Air Quality Assessment - Technical Review

Lot 41, 17 Cardup Siding Road, Cardup Air Quality Assessment

Shire of Serpentine Jarrahdale

01 August 2023

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Helen Maruta
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Air Quality Assessment - Technical Review

Dear Helen,

This technical review provides comments on the accuracy, and representativeness of the *Technical Report – Air Quality Impact Assessment of Rotomould Facility (Cardup)* conducted by EAQ Consulting in 2022. The review focuses on investigating whether there are matters of potentially material significance, rather than seeking to explore potential minor improvements.

Kind regards,

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1. Introduction

1.1 Purpose of this report

GHD Pty Ltd (GHD) was engaged by the Shire of Serpentine-Jarrahdale (SSJ) to provide an independent technical review of an air quality impact assessment (the assessment), prepared by EAQ Consulting (EAQ, 2022) for a rotomoulding facility in Cardup, Western Australia.

1.2 Scope

This scope of this technical review is summarised as follows:

– Consider the methodology and approach for the assessment, regarding the characterisation of existing environment, accuracy of emissions estimation and suitability of models used.
– Identify any data gaps, errors, or inconsistencies in the assessment.
– Determine the adequacy and accuracy of the assessment based on the modelling.
– Provide any additional recommendations going forward.

The following documents were reviewed:

– Technical Report – Air Quality Impact Assessment of Rotomould Facility (EAQ, 2022), including:
  - Appendix A – Ektimo Laboratory Results
  - Appendix B – Meteorological Development and Modelling Details
  - CALMET and CALPUFF input files
– Notice of Determine on Application for Development Approval (SSJ, 2017).

1.3 Limitations

This report has been prepared by GHD for the Shire of Serpentine-Jarrahdale and may only be used and relied on by Shire of Serpentine-Jarrahdale for the purpose agreed between GHD and Shire of Serpentine-Jarrahdale as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Shire of Serpentine-Jarrahdale arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

2. Project summary

Smartstream Technology owns and operates a plastic production facility (the facility) at Lot 41, 17 Cardup Siding Road, Cardup. The facility undertakes rotational moulding (often called rotomoulding), which produces hollow plastic products. During the rotomoulding process, high temperatures are generated in the rotational moulding oven, and toxic pollutants may form. The atmospheric toxic pollutants may then be released through the ovens stack.

An emission testing report and an ambient air quality assessment are required as Condition 7 of the facility's Development Approval (SSJ, 2017). EAQ (2022) assessed the stack's air dispersion and completed odour modelling to assess the potential impacts on ambient air quality. The assessment is discussed in the sections below.

3. Assessment criteria

The criteria pollutants and principal toxic substances selected for assessment are based on stack testing results from a suite of combustion gases and aldehydes conducted on 20 September 2022 by Ektimo Pty Ltd (Ektimo). The assessment does not specify which guideline has been used to define the maximum 1-hour criteria; however, the majority of the criteria used are obtained from Department of Water and Environmental Regulation (DWER) *Guideline: Air Emissions (2019)*. 24-hour criteria are not provided for sulphur dioxide (SO_2), acetaldehyde or acrolein, nor are the annual average criteria for nitrogen dioxide (NO_2), SO_2 and acetaldehyde, however, the 1-hour criteria is given for all toxic and criteria pollutants. It can be assumed if the 1-hour criteria is met, then so too will the 24-hour and annual average criteria.

A criterion of 890,000 µg/m^3 for methyl ethyl ketone (MEK) is provided, which is a Safe Work Australia (SWA) short term exposure limit (STEL) (SWA, 2019) to supplement missing criterion in DWER guideline. STELs are the maximum exposure limited over 15-minutes. AERMOD does not output 15-minute concentrations with an hourly meteorological file, and therefore post processing using peak-to-mean adjustment must be applied to the modelling results. A more appropriate criterion would have been to supplement the MEK criterion with a 1-hour equivalent criterion from an interstate guideline. Such an example is the MEK air pollution assessment criteria of 13,000 µg/m^3 from EPA Victoria's *Guideline for Assessing and Minimising Air Pollution in Victoria (for air pollution managers and specialists)*.

An odour exposure criterion of 1.0 odour units (OU) at the 100th percentile was nominated for the assessment by the author. The former odour guideline value for a 1-hour average criterion was 2.5 OU at the 99.5th percentile (Department of Environmental Protection, 2002). A value of 2.5 OU is classified as very weak (Department of Environmental Protection, 2002).

4. Existing environment

The assessment has no characterisation of the existing environment. Additionally, the assessment does not locate or identify any nearby sensitive receptors. Although a contour modelling plot of the predicted odour concentration with marked sensitive receptors is presented later in the assessment, the exact location of the five sensitive receptors is not provided. Specifically, the assessment has not defined the 'nearest receptor', where the predictive modelling results are presented later in the report.

There also appears to be a receptor south of the modelling domain that has not been included in the assessment, however the receptor south of the facility is 600 m away, whereas the other receptors north, east and west of the facility are closer, approximately 100 m. Furthermore, the predicted odour concentration plot shown in the results section shows the contours do not extend to the southern receptor, so this may not be of concern.

An odour complaints register was not reviewed as a part of this assessment, which is advised for an odour assessment under DWER guidelines. However, a register is not a specific condition of the Development Approval and thus may not exist.

5. Emission estimation

The emission inventory was based on stack testing results of the rotomoulding oven exhaust stack, undertaken on 20 September 2022 by Ektimo. Ektimo is a National Association of Testing Authorities (NATA) accredited laboratory and undertook the stack testing under the appropriate United State Environmental Protection Agency methods and Australian Standards. Monitoring sampled odour, criteria pollutants (nitrous oxides (NO_x), SO_2 and CO), aldehydes and ketones, carbon dioxide and oxygen. GHD reproduced the emissions rates from the stack testing results, which were calculated correctly from the monitoring results.

NO_2 is considered to be one of the criteria pollutants for the assessment. However, the details of the approach for NO_x to NO_2 conversion (if any) is not provided. As such the reviewer will assume 100 percent NO_x is being assessed as NO_2.

The basis for the modelling scenario is to represent operating all hours of the year. The operating conditions for the site are restricted to 7:00 am to 5:30 pm Monday to Friday and 7:00 am to 1:00 pm on Saturdays. However, to model emissions all hours of the year is considered a more conservative emission than modelling the permitting times only.

Overall, apart from the lack of clarity surrounding the NO_x to NO_2 conversion, the emission source and estimation approach are considered appropriate.

6. Meteorological and dispersion modelling

The CALMET/CALPUFF modelling suite used for the assessment is an appropriate model for use. Section 6 breaks down each component of the modelling which the reviewer considers important.

6.1 Selection of representative modelling year

Most Regulators require demonstration that the modelling year is representative of long-term average conditions. For example, the US EPA's *Meteorological Monitoring Guidance for Regulatory Modelling Applications* (2000) recommends when reviewing meteorological data as input to dispersion modelling to review consecutive years from the most recent and readily available five-year period.

The report only mentions that the two most recent calendar years (2020 and 2021) were used for modelling, with no justification of the use for modelling year. Meteorological observations for 2020 and 2021 were not supported by any numerical evidence, graphical evidence, or statistical tests for average or typical weather conditions. If there were a significant amount of air pollutant emissions from the facility, failing to capture typical weather conditions may be problematic. However, given the air pollutant emissions are relatively low this is unlikely to be a significant problem.

6.2 TAPM

The Air Pollution Model (TAPM) was used to synthesise a three-dimensional prognostic meteorological dataset for input to CALMET. TAPM is not well suited to generate and represent such complex meteorological patterns that are known to exist at times along the Darling Scarp (CSIRO, 2004). The most appropriate tool to be used in the Weather Research and Forecast (WRF). WRF model typically generates more representative wind fields and has been demonstrated to capably simulate the turbulent eddies that form close to the Darling Scarp (Rye, 2017). However, considering the facility has low emissions from the one stack, using TAPM to generate 3D prognostic data is unlikely to problematic.

TAPM was configured with an outer grid of 30 km and nesting grids 10 km, 3 km, 1 km and 0.3 km, 41 x 41 grid points and 25 vertical levels. This configuration meets the minimum requirements under the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (NSW EPA, 2022).

The report also mentions hybridising the output dataset was undertaken to allow the CALMET processor to incorporate those sea breeze and land breeze effects at the extremes of the modelling domain. However, it appears the model was run in no-observations mode. No-observations mode in CALMET means the meteorological data is based purely on prognostic, simulated meteorological data. A hybridised meteorological dataset in CALMET is when the TAPM prognostic meteorological data is combined with an observational meteorological dataset from a station nearby to make a meteorological input file for CALPUFF.

6.3 CALMET

CALMET input data is discussed below.

6.3.1 Geophysical configuration

The assessment sourced 1-second Shuttle Radar Topography Mission (STRM) data for the terrain file. This is the preference for topographical data in Australia. The data used in the model is at a 100 m resolution, which gives confidence there would be a good characterisation of wind flow.

6.3.2 CALMET file configuration

CALMET was run as no-observations mode which uses TAPM prognostic data to produce surface and upper air meteorological data. This option allows certain features of the flow field such as the sea breeze circulation with return flow aloft, which may not be captured in the surface observational data.

The CALMET wind roses generated with TAPM data were displayed along with general statistics such as annual average, seasonal and 6-hourly wind roses, however they were not tested for representativeness. This would be

done by comparing the observational meteorological data from Jandakot Aero Bureau of Meteorology (BoM) station which is approximately 25 km north east of the site. The Darling Scarp does have some meteorological complexities from the summer sea breezes combining with drainage flows and pressure jumps from the escarpment. Additionally, eddies can form under strong easterly winds. Given meteorology is one of the main factors influencing air dispersion, an assessment to validate the CALMET data for wind direction and wind speed against meteorological observations ensures the site's complex wind flows are being adequately captured in the meteorological inputs. However, as stated in the section above, the emissions are low and unlikely to be problematic in the results.

The O'Brien procedure was not activated in CALMET. The O'Brien procedure is an optional feature that adjusts wind fields so that the vertical velocity at the top of the model domain is forced to be zero. This avoids reflections from the top layer at the top of the model domain. However, given the stack emission is in the lower level of the atmosphere it is unlikely that the O'Brien procedure will make a difference to the predicted results.

6.3.3 Building wake effects

Building Profile Input Program (BPIP) to model building downwash effects was activated, which was appropriate for the objective of the modelling. SSJ informed GHD the stack height is 1.2 m above the building height. The stack height was set to the same height as the factory building to ensure maximum building downwash effects. This is a more conservative approach and therefore considered appropriate.

6.3.4 CALPUFF configuration

The CALPUFF model input files as well as the assessment were reviewed and feedback for the configuration is as follows:

- 100 m x 100 m for NX and NY cells is typically a too fine resolution. Most CALPUFF applications are run with a relatively small grid resolution of around 250 m (New South Wales Office of Environment and Heritage (NSW OEH), 2011), however in this instance 100 m can be considered appropriate, as the 100 m size can account for the complexity of the wind flows.
- The domain size is 10 km x 10 km, which is a typical size of 100 points if using 100 m x 100 m cell sizes.
- The dispersion coefficient was set to MDISP = 2, which is an acceptable and appropriate setting.
- Sigma v values were set to 0.2, which is the recommended sigma v value from the default 0.5 to 0.2 (NSW OEH, 2011).
- The model was setup for 11 vertical levels, with a higher resolution of 50 m x 50 m in the gridded layer. Considering the low height of the facility's point source that represents the stack, another layer with a midpoint between 80 and 120 m would have been good to consider the dispersion between 80 and 160 m in the surface layer of the model.
- TERRAD value was 0.7. A TERRAD value should be ridge to ridge divided by two, plus 1 km or 2 km (NSW OEH, 2011). Typical TERRAD values are 5 to 15 km (NSW OEH, 2011). The Darling Scarp is approximately 3 km from the modelling stack, and therefore a TERRAD value of 5 km should have been used. A TERRAD value of 0.7 means that there will most likely not be drainage easterly flow from the Scarp and below onto receptors to the west of the site. However, given the low amount of emissions from the facility this is unlikely to be a significant problem.
- The remaining switches were set to default values and are acceptable.

GHD reproduced the odour modelling with the AUSPLUME dispersion model. The meteorology was based on the use of the METSAMP meteorological data file supplied with AUSPLUME. METSAMP is a synthetic dataset containing a full range of worst case meteorological conditions (wind speed, ambient temperature, mixing height and stability class category) and can be used to provide a conservative estimate of worst case downwind concentrations for averaging periods of 1-hour or less. The values predicted with AUSPLUME were approximately half than that shown in the predicted odour concentration plot.

7. Assessment of results

The predicted concentrations at the nearest receptor for odour and air pollutant results were presented in Table 3-3. The predicted odour was also presented as a contour plot. Other pollutants were not shown as contour

plots, as the assessment states they were too low to be visually representative. If the contour plots for the predicted air pollutants are not provided, then all predicted concentrations at all five receptors shown in Figure 3-1 should be provided in a table of results.

The predicted concentrations do not result in exceedance against any of the assessment criteria. Results are presented for NO_x predicted concentrations where NO_2 is the criteria pollutant. This is considered appropriate, as the predicted NO_x concentration is 0.5 percent of the NO_2 criteria.

Analysis and interpretation of the predicted airborne concentrations at the 'nearest receptor' results are provided and compared to the relevant criteria. The assessment discusses the variability compared to the previous and current odour stack testing results regarding odour strength, formaldehyde and acetaldehyde. The previous stack testing event was conducted at Smartstream's rotomoulding facility in Kewdale, prior to relocating the plant to Cardup.

8. Conclusions

This technical review has been conducted based on the information presented in *Technical Report - Air Quality Impact Assessment of Rotomould Facility (Cardup)* by EAQ Consulting (2022). The air quality assessment, which also includes odour, presents the measured concentration of the facility's oven stack and modelling of relevant airborne pollutants.

The key findings for improvement are outlined below:

– Airborne pollutant criteria – for the select modelled pollutants the appropriate 1-hour criteria was selected. 24-hour and annual average criteria were not provided.
– Existing environment – Discussion of the surrounding environment was not captured in the assessment. The location of the 'nearest receptor', where the predicted modelling concentrations were presented in the results, was not identified. The five sensitive receptors shown in the odour modelling contour plots were also not identified nor classified. Considering the facility's operations is a contentious issue amongst the local community, further discussion about the land use and surrounding receptors should have been included.
– Emission estimation – Emission rates for modelling are considerately low, however this is not unexpected given the scale of the facility's operations. Using the results from stack testing by Ektimo to determine emissions gives credibility to emission rates.
– Meteorology - The meteorological model, TAPM, was not the most suitable modelling tool for the purposes of this assessment. The selection of representative model year was not supported by any review of the past five years of meteorological as per US EPA standards. Although TAPM may have not been the appropriate model, it was configured to the appropriate guidelines.
– Dispersion modelling - Using the CALPUFF modelling suite used in the study is a suitable model choice for this location, including the model settings. The model scenario practicable and gives the conservative assumption and comparison of previous reports for odour of the plant operating all hours of the year. A TERRAD value of 5 would have included drainage flow from the Darling Scarp and potentially some winds from the east.
– Assessment of results – A sound analysis and interpretation of the predicted airborne results for the 'nearest receptor' is provided, particularly for odour. The predicted concentrations of the air pollutants at the four other receptors shown in the odour contour plot are not shown in the results table. This is unlikely to be problematic, as the results at the 'nearest receptor' are extremely low; however only one predicted contour plot (for odour) is shown in the report and it is unknown what the predictive results are for other pollutants. It is unknown why the 24-hour and annual average predicted pollutants were not included in the assessment; however, it can be safe to assume that if the 1-hour criteria are met for airborne pollutants then 24-hour and annual average criteria will be met too.

Although there could have been some improvements to the assessment, it is in the technical reviewer's opinion that the assessment meets the necessary requirements the Conditions related to the SSJ's Development Approval. The methodology is sound and includes an acceptable level of conservatism for odour, which is the biggest risk associated with the operations of the facility. GHD recommends that an air dispersion modelling assessment is not required annually due to the low amount of atmospheric stack emissions and low-risk to air quality; however annual stack testing of criteria pollutants, aldehydes, ketones and odour is recommended.

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