

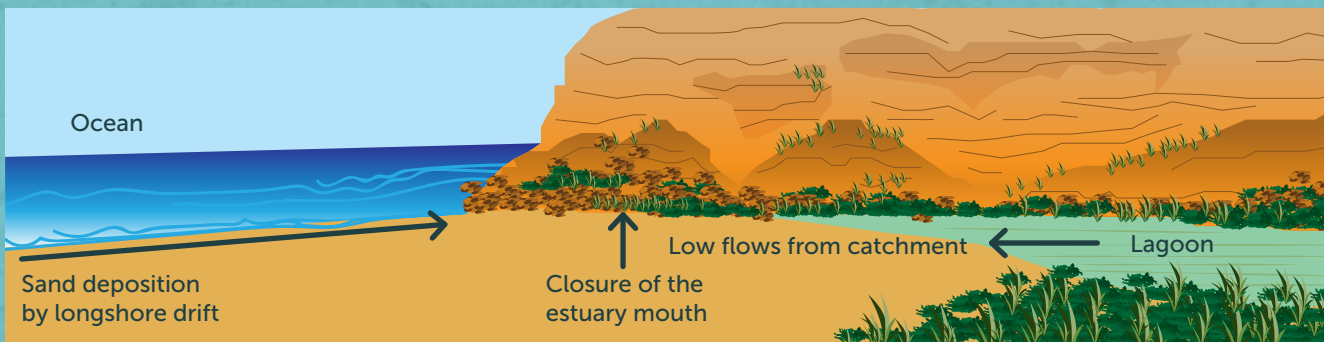


# INVESTIGATION OF LOW FLOW CONDITIONS IN THE GELLIBRAND RIVER ESTUARY

## PURPOSE

This fact sheet summarises the findings of a scientific investigation into low flows and estuary processes in the Gellibrand River estuary. The fact sheet includes the estuary mouth opening processes, the effects of low flows and estuary mouth closure, and the management strategies in place to address these.

This project is a collaboration between the Corangamite CMA, Wannon Water and Parks Victoria. The scientific investigation was undertaken by Alluvium.



## NATURAL ESTUARY DYNAMICS

In Intermittently Closed Estuaries (ICE) such as the Gellibrand River estuary, it is natural for the mouth to close from time to time because of a sandbar forming over the entrance to the estuary. The river mouth can remain closed for a short or long timeframe and it is an important process for supporting vegetation communities, fish recruitment and ecosystem processes.

The dominant process causing closure of the Gellibrand River estuary involves the build-up of sand transported from the south end of the beach (longshore drift) and from wave action. Closures most often occur during November - May, when river flows into the estuary are at their lowest.

The natural process of estuaries opening and closing and fluctuations in water levels, impact plants and animals differently at different times. Some will thrive under certain conditions, while others will naturally decline.

Part of natural estuary dynamics can lead to low levels of dissolved oxygen (DO) in the water column. These conditions pose a risk to fish and aquatic life as they are dependent on DO levels for survival. Fish deaths resulting from low DO conditions is a natural process in the Gellibrand River. The severity of fish death events depends on how low DO falls and how long low DO conditions persist.

Estuarine fish communities have adapted to estuary dynamics and are capable of recovering from extreme changes in water quality conditions. During periods of low DO, freshwater and estuarine fish will generally migrate upstream to more favourable conditions, while it is the saltwater species that are "trapped" that are most at threat. When a fish death occurs, estuarine fish communities are resilient and have been observed to recover quickly at estuaries across the Corangamite region.

## ARTIFICIAL ESTUARY OPENINGS

Floodplain inundation, while important in supporting certain ecological functions, can threaten human assets (e.g. jetties, boardwalks, roads, private property) and productive use of the surrounding land. At the Gellibrand River estuary, this includes assets such as Old Coach Road. The risk to built infrastructure can lead to a decision to artificially open the estuary.

An artificial estuary opening involves creating an opening through the sand berm between the estuary and the ocean with earth moving equipment. While this instigates the opening process, we rely on the energy from water movement in and out of the estuary to keep the estuary open.

Managers use the Estuary Entrance Management Support System (EEMSS) when planning artificial estuary openings to assess the likely impact to the social, economic and environmental values of the estuary.







When investing in an artificial estuary opening, the intent is to ensure the estuary remains open for prolonged period such that the floodplain inundation is reduced and the estuary does not immediately return to its previous state. This also supports greater tidal interchange, which is an important factor in the resultant water quality (see 'changes in dissolved oxygen during an opening' below). The conditions when an artificial estuary opening is undertaken influences whether an artificial opening is likely to remain open for a prolonged period. The main factors to support prolonged openings are:

- High flows from the catchment
- Low wave height
- Appropriate wave/wind direction

Even though fish deaths can result from the natural process of estuaries opening and closing, artificial estuary openings can create an additional risk of low dissolved oxygen conditions which can cause a fish death event. When undertaking artificial estuary openings, the impacts on the local ecosystem and preventing high risk DO levels needs to be considered.

## CHANGES IN DISSOLVED OXYGEN

Given that artificial estuary openings occur mostly to protect built assets, understanding the conditions at the time of an artificial estuary opening is particularly important to ensure the timing of the opening has the lowest possible impact to the environment. The resultant DO and risk to the environment after an artificial estuary opening depends on the DO while the estuary is closed and the drop in DO when an opening occurs.

### Dissolved oxygen in a closed estuary

The three main factors that drive declines in dissolved oxygen levels in the Gellibrand River estuary while it is closed are as follows:

**Plant respiration:** On a daily cycle DO increases and decreases in response to the amount of plant photosynthesis and respiration. When plants are active during a sunny day, DO levels increase whereas at night or during cloudy whether DO levels reduce.

### Mixing of the water columns from catchment inflows:

During periods of low river flows estuaries often develop stratification, where the top and bottom layers of the water column do not mix. The surface (top) layer will have higher dissolved oxygen levels and is important to the survival of fish. Meanwhile, DO in the bottom layer will decline over time, sometimes to critical levels. Significant river flows into the estuary can mix these layers (disrupt the stratification), and the top water (higher DO) will mix with the bottom layer (very low DO). This can result in a decline in DO levels for the water column overall.

**High organic load:** River flows entering the estuary with a high organic content (e.g. leaves, grass, bark) can bring an increase in bacterial activity, depleting available oxygen from the surrounding water. The severity of such an event is dependent on the amount, temperature and type of organic material.

### Potential changes in dissolved oxygen during an opening

When the estuary openings occur, the DO levels can drop significantly which can further exacerbate impacts on the local ecosystem, including fish deaths.

When the estuary is closed, DO (along with salinity and temperature) typically separates into layers of water. The surface layer has the highest concentration of DO. If an estuary is opened artificially, the oxygen-rich surface layer of water flows out first, leaving behind water with low oxygen levels. The resultant DO depends on the degree of mixing with other water sources (and their DO levels):

- The **water from the estuary floodplain** is generally low in DO and is a risk to DO levels where the floodplain drains quickly into the estuary without mixing from an additional water source.
- **Catchment inflows** are generally a source of well-oxygenated water (unless there is high organic content from the catchment). Higher catchment inflows generally increase mixing, and reduce floodplain draining effects.
- **Tidal interchange** brings in sea water that is high in DO. The amount of tidal interchange depends on the extent of scour at the entrance to the estuary.

## A NEW FRAMEWORK TO MINIMISE ECOLOGICAL IMPACTS

The investigation produced a framework to minimise the potential impact of artificial estuary openings on native aquatic fauna. This framework will be applied alongside implementation of the EEMSS, to guide decisions on the environmental consequences of a potential opening.

The framework considers three main topics:

1. What is the DO risk if the estuary remains closed?
2. What is the DO risk if the estuary is artificially opened?
3. If an artificial estuary opening is proposed, will the estuary remain open and for how long?

This framework has been developed to assist managers answer these questions and understand the likely implications of estuary opening on native aquatic fauna.

The detailed findings of the scientific investigation are available on the Corangamite CMA Knowledge Base at <http://www.ccmaknowledgebase.vic.gov.au>.

Search for the 'Gellibrand River estuary low flow investigation' for the full report.

