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POTENTIAL EFFECTS ON OFFENSIVE AND OBJECTIONABLE ODOURS FROM POSSIBLE LIVING EARTH OPERATIONAL CHANGES

1.0 Introduction

On the 21st of June 2023, the Christchurch City Council (CCC) mayor and councillors considered a staff report on interim options to manage kerbside organics (KSO) while a replacement facility for the Living Earth (LE) organics processing plant (OPP) is developed. The report recommended that Council engage with the community and mana whenua, seeking views on interim options, which staff had identified as most feasible to implement at the earliest opportunity. The staff recommendation did not favour a “status quo” option.

Three of the interim options include an element of continued composting with operational improvements. CCC have engaged Pattle Delamore Partners (PDP) to provide advice on the effectiveness of the status quo and each improvement option.

The Council has informed us that LE has already committed to buying a second screen and using it outdoors. That second screen will be operating by this summer season. Accordingly, the “status quo” option is implementing the lessons learnt from last season, together with using a second screen outdoors.

A list of standard site terms and definitions is appended to this letter.

2.0 Interim Options Considered

2.1 “Status Quo” Option: Implement Lessons Learnt and Use a Second Screen Outdoors

LE have committed to purchasing a second screen, which is currently proposed to be operated outside. The screen is proposed to provide extra screening capacity, allowing unscreened compost to be processed through into tailings and fines more efficiently, especially during summer when volumes through the plant increase.

The status quo option does not include a limit on the tonnage of material stored outside.

2.2 Interim Option 1: Enclose the Second Screen

Under Interim Option 1 (IO1), the second screen (see the status quo option) would be enclosed, with processing air being treated through a biofilter (or other appropriate treatment method).

2.3 Interim Option 2: Optimise the Process and Reduce Outdoor Storage

Under Interim Option 2 (IO2), the volume of material processed through the OPP would be reduced to ensure an optimised composting process in the tunnels.

The remaining kerbside organics (KSO) will be diverted to either an alternative, or several alternative, commercial composting and worm farm facilities if, and when, they have all necessary regulatory approvals, or Kate Valley Landfill if, and when, Kate Valley has all the necessary regulatory approvals.

Reducing the volume of material through the OPP is expected to reduce the tonnage of material stored outside¹. LE have not provided a specific estimate of the maximum volume that will be achieved.

2.4 Interim Option 3: Compost in Tunnels with Stage 2 Offsite

Under Interim Option 3 (IO3), the tunnel composting process at the OPP will remain unchanged. The tunnel composted material will then be loaded into trucks (indoors) and transported off-site for the second stage of maturation and screening.

3.0 LE Odour Summary

3.1 Previous Advice

PDP have previously provided advice² (PDP letter, 12th of June 2023) as to the sources of odour on the site, and primary options for odour mitigation at the LE site. A summary of the conclusions is:

- 1) The three primary odour sources on the site are:
 - a) The Organics Processing Plant (OPP), typically described as a **'biofilter odour'**.
 - b) The material stored outside which includes, fresh, *unscreened compost* (removed from the tunnels and awaiting screening), and *fines* and *tailings*, typically described as a **'compost odour'**.
 - c) Odour resulting from screening the compost in the main screen, which will produce **'compost'** and **'biofilter'** odours.
- 2) All indications from scouting are that the primary risk is from the outdoor storage of *unscreened compost*, *fines*, and *tailings*. Addressing the discharge of 'compost' odour from the outdoor material has the greatest potential to eliminate offensive or objectionable odours originating from the LE site during normal operation. It is not certain that, after addressing the 'compost' odour on the site, the remaining 'biofilter' odour will not be offensive or objectionable. The results of PDPs odour scouting indicate the residual risk is low.
- 3) Primary methods for addressing compost odour are:
 - a) Treat the odour by fully enclosing the outdoor piles and screens and ventilating those spaces through an appropriately sized biofilter; or
 - b) Reduce the odour source by either:
 - i) Reducing or eliminating the volume of material (unscreened compost, tailings and fines) stored outdoors; or,

¹ LE advice dated 20th July 2023 states that tailings are produced in excess at the site September through May, and in deficit June through August (winter). Therefore, a reduction in OPP throughput to, at maximum, winter production rates is expected to result in minimal working volumes of tailings stored outside.

² Potential Effects on Offensive and Objectionable Odours from Possible Living Earth Operational Changes (12th of June 2023). *Pattle Delamore Partners Ltd.*

- ii) Increasing the maturity of the compost coming from the tunnels, thereby decreasing the amount of odour the material is generating (the feasibility of this at the OPP is discussed for Interim Option 2 below).

3.2 Evaluation of Odour Scout Observations

PDP have been regularly reporting the results of their odour scouting to CCC since 31st January 2023. A summary of those reported odour scouting events, the tonnages of material held on the LE site, and the dates where Environment Canterbury (ECan) issued a Notice of Non-Compliance (NONC) is included in **Figure 1**.

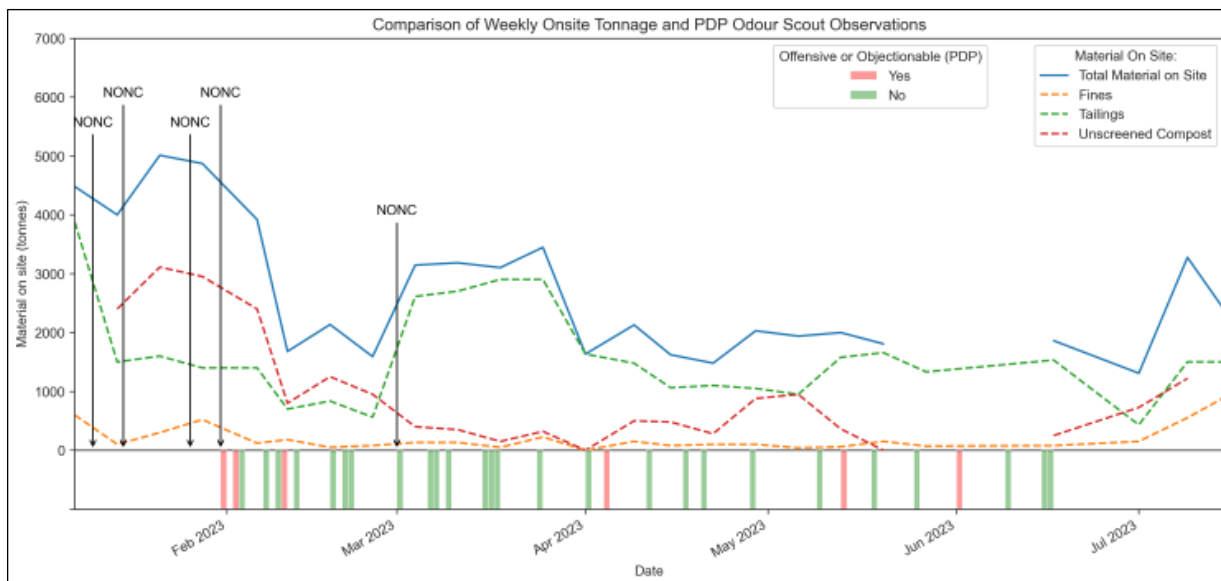


Figure 1: Tonnage of Material on LE Site, Compared to PDP Odour Scout Findings and ECan NONCs

Around the May-June period, the main biofilter was undergoing refurbishment. During this time, the process was upset. This accounts for the June observation by PDP of offensive or objectionable odour and may also account for the gap in reported tonnages of unscreened compost³ during this time.

The proportion of north-easterly conditions in the summer months was higher than in autumn however this should not affect the proportion of offensive or objectionable odour observations in PDP's scouting results as scouts only attended the site during forecast north-easterly conditions.

The higher frequency of observed offensive or objectionable odours by PDP, and issued NONCs by ECan in January and early February is thought to be the result higher volumes of material on the LE site, caused by two factors:

1. Greater volumes coming to the OPP, resulting in a less mature product; and,
2. A breakdown of the main screen, preventing the fresh compost from being screened (which would allow the fines to be removed from the site) and therefore resulting in a build-up of material on the site.

³ LE advised that the performance of the IVC tunnels was negatively affected during this time which resulted in unscreened compost piles that were unusually odorous. PDP understands these piles were covered in fresh green waste in an effort to ameliorate the odour. Odour scouting during this period observed a significantly different odour character off-site.

As site volumes have stabilised towards approximately 2,000 tonnes of total material onsite, the frequency of observations of offensive or objectionable odour (relative to PDP observations of not offensive or objectionable odour) has decreased⁴. Of note, however the observations made on the 13th of May 2023 had the highest proportion of compost odour (approximately 70%) across all the 2023 odour scouts. This may be due to cooler, more stable conditions limiting the dispersion of odour as the plume moves downwind.

The following conclusions can be drawn:

1. The reduction in total tonnage of material onsite has had a positive effect on the frequency of offensive or objectionable odour in the residential zone during north-easterly conditions.
2. In summer, north-easterly winds are more frequent, providing greater opportunity for odour transport towards sensitive residential receptors.
3. Odour discharged from the site in north-easterly conditions does not always result in offensive or objectionable odour (or even at times detectable odour) in the downwind residential area.
4. Stable atmospheric conditions contribute to poorer mixing of the odour plume, resulting in more consistent odour (when detected)⁵.
5. Offensive or objectionable odour has been observed on a Sunday⁶ when no screening was occurring - i.e., the odour from the outdoor material is sufficient to cause offensive or objectionable effects under the right meteorological conditions. Screening and handling the compost is understood to increase the odour emissions from the material.
6. There is no clear pattern in Figure 1 between the ratio of unscreened compost, tailings, and fines on the site, and causes of offensive or objectionable odour. Therefore, total material volumes should be addressed.
7. While 5,000 tonnes of compost material were onsite, PDP scouts observed a resulted in a higher occurrence of offensive or objectionable odour during north-easterly conditions compared to when 2,000 tonnes of compost material were onsite. The volume of material with which no offsite offensive or objectionable odour will occur⁷, is somewhere between 2,000 tonnes and 0 tonnes on the site.

4.0 Evaluation of the Interim Options

4.1 "Status Quo" Option: Implement Lessons Learnt and Use a Second Screen Outdoors

LE have advised that a second screen will allow them to better match the rate of compost production from the tunnels with the screening capacity of the main screen. This will ostensibly:

- ✧ Reduce maximum working volumes of unscreened compost as it is processed more quickly into fines and tailings; and
- ✧ Reduce the likelihood of a build-up of unscreened compost on the site, as was observed in January 2023 (as a result of high compost production rates and equipment breakdowns).

⁴ Not considering the 'upset' operation during the main biofilter remediation.

⁵ Living Earth Odour Monitoring: 24th April 2023 to 21st May 2023 Summary (12 June 2023). *Pattle Delamore Partners Ltd*

⁶ Living Earth Odour Monitoring: 24th April 2023 to 21st May 2023 Summary (12 June 2023). *Pattle Delamore Partners Ltd*

⁷ Assuming material with Solvita Maturity Indexes like those currently produced by the OPP.

No limit on the total tonnage of material⁸ to be stored on the site is proposed. Without a concrete limit to onsite material volumes, the effect of this option is expected to be limited.

4.2 Interim Option 1: Enclose the Second Screen

Under Interim Option 1 (IO1), the second screen would be enclosed, with processing air being treated through a biofilter (or other appropriate treatment method).

PDP odour scouts have observed offensive or objectionable odour on days when no screening was occurring. Enclosing the screen will help address the elevated odour production during screening, but will not, in isolation, sufficiently reduce the risk of offensive or objectionable odour generation from the site.

4.3 Interim Option 2: Optimise the Process and Reduce Outdoor Storage

Under Interim Option 2 (IO2), the volume of KSO material processed through the OPP would be reduced to ensure an optimised composting process in the tunnels. The intent would be to cap the processing volumes at a level that eliminates outdoor storage (as far as practicable) and produces compost out of the tunnels with a higher Solvita Maturity Index (SMI, summarised in Figure 2). This will:

- ✧ Reduce the amount of odorous compounds produced by the outdoor piles; and
- ✧ Reduce the tonnage of material stored outside.

The combined effect will be to require less downwind dilution of discharged odour to achieve offsite odour below offensive or objectionable levels.

⁸ Unscreened compost, fines and tailings.

| IF SOLVITA MATURITY INDEX IS: | THE STAGE OF THE COMPOSTING PROCESS IS: | Equivalency to other maturity indicators ^a | | |
|-------------------------------|--|---|--------------------------|--------------------------|
| | | DEWAR (b) | CO ₂ Rate (c) | O ₂ -Rate (d) |
| 8. | Inactive, highly matured compost, very well aged, possibly over-aged, like soil; no limitations for usage | V | 1 | <3 |
| 7. | Well matured, aged compost, cured; few limitations for usage | | 2 | 5 |
| 6. | Curing; aeration requirement reduced; compost ready for piling; significantly reduced management requirements | | 4 | 11 |
| 5. | Compost is moving past the active phase of decomposition and ready for curing; reduced need for intensive handling | IV | 6 | 16 |
| 4. | Compost in medium or moderately active stage of decomposition; needs on-going management | III | 8 | 21 |
| 3. | Active compost; fresh ingredients, still needs intensive oversight and management | II | 10 | 27 |
| 2. | Very active, putrescible fresh compost; high-respiration rate; needs very intensive aeration and/or turning | I | 12 | 32 |
| 1. | Fresh, raw compost; typical of new mixes; extremely high rate of decomposition; putrescible or very odorous material | | >15 | > 40 |

Figure 2: Interpreting the Solvita Maturity Index

Records of the Solvita analysis of compost processed in 2022⁹, and included in Figure 3 (below), show that:

- ✧ In spring and summer, compost was processed for approximately 16 days in tunnel, resulting in an average SMI of 2.5 (raw to very active compost).
- ✧ In winter, compost was processed for approximately 28 days in tunnel, resulting in an average SMI of 3.5 (very active compost).

⁹ Provided by LE in February 2023.

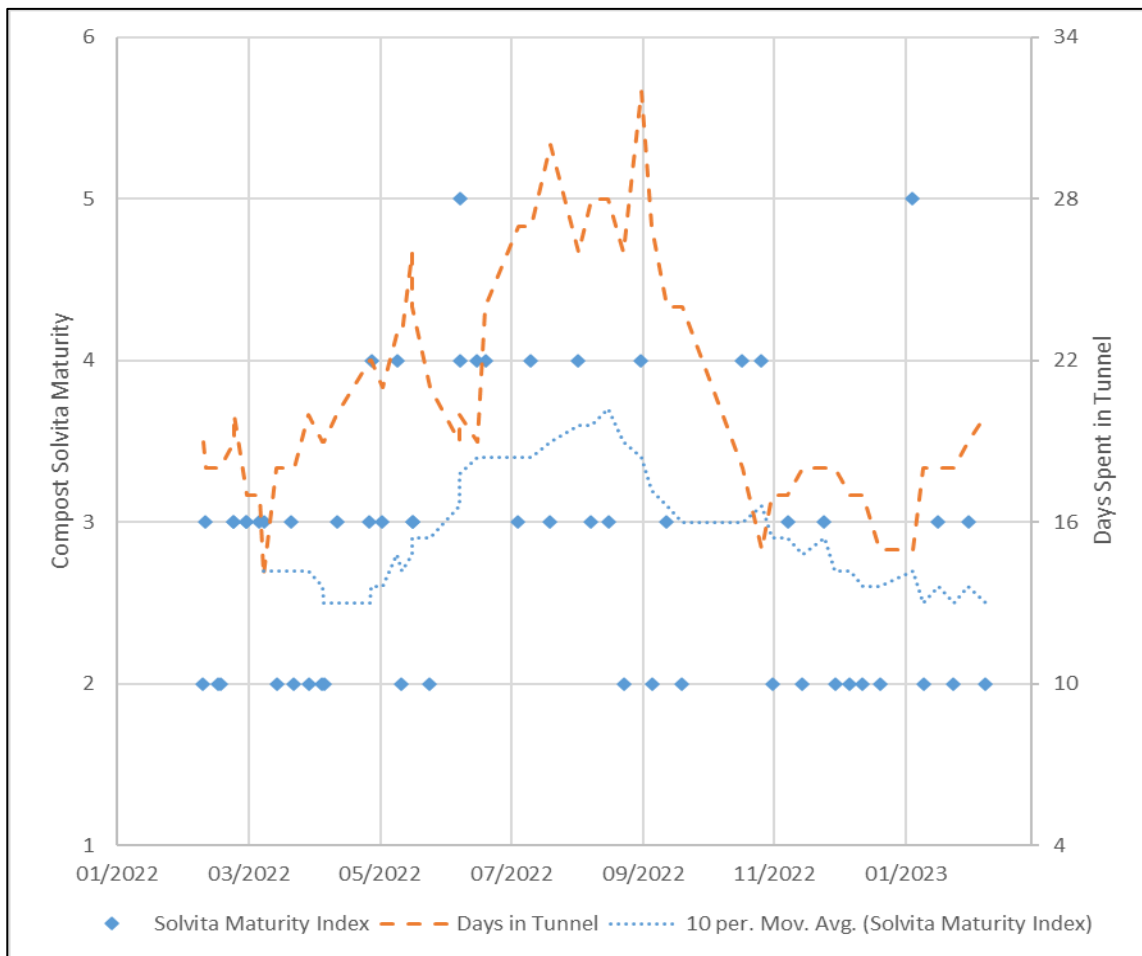


Figure 3: LE 2022 Solvita Maturity Index and Time in Tunnels

PDP are not aware of any data from the LE site that demonstrates the effectiveness of longer tunnel times (>28 days) at the LE site. At 28 days in tunnel the compost is still very active with a high potential for odour production.

PDP cannot advise what processing limit would allow LE to eliminate outdoor storage. PDP understand some working volumes of material would still be present, associated with:

- ✧ Material awaiting screening;
- ✧ Screened fines awaiting transport from the site; and
- ✧ Tailings awaiting reintroduction to the OPP.

If PDP assume OI2 proceeds with a reduced processing rate similar to LE's current winter processing rate (providing 22 to 28 days in tunnel with up to 2,000 tonnes of material onsite), odour risk will be similar to that currently observed (May through July 2023). This would mean:

- ✧ A negligible change to odour risk during winter; but
- ✧ A reduction in odour risk during months with normally elevated process rates (such as spring and summer).

Further reductions to the processing rate may yield:

- ✧ Improvements to the SMI; and
- ✧ Reductions in site volumes (although a working volume will still be required).

The practicality of what can be achieved within the constraints of the current tunnel infrastructure on the site is unknown due to a lack of data under such operating conditions.

The effectiveness of this option would have to be evaluated through odour scouting, with adaptive management of the OPP processing rate based on observed odour levels.

4.4 Interim Option 3: Compost in Tunnels with Stage 2 Offsite

Under Interim Option 3 (IO3), the tunnel composting process at the OPP will remain unchanged. The tunnel composted material will then be loaded into trucks (indoors) and transported off-site for the second stage of maturation and screening.

This option proposes to functionally eliminate the storage of outdoor piles of compost material from the site. A working volume of green waste (necessary to provide a carbon source for good composting) would remain. PDP's observations of the green waste stockpiles on the site currently indicate they:

- ✧ Do not have a negative hedonic tone/character (rather, smell like fresh pruning's); and
- ✧ Their odour has not been observed offsite.

The outdoor compost material (unscreened compost, tailings and fines) and associated storage and screening has been observed to be the most significant source of odour onsite. Therefore, in PDP's opinion eliminating this material from the site is the most effective method of reducing the risk of offensive or objectionable odours from the site.

A low risk remains that the biofilter odour, in the absence of the compost odour may be detected beyond the boundary of the site. Outside of the period of biofilter maintenance in May-June, the character of the odour observed by odour scouts offsite has always matched onsite observations of the compost odour sources. Therefore, POP have concluded that while the biofilter odour may be detected or recognisable, it will be weaker/less intense than the compost odour, with a less offensive character. As such, the risk of offensive or objectionable biofilter odours is considered low.

5.0 Summary

CCC have asked PDP to advise whether the status quo, with a second outdoor screen, or three other possible interim mitigation options would adequately reduce the risk of offensive and objectionable odours beyond the boundary of the site.

1. "Status Quo" Option: Implement Lessons Learnt and Use a Second Screen Outdoors

Without a commitment to reduce or limit the volumes of onsite material, the risk of offensive or objectionable odour would remain largely unchanged from present.

2. Interim Option 1: Enclose the Second Screen

PDP assess that enclosure of the second screen might have a small positive impact on the odour production from the site.

Without a commitment to reduce or limit the volumes of onsite material, the risk of offensive or objectionable odour would remain largely unchanged from present.

3. Interim Option 2: Optimise the Process and Reduce Outdoor Storage

A limit to the processing rate may yield:

- ✧ Improvements to the SMI; and
- ✧ Reductions in site volumes - although a working volume will still be required.

If PDP assume OI2 limits the processing rate to LE's current winter processing rate, there will be a negligible change to odour risk during winter, but a reduction in odour risk spring through autumn.

Further reductions to the processing rate may result in a lower odour risk. PDP do not have confidence the potential reduction would be as significant as the reduction gained from eliminating on-site storage volumes completely.

The effectiveness of the reduction in maximum processing rate would have to be evaluated through odour scouting, with adaptive management of the OPP processing rate based on observed odour levels.

4. Interim Option 3: Compost in Tunnels with Stage 2 Offsite

IO3 will remove the outdoor compost odour source from the site. The remaining biofilter odour may become detectable or recognisable offsite, however it will be weaker/less intense than the compost odour that previously masked it, with a less offensive character. PDP's opinion is that the risk of offensive or objectionable odour for IO3 is low.

6.0 Limitations

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of information provided by Christchurch City Council and Living Earth. PDP has not independently verified the provided information and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of Christchurch City Council for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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Yours faithfully

PATTLE DELAMORE PARTNERS LIMITED

Prepared by



Senior Environmental Engineer

Reviewed and Approved by



Group Director

| Living Earth Reporting - Standard Terminology | | | |
|---|---|---|---|
| Term | Definition | Site Context | Odour Descriptions |
| <i>Living Earth (LE) Site</i> | Typically used to describe the whole site and all activities encompassed within. | | |
| <i>Organics Processing Plant (OPP)</i> | Composting plant, refers to the physical building on the site, which contains the In-Vessel Composting (IVC) tunnels and Processing Hall. | | |
| <i>Processing Hall</i> | Main building where material is receipted, processed and sent to the In-Vessel Composting (IVC) Tunnels. | Trucks deposit Kerbside Organics (KSO) inside the hall. This is blended with Green Waste (GW), shredded, and then composted in the IVC tunnels. The building is ventilated under negative pressure. Any odour in the discharge is treated via a biofilter. | <i>Refers to fugitive odour from within the building that is not extracted and mitigated through the biofilter.</i> |
| <i>In-Vessel Composting (IVC) Tunnels/ The Tunnels</i> | 18 completely enclosed concrete vessels where the composting process takes place. | The IVC process uses naturally occurring microbes feeding on organic material. This is a form of aerobic digestion and requires oxygen. Temperature is monitored and can be controlled to facilitate this process. Odorous air from the process is treated via a biofilter. | <i>Refers to fugitive odour from within the tunnels that is not extracted and mitigated through the biofilter.</i> |
| <i>Green Waste (GW)</i> | Garden organics, typically with a higher wood/carbon content than FOGO. | Sourced from Metro Place EcoDrop. If required, can source from Styx Mill EcoDrop. GW is blended with KSO to improve the compost porosity, allowing air to travel through the compost, and helps maintain the optimum carbon to nitrogen ratio. | <i>Refers to odour of raw material.</i> |
| <i>Kerbside Organics (KSO), or Food Organics and Garden Organics (FOGO)</i> | Material collected at the kerbside by Christchurch City Council (CCC). | Deposited in the Processing Hall, blended with Garden Waste, is shredded and then processed through the IVC Tunnels. | <i>Refers to odour of raw material.</i> |

| Living Earth Reporting - Standard Terminology | | | |
|---|---|---|--|
| Term | Definition | Site Context | Odour Descriptions |
| <i>Biofilter</i> | Two biofilters on the site: 1. The large biofilter treats ventilation and process air from the OPP - Processing Hall and IVC tunnels. 2. The small biofilter treats ventilation air from the Main Screen. | The biofilters use a bark media to host microbes that consume and help degrade compounds from air. <i>The small biofilter was added after the plant opened and is not a requirement of the original consent.</i> | <i>The Biofilter descriptor refers to treated odour discharged from the relevant biofilter.</i> |
| <i>Unscreened Compost</i> | Refers to compost from the composting tunnels, prior to screening. | Unscreened compost is removed from the tunnels and stored on-site prior to screening. | <i>The Compost descriptor relates to the character observed from this material and other stockpiles on-site which generally are indistinguishable in character downwind.</i> |
| <i>Screening</i> | Screening separates the compost into: 1. Fines, which are removed from the site, and 2. Tailings, for reintroduction into the tunnel composting process. | Unscreened compost is removed from the tunnels and processed through the Main Screen. | |
| <i>Main Screen</i> | Screens the material. | The main screen is partially enclosed in a building. The building air is extracted for treatment in the Small Biofilter. If the Main Screen requires maintenance or repairs, a mobile screen is used. | <i>The character of the Compost odour during screening has not been differentiated from that of the on-site stockpiles.</i> |

| Living Earth Reporting - Standard Terminology | | | |
|---|---|--|--|
| Term | Definition | Site Context | Odour Descriptions |
| <i>Fines</i> | The fine material separated during screening. | This material is removed from the site. Currently a majority of this material is removed by Fulton Hogan and spread on the oxidation pond paddocks of the Christchurch Wastewater Treatment Plant (CWTP). This is part of their native planting programme to address issues with midges. | <i>The Compost descriptor relates to the character observed from this material and other stockpiles on-site which generally are indistinguishable in character downwind.</i> |
| <i>Tailings</i> | The larger compost material separated during screening. | This material is stored on site before being reintroduced into the process and the tunnels. Tailings, like GW, support the composting process by providing porosity and carbon for the carbon to nitrogen ratio. | <i>The Compost descriptor relates to the character observed from this material and other stockpiles on-site which generally are indistinguishable in character downwind.</i> |