



Gippsland Lakes Environmental Study - Fact Sheet No. 4

What controls water level in the Lakes?

The Gippsland Lakes are a series of shallow, interconnected coastal lagoons separated from Bass Strait by a series of coastal dune barriers. A 120 m wide passage connects the Lakes with Bass Strait near Lakes Entrance. Fluctuations of water levels within the Lakes vary significantly across the system in both magnitude and time. At the Entrance the fluctuation is almost one metre and at the mouth of the Latrobe River, which drains into Lake Wellington it is about half a metre.

Tides

The causes of these fluctuations are four fold. The first is tides, which are the twice daily cyclical water level changes caused by the pull of the sun and the moon. These tidal fluctuations are always present and are superimposed on the other sources of water level change described below.

Atmospheric Conditions

Fluctuations in water level also arise from passing weather patterns. Variations in atmospheric pressure cause an 'inverse barometer' effect. With a High pressure, the ocean is effectively "pushed down", dropping the average level. Similarly a Low pressure results in the ocean level being higher than the average. Variations in coastal water level is also affected by both regional winds and from changes generated elsewhere which propagate through Bass Strait via continental shelf waves. These changes to Bass Strait water level are propagated through the Lakes

Winds

Within the Lakes, the wind blowing on the Lakes' surface can affect water levels. Strong winds tend to "pile up" water at one end or other of the Lakes, causing a corresponding drop in level at the other end. The predominant wind direction over the Lakes is westerly, with infrequent strong westerly winds capable of lowering the water surface in the western parts of Lake Wellington by up to 60 cm. The resultant elevated water surface in eastern parts of Lake Wellington act to force water through McLennan Strait to Lake Victoria at a greater rate than would occur without the strong wind. Westerly winds also cause higher water levels in the eastern parts of the Lakes, causing outflows to Bass Strait to be higher. Over the warmer months, easterly winds, reinforced by sea breezes, can have the opposite effect; these can blow strongly for quite long periods, although the really extreme wind speeds tend to be westerly.

In addition to influencing water levels in each of the lakes, wind assists with mixing the water column. This helps to break down stratification in the deeper lakes, which has important consequences on the ecology of the Lakes.

Rivers, Rain and Evaporation

Finally, river inflows, direct rainfall and evaporation cause the lake levels to change as floods or periods of low flow cause changes in the total amount of water in the Lakes. River inflows provide the main freshwater inputs to the Lakes, with smaller volumes provided by rainfall. Losses from evaporation are about twice those estimated for direct rainfall inputs, and there are periods in summer during low river flows when the evaporation from the Lakes is larger than the inflowing fresh water, causing net inflows of sea water. Water levels within the lakes can rise by 1 to 2 m as a result of large river inflows.

Effects of the Entrance

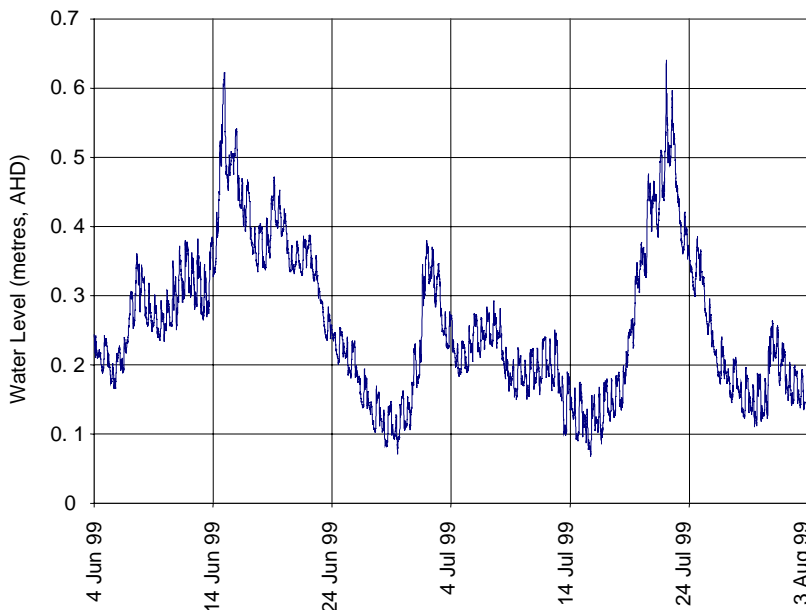
The Entrance provides for exchange of water between Bass Strait and the Lakes. Twice each day more than 20,000 megalitres (ML) of water enters the Lakes during the flood tide and exits on the ebb tide. These tidal exchanges result in water level differences of about 5 to 10 cm within Lakes Victoria and King, which is small compared with tidal range variations in adjacent coastal waters of about 1 m. The restriction of the flow through the Entrance and inner channels causes the large difference in tidal influence between these two Lakes and the open coast. The tidal fluctuations are further reduced in Lake Wellington due to the restriction of McLennan Strait.

However, the low-frequency water level fluctuations associated with the passage of weather systems across Australia can penetrate much more effectively into the Lakes than the tides. In effect the tide turns long before the flow through the Entrance is able to 'fill' or 'empty' the Lakes, but a low-frequency level fluctuation having a period of 5 to 10 days or more is high or low for long enough that the Lake water level can approach the level of the water outside the Entrance. Low-frequency water level fluctuations in Bass Strait can vary water levels in Lakes Victoria and King by more than 30 cm; many times larger than the tidal variation. This means that the volume of water exchange through a low-frequency cycle of level fluctuation is much greater than the tidal exchange and also that the oceanic water penetrates much further along the channel connecting the Entrance to the main body of the Lakes. Consequently, low-frequency meteorological phenomena are much more effective at exchanging water between the Lakes and the ocean than are the tides.

Water level measurements

In a collaborative effort between Gippsland Ports and the University of Melbourne's Centre for Environmental Applied Hydrology, a network of water level recorders have been installed and operated throughout the Gippsland Lakes since November 1998. The sensors, which automatically record water levels every 12 minutes, are providing important information for several studies, including the Gippsland Lakes Environmental Study.

The data have enabled the effects on Lake water levels of wind, tide, low-frequency variations in sea level, and river inflows to be quantified. They are also a key source of testing data for the CSIRO hydrodynamic model.



Graph of surface water levels measured in June and July 1999 at Fraser Island, which is about 3km in from the Entrance. The regular tidal fluctuations are clearly seen along with the longer period fluctuations caused by passing weather patterns.

The Lakes display a large range of diversity in terms of their physical attributes and the pressures placed on them by the catchments that drain to them. This fact sheet is part of a series aimed at informing the community on the results of the study. More detailed information is provided in the technical and final reports, which are available on the Gippsland Coastal Board website (<http://www.gcb.vic.gov.au>).

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