Baseline Report – Unnamed Creek and Wianamatta-South Creek at St Marys

Prepared for:
Sydney Water

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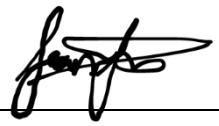
Reviewed by 

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Acronyms / Abbreviations / Glossary

ANZG	Australian and New Zealand guidelines for fresh and marine water quality
AWTP	Advanced Water Treatment Plant
DGV	Default Guideline Value
DO	Dissolved Oxygen
eDNA	Environmental DNA
EPBC Act	*Environment Protection and Biodiversity Conservation Act*
EPL	Environment Protection Licence
EPT index	*Ephemeroptera, Plecoptera* and *Trichoptera* family index
FM Act	*Fisheries Management Act 1994*
GGBF	Green and Golden Bell Frog
LDP	Licensed Discharge Point
LOO	Likelihood of Occurrence
LVA	Licence variation application
km	kilometres
Monitoring Plan	St Marys and Penrith Diversion Aquatic Monitoring Plan 2023–27
NSW	New South Wales
ON	Oxidised Nitrogen
PMST	Protected Matters Search Tool
RAM	Rapid Assessment AUSRIVAS Methodology
Receiving Environment	Unnamed Creek, Wianamatta-South Creek below the confluence with Unnamed Creek and the Hawkesbury-Nepean River below the confluence with Wianamatta-South Creek
RRA	Rapid Riparian Assessment
Stantec	Stantec Australian Pty Ltd
SIGNAL-SG	Stream Invertebrate Grade Number Average Level – Sydney Genus
TN	Total Nitrogen
WRRF	Water Resource Recovery Facility

1 Introduction

Sydney Water operates a network of sewage treatment, water supply and recovery facilities in the Hawkesbury-Nepean catchment including the St Marys, Quakers Hill and Penrith Water Resource Recovery Facilities (WRRF) and the St Marys Advanced Water Treatment Plant (AWTP) (Figure 1-1).

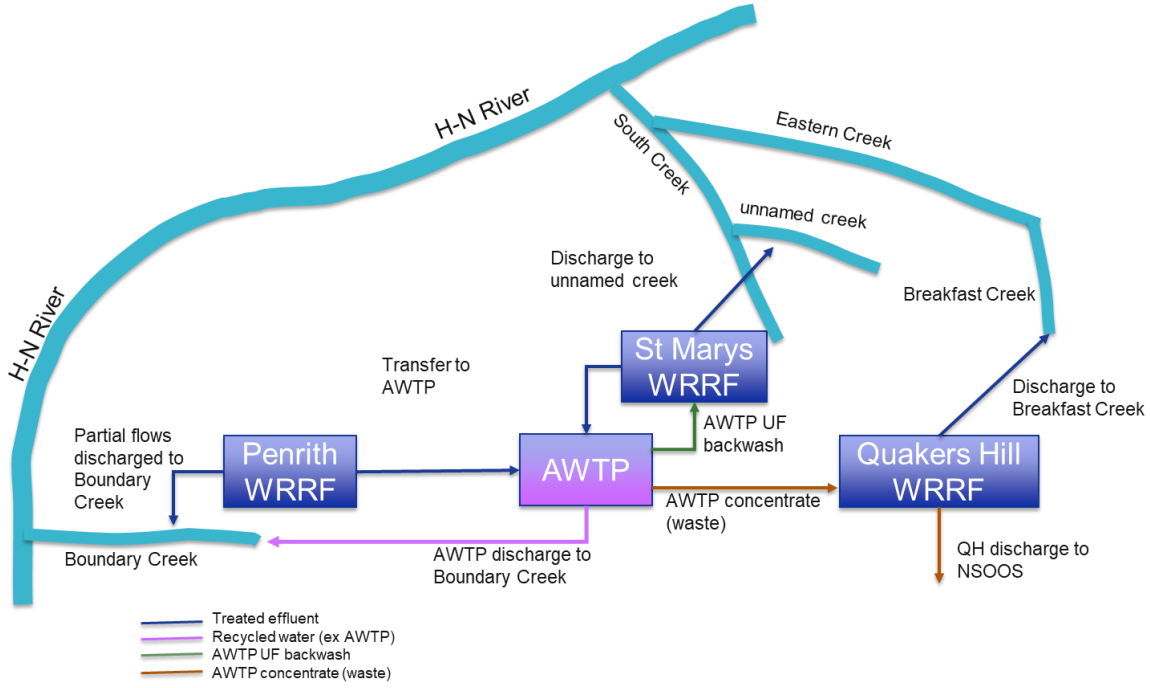


Figure 1-1: Sydney Water Network Diagram

St Marys WRRF discharges into an unnamed creek, a first order stream which flows into Wianamatta-South Creek and then into the Hawkesbury-Nepean River. St Marys WRRF historically has discharged 10–40 ML/day with this making up the vast majority of dry weather flows in the creek over the last 8 decades. Discharges from St Marys WRRF are licenced under Environment Protection Licence (EPL) 1729.

Remedial works in Boundary Creek require ceasing the discharge of flows from the St Marys AWTP into Boundary Creek and the diversion of all flows normally treated by the AWTP (from Penrith WRRF and St Marys WRRF) to an alternate discharge location. Sydney Water has determined that the unnamed tributary of South Creek, where St Marys WRRF current licensed discharge point (LDP) resides is the only feasible alternate discharge location. Discharge arrangements commenced on 27 August 2024 and will be in place until around November 2026 when remedial works are estimated to be completed.

A variation to EPL 1729 has been acquired to account for the change of discharges from St Marys WRRF. It is estimated that the flows from St Marys WRRF to the unnamed creek will increase from an average dry weather flow of 10 ML/d, up to a maximum of 60 ML/d.

Sydney Water will undertake water quality and ecosystem health monitoring under the St Marys and Penrith Diversion Aquatic Monitoring Plan 2023–27 prior to, during, and following flow diversions, to understand any possible impacts to receiving waterways.

1.1 St Marys and Penrith Diversion Aquatic Monitoring Plan 2023–27

Sydney Water has developed the St Marys and Penrith Diversion Aquatic Monitoring Plan 2023–27 (Monitoring Plan) with the objectives:

- To monitor the baseline assessment, during and post-diversion potential impacts to the unnamed creek and South Creek, downstream of St Marys WRRF due to increased volumes discharged to waterways (primary objective).
- To continue monitoring Boundary Creek and the Nepean River at Penrith as part of routine waterway monitoring programs to determine any impacts from the reduced flows during diversion, on the receiving waterways.

The expected timeframe that this Monitoring Plan covers is:

- **Baseline period:** Prior to flows increasing (i.e. before AWTP offline), between November 2023 and 27 August 2024
- **During diversion works:** August 2024 to November 2026
- **Post-diversion works:** November 2026 onwards

As part of meeting the primary objective of the Monitoring Plan it is required to assess environmental conditions in the unnamed creek and Wianamatta-South Creek, downstream of St Marys WRRF at proposed monitoring sites NS241, NS242, NS23A, NS26 prior to flow increases. These assessments will establish a baseline of pre-impact conditions, as detailed in this Baseline Report.

It is noted that sites on the unnamed creek (NS241, NS242) have not been monitored until recently with limited historical data available. The water quality data available is not sufficient to form a baseline as per ANZG (2018), with a descriptive assessment provided as an alternative.

Figure 1-2 Map of St Marys WRRF and red monitoring sites on the unnamed creek (NS241, NS242) and blue monitoring sites at Wianamatta-South Creek (NS23A, NS26)

1.2 Aims and Objectives

This baseline report aims to provide a broad description of the environment including water quality, habitats and species present in both Unnamed Creek and Wianamatta-South Creek downstream of St Marys WRRF, including at proposed Monitoring Sites NS241, NS242, NS23A, NS26 prior to flows increasing.

2 Methodology

A review of publicly available information and documents provided by Sydney Water was carried out to identify the existing biodiversity and natural environment features, such as aquatic habitat, threatened species, populations, and communities. Reviewed information included:

- Fish Biodiversity Assessment at St Marys Treatment Plant – December 2023
- Fish Biodiversity Assessment at St Marys Treatment Plant – March 2024
- EnviroDNA Metadata and qPCR results – Green and Golden Bell frog December 23 & March 24
- Rapid Riparian Assessment (RRA) – Summer 2023
- Rapid Riparian Assessment (RRA) – Autumn 2024
- Rapid Riparian Assessment (RRA) – Winter 2024
- St Marys Water Quality Data 17/11/2023 – 12/08/2024
- St Marys Platypus eDNA results.xlsx – March 2024
- St Marys and Penrith Diversion – Aquatic Monitoring Plan 2023-27
- South Creek Spring 2023 SIGNAL_SG raw data and scores.xlsx
- South Creek Summer 2023 SIGNAL_SG raw data and scores.xlsx
- St Marys Macroinverts sp23 to win24.xlsx
- St Marys Macrophytes site inspections photos 26.10.23, 13.12.23 & 08.02.24
- Macrophyte Mapping Field data sheet's at sites NS23, NS241, NS242, NS26(December 23, March 24, July 24).

3 Baseline Condition Assessment

The existing environment of the unnamed creek and Wianamatta-South Creek downstream of St Marys WRRF during the baseline period are described below.

3.1 The unnamed creek

The unnamed creek, which the St Marys WRRF discharges into, is a first order stream and tributary of Wianamatta-South Creek, located within the Hawkesbury-Nepean catchment. Since 1939 the unnamed creek has functioned as a permanently flowing stream from the consistent discharges from St Marys WRRF even during dry weather conditions. It is likely, the unnamed creek would have functioned as an ephemeral system with limited periodic flows from its small catchment area.

3.1.1 Riparian and Aquatic Habitat

The unnamed creek presents as a sequence of pools connected by riffles and runs with a fine-grained channel bed overhung by well-established tree canopy cover. The channel is fringed with native grasses, weeds and submerged macrophytes. Downstream, the creek meets Wianamatta-South Creek below a newly constructed bridge on the Wianamatta Parkway.

As part of a condition assessment conducted in January 2024 (Sydney Water, 2024) the unnamed creek was divided into 5 “Reaches” based on the observed geomorphological conditions. Riparian and aquatic habitat was described in each reach with this description remaining similar through to the next survey in February 2024 (Table 3-1).

Table 3-1. Habitat description – the unnamed creek

Reach ID	Habitat description
1	System of riffles and pools, with limited riparian vegetation. Flood impact damage and scouring was present including undercut banks and root exposure. Both banks presented significant weed cover (more than 50% ground cover). School of approximately 15 Australian Bass (*Percalates novemaculeata)* were observed at the confluence between Unnamed Creek and Wianamatta-South Creek.

Left bank

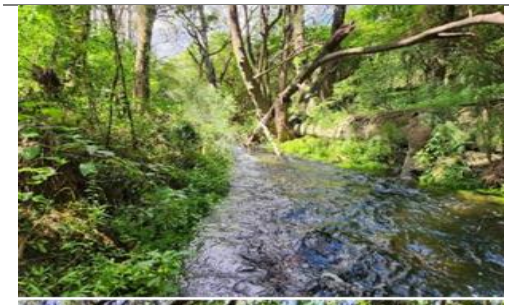
Right bank

2 System of riffles and pools with floodplain habitat present on both banks. Flood impact damage and scouring was present including bank undercut and root exposure. Both banks presented significant weed cover (more than 50% ground cover).

Left bank

Right bank

3 Consisted of a system of riffle pool format, with substantial riparian growth made up primarily of weeds on both banks. Canopy trees were well established with floodplain habitat present on both left and right banks. Substrate was mostly pebbles and small cobbles with fish, water dragons and dragonflies observed.

	Left bank	Right bank
4	Riffle and pool sequence, with substantial riparian vegetation and large instream woody debris. Floodplain habitats present on both left and right banks. Substrate was mostly pebbles, silt, sand and small cobbles.	
		
	Left bank	Right bank
5	Furthest downstream reach of Unnamed Creek to confluence with Wianamatta-South Creek. Culvert present. Substantial riparian vegetation with large instream woody debris. Both banks presented significant weed cover (more than 50% ground cover). Floodplain habitats present on both left and right banks. Substrate was mostly pebbles, silt, sand, cobbles, and detritus.	
	 	 

Left bank	Right bank

Further observations of aquatic habitat and instream vegetation have been provided for NS242(upstream) and NS241 (downstream) of St Marys WRRF, during December 2023, March 2024 and July 2024 (Table 3-2).

Table 3-2. Observations – the unnamed creek

Site	**General habitat description**	**Macrophytes**		**Sample Events**			
		Scientific name	**Common name**	**Dec 2023**	**March 2024**	**July 2024**	**Native/ Exotic**
NS242 (upstream)	Water visibility: generally clear during not rainfall periods otherwise creek water observed turbid (brown colour). Observed algae, overhanging riparian vegetation and organic debris.	*Persicaria decipens*	Slender knotweed	✓	-	-	Native
		Cyperus eragrostis	Umbrella sedge	✓	-	-	Native
		Alternanthera philoxeroides	Alligator weed	✓	-	-	Exotic
		Typha spp.	Cumbungis	✓	-	✓	Unknown to species level
		-	Green filamentous algae	-	-	✓	-
NS241 (downstream)	Water visibility: generally clear during not rainfall periods otherwise creek water	*Sagittaria platyphylla*	Arrowhead	✓	✓	✓	Exotic
		Potamageton crispus	Curled pondweed	✓	✓	✓	Native

Site	General habitat description	Macrophytes		Sample Events			
		Scientific name	**Common name**	**Dec 2023**	**March 2024**	**July 2024**	**Native/ Exotic**
	observed turbid (brown colour). Observed algae, overhanging riparian vegetation and organic debris.	*Samolus valerandi*	Common brookweed	✓	✓	✓	Native
		Persicaria hydropiper	Water pepper	✓	-	-	Native
		Vallisneria	Eelgrass	✓	✓	✓	Native

In addition to assessing the riparian vegetation and creek channel conditions a Rapid Riparian Assessment (RRA) technique has been applied at sites in the unnamed creek. The RRA is a robust, rapid, and cost-effective method for the collection of data on the ecological and geomorphological condition of waterways in urban catchments (Dean and Tippler 2016). The RRA provides information on and assessment of the features of the stream and the vegetation assemblages surrounding the stream including the assessment of features relating to the site, channel, deposition, erosion, riparian vegetation, and vegetation structure. Each variable within these categories is scored and forms a score that will fall into an overall riparian health category.

Three RRAs have occurred in the baseline period in December 2023, March 2024 and July 2024). NS242, located upstream at unnamed creek scored poor in December 2023 and fair in March and July 2024, indicative of 'poor channel stability and limited riparian capacity where "hard' engineering solutions may be needed' (Dean and Tippler 2016). NS241, located downstream at unnamed creek scored Good across all assessments, indicative of a 'reach that may show a stable channel but poor riparian zone and vegetation condition requiring limited/elementary rehabilitation works' (Dean and Tippler 2016). Full breakdown of the results can be displayed within Table 3-4 RRA results at unnamed creek with colour scoring legend found within Table 3-3.

Table 3-3 RRA score range grading legend

Category	Score Range	Symbology
Excellent	>60	
Good	27 to 59.99	

Fair	-6 to 26.99	
Poor	-39 to -5.99	
Very Poor	-72 to -39.99	

Table 3-4 RRA results at unnamed creek

Site	December 2023	March 2024	July 2024
NS242 (upstream)			
NS241 (downstream)			

3.1.2 Water Quality

Water quality parameters have been monitored in the unnamed creek from November 2023 with data collected from up to 15 sampling events during the baseline period.

Water quality was generally of poor condition upstream (NS242) of St Marys WRRF than downstream (NS241). Turbidity, ammonia and total iron all markedly decreased at downstream, whilst total nitrogen (TN), oxidised nitrogen (ON) and total copper increased. The increase in TN, ON and total copper is consistent with what is expected due to discharges from St Marys WRRF.

Full comprehensive breakdown of water quality data is presented within *Table 3-5* with all red values highlighting exceedance of guideline values. Relevant guideline levels for the receiving environment based on the ANZG DGVs and Wianamatta-South Creek WQOs for each parameter are provided. Values given are to a 80-90% species protection level where applicable as unnamed creek is considered a 'highly disturbed' ecosystem condition.

Table 3-5. Baseline water quality values – unnamed creek

		NS242 (upstream)					NS241 (downstream)				
Parameters	**Guideline values**	**Median**	**Mean**	**Min**	**Max**	**N=**	**Median**	**Mean**	**Min**	**Max**	**N=**
Temperature (ºC)	-	19.9	17.8	10.2	25.8	15	22.5	21.8	15.2	27.3	13
Field dissolved oxygen (mg/L)	-	4.6	5.0	2.3	8.3	15	8.1	8.5	7.4	10.2	13
Percent dissolved oxygen (%sat)	43-75[2]	50.0	53.2	28.6	91.1	15	95.6	96.0	87.7	111	13
pH	6.5-8.0[1]	7.30	7.34	6.99	7.90	15	7.49	7.57	7.20	8.31	13
Conductivity (µS/cm)	125–2200	639	850	97.0	1937	15	997	961	483	1223	13
Turbidity (NTU)	6-50[2]	7.0	37.8	2.0	420	15	1.3	11.9	0.6	120	13
Total suspended solids (mg/L)	-	9.00	28.4	2.00	250	15	2.00	5.57	2.00	25.0	13
Ammonia NH3-N (mg/L)	1.43-2.3[1]	1.73	8.11	0.15	64.2	14	0.02	0.23	0.01	2.64	13
Oxidised nitrogen (mg/L)	0.04[1]	0.32	0.33	0.02	0.92	14	5.70	5.06	0.40	7.25	13
Total nitrogen (mg/L)	0.35[1]	2.27	8.95	1.14	66.40	14	6.14	5.95	0.82	7.95	13
Soluble reactive phosphorus (mg/L)	-	0.06	0.06	0.01	0.17	14	0.01	0.06	0.01	0.33	13
Total phosphorus (mg/L)	0.025[1]	0.21	0.20	0.06	0.33	14	0.05	0.11	0.02	0.65	13
Total aluminium (µg/L)	80-150[1]	96.0	854	14.0	1040	15	57.0	378	32.0	3870	13
Total cobalt (µg/L)	1.4[1]	0.60	0.90	0.20	4.60	15	0.70	0.71	0.40	1.30	13
Total copper (µg/L)	11-20[3]	2.9	6.4	0.8	46.2	15	12.0	12.0	7.9	15.5	13

		NS242 (upstream)					NS241 (downstream)				
Parameters	**Guideline values**	**Median**	**Mean**	**Min**	**Max**	**N=**	**Median**	**Mean**	**Min**	**Max**	**N=**
Total nickel (µg/L)	*13-17*[1]	1.3	2.0	1.0	9.7	15	3.7	3.8	2.9	6.7	13
Total zinc (µg/L)	15-31[1]	48.0	65.5	11.0	346.0	15	23.00	24.9	14.0	56.0	13
Total iron (µg/L)	-	999	1745	338	10900	14	86	516	54	4900	12
Dissolved organic carbon (mg/L)	-	8.50	8.51	6.20	11.40	14	8.85	9.84	7.50	20.70	12
Chlorophyll – a (mg/L)	0.003[1]	1.60	1.90	0.70	4.10	15	0.50	0.97	0.30	3.60	13

[1] *ANZG DGV*

[2]*Wianamatta-South Creek WQO*

[3]*Draft Copper Guideline Values*

3.1.3 Threatened Species

A review of the NSW Bionet and Commonwealth Protected Matters Search Tool (PMST) conducted as part of the Waterways Assessment Technical Report (Stantec, 2024) revealed 52 threatened species and/or populations of freshwater, estuarine or nearshore species that have a potential to occur in the locality of the unnamed creek.

A review of the habitat requirements for these species and the habitats within the unnamed creek identified that only one amphibian, the Green and Golden Bell Frog (*Litoria aurea*) (GGBF) had a moderate likelihood of occurrence (LOO) due to the presence of potential habitat present within the unnamed creek. Targeted Environmental DNA (eDNA) sampling for GGBF was conducted, as discussed in Section 3.1.5.

Note that birds were excluded from the assessment due to it being highly unlikely that they would be impacted by the changed flow regime.

3.1.4 Fish and Aquatic Mammals

Fish biodiversity was sampled twice (December 2023 and March 2024) in the unnamed creek, at sites NS241(downstream) and NS242(upstream) using eDNA metabarcoding. eDNA is a new and

innovative monitoring tool able to provide presence/absence, qualitative assessments of aquatic ecology with more accurate and defensible results than traditional methods alone.

Six fish species were detected at NS242 (upstream) and nine species at NS241 (downstream). A mix of exotic and native species were present at each site. This fish assemblage is typical for NSW urban creeks. No fish species found are protected under the EPBC Act or FM Act. Fish biodiversity was higher downstream of St Marys WRRF (NS241) likely due to the additional flows and increased dissolved oxygen (DO) in this area and connectivity with downstream Wianamatta-South Creek.

More species were detected in March 2024 compared to December 2023, with 14 species identified across both sites in March versus 8 in December. At NS242, 50% of all species detected were observed in both sampling events, while at NS241, 20% of all species were detected. This may or may not indicate that these species were not present at the time of sampling. eDNA analysis has limitations, as dominant species with higher biomass within a given aquatic environment can overshadow others by occupying the majority of available eDNA barcoding spaces, potentially leading to underrepresentation of less abundant species.

Targeted eDNA sampling for platypus (*Ornithorhynchus anatinus*) was also undertaken at NS241 and NS242 in March 2024. Targeted eDNA has a higher detection threshold for the 'target' species compared to metabarcoding. No platypus were detected at either site across all events.

Table. 3-6 Fish species detected by eDNA sampling during the baseline period

Site	Fish/Aquatic Mammal		Sample Events		
	Scientific name	**Common name**	**Dec 2023**	**March 2024**	**Native/Exotic**
NS242 (upstream)	*Anguilla australis*	Shortfin Eel	**-**	✓	Native
	Anguilla reinhardtii	Longfin Eel	✓	✓	Native
	Misgurnus anguillicaudatus	Oriental Weatherloach	✓	✓	Exotic
	Gambusia holbrooki	Eastern Mosquito fish	✓	✓	Exotic
	Eleotridae	Family of Sleeper Gobies	-	✓	-

Site	Fish/Aquatic Mammal		Sample Events		
	Scientific name	**Common name**	**Dec 2023**	**March 2024**	**Native/Exotic**
	Gobiomorphus coxii	Cox's Gudgeon	-	✓	Exotic
	Ornithorhynchus anatinus	Platypus	-	-	Native
NS241 (downstream)	*Anguilla australis*	Shortfin eel	✓	✓	Native
	Anguilla reinhardtii	Longfin Eel	-	✓	Native
	Carassius auratus	Goldfish	-	✓	Exotic
	Cyprinus carpio	European carp	✓	-	Exotic
	Gambusia holbrooki	Eastern Mosquito fish	-	✓	Exotic
	Eleotridae	Family of Sleeper Gobies	-	✓	-
	Hypseleotris	Genus of Carp Gudgeons	✓	✓	-
	Gobiomorphus coxii	Cox's Gudgeon	-	✓	Native

Site	Fish/Aquatic Mammal		Sample Events		
	Scientific name	**Common name**	**Dec 2023**	**March 2024**	**Native/Exotic**
	Ornithorhynchus anatinus	Platypus	-	-	Native
	Philypnodon macrostomus	Dwarf Flathead Gudgeon	-	✓	Native
	Percalates novemaculeata	Australian bass	✓	-	Native
	Potamalosa richmondia	Australian freshwater herring	✓	-	Native

3.1.5 Amphibians

Targeted eDNA surveys were conducted at NS241 and NS242 in December 2023 and March 2024 based on the potential presence of the GGBF. All samples at both sites returned negative. This targeted survey likely reduces the probability of GGBF being present in the unnamed creek.

3.1.6 Macroinvertebrates

The Rapid Assessment AUSRIVAS methodology (RAM) is widely used for the assessment of aquatic ecosystem health in Australia at broad spatial scales and has been used in the unnamed creek. As a component of RAM the SIGNAL-SG biotic index (Stream Invertebrate Grade Number Average Level – Sydney Genus) developed by Besley and Chessman (2008) was used to determine the environmental quality of sites. The SIGNAL-SG is a biotic index based on pollution sensitivity values (grade numbers) assigned to aquatic macroinvertebrate taxa at the Genus level. Each taxon is assigned a grade from 1 (tolerant) to 10 (highly sensitive) based on eco-toxicity assessment data (Besley and Chessman 2008).

Macroinvertebrates were sampled in unnamed creek during 3 events across summer 2023, autumn 2024 and winter 2024. Signal scores were similar between sites. Sites showed some minor variability with scores improving at NS242 (upstream) and declining at NS241 (downstream) during the baseline period. No EPT taxa were found upstream of St Marys WRRF (NS242) indicative of higher water pollution. SIGNAL-SG scores were indicative of sites with ‘mild to moderate water pollution’.

Macroinvertebrate communities at both sites lacked sensitive taxa and included many pollution tolerant insensitive taxa that have lower SIGNAL-SG sensitivity grades.

Figure 3-1 Average SIGNAL-SG Scores in unnamed creek from 2023-24 sampling

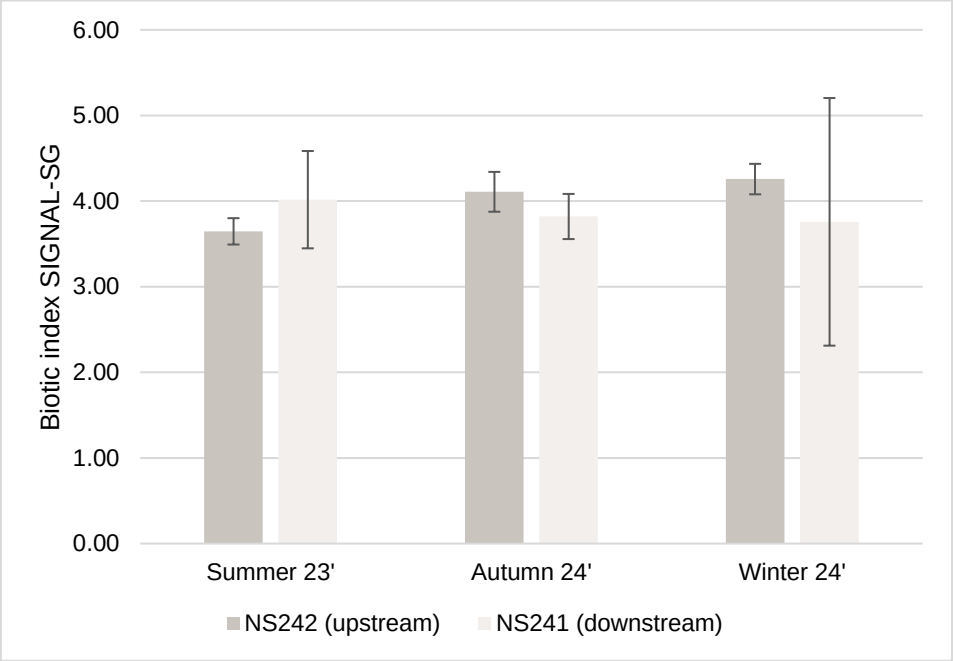


Table 3-7 Average SIGNAL-SG scores in Unnamed Creek from 2023-24 sampling

	NS242 (upstream)			NS241 (downstream)		
	Summer 2023	**Autumn 2024**	**Winter 2024**	**Summer 2023**	**Autumn 2024**	**Winter 2024**
SIGNAL-SG scores	3.65	4.11	4.26	4.02	3.82	3.76
EPT Index (%)	0	0	0	2.5	4.16	8.33

3.2 Wianamatta-South Creek

Wianamatta-South Creek is one of the major tributaries to the Hawkesbury-Nepean River, originating at Narellan and travelling 64 km through the Western Cumberland Plain before meeting the Hawkesbury River at Windsor. The waterway is tidally influenced in its lower reaches. Land use along Wianamatta-South Creek is predominantly rural including grazing and market gardening, and intensive agriculture such as poultry farming. Sampling sites in Wianamatta-South Creek include NS26 upstream of St Marys WRRF (control location) and Site NS23A downstream of St Marys WRRF

3.2.1 Riparian and Aquatic Habitat

RRA and aquatic habitats were surveyed in Wianamatta-South Creek during December 2023, March 2024 and July 2024. Riparian growth at both NS26 (upstream) and NS23A (downstream) is primarily made up of weed cover on both banks (more than 50% ground cover). There is extensive large instream wood debris. Riffles and pool sequences are present around the debris with floodplain habitat with low wooded scrub vegetation established along both banks. Semi-mature and mature trees are present, albeit infrequently.

RRA's were undertaken at both sites across all three sampling events with data indicating the riparian condition was 'Good', indicating 'reaches that may show a stable channel but poor riparian zone and vegetation condition requiring limited/elementary rehabilitation works' (Dean and Tippler 2016) (Table 3-8).

Table 3-8 RRA results for Wianamatta-South Creek

Site	December 2023	March 2024	July 2024
NS26 (upstream)			
NS23A (downstream)			

Figure 3-2: Aquatic habitat and riparian vegetation in Wianamatta-South Creek

Table 3-9. Observations - Wianamatta-South Creek

Site	General habitat description	Macrophytes		Sample Events			
		Scientific name	Common name	Dec 2023	March 2024	July 2024	Native/ Exotic
NS26 (upstream of confluence of the unnamed creek)	Water visibility: generally clear during not rainfall periods otherwise creek water observed slightly turbid and turbid (brown colour). Observed algae, overhanging riparian vegetation and organic debris.	*Cyperus eragrostis*	Umbrella sedge	✓	-	-	Native
		Persicaria decipens	Slender knotweed	✓	✓	-	Native
		Submerged Lomandra Sp.	Mat Rush	-	-	✓	Native
NS23A (Downstream)	Water visibility: generally clear during not rainfall periods	*Vallisneria*	Eelgrass	✓	✓	✓	Native

	otherwise creek water observed slightly turbid and turbid and/or sections of high flow (i.e. flow meter = 44 pulses/40 seconds) Observed algae, overhanging riparian vegetation, macrophytes and organic debris.	

3.2.2 Water Quality

Water quality parameters have been monitored in Wianamatta-South Creek from November 2023 with data collected from up to 15 sampling events during the baseline period.

Water quality was generally marginally better downstream of its confluence with the unnamed creek (NS23A) compared to upstream (NS26). Turbidity, total suspended solids, total aluminium, total iron and chlorophyll-a all decreased whilst total and oxidised nitrogen and total copper increased.

A breakdown of water quality data is presented in *Table 3-10* with guideline values exceedances highlighted in red.

Table 3-10. Baseline water quality values – Wianamatta-South Creek

		NS26 (upstream)					NS23A (downstream)				
Parameters	**Guideline values**	**Median**	**Mean**	**Min**	**Max**	**N=**	**Median**	**Mean**	**Min**	**Max**	**N=**
Temperature (ºC)	-	20.2	18.6	10.7	28.1	15	21.3	19.3	10.6	26.3	13
Field dissolved oxygen (mg/L)	-	7.9	7.8	6.0	10.3	15	7.5	8.1	6.8	10.4	13
Percent dissolved oxygen (%sat)	43-75[2]	85.9	82.2	67.4	94.1	15	85.1	85.7	77.7	93.6	13
pH	6.5-8.0	7.48	7.49	6.99	7.85	15	7.58	7.53	7.15	7.86	13

Parameters		NS26 (upstream)					NS23A (downstream)				
	Guideline values	Median	Mean	Min	Max	N=	Median	Mean	Min	Max	N=
Conductivity (µS/cm)	125–2200	920	967	284	1524	15	990	941	455	1283	13
Turbidity (NTU)	6-50[2]	57.0	79.1	26.0	170	15	46.0	59.3	18.0	130	13
Total suspended solids (mg/L)	-	50.0	65.0	24.0	140	15	36.5	42.6	13.0	97.0	13
Ammonia NH3-N (mg/L)	0.9[1]	0.05	0.06	0.02	0.11	14	0.04	0.08	0.02	0.36	13
Oxidised nitrogen (mg/L)	0.04[1]	0.64	0.82	0.08	2.75	14	2.39	2.15	0.64	3.28	13
Total nitrogen (mg/L)	0.35[1]	1.31	1.63	0.71	3.74	14	3.31	3.03	1.19	4.43	13
Soluble reactive phosphorus (mg/L)	-	0.03	0.05	0.00	0.16	14	0.03	0.04	0.01	0.11	13
Total phosphorus (mg/L)	0.025[1]	0.14	0.17	0.06	0.40	14	0.13	0.14	0.06	0.29	13
Total aluminium (µg/L)	55[1]	1180	1389	399	3340	15	702	901	150	2090	13
Total cobalt (µg/L)	1.4[1]	1.20	1.42	0.90	2.50	15	1.10	1.14	0.70	2.00	13
Total copper (µg/L)	7.1[3]	5.40	5.65	2.50	9.40	15	7.60	7.57	4.20	10.1	13
Total nickel (µg/L)	11[1]	2.90	2.91	2.00	4.10	15	3.20	3.03	1.80	3.90	13
Total zinc (µg/L)	8[1]	15.0	20.2	9.0	76.0	15	21.0	20.6	13.0	44.0	13
Total iron (µg/L)	-	2420	3144	391	13000	14	1755	1957	274	3920	12

Parameters		NS26 (upstream)					NS23A (downstream)				
	Guideline values	Median	Mean	Min	Max	N=	Median	Mean	Min	Max	N=
Dissolved organic carbon (mg/L)	-	10.4	11.1	7.8	15.8	14	11.0	11.2	8.8	21.0	12
Chlorophyll – a (mg/L)	0.003[1]	11.8	15.2	3.5	47.5	15	6.6	8.9	0.4	31.3	13

[1] *ANZG DGV*

[2]*Wianamatta-South Creek WQO*

[3]*Draft Copper Guideline Values*

3.2.3 Threatened Species

A review of the NSW Bionet and Commonwealth PMST conducted as part of the Waterways Assessment Technical Report (Stantec, 2024) revealed 52 threatened species and/or populations of freshwater, estuarine or nearshore species that have a potential to occur in the locality of the Wianamatta-South Creek.

A review of the habitat requirements for these species and the habitats within Wianamatta-South Creek identified that only one amphibian, the GGBF had a moderate LOO due to the presence of potential habitat present within the unnamed creek. Targeted eDNA sampling for GGBF was conducted, as discussed in Section 3.2.5.

Note that birds were excluded from the assessment due to it being highly unlikely that they would be impacted by the changed flow regime.

3.2.4 Fish and Aquatic Mammals

Fish biodiversity has been sampled in Wianamatta-South Creek at sites NS26 (upstream) and NS23A (downstream) using eDNA metabarcoding. Two sampling events were conducted in December 2023 and March 2024. Technical issues at NS26 during December 23 sampling event generated inconclusive results.

Fourteen (14) fish species were detected at NS26 (upstream) and fifteen (15) species at NS23A (downstream). A Genus of Gudgeons and Pinkeye Mullet were found at NS26(upstream) but not at N23A(downstream). The Australian Freshwater Herring and Flathead Gudgeon was present at NS23A(downstream) only. A mix of exotic and native species were present at each site. This fish assemblage is typical for NSW urban creeks. No fish species found are protected under the EPBC Act or FM Act.

More species were detected in March 2024 than in December 2023 at NS23A (downstream). At NS23A(downstream), 43% of all species detected at were detected across both sampling events. See Section 3.1.4 for considerations regarding the use of eDNA biodiversity assessments.

Targeted eDNA sampling for platypus (*Ornithorhynchus anatinus*) was also undertaken at NS26(upstream) and NS23A(downstream) in March 2024. Targeted eDNA has a higher detection threshold for the 'target' species compared to metabarcoding. No platypus were detected at either site across all events.

Table 3-11. Fish Taxon detected by eDNA sampling in Wianamatta-South Creek

Site	Fish/Aquatic Mammal		Sample Events		
	Scientific name	**Common name**	**Dec 2023**	**March 2024**	**Native/Exotic**
NS26 (upstream)	*Anguilla reinhardtii*	Longfin Eel	-	✓	Native
	Anguilla australis	Shortfin Eel	-	✓	Native
	Carassius auratus	Goldfish	-	✓	Exotic
	Cyprinus carpio	European Carp	-	✓	Exotic
	Eleotridae	Family of Sleeper Gobies	-	✓	-
	Elotridae	Genus of Carp Gudgeons	-	✓	-
	Elotridae	Genus of Gudgeons	-	✓	-
	Gambusia holbrooki	Eastern Mosquito fish	-	✓	Exotic
	Gobiomorphus coxii	Cox's Gudgeon	-	✓	Native
	Mugil cephalus	Sea Mullet	-	✓	Native
	Ornithorhynchus anatinus	Platypus	-	-	Native
	Percalates novemaculeata	Australian Bass	-	✓	Native
	Philypnodon macrostomus	Dwarf Flathead Gudgeon	-	✓	Native

Site	Fish/Aquatic Mammal		Sample Events		
	Scientific name	**Common name**	**Dec 2023**	**March 2024**	**Native/Exotic**
	Retropinna semoni	Australian Smelt	-	✓	Native
	Trachystoma petardi	Pinkeye Mullet	-	✓	Native
NS23A (downstream)	*Anguilla reinhardtii*	Longfin Eel	✓	✓	Native
	Anguilla australis	Shortfin Eel	-	✓	Native
	Percalates novemaculeata	Australian Bass	✓	✓	Native
	Carassius auratus	Goldfish	-	✓	Exotic
	Cyprinus carpio	European Carp	✓	✓	Exotic
	Eleotridae	Family of Sleeper Gobies	-	✓	-
	Elotridae	Genus of Carp Gudgeons	✓	✓	-
	Gambusia holbrooki	Eastern Mosquito fish	✓	✓	Exotic
	Gobiomorphus coxii	Cox's Gudgeon	-	✓	Native
	Mugil cephalus	Sea Mullet	✓	-	Native
	Ornithorhynchus anatinus	Platypus	-	-	Native
	Philypnodon grandiceps	Flathead Gudgeon	-	✓	Native
	Philypnodon macrostomus	Dwarf Flathead Gudgeon	-	✓	Native
	Potamalosa richmondia	Australian Freshwater Herring	✓	-	Native
	Retropinna semoni	Australian Smelt	✓	✓	Native

3.2.5 Amphibians

Based on the potential presence of the GGBF targeted eDNA surveys were conducted at NS26(upstream) and NS23A(downstream) in December 2023 and March 2024. All samples at both sites returned negative. This targeted survey likely reduces the likelihood of GGBF being present in Wianamatta-South Creek at these sites.

3.2.6 Macroinvertebrates

Macroinvertebrates were sampled in Wianamatta-South Creek during 4 sampling events between Spring 2023 and Winter 2024.

Both sites showed a similar pattern of improvement from spring to summer before levelling off in autumn before a notable decline in winter. This trend is likely due to seasonal flow patterns, not related to operation of St Marys WRRF. EPT taxa were low consistently throughout the baseline period at both sites aside from at NS23A(downstream) in Winter 2024 where low taxa richness and abundance within the sample disproportionally influenced the index score.

SIGNAL-SG scores were on average slightly higher at NS23A(downstream) however both sites had scores indicative of sites with ‘mild to moderate water pollution’. Macroinvertebrate communities at both sites lacked sensitive taxa and included many pollution tolerant insensitive taxa that have lower SIGNAL-SG sensitivity grades.

Figure 3-3 Average SIGNAL-SG scores in Wianamatta-South Creek from 2023-24 sampling.

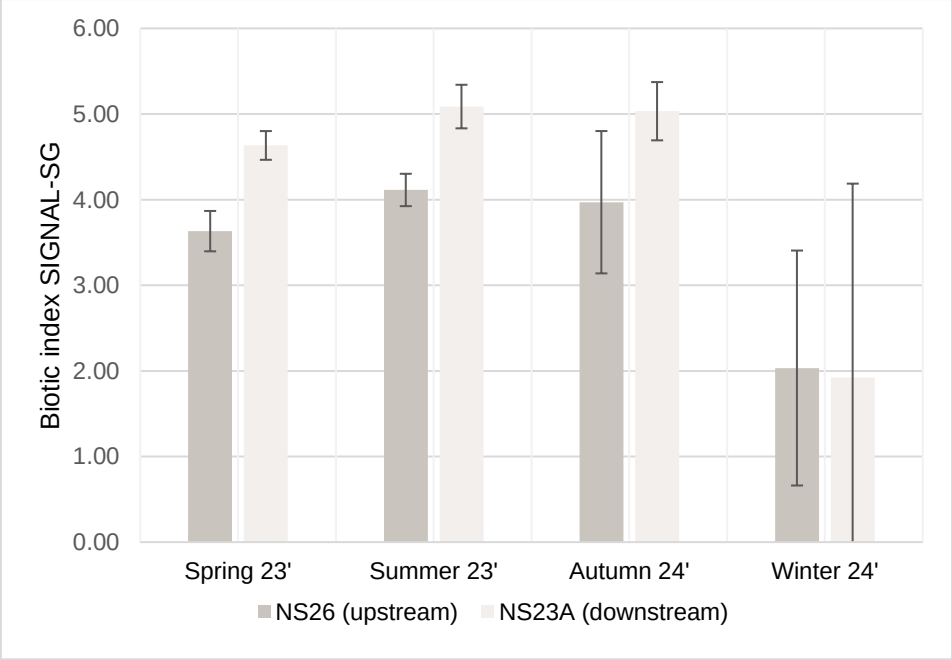


Table 3-12. Average SIGNAL-SG scores in Wianamatta-South Creek from 2023-24 sampling.

	NS26 (upstream)				NS23A (downstream)			
	Spring 2023	**Summer 2023**	**Autumn 2024**	**Winter 2024**	**Spring 2023**	**Summer 2023**	**Autumn 2024**	**Winter 2024**
SIGNAL-SG scores	3.63	4.11	3.97	2.03	4.63	5.09	5.03	1.92
EPT index (%)	0	2.7	0	0	0	5	0	8.33

4 Conclusion

This report assessed conditions within the unnamed creek and Wianamatta-South Creek from November 2023 to August 2024. This is the baseline period before the change in discharge due to works in Boundary Creek. The flow diversion commenced on 27 August 2024 for the purposes of the St Marys and Penrith Diversion – Aquatic Monitoring Plan 2023-27. Note that data provided for unnamed creek spans a 10 month period and is not considered sufficient to form a baseline for water quality as per ANZGs(2018). Wianamatta-South Creek has been monitored prior to November 2023.

The unnamed creek

Data from the unnamed creek has been provided for two sites, NS242 (upstream) and NS241(downstream).

The unnamed creek is considered to be in good riparian condition based on RRA results. Five species of aquatic macrophytes was observed at both sites with one exotic species observed. Water quality was generally better downstream of St Marys WRRF with turbidity, ammonia and total iron all markedly decreasing. TN and total copper increased downstream of St Marys WRRF as expected with the quality of the facilities discharge.

Biota in the unnamed creek is consistent with that found in NSW urban creek. A mix of native and exotic fish species are present. Fish biodiversity was higher downstream of St Marys WRRF likely due to the additional flows in this area and connectivity with downstream Wianamatta-South Creek. Abundance of fish has not been assessed. Following a desktop assessment and targeted eDNA surveys no threatened species were identified as likely to occur within the unnamed creek.

Macroinvertebrates were sampled in the unnamed creek during three events across summer 2023, autumn 2024 and winter 2024. SIGNAL scores were similar between sites. Sites showed some minor variability with scores improving at NS242 (upstream) and declining at NS241 (downstream) during the baseline period. No EPT taxa were found upstream of St Marys WRRF (NS242) indicative of higher water pollution. SIGNAL-SG scores were indicative of sites with ‘mild to moderate water pollution’. Macroinvertebrate communities lacked sensitive taxa and included many pollution tolerant insensitive taxa that have lower SIGNAL-SG sensitivity grades.

Wianamatta-South Creek

Data from Wianamatta-South Creek has been provided for two sites NS26(upstream) which is not subject to discharges from St Marys WRRF and NS23A(downstream) which received inflow via its confluence with unnamed creek.

Winamatta-South Creek is considered to be in good riparian condition based on RRA results. Two species of aquatic macrophytes was observed upstream of the confluence with the unnamed creek (NS26) and one species downstream (NS23A). Water quality was generally marginally better downstream of the unnamed creek with lower turbidity, total suspended solids, total aluminium, total

iron and chlorophyll-a. TN and total copper increased downstream of St Marys WRRF as expected with the quality of the facilities discharge.

Following a desktop assessment and targeted eDNA surveys no threatened species were identified as likely to occur within Wianammatta-South Creek

Biota in Wianamatta-South Creek is consistent with that found in NSW urban creek. A mix of native and exotic fish species are present. Fish biodiversity is higher in Wianamatta-South Creek than in the unnamed creek likely due to the increased flow volumes and quantity of aquatic habitat available. Abundance of fish has not been assessed. Following a desktop assessment and targeted eDNA surveys no threatened species were identified as likely to occur at NS26(upstream) and NS23A(downstream).

Macroinvertebrates were sampled in Wianamatta-South Creek during 4 sampling events between spring 2023 and winter 2024. SIGNAL-SG scores were on average slightly lower at NS26(upstream) of the confluence with unnamed creek than at NS23A (downstream). Both sites had scores indicative of sites with ‘mild to moderate water pollution’. Both sites showed a similar pattern of improvement from spring to summer before levelling off in autumn before a notable decline in Winter. This trend is likely due to seasonal flow patterns, not related to operation of St Mary’s WRRF. EPT taxa were low consistently throughout the baseline period at both sites.

Stantec

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