Scotsdale Brook

This data report provides a summary of the nutrients at the Scotsdale Brook 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 brook enters the Denmark River. 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.

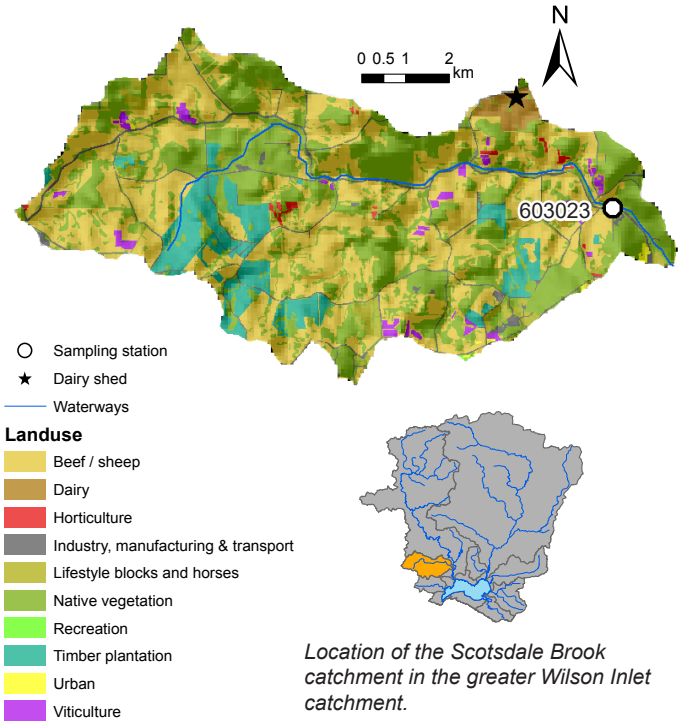
About the catchment

Scotsdale Brook has a catchment area of about 66 km^2, more than half of which has been cleared, mostly for beef cattle grazing (which covers more than 40 per cent of the catchment). The brook does not discharge into Wilson Inlet but, instead, joins the Denmark River in Denmark, a few kilometres above the Denmark townsite and just above the Denmark Ag sampling site. While a large portion of the catchment has been cleared, the brook still retains some fringing vegetation along much of its length. Scotsdale Brook is ephemeral during low rainfall years (about half of the years included in this report).

Water quality is measured at site 603023, near Scotsdale Road in Scotsdale, a few kilometres upstream of the confluence with the Denmark River.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in Scotsdale Brook were low. The nutrient loads were low to moderate compared with the amount of nutrients leaving the other monitored catchments. The loads per square kilometre were also moderate.



Location of the Scotsdale Brook catchment in the greater Wilson Inlet catchment.

Facts and figures

Sampling site code	603023
Rainfall at Denmark (2018)	776 mm
Catchment area	66 km^2
Per cent cleared area (2014)	60%
River flow	Ephemeral, dry for a short period in summer in about half of the past 15 years
Annual flow (2018)	9.4 GL
Main land use (2014)	Beef cattle grazing and native vegetation

Scotsdale Brook

Nitrogen over time (2004–18)

Concentrations

Overall, total nitrogen (TN) concentrations were low in Scotsdale Brook. TN fluctuated over the past 15 years but the median remained below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value every year. The 2018 median concentration was the lowest of the sampled sites (0.45 mg/L). Both sites on the Denmark River (which Scotsdale Brook discharges into) had slightly higher median concentrations (Denmark ML had a median of 0.59 mg/L and Denmark Ag a median of 0.52 mg/L).

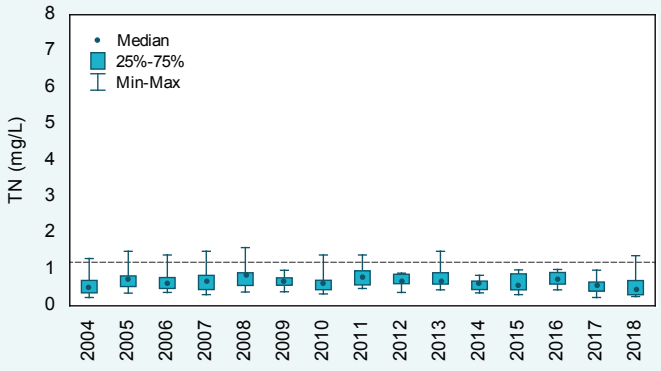
Trends

There was a small decreasing short-term trend in TN concentrations of 0.03 mg/L/yr (2014–18). This may be part of the natural fluctuations at this site or because of an actual increase in TN concentrations. Ongoing monitoring will help determine if water quality at this site is getting worse. There was no long-term (2004–18) trend.

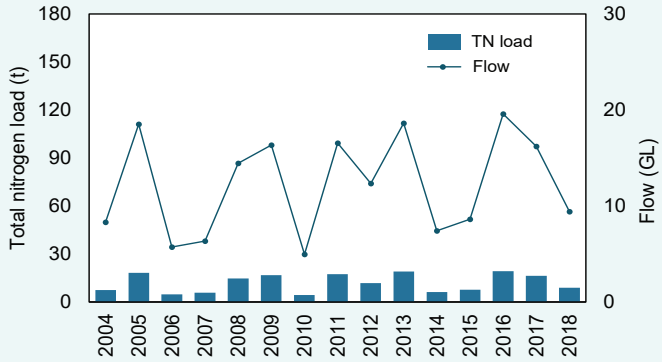
Estimated loads

In 2018, the estimated TN load at the Scotsdale Brook sampling site was 9 t. The load per unit area was 136 kg/km^2. This is much larger than the load per unit area at Denmark Ag (which is downstream of the confluence with Scotsdale Brook) of 19 kg/km^2. This is because of the more intensive land use found in the Scotsdale Brook catchment which contributes more N per unit area than the land use in the Denmark River catchment. Annual TN loads were closely related to flow volumes; years with high annual flow had large TN loads and vice versa.

Scotsdale Brook



Total nitrogen concentrations, 2004–18 at site 603023. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 603023.

High water levels in Scotsdale Brook, September 2017.

Nitrogen (2018)

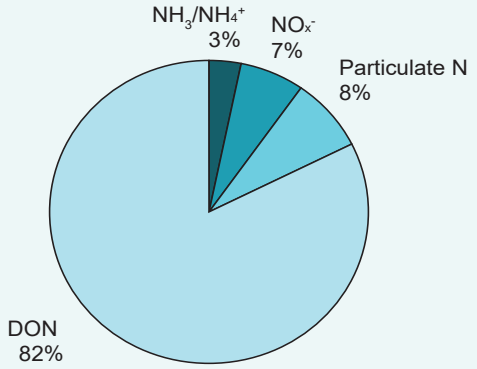
Types of nitrogen

Total N is made up of many different types of N. In Scotsdale Brook, 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. 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 nitrogen – NO_x^-) which is bioavailable to plants and algae and can fuel rapid growth.

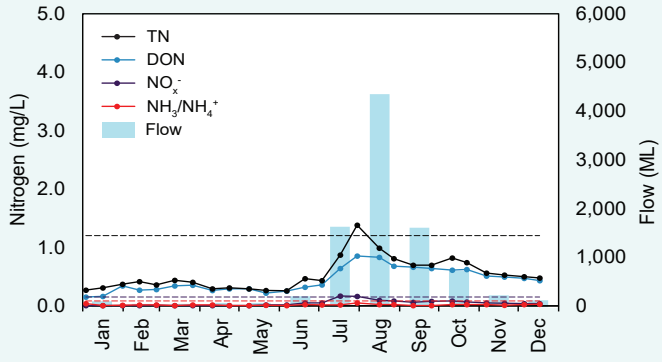
Concentrations

N concentrations varied throughout the year with evidence of a seasonal pattern in TN, DON and NO_x^- concentrations. These were generally higher during the months when flow was greater. DON contributed a significant proportion of the TN year-round. This suggests DON was entering the brook via a number of pathways including surface flows as well as groundwater and in-stream sources. The peak in NO_x^- in July to August suggests a first-flush response by which NO_x^- was rapidly transported to the brook from surrounding farmland after the onset of winter rains. Overall, NO_x^- concentrations were low and were below the ANZECC trigger value on all but two sampling occasions. NH_3/NH_4^+ concentrations were low (below the ANZECC trigger value on all sampling occasions) and showed little variation over the year.

Scotsdale Brook



2018 average nitrogen fractions at site 603023.



2018 nitrogen concentrations and monthly flow at 603023. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

Sand deposits left on the bank after a high flow event, September 2017.

Scotsdale Brook

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations were relatively low in Scotsdale Brook, with all median concentrations below the ANZECC trigger value. The number of samples above the ANZECC trigger value appears to be decreasing, with four of the past five years having no samples over the trigger value (2014 and 2016–18).

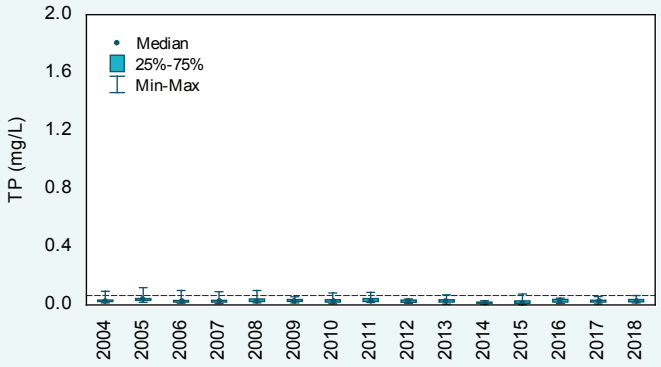
Trends

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

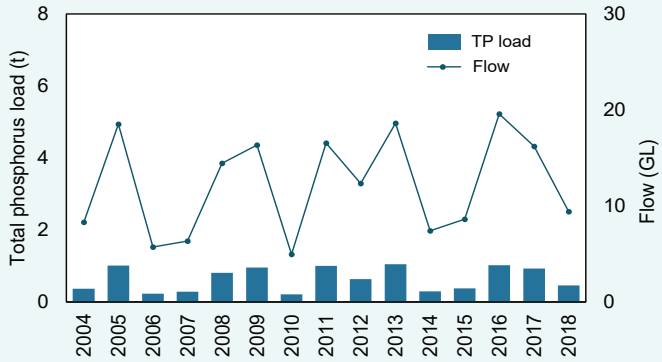
Estimated loads

In 2018, the estimated TP load at the Scotsdale Brook sampling site was 0.46 t. The load per unit area was 7 kg/km^2. This was much larger than the load per unit area at Denmark Ag (which is downstream of the confluence with Scotsdale Brook) of 0.6 kg/km^2. This is because of the more intensive land use found in the Scotsdale Brook catchment which contributes more P per unit area than the land use in the Denmark River catchment. Annual TP loads were closely related to flow volumes; years with high annual flow had large TP loads and vice versa.

Scotsdale Brook



Total phosphorus concentrations, 2004–18 at site 603023. The dashed line is the ANZECC trigger value for lowland rivers.



Total phosphorus loads and annual flow, 2004–18 at site 603023.

Low water levels in Scotsdale Brook, January 2018. Note the erosion of the banks.

Scotsdale Brook

Phosphorus (2018)

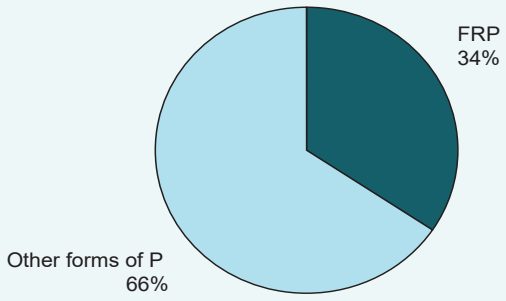
Types of phosphorus

Total P is made up of different types of P. In Scotsdale Brook, a third of the P was present as filterable reactive P (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.

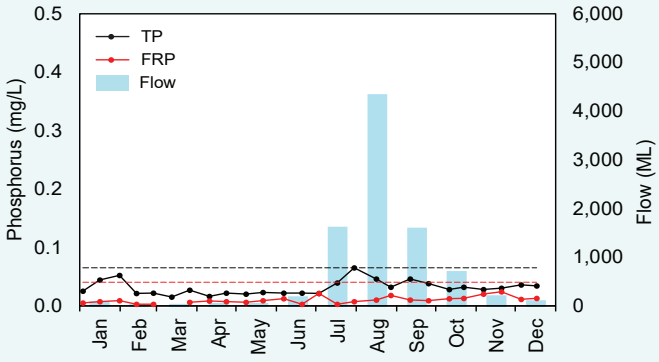
Concentrations

Both TP and FRP concentrations were low in Scotsdale Brook in 2018 and fluctuated over the year. TP concentrations showed a relationship to flow, increasing in July when flow volumes in the brook increased. This is likely because of winter rains flushing particulate P into the brook from surrounding land use and increased flow mobilising particulate P already present in the brook. One of the reasons for the low P concentrations is the high phosphorus-binding capacity of the soils in the catchment. This means they bind P well, preventing it from entering the brook. The reason for the peak in TP in January to February is unknown.

Scotsdale Brook



2018 average phosphorus fractions at site 603023.



2018 phosphorus concentrations and monthly flow at 603023. The dashed lines are the ANZECC trigger values for lowland rivers for the different P species.

Taking flow measurements in Scotsdale Brook during high flow, September 2017.

Scotsdale Brook

Total suspended solids over time (2004–18)

Concentrations

Median total suspended solids (TSS) concentrations in Scotsdale Brook were relatively low with all annual medians classified as low using the Statewide River Water Quality Assessment classification bands (SWRWQA). Before 2009, each year had some samples classified as very high. Between 2010 and 2016, TSS was collected sporadically so the data have not been graphed.

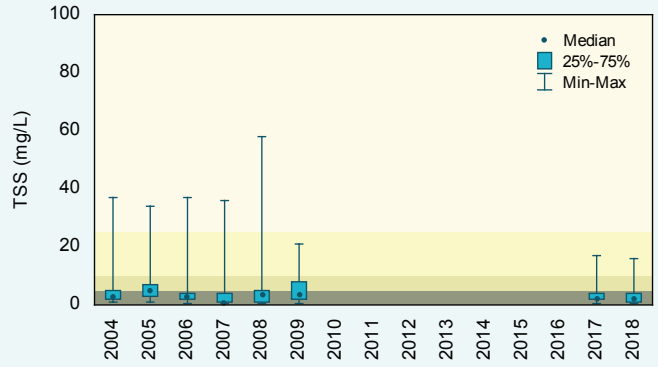
Trends

As TSS was sporadically collected between 2010 and 2016, it was not possible to perform trend tests on the TSS data from Scotsdale Brook.

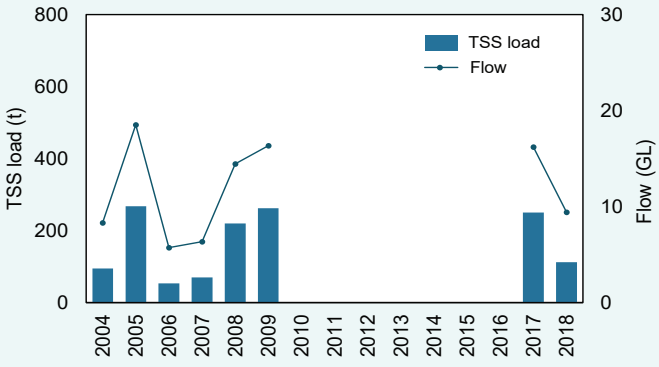
Estimated loads

In 2018, the estimated TSS load at the Scotsdale Brook sampling site was 112 t. The load per unit area was 1,697 kg/km^2. This was much larger than the load per unit area at Denmark Ag of 85 kg/km^2. Annual TSS loads were closely related to flow; years with high annual flow had large TSS loads and vice versa.

Scotsdale Brook



Total suspended solids concentrations, 2004–18 at site 603023. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 603023.

very high high moderate low

Scotsdale Brook, showing intact fringing vegetation and a natural stream channel, June 2018.

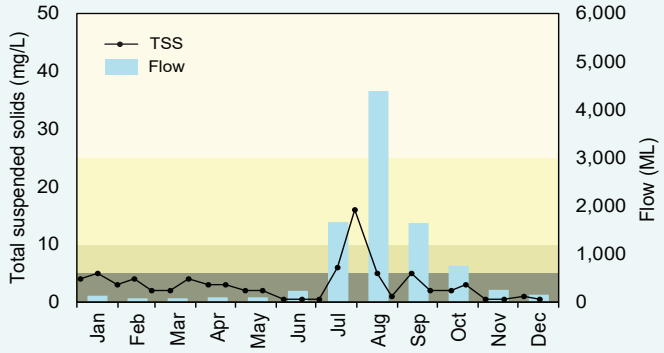
Scotsdale Brook

Total suspended solids (2018)

Concentrations

TSS concentrations showed a seasonal pattern in Scotsdale Brook. In 2018, the highest values occurred between July and August, coinciding with the increase in flow volumes in the brook. At this time, particulate matter was flushed into the brook from the surrounding catchment via surface flows as well as coming from in-stream sources such as erosion.

Scotsdale Brook



2018 total suspended solids concentrations and monthly flow at 603023. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

The weir at the Scotsdale Brook sampling site, note the tannin-stained water, July 2018.

Scotsdale Brook

pH over time (2004–18)

pH values

The median pH in Scotsdale Brook was within the ANZECC trigger values every year except 2017. pH appears to fluctuate over the 2004–18 time period, with the exception of 2016 and 2017 when it was much lower. These values should be treated with caution, however, as there is some concern regarding the more recent pH values; see comment under 'pH (2018)'.

Trends

There were no short- (2014–18) or long-term (2004–18) trends in pH at Scotsdale Brook.

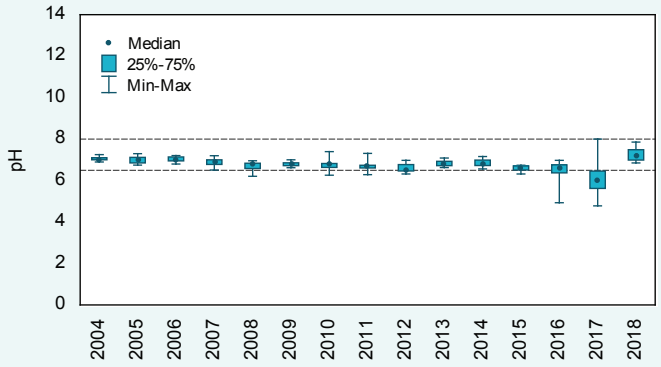
pH (2018)

pH values

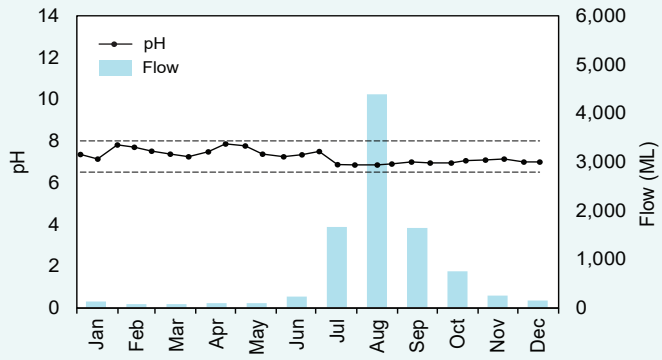
In 2018, all samples collected fell within the ANZECC trigger values. pH was higher in the first half of the year in Scotsdale Brook. This is possibly because of the groundwater having a slightly higher pH than the surface water.

There is some concern that the probe used to collect the pH data from the catchments of Wilson Inlet (including the Scotsdale Brook site) from about October 2016 to October 2017 was not functioning correctly. This may have caused the low pH values shown in the graphs below. After October 2017, a new probe was used and the pH values increased and stabilised. Although there is no way of verifying the 2016–17 pH data, they have still been presented here.

Scotsdale Brook



pH levels, 2004–18 at site 603023. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 603023. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

A largely natural section of Scotsdale Brook, June 2018.

Scotsdale Brook

Salinity over time (2004–18)

Concentrations

Scotsdale Brook was fresh and showed only slight fluctuations over the 2012–18 period. All samples collected were classified as fresh using the SWRWQA classification bands, with the exception of two samples in 2015 which were just in the marginal category. The 2018 median salinity was one of the lowest of the nine sites sampled (275 mg/L; Little River had a median salinity of 225 mg/L). Salinity was not measured between 2004–11.

Trends

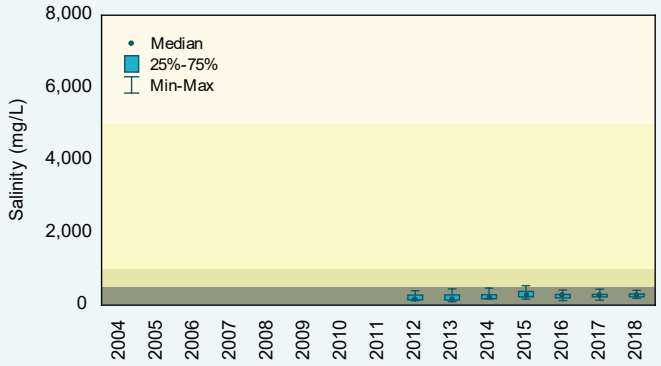
There was no short-term (2014–18) trend in salinity at Scotsdale Brook.

Salinity (2018)

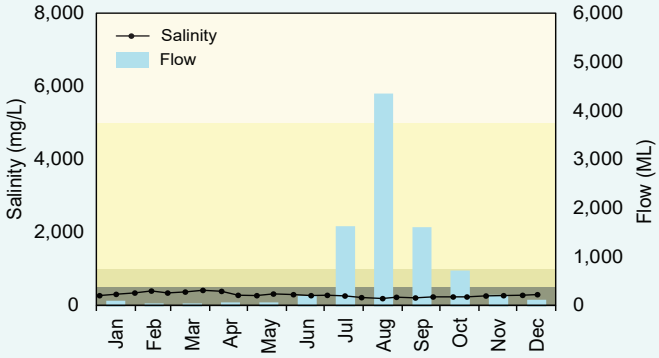
Concentrations

Salinity showed a very slight inverse relationship to flow volume in Scotsdale Brook. That is, when flow volumes were high, salinity levels were marginally lower than when flow volumes were low and vice versa. In 2018, all samples fell into the fresh band. Groundwater is likely slightly more saline than surface water runoff in the Scotsdale Brook catchment, though it is still fresh. Evapoconcentration in the drier months may also be contributing to the slightly higher salinities at this time.

Scotsdale Brook



Salinity concentrations, 2004–18 at site 603023. The shading refers to the SWRWQA classification bands..



2018 salinity concentrations and monthly flow at 603023. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

Scotsdale Brook sampling site, July 2019.

Scotsdale Brook

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.

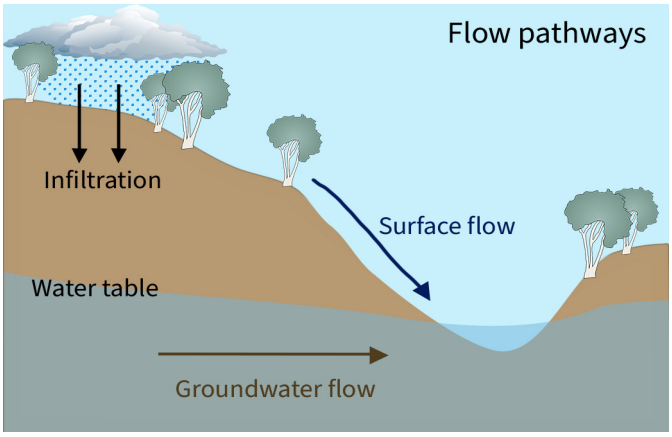
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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