Mayfield Drain

This data report provides a summary of the nutrients at the Mayfield 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 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

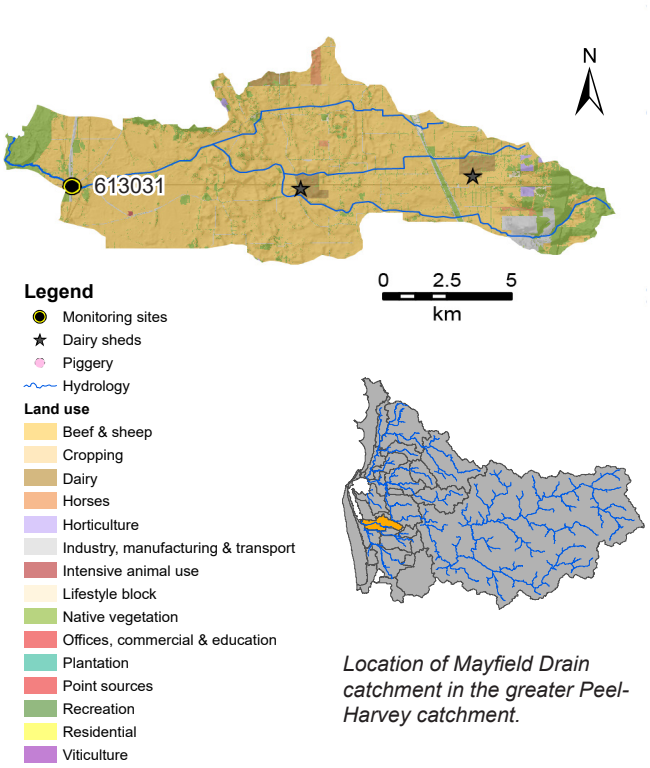
Mayfield Drain has a catchment area of about 122 km^2, more than 80 per cent of which has been cleared for agriculture, predominantly beef and sheep grazing. There are two dairy sheds present in the catchment. Apart from Mayfield Drain, there are numerous other small drains which were constructed to 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 low capacity to bind phosphorus. 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 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 moderate. Annual nutrient loads were moderate and loads per square kilometre were large 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. All of these factors contribute to the high nutrient concentrations and moderate loads per square kilometre.



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

Facts and figures

Sampling site code	613031
Catchment area	122 km^2
Per cent cleared area (2015)	84 per cent
River flow	Permanent
Annual flow (2018)	24 GL
Main land use (2015)	Beef and sheep grazing

Mayfield Drain

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations fluctuated over the reporting period at the Mayfield Drain sampling site. The annual median TN concentrations were below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value in all years except 2007 and 2013, when they were just above. However, each year recorded some samples above the trigger value. Compared to the other sampling sites in the Peel-Harvey catchment, TN concentrations were low; however, given that a number of samples were above the ANZECC trigger value, concentrations can best be described as moderate at this site.

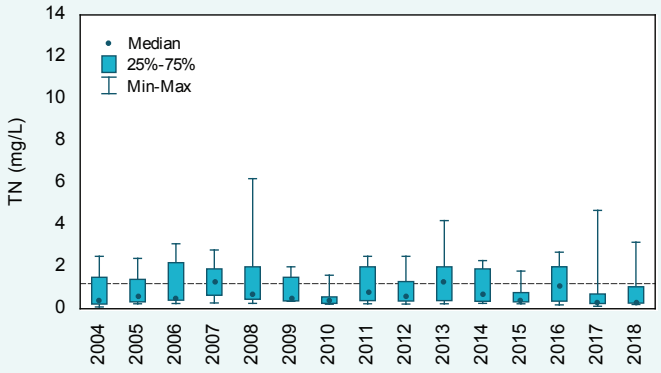
Trends

There was a short-term (2014–18) decreasing trend present in TN concentrations of 0.03 mg/L/yr. This may be because of natural fluctuations at this site or an actual decrease in TN concentrations. Ongoing monitoring will help determine if water quality is getting better at this site. There was no long-term (2004–18) trend present.

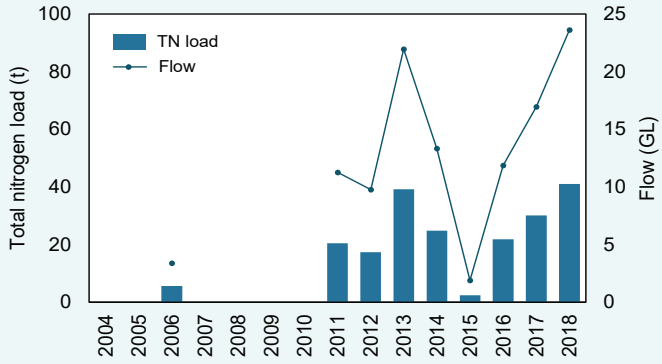
Estimated loads

Estimated TN 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 2018, Mayfield Drain had an estimated TN load of 41 t, similar to Nambeelup (45 t) and Dirk Brook (36 t). The load per unit area was moderate in 2018, at 366 kg/km^2, the third largest of the Peel-Harvey catchments. TN loads were closely related to flow volume, years with high annual flow having large TN loads and vice versa.

Mayfield Drain



Total nitrogen concentrations, 2004–18 at site 613031. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 613031.

The Mayfield Drain sampling site, April 2018

Mayfield Drain

Nitrogen (2018)

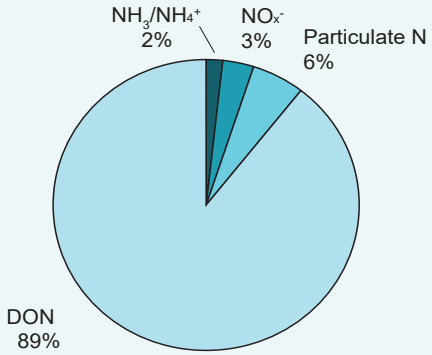
Types of nitrogen

Total N is made up of many 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 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.

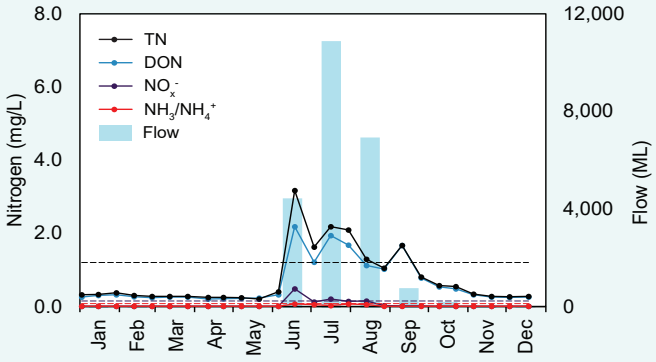
Concentrations

All forms of N 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 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. NO_x^- concentrations decreased in August, and DON and TN in September. These decreases coincide with the flow volume decreasing at this site. It is probable that most of the N is entering the drain via surface water runoff, with groundwater contributing proportionally less N.

Mayfield Drain



2018 average nitrogen fractions at site 613031.



2018 nitrogen concentrations and monthly flow at 613031. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

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

Mayfield Drain

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period at the Mayfield Drain sampling site. The annual median TP concentration was below the Peel-Harvey Water Quality Improvement Plan (WQIP) target in all but two years (2007 and 2013). While the medians were generally low, there were some samples above the WQIP target each year. Compared with the other 12 sites sampled in the Peel-Harvey catchment, Mayfield Drain had the second smallest 2018 median TP concentration (0.022 mg/L, only the site in the Middle Murray Catchment had a lower median of 0.012 mg/L).

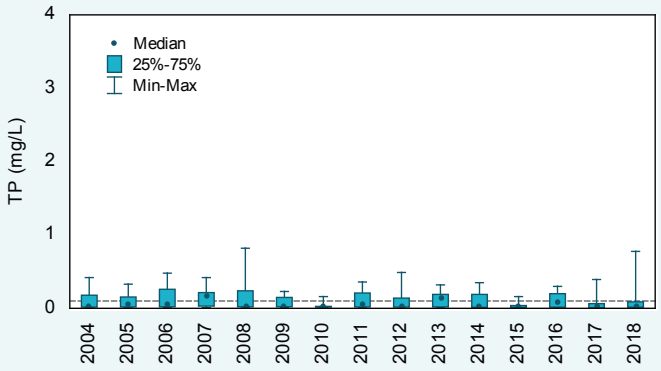
Trends

There was no short- (2014–18) or long-term (2004–18) trends present in TP concentrations at the Mayfield Drain site.

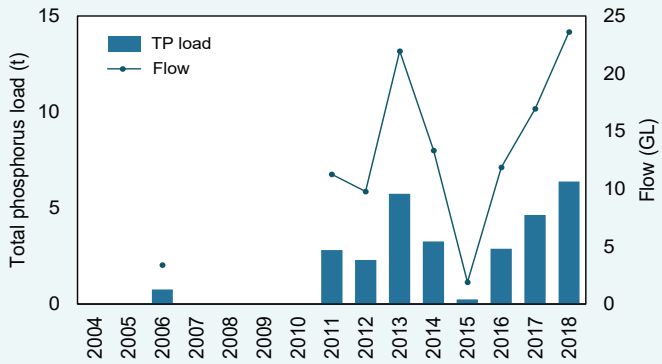
Estimated loads

Estimated TP 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 2018, the site had an estimated TP load of 6.4 t. The load per unit area of 57 kg/km^2 was moderate compared with the other Peel-Harvey sites, with only Nambeelup Brook and the Harvey River having larger loads per unit area. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Mayfield Drain



Total phosphorus concentrations, 2004–18 at site 613031. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 613031.

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

Phosphorus (2018)

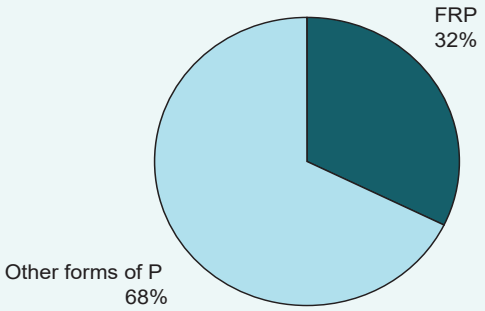
Types of phosphorus

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 filterable reactive P (FRP) which is readily bioavailable. The FRP 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 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.

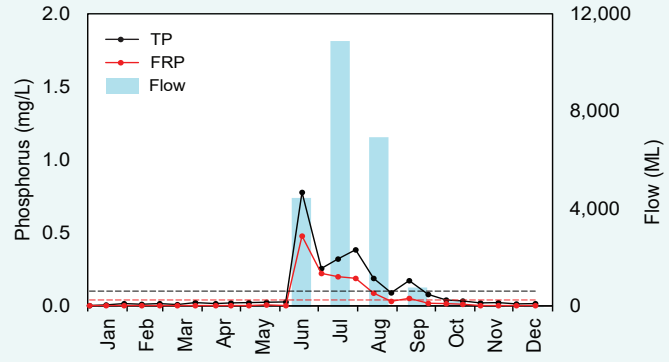
Concentrations

Both TP and FRP showed a seasonal response, peaking in June before falling during the rest of the year. The peak in June is likely because of a first flush effect where nutrients that had accumulated from fertilisers and animal waste on surrounding farmland were flushed into the drain following the onset of winter rains. The reason for the peak in TP in early August and September is unknown but may be because of the application of fertiliser to paddocks with the warming weather. During the drier months, when flow volumes were less, both TP and FRP concentrations were low, below the Peel-Harvey WQIP target (for TP) and the ANZECC trigger value (FRP). This suggests that most of the P is entering the drain via surface flow rather than groundwater.

Mayfield Drain



2018 average phosphorus fractions at site 613031.



2018 phosphorus concentrations and monthly flow at 613031. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger values for lowland rivers.

Mayfield Drain during low flows, June 2010.

Mayfield Drain

Dissolved organic carbon over time (2004–18)

Concentrations

There were only two years with enough DOC data available to graph at the Mayfield Drain sampling site. Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, both annual medians were classified as moderate; however, there were a number of samples in the high and very high bands in both years.

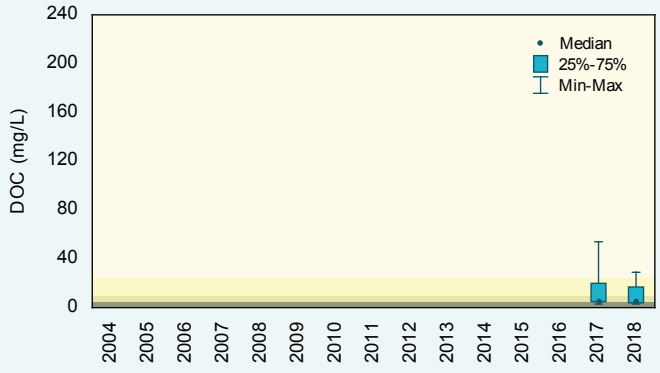
Trends

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

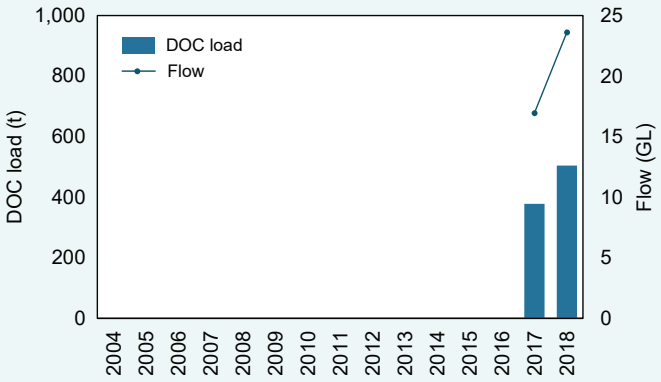
Estimated loads

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 2018, the estimated DOC load was 504 t. The load per unit area of 4,500 kg/km^2 was moderate to large compared with the other Peel-Harvey catchment sites. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Mayfield Drain



Dissolved organic carbon, 2004–18 at site 613031. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2004–18 at site 613031.

very high high moderate low

Waterlogging in cattle paddocks, June 2018.

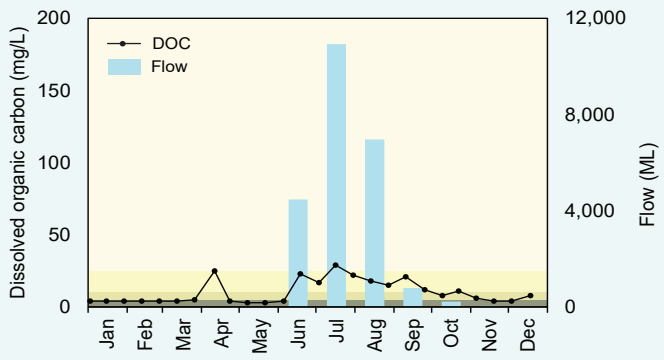
Mayfield Drain

Dissolved organic carbon (2018)

Concentrations

Dissolved organic carbon showed a seasonal pattern at the Mayfield Drain sampling site, with concentrations generally higher during the wetter months when rainfall and flow were at their greatest. At this time, DOC would have been entering the drain via surface and groundwater flow as well as coming from in-stream sources. The reason for the peak in early April is unclear. 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.

Mayfield Drain



2018 dissolved organic carbon concentrations and monthly flow at 613031. The shading refers to the SWRWQA classification bands.

very high high moderate low

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 (2004–18)

Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA classification bands, the annual medians were classed as either low or moderate in each year where there were sufficient data to report. However, most years had some samples that fell within the high and very high bands.

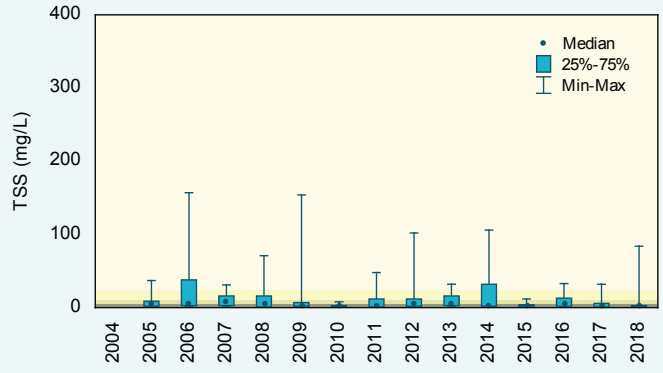
Trends

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

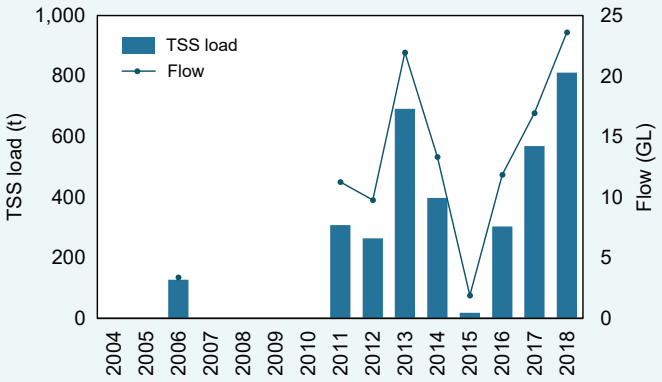
Estimated loads

Estimated TSS 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 2018, the estimated TSS load at this site was 812 t. The load per unit area of 7,248 kg/km^2 was the second largest of the Peel-Harvey catchment sites, with only the Harvey River having a larger load per unit area of 10,721 kg/km^2. TSS loads were closely related to flow volume, years with high annual flow having large TSS loads and vice versa.

Mayfield Drain



Total suspended solids concentrations, 2004–18 at site 613031. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 613031.

very high high moderate low

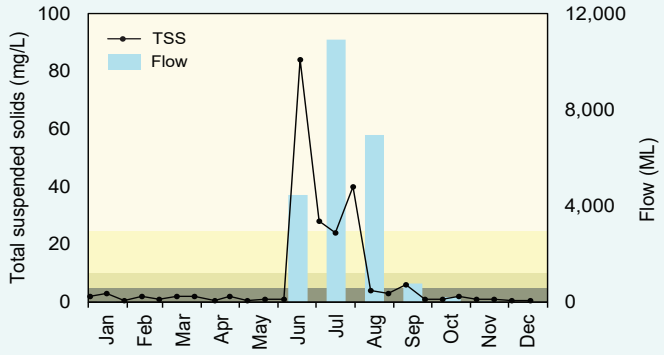
Mayfield Drain at the Forrest Highway bridge. Note the erosion and undercutting of the bank on the left side of this photograph, March 2009.

Total suspended solids (2018)

Concentrations

In 2018 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 smaller peak in late July because of unknown reasons. During the drier months, when flow volumes were low, TSS concentrations were consistently low.

Mayfield Drain



2018 total suspended solids concentrations and monthly flow at 613031. The shading refers to the SWRWQA classification bands.

very high high moderate low

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.

Mayfield Drain

pH over time (2004–18)

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.

Trends

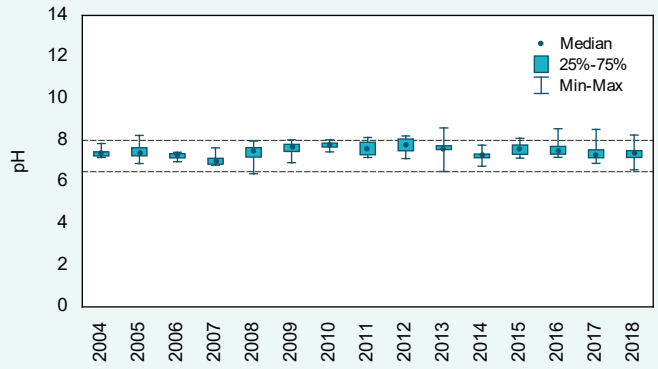
There was no trend in pH at Mayfield Drain over either the short- (2014–18) or long-term (2006–18)

pH (2018)

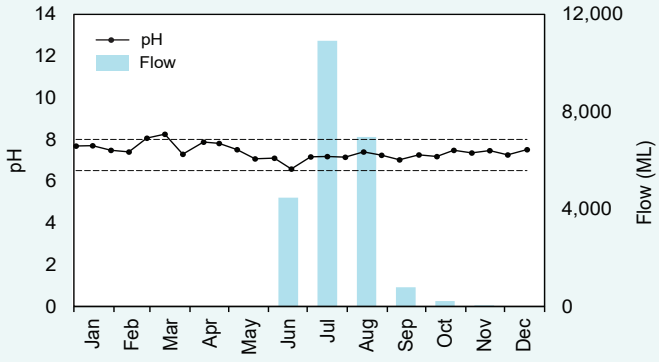
pH values

There was some evidence of a slight reverse seasonal trend in pH values at the Mayfield Drain sampling site. pH was higher at the beginning of the year before dropping in May and June as rainfall and streamflow increased. pH then slowly increased again during the rest 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, 2004–18 at site 613031. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 613031. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Collecting flow measurements in Mayfield Drain, August 2017.

Mayfield Drain

Salinity over time (2004–18)

Concentrations

Salinity fluctuated over the reporting period at the Mayfield Drain sampling site; however, the medians appear to be increasing (see Trends, below). Using the SWRWQA bands, the annual median salinities were classified as either marginal or brackish and only a few samples fell within the low band each year.

Trends

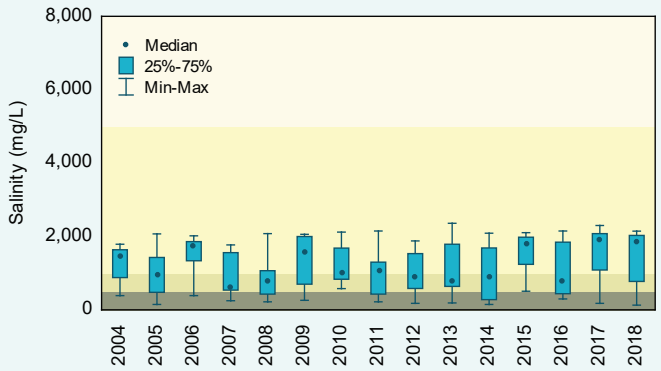
There was a short-term (2014–18) increasing trend in salinity of 15 mg/L/yr and a long-term (2004–18) trend of 23 mg/L/yr. These trends are probably because of the drying climate which has resulted in the proportion of groundwater to surface water changing over time.

Salinity (2018)

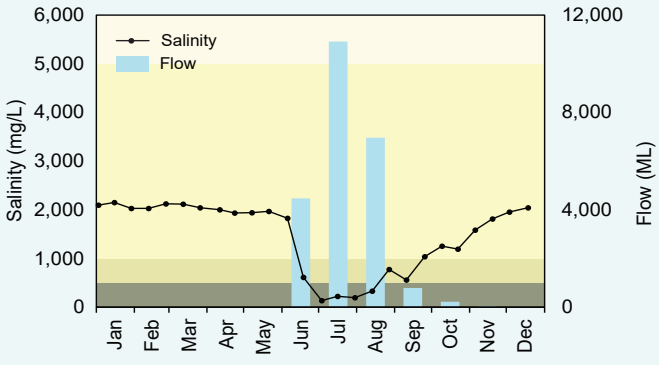
Concentrations

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 August, as flow dropped. Groundwater at this site was more saline than the surface water, which is why, during the drier months when there is proportionally more groundwater in the drain, salinities were higher.

Mayfield Drain



Salinity concentrations, 2004–18 at site 613031. The shading refers to the SWRWQA classification bands.



2018 salinity concentrations and monthly flow at 613031. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

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

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.

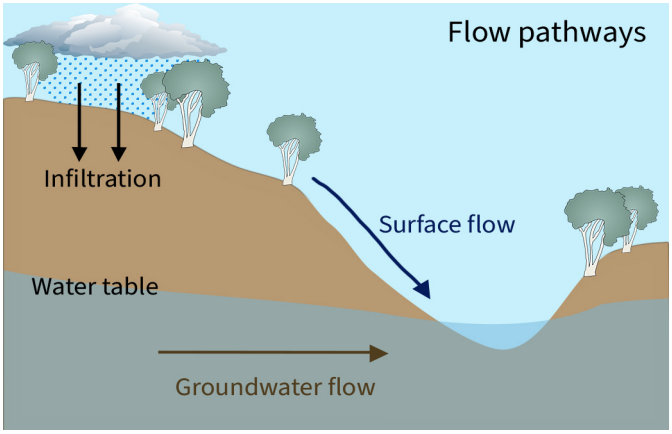
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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