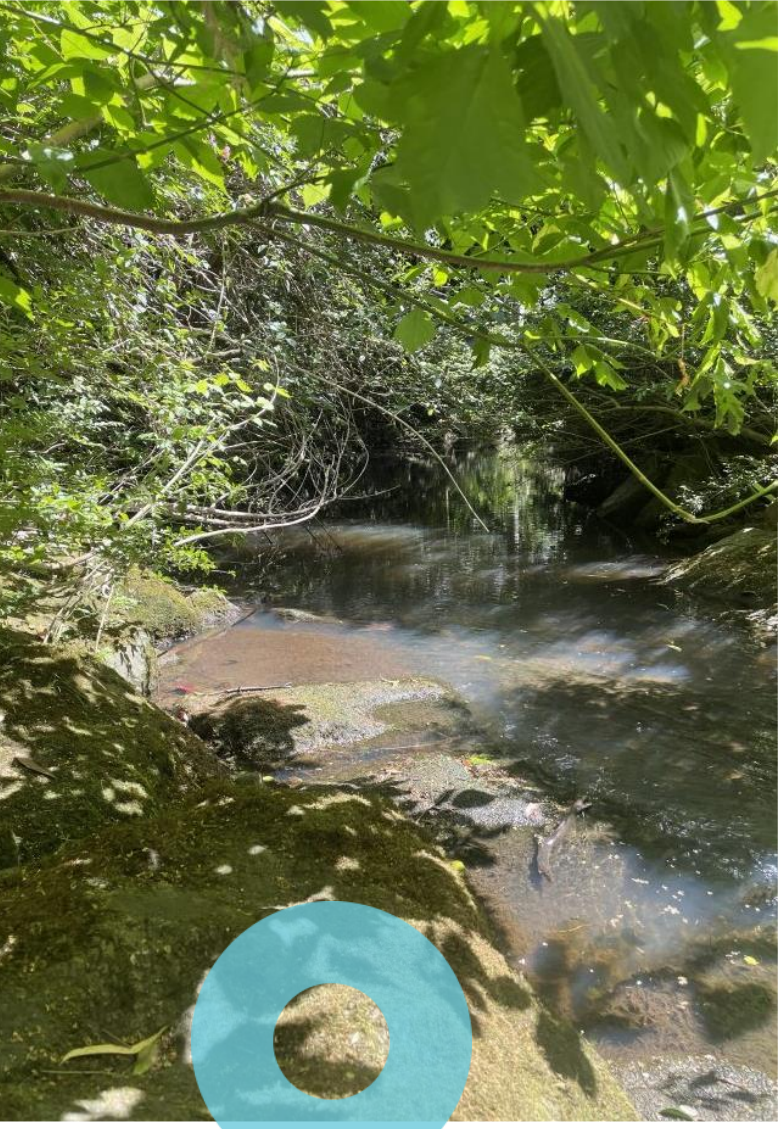

City of Ryde

Preliminary Water Quality Report

Spring 2022

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Executive summary

This report comprises the Spring 2022 water quality results for the Shrimptons, Archers, Buffalo, Terrys, and Porters Creek catchments within the City of Ryde local government area. Field collection, in-stream measurements, field observations and laboratory analysis were used to compile data for the following parameters: (i) Macroinvertebrate community indices, (ii) Physico-chemical Water Quality and (iii) Rapid Riparian Assessment.

Freshwater Macroinvertebrate analysis was conducted at the five core sampling sites. For each site SIGNAL SF scores were calculated. The highest average signal score during the Spring 2022 sampling season was 4.8 and was observed at Shrimptons Creek (CR1S). This result was higher than the historical average for this site. This was also the case for Porters Creek site CR5P. The lowest SIGNAL score observed during this season was 3.5 at Buffalo Creek, although this was still comparable with the historical average for this site (4.1). In general, scores calculated for this current sampling period were observed to be consistent with the results of previous seasons.

Macroinvertebrate Taxa Richness scores were also calculated for each of the five core sites. Higher Macroinvertebrate taxa diversity can be indicative of higher water quality. For the Spring 2022 period Shrimptons Creek had the highest average taxa richness with a score of 12.5. The lowest richness score was observed at Terrys Creek with a value of 6. During Spring 2022, most sites had richness results lower than the historical Spring average, aside from Shrimptons Creek.

Chemical water quality analysis was also performed at each of the 14 sites. Data was collected using in-field sampling as well as laboratory analysis. These results were then compared to thresholds outlined in the 2000 ANZECC guidelines for water quality. In-field sampling results for parameters such as pH, conductivity and dissolved oxygen were consistent with the results of previous seasons. Most sites had faecal coliform results below guideline levels. Nutrient results across the sites were higher than threshold levels. This may stem from the proximity of these sites to zones of potential urban run-off (park spaces, residential zones, and roadways). Additional heavy metals analysis conducted at the four Porters Creek sites detected elevated levels of copper and zinc at site CR5PB.

Rapid Riparian Assessment (RRA) results were consistent with the previous season with most sites maintaining the same score. However, Terrys Creek and Buffalo Creek sites saw an improvement in RRA scores with both sites increasing from a “Fair” score (Spring 2020) to a “Good” score (Spring 2022).

1 Study Area

The City of Ryde is located 12 km North-West of central Sydney with a local government area of 40.651 km². It consists primarily of residential housing and is comprised of 16 suburbs and 14 separate stormwater catchments. It includes several important commercial and industrial sectors.

Limited areas of natural bushland border urban infrastructure, including several significant natural bush corridors and areas of open space that support recreation and sporting activities. There are small sections of Lane Cove National Park present on the eastern and northern borders of Shrimptons, Porters and Buffalo creeks. All five creeks drain into the greater Parramatta River catchment. Archers Creek enters Parramatta River directly and the remaining creeks through the Lane Cove River catchment.

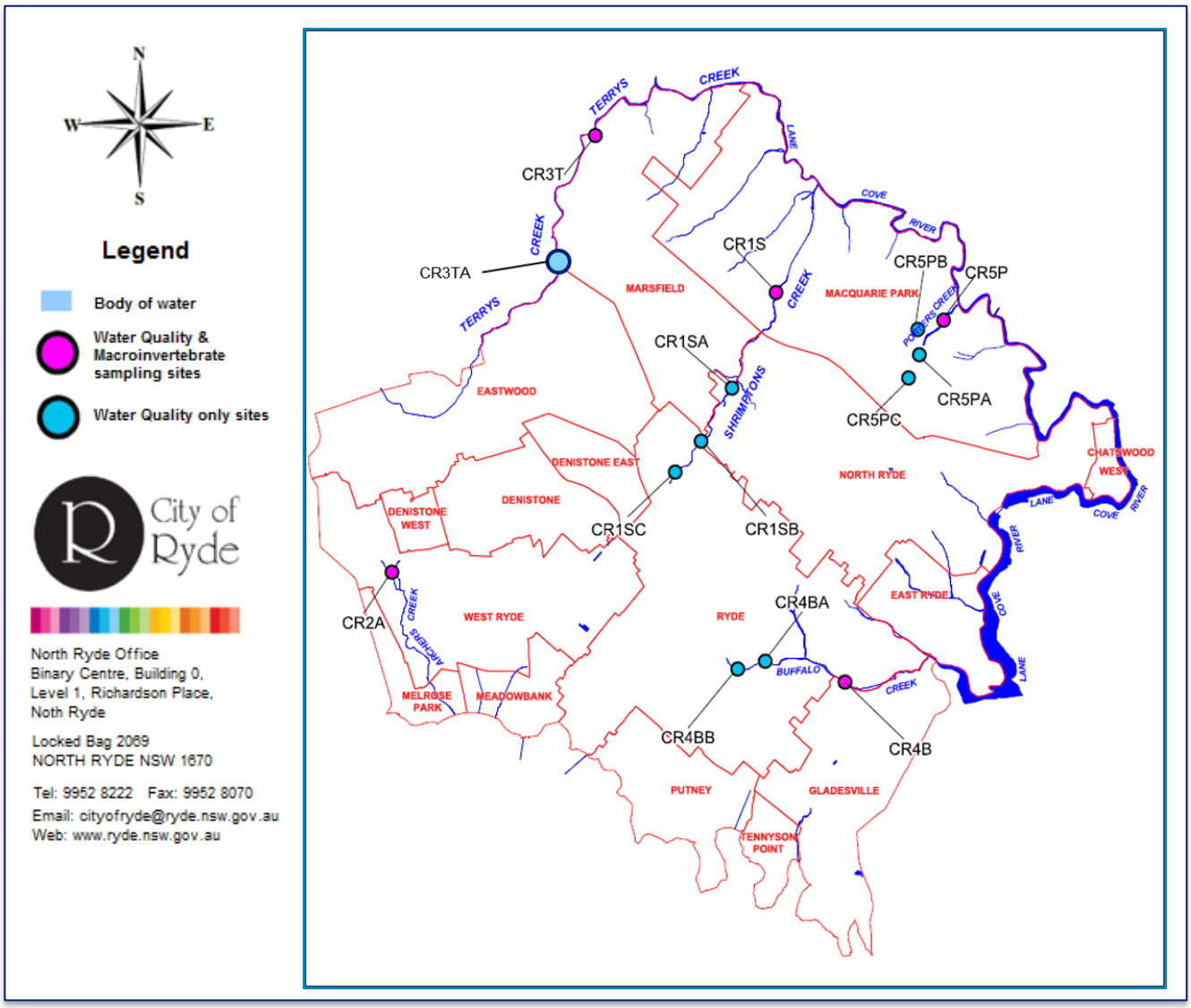

Figure 1 City of Ryde Water Quality Management Program Sites Map of sites for chemical and ecological monitoring across five creeks.

2 Sampling sites

For each of the catchments there is a core site where macroinvertebrate, water quality, and rapid riparian assessments are conducted. Additional water quality-only sites for each of the catchments are also sampled, as summarised in the table below.

Table 1 Survey sites for monitoring chemical and ecological attributes

Site	Location	Water Quality (wet & dry weather)	Macroinvertebrates	Rapid Riparian Assessment
CR1S	Shrimptons Creek at Wilga Park			
CR1SA	Shrimptons Creek at Kent Rd			
CR1SB	Shrimptons Creek at Bridge St			
CR1SC	Shrimptons Creek at Quarry Rd			
CR2A	Archers Creek at Maze Park			
CR3T	Terrys Creek at Somerset Park			
*CR3TA	Terrys at Foresters Park			
CR4B	Buffalo Creek			
CR4BA	Buffalo Creek d/s Burrows Park			
CR4BB	Buffalo Creek u/s Burrows Park			
CR5P	Porters Creek d/s of depot			
CR5PA	Porters Creek main branch			
CR5PB	Porters Creek spur branch			
CR5PC	Porters Creek at Wicks Rd			

**Indicates site added to the program in Spring 2017*

3 Rainfall and Sampling

Rainfall can directly influence biological and chemical parameters in aquatic environments. It can significantly impact the flow rate of a waterway and can influence both the influx and dilution of nutrients and other contaminants. Daily, Monthly, and Cumulative rainfall for the sampling period is summarised in Figure 2.

During the year 2022, peak rainfall fell during March with a total monthly volume of 572mm. Macroinvertebrate collection, physico-chemical water quality testing and Rapid Riparian Assessment were conducted on the 1st of November 2022. The month of November had one of the lowest volumes of rainfall, with a total monthly rainfall volume of 43mm.

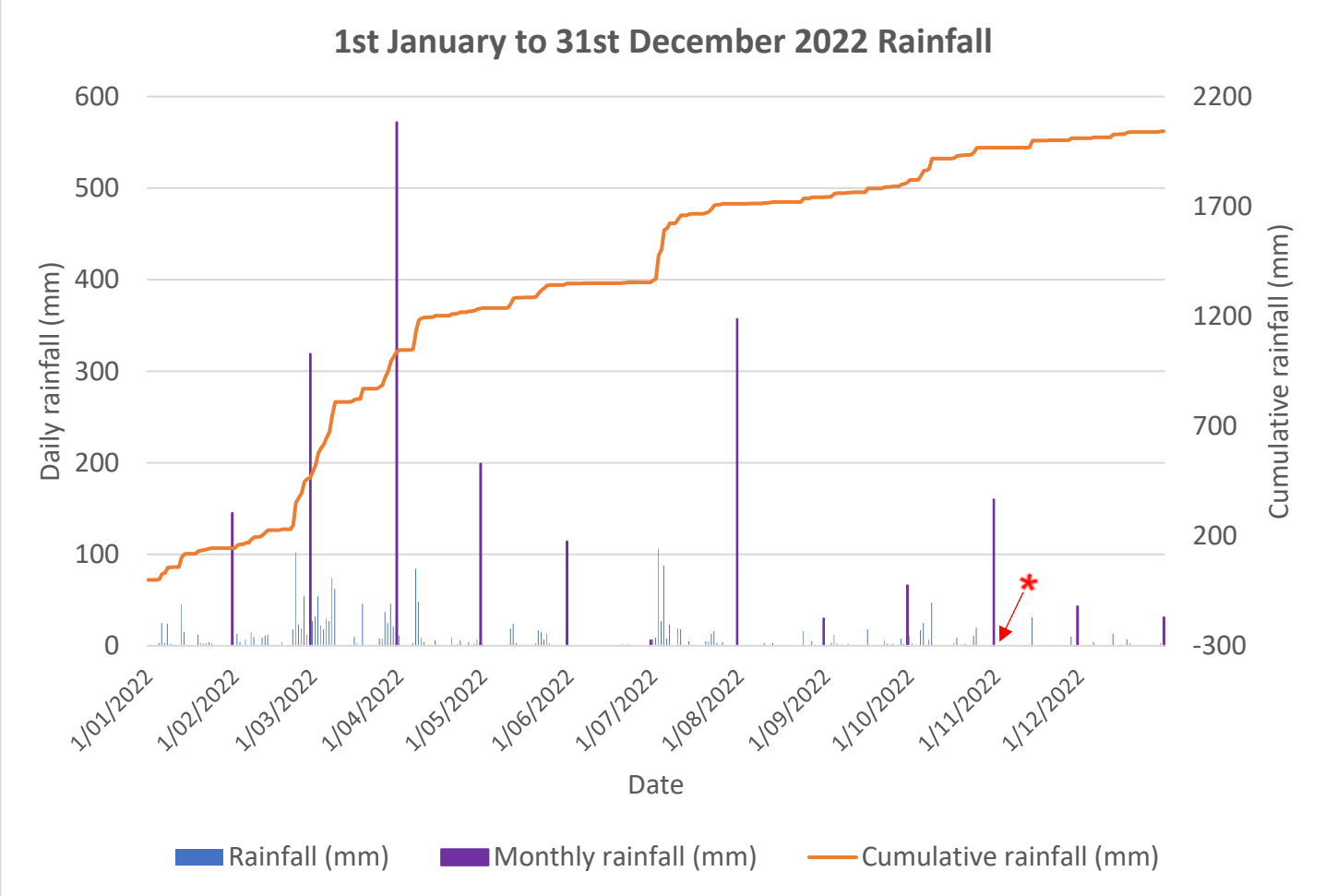

Figure 2 Rainfall and Spring 2022 sampling event. Note cumulative rainfall scale is on the right.

* - Signifies date of sampling (01/11/2022)

4 Results and interpretation

(i) Macroinvertebrates

SIGNAL SF

For each of the five core sites two replicate macroinvertebrate samples were collected. From each sample a representative sub-sample of animals was compiled, and specimens were identified in the lab to a Family level. This data was used to calculate the average SIGNAL SF score for each core site (Figure 3).

SIGNAL SF scores for Spring 2022 were observed to be in general consistent with the results of the previously sampled Spring period (2020) as well as the historical Spring average.

Shrimptons Creek had the highest SIGNAL SF score for the current season (4.8) and was higher than the historical Spring average. The lowest was observed at Buffalo Creek (3.5).

Archers Creek site results were slightly lower than both the previous season and the historical site average for Spring.

Porters Creek SIGNAL SF results were consistent across both sampling periods as well as the Spring average.

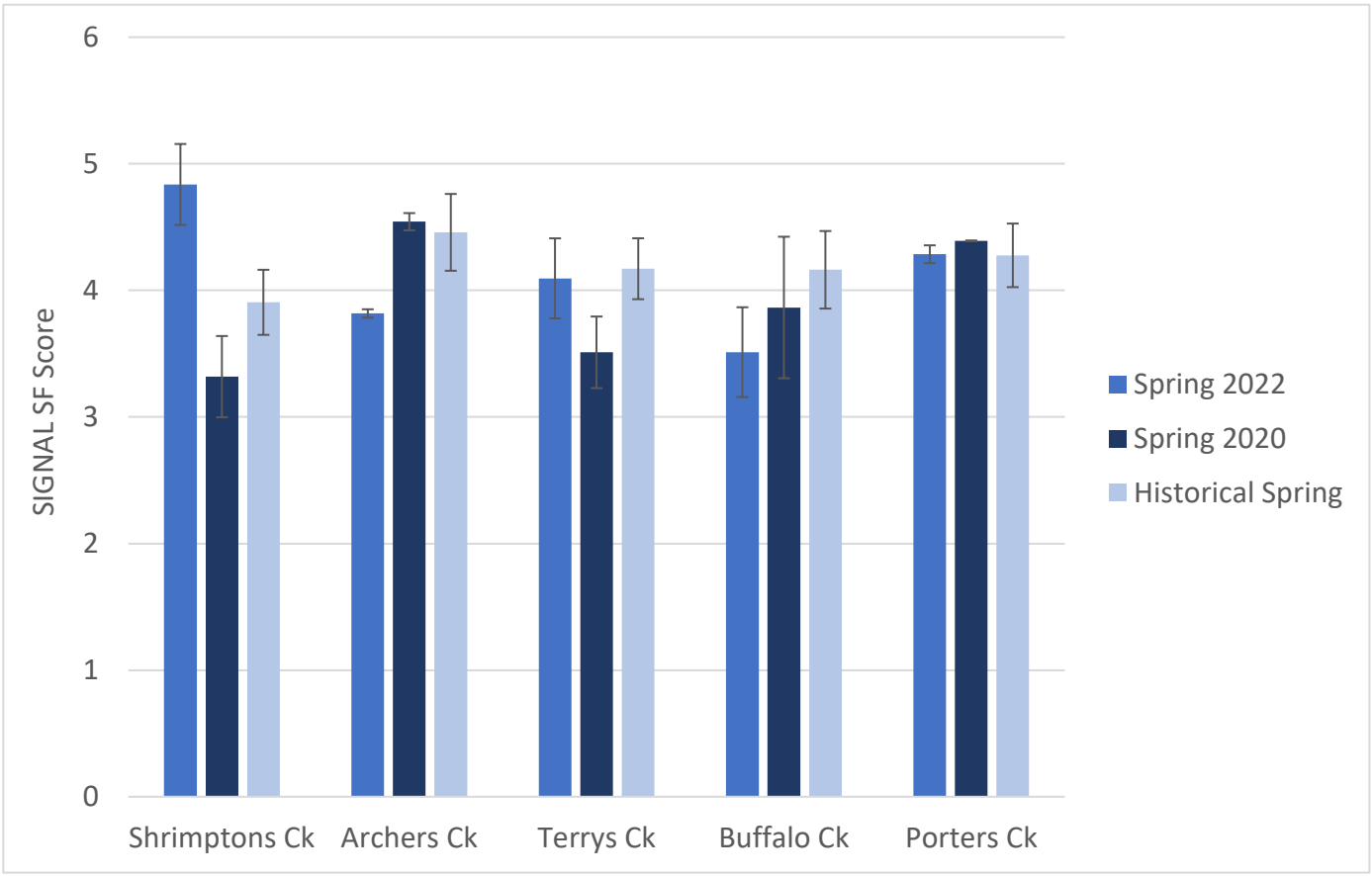

Figure 3 Average SIGNAL score results for each of the five core sampling sites

(i) Macroinvertebrates

Taxa Richness

Average Taxa Richness results were also calculated for each of the five core sites. A high richness result represents high macroinvertebrate community diversity, which can be used as an indicator of waterway health.

Taxa Richness results for Spring 2022 were variable across the sites. Shrimptons Creek had the highest Richness result for the season (12.5, Figure 4) which was more than double the result of the previous season (6, Spring 2020). Buffalo Creek results also saw an increase in richness score from 7 (2020) to 8.5 (2022).

The lowest Richness result was observed at Terrys Creek (6) which was a decline from the previous season Richness result of 9.5.

Archers and Porters creeks had slightly lower observed values during this season, the results were still consistent with the scores of the previous season.

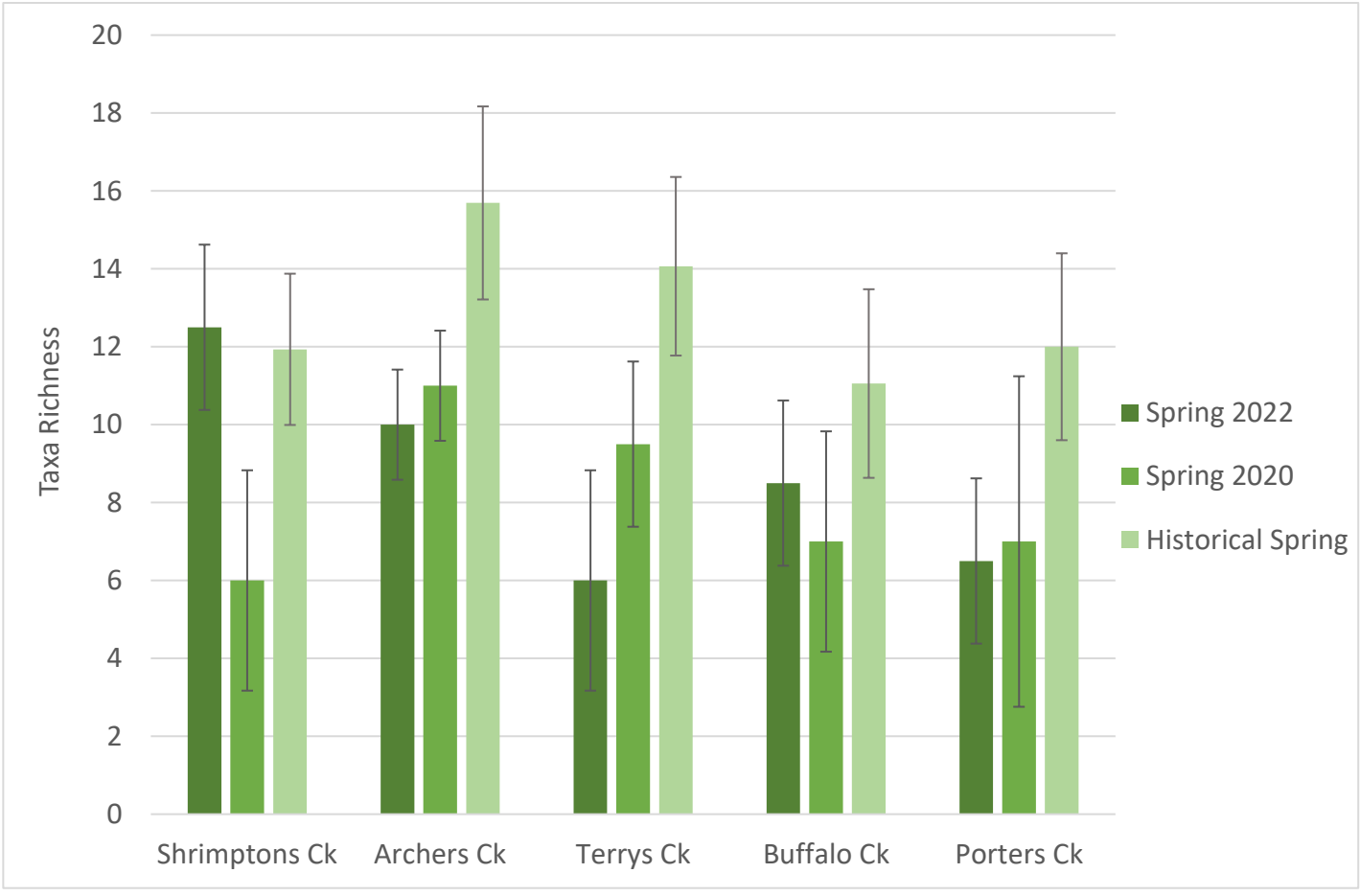

Figure 4 Average Taxa Richness score results for each of the five core sampling sites

(ii) Water Quality

Water quality sampling was conducted at each of the 14 sampling sites. This included both in-situ field measurements using multi-probe equipment as well as water quality sample bottle collection which were delivered to the West Ryde analytical laboratories for testing.

In-field observations

Field measurements were conducted on the day of sampling to test for a range of physico-chemical parameters. These results have been tabulated below (Table 2).
Most sites had dissolved oxygen results lower than the ANZECC guidelines (85-110%).
Conductivity results were within ANZECC guideline limits for each of the 14 sites (125 - 2500µS/cm).

Each of the sites had pH results within threshold values (6.5 – 8.5 pH units) aside from CR5PA which had a slightly elevated result of 8.62.

Analytical results

Most sites had faecal coliform results lower than the guideline value (1000CFU/100mL, Table 3) which was an improvement from previous sampling periods.
Total Nitrogen and Total Phosphorus results were above recommended thresholds (350µg/L and 25µg/ respectively). A similar trend was observed during the previous Spring season. This may stem from location of these sites in urban areas with potential run-off from land-use, fertilizer application and proximity to roadways.

The results for Total Hardness, Total Magnesium, Calcium and Aluminium are displayed in Table 4. ANZECC guidelines do not include recommended thresholds for these parameters. However, the results for this period were comparable with historical results across each of the 14 sampling sites.

Table 2 In-field physico-chemical results

Site	Temperature (Celsius)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% saturation)	Turbidity (NTU)	Conductivity (µS/cm)	pH
CR1S	19.5	6.30	69.2	9.58	578	7.39
CR1SA	18.0	5.95	64.4	6.64	602	7.21
CR1SB	18.0	7.70	82.5	5.07	606	7.43
CR1SC	18.8	9.47	104.4	5.08	616	7.84
CR2A	19.4	8.09	90.2	3.85	424	7.80
CR3T	17.3	7.40	79.9	4.10	599	7.45
CR3TA	17.8	5.83	60.3	3.04	737	7.40
CR4B	19.9	8.40	95.5	13.70	707	7.52
CR4BA	18.4	6.62	73.4	10.90	796	7.32
CR4BB	18.1	7.68	83.5	3.50	681	7.59
CR5P	18.3	6.87	80.1	7.29	573	7.43
CR5PA	22.7	10.70	127.2	7.81	498	8.62
CR5PB	19.1	9.35	103.0	8.80	411	8.31
CR5PC	19.3	8.63	95.4	2.63	533	7.74

Table 3 Coliform and nutrient results for each of the 14 sampling sites

	Faecal Coliform	Total Nitrogen	Total Phosphorus	TKN by calculation	Ammonia NH3 -N Low Level	Oxidised Nitrogen NOx-N Low Level
Site code	CFU/100mL	ug/L	ug/L	ug/L	ug/L	ug/L
CR1S	270	770	61	460	110	310
CR1SA	330	540	51	340	20	200
CR1SB	~780	810	41	340	40	470
CR1SC	2800	1070	26	290	20	780
CR2A	580	1260	42	370	10	890
CR3T	60	600	37	320	10	280
CR3TA	2500	910	43	550	<10	360
CR4B	480	850	32	330	<10	520
CR4BA	1500	1170	78	410	<10	760
CR4BB	2800	1350	93	470	10	880
CR5P	400	3500	66	1210	560	2290
CR5PA	480	1230	90	510	60	720
CR5PB	1500	560	49	560	<10	<10
CR5PC	~8700	2780	65	850	250	1930

Table 4 Total Hardness, Calcium, Magnesium and Alkalinity results for the 14 sampling sites

	Total Hardness	Total Calcium	Total Magnesium	Alkalinity (Total)
Site code	mg CaCO3/L	mg/L	mg/L	mg CaCO3/L
CR1S	130	36.7	9.92	98
CR1SA	120	32.6	9.94	82
CR1SB	130	33.3	10.4	83
CR1SC	120	28.9	10.5	69
CR2A	100	23.6	10.4	73
CR3T	130	34.7	10.7	98
CR3TA	150	37.2	13	112
CR4B	140	36.8	12.6	96
CR4BA	140	34	13.2	97
CR4BB	130	34.1	11.2	96
CR5P	160	45.4	12.1	139
CR5PA	140	39.3	9.75	105
CR5PB	150	45.5	8.78	146
CR5PC	160	40.6	14.1	96

Porters Creek heavy metals testing

During this period of sampling additional heavy metals testing was carried out at each of the four Porters Creek sites (CR5P, CR5PA, CR5PB, CR5PC).

The results of these analyses are provided in Table 5. Most metals results were below detection levels (Totals for analytes: mercury, arsenic, cadmium, chromium, and lead).

Site CR5PB was observed to have the highest total metal result; copper (10µg/L), iron (3250 µg/L), manganese (292 µg/L), and zinc (40µg/L).

When examining the ANZECC guidelines, copper and zinc results exceeded the recommended threshold values of 2.5 µg/L and 31µg/L respectively. Manganese was below threshold value.

Table 5 Additional heavy metals analyses for Porters Creek sites *results reported as mg/L

	Total Mercury	Total Arsenic	Total Cadmium	Total Chromium	Total Copper	Total Iron	Total Lead	Total Manganese	Total Zinc
Site code	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
CR5P	<0.0003	<0.02	<0.005	<0.005	0.005	0.99	<0.01	0.035	0.01
CR5PA	<0.0003	<0.02	<0.005	<0.005	<0.005	0.47	<0.01	0.019	0.01
CR5PB	<0.0003	<0.02	<0.005	<0.005	0.01	3.25	<0.01	0.292	0.04
CR5PC	<0.0003	<0.02	<0.005	<0.005	0.005	0.42	<0.01	0.03	0.02

(iii) Rapid Riparian Assessment

A Rapid Riparian Assessment (RRA) was conducted at each of the five core sites. The process of this assessment involves the observation of stream features as well as the vegetation community surrounding the stream.

All features are assigned a numerical result, and the final score is calculated. The comparison table below shows results from the two most recent Spring sampling seasons (Table 6).

In general, results were consistent with the previous season (Spring 2020). Shrimptons and Archers Creek sites both recorded a “Fair” health score during the Spring 2020 and Spring 2022 sampling seasons. Porters Creek site were also consistent with a “Good” health score for both seasons.

Terrys Ck and Buffalo Creek saw an improvement in RRA scores with both sites moving from a “Fair” score (Spring 2020) to a “Good” score (Spring 2022).

Table 6 Rapid Riparian Assessment (RRA) scores for Spring 2020 & Spring 2022 seasons

	Season	
Site	Spring 2020	Spring 2022
Shrimptons Ck	13.1	26.3
Archers Ck	-1.1	13.0
Terrys Ck	20.8	56
Buffalo Ck	22.1	36.9
Porters Ck	53.6	49.7

The figure below provides an example of a riparian environment. Features examined during RRA assessment include bank stability, waterway shape and structure, as well as the type and density of canopy cover.

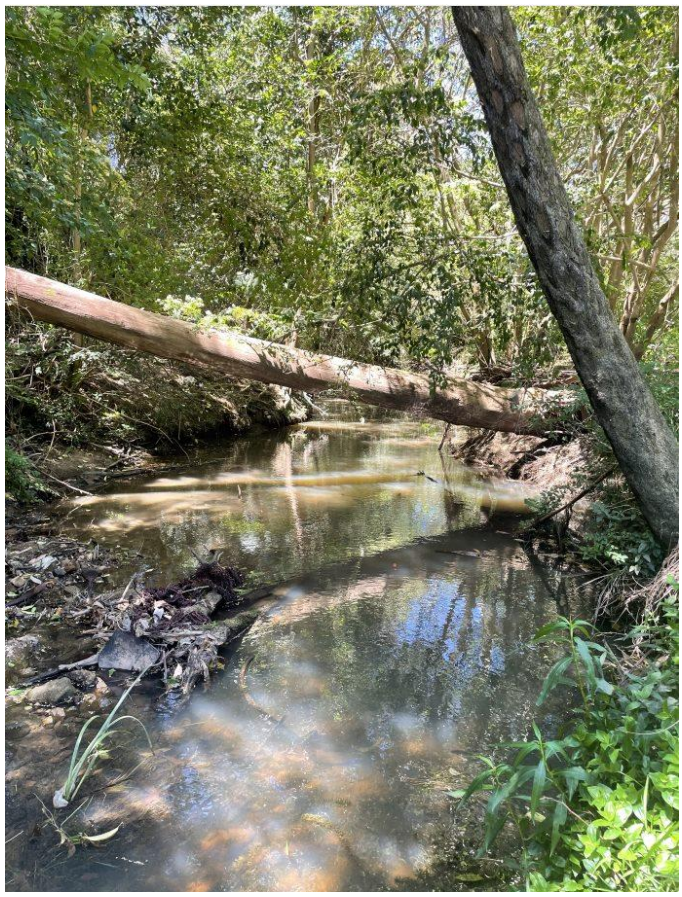

Figure 5 An example of riparian cover

5 Conclusion

Macroinvertebrates

During Spring 2022, Shrimptons Creek had the highest SIGNAL score as well as the highest Taxa Richness result. This result contrasts with the previous Spring sampling period (2020) where this site recorded the lowest SIGNAL score. This current sampling period saw a greater diversity of macroinvertebrate taxa observed at Shrimptons Creek. This included an increase in the number of Diptera and Gastropoda families, as well as the presence of Odonata taxa. Conversely, the SIGNAL score for Buffalo Creek was lower than the previous season. This can be attributed to a reduction in the presence of taxa including Gastropoda families. Terrys Creek saw a decline in Taxa Richness during this season, this can be attributed to a reduction in both Odonata and Trichoptera taxa during the current season as compared to the previous Spring.

Water Quality

During Spring 2022, faecal coliform concentrations were mostly within threshold guidelines. All sites exhibited nutrient results above threshold guidelines. This can be influenced by a range of factors including run-off from urban environments and roadways as well as vegetation degradation. Dissolved oxygen results were below ANZECC guidelines for 8 of the 14 sampling sites and are often indicative of low-flow environments. Dissolved oxygen levels can also be influenced by the respiration of aquatic organisms in the water column such as fish and macroinvertebrates. During this season additional heavy metals analyses were conducted at the four Porters Creek sites. Site CR5PB was observed to have exceedances for the heavy metals copper and zinc. These elevated levels are likely to be influenced by the location of this site within the Ryde resource recovery centre. The site is also located on the boundary of the centre, adjacent to the motorway where urban run-off can occur. The flow at this site is restricted to a narrow and low-flowing concrete channel, an environment where contaminants are likely to accumulate.

Rapid Riparian Assessment

Generally, Rapid Riparian scores during this sampling season were observed to be consistent with the results of the previous Spring. However, both Terrys and Buffalo Creek saw an improvement in RRA score. During Spring 2022, Terrys Creek saw a reduction in the presence of litter observed on site when compared to Spring 2020. There was also an increase in the density of over-hanging vegetation as well as a reduction in the impacts of erosion, for example, there was a lower presence of bank slumps and channel erosion. As with Terrys Creek, less litter was observed at the Buffalo Creek site. During this season there was also a greater density of riparian vegetation. This season also had less observed bank erosion and channel restriction when compared to the previous season.

6 Recommendations

- At each of the established sampling sites, continue to monitor:

  i) Macroinvertebrate communities (SIGNAL SF and Taxa Richness indices)

  ii) Chemical water quality parameters

  iii) Riparian condition
- Continue Gross Pollutant Trap maintenance and rubbish removal
- Consider collecting pre-and post-work water quality data on any Council projects that aim to improve water quality
- Continued monitoring of additional heavy metals at Porters Creek sites

Glossary

Item	Meaning
Abundance	The total number of individual specimens; in a sample, community, ecosystem etc.
Algae	Comparatively simple chlorophyll-bearing plants, most of which are aquatic and microscopic in size.
Alkalinity	The ability of a solution to neutralise acid (or buffer).
Ammonia	A colourless gas. In the aquatic environment, it exists in the relatively harmless form ammonium (NH4) and the toxic form ammonia (NH3).
Analyte	The physical and chemical parameters (indicators) to be measured.
Anthropogenic	Impacts on an environment that are produced or caused by humans
ANZECC	ANZECC is a forum for member governments to develop coordinated policies about national and international environment and conservation issues.
Catchment	The area that is drained by a river, lake or other water body.
Community	Assemblage of organisms characterised by a distinctive combination of species occupying a common environment and interacting with one another.
Concentration	The quantifiable amount of a chemical divided by the total volume of a mixture.
Conductivity	The measure of salt content in soil or water; it refers to the ability of the substance to transfer an electrical charge.
Dissolved Oxygen	The measurement of the concentration of oxygen that is dissolved in a water body.
Diversity (Biological)	The measure of the number and/or degree of available organisms in an environment.
Eutrophication	Enrichment of a water body with nutrients that results in increased aquatic plant growth and low oxygen levels.
Faecal Coliforms	Bacteria which inhabit the intestines of humans and other vertebrates and are present in faeces. Used as a primary indicator of sewage pollution in the environment.
Guideline (water quality)	Concentration limit or narrative statement recommended to support and maintain a designated water use.
Habitat	The place where a population lives and its surroundings, both living and non-living.
Indicator	A parameter (chemical, biological or geological) that can be used to provide a measure of the quality of water or the condition of an ecosystem.
Macroinvertebrate (Aquatic)	Animals without backbones that when mature are greater than 1 millimetre; live in the water column, on the water surface or on the bottom of a waterway.

Item	Meaning
Nitrogen (Aquatic)	An element that is essential for plant and animal growth, it occurs in three forms Nitrate, Nitrite and ammonium.
Nutrients	Compounds required for growth by plants and other organisms. Major plant nutrients are phosphorus and nitrogen.
pH	A measure of the degree of acidity or alkalinity; expressed on a logarithmic scale of 1 to 14 (1 is most acid, 7 neutral and 14 most alkaline).
Phosphorus	Is an element that is essential for plant and animal growth, excess concentrations can lead to eutrophication.
Physico-Chemical (Aquatic)	The measure and relationship between the physical and chemical identities of a water body.
Sensitive organism	An organism that's survival is highly susceptible to shifts in environmental conditions.
Sewage	The waste water from homes, offices, shops, factories and other premises discharged to the sewer. Is usually 99% water.
SIGNAL SF	SIGNAL (Stream Invertebrate Grade Number Average Level) is a biotic index using aquatic macroinvertebrates to assess stream health.
Stormwater	Rainwater that runs off the land, frequently carrying various forms of pollution such as litter and detritus, animal droppings and dissolved chemicals. This untreated water is carried in stormwater channels and discharged directly into water bodies.
Stormwater system	The system of pipes, canals and other channels used to carry stormwater to bodies of water, such as rivers or oceans. The system does not usually involve any significant form of treatment.
Tolerant organism	Is an organism that can survive in highly variable environmental conditions.
Turbidity	A measure of the amount of suspended solids (usually fine clay or silt particles) in water and thus the degree of scattering or absorption of light in the water.

Acronyms and abbreviations

Acronyms/ Abbreviation	Meaning
ANZECC	Australian and New Zealand Environment and Conservation Council
CFU	Colony Forming Unit
mg/L	Milligrams per litre
NTU	Nephelometric Turbidity Units
SIGNAL SF	Stream Invertebrate Grade Number Average Level – Sydney Family
µg/L	Micrograms per litre
µS/cm	Micro-siemens per centimetre (unit of conductivity)