Report

Te Mata Mushrooms Odour Source Assessment

Prepared for Te Mata Mushrooms Ltd (Client)

By Beca Infrastructure Ltd (Beca)

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Revision History

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A	Michele Dyer Tracy Freeman	Draft for client review	9 February 2010
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Document Acceptance

Action	Name	Signed	Date
Prepared by	Michele Dyer	MDyer	24 February 2010
Reviewed by	Tracy Freeman	Tracy Freeman	24 February 2010
Approved by	Tracy Freeman	Tracy Freeman	24 February 2010
on behalf of	Beca Infrastructure Ltd		

Table of Contents

Appendices

1 Introduction

Te Mata Mushrooms Ltd (TMM) operates a mushroom growing factory near Havelock North, Hawke's Bay. The factory includes a compost making facility where the compost substrate for growing the mushrooms is prepared.

The composting facility has historically been surrounded by rural-type activities including a camping ground, but in recent times has been subject to urban encroachment with residential subdivision occurring close by. The operation has been operating under a series of resource consents, two of which, including a discharge into air permit, are due to expire on 31 May 2010.

The purpose of this report is to identify the sources of odour at the composting plant on the TMM site, the extent of odour mitigation currently in place, and additional odour mitigation measures for the site that could be implemented.

2 Site Location

2.1 Location and Neighbouring Land Uses

The TMM site is located at 174-176 Brookvale Road, Havelock North. The location is shown in Figure 2.1. The site is bounded by farmland to the east and a new housing development known as "Brookvale", recently rezoned from rural land use to the southwest (Figure 2.2).

The nearest existing residential dwelling is currently located about 250 m to the southwest from the ridge on the southwestern boundary of the TMM site, however when the new residential development is completed a greater number of residential dwellings will be about 200 m to the southwest from this ridge.

Figure 2.1 Location of TMM site.

Figure 2.2 New residential subdivision to the southwest of TMM site

3 Description of Activities

3.1 Composting

Compost is an essential part of the mushroom growing process and is used as part of the substrate that the mushrooms are grown on. Compost consists of straw, chicken litter and gypsum. The key components of the composting process are described in this section. A number of photos illustrating the various processes are included in Appendix A.

Straw is kept on a gravel pad on site until it is required. Chicken litter is stored in a concrete bunker which consists of a concrete pad, three walls and a roof (Photo A1, Appendix A). The front of the chicken litter bunker faces approximately south-southwest and TMM advises that this opening is not often subject to rain. Gypsum is mixed with the chicken litter as it is required and the gypsum and the resultant chicken litter mix is stored in an adjacent bunker to the bulk chicken litter (Photo A1). The smaller chicken litter mix bunker consists of a concrete pad and three concrete walls, and a tarpaulin is used to cover the mix during rain.

Approximately 120 tonnes of compost is produced per week. Compost is processed in two parallel batches at any one time. The composting timeline for a single batch is as shown in the schedule below. Photos of various parts of this process, taken during the Beca staff site visit on 14-15 December 2009 are shown in Photos A2 to A11 in Appendix A.

Week 1	Thursday	Bales laid out on outside concrete pad	
	Friday		
	Saturday		
	Sunday		
	Monday	Bales wet with effluent for approximately 30 hours (less if the weather is hot)	Photos A2, A3
	Tuesday		
	Wednesday		
Week 2	Thursday	Chicken litter and gypsum placed on top of bales. Bales turned twice and put into covered concrete bunker "Phase 1"	
	Friday	Compost in Phase 1 bunker	
	Saturday		
	Sunday		
	Monday	Compost removed from bunker and mixed. Returned to bunker	Photos A4, A5, A6
	Tuesday	Compost in Phase 1 bunker	
	Wednesday		
Week 3	Thursday		
	Friday	Compost removed from bunker and mixed. Returned to bunker	
	Saturday	Compost in Phase 1 bunker	
	Sunday		
	Monday		
	Tuesday	Half of compost removed from bunker. Compost is turned and	Photo A7,

		extra water is added if necessary. Compost is put into "Phase 2" bunker and is pasteurised	A8, A9, A10
	Wednesday	Second half of compost is removed from the "Phase 1" bunker, turned and wetted, and put into a second "Phase 2" bunker	
Week 4	Thursday	Compost in Phase 2 bunker	
	Friday		
	Saturday		
	Sunday		
	Monday		
	Tuesday	Remove pasteurised compost from "Phase 2" using front-end loader. Processed into mushroom trays	Photo A11
	Wednesday	Remove pasteurised compost from "Phase 2". Processed into mushroom trays	

The composting facility consists of two "Phase 1" bunkers which are emptied and filled on a fortnightly basis, with each bunker being emptied and filled with a new batch on alternative weeks. These bunkers have a concrete floor, two concrete walls and insulated panel roof, and the end openings are closed with heavy tarpaulins (Photo A12). The Phase 1 bunker concrete floor has recessed lines which act in parallel as a leachate collection system and aeration lines (Photo A13). These lines are hosed out weekly to prevent blockages, and a full inspection of the lines (checking for blocked nozzles, wear and tear etc) is conducted every two months.

During the composting in Phase 1 air is blown through the composting material to maintain aerobic conditions. Oxygen probes are placed approximately 1200 mm deep into the material at one location in each bunker. These probes also measure the temperature within the compost. Temperature probes are also located in the headspace near the roof of the bunker. An oxygen content of 6-8% within the compost is maintained, however this is often higher if extra air is needed for temperature control. Foul air within the bunker is drawn from a single collection point in the top of each bunker (Photo A13) and blown through a bark biofilter (Photo A14, also refer section 4.2).

The bunker is normally operated under a slight vacuum or negative pressure compared to outside air, except in some circumstances which are discussed later in this report.

The "Phase 2" bunkers consist of a concrete floor, walls and roof (Photo A15). Oxygen probes and temperature gauges are inserted into the compost at several points. During the Phase 2 cycle, air in the bunker is recirculated at one end of the bunker (Photo A15), and a portion of the air is passively vented to atmosphere at the other end of the bunker (Photo A15 and A16). During filling of the Phase 2 bunkers, the ends of the bunkers are open to atmosphere (Photo A17).

3.2 Effluent Collection and Storage

The composting is all conducted on a concrete pad and all stormwater and leachate from the composting system is collected into the effluent system through drain lines recessed into the concrete. The effluent is stored and recycled to wet the bales. Occasionally excess effluent is applied to the land within the TMM site.

The effluent is screened then aerated in a sump and circulated continuously through a storage pond, however no monitoring is conducted. Photos A18 to A22 in Appendix A show pictures of the effluent system.

4 Description of Odour Discharges and Mitigation

4.1 Approach to Odour Control

A number of mitigation and operating procedures have been implemented to reduce the odour and effects of odour from the site. The primary mitigation measures are the use of a biofilter to treat odours originating within the Phase 1 bunkers, plus the use of odour control sprays.

4.2 Biofilter

A biofilter is used to treat the air ventilated from the compost during Phase 1 (Figure 4.1). The biofilter specifications are summarised in Table 4.1. Visual inspection of the biofilter found that it appeared to be in good condition and damp under the surface. The biofilter emitted no recognisable composting odours other than the faint but characteristic earthy odours commonly associated with well-operating biofilters.

Figure 4.1 – Biofilter surface.

Table 4.1 - Biofilter specifications

Design parameter	
Dimensions (external, design)	24.6 m x 6.6 m
Dimensions (internal, approx)	24 m x 6 m
Surface area	144 m²
Depth	2 m (1.5 m Bark 10-20 mm, 0.25 m bark 25-75 mm, 0.25m river gravel 20-40 mm)
Volume	252 m³ (excludes depth of river gravel)
Biofilter media	Radiata pine bark with washed river gravel base
Maximum air flow	20250 m^3/hr (from fan specification curve)
Maximum hydraulic loading rate	80 m^3/hr per m^3 media

The fan speed is regulated by using an electronic variable speed fan drive and is regulated to keep the "Phase 1" bunkers at approximately 38 – 40°C when the doors are shut. The biofilter inlet temperature is measured 2-3 times per day and fresh air is added by manual duct adjustment at the biofilter inlet as required to maintain the inlet air temperature at 40°C or less. The biofilter moisture is maintained at 50 – 70% using an irrigation system and is tested weekly.

TMM has recently fitted a water spray system into the duct upstream of the biofilter blower. Once commissioned, this will increase the humidity of the air entering the biofilter and may also act as a partial wet scrubber, removing some ammonia from the air stream.

Table 4.2 summarises recommendations for typical biofilter capacity design in New Zealand, published in Cudmore & Gostomski (2005). Based on the criteria in this table for bark biofilters, and considering the type of air extracted to the biofilter, it is considered that an appropriate design loading rate for the biofilter would be 20-40 m^3/hr per m^3 media. The actual hydraulic loading rate under maximum air flows is higher than this, at 80 m^3/hr per m^3 media, however despite this the biofilter appears to be operating well and no immediate modifications to increase the capacity are recommended.

It is recommended however that no additional air flows should be put through this biofilter, unless the biofilter is increased in size and/or the medium is modified to include approximately 10-20% soil in addition to the bark (which increases the design capacity of the biofilter).

Table 4.2 - Biofilter recommended design loading rates, from Table 11.1 of Cudmore & Gostomski (2005).

Table 11.1. Recommended biofilter loading rates for different air sources and different media

Air source	Media type	Recommended loading rate (m^3 air/h per m^3 media)	Residence time (s)
Building air (ambient conditions, low odor)	Soil–bark	60–150	24–60
Building air (ambient conditions, low odor)	Graded bark	20–40	90–180
Cooled process air, $\leq$ 40 °C, saturated, no smoke	Soil–bark	30–50	72–120
Cooled process air, 40–60 °C, saturated, no smoke[a]	Graded bark	10–20	180–360
Saturated process air, $\leq$ 40 °C, saturated, significant smoke	Soil–bark	30–40	90–120
Saturated process air with significant smoke	Graded bark	Not recommended	–

[a] Graded bark beds are more stable at higher temperatures than soil–bark mixtures

4.3 Odour Control Sprays

Odour control sprays are provided around the composting yard at many odour emission points that are not controlled by the biofilter. The odour control chemical that is currently used is called "Super Spice" from Cyndan Chemicals (supplied by Hi-Chem NZ Ltd), and it is understood this was originally recommended by the Hawke's Bay Regional Council.

The label on the Super Spice containers describes the chemical as *"an environmentally friendly odour-controlling agent made from essential oils and compounds that neutralizes odours and converts them into an acceptable state"*.

The Super Spice is dispersed using spray nozzles suspended near the concrete turning pads and around the Phase 1 and Phase 2 bunkers. Super Spice is used when the compost is being turned, or is getting loaded or unloaded from the "Phase 1" and "Phase 2" bunkers, and when the wind is blowing from the northeasterly sector.

These spray nozzles are visible in some of the photos in Appendix A.

There are a range of odour control chemicals available on the market. These chemicals generally fall into one of the following categories in terms of active ingredients and method of odour control:

1. Masking agents:
   - Perfumed sprays, solids, gels, liquids, and powders, all designed to mask or cover up odours but will not eliminate them.
2. Odour absorbents:
   - Like baking soda, products that absorb odour, but usually not effective enough to eliminate strong odour in a large area.
3. Enzyme and bacterial odour control products:
   - These products destroy and liquefy organic substances and eliminate the odour.
4. Chlorine dioxide:
   - Chlorine dioxide is activated by and reacts with hydrogen sulphide, volatile organic acids, and most offensive odour compounds, removing them from the air and rendering them odourless and harmless.
5. Organic odour control systems:
   - These products neutralize offensive odours and also leave a fragrance in the air.

The Super Spice product would appear to fall in the category of an "organic odour control system", (category 5). Alternative products that may be effective at TMM could be those based on chlorine dioxide. A number of odour control sprays are now available that are based on this active ingredient. Chlorine dioxide is an oxidising biocide and a 'molecular free radical'. This means that it has an odd number of electrons and is highly reactive with substances that act as electron donors. This means that reactions are effective for sulphur compounds, secondary and tertiary amines and other highly reduced organics – all compounds that could be present in the compost odour from TMM.

4.4 Previous Process Improvements

TMM has made a number of changes to processes and management practices used on site over the last few years to reduce odour emissions. These changes include:

- Bale wetting.
  - Bales are wet for shorter periods in summer because of warmer ambient temperatures, this minimises the potential for odour emissions from the middle of the bales when they are broken open.
- Bale break/litter mixing
  - Chicken litter is no longer left on top of broken bales overnight
  - Compost is not left out overnight after chicken litter has been mixed in.
- Compost mixing in outdoor windrows
  - When compost is brought out of bunkers for mixing, it is placed in windrows along air strips in the concrete slab and air is blown through the compost whilst it is outside.
- In-bunker compost aeration

  - The blower oxygen setpoint increases and the minimum fan runtime is increased during the 12 hours before compost is removed from the bunkers. This minimises occurrence of anaerobic conditions within the compost.
- Bunker air extraction
  - Fan speed is set to maximum (50 Hz) when bunker door is open
- Chicken litter raw material
  - Litter is received only from suppliers that TMM can rely on to provide dry litter.
- Staff training
  - Detailed instructions for air flow management and operation of the odour control spray system are posted on the wall in the control room shed.
- Compost moisture content
  - HBRC has historically identified this as a cause of increased odour when the compost is turned. Now that they compost is kept in bunkers rainfall is kept out so overwetting doesn't occur. Overwetting of bales before bale break is also now an infrequent event as the duration of wetting time has been minimised.
- Biofilter media moisture
  - The biofilter media becoming too dry was another historical cause of odour problems identified by HBRC. The biofilter moisture content is now monitored and tested weekly, and watering provided as necessary. A new humidifier is also being added in the inlet air duct.
- Phase 2 bunkers
  - TMM has found that most of the odour from these bunkers occurs in the 2-3 hours after filling. During this time the fan speed is now reduced, and odour spray nozzles are operated around the vent. In addition, air is now blown through the compost windrow while it is sitting on the concrete slab before being loaded in the Phase 2 bunker.

5 Meteorology and Sensitivity of the Receiving Environment

Prior to identifying the primary sources of odour emissions and additional mitigation options, it is important to identify the meteorological conditions of the area and the sensitivity of the site's surrounds.

5.1 Meteorology

5.1.1 Influence of Meteorology in Odour Dispersion

The most important meteorological conditions affecting dispersion of odour after emission are wind speed and direction, and atmospheric stability. For emissions occurring close to ground or entrained in building downwash eddies, low wind speeds (roughly less than about 2 - 3 metres per second, or 4 - 6 knots) tend to result in noticeable odour at greater downwind distances than at higher wind speeds.

Wind characteristics can vary significantly for a site depending on the wind direction; for example, while a separation distance of 100 m may be sufficient to protect the amenity of a property in one direction, an adverse odour effect from the same source may be experienced for several hundred metres in the opposite direction.

Near-calm winds conditions are always a matter of special interest in assessing the potential for odour effects from an activity. In these conditions, relatively intense pockets of odour can accumulate in the air at the site while the weather is calm, then move off-site when the wind fluctuates. These air movements may also follow terrain fluctuations. This can cause relatively brief periods of strong odour concentrations downwind, which can rapidly disperse once the wind picks up.

5.1.2 Local Wind Records

The nearest meteorological monitoring station with publicly available data is at Whakatu, about 10.5 km north-northwest of the TMM site (refer Figure 5.1). TMM also records meteorological data on-site although to date this has not been logged and saved for subsequent data analysis.

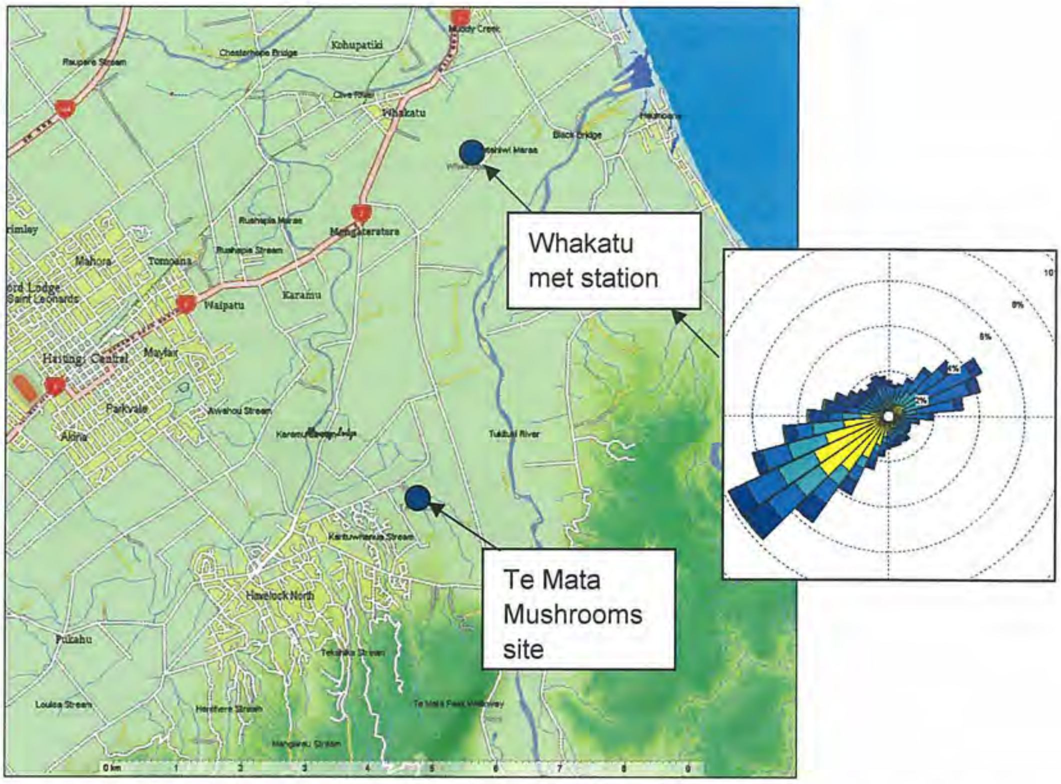

Figure 5.1: Location of Whakatu meteorological data station and proximity to TMM site. Map from TUMONZ (The Ultimate Map of New Zealand).

Wind patterns at TMM may differ slightly to those at Whakatu because the TMM site is closer to the hills at the southeastern end of the Bay and is also more distant from the coast. The main significant wind direction for carrying odour towards Brookvale is an easterly/northeasterly, and the frequency of occurrence of these winds are likely to be similar at both the Whakatu and TMM sites. However, overall wind speeds would be expected to be slightly lower at TMM than at Whakatu.

Hourly wind speed and direction data between January 1997 and December 2008 for Whakatu was downloaded from the NIWA Cliflow Online Database [1]. A windrose for Whakatu is shown in Figure 5.2. This shows that the prevailing wind is a southwesterly, which would carry odours from the site away from any sensitive receptors. This windrose is also shown overlaid on a site locality map in Figure 5.1. Any winds recorded at Whakatu from the north-northeasterly to easterly directions are considered to have the potential to carry odours from TMM towards sensitive receptors in the Brookvale area.

[1] http://cliflow.niwa.co.nz/.

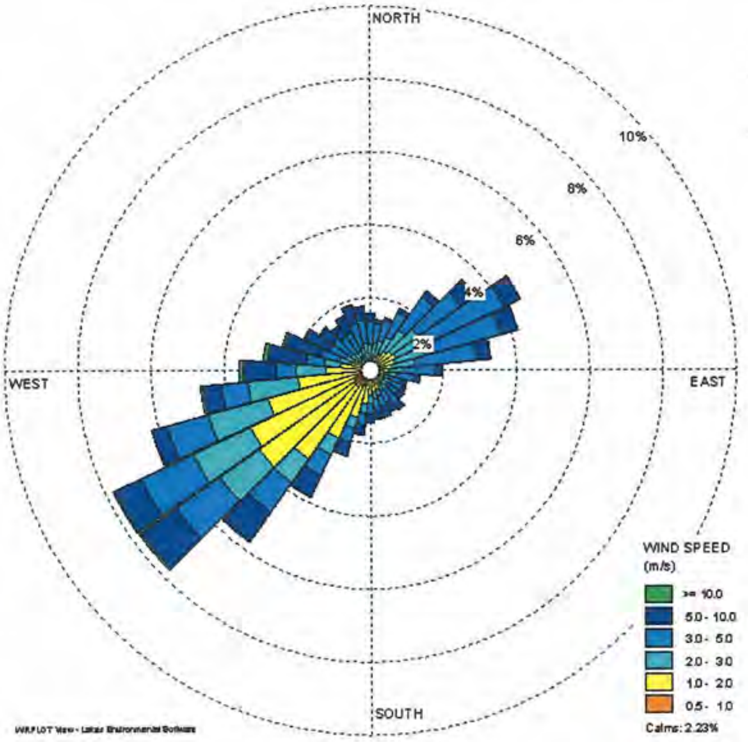

Figure 5.2 - Windrose for Whakatu, 1997 to 2008.

Wind patterns at TMM are also influenced by a ridge which lies along the southwestern boundary of the site (Figure 5.3). Terrain to the southwest of this ridge, where the new residential subdivision of Brookvale is located, remains at the same height as the ridge several metres higher in elevation than the TMM site. Wind directions are observed to fluctuate and swirl around the site, in response to the presence of the ridge.

This ridge will help provide some enhanced initial dilution of any odours from the composting plant.

Figure 5.3 – Ridge on southwest boundary of TMM property.

5.1.3 Low Wind Speeds

Of particular interest in the potential for odours occurring beyond the boundary are instances of low wind speeds. The frequency of low wind speeds occurring with wind directions from the north-northeast through to east, recorded at the Whakatu monitoring site for the 1997 to 2008 period is shown in Table 5.1. The frequency of low wind speeds and this wind direction is not particularly high, and in addition the presence of the ridge on the TMM boundary will aid initial dilution of the odour in these conditions.

Table 5.1 - Wind speed frequencies (winds from north-northeast through to east) at Whakatu

Wind speed range	Percentage of all records in 1997 – 2008 which are from the north-northeast through to east, and in wind speed range
	Whakatu
≤ 0.5 m/s	0.3%
≤ 1.0 m/s	1.1%
≤ 2.0 m/s	5.1%
≤ 3.0 m/s	10.5%

5.2 Sensitivity of the Receiving Environment

5.2.1 How Does Odour Cause Adverse Effects?

The effects of any odour depend on a number of features of the odour exposure which are collectively known as the "FIDOL" factors:

- Frequency — How often an individual is exposed to odour
- Intensity — The strength of the odour
- Duration — The length of a particular odour event
- Offensiveness/character — The character relates to the "hedonic tone" of the odour, which may be pleasant, neutral or unpleasant
- Location — The type of land use and nature of human activities in the vicinity of an odour source.

As part of the "location" factor, the sensitivity of the receiving environment must be taken into account.

Different combinations of these factors are significant when assessing adverse effects. Depending on the severity of the odour event, one single occurrence may be significantly adverse and this is known as an "acute" odour effect. However, in other situations, where there is a higher frequency of odorous events the threshold odour level would be lower. This longer term impact is known as a "chronic" odour effect.

In this case, as shown in the previous section the frequency of low wind speeds blowing towards the Brookvale area is not particularly high. This would be of particular advantage to TMM in rural environments (see below) where occasional odour occurrence may be considered acceptable. However in a residential area the acceptable odour frequency is likely to be much lower.

5.2.2 Sensitivity to Odour in Rural Environments

Different locations have different sensitivities to odour and can be classified as having high, moderate or low sensitivity. The degree of sensitivity in any particular location to odour is based on characteristics of the land use, including the time of day and the reason people are at the particular location (e.g. for work, home living or recreation).

There are a large number of rural activities commonly carried out as part of the routines of animal farming, horticultural farming and forestry, which have the potential to cause odour discharges. General pastoral farming activities with potential to generate odour emissions include stockyards, silage bales/pits and silage spreading, feed pads and intensive winter feeding, dairy sheds, wastewater ponds, spray irrigation and truck spreading of dairy wastewaters, fertiliser application, calf rearing, and kale grazing.

It is noted that rural properties appear to be used predominantly for horticultural farming, rather than animal farming. However, animal farming could be carried out in these areas as a permitted activity. These activities and their associated odours define the permitted baseline for odour occurrence in a rural area and the concept of rural amenity.

People living in rural areas generally have a high tolerance for rural-type odours, which are acceptable to most rural people and fit the description of a rural odour in a rural area. However, some types of odour are quite different to the normally expected rural odours (due either to the strength, character and unpleasantness of the odour, or to the frequency and duration of the odour), and are much less acceptable.

5.2.3 Sensitivity to Odour in Residential Environments

People living in residential-zoned areas typically have a high sensitivity to both rural and non-rural odours, because of the following factors:

- People of high sensitivity to odours can be exposed.
- People can be present at all times of day and night, both indoors and outdoors.
- People tend to carry out activities at residences which are highly sensitive to non-rural odours, such as dining, entertaining, outdoor living, sleeping.
- Visitors to the area who are unfamiliar with an odour are more likely to be sensitive to odours they are not used to, and may raise awareness of a problem.
- People usually expect a high level of air quality including the absence of odours, and have a low tolerance of even typical rural odours.

Amenity conflicts between residential and rural zones in terms of incompatible neighbouring land uses and odour presence are recognised as an issue in many district and regional plans in New Zealand.

These same issues are likely to reveal themselves as a result of the new residential development to the southwest of the site now introducing a residential component to the TMM sites receiving environment. Discussion of the planning-related aspects of this issue as they relate to the TMM site is outside the scope of this report.

6 Inventory of Odour Emissions and Additional Mitigation Options

Table 6.1 lists each of the odour sources within the composting plant, the existing means of odour mitigation, and potential odour mitigation improvements. The potential odour mitigation improvements are grouped into "First Level" improvements and "Second Level" improvements, where "First Level" refers qualitatively to a relatively minor extent of expense and/or effort required to implement the improvement, and "Second Level" refers to a relatively major extent of expense and/or effort.

The table also provides a qualitative rating of the contribution each source makes to odour levels beyond the site boundary. This rating is based on Beca's experience with the New Zealand Mushrooms Ltd site in Morrinsville, plus our understanding of the hedonic tone (or character) of the various odour emissions and typical patterns of dispersion of different types of odour sources.

A further improvement that could be trialled may be changing the odour spray to a neutralising spray such as chlorine dioxide.

Finally, it is recommended that TMM implement a fixed-term odour diary programme with neighbours. Diary records provide valuable information about the nature, timing and duration of odour events observed by neighbours. This can be useful in identifying priority measures for odour mitigation and would support the provisional odour ratings provided in Table 6.1.

Table 6.1 - Odour Inventory and Description of Mitigation Options

Odour Source	Existing Mitigation and Comments	Rating of odour potential beyond boundary		"First Level" Mitigation Improvement Options	"Second Level" Mitigation Improvement Options
		Existing (end 2009) receiving environment	Receiving environment after subdivision completed		
Bale wetting. review condition of odour low risk	Mitigation is achieved by minimising duration of spraying and length of time that bales are kept wet.	Low	Moderate	Change to dunking bales instead of spraying. Spraying of effluent has the potential to release odorous compounds into the air. This would be removed if the bales were dunked, provided that this is a practical operation.	Nil.
Chicken litter storage and mixing with gypsum cams proposal	Kept dry through shelter and control of supply quality	Low	Low	Keeping the litter dry is the primary odour control means. This appears to be achieved from the Beca site visit, however at wet times of year there could potentially problems.	The litter could be stored in a larger bunker to avoid the potential for wetting if this was a problem.
Bale break and initial mixing	Mitigation is achieved by minimising the length of time that bales are kept wet before they are broken. As the bales are soaked with effluent that is highly organically loaded, and may even have been held in an anoxic state, there may be some odour emission from these bales as they are broken apart.	Low-moderate	Low-moderate	Ensure odour sprays are used. Change to dunking bales instead of spraying (this was effective at NZ Mushrooms to reduce odour during bale break).	Use a bale break automated machine, and/or enclose bale mixing process. ✓ ventilate to odour control.
Chicken litter placement during bale mixing	The chicken litter is no longer left on top of the outdoor bale windrows overnight, so the potential for odour emissions from the litter is minimised.	Low provided litter is kept dry in storage	Low provided litter is kept dry in storage	Nil provided litter is kept dry in storage	Nil provided litter is kept dry in storage

Odour Source	Existing Mitigation and Comments	Rating of odour potential beyond boundary		"First Level" Mitigation Improvement Options	"Second Level" Mitigation Improvement Options
		Existing (end 2009) receiving environment	Receiving environment after subdivision completed		
Compost mixing (removal from bunker, mixing, and replacement in bunker)	Use odour control sprays. Blow air through compost whilst in outside windrow.	High	High	Commission use of odour sprays on the turning machine. Minimise amount of air that is blown through compost in outside windrow so that aerobic conditions are maintained whilst avoiding stripping odours.	Provide an extra bunker so that compost can be mixed without being outside, also provide additional ventilation of bunkers and enclose the front end to minimise odour emission during bunker-to-bunker transfers. Would also require much larger biofilter.
Fugitive emissions from bunkers	The means of odour control is maintaining negative pressure inside bunkers. This is not always possible when the blowers are operating.	Low	Low-moderate		Increase extraction blower capacity to maintain negative pressure at all times when the doors are closed. May also require larger biofilter depending on amount of additional blower capacity required.
Compost transfer from Phase 1 to Phase 2 bunkers and outdoor mixing	Use odour control sprays. Blow air through compost in outdoor windrow.	High	High	Commission use of odour sprays on the turning machine.	Enclose mixing operation. Active ventilation of Phase 2 bunker to avoid fugitive emissions during filling.
Emptying of Phase 2 bunker	Use odour control sprays. Mature compost appears to have low odour potential.	Low	Low	Nil	Nil
Biofilter	Maintain according to good practice. Use sprays in inflow duct to maintain air humidity.	Low	Low	Nil	Nil, although may need to be increased in size if other ventilation factors are changed.
Effluent aeration sump	Nil. Main risk of odour would be if effluent in pond (see below) is anoxic, and any foul odours are stripped out of the effluent as it is recycled from the pond back to the sump.	Low	Low, possibly moderate (risk linked to effluent pond, see below)	Mitigation linked to mitigation of effluent pond (see below).	

Odour Source	Existing Mitigation and Comments	Rating of odour potential beyond boundary		"First Level" Mitigation Improvement Options	"Second Level" Mitigation Improvement Options
		Existing (end 2009) receiving environment	Receiving environment after subdivision completed		
Effluent pond	Whilst the effluent is aerated by recirculation though the sump, the effluent is highly organically loaded and may be consuming the oxygen rapidly in the pond. The aeration provided in the sump may not be sufficient to maintain the effluent in the pond in an aerobic state.	Possibly moderate	Possibly moderate-high	Monitoring of dissolved oxygen levels in the pond is required, followed by review of aeration capacity of effluent system if dissolved oxygen levels are less than approximately 1 mg/L. Degree of mitigation required will depend on the outcomes of this review.	

7 Summary

This report identifies the sources of odour at the composting plant on the TMM site, the extent of odour mitigation currently in place, and additional odour mitigation measures for the site that could be implemented.

A number of mitigation and operating procedures have been implemented to reduce the odour and effects of odour from the site. The primary mitigation measures are the use of a biofilter to treat odours originating within the Phase 1 bunkers, plus the use of odour control sprays. TMM has also made a number of changes to processes and management practices used on site over the last few years to reduce odour emissions. In addition, a further improvement that could be trialled may be changing the odour spray to a chlorine dioxide-based chemical.

The biofilter appears to be in good condition and damp under the surface. At the site visit attended by Beca, the biofilter emitted no recognisable composting odours other than the faint but characteristic earthy odours commonly associated with well-operating biofilters. Whilst the biofilter is currently operating well, it is operating near typical maximum capacity for biofilters. Therefore it is recommended that no additional air flows should be put through this biofilter, unless the biofilter is increased in capacity.

Additional potential odour mitigation improvements have been identified for each part of the composting process. The potential odour mitigation improvements are grouped into "First Level" improvements and "Second Level" improvements, where "First Level" refers qualitatively to a relatively minor extent of expense and/or effort required to implement the improvement, and "Second Level" refers to a relatively major extent of expense and/or effort.

Appendix A

Site photos

APPENDIX A – SITE PHOTOS

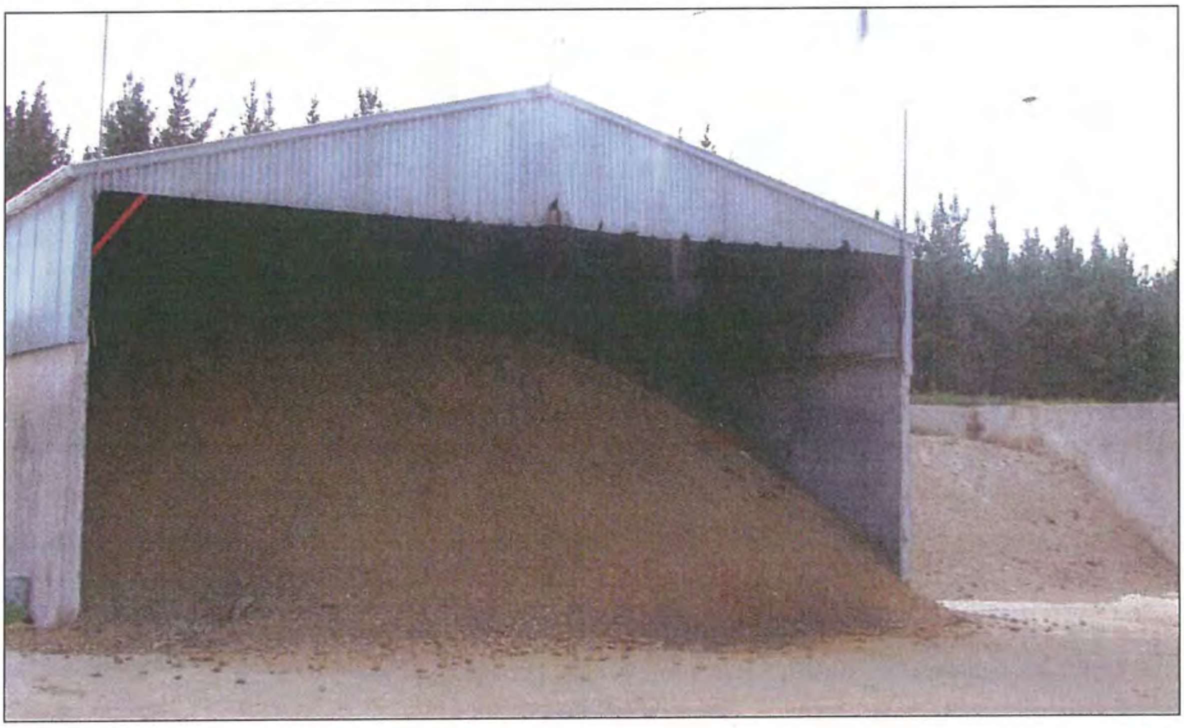

Photo A1 - Chicken litter bulk storage bunker (left), and adjacent bunker for storage of chicken litter mixed with gypsum (right).

Photo A2 - Bale wetting.

Photo A3 – Bale wetting, showing close-up of effluent spray over bales.

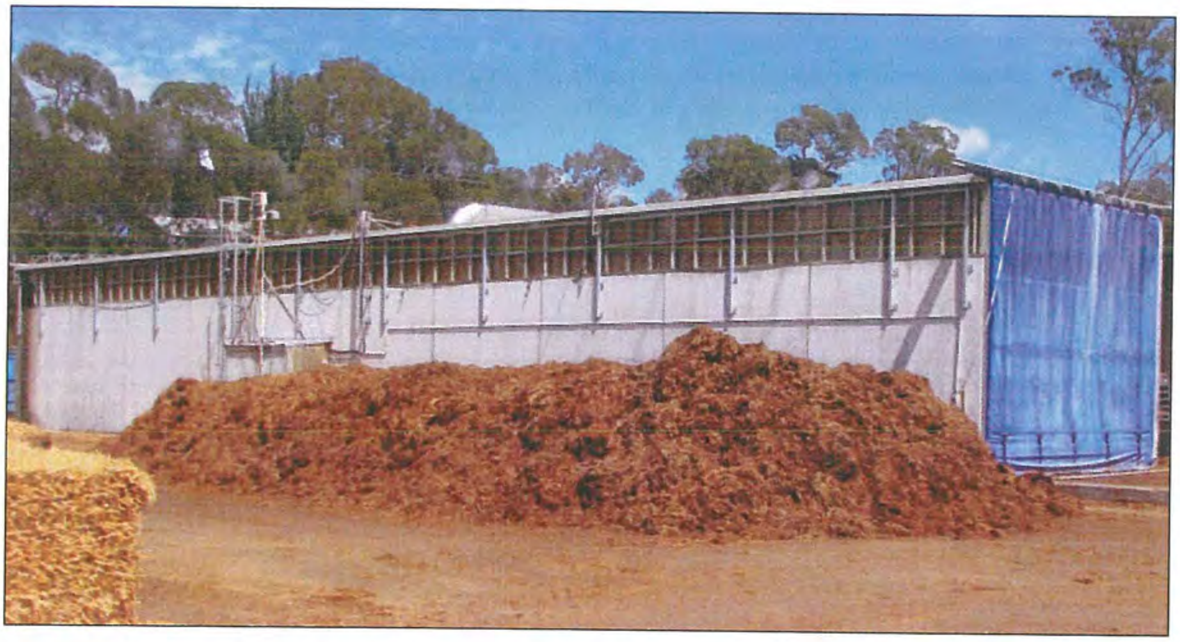

Photo A4 – Partially-completed Phase 1 compost after it is removed from the bunker and turned.

Photo A5 - Mixed compost being returned to bunker.

Photo A6 – Compost being placed into Phase 1 bunker using stacker.

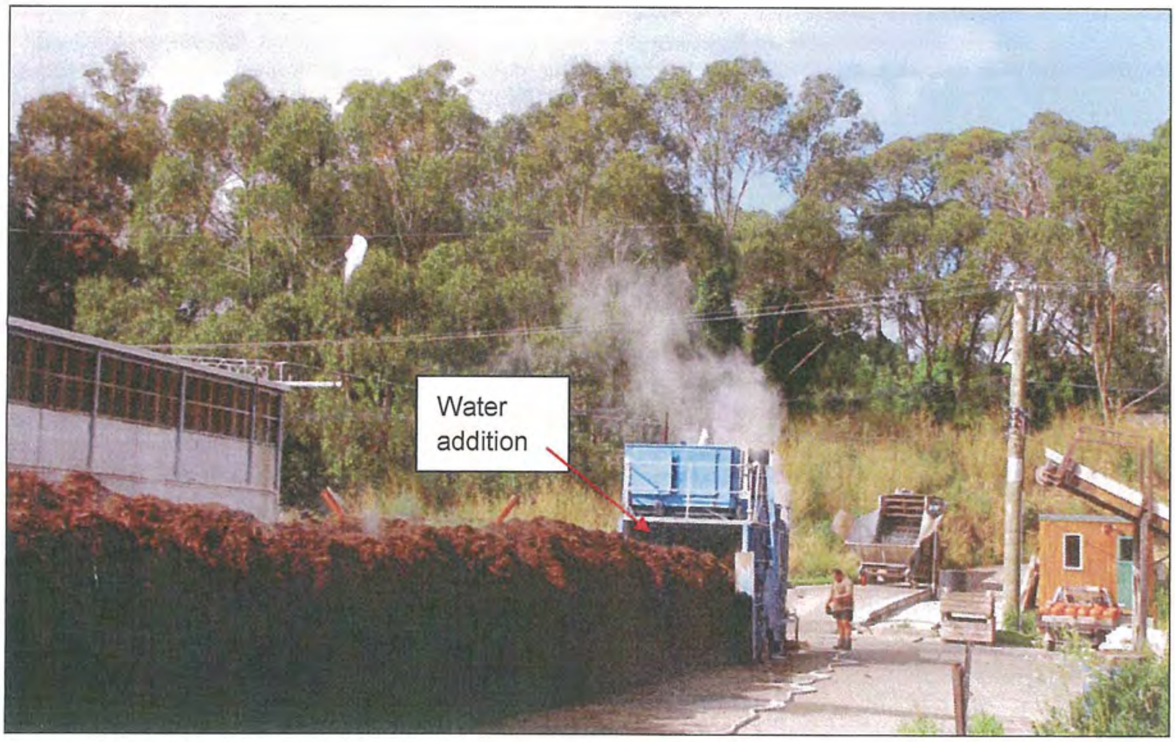

Photo A7 – Phase 1-completed compost after removal from bunker. Water is being added and the compost turned prior to being placed in Phase 2 bunker.

Photo A8 –Steam evolved from Phase 1-completed compost as it is turned.

Photo A9 – Phase 1-completed compost being transferred to Phase 2 bunker.

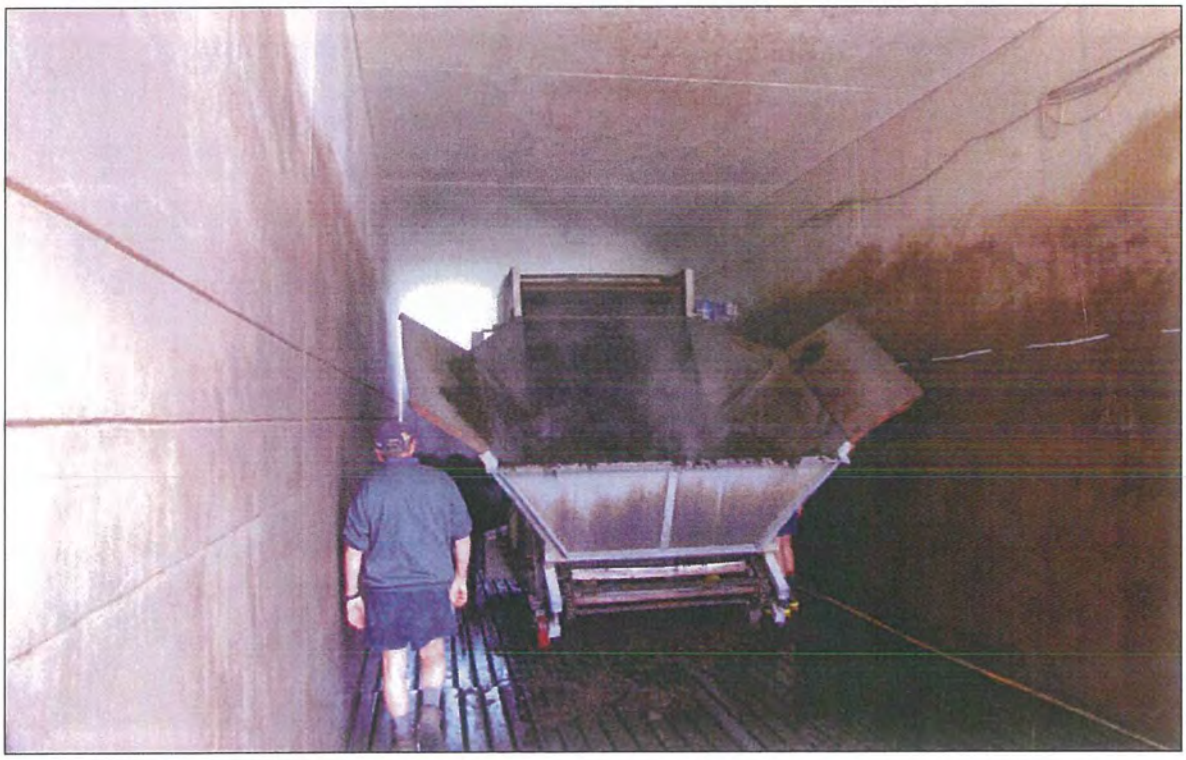

Photo A10 – Compost being placed into Phase 2 bunker using stacker.

Photo A11 – Matured and pasteurised compost being placed into mushroom-growing trays.

Photo A12 – Phase 1 bunkers.

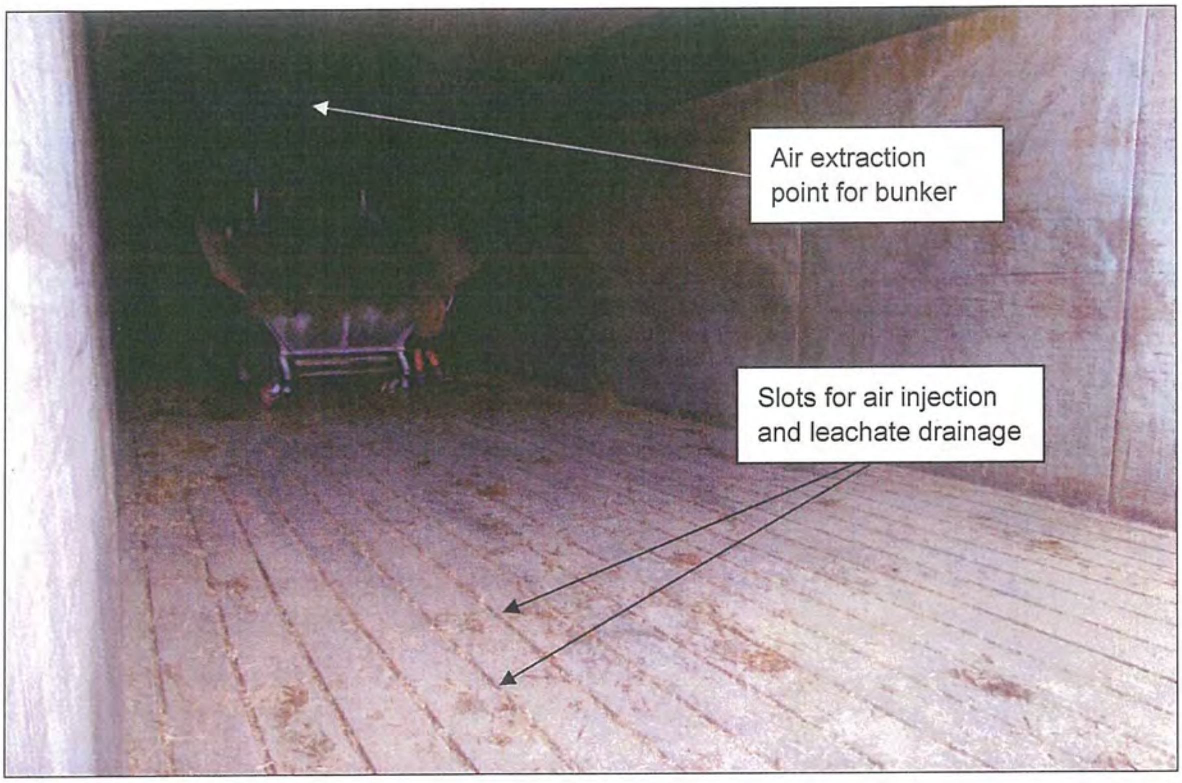

Photo A14 – Blower driving extraction from Phase 1 bunkers, and biofilter.

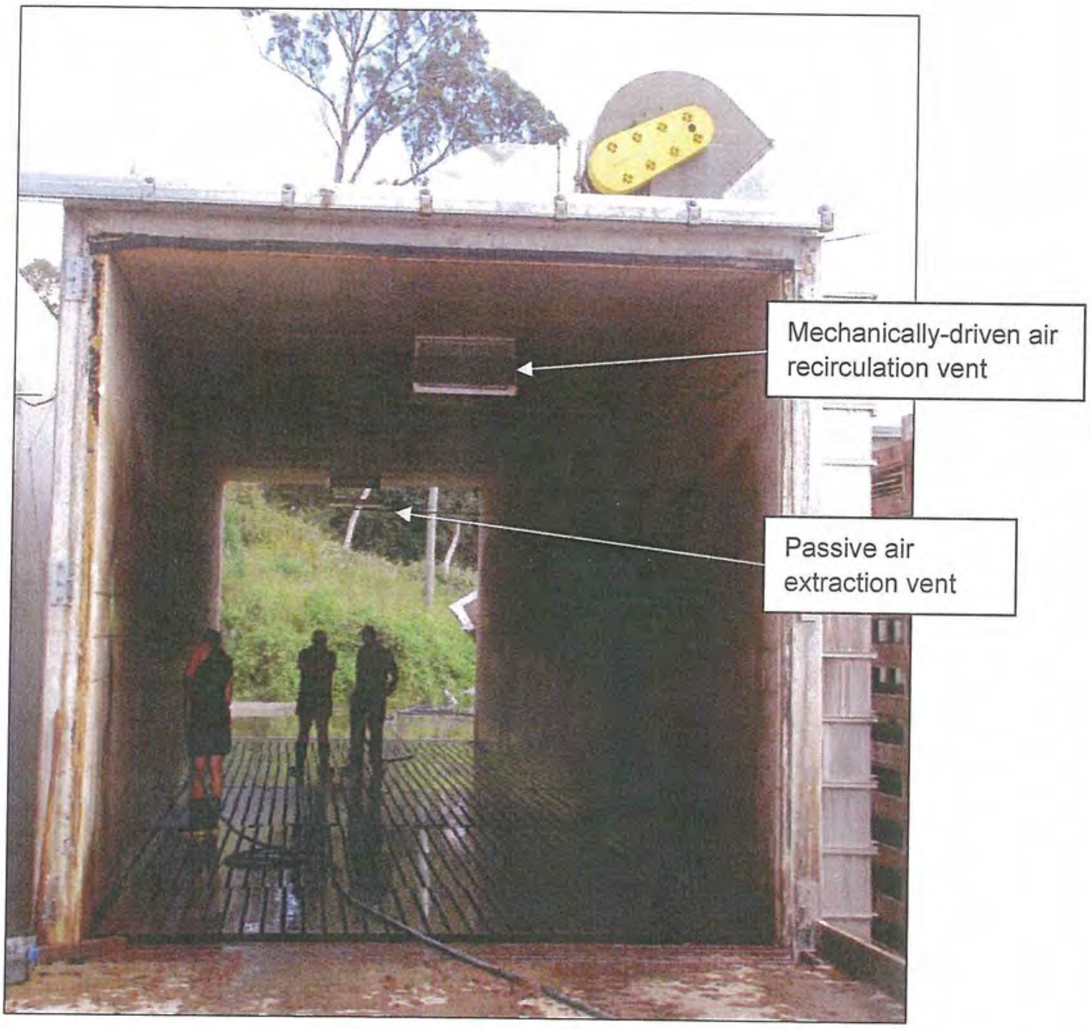

Photo A15 –Phase 2 bunker, and air extraction points.

Photo A16 –Phase 2 bunker passive air extraction point and roof top vent.

Photo A17 – Phase 2 bunker during filling, showing steam evolved from compost.

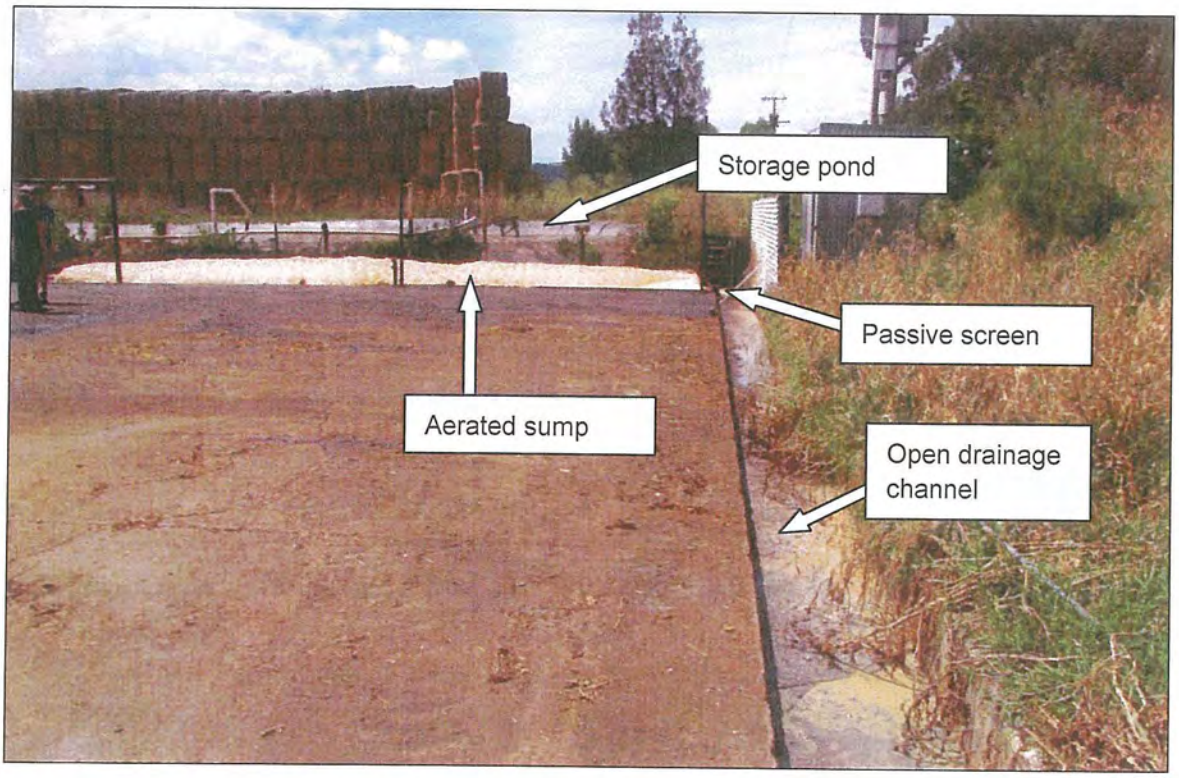

Photo A18 – Overview of effluent system.

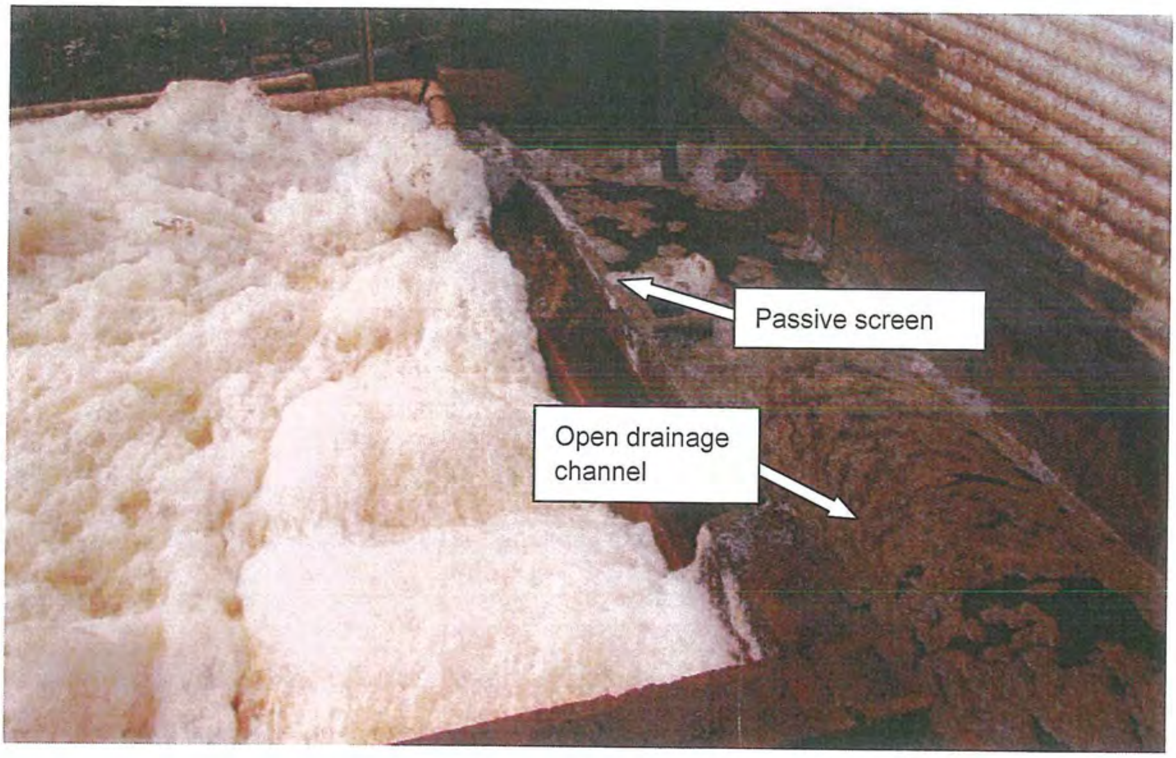

Photo A19 – Passive screen in effluent sump.

Photo A20 – Aerated effluent sump.

Photo A21 – Effluent storage pond.

Photo A22 – Effluent storage pond.