# Meredith Drain

This data report provides a summary of the nutrients at the Meredith Drain 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 drain enters the Harvey River and, from there, discharges into the Harvey Estuary.

## About the catchment

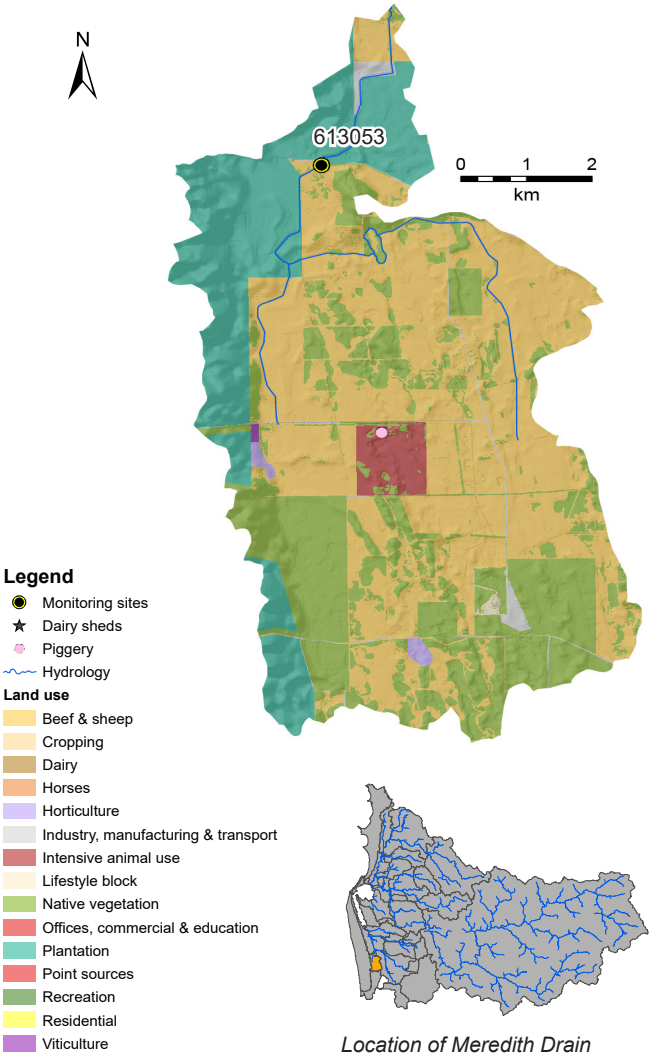
Meredith Drain has a total catchment area of about 53 km$^2$, about 70 per cent of which has been cleared for agriculture, mainly beef and sheep grazing. A piggery is in the centre of the catchment. Most of the streams have been converted into straight drains and extra drains have been constructed to 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 or leached into drains and other waterways.

Water quality is monitored at site 613053, Johnston Road, where Meredith Drain passes under Johnston Road in Wagerup.

## Results summary

Nutrient concentrations (total nitrogen and total phosphorus) were classified as very high at the Meredith Drain sampling site. Nutrient loads were small to moderate and the load per square kilometre were moderate (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.






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

## Facts and figures

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

## Estimated loads and flow at Meredith Drain

| 613053 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow (GL) | 6.2 | 0.8 | 2.2 | 3.5 | 1.4 | | | | | | | | | 4.3 | 1.4 |
| TN load (t) | 18 | 1.7 | 5.9 | 9.7 | 3.7 | | | | | | | | | 12 | 3.6 |
| TP load (t) | 3.85 | 0.29 | 1.18 | 1.98 | 0.69 | | | | | | | | | 2.52 | 0.62 |

# Meredith Drain

## Nitrogen over time (2005–19)

### Concentrations

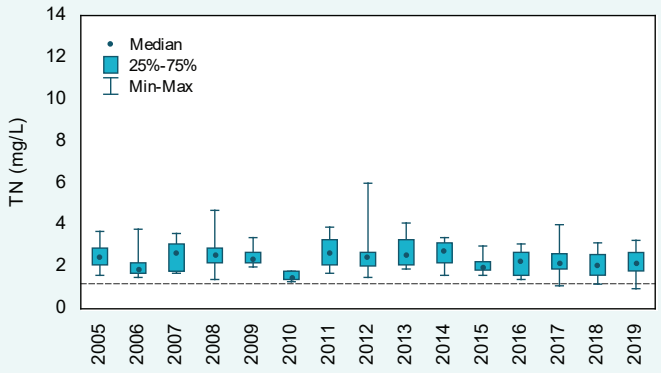
Total nitrogen (TN) concentrations in the Meredith Drain were very high with all years classified as having very high concentrations using the State Wide River Water Quality Assessment (SWRWQA) methodology. Further, almost all samples collected were over the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations. Concentrations fluctuated over the reporting period.

In 2019, Meredith Drain had a median TN concentration of 2.16 mg/L, the fourth highest of the 13 sites sampled in the Peel-Harvey catchment and similar to Punrak Drain which had a median of 2.33 mg/L.

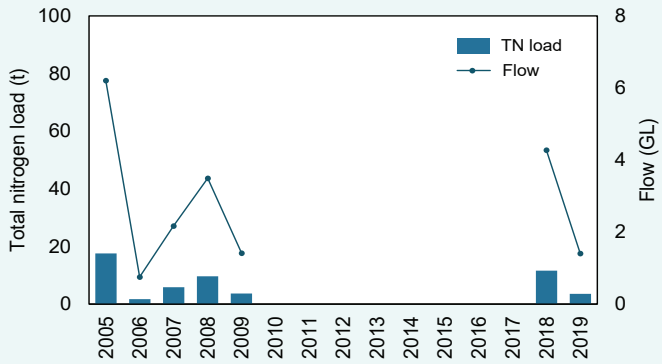
### Estimated loads

Estimated TN loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, Meredith Drain had an estimated TN load of 3.6 t, the third smallest of the 10 sites where it was possible to calculate loads. Only the site in the Gull Road Drain (0.3 t) and Coolup South Main Drain (3.1 t) catchments had smaller loads. The small TN loads at Meredith Drain were driven by the small flow volumes at this site; TN concentrations were very high. The 2019 load per square kilometre was moderate, at 73 kg/km$^2$. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

## Meredith Drain




*Total nitrogen concentrations, 2005–19 at site 613053. The dashed line is the protection plan TN target.*




*Total nitrogen loads and annual flow, 2005–19 at site 613053.*

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

# Meredith Drain

## Nitrogen (2019)

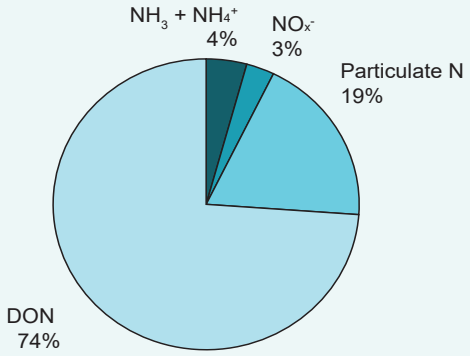
### Types of nitrogen

Total N is made up of 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 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 to become bioavailable. The proportion of N present as highly bioavailable dissolved inorganic N (DIN – consisting of nitrate, $NO_x^-$, and total ammonia, $NH_3 + NH_4^+$) was low. These types of N are often sourced from animal waste and fertilisers.

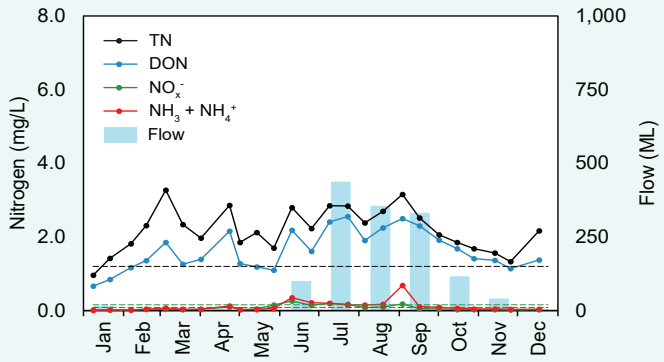
### Concentrations

Nitrate, total ammonia and, to a lesser extent, TN and DON showed a seasonal pattern at Meredith Drain, generally being highest when rainfall and flow were at their greatest. There were multiple peaks in TN and DON concentrations during the year, the reason for which are unclear. It is possible that different parts of the catchment were contributing different proportions of flow (and nutrients) at different parts of the year. The small dip in TN and DON in August was probably the result of a dry spell which caused parts of the catchment to dry out, therefore no longer contributing nutrients. This dip was present at many of the Peel-Harvey catchment sites in both N and phosphorus concentrations. TN concentrations were over the protection plan water quality target on all sampling occasions except one (early in January). During the year it is likely most of the N was entering the drain via both surface flow and groundwater, with in-stream sources also contributing N.

## Meredith Drain




*2019 average nitrogen fractions at site 613053.*




*2019 nitrogen concentrations and monthly flow at 613053. 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.*

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

# Meredith Drain

## Phosphorus over time (2005–19)

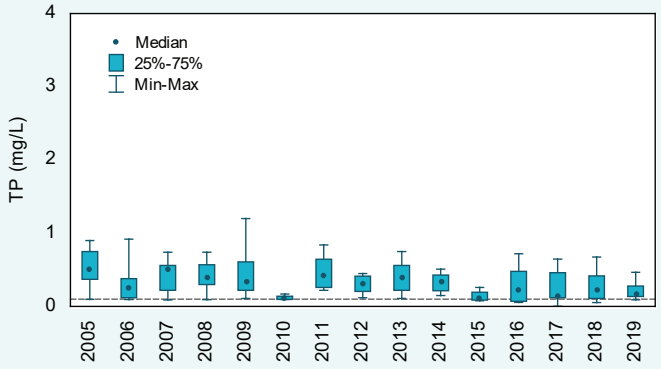
### Concentrations

Total phosphorus (TP) concentrations were very high, with all annual medians and most samples over the protection plan water quality target for TP concentrations. Using the SWRWQA methodology, all years were classified as having very high TP concentrations. Concentrations fluctuated over the reporting period but appear to be decreasing. Both 2010 and 2015 had lower TP concentrations, possibly because of reduced flows these years.

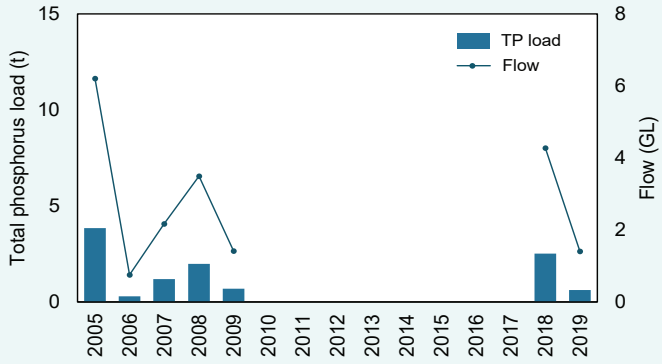
### Estimated loads

Estimated TP loads at the Meredith Drain sampling site were small to moderate compared with the other sites in the Peel-Harvey catchment. In 2019, the site had an estimated TP load of 0.62 t, the third smallest TP load of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The relatively small TP load was driven by the small flow volumes at this site; TP concentrations were very high. In 2019, Meredith Drain had the second smallest flow volume (1.4 GL) with only Gull Road Drain having a smaller volume (0.1 GL). The load per square kilometre of 12.6 kg/km$^2$ was moderate compared with the other Peel-Harvey sites. TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

## Meredith Drain




*Total phosphorus concentrations, 2005–19 at site 613053. The dashed line is the protection plan TP target.*




*Total phosphorus loads and annual flow, 2005–19 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 (2019)

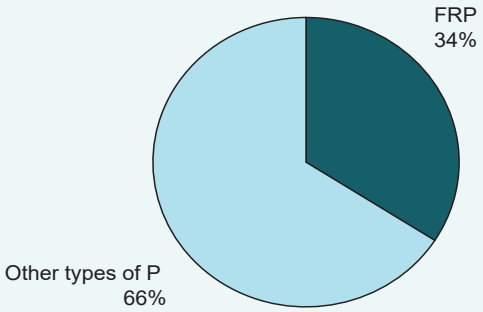
### Types of phosphorus

Total P is made up of different types of P. At the Meredith Drain sampling site, about two-thirds of the P was present as either particulate P or 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.

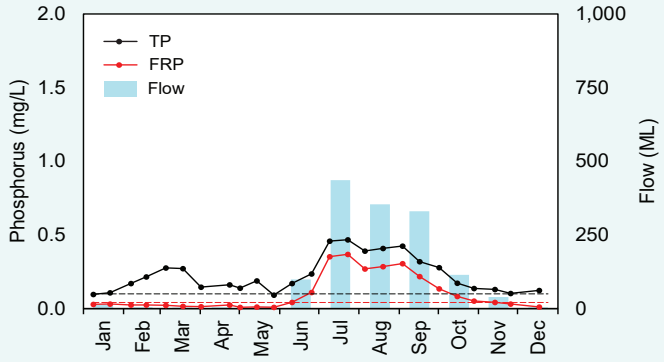
### Concentrations

Both TP and phosphate showed a seasonal response, increasing in June when rainfall and flow increased, peaking in July when flow was at its highest and then decreasing again for the remainder of the year. Phosphate 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 protection plan water quality target for a large portion of the year. There was also a small peak in TP concentrations in March. The reason for this peak is unclear, though it was likely driven by particulate P because 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 was entering the drain via surface flow, with groundwater providing proportionally less. In-stream sources were also contributing P.

## Meredith Drain




*2019 average phosphorus fractions at site 613053.*




*2019 phosphorus concentrations and monthly flow at 613053. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for phosphate.*

*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.*

# Meredith Drain

## Dissolved organic carbon over time (2005–19)

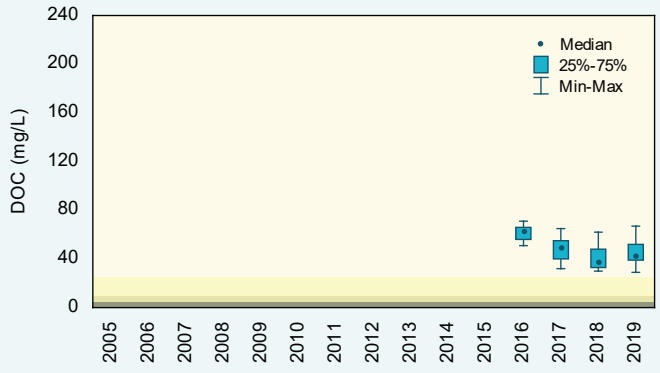
### Concentrations

There were only four years with sufficient dissolved organic carbon (DOC) data available to graph at the Meredith Drain sampling site. Using the SWRWQA methodology, DOC concentrations were classified as very high. Compared with the other sites sampled in the Peel-Harvey catchment, Meredith Drain had a high DOC concentration with the 2019 median being the third highest of the 13 sites sampled.

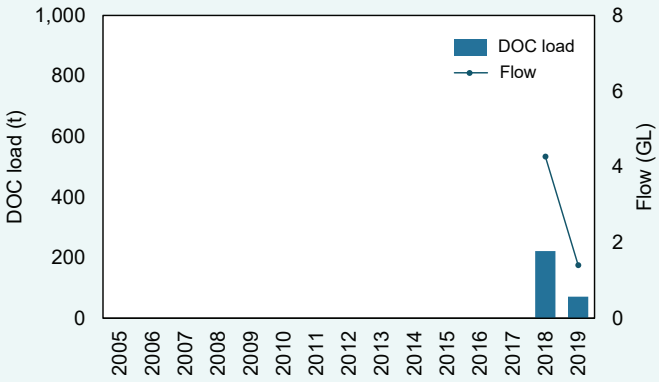
### Estimated loads

Estimated DOC loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, the estimated DOC load was 72 t, the third smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The small DOC load was driven by the small flow volumes at this site; DOC concentrations were very high. In 2019, Meredith Drain had the second smallest flow volume (1.4 GL) with only Gull Road Drain having a smaller volume (0.1 GL). The load per square kilometre of 1,462 kg/km$^2$ was 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.

## Meredith Drain




*Dissolved organic carbon concentrations, 2005–19 at site 613053. The shading refers to the SWRWQA classification bands.*




*Dissolved organic carbon loads and annual flow, 2005–19 at site 613053.*

low moderate high very high

*Meredith Drain flowing through grazing paddocks, July 2019.*

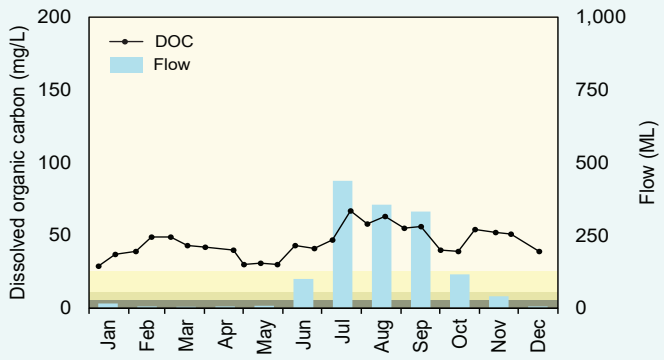
# Meredith Drain

## Dissolved organic carbon (2019)

### Concentrations

In 2019, 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. 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.

## Meredith Drain




*2019 dissolved organic carbon concentrations and monthly flow at 613053. The shading refers to the SWRWQA classification bands.*

low moderate high very high

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

# Meredith Drain

## Total suspended solids over time (2005–19)

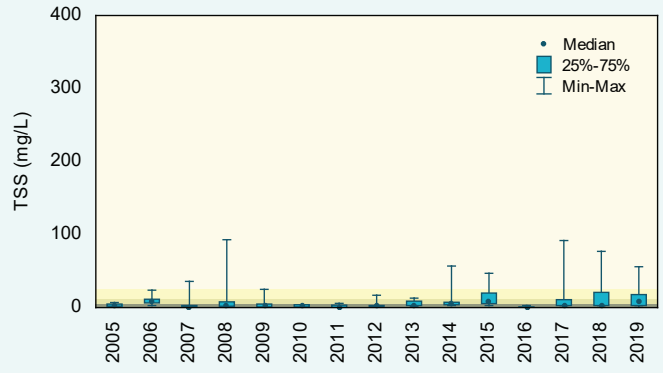
### Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA methodology, all annual TSS concentrations were classified as low, with the exception of 2015–17 which were classified as moderate. Most years had some samples that fell within the high and very high bands.

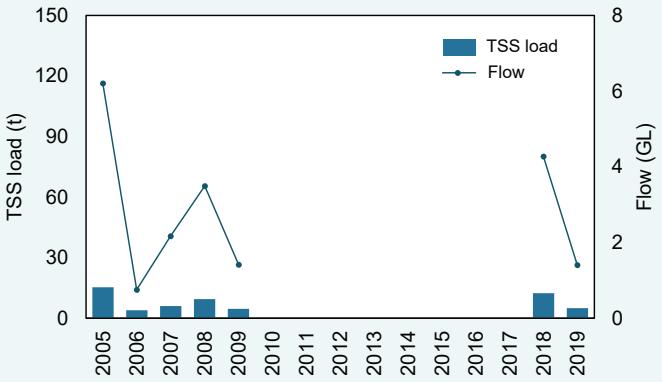
### Estimated loads

Estimated TSS loads at the Meredith Drain sampling site were small compared with the other sites in the Peel-Harvey catchment. In 2019, the estimated TSS load at this site was 5 t, the second smallest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The small TSS load was caused by a combination of the low TSS concentrations and small flow volumes at this site. The load per square kilometre of 103 kg/km$^2$ was 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.

## Meredith Drain




*Total suspended solids concentrations, 2005–19 at site 613053. The shading refers to the SWRWQA classification bands.*




*Total suspended solids loads and annual flow, 2005–19 at site 613053.*

low moderate high very high

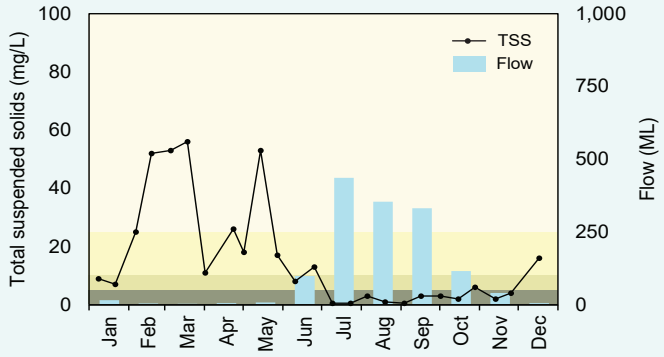
*A pine plantation along the edge of Meredith Drain. Plantations cover about 20 per cent of the Meredith Drain catchment, May 2020.*

## Total suspended solids (2019)

### 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 or macrophyte growth.

## Meredith Drain




*2019 total suspended solids concentrations and monthly flow at 613053. The shading refers to the SWRWQA classification bands.*

low moderate high very high

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

# Meredith Drain

## pH over time (2005–19)

### pH values

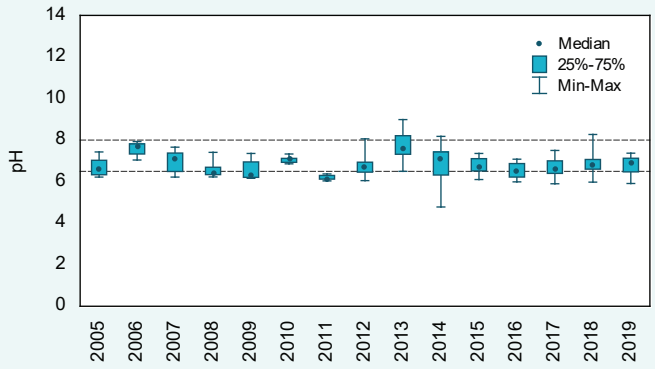
pH fluctuated over the reporting period at the Meredith Drain sampling site. Annual medians were between the upper and lower ANZECC trigger values each year except for 2008, 2009, 2011 and 2016 when they were below the lower trigger value. Most years had at least some samples below the lower trigger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

## pH (2019)

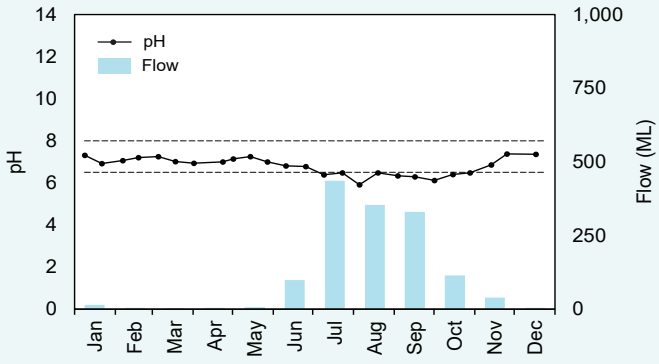
### pH values

In 2019, pH values fluctuated at the Meredith Drain sampling site with some evidence of a seasonal pattern. pH was generally lower during the wetter part of year, suggesting that the surface water is slightly more acidic than the groundwater at this site.

## Meredith Drain




*pH levels, 2005–19 at site 613053. The dashed lines are the upper and lower ANZECC trigger values.*




*2019 pH levels and monthly flow at 613053. The dashed lines are the upper and lower ANZECC trigger values.*

*Taking flow measurements at Meredith Drain, August 2017.*

# Meredith Drain

## Salinity over time (2005–19)

### Concentrations

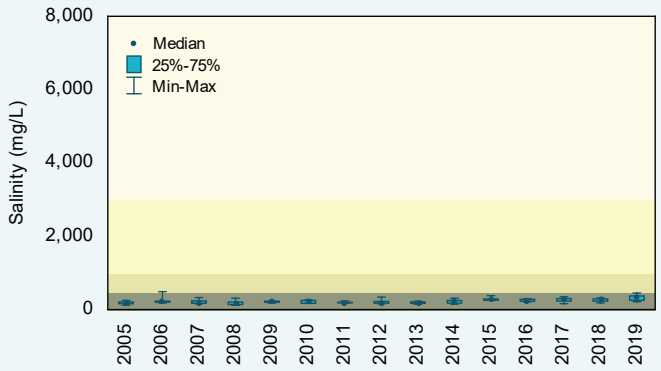
Salinity in Meredith Drain was consistently low. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh (note, in 2018 the SWRWQA classification bands were used).

## Salinity (2019)

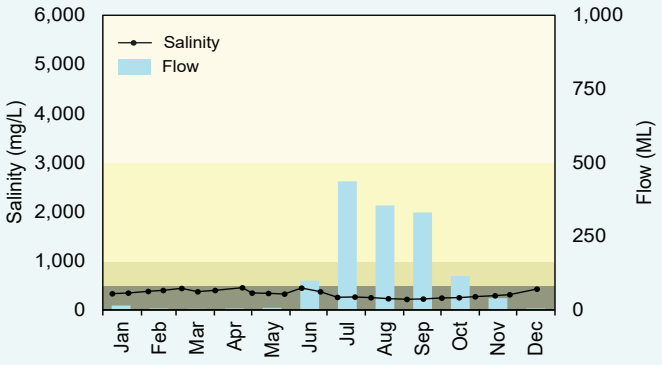
### Concentrations

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 September before concentrations increased again. This suggest that the groundwater is slightly more saline than the surface water at this site.

## Meredith Drain




*Salinity concentrations, 2005–19 at site 613053. The shading refers to the Water Resources Inventory 2014 salinity ranges.*




*2019 salinity and monthly flow at 613053. The shading refers to the Water Resources Inventory 2014 salinity ranges.*

fresh marginal brackish saline

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

# Meredith Drain

## 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 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 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.

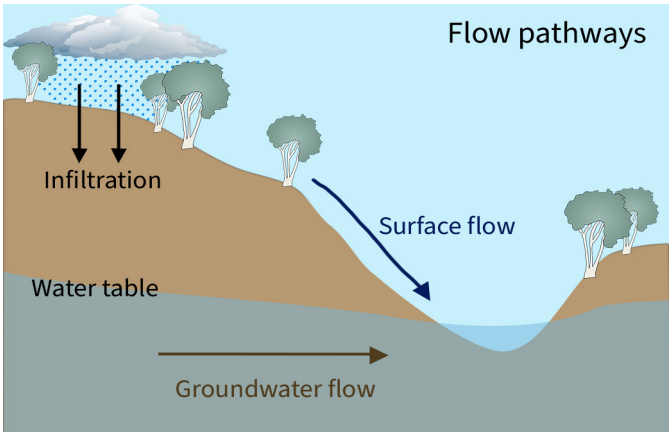
**Laboratory limit of reporting**: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

**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.






Meredith Drain Issue 2
Publication date: October 2023
ISSN: 2209–6779 (online only)