Review of Air Quality Aspects of Gunns Ltd "Bell Bay Pulp Mill Draft Integrated Impact Statement, July 2006"

Prepared for
Resource Planning and Development Commission
Tasmania

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EXECUTIVE SUMMARY

This review has been requested by the Resource Planning and Development Commission of Tasmania. It is a review of the air quality aspects of the "*Bell Bay Pulp Mill Draft Integrated Impact Statement*" dated 14 July 2006 from Gunns Ltd. It also considers a late submission "*Supplementary Air Quality Assessment of Proposed Pulp Mill, Final Report*" dated 8 August 2006 and prepared by Pacific Air & Environment (PAE) for Gunns Ltd.

Informed by the *"Environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania"* and the *"Final Scope Guidelines for the Integrated Impact Statement"*, the major issues identified in this review are:

a) **TRS**. The omission of background TRS concentrations in the modelling is a serious weakness in the Draft IIS given the potential significance of TRS as an air quality issue from an operating pulp mill.

b) **TRS.** The modelling has not included the possibility of fugitive emissions of TRS (or other offensive odours) even though the Draft IIS monitoring plan acknowledges the possibility of diffuse TRS sources in the proposed on-site odour monitoring program.

c) **In-stack criteria.** There is insufficient information provided in the report to determine whether the RPDC in-stack concentration criteria will be met.

d) **NO_x emissions.** NO_x emissions of 1.676 kg NO_2/ADt from the proposed mill exceed the RPDC limit of 1.3 kg NO_2/ADt.

e) **Main mill stack height**. The main stack height of 130 m is only 1.5 times the recovery boiler building height. A justification needs to be provided for selecting a lower stack height than the sound engineering practice of the 2.5-times "rule".

f) **Model differences.** There are significant and unexplained differences between some of the key model results presented in the PAE and the GHD reports, particularly for TRS and ClO_2. These differences are not discussed, nor even mentioned, in the supplementary PAE report.

g) **Bell Bay Industry Emissions**. Details of the emissions from Bell Bay industry used in the modelling have yet to be provided to CSIRO. The relatively poor agreement between the model results and observations at Gunns AQMS do not give confidence that the model is able to predict background concentrations due to emissions from the existing Bell Bay industries.

h) **Main stack modelling**. No information is provided to indicate whether the four flues in the main stack were modelled separately or as a single source.

i) **Construction phase dust.** Compliance with the modelled impacts of dust emissions during the construction phase depends strongly on ensuring that the dust emission rates remain within the values assumed in the modelling.

j) **Model & meteorological data.** The reviewers consider that the configuration of the model TAPM is suitable for the required task. The siting of the Gunns AQMS data is such that it provides more representative meteorological data for input to the model than the data from the Comalco AWS.

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1. BACKGROUND

This review has been requested by the Resource Planning and Development Commission of Tasmania. It is a review of the air quality aspects of the "*Bell Bay Pulp Mill Draft Integrated Impact Statement*" dated 14 July 2006 from Gunns Ltd. It also considers a late submission "*Supplementary Air Quality Assessment of Proposed Pulp Mill, Final Report*" dated 8 August 2006 and prepared by Pacific Air & Environment (PAE) for Gunns Ltd.

Gunns Ltd has based their Impact Assessment for air issues principally on meteorological and air quality monitoring near the proposed site, and on numerical modelling of the existing and possible future conditions with the plant operating.

1.1 Review criteria

The RPDC has requested that the review include advice on:

- The adequacy of how the Draft IIS addresses the issues set out in the Final Scope Guidelines for the IIS. Is it adequate for the RPDC's assessment purposes?
- The validity of the methodology and findings
- Whether the proponent's conclusions are reasonable and scientifically based
- Identify and major/critical errors or omissions in the Draft IIS and specify what further work is required.

1.2 Outline of Review

The format of this review is as follows:

- A summary of the differences between the modelling conditions used in the various air quality assessment reports:
    - GHD, June 2006 "*Air Quality Assessment Pulp Mill Emissions, Impact on Air Quality*" (presented as Appendix 16, Volume 9, of the Draft IIS)
    - GHD, July 2006 "*Air Quality Assessment for Construction Impacts – Proposed Gunns Pulp Mill*" (presented as Appendix 17, Volume 9 of the Draft IIS)
    - PAE, 22 November 2005 "*Review of Air Dispersion Modelling and Background Monitoring Data for the Proposed Bell Bay Pulp Mill*" (presented as Appendix 19, Volume 9 of the Draft IIS)
    - PAE, 8 August 2006, "*Supplementary Air Quality Assessment of Proposed Pulp Mill, Final Report*" (not included in the Draft IIS).

- A review of these air quality assessment reports.

- A review of the sections of the Draft IIS that concern air quality. Most of these are based on material contained in the above reports and so where appropriate, reference is made to those reviews. The sections of the Draft IIS that have been reviewed are:

  - Vol. 1, §1.4.1 Guideline requirements not addressed in the draft IIS – air quality
  - Vol. 1, §4.3.2–4.3.4, Regional Environment – Climate, Meteorology & Air Quality
  - Vol. 2, §2.4–2.5, Existing Environment – Climate, Meteorology & Air Quality
  - Vol. 2, §4.4–4.5, Potential Environmental Impacts and Management Issues – Climate, Meteorology & Air Quality
  - Vol. 4, §4.3.1 & 4.4.2, Strategic Management Plan, Monitoring Plan – Point Source Monitoring, Ambient Monitoring.
- A review of the adequacy of the Draft IIS in addressing the air quality issues in the Final Scope Guidelines.

2. SUMMARY OF MODELLING CONDITIONS IN GHD AND PAE ASSESSMENT REPORTS

The modelling in the GHD and PAE reports has been undertaken using TAPM (The Air Pollution Model). TAPM has been run with four nested grids with resolutions of 10 km, 3 km, 1 km, and 500 m and 76 x 81 grid points on each grid for meteorology and 72 x 63 grid points for pollution dispersion The default geophysical characteristics (terrain elevation, land use and soil type) were replaced with the best available information, which the reviewers consider provide a good representation of the surface. **The reviewers consider that the model configuration is suitable for the required task.**

Table 2.1 – Main differences in modelling conditions used in the GHD and PAE assessment reports

	PAE report (22 Nov 2005)	**GHD report (June 2006)**	**PAE report (8 Aug 2006)**
TAPM version	?	v. 2.6 for meteorology v. 3 for dispersion	?
Period modelled	2004 (Jan–Dec) Jul–Aug 2005	2004 (Jan–Dec) Jul–Aug 2005	Jul 2005–Jun 2006
Data assimilation of observed winds	? Comalco AWS (2004) Gunns AQMS Jul–Aug 2005	Comalco AWS (2004) ? Jul–Aug 2005	Gunns AQMS Launceston airport Ti Tree Bend
Minimum model resolution	Mainly 500 m, some at 1000 m	500 m	500 m
Method used for 3-minute predictions		? TAPM prediction of 3-minute averages	? TAPM prediction of 3-minute averages
Period compared with Gunns AQMS pollution data	Jul–Aug 2005	Jul–Aug 2005	Jul 2005–Jun 2006
Comments	Analysis based on model results supplied by GHD		Run in chemistry mode with GRS photochemistry

The main differences between the modelling conditions in the various reports are listed in Table 2.1. The GHD report on construction impacts (not listed in this Table) uses a finer inner grid spacing of 125 m and although the other model conditions aren't described in the report, it is reasonable to conclude that it was run for 2004 in the same way as listed for the GHD report in Table 2.1. The main reports are those listed in the two right-hand columns. The principal differences between them are the year modelled and the source of the wind data assimilated in the model. **The reviewers consider that the siting of the Gunns AQMS (air quality monitoring station) is such that it provides more representative data for input to the model than the data from the Comalco AWS (automatic weather station), which is located further from the mill and in a position more influenced by local topographic features.**

3. REVIEW OF THE AIR QUALITY ASSESSMENT REPORTS

3.1 GHD "Air Quality Assessment Pulp Mill Emissions, Impact on Air Quality", June 2006

This report is included as Appendix 16, Volume 9, of the Draft IIS.

Most of the modelling presented is for the calendar year 2004. Some modelling was carried out for July & August 2005 but this is superseded by the supplementary PAE report (8 August 2006), which modelled the full July 2005–June 2006 year.

The results in Figure 4.5 of the GHD report show good performance of the model in predicting the annual wind rose for the Comalco AWS site before assimilation of the observed winds. For the main model runs, the observed winds at the Comalco AWS site were assimilated into TAPM to improve performance. In the absence of other wind data for assimilation, use of the Comalco data was appropriate, but the data from the Gunns AQMS (used in the later PAE report) is probably more representative of winds in the vicinity of the proposed mill.

A major omission from the report is that it does not provide sufficient details of the mill emissions to be able to properly assess this aspect of the modelling. The "*Final Scope Guidelines for the IIS"* also states that this information must be provided (section 7.8.2, numbered paragraphs (1) and (2)). In particular:

- **The report is missing Table A-2 in Appendix A.** This table together with Table A-1 is referred to in section 6.1 as providing full source details. The reviewers are unable to find the maximum emission rates from each source listed anywhere. The report *does* list the total mill emissions of sulfur and NO_x as well as the in-stack concentration of inorganic chlorinated compounds in Table 6-2, and the TRS total mill emissions (from the main stack and effluent treatment plant) are listed in Table 9-2.

- There are four flues in the main stack (from the recovery boiler, lime kiln, power boiler, and non-condensable gas boiler). **No information is provided to indicate whether these flues were modelled separately or as a single source.** The report should list the diameter, exit velocity and exit temperature for each flue and if they were modelled as a single source, provide a justification for the modelling approach adopted, specifically

showing evidence that the plumes from all flues would be expected to merge into a single plume. This depends on the flue separations as well as the relative temperatures and efflux velocities of the flue emissions.

- **There is insufficient information in the report to determine whether the RPDC in-stack concentration criteria (Table 5-1 in the GHD report) have been met with the proposed mill design.** Information listed in the previous dot point together with emission rates of each pollutant from each flue/stack would allow an assessment of whether these criteria have been satisfied.

The modelling of existing Bell Bay industries used emission inventories that are commercial-in-confidence and so are not included it the report. The report states that "*the detailed emission inventories used by GHD for the TAPM modelling of existing background level* ***will be provided to the RPDC's technical consultant, CSIRO",*** **but this has not yet occurred.** As discussed in our review of the PAE report (section 3.2 of this review), **we have concerns about the accuracy of the emission rates used for the existing Bell Bay industries, so this remains an outstanding issue.**

The GHD modelling includes non-industrial emissions, both biogenic (emissions of NO from soil, emissions of reactive VOCs from vegetation) and domestic (emissions from residences and motor vehicles). **The reviewers consider that the way these emission have been included is appropriate.**

Table 6-2 of the GHD report shows that **the NO_x emissions of 1.676 kg NO_2/ADt from the proposed mill exceed the RPDC limit of 1.3 kg NO_2/ADt.** As noted in the Guidelines, these values are the totals for all NO_x species, expressed as NO_2. The report makes a case for the RPDC limit to be raised. The reviewers note that the modelling shows that the predicted ground-level concentrations of NO_2 of about 65 ppb are significantly below the RPDC criterion of 160 ppb. However, a range of factors was taken into account in setting the RPDC Emission Limit Guideline of 1.3 kg NO_2/ADt. **It is beyond the scope of the current review to comment on the appropriateness of changing this Emission Limit Guideline.**

The main results from the modelling are presented in Tables 9-1 and 9-3 (of the GHD report) as predicted concentrations at 14 selected locations. **The reviewers consider that the predictions should be presented as contour plots for all pollutants modelled**, not just for TRS, Cl_2, ClO_2, and HCl given in Figures 9.13–9.16. The reviewers recognise that the increment in ground-level concentrations of SO_2, NO_x, and PM10 due to mill emissions is shown in Table 9-1 to be small, however contour plots would provide confidence that the selected locations show the full picture. They would also demonstrate the representativeness of the Gunns AQMS site for determining "background" levels. Given the small increment, it may be appropriate to show separate contour plots of the mill impact as well as the combined impact of the background plus mill emissions.

Table 9-1 lists some values that are inconsistent with the data shown in Figures 9.9 and 9.10. **The Table lists the peak 1-hour SO_2 concentration at Tippogoree Hills as 103.9 ppb, but Figure 9.10 shows at least 6 peaks higher than this with the largest having a value of 289.9 ppb. This is not discussed in the text, even though it is significantly greater than the RPDC and DPIWE criterion of 200 ppb.**

There are a few exceedences of the RPDC ground-level criteria at the sites listed in Table 9-1 but in all cases the contribution to these by the mill is less than 0.1 ppb for SO_2 or less than 0.01 µg/m^3 for PM.

The predictions in Table 9-3 for TRS, HCl, Cl_2, and ClO_2 all assume that the background concentrations of these pollutants "*are effectively zero*". However, the plot of TRS results from Gunns AQMS (second last figure of Appendix D, reproduced in this review as Figure 1) seems to indicate an average TRS background concentration of about 0.4 ppb (≈ 0.6 µg/m^3), which is approximately 40% of the RPDC design criterion of 1.5 µg/m^3. **The GHD report makes no comment about the significance or otherwise of these TRS measurements. The reviewers consider that the absence of a discussion of the meaning of the available TRS measurements is a major weakness of the GHD report.** If the background values are indeed approximately 0.6 µg/m^3, then this has a significant impact on the extent of the regions predicted to have TRS concentrations exceeding the RPDC criterion.

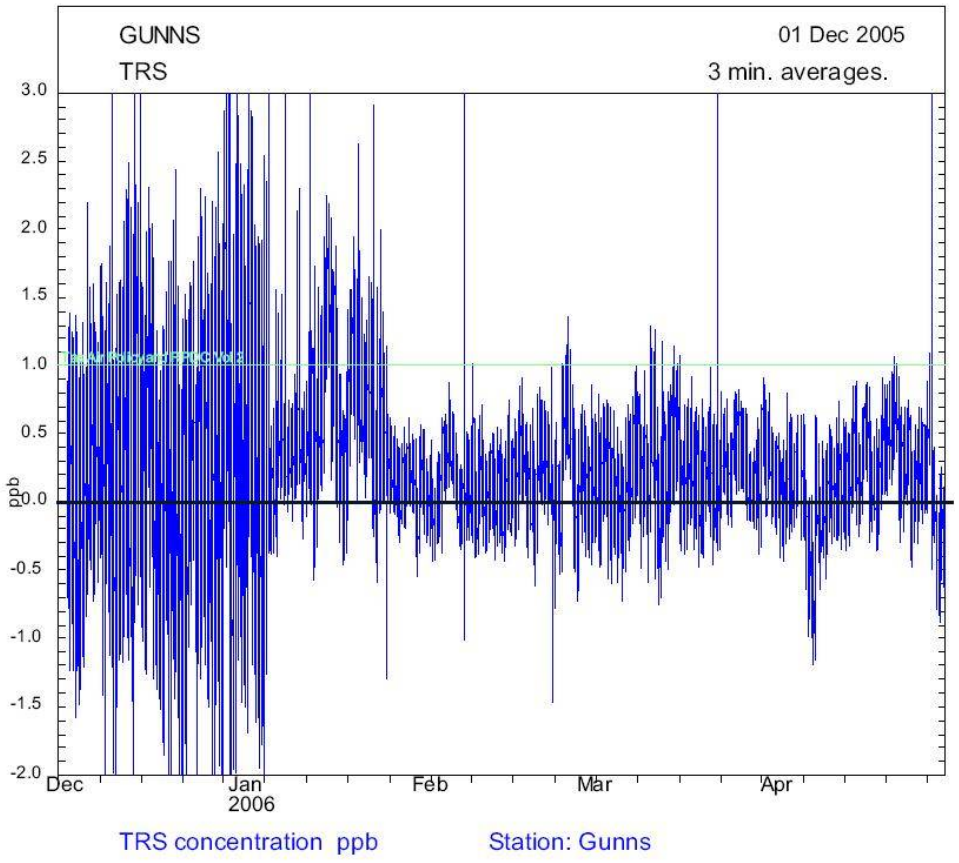


Figure 1 Copy of TRS time series from Appendix D (Time Series Plots: Measurements at Gunns AQMS) of the GHD report "Proposed Pulp Mill Bell Bay Impact on Air Quality". A horizontal line at 0 ppb has been added to aid in interpreting the data.

Notwithstanding the assumption of zero background concentrations, Table 9-3 shows that the TRS prediction on Mt George of 1.78 µg/m^3 exceeds the RPDC criterion of 1.5 µg/m^3. Figure 9.13 also shows a region near the plant where TRS exceeds the RPDC criterion. The GHD report presents an argument about the likely frequency of these exceedences given that the TRS emission rate used in the modelling is estimated to occur only sporadically for 88 hours per year. This gives return times for exceedences of the RPDC criteria of 54 years on Mt George

and 3.8 years at the most exposed estuary grid receptor adjacent to the mill. **The reviewers consider the methodology used to estimate return times is appropriate.**

Section 9.6 of the GHD report discusses the potential for mill emissions of TRS under start-up and upset/malfunction conditions. It details a range of back-up systems and notes that allowance has been made in the modelling for the short-term TRS emissions from the main stack to reach a maximum of 1.94 g/s. **Modelling has not included the possibility of fugitive emissions of TRS**. Section 7.8.2 (numbered paragraph (3)) of the "*Final Scope Guidelines for the IIS"* also states that this information must be provided. Only emissions from the main stack and the effluent treatment plant are modelled, even though the Draft IIS (Volume 4, section 4.4.2) describes odour monitoring to be conducted once the mill is constructed "*to characterise, identify, locate and minimise diffuse sources of Total Reduced Sulphides (TRS) odour within the mill*." **The reviewers understand that further consideration is being given to the issue of fugitive emissions by another reviewer.**

3.1.1 Minor issues in GHD report

The discussion of Figures 7.1 and 7.2 makes a number of assertions that are not supported by the data. The third last paragraph on page 24 says "[in] *the north west (up valley) quadrant, both SO_2 and NO_2 show lowered peak levels* [in Figure 7.2] *compared to those in Figure 7.1. This is what would be expected from upwind fixed emission rate sources – the increase in wind speed acts to dilute concentrations downwind. In contrast, the PM10 data does not show a reduction in peak levels.*" In fact, Figure 7.2 shows the same peak levels for SO_2 as Figure 7.1 and for PM10 peaks that are significantly lower in Figure 7.2.

The captions to Figure 7.1 and 7.2 describe the observations as being from Gunns AQMS for July 2004 to June 2005. Given the information in the text, the data are probably from July 2005 to February 2006.

The discussion of Figure 8.4a at the bottom of page 26 says "*it can be seen that the degree of over-prediction reduces to less than 2:1 at SO_2 concentrations > 8 ppb.*" The figure does not show any observations > 8 ppb and for the peak values, the degree of over-prediction is still more than 4:1.

The results in Figures 8.1 to 8.6 are described in the text as being observations and TAPM modelling for the period July–August 2005 although this is not stated in the captions. The model results differ from those presented in the PAE report of November 2005 (included in the Draft IIS) "*Review of Air Dispersion Modelling and Background Monitoring Data for the Proposed Bell Bay Pulp Mill*". Although not stated in the GHD report, this is because the PAE results were obtained with a 1 km grid, whereas the GHD results were obtained with a 500 m grid. Because the later PAE results (in the 8 August 2006 report) make for a far more comprehensive comparison against observations from the Gunns AQMS, the results in Section 8 of the GHD report are not reviewed in any more detail here.

3.2 PAE "Supplementary Air Quality Assessment of Proposed Pulp Mill, Final Report", 8 August 2006

This report is not included in the Draft IIS although it was foreshadowed. It was supplied to RPDC as a separate document.

The PAE report notes "*the modelling approach in this report almost entirely matches the approach taken by GHD. […] Some improvements in geophysical data used in the TAPM model have been incorporated into this work, but otherwise model settings are essentially unchanged from the GHD study.*" It is not clear exactly how significant these changes are, but the reviewers consider that any improvement in the description of the soil and vegetation should lead to better model predictions.

The PAE report states that the model was run in chemistry mode with GRS photochemistry. As the GHD report does not explicitly state that they also used the chemistry mode, the reviewers do not know whether this was a difference between the modelling by PAE and GHD. The PAE report does not comment on the sensitivity of the results to the inclusion of photochemistry, however the reviewers consider that inclusion of the photochemistry should lead to better model predictions.

The model was run for the period July 2005–June 2006. Wind data was assimilated from the Gunns AQMS site, Launceston airport and Ti Tree Bend. Table 2.1 of this review shows the differences from modelling conditions used in the GHD modelling. **The reviewers consider that the model configuration is suitable for the required task. They consider that the siting of the Gunns AQMS is such that it provides more representative data for input to the model than the data from the Comalco AWS used in the GHD modelling.**

The mill emissions used in the modelling were the same as those used by GHD. The same comments about insufficient reporting of emissions as listed in the dot points of section 3.1 of this review apply to the PAE report.

Section 3.4.2 of the PAE report notes changes in the Bell Bay Industry emissions for 2005 compared to 2004 but it is not clear to the reviewers whether this refers to the NPI estimates or the emission rates used in the modelling. The accuracy of the emissions from the Bell Bay industries used in the modelling is commented upon below.

The main results presented in the PAE report are:

i) Ambient air quality monitoring data for July 2005–June 2006 from Gunns AQMS for SO_2, NO_2, and PM10, **but not for TRS**.

ii) Model validation – comparison of model predictions for NO_2, SO_2 and PM10 against the observations at the Gunns AQMS and at Ti Tree Bend for PM10.

iii) Model predictions for the impact of emission from existing Bell Bay Industry emissions and the proposed mill, presented as contour plots in a 16 x 16 km region around the mill for TRS, Cl_2, ClO_2, and HCl, and as time series at selected sites for SO_2, NO_2 and PM10.

i) **The PAE report does not show any TRS data from the Gunns AQMS.** The TRS results are not included in Table 4.1 of the PAE report, which summarises all other results of the 12 months monitoring. **There is no comment or any reason given for this absence, even though the earlier PAE report (22 Nov 2005) lists TRS as one of the pollutants being measured at this station and some TRS results are presented in the GHD report. <u>This is a serious omission given the potential significance of TRS emissions from pulp mills.</u>**

The ambient air quality data from the Gunns AQMS that are shown are plotted against wind direction to assist in identifying the source of the emissions. They show the impact of existing industries to the north-west of the AQMS, particularly for SO_2. However, the peak SO_2 value of 10 ppb is less than the peak value of 14 ppb shown in the GHD report for a subset of these data. There is no comment in the PAE report about the reason for this difference. It is likely to be a calibration issue, but it deserves at least a comment. Similarly, a brief discussion of the two highest values for NO_2, which lie well above all other values in Figure 4.4, would be warranted.

There are some inconsistencies between the data for NO_2 shown in Figure 4.4 and 4.9 of the PAE report. Figure 4.4 shows all except two data points capped at 0.01 ppm whereas Figure 4.9 shows five or six points above 0.01 ppm. Similarly for SO_2, Figure 4.5 shows three values very close to 0.01 ppm whereas Figure 4.11 shows approximately 8 values with the same concentration close to 0.01 ppm. While all these values are well below the RPDC criteria, **these inconsistencies reduce the reviewers' confidence in the results presented.**

ii) **The relatively poor agreement between the model results and observations at Gunns AQMS (particularly Figures 4.9 and 4.11 of the PAE report) do not give confidence that the model is able to predict background concentrations due to emissions from the existing Bell Bay industries.** The PAE report notes that "*The over-prediction is most likely due to conservative estimates of emissions supplied to PAE, coupled with the fact that the modelling was performed with the assumption of constant emission throughout the year. In reality, emission rates are likely to vary significantly throughout the year*." Furthermore, in Volume 2, section 2.5.4 of the Draft IIS, there is a quote from the Human Health Risk Assessment "*it is noted the air dispersion modelling of existing industry emissions may have over-estimated ground level concentrations. The modelling used 2004 data, but since then the local industry has fitted additional pollution controls designed to significantly reduce emissions.*" **The reviewers consider that the opportunity to validate the modelling with model-observation comparisons has been lost by the use of poor emission estimates for the existing Bell Bay industries.** However, the reviewers agree that it is likely that the predicted impacts from the Bell Bay industries have been over-estimated, so that it is reasonable to use the model output to demonstrate compliance with the RPDC criteria for emissions from the same sources and for pollutants that behave similarly.

iii) As commented upon in reviewing the GHD report, the reviewers consider that the predictions should be presented as contour plots for all pollutants modelled, not just for Cl_2, ClO_2, HCl and TRS given in Figures 4.21–4.25. Contour plots would provide confidence that the selected locations show the full picture of the impacts from the proposed mill.

There are significant and unexplained differences between the some of the model results presented in the PAE and the GHD reports. Examples are shown in Figure 2 and Figure 3 of this review for TRS and ClO_2 and the significant features are described in the following dot points. **The reasons for these differences need to be explained.**

- Figure 2 for TRS shows that GHD predicts exceedences of the 1.5 µg/m^3 criterion to the north-west around Mt George and 6 km to the east on Tippogoree Hills as well as in the immediate vicinity of the proposed mill. In contrast, the PAE modelling shows peak concentration about 3 km north-east of the proposed mill, but **the exceedence contours are not labelled** so it is not known what the peak concentration are. These concentration contours should be labelled. Also the region shown does not extend as far east as the GHD plot so there is no information on whether the GHD peak 6 km east of the mill also occurs in the PAE modelling. Furthermore, the high concentrations up to 5 µg/m^3 close to the mill in the GHD plot are absent in the PAE plot. Given that both reports used the same mill emission rates and that the only significant changes were the year modelled and the source of the assimilated winds, the reviewers find it very unusual that the peak TRS concentrations near the mill from the low level or area sources would differ so much. The reasons for these differences need to be explained.

- Figure 3 for ClO_2 shows factor of two to three differences between the model results. The GHD report shows some exceedences of the 10 µg/m^3 criterion, whereas the peak prediction in the PAE modelling is about 3 µg/m^3. In the absence of any discussion about these differences, the reviewers have little confidence in the reliability of either set of predictions.

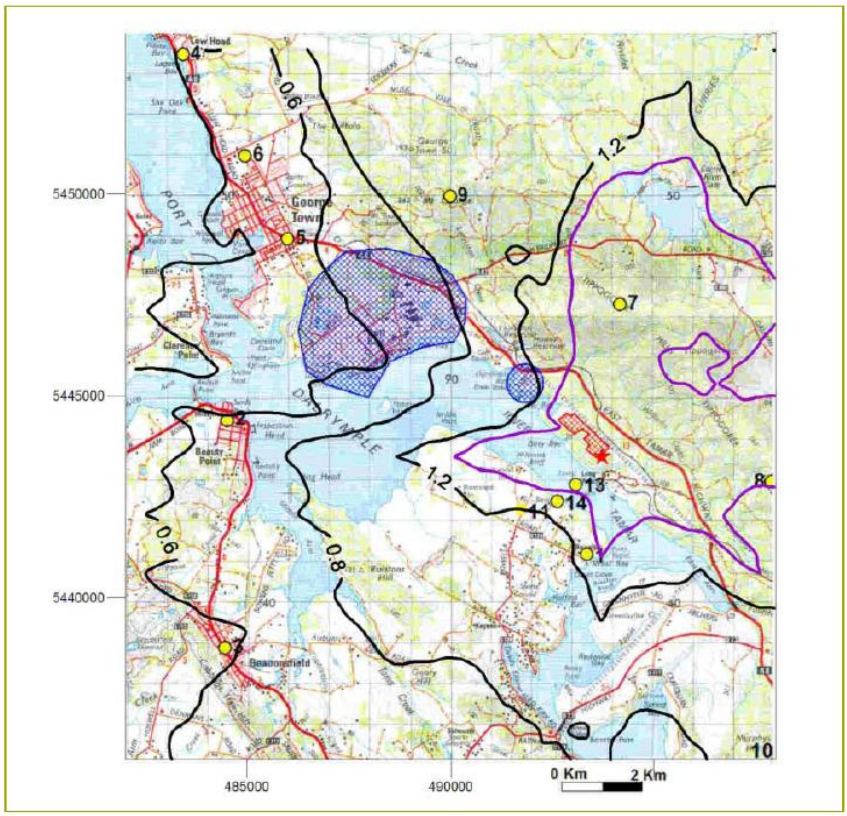


Figure 4.25 Predicted peak 99.9% TRS levels (3-minute average) in µg/m^3 with peak emissions. Predicted contours above the DPIWE criterion are shown in purple.

Figure 2 Model predictions for peak 99.9% TRS levels (3-minute average) in µg/m^3 with maximum continuous emissions. Upper panel shows part of Figure 9.13 from the GHD report; the lower panel shows results from Figure 4.25 of the PAE report. The panels are offset so that the mill positions are aligned vertically; the map scales differ between the panels. **The significant differences between the regions with exceedences of the 1.5 µg/m^3 are not discussed in the reports.**

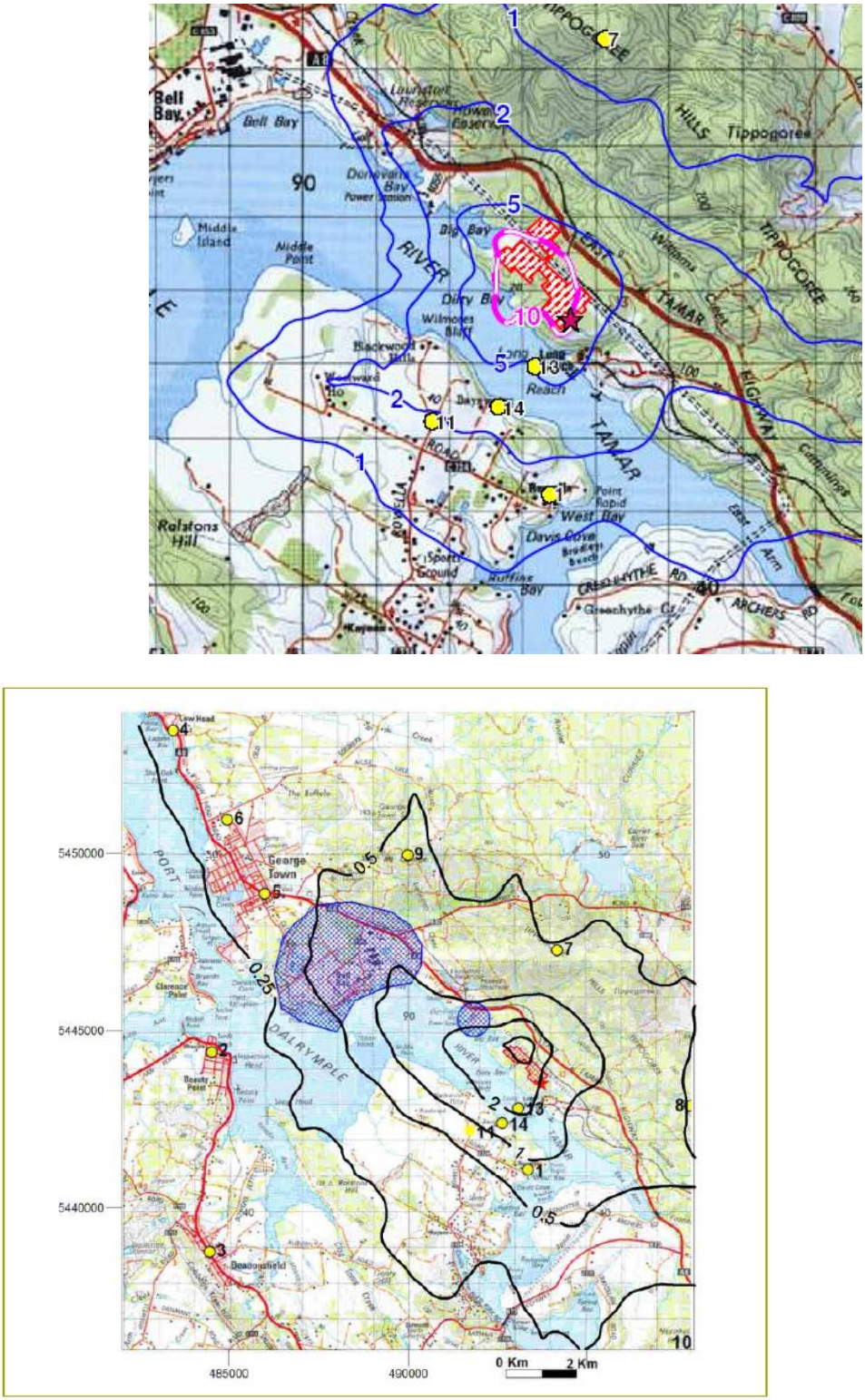


Figure 4.22: Predicted peak 99.9% Chlorine Dioxide levels (3-minute average) in µg/m³. Predicted contours above the DPIWE criterion are shown in purple.

Figure 3 Model predictions for peak 99.9% Chlorine Dioxide levels (3-minute average) in µg/m3. Upper panel shows part of Figure 9.15 from the GHD report; the lower panel shows results from Figure 4.22 of the PAE report. The panels are offset so that the mill positions are aligned vertically; the map scales differ between the panels. **The concentrations are more than a factor of two lower in the PAE results – these differences are not discussed in the reports.**

3.3 PAE "Review of Air Dispersion Modelling and Background Monitoring Data for the Proposed Bell Bay Pulp Mill", 22 November 2005

This report is presented as Appendix 19, Volume 9, of the Draft IIS. This report has been superseded by the PAE report considered in the previous section of this review and so is not considered further.

3.4 GHD, July 2006 "Air Quality Assessment for Construction Impacts – Proposed Gunns Pulp Mill", July 2006

This report is presented as Appendix 17, Volume 9, of the Draft IIS. It models the impact of dust emissions during the main construction phase of the proposed mill. The dust sources are clearly described and the emission rates are derived from reliable publications including the NPI Emission Estimation Technique Manual for Mining and a NSW Minerals Council and Holmes Air Sciences report on Particulate Matter and Mining.

The four largest sources contributing almost 80% of the total dust emissions are identified as:

25% Excavation, front end loader, shovel into trucks in excavation and in-filling

23% Bulldozer operations in excavation and in-filling

20% Vehicle induced dust along haul routes over unsealed surfaces

11% Unloading stockpiles.

The modelling has included an allowance for a 50 µg/m^3 background PM10 contribution. The reviewers agree with GHD that this is a conservative estimate because the maximum observed 24-hour average PM10 concentration at Gunns AQMS site during July 2005–June 2006 was 34.2 µg/m^3.

The report notes that the modelling has assumed high levels of dust control for the haul routes and that a separate Environment Management Plan will be prepared to ensure that dust emissions are properly controlled. **The reviewers comment that compliance with the modelled impacts depends strongly on ensuring that the dust emission rates remain with the values assumed in the modelling.**

4. REVIEW OF AIR QUALITY ISSUES IN THE DRAFT IIS

4.1 Volume 1, section 1.4.1

Section 1.4.1 of the Draft IIS deals with "*Guideline Requirements not addressed in the Draft IIS – 12 Months Air Quality Monitoring Data*".

Section 7.8.2 (5) of the RPDC "*Final Scope Guidelines for the Integrated Impact Statement*" states that

> *The modelling should be based on meteorological data collected over a twelve month period.*

Table 2.1 of this review lists the meteorological data used by the air quality modelling reports. The supplementary report by PAE (dated 8 August 2006 and submitted after the Draft IIS) used 12 months of meteorological data from the Gunns AQMS as well as from two Launceston sites. The earlier reports used 12 months of meteorological data from the Comalco AWS and up to two months (July & August 2005) of meteorological data from the Gunns AQMS. **The reviewers consider that both the GHD and PAE reports have addressed the requirements for meteorological data in the Final Scope Guidelines.** Differences between the wind data from the Gunns AQMS and the Comalco AWS are shown in Figure 4 of this review and discussed in section 4.3. **The reviewers consider that the PAE modelling has used more representative meteorological data than the GHD modelling.**

Section D 3.7 of the RPDC "*Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania, Volume 2*", states:

> *A minimum of 12 months' data is considered essential if these parameters for air quality monitoring are to be used with reasonable confidence. In the absence of other pollutant sources, background levels could be assumed to equal existing ground level concentrations of particular pollutants.*

The Gunns AQMS has been operational since July 2005 monitoring the following pollutants:

- SO_2; 1.0 ppb (detection limit)
- $NO/NO_2/NO_x$; 1.0 ppb
- PM10; 0.1 $\mu g/m^3$
- TRS; 200 ppt or 0.30 $\mu g/m^3$ as H_2S

The data for SO_2, NO_2 and PM10 were used by PAE (8 August 2006 report) in their model validation and the summary statistics for these pollutants and NO_x are listed in Table 4.1 of their report. However, **a significant omission is that the monitoring data for TRS are not presented nor discussed in the PAE report.** A TRS background value of zero is assumed in the presentation of the model results even though (incomplete) data presented in one of the GHD reports indicates that background concentrations may contribute about 40% of the TRS criterion; see Figure 1 of this review. **Given the potential significance of TRS as an air quality issue from an operating pulp mill, the absence of full TRS results and a discussion of their validity and significance remains a significant omission from the Draft IIS.**

4.2 Volume 1, section 4.3.2–4.3.4

Sections 4.3.2–4.3.4 of the Draft IIS deal with "*Regional Environment – Climate, Meteorology & Air Quality*".

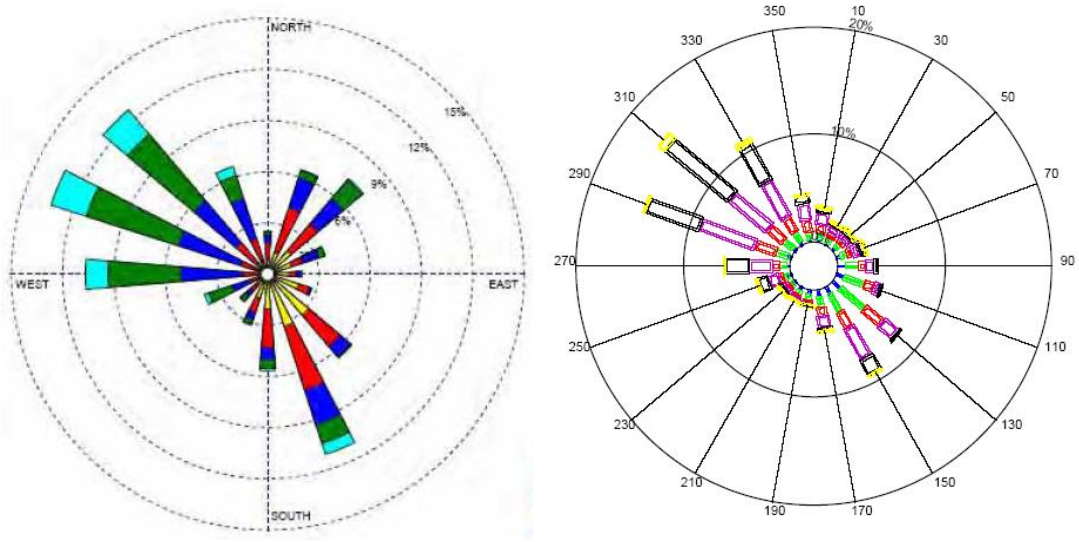
The section on air quality (4.3.4) notes that the Rowella air quality station (referred to elsewhere as the Gunns AQMS) measured TRS as well as PM10, SO_2 and NO_2, but **makes no comment about the absence of any TRS data from Table 4-4**, which summarises the results for the other pollutants.

The results of one year's monitoring at this site for PM10, SO_2, and NO_2 indicate that these results are all well below the NEPM Ambient Air objectives. **The reviewers consider that the concentrations measured at this site are likely to be representative of the ambient air quality in the vicinity of the proposed pulp mill in the absence of mill emissions.**

4.3 Volume 2, section 2.4–2.5

Sections 2.4–2.5 of Volume 2 of the Draft IIS deal with "*Existing Environment – Topography, Climate, Meteorology & Air Quality*".

Section 2.4.2 compares the wind roses from the Comalco AWS (referred to as Bell Bay) for 2004 with those from the Gunns AQMS for July 2005–May 2006 and notes that "*the same dominant wind trends are observed for this site* [Gunns AQMS], *with fewer winds from the north-east*". The wind roses are shown in Figure 4 of this review. The comparison shows that there are also far fewer westerlies and southerlies at the Gunns AQMS site. Because the data from each site are from different years, the differences may be due in part to the normal year-to-year variation in wind patterns, but the reviewers consider that the main differences arise



Comalco AWS (2004) Gunns AQMS (July 2005–May 2006)

Figure 4 Comparison of wind roses for the Comalco AWS at Bell Bay and the Gunns AQMS near Rowella. Copied from Figures 2-5 and 2-7 on pages 2-6 and 2-8 of Volume 2, Part 2 of the Draft IIS.

because of the different siting of the two stations, i.e. differences in local topography. The wind rose for the Gunns AQMS shows a stronger alignment of the winds along the NW-SE axis of the river at the proposed mill site and is thus considered to more representative of winds at the proposed mill.

Use of representative winds is important because the modelled winds at the proposed mill site are strongly influenced by the assimilated winds. The proposed mill site is approximately 5 km south-east of the Comalco AWS and 2½ km north-east of the Gunns AQMS. It is possible that these differences contributed to the differences between the predicted patterns of ground-level concentrations in the GHD and PAE reports.

The third and fourth last sentences of section 2.5.4 quoting the Human Health Risk Assessment say "*it is noted the air dispersion modelling of existing industry emissions may have over-estimated ground level concentrations. The modelling used 2004 data, but since then the local industry has fitted additional pollution controls designed to significantly reduce emissions.*" **The reviewers consider that the dispersion modelling should have used the best available emissions data.** As discussed elsewhere, while the use of conservative emission estimates produces conservative predictions for ground-level concentrations, it prevents the model predictions from being validated against observations. It does not give confidence that the model is able to predict background concentrations due to emissions from the existing Bell Bay industries**. Worse, there is then no confidence that the predictions of the impacts of mill emissions of TRS are indeed conservative when they show exceedences of the RPDC criterion, and observed TRS levels are a substantial fraction of the criterion but are omitted from the predictions**.

4.4 Volume 2, section 4.4–4.5

Sections 4.4–4.5 of Volume 2 of the Draft IIS deal with "*Potential Environmental Impacts and Management Issues – Climate, Meteorology & Air Quality*".

The in-stack concentration criteria – Emission Limit Guidelines are listed in Table 3 of the RPDC "*Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania, Volume 2*".

The report does not appear to list anywhere all of the proposed in-stack concentrations for the proposed mill, just the criteria. **Information is required on the proposed in-stack concentrations for the power boiler flue (PM, NO_x, PCDD/PCDF), the recovery boiler flue (PM, TRS, PSDD, PCDF), the lime kiln flue (PM, TRS, PCDD/PCDF), and the non-condensable gas boiler flue (TRS).** In contrast, the *total* mill emission rates for sulfur, NO_x, and inorganic chlorinated compounds are listed and compared with the Guidelines.

The report shows that the proposed total mill emissions of NO_x will be 1.676 kg NO_2/ADt compared to the RPDC limit of 1.3 kg NO_2/ADt. The report makes a case for the RPDC limit to be raised with more detail given in Annex XV of Appendix 7. The reviewers have not addressed the merits of this case as they are not aware of the full details for the decision to set the limit at 1.3 kg NO_2/ADt.

Details of the Bell Bay Industry emissions are not provided in the report (due to confidentiality agreements). A statement at the top of page 4-255 notes: "*The detailed emission inventories used for the TAPM modelling of existing background levels will be provided to the RPDC technical consultants, CSIRO."* **They have yet to be provided.**

Section 4.5.6 presents the predicted mill impacts on air quality based on the results from the GHD report. This modelling has been updated by PAE and **the reviewers consider that the conclusions about the low impacts of SO_2, NO_2 and PM10 remain true**. But **there needs to be** a discussion of the differences between the GHD and the PAE results, and **a re-estimate of the potential impact of TRS given the different distribution in the PAE results and the fact the background TRS has been ignored.**

4.5 Volume 4, section 4.3.1 & 4.4.2

Sections 4.3.1 & 4.4.2 of Volume 4 of the Draft IIS deals with "*Strategic Management Plan, Monitoring Plan – Point Source Monitoring, Ambient Monitoring*".

Section 4.3.1 describes the monitoring program for atmospheric emissions from the pulp mill in order to ensure that the RPDC Emission Limit Guidelines are met during operation of the mill.

Section 4.4.2 describes a comprehensive monitoring program including expansion of the air quality measurements made at the Gunns AQMS site in order to meet the RPDC offsite design criteria. **The reviewers note that the possibility of diffuse TRS emissions is recognised in the Draft IIS** in the description of the on-site odour monitoring program "*to characterise, identify, locate and minimise diffuse sources of Total Reduced Sulphides (TRS) odour within the mill.*"

The reviewers consider that the proposed monitoring will make it possible to check whether the proposed pulp mill is complying with RPDC "*Recommended environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill*".

5. ADEQUACY OF DRAFT IIS IN ADDRESSING THE AIR QUALITY ISSUES IN THE FINAL SCOPE GUIDELINES.

The above reviews in sections 3 and 4 have taken into account the requirements in the *"Final Scope Guidelines for the Integrated Impact Statement, Proposed bleached kraft pulp mill in Northern Tasmania by Gunns Limited"*, December 2005, in particular the relevant parts of section 7.8.2 on *"Atmospheric Emissions"*.

Here we review the adequacy of the Draft IIS in addressing section 7.8.2 of the *"Final Scope Guidelines"*. We consider the numbered points (2), (3), and (5) of the *Guidelines*.

> ***Guideline 7.8.2*** *(2) The gas volume, composition and particle size distribution, including velocity, temperature and pollutant concentrations and mass emission rates (in g/s) for each source at the point of discharge must be described (crossreference to the chapter 'Project Description') and compared with performance requirements. This should also include the discharge pattern i.e. normal, startup/shutdown, diurnal variation, seasonal variation, production dependence. For each source location (in map coordinates), height and diameter of*

> *chimney stacks and vents from which the emission will occur must be given (in accordance with the principle set out in D.3.11 of the Tasmanian Government 2004, Environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania).*

This point is not adequately addressed in the Draft IIS. **The emission characteristics for all sources are not presented in the Draft IIS**; this omission is described in more detail in the first two dot points in Section 3.1 of this review. The details of the maximum emission rates from each source are not provided. There is insufficient information to compare emissions with all performance requirements. The emissions that are listed are mainly for annual average and maximum continuous mill production rates. **Emissions at startup/shutdown are not discussed** in the sections of the Draft IIS dealing with air pollution modelling, except back-up strategies for preventing TRS emissions under these conditions.

The main mill stack, which includes flues for the recovery boiler, lime kiln, non-condensible gas boiler, and power boiler, is proposed to be 130 m high. This is 1.5 times the height of the recovery boiler building (86 m) as indicated by the sketches in Figure 5. **This does not satisfy the principle in D.3.11** that **"***It is sound engineering practice (USEPA 1985) for the exhaust stack to be at least 2.5 times higher than the recovery boiler building height and for the stacks from lime kiln, CNCG incinerator, CNCG emergency incinerator and power boiler to be taken to the same height as the recovery boiler stack. Site selection factors such as geographic location and air dispersion modelling will also influence the common stack height."* **The arguments for selecting a lower stack height than the 2.5-times rule need to be presented.**

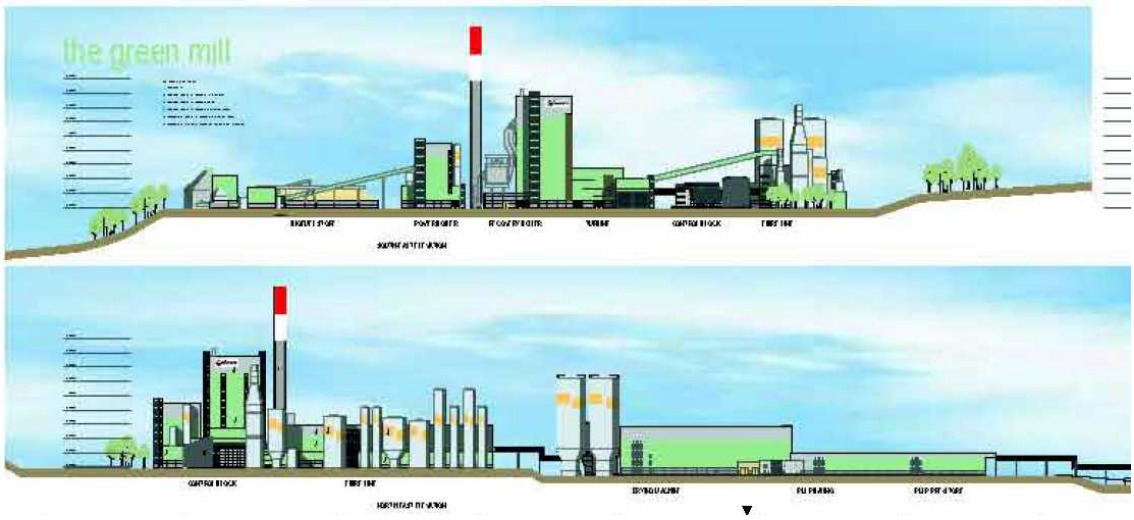


Figure 5 Illustrative sketches showing the relative heights of the proposed pulp mill buildings and the 130 m main stack. Copied from Page 4-224 of Volume 2, Part 4 of the Draft IIS.

> ***Guideline 7.8.2*** *(3) Provide details of the number of anticipated odour emissions from the proposed pulp mill during normal operation and maintenance cycles per annum, particularly the number of anticipated fugitive emissions. Potential sources of fugitive emissions must be identified and measures proposed to reduce them to a minimum, particularly with respect to facilities for collection and storage of foul kraft condensates, evaporation of black liquor and generation of sulfate turpentine, 'red oil'7, tall oil and, or, contaminated kraft 'soaps'. Provide estimates of the quantities of each pollutant for each type of identified fugitive emission and the managment practices that are proposed to minimise these emissions.*

This point is not fully addressed in the Draft IIS. Although the range of back-up systems to cope with mill emissions of TRS under start-up and upset/malfunction conditions is described, emissions are only considered from the main stack and the effluent treatment plant. **There are**

no details of potential fugitive emissions even though the Draft IIS (Volume 4, section 4.4.2) indicates that odour monitoring will be conducted once the mill is constructed "*to characterise, identify, locate and minimise diffuse sources of Total Reduced Sulphides (TRS) odour within the mill*."

> ***Guideline 7.8.2*** *(5) Ambient ground level concentrations of gaseous pollutants, including odours, must be estimated under normal and worst case dispersion scenarios, and compared with performance requirements. Ground level pollutant concentration calculations must be supported by a technical appraisal of the effect of local topographical and meteorological conditions on dispersal. The calculations should be based on prognostic atmospheric dispersion modelling, such as TAPM8, which takes into account topography, three-dimensional time and space varying meteorological fields, plume transformation, and building downwash. Modelling should be conducted by a consultant with wide experience in the use of prognostic models. The modelling should be based on meteorological data collected over a twelve month period as required by the Tasmanian Government 2004, Environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania. The temporal scale of the ambient ground level concentrations of gaseous pollutants should be specified, e.g. 3-minute average, hourly, daily, monthly etc. The air model used must have the capacity to take into consideration complex topographies, inversion layer presence and current airshed pollution effects and capacity with respect to National Environment Protection Standards for Air Quality, defined in Part 3 National Environment Protection (Ambient Air Quality) Measure as amended 2003. The aerial extent of the model must embrace the point where pollutant effects are negligible relative to background levels. Modelling should include normal and worst case. All configuration 'default' files, input files (such as source characterization files; the vegetation and land-use file; and the soil file), and output files, (such as the meteorological and pollution files), are to be made available to the regulator in electronic form to facilitate detailed review and possible replication of the dispersion modelling.*

Most of the points listed here are addressed in the Draft IIS. The modelling has been undertaken using TAPM by consultants (GHD and PAE) with wide experience in the use of prognostic models. The reviewers consider that the model configuration is suitable for the required task. The modelling has been undertaken using 12 months of meteorological data. This issue is considered more fully in section 4.1 of this review. The reviewers consider that the data from the Gunns AQMS (as used in the PAE Supplementary Report) is more representative of the proposed pulp mill site than the data from the Comalco AWS used in the GHD modelling. The air pollution modelling has been undertaken for a full year and so can be considered to have considered both normal and worst-case dispersion scenarios. The predicted ground-level concentrations are compared against the design criteria.

The effects of local topographic and meteorological conditions are accounted for in the modelling, but as discussed in section 3.2 of this review, the reviewers consider that the opportunity to validate the modelling with model-observation comparisons has been lost by the use of poor emission estimates for the existing Bell Bay industries.

The Draft IIS addresses the extent to which the capacity of the airshed is affected with respect to the Air NEPM.

The reviewers consider that **the predicted maximum ground-level concentrations should be presented as contour plots for all the pollutants modelled** (not just TRS, Cl_2, ClO_2, and HCl) in order to demonstrate that the region modelled extends to "*the point where pollutant effects are negligible relative to background levels*".

The model files (configuration, input, output) have not been supplied to these reviewers. We do not know whether they have been supplied to the regulator.

6. SUMMARY

Informed by the *"Environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania"* and the *"Final Scope Guidelines for the Integrated Impact Statement"*, the major issues identified in this review of the air quality aspects of the Draft IIS for the Proposed Pulp Mill are:

a) **TRS**. **The omission of background TRS concentrations in the modelling is a serious weakness in the Draft IIS given the potential significance of TRS as an air quality issue from an operating pulp mill.** Although the Gunns AQMS has been monitoring TRS since at least December 2005, the only data shown are a time series trace in Appendix D of the June 2006 GHD report. There is no discussion nor interpretation of these results in the main body of the report. The supplementary PAE report does not even refer to the TRS data. This issue must be addressed.

b) **TRS. The modelling has not included the possibility of fugitive emissions of TRS (or other offensive odours) from the building**. Only emissions from the main stack and the effluent treatment plant are modelled, even though **the Draft IIS monitoring plan acknowledges the possibility of diffuse TRS sources** in the proposed on-site odour monitoring program. The reviewers understand that further consideration is being given to the issue of fugitive emissions by another reviewer.

c) **In-stack criteria. There is insufficient information provided in the report to determine whether the RPDC in-stack concentration criteria will be met.** Information is required on the proposed in-stack concentrations for the power boiler flue (PM, NO_x, PCDD/PCDF), the recovery boiler flue (PM, TRS, PSDD, PCDF), the lime kiln flue (PM, TRS, PCDD/PCDF), and the non-condensable gas boiler flue (TRS).

d) **NO_x emissions.** NO_x emissions of 1.676 kg NO_2/ADt from **the proposed mill exceed the RPDC limit of 1.3 kg NO_2/ADt**.

e) **Main mill stack height**. The height of the main stack (130 m) is only 1.5 times the height of the recovery boiler building. **A justification needs to be provided for selecting a lower stack height than the sound engineering practice of the 2.5-times "rule"** presented in D.3.11 of the *Environmental emission limit guidelines for any new bleached eucalypt kraft pulp mill in Tasmania.*

f) **Model differences.** There are significant and unexplained differences between some of the key model results presented in the PAE and the GHD reports, particularly for TRS and ClO_2. These **differences are not discussed nor even mentioned in the supplementary PAE report.** The reasons for these differences need to be explained.

g) **Bell Bay Industry Emissions**. Details of the emissions from Bell Bay industry used in the modelling have yet to be provided to CSIRO. The reviewers consider that the opportunity to validate the modelling with model-observation comparisons has been lost by the **use of poor emission estimates for the existing Bell Bay industries**. The relatively poor agreement between the model results and

observations at Gunns AQMS do not give confidence that the model is able to predict background concentrations due to emissions from the existing Bell Bay industries nor for pollutants that behave differently or have different emission characteristics.

h) **Main stack modelling**. No information is provided to indicate whether the four flues in the main stack were modelled separately or as a single source. If they were modelled as a single source, the report needs to justify this modelling approach.

i) **Construction phase dust.** Compliance with the modelled impacts of dust emissions during the construction phase depends strongly on ensuring that the dust emission rates remain within the values assumed in the modelling.

j) **Model & meteorological data.** The reviewers consider that the configuration of the model TAPM is suitable for the required task. The siting of the Gunns AQMS data is such that it provides more representative data for input to the model than the data from the Comalco AWS.