



SCIENCE + ENGAGEMENT
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Key Factors Affecting Lake Trophic Level Index (TLI)

MIXING TYPE

How lake water is mixed:

This refers to the mixing of lake water, which in turn influences the natural physics, chemistry and ecology of the lake. The mixing type is influenced by geomorphic type, as some geomorphic components of the lake (such as depth and shape) play a role in the mixing regime, as does the connectivity of a lake to the sea.

The surface of a lake is exposed to wind and temperature changes which can cause either mixing of the water (typically in colder weather), or the creation of stratified layers (cold bottom waters to warmer surface waters, referred to as a thermocline), typically in warmer weather.

There are two main mixing types:

1. **Polymictic** – mixed all year round.
 2. **Monomictic** – stratified (i.e., has distinct water layers based off temperature and density), with one mixing event per year.
- The two other lake mixing types are connected to the sea:
3. **Brackish lakes**
 4. **ICOL** = intermittently closing & opening lakes.

GEOMORPHIC TYPE

How lake was formed:

A lake's geomorphic type directly influences its depth, shape and connection (if any), to the coast – all of which can directly impact its ecosystem. It's important to know a lakes geomorphic type as each type has different starting natural environmental conditions, e.g., a peat lake has naturally higher concentrations of nitrate and phosphorus than a glacial lake.

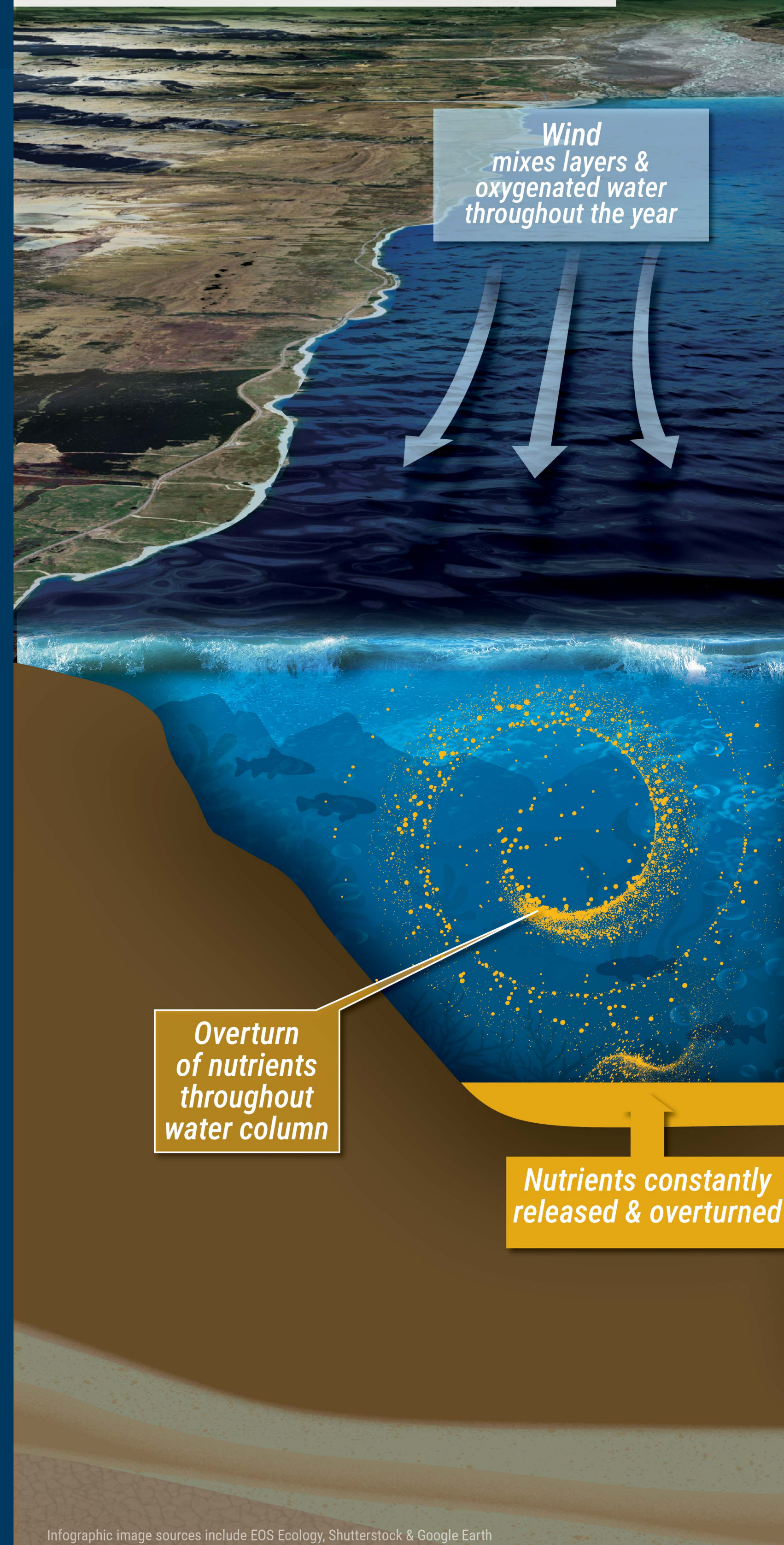
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1. Polymictic mixed all year

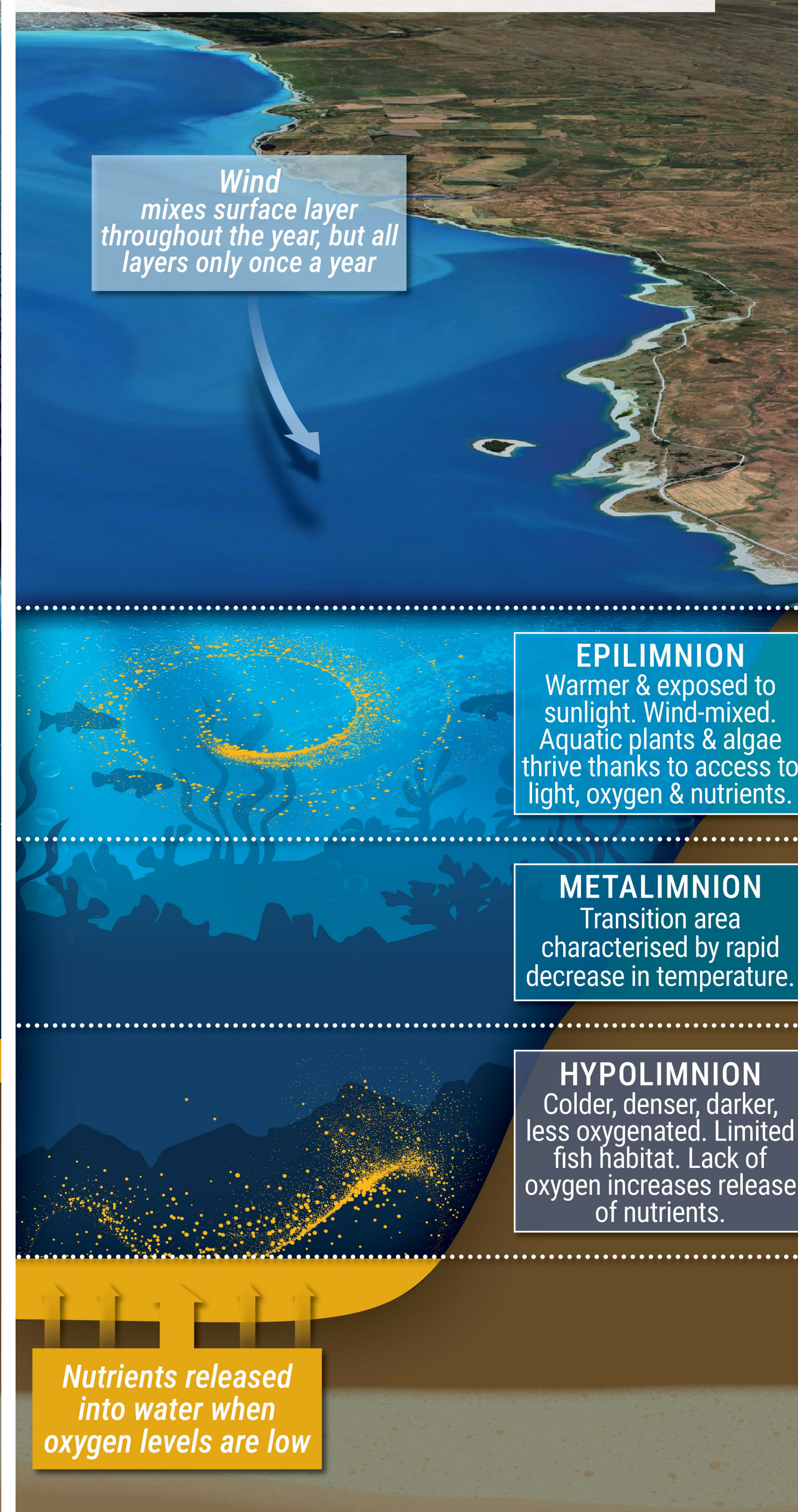
Wind disturbs the surface of the water causing the constant overturning of nutrients throughout the water column. Waters are oxygenated throughout, providing good habitat for fish. This occurs in most shallow lakes.



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2. Monomictic stratified with 1 mix event per year

For most of the year a thermocline is in place due to the depth of the lake. A thermocline is a distinct layer in the water column where temperature changes rapidly with depth – separating warmer, mixed surface water from cooler, deeper water. In colder, windier conditions, stratification can be broken down and the lake becomes mixed, roughly once a year. This occurs in most deeper lakes.



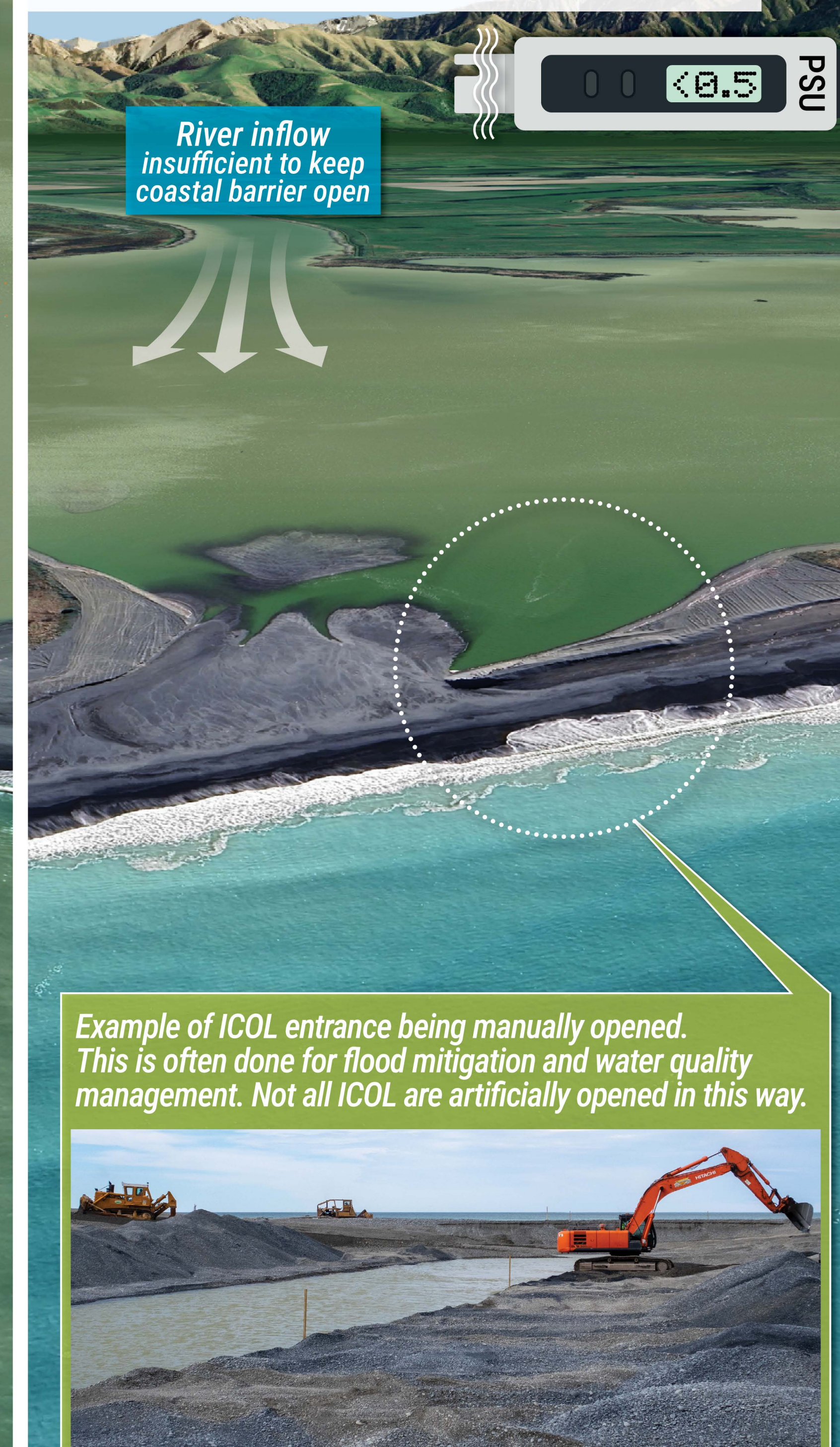
3. Brackish lakes

These are coastal lakes with a practical salinity unit (psu) measurement consistently or temporarily higher than freshwater (0.5 psu), but lower than seawater (30–38 psu). Brackish lakes can be temporarily or permanently closed to the sea. Rainfall, river discharges and tides lead to salinity fluctuations. They're home to diverse ecosystems that support a unique mix of fresh and saltwater organisms.



4. ICOL intermittently closing & opening lakes

These are coastal lakes, tidal lakes or lagoons formed by a barrier to the ocean. They fill with freshwater until they breach the coastal barrier, which results in a rapid loss of freshwater from the lake. River inflows are not sufficient to maintain permanent sea openings, causing them to close off periodically. They're a unique freshwater ecosystem with fluctuating water levels due to changes in river inflow, sea level, wind, and tides. Sediment transport plays a role in the formation and closure of these lakes.



Lake Geomorphic Types as described by Lowe & Green (1992)

AEOLIAN/DUNE	PEAT	GLACIAL	LANDSLIDE	RIVERINE	SHORELINE/BARRIER BAR	VOLCANIC/TECTONIC & GEOTHERMAL	DAMS/ARTIFICIAL LAKES/RESERVOIRS
Dune lakes are formed in behind an accumulation of windblown sand deposits, particularly common in coastal regions. Most dune lakes are found on the west coast of the North Island due to the abundance of windblown sand deposits, e.g., Karikari Beach dune lake, Northland.	Lakes that are formed primarily as the result of the accumulation of partially decomposed plant material (organic matter) or better known as peat. Hollows are created in the peat surface by different rates of decomposition of the peat by fires, this is where water collects and forms a lake, e.g., Lake Ruatuna, Waikato.	Found exclusively in the South Island due to extensive glacial action. Formed by one or more glacial processes (ice-excavation, glacial moraine or melting ice blocks) and potentially further modified by non-glacial processes (faulting or landslides), e.g., Tasman Lake, Canterbury.	Formed by a rockfall or landslide that has blocked drainage at the base of a gully, e.g., Lake Rotokare, Taranaki.	There are two main types of riverine lakes: lateral lakes, and oxbow lakes. Lateral lakes form when a large river builds flood deposits faster than its tributaries, cutting off the tributary. Oxbow lakes are formed when a river changes course cutting off a bend in the river forming a disconnected water body, e.g., Hokowhitu Lagoon, Palmerston North.	Long-shore drift of a barrier bar or spit often intermittently closes inlets, embayments or estuaries, causing the lake to be brackish at times. The barriers themselves are formed by wave action, fluctuations in sea level or tectonic movement. The lakes usually occur adjacent to the outlets of rivers near the coast at low altitude, e.g., Te Waihora/Lake Ellesmere.	Formed by various volcanic processes such as a caldera collapse from a larger volcano, craters produced by smaller eruptions or blocked valleys by the way of lava flows. Lake Taupō is an example, formed by a collapsed caldera. Tectonic lakes are formed by movements in the earth's crust.	Part of a waterbody held in place by a barrier across a river valley, usually for hydropower or water storage, e.g., Lake Dunstan.

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