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**Resource Planning and Development Commission**
**GPO Box 1691**
**Hobart. Tas 7001.**

**Dear Sir/Madam**

**RE: Hydrodynamic modelling studies which form part of the IIS for the proposed Pulp Mill Development by Gunns Ltd at Bell Bay in the Tamar Estuary, Tasmania**

The hydrodynamic modelling studies by GHD Pty Ltd associated with the wharf development site at Bell Bay and the proposed marine outfall site in Bass Strait, which are part of the Gunns Ltd pulp mill development environmental impact statement, have certain issues which I believe should be addressed. As with all oceanographic modelling studies there are limitations to what can be achieved. The issue of how well the model performs compared to reality (which is often an elusive thing) is encountered in all modelling studies. Models are usually acceptable if the findings are rigorously supported by previous scientific studies and field observations. The findings of the modelling studies by GHD Pty Ltd are not fully supported in this way, and the circulation in Bass Strait is not adequately resolved. Also, studies of the flushing of the Tamar Estuary and Bass Strait have not been carried out.

In the Bell Bay wharf development study, model results show that the estuary has relatively strong tidal currents and is well mixed. The main finding is that the wharf development will significantly slow flow rates and sediment transport in the Estuary at its proposed location inducing a stagnation area. This implies that over time, this part of the Estuary could become concentrated with any contaminants and pollutants entering it. In the longer term, the area could become a potential source for other areas. Tides mix water from Bass Strait all the way up the Estuary. The Tamar entrance channel has mean salinity of around 34.5 ppt, with little seasonal variation (Lara and Neira, 2003). This means waters from Bass Strait are fairly well mixed into this part of the Estuary. Salinity distribution in the Estuary indicates that seawater from Bass Strait is mixed all the way up to Launceston, where in winter, mean minimum values in the upper region are around 10 ppt and in summer mean minimum values are around 20 ppt (Lara and Neira, 2003). This is evidence that between approximately one to two thirds of the water in the upper region of the Estuary is derived from the waters of Bass Strait. The salinity distribution in the Estuary also tells us what the likely concentration of a conservative contaminant or pollutant dissolved in seawater would be over long periods of time. The long-term background concentrations of conservative contaminants and pollutants in the entrance channel will generally scale like the salinity distribution in the Estuary, meaning that for whatever the concentration they are in the entrance channel, they will be between one and two thirds the concentration in the upper region. A study of the Tamar Estuary using tracers would indicate the timescale for the transport of salt water up the Estuary and provide important information regarding the issue of the vulnerability of the Estuary to contamination. The IIS does not address this issue. If longer-term environmental impacts are considered important, then consideration of the flushing of the Estuary with respect to freshwater inputs and tidal mixing of waters from Bass Strait should be made.

The main finding of the study concerning the proposed outfall in Bass Strait is that all potentially harmful effluent constituents, with the exception of AOX (adsorbable organic halogens) will be sufficiently diluted to 'satisfactory' concentrations in the predefined 'mixing zone'. For AOX concentrations to fall below WQO (water quality objectives) of 0.046 mg $L^{-1}$, a larger mixing zone is recommended. The use of the mixing zone implies effluent constituents are completely mixed in the volume of the mixing zone. In reality, the effluent discharge will be a plume which increases in concentration towards the diffuser, rather than being completely mixed in the predefined mixing zone. The result for levels of pollutants and contaminants in the mixing zone critically depends on parameterisation of horizontal mixing in the numerical model. The horizontal mixing coefficients used in the study are not given and sensitivity studies which show how concentrations may vary according to the choice of horizontal mixing coefficient are not presented.

The study acknowledges the limitations of the model verification, being restricted to tidal comparisons. As with the wharf development study, verification of the residual circulation in the model against previous studies and/or field observations has not been carried out.

The authors state that local winds and tides are the most important drivers of circulation in Bass Strait. Previous studies show approximately half of the residual circulation in Bass Strait can be accounted for by local winds (Middleton and Black, 1994; Middleton and Viera, 1991). Coastal trapped waves and the South Australian Current influence sea-level at the north-western Strait entrance. It is residual sea-level at this location which also influences residual circulation in the Strait. The study does not account for the effect of far-field forcings, nor any likely changes in the circulation brought about by climate change. Climate scientists suggest the westerly wind belt will move further south due to climate change, implying that the currents in Bass Strait will probably weaken and the flushing times increase.

The use of a depth-averaged model for Bass Strait is only applicable for approximately half of the year when Strait waters are vertically well mixed (Baines and Fandry, 1983; Sandery and Kämpf, 2005; Tomczak, 1985). The depth-averaged model assumes pollutant concentrations are mixed uniformly over the entire water column in Bass Strait at all times of the year. This approach may only be justified in winter and spring. There is evidence that a shallow warmer surface mixed layer up to approximately 40 m depth exists throughout summer over most of the deeper Strait interior. The effluent is of much lower density than seawater so pollutant concentrations at this time of year could be confined to the surface mixed layer and would be higher than suggested by a depth-averaged model.

Two weeks of observations from two moorings, ~ 3 km offshore in ~ 13 m water depth should not be used to justify the Strait is well mixed most of the time throughout the year 'except in calm summer conditions'. Of course there will be little or no stratification observed at this location due to the shallowness and relatively strong tidal currents in the area. There is information in the scientific literature (Baines and Fandry, 1983) and from CTD casts taken on oceanographic research voyages which show most of Bass Strait is subject to a reasonable degree of stratification in summer and autumn. The study does not appropriately draw on the available literature regarding circulation and the density field in Bass Strait. Salinity values representative of Bass Strait Water are not used in the model, nor those encountered in field work associated with the study by Aquenal Pty. Ltd., but rather a standard value which is much lower. By doing this, the density of receiving waters is incorrect.

The result for residual currents for Nov-Jan 2006 (Fig D-25) shows a stationary eddy. Eddies are associated with low flushing. This supports the idea that flushing in this part of the Strait is relatively low compared to other parts.

Given the Strait has low flushing in the area where effluent is to be released (Sandery and Kämpf, 2005), long-term simulations of the proposed ocean outflow discharge with a more adequate representation of the circulation in Bass Strait should be carried out.

The finding that AOX will exceed water quality objectives 5% of the time is a concern because 5% of 30 years, for example, adds up to 548 days. Exposure of marine ecosystem to particular pollutants integrates over time. The issue of particular pollutants and contaminants, in particular AOX, bio-accumulating in parts of Bass Strait over the life of the development is a possibility and has not been considered in the IIS.

Short-term simulations were carried out which seems inappropriate for a long-term process. Recent studies suggest significant amounts of water reside in Bass Strait longer than previously thought. If the concern was for the health of marine ecosystems in the long-term, then I believe the problem would be one of exposure to low levels of contaminants and pollutants, rather than just one of adequate dilution to water quality objectives in the short-term.

The flushing of Bass Strait as a whole is not accounted for in the IIS. Recent three-dimensional modelling simulations over many years suggest that the flushing of Bass Strait, which is related to water age distribution (fig. 1), is a seasonal process and remnant water not flushed out each winter remains through the summer (Sandery and Kämpf, 2006).

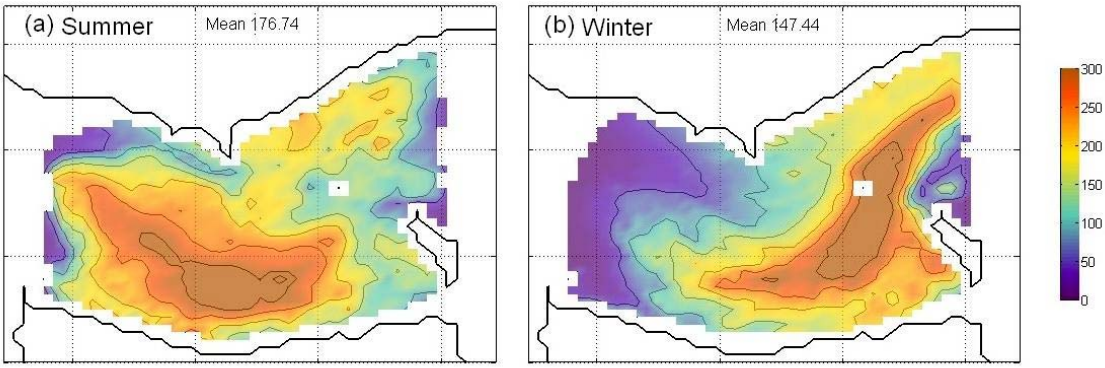


***Figure 1***. *Seasonal averaged age distributions (days) for (a) summer and (b) winter.*

With unresolved issues regarding the circulation in Bass Strait, background levels of contaminants and pollutants and their subsequent variations cannot be determined correctly. The development will potentially be a long-term source of contaminants and pollutants for the marine environment, so long-term simulations incorporating the seasonal nature of the circulation raised in Sandery and Kämpf, (2006) are needed.

Since the intended scale of the development is large, further investigation should be carried out to understand long-term impacts. The studies associated with the Gunns Ltd IIS seem to me to not appease uncertainty associated with potential long-term environmental impacts to the marine environment stemming from the development in relation to:

- Accumulation of contaminants and pollutants, particularly dioxins and furans, in sediments and biota over time in Bass Strait and the Tamar Estuary.

- Potential long-term impact on Tamar Estuary nurseries, Bass Strait marine ecosystems and South East Fishery.

In my view, the information presented in the studies is not enough to properly understand potential long-term environmental impacts on the Tamar Estuary and Bass Strait from the proposed development.

I would appreciate that the issues and concerns raised in this submission were addressed by the Research Planning and Development Commission. If the further information or clarification is required please do not hesitate to contact.

**Yours Sincerely**

**Paul Sandery**

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