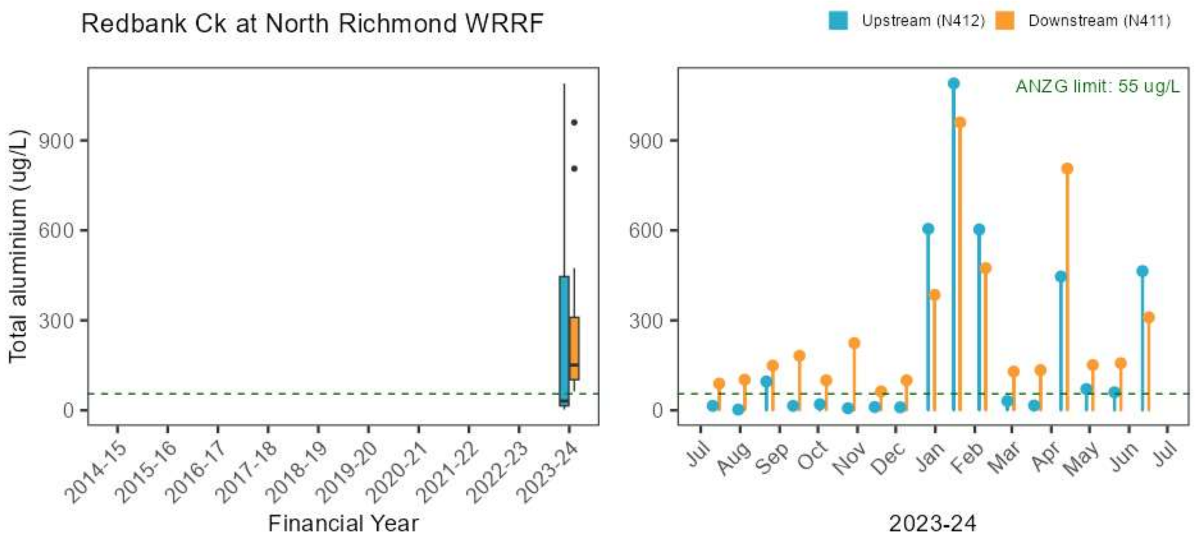


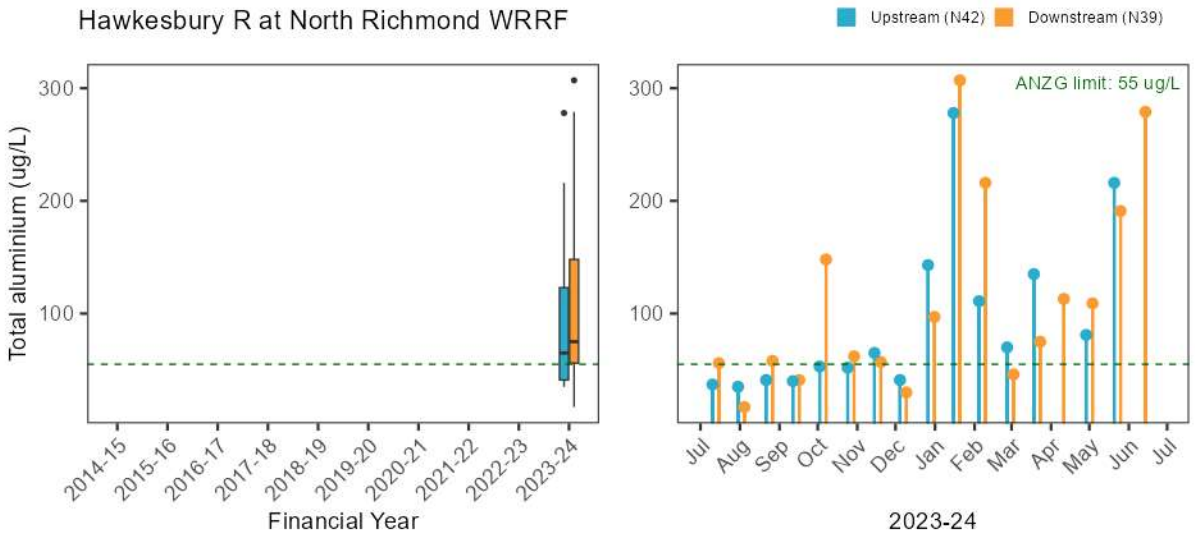
Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

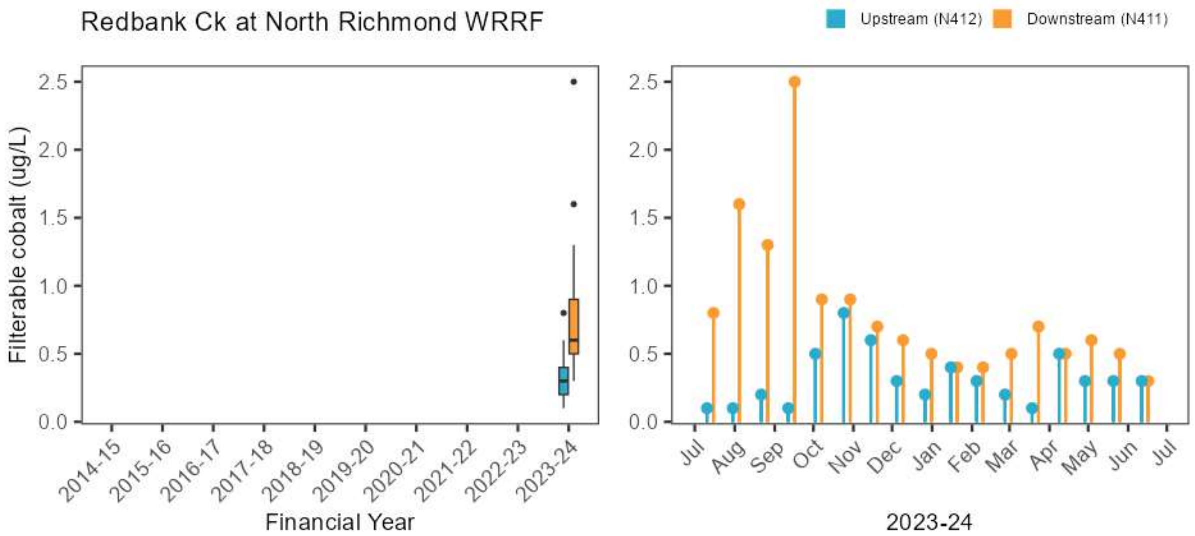
A.6.8. Stressor – Trace metals








Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Total aluminium (ug/L)
300
200
100
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 55 ug/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Filterable cobalt (ug/L)
2.5
2.0
1.5
1.0
0.5
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Nov
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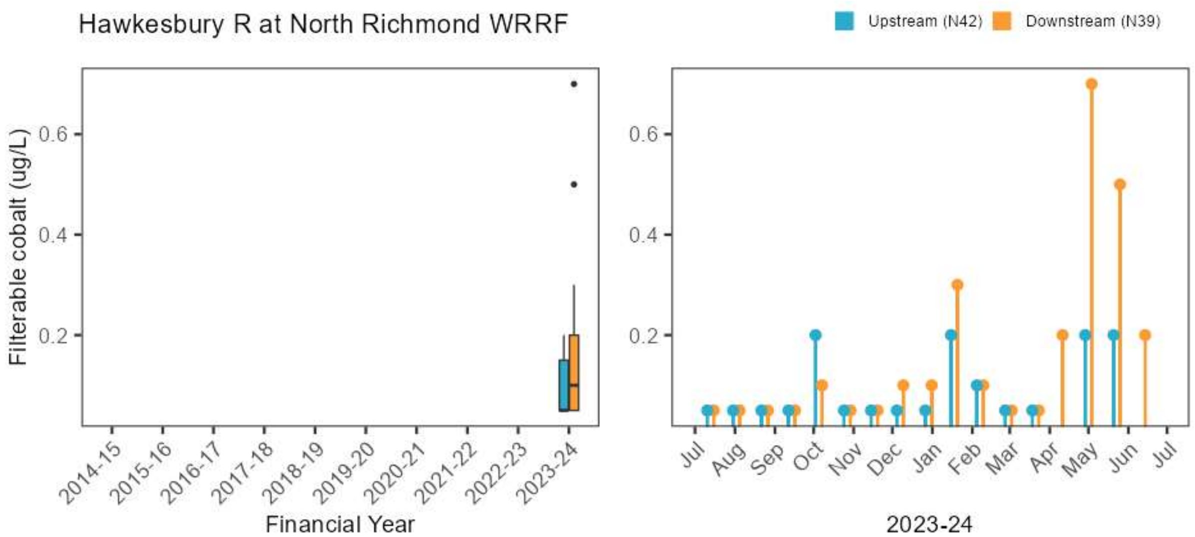
Apr
May
Jun
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Filterable cobalt (ug/L)
0.6
0.4
0.2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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Nov
Dec
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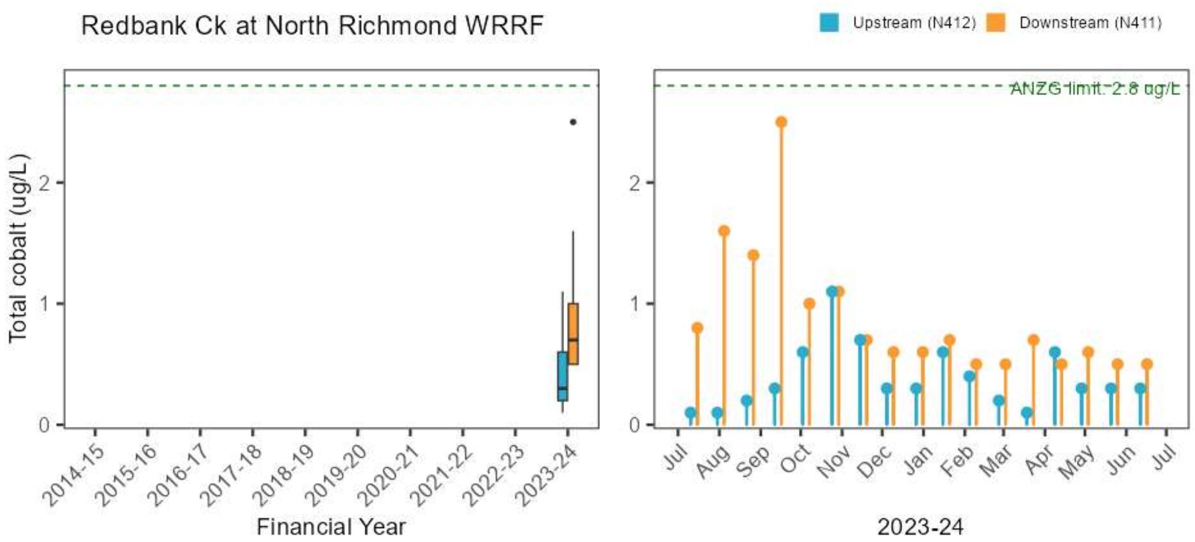
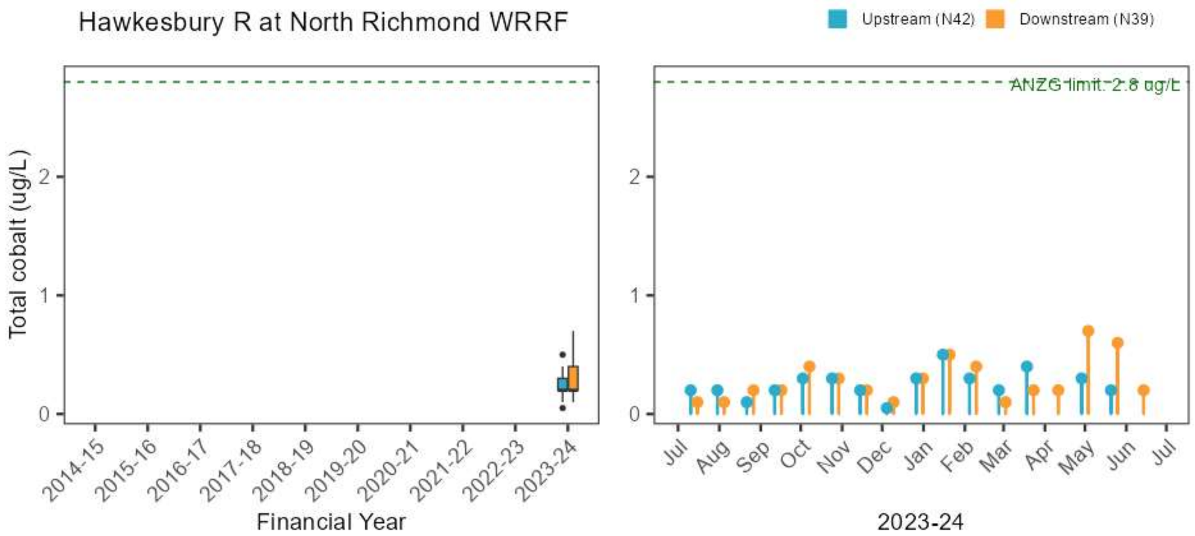
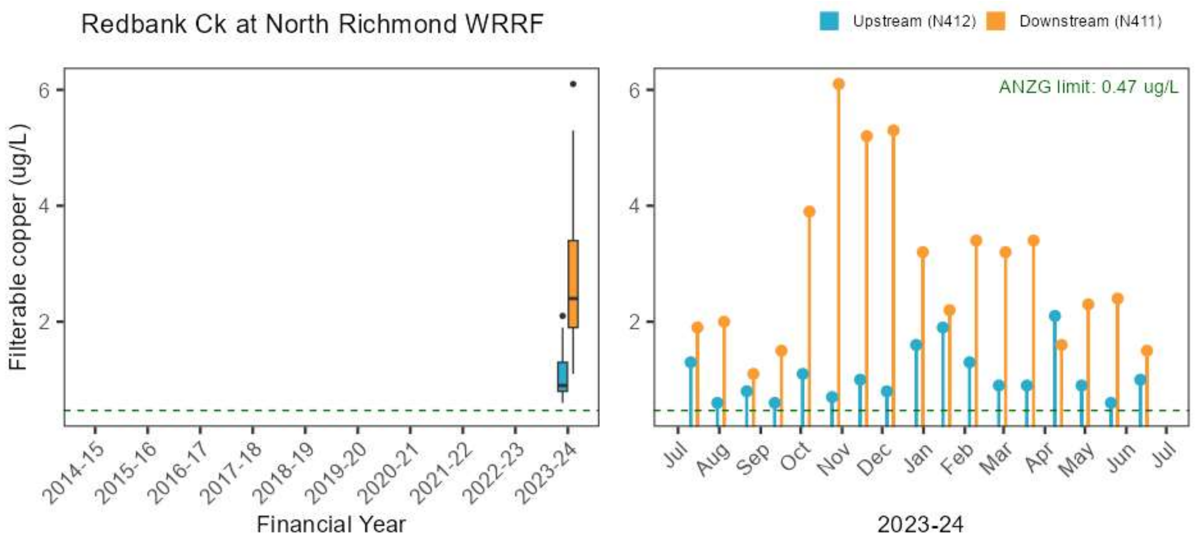
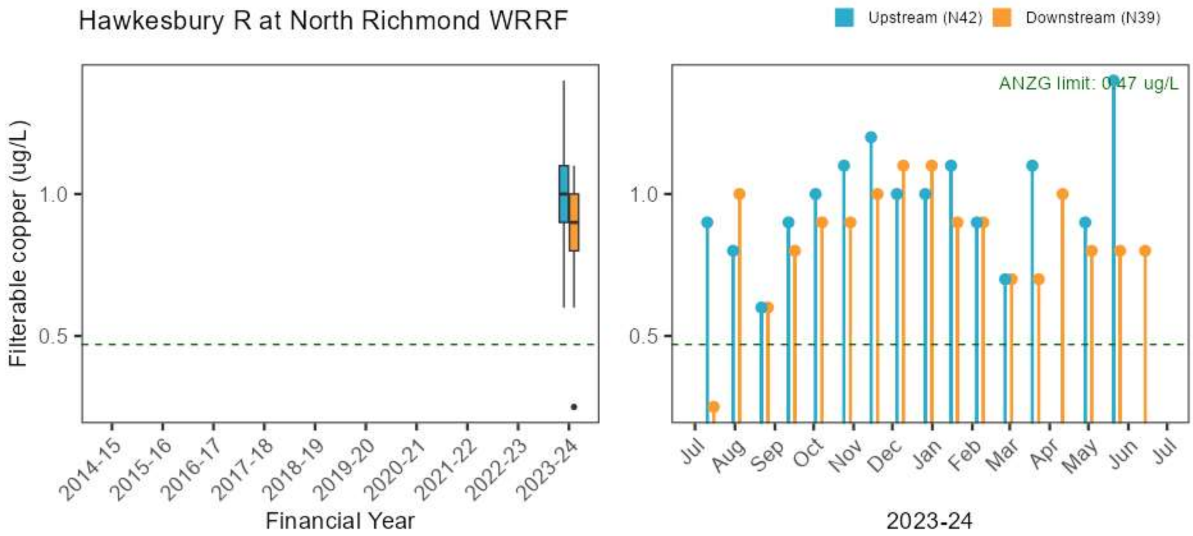
May
Jun
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Total cobalt (ug/L)
Financial Year
ANZG limit: 2.8 ug/L
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Total cobalt (ug/L)
Financial Year
ANZG limit: 2.8 ug/L
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Filterable copper (ug/L)
Financial Year
ANZG limit: 0.47 ug/L
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
1.0
0.5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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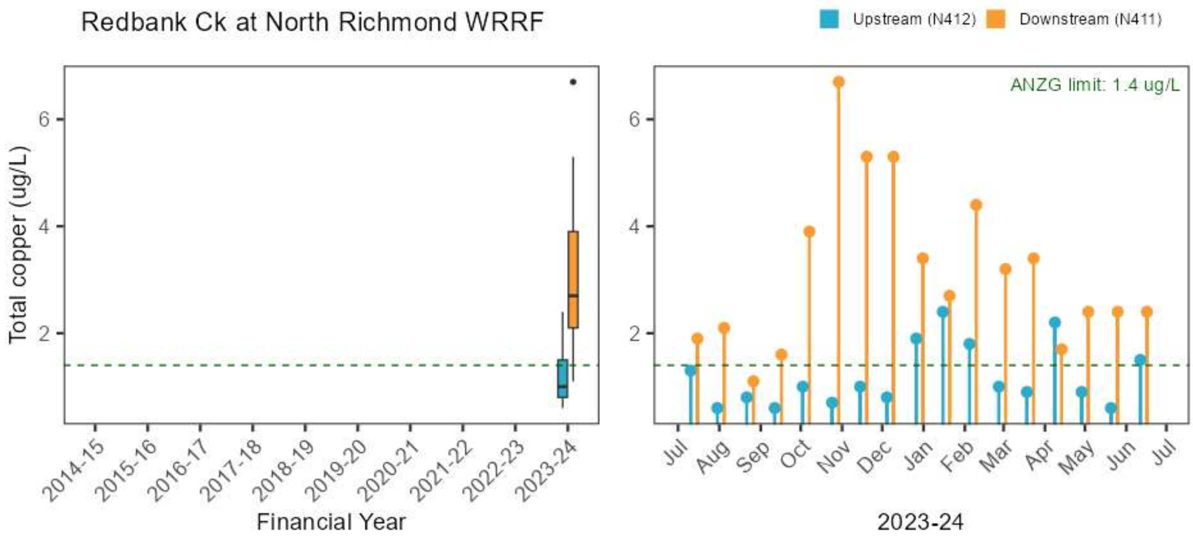
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
6
4
2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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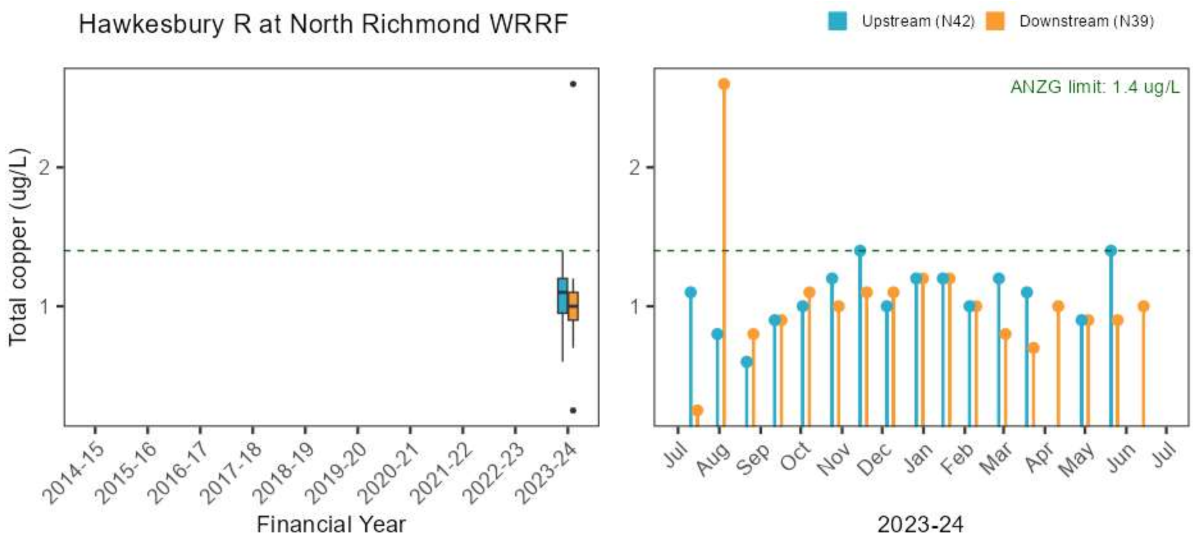
May
Jun
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
2
1
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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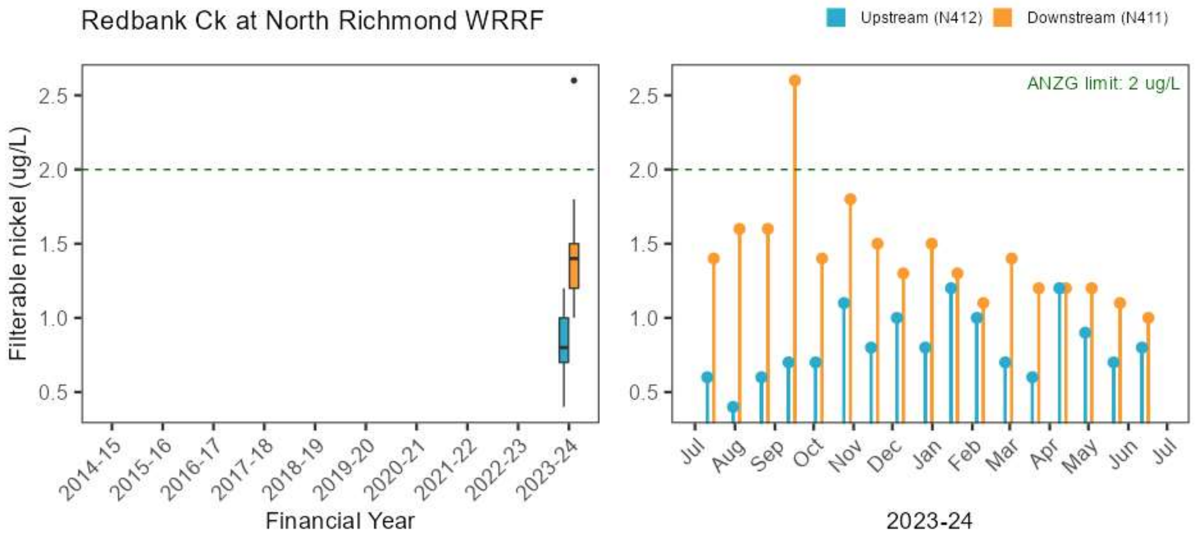
May
Jun
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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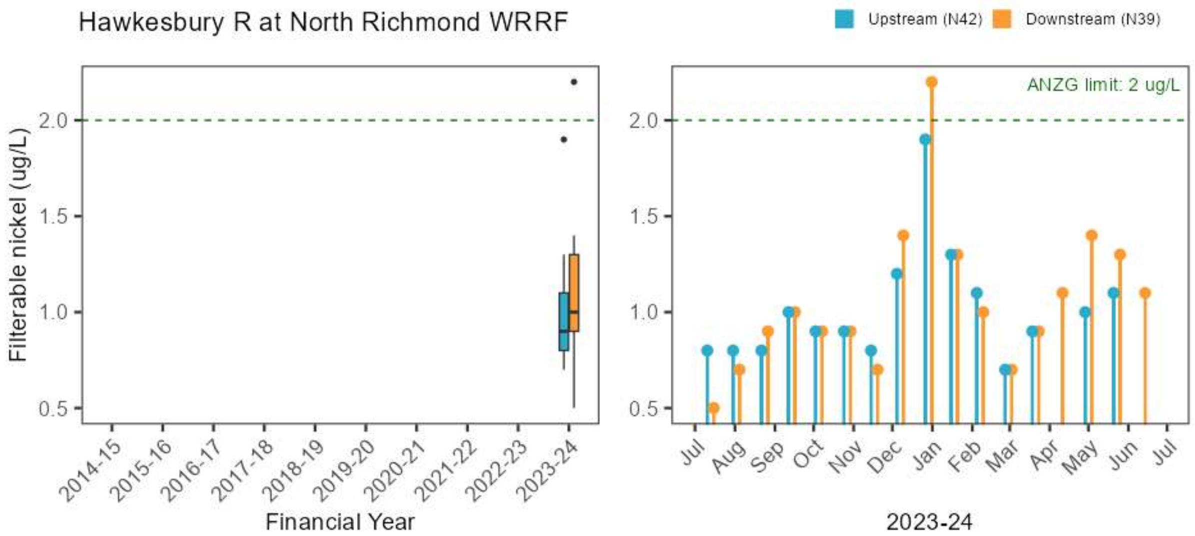
Jun
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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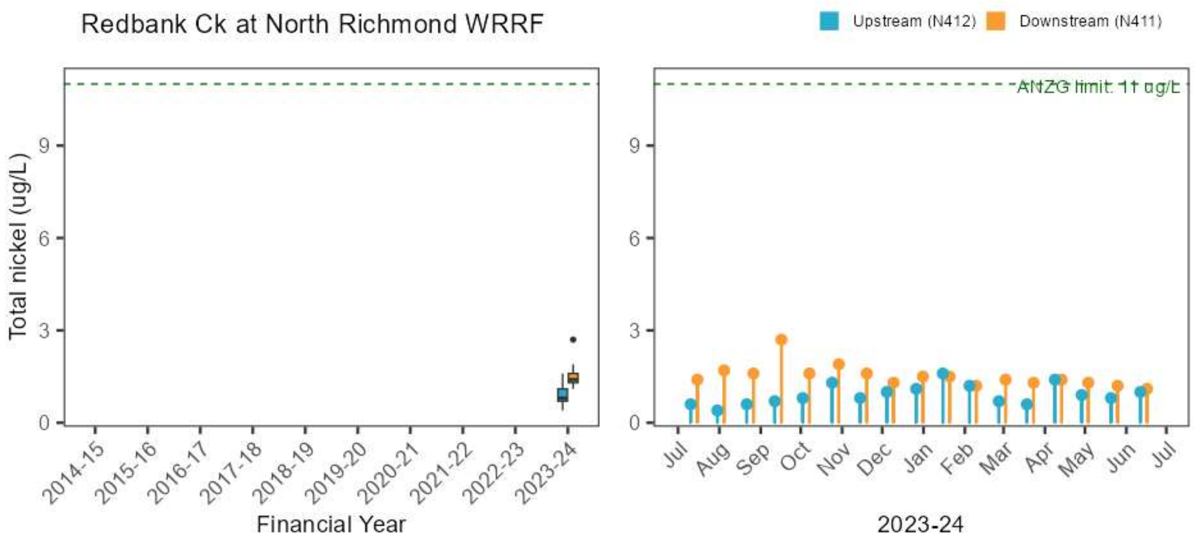
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
ANZG limit: 11 ug/L
Total nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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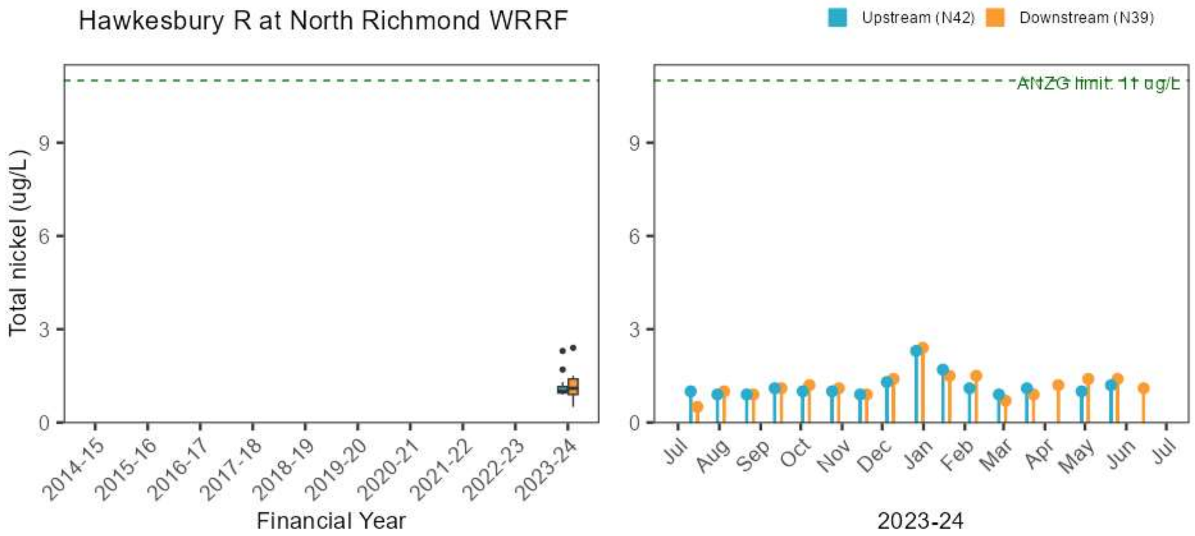
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
ANZG limit: 11 ug/L
Total nickel (ug/L)
0
3
6
9
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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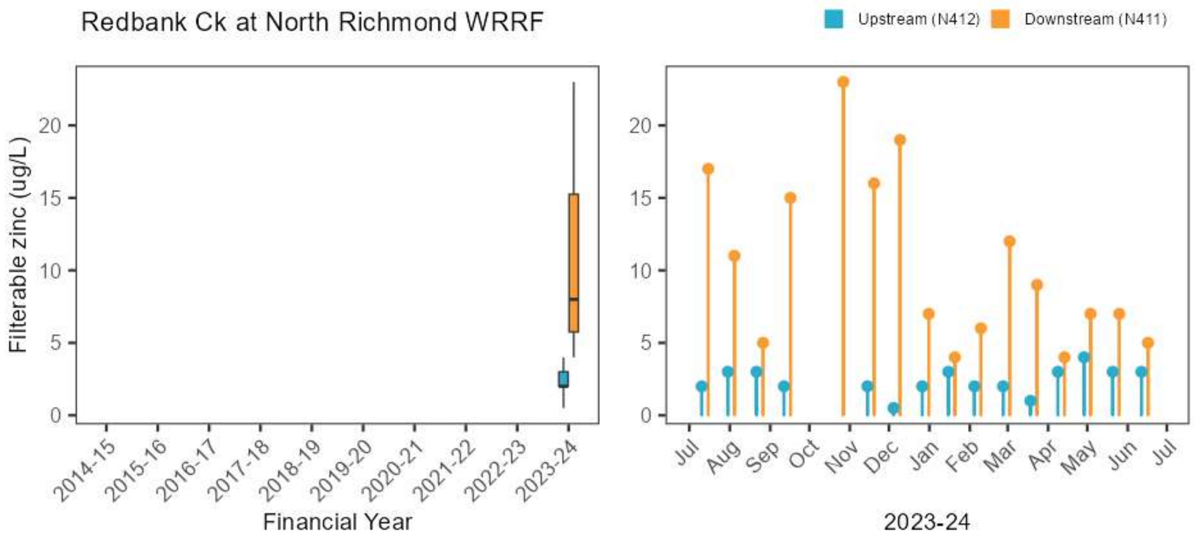
Jul
2023-24


Redbank Ck at North Richmond WRRF
Upstream (N412)
Downstream (N411)
Filterable zinc (ug/L)
0
5
10
15
20
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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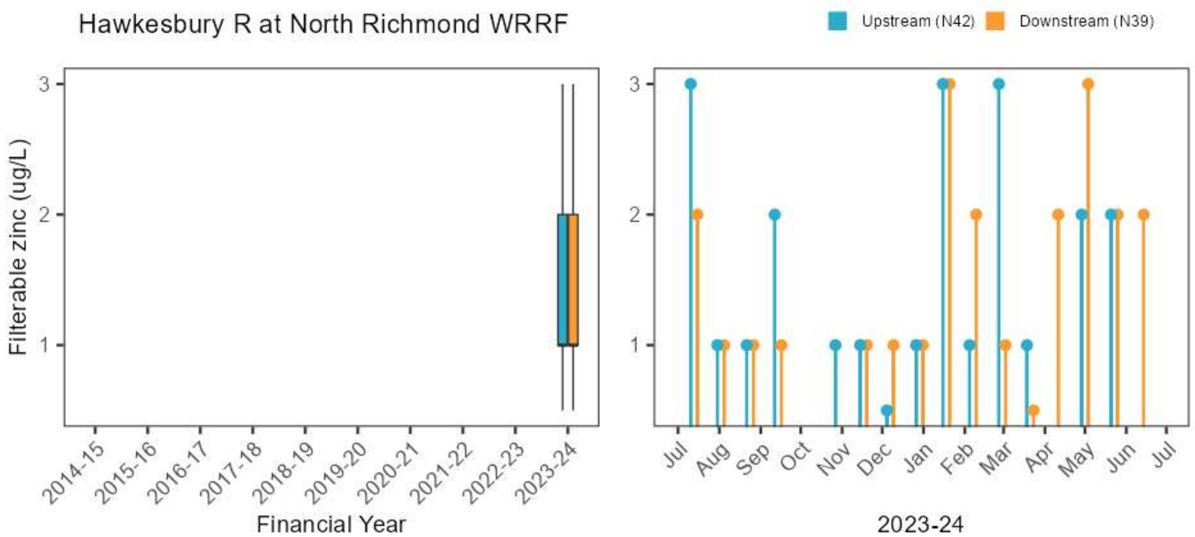
Jun
Jul
2023-24


Hawkesbury R at North Richmond WRRF
Upstream (N42)
Downstream (N39)
Filterable zinc (ug/L)
1
2
3
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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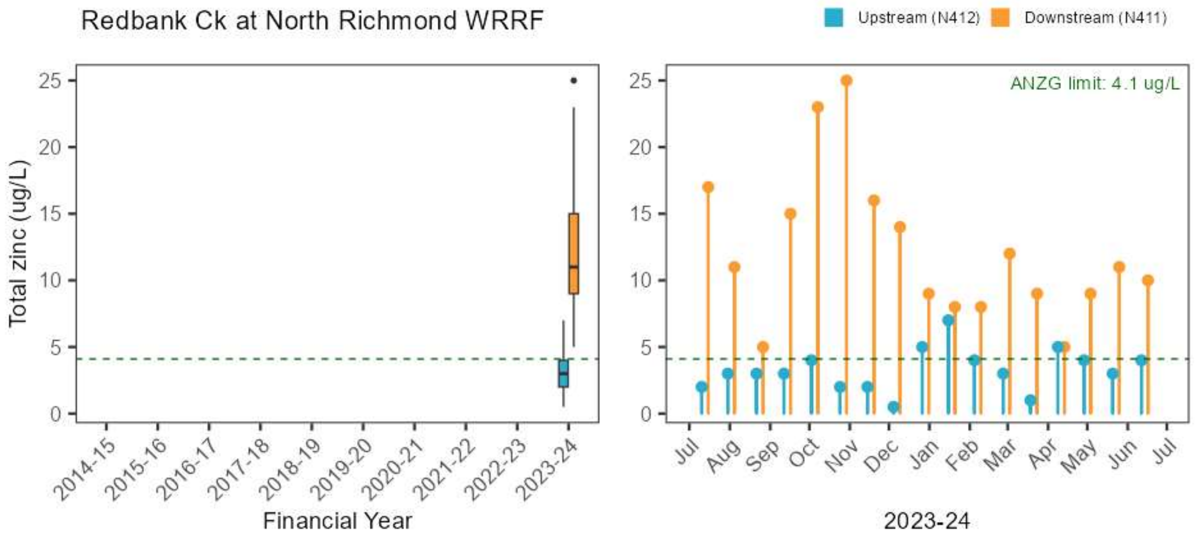
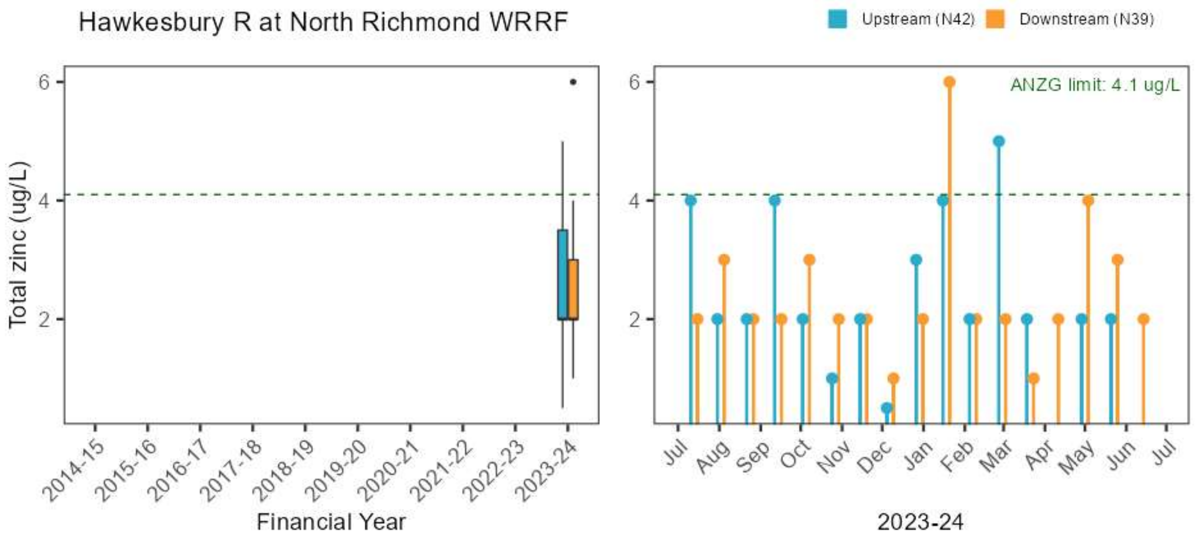
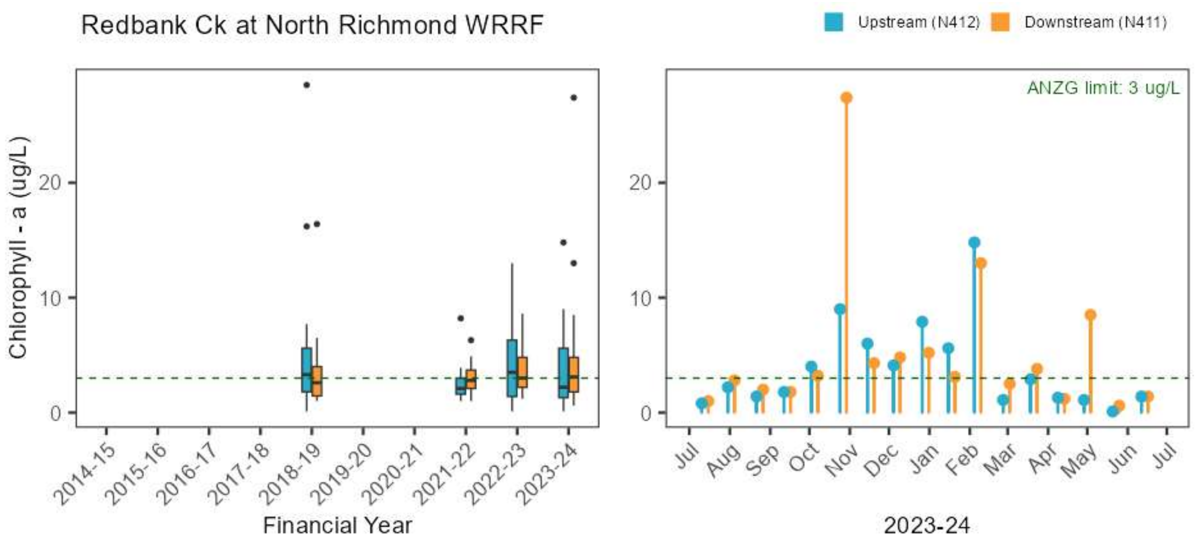
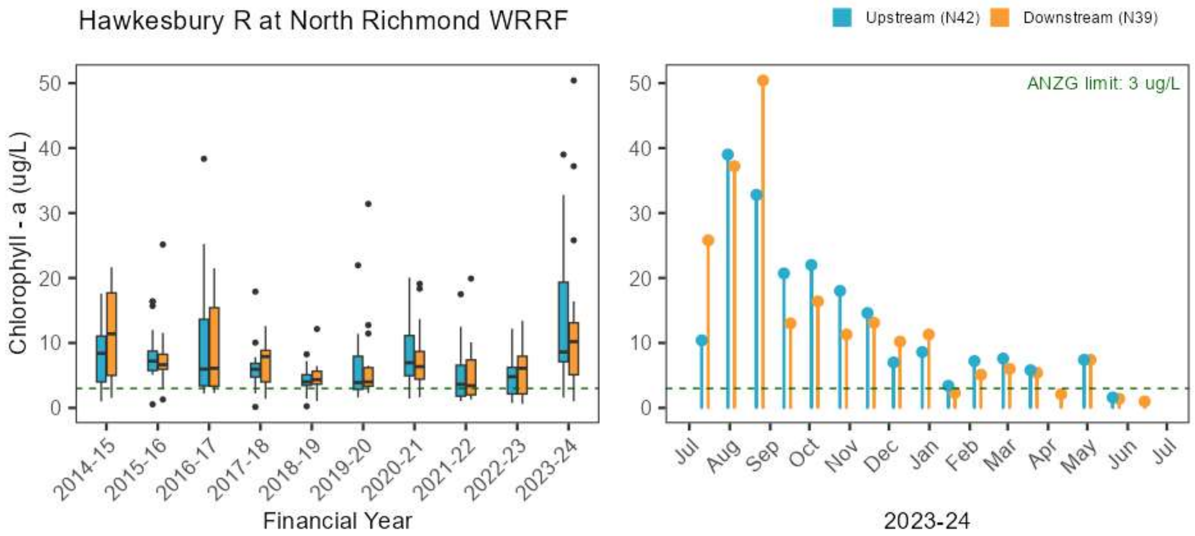
May
Jun
Jul
2023-24





A.6.9. Ecosystem receptor – Phytoplankton





A.6.10. Ecosystem receptor – Macroinvertebrates

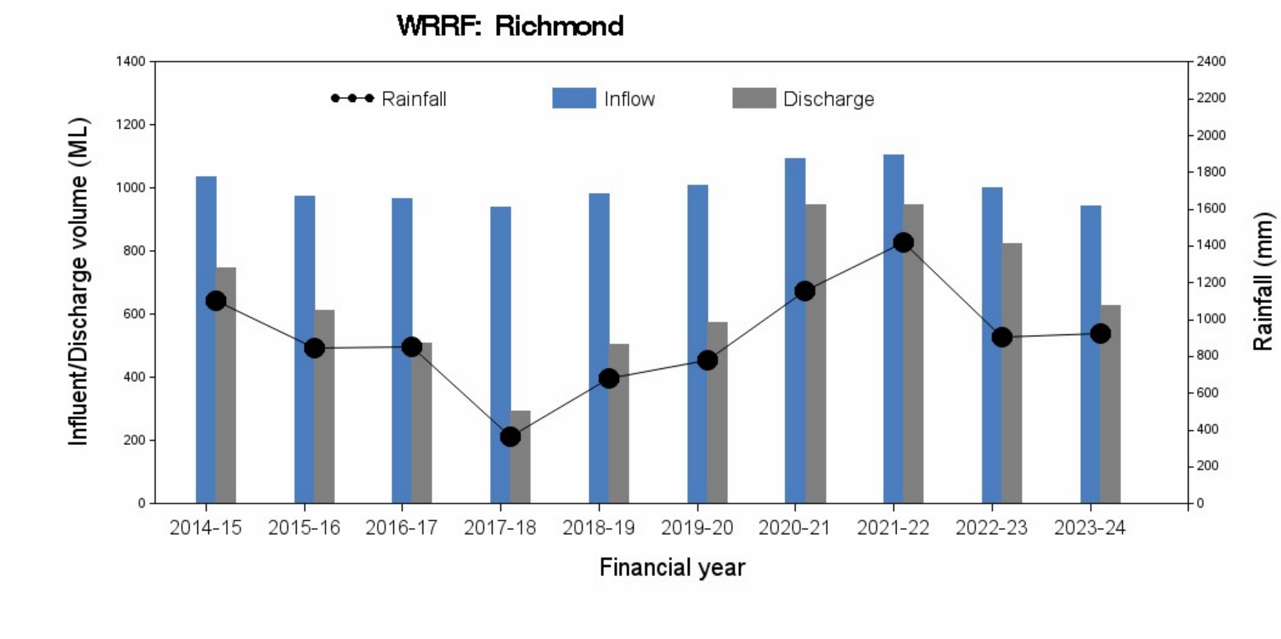
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Redbank Creek	Tributary (N412 vs N411)	Welch Two Sample t-test	0.5	3.29	8.8	0.010
Hawkesbury River	River (N42 vs N39)	Welch Two Sample t-test	0.13	0.41	8.5	0.689

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

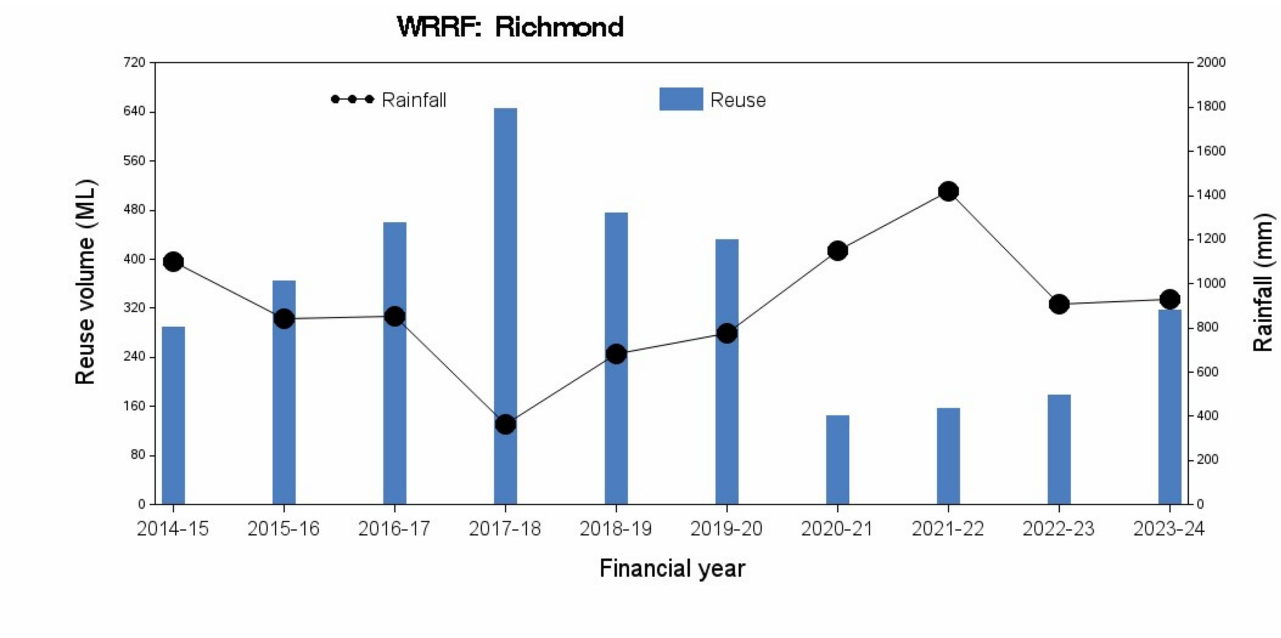
A.7. Richmond WRRF

A.7.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

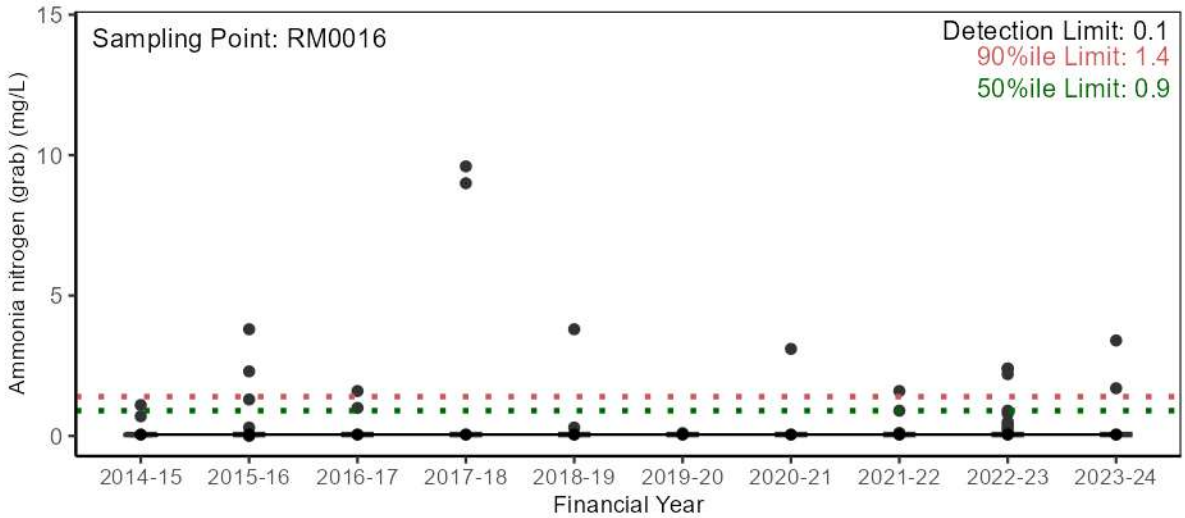


Reuse volume and rainfall

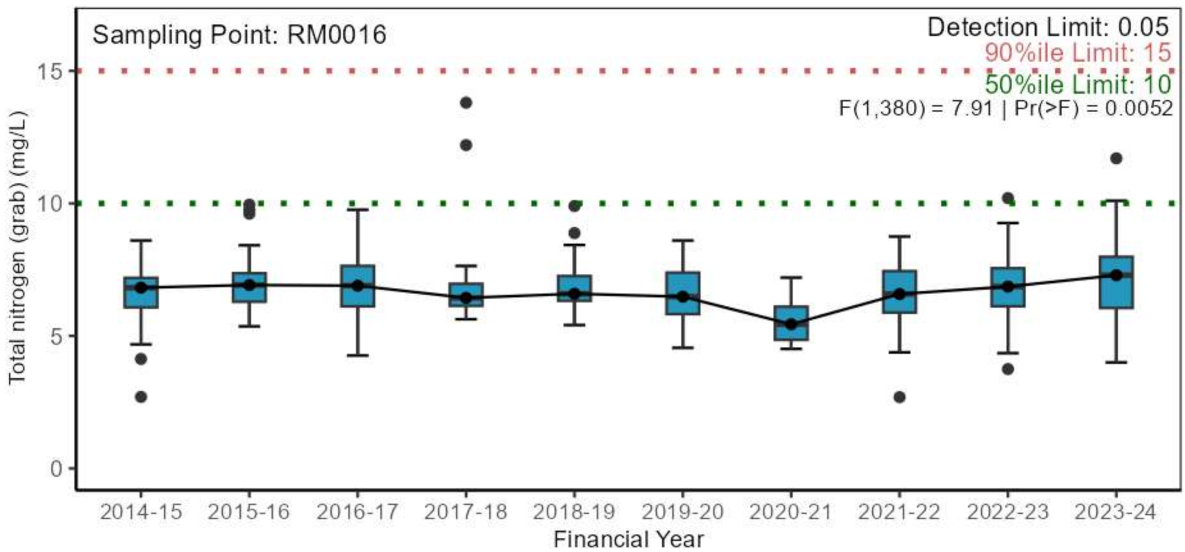


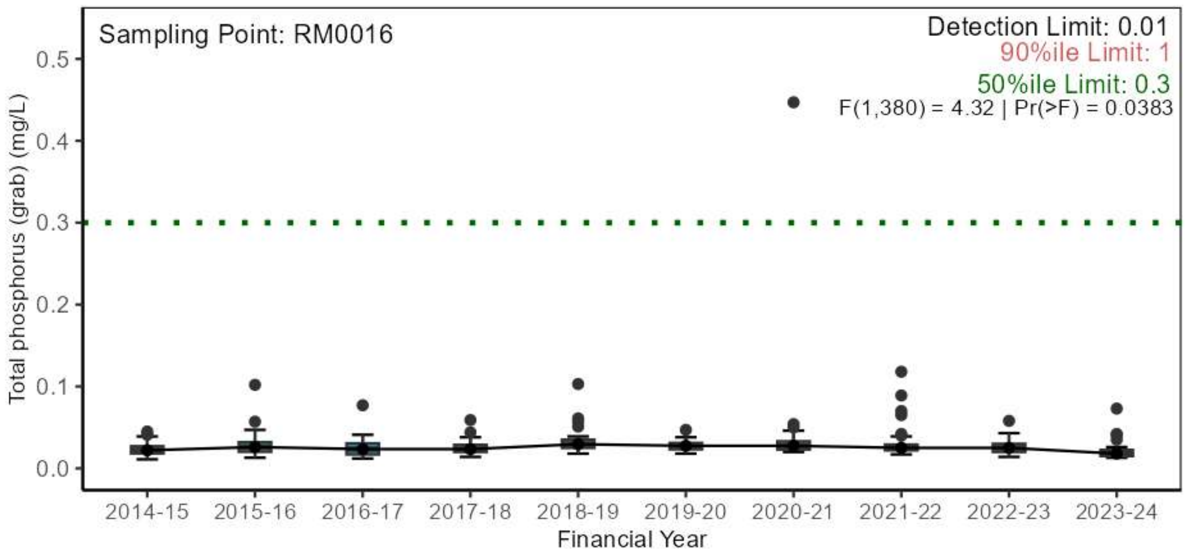
A.7.2. Pressure – Wastewater quality

Nutrients (RM0016 Bypass Effluent)

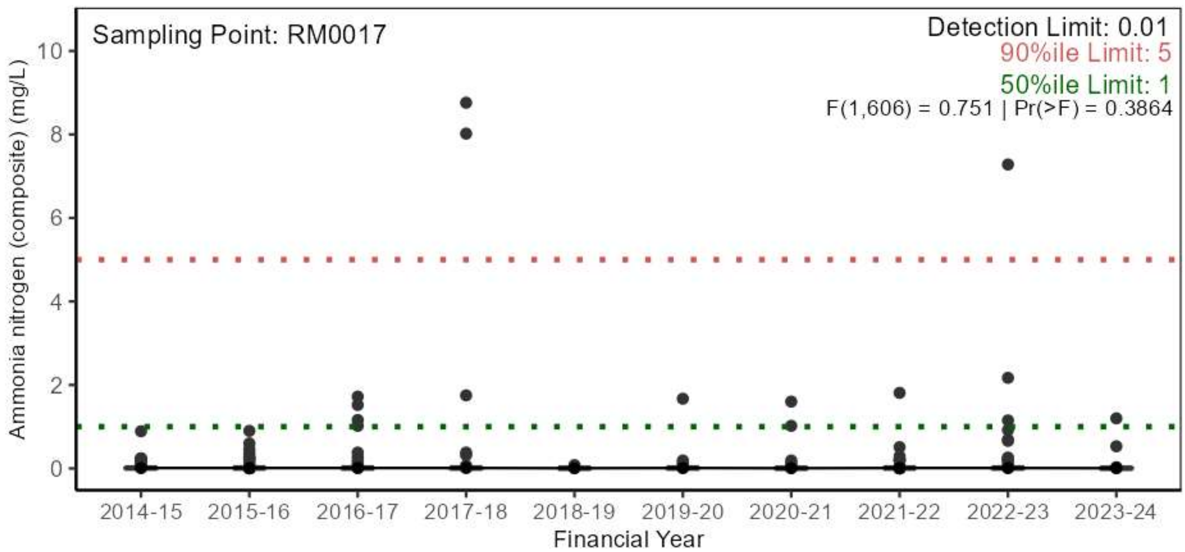


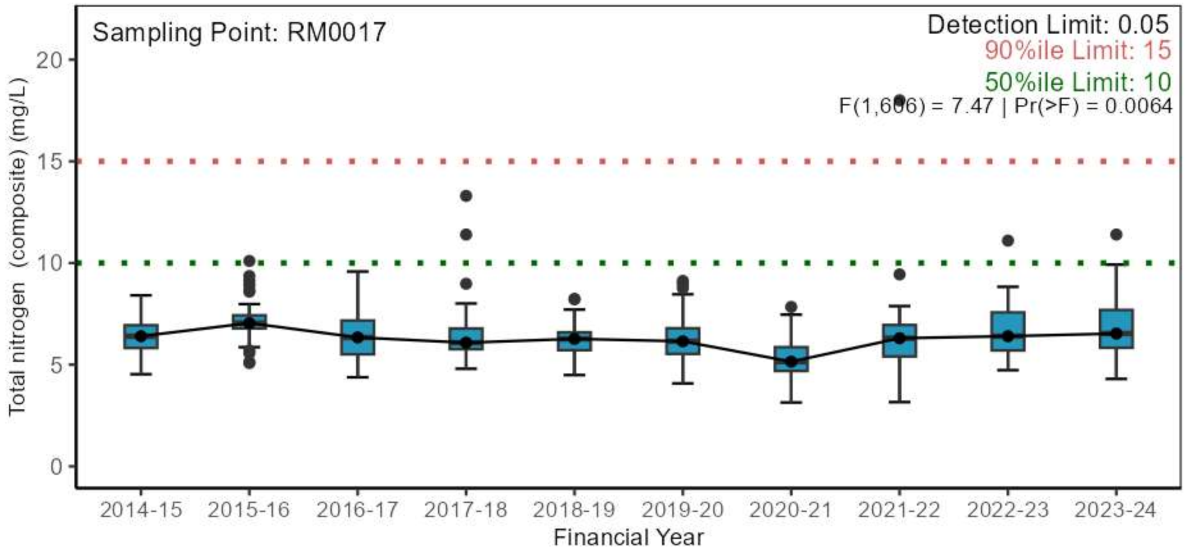
Statistical test not conducted as >90% of results were below detection limits.

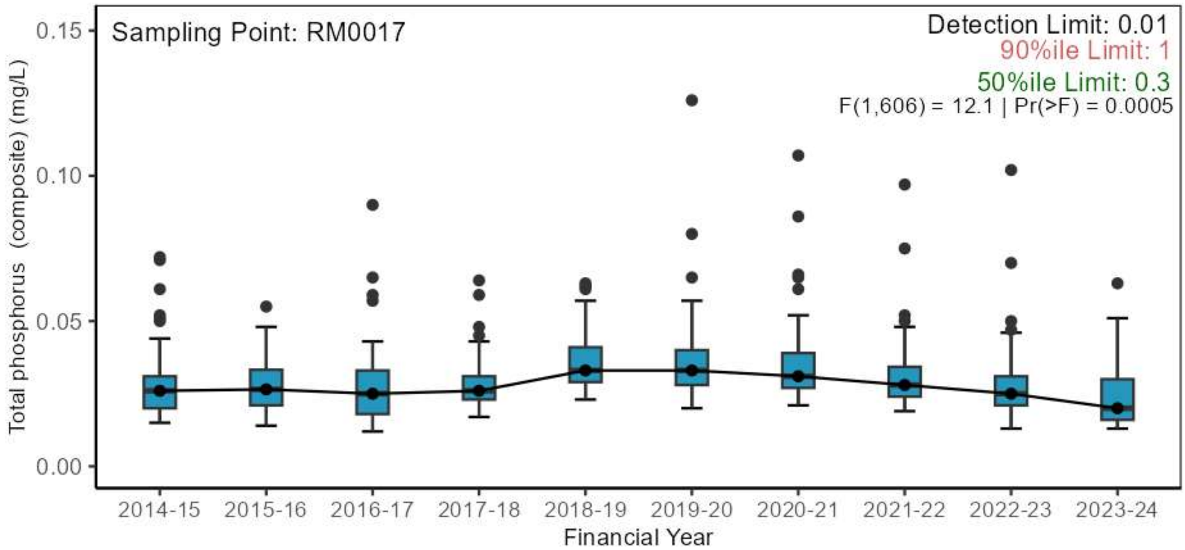




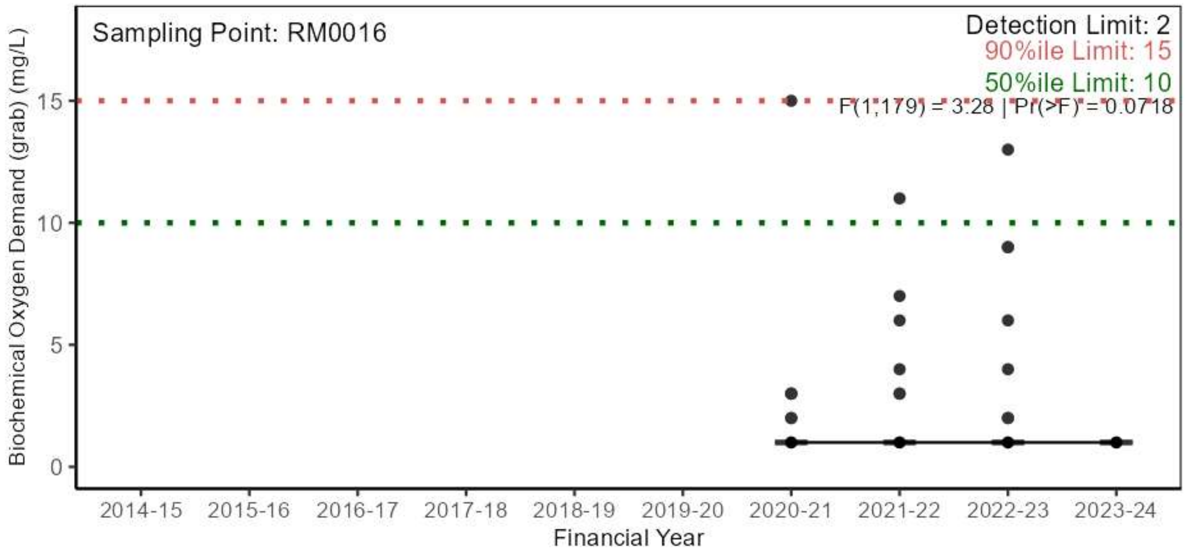
Nutrients (RM0017 Effluent)

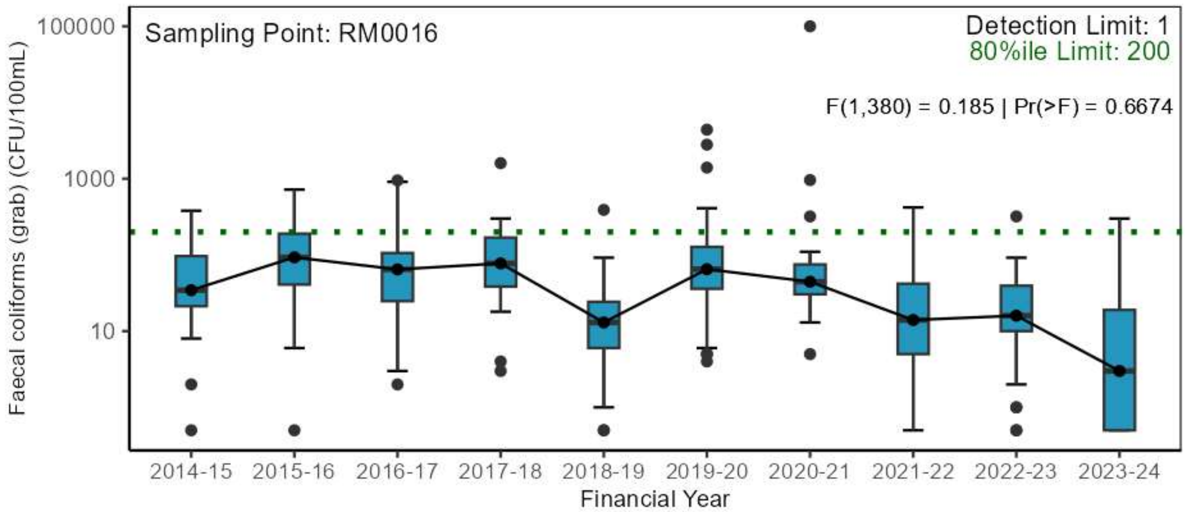



Sampling Point: RM0017
Detection Limit: 0.05
90%ile Limit: 15
50%ile Limit: 10
F(1,606) = 7.47 | Pr(>F) = 0.0064
Total nitrogen (composite) (mg/L)
0
5
10
15
20
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

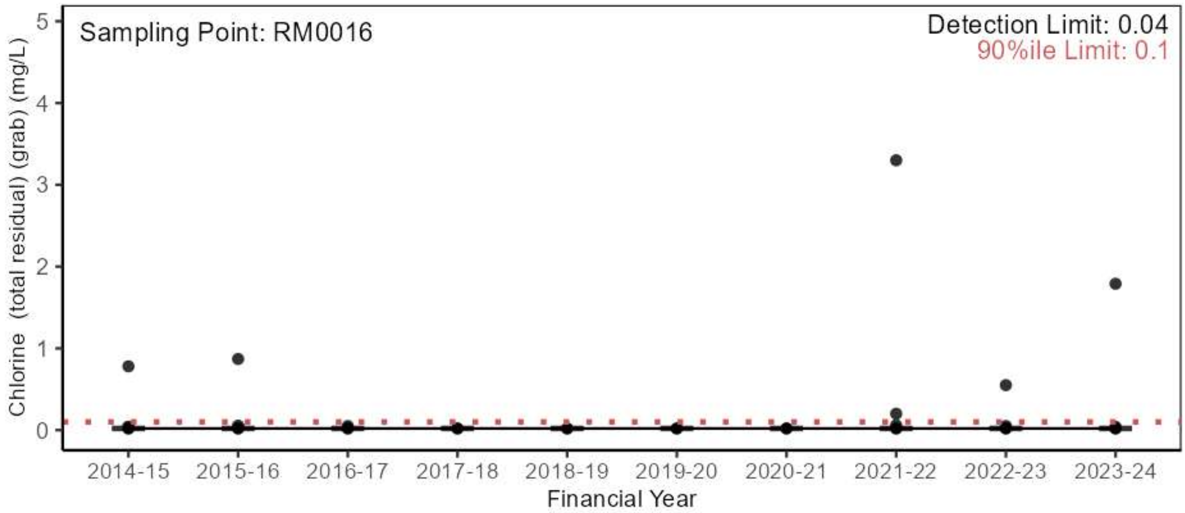

Sampling Point: RM0017
Detection Limit: 0.01
90%ile Limit: 1
50%ile Limit: 0.3
F(1,606) = 12.1 | Pr(>F) = 0.0005
Total phosphorus (composite) (mg/L)
0.00
0.05
0.10
0.15
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

Major conventional analytes (RM0016 Bypass Effluent)

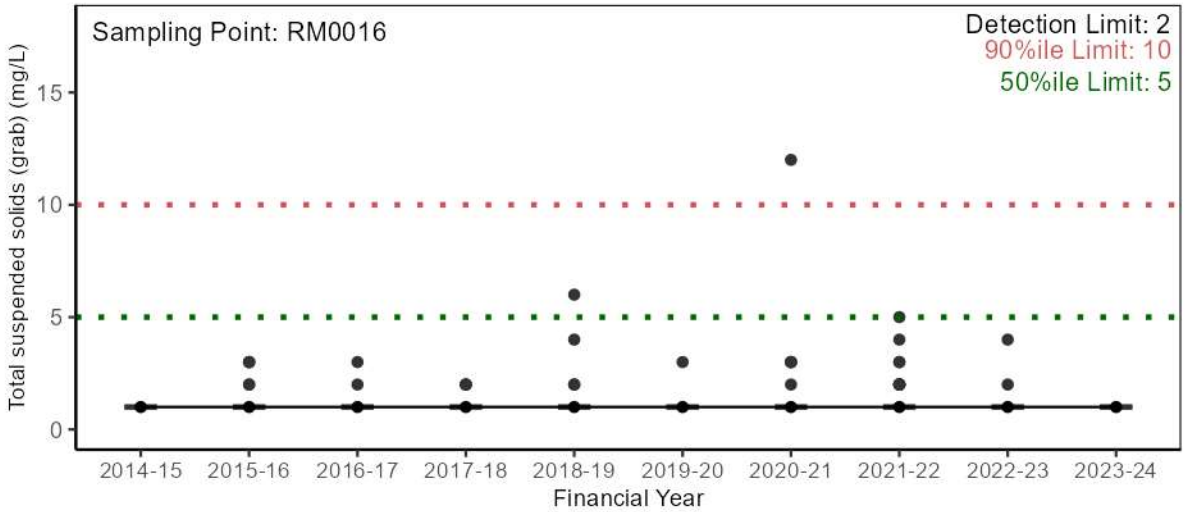




Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

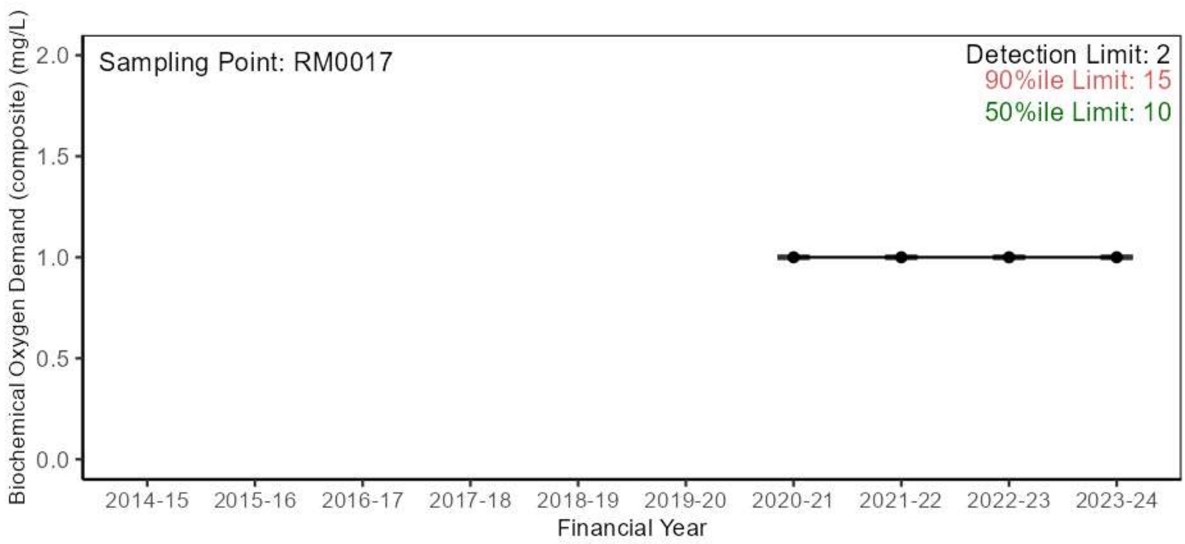


Statistical test not conducted as >90% of results were below detection limits.

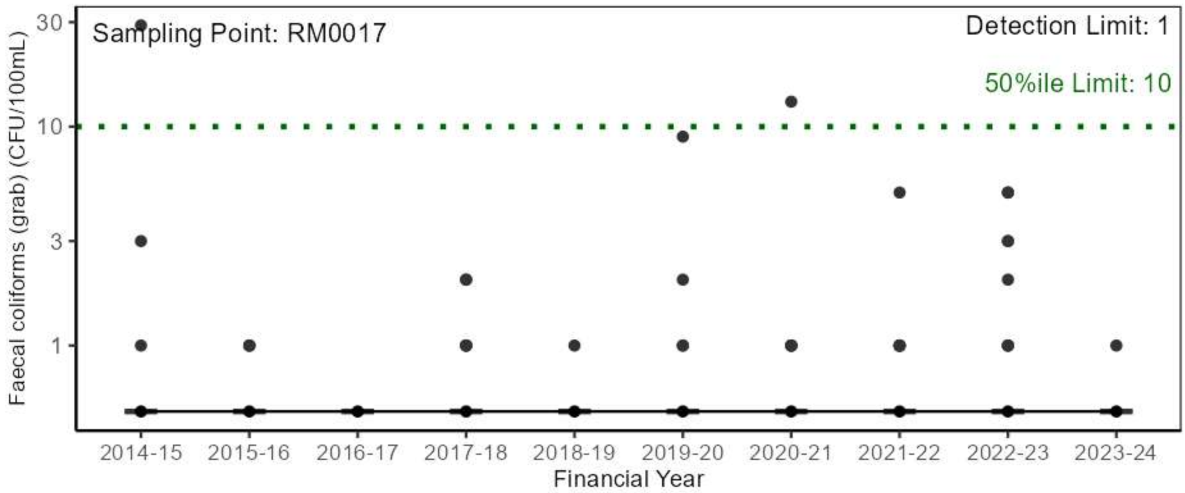


Statistical test not conducted as >90% of results were below detection limits.

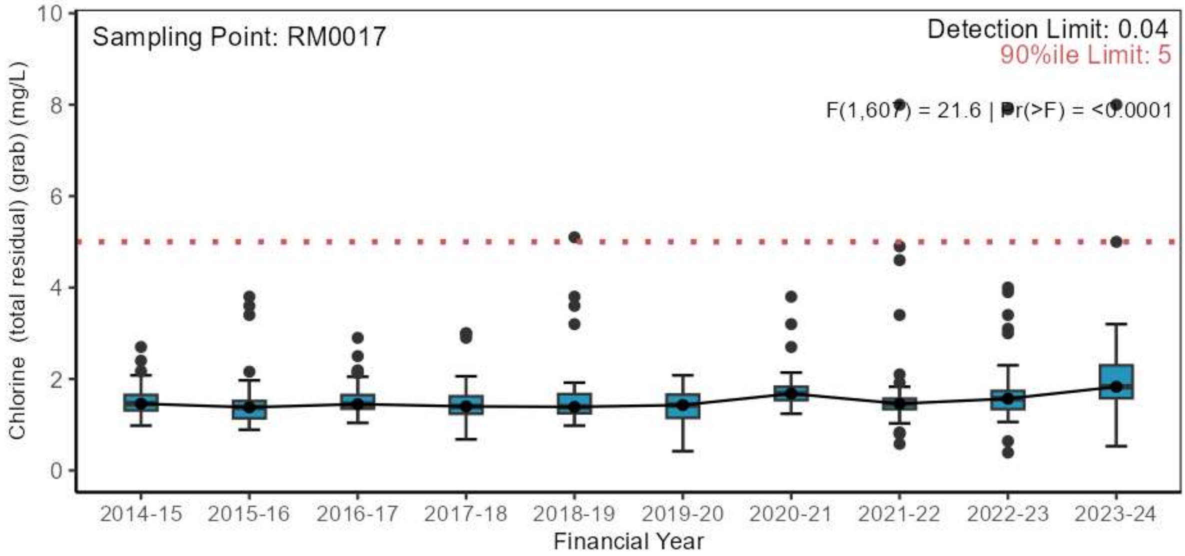
Major conventional analytes (RM0017 Effluent)

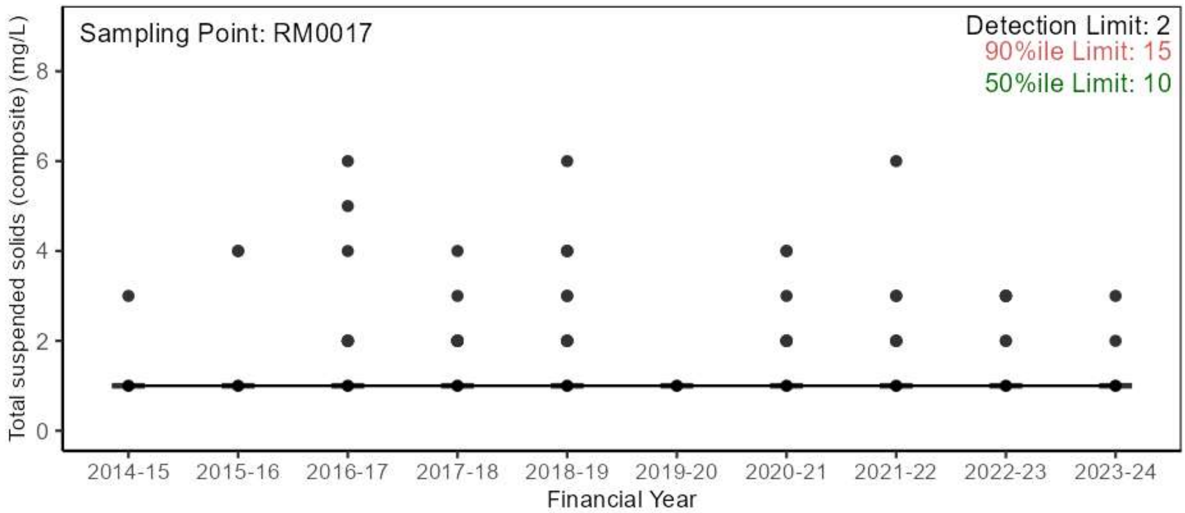


Statistical test not conducted as >90% of results were below detection limits.



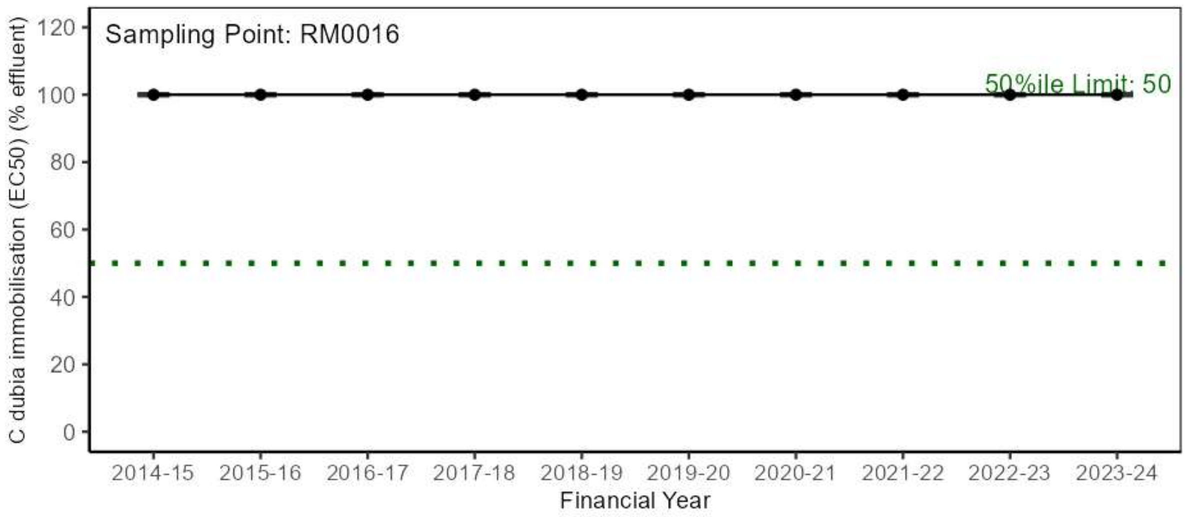
Statistical test not conducted as >90% of results were below detection limits.
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.





Statistical test not conducted as >90% of results were below detection limits.

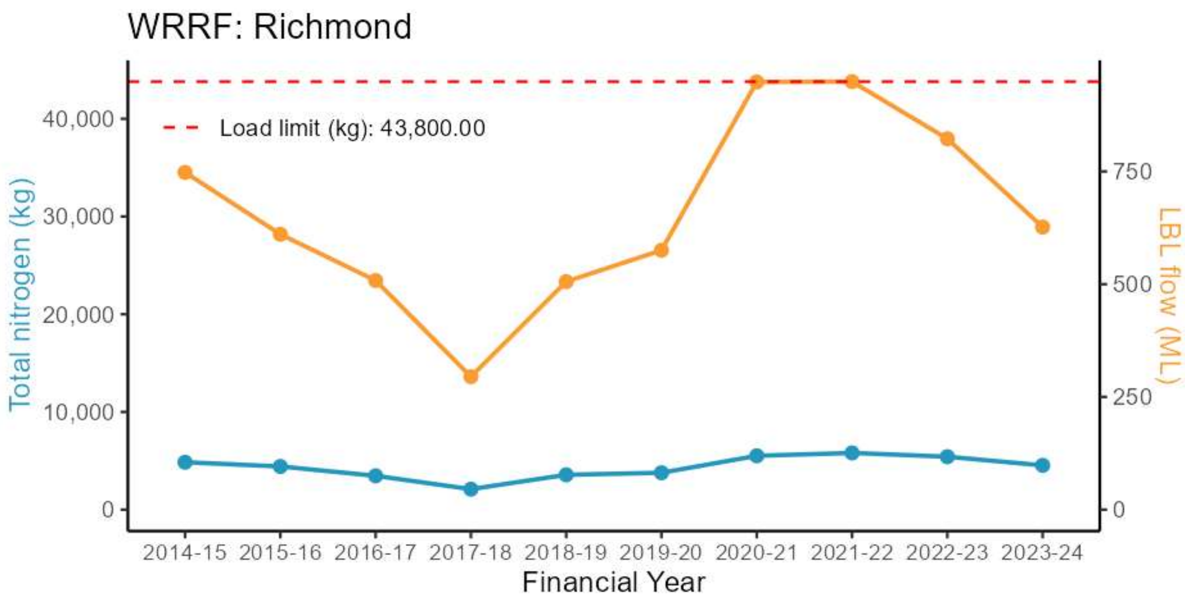
A.7.3. Pressure – Wastewater toxicity

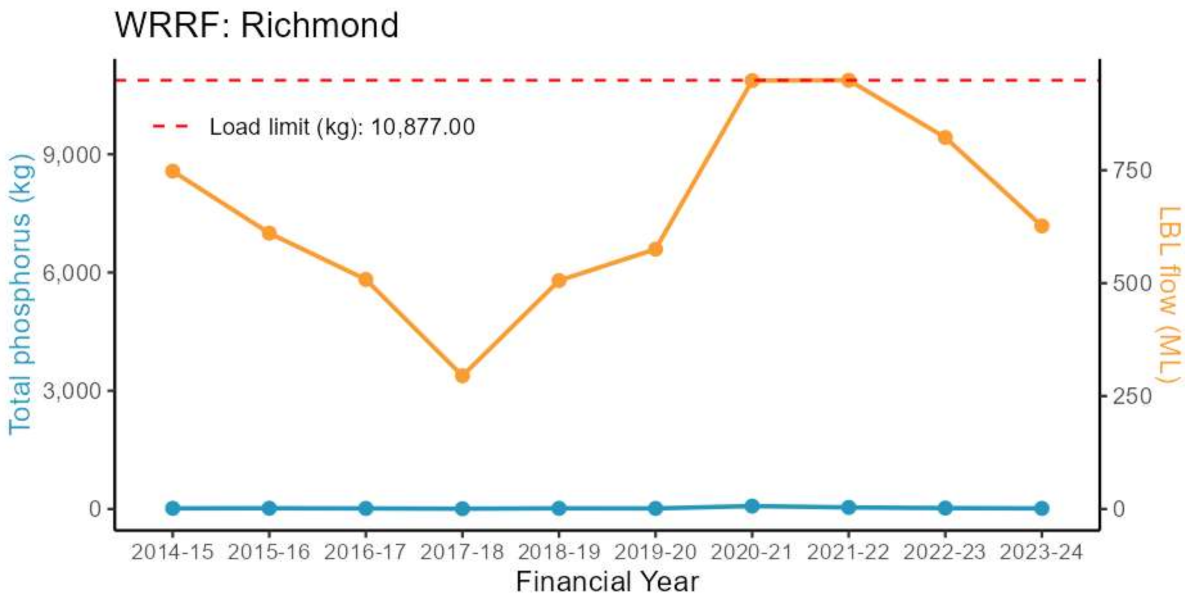


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

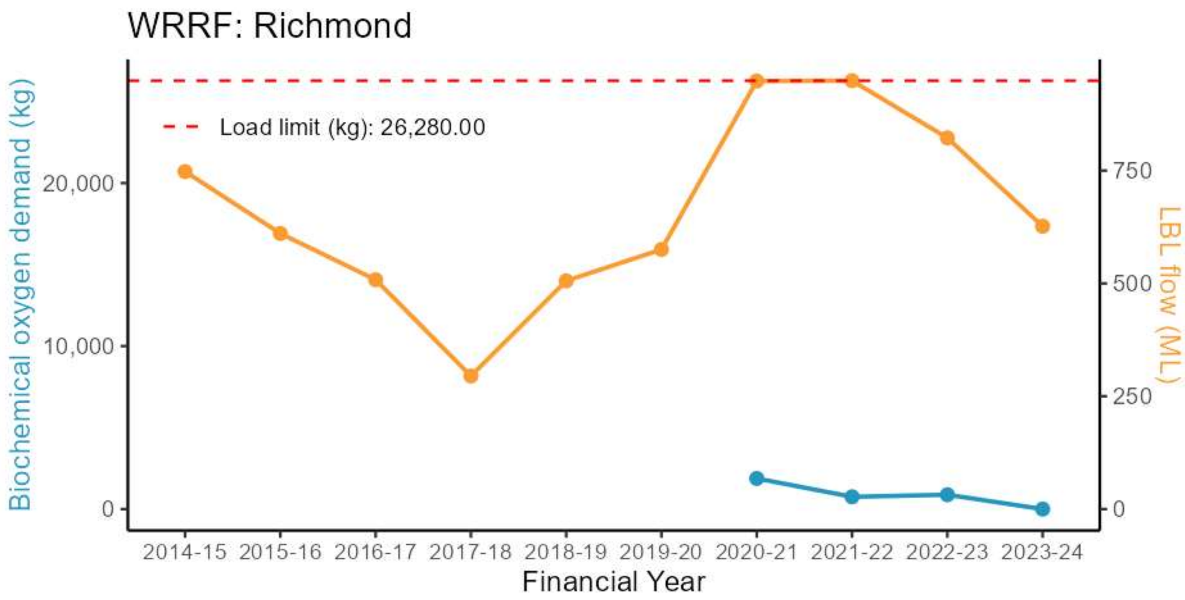
A.7.4. Pressure – Wastewater discharge load

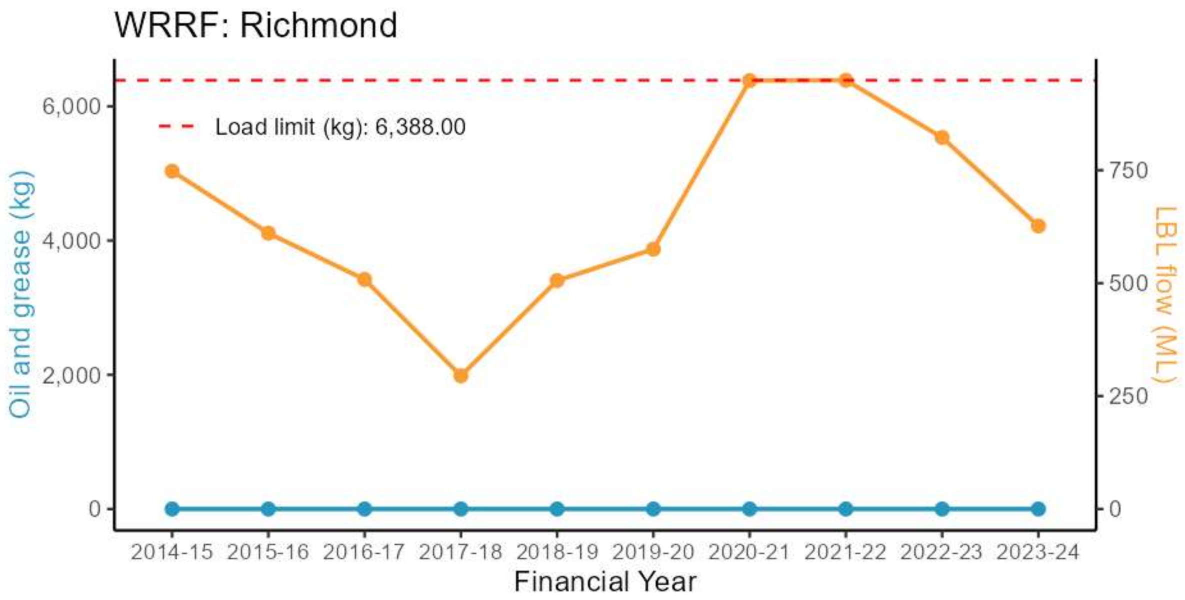
Nutrients



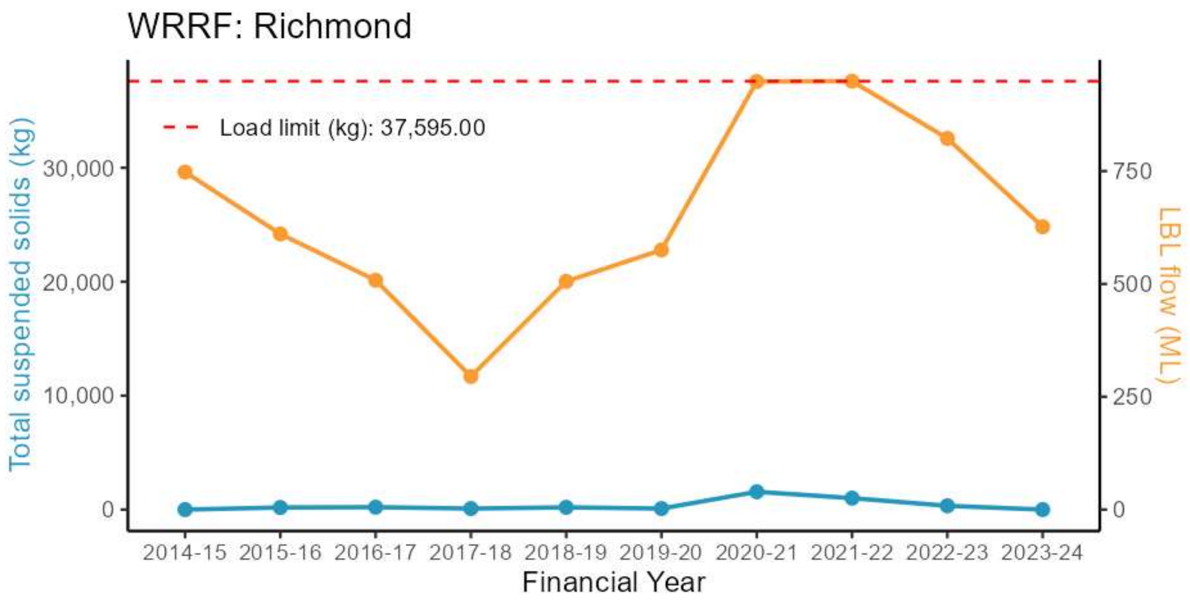


Major conventional analytes





WRRF: Richmond
Load limit (kg): 6,388.00
Oil and grease (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24



WRRF: Richmond
Load limit (kg): 37,595.00
Total suspended solids (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24

A.7.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-13 Downstream vs upstream comparison (current period) contrast outcomes for Richmond WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Rickabys Ck	N389 vs N388	Total ammonia nitrogen	1.01	0.49	83	0.03	1.000
Rickabys Ck	N389 vs N388	Oxidised nitrogen	2.52	1.53	83	1.53	0.425
Rickabys Ck	N389 vs N388	Total nitrogen	1.15	0.19	83	0.83	0.838
Rickabys Ck	N389 vs N388	Filterable total phosphorus	1.33	0.45	83	0.83	0.842
Rickabys Ck	N389 vs N388	Total phosphorus	1.08	0.32	83	0.26	0.993
Rickabys Ck	N389 vs N388	Conductivity	0.88	0.24	82	-0.46	0.967
Rickabys Ck	N389 vs N388	Dissolved oxygen	1.33	0.11	83	3.56	0.003
Rickabys Ck	N389 vs N388	Dissolved oxygen saturation	18.48	4.89	83	3.78	0.002
Rickabys Ck	N389 vs N388	pH	0.21	0.12	83	1.81	0.277
Rickabys Ck	N389 vs N388	Water temperature	1.00	0.11	83	-0.02	1.000
Rickabys Ck	N389 vs N388	Turbidity	0.91	0.18	83	-0.50	0.959
Rickabys Ck	N389 vs N388	Chlorophyll - a	0.92	0.35	83	-0.22	0.996

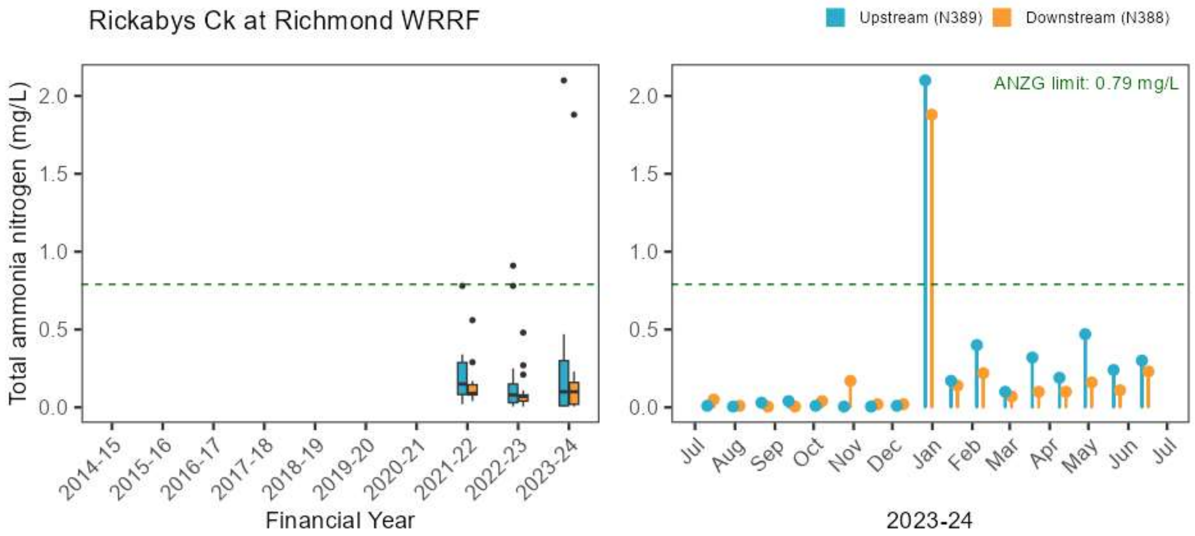
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

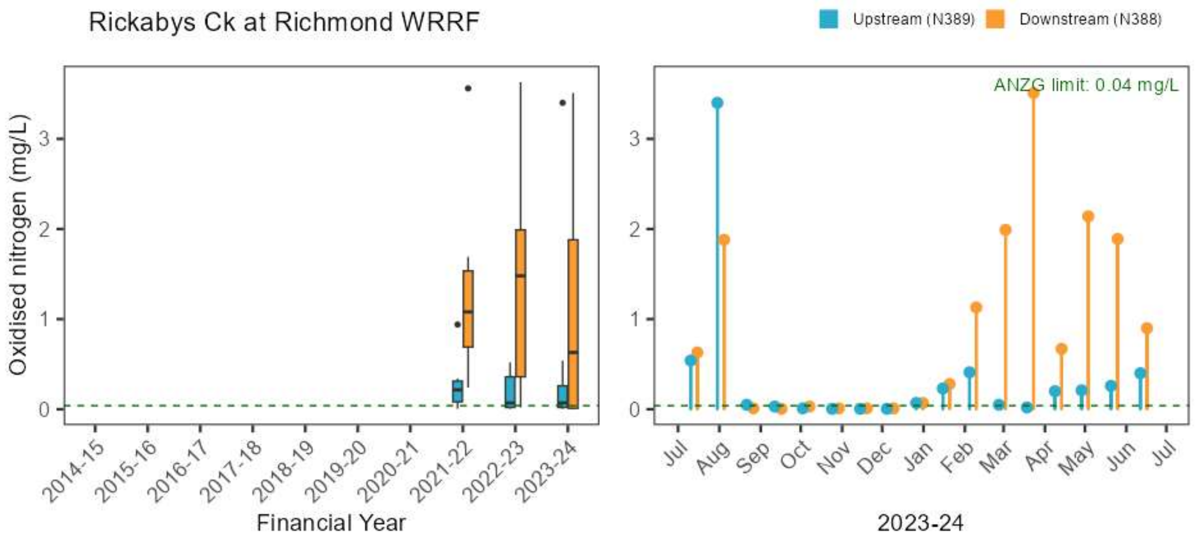
Table A-14 Current period vs previous period comparison (single site) contrast outcomes for Richmond WRRF

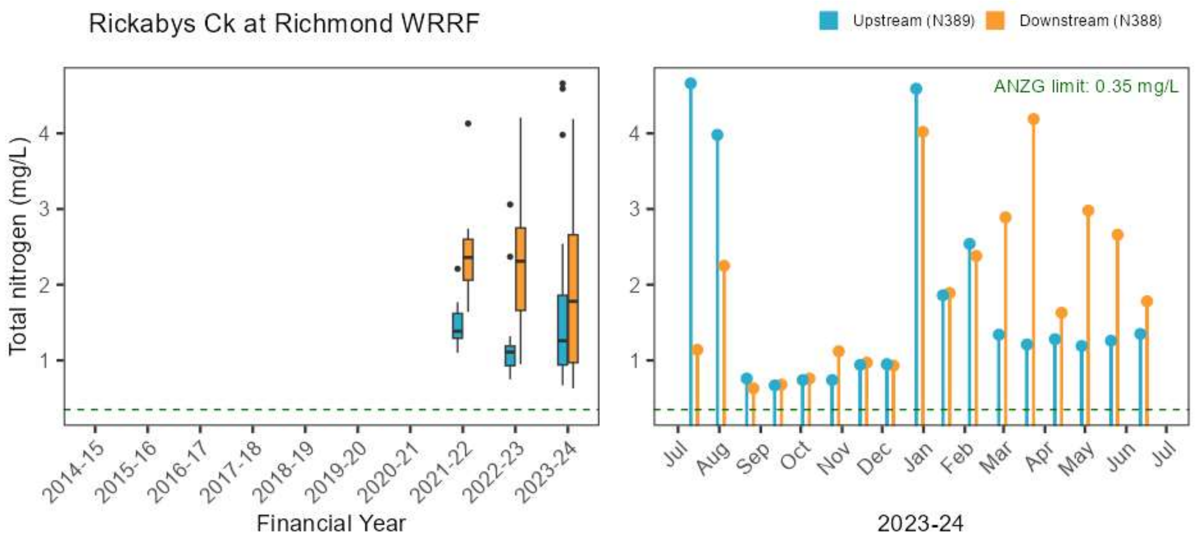
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Rickabys Ck	N389	Total ammonia nitrogen	0.64	0.28	83	-1.01	0.746
Rickabys Ck	N389	Oxidised nitrogen	0.78	0.43	83	-0.45	0.970
Rickabys Ck	N389	Total nitrogen	1.11	0.17	83	0.69	0.900
Rickabys Ck	N389	Filterable total phosphorus	0.93	0.29	83	-0.22	0.996
Rickabys Ck	N389	Total phosphorus	1.05	0.28	83	0.19	0.997
Rickabys Ck	N389	Conductivity	1.25	0.31	82	0.91	0.800
Rickabys Ck	N389	Dissolved oxygen	1.07	0.08	83	0.87	0.820
Rickabys Ck	N389	Dissolved oxygen saturation	8.53	4.47	83	1.91	0.233
Rickabys Ck	N389	pH	0.05	0.11	83	0.48	0.963
Rickabys Ck	N389	Water temperature	1.09	0.11	83	0.90	0.806
Rickabys Ck	N389	Turbidity	0.87	0.16	83	-0.78	0.865
Rickabys Ck	N389	Chlorophyll - a	1.21	0.42	83	0.55	0.946
Rickabys Ck	N388	Total ammonia nitrogen	0.79	0.34	83	-0.55	0.946
Rickabys Ck	N388	Oxidised nitrogen	0.25	0.14	83	-2.54	0.061
Rickabys Ck	N388	Total nitrogen	0.73	0.11	83	-2.12	0.156
Rickabys Ck	N388	Filterable total phosphorus	0.56	0.17	83	-1.86	0.252
Rickabys Ck	N388	Total phosphorus	0.63	0.17	83	-1.73	0.314
Rickabys Ck	N388	Conductivity	2.13	0.51	82	3.15	0.012
Rickabys Ck	N388	Dissolved oxygen	1.00	0.07	83	-0.01	1.000
Rickabys Ck	N388	Dissolved oxygen saturation	1.59	4.42	83	0.36	0.984
Rickabys Ck	N388	pH	-0.21	0.10	83	-1.99	0.201
Rickabys Ck	N388	Water temperature	1.07	0.11	83	0.70	0.895
Rickabys Ck	N388	Turbidity	0.88	0.15	83	-0.74	0.879
Rickabys Ck	N388	Chlorophyll - a	0.92	0.31	83	-0.24	0.995

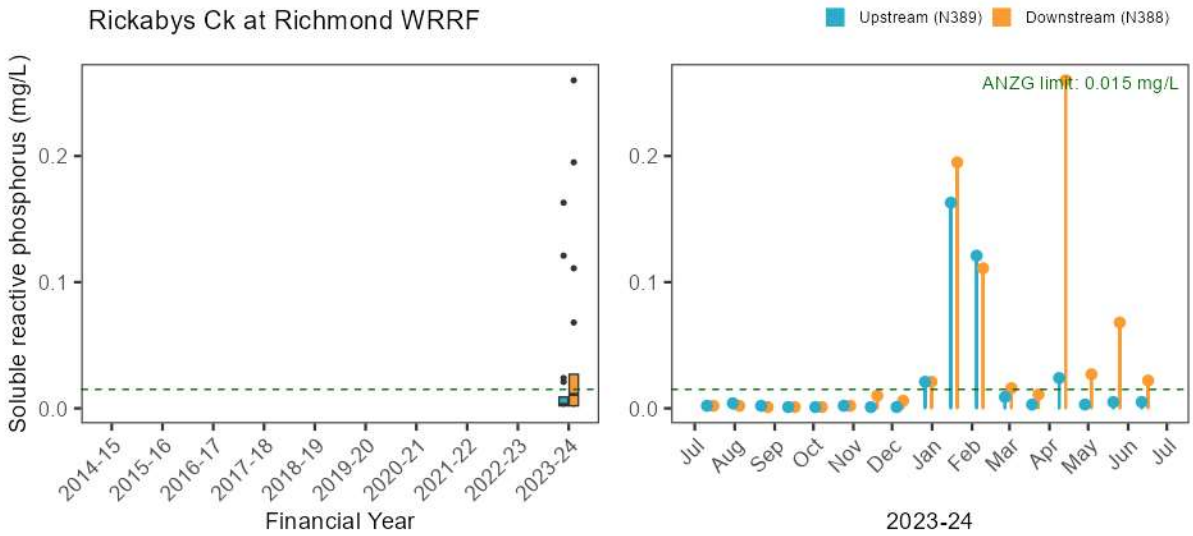
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

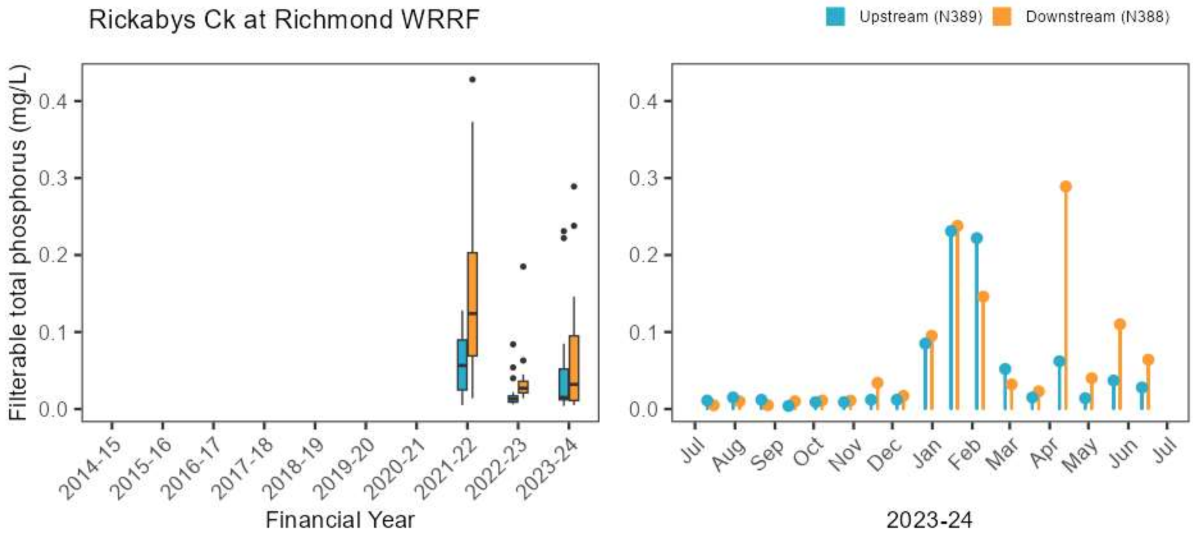
A.7.6. Stressor – Nutrients

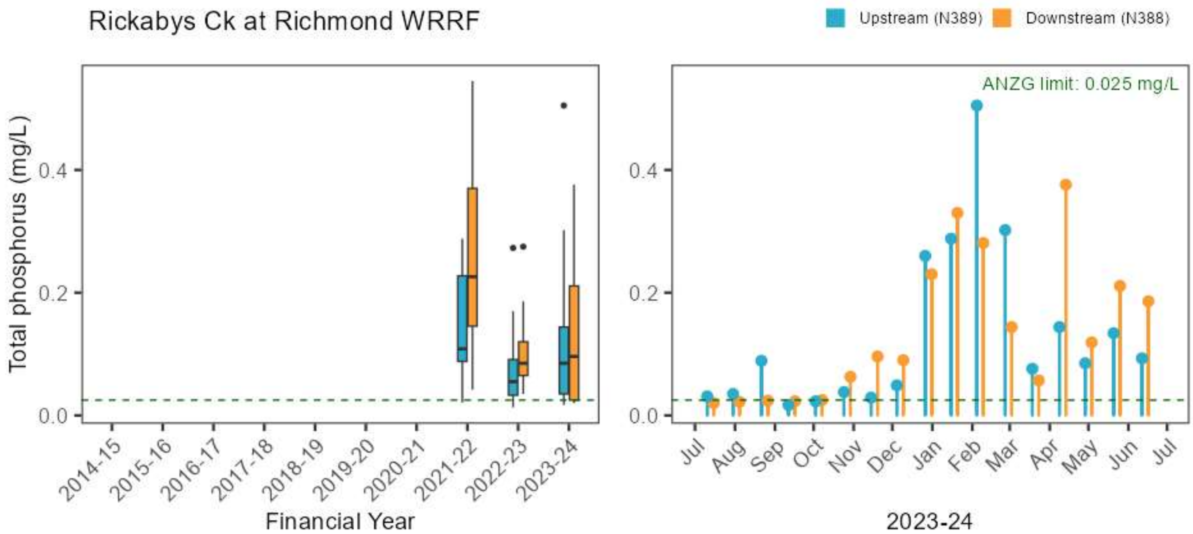




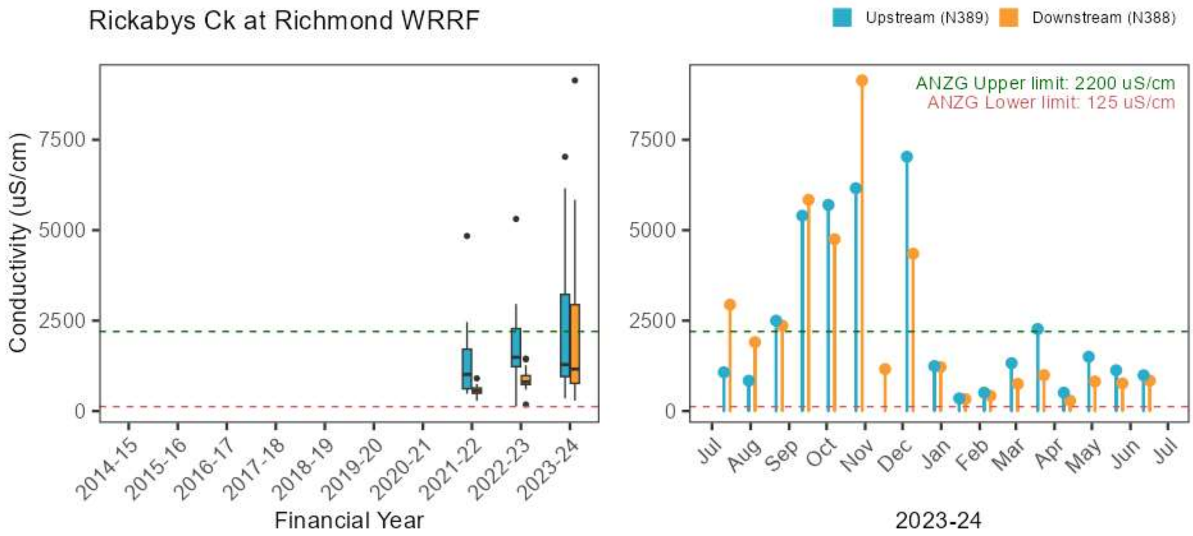


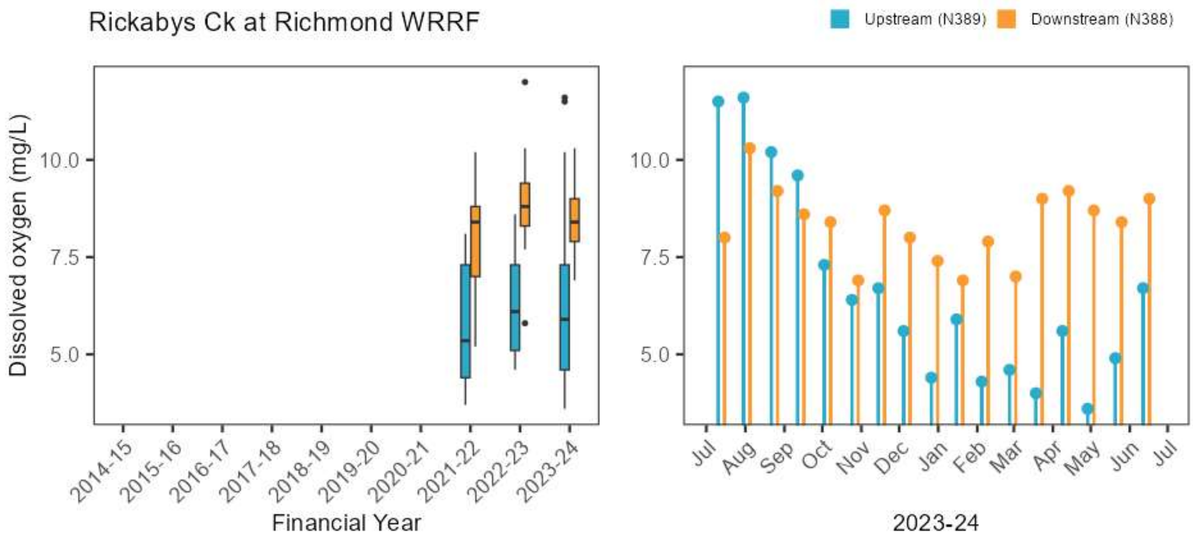

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
ANZG limit: 0.015 mg/L
Soluble reactive phosphorus (mg/L)
0.0
0.1
0.2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

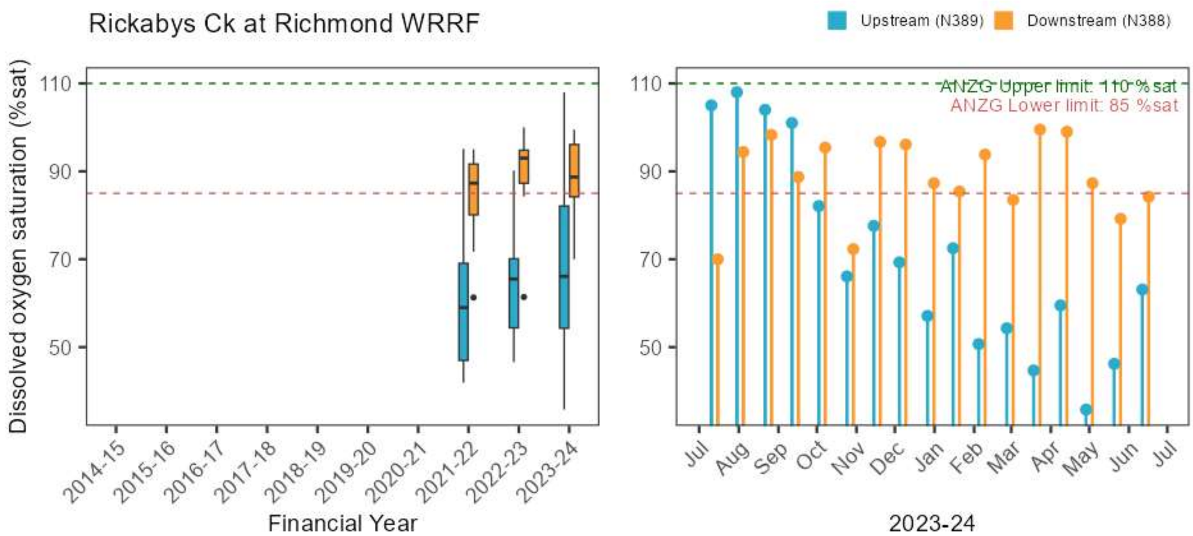

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Filterable total phosphorus (mg/L)
0.0
0.1
0.2
0.3
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

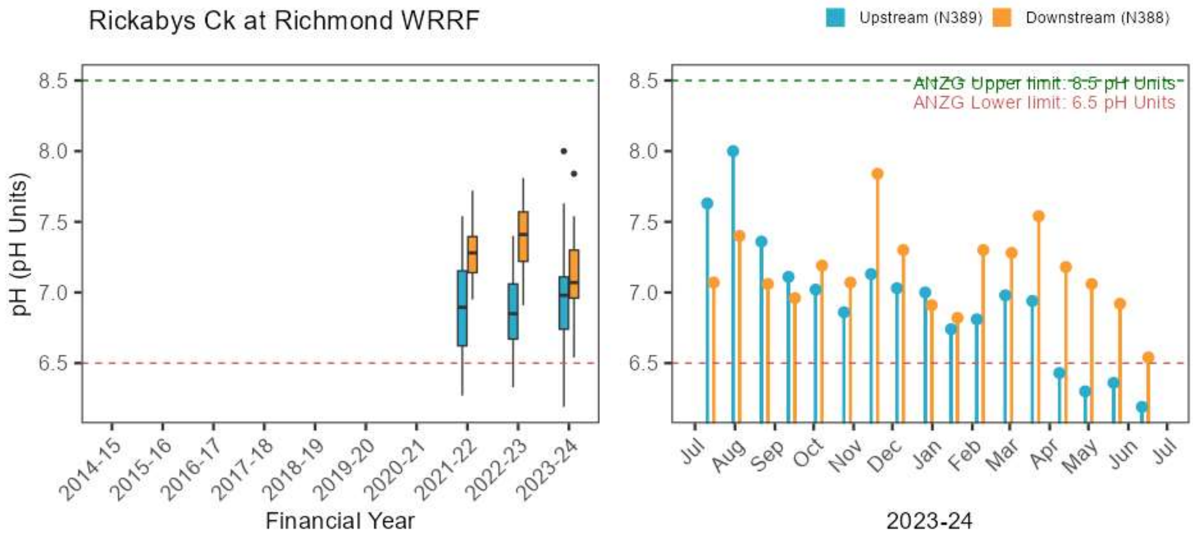

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.0
0.2
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

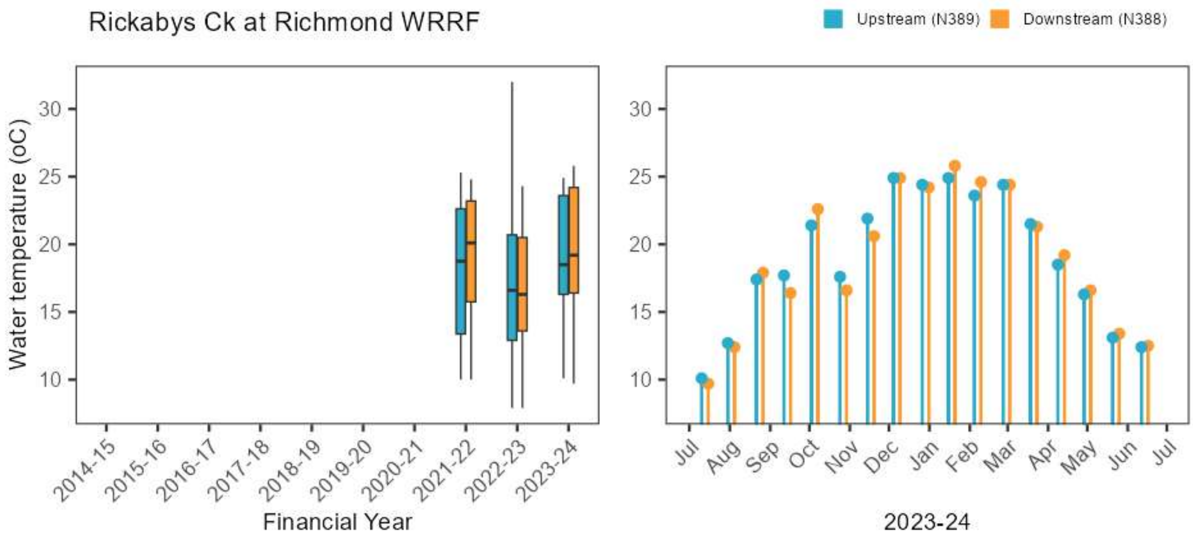
A.7.7. Stressor – Physico-chemical water quality

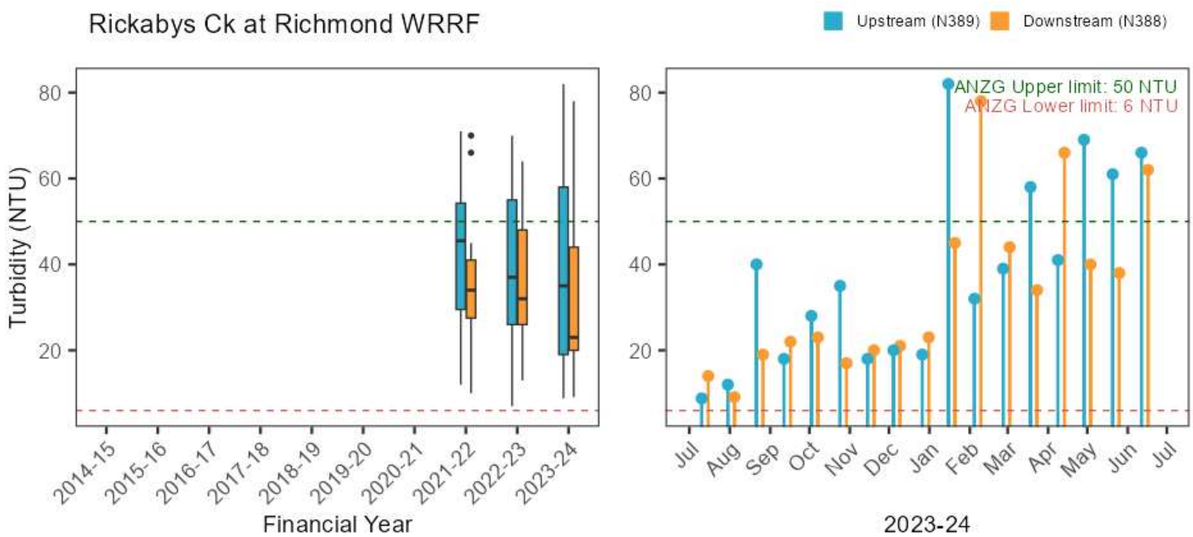




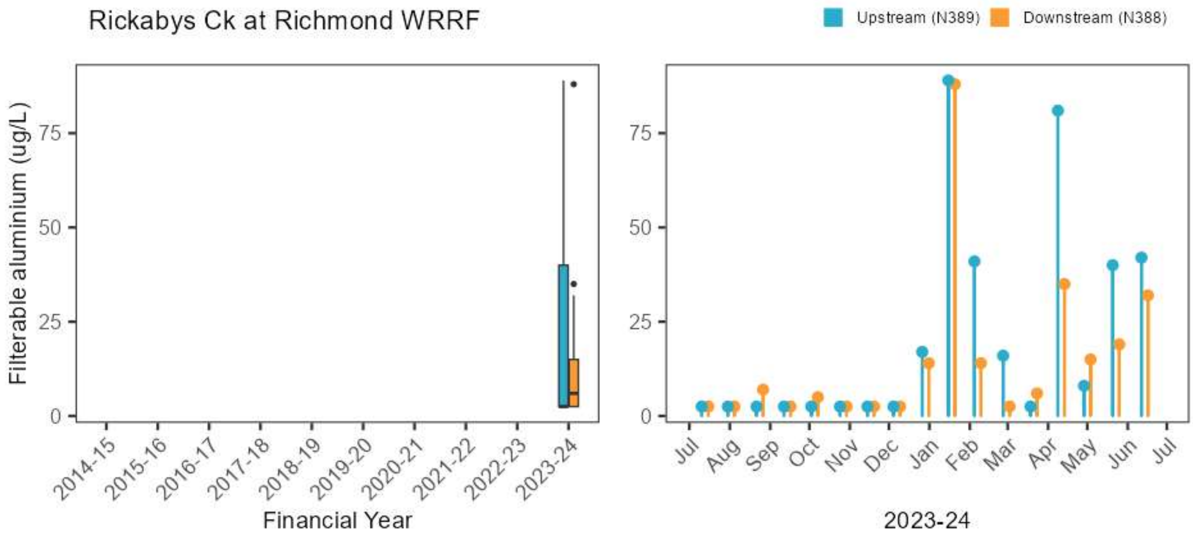


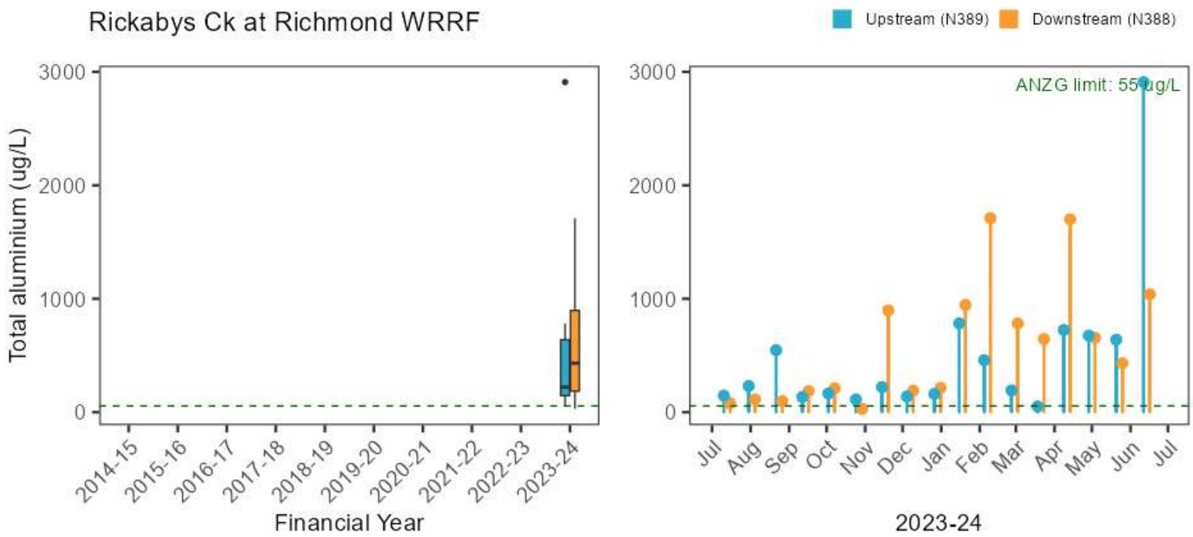

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
pH (pH Units)
Financial Year
2023-24
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units

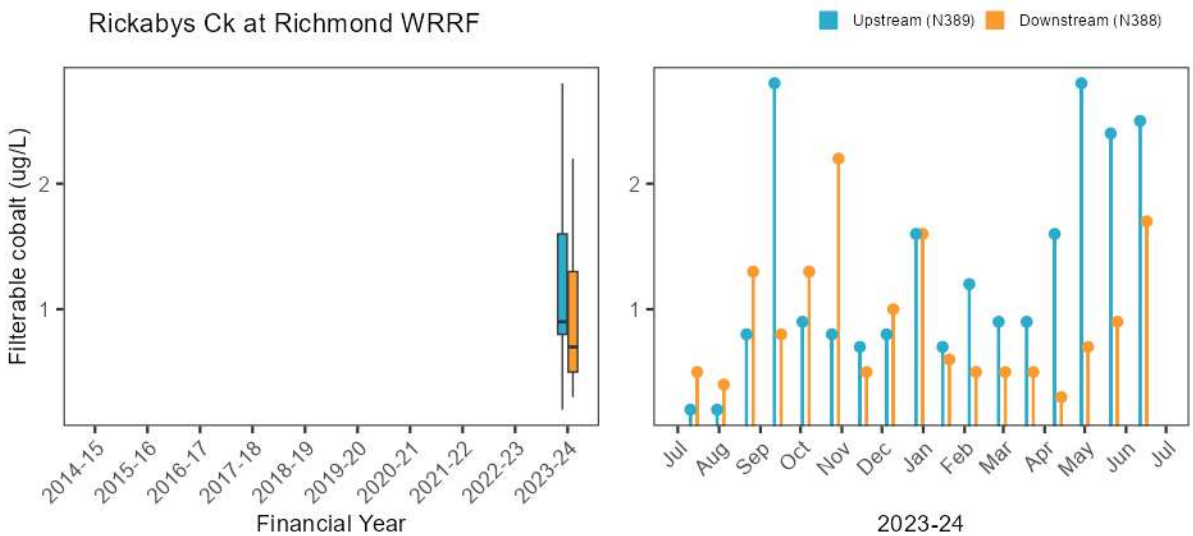

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Water temperature (oC)
Financial Year
2023-24

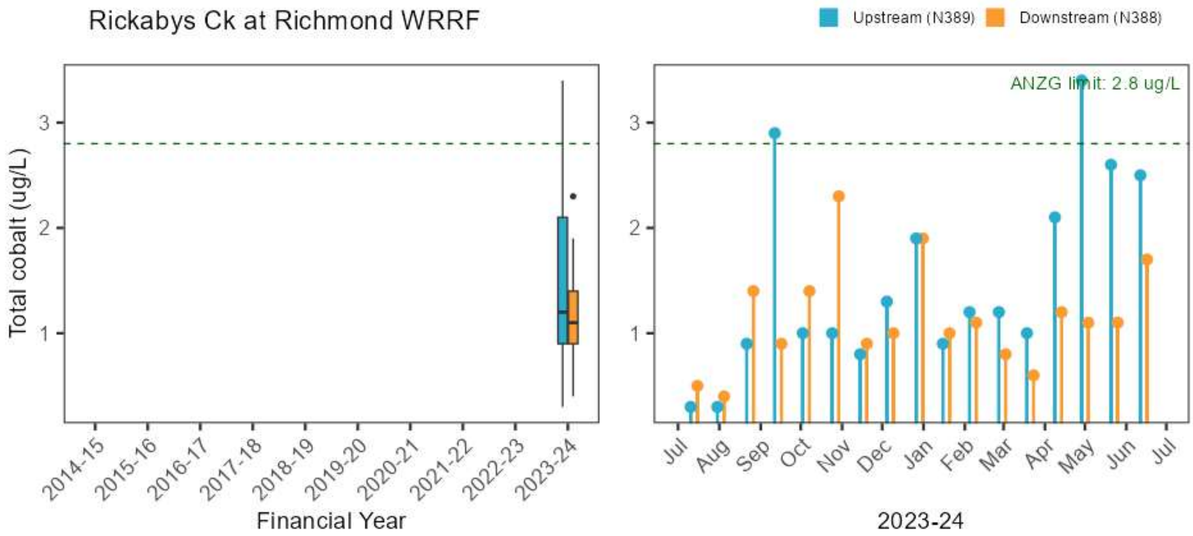

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Turbidity (NTU)
Financial Year
2023-24
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU

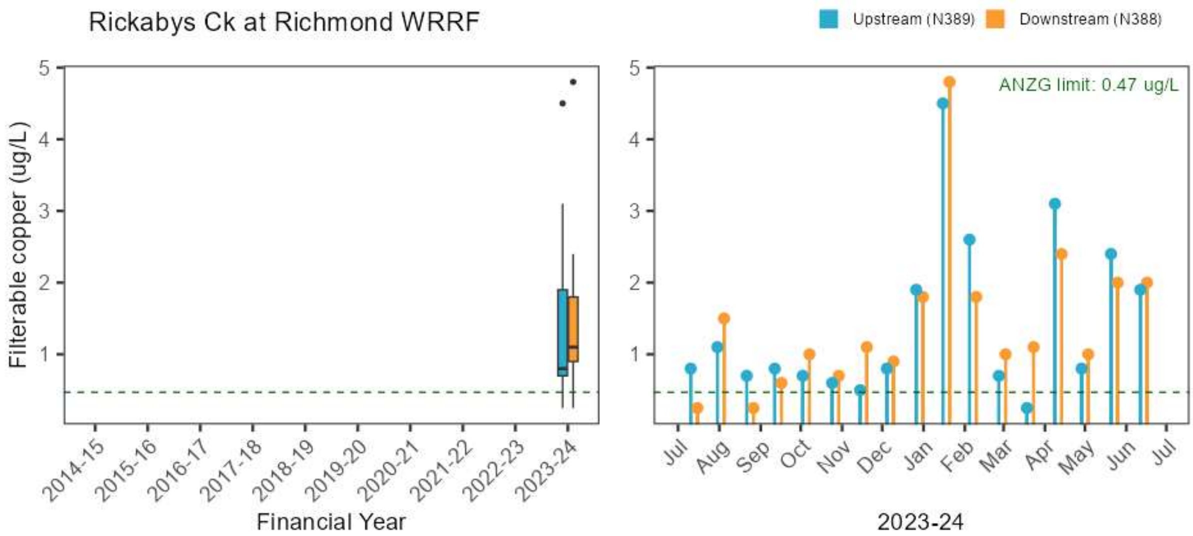
A.7.8. Stressor – Trace metals

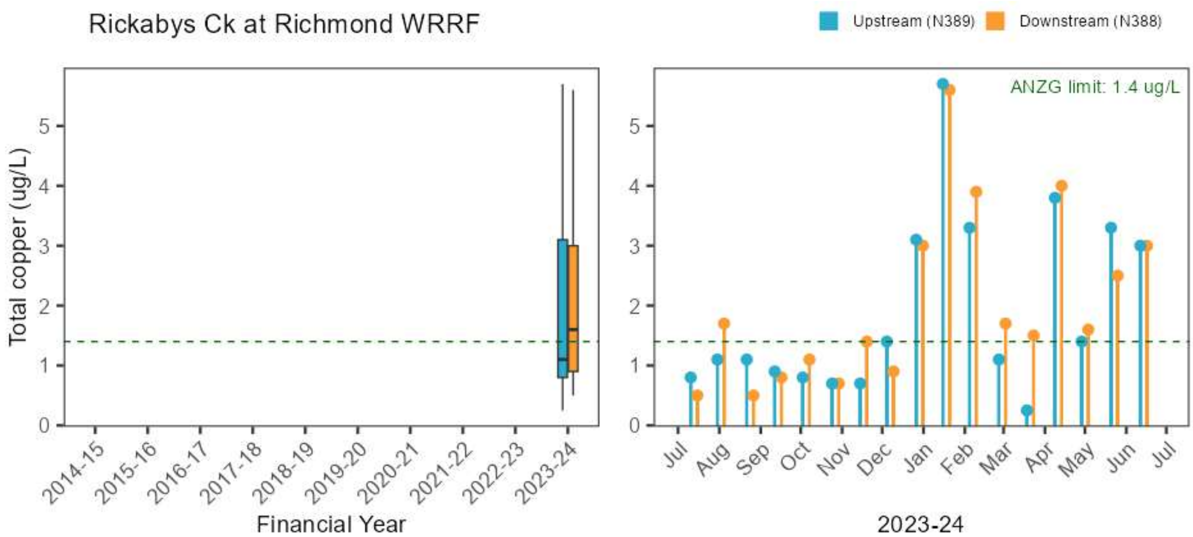


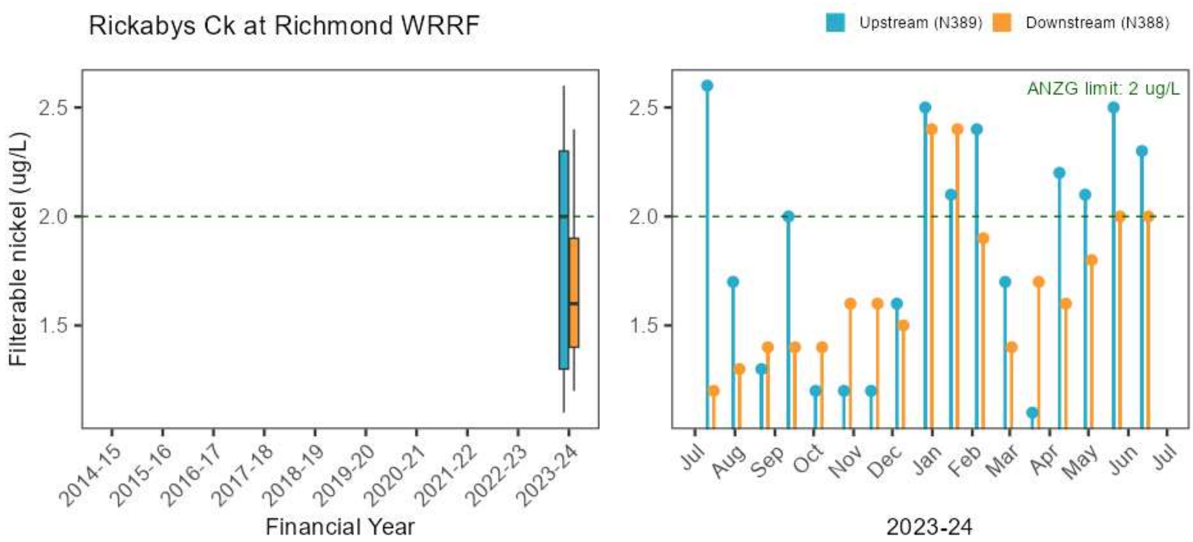


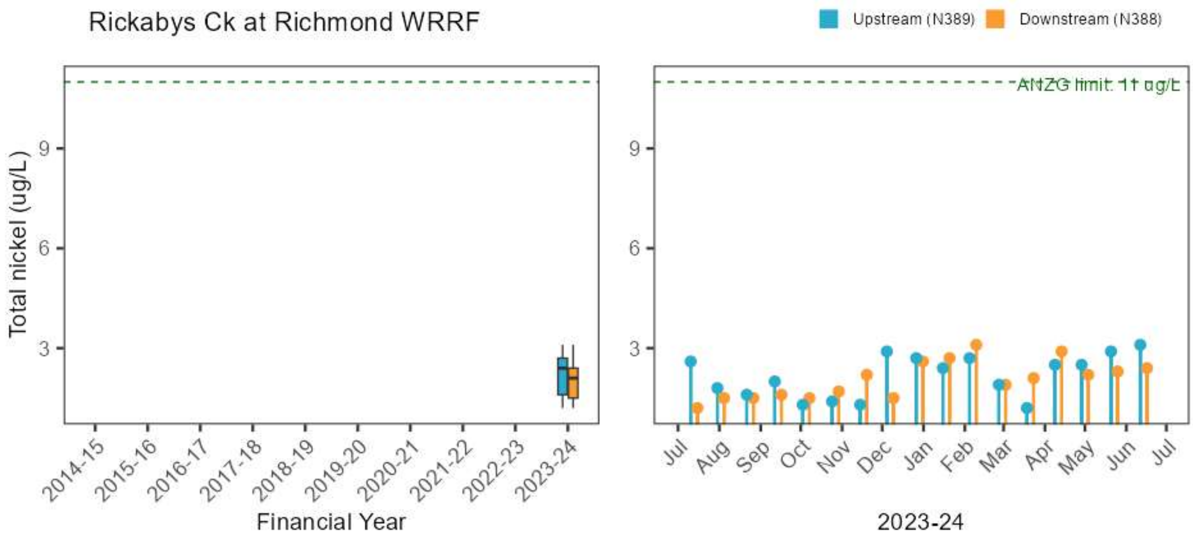


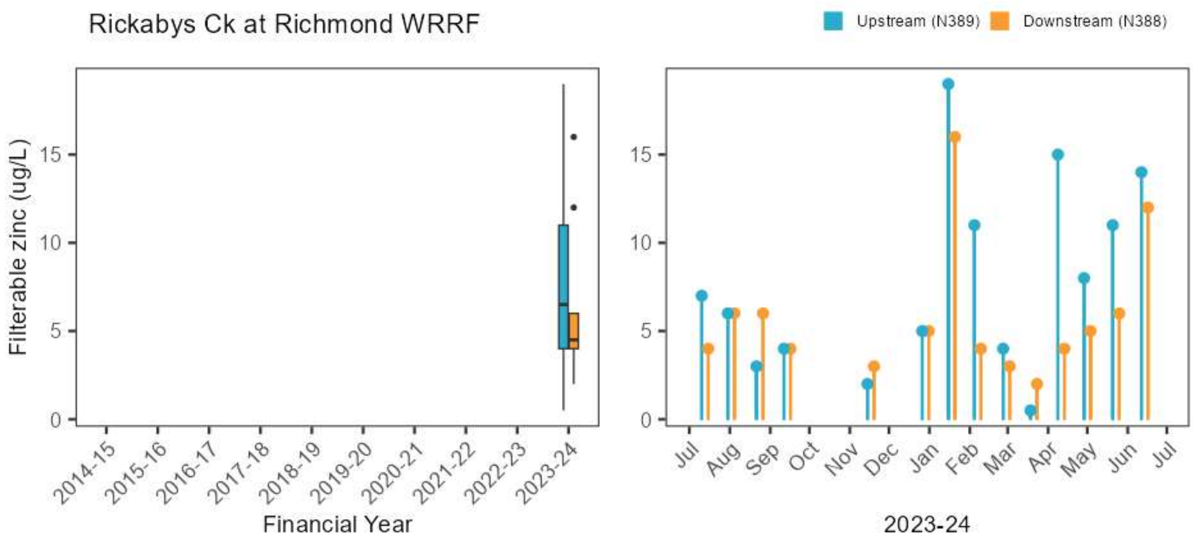

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Total cobalt (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG limit: 2.8 ug/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

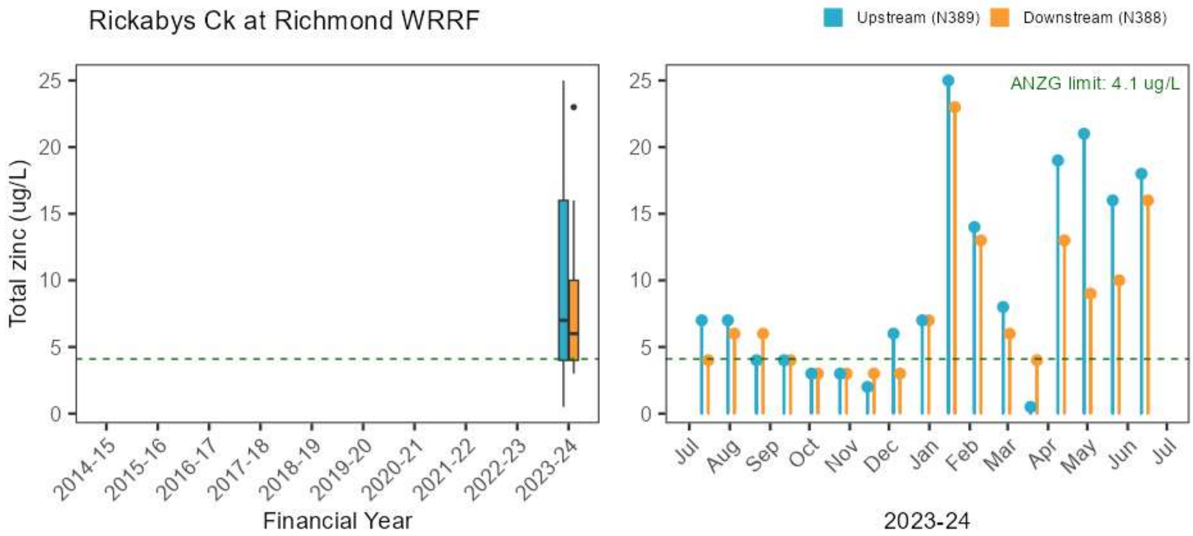

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Filterable copper (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG limit: 0.47 ug/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Total copper (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
ANZG limit: 1.4 ug/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

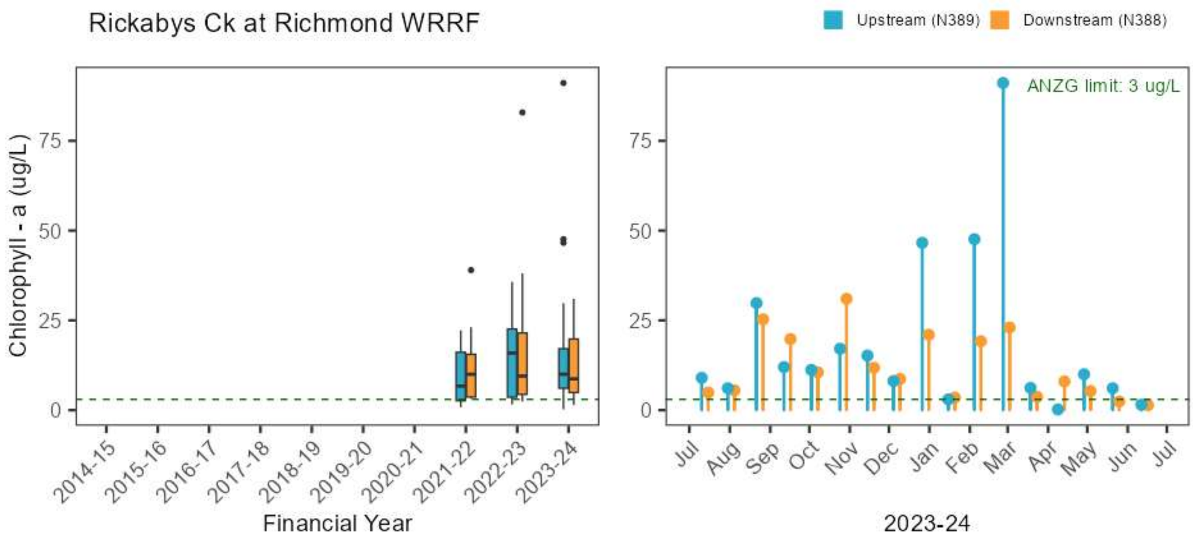

Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
Financial Year
2023-24


Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
ANZG limit: 11 ug/L
Total nickel (ug/L)
Financial Year
2023-24


Rickabys Ck at Richmond WRRF
Upstream (N389)
Downstream (N388)
Filterable zinc (ug/L)
Financial Year
2023-24



A.7.9. Ecosystem receptor – Phytoplankton



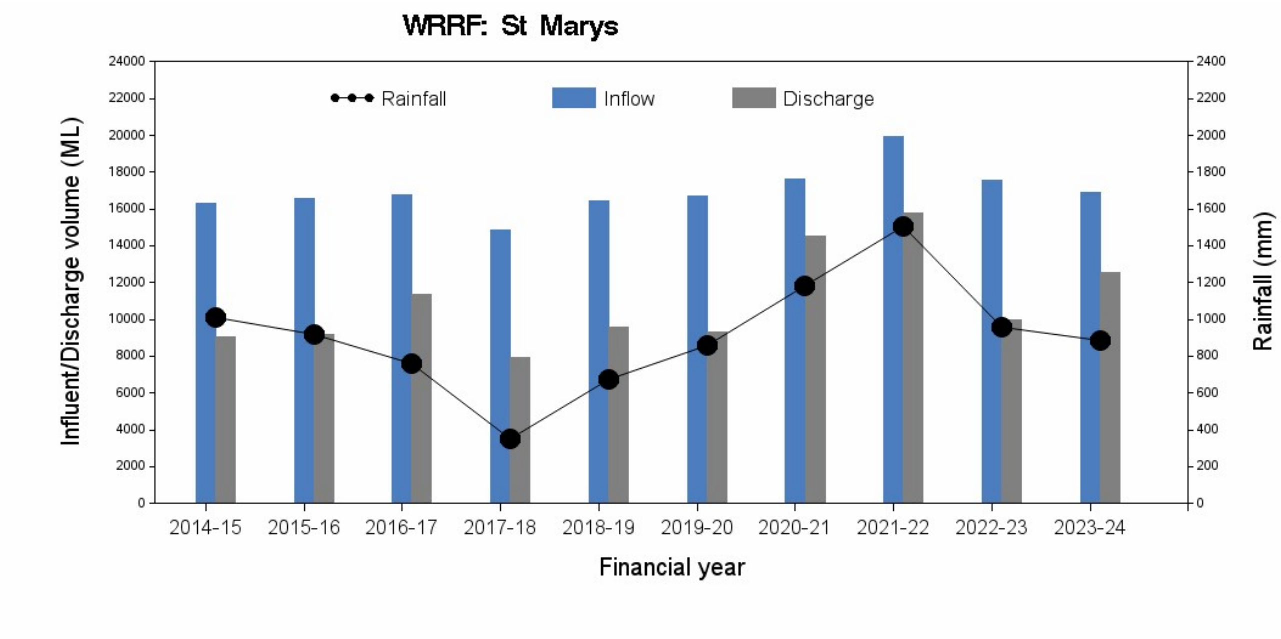
A.7.10. Ecosystem receptor – Macroinvertebrates

Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Rickabys Creek	Tributary (N389 vs N388)	Welch Two Sample t-test	-0.22	-0.98	7.5	0.360

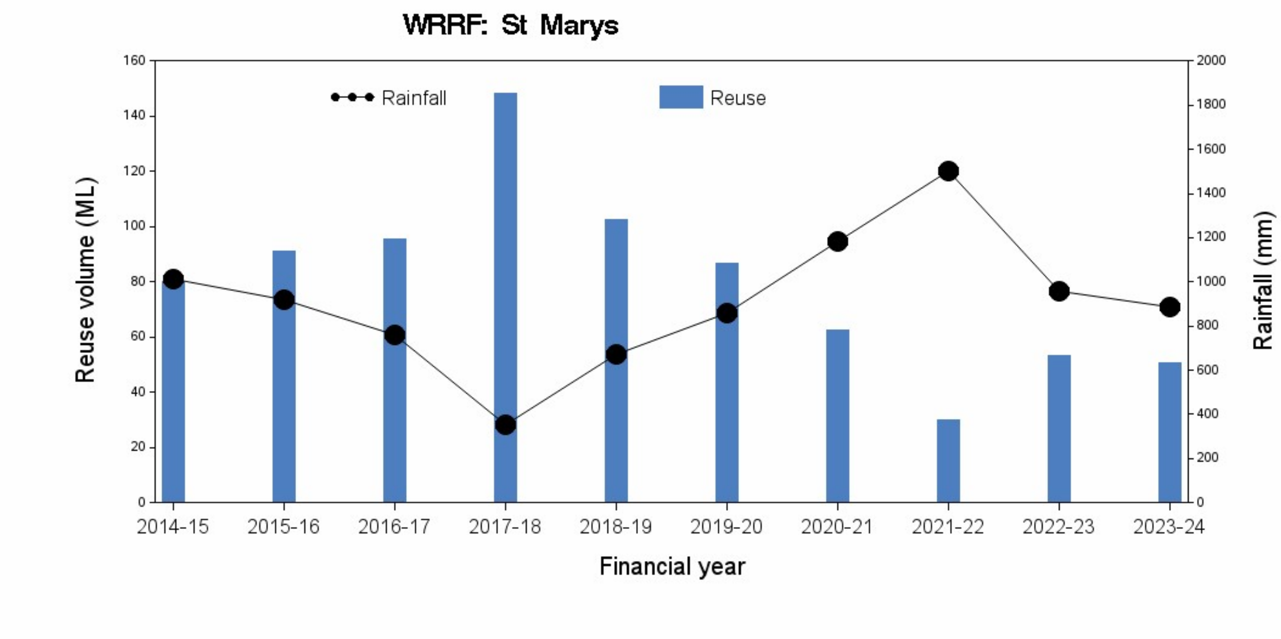
A.8. St Marys WRRF

A.8.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

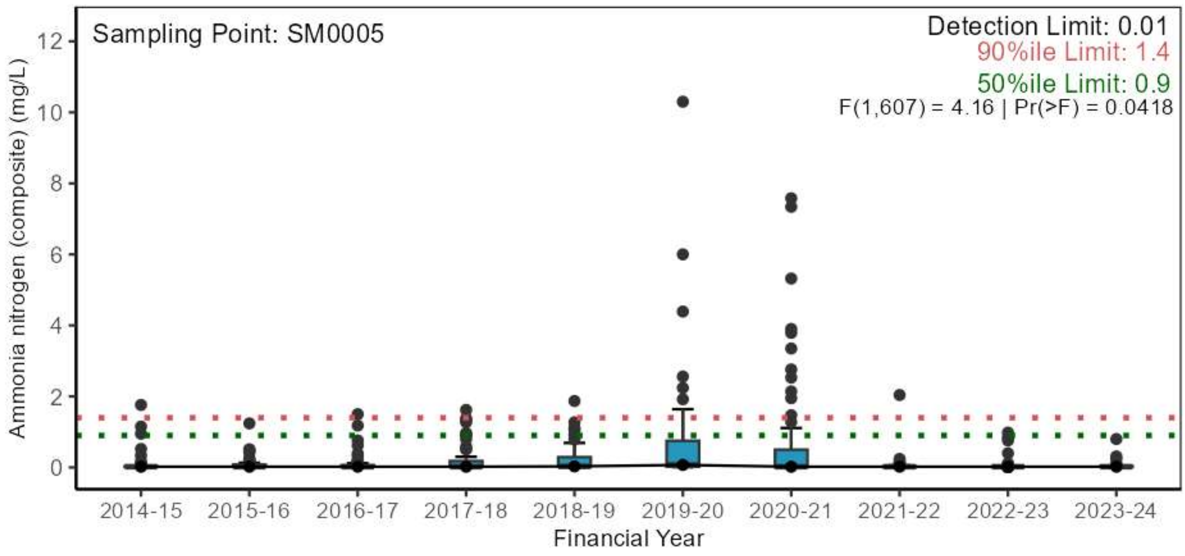


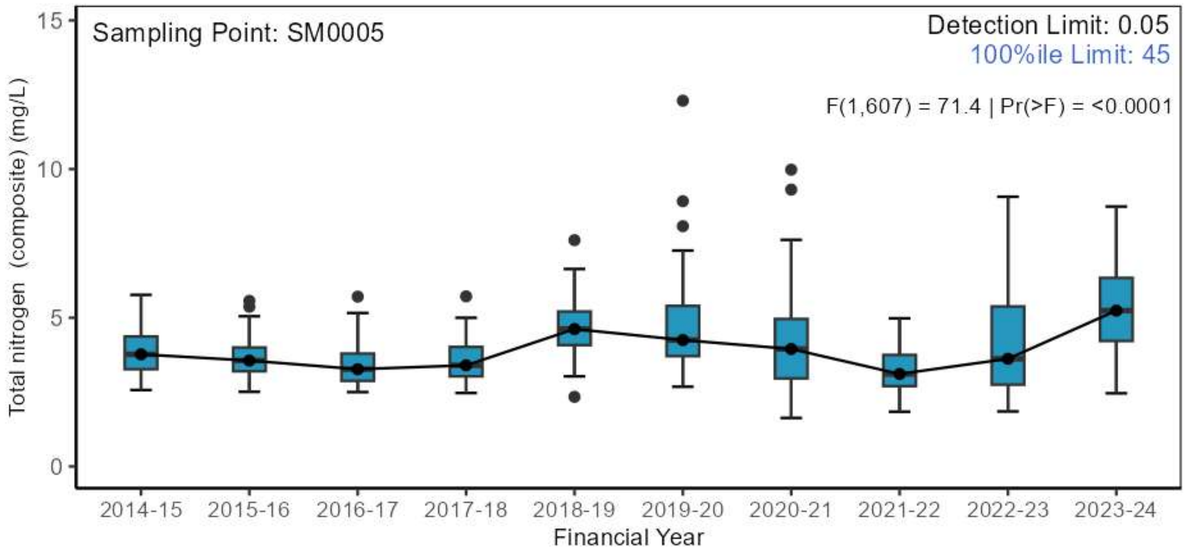
Reuse volume and rainfall

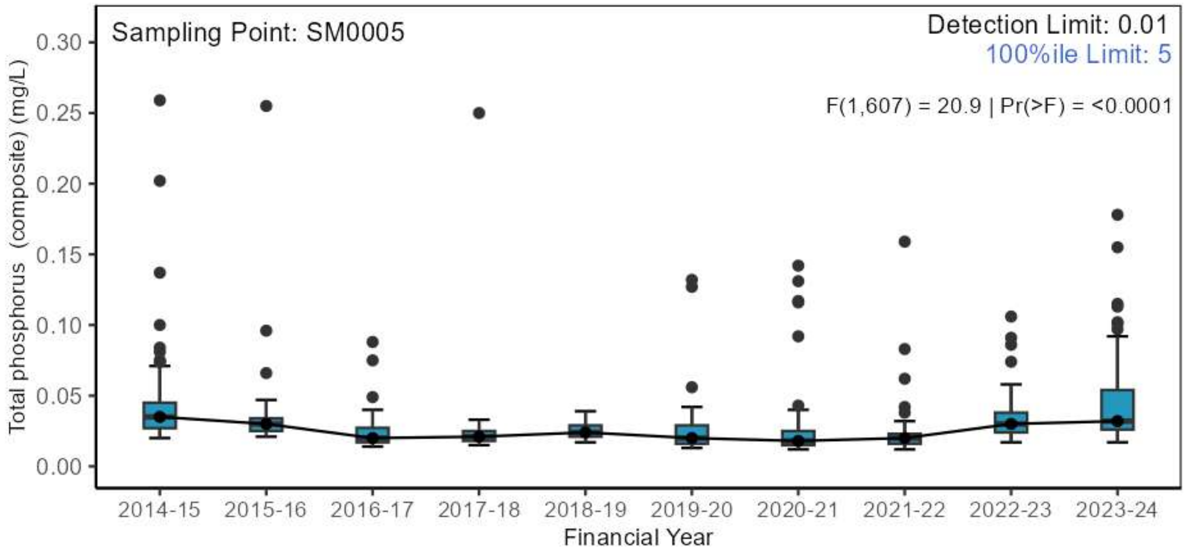


A.8.2. Pressure – Wastewater quality

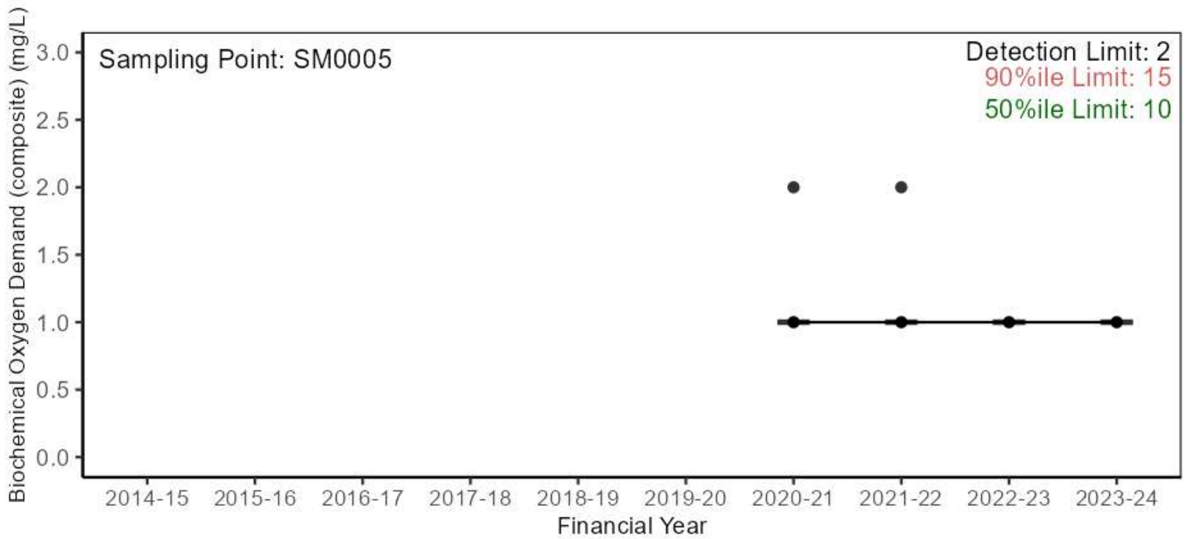
Nutrients



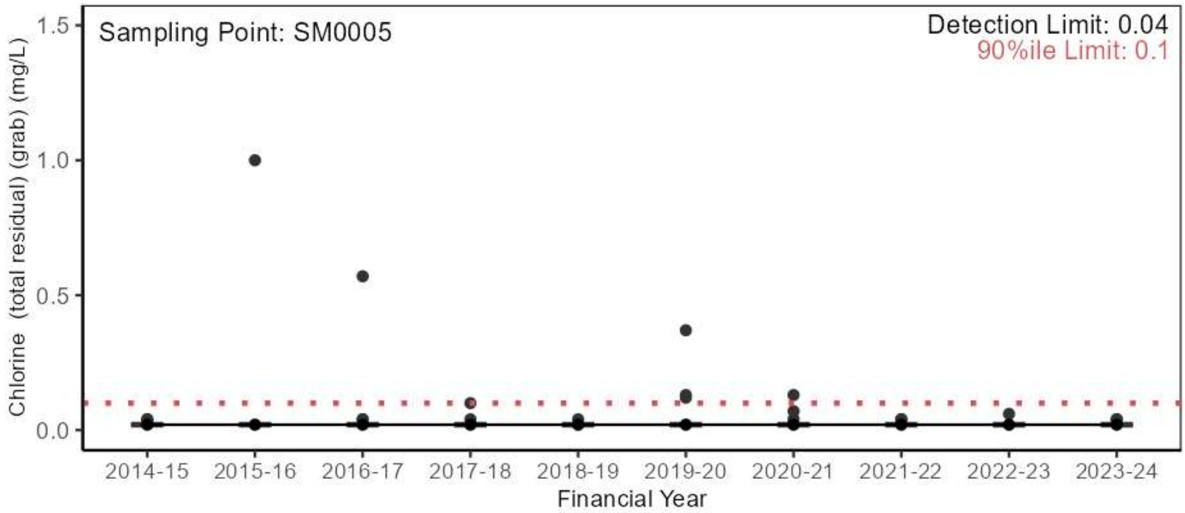




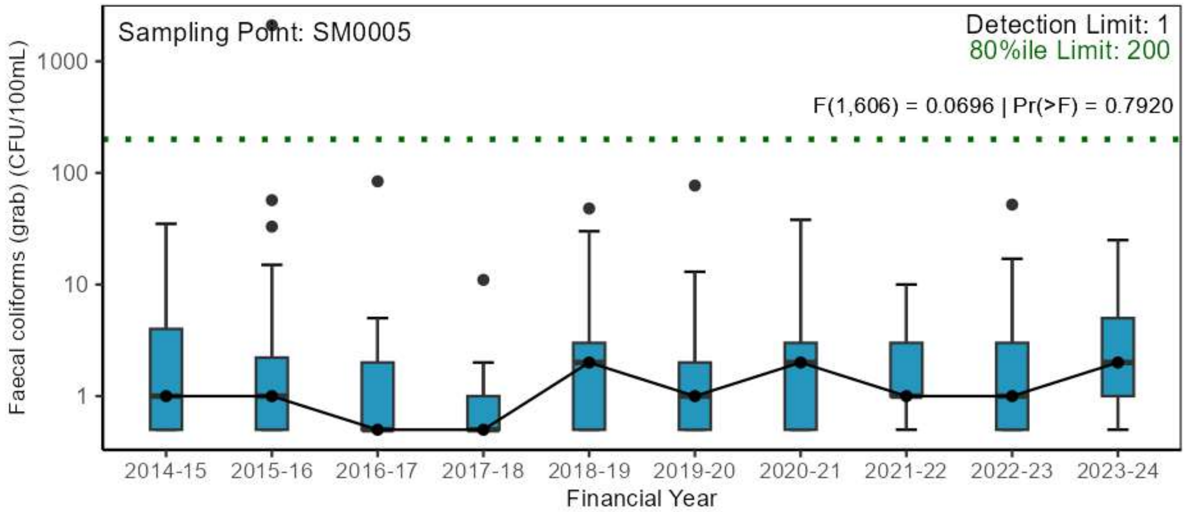
Major conventional analytes



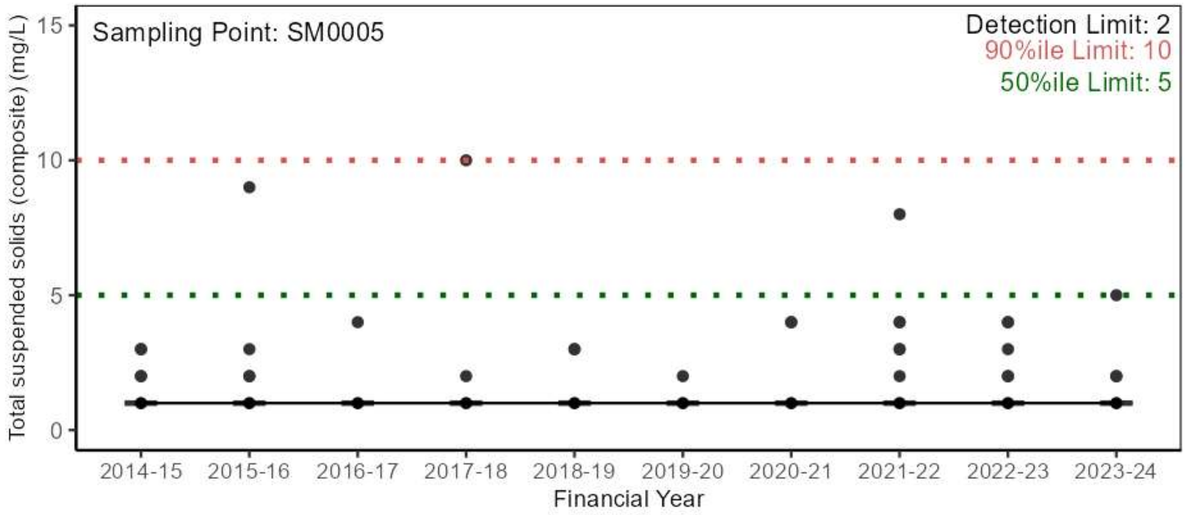
Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

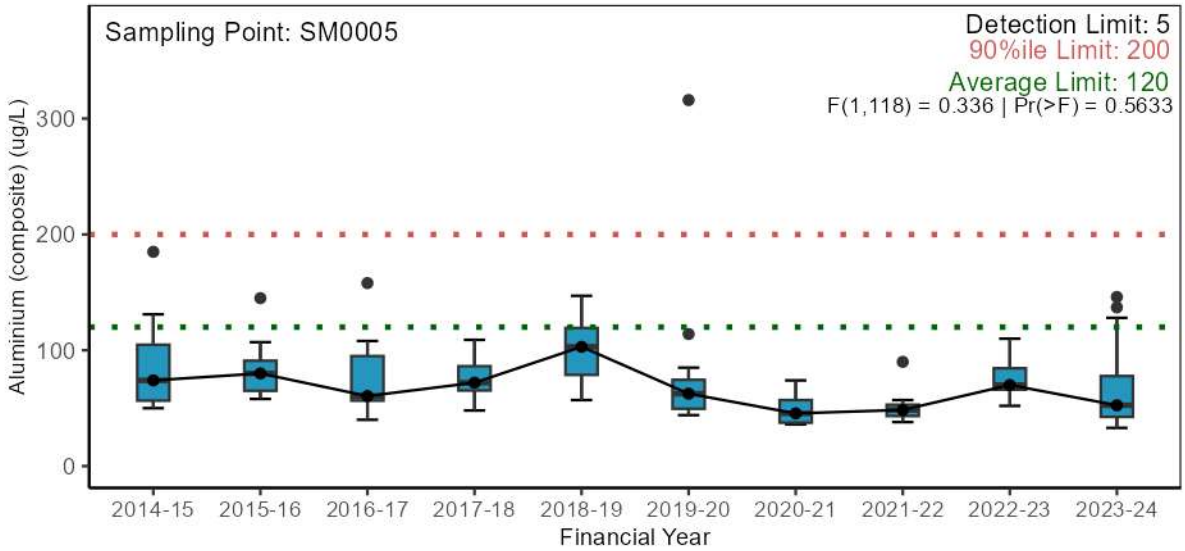


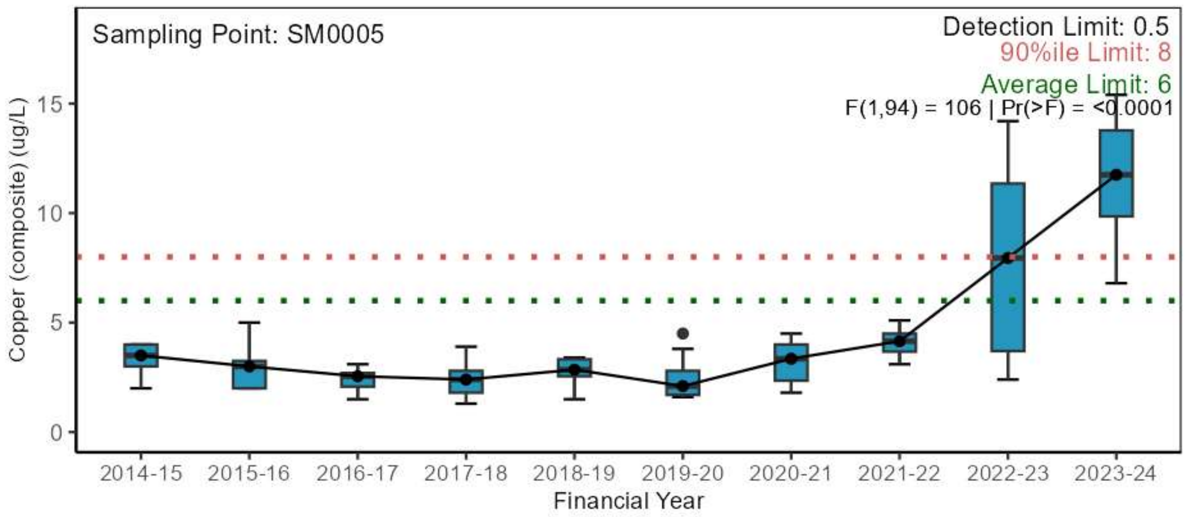
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



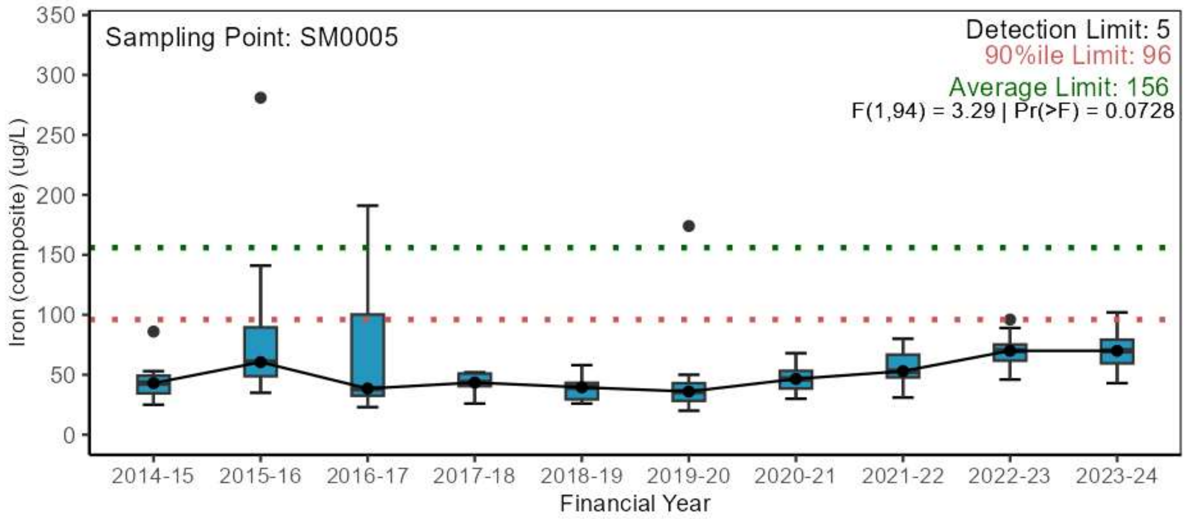
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

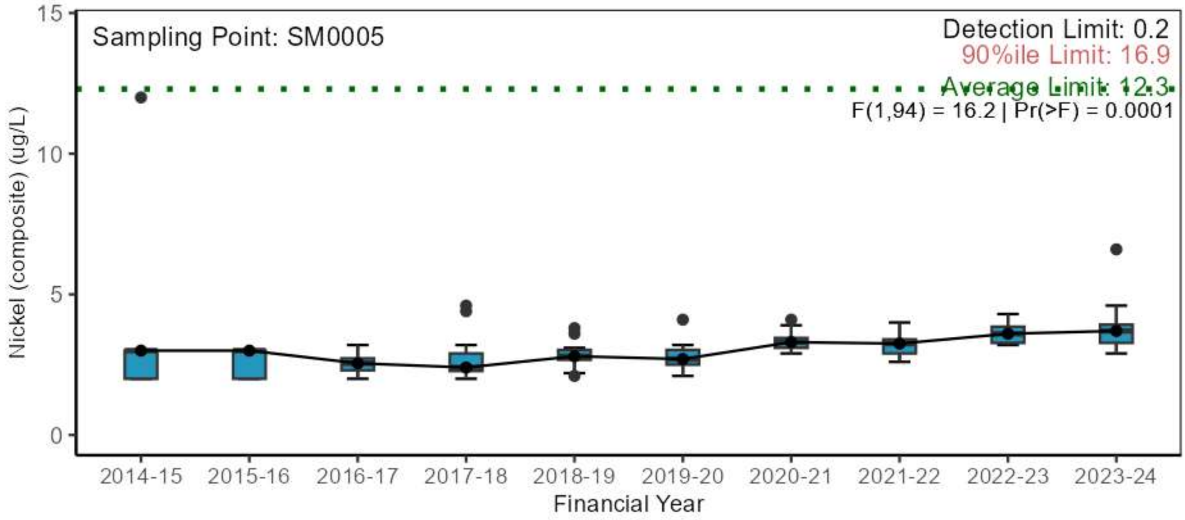




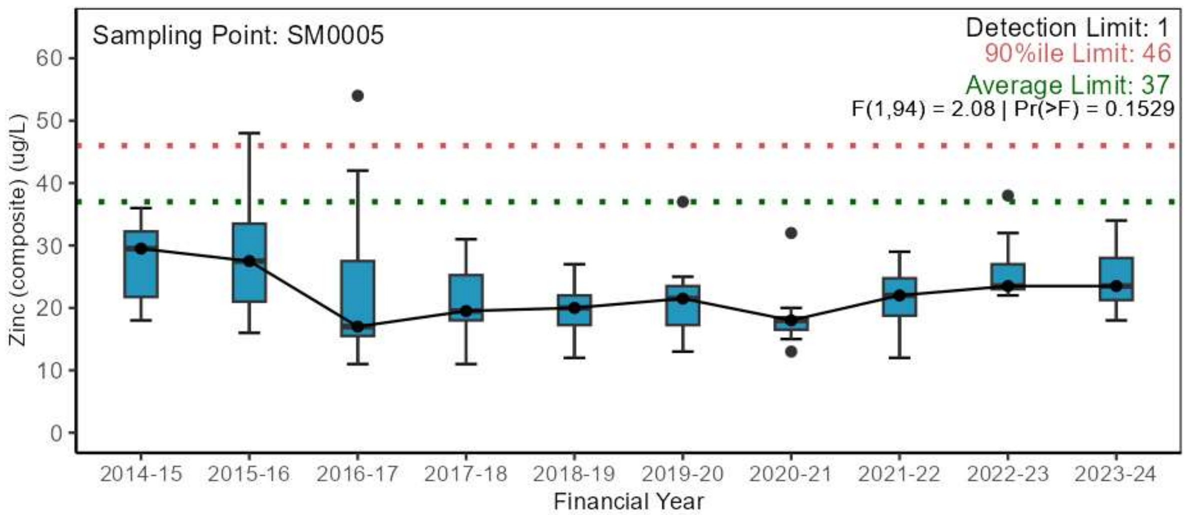
Statistical test excludes data prior to 2016-17 due to method detection limit change.



Statistical test excludes data prior to 2016-17 due to method detection limit change.

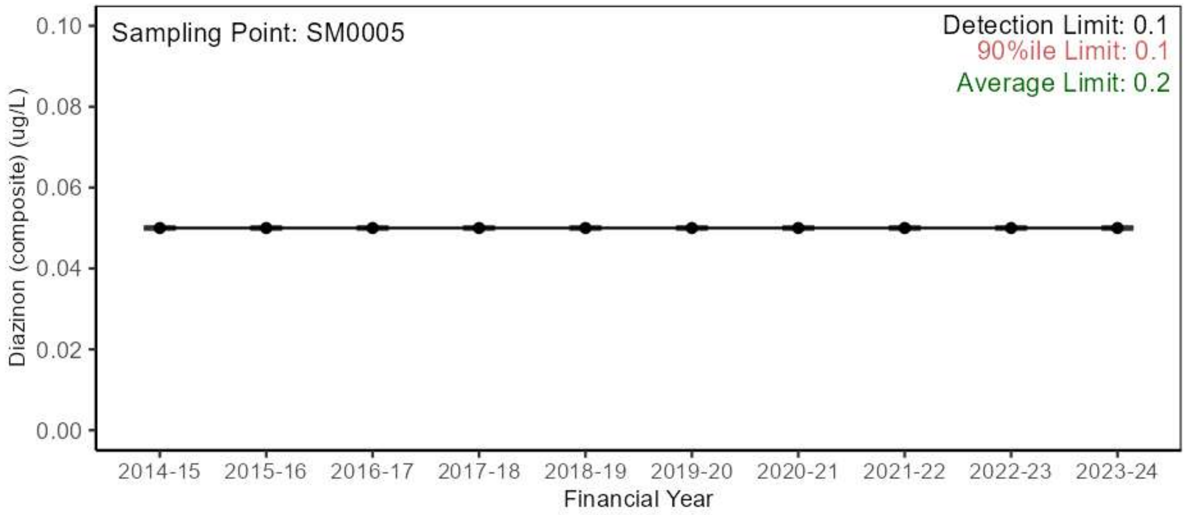


Statistical test excludes data prior to 2016-17 due to method detection limit change.

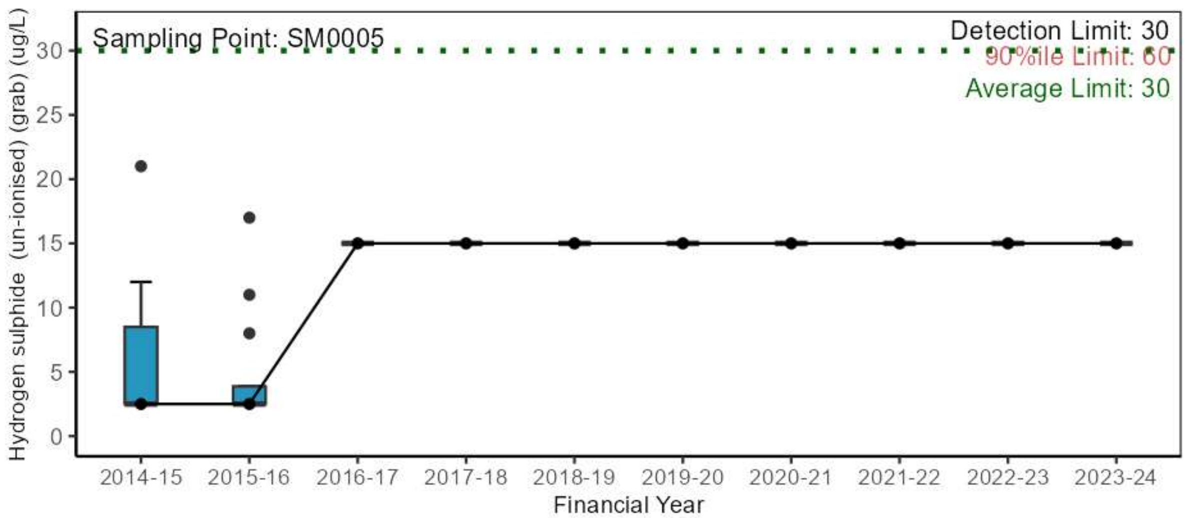


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

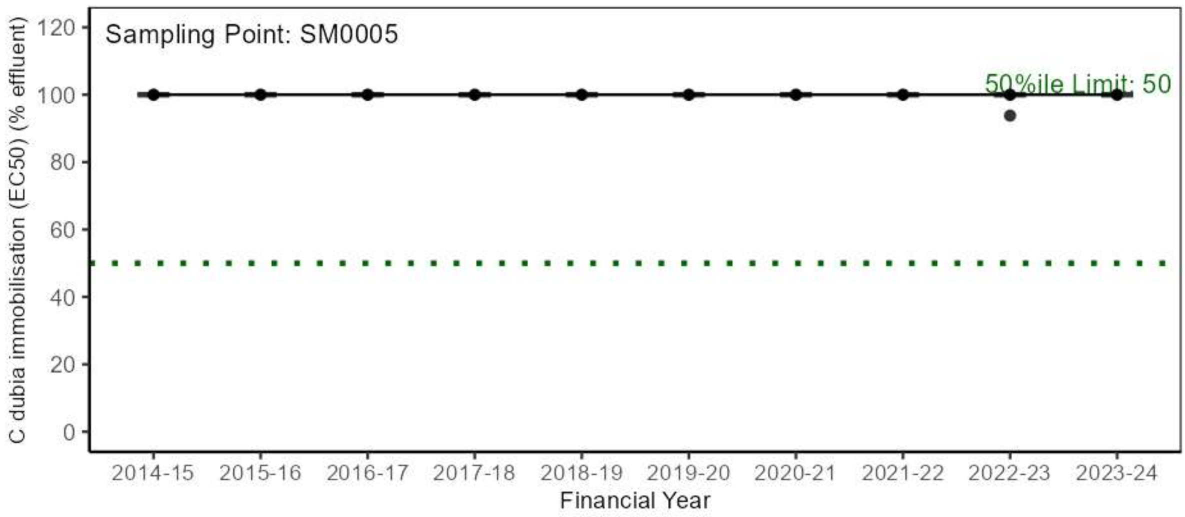


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

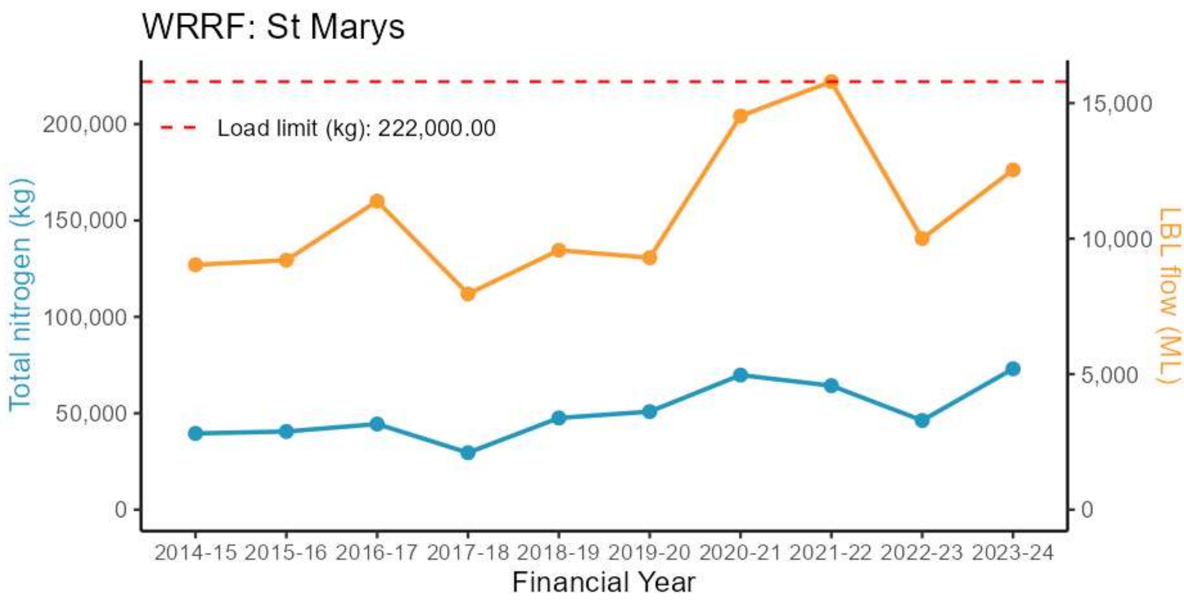
A.8.3. Pressure – Wastewater toxicity

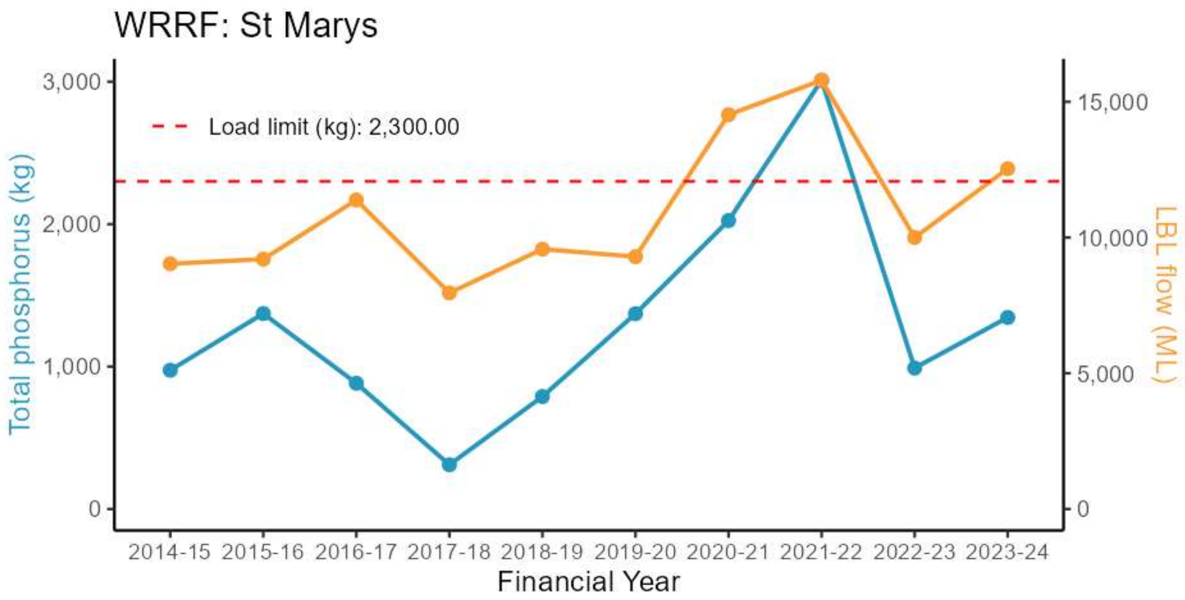


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

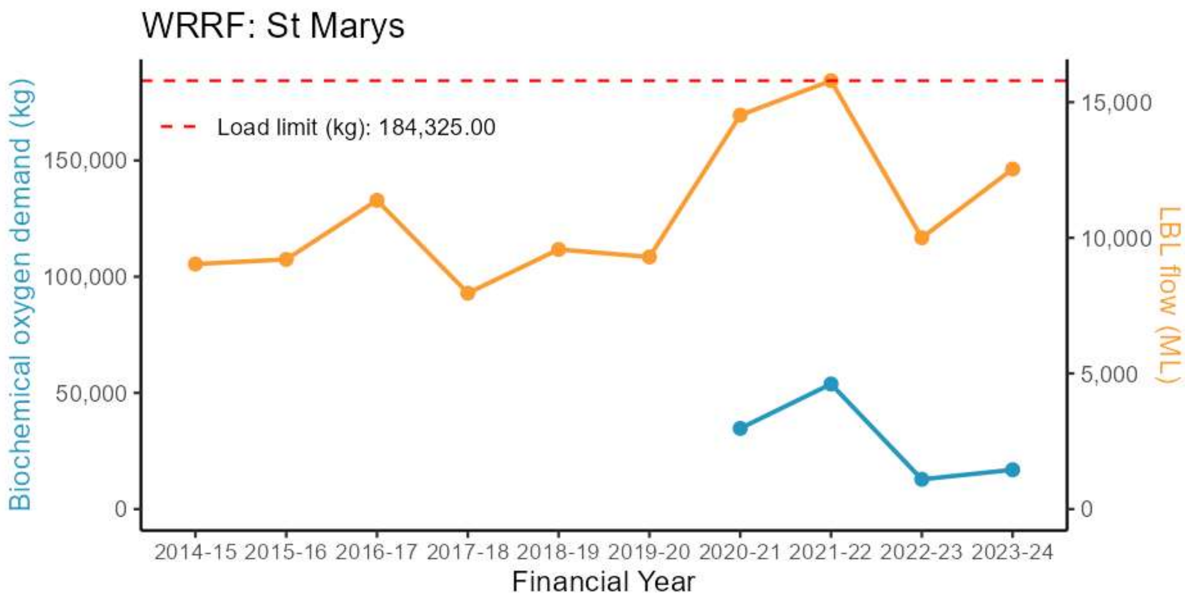
A.8.4. Pressure – Wastewater discharge load

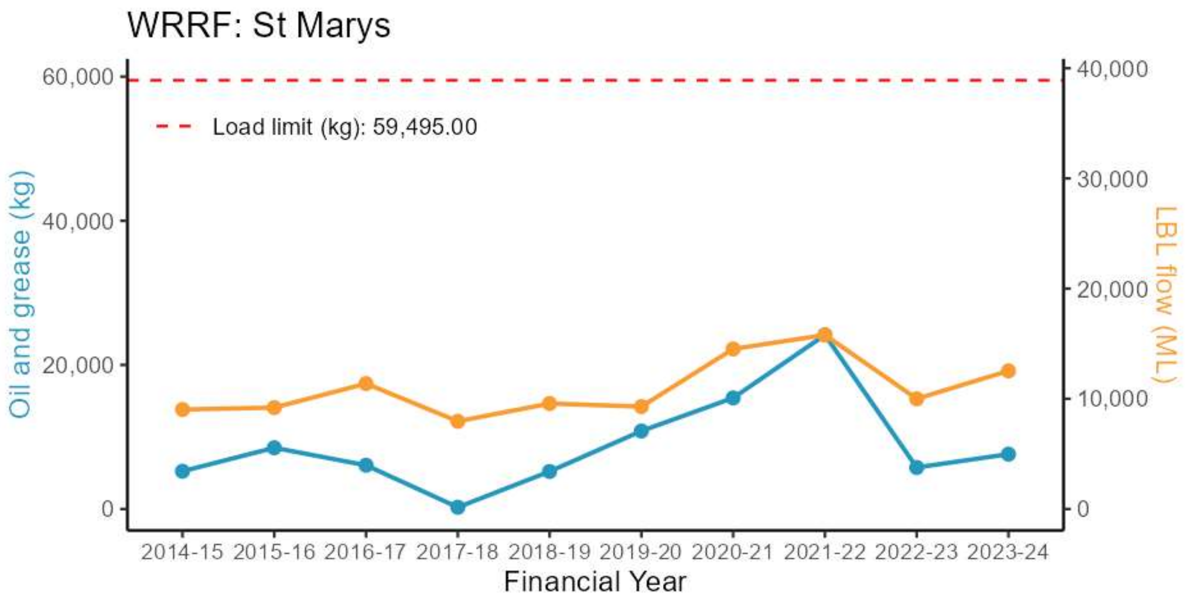
Nutrients

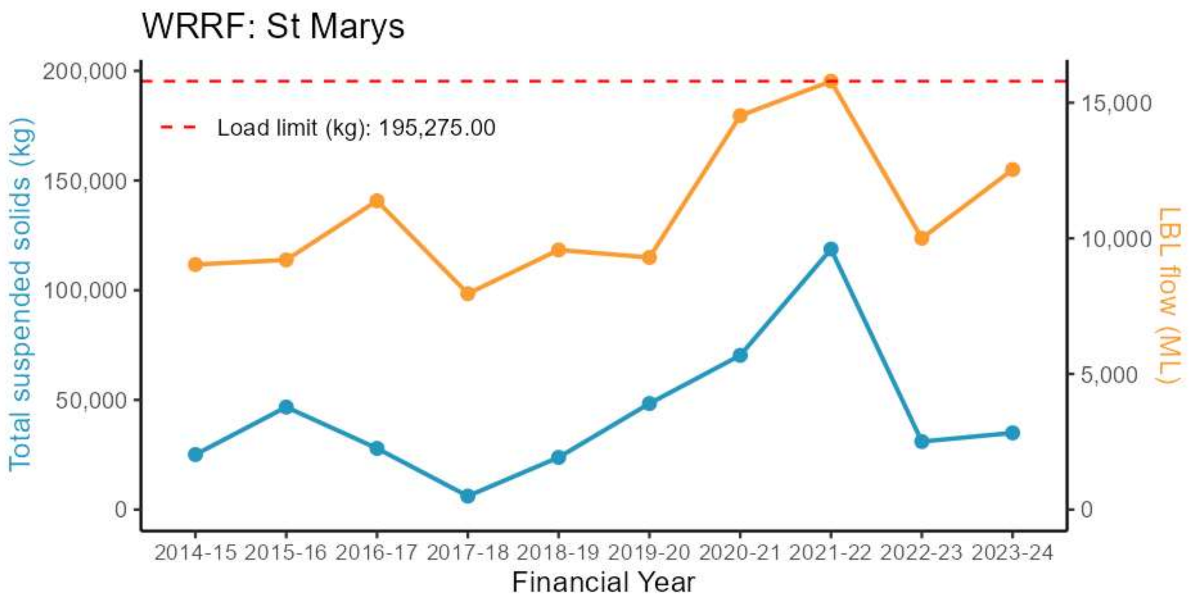




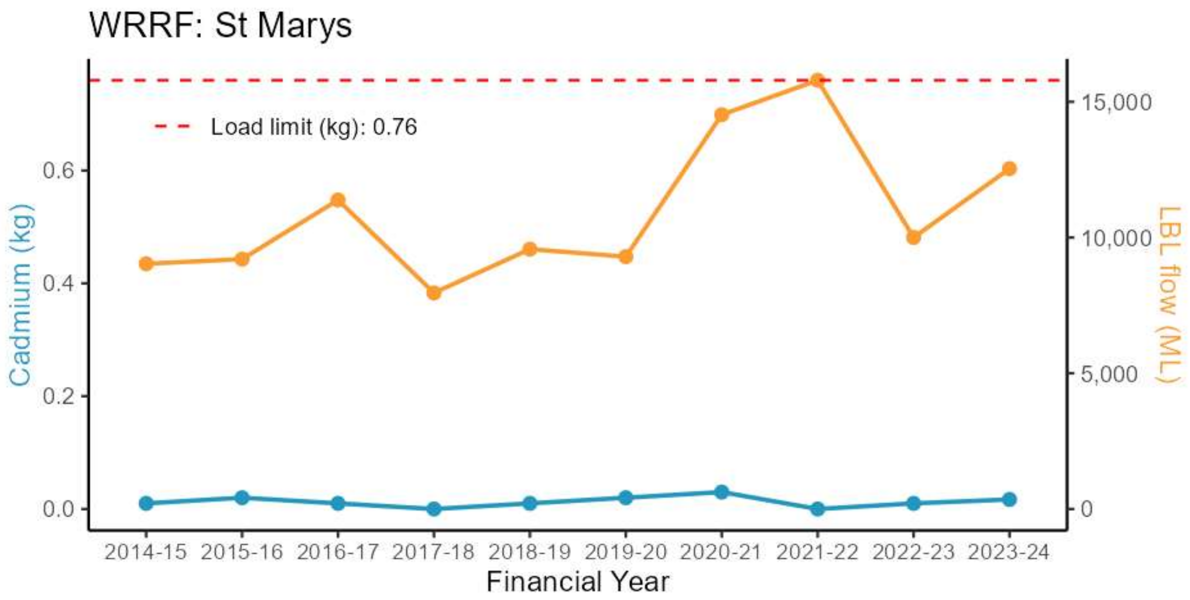
Major conventional analytes



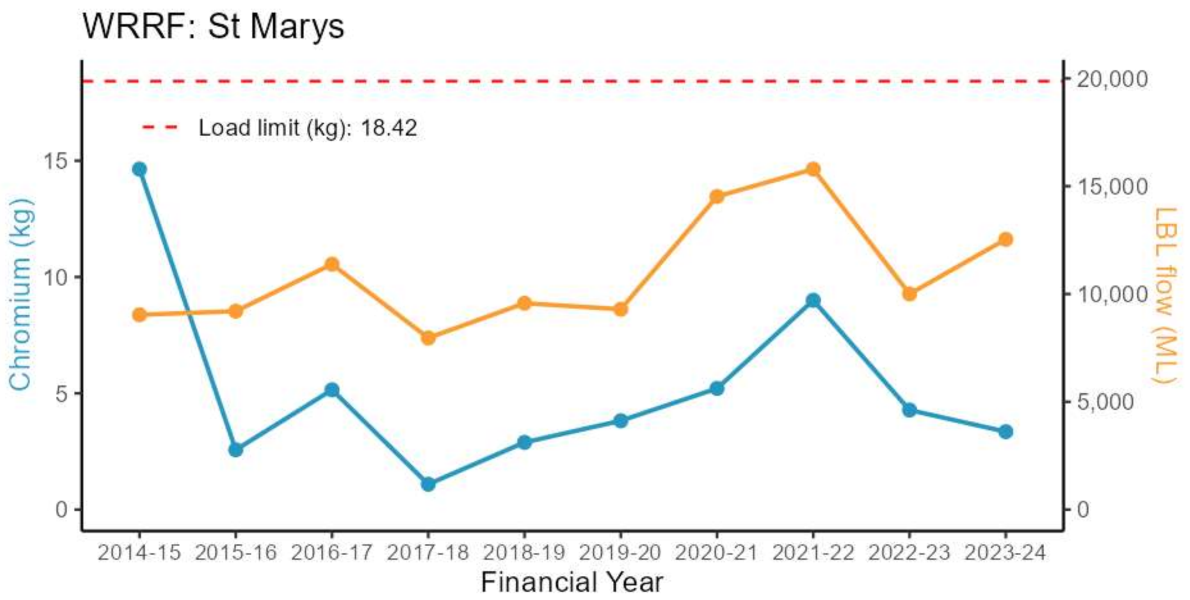




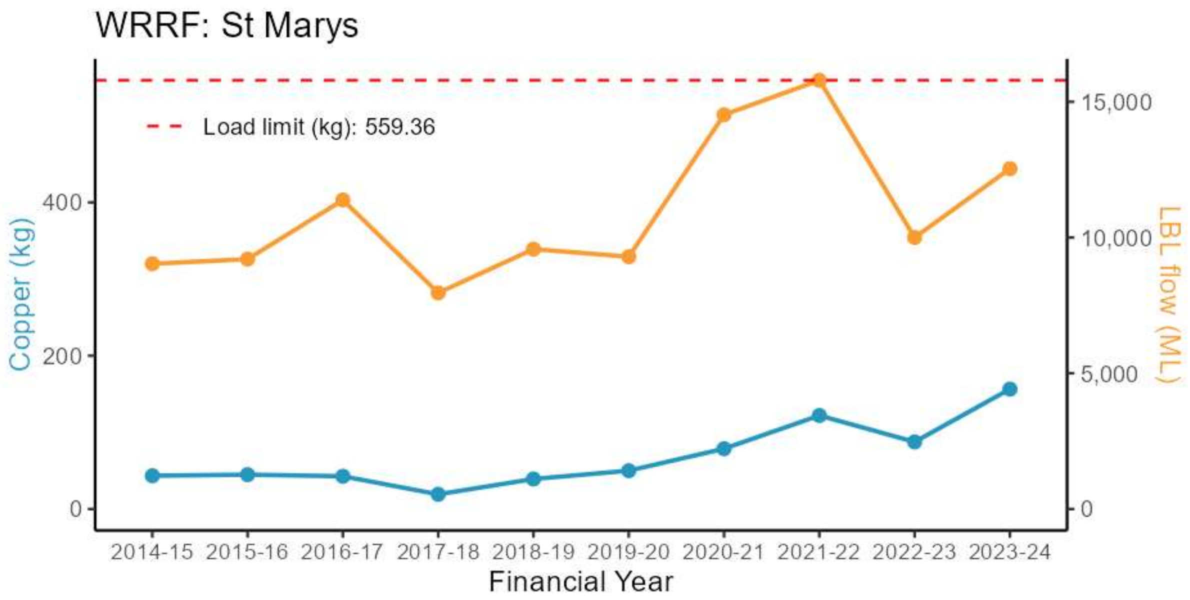
Trace metals

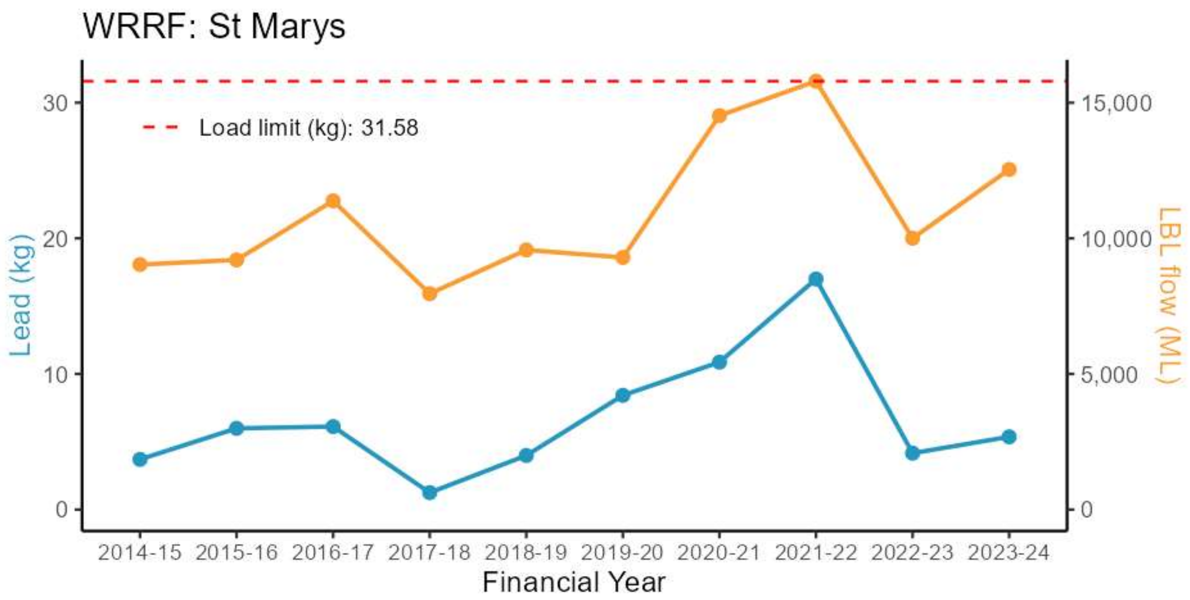


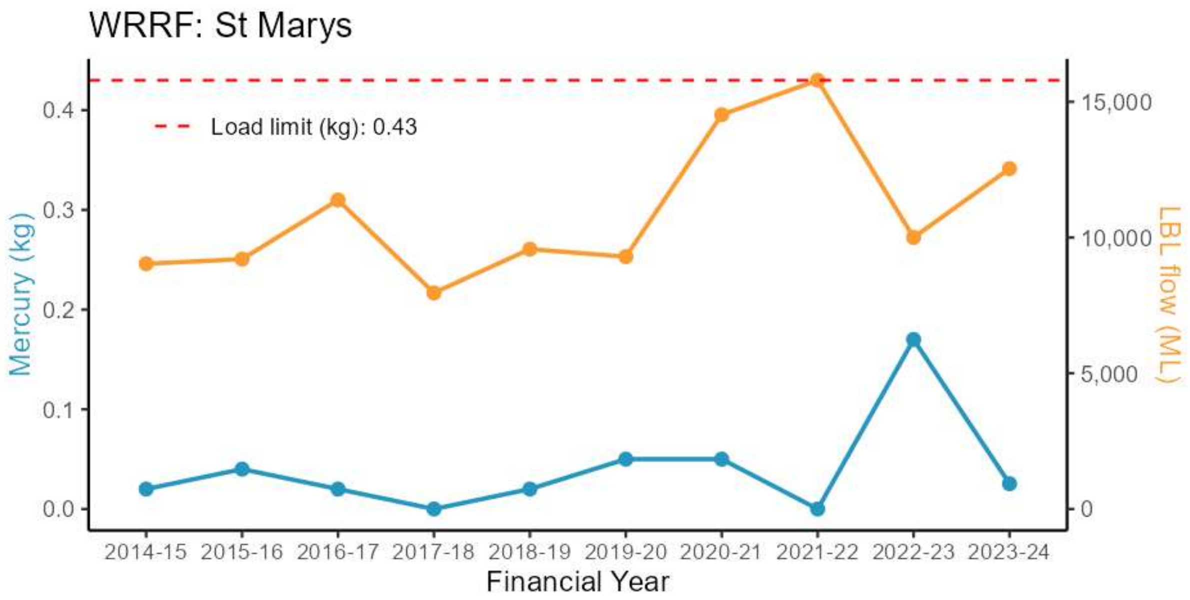
WRRF: St Marys
Load limit (kg): 0.76
Cadmium (kg)
LBL flow (ML)
0.0
0.2
0.4
0.6
0
5,000
10,000
15,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year



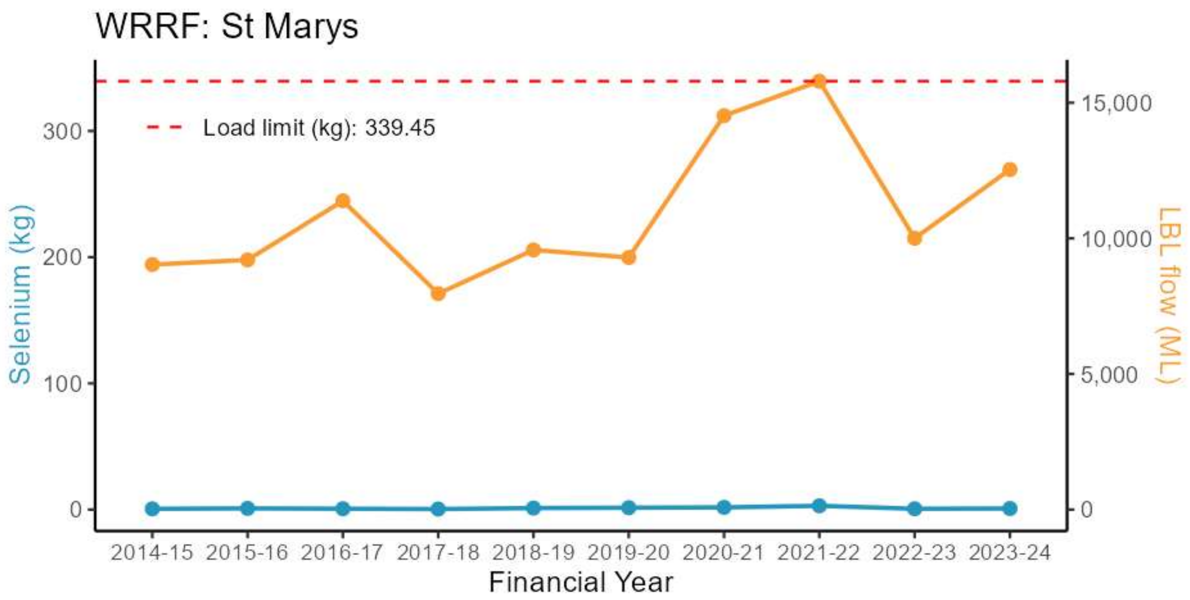
WRRF: St Marys
Load limit (kg): 18.42
Chromium (kg)
LBL flow (ML)
0
5
10
15
0
5,000
10,000
15,000
20,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: St Marys
Load limit (kg): 559.36
Copper (kg)
LBL flow (ML)
400
200
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

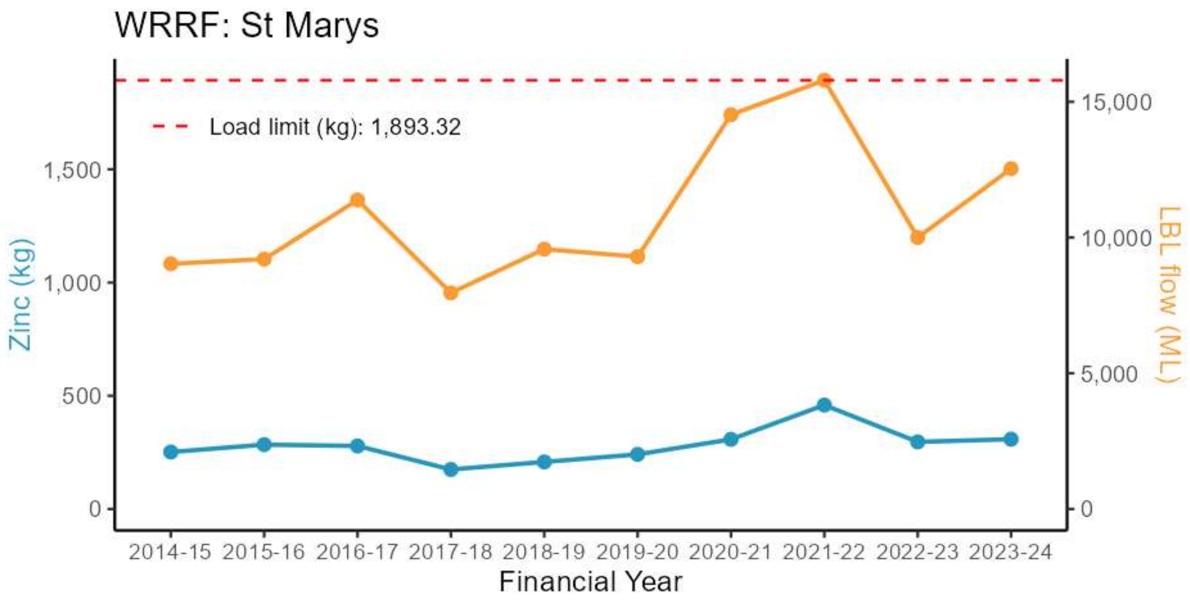

WRRF: St Marys
Load limit (kg): 31.58
Lead (kg)
LBL flow (ML)
30
20
10
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year



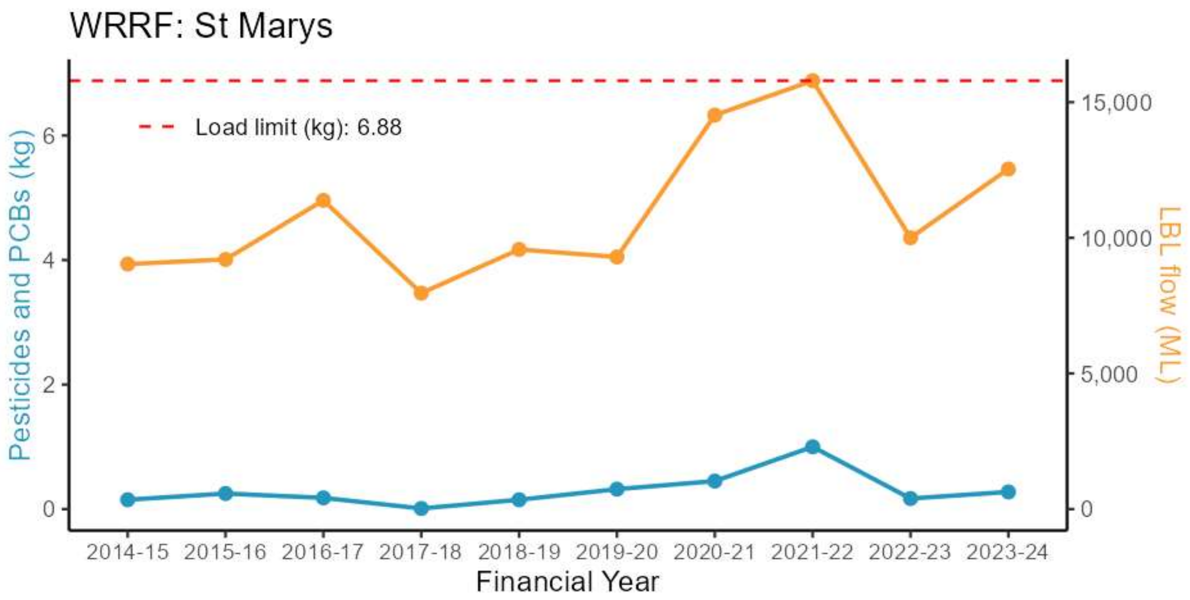
WRRF: St Marys
Load limit (kg): 0.43
Mercury (kg)
LBL flow (ML)
0.0
0.1
0.2
0.3
0.4
0
5,000
10,000
15,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year



WRRF: St Marys
Load limit (kg): 339.45
Selenium (kg)
LBL flow (ML)
0
100
200
300
0
5,000
10,000
15,000
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year



Other chemicals and organics (including pesticides)



A.8.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-15 Downstream vs upstream comparison (current period) contrast outcomes for St Marys WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
South Ck	NS26 vs NS23A	Total ammonia nitrogen	0.99	0.38	122	-0.04	1.000
South Ck	NS26 vs NS23A	Oxidised nitrogen	5.99	2.01	122	5.33	<0.001
South Ck	NS26 vs NS23A	Total nitrogen	2.29	0.36	122	5.27	<0.001
South Ck	NS26 vs NS23A	Filterable total phosphorus	1.15	0.29	122	0.54	0.949
South Ck	NS26 vs NS23A	Total phosphorus	0.88	0.20	122	-0.56	0.944
South Ck	NS26 vs NS23A	Conductivity	1.02	0.12	121	0.18	0.998
South Ck	NS26 vs NS23A	Dissolved oxygen	1.04	0.06	122	0.68	0.906
South Ck	NS26 vs NS23A	Dissolved oxygen saturation	5.06	3.08	122	1.64	0.359
South Ck	NS26 vs NS23A	pH	0.03	0.06	122	0.49	0.961
South Ck	NS26 vs NS23A	Water temperature	1.10	0.11	122	0.96	0.770
South Ck	NS26 vs NS23A	Turbidity	0.71	0.22	122	-1.11	0.683
South Ck	NS26 vs NS23A	Chlorophyll - a	0.42	0.15	122	-2.50	0.065

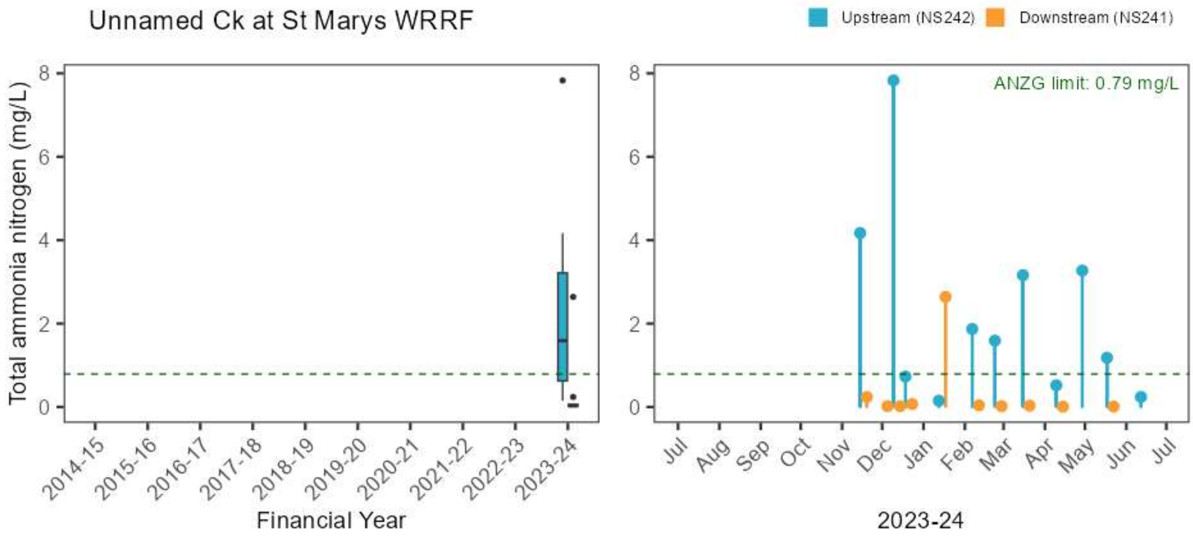
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

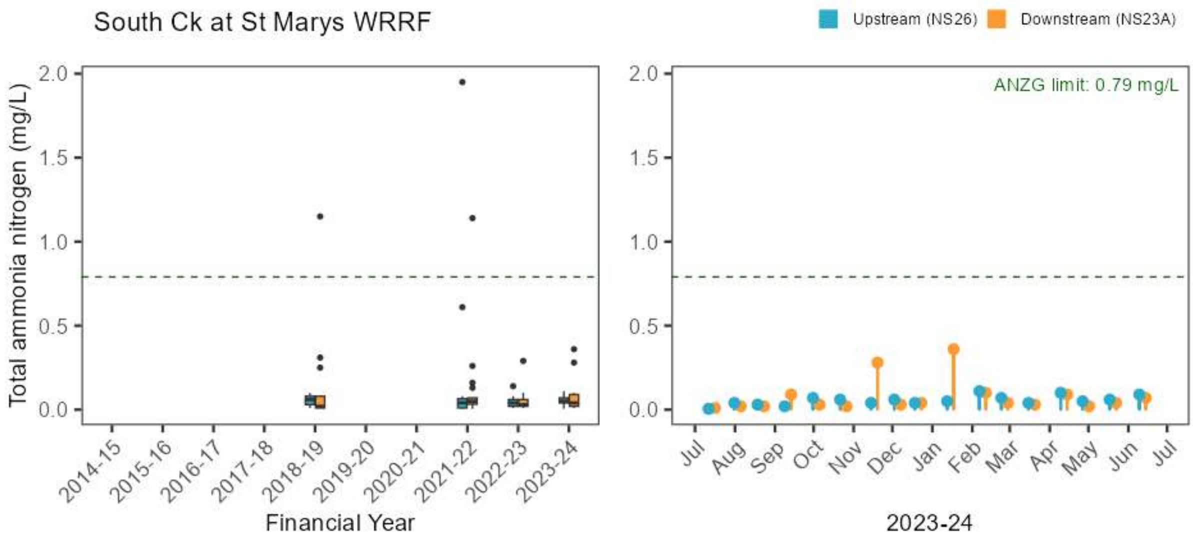
Table A-16 Current period vs previous period comparison (single site) contrast outcomes for St Marys WRRF

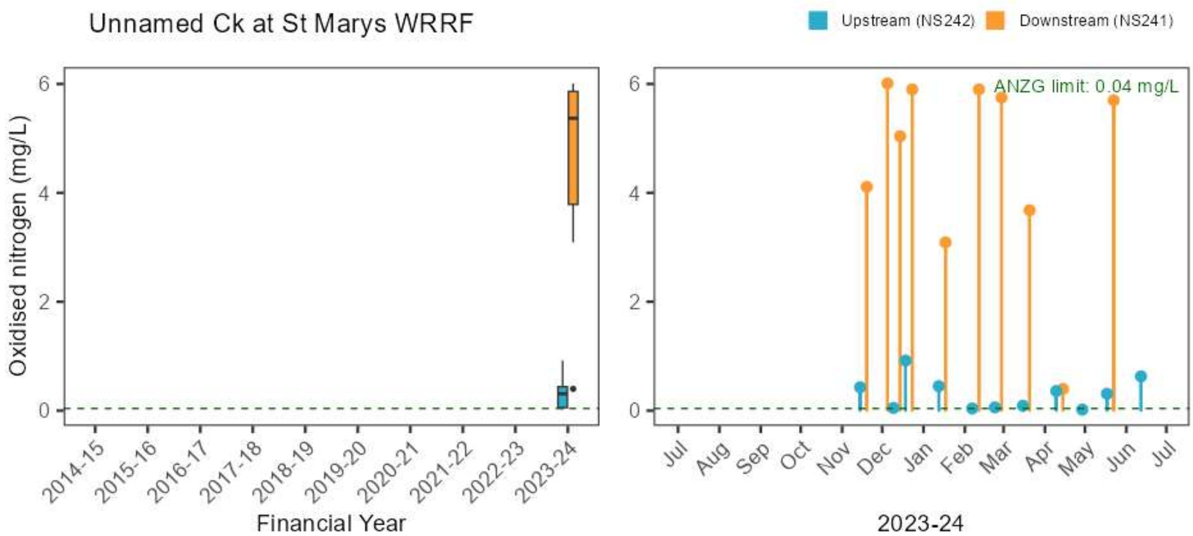
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
South Ck	NS26	Total ammonia nitrogen	1.19	0.37	122	0.55	0.947
South Ck	NS26	Oxidised nitrogen	1.02	0.28	122	0.07	1.000
South Ck	NS26	Total nitrogen	1.00	0.13	122	0.00	1.000
South Ck	NS26	Filterable total phosphorus	1.30	0.27	122	1.26	0.592
South Ck	NS26	Total phosphorus	1.08	0.20	122	0.42	0.975
South Ck	NS26	Conductivity	0.90	0.08	121	-1.12	0.675
South Ck	NS26	Dissolved oxygen	1.11	0.05	122	2.06	0.173
South Ck	NS26	Dissolved oxygen saturation	7.35	2.54	122	2.89	0.023
South Ck	NS26	pH	0.04	0.05	122	0.78	0.862
South Ck	NS26	Water temperature	1.02	0.08	122	0.29	0.991
South Ck	NS26	Turbidity	1.17	0.30	122	0.61	0.928
South Ck	NS26	Chlorophyll - a	1.14	0.32	122	0.48	0.964
South Ck	NS23A	Total ammonia nitrogen	1.09	0.34	122	0.27	0.993
South Ck	NS23A	Oxidised nitrogen	1.38	0.38	122	1.16	0.651
South Ck	NS23A	Total nitrogen	1.17	0.15	122	1.22	0.616
South Ck	NS23A	Filterable total phosphorus	1.34	0.28	122	1.42	0.491
South Ck	NS23A	Total phosphorus	1.21	0.23	122	1.01	0.744
South Ck	NS23A	Conductivity	0.94	0.09	121	-0.65	0.916
South Ck	NS23A	Dissolved oxygen	1.01	0.05	122	0.22	0.996
South Ck	NS23A	Dissolved oxygen saturation	1.07	2.54	122	0.42	0.975
South Ck	NS23A	pH	-0.01	0.05	122	-0.21	0.997
South Ck	NS23A	Water temperature	1.03	0.08	122	0.35	0.986
South Ck	NS23A	Turbidity	1.24	0.32	122	0.86	0.824
South Ck	NS23A	Chlorophyll - a	0.98	0.28	122	-0.08	1.000

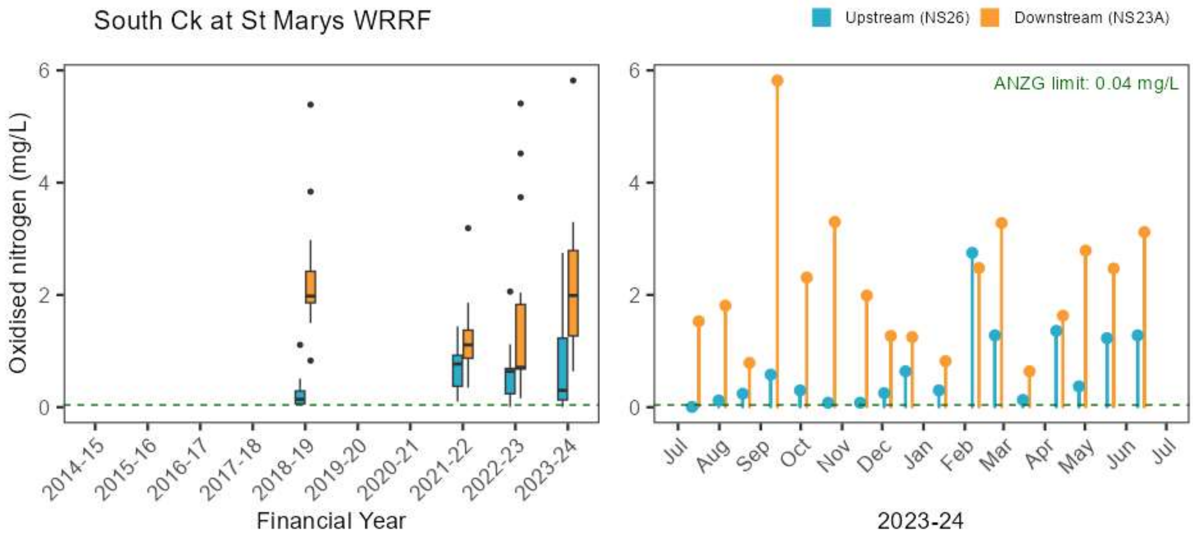
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.8.6. Stressor – Nutrients








South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
0
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Oct
Nov
Dec
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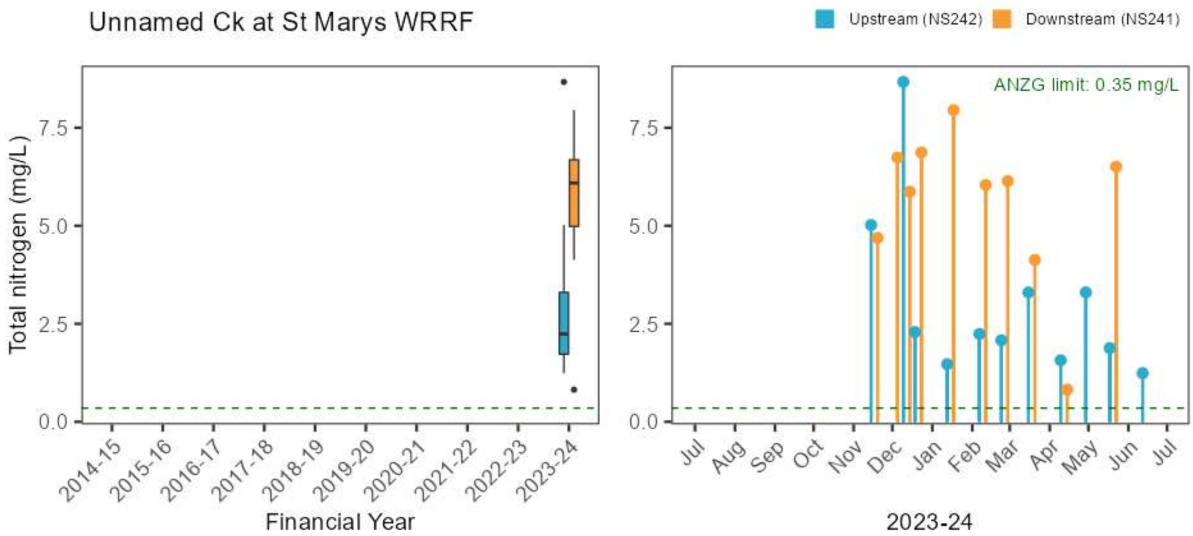
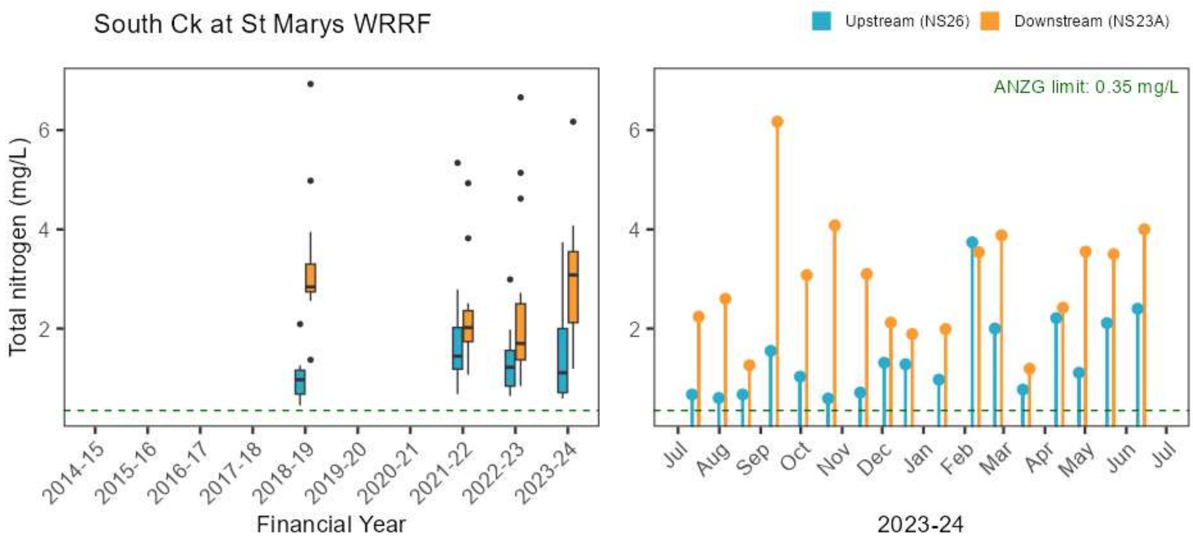
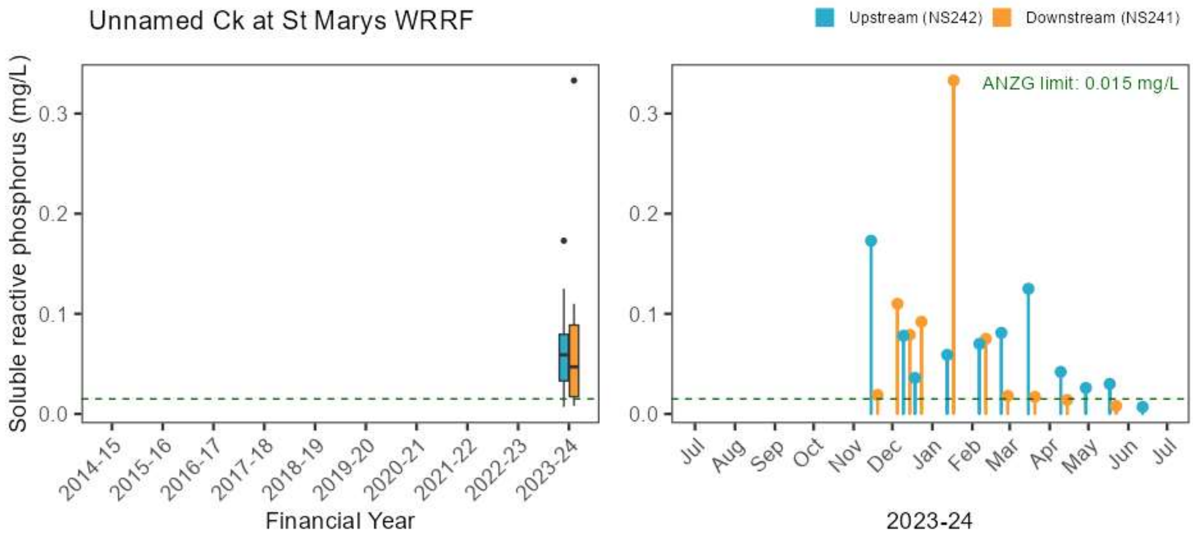
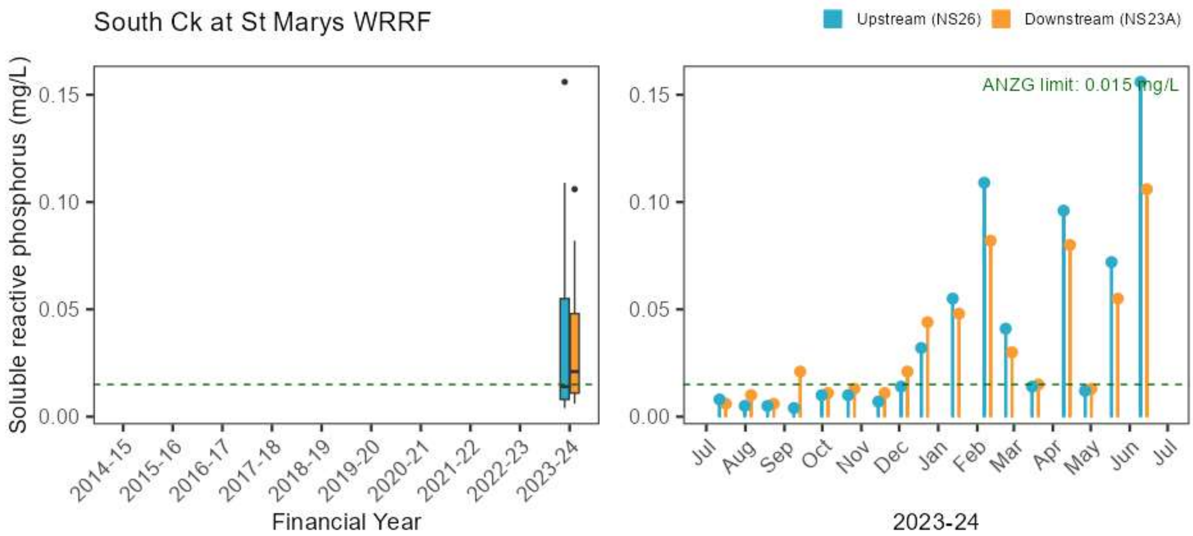
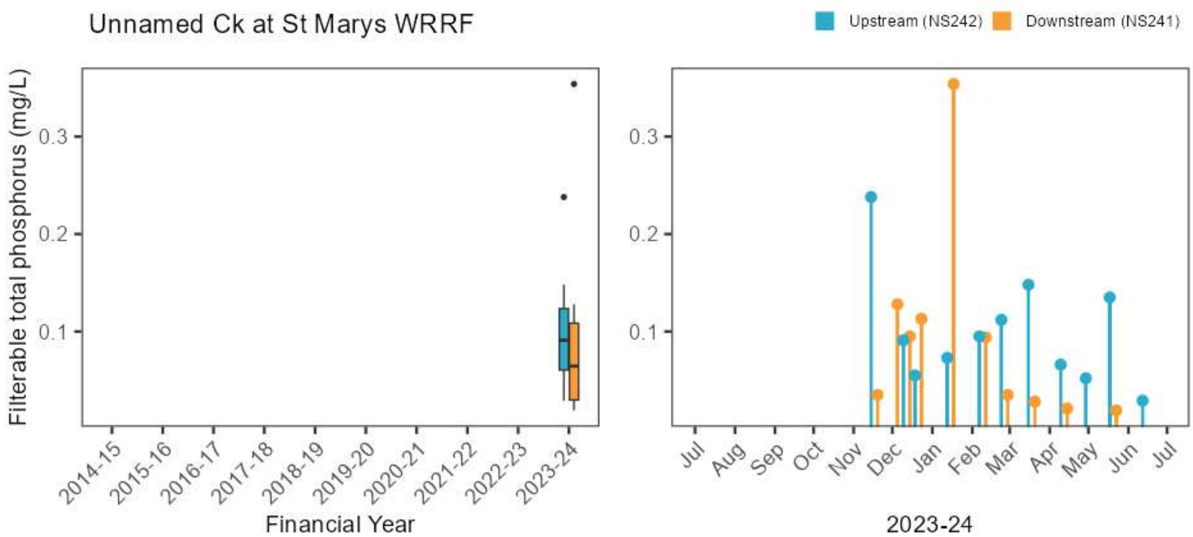
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
0.0
2.5
5.0
7.5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Soluble reactive phosphorus (mg/L)
0.0
0.1
0.2
0.3
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.015 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Soluble reactive phosphorus (mg/L)
0.00
0.05
0.10
0.15
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.015 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Filterable total phosphorus (mg/L)
0.1
0.2
0.3
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
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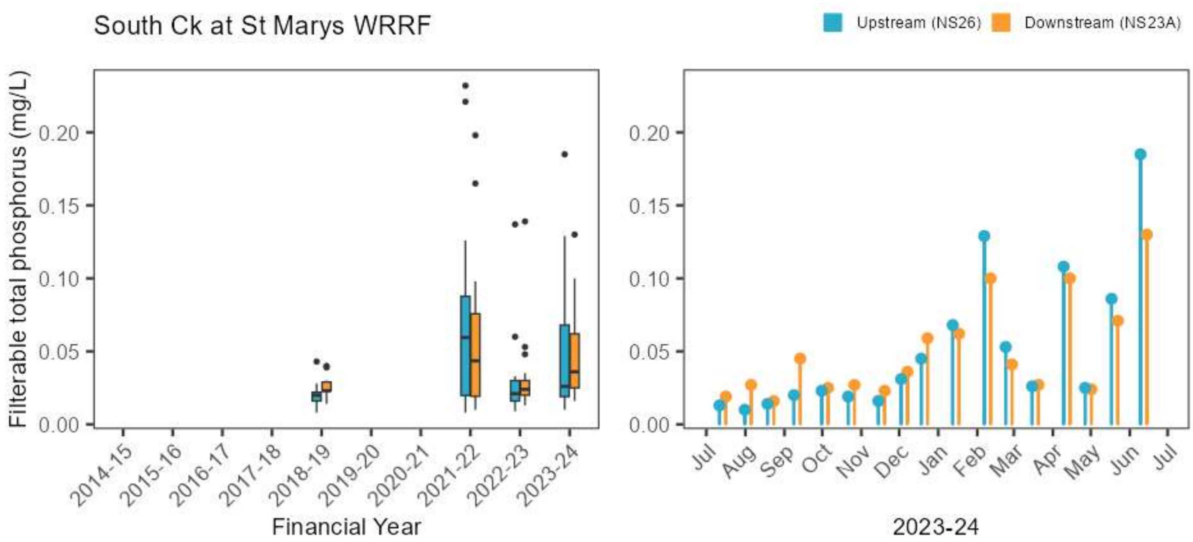
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Filterable total phosphorus (mg/L)
0.00
0.05
0.10
0.15
0.20
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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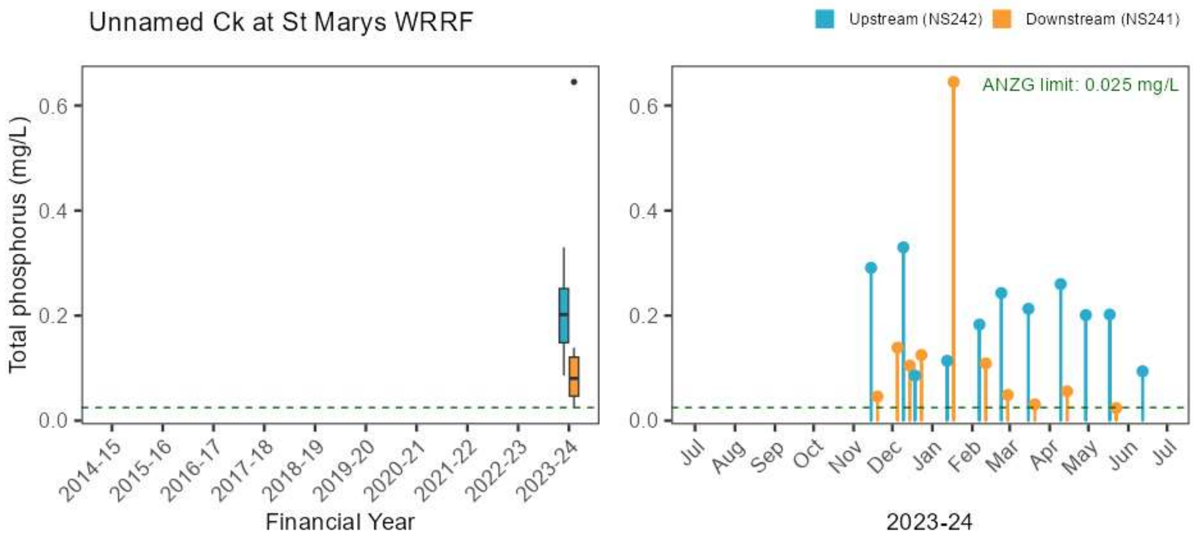
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.0
0.2
0.4
0.6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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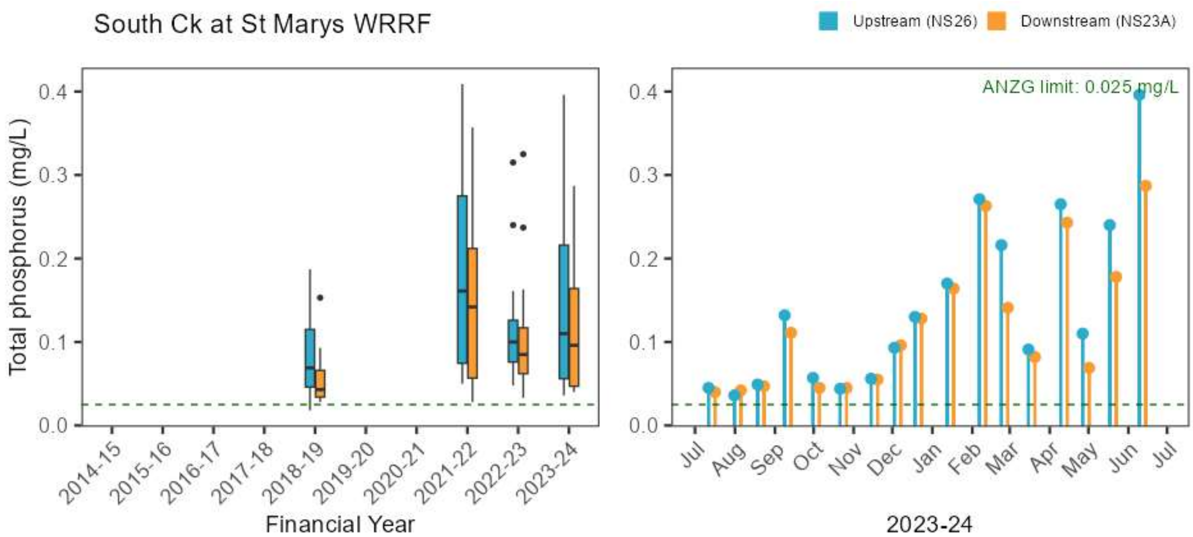
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 0.025 mg/L
Total phosphorus (mg/L)
0.0
0.1
0.2
0.3
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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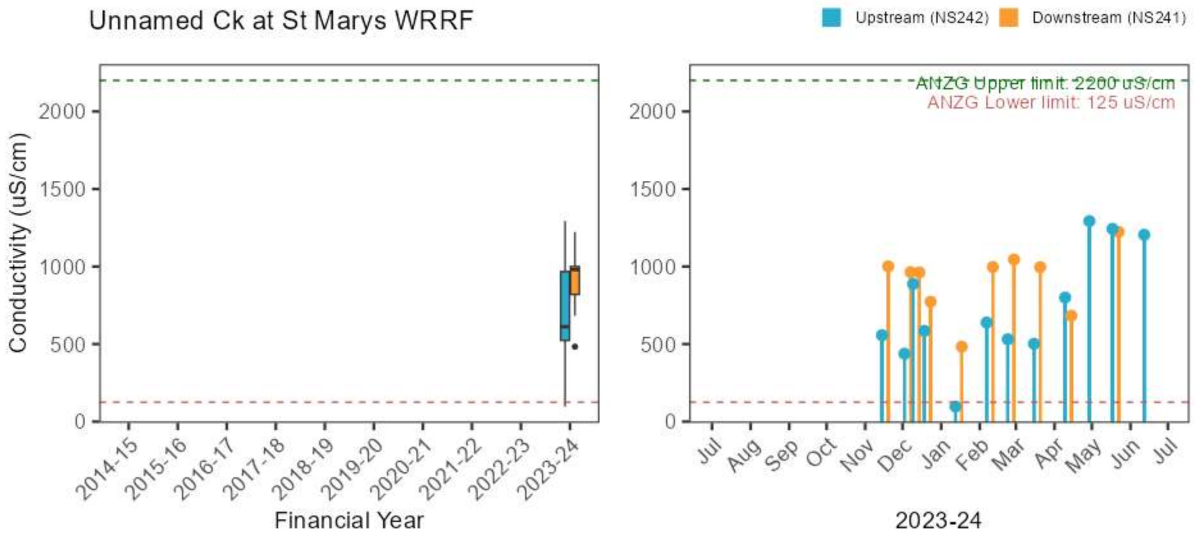
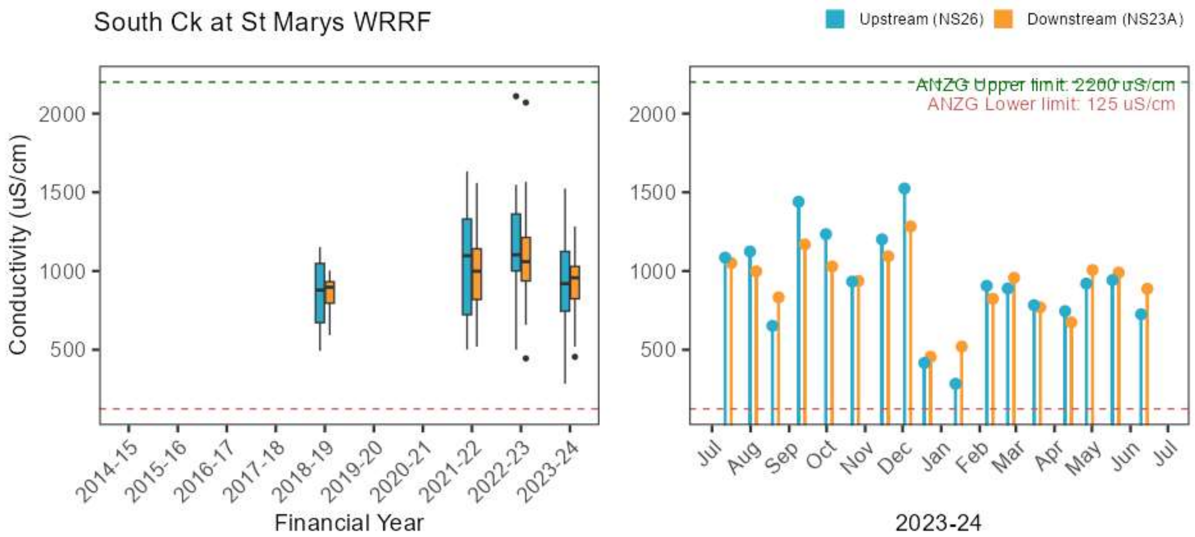
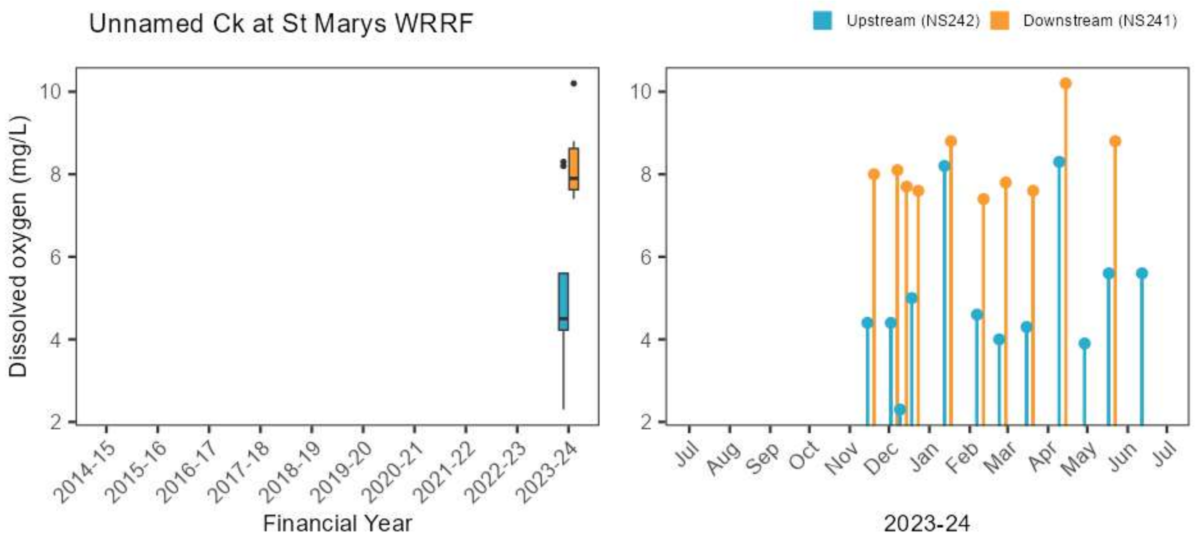
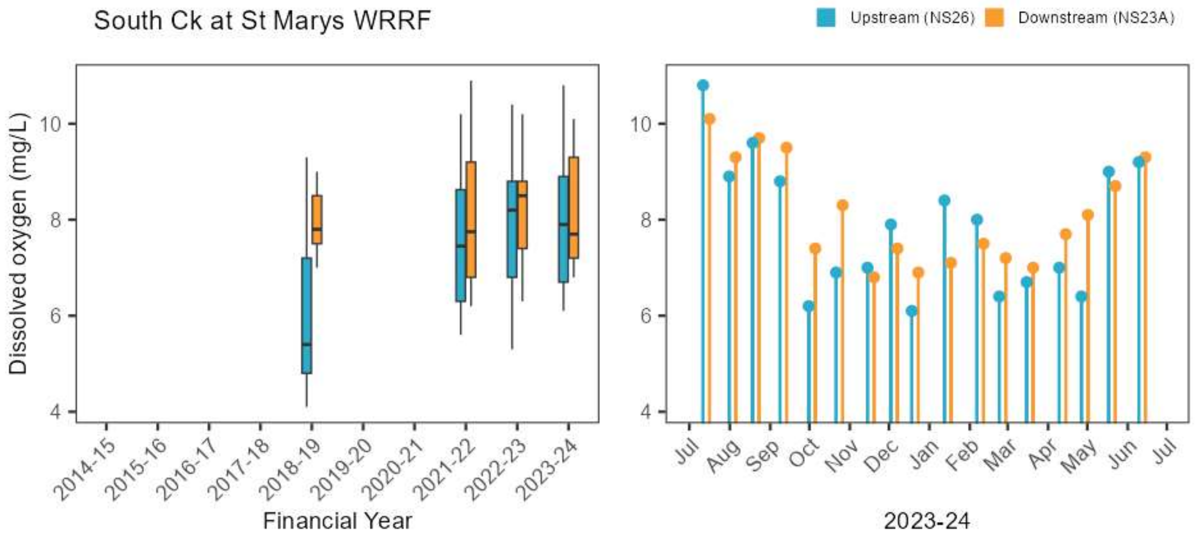
Mar
Apr
May
Jun
Jul
2023-24

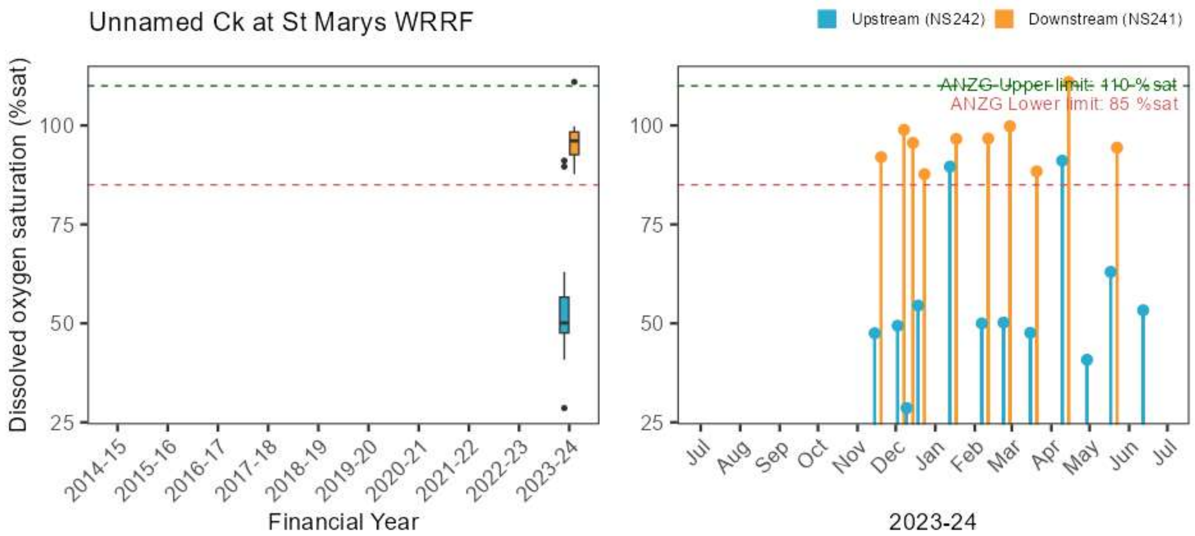
A.8.7. Stressor – Physico-chemical water quality








South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Dissolved oxygen (mg/L)
4
6
8
10
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Dissolved oxygen saturation (%sat)
25
50
75
100
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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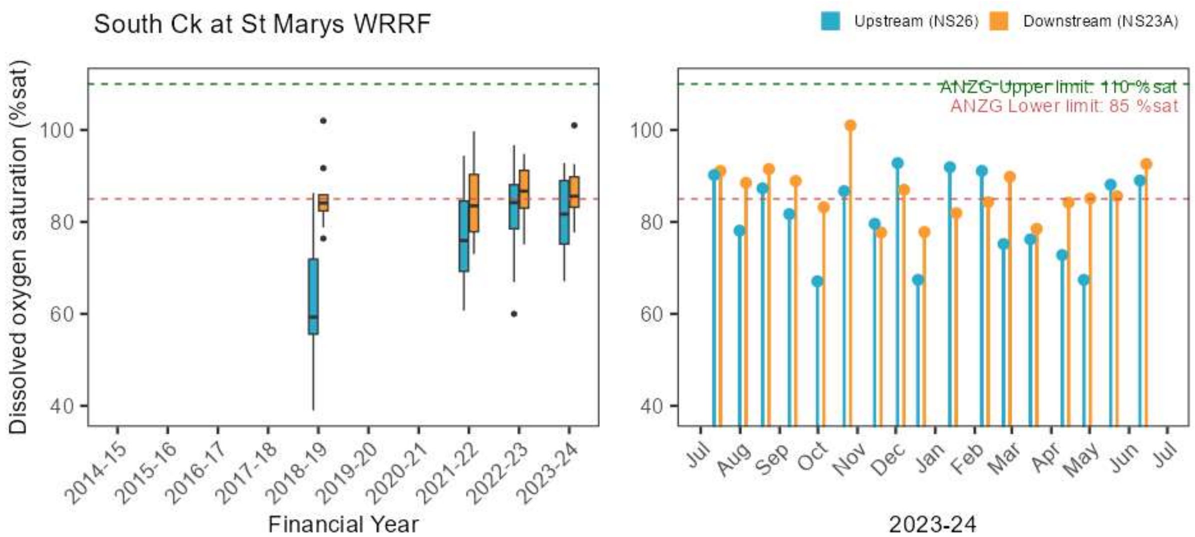
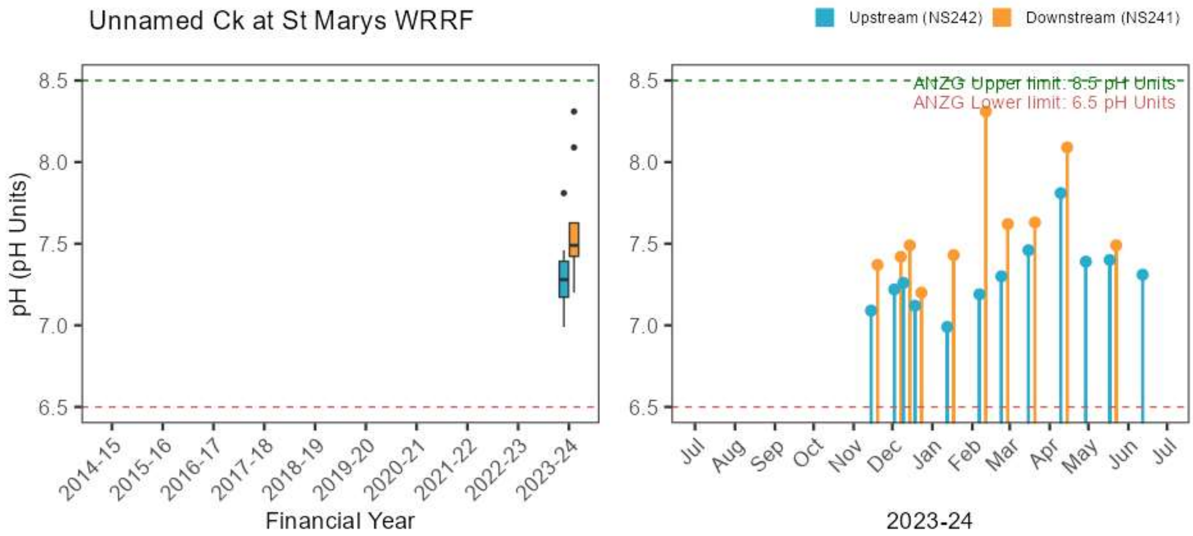
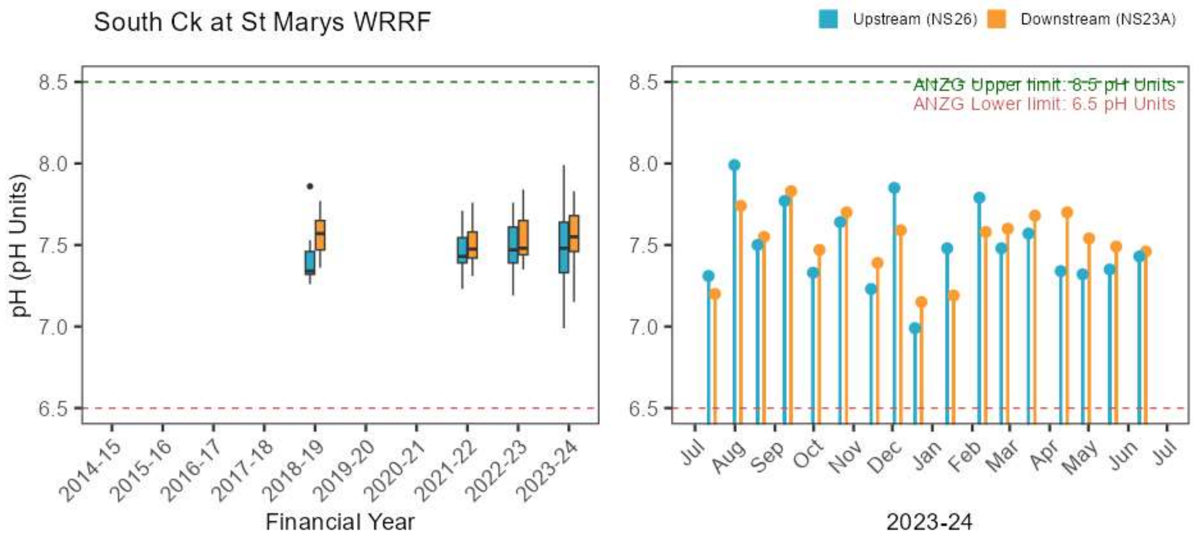
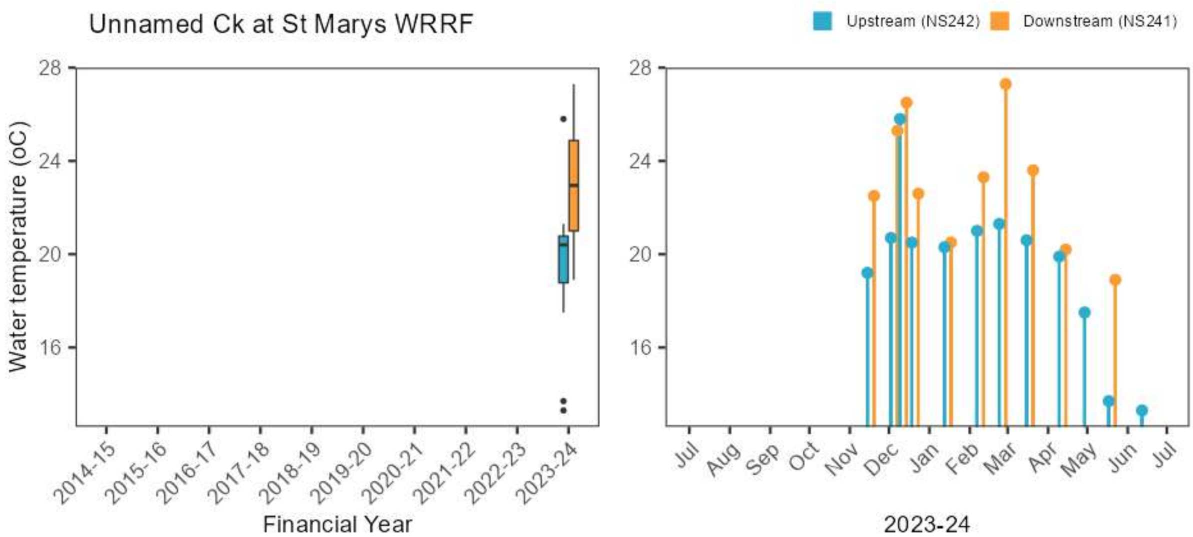
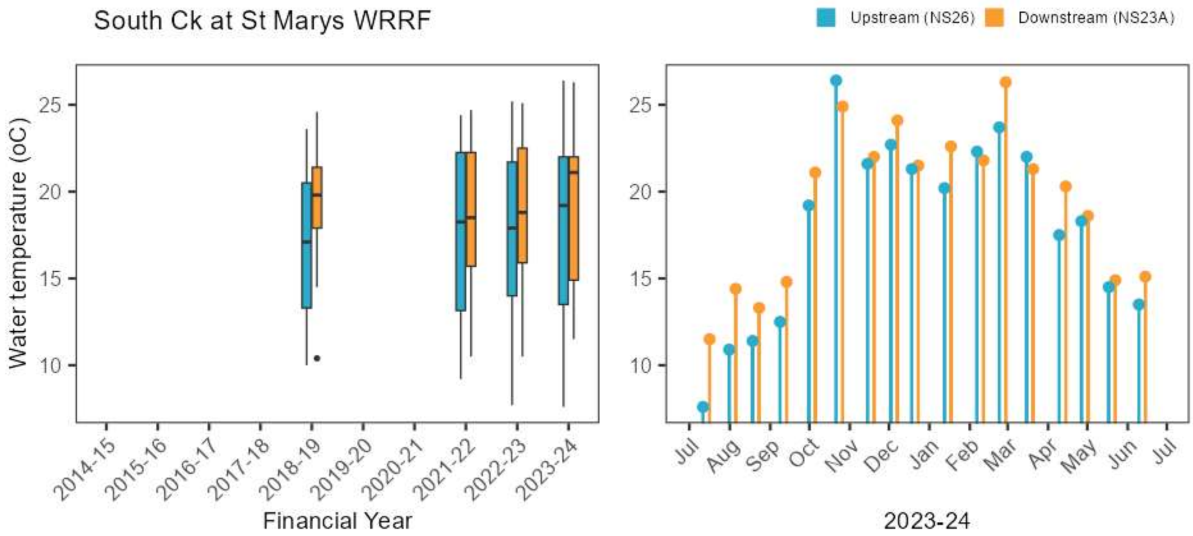
May
Jun
Jul
2023-24

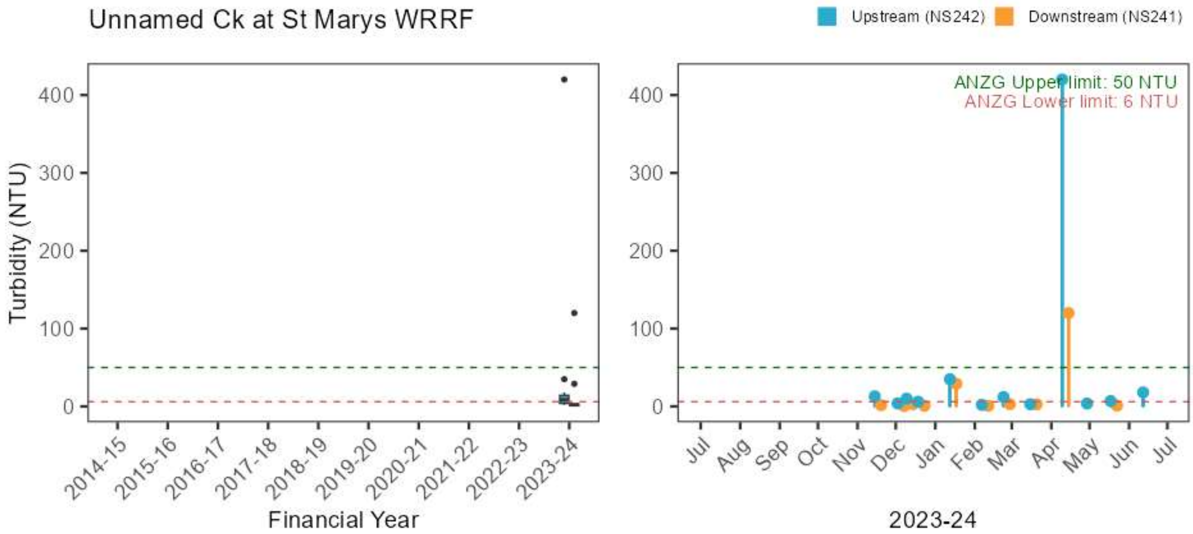

South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Dissolved oxygen saturation (%sat)
40
60
80
100
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
pH (pH Units)
Financial Year
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
pH (pH Units)
Financial Year
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Water temperature (oC)
Financial Year
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Water temperature (oC)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
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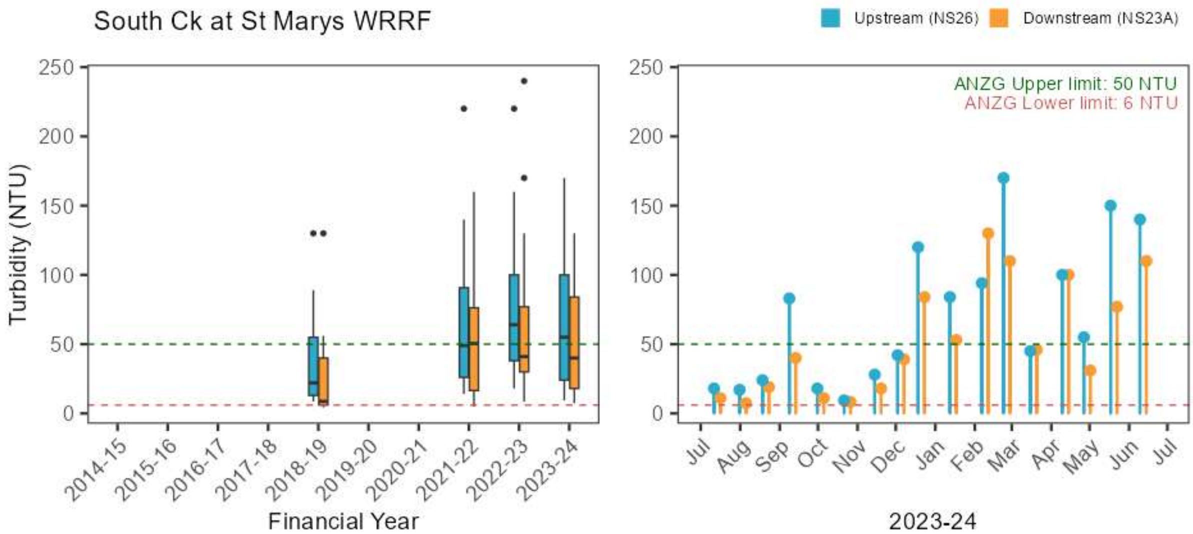
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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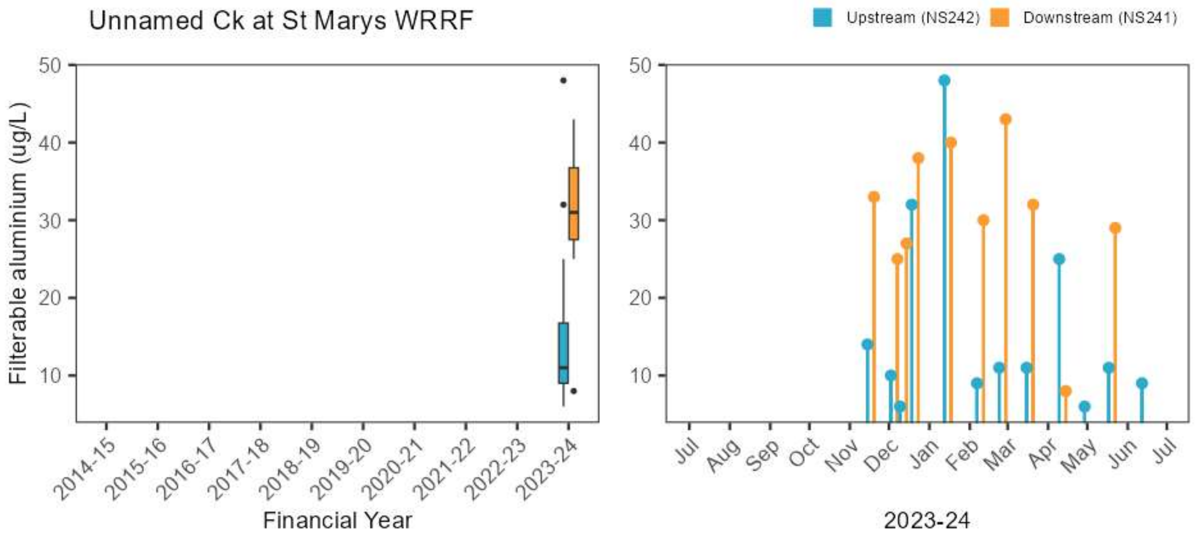
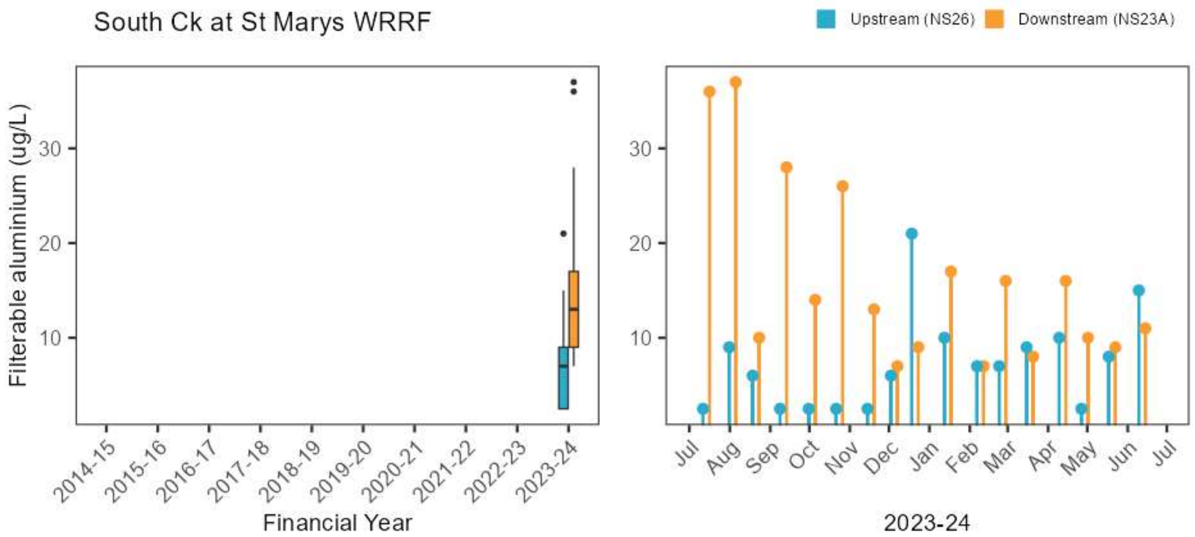
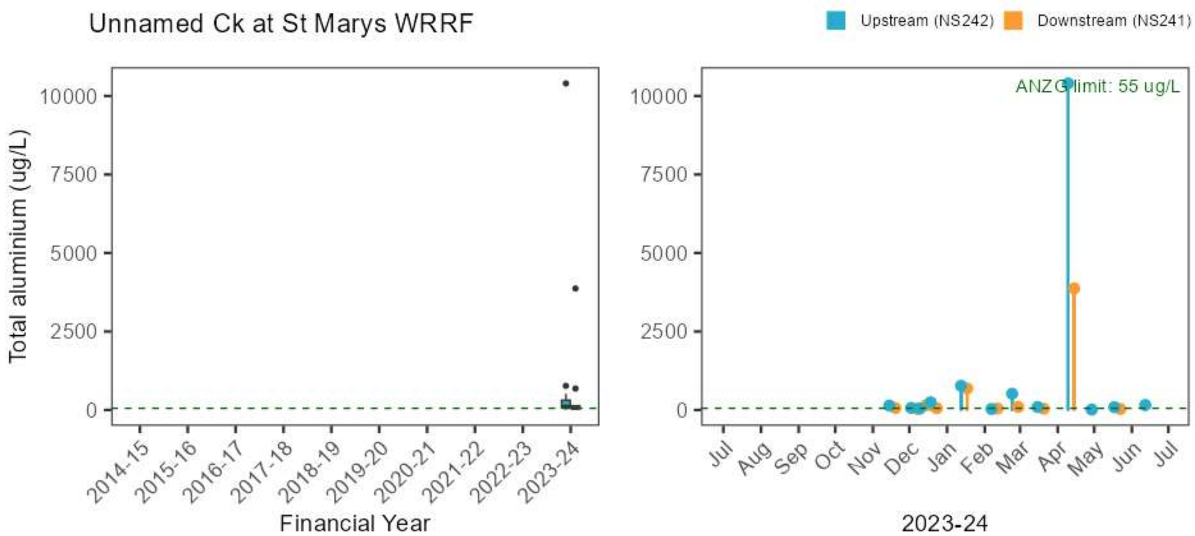
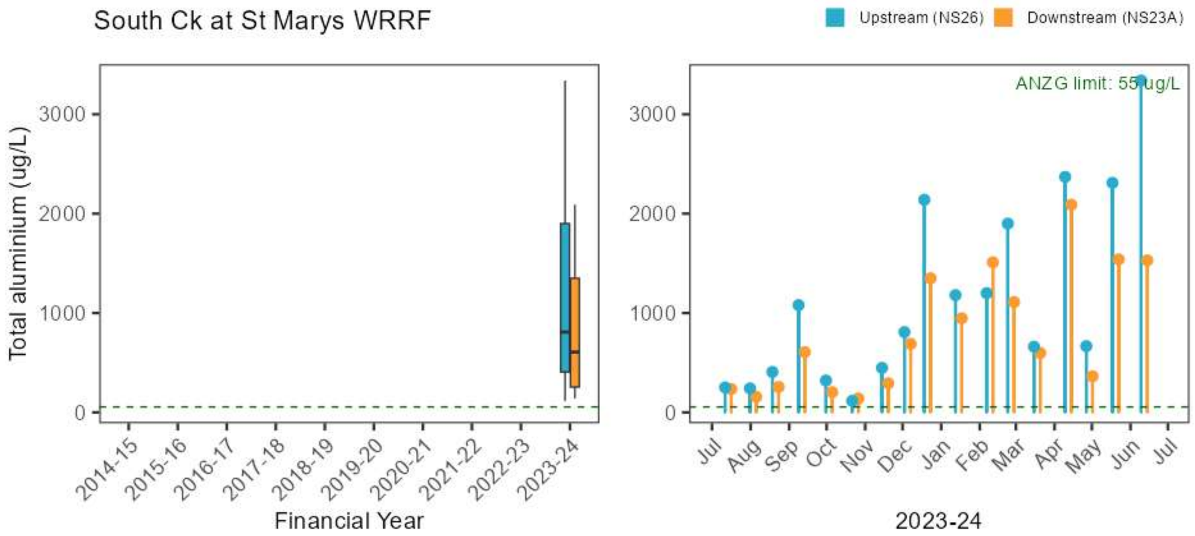
2023-24

A.8.8. Stressor – Trace metals








South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Total aluminium (ug/L)
ANZG limit: 55 ug/L
3000
2000
1000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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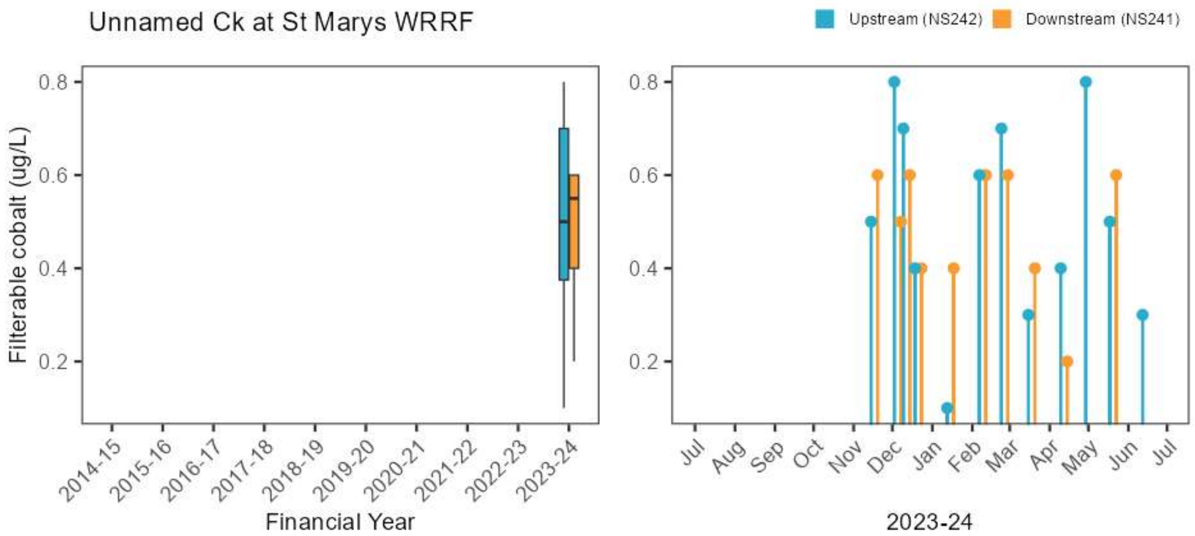
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Filterable cobalt (ug/L)
0.8
0.6
0.4
0.2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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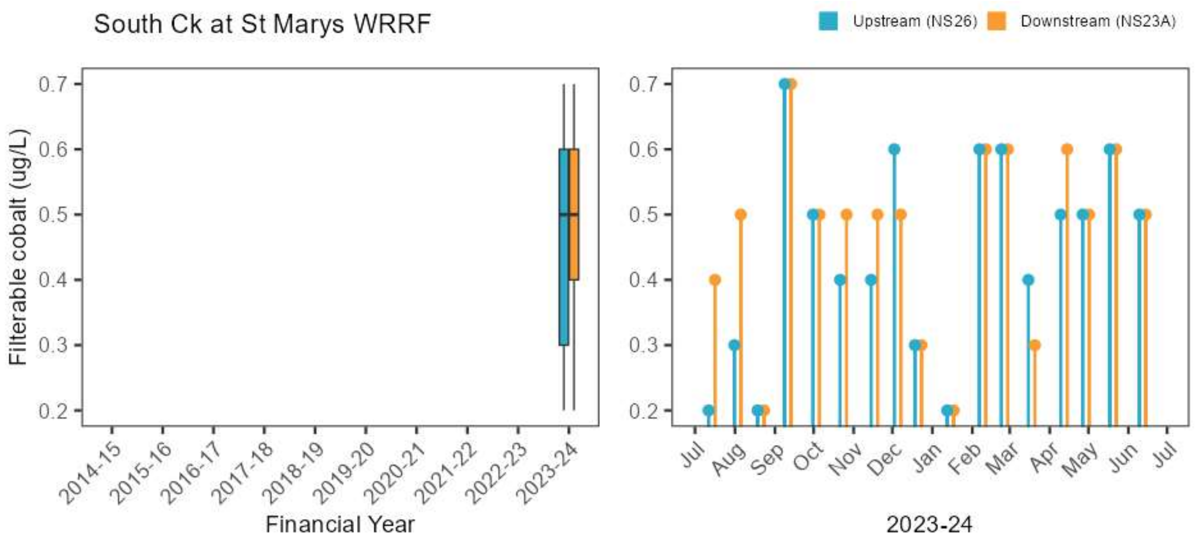
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Filterable cobalt (ug/L)
0.7
0.6
0.5
0.4
0.3
0.2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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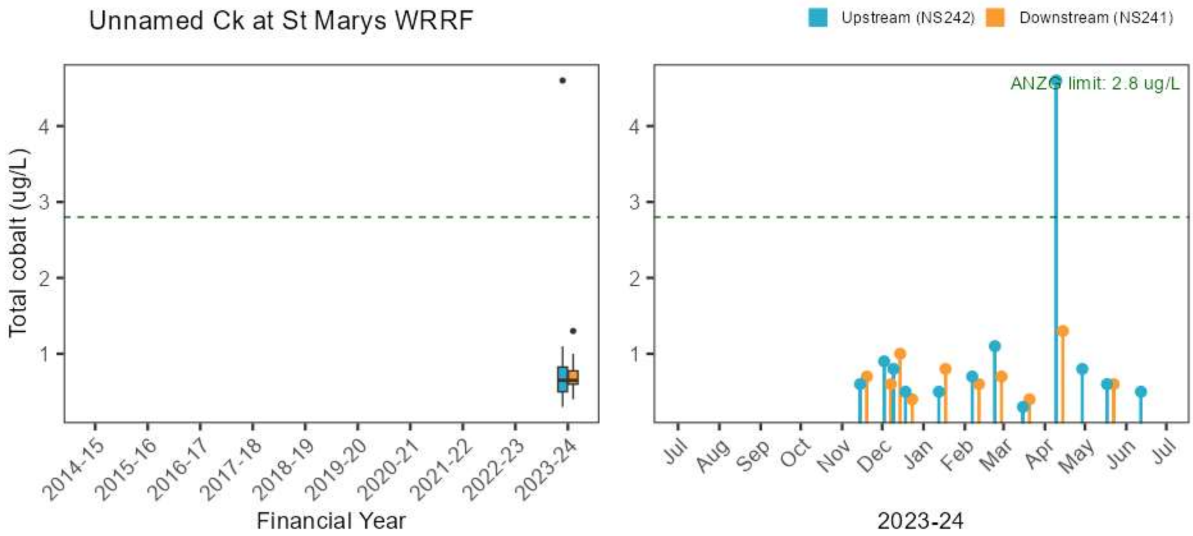
May
Jun
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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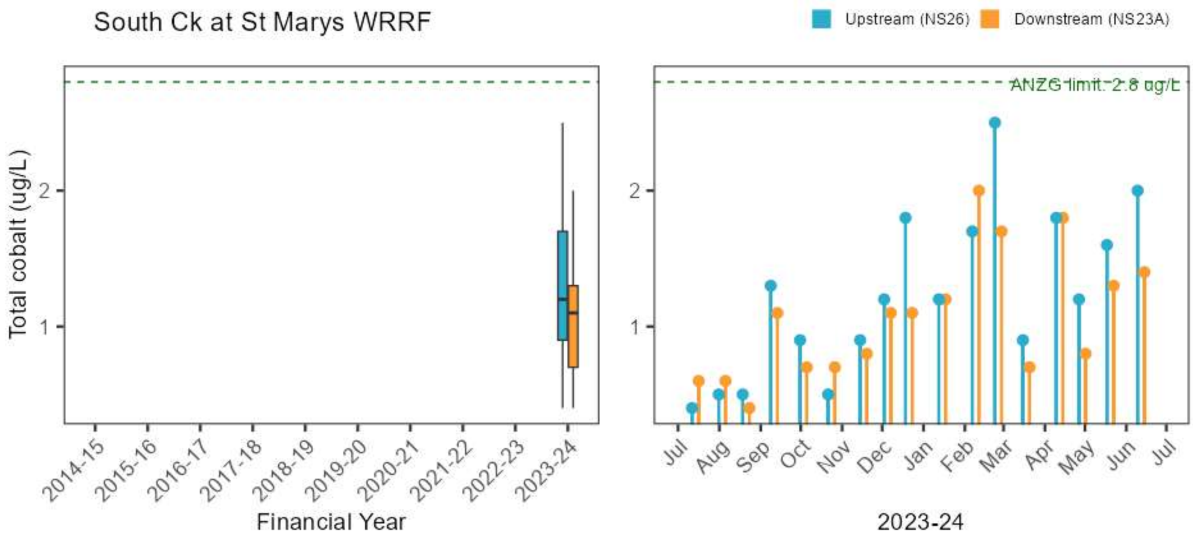
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
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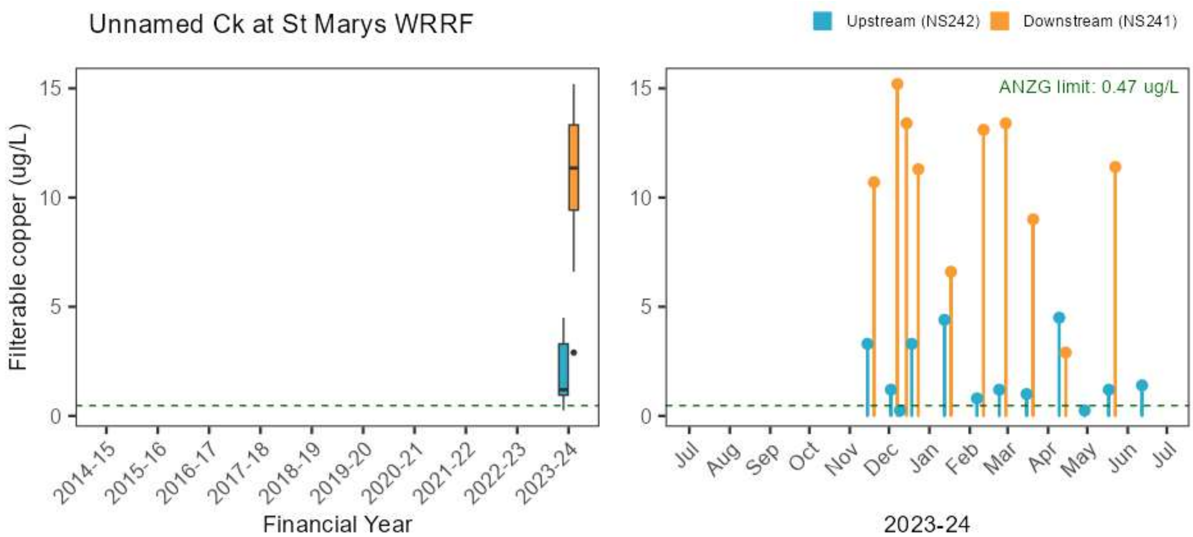
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
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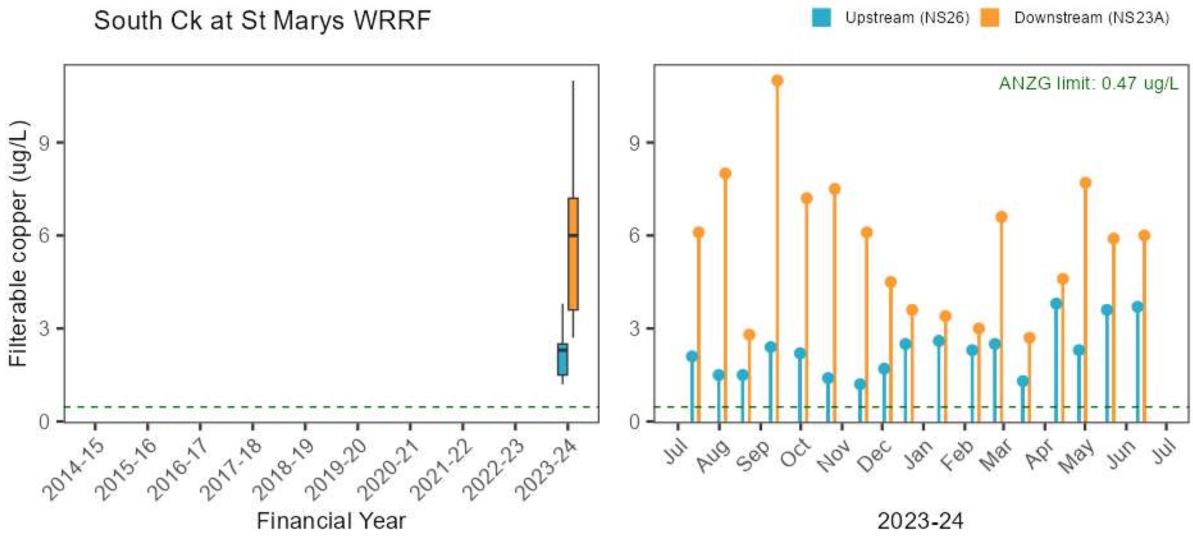
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 0.47 ug/L
Filterable copper (ug/L)
0
3
6
9
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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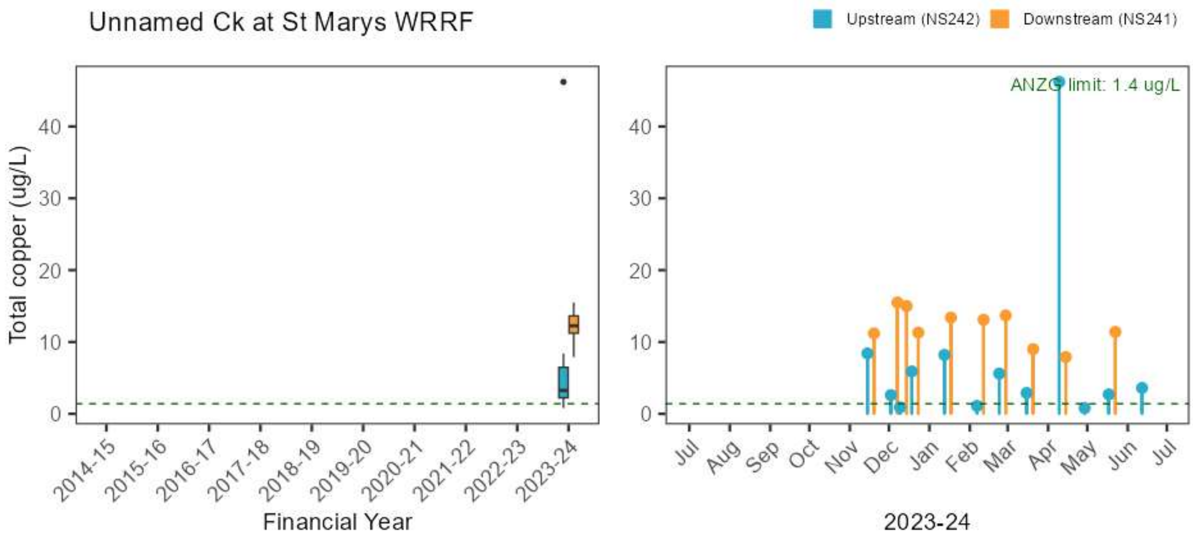
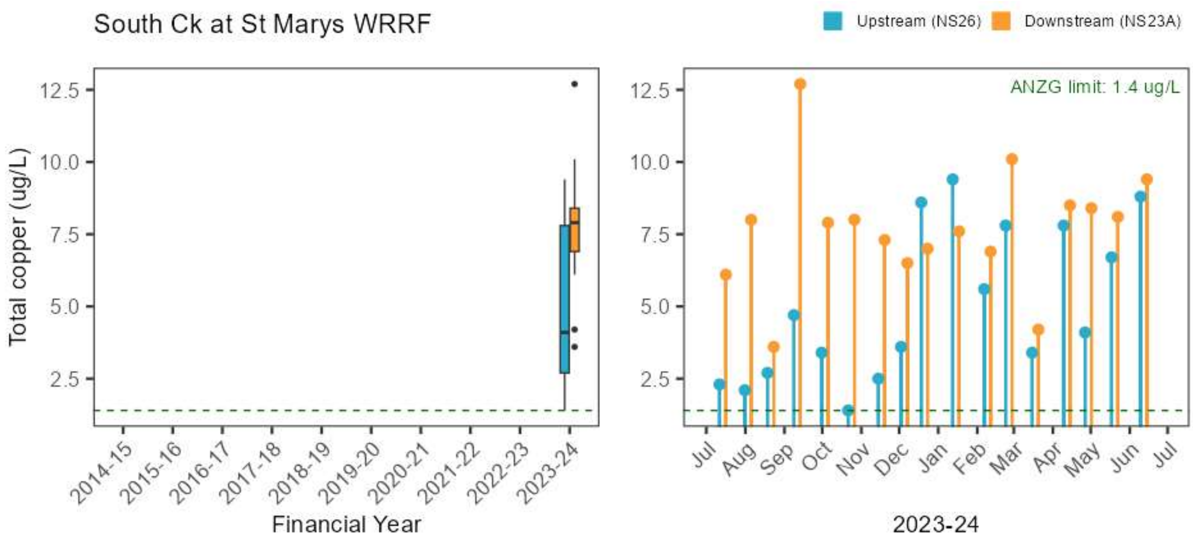
Jul
2023-24


Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
0
10
20
30
40
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 1.4 ug/L
Total copper (ug/L)
2.5
5.0
7.5
10.0
12.5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
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Apr
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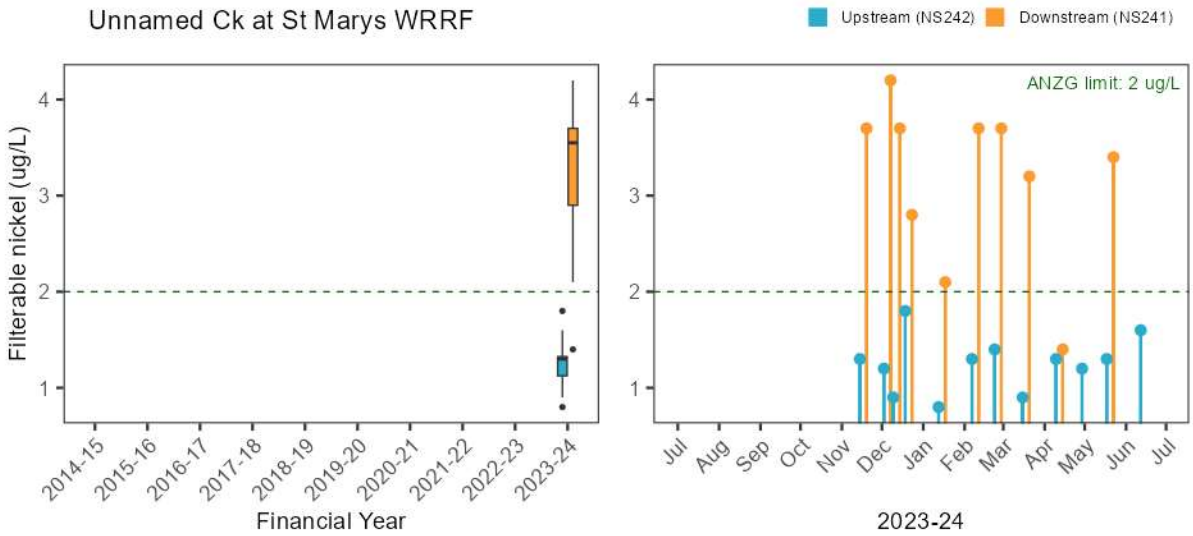
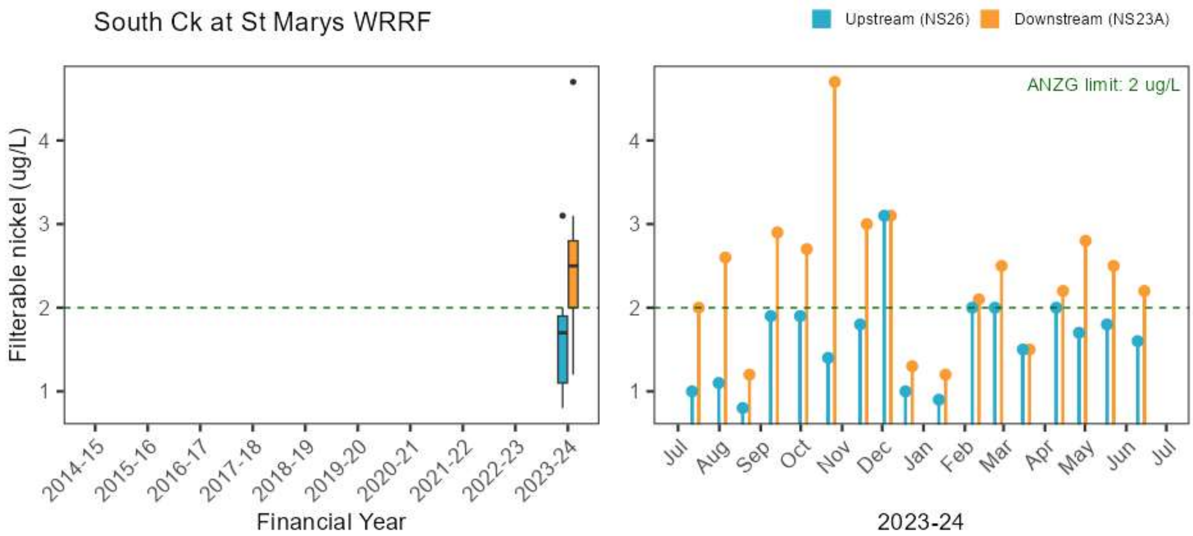
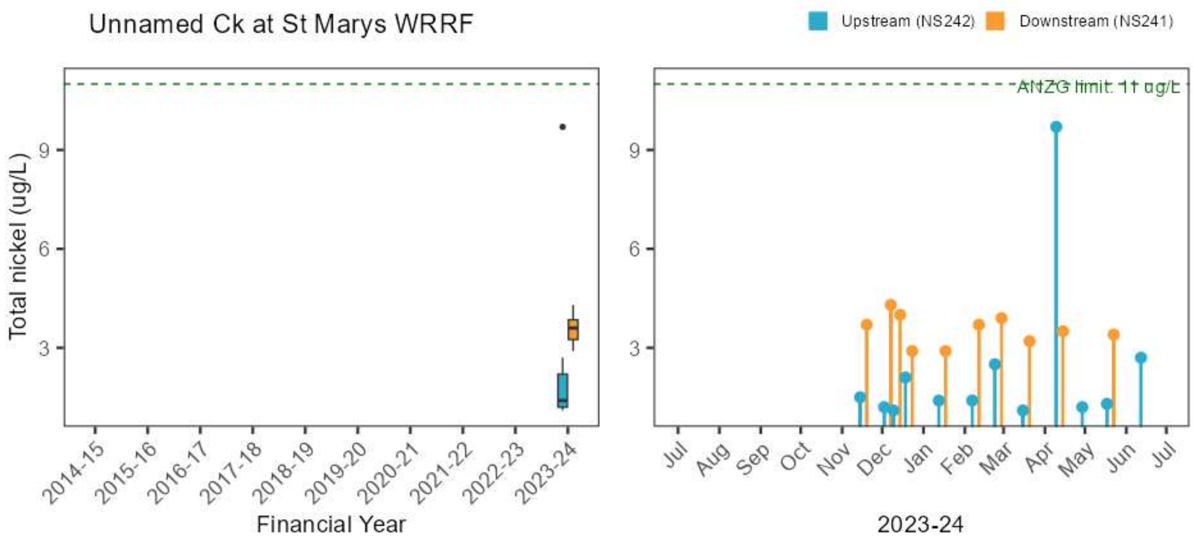
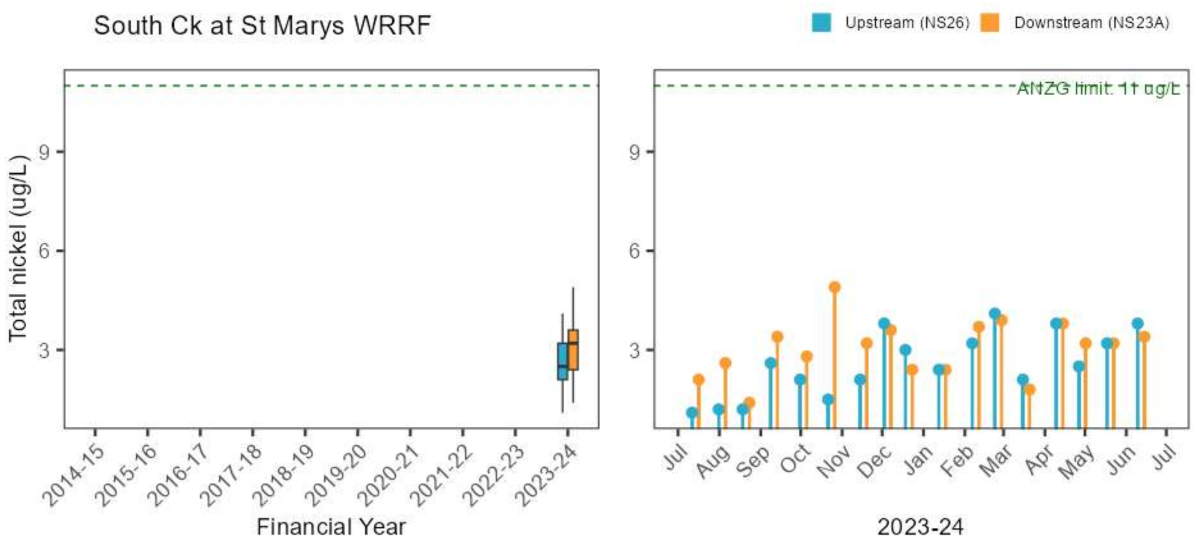
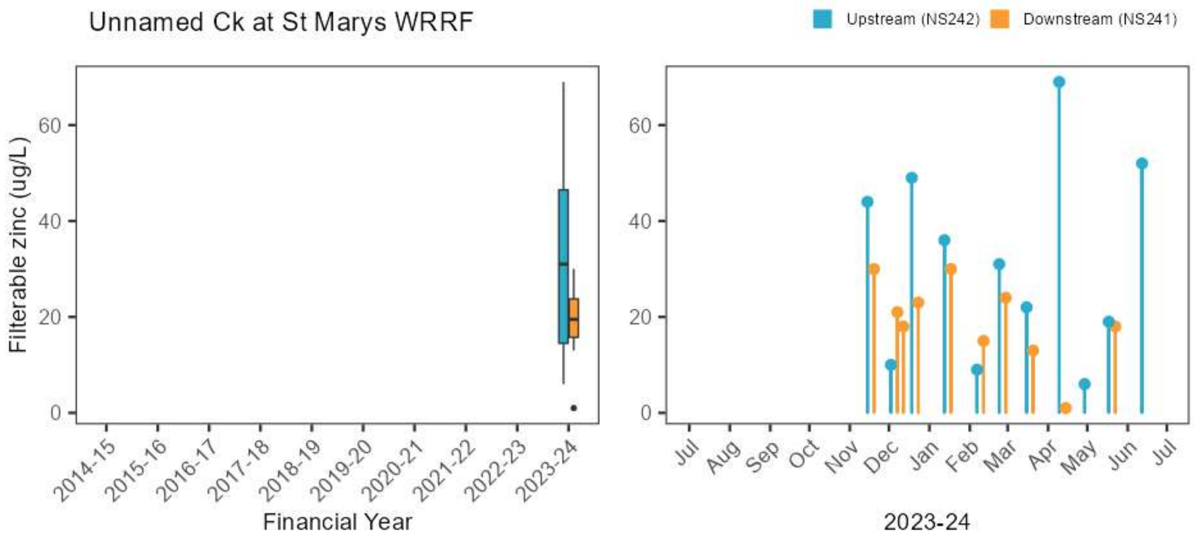
Jun
Jul
2023-24

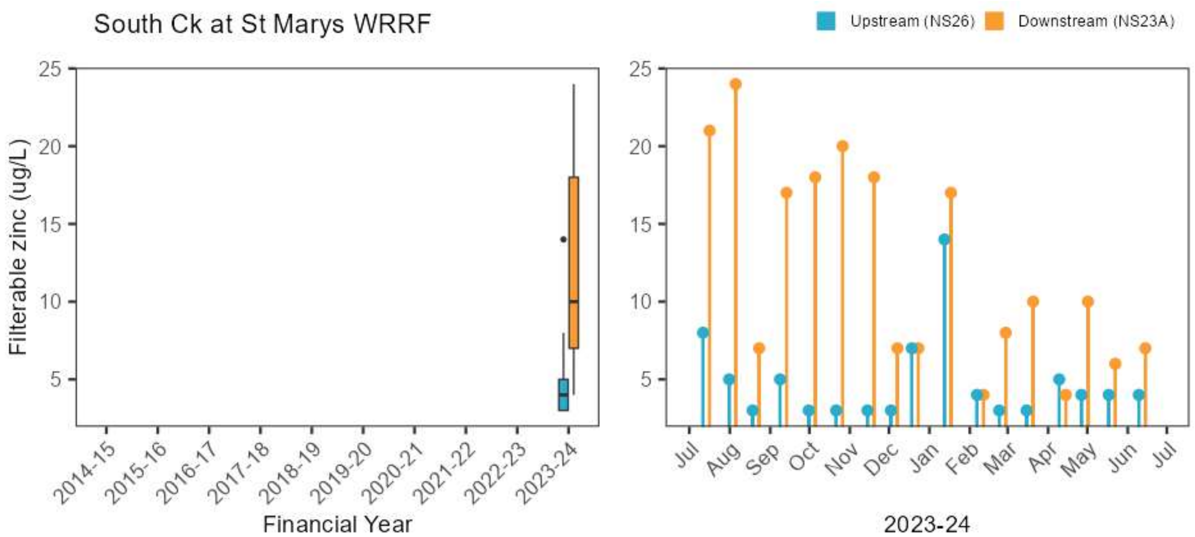

Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

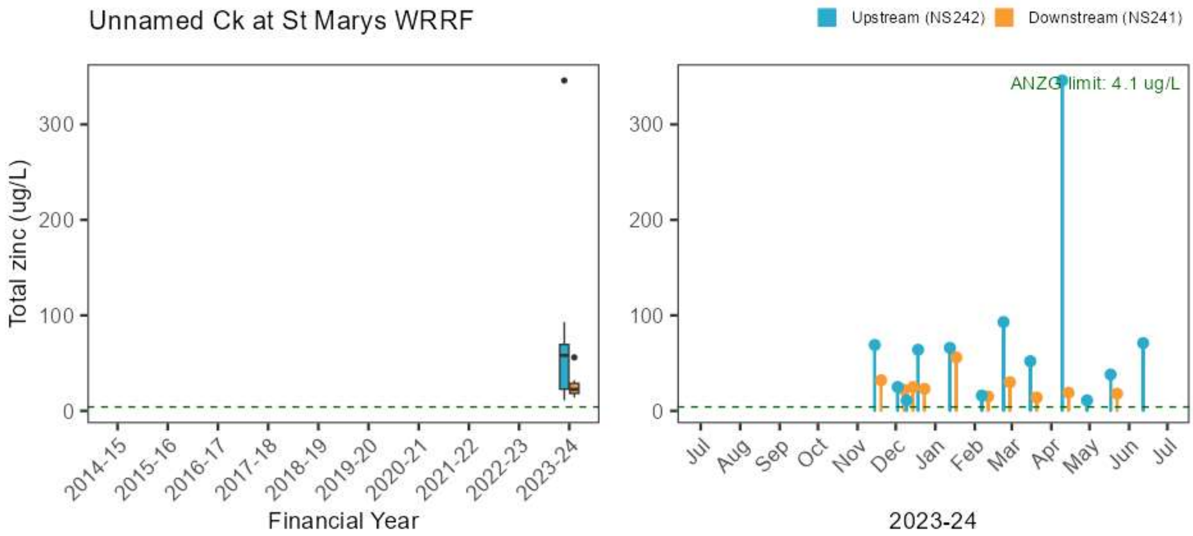

South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

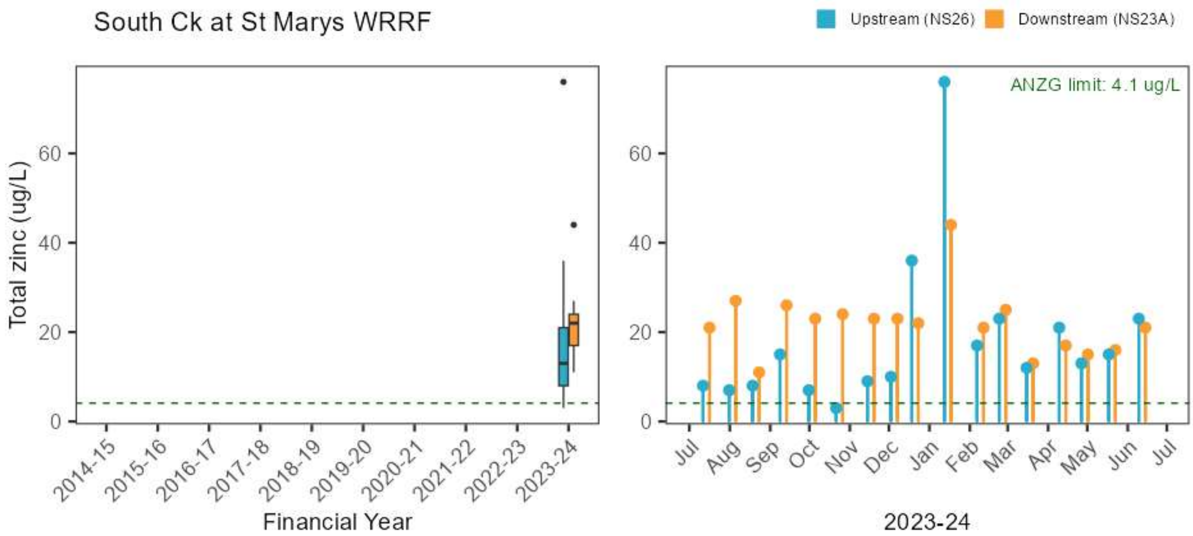

Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
ANZG limit: 11 ug/L
Total nickel (ug/L)
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
ANZG limit: 11 ug/L
Total nickel (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

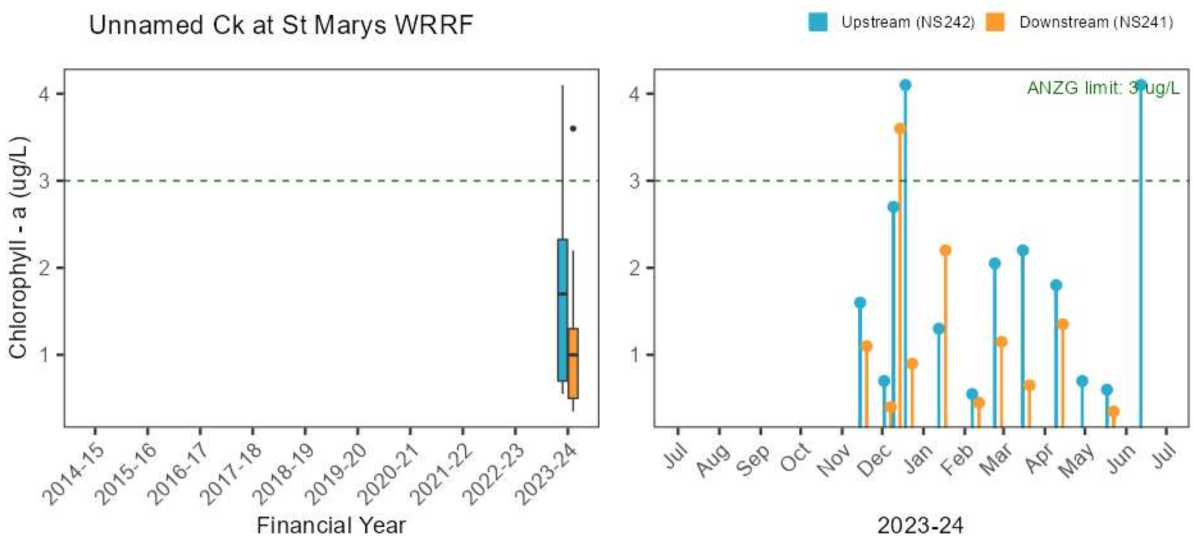

Unnamed Ck at St Marys WRRF
Upstream (NS242)
Downstream (NS241)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

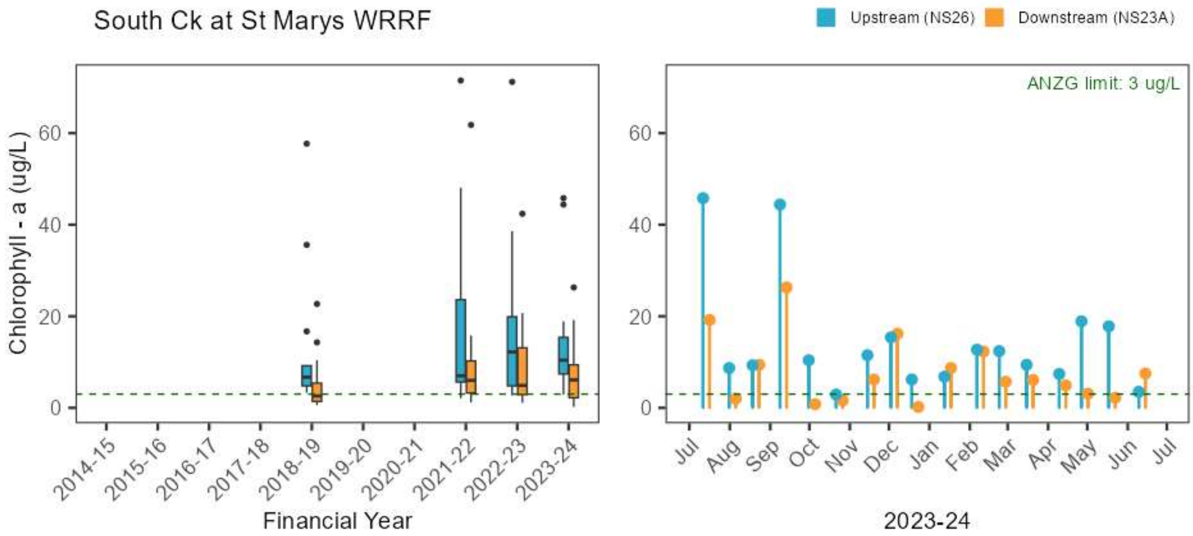

South Ck at St Marys WRRF
Upstream (NS26)
Downstream (NS23A)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24





A.8.9. Ecosystem receptor – Phytoplankton





A.8.10. Ecosystem receptor – Macroinvertebrates

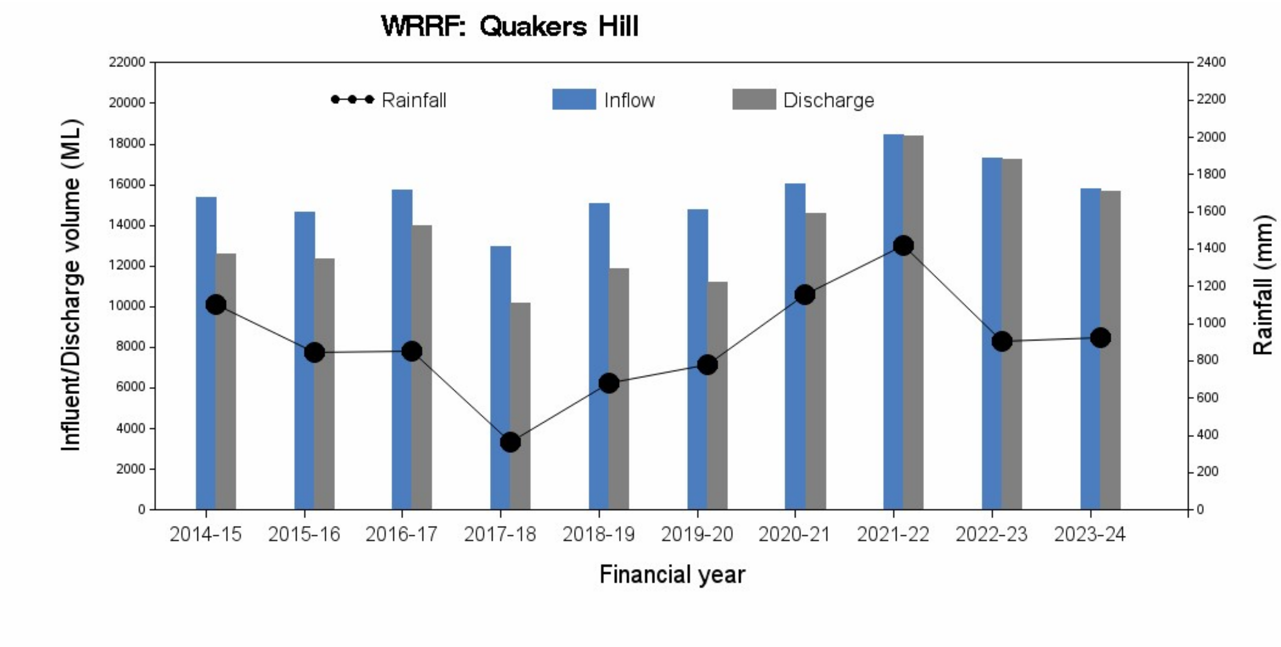
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Unnamed Creek	Tributary (NS242 vs NS241)	Welch Two Sample t-test	0.29	1.64	5.9	0.153
South Creek	River (NS26 vs NS23)	Welch Two Sample t-test	-1.04	-3.84	9.2	0.004

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

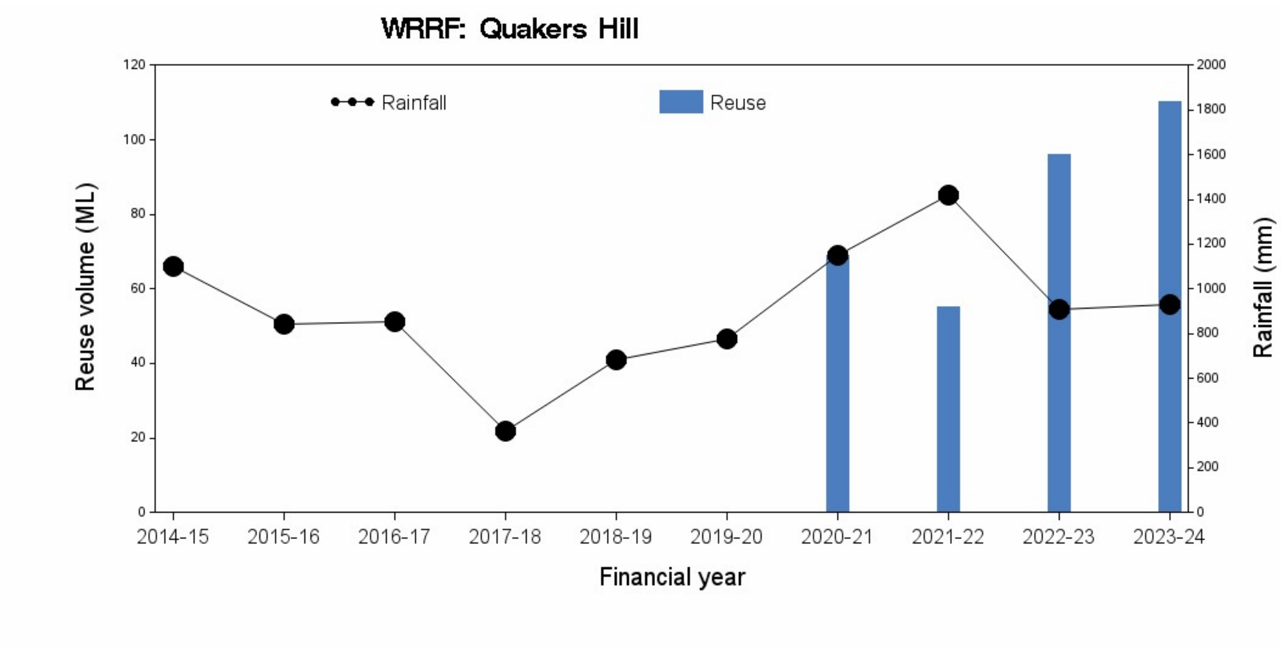
A.9. Quakers Hill WRRF

A.9.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

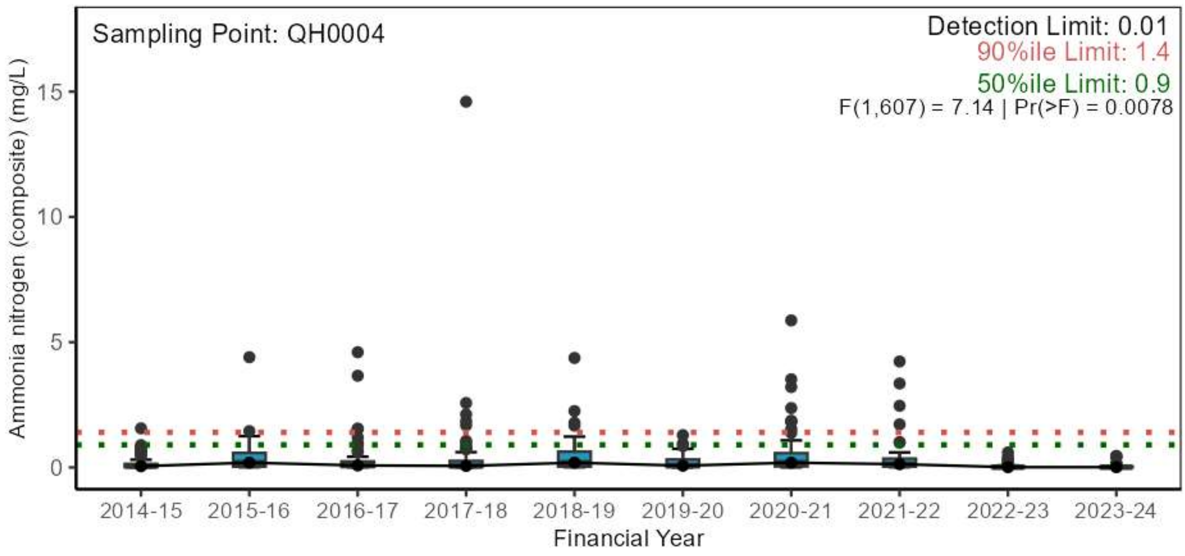


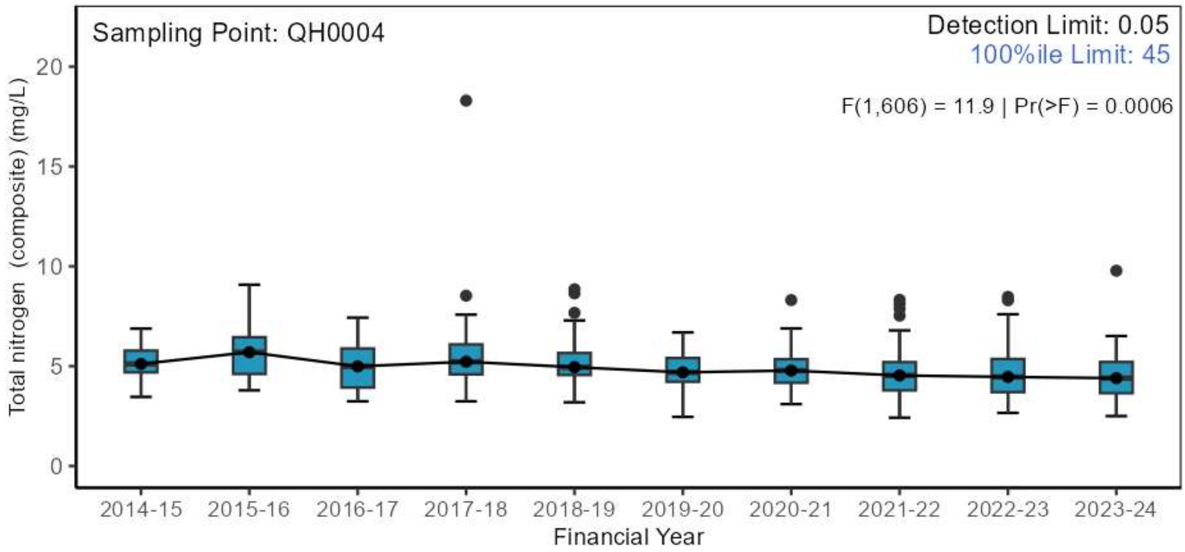
Reuse volume and rainfall

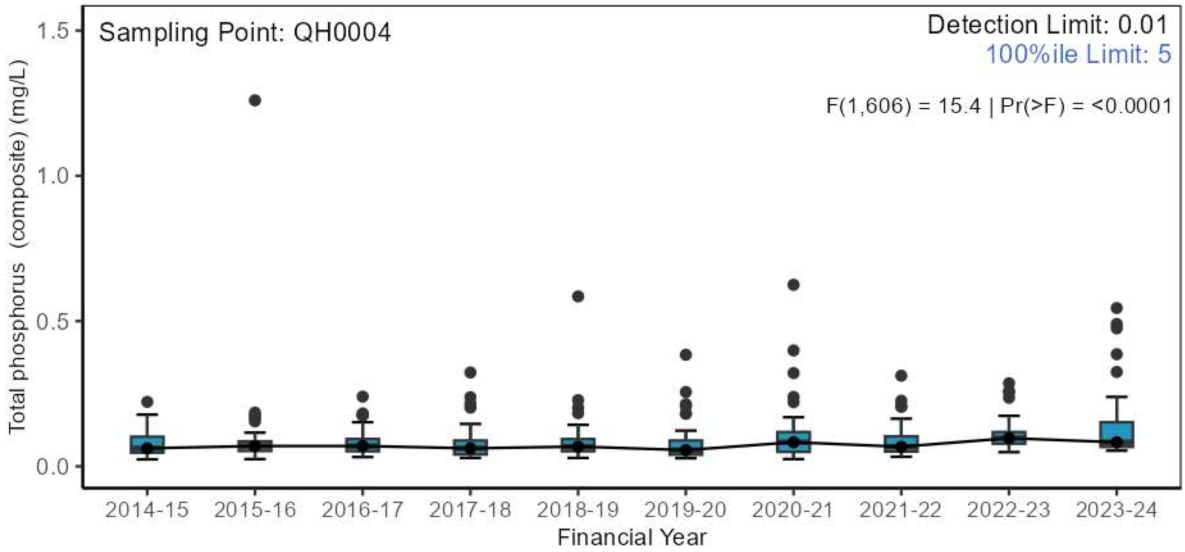


A.9.2. Pressure - Wastewater quality

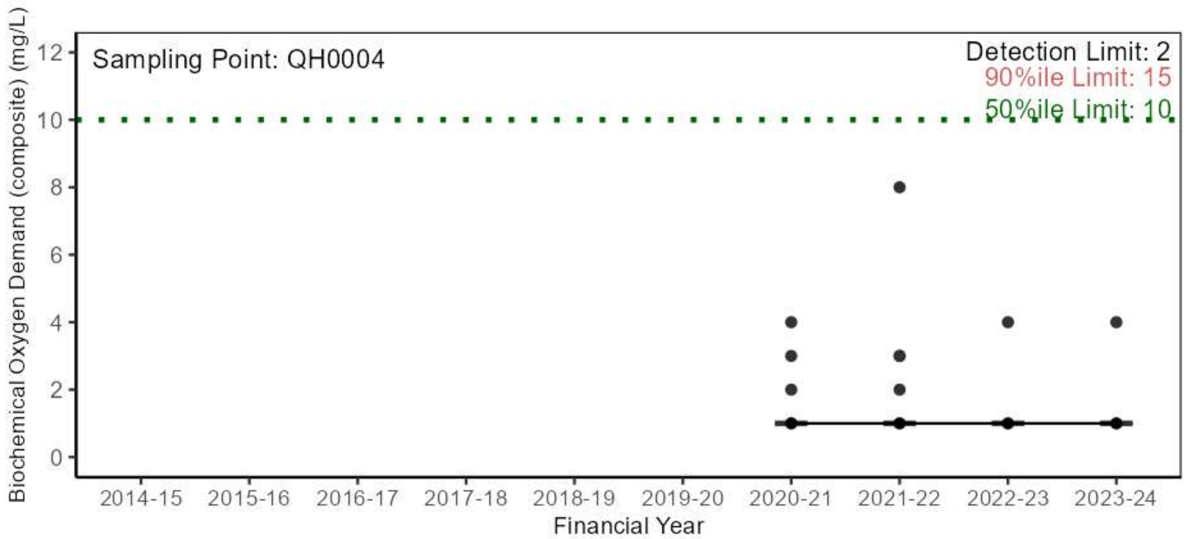
Nutrients



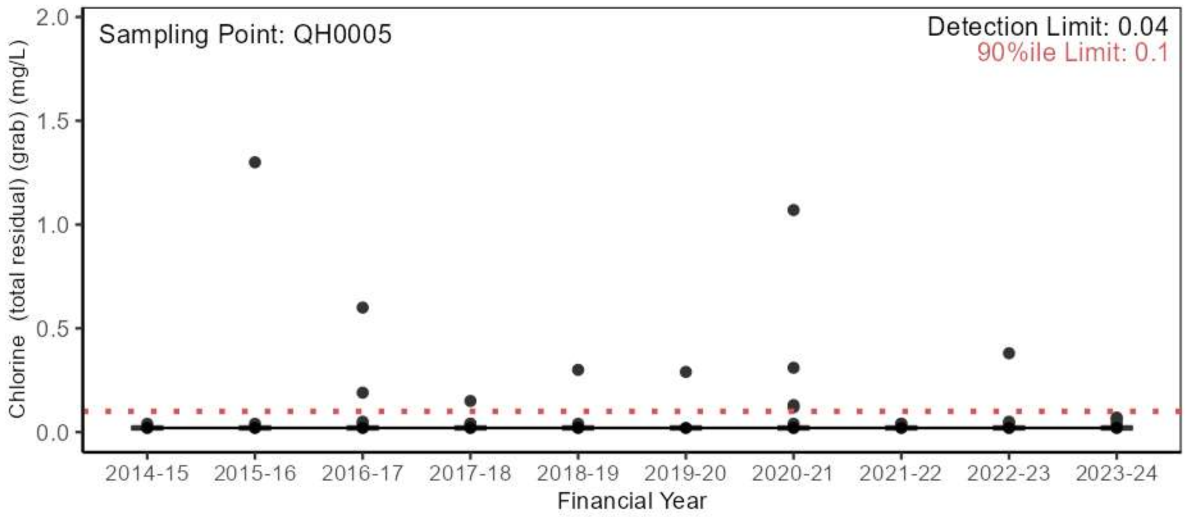




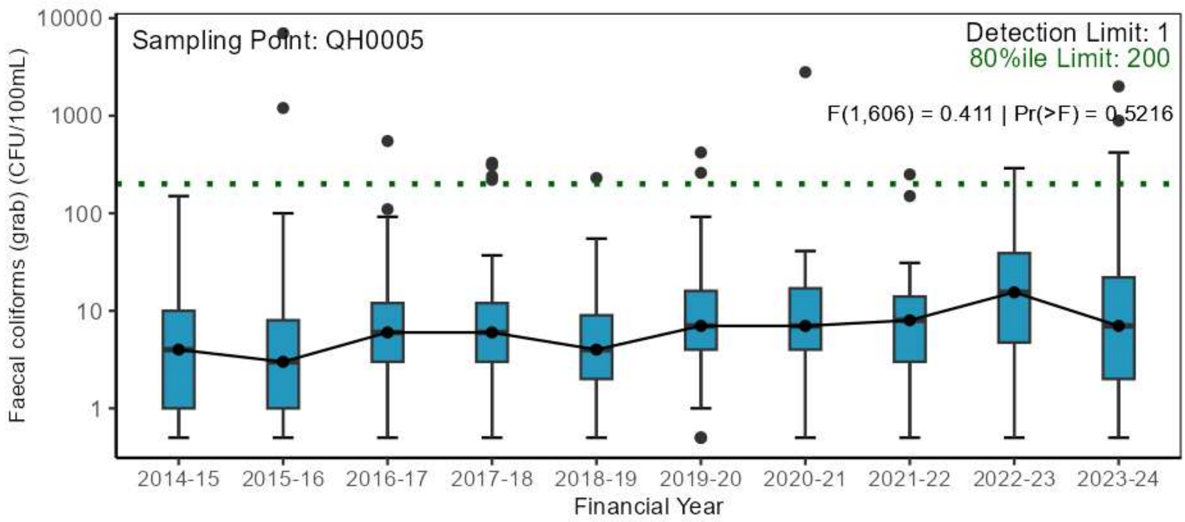
Major conventional analytes



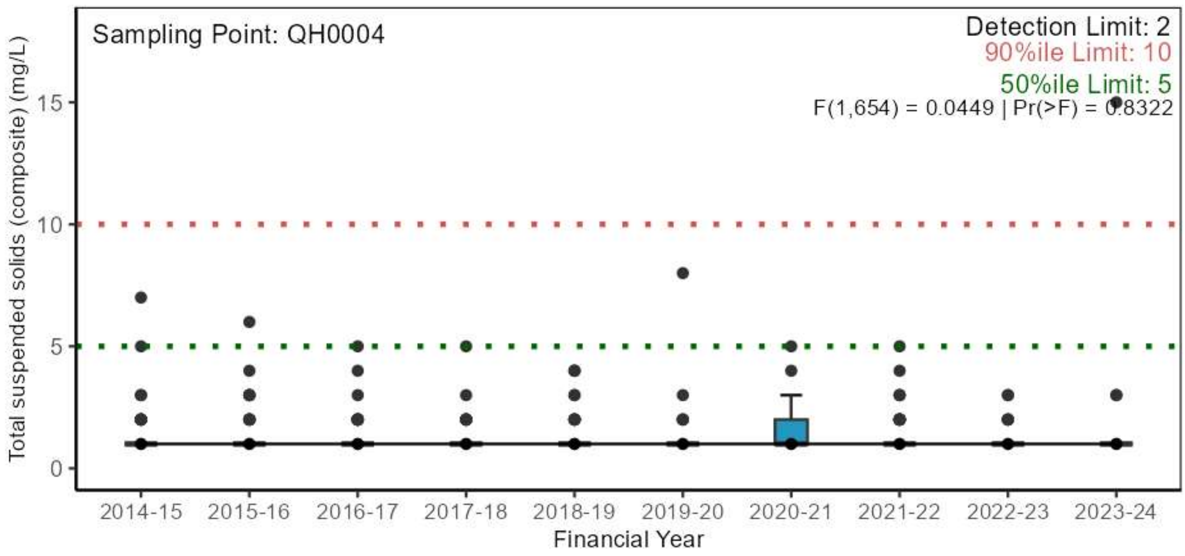
Statistical test not conducted as >90% of results were below detection limits.



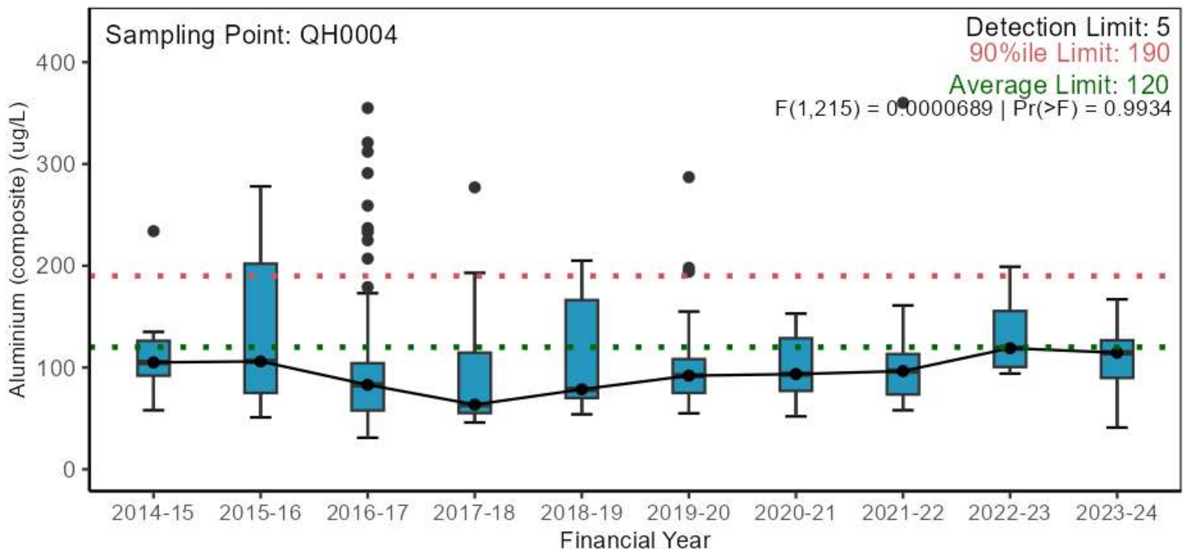
Statistical test not conducted as >90% of results were below detection limits.

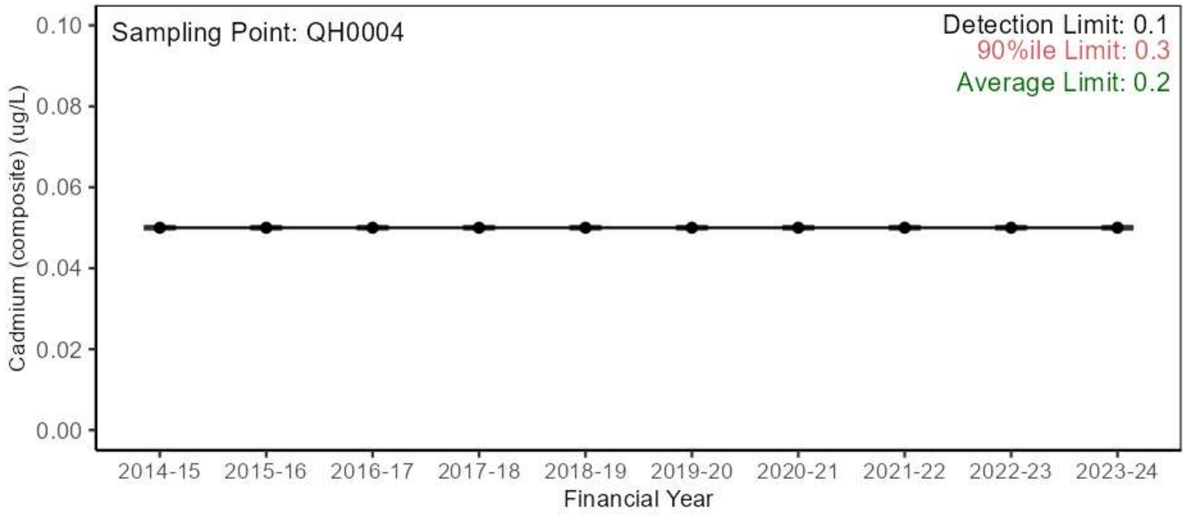


Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

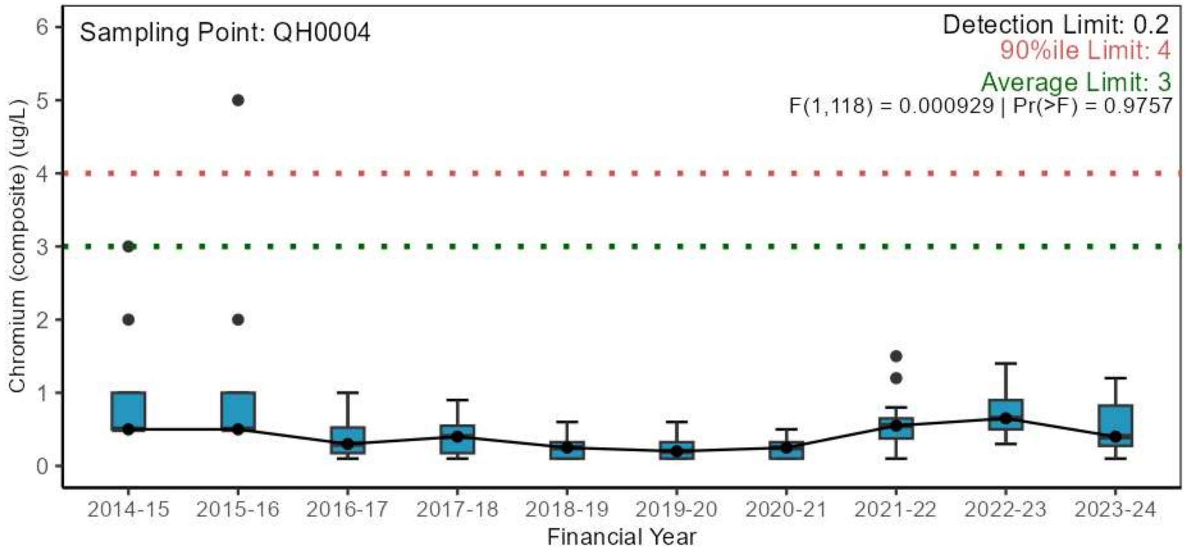


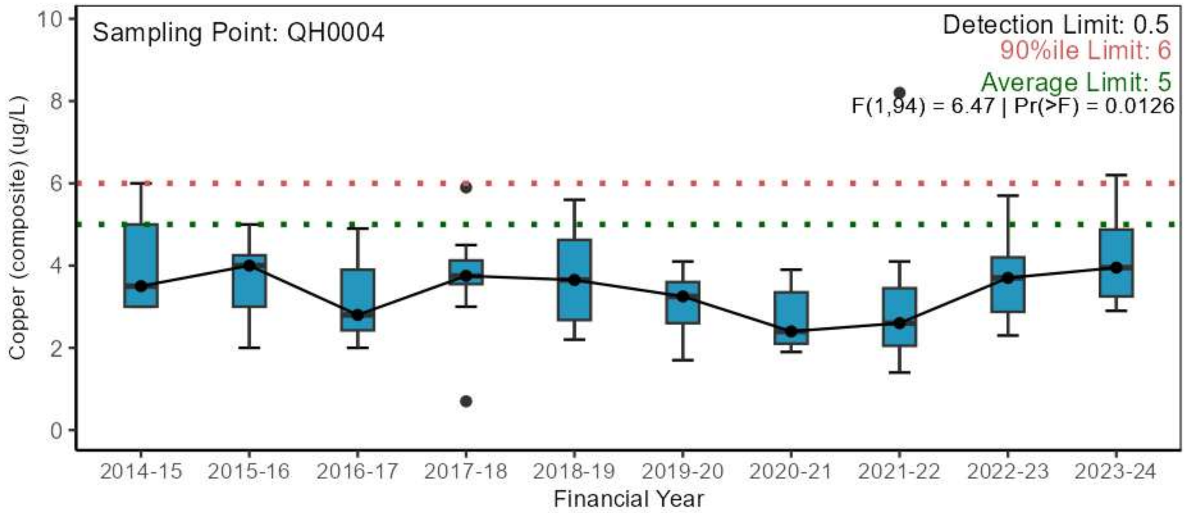
Trace metals



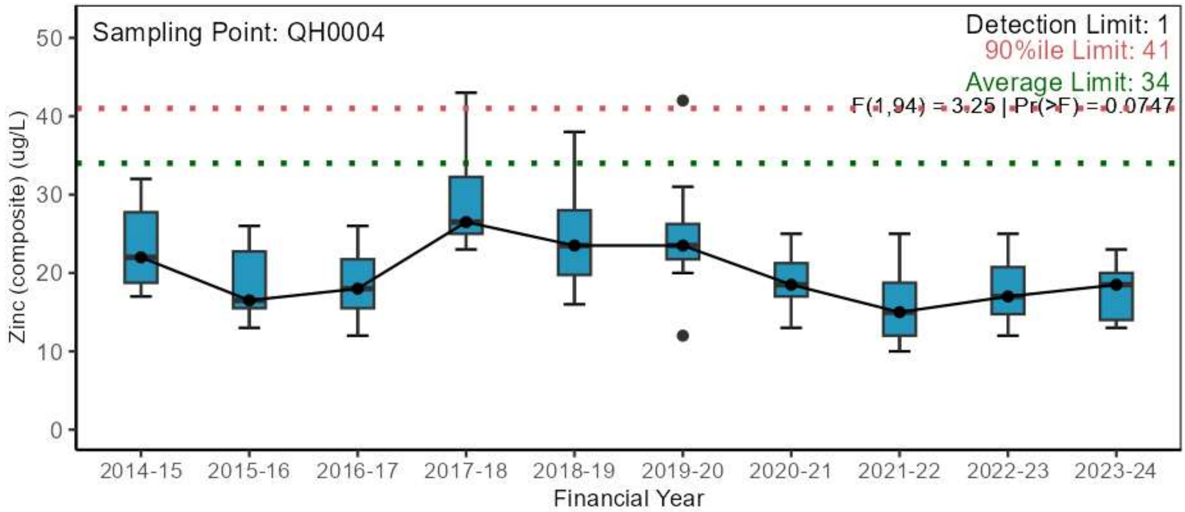


Statistical test not conducted as >90% of results were below detection limits.



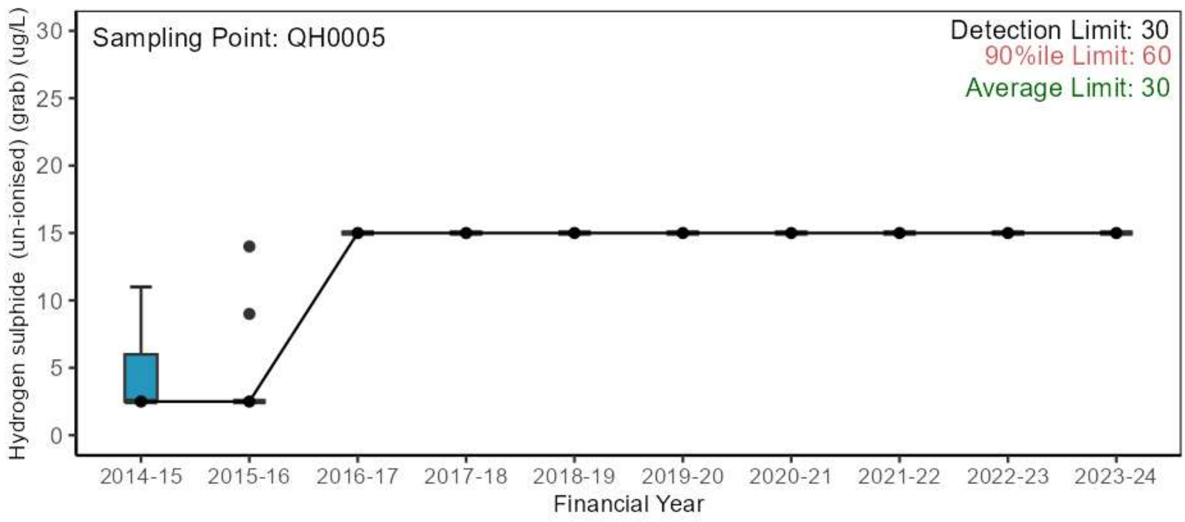


Statistical test excludes data prior to 2016-17 due to method detection limit change.



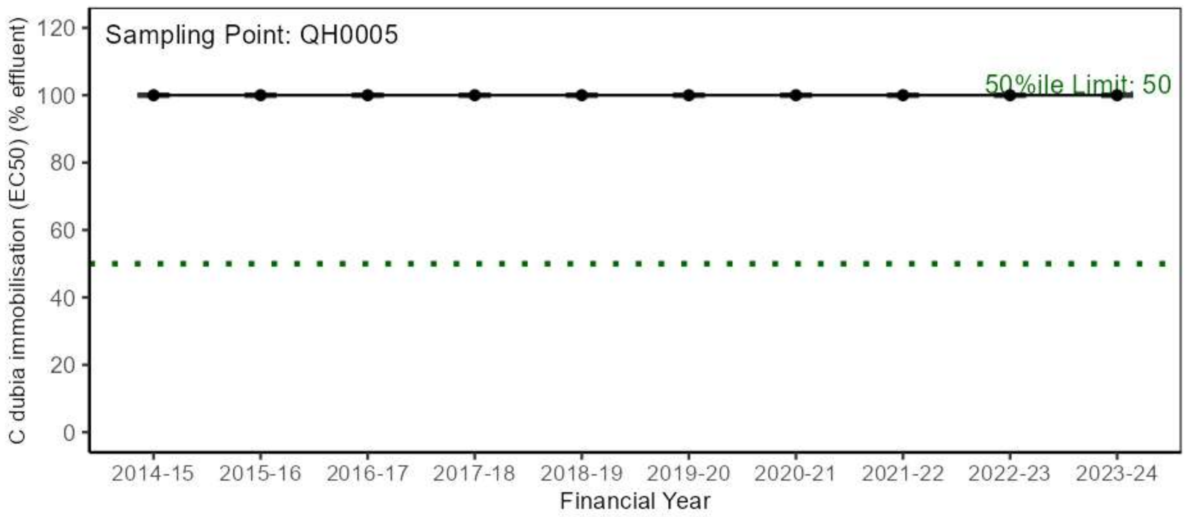
Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)



Statistical test not conducted as >90% of results were below detection limits.

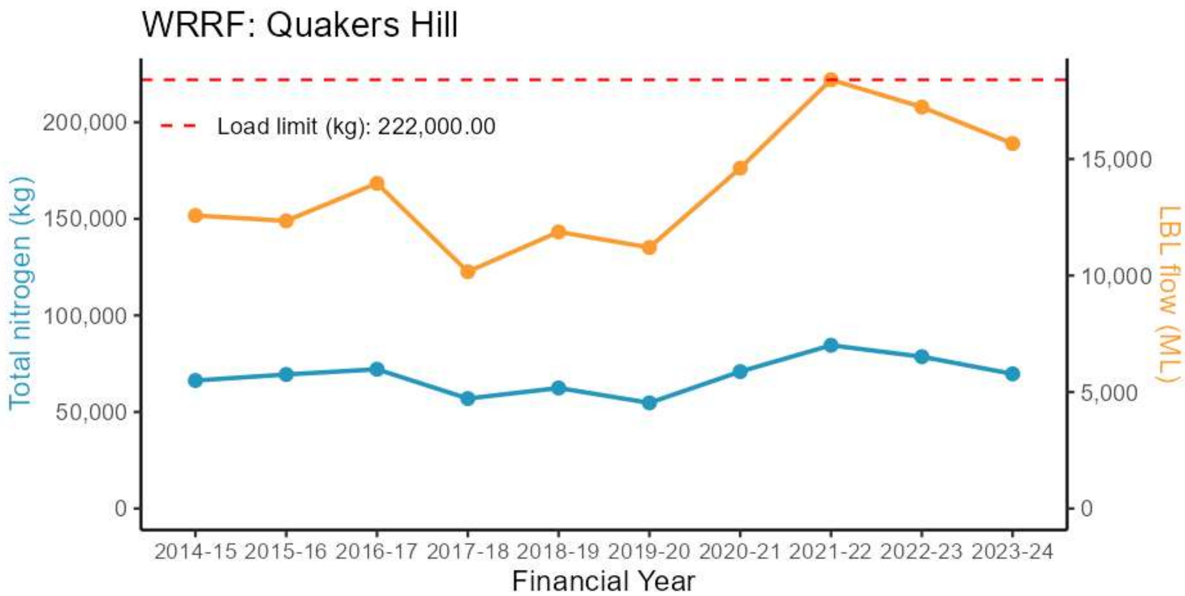
A.9.3. Pressure - Wastewater toxicity

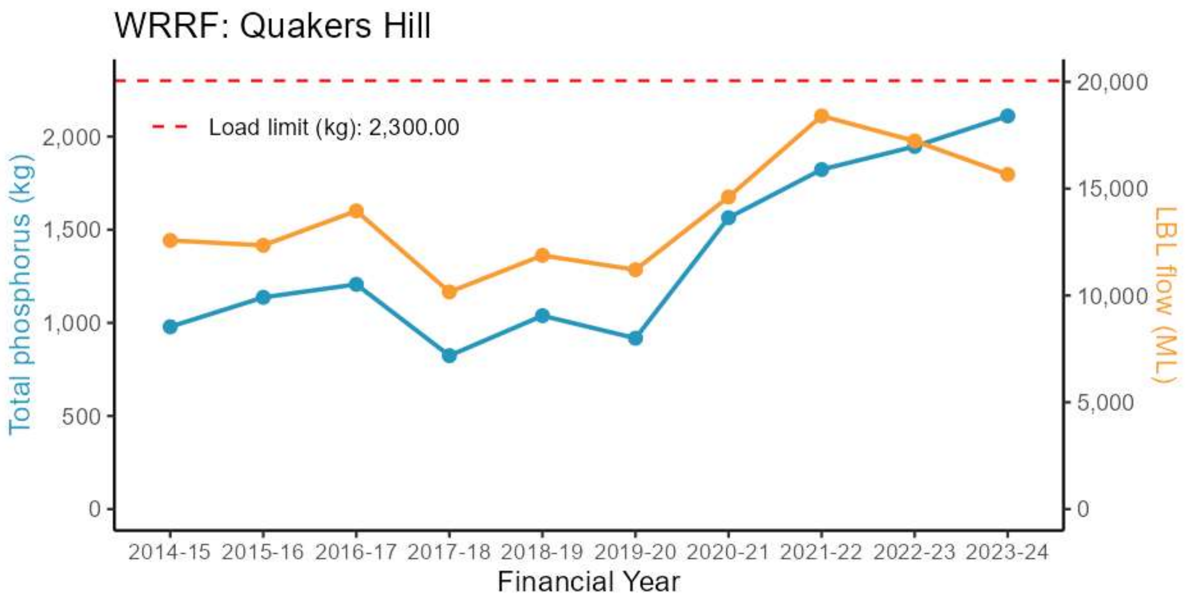


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

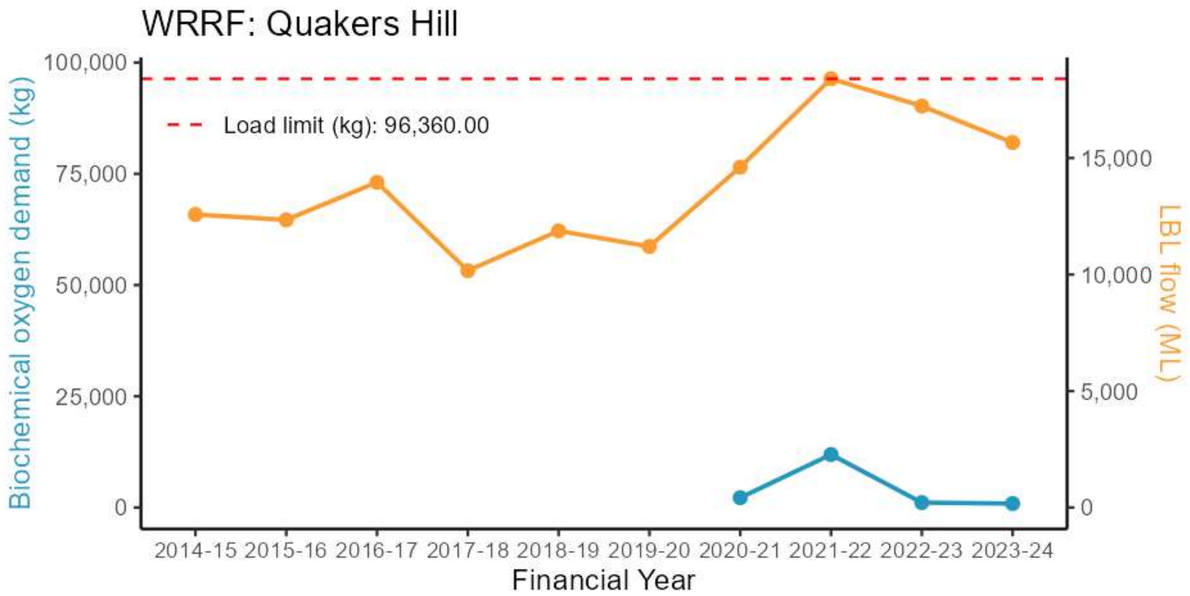
A.9.4. Pressure – Wastewater discharge load

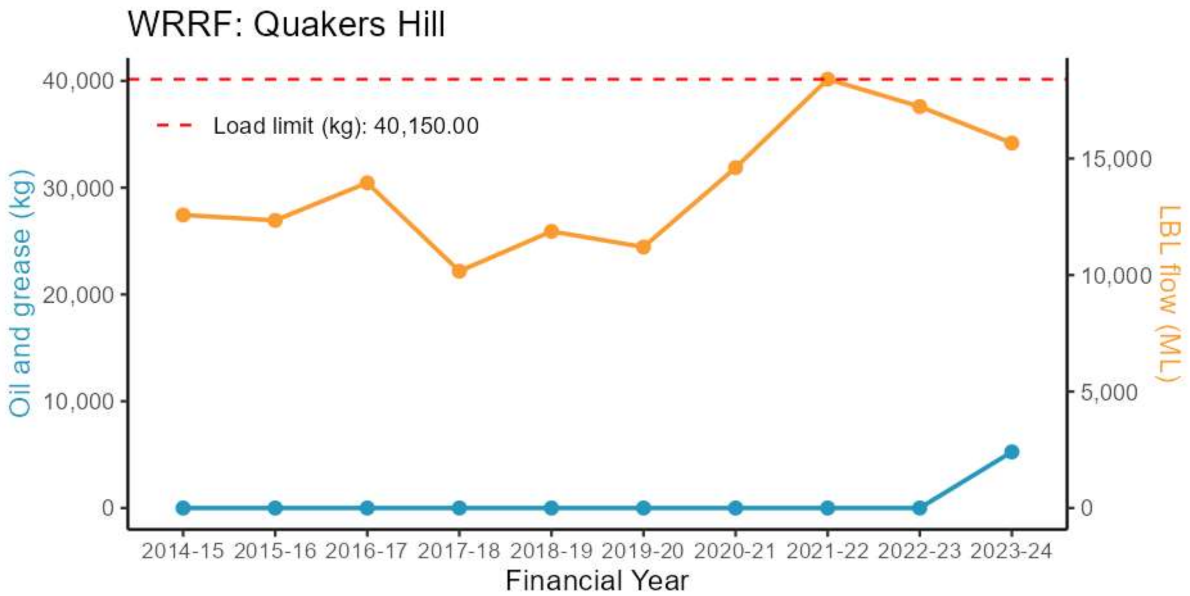
Nutrients

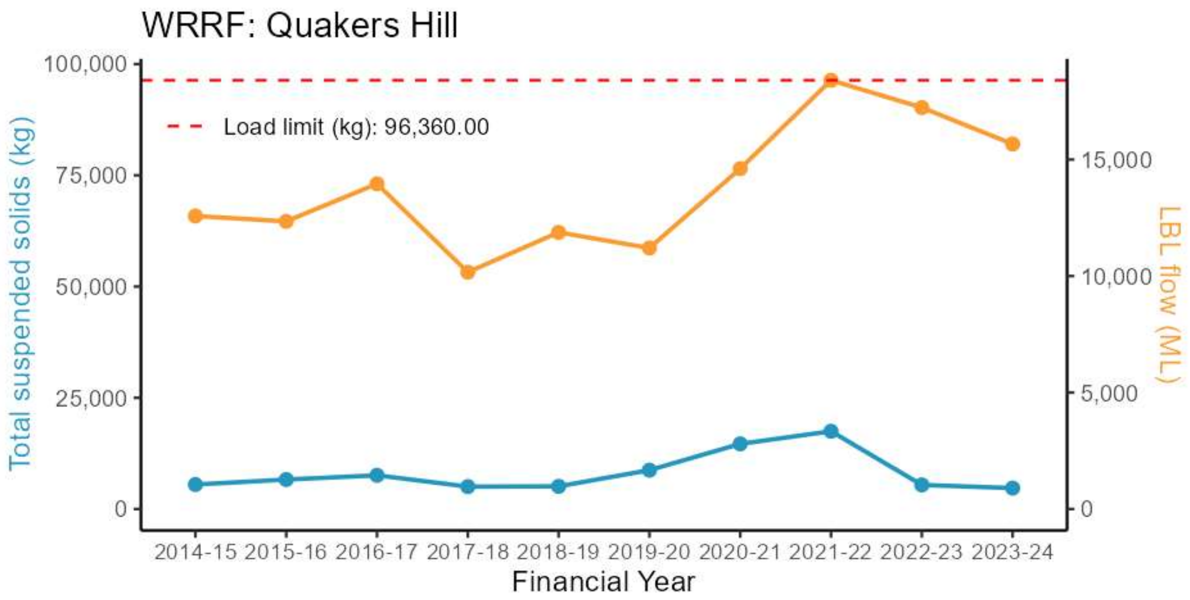




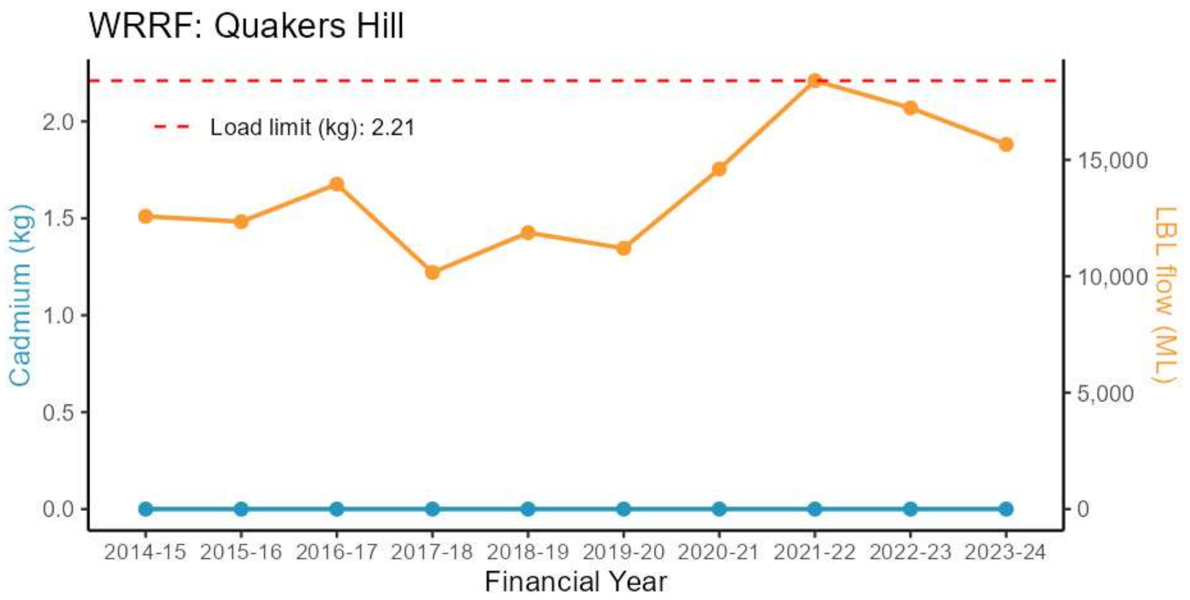
Major conventional analytes

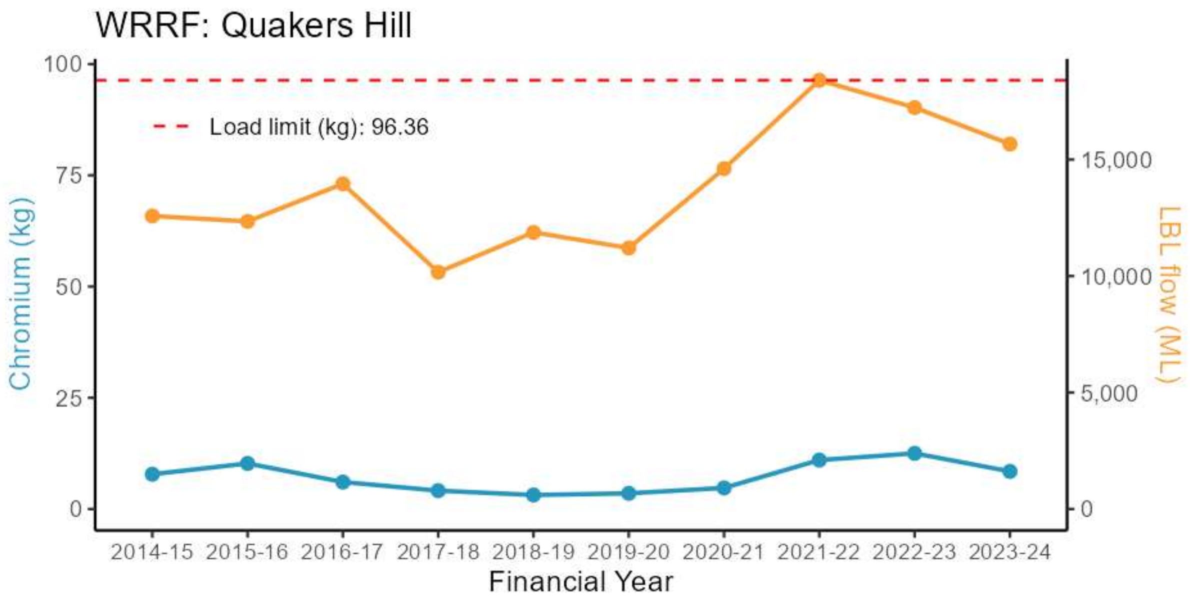


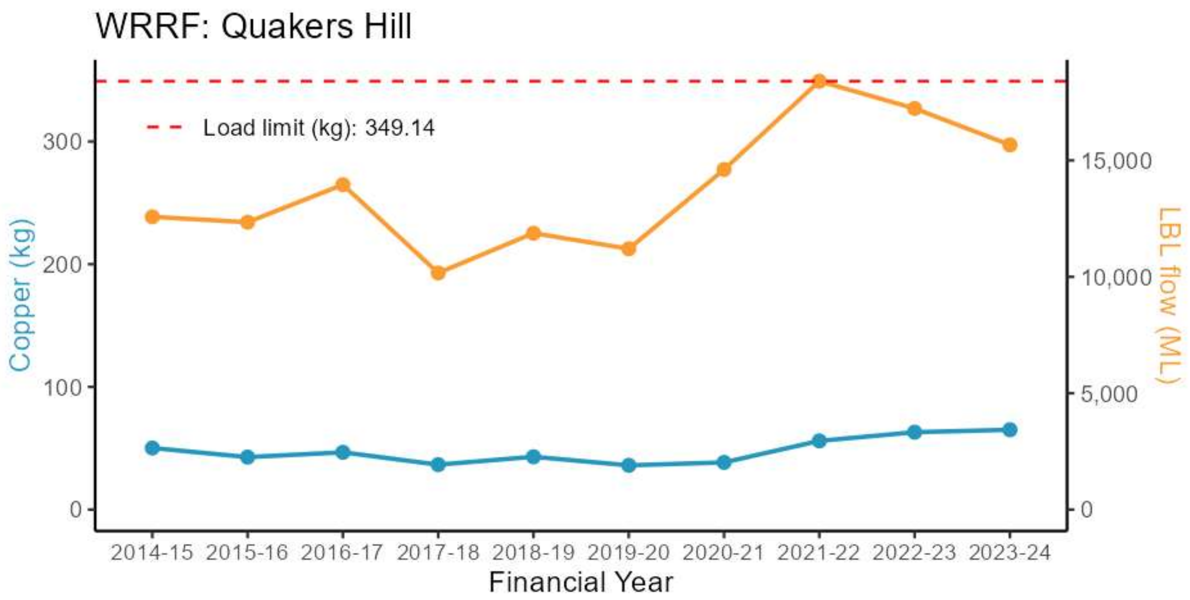


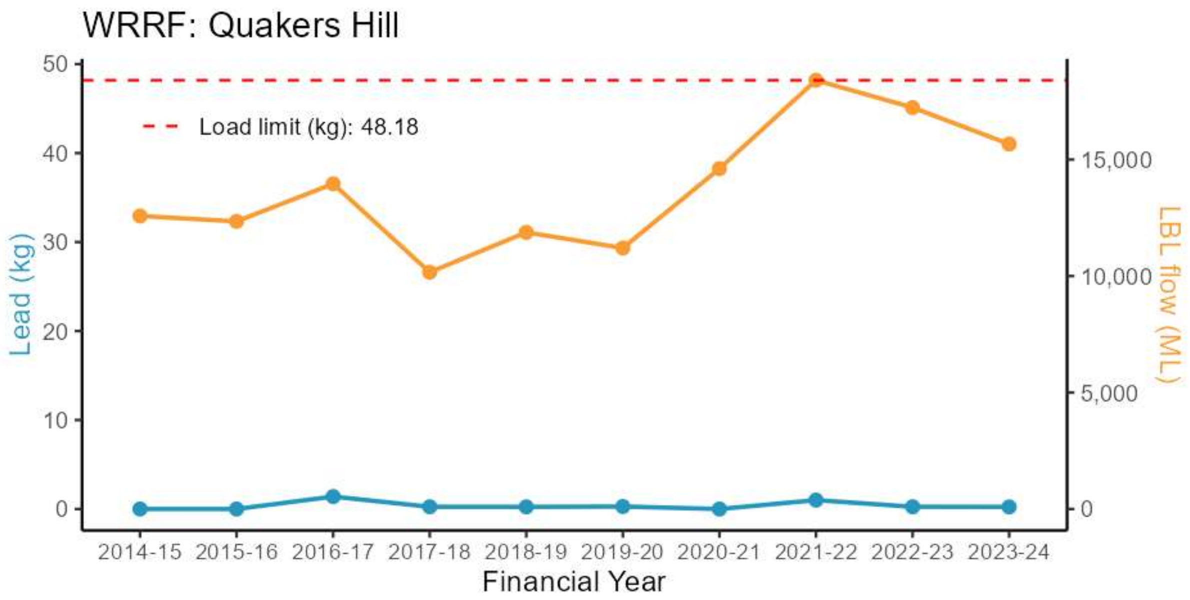


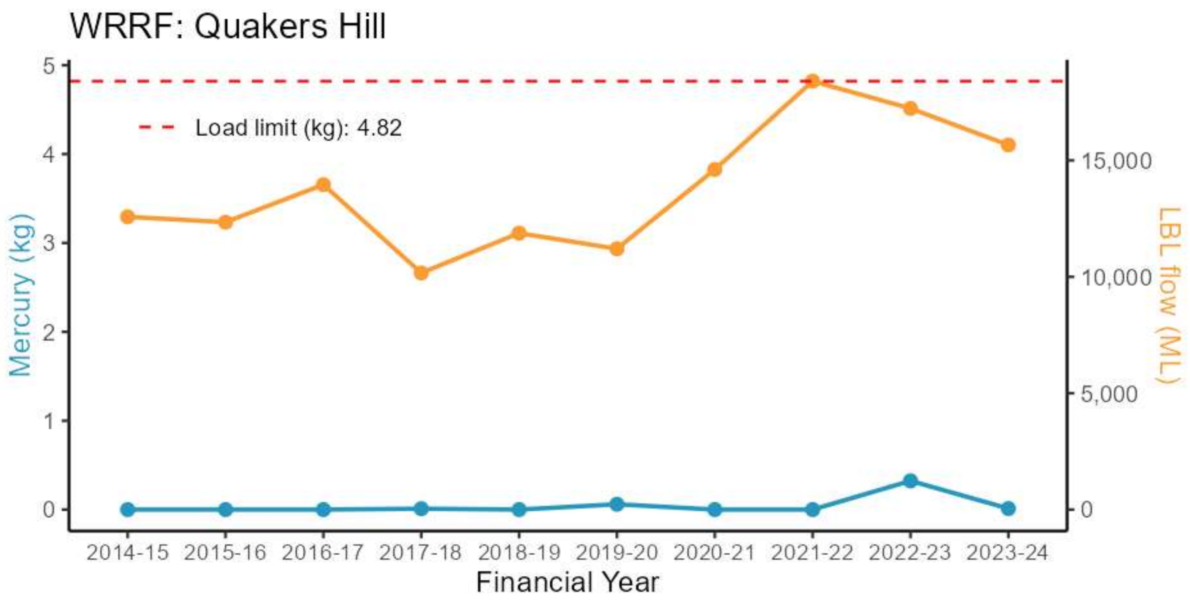
Trace metals

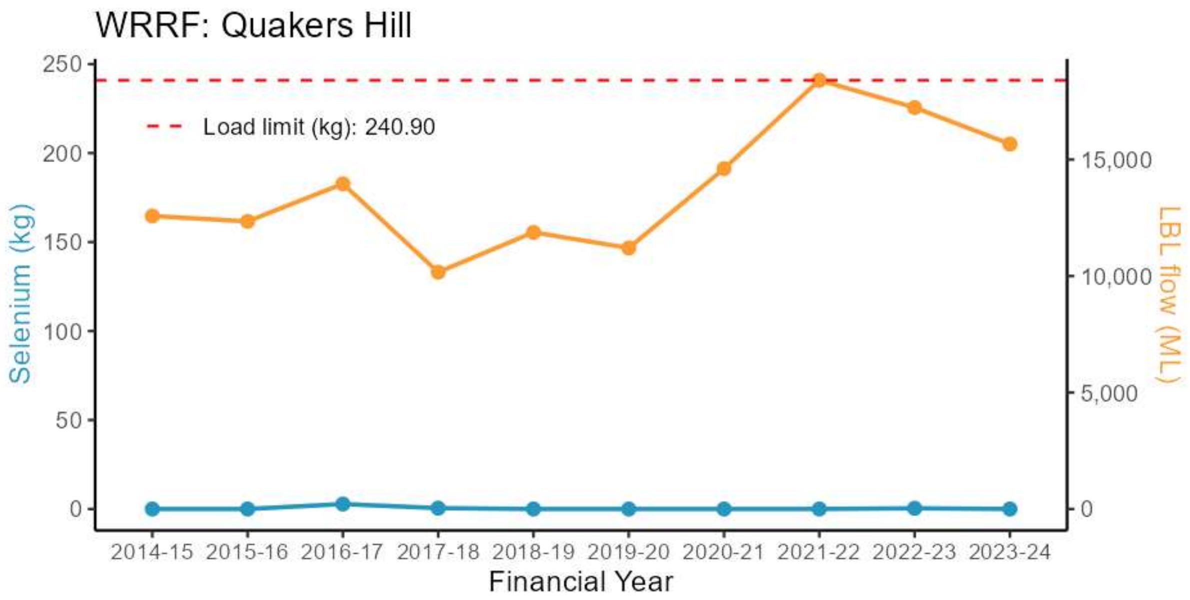


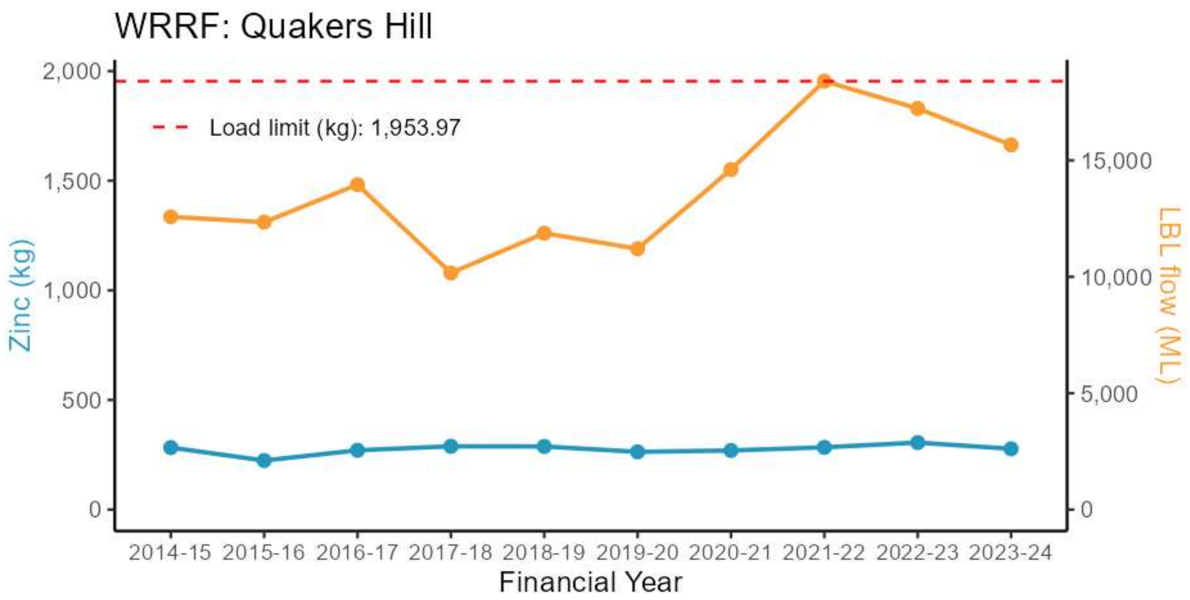

WRRF: Quakers Hill
Load limit (kg): 96.36
Chromium (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
0
25
50
75
100
5,000
10,000
15,000


WRRF: Quakers Hill
Load limit (kg): 349.14
Copper (kg)
LBL flow (ML)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
0
100
200
300
5,000
10,000
15,000

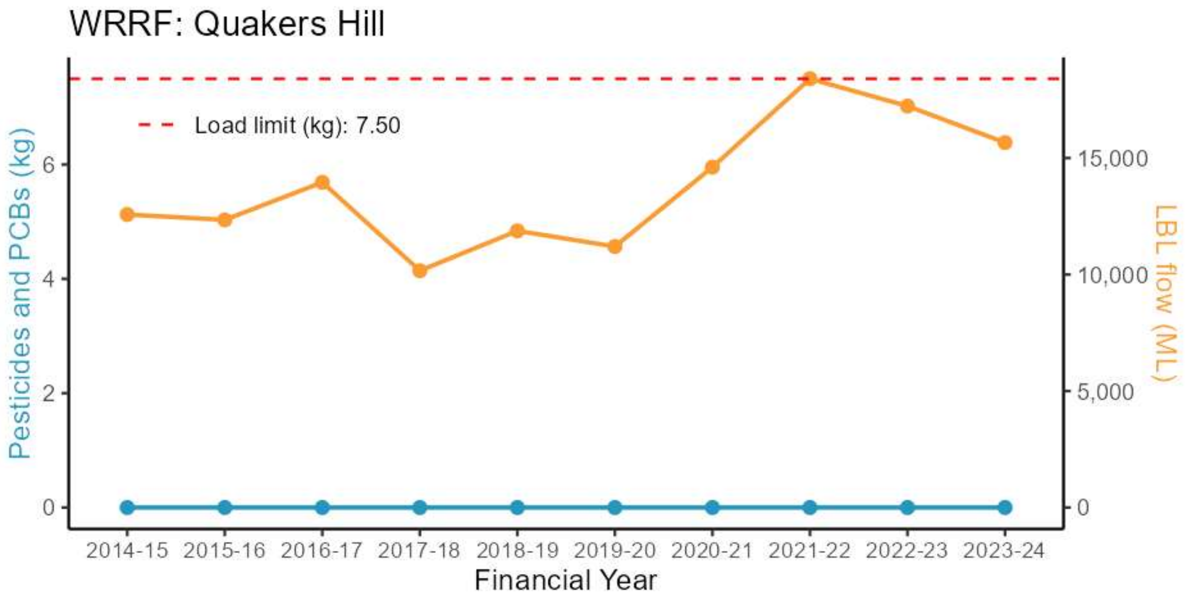

WRRF: Quakers Hill
Load limit (kg): 48.18
Lead (kg)
LBL flow (ML)
50
40
30
20
10
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: Quakers Hill
Load limit (kg): 4.82
Mercury (kg)
LBL flow (ML)
5
4
3
2
1
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: Quakers Hill
Load limit (kg): 240.90
Selenium (kg)
LBL flow (ML)
250
200
150
100
50
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


WRRF: Quakers Hill
Load limit (kg): 1,953.97
Zinc (kg)
LBL flow (ML)
2,000
1,500
1,000
500
0
15,000
10,000
5,000
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

Other chemicals and organics (including pesticides)



A.9.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-17 Downstream vs upstream comparison (current period) contrast outcomes for Quakers Hill WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Breakfast Ck	NS090 vs NS087	Total ammonia nitrogen	0.35	0.14	130	-2.55	0.057
Breakfast Ck	NS090 vs NS087	Oxidised nitrogen	13.26	4.49	130	7.63	<0.001
Breakfast Ck	NS090 vs NS087	Total nitrogen	3.50	0.44	130	9.86	<0.001
Breakfast Ck	NS090 vs NS087	Filterable total phosphorus	1.61	0.31	130	2.44	0.075
Breakfast Ck	NS090 vs NS087	Total phosphorus	1.17	0.21	130	0.87	0.820
Breakfast Ck	NS090 vs NS087	Conductivity	0.90	0.15	130	-0.63	0.923
Breakfast Ck	NS090 vs NS087	Dissolved oxygen	1.33	0.09	130	4.30	<0.001
Breakfast Ck	NS090 vs NS087	Dissolved oxygen saturation	26.92	3.76	130	7.16	<0.001
Breakfast Ck	NS090 vs NS087	pH	-0.08	0.06	130	-1.35	0.530
Breakfast Ck	NS090 vs NS087	Water temperature	1.17	0.11	130	1.80	0.278
Breakfast Ck	NS090 vs NS087	Turbidity	0.20	0.07	130	-4.40	<0.001
Breakfast Ck	NS090 vs NS087	Chlorophyll - a	0.45	0.16	130	-2.25	0.115

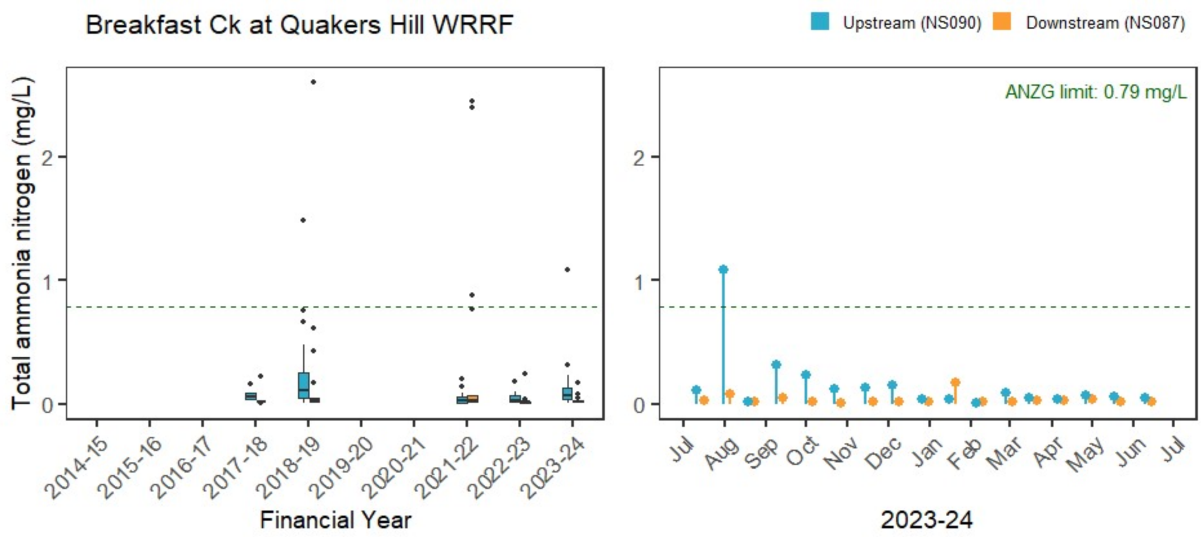
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

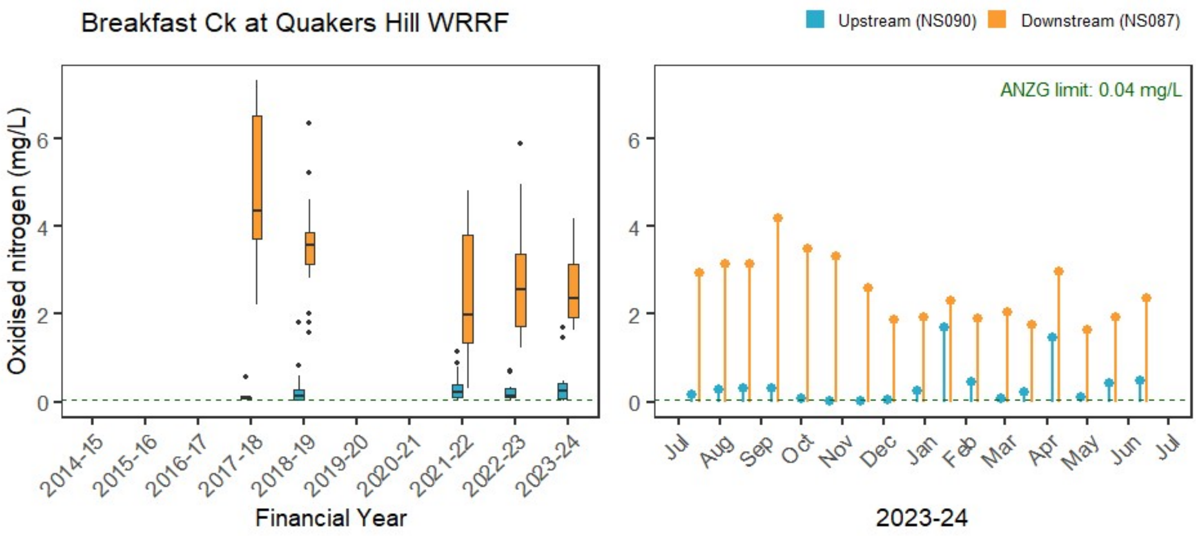
Table A-18 Current period vs previous period comparison (single site) contrast outcomes for Quakers Hill WRRF

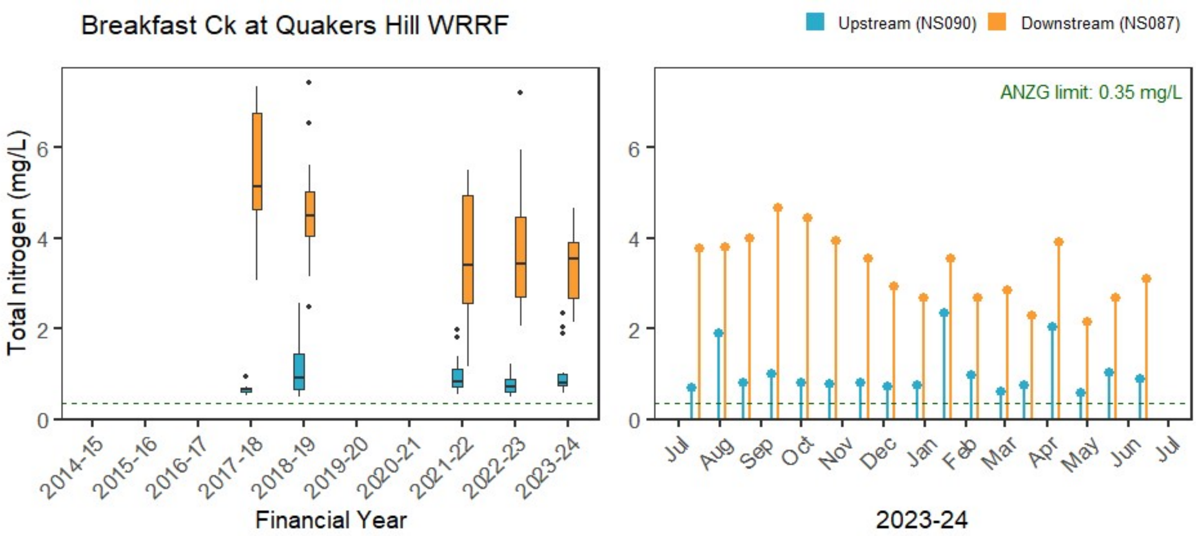
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Breakfast Ck	NS090	Total ammonia nitrogen	1.73	0.58	130	1.62	0.373
Breakfast Ck	NS090	Oxidised nitrogen	1.31	0.36	130	0.99	0.756
Breakfast Ck	NS090	Total nitrogen	1.05	0.11	130	0.52	0.955
Breakfast Ck	NS090	Filterable total phosphorus	1.10	0.17	130	0.60	0.931
Breakfast Ck	NS090	Total phosphorus	1.06	0.15	130	0.37	0.982
Breakfast Ck	NS090	Conductivity	1.01	0.13	130	0.04	1.000
Breakfast Ck	NS090	Dissolved oxygen	0.95	0.05	130	-1.03	0.729
Breakfast Ck	NS090	Dissolved oxygen saturation	-4.04	3.06	130	-1.32	0.552
Breakfast Ck	NS090	pH	-0.08	0.05	130	-1.73	0.312
Breakfast Ck	NS090	Water temperature	1.00	0.07	130	-0.07	1.000
Breakfast Ck	NS090	Turbidity	1.03	0.31	130	0.10	1.000
Breakfast Ck	NS090	Chlorophyll - a	0.62	0.18	130	-1.64	0.360
Breakfast Ck	NS087	Total ammonia nitrogen	0.71	0.24	130	-1.02	0.739
Breakfast Ck	NS087	Oxidised nitrogen	0.97	0.27	130	-0.10	1.000
Breakfast Ck	NS087	Total nitrogen	0.88	0.09	130	-1.28	0.580
Breakfast Ck	NS087	Filterable total phosphorus	1.44	0.23	130	2.31	0.100
Breakfast Ck	NS087	Total phosphorus	1.29	0.19	130	1.72	0.316
Breakfast Ck	NS087	Conductivity	1.03	0.14	130	0.23	0.996
Breakfast Ck	NS087	Dissolved oxygen	1.01	0.05	130	0.12	0.999
Breakfast Ck	NS087	Dissolved oxygen saturation	0.38	3.06	130	0.12	0.999
Breakfast Ck	NS087	pH	-0.02	0.05	130	-0.40	0.979
Breakfast Ck	NS087	Water temperature	0.95	0.07	130	-0.78	0.866
Breakfast Ck	NS087	Turbidity	1.06	0.32	130	0.19	0.998
Breakfast Ck	NS087	Chlorophyll - a	0.58	0.17	130	-1.92	0.223

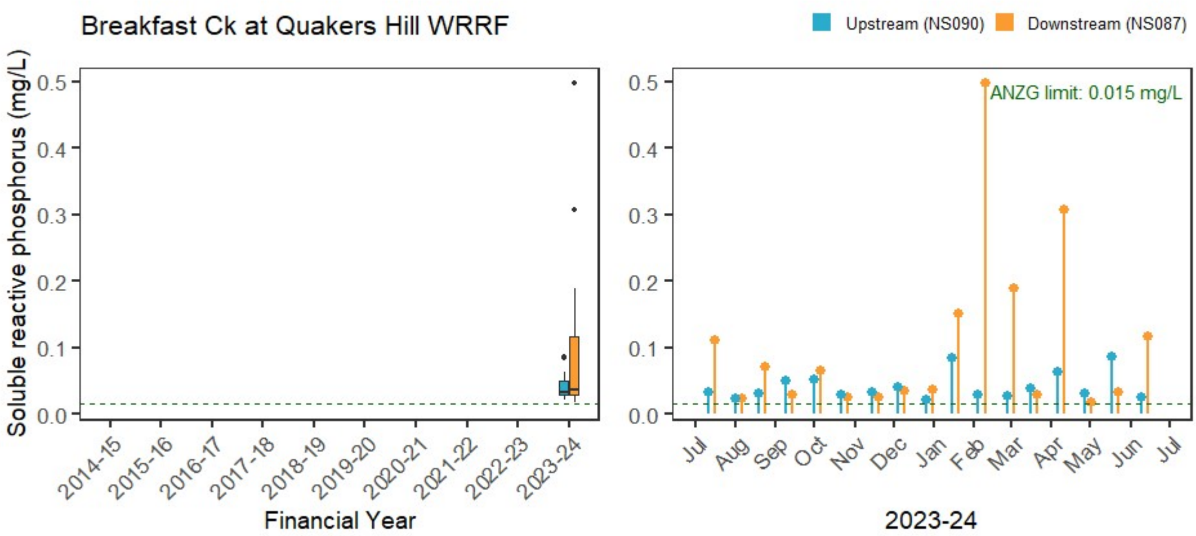
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

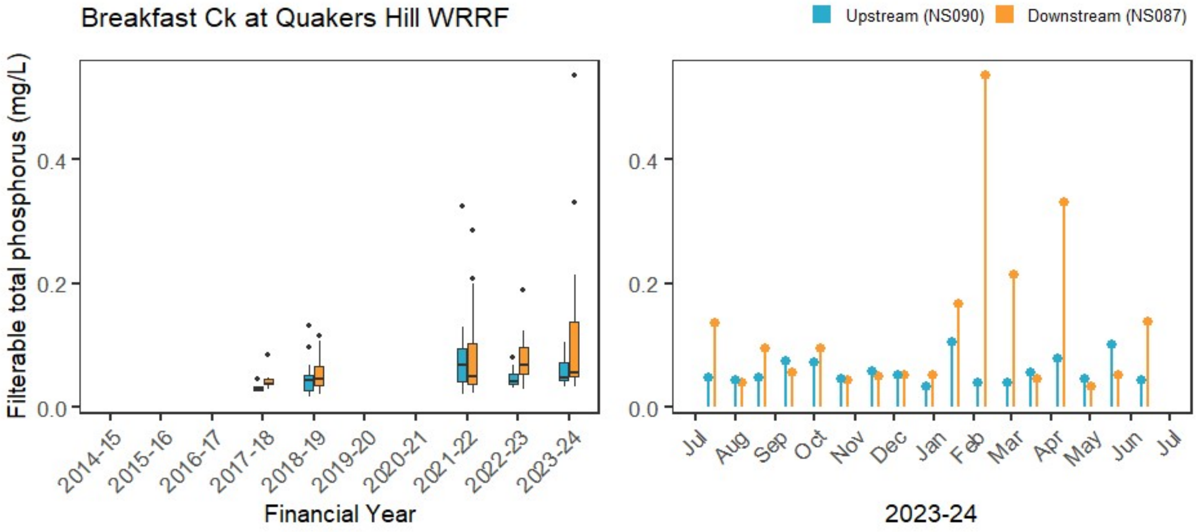
A.9.6. Stressor – Nutrients

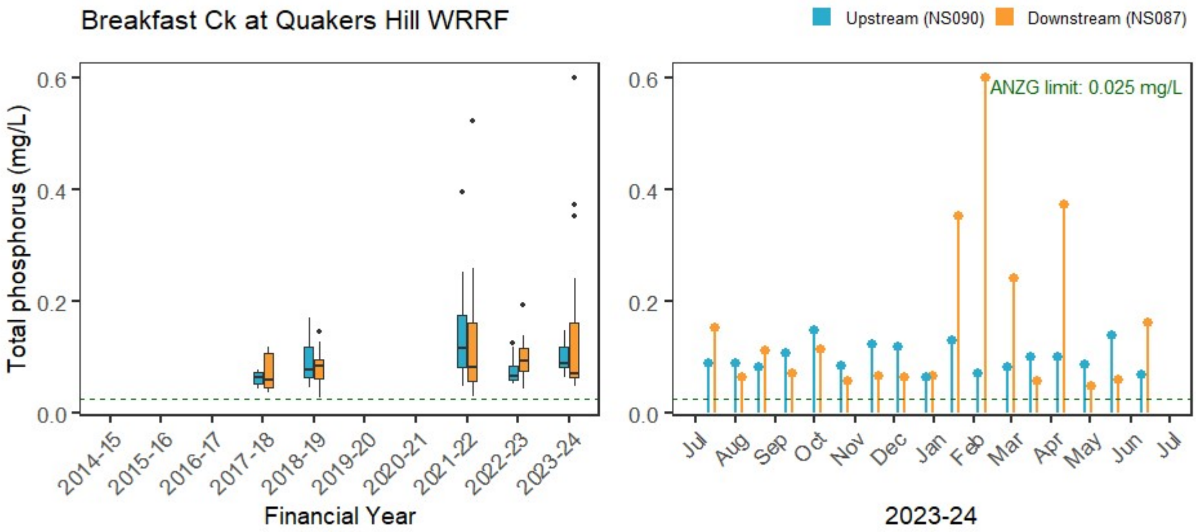



Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
Financial Year
2023-24

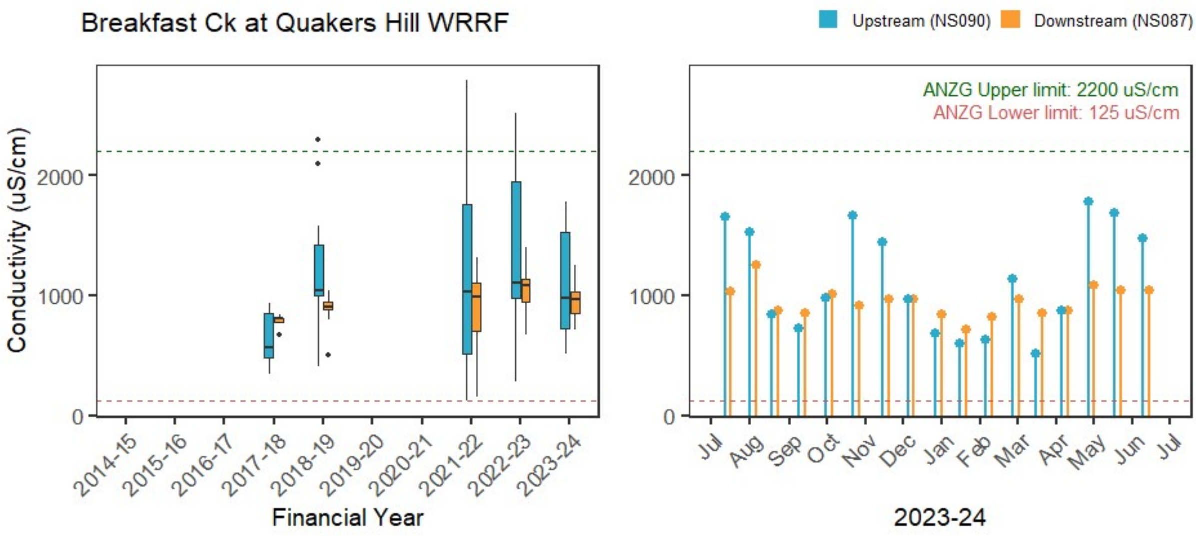

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24

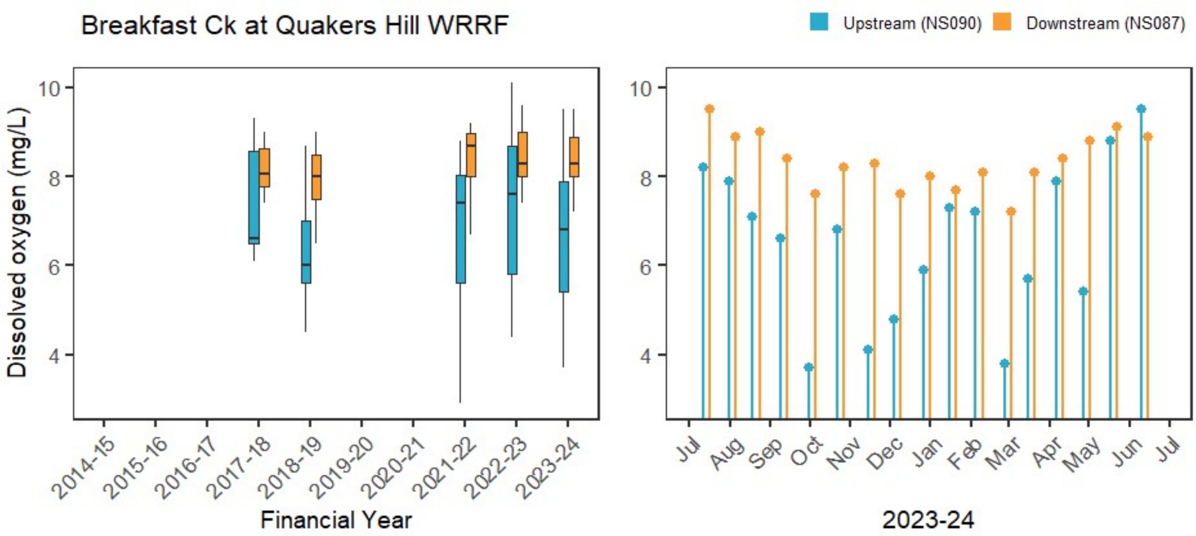

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24

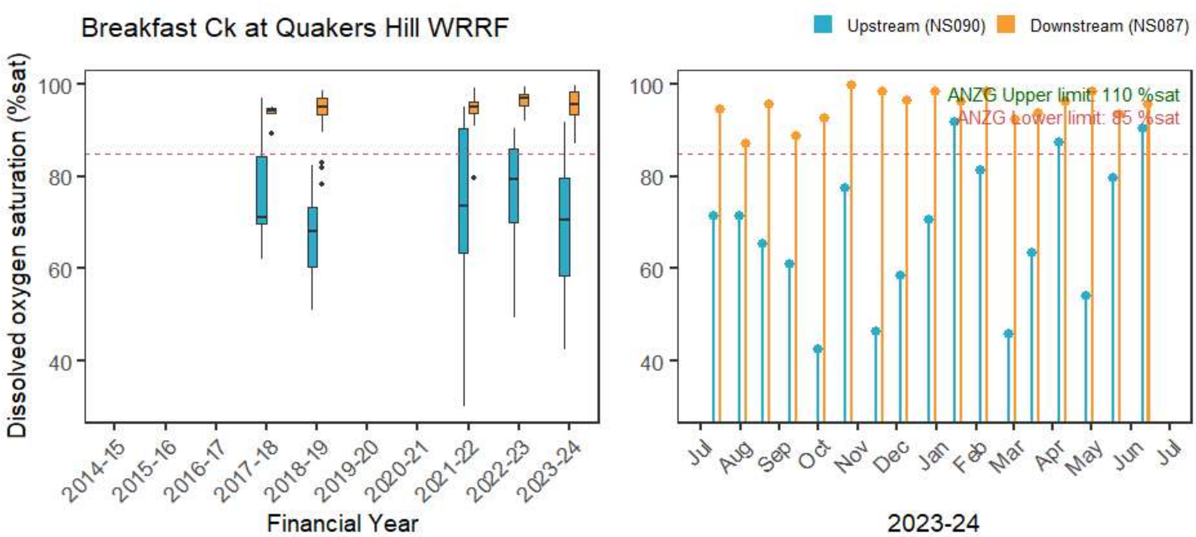

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Filterable total phosphorus (mg/L)
0.0
0.2
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

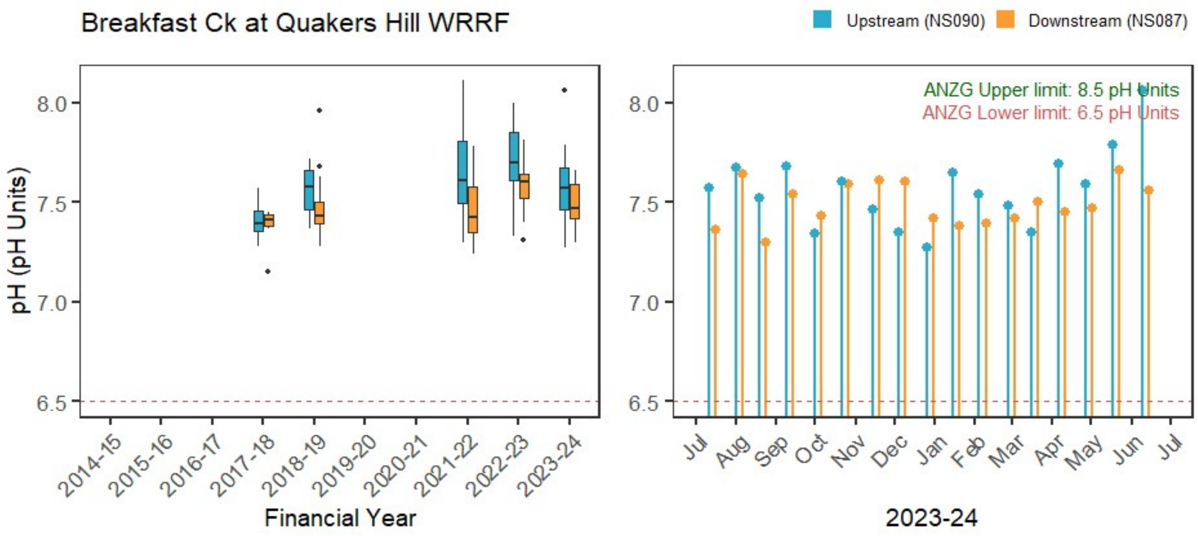

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Total phosphorus (mg/L)
0.0
0.2
0.4
0.6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG limit: 0.025 mg/L
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

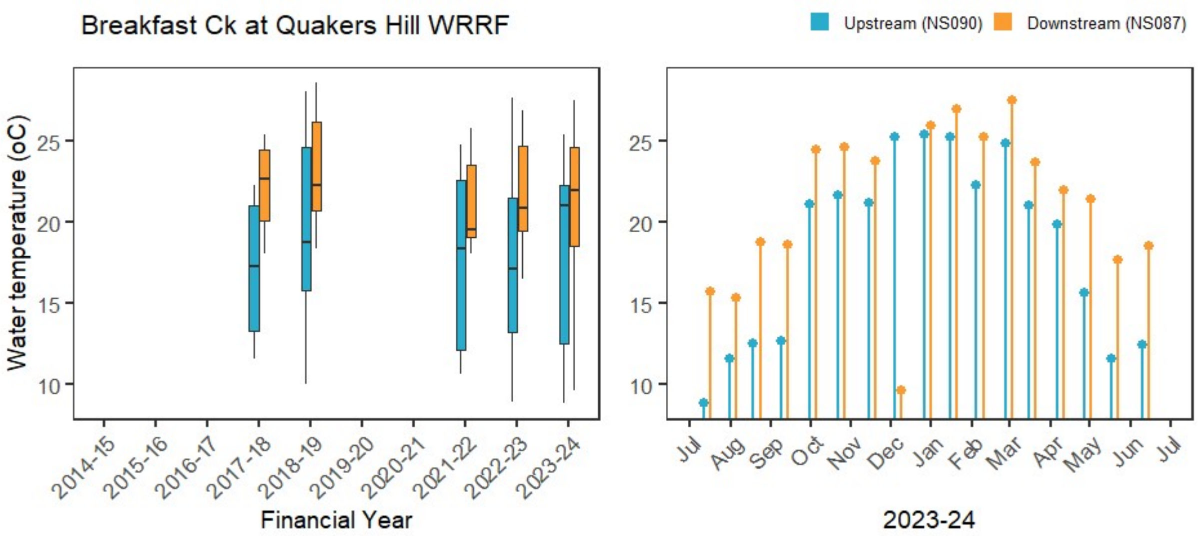
A.9.7. Stressor – Physico-chemical water quality

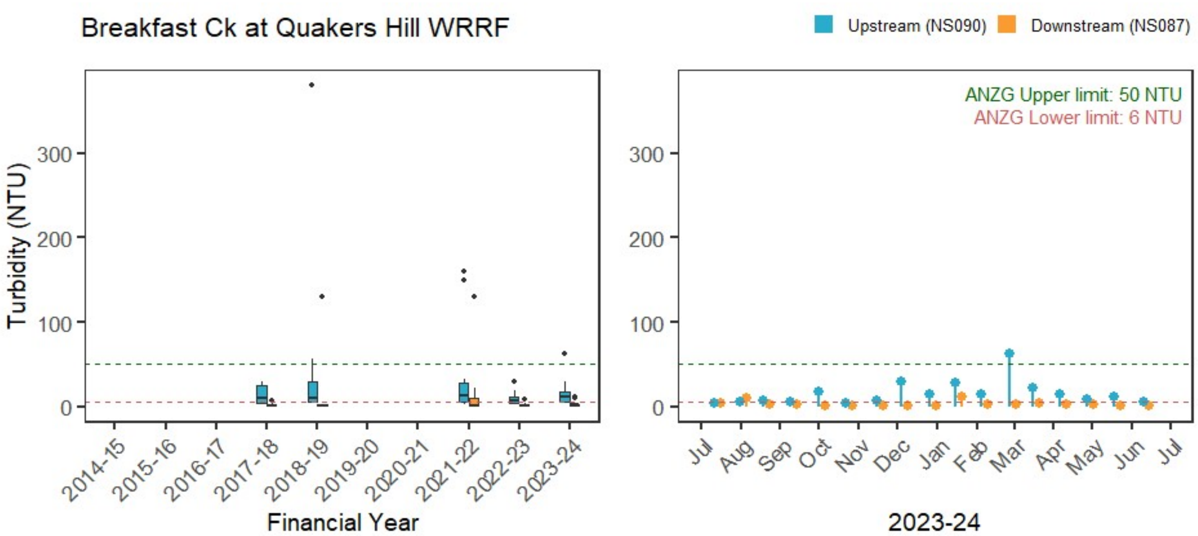




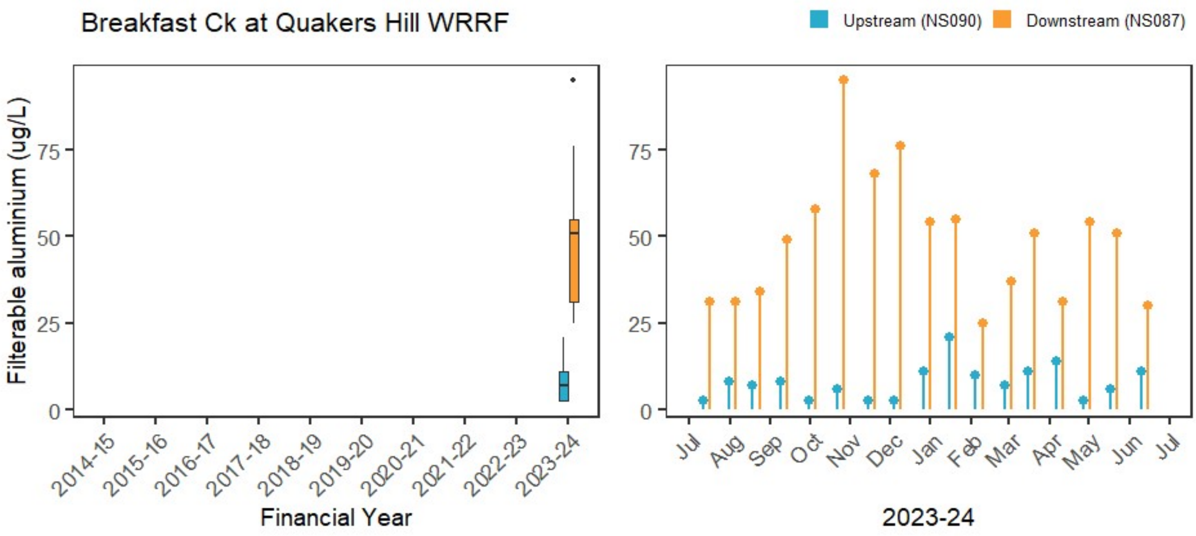


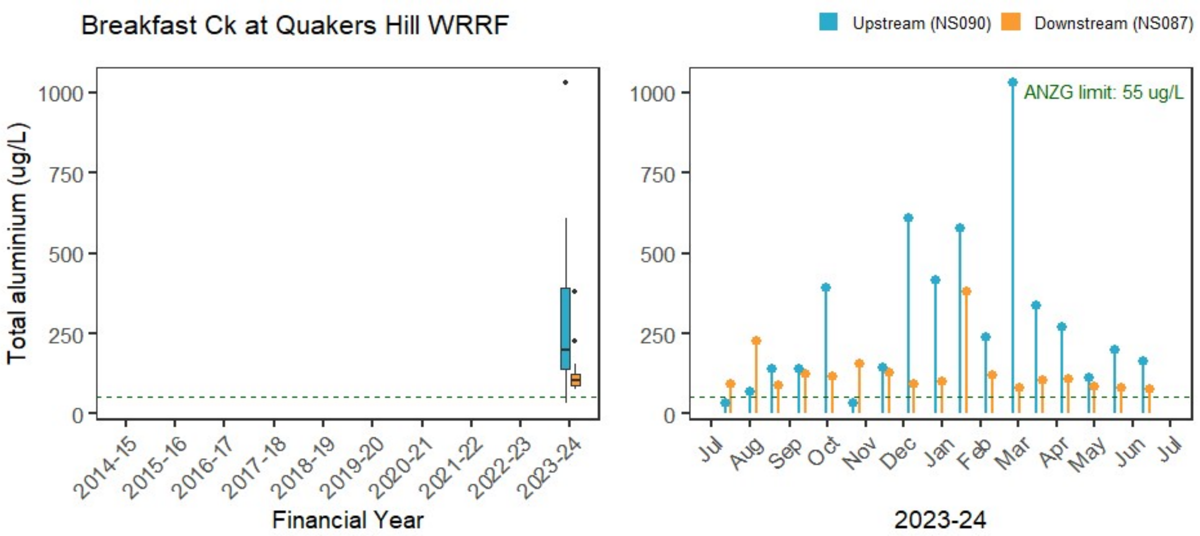

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
pH (pH Units)
8.0
7.5
7.0
6.5
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

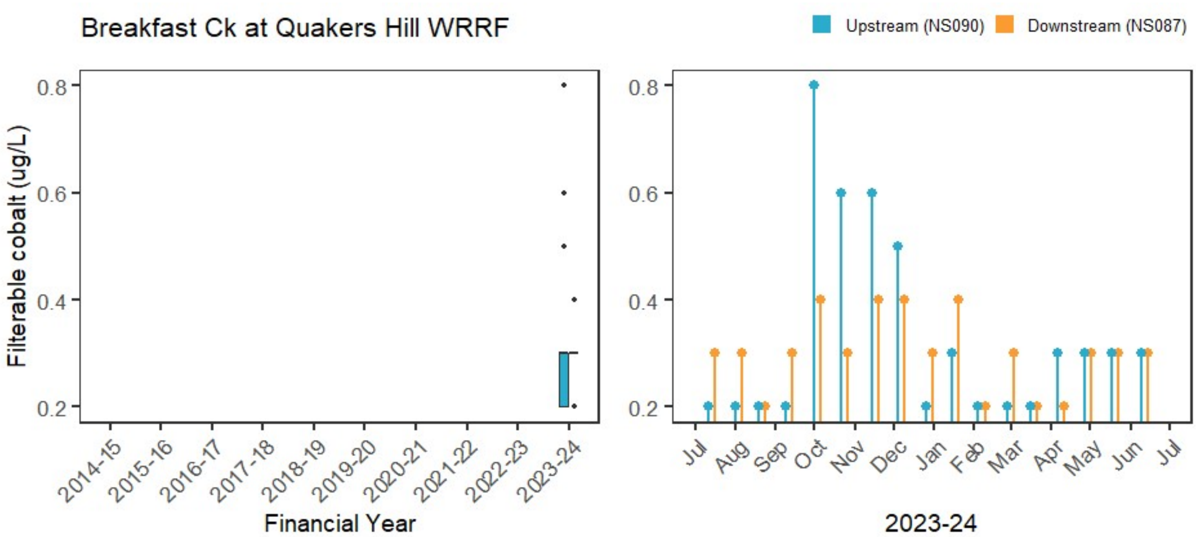

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Water temperature (oC)
25
20
15
10
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

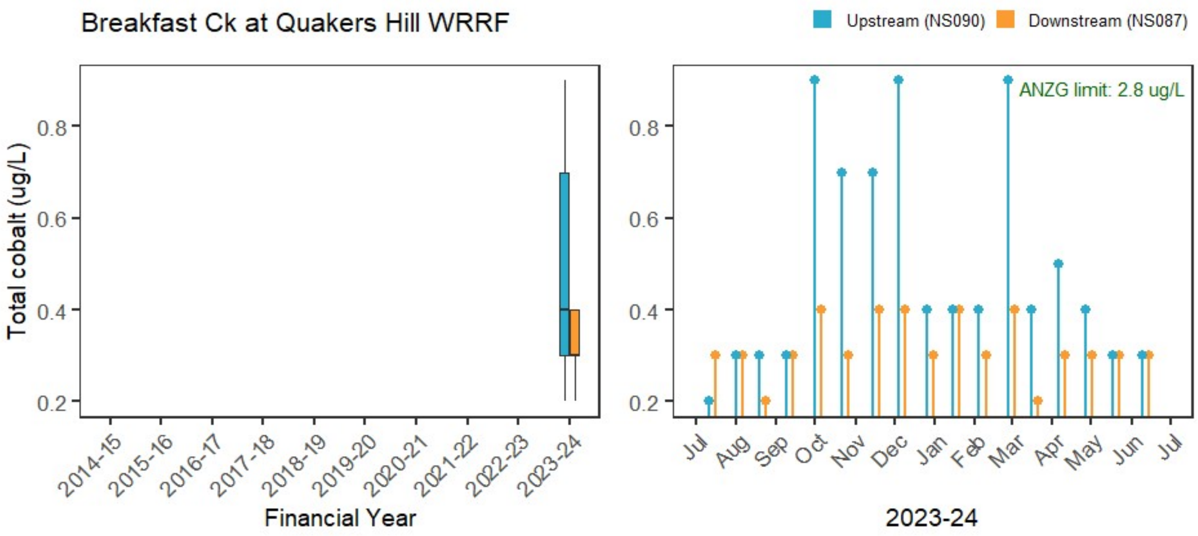

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Turbidity (NTU)
300
200
100
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

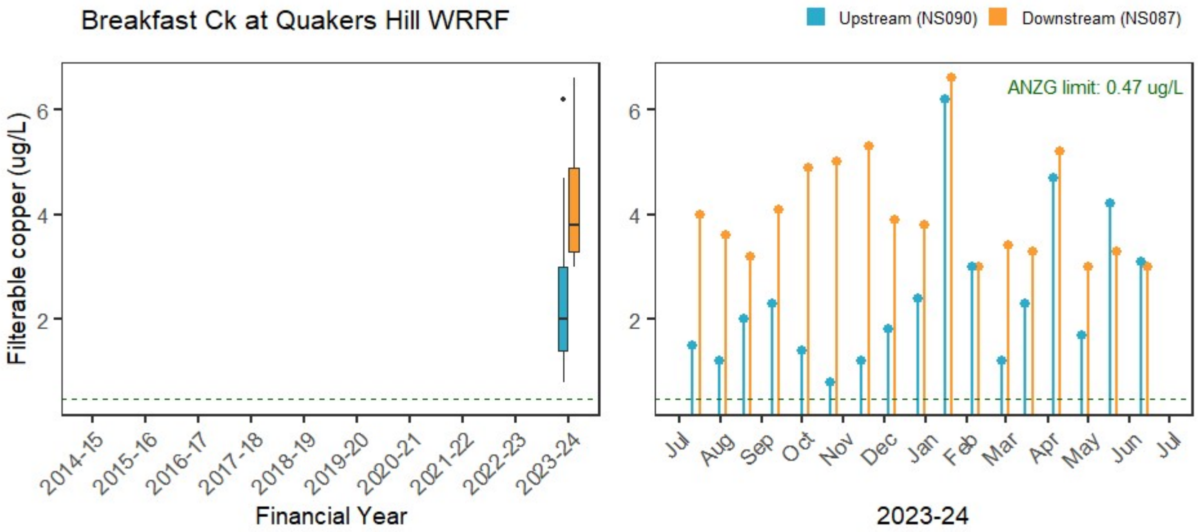
A.9.8. Stressor – Trace metals

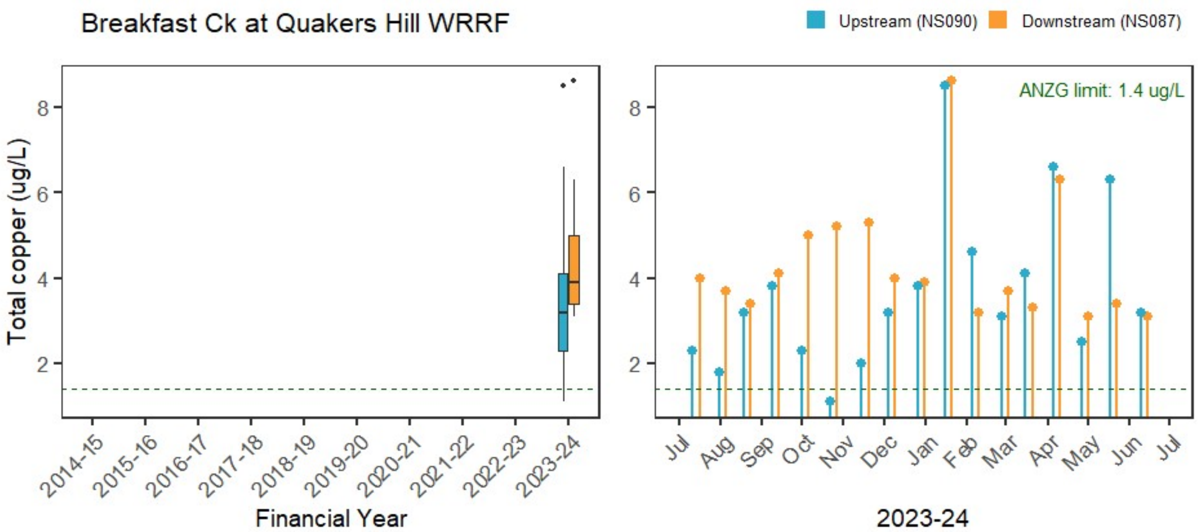


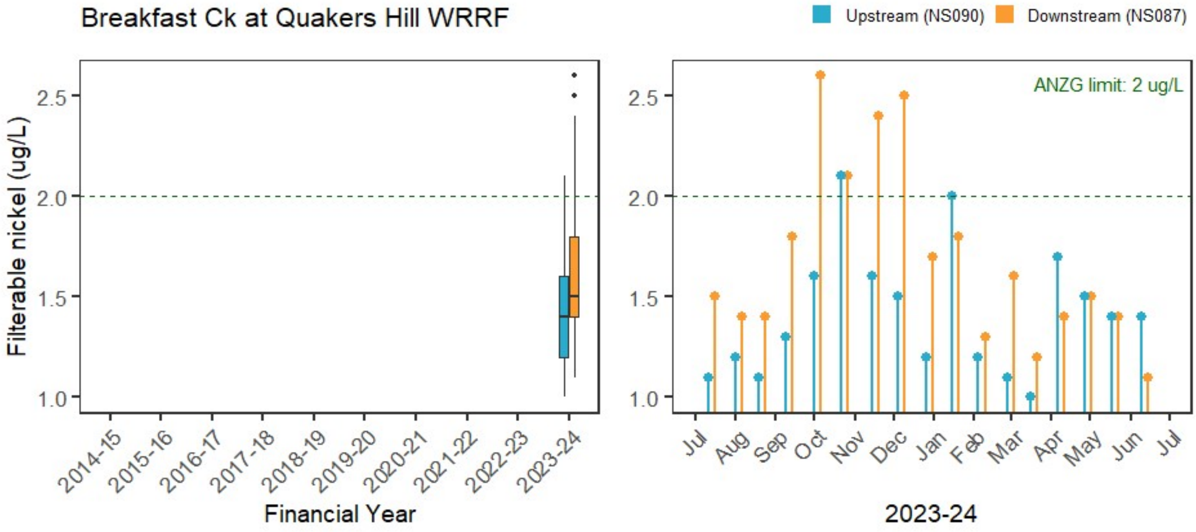


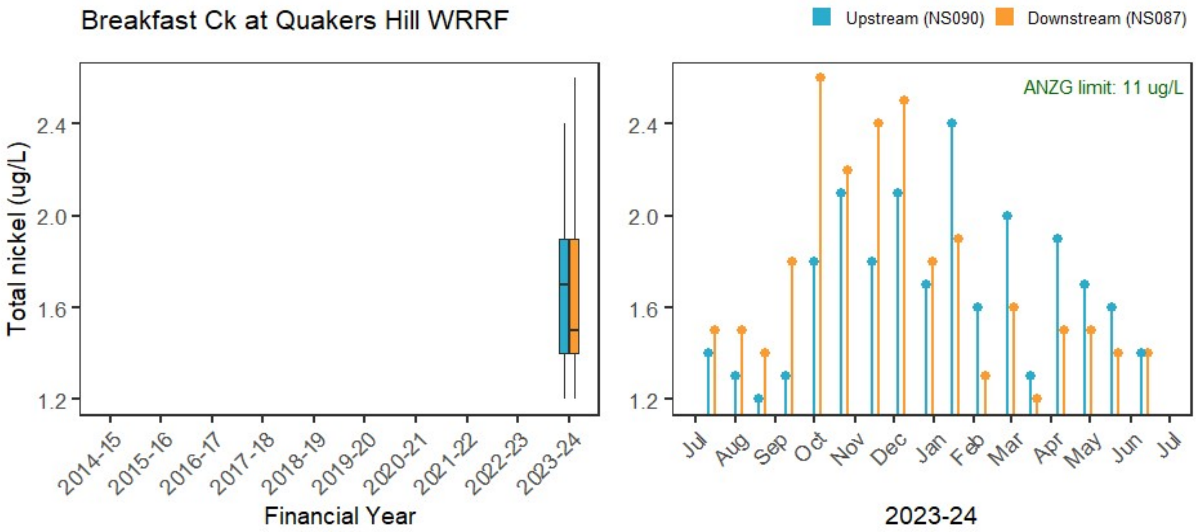


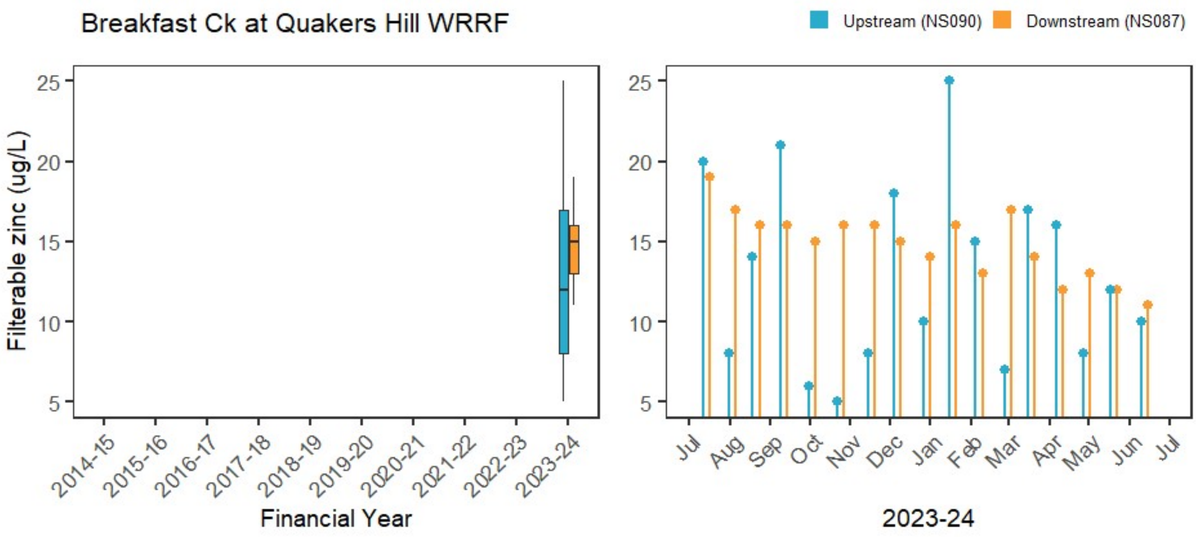

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
0.2
0.4
0.6
0.8
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

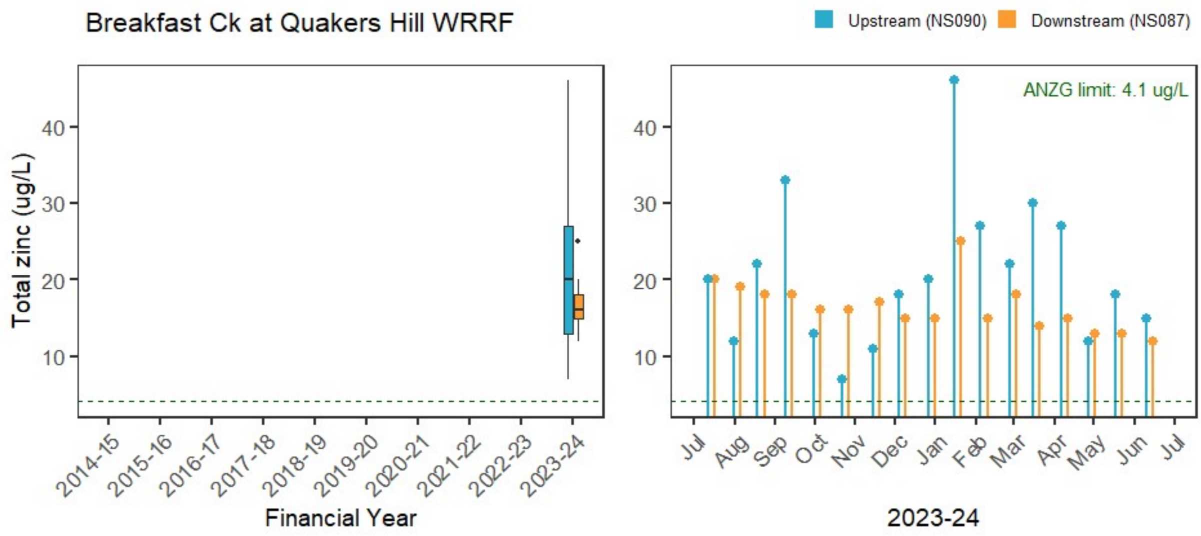

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
2
4
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Total copper (ug/L)
ANZG limit: 1.4 ug/L
2
4
6
8
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

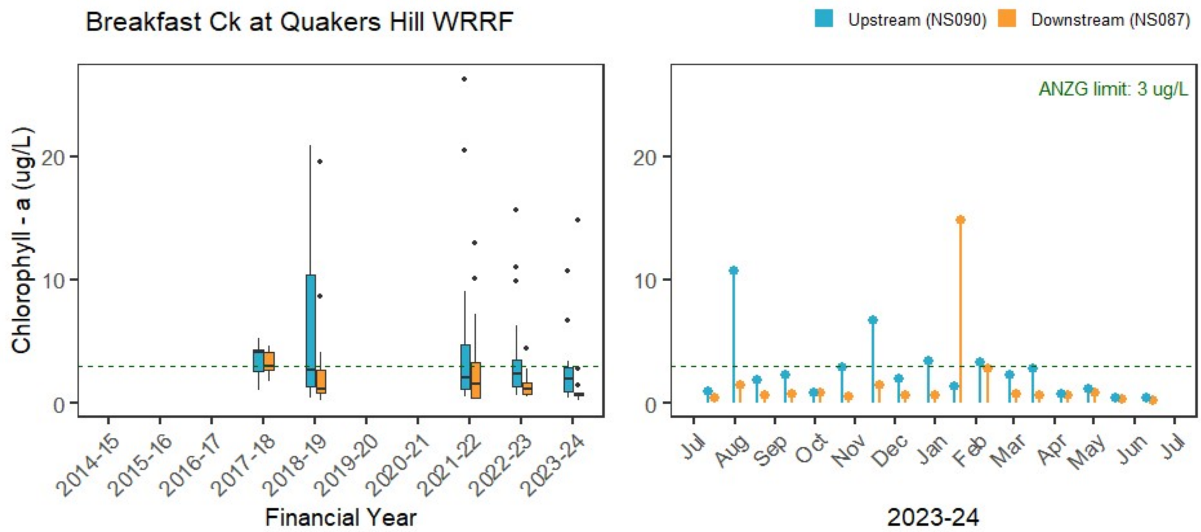

Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
ANZG limit: 2 ug/L
Filterable nickel (ug/L)
Financial Year
2023-24


Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
ANZG limit: 11 ug/L
Total nickel (ug/L)
Financial Year
2023-24


Breakfast Ck at Quakers Hill WRRF
Upstream (NS090)
Downstream (NS087)
Filterable zinc (ug/L)
Financial Year
2023-24



A.9.9. Ecosystem receptor – Phytoplankton



A.9.10. Ecosystem receptor – Macroinvertebrates

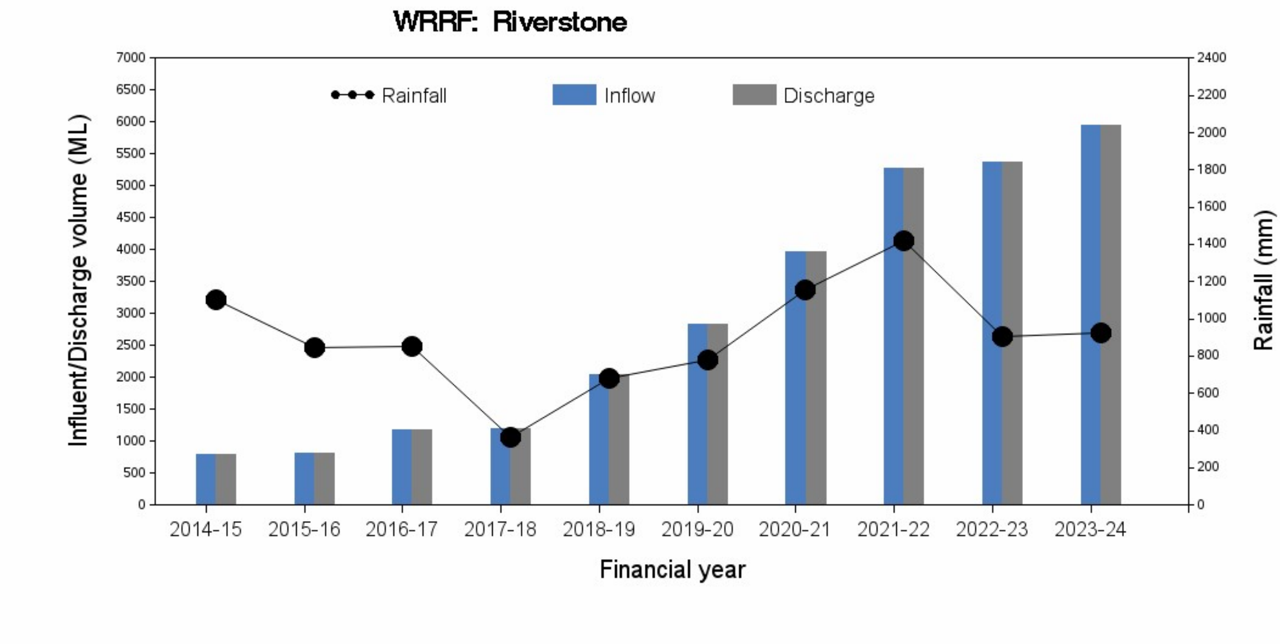
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Breakfast Creek	River (NS090 vs NS087)	Welch Two Sample t-test	-0.64	-2.43	10.0	0.036

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.10. Riverstone WRRF

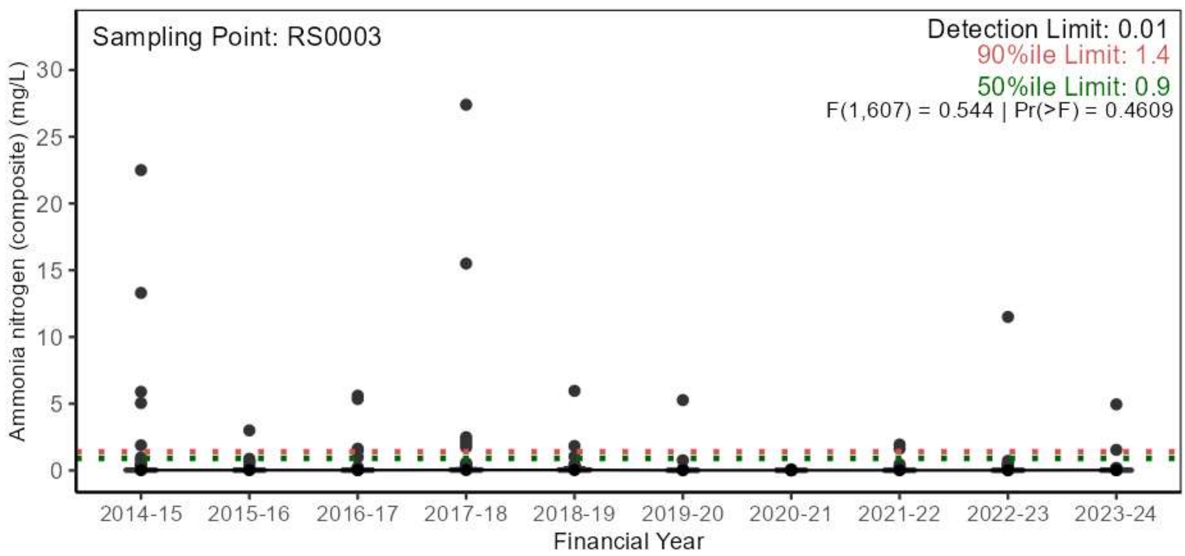
A.10.1. Pressure – Wastewater quantity

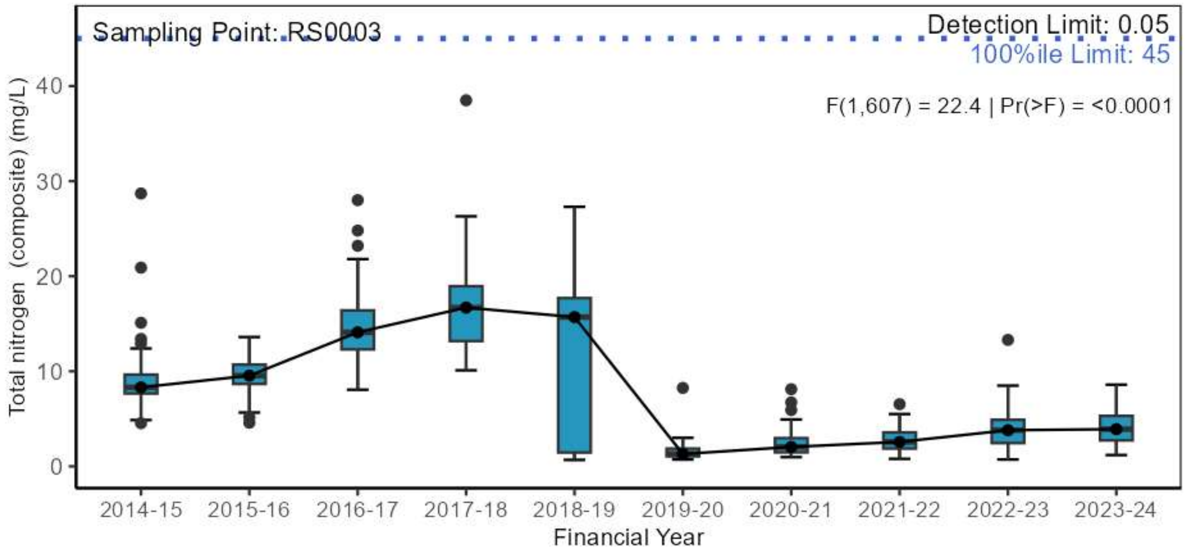
Inflow/discharge volume and rainfall

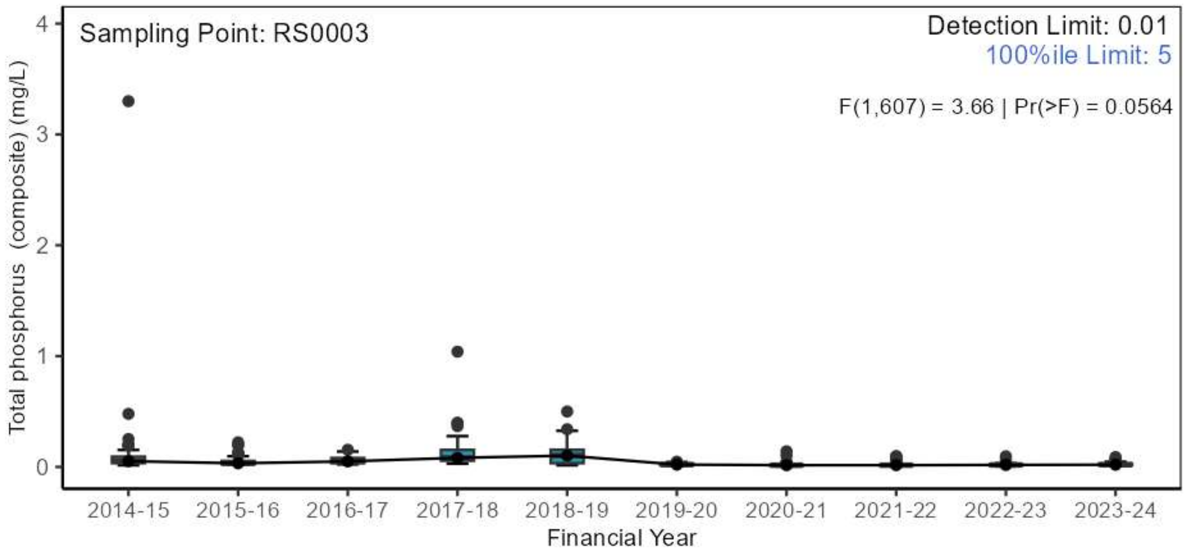


A.10.2. Pressure – Wastewater quality

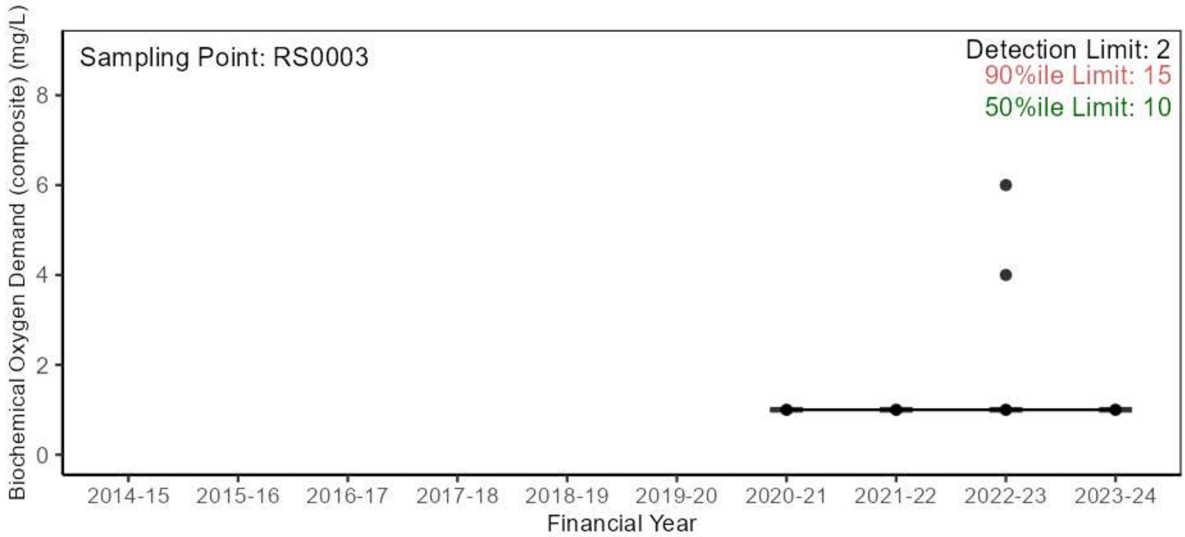
Nutrients



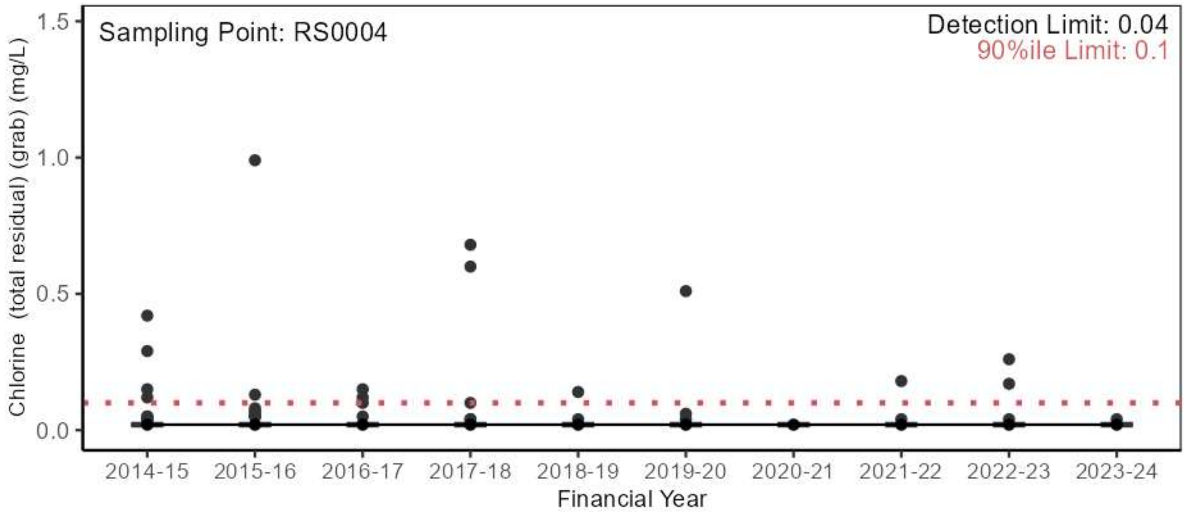

Sampling Point: RS0003
Detection Limit: 0.05
100%ile Limit: 45
F(1,607) = 22.4 | Pr(>F) = <0.0001
Total nitrogen (composite) (mg/L)
0
10
20
30
40
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


Sampling Point: RS0003
Detection Limit: 0.01
100%ile Limit: 5
F(1,607) = 3.66 | Pr(>F) = 0.0564
Total phosphorus (composite) (mg/L)
0
1
2
3
4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

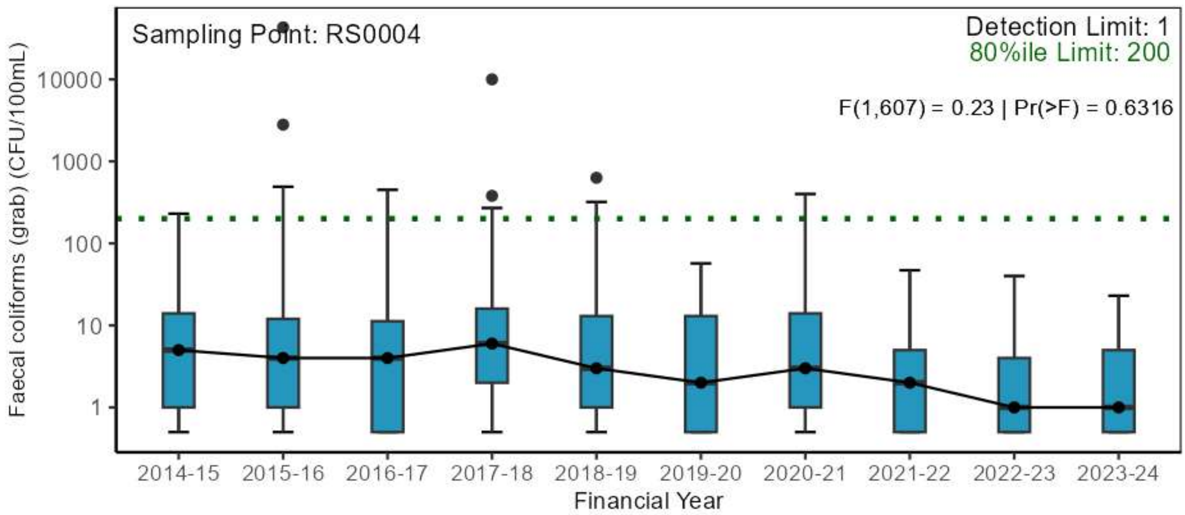
Major conventional analytes



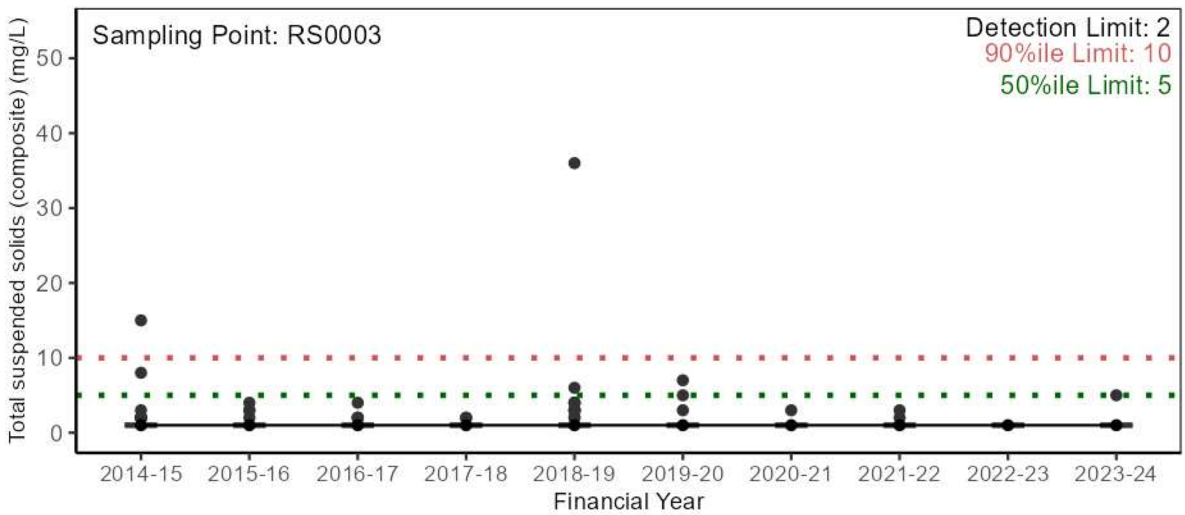
Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

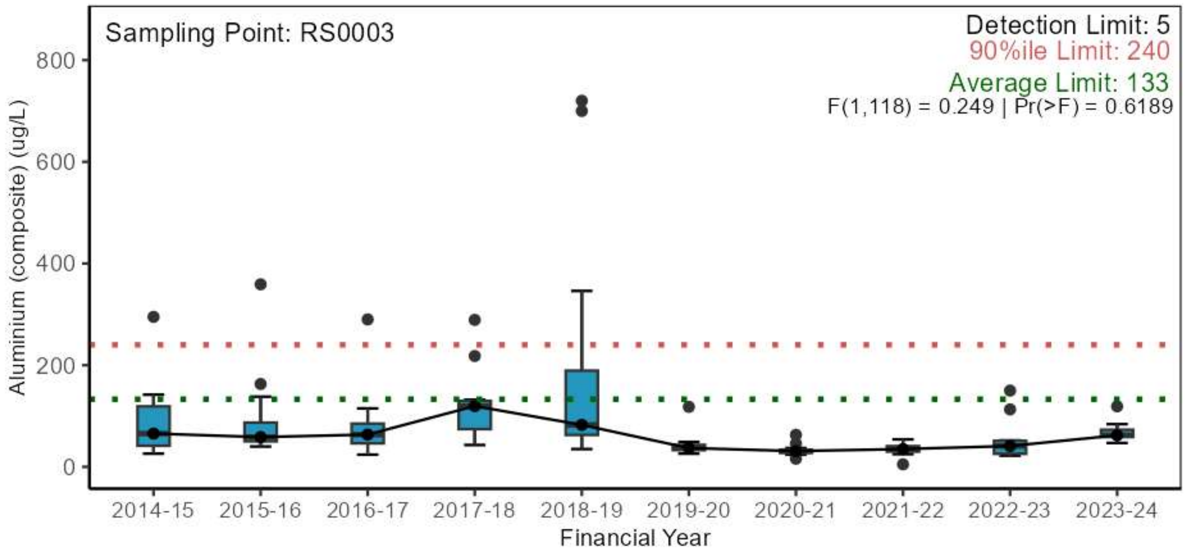


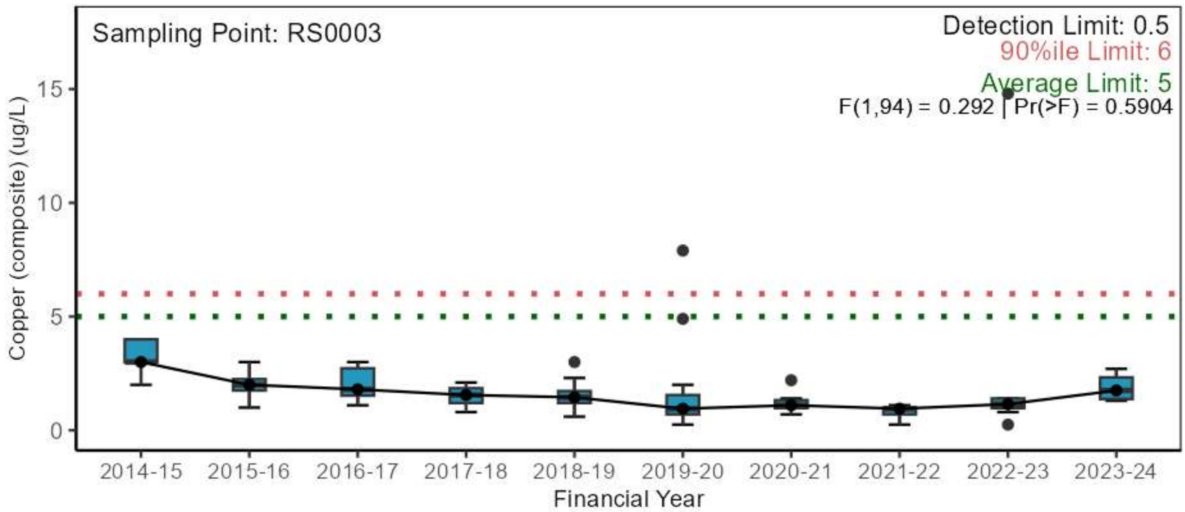
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



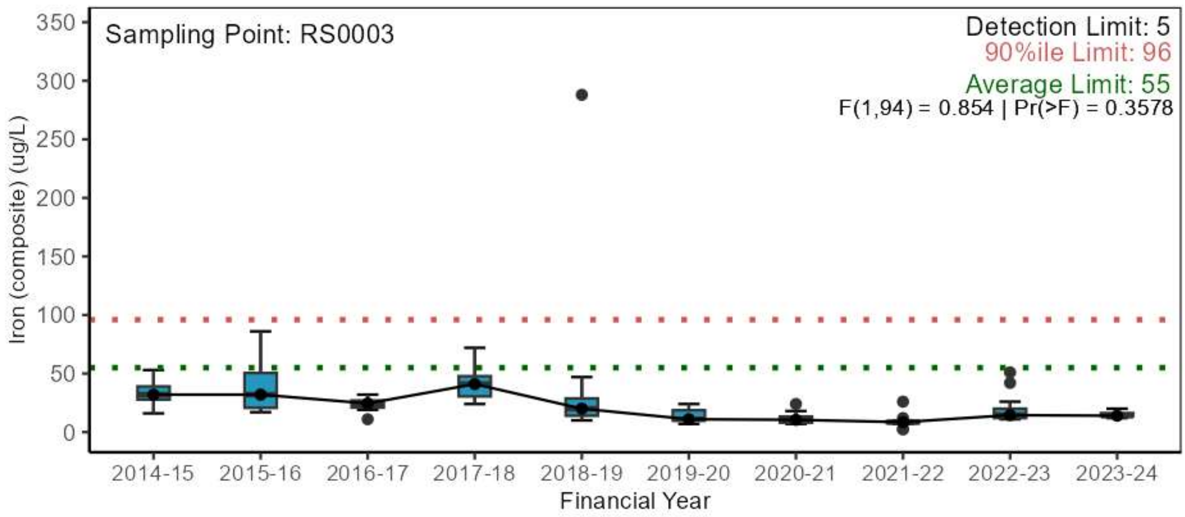
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

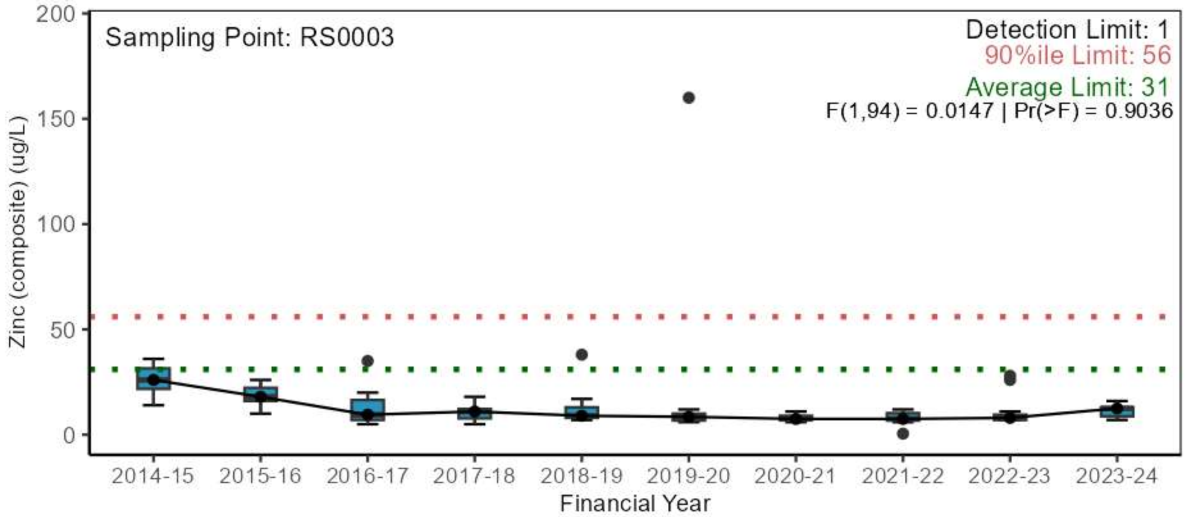




Statistical test excludes data prior to 2016-17 due to method detection limit change.

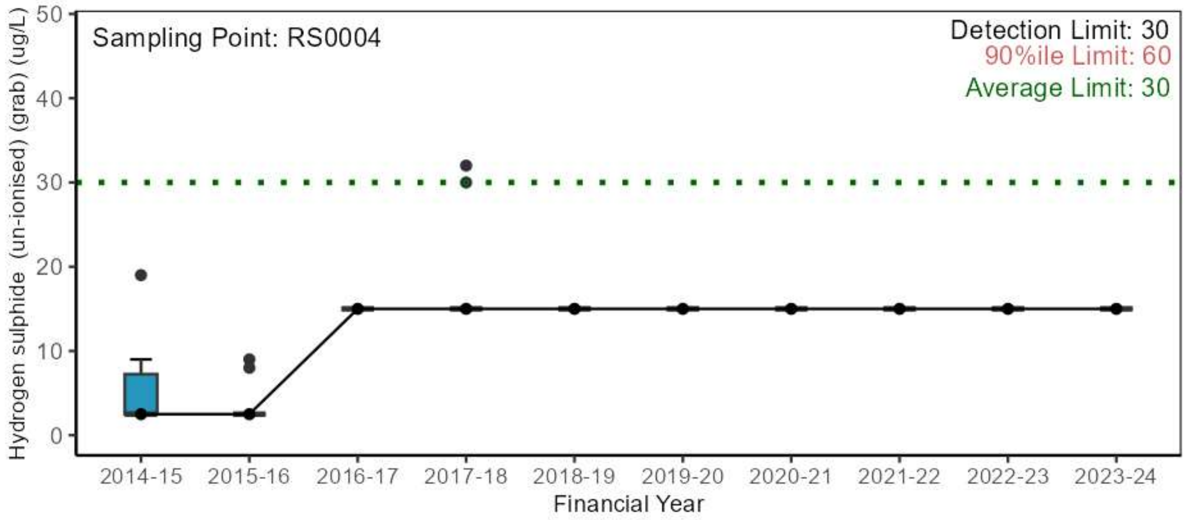


Statistical test excludes data prior to 2016-17 due to method detection limit change.



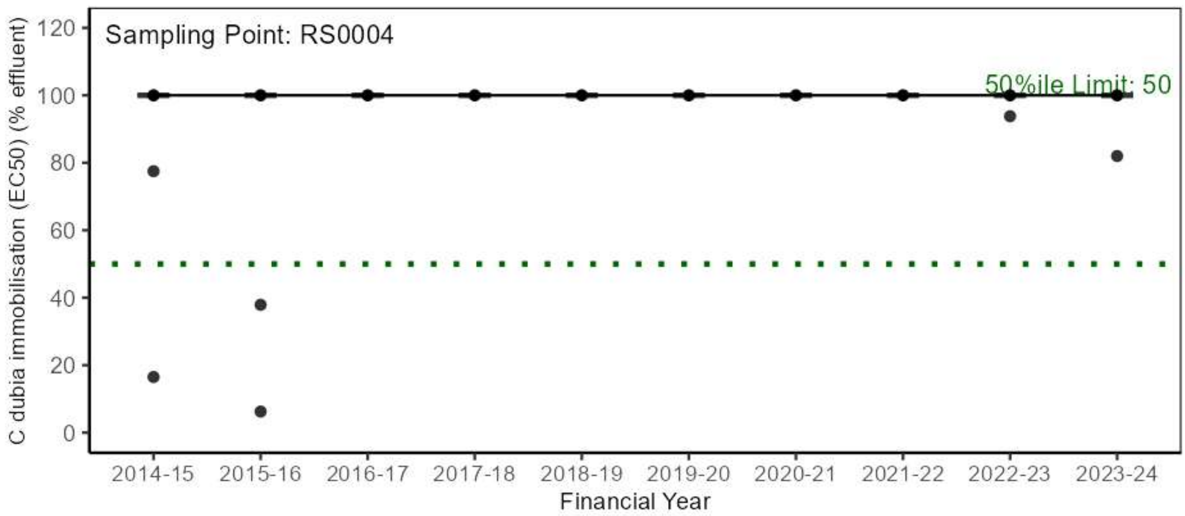
Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)



Statistical test not conducted as >90% of results were below detection limits.

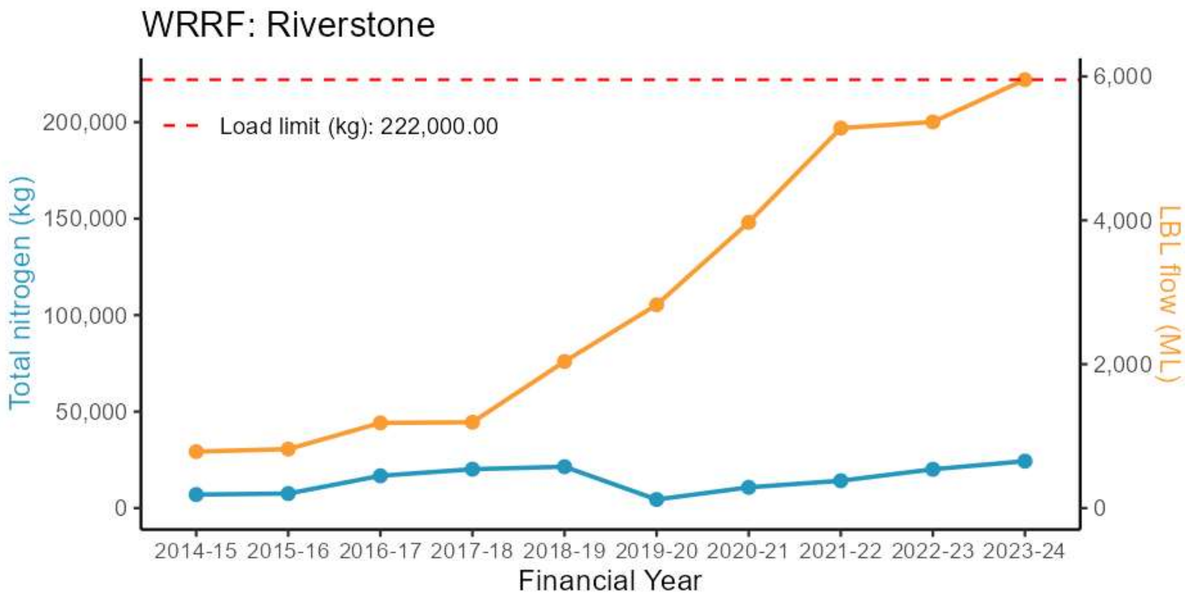
A.10.3. Pressure – Wastewater toxicity

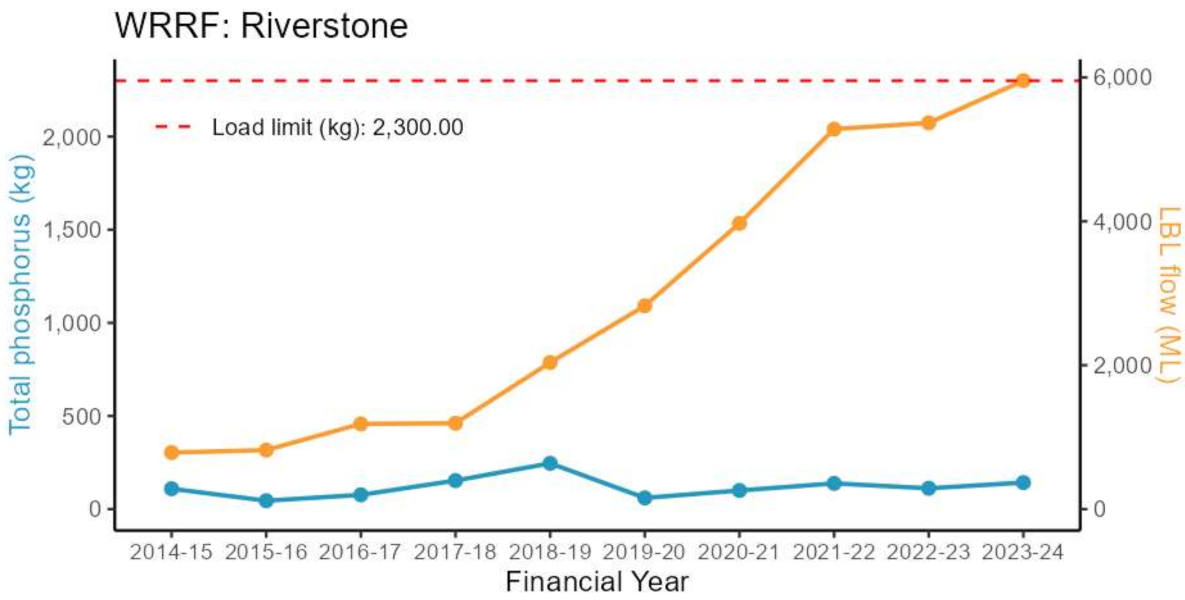


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

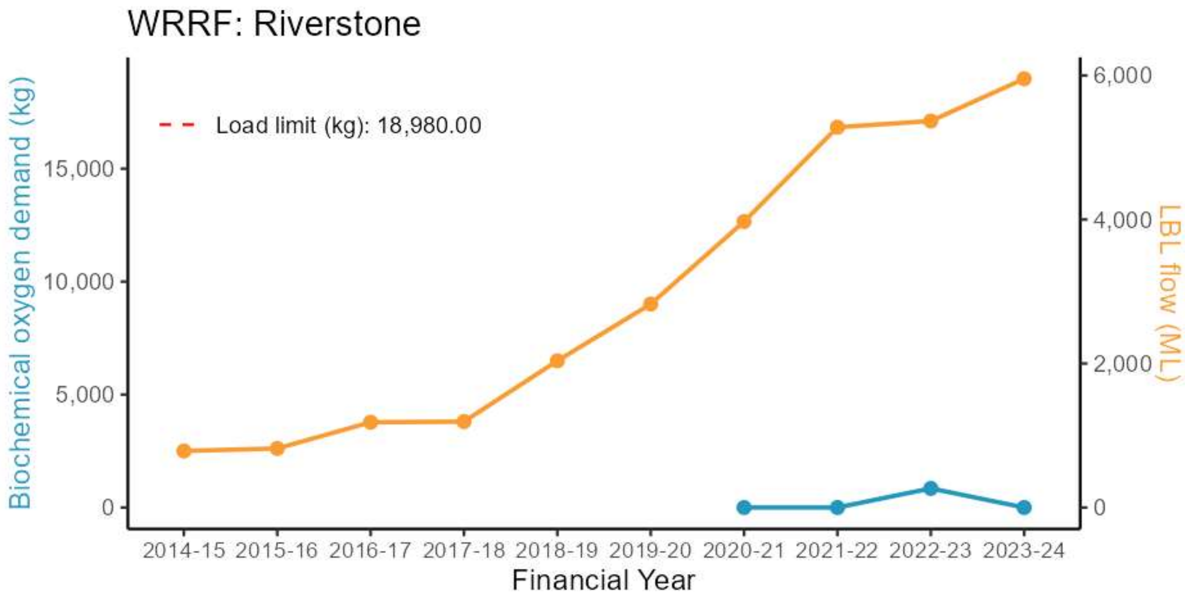
A.10.4. Pressure – Wastewater discharge load

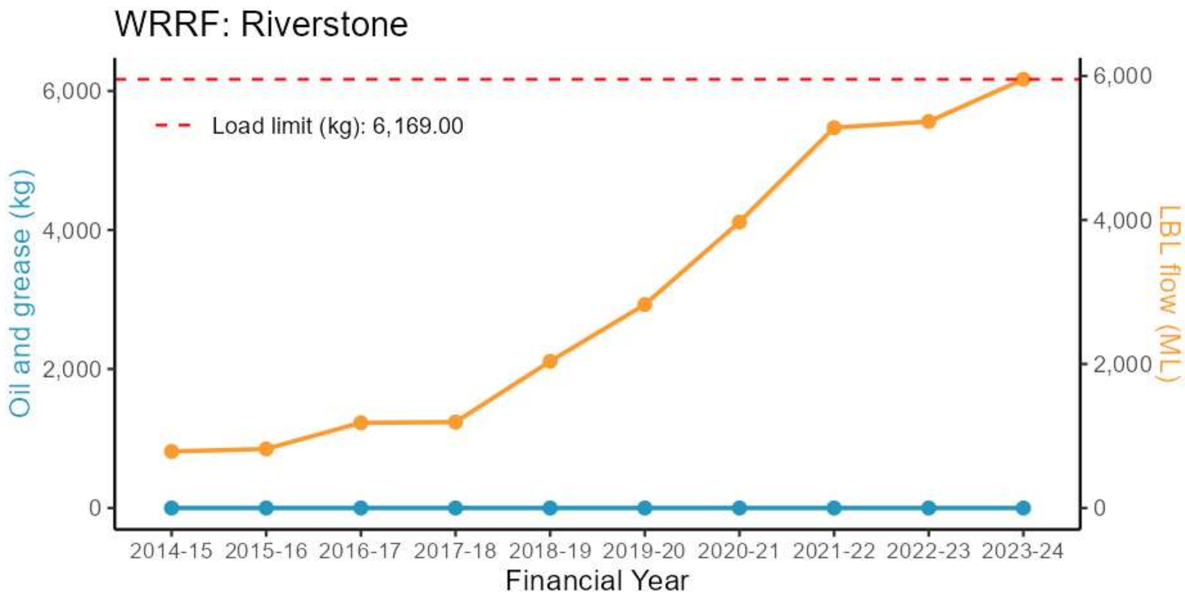
Nutrients

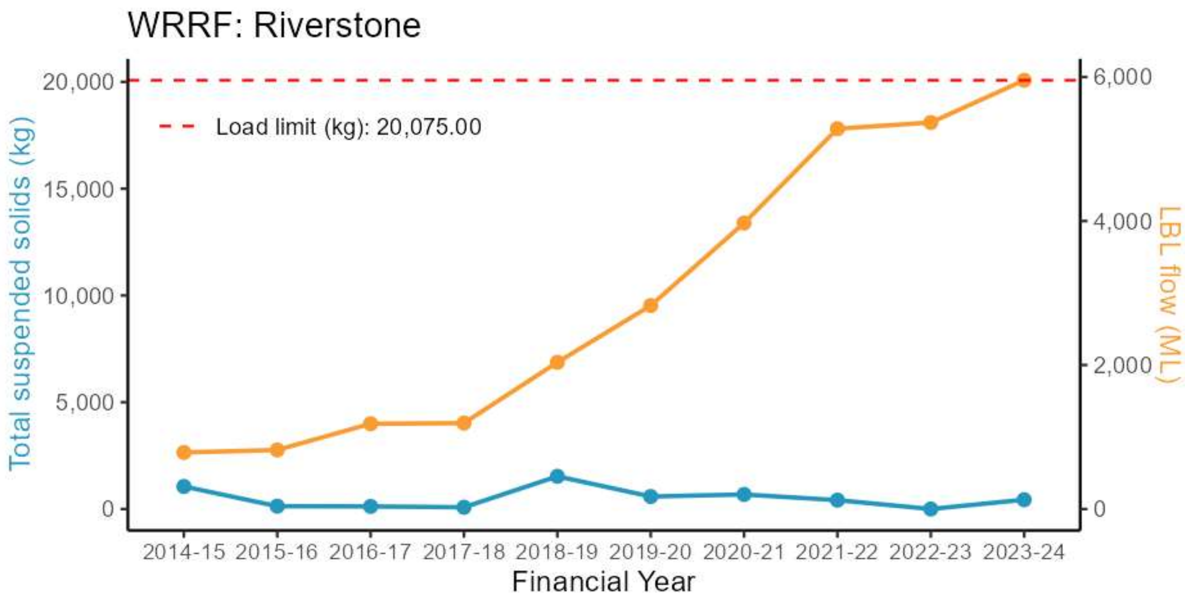




Major conventional analytes







A.10.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-19 Downstream vs upstream comparison (current period) contrast outcomes for Riverstone WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Eastern Ck	NS082 vs NS081	Total ammonia nitrogen	0.87	0.25	153	-0.46	0.967
Eastern Ck	NS082 vs NS081	Oxidised nitrogen	1.28	0.28	153	1.12	0.678
Eastern Ck	NS082 vs NS081	Total nitrogen	1.16	0.15	153	1.13	0.673
Eastern Ck	NS082 vs NS081	Filterable total phosphorus	0.80	0.15	153	-1.23	0.611
Eastern Ck	NS082 vs NS081	Total phosphorus	0.80	0.13	153	-1.42	0.492
Eastern Ck	NS082 vs NS081	Conductivity	1.07	0.12	153	0.59	0.934
Eastern Ck	NS082 vs NS081	Dissolved oxygen	1.01	0.05	151	0.09	1.000
Eastern Ck	NS082 vs NS081	Dissolved oxygen saturation	6.47	3.35	151	1.93	0.220
Eastern Ck	NS082 vs NS081	pH	0.03	0.07	151	0.46	0.967
Eastern Ck	NS082 vs NS081	Water temperature	1.01	0.10	153	0.15	0.999
Eastern Ck	NS082 vs NS081	Turbidity	0.76	0.17	153	-1.21	0.622
Eastern Ck	NS082 vs NS081	Chlorophyll - a	0.71	0.23	153	-1.06	0.717

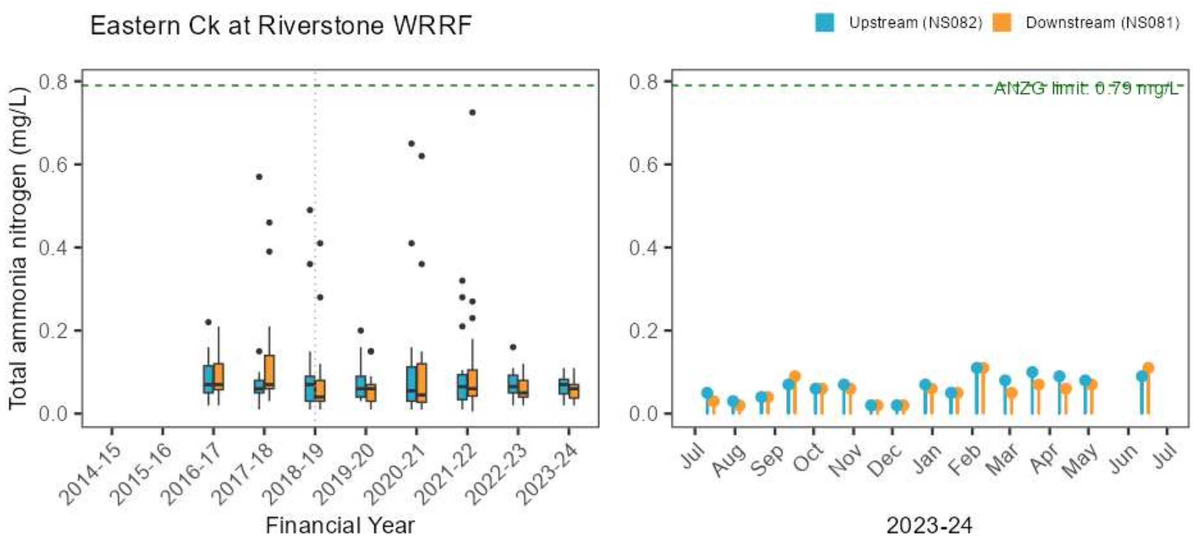
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

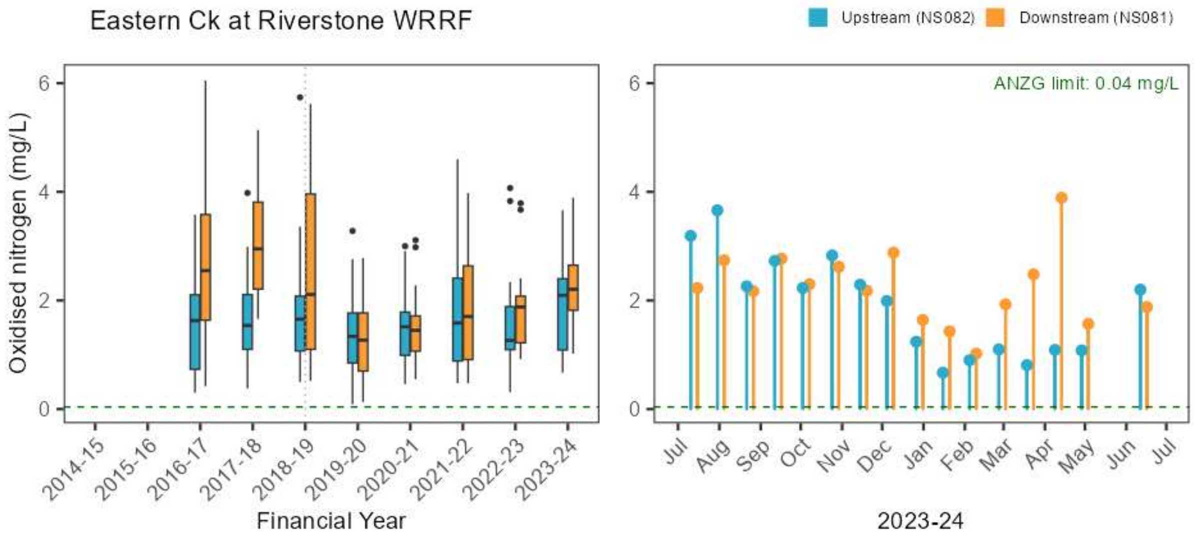
Table A-20 Current period vs previous period comparison (single site) contrast outcomes for Riverstone WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Eastern Ck	NS082	Total ammonia nitrogen	0.90	0.21	153	-0.44	0.971
Eastern Ck	NS082	Oxidised nitrogen	1.28	0.22	153	1.40	0.498
Eastern Ck	NS082	Total nitrogen	1.12	0.11	153	1.12	0.679
Eastern Ck	NS082	Filterable total phosphorus	1.41	0.20	153	2.38	0.084
Eastern Ck	NS082	Total phosphorus	1.18	0.15	153	1.28	0.580
Eastern Ck	NS082	Conductivity	0.84	0.08	153	-1.97	0.203
Eastern Ck	NS082	Dissolved oxygen	1.01	0.04	151	0.18	0.998
Eastern Ck	NS082	Dissolved oxygen saturation	-0.77	2.65	151	-0.29	0.992
Eastern Ck	NS082	pH	-0.07	0.06	151	-1.28	0.580
Eastern Ck	NS082	Water temperature	1.14	0.09	153	1.66	0.348
Eastern Ck	NS082	Turbidity	0.84	0.15	153	-0.97	0.765
Eastern Ck	NS082	Chlorophyll - a	1.05	0.27	153	0.21	0.997
Eastern Ck	NS081	Total ammonia nitrogen	0.89	0.20	153	-0.51	0.956
Eastern Ck	NS081	Oxidised nitrogen	1.52	0.26	153	2.42	0.078
Eastern Ck	NS081	Total nitrogen	1.28	0.13	153	2.41	0.080
Eastern Ck	NS081	Filterable total phosphorus	1.27	0.18	153	1.66	0.349
Eastern Ck	NS081	Total phosphorus	1.11	0.14	153	0.79	0.857
Eastern Ck	NS081	Conductivity	0.85	0.08	153	-1.80	0.278
Eastern Ck	NS081	Dissolved oxygen	1.00	0.04	151	-0.07	1.000
Eastern Ck	NS081	Dissolved oxygen saturation	3.59	2.65	151	1.36	0.528
Eastern Ck	NS081	pH	-0.06	0.06	151	-0.99	0.755
Eastern Ck	NS081	Water temperature	1.11	0.08	153	1.38	0.514
Eastern Ck	NS081	Turbidity	0.76	0.14	153	-1.54	0.418
Eastern Ck	NS081	Chlorophyll - a	0.90	0.23	153	-0.41	0.976

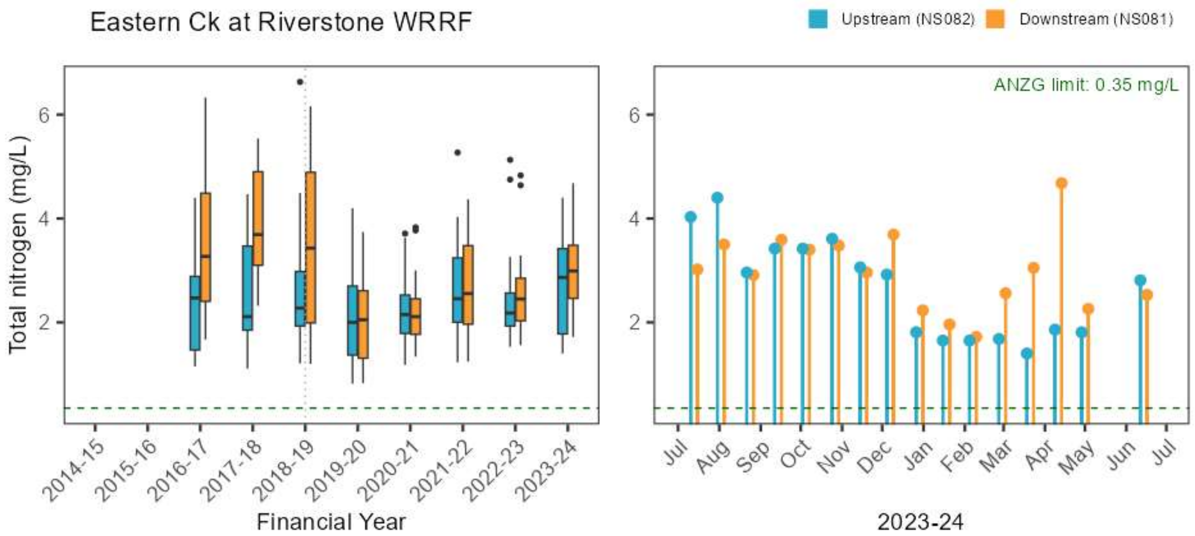
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.10.6. Stressor – Nutrients

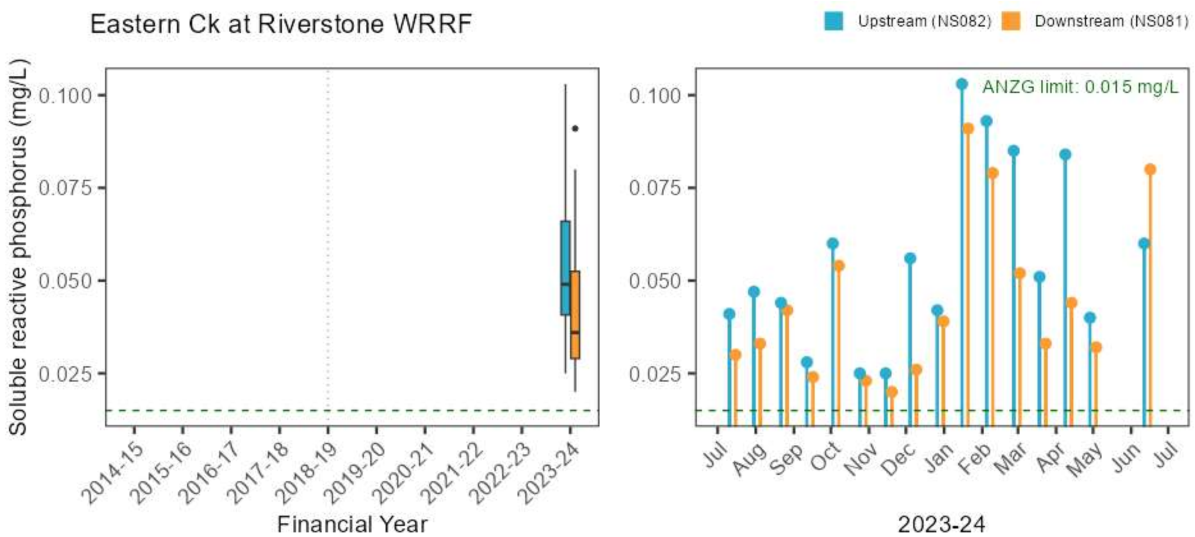




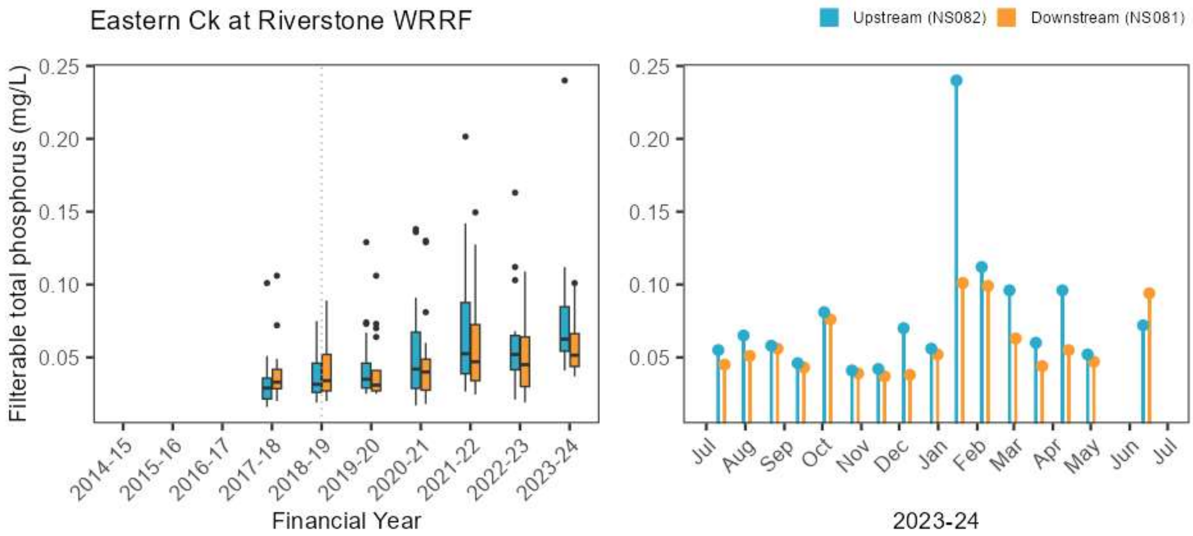
Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
Financial Year
2023-24

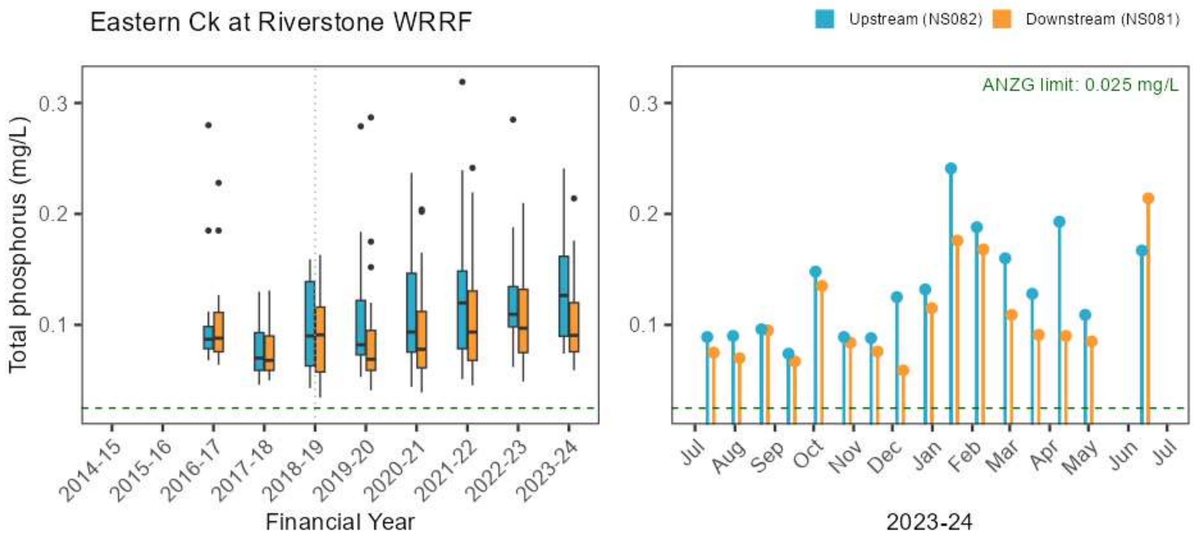


Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24

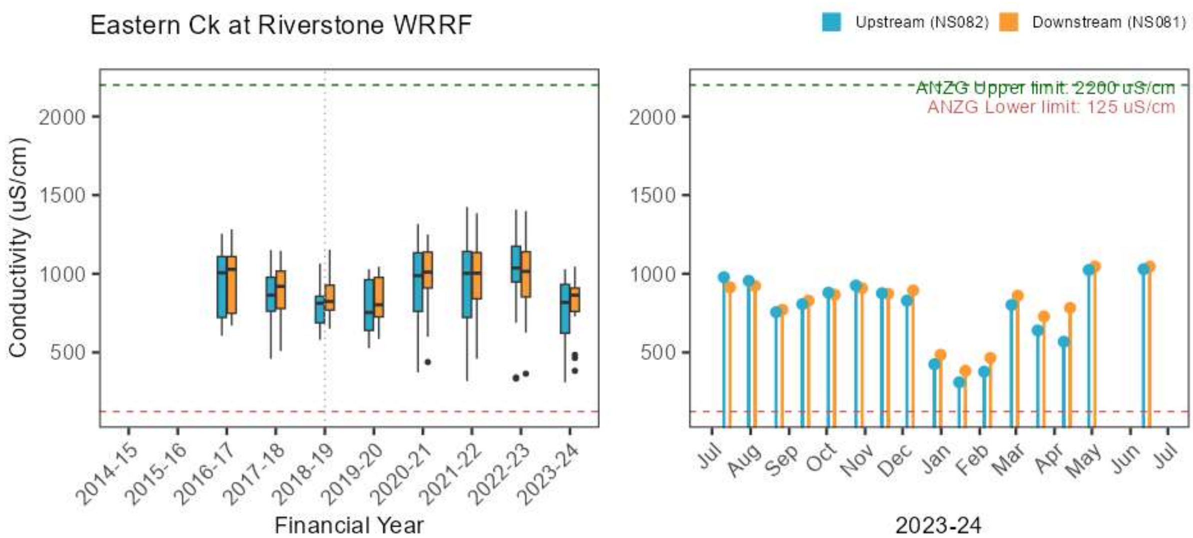


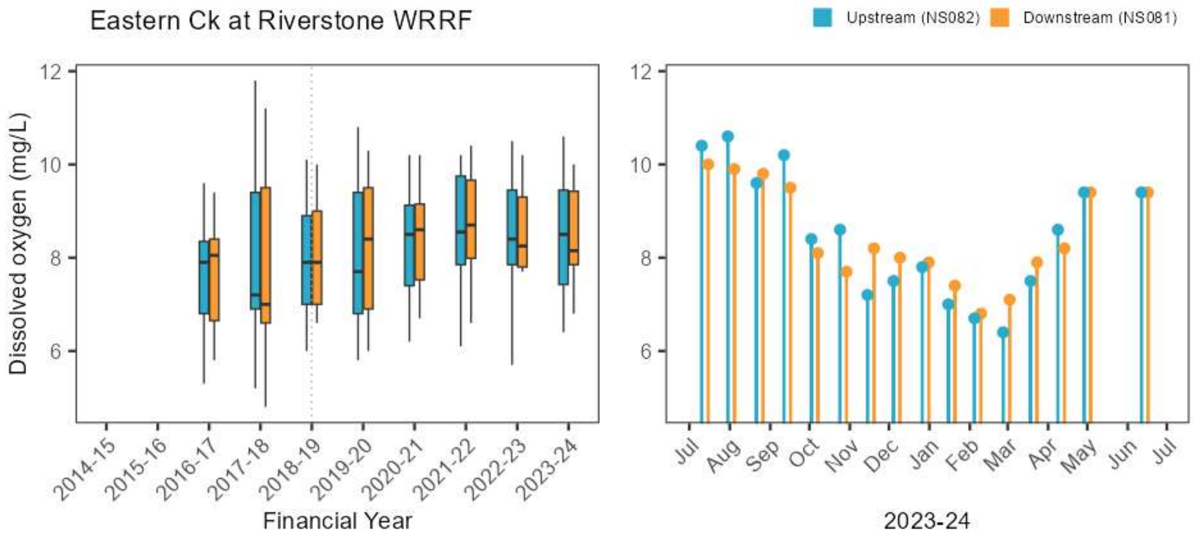
Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24

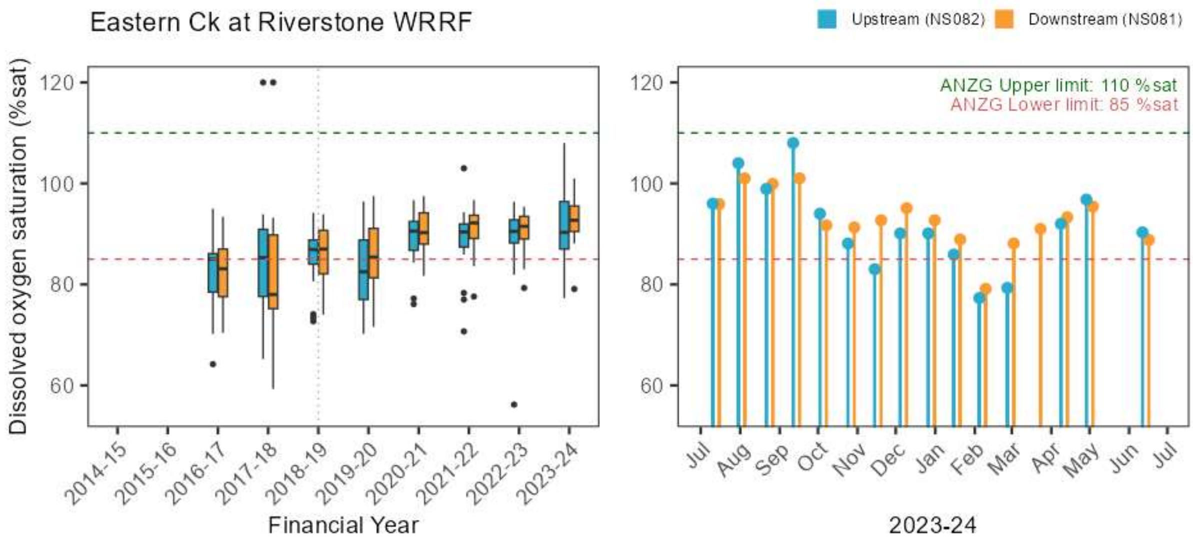


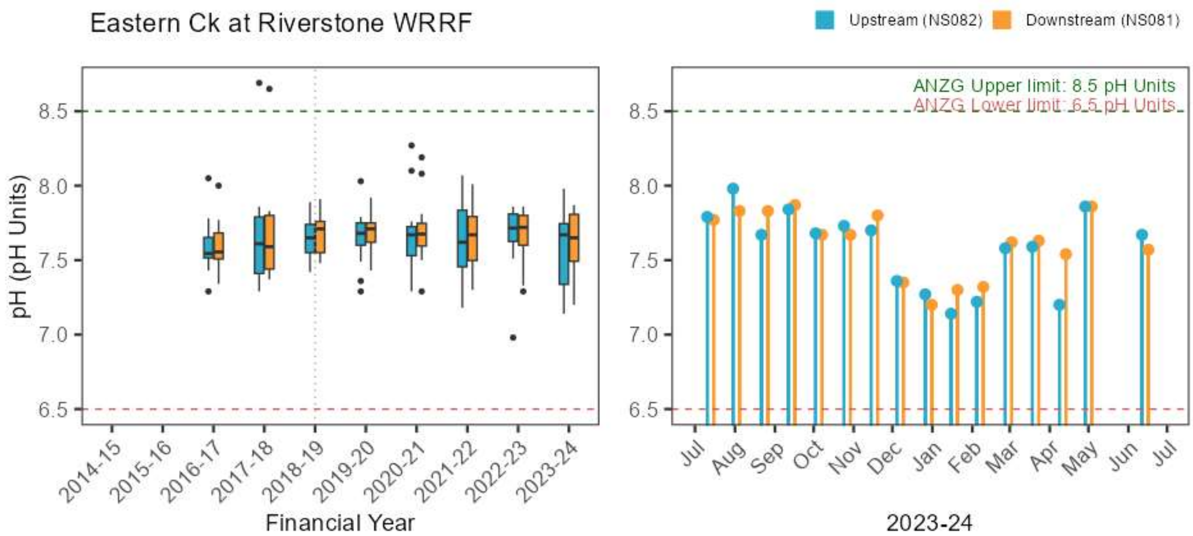


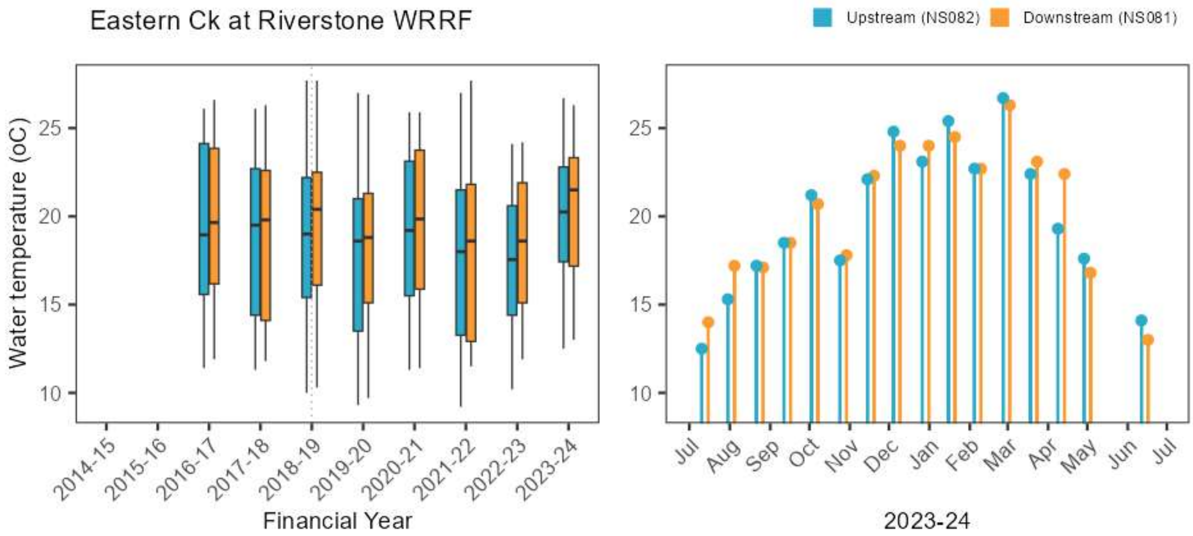
A.10.7. Stressor – Physico-chemical water quality

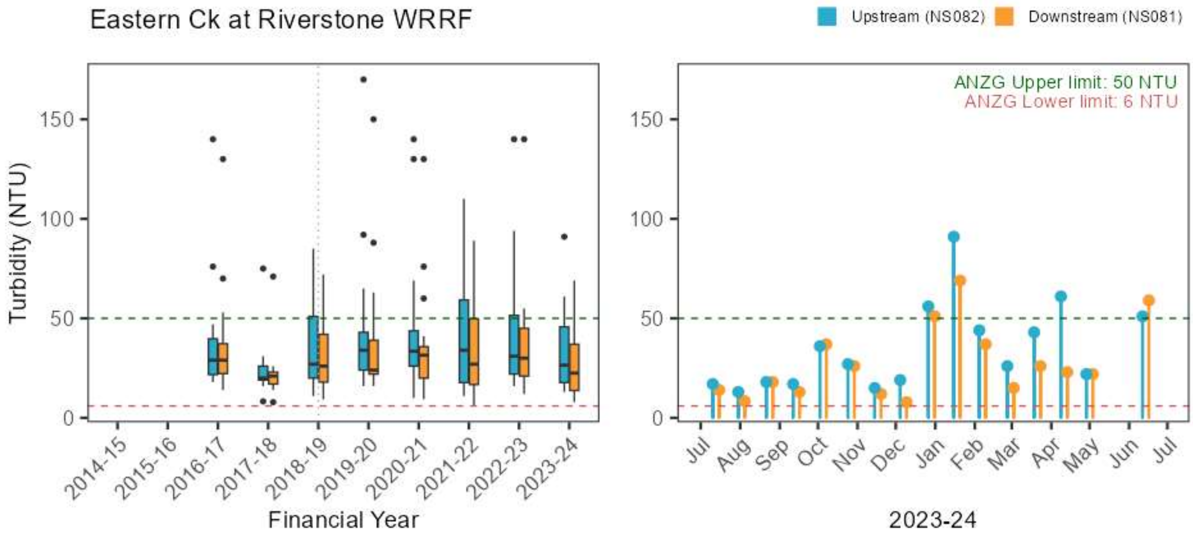



Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Dissolved oxygen (mg/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

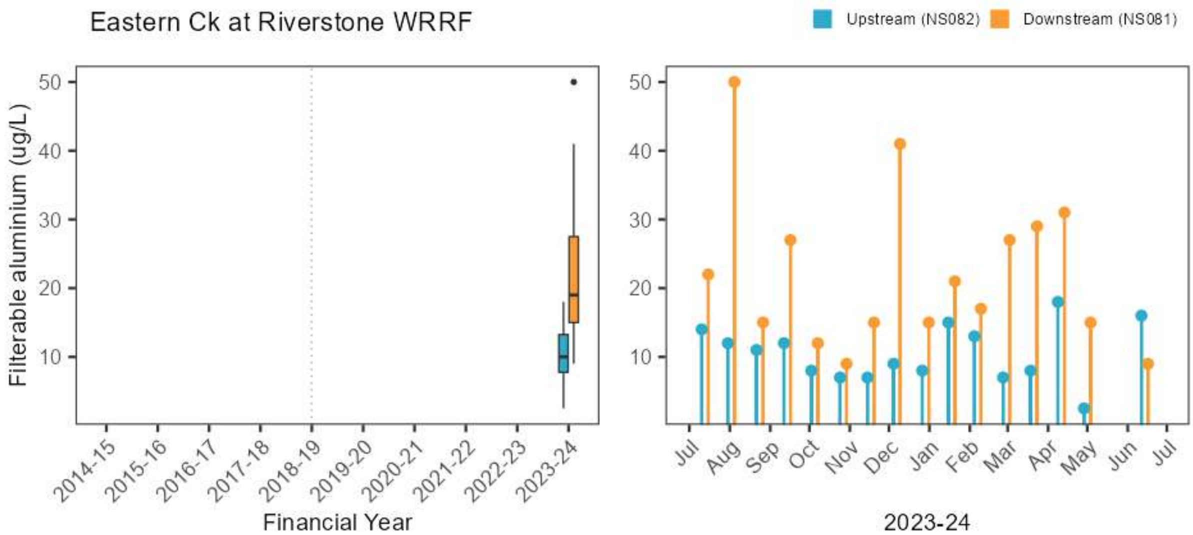

Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

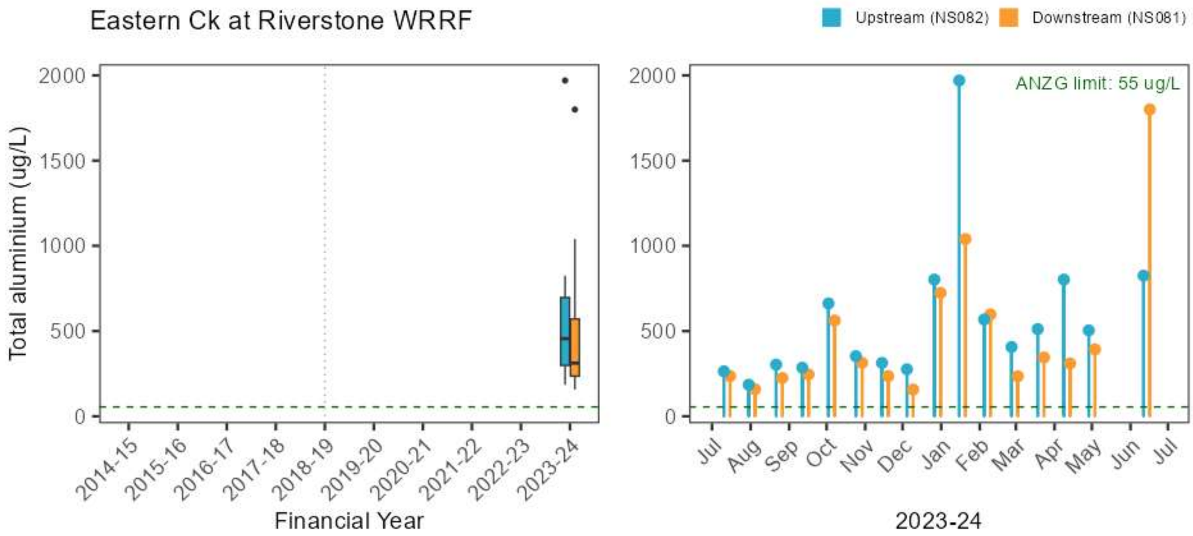

Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

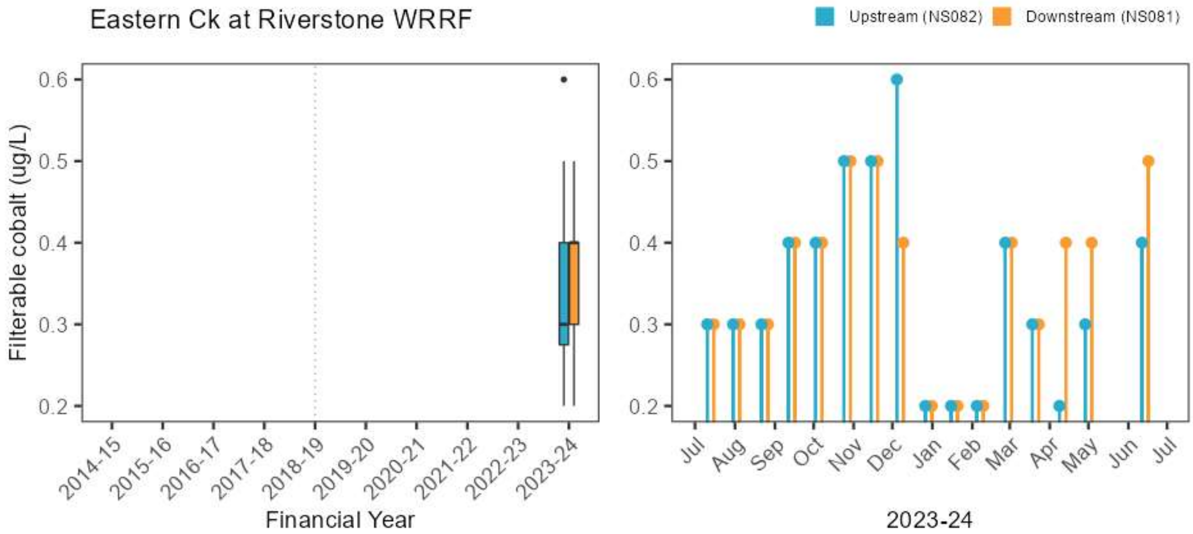


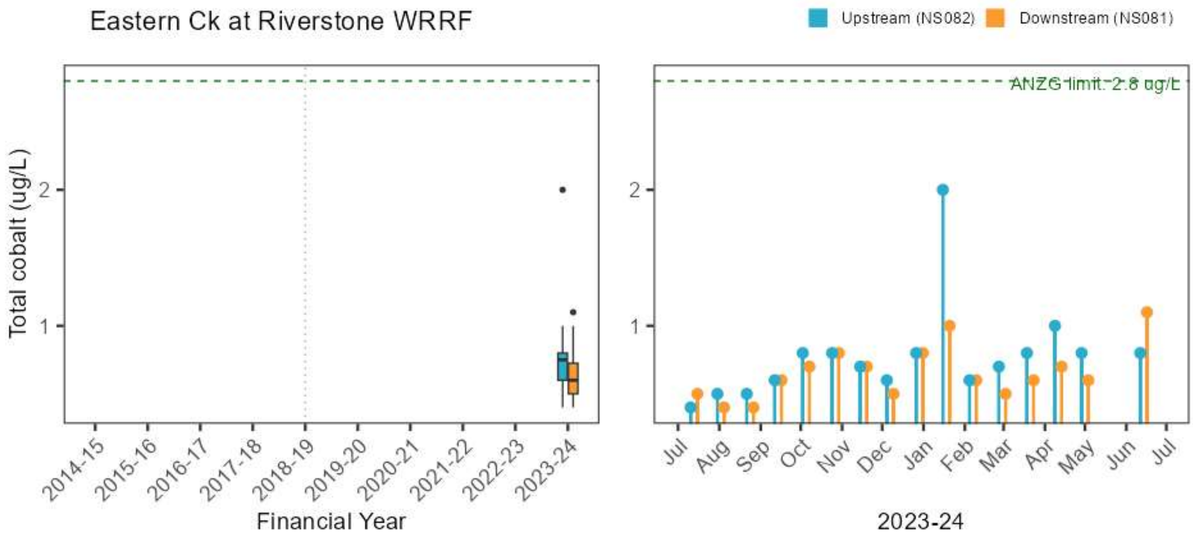


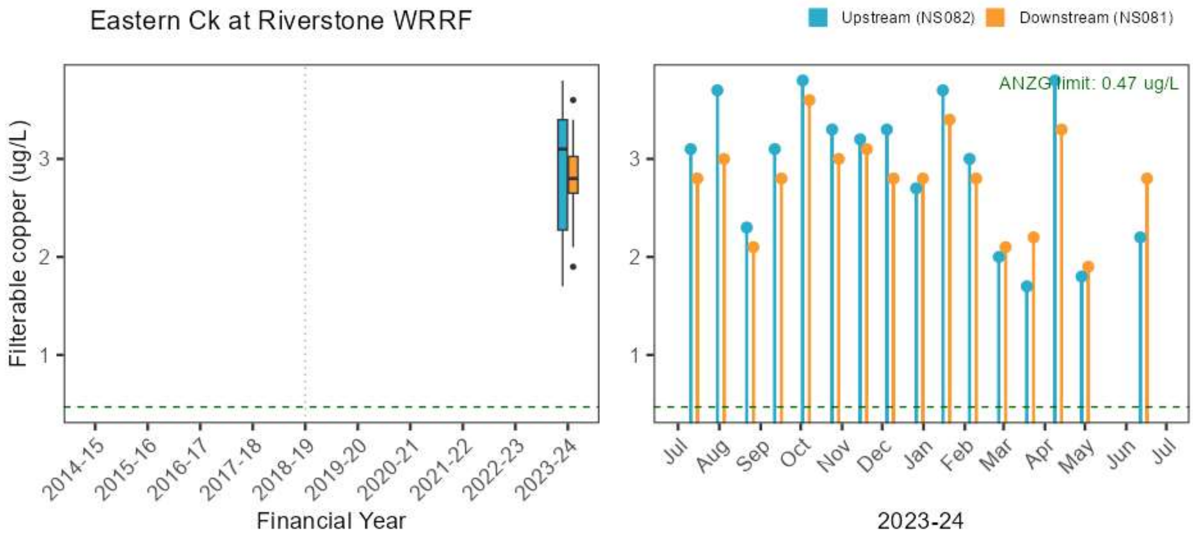
A.10.8. Stressor – Trace metals



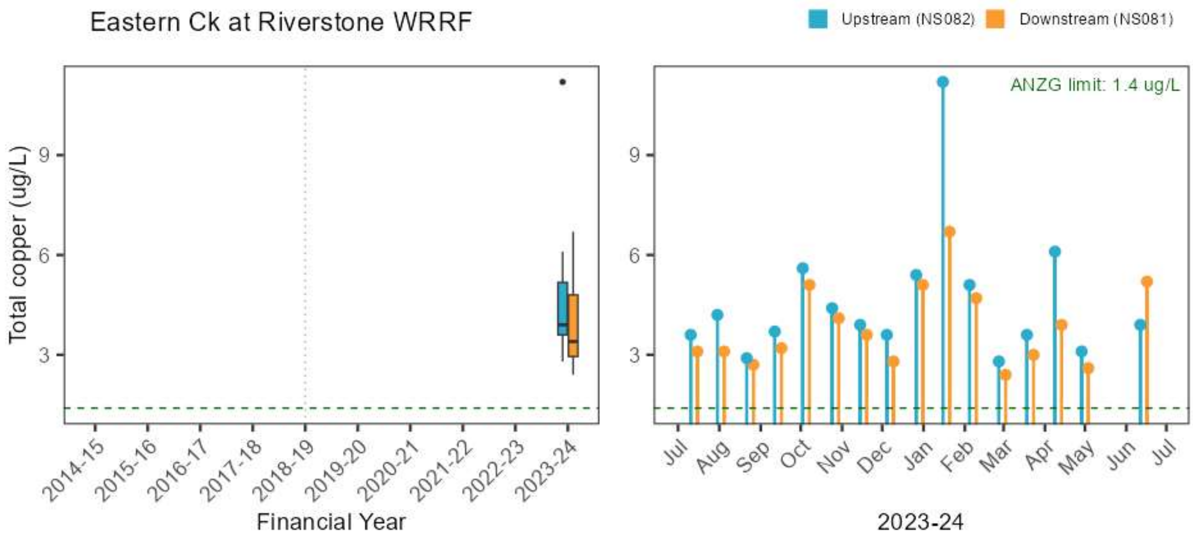

Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
ANZG limit: 55 ug/L
Total aluminium (ug/L)
Financial Year
2023-24


Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Filterable cobalt (ug/L)
Financial Year
2023-24

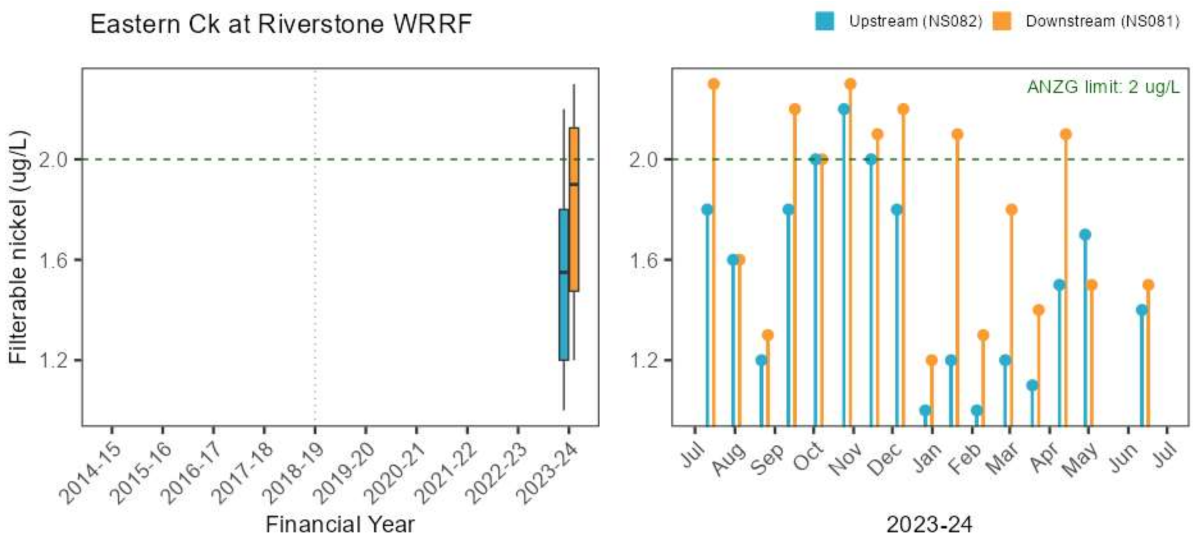

Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
ANZG limit: 2.8 ug/L
Total cobalt (ug/L)
Financial Year
2023-24



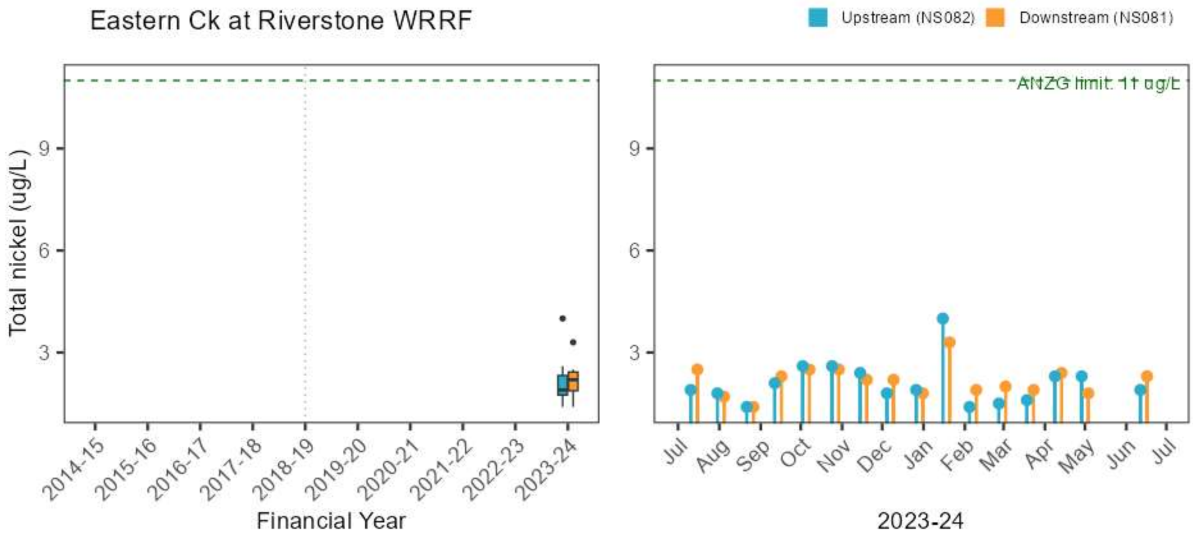
Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
Financial Year
2023-24

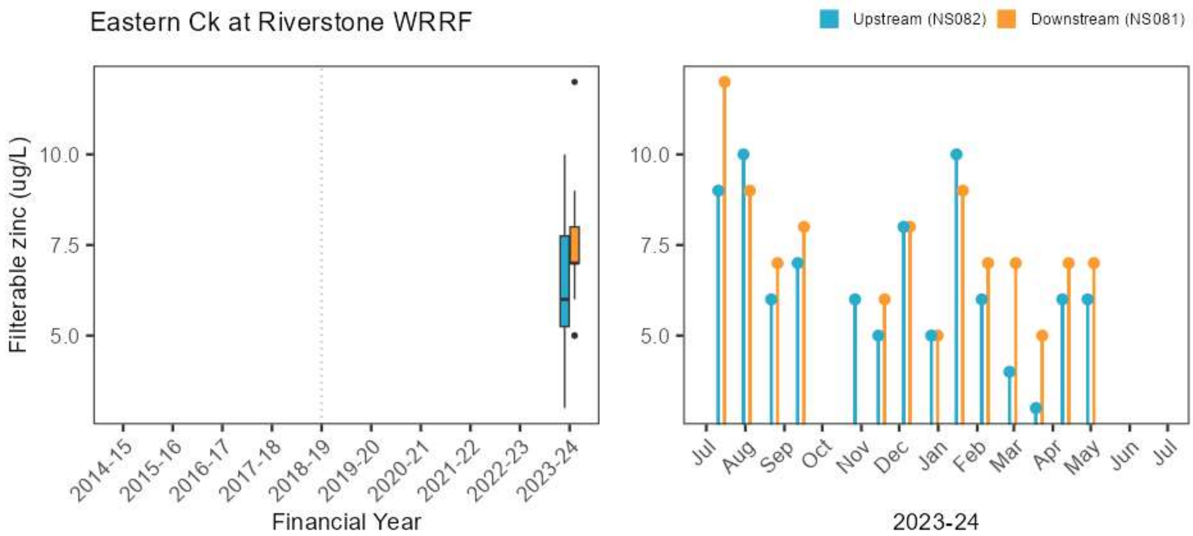


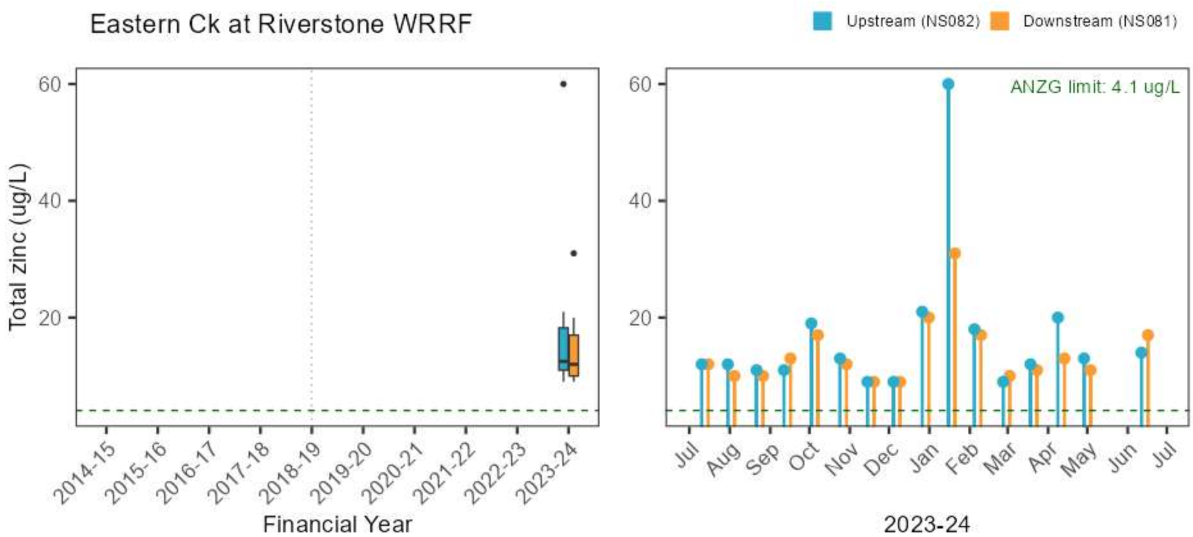
Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Total copper (ug/L)
ANZG limit: 1.4 ug/L
Financial Year
2023-24



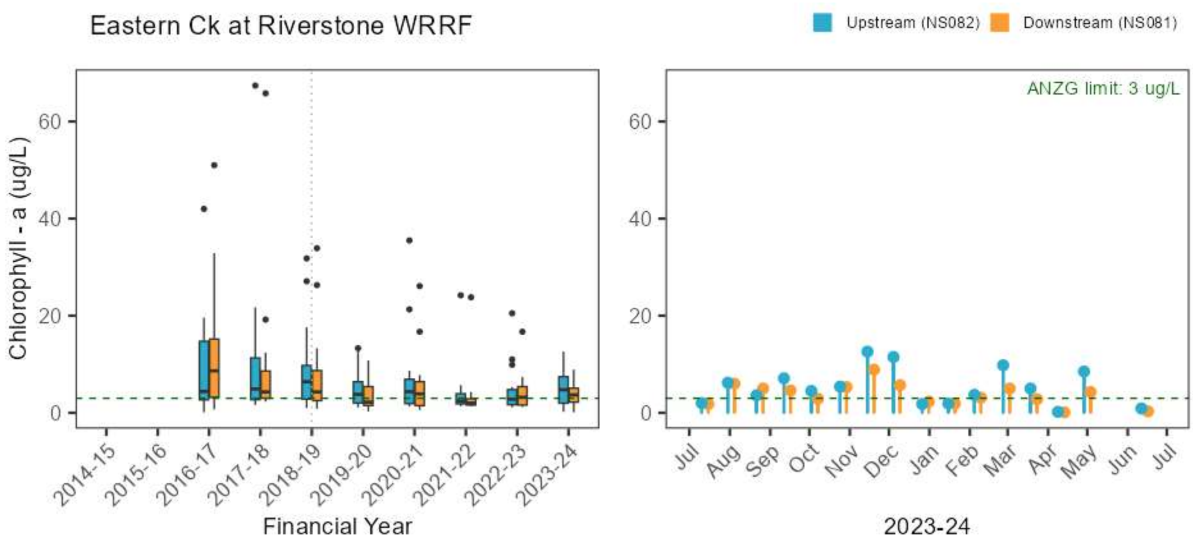
Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Filterable nickel (ug/L)
ANZG limit: 2 ug/L
Financial Year
2023-24


Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Total nickel (ug/L)
ANZG limit: 11 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24


Eastern Ck at Riverstone WRRF
Upstream (NS082)
Downstream (NS081)
Total zinc (ug/L)
ANZG limit: 4.1 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul
2023-24

A.10.9. Ecosystem receptor – Phytoplankton



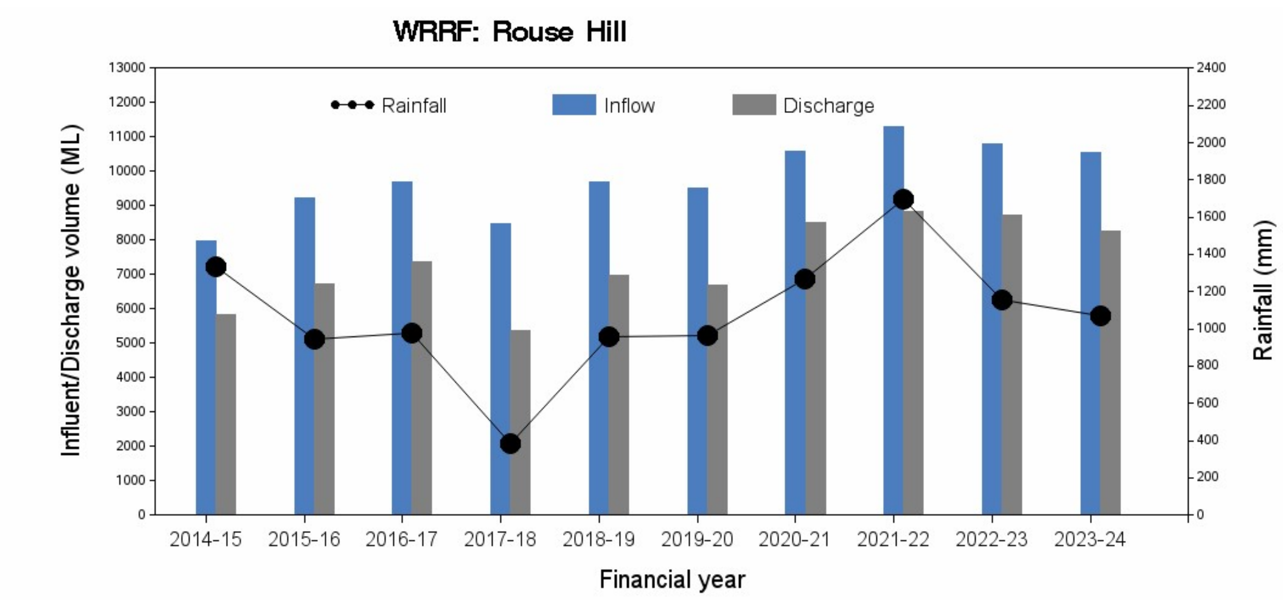
A.10.10. Ecosystem receptor – Macroinvertebrates

Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Eastern Creek	River (NS082 vs NS081)	Welch Two Sample t-test	0.39	1.7	5.3	0.148

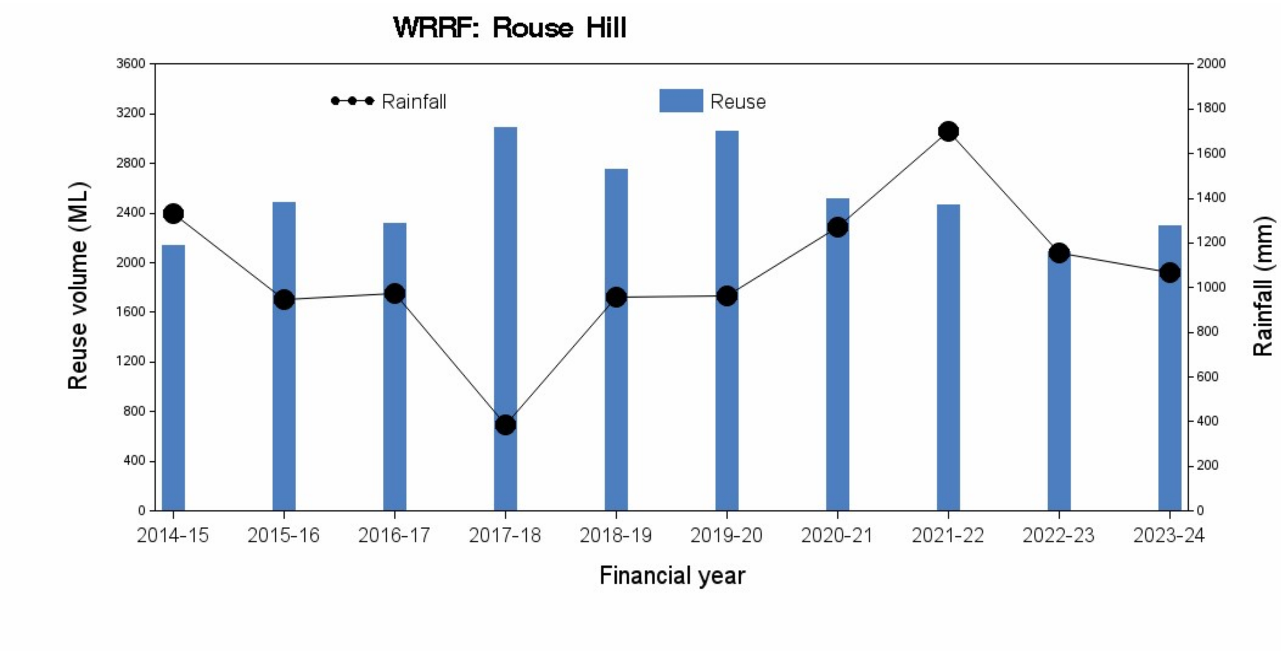
A.11. Rouse Hill WRRF

A.11.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

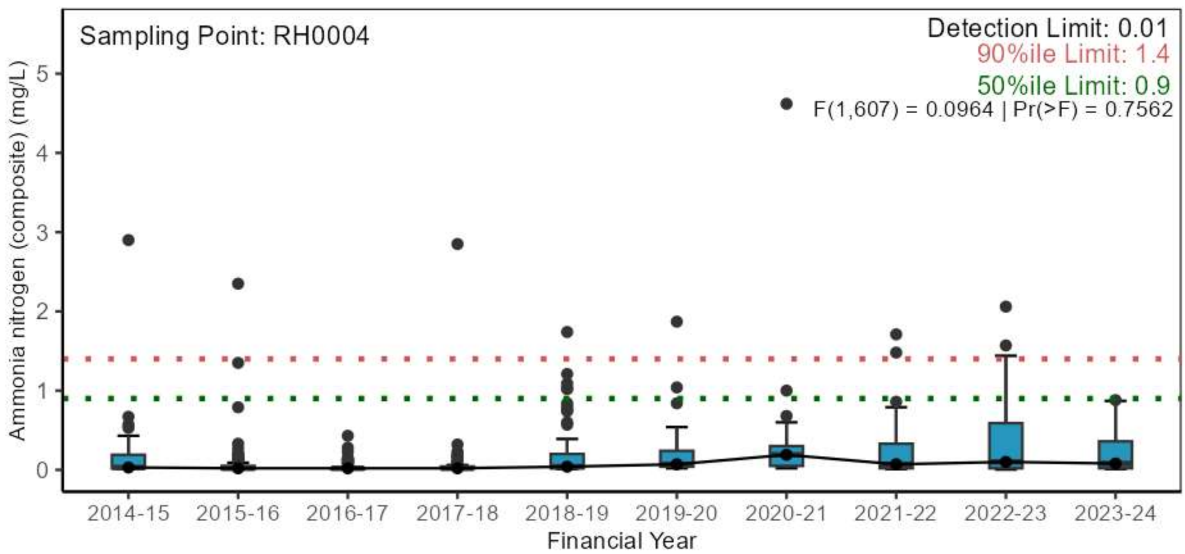


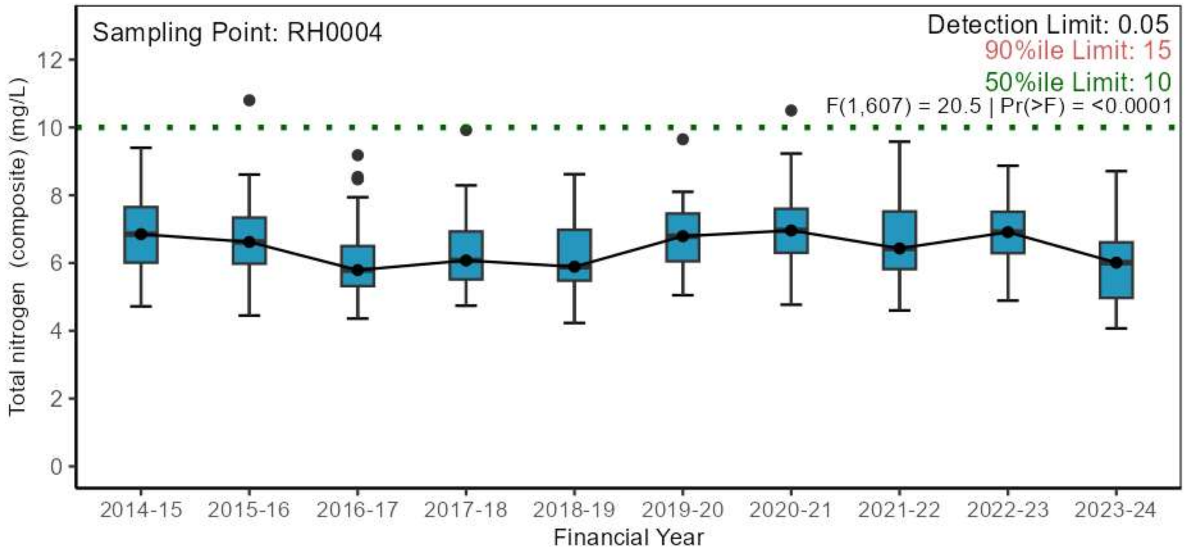
Reuse volume and rainfall

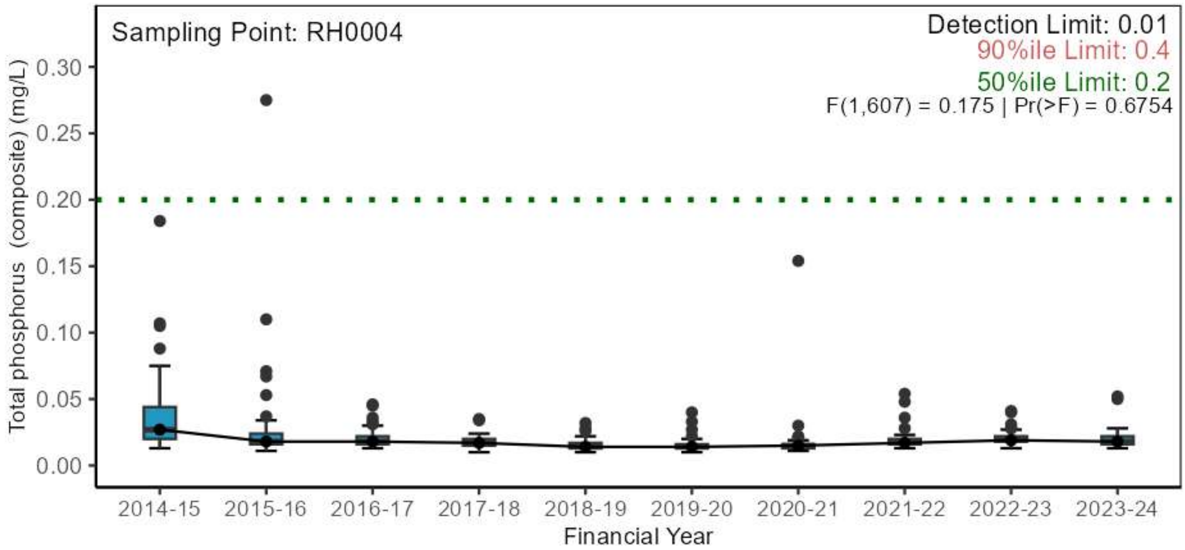


A.11.2. Pressure – Wastewater quality

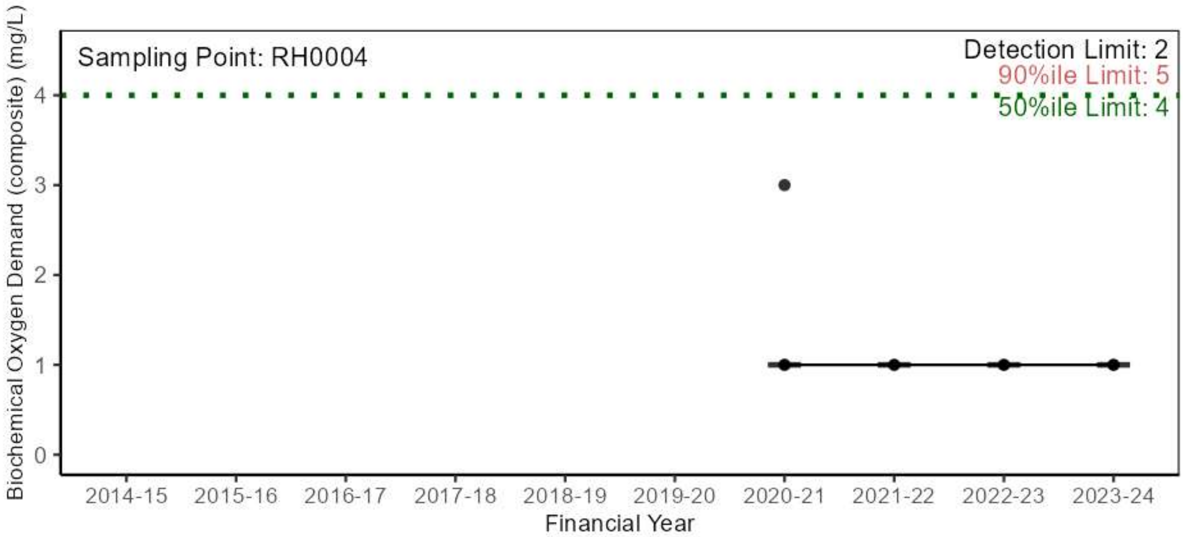
Nutrients



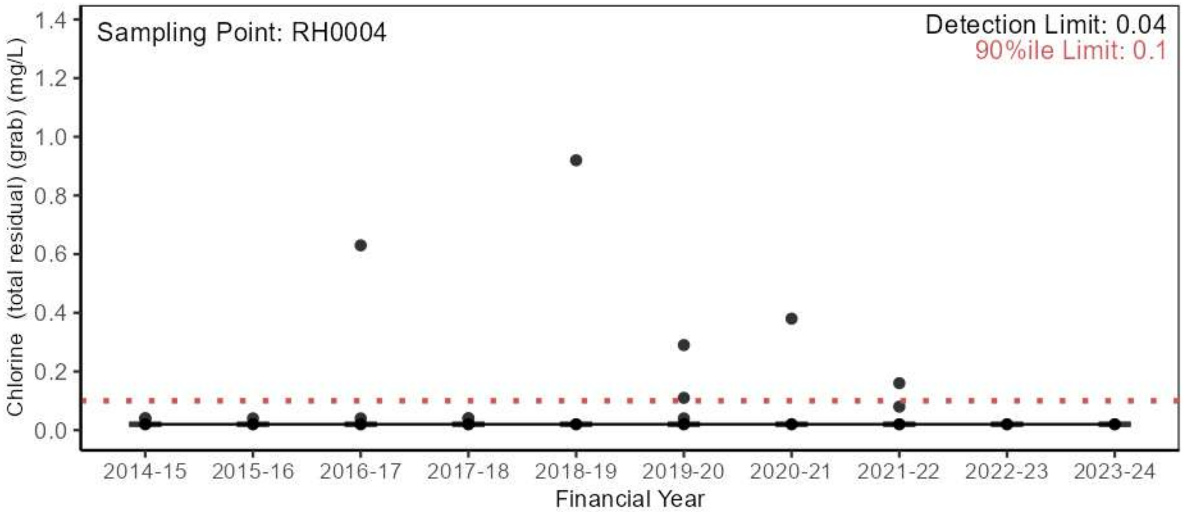

Sampling Point: RH0004
Detection Limit: 0.05
90%ile Limit: 15
50%ile Limit: 10
F(1,607) = 20.5 | Pr(>F) = <0.0001
Total nitrogen (composite) (mg/L)
0
2
4
6
8
10
12
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


Sampling Point: RH0004
Detection Limit: 0.01
90%ile Limit: 0.4
50%ile Limit: 0.2
F(1,607) = 0.175 | Pr(>F) = 0.6754
Total phosphorus (composite) (mg/L)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

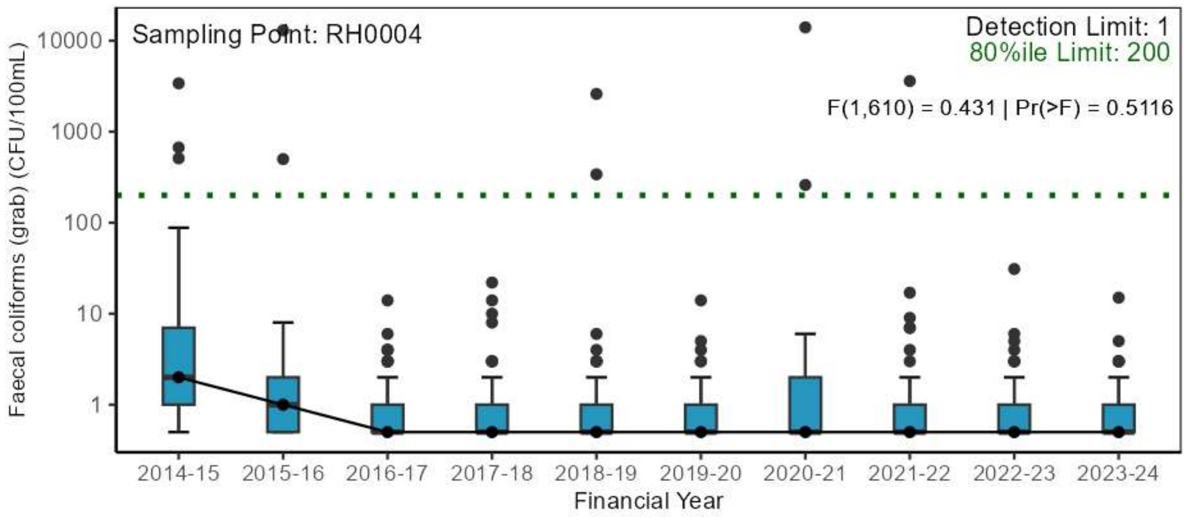
Major conventional analytes



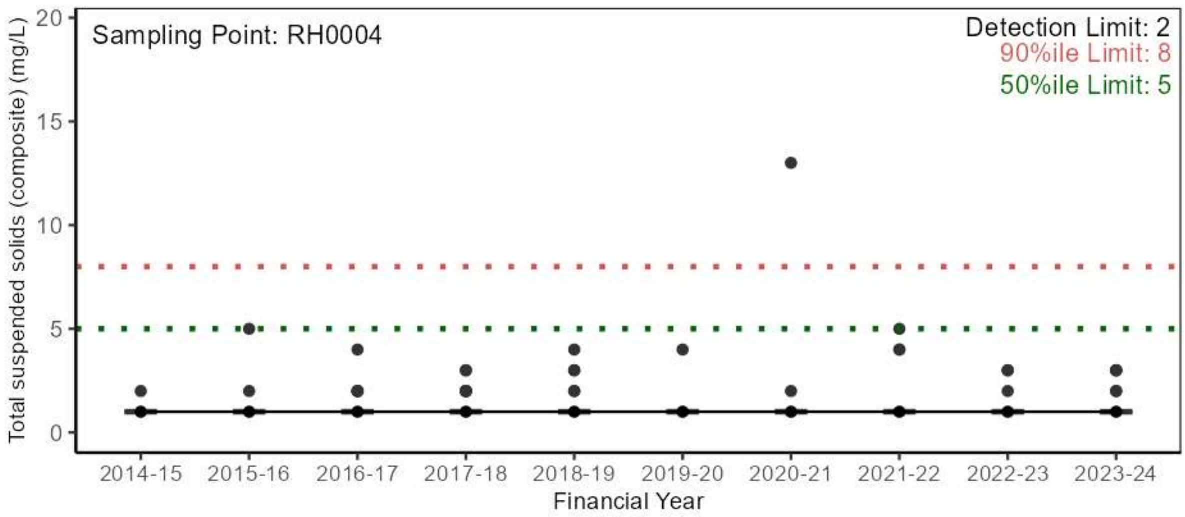
Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

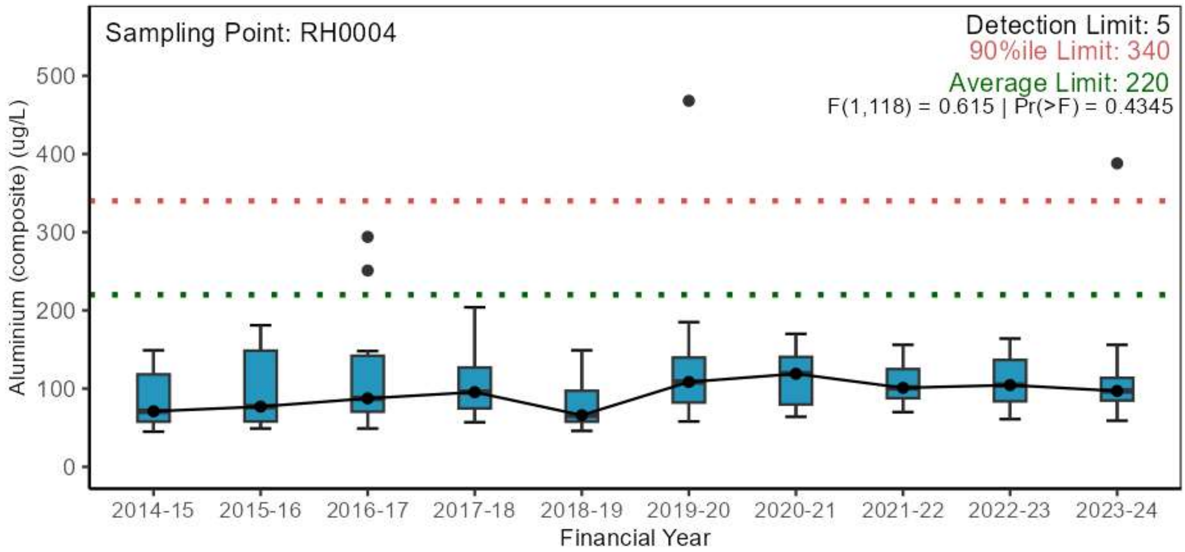


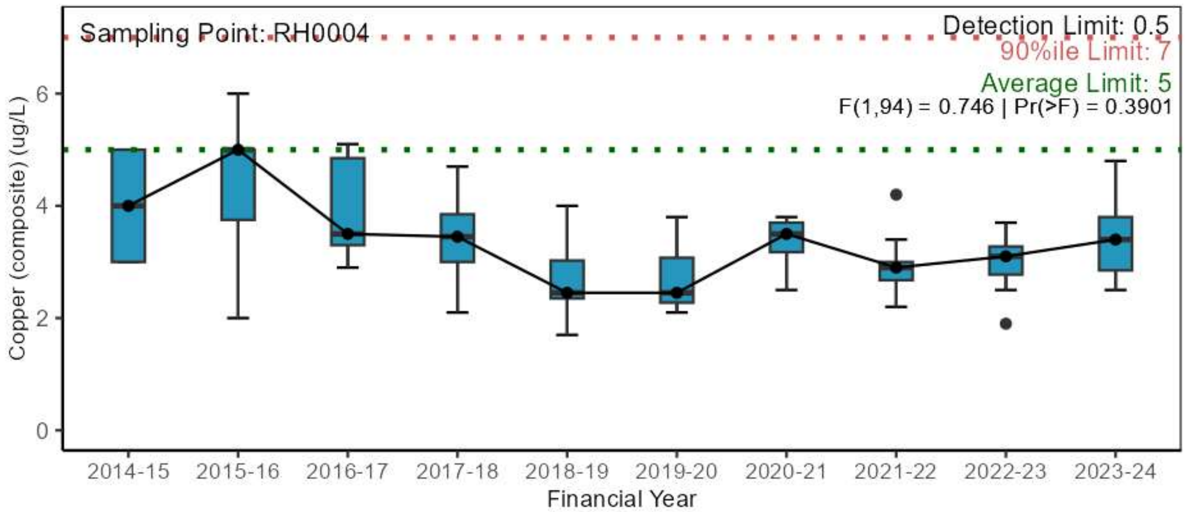
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



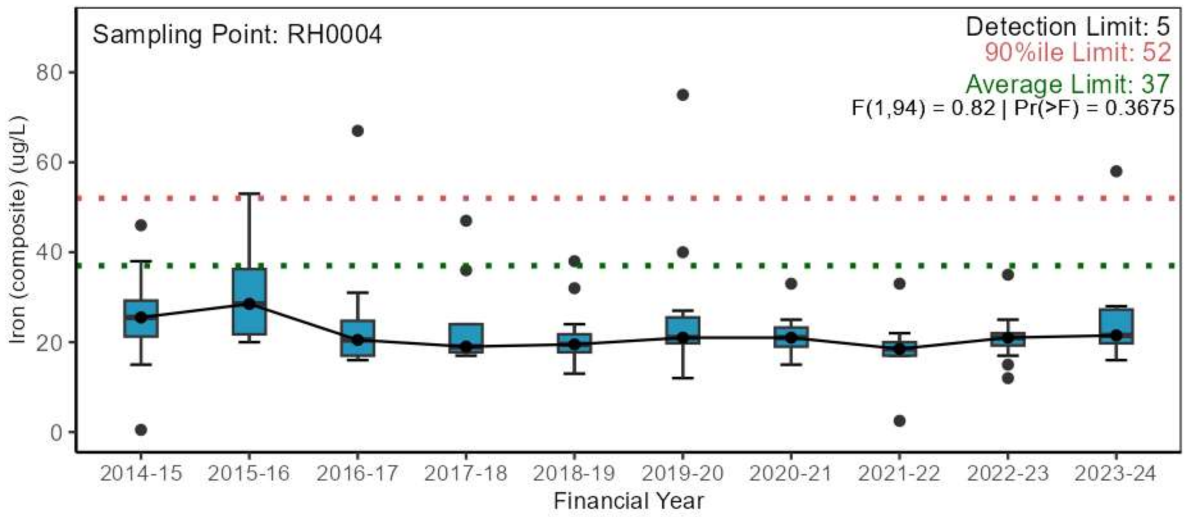
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

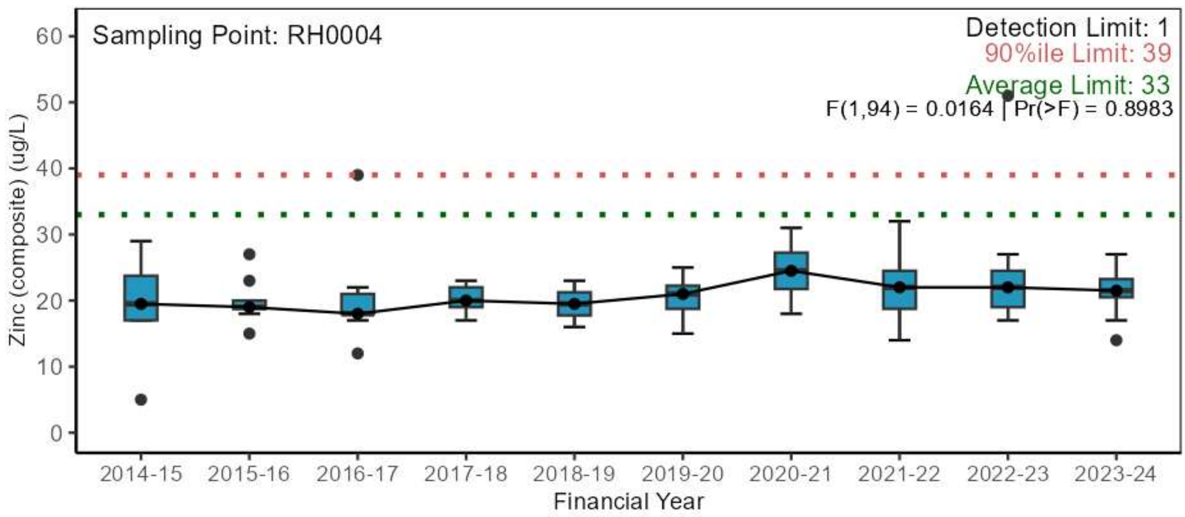




Statistical test excludes data prior to 2016-17 due to method detection limit change.

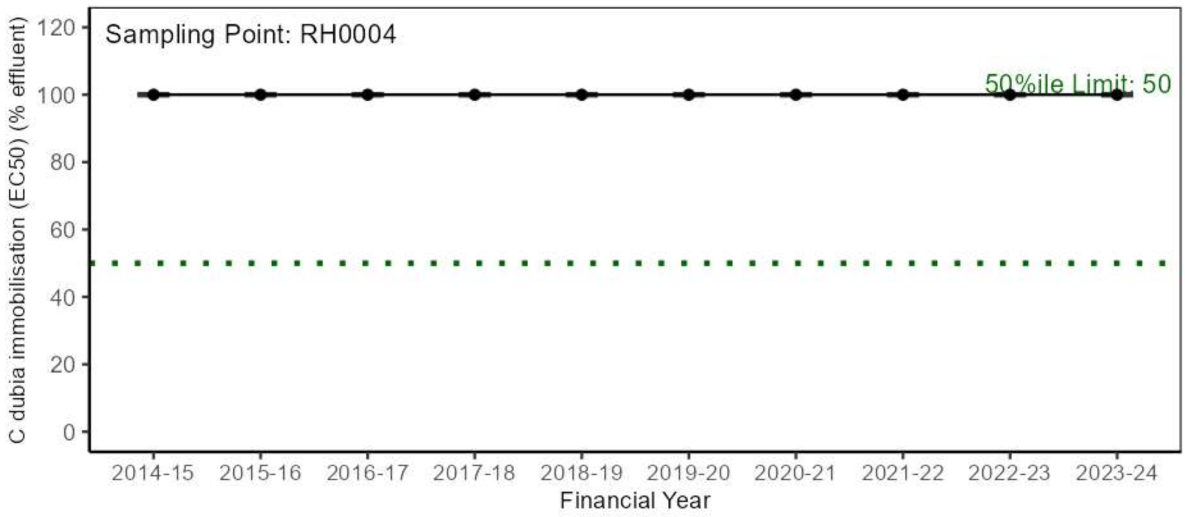


Statistical test excludes data prior to 2016-17 due to method detection limit change.



Statistical test excludes data prior to 2016-17 due to method detection limit change.

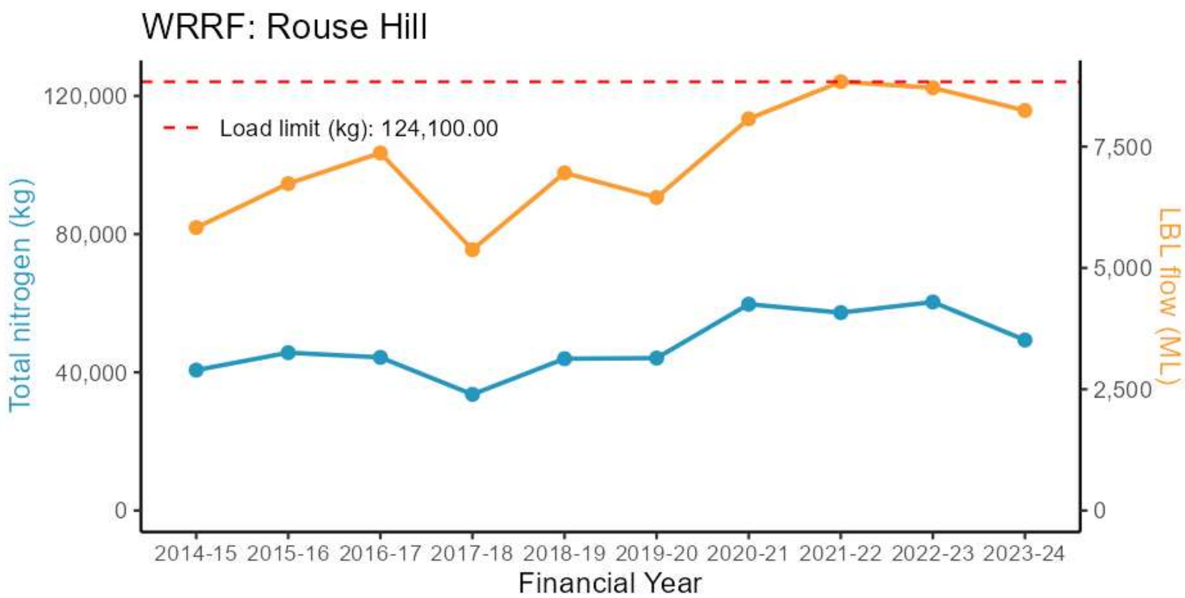
A.11.3. Pressure – Wastewater toxicity

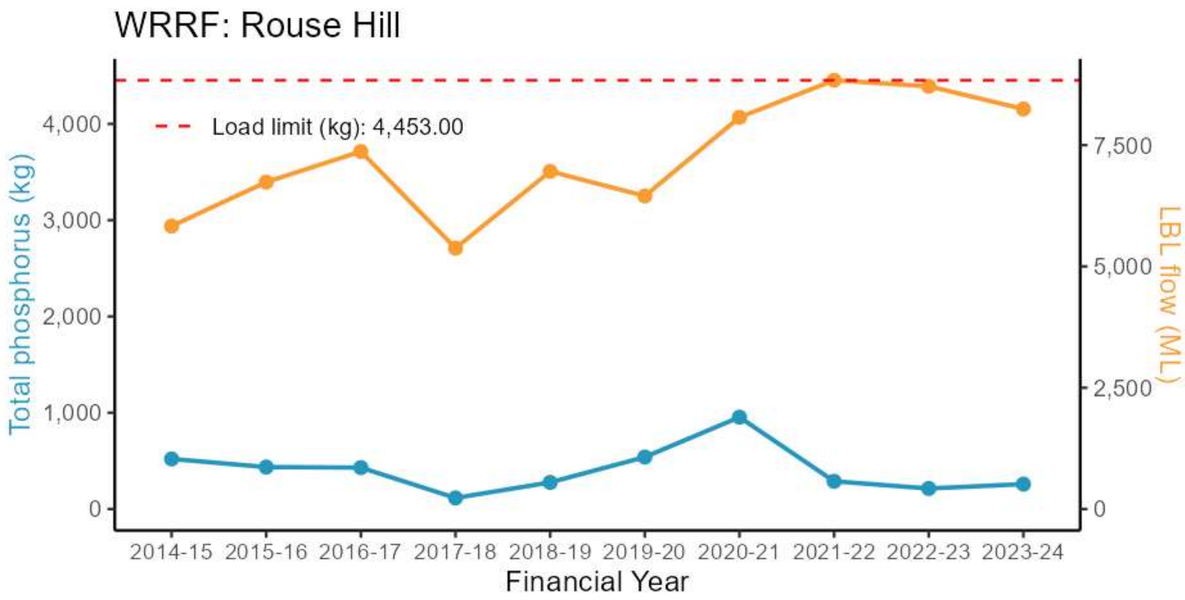


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

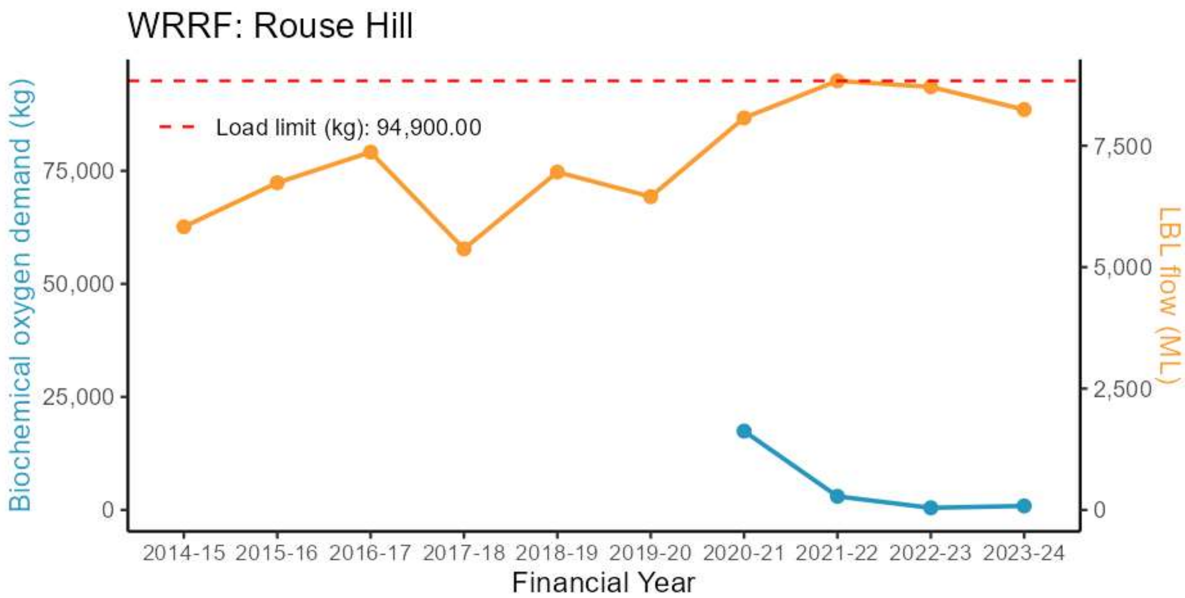
A.11.4. Pressure – Wastewater discharge load

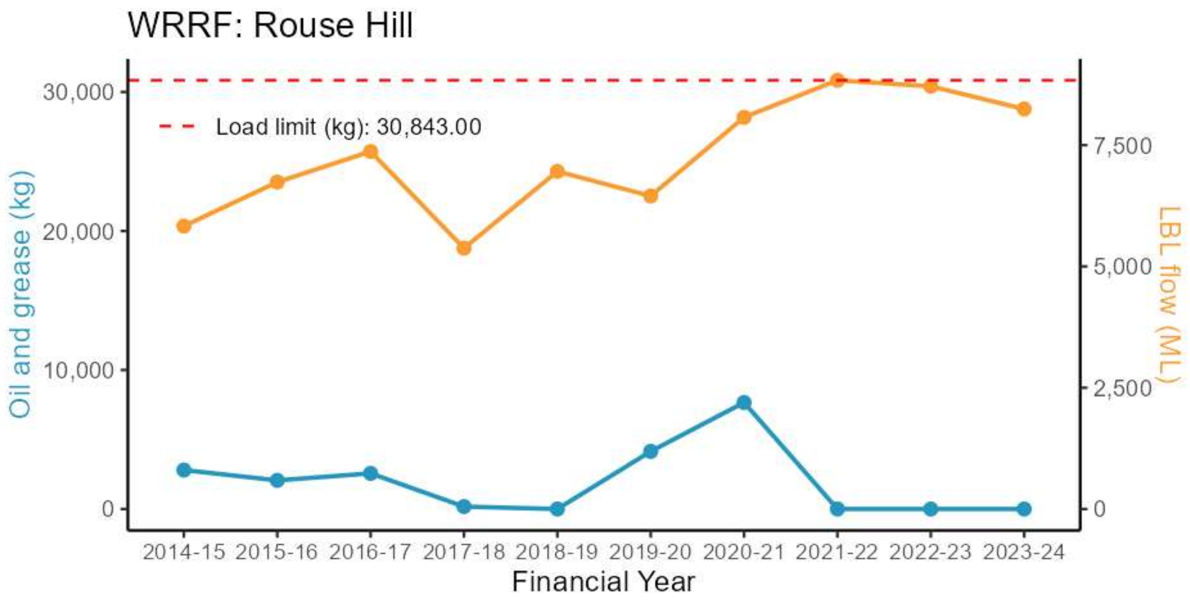
Nutrients



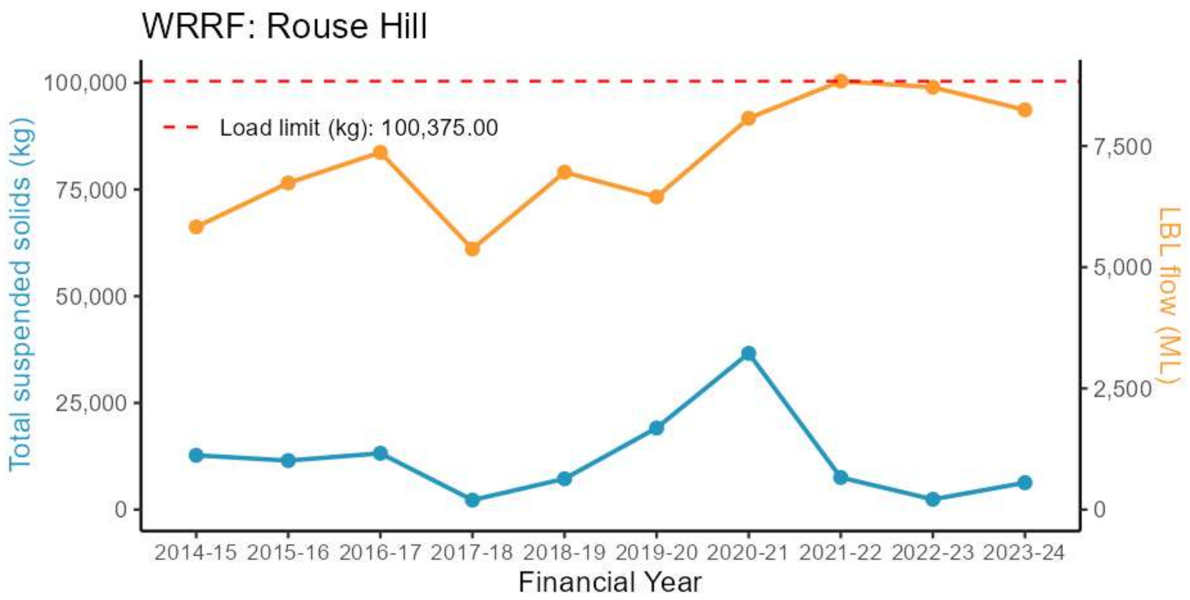


Major conventional analytes





WRRF: Rouse Hill
Load limit (kg): 30,843.00
Oil and grease (kg)
LBL flow (ML)
30,000
20,000
10,000
0
7,500
5,000
2,500
0
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Financial Year



WRRF: Rouse Hill
Load limit (kg): 100,375.00
Total suspended solids (kg)
LBL flow (ML)
100,000
75,000
50,000
25,000
0
7,500
5,000
2,500
0
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24
Financial Year

A.11.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-21 Downstream vs upstream comparison (current period) contrast outcomes for Rouse Hill WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Second Pond Ck	NC53 vs NC516	Total ammonia nitrogen	2.17	0.62	128	2.70	0.039
Second Pond Ck	NC53 vs NC516	Oxidised nitrogen	20.63	6.47	128	9.64	<0.001
Second Pond Ck	NC53 vs NC516	Total nitrogen	6.47	0.77	128	15.63	<0.001
Second Pond Ck	NC53 vs NC516	Filterable total phosphorus	0.58	0.10	112	-3.25	0.008
Second Pond Ck	NC53 vs NC516	Total phosphorus	0.63	0.10	128	-2.87	0.025
Second Pond Ck	NC53 vs NC516	Conductivity	1.15	0.11	128	1.41	0.496
Second Pond Ck	NC53 vs NC516	Dissolved oxygen	1.27	0.08	128	3.66	0.002
Second Pond Ck	NC53 vs NC516	Dissolved oxygen saturation	24.69	3.39	127	7.28	<0.001
Second Pond Ck	NC53 vs NC516	pH	0.00	0.05	128	-0.02	1.000
Second Pond Ck	NC53 vs NC516	Water temperature	1.21	0.10	128	2.30	0.103
Second Pond Ck	NC53 vs NC516	Turbidity	0.50	0.16	128	-2.17	0.137
Second Pond Ck	NC53 vs NC516	Chlorophyll - a	0.49	0.15	128	-2.30	0.104

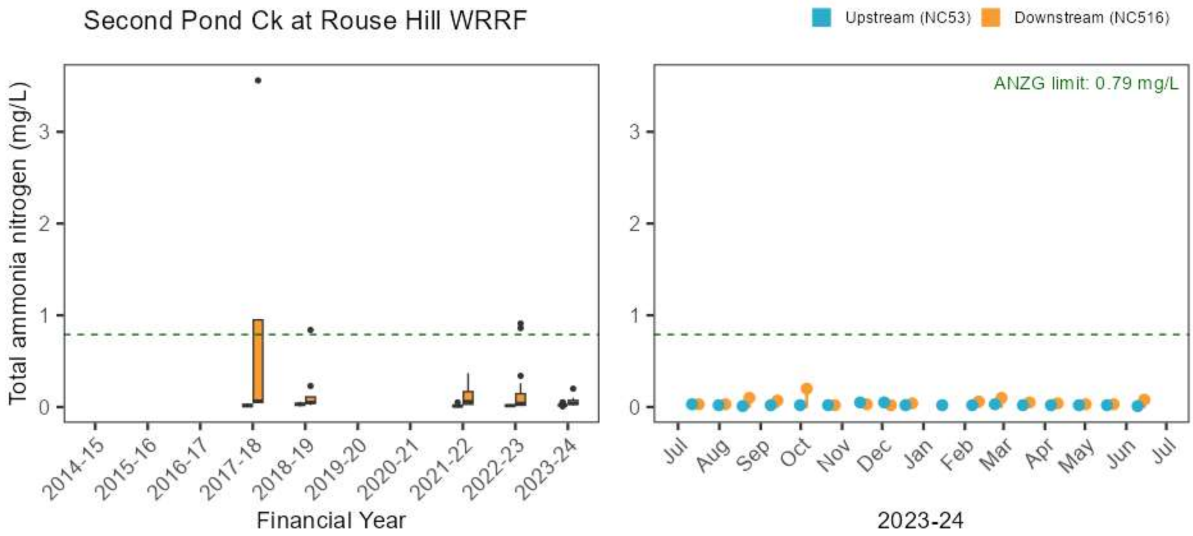
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

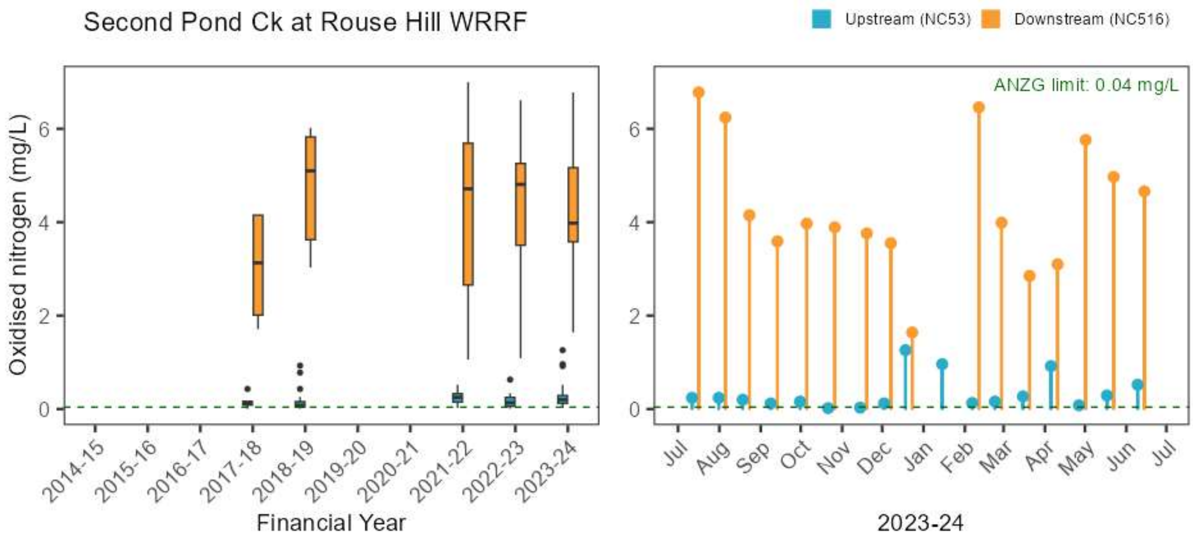
Table A-22 Current period vs previous period comparison (single site) contrast outcomes for Rouse Hill WRRF

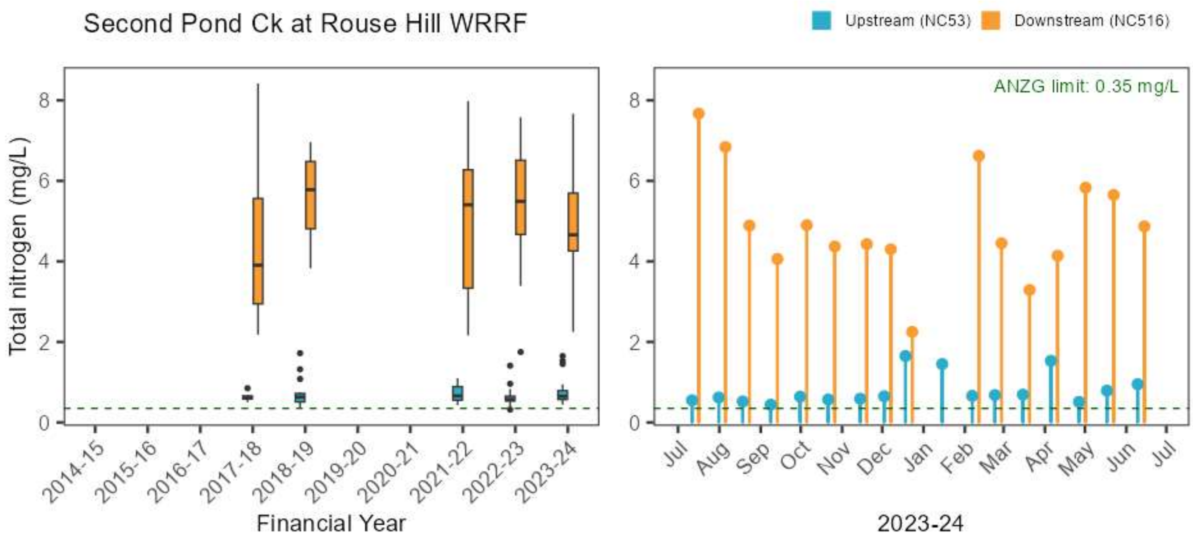
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Second Pond Ck	NC53	Total ammonia nitrogen	1.41	0.32	128	1.49	0.449
Second Pond Ck	NC53	Oxidised nitrogen	1.76	0.44	128	2.25	0.115
Second Pond Ck	NC53	Total nitrogen	1.13	0.11	128	1.28	0.576
Second Pond Ck	NC53	Filterable total phosphorus	1.37	0.19	112	2.24	0.119
Second Pond Ck	NC53	Total phosphorus	1.29	0.17	128	1.93	0.222
Second Pond Ck	NC53	Conductivity	0.89	0.07	128	-1.48	0.455
Second Pond Ck	NC53	Dissolved oxygen	0.93	0.05	128	-1.40	0.503
Second Pond Ck	NC53	Dissolved oxygen saturation	-4.45	2.72	127	-1.64	0.362
Second Pond Ck	NC53	pH	-0.09	0.04	128	-2.15	0.142
Second Pond Ck	NC53	Water temperature	1.06	0.07	128	0.82	0.847
Second Pond Ck	NC53	Turbidity	1.03	0.27	128	0.12	0.999
Second Pond Ck	NC53	Chlorophyll - a	1.31	0.32	128	1.08	0.703
Second Pond Ck	NC516	Total ammonia nitrogen	0.68	0.16	128	-1.59	0.389
Second Pond Ck	NC516	Oxidised nitrogen	0.99	0.26	128	-0.03	1.000
Second Pond Ck	NC516	Total nitrogen	0.93	0.09	128	-0.72	0.890
Second Pond Ck	NC516	Filterable total phosphorus	1.00	0.15	112	0.03	1.000
Second Pond Ck	NC516	Total phosphorus	1.00	0.14	128	0.02	1.000
Second Pond Ck	NC516	Conductivity	1.00	0.08	128	0.00	1.000
Second Pond Ck	NC516	Dissolved oxygen	1.03	0.06	128	0.52	0.954
Second Pond Ck	NC516	Dissolved oxygen saturation	5.74	2.83	127	2.03	0.182
Second Pond Ck	NC516	pH	0.03	0.04	128	0.78	0.866
Second Pond Ck	NC516	Water temperature	1.11	0.08	128	1.54	0.415
Second Pond Ck	NC516	Turbidity	0.67	0.18	128	-1.48	0.454
Second Pond Ck	NC516	Chlorophyll - a	0.36	0.09	128	-3.92	<0.001

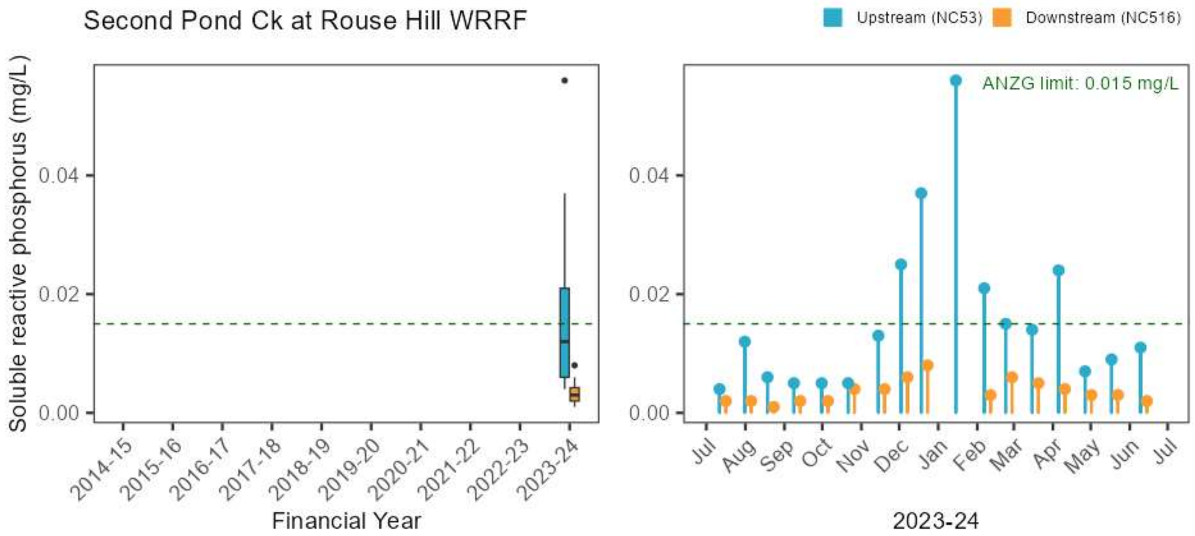
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.11.6. Stressor – Nutrients








Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
0.00
0.02
0.04
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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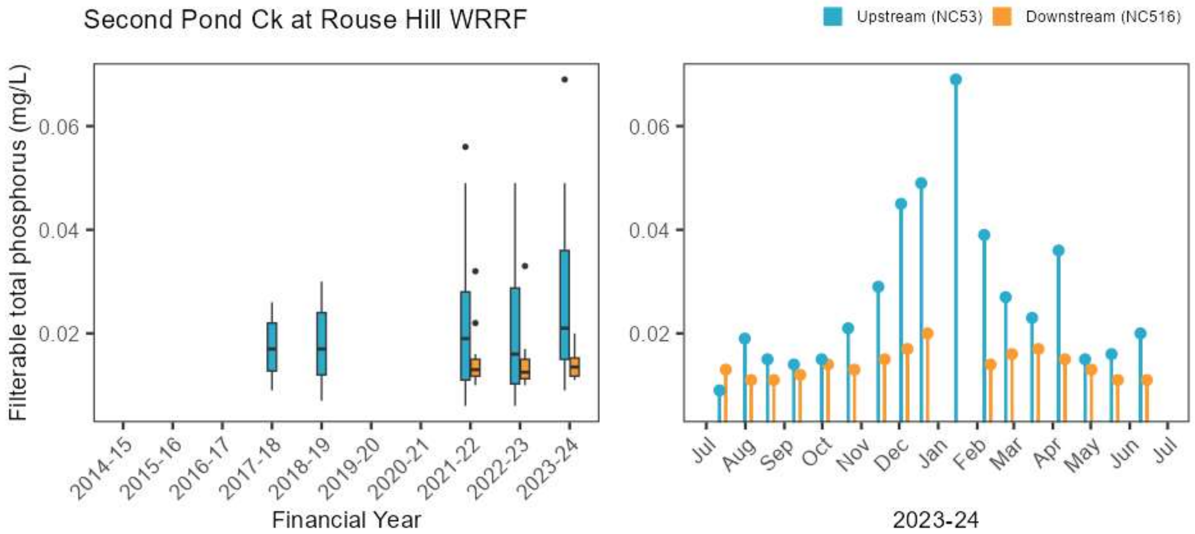
Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Filterable total phosphorus (mg/L)
0.02
0.04
0.06
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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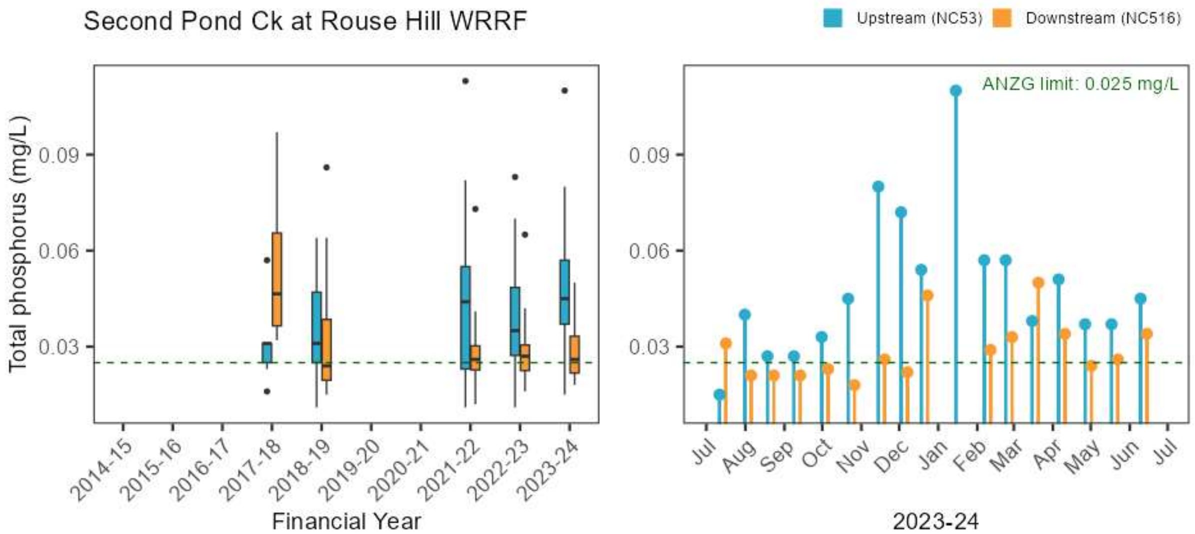
Jul
2023-24


Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Total phosphorus (mg/L)
ANZG limit: 0.025 mg/L
0.03
0.06
0.09
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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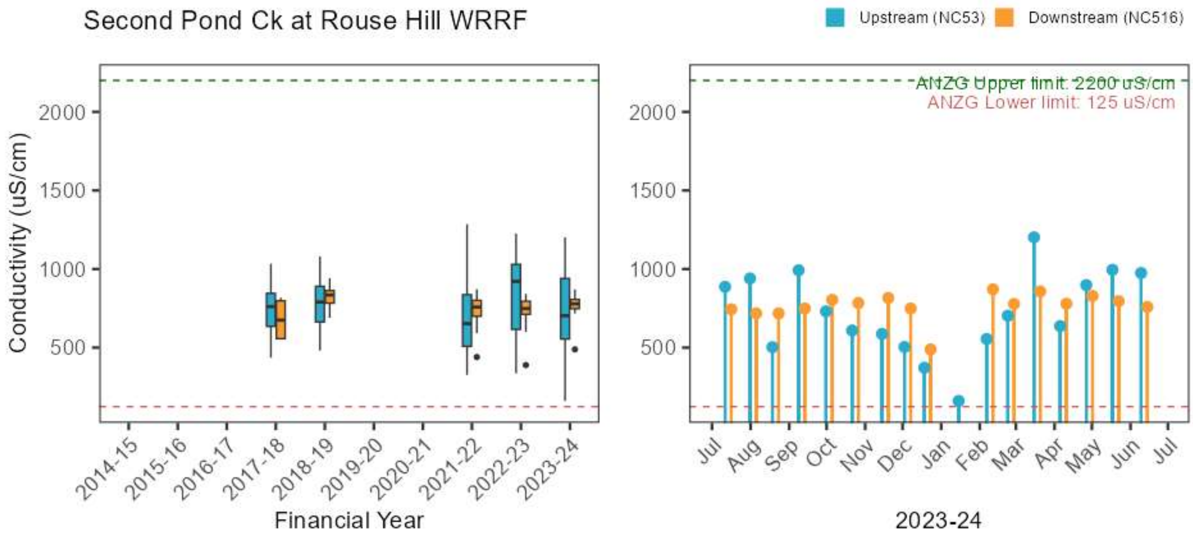
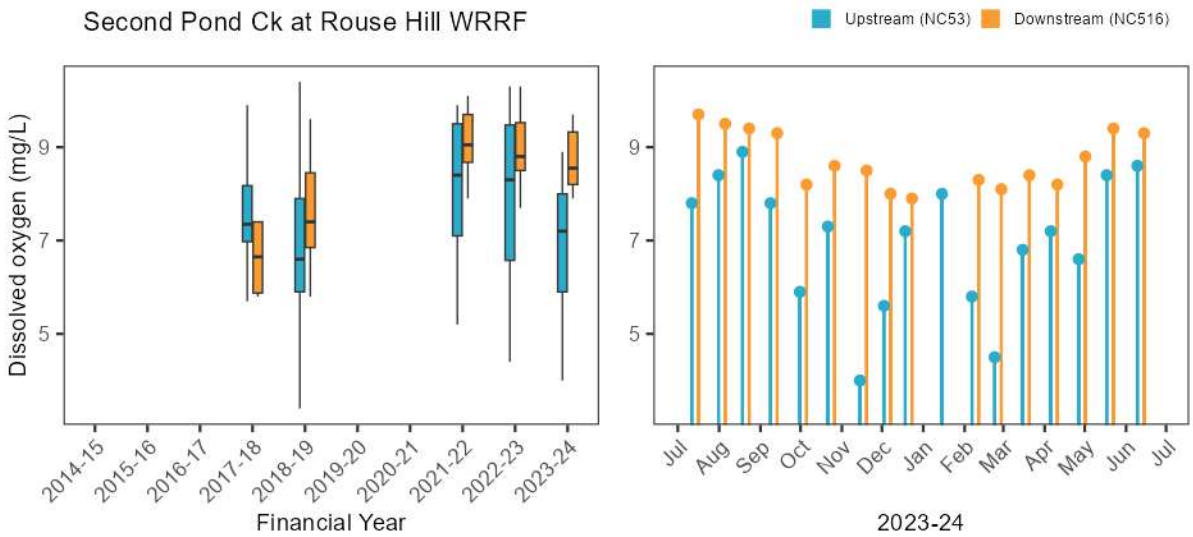
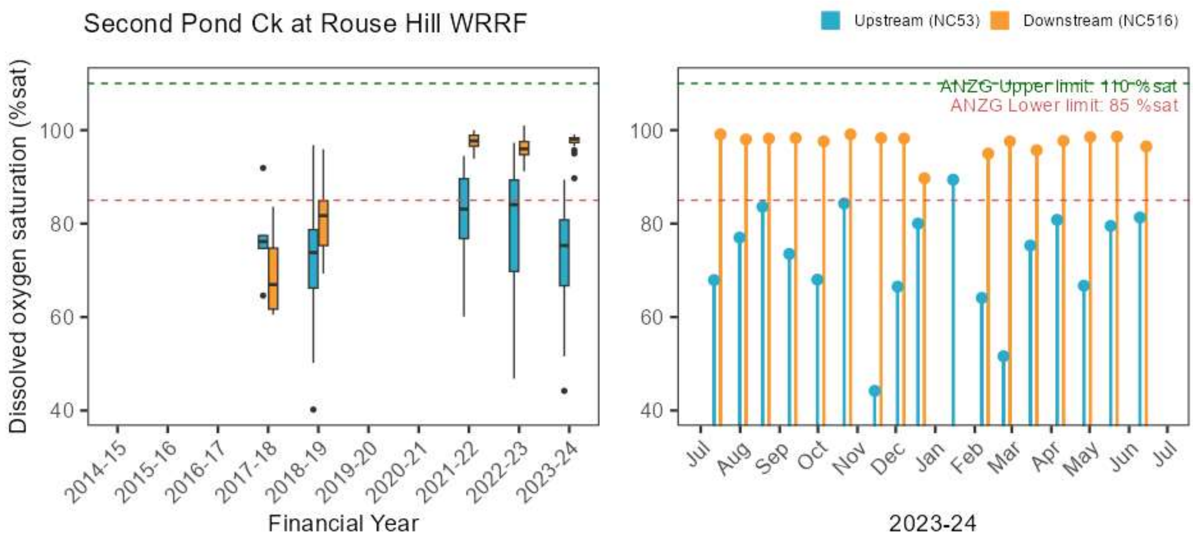
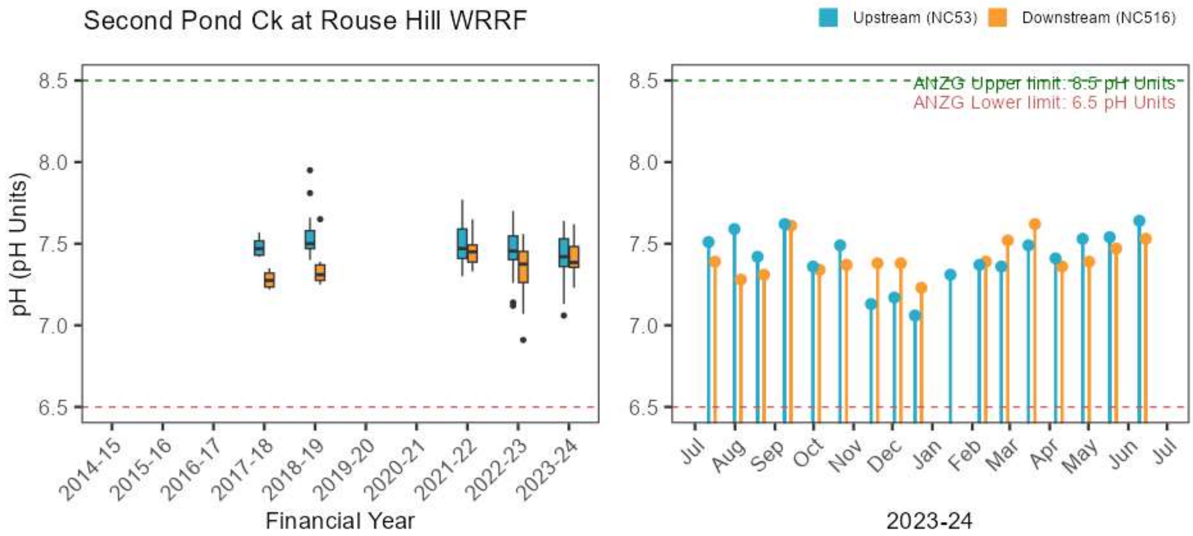
2023-24

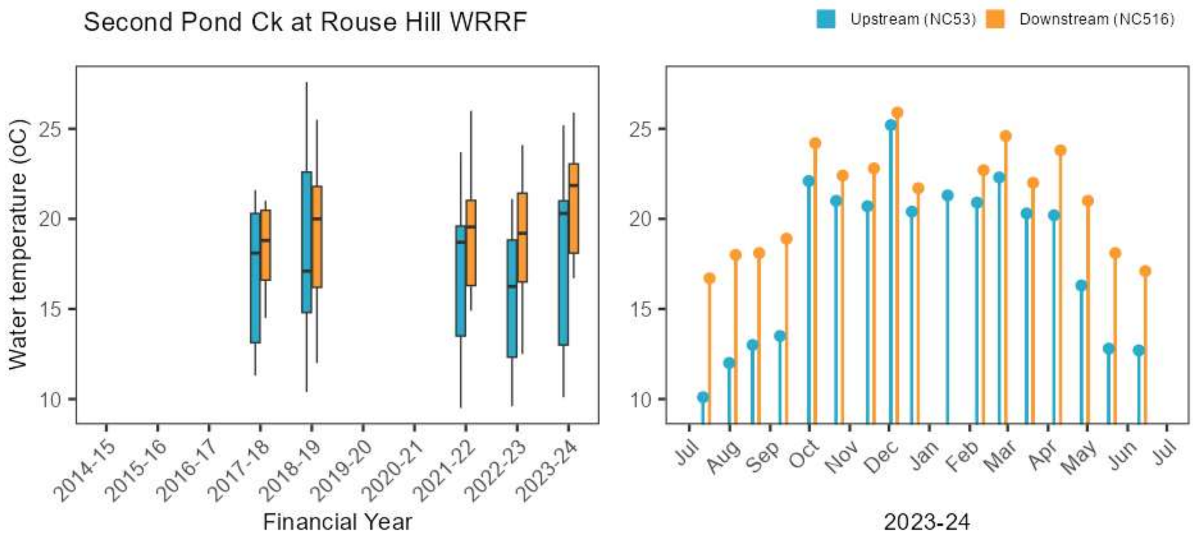
A.11.7. Stressor – Physico-chemical water quality

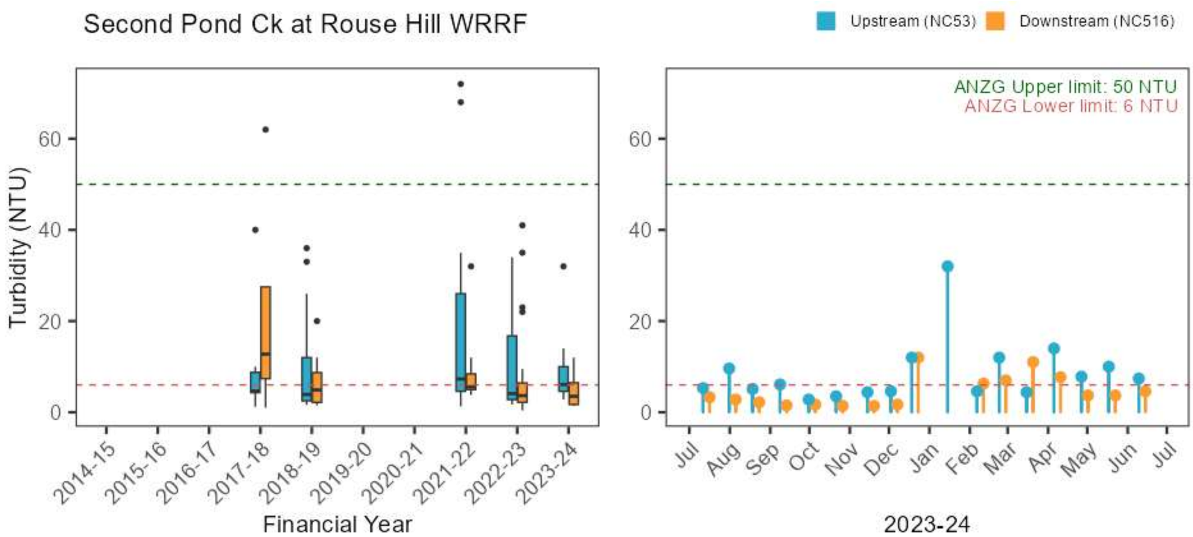




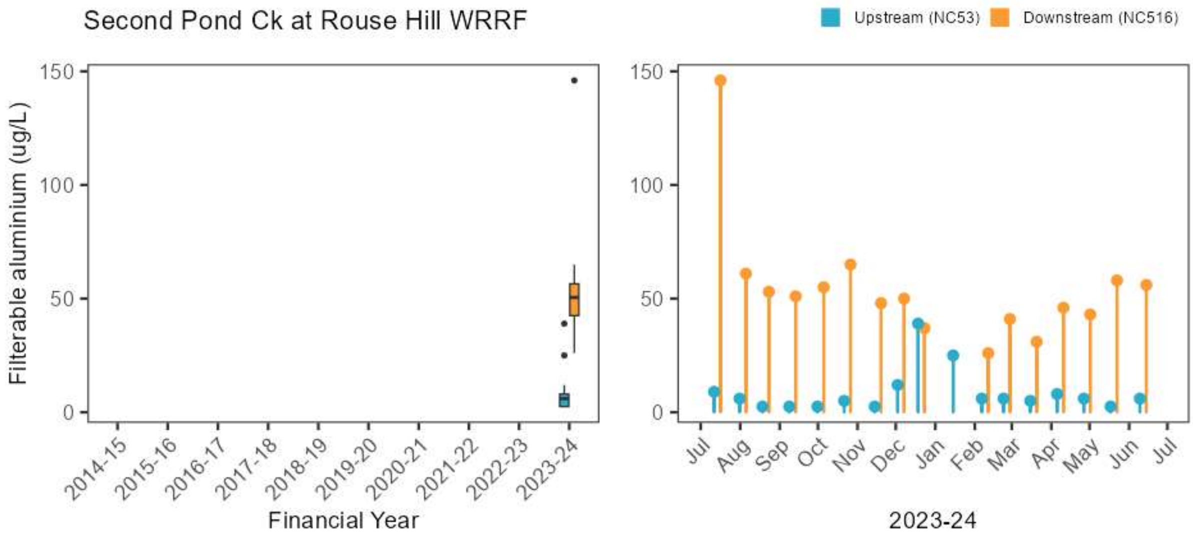


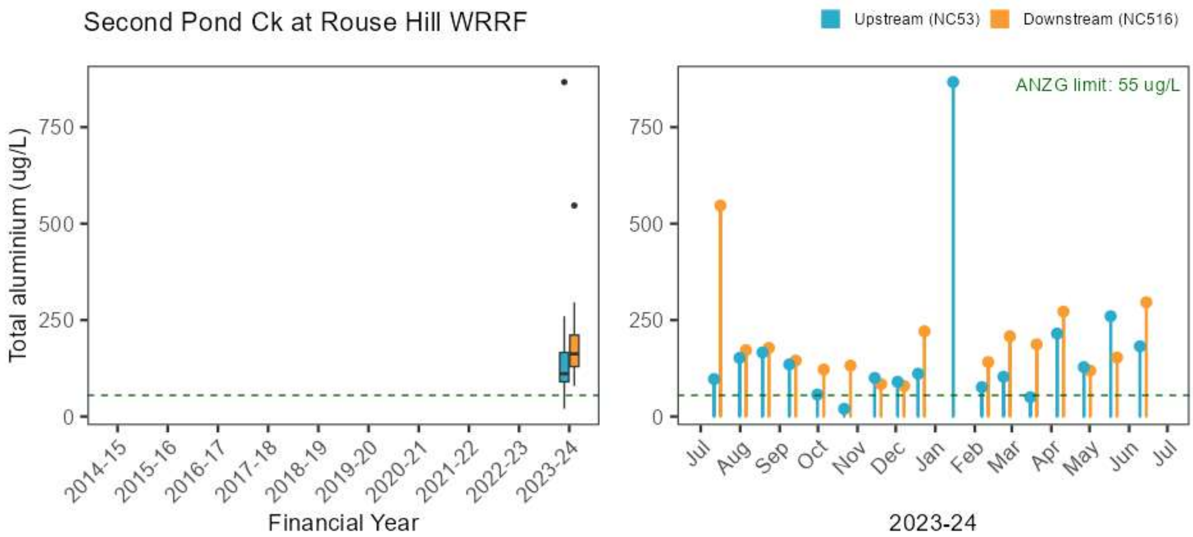

Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
Financial Year
2023-24

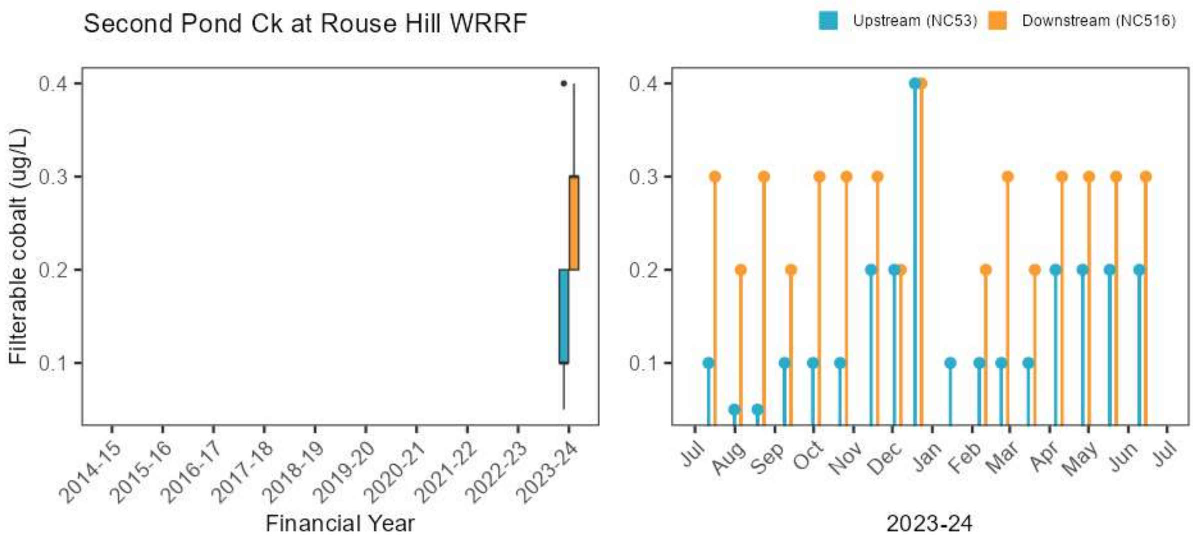

Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Water temperature (oC)
Financial Year
2023-24

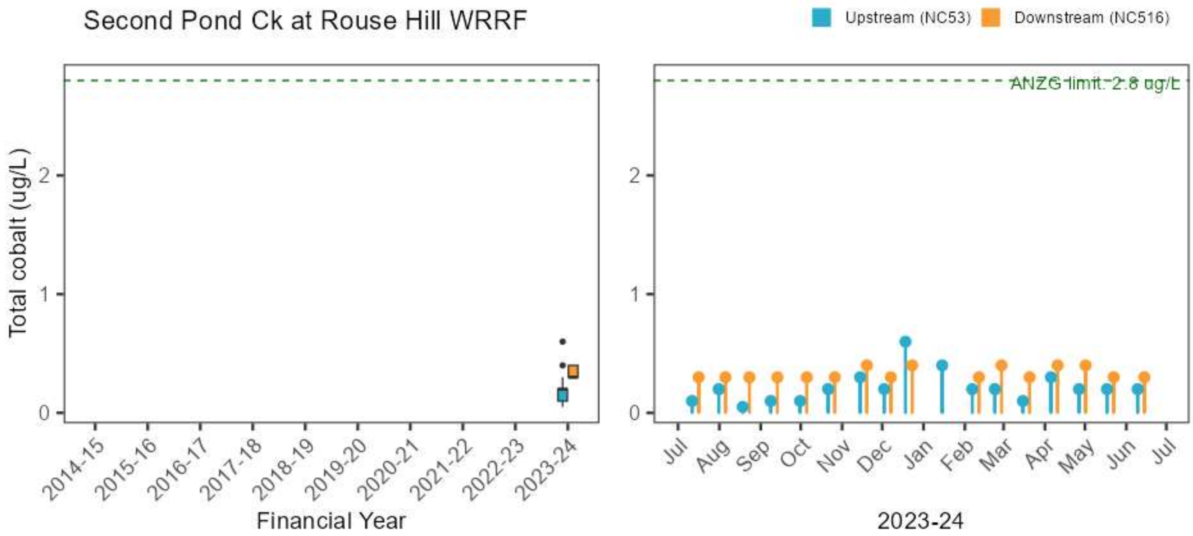

Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

A.11.8. Stressor – Trace metals








Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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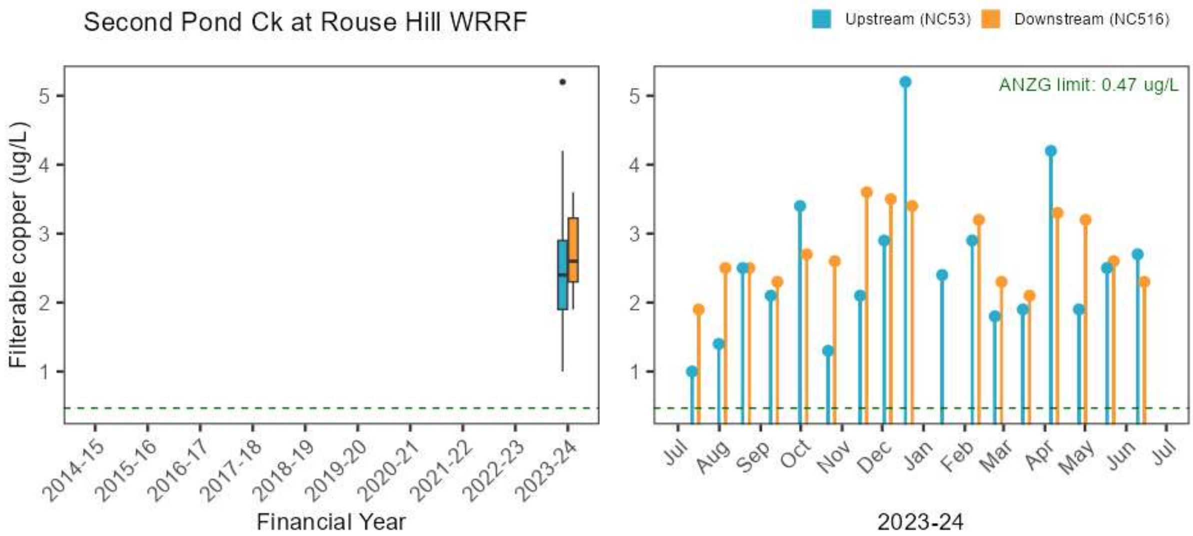
Jul
2023-24


Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Filterable copper (ug/L)
ANZG limit: 0.47 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
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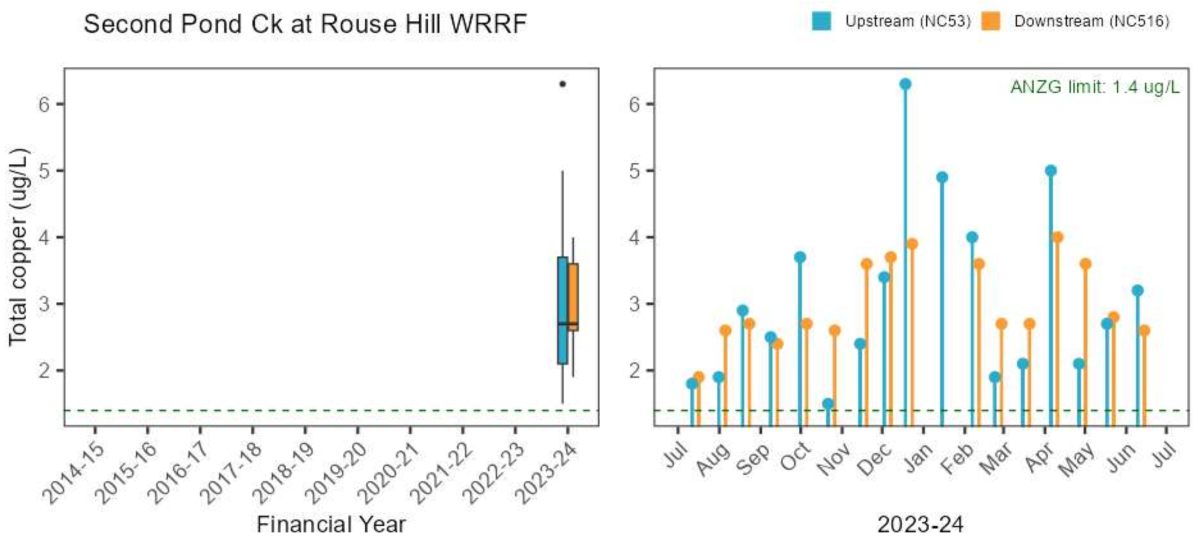
2023-24


Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Total copper (ug/L)
ANZG limit: 1.4 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
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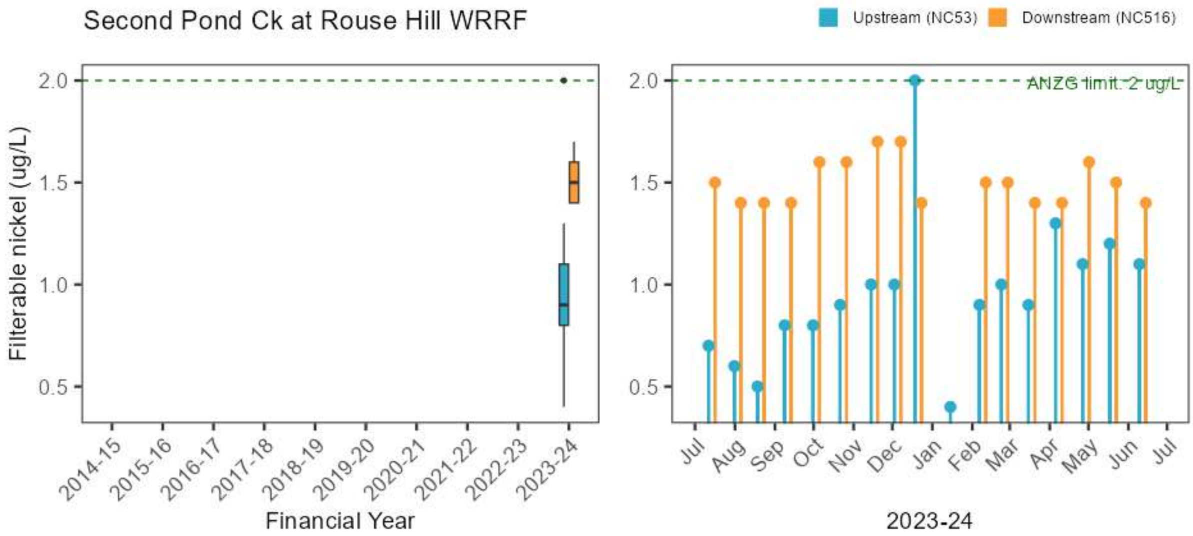
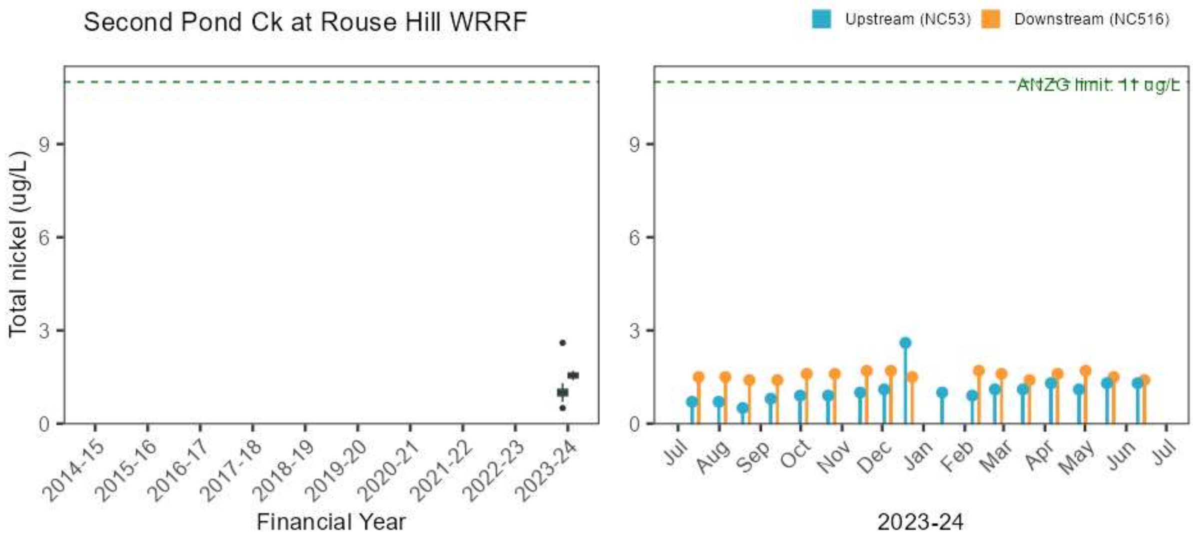
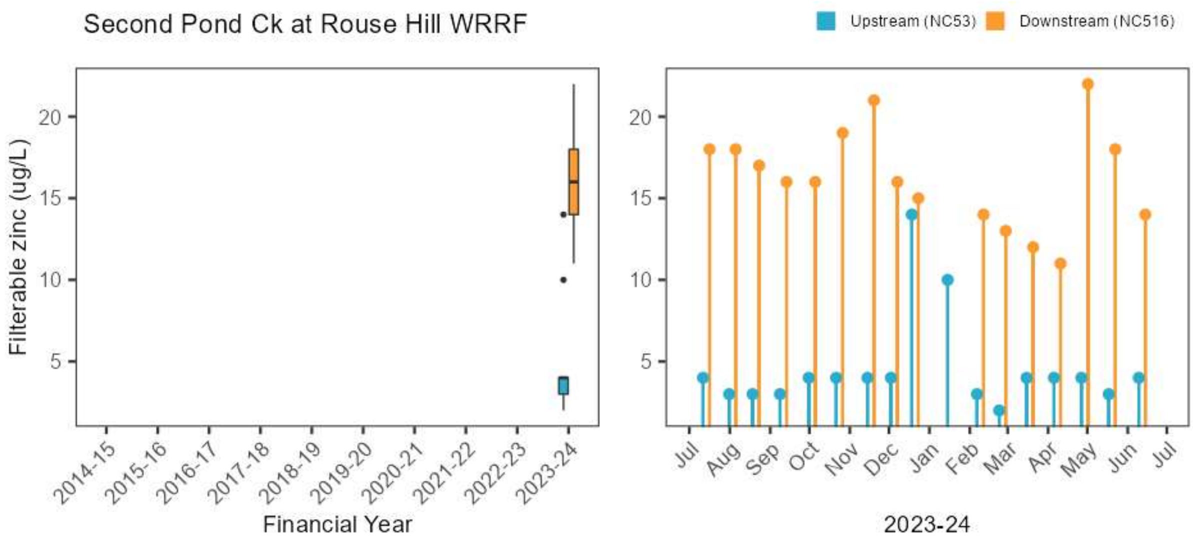
2023-24



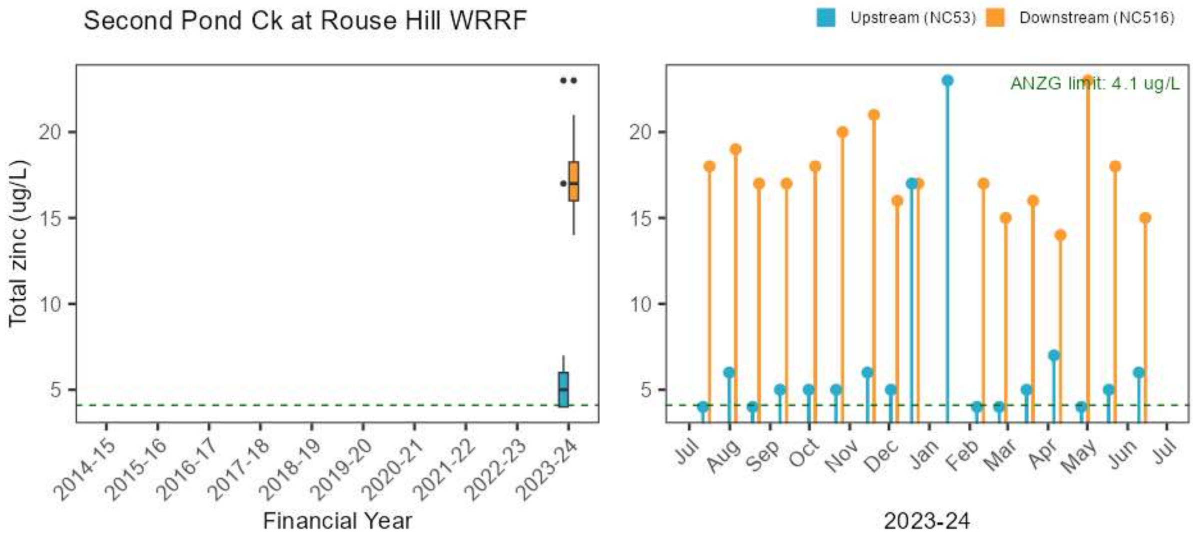
Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Filterable nickel (ug/L)
ANZG limit: 2 ug/L
Financial Year
2023-24



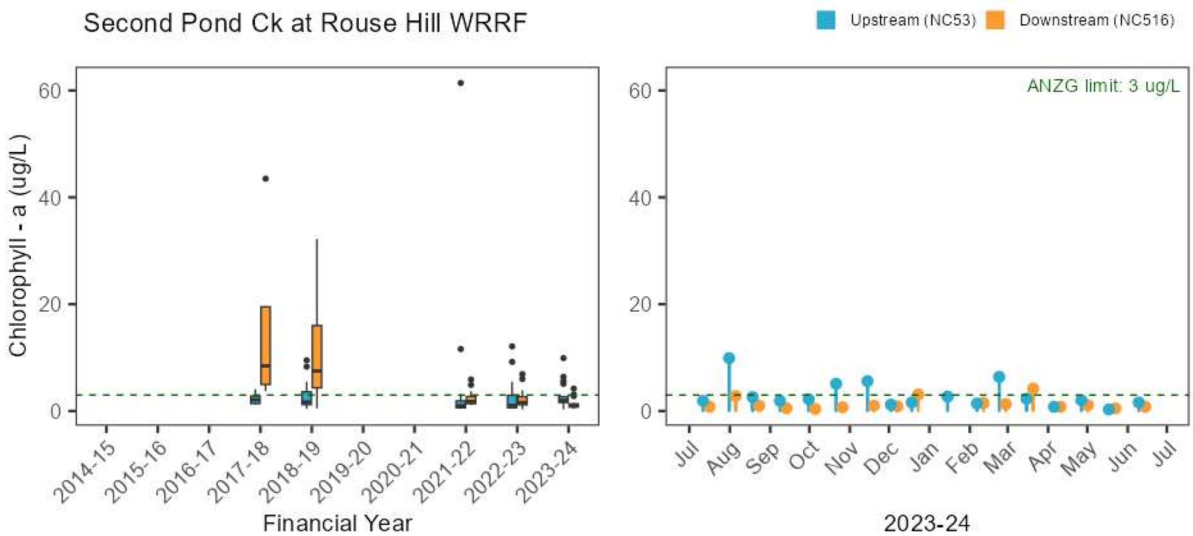
Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Total nickel (ug/L)
ANZG limit: 11 ug/L
Financial Year
2023-24



Second Pond Ck at Rouse Hill WRRF
Upstream (NC53)
Downstream (NC516)
Filterable zinc (ug/L)
Financial Year
2023-24



A.11.9. Ecosystem receptor – Phytoplankton



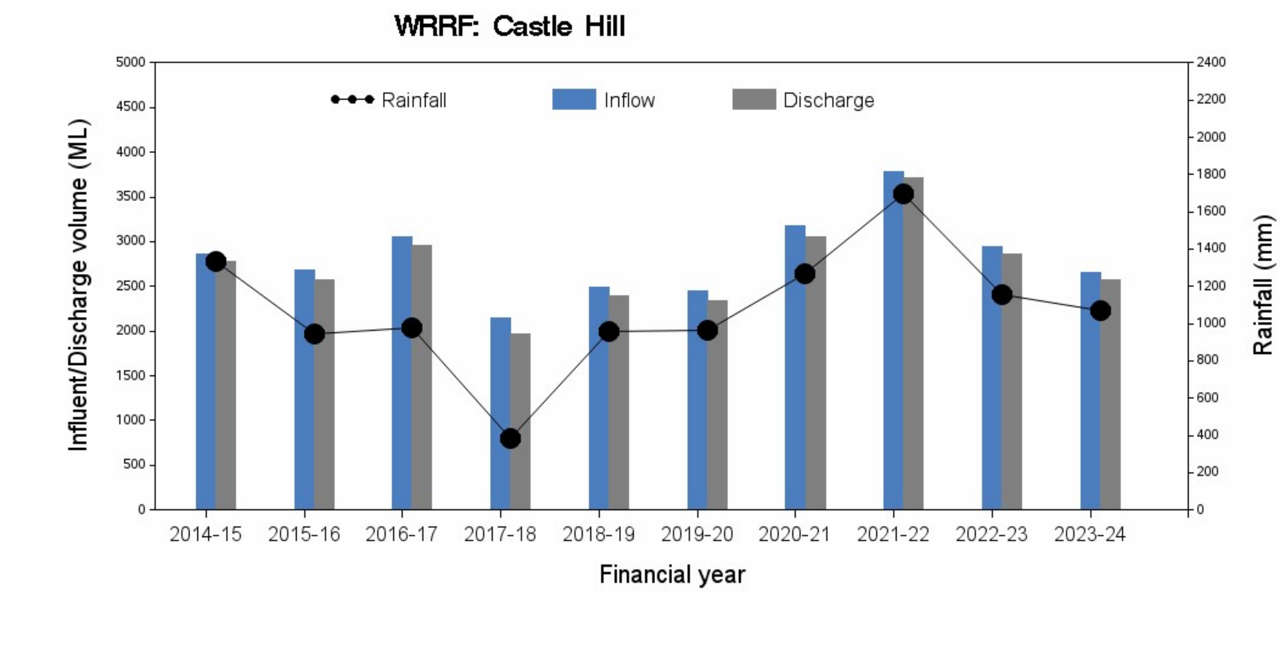
A.11.10. Ecosystem receptor – Macroinvertebrates

Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Second Ponds Creek	River (NC53 vs NC515)	Welch Two Sample t-test	-0.23	-0.87	8.3	0.408

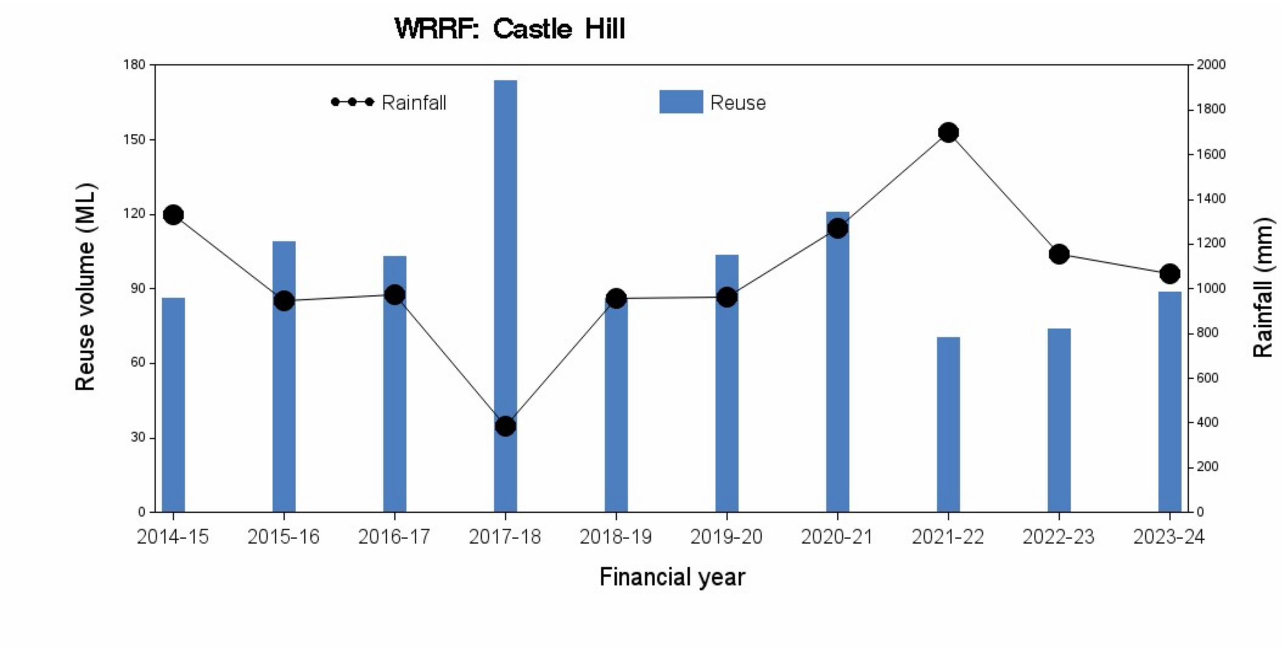
A.12. Castle Hill WRRF

A.12.1. Pressure – Wastewater quantity

Inflow/discharge volume and rainfall

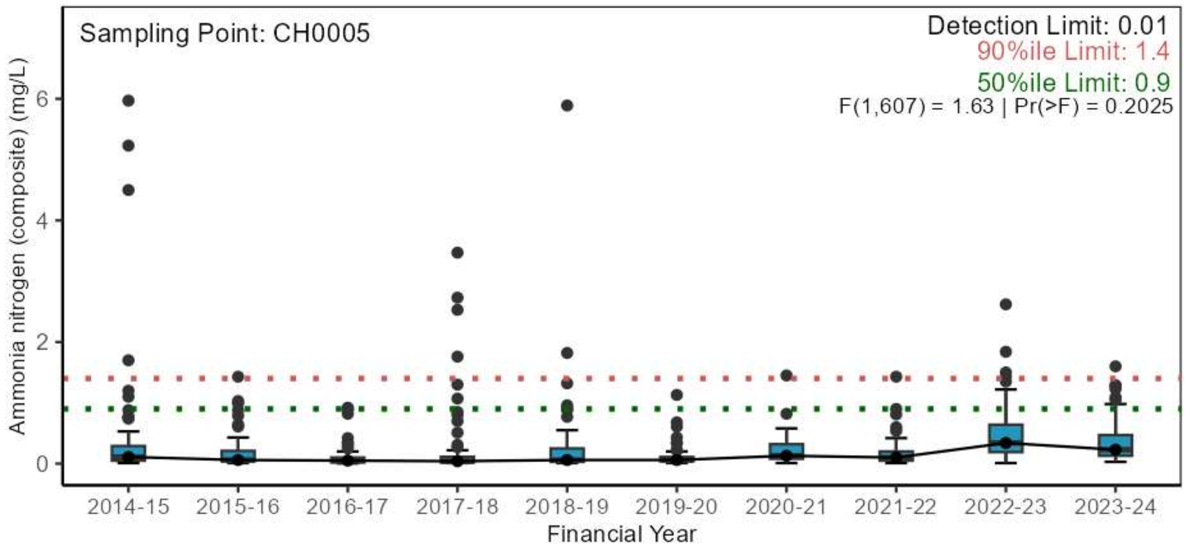


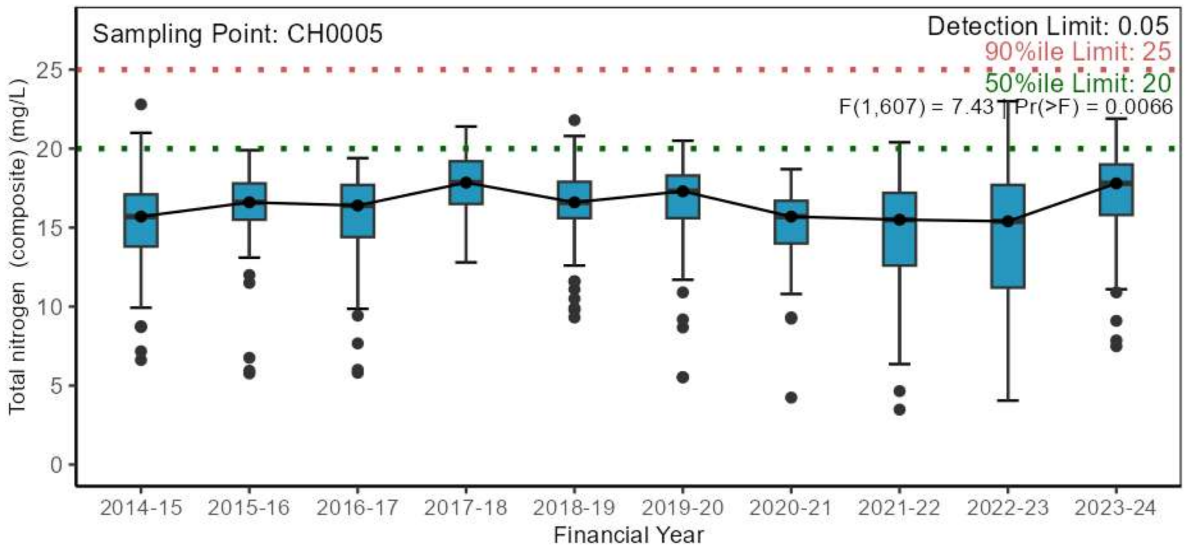
Reuse volume and rainfall

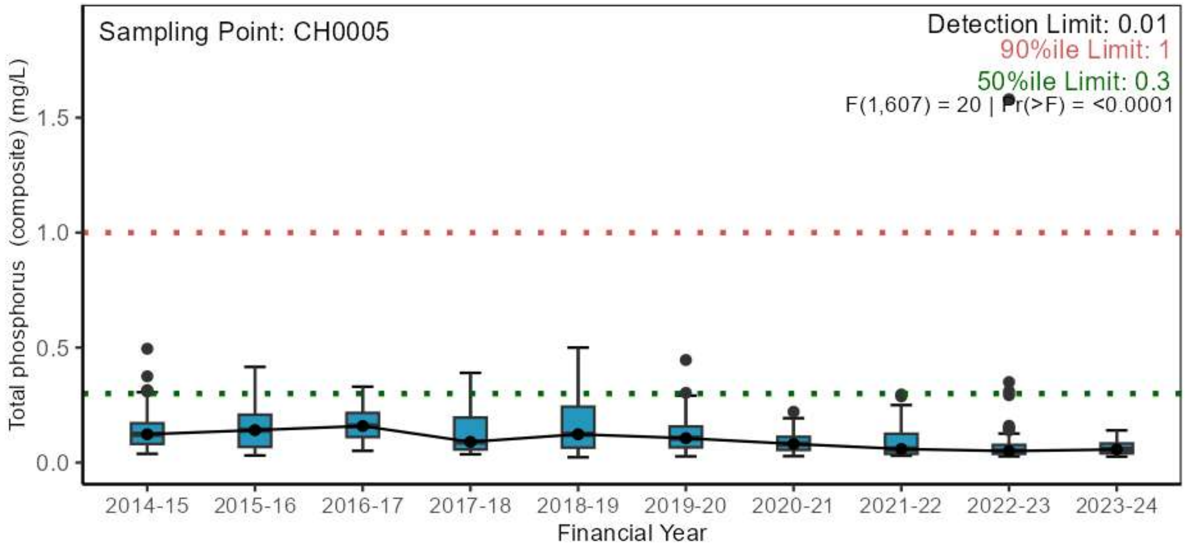


A.12.2. Pressure – Wastewater quality

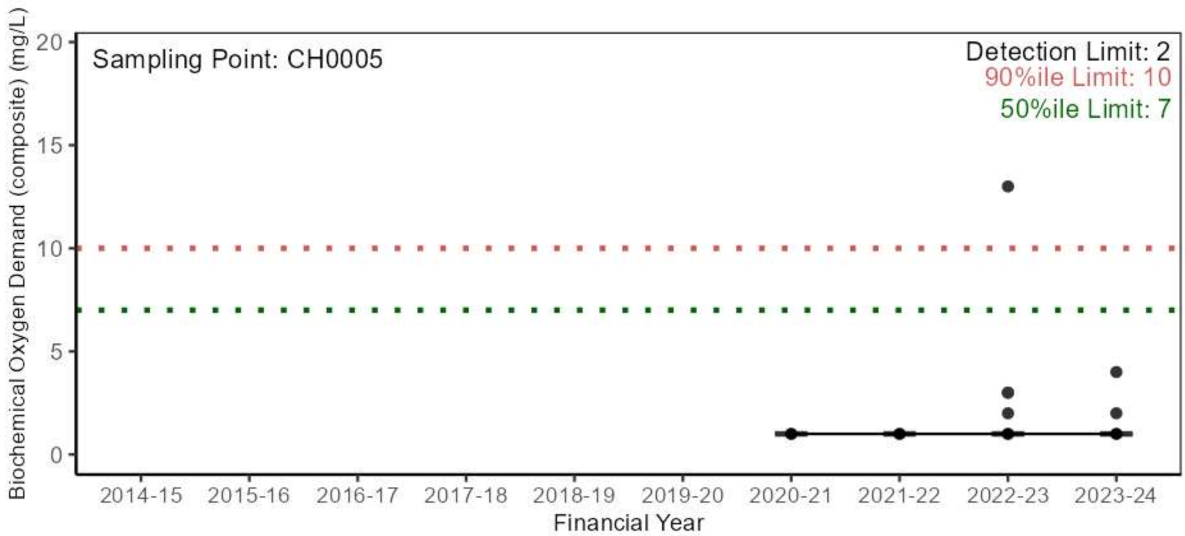
Nutrients



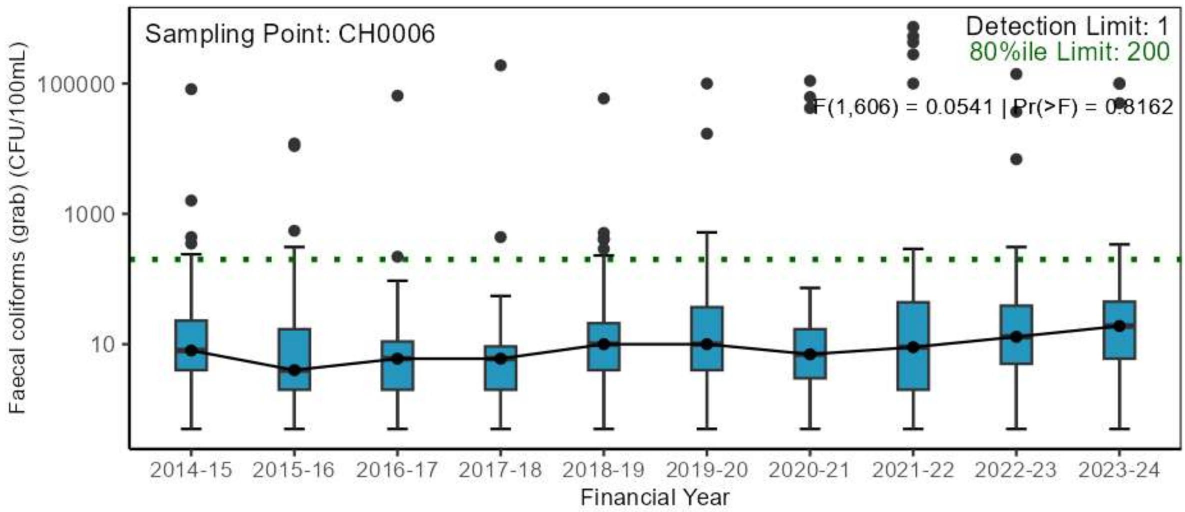




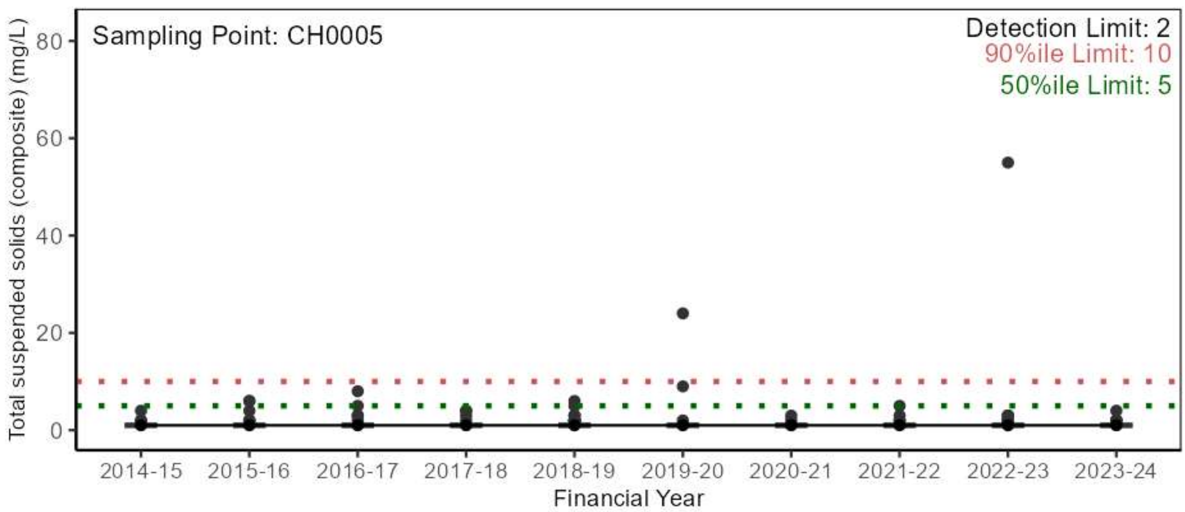
Major conventional analytes



Statistical test not conducted as >90% of results were below detection limits.

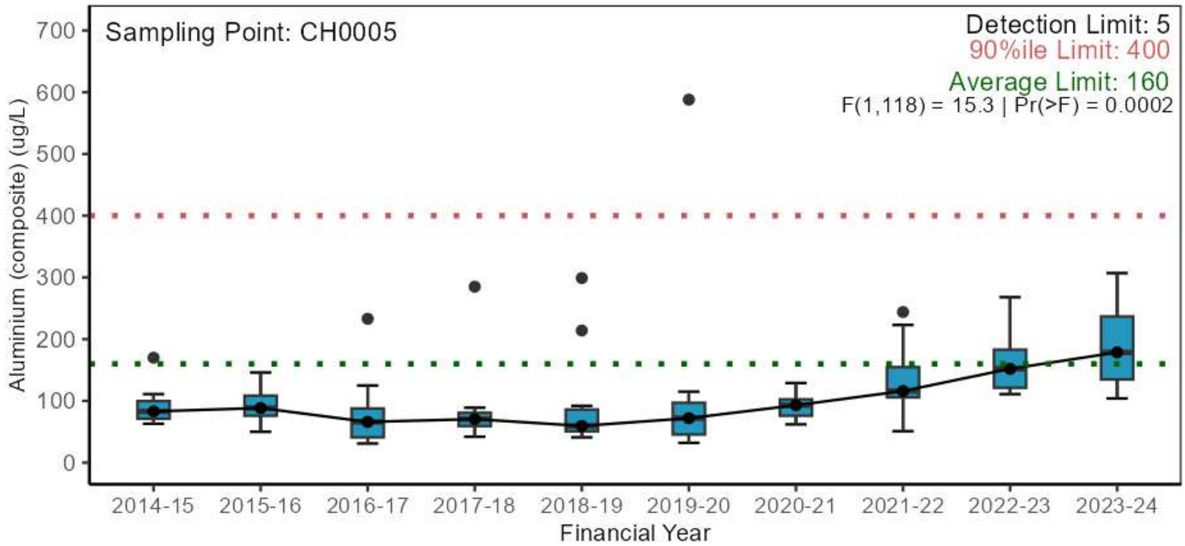


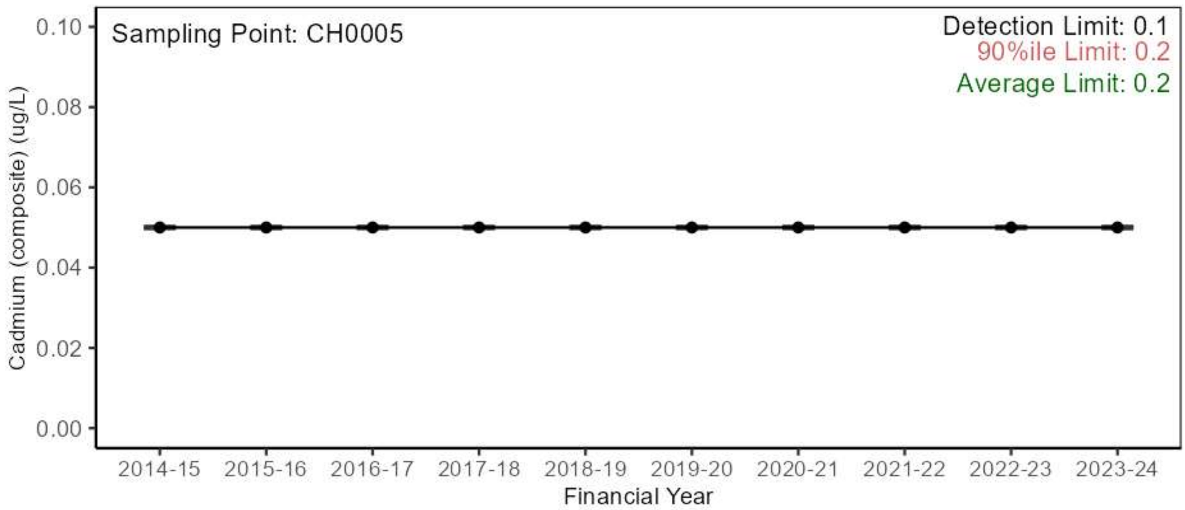
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



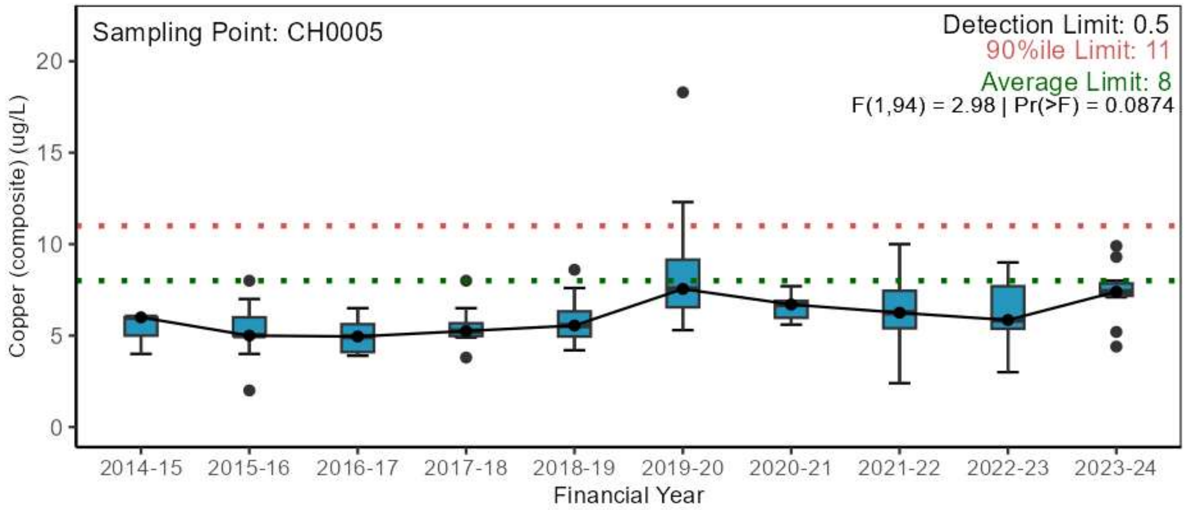
Statistical test not conducted as >90% of results were below detection limits.

Trace metals

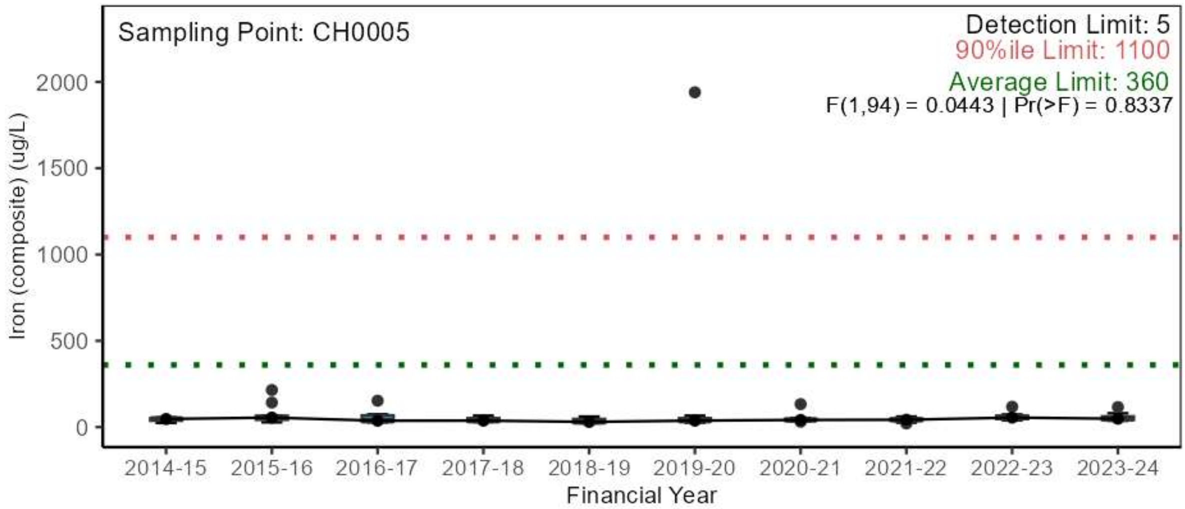




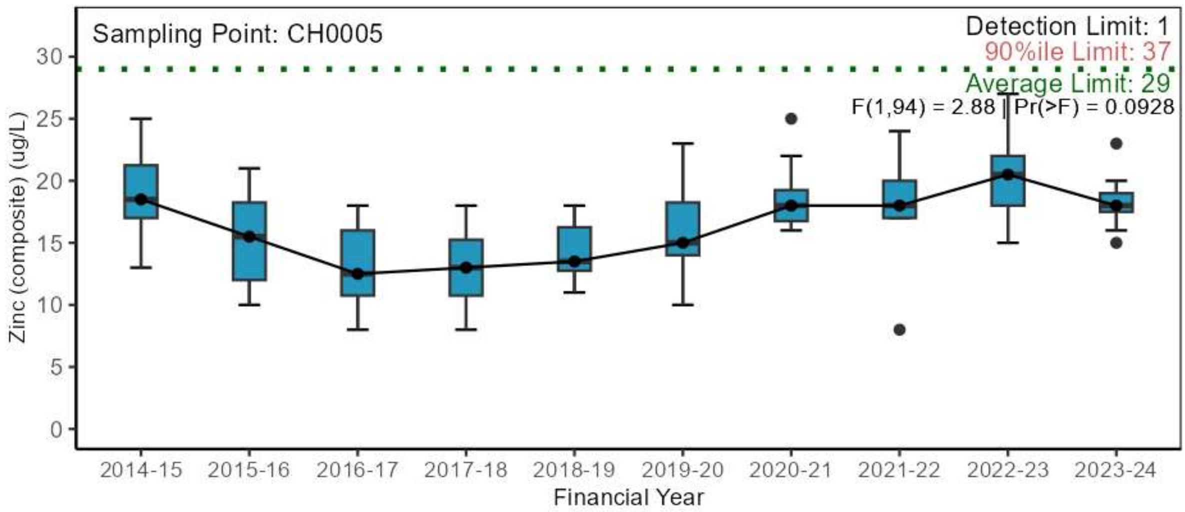
Statistical test not conducted as >90% of results were below detection limits.



Statistical test excludes data prior to 2016-17 due to method detection limit change.

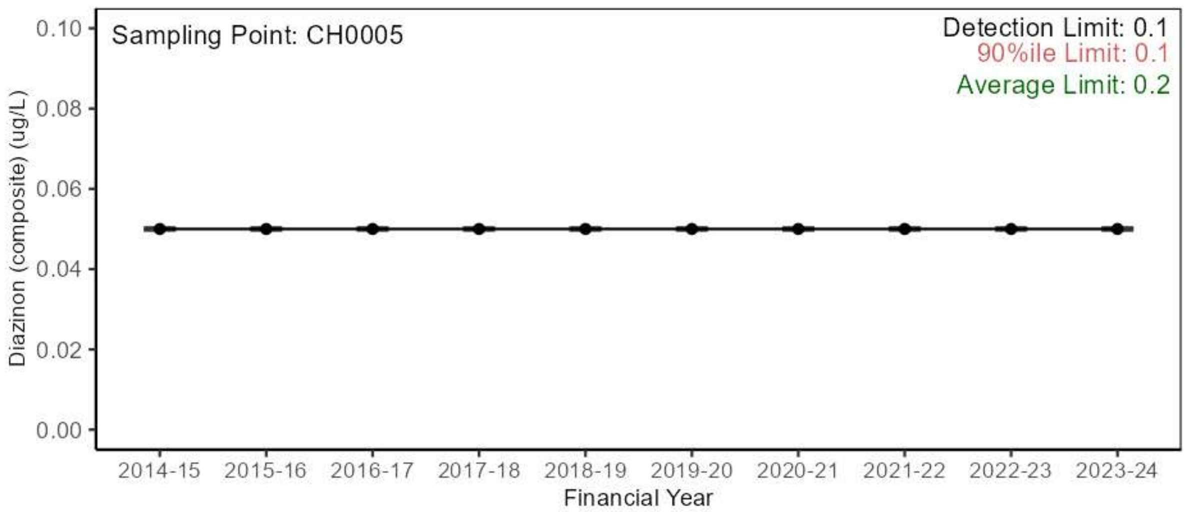


Statistical test excludes data prior to 2016-17 due to method detection limit change.

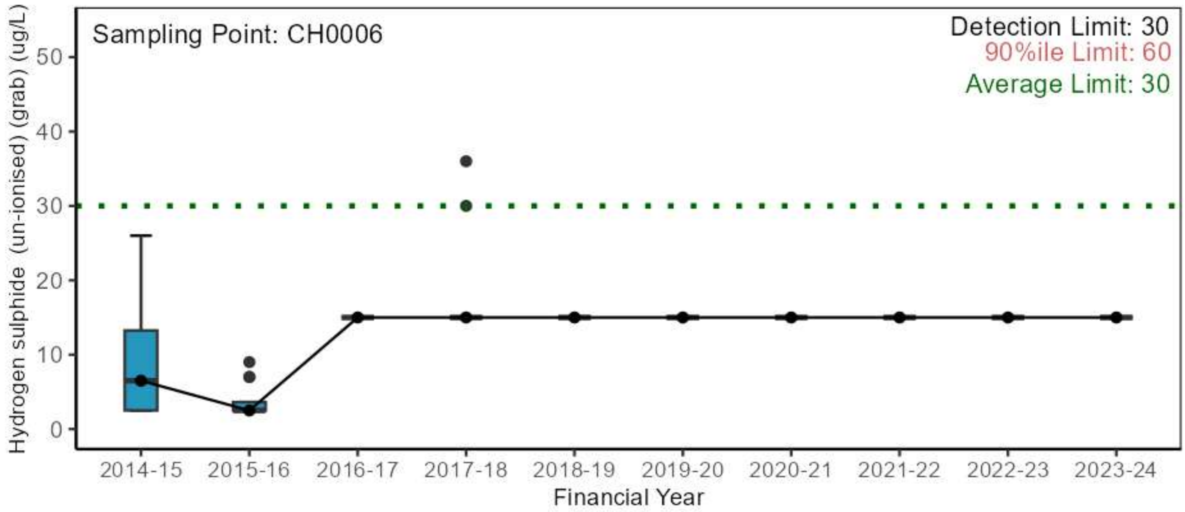


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

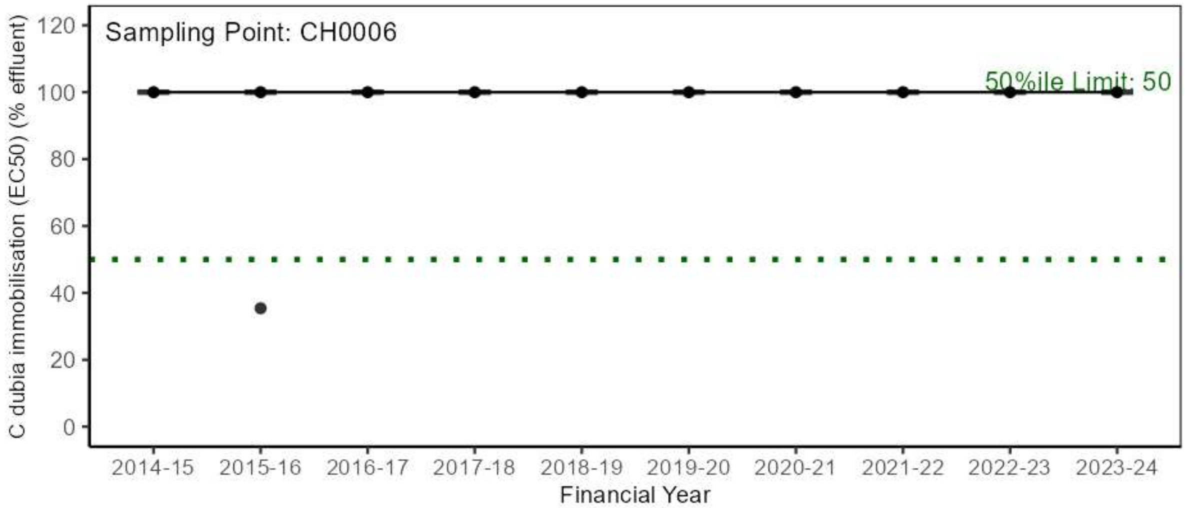


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

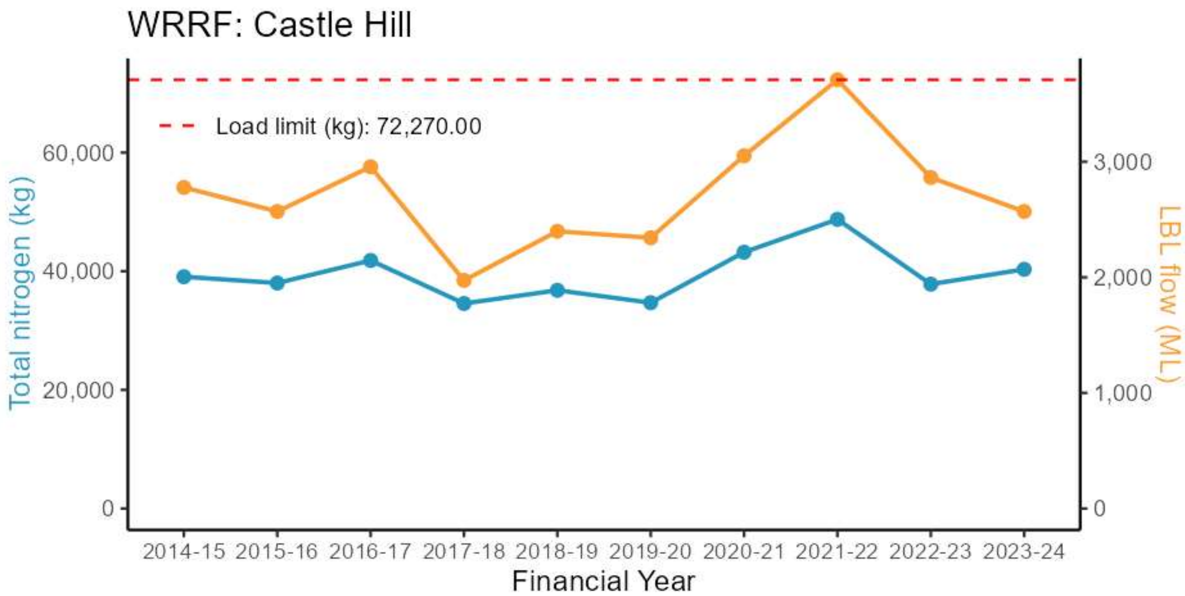
A.12.3. Pressure – Wastewater toxicity

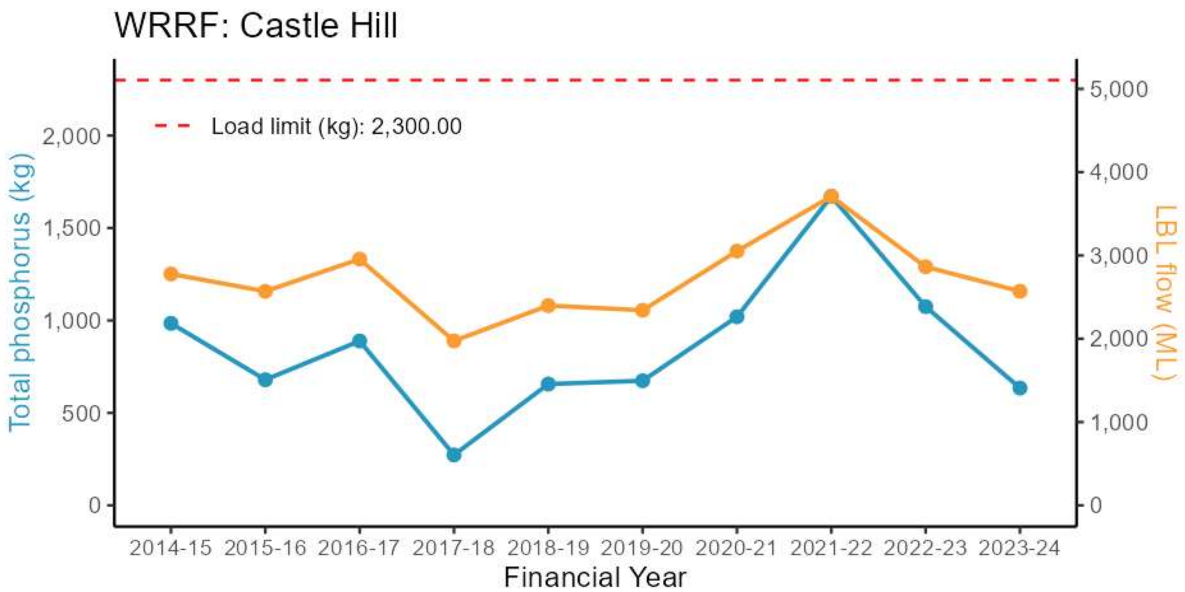


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

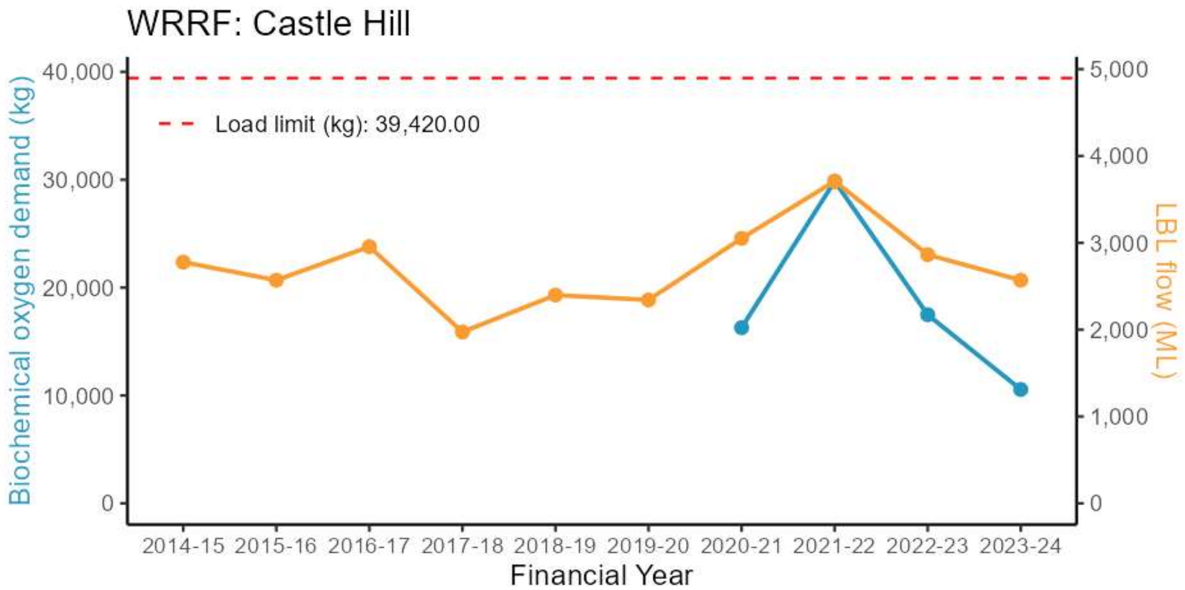
A.12.4. Pressure – Wastewater discharge load

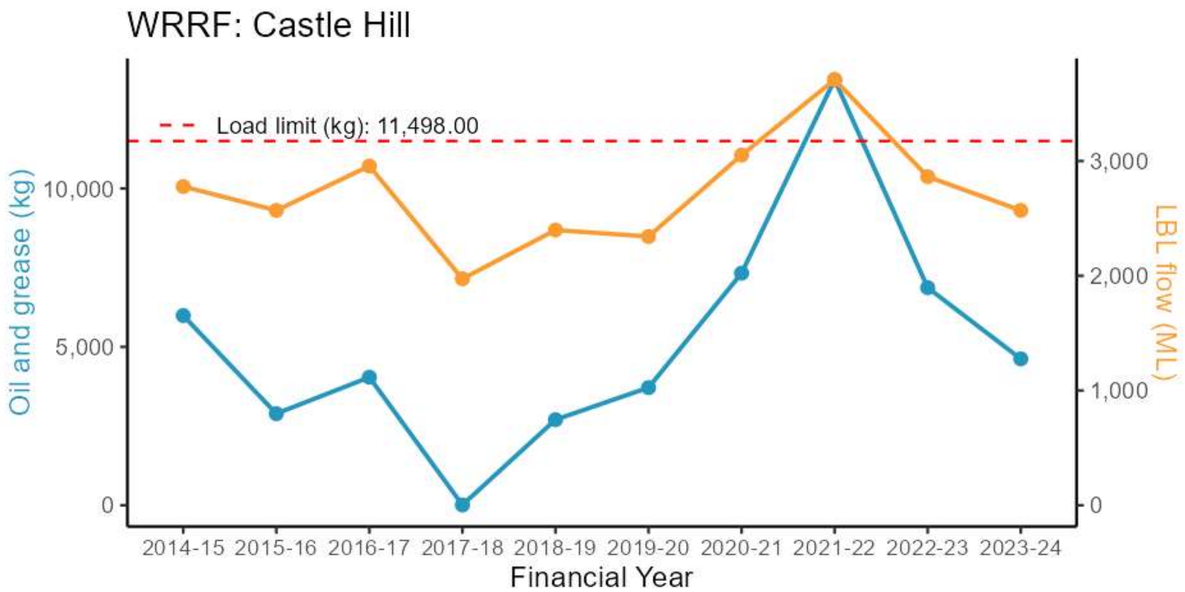
Nutrients

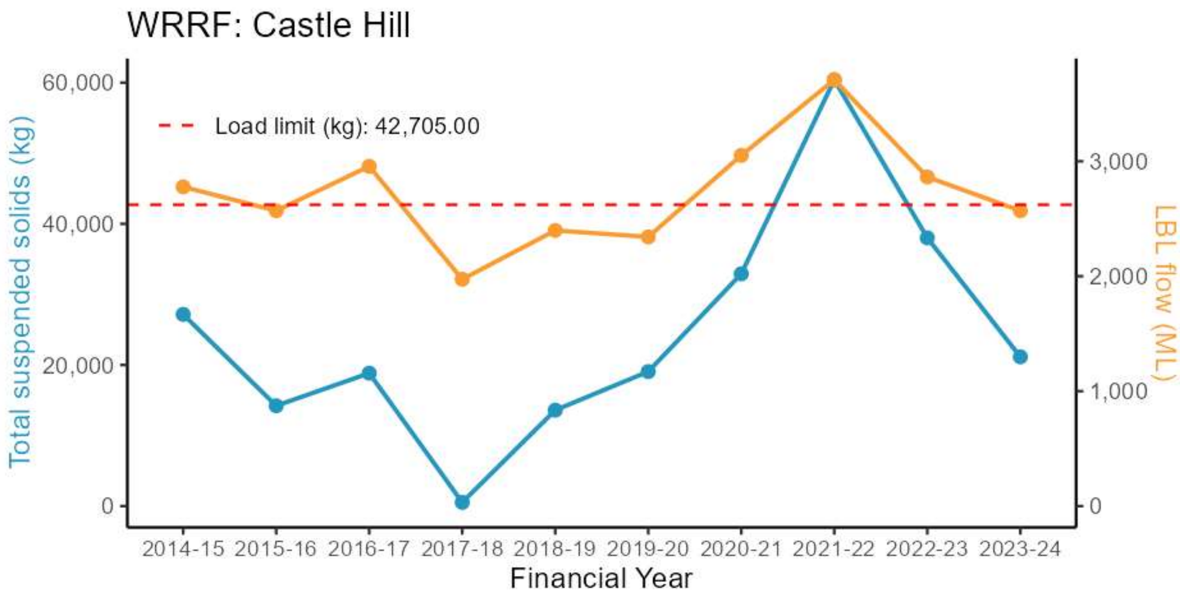




Major conventional analytes







A.12.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-23 Downstream vs upstream comparison (current period) contrast outcomes for Castle Hill WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Cattai Ck	NC8 vs NC75	Total ammonia nitrogen	1.03	0.34	146	0.09	1.000
Cattai Ck	NC8 vs NC75	Oxidised nitrogen	30.50	11.94	146	8.73	<0.001
Cattai Ck	NC8 vs NC75	Total nitrogen	13.84	3.94	146	9.24	<0.001
Cattai Ck	NC8 vs NC75	Filterable total phosphorus	2.24	0.60	146	3.03	0.015
Cattai Ck	NC8 vs NC75	Total phosphorus	1.32	0.26	146	1.37	0.519
Cattai Ck	NC8 vs NC75	Conductivity	1.50	0.23	146	2.62	0.048
Cattai Ck	NC8 vs NC75	Dissolved oxygen	1.01	0.05	146	0.19	0.997
Cattai Ck	NC8 vs NC75	Dissolved oxygen saturation	5.23	2.40	146	2.18	0.133
Cattai Ck	NC8 vs NC75	pH	-0.19	0.06	146	-3.28	0.007
Cattai Ck	NC8 vs NC75	Water temperature	1.14	0.10	146	1.59	0.389
Cattai Ck	NC8 vs NC75	Turbidity	0.31	0.12	146	-2.99	0.017
Cattai Ck	NC8 vs NC75	Chlorophyll - a	0.54	0.18	146	-1.89	0.236

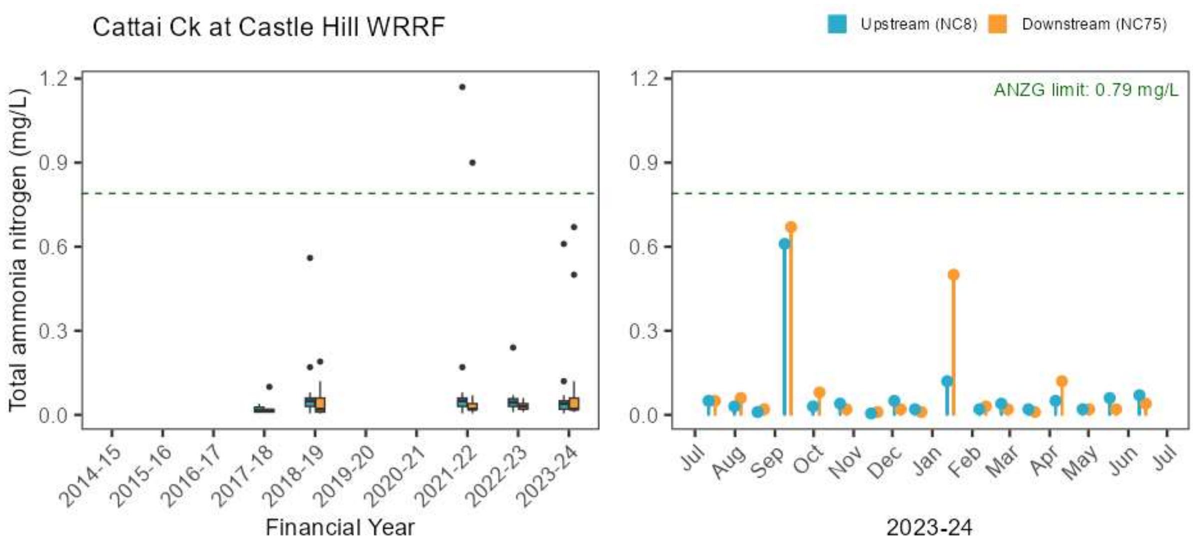
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

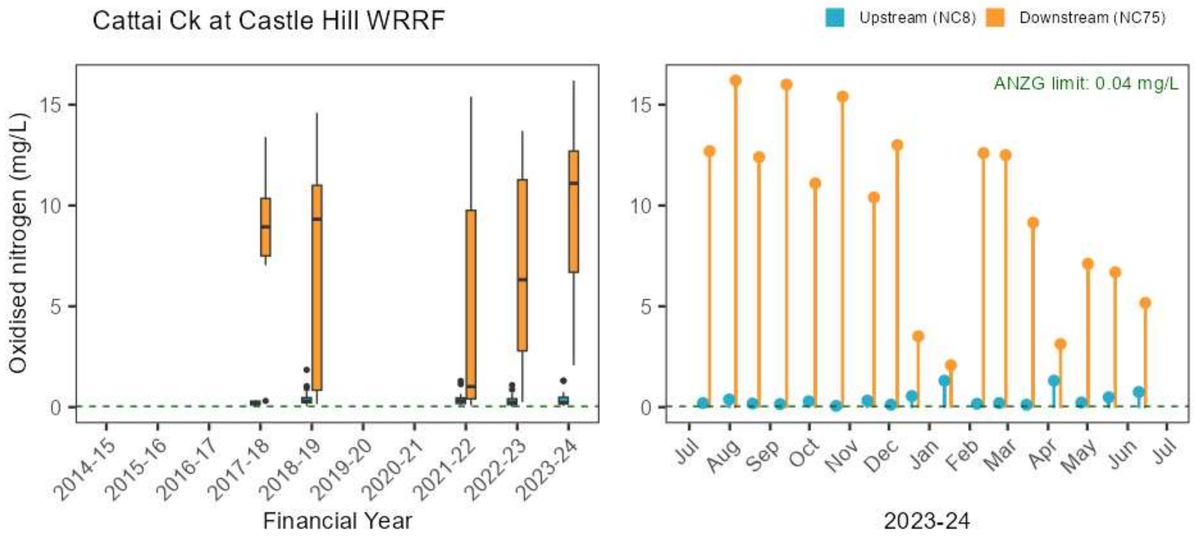
Table A-24 Current period vs previous period comparison (single site) contrast outcomes for Castle Hill WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Cattai Ck	NC8	Total ammonia nitrogen	0.85	0.22	146	-0.63	0.922
Cattai Ck	NC8	Oxidised nitrogen	0.98	0.31	146	-0.07	1.000
Cattai Ck	NC8	Total nitrogen	0.97	0.22	146	-0.12	0.999
Cattai Ck	NC8	Filterable total phosphorus	1.32	0.28	146	1.28	0.575
Cattai Ck	NC8	Total phosphorus	1.32	0.21	146	1.74	0.309
Cattai Ck	NC8	Conductivity	1.01	0.13	146	0.08	1.000
Cattai Ck	NC8	Dissolved oxygen	0.99	0.04	146	-0.28	0.992
Cattai Ck	NC8	Dissolved oxygen saturation	2.05	1.92	146	1.07	0.711
Cattai Ck	NC8	pH	-0.01	0.05	146	-0.21	0.997
Cattai Ck	NC8	Water temperature	1.12	0.08	146	1.71	0.322
Cattai Ck	NC8	Turbidity	1.01	0.32	146	0.02	1.000
Cattai Ck	NC8	Chlorophyll - a	0.85	0.22	146	-0.63	0.923
Cattai Ck	NC75	Total ammonia nitrogen	1.39	0.37	146	1.24	0.604
Cattai Ck	NC75	Oxidised nitrogen	2.95	0.93	146	3.44	0.004
Cattai Ck	NC75	Total nitrogen	2.34	0.54	146	3.73	0.002
Cattai Ck	NC75	Filterable total phosphorus	1.23	0.26	146	0.96	0.775
Cattai Ck	NC75	Total phosphorus	1.14	0.18	146	0.79	0.860
Cattai Ck	NC75	Conductivity	1.26	0.16	146	1.88	0.241
Cattai Ck	NC75	Dissolved oxygen	0.97	0.04	146	-0.85	0.828
Cattai Ck	NC75	Dissolved oxygen saturation	1.30	1.92	146	0.67	0.907
Cattai Ck	NC75	pH	-0.19	0.05	146	-4.15	<0.001
Cattai Ck	NC75	Water temperature	1.12	0.08	146	1.65	0.352
Cattai Ck	NC75	Turbidity	0.73	0.23	146	-0.98	0.764
Cattai Ck	NC75	Chlorophyll - a	0.45	0.12	146	-3.06	0.014

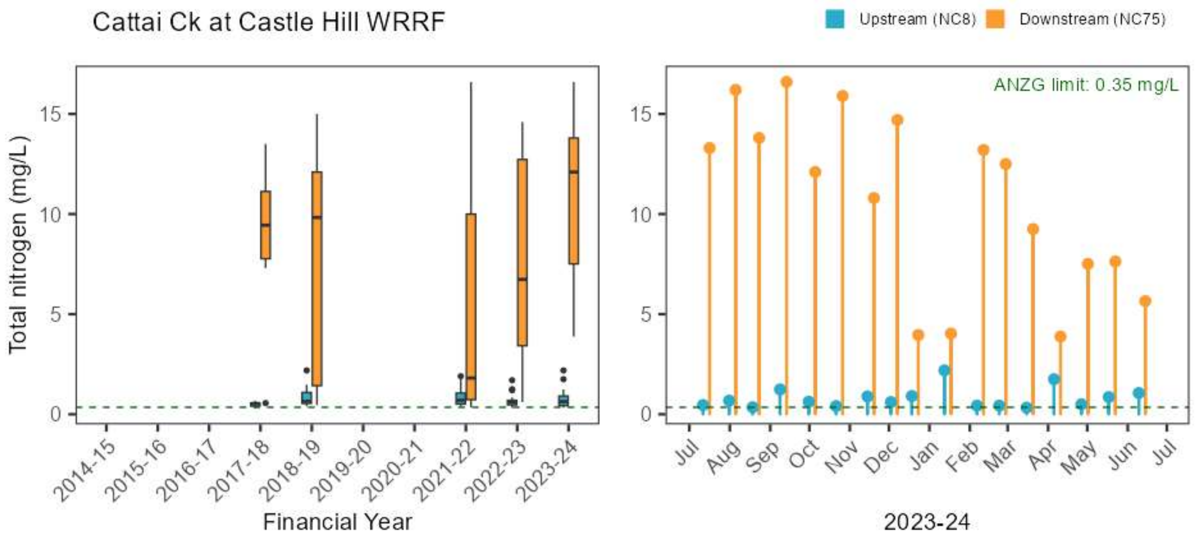
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.12.6. Stressor – Nutrients

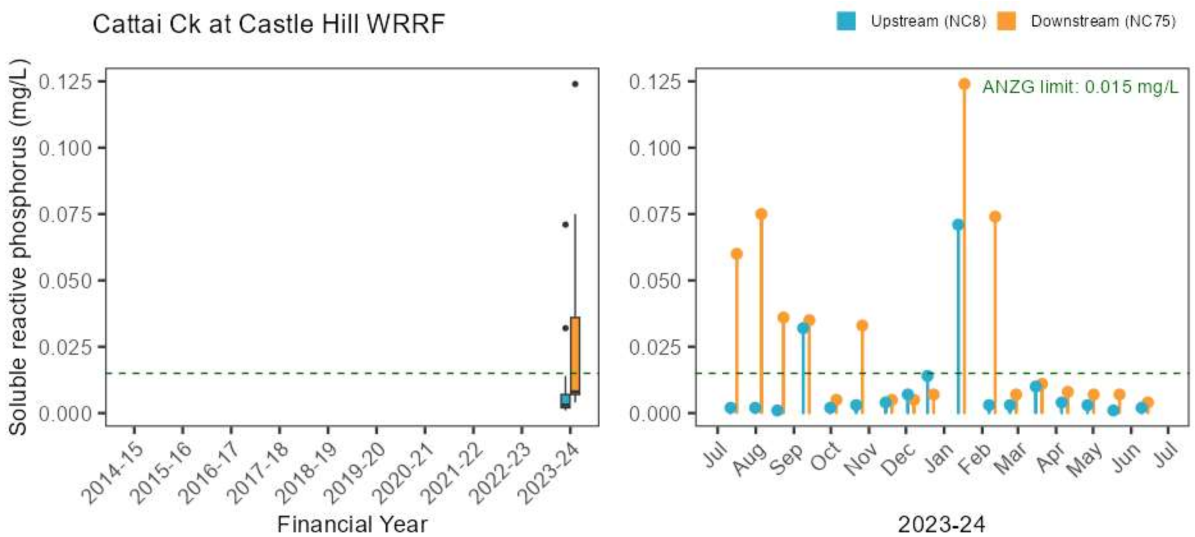




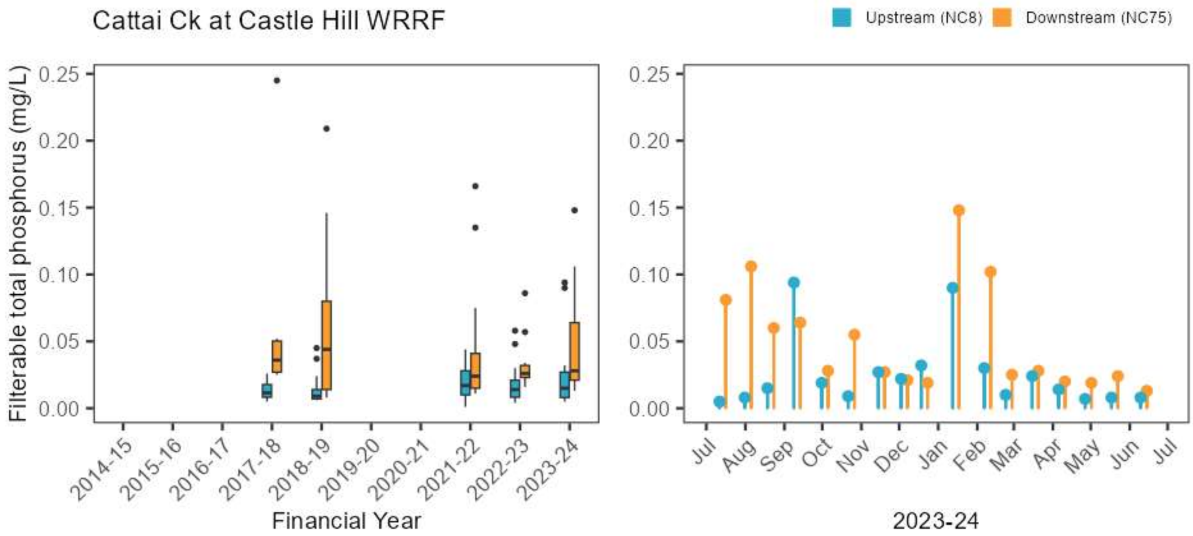
Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Oxidised nitrogen (mg/L)
ANZG limit: 0.04 mg/L
Financial Year
2023-24

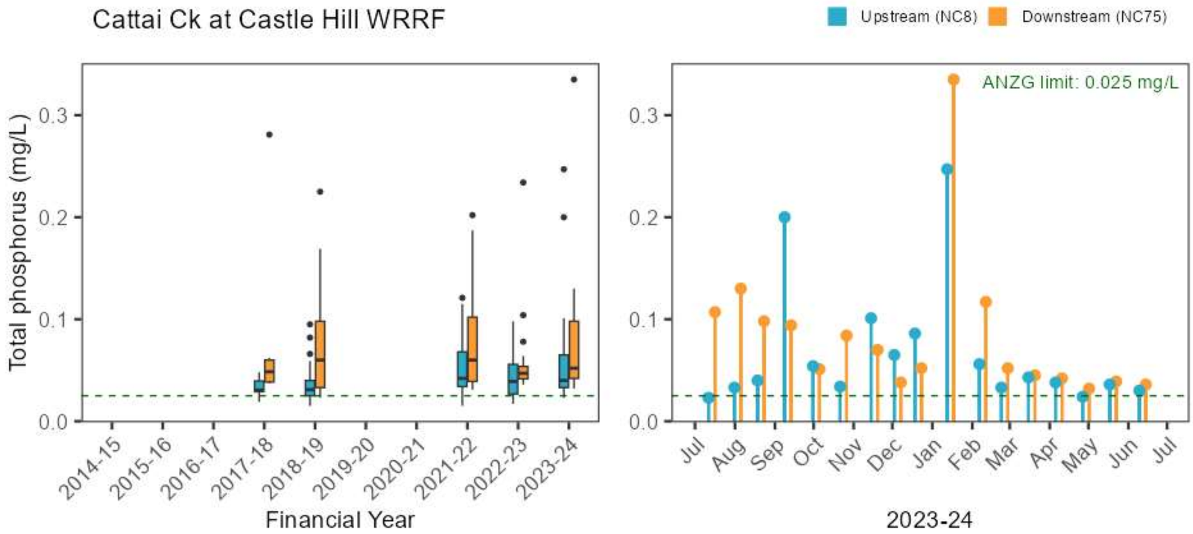


Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Total nitrogen (mg/L)
ANZG limit: 0.35 mg/L
Financial Year
2023-24

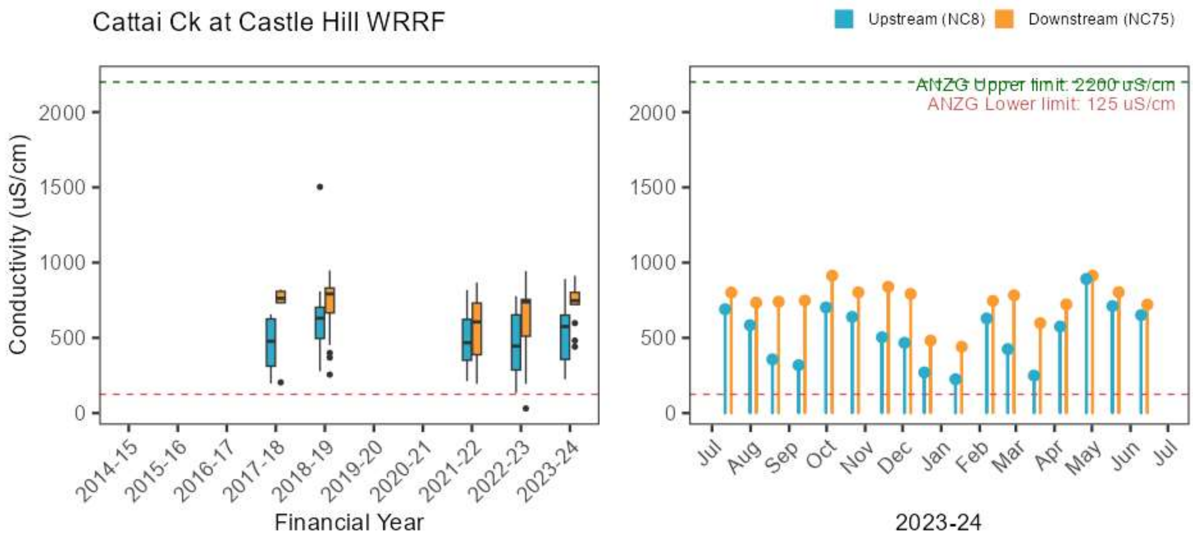


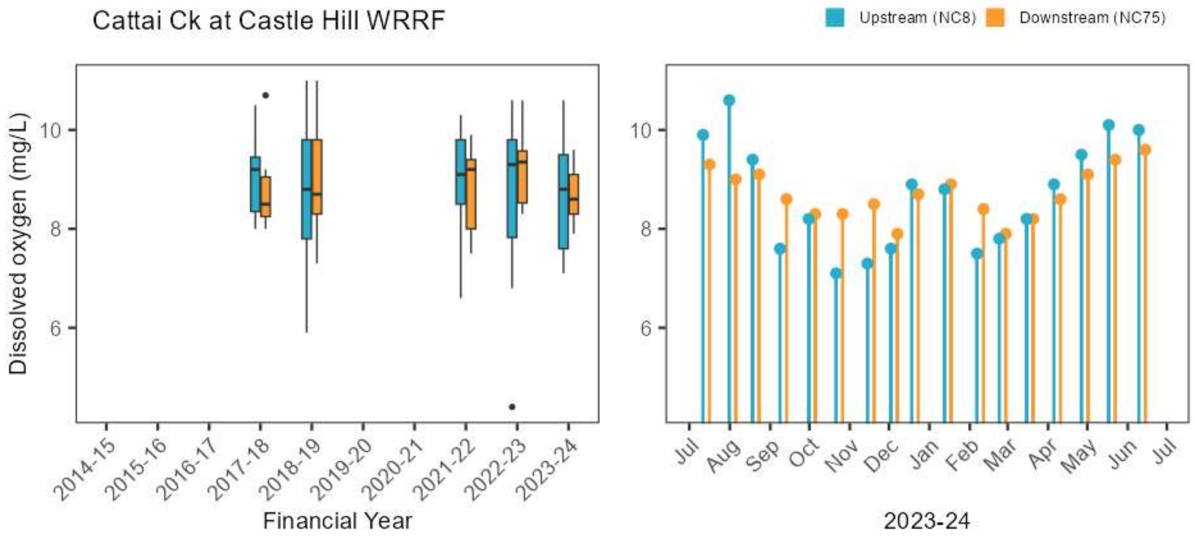
Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24

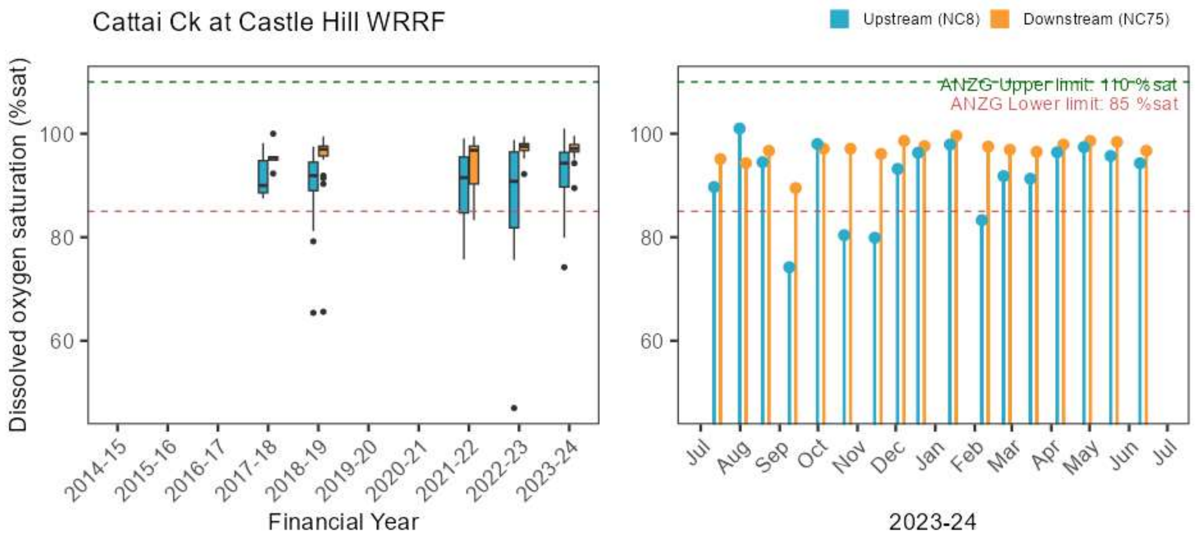


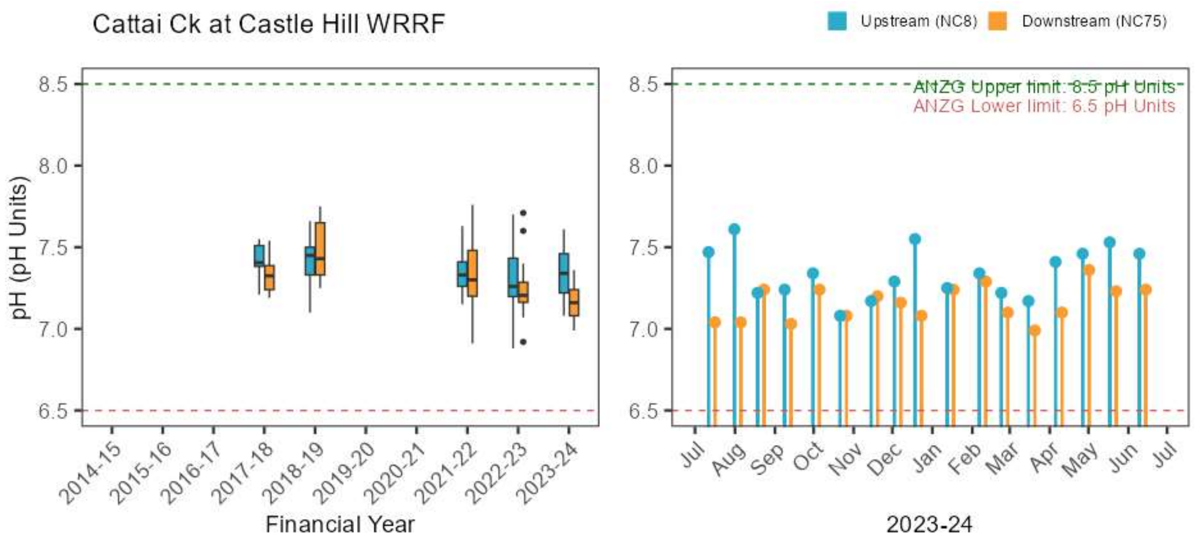


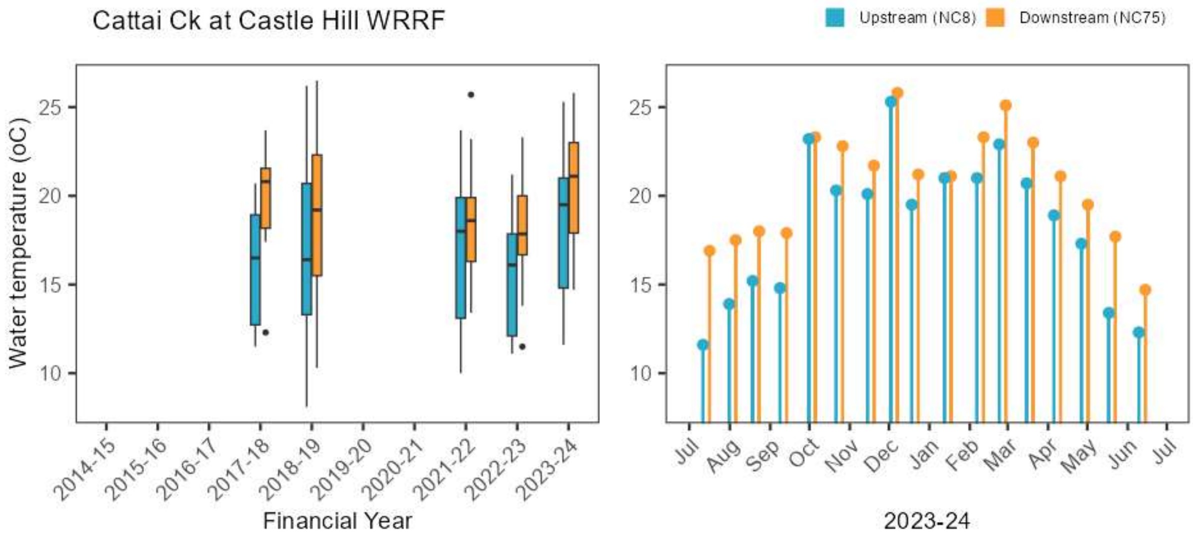
A.12.7. Stressor – Physico-chemical water quality

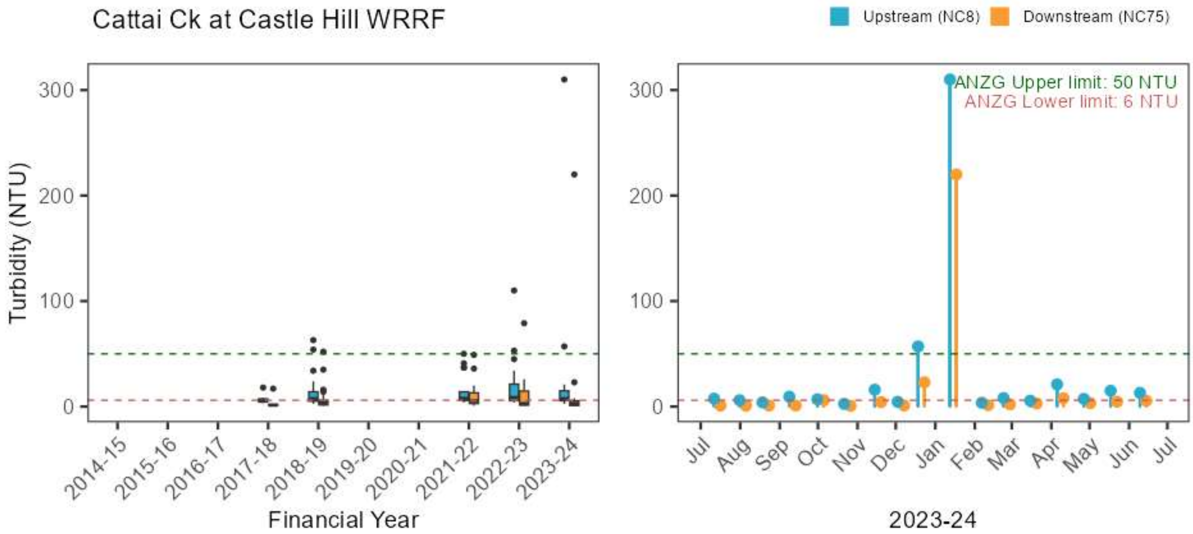



Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Dissolved oxygen (mg/L)
10
8
6
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

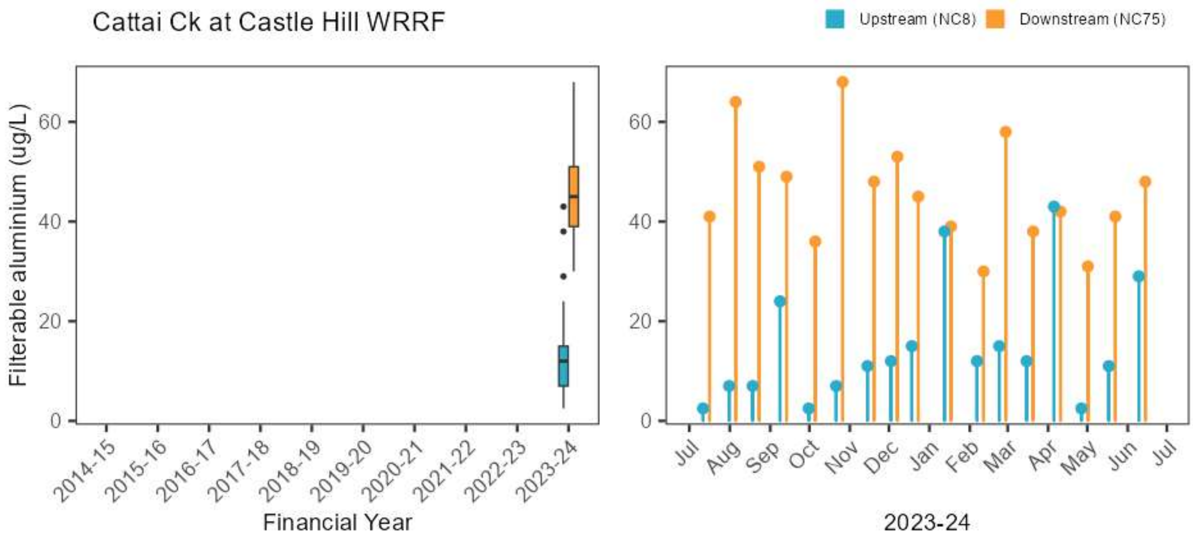

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Dissolved oxygen saturation (%sat)
100
80
60
ANZG Upper limit: 110 %sat
ANZG Lower limit: 85 %sat
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

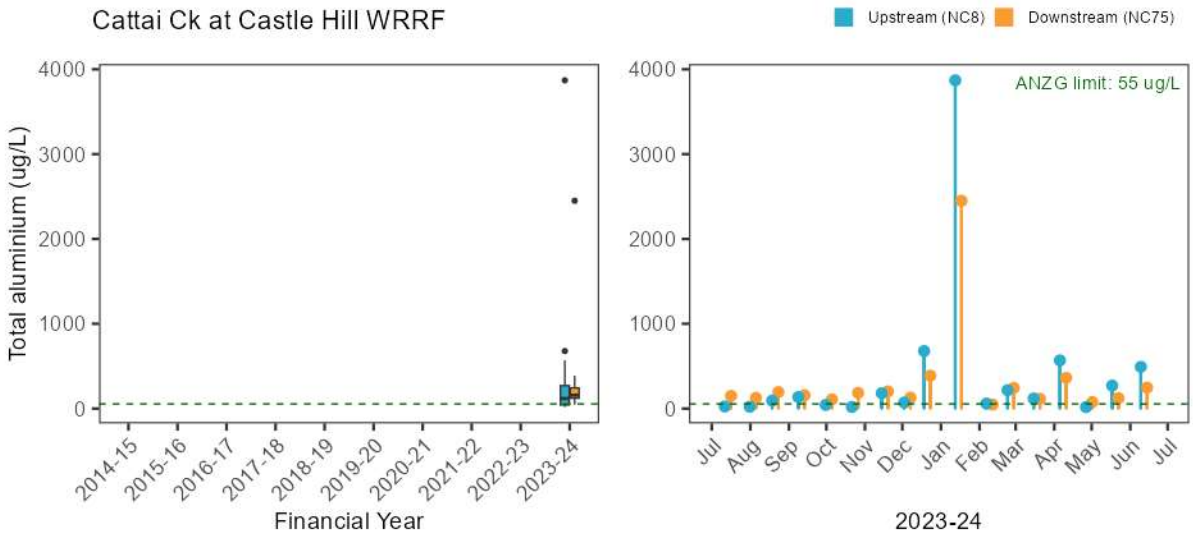

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
pH (pH Units)
8.5
8.0
7.5
7.0
6.5
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 6.5 pH Units
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

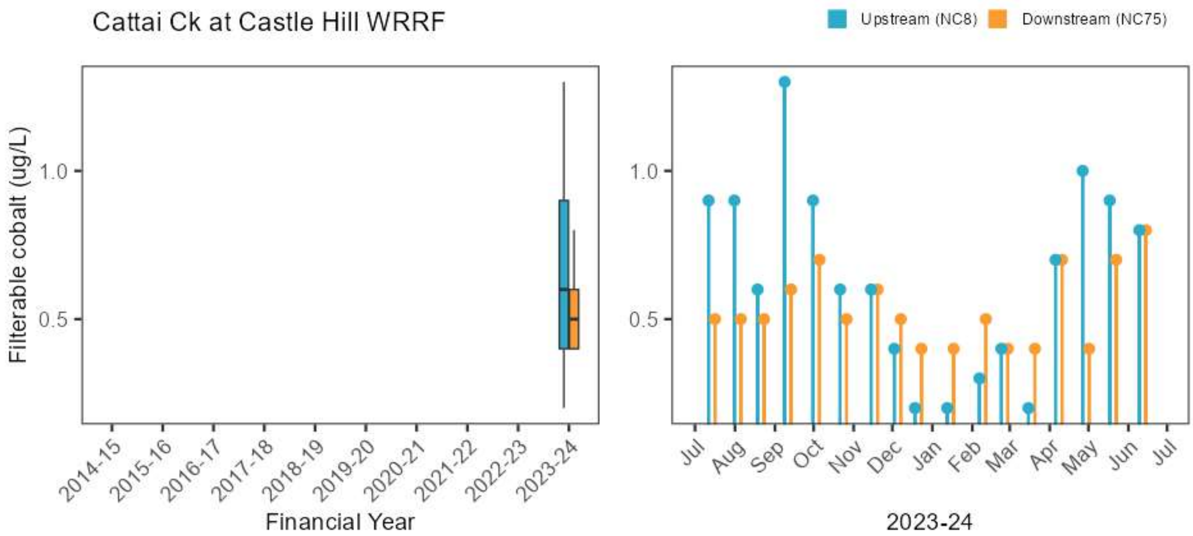


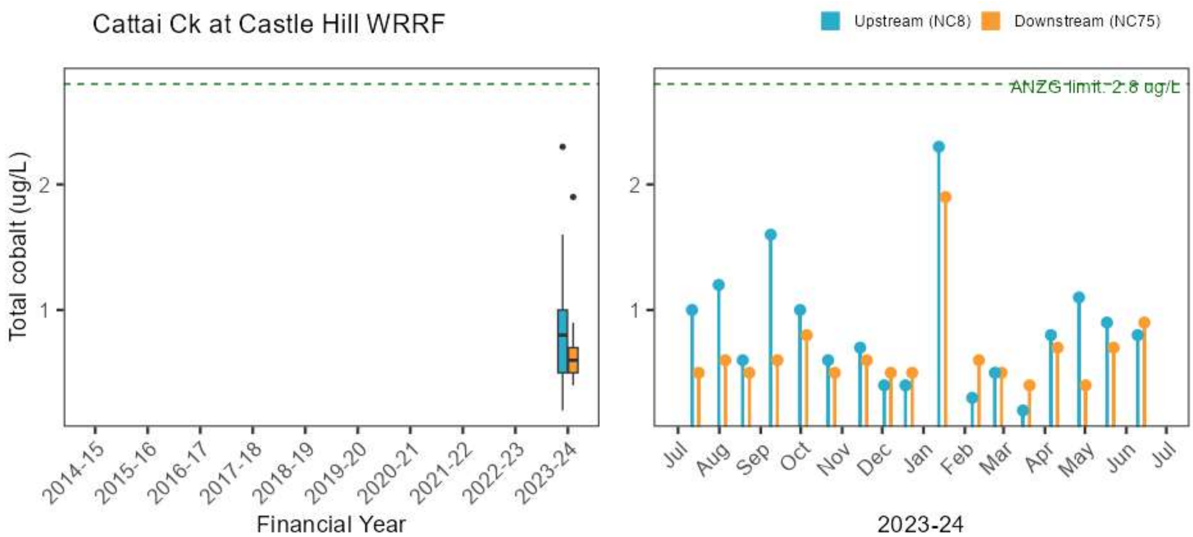


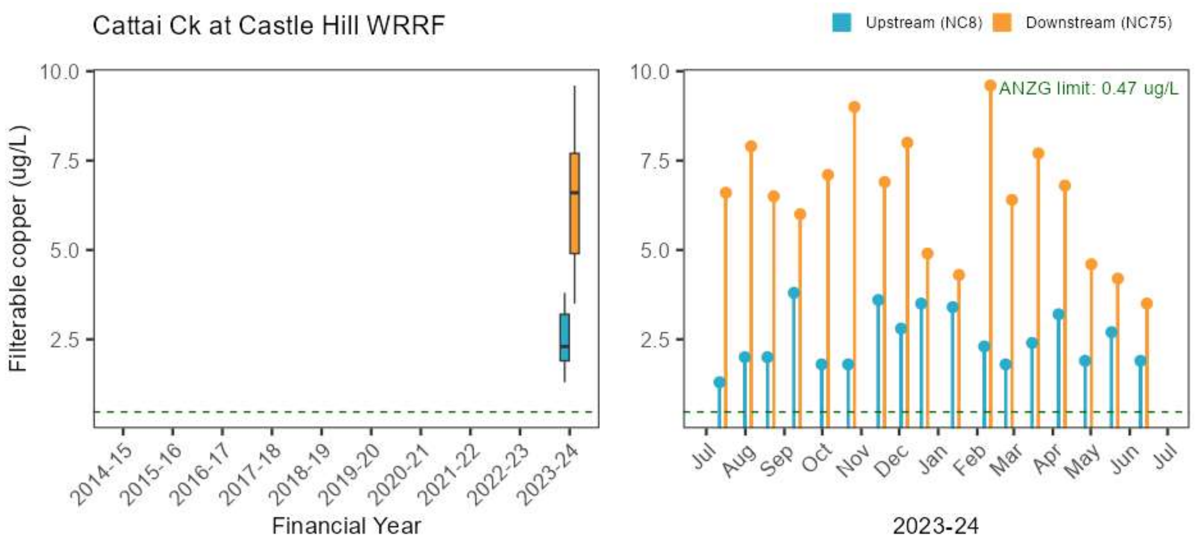
A.12.8. Stressor – Trace metals

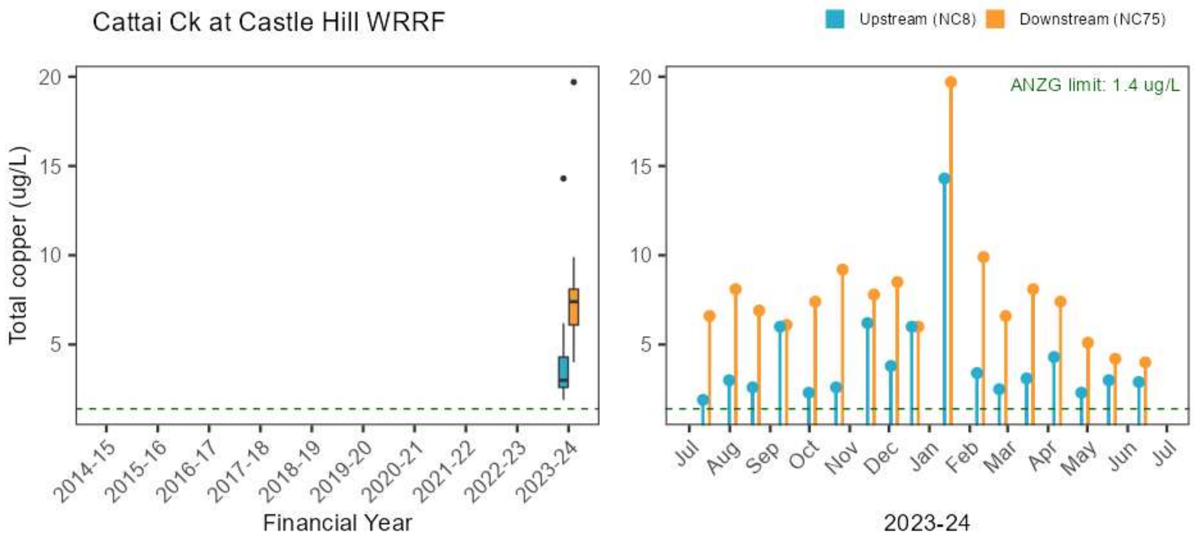


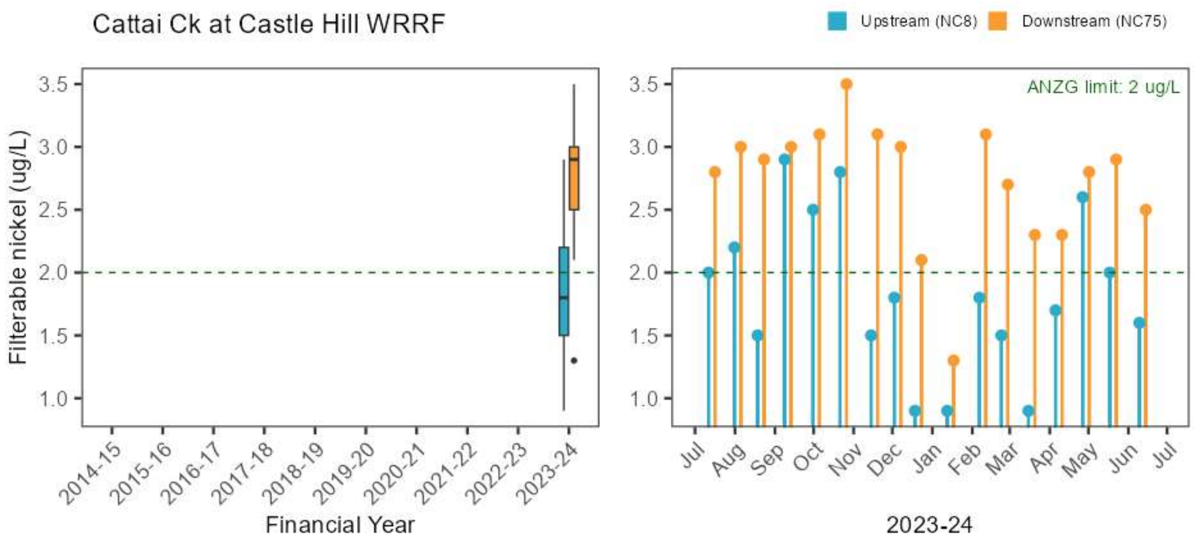

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Total aluminium (ug/L)
ANZG limit: 55 ug/L
Financial Year
2023-24

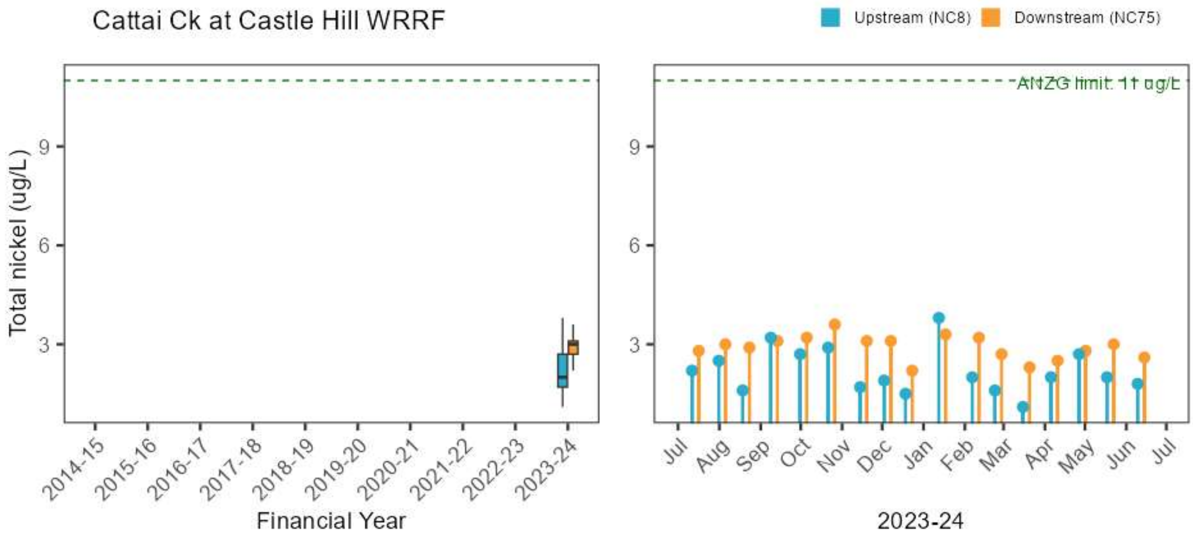

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Filterable cobalt (ug/L)
Financial Year
2023-24

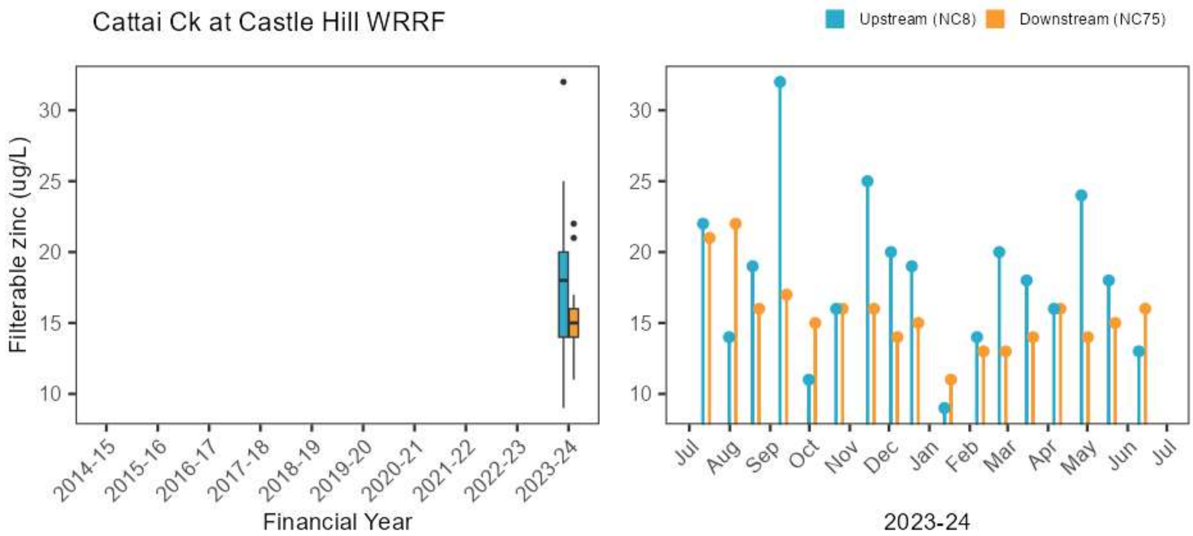

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Total cobalt (ug/L)
ANZG limit: 2.8 ug/L
Financial Year
2023-24

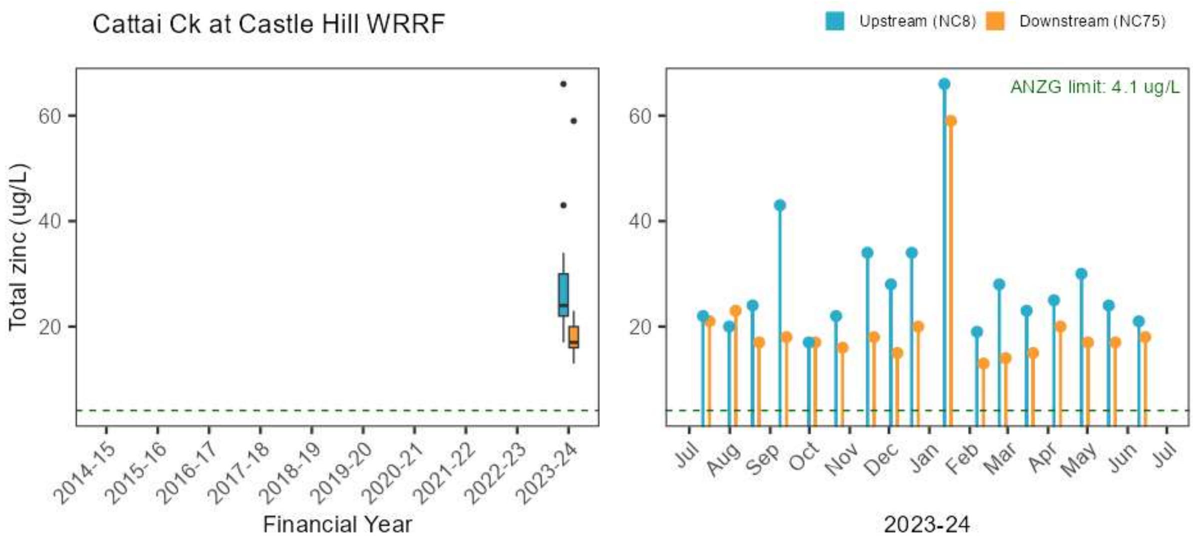

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Filterable copper (ug/L)
Financial Year
2023-24
ANZG limit: 0.47 ug/L


Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Total copper (ug/L)
Financial Year
2023-24
ANZG limit: 1.4 ug/L

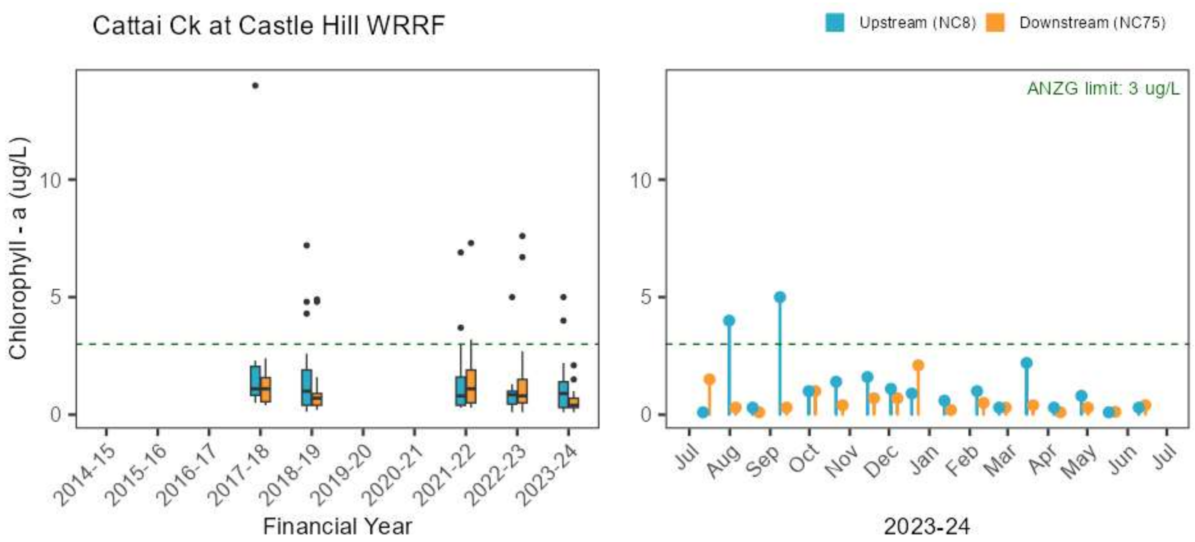

Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Filterable nickel (ug/L)
Financial Year
2023-24
ANZG limit: 2 ug/L


Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
ANZG limit: 11 ug/L
Total nickel (ug/L)
Financial Year
2023-24


Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
Filterable zinc (ug/L)
Financial Year
2023-24


Cattai Ck at Castle Hill WRRF
Upstream (NC8)
Downstream (NC75)
ANZG limit: 4.1 ug/L
Total zinc (ug/L)
Financial Year
2023-24

A.12.9. Ecosystem receptor – Phytoplankton



A.12.10. Ecosystem receptor – Macroinvertebrates

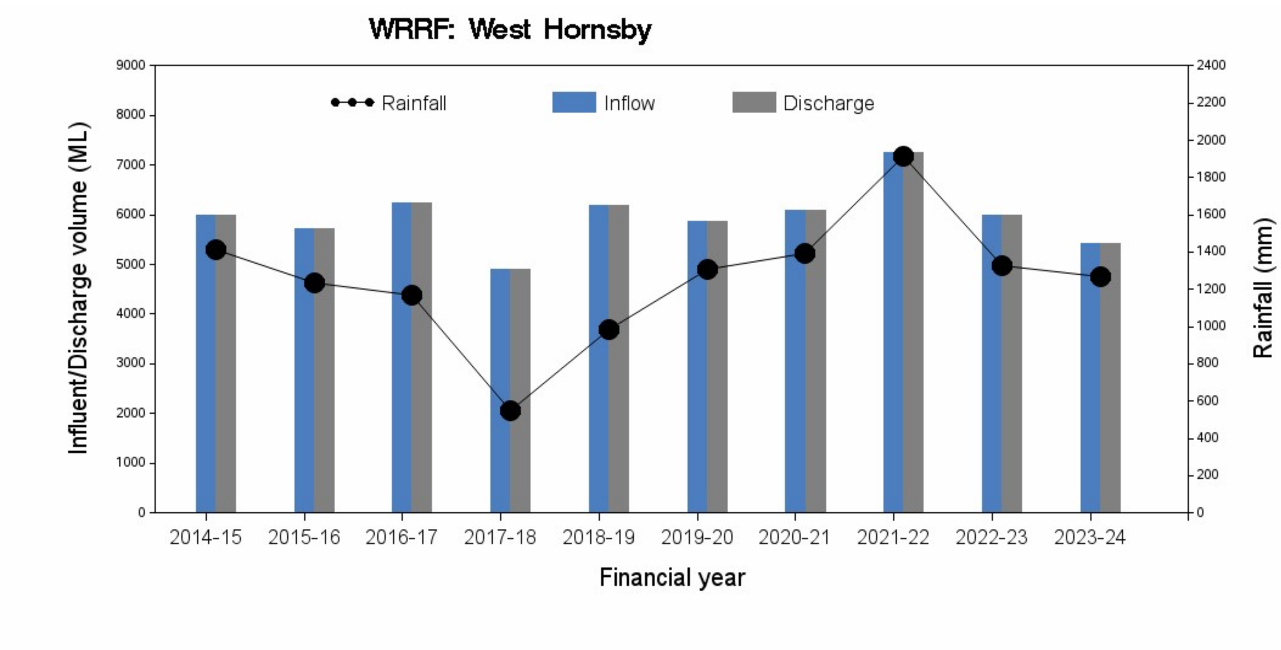
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Cattai Creek	River (NC8 vs NC75)	Welch Two Sample t-test	0.49	2.36	9.5	0.041

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.13. West Hornsby WRRF

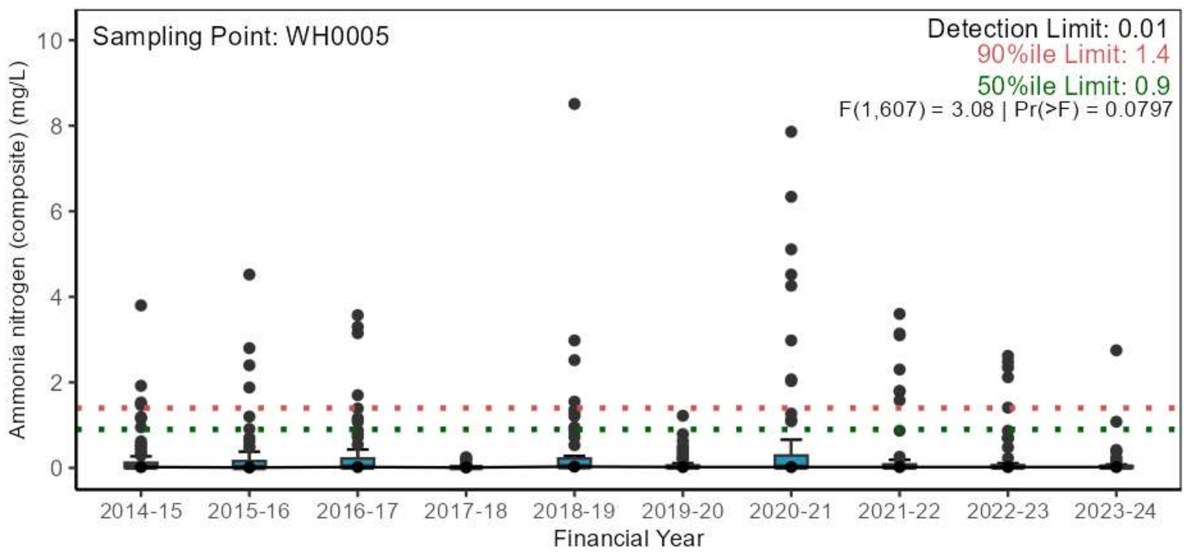
A.13.1. Pressure – Wastewater quantity

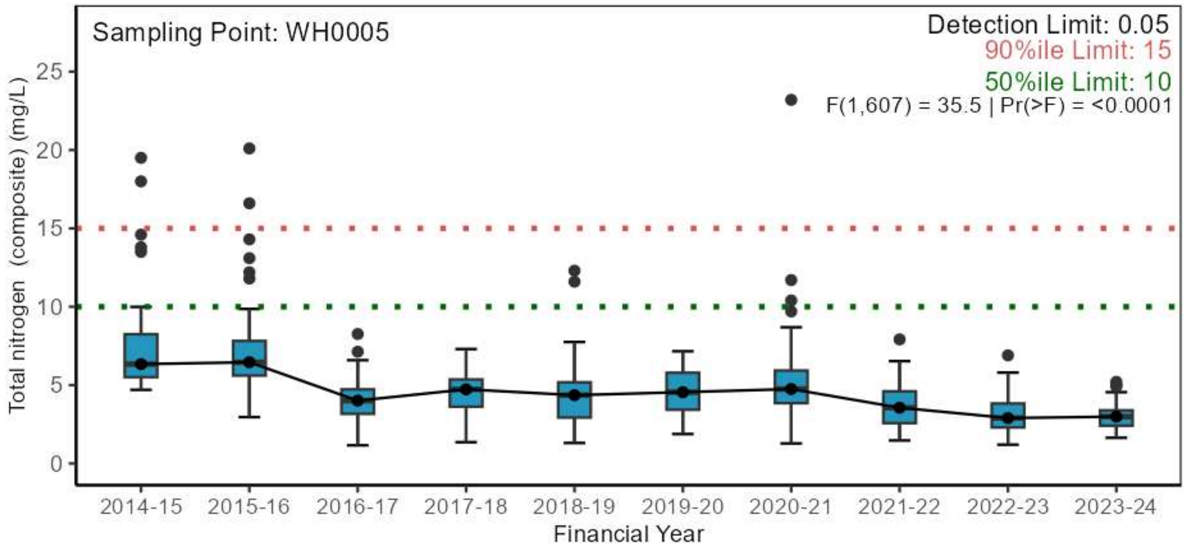
Inflow/discharge volume and rainfall

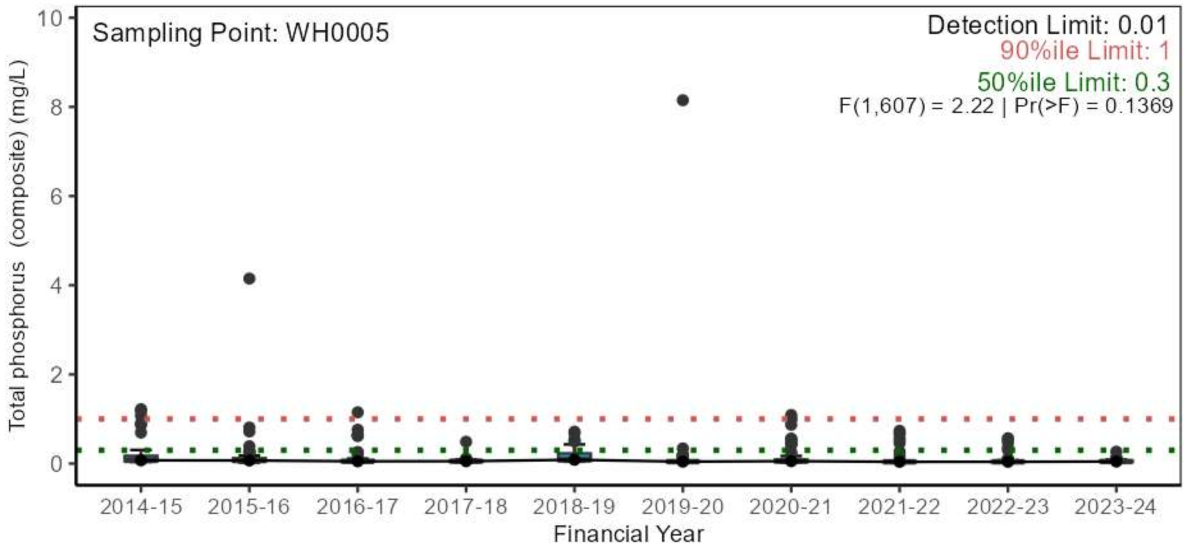


A.13.2. Pressure – Wastewater quality

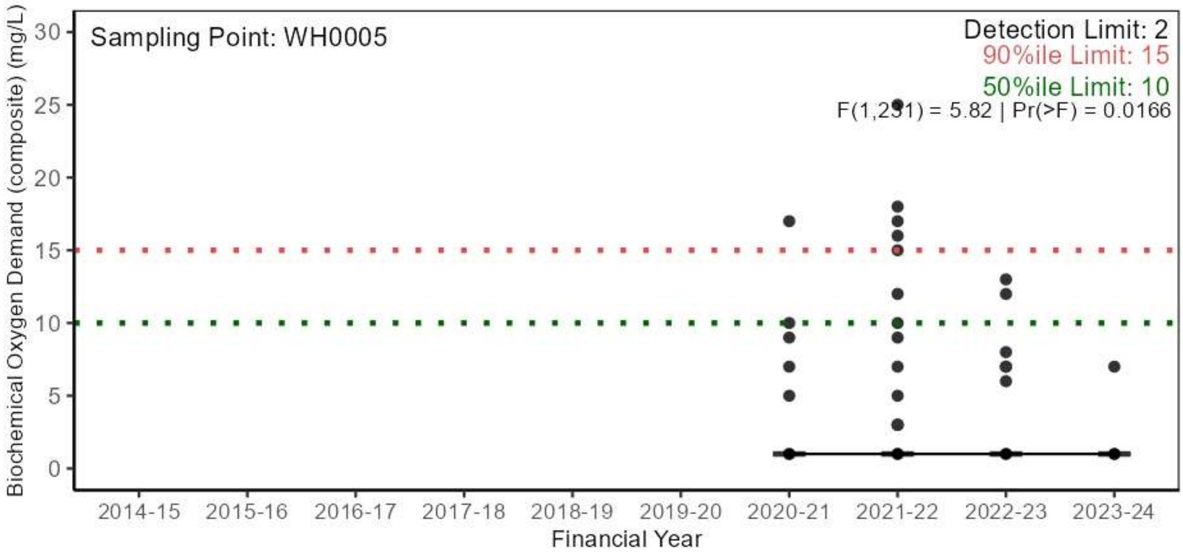
Nutrients

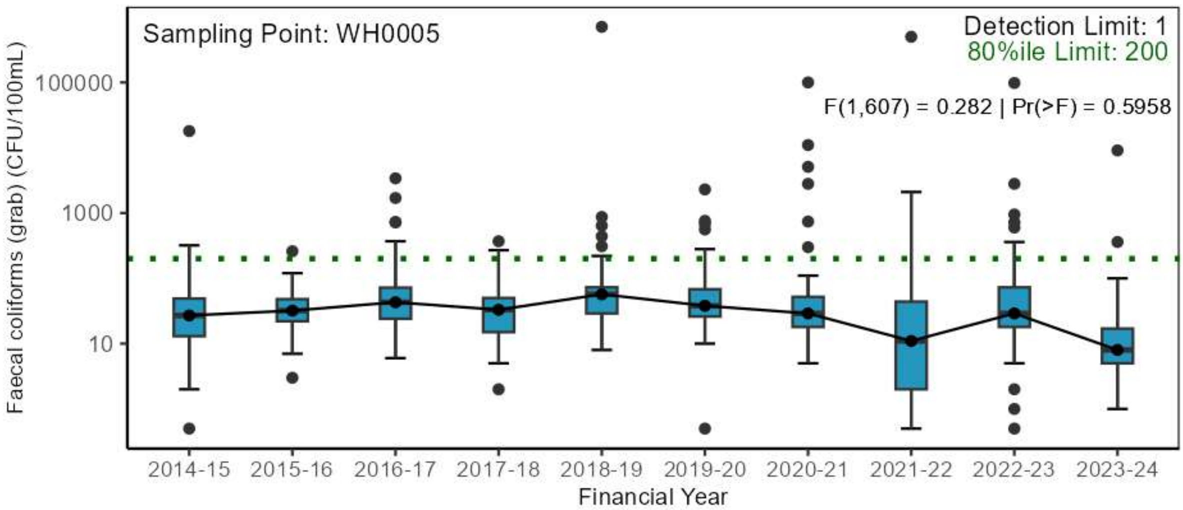



Sampling Point: WH0005
Detection Limit: 0.05
90%ile Limit: 15
50%ile Limit: 10
F(1,607) = 35.5 | Pr(>F) = <0.0001
Total nitrogen (composite) (mg/L)
25
20
15
10
5
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

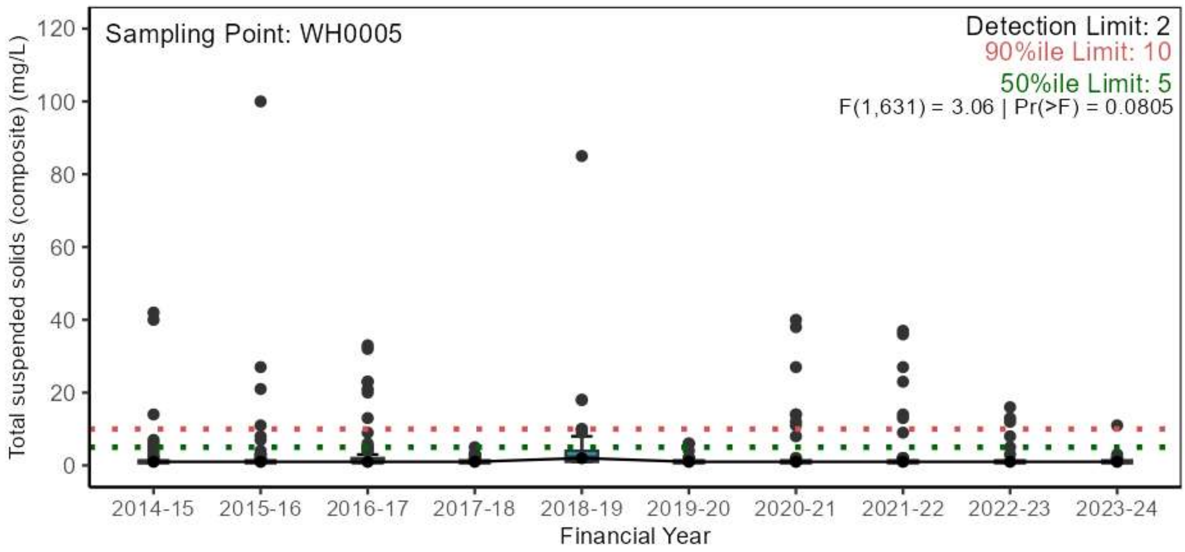

Sampling Point: WH0005
Detection Limit: 0.01
90%ile Limit: 1
50%ile Limit: 0.3
F(1,607) = 2.22 | Pr(>F) = 0.1369
Total phosphorus (composite) (mg/L)
10
8
6
4
2
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

Major conventional analytes

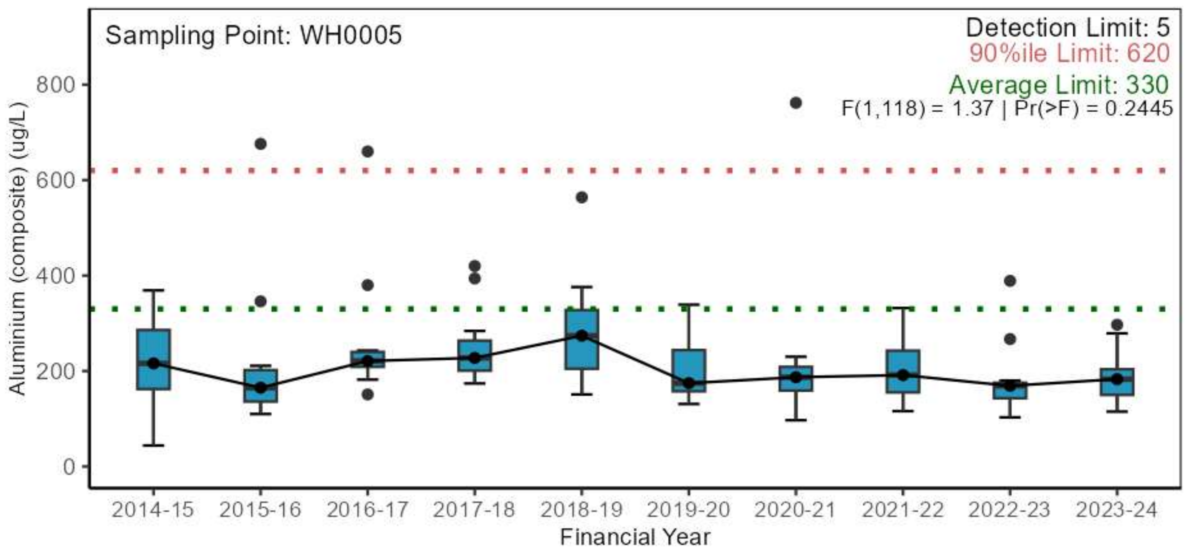


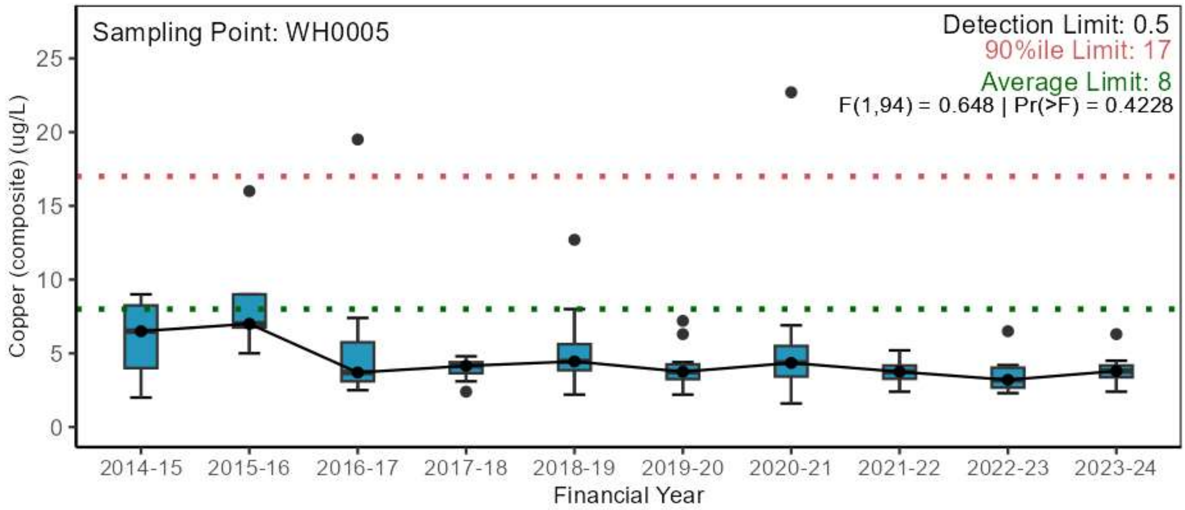


Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

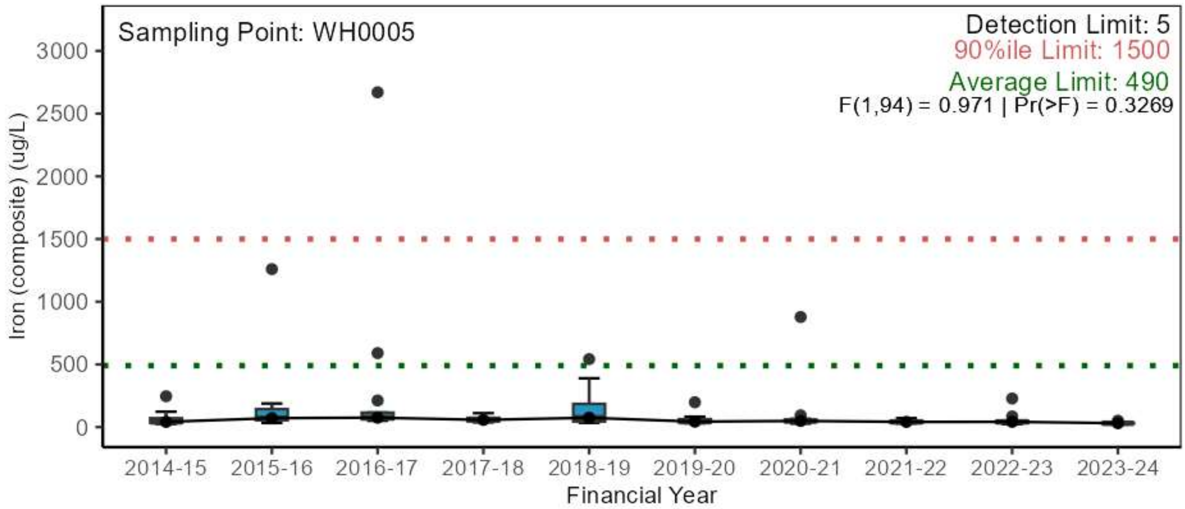


Trace metals

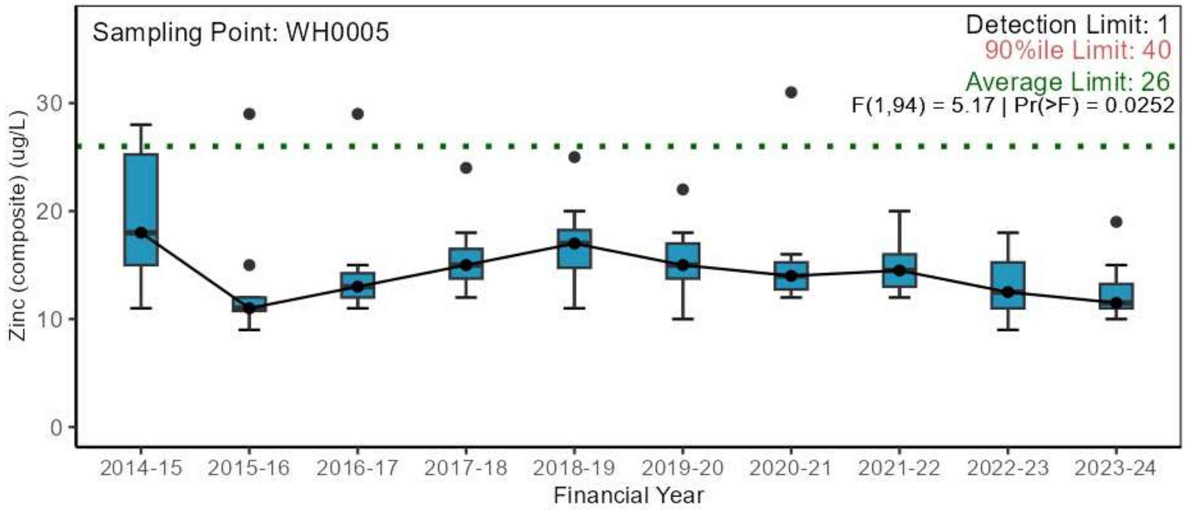




Statistical test excludes data prior to 2016-17 due to method detection limit change.

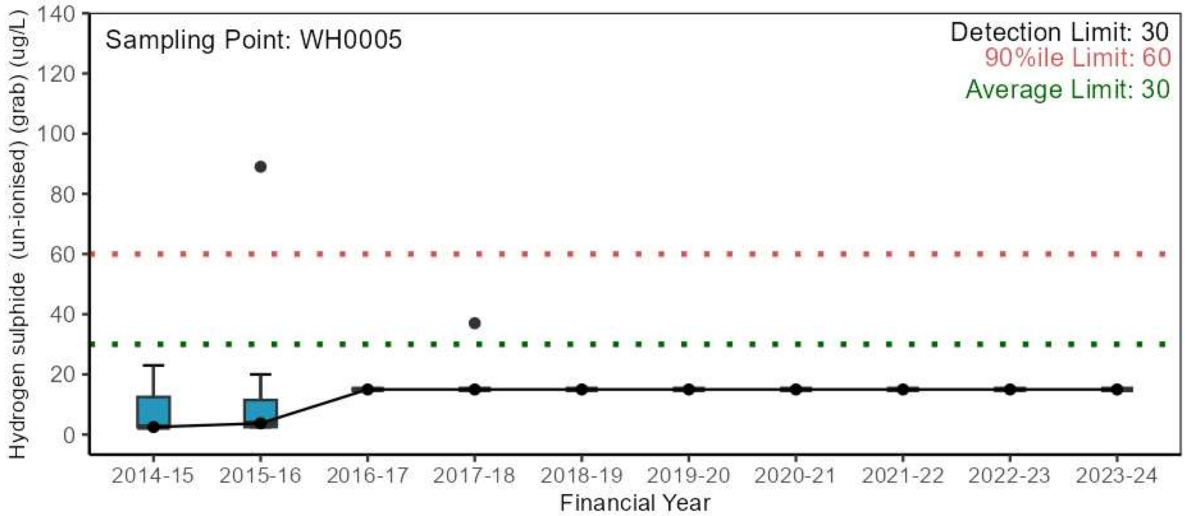


Statistical test excludes data prior to 2016-17 due to method detection limit change.



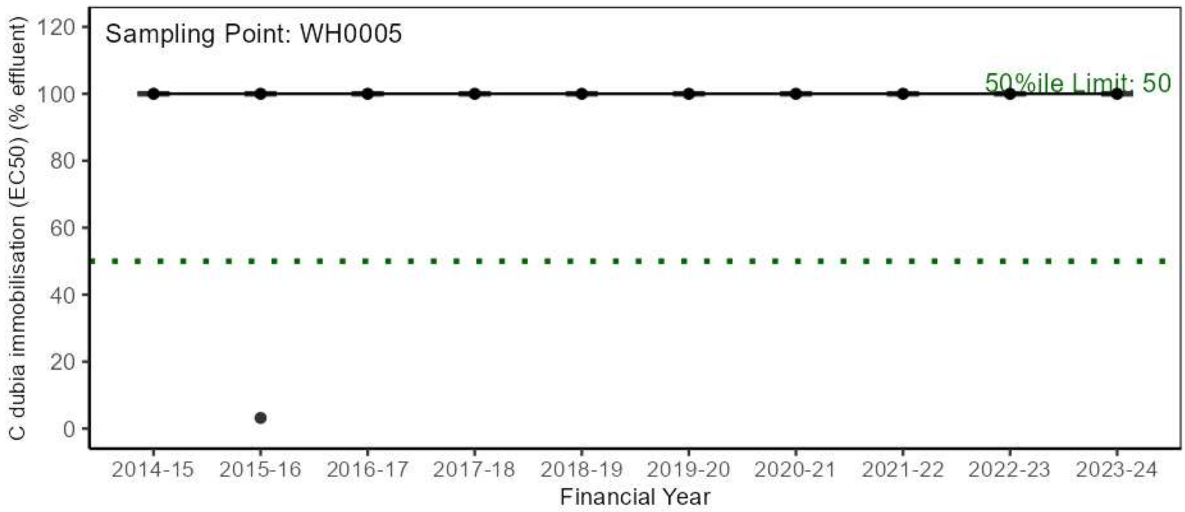
Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)



Statistical test not conducted as >90% of results were below detection limits.

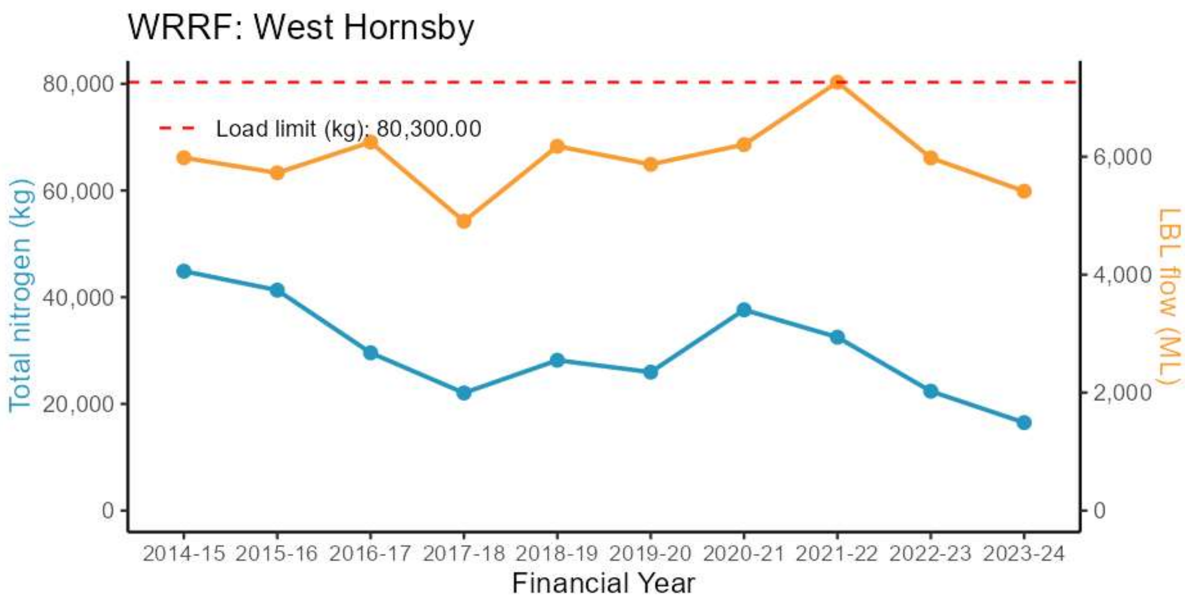
A.13.3. Pressure – Wastewater toxicity



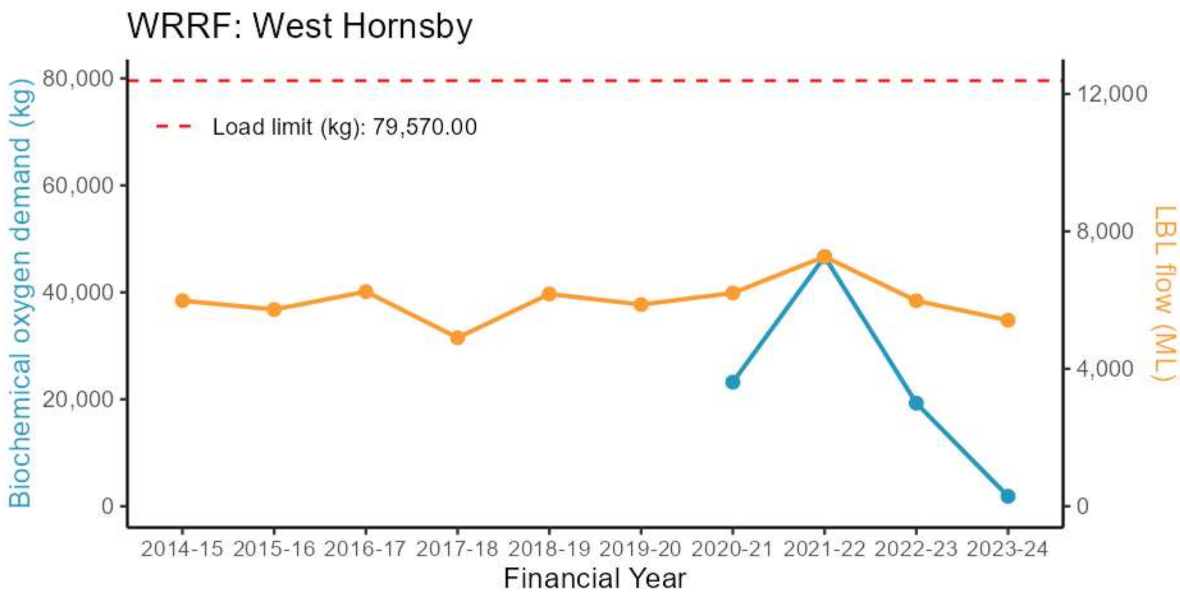
Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

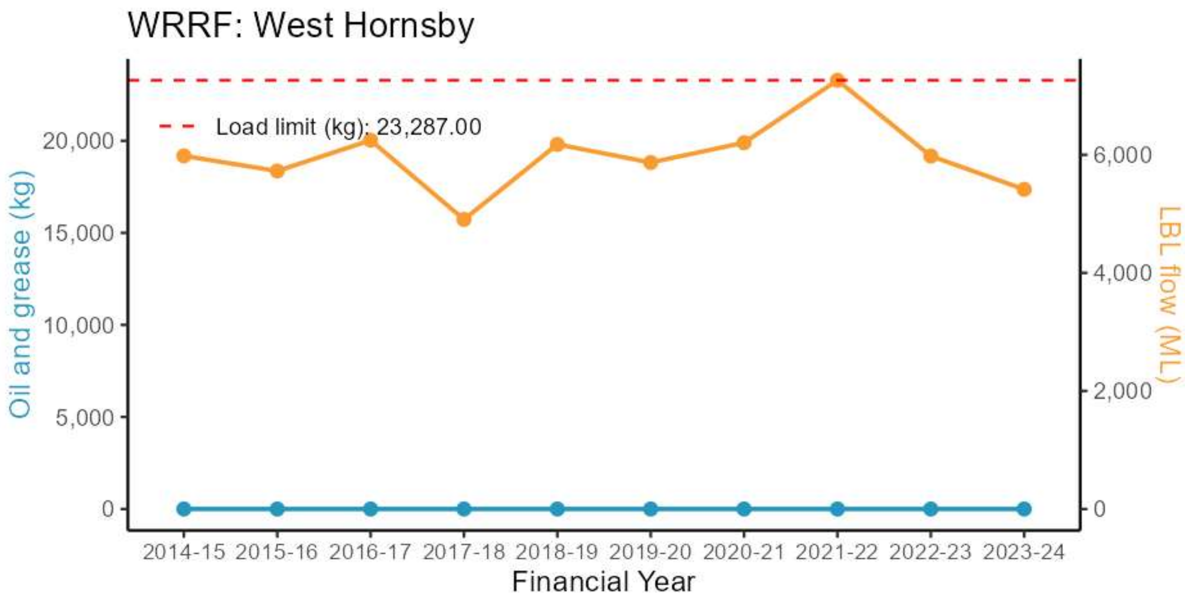
A.13.4. Pressure – Wastewater discharge load

Nutrients

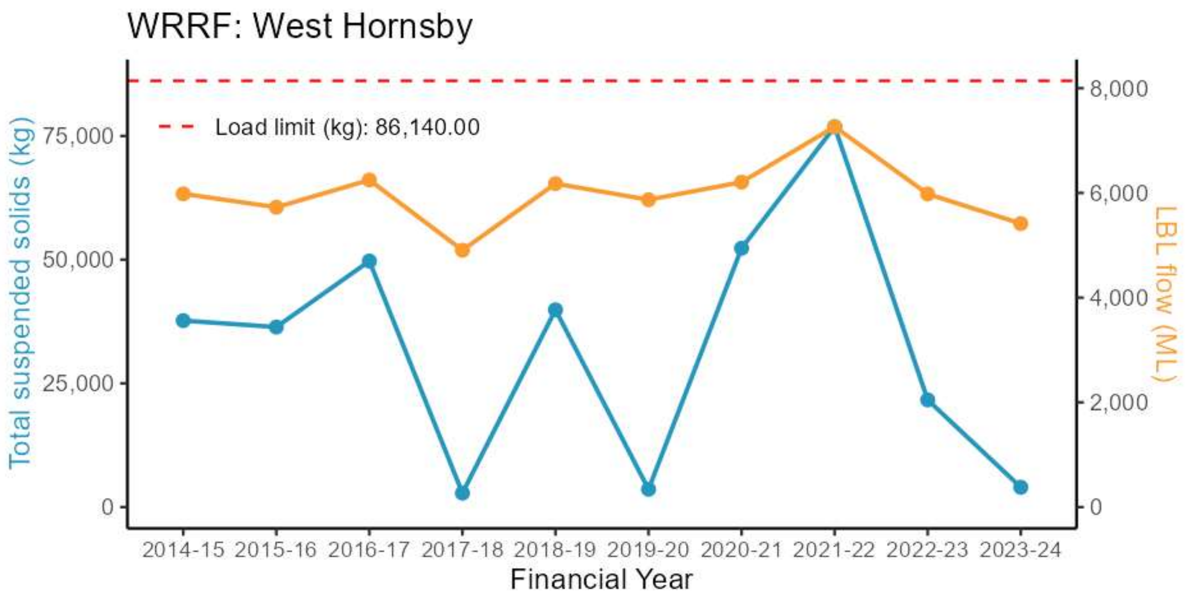


Major conventional analytes





WRRF: West Hornsby
Load limit (kg): 23,287.00
Oil and grease (kg)
LBL flow (ML)
Financial Year
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24



WRRF: West Hornsby
Load limit (kg): 86,140.00
Total suspended solids (kg)
LBL flow (ML)
Financial Year
2014-15 2015-16 2016-17 2017-18 2018-19 2019-20 2020-21 2021-22 2022-23 2023-24

A.13.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-25 Downstream vs upstream comparison (current period) contrast outcomes for West Hornsby WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Waitara Ck	NB83 vs NB825	Total ammonia nitrogen	0.52	0.23	130	-1.49	0.445
Waitara Ck	NB83 vs NB825	Oxidised nitrogen	3.44	1.30	130	3.27	0.008
Waitara Ck	NB83 vs NB825	Total nitrogen	2.53	0.50	130	4.64	<0.001
Waitara Ck	NB83 vs NB825	Filterable total phosphorus	1.56	0.41	130	1.69	0.335
Waitara Ck	NB83 vs NB825	Total phosphorus	1.00	0.24	130	-0.01	1.000
Waitara Ck	NB83 vs NB825	Conductivity	2.37	0.26	130	7.96	<0.001
Waitara Ck	NB83 vs NB825	Dissolved oxygen	1.18	0.10	130	2.02	0.188
Waitara Ck	NB83 vs NB825	Dissolved oxygen saturation	13.86	5.39	130	2.57	0.054
Waitara Ck	NB83 vs NB825	pH	0.06	0.07	130	0.82	0.845
Waitara Ck	NB83 vs NB825	Water temperature	1.27	0.09	130	3.18	0.010
Waitara Ck	NB83 vs NB825	Turbidity	0.20	0.07	130	-4.45	<0.001
Waitara Ck	NB83 vs NB825	Chlorophyll - a	1.24	0.48	128	0.55	0.947

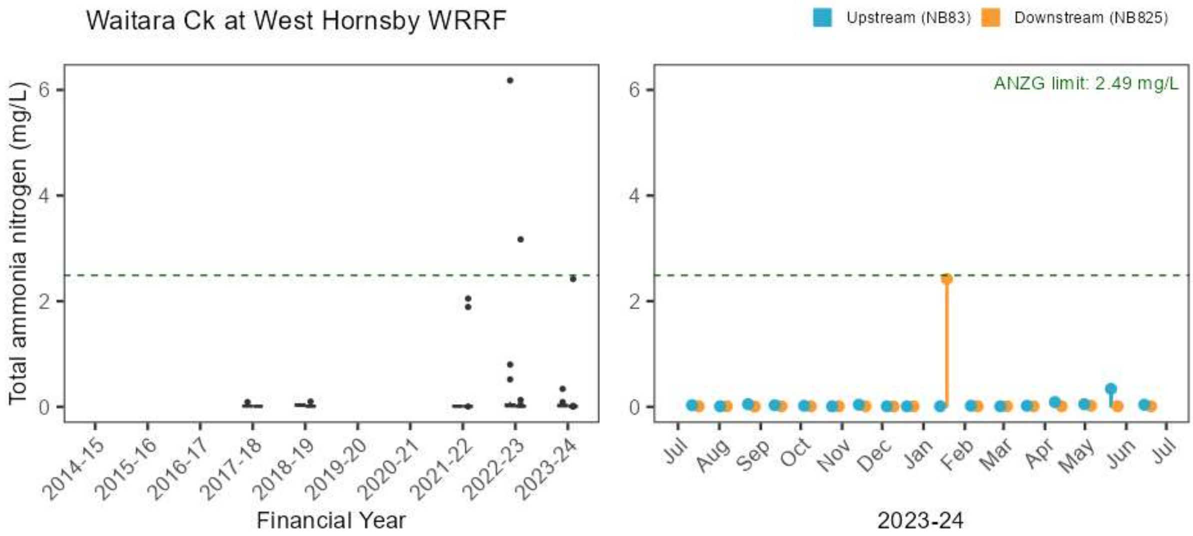
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

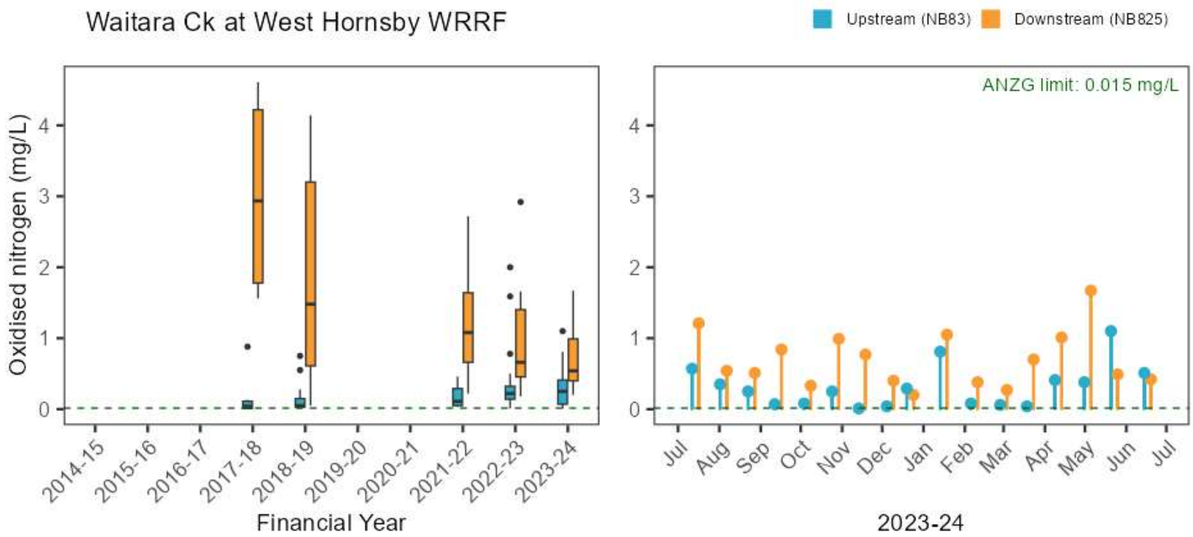
Table A-26 Current period vs previous period comparison (single site) contrast outcomes for West Hornsby WRRF

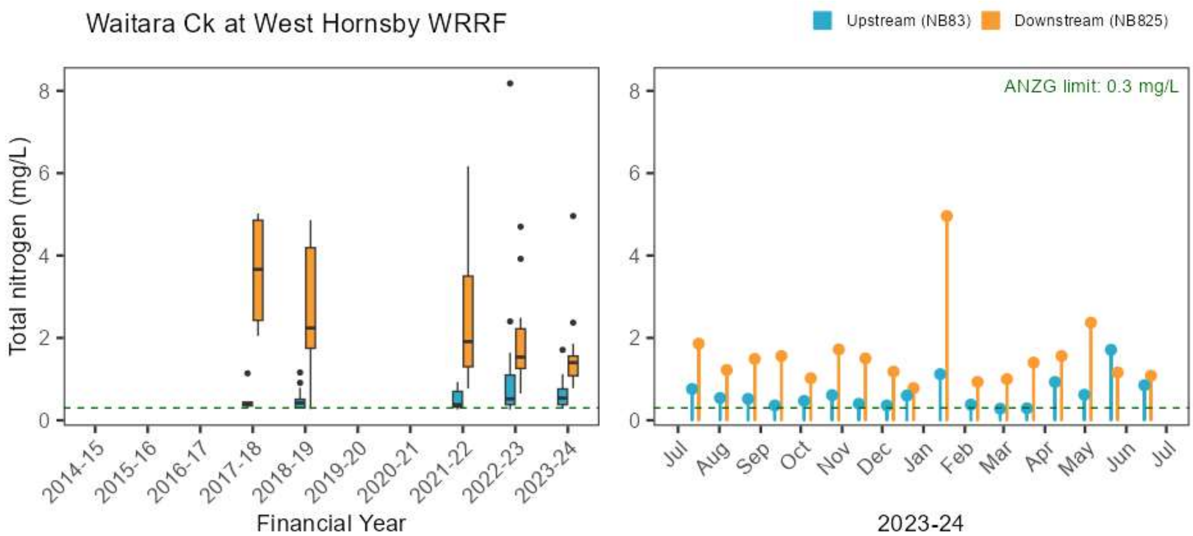
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Waitara Ck	NB83	Total ammonia nitrogen	1.13	0.41	130	0.35	0.985
Waitara Ck	NB83	Oxidised nitrogen	1.51	0.47	130	1.35	0.535
Waitara Ck	NB83	Total nitrogen	1.09	0.18	130	0.51	0.955
Waitara Ck	NB83	Filterable total phosphorus	1.26	0.27	130	1.08	0.701
Waitara Ck	NB83	Total phosphorus	1.19	0.24	130	0.89	0.809
Waitara Ck	NB83	Conductivity	0.89	0.08	130	-1.36	0.524
Waitara Ck	NB83	Dissolved oxygen	1.00	0.07	130	-0.07	1.000
Waitara Ck	NB83	Dissolved oxygen saturation	0.40	4.39	130	0.09	1.000
Waitara Ck	NB83	pH	-0.02	0.06	130	-0.42	0.975
Waitara Ck	NB83	Water temperature	1.07	0.06	130	1.04	0.728
Waitara Ck	NB83	Turbidity	0.79	0.23	130	-0.81	0.848
Waitara Ck	NB83	Chlorophyll - a	1.04	0.33	128	0.12	0.999
Waitara Ck	NB825	Total ammonia nitrogen	0.78	0.28	130	-0.71	0.894
Waitara Ck	NB825	Oxidised nitrogen	0.64	0.20	130	-1.44	0.479
Waitara Ck	NB825	Total nitrogen	0.72	0.12	130	-2.06	0.172
Waitara Ck	NB825	Filterable total phosphorus	1.03	0.22	130	0.15	0.999
Waitara Ck	NB825	Total phosphorus	0.90	0.18	130	-0.52	0.954
Waitara Ck	NB825	Conductivity	1.01	0.09	130	0.09	1.000
Waitara Ck	NB825	Dissolved oxygen	0.99	0.07	130	-0.22	0.996
Waitara Ck	NB825	Dissolved oxygen saturation	-5.20	4.39	130	-1.18	0.638
Waitara Ck	NB825	pH	-0.01	0.06	130	-0.18	0.998
Waitara Ck	NB825	Water temperature	1.05	0.06	130	0.79	0.859
Waitara Ck	NB825	Turbidity	0.76	0.22	130	-0.95	0.775
Waitara Ck	NB825	Chlorophyll - a	0.80	0.25	128	-0.71	0.894

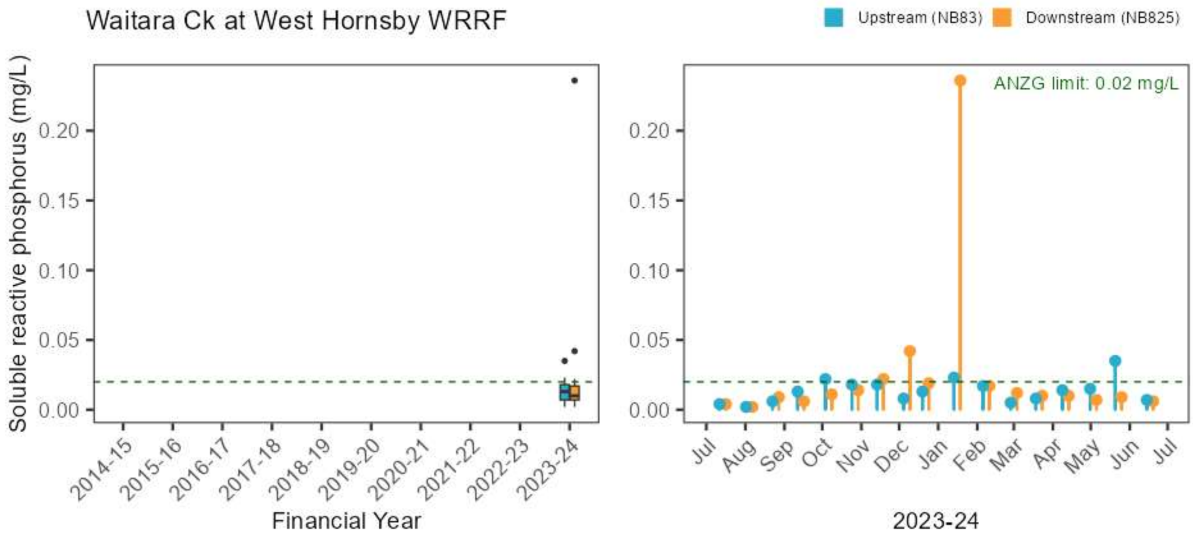
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.13.6. Stressor – Nutrients








Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 0.02 mg/L
Soluble reactive phosphorus (mg/L)
0.00
0.05
0.10
0.15
0.20
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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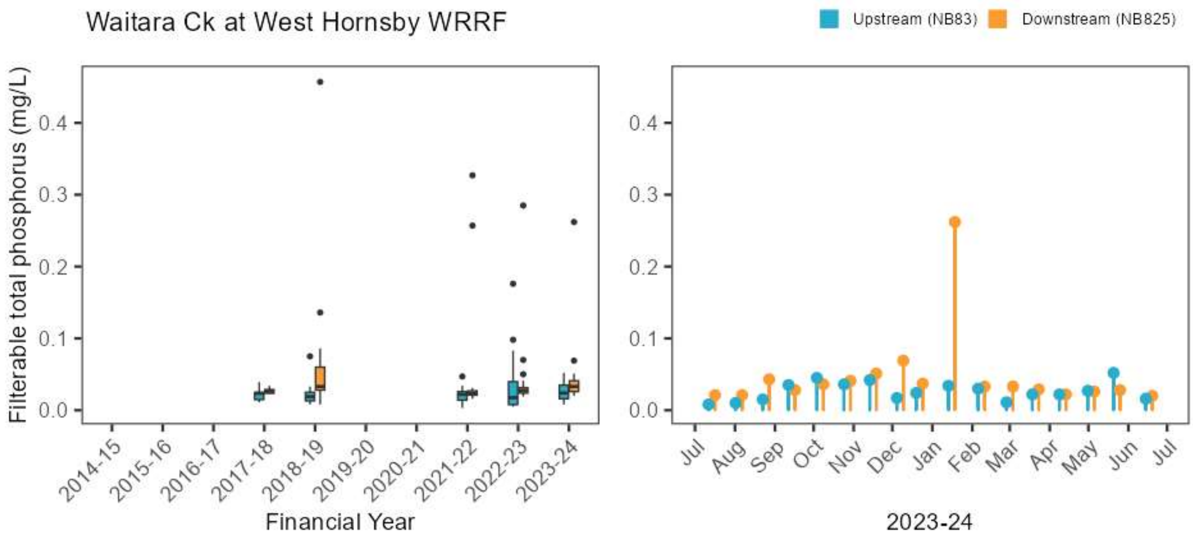
2023-24


Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
Filterable total phosphorus (mg/L)
0.0
0.1
0.2
0.3
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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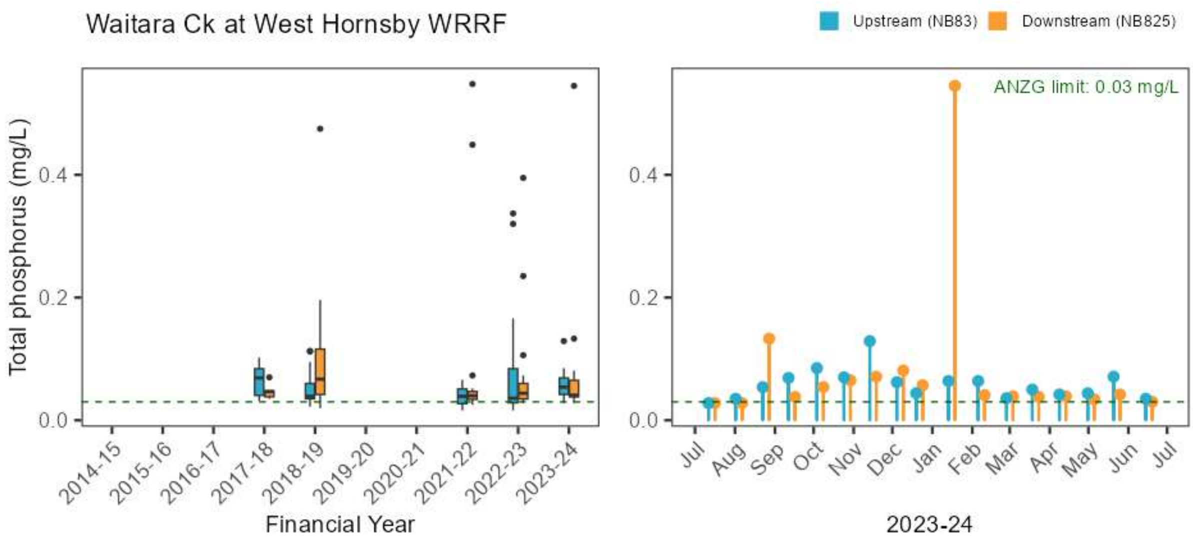
Jun
Jul
2023-24


Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 0.03 mg/L
Total phosphorus (mg/L)
0.0
0.2
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
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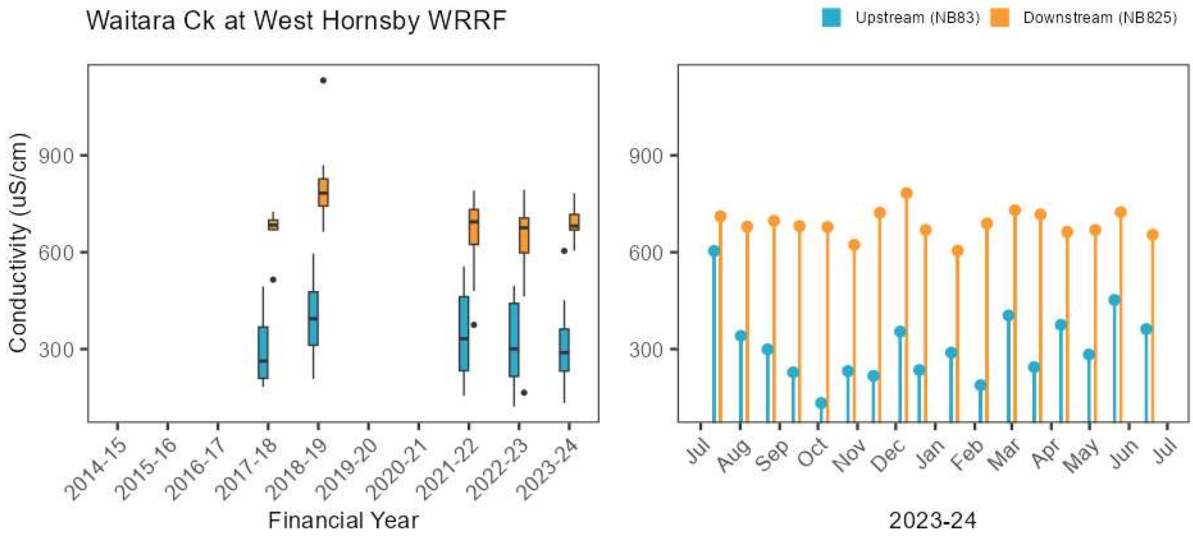
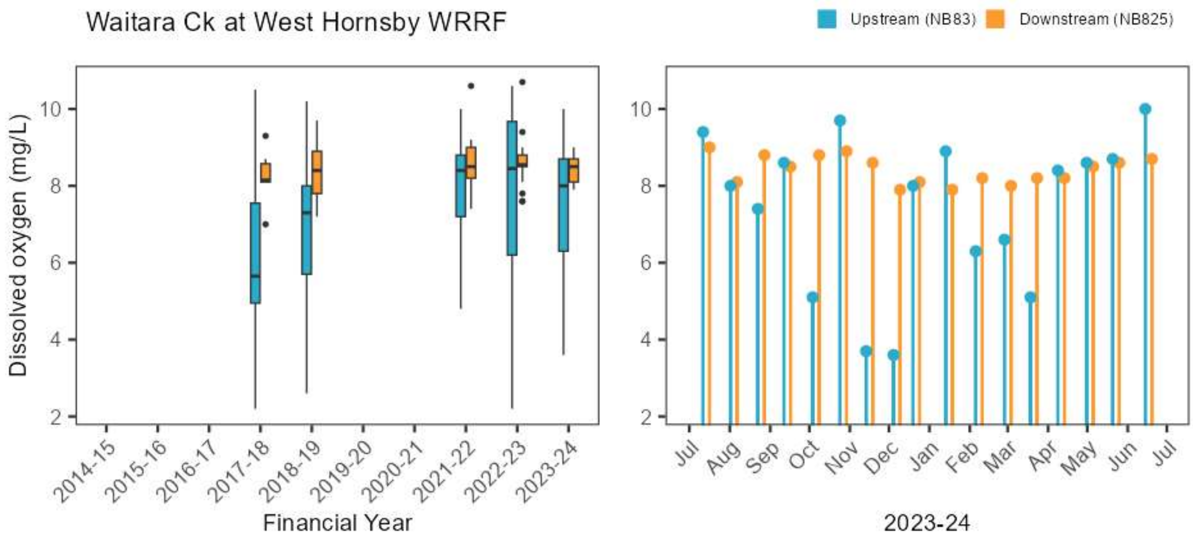
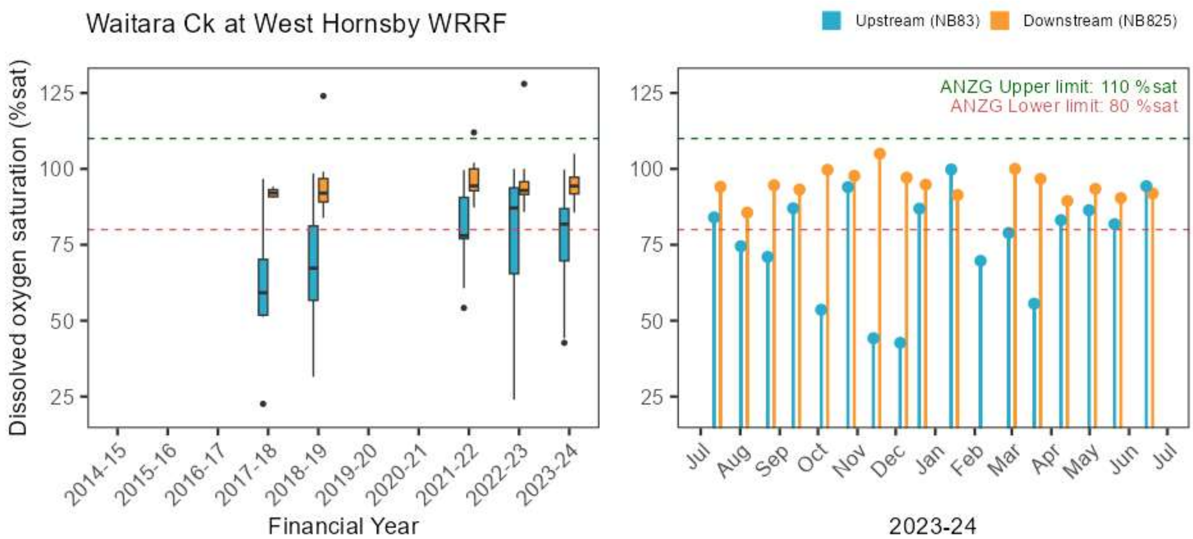
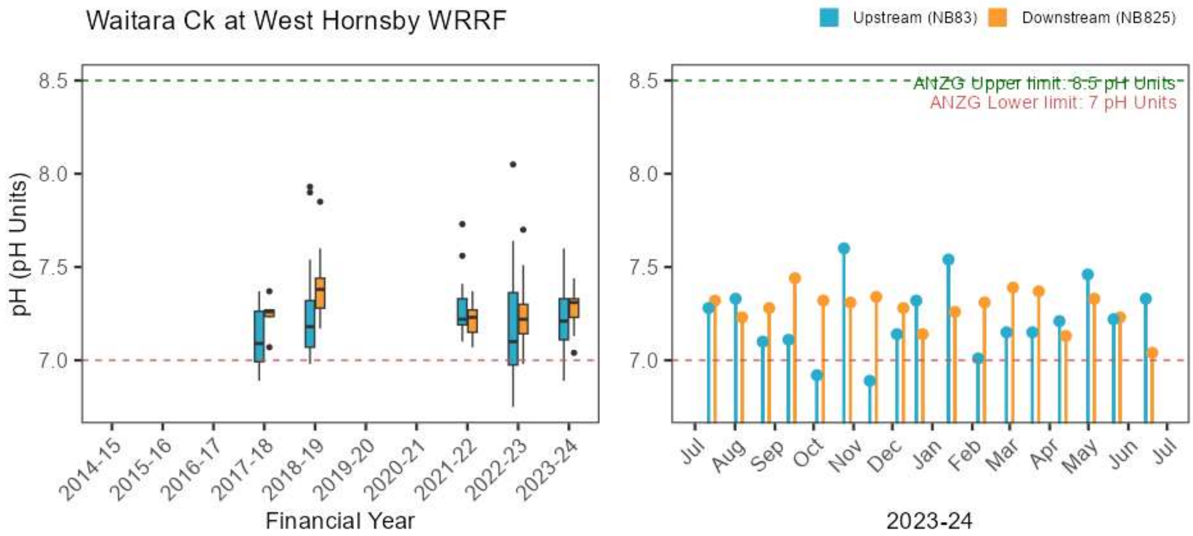
Jul
2023-24

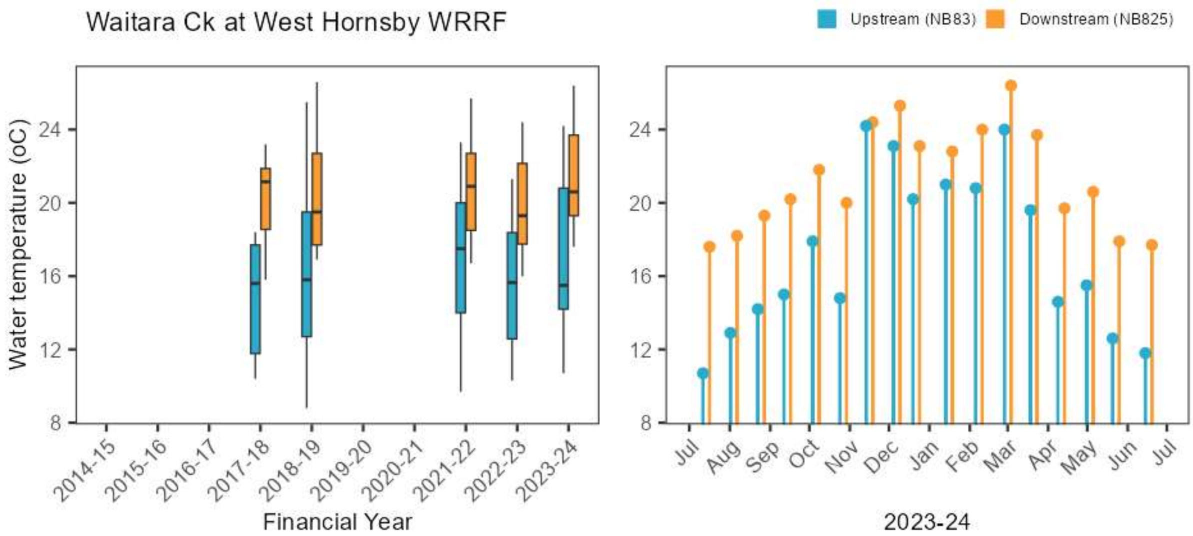
A.13.7. Stressor – Physico-chemical water quality

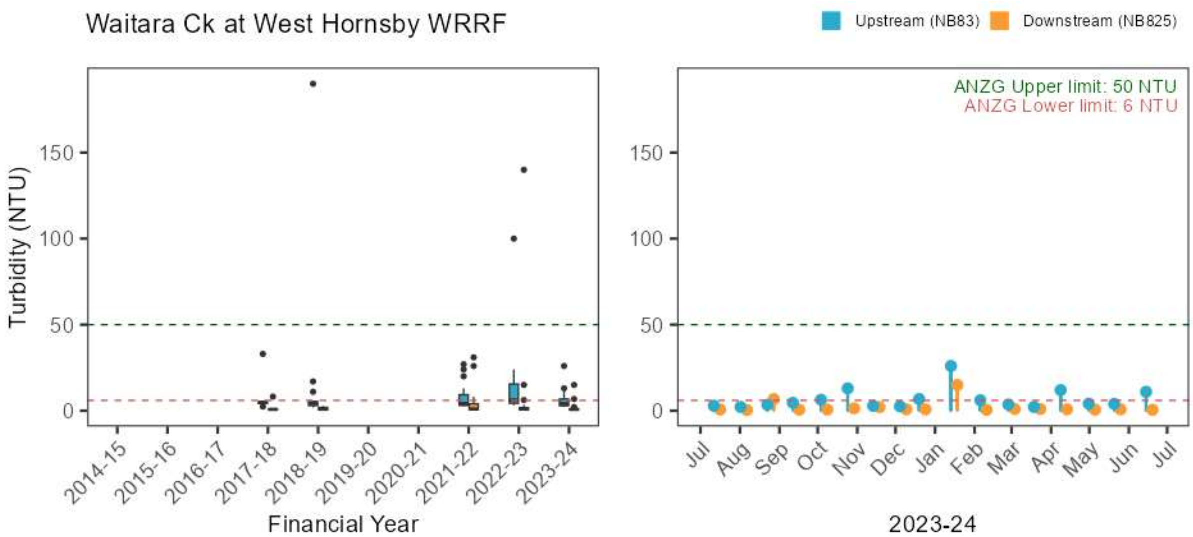




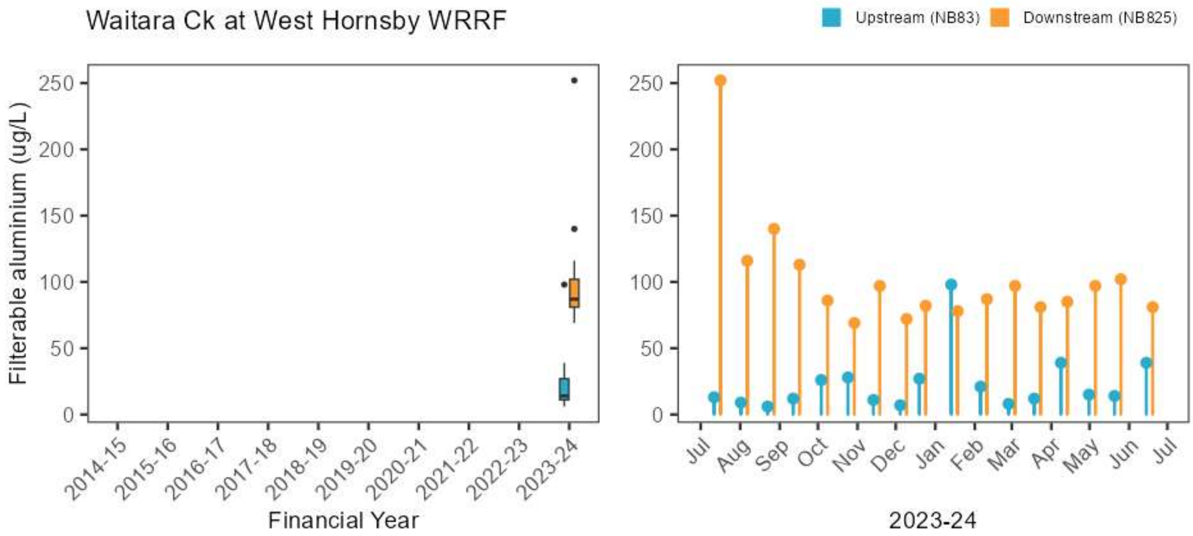


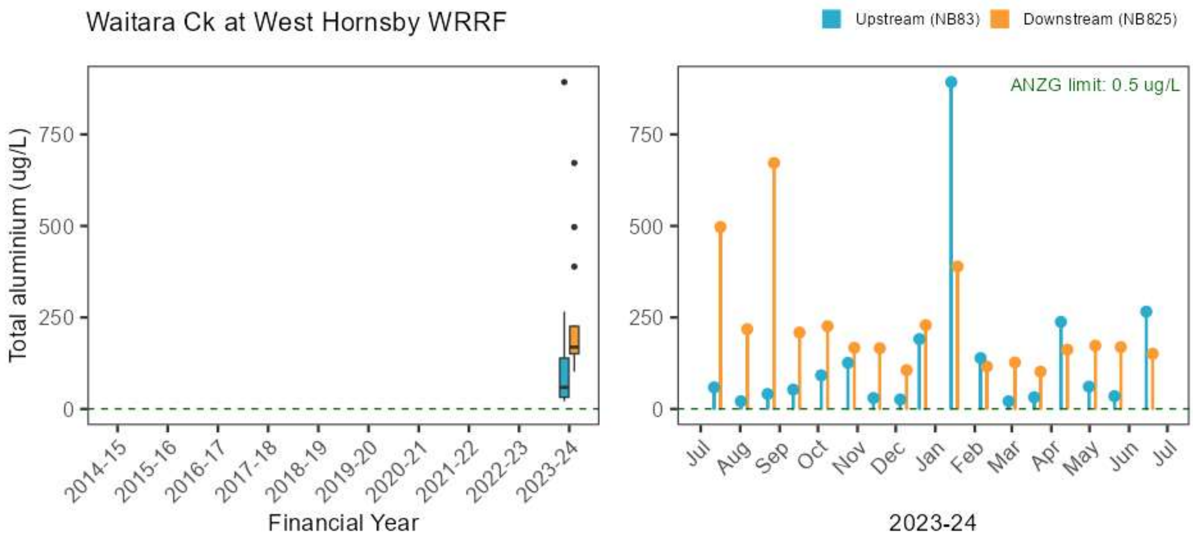

Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 7 pH Units
Financial Year
2023-24

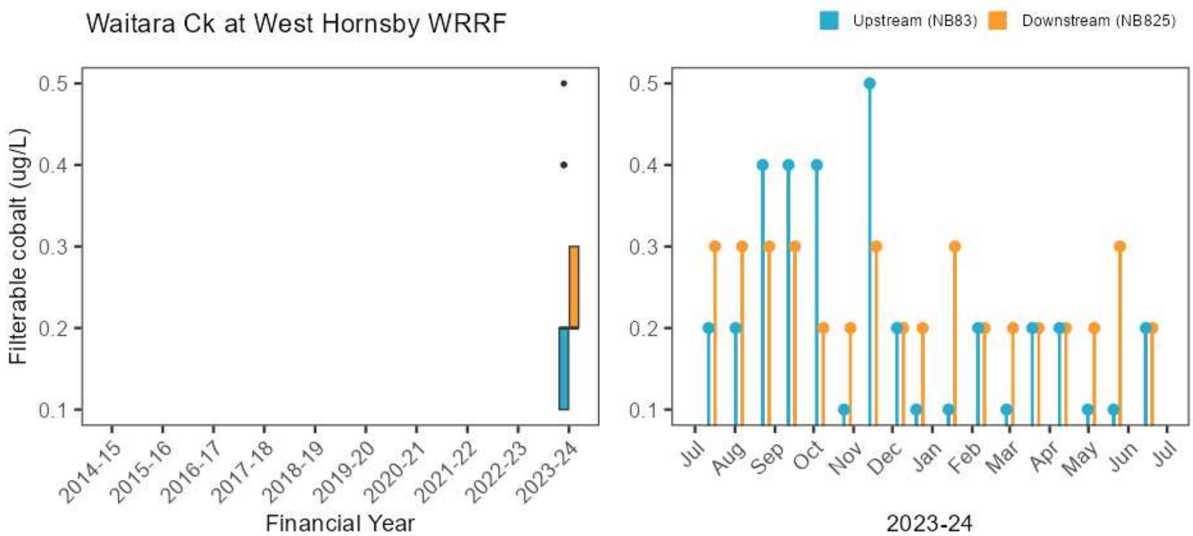

Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
Water temperature (oC)
Financial Year
2023-24

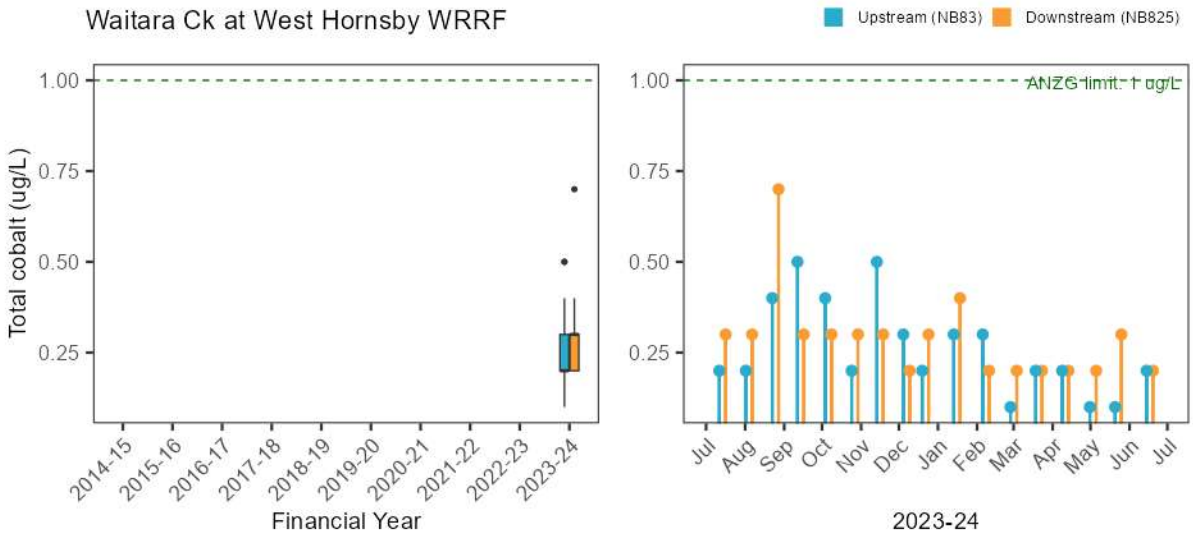

Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
Turbidity (NTU)
ANZG Upper limit: 50 NTU
ANZG Lower limit: 6 NTU
Financial Year
2023-24

A.13.8. Stressor – Trace metals

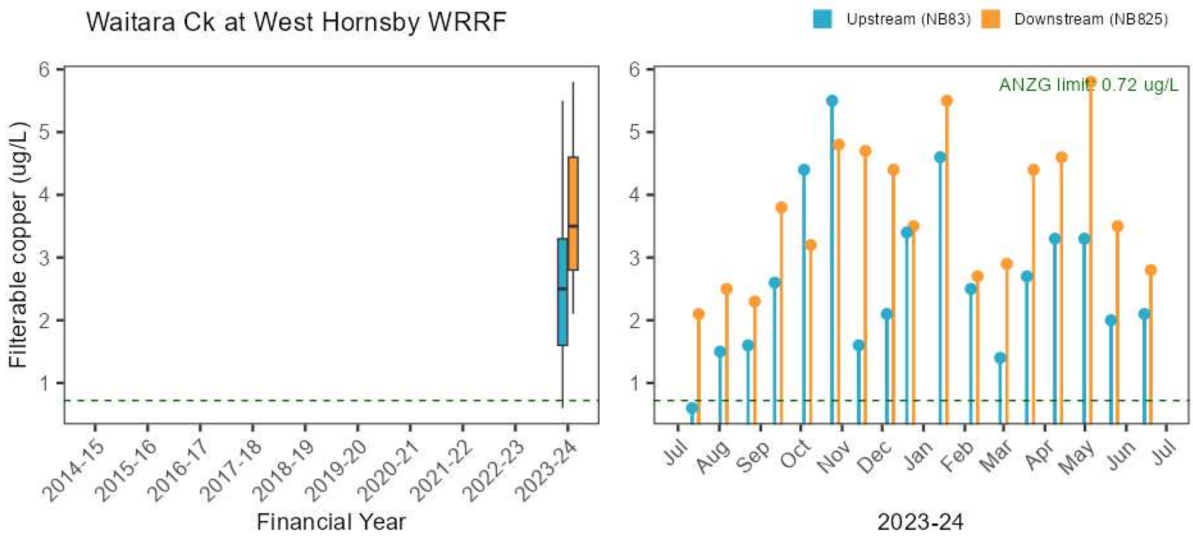




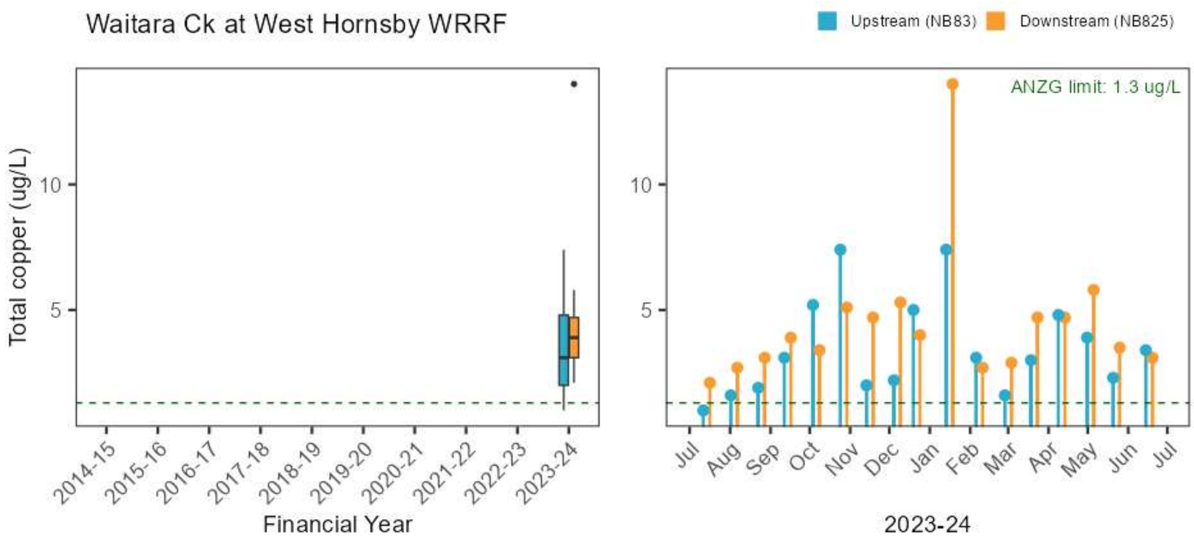




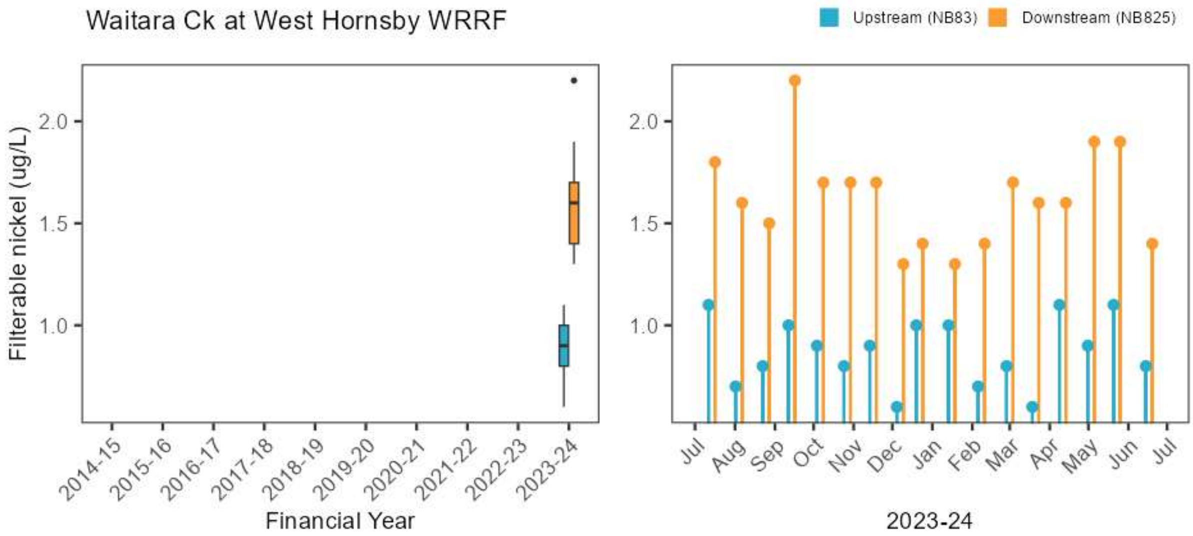
Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 1 ug/L
Total cobalt (ug/L)
Financial Year
2023-24



Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 0.72 ug/L
Filterable copper (ug/L)
Financial Year
2023-24



Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 1.3 ug/L
Total copper (ug/L)
Financial Year
2023-24


Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
Filterable nickel (ug/L)
2.0
1.5
1.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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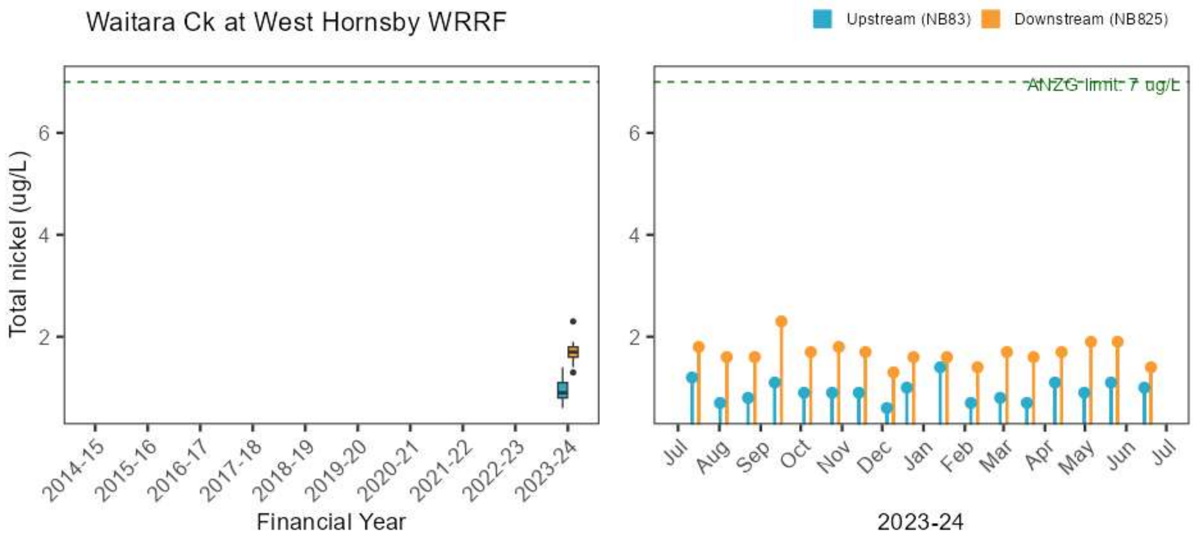
Jun
Jul
2023-24


Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
ANZG limit: 7 ug/L
Total nickel (ug/L)
6
4
2
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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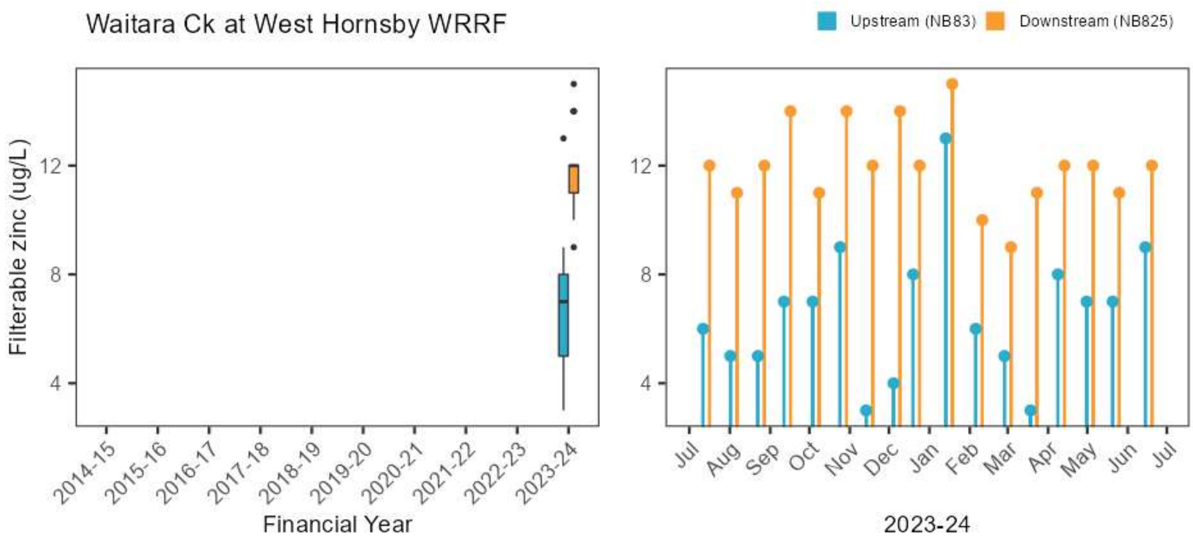
2023-24


Waitara Ck at West Hornsby WRRF
Upstream (NB83)
Downstream (NB825)
Filterable zinc (ug/L)
12
8
4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
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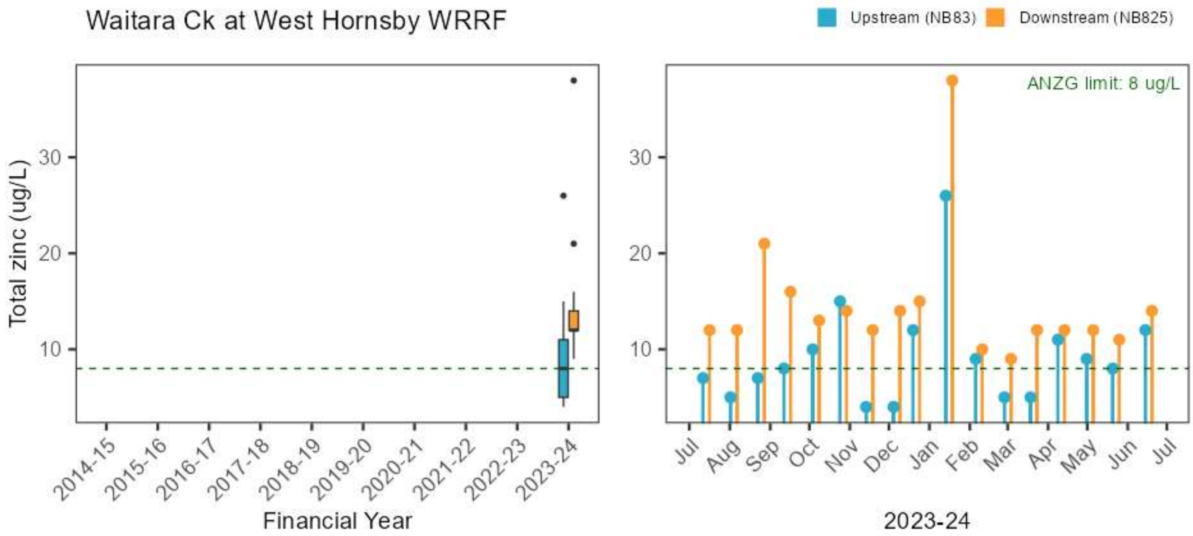
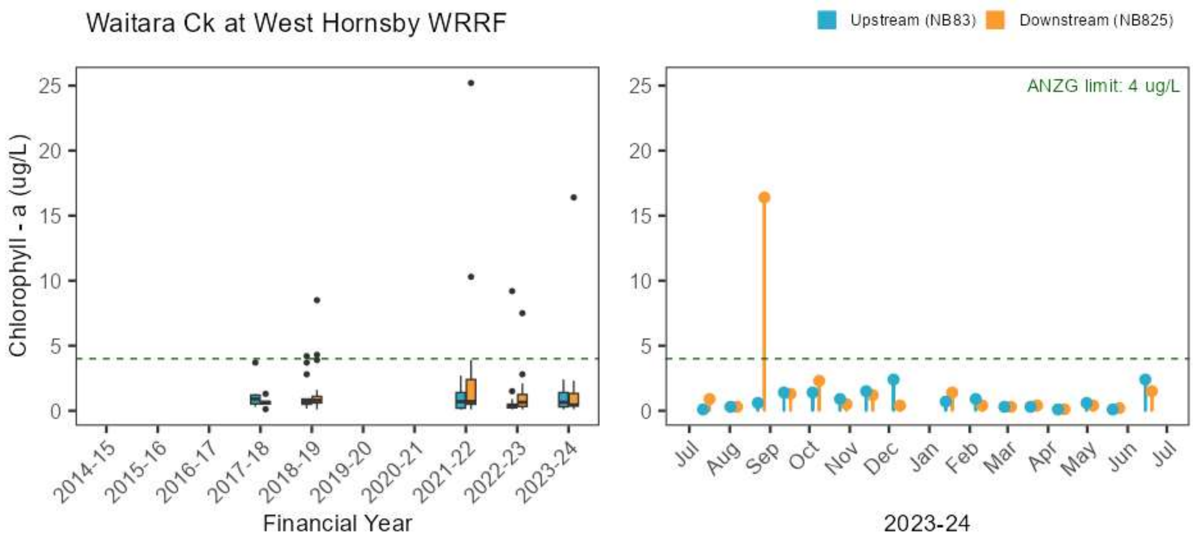
Jun
Jul
2023-24



A.13.9. Ecosystem receptor – Phytoplankton



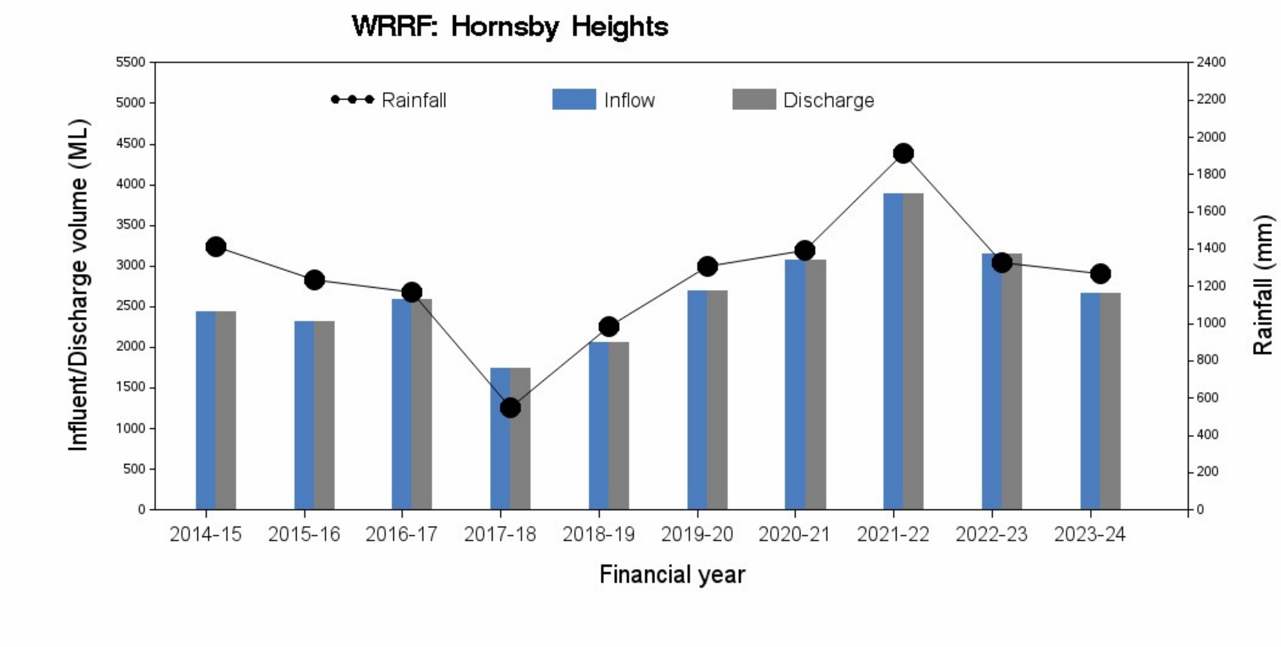
A.13.10. Ecosystem receptor – Macroinvertebrates

Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Waitara Creek	River (NB83 vs NB825)	Welch Two Sample t-test	0.13	0.82	5.7	0.443

A.14. Hornsby Heights WRRF

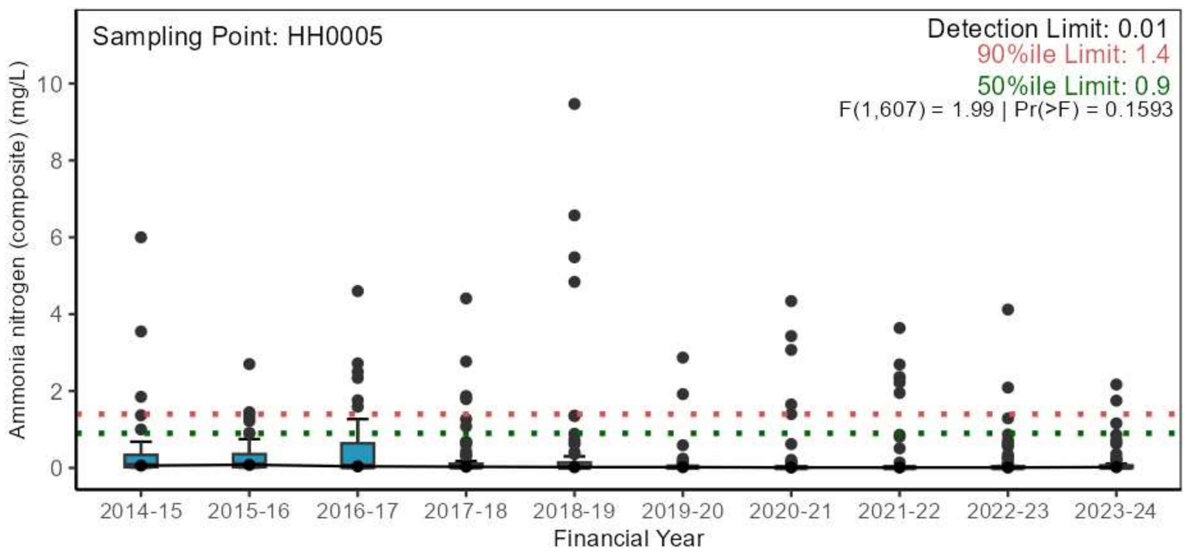
A.14.1. Pressure – Wastewater quantity

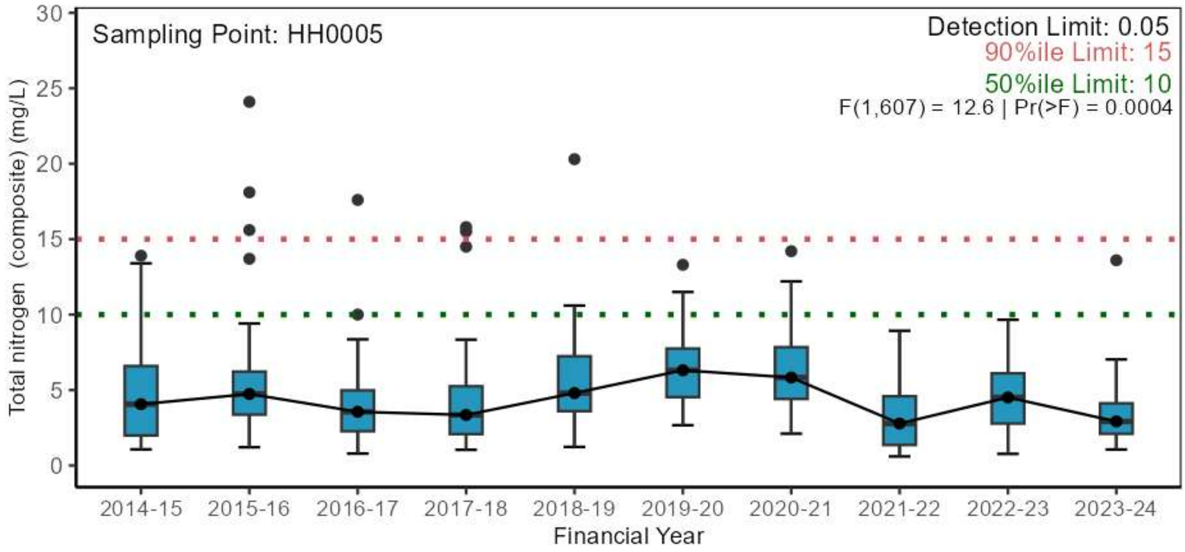
Inflow/discharge volume and rainfall

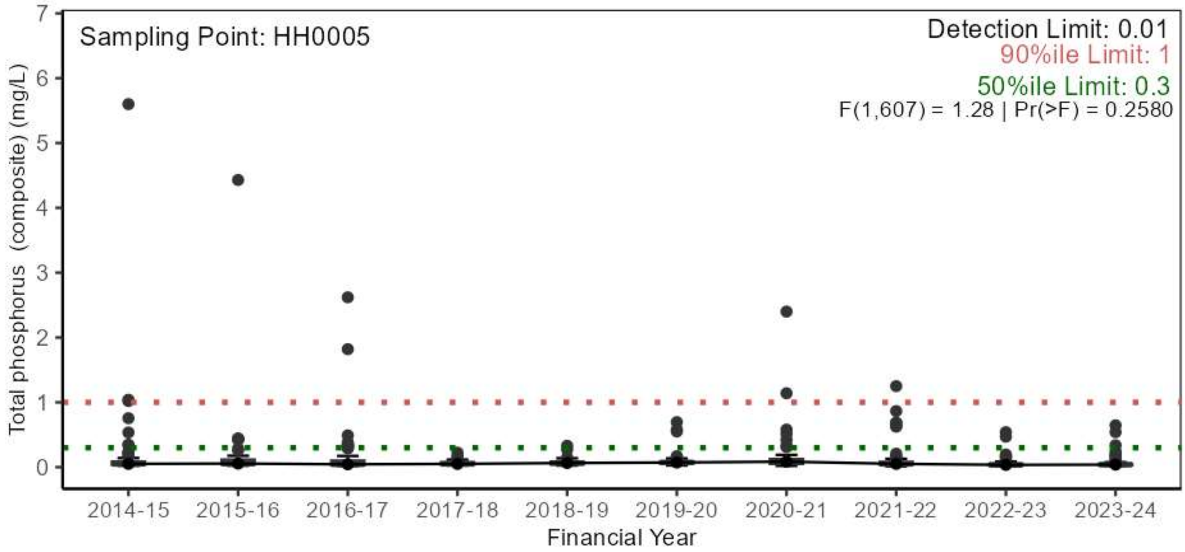


A.14.2. Pressure – Wastewater quality

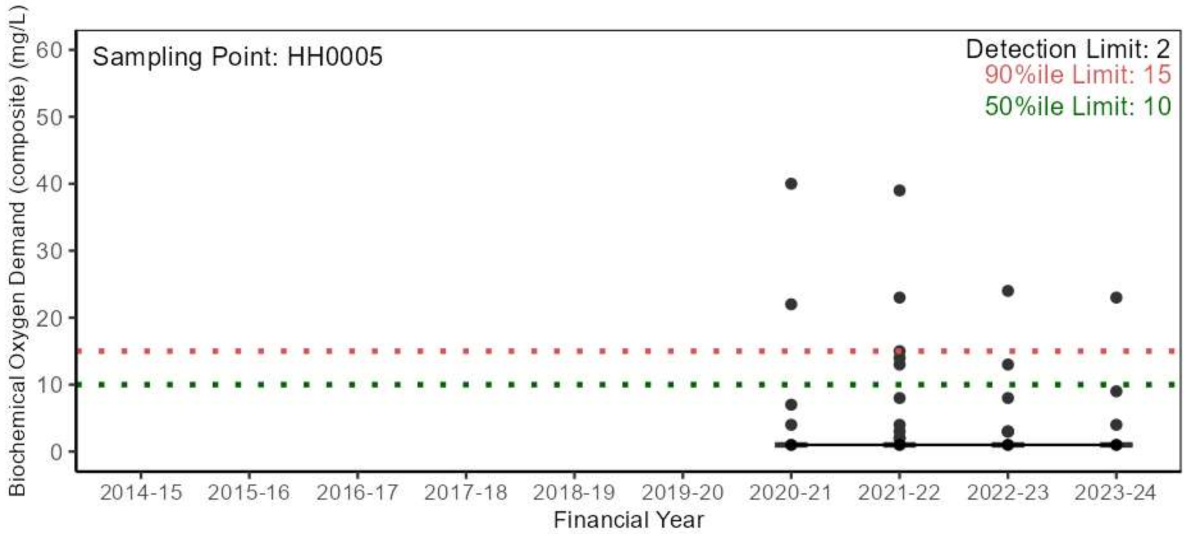
Nutrients



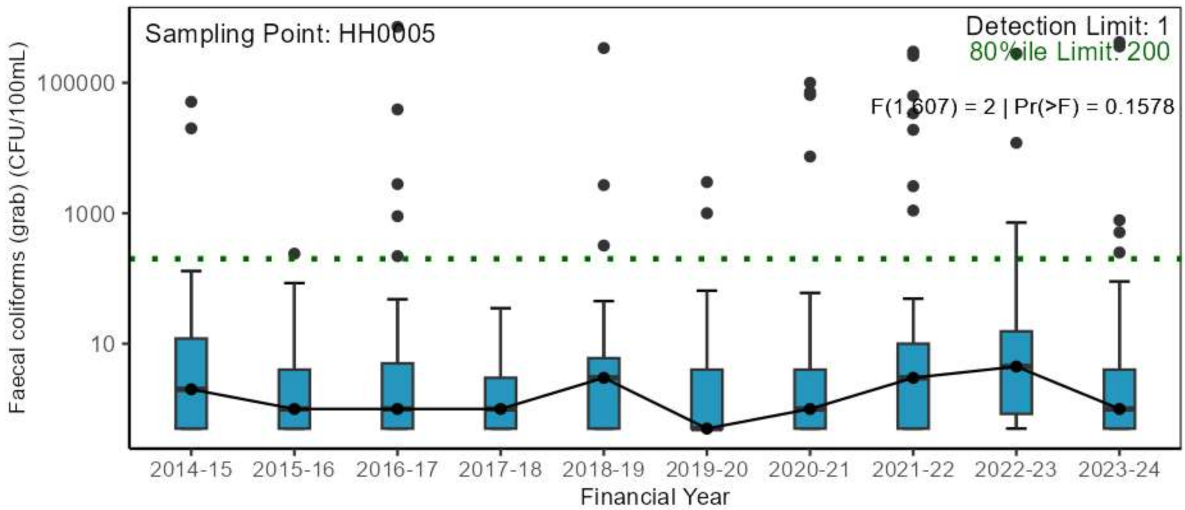

Sampling Point: HH0005
Detection Limit: 0.05
90%ile Limit: 15
50%ile Limit: 10
F(1,607) = 12.6 | Pr(>F) = 0.0004
Total nitrogen (composite) (mg/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24


Sampling Point: HH0005
Detection Limit: 0.01
90%ile Limit: 1
50%ile Limit: 0.3
F(1,607) = 1.28 | Pr(>F) = 0.2580
Total phosphorus (composite) (mg/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24

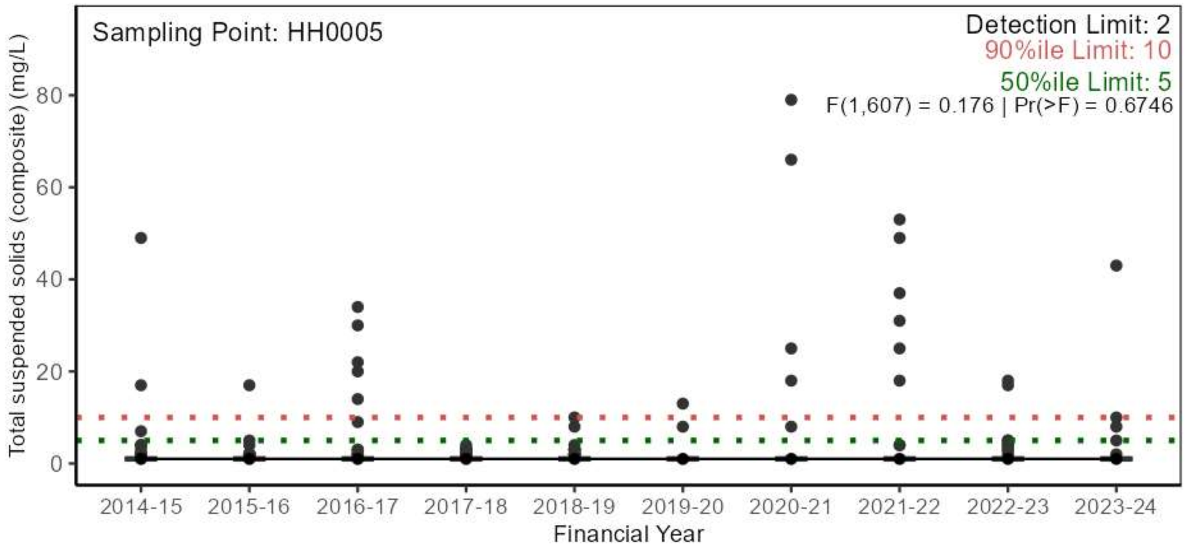
Major conventional analytes



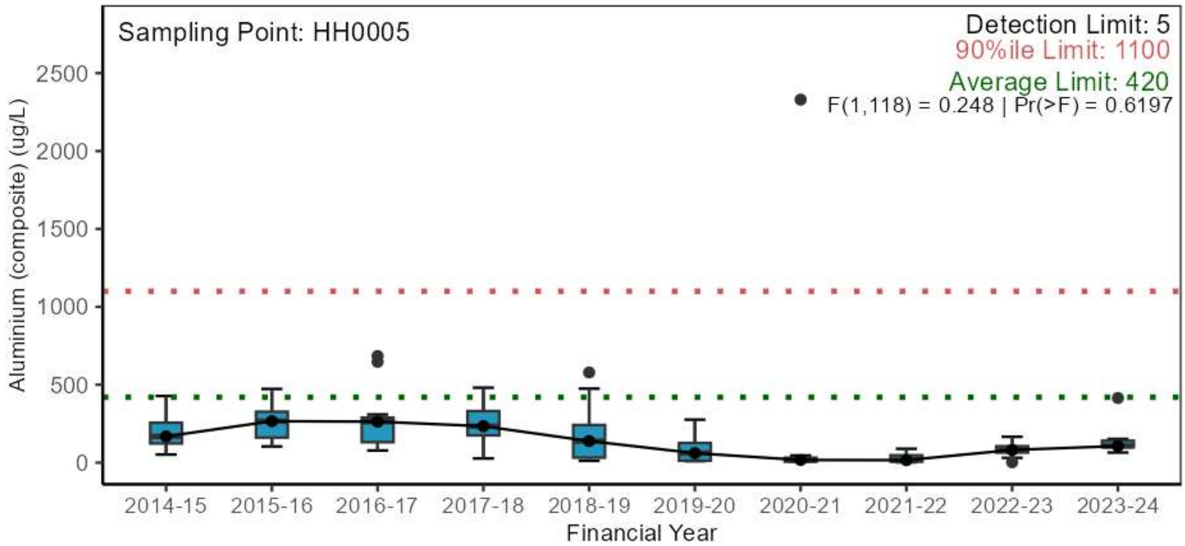
Statistical test not conducted as >90% of results were below detection limits.

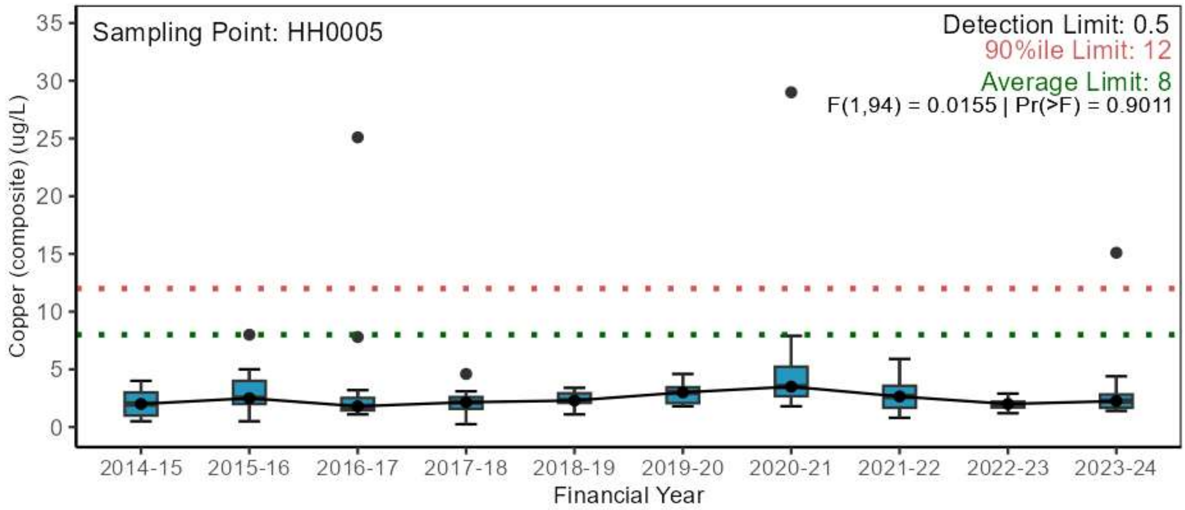


Data has been log10 transformed and y-axis backtransformed for ease of interpretation.

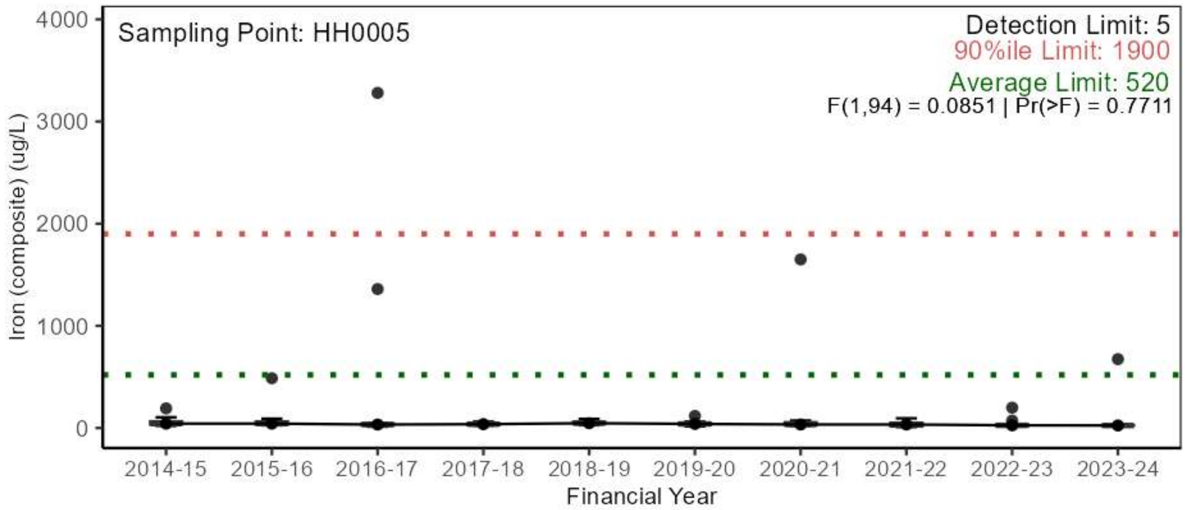


Trace metals

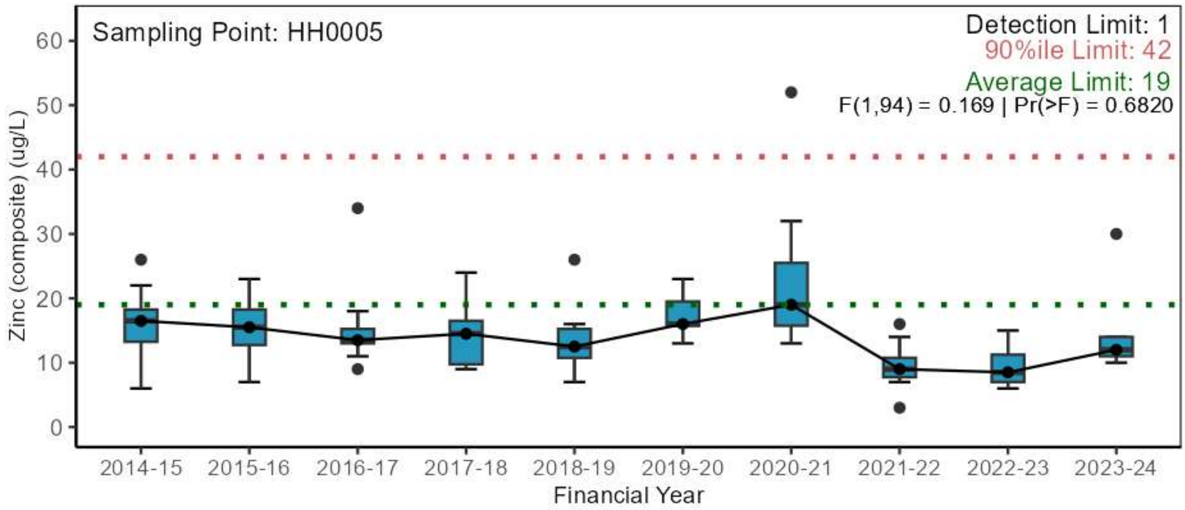




Statistical test excludes data prior to 2016-17 due to method detection limit change.

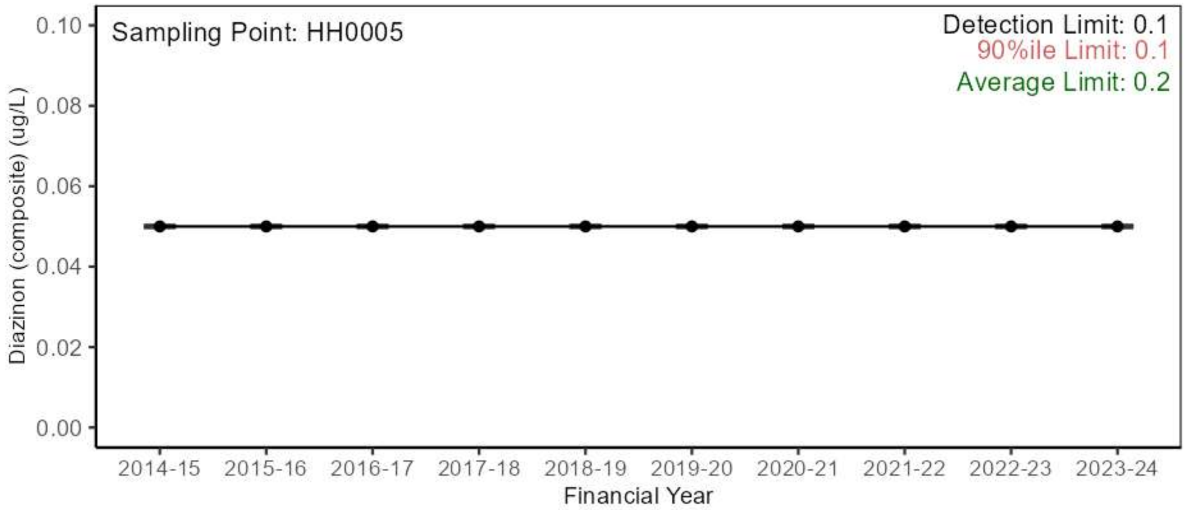


Statistical test excludes data prior to 2016-17 due to method detection limit change.

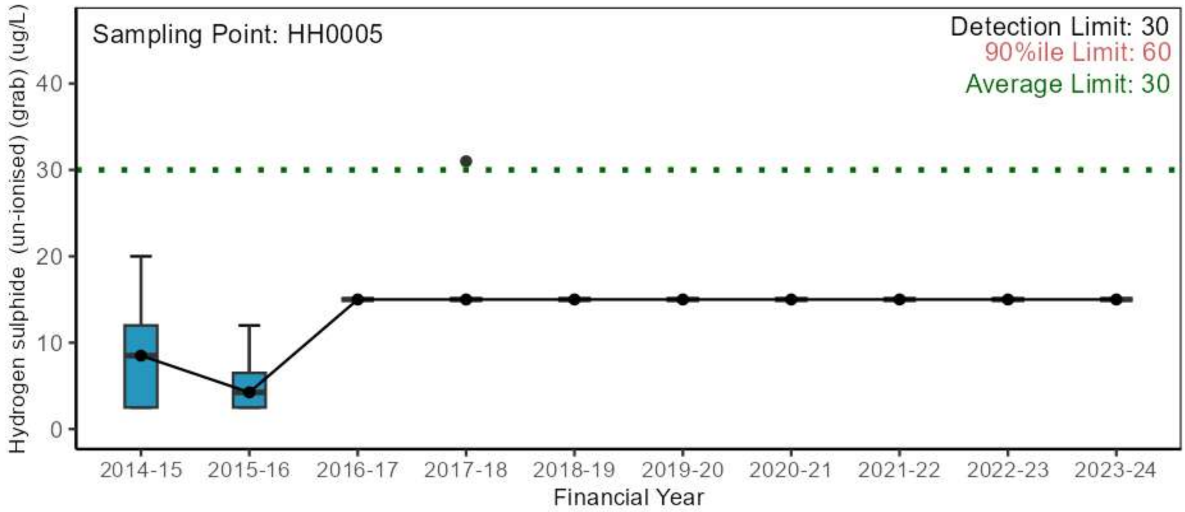


Statistical test excludes data prior to 2016-17 due to method detection limit change.

Other chemicals and organics (including pesticides)

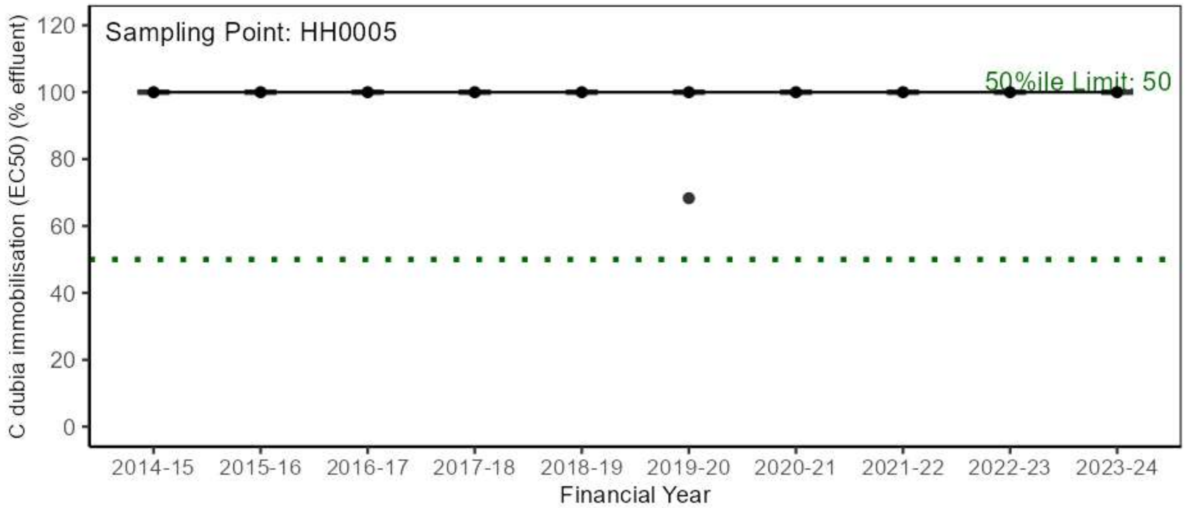


Statistical test not conducted as >90% of results were below detection limits.



Statistical test not conducted as >90% of results were below detection limits.

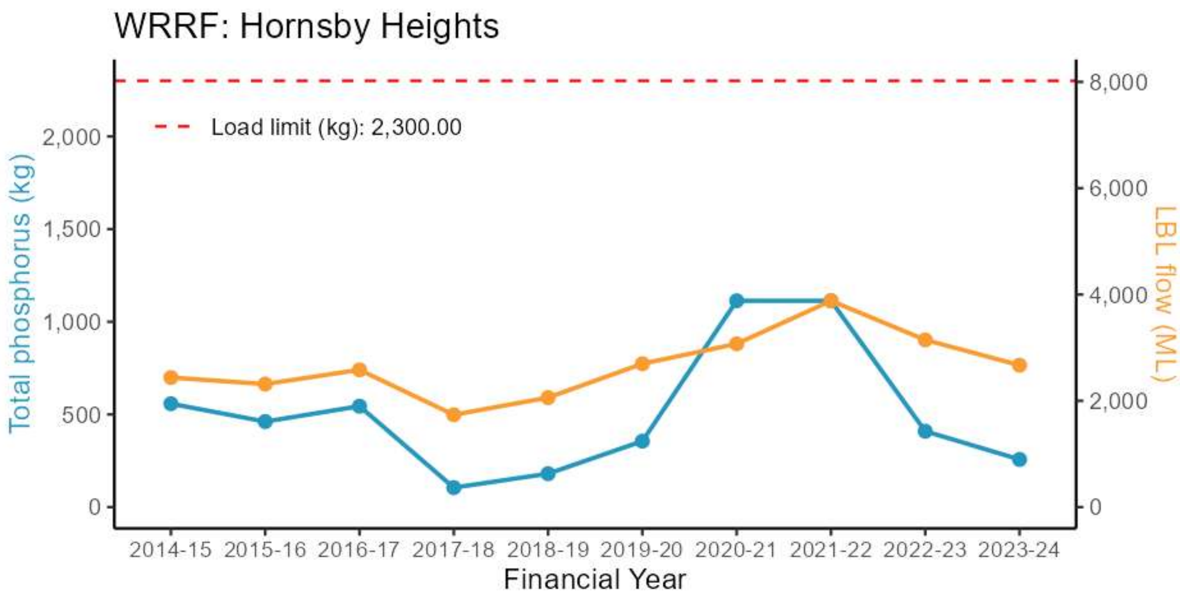
A.14.3. Pressure – Wastewater toxicity



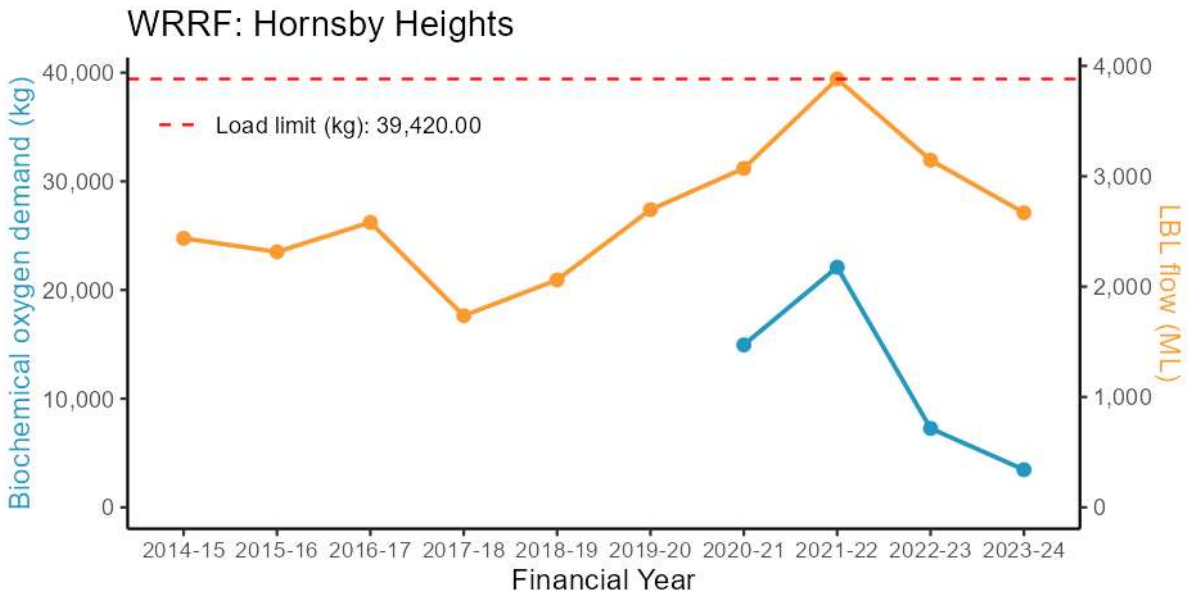
Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

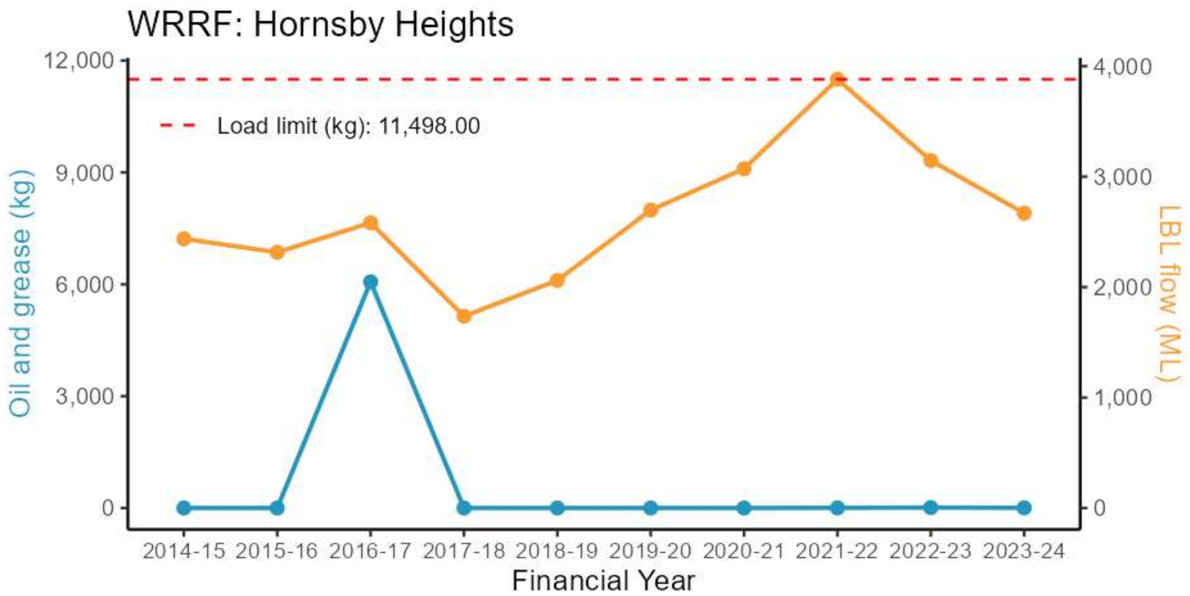
A.14.4. Pressure – Wastewater discharge load

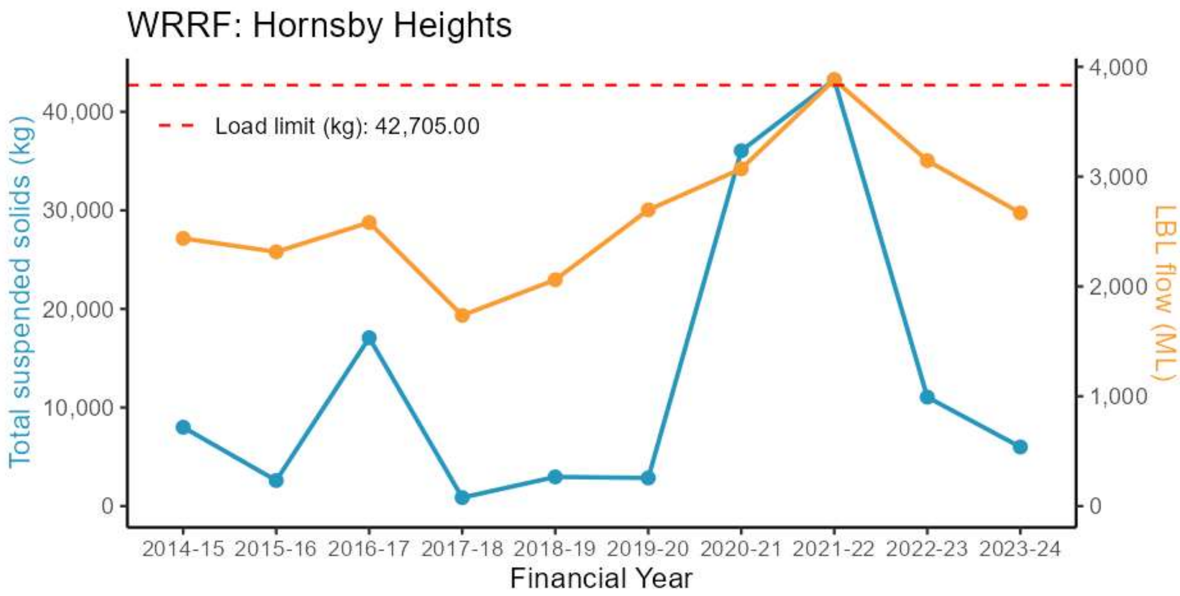
Nutrients



Major conventional analytes







A.14.5. Stressor and Ecosystem receptor – Statistical analysis outcomes

Table A-27 Downstream vs upstream comparison (current period) contrast outcomes for Hornsby Heights WRRF

Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Calna Ck	NB43 vs NB42	Total ammonia nitrogen	2.76	1.15	127	2.44	0.075
Calna Ck	NB43 vs NB42	Oxidised nitrogen	19.27	7.11	127	8.02	<0.001
Calna Ck	NB43 vs NB42	Total nitrogen	6.44	1.37	127	8.79	<0.001
Calna Ck	NB43 vs NB42	Filterable total phosphorus	5.05	1.34	127	6.12	<0.001
Calna Ck	NB43 vs NB42	Total phosphorus	2.29	0.59	127	3.21	0.009
Calna Ck	NB43 vs NB42	Conductivity	2.46	0.25	127	8.82	<0.001
Calna Ck	NB43 vs NB42	Dissolved oxygen	1.05	0.05	127	1.02	0.738
Calna Ck	NB43 vs NB42	Dissolved oxygen saturation	11.82	2.29	127	5.17	<0.001
Calna Ck	NB43 vs NB42	pH	0.46	0.07	127	6.84	<0.001
Calna Ck	NB43 vs NB42	Water temperature	1.25	0.10	127	2.87	0.025
Calna Ck	NB43 vs NB42	Turbidity	0.24	0.08	127	-4.22	<0.001
Calna Ck	NB43 vs NB42	Chlorophyll - a	0.90	0.34	125	-0.27	0.993

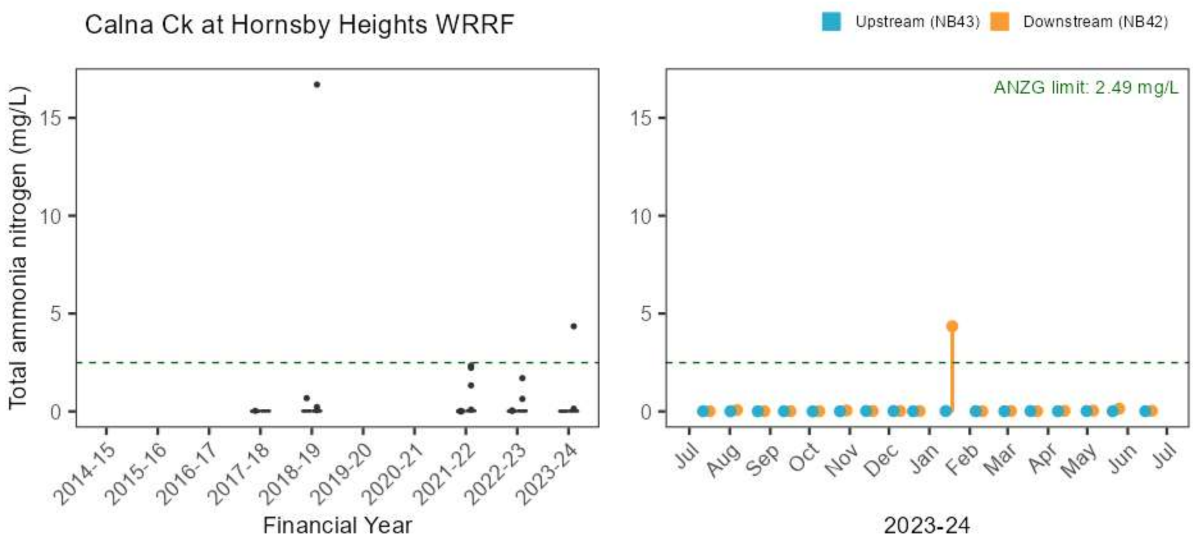
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

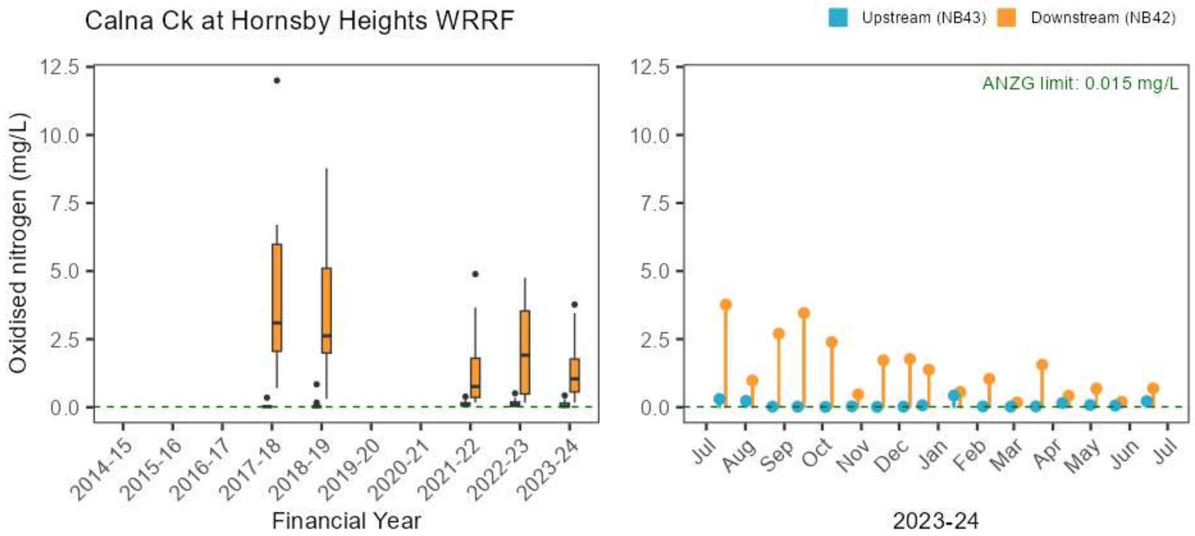
Table A-28 Current period vs previous period comparison (single site) contrast outcomes for Hornsby Heights WRRF

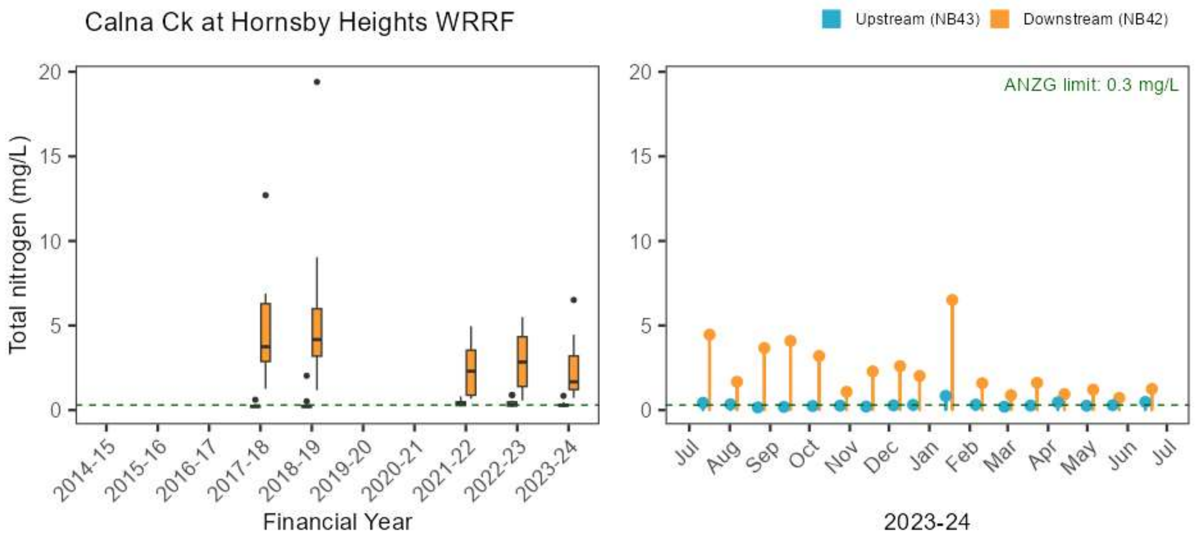
Waterway	Site(s)	Analyte	Estimate	SE	DF	T ratio	P value
Calna Ck	NB43	Total ammonia nitrogen	0.72	0.24	127	-0.96	0.774
Calna Ck	NB43	Oxidised nitrogen	0.86	0.26	127	-0.49	0.961
Calna Ck	NB43	Total nitrogen	0.91	0.16	127	-0.56	0.945
Calna Ck	NB43	Filterable total phosphorus	0.82	0.18	127	-0.94	0.786
Calna Ck	NB43	Total phosphorus	0.88	0.18	127	-0.62	0.924
Calna Ck	NB43	Conductivity	1.05	0.09	127	0.62	0.924
Calna Ck	NB43	Dissolved oxygen	1.03	0.04	127	0.89	0.811
Calna Ck	NB43	Dissolved oxygen saturation	2.48	1.86	127	1.33	0.545
Calna Ck	NB43	pH	0.01	0.05	127	0.11	1.000
Calna Ck	NB43	Water temperature	1.05	0.07	127	0.85	0.829
Calna Ck	NB43	Turbidity	0.70	0.19	127	-1.30	0.564
Calna Ck	NB43	Chlorophyll - a	0.85	0.26	125	-0.55	0.947
Calna Ck	NB42	Total ammonia nitrogen	0.67	0.23	127	-1.17	0.648
Calna Ck	NB42	Oxidised nitrogen	0.76	0.23	127	-0.91	0.799
Calna Ck	NB42	Total nitrogen	0.74	0.13	127	-1.73	0.315
Calna Ck	NB42	Filterable total phosphorus	0.90	0.20	127	-0.46	0.967
Calna Ck	NB42	Total phosphorus	0.83	0.18	127	-0.87	0.819
Calna Ck	NB42	Conductivity	1.10	0.09	127	1.08	0.700
Calna Ck	NB42	Dissolved oxygen	1.01	0.04	127	0.14	0.999
Calna Ck	NB42	Dissolved oxygen saturation	1.33	1.88	127	0.71	0.893
Calna Ck	NB42	pH	-0.03	0.06	127	-0.53	0.950
Calna Ck	NB42	Water temperature	1.04	0.07	127	0.61	0.928
Calna Ck	NB42	Turbidity	0.69	0.19	127	-1.36	0.527
Calna Ck	NB42	Chlorophyll - a	0.81	0.25	125	-0.67	0.909

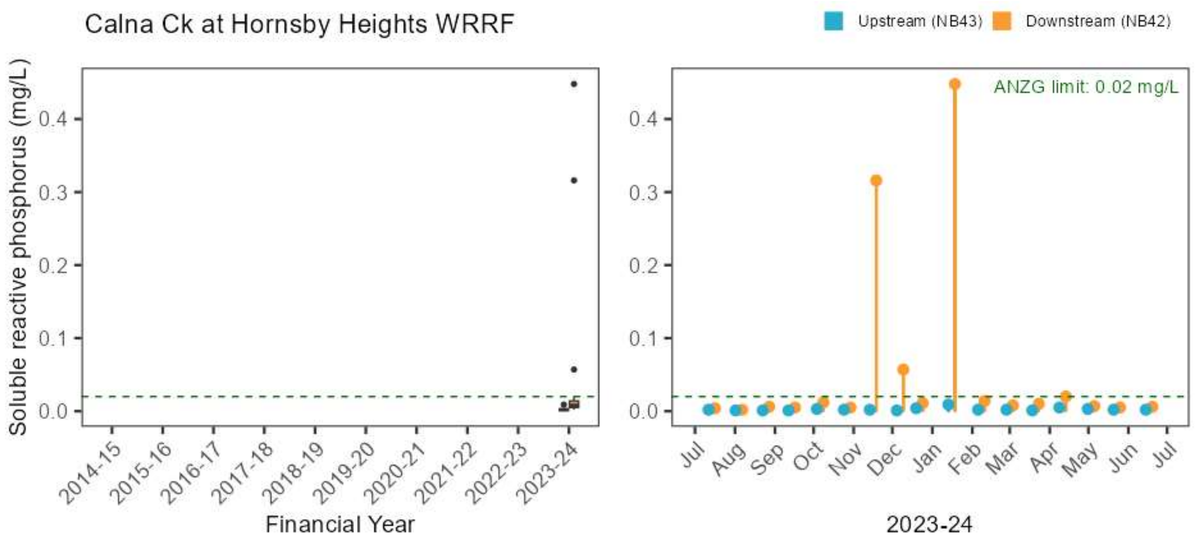
	not significant (p>0.05)		p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

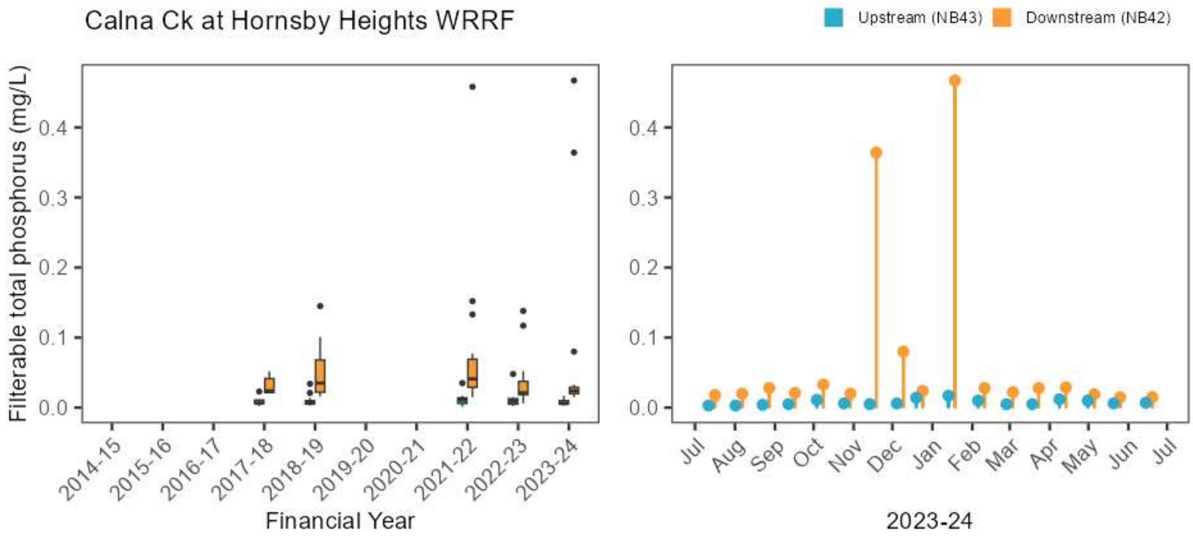
A.14.6. Stressor – Nutrients

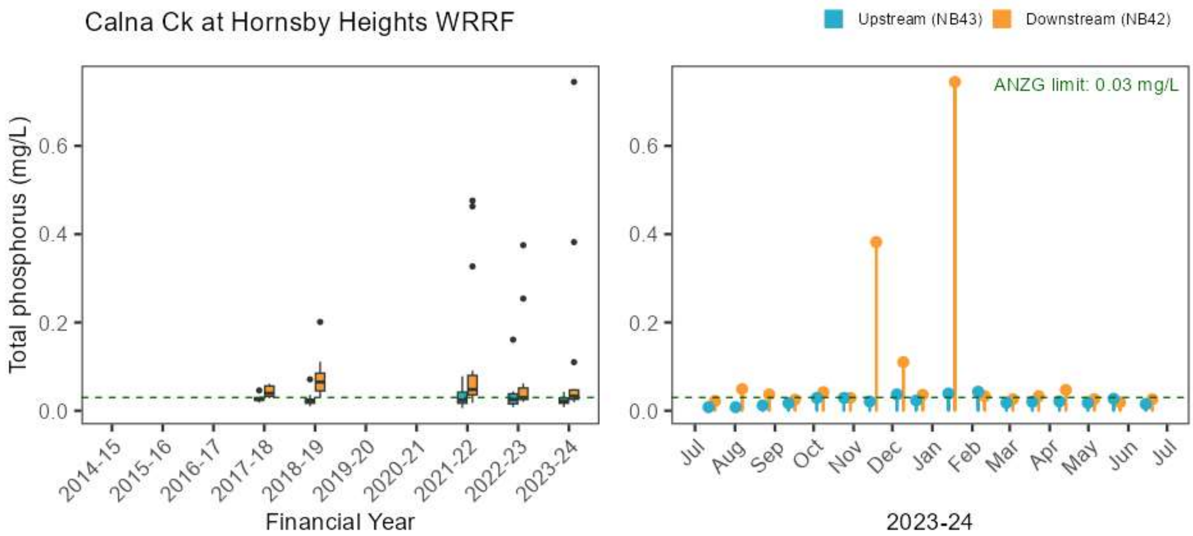



Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Oxidised nitrogen (mg/L)
ANZG limit: 0.015 mg/L
Financial Year
2023-24

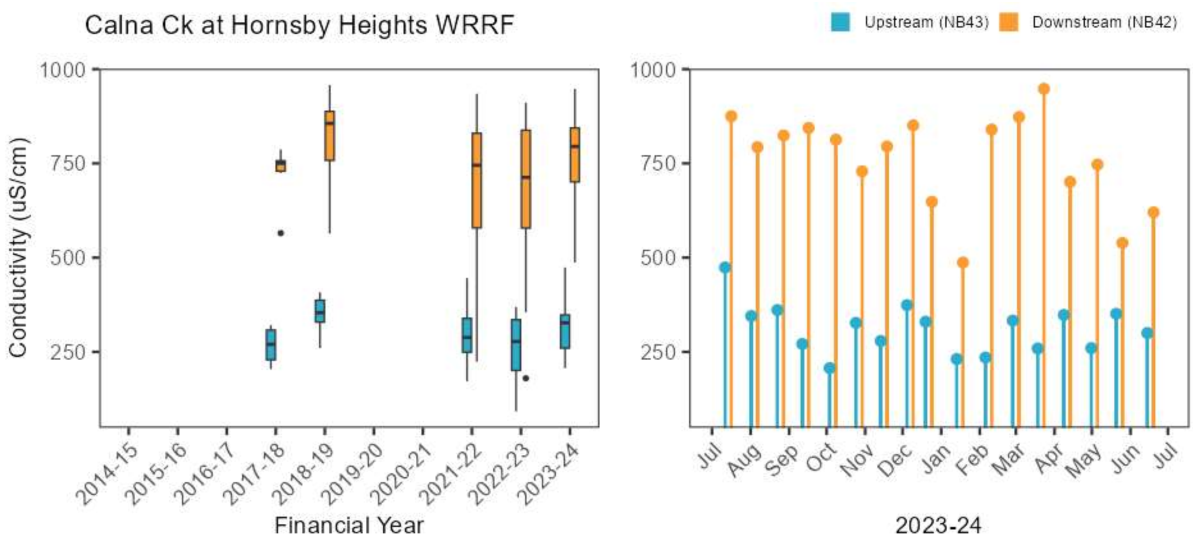

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Total nitrogen (mg/L)
ANZG limit: 0.3 mg/L
Financial Year
2023-24

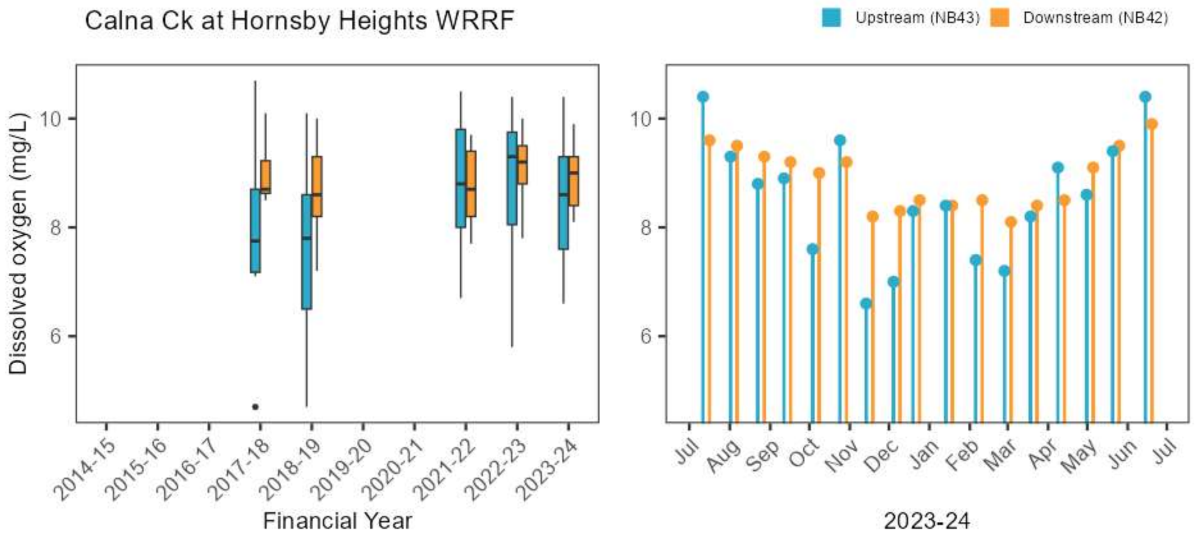

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Soluble reactive phosphorus (mg/L)
ANZG limit: 0.02 mg/L
Financial Year
2023-24

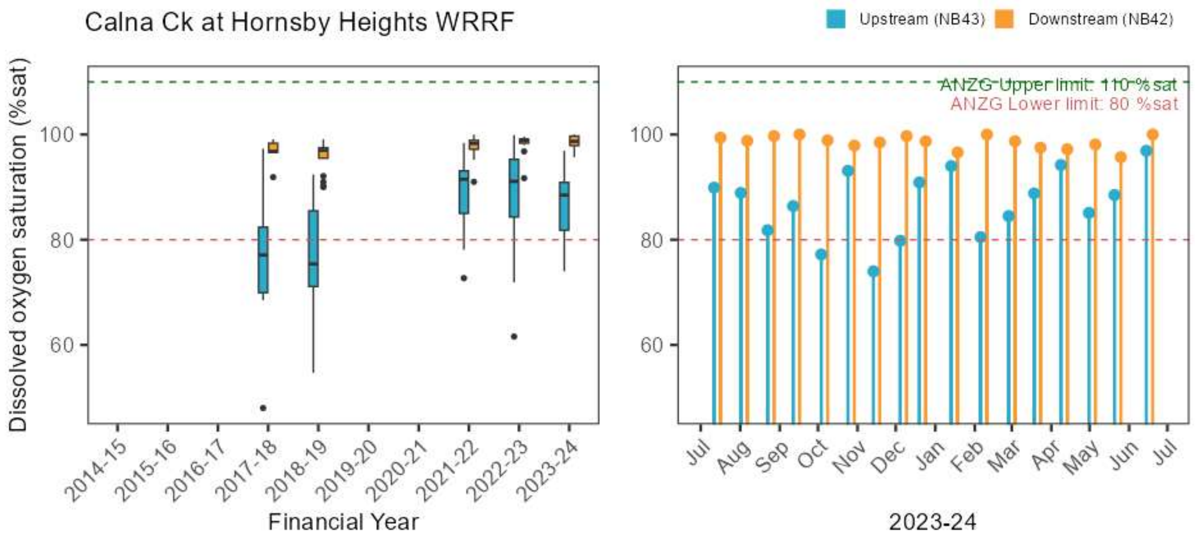


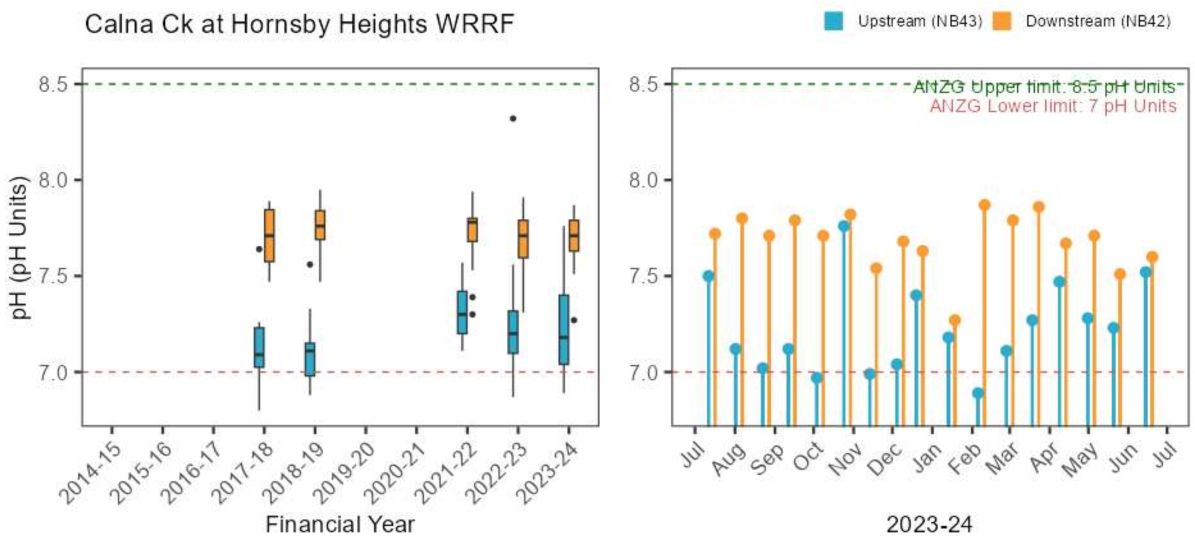


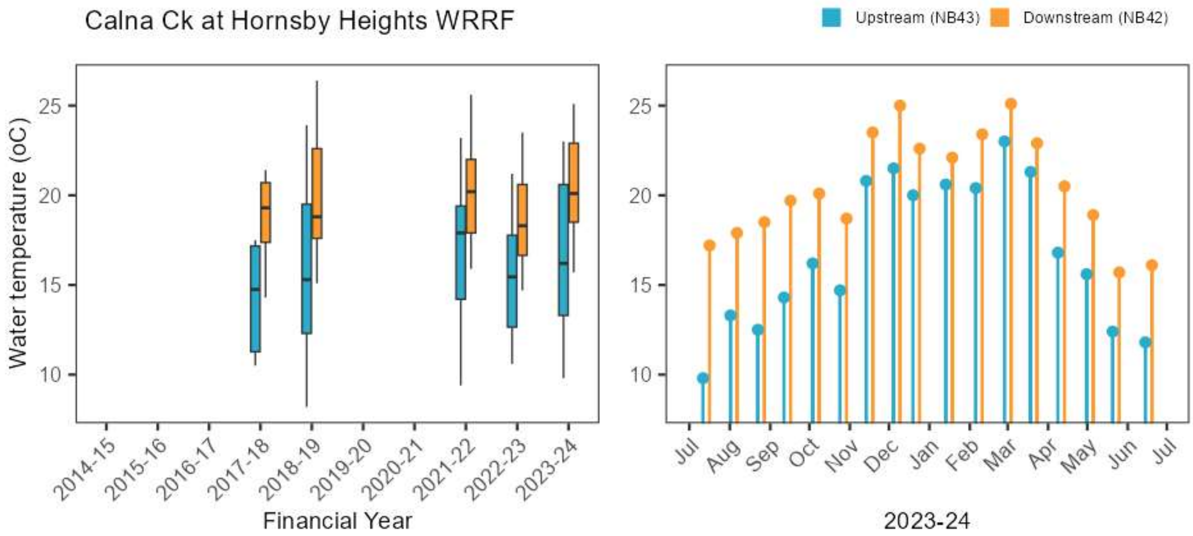
A.14.7. Stressor – Physico-chemical water quality

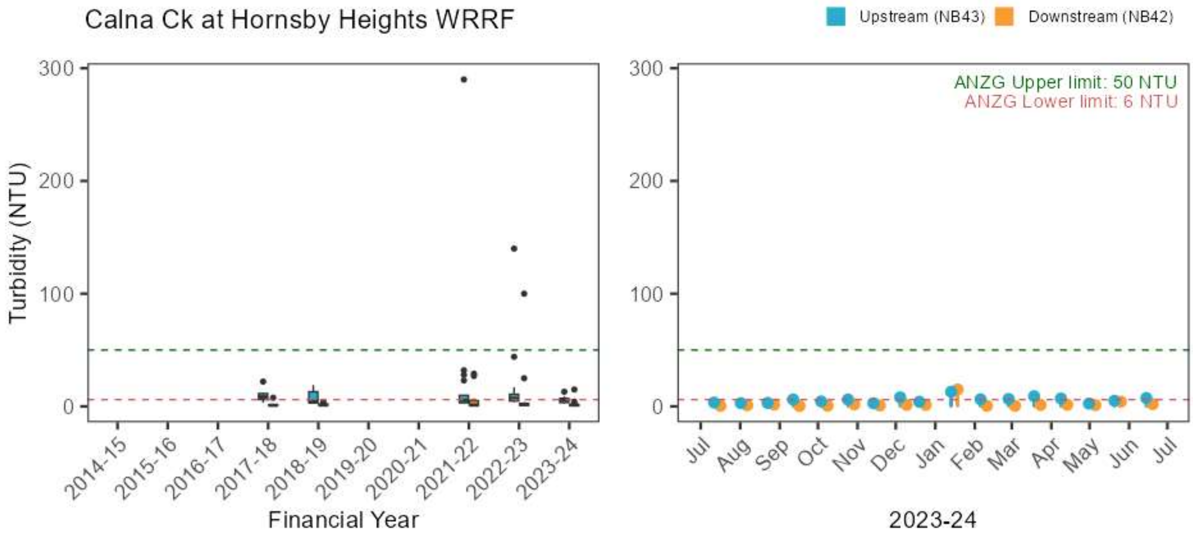



Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Dissolved oxygen (mg/L)
Financial Year
2023-24

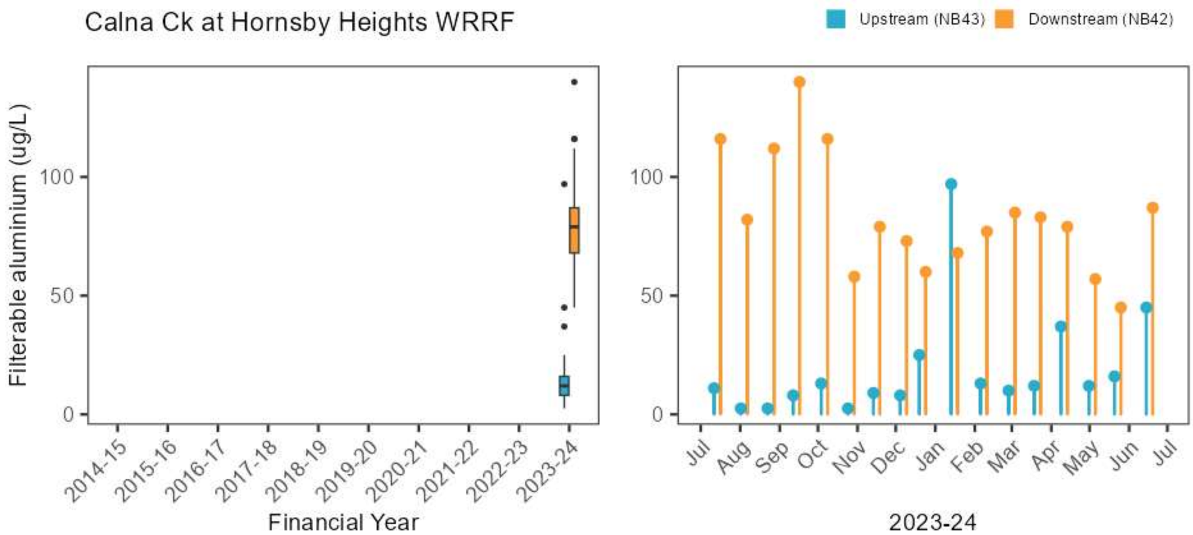

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Dissolved oxygen saturation (%sat)
ANZG Upper limit: 110 %sat
ANZG Lower limit: 80 %sat
Financial Year
2023-24

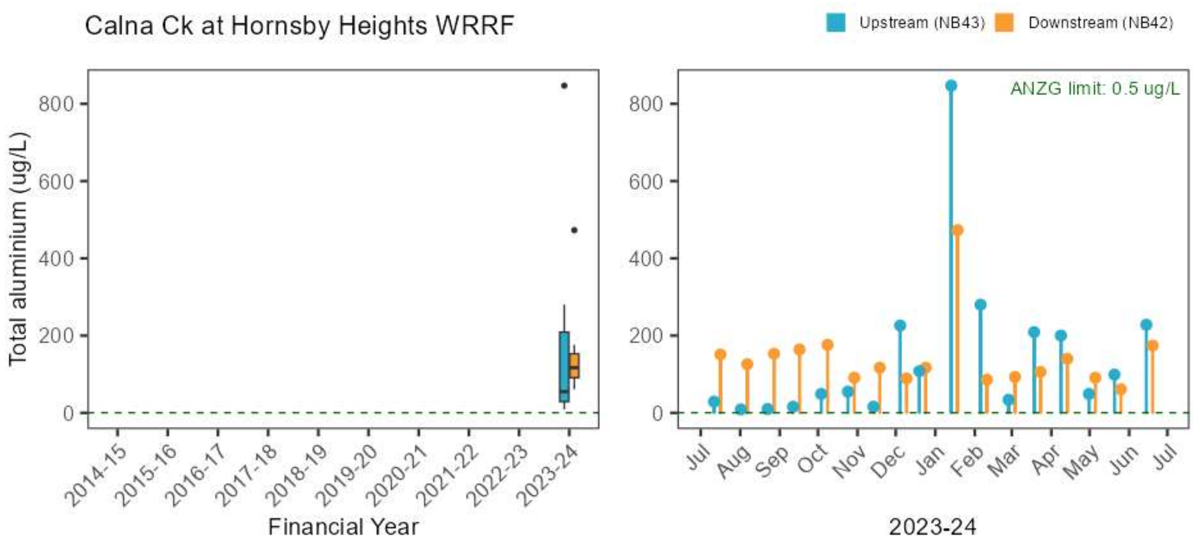

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
pH (pH Units)
ANZG Upper limit: 8.5 pH Units
ANZG Lower limit: 7 pH Units
Financial Year
2023-24

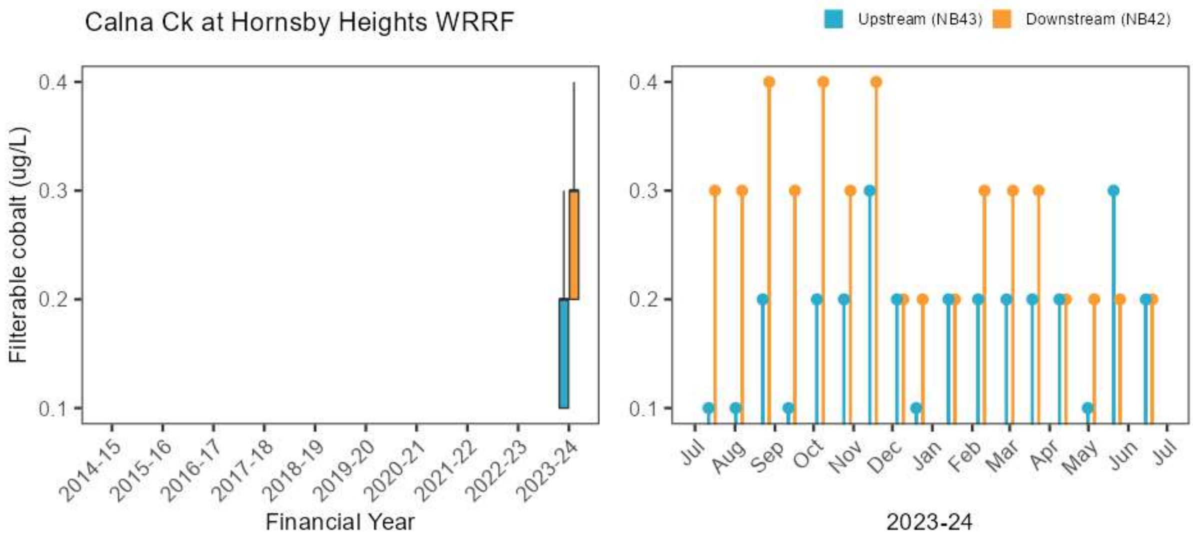


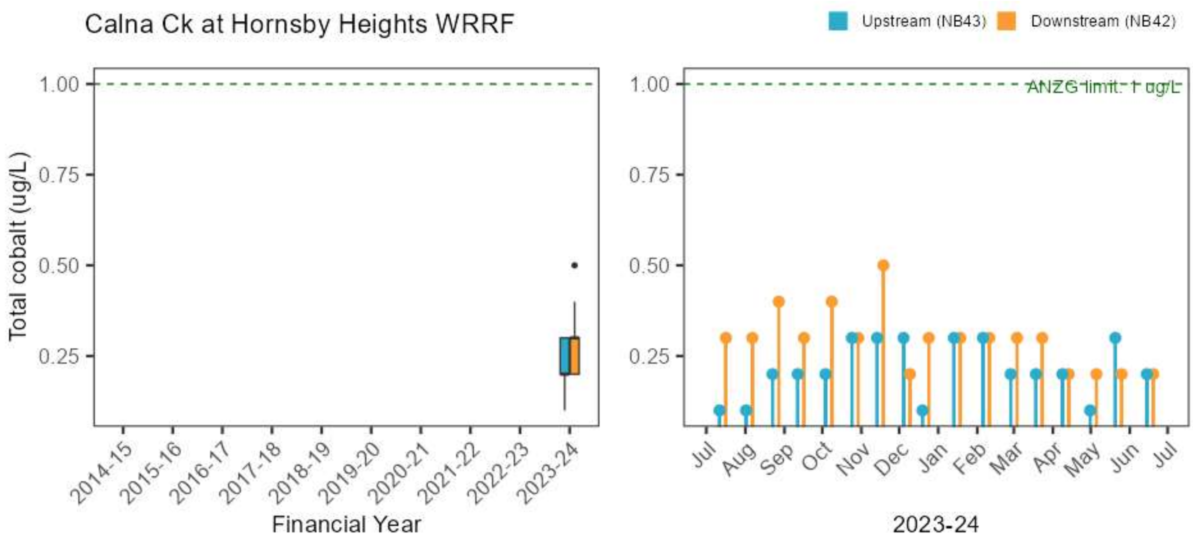


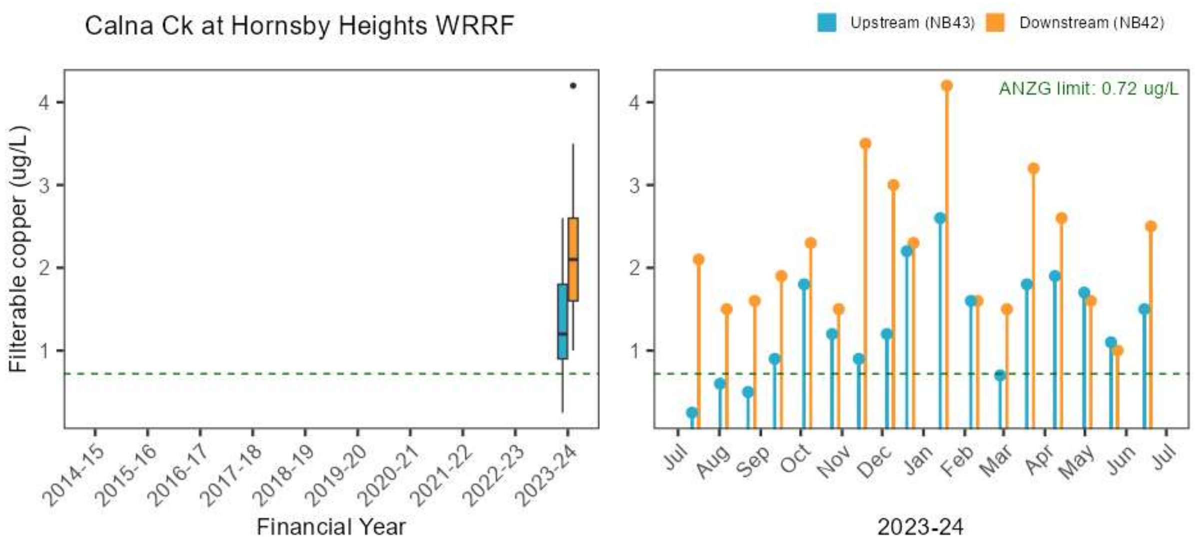
A.14.8. Stressor – Trace metals

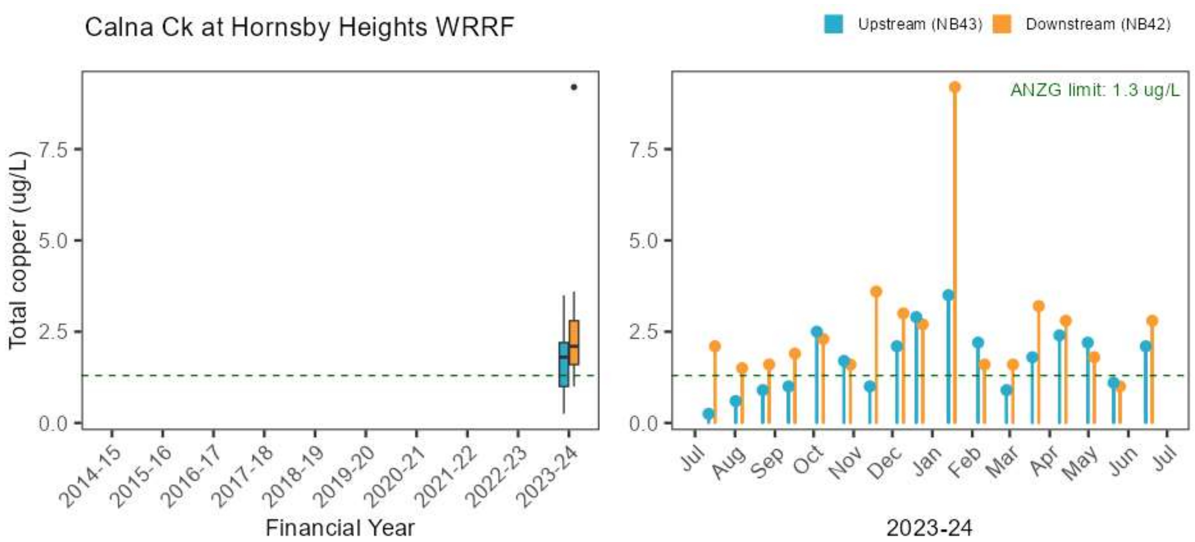


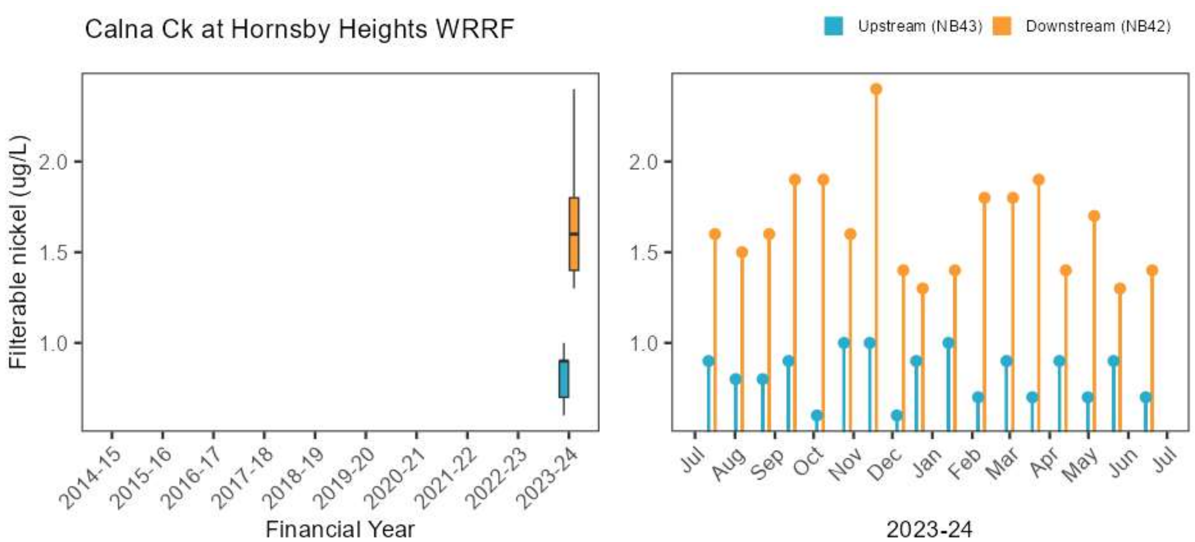

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Total aluminium (ug/L)
ANZG limit: 0.5 ug/L
0
200
400
600
800
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

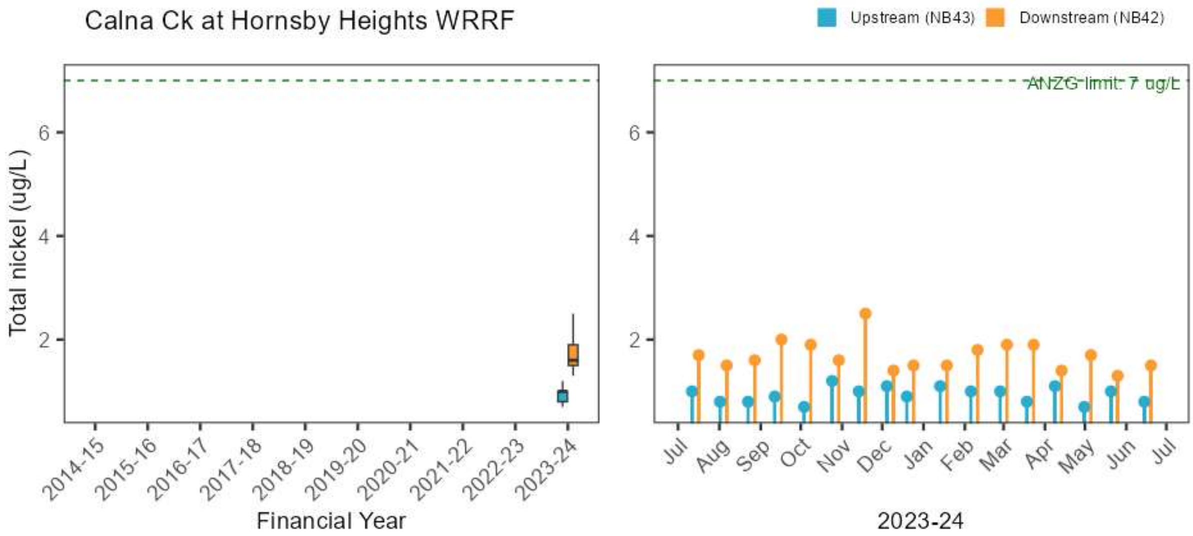

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Filterable cobalt (ug/L)
0.1
0.2
0.3
0.4
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

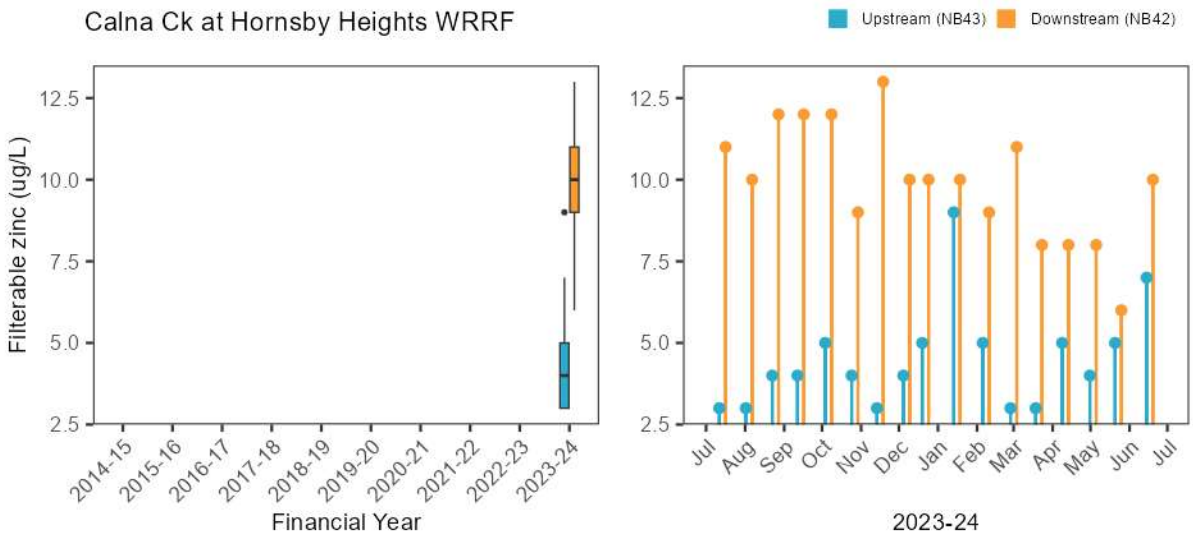

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Total cobalt (ug/L)
ANZG limit: 1 ug/L
0.25
0.50
0.75
1.00
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

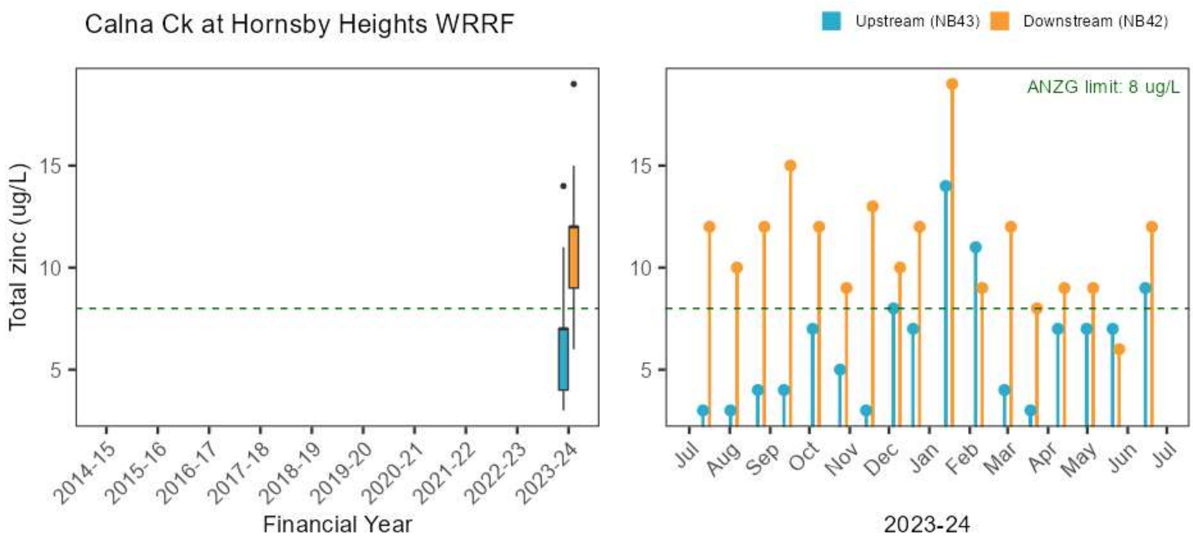

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
ANZG limit: 0.72 ug/L
Filterable copper (ug/L)
Financial Year
2023-24


Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
ANZG limit: 1.3 ug/L
Total copper (ug/L)
Financial Year
2023-24

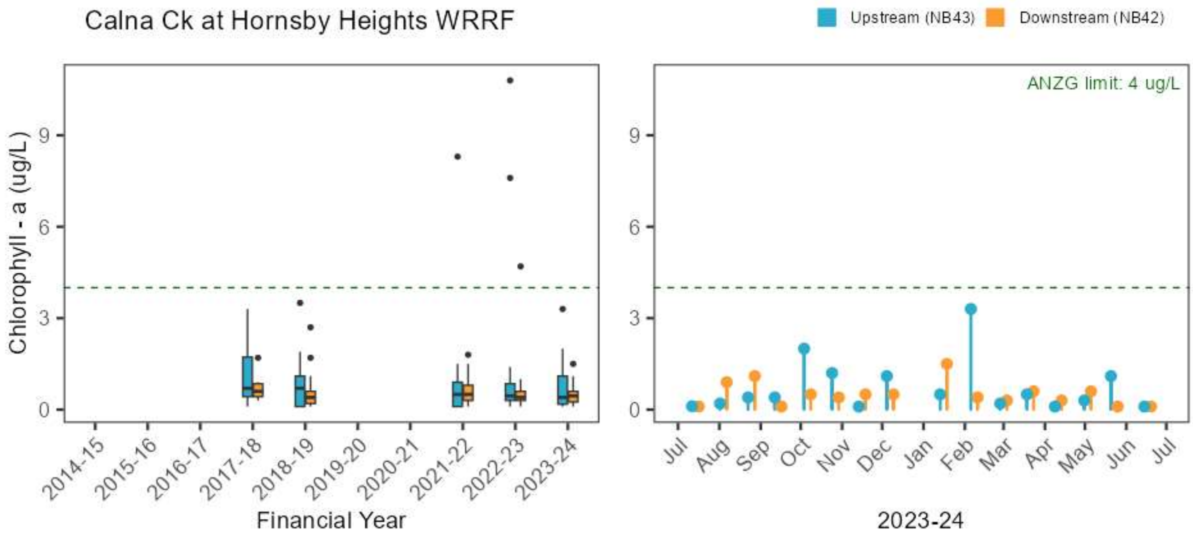

Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Filterable nickel (ug/L)
Financial Year
2023-24


Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Total nickel (ug/L)
ANZG limit: 7 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Filterable zinc (ug/L)
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24


Calna Ck at Hornsby Heights WRRF
Upstream (NB43)
Downstream (NB42)
Total zinc (ug/L)
ANZG limit: 8 ug/L
Financial Year
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
2023-24

A.14.9. Ecosystem receptor – Phytoplankton



A.14.10. Ecosystem receptor – Macroinvertebrates

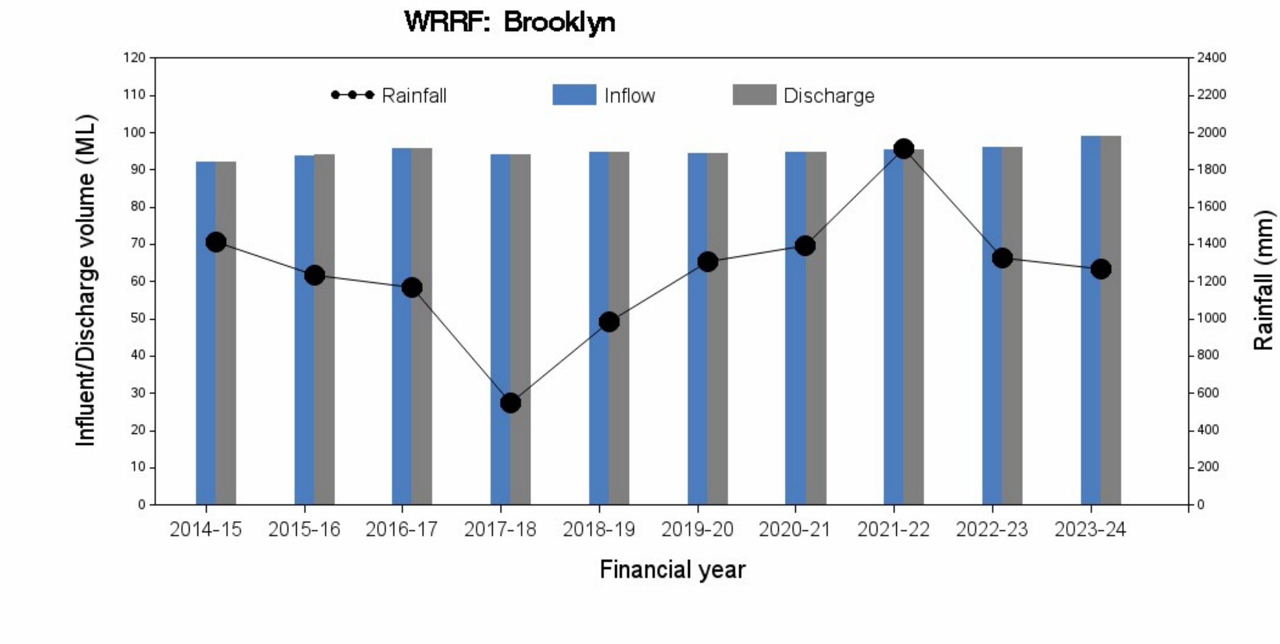
Waterway	Paired comparison (upstream vs downstream)	Method	Estimate	Statistic	DF	P value
Calna Creek	River (NB43 vs NB42)	Welch Two Sample t-test	1.28	5.82	7.8	<0.001

	p <0.05 and >=0.01		p <0.01 and >=0.001		p <0.001

A.15. Brooklyn WRRF

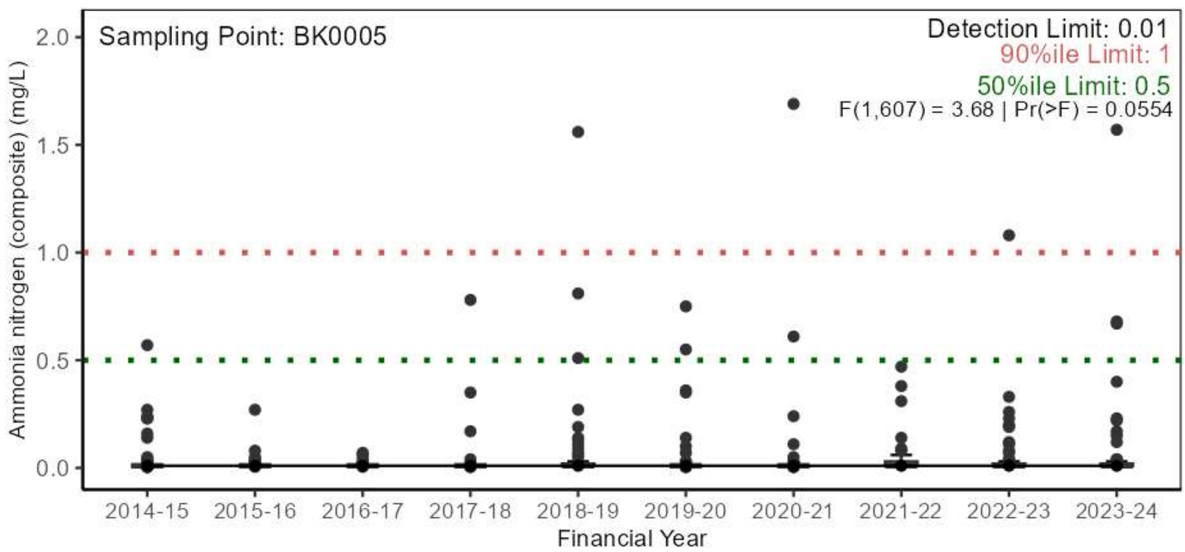
A.15.1. Pressure – Wastewater quantity

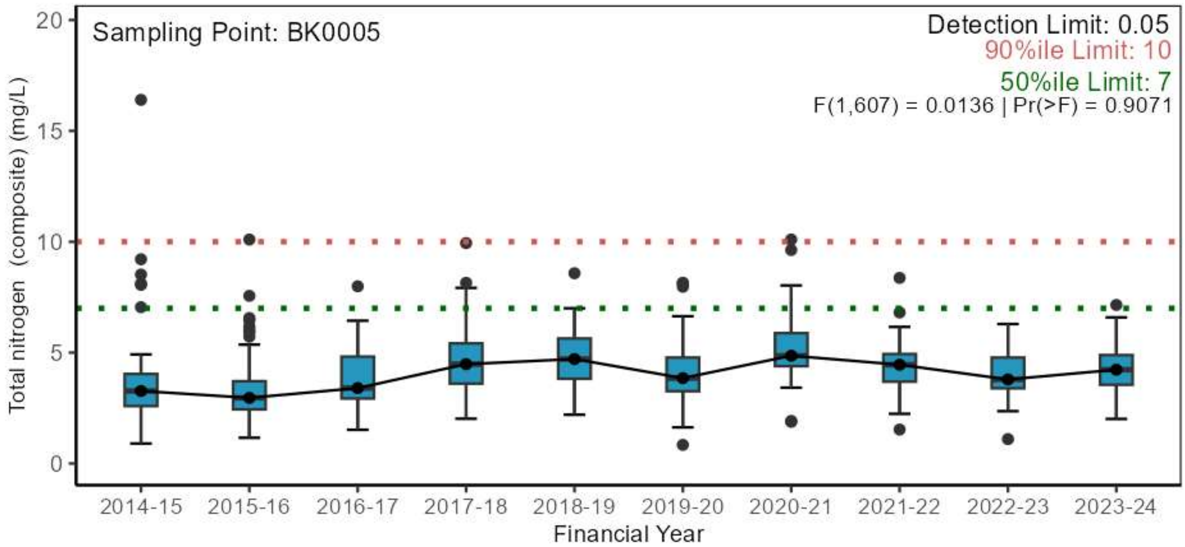
Inflow/discharge volume and rainfall

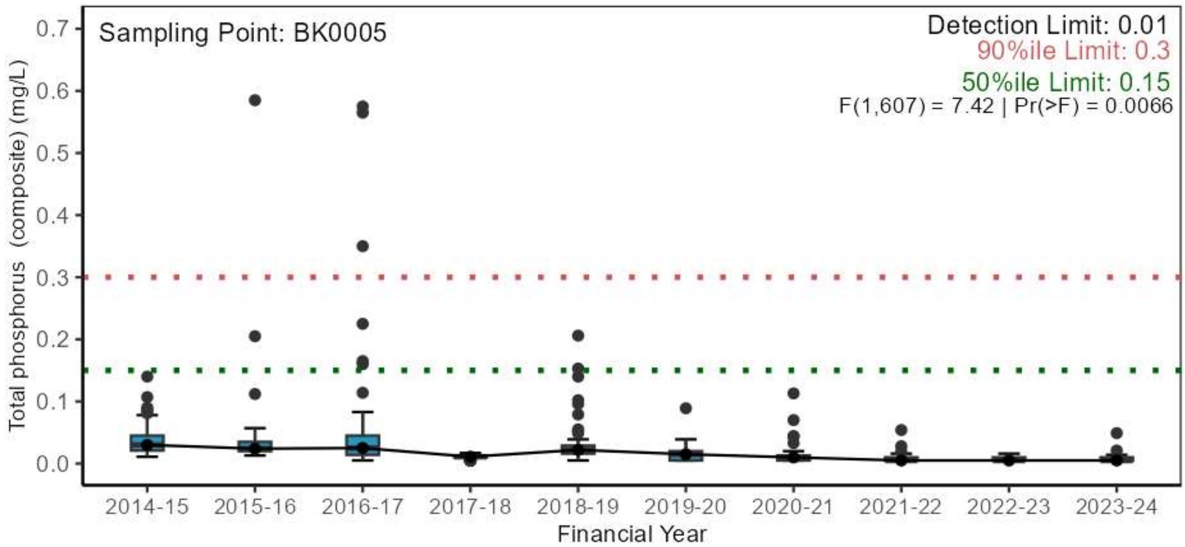


A.15.2. Pressure – Wastewater quality

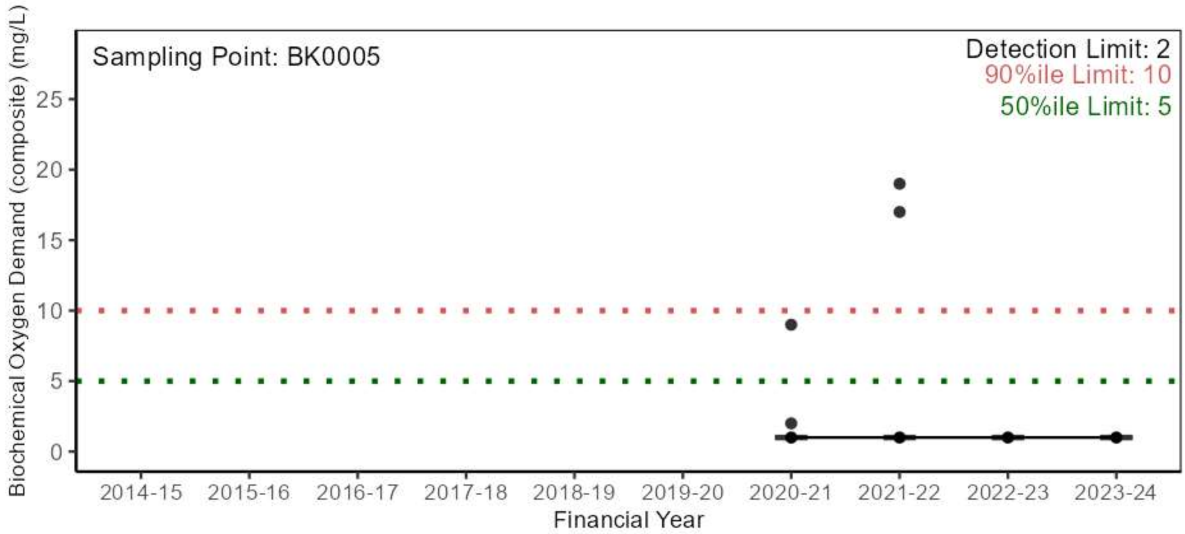
Nutrients



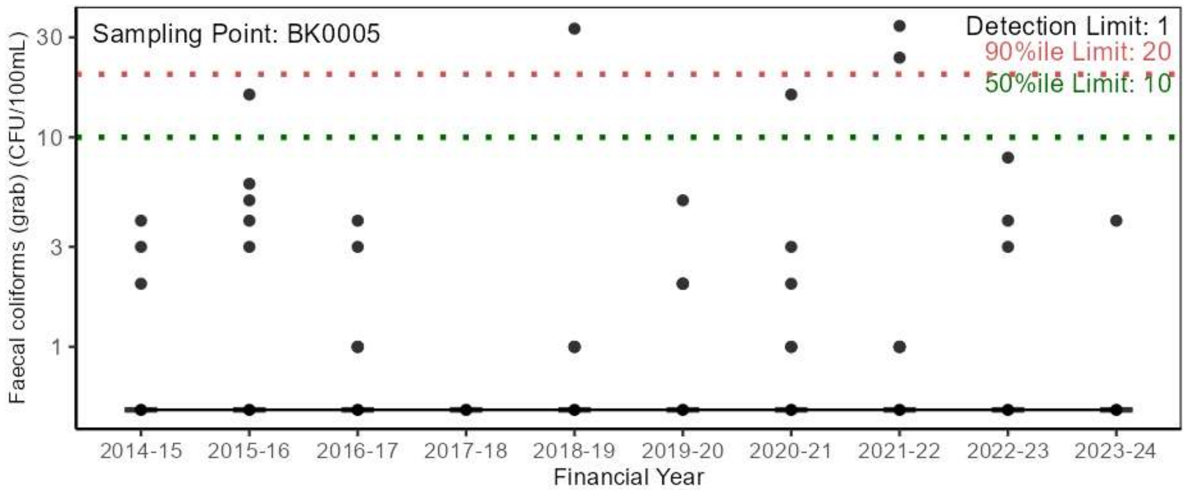

Sampling Point: BK0005
Detection Limit: 0.05
90%ile Limit: 10
50%ile Limit: 7
F(1,607) = 0.0136 | Pr(>F) = 0.9071
Total nitrogen (composite) (mg/L)
20
15
10
5
0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year


Sampling Point: BK0005
Detection Limit: 0.01
90%ile Limit: 0.3
50%ile Limit: 0.15
F(1,607) = 7.42 | Pr(>F) = 0.0066
Total phosphorus (composite) (mg/L)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21
2021-22
2022-23
2023-24
Financial Year

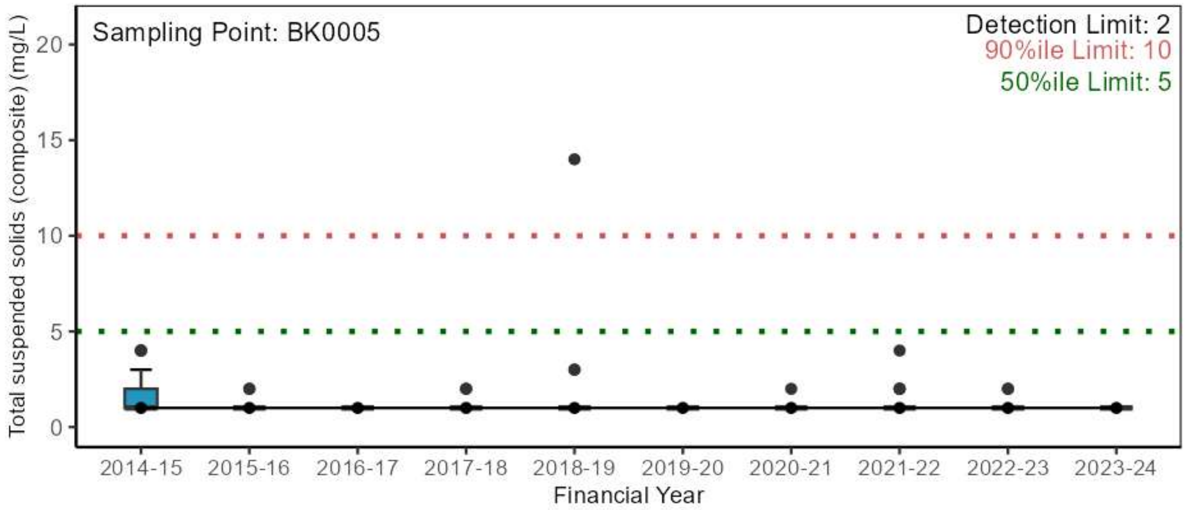
Major conventional analytes



Statistical test not conducted as >90% of results were below detection limits.

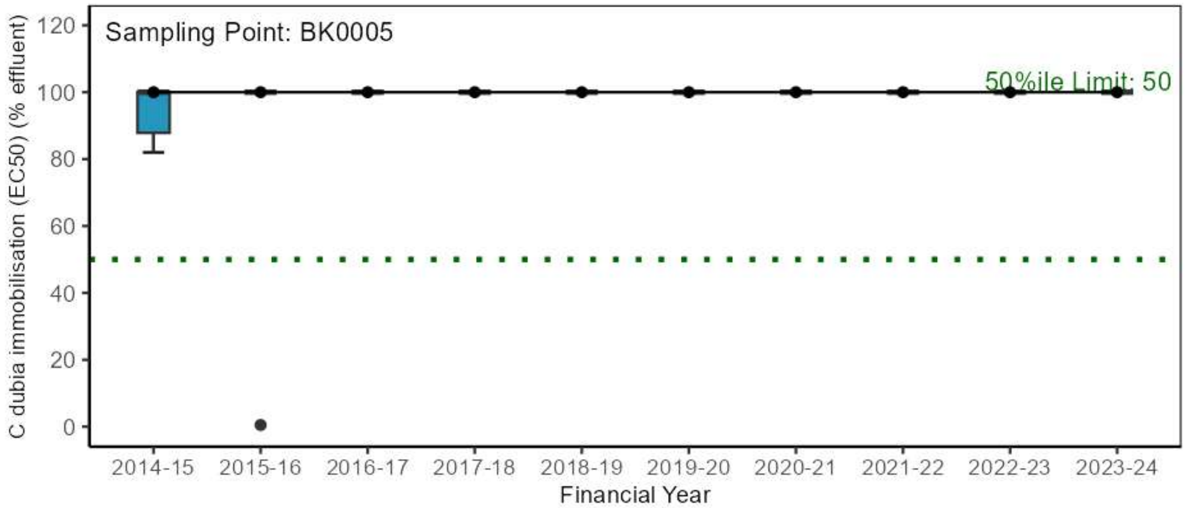


Statistical test not conducted as >90% of results were below detection limits.
Data has been log10 transformed and y-axis backtransformed for ease of interpretation.



Statistical test not conducted as >90% of results were below detection limits.

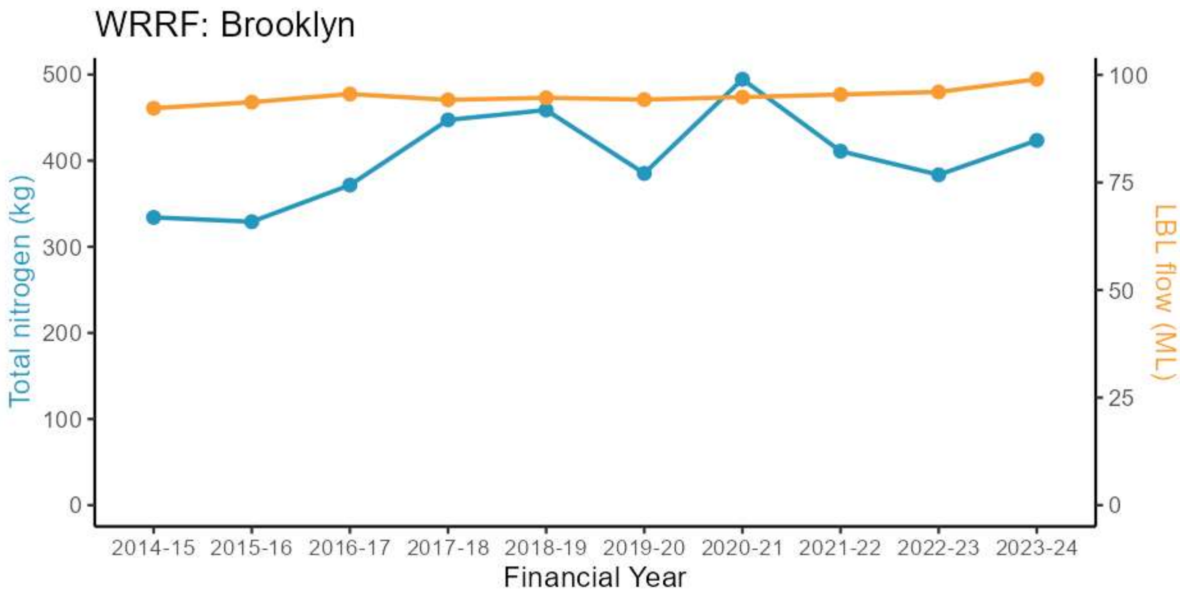
A.15.3. Pressure – Wastewater toxicity

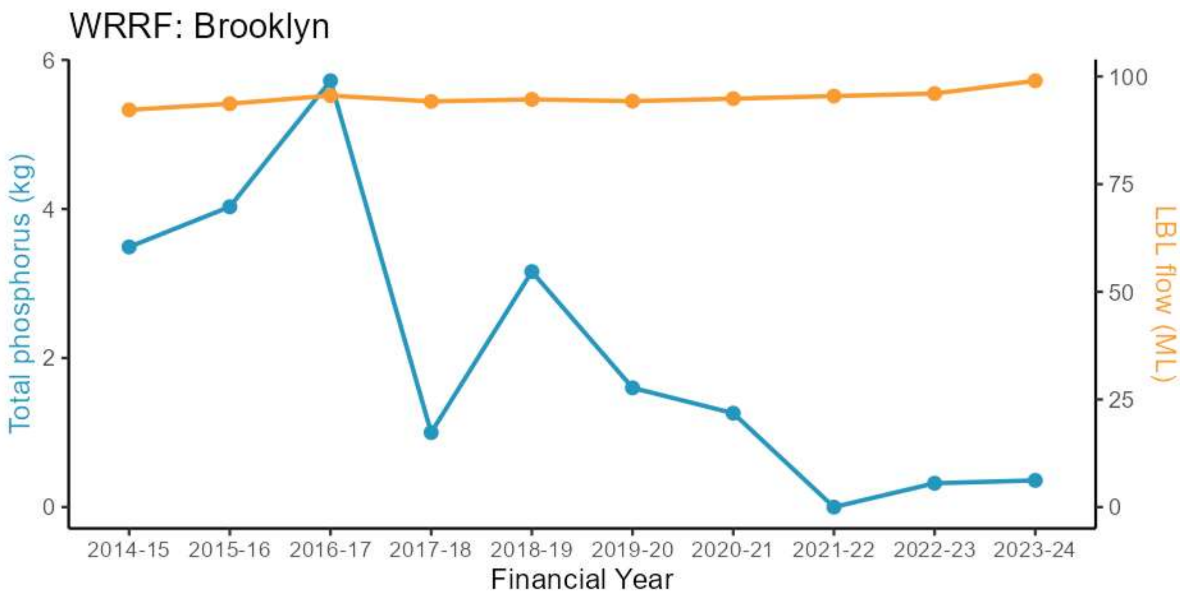


Statistical test not conducted as >90% of results were recorded at 100% survival for C.dubia

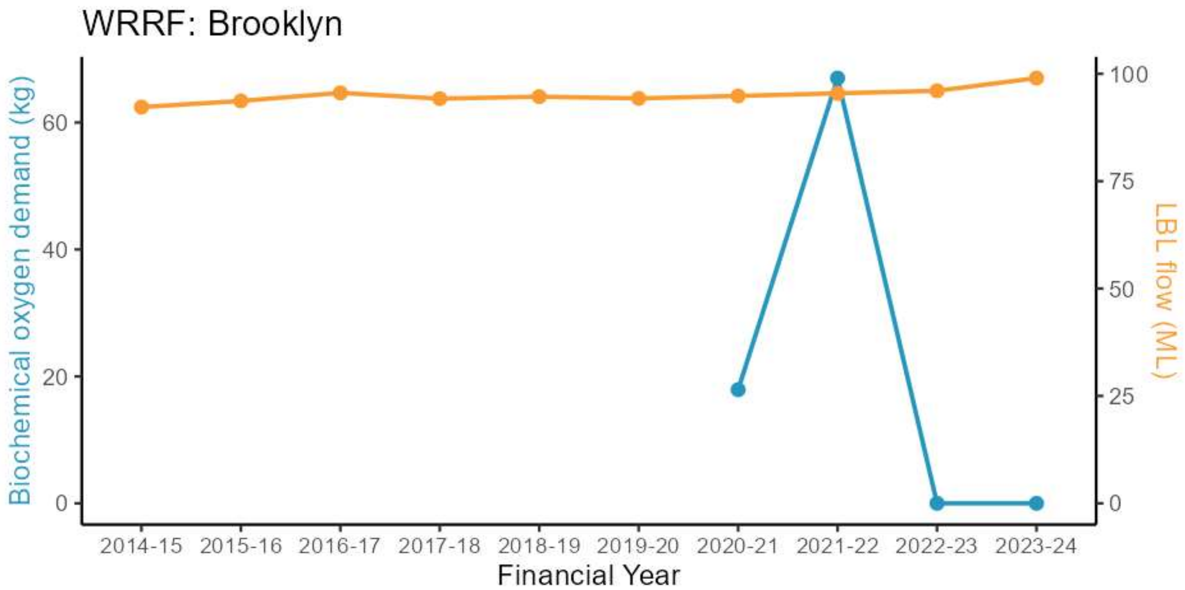
A.15.4. Pressure – Wastewater discharge load

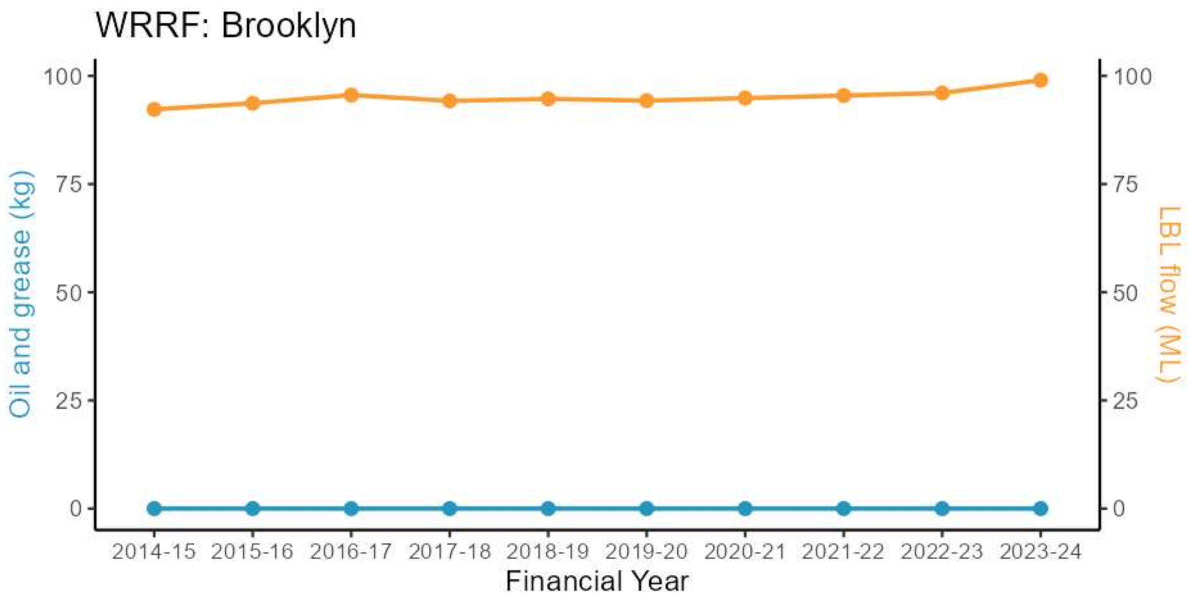
Nutrients

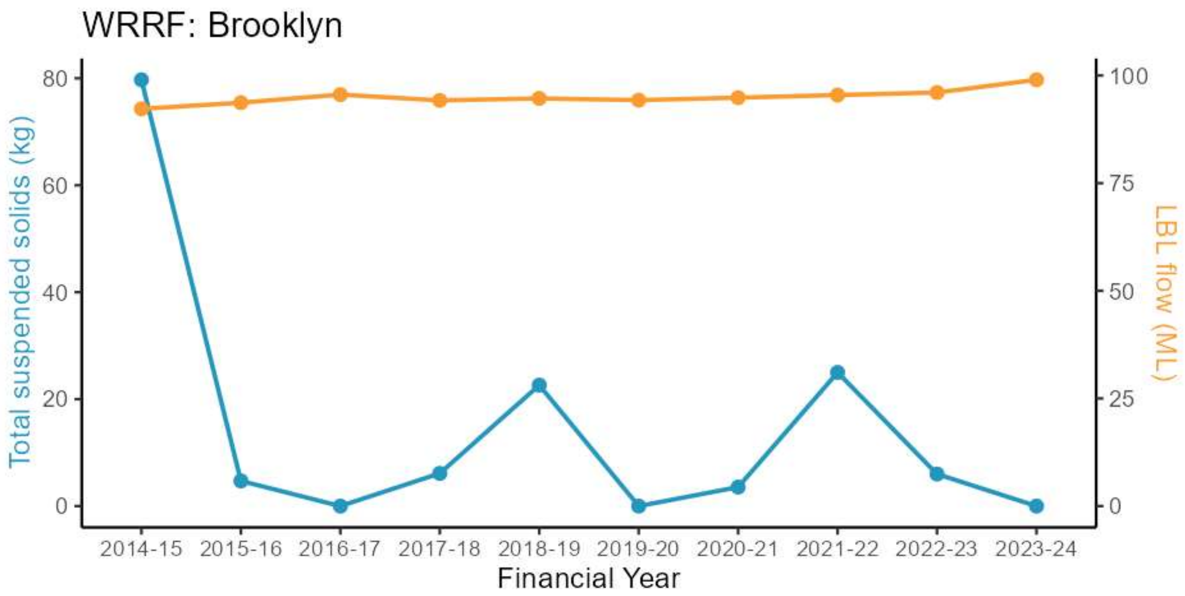




Major conventional analytes







A.15.5. Stressor – Nutrients

No previous monitoring data, Brooklyn outfalls are not recommended for regular monitoring in the revised STSIMP given treatment level, receiving environment, mixing and dilution, but this decision should be regularly reviewed.

A.15.6. Stressor – Physico-chemical water quality

No previous monitoring data, Brooklyn outfalls are not recommended for regular monitoring in the revised STSIMP given treatment level, receiving environment, mixing and dilution, but this decision should be regularly reviewed.

A.15.7. Stressor – Trace metals

No previous monitoring data, Brooklyn outfalls are not recommended for regular monitoring in the revised STSIMP given treatment level, receiving environment, mixing and dilution, but this decision should be regularly reviewed.

A.15.8. Ecosystem receptor – Phytoplankton

No previous monitoring data, Brooklyn outfalls are not recommended for regular monitoring in the revised STSIMP given treatment level, receiving environment, mixing and dilution, but this decision should be regularly reviewed.

A.15.9. Ecosystem receptor – Macroinvertebrates

Brooklyn WRRF lies in the Hawkesbury estuary, where freshwater macroinvertebrate monitoring is not suitable due to tidal conditions, depth and fast flows (refer to van Dam et al. 2023 for further information).

A.16. EPL limits of the Hawkesbury-Nepean River WRRFs

A.16.1. EPL concentration limits for the Hawkesbury-Nepean River WRRFs (2023-24)

WRRF	Sampling Points	Nitrogen (Ammonia) (mg/L)		Total Nitrogen (mg/L)			Total Phosphorus (mg/L)			Biochemical Oxygen Demand (mg/L)		Chlorine (Total Residual) (mg/L)	Faecal Coliform (cfu/100mL)			pH (pH units)	Total Suspended Solids (mg/L)		Ceriodaphnia dubia (% effluent)
		50th %-ile	90th %-ile	50th %-ile	90th %-ile	100th %-ile	50th %-ile	90th %-ile	100th %-ile	50th %-ile	90th %-ile	90th %-ile	50th %-ile	80th %-ile	90th %-ile	50th %-ile	50th %-ile	90th %-ile	50th %-ile
Picton	PI0001 (G)	0.5	1	4.5	7		0.15	0.3		2	5			200			5	10	
	PI0011 (G)	2	5	10	15		8	9		10	15		2000		10000	6.5 to 9.5	120	480	
	PI0013 (G)	0.5	1	6	10		0.2	0.4		7	10			200		6.5 to 9.5	7	15	
West Camden	WC0005 (C), (G)	1[a]	3.5[a]	10	15		0.3	1		10	15	0.1		200			10	15	50
Wallacia	WL0004 (C), (G)	0.5	1	7.5	10		0.15	0.3		5	10			200			5	10	50
Penrith	PR0005 (C), (G)	1[b]	5[b]	10	15		0.2	0.4		10	15			200			5	10	
	PR0021 (G)											0.1							
	PR0022 (G)																		50
Winmalee	WM0004 (C), (G)	0.9[c]	5	6[c]	12[c]		1.5[c]	3		10	15	0.1		200			5[c]	15	50
North Richmond	NR0004 (C), NR0005 (G)	0.9	1.4	10	15		2	5		10	15			200			5	10	50
Richmond	RM0016 (G)	0.9	1.4	10	15		0.3	1		10	15	0.1		200			5	10	50
	RM0017 (C), (G)	1	5	10	15		0.3	1		10	15	5	10				10	15	
St Marys	SM0005 (C), (G)	0.9	1.4			45			5	10	15	0.1		200			5	10	50
Quakers Hill	QH0004 (C), QH0005 (G)	0.9	1.4			45			5	10	15	0.1		200			5	10	50
Riverstone	RS0003 (C), RS0004 (G)	0.9	1.4			45			5	10	15	0.1		200			5	10	50
Castle Hill	CH0005 (C), CH0006 (G)	0.9	1.4	20	25		0.3	1		7	10			200			5	10	50
Rouse Hill	RH0004 (C), (G)	0.9	1.4	10	15		0.2	0.4		4	5	0.1		200			5	8	50
Hornsby Heights	HH0005 (C), (G)	0.9	1.4	10	15		0.3	1		10	15			200			5	10	50
West Hornsby	WH0005 (C), (G)	0.9	1.4	10	15		0.3	1		10	15			200			5	10	50
Brooklyn	BK0005 (C), (G)	0.5	1	7	10		0.15	0.3		5	10		10		20		5	10	50

WRRF	Sampling Points	Aluminium		Cadmium		Chromium		Copper		Iron		Nickel		Zinc		Diazinon		Un-ionised H_2S		Nonylphenol ethoxylates	
		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)		(µg/L)	
		90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average	90th %-ile	Average
Picton	PI0001 (G)																				
	PI0011 (G)																				
	PI0013 (G)																				
amden	WC0005 (C), (G)	500	130					5	4	240	170			37	31	0.1	0.2	60	30		
lacia	WL0004 (C), (G)	85	81					31	18					26	20			60	30	580	64
Penrith	PR0005 (C), (G)	270	200	0.2	0.2			9	8	350	330			180	60			60	30		
	PR0021 (G)																				
	PR0022 (G)																				
nalee	WM0004 (C), (G)	270	190					9	7	880	650			33	25	0.1	0.2				
North Richmond	NR0004 (C), NR0005 (G)	873	500					7	5	180	95			57	44	0.1	0.2	60	30		
Richmond	RM0016 (G)																				
	RM0017 (C), (G)																				
larys	SM0005 (C), (G)	200	120					8	6	96	156	16.9	12.3	46	37	0.1	0.2	60	30		
ers Hill	QH0004 (C), QH0005 (G)	190	120	0.3	0.2	4	3	6	5					41	34			60	30		
stone	RS0003 (C), RS0004 (G)	240	133					6	5	96	55			56	31			60	30		
le Hill	CH0005 (C), CH0006 (G)	400	160	0.2	0.2			11	8	1100	360			37	29	0.1	0.2	60	30		
se Hill	RH0004 (C), (G)	340	220					7	5	52	37			39	33						
Hornsby Heights	HH0005 (C), (G)	1100	420					12	8	1900	520			42	19	0.1	0.2	60	30		
Iornsby	WH0005 (C), (G)	620	330					17	8	1500	490			40	26			60	30		
oklyn	BK0005 (C), (G)																				

Note: Sample collection method (C) = Composite, (G) = Grab

a Values shown are West Camden WRRF's temporary ammonia nitrogen limits effective from 1 April 2022. Prior to this date the ammonia nitrogen 50th and 90th percentile limits were 0.9 and 1.4, respectively.

b Values shown are Penrith WRRF's temporary ammonia nitrogen limits effective from 19 May 2023. Prior to this date the ammonia nitrogen 50th and 90th percentile limits were 0.9 and 1.4, respectively.

c Values shown are Winmalee WRRF's interim limits during facility upgrades effective from 1st January 2024. Prior to this date: temporary ammonia nitrogen 50th limit was 2.0 mg/L, total nitrogen 50th and 90th limits were 15 and 20 mg/L respectively, total phosphorus 50th limit was 2.0 mg/L and total suspended solids 50th limit was 10 mg/L.

A.16.2. EPL load limits for the Hawkesbury-Nepean River WRRFs (2023-24)

Load limits (kg) 2023-24	Picton	West Camden	Wallacia	Penrith	Winmalee	North Richmond	Richmond	St Marys	Quakers Hill	Riverstone	Castle Hill	Rouse Hill	Hornsby Heights	West Hornsby	Brooklyn
Total Suspended Solids	2,400	39,420	8,760	144,540	67,160	10,585	37,595	195,275	96,360	20,075	42,705	100,375	42,705	86,140	
Biological Oxygen Demand	2,400	37,230	8,395	136,510	67,160	7,300	26,280	184,325	96,360	18,980	39,420	94,900	39,420	79,570	
Total Nitrogen	4,400	91,980	12,410	176,660	110,595	7,118	43,800	222,000	222,000	222,000	72,270	124,100	72,270	80,300	
Total Phosphorus	80	2,190	1,606	8,030	6,687	803	10,877	2,300	2,300	2,300	2,300	4,453	2,300	4,643	
Oil & Grease	292	12,045	1,132	44,165	28,762	3,650	6,388	59,495	40,150	6,169	11,498	30,843	11,498	23,287	
Cadmium				5.03				0.76	2.21						
Chromium				6.58				18.42	96.36						
Copper				154.8				559.36	349.14						
Lead				48.18				31.58	48.18						
Mercury				0.44				0.43	4.82						
Selenium				240.9				339.45	240.9						
Zinc				2,312.83				1,893.32	1,953.97						
Pesticides				7				6.88	7.5						