ECOCAST LIMITED

296A TARAWERA ROAD

KAWERAU

AIR MATTERS REPORT 20088

Odour, Dust and Bioaerosol Assessment

Report Date: 6/07/2020

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Report prepared for Ecocast Limited by Air Matters Limited.

Air Matters Report: 20088

Date: 6/07/2020

Status: Final

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1. INTRODUCTION

Ecocast Limited (Ecocast) currently operates a vermicomposting operation in the Kawerau District. Ecocast's existing activity operates under a resource consent (Discharge Permit No. 65549) from Bay of Plenty Regional Council (BoPRC) and a Certificate of Compliance from Kawerau District Council (KDC). Ecocast seek resource consents from both BoPRC and Whakatāne District Council (WDC) to enable expansion of their existing vermicomposting activity; both on the existing site and onto a new adjoining site. An application has been submitted to the BoPRC who has requested further information under Section 92 in relation to odour, dust and bioaerosols.

2. PROJECT DETAILS

Ecocast's existing vermicomposting activity on Lot 3 DPS 308053 operates under a resource consent (Discharge Permit No. 65549) from BoPRC. Resource Consent 65549 provides for:

- Discharge of contaminants to land in circumstances where contaminants may enter groundwater in the Tarawera Catchment.
- Discharge contaminated stormwater to land in circumstances where contaminants may enter groundwater in the Tarawera Catchment; and
- Discharge odorous gases to air from a vermicomposting operation.

The consent provides for a maximum of 28,000 tonnes of raw material, in any 12-month period, to be deposited on the site for the purpose of feeding the worm beds. Ecocast anticipate the need to accommodate up to 70,000 tonnes of raw material annually and are looking to expand their operation onto an adjoining site to the south.

Vermicomposting is the use of earthworms to convert organic waste into nutrient-rich compost/ fertiliser. It involves the breaking down of organic material using worms, bacteria and fungi. The compost produced from this process is sold to farms and orchards across the Bay of Plenty region.

Vermicomposting is an effective and environmentally beneficial method for dealing with organic waste. This operation is aligned with the New Zealand Waste Strategy (Ministry for the Environment, 2002) and related guidelines by the Ministry for the Environment. The vermicomposting operation provides a sustainable method for the Bay of Plenty region to remediate and aerobically recycle organic waste on a large scale. Waste that, otherwise, would be sent to landfill.

The concrete slab and bunker (pit) used for holding and mixing biosolids, prior to placing in the vermicast rows on the site, will be shifted to the south further away from the Log Yard.

3. VERMICOMPOST PROCESS

3.1 Source and type of material

The operation recycles bio wastes from the wider Bay of Plenty by using vermicomposting technology to process, stabilise, and fragment the bio waste and produce a high quality vermicast. The bio waste is predominantly from biosolids from several district council Wastewater Treatment Plants (WWTP) within the Bay of Plenty, septic tank sludge from residential properties and sludge from Fonterra's Edgecumbe milk processing plant. These are all mixed with wood fibre from the primary clarifiers at Norske Skog, OJI and Carter Holt Harvey pulp and paper mills.

3.2 Site Processes

The vermicomposting process recycles carbon-rich wood fibre bio wastes (primary solids) from the Norske Skog, OJI and Carter Holt Harvey mills, with biosolid waste high in nitrogen and phosphorus from various sources detailed above.

Biosolids are collected from the various WWTPs and transported to the existing site via truck and trailer units, where they are deposited into the concrete receptor bunker (pit). Deliveries come in loads of around 25-30 tonnes. Fresh material is covered by a layer of primary pulp screenings to eliminate an odour at this point. A mixing wagon is then loaded with biosolids and primary pulp screenings at a ratio of 1:1.

The mix of the biosolids and primary pulp screenings is then deposited into raw windrows where worms process the biosolid and fibre mix over a period of 6-12 months. Worms naturally migrate to the rows and periodically Ecocast will seed additional worms when needed. The process is aerobic which lowers odour potential and anaerobic conditions are avoided as the worms die or migrate away in such conditions. Ecocast commissioned ALDRO Ltd to study the role of pulpmill screenings in odour control and vermicomposting of biosolids. This report can be found in Appendix A.

After 6-12 months, and once the windrow is deemed ready the raw windrow is raked up into a heaped windrow using the digger. If the raw windrow is not far enough through the composting process, then turning the row may generate odour. Checks are made to ensure the raw windrow is ready for turning using the digger to uncover a small section before this process is carried out.

The heaped windrows are left a month or more and the temperature is checked weekly to ensure composting is taking place to 'sterilise' the material. Once the temperature inside the row has reached 57°C and begun to drop the windrows are then turned using a tractor and composter machine to form turned windrows which continue the composting process for 1 month or so. This process is repeated a further two times to ensure the compost is broken up into a finer fraction and that all material is sterilised. At the end of this process the final product is formed into large heaped windrows. After 12-18 months the final product is tested against New Zealand biosolids standards and is ready to be supplied as a recycled and sustainable compost product.

4. NATURE OF DISCHARGE

4.1 Odour

The main effect of the discharge to air associated with the vermicomposting process is odour. Organic and inorganic forms of sulphur, mercaptans, ammonia, amines, and organic fatty acids are identified as the most offensive odour causing compounds associated with biosolids production. These compounds typically are released from the biosolids by heat, aeration, and digestion. The odours vary by the type of residual solids processed and the method of processing (EPA, 2000).

The odour will vary depending on the part of the process (i.e. how far through the composting process the material is). Based on site visits by Air Matters, the odour can be described as having the following general characteristics.

Fresh Product/Raw Windrow	Heaped Windrow	Turned Windrow/Final Product
•Sewer	•Musty, earthy, mouldy	•Compost

Figure 4-1 Odour characteristics of biosolid vermicomposting at Ecocast

4.2 Dust

Dust is generated by the movement of biosolids onto and around the site, and the mixing, screening and transport of end product and pulp.

4.3 Bioaerosols

Bioaerosols are defined as airborne material containing biological material from animals, plants, insects or micro-organisms. They are produced wherever biological material is being processed, milled, or chopped and should be regarded as ubiquitous. There are two different classes of biological material that contribute to the makeup of bioaerosols that can pose a potential health risk to susceptible persons; those that contain viable micro-organisms (such as bacteria, viruses, fungi or fungal spores) that can potentially cause infections; and those that contain non-viable material (for example, animal dander, pollen, or endotoxins) that act as allergens (Waste Management Institute New Zealand, 2017).

The potential for bioaerosols to be released from the composting process can occur at the following stages:

- filling of the pit
- formation of windrows
- the physical turning of the material in the windrow during the maturation stage
- the loading out of the mature compost

Once aerosolised, the bioaerosol can remain suspended for considerable time, from minutes to hours. The amount of bioaerosol in the air reduces the further the distance from the activity due to particle settling and the dilution affect from air movement. Prevailing weather and wind conditions will affect the dispersal and spread of any bioaerosol from the site.

5. ENVIRONMENTAL SETTING

5.1 Zoning and Sensitive Receptors

The current site is in the Kawerau District (zoned as Rural Lifestyle) and the additional proposed site is located within Whakatāne District (zoned as Rural Foothills). Access to both sites is via Tarawera Road.

The proposed site adjoins the southern boundary of Ecocast's existing 15-hectare vermicomposting site, which is located within Kawerau District. The entire site (existing and proposed) therefore traverses the Kawerau and Whakatāne District Council boundaries, as shown on Figure 5-1.

The site is located approximately 375m east of Tamarangi Drive (SH34), to the southeast of Tasman Mill (pulp and paper) and south of the Kawerau Diary Plant and Kawerau Log Yard. These sites are located in Industrial Zones 1 and 3. Policy C2.2.2.1 of the Kawerau District Plan (2012) states that *"Higher tolerances for… odour… is provided in the industrial zone, where it does not cause adverse effects outside of the zone taking into account the existing environment which includes a number of lawfully established industries in proximity to rural and residential activities".* Within this industrial zone there are several large industries that are significant sources of odour and dust – these are discussed further in Section 5.4. Given this context, the land within the industrial zone is considered to have a low sensitivity to odour and dust impacts.

Rural pastoral land adjoins the site to the west, northwest and southwest and wetland-type vegetation characterises the adjoining property to the south. The closest rural residence is located 900m to the northeast of the current site and the closest residential property will be located approximately 1.3km to the west southwest at River Road in the Kawerau township. There will be an additional buffer of around 300m from the boundary to the windrows on the proposed site (scrub land) to the residential area to the west southwest. Sensitive receptors can be seen in Figure 5-2.

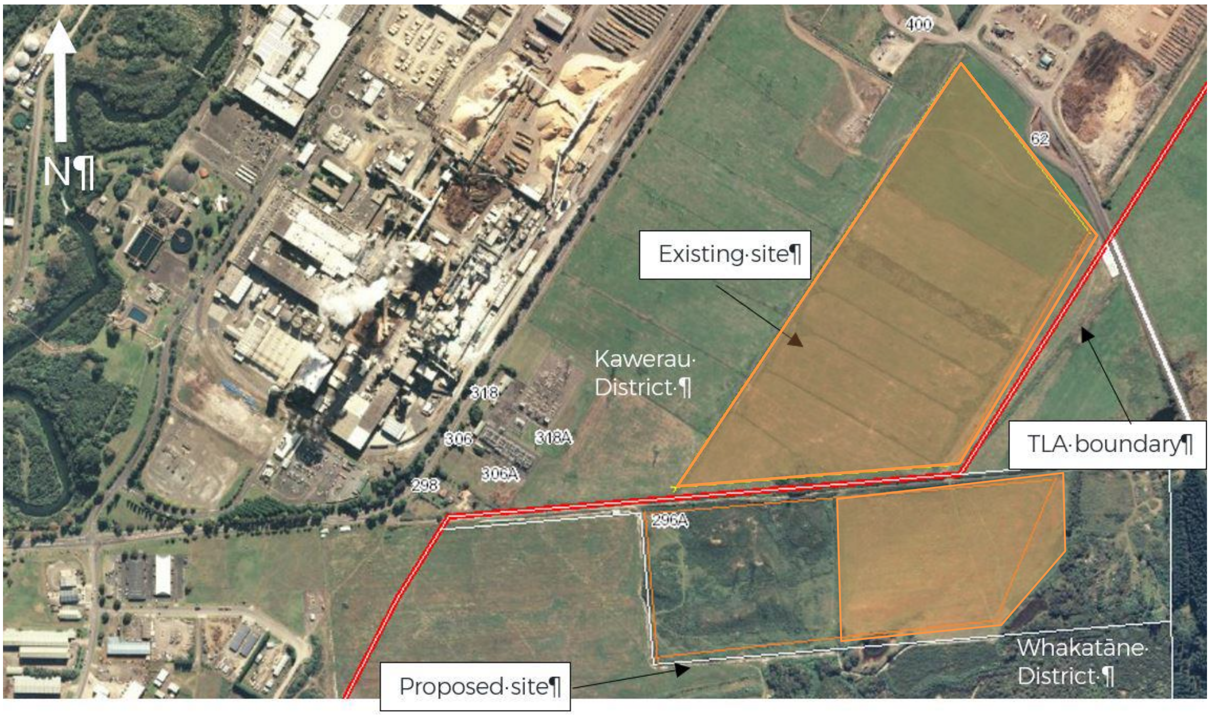

Figure 5-1 Ecocast site location

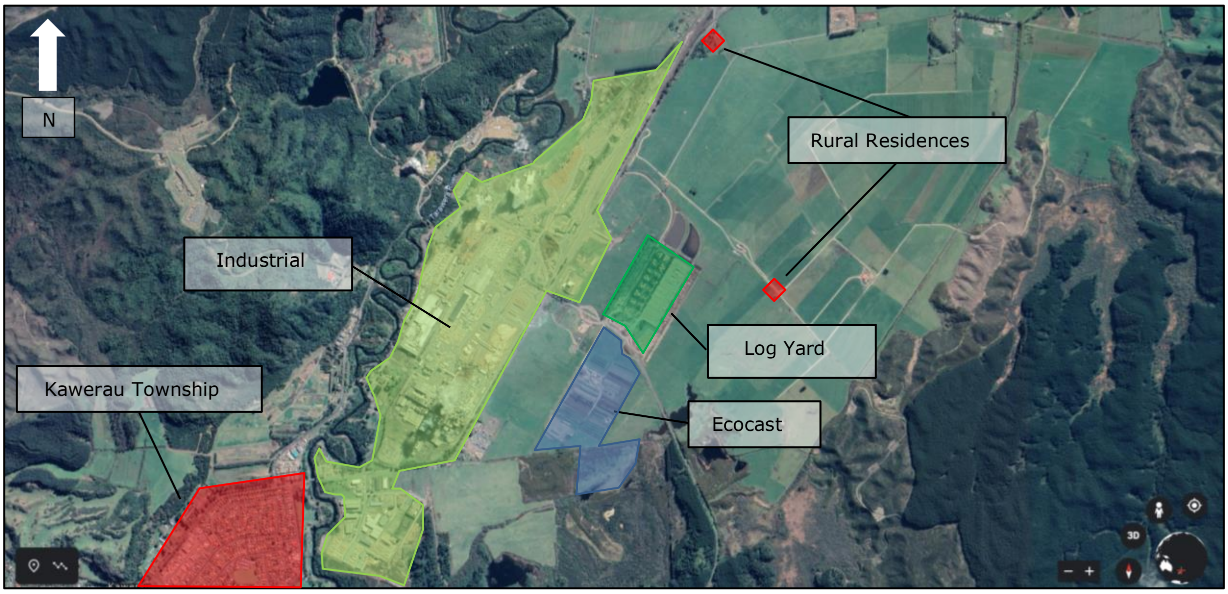

Figure 5-2 Ecocast location and sensitive receptors (locations are approximate)

5.2 Topography

The topography of the Kawerau area significantly affects local winds and the dispersion of pollutants. The Tarawera River flows from Lake Tarawera (298m above sea level and 22km to the southeast), down through the township of Kawerau (31m above sea level) and out onto the coastal plains before discharging into the Pacific Ocean more than 25km to the northeast. Land on the western side of Kawerau is flat before rising against the Onepū hills. The land to the east of Kawerau is flat before rising to the Matahina Forest. Further to the south is Putauaki (Mount Edgecumbe) which rises to 821m. The topography of the area can be seen in Figure 5-3 and an additional map can be seen in Appendix B.

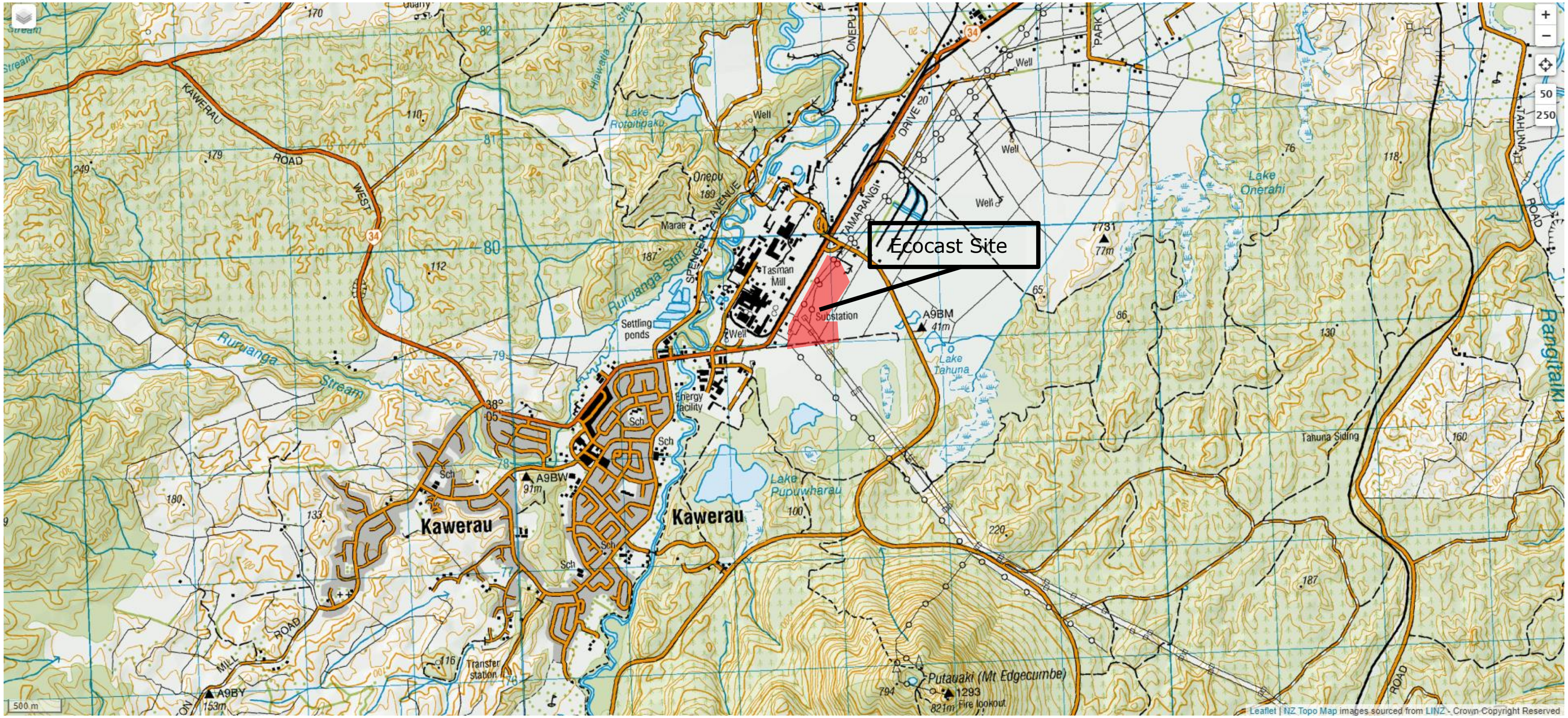

Figure 5-3: Kawerau and surrounding areas

5.3 Meteorology

Measurement of meteorological conditions (wind direction and wind speed) has been recorded by the Bay of Plenty Regional Council at Edgecumbe, which is located approximately 13km to the northeast of the site. The map in Appendix B shows the locations of Kawerau and Edgecumbe, the topographic map shows that Edgecumbe is located on the coastal plains and Kawerau is located further inland at a similar elevation with hilly terrain to both the northeast/east (Rotoma Forest) and southeast/south (Matahina Forest and Putauaki – 821m). To the southwest the valley climbs in altitude as it follows the Tarawera River up to Lake Tarawera. The meteorological conditions will be similar in Edgecumbe and Kawerau, however, the geographic features surrounding Kawerau will have an influence and it is expected that the predominant wind directions would be from the SW and NNE. Data from the Edgecumbe met station has been used for the years 2017, 2018 and 2019 and can be seen in Figure 5.4. The predominant wind directions in Edgecumbe are from the southwest quarter and from the north/northwest. As noted above, it is expected that the winds from the north are more likely to come from the north northeast as opposed to the north northwest, however the area to south southwest round to the south southeast of the site is rural foothills with no sensitive receptors. Data from this site is considered representative of conditions at the Ecocast site and appropriate for this assessment.

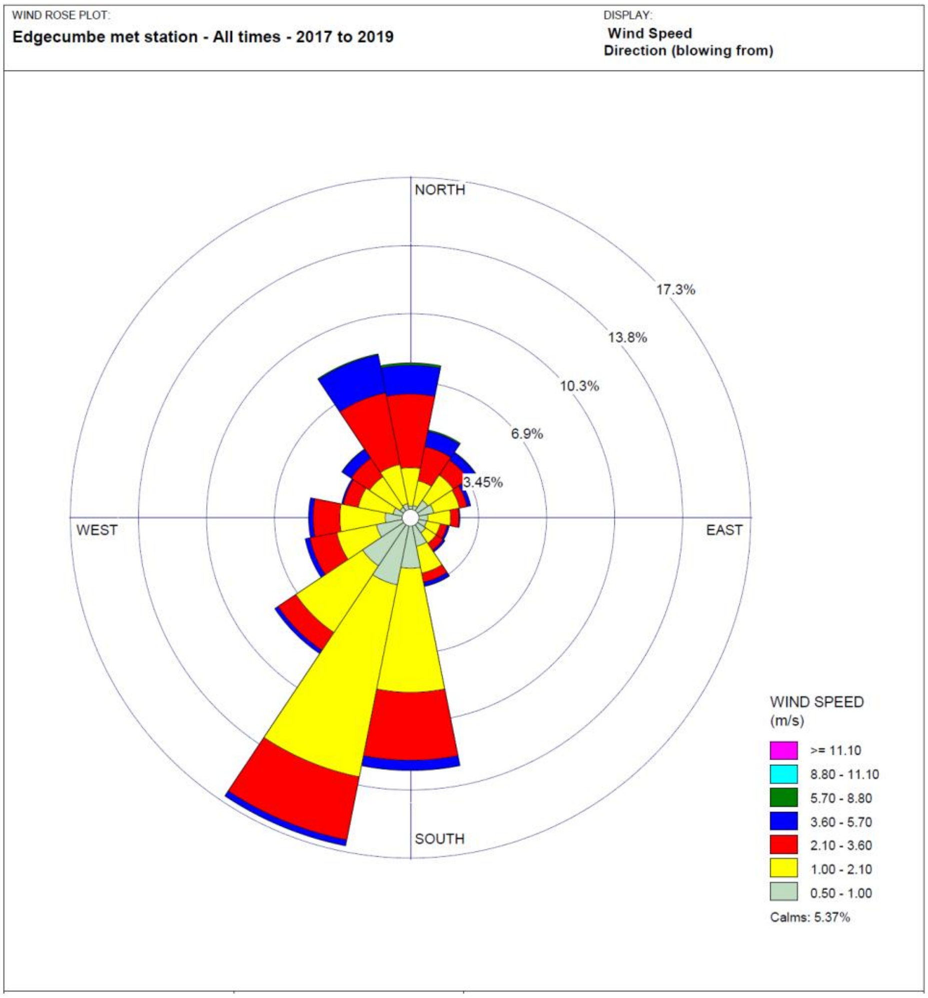

Figure 5-4: Windrose for Edgecumbe 2017-2019

The windrose for all hours (Figure 5.4) shows that the prevailing winds are from the south southwest. The lightest winds also tend to come from this direction, generally following the path of the valley system out to the coast. Windroses have been generated for various times of the day and can be seen in Appendix C. When looking at the trends in wind direction over the different stages of the day the windroses indicate the following:

- Relatively calm winds are most prevalent during the early morning through to sunrise (00:00-07:00). Light winds also frequently occur from the southwest.
- During the daytime, winds are much stronger and are predominately from the southern quarter and the north/north northwest.
- During the evening, winds are much more varied but tend to be from the southwest quarter with wind speeds decreasing.

Windroses have also been generated for seasonal analysis and can be seen in Appendix D. Seasonal analysis indicates that the lightest winds are most prevalent during the autumn and winter months, when calm inversion conditions are expected to occur most frequently. As expected, the spring and summer months have a higher frequency of stronger winds.

The windrose for all times (2017-2019) has been overlaid on the Ecocast site in Figure 5-5.

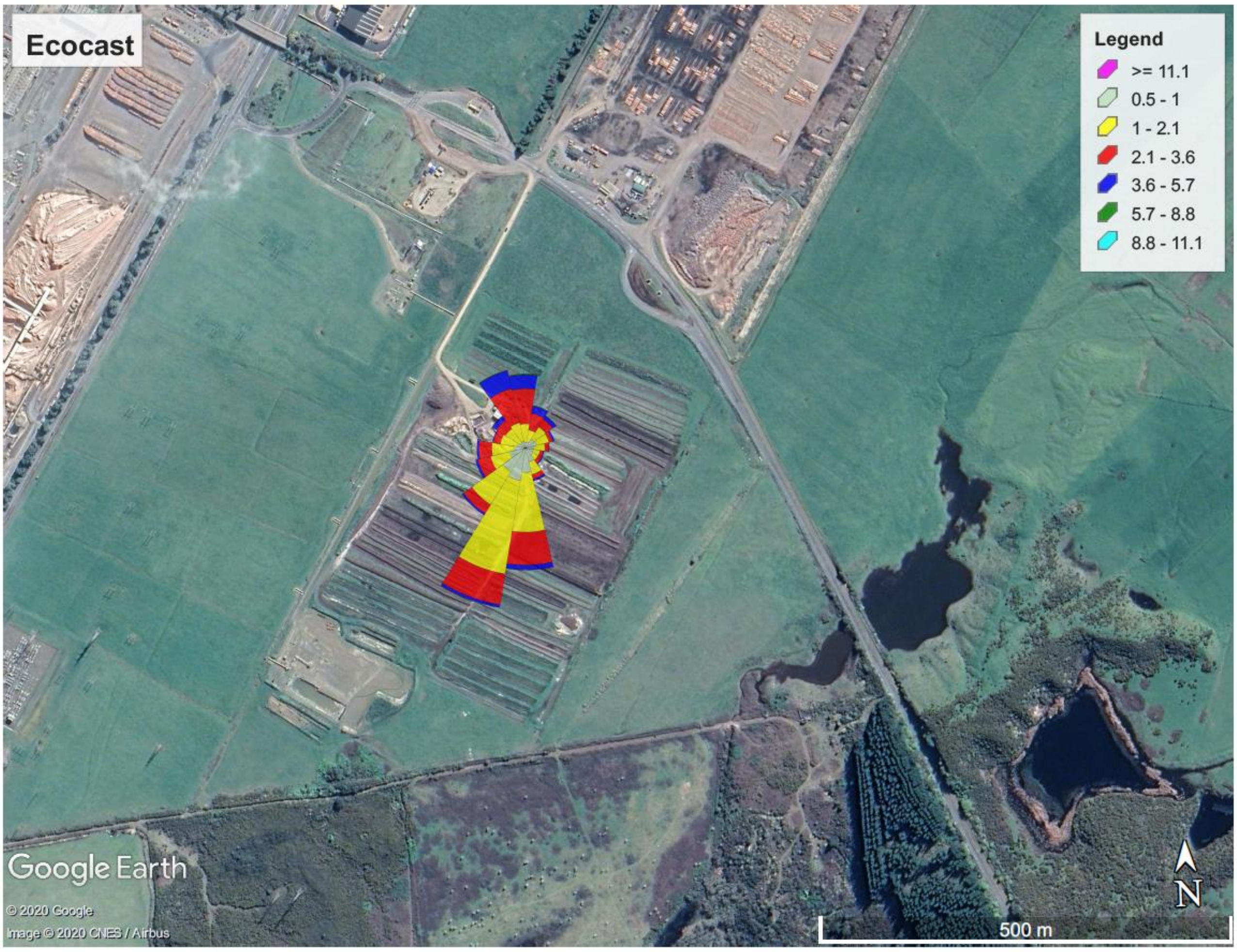

Figure 5-5 Windrose for Ecocast site

5.4 Background sources of odour and dust

The Ecocast vermicomposting site is near several other odour generating industries. These industries include:

- OJI timber mill and pulp and paper plant
- Norske Skog Tasman pulp mill
- Carter Holt Harvey timber mill
- Asaleo Care tissue paper plant
- Geothermal Fields

In addition to these industrial sources there is natural geothermal activity located in the area.

6. ASSESSMENT OF ODOUR

Potential odour nuisance effects associated with the Ecocast composting activity have been assessed in accordance with the MfE's 'Good Practice Guide for Assessing and Managing Odour' (MfE 2016). This guidance recommends a hierarchy of assessment tools for evaluating odours from existing activities. Air Matters has carried out a qualitative odour assessment in conjunction with odour surveys. The qualitative approach evaluates the likelihood of odour generated on site giving rise to 'offensive or objectionable odour effects' based on an evaluation of the FIDOL factors described below. The FIDOL factors are similarly described in the Bay of Plenty Regional Air Plan.

- **Frequency**: The frequency of exposure to odour impacts experienced at a given location. The frequency of exposure depends on both the frequency of occurrence of discharges and the frequency of weather conditions that could transport any discharge towards a sensitive location.
- **Intensity**: The intensity of odour impacts depends on the degree to which odour sources are controlled but also the separation distance between a source and the receptor.
- **Duration**: The duration of exposure depends on how long a sensitive location may be exposed to odour from a source.
- **Offensiveness**: The offensiveness (or character) of odour relates and its hedonic tone (how pleasant or unpleasant the odour is).
- **Location**: The location factor relates to the sensitivity of the location being assessed, and is typically expressed as low, medium, or high. Residential dwellings are considered to have a high sensitivity to odour impacts, whereas rural/pastoral land is considered to have a low sensitivity.

The FIDOL assessment is informed by a review of exposure of sensitive locations to certain wind conditions and terrain features to inform the likely frequency and duration of potential impacts. This focuses on the occurrence of light winds, as these are often indicative of poor dispersion conditions, which are a worst-case for odour impacts from ground level release of odour. A FIDOL evaluation has been carried out for the three main odour generating activities that have been identified on site:

- Receiving biosolids
- Laying out raw windrows
- Heaping windrows

Table 6-1: FIDOL Assessment for Receiving Biosolids

FIDOL Parameter	Evaluation
Frequency	Biosolids are received daily on site. On average there are 6-8 truckloads per day received on site. Currently, some deliveries occur early (around 06:00) but the majority occur after 16:00 in the afternoon. When the pit is relocated to the proposed site the deliveries will occur at any time of the day. The potential for odour nuisance will be affected by the of various wind conditions and the number of loads received daily. Analysis of the meteorology and topography along with the location of sensitive receptors include: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site and at 407A Kawerau Road to the north of the site. Wind blowing from the pit area towards these are relatively frequent and in worst case conditions. However, the property on the adjacent farm and at 407A Kawerau Road will be approximately 1.4km and 2.4km away from the pit respectively (when it is moved to the proposed location). • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau is 1.7km to the SW of the site on River Road. Although Kawerau will frequently be downwind during the common NE wind, this wind is not typically associated with the worst-case calm conditions. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard immediately to the north of the site. Winds blowing from the pit area towards the Log Yard are relatively frequent and in occur worst case conditions.
Intensity	Observation was made by Robert Murray (Air Matters) on 12/05/20 when a truck load of biosolids had been dropped off from Rotorua (sometime earlier). The loader was used to turn over the biosolids in the pit to replicate the process and odour. A strong odour was present which was considered unpleasant. However, after a truck unloads into the pit the material is immediately covered with a layer of pulp. On the 12/05/20 once covered with pulp the odour is no longer noticeable. The potential for odour to have an impact on receptors from this part of the operation, it is heavily influenced by separation distances. It is proposed that the pit will be moved further to the south on the new site which will increase the distance to sensitive receptors to the north by an additional 350m. Impacts of intensity of potential odour on the surrounding area are: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site (approximately 1.4km from the proposed location of the pit) and at 407A Kawerau Road to the north of the site (approximately 2.4km from the proposed location of the pit). These distances of 1.4km and 2.4km are considered large distances and it is expected that odours will dilute to a point of being undetectable even under worst case dispersion conditions. • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau is 1.7km from the proposed pit location and they are not downwind in worst case conditions, therefore, it is considered that odour from this activity will not be detectable. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard immediately to the north of the site. The site will be located approximately 650m from the proposed location of the pit. This will double the current distance as it stands. Although winds blowing from the pit area towards this site are relatively frequent and do occur under worst case conditions, this is controlled by the short time it takes to unload and the covering of the biosolids with a layer of pulp.
Duration	The duration of impacts depends on the duration of wind conditions and the frequency of the discharge. In the case of receiving biosolids (frequency), the discharge of the odour will be short and will take up to 5 minutes between the load being discharged and covered by a layer of pulp (to eliminate odour). The duration factor also depends on the duration of the wind blowing in the direction of a receptor. The closest sensitive receptor will be approximately 1.4km downwind of the proposed location of the pit when the wind is from the SW which is the predominant wind direction. Other receptors include the Log Yard to the north of the site which will be approximately 650m downwind from the proposed location of the pit.
Offensiveness	The odour has the potential to be offensive with a sewer like characteristic therefore it is important that the loads of biosolids are covered with pulp as soon as possible.
Location	The pit is to be relocated to the proposed site around 350-400m south of the current location. The pit will then be approximately 1.4km away from the nearest sensitive receptor and double the current distance from the nearest industrial site (Log Yard). The Log Yard is in an Industrial 3 Zone where a higher tolerance for noise, odour and visual effects is accepted.

Table 6-2: FIDOL Assessment for Laying out Raw Windrows

FIDOL Parameter	Evaluation
Frequency	Biosolids are laid out in raw windrows daily and this is considered a frequent activity. When laying out windrows in the northern part of the site the work is started around 15:00 and can finish around 22:00. Rows in the middle of the site and the south end of the site can be laid out at any time during the day. The potential for odour nuisance will be affected by the various wind conditions and the time it takes to lay out raw windrows. Analysis of the meteorology and topography along with the location of sensitive receptors include: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site and at 407A Kawerau Road to the north of the site will be downwind frequently and in worst case conditions. • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau will frequently be downwind during the common NE wind, however, this wind is not typically associated with the worst-case calm conditions. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard. The Log Yard if immediately to the north of the site. Winds blowing from the site towards the Log Yard are frequent and occur under worst case conditions for odour dispersion.
Intensity	Observations were made by Robert Murray (Air Matters) on 01/07/20 when a row was laid out in northern part of the site. It was late in the day and it was cool with clear skies and the wind was moderate to light from the S/SW. A distinct/strong odour was present when at the boundary (approximately 50m from the row) which was considered unpleasant when the material was being discharged from the mixer wagon. Once the material was laid in the windrow the odour was weak and when the pulp was laid over the top the odour was difficult to detect above the background odour from the site. Impacts of intensity of potential odour on the surrounding area are: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site (approximately 900m from the most northern location for windrows on site) and at 407A Kawerau Road to the north of the site (approximately 1.8km from the most northern location for windrows on site). These distances of 900m and 1.8km are considered large distances and it is expected that odours will dilute to a point of being undetectable even under worst case dispersion conditions. • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau is 1.3km from the southernmost location of windrows on site and they are not downwind in worst case conditions, therefore, it is considered that odour from this activity will not be detectable. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard immediately to the north of the site. The site will be located approximately 150m from the northernmost location of windrows on site. Although wind blowing from the windrows towards this site are relatively frequent and do occur under worst case conditions, this is controlled by when laying out windrows in the northern part of the site, work is done in the evening (after hours for Log Yard) and a layer of pulp is used to cover the windrows after they have been laid out to eliminate odour.
Duration	The duration of impacts depends on the duration of wind conditions and the frequency of the discharge. The process laying out raw windrows currently takes 4-6 hours (this will double when the proposed site is operational, however, this time may be reduced if additional machinery is purchased to carry out this process). The closest sensitive receptor may be located a minimum distance of 900m downwind of the site when the wind is from the SW and the closest industrial receptor (Log Yard may be a minimum distance of 150m downwind of the windrow when the wind is from the S/SW. It takes around 10 minutes to fill the mixer wagon and the between 3-5 minutes to lay the material in the windrow. Current practice is that the operator will do around 5-6 loads before covering the material with a layer of pulp to eliminate odour. Odour may be present for approximately 1 hour before it is covered with pulp. This is a short time and any odour detected offsite will also only be for short periods of time.
Offensiveness	The odour has the potential to be offensive with a faecal (manure)/sewer characteristic for a short period when material is discharged from the mixer wagon. When working in the northern part of the site, a layer of pulp is used to cover the raw windrows which is effective at eliminating odour.

Location	The surrounding areas where odour could have an impact are zoned Rural which is an area less populated and Industrial where a higher tolerance for noise, odour and visual effects is expected. Raw rows are laid out over the entire site. Along the northern boundary where the closest neighbour is located (Log Yard) Ecocast leave a buffer zone of 50-170m between the rows and the boundary. When the proposed site is up and running it is planned that rows will be laid out at any time of the day and when rows are laid out on the current site the work will take place at the end of the day to minimise the time that staff on the neighbouring property to the north are present.

Table 6-3: FIDOL Assessment for Heaping Windrows

FIDOL Parameter	Evaluation
Frequency	The raw windrows are turned after 6-12 months. This process happens on two days per month. This is an infrequent activity. The potential for odour nuisance will be affected by the of various wind conditions, how often raw windrows are heaped and the time it takes to heap the raw windrows. Analysis of the meteorology and topography along with the location of sensitive receptors include: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site and at 407A Kawerau Road to the north of the site will be downwind frequently and in occur worst case conditions. • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau will frequently be downwind during the common NE wind, however, this wind is not typically associated with the worst-case calm conditions. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard. The Log Yard if immediately to the north of the site. Winds blowing from the site towards the Log Yard are frequent and occur under worst case conditions for odour dispersion.
Intensity	Observation was made by Robert Murray (Air Matters) on 05/06/20 when the loader was used to rake a windrow that was 1 year old. The day was clear, it had rained the day prior, it was cool, and the wind was classified as 'light air'. When this process was carried out no odour could be detected for most of the time and at other times a very weak odour could be detected in a downwind location 20-30m from the windrow. The intensity of the odour is linked with the time that the raw windrow has been composting, and a very strong odour will be present where the raw rows have not been left long enough to compost fully and where the rows have composted sufficiently the intensity of the odour is greatly reduced. A minimum of 6 months is required before a raw windrow is turned but it would generally be longer than this. Impacts of intensity of potential odour on the surrounding area are: • Rural residences. Rural dwellings are located on the farm immediately to the northeast of the site (approximately 900m from the most northern location for windrows on site) and at 407A Kawerau Road to the north of the site (approximately 1.8km from the most northern location for windrows on site). These distances of 900m and 1.8km are considered large distances and it is expected that odours will dilute to a point of being undetectable even under worst case dispersion conditions. • Residential dwellings in the Kawerau Township. The closest residential property in Kawerau is 1.3km from the southernmost location of windrows on site and they are not downwind in worst case conditions, therefore, it is considered that odour from this activity will not be detectable. Analysis of the meteorology and topography along with the location of industrial properties include: • Log Yard immediately to the north of the site. The site may be located approximately 150m from the northernmost windrows on site. Although wind blowing from the site towards the Log Yard are relatively frequent and do occur worst case conditions, this is controlled by ensuring that raw windrows are given sufficient time to compost before being disturbed.
Duration	The duration of odour impacts depends on the duration of wind conditions and the frequency of the discharge. The process heaping windrows takes 4-6 hours (this will double when the proposed site is operational, however, this time may be reduced if additional machinery is purchased to carry out this process). The closest sensitive receptor may be located a minimum distance of 900m downwind of the site when the wind is from the SW and the closest industrial receptor (Log Yard may be a minimum distance of 150m downwind of the windrow when the wind is from the S/SW
Offensiveness	The odour of an appropriately composted windrow is neutral with a compost/faecal (manure) like odour characteristic. A windrow that has not composted appropriately

	may have an unpleasant sewer/musty, earthy, mouldy like odour which has the potential to be offensive.
Location	Raw rows are laid out over the entire site and therefore the heaping windrows will also take place over the entire site. Along the northern boundary where the closest neighbour is located (Log Yard) Ecocast leave a buffer zone of 120-170m between the rows and the boundary. The surrounding areas to the north of the site are Rural or Industrial and classified as low sensitivity.

Considering the above FIDOL assessments and the odour surveys carried out, the potential for offensive and objectionable odour effects at sensitive locations is very low. This is largely due to the separation distances and the controls that Ecocast has in place.

The FIDOL assessment does indicate that there is some risk around offensive and objectionable odour being detected by the neighbouring Log Yard. This is confirmed by investigating the complaints history for the site where one compliant was received in 2018 and twelve complaints have been received in 2020. Six of these 12 complaints were verified by an Officer form the Bay of Plenty Regional Council. Although details of the exact location of the complaints is not known, it is known that they were from the same source on McKee/Tarawera Road area which is directly to the north of the site and consistent with prevailing downwind conditions when the wind is from the south/southwest. The complaint history has been charted in Appendix E and the additional controls implemented by Ecocast have also been noted.

The first issue identified by Ecocast was that the biosolids from Kawerau WWTP are not processed to the same degree as more advanced WWTP (i.e. digestion) and because of this these solids are much more odorous. Ecocast stopped receiving biosolids from Kawerau WWTP in the middle of March (20/03/20). An additional two complaints were received in May when windrows were being laid out in the northern part of the site when a southerly wind was blowing. As the wind direction is changeable, when working in the northern part of the site, Ecocast now place a layer of pulp over the raw windrow once it has been laid out. This is done by filling the mixer wagon with pulp and discharging it over the laid-out row. This achieves a cover of around 90 to 95% which is deemed to be sufficient to eliminate the majority of the odour. Since this process has been implemented, no further complaints have been received.

6.1 Mitigation

Due to the nature of the process with windrows being laid out in the open, treatment of air through a specific abatement system before being discharged is not possible. There are several procedural controls that have been implemented to minimise the odour emission or the potential for odour to impact neighbouring properties. Mitigation and minimising odour may be managed through consent conditions but it is recommended that it is managed with the use of an odour management plan which can be modified when necessary The current procedures will be finalised and outlined in more detail in the Odour Management Plan but are summarised below:

- The pit for receiving biosolids is to be located further to the south on the proposed site. This will double the current distance away from the neighbouring Log Yard to the north of the site.

- Truckloads of biosolids are covered immediately with pulp after they are discharged into the pit.
- Currently, truckloads of biosolids are generally received outside of the neighbouring Log Yard site working hours. They are received at 06:00 in the morning and after 16:00 in the afternoon. However, this will be less important when the pit is relocated to the proposed site.
- The northern part of the site is deemed as higher risk in terms of potential odour impacting on neighbours. Raw windrows are laid out in this area in the afternoon from 15:00 onwards and are covered with a layer of pulp once laid out to reduce odour.
- Prior to raking up a raw windrow into a heaped windrow after a period of 6-12 months of composting, the digger driver will uncover a small representative area with the bucket to determine the odour level. If the odour level is low and within an acceptable range, then the row can be raked up into a heaped windrow. Where the odour is determined to be unacceptable the operator will recover the area. The row will be checked later after additional composting has taken place.

7. ASSESSMENT OF DUST

Dust discharged from the site will be in the size range of 1-100µm (soil and road dust) (WHO, 2006). It is expected that the dust discharged from site will be larger dust particles that are responsible for nuisance effects. This is because they are more visible to the naked eye, and therefore more obvious as deposits on clean surfaces.

Some nuisance dust may have the potential to cause direct health effects because of the presence of specific biologically active materials. In this instance, sewage sludge dust can contain pathogens that have not been deactivated during the wastewater treatment process and compost dust may contain soil microbes, allergens, and pathogens. These factors are assessed separately in Section 8.

7.1 FIDOL Factors

As with odour, the nuisance effects of dust emissions are influenced by the nature of the source, sensitivity of the receiving environmental and on individual perception. For example, the level of tolerance to dust deposition can vary significantly between individuals. Individual responses can also be affected by the perceived value of the activity producing the dust. For example, people living in rural areas may have a high level of tolerance for the dust produced by activities such as ploughing or top-dressing, but a lower tolerance level for dust from quarries.

Whether a dust event has an objectionable or offensive effect always depends on the frequency, intensity, duration, offensiveness/character, and location of the dust event. These factors specific to dust are described below.

- **Frequency:** How often an individual is exposed to the dust
- **Intensity:** The concentration of the dust
- **Duration:** The length of exposure
- **Offensiveness/character:** The type of dust

- **Location:** The type of land use and the nature if human activities of the dust source.

A FIDOL assessment has been carried out based on the visits to site by Robert Murray of Air Matters on the 12/05/20 and the 05/06/20 where various dust generating activities were observed. This assessment is summarised in Table 7-1.

Table 7-1 FIDOL Assessment for Dust

Frequency	Vehicle movements on unsealed surfaces occur daily. Loading of pulp to mix with raw biosolids in the mixer wagon occurs daily. Turning rows using the windrow turner is carried out around 5 days per month. Pulp delivered to site by truck load on average 20 out of 30 days per month. Loading out of final product with the digger filling a truckload is carried out 5 days per month
Intensity	Fugitive emissions of dust from site will mostly be in the nuisance size range and it is expected that this dust will settle out onto surfaces closer to the site. Based on settling velocity for a particle 100 micrometres in diameter in a 10-knot wind (5 m/sec), the 100-micrometre particles would only be blown about 10 metres away from the source while 10-micrometre particles have the potential to travel about a kilometre. Fine particles can therefore be widely dispersed, while the larger particles simply settle out in the immediate vicinity of the source (under calm conditions). The dust concentration at any sensitive receptors which are a minimum distance of 900m away from the site will be minimal. The Log Yard located immediately to the north across Tarawera Road is much closer, however as Ecocast leave a buffer between the boundary of their site and the windrows, the Log Yard will be at least 150m from the northern most windrow.
Duration	The activities carried out on site that have the potential to generate dust take various amount of time, from a few minutes (driving on unsealed road) to 3-5 hours (turning rows) but no dust generating activities are continuous.
Offensiveness/character	The dust generated from site will be pulp, dust from unsealed roadways and dust from composted rows. It is expected that there will be no discharge of dust from the raw biosolids.
Location	Surrounding land uses are either rural or industrial. The MfE Good Practice Guide for Assessing Dust gives general sensitivity classifications for different land uses for assessment of health effects and amenity effects. Rural zones have a low sensitivity for rural activities and heavy industrial areas also have a low sensitivity where amenity affects tend to be tolerated if the effects are not severe.

7.2 Mitigation

There are several controls in place to reduce the fugitive dust emissions from site. These are outlined below:

- Separation distances. Ecocast maintains a buffer zone between the northern most windrow and the boundary of the site to minimise the effect any dust generated from the turning of windrows and loading of final product.
- Vehicle speed limits. There is a vehicle speed limit on site of 15km/hr.
- Moisture Content. Maintaining moisture in the windrows is critical for the vermicomposting process to work effectively and for odour reduction. The moisture content of the windrows ensures that that the potential for dust generation when windrows laid out, heaped, and turned is minimised.
- The pulp that is delivered to site is damp
- Meteorological conditions will be monitored by Ecocast by installing an onsite meteorological station. If there are any complaints, then the meteorological conditions can then be assessed in any follow up investigation.

8. ASSESSMENT OF BIOAEROSOL

Bioaerosols are produced wherever biological material is being processed, milled, or chopped and should be regarded as ubiquitous. Examples of sites where significant bioaerosols are produced include oxidation ponds at wastewater treatment plants (including dairy effluent ponds), composting facilities, harvesting agricultural crops, and log processing at timber mills. There are several other sources of bioaerosols in the vicinity of Ecocast.

The characteristics of biosolids vary depending on their origin (vegetable, animal, human) and the treatment process they have gone through (physiochemical or biological, aerobic or anaerobic digestion, lime stabilisation). (Forcier, 2002). Typically, bioaerosols consist of fine particles measuring less than 20 microns in diameter (Goyer et al., 2001). Bioaerosols become airborne through the release of dust and water droplets (aerosolization). These particles can be inhaled by humans (breathed in and held in the nasal cavities and the mouth) while the smallest, less than 5 microns, are respirable and can penetrate deep into the lungs (Cole et al., 1999).

Most micro-organisms present in the environment, especially in soil, manure or biosolids, have no negative effect on health. However, following aerosolization, some can be found in abnormally high concentrations in the air, and present a risk for individuals exposed to them, more so for the workers on site. (Forcier, 2002). Once generated, the bioaerosol can remain suspended for considerable time, from minutes to hours. The amount of bioaerosol in the air reduces the further the distance from the activity due to particle settling and the dilution affect from air movement and dispersion.

For certain sensitive individuals such as those who suffer from allergies or are immunocompromised, young children, pregnant women, and the elderly, inhaling bioaerosols can lead to inflammation, respiratory allergies and sometimes infection. On the other hand, exposure for healthy individuals does not usually lead to serious consequences although symptoms may occur in certain cases (Sattar and Springthorpe, 1997). The main types of bioaerosols likely to originate in residuals or manure, and the health symptoms associated with them, are presented in Table 8-1.

Table 8-1 Bioaerosols associated with biosolids and their health effects

Bioaerosol	Origin	Reported Symptoms
BACTERIA Gram negative bacteria (*E. coli, Salmonella*); thermophilic actinomycetes	Abundant in nature and in humans. Outdoors, they originate in water, soil, and plants, and they are associated with the presence of humans and animals.	Mucous membrane irritation, gastro-intestinal and respiratory problems (Gram negative bacteria and endotoxins), hypersensitivity pneumonitis (thermophilic actinomycetes).
MOULDS *Aspergillus fumigatus*	Ubiquitous in nature; proliferates well in humid conditions. *Aspergillus fumigatus* is thermotolerant, sometimes pathogenic; it is found on manure, compost, wood, other organic material.	Allergic reactions, infections and irritation, toxic syndrome through exposure to organic dusts (ODTS). The nature of the dose-response relationship is not known, nor is the existence of a safe exposure threshold.
METABOLITES OR TOXINS Endotoxins Mycotoxins	Ubiquitous, endotoxins are complexes that are integral parts of the outer membrane of Gram negative bacteria. Their presence is often associated with organic dust. Mycotoxins (spores and propagules) are released by moulds.	The effects of endotoxins and their role as a bioaerosol are not well known (Olenchock, 1994). Symptoms are a cough, shortness of breath, fever, obstruction and inflammation of the lungs, and gastro-intestinal problems. The effects of mycotoxins are not well known. Symptoms are skin and mucous membrane irritations, dizziness, immunosuppression, headache, nausea, cognitive effects
VIRUS Enteric viruses (*Rotavirus* and others)	A live host cell is required for a virus to survive, spread, and reproduce. It may be spread when droplets from an infected source are released but it may not survive long in the air.	Certain enteric viruses could become airborne and under certain conditions lead to infections in susceptible individuals (Brenner et al., 2000). The release and transportation of airborne viruses and their potential effects on human health in the context of activities involving the application of biosolids are theoretical and have not been documented (Pillai et al., 1996).

Adapted from Forcier (2002) who references Goyer et al. (2001) and various authors.

Forcier (2002) studied the application of biosolids onto land and concluded that there is a potential to generate bioaerosols that can be harmful to health. Forcier concluded that the scientific studies referred to at the time indicate that the risks are relatively low for the workers who are most likely to be exposed to bioaerosols, such as farmers and those who specialise in the management of biosolids. In addition to this, the risk of transmitting pathogenic organisms to workers would more likely be through direct contact than through the air in the form of bioaerosols.

Robertson et al (2015) reported that there was some, albeit limited, qualitative evidence linking bioaerosol emissions from composting facilities to poor respiratory health in nearby residents. However, the limited evidence precluded any quantitative assessment. Robertson et al (2019) carried out a review of more current literature and the conclusions remain largely unchanged.

As with odour and dust, the prevailing weather and wind conditions will affect the dispersal and spread of any bioaerosol. The closest sensitive receptor is the rural residence to the northeast and the closest industrial receptor is the Log Yard to the north of the site. Bioaerosols will be generated at both sites where cattle waste is sprayed onto farmland and where trees are processed and the exposure to people in these locations may in fact be higher from these sources than that which are generated from Ecocast.

9. CONCLUSION

The Ecocast vermicomposting activity is appropriately located according to the Kawerau and Whakatāne District Plans. Sensitive receptors are located at 900m or more from the site and it is expected that there will be no objectionable or offensive effects from odour or dust generated on the Ecocast site at these locations. This is supported by the fact that no complaints have been received from either rural or residential properties surrounding the site.

Although there have been historic odour complaints from the adjacent property to the north of the site (Log Yard), Ecocast have implemented additional controls to reduce the impact on this site which has been effective to date. It is also important to note that this site is located within an industrial zone where it is expected that there will be a higher tolerance of odour and dust.

There is limited guidance relating to bioaerosols from the vermicomposting of biosolids, however, a literature review indicates that the highest risk will be to staff working on site opposed to any individual at a neighbouring property.

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APPENDICES

APPENDIX A: ALDRO REPORT

On the role of pulpmill solids in odour control during composting and vermicomposting of biosolids

Introduction

Aldro Ltd were commissioned by John Fell (Ecocast) to clarify the mechanism of biochemical conversions particularly related to the role of pulpmill solids in the process of generation and control of odorous gases during composting and vermicomposting of biosolids.

The odorous component of the biosolids originates from anaerobic decomposition of organic matter, especially in the presence of sulphur-containing organic and inorganic substances. Basics of biochemical conversions during composting are given with emphasis on the main subject of this work. It was shown that the rate of composting being predominantly an aerobic process, is largely affected by the nutrient balance (C:N ratio), moisture content, temperature and oxygen supply within the composting system. Therefore, these factors should be considered first to achieve the sought goal.

Why biosolids can be odorous?

It is commonly known that the odorous gases are associated with the processes of anaerobic degradation of organic matter. The anaerobic systems establish a population of hydrolysing anaerobic bacteria, acid forming bacteria and methane forming bacteria. The hydrolysing bacteria break down the complex biodegradable organic material to simpler compounds that are then transformed to short chain fatty acids by the acid forming bacteria. These short chain fatty acids then serve as food or substrate for the methane forming bacteria.
The methane bacteria are extremely sensitive to dissolved oxygen. Minimisation of oxygen diffusion either by formation of surface tension, formation of a surface crust or use of an artificial cover, is essential to prevent oxygen damage of the methane forming bacteria. Damage to the methane forming bacteria will result in reduced conversion of the short chain fatty acids and emission of some of these compounds as odours. Characteristic odours include:

Odorous compounds typical for anaerobic processes		
Substance	**Odour threshold (liquid phase), ppb**	**Odour description**
Ammonia	17000	Sharp, pungent
Methylamine	4700	Putrid, fishy
Ethylamine	270	Ammonia-like
Dimethylamine	340	Putrid, fishy
Skatole	1.0	Faecal, repulsive
Indole	0.1	Faecal, repulsive

Dimethyl sulphide	1.0	Decayed vegetables
Dimethyl disulphide	1.0	Decayed vegetables
Hydrogen sulphide	0.47	Rotten eggs
Methane thiol	0.50	Decayed cabbage
Ethane thiol	0.30	Decayed cabbage
Acetic acid	0.16	Vinegar
Butyric acid	0.10	Rancid
Valeric acid	1.8	Sweaty

Composting basics

Composting is generally defined as the biological oxidative decomposition of organic matter in wastes under controlled conditions.

In this process the organic substances are reduced from large volumes of rapidly decomposable materials to small volumes that continue to decompose slowly. The process brings the ratio of carbon to other elements into a balance, thus providing nutrients to plants in the absorbable, bioavailable state.

Based on their functions, the organisms involved in composting can be classified as:

- first-order consumers, which feed directly on the dead plant or animal materials;
- second-order consumers, which feed primarily on the first-order consumers or on the produce of these consumers; and
- third-order consumers, which feed on the second-order consumers.

The vast array of organisms found in the compost pile can be classified based on their functions as chemical and physico-chemical decomposers. Microscopic organisms such as bacteria, fungi, actinomycetes and protozoa are the chemical decomposers, while larger organisms such as worms, mites, snails, beetles, centipedes, and millipedes are mainly physico-chemical decomposers. Among these multiple species bacteria and worms are the powerhouse of physical and biochemical processes at composting. Microbes and invertebrates carry out decomposition of organic litter by utilizing its carbon and nitrogen contents as the energy source with oxygen and water, resulting in production of carbon dioxide, heat, water and soil-enriching compost.

Most organisms preferred for composting are aerobic as they provide rapid and complete composting. Other organisms can operate without oxygen (anaerobic conditions), and this process is sometimes called fermentation and usually occurs at a much slower rate. They utilize nitrate, sulfate, carbonate, ferric and other ions to oxidise organic compounds. However, the greatest disadvantage of anaerobic process is the offensive odours produced during the process. It also produces organic acids, alcohols, methane and other gases which may be harmful to the plants.

The processes at composting are accomplished by different phases:

- Initial phase, during which readily degradable components are decomposed;

- Thermophillic phase, during which cellulose and similar materials are degraded by the high bio-oxidative activity of microorganisms;
- Maturation and stabilization phase.

The above processes can also be explained in terms of two well-defined phases, namely mineralization and humification. The former is an intensive process involving the degradation of readily fermentable organic substances like carbohydrates, amino acids, proteins and lipids, while the latter occurs in less oxidative conditions, thus allowing the formation of the humic-type substances and eliminating the dense toxic compost, eventually formed during the first phase.

The rate of composting, like the rate of plant or animal growth, can be affected by many factors, the main ones being nutrient balance (C:N ratio), moisture content, temperature and aeration (oxygen supply).

C:N ratio

Of the many elements required for microbial decomposition, carbon and nitrogen are the most important and the most commonly limiting. Carbon is both an energy source and the basic building block making up about 50% of the mass of microbial cells. Nitrogen is the crucial component of the proteins, amino acids, enzymes and DNA necessary for cell growth and function. Bacteria, whose biomass is over 50% protein, need plenty of nitrogen for rapid growth.

The ideal carbon-to-nitrogen ratio for composting is generally considered to be around 30:1, or 30 parts of carbon per each part nitrogen by weight. Why 30:1? Although the typical microbial cell is made up of carbon and nitrogen in ratios as low as 6:1, additional carbon is needed to provide the energy for metabolism and synthesis of new cells. C:N ratios lower than 30:1 allow rapid microbial growth and speedy decomposition, but excess nitrogen will be lost as ammonia gas, causing undesirable odours as well as loss of the nutrient. C:N ratios higher than 30:1 do not provide sufficient nitrogen for optimal growth of the microbial populations. This causes the compost to remain relatively cool and to degrade slowly, at a rate determined by the availability of nitrogen (rate-limiting reaction).

As composting proceeds, the C:N ratio gradually decreases from 30:1 to 10-15 for the finished product. This occurs because each time that organic compounds are consumed by microorganisms, two-thirds of the carbon is lost to the atmosphere as carbon dioxide gas, while most of the nitrogen is recycled into new microorganisms. Although finished compost has a low C:N ratio, this does not result in the odour problems mentioned above because the organic matter is in a stable form, having already undergone extensive decomposition.

Aeration and moisture

Maintaining the proper balance between moisture and oxygen is one of the keys to successful composting. Because oxygen diffuses thousands of times faster through air than through water, oxygen transfer is impeded if water fills the pores between compost particles. If the thin films of water surrounding individual particles dry out, however, the microorganisms that decompose inorganic matter will become inactive.

An initial moisture content of 50–60% by weight is generally considered optimum for composting because it provides sufficient water to maintain microbial growth but not so much that air flow is blocked. Decomposition by microorganisms occurs most rapidly in the thin films of water surrounding compost particles. When conditions become drier than 35–40%, bacterial activity is inhibited because these films begin to dry up. At the other end of the range, moisture levels above 65% result in slow decomposition, odour production in anaerobic pockets, and nutrient leaching.

Therefore, the key to successful composting is to provide enough water to maintain the thin films around compost particles, but not so much that it replaces air in the larger pores. At the start of the composting process, the oxygen concentration in the pore spaces is about 15–20% (similar to the normal composition of air), and the CO_2 concentration varies from 0.5–5%. As biological activity progresses, the O_2 concentration decreases and CO_2 concentration increases. If the average O_2 concentration in the pile falls below 5%, regions of anaerobic conditions develop. Providing that the anaerobic activity is kept to a minimum, the compost pile acts as a biofilter to trap and degrade the odorous compounds produced as a by-product of anaerobic decomposition. However, should the anaerobic activity increase above a certain threshold, undesirable odours may result. Oxygen concentrations greater than 10% are considered optimal for aerobic composting. Some systems are able to maintain adequate oxygen passively, using air holes or aeration tubes. Others require forced aeration provided by blowers or agitators.

Characterization of pulp mill solids

Paper wastes with high C:N ratio were used as a carbon rich blending agent for nutrient rich wastes such as biosolids, food waste, manure, and other industrial wastes. Since the 1990th solids from pulp and paper mills were used as carbon rich fibrous material for blending with nutrient rich wastes in vermicomposting processes.

The said pulp mill solids are composed essentially of fibrous fines and some inorganics such as kaolin clay, calcium carbonate, and other chemicals used in the specific manufacturing process. The fibrous fines are 59-72% (dry basis) cellulose, 6-16% lignin and 7-10% hemicellulose. The high cellulose and lignin contents make the material rather slowly degradable by microorganisms.

Below are the main characteristics of primary solids from Tasman and Kinleith Pulp and Paper Mills:

Characteristics of primary solids from the NZ Pulp and Paper Mills		
Parameter	Primary solids from Tasman Mill	Primary solids from Kinleith Mill
Dry matter, %	58.9	17.8
Total carbon, %	34.2	37.6
Total Nitrogen, %	0.43	0.5
C:N ratio	80	75

The above comparison shows that the primary solids have excessively high C:N ratio for successful composting, and can only be used as a source of carbon, for subsequent mixing with other nitrogen rich materials.

What happens when pulp mill solids are mixed with odorous biosolids?

Biosolids are typically characterized by relatively low C:N ratios. Thus, the municipal biosolids from Hamilton were reported as being 7.6, while from Kinleith Pulp and Rotorua - 8.5 and 5.5, respectively. Therefore, for successful composting, the C:N ratio should be increased by adding carbon, to achieve the sought level of about 30, as mentioned above.

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Subsequently, as a result of mixing of odorous biosolids with the pulp mill solids (approx at 1:1 ratio) for composting or vermicomposting purposes, the following can be expected:

1. The pulp mill solids with developed three-dimensional porous structure will create voids in the compost mix which would allow access of air to the treatment sites, i.e. facilitate aerobic decomposition of organic matter thus suppressing anaerobic processes (requiring absence of air);
2. The carbon-to-nitrogen ratio of the mix will be adjusted to an optimal value (C:N = approx 30:1) to promote the growth of aerobic microflora. The nitrogen content here will be slightly in deficiency, to prevent the formation of ammonia, i.e. undesirable odours;
3. The pulp mill solids will also act as a bulking agent, providing structural support to the compost system. The fibrous structure of this material has a high water holding capacity which will help regulate heat and moisture, so that the compost will be sufficiently moist to support microbial growth but not so wet that it becomes anaerobic;
4. Addition of pulp mill solids will increase porosity of the compost system and optimise the particle size of organic materials, which will also help their aerobic conversion and inhibit anaerobic decomposition;
5. The pH values in anaerobic sludge are typically acidic, i.e. between 4.0 and 6.5, due to the presence of organic acids and carbon dioxide. It is commonly known that most odorous compounds, especially those containing sulphur (methane thiol, dimethyl sulphide, dimethyl disulphide, hydrogen sulphide, etc) are non-ionized in these conditions, therefore volatile. The added pulp mill solids within several days will promote fast growth of aerobic microorganisms which will digest readily biodegradable substances, eliminate carbon dioxide and increase alkalinity of the compost system. As a result, the pH will increase up to 8.0-8.5 which, in turn, will cause ionization of the odorous substances and make them more susceptible to oxidation under aerobic conditions. Hence the decrease of undesirable odours;
6. The addition of the pulp mill solids to the vermicomposting system containing anaerobic biosolids may cause even faster elimination of undesirable odours, as the earthworms play the role of natural aerators, detoxifiers, pH-regulators and the catalysts of biochemical conversions.

Dr Alexander Rodionov
ALDRO Ltd

22.02.2017

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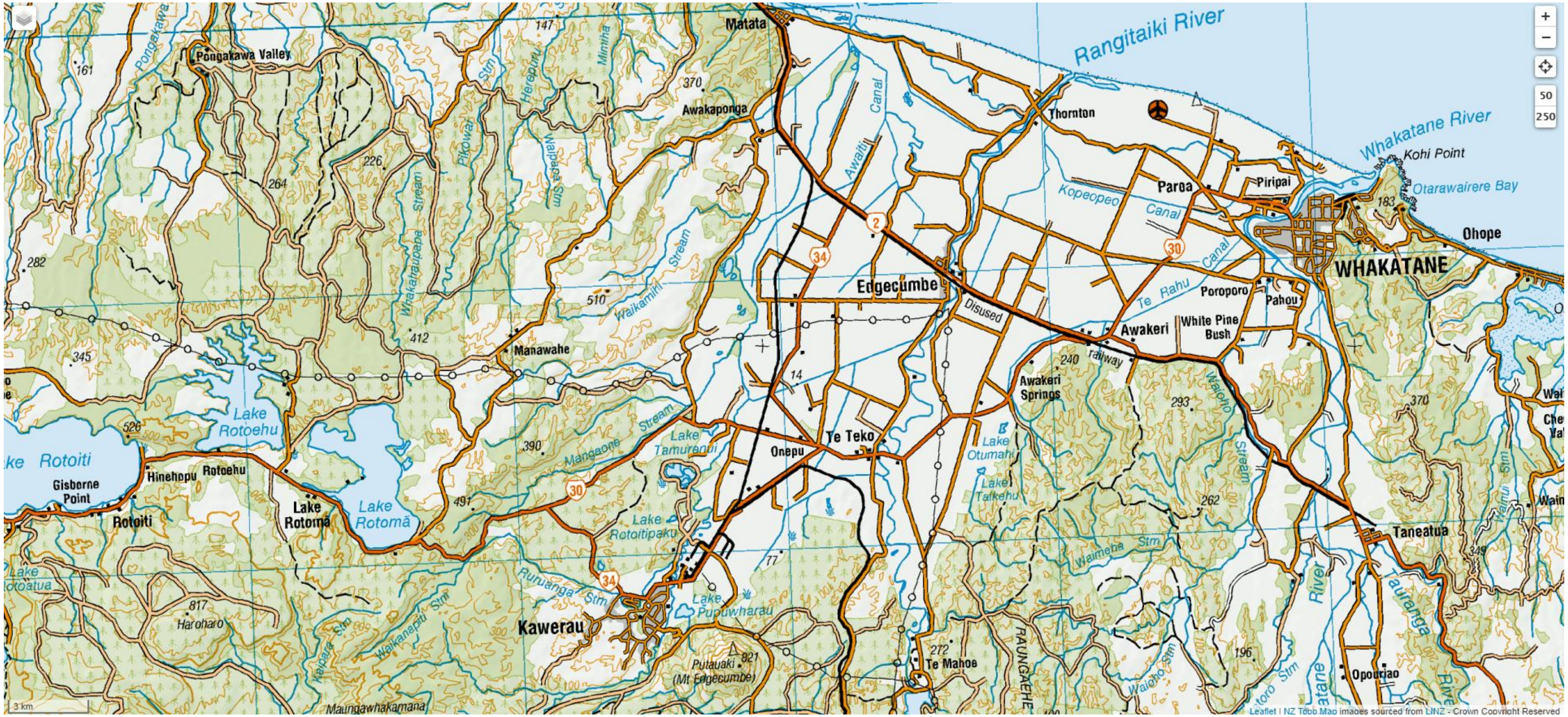
APPENDIX B: TOPOGRAPHIC MAP



APPENDIX C: DAILY WINDROSES

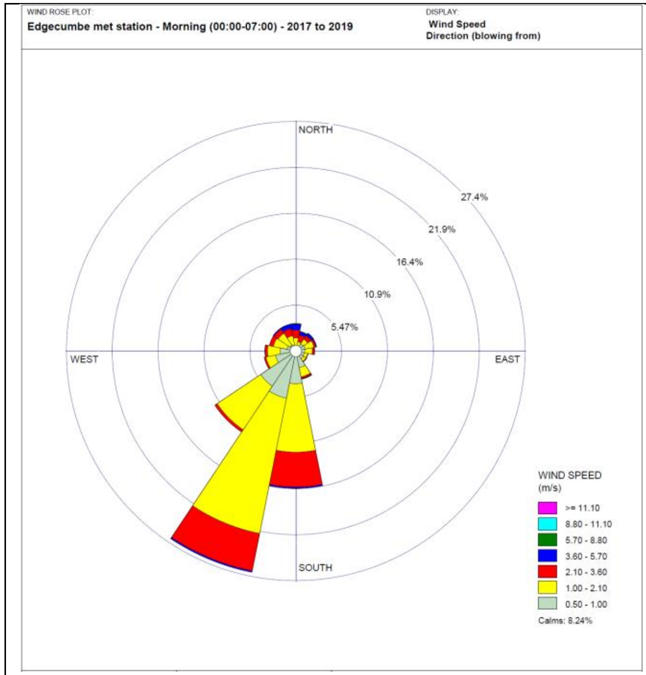


Figure B1: Mornings 00:00-07:00

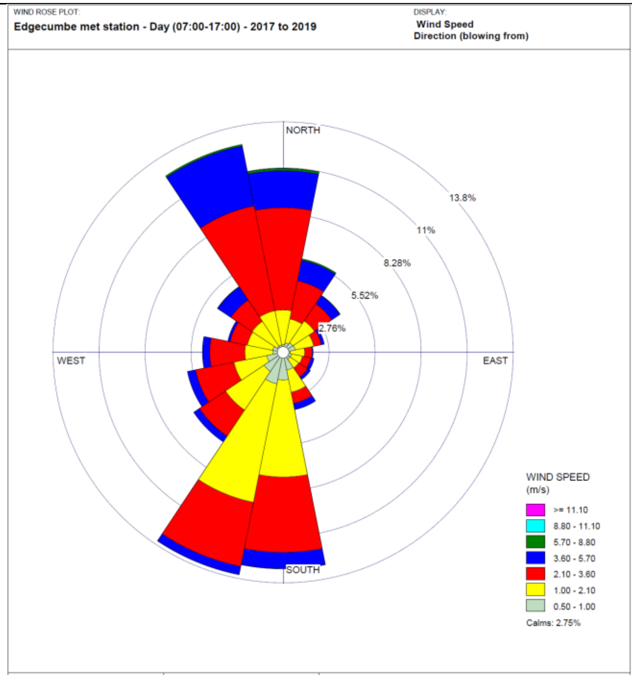


Figure B2: Day 07:00-17:00

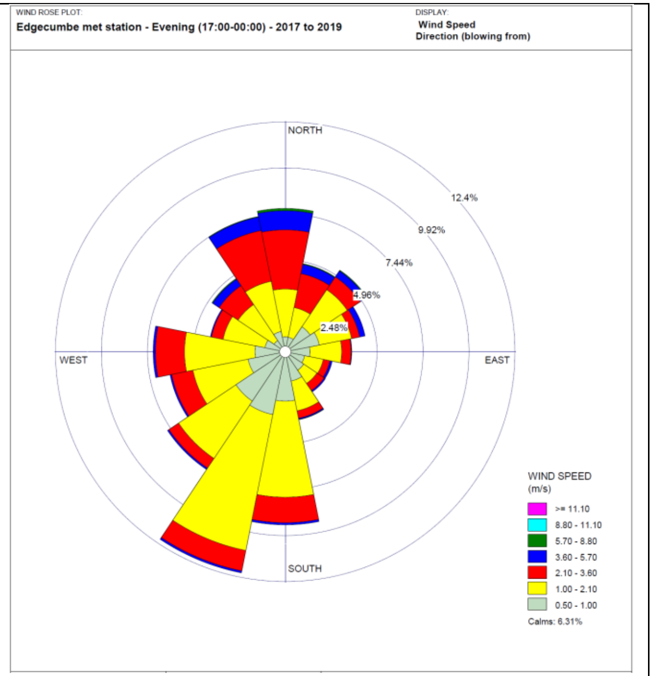


Figure B3 Evenings 17:00-00:00

APPENDIX D: SEASONAL WINDROSES

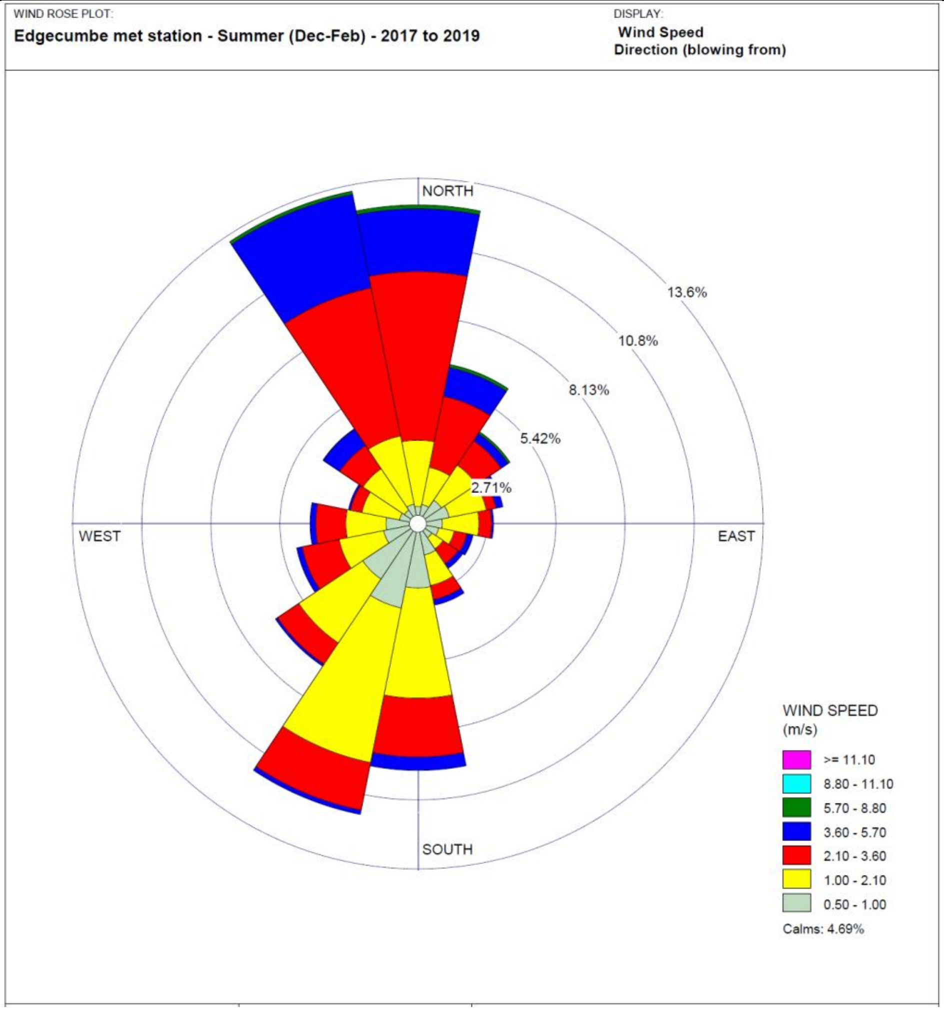


Figure C1: Summer

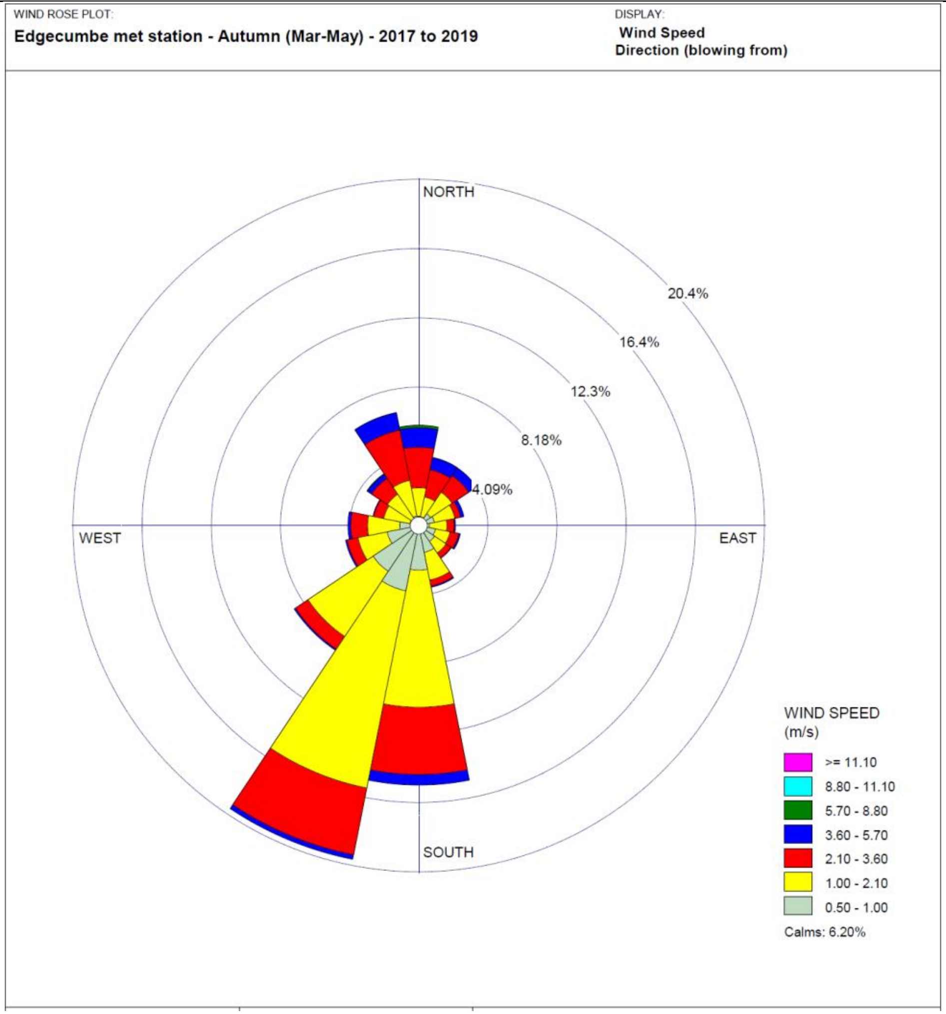


Figure C2: Autumn

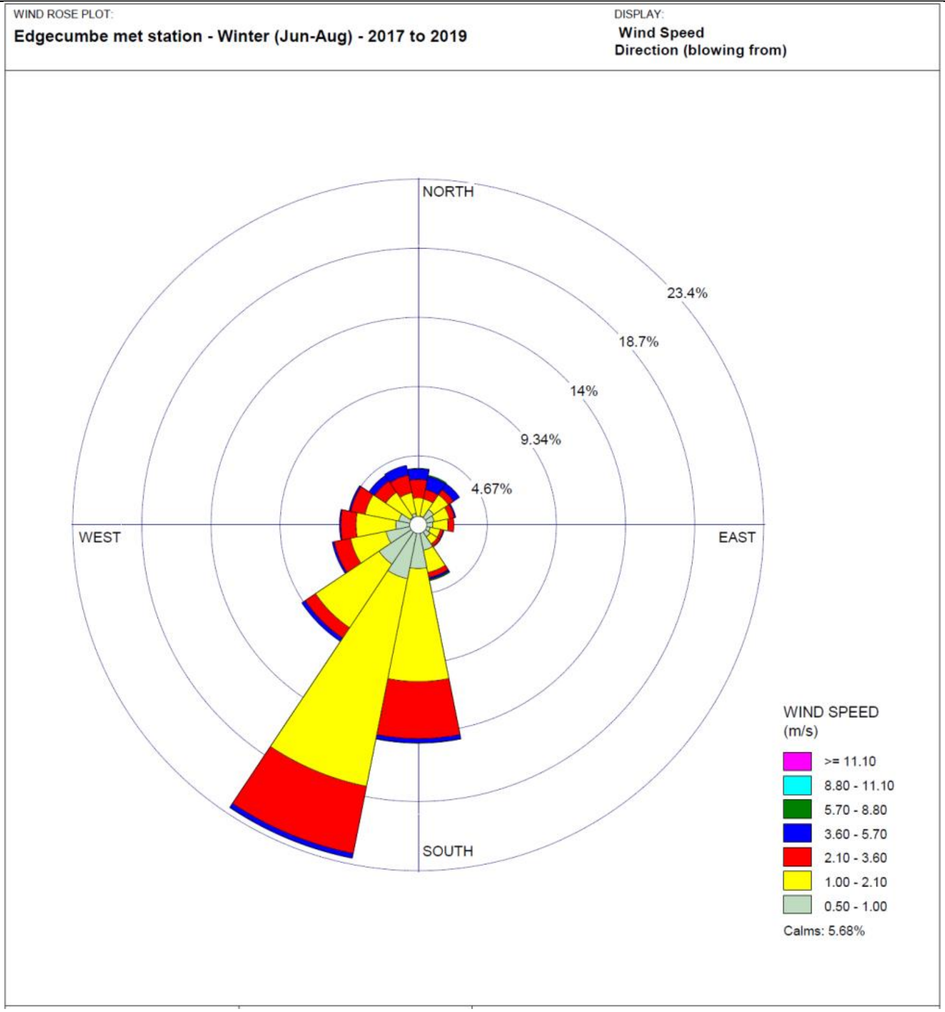


Figure C3: Winter

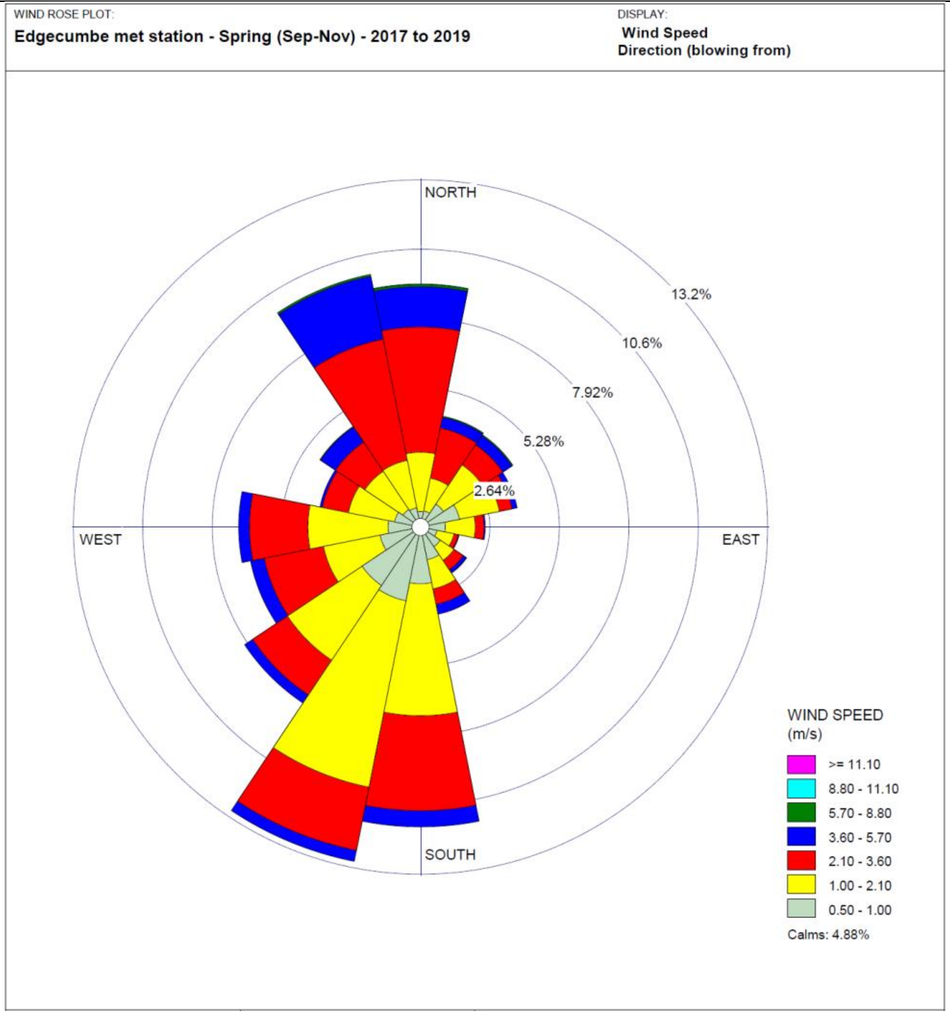
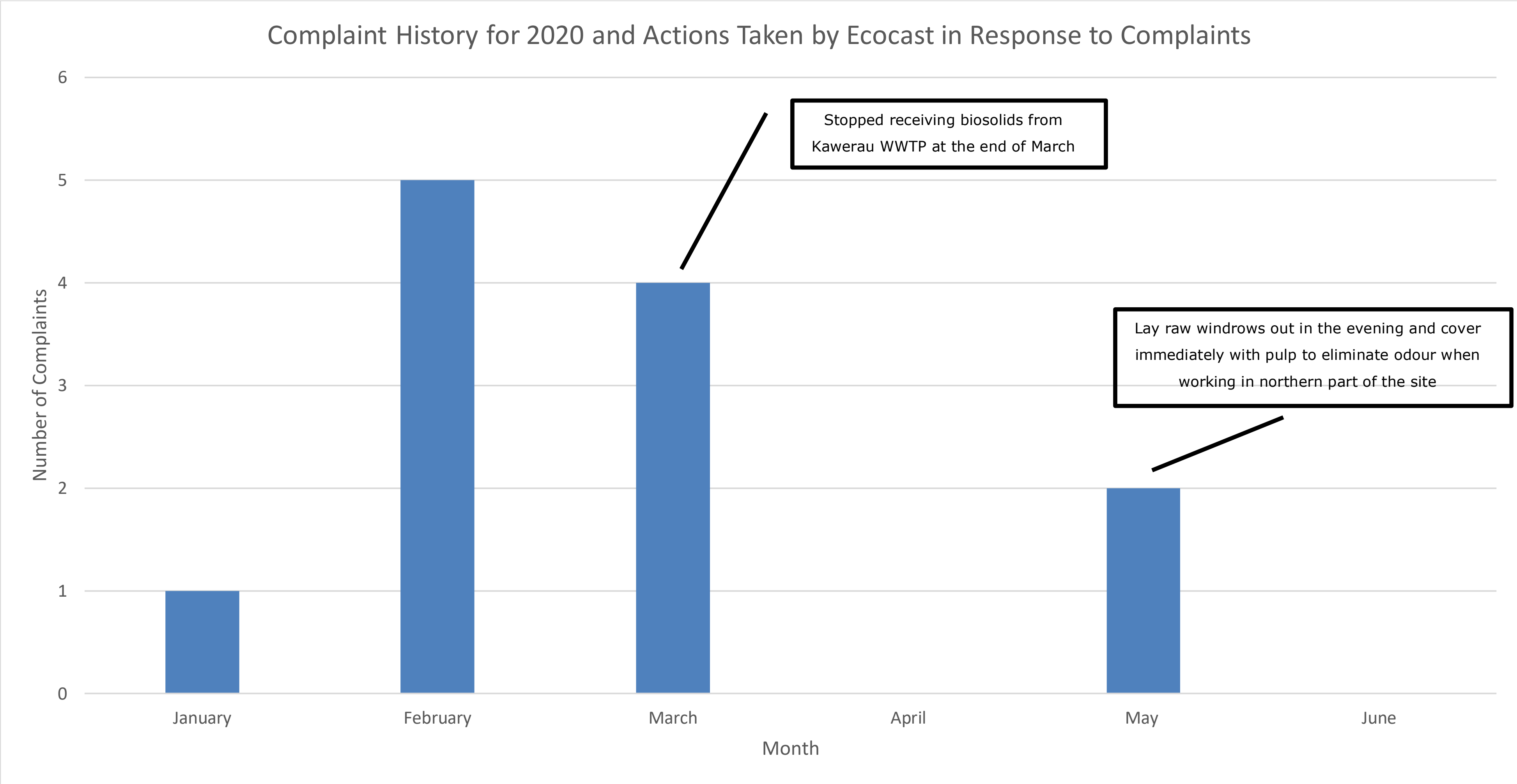


Figure C4: Spring

APPENDIX E: ECOCAST COMPLAINTS HISTORY



Note: there has only been one complaint relating to the site prior to 2020.