Elf Farm Supplies Pty Ltd

Mushroom Substrate Plant –
Modification to Approved Expansion

Odour Impact Assessment

Mulgrave, NSW

Amended Final Report

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Project Number: **N1952R**

Report Revision		
Report Version	**Date**	**Description**
Draft report	24.12.2014	Preliminary draft report issued to client
Draft Report #2	02.01.2015	Draft report issued for internal review
Draft Report #3	05.01.2015	Revised Draft report issued to client
Final Report	08.01.2015	Final report issued
Amended Final Report #1	20.02.2015	EPA requests addressed and issued to client
Amended Final Report #2	23.02.2015	Amended final report issued
Report Preparation		
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Report Title: Elf Farm Supplies Pty Ltd: Mushroom Substrate Plant – Modification to Approved Expansion Odour Impact Assessment		

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APPENDICES

1 INTRODUCTION

In September 2014 Elf Farm Supplies Pty Ltd (Elf Farm) engaged The Odour Unit Pty Ltd (TOU) to undertake an odour impact assessment for the modification to the approved expansion project of the mushroom substrate facility at Mulgrave, NSW (the Facility). The Department of Planning & Environment (DPE) project number for the proposed modifications to the approved expansion is 08_0255 MOD1.

1.1 PROJECT BACKGROUND

The original odour impact assessment for the approved expansion project was undertaken by PAE Holmes in a report titled *Air Quality Assessment Expansion of Substrate Facility* and dated 9 December 2010 (PAE Holmes, 2010). Since the approval, Elf Farm have identified and acquired new emissions technology specific for the mushroom compost industry that has superseded the existing technology currently employed at the Facility. This has resulted in the need for a modification of the approved expansion project.

1.2 ASSESSMENT SCOPE OF WORKS

The scope of works for this study is to undertake an odour impact assessment that reflects the new emissions technology that will be employed for the approved expansion project and identify all future odour emission sources. The assessment scope of works includes:

- Identification of all future odour emission sources;
- Sampling and testing of all future odour emission sources (both at the interim and final stages of the modification works – discussed later in **Section 3**);
- The development of a site-specific odour emissions inventory;
- Procurement of a suitable meteorological data file representative of the Facility location including local terrain and prevailing meteorological conditions;
- Input of the site-specific odour emissions inventory data for the purposes of odour dispersion modelling using the CALPUFF modelling system; and

- Report on whether the modification to the approved expansion project is expected to comply with the applicable New South Wales Environment Protection authority (NSW EPA) Odour Performance Criterion (opc) guidelines.

1.3 APPROVED PLANNED EXPANSION PROJECT

As outlined in the original odour impact assessment report (PAE Holmes, 2010), the approved expansion involved three key construction stages as follows:

- ***Stage 1*** *– construction of a new straw bale storage shed as the production level is increased to 1,600 tonnes of Phase 1 product per week;*
- ***Stage 2*** *- construction of a second bale storage shed, a new bale wetting area with water recycling pit, a new Phase 2/3 building and an extension to the existing pre-wet shed with an additional bio-scrubber. All fugitive odour sources will be enclosed and odours arising from these sources will be processed by the bio-scrubbers. Production is designed to reach 2,400 tonnes of Phase 1 substrate per week; and*
- ***Stage 3*** *- further extension to the new Phase 2/3 building and an extension of the Phase 1 building, the capacity of the facility is proposed to reach a maximum of 3,200 tonnes of Phase 1 substrate per week.*

The chronology of the construction stages will continue to remain generally consistent with the approved expansion project, however, will require the following key proposed modifications:

- Full containment and emissions capture at key process areas and sources;
- Primary air treatment of all captured emissions by the proposed on-site Emissions Plant. The Emissions Plant will consist of six ammonia scrubbers operating in parallel. The key air containment that will be targeted by the scrubbers is ammonia gas (NH_3); and
- Secondary air treatment of all captured emissions by an open-bed Biofilter System. The Biofilter System will be downstream of the Emissions Plant.

The details of the proposed modification works to the approved expansion is discussed in **Section 2.2.**

2 PROCESS OPERATIONS

The process operations at the Facility is a complex and dynamic operation that varies both spatially and temporary. The end product of the process is a mushroom substrate used for mushroom farming. The following sections aim to describe the existing process operations and how these operations will be impacted from the modification works to the approved expansion project.

2.1 EXISTING PROCESS OPERATIONS

The Facility produces a mushroom substrate by utilising a five-stage composting process, all of which is undertaken at the Facility. The five key stages are as follows:

1. **Raw Materials Storage Shed, Bale Wetting & Stable Bedding Areas:** storing and combining all ingredients ready for transport to the Pre-wet Shed (discussed in **Sections 2.1.1).** Bale wetting involves gradually adding water and pulsing fresh air through the straw bales to keep the material aerobic (discussed in **Section 2.1.2**). Similarly, the stable bedding material undergoes wetting and fresh air is pulsed through to keep the material aerobic (discussed in **Section 2.1.3**);
2. **Pre-Wetting**: the straw bales and the ingredients are blended in the Pre-wet Shed and re-blended a number of times whilst always adding recycled water (discussed in **Section 2.1.4**);
3. **Phase 1:** the material is processed in bunkers whereby temperature, oxygen and moisture conditions are controlled and regulated (discussed in **Section 2.1.5**);
4. **Phase 2:** material is transferred to clean tunnels where it is pasteurised and peak heated to remove any weed, moulds or pests before spawning (discussed in **Section 2.1.6**); and
5. **Phase 3**: mushroom spawn is added and grown through the substrate for a minimum of two weeks prior to mushroom farm delivery (discussed in **Section 2.1.6.1**).

2.1.1 Raw Materials Storage Shed Area

The raw materials storage shed area consists of several bay areas that store dry additive products including chicken manure, cotton seed, gypsum and other seasonal organic nitrogen sources. The ingredients are weighed and mixed together in calculated ratios in a semi-enclosed area, where the dry chicken manure is stored. The mixing is carried out by the Kuhn mixing machine. Once mixed, the material is conveyed by a front-end loader to the Pre-wet Shed where it is placed on top of the straw bales ready for bale breaking by the Thilot blending machine. The mixing of the raw materials is known as the preparation of the 'brew' which is a blend of the above ingredients. This preparation process currently occurs in the south-western corner of the raw materials storage shed. The frequency and duration of this process is approximately four hours per week.

2.1.2 Bale Wetting Stage

The bale wetting stage involves the wetting of straw bales with process water (comprising predominately of water from the nearby creek) for several days (currently four days per week).

2.1.3 Stable Bedding Area

The stable bedding area is located in the north-eastern corner of the Pre-wet Building. The stable bedding material is wetted prior to transfer to the Pre-wet Shed and is placed as the final layer of a rick before the bale breaking process (see **Section 2.1.4** for details).

2.1.4 Pre-wet Shed

After bale wetting, the wetted bales are transported by front-end loader into the Pre-wet Shed and manually destringed. Whilst inside the Pre-wet Shed, the construction of a rick is undertaken. The process for constructing of a rick involves the breaking of bales and placement of brew and wetted stable bedding material. This essentially forms the construction of a three-layered rick which is, on average, 90 metres long, 2-3 metres wide and 6 metres high. Once the construction of a rick is complete, a Thilot blending machine is passed over each rick to mix and break all three layers of material. This process is known as bale breaking. Once the bale breaking process is complete, air is pulsed through each rick via a proprietary in-floor aeration system. Currently, three ricks are typical constructed in the Pre-wet Shed.

The initial low temperature stage of the mushroom composting process occurs in the Pre-wet Shed. The building is currently fully enclosed, except for a (curtained) opening on the eastern-side through which a front-end loader transfers material to the Phase 1 Working Hall and two large (door) openings in the south-eastern and north eastern corners of the building. Building ventilation air from the Pre-wet Shed is currently collected by four ducts, each with in-duct axial fans, and conveyed to the Bioscrubber System through the Phase 1 Bunkers for treatment (see **Sections 2.1.5 & 2.1.7** for details) before discharge via a tall stack.

2.1.5 Phase 1 Working Hall & Bunkers

The material transferred from the Pre-wet Shed is placed into a hopper mixer in the Phase 1 Working Hall. Material in the hopper mixer is conveyed into designated aerated bunkers via an inclined overhead conveyor, located external to the Phase 1 building. The material is deposited into the bunkers where the aeration rate and temperature are tightly controlled. Material in each filled bunker is removed, deposited back into the hopper mixer and returned to an available bunker, to continue the Phase 1 process. Once the Phase 1 process cycle is complete, material is transferred to the Phase 2/3 building via the Phase 1 to Phase 2 transfer conveyor located outside in the north-western corner area of the Phase 1 Working Hall Area.

Ventilation air from the Pre-wet Shed is passed through the Phase 1 bunkers with the subsequent exhaust air emissions from the bunkers treated by the existing Bioscrubber System before discharge via a tall stack.

2.1.6 Phase 2/3 Building

The existing Phase 2/3 Building consists of a working hall area and a total of twenty two tunnels. Once the Phase 1 process is complete, material is loaded into a second hopper mixer in the Phase 1 Working Hall and outgoing material placed onto a conveyor (known as the Phase 1 to Phase 2 Cross Conveyor) to the Phase 2/3 Working Hall Area. Once material arrives at the Phase 2/3 Working Hall, a series of conveyors transfer the material into a dedicated tunnel. During this process, the tunnel is fully vented for up to two hours until filling is complete. The exhaust air during this process stage is discharged via dedicated roof stacks on the current Phase 2/3 Building and is known as Tunnel Venting.

Material in the tunnels are kept constantly under aerobic conditions. This is achieved via an extensive airflow channel network. The quality of airflow is controlled by the PLC Supervisory which determines the volumes of recirculated air, make-up air and discharged air. The exhaust air is discharged via exhaust roof stacks that exist parallel to the tunnel venting exhaust roof stacks (i.e. the southern section of the Phase 2/3 building). Make-up air is drawn through filters in the Phase 2/3 Fan Room. Each tunnel has dedicated exhaust roof stacks and is capable of processing material through all Phase 2/3 stages.

The Phase 2/3 Building is kept under a slight positive pressure for quarantine reasons and tunnel conditions are monitored, automated and controlled via a PLC System. The Phase 2/3 process operations consist of several process stages (described in **Sections 2.1.6.1 & 2.1.6.2** respectively) with all stages automatically controlled by the PLC system.

2.1.6.1 Phase 2 Process Stages

The Phase 2 process cycle consists of the following stages:

- Tunnel Filling;
- Levelling;
- Warm-up Pasteurisation;
- Pasteurisation;
- Cool-down (conditioning); and
- Conditioning.

Once the Phase 2 process stages are complete, the tunnel will then enter into Phase 3.

2.1.6.2 Phase 3 Process Stages

The Phase 3 process cycle is characterised by the addition of mushroom spawn and consists of the following stages:

- Spawn Run 1;
- Spawn Run 2; and
- Cool-down (spawn/shipout).

Once the Phase 3 stages are complete, the fully processed product is shipped out either as a bulk product or packaged in twenty kilogram blocks.

2.1.7 Bioscrubber System

The existing Bioscrubber System services the Pre-wet and Phase 1 process operations only. Phase 2 and 3 exhaust air emissions are currently discharged untreated via roof stacks.

2.2 PROPOSED MODIFICATIONS

The proposed 7-week production cycle is depicted as a process flow schematic in **Figure 2.1** (**Dwg No.** 1952-001). **Figure 2.2** shows the proposed site layout. The proposed modifications to the approved expansion project entails the following elements:

1. Raw materials shed area will be contained within a new building enclosure;
2. The establishment of a Bale Wetting Building: the existing bale wetting area and associated process operations will shift from outdoors to indoors. The existing Pre-wet Shed Building will become the new Bale Wetting Building. This modification will be undertaken in two stages (discussed in **Section 7.1.2**);
3. Pre-wet process operations will shift from the existing Pre-wet Shed to newly constructed Pre-wet bunkers with a working hall area;
4. Phase 1 inclined and cross transfer conveyors operation will be contained;
5. Extension of the existing Phase 2/3 Building from twenty-two to twenty-five tunnels and the construction of a new Phase 2/3 building with twenty-five tunnels. This proposed modification will collectively provide up to fifty tunnels for Phase 2/3 process operations;

6. Air emissions generated at the Facility will be directed to an Emissions Plant and Biofilter System (see **Section 2.2.1**). Air emissions will be extracted from the following process areas and sources:

    a. Raw Material Shed Area;

    b. Bale Wetting Building;

    c. The new Pre-wet Bunkers and Working Hall Area;

    d. Phase 1 Working Hall Area;

    e. Phase 1 Bunkers; and

    f. Phase 2 Tunnels (existing and proposed): Only the initial stages of the Phase 2 discharge emissions will be directed to the Emissions Plant and Biofilter System. The latter Phase 2 stages and all of Phase 3 discharge emissions will be directed to dedicated tunnel exhaust roof stacks on the Phase 2/3 Buildings.

7. Future plans to increase on-site Phase 2/3 tunnel capacity to a total of fifty tunnels. This increase in tunnel numbers would necessitate the construction of a new Phase 2/3 building with twenty-five tunnels plus extending the existing Phase 2/3 building by three tunnels (currently there are twenty-two tunnels). The new Phase 2/3 building will be adjacent to the existing Phase 2/3 Building in the north-western corner of the Facility (see **Figure 2.2**);

8. The mothballing of the Bioscrubber System and stack; and

9. Provision for additional ammonia scrubbers and biofilter bed area. This may require an update to the odour dispersion modelling that has been undertaken in this odour impact assessment study and would be in conjunction with any future plant tonnage increase application to determine if additional emissions treatment capacity is required.

2.2.1 Emissions Plant and Biofilter System

The proposed modification works will be undertaken in a stage-wise approach consisting of two key stages as follows: an interim stage; and a final stage. This is described in **Section 3**. As part of this approach, the construction and commissioning of the Emissions Plant and Biofilter System will be completed in the first instance as to manage odour emissions from existing process operations at the Facility. This would subsequently result in the existing bioscrubber system becoming quiescent. Once in operation, the Emissions Plant and Biofilter System will then gradually receive emissions from the new source groups that will exist upon completion of the proposed modification works.

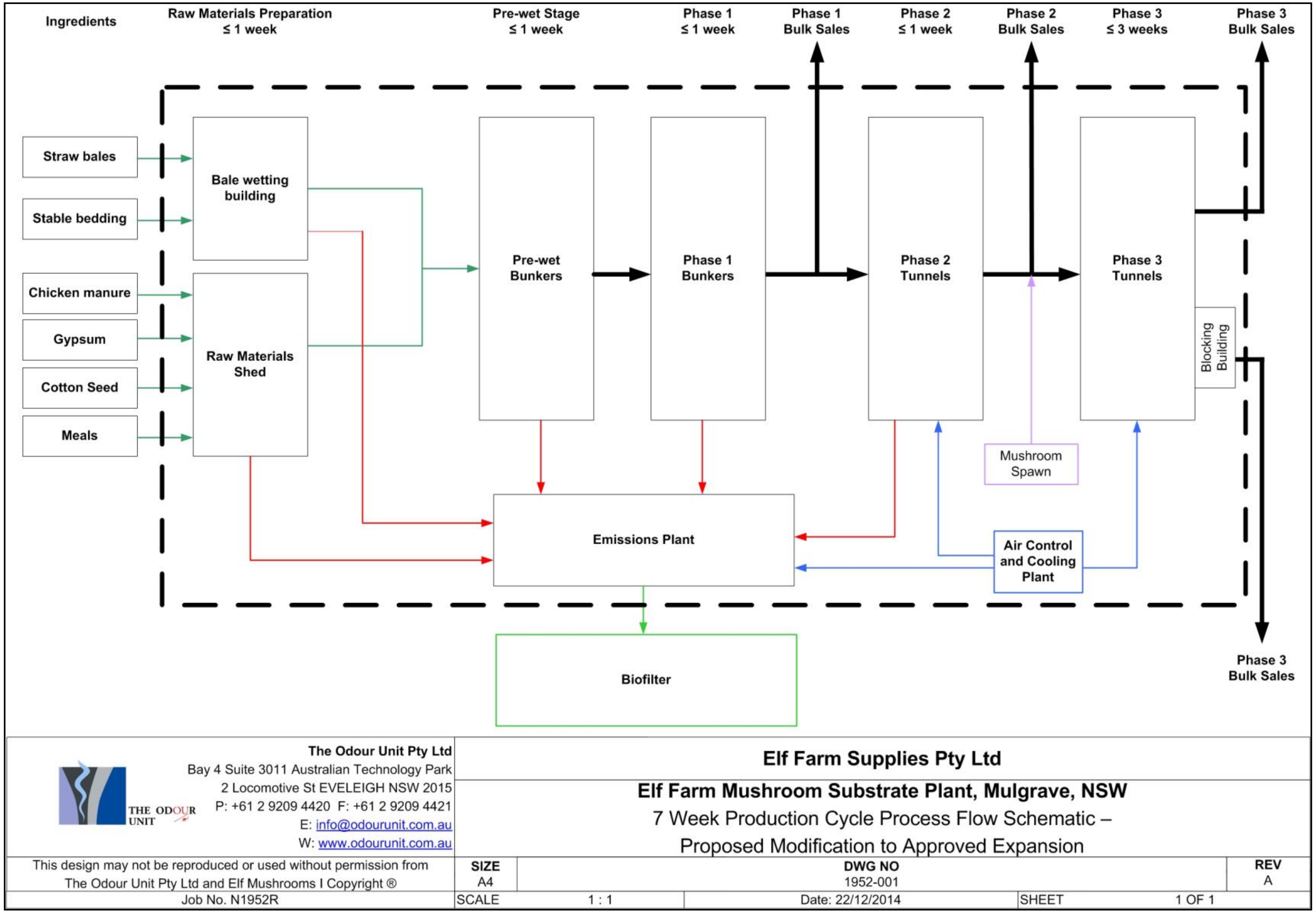


Figure 2.1 – 7 Week Production Cycle Process Flow Schematic: Proposed Modification to Approved Expansion

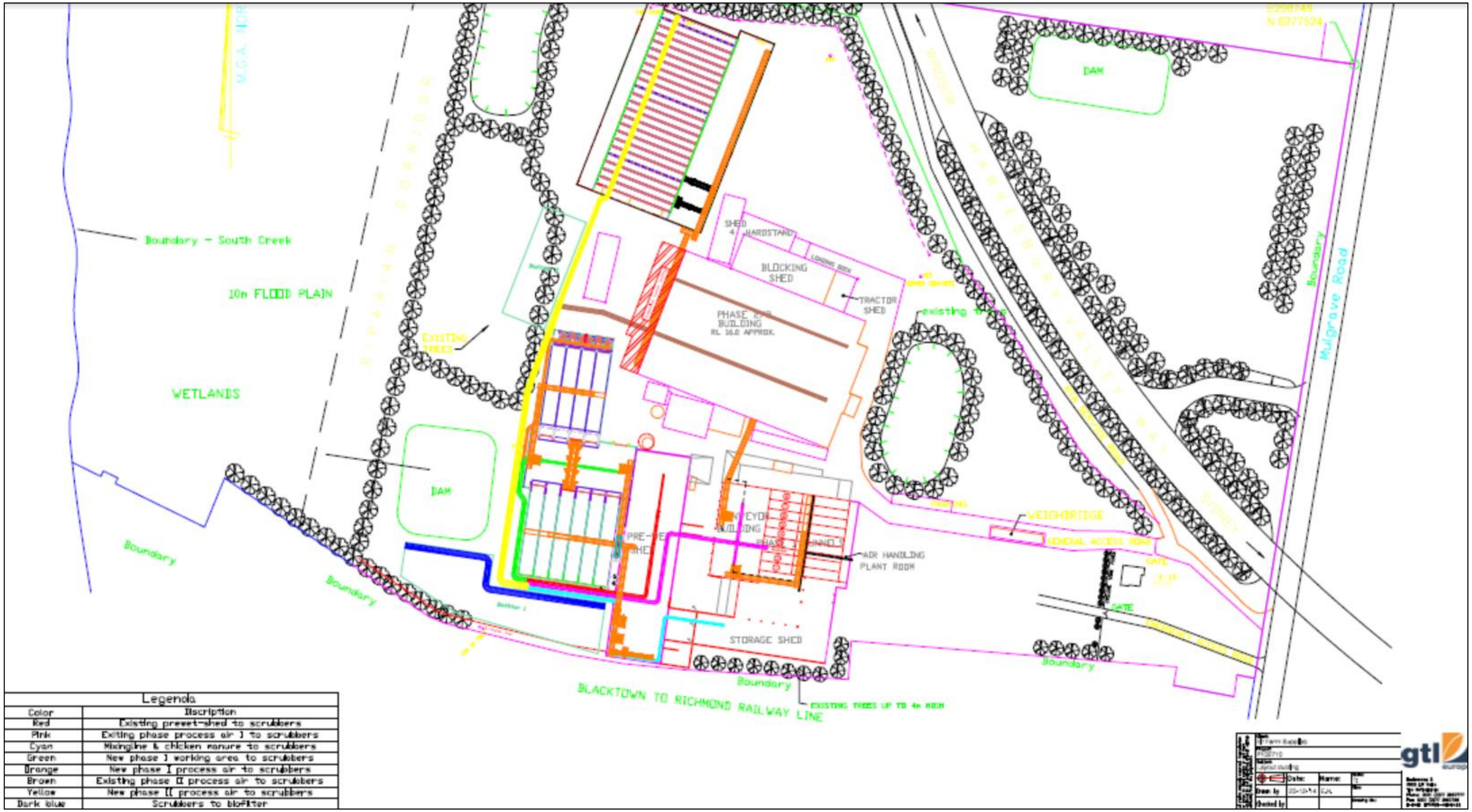


Figure 2.2 – Proposed layout of the Facility (valid as of 23 December 2014)

3 SAMPLING AND TESTING

As part of the proposed modifications to approved expansion project, TOU developed a site-wide odour emissions inventory. The objective of this inventory is to determine the odour emissions contribution from the various areas/sources that will exist at the Facility, both in the interim and final stages, and undertake odour dispersion modelling to assess the odour impact projection from those areas/sources.

The development of the odour emissions inventory required odour sampling and testing at the Facility over the period between August 2014 and November 2014 of all odour emission sources that will exist in the interim and final stages for the proposed modification works. Each modelled stage consists of the following key odour emission sources:

- Interim stage modelled odour emission sources:
  - Bale wetting area;
  - Stable bedding area;
  - Water recycle pit; and
  - Phase 2/3 process operations.
- Final stage modelled odour emission sources:
  - The later stages of Phase 2 and all of Phase 3 process operations (see **Section 3.2.1**) ; and
  - Biofilter system.

The sampling and testing undertaken at each of the above source groups is discussed in the following sections.

3.1 BALE WETTING & STABLE BEDDING AREAS

The bale wetting and stable bedding areas currently exist outdoors, immediately adjacent to the Pre-wet Shed. The sampling and testing in these areas consisted of:

- **Bale wetting area:** area source sampling of the straw bales during different stages of the bale wetting cycle. The sampling also accounted for aerating and non-aerating conditions; and
- **Stable bedding area:** area source sampling of wetted stable bedding.

Photo 3.1 & Photo 3.2 shows the sampling at the bale wetting area and stable bedding area on 27 & 29 October 2014 respectively.

Photo 3.1 – Area source sampling of wetted straw bales

Photo 3.2 – Area source sampling of wetted stable bedding material

3.1.1 Bale wetting & Stable Bedding Areas Odour Testing Results

The results of the odour sampling and testing of the Bale Wetting and Stable Bedding Areas are presented in **Table 3.1.**

Table 3.1 – Bale Wetting and Stable Bedding Areas: Odour concentration testing results

Source description	Odour concentration (ou)	Specific Odour Emission Rate (ou.m³/m²/s)
Bale wetting area: Monday (aerating)	42,500	25.3
Bale wetting area: Monday (non-aerating)	39,000	23.9
Bale wetting area: Tuesday (aerating)	60,100	32.7
Bale wetting area: Tuesday (non-aerating)	77,900	39.9
Bale wetting area: Broken Bales (Wednesday: non-aerating)	13,800	9.31
Bale wetting area: Broken Bales (Wednesday: aerating)	6,320	3.56
Bale Wetting Area (Sunday: aerating)	2,900	1.80
Bale Wetting Area (Sunday: non-aerating)	2,900	1.80
Stable bedding area (Wednesday: non-aerating)	11,600	5.28
Stable bedding area (Wednesday: aerating)	16,400	6.33

The following emission rates were used for the purposes of odour dispersion modelling:

- **Bale Wetting Area:** worst-case emission rate of 20,909 ou.m^3/s based upon the mean value of Tuesday testing results and a maximum utilised area of 576 m^2; and
- **Stable Bedding Area**: odour emission rate of 575 ou.m^3/s based upon the mean value of testing results and a maximum utilised area of 99 m^2.

3.2 WATER RECYCLE PIT

The water recycle pit exists outdoors and adjacent to the stable bedding area. The sampling and testing of this source consisted of:

- **Water recycle pit:** area source sampling of the water recycle pit near the completion of the bale wetting cycle (i.e. on the Wednesday of a typical 7-day production cycle). The recycled water contents inside the pit is most concentrated and was therefore considered to have the highest odour emission potential at this point of the cycle (i.e. worst case emission).

Photo 3.3 shows sampling of the water recycle pit on 29 October 2014.

Photo 3.3 – Area source sampling of the water recycle pit

3.2.1 Water Recycle Pit Odour Testing Results

The result of the water recycle pit testing is contained in **Table 3.2.**

Table 3.2 – Water Recycle Pit: Odour concentration testing results

Source description	Odour concentration (ou)	Specific Odour Emission Rate ($ou.m^3/m^2/s$)
Water Recycle Pit (non-aerating)	156,000	98.8

3.3 PHASE 2/3 PROCESS OPERATIONS

As described in **Sections 2.1.6.1 & 2.1.6.2,** Phase 2/3 process operations consist of several key stages that occur over a typical 7-week production cycle. Over this cycle, process air can be both recirculated and discharged simultaneously. This is controlled by a series of automated damper control systems that are designed to optimise operating conditions in the tunnels. The process air that is discharged over a typical production cycle via the exhaust roof stacks was sampled in this assessment study for each key Phase 2/3 process stage.

3.3.1 Phase 2/3 Odour Testing Results

The time period over which a tunnel would enter each process stage of a typical Phase 2/3 cycle and the corresponding mean odour concentration result is summarised in **Table 3.3**. The odour concentration laboratory testing result sheets can be found in **Appendix A**. **Photo 3.4** shows the tunnel exhaust roof vents on the roof of the existing Phase 2/3 Building.

In combination with the Phase 2/3 airflow data matrix supplied by Elf Farm, the mean odour concentration data presented in **Table 3.3** was used for the development of an odour emissions inventory to represent all stages over a typical Phase 2/3 production cycle.

Table 3.3 – Phase 2/3 typical 7-day production cycle: Mean odour concentration testing results

Process Stage	Cycle time (hrs)	Mean odour concentration (ou)
Phase 2 process cycle		
Tunnel Venting	0-2	2,900
Levelling	2-18	5,090
Warm-up Pasteurisation	18-26	2,390
Pasteurisation	26-34	2,440
Cool-down (conditioning)	34-42	470
Conditioning #1	42-90	332
Conditioning #2	90-114	91
Cool-down (spawn)	114-148	43
Phase 3 process cycle		
Spawn run 1	148-334	118
Spawn run 2	334-652	152

Photo 3.4 – Existing tunnel exhaust roof stacks on the Phase 2/3 Building

3.3.2 Phase 2/3 Odour emissions trend profile

In the context of the proposed modification works, Elf Farm intend on directing the emissions from the first 36 hours (i.e. from Tunnel Venting to the initial stages of the Cool-down Conditioning) to the Emissions Plant and Biofilter System. At the end of this time period, the exhaust airflow discharge (i.e. post-36 hour time period) will be directed to the roof exhaust stack for direct atmospheric discharge via dedicated roof stacks. This proposed operating regime will apply to both the extended and new Phase 2/3 Buildings. An analysis of the odour emissions trend over the Phase 2/3 7-day production cycle supports this proposed operating regime, which indicates that odour emissions gradually reduce during the first 36 hour time period and virtually stabilise after this time period. This trend is illustrated in **Figure 3.1 & Figure 3.2** over an entire production cycle and 7-day production cycle respectively. The odour emissions tend profile worksheet representing the entire Phase 2/3 process stages can be found in **Appendix D**.

It should be noted that the fresh air inlet airflows were used in the determination of all Phase 2/3 odour emission rates and are therefore considered to be conservative. In reality, a portion of the airflow is recirculated and the other portion discharged via the tunnel exhaust roof vents that exist on the Phase 2/3 Building. As previously mentioned in **Section 2.1.6,** this process is controlled by the PLC system which is designed to optimise operating conditions in the tunnels over the entire Phase 2/3 production cycle.

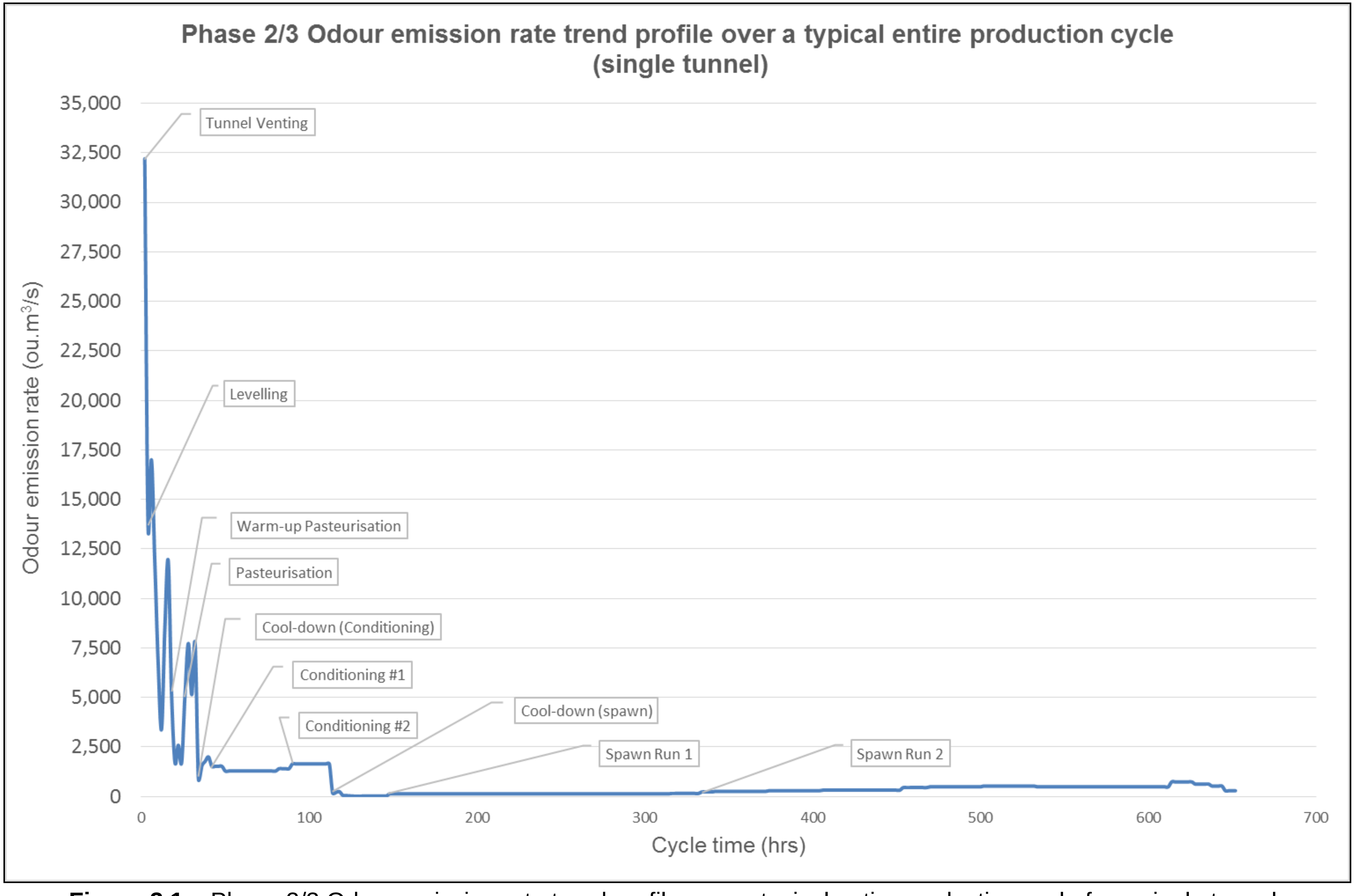


Figure 3.1 – Phase 2/3 Odour emission rate trend profile over a typical entire production cycle for a single tunnel

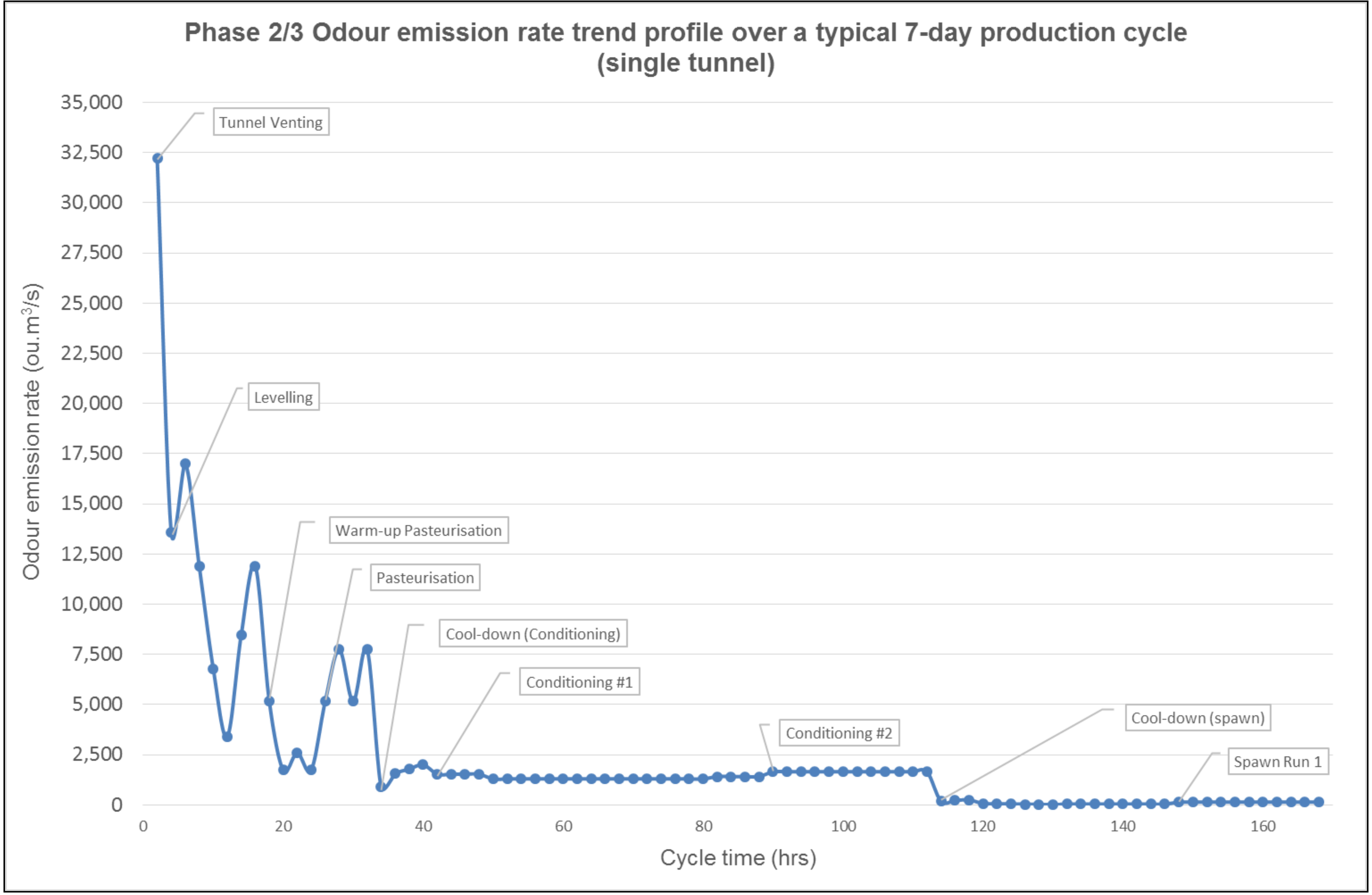


Figure 3.2 – Phase 2/3 Odour emission rate trend profile over a typical 7-day production cycle for a single tunnel

4 SAMPLING METHODOLOGIES

4.1 POINT SOURCE SAMPLING

The method used for collecting gas samples from the Phase 3 process emissions involved drawing the sample air through a polytetrafluoroethylene (PTFE) sampling tube into a single use, Nalophan sample bag. The bag was housed within a container (sampling drum) that was evacuated with a vacuum pump, and the sample collected by induced flow. The "lung method", by which this sampling procedure is known, allowed the sample air to be collected without coming into contact with any potentially odourous material. **Figure 4.1** illustrates a schematic of the point source sampling method.

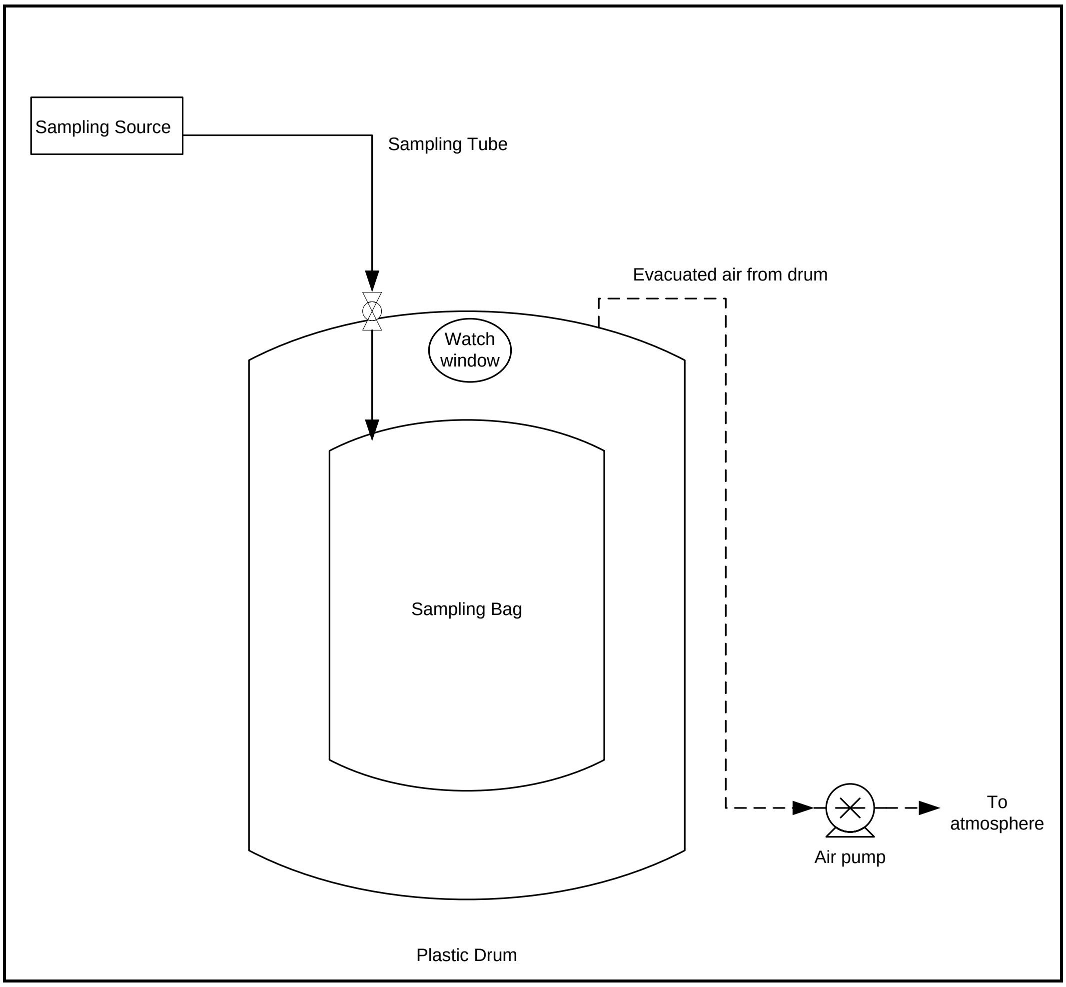


Figure 4.1 – Schematic of point source sampling

4.2 AREA SOURCE SAMPLING METHOD

The objective of the area source sampling programme was to collect representative samples at various locations at the Site, and included both solid and liquid surface area sources. The area source sampling is undertaken using an apparatus known as an isolation flux hood (IFH). All sampling using the IFH is carried out according to the method described in the United States Environment Protection Agency (US EPA) technical report '*EPA/600/8-86/008*'. This method is also defined in Australian Standard AS/NZS4323.4. TOU's IFH adheres to the design specifications, materials of construction and supporting equipment that the US EPA report '*EPA/600/8-86/008*' defines. **Table 4.1** summarises the design specifications of the IFH.

Once the IFH apparatus is set up for sample collection, dry nitrogen gas (N_2) is then introduced into the hood at a sweep rate of 5 litres per minute.

Table 4.1 - IFH design specifications

Parameter	Value
Diameter (m)	0.406
Surface Area (m^2)	0.13
Volume (L)	30*

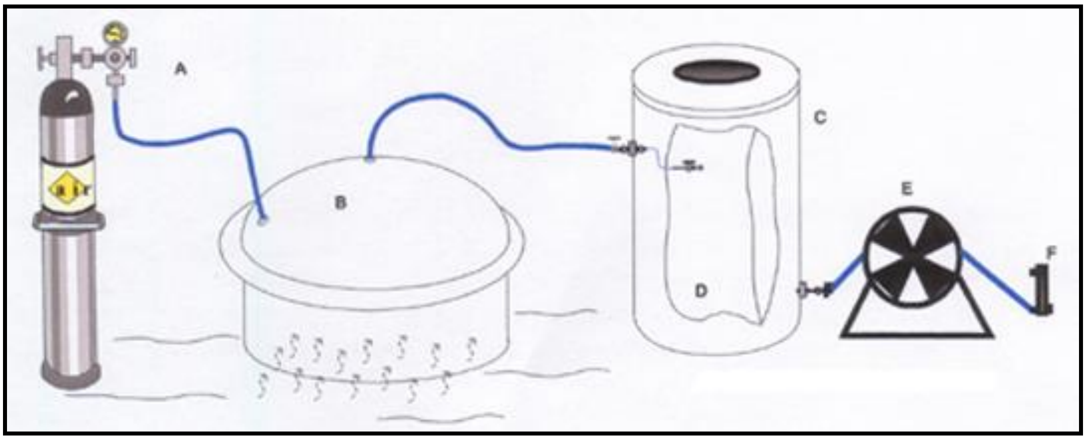
* When the skirt of the hood is immersed into the water or solid surface by the specified 25 millimetres

Area source samples are opened to the atmosphere resulting in wind being a major factor in the release of odorous pollutants from the surface and conveying the pollutant from the source to areas beyond the boundary of the Site. The IFH system is designed to simulate the mass transfer of odorous pollutants into the atmosphere, resulting in a controlled and consistent sampling environment. This is achieved by the flux of dry nitrogen sweep gas into the IFH, as it is positioned on the solid or liquid surface. On a liquid surface this is achieved by floating the IFH within an inflated tyre inner tube. The nitrogen gas then transports the odour from the surface in a similar manner to the wind, albeit at a very low sweep velocity. This odorous air is then sampled for subsequent odour testing.

As the IFH has a constant 5 litres per minute inflow of nitrogen gas to it, the sampling chamber remains under very slight positive pressure (less than 2 Pa) and produces a net outflow through the vent on top of the IFH, therefore eliminating any chance of contamination with external air from the atmosphere. The IFH's volume of 30 litres and the 5 litres per minute nitrogen sweep rate results in a gas residence time of 6 minutes. The standard method prescribes a minimum of four air changes in order to achieve optimum purging and equilibrium in the hood, and hence a total of 24 minutes is allowed before sampling commences. The sample is then collected at a flow rate of approximately 2 litres per minute over a 5–10 minute period to obtain a 10–20 litre gas sample for analysis.

The method followed by for the area sampling in this project is depicted in the schematic of the sampling equipment shown in **Figure 4.2 & Figure 4.3**. The IFH is manufactured from acrylic resin to ensure it does not contribute to the odour sample. All other surfaces in contact with the sample are made from PTFE or stainless steel.

Figure 4.2 - Schematic Drawing of Sampling with the IFH

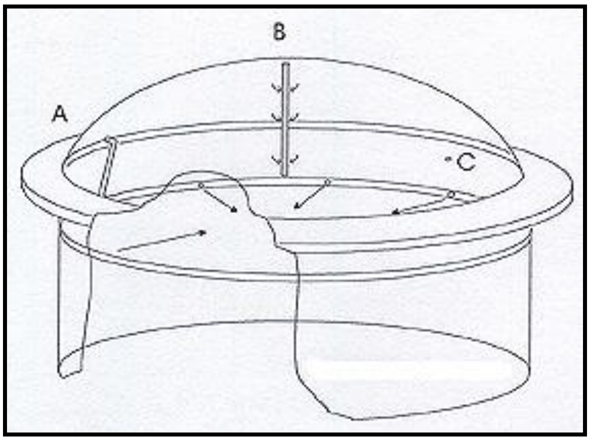


Source: Odortech - Odoflux IFH Manual

Key

A	Cylinder of medical air, nitrogen or any neutral gas.
B	IFH (detailed diagram shown in **Figure 4.3**)
C	Lung chamber (sampling drum)
D	Nalophan sampling bag
E	Sampling pump
F	Air flow meter

Figure 4.3 - Schematic of the IFH



Key

A Inlet gas from gas cylinder.

B Outlet to sample bag.

C Additional gas outlet points for other sampling, or temperature and moisture monitoring.

Source: Odotech - Odoflux IFH Manual

The use of the IFH method enables a Specific Odour Emission Rate (SOER) to be calculated (ou.m^3/m^2/s). A SOER is a measure of odour released from a representative area unit. The SOER is multiplied by the area of the source to obtain an Odour Emission Rate (OER) (ou.m^3/s), or the total odour released from each source. This calculation is demonstrated in **Equation 4.1 & Equation** 4.2 below.

$$SOER\ (ou.m^3 m^{-2} s^{-1}) = OC * \frac{Q}{A}$$ **Equation 4.1**

$$OER\ (ou.m^3 s^{-1}) = SOER * area\ of\ source\ unit\ (m^2)$$ **Equation 4.2**

where

OC = odour concentration of compound from air in the chamber (ou)

Q = sweep gas volumetric flow rate into chamber (m^3/s)

A = sample source total surface area (m^2)

All area source samples collected in this odour impact assessment were collected using the area source sampling method.

5 ODOUR CONCENTRATION MEASUREMENT METHOD

TOU's odour laboratory operates to the Australian Standard for odour measurement '*Determination of odour concentration by dynamic olfactometry'* (AS/NZS 4323.3:2001) which prescribes a method for sample analysis that provides quality assurance/quality control and ensures a high degree of confidence in the accuracy, repeatability and reproducibility of results.

The concentration of the gaseous odour samples were measured using a technique known as dynamic olfactometry. Dynamic olfactometry involves the repeated presentation of both a diluted gaseous odour sample and an odour-free air stream to a panel of qualified assessors through two adjacent ports on the olfactometer (known as the Odormat™). TOU utilises four to six trained assessors (or panellists) for sample analysis, with the results from four qualified panellists being the minimum allowed under the Australian Standard AS/NZS 4323.3:2001. For the odour testing in this project, four panelists were used.

The method for odour concentration analysis involves the odorous gas sample initially being diluted to the point where it cannot be detected by any member of the panel. The assessor's step- up to the olfactometer in turn, takes a sniff from each port, then choose which port contains the odour and enter their response. At each stage of the testing process, the concentration of the odorous gas is systematically increased (doubled) and re-presented to the panellist's. A round is completed when all assessors have correctly detected the presence of the odour with certainty. The odour is presented to the panel for three rounds and results taken from the latter two rounds, as stated in AS/NZS 4323.3:2001.

The results obtained give an odour measurement measured in terms of odour units (ou). One (1) ou is the concentration of odorous air that can be detected by 50% of members of an odour panel (persons chosen as representative of the average population sensitivity to odour). This process is defined within AS/NZS 4323.3:2001. The odour units can be subsequently multiplied by an emission rate or volumetric flow to obtain an Odour Emission Rate (ou.m^3/s) or a SOER (ou. m^3/m^2/s) for area source samples collected using the IFH method (described previously in **Section 4.2**).

5.1 ODOUR MEASUREMENT ACCURACY

The repeatability and odour measurement accuracy of the Odormat™ is determined by its deviation from statistically reference values specified in AS/NZS4323.3:2001. This includes calculation of instrumental repeatability (r), where r must be less than 0.477 to comply with the standard criterion for repeatability. Its accuracy (A) is also tested against the 95th percentile confidence interval, where A must be less than 0.217 to comply with the accuracy criterion as mentioned in the Standard.

The Odormat™ V05 was last calibrated in April 2014 and complied with all requirements set out in the AS/NZS4323.3:2001 (see **Appendix A** – Result sheets: *Repeatability and Accuracy*). The calibration gas used was 50 ppm n-butanol in nitrogen gas.

6 ODOUR MODELLING METHODOLOGY

6.1 NSW ODOUR CRITERIA AND DISPERSION MODEL GUIDELINES

Regulatory authority guidelines for odorous impacts of gaseous process emissions are not designed to satisfy a 'zero odour impact criteria', but rather to minimise the nuisance effect to acceptable levels of these emissions to a large range of odour sensitive receptors within the local community.

The odour impact assessment for this project has been carried out in accordance with the methods outlined by the documents:

- Environment Protection Authority, 2005. *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*;
- Environment Protection Authority, 2006. *Technical Framework (and Notes): Assessment and Management of Odour from Stationary Sources in NSW;* and
- Barclay & Scire, 2011. *Generic Guidance and Optimum Model Settings for the CALPUFF Modeling System for Inclusion into the 'Approved Methods for the Modeling and Assessments of Air Pollutants in NSW, Australia'.*

The documents specify that the odour modelling for Level 3 impact assessments upon which this study has been conducted be based on the use of:

- 99.0th percentile dispersion model predictions;
- 1-hour averaging times with built–in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time;
- Odour emission rates multiplied by the peak-to-mean ratios as outlined in **Table 6.1**;
- The near field distance, defined typically as 10 times the largest source dimension, either height or width; and
- The appropriate odour unit performance criterion, based on the population of the affected community in the vicinity of the development.

Table 6.1 - EPA peak-to-mean factors			
Source type	**Pasquill-Gifford stability class**	**Near-field P/M60***	**Far-field P/M60***
Area	A, B, C, D	2.5	2.3
	E, F	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A, B, C	12	4
	D, E, F	25	7
Tall wake-free point	A, B, C	17	3
	D, E, F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

* Ratio of peak 1-second average concentrations to mean 1-hour average concentrations
Source: Environment Protection Authority, 2005 – Table 6.1

The impact assessment criteria (IAC) for complex mixtures of odours are designed to include receptors with a range of sensitivities. Therefore a statistical approach is used to determine the acceptable ground level concentration of odour at the nearest sensitive receptor. This criterion is determined by the following equation (Environment Protection Authority, 2005, p. 37):

$$IAC = \frac{\log_{10}(p) - 4.5}{-0.6}$$

Equation 6.1

where,

IAC = Impact Assessment Criteria (ou)

***p* =** population

Based on **Equation 6.1**, **Table 6.2** outlines the odour performance criteria for six different affected population density categories. It states that higher odour concentrations are permitted in lower population density applications.

Table 6.2 - Odour Performance Criteria under Various Population Densities	
Population of affected community	**Odour performance criterion (ou)**
Urban Area (≥ ~2000)	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤ ~2)	7.0

Source: NSW Environment Protection Authority, 2005 – Table 7.5

Receptors to the south-west, west, north-west and north-east of the site are considered urban. Receptors to east and south-east of the Mulgrave site are of semi-rural and industrial nature. The original odour impact assessment had adopted the IAC of **2 ou** for the urban areas and **4 ou** to **7 ou** for the semi-rural and industrial areas "*as the population was sparser and in some instances only present during part of the day*" (PAE Holmes, 2010). TOU has maintained consistency with this approach as conditions have not significantly changed.

6.2 ODOUR DISPERSION MODEL SELECTION

The odour dispersion modelling assessment was carried out using the CALPUFF System (Version 6.42). CALPUFF is a multi-layer, multi-species, non-steady-state puff dispersion model that is able to simulate the effects of time- and space-varying meteorological conditions on pollutant transport (Environment Protection Authority, 2005). CALMET is a meteorological model that produces three dimensional gridded wind and temperature fields to be fed into CALPUFF (Atmospheric Studies Group, 2011). The primary output from CALPUFF is hourly pollutant concentrations evaluated at gridded and/or discrete receptor locations. CALPOST processes the hourly pollutant concentration output to produce tables at each receptor and contour plots across the modelling domain. The result is a summary of pollutant concentrations at various time averages and percentiles or a tally of hours where a pollutant has exceed a pre-determined concentration (Atmospheric Studies Group, 2011). For further technical information about the CALPUFF modelling system refer to the document *CALPUFF Modeling System Version 6 User Instructions* (Atmospheric Studies Group, 2011).

The CALPUFF system can account for a variety of effects such as non-steady-state meteorological conditions, complex terrain, varying land uses, plume fumigation and low wind speed dispersion (Environment Protection Authority, 2005). CALPUFF is considered an appropriate dispersion model for impact assessment by EPA in their document - *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* in one or more of the following applications:

- complex terrain, non-steady-state conditions,
- buoyant line plumes,
- coastal effects such as fumigation,
- high frequency of stable calm night-time conditions,
- high frequency of calm conditions, and
- inversion break-up fumigation conditions.

In the case of the EFS odour impact assessment, CALPUFF was required in order to handle the complexity of surrounding terrain features. Also, the high incidence of calms and very light winds (60% annual frequency < 2.0 m/s) were likely to induce non-steady-state conditions such as accumulation of odour and/or downslope movement with drainage air flow.

For this study, the air contaminant was odour and ground level concentrations in odour units (ou) have been projected.

6.3 GEOPHYSICAL AND METEOROLOGICAL CONFIGURATION

A CALMET hybrid three-dimensional meteorological data file for Mulgrave, NSW was developed by pDs Consultancy that incorporated topography and land use over the domain area. The meteorological data file incorporated a 3 kilometre resolution 3D data tile prepared by The Air Pollution Model (TAPM) and two observed meteorological data sources including site-specific meteorological data supplied by EFS and an Australian Bureau of Meteorology site. The year 2008 was selected in order to maintain consistency with the original odour impact assessment (PAE

Holmes, 2010). The configurations are contained within the full meteorological dataset report provided in **Appendix B**.

6.4 GRIDDED RECEPTOR CONFIGURATION

The gridded receptors were configured as a Cartesian grid spaced at 50 m by 50 m intervals over a 5.0 km by 2.8 km computational domain. The gridded receptor values were based on the projected coordinate system *WGS 84 / UTM Zone 56S*. The contour plots derived from the receptor grid were overlaid on a geo-referenced Google Earth satellite image.

6.5 DISCRETE RECEPTOR CONFIGURATION

Discrete receptors used were placed in identical locations to those used in the original odour impact assessment (PAE Holmes, 2010) in order to maintain consistency. The nearest receptor locations at ground level are listed in **Table 6.3** and illustrated in **Figure 6.1**.

Table 6.3 - Discrete receptor locations

Sensitive Receptor	Easting (km)	Northing (km)
1	297.908	6277.456
2	297.920	6277.439
3	297.910	6277.399
4	297.888	6277.399
5	297.868	6277.420
6	297.863	6277.436
7	298.607	6277.090
8	298.711	6277.062
9	298.750	6277.071
10	298.772	6277.261
11	298.749	6277.138
12	298.833	6277.045
13	298.873	6277.024
14	298.893	6277.015
15	298.838	6276.901
16	298.906	6276.894
17	298.990	6276.947
18	298.798	6276.754
19	298.671	6276.768

Figure 6.1 - Discrete receptor locations (red = near-field, blue = far-field)

6.6 BUILDING PROFILE INPUT PROGRAM

All significant structures were incorporated into the Building Profile Input Program (BPIP) and modelled with the PRIME algorithm and is illustrated in **Figure 6.2** along with odour source (including future redundant) locations.

6.7 SOURCE ODOUR EMISSION RATES

Full odour source configurations and emission rate details are available in **Appendix C**.

6.7.1 Phase 2/3 Building Upgrade

Odour emission rates (OER) from the existing and proposed Phase 2/3 buildings were modelled with use of worst-case diurnal 24 hour snapshot calculated from the sampling, analysis and fan inlet design airflows. The Phase 2/3 process airflows were provided by Elf Farm in order to enable the determination of odour emission rates and can be found in **Appendix D**. The worst case 24 hour emissions snapshot from the Phase 2/3 exhaust roof stacks was determined to be during the Phase 2 process period, typically from Thursday 8 pm to Friday 8 pm (i.e. 66-88 hrs cycle time). This is the highest odour emission potential period when a full batch of eight tunnels within the existing building are in the Conditioning stage and when the batch contained within the proposed building has completed the Pasteurisation stage and entered the Cooldown stage in preparation for Conditioning (refer to **Section 3.2.1** for an outline of the various Phase 2/3 process stages). Concurrent to this period, the fifteen other tunnels are in later Phase 3 stage (i.e. spawn runs, cooldown and shipout). The worst case diurnal 24 hour snapshot was modelled every day of the year. This is highly conservative and it is probable to produce a higher result than if an arbitrarily varying emissions profile was used as input.

To represent the proposed modification upgrades it was assumed that the existing Phase 2/3 building emission sources are increased from twenty-two to twenty-five exhaust roof stacks and the construction of a new Phase 2/3 building with twenty-five exhaust roof stacks. This resulted in a total of fifty exhaust roof stacks modelled. The fan inlet design airflows for the existing Phase 2/3 Building will remain the same at 40,000 m^3/hr per tunnel and the new Phase 2/3 Building will have a new fan design airflow of 50,000 m^3/hr per tunnel. These are inlet fan conditions and therefore the derived odour emission rates are considered highly conservative (see **Section 3.2.1** for further details).

6.7.2 Proposed Biofilter System

The detailed design of the proposed biofilter has yet to be finalised. However the final design parameters for the biofilter have been selected. These are listed below as follows:

- **Design Airflow**: 390,000 m^3/hr (maximum, see below)
- **Layout:** Two cells, upflow, open discharge,
- **Bed Area:** 2,800 m^2 total (1,300 m^2 and 1,500 m^2)
- **Bed Depth:** 1.7 m

- **Surface Loading:** 139 m^3/m^2/hr (maximum),
- **Residence Time:** 44 secs (minimum, Empty Bed Residence Time)
- **Inlet air temperature:** 36^{o}C design (40^{o}C maximum)
- **Expected performance:** Less than 1,000 ou

TOU has vast experience in the design of large biofilters and has reviewed the proposed design of both the biofilter and odour collection system and found it to be conservative and appropriate for the Elf Farm application. A significant feature of the design and operation of the biofilter system is that airflows will vary with the cyclic nature of the composting process, such that the biofilter will mostly operate at airflow loadings well below the above maximum design value.

The modelled performance level of 1,000 ou reflects an odour concentration that is not expected to be exceeded, even as the biofilter medium is nearing the end of its useful life. Mean treated odour levels of 500 ou or better are anticipated. It is expected that the treated air from the biofilter will have little or no inlet odour character.

For modelling purposes the proposed biofilter odour emission rate was estimated with the use of the above target performance concentration of 1,000 ou and maximum design extraction airflow of 450,000 m^3/hr, this being the best estimate of the airflow at the time. As shown above, this was revised downwards to 390,000 m^3/hr during the design stage. This emission was modelled as a constant emission rate. This assumes full containment and capture at all source groups except post-Pasteurisation Phase 2 and Phase 3 discharges. As a result of the above, the modelling projections for the biofilter emission are highly conservative.

The design maximum airflow to the biofilter has been based on the need to achieve an adequate level of negative pressure inside the processing areas, and maintain safe working conditions for operators. Actual air exchange rates will vary between 5 and 10 air changes per hour. At the lower end of this range working conditions for operators will still be more than adequate.

The performance and condition of the biofilter will be assessed and controlled in several ways. A key element will be the logging (Supervisory Control and Data Acquisition - SCADA) of inlet air condition parameters (temperature, relative humidity, ammonia etc.) to ensure that the air is in optimal condition for biofiltration. Biofilter back-pressure will also be logged, as this is a key indicator of potential bed moisture problems. The biofilter system will also be inspected on at least a daily basis to check treated air quality and adequate airflow distribution across the biofilter cells. Finally, independent biofilter system assessments will be carried out by a biofilter specialist, at frequencies that have yet to be finalised.

The performance of the ammonia scrubbers will be monitored via the plant's SCADA system. This will enable operators to check the condition of these units alongside routine checking of all other process conditions at the plant. The scrubbers themselves will be fitted with pH control to ensure optimum scrubbing performance.

A total of six scrubbers are proposed. This will provide a degree of redundancy in the event that one unit needs to be taken off line. The biofilter, being configured in two cells, will enable one cell to be taken off line for maintenance and/or medium replacement (every 4-5 years). During this short period (5-7 days) airflows in the collection system can be managed to ensure that the biofilter capacity is not exceeded, while retaining negative pressure conditions where required. A total failure of the biofilter system is not a realistic scenario that requires consideration.

6.7.3 Interim Raw Materials and Recycled Water Handling Upgrade

For the interim upgrade, the stormwater overflow retention dam will only continue to be used by Elf Farm under conditions such as high rainfall periods and will be kept empty at all other times. Also, the chicken manure and brew mix sources are to be fully contained by a new building enclosure. The bale wetting area, stable bedding area and water recycle pit will remain unchanged in the interim stage. Worst-case OERs have been modelled for the bale wetting area, stable bedding area and water recycle pit.

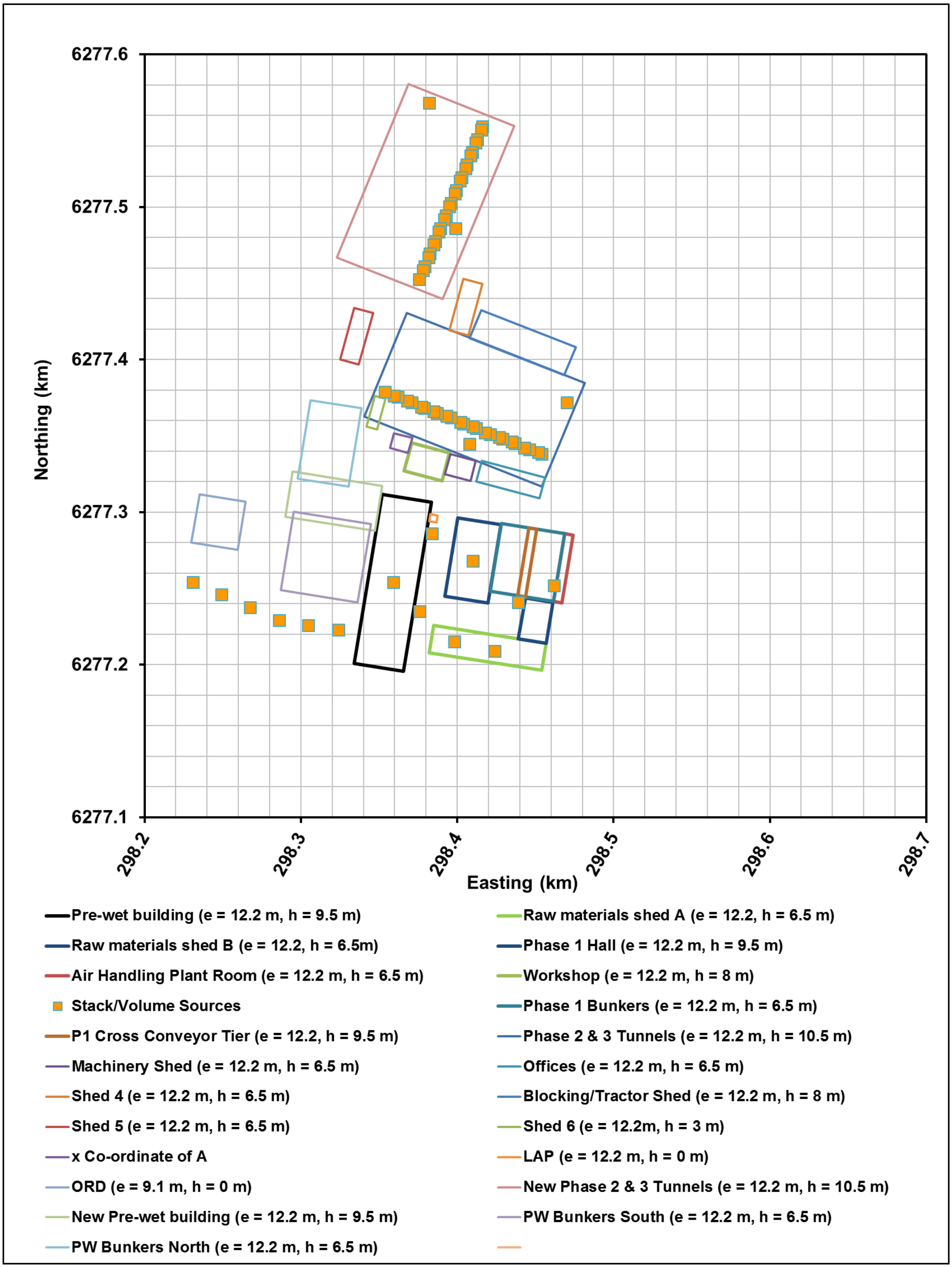


Figure 6.2 - BPIP input and odour source illustration

6.8 CALPUFF MODEL OPTIONS

CALPUFF default model options were set except for the following as recommended in *Table A*-4 contained and explained within Barclay & Scire, 2011:

- Dispersion coefficients (MDISP) = dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (2);

- Probability Density Function used for dispersion under convective conditions (MPDF) = Yes (1); and

- Minimum turbulence velocities sigma v for each stability class over land and water (SVMIN) = 0.2 m/s for A, B, C, D, E, F (0.200, 0.200, … , 0.200).

Further model configurations including a truncated CALPUFF list file are available in **Appendix C.**

6.9 ODOUR DISPERSION MODELLING SCENARIOS

Several odour dispersion modelling scenarios were modelled focusing on the following source groups:

- **Scenario 1** – Proposed modification interim stage: Raw Materials Area and Recycled Water Handling Upgrade. The source groups modelled included emissions from bale wetting area, stable bedding area and water recycle pit only. The raw materials area at this stage is contained i.e. set to zero emissions;

- **Scenario 2** – Biofilter System: modelled emissions from the biofilter system at 1,000 ou mean target concentration performance with containment of all other emission areas and sources; and
- **Scenario 3** – Phase 2 and 3 Upgrade: modelled emissions from the later stages of Phase 2 and all of Phase 3 from the roof exhaust vents from the extended and new Phase 2/3 Buildings. A total of fifty roof exhaust vents were modelled (i.e. twenty-five vents per building). The model represents the exhaust emissions of a worst-case 24 hour snapshot that was determined to be total of 26,625 ou.m^3/s one hour average running over a 24 hour period.

7 ODOUR EMISSIONS INVENTORY

The odour emissions inventory developed for the Site is complex as emissions vary both spatially and temporary. However the modifications to the approved expansion project has simplified this inventory as virtually all emissions will be contained and directed to the Emissions Plant and Biofilter System in the final stage of the modification works.

The following sections outline the assumptions and characteristics of each future emission source group that was taken into consideration in deriving all modelled odour emission rates.

7.1 ODOUR EMISSION SOURCE GROUPS

Each source group has been discussed and, where applicable, removed as an odour emission source as a result of the proposed modification works. The details for this is discussed for each source group in the following sections.

7.1.1 Raw Materials Shed Area

The raw materials shed area will be contained within a building. This building will have airflow extraction. The extracted airflow emissions from this area will be directed to the Emissions Plant and Biofilter System before discharge to atmosphere.

The modelling assumes that fugitive emissions from this area will be negligible given that the process operations and raw materials in this area will be contained in the proposed modification works.

7.1.2 Recycled Water Handling Areas

The recycled water handing areas include: the existing bale wetting area; the existing stable bedding area; and the water recycle pit. The bale wetting and stable bedding process operations will shift from outdoors to indoors and be contained. The existing Pre-wet Shed building will become the new Bale Wetting Building and have airflow extraction. The extracted airflow emissions from this area will be directed to the Emissions Plant and Biofilter System before discharge to atmosphere.

The modification works for the bale wetting area will continue once the Emissions Plant and Biofilter System has been successfully constructed and commissioned. Therefore, two scenarios exist for this source group in the proposed modification works:

1. An interim scenario where the recycled water handling process operations will continue to operate under existing conditions. The odour emission rates selected for the interim scenario are identical to those derived from the odour sampling and testing exercise conducted by TOU (see **Sections 3.1 & 3.2**); and

2. The final scenario where the recycled water handling process operations shift to the existing Pre-wet Shed building and is contained. A nominal air change in this building will be up to 5 air changes/hr. The modelling assumes that fugitive emissions from this area will be negligible given this airflow extraction rate proposed.

7.1.3 Pre-wet Process Operations

The Pre-wet process operations will shift from the existing Pre-wet Shed building to new dedicated bunkers and working hall area that will exist in the western area of the Facility adjacent to the Pre-wet Shed building. All bunkers will have full airflow extraction with exhaust air directed to the Emissions Plant and Biofilter System for emissions treatment prior to discharge to atmosphere. A portion of the air used in the bunkers will be recirculated with the remainder discharged. This will be controlled by the PLC system.

The new Pre-wet working hall area will be contained and have a nominal airflow extraction rate of up to 5 air changes/hr during operations. The extracted air will be directed to the Emissions Plant and Biofilter System.

The modelling assumes that fugitive emissions from the proposed Pre-wet bunker and working hall will be negligible.

7.1.4 Phase 1 Process Operations

The Phase 1 inclined & cross transfer conveyors operation will be contained. The extracted airflow emissions from this area will be directed to the Emissions Plant and Biofilter System before discharge to atmosphere. A nominal air change in this building will be up to 5 air changes/hr during operations.

The modelling assumes that fugitive emissions from the Phase 1 process operations will be negligible.

7.1.5 Phase 2/3 Process Operations

All emissions generated during Phase 2/3 process operations (for both existing and proposed) will have the capacity to be directed to the proposed Emissions Plant and Biofilter System. However, based on the modelling results (see **Section 9**), it has been determined that only Phase 2 process emissions will need to be directed to the Emissions Plant and Biofilter System for treatment with Phase 3 emissions discharged directly via the dedicated exhaust roof stacks for the existing and proposed Phase 2/3 buildings. This is considered an optimal manner in which to operate given that the Phase 3 emissions are of a low odour emission rate and neutral odour character.

The modelling assumes that fifty tunnels will be in the latter stages of Phase 2 (i.e. cool-down conditioning) and Phase 3 as the worst case scenario and fugitive emissions from process operations at both Phase 2/3 Buildings will be negligible.

7.1.6 Bioscrubber System

The existing bioscrubber system and stack will be mothballed following the completion and commissioning of the proposed modification works. Therefore, the modelling has assumed that this will no longer be an odour emission source at the Facility and has been removed from the modelling.

7.2 ODOUR EMISSIONS INVENTORY TABLES

The odour emissions inventory tables can be found in **Appendix C**.

8 ODOUR MODELLING RESULTS

The following model plots represent the ground level odour concentration (ou, 99th percentile, 1 second average) for all source groups. This represents TOU best estimate of worst-case emissions scenarios from Elf Farm. The odour impact results are therefore considered conservative:

- **Figure 8.1 (Scenario 1):** Projection of far-field odour impact from the recycled water handling areas including bale wetting area, stable bedding are and water recycle pit only. This was modelled as an interim stage before completion of the final modification works (i.e. full containment of these source groups). The stormwater overflow retention dam is not included in this scenario as advice from Elf Farm is that it will only be utilised under emergency conditions such as high rainfall periods and plant breakdowns and will be kept empty at all other times;
- **Figure 8.2 (Scenario 2):** Proposed biofilter odour control system at 1,000 ou mean target performance concentration at maximum design airflow of 450,000 m^3/hr. This assumes full containment and capture at all source groups. The emissions from the initial stages of the Phase 2 are not represented in this modelling plot and are shown in Scenario 3; and
- **Figure 8.3 (Scenario 3):** Phase 2/3 emission upgrade conditions i.e. emissions from the later stage of Phase 2 (i.e. from cool-down conditioning till cool-down spawn) and Phase 3 (i.e. spawn runs 1 & 2 and cool-down (spawn/ship-out)). It is assumed emissions during the early stages of the Phase 2 process cycle (i.e. tunnel venting, levelling, warm-up pasteurisation, pasteurisation and the commencement of cool-down conditioning) is directed to Emissions Plant and Biofilter System. The model represents the exhaust emissions of a worst-case 24 hour snapshot that was determined to be total of 26,625 ou.m^3/s one hour average running over a 24 hour period.

Projected ground level odour concentrations (ou, 99%, 1 second average) at each modelled discrete receptor are available in **Table 8.1**.

Table 8.1 - Discrete receptor odour impact results (ou, 99%, 1-s)				
Sensitive Receptor	**Scenario 1 Interim Upgrade**	**Scenario 2 Biofilter Upgrade**	**Scenario 3 Phase 2/3 Upgrade**	**Impact Assessment Criteria**
1	11.5	3.2	1.5	2
2	12.5	3.4	1.5	2
3	13.0	3.3	1.4	2
4	12.3	3.2	1.4	2
5	11.2	3.1	1.4	2
6	10.7	3.0	1.4	2
7	39.7	6.1	2.3	4 - 7
8	27.4	4.4	1.7	4 - 7
9	23.7	4.2	1.6	4 - 7
10	22.7	3.5	1.7	4 - 7
11	26.6	4.3	1.7	4 - 7
12	16.7	3.5	1.4	4 - 7
13	14.4	3.2	1.3	4 - 7
14	13.3	3.1	1.3	4 - 7
15	14.1	2.6	1.3	4 - 7
16	12.1	2.6	1.2	4 - 7
17	10.3	2.6	1.2	4 - 7
18	11.8	2.4	1.4	4 - 7
19	16.3	2.6	1.5	4 - 7

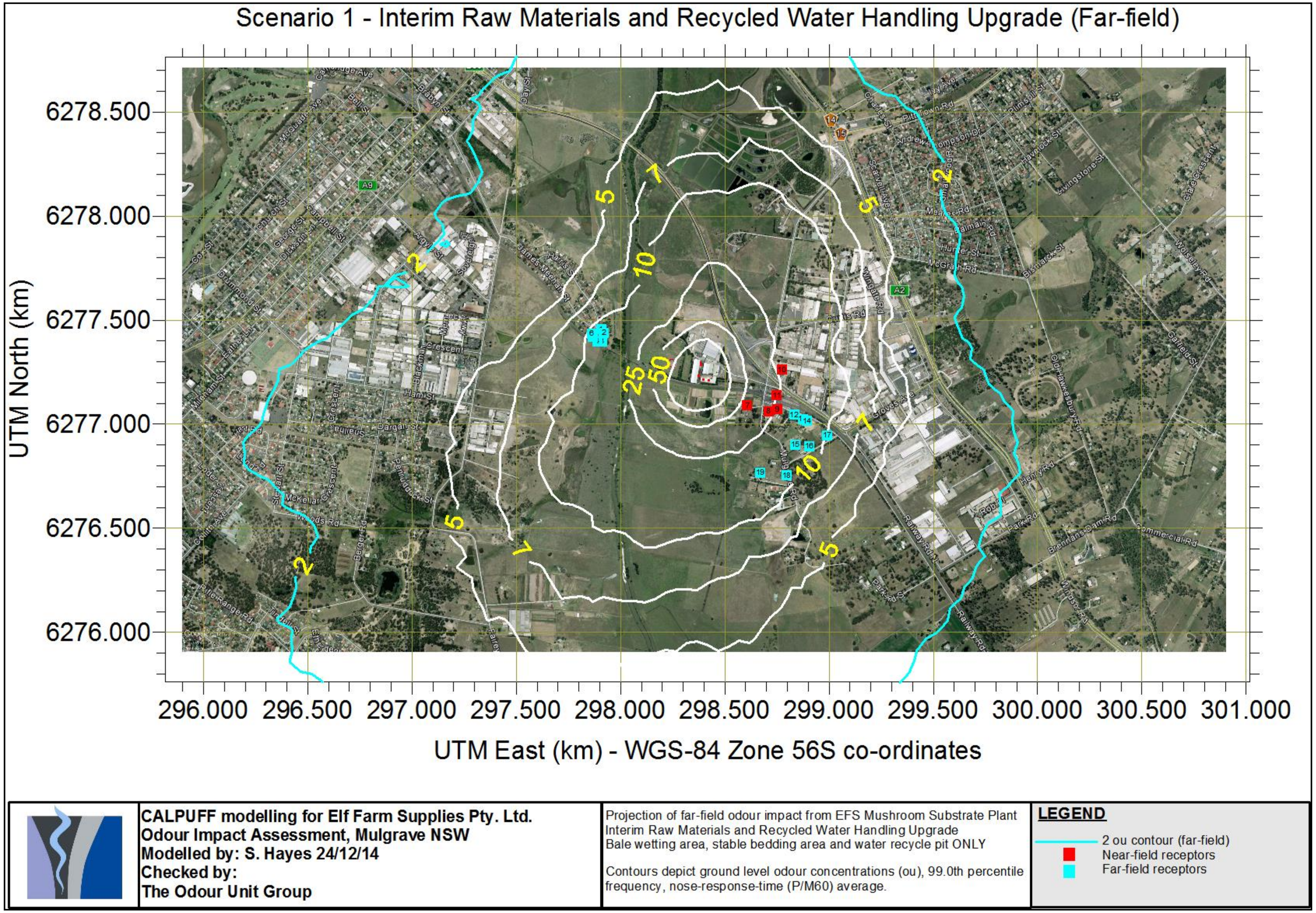
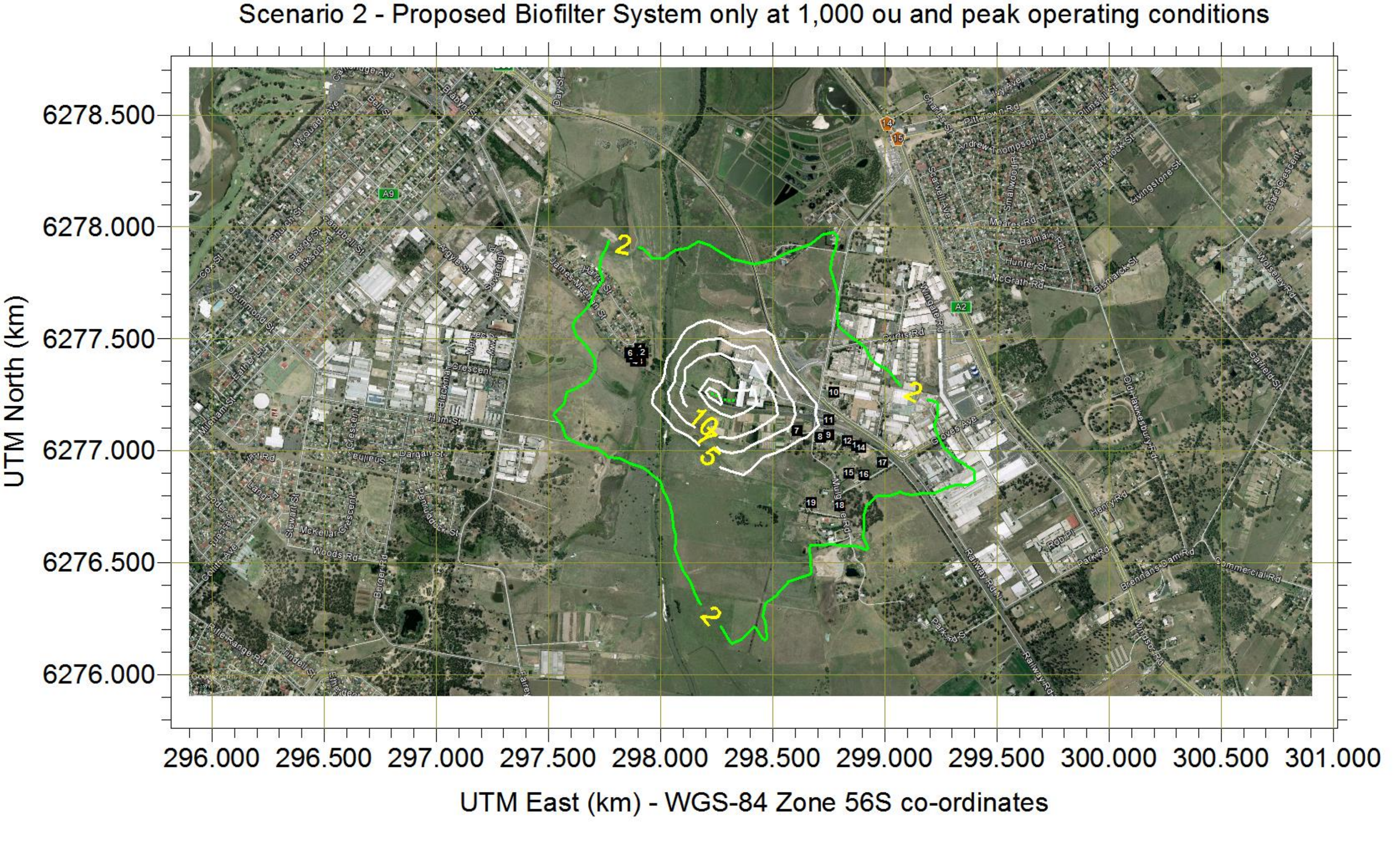


Figure 8.1 – Projection of far-field odour impact at the interim stage from the recycled water handling areas only



CALPUFF modelling for Elf Farm Supplies Pty. Ltd. **Odour Impact Assessment, Mulgrave NSW** **Modelled by: S. Hayes 17/12/14** **Checked by:** **The Odour Unit Group**	Projection of odour impact from EFS Mushroom Substrate Plant Proposed Biofilter System only at 1,000 ou and peak operating conditions Contours depict ground level odour concentrations (ou), 99.0th percentile frequency, nose-response-time (P/M60) average.	**LEGEND** 2 ou contour Discrete receptors

Figure 8.2 – Projection of odour impact map plot for proposed biofilter system at 1,000 ou mean target performance concentration

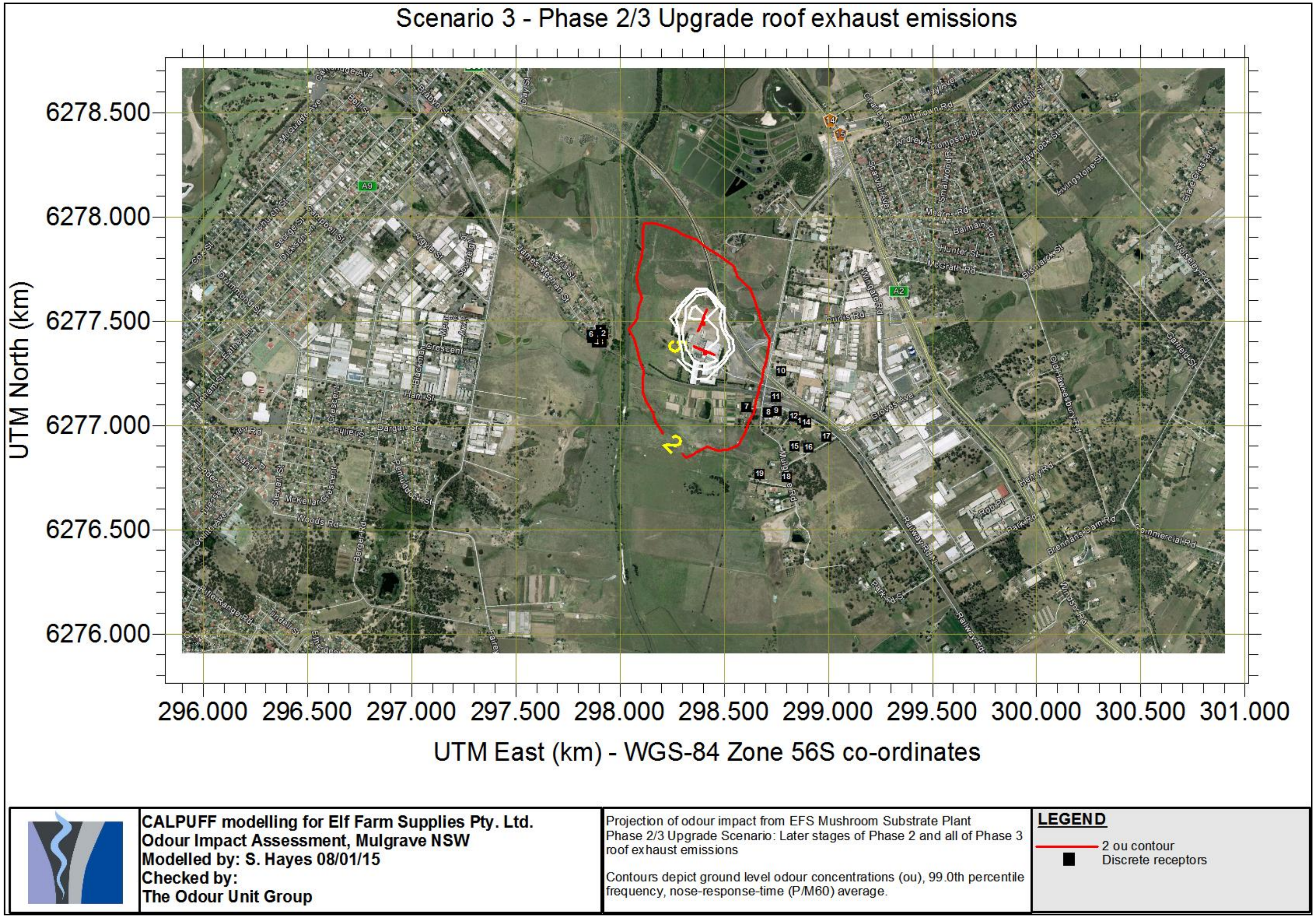


Figure 8.3 – Projection of odour impact map plot for proposed upgrade works for Phase 2 & 3 process operations

9 DISCUSSION OF MODELLING RESULTS

The following discusses the modelling results for the proposed modification works for each scenario including the interim and final stages.

9.1 SCENARIO 1 – INTERIM STAGE

Projection of far-field odour impact from bale wetting area, stable bedding area and water recycle pit shows exceedance of the 2 ou odour performance criterion for the urban areas to the south-west, west, north-west and north-east of the Facility. In addition, there is exceedance of the 4 ou to 7 ou for the semi-rural and industrial areas to east and south-east of the Facility. This projection is at the interim stage before completion of the final modification works (i.e. full containment of these source groups). It should be noted that worst case odour emission rates have been modelled for the bale wetting area, stable bedding area and water recycle pit. Therefore, the projected odour impact is highly conservative and will vary throughout a typical 7-day production cycle where water recycle quality is known to vary (see odour emission data for bale wetting area in **Appendices A & C**).

9.2 SCENARIO 2 – FINAL STAGE

The odour impact projection for this scenario shows that the proposed Emissions Plant and Biofilter System at 1,000 ou mean target performance concentration at maximum design airflow of 450,000 m^3/hr shows compliance with the 2 ou odour performance criterion for most of the urban areas to the south-west, west, north-west and north-east of the Facility. In addition, compliance is achieved with the 4 ou to 7 ou odour performance criterion for the semi-rural and industrial areas to east and south-east of the Facility.

This scenario represents worst case scenario under maximum operating conditions and is therefore considered conservative. In reality, the projected odour impact is likely to be much less than that modelled given the temporal and spatial variations that will occur during a typical 7-day production cycle at the Facility. These variations will have a significant impact on the airflow extraction demand on the Emissions Plant and Biofilter System over a production cycle. Also, the modelled biofilter emissions will be of a treated quality with no original process character present. Therefore, given the above analysis, the exceedance shown in part of the urban area to the north-west is not considered to be problematical.

9.3 SCENARIO 3 – FINAL STAGE

The odour impact projection for this scenario shows that discharge of Phase 3 emissions under the proposed modification (i.e. two Phase 2/3 Buildings, each with twenty-five tunnels, equivalent to a total of fifty tunnels) shows compliance with the 2 ou odour performance criterion for the urban areas to the south-west, west, north-west and north-east of the Facility. In addition, there is compliance with the 4 ou to 7 ou odour performance criterion for the semi-rural and industrial areas to east and south-east of the Facility. This reflects emissions that are discharged post-36 hours' time period over the Phase 2/3 production cycle (i.e. upon the completion of the pasteurisation stage). All emission pre-the 36 hours' time period will be directed to the Emissions Plant and Biofilter System.

10 CONCLUSION

In September 2014 Elf Farm engaged TOU to undertake an odour impact assessment for the modification to the approved expansion project of the Facility. The Department of Planning & Environment (DPE) project number for the proposed modifications to the approved expansion is 08_0255 MOD1.

A site-wide odour emissions inventory was developed that is representative of conditions that will exist at the Facility following the proposed modification works. The key features of the proposed modification are full containment and airflow extraction of all existing odour emission source groups and process operations. The exception to this is the stormwater overflow retention dam and the later stages of Phase 2 and all of Phase 3 exhaust emissions.

The stormwater overflow retention dam has not included been included in the final stage scenarios as advice from Elf Farm is that it will continue only to be utilised under conditions such as high rainfall periods and will be kept empty at all other times. The Phase 2/3 modelled emissions shows clear compliance under the proposed upgrade scenario where emissions are discharged directly to atmosphere without the need for treatment by the proposed Emissions Plant and Biofilter System.

Overall, the proposed modifications at the final stage is expected to result in a highly significant reduction to the Facility's existing odour emissions and impact profile. The proposed modifications will achieve compliance with the 2 ou odour performance criterion for most of the urban areas to the south-west, west, north-west and north-east of the Facility and compliance with the 4 ou to 7 ou odour performance criterion for the semi-rural and industrial areas to east and south-east of the Facility. The modelled biofilter emissions will be of a treated quality with no original process character present. Also, in reality, the projected odour impact is likely to be much less than that modelled given the temporal and spatial variations that will occur during a typical 7-day production cycle at the Facility. Therefore, the exceedance of the odour performance criterion shown in part of the urban area to the north-west is not considered to be problematical.

The final stage modelling has not considered cumulative odour effects that would arise if the various odour types were to combine in the atmosphere. This decision was taken in the knowledge and experience by TOU that the widely different odour character in each of the two odour source groups (biofilter and Phase 2 emissions) retain their individual detectability at downwind locations, and do not combine into a homogeneous odour character.

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