

Middle Collie River

This data report provides a summary of the nutrients at the Middle Collie River 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 the site, the river flows through the Tidal Collie River catchment before discharging to the Leschenault Estuary. 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.

About the catchment

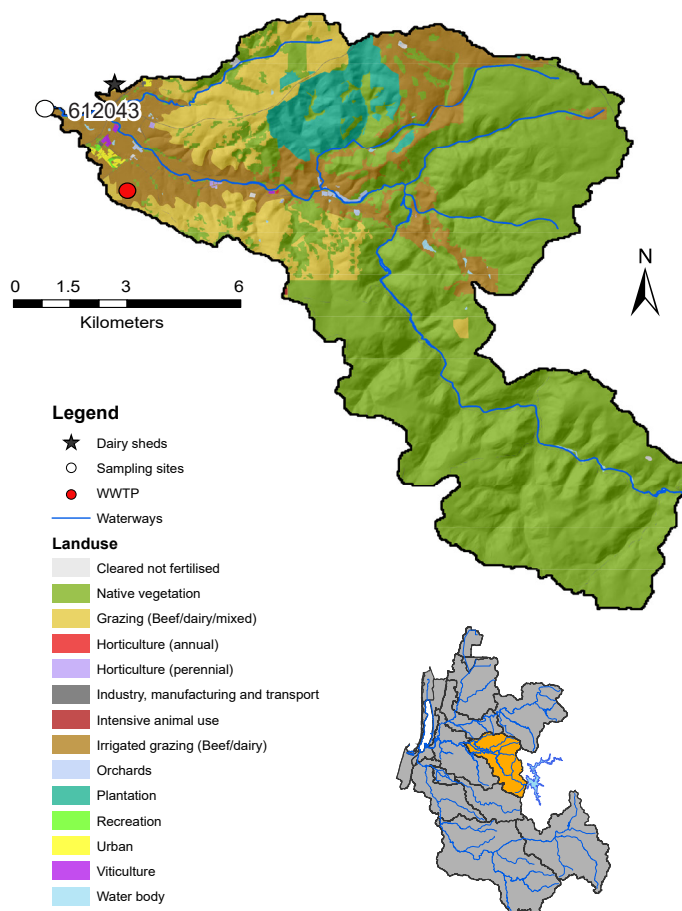
The Middle Collie River has a catchment area of about 145 km², about 70 per cent of which is covered in native vegetation, mostly in the upper part of the catchment. The other major land use in the catchment is beef and dairy cattle grazing. Just upstream of the catchment boundary, on the Collie River, lies Wellington Dam, downstream of which there is a smaller dam, Burekup Weir. The weir is used to divert water into the open channels of the Collie River Irrigation Network. The town of Burekup also lies within the catchment, with its waste water treatment plant.

Most of the catchment lies on soils which bind phosphorus well, slowing the rate at which applied phosphorus moves to waterways.

Water quality is measured at site 612043, Rose Road, near Rose Road in Burekup.

Results summary

Nutrient concentrations at the Collie River sampling site were low (total phosphorus) to moderate (total nitrogen). The proportion of nitrogen present in a bioavailable form was reasonably high. Nutrient loads were small, and loads per unit area were moderate compared with the other Leschenault catchment sites. Most of the catchment is on the Darling Plateau where soils tend to bind phosphorus well, contributing to the low phosphorus concentrations observed.



Location of Middle Collie River catchment in the greater Leschenault catchment.

Facts and figures

Sampling site code	612043
Catchment area	145 km ²
Per cent cleared area (2018)	32%
River flow	Usually flows year round but will sometimes dry over summer
Annual flow (2018)	49 GL
Main land use (2018)	Native vegetation and cattle grazing

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Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations at the Middle Collie River sampling site were low to moderate compared with the other sites sampled in the Leschenault catchment. The annual medians were below the Leschenault Water Quality Improvement Plan (WQIP) target for upland rivers in all years except 2009, though each year had some samples above the target. In 2018, the annual median (0.40 mg/L) was the equal second lowest of the 10 sites sampled in the Leschenault catchment, along with the site in the Upper Preston catchment. Only the Middle Preston sampling site had a lower median (0.20 mg/L).

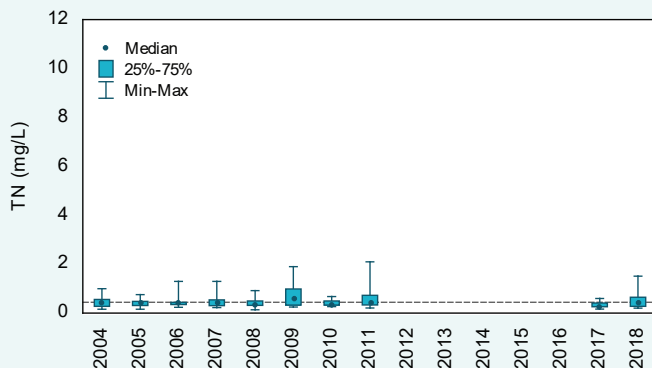
Trends

As the Middle Collie River site was not sampled between 2012–16 it was not possible to test for trends at this site. A minimum of five consecutive years of data are required to test for trends.

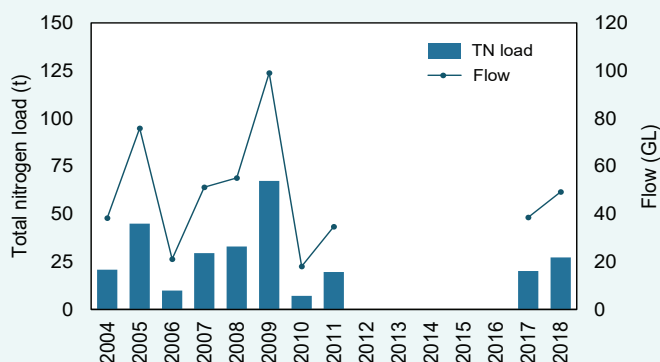
Estimated loads

In 2018, of the four sites with flow data in the Leschenault catchment, the Middle Collie River had a small estimated TN load (27 t, similar to the Upper Preston, 28 t, and the Ferguson River, 33 t; the Middle Preston site had a much larger TN load of 82 t). This is despite it having the second highest annual flow volume (49 GL versus 22 GL at the Upper Preston, 24 GL at Ferguson and 82 GL at the Middle Preston) indicating that the small TN load is because of the low concentrations. The Middle Collie River had the second largest load per unit area at 206 kg/km², exceeded only by the Ferguson River at 241 kg/km². Annual TN loads were closely related to flow volumes; years with large annual flow volumes had large TN loads and vice versa.

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Total nitrogen concentrations, 2004–18 at site 612043. The dashed line is the Leschenault WQIP target for upland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 612043.



A gilgie, *Cherax quinquecarinatus*, caught as part of a river health assessment in the Collie River, March 2017.

Middle Collie River

Nitrogen (2018)

Types of nitrogen

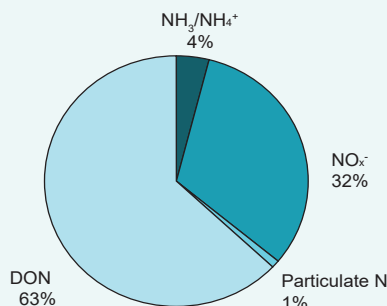
Total N is made up of many different forms of N. At the Middle Collie River sampling site about a third of the N was present as highly bioavailable dissolved inorganic N (DIN – consisting of oxides of N, NO_x^- and ammonia N, $\text{NH}_3/\text{NH}_4^+$). DIN is commonly sourced from fertilisers and animal wastes. Most of the remainder of the N was present as dissolved organic N (DON). DON consists mainly of plant and animal matter but may include other forms. DON varies in its bioavailability; plant and animal matter usually needs to be further broken down before it becomes available whereas other forms of DON are readily bioavailable. High proportions of DIN are commonly seen in agricultural catchments.

Concentrations

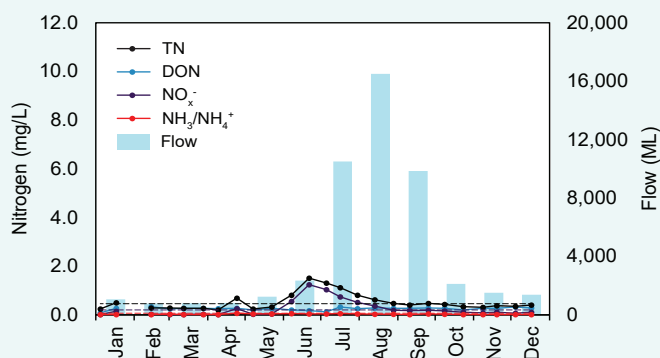
In 2018, TN and NO_x^- concentrations showed a seasonal pattern, increasing in June when river flow first started to increase and then decreasing again later in the year. This early peak is evidence of a first-flush effect where N was mobilised following heavy rainfall. Much of this N was probably the result of mineralisation of organic N in soils and drains over the summer period, and runoff from agricultural land where fertilisers and animal wastes build up over the summer period. The reason for the peak in April is unclear.

The missing data point in January was because of the site being inaccessible. The river was flowing at this time.

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2018 average nitrogen fractions at site 612043.



2018 nitrogen concentrations and monthly flow at 612043. The black dashed line is the Leschenault WQIP target for upland rivers, the red and purple are the ANZECC trigger values for upland rivers.



Water being released from Wellington Dam, March 2017. The dam is on the Collie River, just upstream of the Middle Collie River catchment boundary.

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Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations at the Middle Collie River sampling site were low compared with the other sites in the Leschenault catchment. All annual medians were below the WQIP TP target for upland rivers though most years had some samples above the target. The site had the lowest 2018 median concentration (0.009 mg/L) of the 10 sites sampled in the Leschenault catchment. The low TP concentrations at the Middle Collie River site are likely because of the large areas of native vegetation in the upper catchment and the soils found in the catchment which have a large capacity to bind P.

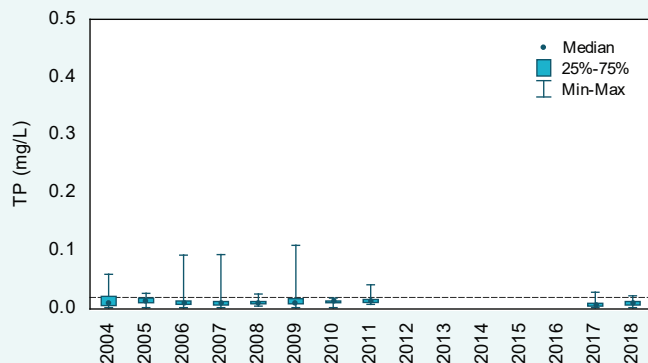
Trends

As the Middle Collie River site was not sampled between 2012–16 it was not possible to test for trends at this site. A minimum of five consecutive years of data are required to test for trends.

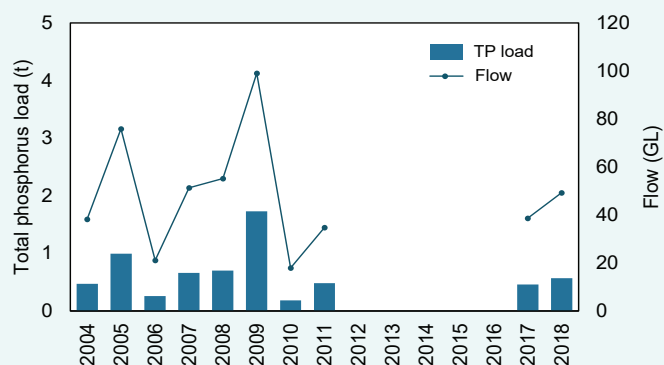
Estimated loads

In 2018, of the four sites with flow data in the Leschenault catchment, the Middle Collie River had a small estimated TP load (0.57 t) which was similar to the load at the Upper Preston River site (0.42 t). Both the Ferguson River (1.5 t) and the Middle Preston River (2.1 t) sites had larger TP loads. The small load was driven by the relatively low TP concentrations; the 2018 flow at the Middle Collie River site was the second largest (49 GL, the Upper Preston site was 22 GL, the Ferguson site was 24 GL and the Middle Preston was 82 GL). The load per unit area was the second smallest of the catchments at 4.3 kg/km², much smaller than at the Ferguson River site (11 kg/km²). Annual TP loads were closely related to flow volumes; years with large annual flow volumes had large TN loads and vice versa.

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Total phosphorus concentrations, 2004–18 at site 612043. The dashed line is the Leschenault WQIP target for upland rivers.



Total phosphorus loads and annual flow, 2004–18 at site 612043.



The Collie River upstream of Honeymoon Pool in Worsley, March 2007. The river here is in a largely natural state.

Middle Collie River

Phosphorus (2018)

Types of phosphorus

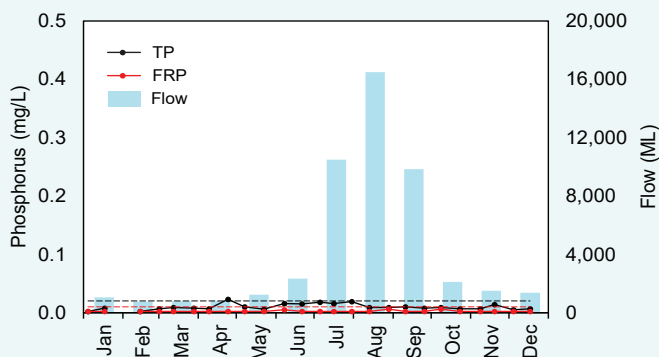
Total P is made up of different forms of P. Because a large number of samples were below the laboratory limit of reporting in 2018, phosphorus fraction pie charts were not generated for the Middle Collie River site. At this site, two of the 25 TP samples and 22 of the 25 filterable reactive phosphorus (FRP) samples were below their limit of reporting (LOR, 0.005 mg/L in each case). FRP is a highly bioavailable form of P and is used by plants and algae to fuel rapid growth.

Concentrations

Total P showed a slight seasonal pattern at the Middle Collie River sampling site, increasing slightly in June as rainfall and flow increased, before falling again in August. There was also a small peak in TP concentrations in April, the reason for which is unknown. FRP did not show a clear pattern, being below the LOR for most of the year. Most of the P at this site was likely entering the river via surface flows, in-stream sources and groundwater contributing proportionally less.

The missing data point in January was because of the site being inaccessible. The river was flowing at this time.

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2018 phosphorus concentrations and monthly flow at 612043. The black dashed line is the Leschenault WQIP target for upland rivers, the red is the ANZECC trigger value for upland rivers.



The Collie River has a healthy fish community. Freshwater cobbler (*Tandanus bostocki*) were caught downstream of Burekup Weir during a river health assessment, January 2009.

Middle Collie River

Total suspended solids over time (2004–18)

Concentrations

Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, all annual medians were classified as low, though some samples fell into higher bands each year.

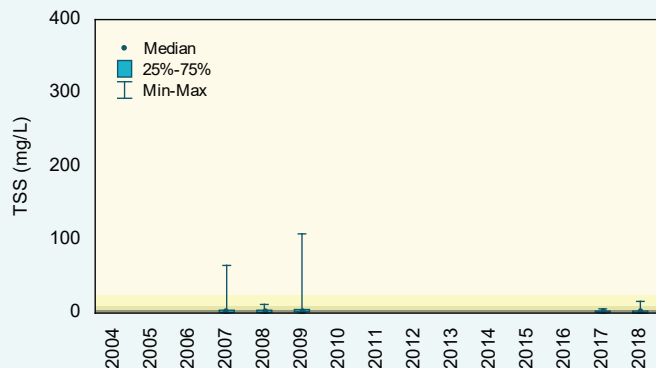
Trends

As the Middle Collie River site was not sampled between 2010–16 it was not possible to test for trends at this site. A minimum of five consecutive years of data are required to test for trends.

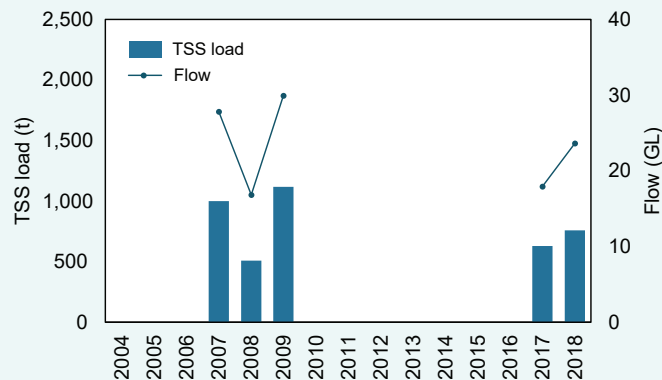
Estimated loads

The estimated TSS loads at the Middle Collie River sampling site were small compared with the other three sites with flow data in the Leschenault catchment. In 2018, the estimated TSS load (144 t) was the second smallest behind the Upper Preston River site (91 t). TSS loads were much larger at the Ferguson River (759 t) and Middle Preston River (1,290 t) sites. The small load was driven by the relatively low TSS concentrations rather than the flow volume. In 2018, flow at the Middle Collie River site was the second highest (49 GL, the Upper Preston site was 22GL, the Ferguson site was 24 GL and the Middle Preston was 82 GL). The load per unit area was the smallest of the catchments at 1,097 kg/km², similar to the Middle Preston site (1,598 kg/km²). The loads per unit area were much larger at the Ferguson River site (5,492 kg/km²). Annual TSS loads were closely related to flow volumes; years with large annual flow volumes had large TSS loads and vice versa.

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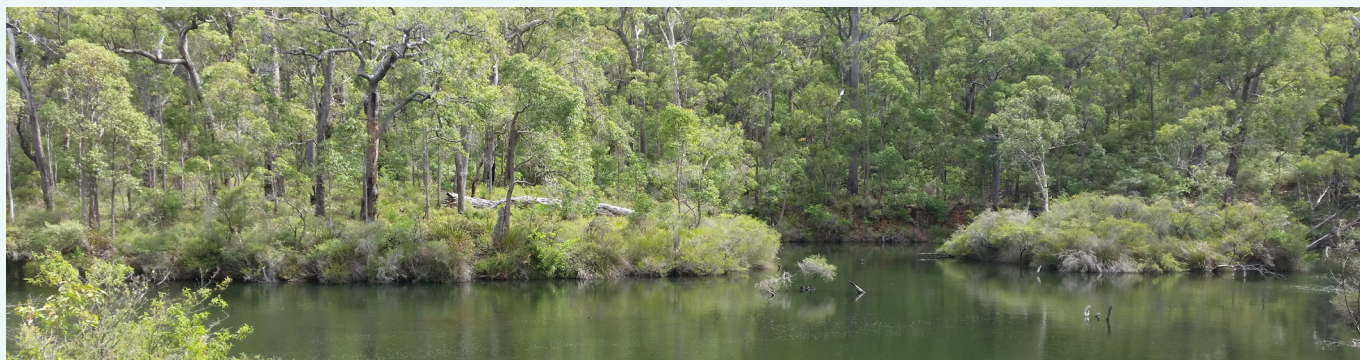


Total suspended solids concentrations, 2004–18 at site 612043. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 612043.

very high high moderate low



The Collie River, not far downstream of Wellington Dam, March 2017. Note the intact fringing vegetation along much of the banks (though there is some erosion along the bank furthest from the photographer).

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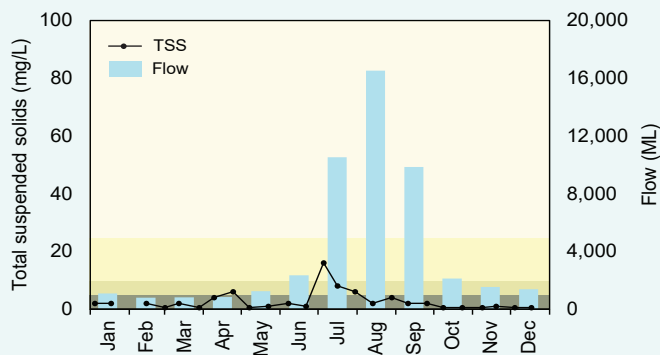
Total suspended solids (2018)

Concentrations

In 2018, TSS concentrations showed a seasonal pattern, increasing in early July as rainfall and flow increased before falling again in August. It is likely that the peak in early July is because of a first-flush effect where early rainfall and flow washed particulate matter into the river as well as dislodging any that had accumulated in the channel over the summer. The reason for the peak in TSS in April is unknown.

The missing data point in January was because of the site being inaccessible. The river was flowing at this time

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2018 total suspended solids concentrations and monthly flow at 612043. The shading refers to the SWRWQA classification bands.

very high high moderate low



Burekup Weir, April 2018. This weir diverts water from the Collie River to the Collie River Irrigation Network.

Middle Collie River

pH over time (2004–18)

pH values

At the Middle Collie River sampling site, pH values fluctuated over the reporting period. All annual medians were within the upper and lower ANZECC trigger values; however, there were a number of years with samples that fell either above the upper trigger value or below the lower one.

Trends

As the Middle Collie River site was not sampled between 2014–16 it was not possible to test for trends at this site. A minimum of five consecutive years of data are required to test for trends.

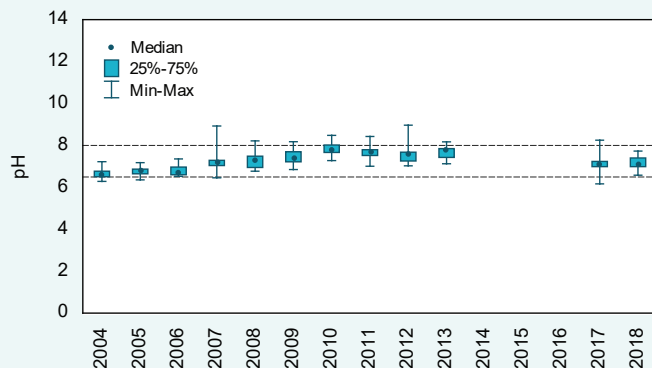
pH (2018)

pH values

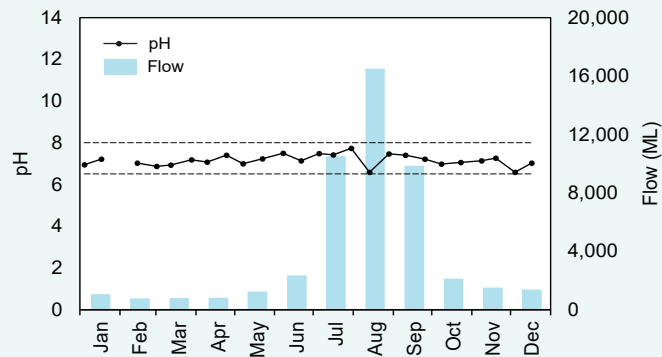
There was no clear seasonal pattern in pH at the Middle Collie River sampling site, with values fluctuating during the year. The reason for the dips in pH in August and December is unknown.

The missing data point in January was because of the site being inaccessible. The river was flowing at this time.

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pH levels, 2004–18 at site 612043. The dashed lines are the upper and lower ANZECC trigger values for upland rivers.



2018 pH levels and monthly flow at 612043. The dashed lines are the upper and lower ANZECC trigger values for upland rivers.



The River Road bridge over the Collie River in Worsley, March 2017.

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Salinity over time (2004–18)

Concentrations

Salinity at the Middle Collie River sampling site was marginal compared with the other sites in the Leschenault catchment. With the exception of 2004, 2013 and 2017–18 which were classified as brackish, all annual medians were classified as marginal using the SWRWQA classification bands. There was a range of salinities each year, with most years having samples ranging from fresh to brackish.

Trends

As the Middle Collie River site was not sampled between 2014–16 it was not possible to test for trends at this site. A minimum of five consecutive years of data are required to test for trends.

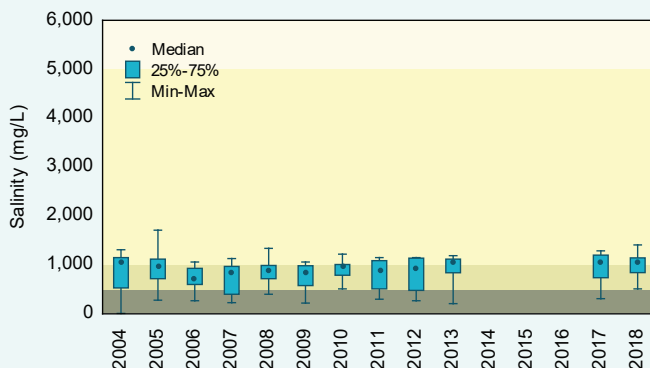
Salinity (2018)

Concentrations

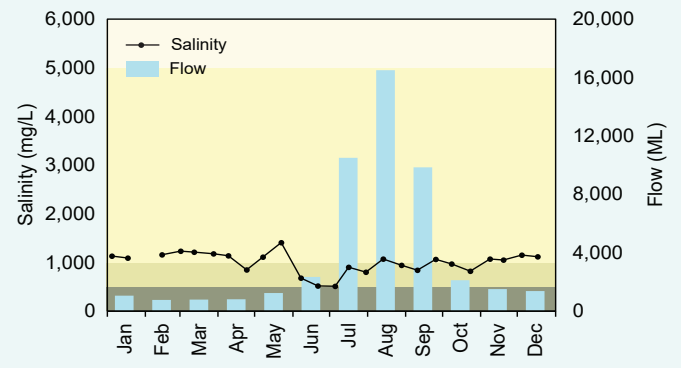
There was some evidence of an inverse relationship between salinity and flow. Salinity was higher in the first part of the year before reducing in June as rainfall and flow increased. The reason for the dip in salinity in April is unknown.

The missing data point in January was because of the site being inaccessible. The river was flowing at this time.

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Salinity concentrations, 2004–18 at site 612043. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at 612043. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh



The Collie River sampling site, January 2019.

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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 on 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 the Leschenault Estuary at estuaries.dwer.wa.gov.au/estuary/leschenault-estuary

The Regional Estuaries Initiative partners with the Leschenault Catchment Council 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 Leschenault Catchment Council go to www.leschenaultcc.org.au
- To find out more about the health of the rivers in the Leschenault Estuary Catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Total phosphorus and total nitrogen concentrations were compared with the Leschenault Estuary WQIP targets. These targets represent the allowable annual median winter concentrations in both lowland (TN 1.0 mg/L, TP 0.1 mg/L) and upland (TN 0.45 mg/L, TP 0.02 mg/L) catchments. Sites were compared with the appropriate target. Where possible, other 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 represents the acceptable pH range. Where there were no ANZECC trigger values (for TSS and salinity), the SWRWQA classification bands were used to allow samples and sites to be classified and compared. For all parameters, the full year of data were used when comparing with targets, trigger values and classification bands.

Gaps in the data meant it was not possible to calculate trends for the Leschenault catchment sites. A minimum of five consecutive years of data are required.

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 the 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.

