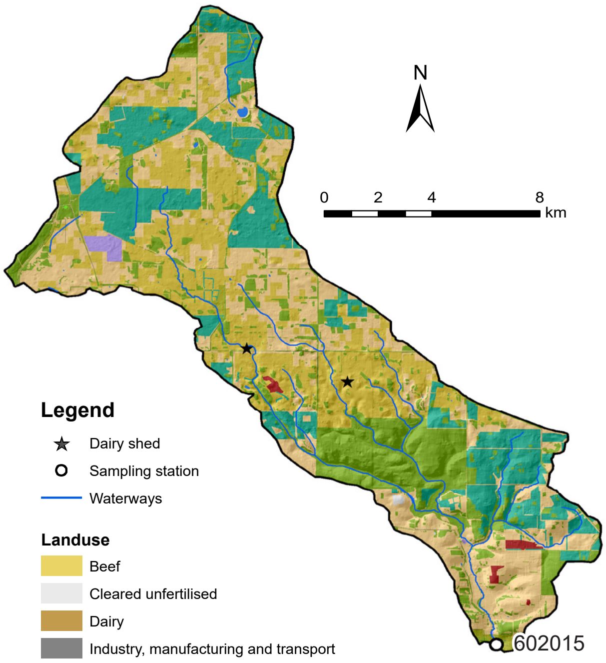
Mill Brook

This data report provides a summary of the nutrients at the Mill Brook sampling site in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Downstream of the site, the brook flows into the King River which then discharges to Oyster Harbour.

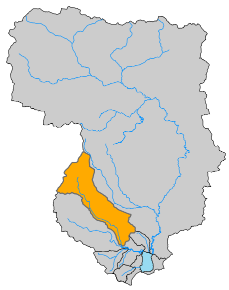


About the catchment

Mill Brook has a catchment area of about 180 km², 90 per cent of which has been cleared, mainly for cropping and mixed grazing, beef cattle and bluegum plantations. There are also two dairy sheds present and a large area of remnant vegetation in the Mill Brook Nature Reserve which is in the lower half of the catchment. While the waterways remain in a mostly natural state, much of the fringing vegetation has been lost or is in poor condition.

Along Mill Brook, the soils tend to have a low phosphorus-binding capacity. This means that any phosphorus applied to them can be quickly washed into waterways. The rest of the catchment has soils which tend to bind phosphorus reasonably well.

Water quality is measured at site 602015, Mill Brook, where the brook passes under Warren Road in Millbrook.



Location of the Mill Brook catchment in the greater Oyster Harbour catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Mill Brook sampling site were classified as moderate to low (total nitrogen) and moderate (total phosphorus). Nutrient loads were small, though the loads contributed per square kilometre of catchment were moderate. The Mill Brook catchment was the second saltiest of the Oyster Harbour catchments, after the Kalgan River which was much saltier.

Facts and figures

Sampling site code	602015
Catchment area	180 km^2
Per cent cleared area (2018)	90 per cent
River flow	Permanent
Main land use (2018)	Cropping and mixed grazing, beef cattle and blue gum plantations

Estimated loads and flow at Mill Brook

602015	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)	8.1	3.4	3.8	5.2	5.2	3.0	4.2	4.3	4.4	2.9	3.5	6.0	5.9	2.8	2.5
TN load (t)	13	3.3	4.2	7.0	7.5	3.2	5.3	6.0	5.7	3.3	4.0	8.7	8.8	2.9	2.5
TP load (t)	1.20	0.24	0.32	0.59	0.66	0.24	0.43	0.53	0.49	0.27	0.32	0.75	0.83	0.23	0.20

Mill Brook

Nitrogen over time (2005–19)

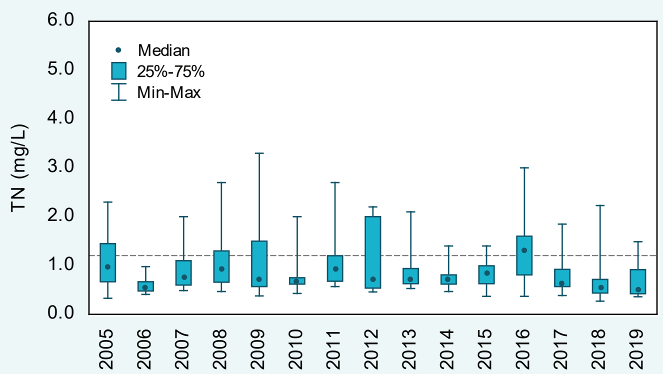
Concentrations

Total nitrogen (TN) concentrations fluctuated over the reporting period at the Mill Brook sampling site. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, 2009–17 were classified as having moderate concentrations and all other years were classified as having low concentrations. All annual medians except one (2016) were below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value.

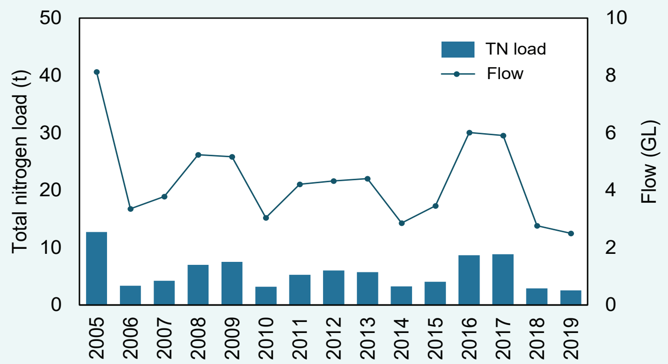
Estimated loads

Estimated TN loads at the Mill Brook sampling site were consistently the smallest of the three sites in the Oyster Harbour catchment where it was possible to calculate loads. In 2019, Mill Brook had the smallest TN load of the three sites (2.5 t; the King River site had the next largest load of 5.1 t). The small loads were driven by the combination of the low to moderate TN concentrations and the small flow volumes. Mill Brook has the smallest annual flows of the Oyster Harbour catchment sites. In 2019 it was 2.5 GL; the King River had the next smallest flow volume of 4.0 GL. The load per square kilometre was moderate, with Mill Brook having the second largest load per square kilometre in 2019 (14 kg/km^2, the King River had the next largest load per square kilometre of 32 kg/km^2). TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Mill Brook



Total nitrogen concentrations, 2005–19 at site 602015. The dashed line is the ANZECC trigger value.



Total nitrogen loads and annual flow, 2005–19 at site 602015.

The weir and gauging station at the Mill Brook sampling site. The exotic grass along the brook has been cut back, January 2017.

Mill Brook

Nitrogen (2019)

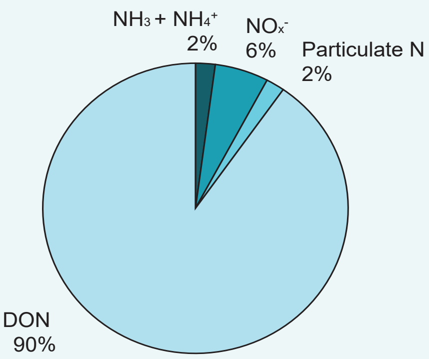
Types of nitrogen

Total N is made up of different types of N. The dominant type of N in Mill Brook was dissolved organic N (DON). DON consists mainly of degrading plant and animal matter but may also include other types. The bioavailability of DON varies depending on its type; some are highly bioavailable whereas others, like degrading plant and animal matter, often need to be further broken down. The proportion of N present as bioavailable dissolved inorganic N (total ammonia – NH_3 + NH_4^+ and nitrate – NO_x^-) was very low. It is worth noting that 10 of the 26 nitrate samples and 11 of the 26 total ammonia samples were below the laboratory limit of reporting (LOR).

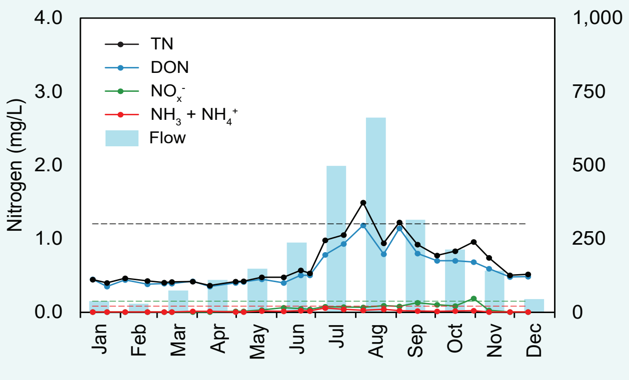
Concentrations

Total N and DON concentrations showed a seasonal pattern, increasing as flow and rainfall increased before falling again. The DON was likely washed from soils and remnant wetlands where it had built up over summer. Nitrate concentrations were very low and showed a slight seasonal pattern though they peaked later than TN and DON. During the wetter months, it is likely that much of the N at this site was being washed into the brook via surface flows, with groundwater contributing proportionally less. During the drier months, groundwater was contributing proportionally more N. In-stream sources also contributed N.

Mill Brook



2019 average nitrogen fractions at site 602015.



2019 nitrogen concentrations and monthly flow at 602015. The dashed lines are the ANZECC trigger values for the different N species.

Mill Brook flowing through paddocks. The fringing vegetation consists almost entirely of exotic grasses with a few remnant trees, June 2018.

Mill Brook

Phosphorus over time (2005–19)

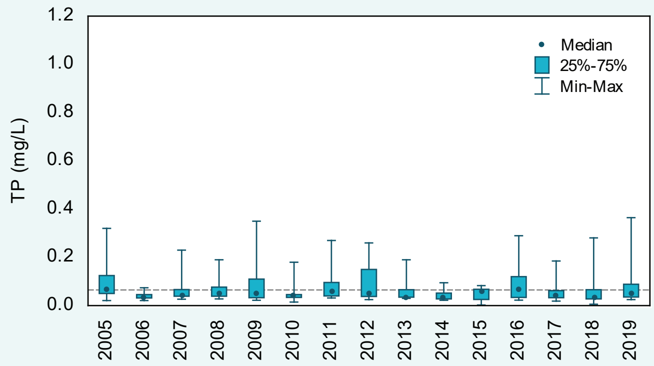
Concentrations

Total phosphorus (TP) concentrations at the Mill Brook sampling site fluctuated over the reporting period and all years were classified as moderate using the SWRWQA methodology. With the exception of 2005 and 2016, all annual medians were below the ANZECC trigger value, though there were some samples above the trigger value each year.

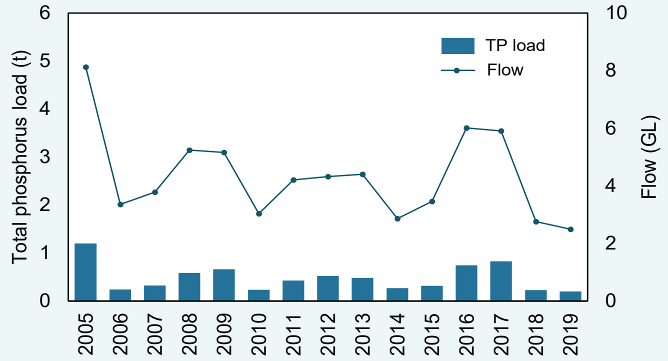
Estimated loads

Estimated TP loads at the Mill Brook sampling site were small compared with the other sites in the Oyster Harbour catchment. In 2019, Mill Brook had the smallest TP load of the three sites where it was possible to calculate loads (0.20 t; the Kalgan River site had the next largest load of 0.29 t). The small loads were driven by the moderate TP concentrations combined with the small annual flow volumes. In 2019, Mill Brook had an annual flow volume of 2.5 GL; the King River had the next smallest flow volume of 4.5 GL. The load per square kilometre was moderate, with Mill Brook having the second largest load per square kilometre in 2019 (1.1 kg/km^2; King River had the largest load per square kilometre of 3.6 kg/km^2). TP loads were closely related to flow volume; years with large annual flow volume had large TP loads and vice versa.

Mill Brook



Total phosphorus concentrations, 2005–19 at site 602015. The dashed line is the ANZECC trigger value.



Total phosphorus loads and annual flow, 2005–19 at site 602015.

During the wetter months, the exotic grasses lining Mill Brook can almost completely cover it, June 2018.

Phosphorus (2019)

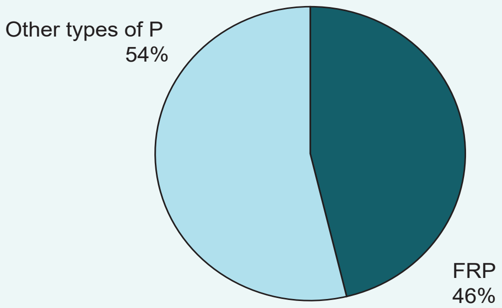
Types of phosphorus

Total P is made up of different types of P. At the Mill Brook sampling site, just over half 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.

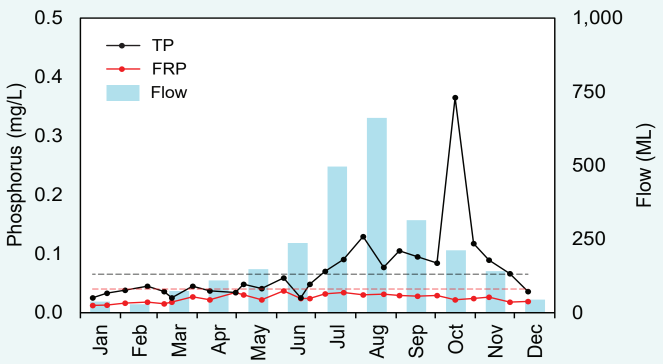
Concentrations

Total P and phosphate showed a seasonal pattern in 2019 at the Mill Brook sampling site. Concentrations increased in July as rainfall and flow increased. It is likely that most of the P at this site was entering the brook via surface flows from surrounding land use, with groundwater contributing proportionally less during the wetter months. In the drier months, groundwater was contributing proportionally more P. In-stream sources were also contributing P. The reason for the peak in TP concentrations in October is unclear.

Mill Brook



2019 average phosphorus fractions at site 602015.



2019 phosphorus concentrations and monthly flow at 602015. The dashed lines are the ANZECC trigger values for the different P species.

Staff gauge at the Mill Brook sampling site, June 2018.

Total suspended solids over time (2005–19)

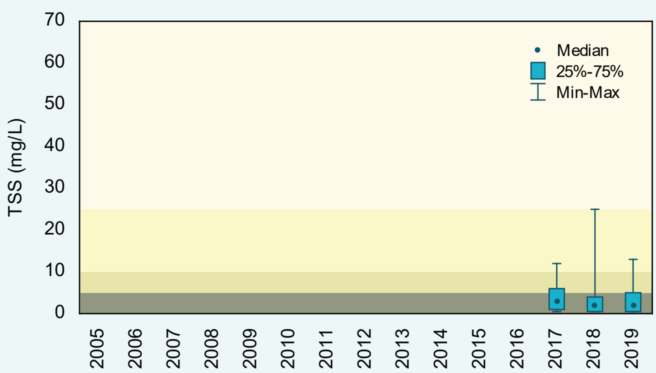
Concentrations

There were only three years with sufficient total suspended solids (TSS) data available to plot. Using the SWRWQA methodology, all years were classified as having a low TSS concentration.

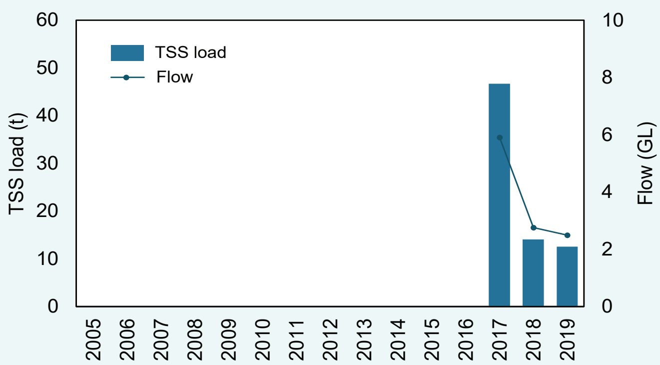
Estimated loads

Estimated TSS loads at the Mill Brook sampling site were consistently small compared with the other sites in the Oyster Harbour catchment. In 2019, Mill Brook had the smallest TSS load of the three sites where it was possible to calculate loads (13 t; the Kalgan River site had the next largest load of 18 t). The small loads were driven by the low TSS concentrations combined with the small annual flow volumes. In 2019, Mill Brook had an annual flow volume of 2.5 GL; the King River had the next smallest flow volume of 4.0 GL. The load per square kilometre was moderate, with Mill Brook having the second smallest load per square kilometre in 2019 (71 kg/km^2; the King River had the largest load per square kilometre of 143 kg/km^2). TSS loads were closely related to flow volume; years with large annual flow volumes had large TSS loads and vice versa.

Mill Brook



Total suspended solids concentrations, 2005–19 at site 602015. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 602015.

low | moderate | high | very high

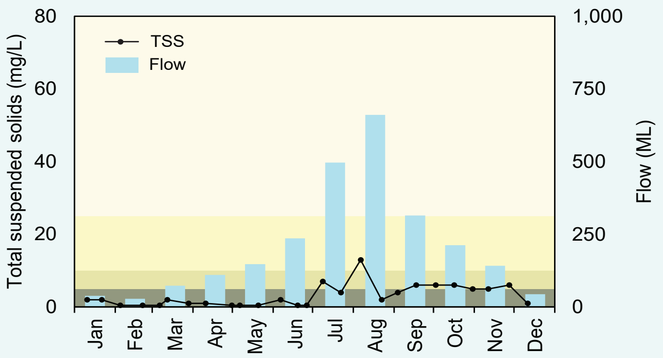
Collecting discharge measurements using a StreamPro Acoustic Doppler Current Profiler during high flows, September 2017.

Total suspended solids (2019)

Concentrations

In 2019, there was a some evidence of a seasonal pattern in TSS concentrations at the Mill Brook sampling site; concentrations were generally higher during the wetter months. There was a peak in TSS in August which coincided with rainfall on the day of sampling. It is likely that this rainfall was washing particulate matter into the brook from surrounding land use and the corresponding increased flow was dislodging particulate matter from the banks and bed.

Mill Brook



2019 total suspended solids concentrations and monthly flow at 602015. The shading refers to the SWRWQA classification bands.

low | moderate | high | very high

A natural section of Mill Brook, near Old Millbrook Road, March 2020.

Mill Brook

pH over time (2005–19)

pH values

pH at the Mill Brook sampling site fluctuated over the reporting period, though all annual medians were within the upper and lower ANZECC trigger values.

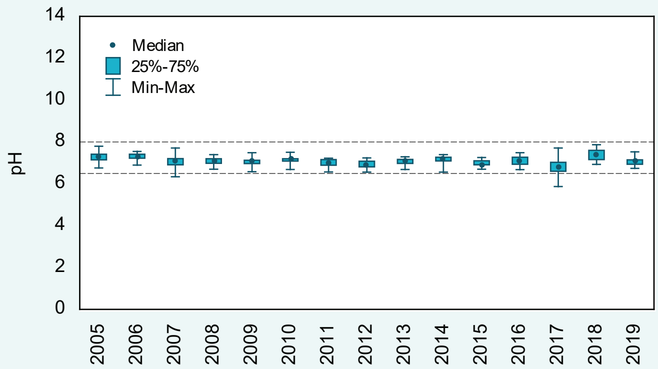
There is some concern that the probe used to collect the pH data from the catchments of Oyster Harbour (including the Mill Brook site) from about October 2016 to October 2017 was not functioning correctly. This may have caused lower-than-actual pH values to be recorded. From October 2017 a new probe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

pH (2019)

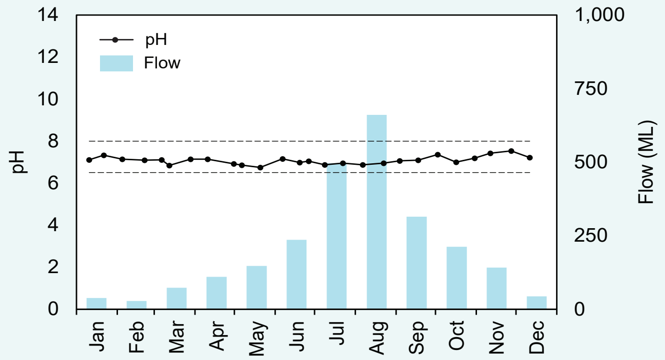
pH values

There was no clear evidence of a seasonal pattern in pH values at the Mill Brook sampling site in 2019, with values fluctuating during the year. The slight seasonal pattern observed in 2018 is not evident in 2019.

Mill Brook



pH levels, 2005–19 at site 602015. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 602015. The dashed lines are the upper and lower ANZECC trigger values.

The Mill Brook sampling site, June 2017. The exotic grasses surrounding the creek have been burnt.

Mill Brook

Salinity over time (2005–19)

Concentrations

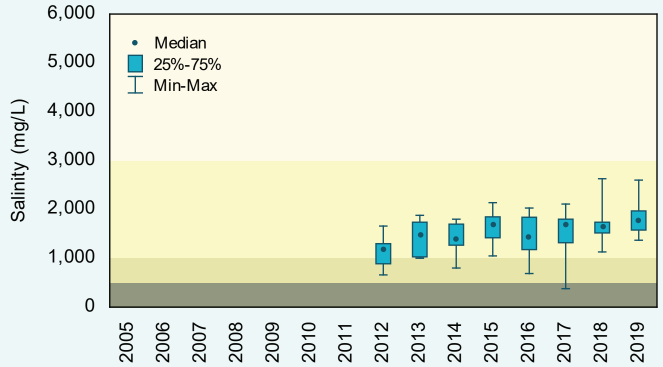
Salinity appeared to be increasing over the reporting period at the Mill Brook sampling site. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as having marginal salinity (note, the 2018 nutrient report used the SWRWQA bands). Mill Brook was the second saltiest of the six sites sampled in the Oyster Harbour catchment; in 2019 only the Kalgan River had a higher median (6,300 mg/L compared with 1,765 mg/L at Mill Brook).

Salinity (2019)

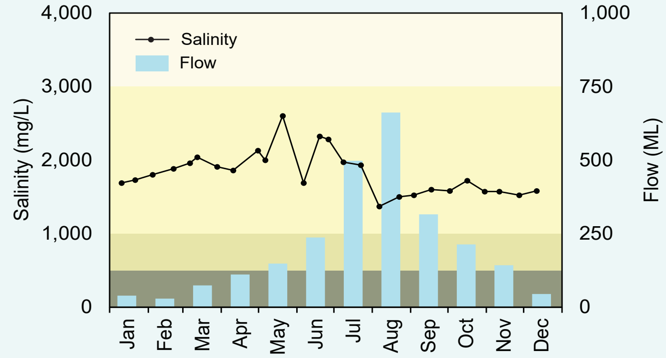
Concentrations

In 2019, salinity showed a seasonal pattern at the Mill Brook sampling site. Salinity was highest between about May to July, coinciding with flow volumes slowly increasing. In August, when flow volumes were greatest, salinity dropped. It is likely that the groundwater at this site has elevated salinity, as salinity levels were brackish, even during the dry summer months when it was probable that groundwater was contributing proportionally more water than surface runoff to the brook's flow.

Mill Brook



Salinity concentrations, 2005–19 at site 602015. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at site 602015. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

Bridge over Mill Brook downstream of the sampling site, June 2018.

Mill Brook

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 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 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.

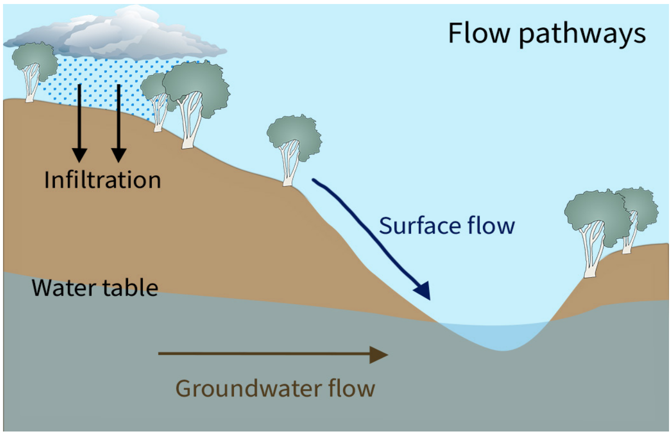
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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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