

Cadia region surface water testing – 20 to 21 August sampling





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We recognise Aboriginal peoples' spiritual and cultural connection and inherent right to protect the land, waters, skies and natural resources of NSW. This connection goes deep and has since the Dreaming.

We also acknowledge our Aboriginal and Torres Strait Islander employees who are an integral part of our diverse workforce and recognise the knowledge embedded forever in Aboriginal and Torres Strait Islander custodianship of Country and culture.

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On 20 to 21 August 2024 the NSW Environment Protection Agency conducted sampling in the Belubula River catchment area to investigate potential sources of contamination and monitor water quality. This report summarises the results from that sampling.

Background

Land-use in the Belubula River catchment is dominated by agriculture but also contains some industry, including quarries, a decommissioned abattoir, Blayney Sewage Treatment Plant (STP), the Newmont Cadia gold mine, Blayney landfill and a composting and waste storage facility. There are some townships on the Belubula River, including Blayney and Carcoar.

On 30 May, the NSW Environment Protection Authority collected water samples from Cadiangullong Creek, Flyers Creek and the Belubula River. This was in response to concerns raised by the community regarding water quality of the creeks surrounding Cadia gold mine and the Belubula River. On 4 July, the EPA conducted additional sampling of surface water and foam in the Belubula River in response to community reports of foam in the river. Perfluorooctanesulfonic acid (PFOS) was detected in samples collected from the Belubula River above ecological water quality guidelines and dissolved copper exceeded ecological guidelines in Cadiangullong Creek. Surfactants were also detected. These results identified the need for a more thorough investigation into potential contaminant sources within the catchment.

Reports summarising those sampling results are available on the EPA's website.

Approach taken

On 20 and 21 August 2024, the EPA collected surface water samples from 16 locations along the Belubula River and surrounding locations to investigate potential sources of contaminants and monitor water quality in the Belubula River catchment. Site selection focused on key locations both upstream and downstream of potential contamination sources (where access was possible) and some sites sampled previously (see Figure 1).

A water sample was collected from each site for chemical analysis and a water quality meter was used to record pH, electrical conductivity and temperature. Analytes selected were similar to those measured in previous sampling in the Belubula River. Samples were sent to the NSW Environmental Forensics laboratory and analysed for surfactants, per- and polyfluoroalkyl substances (PFAS), total and dissolved metals, total dissolved solids, nutrients and hydrocarbons. In addition to the water samples, a foam sample was collected at Errowanbang Weir in Flyers Creek and analysed for PFAS, surfactants and hydrocarbons.

We compared the surface water results to the Australian livestock, irrigation and ecological water quality guidelines where they were available (ANZECC and ARMCANZ 2000, ANZG 2018, PFAS NEMP 2.0 2020). Total metals were compared to the Australian livestock and irrigation guidelines and dissolved metals were compared to ecological water quality guidelines. Total metals provide a more conservative estimate of exposure for livestock, whereas dissolved metals are used for ecological assessments as this is the bioavailable fraction of the metal (the part that is toxic to organisms).

Natural and synthetic foams can concentrate chemicals from the surrounding water. Due to this behaviour, chemical levels in foam can be significantly higher than in the surrounding water. It is therefore not appropriate to compare the foam results with water quality guidelines.

Perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA) and perfluorohexanesulfonic acid (PFHxS) concentrations were compared to ecological water quality guidelines in the PFAS National Environmental Management Plan (PFAS NEMP 2.0).

Sample locations

The aim of this sampling was to further investigate potential sources of contaminants and assess water quality in the Belubula River. Sampling locations were chosen based on locations of community concern, accessibility for sampling, previous testing and proximity to potential industrial sources of pollution. See the full list of sampling locations in Table 1 below.

The Newmont Cadia gold mine is surrounded by Cadiangullong Creek to the west and Flyers Creek to the east where they feed into the Belubula River south of the mine. These creeks have been part of the previous sampling events in the area.

The Blayney landfill, located at 4165 Mid Western Highway, operates under an Environmental Protection Licence (EPL 6180), and is subject to environmental monitoring as part of its operations. The landfill is adjacent to Mackenzies Waterholes Creek, which flows into Cowriga Creek and then into the Belubula River.

The sewage treatment plant (STP) located at 3502 Hobbys Yard Road supports the town of Blayney in the treatment and management of wastewater. It sits adjacent to the Belubula River, upstream of Carcoar Dam. It holds an EPL (1647) allowing discharge of up to 950 kL of treated effluent per day.

The Blayney Abattoir is located at the north end of Blayney adjacent to Abattoir Creek, which flows into the Belubula River. It is not operational and was closed more than 20 years ago.

Two quarries are located in the upper reaches of Abattoir Creek.

There is a composting and waste storage facility adjacent to Cowriga Creek.

Other diffuse sources of pollution in the catchment include run-off from agricultural lands and small townships (such as Blayney and Carcoar).

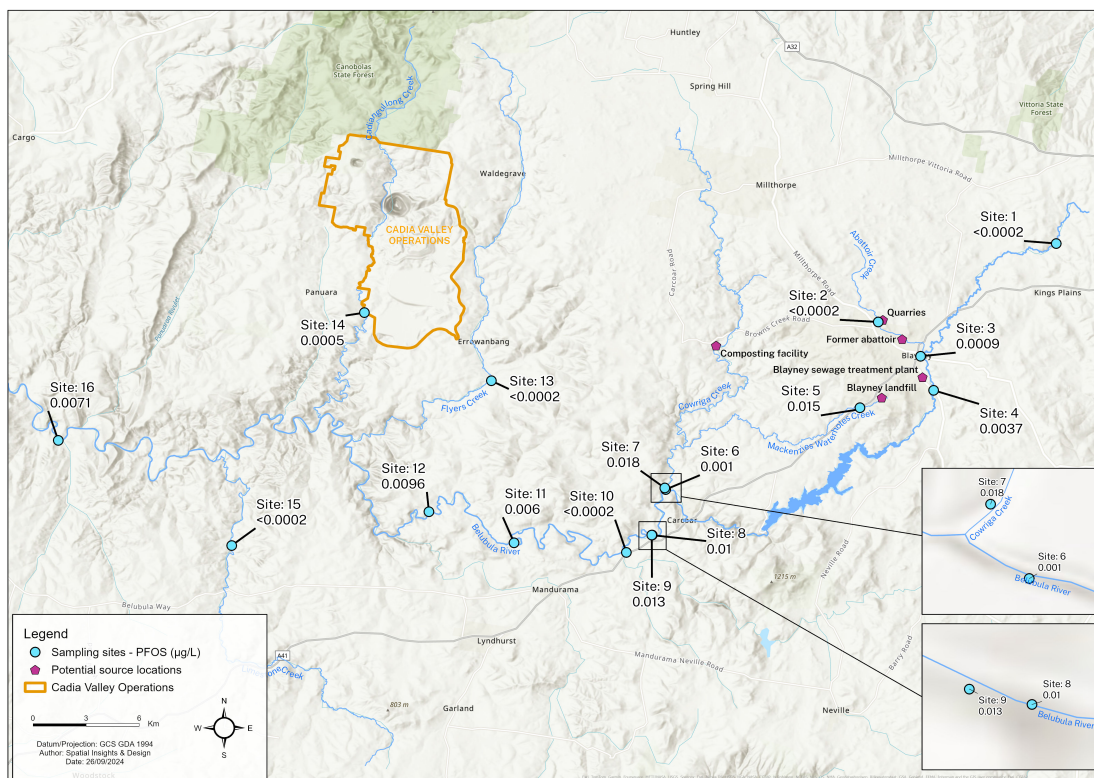
Sites with no known potential contamination sources were sampled for comparison.

Table 1 Sample site and location descriptions for surface water samples collected in the Belubula River catchment on 20 and 21 August 2024

Sampling site	Laboratory sample ID	Waterway	Location description	Potential contamination sources
SW 1	BRU SW10	Belubula River	Upstream of Blayney at Dungeon Road	No known sources
SW 2	BRS SW11	Abattoir Creek	Upstream of old abattoir and the Belubula River at Blayney	Adjacent to quarries
SW 3	BRD SW12	Belubula River	Off Newbridge Road, Goose Park, within township of Blayney	Old abattoir
SW 4	BRD SW13	Belubula River	~1 km downstream of Blayney Sewage Treatment Plant (STP) off Hobbys Yards Road	STP, old abattoir
SW 5	BRD SW14	Mackenzies Waterholes Creek	~1 km downstream of Blayney landfill	Landfill
SW 6	BRD SW15	Belubula River	~100 m upstream of Cowriga Creek junction with Belubula River, downstream of Carcoar Dam	STP, old abattoir

Sampling site	Laboratory sample ID	Waterway	Location description	Potential contamination sources
SW 7	BRJ SW17	Cowriga Creek	~15 km downstream of Blayney landfill; ~50 m upstream of the Belubula and Cowriga Creek junction, near Carcoar	Landfill, composting facility
SW 8	CC SW23	Belubula River	Immediately upstream of Ashburton Bridge, off Errowanbang Road	Landfill, old abattoir and STP, composting facility
SW 9	BRJ SW16	Belubula River	Immediately downstream of Ashburton Bridge off Errowanbang Road	Landfill, old abattoir, STP, composting facility
SW 10	CC SW26	Coombing Creek	~100 m upstream of Coombing Creek junction with the Belubula River, off Mid Western Highway	No known sources
SW 11	BRU SW22	Belubula River	Burnt Yards Road Bridge	Landfill, old abattoir, STP, composting facility
SW 12	CAD SW9	Belubula River	Bakers Shaft Reserve	Landfill, old abattoir, STP, composting facility
SW 13 (water and foam sampled)	FC SW24	Flyers Creek	~10 km upstream of junction with Belubula River, off Old Errowanbang Road	Mining
SW 14	CAD SW28	Cadiangullong Creek	Off Panuara Road, directly west of Cadia mine	Mining
SW 15	BRP SW20	Limestone Creek	~8 km upstream of junction with Belubula River at Boonderoo	No known sources
SW 16	BR SW27	Belubula River	Off Malongulli Road	Landfill, old abattoir, STP, composting facility and mining

Figure 1 Overview of the sampling sites



Sampling results

Sampling and analysis results for surfactants and PFAS, physicochemical parameters, total and dissolved metals and hydrocarbons are described below, with data listed in Tables 2 and 3. Sampling and analysis results for the foam sample collected at Errowanbang Weir in Flyers Creek are listed in Table 4.

Livestock and irrigation water quality guidelines

There are no established livestock drinking or irrigation guidelines for PFAS, or any that cover all surfactant chemicals.

Aluminium slightly exceeded the livestock drinking water guideline value of 5mg/L in the Belubula River upstream of Blayney, with no known contamination sources (site 1, Table 2). Specifically, the draft livestock drinking water guideline values for poultry, sheep and cattle are 3.6, 5.1, and 5.6 mg/L, respectively (ANZG, 2023). The concentration at site 1 (5.3 mg/L) exceeds the draft livestock guideline value for sheep and poultry however, does not exceed the cattle guideline value. The ANZG (2023) guidance document notes that an exceedance of the default livestock guideline value may suggest potential harm to animal health; however, also notes that higher concentrations of aluminium may be tolerated in many instances.

There were no other exceedances of any current irrigation or livestock water guideline values. Where the concentration of a pollutant is below or outside the range for the relevant guideline value, the pollutant is unlikely to pose a risk for irrigation or stock water use.

It should be noted however, that the draft livestock drinking water guidelines (in review) provide a more conservative value for total dissolved solids (TDS) (500mg/L), which is slightly exceeded in samples taken

from Mackenzies Waterholes Creek (site 5; 620mg/L) and Limestone Creek (site 15; 550mg/L). At these concentrations, it is unlikely there will be any adverse effects experienced by livestock, except a slight impact on taste (ANZG 2023). Preliminary assessments suggests that risks to humans from consuming cattle that utilise these waterways is considered low. However further sampling data is being collected for advice by the PFAS Technical Advisory Group.

Ecological water quality guidelines

Surfactants including PFAS

Samples were tested for anionic and non-ionic surfactants, including a targeted range of per- and polyfluoroalkyl substances (PFAS). All samples contained non-ionic surfactants, including those collected from locations with no known contamination sources (Table 3). The PFAS compounds that were analysed are anionic surfactants. ‘Surfactants’ can cause foam in waterways, especially after heavy rainfall and in turbulent water. They can be either natural or synthetic chemicals. The presence of surfactants in locations with no known contamination sources is consistent with foam observations in other catchments with no known industrial sources. There are no established ecological guidelines that cover all surfactant chemicals.

The widespread presence of PFAS in the environment in Australia and around the world is a result of its unique properties, which have led to it being widely used for many decades. For example, PFAS are persistent and highly resistant to physical, chemical and biological degradation. Consequently, PFAS are found in humans, animals and the environment around Australia (PFAS NEMP 2.0 2020).

Figure 1 displays the PFOS concentrations measured in the Belubula River catchment. The map includes local industry locations, including the Cadia gold mine, Blayney landfill, Blayney Sewage Treatment Plant (STP), a decommissioned abattoir, quarries and composting and waste storage facility.

PFAS substances, including PFOS (perfluorooctanesulfonic acid), PFOA (perfluorooctanoic acid) and PFHxS (perfluorohexanesulfonic acid) were detected in 13 of the 16 sites sampled, with PFOS detected above the ecological water quality guidelines (NEMP 2020) at 11 sites (Table 3). The presence of PFOS in water samples does not necessarily mean there is a risk to human health or livestock. Sampling locations in Mackenzies Waterholes and Cowriga Creek had the highest PFOS concentrations (0.0115 - 0.018 µg/L). These elevated levels continued into the Belubula River down to the furthest sampling point downstream (0.006–0.013 µg/L). These are above ambient concentrations measured in Victorian agricultural catchments (up to 0.003 µg/L, VIC EPA 2022). PFOS concentrations in samples collected from the Belubula River on 21-22 August 2024 (highest concentration 0.013 µg/L) were lower than those collected in May and July (highest concentration 0.06 and 0.071 µg/L, respectively).

PFAS was detected in the foam sample, including PFOS and PFOA, but not at concentrations expected for a foam based on these chemicals (Table 4). A concentration of 3.9mg/L for non-ionic surfactants in the foam sample confirms that the foam is probably coming from some other source (not a PFAS source), containing a mixture of surfactants.

Physicochemical stressors

Electrical conductivity and pH were outside the default ecological guideline ranges (ANZECC 2000) at some sites, including those with no known potential contamination sources (Table 3). It is important to note that these exceedances may not indicate ecological risk, as they are not site-specific.

Nutrient levels in the Belubula River catchment were all compared against the ecological guideline values for upland river ecosystems in NSW (ANZECC 2000). Most sites detected nutrient levels above the guideline values, with total nitrogen detected at up to eight times above the guideline value, oxides of nitrogen at up to 26 times the guideline value, and total phosphorus at up to 10 times the guideline value. High concentrations of nutrients can result in excessive growth of algae (ANZECC 2000).

Ammonia was also elevated in 12 of the 16 sites within the catchment, including sites with no known industrial contamination sources, when compared against the guideline value protecting against algal blooms (ANZECC 2000). However, the ammonia concentrations of all samples were below the toxicant guideline value (ANZG 2018).

Metals

Dissolved aluminium and copper concentrations exceeded ecological water quality guidelines at some sites, including those with no known potential contamination sources (Table 3). Dissolved copper concentrations were above the guideline value at all sites except one site in the Belubula River, just upstream of where Cowriga Creek flows in (site 6). The dissolved aluminium concentrations exceeded the guideline value at sites 1 (Belubula River, upstream of Blayney), 10 (Coombing Creek) and 14 (Cadiangullong Creek). There are no known potential sources of contamination upstream of site 10 (Coombing Creek) or site 1 (Belubula River, upstream of Blayney). Cadiangullong Creek (site 14) is adjacent to Cadia mine. The dissolved copper concentration in Cadiangullong Creek was several times higher than at any other site.

All other dissolved metal concentrations were below the ecological guideline values at all sites.

Copper exceedances above the ecological guideline value in this testing are consistent with sampling results from May, with elevated levels particularly concentrated in Cadiangullong Creek. However, there were exceedances across the entire Belubula River catchment, including upstream of identified industry.

Hydrocarbons

There were no volatile and semi-volatile hydrocarbons detected in any samples.

Table 2 TDS, nutrient and metal (total acid-extractable) concentrations compared to the Australian Livestock Drinking Water Quality Guidelines and the Australian Irrigation Water Quality Guidelines (ANZECC & ARMCANZ 2000)

Parameter	Guideline for livestock drinking water mg/L	Guideline for irrigation water (short-term use) mg/L	Site 1 Belubula River mg/L	Site 2 Abattoir Creek mg/L	Site 3 Belubula River mg/L	Site 4 Belubula River mg/L	Site 5 Mackenzies Waterholes Creek mg/L	Site 6 Belubula River mg/L	Site 7 Cowriga Creek mg/L	Site 8 Belubula River mg/L
TDS	0–2000*	-	420	330	380	350	620	220	230	220
Total nitrogen	-	25–125	2	1.3	1.7	1.6	1.1	0.9	1.4	1.2
Total phosphorus		0.8–12	0.2	0.1	0.1	0.2	0.06	<0.05	0.1	0.08
Metals										
Aluminium	5	20	5.3	0.61	1.4	1.5	1.1	0.31	2.2	1.1
Arsenic	0.5	2	0.003	0.002	0.002	0.002	0.001	0.001	0.005	0.003
Copper	0.5**	5	0.0058	0.0033	0.0042	0.0052	0.0044	0.0017	0.0051	0.0041
Lead	0.1	5	0.0024	0.0003	0.0008	0.0008	0.0006	0.0003	0.0009	0.0006
Manganese	No value	10	0.12	0.045	0.11	0.14	0.24	0.077	0.076	0.08
Mercury	0.002	0.002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel	1	2	0.0073	0.005	0.0055	0.0054	0.0045	0.0013	0.0035	0.0026
Zinc	20	5	0.012	0.003	0.006	0.007	0.004	0.002	0.005	0.004

Parameter	Guideline for livestock drinking water mg/L	Guideline for irrigation water (short-term use) mg/L	Site 9 Belubula River mg/L	Site 10 Coombing Creek mg/L	Site 11 Belubula River mg/L	Site 12 Belubula River mg/L	Site 13 Flyers Creek mg/L	Site 14 Cadiangu llong Creek mg/L	Site 15 Limestone Creek mg/L	Site 16 Belubula River mg/L
TDS	0–2000*	-	220	150	190	200	270	150	550	310
Total nitrogen	-	25–125	1.2	1.1	1.1	1.1	0.8	0.4	1.1	1.1
Total phosphorus	-	0.8–12	0.09	0.1	0.08	0.07	<0.05	<0.05	<0.05	0.07
Metals										
Aluminium	5	20	1.2	1.9	1.5	1.3	0.75	2	0.72	1.5
Arsenic	0.5	2	0.003	0.001	0.002	0.002	0.002	<0.001	0.001	0.004
Copper	0.5**	5	0.0039	0.0053	0.0043	0.0047	0.0035	0.037	0.0034	0.0064
Lead	0.1	5	0.0007	0.0009	0.0007	0.0007	0.0004	0.0008	0.0003	0.0007
Manganese	-	10	0.11	0.19	0.081	0.097	0.09	0.11	0.058	0.095
Mercury	0.002	0.002	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel	1	2	0.0024	0.0025	0.0024	0.0024	0.0014	0.0014	0.0021	0.0022
Zinc	20	5	0.004	0.005	0.004	0.006	0.003	0.014	0.002	0.004

*Value for poultry; other livestock tolerate higher TDS concentrations. Draft revised livestock drinking guidelines have TDS set to <500mg/L: this is exceeded in the Mackenzies Waterholes Creek and Limestone Creek sites (samples 5 and 11).

**Guideline value for sheep. Value is higher for other typical types of livestock.

Any guideline exceedances have been bolded.

Table 3 Physicochemical water quality, nutrient and metal concentrations compared to ecological water quality guidelines (ANZG 2018, ANZECC & ARMCANZ 2000 and PFAS NEMP 2.0 2020)

Parameter	Ecological water quality guideline	Site 1 Belubula River	Site 2 Abattoir Creek	Site 3 Belubula River	Site 4 Belubula River	Site 5 Mackenzies Waterholes Creek	Site 6 Belubula River	Site 7 Cowriga Creek	Site 8 Belubula River
Phys Chem									
Temperature (°C)	-	10.8	11.9	11.1	10.9	12.1	12.5	12.6	11.8
Conductivity (µS/cm)	30–350	384	529	548	527	953	367	291	356
pH	6.5–8.0	7.9	8.0	7.8	7.8	7.7	8.2	7.9	6.8
Nutrients (mg/L)									
Total Nitrogen	0.25	2.0	1.3	1.7	1.6	1.1	0.9	1.4	1.2
Ammonia	0.013	0.033	0.022	0.033	0.03	0.006	<0.005	0.025	0.016
NOx as N	0.015	0.2	0.2	0.2	0.2	0.2	0.1	0.3	0.2
Total Phosphorus	0.02	0.2	0.1	0.1	0.2	0.06	<0.05	0.1	0.08
Metals (mg/L)									
Aluminium	0.055	0.24	0.01	0.05	0.05	0.01	<0.01	0.1	0.01
Arsenic	0.013	0.002	0.002	0.002	0.002	<0.001	0.001	0.004	0.002
Copper	0.0014	0.0034	0.0019	0.0027	0.003	0.0027	0.0008	0.0029	0.002
Lead	0.0034	0.0005	<0.0001	0.0001	0.0001	<0.0001	<0.0001	0.0001	<0.0001
Manganese	1.9	0.084	0.005	0.074	0.082	0.18	0.017	0.02	0.019

Mercury	0.00006	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel	0.011	0.0047	0.0032	0.0051	0.0038	0.0029	0.001	0.002	0.0014
Zinc	0.008	0.002	<0.001	0.001	0.002	0.002	<0.001	<0.001	<0.001
Surfactants & PFAS (µg/L)									
PFHxS	-	0.0005	0.0002	0.001	0.0078	0.028	0.0025	0.0097	0.0062
PFOA	19	<0.0002	0.0002	0.0004	0.001	0.032	0.0007	0.001	0.001
PFOS	0.00023	<0.0002	<0.0002	0.0009	0.0037	0.015	0.001	0.018	0.01
Anionic surfactants	-	<100	<100	<100	<100	<100	<100	<100	<100
Non-ionic surfactants	-	1300	1000	1800	1900	1300	2000	2600	2300
Parameter	Ecological water quality guideline	Site 9 Belubula River	Site 10 Coombing Creek	Site 11 Belubula River	Site 12 Belubula River	Site 13 Flyers Creek	Site 14 Cadiangullong Creek	Site 15 Limestone Creek	Site 16 Belubula River
Phys Chem									
Temperature (°C)	-	12.5	13.6	12.6	13.6	13.3	12.7	12.9	14.0
Conductivity (µS/cm)	30–350	337	202	279	302	444	189	969	462
pH	6.5–8.0	8.0	8.2	8.0	8.0	7.4	7.7	7.6	7.9

Nutrients (mg/L)									
Total Nitrogen	0.25	1.2	1.1	1.1	1.1	0.8	0.4	1.1	1.1
Ammonia	0.013	0.009	<0.005	0.021	0.008	0.016	<0.005	0.033	<0.005
NOx as N	0.015	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.4
Total Phosphorus	0.02	0.09	0.1	0.08	0.07	<0.05	<0.05	<0.05	0.07
Metals (mg/L)									
Aluminium	0.055	0.01	0.24	0.04	0.03	0.04	0.12	<0.01	0.02
Arsenic	0.013	0.002	<0.001	0.002	0.002	0.001	<0.001	<0.001	0.002
Copper	0.0014	0.0019	0.0026	0.0024	0.0024	0.0026	0.01	0.002	0.0031
Lead	0.0034	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Manganese	1.9	0.022	0.023	0.02	0.015	0.067	0.014	0.022	0.004
Mercury	0.00006	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Nickel	0.011	0.0015	0.0013	0.0015	0.0015	0.0012	<0.0005	0.0015	0.0012
Zinc	0.008	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Surfactants & PFAS (µg/L)	-								
PFHxS	-	0.0057	<0.0002	0.003	0.0033	<0.0002	0.0003	<0.0002	0.002
PFOA	19	0.001	<0.0002	0.0006	0.0007	<0.0002	<0.0002	<0.0002	0.0004

PFOS	0.00023	0.013	<0.0002	0.006	0.0096	<0.0002	0.0005	<0.0002	0.0071
Anionic surfactants	-	<100	<100	<100	<100	<100	<100	<100	<100
Non-ionic surfactants	-	1400	1000	1900	2600	2800	2700	1200	1600

Any guideline exceedances have been bolded.

Table 4 Sample results for the foam sample collected at Errowanbang Weir, Flyers Creek

Parameter (µg/L)	Foam sample results (Errowanbang Weir, Flyers Creek)
PFHxS	<0.0002
PFOA	0.0002
PFOS	0.016
Anionic surfactants	<100
Non-ionic surfactants	3900

What happens next

This sampling provides a snapshot of water quality at a point in time and does not capture variability over time, limiting how the data is interpreted and the conclusions that can be drawn. Sampling to date has shown elevated PFAS levels in the Belubula River catchment and copper levels in Cadiangullong Creek. Surfactants are present in samples collected from throughout the catchment, including sites without known contamination sources.

The presence of PFAS in the environment does not necessarily mean there is a health risk, however identifying sites that need investigating is an important precaution to reduce the risk of community exposure to PFAS. We have shared the results of our sampling in the region with the NSW PFAS Technical Advisory Group for advice.

The NSW PFAS Technical Advisory Group includes representatives from NSW Health, Department of Primary Industries and the NSW Department of Climate Change, Energy, the Environment and Water. NSW Health advises that water from rivers and creeks should not be used for drinking or cooking without appropriate treatment. Untreated water may contain disease causing micro-organisms, chemical contaminants or algal blooms.

The EPA is continuing to review and monitor surface water quality in the region. We will provide ongoing updates to the community as new data becomes available. If any situation involving the water quality changes, the EPA will immediately inform the community.

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