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GROWTH AREAS AUTHORITY - WOLLERT PRECINCT STRUCTURE PLAN

Hanson Landfill and Quarry - Risk Assessment

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REPORT



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Table of Contents

1.0 INTRODUCTION.....	1
1.1 Wollert PSP	1
2.0 HANSON LANDFILL AND QUARRY	2
2.1 Current and Proposed Activities	3
2.1.1 Landfill.....	3
2.1.2 Quarry	3
3.0 POTENTIAL IMPACTS CONSIDERED	3
4.0 QUALITATIVE RISK ASSESSMENT	4
4.1 Site Conceptual Model.....	5
5.0 ODOUR ASSESSMENT	9
5.1 Source Characterisation	9
5.1.1 Odour Emission Rate Determination.....	12
5.2 The Model.....	15
5.3 Meteorological Data.....	15
5.4 Model Input Data	18
5.5 Model Receptors.....	19
5.6 Assessment Methodology.....	20
5.7 Modelling Assessment Results	22
6.0 LANDFILL GAS ASSESSMENT	25
7.0 DUST ASSESSMENT.....	27
8.0 NOISE ASSESSMENT	27
9.0 POTENTIAL IMPACTS ON PSP AREA	30
10.0 CONCLUSIONS.....	31
11.0 ABBREVIATIONS	33
12.0 REFERENCES.....	34
 TABLES	
Table 1: Environmental Consequence Categories	4
Table 2: Probability of Occurrence Categories	5
Table 3: Environmental Risk Potential Matrix	5
Table 4: Potential Source/Receptor Linkages	6



Table 5: Landfill Emission Rates Summary – Tipping Face	13
Table 6: Landfill Emission Rates Summary – Daily Cover	14
Table 7: Landfill Emission Rates Summary – Interim Cap	14
Table 8: Landfill Emission Rates Summary – Leachate Pond	15
Table 9: Hanson Landfill: Odour Emission Rates	15
Table 10: Meteorology Details	16
Table 11: Input Data for Area Sources	19
Table 12: Receptor Grid	19
Table 13: Risk Matrix Likelihood Descriptors	21
Table 14: Risk Matrix Consequence Descriptors	22
Table 15: Risk Matrix	22
Table 16 Worst Case Noise Levels from Quarrying Activities	28
Table 17 Worst Case SEPP (N-1) Limits	28
Table 18: Recommended Buffer Distances - EPA Victoria	30
Table 19 Separation Distances	31

FIGURES

Figure 1: Hanson Landfill and Quarry - 45 Bridge Inn Road, Wollert VIC 3750	2
Figure 2: Site Schematic - Modelling Scenario 1	11
Figure 3: Site Schematic: Modelling Scenario 2	11
Figure 4: AUSPLUME Meteorology File: Temperature Summary	17
Figure 5: AUSPLUME Meteorology File: Mixing Height Summary	17
Figure 6: AUSPLUME Meteorology File: Stability Class Summary	17
Figure 7: AUSPLUME Meteorology File: Wind Speed/Wind Direction Summary	18
Figure 8: Modelling Domain and Sensitive Receptor Locations	20
Figure 9: Odour Modelling Results - Scenario 1	23
Figure 10: Odour Modelling Assessment Results - Scenario 2	24
Figure 11: Overview of the Hanson Landfill and Quarry Risk Assessment Process and Outcomes	32

APPENDICES

APPENDIX A

Limitations

APPENDIX B

Meteorological Modelling

APPENDIX C

Overview Figure



1.0 INTRODUCTION

Golder Associates (Golder) was commissioned by the Growth Areas Authority (GAA) to conduct an assessment of risk of the environmental impacts associated with the Hanson Landfill and Quarry on the development of the Wollert Precinct Structure Plan (PSP).

The purpose of the assessment is to provide an indication of the environmental issues associated with operation of the landfill and quarry which may affect development of the Wollert PSP.

This report updates the previous report prepared by Golder (Hanson Landfill and Quarry Risk Assessment, Reference 117615033-R-Rev0, 30 July 2012) following advice from EPA Victoria. This report includes the creation and use of a site specific meteorological file for input into the AUSPLUME model using data measured by EPA Victoria in 2003/2004 at Craigieburn located approximately 12 km west of the Hanson Landfill.

Your attention is drawn to the document - "Limitations" (LEG04, RL1), which is included in Appendix A of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions the reader may have regarding these 'Limitations'.

1.1 Wollert PSP

PSPs are master plans for communities which can cater for between 10,000 to 30,000 people. PSPs lay out roads, shopping centres, schools, parks, housing, and employment connections to transport by considering issues of biodiversity, cultural heritage, infrastructure provision and council charges.

The development of greenfield sites, along with urban consolidation, is an important part of the State Government's strategy to address strong population growth and the housing and employment demands that flow from this.

Precinct structure plans are the "blueprint" for development and investment that will occur over many years. They provide an up to date approach to address current global issues such as adapting to climate change, reducing carbon emissions, rising living costs and pressures of increasing travel distances as our cities grow. Precinct structure plans provide a balance between meeting complex policy requirements and providing affordable development.

The Wollert PSP is 1,540 hectares in size and provides growth opportunities for housing, mixed use town centres and employment opportunities. The PSP area incorporates areas of national and local significance including a major gas transmission easement, a rural conservation zone and various areas of high biodiversity values.

The Wollert PSP area is bordered to the north west by the APA Gasnet Compressor station and to the south east by the Hanson Landfill and Quarry.

The GAA is the statutory authority responsible for overseeing the preparation of all PSPs in Melbourne's growth areas and advising the Minister for Planning on their approval.

The GAA is working in partnership with the City of Whittlesea to develop the Wollert PSP.

The purpose of the risk assessment is to assist the GAA and the City of Whittlesea in understanding how the Hanson Landfill and Quarry may affect the development of the PSP for the Wollert area. In particular the risk assessment will consider impacts on the establishment of sensitive land uses and buildings within the Wollert PSP area.



2.0 HANSON LANDFILL AND QUARRY

The Hanson Landfill and Quarry is a major facility located to the east of the Wollert PSP area. The site is approximately 350 hectares in size. The landfill is one of the major landfills in the north and west of Melbourne accepting putrescible waste for disposal.

The Metropolitan Waste and Resource Recovery Strategic Plan (Landfill Schedule) identifies that the likely closure date of the Hanson landfill is beyond 2040.

The location of the Landfill and Quarry is highlighted in the aerial image displayed in Figure 1.



Figure 1: Hanson Landfill and Quarry - 45 Bridge Inn Road, Wollert VIC 3750



2.1 Current and Proposed Activities

2.1.1 Landfill

The operation of the landfill is subject to the requirements of an Environment Protection Authority of Victoria (EPA Victoria) Waste Discharge Licence. The licence identifies the total area of the landfill where waste disposal can occur and the specific areas where waste can be deposited as cells are progressively constructed. Schedule 1A of the licence identifies the Hanson land extending from Bridge Inn Road to Masons Road to the north and, in an easterly direction, for approximately 2.4 km from Epping Road. The south east corner of the site is bordered by Darebin Creek.

The licence identifies that waste is currently able to be deposited in landfill cells 1-7 (Stage 1) located in the central northern section of the licensed area.

The section of the landfill bordering Epping Road is the closest area to the PSP area that waste can be permitted to be disposed of.

Golder is not aware of any proposed extension of the total licensed area for waste disposal beyond that contained in the existing EPA licence.

2.1.2 Quarry

The Quarry is subject to a Work Authority (WA393) issued by the Department of Primary Industries. The WA covers a total area of approximately 370 hectares. The land covered by the Work Authority is in two parts, the first, north of Bridge Inn Road, is similar to that described in the EPA Waste Discharge Licence. The second area is south of Bridge Inn Road and covers an area of approximately 65 hectares.

3.0 POTENTIAL IMPACTS CONSIDERED

The primary focus of the risk assessment is to consider how operation of the Hanson Landfill and Quarry may affect the development of the PSP. The purpose of the qualitative risk assessment is to identify those environmental impacts with the potential to affect development of sensitive land uses within the Wollert PSP.

The Environment Protection Authority Victoria has published guidance documentation on separation distances, (*Recommended Buffer Distances for Industrial Residual Air Emissions, AQ 2/96*) (IRAE). These guidelines focus on the separation of potential sources of adverse amenity impacts and sensitive land uses.

The IRAE describe EPA Victoria's recommendations on how separation distances should be applied between sources and sensitive land uses by taking into account:

- Land Use. People who use land for differing purposes have different expectations on the standard of amenity of that land. Residents generally have a higher expectation that those working in an industrial area. The IRAE guidelines describe three classifications on the type of land use:
 - Land use that warrants amenity protection. Sensitive uses include *"residential areas and zones, hospitals, schools, caravan parks and other similar uses involving the presence of people for extended periods, except in the course of their employment or for recreation"*
 - Land use that does not generate emissions or warrant amenity protection from emission sources. Examples include open space, commercial and business zones, public roads and light industry.
 - Land use around which a separation distance to protect from amenity reducing impacts should be maintained (for example industrial sources, landfills, waste water treatment facilities).



- **Receptor/Emitter Considerations.** The points at which the separation distance between a source and a sensitive receptor apply need to be clearly understood. All potential sources of odour should be considered on the source site and the boundary of the sensitive land use needs to be established. The ideal situation is where a separation distance is provided by the emitter, however this will not always be practicable.
- **Other Planning Considerations.** Whilst the focus of the IRAE guidelines is to prevent emitting sources encroaching on sensitive land uses, encroachment of sensitive land uses on emitting sources should also be avoided.

For the purpose of this risk assessment, sensitive land uses have been considered consistent with the description in the IRAE guidelines, ie those that involve people staying in that location for extended periods of time except for the purposes of recreation or employment.

Sensitive land uses include:

- Residential areas
- Hospitals
- Schools
- Caravan parks.

This assessment does not attempt to consider amenity expectations for people in non-sensitive land uses such as commercial zones.

4.0 QUALITATIVE RISK ASSESSMENT

Golder has identified the potential impacts to the development of the PSP based on our experience with landfill and quarry activities. It should be noted that an evaluation of potential risk varies as source receptor considerations change.

We understand that Hanson is required to develop a Monitoring Plan for the landfill as part of its EPA Victoria licence obligations. EPA Victoria requires the Monitoring Plan to be based on a risk assessment conducted broadly in accordance with the risk management principles and guidelines outlined in AS/NZS ISO 31000:2009 *Risk Management – Principles and Guidelines* and that the Plan be reviewed by an independent Environmental Auditor.

As part of a risk assessment, consequence and probability are considered according to a six category risk ranking system, as detailed in Table 1 and Table 2.

Table 1: Environmental Consequence Categories

Consequence Category	Qualitative Description of Environmental Effects
Severe	Substantial offsite impacts to broader environment, long-term environmental damage, and extensive clean-up required, complete failure of environmental protection controls.
Significant	Offsite impacts to a segment of the environment, medium-term environmental damage, offsite clean-up required, breach of environmental legislation.
Medium	Some offsite, temporary impacts, moderate onsite impacts.
Minor	Minimal onsite impacts immediately contained, no discernible offsite impacts, no external complaints received.
Negligible	No or negligible onsite impacts, no offsite impacts.



Table 2: Probability of Occurrence Categories

Probability Category	Description of Occurrence
Almost Certain	Is expected to occur almost all of the time.
Likely	Is expected to occur most of the time.
Probable	Might occur.
Unlikely	Might occur but not expected.
Rare	Only expected to occur under exceptional circumstances.

The level of risk is based on the joint consideration of consequence and probability of the effect being realised using a qualitative risk analysis matrix comprising four risk categories (i.e. Low (L), Medium (M), High (H) or Severe (V)). The risk analysis matrix is presented in Table 3.

Table 3: Environmental Risk Potential Matrix

Consequence	Likelihood				
	Almost Certain	Likely	Probable	Unlikely	Rare
Severe	V	V	V	V	H
Significant	V	V	V	H	H
Medium	V	H	H	M	M
Minor	H	H	M	L	L
Negligible	H	M	L	L	L

4.1 Site Conceptual Model

As a basis to qualitative risk assessment the following Site Conceptual Model has been prepared. Table 4 below illustrates the interactions between activities and associated hazards (source) associated with operation of a putrescible waste landfill and extractive industry, such as the Hanson site and the assumed PSP environmentally sensitive receptors. The pathway is what could link the site with a receptor.

This assessment considers hazards that, as a result of exposure pathways being present, could present a risk to sensitive uses within the PSP.



Table 4: Potential Source/Receptor Linkages

Source	Pathway	Receptor
Waste (landfill gas)	Geology (lateral migration)	Sensitive land use in PSP area
Waste (landfill gas)	Water (dissolved gas through lateral vertical migration)	None identified
Waste (odour/landfill gas)	Air	Sensitive land use in PSP area
Waste (fire, odour and smoke)	Air	Sensitive land use in PSP area
Waste (wind blown litter)	Air	Sensitive land use in PSP area
Waste (leachate)	Groundwater/surface water	Sensitive land use in PSP area and creek
Waste (vermin and diseases)	Direct contact/overland	Hanson employees
Waste (asbestos dust)	Air	Hanson employees and sensitive land use in PSP area
Waste operations (dust)	Air	Hanson employees and sensitive land use in PSP area
Waste operations (noise)	Air	Hanson employees and sensitive land use in PSP area
Waste operations (wheel wash contaminants)	Direct contact/ingestion/geology	Hanson employees, contractors, groundwater, flora, fauna and local creek
Waste operations (litter picking)	Direct physical damage/air	Flora and fauna
Waste operations (contamination through sampling groundwater and leachate monitoring)	Geology/direct physical damage/air	Groundwater, flora and fauna
Quarrying operations (vibration)	Ground	Hanson employees
Quarrying operations (dust)	Air	Hanson employees and sensitive land use in PSP area
Quarrying operations (noise)	Air	Hanson employees, land use in within PSP area
Quarrying (stormwater/groundwater)	Overland	Darebin Creek, sensitive land use in PSP area, industrial buildings and services within PSP
Quarrying (fly rock)	Air	Hanson employees
Repairs and maintenance to waste and quarry vehicles and plant (noise)	Air	Hanson employees, contractors and sensitive land use in PSP area
Repairs and maintenance to waste and quarry vehicles and plant (emissions and green house gas)	Air	Hanson employees, contractors
Repairs and maintenance to site vehicles and plant (toxic/prescribe materials)	Direct contact/air/vehicle migration	Hanson employees, contractors local creek and sensitive land use in PSP area
Pest and weed management (toxic chemicals)	Air/direct contact/overland flow/ingestion	Hanson employees, flora, fauna and groundwater
Pest and weed management (removal of weeds)	Physical damage/erosion	Flora and fauna



To identify the most relevant aspects for this assessment we have identified those issues where the pathway results in potential exposure to sensitive uses in the PSP area and then ranked each aspect, based on our experience, as having high, medium or low risk of impact on the PSP area.

The following sources of potential impacts have been identified as having the potential to impact on the development of sensitive land uses in the PSP area:

■ Waste – Landfill Gas

Landfill practices at Wollert Landfill are required to be in accordance with the EPA Victoria Publication 788.1 *Best Practice Environmental Management Siting, Design, Operation and Rehabilitation of Landfills*, dated September 2010 (BPEM) which establish how environmental impacts are managed.

Waste received at Wollert landfill includes putrescible, asbestos and solid inert wastes and therefore contains biodegradable material resulting in landfill gas. The current landfill gas management system includes permanent capping, temporary capping and landfill gas extraction.

The production of landfill gas is likely to continue for decades after each cell is filled. The risk of landfill gas migrating offsite and the associated risks of fire and explosion are further discussed in Section 6.0.

■ Waste – Fire

Wollert Landfill manages the waste intake and undertakes waste inspections in order to manage the risk of fire resulting from the import of waste. The likelihood of a landfill fire is considered to be unlikely. The occurrence of fire escaping the bounds of the site is considered to be rare. The main impacts associated with a fire are emissions of smoke and odour and are considered to present a low risk.

■ Waste – Odour

Wollert Landfill has adopted practices to manage odour. These include regular daily cover of waste and reducing the extent of active landfill by progressively capping cells as they become full. Whilst the management measures are in place to control the emission of odour, odour can have a significant impact on amenity in sensitive land uses, as experienced at other landfills. Taking into account this potential impact, odour is considered to be a medium to high risk to sensitive land uses in the PSP area and is discussed further in Section 5.0.

■ Waste – Wind Blown Litter

Wollert Landfill manages wind blown litter with a series of litter fences and the use of litter pickers who regularly collect rubbish around the site perimeter. The occurrence of litter escaping the bounds of the site is dependent on the prevailing meteorological conditions. Based on the current management system, the risk of wind blown litter escaping the property to the extent that it could have an impact on sensitive land uses in the PSP area is considered low.

■ Waste – Leachate

Wollert Landfill has been constructed with leachate control measures which include composite lining systems in Cells 2 to 7 and compacted clay liner in Cell 1. The leachate levels in the cells are also managed with an active leachate extraction system.

Although the production of leachate is likely to continue whilst areas of the landfill remain uncapped, it is considered that, under the current management system leachate migration offsite is unlikely. It is therefore considered that leachate migration poses a low risk to sensitive land uses established in the PSP area.



■ Waste – Asbestos Dust

Wollert Landfill accepts only double wrapped asbestos waste in heavy-grade builder's plastic (0.2 mm thickness) or in sealed containers no bigger than 200 litres. Household asbestos must be brought to a special bin at the Transfer Station and be contained within packages. Commercial asbestos loads must be taken to a specially-assigned area of the landfill tipping face to offload. It must also be delivered in a specialised bin, not a tip truck, so it can be slid on an angle into the landfill, rather than dropped onto the ground.

Based on the above practice it is considered that the risk of asbestos dust leaving site is low.

■ Waste and Quarry Operations– Noise and Dust

The dust and noise resulting from waste and quarry operations should be considered a potential risk, however the extent of the risk is unknown based on the variance of the receptor considerations. Dust and noise from quarrying operations has the potential to significantly affect amenity in sensitive land uses. The risk of noise and dust has been considered as a high risk for this site and is discussed further in Section 6.0.

■ Waste and Quarry – Migration of Contaminants

The resulting contaminants from waste and quarry operations such as leachate, toxic chemicals and prescribed materials are considered to pose a low risk to sensitive land uses in the PSP area.

■ Quarry – Stormwater/Groundwater

Hanson quarry are required to manage the stormwater and groundwater through a number of large storage ponds. Prior to discharge from site these ponds are required to be assessed for contaminants and treated as necessary, in accordance with EPA Victoria guidelines.

The risk of contaminants being discharged from site is considered to be low and therefore pose a low risk to sensitive land uses in the PSP area.

The potential pathways which may impact on development of sensitive land uses in the PSP area are:

■ Geology

The basalt found on this quarry is likely to exhibit variations in term of permeability to gas and water. Quarry practices are likely to result in additional fracturing. These fractures are considered pathways for lateral migration of gas and liquid from the landfill.

■ Groundwater

Should gas or liquid contaminants escape the landfill confines then there is the potential for it to come in contact with groundwater beneath the site. The water is considered to be a potential receptor however it may also transfer the contamination and hence act as a pathway.

■ Air

Air acts as a pathway for potential odour, noise, smoke and dust emissions from a landfill site. Meteorological conditions at the time of the emission will dictate the direction of migration for offsite impacts.

As the land uses within the PSP area are yet to be determined, the identification of relevant sources that could have an impact on the PSP area for this assessment require an assumption of the potential extent of the sensitive land use development. Where a source exists, but a pathway or a receptor does not exist, the likelihood of an adverse outcome is negligible.



For the purpose of identifying those sources that will be further considered in this assessment it has been assumed that sensitive land uses could extend throughout the PSP area up to the eastern boundary of the Hanson site. This assumption is only for the purpose of identifying potential impacts.

Based on our above qualitative assessment and assumptions the following sources of potential impact are considered medium or high risk:

- Odour
- Landfill gas
- Dust
- Noise.

These high or medium ranked risks have been assessed further as to their potential impact on the development of the PSP.

5.0 ODOUR ASSESSMENT

Odour issues are primarily related to operation of the landfill. Experience would suggest that odour risks can have extensive off site impacts. Whilst the existing landfill operation is likely to have a low residual risk rating this is due to a combination of landfill management techniques and the current distance to houses that limit the potential for migration of odorous emissions.

To better consider potential impacts of landfill odours on the development of the PSP, Golder has undertaken an odour assessment using a model which predicts odour ground level concentrations beyond the site boundary. The results are presented as qualitative risk level contours, with reference to the relevant air quality guidelines.

The details and results of this process are contained in the following section.

5.1 Source Characterisation

Odour from landfills is due to gas generation during the aerobic and anaerobic phases of waste decomposition. Aerobic decomposition occurs first, with freshly deposited waste breaking down in the presence of oxygen, whilst anaerobic landfill gas generation occurs as buried waste degrades over time. The constituents of landfill gas are dependent on time since waste burial and the limiting factors of water content, nutrient level and bacterial colonisation. The main landfill gas constituents are odourless (methane and carbon dioxide), however trace levels of other gases such as organosulphur compounds and hydrogen sulphide have the potential to cause odour amenity issues.

Therefore potential sources of odour from the Hanson Landfill are covered and uncovered waste and associated activities including the following:

- Waste truck delivery
- Tipping face
- Waste covered with daily cover
- Waste covered with an interim cap
- Waste contained by a final cap
- Leachate.



Implementation of best practice environmental management elements requires control and management of landfill gas and leachate and consequently odour. Aerobic degradation is reduced through limiting waste exposure to the air through transport of waste in covered loads, quick burial and, initially, covering with daily cover; then covering with an interim cap and final cap when the cell is closed. Landfill gas generated by anaerobic degradation is controlled by active gas extraction followed by combustion of the gas through an onsite power plant.

For the purpose of the assessment the major sources of odour emissions considered were the tipping face, waste covered by daily cover and the interim cap and the leachate pond. The other potential odour sources identified were considered to have a low risk of causing offsite odour impacts when managed in accordance with the best practice environmental management elements described.

The currently configuration of the Hanson landfill includes eight cells, aligned east-west along the northern boundary. Cells 1 – 3 are complete and final capping has been installed. The addition of waste to Cells 4 and 5/6 is also complete, with the waste covered by a mixture of interim cap measures ranging from; daily cover material to longer term interim caps with geomembranes liners and quarry processing by-products.

Cell 7 is the active cell, with half being used for waste placement and the second half under construction. The tipping face is maintained at an approximate angle of 30°, at a height of 2 m extending in an east west orientation. At the conclusion of each day, the tipping face is covered with daily cover material. The active cell also contains buried waste sealed by daily cover.

Cell 8 is the final existing cell and is currently under construction.

Typical operations at the Hanson Landfill therefore include the following odour sources:

- Tipping face (day)/daily cover (night)
- Active cell – daily cover
- Interim cap – 2 cells
- Leachate pond.

Two theoretical landfill configurations have been assessed, with odour sources in both scenarios located to represent worst case configurations for offsite impacts, with the distance between odour sources and future sensitive receptors in the Wollert PSP minimised. In both scenarios the tipping face has been located at the southern end of the active cell with the remainder of the cell sealed with an interim cap of daily cover. This active cell configuration also represents worst case emissions as the entire cell is included as an odour source. Whilst Golder Associates understands that cell development will occur predominantly in the east of the landfill site, the configurations used in the odour assessment are those with the greatest potential to impact on development within the PSP area. As development in the locations in Figure 2 and Figure 3 has not been confirmed it should be noted that these scenarios are a “worst case” situation. As the future operating life of the landfill may be in the order of 50 years Golder Associates believes it is prudent to consider these scenarios.

Schematic diagrams representing the two scenarios are presented in Figures 2 and 3.

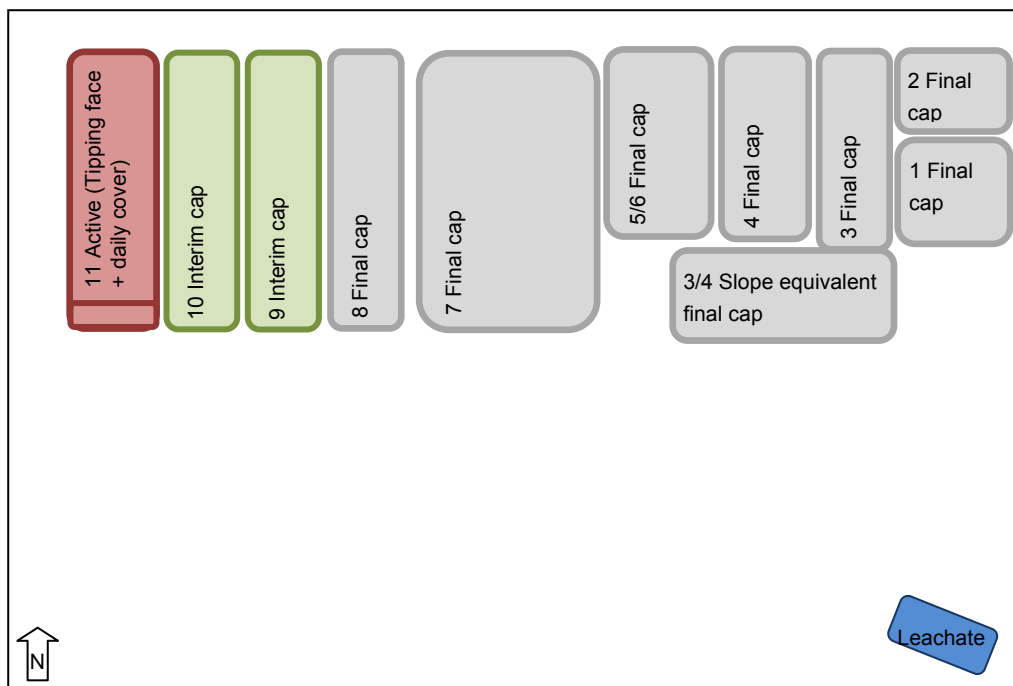


Figure 2: Site Schematic - Modelling Scenario 1

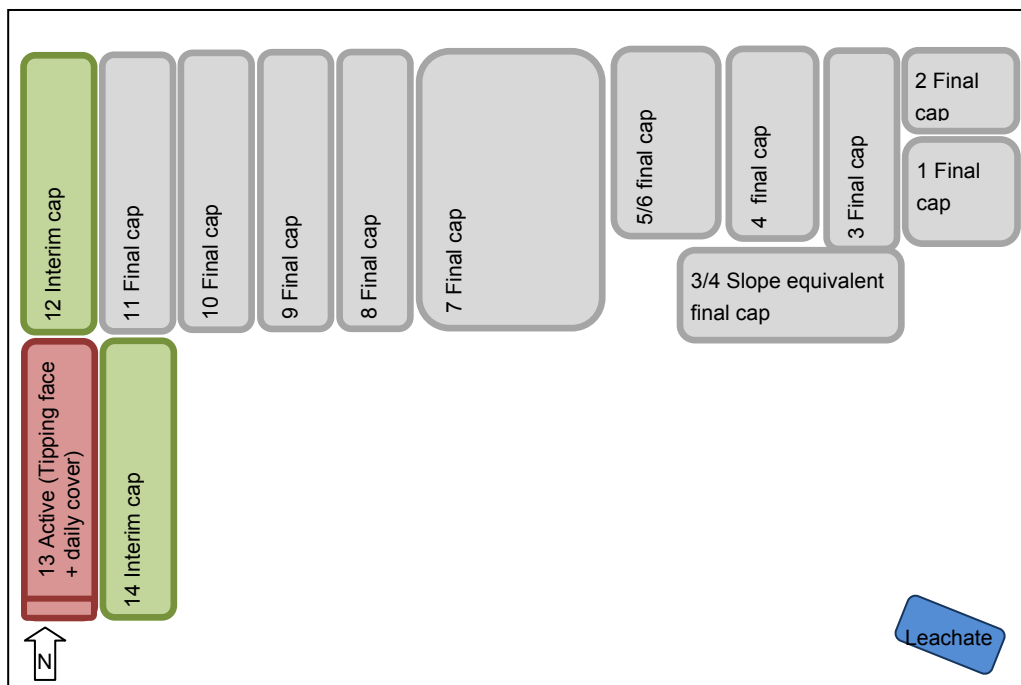


Figure 3: Site Schematic: Modelling Scenario 2



5.1.1 Odour Emission Rate Determination

Odour emission monitoring at the Hanson Landfill is beyond the scope of this assessment. Instead odour emission rates have been determined through the conduct of a literature review.

It is widely acknowledged that determination of odour emission rates from landfill sources is complicated due to variability in waste homogeneity, gas generation rates and mixed application of control mechanisms such as capping and gas extraction systems. Moreover, the applied measurement method is dependent on the jurisdiction, technology available and experience and focus of the environmental consultant.

Within Australia, current industry best practice for measurement of odour emissions from landfill surfaces is the United States Environmental Protection Agency (USEPA) emission isolation flux chamber, operated in accordance with AS/NZS 4323.4 *Stationary Source Emissions - Area Source Sampling - Flux Chamber Technique*, coupled with analysis by AS/NZS 4323.3 *Stationary Source Emissions – Determination of Odour Concentration by Dynamic Olfactometry*. Studies conducted prior to the release of AS/NZS 4323.4 in 2009 have included other measurement techniques such as the wind tunnel or static flux box. Similarly, studies conducted prior to 2001 have applied alternative odour analysis methods, such as EPA Victoria Method B2 *Odour (Dynamic Olfactometry)*.

As an alternative to direct surface measurement a number of studies estimate surface emission rates using field survey results, meteorological data and a back calculation mathematical modelling method. This technique is dependent on a number of factors; the accuracy of the meteorological data available at the time of the field survey, the odour concentration assumed for detection in the field, the odour percentile predicted and the computer model utilised. For these reasons, the results from back calculation assessments vary substantially between studies.

The variability of field survey/back calculation determined odour emission rates is demonstrated by the study conducted by Nicolas et al¹ where measured odour flux emission rates from two landfills in Wallonia, Belgium were compared with back calculated derived emission rates. The results obtained from a small number of samples indicated odour flux emission rates of 0.5, 0.4 and 0.2 ou.m³/m²/s, with the paper noting that the landfill odour emission rates based on these values were inconsistent with those back calculated from odour field surveys utilising mathematical modeling techniques. Odour flux emission rates determined by the back calculation technique were considered to be a factor of 10 times more.

Due to the inherent variability and uncertainty in field survey and back calculation techniques, published emission factors derived using these methods have been discounted from consideration for the Hanson Landfill Assessment. Instead the factors will be sourced from surface measurement field studies. It is acknowledged that surface measurement also has disadvantages. For example, the flux chamber is unable to sample as waste is deposited or subsequently disturbed through the action of bulldozers or other machinery and a large number of samples are required to adequately characterise the source.

A summary of published odour emission rates and Golder database emission rates for landfill odour sources is presented in Tables 5 to 8. A rating has been allocated to each result indicating its applicability to the Hanson Landfill odour modelling assessment. The rating was based on similarities between the measured source and those present at the Hanson Landfill and the reliability of the measurement/estimation technique.

¹ Nicholas, J., Romain, A. C., Delva, J., Collart, C., & Lebrun, V. (2008). *Odour Annoyance Assessment Around Landfill Sites: Methods and Results*. NOSE 2008 International Conference on Environmental Odour Monitoring and Control. Rome.



GAA: HANSON LANDFILL AND QUARRY RISK ASSESSMENT

Table 5: Landfill Emission Rates Summary – Tipping Face

Study	Golder database	Golder database	Nambour Landfill	Summerhill Waste Disposal Centre	Putrescibles Waste Transfer Station	Putrescibles Waste Transfer Station	Putrescibles Waste Transfer Station	Seven Italian Landfills
Odour Emission Rate (ou.m ³ /m ² /s)	0.040	1.1	2.6	0.35	3.7	6.4	1.4	59
Location	Victoria	NSW	Queensland	NSW	NSW	NSW	NSW	Italy
Surface Description	MSW– tipping face	MSW – tipping face	MSW – tipping face	MSW – tipping face	Vegetable waste	General waste	Cooked chicken waste	MSW – freshly tipped waste
Measurement Method	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3) Winter sampling with replicate samples collected	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3)	Flux chamber coupled with dynamic dilution olfactometry (AS/NZS 4323.3) ² Replicate samples collected	Static flux chamber Analysis technique not described	Not stated	Not stated	Not stated	Wind tunnel, with samples analysed in accordance with European Standard EN 13725 ³ . EN 13725 is an equivalent procedure to that described in AS/NZS 4323.3. Geometric mean of reported results
Reference	In house	In house	Katestone Environmental. (2007). <i>Air Quality Assessment of the Proposed Ferntree Landfill</i> . Brisbane: Katestone Environmental.	Sampling conducted by HLA Envirosciences 1998. Published in: HLA Envirosciences Pty Limited. (2006). <i>Air Quality Impact Assessment - Central Waste Facility Environmental Assessment Wanatta Lane, Wolumla NSW</i> .	Sampling conducted by Holmes Air Science 1998. Published in: HLA Envirosciences Pty Limited. (2006). <i>Air Quality Impact Assessment - Central Waste Facility Environmental Assessment Wanatta Lane, Wolumla NSW</i> .	Sampling conducted by Holmes Air Science 1998. Published in: HLA Envirosciences Pty Limited. (2006). <i>Air Quality Impact Assessment - Central Waste Facility Environmental Assessment Wanatta Lane, Wolumla NSW</i> .	Sampling conducted by Holmes Air Science 1998. Published in: HLA Envirosciences Pty Limited. (2006). <i>Air Quality Impact Assessment - Central Waste Facility Environmental Assessment Wanatta Lane, Wolumla NSW</i> .	Sironi, S., Capelli, L., Centola, P., Del Rosso, R., & M., I. G. (2005). <i>Odour Emission Factors for Assessment and Prediction of Italian MSW Landfills Odour Impact</i> . Atmospheric Environment 39 (29), 5387 - 5394.
Rating	Applicable	Applicable	Applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable

² Sampling was conducted utilising an emission isolation flux chamber and should therefore be generally in accordance with AS/NZS 4323.4, although this cannot be stated with certainty given that sampling was conducted prior to release of the standard in 2009

³ *Air Quality - Determination Of Odour Concentration By Dynamic Olfactometry*, Comité Européen de Normalisation, EN 13725, 2003



GAA: HANSON LANDFILL AND QUARRY RISK ASSESSMENT

Table 6: Landfill Emission Rates Summary – Daily Cover

Study	Golder Database	Nambour Landfill
Odour Emission Rate (ou.m ³ /m ² /s)	1.0	0.69
Location	NSW	Queensland
Surface Description	MSW daily cover (150 mm) – no gas extraction system	MSW day cover – no gas extraction system
Measurement Method	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3)	Flux chamber coupled with dynamic dilution olfactometry (AS/NZS 4323.3) ⁴ Replicate samples
Reference	In house	Katestone Environmental. (2007). <i>Air Quality Assessment of the Proposed Ferntree Landfill</i> . Brisbane: Katestone Environmental.
Rating	Applicable	Applicable

Table 7: Landfill Emission Rates Summary – Interim Cap

Study	Golder database	Golder database	Nambour Landfill	Putrescible Landfill Site	Seven Italian Landfills
Odour Emission Rate (ou.m ³ /m ² /s)	<0.04	0.035	0.51	0.023	4
Location	Victoria	NSW	Queensland	NSW	Italy
Surface Description	MSW – interim clay cap – gas extraction	MSW – 300 mm cover – no gas extraction	MSW semi permanent cover – no gas extraction system	Intermediate cover – no gas extraction system	MSW– active cell
Measurement Method	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3) Winter sampling	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3)	Flux chamber coupled with dynamic dilution olfactometry (AS/NZS 4323.3) ⁵ Replicate samples	Measurement method not stated, Analysis by EPA Victoria B2 method. Results corrected.	Wind tunnel, with samples analysed in accordance with European Standard EN 13725 ⁶ . EN 13725 is an equivalent procedure to that described in AS/NZS 4323.3.
Reference	In house	In house	<i>Air Quality Assessment of the Proposed Ferntree Landfill</i> , Katestone Environmental, September 2007	Sampling commissioned by CEE, 1994. Published in: HLA Envirosciences Pty Limited. (2006). <i>Air Quality Impact Assessment - Central Waste Facility Environmental Assessment Wanatta Lane, Wolumla NSW.</i>	Sironi, S., Capelli, L., Centola, P., Del Rosso, R., & M., I. G. (2005). <i>Odour Emission Factors for Assessment and Prediction of Italian MSW Landfills Odour Impact</i> . Atmospheric Environment 39 (29), 5387 - 5394.
Rating	Applicable	Not applicable	Not applicable	Not applicable	Not applicable

⁴ Sampling was conducted utilising an emission isolation flux chamber and should therefore be generally in accordance with AS/NZS 4323.4, although this cannot be stated with certainty given that sampling was conducted prior to release of the standard in 2009

⁵ Sampling was conducted utilising an emission isolation flux chamber and should therefore be generally in accordance with AS/NZS 4323.4, although this cannot be stated with certainty given that sampling was conducted prior to release of the standard in 2009

⁶ *Air Quality - Determination Of Odour Concentration By Dynamic Olfactometry*, Comité Européen de Normalisation, EN 13725, 2003



Table 8: Landfill Emission Rates Summary – Leachate Pond

Study	Golder Database	Golder Database	Golder Database
Odour Emission Rate (ou.m ³ /m ² /s)	0.61	<0.04	0.15
Location	Victoria	Victoria	NSW
Measurement Method	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3) Two samples collected from different sections of the pond. The emission rate is the geometric mean of the two samples.	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3)	Flux chamber (AS4323.4) coupled with dynamic dilution olfactometry (AS/NZS 4323.3)
Reference	In house	In house	In house
Rating	Applicable	Applicable	Applicable

Tables 5 to 8 demonstrate the range of published emission factors for odour from landfill sources. For the purpose of conducting a worst case assessment the modelling scenarios have incorporated the highest emission rate for each source, where the rating was designated as “applicable”.

A summary of emission rates utilised in this assessment are presented in Table 9.

Table 9: Hanson Landfill: Odour Emission Rates

Source	Odour Emission Rate ou.m ³ /m ² /s
Tipping face	2.6
Daily cover	1.0
Interim cap	0.04
Leachate pond	0.61

5.2 The Model

AUSPLUME Version 6.0 was the model used in this assessment.

Assumptions made in the application of the model included the following:

- Roughness height of 0.4 metres was assumed
- Plume buoyancy effects were considered
- Pasquill-Gifford formulae were adjusted for roughness height.

Terrain effects were not included for the screening level assessment. This is a limitation of the approach as the modelling domain has terrain contours ranging from 180 m to 211 m (AHD), whilst the landfill form is dynamic as cells are excavated and filled.

5.3 Meteorological Data

A site specific meteorological file for input into the AUSPLUME model was prepared using data measured by EPA Victoria in 2003/2004 at the Craigieburn station located approximately 12 km west of the Hanson Landfill. The data does not cover a whole year and has gaps within the measurement period. The meteorological processor within The Air Pollution Model (TAPM) was used generate synthetic data to supplement the measured dataset for inclusion into AUSPLUME.



The AUSPLUME model requires the following hourly meteorological data for a one year period:

- Wind speed and direction
- Temperature
- Atmospheric stability (Pasquill class)
- Mixing height.

The origin of each parameter included in the AUSPLUME meteorological file is described in Table 10. The file was created for the period 25 June 2003 – 24 June 2004 to encompass all the measured data.

Table 10: Meteorology Details

Parameter	Time	Source
Wind speed	25 June 2003 – 13 October 2003	TAPM
	13 October 2003 – 24 June 2004	EPA Victoria Craigieburn, data gaps filled using TAPM data
Wind direction	25 June 2003 – 13 October 2003	TAPM
	13 October 2003 – 24 June 2004	EPA Victoria Craigieburn, data gaps filled using TAPM data
Temperature	25 June 2003 – 1 October 2003	TAPM
	1 October 2003 – 24 June 2004	EPA Victoria Craigieburn, data gaps filled using TAPM data
Atmospheric stability	25 June 2003 – 24 June 2004	Calculated using TAPM output in accordance with EPA Victoria Publication 1459, "Construction of Input Meteorological Data Files for AUSLUME".
Mixing height	25 June 2003 – 24 June 2004	Mechanical mixing heights were calculated using TAPM output in accordance with EPA Victoria Publication 1459, "Construction of Input Meteorological Data Files for AUSLUME". The minimum mixing height depth was set at 80 m. Convective mixing heights were not included in the file as requested by EPA Victoria.

The details of the TAPM model configuration and EPA Victoria Craigieburn station are included in Appendix B.

A summary of the temperature, mixing height and stability class parameters contained within the site specific AUSPLUME file are presented in Figures 4 - 6. The wind speed and direction components are illustrated in the wind rose presented in Figure 7. The windrose indicates that the dominant wind directions are from the north and south, with odour emissions generally directed away from the Wollert PSP area.

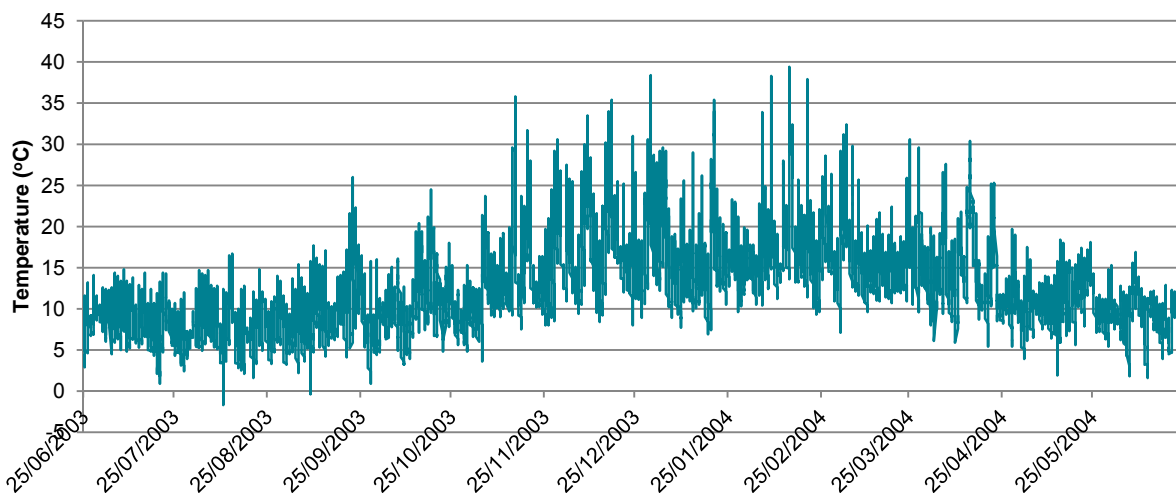


Figure 4: AUSPLUME Meteorology File: Temperature Summary

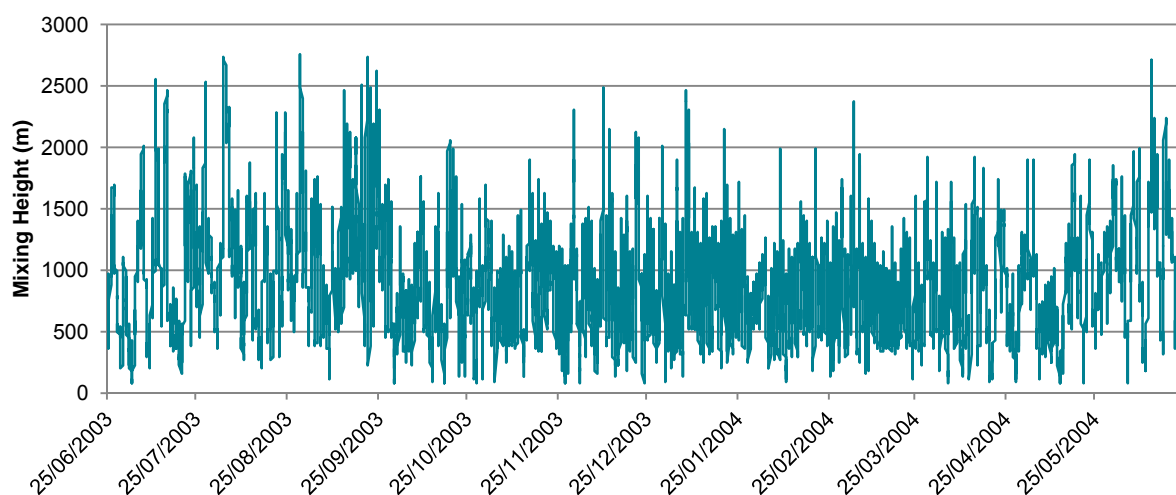


Figure 5: AUSPLUME Meteorology File: Mixing Height Summary

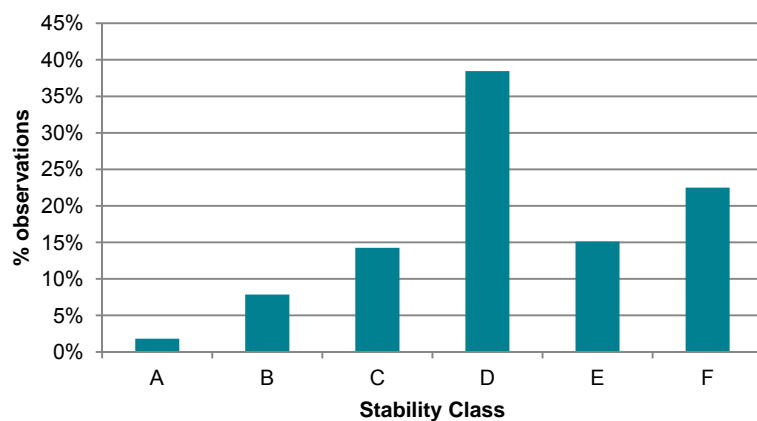


Figure 6: AUSPLUME Meteorology File: Stability Class Summary

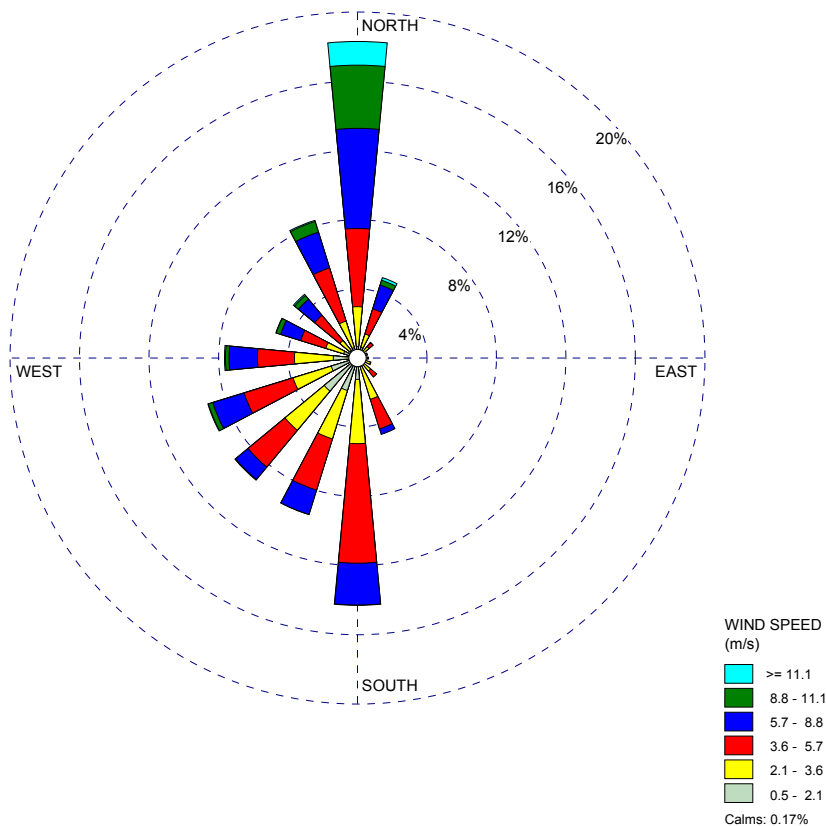


Figure 7: AUSPLUME Meteorology File: Wind Speed/Wind Direction Summary

5.4 Model Input Data

Odour sources at the Hanson landfill were modelled as area sources.

An area source is a source that emits pollutants at or near ground level over a large area, without mechanical plume rise.

Discharge parameters for the five identified odour sources are summarised in Table 11.



Table 11: Input Data for Area Sources

Source ID	Description	Initial Vertical Spread (metres)	Odour Emission Rate (ou.m ³ /m ² /s)	Emission Frequency
AC	Active cell – covered with daily cover	0	1.0	Constant
TF	Tipping face	2	2.6	07:00 – 17:00
DC	Daily cover	2	1.0	17:00 – 07:00
IC1	Completed cell – covered with an interim cap	0	0.04	Constant
IC2	Completed cell covered with an interim cap	0	0.04	Constant
Leachate Pond	Leachate Pond	0	0.61	Constant

The tipping face and daily cover have been considered as one source, with different emission rates during operating and non-operating hours.

Emissions to air from the cells with interim caps and the leachate pond have been input as non buoyant area sources, with a release height at ground level and a zero initial vertical spread. The tipping face/daily cover area source was input with an initial vertical spread of 2 m to represent emissions released from the face, angled at 30°.

5.5 Model Receptors

A 6 km square receptor grid, with 100 m spacing, was utilised in this assessment. The grid encompasses the Hanson Landfill in the north-east corner and the Wollert PSP urban area in the western portion.

A number of discrete receptors representing sensitive uses were also included in the modelling domain. The discrete receptors were located in housing blocks on Bodycoats Road and Boundary Road, representing the closest existing sensitive uses to the western boundary of the landfill.

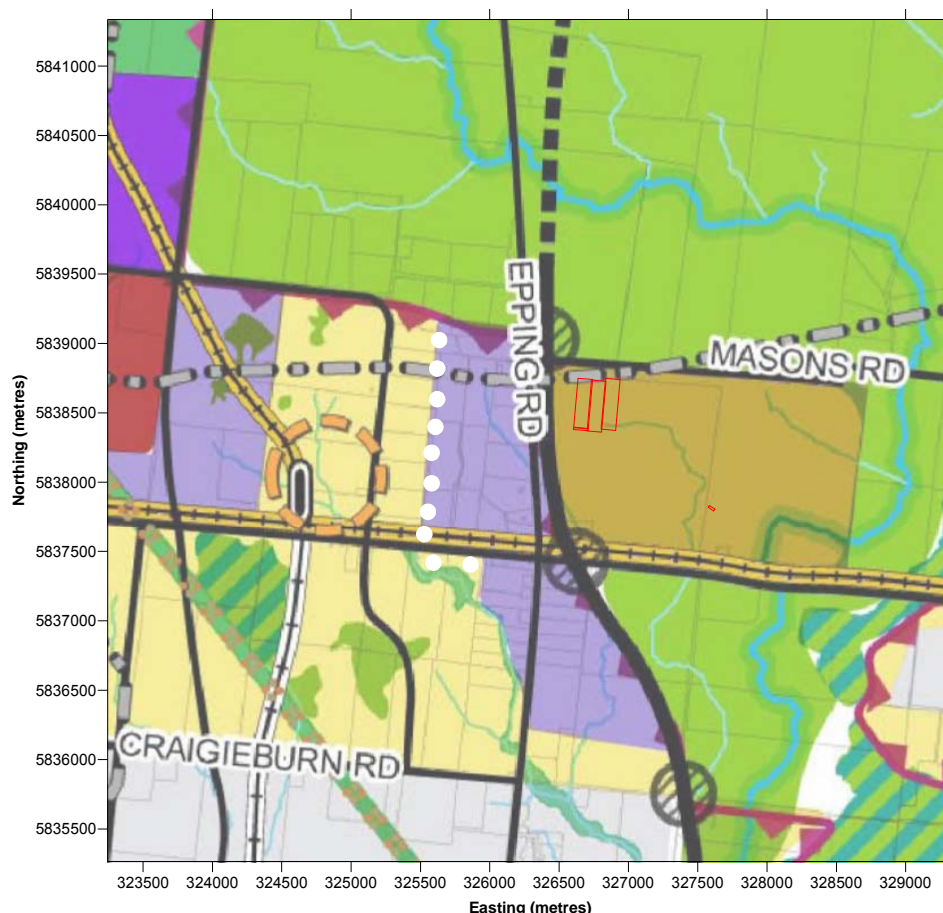
Details of the receptor grid are presented in Table 12.

Table 12: Receptor Grid

Component	Details	Units
Gridded receptors south west corner	323,857; 5,835,574	AMG (coordinate) (x,y) (m)
Gridded receptor spacing	50	m
Gridded receptor extents	4,000	m
Sensitive receptor – Bodycoats Road	325,635; 5,839, 025	AMG (coordinate) (x,y) (m)
Sensitive receptor – Bodycoats Road	325,621; 5,838,819	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	325,621; 5,838,598	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	625,608; 5,838,398	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	325,581; 5,838,212	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	325,581; 5,837,992	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	325,554; 5,837,786	AMG (coordinate) (x, y) (m)
Sensitive receptor – Bodycoats Road	325,528; 5,837,625	AMG (coordinate) (x, y) (m)
Sensitive receptor – Boundary Road	325,594; 5,837,419	AMG (coordinate) (x, y) (m)
Sensitive receptor – Boundary Road	325,862; 5,837,406	AMG (coordinate) (x, y) (m)



Figure 8 illustrates the extent of the modelling domain and the sensitive receptor locations.



Key:

- Sensitive receptor locations
- Odour sources – Scenario 1

Figure 8: Modelling Domain and Sensitive Receptor Locations

5.6 Assessment Methodology

Environmental objectives in Victoria are established by the *Environment Protection Act, 1970*. The Act makes provision for the declaration of State Environment Protection Policies which must be “observed with respect to the environment generally or in any portion or portions of Victoria or with respect to any element or elements or segment or segments of the environment.”⁷ The *State Environment Protection Policy (Air Quality Management)* (SEPP(AQM)) is relevant to the Hanson Landfill odour assessment. The intent of the Policy is to manage air emissions such that the beneficial uses of the air environment are protected, where beneficial uses include “local amenity and aesthetic enjoyment”.⁸ Protection of this beneficial use is principally related to management of odour and nuisance dust.

The objectives for the management of odour rests on the presumption that local amenity and aesthetic enjoyment are impacted by odour “offensive to the senses of human beings”.⁹ Perception of odour offensiveness is a subjective measure dependent on an individual’s olfactometry response to atmospheric contaminants, based on the concentration, duration and frequency of exposure.

⁷ Environment Protection Act. (1970). Version No. 171

⁸ State Environment Protection Policy (Air Quality Management), 2001. (2001, December). *Victoria Government Gazette*. Victorian Government Printer.

⁹ Section 41 (1a) Environment Protection Act. (1970). Version No. 171



Odour concentration can be quantified using the dynamic olfactometry procedure described by AS/NZS 4323.3¹⁰ with 1 odour unit (ou) representing the dilution threshold of odorant eliciting a physiological response equivalent to one Reference Odour Mass (ROM). In simplistic terms one odour unit represents a 50% chance of detection of the presence of an odour. Due to the subjective nature of odour perception, the concentration of odour representing offensiveness is dependent on the individual.

A concentration of 5 ou is often defined as the concentration where beneficial uses are compromised. The Draft Guidelines for Environmental Risk Assessments for Victorian Broiler Farms has an off-site odour criterion of 5 ou, when a range of integrated criteria regarding siting and management are also achieved.¹¹ Similarly the American OFFSET methodology for determining buffer distances defines odour annoyance free zones as areas where the odour concentration ranges between 0 – 5 ou.¹² The SEPP (AQM) contains an odour criterion for new or modified point source discharges as 1 ou, beyond the site boundary.

Offensiveness is determined by the duration and frequency of the odour impact. This assessment takes both these factors into account.

The Victorian odour criterion is based on a short event duration represented in modelling scenarios as a 3 minute averaging period. The frequency of events is described by the percentage of hours within one year of data where odour events occur.

In summary, the assessment methodology for odour impacts on the Wollert PSP is based on assessment of the risk of odour offensiveness, as defined by the concentration, duration and frequency. The risk assessment approach is defined in the Standards Australia Handbook, *Environmental Risk Management Systems – Requirements with Guidance for Use*, where a risk level is determined through analysis of likelihood and consequence.

Risk is defined as the “chance of something happening that will have an impact on objectives”.¹³ In the context of the Hanson Landfill odour assessment risk is defined as the chance of offensive odour impacting on local amenity and aesthetic enjoyment. Similarly the measures of likelihood and consequence have been defined by the parameters of the plume dispersion modelling assessment. In general terms likelihood is defined as “a general description of probability or frequency”, whilst consequence is defined as “an outcome or impact of an event”.¹⁴ When related to the modelling methodology, likelihood is the number of hours in the year where an odour event occurs, whilst consequence is measured by the predicted odour concentration (ou).

The assigned likelihood descriptors are presented in Table 13.

Table 13: Risk Matrix Likelihood Descriptors

Level	Descriptor of likelihood of offensive odour impacting on local amenity and enjoyment	Measure – Expressed as events per year	Measure – Expressed as percentage of the year where odour events are predicted
A	Almost certain	>164	2%
B	Likely	42 – ≤163	1%
C	Probable	11 - ≤41	0.5%
D	Unlikely	2 - ≤10	0.1%
E	Rare	0 - ≤1	0%

¹⁰ AS/NZS 4323.3: *Stationary Source Emissions: Part 3: Determination of Odour Concentration by Dynamic Olfactometry*. (2001). Standards Australia.

¹¹ Department of Primary Industries. (2009, February). *Draft Guidelines for Odour Environmental Risk Assessments for Victorian Broiler Farms*. Victoria.

¹² Dairy Australia. (2008, December). *Effluent and Manure Management Database for the Australian Dairy Industry*.

¹³ HB 203:2006. (2006). *Environmental Risk Management - Principles and Process*. Standards Australia/Standards New Zealand.

¹⁴ HB 203:2006. (2006). *Environmental Risk Management - Principles and Process*. Standards Australia/Standards New Zealand.



The assigned consequences are presented in Table 14.

Table 14: Risk Matrix Consequence Descriptors

Level	Descriptor of Consequence	Measure Expressed as ou
A	Severe	30+
B	Significant	21 - ≤30
C	Medium	11 - ≤20
D	Minor	6 - ≤10
E	Negligible	1 - ≤5

The relationship between consequences and likelihood and the resulting risk level is defined by the standard risk assessment matrix described in Section 4.0, where a level of risk between “Low” and Very High” is allocated. The standard EPA Victoria risk matrix has been slightly modified, where the risk of an unlikely event with a minor consequence was upgraded from low to medium. In terms of the odour assessment this represents a medium risk for odour concentrations above 5 ou, detected more than once. This modification is considered consistent with the EPA Victoria criterion for odour impacts.

The odour assessment risk matrix used in this assessment is described in Table 15.

Table 15: Risk Matrix

Likelihood	Consequence (ou)				
	+30	21 - ≤30	11 - ≤20	6 - ≤10	1 - ≤5
>164 events per year	V	V	V	V	H
42 - ≤163 events per year	V	V	V	H	H
10 - ≤41 events per year	V	H	H	M	M
2 - ≤9 events per year	H	H	M	M	L
0 - ≤1 events per year	H	M	L	L	L

Key:

V = Very high risk of impact on amenity and aesthetic enjoyment

H = High risk of impact on amenity and aesthetic enjoyment

M = Medium risk of impact on amenity and aesthetic enjoyment

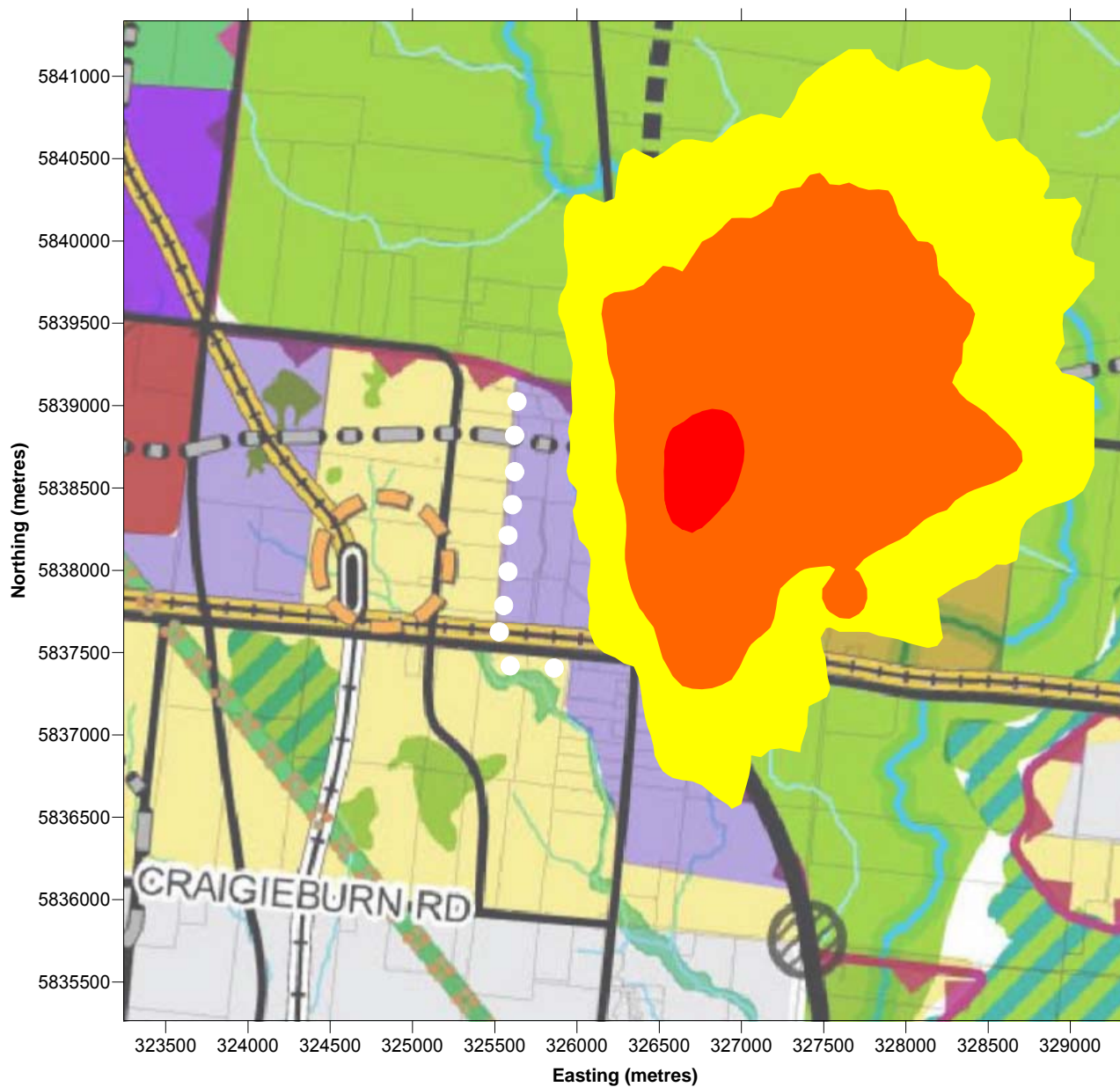
L = Low risk of impact on amenity and aesthetic enjoyment

The risk matrix used in this assessment is consistent with the objectives of the Act and subordinate Policies. Consequently a risk of “medium” or above represents an unacceptable risk to the beneficial uses associated with sensitive land uses as described in Section 3.0.

The plume dispersion modelling results have been plotted as a series of contours representing the identified risk matrix risk levels.

5.7 Modelling Assessment Results

The risk level contour plot for Scenario 1 is presented in Figure 9 whilst the risk contour plot for theoretical future developments is presented in Figure 10.



Key:

- | | |
|-----------------|---|
| ○ | Sensitive receptor locations |
| Yellow | Medium risk of odour impact on amenity and aesthetic enjoyment |
| Orange | High risk of odour impact on amenity and aesthetic enjoyment |
| Red | Very high risk of odour impact on amenity and aesthetic enjoyment |
| Base map source | City of Whittlesea, <i>Growth Area Framework Plan Submission</i> . 2010 |

Figure 9: Odour Modelling Results - Scenario 1

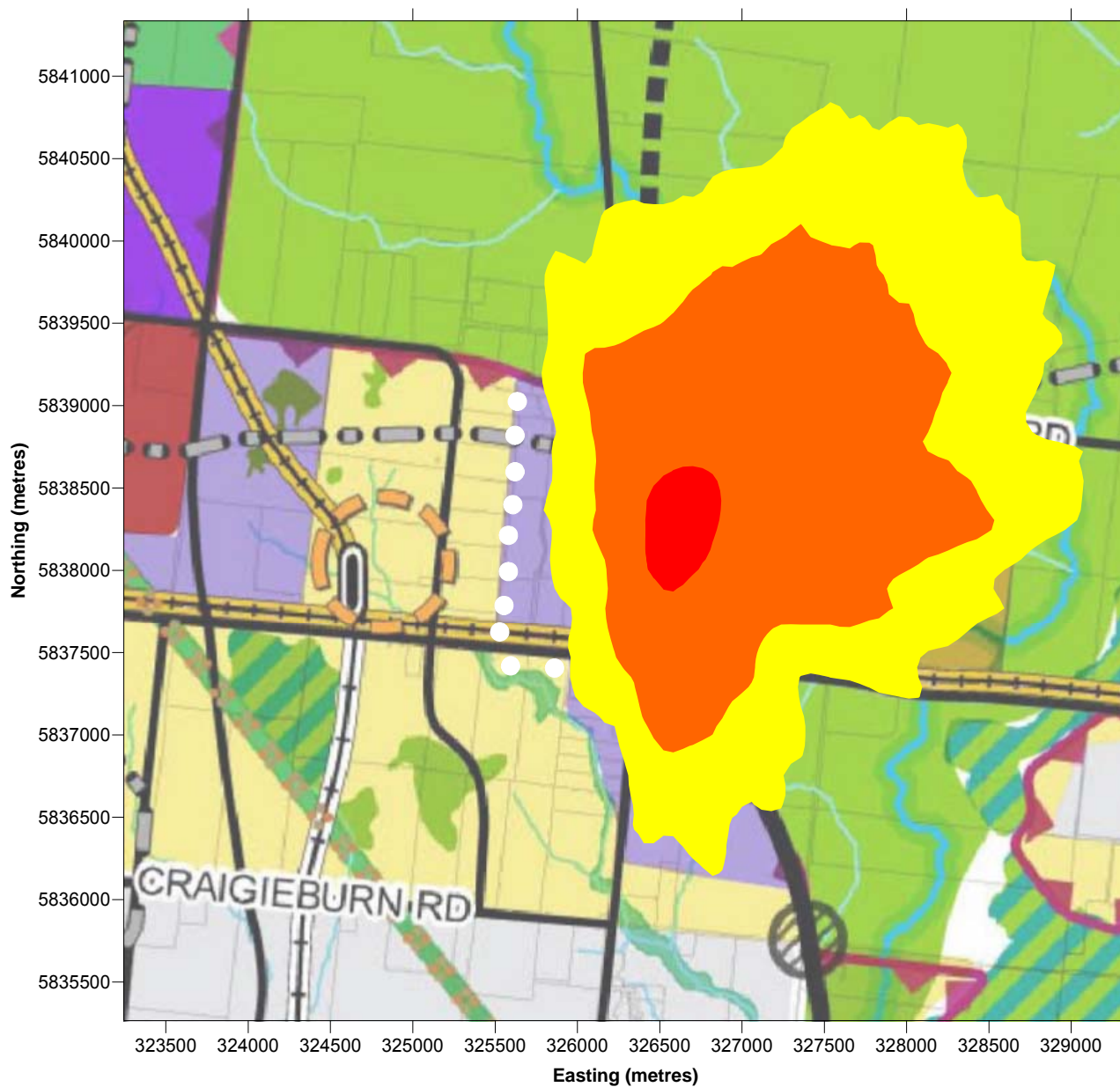


Figure 10: Odour Modelling Assessment Results - Scenario 2

Figures 9 and 10 illustrate the extent of medium to high risk odour impacts for worst case odour emissions from the Hanson Landfill. Both scenarios demonstrate that the predominant westerly winds influence the shape of the risk contours with high and very high risk areas located within the landfill, on top of and immediately to the east of odour sources.



Medium and high risk contours extend beyond the boundary into the Wollert PSP area for both scenarios, however the medium and high risk contours are limited to employment and farming zones to the west and south of the landfill. The medium risk contours extend further from the Landfill in Scenario 2, where the active cell and tipping face are further south and closer to southern residential areas.

6.0 LANDFILL GAS ASSESSMENT

Potential landfill gas impacts are described below:

- Uncontrolled release of landfill gas contributing to net global warming
- Asphyxiation of plants on rehabilitated areas of the landfill and surrounding areas
- Fugitive landfill gas emissions causing a human health hazard
- Explosion impacts on people in onsite and offsite buildings
- Asphyxiation impacts on people in on-site and off-site buildings
- Explosion impacts on workers in on-site and off-site trenches and pits
- Asphyxiation impacts on workers in on-site and off-site trenches and pits
- Explosion impacts to on-site and off-site physical infrastructure
- Corrosive impacts to on-site and off-site physical infrastructure including tanks.

The extent to which these risks are present is highly dependent on site specific considerations such as:

- Landfill design and construction
- Landfill operation and gas collection
- Local geology and hydrogeology
- Proximity of sensitive land uses or structures.

Landfill gas can have significant risks associated with emissions, largely because of the magnitude of the potential consequence (even at a low predicted frequency of occurrence of the identified risks, namely explosion and/or asphyxiation, and the associated risks to human health). Currently the highest residual risks are likely to be explosion impacts in onsite buildings, and asphyxiation impacts on workers in trenches and pits on-site.

Typically the rate and volume of landfill gas produced at a specific site depends on the characteristics of the waste (e.g. composition and age of the wastes) and a number of environmental factors (e.g. the presence of oxygen in the landfill, moisture content and temperature) as described in Section 5.0. In general

- The more organic waste present, the more landfill gas is produced by the bacteria during decomposition.
- Generally more recently buried waste produces more landfill gas through bacterial decomposition, volatilisation and chemical reactions than waste buried for a longer period.
- The presence of moisture (unsaturated conditions) increases gas production because it encourages bacterial decomposition.



Landfill gas can migrate through the ground via diffusion (movement of gases from areas of high pressure to low pressure) or advection. The rate of movement of landfill gas through the ground is affected by the permeability of the ground and other factors such as soil and rock porosity and the presence of underground infrastructure, such as drains and service or utility pipes, and changes in atmospheric pressure and the hydrogeological conditions.

Primary control measures applied at the Hanson Landfill site, aimed at minimising landfill gas impacts, include:

- Cells 1 and 2 are lined with a compacted clay base liner.
- Cells 3 to 7 are lined with a composite compacted clay and geomembrane base liner.
- Geocomposite side liner along the northern perimeter of the landfill.
- Active landfill gas extraction system.
- Cells are continuously capped as the waste achieves the final profile.
- Exposed waste is temporarily capped prior to the next stage of landfilling.

The EPA Victoria licence for the Hanson Landfill requires that:

- *You must prevent emissions of landfill gas from exceeding the levels specified in Best Practice Environmental Management (Siting, Design, Operation and Rehabilitation of Landfills) (EPA Victoria Publication 788)(BPEM).*

The BPEM identifies the following landfill gas action levels (BPEM trigger levels):

- 1% v/v methane and 1.5% v/v carbon dioxide above background concentration within the subsurface geology and subsurface services at the landfill boundary.
- 1% v/v methane and 1.5% v/v carbon dioxide above background concentration within the subsurface services within the landfill and within adjacent areas.
- 0.5% v/v methane and 0.5% v/v carbon dioxide above background concentration within buildings and structures within the landfill and in adjacent areas.
- Landfill surface final cover areas and penetrations through it - 100 parts per million by volume (ppm) methane.

As part of the licence requirements Hanson must submit an Annual Performance Statement (APS) to EPA Victoria each year. The most recent APS (2010/11) states that Hanson is currently unable to determine compliance with this condition and landfill gas surface monitoring will commence before the end of 2011 and boundary sub-surface monitoring wells will be constructed before the end of 2011. Under the requirements of its EPA Victoria licence Hanson is required to assess and report on compliance with the above licence condition each year in its APS. No comment can therefore be made on the extent of actual landfill gas impacts associated with the landfill.

However, in the absence of a site specific assessment the buffer distance of 500 m specified by the BPEM for Type 2 (putrescible) landfills is considered appropriate to ameliorate medium to high risks from landfill gas migration.



7.0 DUST ASSESSMENT

Quarry operations at the Hanson Landfill and Quarry have the potential for particulate matter emission to air from the excavation and removal process, rock processing, products of combustion from fuel use in vehicles/machinery and detonation of explosives.

Extraction and removal particulate matter sources include airborne dust from the movement of vehicles on unpaved roads, windblown dust from exposed areas and emissions from the uplift and deposit of material through blasting, bulldozer action, front end loaders and stockpile creation. Rock processing also has the potential to generate airborne dust through the use of crushers, screens and conveyor systems.

Airborne particulate matter is defined as total suspended particulate matter (TSP) or a size fraction based on particle size. PM_{10} represents particles with an equivalent aerodynamic diameter less than 10 micrometres and $PM_{2.5}$ represents particles with an equivalent aerodynamic diameter less than 2.5 micrometres. The risks to human health from inhalation of PM_{10} and $PM_{2.5}$ have been well demonstrated, with particles in these size fractions able to pass through the nose and throat and deposit in the lower regions of the respiratory tract. TSP impacts are generally associated with nuisance, with large particles rapidly settling from air causing amenity issues. The assessment of particulate matter emissions can also be expressed in terms of deposited dust. Deposited dust refers to "particles which are brought to the surface through the combined processes of turbulent diffusion and gravitational settling. Once near the surface, they may be removed from the atmosphere and deposited on the surface."¹⁵

With the exception of blasting, quarry particulate matter emission sources are typically surface based with near field impacts. Moreover, particulate matter emissions can be managed through dust suppression systems, shielding, active management strategies such as work stoppage in high winds and reactive management strategies such as work stoppage if onsite trigger levels are breached.

In the absence of a site specific buffer distance assessment, the default 500 m buffer distance required for extractive industries in Victoria is used in this assessment as a suitable separation distance for protection of sensitive land uses (as described in Section 3.0) in the PSP area from particulate matter impacts at the Hanson Landfill and Quarry.

8.0 NOISE ASSESSMENT

Noise risks associated with landfill activities are assessed as having a low residual risk rating. This is primarily due to the distance between noise generating activities at the site and sensitive receptors.

The Victorian Planning Provisions contain provisions relating to extractive industry and Extractive Industry Interest Areas (EIIA). The provisions ensure that the use and development of land for an extractive industry does not adversely affect the environment or amenity of the area, that excavation areas can be appropriately rehabilitated and that sand and stone resources are protected from inappropriate development.

The provisions apply to:

- The use and development of land for extractive industry
- The use and development of land within a designated EIIA
- The use and development of land within 500 metres of an extractive industry.

Typical noise levels produced by plant equipment used in hard rock quarries were sourced from BS5228-1:2009 *British Standards: Code of Practice for Noise and Vibration Control on Construction and Open Sites* and from Golder's internal database. The power levels for various items of plant equipment were used to estimate the resulting noise levels at various distances from the plant.

¹⁵ AUSPLUME Users Manual



Propagation calculations take into account sound intensity losses due to hemispherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations.

Calculations assume that there are no noise barriers or acoustic shielding in place and that each plant item is operating at full power.

As a result of applying these assumptions predicted received noise levels are expected to overstate actual received levels.

The resultant noise levels noise produced by typical quarry activities under these assumptions are shown in Table 16.

Table 16 Worst Case Noise Levels from Quarrying Activities

Plant Item	SWL dB(A)	Distance from Source (m)															
		1	10	25	50	100	150	200	300	400	500	750	1,000	1,500	2,000	2,500	3,000
Crusher	120	112	92	84	78	72	68	66	62	60	58	55	52	48	46	44	42
Vibratory Screen	118	110	90	82	76	70	66	64	60	58	56	53	50	46	44	42	40
Conveyor	89	81	61	53	47	41	37	35	31	29	27	24	21	17	15	13	11
Excavator	110	102	82	74	68	62	58	56	52	50	48	45	42	38	36	34	32
Wheeled Loader	109	101	81	73	67	61	57	55	51	49	47	44	41	37	35	33	31
Dump Truck	108	100	80	72	66	60	56	54	50	48	46	43	40	36	34	32	30

The Victorian State Environment Protection Policy (Control of Noise of Noise from Industry, Commerce and Trade) (SEPP N-1) sets minimum base noise limits for industry over day, evening and night periods. Depending on actual land use in the vicinity of a source these limits may be set at a higher level. These are summarised in Table 17.

Table 17 Worst Case SEPP (N-1) Limits

Period	Minimum Noise limit dB(A)
Day	45
Evening	40
Night	35

Comparison of the predicted noise levels in Table 16 and Table 17 show that predicted noise levels may be greater than noise limits up to 2.5 km from the source.

There are a number of factors which could significantly affect the actual noise level experienced at sensitive land uses within the PSP area as a result of noise emissions from the Hanson quarry. These include:

The level of noise attenuation and control applied to equipment at the site.

- The actual sound power rating of plant items.
- Local terrain and associated shielding.

The impact of these factors has not been assessed for the Hanson Quarry. For example locating crushing equipment at the base rather than the top of the quarry land and installation of plant attenuation or shielding is likely to have a major impact on predicted noise levels.



Blasting and Ground Vibrations

The Department of Natural Resources and Environment, Minerals and Petroleum Victoria, *Environmental Guidelines, Ground Vibration and Airblast Limits for Blasting in Mines and Quarries*, 2001 provides the following guidance in relation to blasting and vibration impacts from quarries on residential premises and other sensitive receptors (the guideline does not apply to commercial or industrial premises where less stringent standards may be appropriate):

- Existing operations:
 - Ground vibration at sensitive sites should be below 10 mm/s (ppv) at all times; and
 - Airblast at sensitive sites should be below 120 dB (Lin Peak) at all times.
- New sites:
 - Ground vibration at sensitive sites should be below 5 mm/s (ppv) for 95% of all blasts; and
 - Airblast at sensitive sites should be below 115dB (Lin Peak) for 95% of all blasts.
- Where new sensitive sites are developed closer to an existing quarry, the existing vibration and airblast criteria will be applied to the new properties. This includes encroachment of legally approved housing or other sensitive receptors.

According to the guideline a sensitive site refers to “any land within 10 m of a residence, hospital, school, or other premises in which people could reasonably be expected to be free from undue annoyance and nuisance caused by blasting”.

The Work Authority issued to Hanson Construction Materials Pty Ltd by the Department of Primary Industries dated 14 January 2004 (reference number 393) was reviewed. In relation to airblast and ground vibration Clause 13 of the Work Authority stipulates the following limits:

- Peak particle velocity from blasting operations not to exceed 10 mm/s in the vicinity of “any building not owned by the Work Authority holder” (offsite buildings).
- Airblast overpressure from blasting operations not to exceed 120 decibels in the vicinity of “any building not owned by the Work Authority holder” (offsite buildings).

It is beyond the scope of this assessment to undertake a site specific noise monitoring and vibration assessment. We therefore have applied a 500 m separation distance as representing a medium or greater risk to sensitive land uses (as described in 3.0) for noise emissions.

Noise monitoring would be necessary to enable a site specific assessment of risk to be undertaken.



9.0 POTENTIAL IMPACTS ON PSP AREA

Assessment of risk for each of the nominated hazards includes categorisation of risk associated with recommended and modelled separation distances.

Clause 15 of the Work Authority refers to buffer zones where excavations are not permitted. However, these areas are not clearly visible on the marked plans. The “*Code of Practice for Small Quarries*” published by the Department of Primary Industries in 2010 states that there should be no extraction within 10 m (or wider where required to protect infrastructure and minimise visual impacts) of the Work Authority boundary. Whilst this does not provide an absolute buffer distance between quarrying and sensitive land uses, it does establish the limit of quarrying activities within the site boundary.

The EPA Victoria BPEM provides guidance relating to the technical requirements for siting, design, operation, management and monitoring landfills in Victoria, specifying buffer distances for Type 1 (solid inert waste) and Type 2 (putrescible waste) landfills as 250 m and 500 m respectively.

EPA Victoria also provides recommended buffer distances for other industrial activities in the publication *Recommended Buffer Distances for Industrial Residual Air Emissions* EPA Victoria Publication AQ 2-86, dated July 1990 (EPA Victoria). This includes recommended buffer distances for mining and extractive industry, including hard rock quarrying.

Table 18: Recommended Buffer Distances - EPA Victoria.

Industry	EPA Victoria Guidance Buffer Distance (metres)
Putrescible landfill - site accepts inert, putrescible, contaminated solid waste	500
Extractive industries – hard rock with blasting	500
Extractive industries – not hard rock; blasting, grinding and milling works.	300
Extractive industries – no blasting conducted; material processed by grinding, milling or aerated by sieving etc.	200
Extractive industries – sand and limestone extraction; no grinding or milling works	200

As it is not within the scope of this report to undertake a site specific assessment of the extent to which landfill gas could potentially affect the development of the PSP, the default buffer recommendation from the EPA Victoria Best Practice Environmental Management Guideline of 500 m has been utilised.

EPA Victoria recommends that where sensitive uses of buildings and structure are proposed to be developed within 500 m of a putrescible waste landfill then a site specific assessment of the risk should be undertaken, preferably through the conduct of an environmental audit under Section 53V of the Environment Protection Act.

For the purpose of the landfill gas component of this assessment a risk ranking of medium (or greater) has therefore been assigned to land located within 500 m of the area within which waste can be deposited, as specified in the EPA Victoria licence.



Table 19 Separation Distances

Issue	Separation Distance From Activity	Risk of Impact on Sensitive Use
Odour	Refer to Figures 9 and 10	Medium or greater
Landfill gas	500 m from waste disposal area	Medium or greater
Noise and vibration	500 m quarrying boundary	Medium or greater

The results of the risk assessment with the separation distances for risk levels greater than medium are presented in an overview Figure included in Appendix C. The overview figure includes odour results from Scenario 2 as this landfill configuration was shown to represent worst case results.

10.0 CONCLUSIONS

In summary the Hanson Landfill and Quarry risk assessment involved preparation of a site conceptual model to identify source/receptor pathways, allocation of risk where pathways existed, and assessment of medium or greater risks. This process resulted in an assessment of landfill gas, odour, dust and noise. Figure 11 provides a schematic representation of the project process and outcomes.

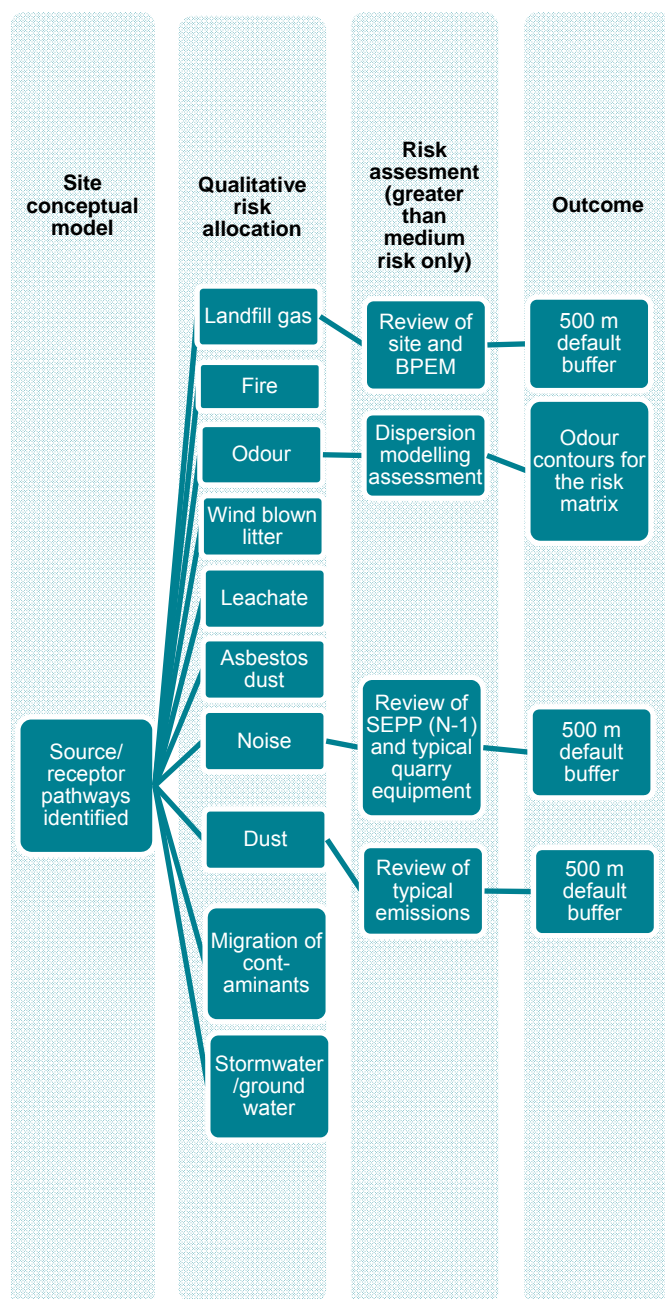


Figure 11: Overview of the Hanson Landfill and Quarry Risk Assessment Process and Outcomes

Representation of the potential impacts of issues associated with the Hanson Landfill and Quarry are presented in Appendix C, with the overlapping contours for each of the identified potential impacts on sensitive uses within the PSP area highlighting medium or greater risk. The overview figure demonstrates that odour impacts are the primary issue affecting development of sensitive land uses within neighbouring land to the north, exceeding the nominal landfill gas separation distance. The medium risk odour contour mirrors the nominal landfill gas separation distance to the west within the Wollert PSP and is contained within the noise buffer distance to the south. The medium risk odour contour is also within the nominal landfill separation distance in the east. However the scenario used to generate the contour includes worst case position of odour sources for impacts in the Wollert PSP; if odour sources were positioned for worst case odour impacts in the east, the extent of the medium risk odour contour may not be contained within the nominal 500 m buffer to the east.



11.0 ABBREVIATIONS

- APS - Annual Performance Statement
- BPEM - Best Practice Environmental Management Siting, Design, Operation and Rehabilitation of Landfills
- GAA - Growth Areas Authority
- Golder - Golder Associates
- GLC - Ground Level Concentration
As determined by application of the AUSPLUME gaussian plume dispersion model
- PM₁₀ - Particles with an equivalent aerodynamic diameter less than 10 micrometres
- PM_{2.5} - Particles with an equivalent aerodynamic diameter less than 2.5 micrometres
- PSP - Precinct Structure Plan
- SEPP (AQM) - State Environment Protection Policy (Air Quality Management)
- SEPP(N-1) - State Environment Protection Policy (Control of Noise of Noise from Industry, Commerce and Trade)
- WA - Work Authority



12.0 REFERENCES

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Report Signature Page

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APPENDIX A

Limitations



LIMITATIONS

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APPENDIX B

Meteorological Modelling



APPENDIX B

Meteorological Modelling

1.0 TAPM MODEL SET UP

Prognostic models such as TAPM solve the equations of atmospheric dynamics to produce physically realistic three-dimensional meteorological fields, such as wind, temperature, humidity, surface fluxes and boundary-layer structure. They are the models used in weather forecasting and climate research, and as a basis for dispersion modelling.

TAPM has been used to generate the AUSPLUME meteorological data used to supplement the EPA Victoria Craigieburn observations for this study. TAPM is a PC-based model which is widely used throughout Australia for this purpose and is recognised by state regulatory authorities.

The EPA Victoria Craigieburn meteorological station parameters are summarised in Table 1.

Table 1: Meteorological Station Parameters

Station Name	EPA Victoria Craigieburn Station
Temperature measurement method	AS 2091 – 1981
Wind speed/wind direction measurement method	AS 2923 - 1987
Anemometer height (m)	10
Latitude/longitude	-37.6051178°, 144.8956909°
Start and end dates	Wind speed/direction 13/10/2003 – 24/06/2004 Temperature 1/10/2003 – 24/06/2004
Data frequency	Hourly
Data gaps	Wind speed/direction 96% complete Temperature 97% complete

TAPM was run for the years 2003 and 2004 in accordance with the EPA Victoria publication “*Construction of Input Meteorology Data Files for AUSPLUME*”. The TAPM configuration parameters are presented in Table 2.

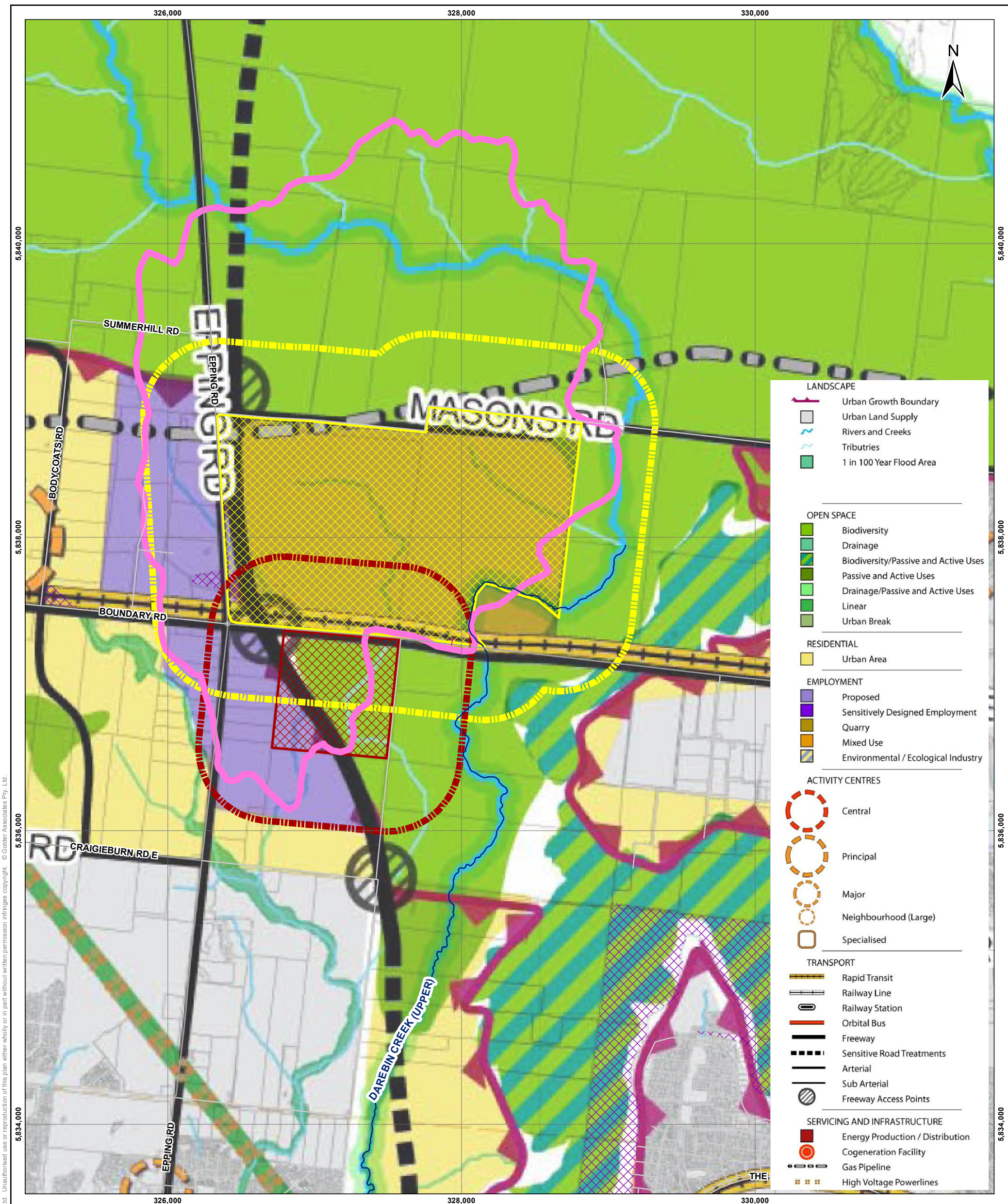
Table 2: TAPM Configuration Parameters

Parameter	Value
Start and end dates	1 January 2003 – 31 December 2004
Grid Centre (Lat/Long)	-37° 36 min/144°54 min
No. of grids	4
No. of horizontal grid points	41 x 41
Horizontal grid spacing	10 km, 3 km, 1 km, 0.3 km
No. of vertical levels	25
Monthly deep-soil moisture content (12 values, model defaults)	0.15 m ³ /m ³
Location of profile extracted for AUSPLUME	-37° 36 min/144°54 min



APPENDIX C

Overview Figure



HANSON LANDFILL AND QUARRY - RISK ASSESSMENT

GROWTH AREAS AUTHORITY

RISK ASSESSMENT RESULTS

LEGEND

- Extent of Odour risk (medium)
- Landfill and Quarry (Approximate)
- Landfill and Quarry 500m Buffer
- Proposed Future Quarry (Approximate)
- Proposed Future Quarry 500m Buffer

NOTES

- Background image sourced from client (101110 Final GAFF submission.jpg) received Feb 2011, georeferenced to Streetpro roads data.

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0 100 200 400 600 800 1,000 meters

SCALE (at A3) 1:25,000

DATUM GDA 94, PROJECTION MGA Zone 55

PROJECT: 117615033

DATE: 03 OCT 2012

DRAWN: PM / JPH

CHECKED: JSHE/FF

FIGURE 11



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