



CTENVIRONMENTAL

ECOSYSTEM MANAGEMENT AND MONITORING



December 2024 Biannual Aquatic Ecosystem Monitoring Report

Liverpool City Council

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Report Structure

This report presents the December Aquatic Ecosystem Monitoring Monthly Progress Report (Part 1) which is accompanied by the biannual report for July to December 2024 (Part 2).

Part 1: Aquatic Ecosystem Monitoring Monthly Progress Report - December 2024

December 2024 aquatic ecosystem monitoring of the Georges River and South Creek catchments was undertaken on 5 and 6 December 2024.

This report provides a summary of recreational water quality indicators (cyanobacteria, *Enterococci* and thermotolerant coliforms) at Georges River recreation monitoring sites and observations from freshwater monitoring sites.

Badgerys Creek AWS NSW weather monitoring station is expected to be representative of weather conditions in the Kemps Creek catchment and Holsworthy Aerodrome NSW station is expected to be representative of conditions in the locale of the Georges River monitoring sites.

Weather conditions for the week prior to sampling was hot with occasional showers. Rainfall was recorded at both Badgerys Creek AWS (Table 1) and Holsworthy Aerodrome (Table 2), with 19.2 mm and 36 mm recorded respectively.

Table 1. Weather observations for Badgerys Creek AWS NSW (BOM 2024) in the week prior to sampling

DATE	TEMPERATURE MIN (°C)	TEMPERATURE MAX (°C)	RAINFALL (MM)
30/11/2024	15.5	29.1	4.0
01/12/2024	19.9	29.7	11.0
02/12/2024	16.6	36.2	2.2
03/12/2024	18.6	32.0	0
04/12/2024	20.2	28.4	2.0
05/12/2024	19.6	30.2	0
06/12/2024	20.8	35.4	0

Table 2. Weather observations for Holsworthy Aerodrome NSW (BOM 2024) in the week prior to sampling

DATE	TEMPERATURE MIN (°C)	TEMPERATURE MAX (°C)	RAINFALL (MM)
30/11/2024	14.2	28.2	16.4
01/12/2024	19.5	30.7	8.6
02/12/2024	15.9	35.6	10.8
03/12/2024	19.2	33.0	0.2
04/12/2024	20.4	26.8	0
05/12/2024	19.6	28.6	0
06/12/2024	20.8	31.8	0

Cyanobacteria (blue-green algae) monitoring at recreation sites in the Georges River was undertaken on 6 December 2024, during high tide.

Results show that potentially toxic cyanobacteria were detected at GR1 and GR3 during the December sampling event (Table 3).

Results show that GR1 recorded five species of cyanophytes—*Aphanocapsa* spp. (100 cells/mL), *Cyanogranis libera* (125 cells/mL), *Cyanonephron* spp. (400 cells/mL), *Microcystis cf. aeruginosa* (PTP) (1400 cells/mL), and *Pseudanabaena* spp. (225 cells/mL). Due to the low biovolume of this species, including the PTP, a 'Green Level Surveillance Mode' was triggered.

GR1.5 recorded four species of cyanophytes—*Anagnostidinema* spp. (750 cells/mL), *Aphanocapsa* spp. (1400 cells/mL), *Cyanonephron* spp. (200 cells/mL), and *Pseudanabaena* spp. (3580 cells/mL), resulting in a 'Green Level Surveillance Mode' being triggered.

At GR2, three species were recorded, including *Aphanocapsa* spp. (3000 cells/mL), *Cyanonephron* spp. (250 cells/mL), and *Pseudanabaena* spp. (325 cells/mL). Due to the low biovolume of this species, no NHMRC (2008) response was triggered.

Results for GR3 recorded four species of cyanophytes, one of which was a potentially toxic species. These species include *Aphanocapsa* spp. (1100 cells/mL), *Microcystis cf. aeruginosa* (PTP) (115 cells/mL), *Pseudanabaena* spp. (18800 cells/mL), and *Romeria* spp. (100 cells/mL). Due to the low biovolume of this species, including the PTP, a 'Green Level Surveillance Mode' was triggered.

GR4 had four non-toxic species recorded—Picoplanktic Cyanophytes (18800 cells/mL), *Planktothrix* spp. (1020 cells/mL), *Pseudanabaena* spp. (175 cells/mL), and *cf. Synechococcus* spp. (325 cells/mL). Due to the low biovolume of this species, including the PTP, a 'Green Level Surveillance Mode' was triggered.

At GR5, two species were recorded—Picoplanktic Cyanophytes (9830 cells/mL), and *cf. Synechococcus* spp. (100 cells/mL). Due to the low biovolume of this species, no NHMRC (2008) response was triggered.

Table 3. Results summary for recreation monitoring sites, December 2024. Less than 5 cells/mL represents a 'not detected' result

SITE	SAMPLED	POTENTIALLY TOXIC CYANOBACTERIA (CELLS/ML)	NHMRC (2008) ALERT LEVEL	SAFETY ISSUES
GR1	Yes	1400	Green (surveillance)	None
GR1.5	Yes	<5	Green (surveillance)	None
GR2	Yes	<5	None	None
GR3	Yes	115	Green (surveillance)	None
GR4	Yes	<5	Green (surveillance)	None
GR5	Yes	<5	None	None

Due to the persistence of cyanobacteria, there is potential for future blooms to occur. NHMRC (2008) recommends weekly or fortnightly monitoring when 'Green' mode is triggered (Table 4).

Table 4. Recommended monitoring actions and corresponding NHMRC Alert Levels for cyanobacteria

NHMRC ALERT LEVEL	RECOMMENDED ACTIONS
GREEN LEVEL SURVEILLANCE MODE	- Weekly sampling and cell count at representative locations in the water body where known toxigenic species are present. - Fortnightly for other types including regular visual inspection of water surface for scums.
AMBER LEVEL ALERT MODE	- Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. - Monitor weekly or fortnightly where other types are dominant. - Make regular visual inspections of water surface for scums. - Decide on requirement for toxicity assessment or toxin monitoring.
RED LEVEL ACTION MODE	- Continue monitoring as for alert mode. - Immediately notify health authorities for advice on health risk. - Make toxicity assessment or toxin measurement of water if this has not already been done. - Health authorities warn of risk to public health (ie the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).

Results of bacteria monitoring at recreation sites in December show that the ANZECC primary contact guideline for thermotolerant coliforms was exceeded at GR1, GR1.5, GR3, and GR5, while the ANZECC secondary contact guideline for was exceeded at GR4 only.

The ANZECC primary contact guideline for *Enterococci* was exceeded at GR1, GR1.5, and GR2, while the secondary contact guideline was exceeded at GR3, GR4, and GR5 (Table 5).

Table 5. Summary of conditions observed/recorded at each site during December 2024 monitoring. Orange indicates exceedance of the primary contact guideline; red indicates exceedance of the secondary contact guideline

SITE	SAMPLED	TIDE	THERMOTOLERANT COLIFORMS CFU/100 ML	ENTEROCOCCI CFU/100 ML	OBSERVATIONS
GR1	Yes	High	71	44	Clear
GR1.5	Yes	High	410	220	Clear
GR2	Yes	High	100	66	Clear
GR3	Yes	High	330	680	Clear
GR4	Yes	High	1200	550	Turbid
GR5	Yes	High	860	2200	Turbid
PRIMARY CONTACT GUIDELINES			150	35	
SECONDARY CONTACT GUIDELINES			1000	230	

Surface water samples were collected at all freshwater monitoring sites in December 2024 except for KC5, KC6 and KC11 all due to restricted access due to construction. Aquatic macroinvertebrates and benthic diatoms were not sampled in December.

Table 6. Summary of conditions observed/recorded at each site during December 2024

SITE	WATER QUALITY SAMPLED	AQUATIC MACRO- INVERTEBRATES	BENTHIC DIATOMS	FLOW	OBSERVATIONS	SAFETY ISSUES
MC1	Yes	No	No	Normal	Clear	None
AC1	Yes	No	No	Normal	Clear	None
KC1	Yes	No	No	Normal	Clear	None
KC2	Yes	No	No	Normal	Clear	None
KC3	Yes	No	No	Normal	Clear	None
KC5	No	No	No	-	-	No access due to construction

KC6	No	No	No	-	-	No access due to construction
KC8	Yes	No	No	Normal	Turbid	None
KC10	Yes	No	No	Normal	Turbid	None
KC11	No	No	No	-	-	No access due to construction
KC12	Yes	No	No	Normal	Turbid	None
SC1	Yes	No	No	Normal	Clear	None
SC2	Yes	No	No	Normal	Turbid	None
BC1	Yes	No	No	Normal	Turbid	None
WG	Yes	No	No	Normal	Clear	None
HC	Yes	No	No	Normal	Clear	None

All data has been supplied in an Excel spreadsheet separate to this report and no safety issues were recorded/observed during monitoring.

Part 2: Biannual Report – July to December 2024

Introduction

This report outlines results for the biannual report (July to December 2024) for the 2024-2025 monitoring period. This report presents results of nutrient, turbidity, bacteria, and cyanobacteria parameters which are typical indicators used to assess degradation of urban streams. Analysis of all parameters monitored by this program will be presented in the annual report.

Freshwater Monitoring Sites comprises of the South Creek catchment sites – South Creek (SC1 and SC2), Badgerys Creek (BC1), Kemps Creek (KC1, KC5, KC8, KC10, KC11, and KC12) and Kemps Creek tributaries (KC2, KC3, and KC6) – and the Georges River tributaries (AC1, MC1, HC, and WG).

Georges River Recreation Monitoring Sites comprises of the Georges River catchment sites (GR1, GR1.5, GR2, GR3, GR4, and GR5).

Rainfall

Rainfall recorded at Badgerys Creek AWS (BOM 2024) was below the mean rainfall for four months during the six-month sampling period (August, October, and November 2024). The lowest rainfall was recorded in August with 11.8 mm compared to the mean August rainfall of 36.3 mm. The highest rainfall was recorded in November with 45.2 mm (

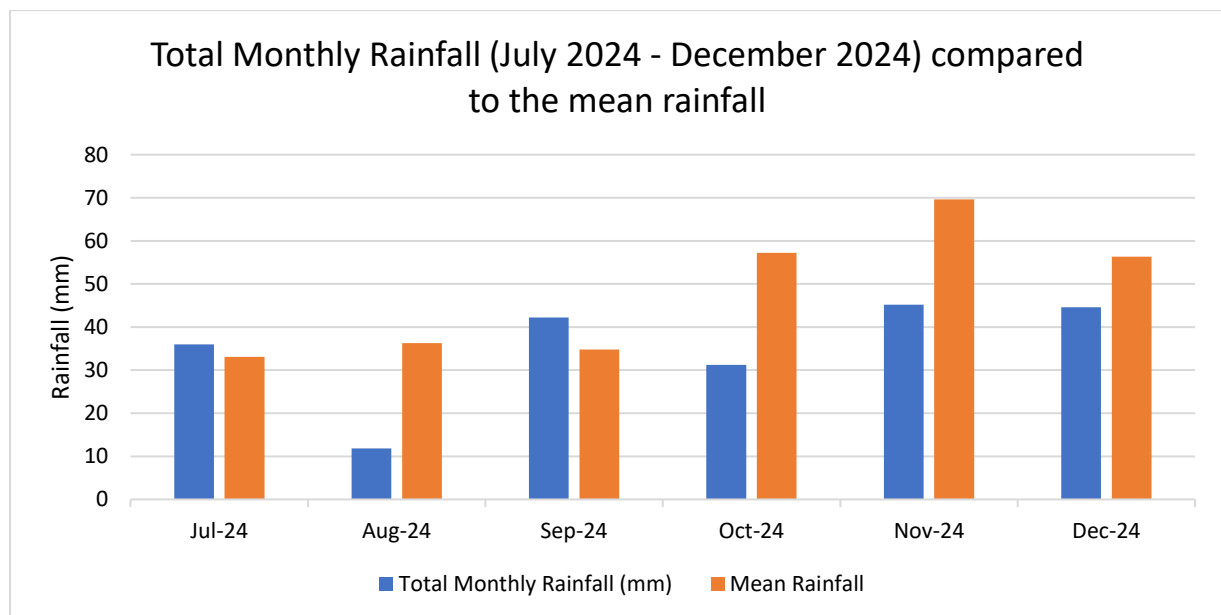


Figure 1). Aside from the August low, flow across freshwater monitoring sites was similar month to month throughout the six-month period.

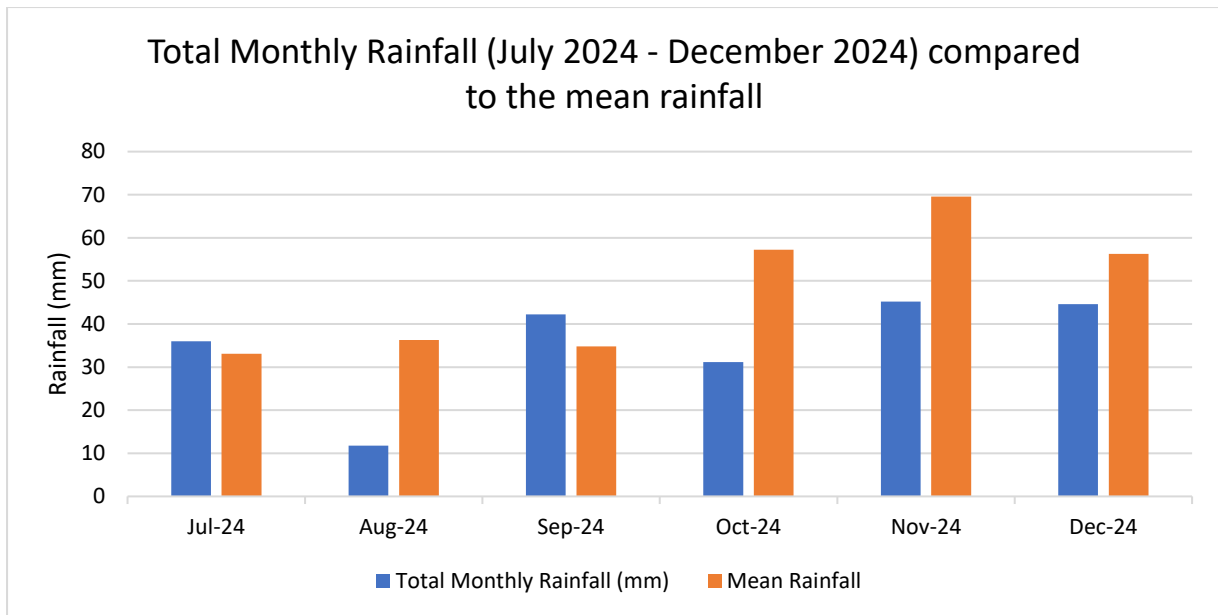


Figure 1. Rainfall recorded at Badgerys Creek AWS July to December 2024 compared to the mean rainfall

Freshwater monitoring sites

Water quality was variable across all freshwater monitoring sites and all sites recorded degraded water quality and impairment typical of urban streams. The phrase ‘urban stream syndrome’ (Walsh et al. 2005) was coined to describe these common symptoms occurring in urban streams, including degraded water quality, geomorphology, hydrology, and biodiversity. All freshwater sites frequently recorded nutrient levels (total phosphorous and total nitrogen) that exceeded either the Wianamatta-South Creek Stormwater Management Targets (WQO for South Creek), relevant to South Creek catchments sites, or the Australian and New Zealand Environment Conservation Council (ANZECC) Guidelines for Fresh and Marine Water Quality (2000), relevant to the Georges River tributaries. Other parameters, including turbidity, electrical conductivity, pH, and dissolved oxygen, were also recorded to be outside the WQO for South Creek and ANZECC water quality guidelines at most sites throughout the six-month monitoring period.

Total Nitrogen

Total nitrogen (TN) variations were consistent across the Kemps Creek sites for the July to December 2024 period (Figure 2). Results show that all sites exceed the TN WQO for South Creek (1.72 mg/L). The highest concentration, 61.7 mg/L, was recorded at KC1 in November 2024, followed by a peak at KC5 of 36.4 mg/L in the same month when rainfall was at its highest. There was a spatial trend where sites in the upper catchment (KC1, KC5 and KC8) had increased TN concentrations than the sites further downstream (KC10 and KC12).

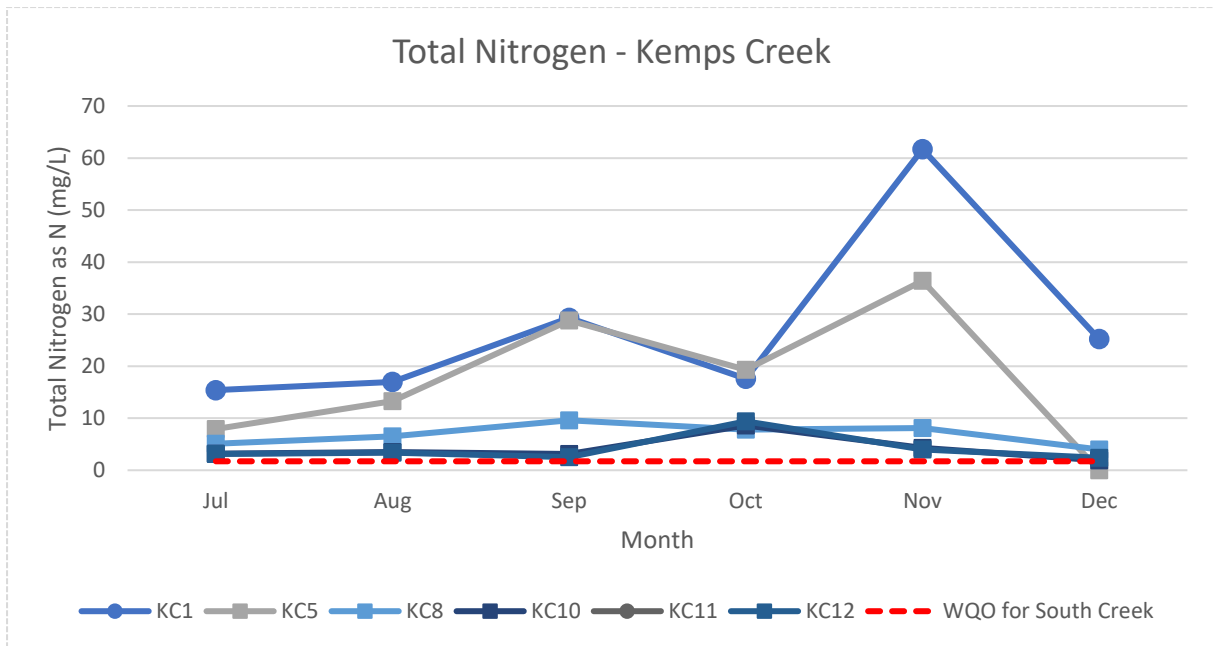


Figure 2. Total Nitrogen concentration at Kemps Creek monitoring sites (KC1, KC5, KC8, KC10, KC11 and KC12) July to December 2024

Total nitrogen was variable across Kemps Creek tributary sites (Figure 3). All sites exceeded the TN WQO for South Creek of 1.72 mg/L in July, with only KC2 remaining within the TN objective for the remaining six months. The highest concentration of TN was recorded at KC3 at 6 mg/L in September. A spike in TN also occurred at KC6 in October with a value of 5.8 mg/L.

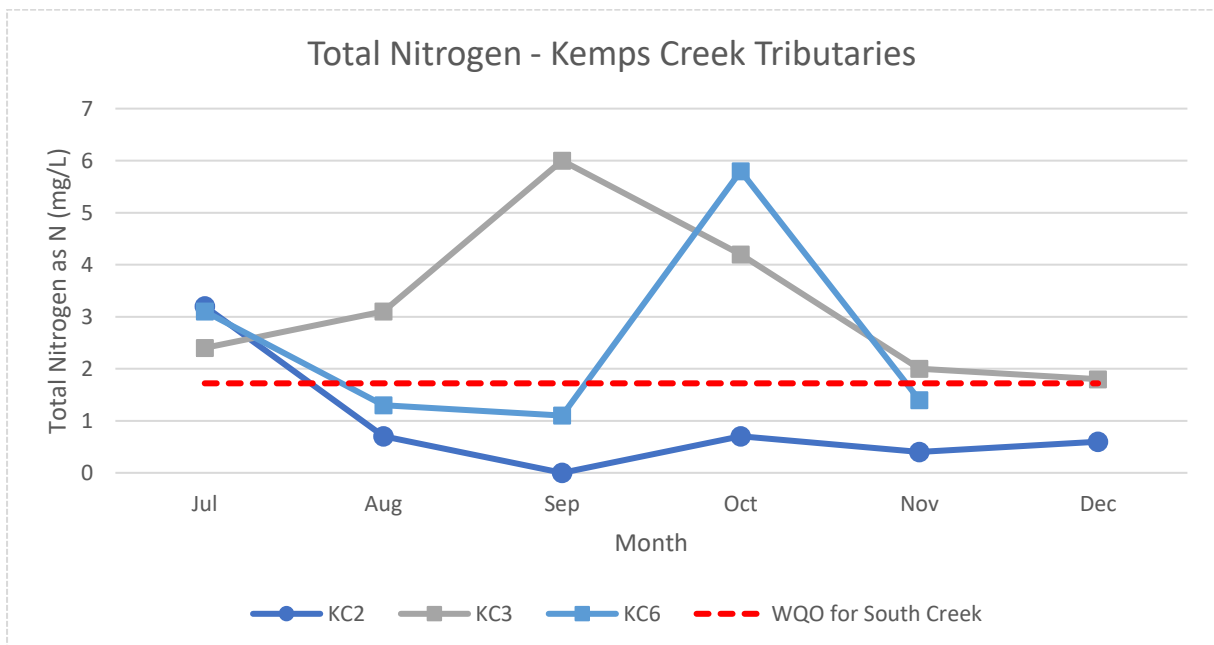


Figure 3. Total Nitrogen concentration at Kemps Creek tributary monitoring sites (KC2, KC3 and KC6) July to December 2024

Total nitrogen levels in sites along South Creek and Badgerys Creek were variable and did not comply with the WQO for South Creek of 1.72 mg/L at all sites on two occasions during the monitoring period (Figure 4). Total nitrogen concentration was highest at SC1 in August reaching 6 mg/L, followed by a

5.6 mg/L in November. Badgerys Creek sampling has the lowest TN across the six-month period, with a high of 1.9 mg/L in July, indicating only a marginal exceedance of the TN WQO for South Creek of 1.72 mg/L.

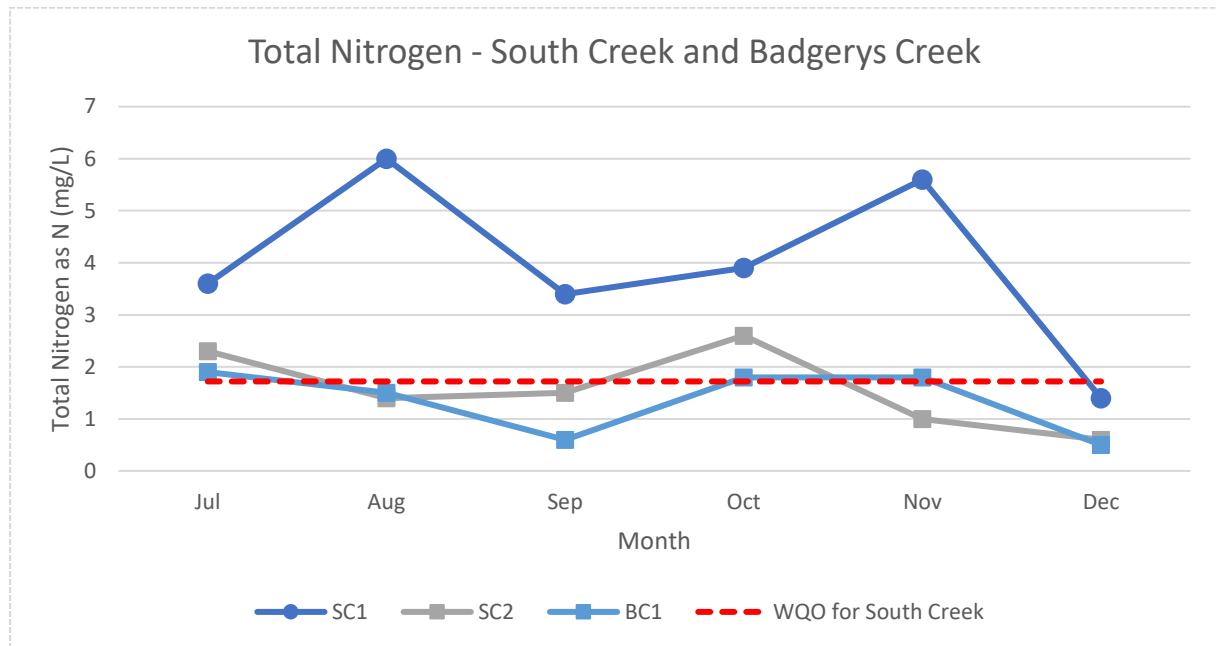


Figure 4. Total Nitrogen concentration at South Creek and Badgerys Creek monitoring sites (SC1, SC2 and BC1) July to December 2024

Apart from HC, TN within all sites of Georges River tributaries varied and exceeded the ANZECC lowland river guideline for southeast Australia of 0.35 mg/L (Figure 5). The highest reading of TN was recorded at the spike at MC1 in August at 1.7 mg/L showing a significant decline than the previously highest recorded TN in March.

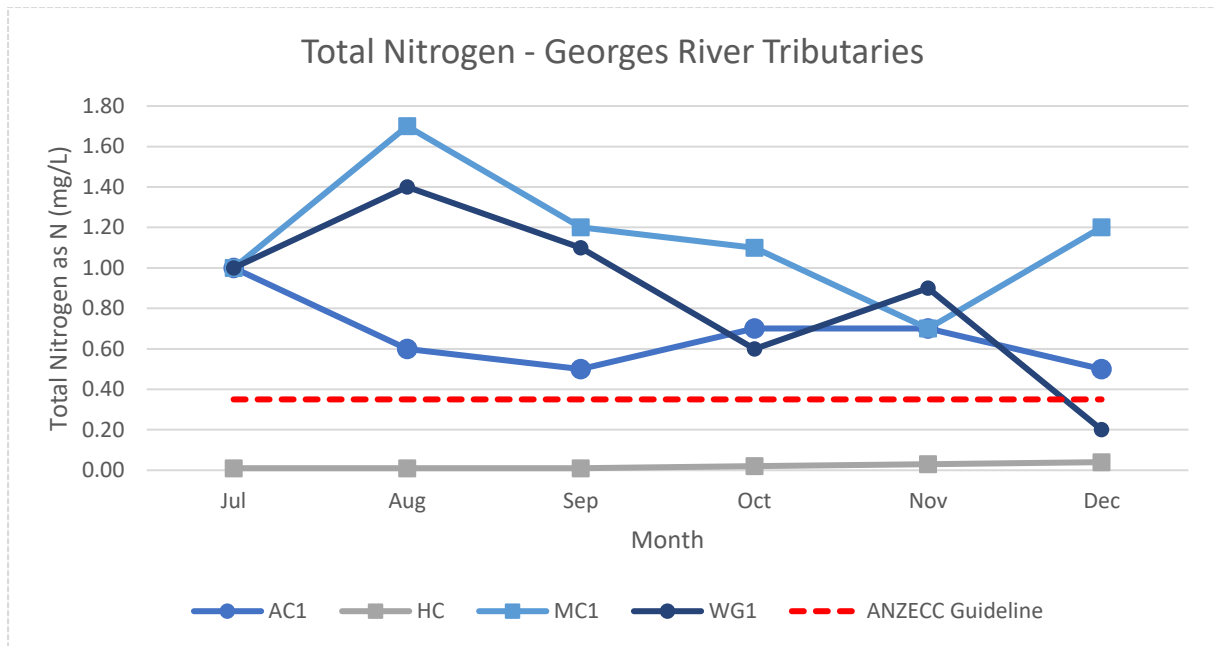


Figure 5. Total Nitrogen concentrations at Georges River tributary monitoring sites (AC1, HC, MC1 and WG1) July to December 2024

Total Phosphorous

Similar to total nitrogen, total phosphorous (TP) was variable across Kemps Creek sites and spiked in the upper catchment (KC1 and KC5) in November likely coinciding with heavy rainfall with KC1 reaching 7.39 mg/L, approximately 50 times the objective limit (Figure 6). All sites recorded non-compliance to the TP WQO for South Creek of 0.14 mg/L throughout the six-month period. KC1 recorded the highest TP concentration of 3.04 mg/L in September, approximately 22 times the objective.

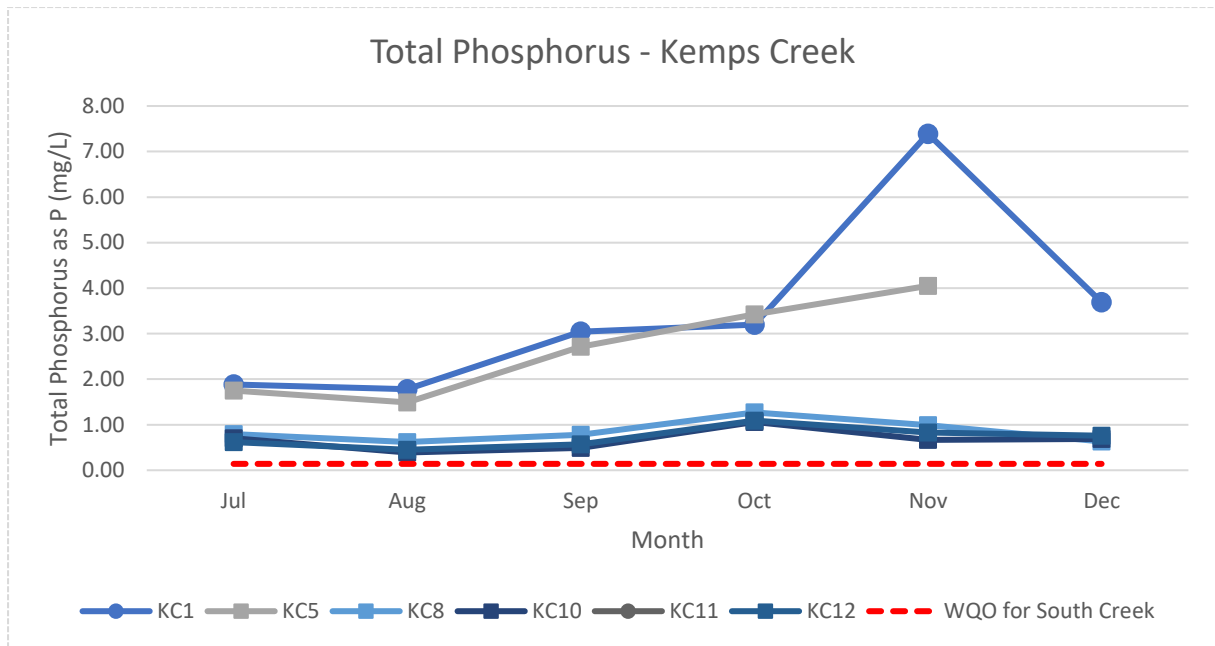


Figure 6. Total Phosphorus concentrations at Kemps Creek monitoring sites July to December 2024

Kemps Creek tributary sites had elevated TP with spikes in September and October for KC3 (0.77 mg/L) and KC6 (0.87 mg/L) respectively (Figure 7). Severely instances were recorded across the six-month period where TP did not comply with the WQO for South Creek of 0.14 mg/L, with only KC2 remaining relatively consistent and within the objective limit from August to December.

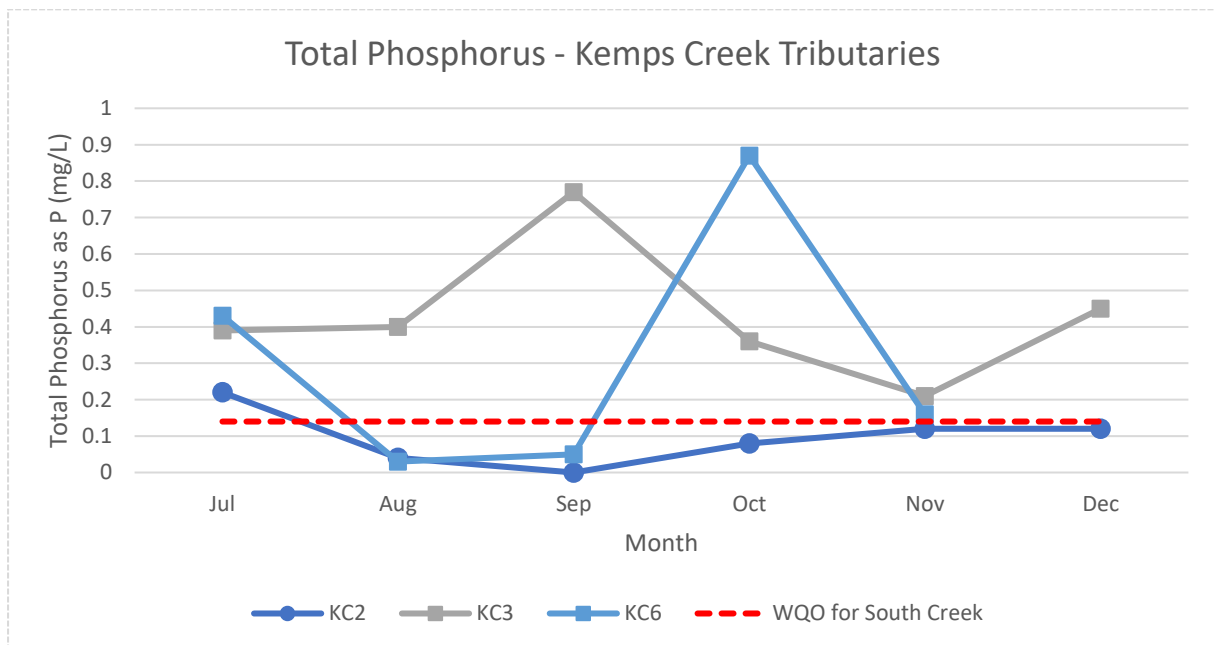


Figure 7. Total Phosphorus concentrations at Kemps Creek tributary monitoring sites July to December 2024

Total phosphorus concentrations at all South Creek and Badgerys Creek sites (SC1, SC2, and BC1) were variable and exceeded the TP WQO for South Creek of 0.14 mg/L for majority of monitoring events (Figure 8). Total phosphorus was highest at SC1 in November with a value of 0.7 mg/L and dropped

considerably in December. SC2 and BC1 followed a similar trend to each other with a peak in October/November and a drop in December.

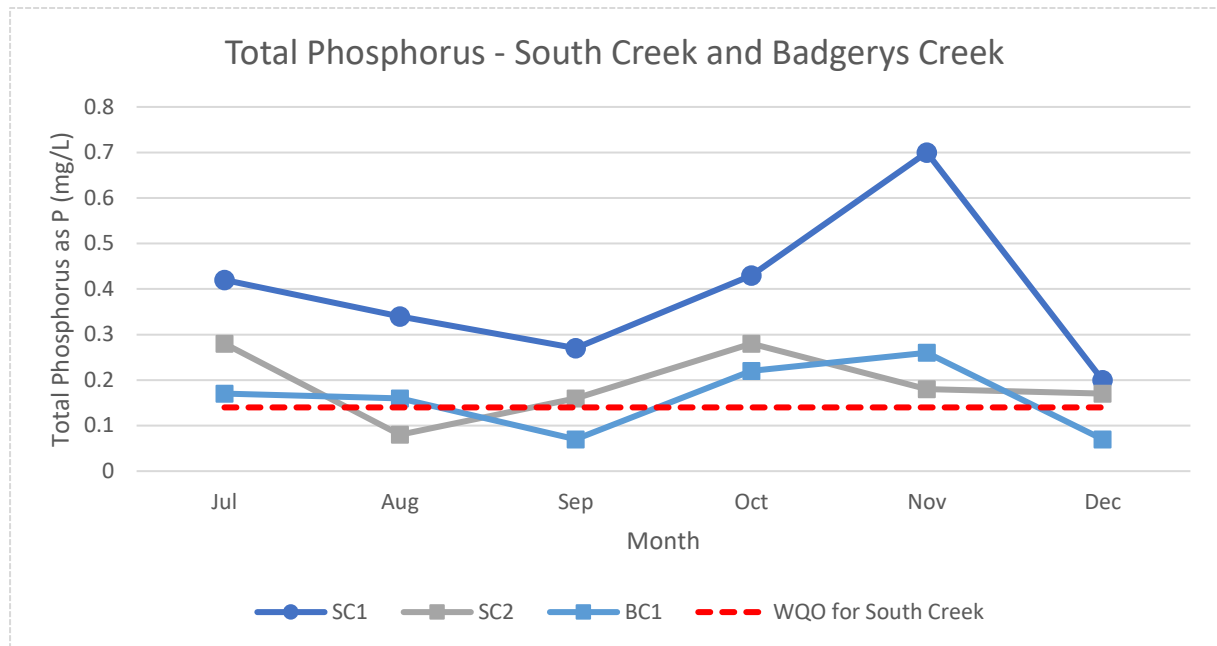


Figure 8. Total Phosphorus concentrations at South Creek and Badgerys Creek monitoring sites July to December 2024

Georges River tributary sites (AC1, HC, MC1 and WG1) had variable total phosphorus. All sites were non-compliant to the ANZECC guideline of 0.025 mg/L on all but two monitoring events with MC1 in August, and AC1 in August and September (Figure 9). HC showed a gradual increase in TP from July to September reaching 0.23 mg/L and similar steady decline again to November before TP started rising again in December. All other sites had a slight peak in November.

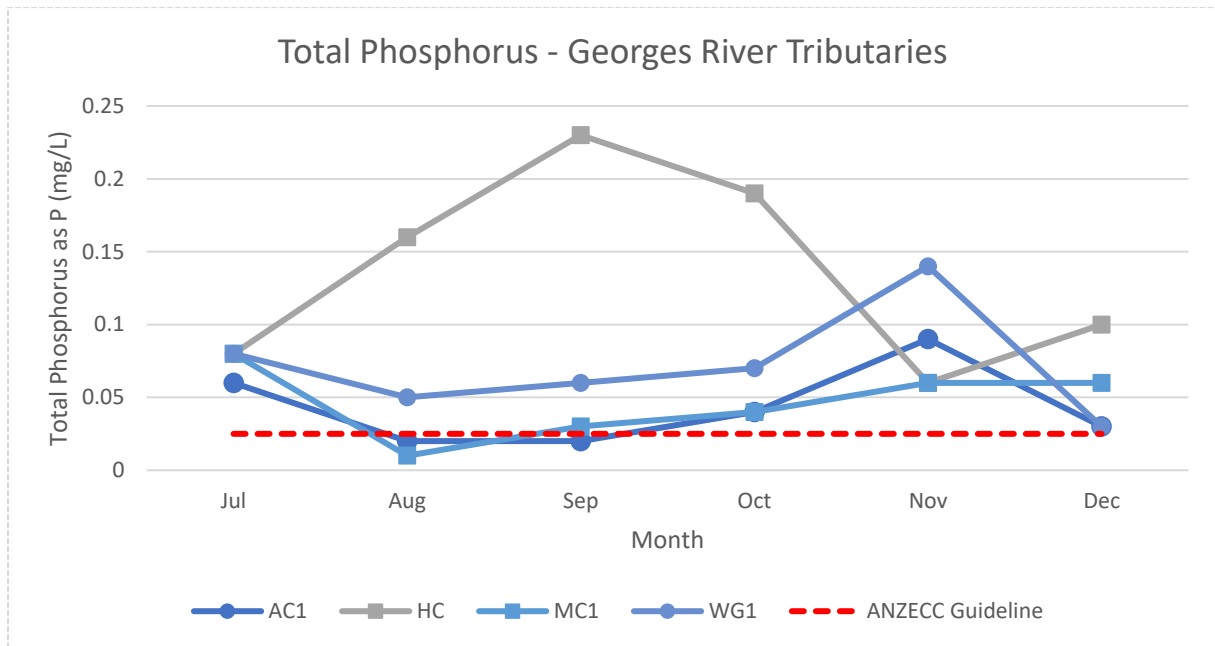


Figure 9. Total Phosphorus concentrations at Georges River tributary monitoring sites July to December 2024

Turbidity

During the six-month monitoring period, turbidity at Kemps Creek sites complied with the turbidity WQO for South Creek of 50 NTU (Figure 10). All sites except for KC1 followed a similar trend, with higher turbidity in July, dropping lower across September and October, and rising again in December. The highest recorded turbidity was at KC12 in December with 37.28 mg/L.

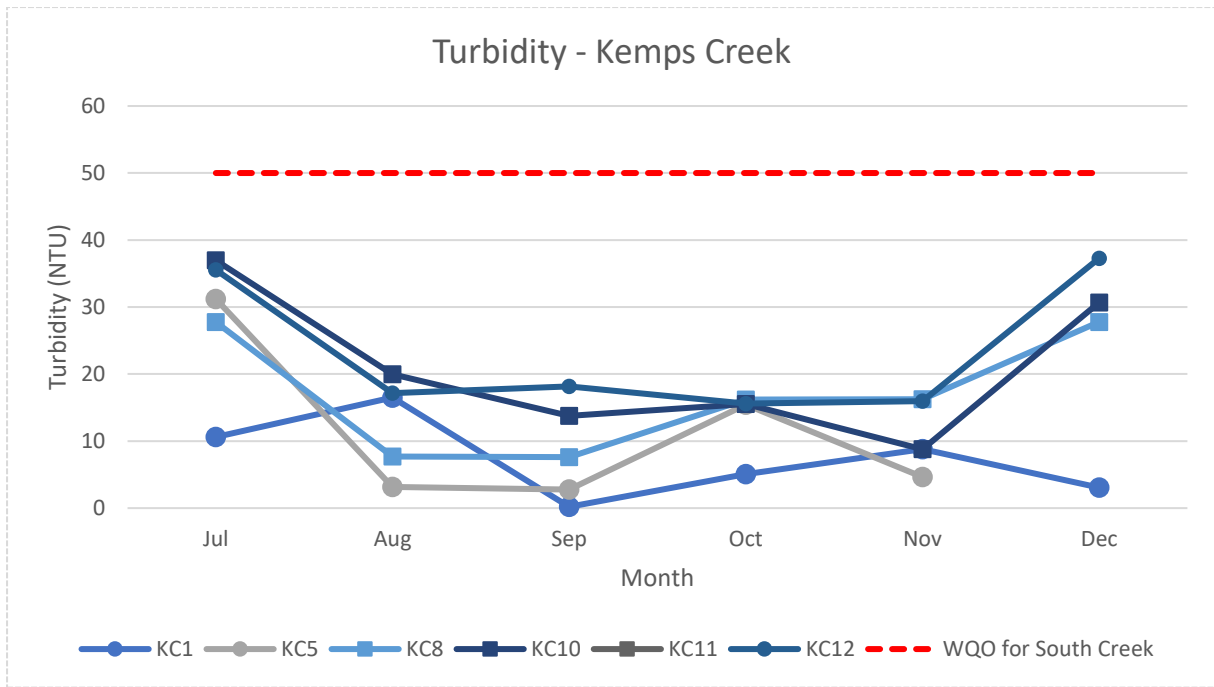


Figure 10. Turbidity at Kemps Creek monitoring sites July to December 2024

During the six-month monitoring period, turbidity at Kemps Creek tributary sites was within the turbidity WQO for South Creek of 50 NTU, with the exception of KC2 in July with a recording of 74, however this is a decrease from June's reading of 83 NTU (Figure 11). This reading was followed by a spike of 49.3 NTU at KC3 in October. KC 6 was not monitored in December as there was no access due to construction.

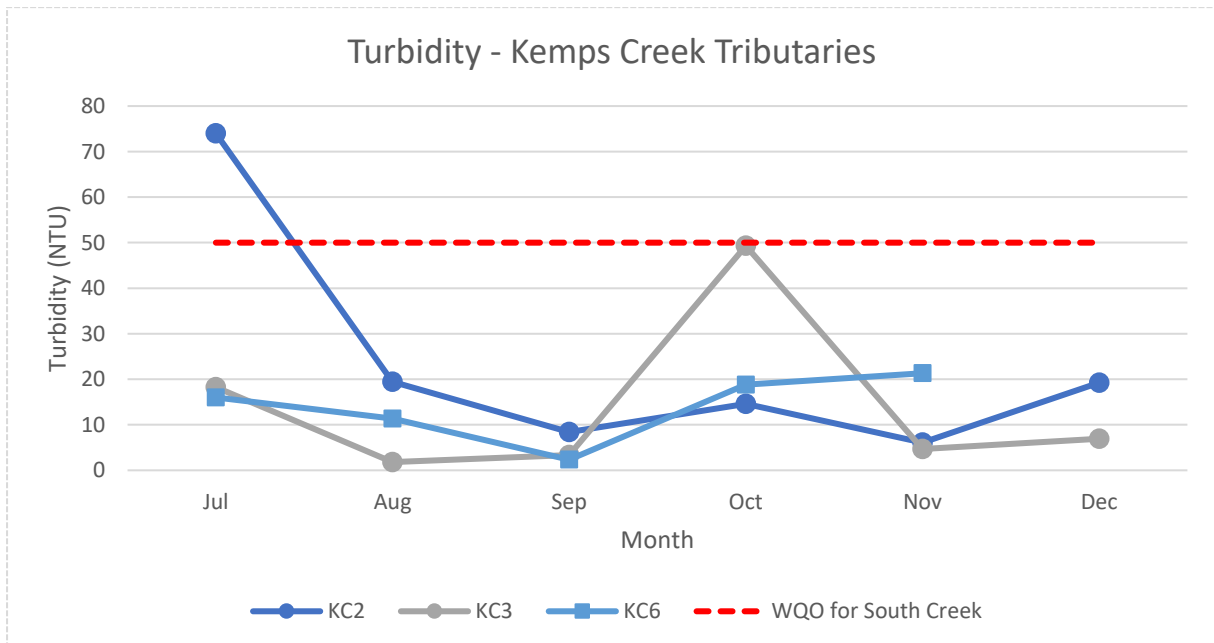


Figure 11. Turbidity at Kemps Creek tributary monitoring sites July to December 2024

Results for South Creek and Badgerys Creek sites show turbidity was highest in July with 82 NTU at SC2, becoming relatively consistent from August to December, remaining within the WQO for South

Creek of 50 NTU (Figure 12). The second highest reading was 51 NTU at BC1 in July. This was a similar trend to the Kemps Creek and Kemps Creek tributaries sites.

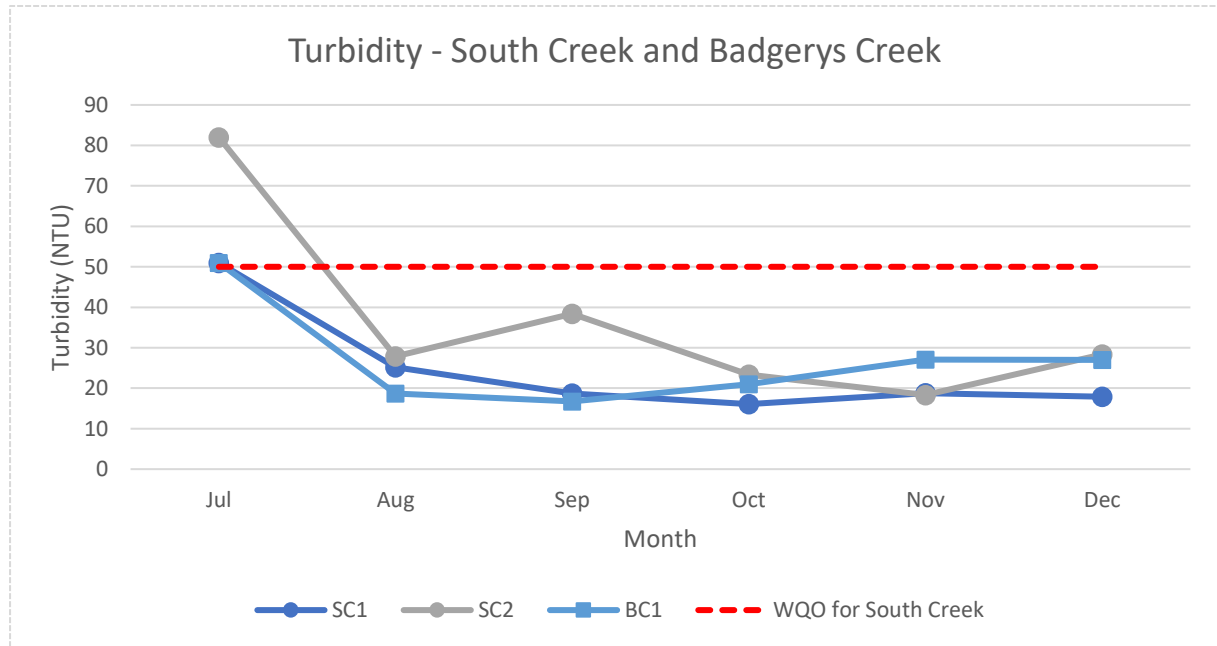


Figure 12. Turbidity at South Creek and Badgerys Creek monitoring sites July to December 2024

Georges River tributaries had turbidity ranging from 0.05 to 49.82 NTU (Figure 13) across the six-month period, dropping below the ANZECC trigger value minimum of 6 NTU. The highest turbidity was recorded at HC in July 2024, however all other sites remained below 20 NTU from July to December.

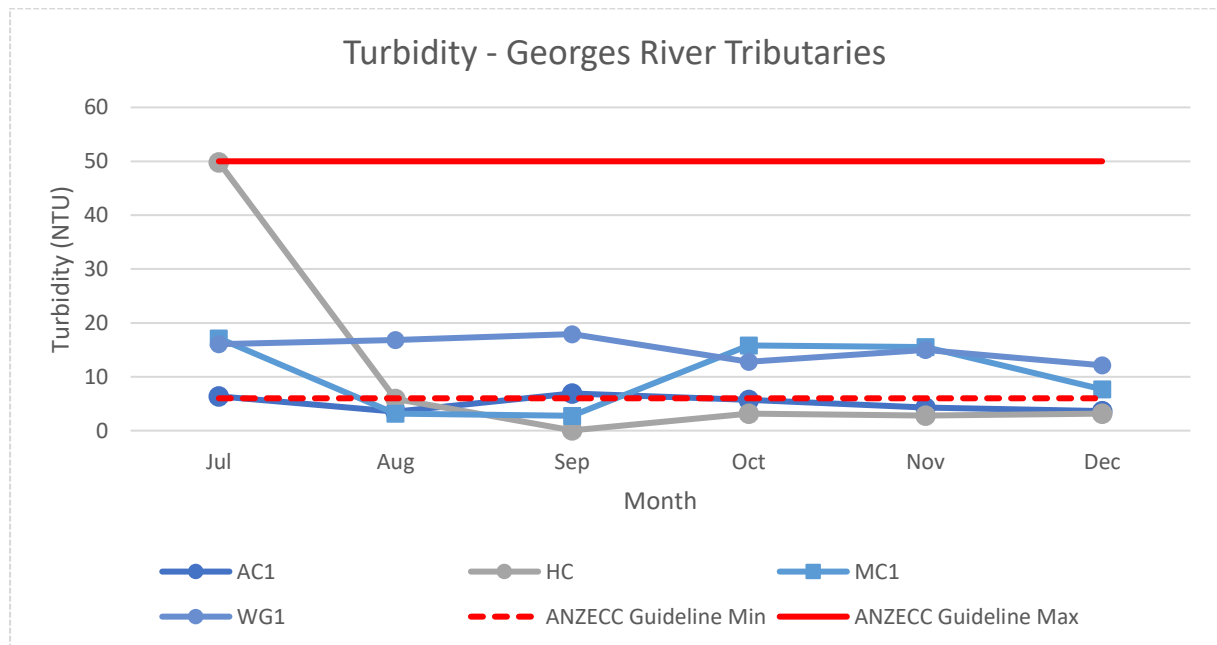


Figure 13. Turbidity at Georges River tributary monitoring sites July to December 2024

Electrical Conductivity

Results for Kemps Creek sites show electrical conductivity was lowest in July at KC5 with 14.56 $\mu\text{S}/\text{cm}$ and highest in September with a reading of 3090 $\mu\text{S}/\text{cm}$, far greater than the WQO for South Creek of 1103 $\mu\text{S}/\text{cm}$ (Figure 14). Results were similar across all sites from October onwards, showing an overall decline to below the WQO for KC8, KC10 and KC12 by December 2024.

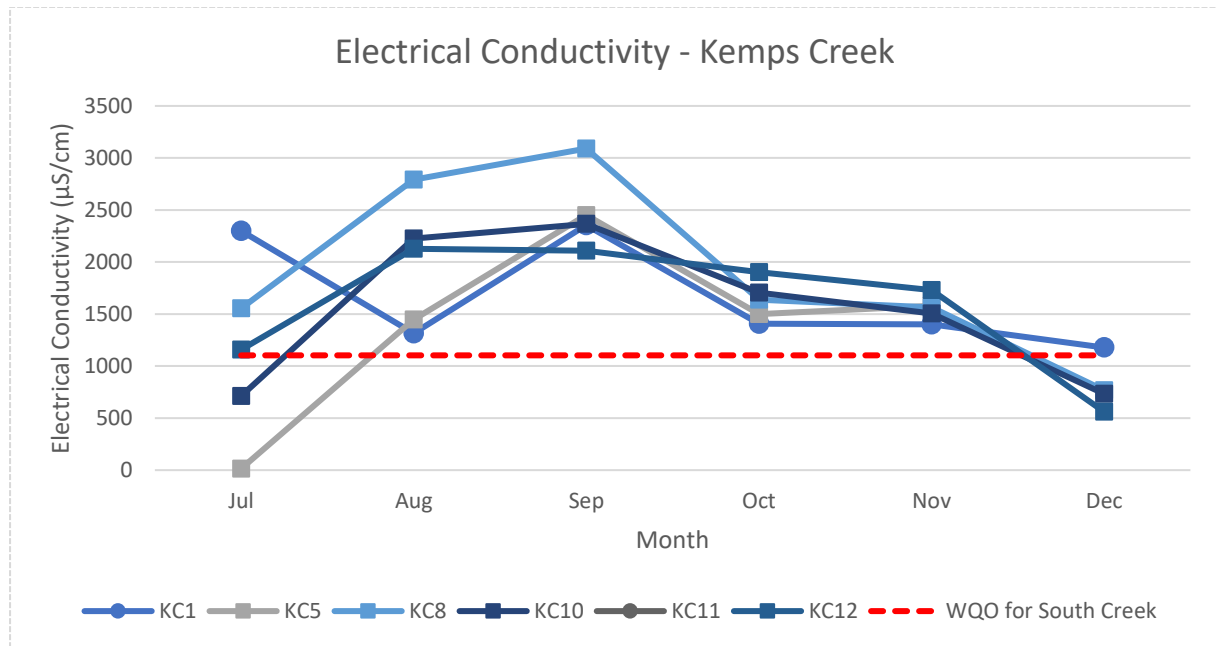


Figure 14. Electrical conductivity at Kemps Creek monitoring sites July to December 2024

Kemps Creek tributary sites had a similar peak in electrical conductivity in September at KC6 with a reading of 4030 $\mu\text{S}/\text{cm}$, far greater than the WQO for South Creek of 1103 $\mu\text{S}/\text{cm}$ (Figure 15). KC2 and KC3 peaked in August and had a gradual decline to below the WQO for South Creek by November. KC2 and KC3 peaked in August and then declined. Results were similar across all sites from October onwards, showing an overall decline to below the WQO for KC8, KC10 and KC12 by December 2024.

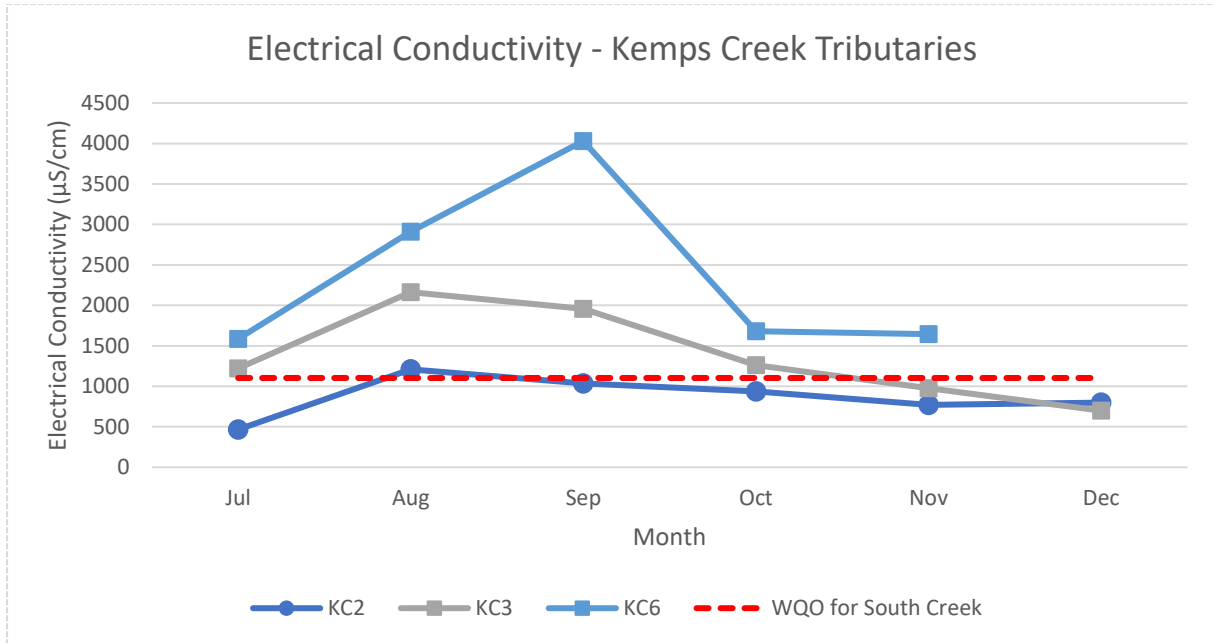


Figure 15. Electrical conductivity at Kemps Creek tributary monitoring sites July to December 2024

South Creek and Badgerys Creek sites peaked in November at BC1 with a reading of 1791 $\mu\text{S/cm}$ (

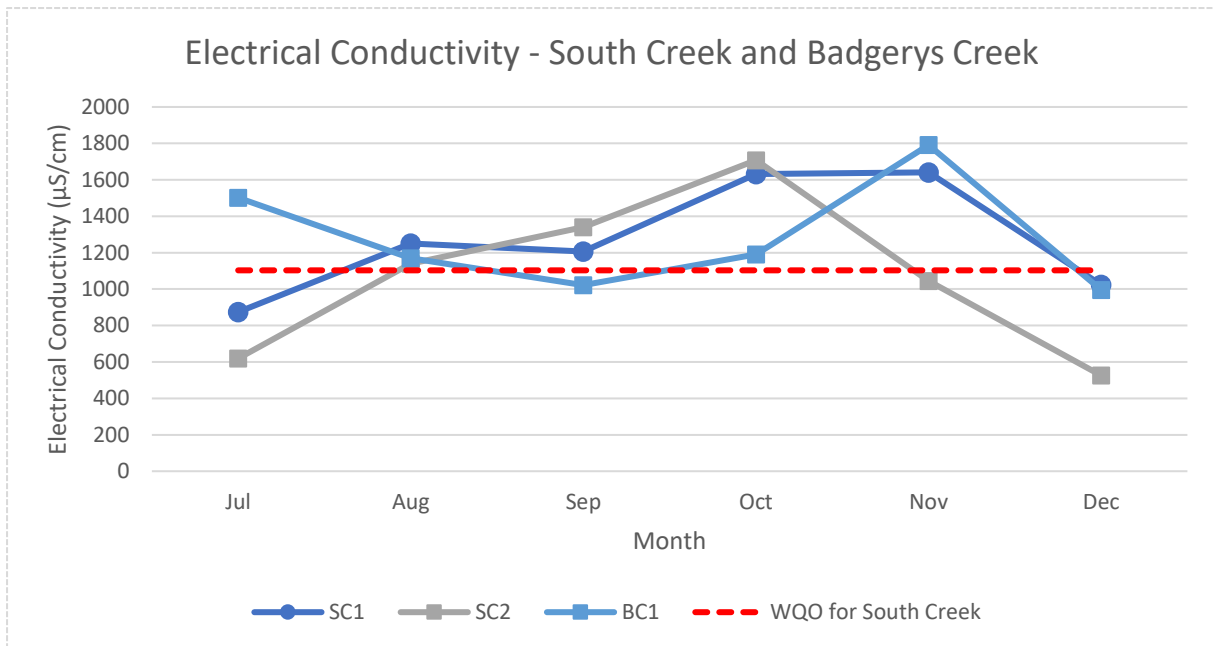


Figure 16). Most sites recorded a reading above the electrical conductivity WQO for South Creek of 1103 $\mu\text{S/cm}$. SC1 and BC1 followed a similar trend to each other, with lower electrical conductivity in July and December.

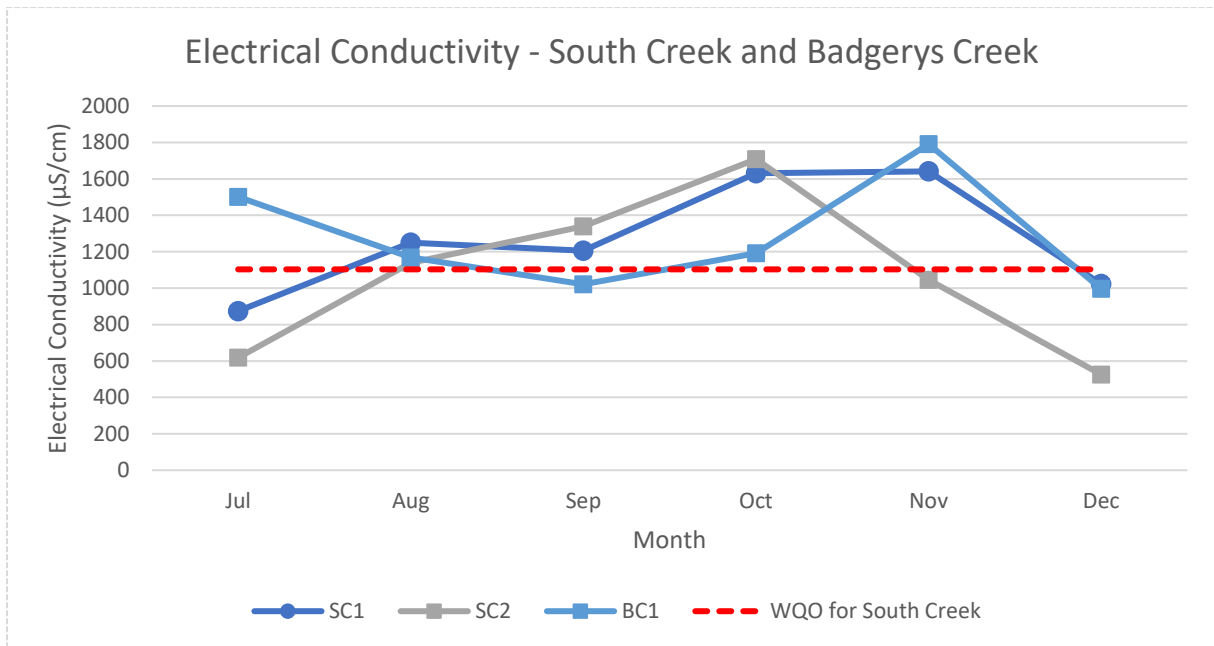


Figure 16. Electrical conductivity at South Creek and Badgerys Creek monitoring sites July to December 2024

All Georges River tributary sites remained within the ANZECC guideline of 125 to 2200 $\mu\text{S}/\text{cm}$ between July and December (Figure 17). Two spikes occurred over the six-month period, in August and September at MC1 (1605 $\mu\text{S}/\text{cm}$) and HC (1707 $\mu\text{S}/\text{cm}$) respectively.

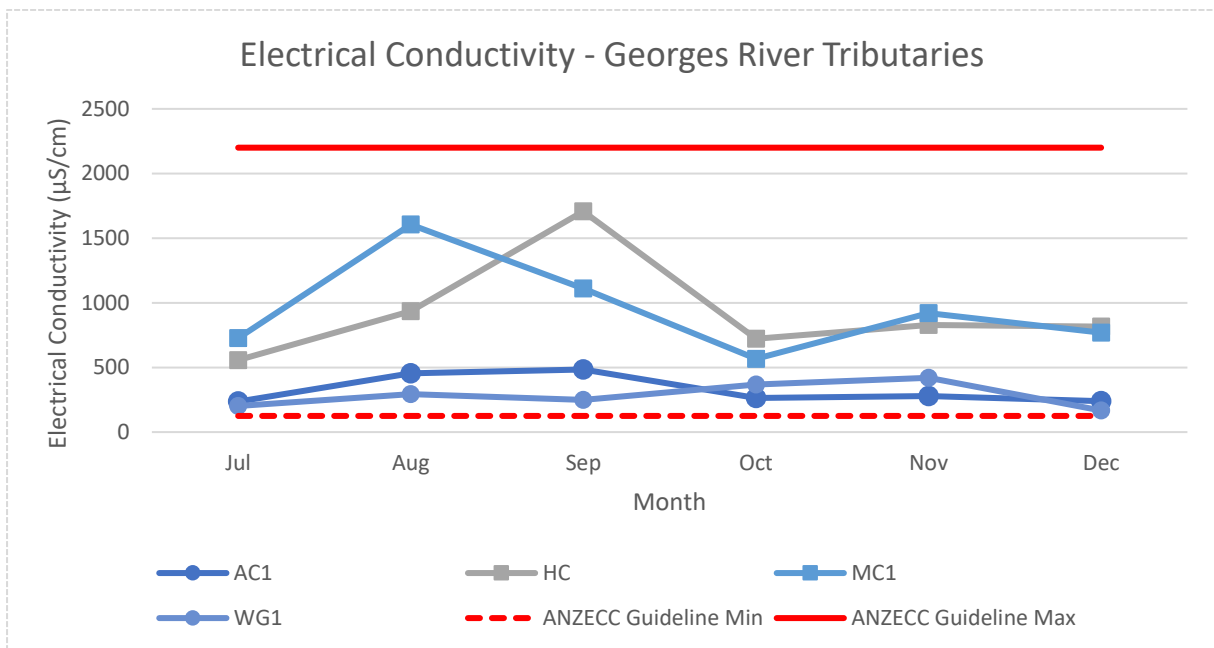


Figure 17. Electrical conductivity at Georges River tributary monitoring sites July to December 2024

pH

pH at Kemps Creek varied above and below the pH WQO for South Creek of 7.6, with a low of 7.30 at KC12 in August and a high of 8.15 at KC1 in September across the six-month period (**Error! Reference**

source not found.) Results for all Kemps Creek sites followed a similar trend of highs and lows from Jul to December.

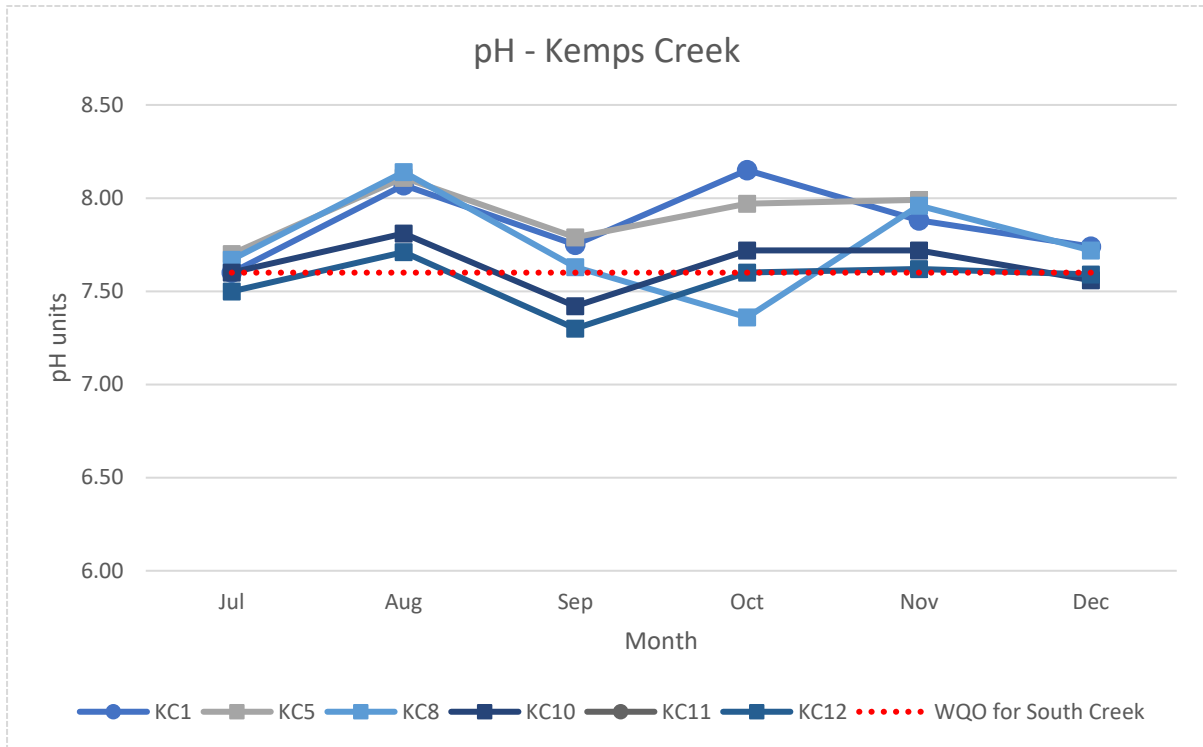


Figure 18. pH at Kemps Creek monitoring sites July to December 2024

Kemps Creek tributaries followed a similar pattern to Kemps Creek sites over the six months although all sites recorded pH above the WQO for South Creek (7.6). A high of 8.11 was recorded in August at KC3 (Figure 19).

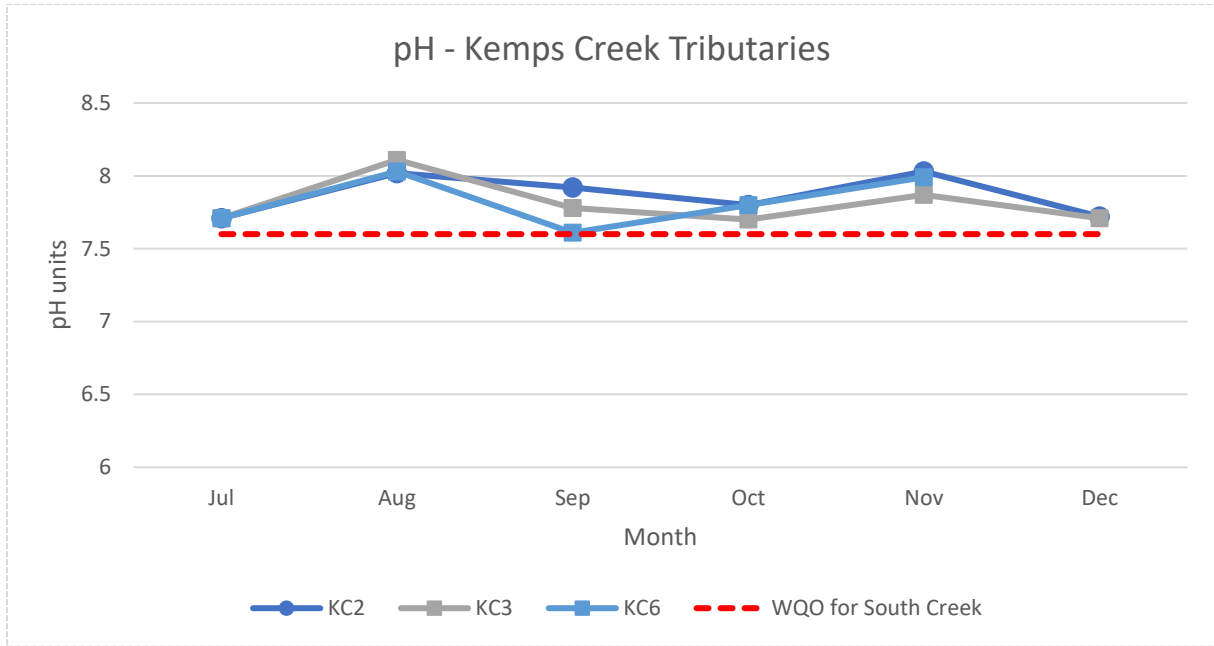


Figure 19. pH at Kemps Creek tributary monitoring sites July to December 2024

South Creek and Badgerys Creek pH results had similar patterns however, BC1 recorded a low of 6.22 in September, well below the WQO for South Creek of 7.6. SC2 largely remained above the WQO for five of six months (Figure 20). SC1 and SC2 remained below the WQO for all six months.

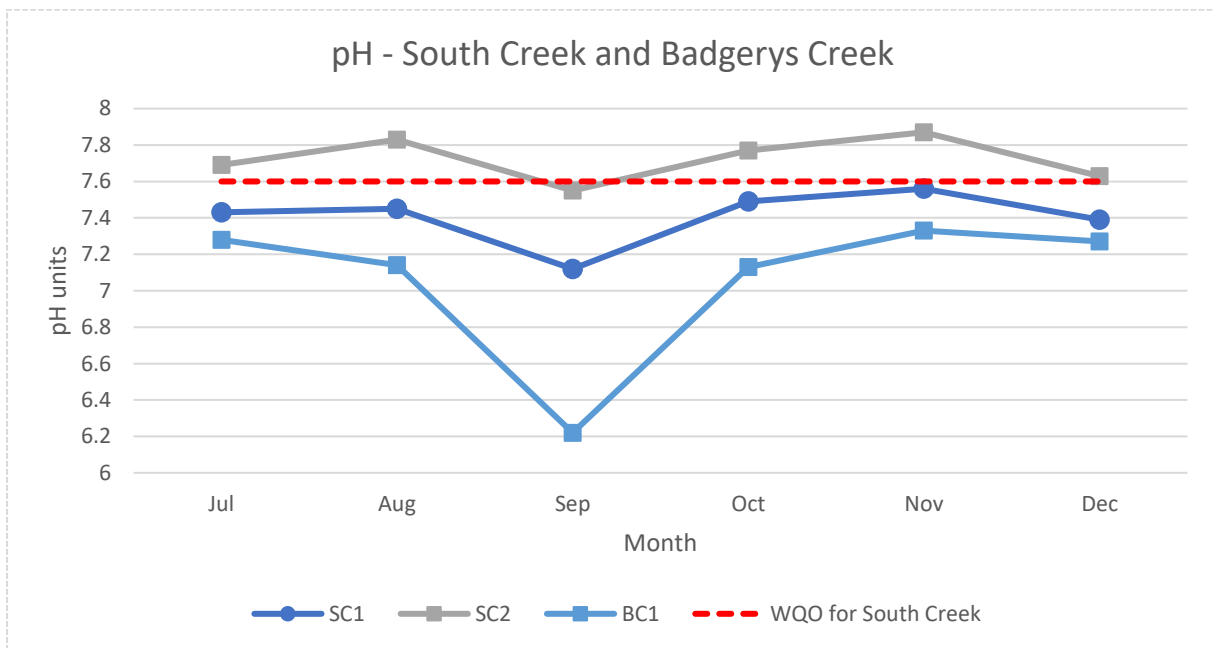


Figure 20. pH at South Creek and Badgerys Creek monitoring sites July to December 2024

Georges River tributaries pH results varied widely across July to December 2024. MC1 remained above the ANZECC maximum guideline of pH 8 for all six months, with a high of 8.7 in August (Figure 21). HC, MC1, and WG1 remained within the minimum and maximum guidelines for most months except for a spike in November at WG1 with a record of pH 8.52.

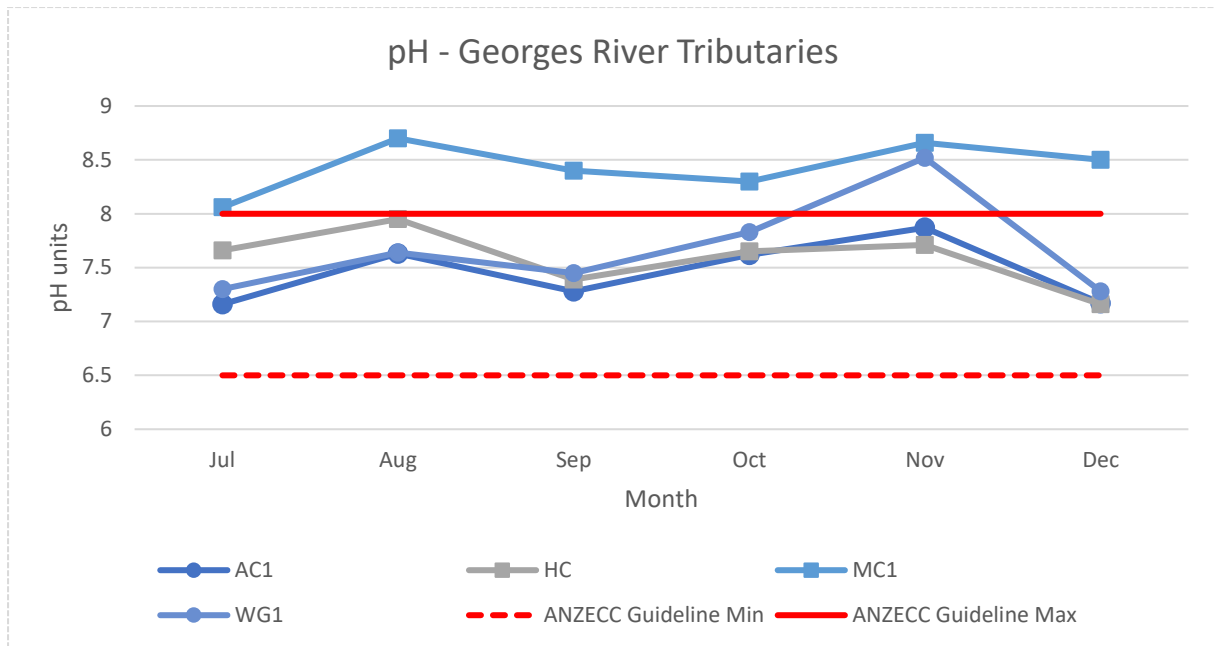


Figure 21. pH at Georges River tributary monitoring sites July to December 2024

Dissolved Oxygen

Dissolved oxygen at Kemps Creek sites followed a similar pattern to each other with a slight peak in August trending to lower DO results in December (Figure 22). Results remained above the DO WQO for South Creek of 43 % for all samples taken across the six-month period except for KC12 in December with 35.7 %. Lack of results in November was due to probe malfunctions.

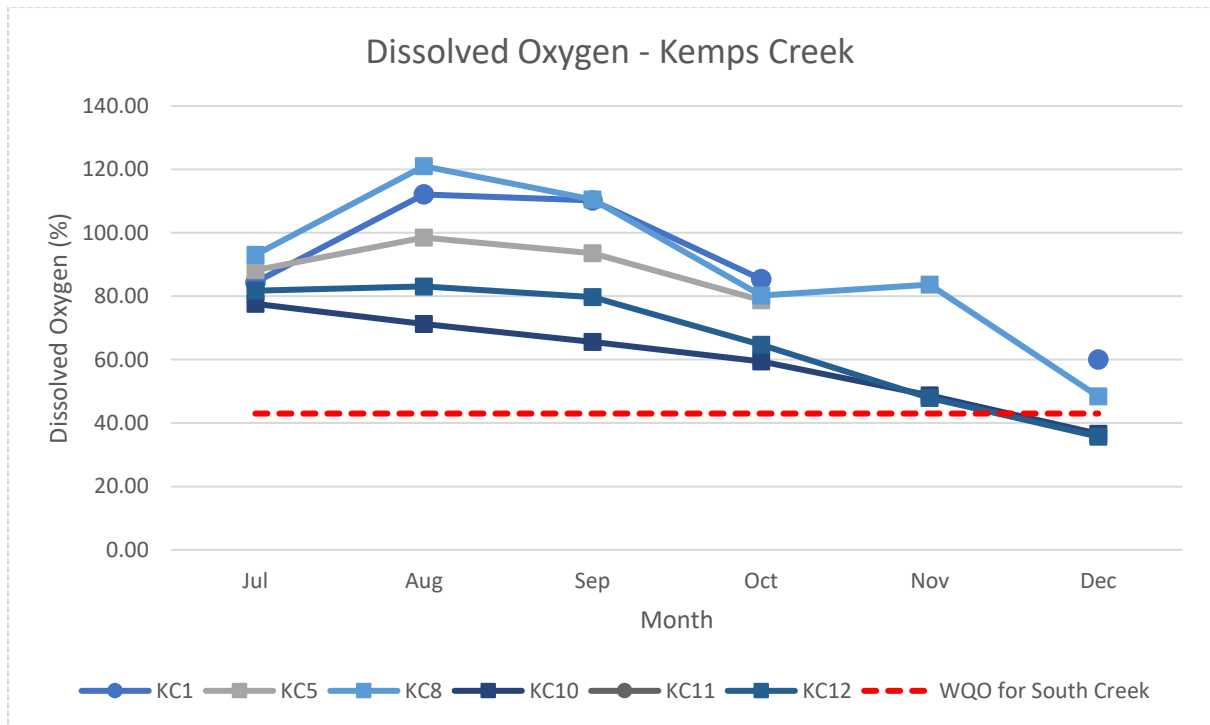


Figure 22. Dissolved oxygen at Kemps Creek monitoring sites July to December 2024

Kemps Creek tributaries also had greater dissolved oxygen than the 43 % WQO for all months excepts for KC3 with 37.21 % recorded in October (Figure 23). Lack of results in November was due to probe malfunctions.

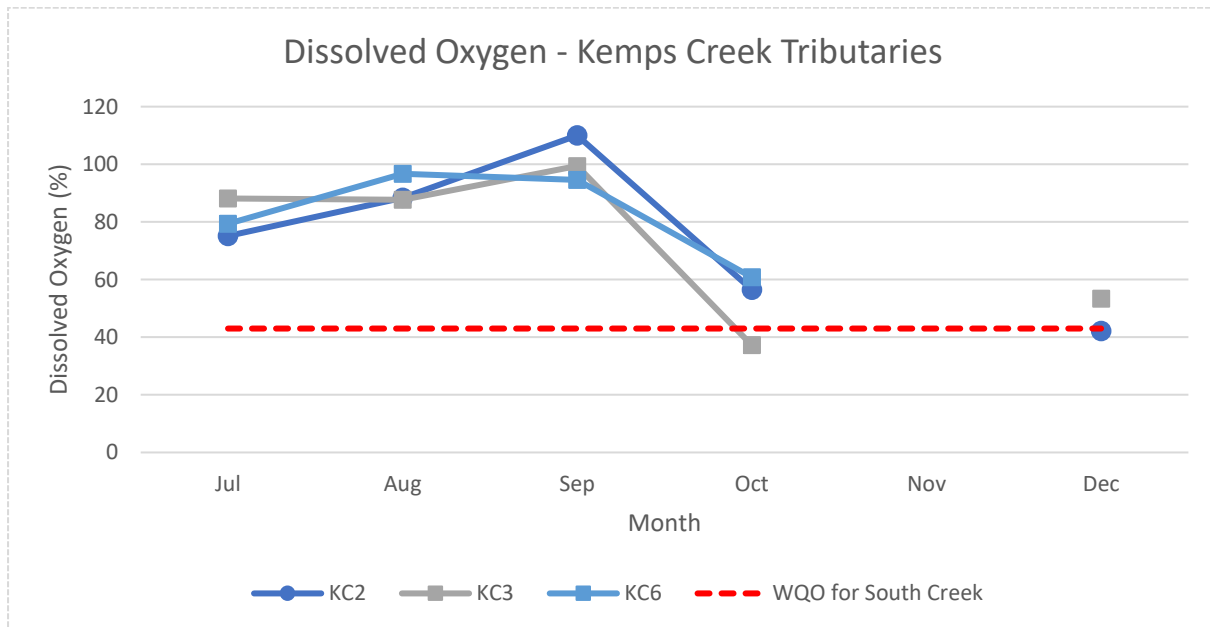


Figure 23. Dissolved oxygen at Kemps Creek tributary monitoring sites July to December 2024

Dissolved oxygen recorded at South Creek sites and Badgerys Creek remained above the WQO for South Creek (43 %) in July, August and September (Figure 24). October's results show a drop in DO at SC2, followed by a drop in DO at all sites in November. The overall low recorded for the six-month period was seen at SC2 in December with 21.2 %, well below the WQO for South Creek.

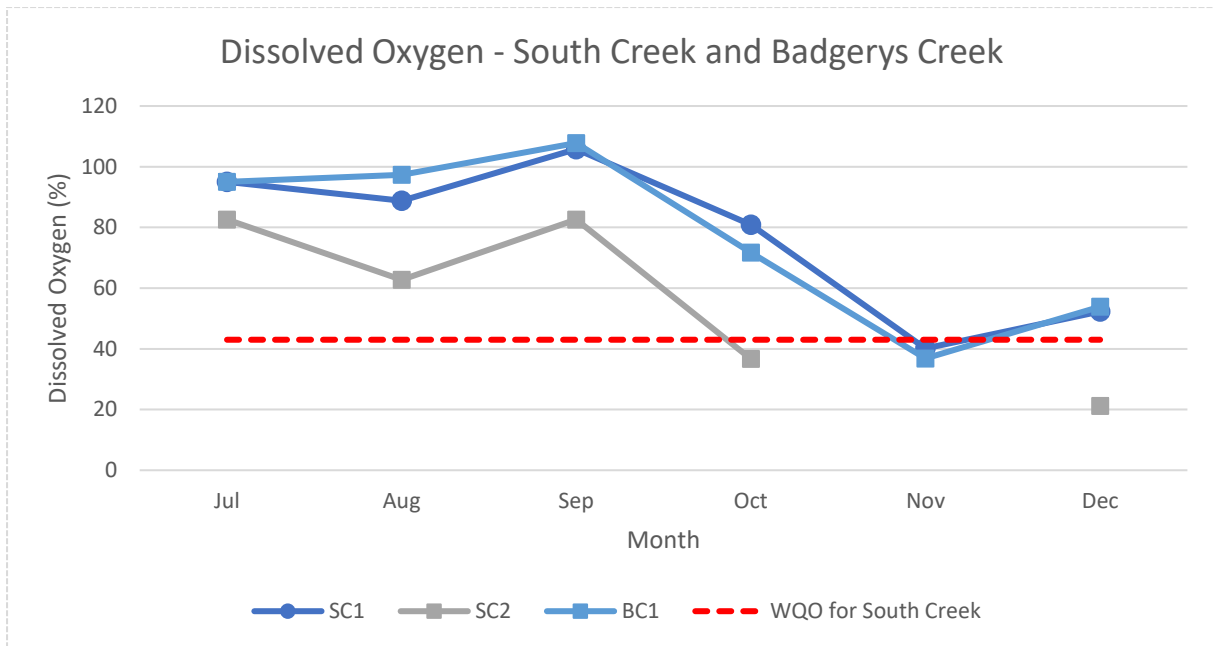


Figure 24. Dissolved oxygen at South Creek and Badgerys Creek monitoring sites July to December 2024

Dissolved oxygen at Georges River tributaries varied from 8.1 % at HC in December to 156.1 % at MC1 in August (Figure 25). Results overall largely fell outside the ANZECC minimum and maximum DO guidelines of 85-110 %, with only four samples recorded within the guidelines over the six-month period at AC1 and WG1. Lack of results in November was due to probe malfunctions.

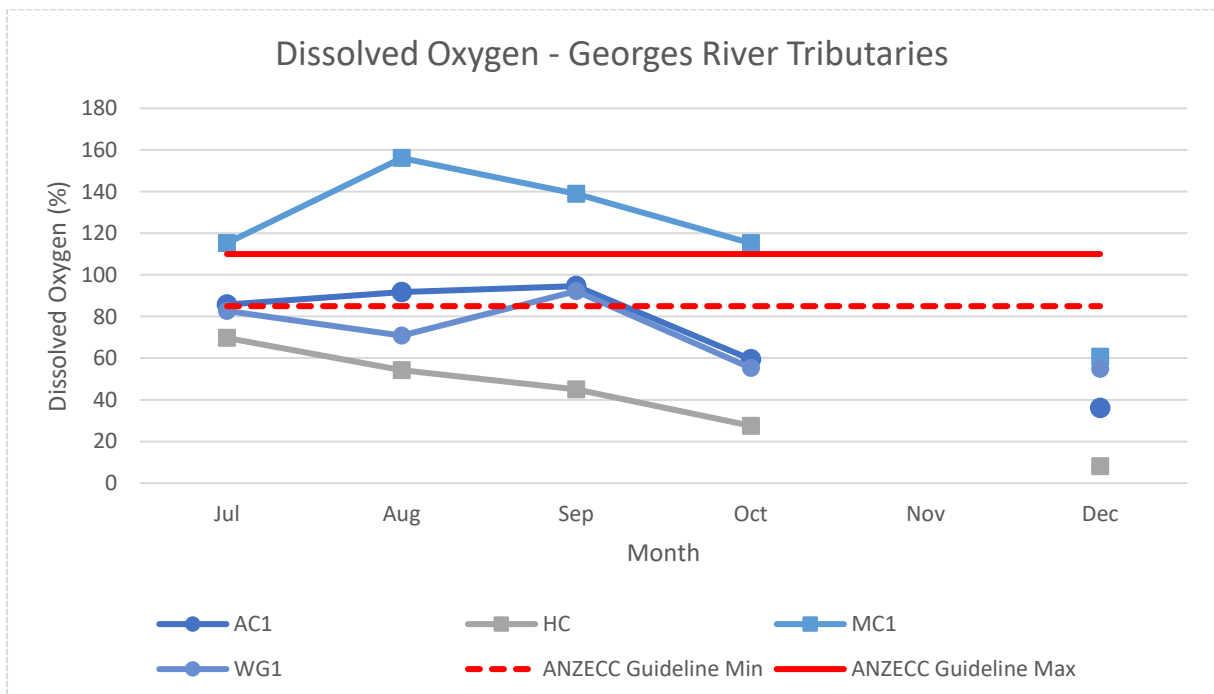


Figure 25. Dissolved oxygen at Georges River tributary monitoring sites July to December 2024

Georges River Recreation Monitoring Sites

Turbidity

Turbidity at Georges River recreation sites varied over the six-month period, remaining above the ANZECC primary contact guideline (0.5 NTU) on all occasions and often above the ANZECC secondary contact guideline (10 NTU) during this period. At GR3, GR4 and GR5, there was no compliance with the primary contact guideline of 0.5 NTU, and estuary sites were frequently above the secondary contact guideline of during the six-month monitoring period.

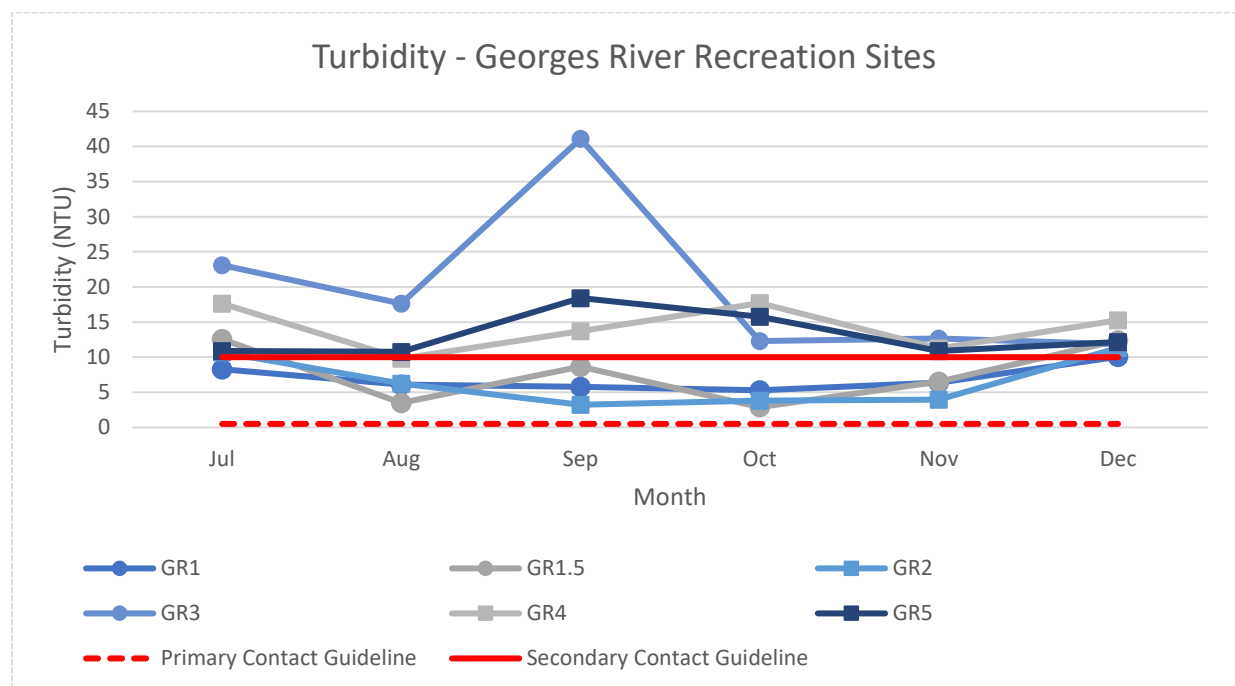


Figure 26. Turbidity at Georges River Recreation monitoring sites July to December 2024

Thermotolerant coliforms

Results of bacteria monitoring at the Georges River Recreation sites shows that breaches of the ANZECC primary contact guideline (150 CFU/100 mL) for thermotolerant coliforms occurred within in all months of this sampling period and breaches of ANZECC secondary contact guideline (1000 CFU/100 mL) for thermotolerant coliforms occurred in July, October, November and December (Figure 27). August was the only monitoring month with no breaches of either contact guideline for any Georges River site.

GR1 breached the ANZECC primary contact guideline for thermotolerant coliforms on two occasions, July and September. For GR1.5, the primary contact guideline was exceeded in July, November and

December, with GR2 showing similar results with a primary contact guideline breach in July and November.

Results for GR3 showed primary contact guideline breaches in all months except for August, and a secondary contact guideline breach in October and November. GR4 breached primary and secondary contact guidelines in July, October and December, with a primary contact guideline breach only in November. GR5 has similar records, with a secondary contact breach in July and October, and a primary contact breach in December.

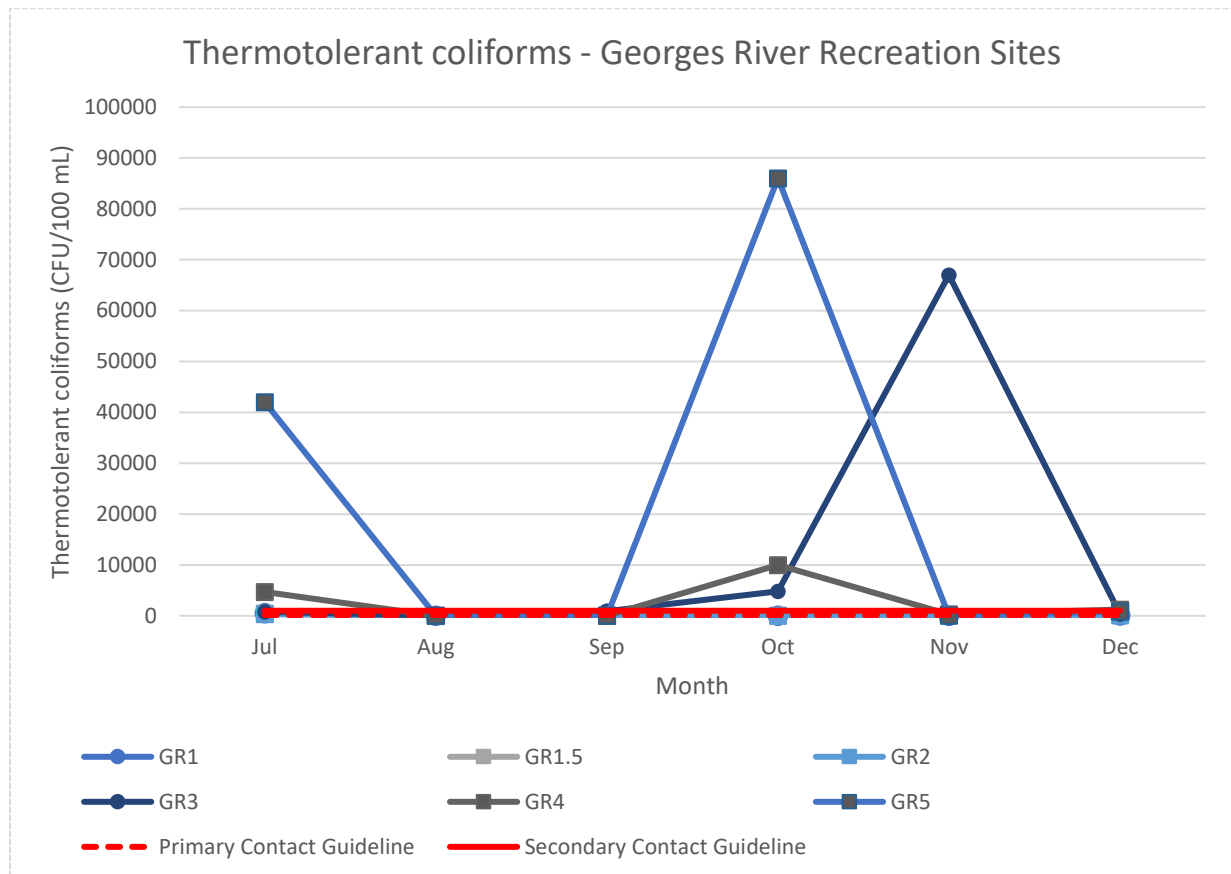


Figure 27. Thermotolerant coliforms at Georges River Recreation monitoring sites July to December 2024

Enterococci

Breaches of the ANZECC primary contact guideline (35 CFU/100 mL) for *Enterococci* occurred within all months of sampling except for August. Breaches of the secondary contact guideline (230 CFU/100 mL) occurred in July, September, October, November and December (Figure 28).

Results for GR1 show that the ANZECC secondary contact guideline was exceeded in July and September, and similarly and the primary contact guideline in November and December. GR1.5 exceeded the primary contact guideline in July, September and December, with a secondary contact guideline breach in November only. GR2 had primary contact guideline breaches only in July, October and December.

GR3, GR4, and GR5 had a greater number of secondary contact guideline breaches. GR3 exceeded the secondary contact guideline in July, September, November and December, with a primary contact breach in October only. Results for GR4 and GR5 has similar trends, with both sites exceeding the secondary contact guideline for July, October and December. The primary contact guideline was breached in September for GR5 and again in November for both GR4 and GR5.

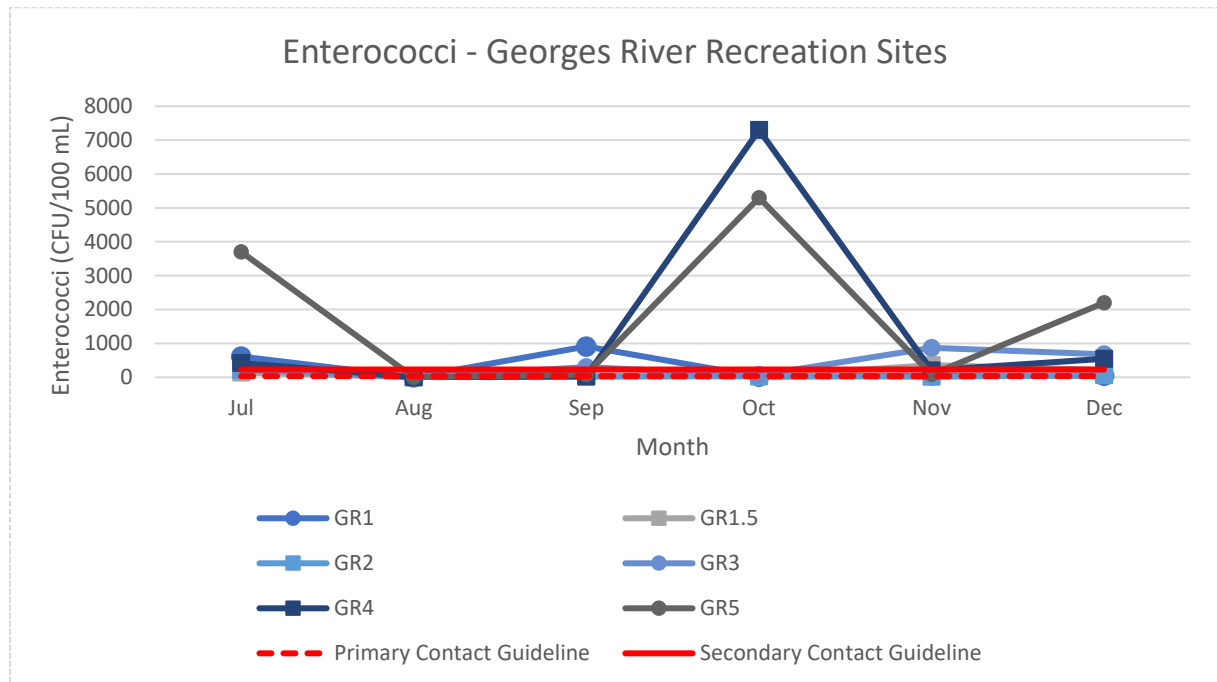


Figure 28. *Enterococci* at Georges River Recreation monitoring sites July to December 2024

Cyanobacteria (blue-green algae)

Monitoring of cyanobacteria (blue-green algae) show that all recreation sites are susceptible to cyanobacteria blooms, and potentially toxic species of cyanobacteria are commonly detected (Table 7). The highest NHMRC monitoring level is 'Red Level Action Mode' followed by the 'Amber Level Alert Mode' with 'Green Level Surveillance Mode' being the lowest level in the NHMRC (2008). Each monitoring level has a recommended response (Table 8).

Cyanobacteria biovolume levels recorded across the Georges River monitoring sites triggered NHMRC (2008) monitoring level 'Green Level Surveillance Mode' (NHMRC 2008) 16 times throughout the six-month sampling period. The NHMRC (2008) 'Amber Level Alert Mode' was triggered once, while the NHMRC (2008) 'Red Level Action Mode' was not triggered at all.

GR1 triggered the 'Green Level Surveillance Mode' in December only. GR1.5 triggered the 'Green Level Surveillance Mode' in September, November and December. The 'Green Level Surveillance Mode' was triggered at GR2 in September and November. GR3 triggered the 'Green Level Surveillance Mode' in September, November and December, with the 'Amber Level Alert Mode' being triggered in October.

GR4 triggered the 'Green Level Surveillance Mode' in July, August, October, November and December, while GR5 triggered the 'Green Level Surveillance Mode' in July and September only.

Table 7. NHMRC cyanobacteria monitoring levels for Georges River Estuary monitoring sites July 2024 to December 2024

MONTH	GR1	GR1.5	GR2	GR3	GR4	GR5
JULY 2024	None	None	None	None	Green	Green
AUGUST 2024	None	None	None	None	Green	None
SEPTEMBER 2024	None	Green	Green	Green	None	Green
OCTOBER 2024	None	None	None	Amber	Green	None
NOVEMBER 2024	None	Green	Green	Green	Green	None
DECEMBER 2024	Green	Green	None	Green	Green	None

Table 8. NHMRC cyanobacteria levels and recommended response (NHMRC 2008)

NHMRC MONITORING LEVEL	RECOMMENDED RESPONSE
GREEN LEVEL SURVEILLANCE MODE	This level involves routine sampling to measure contaminants (e.g. physical, microbial, cyanobacterial and algal).
AMBER LEVEL ALERT MODE	This level requires investigation into the causes of elevated contaminant levels, and increased sampling to enable a more accurate assessment of the risks to recreational users.
RED LEVEL ACTION MODE	This level requires the local government authority and health authorities to warn the public that the water body is considered unsuitable for recreational use.

Conclusion

It is evident that most freshwater sites across the Liverpool LGA have elevated nutrients often higher than the recommended Wianamatta-South Creek Stormwater Management Targets (WQO for South Creek) and/or the ANZECC guidelines.

Elevated total nitrogen and total phosphorus in the urban and peri-urban setting are commonly sourced from stormwater run-off, sewer leakage or other wastewater sources, fertiliser contamination and decay of organic material. Whilst this program cannot quantify the source of the elevated results continually recorded across the Kemps Creek sites, likely drivers include the combination of low/no flow conditions associated with below average rainfall, the decay of organic matter, and increased stormwater runoff due to high rainfall and flooding events.

Total nitrogen at freshwater sites had fewer spikes and outliers compared to January to June results. Result patterns were more like other sites within the same area and spikes that did occur were likely due to high rainfall. Results overall largely exceeded the WQO for South Creek (1.72 mg/L) and the ANZECC guideline (0.35 mg/L).

Total phosphorus showed similar trends to total nitrogen results, with peaks likely associated with higher rainfall and greater run-off. Total phosphorus results exceeded the WQO for South Creek and ANZECC guidelines for most sampling events.

Turbidity at freshwater sites was similar compared to the previous biannual monitoring period, with results largely within the WQO for South Creek (50 NTU) and ANZECC range of 6-50 NTU. July saw higher turbidity at most sites across the Kemps Creek, Kemps Creek tributaries, South Creek and Badgerys Creek, and Georges River tributaries. This was likely in response to higher-than-average rainfall.

Electrical conductivity remained largely higher than the WQO for South Creek however Georges River tributaries remained within the minimum and maximum ANZECC guidelines for the entire six-month period.

pH results for Kemps Creek and Kemps Creek tributaries were largely greater than the pH 7.6 WQO for South Creek. South Creek and Badgerys Creek saw the greatest decline of pH in September falling well below the 7.6 objective. pH at the Georges River tributary sites stayed within the ANZECC guidelines for the most part across the six-month period.

Dissolved oxygen was greater than the WQO for South Creek for most sampling events, likely due to high water flow during the higher rainfall months. Georges River tributary sites' dissolved oxygen was largely below the minimum ANZECC guideline for this six-month monitoring period.

Georges River recreation monitoring sites exceeded the ANZECC primary contact guideline for turbidity on all monitoring occasions. The secondary contact guideline was exceeded for three sites (GR3, GR4 and GR5) for all monitoring occasions.

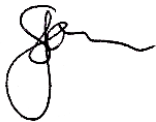
Monitoring of the Georges River recreation sites showed thermotolerant coliforms and *Enterococci* bacteria levels were frequently elevated above their respective ANZECC primary and secondary contact guidelines with peaks largely occurring in October. Elevated levels of bacteria and cyanobacteria are typical of urban estuaries which receive sewer overflow and nutrient enriched stormwater, which when combined with warm days can create ideal conditions for algae blooms which may include potentially toxic cyanobacteria, as seen in the Georges River Estuary.

The 'Green Level Surveillance Mode' (NHMRC 2008) was triggered 16 times throughout the six-month sampling period, and the 'Amber Level Alert Mode' (NHMRC 2008) was triggered once. The 'Red Level Action Mode' (NHMRC 2008) was not triggered. This represents an overall decrease in algal blooms this biannual period compared with the previous six-month period.

Statistical analysis of data collected by the monitoring program will be undertaken and presented in the annual report and program recommendations will be made. All data has been supplied in an Excel spreadsheet separate to this report and no safety issues were recorded/observed during monitoring.

If you have any questions, please get in touch.

Kind regards,



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