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17 February 2016

Attn: Marc Cornell

Sunshine Coast Regional Council
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Email: marc.cornell@sunshinecoast.qld.gov.au

Re: Independent review of air quality assessment for proposed cremator at 139 – 159 Wises Road Buderim

Dear Marc,

Sunshine Coast Regional Council commissioned Katestone Environmental Pty Ltd (Katestone) to conduct a peer review of the report: Air Quality Assessment Proposed Cremator 139 – 159 Wises Road, which was prepared by MWA Environmental. Katestone understands that there is currently a funeral parlour and a caretaker's residence at the address and that a Material Change of Use Application is being lodged for the inclusion of a cremator within a previously approved building.

In conducting this review Katestone has considered:

- The report Air Quality Assessment Proposed Cremator 139 – 159 Wises Road by MWA Environmental
- Modelling input and output files provided by MWA Environmental.

The proposed cremator is located 100 metres from residences to the south and 200 meters from residences to the west. A sporting facility is located adjacent to the proposed cremator site to the east.

Katestone has reviewed the recommended separation distances for crematoria in the literature and has found that recommended separation distances range between 100 metres to 300 metres (Australian Cemeteries and Crematoria Association, May 2004 and EPA Western Australia, 2005). The literature also indicates that these separation distances have been nominated to minimise the potential impact of noise, gaseous emissions and other risks. Odour is not generally cited as an important factor for siting crematoria. Separation distances are used as a guide for siting new activities. However, non-compliance with recommended separation distances is not necessarily a fatal flaw. Where the available distances between a crematorium and residences are shorter, detailed air quality modelling may be used to demonstrate that emissions from the crematorium will not adversely affect residences located closer than the recommended separation distance.

A summary of the outcomes of Katestone's technical review of the air quality assessment is provided below. Details are provided in Attachment 1.

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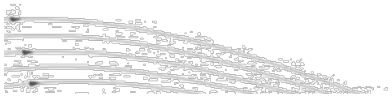
The key aspects considered in this review of the air quality assessment are:

- Emissions inventory
- Assessment criteria
- Meteorological data
- Background air quality
- Dispersion modelling and results.

The review has found:

- An emissions inventory was developed to account for emissions due to gas combustion and cremator emissions.
    - The emission rates were calculated using emission factors published in the literature and manufacturer's specifications for the Ener-Tek – IV Plus cremator as well as operating conditions (one cremation per hour, 16 hours per day). Emission rates were calculated for numerous air pollutants including: oxides of nitrogen, carbon monoxide, sulfur dioxide, particulates, metals, dioxins and furans (PCDFs) and polyaromatic hydrocarbons (PAHs).
    - Emission rates were based on National Pollutant Inventory Emission Estimation Technique (NPI) Manual for Crematoria (2011) and United States Environmental Protection Agency (USEPA) AP-42 Ch2.3 Solid Waste - Medical Waste Incineration. Emission rates of all air pollutants were calculated correctly.
    - Deposition rates of mercury were quantified in the assessment assuming that 4% is in the particle phase. This assumption was based on the UK report Particulate and Heavy Metal Emissions from Industrial Processes produced for the UK Department of Environment, Food and Rural Affairs (DEFRA Report). The DEFRA report refers to stringent particulate matter controls of modern incineration plant whilst saying in the case of cremators, particulate matter abatement is less good. The MWA Environmental Report has not demonstrated the applicability of the assumption of percentage of mercury in the particle phase in relation to effectiveness of controls for the proposed cremator. Therefore, more information should be provided. Whilst Katestone agrees that the percentage of mercury in the particle phase is likely to be relatively low due to the high vapour pressure of mercury, it is also the case that the outcome of the assessment is sensitive to the assumption that 4% is in the particle phase.
    - Odour was not included in the emissions inventory. A cremator that is operated in accordance with good practice and in a proper and efficient manner will minimise emissions of odour. Therefore, it is recommended that a condition regarding odour from the site be included in any approval along the lines of "any release of noxious or offensive odours will not cause a nuisance at any odour sensitive place".
- The study referred to the air quality planning criteria contained in BCC City Plan 2014 and, in the absence of criteria in the BCC City Plan 2014, the Texas Commission on Environmental Quality Effects Screening Levels were used. These air quality criteria are appropriate.
- The assessment utilised the TAPM and CALMET meteorological models. These models are appropriate and were configured generally in accordance with standard methodologies.
- The background levels of air pollutants used in the assessment are appropriate.
- The assessment utilised the CALPUFF dispersion model. This model is appropriate and was configured generally in accordance with standard methodologies.



- Characterisation of the cremator in the dispersion model is appropriate.
- The assessment indicates compliance with the relevant air quality criteria. The most critical pollutants are:
    - PAHs as benzo(a)pyrene (19% of criteria at residence and 61% of criteria off-site)
    - PCDFs (24% of criteria at residence and 41% of criteria off-site)
    - Nitrogen dioxide (28% of criteria at residence and 46% of criteria off-site)
    - Mercury (8% of criteria at residence and 14% of criteria off-site)
    - Deposited mercury is also a key pollutant, with deposition rates predicted to be 26% of the TA Luft trigger level at a residence and 64% of the TA Luft trigger level off-site.

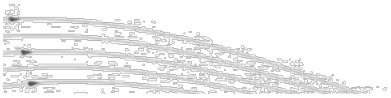
The results in relation to the predicted levels of deposited mercury are sensitive to the assumption regarding the percentage of mercury in the particle phase. It is recommended additional information be provided by MWA Environmental regarding relevance of the assumption of 4% of mercury in the particle phase to this particular cremator.

Further work which may be undertaken to provide confidence in the outcome of the assessment is a health risk assessment. The health risk assessment would consider multiple pollutants and multiple pathways and would determine the short term and long term health impacts due to the operation of the cremator.

Please contact the undersigned on (07) 3369 3699 if you would like to discuss the review.

Yours sincerely,

Natalie Shaw



ATTACHMENT 1

Table 1 Detailed findings of the review

Section	Subsection	Comment
Emissions	Cremator	• Emission rates were based on National Pollutant Inventory Emission Estimation Technique (NPI) Manual for Crematoria (2011) and United States Environmental Protection Agency (USEPA) AP-42 Ch2.3 Solid Waste - Medical Waste Incineration. The MWA Environment report (p5) states that there is no emission factor specified in the NPI for polychlorinated dioxins and furans (PCDFs) and therefore emissions of which were based on the Bay Area Air Quality Management District (BAAQMD) Permit Handbook Chapter 11.6 – Crematories (2009). However, this is not correct. The NPI emission factor for PCDFs is 4.9 x 10^{-9} kg/cremation, which is higher than the BAAQMD emission factor (1.4 x 10^{-9} lb/body – equivalent to 0.63 x 10^{-9} kg/body). The NPI states that, on average, a 70kg body and 20kg casket are cremated – a total of 90kg per cremation. The BAAQMD emission factors are based on an average weight of body and casket of 150lb – equivalent to 68kg. • Katestone's review of the modelling output supplied by MWA Environmental determined that the assessment did use the correct NPI emission factor for PCDFs. • This approach is acceptable for all pollutants.
	Gas combustion	• Emission rates associated with combustion of natural gas in the cremator were based on the USEPA AP-42 Ch1.4 Natural Gas Combustion and manufacturer's specifications for the Ener-Tek – IV Plus cremator
	Heavy metals	• Deposition rates of mercury were quantified in the assessment assuming that 4% is in the particle phase based on the DEFRA Report. The DEFRA report refers to stringent particulate matter controls of modern incineration plant whilst saying in the case of cremators, particulate matter abatement is less good. The MWA Environmental Report has not demonstrated the applicability of the assumption in relation to effectiveness of controls proposed at this cremator. Therefore, more information should be provided. Whilst Katestone agrees that the percentage of mercury in the particle phase is likely to be relatively low due to the high vapour pressure of mercury, it is also the case that the outcome of the assessment is sensitive to the assumption that 4% is in the particle phase.
	Odour	• Odour emission rates were not calculated. Odour will not be a major issue with a well maintained and operated facility. This issue can be addressed through conditioning as detailed above.
	Total	• Emission rates calculations have been checked and were calculated correctly for all pollutants. • Emissions are based on the key assumptions that: - one cremation per hour will occur (expected cremation time is 75 minutes)

Section	Subsection	Comment
		- the cremator will be operated in accordance with good practice and in a proper and efficient manner
Objectives / guidelines		• Impact assessment criteria from the BCC City Plan 2014 and Texas Commission on Environmental Quality Effects Screening Levels were used for all pollutants • For the assessment of deposition rates of heavy metals trigger levels proposed in the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety TA Luft First Federal Administrative Regulation Pertaining to the Federal Immission Control Act (Technical Instructions on Air Quality Control – TA Luft) were used • These are acceptable
Background air quality		• Air quality measurements from the following EHP monitoring stations were used to represent background levels of NO_2, SO_2, TSP, PM_{10}, $PM_{2.5}$ and CO: - Mountain Creek (70^{th} percentile 2011 to 2014) - Springwood (70^{th} and 90^{th} percentiles 2011 to 2014) - South Brisbane (70^{th} percentile 2010 to 2014) • These monitoring stations are suitably representative of the site. The 70^{th} percentile is acceptable for determining background levels. • No background levels were included for other pollutants as these are not measured by EHP. This is standard practice as these other pollutants are not widely found in the natural background.
Meteorological modelling	TAPM	• TAPM configuration files were provided and have been reviewed. • TAPMv4.05 was used. This is acceptable. • Default land use database was used. • Data assimilation of Nambour and Maroochydore Airport.
	CALMET	• CALMET configuration files were provided and have been reviewed. • CALMETv6.4.1 has been run with a 3dimensional wind field generated from TAPM. This is acceptable. • The land use (refined compared with that in TAPM) and terrain information included in the Calmet modelling appears appropriate. • CALMET has been run in NOOBS mode, which is acceptable. • Critical parameters to be specified by the user are detailed in the table below

User specified parameters	Value	Acceptable (Yes/No)

Section	Subsection	Comment
		TERRAD: 5 km — Yes MCLOUD: 4 (MM5 to Grads Algorithm) — Yes IWFCOD: 1 — Yes IFRADJ: 1 — Yes IKINE: 0 — Yes IOBR: 0 — Yes ISLOPE: 1 — Yes IPROG: 14 — Yes Other parameters appropriate
	Presentation of meteorological parameters	• Standard meteorological parameters of wind speed, wind direction, stability class, temperature and mixing height were presented in Attachment 4 of the MWA Report for the project site. • The wind roses (annual and diurnal) show light to moderate winds from the southwest during the early hours of the morning, whilst moderate to strong winds are generally from the south and southeast. Based on Katestone's experience and review of meteorological data from EHP's Mountain Creek monitoring station this seems appropriate. • The wind speed frequencies, temperature and diurnal mixing height appear appropriate for the location.
Dispersion modelling	CALPUFF - Configuration	• The use of CALPUFF (v6.42) is acceptable. • All user specified model parameters are consistent with regulatory defaults and therefore are acceptable.
	CALPUFF – source characteristics	• Point source characteristics have been modelled correctly: - Stack height - Exit velocity - Stack diameter - Stack temperature - Hours of operation 6am to 10pm - Building wakes were included and the Prime algorithm used for determining building wakes
	CALPUFF – source emission rates	• The emissions were modelled at 1 g/s and then the results scaled accordingly for each pollutant. • Incorrect scaling used for PCDFs. Emission factor 1.36E-9 lb/body used instead of emission rate of 6.13E-10 g/s (NPI). Therefore, ground level concentrations will be lower than what is presented in the report. All other pollutants are scaled

Section	Subsection	Comment
		correctly. • Emissions were included for hours 6am to 10pm. This is acceptable.
	CALPUFF – deposition rates	• Particle size distribution for gravitational settling was based on size distribution reported in USEPA AP-42 Solid Waste Disposal – Medical Waste Incineration. • This is appropriate.
Results	Presentation	• Tables of results were presented for the 12 closest sensitive receptors and the maximum off-site for all pollutants • Contours of predicted ground-level concentrations were presented for: - Dioxins and furans as TCDD I-TEQs - Hydrogen fluoride - Mercury - Nitrogen dioxide - PAH as benzo(a)pyrene equivalents - PM_{10} - $PM_{2.5}$ • Averaging periods of 1-hour were assessed against the 99.9th percentile. The use of the 99.9th percentile is generally used when an assessment is made that includes background (for example for NO_2). In assessments where no background is included it is standard practice to use the maximum predicted ground-level concentrations. Notwithstanding this, Katestone has reviewed the modelling outputs and has determined that if the maximum 1-hour ground-level concentrations had been used the outcomes of the assessment would remain unchanged. That is compliance would still be achieved. • Averaging periods greater than 1-hour were assessed against the maximum. This is appropriate.
	Outcomes	• Results indicated: - Predicted ground-level concentrations are below the relevant criteria for all pollutants - Main pollutants are: o PAHs as benzo(a)pyrene (19% of criteria at residence and 61% of criteria off-site) o PCDFs (24% of criteria at residence and 41% of criteria off-site) o nitrogen dioxide (28% of criteria at residence and 46% of criteria off-site) o mercury (8% of criteria at residence and 14% of criteria off-site) - Deposited mercury is also key pollutant, with deposition rates predicted to be 26% of the TA Luft trigger level at a residence and 64% of the TA Luft trigger level off-site

Section	Subsection	Comment
		- Ground-level concentrations of PM_{10} and $PM_{2.5}$ are 23% and 38% of the criteria; however, the main contributor is ambient background levels
Recommendations		• The MWA Environmental report demonstrates that predicted ground-level concentrations are acceptable. The assessment is based on assumptions regarding operation of the cremator (one cremation per hour with cremator operating between 6am and 10pm). Another assumption which is key to the outcome is the percentage of mercury that is in the particle phase when emitted. With off-site impacts predicted to be 64% of the TA Luft trigger level, the results are potentially sensitive to the assumption regarding percentage of mercury in the particle phase. It is recommended that additional information be provided by MWA Environmental regarding relevance of the assumption of 4% of mercury in the particle phase to this particular cremator. • Further work which may be undertaken to provide confidence in the outcome is a health risk assessment. The health risk assessment would consider multiple pollutants and multiple pathways and would determine the short term and long term health impacts due to the operation of the cremator. • It was identified that odour was not assessed. This can be dealt with by including a condition in the approval that states " any release of noxious or offensive odours will not cause a nuisance at any odour sensitive place".

References

Australian Cemeteries and Crematoria Association, May 2004, "Environmental Guidelines for crematoria and cremators"

EPA Western Australia, 2005, "Guidance for the Assessment of Environmental Factors"

Environment Australia, 2011, "National Pollutant Inventory Emission Estimation Technique Manual for Crematoria"

Lee, C, 2009, "Bay Area Air Quality Management District (BAAQMD) Permit Handbook Chapter 11.6 – Crematories"

Passant, N. et al, 2002, "UK Particulate and Heavy Metal Emissions from Industrial Processes, Issue 2", Report Number AEAT-6270, DEFRA

TRC Environmental Corporation, 2011, "Generic Guidance and Optimum Model Settings for the Calpuff Modeling System for inclusion into the 'Approved Methods for the modeling and assessments of air pollutants in NSW'"

United States Environmental Protection, 1993, "Solid Waste - Medical Waste Incineration"