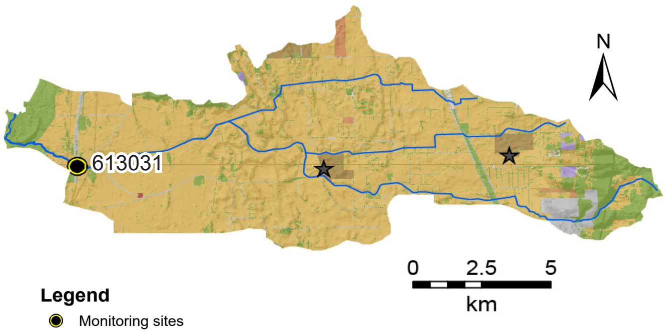
Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

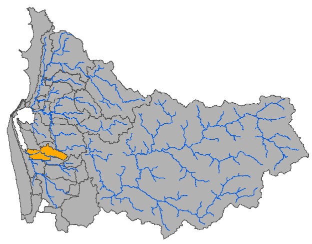
Peel-Harvey estuary catchment nutrient report 2019

HEALTHY ESTUARIES WA

Mayfield Drain

This data report provides a summary of the nutrients at the Mayfield 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 discharges into the Harvey Estuary.





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

About the catchment

Mayfield Drain has a catchment area of about 122 km^2, more than 80 per cent of which has been cleared for agriculture, predominantly beef and sheep grazing. There are two dairy sheds present in the catchment. Apart from Mayfield Drain, there are numerous other small drains which were constructed to quickly drain water from agricultural land to the main drains. The area upstream of the sampling site is about 112 km^2.

Most of the catchment has soils with a good capacity to bind phosphorus. This means that any phosphorus applied to them tends to bind to the soils, reducing the amount entering waterways.

Water quality is monitored at site 613031, Old Coast Road, just upstream of where the drain passes under Forrest Highway in Waroona.

Results summary

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

Facts and figures

Sampling site code	613031
Catchment area	122 km^2
Per cent cleared area (2015)	84 per cent
River flow	Permanent
Main land use (2015)	Beef and sheep grazing

Estimated loads and flow at Mayfield Drain

613031	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)		3.4					11	9.8	22	13	1.9	12	17	24	8.5
TN load (t)		5.6					20	17	39	25	2.4	22	30	41	15
TP load (t)		0.76					2.81	2.29	5.74	3.26	0.25	2.88	4.64	6.37	2.17

Mayfield Drain

Nitrogen over time (2005–19)

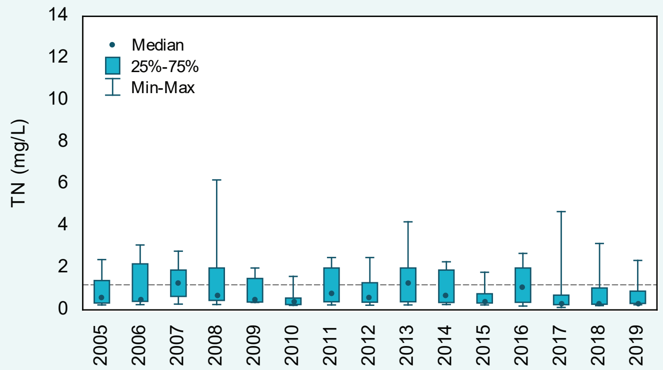
Concentrations

Total nitrogen (TN) concentrations fluctuated over the reporting period at the Mayfield Drain sampling site. The annual median TN concentrations were below the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations in all years except 2007 and 2013, when they were just above. However, each year recorded some samples above the water quality target. Using the State Wide River Water Quality Assessment (SWRWQA) methodology, all years were classified as having low TN concentrations.

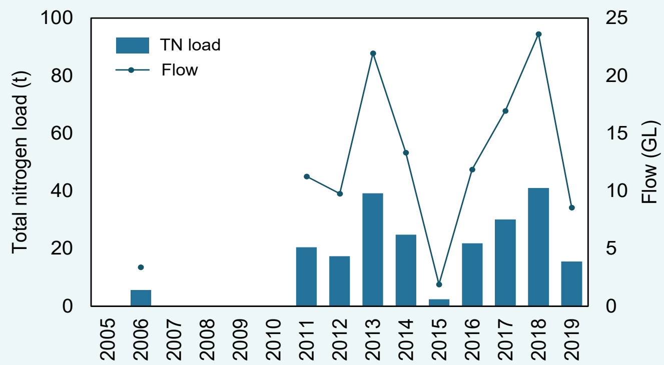
Estimated loads

Estimated TN loads at the Mayfield Drain sampling site were large compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2019, Mayfield Drain had an estimated TN load of 15 t, the fourth largest of the Peel-Harvey catchment sites. The load per square kilometre was also large in 2019, at 138 kg/km^2, the second largest of the Peel-Harvey catchments. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Mayfield Drain



Total nitrogen concentrations, 2005–19 at site 613031. The dashed line is the protection plan TN target.



Total nitrogen loads and annual flow, 2005–19 at site 613031.

The Mayfield Drain sampling site, April 2018

Mayfield Drain

Nitrogen (2019)

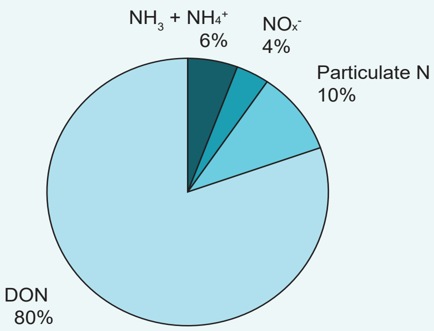
Types of nitrogen

Total N is made up of different types of N. Mayfield 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.

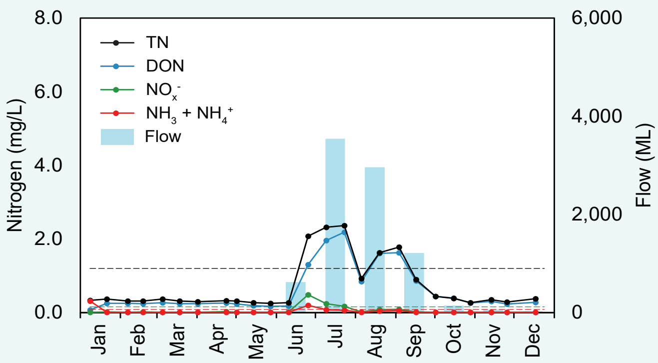
Concentrations

All types of N exhibited a seasonal response, increasing in June after the onset of winter rains before decreasing again later in the year. The peak in June was likely because of a first flush effect where N was mobilised following heavy rainfall. Much of this N was in an organic form, washed from agricultural soils and remnant wetlands where it had built up over the summer period. A small part of the first flush was because of mineralisation of organic N in soils and drains, also over the summer period. The dip in TN, DON and nitrate 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. Over the year, it is probable that most of the N was entering the drain via surface water runoff, with groundwater contributing proportionally less N.

Mayfield Drain



2019 average nitrogen fractions at site 613031.



2019 nitrogen concentrations and monthly flow at 613027. 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.

Looking upstream from the Mayfield Drain sampling site, April 2019.

Mayfield Drain

Phosphorus over time (2005–19)

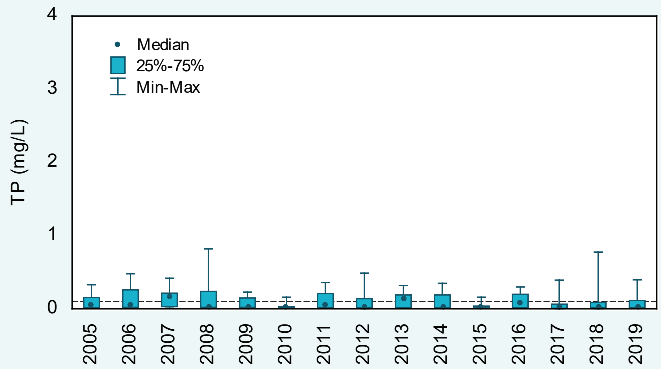
Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period at the Mayfield Drain sampling site. The annual median TP concentration was below the protection plan water quality target for TP concentrations in all but two years (2007 and 2013). While the medians were generally low, there were some samples above the protection plan water quality target each year. Using the SWRWQA methodology, all years were classified as having moderate TP concentrations. However, compared with the other 12 sites sampled in the Peel-Harvey catchment, Mayfield Drain's TP concentrations were low, with the site having the second smallest 2019 median TP concentration (0.026 mg/L, only the site in the Middle Murray Catchment had a lower median of 0.018 mg/L).

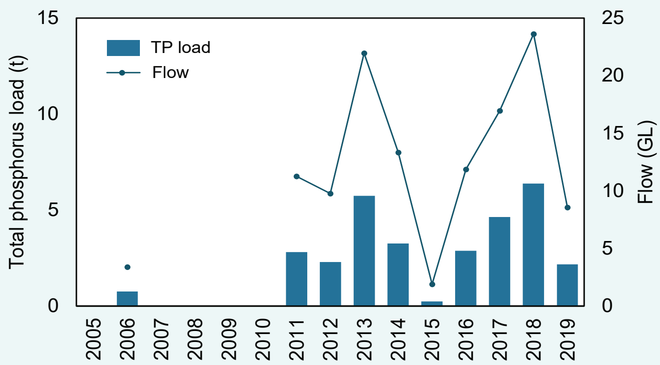
Estimated loads

Estimated TP loads at the Mayfield Drain sampling site were large compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2019, the site had an estimated TP load of 2.17 t. The load per square kilometre of 19.4 kg/km^2 was also large, with only the Harvey River having a larger load per square kilometre (31.5 kg/km^2). TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

Mayfield Drain



Total phosphorus concentrations, 2005–19 at site 613031. The dashed line is the protection plan TP target.



Total phosphorus loads and annual flow, 2005–19 at site 613031.

Excessive algal growth is a common problem in agricultural drains like Mayfield Drain, April 2018.

Phosphorus (2019)

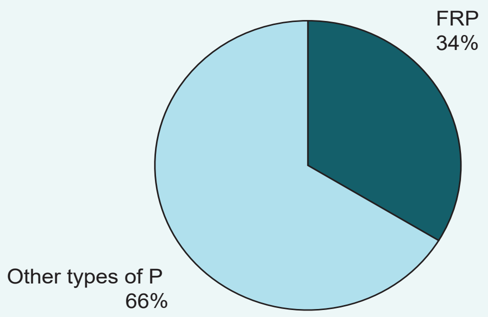
Types of phosphorus

Total P is made up of different types of P. At the Mayfield Drain sampling site, about a third of the P was present as phosphate, measured as filterable reactive P (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. The remainder 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.

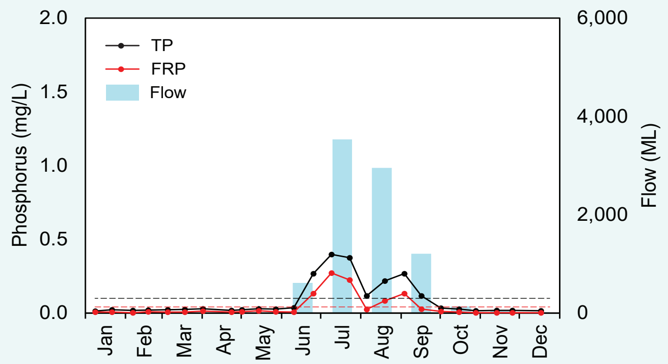
Concentrations

Both TP and phosphate showed a seasonal response, peaking in July before falling during the rest of the year. The peak in July was likely because of a first flush effect where nutrients that had accumulated from fertilisers and animal waste on surrounding agricultural land were flushed into the drain following the onset of winter rains. The dip in TP and phosphate 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 P concentrations. During the drier months, when flow volumes were smaller, both TP and phosphate concentrations were low, below the protection plan water quality target (for TP) and the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value (phosphate). This suggests that most of the P was entering the drain via surface flow rather than groundwater.

Mayfield Drain



2019 average phosphorus fractions at site 613031.



2019 phosphorus concentrations and monthly flow at 613031. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for phosphate.

Mayfield Drain during low flows, June 2010.

Mayfield Drain

Dissolved organic carbon over time (2005–19)

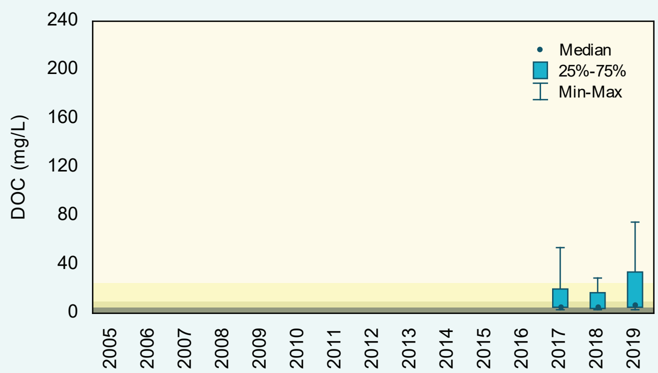
Concentrations

There were only three years with enough dissolved organic carbon (DOC) data available to graph at the Mayfield Drain sampling site. Using the SWRWQA methodology, DOC concentrations were classified as moderate at Mayfield Drain; however, there were a number of samples in the high and very high bands each year.

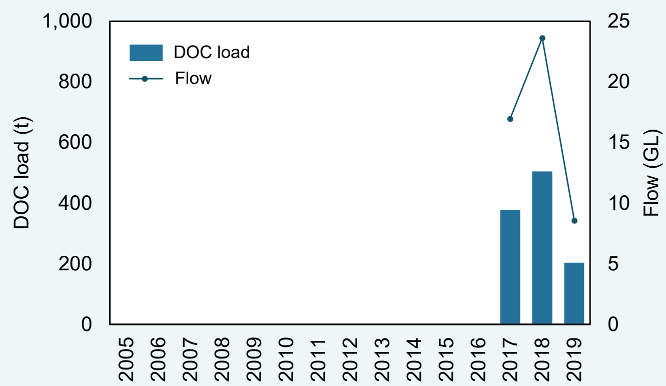
Estimated loads

Estimated DOC loads at the Mayfield Drain 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 203 t. The load per square kilometre of 1,816 kg/ km^2 was large 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.

Mayfield Drain



Dissolved organic carbon, 2005–19 at site 613031. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2005–19 at site 613031.

low moderate high very high

Waterlogging in cattle paddocks, June 2018.

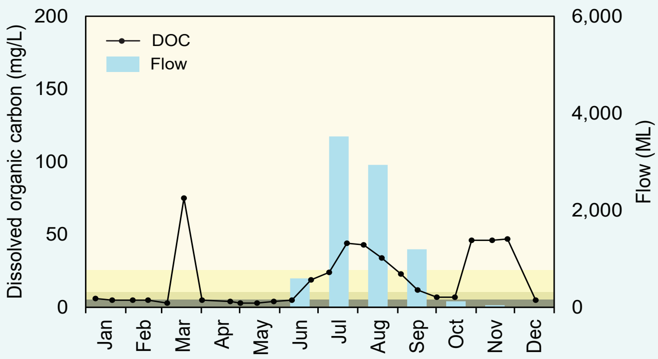
Mayfield Drain

Dissolved organic carbon (2019)

Concentrations

Dissolved organic carbon showed a seasonal pattern at the Mayfield Drain sampling site, with concentrations generally high during the wetter months when rainfall and flow were at their greatest. At this time, DOC was entering the drain via surface and groundwater flow as well as coming from in-stream sources. The reason for the peak in March is unclear, as is the reason for the peak later in the year, from October to December. 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.

Mayfield Drain



2019 dissolved organic carbon concentrations and monthly flow at 613031. The shading refers to the SWRWQA classification bands.

low moderate high very high

A smaller drain entering the Mayfield Drain. Note the less-turbid water from the smaller drain compared with the water in Mayfield Drain, August 2011.

Mayfield Drain

Total suspended solids over time (2005–19)

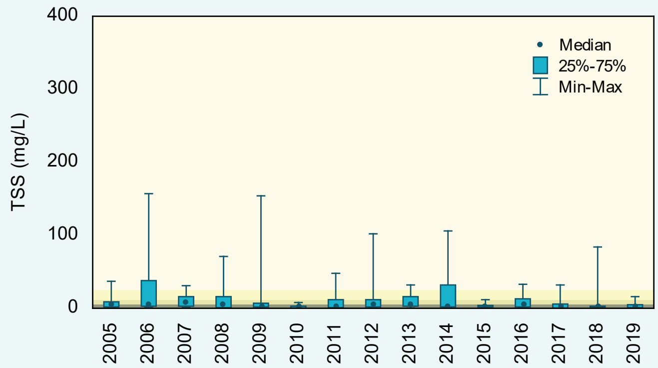
Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA methodology, 2005–15 were classified as moderate and 2016–19 were classified as low. However, most years had some samples that fell within the high and very high bands.

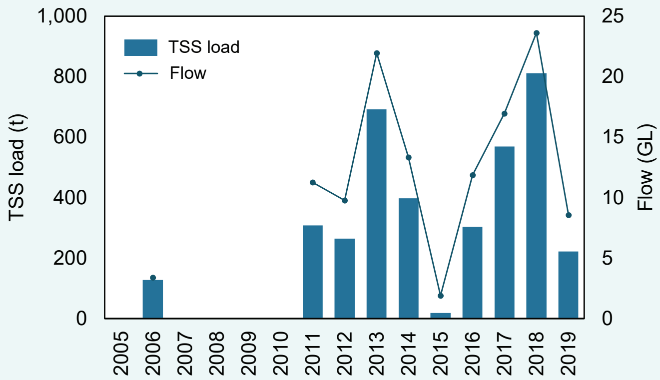
Estimated loads

Estimated TSS loads at the Mayfield Drain sampling site were large 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 221 t. The load per square kilometre of 1,977 kg/km^2 was the second largest of the Peel-Harvey catchment sites, with only the Harvey River having a larger load per square kilometre of 3,550 kg/km^2. TSS loads were closely related to flow volume; years with large annual flow volumes had large TSS loads and vice versa.

Mayfield Drain



Total suspended solids concentrations, 2005–19 at site 613031. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 613031.

low moderate high very high

Mayfield Drain at the Forrest Highway bridge. Note the erosion and undercutting of the bank on the left side of this photograph, March 2009.

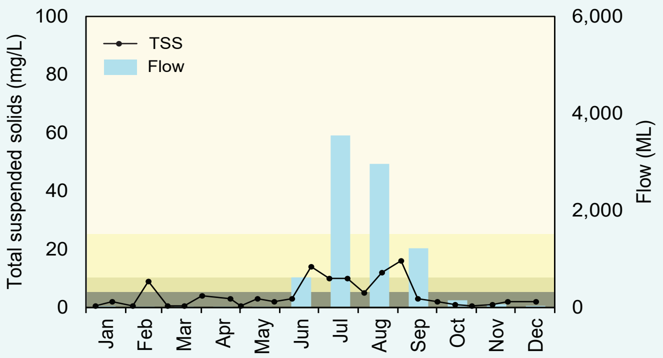
Mayfield Drain

Total suspended solids (2019)

Concentrations

In 2019 TSS concentrations showed a seasonal pattern at the Mayfield Drain sampling site. There was a first flush effect in June where rainfall washed particulate matter into the drain from surrounding land use as well as mobilising any that was present in the drain, causing the peak in TSS concentrations observed in the graph. Concentrations then fell during the year, with a second peak in early September because of unknown reasons. During the drier months, when flow volumes were small, TSS concentrations were generally low.

Mayfield Drain



2019 total suspended solids concentrations and monthly flow at 613031. The shading refers to the SWRWQA classification bands.

low   moderate   high   very high

Stabilisation works undertaken on Mayfield Drain to help prevent bank erosion. This photograph was taken at the same location as the one of the previous page, June 2009.

pH over time (2005–19)

pH values

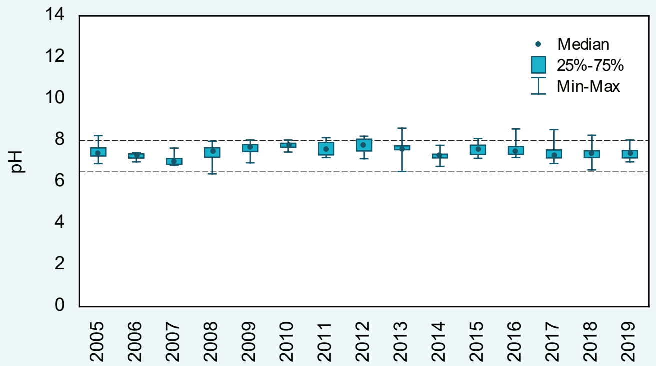
pH fluctuated over the reporting period at the Mayfield Drain sampling site, though the annual medians were within the upper and lower ANZECC trigger values every year.

pH (2019)

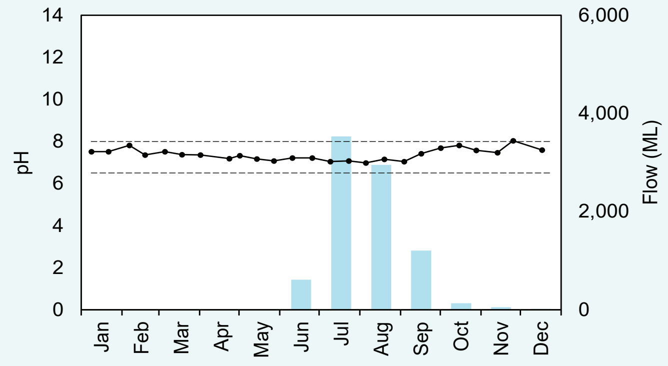
pH values

There was some evidence of a slight reverse seasonal pattern in pH values at the Mayfield Drain sampling site. pH was higher at the beginning of the year before dropping as rainfall and streamflow increased. pH then slowly increased again in the later part of the year. This suggests that the surface water runoff is slightly more acidic (has a lower pH) than the groundwater.

Mayfield Drain



pH levels, 2005–19 at site 613031. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 613031. The dashed lines are the upper and lower ANZECC trigger values.

Collecting flow measurements in Mayfield Drain, August 2017.

Mayfield Drain

Salinity over time (2005–19)

Concentrations

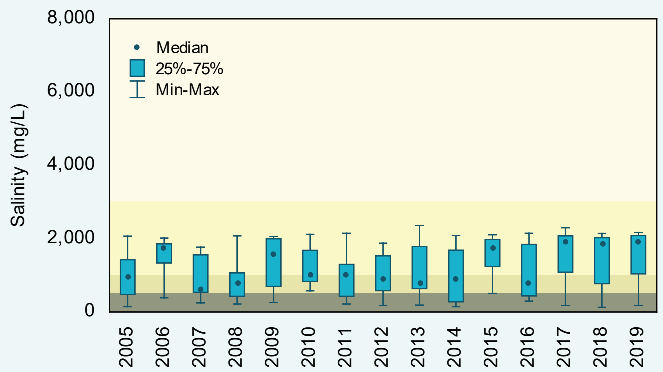
Salinity fluctuated over the reporting period at the Mayfield Drain sampling site; however, the medians appear to be increasing. Using the Water Resources Inventory 2014 salinity bands, annual salinity was classified as brackish except for 2009–14 which were classified as marginal. Only a few samples fell within the fresh band each year (note the 2018 nutrient report used the SWRWQA bands).

Salinity (2019)

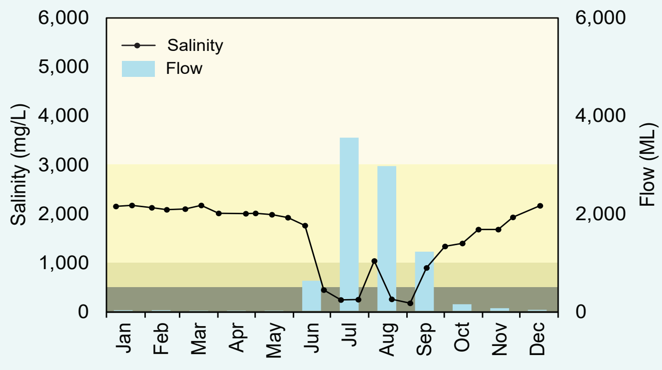
Concentrations

Salinity showed an inverse relationship to flow at the Mayfield Drain sampling site. That is, when flow volumes were high, salinity levels were low and vice versa. Salinity was brackish at the start of the year and only fell in June, when winter rainfall started and the amount of flow in the drain increased. Salinity started to increase again in September, as flow dropped. Groundwater at this site was more saline than the surface water, which is why, during the drier months when there was proportionally more groundwater in the drain, salinities were higher. The reason for the peak in August is unknown, though it coincides with a dip in N and P concentrations. Water levels were very low on this sampling occasion so it is possible that some parts of the catchment had dried out and also that the proportion of groundwater present was higher than normal at this time.

Mayfield Drain



Salinity concentrations, 2005–19 at site 613031. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations and monthly flow at 613031. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

A kangaroo jumping through a flooded paddock. Consistent rainfall over an extended period of time led to widespread waterlogging of paddocks near the drain, June 2018.

Mayfield 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.

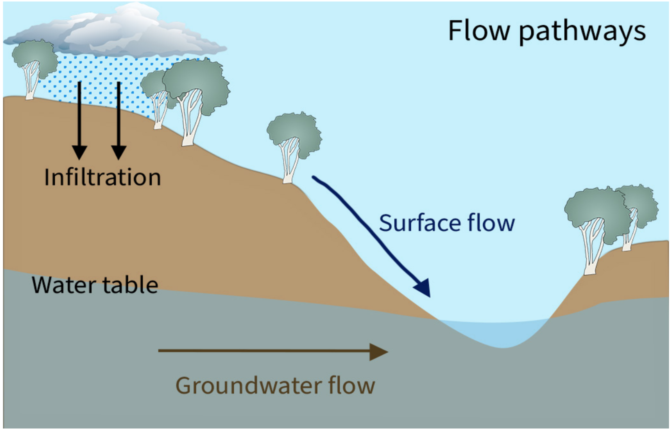
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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.



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