Peel Main Drain

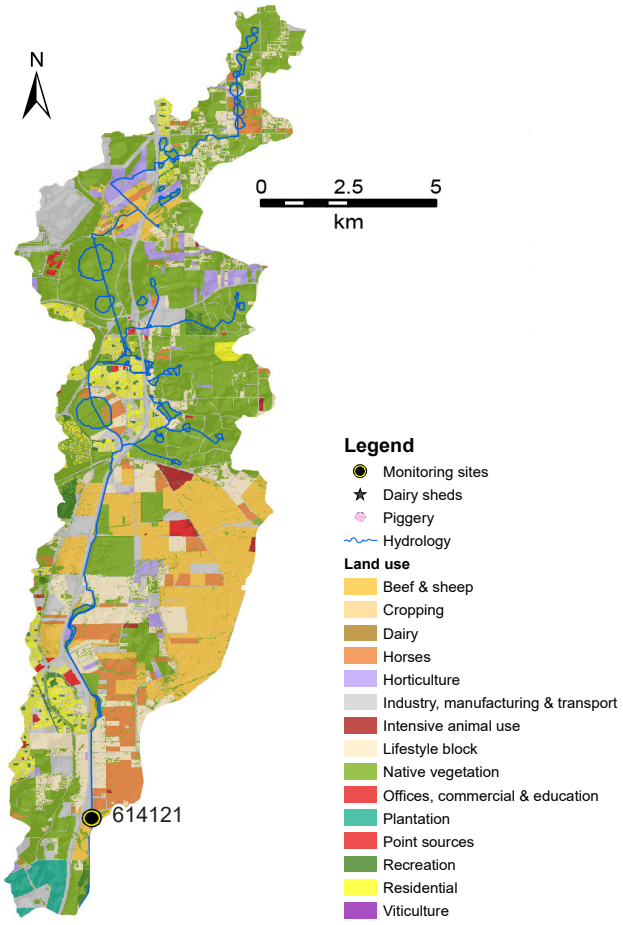
This data report provides a summary of the nutrients at the Peel Main Drain sampling site in 2018 as well as historical data from 2004–18. This report was produced as part of the Regional Estuaries Initiative. Downstream of the site, the drain enters the Serpentine River and, from there, discharges into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

Peel Main Drain has a catchment area of about 125 km^2, just over half of which has been cleared. Residential areas are present in the catchment, such as Baldivis and Wellard, as well as beef and sheep grazing and properties with horses. The upper portion of the catchment retains some native vegetation. Peel Main Drain is a highly modified system and there are a number of other drains in the catchment, constructed to quickly remove water from agricultural and residential land. The area above the sampling site is about 118 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 measured at site 614121, Karnup Road, south of where the Peel Main Drain passes under Karnup Road in Baldivis.



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

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Peel Main Drain sampling site were high, though total nitrogen concentrations improved over the 2007–18 period. The proportion of phosphorus present as filterable reactive phosphorus was large. The high-intensity agricultural and urban land use, as well as the highly modified drainage system present, contributed to the high nutrient concentrations recorded at this site.

Facts and figures

Sampling site code	614121
Catchment area	125 km^2
Per cent cleared area (2015)	59 per cent
River flow	Permanent
Annual flow (2018)	11.6 GL
Main land use (2015)	Native vegetation, industry manufacturing and transport, and beef and sheep grazing

Peel Main Drain

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations in Peel Main Drain were high, with only two annual medians below the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value (2010 and 2015). It appears that TN concentrations have reduced over the reporting period (see 'Trends' section below).

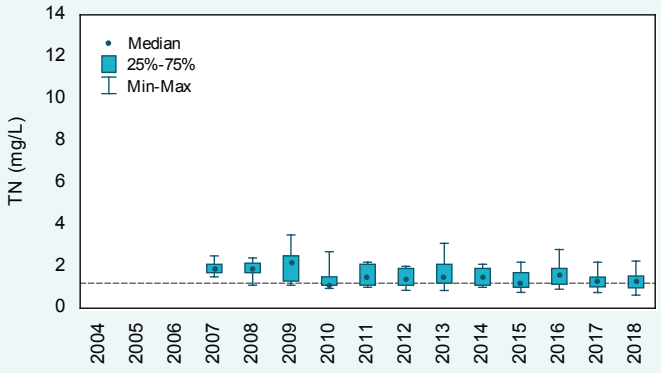
Trends

There was a long-term (2007–18) decreasing trend in TN concentrations of 0.04 mg/L/yr. However, there was no short-term (2014–18) trend, suggesting that concentrations may have stabilised.

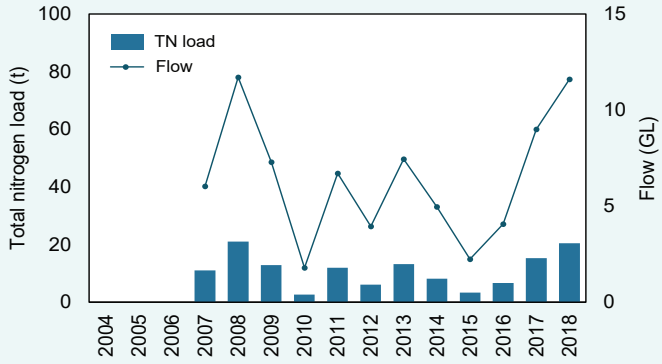
Estimated loads

Estimated TN loads at the Peel Main Drain sampling site were small to moderate compared with the other sites in the Peel-Harvey catchment. In 2018, Peel Main Drain had an estimated TN load of 20.5 t. The load per unit area was moderate, at 173 kg/km^2. TN loads were closely related to flow volume, years with high annual flow having large TN loads and vice versa.

Peel Main Drain



Total nitrogen concentrations, 2004–18 at site 614121. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 614121.

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

Peel Main Drain

Nitrogen (2018)

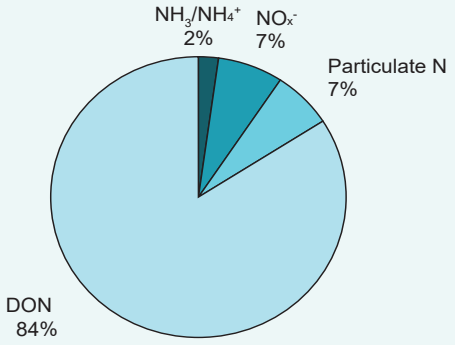
Types of nitrogen

Total N is made up of many different types of N. At the Peel Main Drain sampling site, most of the N was present as dissolved organic N (DON) which consists mainly of degrading plant and animal matter but may also include other forms. Most forms of DON need to be further broken down to become available to plants and algae, though some forms are readily bioavailable. Only a small portion of N was present as readily bioavailable dissolved inorganic N (DIN—consisting of oxides of N, NO_x^- and ammonia N, NH_3/NH_4^+). Likely sources of these kinds of N include fertilisers and animal wastes as well as natural sources.

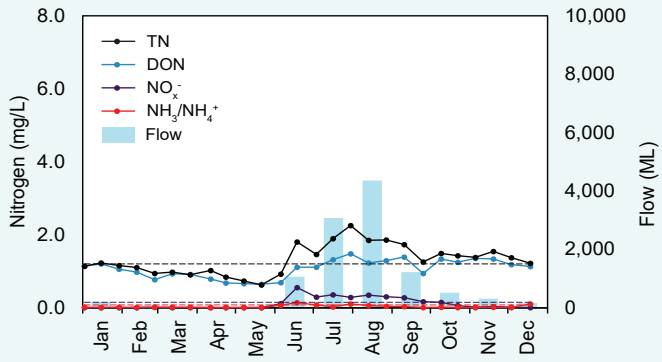
Concentrations

All forms of N showed a seasonal pattern, increasing in June as rainfall and flow increased, before peaking in July and dropping again. NO_x^- was the only form that peaked earlier, in June, shortly after flow started to increase. This peak is likely because of a first flush effect where NO_x^- was mobilised from soils following heavy rainfall. Much of this N was probably the result of mineralisation of organic N in soils and streams over the summer period, and runoff of high concentration waters from agricultural land which build up with fertilisers and animal waste over summer. The proportion of N present as DON was lower over the wetter months, when NO_x^- made up a greater proportion. It is likely that most of the NO_x^- and NH_3/NH_4^+ at this site were coming from surface flow whereas the majority of the DON was coming from groundwater. In-stream sources would also have been contributing N year round.

Peel Main Drain



2018 average nitrogen fractions at site 614121.



2018 nitrogen concentrations and monthly flow at 614121. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

The weir at the Peel Main Drain sampling site, May 2007.

Peel Main Drain

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations were high to very high at the Peel Main Drain sampling site compared with the other sites in the Peel-Harvey catchment. With the exception of 2010, all annual medians were above the Peel-Harvey Water Quality Improvement Plan (WQIP) target. Why the range in TP concentrations was much greater in 2010 and 2013 than other years is unclear.

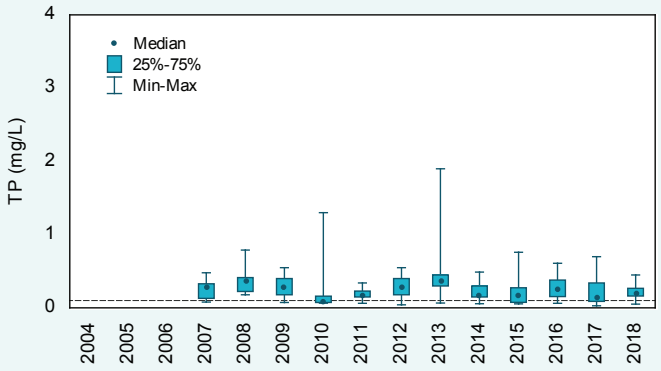
Trends

There was neither a short- (2014–18) or long-term (2007–18) trend in TP concentrations at the Peel Main Drain sampling site.

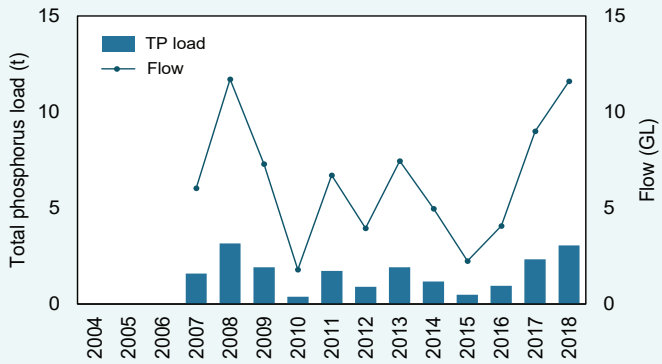
Estimated loads

Estimated TP loads at the Peel Main Drain sampling site were small to 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 3.1 t. The load per unit area of 25.8 kg/km^2. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Peel Main Drain



Total phosphorus concentrations, 2004–18 at site 614121. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 614121.

Warm slow flowing water and high nutrient concentrations all help contribute to excess macrophyte growth like that shown here in Peel Main Drain, February 2013.

Peel Main Drain

Phosphorus (2018)

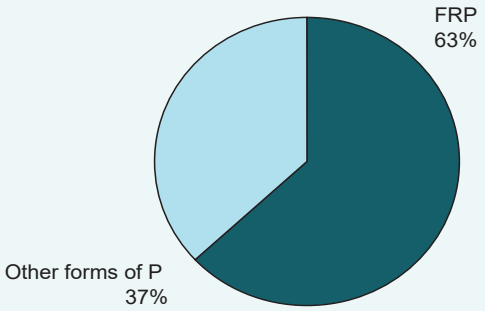
Types of phosphorus

Total P is made up of different types of P. At the Peel Main Drain sampling site, nearly two-thirds of the P was present as highly bioavailable filterable reactive P (FRP). This form of P is readily used by plants and algae to fuel growth and is likely sourced from fertilisers and animal waste as well as natural sources. The remaining P was present as either particulate P or dissolved organic P (DOP) or both. Particulate P generally needs to be broken down before becoming bioavailable to algae. The bioavailability of DOP varies and is poorly understood. The proportion of P present as FRP was high compared with the other Peel-Harvey catchment sites, with the Peel Main Drain having the second highest proportion of P present as FRP of the 13 sites sampled.

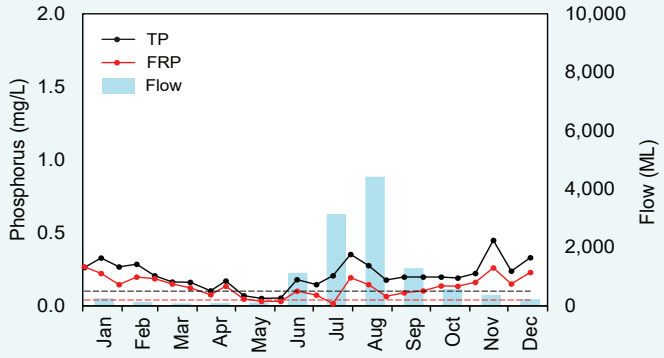
Concentrations

There was some evidence of a seasonal pattern in TP and FRP concentrations at the Peel Main Drain sampling site. Concentrations were high early in the year before reducing, being at their lowest in May, just before rainfall and flow increased. They then peaked in winter before falling again and then slowly increasing from about September onwards. This suggests P was entering the drain via both groundwater and surface water as well as coming from in-stream sources, with groundwater dominating in summer months and surface water and groundwater together in winter months.

Peel Main Drain



2018 average phosphorus fractions at site 614121.



2018 phosphorus concentrations and monthly flow at 614121. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger values for lowland rivers.

The culverts where Peel Main Drain passes under Karnup Road near the sampling site, July 2002.

Peel Main Drain

Dissolved organic carbon over time (2004–18)

Concentrations

There were only three years with sufficient dissolved organic carbon (DOC) data to graph at the Peel Main Drain sampling site. Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, the 2016–17 annual medians fell into the high band and the 2018 median was classified as moderate.

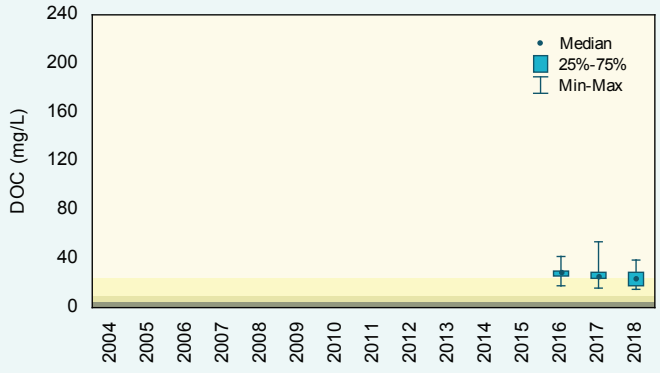
Trends

It was not possible to calculate trends in DOC concentrations at the Peel Main 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

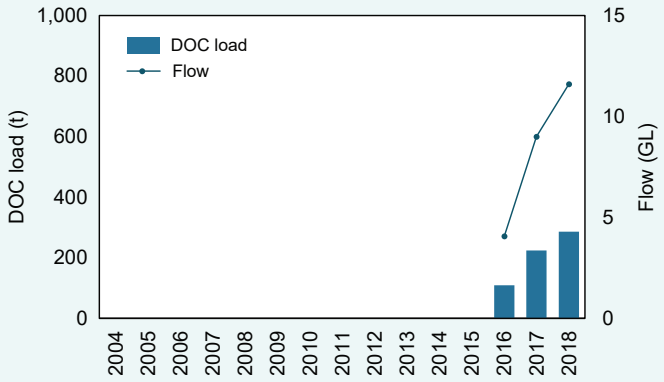
Estimated DOC loads at the Peel Main Drain sampling site were moderate compared with the other 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. In 2018, the estimated DOC load was 287 t. The load per unit area of 2,428 kg/km^2 was also moderate compared with the other Peel-Harvey catchment sites. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Peel Main Drain



Dissolved organic carbon concentrations, 2004–18 at site 614121. The shading refers to the SWRWQA classification bands.

very high high moderate low



Dissolved organic carbon loads and annual flow, 2004–18 at site 614121.

Peel Main Drain flowing through farmland, July 2002.

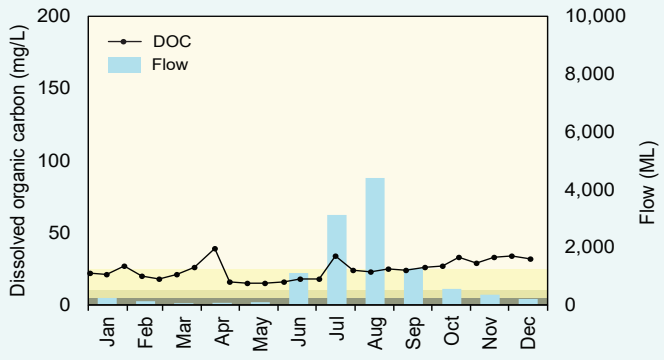
Peel Main Drain

Dissolved organic carbon (2018)

Concentrations

Dissolved organic carbon concentrations varied in 2018 at the Peel Main Drain sampling site. There was a small peak in DOC concentrations in July, driven by the increase in rainfall and flow which flushed DOC into the river from surrounding land use at this time. After the peak, concentrations fell then steadily increased for the remainder of the year. The reason for the peak in April is unknown. DOC was entering the Peel Main Drain via surface and groundwater flows as well as coming from in-stream sources. 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.

Peel Main Drain



2018 dissolved organic carbon concentrations and monthly flow at 614121. The shading refers to the SWRWQA classification bands.

very high high moderate low

Peel Main Drain flowing through paddocks, August 2004.

Peel Main Drain

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period at the Peel Main Drain sampling site. Both 2008 and 2009 recorded an unusually high TSS concentration. In both cases it was the first sample taken after the drain resumed flowing, suggesting that particulate matter was washed into the drain at this time as well as being disturbed from within the drain. Most of the annual medians were classified as moderate using the SWRWQA bands, though some years were high and one (2009) was very high.

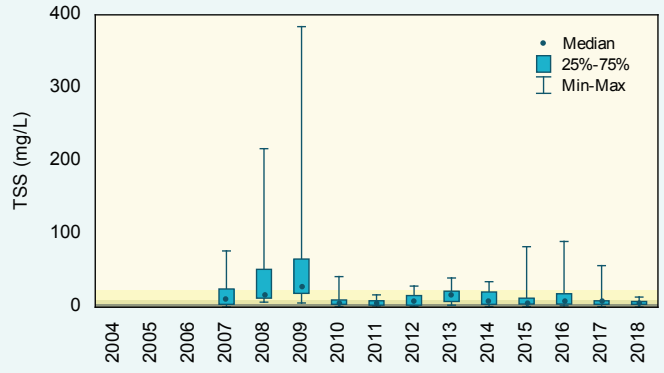
Trends

There was a small, short-term (2014–18) decreasing trend in TSS concentrations of 1 mg/L/yr at the Peel Main Drain sampling site. There was no long-term (2007–18) trend.

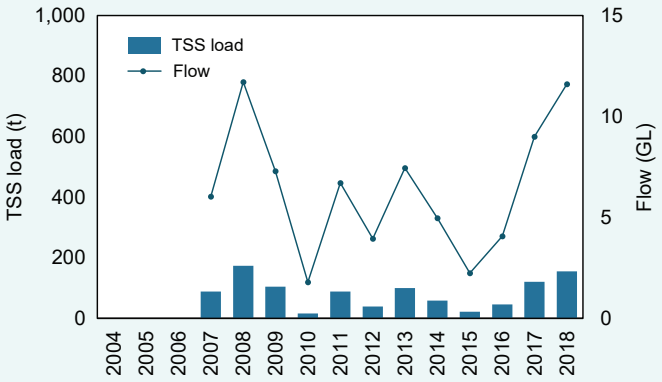
Estimated loads

Estimated TSS loads at the Peel Main Drain sampling site were small to 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 155 t. The load per unit area of 1,311 kg/km^2 was moderate to large compared with the other Peel-Harvey catchment sites. TSS loads were closely related to flow volume, years with high annual flow having large TSS loads and vice versa.

Peel Main Drain



Total suspended solids concentrations, 2004–18 at site 614121. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 614121.

very high high moderate low

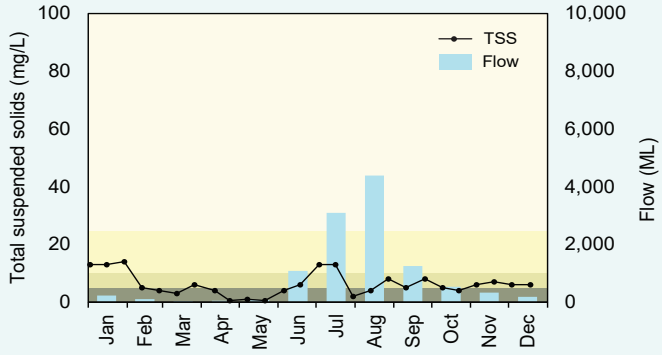
Cattle with unrestricted access to Peel Main Drain, October 2006.

Total suspended solids (2018)

Concentrations

In 2018, TSS concentrations showed a similar pattern to TP. That is, they were high at the beginning of the year, peaked again in July and were steady between August and the end of the year. It is likely particulate matter was being washed into the drain via surface flow from surrounding land use as well as coming from in-stream sources such as erosion. Algal growth might also have been contributing to the TSS concentrations observed in the drier months.

Peel Main Drain



2018 total suspended solids concentrations and monthly flow at 614121. The shading refers to the SWRWQA classification bands.

very high high moderate low

Peel Main Drain, note the waterlogging along the fenceline to the right of the photograph, June 2019.

Peel Main Drain

pH over time (2004–18)

pH values

After an initial rise in pH values between 2007–09, pH fluctuated at the Peel Main Drain sampling site. With the exception of 2009 (when it was above the upper trigger value), all annual medians were between the upper and lower ANZECC trigger values.

Trends

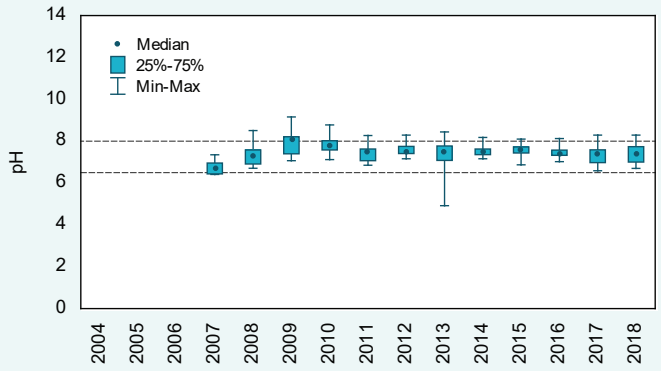
There was no trend in pH at Peel Main Drain over either the short- (2014–18) or long-term (2007–18).

pH (2018)

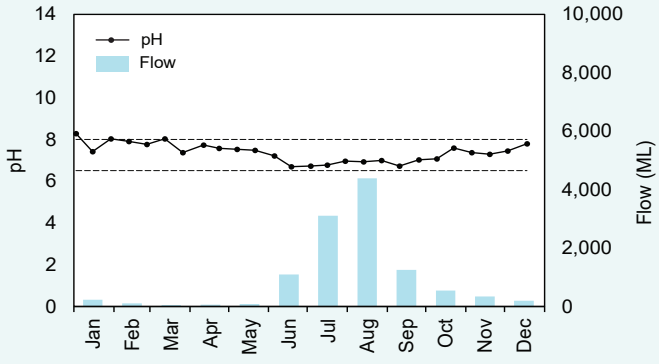
pH values

There was some evidence of a seasonal pattern in pH values at the Peel Main Drain sampling site. pH was highest at the beginning and end of the year and lowest in the middle of the year when rainfall and flow were at their highest. This suggests the groundwater at the sampling site may be slightly less acidic than the surface water as there would have been proportionally more groundwater in the drier months when pH values were higher. In-stream processes during summer were also contributing to the higher pH values at this time.

Peel Main Drain



pH levels, 2004–18 at site 614121. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 614121. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

Recording flow measurements at the Peel Main Drain sampling site, July 2017.

Peel Main Drain

Salinity over time (2004–18)

Concentrations

Salinity at the Peel Main Drain fluctuated over the reporting period, though all annual medians were classified as marginal using the SWRWQA classification bands. Most years had a few samples classified as fresh, and a few as high.

Trends

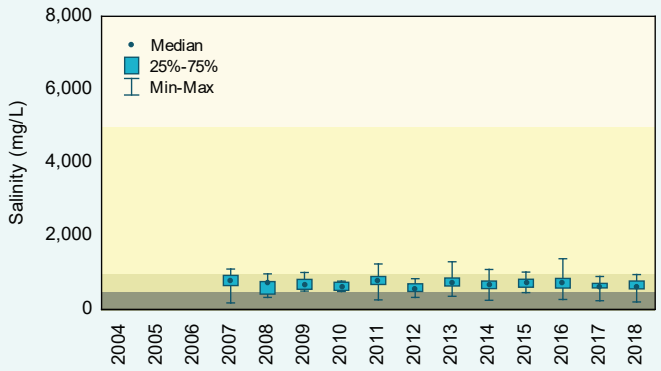
There was no trend in salinity at the Peel Main Drain sampling site over either the short- (2014–18) or long-term (2007–18).

Salinity (2018)

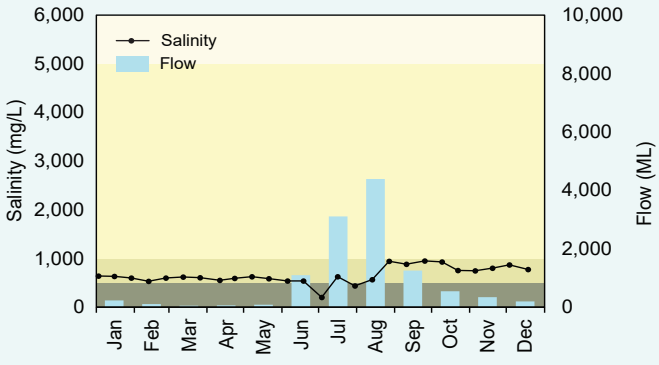
Concentrations

Salinity showed a slight seasonal pattern. Concentrations were fairly consistent during the first part of the year before reducing in early July after the onset of winter rains. They then slowly increased until late August, after which they remained fairly constant again. This suggests the surface runoff at this site starts off as fresh, then as more of the catchment contributes flow to the drain and groundwater levels rise, the water becomes more salty.

Peel Main Drain



Salinity concentrations, 2004–18 at site 614121. The shading refers to the SWRWQA classification bands.



2018 salinity and monthly flow at 614121. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

Localised flooding following heavy rains in the Peel Main Drain catchment, August 2005.

Peel Main 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.

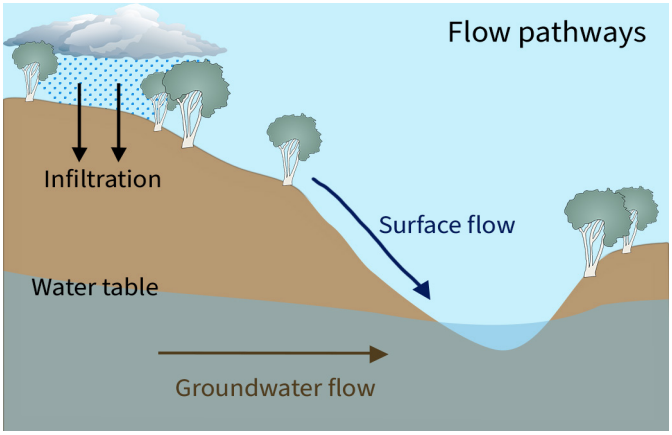
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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.



Peel Main Drain Issue 1
Publication date: May 2021
ISSN: 2209–6779 (online only)