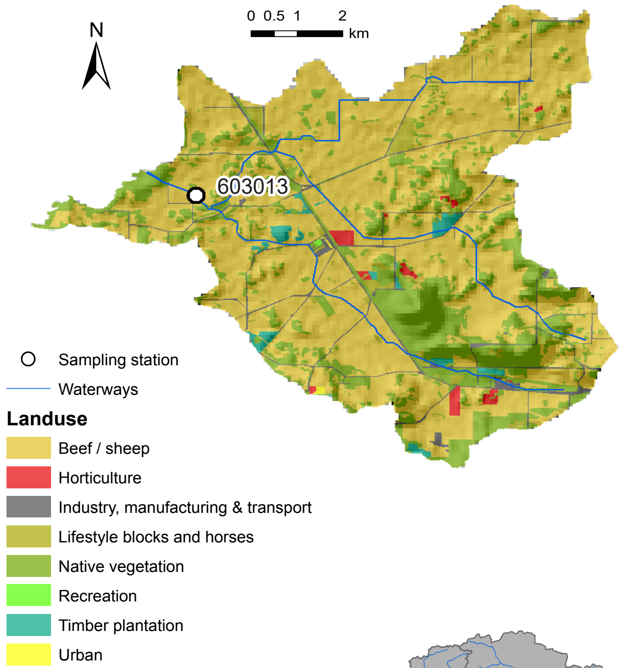
GOVERNMENT OF WESTERN AUSTRALIA
Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**

Wilson Inlet catchment nutrient report 2019

HEALTHY ESTUARIES WA

Cuppup Creek

This data report provides a summary of the nutrients at the Cuppup Creek sampling site in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Downstream of this site, the creek discharges to Wilson Inlet.



About the catchment

Cuppup Creek has a catchment area of about 70 km^2 which is largely cleared for agriculture. The dominant land use is beef cattle grazing, covering nearly 70 per cent of the catchment. The creek has been artificially modified to enhance drainage, with the creek line converted into straight channel drains in many locations. Most of the catchment has soils which have a good capacity to bind phosphorus applied to them, helping to reduce the amount entering waterways.

The combination of clearing native vegetation and straightening the creek lines has increased the rate at which water moves through the landscape to Wilson Inlet. The creek is ephemeral, drying over summer most years.

Water quality is measured at site 603013, downstream of Eden Road in Youngs Siding, shortly before the creek discharges into Wilson Inlet, near Morley Beach on the eastern shoreline.

Location of Cuppup Creek catchment in the greater Wilson Inlet catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in the Cuppup Creek catchment were classified as high. The nutrient loads were large compared with the other monitored catchments, as were the loads per square kilometre. These large loads were because of the high nutrient concentrations, caused by the agricultural land use in the catchment, the lack of fringing vegetation along stretches of the creek and the fact that much of the creek has been converted into straight channels.

Facts and figures

Sampling site code	603013
Catchment area	70 km^2
Per cent cleared area (2014)	76 per cent
River flow	Ephemeral, dries over summer
Main land use (2014)	Beef cattle grazing and native vegetation

Estimated loads and flow at Cuppup Creek

603013	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)	12	6.0	8.4	16	19	6.7	13	15	14	3.0	1.0	14	17	6.9	3.7
TN load (t)	28	14	20	40	47	16	30	38	34	6.7	2.4	33	43	17	8.8
TP load (t)	2.50	1.24	1.79	3.77	4.39	1.41	2.79	3.44	3.12	0.56	0.19	2.98	4.10	1.58	0.77

Cuppup Creek

Nitrogen over time (2005–19)

Concentrations

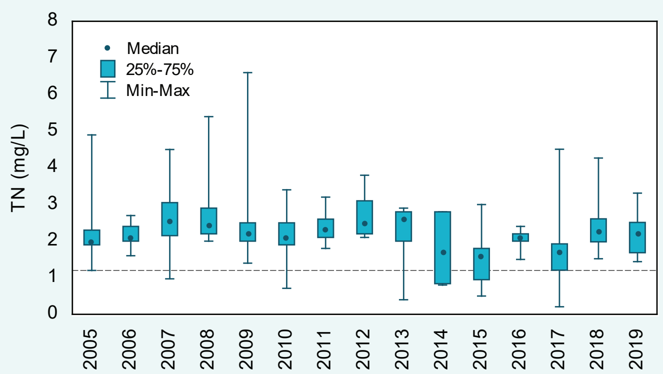
Total nitrogen (TN) concentrations in Cuppup Creek fluctuated over the reporting period, with the median concentration above the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value each year.

Using the State Wide River Water Quality Assessment (SWRWQA) methodology, annual TN concentrations were classified as high from 2017 (before this they were classified as very high) and were also high compared with the other monitored sites in the Wilson Inlet catchment. The 2019 median concentration was second highest of the sampled sites (2.2 mg/L; Sunny Glen Creek had a median of 2.5 mg/L). The high N concentrations at this site were caused by a combination of agricultural land use, clearing of fringing vegetation and the construction of drains which means nutrients can be washed from soils to waterways and transported downstream quickly rather than being assimilated.

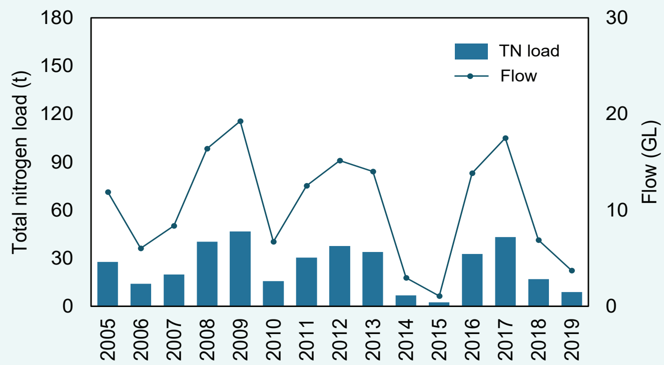
Estimated loads

Estimated TN loads at the Cuppup Creek sampling site were relatively large compared with the other Wilson Inlet catchment sites. In 2019, the creek had a TN load of 8.8 t, the second largest load of the six monitored catchments of the Wilson Inlet. Only the Sleeman River, had a larger TN load (12 t). Cuppup Creek had the second largest TN load per square kilometre, with 142 kg/km^2 exported in 2019 (the Sleeman River exported 152 kg/km^2). The large loads compared with the other Wilson Inlet catchments were driven by the relatively high TN concentrations at this site. Annual TN loads were closely related to flow volumes; years with large annual flow volumes had large TN loads and vice versa.

Cuppup Creek



Total nitrogen concentrations, 2005–19 at site 603013. The dashed line is the ANZECC trigger value.



Total nitrogen loads and annual flow, 2005–19 at site 603013.

Cuppup Creek, June 2018. Note the sand deposits on the riverbed which suggests upstream erosion, and the lack of fringing vegetation.

Cuppup Creek

Nitrogen (2019)

Types of nitrogen

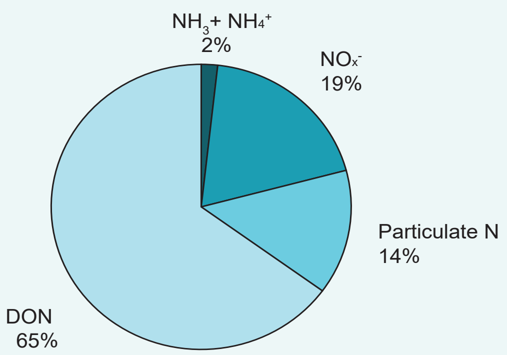
Total N is made up of different types of N. In Cuppup Creek most of the N was present as dissolved organic N (DON), which consists mainly of degrading plant and animal matter but may include other, bioavailable types. Cuppup Creek had the highest proportion of N present as particulate N of the sampled sites. Particulate N is composed of plant and animal detritus. Most types of particulate N and DON need to be further broken down to become available to plants and algae, though some DON types are readily bioavailable. The site also had a large proportion of N present as dissolved inorganic N (total ammonia – NH_3 + NH_4^+ and nitrate – NO_x^-), which is bioavailable to plants and can be used to fuel rapid growth. The proportion of N present as nitrate in 2019 was larger than in 2018 (19 per cent versus 8 per cent).

Concentrations

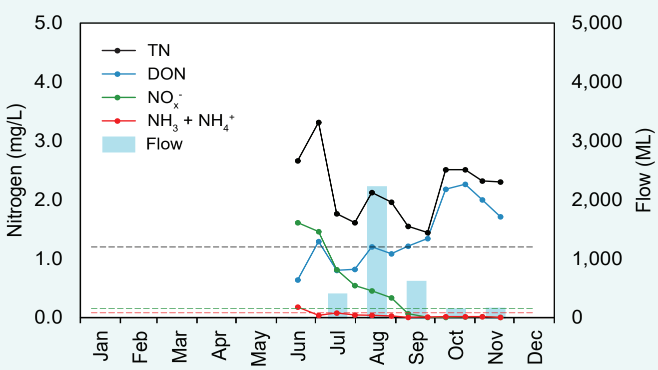
N concentrations varied throughout the year. TN, nitrate and total ammonia concentrations were highest when the creek started flowing in June and early July. This was likely a result of a first flush effect where N was mobilised following heavy rainfall. Much of this N was probably the result of mineralisation of organic N in soils and drains over the summer period, and runoff of high-concentration waters from agricultural land which builds up with fertilisers and animal waste over the summer. DON increased during the time the creek was flowing, suggesting that DON is coming mainly from groundwater (with the DIN coming mainly from surface flow) as the proportion of groundwater in the creek will have increased during the year.

Where there are no data shown on the graph, the creek was not flowing.

Cuppup Creek



2019 average nitrogen fractions at site 603013.



2019 nitrogen concentrations and monthly flow at 603013. The dashed lines are the ANZECC trigger values for the different N species.

Cuppup Creek, May 2019. Note the lack of stock fencing, absence of fringing vegetation and the drain-like formation of the creek.

Cuppup Creek

Phosphorus over time (2005–19)

Concentrations

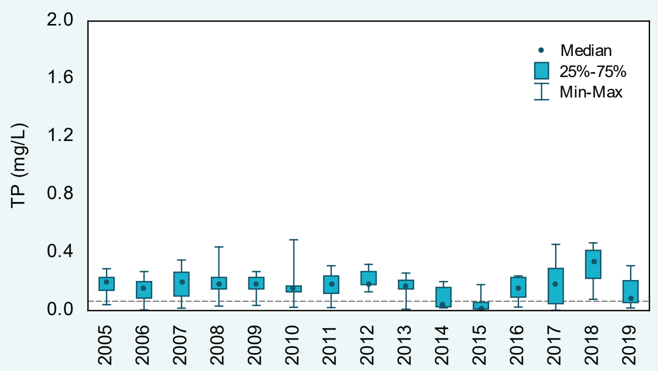
Total phosphorus (TP) concentrations fluctuated over the reporting period. 2014 and 2015 were the only years where the annual medians were below the ANZECC trigger value. In 2012 and 2018 all samples were greater than the trigger value and most years saw more than 75 per cent of collected samples over the trigger value.

In 2019, TP concentrations were lower than 2018; however, using the SWRWQA methodology they were still classified as high, as they have been every year. The 2019 median was the third highest of the sites in the Wilson Inlet catchment (0.089 mg/L); only the Sleeman River (0.118 mg/L and Sunny Glen Creek (0.324 mg/L) had higher medians.

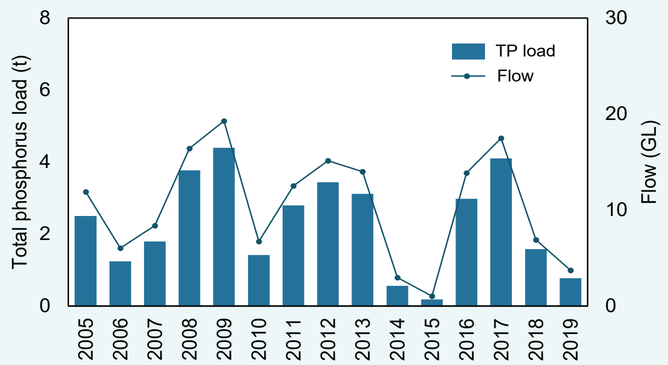
Estimated loads

Estimated TP loads at the Cuppup Creek sampling site were moderate compared with the other Wilson Inlet catchment sites. Cuppup Creek had the second largest TP load in 2019 (0.77 t); the Sleeman River had the largest load (1.36 t). In 2019 Cuppup Creek also had the second largest load per square kilometre of 12 kg/km^2. Annual TP loads were closely related to flow volumes; years with large annual flow volumes had large TP loads and vice versa.

Cuppup Creek



Total phosphorus concentrations, 2005–19 at site 603013. The dashed line is the ANZECC trigger value.



Total phosphorus loads and annual flow, 2005–19 at site 603013.

Filamentous algae growing upstream of the sampling site in Cuppup Creek, November 2017.

Cuppup Creek

Phosphorus (2019)

Types of phosphorus

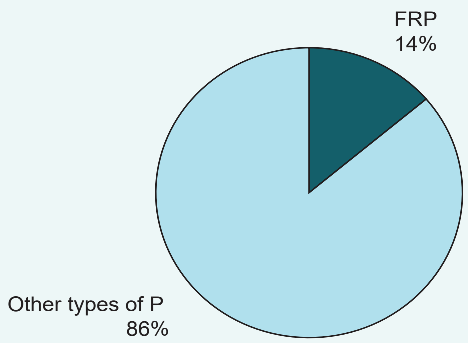
Total P is made up of different types of P. In 2019, Cuppup Creek had the smallest percentage of P present as phosphate of the Wilson Inlet sites. Phosphate is measured as filterable reactive phosphorus (FRP); in surface waters this is mainly present as phosphate (PO_4^{3-}) species. The presence of soils which have a high capacity to bind P is the likely reason for the relatively small percentage of phosphate at this site. This type of P is readily bioavailable. Phosphate was probably derived from animal waste and fertilisers as well as natural sources. The remainder of the P was present as either particulate P or dissolved organic P (DOP) or both (shown as 'Other types of P' in the chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood.

Concentrations

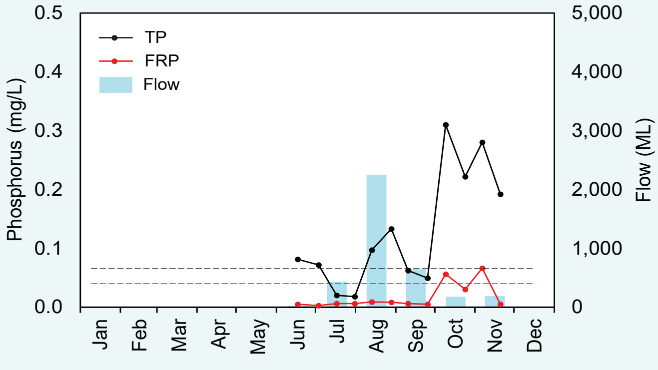
Both TP and phosphate concentrations were lower in the first part of the year and higher near the end of the year. The run of low-phosphate samples at the beginning of the year is unusual for Cuppup Creek. The reason for these low samples is unclear; perhaps it is related to the low flow recorded in the creek in 2019. It is likely that P was entering the creek via surface flows as well as coming from in-stream sources such as erosion. Groundwater likely contributes more P near the end of the year when surface flows were reducing and the proportion of groundwater in the creek increased.

Where there are no data shown on the graph, the creek was not flowing.

Cuppup Creek



2019 average phosphorus fractions at site 603013.



2019 phosphorus concentrations and monthly flow at 603013. The dashed lines are the ANZECC trigger values for the different P species.

Pipe discharging into Cuppup Creek, June 2018.

Cuppup Creek

Total suspended solids over time (2005–19)

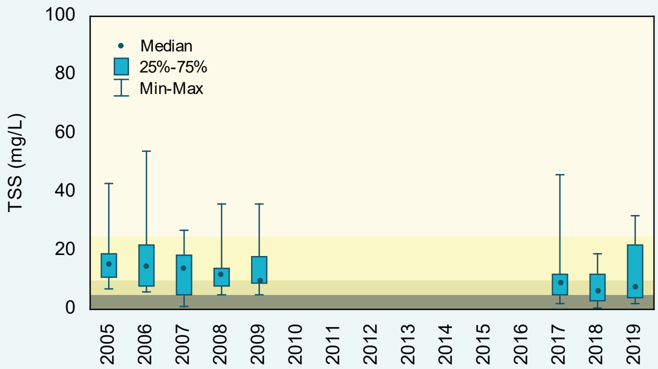
Concentrations

Compared with the other sites sampled in the Wilson Inlet catchment, total suspended solids (TSS) concentrations were high in Cuppup Creek. Using the SWRWQA methodology, all years pre-2010 were classified as high, whereas since 2017, all years were moderate. The 2019 median (8 mg/L) was the highest of the Wilson Inlet catchment sites, with Sleeman and Little rivers and Sunny Glen Creek having the next highest median (4 mg/L each). Between 2010 and 2016; TSS was only collected sporadically so the data have not been graphed.

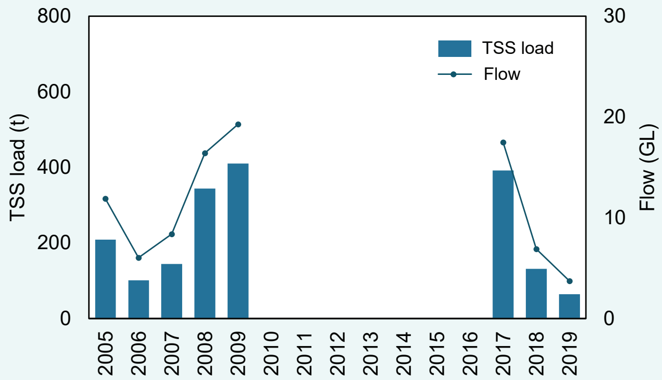
Estimated loads

Estimated TSS loads at the Cuppup Creek sampling site were relatively large, with Cuppup Creek contributing the largest TSS load of the monitored catchments in 2019 (64 t, the Sleeman River had the next largest load of 45 t). In 2019 it had the second largest load per square kilometre of 1,032 kg/km^2 (just smaller than the load per square kilometre from Little River at 1,188 kg/km^2). The large loads are likely because of a combination of factors including the agricultural land use in the catchment, the fact that much of the creek has been straightened to assist drainage and the lack of fringing vegetation along large sections of the creek. Annual TSS loads were closely related to flow volumes; years with large annual flow volumes had large TSS loads and vice versa.

Cuppup Creek



Total suspended solids concentrations, 2005–19 at site 603013. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 603013.

low moderate high very high

The Cuppup Creek sampling site, September 2018. The weir is completely covered with water.

Cuppup Creek

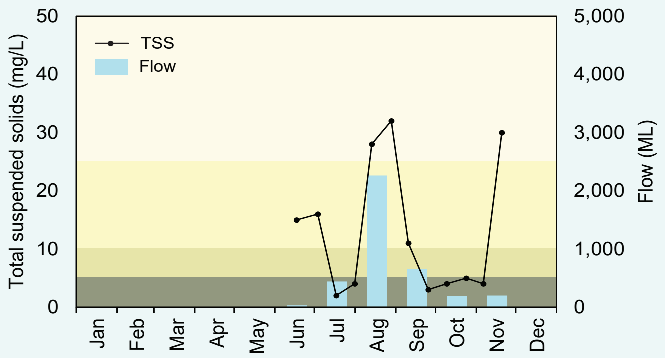
Total suspended solids (2019)

Concentrations

Unlike in 2018, when concentrations were highest at the beginning of the year, there were three distinct peaks in TSS in 2019. The first peak in June/July was caused by rain washing particles into the stream and mobilising particulates that had accumulated in the stream when it was dry. The second peak in August/September coincides with the largest flow volumes, suggesting that particulates were coming from in-stream erosion as well as runoff from surrounding land. In-stream erosion is exacerbated by stock accessing the creek. Cleared agricultural land is more prone to erosion than land covered by native vegetation and streams with little or no fringing vegetation, like much of Cuppup Creek, are more prone to in-stream erosion. The peak in November may have been because of rainfall on that day.

Where there are no data shown on the graph, the creek was not flowing.

Cuppup Creek



2019 total suspended solids concentrations and monthly flow at 603013. The shading refers to the SWRWQA classification bands.

low | moderate | high | very high

The Cuppup Creek sampling site, completely dry, February 2019.

Cuppup Creek

pH over time (2005–19)

pH values

pH in Cuppup Creek was slightly acidic, with the median pH being below, or only just above, the lower ANZECC trigger value in most years. In 2019 the median pH was lower in Cuppup Creek (6.0) than any other monitored site.

There is some concern the probe used to collect the pH data from the catchments of Wilson Inlet (including the Cuppup Creek site) was not functioning correctly from about October 2016 to October 2017. This may have caused lower than actual pH values to be recorded. After October 2017, a new probe was used. Although there is no way of verifying the 2016–17 pH data, they have still been presented here.

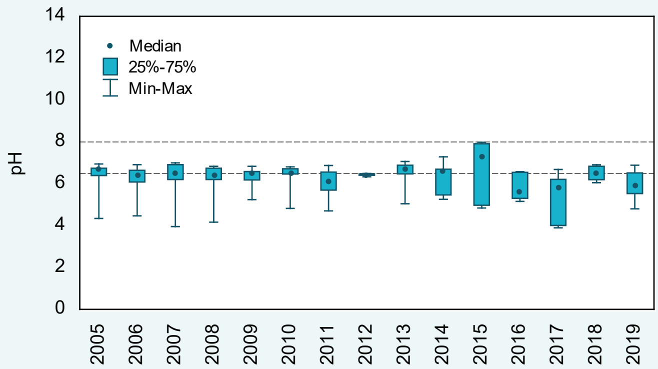
pH (2019)

pH values

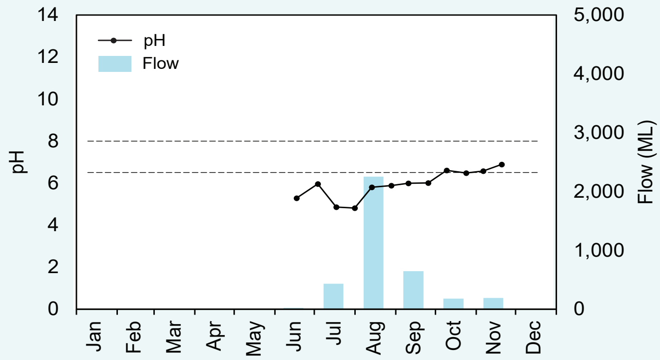
One-quarter of the samples collected in 2019 were within the ANZECC trigger values, with the remainder below the lower trigger value. pH appears to slowly increase during the year which may indicate that the groundwater is less acidic than the surface water runoff (groundwater will be contributing a larger proportion of the water in the creek later in the year).

Where there are no data shown on the graph, the creek was not flowing.

Cuppup Creek



pH levels, 2005–19 at site 603013. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 603013. The dashed lines are the upper and lower ANZECC trigger values.

The Cuppup Creek sampling site, December 2015. Note the steep banks covered in Watsonia, an invasive weed species.

Cuppup Creek

Salinity over time (2005–19)

Concentrations

Using the Water Resources Inventory 2014 salinity ranges, all years were classified as marginal (note, the 2018 nutrient report used the SWRWQA bands). In 2019, Cuppup Creek had the third highest median salinity (975 mg/L) of the sites sampled in the Wilson Inlet catchment. The only sites with higher medians were the two sites on the Hay River (where salinity was much higher at 4,420 mg/L and 5,770 mg/L). Salinity was not measured from 2005–11.

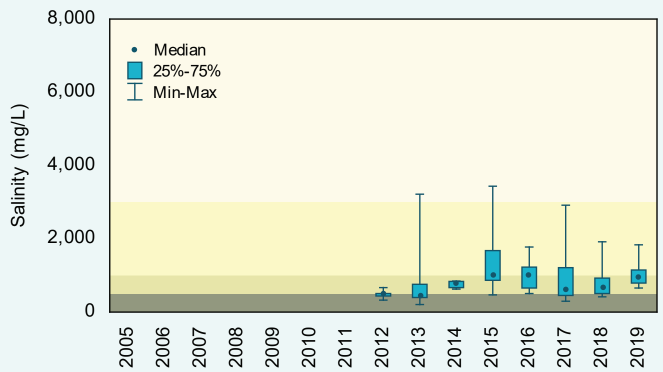
Salinity (2019)

Concentrations

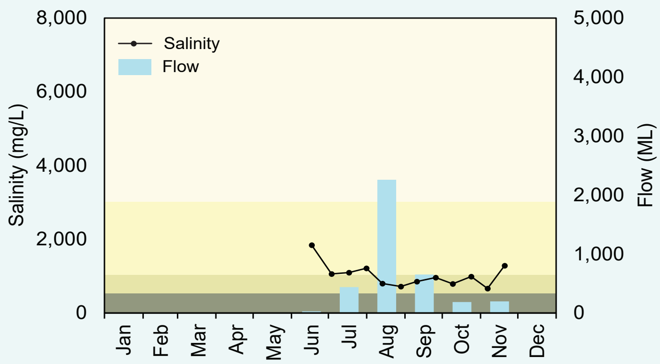
In 2019, salinity showed a slight seasonal pattern, being highest at the beginning and end of the year. The higher salinity at the start of the year is likely because of salts being washed into the creek from surrounding farmland with the onset of winter rains as well as any salt left behind in the creek being mobilised with the commencement of flow. The increase in concentrations in November coincided with water in the creek drying up, causing evapoconcentration of the salts present. At this time, most of the water present in the creek is from groundwater. So it is possible that the groundwater is more saline than the surface water at this site, which may also have contributed to the observed increase in salinity.

Where there are no data shown on the graph, the creek was not flowing.

Cuppup Creek



Salinity concentrations, 2005–19 at site 603013. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at 603013. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

Woody debris caught on a trash rack in Cuppup Creek, July 2018.

Cuppup Creek

Background

Healthy Estuaries WA is a State Government program launched in 2020 and builds on the work of the Regional Estuaries Initiative. Collecting and reporting water quality data, such as in this report, helps build understanding of the whole system; both the catchment and the estuary. By understanding the whole system, we can direct investment towards the most effective actions in the catchments to protect and restore the health of our waterways.

Nutrients (nitrogen and phosphorus) are compounds that are important for plants to grow. Excess nutrients entering waterways from effluent, fertilisers and other sources can fuel algal growth, decrease oxygen levels in the water and harm fish and other species. Total suspended solids, pH and salinity data are also presented as these help us better understand the processes occurring in the catchment.

You can find information on the condition of Wilson Inlet at estuaries.dwer.wa.gov.au/estuary/wilson-inlet/

Healthy Estuaries WA partners with the Wilson Inlet Catchment Committee to fund best-practice management of fertiliser, dairy effluent and watercourses on farms.

- To find out how you can be involved visit estuaries.dwer.wa.gov.au/participate
- To find out more about the Wilson Inlet Catchment Committee go to wicc.org.au
- To find out more about the health of the rivers in the Wilson Inlet catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Variables were compared with ANZECC trigger values where available, or the SWRWQA bands or 2014 Water Resources Inventory ranges. They were classified using the SWRWQA methodology. Standard statistical tests were used to calculate trends and loads. For further information on the methods visit estuaries.dwer.wa.gov.au/nutrient-reports/data-analysis

Glossary

Bioavailable: bioavailable nutrients refers to those nutrients which plants and algae can take up from the water and use straight away for growth.

Concentration: the amount of a substance present per volume of water.

Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

First flush: material washed into a waterway by the first rainfall after an extended dry period. The first flush is often associated with high concentrations of nutrients and particulate matter.

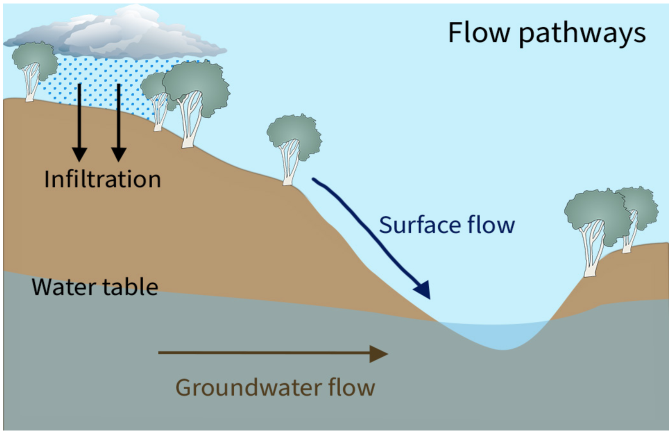
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

Load: the total mass of a substance passing a certain point.

Load per square kilometre: the load at the sampling site divided by the entire catchment area upstream of the sampling site.

Nitrate: The measurement for the nutrient nitrate actually measures both nitrate (NO_3^-) and nitrite (NO_2^-), which is reported as NO_x^-. We still refer to this as nitrate as in most surface waters nitrite is present in very low concentrations.

The schematic below shows the main flow pathways which may contribute nutrients, particulates and salts to the waterways. Connection between surface water and groundwater depends on the location in the catchment, geology and the time of year.



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