

# Four Acres

This data report provides a summary of the nutrients at the two Four Acres sampling sites in 2019 as well as historical data from 2005–19. This report was produced as part of Healthy Estuaries WA. Downstream of these sites, the stream enters the Scott River and subsequently the Hardy Inlet.

## About the catchment

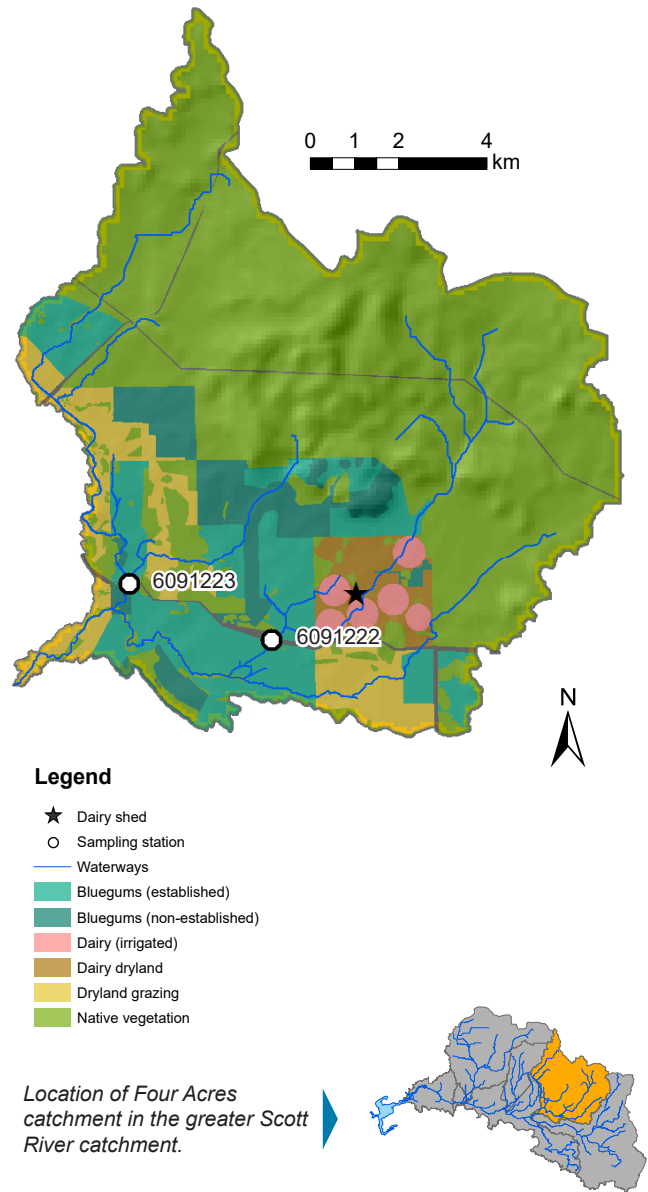
Four Acres has a catchment area of about 130 km<sup>2</sup>, nearly two-thirds of which is covered in native vegetation. Other main land uses include bluegum plantations and dryland grazing. There are also areas of irrigated and dryland dairy present and a dairy shed. In some areas, drains have been constructed to help reduce waterlogging, which increases the speed that water leaves the catchment and enters the waterways. In the agricultural areas, much of the fringing vegetation has been lost along the waterways.

Most of the soils in the cleared portion of the catchment 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.

There are two sites monitored in the Four Acres catchment, on two different waterways. Site 6091223, Electric Fence – 4 Acres is downstream of where the stream passes under Four Acres Road. Upstream of this site are bluegum plantations and dryland beef grazing, and then extensive areas of native vegetation. Site, 6091222, S Bend, is on a different stream, just downstream of where it passes under Four Acres Road. Immediately upstream of this site are bluegum plantations then dryland and irrigated dairy, as well as a dairy shed.

## Results summary

Nutrient concentrations (total nitrogen and total phosphorus) were classified as high at Electric Fence – 4 acres and very high at S Bend. The proportion of nitrogen present as total ammonia at S Bend was extremely high, suggesting that effluent from the upstream dairy shed is entering the waterway. Nutrient concentrations, especially nitrogen, were higher in 2019 than previous years at S Bend. The lack of fringing vegetation and the construction of drains to reduce surface water ponding means nutrients can be washed from soils to waterways and be transported downstream quickly rather than being assimilated.



## Facts and figures

Sampling site code	6091223 (Electric Fence – 4 Acres) 6091222 (S Bend)
Catchment area	130 km <sup>2</sup>
Per cent cleared area (2009)	35 per cent
River flow	Ephemeral
Main land use (2009)	Native vegetation, bluegum plantations and dryland grazing

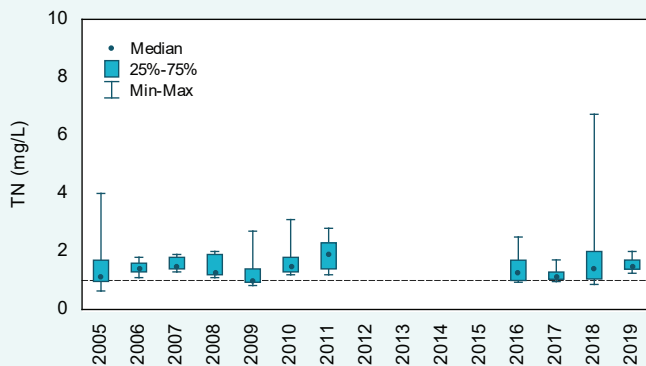
# Four Acres

## Nitrogen over time (2005–19)

### Concentrations

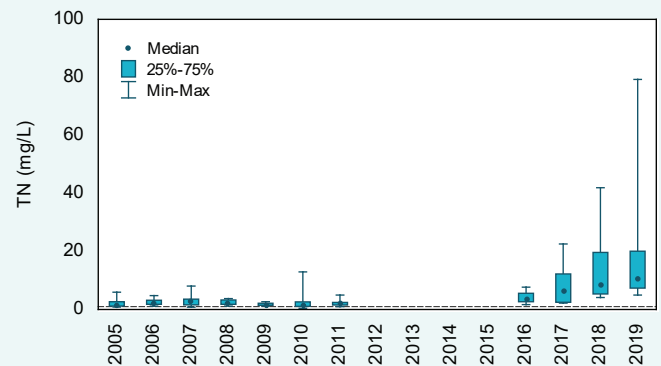
Using the State Wide River Water Quality Assessment (SWRWQA) methodology, annual total nitrogen (TN) concentrations were classified as moderate in 2005 and high every year since then at Electric Fence – 4 Acres. At S Bend, annual TN concentrations were classified as high in 2005–07 and 2011 and very high in all other years. The annual median TN concentration has been at or above the Water Quality Improvement Plan (WQIP) target for TN concentrations of 1 mg/L every year at both sites (note the different vertical axes in the two graphs below; TN concentrations were much higher at S Bend than Electric Fence – 4 Acres). At S Bend, TN concentrations were much higher after the break in monitoring and appear to be increasing. The 2019 median TN concentration at S Bend was substantially higher than the other eight sites sampled in the Scott River catchment (S Bend had a 2019 median of 10.8 mg/L and Coonack Downs had the next highest median, of 3.0 mg/L).

### Electric Fence – 4 Acres



Total nitrogen concentrations, 2005–19 at site 6091223. The dashed line is the Scott River WQIP target for median TN concentrations.

### S Bend



Total nitrogen concentrations, 2005–19 at site 6091222. The dashed line is the Scott River WQIP target for median TN concentrations.



The Electric Fence – 4 Acres sampling site in October. Note the lack of fringing vegetation.

# Four Acres

## Nitrogen (2019)

### Types of nitrogen

Total N is made up of different types of N. The relative proportions of N at the two sites in the Four Acres catchment were very different. At S Bend, the proportion of total ammonia ( $\text{NH}_3 + \text{NH}_4^+$ ) was the highest of all the sites sampled in the Scott River catchment (69 per cent, the next highest proportion was present at Coonack Downs which had 53 per cent). This type of N is bioavailable to plants and algae, and is used to fuel rapid growth. It is likely that this type of N was coming from the dairy farm upstream as it is found in high concentrations in animal waste. This site also had very low dissolved oxygen concentrations, most likely because of the presence of dairy effluent entering the waterway. The proportions of N at this site are typical of sites where there is a point source present not far upstream.

### Concentrations

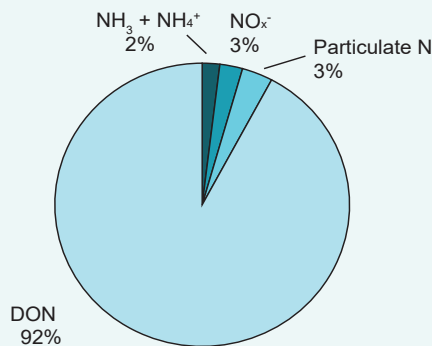
N concentrations at Electric Fence – 4 Acres were highest in June to August, when the stream flow was

largest. It is likely that the N present at this time was the result of mineralisation of organic N in soils and drains over the summer period, and runoff of high-concentration waters from irrigated pasture which builds up with fertiliser and animal waste over the summer. The large peak in nitrate ( $\text{NO}_x^-$ ) concentrations evident as a first flush effect in 2018 was not present in 2019.

At S Bend, a reverse seasonal pattern was evident, similar to 2018. It is likely the large peaks in TN and total ammonia in the first half of the year were because of dairy effluent entering the waterway. While this entered the waterway year round, it was diluted during the winter months when there was more water in the stream from other sources. The concentrations of N, especially TN and total ammonia seen at S Bend, are extremely high, and much higher than occurs naturally in streams in the south-west of Western Australia.

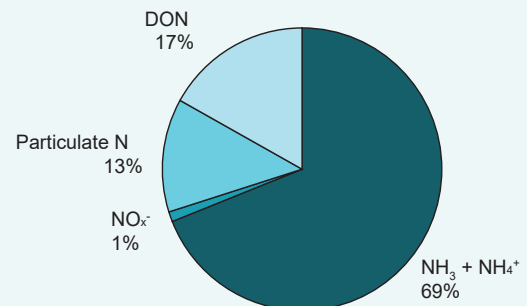
Where there are no data in the graph, the site was not flowing.

### Electric Fence – 4 Acres

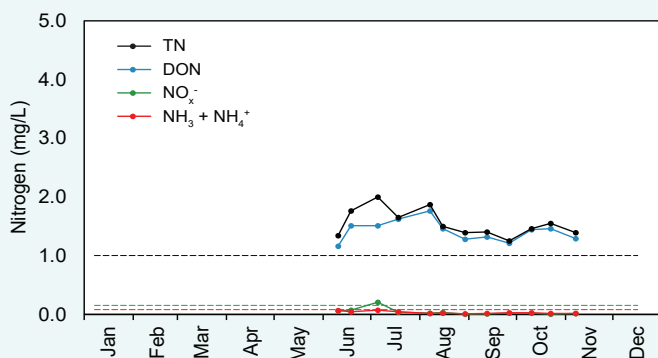


2019 average nitrogen fractions at site 6091223.

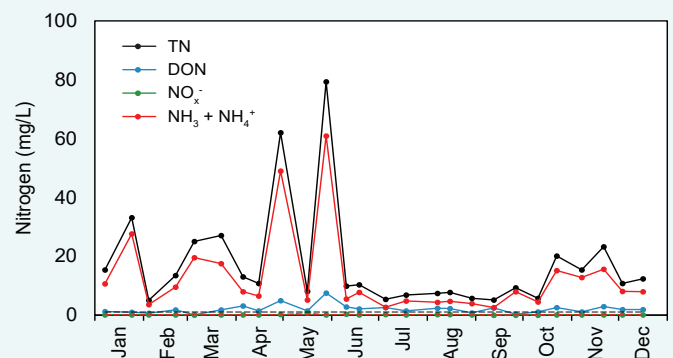
### S Bend



2019 average nitrogen fractions at site 6091222.



2019 nitrogen concentrations at 6091223. The black dashed line is the Scott River WQIP target for TN, the red and green lines are the ANZECC trigger values for total ammonia and nitrate.



2019 nitrogen concentrations at 6091222. The black dashed line is the Scott River WQIP target for TN, the red and green lines are the ANZECC trigger values for total ammonia and nitrate.



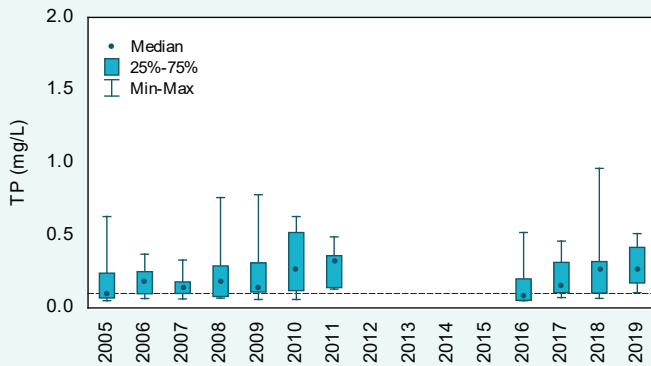
# Four Acres

## Phosphorus over time (2005–19)

### Concentrations

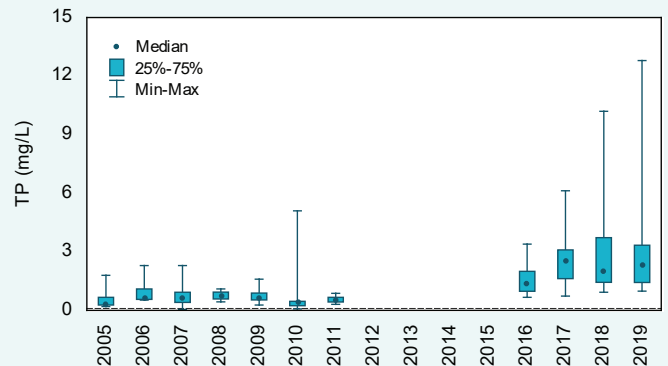
While TP concentrations were high at Electric Fence – 4 Acres, they were much higher again at S Bend (note that the vertical axes on the two graphs below are different). TP concentrations at both sites fluctuated over the reporting period, though at S Bend concentrations were higher after the break in monitoring and appear to be increasing. Using the SWRWQA methodology, all annual TP medians were classified as high at Electric Fence – 4 Acres and very high at S Bend. With the exception of 2005 and 2017 at Electric Fence – 4 Acres, all annual medians were above the WQIP target for TP concentrations of 0.1 mg/L.

### Electric Fence – 4 Acres



Total phosphorus concentrations, 2005–19 at site 6091223. The dashed line is the Scott River WQIP target for median TP concentrations.

### S Bend



Total phosphorus concentrations, 2005–19 at site 6091222. The dashed line is the Scott River WQIP target for median TP concentrations.



The S Bend sampling site in August.

# Four Acres

## Phosphorus (2019)

### Types of phosphorus

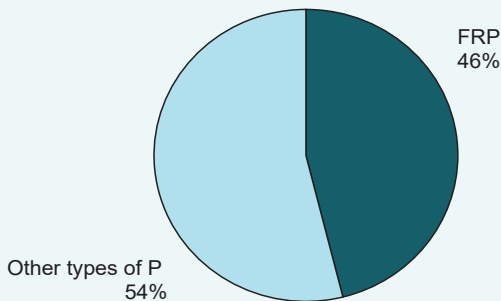
Total P is made up of different types of P. The proportion of P present as phosphate was high at both sites and the highest (S Bend) and third highest (Electric Fence – 4 Acres) of the Scott River sampling sites. Phosphate is measured as filterable reactive phosphorus (FRP); in surface waters this is mainly present as phosphate ( $\text{PO}_4^{3-}$ ) species and is readily bioavailable. The large proportion of phosphate is likely because of dairy effluent and irrigation returns in the streams. S Bend also had high TSS concentrations, which may explain why the proportion of phosphate at this site was not even higher; phosphate tends to bind to suspended sediments in the water column. The remainder of the P was present as particulate P or dissolved organic P (DOP), or both (labelled as 'Other types of P' in the pie chart below). Particulate P generally needs to be broken down before becoming bioavailable. The bioavailability of DOP varies and is poorly understood.

### Concentrations

At both sites, TP and phosphate concentrations showed a slight reverse seasonal pattern, with higher concentrations at the beginning and end of the flow year. At Electric Fence – 4 Acres, the high concentrations at the start of the flow year were possibly because of a first flush effect where rainfall washed P into the stream as well as mobilising any present in the dry stream. At S Bend, all samples collected were well above their WQIP target and Australian and New Zealand Environment and Conservation Council (ANZECC) trigger values. Dairy effluent and irrigation returns were likely contributing to the extremely high concentrations at this site year-round. However, during the wetter months, when flow was higher, concentrations were lower because of dilution by the water already present in the stream.

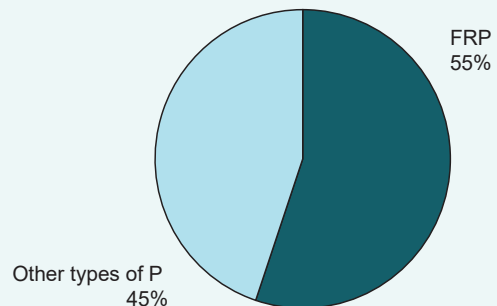
Where there are no data in the graph, the site was not flowing.

### Electric Fence – 4 Acres

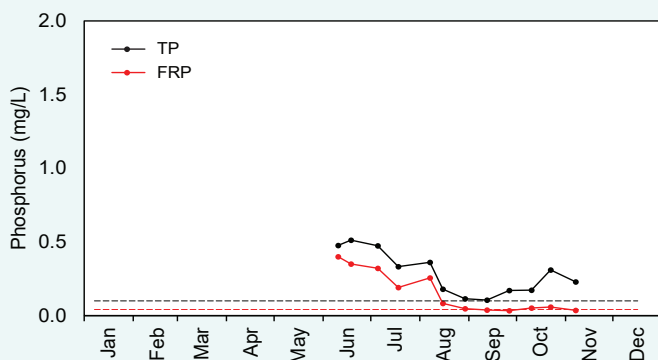


2019 average phosphorus fractions at site 6091223.

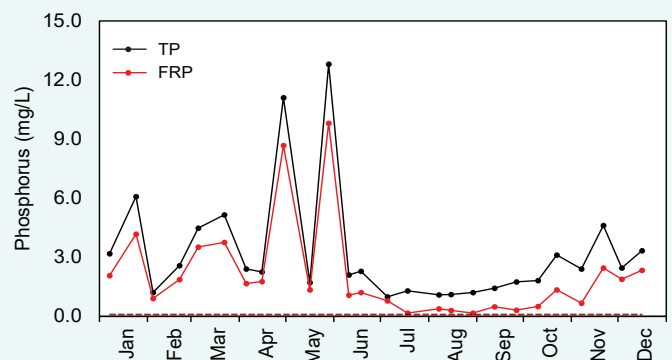
### S Bend



2019 average phosphorus fractions at site 6091222.



2019 phosphorus concentrations at 6091223. The black dashed line is the Scott River WQIP target for TP, the red is the ANZECC trigger value for phosphate.



2019 phosphorus concentrations at 6091222. The black dashed line is the Scott River WQIP target for TP, the red is the ANZECC trigger value for phosphate.

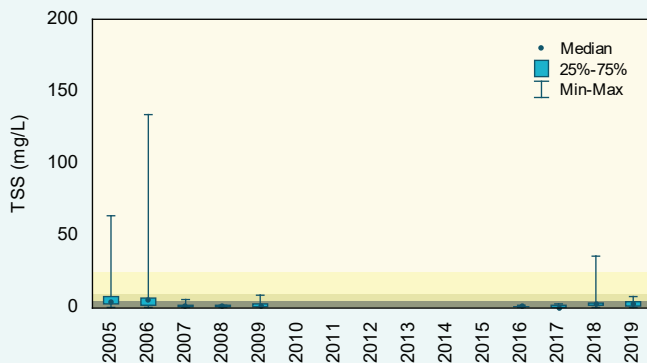
# Four Acres

## Total suspended solids over time (2005–19)

### Concentrations

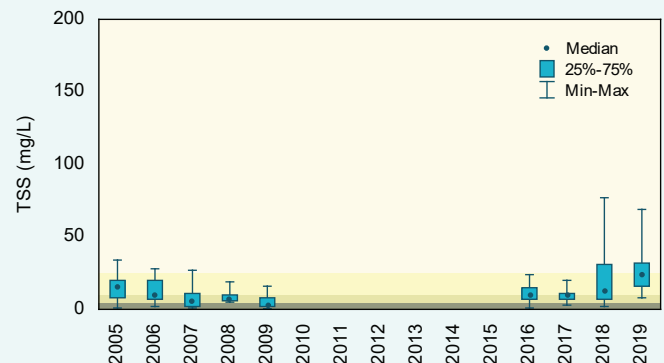
Annual total suspended solids (TSS) concentrations were classified as low using the SWRWQA methodology at Electric Fence – 4 Acres and moderate at S Bend except for 2019 when they were high. TSS concentrations at both sites fluctuated over the reporting period, though at S Bend they appear to be increasing since the break in monitoring. The 2019 median at S Bend was by far the highest of the Scott River catchment sites (25 mg/L, Coonack Downs had the next highest median at 9 mg/L).

### Electric Fence – 4 Acres



Total suspended solids concentrations, 2005–19 at site 6091223. The shading refers to the SWRWQA classification bands.

### S Bend



Total suspended solids concentrations, 2005–19 at site 6091222. The shading refers to the SWRWQA classification bands.

low      moderate      high      very high



The extremely high nutrient levels found at the S Bend sampling site encourage prolific growth of the exotic vegetation lining the waterway as well as floating macrophytes such as the duckweed or lemna seen in this photograph.



# Four Acres

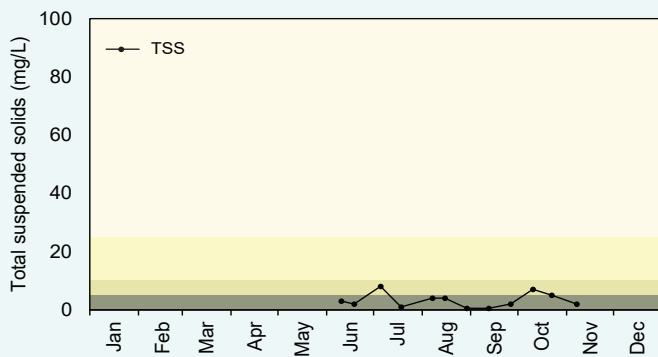
## Total suspended solids (2019)

### Concentrations

TSS concentrations fluctuated over the year at both sampling sites. Concentrations were much lower at Electric Fence – 4 Acres than S Bend. A lot of the particulate matter at S Bend was likely entering the stream from dairy effluent.

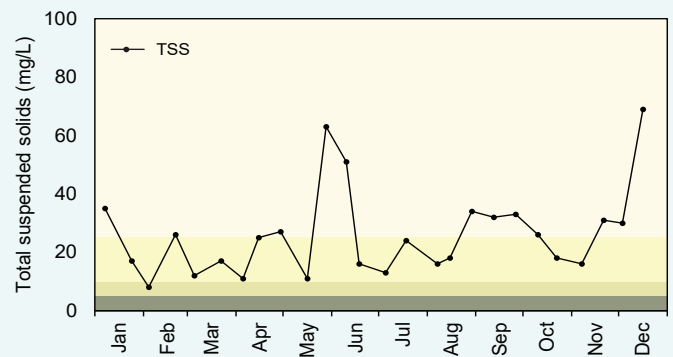
Where there are no data in the graph, the site was not flowing.

### Electric Fence – 4 Acres



2019 total suspended solids concentrations at 6091223. The shading refers to the SWRWQA classification bands.

### S Bend



2019 total suspended solids concentrations at 6091222. The shading refers to the SWRWQA classification bands.

low      moderate      high      very high



Looking upstream at the S Bend sampling site in October.

# Four Acres

## pH over time (2005–19)

### pH values

pH at both sites fluctuated in a similar pattern over the reporting period, though the variation was greater at S Bend than Electric Fence – 4 Acres. At both sites, the median pH was below the lower ANZECC trigger value on a number of years, though this was more frequent at S Bend.

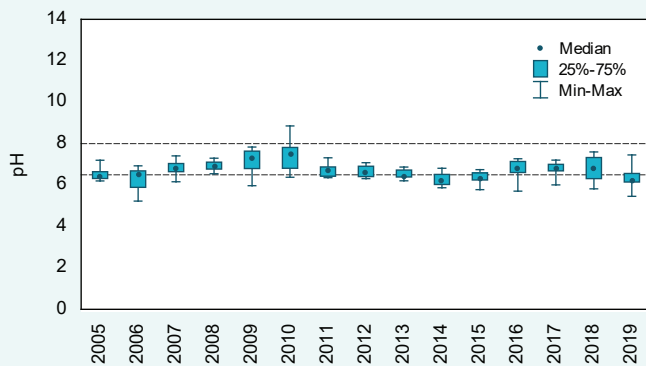
## pH (2019)

### pH values

At both sites, pH fluctuated during the year with many samples being below, or only just above, the lower ANZECC trigger value.

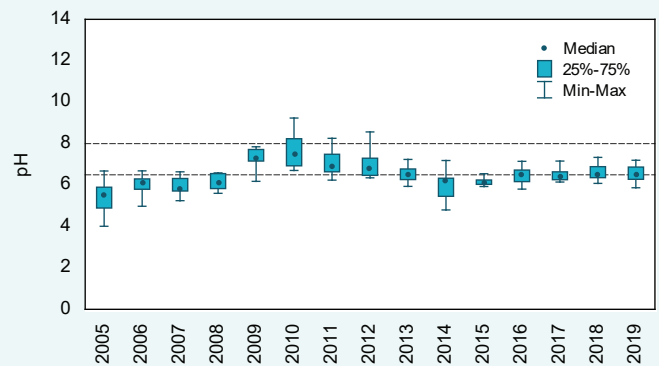
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## Electric Fence – 4 Acres

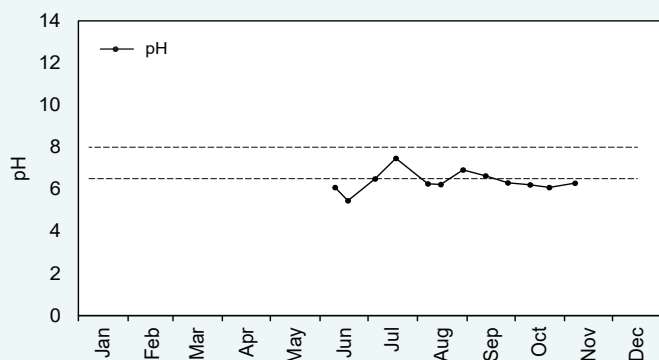


pH levels, 2005–19 at site 6091223. The dashed lines are the upper and lower ANZECC trigger values.

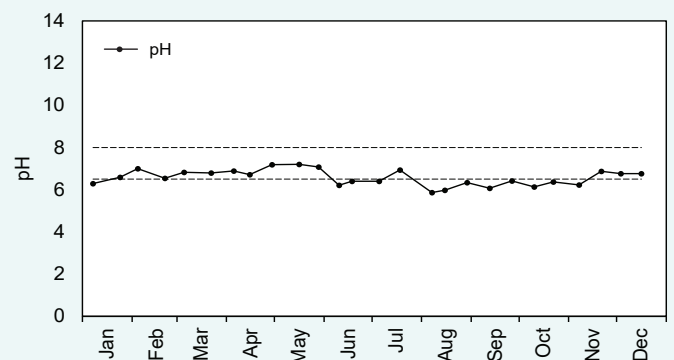
## S Bend



pH levels, 2005–19 at site 6091222. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels at 6091223. The dashed lines are the upper and lower ANZECC trigger values.



2019 pH levels at 6091222. The dashed lines are the upper and lower ANZECC trigger values.



# Four Acres

## Salinity over time (2005–19)

### Concentrations

Salinity at both sites fluctuated slightly over the reporting period. Using the Water Resources Inventory 2014 salinity ranges, all years were classified as fresh at both sites (note, the 2018 nutrient report used the SWRWQA bands). The maximum salinity at S Bend was higher in 2018–19 compared with previous years.

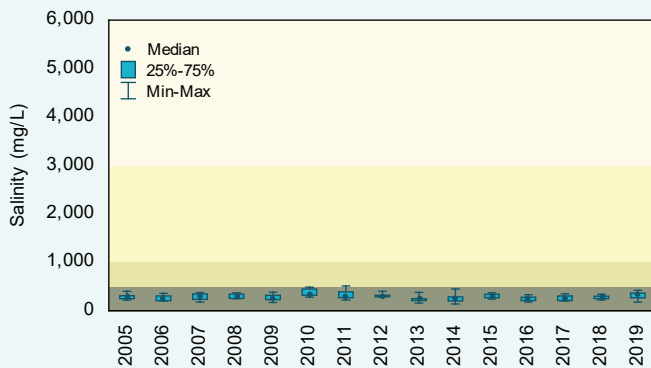
## Salinity (2019)

### Concentrations

In 2019, most of the samples collected at both sites fell into the fresh band. The two peaks in late April and late May at S Bend coincided with peaks in N and P concentrations. It is likely that these peaks are a result of dairy effluent entering the stream upstream of the sampling site.

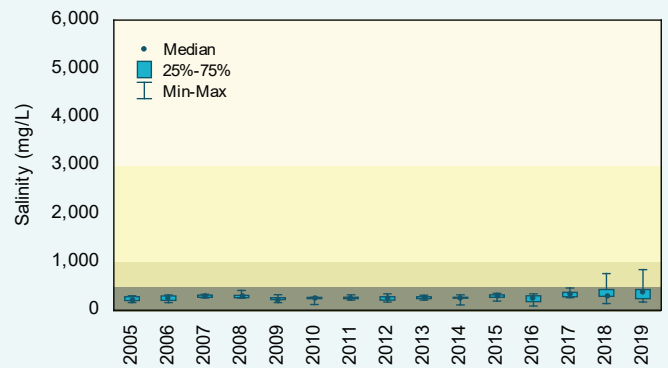
Where there are no data in the graph, the site was not flowing.

## Electric Fence – 4 Acres

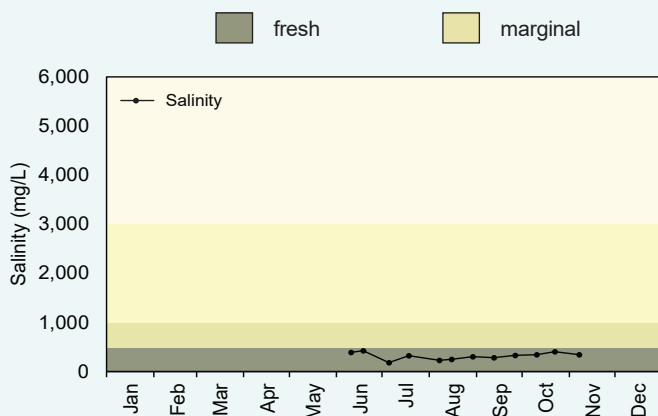


Salinity concentrations, 2005–19 at site 6091223. The shading refers to the Water Resources Inventory 2014 salinity ranges.

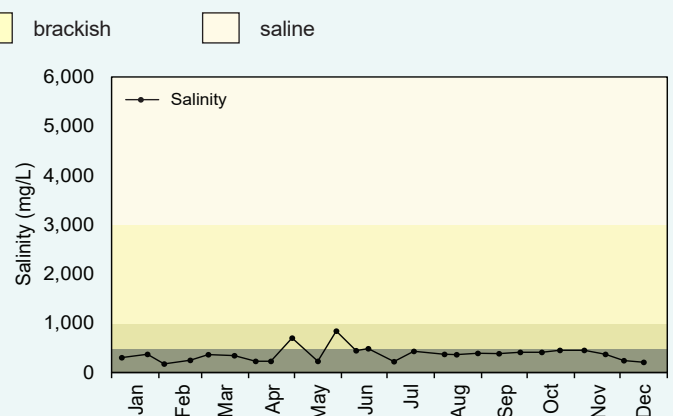
## S Bend



Salinity concentrations, 2005–19 at site 6091222. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations at 6091223. The shading refers to the Water Resources Inventory 2014 salinity ranges.



2019 salinity concentrations at 6091222. The shading refers to the Water Resources Inventory 2014 salinity ranges.

## 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; both the catchment and estuary. 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 more information on the condition of Hardy Inlet at [estuaries.dwer.wa.gov.au/estuary/hardy-inlet/](https://estuaries.dwer.wa.gov.au/estuary/hardy-inlet/)

Healthy Estuaries WA partners with the Lower Blackwood Land Conservation District Committee (Lower Blackwood LCDC) to fund best-practice management of fertiliser, dairy effluent and watercourses.

- To find out how you can be involved visit [estuaries.dwer.wa.gov.au/participate](https://estuaries.dwer.wa.gov.au/participate)
- To find out more about the Lower Blackwood LCDC go to [lowerblackwood.com.au](https://lowerblackwood.com.au)
- To find out more about the health of the rivers in the Hardy Inlet catchment go to [rivers.dwer.wa.gov.au/assessments/results](https://rivers.dwer.wa.gov.au/assessments/results)

## Methods

Variables were compared with the Scott River WQIP targets or ANZECC trigger values where available, or the SWRWQA bands or 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](https://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 in the 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:** 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 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 ( $\text{NO}_3^-$ ) and nitrite ( $\text{NO}_2^-$ ), which is reported as  $\text{NO}_x^-$ . 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.

