Harvey River

This data report provides a summary of the nutrients at the Harvey River 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 river flows 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

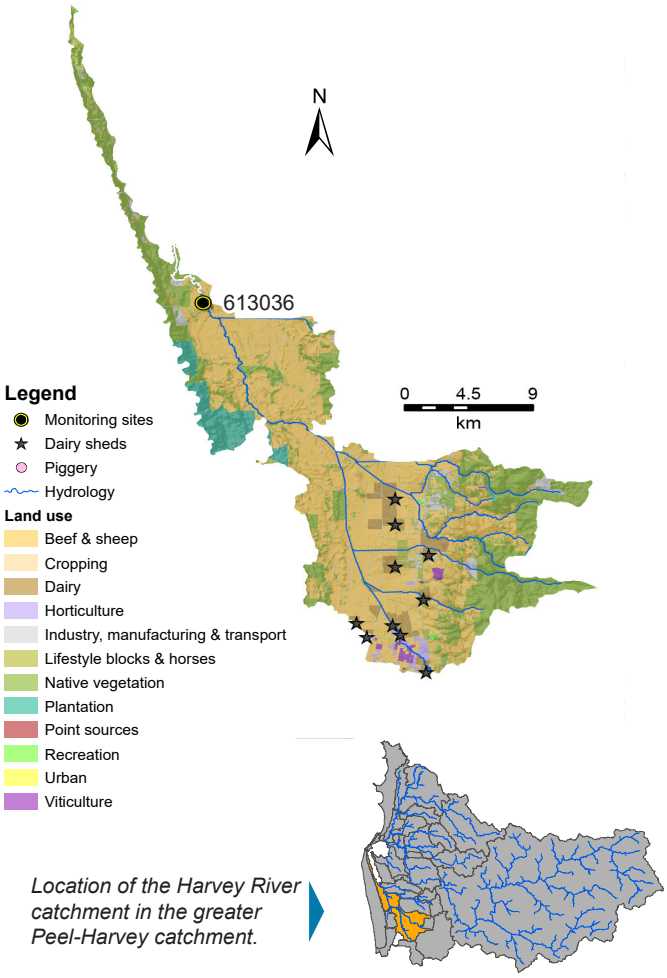
The reported portion of the Harvey River has a catchment area of about 375 km^2 (the total catchment area that contributes flow to the sampling site is about 400 km^2). More than half has been cleared for agriculture, predominantly beef and sheep grazing. There are a number of dairy sheds in the catchment. Upstream of the catchment is the Harvey Dam, on the Harvey River. While the portion of the river close to the Harvey Estuary retains a natural form, much of the river has been converted into a straight drain and there are numerous other drains constructed in the catchment to rapidly remove water from farmland. Some fringing vegetation remains along the more natural section of the river; however, there is very little along the drains.

Most of the soils in the coastal plain portion of the catchment, where much of the agriculture is, have 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.

Since 2017, water quality is measured at site 613036, Forrest Highway, where the river passes under Forrest Highway on the border of Lake Clifton and Waroona. Before this, it was measured at site 613052, Clifton Park, a few hundred meters downstream of Forrest Highway.

Results summary

Nutrient concentrations (total nitrogen and total phosphorus) were moderate to high at the Harvey River sampling site. Nutrient loads as well as the loads per square kilometre were large compared with the other Peel-Harvey catchment sites. The highly modified nature of the catchment and river, and agricultural land use, collectively contribute to most of the high nutrient concentrations and large loads observed.



Location of the Harvey River catchment in the greater Peel-Harvey catchment.

Facts and figures

Sampling site code	613036
Catchment area	375 km^2
Per cent cleared area (2015)	67 per cent
River flow	Permanent
Annual flow (2018)	127 GL
Main land use (2015)	Beef and sheep grazing and native vegetation

Harvey River

Nitrogen over time (2004–18)

Concentrations

Total nitrogen (TN) concentrations at the Harvey River sampling site fluctuated over the reporting period. The annual median concentration was above the Australian and New Zealand Environment and Conservation Council (ANZECC) trigger value in five of the 15 years presented. In 2018, the Harvey River site had the fifth-lowest median TN concentration of the 13 sites sampled in the Peel-Harvey catchment.

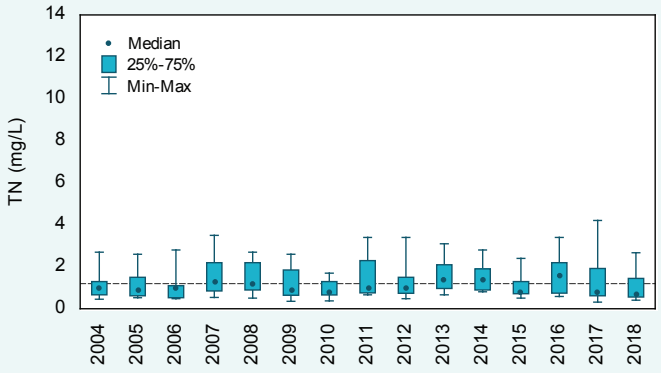
Trends

There was a short-term (2014–18) decreasing trend present in TN concentrations of 0.09 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 the water quality is getting better at this site. There was no long-term (2004–18) trend present.

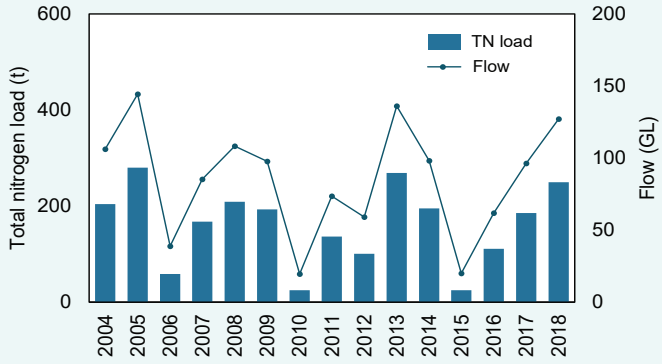
Estimated loads

Estimated TN loads at the Harvey River sampling site were large compared with the other sites in the Peel-Harvey catchment. In 2018, the Harvey River had an estimated TN load of 250 t, the largest TN load of those catchments which had the majority of their catchment on the Swan Coastal Plain and the second largest of the 10 sites where it was possible to calculate loads. Only the site in the Middle Murray Catchment had a larger load of 401 t. The load per unit area was also large, at 624 kg/km^2 in 2018, the largest load per unit area 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.

Harvey River



Total nitrogen concentrations, 2004–18 at site 613036. The dashed line is the ANZECC trigger value for lowland rivers.



Total nitrogen loads and annual flow, 2004–18 at site 613036.

A drain in the Harvey River catchment. Almost all the fringing vegetation is exotic, mostly a mix of Watsonia and grasses, October 2001.

Nitrogen (2018)

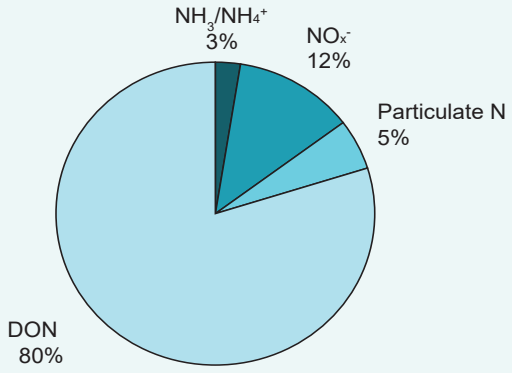
Types of nitrogen

Total N is made up of many different types of N. In the Harvey River, four-fifths of the N was present as dissolved organic N (DON). This type of N consists mainly of degrading plant and animal matter but may include other forms. DON varies in its bioavailability; plant and animal matter usually needs to be further broken down before becoming available whereas other forms are readily bioavailable. Fifteen per cent of the N was present as dissolved inorganic N (DIN—consisting of oxides of N, NO_x^-, and ammonia N, NH_3/NH_4^+). These forms of N are likely sourced from fertilisers and animal wastes as well as mineralisation of organic N in soils, streams and drains, and are readily bioavailable for plants and algae to use to fuel rapid growth.

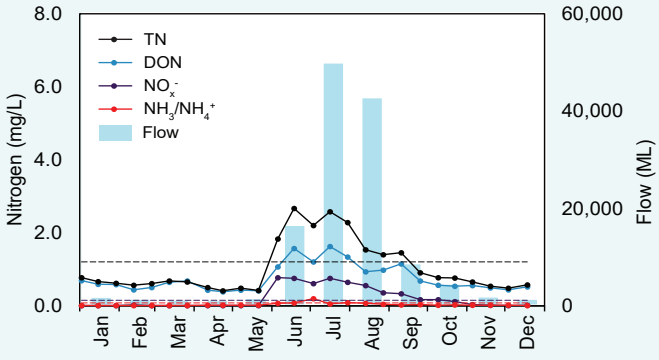
Concentrations

In 2018, there was a seasonal pattern in all forms of N at the Harvey River site, though it was less evident in NH_3/NH_4^+ than the other forms. The peak in June is likely because of a first flush effect where N was mobilised following heavy rainfall. Much of this N was likely to be the result of mineralisation of organic N in soils, streams and drains over the summer period, and runoff from grazing land, which builds up with animal waste and fertiliser over the drier months as well as organic N washing in from soils and remnant wetlands where it had built up over the same period. TN, DON and NO_x^- concentrations remained high during July and August, only starting to fall near the end of August as rainfall and runoff started to ease, suggesting that proportionally more N at this site is coming from surface flows rather than shallow groundwater.

Harvey River



2018 average nitrogen fractions at site 613036.



2018 nitrogen concentrations and monthly flow at 613036. The dashed lines are the ANZECC trigger values for lowland rivers for the different N species.

The Harvey River at the sampling site. The river is choked with macrophytes covered in filamentous algae, March 2016

Phosphorus over time (2004–18)

Concentrations

Total phosphorus (TP) concentrations fluctuated over the reporting period. The annual median concentrations were above the Peel-Harvey Water Quality Improvement Plan (WQIP) target in 10 of the past 15 years. In 2018, the Harvey River sampling site had the fourth-lowest median TP concentration of the 13 sites sampled in the Peel-Harvey catchment.

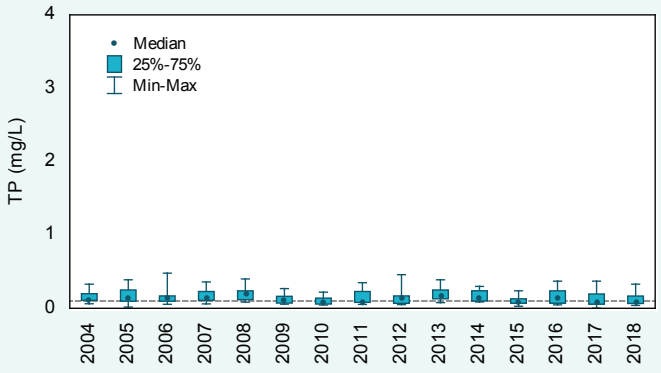
Trends

There was a short-term (2014–18) decreasing trend present in TP concentrations of 0.008 mg/L/yr. This may be because of natural fluctuations at this site or an actual decrease in TP concentrations. Ongoing monitoring will help determine if the water quality is getting better at this site. There was no long-term (2004–18) trend present.

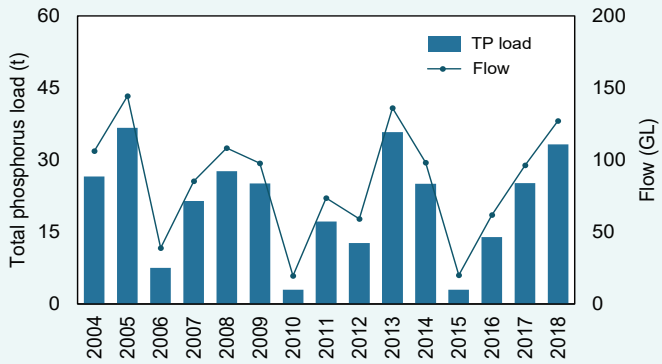
Estimated loads

Estimated TP loads at the Harvey River sampling site were large compared with the other sites in the Peel-Harvey catchment. In 2018, the site had an estimated TP load of 33 t and a load per unit area of 83 kg/km^2, both of which were the largest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The TP load was more than double the size of the next largest load at the Upper Serpentine site of 13 t. TP loads were closely related to flow volume, years with high annual flow having large TP loads and vice versa.

Harvey River



Total phosphorus concentrations, 2004–18 at site 613036. The dashed line is the Peel-Harvey WQIP target for winter median TP concentrations.



Total phosphorus loads and annual flow, 2004–18 at site 613036.

Staff gauges at the Harvey River sampling site, March 2017.

Phosphorus (2018)

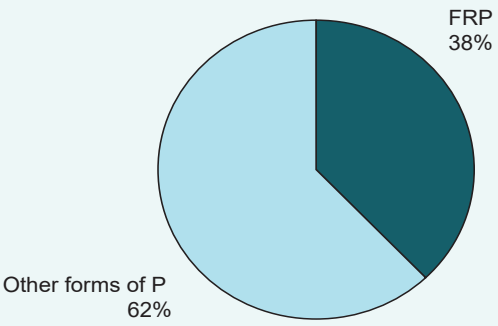
Types of phosphorus

Total P is made up of different types of P. At the Harvey River sampling site, nearly two-thirds of the P was present as either particulate P, 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 remainder of the P was present as filterable reactive P (FRP) which is readily bioavailable. FRP was probably derived from animal waste and fertilisers as well as natural sources.

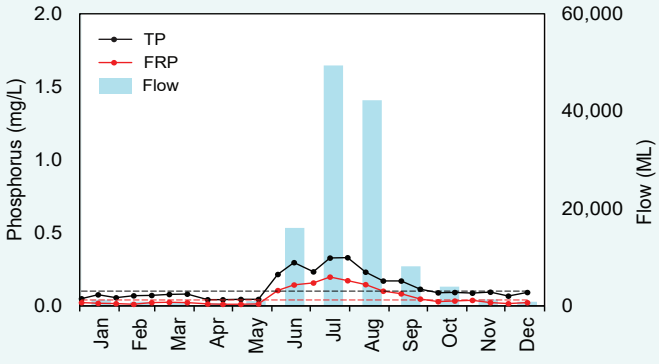
Concentrations

Total P and FRP showed a seasonal pattern, increasing in June when rainfall and flow increased before decreasing again later in the year, when rainfall and flow eased. The increase in June was because of the start of winter rains washing P into the river from the surface soils of the mostly farmed land adjacent to the rivers. It is likely P is entering the river via surface flows with a minor contribution from shallow groundwater. P is also likely to be coming from in-stream sources such as erosion of banks and sediment-filled pools.

Harvey River



2018 average phosphorus fractions at site 613036.



2018 phosphorus concentrations and monthly flow at 613036. The dashed black line is the Peel-Harvey WQIP target, the red line is the ANZECC trigger values for lowland rivers.

Collecting flow measurements at the Harvey River sampling site, July 2016

Dissolved organic carbon over time (2004–18)

Concentrations

Dissolved organic carbon (DOC) concentrations fluctuated over the reporting period at the Harvey River sampling site. Using the Statewide River Water Quality Assessment (SWRWQA) classification bands, all annual medians were classified as high. Compared with the other sites in the Peel-Harvey catchment, DOC concentrations were moderate, with the Harvey River site having the fifth-lowest annual median in 2018.

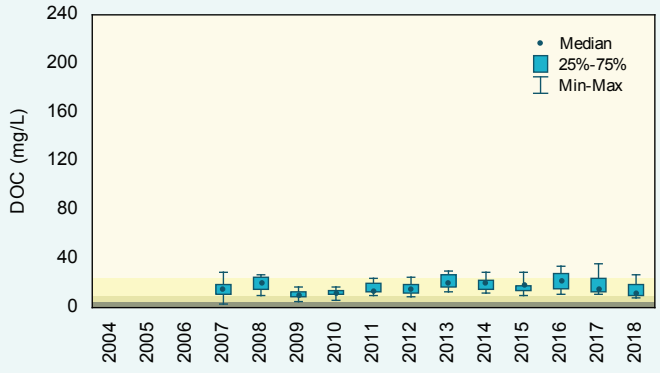
Trends

There was a short-term (2014–18) decreasing trend present in DOC concentrations of 1 mg/L/yr. This may be because of natural fluctuations at this site or an actual decrease in DOC concentrations. Ongoing monitoring will help determine if the water quality is changing at this site. There was no long-term (2007–18) trend present.

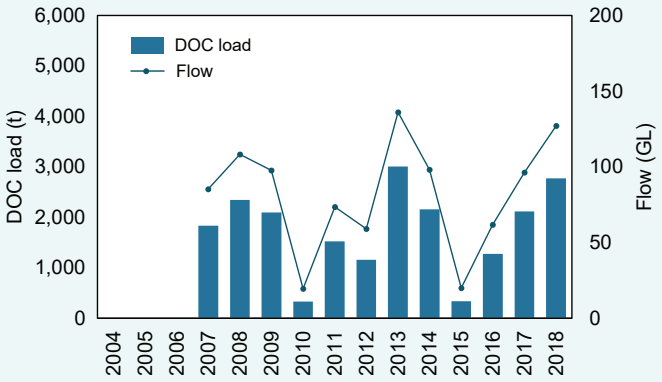
Estimated loads

Estimated DOC loads at the Harvey River sampling site were large compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated DOC load was 2,773 t, the second largest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. The load per unit area of 6,933 kg/km^2 was the largest of the Peel-Harvey catchment sites. DOC loads were closely related to flow volume, years with high annual flow having large DOC loads and vice versa.

Harvey River



Dissolved organic carbon, 2004–18 at site 613036. The shading refers to the SWRWQA classification bands.



Dissolved organic carbon loads and annual flow, 2004–18 at site 613036.

very high high moderate low

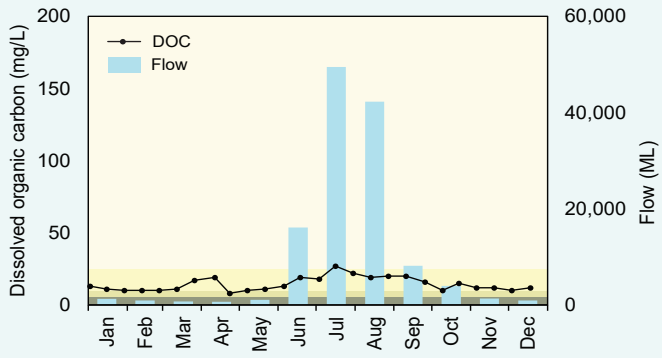
The rock weir at the Harvey River sampling site, March 2017.

Dissolved organic carbon (2018)

Concentrations

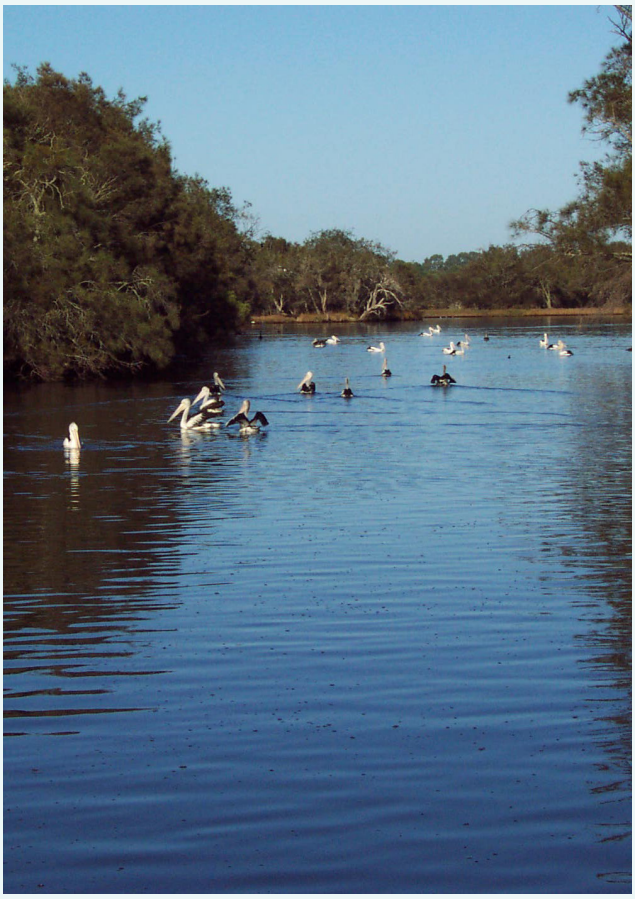
Dissolved organic carbon concentrations showed a seasonal pattern at the Harvey River sampling site. Concentrations increased in May to June as rainfall and flow increased before peaking in July. After the peak, concentrations fell again. There was also a peak in March to April; the reason for this peak is unknown. 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. At the Harvey River sampling site, DOC was coming from surface flow and groundwater as well as in-stream sources.

Harvey River



2018 dissolved organic carbon concentrations and monthly flow at 613036. The shading refers to the SWRWQA classification bands.

very high high moderate low



Pelicans on the Harvey River, April 2004.

Harvey River

Total suspended solids over time (2004–18)

Concentrations

Total suspended solids (TSS) concentrations fluctuated over the reporting period. Using the SWRWQA classification bands, four years had an annual median concentration classified as high (2006–08 and 2013), while the remainder were classified as low.

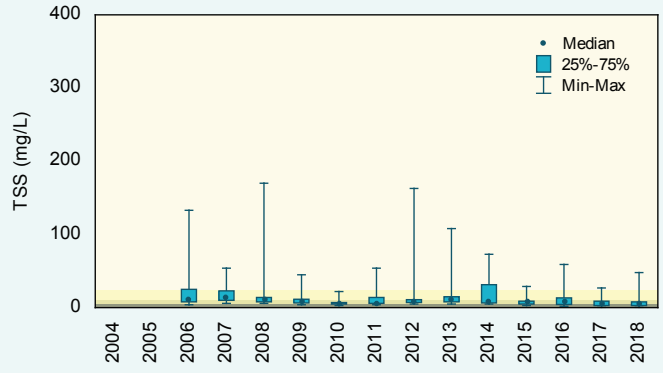
Trends

There was a short-term (2014–18) decreasing trend in TSS concentrations of 1 mg/L/yr. This may be because of natural fluctuations at this site or an actual decrease in TSS concentrations. Ongoing monitoring will help determine if the water quality is changing at this site. There was no long-term (2006–18) trend present.

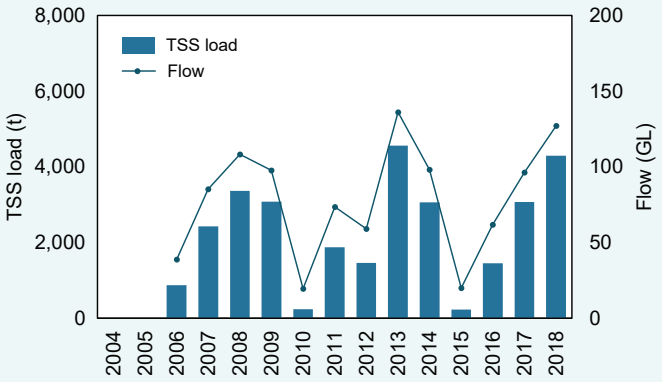
Estimated loads

Estimated TSS loads at the Harvey River sampling site were large compared with the other sites in the Peel-Harvey catchment. In 2018, the estimated TSS load at this site was 4,288 t, the largest of the 10 sites in the Peel-Harvey catchment where it was possible to calculate loads. It also had the largest load per unit area (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.

Harvey River



Total suspended solids concentrations, 2004–18 at site 613036. The shading refers to the SWRWQA classification bands.



Total suspended solids loads and annual flow, 2004–18 at site 613036.

very high high moderate low

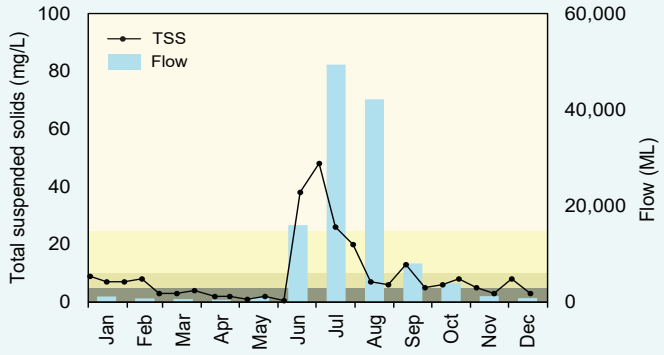
A walkway over the Harvey River. Note the grazing land in the background, beef and sheep grazing is a major land use in the Harvey River catchment, October 2001.

Total suspended solids (2018)

Concentrations

There was a seasonal pattern present in the 2018 TSS concentrations at the Harvey River sampling site. Concentrations peaked sharply in June, following the onset of winter rains, before falling again. Heavy rainfall in June washed particulate material that had accumulated over the drier months into the river as well as mobilising any that was present in dry drains or streams in the catchment. In-stream erosion was also contributing particulate matter.

Harvey River



2018 total suspended solids concentrations and monthly flow at 613036. The shading refers to the SWRWQA classification bands.

very high | high | moderate | low

Revegetation on the bank of the Harvey River at the sampling site. This helps stabilise the banks and reduces erosion, December 2008.

Harvey River

pH over time (2004–18)

pH values

pH fluctuated over the reporting period with all annual median concentrations within the upper and lower ANZECC trigger values. Only six years had any samples which lay above or below the ANZECC trigger values, and the number of these samples were very low.

Trends

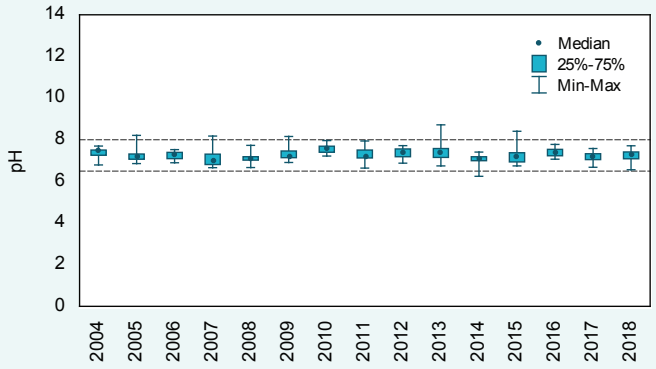
There was no trend in pH levels at the Harvey River site over either the short- (2014–18) or long-term (2004–18).

pH (2018)

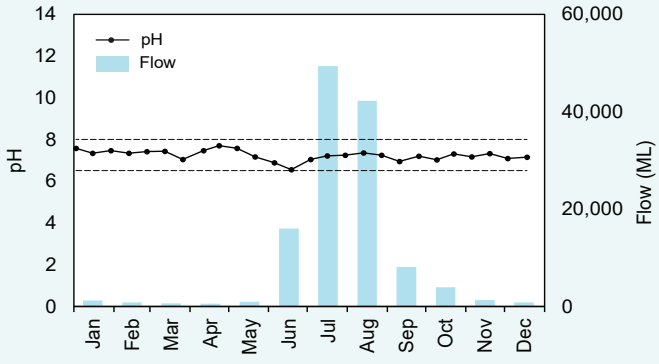
pH values

In 2018, all samples collected at the Harvey River site fell within the upper and lower ANZECC trigger values. Values fluctuated over the year with no clear evidence of a seasonal pattern present.

Harvey River



pH levels, 2004–18 at site 613036. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.



2018 pH levels and monthly flow at 613036. The dashed lines are the upper and lower ANZECC trigger values for lowland rivers.

The old Harvey River sampling site at Clifton Park, August 2012.

Harvey River

Salinity over time (2004–18)

Concentrations

Salinity was generally low at the Harvey River sampling site with all annual median concentration classified as low using the SWRWQA bands except 2016, when it was marginal. While it appears that salinities may have increased over time, this was not verified by trend testing. Why salinities appeared higher from 2015–17 is unknown.

Trends

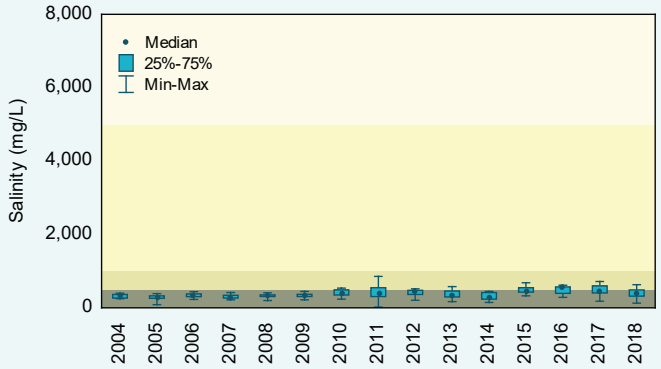
There was neither a short- (2014–18) or long-term (2004–18) trend in salinity at the Harvey River sampling site.

Salinity (2018)

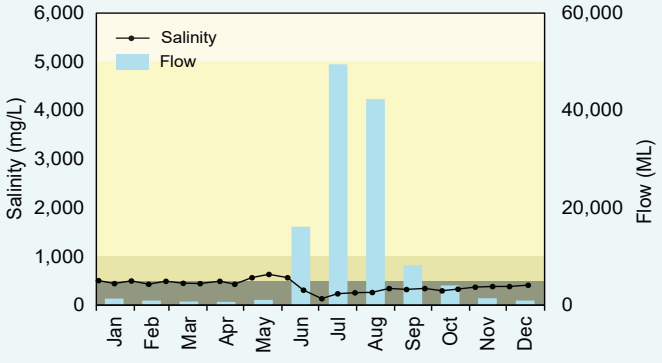
Concentrations

Salinity concentrations were stable in the early part of the year before increasing slightly in May before a relatively large decrease in June to early July when winter rainfall and flows commenced. After the lowest concentration recorded in July, salinity increased again slowly during the rest of the year. This suggests the groundwater at this site is slightly more saline than the surface water. During the first part of the year, a larger proportion of the water in the river will be from groundwater. It is important to note that while there was a pattern present in salinity at this site, concentrations were low year round.

Harvey River



Salinity concentrations, 2004–18 at site 613036. The shading refers to the SWRWQA classification bands.



Salinity concentrations and monthly flow at 613036. The shading refers to the SWRWQA classification bands.

saline brackish marginal fresh

High flows at the Harvey River sampling site, July 2018.

Harvey River

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.

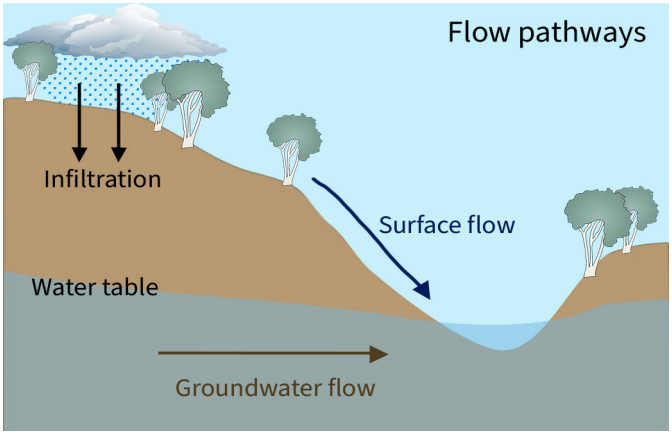
Evapoconcentration: the increase in concentration of a substance dissolved in water because of water being lost by evaporation.

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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