Peel Main Drain

This data report provides a summary of the nutrients at the Peel Main 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 Serpentine River and, from there, discharges into the Peel Inlet.

About the catchment

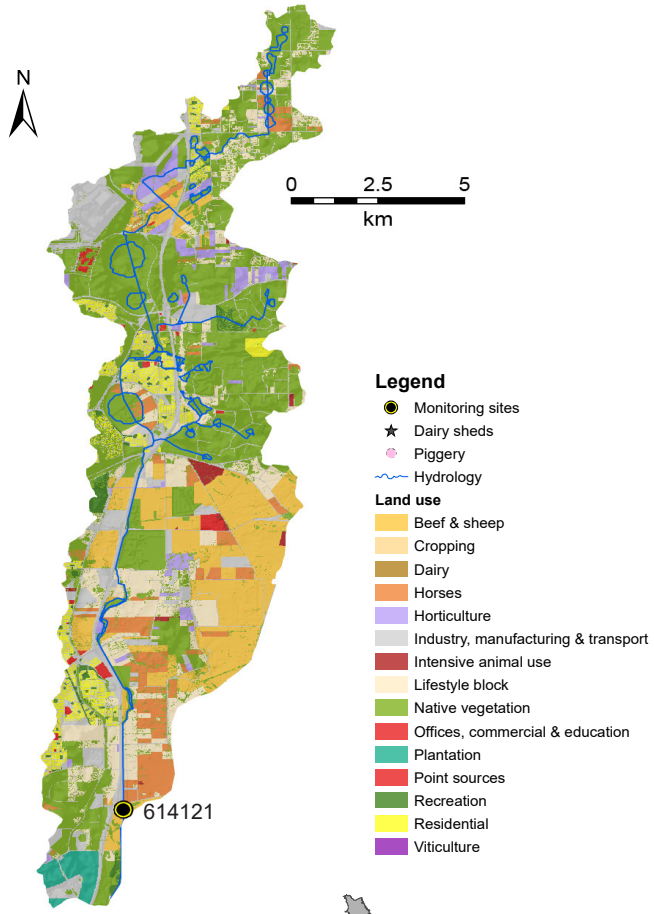
Peel Main Drain has a catchment area of about 125 km^2, just more than half of which has been cleared. Residential areas are present in the catchment, such as Baldivis and Wellard, as well as beef and sheep grazing and properties with horses. The upper portion of the catchment retains some native vegetation. 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.

About half 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 or leached 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.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) at the Peel Main Drain sampling site were classified as high (nitrogen) and very high (phosphorus), though total nitrogen concentrations improved over the 2007–19 period. The proportion of phosphorus present as phosphate 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.



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

Facts and figures

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

Estimated loads and flow at Peel Main Drain

614121	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Flow (GL)			6.0	12	7.3	1.8	6.7	3.9	7.5	5.0	2.2	4.1	9.0	12	5.6
TN load (t)			11	21	13	2.6	12	6.0	13	8.2	3.4	6.7	15	20	9.1
TP load (t)			1.59	3.16	1.91	0.38	1.72	0.89	1.91	1.18	0.49	0.94	2.33	3.05	1.33

Peel Main Drain

Nitrogen over time (2005–19)

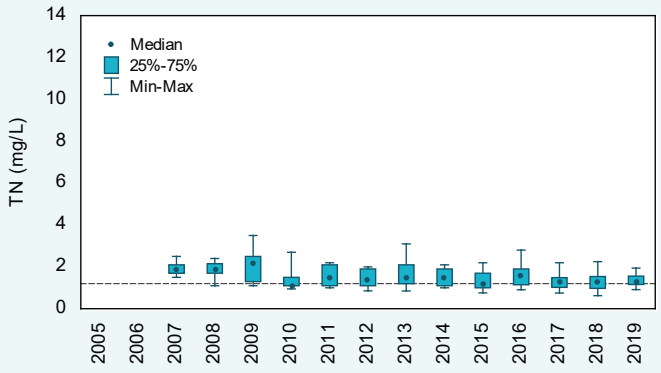
Concentrations

Annual total nitrogen (TN) concentrations in Peel Main Drain were classified as having a high concentration using the State Wide River Water Quality Assessment (SWRWQA) methodology. Further, only two annual medians were below the Bindjareb Djilba (Peel-Harvey estuary) Protection Plan water quality target for TN concentrations (2010 and 2015, both years with small flow volumes). It appears that TN concentrations have reduced over the reporting period.

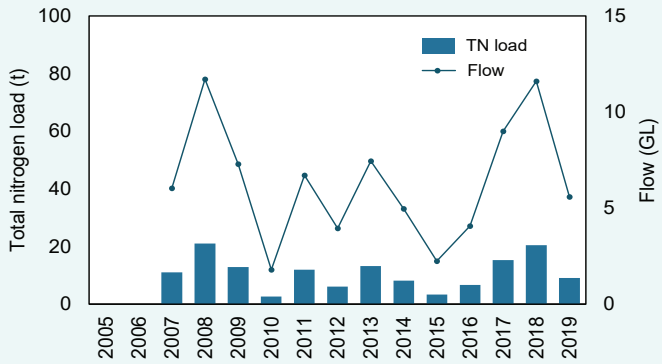
Estimated loads

Estimated TN loads at the Peel Main Drain sampling site were moderate compared with the other sites in the Peel-Harvey catchment. In 2019, Peel Main Drain had an estimated TN load of 9.1 t. The load per square kilometre was also moderate, at 77 kg/km^2. TN loads were closely related to flow volume; years with large annual flow volumes had large TN loads and vice versa.

Peel Main Drain



Total nitrogen concentrations, 2005–19 at site 614121. The dashed line is the protection plan TN target.



Total nitrogen loads and annual flow, 2005–19 at site 614121.

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

Peel Main Drain

Nitrogen (2019)

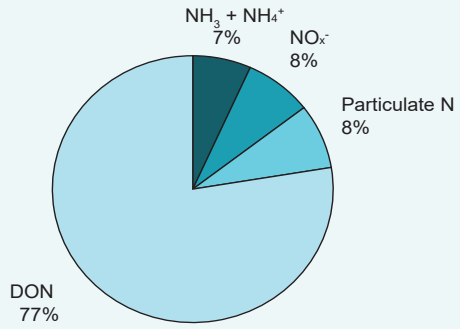
Types of nitrogen

Total N is made up of 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 types. Most types of DON need to be further broken down to become available to plants and algae, though some types are readily bioavailable. Only a small portion of N was present as readily bioavailable dissolved inorganic N (DIN – consisting of nitrate, NO_x^- and total ammonia, $NH_3 + NH_4^+$). Likely sources of these kinds of N include fertilisers and animal wastes as well as natural sources.

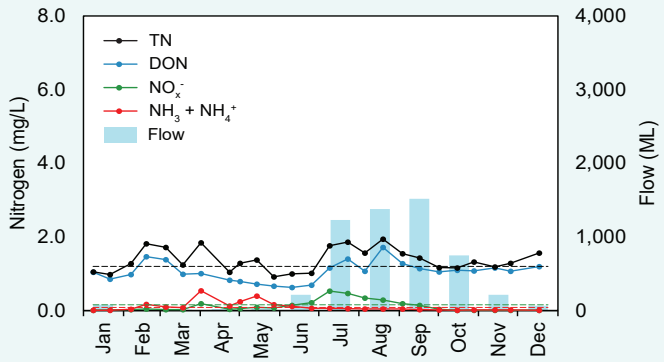
Concentrations

All types of N except total ammonia showed a seasonal pattern, increasing in July as rainfall and flow increased, and generally being higher during the wetter part of the year. This increase is likely because of a first flush effect where N was entering the drain 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 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. Unlike in 2018, N concentrations were also high early in the year, when streamflow was lower, including a peak in total ammonia in early April. It is likely that N at this time was coming from groundwater as well as a point source close to the sampling site (total ammonia tends to be rapidly converted to nitrate).

Peel Main Drain



2019 average nitrogen fractions at site 614121.



2019 nitrogen concentrations and monthly flow at 614121. 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 weir at the Peel Main Drain sampling site, May 2007.

Peel Main Drain

Phosphorus over time (2005–19)

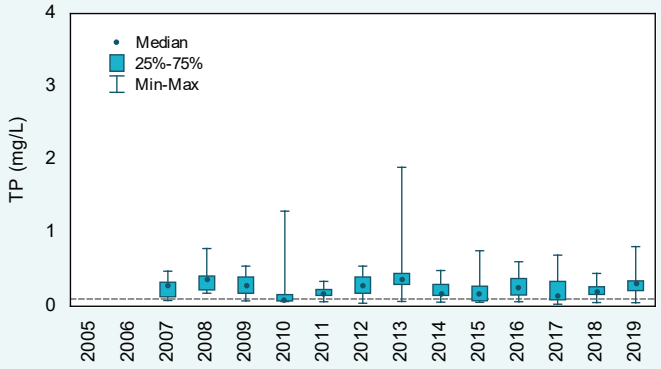
Concentrations

Annual total phosphorus (TP) concentrations were classified as very high using the SWRWQA methodology. With the exception of 2010, all annual medians were above the protection plan water quality target for TP concentrations. Why the range in TP concentrations was much greater in 2010 and 2013 than other years is unclear.

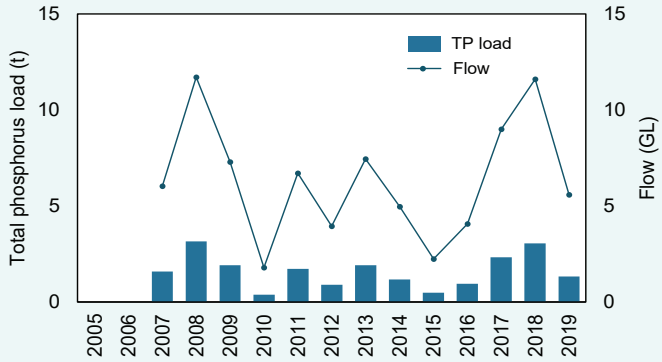
Estimated loads

Estimated TP 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 2019, the site had an estimated TP load of 1.33 t. The load per square kilometre of 11.3 kg/km^2 was also moderate. TP loads were closely related to flow volume; years with large annual flow volumes had large TP loads and vice versa.

Peel Main Drain



Total phosphorus concentrations, 2005–19 at site 614121. The dashed line is the protection plan TP target.



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

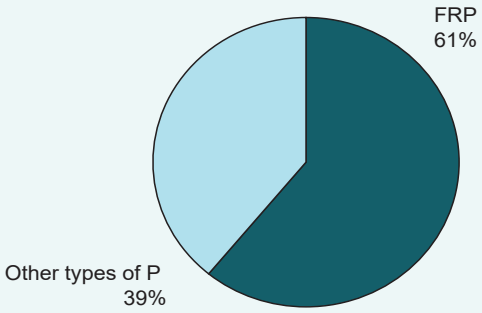
Types of phosphorus

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 phosphate; measured as filterable reactive P (FRP), which in surface waters is mainly present as phosphate (PO_4^{3-}) species. The phosphate was 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 (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 proportion of P present as phosphate was large compared with the other Peel-Harvey catchment sites, with the Peel Main Drain having the second largest proportion of P present as phosphate of the 13 sites sampled; only Gull Road Drain had a larger proportion of phosphate.

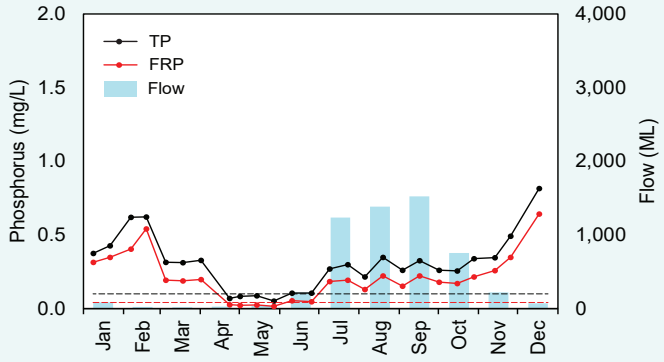
Concentrations

There was some evidence of a seasonal pattern in TP and phosphate 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 increased during the rest of the year. 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. 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.

Peel Main Drain



2019 average phosphorus fractions at site 614121.



2019 phosphorus concentrations and monthly flow at 614121. The dashed black line is the protection plan TP target, the red is the ANZECC trigger value for phosphate.

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

Peel Main Drain

Dissolved organic carbon over time (2005–19)

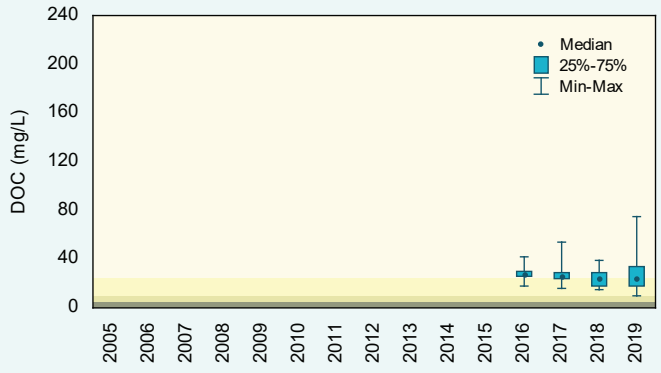
Concentrations

There were only four years with sufficient dissolved organic carbon (DOC) data to graph at the Peel Main Drain sampling site. Using the SWRWQA methodology, all years were classified as having a very high DOC concentration. The range in DOC was larger in 2019 than previous years though the reason for this is unknown.

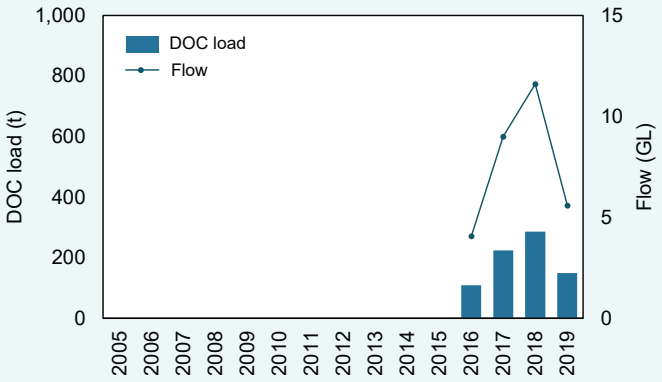
Estimated loads

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 2019, the estimated DOC load was 149 t. The load per square kilometre of 1,264 kg/km^2 was also 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.

Peel Main Drain



Dissolved organic carbon concentrations, 2005–19 at site 614121. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2005–19 at site 614121.

low moderate high very high

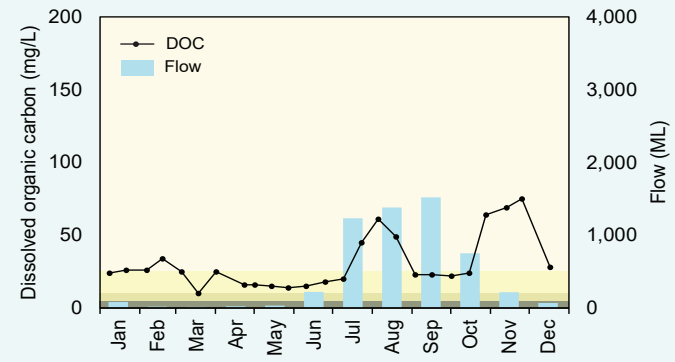
Peel Main Drain flowing through farmland, July 2002.

Dissolved organic carbon (2019)

Concentrations

Dissolved organic carbon concentrations varied in 2019 at the Peel Main Drain sampling site. There was a peak in early August, which coincided with the small dip in TN and TP concentrations. There was also a peak from October to November, the reason for which is unclear. 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 from agricultural land and natural organic matter in soils and wetland. It varies widely in its bioavailability.

Peel Main Drain



2019 dissolved organic carbon concentrations and monthly flow at 614121. The shading refers to the SWRWQA classification bands.

low moderate high very high

Peel Main Drain flowing through paddocks, August 2004.

Peel Main Drain

Total suspended solids over time (2005–19)

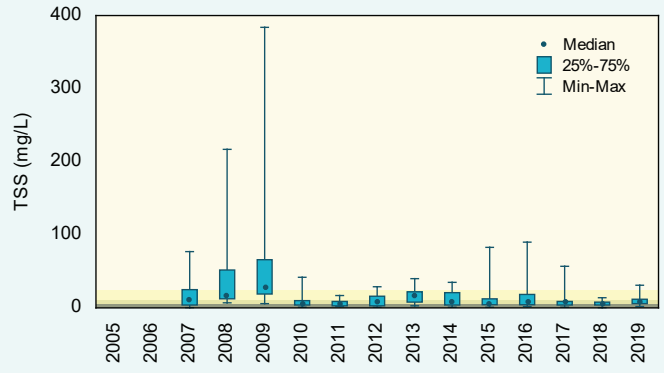
Concentrations

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. Using the SWRWQA methodology, all years from 2012 were classified as having moderate TSS concentrations, with earlier years classified as high.

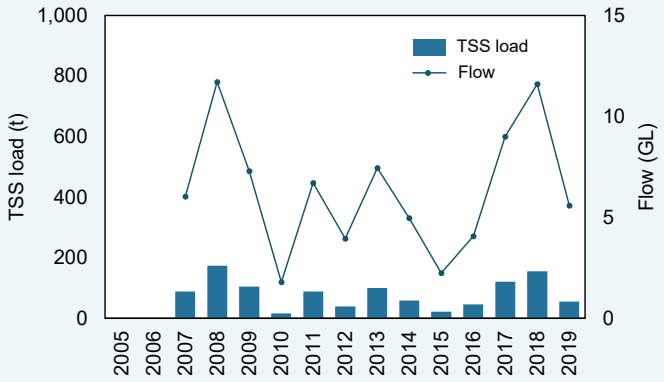
Estimated loads

Estimated TSS 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 2019, the estimated TSS load at this site was 55 t. The load per square kilometre of 465 kg/km^2 was large 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.

Peel Main Drain



Total suspended solids concentrations, 2005–19 at site 614121. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2005–19 at site 614121.

low moderate high very high

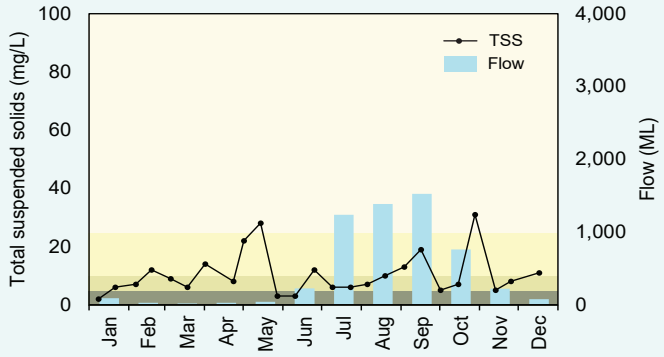
Cattle with unrestricted access to Peel Main Drain, October 2006.

Total suspended solids (2019)

Concentrations

In 2019, TSS concentrations fluctuated during the year with a number of peaks present. The reason for the peaks is unknown, they may have been caused by particulate matter being washed into the drain or being disturbed from the beds or banks of the drain. Overall, 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



2019 total suspended solids concentrations and monthly flow at 614121. The shading refers to the SWRWQA classification bands.

low moderate high very high

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

Peel Main Drain

pH over time (2005–19)

pH values

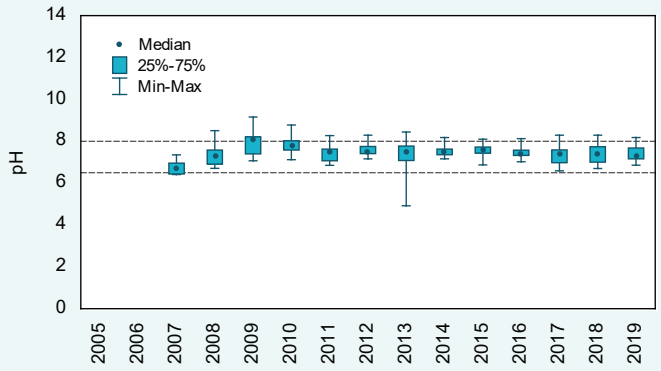
pH fluctuated over the reporting period at the Peel Main Drain sampling site. With the exception of 2009 (when it was above the upper trigger value), all annual medians were between the upper and lower Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values.

pH (2019)

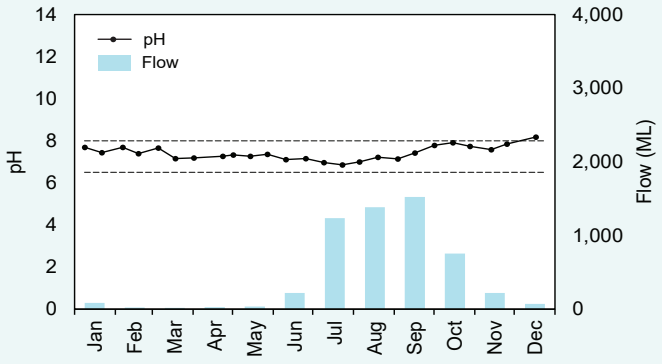
pH values

There was some evidence of a seasonal pattern in pH values at the Peel Main Drain sampling site. pH was slightly higher 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, 2005–19 at site 614121. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels and monthly flow at 614121. The dashed lines are the upper and lower ANZECC trigger values.

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

Peel Main Drain

Salinity over time (2005–19)

Concentrations

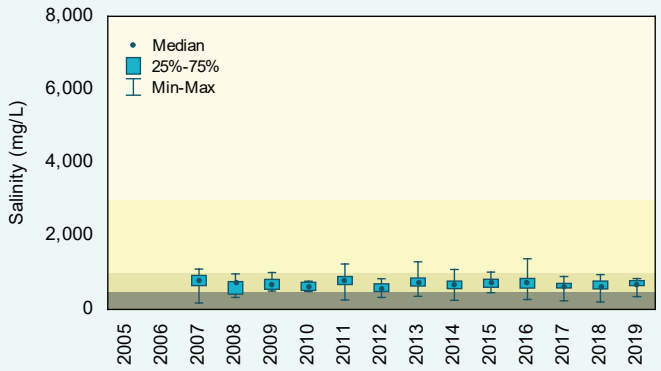
Salinity at the Peel Main Drain fluctuated over the reporting period, though all years were classified as marginal using the Water Resources Inventory 2014 salinity ranges (note in 2018, the SWRWQA bands were used).

Salinity (2019)

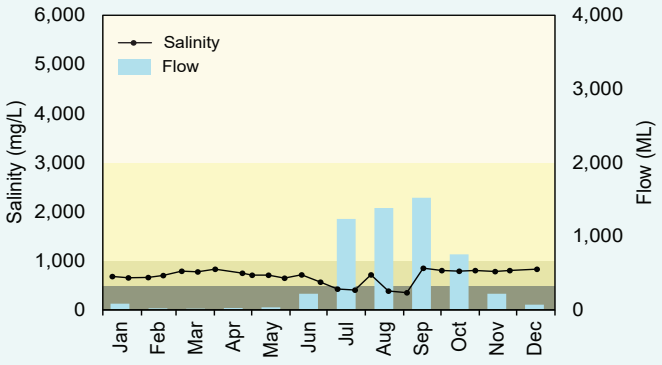
Concentrations

Salinity showed a slight seasonal pattern. Concentrations were fairly consistent during the first part of the year before reducing in June after the onset of winter rains. They then increased again in September, 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, the surface runoff becomes more salty. The groundwater is likely to be more saline than the surface water at this site. The peak in August was probably the result of a dry spell which led to a larger proportion of groundwater in the drain than is usual at this time.

Peel Main Drain



Salinity concentrations, 2005–19 at site 614121. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity and monthly flow at 614121. The shading refers to the Water Resources Inventory 2014 salinity ranges.

fresh marginal brackish saline

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

Peel Main 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.

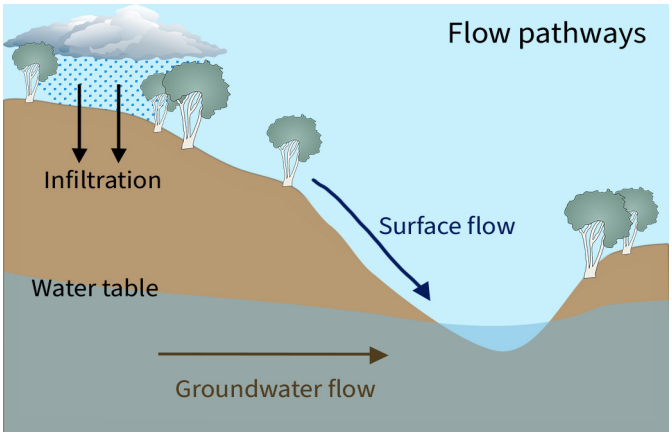
Laboratory limit of reporting: (LOR) this is the lowest concentration of an analyte that can be reported by a laboratory.

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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