Tonkin+Taylor

Job No: 1014454
27 January 2021

NCI Packaging (NZ) Ltd
PO Box 14-443
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Attention: Kevin Leonard

Dear Kevin

NCI Packaging, Upper Hutt - Summary of further odour investigations and recommendations

1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by NCI Packaging (NZ) Ltd (NCI Packaging) to provide technical air quality advice in relation to the application for a replacement air discharge consent for the site at 62 Montgomery Crescent, Upper Hutt.

T+T has previously carried out a site visit, undertaken a review of available information and provided recommendations to NCI Packaging for further work that could be undertaken to better understand the effects of the site's odour emissions and/or options to improve odour management. This work was summarised in our letter report dated 17 July 2020.

The conclusions of our review were that current levels of odour emissions from NCI Packaging are likely to be causing occasional odour nuisance in a localised area around Mountbatten Grove, however odours are unlikely to be at a frequency, intensity or duration that would be considered offensive or objectionable. Given this finding, we considered that the focus for NCI Packaging should be on minimising odour effects to the extent practicable (i.e. to ensure odour controls are the 'best practicable option' (BPO)).

The specific recommendations of our review were as follows:

- Develop and implement a programme of proactive odour field observations to better characterise the effects of emissions from the site and identify possible other sources;
- Evaluate the results of the biofilter trial including assessing the effects of residual odour emissions;
- Evaluate the results of further odour emission monitoring, including monitoring the emissions from the specific sources to understand their contribution to overall odour emissions; and
- Depending on the evaluation of the biofilter trial results, carry out the following:
  - Sensitivity analysis of dispersion modelling to differing stack heights;
  - Refinement of the Adaptive Management Odour Plan (29 July 2019) (AMOP) to incorporate field odour observations and a staged approach to investigating and implementing options to minimise odour emissions/impacts.

NCI Packaging has completed these additional investigations and this letter sets out a summary of the key findings and implications for further improvement in off-site odour effects, particularly in relation to the area around Mountbatten Grove.

This report has been prepared in accordance with our engagement dated 4 June 2020.

2 Odour field observations

NCI commissioned a short-term programme of odour field observations, which were undertaken over 17 working days from 10th August 2020 to 8th September 2020. Odour observations were undertaken in two residential locations on Mountbatten Road and 5 other locations in the industrial area (see Figure 2.1). The NCI plant was operating all days during the sampling except for 31st August 2020. The findings of the field odour observation programme are set out in Appendix A.

The field odour observations were carried out by a person who does not work at the site (and is therefore not potentially de-sensitised to the odours) and largely in accordance with the methods recommended in the German VDI standards and German Guidelines on Odour in Ambient Air (GOAA)[1]. Some deviations from the VDI standards are reported by NCI and include that the observer had not been "calibrated" to determine their sensitivity. However, looking at the range of odour concentrations reported, there is no reason to expect that they would be particularly over- or under-sensitive. Therefore, these deviations should not affect the reliability of the results.

The GOAA define any hour where 10% or more of the observations within the hour have a 'recognisable' odour intensity (level 2 on a scale of 0 to 6) or greater is deemed an 'odour hour'. The GOAA suggests threshold values of 10% frequency for residential and mixed areas and 15% for industrial areas to avoid significant odour nuisance. These percentages represent the overall frequency of occurrence of odour hours, and therefore a large enough dataset covering a range of meteorological conditions is required to evaluate against this guideline.

The total number of observations taken during the NCI odour monitoring programme does not meet the minimum requirements in the VDI standard for a robust statistical assessment. However, to provide an indicative assessment, the number of odour hours for solvent-type odours has been calculated for the two residential monitoring locations (see Table 2.1). This evaluation suggests that solvent-type odours are likely to be occurring at a sufficient intensity, frequency and duration to constitute an odour nuisance, particularly around the end of Mountbatten Road closest to the site.

Table 2.1: Odour hours and percentage odour hours for solvent-type odours at residential monitoring locations

	Location	Number of field observations	Number of odour hours	Percentage of odour hours	Greater than 10% odour hours
1	End of Mountbatten Rd	17	4	24%	Yes
2	Mid Mountbatten Rd	17	1	6%	No

There are a number of potential sources of similar solvent-type odours in the area, including NCI. Examination of wind conditions at the time of the odour observations can indicate the upwind direction of the likely source. Wind speed and wind direction (using the Beaufort scale) were reported.

[1] Determination and Evaluation of Odour Emissions - Directive on Odour (Feststellung und Beurteilung von Geruchsimmissionen (Geruchsimmissions-Richtlinie) mit Begründung und Auslegungshinweisen), Laenderausschuss fuer Immissionsschutz, LAI Schriftenreihe No.5, Berlin, 1994/1999 (http://www.lua.nrw.de/luft/gerueche/infos.htm)

Sweet solvent odour was detected on 6 occasions at the end of Mountbatten Rd, including 4 occasions which met the criteria for an 'odour hour'. The wind conditions during these 4 odour hours are summarised in Table 2.2. On three of these occasions the wind speed was reported as 0 or 1 on the Beaufort scale, which means that there were calm or very low wind speed conditions and therefore the wind direction may not be reported accurately by an anemometer.

Overall, this data suggests that the odour source was likely to have been NCI on three occasions, and there was one occasion where the odour source was more likely to be one of the businesses on Montgomery Crescent (west of the NCI site).

Table 2.2: Wind conditions on days with 'odour hours' for solvent-type odours at end of Mountbatten Rd

Date	Maximum odour intensity	Wind direction	Wind strength (Beaufort)	Comment on source
12/8/20	3	SSE	2	Likely to be NCI
13/8/20	3	[WNW]	0	Calm conditions (source cannot be identified based on wind direction)
26/8/20	4	WSW	1	Unlikely to be NCI if wind direction accurate
3/9/20	3	SSW	1	Likely to be NCI if wind direction accurate

Figure 2.1: Location of odour observation points (image provided by NCI) (note: NCI plant is the facility located between monitoring sites (1) and (5))

3 Biofilter trial

Biofilters work by establishing a population of bacteria that break down odorous compounds. The compounds that give rise to odours at the NCI facility are Volatile Organic Compounds (VOCs) from the use of surface coatings. Although they are more commonly used on biological odour sources (e.g. odours from sewage, meat processing, composting, etc), they can also be successfully used on gas streams containing relatively low levels of VOCs.

The key operational criteria for biofilters are maintaining optimal temperature, moisture and pH conditions for the bacteria and ensuring adequate residence time within the biofilter for the odours to be removed. The (former) Auckland Regional Council has published guidance on design and operational criteria for biofilters.[2] This guidance recommends that the ratio of total gas volume to bed cross sectional area does not exceed $50m^3$/hour per m^2. Assuming a bed depth of 1 m, this equates to a residence time within the bed of 90 seconds.

NCI installed a pilot-scale biofilter in late June 2020 to treat a side-stream of gas from the Internal Lacquer/Assembly Stack. This stack was selected in preference to the Line 2 Main Stack because it operates at a relatively low temperature (about 40°C). The purpose of the trial was to determine whether biofiltration would be a suitable odour treatment method for the odours at this site.

The trial biofilter was constructed inside a nominal 1 m^3 capacity pallet-mounted rigid plastic 'Intermediate Bulk Container' (0.95m x 1.15 m cross sectional area) filled with approximately 650mm depth of garden mix and bark (media volume approximately 0.71 m^3). Photographs of the pilot scale biofilter are shown in Figure 3.1. A water spray was installed on the inlet gas (prior to the biofilter) to provide cooling and humidification of the incoming gas stream. The top of the biofilter was fitted with a water spray system that could be used in the event that the bed dried out.

The volumetric flow rate through the trial biofilter was approximately 27 m^3/hr, giving a residence time within the biofilter of approximately 96 seconds (which exceeded the recommended minimum residence time of 90 seconds).

The performance of the biofilter was evaluated by recording observations of odour at the inlet (untreated) and outlet (above the biofilter). The odours were evaluated using the same 0 to 6 scale used for ambient odour observations. Three staff were involved in the odour evaluations, with 2 staff doing the observations in parallel on most occasions to address any potential for differences in sensitivity.

The outlet of the biofilter was generally reported as essentially odour-free, apart from an earthy smell associated with the media. The inlet concentration was variable, but was often reported as a "3" (Distinct). The performance of the biofilter did not change over the 11-week period of the trial.

After the trial was completed on the Internal Lacquer/Assembly Stack, it had been intended to move the biofilter to treat the emissions from the aluminium aerosol can basecoat oven. However, the elevated temperature of the oven exhaust (147°C) meant that a cooling system would have had to be installed for the purposes of a trial. Given the similarity in the nature of the VOCs in both areas, it was decided that there was sufficient information from the initial trial to be confident that a biofilter would also be effective on the Line 2 Main Stack.

The trial demonstrated that a biofilter designed in accordance with recommended criteria can effectively control the types of odours generated at the site. The required size of the biofilter is proportional to the airflow rate that needs to be treated, to ensure that there is an adequate residence time. There are varying gas steams, with differing levels of odour, that contribute to the two stack emission sources. Given the relationship between air flow rate and biofilter capital cost, it

[2] Auckland Regional Council. (2002). Technical Publication 152 – Assessing Discharges of Contaminants into Air (Draft).

is sensible to investigate whether an appropriate reduction in odour emissions could be achieved by targeting the high-odour sources, rather than attempt to treat the entire discharge volume.

Figure 3.1: Pilot-scale biofilter (left) and close-up of media (right)

4 Odour emission monitoring

Odour emission monitoring undertaken in December 2018 gave maximum emission rates (highest of two sampling runs) of approximately 4,200 OU/s and 5,500 OU/s on the Line 2 Main Stack and Internal Lacquer/Assembly Stack, respectively. [3]

NCI Packaging commissioned Source Testing NZ Ltd (STNZ) to undertake odour and flow monitoring at a number of locations within the two plant assembly lines to establish if there are dominant sources contributing to odour emissions from each of the stacks. A summary and evaluation of the results was provided to T+T.

The discharges into the Line 2 Main Stack are from the production of Aluminium Aerosol cans. There are five stages in the Aluminium Aerosol can process line where odour can be generated:

[3] Odour emission rates are described in Odour Units per second (OU/s)

1 Application of the internal lacquer
2 Curing of the lacquer in an oven
3 Application of basecoat and its associated oven
4 Printing and print oven
5 Varnish application and oven.

The odours generated from stages 2 to 5 are discharged via the Line 2 Main Stack. The odour from spray application of internal lacquer (stage 1) is discharged via the Internal Lacquer/Assembly Stack.

A summary of the odour monitoring results for the contributing sources to the Line 2 Main Stack are shown in Table 4.1. This includes some assumptions about the contribution from sources that could not be directly measured. The key finding from this monitoring was that the basecoat process (basecoat application, basecoat oven conveyor inlet and basecoat curing oven outlet) accounts for about 22% of the total flow rate but 72% of the odour emissions in the Line 2 Main Stack.

Table 4.1: Line 2 Main stack odour emissions

Aluminium aerosol process stage	Flow rate (m^3/s at 20°C, 1 atm)	Percentage of total flow rate	Odour emission rate (OU/s)	Percentage of total odour emissions
Internal Lacquer oven	0.541	48%	323	9%
Basecoat	0.250	22%	2,630	72%
Print	0.189	17%	532	15%
Varnish	0.139	12%	149	4%
Total Line 2 stack emission rate	1.12		3,634	

The monitoring on the individual process stages of the Internal Lacquer/Assembly line gave very low results (less than 100 OU/s) that were not consistent with previous monitoring in 2018. This was possibly due to not all processes being operated while the monitoring was being carried out. Consequently, these results have not been considered further.

5 Further dispersion modelling to evaluate stack height

NCI Packaging engaged Jacobs Ltd to undertake further dispersion modelling to evaluate the potential impact of increasing the height of the stacks at the site (see Appendix B).

The Line 2 Main Stack and Internal Lacquer/Assembly Stacks are both currently at a height of 25 m and the impacts of increasing the heights of both stacks to 27 m and 30 m were investigated. The dispersion modelling was used to predict maximum ground level concentrations (mglc) of odour, expressed as the 99.5th percentile of the 1-hour average model predictions at neighbouring residential receivers. These predictions can be compared to the results from the original assessment prepared by Jacobs. The modelling suggests that increasing the stack height would result in a moderate improvement in ground level concentrations of odour (see Table 5.1).

Table 5.1: Sensitivity of predicted odour concentrations to stack height

Receiving environment	Baseline (existing 25 m stacks)	27 m stack heights		30 m stack heights	
	Predicted mglc (OU/m^3)	Predicted mglc (OU/m^3)	Percentage reduction	Predicted mglc (OU/m^3)	Percentage reduction
Residential	2.6	1.5	-42%	1.3	-50%
Industrial	3.8	2.1	-45%	2.4	-37%

The odour modelling assessment criteria, against which these model predictions can be compared, are:

- 2 OU/m^3 for the residential area (high sensitivity); and
- 10 OU/m^3 for the industrial area (low sensitivity).

Increasing heights of both stacks would reduce the predicted concentrations in the residential area to below the assessment criterion. As the odour emission rates from both stacks were assumed to be similar (the maximum concentrations measured in December 2018, as discussed in Section 4) if only one stack were increased then the improvement will be approximately halved, i.e. if only one stack was increased to 27 m, there would be an approximately 20% reduction in the mglc of odour.

6 Discussion and conclusions

NCI has undertaken further investigations to better understand the sources of odour at the site and the effectiveness of possible odour mitigation measures. This information provides the basis for a staged approach to implementation of odour mitigation, as follows:

i Stage 1: Installation of a biofilter to treat the emissions from the basecoat process (basecoat application, basecoat oven conveyor inlet and basecoat curing oven outlet). This is expected to reduce the odour emissions from the Line 2 Main Stack by approximately 70%.

ii Stage 2 (if needed based on outcome of field odour investigations): Increase height of internal Lacquer/Assembly Stack by 2 m (to a height of 27 m). This is expected to reduce the mglc of odour from this source by approximately 40%.

If agreed, this staged approach can be reflected in an update to the site's Adaptive Management Odour Plan and/or incorporated into consent conditions.

The likely impact of these staged measures on mglc of odour at residential receptors can be estimated on a pro rata basis from the dispersion modelling, as shown in Table 6.1.

Table 6.1: Pro rata estimate of reductions in mglc from staged improvements

Emission source	Predicted mglc (OU/m^3)		
	Current situation	**Stage 1** **Installation of biofilter to treat basecoat process emissions**	**Stage 2** **Increase Internal Lacquer/Assembly Stack**
Line 2 Main Stack mglc contribution	1.3	0.4	0.4
Internal Lacquer/Assembly Stack mglc contribution	1.3	1.3	0.8
Total predicted mglc	2.6	1.7	1.2
Odour modelling assessment criterion (OU/m^3)	2		

This evaluation suggests installing a biofilter to treat the basecoat process emissions would reduce predicted odour concentrations to within the odour modelling assessment criterion. Therefore, on its own, this may provide sufficient odour mitigation to avoid nuisance odours in the Mountbatten Grove area. However, if needed, increasing the height of the Internal Lacquer/Assembly Stack would provide a further 30% reduction in predicted odour concentrations.

7 Applicability

This report has been prepared for the exclusive use of our client NCI Packaging (NZ) Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client may submit this report as part of an application for resource consent and that Greater Wellington Regional Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by: Authorised for Tonkin & Taylor Ltd by:

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Appendix A: Odour field observations

Report

Date: 8 October 2020

To: Kevin Leonard

From: Rhys Kevern

Subject: Ambient Odour Monitoring Upper Hutt

Table of Contents

Tables

Figures

Appendices

Executive Summary

NCI has undertaken a short term odour survey of the area around the plant as part of the assessments for and air discharge permit application.

Methodology

The ambient odour monitoring methodology utilised in this study is a variation of the method described in the German Standard VDI 3940 "Determination of Odorants in Ambient Air by Field Inspections" (VDI Method). The modified method uses a single 'field odour assessor'[1] to visit 7 sites and sample the ambient air every 10 seconds for 10 minutes giving a total of 60 samples per location per day.

Assessment Criteria

Assessments were made against the standard odour intensity criteria from the VDI Standard but some extra odour descriptors were added to identify specific types of odour in the area such as vehicle emissions and certain solvent types.

Results

The majority of odour intensity was 2 (weak) or less over the 17 day programme. The odour description of the odours that were 3 (distinct) or 4 (strong) are shown in Table 3-1. The very strong odour (level 5) observed in location 1 was household fire smoke (1x 10 second observation), location 4 (2x 10 second observations) and location 5 was vehicle exhaust (1x 10 second observation). This shows that it is not common to experience distinctive odours in the area around the plant and there are no extremely strong odours and virtually no strong odours present in the area. Figure 3-8 presents the average percentage of the main odour types from each wind direction. Figures 3-9 to 3-15 present the average intensity of odour from each wind direction.

Conclusion

Over the whole monitoring programme there were significant periods of no odour in the area (typically greater than 70% of the observations) and there were no measurements above odour intensity 4 except for 4 individual 10 second observations at level 5 (very strong) which shows that odour in the area around the plant is not particularly strong.

The main odours observed were household fires, vehicle exhaust, solvent and turps like and sweet solvent and the average intensity was typically 2 (weak) in the range of wind directions observed. The solvent like and sweet solvent emissions were observed at many of the locations, vehicle odours were more prevalent at the Montgomery crescent locations as there are greater traffic movements.

[1] The staff member has not been assessed for odour sensitivity due to the unavailability of an odour assessment laboratory, however they consider their odour sensitivity to be typical.

1 Introduction

NCI Packaging (NZ) Limited (NCI) in Upper Hutt has applied to Greater Wellington Regional Council (GWRC) for an air discharge permit. The application has been notified and submissions have been received. NCI has undertaken a short term odour survey of the area around the plant. Seven sites were chosen and the monitoring occurred over 17 days.

2 Monitoring Methodology

The ambient odour monitoring methodology utilised in this study is a variation of the method described in the German Standard VDI 3940 "Determination of Odorants in Ambient Air by Field Inspections" (VDI Method). This is the method recommended in the New Zealand Ministry for the Environment (MfE) Good Practice Guide for Assessing and Managing Odour in New Zealand, and is commonly used in Australia and Europe for odour assessment.

The modified method uses a single 'field odour assessor'[2] to visit a selection of sites and sample the ambient air every 10 seconds for 10 minutes giving a total of 60 samples per location per day. The sites were monitored in the order of the site numbers which start at the end of Mountbatten Grove and then continue down Montgomery Crescent to Fergusson Drive as shown in Appendix A. The field odour assessor recorded the intensity of the odour (according to a set intensity scale), the odour character (from a list of 43 various odour descriptors), the wind direction, the wind speed, any rainfall, and the date and time for every sample. The intensity scale and odour descriptors are those described in the MfE Good Practice Guide and are presented in Tables 2-1 and 2-2. Wind speed and direction was recorded according to the Beaufort Force scale (1 – 10) and the NCI meteorological monitoring mast. The monitoring occurred over 17 working days from 10/8/2020 to 8/9/2020 and the plant was operating all days during the sampling except for 31 August 2020..

The main variations from the VDI Method were:

- That a single field odour assessor was used instead of the recommended panel of at least 10 odour assessors for a gridded study.
- Sampling occurred several days a week for a period of five weeks which is a shorter term than the recommended 52 measurement days over the course of six months. Sampling was undertaken on 17 days.
- The sample points were based on locations encompassing the NCI site and where submitters were, rather than one of the various grid methods discussed in the VDI method.
- The analysis and reporting of the results is not in the same form as that discussed in the VDI Method.

2.1.1 Assessment Criteria

The intensity scale chosen to compare the sampled air to is presented in Table 2-1 and the odour descriptors are presented in Table 2-2. The odour from the business on the corner of Montgomery crescent and Fergusson Road has been categorised as solvent like or Paint like - Turps and the coating odour from NCI is categorised as sweet solvent.

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[2] The staff member has not been assessed for odour sensitivity due to the unavailability of an odour assessment laboratory, however they consider their odour sensitivity to be typical.

Table 2-1 Odour Intensity Scale

Intensity Level	Odour intensity
0	No odour
1	Very Weak
2	Weak
3	Distinct
4	Strong
5	Very strong
6	Extremely Strong

Table 2-2 Hedonic Tone Descriptors

No	Description	No	Description	No	Description
1	Fragrant	**15**	Soapy	**29**	Tar-like
2	Perfumy	**16**	Garlic, onion	**30**	Oily, fatty
3	Sweet	**17**	Cooked vegetables	**31**	Like Petrol
4	Fruity	**18**	Chemical (chlorine, ammonia etc)	**32**	Fishy
5	Bakery (fresh bread)	**19**	Etherish, anaesthetic	**33**	Putrid, foul, decayed
6	Coffee-like	**20**	Sour, acrid, vinegar	**34**	Oil Based Paint-like including mineral turpentine
7	Spicy	**21**	Like blood, raw meat	**35**	Rancid
8	Meaty (cooked, good)	**22**	Rubbish	**36**	Sulphidic
9	Sea/marine	**23**	Compost	**37**	Dead animal
10	Herbal, green, cut grass	**24**	Silage	**38**	Faecal (like manure)
11	Bark-like, birch bark	**25**	Sickening	**39**	Sewer odour
12	Woody, resinous	**26**	Musty, earthy, mouldy	**40**	Other
13	Medicinal	**27**	Sharp, pungent, acid	**41**	Vehicle exhaust
14	Burnt, smoky	**28**	Metallic	**42**	Solvent like
				43	Sweet Solvent

3 Odour Monitoring Results

Average odour intensity and odour types were assessed over the 17 day programme.

3.1 Intensity

The majority of odour intensity was 2 (weak) or less over the 17 day programme. The odour description of the odours that were 3 (distinct) or 4 (strong) are shown in Table 3-1. The very strong odour (level 5) observed in location 1 was household fire smoke (1x 10 second observation), location 4 (2x 10 second observations) and location 5 was vehicle exhaust (1x 10 second observation). This shows that it is not common to experience distinctive odours in the area around the plant and there are no extremely strong odours and virtually no strong odours present in the area. Even when the odours are distinct, a lot of the time the odours are from domestic wood smoke rather than industrial sources.

Table 3-1 Average Odour Intensity over the Survey Period

Site No / Odour Intensity	1	2	3	4	5	6	7
Percentage of 0's	61.9%	63.6%	54.7%	58.1%	61.7%	40.0%	35.9%
Percentage of 1's	25.3%	23.4%	24.8%	22.4%	25.2%	32.4%	36.5%
Percentage of 2's	9.3%	9.5%	14.2%	13.9%	10.6%	18.5%	18.6%
Percentage of 3's	2.9%	3.1%	5.1%	4.7%	2.5%	6.6%	7.0%
Percentage of 4's	0.6%	0.4%	1.1%	0.6%	0.1%	2.5%	1.8%
Percentage of 5's	0.1%	0.0%	0.0%	0.2%	0.0%	0.0%	0.2%
Percentage of 6's	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Odour descriptor for 3 or 4	Sweet solvent, burnt smoky, vehicle exhaust, woody	Sweet solvent, medicinal, vehicle exhaust, burnt smoky, petrol, solvent, herbal	Woody, bark like, oily/fatty, solvent, sweet solvent, burnt smoky, vehicle exhaust.	solvent, sweet solvent, burnt smoky, vehicle exhaust	Sweet solvent, vehicle exhaust, chemical, metallic	Vehicle exhaust, musty earth, Solvent, rubbish, petrol, oil based paint/Turps	Vehicle exhaust, , Solvent, rubbish, compost, burnt smoky, chemical/ artificial, woody, sweet solvent, petrol

3.2 Odour Type and Frequency

The average percentage of the different odour types detected at each location is presented graphically in Figures 3-1 to 3-7. For each site there was a significant period where there was no odour detected or the odour concentration was below the detection threshold so a specific type couldn't be identified.

Figure 3-1 Odour Types End of Mountbatten Grove

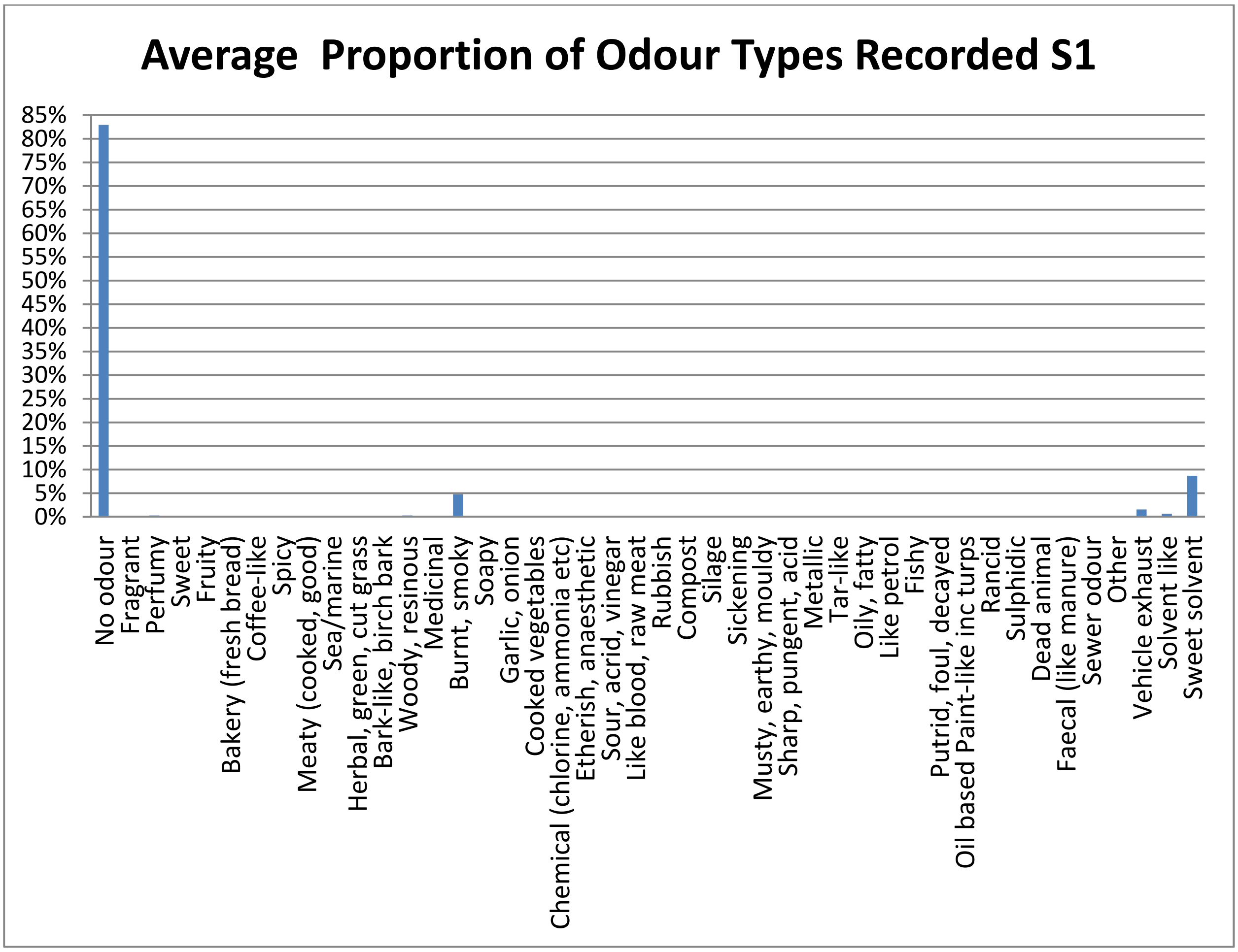


Figure 3-2 Odour Types Mid Mountbatten Grove

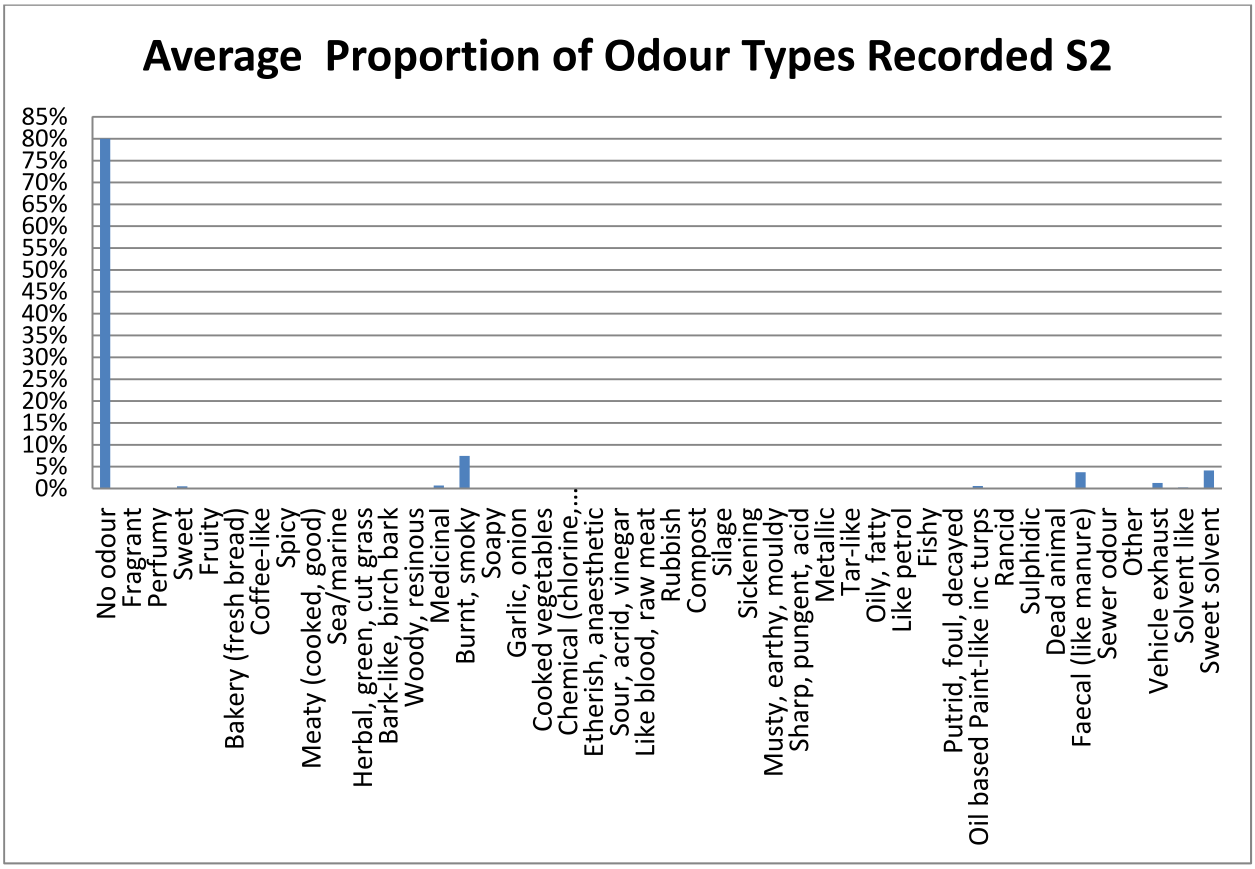


Figure 3-3 Odour Types Start of Mountbatten Grove

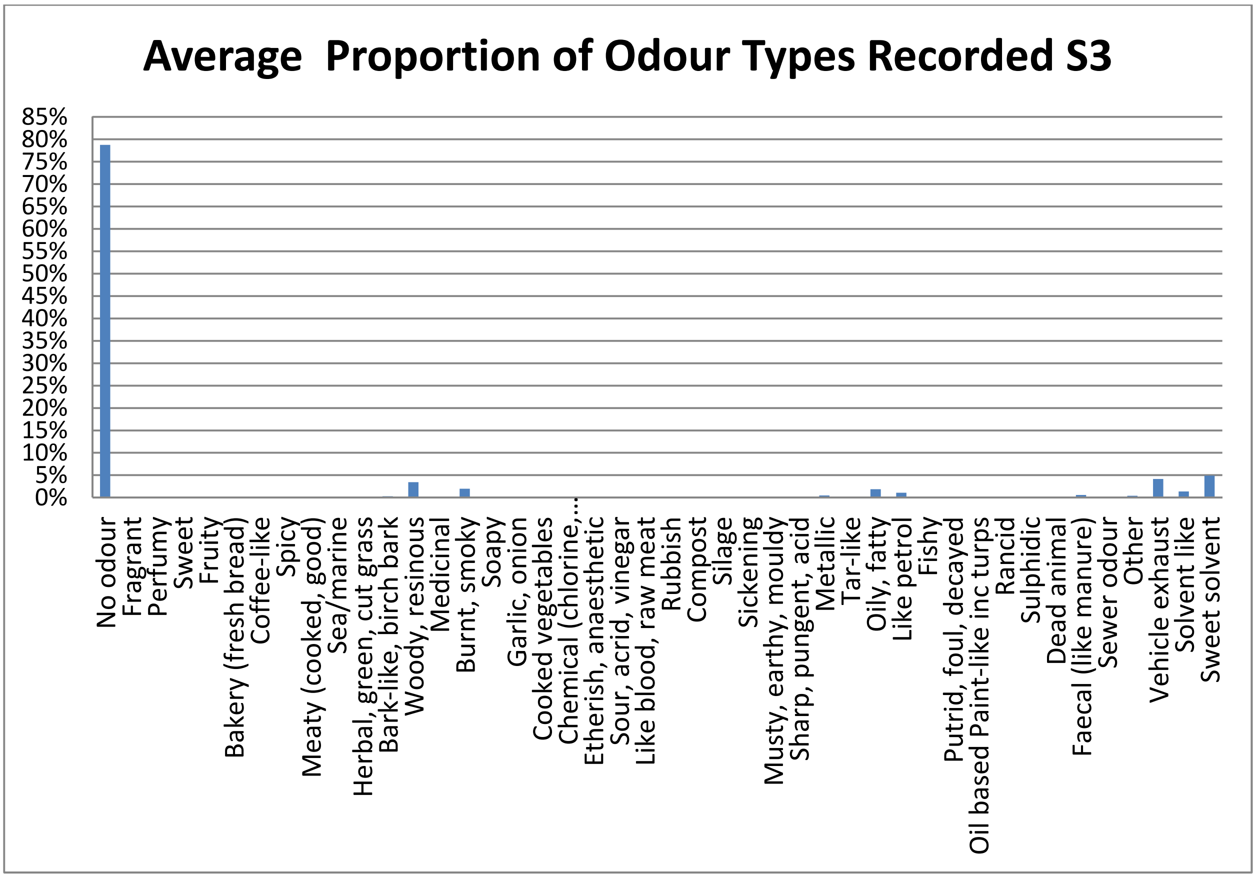


Figure 3-4 Odour Types Montgomery Crescent

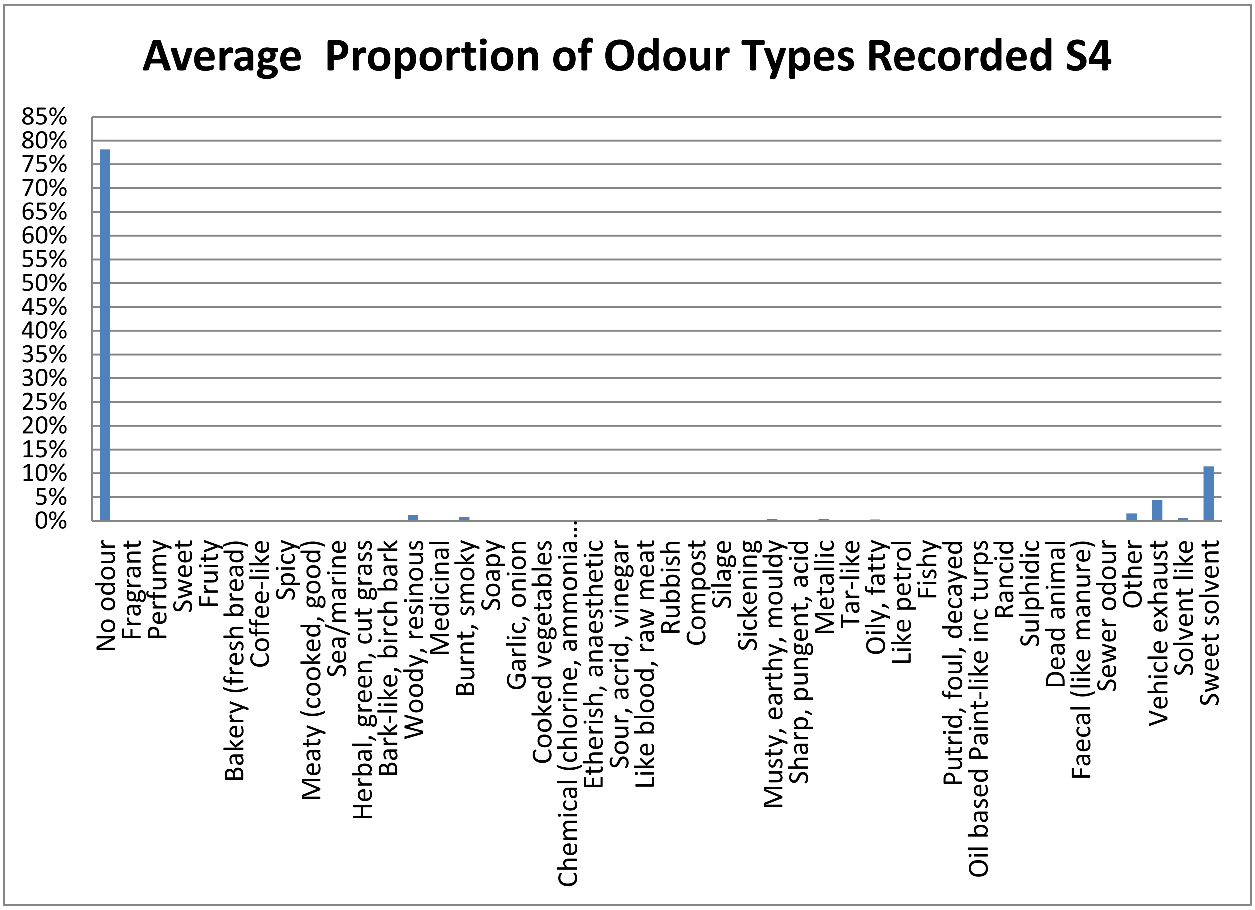


Figure 3-5 Odour Types 73 Opposite NCI Entrance

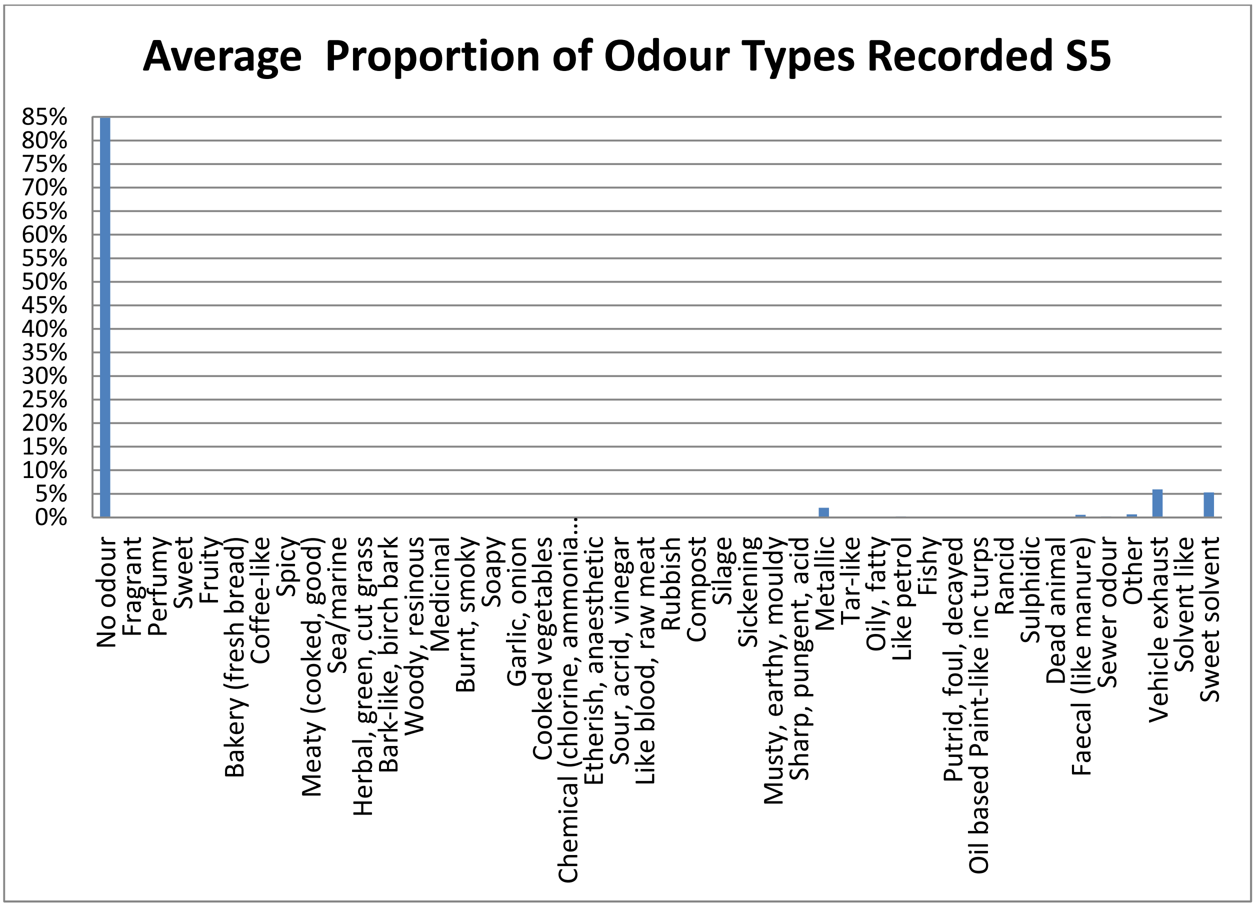


Figure 3-6 Odour Types Montgomery Crescent West of the Plant

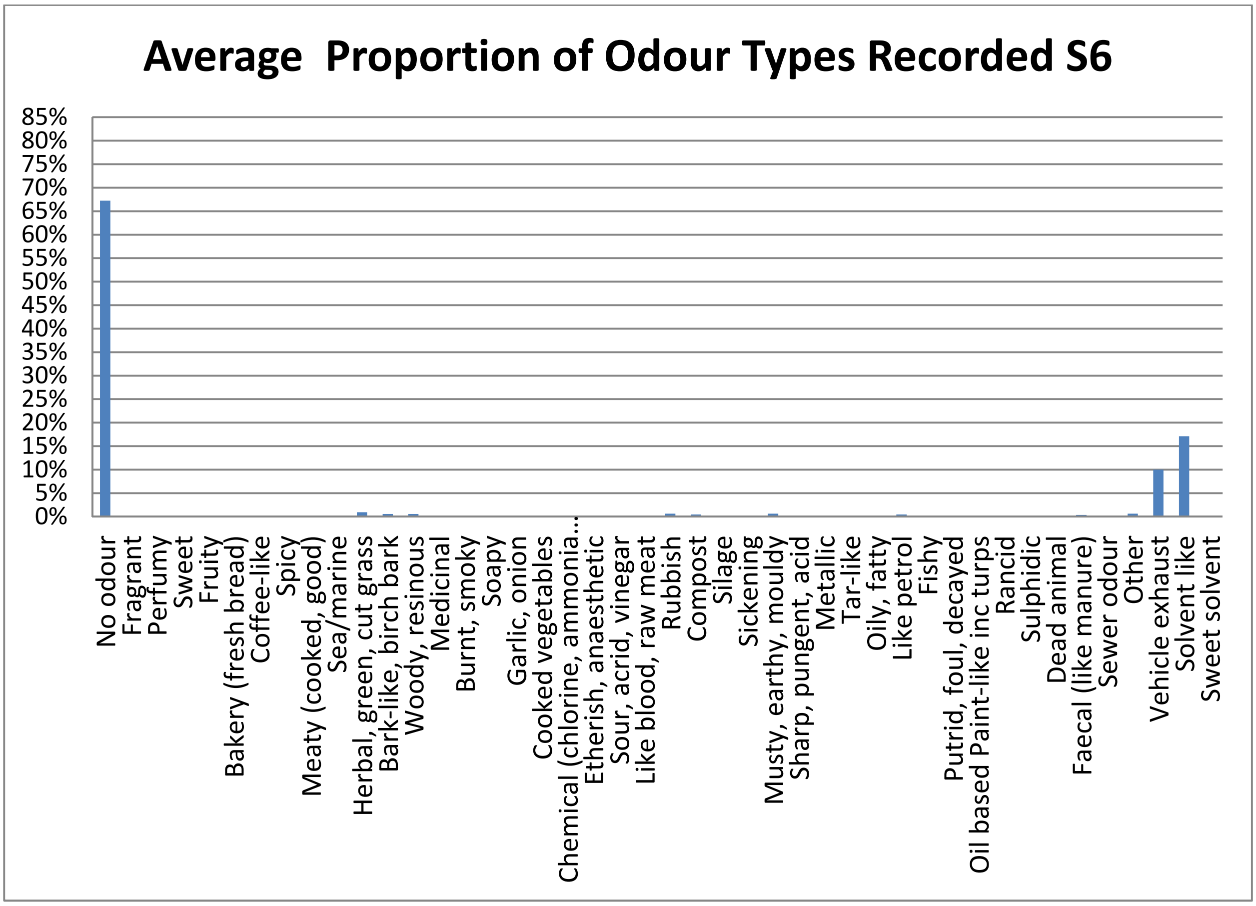
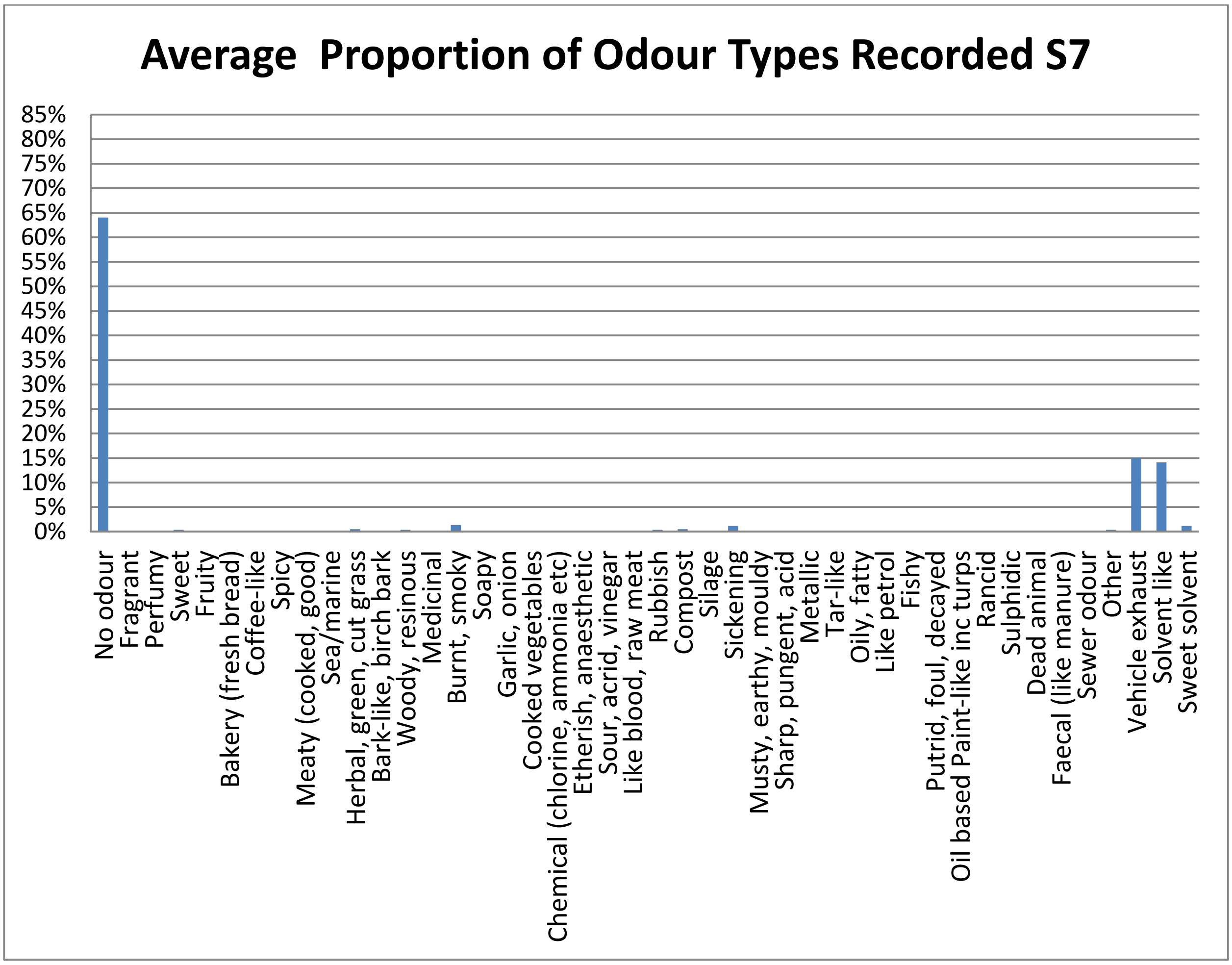


Figure 3-7 Odour Types Montgomery Crescent Fergusson Road End



3.3 Odours verses Direction

Figure 3-8 presents graphs at each monitoring location showing the percentage of different types of odour from each wind direction.

3.3.1 End of Mountbatten Grove

Some burnt smoky odours were observed from the WSW to NNE direction. Weak sweet solvent odours were observed mainly between SSE to SSW direction (NCI), WSW (Wedgelock) and very weak from the WNW direction. Weak solvent like odours were noticed from the WSW direction, around the Fergusson end of Montgomery Crescent. Average odour intensities in each wind direction are presented in Figure 3-9.

Figure 3-8 Direction of Odours at each direction

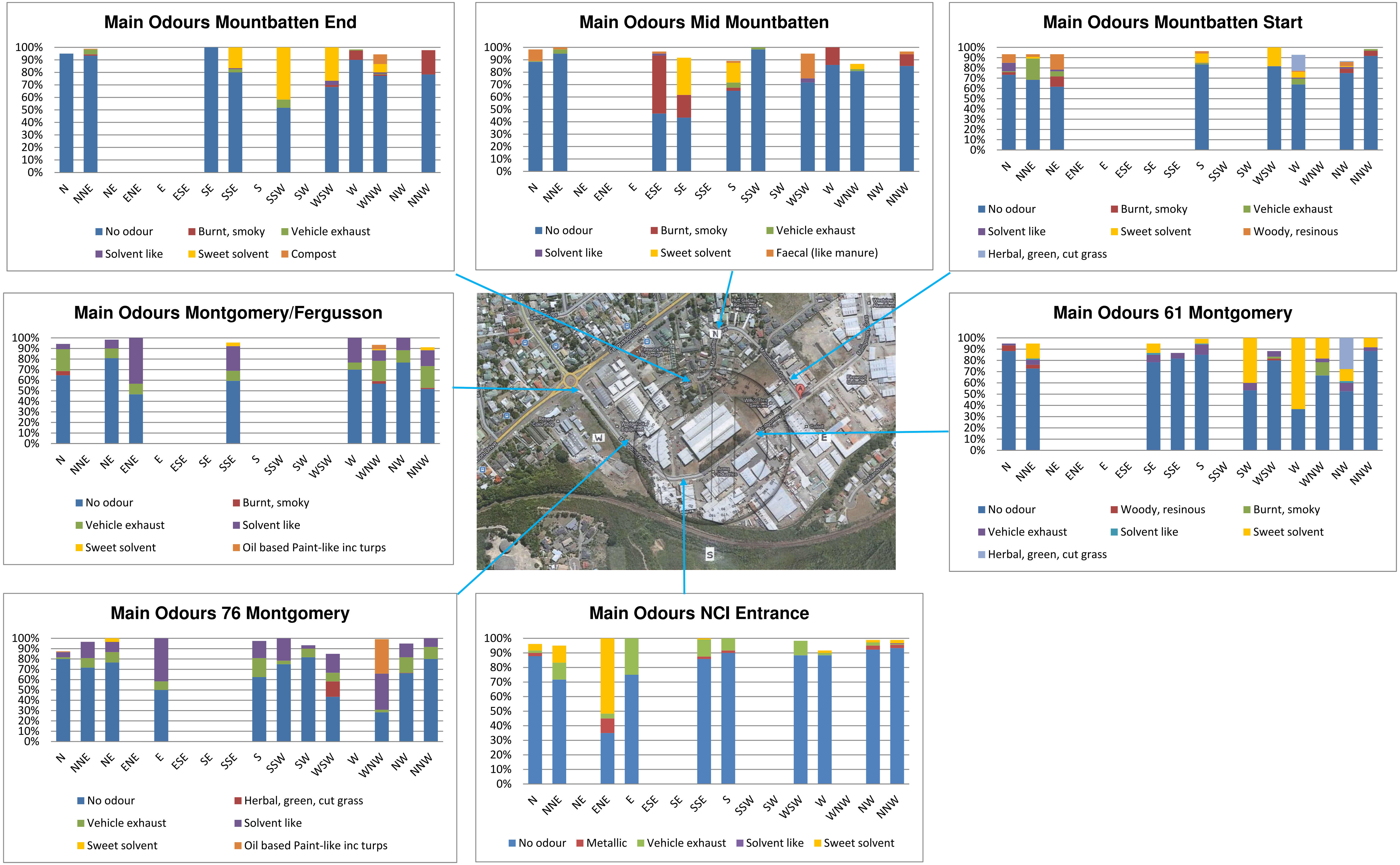
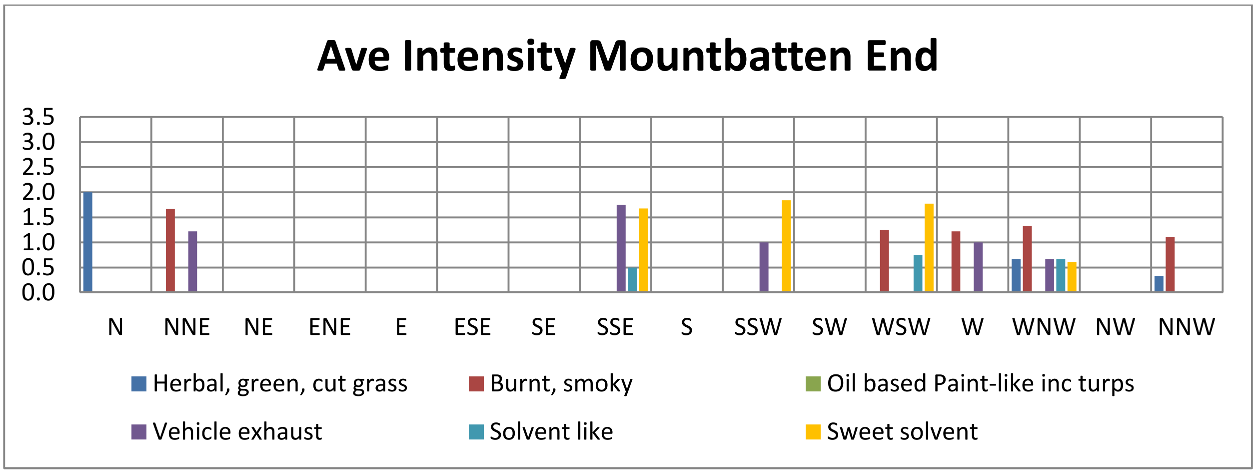


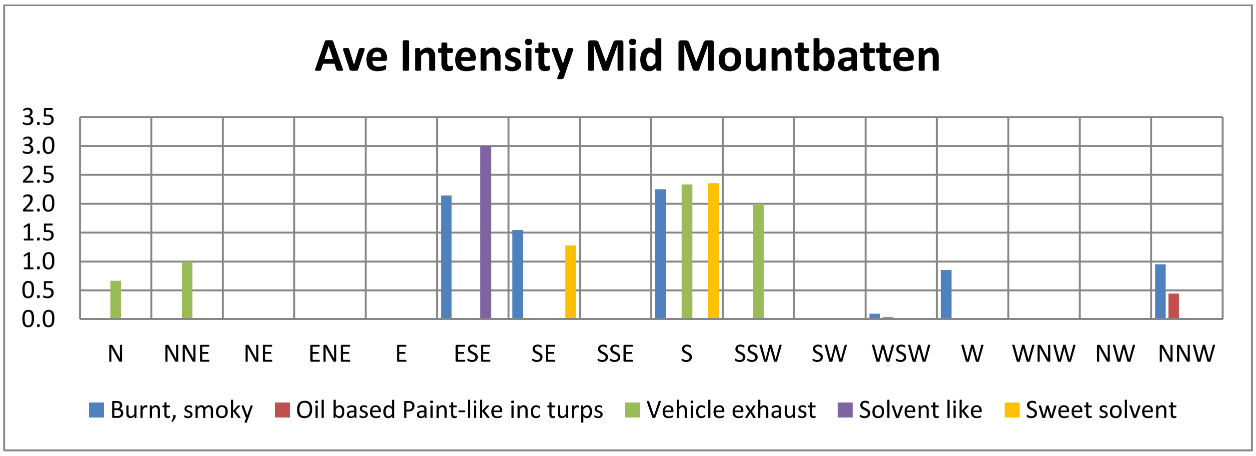
Figure 3-9 Average Intensity Mountbatten End



3.3.2 Mid Mountbatten Grove

Some weak burnt smoky odours were observed from ESE to S, and very weak odours from the W and NNW direction. Weak sweet solvent odours were observed mainly between SE and S. A small percentage of distinct solvent odours were detected from the ESE direction. Vehicle exhaust odours were observed at this location as well from the N-NNE and S-SSW wind directions. Average odour intensities in each wind direction are presented in Figure 3-10.

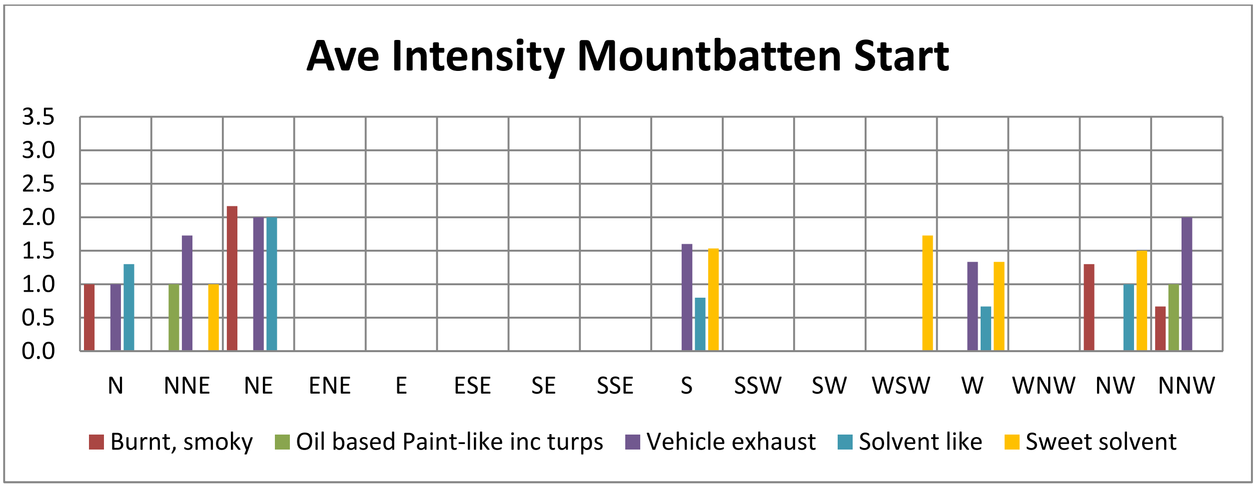
Figure 3-10 Average Intensity Mountbatten End



3.3.3 Start Mountbatten Grove

Some burnt smoky odours were observed from NW to NE direction. Sweet solvent odours were observed mainly between S (possibly other industry) & WSW (NCI), W (Fergusson end of Montgomery), N & NNE (unknown). Solvent like odours came from S, W, NNW, N & NE. Vehicle exhaust and solvent like odours were observed at most wind directions. Average odour intensities in each wind direction are presented in Figure 3-11.

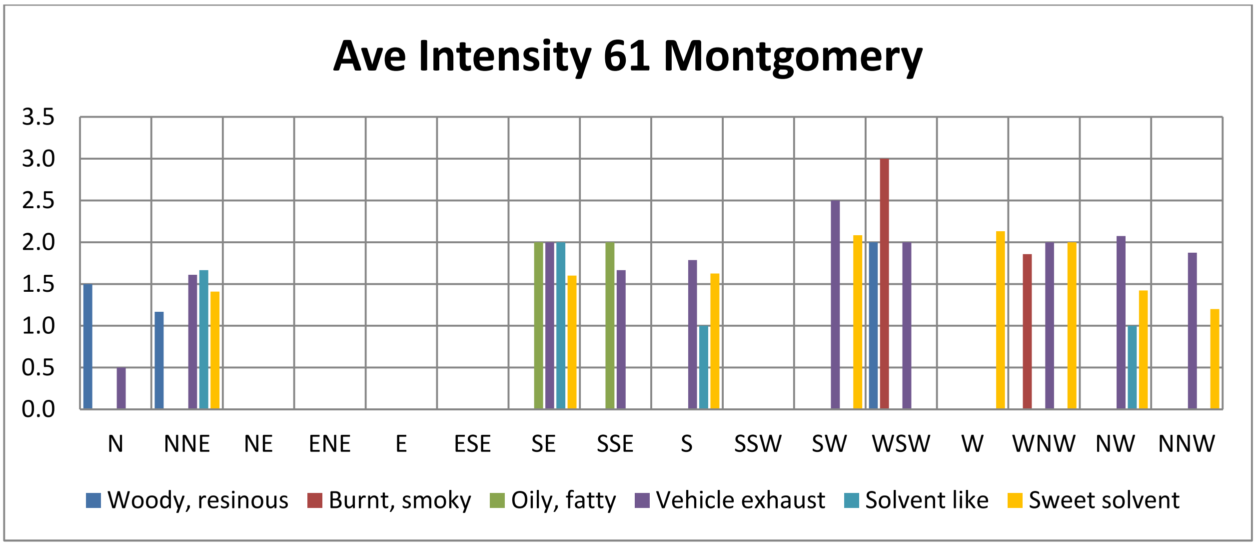
Figure 3-11 Average Intensity Mountbatten Start



3.3.4 61 Montgomery

Some burnt smoky odours were observed from WSW and NNW direction. Weak sweet solvent odours were observed at most observed wind directions with west lining up with NCI. Vehicle exhaust odours were observed at most locations as well. Average odour intensities in each wind direction are presented in Figure 3-12.

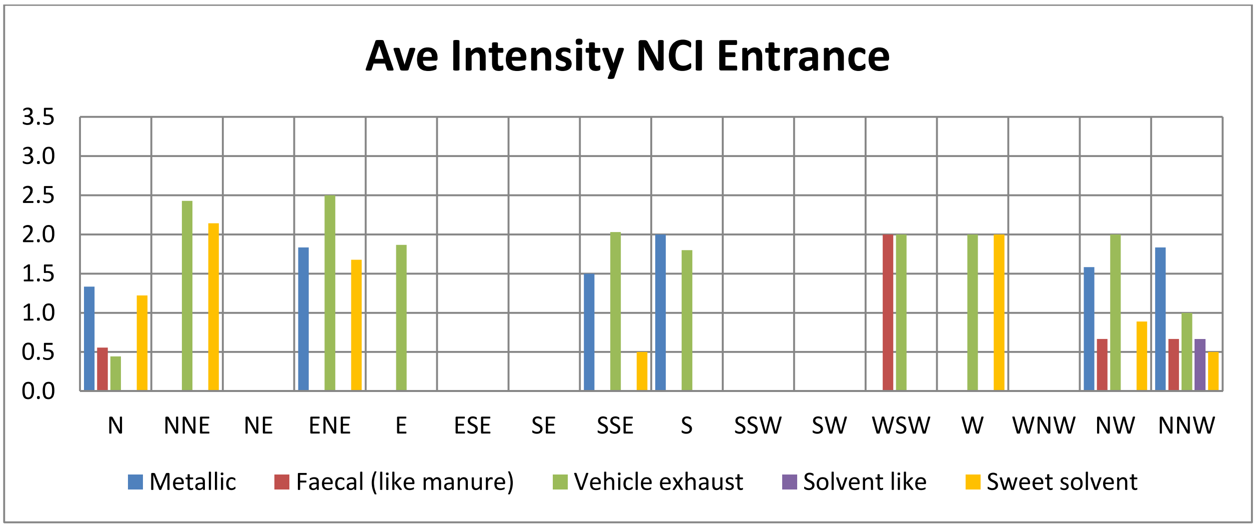
Figure 3-12 Average Intensity 61 Montgomery



3.3.5 NCI Entrance

Some metallic odours were observed from NW to N as well as to the south. Most sweet solvent odours were from the ENE direction which is along Montgomery Crescent. Only about 12% of the observations at the NNE direction (NCI) were sweet solvent. Solvent like odours were detected from the NNW which would be inline with businesses to the west of NCI. Vehicle exhaust odours were noticed at most observation wind directions. Average odour intensities in each wind direction are presented in Figure 3-13.

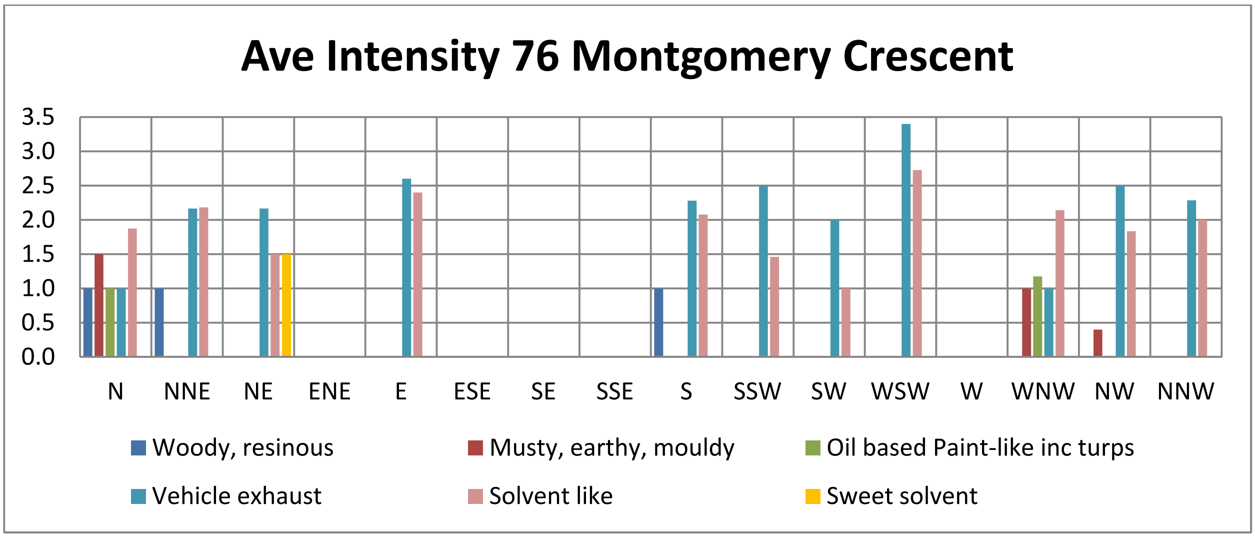
Figure 3-13 Average Intensity NCI Entrance



3.3.6 76 Montgomery

Some woody and musty odours were observed at this location. Solvent like and Vehicle exhaust odours were found in most directions. Both solvent like and oil based paint odours dominated the WNW wind direction. Sweet solvent odours were only observed from the NE which would line up with Wedgelock. Average odour intensities in each wind direction are presented in Figure 3-14.

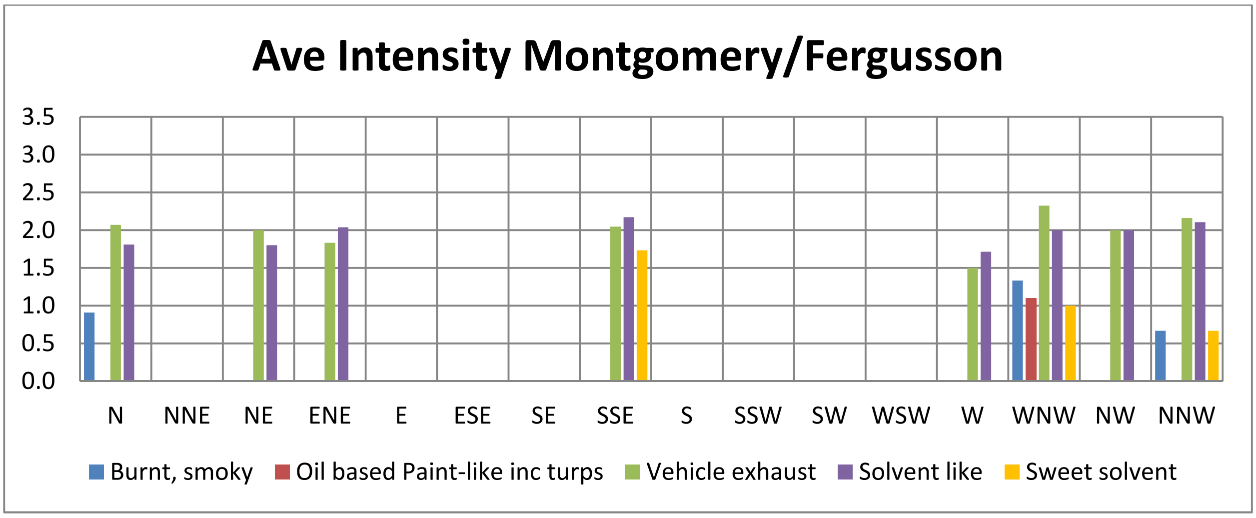
Figure 3-14 Average Intensity 76 Montgomery



3.3.7 Montgomery/Fergusson

Solvent like and Vehicle exhaust odours were found in most directions. Sweet solvent odours were observed in the SSE which lines up more with the business at the Fergusson end of Montgomery, the WNW and NNW directions are in the direction of residential so the source is unknown. Average odour intensities in each wind direction are presented in Figure 3-15.

Figure 3-15 Average Intensity Montgomery/Fergusson

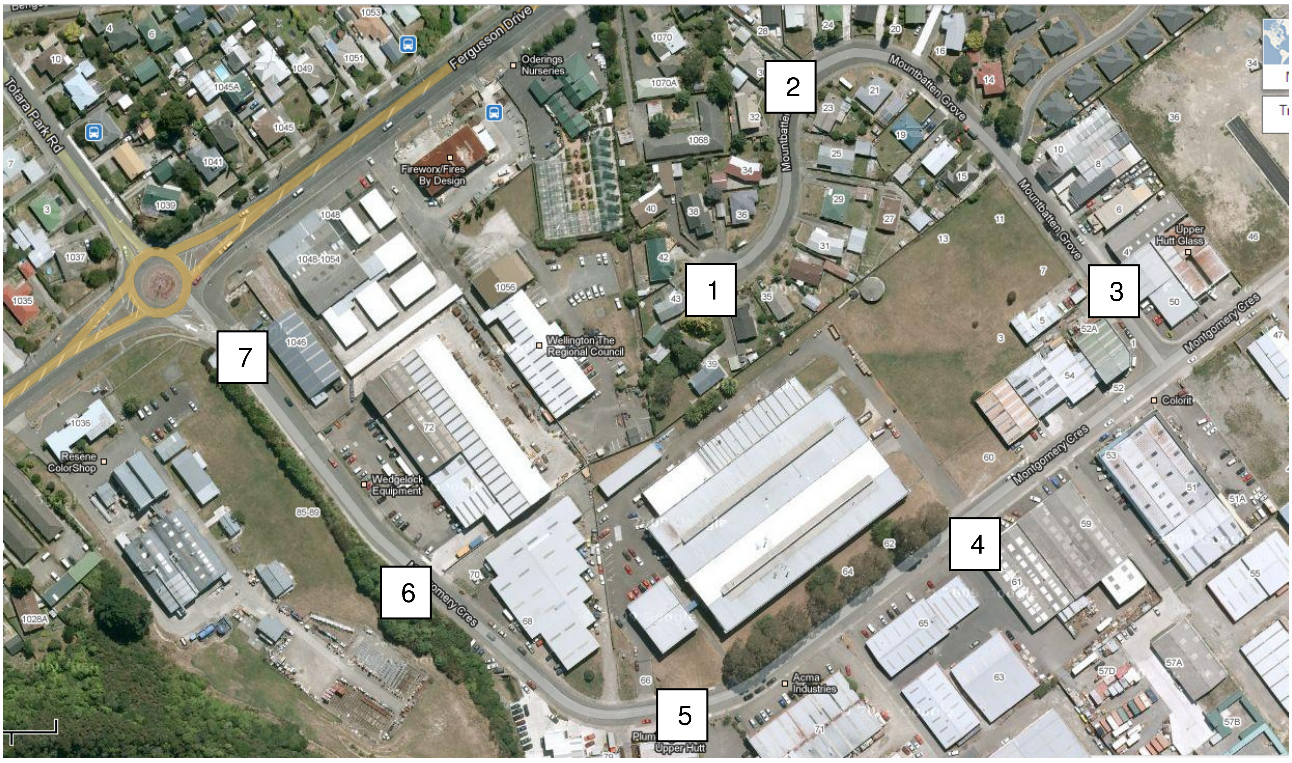


4 Conclusion

Over the whole monitoring programme there were significant periods of no odour in the area (typically greater than 70% of the observations) and there were no measurements above odour intensity 4 except for 4 individual 10 second observations at level 5 (very strong) which shows that odour in the area around the plant is not particularly strong.

The main odours observed were household fires, vehicle exhaust, solvent and turps like and sweet solvent and the average intensity was typically 2 (weak) in the range of wind directions observed. The solvent like and sweet solvent emissions were observed at many of the locations, vehicle odours were more prevalent at the Montgomery crescent locations as there are greater traffic movements.

Appendix A Site Plan of Sampling Locations



Appendix B: Sensitivity analysis of odour dispersion modelling predictions to stack height

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19 August 2020

Attention: Rhys Kevern
Plant Chemist & Compliance Manager
NCI Packaging Limited
113 Savill Drive
Favona, Auckland 2024
New Zealand

Project Name: NCI Packaging Ltd
Project Number: IZ119600

Subject: Supplementary air dispersion modelling

Dear Rhys

This letter provides the outcomes of additional air dispersion modelling undertaken for NCI Packaging Limited's metal packaging factory at 62-66 Montgomery Crescent, Clouston Park in Upper Hutt, New Zealand. The modelling was conducted to assess what the effects are on predicted odour ground level concentrations by increasing the heights of the two main stacks to 27 m and to 30 m. This information is intended to supplement the assessment presented in the report, 'Air Dispersion Modelling Assessment NCI Packaging Ltd', (Jacobs February 2019).

Yours sincerely

Bruce Clarke

pp

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Copies to: Bruce Clarke

1. Background

NCI Packaging Limited (NCI) operate a metal packaging factory at Clouston Park under air discharge consent WGN110219 issued by Greater Wellington Regional Council. An assessment, 'Air Dispersion Modelling Assessment NCI Packaging Ltd', (Jacobs February 2019) was completed in the lead-up to the renewal of this consent in 2019.

Discharges to air from the site are released via two stack sources; the 'L2 main stack' and 'L2 internal lacquer and assembly stack'. 1-hour averaged 99.5th percentile ground level odour concentrations up to 3.8 odour units (OU) and 2.6 OU were previously predicted from the Clouston Park metal packaging factory at surrounding industrial and residential receiving areas (Jacobs, 2019). In the Jacobs 2019 assessment both stacks had a height of 25 metres above ground level. NCI is reviewing the height of these stacks to better manage the potential for off-site odour effects.

The purpose of this letter was to provide results and assessment of predicted 1-hour averaged 99.5th percentile ground level odour concentrations from updated modelling with the 'L2 main stack' and 'L2 internal lacquer and assembly stack' heights both increased to initially 27 metres and then to 30 metres.

2. Assessment details

The site dispersion model developed in CALPUFF applied in the Jacobs, 2019 assessment was also used for this review. Details of the model are presented in Section 4.1.2 to Section 4.1.5 of the Jacobs, 2019 assessment report. Heights of the 'L2 main stack' and 'L2 internal lacquer and assembly stack' were both increased 27 and 30 metres above ground level. Key setup details for both sources in the updated model are listed below in **Table 2-1**.

Table 2-1 Updated model source setup details

Parameter	L2 main stack	L2 internal lacquer and assembly stack
Easting (km)	339.336	339.326
Northing (km)	5446.074	5446.087
Base elevation (m)	65	65
Stack height (m)	27 and 30	27 and 30
Exit diameter (m)	0.325	0.325
Exit temperature (Degrees Celsius)	91	34
Exit velocity	14.2	14.9
Odour emission rate (OU/s)	4,152	5,524

The model was used to predict 1-hour averaged 99.5th percentile ground level odour concentrations around the Clouston Park metal packaging factory.

3. Predicted results

99.5th percentile, 1-hour averaged ground level odour concentration plots for the 'L2 main stack' and 'L2 internal lacquer and assembly stack' increased to 27 and 30 metres above ground level are displayed below in **Figure 3-1** to **Figure 3-4**. **Table 3-1** summarises the highest predicted results at surrounding residential and industrial areas. Results from the Jacobs, 2019 assessment are also included in this table. Results for the 27 and 30 metre stack options were assessed with and without building downwash effects enabled in order to test the sensitivity of this option.

Table 3-1 Summary of highest predicted 99.5th percentile, 1-hour averaged ground level odour concentrations (OU) at surrounding residential and industrial receiver areas

Receiver	27 m 'L2 main stack' and 'L2 internal lacquer and assembly stack'		30 m 'L2 main stack' and 'L2 internal lacquer and assembly stack'		25 m 'L2 main stack' and 'L2 internal lacquer and assembly stack' (Jacobs, 2019)	Criterion
	With building downwash	Without building downwash	With building downwash	Without building downwash		
Residential	1.5	1.4	1.3	1.3	2.6	2
Industrial	2.1	3.0	2.4	2.4	3.8	10

Regarding results for the most affected residential location with 'L2 main stack' and 'L2 internal lacquer and assembly stack' increased to 27 and 30 metres above ground level, 99.5th percentile, 1-hour averaged concentrations ranging between 1.3 and 1.5 OU were predicted. These values are below but approaching the 2 OU criterion from the "Good Practice Guide for Assessing and Managing Odour", (Ministry for the Environment, 2016). For the 27 metre stack option, results with 'building downwash' enabled are higher closer to the site with emissions affected by the wakes created by the surrounding structures with concentrations lower further from the site. When the stacks were set at 30 metres building wake effects were found to be negligible.

Finally regarding the surrounding industrial receivers, the proposed stack height changes resulted in maximum 99.5th percentile, 1-hour averaged ground level odour concentrations ranging between 2.1 and 3 OU; well below the Ministry for the Environment's recommended criterion value of 10 OU. Consequently, it has been concluded that the potential odour impacts of these scenarios will be acceptable.

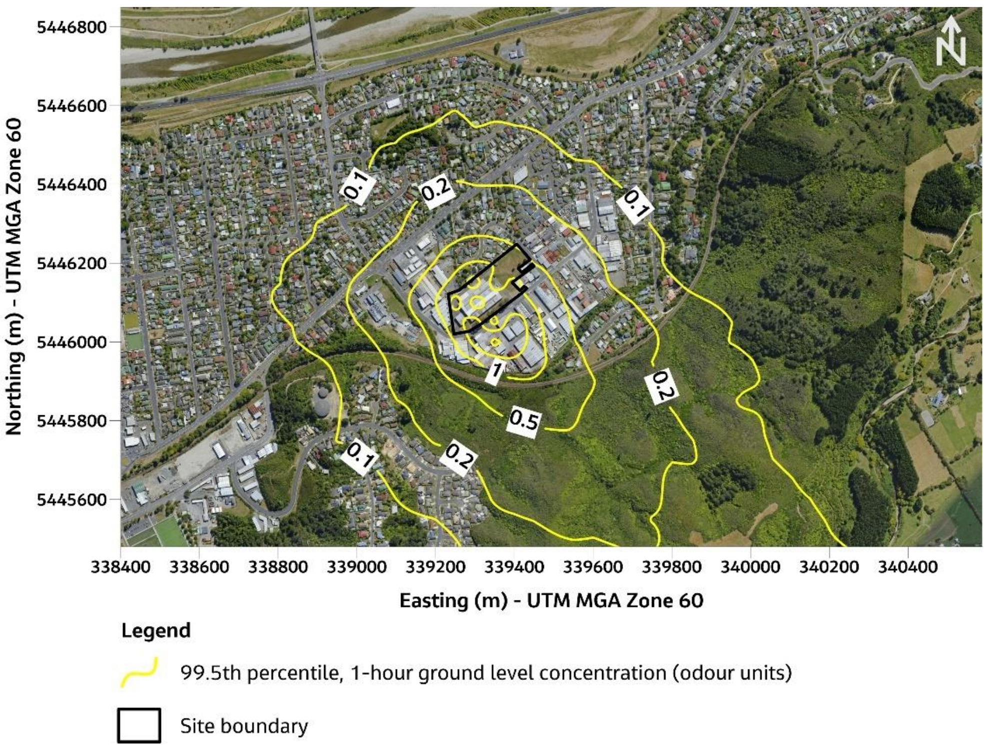

Figure 3-1 99.5th percentile, 1-hour averaged ground level odour concentrations for 27m stacks (with building downwash enabled)

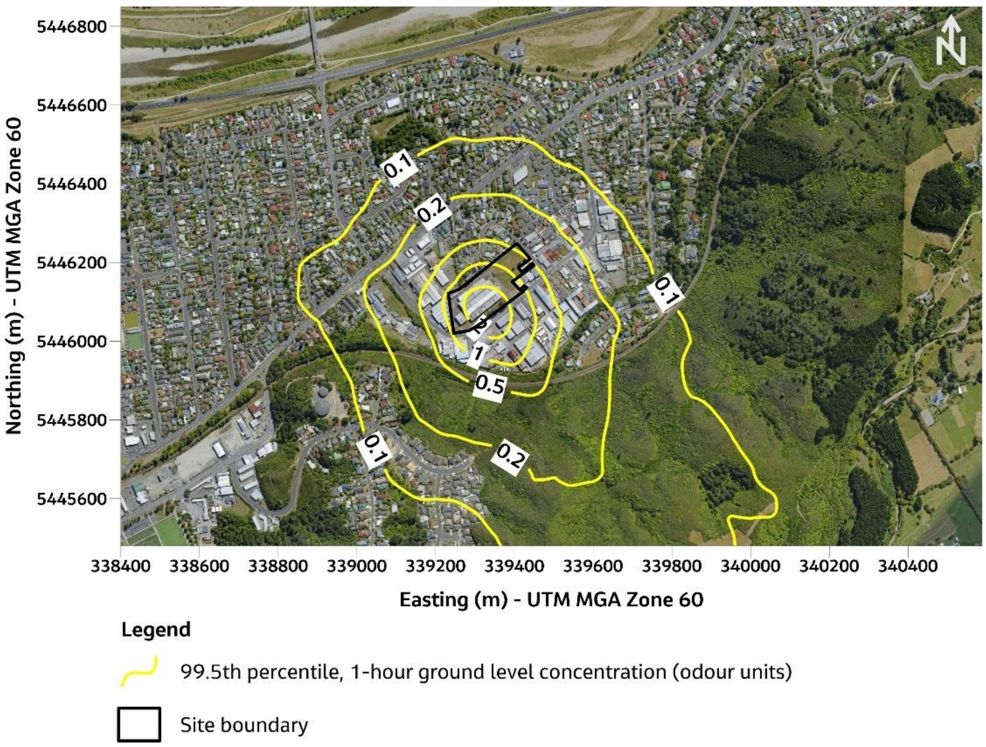

Figure 3-2 99.5th percentile, 1-hour averaged ground level odour concentrations for 27m stacks (with building downwash disabled)

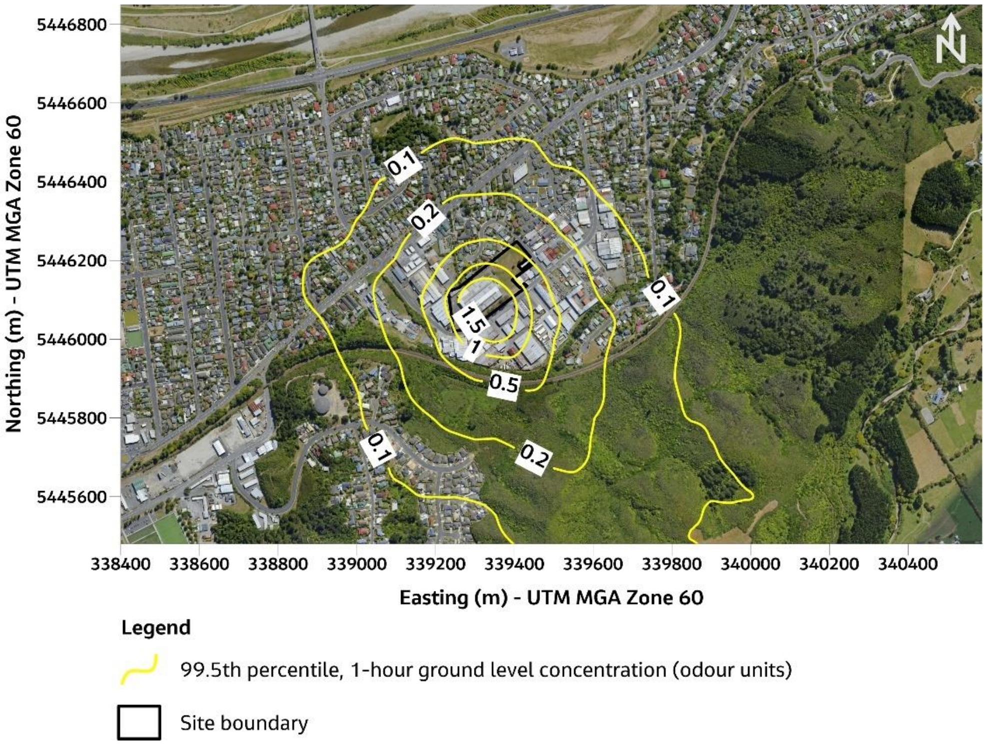

Figure 3-3 99.5th percentile, 1-hour averaged ground level odour concentrations for 30m stacks (with building downwash enabled)

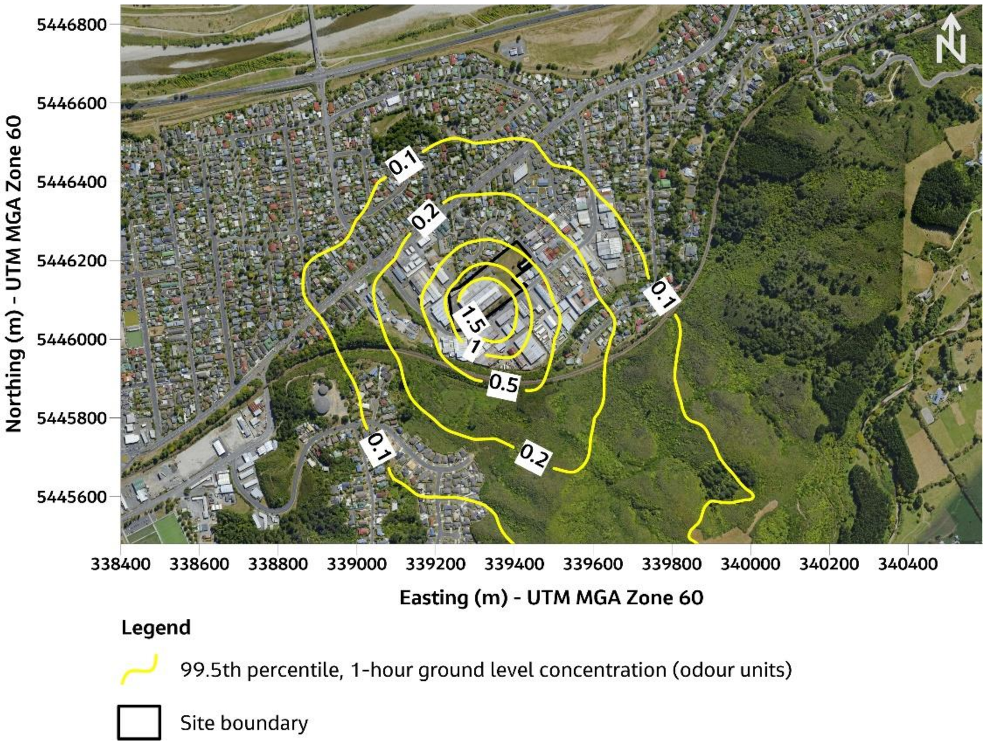

Figure 3-4 99.5th percentile, 1-hour averaged ground level odour concentrations for 30m stacks (with building downwash disabled)