Mill Brook

This data report provides a summary of the nutrients at the Mill 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 the site, the brook flows into the King River which then discharges to Oyster Harbour. 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

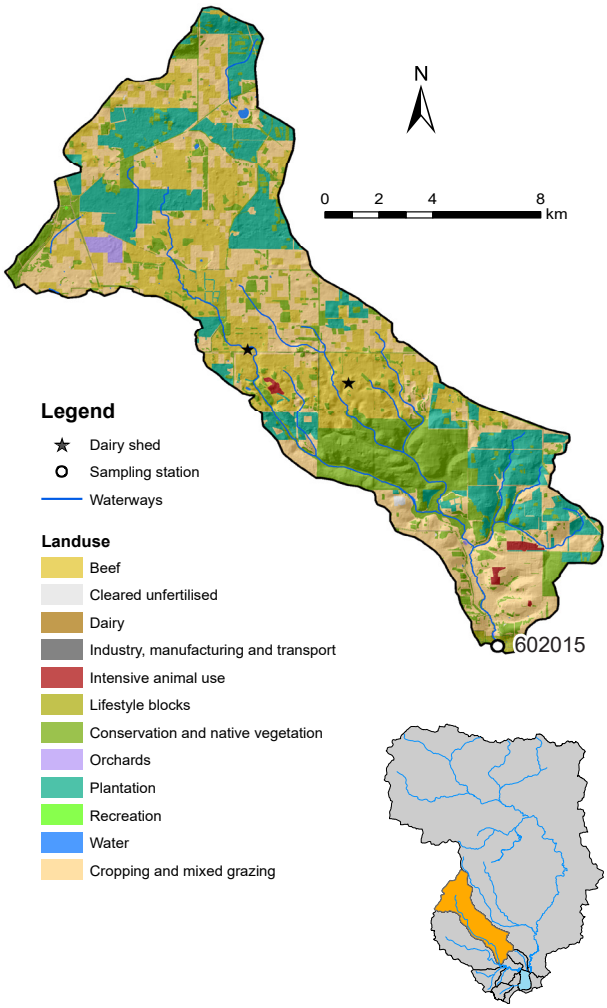
Mill Brook has a catchment area of about 180 km², 90 per cent of which has been cleared, mainly for cropping and mixed grazing, beef cattle and blue gum plantations. There are also two dairy sheds present and a large area of remnant vegetation in the Mill Brook Nature Reserve which is in the lower half 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 imeans 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.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Mill Brook sampling site were moderate. Nutrient loads were small, though the loads contributed per square kilometer 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.



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

Facts and figures

Sampling site code	602015
Catchment area	180 km²
Per cent cleared area (2018)	90%
River flow	Permanent
Annual flow (2018)	3 GL
Main land use (2018)	Cropping and mixed grazing, beef cattle and blue gum plantations

Mill Brook

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations fluctuated over the reporting period at the Mill Brook sampling site. TN concentrations were moderate, with all annual medians except one (2016) below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value. There were some samples above the ANZECC trigger value in all years except for 2006.

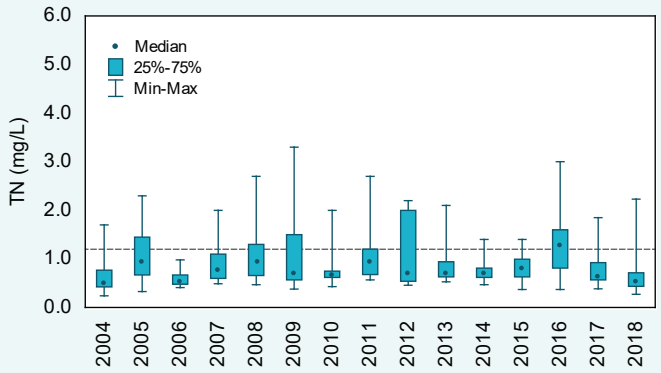
Trends

There was a short-term (2014–18) decreasing trend in TN concentrations at the Mill Brook sampling site of 0.06 mg/L/yr. Ongoing monitoring will help determine if this trend is because of natural fluctuations at this site or an actual improvement in water quality. There was no long-term (2004–18) trend present.

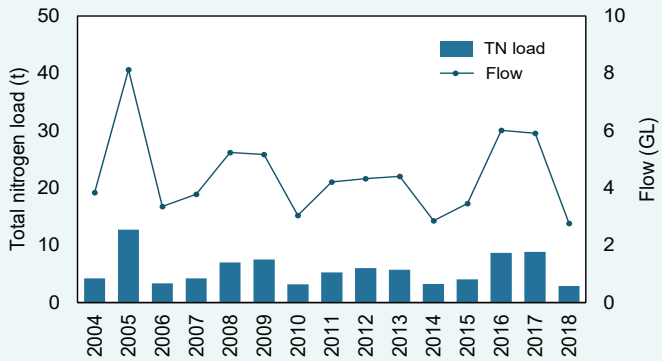
Estimated loads

Estimated TN loads at the Mill Brook sampling site were small compared with the other sites in the Oyster Harbour catchment. In 2018, Mill Brook had the smallest TN load of the three sites where it was possible to calculate loads (3 t; the King River site had the next largest load of 7 t). The load per unit area was moderate, with Mill Brook having the second largest load per unit area in 2018 (16 kg/km^2; the King River had the next largest load per unit area of 44 kg/km^2). TN loads were closely related to flow volume, years with high annual flow had large TN loads and vice versa.

Mill Brook



Total nitrogen concentrations, 2004–18 at site 602015. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual discharge, 2004–18 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.

Nitrogen (2018)

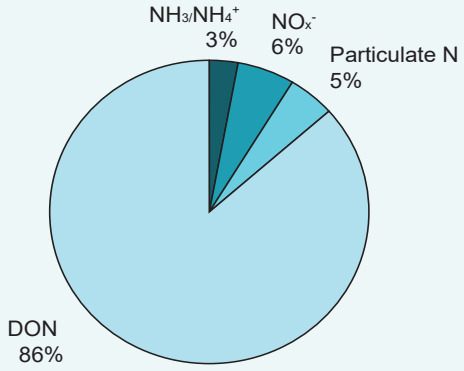
Types of nitrogen

Total N is made up of different forms of N. The dominant form of N in Mill Brook was dissolved organic N (DON), in fact this sampling site had the highest proportion of N present as DON of the six Oyster Harbour catchment sites. DON consists mainly of degrading plant and animal matter but may also include other forms. The bioavailability of DON varies depending on its form; 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 (ammonia N – NH_3/NH_4^+ and total oxides of nitrogen – NO_x^-) was very low.

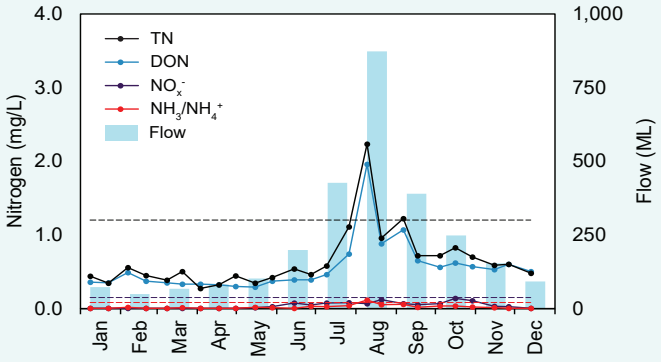
Concentrations

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 built up over summer. NO_x^- concentrations were very low and showed a slight seasonal pattern. All NO_x^- samples collected before May were below the laboratory limit of reporting. 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. In-stream sources also contributed N.

Mill Brook



2018 average nitrogen fractions at site 602015.



2018 nitrogen concentrations and monthly discharge at 602015. The dashed lines are the ANZECC trigger values for lowland rivers 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 (2004–18)

Concentrations

Total phosphorus (TP) concentrations at the Mill Brook sampling site were moderate and fluctuated over the reporting period. 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.

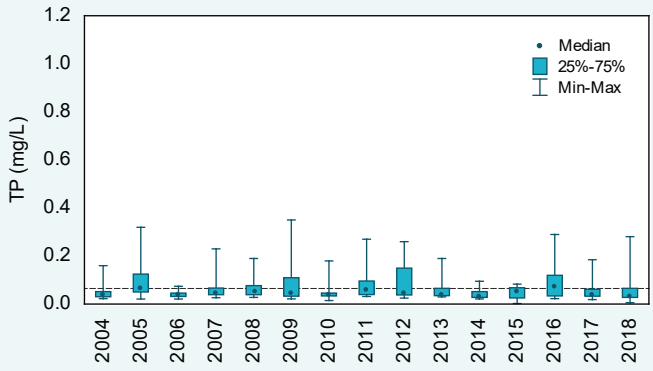
Trends

There was neither a short- (2014–18) or long-term (2004–18) trend present in TP concentrations at the Mill Brook sampling site.

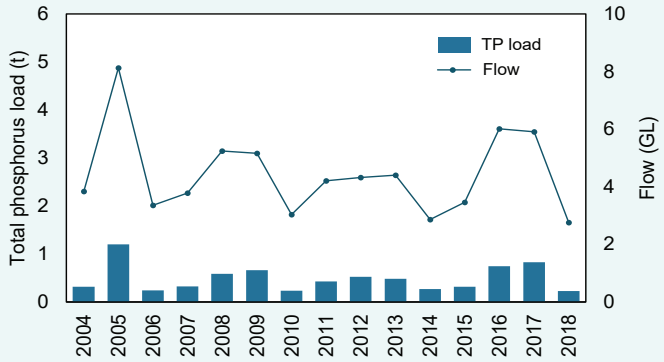
Estimated loads

Estimated TP loads at the Mill Brook sampling site were small compared with the other sites in the Oyster Harbour catchment. In 2018, Mill Brook had the smallest TP load of the three sites where it was possible to calculate loads (0.23 t; the Kalgan River site had the next largest load of 0.80 t). The load per unit area was moderate, with Mill Brook having the second largest load per unit area in 2018 (1.3 kg/km^2; King River had the largest load per unit area of 5.1 kg/km^2). TP loads were closely related to flow volume, years with high annual flow had large TP loads and vice versa.

Mill Brook



Total phosphorus concentrations, 2004–18 at site 602015. The dashed line is the ANZECC trigger value for lowland rivers.



Total phosphorus loads and annual discharge, 2004–18 at site 602015.

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

Phosphorus (2018)

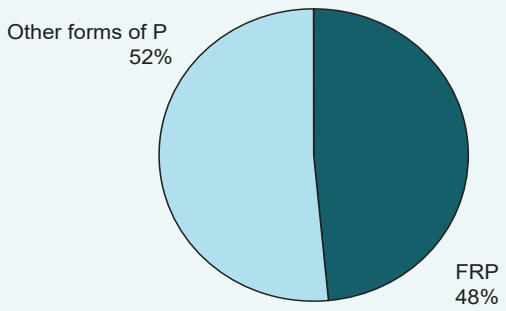
Types of phosphorus

Total P is made up of different forms 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 forms of P' in the chart below). Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood. The remainder of the P was present as filterable reactive phosphorus (FRP) which is readily bioavailable, meaning that plants and algae can use it to fuel rapid growth. The FRP was probably derived from animal waste and fertilisers as well as natural sources.

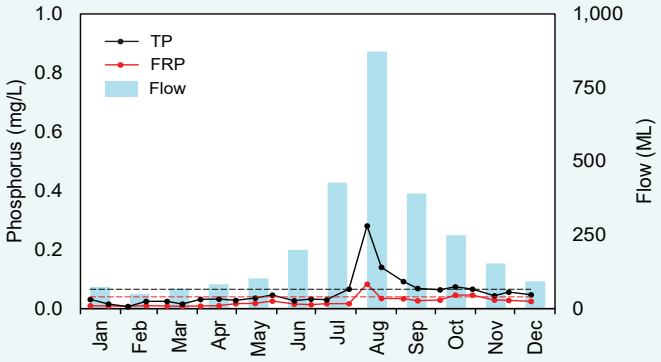
Concentrations

Total P and FRP showed a seasonal pattern in 2018 at the Mill Brook sampling site. Concentrations peaked in August when flow was at its highest. Concentrations were also slightly higher in the second half of the year than early in the year. 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. In-stream sources were also contributing P.

Mill Brook



2018 average phosphorus fractions at site 602015.



2018 phosphorus concentrations and monthly discharge at 602015. The dashed lines are the ANZECC trigger values for the different P species in lowland rivers.

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

Mill Brook

Total suspended solids over time (2004–18)

Concentrations

There were only two years with sufficient total suspended solids (TSS) data available to plot. Both of these annual medians fell into the low band of the Statewide River Water Quality Assessment (SWRWQA) classification bands, though there were samples that fell into the higher bands in each year.

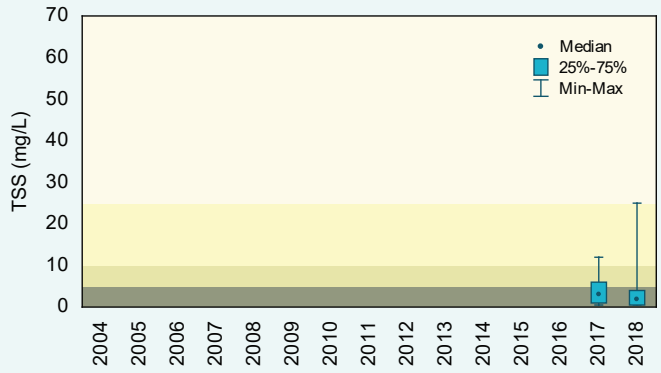
Trends

As there were only two years of data, it was not possible to calculate trends in TSS concentrations at the Mill Brook sampling site. A minimum of five consecutive years of data are required to test for trends.

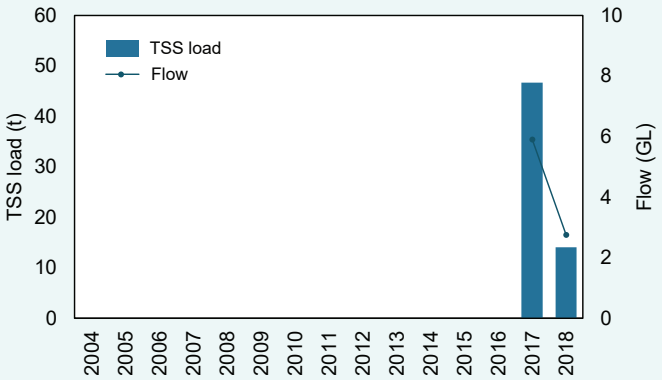
Estimated loads

Estimated TSS loads at the Mill Brook sampling site were small compared with the other sites in the Oyster Harbour catchment. In 2018, Mill Brook had the smallest TSS load of the three sites where it was possible to calculate loads (14 t; the King River site had the next largest load of 31 t). The load per unit area was moderate, with Mill Brook having the second smallest load per unit area in 2018 (79 kg/km^2; King River had the next largest load per unit area of 197 kg/km^2). TSS loads were closely related to flow volume, years with high annual flow had large TSS loads and vice versa.

Mill Brook



Total suspended solids concentrations, 2004–18 at site 602015. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual discharge, 2004–18 at site 602015.

very high high moderate low

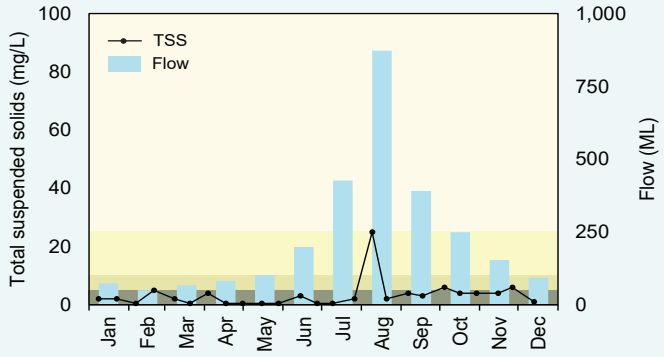
Collecting discharge measurements using a StreamPro Acoustic Doppler Current Profiler during high flows, September 2017.

Total suspended solids (2018)

Concentrations

In 2018, there was a some evidence of a seasonal pattern in TSS concentrations at the Mill Brook sampling site. There was a peak in TSS in August which coincided with steady rainfall over the previous week as well as rainfall and on the day of sampling. These both contributed to rising water levels on the day of sampling. It is likely that this rainfall was washing particulate matter into the brook from surrounding land use and the increased flow was dislodging particulate matter from the banks and bed. Overall TSS concentrations were low, however, with almost all samples falling in the low band of the SWRWQA classification bands.

Mill Brook



2018 total suspended solids concentrations and monthly discharge at 602015. The shading refers to the SWRWQA classification bands.

very high high moderate low

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

Mill Brook

pH over time (2004–18)

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.

Trends

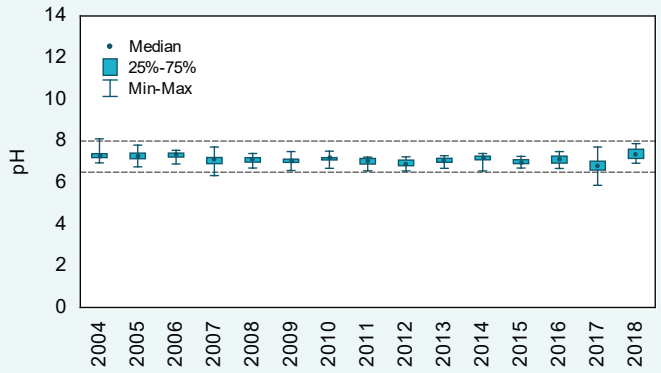
There was no trend in pH at Mill Brook over either the short- (2014–18) or long-term (2004–18).

pH (2018)

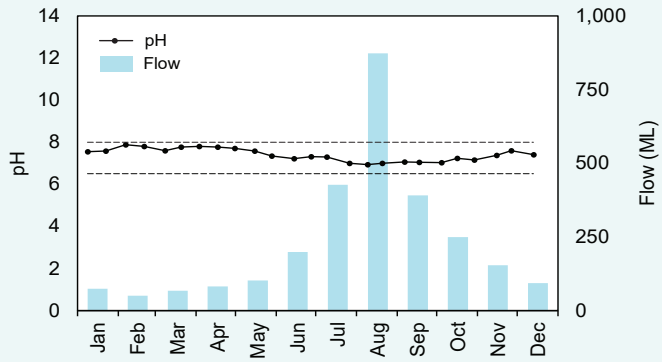
pH values

There was evidence of a slight reverse seasonal pattern in pH values at the Mill Brook sampling site, with values slightly lower during the middle of the year when rainfall and flow were at their highest. This suggests that the groundwater at this site may be slightly more alkaline that the surface water runoff.

Mill Brook



pH levels, 2004–18 at site 602015. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 602015. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

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

Mill Brook

Salinity over time (2004–18)

Concentrations

Salinity fluctuated over the reporting period at the Mill Brook sampling site. All annual medians fell into the brackish band of the SWRWQA classification bands. Mill Brook was the second saltiest of the six sites sampled in the Oyster Harbour catchment; in 2018 only the Kalgan River had a higher median (4,360 mg/L compared with 1,650 mg/L).

Trends

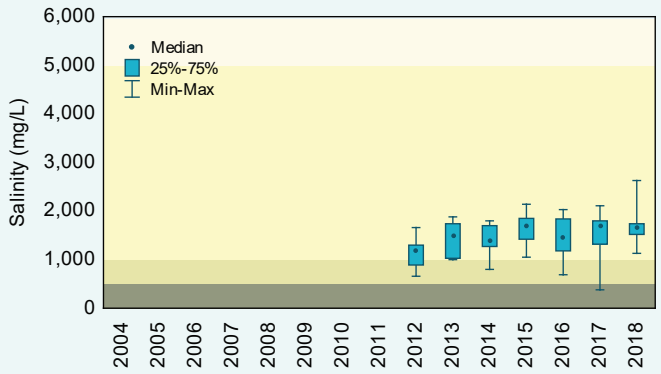
There was neither a short- (2014–18) or long-term (2004–18) trend in salinity at the Mill Brook sampling site.

Salinity (2018)

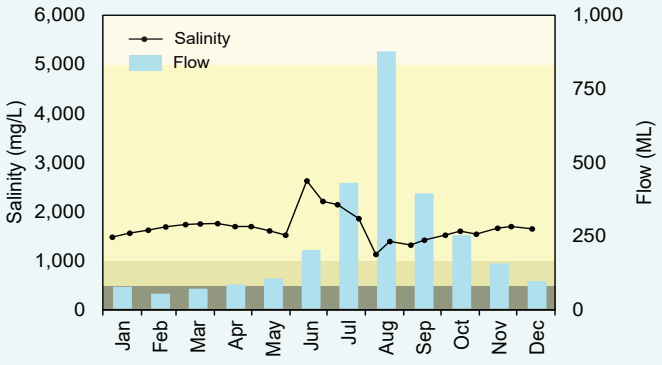
Concentrations

In 2018 salinity showed a first-flush response at the Mill Brook sampling site. The start of winter rains in June flushed salts into the brook from surrounding land where they had accumulated over the drier summer months. After this initial flush, concentrations slowly decreased again. 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, 2004–18 at site 602015. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at site 602015. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

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

Mill 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 Oyster Harbour at estuaries.dwer.wa.gov.au/estuary/oyster-harbour/

The Regional Estuaries Initiative partners with the Oyster Harbour Catchment Group 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 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

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.

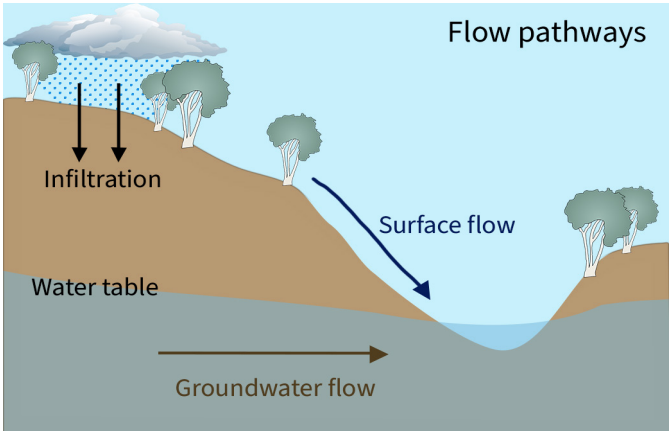
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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