Sleeman River

This data report provides a summary of the nutrients at the Sleeman River 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 river discharges to Wilson Inlet.

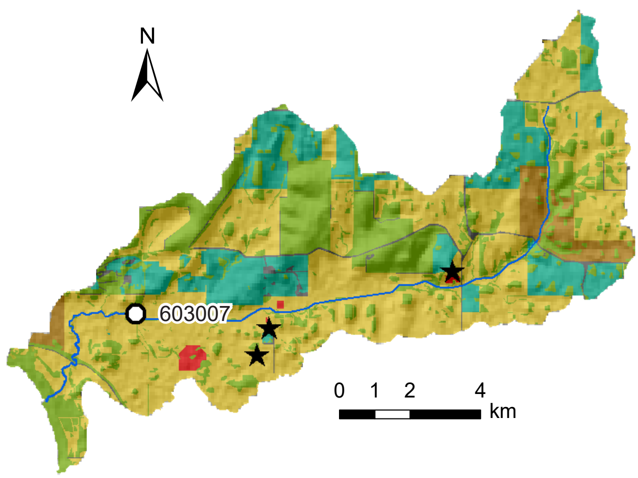
About the catchment

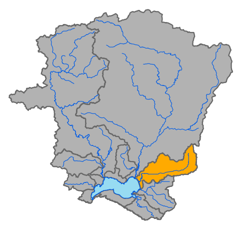
The Sleeman River has a catchment area of about 92 km^2, almost three-quarters of which has been cleared for agriculture and plantations. The dominant land use is beef cattle grazing, which covers just over half the catchment. Other land uses in the catchment include dairy farms and potato growing areas. While the Sleeman River is a natural system, portions of it have been modified into drains to remove water from the surrounding agricultural areas. The combination of clearing native vegetation and straightening the river has increased the speed at which the water moves through the landscape, reducing the opportunity for nutrient processing.

Soils close to the waterways tend to bind phosphorus poorly, meaning that any phosphorus applied to them can travel to the waterways.

The Sleeman River flows year-round and discharges into the eastern side of Wilson Inlet in Youngs Siding, between the discharge points of the Hay River and Cuppup Creek.

Water quality is measured at site 603007, where the river crosses Sleeman Road in Youngs Siding.





Location of Sleeman River catchment in the greater Wilson Inlet catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) in the Sleeman River were classified as moderate (nitrogen) to high (phosphorus). The nutrient loads were large, as were the loads per square kilometre. The large loads were because of the high nutrient concentrations, caused by the intensive land use in the catchment, widescale clearing of native vegetation, the lack of fringing vegetation along much of the river, and the straightening of large sections of the river into drains.

Facts and figures

Sampling site code	603007
Catchment area	92 km^2
Per cent cleared area (2014)	74 per cent
River flow	Flows year-round
Main land use (2014)	Beef cattle grazing, native vegetation and plantation

Estimated loads and flow at Sleeman River

603007	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)	18	4.1	5.1	11	11	5.0	13	12	13	4.8	3.4	19	20	6.3	5.7
TN load (t)	42	7.1	10	26	25	9.4	29	28	30	9.5	6.2	45	49	13	12
TP load (t)	5.96	0.77	1.14	3.43	3.10	1.02	3.52	3.45	3.66	1.07	0.65	5.54	6.92	1.59	1.36

Sleeman River

Nitrogen over time (2005–19)

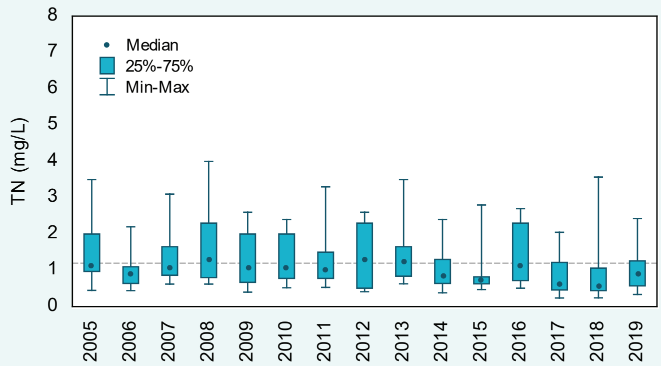
Concentrations

While the median total nitrogen (TN) concentrations were relatively low in the Sleeman River (most of the medians over the past 15 years were below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value), the annual range in concentrations was large, with a number of samples above the ANZECC trigger value each year. Annual TN concentrations were classified as moderate using the State Wide River Water Quality Assessment (SWRWQA) methodology. TN fluctuated over the reporting period.

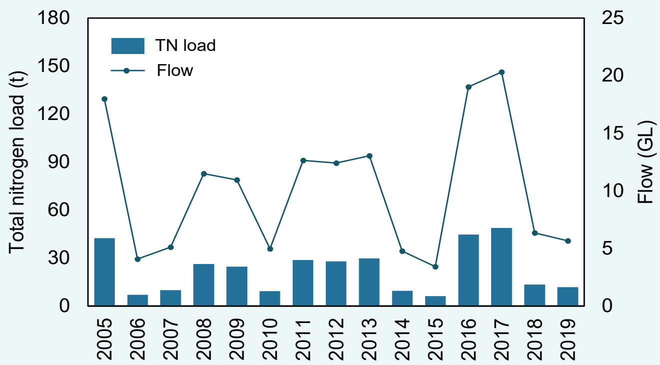
Estimated loads

Estimated TN loads at the Sleeman River sampling site were large compared with the other sites in the Wilson Inlet catchment. In 2019, the river had a load of 12 t, the largest TN load of the six monitored catchments of the Wilson Inlet. It also had the largest load per square kilometre of 152 kg/km^2. The combination of intensive land use, widescale clearing of native vegetation and the straightening of large sections of the river all contributed to the large loads and loads per square kilometre from the Sleeman River. Annual TN loads were closely related to flow volumes; years with large annual flow volumes had large TN loads and vice versa.

Sleeman River



Total nitrogen concentrations, 2005–19 at site 603007. The dashed line is the ANZECC trigger value.



Total nitrogen loads and annual flow, 2005–19 at site 603007.

Sand deposit in the centre of the channel at the Sleeman River sampling site, November 2018.

Nitrogen (2019)

Types of nitrogen

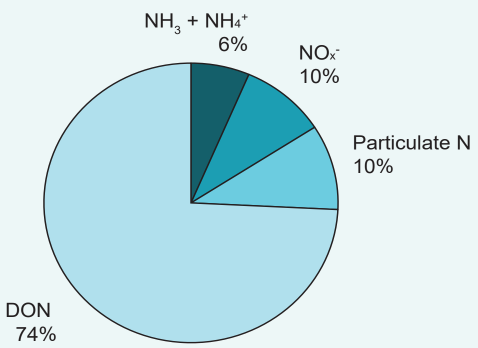
Total N is made up of different types of N. In the Sleeman River, most of the N was present as dissolved organic N (DON) which consists mainly of degrading plant and animal matter but may include other, bioavailable, types. Particulate N is composed of plant and animal matter. Most types of particulate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

Concentrations

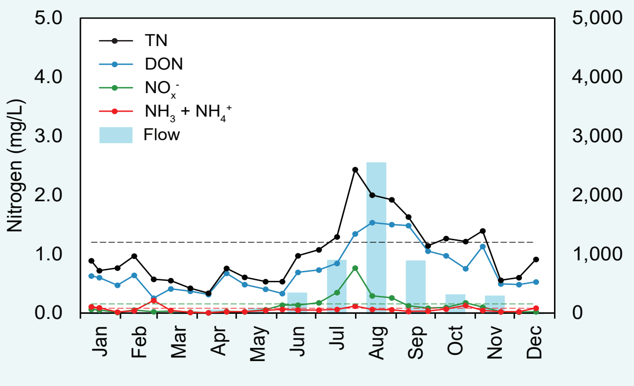
Nitrogen concentrations varied throughout the year, with evidence of a seasonal pattern in all types of N which increased as rainfall and flow increased before decreasing again near the end of the year as rainfall and flow eased. This suggests N was entering the river via a number of pathways such as groundwater, surface flows and in-stream sources. It is likely the main sources changed during the year, with groundwater being more important in the drier months and surface flows being more important when the catchment was wet.

Because large sections of the river have been straightened and there is a lack of fringing vegetation, any N entering the river is rapidly transported downstream. This reduces the opportunity of it being assimilated within the river compared with a more natural system.

Sleeman River



2019 average nitrogen fractions at site 603007.



2019 nitrogen concentrations and monthly flow at 603007. The dashed lines are the ANZECC trigger values for the different N species.

Removing the sand deposit in the weir pool at the Sleeman River sampling site, February 2019. This was done to improve the gauging station's ability to measure flow.

Sleeman River

Phosphorus over time (2005–19)

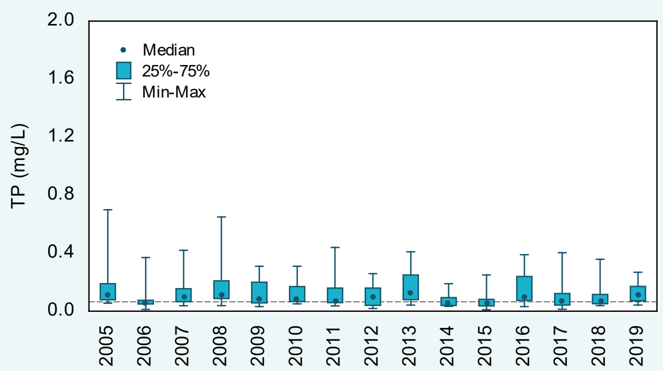
Concentrations

Total phosphorus (TP) concentrations fluctuated slightly over the reporting period. A large proportion of the samples were above the ANZECC trigger value each year; in fact, the Sleeman River had some of the highest TP concentrations of the sites sampled in the Wilson Inlet catchment. Using the SWRWQA methodology, 2005–8 were classified as having moderate TP concentrations and 2009–19 were classified as high. The 2019 median TP concentration in the Sleeman River (0.118 mg/L) was the second highest of the nine sites monitored in the Wilson Inlet catchment. However, the median was still substantially lower than in Sunny Glen Creek (0.324 mg/L).

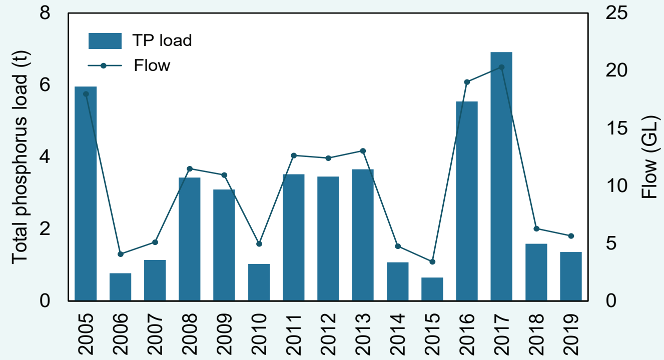
Estimated loads

Estimated TP loads at the Sleeman River sampling site were large. In 2019, the river had a TP load of 1.36 t, the largest P load of the six monitored catchments of the Wilson Inlet. It also had the largest load per square kilometre, 18 kg/km^2. The combination of intensive land use, widescale clearing of native vegetation and the straightening of large sections of the river all contributed to the large loads and loads per square kilometre from the Sleeman River. Annual TP loads were closely related to flow volumes; years with large annual flow volumes had large TP loads and vice versa.

Sleeman River



Total phosphorus concentrations, 2005–19 at site 603007. The dashed line is the ANZECC trigger value.



Total phosphorus loads and annual flow, 2005–19 at site 603007.

The gauging station at the Sleeman River sampling site during very high flows, August 2017.

Phosphorus (2019)

Types of phosphorus

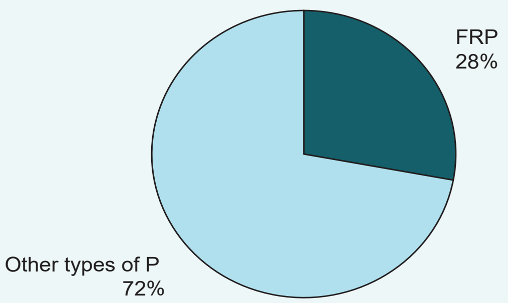
Total P is made up of different types of P. In the Sleeman River, about a third of the P was present as phosphate; measured as filterable reactive phosphorus (FRP), in surface waters this is mainly present as phosphate (PO_4^{3-}) species and is readily bioavailable. Phosphate was probably derived from animal waste and fertilisers as well as natural sources. The remaining P was present as either particulate P or dissolved organic P (DOP) or both (labelled as 'Other types of P' in the pie chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood.

Concentrations

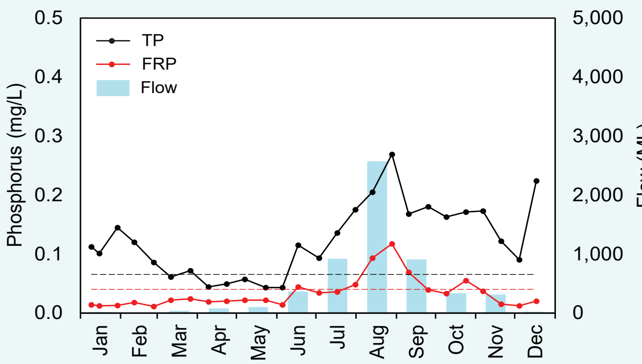
Both TP and phosphate concentrations varied seasonally in the Sleeman River, with the highest concentrations generally recorded during the wettest months. P concentrations increased after the onset of winter rains. As the river levels fell again, P concentrations reduced. The reason for the peaks in TP in January and December are unclear. P was likely entering the river via a number of pathways, with groundwater dominant in the drier months and surface flows, groundwater and in-stream sources all contributing during the wetter months.

Because large sections of the river have been straightened and there is a lack of fringing vegetation, any P entering the river is rapidly transported downstream. This reduces the opportunity of it being assimilated within the river compared with a more natural system.

Sleeman River



2019 average phosphorus fractions at site 603007.



2019 phosphorus concentrations and monthly flow at 603007. The dashed lines are the ANZECC trigger values for the different P species.

A flooded paddock in Sleeman River catchment, August 2017.

Sleeman River

Total suspended solids over time (2005–19)

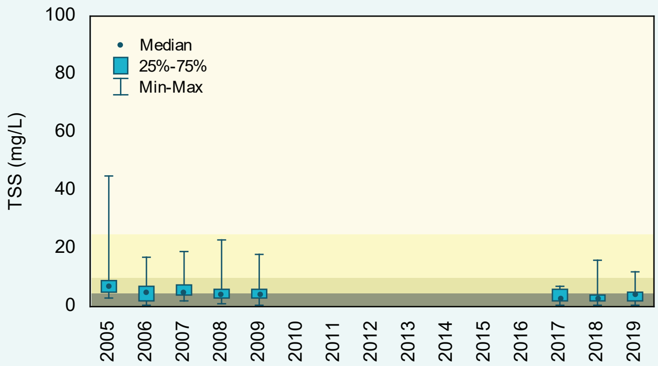
Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Annual TSS concentrations were classified as moderate using the SWRWQA methodology from 2005–9. Since the break in monitoring, TSS was classified as low. Between 2010 and 2016, TSS was collected sporadically so the data have not been graphed.

Estimated loads

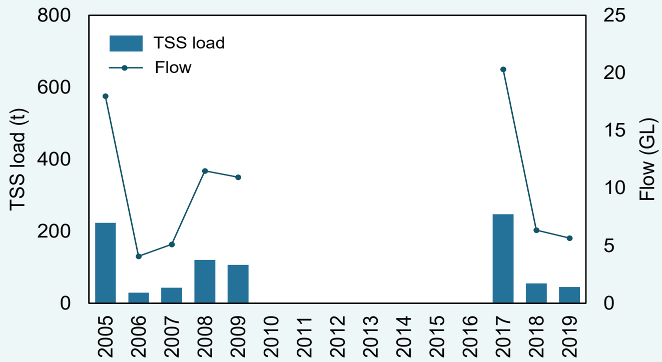
The estimated TSS loads at the Sleeman River sampling site were moderate compared with the other Wilson Inlet catchment sites. The Sleeman River had the second largest TSS load of the monitored Wilson Inlet catchments in 2019 (45 t); only Cuppup Creek had a larger load (64 t). It had a moderate load per square kilometre of 584 kg/km^2 in 2019. Annual TSS loads were closely related to flow volumes; years with large annual flow volumes had large TSS loads and vice versa.

Sleeman River



Total suspended solids concentrations, 2005–19 at site 603007. The shading refers to the SWRWQA classification bands.

low moderate high very high



Total suspended solids loads and annual flow, 2005–19 at site 603007.

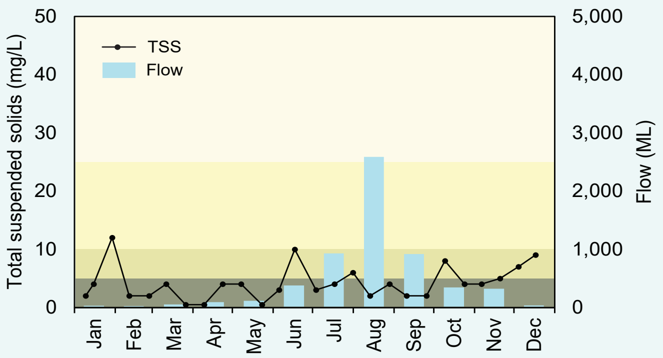
Examining bank undercutting along the Sleeman River, April 2018. This undercutting is caused by erosion which occurs because of a lack of fringing vegetation which helps stabilise banks.

Total suspended solids (2019)

Concentrations

In 2019, there was no clear seasonal relationship present (unlike in 2018) with concentrations fluctuating during the year. It is likely that particulate matter is being washed into the river from surrounding land use as well as being sourced in-stream from erosion. Stock accessing the river may have exacerbated erosion as they trample the bed and banks of the river.

Sleeman River



2019 total suspended solids concentrations and monthly flow at 603007. The shading refers to the SWRWQA classification bands.

low moderate high very high

The weir at the Sleeman River sampling site during low flows, December 2017.

Sleeman River

pH over time (2005–19)

pH values

pH fluctuated in the Sleeman River over the reporting period. The river tends to be slightly acidic, with almost all years having some values below the lower ANZECC trigger values. In 2019, all samples were within the ANZECC trigger values.

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

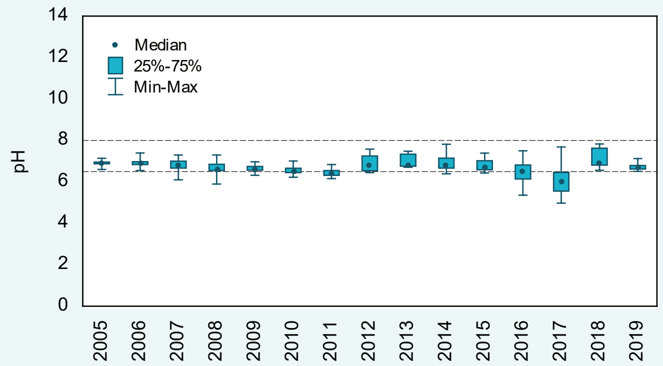
pH (2019)

pH values

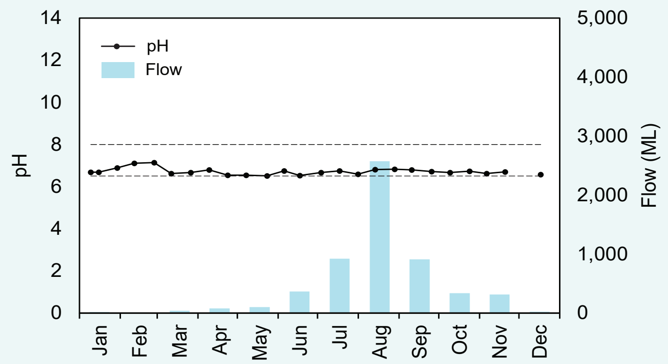
In 2019, pH values remained fairly steady throughout the year, with most samples sitting just above the lower ANZECC trigger value.

The missing data point in December was because of a malfunctioning probe; the river was flowing at this time.

Sleeman River



pH levels, 2005–19 at site 603007. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 603007. The dashed lines are the upper and lower ANZECC trigger values.

Flooding in the Sleeman River catchment, August 2017.

Sleeman River

Salinity over time (2005–19)

Concentrations

Annual salinities in the Sleeman River were classified as marginal using the Water Resources Inventory 2014 salinity ranges (note, the 2018 nutrient report used the SWRWQA bands) for all years where there were data present. Salinity was not measured from 2005–11.

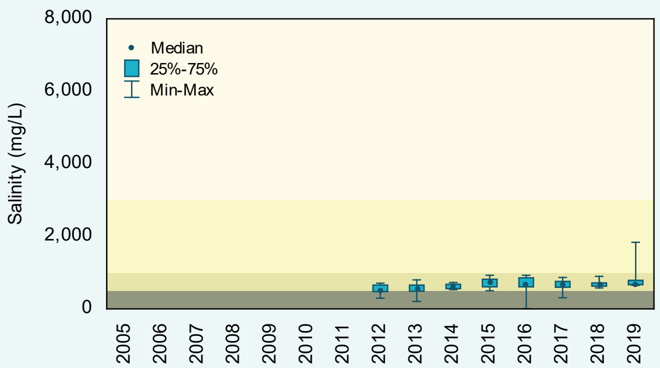
Salinity (2019)

Concentrations

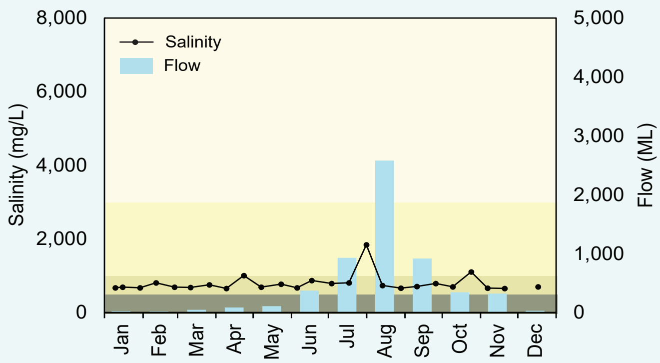
Salinity fluctuated during 2019 (unlike in 2018 when it was fairly constant). It is unknown what caused the peaks in salinity observed in 2019; they were not related to flow or rainfall. It is likely salts are being transported to the river via groundwater and surface flows.

The missing data point in December was because of a malfunctioning probe; the river was flowing at this time.

Sleeman River



Salinity concentrations, 2005–19 at site 603007. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at 603007. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

The Sleeman River sampling site after the sedimentation was removed from the channel and the banks were stabilised using matting which was planted out with native species, October 2019.

Sleeman River

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.

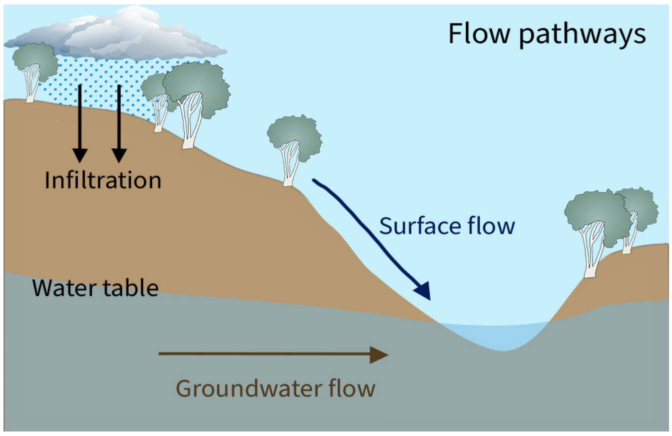
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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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