Love Our Lakes

Gippsland Lakes Environment Report 2024

# Water Quality Key Facts

# Nutrients and algal blooms

## What are nutrients and why are they important?

Nitrogen and phosphorus are two key nutrients that are required for photosynthesis by plants, including wetland plants, saltmarsh, seagrass and algae. They are essential for driving the food web of all ecosystems, however a careful balance is required to ensure sufficient nutrients to support plants and animals, while avoiding excesses that can lead to algal blooms and high growth of epiphytes on seagrass.

Both nitrogen and phosphorus occur in a number of different forms:

- particulate organic - tied up in plant and animal tissue
- particulate, inorganic – in inorganic, solid forms such as attached to soil or sediment particles
- dissolved organic – complex molecules dissolved in water
- dissolved inorganic ions – nitrate-nitrite, ammonium and orthophosphate

It is only this last group (dissolved inorganic) that are generally available for uptake by plants, including algae. In addition, nitrogen has a gaseous phase and can be lost from an aquatic system to the atmosphere through the process of denitrification. Transformation of nitrogen and phosphorus from particulate to dissolved inorganic forms available for plant growth and in the case of nitrogen, to the gaseous phase, occurs predominantly in the lake's sediment and is facilitated by bacteria.

## How are algal blooms related to nutrients?

How and why algal blooms occur in the Gippsland Lakes have been extensively studied and the processes are well understood. In general, blooms of the blue-green algae occur when salinities are relatively low (brackish), temperatures are high, and nitrogen is in short supply. While all species of phytoplankton have requirements for phosphorus, blue-green algal species such as Nodularia have the ability to use

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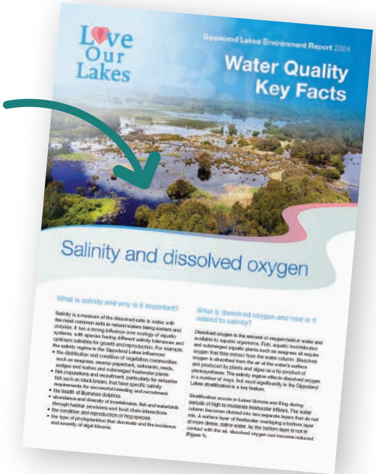
atmospheric nitrogen. This is thought to competitively advantage these species when the nitrogen available for other algal species is low.




Stratified conditions (as outlined in '**Water Quality Key Facts - Salinity and dissolved oxygen**') are also important as this facilitates the movement of phosphorus out of the sediments under the low oxygen conditions in the bottom waters, particularly in Lake Victoria. They also allow blue-green algae to dominate over diatoms, as they can often regulate their buoyancy and thus position in the water-column, whereas diatoms, being heavier than water, tend to sink unless maintained in the water-column by periodic mixing.

While low inorganic nitrogen concentrations may lead to blooms of the nitrogen fixing Nodularia, large inputs of inorganic nitrogen (like those that occurred after the 2006/07 bushfires) can trigger blooms of other algal species and have been implicated in blooms of *Synechococcus* for example.

## How do we measure nutrients and algal blooms?

Environmental Protection Authority (EPA) Victoria monitors water quality at five sites in Lakes Wellington, Victoria and Lake King. They measure total phosphorus, dissolved phosphorus, total nitrogen, nitrate-nitrite and ammonium.

The Department of Energy, Environment and Climate Action (DEECA) regularly monitors samples from the Gippsland Lakes to determine the type, amount and extent of algae present. Monitoring intensity (frequency of sampling and number of locations) is tailored to the risk posed by algal blooms. If an algal bloom develops on the Gippsland Lakes, information (factsheets and maps) will be available on the DEECA website (https://www.water.vic.gov.au/waterways/blue-green-algae) and through local outlets, including local media, visitor information centres and tourism operators. It is also be posted on DEECA's Gippsland Facebook page.

*EPA Victoria monitors water quality at five sites in Lakes Wellington, Victoria and Lake King.*

## Nutrient dynamics

The majority of nutrients enter the Gippsland Lakes through river flows, with agricultural activities identified as the highest point sources. Loads of nutrients entering into the Gippsland Lakes are strongly driven by rainfall in the catchment. In wet years, more water flows into the lakes, bringing with it more nutrients and sediments. Conversely, dry years bring relatively small amounts of nutrients into the Gippsland Lakes system. Once nutrients enter the system, their fate however is complex.

The shallow, well oxygenated environment of Lake Wellington provides ideal conditions for denitrification within the lake sediments, which results in large losses of nitrogen to the atmosphere as nitrogen gas. In addition, high wind action and water turbulence results in most of the phosphorus that enters Lake Wellington being exported to Lake Victoria. As nutrient rich water enters Lake Victoria from Lake Wellington, the higher salinity results in flocculation and deposition to the sediment and there are consequently large sediment stores of particulate nitrogen and phosphorus in Lake Victoria. Under periods of stratification, when bottom waters are depleted of oxygen, nutrients are released from the sediment but remain in the bottom water layer. When mixing events subsequently occur, the nutrient rich bottom waters will mix to the surface making nutrients available for phytoplankton production, where there is more light for photosynthesis. Nutrients are also lost from the system through flushing at the Entrance (Figure 1).

## Sustained change and events

Land use change (increases in urban and agricultural uses and decreases in native vegetation cover) and land and water use practices have a sustained impact on nutrient concentrations in the Gippsland Lakes. There have been increasing trends in the concentration of total nitrogen and phosphorus in Lake Wellington, and to a lesser extent Lake Victoria since the Gippsland Lakes was listed as a Ramsar site in 1982. There is no trend in total nutrient concentrations in Lake King and no trends in dissolved inorganic nutrients in any of the main lakes.

Events such as prolonged drought and floods result in large, but relatively short-term changes to nutrients in the lakes. For example, during periods of prolonged low rainfall, there are decreases in nutrient loads to the lakes. During floods or in years with very high rainfall, high loads of nutrients enter the system. Floods following large scale bushfires, in particular can cause large peaks in nutrient concentrations across the Lakes. It is estimated that three times the average annual load of phosphorus and over twice the average annual load of nitrogen entered the lakes after intense rainfall fell on burned catchments in 2007 mobilising large amounts of sediment and associated nutrients.

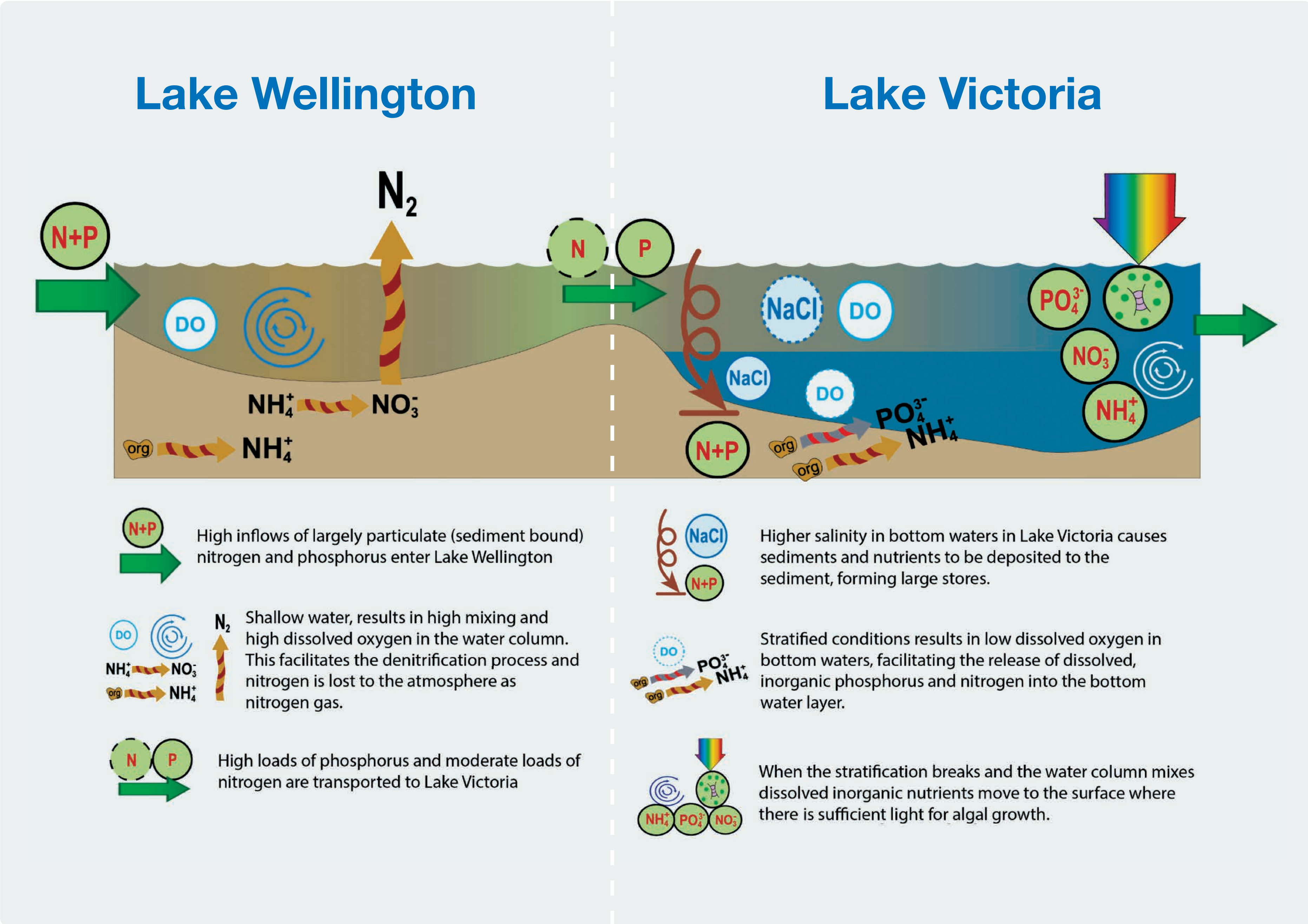



**Figure 1** Conceptual diagram of nutrient cycling in the Gippsland Lakes.

In terms of algal blooms, a study of the long-term history of algal blooms in the Gippsland Lakes from sediment cores indicates that there are two distinct periods of blue-green algal blooms in the Lakes. The first was prior to the permanent opening of the entrance to the Southern Ocean, and it is thought that the intermittently closed and open lagoon system was eutrophic (rich in nutrients and proliferation of algae). This is followed by a period immediately post construction of the channel at Lakes Entrance in 1889 of low algal growth, as the system filled and flushed with marine water. The second period of increased blue-green algal blooms has occurred post 1986 and is a result of a build up of nutrients in the system from historical and contemporary land practices in the catchment.

## What are we doing to manage nutrients and algal blooms?

There are a number of programs operating in the catchments of the Gippsland Lakes that are helping to reduce the amount of nutrients entering the system:

- Working with landholders to develop farm plans, undertake on ground works such as fencing, revegetation, weed control, stock exclusion and off stream watering.
- Managing environmental water to maintain habitat connectivity and reduce sediments enhancing the lower Latrobe Wetlands and estuarine river reach systems.
- Involvement of catchment's irrigators in programs which save water, increase production and retain nutrients and soil on farms.

More information on the processes described here and in Figure 1 can be found in these links:

- Nitrogen cycling - https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/nitrogen-concept-model/processes.html
- Stratification - https://wetlandinfo.des.qld.gov.au/wetlands/ecology/processes-systems/stratification/
- Phytoplankton and nutrients - https://earthobservatory.nasa.gov/features/Phytoplankton

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**Acknowledgement of Country:** We acknowledge the Gunaikurnai people, Traditional Owners and custodians of the land and waters of the Gippsland Lakes region, and pay our respects to their Elders past and present. In particular, we pay tribute to the Brayakaulung, Brabralung and Tatungalung clans, whose custodianship is a vital part of the heritage, knowledge and future management of the Gippsland Lakes.