7.0 Training Walls

Some local community organisations and individuals have long advocated the construction of training walls at the entrance to the Tuggerah Lakes. Both a single wall strategy and dual wall strategy have been suggested. A major and persistent dredging program could also force the entrance area to stay wide open.

The advocates argue that a permanently open, controlled entrance would provide benefits such as flood mitigation around the lake shore, greater accessibility for recreational boating (particularly deep draught vessels being able to enter the lake system) and enhanced water quality and water circulation for swimming and fishing. Some people also believe that a permanently open entrance would mean that more terrestrial sediment from the catchment would pass through the lake system and out to sea, rather than accumulating in the lakes.

These assumed benefits, if they were real and consistent with the best available coastal science and engineering, would be significant. However, all of the coastal science, modelling and engineering studies for Tuggerah Lakes over the last decade have highlighted that the assumed benefits will not be delivered by construction of training walls at The Entrance. In fact, training walls are more likely to have a detrimental transformational impact on the hydrodynamics and fragile ecology of the Tuggerah Lakes.

For more information about the effects of a trained entrance, see:

- Tuggerah Lakes Estuary Management Study and Estuary Management Plan (2006)
- Tuggerah Lakes Floodplain Risk Management Study (draft 2011)
- Tuggerah Lakes Estuary Modelling (DECCW 2010)
- Water Level Trends at Tuggerah Lakes (Manly Hydraulics Laboratory 2010)

The scientific analysis in these studies provides a moderate to high level of certainty about the following conclusions about the links between lake entrance management and lagoon ecology.

- The lakes are a shallow lagoon system. Shallow water provides a good light environment for aquatic plants, favouring high productivity. Shallow water also creates a high daily and seasonal variability in suspended sediment/turbidity with wind driven resuspension of catchment derived bed sediments a major driver of reduced water clarity.
- Sedimentation in the lakes is driven by catchment runoff. The lakes are sediment sinks, with inflows being greater than outflows. The highest sediment and nutrient loads come from large and complex catchments. Catchment discharge is intermittent. There are long periods with no discharge; system wide mixing by waves continues during these periods.
- Under current conditions, salinity and water levels in the lakes vary with intermittent catchment runoff.
- Over the last three decades, there has been, overall, a significant reduction in the variability of waterway area in Tuggerah lakes. DECCW attribute this to the dredging program at The Entrance. By keeping the entrance slightly open at all times, the frequency of extreme water levels appears to have declined and waterway areas is more *stable. It is not clear however, whether the water level effects of El nino/la nina events* have been taken into account. Worley Parsons (2011) note that there have been limited major flood events in nearby Lake Macquarie since 1995. It is also not clear whether

relative water area stability is ecologically beneficial in a lagoon system which has a natural high variability of water levels and shoreline inundation.

- At the same time as DECCW has suggested relative water level stability in the lakes, MHL analysis of water level trends indicates that water levels in Tuggerah Lakes have risen faster than the Fort Denison record since 1995. MHL also note that the complexity of water level drivers in Tuggerah lakes makes it difficult to distinguish real patterns.

- Decadal changes (such as associated with *El nino /La nina* cycles) in the productivity and health of the Tuggerah lakes are not fully understood

- In theory, the period of high lake levels and the potential for flooding are affected by the condition of the entrance, for a given rainfall event. Worley Parsons (2011) note that theoretically an entrance that is as wide and deep as possible will reduce flood levels for a rainfall induced flood event. However, a wide entrance also exposes the estuary to oceanic flooding.

- Worley Parsons 2011 suggest that there is no modelling or detailed measurement of flood water levels to provide real evidence that dredging of the entrance of Tuggerah lakes will significantly reduce the duration or the peak level of flooding. Sophisticated models to provide accurate and certain predictions of complex entrance scouring are not currently available. As both flooding events and dredging are intermittent processes, the benefits of dredging for flood level and duration are limited. Worley Parsons 2011 conclude that dredging the entrance since 1993 *may* have prevented minor flooding, but it has not prevented flooding during 10 year ARI events. Indicatively, Worley Parsons conclude that dredging in the entrance may slightly reduce peak flood level and duration. The cost of dredging, if conducted solely for this purpose is expensive (requiring upfront dredging works and ongoing maintenance dredging). A very large dredging program (much more extensive than the current program) would be required to achieve a significant flood benefit.

- Separate to dredging within the entrance channel, Worley Parsons (2011) have also considered the potential benefits of removing the ocean berm, so that the entrance area is as wide as possible (assume 250m wide to -1 m AHD). If this could be achieved, peak flood levels in a 100 year ARI would be significantly reduced. There are serious practical and environmental issues associated with forcing the entrance berm to stay wide open to the ocean. These include:

    - *Very* significant and ongoing dredging costs to continually remove/lower the berm on a system that naturally trends to closed. An alternative is to force the entrance to stay wide open by constructing training walls. This also has very high costs, of the order of $60 million

    - Environmental consequences for Tuggerah Lakes. In principle, forcing the entrance to stay very wide would reduce (non flood) water levels in the lakes, exposing shallow mudflats around the shore that are adjusted to a lake water level set up above ocean levels. Conceptually, a wide open entrance would increase salinity in the lakes in non flood times.

    - Lack of certainty about the potential interactions of lake water level lowering due to entrance management and lake water level increases due to other factors (including climate change), especially given the lack of robust water level data.

    - A wide open entrance will not improve recreational boating potential in the lakes, because of the overall shallowness of the system. The Tuggerah Lakes have an average depth of approximately 1.4 metres.

- If sand were dredged constantly from the entrance channel and placed on North Entrance Beach, long shore transport processes are likely to move at east some of it away to the north.

SMEC 2011 has considered the potential impacts of training wall construction at the Entrance on hydrodynamic and sedimentary processes. They specifically consider a training wall on the northern side of The Entrance, as the southern shore is largely controlled by natural bedrock outcrop. Based on their modelling analysis of sedimentary processes, SMEC conclude:

- A training wall at the northern side of the entrance could result in the widening and deepening of the entrance channel and significant scour of the existing entrance bar. The sand circulation between the entrance sand bar, upstream shoals and the entrance channel would be cut off by the training wall, as southerly sediment transport into the entrance channel would be blocked, and the ebb tide would continue to scour upstream shoals through the substantial opening entrance throat.

- The creation of a strong ebb tide jet would build up a new entrance sand bar further offshore. Wave action would be unable to move this offshore sand back onto the beach as readily as it does under existing conditions, and the nearshore wave climate at the southern section of North Entrance Beach would be altered due to changes in nearshore bathymetry, which could cause changes in sediment transport patterns and possible erosion of the entrance spit.

- The existing entrance sand shoals would erode due to a permanent loss of sand from littoral drift along northern entrance spit back to the entrance obstructed by the northern training wall. Sand moving onshore by flooding tide and breaking waves would tend to be trapped by the training wall and the ebb tide would continue to scour the upstream sand shoals, transporting sand through the entrance throat onto the new sand bars. Hence the sand deposited onto the upstream shoals would be greatly reduced. However, increased tidal currents would tend to bring sediment further into the estuary and extend the flood tide delta upstream.

- The construction of northern training wall perpendicular to the beach would interrupt the local southerly reversal of littoral drift back onto the entrance upstream shoals. The sand captured against this wall would accumulate so as to form a fillet of sand. If the training wall were to be constructed for the purpose of keeping the entrance channel open, the northern training wall would need to be of a sufficient length that the naturally occurring equilibrium plan alignment of the beach in this fillet results in no sand being able to be swept by waves around its end (and into the mouth of the entrance) during periods of southerly sand transport. This sand is no longer available to be moved onshore from the entrance sand bar due to the scour of the entrance sand bar. This would exacerbate the North Entrance beach erosion due to lack of sand supply to feed northward longshore sediment transport. There would be massive sand relocation from the upstream shoals to the margins of adjacent beaches.

- Continued scour of the entrance channel would result in an increasing trend in the tidal range and tidal prism of the Tuggerah Lake. The entrance channel would evolve toward an equilibrium following entrance training, and allow ocean swell to propagate through the entrance. Scour in the entrance channel as a result of increasing tidal flow could threaten the foundations of the road bridge resulting in expensive remedial works to the bridge abutments. The Wilfred Barrett Drive would be exposed to sediment scour of the bridge piers by swift tidal currents.

- The ecological environment within Tuggerah Lake would be influenced greatly by the rate at which water in the lake is exchanged with oceanic waters through the entrance, as well as changes to the natural tidal regime, changing the natural assemblages of vegetation

communities in the area. Marine sand may penetrate further into the lakes, smothering sea grass communities that are important fishery habitat.

- The gradually removal of upstream shoals would have an adverse effect on entrance stability. An extreme flood event could split the main channel of the entrance into two with one channel along the southern bank and one along the sand spit. A training wall in front of the northern entrance spit would therefore need to extend upstream along the entrance channel toward the bridge so as to prevent breakthrough of the entrance spit in a large flood event.

- Experience from other lake entrances provides clear evidence that training walls have dramatic and detrimental impacts on the recreational and tourism values of what are naturally shoaled entrance areas. For instance, construction of the training walls at Wallis Lake lead to major scouring of the entrance shoals, high velocity tidal currents, scouring of bridge foundations (this has also occurred at Lake Macquarie) and scouring of estuary banks upstream.