THE ODOUR UNIT

Collex Pty Limited

Odour Mitigation Study

Clyde Waste Transfer Terminal

Final Report

December 2005

THE ODOUR UNIT PTY LTD

ACN 091 165 061
Suite G03, Bay 16
Locomotive Workshop Building
Australian Technology Park
Locomotive St, Eveleigh, NSW 1430

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1 INTRODUCTION

As a follow up to The Odour Unit's (TOU) August 2005 report *Collex Pty Limited: Clyde Waste Transfer Terminal – Odour Control System Design and Performance Review*, TOU was commissioned to conduct an odour sampling study at the Clyde Waste Transfer Terminal to determine the actual odour emissions generated, and develop an odour mitigation strategy based on the Department of Environment and Conservation's (DEC) dispersion modelling criteria.

The approach adopted by TOU was to measure the odour emissions produced by the operations at the waste facility by collecting odour samples from the six stacks, along with volumetric flow data from the stacks. Previous measurements and estimations of odour emission rates from the Clyde facility were based on the use of an Isolation Flux Hood (IFH) method of odour emission measurement. It is TOU's view that if it is possible to measure actual odour emissions from a plant then this data should be used as a basis for odour impact assessment, in preference to indirect emission measurements such as the IFH method. Because these two odour emission measurement methods will yield different odour emission rate values, care is needed when assessing the dispersion modelling results with the DEC criteria.

The odour emission data from the stacks was compared to the volume of waste material present during sampling to produce an odour emission rate per tonne of material on the tipping floor, which was then correlated with the facility's hourly waste throughput through a typical production day. The hourly odour emission rate data was then used as an input into an Ausplume dispersion model. The dispersion modelling study was then conducted in two ways:

1. to predict the current ground level odour concentration impact; and
2. to determine the likely odour reduction through an increase in the height of the six stacks.

This report documents the findings of both the odour sampling survey and the dispersion modelling study. It describes the method used to sample and analyse odorous emissions from the waste transfer terminal, and presents the relevant NSW Department of Conservation (DEC) odour criteria and results of the odour dispersion modelling study.

The report also examines the likely impact reductions that would arise if a different stack configuration to the current six short stacks were used. A range of stack configurations were modelled, including raising the existing stack heights beyond the height where plume downwash effects are likely, and a single external ventilation stack. This latter configuration also examined the effects of increasing mechanical air ventilation rates in the building, from the current seven air changes per hour.

2 SAMPLING PROGRAM

The sampling program was designed to determine the rate at which odour is produced by the operations at the Clyde Waste Transfer Terminal, and the way in which that odour is dispersed from the main operations building. The building is designed so that the air is extracted from the building via six roof vents, while a large door is kept open for waste truck access. In order to monitor the flow of air through the building at the time of sampling, TOU conducted an airflow analysis using a smoke machine to determine whether the open door provided a net inflow or outflow. The sampling was intentionally conducted during very light winds and no outflow resulted through the open door. Therefore, TOU is confident that all odorous air emissions were exhausted from the building via the six roof vents during the period of sampling.

Sampling from the six stacks was then conducted simultaneously over a period of 20 minutes. The volume of waste present (in tonnes) during sampling was also recorded in order to calculate an odour emission rate (OER) per tonne. This allowed for the correlation of the OER with the variable hourly waste inventory in the building to be accounted for in the dispersion model. Air velocities were also measured at the time of sampling and a volumetric flow rate calculated.

Prior to the sampling, the carbon filter system on each of the stacks was removed, in order to return the airflow rates for the fans to the design value. Previous testing of the system by TOU in August 2005 had shown that the carbon filters and their pre-filters had resulted in an excessive pressure loss across the filters and a reduction in total ventilation flow from a design flow of 147,000 m^3/hr to 22,400 m^3/hr.

It is clear from these results and Collex's operation and maintenance experience at the site that the selection of the existing carbon filtration system was inappropriate for the Clyde Terminal application. The design of the Clyde carbon filtration system is more suited to indoor air pollution applications.

3 ODOUR SAMPLING METHOD

3.1 POINT SOURCE ODOUR SAMPLING

The method used for collecting samples from standard point sources involved drawing the sample gas through a Teflon™ sampling tube into a single use, Nalophan sample bag. The bag is housed within a container (sampling drum) that is evacuated with a vacuum pump, and the sample collected by induced flow. The “lung method”, by which this sampling procedure is known, allows the sample air to be collected without coming into contact with any potentially odorous material. This method was used to collect samples from the six stack sources on the roof of the main waste transfer building.

At the completion of sampling, all samples were stored in a dark environment as this helps to retain the sample character and strength. The samples were then transported to TOU’s Sydney laboratory for analysis within the 30 hour timeframe specified in AS/NZS 4323.3:2001.

3.2 VOLUMETRIC FLOW MEASUREMENT

The measurement of the air velocity within the six roof vents was conducted using a hot wire anemometer. One traverse was made due to the availability of only one sampling port in each vent. The stability of the velocity measurements for all six stacks indicated that accuracy was not seriously compromised by the lack of a second velocity traverse port. Vent cross sectional area was calculated from the vent diameter, which was both measured and extracted from plant drawings. The volumetric flow ($m^3\ s^{-1}$) was then calculated as the product of the vent cross sectional area (m^2) and air velocity ($m\ s^{-1}$) exiting the vent. The volumetric flow was then normalised for temperature.

4 ODOUR MEASUREMENT METHOD

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

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

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

The results obtained give an odour measurement measured in odour units (ou). The odour units are then multiplied by an emission rate or volumetric flow to obtain an odour emission rate for each source (ou.m^3 s^{-1}).

5 ODOUR SURVEY RESULTS

The results of the odour sampling survey are summarised in **Table 5.1**. The odour concentration results are presented in the official results format in **Appendix A**.

Table 5.1: Odour Concentration and Emission Rate Results

Sample Location	TOU Sample Number	Odour Concentration (ou)	Volumetric Flow Rate ($m^3\ s^{-1}$)	Odour Emission Rate ($ou.m^3\ s^{-1}$)
Roof Vent 1	SC 50432	610	7.6	4,640
Roof Vent 2	SC 50433	558	7.0	3,900
Roof Vent 3	SC 50434	558	6.2	3,480
Roof Vent 4	SC 50435	609	5.7	3,470
Roof Vent 5	SC 50436	558	7.1	3,970
Roof Vent 6	SC 50437	512	7.2	3,700
Total	**-**	**-**	**40.8**	**23,160**

The measured total volumetric flow rate for the six stacks compares very well to the design flow rate of 40 $m^3\ s^{-1}$.

At the time of sampling, Collex reported 156.7 tonnes of waste in the receivals building. As the measured OER was 23,160 $ou.m^3\ s^{-1}$, an OER per tonne was calculated to be 147.8 $ou.m^3\ s^{-1}\ t^{-1}$. This value was then applied to the hourly volume of waste present in the building for the odour dispersion modelling study. These hourly values are discussed in Section 7.4.

6 NSW ODOUR CRITERIA AND DISPERSION MODEL GUIDELINES

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

In accordance with the requirements of the Director General of the Department of Infrastructure Planning and Natural Resources the odour impact assessment for this project has been carried out in accordance with the methods outlined in the following two DEC documents:

> "*Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*" (2001), and
>
> "*Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW*" (2001).

The DEC Approved Methods document specifies that the odour modelling upon which the assessment is made be based on the use of:

- 99.0th percentile dispersion model predictions for Level 3 impact assessments;
- 1-hour averaging times with built–in peak-to-mean ratios to adjust the averaging time to a 1-second nose-response-time;
- The peak-to-mean ratio in the near-field for a wake-affected stack source for Pasquill-Gifford atmospheric stability classes A-F is 2.3.
- The appropriate odour unit performance criterion, based on the population of the affected community in the vicinity of the development.

The impact assessment criteria for complex mixtures of odours are designed to include receptors with a range of sensitivities. Therefore a statistical approach is used to determine the acceptable ground level concentration of odour at the nearest sensitive receptor. This criterion is determined by the following equation outlined in the DEC's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2005* (p. 37):

$$\textbf{Impact assessment criterion (ou)} = (\log_{10}(\text{population}) - 4.5) / -0.6$$

Based on this equation, **Table 6.1** outlines the odour performance criteria for six different affected population density categories, and is reproduced from the DEC's Approved Methods document. It states that higher odour concentrations are permitted in lower population density applications.

Table 6.1: Odour Performance Criteria under Various Population Densities

Population of affected community	Odour performance criterion (ou)
Urban Area (≥ ~2000)	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single residence (≤ ~2)	7.0

Source: Department of Environment and Conservation (NSW), 2001, Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales.

It is apparent from Table 6.1 that the relevant odour performance criterion (OPC) for the Clyde terminal is 2 odour units.

7 ODOUR DISPERSION MODEL CONFIGURATION

7.1 THE ODOUR DISPERSION MODEL

The odour dispersion modelling study for Collex's Waste Transfer Terminal at Clyde was carried out using AUSPLUME Version 6.0, a Gaussian steady-state dispersion model developed by the Victorian Environmental Protection Authority (EPA Victoria). Ausplume is the approved dispersion model recommended by the NSW DEC in their document - *Approved Methods and Guidance For the Modelling and Assessment of Air Pollutants in New South Wales (2001)*.

The Ausplume V6.0 atmospheric dispersion model is used to predict downwind ground level concentrations of air contaminants by taking into consideration various factors including:

- Odour emissions data - odour emission rate and source dimensions;
- Site specific meteorology;
- Geophysical impact (topography); and
- Building wake effects.

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

The surface roughness category (Z_o) used for this study was 0.4m, which equates to a 'residential' land use. The Collex site is surrounded by residential land use, although a distance of between 0.5 – 1 km of rail yards and commercial buildings separates the facility from these households. As a commercial/warehouse type land use equates to a surface roughness factor of 0.8m, and the large rail yard area is flat and unimpeded by structures, equating to a more moderate surface roughness factor of 0.1m, a Z_o of 0.4m was deemed acceptable. The Building Profile Input Program (BPIP) was also incorporated into the model, with the main waste transfer building dimensions being 48m (long) x 33m (wide) 17m (high).

7.2 METEOROLOGICAL DATA

The meteorological data used in this study was supplied by the NSW DEC and collected at the DEC's Chullora met station. The DEC supplied data for the period 1 July 2004 to 30 June 2005, as they deemed this to be a representative year. This observed data included hourly wind direction, wind velocity, ambient air temperature, solar radiation and sigma theta values.

In order for the meteorological data to comply with the Ausplume model's formatting, atmospheric stability and mixing height must be included. These parameters were determined by parameterisation of the Chullora observed data provided in the supplied meteorological file. Atmospheric stability was classified under the Pasquill-Gifford scheme by parameterisation using the NSW DEC approved method (*Approved Methods and Guidance – For the Modelling and Assessment of Air Pollutants in New South Wales, 2001*), using the sigma theta method. Mixing height can then be parameterised using the NSW DEC approved method outlined in the above document, which utilises the wind velocity and atmospheric stability.

7.3 TOPOGRAPHICAL DATA

Topographical information was incorporated into the dispersion model from the topographical map *Parramatta River 9130-3N (Third Edition)*, supplied by the NSW Department of Information, Technology and Management Land Information Centre. In the case of the area of interest in this study, the topography was generally an urban landscape between 0m - 30m above sea level. The confluence of two creeks does occur approximately 2km to the northeast of the Collex site.

7.4 DISPERSION MODEL EMISSION RATE INPUT DATA

As all emission sources are point sources from wake-affected stacks, the emissions have been adjusted for a peak-to-mean factor, in accordance with the NSW DEC regulations. As the emission rate applied varied hourly, the atmospheric stability based odour emission rate option was not used in the model, with the 'hour of day' OER option preferred. A factor of 2.3 was applied to all stability classes (A-F) for the P/M60 in the near-field. **Table 7.1** presents the OERs that have been adjusted for peak-to-mean factors and used in the dispersion model. The hourly waste receivals data provided by Collex are for 28 November 2005, and are representative of an average operating day.

Table 7.1: Modelled vent OERs by hour

Hour of Day	Waste Present in Building (t)	OER (based on tonnage) (ou s^{-1})	OER per Vent (ou s^{-1}/ vent)	OER per Vent with peak-to-mean (ou s^{-1}/ vent)
1	131.188	19,390	3,232	7,433
2	159.748	23,611	3,935	9,051
3	243.268	35,955	5,993	13,783
4	336.448	49,727	8,288	19,062
5	348.734	51,543	8,590	19,758
6	364.460	53,867	8,978	20,649
7	320.843	47,421	7,903	18,178
8	368.033	54,395	9,066	20,852
9	375.290	55,468	9,245	21,263
10	413.439	61,106	10,184	23,424
11	484.252	71,572	11,929	27,436
12	462.000	68,284	11,381	26,175
13	456.584	67,483	11,247	25,869
14	497.855	73,583	12,264	28,207
15	382.885	56,590	9,432	21,693
16	257.263	38,023	6,337	14,576
17	106.776	15,781	2,630	6,050
18	92.809	13,717	2,286	5,258
19	70.374	10,401	1,734	3,987
20	15.852	2,343	390	898
21	0.000	0	0	0
22	4.920	727	121	279
23	43.940	6,494	1,082	2,489
24	43.940	6,494	1,082	2,489

7.5 ODOUR DISPERSION MODELLING SCENARIOS – EXISTING STACKS

These modelling scenarios were designed to address the two main issues related to the operation and possible modification to the existing stacks.

Scenario 1A: To determine the extent of the odour impacts around the waste facility at various ground level concentrations, i.e., 2, 5, 7, 10 and 12 ou.

Scenario 1B: To determine the reduction in ground level concentrations through an increase in the height of the six stacks from the current height, and then adding 3m, 6m, 9m and 12m.

Table 7.2 presents the vent diameter, mean source gas velocity and location of each roof vent odour source in Map Grid of Australia (MGA) co-ordinates.

Table 7.2: Six Roof Vents Source Configurations

Odour Source	Vent Diameter (m)	Modelled Mean Velocity ($m\ s^{-1}$)	X Co-ordinate	Y Co-ordinate
Roof vent 1	0.7	17.9	317146	6254108
Roof vent 2	0.7	17.9	317152	6254100
Roof vent 3	0.7	17.9	317159	6254091
Roof vent 4	0.7	17.9	317166	6254081
Roof vent 5	0.7	17.9	317171	6254074
Roof vent 6	0.7	17.9	317175	6254065

In examining the results from the Scenario 1A modelling (the emissions from existing plant configuration) it is possible to determine a site-specific odour performance criterion (OPC) for the facility, based on known odour impact data since the plant was opened. The fact that a site-specific OPC can often differ from the DEC criterion will be discussed later in this report.

In modelling the impacts of an increase in stack heights (Secnario 1B), both the 2 and 5 ou contours were produced. In addition, a 7 ou contour was also modelled for the +9m stack extension scenario, as a 9m stack height is currently included in the Collex Waste Transfer Terminal's DEC emissions licence. For this scenario, a frequency distribution was produced showing the timing across a production day of the 100 worst hours of odour impact for the year being modelled.

7.6 ODOUR DISPERSION MODELLING SCENARIOS – SINGLE EXTERNAL VENT STACK

These modelling scenarios were designed to assess the performance and viability of replacing the existing six short stacks with a single large ventilation stack, located external to the terminal building. Of particular interest to the study was whether this type of stack would achieve the desired performance at a lower overall stack height, and therefore with an improved visual impact.

A range of stack height/airflow rate scenarios were modelled. Increased air flow rates, from the seven air changes per hour currently in use, were assessed, in the expectation that increased ventilation rates in the building would have the double benefit of reducing fugitive odour emissions from the building and improving initial dispersion from the stack. The configuration of the single stack is summarised in **Table 7.3**.

Table 7.3: Single Stack Source Configuration

Odour Source	Stack Diameter (m)	Modelled Mean Velocity (m s^{-1})	X Co-ordinate	Y Co-ordinate
Single external stack – 5.6 air changes per hour	1.6	20.0	317141	6254126
Single external stack – 8 air changes per hour	1.9	20.0	317141	6254126
Single external stack – 12 air changes per hour	2.4	20.0	317141	6254126
Single external stack – 16 air changes per hour	2.7	20.0	317141	6254126
Single external stack – 24 air changes per hour	3.3	20.0	317141	6254126

The five scenarios using different air ventilation rates through the terminal building were modelled with stack heights varying from 18m, 21m, 24m and 27m.

Scenario 2A – Single external stack in the northwest corner of the terminal building with 5.6 air changes per hour (40.8 m^3/s). . Stack heights modelled for a 2 ou ground level concentration were 18m (and 5 ou), 21m, 24m and 27m.

Scenario 2B – Single external stack in the northwest corner of the terminal building with 8 air changes per hour (58 m^3/s). Stack heights modelled for a 2 ou ground level concentration were 18m, 21m, 24m and 27m.

Scenario 2C – Single external stack in the northwest corner of the terminal building with 12 air changes per hour (87.5 m^3/s). . Stack heights modelled 18m, 21m, 24m and 27m.

Scenario 2D – Single external stack in the northwest corner of the terminal building with 16 air changes per hour (117 m^3/s). . Stack heights modelled for a 2 ou ground level concentration contour were 18m, 21m, 24m and 27m.

Scenario 2E – Single external stack in the northwest corner of the terminal building with 24 air changes per hour (175 m^3/s). . Stack heights modelled for a 2 ou ground level concentration were 18m, 21m, 24m and 27m.

8 ODOUR DISPERSION MODELLING RESULTS

The results of the odour dispersion modelling study are presented in the following odour contour plots:

Scenario 1A - **Figure 8.1**
Scenario 1B – **Figure 8.2**
Scenario 2A – **Figure 8.3**
Scenario 2B – **Figure 8.4**
Scenario 2C – **Figure 8.5**
Scenario 2D – **Figure 8.6**
Scenario 2E – **Figure 8.7**

The frequency distribution of the 100 worst hours for the 7 ou ground level concentration contour (from Figure 8.1) for the current six stack configuration with nine metre stack extensions is presented in **Figure 8.8**. The chart shows that 74% of the worst 100 hours occur before 8am.

An example of the Ausplume V6.0 output file is presented in **Appendix B**.

Figure 8.1: Scenario 1A Odour Contour Plot

Figure 8.2: Scenario 1B Odour Contour Plot

Figure 8.3: Scenario 2A Odour Contour Plot

Figure 8.4: Scenario 2B Odour Contour Plot

Figure 8.5: Scenario 2C Odour Contour Plot

Figure 8.6: Scenario 2D Odour Contour Plot

Figure 8.7: Scenario 2E Odour Contour Plot

Figure 8.8: Frequency distribution for the 100 worst hours for 7 ou glc with 9m extensions to the current 6 stacks

9 DISCUSSION OF RESULTS

Before interpreting the results of the various stack scenarios modelled in this study it is necessary to examine the odour emissions testing and dispersion modelling results for the current plant. As has been mentioned previously TOU has a high level of confidence in the measurement of the total odour emission rate (23,160 ou.m^3 s^{-1}) and the tonnage-specific OER from the tipping floor (148 ou.m^3 s^{-1} t^{-1}), due to the ideal atmospheric conditions that were prevailing during the sampling. While this total OER greatly exceeds the maximum OER specified in the Consent and the DEC licence (7,160 ou.m^3 s^{-1}) it is highly significant that the approved OER was based on data provided by Collex at the application stage of the project. That early data was, in turn, based on odour measurements taken using the Isolation Flux Hood (IFH) method of odour sampling, which collected the samples from directly over the surface of the MSW material. It is a widely known feature of the IFH method of OER determination that the method underestimates the true OER, particularly when compared to point-source emission rates. As will be discussed below, this discrepancy between the approved and measured OERs for the facility has implications when it comes to complying with DEC odour performance criteria.

The modelling results for the current plant (**Figure 8.1**), when assessed against the DEC criterion of 2 ou, indicates a vast odour impact zone around the site – far larger than is known to be occurring. It is clear that a site-specific OPC less than 2 ou is indicated by this modelling result. On the basis of anecdotal odour nuisance information available, and ambient odour assessments carried out by TOU an OPC of not less than 7 ou is indicated by this result. It is possible that this discrepancy on OPC values may be due to the abovementioned different odour emission measurement methods used. Notwithstanding this issue, it is apparent that the existing stacks do not have sufficient elevation above the roof height to provide adequate initial dispersion and prevent plume downwash effects that prematurely drag the odour plume to ground level. Significantly, the development was approved with a minimum specified stack height of 9 metres (presumably above roof level). The existing stacks barely reach the maximum height of the roof.

Another key finding from the modelling of the current plant, and depicted in **Figure 8.8**, is that the most problematical times for adverse odour impact from the existing stacks occur in the period between 4 am and 8 am. This period accounts for 70 per cent of the total daily hours. The remaining 30 per cent are shown to occur between 8 am and 3 pm. Adverse impacts are not indicated beyond 3 pm. The significance of this result is twofold: the bulk of the nuisance is occurring before most local businesses start operations, and there is no 'late afternoon/early evening' odour nuisance period, commonly found in other industries.

The modelling of the various increased stack height scenarios (**Figure 8.2**) indicates that substantial impact reduction would be achieved and the site-specific OPC of 7 ou could be met if the stacks were raised by 9 metres. This height is considered to be close to the maximum practically and aesthetically achievable. Even at this height the DEC OPC of 2 ou is not achievable, although the site-specific OPC of 7 ou can be met for all areas except the adjoining property owned and operated by the principal complainant (The Manildra Group). At this stack height increase TOU considers that a practical solution to the existing odour nuisance problem would occur, to the extent that adverse impacts from the stack emissions would reduce to acceptable and minimal levels.

When assessing the results of the modelling of a new, free-standing ventilation stack located at the north-western corner of the terminal building a very different picture emerges. A range of ventilation rates were modelled, from the current 5.6 per hour, through 8, 12, 16 and up to 24 per hour, at stack heights of 18 metres (marginally above current roof height), 21 metres and 24 metres.

When modelling the current ventilation airflow rate of 5.6 air changes per hour (40.8 m^3/sec) the results (**Figure 8.3**) show a greatly reduced odour impact zone around the plant. This result indicates that a single large stack located on the north-west corner of the building would disperse the current odour emissions far more effectively that the existing six smaller stacks on the roof. This effect is believed to be due to a decrease or elimination of the plume downwash/building wake effect that is currently occurring with the existing stack locations. Significantly this new stack configuration is able to meet the site-specific OPC of 7 ou but is unable to meet the DEC OPC of 2 ou. Stack height increases to 21 and 24 metres (**Figure 8.3**) further decrease the impact area but still fail to meet the 2 ou OPC. A stack height of 27 m is required to meet the DEC criterion, at an airflow rate of 5.6 air changes per hour.

The remaining scenarios modelled in this study (**Figures 8.4 - 8.7**) show decreasing impacts as both the air change rate and stack height increase. While the results in **Figure 8.5** show that a stack height of 18 metres and an air change rate of 12 per hour will meet the DEC OPC of 2 ou, it is recommended that Collex adopt a conservative approach to designing this new stack arrangement, should it choose this as its preferred option for odour impact reduction. These design values, corresponding to stack diameter of 2.5 m and an airflow rate of 87.5 m^3/second, should be the minimum considered for the site.

Appendix A

Odour Concentration Results

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Appendix B

Ausplume Configuration Output File Example

THE ODOUR UNIT PTY LIMITED

Suite G03 Bay 16
Australian Technology Park
Locomotive Street
Eveleigh
NSW 1430

Phone: +61 2 9209 4420
Facsimile: +61 2 9209 4421
Email:tschulz@odourunit.com.au
Internet: www.odourunit.com.au
ABN: 53 091 165 061

Form 06 - Sydney Laboratory
Odour Concentration Measurement Results

The measurement was commissioned by:

Organisation	Collex Pty Ltd	Telephone	02 8571 0000
Contact	Eric Le Provost	Facsimile	02 8571 0210
Sampling Site	Clyde	Email	
Sampling Method	Drum and Pump	Sampling Team	TOU

Order details:

Order requested by	E Le Provost	Order accepted by	T. Schulz
Date of order	October 2005	TOU Project #	1230
Order number	TBA	Project Manager	T. Schulz
Signed by	TBA	Testing operator	D. Hepple

Investigated Item Odour concentration in odour units 'ou', determined by sensory odour concentration measurements, of an odour sample supplied in a sampling bag. Odour character is also assessed, however, this assessment is not covered by AS4323.3:2001.

Identification The odour sample bags were labelled individually. Each label recorded the testing laboratory, sample number, sampling location (or Identification), sampling date and time, dilution ratio (if dilution was used) and whether further chemical analysis was required.

Method The odour concentration measurements were performed using dynamic olfactometry according to the Australian Standard 'Determination of Odour Concentration by Dynamic Olfactometry AS/NZS4323.3:2001. The odour perception characteristics of the panel within the presentation series for the samples were analogous to that for butanol calibration. Any deviation from the Australian standard is recorded in the 'Comments' section of this report.

Measuring Range The measuring range of the olfactometer is $2^2 \leq \chi \leq 2^{18}$ ou. If the measuring range was insufficient the odour samples will have been pre-diluted. The machine is not calibrated beyond dilution setting 2^{17}. This is specifically mentioned with the results.

Environment The measurements were performed in an air- and odour-conditioned room. The room temperature is maintained between 22°C and 25°C.

Measuring Dates The date of each measurement is specified with the results.

Instrument Used The olfactometer used during this testing session was:
ODORMAT SERIES V02

Instrumental Precision The precision of this instrument (expressed as repeatability) for a sensory calibration must be $r \leq 0.477$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: r = 0.3313 (6/12 July, 2005) Compliance – Yes

Instrumental Accuracy The accuracy of this instrument for a sensory calibration must be $A \leq 0.217$ in accordance with the Australian Standard AS/NZS4323.3:2001.
ODORMAT SERIES V02: A = 0.1872 (6/12 July, 2005) Compliance – Yes

Lower Detection Limit (LDL) The LDL for the olfactometer has been determined to be 16 ou (four times the lowest dilution setting)

Traceability The measurements have been performed using standards for which the traceability to the national standard has been demonstrated. The assessors are individually selected to comply with fixed criteria and are monitored in time to keep within the limits of the standard. The results from the assessors are traceable to primary standards of n-butanol in nitrogen.

Date: Friday, 4 November 2005

Report Number / Panel Roster Number: SYD20051101_080

T. Schulz
Principal and Managing Director

D. Hepple
Authorised Signatory

THE ODOUR UNIT PTY LIMITED

Odour Sample Measurement Results

Sample Location	TOU Sample ID	Sampling Date & Time	Analysis Date & Time	Pane Size	Valid ITEs	Nominal Sample Dilution	Actual Sample Dilution (Adjusted for Temperature)	Sample Odour Concentration (as received, in the bag) (ou)	Sample Odour Concentration (Final, allowing for dilution) (ou)	Odour Character
Stack #1	SC 50432	31/10/2005 10:55	01/11/2005 10:19	4	8	-	-	609	609	Garbage
Stack #2	SC 50433	31/10/2005 10:58	01/11/2005	4	8	-	-	558	558	Garbage
Stack #3	SC 50434	31/10/2005 11:02	01/11/2005 10:49	4	8	-	-	558	558	Garbage
Stack #4	SC 50435	31/10/2005 11:05	01/11/2005 11:14	4	8	-	-	609	609	Garbage
Stack #5	SC 50436	31/10/2005 11:08	01/11/2005 11:48	4	8	-	-	558	558	Garbage
Stack #6	SC 50437	31/10/2005 11:10	01/11/2005 12:14	4	8	-	-	512	512	Garbage

Odour Panel Calibration Results

Reference Odorant	Reference Odorant Panel Roster Number	Concentration of Reference gas (ppb)	Panel Target Range for n-butanol (ppb)	Measured Concentration (ou)	Measured Panel Threshold (ppb)	Does this panel calibration measurement comply with AS/NZS4323.3:2001 (Yes / No)
n-butanol	SYD20051101_080	51,000	$20 \leq \chi \leq 80$	724	68	Yes

Comments Sample for Stack 2 was lost. Result shown was geometric mean of the results for the other five stacks.

Disclaimer Parties, other than TOU, responsible for collecting odour samples hereby certify that they have voluntarily furnished these odour samples, appropriately collected and labelled, to The Odour Unit Pty Limited for the purpose of odour testing. The collection of odour samples by parties other than The Odour Unit Pty Limited relinquishes The Odour Unit Pty Limited from all responsibility for the sample collection and any effects or actions that the results from the test(s) may have.

Note This report shall not be reproduced, except in full, without written approval of The Odour Unit Pty Limited.

END OF DOCUMENT

Veolia Environmental Services (Aust.) Pty Limited

Odour Mitigation Study

Clyde Waste Transfer Terminal

Second Addendum to Final Report

August 2007

THE ODOUR UNIT PTY LTD

ACN 091 165 061
Suite G03, Bay 16
Locomotive Workshop Building
Australian Technology Park
Locomotive St, Eveleigh, NSW 1430

Project Number: 1230

Report Revision		
Revision Number	**Date**	**Description**
Draft (Version 1)	21.12.2005	Draft Report for Review by Collex Pty Ltd
Final	13.02.2006	Final Report for Collex Pty Ltd
1st Addendum to Final Report	17.07.2006	Addendum to Final Report For Collex Pty Ltd
2ND Addendum to Final Report	27.08.2007	Second Addendum to Final Report For Veolia Environmental Services

Report Preparation	
Report Prepared By: S. Hayes, T. Schulz	Approved By: T. Schulz
Report Title: Veolia Environmental Services (Aust.) Pty Limited – Clyde Transfer Terminal - Odour Mitigation Study	

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1 INTRODUCTION

In February 2006, The Odour Unit Pty Limited (TOU) issued Collex Pty Limited (Collex) with their report *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study*, which presented the findings of an odour sampling and testing study conducted by TOU, and subsequent dispersion modelling to project the likely odour impact in the local area. The atmospheric dispersion modelling study was also used to determine a mitigation strategy based on the release of process emissions from a single tall stack, rather than the six short roof vents currently operating at the Clyde Waste Transfer Terminal. The modelling study analysed different stack configurations including stack height, stack diameter, stack velocity and various building hourly air changes.

In July 2006, an addendum was issued to TOU's February 2006 report: *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study*. The addendum presented the findings of an additional dispersion modelling study outcome where a single scenario was based on the final stack design height and flow.

In June 2007 Veolia Environmental Services (Australia) Pty Limited (VES), who had acquired the Clyde facility from Collex, commissioned a further modelling study examining the relocation of the stack to a new position at the centre of the longitudinal northeast-facing wall of the building.

This report is a second addendum to TOU's February 2006 report: *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study*. This addendum presents findings of four additional dispersion modelling stack operational scenarios where the final design flow rate of the single stack is varied depending on environmental wind direction. The aim is identify operating regimes that have the potential to reduce the Clyde Waste Transfer Terminal power consumption and thus greenhouse gas emissions while achieving ground level odour concentrations that meet the NSW DECC Odour Performance Criteria.

2 THE ODOUR DISPERSION MODEL METHOD, CONFIGURATION AND CRITERIA

The odour dispersion modelling method employed in this additional study for the VES Waste Transfer Terminal at Clyde was similar to that carried out in the previous addendum report *Collex Pty Limited – Clyde Waste Transfer Terminal - Odour Mitigation Study Addendum July 2006*. **Table 2.1** summarises the stack configuration and input into the dispersion model used in this study. **Table 2.2** summarises the scenarios investigated based on proportion of design flow of 109.48m^3/s and wind direction. **Figure 2.1** illustrates the potential impact zones where different flow configurations apply based on two wind direction aspects. The red sector shows the potentially problematic zone when southerly aspect winds including west to north-westerly winds are apparent. The remaining northerly aspect winds are represented by the green sector. **Table 2.3** and **Figure 2.2** summarises the BPIP building coordinate, dimension and stack location configuration.

Table 2.1: Summary of odour dispersion model configuration.

Stack height (metres above ground level)	Stack height (metres above mean roof level)	Stack Diameter (m)	Stack Location X - coordinate	Stack Location Y - coordinate
21	4	2.64	316983.5	6254101.5

Table 2.2: Scenario stack flow exit rate (based on design of 109.48m^3/s)

Scenario	Percentage of design flow Wind directions 90° – 315°	Percentage of design flow Wind directions 316° – 89°
1	100%	0%
2	100%	50%
3	75%	50%
4	50%	50%

It can be seen from **Table 2.2** that only four different wind direction/airflow scenarios were investigated in this study. In reality there are many other combinations of these two parameters that could have been modelled. However, given that the purpose of this study is to assess the viability of the approach involving varying airflows with wind direction, it was felt that the scenarios modelled were sufficient for this purpose.

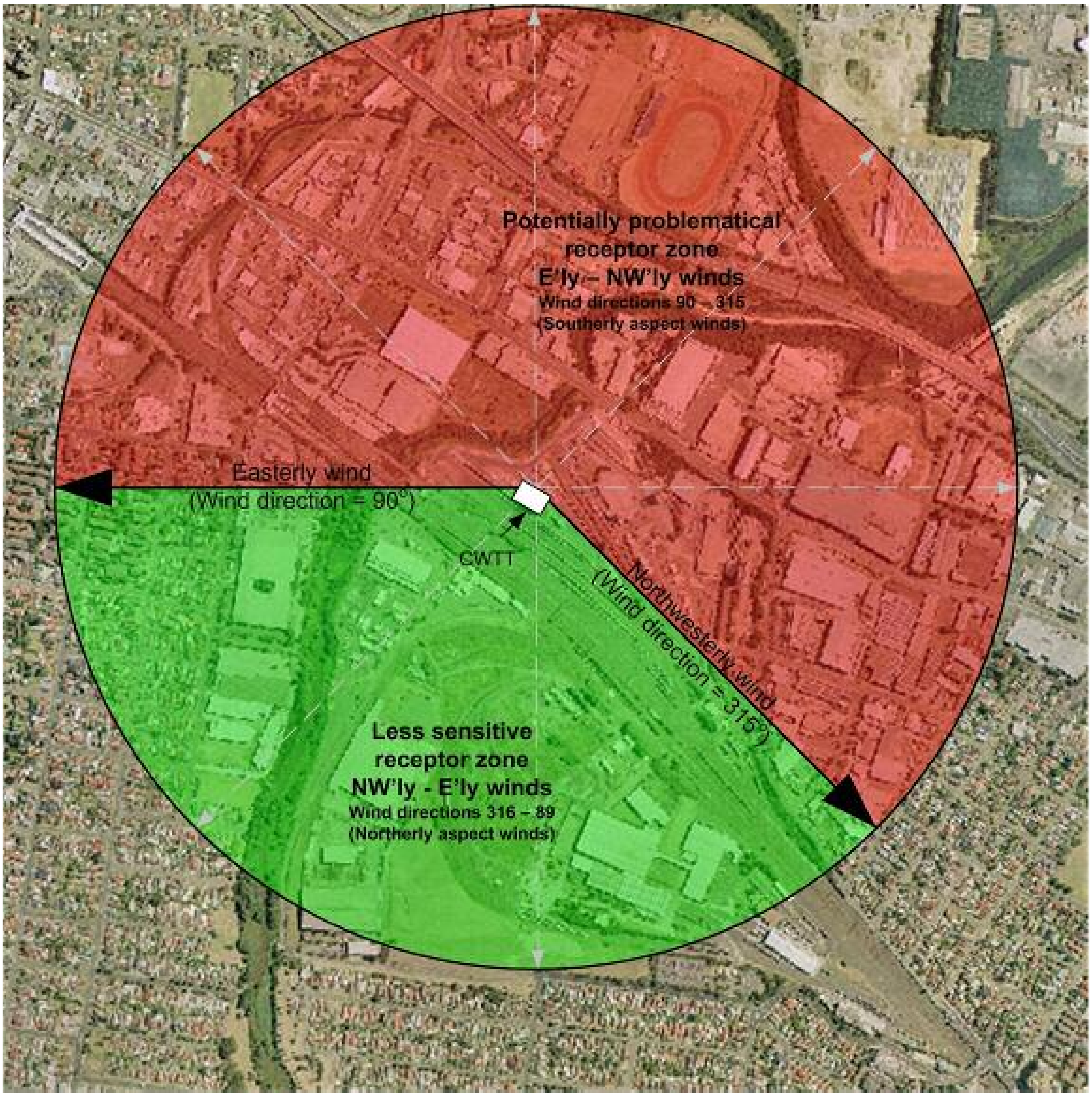

Figure 2.1: Potential impact zones based on wind direction and receptor distance from CWTT. The circumference does not represent the limit of the zones..

Table 2.3: Building corner coordinates input to the BPIP.		
Building corner	**X - coordinate**	**Y - coordinate**
Northwest	316963	6254119
Northeast	317004	6254090
Southeast	316985	6254063
Southwest	316944	6254092

The modelling criteria used in this study was the same as that used in the previous reports, with the AUSPLUME v6.0 model used to project the 1 ou and 2 ou ground level concentration contours at the 99.0th percentile frequency with a 1-second averaging time - 2 ou being the appropriate odour performance criterion for the facility. The same hourly odour emission rate profile was used to reflect the variable volumes of waste material present each hour. The Building Profile Input Program (BPIP) was used to predict the effects of wake turbulence produced by the terminal building.

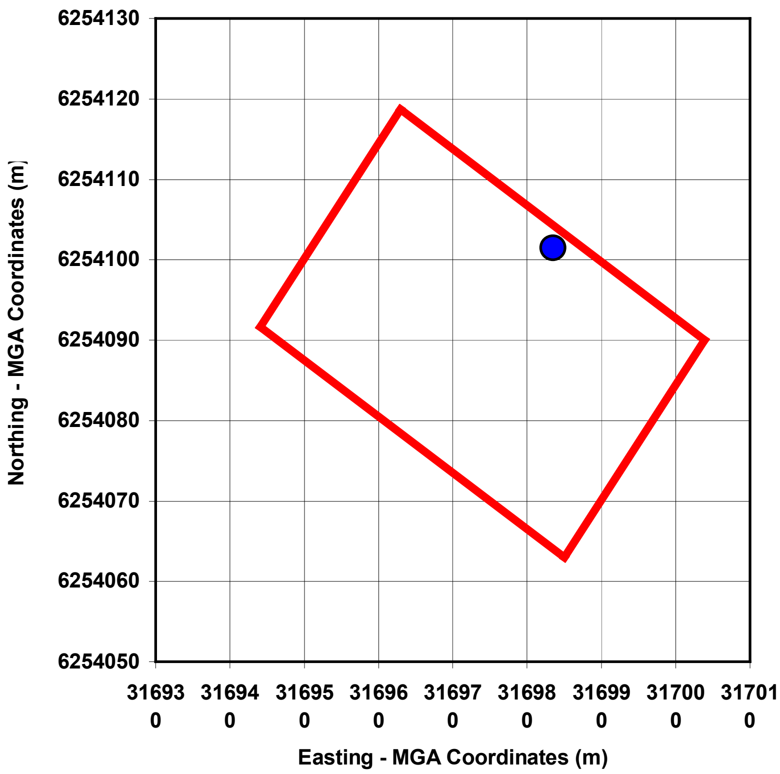

Figure 2.2: VES Waste Transfer Terminal Building and Stack Location as configured in Dispersion Model

3 ODOUR DISPERSION MODELLING RESULTS

The results of this odour dispersion modelling study are presented in **Figure 3.1**, **Figure 3.2**, **Figure 3.3** and **Figure 3.4** for scenarios 1, 2, 3 and 4 respectively.

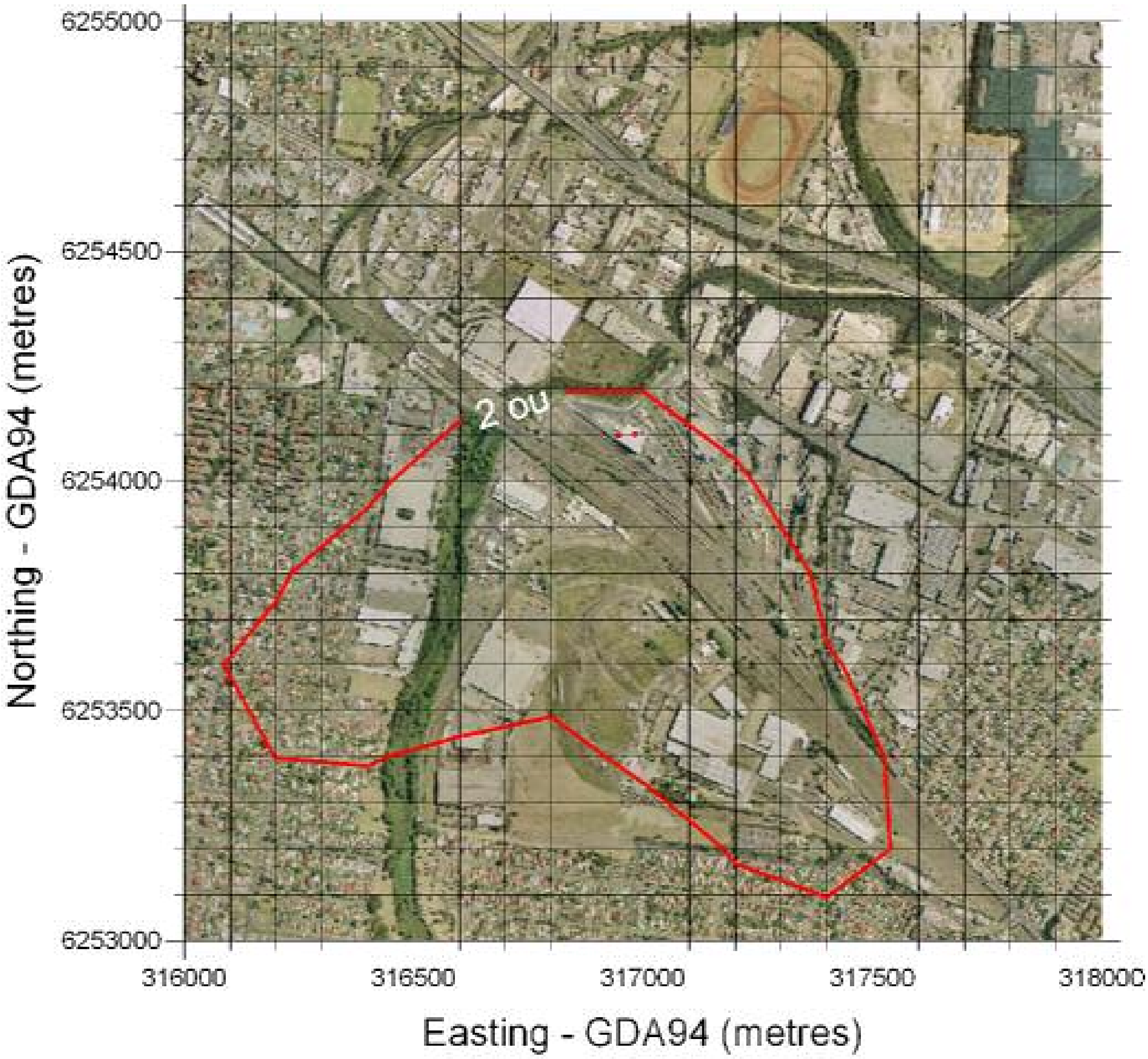

Figure 3.1: Scenario 1 - Projected ground level odour concentration contours for the Veolia ES Waste Transfer Terminal Building at Clyde from a 21m high stack and a 17m high building.

Stack height = 21 m
Stack diameter = 2.64 m
100% design flow rate for wind directions between 90 to 315 degrees
0% design flow rate for wind directions between 316 to 89 degrees
Doorway dimensions (fugitive emissions) = 9m wide x 7m high
Building dimensions modelled (BPIP) = 50m (L) x 33m (W) x 17m (H)
[Building height 17m is mean height between roof eaves and apex above the ground RL]

Legend
2 ou glc = red contour
Stack location = red dot
Doorway location = red square

NSW DECC OPC
2 ou ground level concentration contour
99.0th percentile frequency
1-second averaging

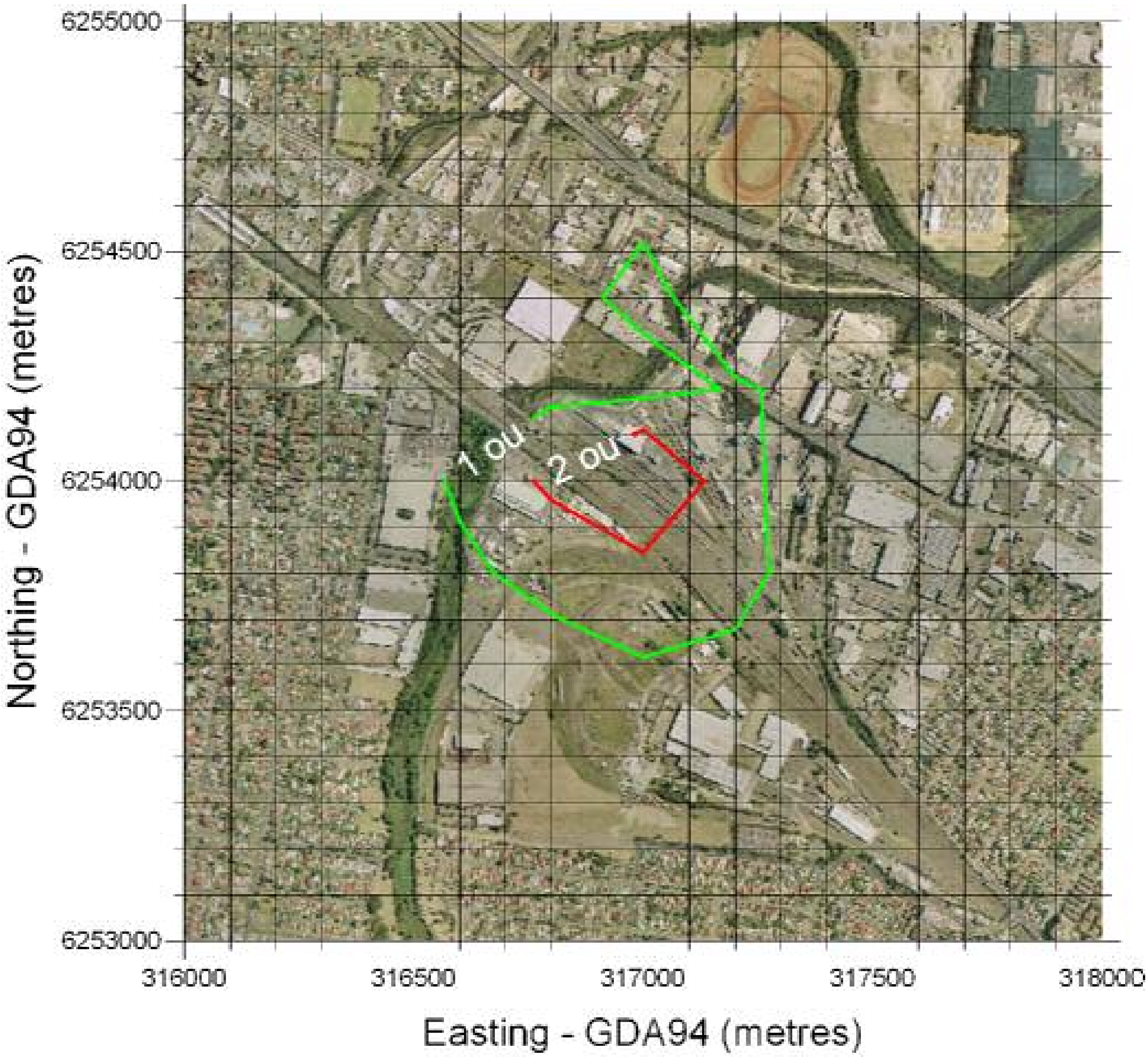

Figure 3.2: Scenario 2 - Projected ground level odour concentration contours for the Veolia ES Waste Transfer Terminal Building at Clyde from a 21m high stack and a 17m high building.

Stack height = 21 m
Stack diameter = 2.64 m
100% design flow rate for wind directions between 90 and 315 degrees
50% design flow rate for wind directions between 316 and 89 degrees
Building dimensions modelled (BPIP) = 50m (L) x 33m (W) x 17m (H)
[Building height 17m is mean height between roof eaves and apex above the ground RL]

Legend
1 ou glc = green contour
2 ou glc = red contour
Stack location = red dot

NSW DECC OPC
2 ou ground level concentration contour
99.0th percentile frequency
1-second averaging

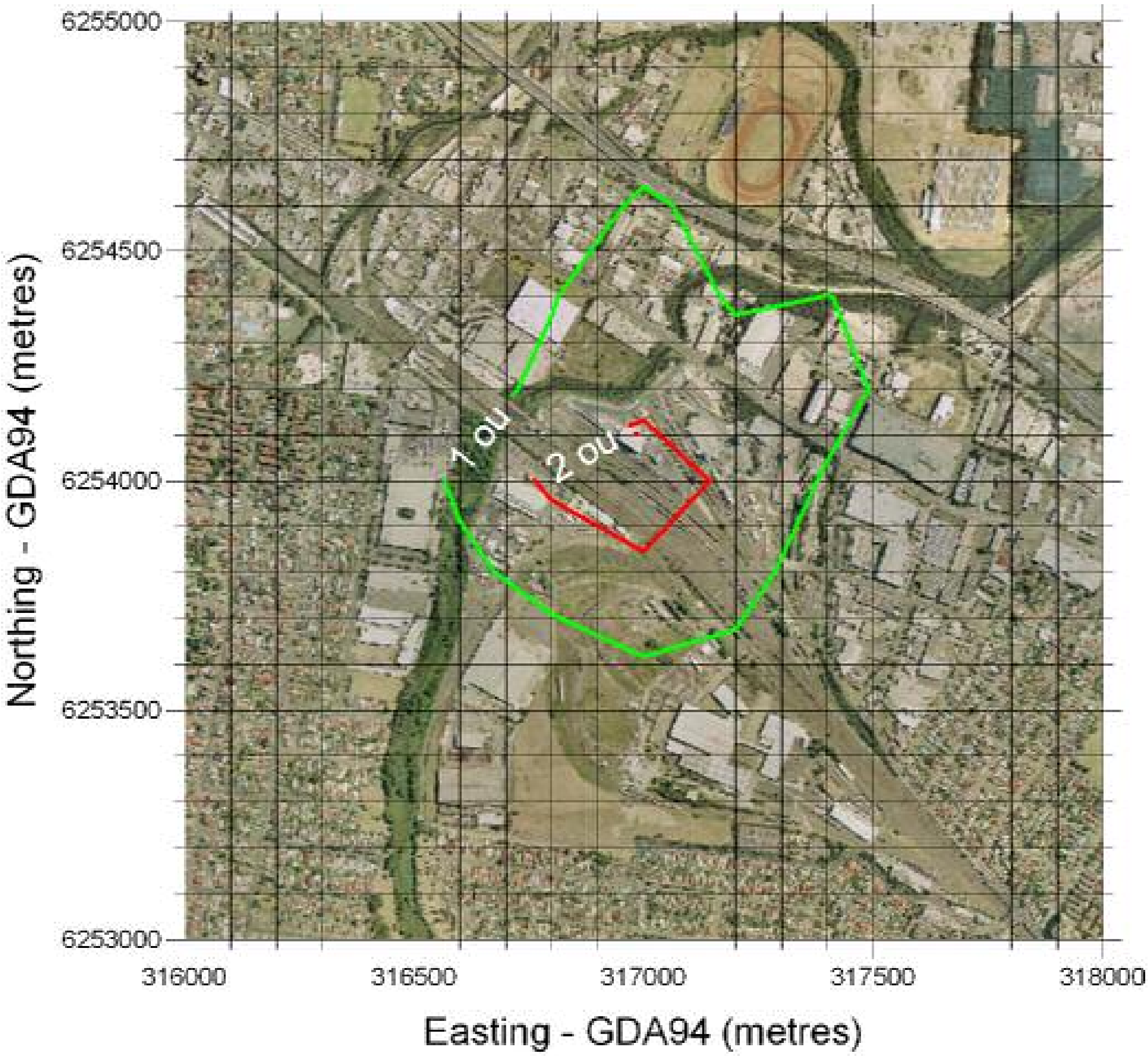

Figure 3.3: Scenario 3 - Projected ground level odour concentration contours for the Veolia ES Waste Transfer Terminal Building at Clyde from a 21m high stack and a 17m high building.

Stack height = 21 m
Stack diameter = 2.64 m
75% design flow rate for wind directions between 90 and 315 degrees
50% design flow rate for wind directions between 316 and 89 degrees
Building dimensions modelled (BPIP) = 50m (L) x 33m (W) x 17m (H)
[Building height 17m is mean height between roof eaves and apex above the ground RL]

Legend
1 ou glc = green contour
2 ou glc = red contour
Stack location = red dot

NSW DECC OPC
2 ou ground level concentration contour
99.0th percentile frequency
1-second averaging

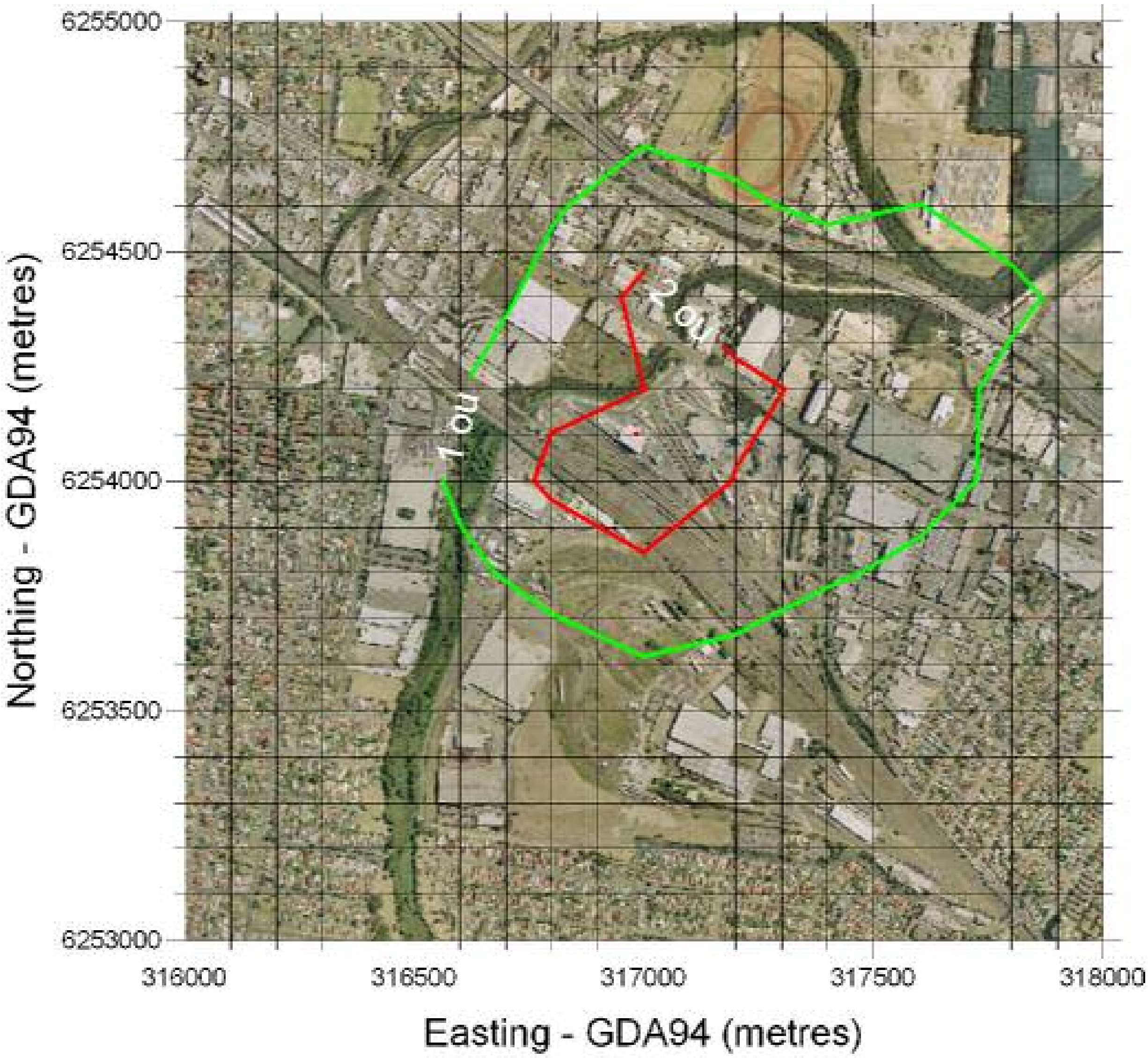

Figure 3.4: Scenario 4 - Projected ground level odour concentration contours for the Veolia ES Waste Transfer Terminal Building at Clyde from a 21m high stack and a 17m high building.

Stack height = 21 m
Stack diameter = 2.64 m
50% design flow rate for all wind directions
Building dimensions modelled (BPIP) = 50m (L) x 33m (W) x 17m (H)
[Building height 17m is mean height between roof eaves and apex above the ground RL]

Legend
1 ou glc = green contour
2 ou glc = red contour
Stack location = red dot

NSW DECC OPC
2 ou ground level concentration contour
99.0th percentile frequency
1-second averaging

4 DISCUSSION OF RESULTS

The results of the dispersion modelling carried in July 2006 out as part of the original design of the ventilation stack at the Clyde facility indicated that a stack 18 metres high and located in the north-western corner of the main building, emitting air at a rate of 87.5 m^3/second would result in ground level odour concentrations that easily complied with the DECC Odour Performance Criterion of 2 ou at the nearest receptor. In subsequent correspondence TOU's recommended that the design of the stack include an additional 3 metres of stack height, as a measure of conservatism in the design. This recommendation was adopted by Collex/Veolia, and the stack was ultimately designed with a total height of 21 metres and an air emission rate of 109.5 m^3/second.

A subsequent investigation in June 2007 showed that the relocation of this 21 m stack to a location mid-point along the northern wall of the building would achieve similar compliance with the DECC Odour Performance Criterion.

This current investigation has examined the possibility of adjusting air discharge rates, by decreasing fan speeds, as a means of decreasing power consumption and thus greenhouse gas emissions, while adhering to the NSW DECC Odour Performance Criterion. The concept was initially developed on the basis that the stack height selected was greater than theoretically needed, and therefore was likely to be able to achieve the required level of plume dispersion at lower airflows than originally modelled.

The results of the modelling confirm the hypothesis that lower-than-design airflows are possible under certain wind conditions. When assessed against the DECC 2 ou Odour Performance Criterion at the nearest sensitive receptor, the scenario depicted in Figure 3.3, representing decreasing stack airflows to 75% and 50% of design flows during winds from 90 to 315 degrees and 316 to 89 degrees respectively, can be seen to represent a viable operational regime for the Clyde facility. Not surprisingly, it was also found that 100 percentile and 50 percentile airflows in these directions also achieved a satisfactory level of odour dispersion (Figure 3.2). Decreasing the airflow under all wind vector conditions to 50% (Figure 3.4) predicted unacceptable odour impacts to the north and northeast of the facility, as did the scenario depicted in Figure 3.1, where the fan operated at full speed except when turned off entirely under 316 to 89 degree wind conditions. This scenario also allowed for all odours to exit the doorway as fugitive emissions when the fan was not operating.

As a result of the findings of this modelling study it is recommended that Veolia seek approval to undertake a trial period of fan operation during which the viability of variable ventilation airflows could be assessed. At this stage it is recommended that such a trial should not involve airflows less than 50% of design, in the interests of minimising the tendency for fugitive odour releases through the main truck access opening in the building. These are considered to have little likelihood of impacting in the community at airflows of 50% and above. Should the initial trial be successful it could then be extended to assess the potential for lower airflows.