


The Gippsland Lakes Artificial Entrance: GIS and Sand Management

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1. **Study area**
2. **History**
3. **Natural processes**
4. **Sand management pre-2005 and deployment of GIS**
5. **Sand management post-2005**
6. **The future???**

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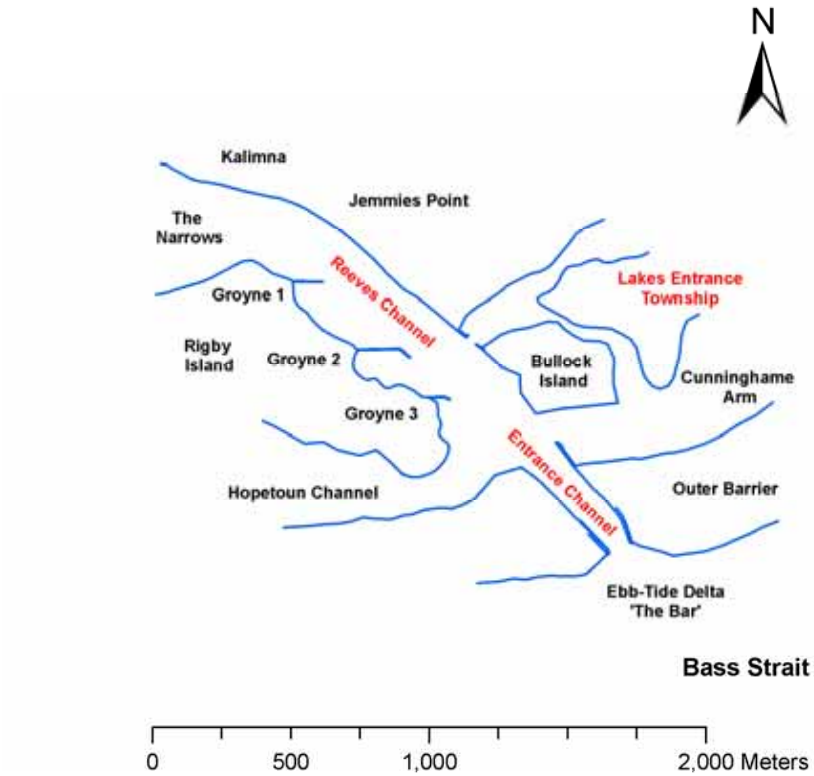
Study Area: Entrance and Reeves Channels, Gippsland Lakes

To document and interpret the bathymetric evolution within the Entrance and Reeves Channels of the Gippsland Lakes over the period 1889-2005 using GIS, with special reference to the nature of time-series sediment volume changes, and the correlation of key catchment events to these changes



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History - Gippsland Lakes evolution (Bird, 1965)

- Late Pleistocene – broad embayment on Bass Strait (e.g. sea cliff Jemmies Point);

- Bluff divides older coastal plateau terrain from newer sandy barrier terrain;

- Successive sandy barrier deposition phases throughout Late Pleistocene and Holocene caused formation of extensive coastal lagoon system;

- Current outer barrier deposited during Holocene (Flandrian Transgression 6-6.5Ka) – SE swell wave environment, quartz sands, micro-tidal (<1.0 m)

- Entrance migration from west to east (e.g. fossil entrances at Ocean Grange, fossil flood-tide delta at Carstairs Banks);

- Europeans found natural entrance at extreme easterly extent of lagoon system near Red Bluff in 1830s.

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History - European

- Natural entrance used for shipping access to ‘The Lakes’
- Lakes Entrance township developed from late-1830s
- Artificial entrance first considered in 1850s
- Works began 1870 – Sir John Coode report 1879
- Works never completed – storm caused entrance to open 1889
- ‘Coode’ plan not followed in entirety – local modifications

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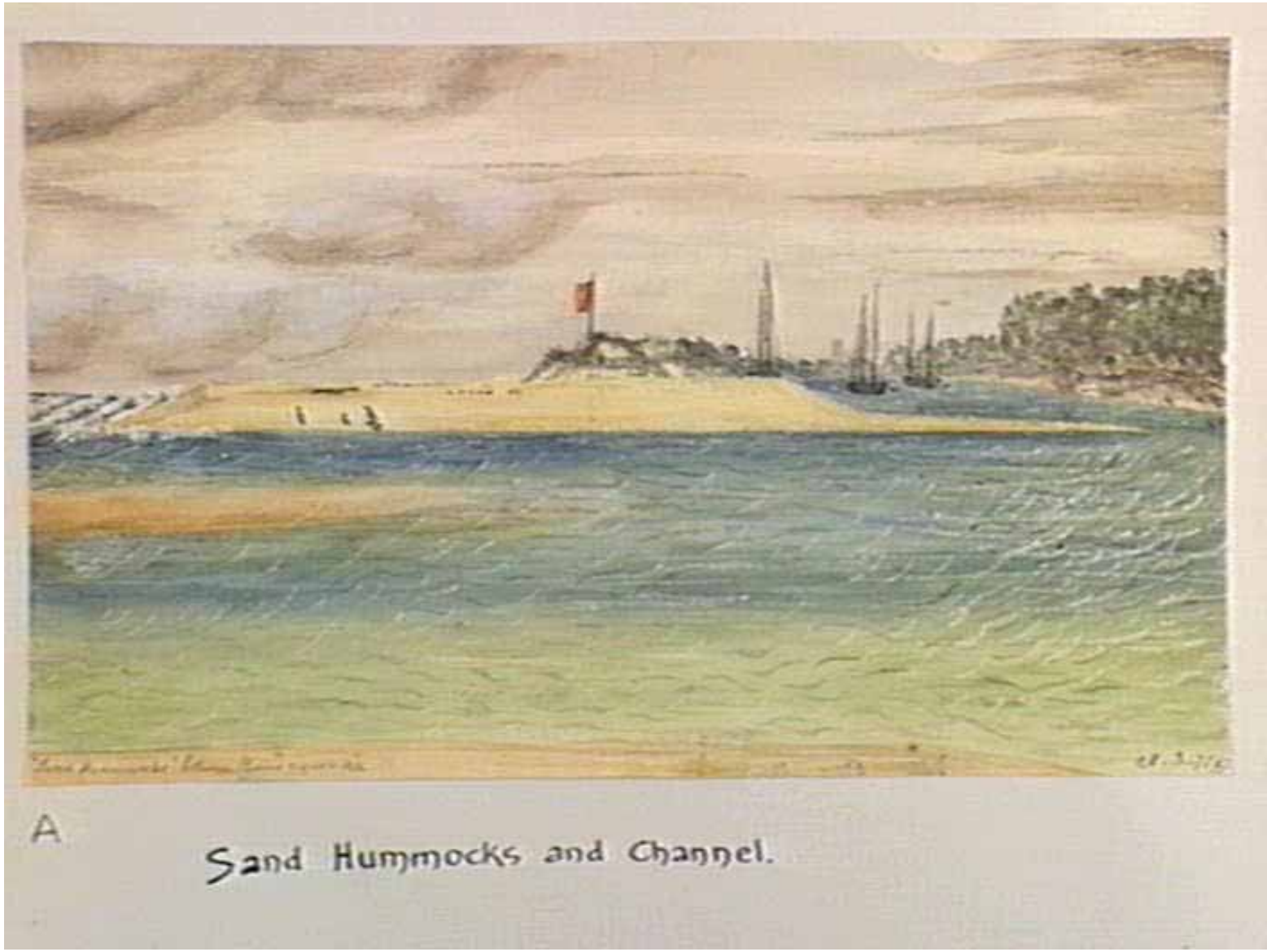

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Sand Hummocks and Channel.

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'During the rainy season, and when the snow melts on the mountains, the lake increases three to four feet in depth…. At this season…the fresh water will have sufficient force to clear away the sand on the bar, and…vessels may then pass over it'.

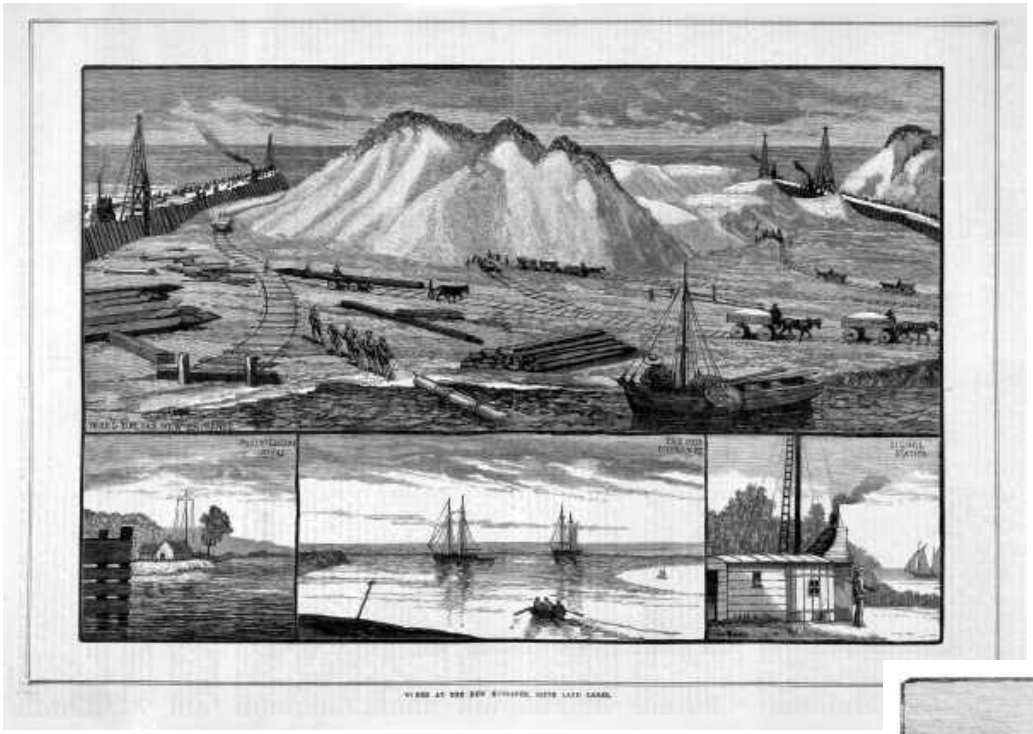
H.B. Morris, 1843

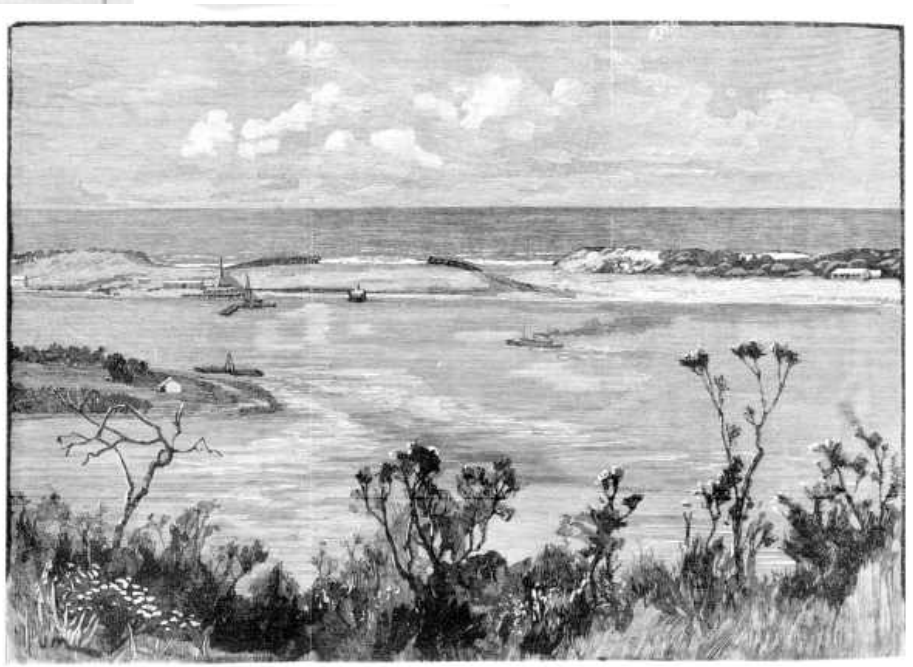
'…the water rises to a great height in the lakes and the country for a distance of one hundred miles back is flooded…the rush of waters very quickly cleared a channel through which even large vessels could sail in'.

W.T. Dawson, 1855

'During heavy land-floods the stream runs continuously seawards [through the seasonal natural entrance] *for weeks; this fact was communicated to me both by Captain Limesechow and Captain McAlpine who appear to have had greater experience of the navigation through the entrance than any other persons. The former mentioned an instance which occurred about six years since, when his schooner was anchored about half a mile to seaward of the entrance; he stated that on this occasion his vessel lay for eight days and nights with her head to the outgoing current, and that the water running past, being quite fresh, was taken up daily for ship's use'.*

Sir John Coode, 1879





THE WORKS AT THE LAKE'S ENTRANCE, GIPPSLAND.

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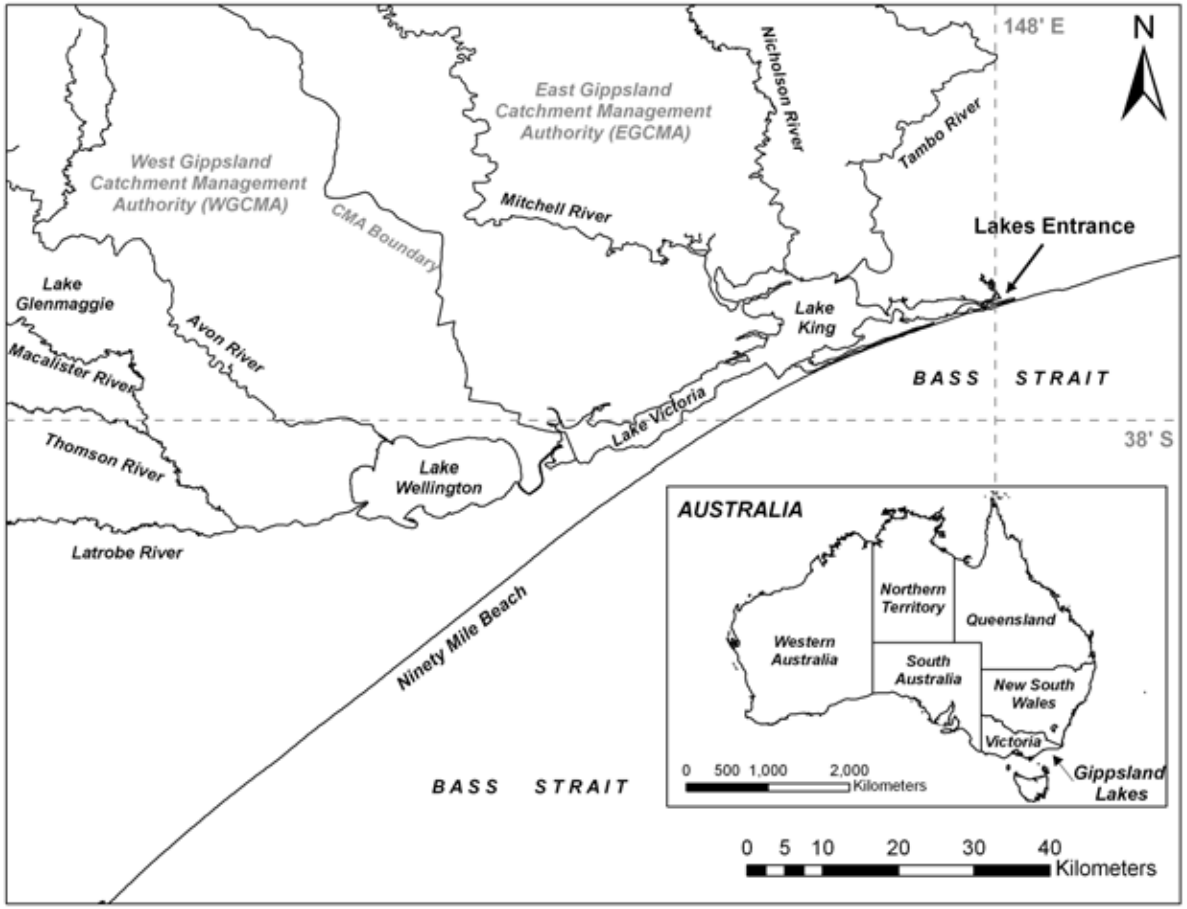
Natural processes: Gippsland Lakes catchment

- Over 20,000 km^2
- 7 Major Inflowing River Systems
- Drains high rainfall/snowfall areas of Eastern Highlands
- Major Reservoirs include Thomson Dam and Lake Glenmaggie
- Divided into management areas: e.g. WGCMA, EGCMA, Gippsland Coastal Board, Gippsland Ports, Melbourne Water, Southern Rural Water



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Coastal lagoon entrances

Bird, 1967; Bruun *et al*., 1978, Ippen, 1966; O'Brien, 1931

- Dimensions and position determined by the contest between currents flowing through the entrance and the effects of onshore and longshore drifting of sand, which tends to seal the entrance off
- Ebb flow current velocity can be greatly augmented by catchment streamflows, causing sediment scouring from channels
- Strong inflow and outflow currents tend to maintain the dimensions of lagoon entrances

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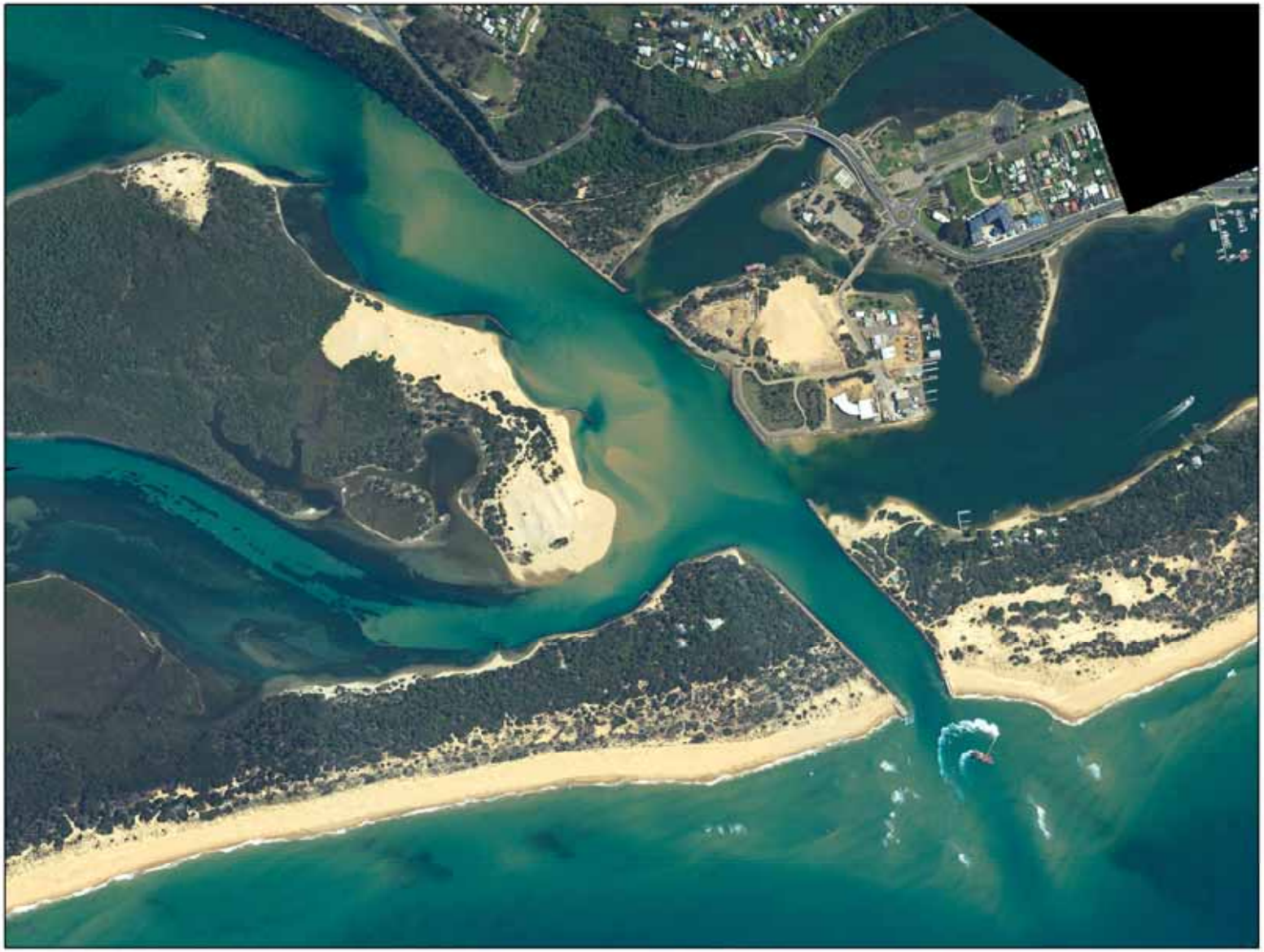
Ebb and flood-tide deltas

- Ebb and flood-tidal deltas form when sediment supply exceeds the capacity of currents to move sediment away.

- Flood-tidal deltas are located within coastal lagoons where flood-tidal velocities decrease to such a point that sediment falls from suspension, or entrainment is diminished.

- Likewise, as sediment is directed out to sea through lagoon entrances in ebb-tidal ‘jets’, current velocity will slow once the influence of the ‘tidal jet’ is diminished, and sediment will fall from suspension and be deposited.

- If this sediment is not removed via longshore or offshore drifting processes, the ebb-tidal delta will form a ‘bar’ across the entrance.



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Sediment management pre-2005…

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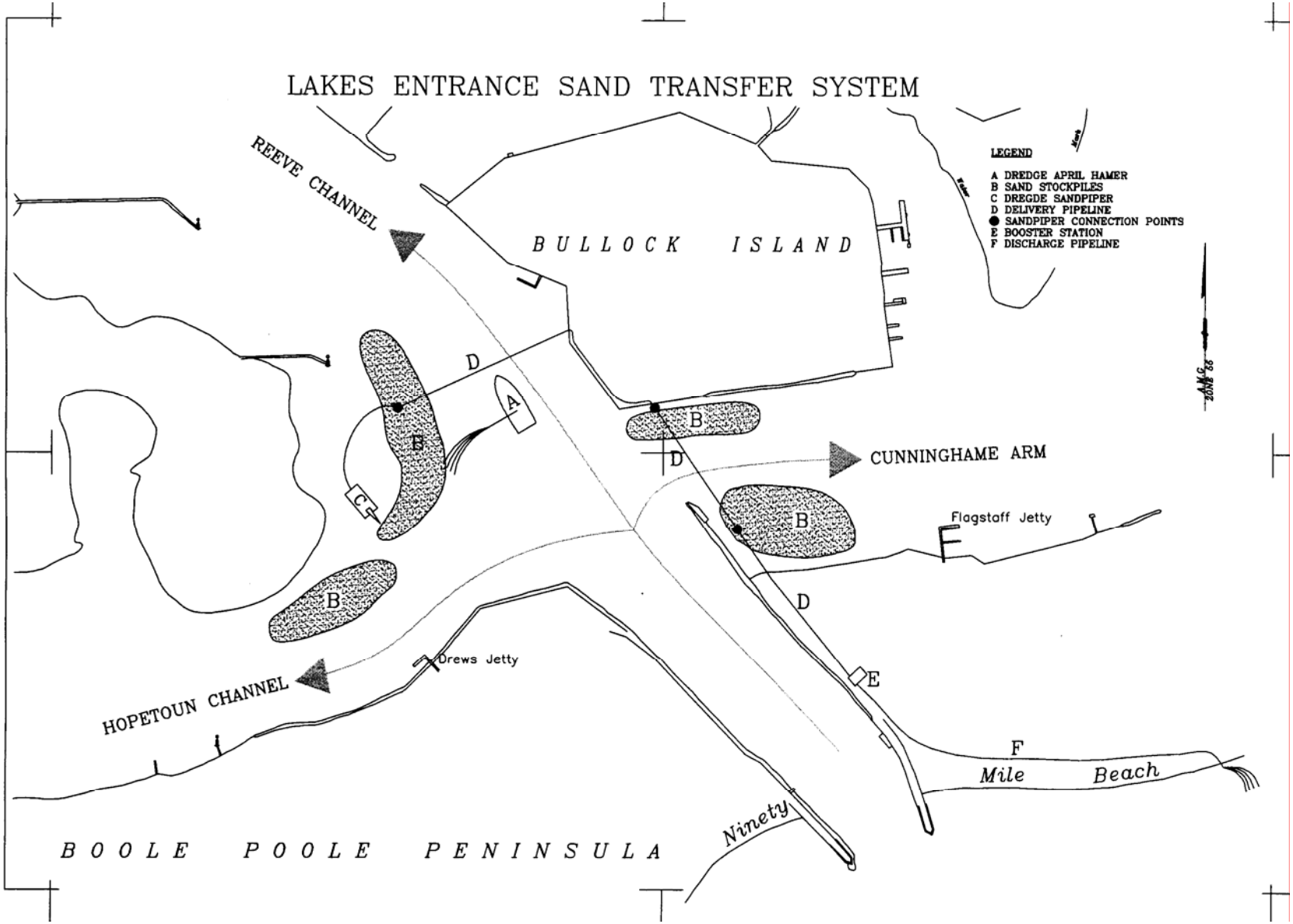

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How can GIS help us visualise, quantify and understand the channel sedimentation problems at Lakes Entrance???

GIS – Geographic Information Systems: A system for collecting, storing, displaying and analysing spatial data from the real world in digital format.

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Time-Series GIS Database Construction

- Hydrographic chart archive held by Port of Melbourne Corporation and Gippsland Ports
- 25 charts suitable for digitisation covering period 1889-2005
- Hydro surveys by Gippsland Ports
- Horizontal/vertical datum in time-series

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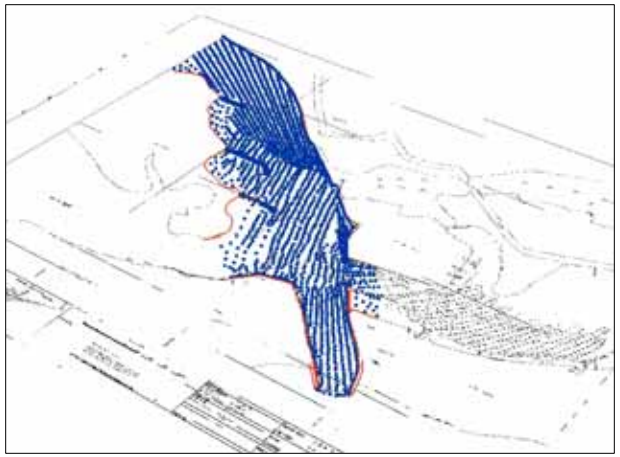

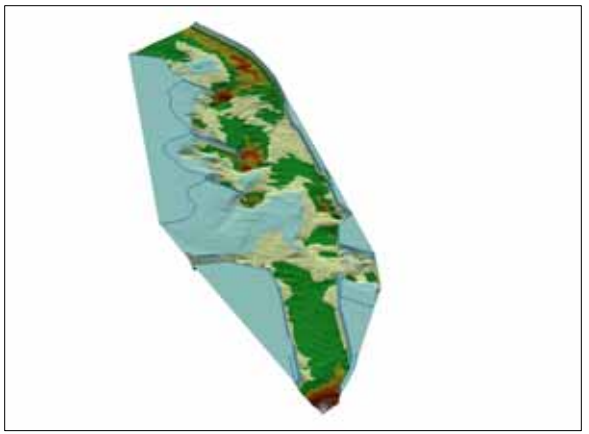

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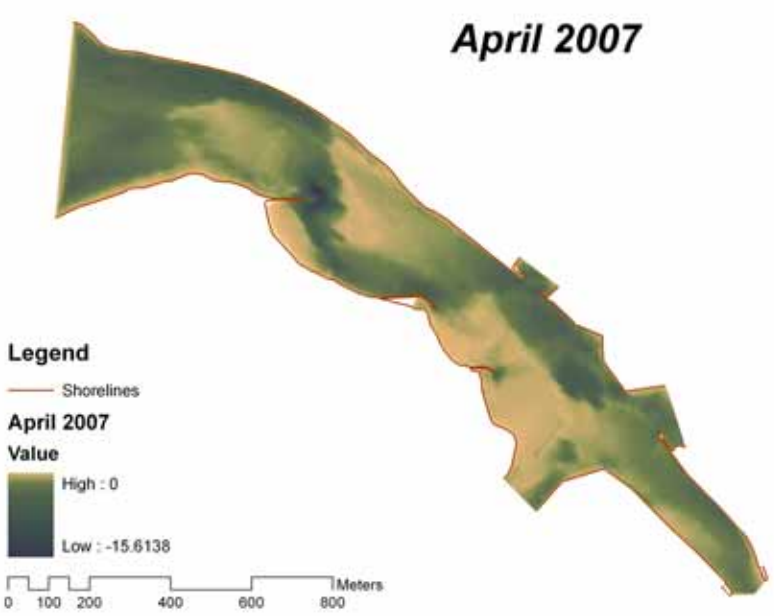

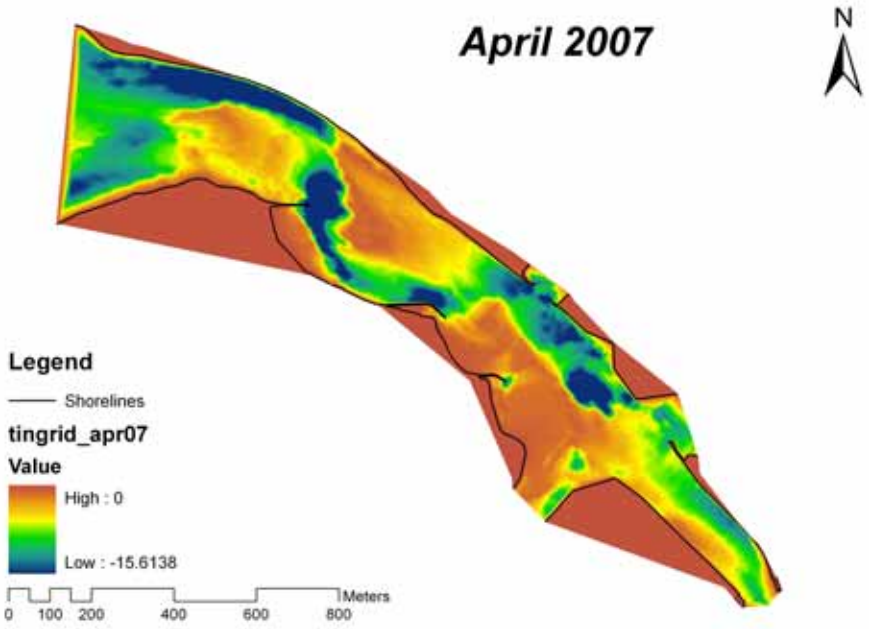

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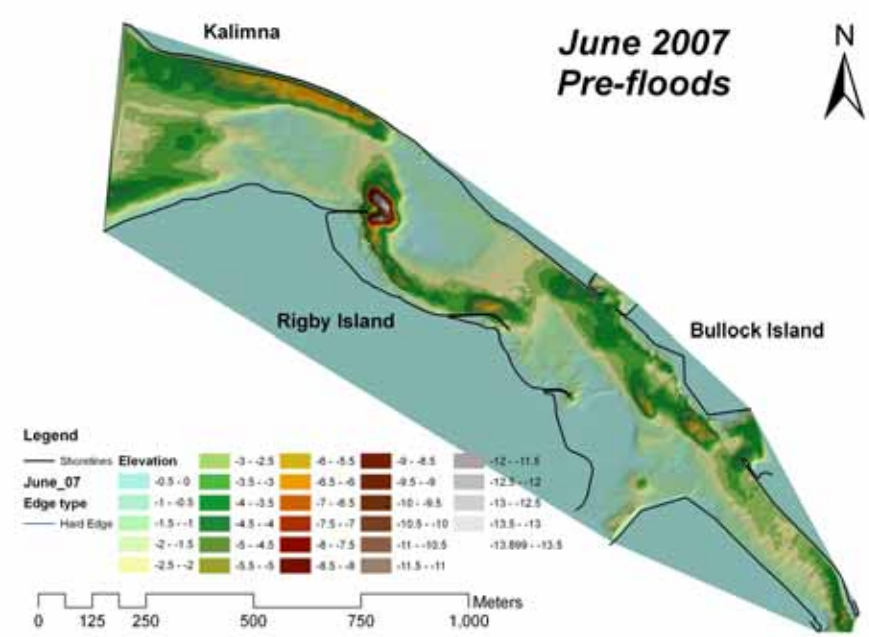

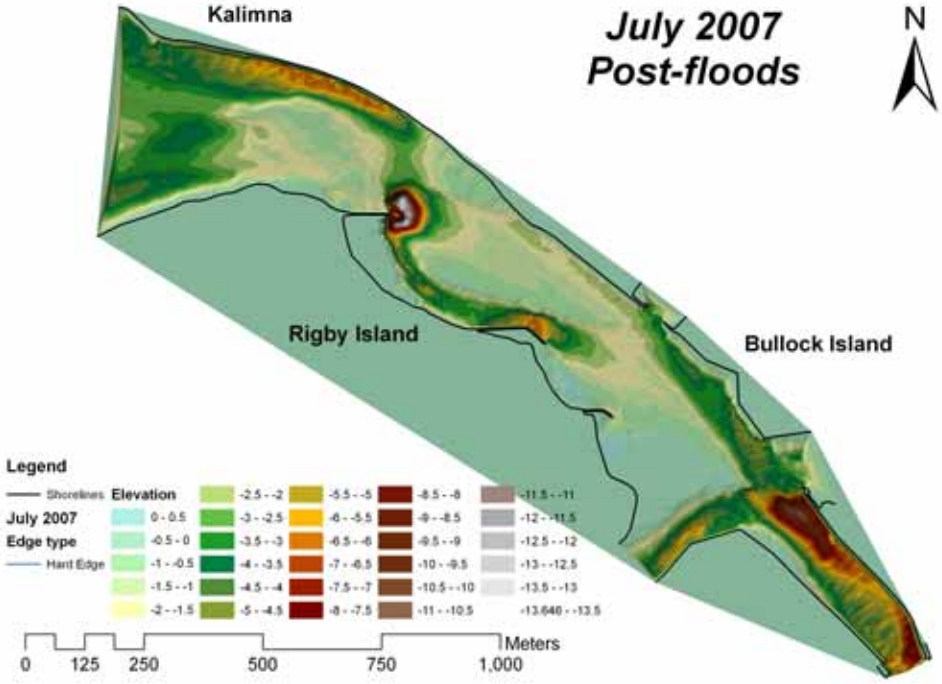

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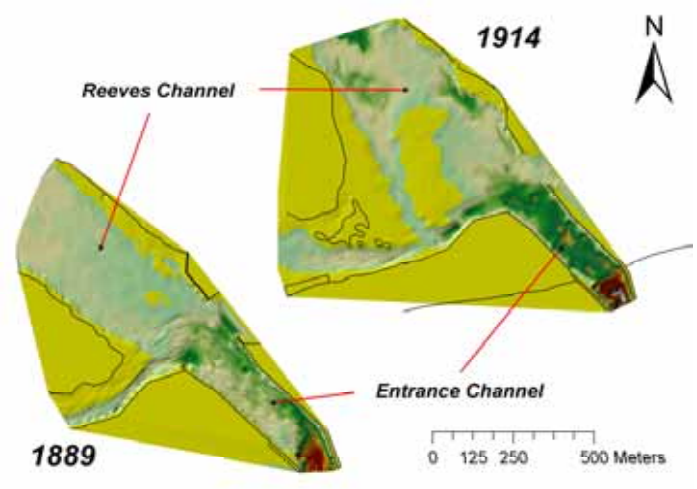

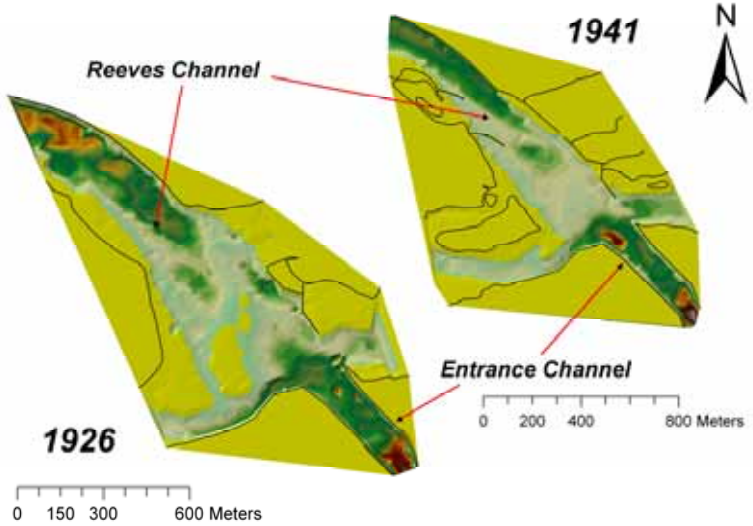

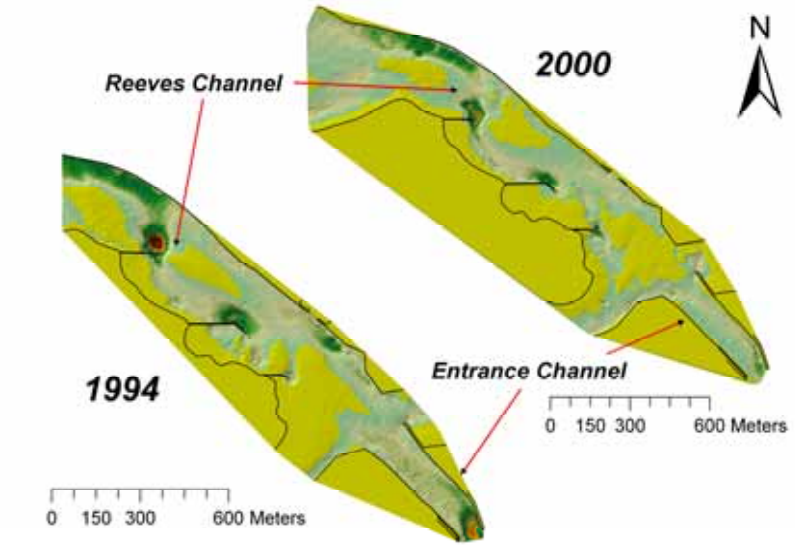

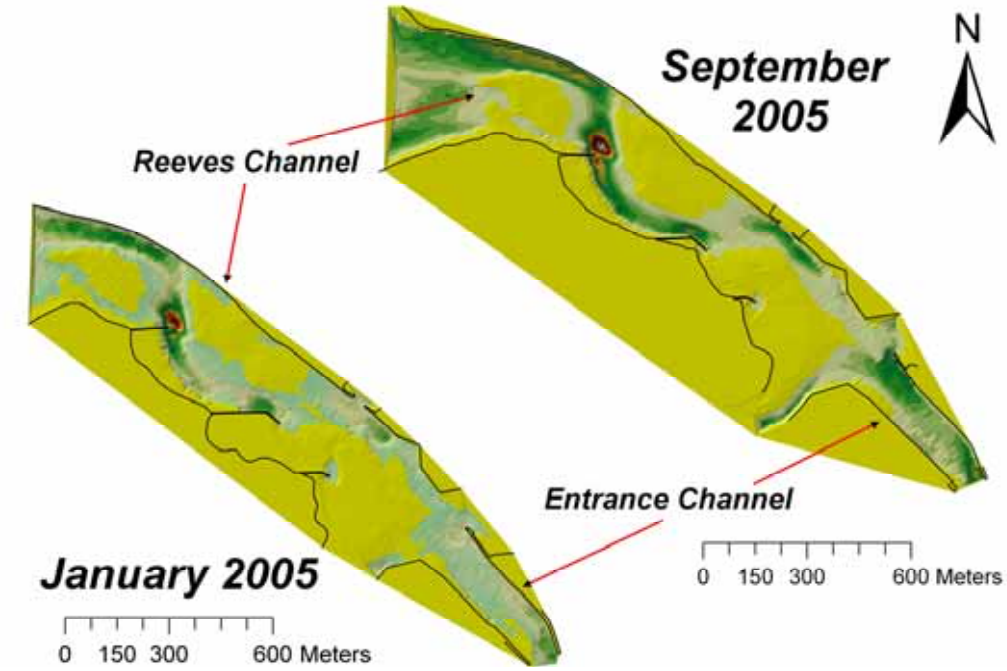

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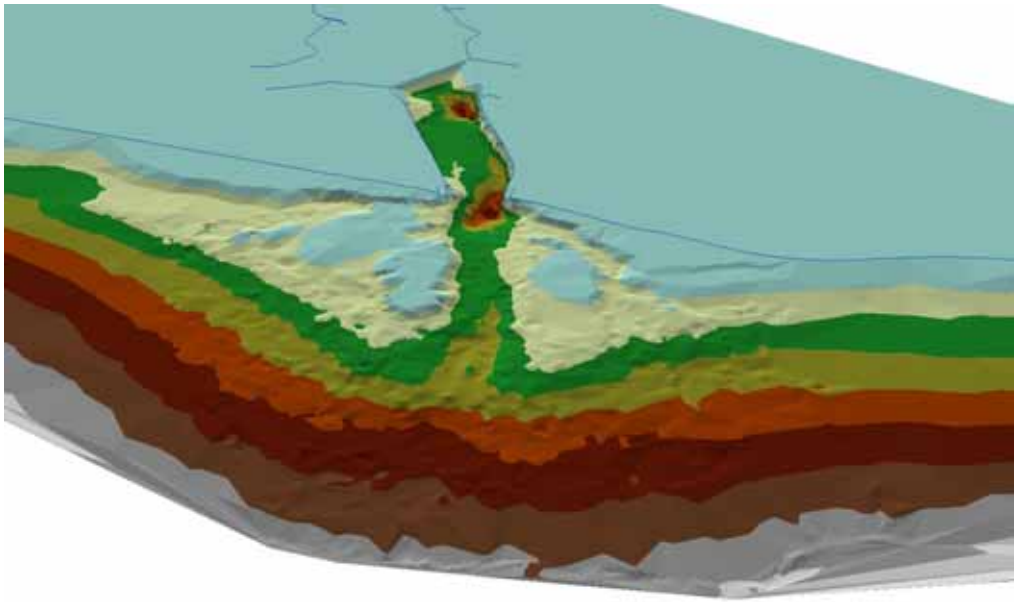

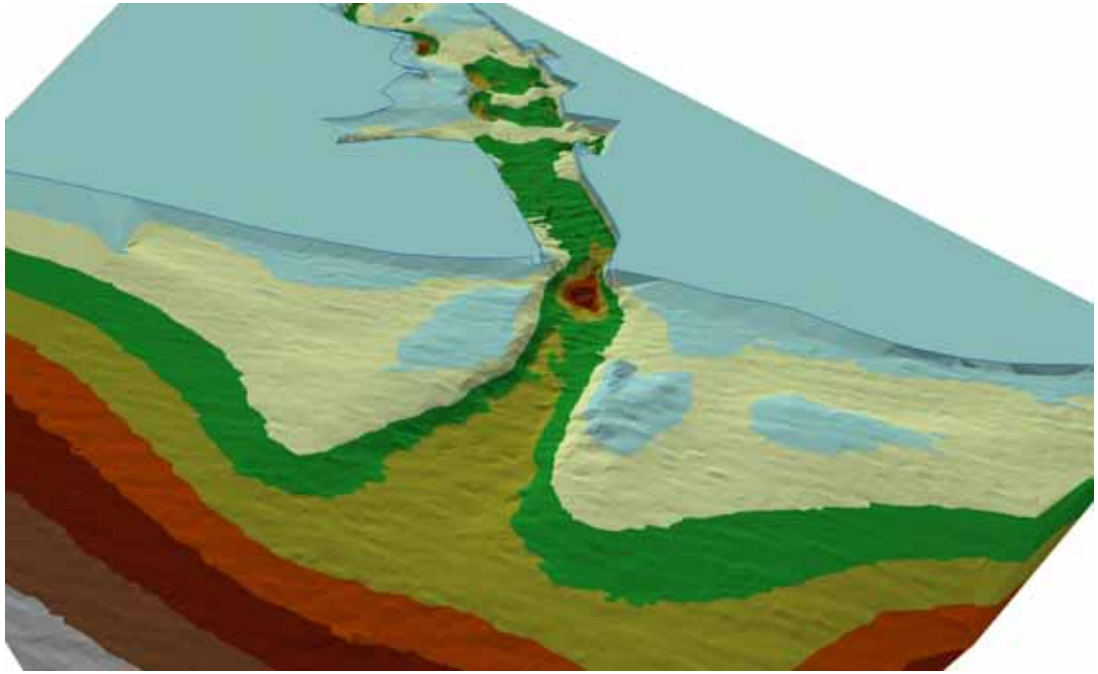

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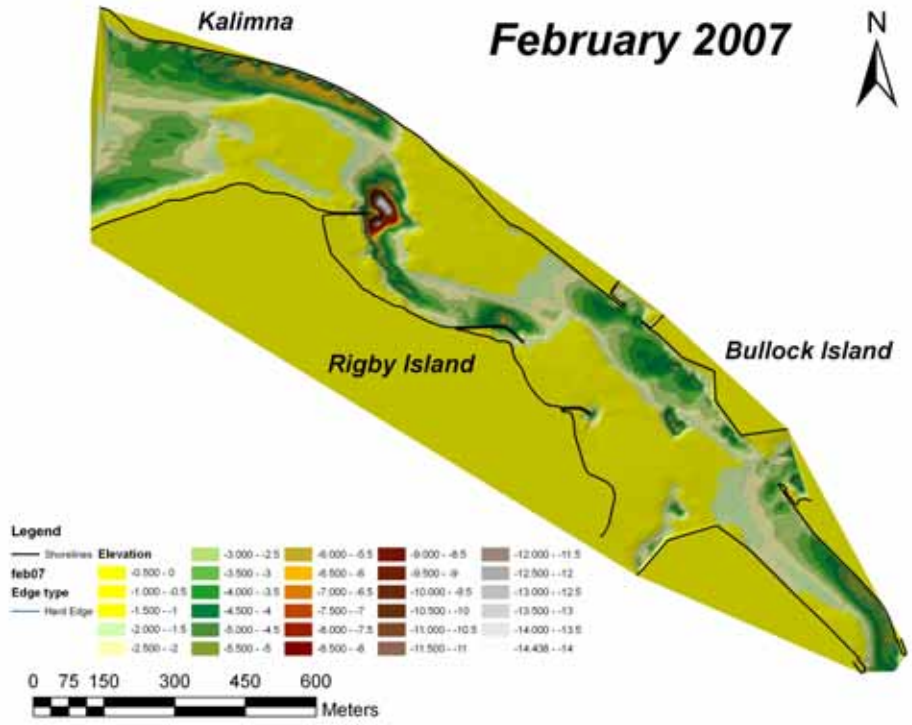

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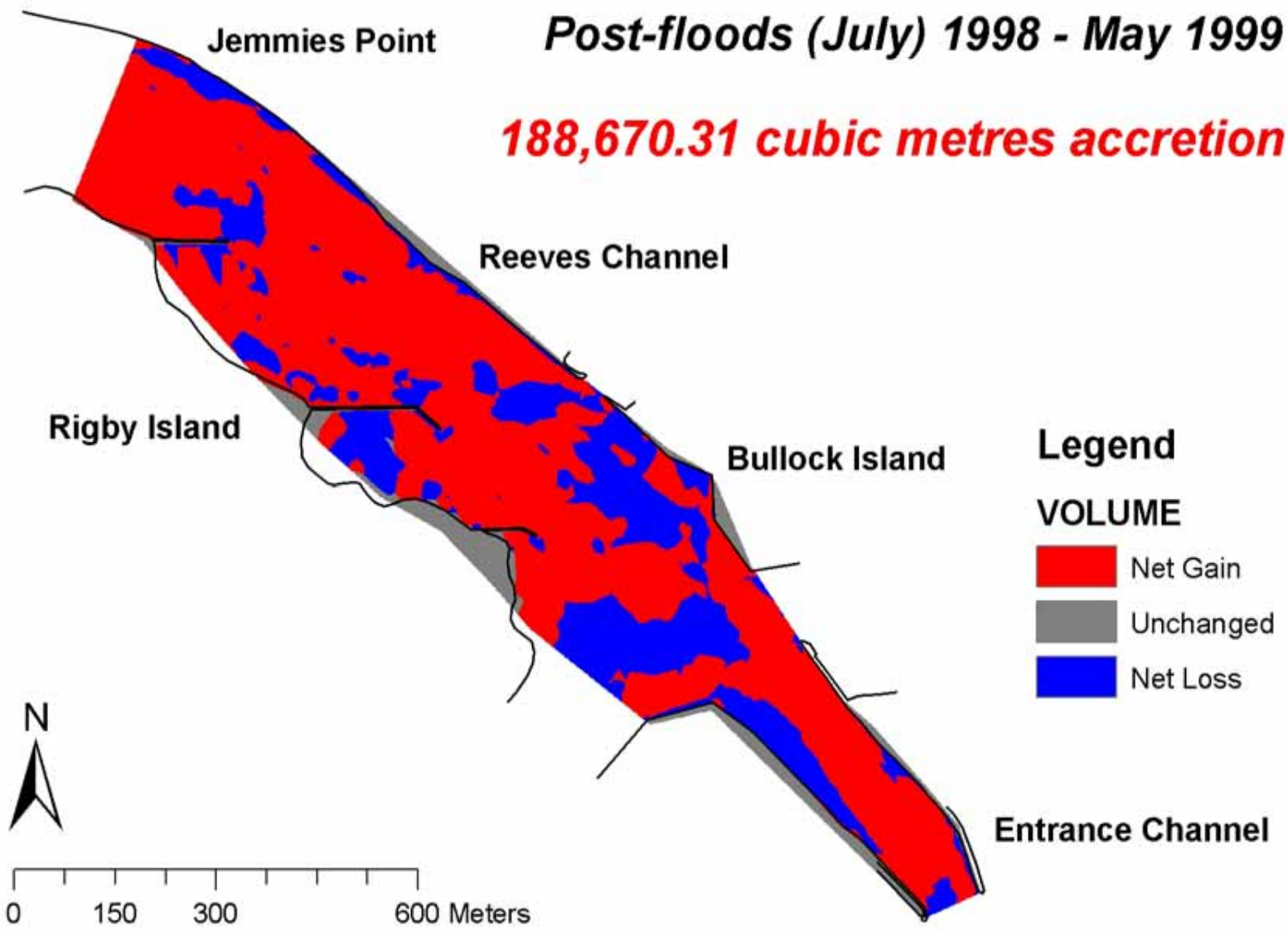

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Table 1. Net estimated Reeves and Entrance Channel sediment volumetric change figures , 1998-2005

Dates of DEM comparison	Estimated sediment volumetric gain/loss (m^3)
January-July 1998	**-169772**
July 1998-May 1999	**188671**
May 1999-July 2000	**-14679**
July 2000-January 2005	**92289**
January 1998-January 2005	**107591**
August 1975-January 2005	**708612**

Engineered sediment management regimes removed/bypassed approx. *1,000,000 cubic metres* of sediment since January 1999

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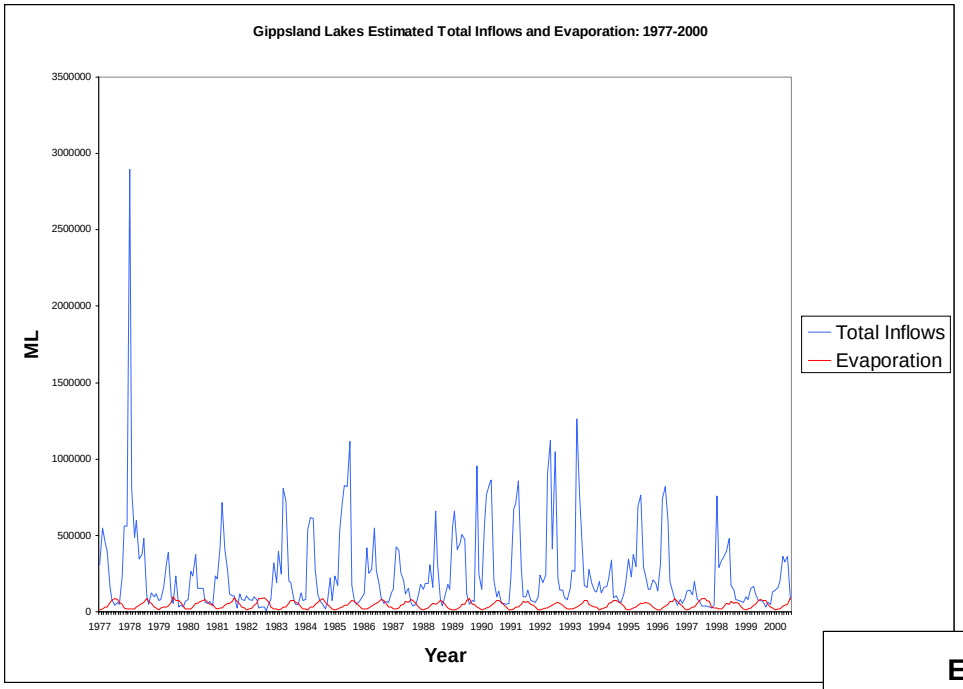

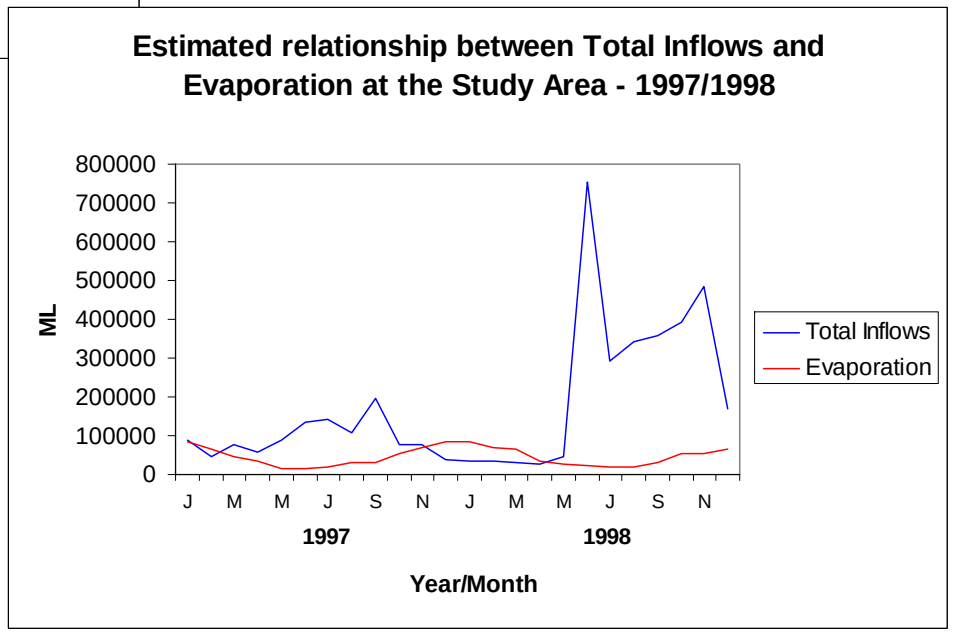

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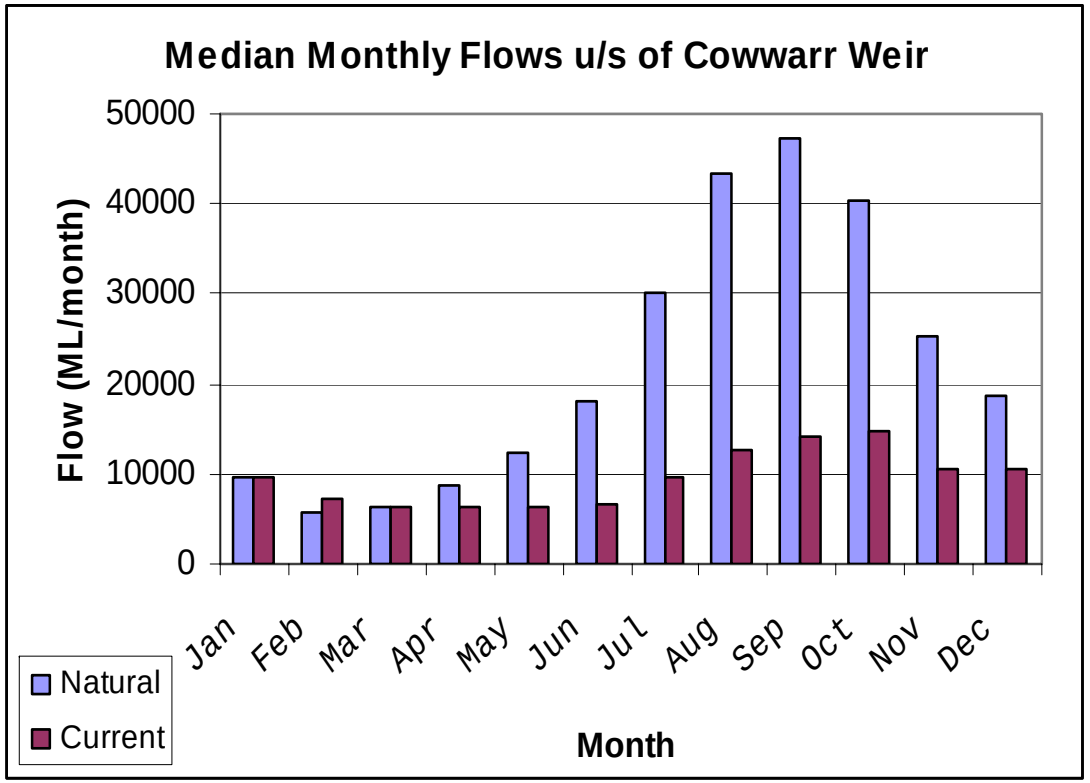

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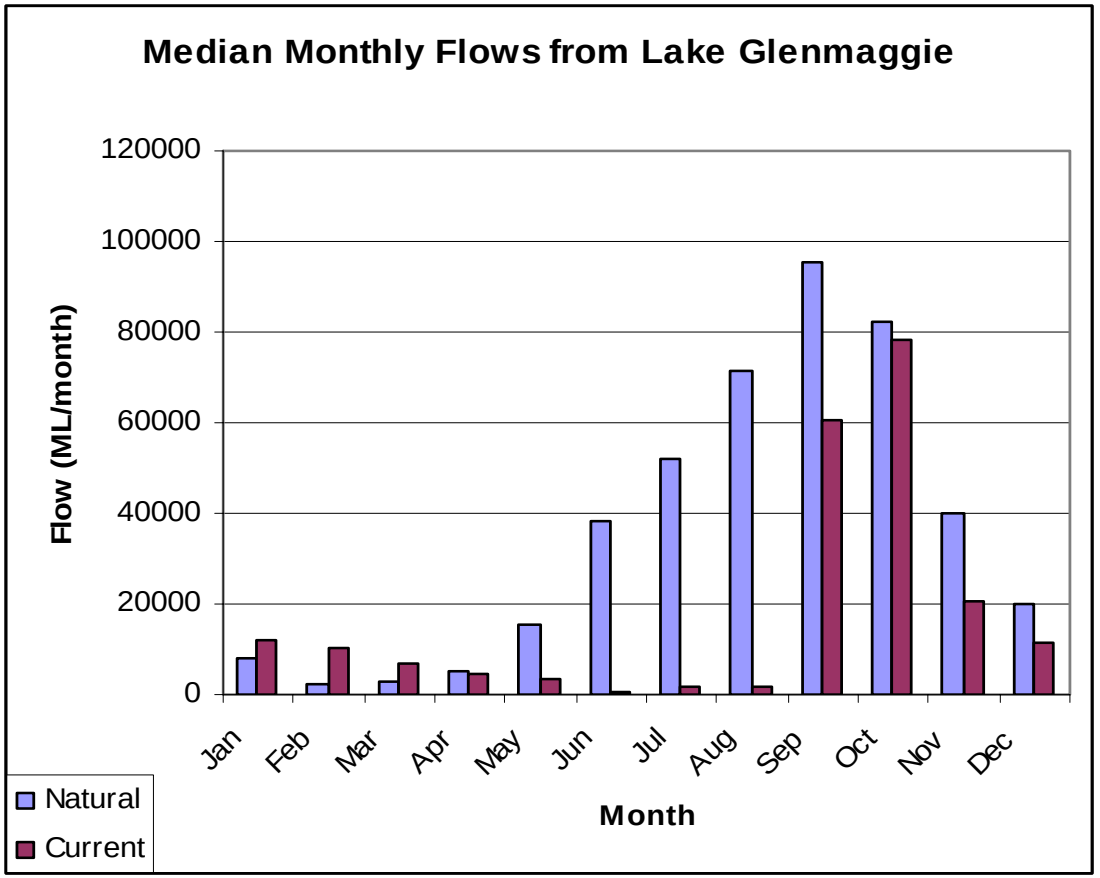

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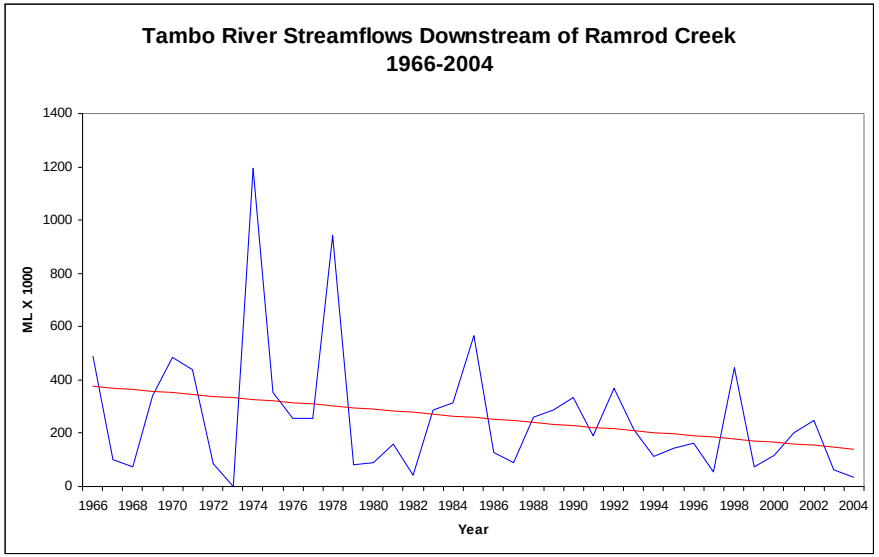
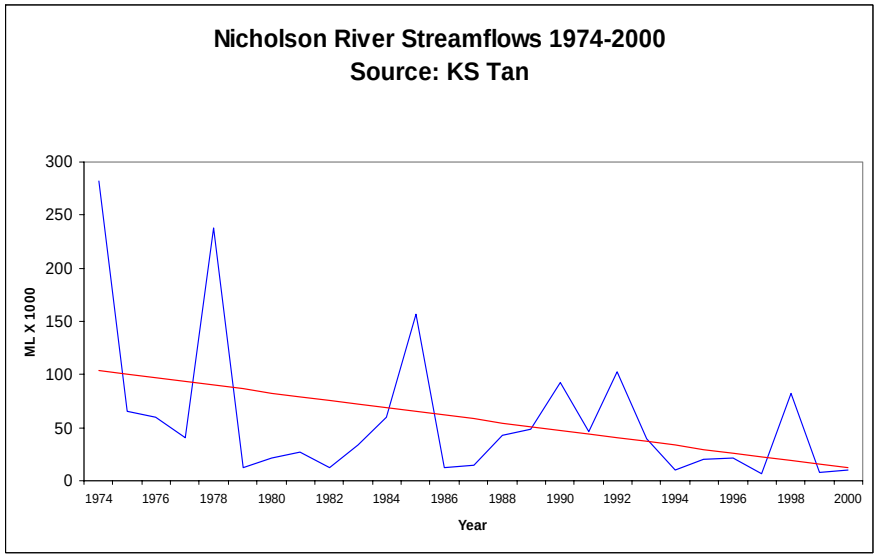
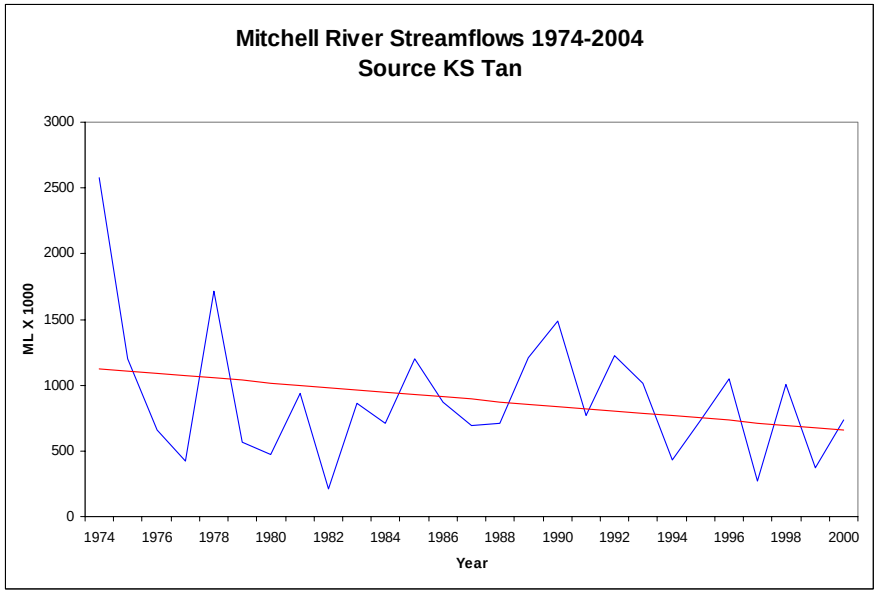
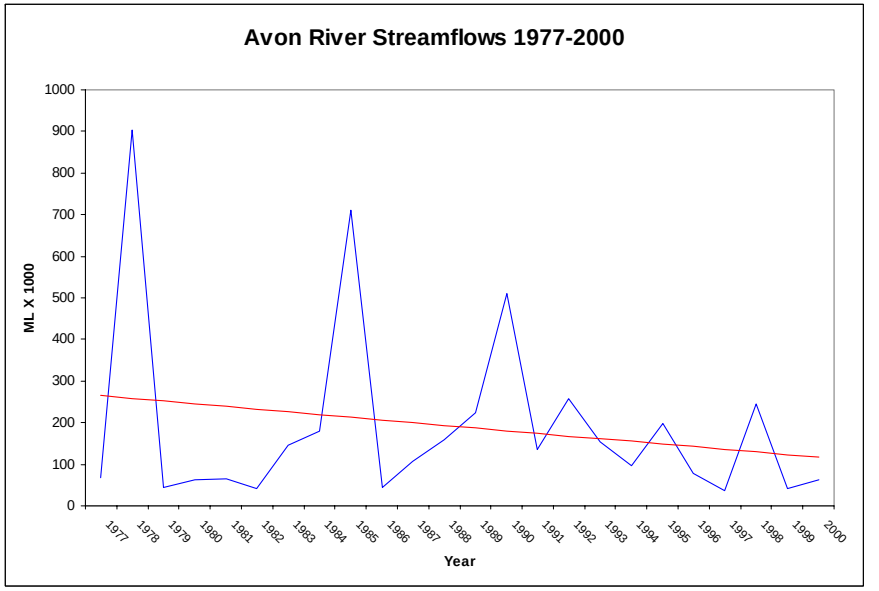
Unregulated (Eastern Rivers) Streamflows









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Sand management post-2005…

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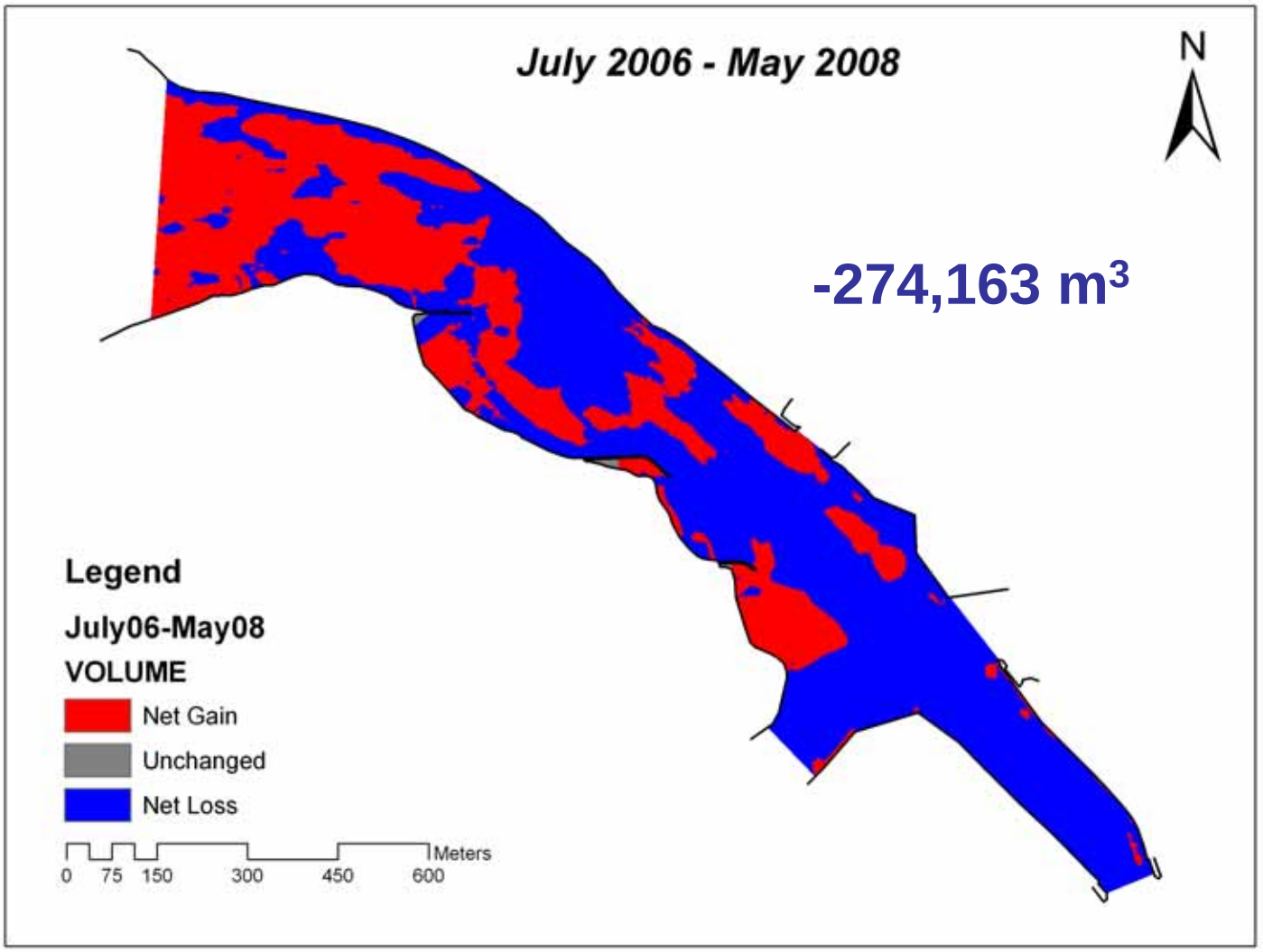

-800,369.0 m³

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-280,000 m^3

The future???

$$$

- Annual precipitation decreases
- More defined and intense ‘dry conditions’ (e.g. droughts)
- Significant reduction in alpine area snow coverage and duration
- More bushfires (increased rainfall to runoff yields)
- Decreased average run-off in streams
- Increased evaporation rates
- Strong population growth in Melbourne and Gippsland (extra 1 million in Melbourne) to 2030
- Increase in water demand by 42% in Melbourne by 2030

- These factors will place progressively greater demands upon sediment management operations at the Gippsland Lakes artificial entrance area, as Gippsland Lakes catchment fresh-water inflow yields are progressively further reduced, and less fresh-water is available to augment the outgoing tidal prism (ebb-tides) through the Reeves, Hopetoun and Entrance Channels to Bass Strait.

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Thankyou

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