

Leschenault catchment

Nutrient report 2023

HEALTHY
ESTUARIES
WA

This data report provides a summary of nutrients in the waterways of the Leschenault Estuary catchment in 2023. Excess nutrients are one of the most significant pressures on our waterways and estuaries, and can lead to algal blooms and fish kills.

About the catchment

The Leschenault Estuary (Derbal Elaap) has a catchment area of about 1,981 km², about 51 per cent of which has been cleared, mostly for grazing. There are extensive areas of artificial drainage on the Swan Coastal Plain, constructed to help speed up water removal from the landscape. A large area of the catchment receives irrigation waters to help support cattle grazing and horticulture. The clearing, drainage and irrigation have changed hydrological pathways (which determine how much and when water flows into the estuary), and increased concentrations of nutrients in the waterways. Together with climate change, this puts pressure on the Leschenault Estuary. Soil types also influence nutrient concentrations (especially phosphorus) as some soil types bind phosphorus better than others, preventing it from entering waterways.

Five rivers contribute most of the flow to the Leschenault Estuary: the Preston, Collie, Wellesley, Brunswick and Ferguson rivers. The Ferguson River enters the Preston River downstream of our Middle Preston monitoring site, before it flows into the estuary. Both these rivers, in addition to the Collie River, are monitored for flow and water quality. We do not monitor flow at the Wellesley or Brunswick river sites. Parkfield Drain, which enters the estuary from the north, is the only significant drain that flows directly into the estuary.

Water quality monitoring is carried out fortnightly at eleven sites in nine subcatchments, with most sites located near the bottom of the subcatchments but above any estuarine influence.

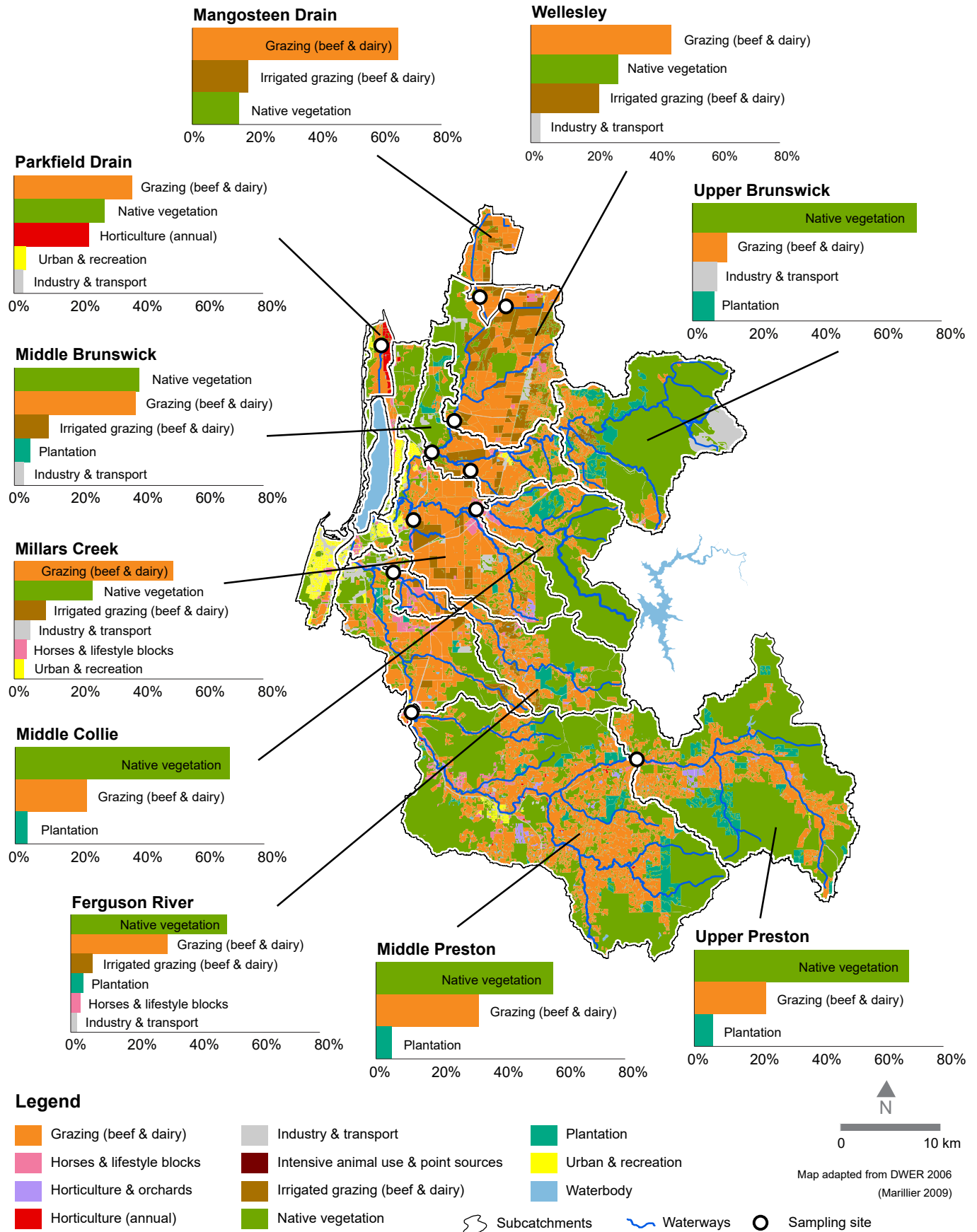
Key points:

- ⇒ Elevated nutrient concentrations are due to a combination of agricultural land uses, the extensive irrigation network and the construction of drains to reduce surface water ponding. The presence of soils that bind phosphorus poorly also contribute to the high phosphorus concentrations.
- ⇒ Priority subcatchments for nutrient reduction actions are Parkfield and Mangosteen drains, and the Brunswick, Wellesley and Ferguson rivers.
- ⇒ Nutrient concentrations are low in the Preston and Collie rivers, however the loads per square kilometre from the Middle Collie are large. Also, water quality deteriorates in the estuarine portion of the Collie River and it experienced two fish kills in 2023, making the Collie River, especially the area downstream of our catchment site, a priority for management.

Facts and figures

Catchment area	1,981 km ²
Per cent cleared area (2018)	51 per cent
Main rivers flowing into Leschenault Estuary	Preston, Collie, Wellesley, Brunswick and Ferguson rivers
River flow to the Leschenault Estuary (2023)	60 GL (flow from Collie, Preston and Ferguson rivers only which cover 1091 km ²)
Main land use (2018)	Beef and dairy grazing (irrigated and dryland) and native vegetation

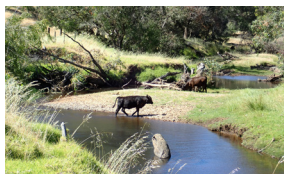
Leschenault Estuary catchment land use map



The percentage land use graphs show the most common land use in each subcatchment. Graphs have only been prepared for the monitored subcatchments.

Subcatchment summaries (2023)

Subcatchments are smaller areas of water catchments where all the rain falling in the local area flows to the same waterway or waterways. **Water quality objectives** are the nutrient concentrations we aim to be below to protect waterway health.



Middle Brunswick River

Nutrient concentrations in the Middle Brunswick River were high, making this subcatchment a priority for management. Both the Middle Brunswick and Elvira Gully sites did not meet our total phosphorus water quality objective and Elvira Gully also failed to meet our total nitrogen water quality objective. It is likely that the nutrient concentrations in the Middle Brunswick are being diluted by better quality water from the Upper Brunswick subcatchment.



Middle Collie River

Nutrient concentrations in the Middle Collie River were low, with the subcatchment meeting both our water quality objectives. However, the load per square kilometre of both nitrogen and phosphorus were large, indicating that the amount of nutrients leaving the subcatchment is excessive for its size. Also, water quality deteriorated downstream of our catchment site in the estuarine region of the river, where two fish kills were recorded in 2023.



Ferguson River

Nutrient concentrations in the Ferguson River were low, and it met both our water quality objectives. However, because it contributed the largest phosphorus load and had large loads per square kilometre for both nitrogen and phosphorus, this subcatchment is a priority for management.



Mangosteen Drain

This subcatchment is a priority for management as water quality was poor. Total nitrogen and total phosphorus concentrations were high and did not meet our water quality objectives.



Millars Creek

Water quality in Millars Creek was poor and did not meet our water quality objectives. In comparison to other subcatchments, a large proportion of nitrogen was present as total ammonia, which can cause algal blooms and fish kills.



Parkfield Drain

Parkfield Drain had the highest total nitrogen concentration and is a priority for management. While it met our phosphorus water quality objective for the first time, it did not meet our nitrogen water quality objective. As Parkfield Drain flows into the north of the estuary where the waters are poorly flushed, the nutrients from Parkfield Drain tend to stay in the estuary for a long time.



Middle Preston River

Water quality in the Middle Preston was good, meeting both our water quality objectives. It also had the smallest nutrient loads per square kilometre for both nitrogen and phosphorous.



Upper Preston River

Water quality in the Upper Preston River subcatchment was good, with the site meeting both our water quality objectives.



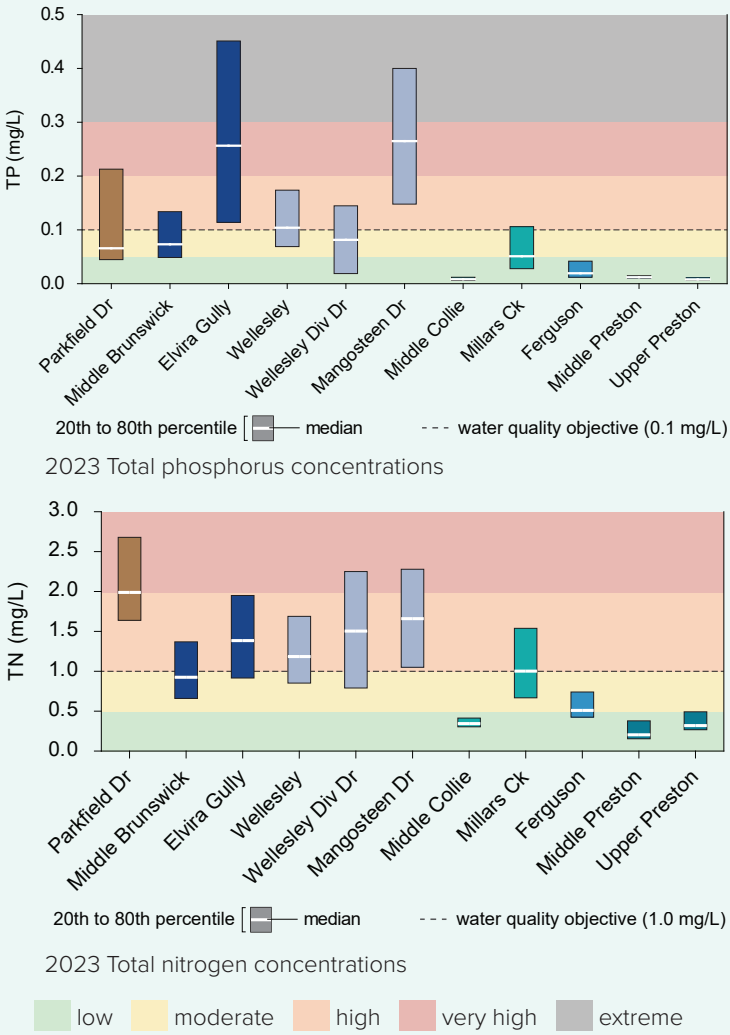
Wellesley River

This subcatchment is a priority for management. Nutrient concentrations in the subcatchment were high with both the Wellesley and the Wellesley Diversion Drain sites not meeting our water quality objectives.

Catchment nutrient concentrations (2023)

Nutrient concentrations varied significantly between the monitored sites. Nitrogen and phosphorus concentrations were generally higher and had the greatest variation across the year at the Brunswick and Wellesley sites and Parkfield Drain. The combination of high median concentrations and a large range in concentrations is indicative of the land use, modification to waterways and construction of drains, and the presence of soils in these subcatchments with a poor capacity to bind phosphorus.

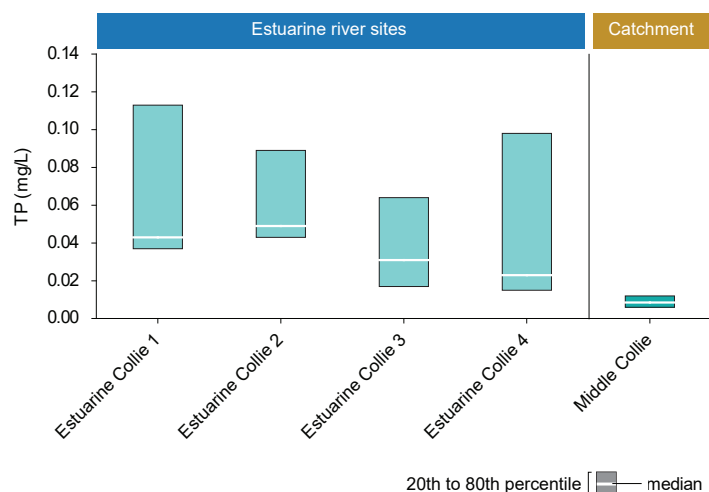
While nutrient concentrations were low in both the Middle Collie and Preston rivers, concentrations increased downstream of the catchment monitoring site in the estuarine reaches of these rivers. The Ferguson River had low nutrient concentrations because of the presence of soil with a good capacity to bind phosphorus in much of the agricultural areas of the catchment, as well as some dilution with water with low nutrient concentrations from the upper portion of the catchment, which is heavily vegetated.



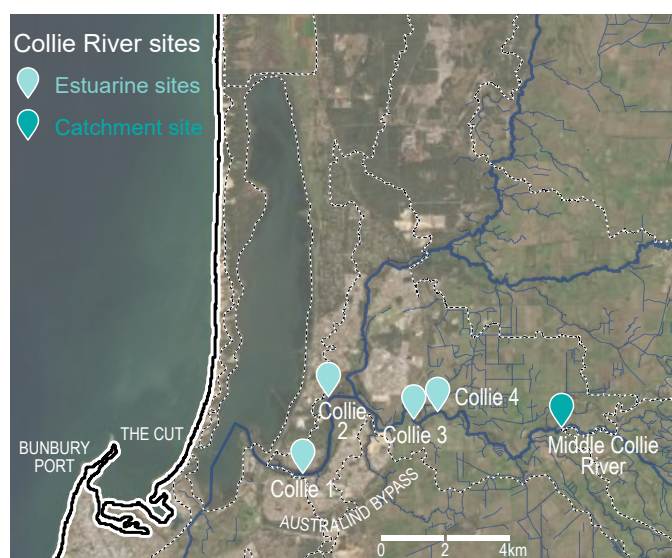


Collie catchment vs estuarine river phosphorus concentrations (2023)

As mentioned, water quality in the Collie River deteriorates in the estuarine portion of the Collie River, downstream of the Middle Collie catchment sampling site. The graph below shows total phosphorus concentrations at the four Estuarine Collie River sites and the Middle Collie catchment site. The higher phosphorus concentrations at the estuarine Collie River sites are caused by a few factors. Firstly, there is significant nutrient input to the Collie River between our Middle Collie site and the Leschenault estuary, predominantly from cattle grazing for beef and dairy (both irrigated and non-irrigated) but also from septic tanks. Secondly, the water in the estuarine portion of the river generally has poor exchange with the estuary.



2023 Total phosphorus concentrations

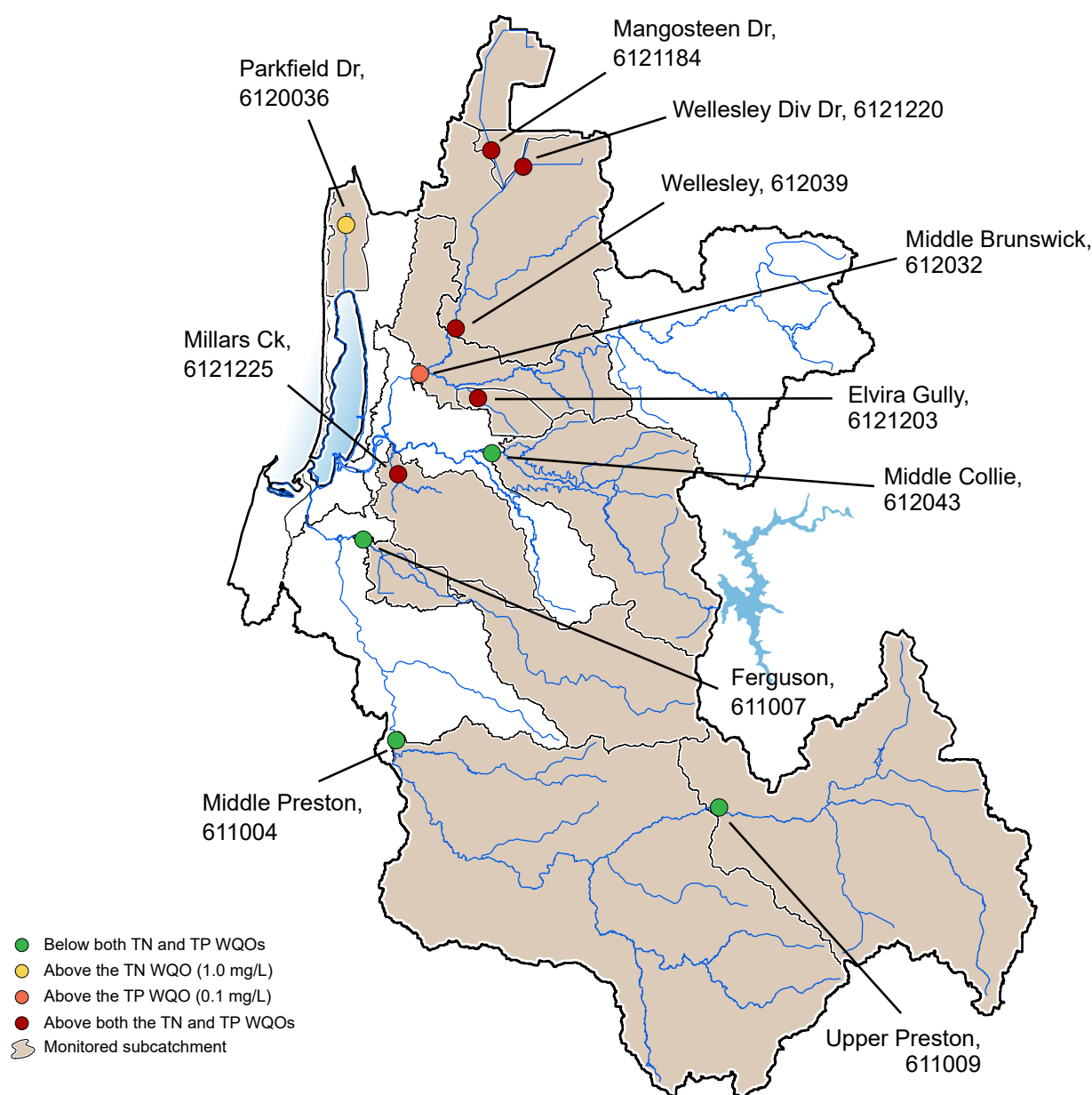


This means that nutrients entering the estuarine Collie tend to remain in place and are available for use by phytoplankton. Lastly, there are large areas of sediment in the estuarine portion of the Collie River which can release nutrients into the water column under certain conditions such as low oxygen levels. It is this combination of factors which has caused the poor environmental condition of the estuarine Collie River which leads to outcomes such as the two fish kills recorded in the estuarine Collie River in 2023. To learn more about water quality in the estuarine portions of the rivers and the Leschenault Estuary, please refer to the 2023 Leschenault estuary condition report.

Performance against water quality objectives (2021–23)

Water quality objectives (WQOs) are the nutrient concentrations we aim to be below to protect the health of the estuary. For the Leschenault Estuary catchment, the WQOs were developed as part of the Leschenault Estuary Water Quality Improvement Plan. Performance against the WQOs were calculated by comparing the three-year (2021–23) wet month (June to October inclusive) medians to the relevant water quality objective.

The Ferguson, Collie and both Preston sites met both their total nitrogen (1.0 mg/L) and total phosphorus (0.1 mg/L) WQOs. The Middle Brunswick met the total nitrogen but not the total phosphorus WQO, whereas Parkfield Drain met the total phosphorus but not the total nitrogen WQO. This is the first time that Parkfield Drain has met either of its WQOs. Ongoing monitoring will determine if water quality is truly improving or if this was an anomaly. All other sites met both WQOs.



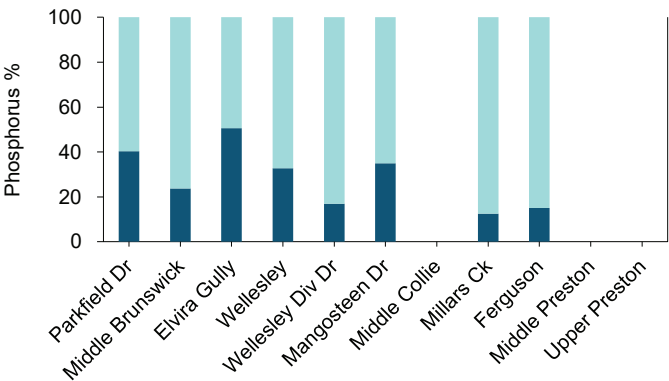
How each site performed against the TN (1.0 mg/L) and TP (0.1 mg/L) water quality objectives in 2021–23

Note: the graphs above show all data (January to December inclusive) collected in 2023, whereas performance against the WQOs are calculated using three-year (2021–23) wet months (June to October) medians. We use a three-year median as it reduces the impact of natural variation between years. This is why a median may be below the WQO in the graphs, yet the site may be shown as being above the WQO in the map, as is the case for phosphorus concentrations at the Middle Brunswick site. Also, our catchment sites are situated above any estuarine influence so there are additional nutrient inputs downstream of our catchment sites, before the rivers reach the estuary. Water quality in these estuarine river zones is often worse than at the corresponding catchment site.

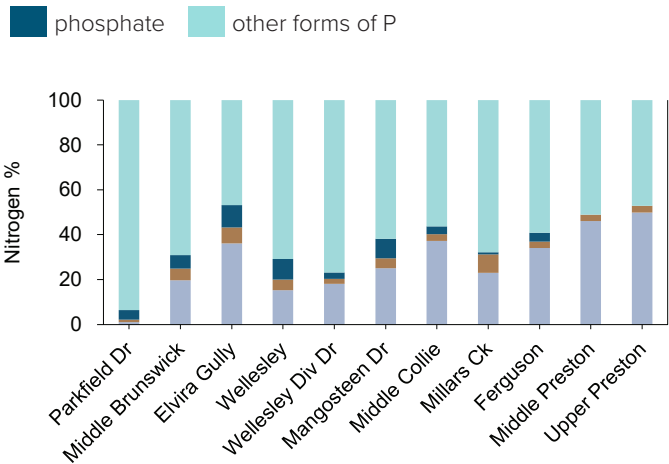
Wet month nutrient forms (2023)

The Parkfield Drain and Elvira Gully sites had the largest proportion of phosphorus present as **phosphate** which is readily used by plants and algae to fuel growth. The soils in both of these subcatchments bind phosphorus poorly, so any phosphorus added (such as in fertiliser) can move quickly into waterways. These soils, and the agricultural land uses in these subcatchments, are the reason for the large proportion of phosphate present.

Dissolved organic nitrogen was the most common form of nitrogen during the wet months at most sites. The proportion of nitrogen present as **nitrate**, which can lead to algal growth and fish kills, was highest at the two Preston River sites. This was due to nitrate entering the river following heavy rainfall from the agricultural areas bordering the rivers. It is worth noting that while the proportion of nitrate was high in the Preston River, the actual total nitrogen concentrations at this site were low. This contrasts with Elvira Gully which similarly had a relatively high proportion of nitrate but with corresponding high total nitrogen concentrations.



Proportion of different forms of phosphorus in the wet months (June to October) of 2023



Proportion of different forms of nitrogen in the wet months (June to October) of 2023

nitrate total ammonia particulate N
dissolved organic N

NOTE: where there are no data shown for a site, it means that a large proportion of the collected samples were below the laboratory limit of reporting.

Total phosphorus and total nitrogen are made up of different forms, or fractions, of phosphorus and nitrogen. Understanding which forms occur helps us to determine the likely sources of the nutrients, and better target management actions.

Phosphate is readily used by plants and algae and can cause excess plant growth, algal blooms and fish kills. It is mostly derived from animal waste and fertilisers and, to a smaller extent, from natural sources. **Other forms of phosphorus** include either particulate phosphorus, dissolved organic phosphorus, or both. Particulate phosphorus usually needs to be broken down before it can be used by plants and algae. The bioavailability of dissolved organic phosphorus varies and is poorly understood.

Dissolved organic nitrogen comes from both natural and human sources and consists of various compounds. Some, like urea (found in fertiliser and

animal urine), are bioavailable to algae. Others, like proteins and humic acids which mostly come from broken down pasture and manure as well as natural vegetation, need to be broken down further before plants and algae can use them. **Particulate nitrogen**, which comes from plant and animal matter, also generally needs to be broken down before it can be used by plants and algae.

Dissolved inorganic nitrogen (**nitrate** and **total ammonia**) is readily used by plants and algae and can cause excess plant growth, algal blooms and fish kills. These nitrogen forms are typically at their highest levels when waterways begin to flow after autumn or winter rains. This is because, during summer, organic nitrogen in the soil and dry waterways breaks down into nitrate and total ammonia. Additionally, fertilisers and animal waste accumulate on agricultural land. When the rainfall starts, it washes this nitrogen into the waterways.

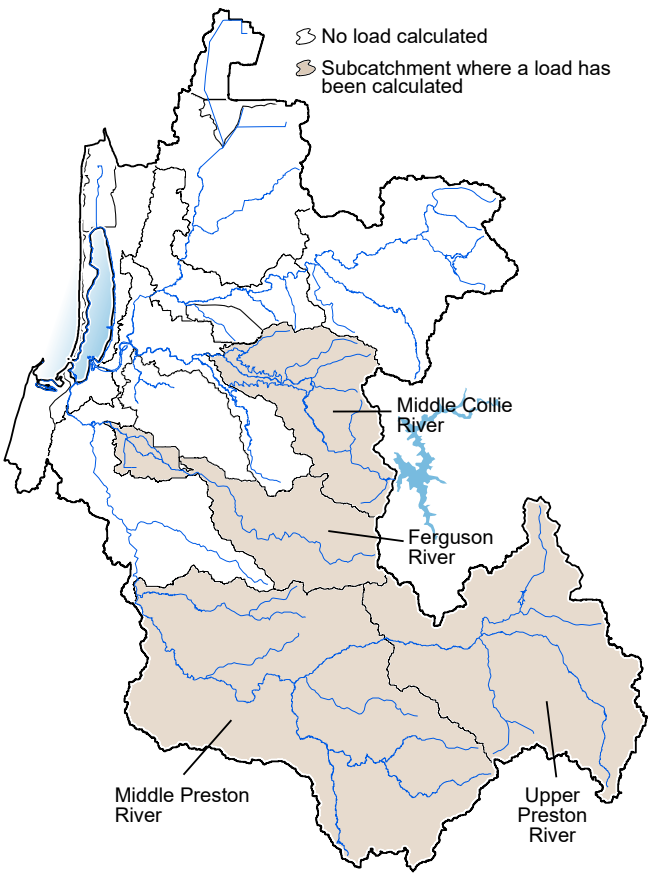
Flow and nutrient loads to the estuary (2023)

In 2023, the Middle Collie subcatchment contributed the largest flow volume to the Leschenault Estuary: almost half of the total flow from the three subcatchments where flow data were available. Nutrient loads, which are the total amount of nutrients leaving a subcatchment each year, are calculated by multiplying the flow at a site by the nutrient concentration. This means that, in general, there is a close relationship between flow volumes and nutrient loads—subcatchments with large flows tend to have large nutrient loads and vice versa. However, if a subcatchment has very high nutrient concentrations, this may not always be true.

The Ferguson River for instance, had the smallest flow volume but the largest total phosphorus load in 2023. This difference was driven by the comparatively higher total phosphorus concentrations in the Ferguson River, which were higher than those in the Middle Collie or Preston. The total nitrogen load in the Ferguson River was also disproportionately large when compared to its flow volume, again caused by the higher total nitrogen concentrations. Nutrient loads at the Middle Collie site were small compared to the flow volume due to the low nutrient concentrations at this site.

While nutrient loads show where most of the nutrients are entering the estuary from, they are heavily influenced by changes in annual flow volumes. Concentrations, on the other hand, are less affected by flow variations and therefore provide a better measure for water quality objectives than loads do.

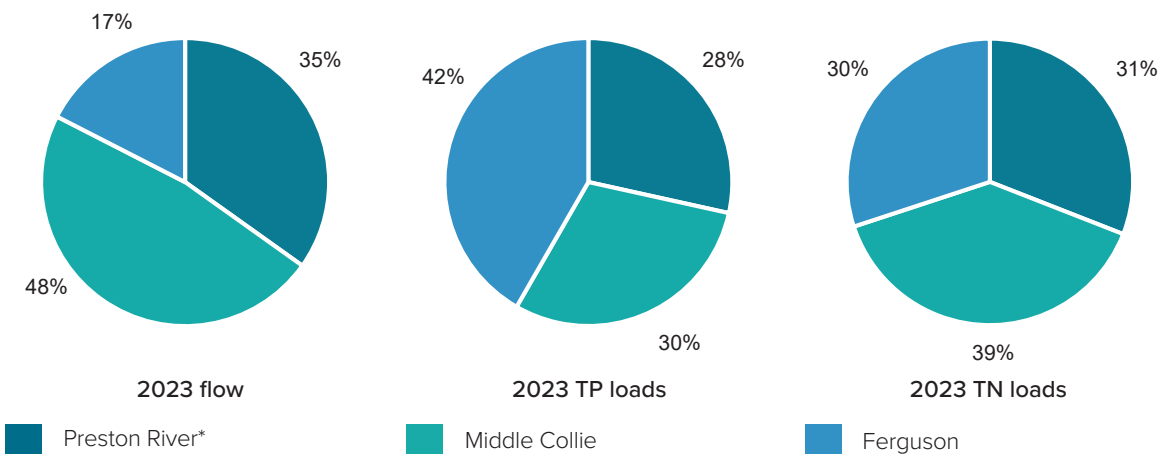
It is important to note, these measurements are taken at the sampling sites, so any flow or nutrients entering the rivers downstream of these locations



Subcatchments for which a load entering the estuary has been calculated

are not included in the data presented here.

It is also worth noting that we do not have flow data available at the Wellesley, Middle Brunswick or Parkfield Drain sites, and therefore it is not possible to calculate the nutrient loads leaving the northern subcatchments. Given that nutrient modelling showed that the Wellesley catchment had the largest nutrient loads, and our monitoring shows that it (and the Middle Brunswick and Parkfield Drain sites) has much higher total nitrogen and total phosphorus concentrations than the Preston, Collie and Ferguson rivers, the nutrient loads shown here are an underestimate of the total loads and flows entering the estuary.

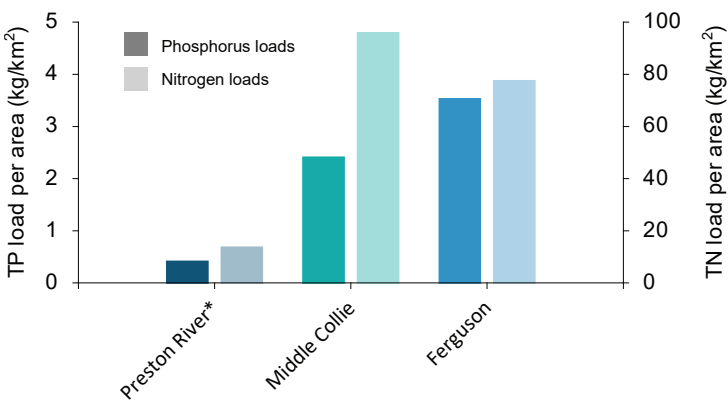


* Combined Middle and Upper Preston River subcatchments

Nutrient loads per square kilometre (2023)

Another way to present nutrient load data is to divide the total annual load at a site by the area of land that contributes to that load, giving a load per square kilometre. This helps prioritise those subcatchments where actions in the catchment to reduce nutrient losses are likely to have the biggest impact.

Of the three subcatchments where we could calculate loads, the Ferguson and Middle Collie had the largest loads per square kilometre and should therefore be prioritised for management actions. However, it is likely that Parkfield Drain would have much higher loads per square kilometre if it was possible to calculate loads there, given it has high nutrient concentrations (especially nitrogen). It is also likely that other subcatchments without flow data such as the Brunswick and Wellesley rivers would have large loads per square kilometre.



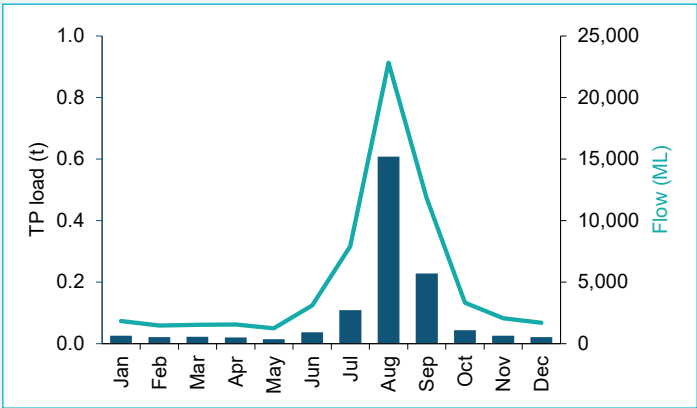
2023 loads per square kilometre for TP (dark columns, left hand axis) and TN (paler columns, right hand axis).

* Combined Middle and Upper Preston river subcatchments

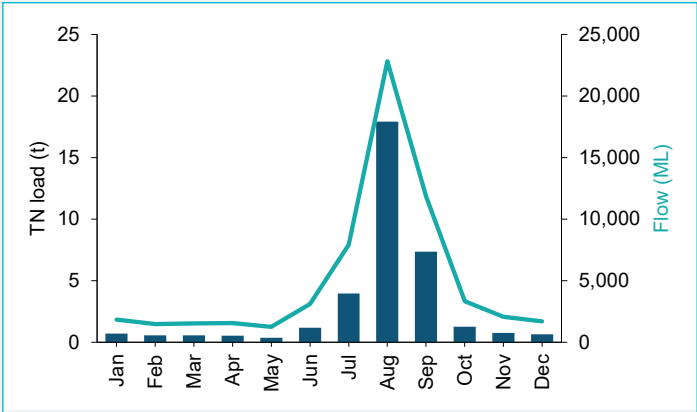
Monthly loads to the estuary (2023)

The largest nitrogen and phosphorus loads entered the estuary during August when flow volume was also largest. As is clear from these graphs, loads are closely linked to flow: as the flow decreased, loads also decreased.

In a typical year, flow is largest during the wet months which is when most of the nutrients are entering the estuarine portions of the rivers as well as the Leschenault Estuary. What happens to the nutrients once they leave the subcatchments depends on the time of year they leave as well as the flow volumes at that time. In wet years, prolonged river flows will help flush the nutrients from the estuary and into the ocean during the wet months. In dry years (and in the dry months), nutrients are more likely to be retained in the estuarine portions of the rivers as they are poorly flushed. The northern section of the estuary is poorly flushed year-round so nutrients entering from Parkfield Drain tend to remain in the estuary rather than being flushed to the ocean.



2023 monthly TP loads (columns) and flow (line) for the three subcatchments where we have flow data.



2023 monthly TN loads (columns) and flow (line) for the three subcatchments where we have flow data.

Background

Healthy Estuaries WA is a State Government program to protect and improve the health of our estuaries. Collecting and reporting water quality data, such as in this report, helps build understanding of the whole system; both the catchment and the estuary. This allows investment to be directed towards the most effective actions in the catchments to protect and restore the health of our rivers, creeks and estuaries.

Nutrients (phosphorus and nitrogen) are compounds that are important for plants to grow. Excess nutrients entering waterways from animal waste, fertilisers and other sources can fuel algal growth, decrease oxygen levels in the water and harm fish and other species.

You can find information on the condition of Leschenault Estuary at estuaries.dwer.wa.gov.au/estuary/leschenault-estuary/

Healthy Estuaries WA partners with the Leschenault Catchment Council and industry groups to fund best-practice management of fertiliser, dairy effluent and watercourses on farms.

To find out more about:

- How you can be involved visit estuaries.dwer.wa.gov.au/participate
- The Leschenault Catchment Council go to leschenaultcc.org.au
- Dairy effluent management visit westerndairy.com.au/healthy-estuaries-wa/
- The health of the rivers in the Leschenault catchment go to rivers.dwer.wa.gov.au/assessments/results

Methods

Information on the methods used can be found here: estuaries.dwer.wa.gov.au/nutrient-reports/data-analysis

Sites sampled

There are eleven sites sampled in the Leschenault catchment, as listed below. Only those sites marked with an * had flow data available in 2023. The number next to the site name is the unique Australian Water Resource Council code for that site.

Parkfield Drain

- Parkfield Dr, 6120036

Middle Brunswick

- Middle Brunswick, 612032
- Elvira Gully, 6121203

Wellesley River

- Wellesley, 612039
- Wellesley Div Dr, 6121220

Mangosteen Drain

- Mangosteen Dr, 6121184

Middle Collie River

- Middle Collie, 612043*

Millars Creek

- Millars Ck, 6121225

Ferguson River

- Ferguson, 611007*

Middle Preston River

- Middle Preston, 611004*

Upper Preston River

- Upper Preston, 611009

Want more?

If you would like to access the data used in the analyses in these reports, please visit: wa.gov.au/service/natural-resources/water-resources/water-information-reporting. The numerical AWRC codes listed above can be used to search for the available data.