Nambeelup Brook

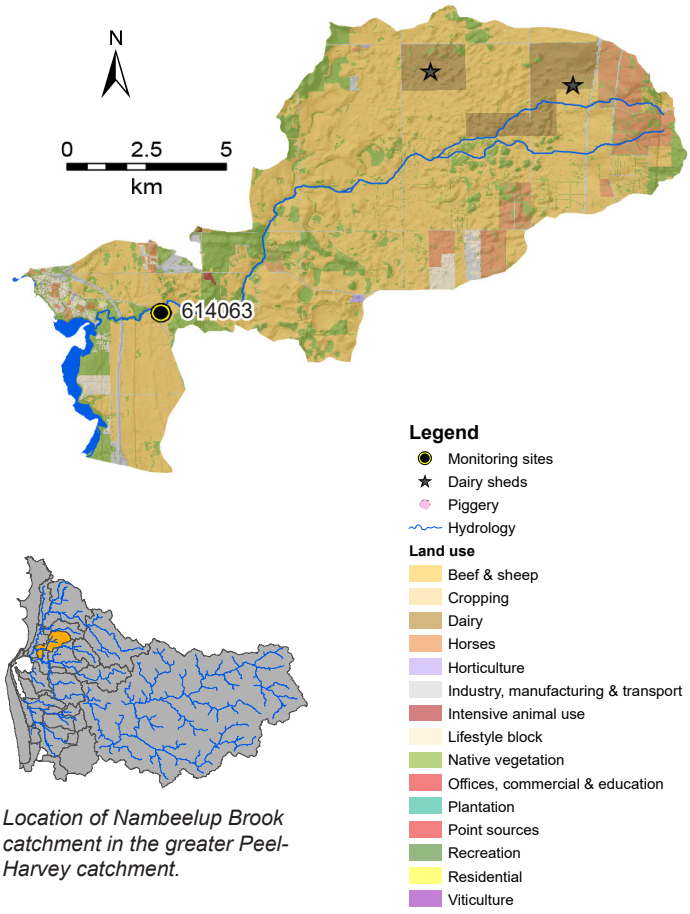
This data report provides a summary of the nutrients at the Nambeelup Brook sampling site in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Downstream of the site, the brook flows into Black Lake, which continues into Goegrup Lake (one of the Serpentine Lakes) before entering the Serpentine River which discharges to the Peel Inlet.

About the catchment

Nambeelup Brook has a catchment area of about 139 km^2, more than three-quarters of which has been cleared for agriculture, predominantly beef and sheep grazing. Two dairy sheds are present in the upper catchment. As of 2015, large areas of farmland have been progressively mined for mineral sands and then rehabiliated for continued use as farmland. While the brook itself retains its natural form, much of the fringing vegetation has been lost or degraded and there are numerous drains constructed to quickly remove water from agricultural land and drain it to the brook.

Most of the catchment soils have a low phosphorus-binding capacity. This is often so poor that any phosphorus applied to them can be quickly washed into drains and other waterways.

Water quality is monitored at site 614063, Patterson Road–Kielman, upstream of where Nambeelup Brook passes under Patterson Road in Nambeelup. The catchment area upstream of the sampling site is about 112 km^2.



Location of Nambeelup Brook catchment in the greater Peel-Harvey catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Nambeelup Brook sampling site were classified as very high. Annual nutrient loads and the loads per square kilometre were moderate (nitrogen) and large (phosphorus) compared with the other Peel-Harvey catchment sites. The combination of agricultural land use, lack of fringing vegetation and the construction of drains to reduce surface water ponding means large amounts of nutrients can be washed from soils to waterways and then be transported downstream quickly rather than being assimilated.

Facts and figures

Sampling site code	614063
Catchment area	139 km^2
Per cent cleared area (2015)	79 per cent
River flow	Ephemeral, dries over summer
Main land use (2015)	Beef and sheep grazing

Estimated loads and flow at Nambeelup Brook

614063	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)	20	3.4	11	13	15	1.5	9.2	6.1	9.8	9.7	1.7	4.8	14	16	3.1
TN load (t)	59	10	35	37	43	4.8	28	19	30	30	5.6	16	39	44	10
TP load (t)	11.2	1.99	6.56	7.24	8.11	0.81	5.24	3.45	5.49	5.46	0.92	2.65	7.62	8.64	1.69

Nambeelup Brook

Nitrogen over time (2005–19)

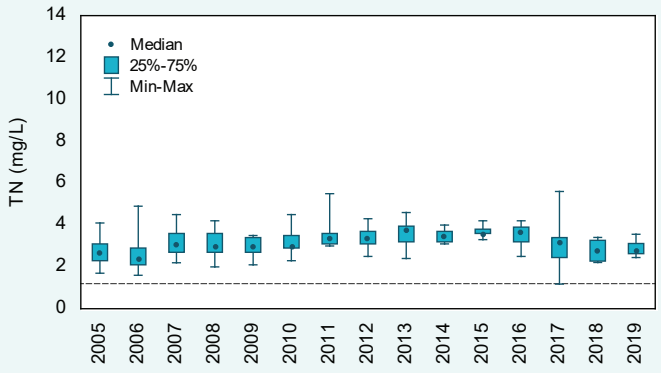
Concentrations

Total nitrogen (TN) concentrations at the Nambeelup Brook sampling site were very high with only one sample in the past 15 years below the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, all years were classified as having very high TN concentrations. Concentrations fluctuated over the reporting period but remained consistently high. Nambeelup Brook had one of the highest TN concentrations of the 13 sites sampled in the Peel-Harvey catchment, with the 2019 median (2.81 mg/L) being the second highest (after the Gull Road Drain site which had a median of 4.69 mg/L).

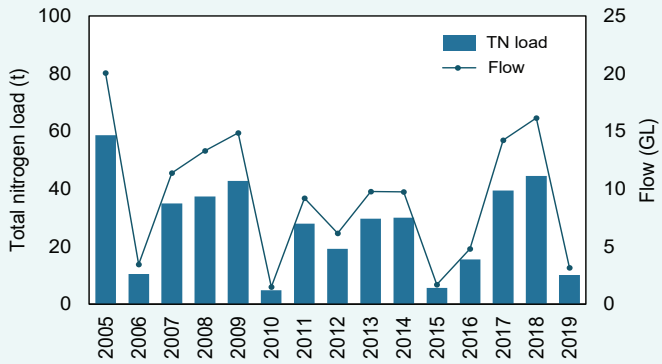
Estimated loads

Estimated TN loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites where it was possible to calculate loads in the Peel-Harvey catchment. In 2019, Nambeelup Brook had an estimated TN load of 10 t, similar to Peel Main Drain which had a load of 9.1 t. The moderate load was driven by the combination of very high TN concentrations and relatively small flow volumes. The load per square kilometre was moderate, 90 kg/km^2 in 2019. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Nambeelup Brook



Total nitrogen concentrations, 2005–19 at site 614063. The dashed line is the protection plan TN target.



Total nitrogen loads and annual flow, 2005–19 at site 614063.

The weir at the Nambeelup Brook sampling site, October 2016.

Nitrogen (2019)

Types of nitrogen

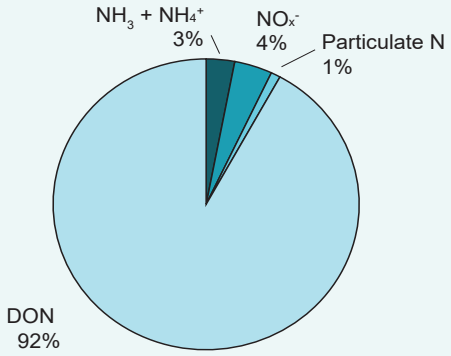
Total N is made up of different types of N. At the Nambeelup Brook sampling site, most of the N was present as dissolved organic N (DON) which consists mainly of degrading plant and animal matter but may also include other types. Most types of DON need to be further broken down to become available to plants and algae, though some types are readily bioavailable. Only a very small portion of N was present as dissolved inorganic N (DIN – consisting of nitrate, NO_x^- and total ammonia, $NH_3 + NH_4^+$).

Concentrations

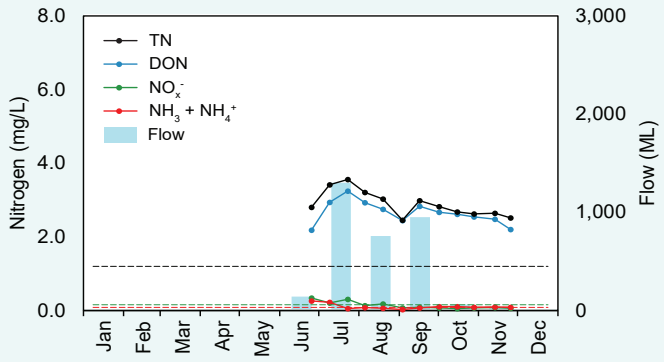
Total N and DON showed some evidence of a seasonal pattern in 2019, increasing in June, shortly after the brook started flowing before peaking in July and then falling over the rest of the year. TN was consistently over the protection plan water quality target whereas both total ammonia and nitrate only exceeded their Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values for about half to a quarter of the year respectively. Nitrate and total ammonia were both highest shortly after the brook started to flow. It is likely much of the nitrate was the result of mineralisation of organic N in soils and drains over the summer period as well as runoff of high-concentrations waters from agricultural land which builds up with fertiliser and animal waste over the summer. Much of the N present was organic (as DON) and likely washed from rewetting remnant wetlands in the catchment and other sources such as degrading plant and animal matter from agricultural land use.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



2019 average nitrogen fractions at site 614063.



2019 nitrogen concentrations and monthly flow at 614063. The black dashed line is the protection plan TN target, the red and green lines are the ANZECC trigger values for total ammonia and nitrate.

Nambeelup Brook completely dry at the sampling site, March 2011.

Nambeelup Brook

Phosphorus over time (2005–19)

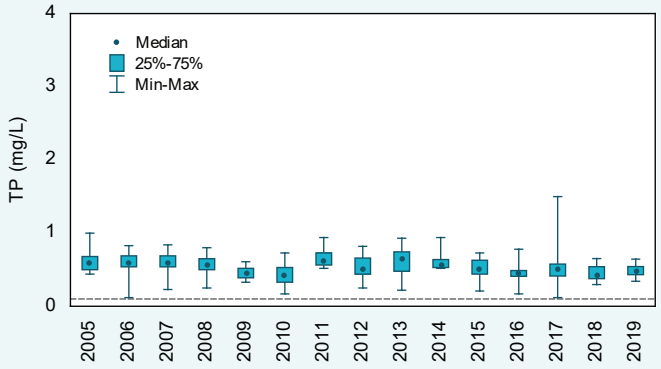
Concentrations

Total phosphorus (TP) concentrations were very high at the Nambeelup Brook sampling site, with all samples collected during the reporting period over the protection plan water quality target for TP concentrations. Further, all years were classified as having very high TP concentrations using the SWRWQA methodology. Concentrations fluctuated over the reporting period.

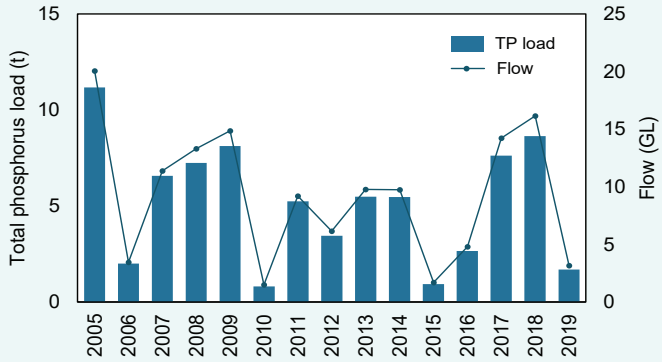
Estimated loads

Estimated TP loads at the Nambeelup Brook sampling site were large compared with the other 10 sites where it was possible to calculate loads in the Peel-Harvey catchment. In 2019, the site had an estimated TP load of 1.69 t. The large TP load was driven by the combination of very high TP concentrations and relatively small flow volumes. The load per square kilometre of 15.1 kg/km^2 was the third largest of the Peel-Harvey sites. TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

Nambeelup Brook



Total phosphorus concentrations, 2005–19 at site 614063. The dashed line is the protection plan TP target.



Total phosphorus loads and annual flow, 2005–19 at site 614063.

High nutrient concentrations contribute to excess algal growth like that shown in this photograph in Nambeelup Brook, November 2017.

Phosphorus (2019)

Types of phosphorus

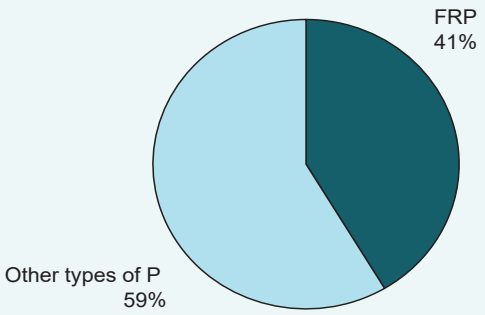
Total P is made up of different types of P. At the Nambeelup Brook sampling site, over a third of the P was present as highly bioavailable phosphate; measured as filterable reactive P (FRP), in surface waters this is mainly present as phosphate (PO_4^{3-}) species. Phosphate is likely sourced from fertilisers and animal waste as well as natural sources. The remaining 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. The bioavailability of DOP varies and is poorly understood.

Concentrations

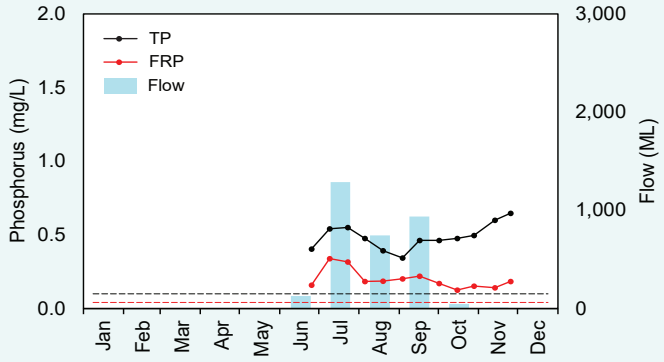
Both TP and phosphate concentrations showed some evidence of a seasonal pattern, increasing from June to July, as rainfall and flow increased. This suggests P was being washed into the brook at this time via surface flows from waterlogged paddocks, as well as any P present in the brook, after it dried over the warmer months, being mobilised. After the peak in July, phosphate concentrations fell during the rest of the year whereas TP fell and then slowly increased again. The rise later in the year was possibly because of greater inflows of nutrients from lower semi-rural reaches of the catchment. Most of the P at this time was either particulate P or DOP, though it is not possible to determine what proportion of each was present.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



2019 average phosphorus fractions at site 614063.



2019 phosphorus concentrations and monthly flow at 614063. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for phosphate.

Paperbark trees along Nambeelup Brook, July 2019.

Nambeelup Brook

Dissolved organic carbon over time (2005–19)

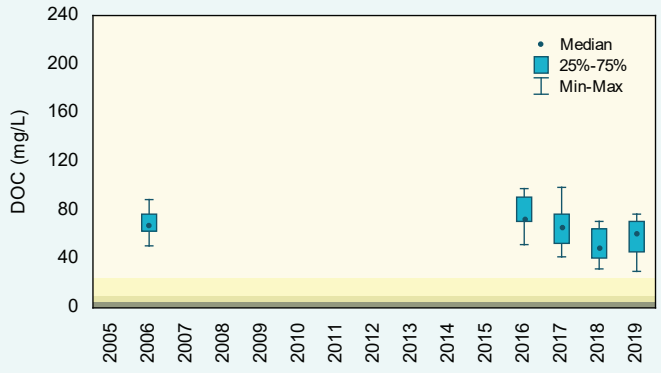
Concentrations

There were only five years with sufficient dissolved organic carbon (DOC) data to graph. Using the SWRWQA methodology, annual DOC concentrations were classified as very high. DOC concentrations appear to have decreased since 2016. Ongoing monitoring will help determine if this is an actual change or just part of the natural fluctuations at this site. Compared with the other sites in the Peel-Harvey catchment, DOC was very high at Nambeelup Brook with the 2019 median being the second highest of the 13 sites sampled (61 mg/L; only the Gull Road Drain site had a higher median of 127 mg/L).

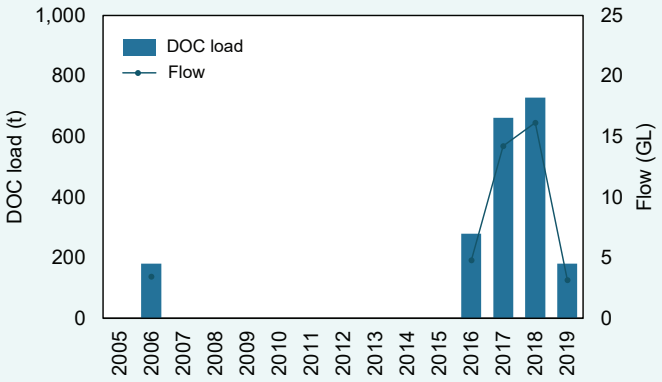
Estimated loads

Estimated DOC loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2019, the estimated DOC load was 180 t. The moderate DOC load was driven by the combination of very high DOC concentrations and relatively small flow volumes. The load per square kilometre of 1,609 kg/km^2 was also moderate compared with the other Peel-Harvey catchment sites. DOC loads were closely related to flow volume; years with large annual flow volumes had large DOC loads and vice versa.

Nambeelup Brook



Dissolved organic carbon concentrations, 2005–19 at site 614063. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2005–19 at site 614063.

low moderate high very high

Grazing pasture in the Nambeelup Brook catchment. Beef and sheep grazing is the dominant land use in this catchment, July 2003.

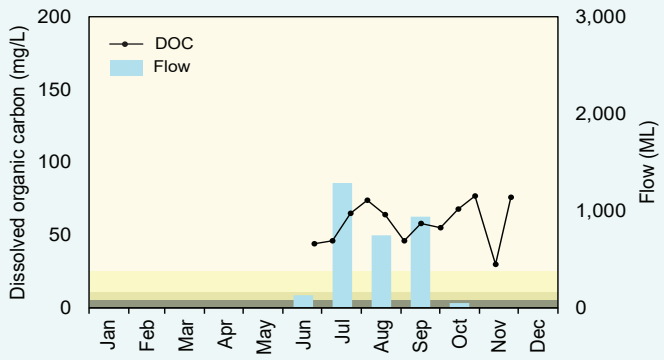
Dissolved organic carbon (2019)

Concentrations

In 2019, all DOC samples collected fell into the very high band of the SWRWQA. There was an initial peak in DOC in early August, suggesting rainfall and flow flushed DOC into the brook from surrounding land use as well as mobilising DOC already present in the dry brook. Concentrations then fell slightly before increasing again from September to October. This pattern reflects the wetting up of the lower catchment, which is dominated by the same soils that generate high DOC concentrations at the Gull Road Drain site. Why there was a dip in DOC concentrations in November is unknown though it did rain in parts of the catchment the preceding day. DOC is sourced mainly from degrading plant and animal matter, including from agricultural land and natural organic matter in soils and wetlands. It varies widely in its bioavailability.

Where there are no data shown on the graph, the drain was not flowing.

Nambeelup Brook



2019 dissolved organic carbon concentrations and monthly flow at 614063. The shading refers to the SWRWQA classification bands.

low moderate high very high

Nambeelup Brook dries over summer. Here there is only a small pool of water left near the sampling site, March 2015.

Nambeelup Brook

Total suspended solids over time (2005–19)

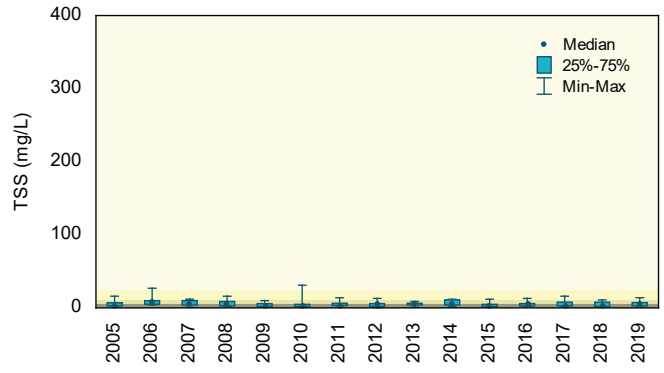
Concentrations

Total suspended solids (TSS) concentrations at the Nambeelup Brook sampling site fluctuated over the reporting period. They were generally low, however, with annual concentrations classified as low using the SWRWQA methodology from 2011 to 2019 and moderate before that. There were only two samples that fell in the very high band (one in 2006 and one in 2010) but, in both instances, they only just fell into this band.

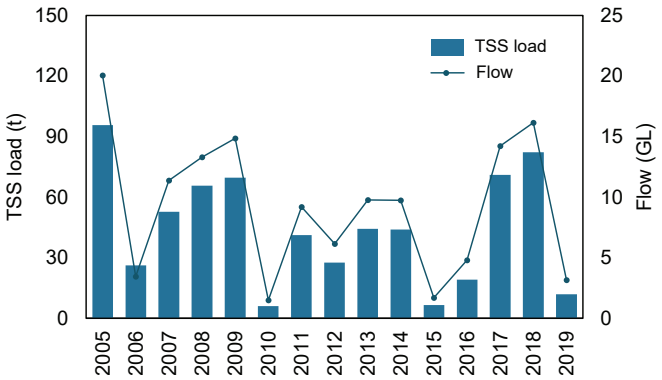
Estimated loads

Estimated TSS loads at the Nambeelup Brook sampling site were moderate compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2019, the estimated TSS load at this site was 12 t. The load per square kilometre of 105 kg/km^2 was also moderate compared with the other Peel-Harvey catchment sites. TSS loads were closely related to flow volume; years with large annual flow volumes had large TSS loads and vice versa.

Nambeelup Brook



Total suspended solids concentrations, 2005–19 at site 614063. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 614063.

low moderate high very high

Taking flow measurements at the Nambeelup Brook sampling site, September 2011.

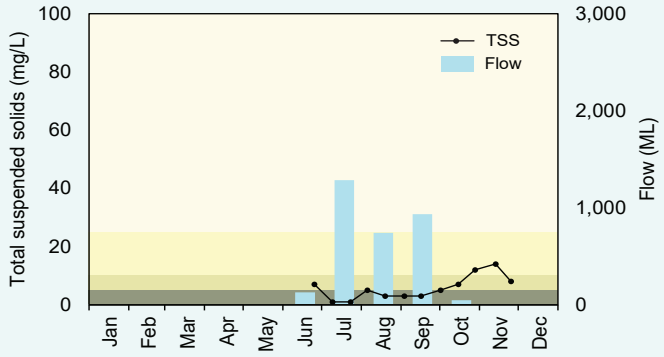
Total suspended solids (2019)

Concentrations

Total suspended solids concentrations showed a slight seasonal pattern, peaking early and late in the flow year. This suggests the onset of winter rains washed particulate matter into the brook from surrounding land use as well as mobilising any that had been deposited into the brook over the drier months when the brook was not flowing. Concentrations then decreased as flow increased before increasing again in November, when the brook started to dry out. This increase could be because of evapoconcentration of particulate matter in the brook at this time, algal growth, or stock accessing the brook upstream of the sampling site.

Where there are no data shown on the graph the brook was not flowing.

Nambeelup Brook



2019 total suspended solids concentrations and monthly flow at 614063. The shading refers to the SWRWQA classification bands.

low moderate high very high

Placing fish and crayfish traps as part of a river health assessment in Nambeelup Brook, November 2017.

Nambeelup Brook

pH over time (2005–19)

pH values

pH at the Nambeelup Brook sampling site fluctuated over the reporting period. All annual medians fell within the upper and lower ANZECC trigger values. The reason why the range in pH was so much larger in 2013 than other years is unknown.

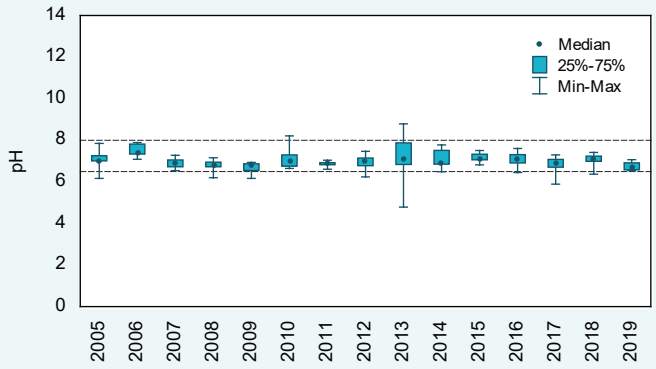
pH (2019)

pH values

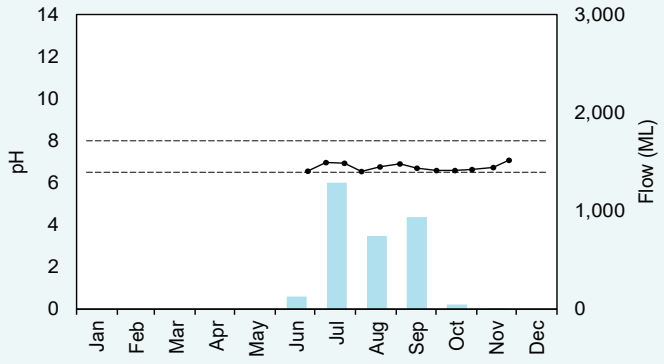
In 2019, all samples fell within the upper and lower ANZECC trigger values. There was no clear evidence of a seasonal pattern in pH values.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



pH levels, 2005–19 at site 614063. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 614063. The dashed lines are the upper and lower ANZECC trigger values.

Nambeelup Brook at the sampling site during high flows, August 2018.

Nambeelup Brook

Salinity over time (2005–19)

Concentrations

Salinity at the Nambeelup Brook sampling site was low. While salinity fluctuated over the reporting period, all years were classified as fresh using the Water Resources Inventory 2014 salinity ranges (note that in 2018, the SWRWQA bands were used).

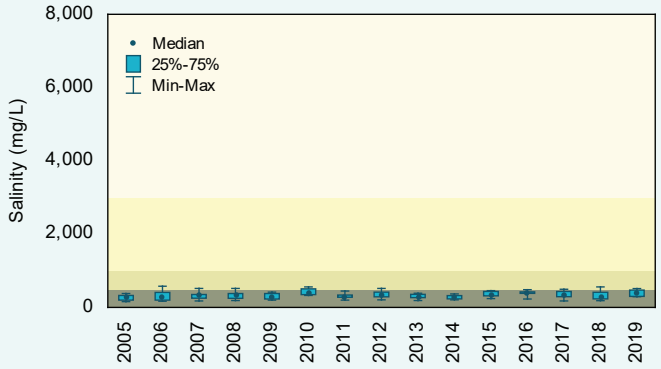
Salinity (2019)

Concentrations

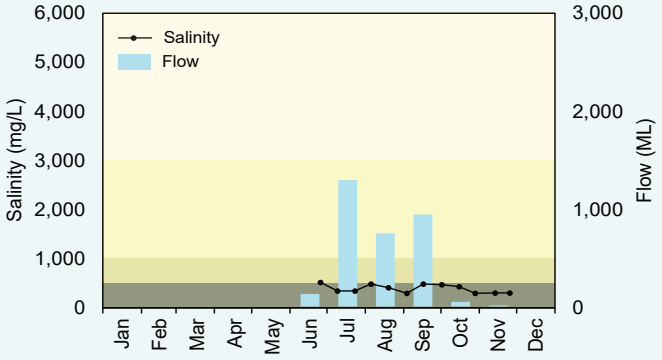
Salinity did not show a seasonal pattern in 2019 at the Nambeelup Brook sampling site, with concentrations fluctuating during the year. Except for the first sample collected in June which fell in the marginal band, all samples were in the fresh band of the Water Resources Inventory 2014 salinity ranges. It is likely most of the salt is entering the brook via surface flow, with groundwater contributing proportionally less.

Where there are no data shown on the graph, the brook was not flowing.

Nambeelup Brook



Salinity concentrations, 2005–19 at site 614063. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at 614063. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

Bushland in the Nambeelup Brook catchment, July 2003.

Naubeelup Brook

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. 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 Peel-Harvey estuary at estuaries.dwer.wa.gov.au/estuary/peel-harvey-estuary/

Healthy Estuaries WA partners with the Peel-Harvey Catchment Council to fund best-practice mangement 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 Peel-Harvey Catchment Council go to peel-harvey.org.au
- To find out more about the health of the rivers in the Peel-Harvey Catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Variables were compared with the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan concentration targets or ANZECC trigger values where available, or the SWRWQA bands or the 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.

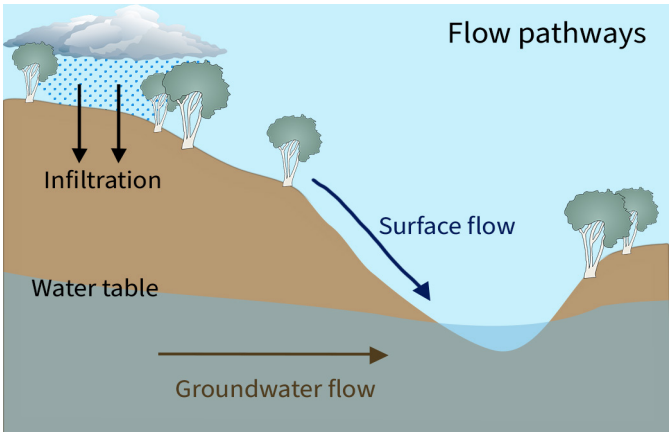
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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.



Naubeelup Brook Issue 2
Publication date: October 2023
ISSN: 2209–6779 (online only)