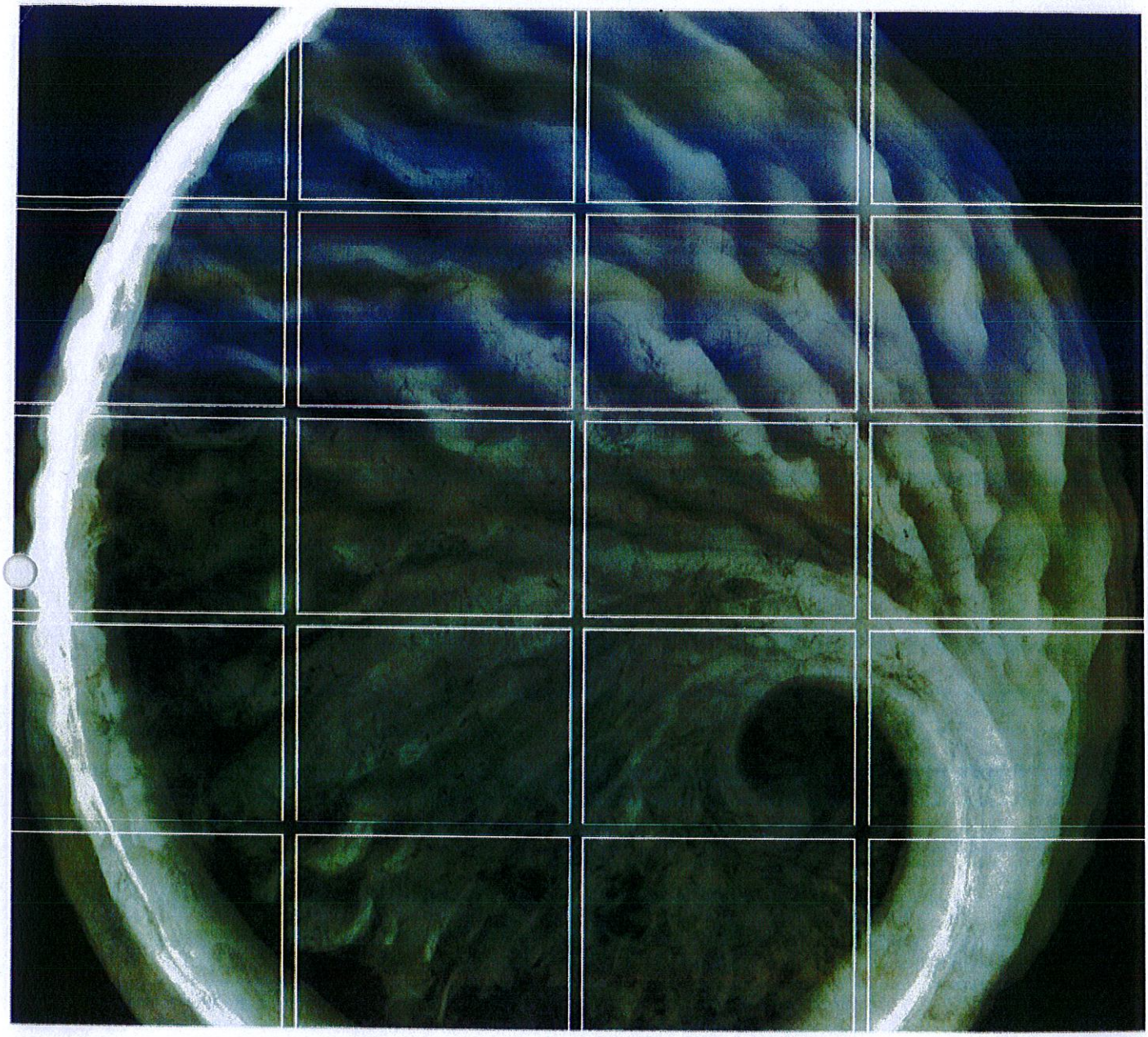

Independent Review: 'Odour Impact Assessment Geelong Resource Recovery Facility, Stonehaven, Victoria', Edge Group, dated August 2015

Golden Plains Shire Council

April 2017

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CONTENTS

EXECUTIVE SUMMARY

ERM was engaged by Golden Plains Shire Council to complete a review of the document entitled '*Odour Impact Assessment, Geelong Resource Recovery Facility, Stonehaven, Victoria*' dated August 2015 and authored by Edge Group (the Odour Assessment).

The Geelong Resource Recovery Facility in Stonehaven is proposed to comprise a:

- 36,000 tonne per annum open windrow green waste composting facility; and
- 100,000 tonne per annum municipal waste and solid inert waste landfill.

In reviewing the Odour Assessment it was determined that there are a number of deficiencies in the assessment that are likely to result in an under-estimation of ambient concentrations of odour and thus the associated risk of odour impact to the surrounding land use. These deficiencies, together with proposed actions for resolutions are outlined in *Table ES.1*.

Table ES.1 Identified Methodological Deficiencies in the Odour Assessment and Recommended Resolutions

General Methodology Item	Specific Methodology Item	Methodological Deficiency	Recommended Resolution
Meteorology	Use of one year of data	• EPA Publication 1551 requires the use of 5 recent sequential years of data	• Modelling to be updated using 5 recent years of meteorological data
	Representativeness of meteorological data	• Meteorological data taken from BoM station 17 km from the subject site • BoM station in an urban setting, resulting in differing wind speeds to the subject site • BoM station 3 km from Port Phillip Bay and thus subject to land sea breezes that would not occur at the subject site	• Use WRF as a prognostic meteorological model , incorporating observations from surrounding BoM stations to produce a 5 year site specific meteorological data set; or • Use CALMET as a diagnostic meteorological model, incorporating observations from surrounding BoM stations to produce a 5 year site specific meteorological data set, with upper air data defined by TAPM.
	No low wind speeds (<0.6 m/sec) included in the dispersion modelling	• Low wind speeds are excluded from the assessment. In odour modelling, low wind speeds substantially influence the 99.9th percentile concentration, meaning exclusion of these wind speeds lowers the predicted concentration	• Prognostic / diagnostic meteorological modelling will produce wind speeds down to 0.1 m/sec • Use site specific meteorology with AERMET with a wind speed threshold of 0.1 m/sec to produce a meteorological data set with low wind speeds • Ensure that U* adjustment is used both in AERMET and AERMOD

Background Odour	Existing odour sources excluded	• 9 broiler farms and 2 other compost facilities are located in the surrounding area
		• The additional odour sources have been excluded on the basis that no odour was detected during the site visit
		• Odour may not have been detectable during the site visit as a result of:
		  • Good dispersion during the site visit
		  • Wrong location to observe odour
		  • At a different point in the broiler cycle for to when peak odour is generated
			• Model existing broiler farms using emission estimation as recommended by EPA to demonstrate existing odour impact to the surrounding land use
			• Model proposed compost facility/landfill together with existing compost facilities
			• Compare the frequency of odour events from the broiler farms with the frequency of odour events as a result of the proposed development to determine whether increased frequency of odour impact is appropriate

General Methodology Item	Specific Methodology Item	Methodological Deficiency	Recommended Resolution
Emission estimation	Number of onsite windrows	• Number of onsite windrows based on a design capacity of 36,000 tonnes per annum • A compost facility design capacity is typically stated in terms of the output capacity rather than intake as the density and volume of the material changes over the composting period as decomposition occurs. This may mean that the number of windrows has been inaccurately calculated.	• The estimation of the number of windrows at the facility needs to account for decomposition and change in density over the composting period to derive an accurate number of windrows on site
	No emission estimation for shredded green waste	• No odour emission estimate has been provided for the shredded green waste of which the Odour Assessment states there will be a ready supply for the formation of windrows	• Include condition that shredded green waste is moved to a windrow formation by the end of each day to prevent a stockpile becoming anaerobic • Include stockpile in dispersion modelling during opening hours
	No odour emission rate for turning of windrows	• Turning of windrows generates substantial emissions over very short periods • Based on number of windrows it is estimated that there will need to be turning of two stage 1 and three stage 2 windrows per hour of opening • Emissions immediately after turning remain elevated for some time before returning to quiescent emission rates	• Turning to be included in the dispersion modelling • Elevated emissions after turning to be included in the dispersion modelling
	Average odour emission rate for quiescent windrows too low	• The average odour emission rate for quiescent windrows is based on testing on the top of Gorecover • Gorecover is a technology designed to reduce the odour emissions from composting, by retaining moisture and temperature within the windrow • Gorecover is not proposed to be used for these windrows • The average odour emission for quiescent odour emissions is under-estimated by approximately a factor of seven	• Odour emission rates for open windrow or uncovered compost windrows need to be used such as those used in (Environmental Resources Management Australia Pty Ltd, 2015)

General Methodology Item	Specific Methodology Item	Methodological Deficiency	Recommended Resolution
	Use of an average emission rate for quiescent windrows	• The proportion of stage 1 and stage 2 windrows are not equal. • Average odour emission rates over all stages under estimates the total emission to the facility by approximately 20 %	• Apportion appropriate quiescent odour emission rates to stage 1 and stage 2 wind rows within the modelling
	Emission rate for landfilling too low	• The emission rate for landfilling is only appropriate for emissions from the surface of the landfill cell after compaction as it was measured using an isolation flux hood • This approach does not account for tipping of the waste on to the landfill cell, or the compaction into the cell • Downwind measurements that incorporate all of these odour sources indicate that odour emissions from placement of waste to be approximately an order of magnitude higher than flux emissions measured from the waste face only	• Update emission rate for landfilling to incorporate odour emissions from unloading of waste and compacting taking account of the hourly variation in waste arrival
Source definition	Use of area sources	• EPA Publication 1551 states that area sources overestimate the impact to the surrounding land use in light wind conditions	• EPA Publication 1551 recommends the use of the USEPA volume source approximation method for area sources. This should be adopted
Separation distance	Landfill BPEM Separation distance	• EPA Publication 788.3 requires a separation distance of 500 m from the nearest building or structures (EPA Victoria, 2015)	• The nearest building or structure appears to be approximately 1 km from the proposed site, indicating that this is acceptable

General Methodology Item	Specific Methodology Item	Methodological Deficiency	Recommended Resolution
	Composting Separation distance	• EPA Publication 1577 requires that an open receival, open turned windrow with open air maturation for 36,000 tonnes has a separation distance of greater than 2 km (EPA Victoria, 2014) • The nearest house is approximately 1.5 km from the proposed composting facility	• Relocate composting to be more than 2 km from the nearest residential receptor • Use of enclosed / controlled aerobic composting (i.e. either in tunnel or use of Gore Cover with active aeration) or a secondary control odour capture and treatment system would enable the reduction of the separation distance to 800m • A specific assessment of upset conditions needs to demonstrate why the separation distance should be reduced from 2 km (this is unlikely to be achievable, based on process upset) • Use of local meteorology to show that the 2 km separation distance can be deviated due to local wind patterns and does not impact any sensitive receptors

1 *INTRODUCTION*

Environmental Resources Management Australia Pty Ltd (ERM) was engaged by Golden Plains Shire Council to undertake an independent review of the document entitled *'Odour Impact Assessment, Geelong Resource Recovery Facility, Stonehaven, Victoria'* completed by Edge Group and dated August 2015 (Odour Assessment).

The Odour Assessment pertains to the development of a 36,000 tonne per annum open windrow green waste composting facility and a 100,000 tonne per annum municipal waste and solid inert waste landfill. The Odour Assessment has sourced odour emission rates from other studies and applied them within the regulatory model AERMOD. Other noted potential odour sources from 7 broiler farms located to the north-west and 2 broiler farms located to the north-east and another compost facility to the south-east of the proposed facility. .

2 INDEPENDANT REVIEW

2.1 APPROACH TO INDEPENDENT REVIEW

This independent review has considered the following aspects of the methodology used in developing the Odour Assessment:

- Development of Meteorology;
- Consideration of background;
- Emission estimation;
- Representation of emission sources within the modelling;
- Presentation of results; and
- Consideration of separation distance requirements.

ERM"s independent review generally provides commentary by exception only. If a matter is not mentioned, therefore, this should be taken to mean that the approach is deemed acceptable.

2.2 DEVELOPMENT OF METEOROLOGY

The meteorological file is a fundamental part of atmospheric dispersion modelling as it defines in what direction emissions are dispersed and how quickly the emissions are dispersed or diluted.

The meteorological file that was used within the Odour Assessment was prepared for the authors by pDs Consultancy. A description of the method used to develop the meteorological files is provided in Appendix B to the Odour Assessment.

The appropriateness of a meteorological file may be determined through several considerations:

- Representativeness of meteorology to the site, incorporating:
  - Proximity of dataset to the site;
  - Surrounding land use for the meteorological observation versus the proposed site; and
  - Terrain at the proposed site.
- Incorporation of low wind speeds; and
- Number of meteorological years considered.

2.2.1 *Representativeness of Adopted Meteorology to the Proposed Site*

Proximity of Dataset Collection to the Proposed Site

Appendix B of the Odour Assessment states that the application site is just within a 20 km radius of the nearest Bureau of Meteorology (BoM) observation station at Grovedale in Geelong. Section 5.1.4 of the Odour Assessment states that the "Geelong weather station is within 5 kilometres of the subject site". Having considered the distance between the subject site and Grovedale in Geelong, the distance is approximately 17 kilometres from the subject site to the BoM station in Grovedale, consequently the statement in Appendix B is more accurate than that in the main body of the report.

EPA Publication 1550 – Construction of Input Meteorological Data Files for EPA Victoria's Regulatory Air Pollution Model (AERMOD) requires that:

"The directly measured parameters (a), (b) and (c) must be site-specific (must [sic] within 5 KM [sic] radius of the application site) and the rest of [sic] measured parameters should be site-representative" (EPA Victoria, 2013)

Parameters (a), (b) and (c) are defined as:

(a) Scalar wind speed (m/s) at wind reference height (e.g. 10m);

(b) Wind direction (degrees measured clockwise from true north) at wind reference height; and

(c) Ambient temperature (K) at screen level height (e.g. 2m).

Consequently, the direct use of meteorological data from the BoM station at Grovedale at this facility does not comply with the requirements of EPA Publication 1550.

Non-compliance with the requirement of Publication 1550 may not be of concern if the land use and topography surrounding the data observation site is similar to the development site, hence these two issues are considered.

Comparison of Land Use Surrounding the BoM Observation Site

The BoM observation site is located in Grovedale, Geelong. In general terms, the site is located at a racecourse and is surrounded by an urbanised environment and is situated at the commencement of the Bellarine Peninsula, approximately 2.8 km from the coast. In contrast the development site in general is located approximately 14 km from Port Phillip Bay in an area of farming land (*Figure 2.1*).

This general setting is important as the wind speed and wind direction at the BoM station will be influenced by sea breezes from Port Phillip Bay, whilst the temperature may be impacted by the surrounding urbanisation, both of which are unlikely to occur at the development site. Thus it is considered that the

observation data from Grovedale is unlikely to be representative of the proposed development Site.

EPA Publication 1550 states that:

"Meteorological files constructed using meteorological data generated by prognostic models such as TAPM or MM5 may also be acceptable in situations where there are no measured mandatory data within a 5 km radius of the application site" (EPA Victoria, 2013).

It is therefore recommended that meteorological modelling is undertaken to define site specific wind speed, wind direction and temperature.

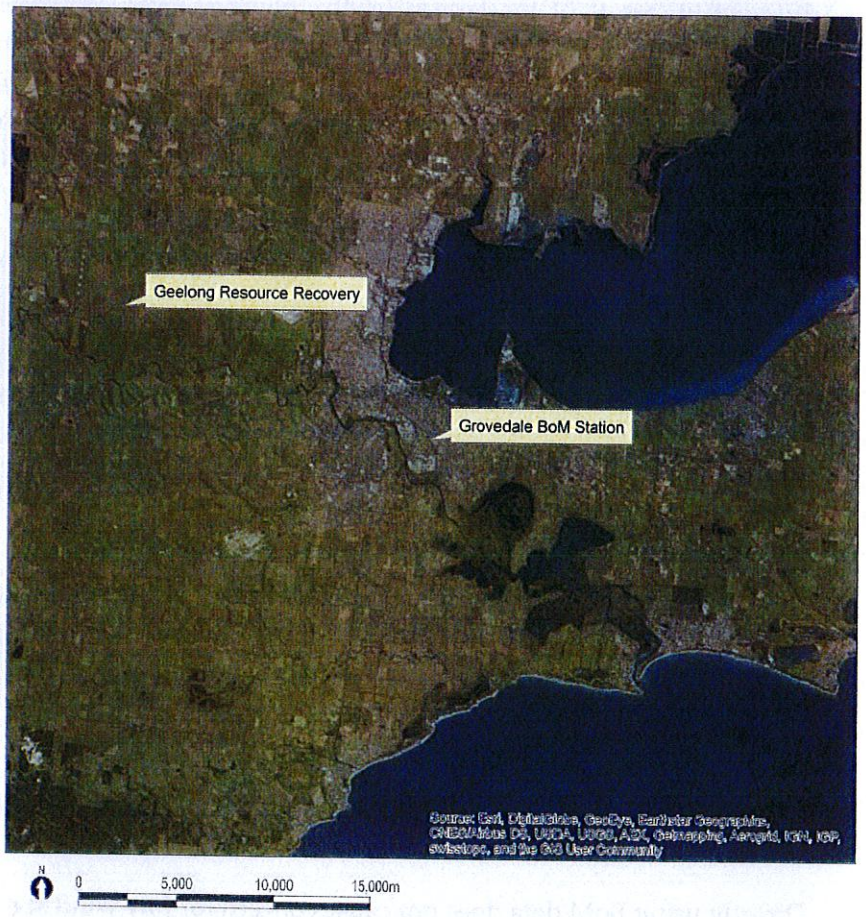

Figure 2.1 ***Location of Grovedale BoM station compared to proposed development site***

Whilst EPA Publication 1550 states the use of TAPM as appropriate, correlation of TAPM with BoM observations at Warrnambool and Ballarat has previously indicated a potential inability to accurately predict surface wind speed and direction on an hour by hour basis (Cowan & Garrison, 2015). It is ERM's experience that more accurate correlation may be obtained using the CALMET meteorological model including data from several surrounding observation stations with upper air data for the site obtained from TAPM.

Terrain at the Proposed Site

Terrain has a significant influence of meteorology that can channel winds in different directions. Higher wind speeds can only be channelled by larger terrain features, however low wind speeds can be channelled by relatively small features resulting in changes in wind direction on a very local scale. When modelling odour, low wind speeds are the driving influence for poor dispersion, thus small terrain features are an important consideration.

Figure 2.2 shows a comparison of terrain at the BoM observation station at Grovedale and the proposed site. It is clear from *Figure* 2.2 that the terrain setting for the BoM observation station and the proposed development site are different in terms of the terrain height, however both are in relatively flat terrain. The difference is that under relatively calm conditions, air will tend to drain to the west at Grovedale, into the nearby river system, whilst at the proposed development site cool air drainage is likely to occur to the south. Consequently under low wind speed conditions, the BoM station would not be representative.

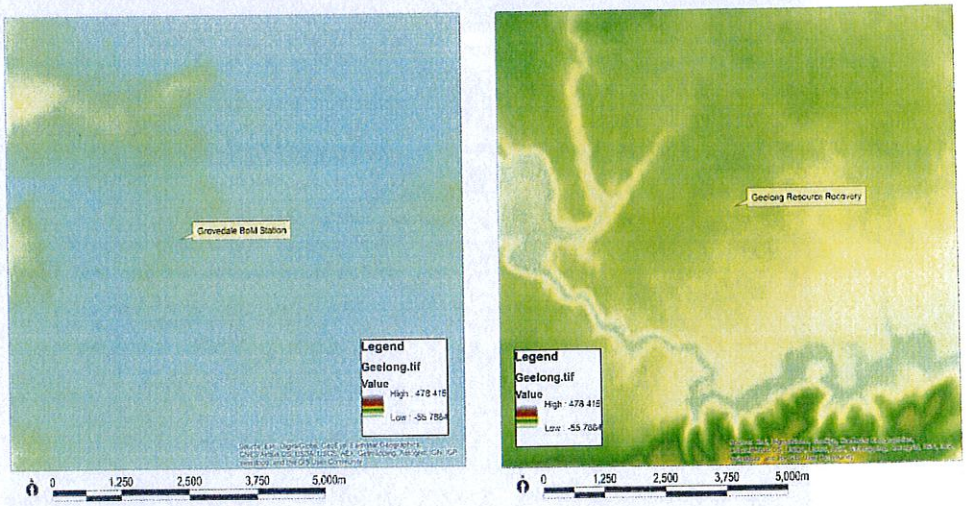

Figure 2.2 ***Comparison of terrain at Grovedale BoM Station (left) and the Proposed Development Site (right)***

Directly using BoM data does not cause concern for low wind speeds as winds of less than 2 kph (which is when cool air drainage occurs) are not recorded. This means that there would not be, within the BoM dataset, low wind speeds impacted by cool air drainage that occur at the BoM station and not at the development site or vice versa. The non-recording of low wind speeds is, in itself a concern, which is considered in Section 2.2.2.

Figure 2.3 shows the terrain setting in a wider context. From this information it can be seen that the proposed development site sits within a broad valley system that is likely to channel winds from the westerly directions, with the Grovedale site situated at the eastern end of the valley system.

Under high wind conditions, therefore it is considered that the BoM at Grovedale is likely to be representative. In lighter wind conditions, there is concern that the elevated terrain to the west of the BoM would block winds that would be present at the development site.

This slightly different terrain setting is another reason why meteorological modelling would be preferred to provide a representative dataset for dispersion modelling at the proposed development site in accordance with the requirements of EPA Publication 1550.

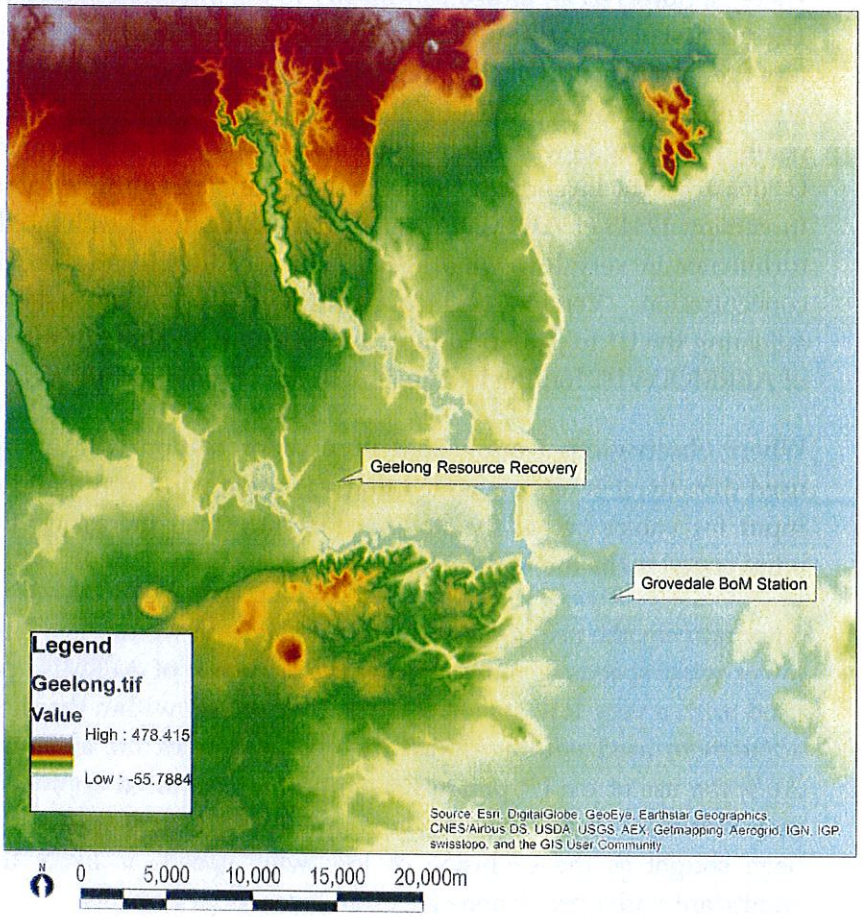

Figure 2.3 ***Wider terrain setting of BoM stations***

2.2.2 *Incorporation of Low Wind Speeds*

In the modelling of odour, low wind speeds result in the worst case impacts, as low wind speeds maintain coherence of the plume and allow high concentration of emissions to traverse the landscape. The State Environment Protection Policy for Air Quality Management (SEPP(AQM)) requires the presentation of dispersion modelling results for odour at the 99.9th percentile. This is equivalent to the 9th highest modelled result out of 8760 modelled results for each year. Consequently, the 99.9th percentile will be dominated by results from low wind speeds.

As stated in Appendix B to the Odour Assessment the anemometer at the BoM Observation Station in Grovedale has a stall speed of 2 kph (0.56 m/sec). When this stall speed is included in the AERMET meteorological processor for AERMOD, any wind speeds recorded as zero are lifted to the stall speed of the observation station, thus the minimum wind speed in the meteorological data is 0.56 m/sec (typically the stall speed is rounded to 0.6 m/sec). Lower wind speeds than this have the potential to result in significantly higher ground level concentrations than predicted.

There is, however, an added complexity to the inclusion of low wind speeds. The version of the AERMOD model used for the Odour Assessment (v 12345) was the latest version of the model at the time of the assessment. The model was known for over predicting concentrations in very low wind speeds as a result of the way in which it handled a meteorological condition known as U*. U* describes the level of horizontal turbulence as the air flows across the land. In version 12345 of AERMOD, the U* parameter under estimated the level of turbulence in very low wind speeds, thus leading to an over prediction of concentration. Version 12345 of AERMOD did contain a beta option for adjusting the U* to provide a more representative value. In the latest version of AERMOD v16216r, the U* adjustment has become default.

Where observations from a BoM observation station with a stall speed are used directly, it is recommended that a random wind speed and direction are input for values below the stall speed rather than increasing the minimum wind speed in the file and the U* adjustment is used.

Alternatively, the use of meteorological modelling would have provided these lower wind speeds as a site specific file. The use of AERMET could then be used with a very low stall speed of 0.1 m/sec set within the file, and the U* adjustment used within AERMOD. At the time of the assessment (August 2015) the use of the U* parameter would have required approval by the EPA as at that time it was a Beta function in AERMOD. This approval should have been sought as the exclusion of low wind speeds is likely to result in a significant under prediction of ground level odour impacts.

2.2.3 *Number of Meteorological Years Considered*

EPA Publication 1551 - Guidance Notes for Using the Regulatory Air Pollution Model AERMOD in Victoria requires that:

"...the meteorological input files are required to contain recent five (5) sequential years of hourly data" (EPA Victoria, 2013).

The Odour Assessment has used one (1) year of meteorology that being of 2010. Given that the assessment was completed in 2015, it would be expected that in order to be compliant with EPA Publication 1551 meteorological data from 2010 to 2014 inclusive should have been used to demonstrate inter-annual variability of the results.

A similar requirement is also stipulated by the United State EPA, the developers of the AERMOD dispersion model who state that:

"The model user should acquire enough meteorological data to ensure that worst-case meteorological conditions are adequately represented in the model results. The use of 5 years of adequately representative NWS (national weather service) or comparable meteorological data, at least 1 year of site-specific, or at least 3 years of prognostic meteorological data, are required" (United States EPA, 2017).

Given the requirement of EPA and the model developer that where data gathered from the national weather service is obtained five years of sequential meteorological data is used, this means that the Odour Assessment is not compliant with available guidance.

ERM recommends the assessment be recompleted using at least five years of site representative data. This is completed using meteorological modelling incorporating observations from Geelong, Sheoaks and Colac from the past five years. Observations should be obtained on a one minute basis and averaged to produce hourly average values. These values should then be used with TAPM to generate an upper air file for the site, and with CALMET to develop a site specific surface file for the site. These two files should then be incorporated in AERMET to produce site specific compatible AERMOD meteorological files.

2.2.4 *Summary of Gaps Identified in Relation to the Development of Meteorology*

With respect to the development of meteorology, the following gaps were identified in the Odour Assessment:

- **Meteorological data taken from BoM station 17 km from the subject site in contravention of the EPA Publication 1550 which requires data from an observation station to be within 5 km of the subject site to be used directly. Specific concerns in relation to the distance of the BoM station from the subject site are:**
  - **BoM station in an urban setting, resulting in differing wind speeds to the subject site; and**
  - **BoM station 3 km from Port Phillip Bay and thus subject to land sea breezes that would not occur at the subject site.**
- **Low wind speeds are excluded from the assessment:**
  - **In odour modelling, low wind speeds substantially influence the 99.9th percentile concentration, meaning exclusion of these wind speeds lowers the predicted concentration;**
- **EPA Publication 1551 requires the use of 5 recent sequential years of data, whilst only data for one year (2010) was included in the assessment;**
- **No justification for the use of 2010 was used and it is unclear how impacts may differ at different sensitive receptors with varying years of meteorology.**

2.3 *CONSIDERATION OF BACKGROUND*

Contemplation of existing odour sources is an important consideration when determining odour impact from a new development. Odour nuisance is often considered in terms of the FIDOL approach:

- Frequency (how often odour events occur);
- Intensity (how strong the odour is);
- Duration (how long an odour event occurs);
- Offensiveness (how offensive a particular odour is to the individual); and
- Location (where the odour impact occurs).

Where there are existing odour sources, odour impact may already be occurring to the surrounding sensitive receptors (houses). The frequency, intensity or offensiveness of those odour impacts may or may not be currently considered by the sensitive receptors to be acceptable. The introduction of a new odour source has the potential to:

- Increase the frequency of odour events due to a new source to a level which is unacceptable;
- Combine with other sources to increase the odour intensity; or
- Provide a new odour character to the environment which is found to be more offensive than the existing sources.

Combination of odour from different sources is difficult to model, as odours released from broiler farms, for example, have a different chemical make-up compared to odour emissions from composting or landfill operations. Thus the combination of broiler odour plus composting odour may be greater or less than individual odour sources on their own. In modelling terms however the two are simply numerically summed, which may provide an over or under estimation of actual likely concentration.

ERM has reviewed landuse surrounding the proposed development and identified that there are:

- Seven broiler farms, each with four or five sheds, between 2 km and 3 km west-north-west of the proposed development;
- Two broiler farms, each with four sheds, approximately 2.5 km and 3.5 km respectively north east of the proposed development; and
- Two open air compost windrows approximately 1.2 km and 2 km respectively south-east of the proposed development.

The Odour Assessment has taken the approach of not including existing odour sources within the dispersion modelling. This decision was taken on the basis that no odour was noted from other surrounding industries on the day of site inspection.

Site inspections are often taken during the middle of the day when dispersion is best, i.e. this is the worst time to determine whether other exiting odour sources cause odour impact within an environment. Further, peak odour emissions from broiler farms occur at the end of the cycle rather than near the beginning or after shed clear out. It is unknown at what stage in the cycle the broiler farms were at the time of the site visit. Exclusion of the other potentially significant odour sources on this basis is not considered appropriate in defining the risk of additional odour emissions to the local environment.

It is therefore considered that the Odour Assessment has undertaken an incremental assessment rather than a cumulative assessment as required by Schedule C, Part B, Section 3c of the SEPP(AQM). An incremental assessment can considered to be appropriate in spite of the requirement in the SEPP(AQM), where it can be demonstrated that in spite of the other industries the proposed development does not pose an additional significant increment. No additional significant increment would be defined as a 99.9th percentile 3-minute concentration at the nearest sensitive receptors of less than 5 OU.

The results in the Odour Assessment suggest that this is the case, however as discussed in Section 2.2.2 and Section 2.4 of ERM's report it is very likely that the results are under-estimated and thus a cumulative impact assessment is likely to be required.

It is considered that this can be completed in two ways:

- Incorporate existing sources in the same model as the proposed sources; or
- Model broiler farms separately to the proposed development and the other composting facilities.

The second option is recommended as:

- It is unclear whether composting / landfilling odour will be cumulative with broiler farm odour;
- The cumulative impacting from increased composting in the area can be defined; and
- The frequency of odour events as a result of broiler farm activities and increased composting activities can be defined separately and determined whether the increase in number of odour events from different sources is of concern.

2.3.1 *Summary of Gaps Identified in the Consideration of Background*

With respect to the inclusion of background, the following gap was identified in the Odour Assessment:

- **9 broiler farms and 2 other compost facilities are located in the surrounding area, and the additional odour sources have been excluded on the basis that no odour was detected during the site visit.**
  - **Odour may not have been detectable during the site visit as a result of:**
    - **Good dispersion on the day of the site visit**
    - **Wrong location to observe odour**
    - **At a different point in the broiler cycle for to when peak odour is generated**

2.4 *EMISSION ESTIMATION*

Emission estimation, along with definition of meteorology, is a critical part of dispersion modelling. If the emissions are incorrect then the predicted odour will be inaccurate by a factor dependant on the actual emissions compared to estimated emissions.

The Odour Assessment considered two odour generating sources:

- 36,000 tonne per year open windrow green waste composting facility; and
- 100,000 tonne per year mixed municipal and solid industrial waste.

Each of the emission sources from these two operations have been considered independently in this review.

2.4.1 *Composting Facility*

In an open windrow green waste composting operation, the following sources of odour would be expected to be present:

- Receival pad for the unloading of waste from trucks;
- Shredder for the shredding of green waste material to a size optimal for composting;
- Stockpile of shredded green waste (as output from the shredder);
- Composting windrows comprising:
  - Stage 1 – Pasteurisation (typically 4 weeks duration); and
  - Stage 2 – Maturation (typically 6 to 8 weeks duration).

- Turning of windrows:
  - Stage 1 - each windrow in this stage turned every 3 to 4 days;
  - Stage 2 - each windrow in this stage turned weekly.
- Trommel to grade the finished products into different sizing options;
- Leachate pond; and
- Stockpiling of finished product.

Table 2.1 provides a summary of the likely odour sources above and the odour emission rates included in the Odour Assessment.

Table 2.1 ***Known Odour Sources at Green Waste Composting Facilities and Included Odour Emission Rate (OER) in the Odour Assessment***

Known odour source	OER included in Odour Assessment	Stated Basis of OER included in Odour Assessment	Comment
Receival Pad	4 OU/m2/sec	Based on Gerogery Assessment completed by ERM	Considered to be an appropriate odour emission rate (may be conservative)
Shredder	5741 OU/sec	Based on Gerogery Assessment completed by ERM	Considered to be an appropriate odour emission rate. In actuality, this odour emission rate is derived from measurements of green waste shredding by URS at Coldstream.
Shredded Green Waste Stockpile	-	-	Shredded stockpile not included
Stage 1 Windrows	0.17 OU/m²/sec	Average of Wodonga VIC for weeks 1, 2, 4 and 5 and Timaru NZ weeks 0 to 7	This odour emission estimate appears to be too low based on data from Wodonga. The use of an average odour emission rate is incorrect due to the proportion of stage 1 and stage 2 windrows.
Stage 2 Windrows			
Stage 1 Windrows Turning	-	-	No turning has been considered.
Stage 2 Windrows Turning	-	-	
Trommel	4960 OU/sec	Based on Gerogery Odour Impact assessment by ERM	Considered to be an appropriate odour emission estimate
Leachate Pond	0.33 OU/m²/sec	Based on data from Biomix Reports (ERM and Edge Group).	Considered to be an appropriate estimate

In addition, where the stockpiling of finished material is expected to be extensive, these stockpiles can result in a significant contribution to odour emissions despite the low odour generated per square meter of stockpile. This source should be discounted from the odour assessment, or included as an odour source. Stockpiling of finished product was not discussed or included in the Odour Assessment.

The Odour Assessment states that there will be 229 windrows based on a design capacity of 36,000 tonnes per annum. Typically, a design capacity for a composting facility is output of compost rather than receipt. During the composting process, the volume and density of the material changes as decomposition takes place, thus there is potential that the volume of material on site at any one time, based on a design capacity of compost output, is incorrect and that the actual number of windrows may be greater than estimated.

Unmodelled Sources

As shown in *Table 2.1* emission estimation, and thus inclusion in atmospheric dispersion modelling has not been included for:

- Shredded green waste stockpile; and
- Turning of windrows.

Shredded Green Waste Stockpile

The modelling includes the receipt of green waste that sits on the receival pad. Once the green waste is picked through it is then put through the shredder, which cuts the green waste into smaller pieces that are more conducive to composting. The act of shredding, results in the release of liquids and odorous compounds at a higher rate than when the green waste is unshredded.

Paragraph 3 of Section 4.1.1 of the Odour Assessment states that:

"A stockpile of decontaminated, chipped and blended feedstock (where warranted) will be maintained at all times to allow for immediate windrow formation. The wheel loader will transport any blended product to the windrow pads and windrows will be formed" (Edge Group, 2015).

The permanent positioning of a stockpile of shredded green waste that is available for immediate windrow formation has neither been included in the dispersion modelling, neither is it desirable. A stockpile of shredded green waste that has not been formed into a windrow has the potential to begin composting and thus generate high odour emissions as it is not being monitored for moisture content, temperature or oxygen content. There is therefore the potential for the formation of anoxic conditions within the stockpile that cause higher odour emissions.

It would be preferable to have a condition within the planning permit that states that all green waste delivered to the facility is shredded within a 12 hour period of arrival and shredded material to be placed within a windrow formation by the end of each working day. Even if only half a windrow is formed, it will at least be monitored to ensure that anoxic conditions are not forming in the centre of the windrow.

Odour emission testing undertaken at Australian Native Landscapes by URS, indicated that shredded green waste that is not left in place for too long has an odour emission rate of 4.26 OU/m²/sec. This odour rate should be used as long as the material is placed within a windrow formation by the end of each working day.

Turning of Windrows

The turning of windrows generates substantially elevated levels of odour emissions compared to quiescent emissions. *Table* 2.2 shows the odour emission rates used to assess the Biomix facility in Stanhope, ERM, as presented to the Victorian Civil Administrative Tribunal (VCAT) (Environmental Resources Management Australia Pty Ltd, 2015). The odour emission rates presented in *Table* 2.2 are based on measured emission rates both at Stanhope and Wodonga.

Table 2.2 ***Odour Emission Rates Adopted by ERM in the Assessment of the Biomix Facility, Stanhope. Emission Rates Are Based on Measured Odour Emission Rates from Wodonga and Stanhope Trials (Environmental Resources Management Australia Pty Ltd, 2015)***

Week	Status of Windrow	Units	Wodonga Trial 2 GTW	Wodonga Trial 2 FOGO	Stanhope Poultry mortality
1	Passive	OU/m²/sec	2.71	3.35	1.37
2	Passive	OU/m²/sec	-	3.92	4.67
	Turning	OU/m²/sec	1.14	2.36	-
	Turning	OU/sec	-	-	50,000
	Following Turning	OU/m²/sec	0.35	0.73	43.33
3	Passive	OU/m²/sec	0.20	0.42	0.5
4	Passive	OU/m²/sec	0.13	0.41	0.47
	Turning	OU/m²/sec	0.71	0.35	-
	Turning	OU/sec	-	-	50,000
	Following Turning	OU/m²/sec	0.22	1.66	2.33
5	Passive	OU/m²/sec	2.28	1.66	2.33
	Turning	OU/ sec	-	-	45,000
	Following Turning	OU/m²/sec	3.99	2.91	216.7
6	Passive	OU/m²/sec	1.99	0.70	2.24
	Turning	OU/m²/sec	1.84	3.98	-
	Turning	OU/sec	-	-	39,662
	Following Turning	OU/m²/sec	0.58	0.58	207.84
7	Passive	OU/m²/sec	1.7	2.07	2.14
	Turning	OU/m²/sec	9.63	11.72	-
	Turning	OU/sec	-	-	33,987
	Following Turning	OU/m²/sec	2.98	3.63	199
8	Passive	OU/m²/sec	1.41	1.72	2.05

Week	Status of Windrow	Units	Wodonga Trial 2 GTW	Wodonga Trial 2 FOGO	Stanhope Poultry mortality
	Turning	OU/m²/sec	7.99	9.72	-
	Turning	OU/sec	-	-	27,975
	Following Turning	OU/m²/sec	2.47	3.01	190.16
9	Passive	OU/m²/sec	1.12	1.36	1.95
	Turning	OU/m²/sec	6.34	7.72	-
	Turning	OU/sec	-	-	21,625
	Following Turning	OU/m²/sec	1.96	2.39	181.32
10	Passive	OU/m²/sec	0.83	1.01	1.86
	Turning	OU/m²/sec	4.70	5.72	-
	Turning	OU/sec	-	-	14,937
	Following Turning	OU/m²/sec	1.45	1.77	172.48
11	Passive	OU/m²/sec	0.54	0.66	1.76
	Turning	OU/m²/sec	3.06	3.72	
	Turning	OU/sec	-	-	7,912
	Following Turning	OU/m²/sec	0.95	1.15	163.64
12	Passive	OU/m²/sec	0.25	0.30	1.67
	Turning	OU/m²/sec	1.42	1.72	-
	Turning	OU/ sec	-	-	550
	Following Turning	OU/m²/sec	0.44	0.53	154.76

1. GTW – Grease Trap Waste
2. FOGO – Mixed Kerbside Waste

From *Table* 2.2 it can be seen that odour emission rates tend to increase substantially during turning, with higher odour emission rates following turning for a period of time. This elevated odour emission rate during and following turning has not been captured within the Odour Assessment.

The Odour Assessment states that it is estimated that there will be 229 windrows. Given the composting process (four weeks in stage 1 and eight weeks in stage 2), it is estimated that in every hour of opening there will be turning of up to:

- Two initial stage windrows; and
- Three second stage windrows.

This is a large increase in odour emissions from the facility that has not been accounted for in the dispersion modelling.

Low Odour Emission Rates

The Odour Assessment has used an average odour emission rate for the quiescent compost wind rows of 0.17 OU/m²/sec. This emission rates is based on the average of testing results from Wodonga VIC for weeks 1, 2, 4 and 5 and Timaru NZ weeks 0 to 7.

ERM is aware that testing at both Wodonga and Timaru was undertaken using Gorecover. Gorecover is a membrane that allows the escape of some gases and water through the membrane, but does not allow water to penetrate

from the ambient environment to the composting material underneath. It is thought that the Gorecover creates a zone near the top of the composting material that acts as a biofilter reducing the odorous emissions prior to release to atmosphere. It is therefore incorrect to use samples taken on the top of Gorecover to represent open windrow composting.

Table 2.2, provides odour emission rates used by ERM, and presented to VCAT, in the assessment of the Biomix facility at Stanhope. The odour emission rates are based on measurements undertaken on uncovered windrows. The average emission rates, over the 12 week period, for the composting process for the three types of composting feedstocks from passive (quiescent) emissions are as follows:

- Wodonga Trial 2, Grease Trap Waste - 1.2 OU/m²/sec;
- Wodonga Trial 2, Food and Garden Organics (FOGO) - 1.2 OU/m²/sec; and
- Stanhope Poultry Mortality Trial - 1.7 OU/m²/sec.

For green waste it is considered that the appropriate odour emission rate to adopt would be from FOGO (1.2 OU/m2/sec) as it is a combination of garden organics and some organic food waste from domestic kitchens. This indicates that the odour emission rate used for average windrows over the period is underestimated by a factor of seven.

Average Odour Emission Rates

The use of an average emission rate across the windrows is not appropriate, as the proportion of the windrows in the earlier stage with higher odour emissions is different to the proportion of windrows in the later stage with lower odour emissions. Overall, the use of an average odour emission rate for all windrows would under-estimate the total emissions from site for quiescent windrows by 20%.

2.4.2 *Landfilling Operation*

The Odour Assessment states that landfilling will comprise a mixture of solid inert waste and putrescible waste loads comprising a total receipt of 100,000 tonnes per annum. It is considered that putrescible waste will generate odour, however the assessment does not give a split of the tonnage of putrescible waste anticipated to be received.

Putrescible Waste Emplacement

The Odour Assessment states that the active tipping face will comprise an area of no more than 30 m X 30 m and assigned and odour emission rate of 2.6 OU/m²/sec based on odour emission rates measured at the Nambour Landfill in Queensland.

Table 2.3 provides a summary of measured odour emission rates from a number of landfills in Australia, obtained from a number of referenced studies.

In Australia, the Standard method for determining emissions from a surface is through the use of a flux hood (AS/NZS 4323.4 - 2009). The flux hood is a chamber that is placed on a surface. A neutral sweep gas, typically nitrogen, is introduced to the chamber to sweep emissions from the surface to the sampling chamber. The flux hood is left for approximately 20 minutes to equilibrate before sampling commences. All emission rates for the active face, with the exception for emission rates measured by GHD and ENVALL, were determined using flux hood measurements, or have been adjusted to an equivalent flux hood value. While flux hood sampling of landfill surfaces is a standard technique in Australia and New Zealand (AS/NZS 4323.4 - 2009), it has been argued that odour emissions from the tipping face measured using this method may be underestimated as the:

- Emitting surface is highly uneven, placement and sealing of hoods and chambers can be difficult;
- Emitting surface is highly heterogeneous, meaning that a sample from one location is not necessarily representative of another within the active tipping area; and
- Tipping of waste from trucks, and compaction / moving of waste by compactor is likely to generate additional odour, which cannot be accounted for using the flux hood or chamber placed on the surface.

Table 2.3 ***Odour Emission Rates (OU/m²/sec) from Available Literature for Landfills in Australia***

Description	Active Face	Interim Covered Cells	Capped Cells	Leachate Ponds	Daily Cover over Active face
Melbourne Regional Landfill[1]	3.3	0.16	0	-	
Lucas Heights Landfill[1]	2.05	0.08	-		
Kimbriki[1]	-	0.08	0.0004		
Eastern Creek[1]	1.97	0.04	0.04		
Woodlawn[1]	0.7	-	0.3		
SITA NSW Waste Treatment Facility[1]	0.2	0.1	0.047		
2 year old section of landfill[1]	-	0.005	-		
5 year old section of landfill[1]		0.004	-		
6 year old section of landfill[1]		0.003	-		
11 year old section of landfill[1]		0.002	-		
14 year old section of landfill[1]		0	-		
Golder database – VIC[2]	0.04	0.04	-	0.61	
Golder database – NSW[2]	1.1	0.035	-	0.15	1.0

Description	Active Face	Interim Covered Cells	Capped Cells	Leachate Ponds	Daily Cover over Active face
Nambour Landfill - QLD[2]	2.6	0.51	-		0.69
Summerhill Waste Disposal Centre - NSW[2]	0.35		-		
Putrescible Landfill Site - NSW[2]		0.023	-		
GHD Wyndham Morning Measurements[3]	9.2, 16.7		-		
GHD Wyndham Afternoon Measurements[3]	9.0, 23		-		
GHD Model Average [3]	10.3		-		
GHD Wyndham Active Leachate Pont - Tipping Point[3]				0.038	-
GHD Wyndham Active Leachate Pont - Opposite Tipping Point[3]				0.035	-
Henderson Landfill[4]	35.6				

1. (Pacific Environment Limited, 2016)
2. (Golder, 2012)
3. (GHD, 2013)
4. (ENVALL, 2012)

As an alternative approach, GHD and ENVALL estimated emission rates through the indirect method of measuring the down-wind plume odour levels along transect at short range (GHD, 2013; ENVALL, 2012). The method involved the following scope of works:

- Concurrent sampling at each station on the transect;
- Measurement of the wind speeds and calculation of atmospheric stability categories at the time of sampling; and
- Dispersion modelling with the nominal emission rate to back-calculate the tipping face SOER.

It should be noted that emission rates estimated using the flux hood are an order of magnitude lower than emission rates estimated using the indirect measurement method.

The elevated odour emission rate using the indirect method, in comparison to the flux hood, is the result of:

- No equilibration time after compacting resulting in a higher odour emission rate from the waste face; and
- Determination of odour emissions during waste unloading and compacting which cannot be determined using a flux hood.

The Odour Assessment includes only odour emissions from the waste face itself as measured after waste tipping and compacting using a flux hood on a municipal landfill in Queensland. It is considered that use of such an emission rate under-estimates odour emission rates during tipping activities as it does not incorporate:

- Odour emissions during the act of tipping, which should incorporate the number of tipping events per hour based on expected receipts; and
- Compacting of the waste, which has the potential to elevate emissions as the roller passes over the top compared to quiescent emissions after compaction has occurred.

Putrescible Waste Leachate Ponds

The assessment has assigned an odour emission rate for the leachate pond of 0.33 OU/m²/sec. This odour emission rate is based on the odour emission rate for leachate from composting taken from the ERM Gerogery Assessment (Envrionmental Resources Management Australia Pty Ltd, 2014). This odour emission rate was derived from testing undertaken by URS at the ANL facility in Lilydale for an aerated green waste leachate pond.

Table 2.3 indicates that measured odour emission rates for leachate ponds generated from landfills with putrescible waste range from 0.035 OU/m²/sec to 0.61 OU/m²/sec. There is therefore potential that the odour emission rate is under estimated or over estimated. The actual odour emission rate will be dependent on the operation of the facility, the degree of aeration and the biological oxygen demand level of the leachate. Conservatively, it would be more appropriate to use the higher odour emission rate for landfill leachate of 0.61 OU/m²/sec.

2.4.3 *Summary of Gaps Identified in Emission Estimation*

In terms of odour emission estimation, the following gaps were identified in the Odour Assessment:

- **Number of onsite windrows based on a design capacity of 36,000 tonnes per annum. A compost facility design capacity is typically stated in terms of the output capacity rather than intake as the density and volume of the material changes over the composting period as decomposition occurs. This may mean that the number of windrows has been inaccurately calculated;**
- **No odour emission estimate has been provided for the shredded green waste of which the Odour Assessment states there will be a ready supply for the formation of windrows;**
- **No turning of windrows has been included in the assessment:**

- Turning of windrows generates substantial emissions over very short periods;
- Based on number of windrows it is estimated that there will need to be turning of two stage 1 and three stage 2 windrows per hour of opening; and
- Emissions immediately after turning remain elevated for some time before returning to quiescent emission rates.

- The average odour emission rate for quiescent windrows is based on testing on the top of Gorecover:
  - Gorecover is a technology designed to reduce the odour emissions from composting, by retaining moisture and temperature within the windrow;
  - Gorecover is not proposed to be used for these windrows; and
  - The average odour emission for quiescent odour emissions is under-estimated by approximately a factor of seven.
- The Odour Assessment has used an average odour emission rate over the entire composting cycle:
  - Odour emissions are not uniform over the composting cycle with higher odour emissions tending to occur in the early stages compared to the later stages;
  - The proportion of stage 1 and stage 2 windrows are not equal.
  - Use of an average odour emission rate over all stages under estimates the total emission to the facility by approximately 20 %
- The emission rate for landfilling is only appropriate for emissions from the surface of the landfill cell after compaction as it was measured using an isolation flux hood:
  - This approach does not account for tipping of the waste on to the landfill cell, or the compaction into the cell
  - Downwind measurements that incorporate all of these odour sources indicate that odour emissions from placement of waste to be approximately an order of magnitude higher than flux emissions measured from the waste face only.

2.5 *REPRESENTATION OF EMISSION SOURCES*

It is unclear from the Odour Assessment whether the sources have been modelled as area sources or volume sources. As the odour emission rate units in Table 8 of the Odour Assessment are specified in OU/m2/sec it is suspected that the sources have been modelled as area sources.

Section 6 of EPA Publication 1551 states:

"It is recognised that AERMOD concentrations and predictions for area sources in the current approved version of AERMOD are likely to be overestimated under very light wind conditions (i.e. for wind speeds less than 1 m/sec).

...EPA Victoria recommends that the interim USEPA approach be adopted until further notice with a volume source approximation used for cases when the key receptors are sufficiently distant from the source" (EPA Victoria, 2013).

Consequently, the area sources should have been modelled as volume sources rather than area sources when using AERMOD, in accordance with EPA Guidance.

2.5.1 *Summary of Gaps Identified in the Representation of Emission Sources*

In terms of representation of emission sources, the following gap was identified in the Odour Assessment:

- **The modelling used area sources whilst EPA Publication 1551 states that the volume source approximation should be used as area sources in AERMOD tend to overestimate ground level concentrations in low wind conditions.**

2.6 *PRESENTATION OF RESULTS*

The odour results are presented at the 99.9th percentile, 3-minute average concentration both at the boundary for the facility and at the nearest sensitive receptors. A contour plot is also presented. The presentation of results is appropriate and in accordance with the requirements of the SEPP(AQM).

Experience of modelling of compost facilities and landfills by ERM indicates that the predicted odour impacts are unlikely to be realised. Modelling of a 100,000 tonne per annum facility by ERM at Stanhope indicated an odour concentration at a distance of approximately 1.7 km (the distance from the proposed facility to southwest house 1) of approximately 15 OU. Given that the proposed facility is a third of the size of the facility at Stanhope, and that only stage 2 is open air at Stanhope, it would be expected that the odour impact at the nearest house for the composting alone at the proposed development is likely to be above the odour criterion. Add in the operation of a landfill and it is likely that odour impact will occur at the nearest receptors.

2.7 SEPARATION DISTANCE REQUIREMENTS

The EPA has published separation distance guidelines for both composting facilities and landfills in EPA Publications 1577 and 788.3 respectively (EPA Victoria, 2014) and (EPA Victoria, 2015). These guidelines state that the separation distance needed are:

- 36,000 tonne per annum open receipt, open windrow, open maturation green waste composting facility - > 2km from nearest sensitive receptor;
- Municipal waste landfill (type 2 landfill) - > 500 m from building or structures.

The nearest residential house is approximately 1.5 km from the proposed composting facility, nominated as Southwest House 1 in the Odour assessment. The nearest building is approximately appears to be approximately 1 km from the proposed landfilling operation.

This indicates that the proposed site does not meet the requirements of the composting guideline (EPA Publication 1577), but does meet the requirements of the Landfill BPEM (EPA Publication 788.3).

In order to meet the separation distance guideline for composting in EPA Publication 1577, one of the following options would need to be adopted:

- Relocate composting to be more than 2 km from the nearest residential receptor;
- Use of enclosed / controlled aerobic composting (i.e. either in tunnel or use of Gore Cover with active aeration) or a secondary control odour capture and treatment system would enable the reduction of the separation distance to 800m;
- A specific assessment of upset conditions needs to demonstrate why the separation distance should be reduced from 2 km (this is unlikely to be achievable, based on process upset); or
- Use of local meteorology to show that the 2 km separation distance can be deviated due to local wind patterns and does not impact any sensitive receptors.

2.7.1 *Summary of Gaps Identified in the Application of Separation Distances*

In terms of the separation distance requirements, the following gap was identified in the Odour Assessment:

- **EPA Publication 1577 requires that an open receival, open turned windrow with open air maturation for 36,000 tonne facility has a separation distance of greater than 2 km. The nearest house is approximately 1.5 km from the proposed composting facility, meaning the application does not fulfil the separation distance requirement.**

No assessment has been completed to demonstrate that deviation from the standard separation distance is appropriate as a result of specific local conditions or the use of technology to reduce odour emissions.

3 CONCLUSIONS AND RECOMMENDATIONS

ERM was engaged by Golden Plains Shire Council to complete a review of the document entitled 'Odour Impact Assessment, Geelong Resource Recovery Facility, Stonehaven, Victoria' dated August 2015 and authored by Edge Group (the Odour Assessment).

In reviewing the Odour Assessment of the following deficiencies in the methodology used to define the risk of odour impact to the surrounding land use were identified and that relate to:

- Representativeness of the meteorological file for the proposed development location;
- The exclusion of low wind speeds from the modelling which typically result in the highest predicted odour impact;
- The exclusion of existing odour sources including 9 broiler farms and 2 other compost facilities meaning that the potential risk of odour events has not been adequately characterised;
- The potential under estimation of the number of windrows based on a site design capacity that is based on output rather than receipt and the non-consideration of the change in density and volume of material over the composting period;
- The exclusion of likely significant odour emission sources from composting including shredded green waste, emissions from the turning of windrows and elevated emissions for a period following turning;
- The use of an average odour emission rate for quiescent windrows based on emission testing on the top of Gore cover when this is an open windrow facility indicating a potential seven fold under-estimation of emission rates;
- The use of an average odour emission rate for all windrows is estimated to underestimate total emissions from quiescent windrows by a further 20% compared to considering emissions for stage 1 and stage 2 windrows;
- Emission estimates for the landfill have been completed based on the emissions from the surface from the open landfill cell only. There is no account of odour released during unloading of waste and compaction at the landfill that were not captured by the method used to obtain the odour emission rate used;
- Modelling appears to have used area sources in contradiction to EPA Publication 1551, which requires the use of volume sources;
- The predicted odour concentrations are not in accordance with the predictions made for other composting and landfill operations, and are therefore not in the expected range of predictions; and

- The separation distance to the nearest sensitive receptor is less than the prescribed separation distance for open receipt, open windrow, open maturation for green waste composting specified in EPA Publication 1577.

It is recommended that to make the assessment compliant with the requirements of the SEPP(AQM) and the requirements of the available Guidance (EPA Publication 1550 and 1551), the Odour Assessment should be updated to:

- Use five recent sequential years of meteorological data based on site specific meteorological modelling to include wind speeds of less than 0.5 m/sec, incorporating the use of the U* adjustment factor in AERMET and AERMOD;
- Model the nearby broiler farms' odour emissions separately and include the existing compost facilities in the odour dispersion model for composting. This is undertaken to determine the current odour impact from surrounding odour sources, and to determine whether the number of odour events will increase as a result of the proposed development. Guidance should be sought from EPA as to the appropriate method for the modelling of odour emissions from broiler farms;
- Inclusion of a source for the shredded green waste pile and a requirement that all shredded green waste is placed within a windrow formation by the end of each day;
- Inclusion of turning of windrows between 7am and 4pm, anticipated to be a turning of 2 windrows per hour for stage 1 windrows and 3 windrows per hour for stage 2 windrows;
- Inclusion of post turning emissions between 7am and 4pm for turned windrows;
- Use of more accurate odour emission rates for open windrow green waste composting rather than based on odour emission measurements on compost windrows with Gore cover;
- Use of specific odour emission rates for stage 1 and stage 2 windrows, rather than an average odour emission rate for the entire composting activity;
- Use of odour emission rates for landfilling of putrescible waste that incorporate deposition of waste and compaction as well as odour emission rates from compacted waste in the waste face;
- Use of volume source approximation in AERMOD rather than the use of area sources; and
- Meet separation distance guidelines for open air green waste composting by relocating the site, or demonstrate why a deviation from the separation distance guidelines is appropriate.

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