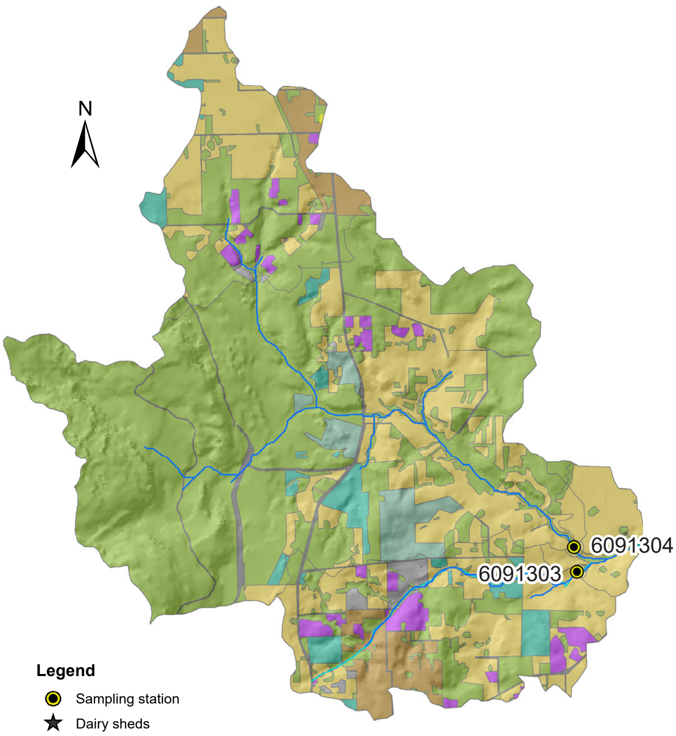
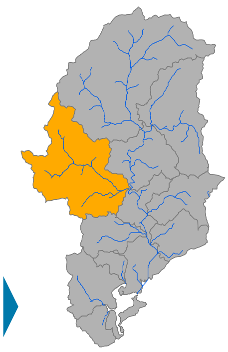
GOVERNMENT OF WESTERN AUSTRALIA
Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**

McLeod Creek

This data report provides a summary of the nutrients at the two McLeod Creek sampling sites in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of the sites, McLeod Creek discharges to the Blackwood River and subsequently the Hardy 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 water and harm fish and other species. Total suspended solids, pH and salinity data are also presented as they help us better understand the processes occurring in the catchment.



Location of McLeod Creek catchment in the greater Lower Blackwood catchment.



About the catchment

McLeod Creek has a catchment area of about 114 km^2, just over half of which is still covered in native vegetation. This is predominantly in the western portion of the catchment which is state forest. The other major land use is beef and sheep grazing. There are two major waterways: McLeod Creek which drains the northern half of the catchment; and Rushy Creek which drains the southern. McLeod Creek still has fringing vegetation along much of its length whereas it has been largely cleared from Rushy Creek. Rushy Creek also has a number of dams on it, including one just upstream of the sampling site. McLeod Creek discharges to the Blackwood River in Forest Grove, just above the Alexandra Bridge Camp Ground.

Most of the catchment has soils with a high phosphorus-binding capacity, reducing the amount that enters streams.

Water quality is measured at two sites. Rushy Creek, 6091303, which is on Rushy Creek where it passes under Millers Road, just upstream from the discharge point into McLeod Creek. And 6091304, Millers Road Crossing, which is on McLeod Creek where it passes under Millers Road. Both sites are in Forest Grove.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the two sites in the McLeod Creek catchment were generally low, though there were individual nitogen samples which were high when compared with the other sites in the Blackwood River catchment. The proportion of nitrogen present as bioavailable dissolved inorganic nitrogen was high, indicative of the agricultural land uses in this catchment.

Facts and figures

Sampling site code	6091303 and 6091304
Rainfall at Alexandra Bridge (2018)	933 mm
Catchment area	114 km^2
Per cent cleared area (2001)	45 per cent
River flow	McLeod Creek (6091304) flows year-round whereas Rushy Creek (6091303) dries over summer.
Main land use (2001)	Native vegetation and beef and sheep grazing

McLeod Creek

Nitrogen over time (2004–18)

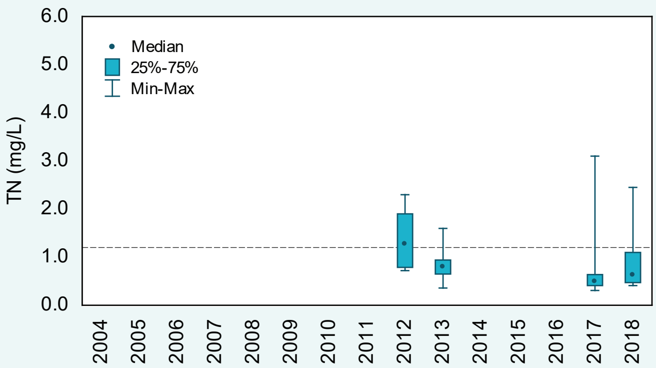
Concentrations

Median total nitrogen (TN) concentrations were generally slightly higher in Rushy Creek than McLeod Creek, though the annual range in concentrations was slightly greater in McLeod Creek. TN has fluctuated over the reporting period, though a similar pattern was observed at both sites. The median TN was below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value most years at both sites.

Trends

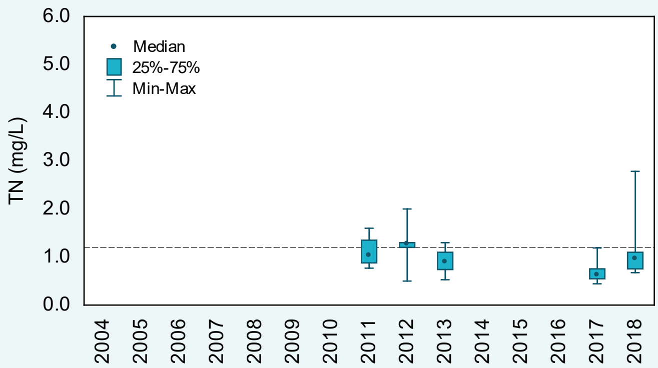
As both McLeod Creek and Rushy Creek were only sampled sporadically over the past 15 years, it was not possible to calculate trends in TN concentrations at either of these sites. A minimum of five years of data are required to test for trends.

McLeod Creek

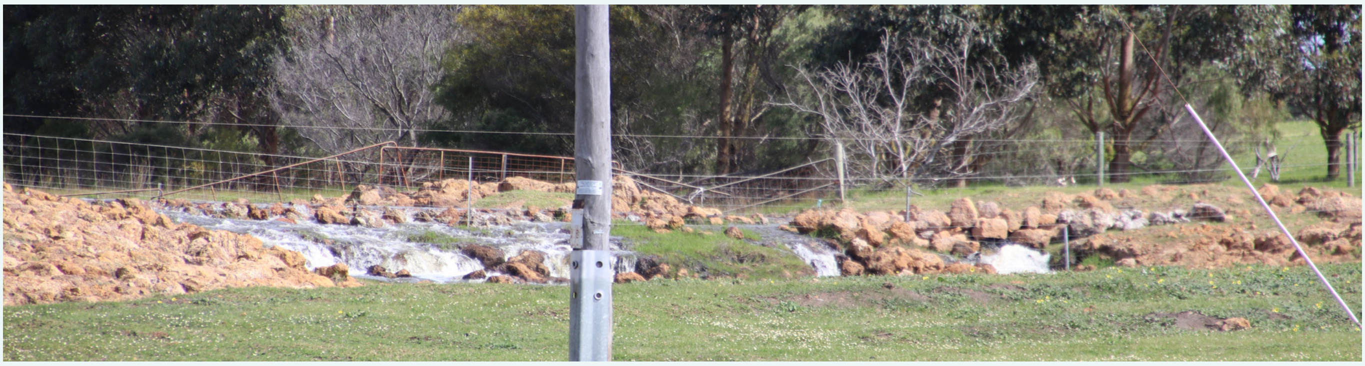


Total nitrogen concentrations, 2004–18 at site 6091304. The dashed line is the ANZECC trigger value for lowland rivers.

Rushy Creek



Total nitrogen concentrations, 2004–18 at site 6091303. The dashed line is the ANZECC trigger value for lowland rivers.



The dam upstream of the Rushy Creek sampling site overflowing, September 2019.

McLeod Creek

Nitrogen (2018)

Types of nitrogen

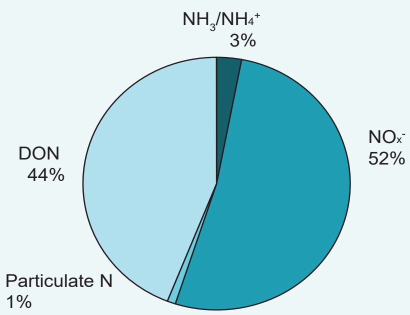
Total N is made up of many different types of N. In 2018, a large portion of the N was present as dissolved inorganic nitrogen (DIN, consisting of oxides of N – NO_x^- and ammonia N – NH_3/NH_4^+) at both sites. DIN is readily utilised by plants and algae to fuel rapid growth and typically makes up a large percentage of the N in agricultural catchments where it is usually sourced from fertilisers and animal wastes. Dissolved organic N (DON) is generally less bioavailable than DIN (though some forms are readily available) and is sourced from degrading plant and animal matter as well as fertilisers and animal wastes. More natural catchments tend to have a higher proportion of N present as DON than these two sites.

Concentrations

Nitrogen concentrations varied differently at the two sites in the McLeod Creek catchment. At McLeod Creek there was a large peak in TN and NO_x^- early in the year. The reason for this is unknown, though it does suggest some kind of discharge to the creek (the missing data point at this time was because of an issue with the sample, the site was flowing). At Rushy Creek there was a large peak in NH_3/NH_4^+ late in the year. This was probably because of runoff from an upstream land-use. Other than these peaks, TN, NO_x^- and DON all showed a seasonal pattern, being higher during the wetter months when there was more flow.

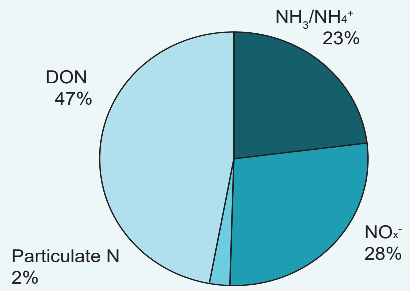
Where there are no data shown in the Rushy Creek graph, the creek was not flowing.

McLeod Creek

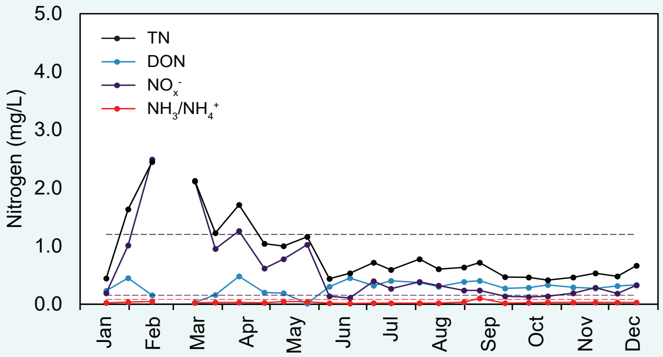


2018 average nitrogen fractions at site 6091304.

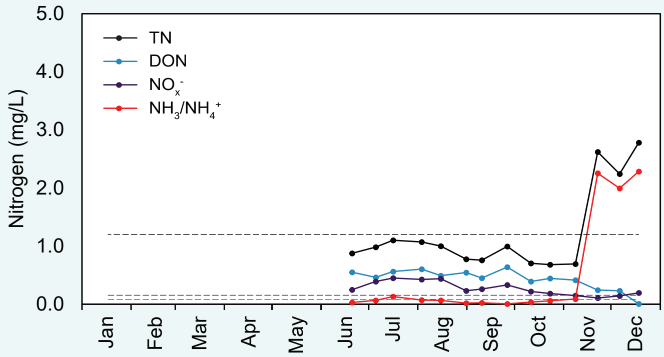
Rushy Creek



2018 average nitrogen fractions at site 6091303.



2018 nitrogen concentrations at 6091304. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.



2018 nitrogen concentrations at 6091303. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

McLeod Creek

Phosphorus over time (2004–18)

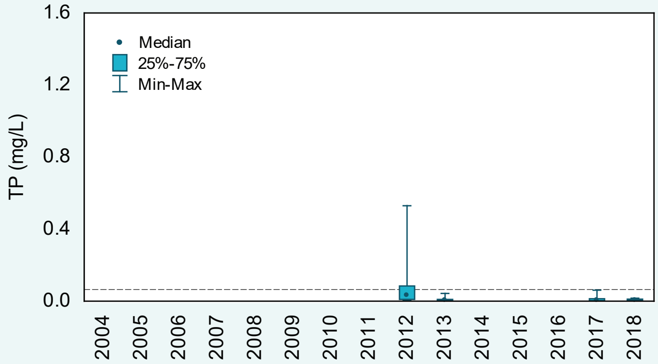
Concentrations

With the exception of 2012 at McLeod Creek, where total phosphorus concentrations (TP) were unusually high, all TP samples were below the ANZECC trigger value at both sites. Why there were some unusually high TP concentrations in 2012 at McLeod Creek is unknown, though the very high reading at this site coincided with a high TSS reading suggesting there may have been some disturbance near the site which contributed P-rich particulate matter to the creek.

Trends

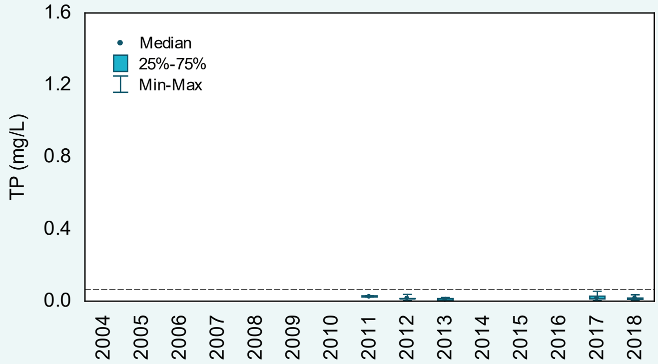
As both McLeod Creek and Rushy Creek were only sampled sporadically over the past 15 years, it was not possible to calculate trends in TP concentrations at either of these sites. A minimum of five years of data are required to test for trends.

McLeod Creek



Total phosphorus concentrations, 2004–18 at site 6091304. The dashed line is the ANZECC trigger value for lowland rivers.

Rushy Creek



Total phosphorus concentrations, 2004–18 at site 6091303. The dashed line is the ANZECC trigger value for lowland rivers.

The McLeod Creek sampling site, June 2019.

Phosphorus (2018)

Types of phosphorus

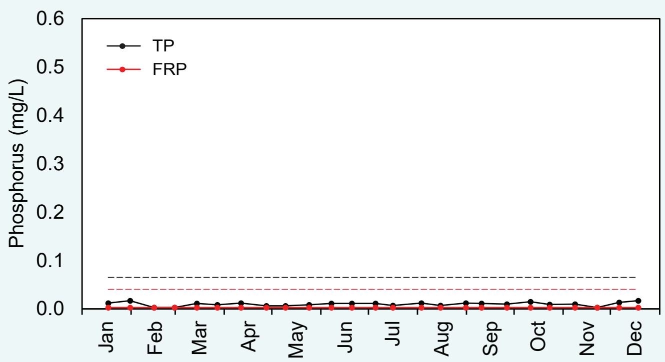
Total P is made up of different types of P. Because a large number of samples were below the laboratory limit of reporting in 2018, phosphorus fraction pie charts were not generated for either the McLeod or Rushy creek sites. At the McLeod Creek site, three of the 26 TP samples and all the filterable reactive P (FRP) samples were below their limits of reporting (0.005 mg/L in each case). At the Rushy Creek site, two of the 14 TP samples and 13 of the 14 FRP samples were below their limit of reporting.

Concentrations

Neither the McLeod Creek or the Rushy Creek site showed a seasonal pattern in TP or FRP concentrations. TP fluctuated at both sites during the year with some minor peaks present. All samples collected were well below their ANZECC trigger values for both TP and FRP. The high P-binding capacity of the soils present in this catchment will be contributing to the low P concentrations observed.

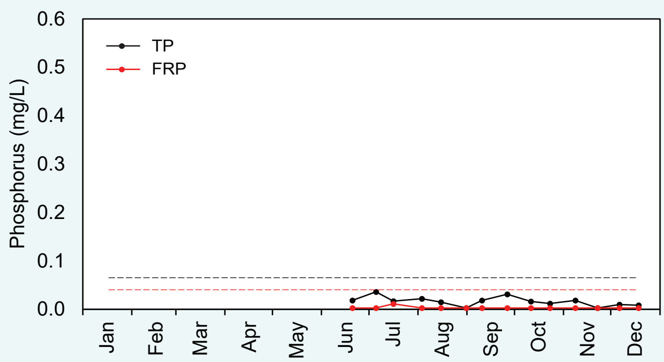
Where there are no data shown in the Rushy Creek graph, the creek was not flowing.

McLeod Creek



2018 phosphorus concentrations at 6091304. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

Rushy Creek



2018 phosphorus concentrations at 6091303. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

The Rushy Creek sampling site, September 2019.

McLeod Creek

Total suspended solids over time (2004–18)

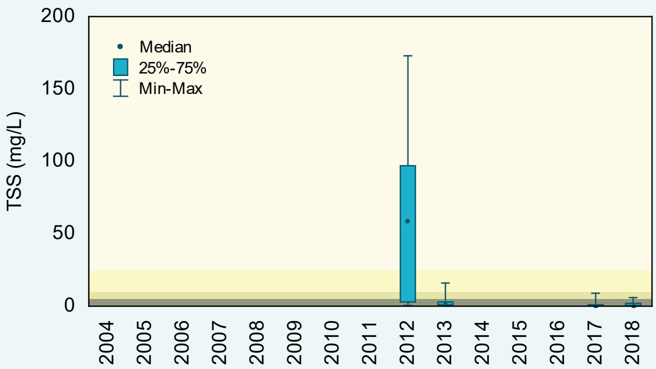
Concentrations

Total suspended solids (TSS) concentrations were mostly classified as low using the Statewide River Water Quality Assessment (SWRWQA) bands, with the exception of 2012 in McLeod Creek and 2011 in Rushy Creek when there were a number of samples classified as moderate, high and very high. Why TSS concentrations were so much higher in these two years is unknown.

Trends

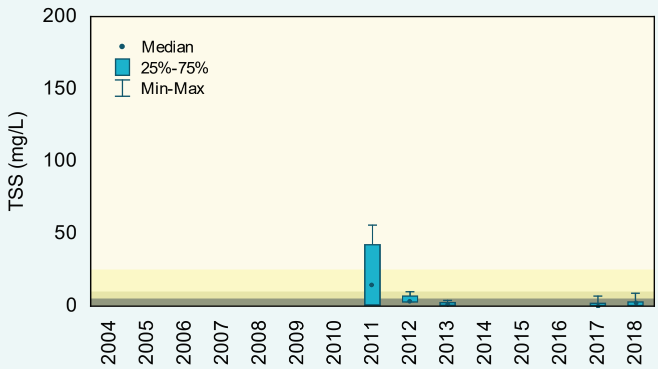
As both McLeod Creek and Rushy Creek were only sampled sporadically over the past 15 years, it was not possible to calculate trends in TSS concentrations at either of these sites. A minimum of five years of data are required to test for trends.

McLeod Creek



Total suspended solids concentrations, 2004–18 at site 6091304. The shading refers to the SWRWQA classification bands.

Rushy Creek



Total suspended solids concentrations, 2004–18 at site 6091303. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

Western minnows in McLeod Creek, March 2019.

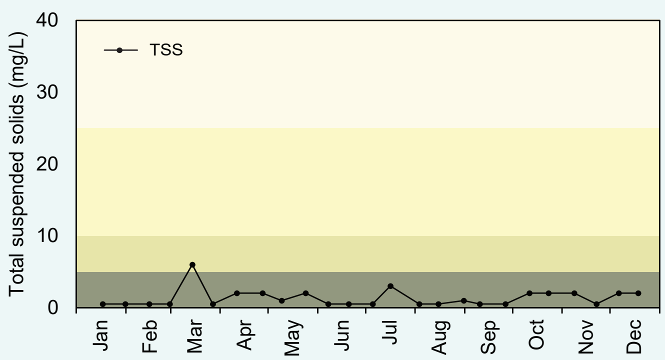
Total suspended solids (2018)

Concentrations

In 2018, most of the samples collected fell into the low band of the SWRWQA bands at both sites. There were a few samples from Rushy Creek which were classified as moderate, collected near the end of the year. These coincided with the high NH_3/NH_4^+ concentrations at this site. It is unclear why TSS was higher at this time, possibly it was because of runoff from an upstream land use. TSS did not exhibit a seasonal pattern at either site, instead fluctuating throughout the year. TSS was probably entering the creeks via surface flows as well as in-stream sources such as erosion.

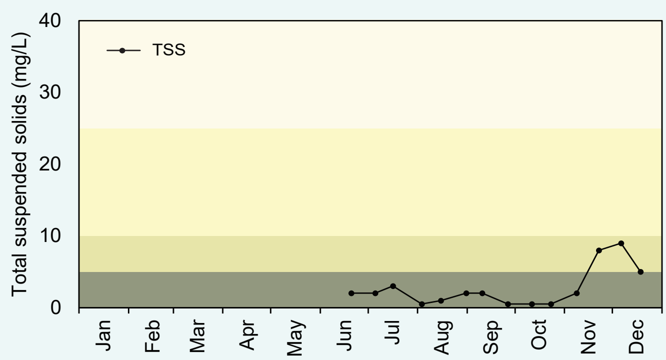
Where there are no data shown on the Rushy Creek graph, the creek was not flowing.

McLeod Creek



2018 total suspended solids concentrations at 6091304. The shading refers to the SWRWQA classification bands.

Rushy Creek



2018 total suspended solids concentrations at 6091303. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

An irrigation pipe being buried at the McLeod Creek sampling site, November 2018. This pipe provides irrigation water from the dam upstream of the Rushy Creek sampling site.

McLeod Creek

pH over time (2004–18)

pH values

The two sites in the McLeod Creek catchment had similar pH values. Most of the samples collected fell within the upper and lower ANZECC trigger values, though there were a few samples outside the trigger values in most years.

Trends

As both McLeod Creek and Rushy Creek were only sampled sporadically over the last 15 years, it was not possible to calculate trends in pH at either of these sites. A minimum of five years of data are required to test for trends.

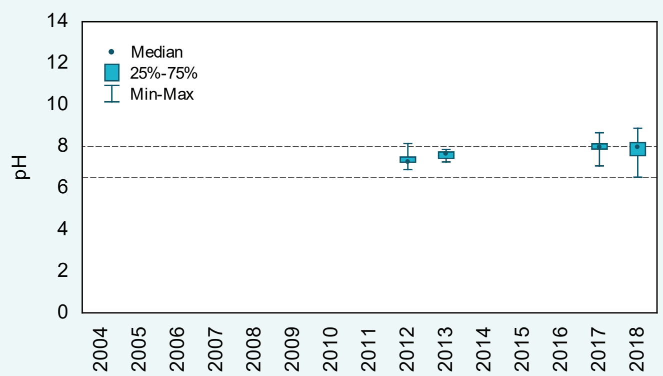
pH (2018)

pH values

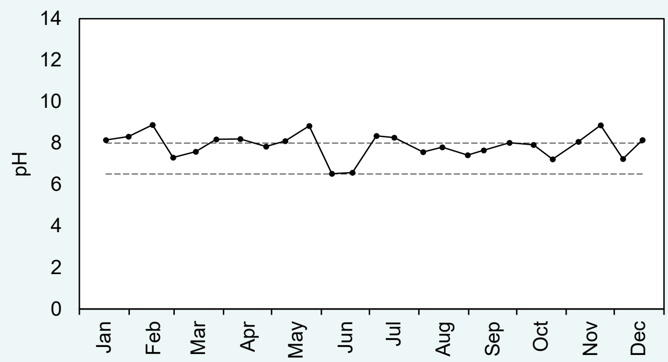
In 2018, there was no evidence of a seasonal pattern in pH at either McLeod Creek or Rushy Creek, with values fluctuating during the year. The majority of samples collected were within the ANZECC trigger values.

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

McLeod Creek

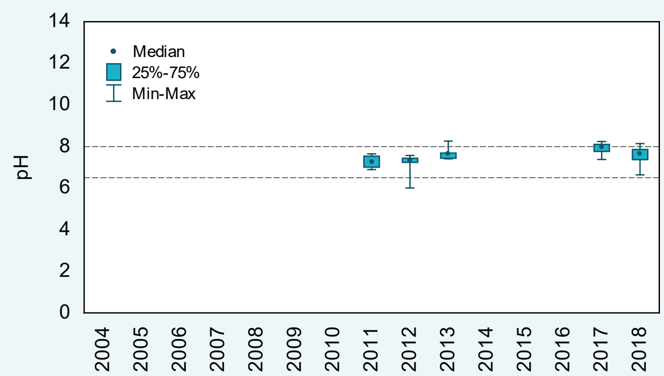


pH levels, 2004–18 at site 6091304. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

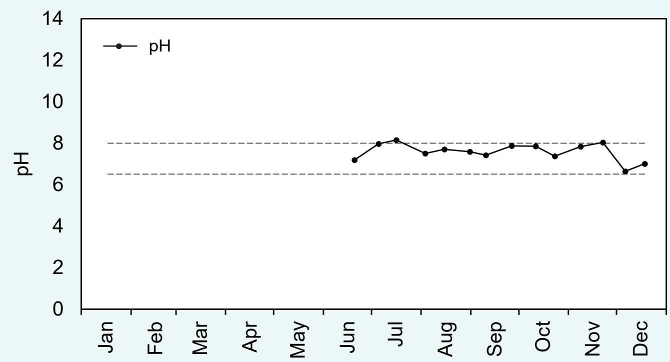


2018 pH levels at 6091304. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Rushy Creek



pH levels, 2004–18 at site 6091304. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels at 6091304. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

McLeod Creek

Salinity over time (2004–18)

Concentrations

The median salinity at both the McLeod and the Rushy Creek sites was classified as fresh using the SWRWQA bands in all years for which there were data.

Trends

As both McLeod Creek and Rushy Creek were only sampled sporadically over the past 15 years, it was not possible to calculate trends in salinity concentrations at either of these sites. A minimum of five years of data are required to test for trends.

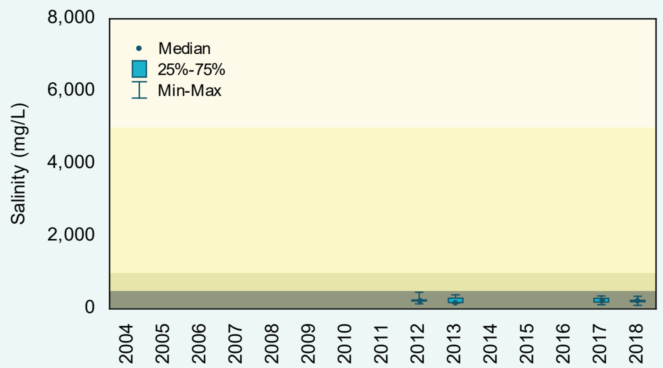
Salinity (2018)

Concentrations

There was no evidence of a seasonal pattern in salinity at either of the sites in the McLeod Creek catchment. Salinity fluctuated slightly during 2018; however, all samples collected fell into the fresh band of the SWRWQA.

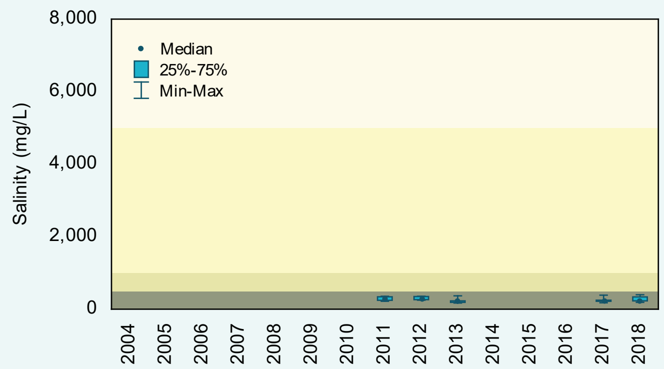
Where there are no data shown on the Rushy Creek graph, the creek was not flowing.

McLeod Creek



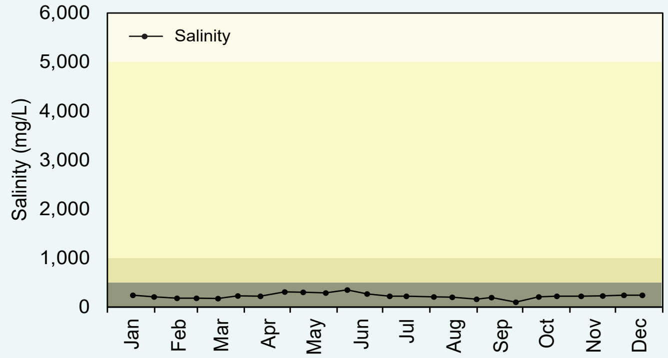
Salinity concentrations, 2004–18 at site 6091304. The shading refers to the SWRWQA classification bands.

Rushy Creek

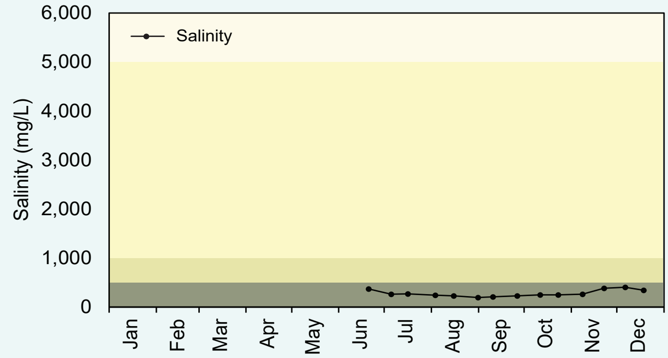


Salinity concentrations, 2004–18 at site 6091303. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh



2018 salinity concentrations at 6091304. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations at 6091304. The shading refers to the SWRWQA classification bands.

McLeod 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 Hardy Inlet at estuaries.dwer.wa.gov.au/estuary/hardy-inlet/

The Regional Estuaries Initiative partners with the Lower Blackwood Land Conservation District Committee (Lower Blackwood LCDC) to fund best-practice fertilisers, 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 Lower Blackwood LCDC go to lowerblackwood.com.au
- To find out more about the health of the rivers in the Hardy 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.

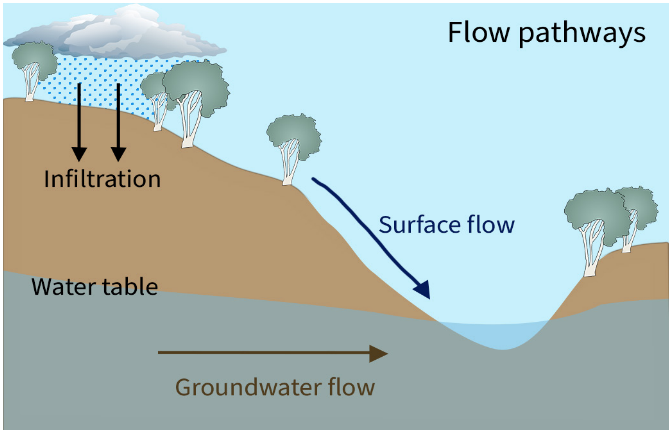
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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