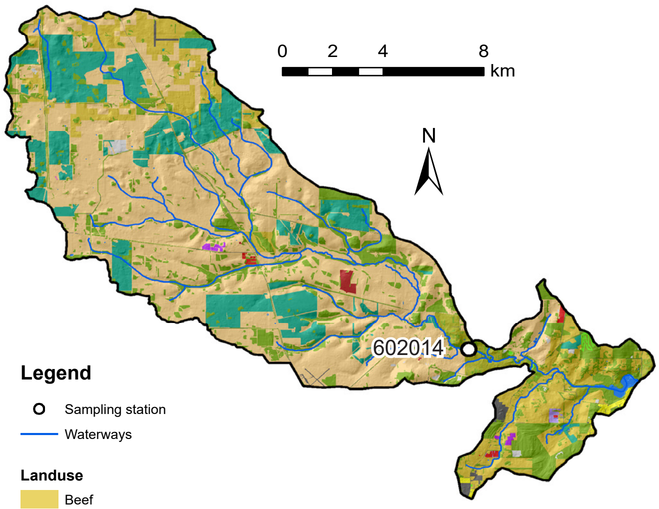
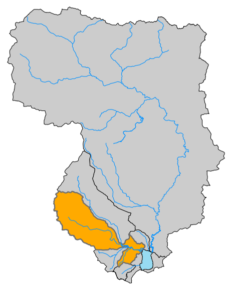
King River

This data report provides a summary of the nutrients at the King River sampling site in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Both Mill Brook and Willyung Creek join the King River downstream of the sampling site before it discharges to Oyster Harbour.





Location of King River catchment in the greater Oyster Harbour catchment.

About the catchment

The King River has a catchment area of about 197 km^2, which has been almost entirely cleared for agriculture. The dominant land use is cropping and mixed grazing which covers nearly 50 per cent of the catchment. There are also substantial areas of bluegum plantations as well as beef cattle farming in the north of the catchment. While the waterways retain their natural form, much of the fringing vegetation is in poor condition or missing.

Most of the catchment has soils with a poor to moderate phosphorus-binding capacity. Where the phosphorus-binding capacity is poor, any phosphorus applied to the soils can move relatively quickly to waterways.

Water quality is measured at site 602014, Billa Boya, within the Billa Boya Reserve, in Millbrook.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the King River sampling site were classified as low (total nitrogen) and moderate (total phosphorus). Total phosphorus loads were large, as were the loads contributed per square kilometre of catchment. These large loads were driven by the moderate phosphorus concentrations which are a result of the agricultural land use in the catchment and the often poor phosphorus-binding capacity of the soils.

Facts and figures

Sampling site code	602014
Catchment area	197 km^2
Per cent cleared area (2018)	96 per cent
River flow	Permanent
Main land use (2018)	Cropping and mixed grazing

Estimated loads and flow at King River

602014	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)	18	5.1	5.8	8.7	11	5.1	7.9	9.9	7.9	4.7	4.7	11	11	4.9	4.0
TN load (t)	43	6.6	8.5	17	22	7.1	14	20	14	6.4	6.5	23	22	6.9	5.1
TP load (t)	5.38	0.73	0.98	1.99	2.78	0.79	1.70	2.51	1.69	0.74	0.73	2.75	2.78	0.80	0.56

Nitrogen over time (2005–19)

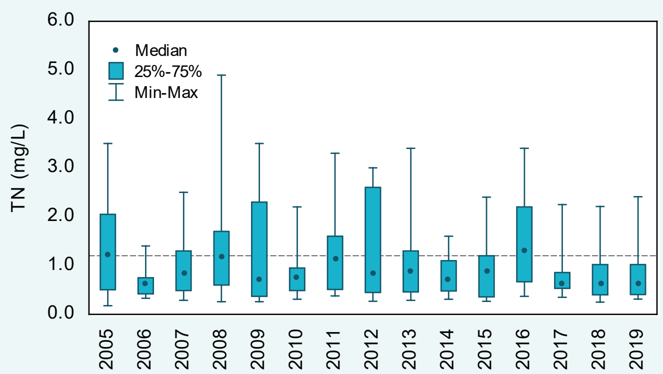
Concentrations

Total nitrogen (TN) concentrations at the King River sampling site fluctuated over the reporting period. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, all years were classified as having a low TN concentration. While summer concentrations were low, winter concentrations were often higher which is the reason that all years had some samples over the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value.

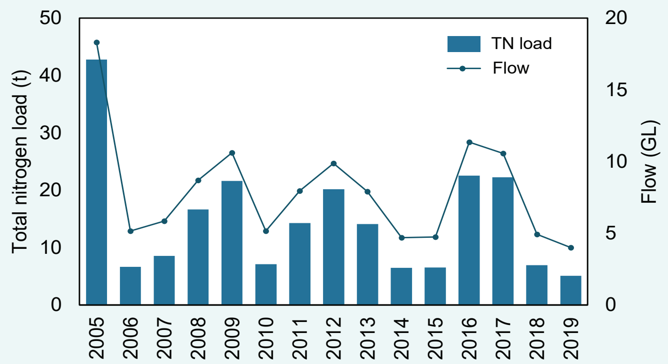
Estimated loads

Estimated TN loads at the King River sampling site were moderate compared with the other two sites in the Oyster Harbour catchment where it was possible to calculate loads. In 2019, the King River had the second largest TN load of the three sites where it was possible to calculate loads (5.1 t; the Kalgan River site had the largest load of 11 t). The load per square kilometre was large, with the King River having the largest load per square kilometre in 2019 (32 kg/km^2; Mill Brook had the next largest load per square kilometre of 14 kg/km^2). TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

King River



Total nitrogen concentrations, 2005–19 at site 602014. The dashed line is the ANZECC trigger value.



Total nitrogen loads and annual flow, 2005–19 at site 602014.

The King River gauging station during normal flows, October 2020. The river is flowing through the channel directly behind the gauging station.

Nitrogen (2019)

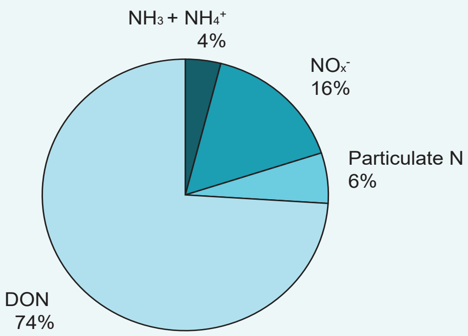
Types of nitrogen

Total N is made up of different types of N. The dominant type of N at the King River site was dissolved organic N (DON). This type of N consists mainly of degrading plant and animal matter but may also include other, more bioavailable types. Degrading plant and animal matter generally needs to be further broken down to become bioavailable, whereas some other types of DON are highly bioavailable. Compared with the other Oyster Harbour catchment sites, the proportion of N present as bioavailable dissolved inorganic N (DIN – consisting of total ammonia – NH_3 + NH_4^+ and nitrate – NO_x^-) was low. This type of N is readily bioavailable and is likely sourced from fertilisers and animal wastes.

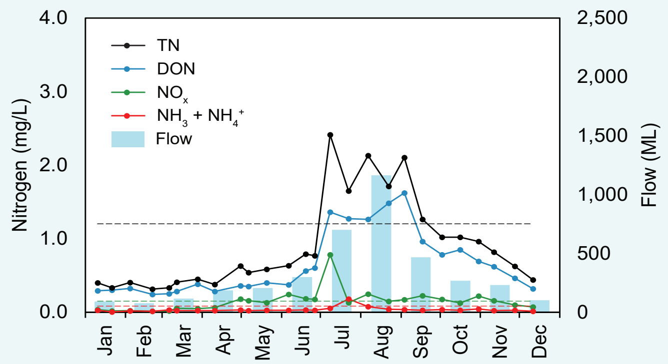
Concentrations

All types of N showed a seasonal response, increasing as rainfall and flow increased. It is likely that the total ammonia was being washed into the river from surrounding land use via surface flows. DON was likely being washed into the river from soils and remnant wetlands as well as coming from groundwater. The peak in nitrate in early July coincided with rainfall in the days before sampling and a peak in flow, suggesting it was also being washed into the river via surface flows at this time.

King River



2019 average nitrogen fractions at site 602014.



2019 nitrogen concentrations and monthly flow at 602014. The dashed lines are the ANZECC trigger values for the different N species.

The King River gauging station submerged during high flows, June 2012. Note the difference in water levels with the photograph on the previous page.

Phosphorus over time (2005–19)

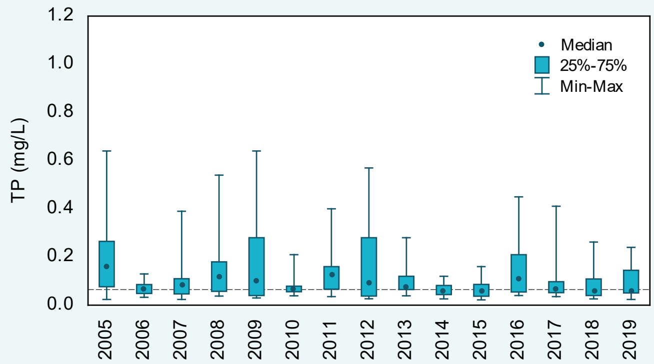
Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period at the King River sampling site. Annual TP concentrations were classified as moderate using the SWRWQA methodology. The annual range in TP concentrations was often the largest of the Oyster Harbour catchment sampling sites.

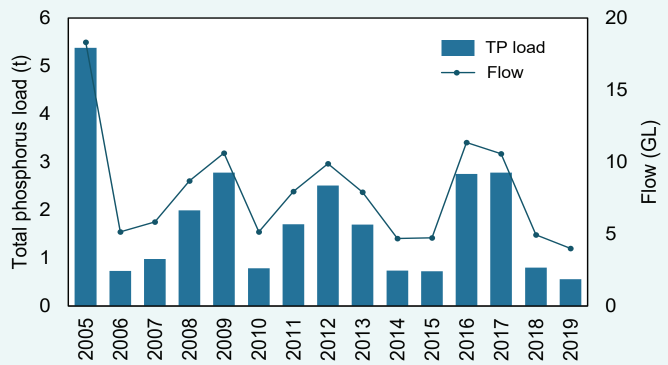
Estimated loads

Estimated TP loads at the King River sampling site were generally large compared with the other sites in the Oyster Harbour catchment. This large load is driven by the combination of relatively high TP concentrations and moderate flow volumes. In 2019, the King River had the largest TP load of the three sites where it was possible to calculate loads (0.56 t; the Kalgan River site had the next largest load of 0.29 t) even though the annual flow was three times greater in the Kalgan River than the King River (12 GL compared to 4.0 GL). The load per square kilometre was also large, with the King River having the largest load per square kilometre in 2019 (3.6 kg/km²; Mill Brook had the next largest load per square kilometre of 1.1 kg/km²). TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

King River



Total phosphorus concentrations, 2005–19 at site 602014. The dashed line is the ANZECC trigger value.



Total phosphorus loads and annual flow, 2005–19 at site 602014.

Fyke net set in the King River to capture fish as part of a river health assessment, March 2020.

Phosphorus (2019)

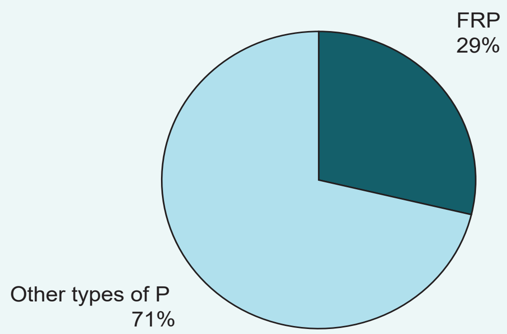
Types of phosphorus

Total P is made up of different types of P. At the King River sampling site, nearly three-quarters of the P was present as either particulate P, dissolved organic P (DOP) or both (shown as 'Other types of P' in the chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood. The remainder 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. The phosphate was probably derived from animal waste and fertilisers as well as natural sources.

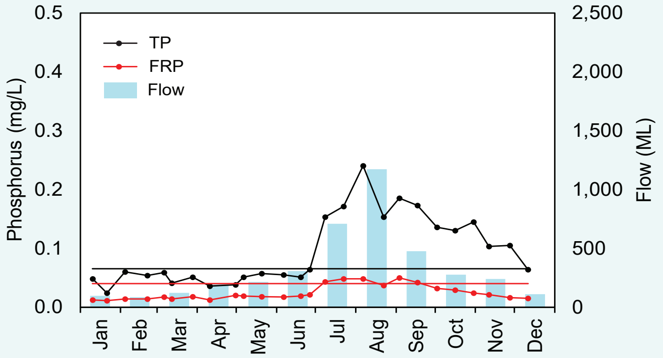
Concentrations

Total P and phosphate concentrations showed a seasonal pattern in 2019 at the King River sampling site. Concentrations were low during the first half of the year before increasing in July as rainfall and flow increased. It is likely that most of the P at this site was entering the river via surface flows, with groundwater contributing proportionally less during the wetter months. In the drier months, groundwater would have been contributing proportionally more P. In-stream sources were contributing P year-round.

King River



2019 average phosphorus fractions at site 602014.



2019 phosphorus concentrations and monthly flow at 602014. The dashed lines are the ANZECC trigger values for the different P species.

Juvenile black bream (Acanthopagrus butcheri) captured as part of the river health assessment in the King River. This is an estuarine species which is also found in the lower reaches of rivers.

Total suspended solids over time (2005–19)

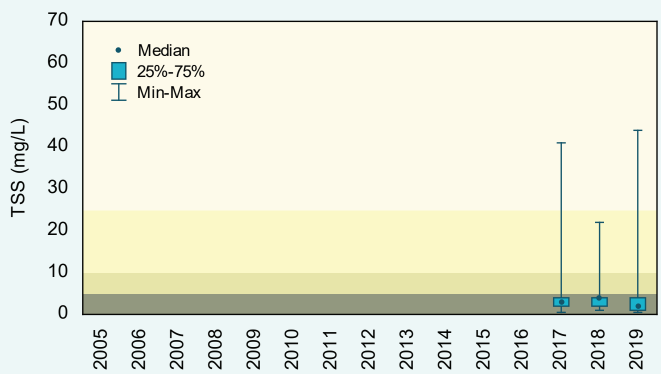
Concentrations

There were only three years with sufficient total suspended solids (TSS) data available to graph at the King River sampling site. Using the SWRWQA methodology, TSS concentrations were classified as low at this site though there were a small number of samples that fell into the very high band each year.

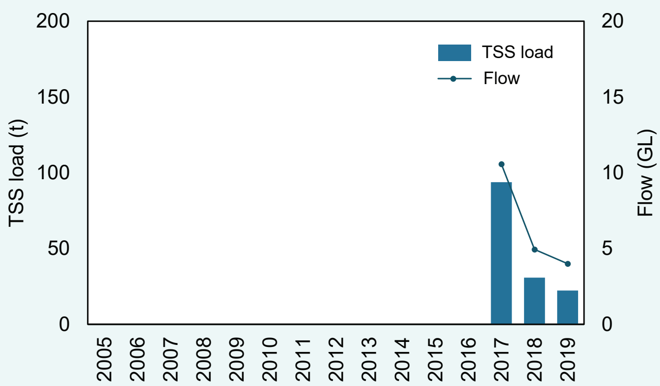
Estimated loads

Estimated TSS loads at the King River sampling site were moderate to large compared with the other sites in the Oyster Harbour catchment. In 2019, the King River had the largest TSS load of the three sites where it was possible to calculate loads (22 t; the Kalgan River site had the next largest load at 18 t). The load per square kilometre was large, with the King River having the largest load per square kilometre in 2019 (143 kg/km^2; Mill Brook had the next largest load per square kilometre of 71 kg/km^2). TSS loads were closely related to flow volume; years with large annual flow volumes had large TSS loads and vice versa.

King River



Total suspended solids concentrations, 2005–19 at site 602014. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 602014.

low moderate high very high

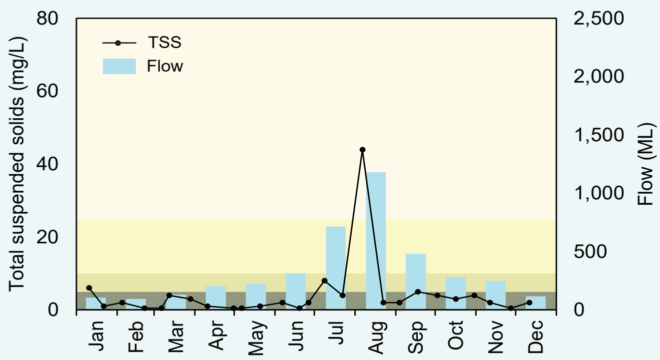
The King River at the sampling site. The fringing vegetation here is a mix of native and exotic species, October 2009.

Total suspended solids (2019)

Concentrations

TSS concentrations showed a seasonal pattern in 2019 at the King River sampling site. Concentrations were generally low in the first half of the year, increasing in July as rainfall and flow increased. The high concentration in August was collected on a day when it was raining and the sampler noted that the water was very brown which was likely caused by particulate matter in the water. Likely sources of TSS at this site were particulate matter being washed into the river via surface flows as well as from in-stream sources such as erosion.

King River



2019 total suspended solids concentrations and monthly flow at 602014. The shading refers to the SWRWQA classification bands.

low moderate high very high

Undercutting of the bank near the sampling site has caused it to slump, October 2017.

King River

pH over time (2005–19)

pH values

pH fluctuated at the King River sampling site during the reporting period. While all annual medians fell within the upper and lower ANZECC trigger values, many years had some samples which were either above or below the trigger values.

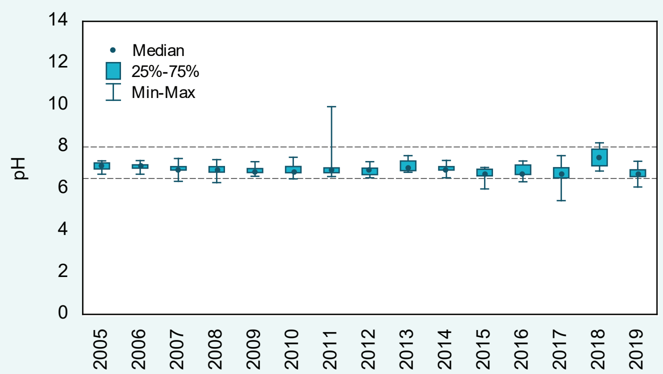
There is some concern that the probe used to collect the pH data from the catchments of Oyster Harbour (including the King River site) from about October 2016 to October 2017 was not functioning correctly. This may have caused lower-than-actual pH values to be recorded. From October 2017, a new probe was used. Although there is no way of verifying the 2016 and 2017 pH data, they have still been presented here.

pH (2019)

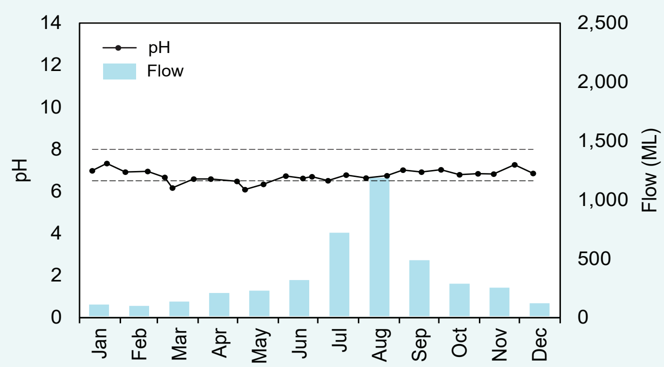
pH values

pH at the King River sampling site did not show a clear seasonal response. Values were lowest between March and May with some samples falling below the lower ANZECC trigger value at this time.

King River



pH levels, 2005–19 at site 602014. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 602014. The dashed lines are the upper and lower ANZECC trigger values.

Aerial view from gauging station, looking across the catchment to Oyster Harbour, March 2020.

King River

Salinity over time (2005–19)

Concentrations

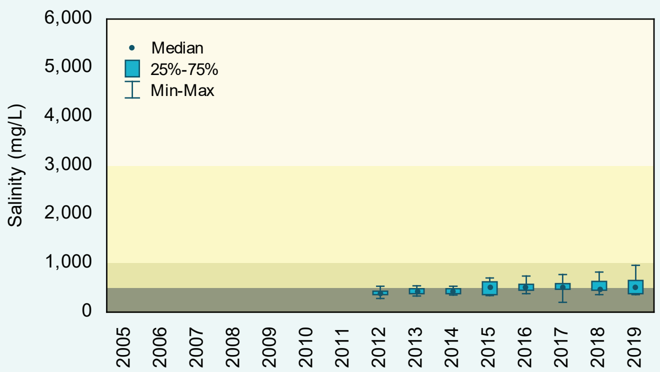
Salinity at the King River sampling site appears to be increasing, ongoing monitoring will help determine if this is an actual increase or if this is part of the natural fluctuations at this site. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh (note, the 2018 nutrient report used the SWRWQA bands).

Salinity (2019)

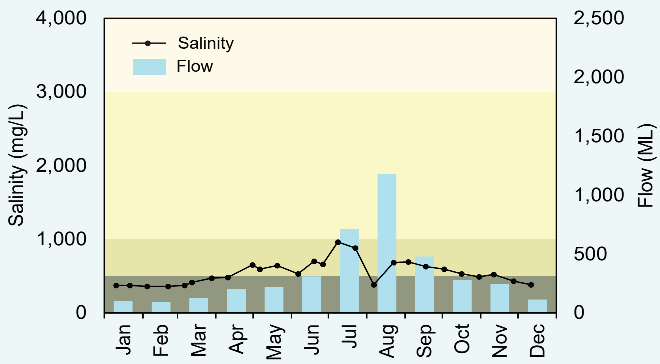
Concentrations

Salinity at the King River sampling site showed a seasonal pattern in 2019. Concentrations were lowest at the start and end of the year when flow and rainfall were at their lowest, and slightly higher in the middle of the year when flow and rainfall were at their highest. This suggests that most of the salt at this site is being washed into the river via surface flows from surrounding land. The reason for the dip in salinity in early August is unclear; however, it was raining on that day so it is possible that the sample was influenced by the fresher water from the rainfall.

King River



Salinity concentrations, 2005–19 at site 602014. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity and monthly flow at 602014. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh | marginal | brackish | saline

The King River sampling site. The understorey of the fringing vegetation is dominated by exotic grasses, August 2019.

King River

Background

Healthy Estuaries WA is a State Government 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; 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 Oyster Harbour at estuaries.dwer.wa.gov.au/estuary/oyster-harbour

Healthy Estuaries WA partners with the Oyster Harbour Catchment Group to fund best-practice managment 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 Oyster Harbour Catchment Group go to ohcg.org.au
- To find out more about the health of the rivers in the Oyster Harbour 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.

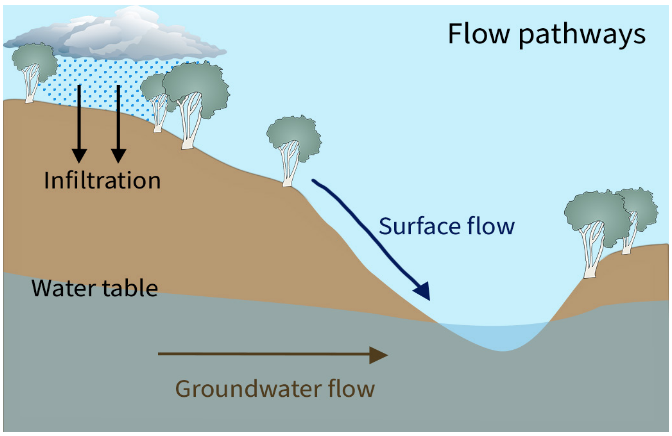
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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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