Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

Meredith Drain

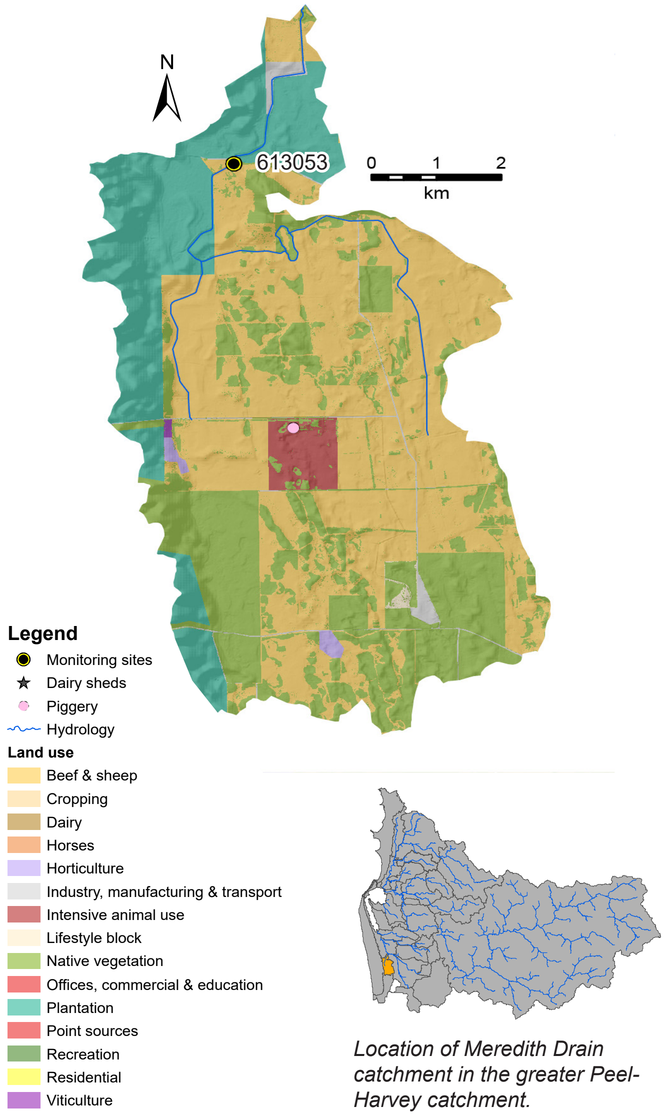
This data report provides a summary of the nutrients at the Meredith Drain sampling site in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of the site, the drain enters the Harvey River and, from there, discharges into the Harvey Estuary. 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

Meredith Drain has a total catchment area of about 53 km^2, about 70 per cent of which has been cleared for agriculture, mainly beef and sheep grazing. A piggery is in the centre of the catchment. Most of the streams have been converted into straight drains and extra drains have been constructed to increase the speed at which water drains from agricultural land. The catchment area upstream of the sampling site is about 49 km^2.

Most of the catchment has soils with 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 613053, Johnston Road, where Meredith Drain passes under Johnston Road in Wagerup.



Location of Meredith Drain catchment in the greater Peel-Harvey catchment.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) were very high at the Meredith Drain sampling site. While nutrient loads were small to moderate, the load per square kilometre was moderate to large (compared with the other Peel-Harvey sites). The combination of the 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 transported downstream quickly rather than being assimilated.

Facts and figures

Sampling site code	613053
Catchment area	53 km^2
Per cent cleared area (2015)	70 per cent
River flow	Permanent
Annual flow (2018)	4.3 GL
Main land use (2015)	Beef and sheep grazing and native vegetation

Meredith Drain

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations in the Meredith Drain were very high, with almost all samples collected over the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value. Concentrations fluctuated over the reporting period.

In 2018, Meredith Drain had a median TN concentration of 2.1 mg/L, the third highest of the 13 sites sampled in the Peel-Harvey catchment and similar to Coolup South Main Drain and Punrak Drain which both had medians of 2.1 mg/L.

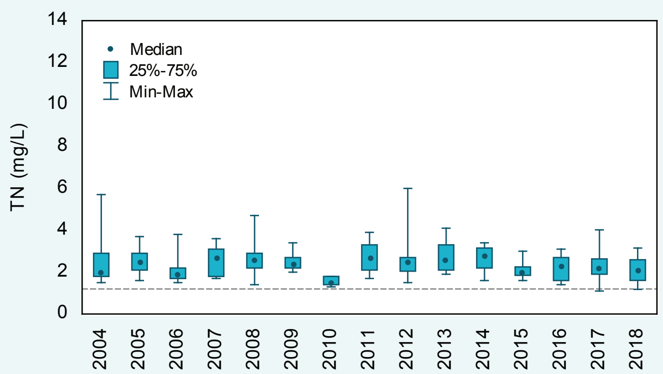
Trends

There were no short- (2014–18) or long-term (2004–18) trends in TP concentrations at the Meredith Drain sampling site.

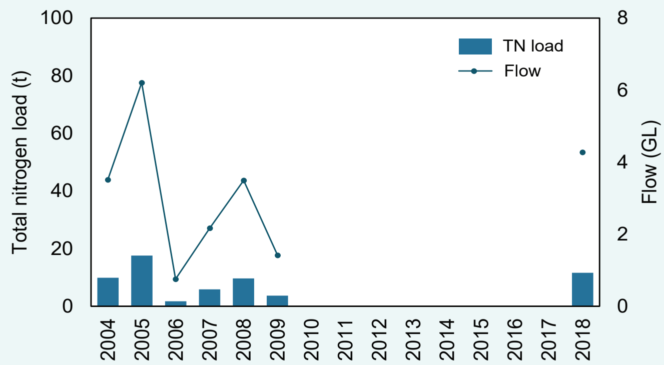
Estimated loads

Estimated TN loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, Meredith Drain had an estimated TN load of 11.6 t, the third smallest of the 10 sites where it was possible to calculate loads. Only the site in the Gull Road Drain (1.3 t) and Coolup South Main Drain (9.6 t) catchments had smaller loads. The 2018 load per unit area was moderate, at 237 kg/km^2. TN loads were closely related to flow volume, years with high annual flow having large TN loads and vice versa.

Meredith Drain



Total nitrogen concentrations, 2004–18 at site 613053. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 613053.

Collecting a water quality sample at the Meredith Drain sampling site, September 2018.

Meredith Drain

Nitrogen (2018)

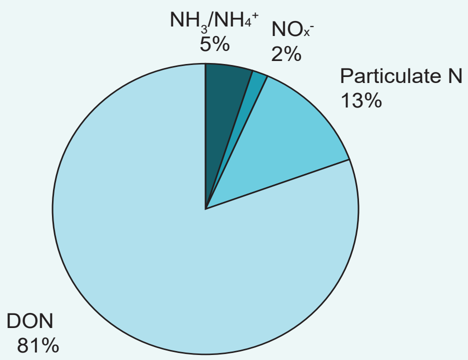
Types of nitrogen

Total N is made up of many different types of N. Meredith Drain had a large proportion of its N present as dissolved organic N (DON). This type of N 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 to become bioavailable. The proportion of N present as highly bioavailable dissolved inorganic N (DIN—consisting of oxides of N, NO_x^-, and ammonia N, NH_3/NH_4^+) was low. These forms of N are often sourced from animal waste and fertilisers.

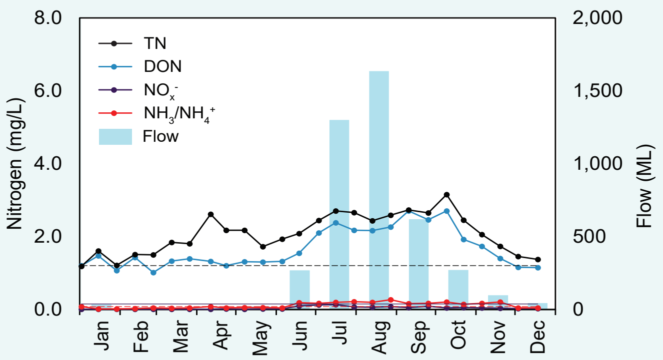
Concentrations

All forms of N showed a seasonal pattern at Meredith Drain, increasing as rainfall and flow increased in June before decreasing again in October. While TN concentrations were over the ANZECC trigger value on all sampling occasions except one (early in January), NH_3/NH_4^+ was only over its trigger value from June to November and NO_x^- was consistently below its trigger value. There was also a small peak in TN concentrations in April. The reason for this peak is unclear though it is likely driven by particulate N as there was a corresponding peak in total suspended solids concentrations at this time. It is likely most of the N is entering the drain via surface flow, with groundwater providing proportionally less N. In-stream sources were also contributing N at this site.

Meredith Drain



2018 average nitrogen fractions at site 613053.



2018 nitrogen concentrations and monthly flow at 613053. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

The Meredith Drain sampling site, where the drain passes under Johnston Road in Wagerup, October 2018.

Meredith Drain

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations were very high, with all annual medians and most samples over the Peel Harvey Water Quality Improvement Plan (WQIP) target. Concentrations fluctuated over the reporting period but appear to be decreasing (as verified by trend testing, see below). Concentrations in 2010 and 2015 were lower than surrounding years, probably because of these being low rainfall years which resulted in most of the catchment not contributing flow during these years.

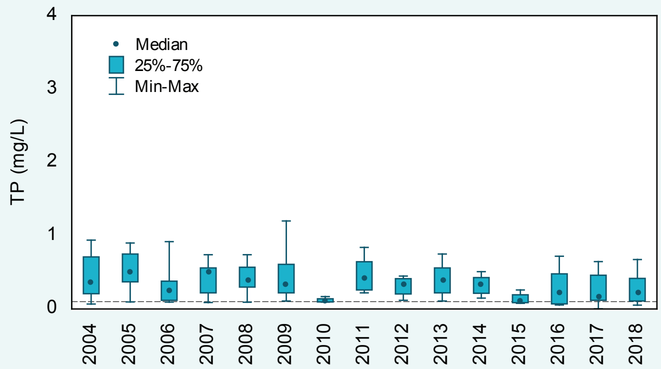
Trends

There was a small long-term (2004–18) decreasing trend in TP concentrations of 0.009 mg/L/yr. This is likely because of Alkaloam that was applied to about 30 per cent of the catchment in the late 1990s. This caused an initial decrease in P concentrations in the late 1990s to early 2000s. The trend seen here is likely because of the run-down of TP in the groundwater that feeds the drain, as a result of the reduced leaching of P from the soils.

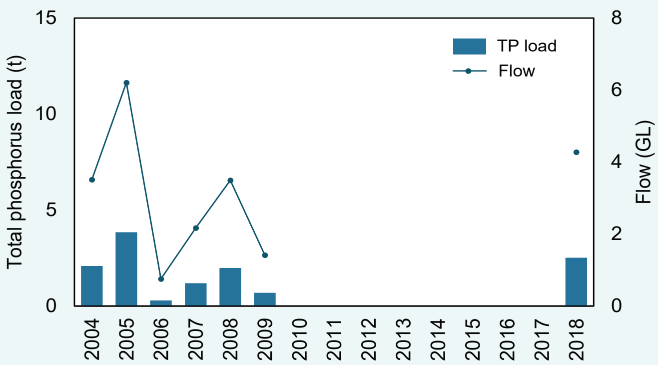
Estimated loads

Estimated TP loads at the Meredith Drain sampling site were small to moderate compared with the other sites in the Peel-Harvey catchment. In 2018, the site had an estimated TP load of 2.5 t, the third smallest TP load of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 51.4 kg/km^2 was moderate compared with the other Peel-Harvey sites. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Meredith Drain



Total phosphorus concentrations, 2004–18 at site 613053. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 613053.

Looking downstream from the sampling site, January 2009. The drain is choked with macrophytes which thrive in the warm, slow-flowing waters found in agricultural drains in summer.

Meredith Drain

Phosphorus (2018)

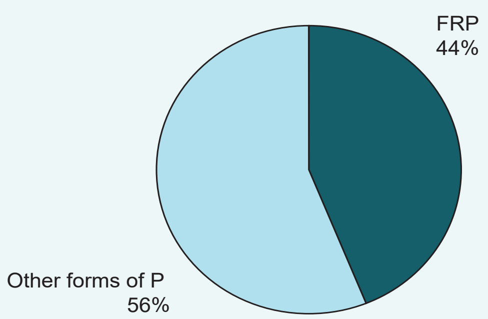
Types of phosphorus

Total P is made up of different types of P. At the Meredith Drain sampling site, just over half of the P was present as either particulate P or 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.

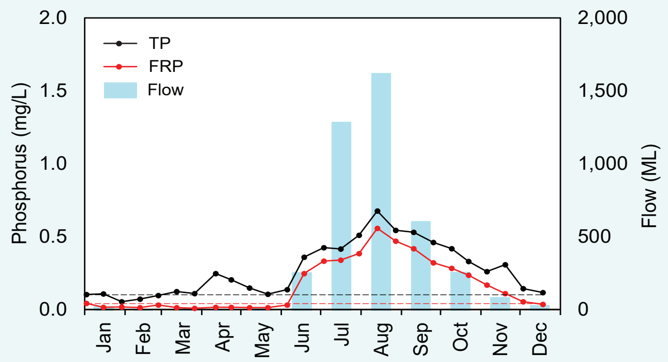
Concentrations

Both TP and FRP showed a seasonal response, increasing in June when rainfall and flow increased, peaking in August when flow was at its highest and then decreasing again for the remainder of the year. FRP concentrations were high, well over the ANZECC trigger value for much of the wetter part of the year. Total P concentrations were also high, above the WQIP target for a large portion of the year. There was also a small peak in TP concentrations in April. The reason for this peak is unclear, though it is likely driven by particulate P as there was a corresponding peak in total suspended solids concentrations at this time. Given the pattern observed in the P data, it is likely that much of the P is entering the drain via surface flow, with groundwater providing proportionally less. In-stream sources were also contributing P.

Meredith Drain



2018 average phosphorus fractions at site 613053.



2018 phosphorus concentrations and monthly flow at 613053. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger values for lowland rivers.

Excess macrophyte growth has been removed from the left bank in the foreground of this picture, leaving an unprotected bank which is prone to erosion in high flows, May 2020.

Dissolved organic carbon over time (2004–18)

Concentrations

There were only three years with sufficient data available to graph at the Meredith Drain sampling site. Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, all three annual medians were classified as very high. While DOC appears to have reduced over the three years, it is not yet possible to test for trends (see Trends section, below). Compared with the other sites sampled in the Peel-Harvey catchment, Meredith Drain had a high DOC concentration with the 2018 median being the third highest of the 13 sites sampled.

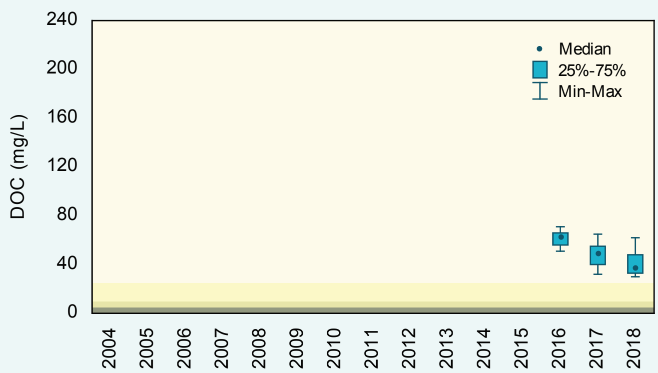
Trends

It was not possible to calculate trends in DOC concentrations at the Meredith Drain site as there were only three years of data present. A minimum of five years of data are required to test for trends.

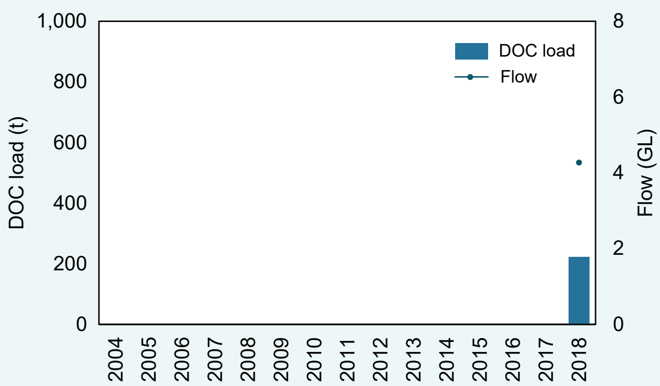
Estimated loads

Estimated DOC loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated DOC load was 222 t, the third smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 4,533 kg/km^2 was moderate compared with the other Peel-Harvey catchment sites, similar to Mayfield Drain with a load per unit area of 4,500 kg/km^2. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Meredith Drain



Dissolved organic carbon concentrations, 2004–18 at site 613053. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2004–18 at site 613053.

very high high moderate low

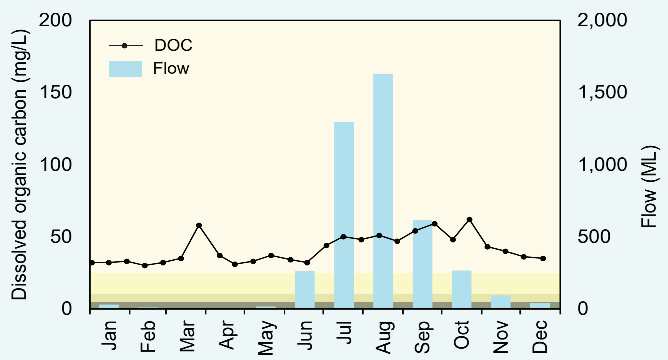
Meredith Drain flowing through grazing paddocks, July 2019.

Dissolved organic carbon (2018)

Concentrations

In 2018, all samples collected at the Meredith Drain sampling site fell into the very high band of the SWRWQA classification bands. There was a seasonal pattern present, with DOC concentrations being high during the months when rainfall and flow were greater. This suggests much of the DOC is entering the drain via surface runoff and groundwater as well as in-stream sources. The reason for the peak in DOC concentrations in late March is unknown. DOC is sourced mainly from degrading plant and animal matter, including natural organic matter in soils and wetlands, with many wetlands on deep sands typically generating high DOC concentrations. It varies widely in its bioavailability.

Meredith Drain



2018 dissolved organic carbon concentrations and monthly flow at 613053. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

A staff gauge at the Meredith Drain sampling site, May 2020.

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA classification bands, the annual medians were classed as low in most years, with only two years classed as moderate (2006 and 2015). Most years had some samples that fell within the high and very high bands.

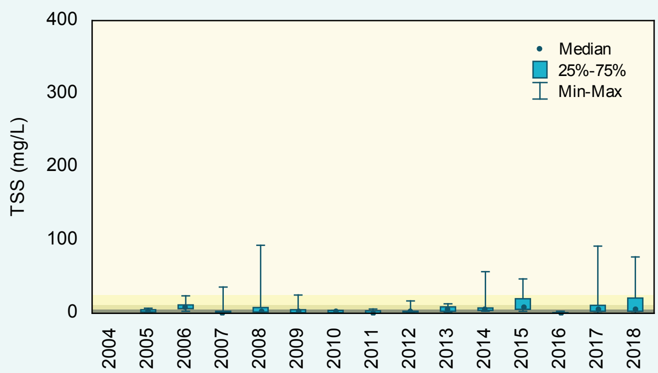
Trends

There was no trend in TSS concentrations at Meredith Drain over either the short- (2014–18) or long-term (2005–18).

Estimated loads

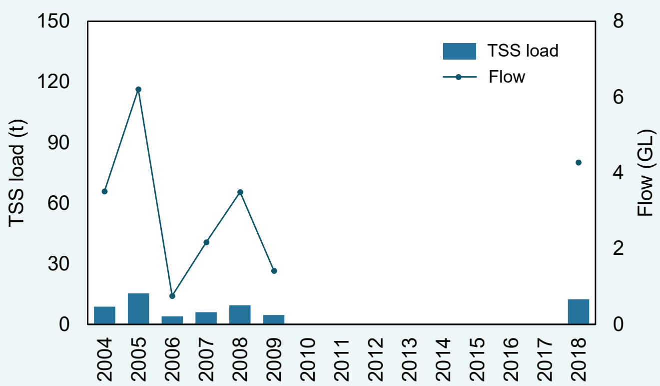
Estimated TSS loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated TSS load at this site was 12 t, the second smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 254 kg/km^2 was small to moderate compared with the other Peel-Harvey catchment sites; only the Gull Road Drain sampling site had a smaller load per unit area of 68 kg/km^2. TSS loads were closely related to flow volume, years with high annual flow having large TSS loads and vice versa.

Meredith Drain



Total suspended solids concentrations, 2004–18 at site 613053. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low



Total suspended solids loads and annual flow, 2004–18 at site 613053.

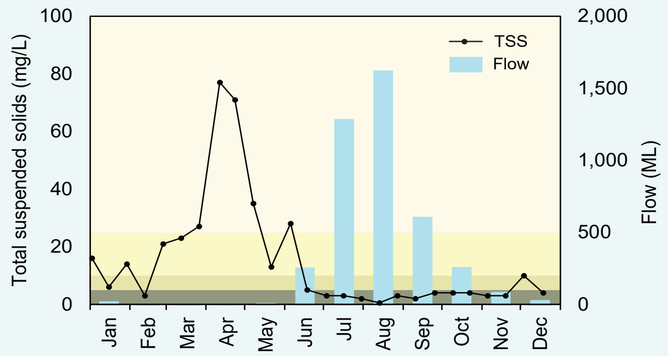
A pine plantation along the edge of Meredith Drain. Plantations cover about 20 per cent of the Meredith Drain catchment, May 2020.

Total suspended solids (2018)

Concentrations

TSS showed a reverse seasonal pattern in Meredith Drain, being highest in the first half of the year when rainfall and flow were lowest and lower during the wetter months when flow was at its highest. TSS concentrations were possibly higher at this time as more stock were accessing the drain for water, though there was no corresponding peak in DIN concentrations (which is often observed as stock tend to defecate and urinate in or near the drain when they access it). The peak may also have been because of an increase in algal growth.

Meredith Drain



2018 total suspended solids concentrations and monthly flow at 613053. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

Removing particulate matter and sediments which have settled in front of the gauging station at Meredith Drain, May 2020.

Meredith Drain

pH over time (2004–18)

pH values

pH fluctuated over the reporting period at the Meredith Drain sampling site. Annual medians were between the upper and lower ANZECC trigger values each year except for 2008, 2009, 2011 and 2016 when they were below the lower trigger value. Most years had at least some samples below the lower trigger value and, in 2011, all samples collected were below the lower trigger value.

Trends

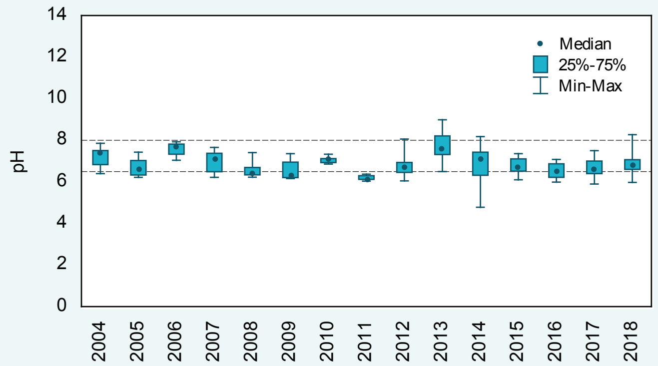
There was no trend in pH at Meredith Drain over either the short- (2014–18) or long-term (2004–18).

pH (2018)

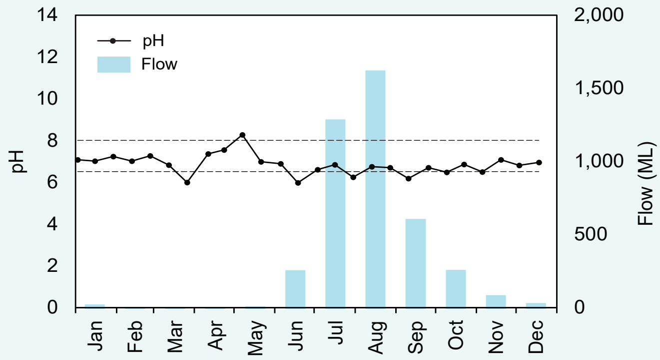
pH values

In 2018, pH values fluctuated at the Meredith Drain sampling site. There was more variation in values in the first half of the year, when flow was lower and it is likely groundwater was contributing a larger proportion of the water present in the drain, as well as in-stream sediment and biological processes having a greater effect at this time. With the exception of two samples (one in March and one in June) that were below the lower ANZECC trigger value, most of the samples in the first half of the year were higher than those collected in the second half of the year.

Meredith Drain



pH levels, 2004–18 at site 613053. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 613053. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Taking flow measurements at Meredith Drain, August 2017.

Meredith Drain

Salinity over time (2004–18)

Concentrations

Salinity in Meredith Drain was consistently low, with only one sample (collected in 2004) classified as marginal using the SWRWQA classification bands. All other samples were classified as fresh.

Trends

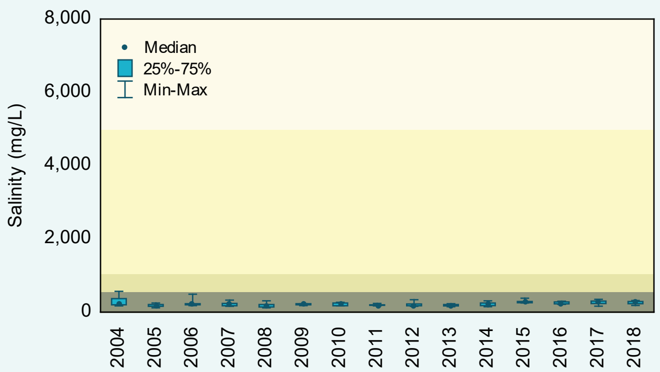
There was no trend in salinity at Meredith Drain over either the short- (2014–18) or long-term (2004–18).

Salinity (2018)

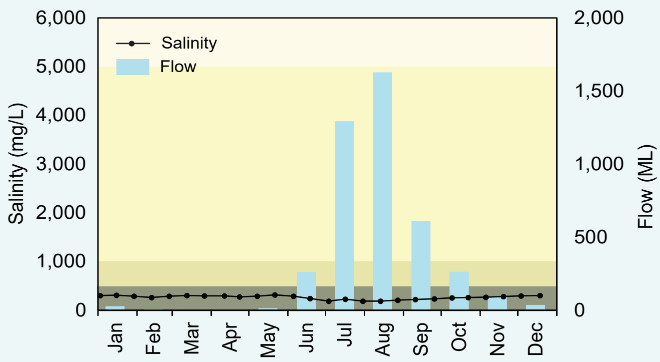
Concentrations

There was a very slight seasonal pattern present in salinity at Meredith Drain. Concentrations were marginally higher at the start of the year, when rainfall and flow were at their lowest. In June, when flow started to increase, salinity dropped slightly. This continued into August when flow was at its highest, before slowly increasing as flow decreased. This suggests that the groundwater at Meredith Drain is marginally more saline than the surface water. It is worth noting, however, that all samples collected were classified as fresh using the SWRWQA.

Meredith Drain



Salinity concentrations, 2004–18 at site 613053. The shading refers to the SWRWQA classification bands.



2018 salinity and monthly flow at 613053. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

The weir at the Meredith Drain sampling site with low flows, January 2009.

Meredith Drain

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

The Regional Estuaries Initiative partners with the Peel-Harvey Catchment Council to fund best-practice fertilisers, 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 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

Total phosphorus concentrations were compared with the Peel Harvey WQIP target. This target represents the median winter concentration that is required for each of the subcatchments to meet their load reduction target. Where possible, other 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 DOC, 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.

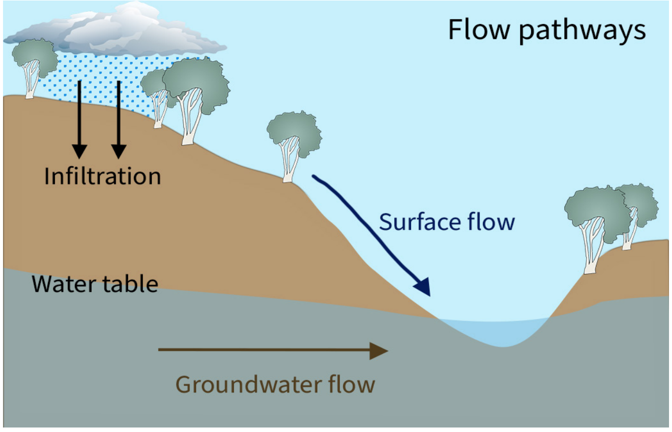
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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