Department of **Water and Environmental Regulation**
Department of **Primary Industries and Regional Development**
GOVERNMENT OF WESTERN AUSTRALIA

Delivering on the Bindjareb Djilba Protection Plan | Peel-Harvey estuary

HEALTHY ESTUARIES WA

Water quality snapshot: Bindjareb Djilba (Peel-Harvey estuary) 2023

Understanding estuary condition and monitoring for change helps to guide how we manage our estuaries

Through Healthy Estuaries WA and the Bindjareb Djilba Protection Plan, the Department of Water and Environmental Regulation monitors water quality in the Bindjareb Djilba / Peel-Harvey estuary, the estuarine sections of the Murray and Serpentine rivers and the surrounding catchment. This snapshot provides insights from our water quality monitoring from winter 2022 to autumn 2023.

Serpentine River winter flows

River flows in winter 2022 met high sea levels and storms that pushed more marine water into the estuary. Nutrient-rich inflows were more easily diluted in the estuary, and due to strong tidal movement, freshwater was retained in the estuarine sections of the rivers.[1] As a result, water quality in the estuary was relatively good during this period, but poor in the Murray and Serpentine rivers.

Nitrogen and phosphorus are essential nutrients for plant growth, but when there is too much in the water, this can lead to overgrowth of algae. While algae play a vital role in aquatic ecosystems, excessive growth can make waterways unsightly and smelly. Microalgae (microscopic plants also known as phytoplankton) can have harmful impacts on ecosystem function when present at high cell densities. Some microalgae produce toxins that pose risks to fish and human health. Macroalgae (seaweed) can accumulate along shorelines, sometimes becoming smelly as the accumulation decays.

[1] Where river channels enter the estuary and fresh and salty water mixes in the river channel for a distance upstream.

Seasonal nutrient concentrations throughout the Peel-Harvey system are presented before focusing on the estuarine section of the Serpentine River, an example of one area in the system experiencing overgrowth of microalgae.

In 2022–23, we observed complex interactions between the timing and volume of winter river flows, tidal exchange and higher-water levels which influenced nutrient distribution and concentrations in the Peel-Harvey estuary. Nutrients that were delivered to the estuary were easily diluted, while concentrations in the estuarine sections of the rivers remained high.

Elevated nutrient concentrations in the estuarine river sections drive instability in the ecosystem and fuel growth of potentially harmful microalgae. This highlights the importance of reducing nutrient loss from the catchments to prevent excessive algal growth in the estuarine sections of the rivers that flow into the Peel-Harvey estuary.

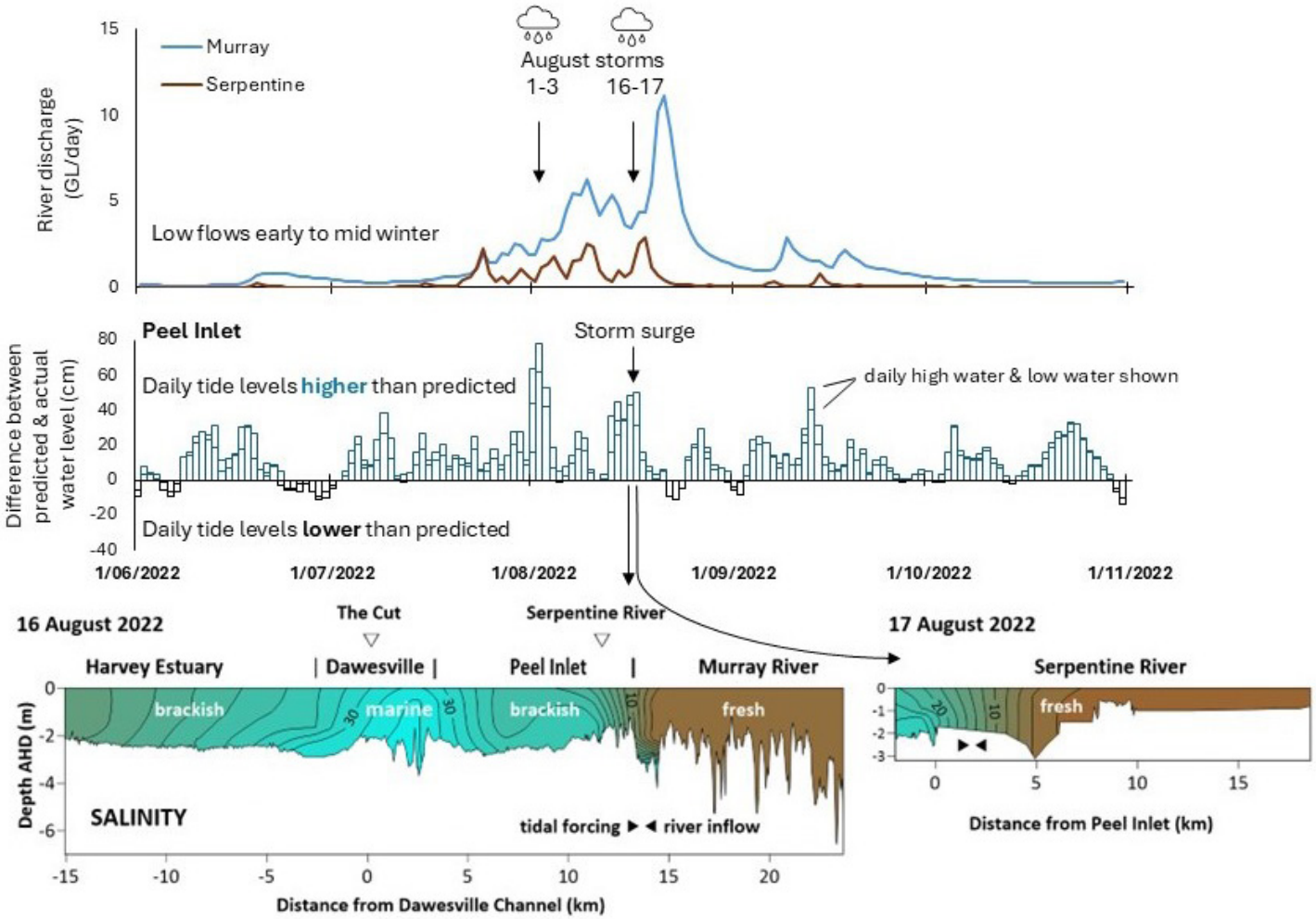
Rainfall and river flow: wet months (June to October)

In 2022, total rainfall during wet months at Mandurah was near average for the period since 2000 on the coast (447 mm) and at Dwellingup 45 km to the east (717 mm). However, the South West experienced intense storms during August which brought heavy rain, 7–10 m sea swells, and damaging winds. This rainfall generated larger flows from the catchments after much lower flows earlier in June and July.

High-water levels were recorded in the Peel-Harvey estuary.[2] Factors contributing to the higher-than-predicted tide levels included low barometric pressure and strong winds associated with the winter storms. Additionally, a La Niña phase of the El Niño – Southern Oscillation (ENSO) was influential between July 2020 and March 2023. ENSO affects sea levels and the strength of the Leeuwin Current.[3] During La Niña the Leeuwin Current is stronger, pushing more water against the coastline; and increasing typical winter sea levels.

[2] Department of Transport, Western Australia. Caddadup (Peel Inlet) water level observations. Residual (cm) = difference between predicted and actual water level.

[3] A current that flows south from the tropics along the Western Australian coast.



Interaction of flow and tides: Storms on 1–3 and 16–17 August boosted winter river flow. In the estuary, water levels were generally higher than expected and further elevated by periodic storm surges.

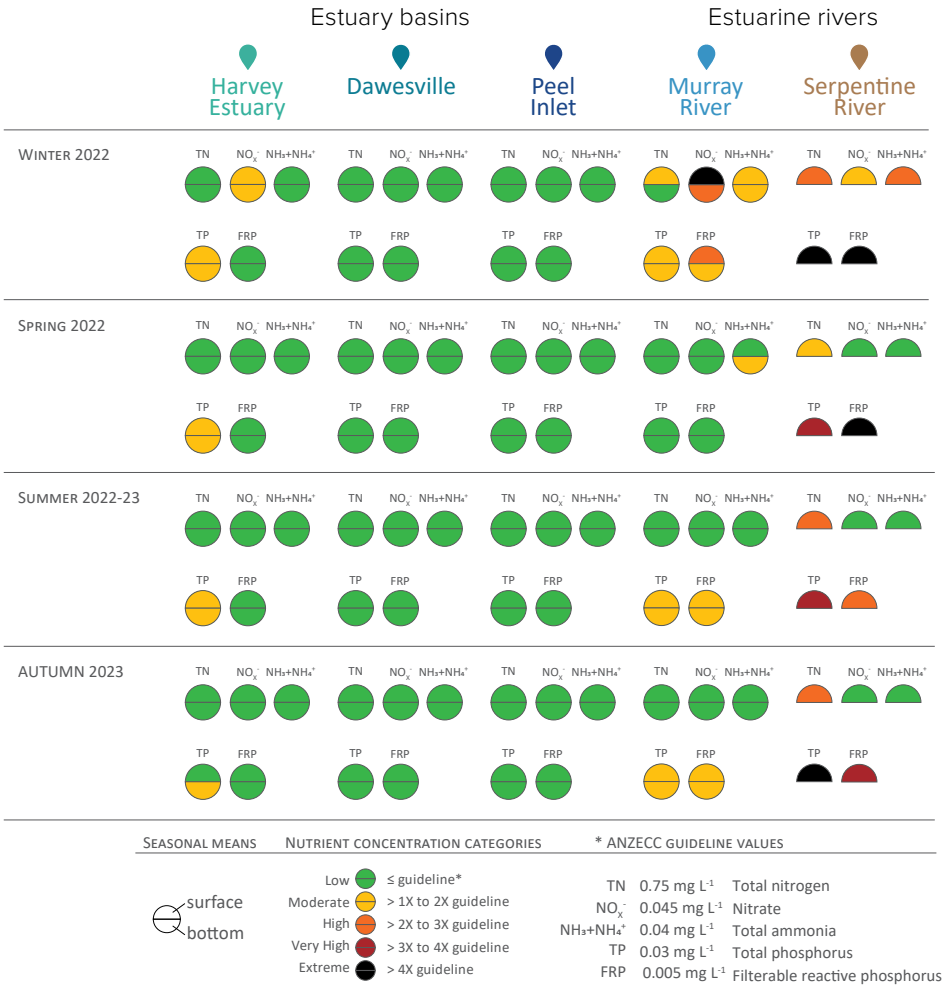
On 16–17 August: our regular water quality monitoring coincided with a storm. Measurements of salinity showed freshwater inflows from the Murray and Serpentine being met by the flooding tide, which constrained fresh (nutrient-rich) water in the river sections. Brackish (between salty and fresh) water in the estuary basins indicated good mixing of earlier inflows that would dilute nutrient concentrations. The larger volume of water in the estuary would enhance the dilution effect.

Nutrients in the estuary: winter 2022 to autumn 2023

In the estuary and the estuarine section of the rivers, nutrient concentrations change throughout the year. Concentrations are typically higher in winter, particularly during wetter years, such as 2021.[4] In winter 2022, the average nutrient concentrations within the estuary basins (Harvey Estuary, Dawesville and Peel Inlet) were almost all healthy, with only moderate concentrations of nitrate and total phosphorus measured in the Harvey Estuary. This was because, during early winter, nutrient-carrying flows were initially low. However, with the onset of heavy rainfall in August and larger flows, elevated water levels and strong tides both diluted the nutrients and kept the fresh water in estuarine sections of the rivers. Average concentrations remained consistently low or moderate from spring 2022 to autumn 2023, so water quality in the estuary itself was good overall.

In the Murray River, average nutrient concentrations in winter almost always exceeded guideline values, an indication of poor water quality. There are significant sources of nitrate in the lower catchment that include animal wastes and fertilisers from agricultural land uses such as grazing. In spring, when the fresh Murray River flows meet saltier water, the resulting differences in salinity prevent easy mixing of water (stratification), leading to reduced oxygen levels near the sediment. This lack of oxygen suppresses healthy microbial processes and allows for release of nutrients from the sediment. In bottom waters, the moderate ammonium in spring, and moderate phosphate in summer and autumn were associated with stratification. The moderate total phosphorus (TP) and phosphate levels in surface water were associated with increased microalgal activity during summer and autumn.

[4] See Bindjareb Djilba Water Quality Snapshot 2021–22



Microalgae: The seasonal average microalgal cell density at sites in the estuarine section of the Serpentine River shows growth in the microalgal population. Warm conditions with ample light, typical from late spring onwards, coupled with abundant nutrients, lead to excessive microalgal growth. These stable conditions can persist well into autumn, allowing dense populations of microalgae to persist until they are dispersed by fresh winter inflows. At such high densities, the microalgae are likely to discolour the water.

In summer and autumn, average microalgal densities in the Serpentine River were more than 200 times greater than the densities in the estuary around Dawesville.

Spotlight on the Serpentine

Using the nutrient heatmap on the previous page as a guide, explore how nutrient concentrations change from winter through autumn in response to rainfall and flows, and microalgal activity.

Winter 2022

During winter, **average concentrations of all nitrogen and phosphorus forms increased above water quality guideline levels, with phosphorus levels categorised as extreme.** This increase is due to rainfall-driven river flows carrying nutrients and organic matter from the catchment. These nutrients originate from agricultural land uses in the Serpentine River's catchment. The sandy soil, which is poor at retaining nutrients – especially phosphorus – exacerbates this issue. Additionally, the extensive drainage network rapidly channels water off the land into the rivers, further contributing to nutrient loss.

Spring 2022

As river flows declined, **average concentrations of nitrate and ammonium (bioavailable forms of nitrogen easily available to algae) decreased** as microalgae used these nutrients for growth. Although **phosphate (a highly bioavailable form of phosphorus)** would also have been taken up by microalgae, we see little impact on concentrations because the water still contains an extremely high amount. Concentrations remained categorised as extreme.

The greater availability of phosphate relative to bioavailable nitrogen can influence the composition of microalgal populations. Certain cyanophytes, commonly known as blue-green algae, which can be potentially harmful, can supplement their nitrogen supply from the air. They were a dominant microalgal group from spring into summer.

Summer (2022–23)

In summer, **average phosphate concentration dropped from extreme to high category** as microalgae continued to uptake phosphate and freshwater inflows were limited.

Total phosphorus (TP) increased but remained categorised as very high, while total nitrogen (TN) rose from moderate to high because of increasing microalgal activity. **Microalgal activity affects concentrations of TN and TP because the measurement includes the nitrogen and phosphorus contained in living and dead algae**, as well as the bioavailable forms of P and N.

Autumn (2023)

Cycles of microalgal growth and decay can create an internal source of nutrients. Algal community composition changes seasonally, especially in response to environmental conditions like salinity. Microalgae that cannot tolerate increasingly hypersaline conditions (saltier than seawater) die off when these conditions occur in the Serpentine during summer and autumn. Their decay releases more phosphate into the water, enabling other microalgae to grow excessively, likely explaining the **increase in both average phosphate and TP concentrations.**

Improving the health of Bindjareb Djilba

Reducing nutrient loss from the catchment, improving water quality and safeguarding the future health of the estuary requires action from government and many groups of people such as beef and dairy industries, farmers, households, and catchment groups.

The State Government drives collaborative action through the Bindjareb Djilba Protection Plan and Healthy Estuaries WA. Many actions are underway including:

- supporting farmers through a subsidised fertiliser management program
- providing funding to the local catchment group (PHCC) to fence stock out of waterways and revegetate streams on farms
- trialling soil amendments and water quality treatments to address existing nutrient loads
- partnering with Western Dairy to help dairy farmers adopt best practice effluent management.

A dedicated community and cross-agency committee is in place to strengthen the land use planning and policy framework to eliminate future sources of nutrients as the area develops and to increase Bindjareb Traditional Owner participation in estuary management.

Much progress has been made but more needs to be done to increase the pace and scale of change to safeguard the estuary and increase its resilience to the impacts of climate change.

Learn more: Explore projects to improve the health of Bindjareb Djilba: estuaries.dwer.wa.gov.au/estuary/peel-harvey-estuary/