19 July 2007

Gunns Limited
PO Box 572
Launceston Tasmaina 7250

Our ref: 41/16384/00/361055
Your ref:

Attn: Calton Frame

Dear Calton,

Gunns Pulp Mill IIS
Response to BMT WBM Assessment of Modelling Reviews

This letter provides a response to BMT WBM's "Assessment of Modelling Reviews" dated 6th July 2007. The BMT WBM review itself refers to various documents authored by GHD and Paterson Britton. These in turn pertain to hydrodynamic modelling works undertaken by GHD as part of the GUNNS Pulp Mill IIS. BMT WBM's review of four documents, suggested that the following issues require further consideration:

- The treatment of low frequency geostrophic oscillations (e.g. East Coast Lows);
- The calibration and validation of the models;
- The duration of the adopted simulation period;
- The long-term build-up of particulate matter in the sediments and the interaction of the proposed pollutant plume and fluvial discharges from the Tamar Estuary resulting in deposition of pollutants.

We note that these issues are largely similar to those raised previously, though in some cases specific details have been mentioned as a sub-set of the issue. This letter seeks to respond to the queries raised, referring to previous responses where relevant, and providing further detail as appropriate.

Furthermore, we note that in July 2007 a document entitled "*Response to submissions under the Environment Protection and Biodiversity Conservation Act 1999"* was submitted by Gunns, and that this document contained additional information pertaining to the hydrodynamic modelling. In particular, this document provided further results, which confirmed that 6 month duration runs provided similar results to those for the shorter duration runs originally completed.

BMT WBM would not have seen this document, which was incomplete at the time of their review. The document, referred to hereafter as the *EPBC document,* provides further comments and answers with respect to the above issues. Relevant sections of the document are reproduced in this letter where indicated.

Additionally, it is evident that the above queries relate as much to conservatism as to process. That is, whilst GHD have adopted conservative assumptions where-ever possible, in order to account for the lack of some data, the actual level of conservatism has been queried. We trust that our response helps to reinforce that an appropriate level of conservatism has been incorporated into the modelling effort.

1 East Coast Lows / Low Frequency Oscillations

Low pressure systems can and do affect tidal currents in Bass Strait. However, as with waves, the resultant changes to currents would tend to increase the energy available for dilution in the receiving waters, and therefore, we have previously suggested that it is conservative to not represent these in the model. The latter statement is made:

- on the basis of numerical results obtained in the vicinity of Devonport. As noted in GHD's response to PB comments (Response to Review of Hydrodynamic Reports, 18 April 2007, section 1.3.1), the B grid model used for the GUNNS's project has been run for a separate, unrelated project with focus on the Victorian Coast and the inclusion of east coast lows. Results from the latter project (including east coast low effects) were compared to tide-only results for Devonport (refer Figure 1 in response to PB comments). The findings, i.e., increase in tidal amplitude at Devonport, were interpreted as east coast lows representing an additional source of dissipating energy with potential to further dilute the effluent, hence providing a less conservative modelling frame;
- taking into consideration the consistency (similar nature) in tidal-only behaviours exhibited at numerical monitoring stations (i.e. results at grid points from the hydrodynamic model) along the North Tasmanian Coast which were used for the verification of the model (refer GHD's July 2006 report, Figures D-7 and D-8 illustrating predicted tidal elevations for Burnie and Devonport, respectively). These results were interpreted as providing support for extrapolating the behaviour of the combined tidal and low frequency signal at Devonport to the outfall site, i.e., east coast lows generate an increase of tidal amplitudes at Devonport and are expected to generate the same effect at the proposed outfall site;
- with the knowledge that conservative assumptions are in place (e.g. non-decaying substances); and
- noting the constraints in retrieving of long-term tidal elevation data measured at remote locations.

Additional discussion is offered below.

It has been suggested that the model results are reliant on data at Devonport.

No statement has been made implying that data from the Devonport site can be extrapolated to encompass the entire Tasmanian coast. However, the analogy between the nature of the combined tide and east coast lows signal at Devonport (modelled by GHD for an unrelated project with focus along the Victorian coastline) with the equivalent signal at the outfall site (not modelled) is considered more than reasonable. The analogy was proposed on the basis of consideration of the wavelengths associated with east coast lows, which are typically significantly larger than 20 km - the distance between Devonport and the outfall site.

The reviewers have suggested that east coast lows may in fact lead to less mixing than represented in the model. If this were the case, then the logical extension of this thought is that the mixing zone may need to be larger than indicated in reports to date. However, this would be compensated for by the conservative assumption that pollutants do not decay.

Furthermore, we have previously suggested that East Coast Lows play a less significant role in the southern part of Bass Strait (along the Tasmanian Coast) than along the Victorian coast. Further details are provided below, as reproduced from pages 134 and 135 of the EPBC response.

In response to queries about the impact of East Coast Lows, using both a numerical model and collected data, Middleton and Viera (1991) found that low-frequency motion within the Strait is the product of both local wind forcing and the incidence of coastally trapped waves from the Great Australian Bight.

Their analysis showed that:

- *At the south-west corner of the Strait, wind stress is the larger contributor to sea-level variability except for very low-frequencies where interference from the effects of coastally trapped waves along the Victorian coast may have an impact; and*
- *Low-frequency sea-level variability should essentially vanish at the south-east corner of the Strait.*

This evidence was interpreted as indicating that:

- *The effects of low-frequency sea-level variability are more pronounced along the northern coast of the Strait;*
- *Modelling of low-frequencies may be excluded from a reasonable first–order approximation of forces governing the hydrodynamics along the Tasmanian coast without necessarily excluding the possibility of undertaking additional hydrodynamic simulations including low-frequency motion during design stages of the Project; and*
- *Ensuring conservatism in the process of assessment of the extent of the mixing zone (by potentially reducing the energy levels in the receiving waters).*

On the basis of the above text, we would suggest that all hydrodynamic simulations do not need to be rerun until additional mixing zone data has been obtained (refer Section 6).

2 Calibration and Validation of the Models

It has been suggested that calibration to mass transport and dispersion processes is required prior to approval, and that data for the Tamar River could be utilised, along with dye tracer experiments and aerial plume tracking. It is also acknowledged that the use of Tamar River data may be open to query from some parties. Given this, we would suggest that whilst calibration to such data may lead to less debate, the rigour of the process described below (and the inherent conservatism described later) have led to conclusions which are unlikely to change.

That is, we do not believe that the adoption of different parameters will result in areas of impact being identified, as all results to date show very low concentrations (ie high dilutions) at the mouth of the Tamar, and along the coastline.

With respect to the sensitivity analysis previously reported, we note that:

- The model was operated with typical values for key parameters such as the horizontal eddy viscosity - Eh, horizontal eddy diffusivity - Dh and Manning's roughness coefficient ("n");
- Different values of horizontal eddy viscosity and horizontal eddy diffusivity have been applied to the various model grids. The adopted values were:
  - Horizontal eddy viscosity Eh=100 m^2/s and horizontal eddy diffusivity Dh=100 m^2/s for the B grid model;
  - Eh=5 m^2/s and Dh=50 m^2/s for the C grid model;
  - Eh=1 m^2/s and Dh=10 m^2/s for the D grid model;

- A value of 0.024 was adopted for Manning roughness coefficient for all runs.
- Non-concurrent data was used to verify the behaviour of the model with comparisons between numerical results and measurements demonstrating a fairly good qualitative agreement;
- The verification of the model included comparison of the numerical results to:
  - predictions at four tidal stations,
  - concurrent data (both tidal elevations and currents) for a period of a month (December 2005); and
  - historic data with respect to currents at eight locations;
- The availability of oceanographic and water quality data needed to describe the receiving waters in the study area was limited;
- The use of non-concurrent data is common practice when data is insufficient;

Other points to note with respect to the model verification follow:

- To circumvent the lack of a full concurrent data set, the modelling team located a range of non-concurrent data, and verified model performance to this data, in accordance with accepted;
- Access rights to some datasets known to exist could not be obtained for this study despite the assistance provided by various State Authorities;
- During the course of the project, GHD continued to explore possibilities to obtain additional data with mixed success;
- With respect to the calibration and verification of the model, GHD is conceptually in agreement with the process stated by BMT WBM, which would ideally be carried out over two independent historical periods where relevant salinity data has been collected. However, none of the existing datasets provided such opportunity (refer Draft IIS, Appendix 63, July 2006, sections 4.5 to 4.7).
- Existing knowledge of the chemical and biological processes affecting the effluent as it is being transported by and disperses in the receiving waters is limited and thus the use of literature values for coefficients such as the eddy diffusivity and eddy viscosity was considered adequate; and
- Hydrodynamic behaviour that is well established in the literature has been reproduced by the model, as was noted by the reviewers. GHD have referred to / used these facts as sanity checks, demonstrating a good match to physical behaviour simulated by the model.

A final point of critical importance is obtained by referencing the ANZECC guidelines. These require a dataset spanning 2 years in order to define the mixing zone. By definition, this dataset is likely to lead to some modification of the suggested mixing zone boundary, and will also provide an opportunity for an additional model validation run.

3 Long Term Accumulation of Pollutants (Adopted Simulation Period)

The initial use of a one-month period for analysis was considered appropriate for the initial assessment of potential impacts in the vicinity of the outfall and in particular the evaluation of the dimensions of the mixing zone. Test runs of six months duration have subsequently confirmed that equilibrium in the process of build-up of concentration (pollutant) was reached in the vicinity of the outfall and that there remains a margin of conservatism in place in the assessment process. Results demonstrating this were

provided in the EPBC Response, with a copy of Figures R3 and R4 offered as an attachment to this letter, as requested by BMT WBM.

The need for additional assessment of potential impacts in environmentally sensitive areas remote from the outfall became evident during the course of the study. Accordingly, as additional environmentally sensitive areas have been suggested during the review process, and recognising the very high levels of public interest in the project, a longer simulation period was completed to assist in addressing issues with respect to potential impacts of these areas.

We therefore note that the 6-month duration run (refer Figure R4) have supported our initial conclusions.

Additional detail (as submitted in response to the EPBC process) is reproduced below.

The primary issue is whether the adoption of a longer period of simulation would lead to a significantly different set of conclusions, which GHD does not believe to be the case.

As additional monitoring is conducted, and water quality objectives and background levels are revised using this data, the size of the mixing zone may change accordingly (in proportion to the revised values) in the future. This is in accordance with the process defined in the ANZECC guidelines.

Slight variations may occur but would not change the overall conclusions of the hydrodynamic modelling reports in the draft IIS and the Supplementary Information. For example, if new measurements show that the background level of chlorate is zero, then the recommended mixing zone could decrease.

The main benefit of additional data is the increase in the confidence limit applied to the results. That is, while the size of the mixing zone may not change, there will be fewer assumptions in place. It is also worth noting that the assessment of mixing zone has been based on the assumption that pollutants do not decay, which is conservative.

In summary, the initial use of one month for analysis was considered appropriate for the initial assessment of potential impacts. Subsequent testing over runs of 6 months duration confirmed that the assumption was reasonable, and that there remains a margin of conservatism in place.

We also provide two sections of text reproduced from the EPBC response, relating to the flushing characteristics of Bass Strait.

"A number of submissions expressed a concern that the work of Sandery and Kampf (2005) has not been considered, and that the hydrodynamic modelling is therefore inadequate to represent potential pollutant build-up within Bass Strait.

Sandery's work is quoted as demonstrating that flushing of Bass Strait may take up to 6 months, and therefore the hydrodynamic model is deficient with respect to:

- *Long term flushing characteristics not being represented, and*
- *Not being run for a sufficient duration to assess the potential build-up of pollutants.*

When the modelling methodology and results detailed in Sandery's paper are compared to the hydrodynamic modelling work completed by GHD, a number of similarities are evident…"

and

"Both Sandery and GHD have completed modelling that shows flushing times of the order of 6 months (shorter in the NW corner and potentially longer in some other areas). This is significant, as it

demonstrates that both models represent key driving forces (tide and wind) in a similar way. The assessment of dilution and pollutant transport using the hydrodynamic model developed for the Project is valid, and is based on sound physics."

The fact that the GHD model demonstrates similar flushing characteristics to those reported by Sandery is of significant importance in judging the validity of the GHD model.

4 Long Term Build Up of Particulate Matter in Receiving Sediments

The issue has been deferred by BMT-WBM to the Toxicos report, whilst noting that: "*If further investigating was warranted, a more detailed sensitivity analysis around the potential for augmentation of deposition considered by Toxicos via interaction with estuarine sediments could assist with resolution".*

5 Conservatism

It remains our opinion that several conservative assumptions were adopted for the original work, that these assumptions account for a reduced dataset (i.e. the lack of concurrent data), and that logical conclusions were reached. Furthermore, the high dilutions (low concentrations) demonstrated in Figure R3 and Figure R4, are such that even a doubling of concentrations would not demonstrate an adverse impact along the coastline or in the Tamar Estuary. Hence, rerunning of the models with slightly adjusted parameters would not lead to a change in conclusions.

6 Mixing Zone Definition

We reiterate our earlier point with respect to the definition of the mixing zone. The ANZECC guidelines require a dataset spanning 2 years in order to define the mixing zone. By definition, this dataset is likely to lead to some modification of the suggested mixing zone boundary, and will also provide an opportunity for an additional model validation run. We understand this issue has been addressed under separate correspondence.

Yours faithfully
GHD Pty Ltd

Ivan Botev
Engineer
(07) 3316 3685

Attachment: Figure R3 and Figure R4