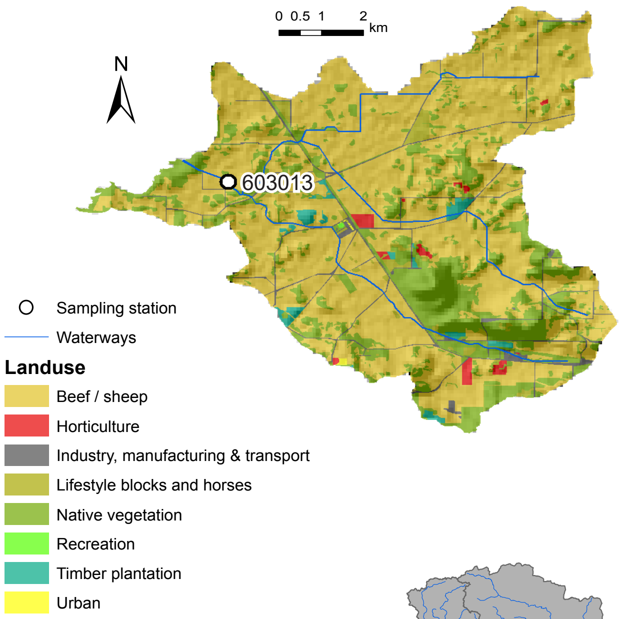
Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

Wilson Inlet catchment nutrient report 2018

REGIONAL ESTUARIES INITIATIVE

Cuppup Creek

This data report provides a summary of the nutrients at the Cuppup Creek sampling site in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of this site, the creek discharges to Wilson Inlet. 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.



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

About the catchment

Cuppup Creek has a catchment area of about 70 km² 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. 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.

The creek enters Wilson Inlet near Morley Beach on the eastern shoreline.

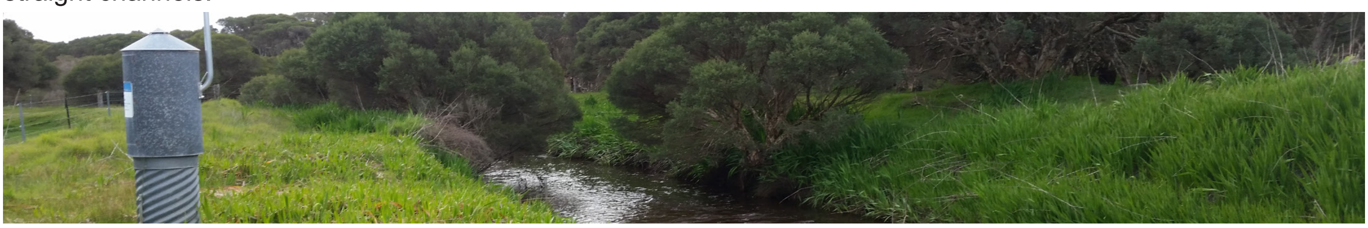
Water quality is measured at site 603013, downstream of Eden Road in Youngs Siding, shortly before the creek discharges into Wilson Inlet.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in the Cuppup Creek catchment were very 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
Rainfall at Denmark (2018)	776 mm
Catchment area	70 km²
Per cent cleared area (2014)	76%
River flow	Ephemeral, dries over summer
Annual flow (2018)	6.9 GL
Main land use (2014)	Beef cattle grazing and native vegetation



Cuppup Creek

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations in Cuppup Creek fluctuated over the 2004–18 period, with the median concentration above the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value each year.

TN concentrations were high compared with the other monitored sites in the Wilson Inlet catchment. The 2018 median concentration was equal highest of the sampled sites (2.3 mg/L; Sunny Glen Creek also had a median of 2.3 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.

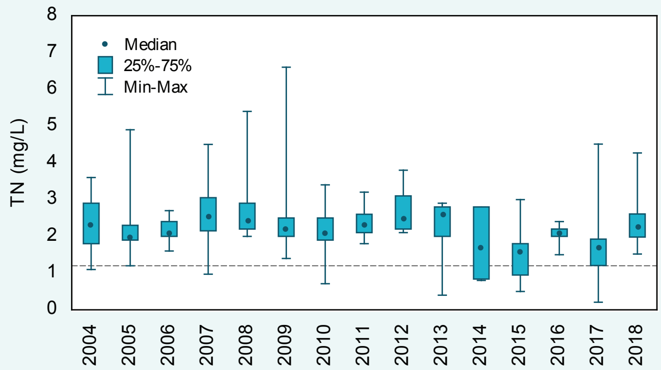
Trends

There were no trends present in the TN data over either the short- (2014–18) or long-term (2004–18).

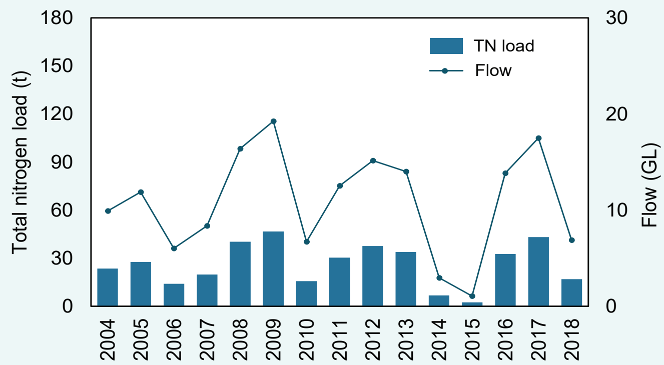
Estimated loads

Estimated TN loads at the Cuppup Creek sampling site were relatively large compared with the other Wilson Inlet catchment sites. In 2018, the creek had a TN load of 17 t, the second largest load of the six monitored catchments of the Wilson Inlet. Only the Hay River, with a catchment area 15 times larger than Cuppup Creek, had a larger TN load (18 t). Cuppup Creek had the largest TN load per unit area, with 245 kg/km^2 exported in 2018. 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, 2004–18 at site 603013. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 603013.

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

Nitrogen (2018)

Types of nitrogen

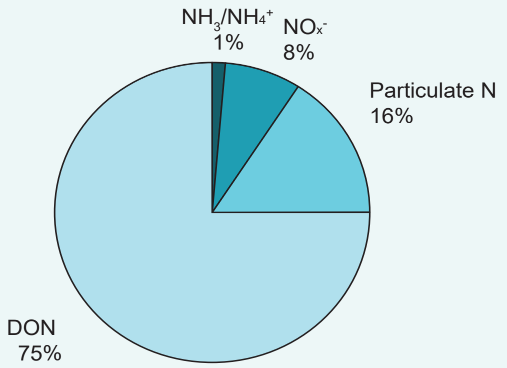
Total N is made up of many different types of N. In Cuppup Creek most of the N was present as dissolved organic N (DON), which consists mainly of degrading plant and animal matter but may include other, bioavailable forms. Cuppup Creek had the highest proportion of N present as particulate N of the sampled sites. Particulate N is composed of plant and animal detritus. Most forms of particulate N and DON need to be further broken down to become available to plants and algae, though some DON forms are readily bioavailable. Only a small proportion of N was present as dissolved inorganic N (ammonia N – NH_3/NH_4^+ and oxides of N – NO_x^-), which is bioavailable to plants and can be used to fuel rapid growth.

Concentrations

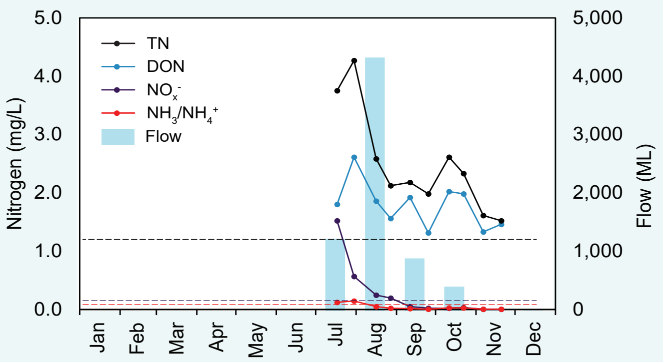
N concentrations varied throughout the year, with evidence of a seasonal pattern in TN, NO_x^- and NH_3/NH_4^+ concentrations, which were highest when the creek started flowing in July. It is likely that NO_x^- was rapidly transported from surrounding farmland to the creek during the first-flush event (when the creek first started to flow). NH_3/NH_4^+ concentrations showed a similar pattern to NO_x^-; however, the peak in July was much smaller. The reason for the peaks in DON concentrations in September and October are unclear.

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

Cuppup Creek



2018 average nitrogen fractions at site 603013.



2018 nitrogen concentrations and monthly flow at 603013. The dashed lines are the ANZECC trigger values for lowland rivers 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 (2004–18)

Concentrations

Total phosphorus (TP) concentrations fluctuated over the past 15 years. 2014 and 2015 were the only years where the 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.

The 2018 median total phosphorus concentration was higher in Cuppup Creek than any of the other monitored sites in the Wilson Inlet catchment (0.340 mg/L; Sunny Glen Creek was next highest with a median of 0.268 mg/L).

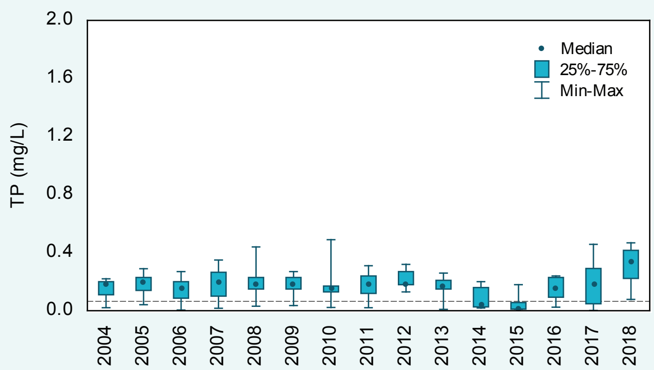
Trends

There was an increasing short-term (2014–18) trend of 0.033 mg/L/yr. This may be part of the natural fluctuations at this site or because of an actual increase in TP concentrations. Ongoing monitoring will help determine if water quality is getting worse at this site. There was no long-term (2004–18) trend.

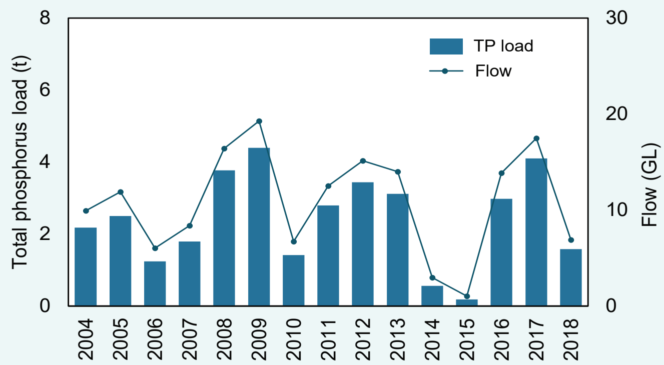
Estimated loads

Estimated TP loads at the Cuppup Creek sampling site were large compared with the other Wilson Inlet catchment sites, with Cuppup Creek having the equal largest TP load in 2018 (with the Sleeman River; 1.6 t each). It also had the largest load per unit area of 23 kg/km^2 in 2018. Annual TP loads were closely related to flow volumes; years with high annual flow had large TP loads and vice versa.

Cuppup Creek



Total phosphorus concentrations, 2004–18 at site 603013. The dashed line is the ANZECC trigger value for lowland rivers.



Total phosphorus loads and annual flow, 2004–18 at site 603013.

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

Phosphorus (2018)

Types of phosphorus

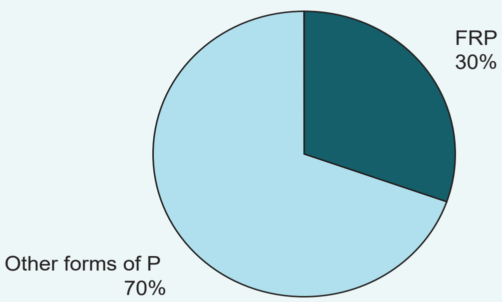
Total P is made up of different types of P. In Cuppup Creek about a third of the P was present as filterable reactive phosphorus (FRP) which is readily bioavailable, meaning plants and algae can use it to fuel rapid growth. FRP was probably derived from animal waste and fertilisers as well as natural sources. The remainder of the P was present as either particulate P or dissolved organic P (DOP) or both. Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood.

Concentrations

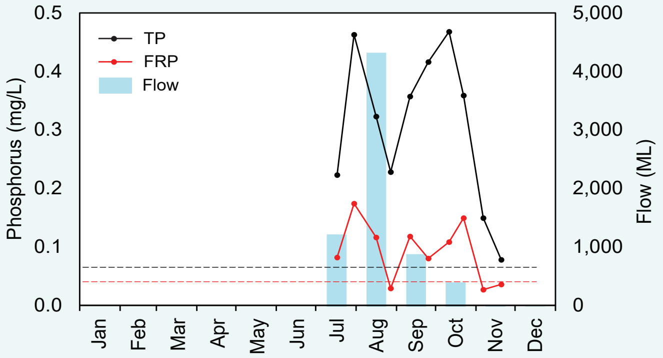
Both TP and FRP concentrations varied throughout the year in Cuppup Creek. All TP and almost all FRP samples were above their ANZECC trigger values. For the majority of the year, it is likely that most of the P is entering the creek via surface flows as well as coming from in-stream sources such as erosion. In November, when concentrations were relatively low, most of the P in the creek was probably being sourced from groundwater. At this time, when water levels in the creek were lower, groundwater was likely contributing proportionally more water to the creek than during the wetter months when there was more surface flow.

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

Cuppup Creek



2018 average phosphorus fractions at site 603013.



2018 phosphorus concentrations and monthly flow at 603013. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

Pipe discharging into Cuppup Creek, June 2018.

Cuppup Creek

Total suspended solids over time (2004–18)

Concentrations

Compared with the other sites sampled in the Wilson Inlet catchment, total suspended solids (TSS) concentrations were high in Cuppup Creek. Using the Statewide River Water Quality Assessment (SWRWQA) bands, median TSS concentrations were classified as high from 2004–08 but dropped to moderate in 2009 and 2017–18. The 2018 median was one of the highest of all sites sampled (7 mg/L, the same as Little River). Between 2010 and 2016; TSS was only collected sporadically so the data have not been graphed.

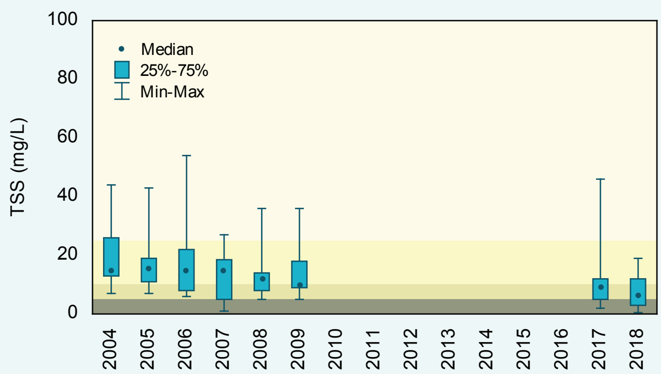
Trends

It was not possible to test for trends because regular monitoring for TSS was not conducted between 2010–16 in Cuppup Creek. A minimum of five years of data are required to test for trends.

Estimated loads

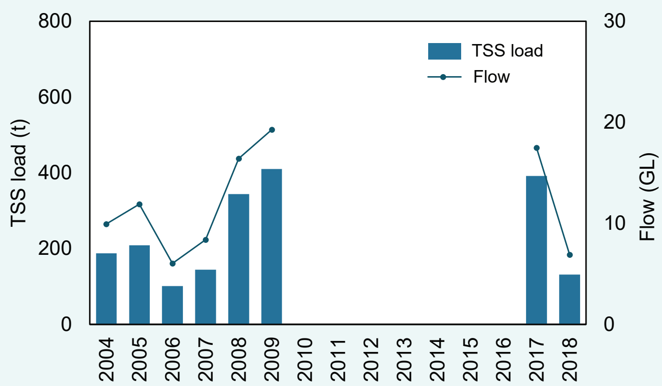
Estimated TSS loads at the Cuppup Creek sampling creek were relatively large, with Cuppup Creek contributing the largest TSS load of the monitored catchments in 2018 (at 132 t, Scotsdale Brook had the next largest load of 112 t). In 2018 it also had the largest load per unit area of 1913 kg/km^2 (just larger than the load per unit area from Little River at 1,906 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 high annual flow had large TSS loads and vice versa.

Cuppup Creek



Total suspended solids concentrations, 2004–18 at site 603013. The shading refers to the SWRWQA classification bands.

very high high moderate low



Total suspended solids loads and annual flow, 2004–18 at site 603013.

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

Cuppup Creek

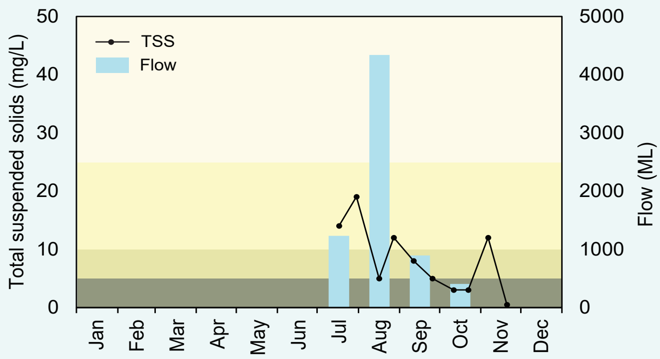
Total suspended solids (2018)

Concentrations

In 2018, most of the samples collected fell within either the moderate or high bands. Concentrations were highest early in the year when rain washed particles into the stream and mobilised particulates that had accumulated in the stream when it was dry. The reason for the peak in early November is unclear though it is possible weeds and algae were unintentionally disturbed during sampling. Year-round, particulates came from either in-stream erosion (which is exacerbated by stock accessing the creek) or runoff from surrounding land. 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.

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

Cuppup Creek



2018 total suspended solids concentrations and monthly flow at 603013. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

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

pH over time (2004–18)

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 2018, the median pH was lower in Cuppup and Sunny Glen Creeks (both had a median of 6.5) than any other monitored site. pH levels fluctuated over the 2004–18 reporting period.

Trends

There were no trends present in the pH data over either the short- (2014–18) or long-term (2004–18).

pH (2018)

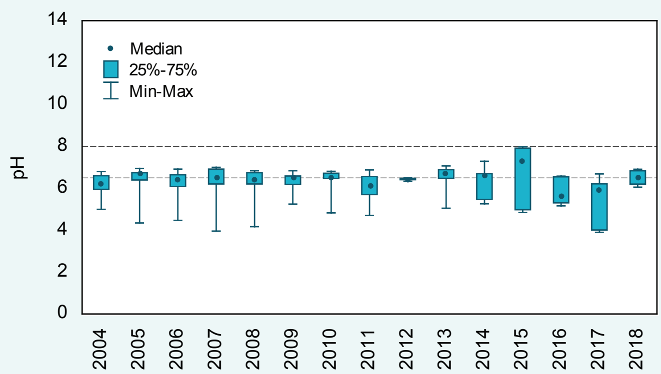
pH values

Just over half of the samples collected in 2018 were within the ANZECC trigger values, with the remainder below the lower trigger value. pH fluctuated throughout the year with no clear seasonal pattern.

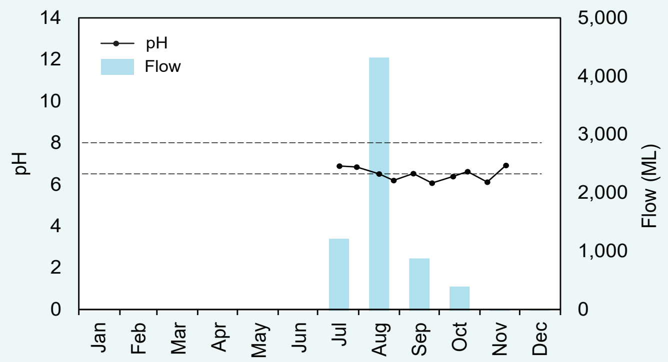
Where there are no data shown on the graph, the creek was not flowing.

There is some concern the probe used to collect the pH data from the catchments of Wilson Inlet (including the Cuppup Creek site) from about October 2016 to October 2017 was not functioning correctly. 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.

Cuppup Creek



pH levels, 2004–18 at site 603013. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 603013. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

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

Cuppup Creek

Salinity over time (2004–18)

Concentrations

Using the SWRWQA classification bands, the median salinity was marginal in all years except 2013 when it was fresh, and 2015–16 when it was brackish. In 2018, Cuppup Creek had the third highest median salinity (670 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 4,140 mg/L and 5,060 mg/L). Salinity was not measured between 2003–11.

Trends

Trend testing showed there were no short-term trends in salinity in Cuppup Creek (2014–18).

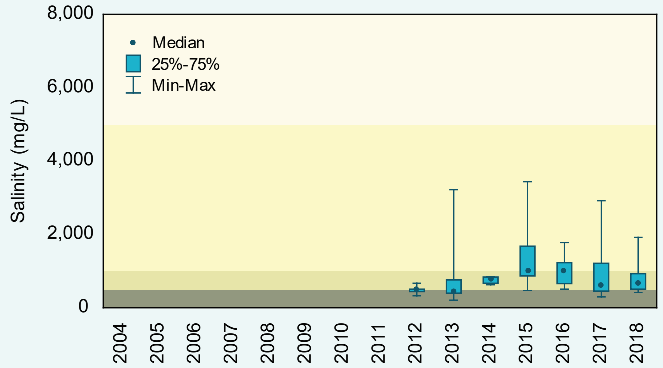
Salinity (2018)

Concentrations

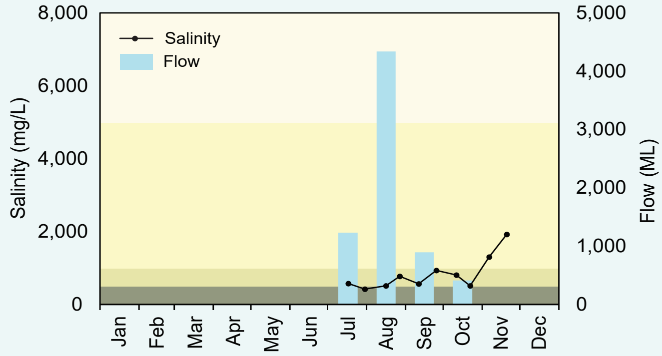
Salinity concentrations were stable for most of 2018 and the majority of samples fell into either the fresh or marginal bands. There were two samples collected in November that were brackish. The increase in concentrations in November coincided with water in the creek drying up, causing evapoconcentration 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, 2004–18 at site 603013. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at 603013. The shading refers to the SWRWQA classification bands.

saline | brackish | marginal | fresh

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

Cuppup Creek

Background

The Regional Estuaries Initiative is a State Government program to improve the health of waterways and estuaries in the south-west of Western Australia. Healthy Estuaries WA is a Royalties for Regions program launched in 2020 and will build 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. 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.

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

The Regional Estuaries Initiative partners with the Wilson Inlet Catchment Committee to fund best-practice fertiliser, dairy effluent and watercourse management 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

Where possible, parameters were compared with the ANZECC trigger values for lowland rivers in south-west Australia. These values provide a value above which there may be a risk of adverse effect. For pH there is both an upper and lower trigger value which represent the acceptable pH range. Where there were no ANZECC trigger values available (for TSS and salinity) the SWRWQA classification bands were used to allow samples and sites to be classified and compared.

Trend testing was carried out using either the Mann or Seasonal Kendall tests as appropriate. Where there were flow data available and there was a flow-concentration relationship, the data were flow-adjusted before trend analysis.

Annual loads were calculated by multiplying daily flow with daily nutrient concentrations and aggregating over the year. Measured daily concentrations were not available as samples were collected fortnightly at best, so daily concentration data were calculated using the locally estimated scatterplot smoothing algorithm (LOESS).

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 in the water.

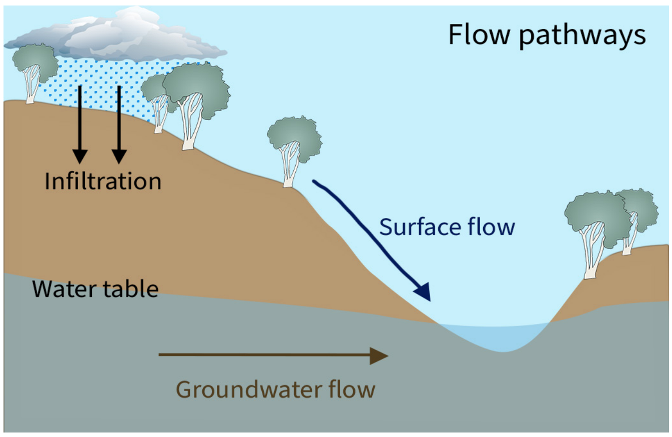
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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

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

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

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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