VISY ALEXANDRIA

AIR QUALITY IMPACT ASSESSMENT

A C O U S T I C S A N D A I R

REPORT NO. 19056-AQ
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PREPARED FOR

BUILD RUN REPAIR
LEVEL 11, 2 SOUTHBANK BOULEVARD
SOUTHBANK VIC 3006

WILKINSON MURRAY

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GLOSSARY OF AIR QUALITY TERMS

Air Pollution – The presence of contaminants or pollutant substances in the air that interfere with human health or welfare, or produce other harmful environmental effects.

Air Quality Standards – The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

Air Toxics – Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e. excluding ozone, carbon monoxide, PM-10, sulphur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne Particulates – Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Sources of airborne particulates include dust, emissions from industrial processes, combustion products from the burning of wood and coal, combustion products associated with motor vehicle or non-road engine exhausts, and reactions to gases in the atmosphere.

Area Source – Any source of air pollution that is released over a relatively small area, but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest that releases hydrocarbons, may be referred to as nonpoint source.

Concentration – The relative amount of a substance mixed with another substance. Examples are 5 ppm of carbon monoxide in air and 1 mg/l of iron in water.

Emission – Release of pollutants into the air from a source. We say sources emit pollutants.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory – A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Flow Rate – The rate, expressed in gallons -or litres-per-hour, at which a fluid escapes from a hole or fissure in a tank. Such measurements are also made of liquid waste, effluent, and surface water movement.

Fugitive Emissions – Emissions not caught by a capture system.

Hydrocarbons (HC) – Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulphide (H_2S) – Gas emitted during organic decomposition. Also, a by-product of oil refining and burning. Smells like rotten eggs and, in heavy concentration, can kill or cause illness.

Inhalable Particles – All dust capable of entering the human respiratory tract.

Nitric Oxide (NO) – A gas formed by combustion under high temperature and high pressure in an internal combustion engine. NO is converted by sunlight and photochemical processes in ambient air to nitrogen oxide. NO is a precursor of ground-level ozone pollution, or smog.

Nitrogen Dioxide (NO_2) – The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen Oxides (NO_x) – A criteria air pollutant. Nitrogen oxides are produced from burning fuels, including gasoline and coal. Nitrogen oxides are smog formers, which react with volatile organic compounds to form smog. Nitrogen oxides are also major components of acid rain.

Mobile Sources – Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers.

Particulates; Particulate Matter (PM-10) – A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Parts Per Billion (ppb)/Parts Per Million (ppm) – Units commonly used to express contamination ratios, as in establishing the maximum permissible amount of a contaminant in water, land, or air.

PM10/PM2.5 – PM10 is measure of particles in the atmosphere with a diameter of less than 10 or equal to a nominal 10 micrometers. PM2.5 is a measure of smaller particles in the air.

Point Source – A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.

Scrubber – An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Source – Any place or object from which pollutants are released.

Stack – A chimney, smokestack, or vertical pipe that discharges used air.

Stationary Source – A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Temperature Inversion – One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Pollutants, especially smog and smog-forming chemicals, including volatile organic compounds, are trapped close to the ground. As people continue driving and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

1 INTRODUCTION

Wilkinson Murray Pty Limited has been engaged by Build Run Repair, on behalf of Visy, to prepare an Air Quality Impact Assessment (AQIA) for a proposed Dry Recyclables Facility (DRF) at 112 Euston Road, Alexandria. An existing facility is to be relocated from 6-10 Burrows Road, St Peters to 112-120 Euston Road, Alexandria (the site) as stage 1. A new material recovery facility (MRF) will be added as stage 2.

The new Resource Recovery Facility in Alexandria is proposed to receive and process up to 155,000 tonnes per annum of commingled recyclable materials, from kerbside collections, and source-separated cardboard and paper from commercial collections. Truck entry and exit points of the new site are to be located on Burrows Road, on the east side of the site.

The Project was declared to be a State Significant Development (SSD). Assessment and approval is being pursued in accordance with the EP&A Act. The Secretary's Environmental Assessment Requirements (SEARs) for the Project have been issued and set out the environmental assessment requirements for the Project.

This AQIA has been prepared to address the relevant SEARs in relation to the preparation of the Environmental Impact Statement (EIS) for the project, and was conducted in general accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

This AQIA assesses potential off-site air quality impacts from the combined operation of stage 1 and stage 2 of the development.

2 PROJECT DESCRIPTION

2.1 Site Description

The site is located at 112 Euston Road, Alexandria, as shown in Figure 2-1. The site covers approximately 12,600 m^2 of land and has two existing buildings. The site has dual frontage to Euston Road and Burrows Road. Truck access for the Proposal is via Burrows Road.

Figure 2-1 Site Location

2.2 Surrounding Land Use and Sensitive Receptors

The land use immediately surrounding the site is industrial. The nearest and most potentially affected existing residential receptors near the site are located approximately 250 metres to the north along Sydney Road, Erskineville and approximately 600 metres to the south west on Campbell Street, Alexandria. It is understood that the parcel of land at 205-225 Euston Road, which is currently used for commercial purposes, is proposed to be redeveloped to include residential uses. Therefore, this parcel of land has been included in the assessment. Additionally, for assessment purposes, the parklands to the west of the site and the childcare centre to the north of the site are identified as sensitive receptors. Industrial land uses surrounding the site are not identified as sensitive receptors for the purposes of this assessment, however the predicted air quality impacts at these locations have been presented by way of the contour plots in Appendix A.

The most potentially affected receptors are shown in Figure 2-2.

Figure 2-2 Sensitive Receptors

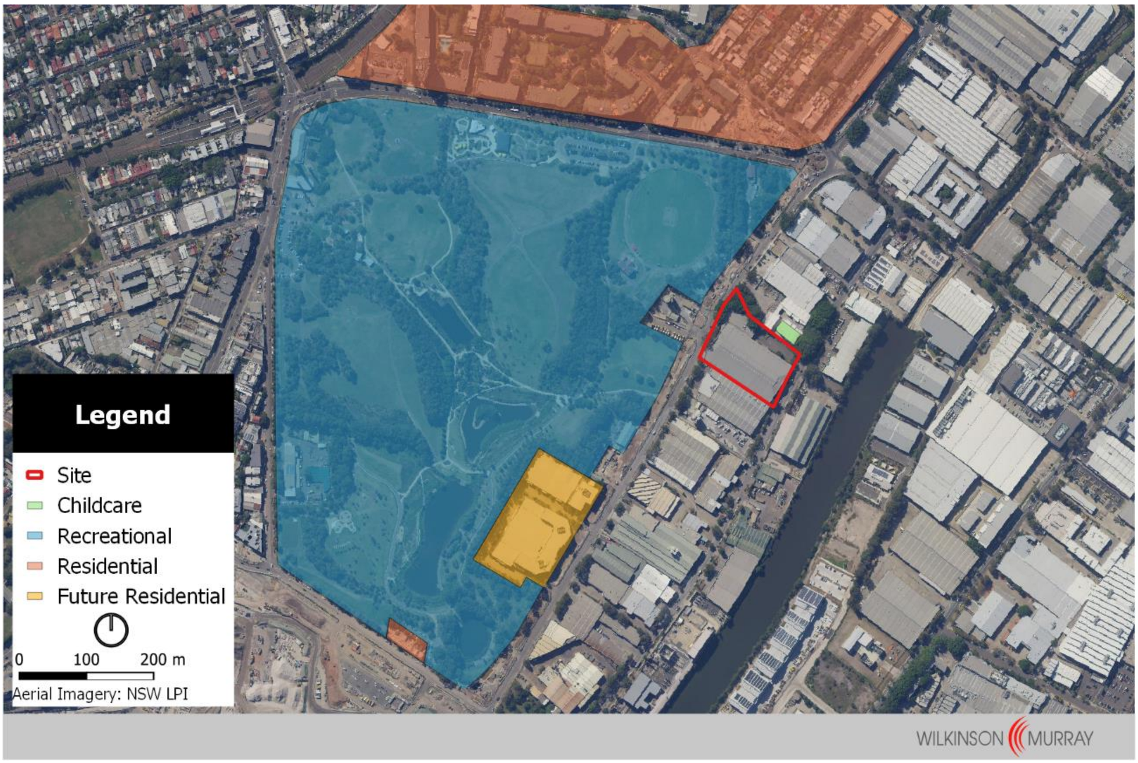


Table 2-1 presents discrete locations representative of the most affected location for each receptor.

Table 2-1 Discrete Receptors

Receptor	MGA56 Coordinates (m)	
	X	Y
Childcare	332,639	6,246,298
Sydney Road Residences	332,594	6,246,595
Campbell Street Residences	332,091	6,245,830
Euston Road Residences	332,310	6,246,108
Parkland	332,461	6,246,288

2.3 Proposal Overview

Stage 1 of the proposed facility will comprise the relocation of an existing Visy recyclable material transfer facility (TRF) and cardboard and paper baling (Baling) operation from 6-10 Burrows Road South, St Peters to the site. Stage 2 of the proposed facility will comprise a Materials Recovery Facility (MRF) anticipated to occur within a few years as dictated by market and business needs. An overview of the operation under stage 1 and stage 2 is shown in Table 2, highlighting operational changes between the two stages.

Under stage 1 operation, all incoming FCM (up to 110,000 tpa) will be consolidated into bulk haul trucks and dispatched daily to Visy's network of MRFs for processing. Source-separated cardboard and paper (up to 45,000 tpa) will be consolidated by baling machine and dispatched daily to Visy's recycled paper machines elsewhere for remanufacture.

The stage 1 TRF has been designed to receive kerbside FCM from around 90 kerbside collection trucks daily Monday to Friday typically between 6am and 4pm, in line with council kerbside collection rounds. Transfer station dispatch of consolidated FCM offsite in bulk haul trucks is planned to occur 24 hours 7 days per week to meet the needs of maintaining FCM storage capacity and onsite residence time, ideally less than 24 hours and up to 48 hours. The night-time and weekend operation will primarily be limited to outgoing bulk haul trucks which dispatch consolidated FCM. The stage 1 operation workforce will be around 20 staff in total, including the TRF and Baling operation. The night-time operation between 10pm to 6 am will involve a 'skeleton' crew of 2 staff. In addition, about 8 Visy management staff will utilise the site office typically during daytime hours Monday to Friday with some presence at other times as required.

The Baling operation will receive loose paper/cardboard from around 55 commercial collection trucks daily throughout the day, primarily across weekdays with some weekend deliveries as required by collection rounds. The baling machine will typically operate 5 days per week between 6am to 10pm but may also operate on weekends as required. Dispatch of baled paper/cardboard in bulk haul trucks will occur 24 hours, 7 days per week to meet the needs of maintaining paper/cardboard storage capacity.

Under stage 2 MRF, all incoming FCM (up to 110,000 tpa) will be either processed through the MRF into separate recyclable material streams (paper, plastics, metals, glass) and dispatched to local and export markets, or consolidated into bulk haul trucks through the TRF and dispatched to Visy's network of MRFs for processing. The MRF operation is sized to process about 70% of FCM (up to about 80,000 tpa) operating 16 hours per day, 5 days per week. The TRF and Baling operation and operation hours will not change, albeit the TRF dispatch volume of FCM should decrease to about 30,000 tpa. The stage 2 workforce will be around 30 operation staff in total. The night-time operation between 10pm to 6 am will involve a 'skeleton' crew of 2 staff. In addition, about 8 staff will utilise the office.

Table 2.1. Operations summary for stage 1 of the proposed facility.

Operation	Incoming material	Incoming trucks	Operations	Outgoing material	Outgoing trucks	Hours / Staff
TRF	Up to 110,000 tpa FCM.	Up to about 90 daily with largest volumes in waves between 6:00am -4:00pm as council trucks discharge FCM loads.	Consolidation of FCM into bulk haul trucks (to allow kerbside trucks to return to their collection rounds).	Daily consolidated FCM to Visy's network of MRFs for processing.	Up to about 19 daily bulk haul trucks primarily during evening and night hours 4:00pm to 5:00am.	24 hrs to accommodate outgoing bulk haul trucks.
	No putrescible, organic or hazardous materials accepted.		Inspection of FCM in receival bay and removal of large or hazardous contaminants to onsite waste.	Unacceptable material as required to approved facility for disposal.	As required.	
Baling	Up to 45,000 tpa source separated cardboard and paper.	Up to about 55 daily throughout the day.	Consolidation via baling machine into strapped bales.	Daily baled cardboard to Visy's network of recycled paper facilities for remanufacture.	Daily up to about 7 semi-trailer trucks across day and night time hours.	

Table 2.2. Overview of operations for stage 2 of the development (orange elements are changes to operation due to the inclusion of a MRF)

Operation	Incoming material	Incoming trucks	Operations	Outgoing material	Outgoing trucks	Hours / Staff
MRF and TRF	Up to 110,000 tpa FCM.	Up to about 90 daily with largest volumes in waves between 6:00am -4:00pm as council trucks discharge FCM loads.	Processing of up to 72% of FCM into separated material streams of paper, cardboard, plastics, steel, aluminium and glass. Residual non-recyclable contamination isolated.	Daily baled paper/cardboard to Visy's network of recycled paper machines for remanufacture. As required baled plastics, steel and aluminium to local and export markets. Daily glass to local and export markets	Up to about 19 daily bulk haul trucks primarily during evening and night hours 4:00pm to 5:00am.	24 hrs to accommodate outgoing bulk haul trucks.
			Consolidation of unprocessed percentage of FCM into bulk haul trucks for transfer to Visy's other MRFs.	Daily excess consolidated FCM to Visy's network of MRFs.		
	No putrescible, organic or hazardous materials accepted		Inspection of FCM in receival bay and removal of large or hazardous contaminants to onsite waste.	Unacceptable and residual waste as required to approved facility for disposal.	As required.	
Baling	All aspects as for stage 1.					

3 AIR QUALITY CRITERIA

3.1 Introduction

The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016) sets out applicable impact assessment criteria for a number of air pollutants.

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the pollutants of interest in this study and the application of air quality criteria for each pollutant.

3.2 Pollutants of Interest

The primary sources of air pollutants associated with the Project are the exhaust emissions from trucks and mobile plant operating within the building. Trucks and mobile plant operating within the building would run on diesel fuel. Air pollutants associated with diesel exhaust comprise:

- Particulate matter;
- Nitrogen dioxide;
- Carbon monoxide;
- Sulfur dioxide; and,
- Volatile organic compounds.

The incoming material to the facility is generally clean and not odorous. However, on occasion, incoming material may be contaminated by odorous waste. Under these circumstances, the contaminated material would be cleaned up immediately. Nevertheless, an assessment of odorous emissions from the facility has been conducted to identify the potential off-site odour impacts in the rare event of contaminated materials being received.

3.3 Impact Assessment Criteria

3.3.1 Criteria Pollutants

Dust and particulate matter, nitrogen dioxide, carbon monoxide and sulfur dioxide are among a group of air pollutants referred to as "criteria pollutants" in the Approved Methods. The impact assessment criteria for criteria pollutants relevant to the Proposal are presented in Table 3-1.

The criteria in Table 3-1 relate to the total concentrations of pollutants in the air and not just that from the Proposal. Therefore, some consideration of background levels needs to be made when assessing the air quality impacts from the Proposal.

Table 3-1 Impact assessment criteria – criteria pollutants

Pollutant	Averaging period	Impact	Criteria
Particulate matter ≤10 µm (PM_{10})	Annual	Total	25 µg/m³
	24 hours	Total	50 µg/m³
Particulate matter ≤2.5 µm ($PM_{2.5}$)	Annual	Total	8 µg/m³
	24 hours	Total	25 µg/m³
Nitrogen dioxide (NO_2)	1 hour	Total	246 µg/m³
	Annual	Total	62 µg/m³
Carbon Monoxide (CO)	15 minutes	Total	100 mg/m³
	1 hour	Total	30 mg/m³
	8 hours	Total	10 mg/m³
Sulfur dioxide	10 minutes	Total	712 µg/m³
	1 hour	Total	570 µg/m³
	24 hours	Total	228 µg/m³
	Annual	Total	60 µg/m³

3.3.2 VOC

Volatile organic compounds (VOCs) are a group of organic chemical compounds with high vapour pressures at room temperature. VOCs are typically not acutely toxic; however, some VOCs can cause chronic health effects from long-term exposure and some VOCs are odorous. The Approved Methods specifies impact assessment criteria for several individual VOCs. Table 3-2 presents the impact assessment criteria for individual VOCs identified within diesel engine exhausts.

Table 3-2 Impact Assessment Criteria – VOC

Substance	Averaging period	Criteria	
		mg/m³ [a]	ppm
Benzene	1 hour	0.029	0.009
1,3-butadiene	1 hour	0.04	0.018
Formaldehyde	1 hour	0.02	0.018
Polycyclic aromatic hydrocarbon (as benzo[a]pyrene)	1 hour	0.0004	N/A
Acetaldehyde	1 hour	0.042	0.023
Toluene	1 hour	0.36	0.09
Xylenes	1 hour	0.19	0.04

a. Gas volumes are expressed at 25°C and at an absolute pressure of 1 atmosphere (101.325 kPa)

The impact assessment criterion in Table 3-2 are to be applied at the most affected points at and beyond the boundary of the facility and are to be reported as the 99.9th percentile of the dispersion model predictions.

The impact assessment criterion in Table 3-2 apply to the total concentration of pollutants in the air. However ambient concentrations of the pollutants in Table 3-2 are typically negligible.

3.3.3 Odour

NSW legislation prohibits emissions that cause offensive odour to occur at any off-site receptor. Offensive odour is evaluated in the field by authorised officers, who are obliged to consider the odour in the context of its receiving environment, frequency, duration, character and so on and to determine whether the odour would unreasonably interfere with the comfort and repose of the normal person. In this context, the concept of offensive odour is applied to operational facilities and relates to actual emissions in the air.

However, in the approval and planning process for proposed new operations or modifications to existing projects, no actual odour exists and it is necessary to consider hypothetical odour. In this context, odour concentrations are used and are defined in odour units. The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus, by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

The range of a person's ability to detect odour varies greatly in the population, as does their sensitivity to the type of odour. Therefore, there can be a wide range of variability in the way odour response is interpreted.

It should be noted that odour refers to complex mixtures of odours, and not "pure" odour arising from a single chemical. Odour from a single, known chemical very rarely occurs (when it does, it is best to consider that specific chemical in terms of its concentration in the air). In most situations, odour will be comprised of a cocktail of many substances that is referred to as a complex mixture of odorous pollutants, or more simply odour.

For developments with potential for odour it may be necessary to predict the likely odour impact that may arise. This is done by using air dispersion modelling which can calculate the level of dilution of odours emitted from the source at the point that it reaches surrounding receptors. This approach allows the air dispersion model to produce results in terms of odour units.

The NSW criteria for acceptable levels of odour range from 2 to 7 OU, with the more stringent 2 OU criteria applicable to densely populated urban areas and the 7 OU criteria applicable to sparsely populated rural areas, as outlined below.

Table 3-3 presents the relevant impact assessment criteria for complex mixtures of odorous pollutants.

Table 3-3 Impact assessment criteria – complex mixtures of odorous pollutants

Population of affected community	Impact assessment criteria (OU)*
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Note: * 99th percentile nose-response time.

Odour sensitive receptors near the Proposal are located in an urban setting. Therefore, an odour impact assessment criterion of 2.0 OU/m^3 has been adopted for the Proposal.

4 EXISTING ENVIRONMENT

4.1 Local Meteorology

Meteorological conditions strongly influence air quality. Most significantly, wind speed, wind direction, temperature, relative humidity, and rainfall affect the dispersion of air pollutants, and are key inputs into dispersion models. The following sub-sections discuss the local meteorology near the Proposal site and identify a representative set of meteorological data for use in the dispersion modelling to be undertaken for this assessment.

4.1.1 Long Term Climate

Long term meteorological data for the area surrounding the site is available from the Sydney Airport weather station operated by the Bureau of Meteorology (BoM). The Sydney Airport weather station is located approximately 4 km south-west of the Site and records observations of a number of meteorological data include wind speed, wind direction, temperature, humidity and rainfall.

Long-term climate statistics are presented in Table 4-1. Temperature data recorded at the Sydney Airport weather station indicates that January is the hottest month of the year, with a mean daily maximum temperature of 26.7°C. July is the coolest month with a mean daily minimum temperature of 7.3°C. June is the wettest month with an average rainfall of 125 mm falling over 9 days. There are, on average, 96 rain days per year, delivering 1,081 mm of rain.

Table 4-1 Climate Averages for Sydney Airport

Obs.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Observations													
Temp (°C)	22.4	22.3	21.1	18.2	14.6	11.9	10.8	12.5	15.7	18.4	19.9	21.6	17.4
Hum (%)	70	73	73	71	73	74	71	65	62	61	64	66	69
3pm Mean Observations													
Temp (°C)	24.8	24.8	23.9	21.7	19.0	16.6	16.1	17.2	19.0	20.7	22.1	23.9	20.8
Hum (%)	60	63	61	59	58	57	52	49	51	54	56	58	57
Daily Minimum and Maximum Temperatures													
Min (°C)	19.0	19.1	17.6	14.3	11.0	8.7	7.3	8.2	10.6	13.3	15.5	17.6	13.5
Max (°C)	26.7	26.5	25.4	23.0	20.2	17.6	17.2	18.4	20.7	22.7	24.2	25.9	22.4
Rainfall													
Rain (mm)	94.5	111.1	117.9	106.8	95.1	125.3	68.6	75.7	60.0	70.6	80.6	73.6	1081.1
Rain (days)	8.1	8.6	9.4	8.4	8.3	8.9	6.6	6.7	6.8	7.9	8.3	7.8	95.8

4.1.2 Wind

Wind data from Sydney Airport weather station has been incorporated into the dispersion modelling for this assessment.

Figure 4-1 to Figure 4-6 present annual and seasonal "wind rose" plots for the Sydney Airport weather station for the period 2014 to 2018, inclusive. The plots show similar patterns of wind speed and wind direction over the five-year period, with north-easterly winds being prevalent in summer and spring and north westerly winds being prevalent in autumn and winter. Wind speed and wind direction during 2015 are generally representative of the five-year period and have therefore been adopted for modelling purposes.

Figure 4-1 Sydney Airport Wind Roses, 2014

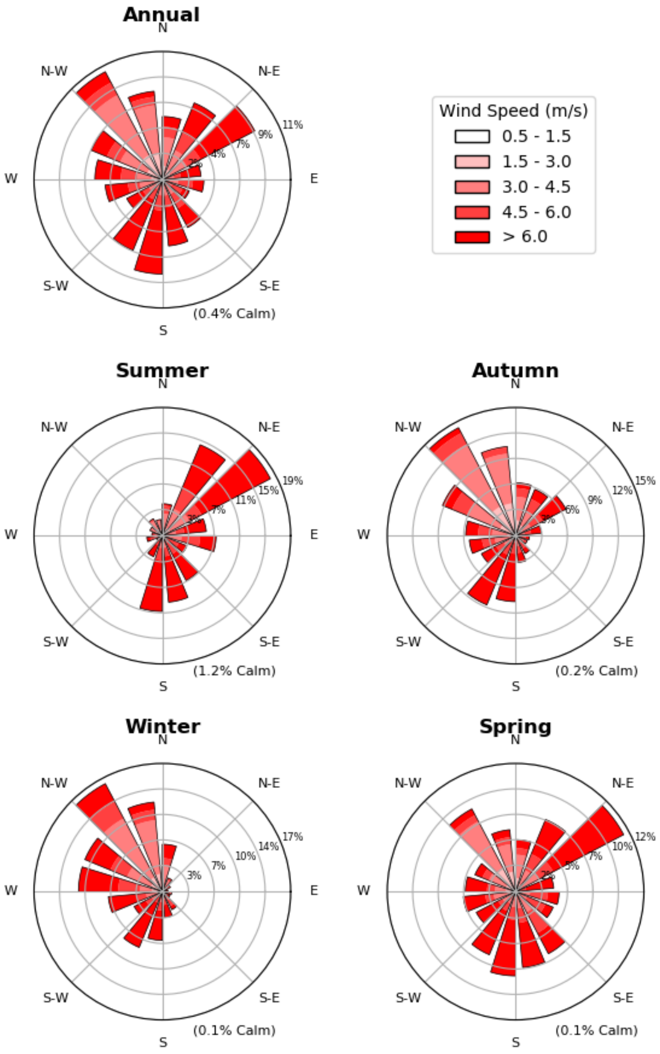


Figure 4-2 Sydney Airport Wind Roses, 2015

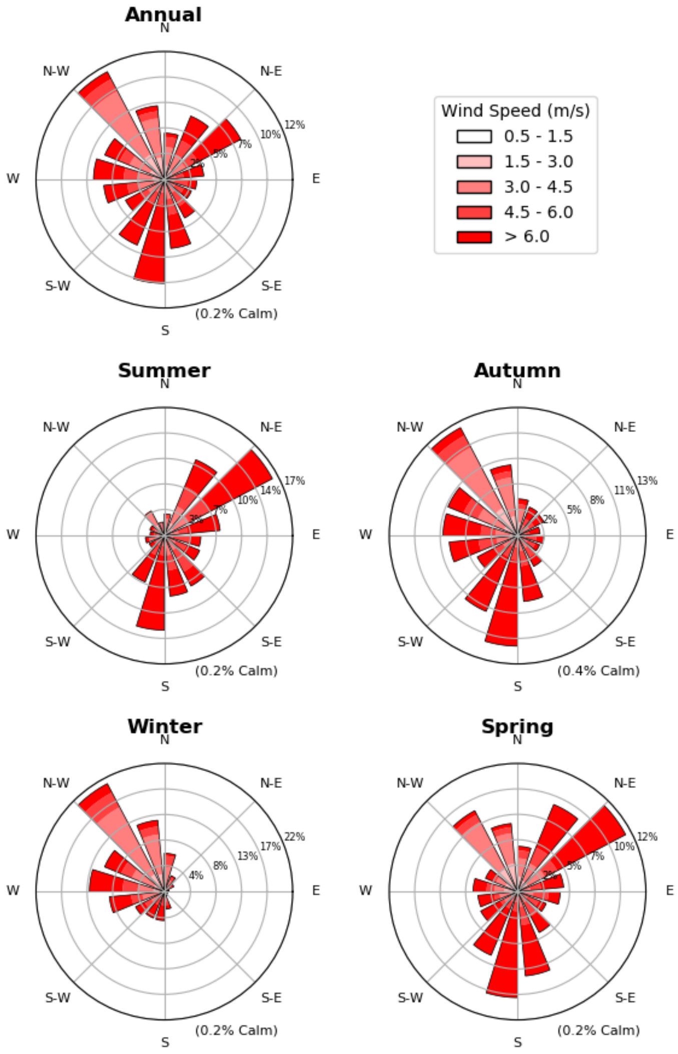


Figure 4-3 Sydney Airport Wind Roses, 2016

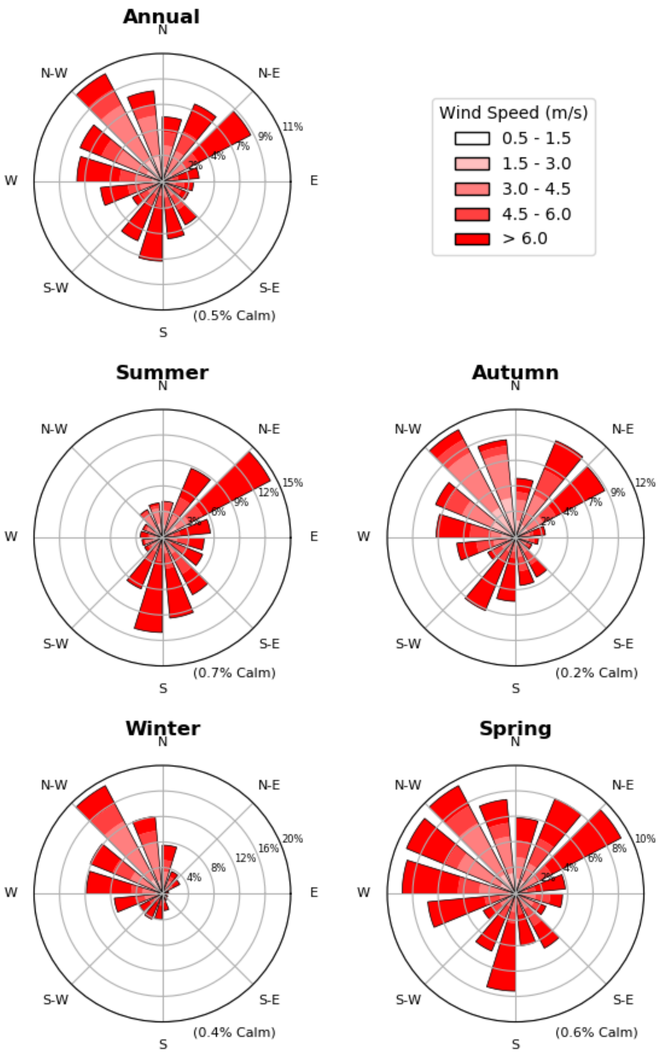


Figure 4-4 Sydney Airport Wind Roses, 2017

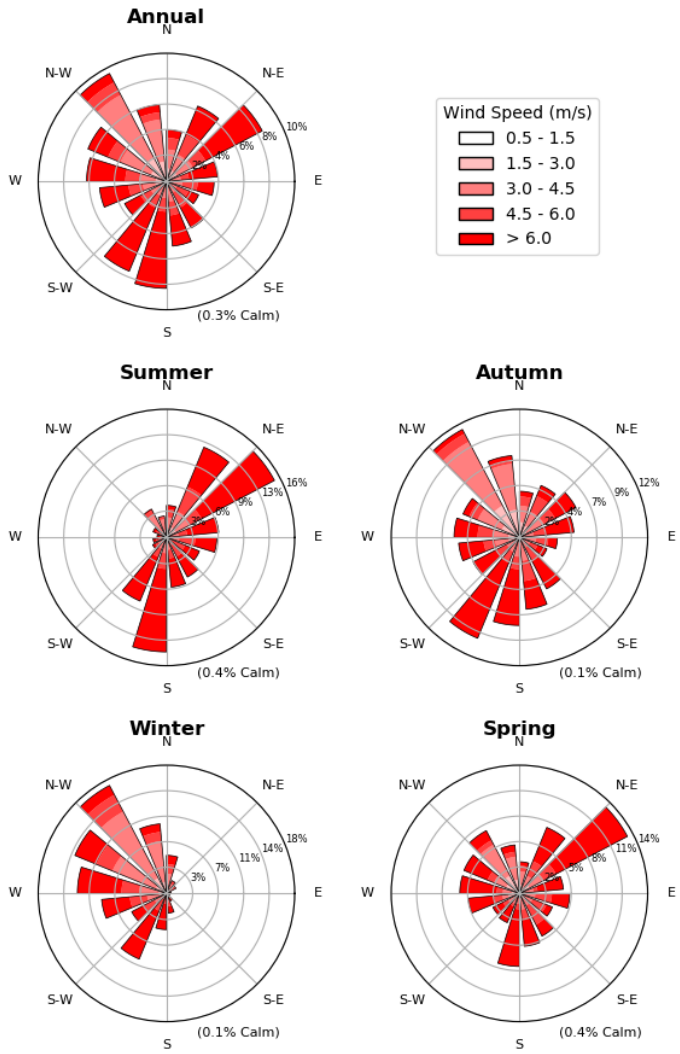


Figure 4-5 Sydney Airport Wind Roses, 2018

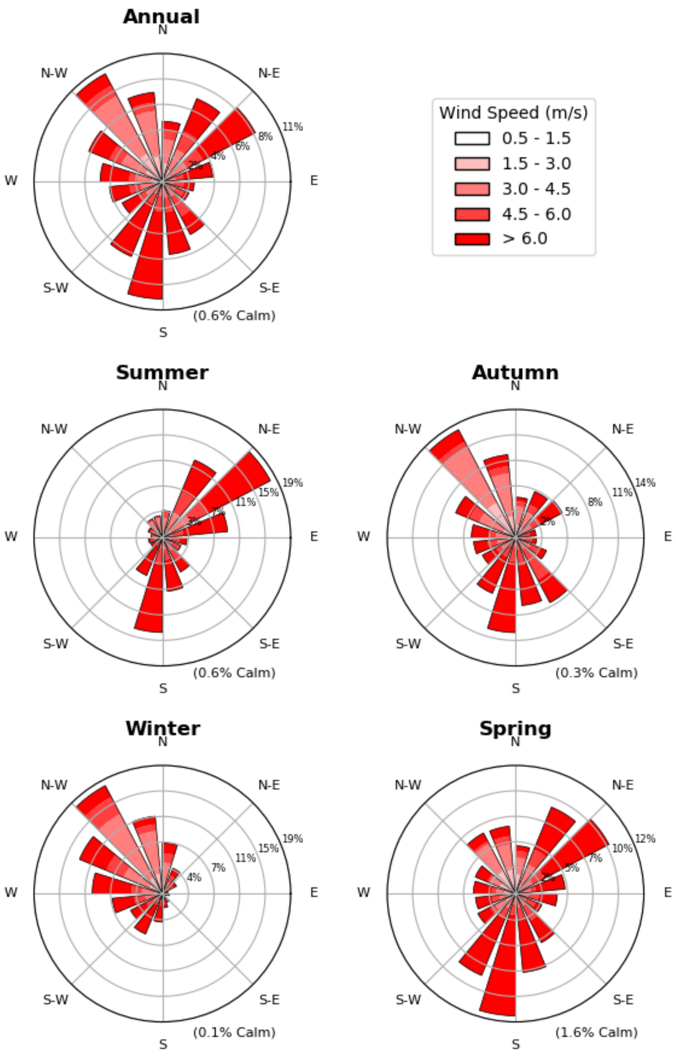
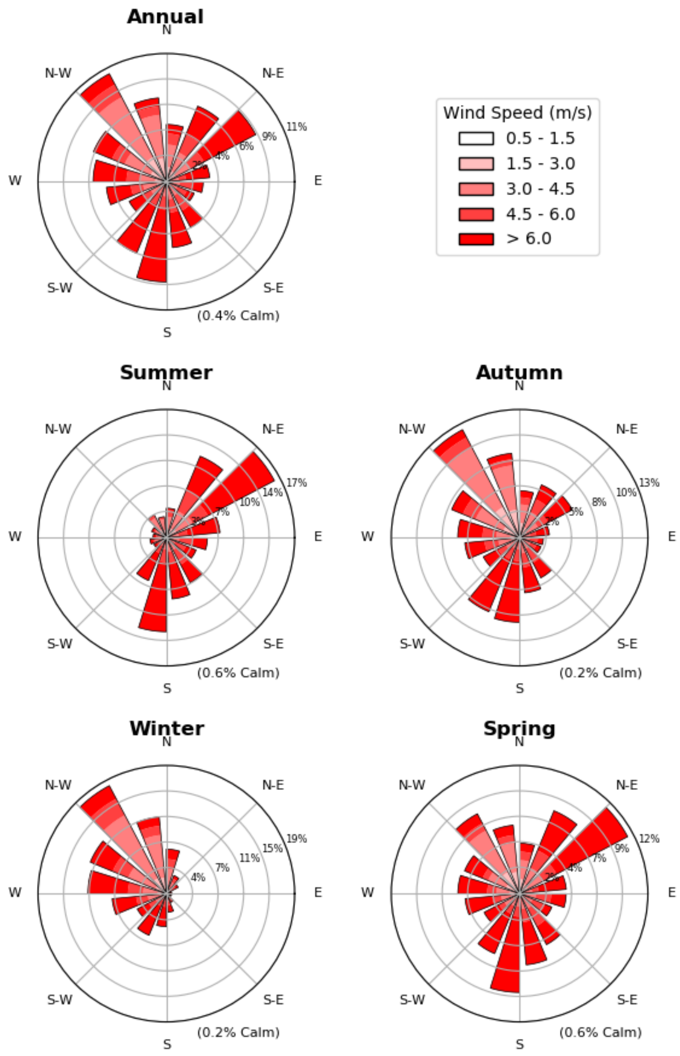


Figure 4-6 Sydney Airport Wind Roses, 2014-2018



4.2 Local Ambient Air Quality

No site-specific data are available to determine the existing concentrations of air pollutants at sensitive receptors near the Proposal. The NSW Office of Environment and Heritage (OEH) operates a network of air quality monitoring stations (AQMS) across NSW. The nearest OEH AQMS is located approximately 5 kilometres west of the Proposal site, at Earlwood. The Earlwood AQMS does not record observations of carbon monoxide or sulfur dioxide. Accordingly, observations of ambient carbon monoxide and sulfur dioxide have been taken from the AQMS located at Rozelle and Randwick, respectively.

A summary of the ambient air quality monitoring data collected at the Earlwood AQMS during 2018 is presented in Table 4-2.

Table 4-2 Ambient air quality monitoring results, 2018

Pollutant	AQMS	Averaging Period	Concentration (µg/m^3)
PM_{10}	Earlwood	24-hours	40.3
		Annual	19.8
$PM_{2.5}$	Earlwood	24-hours	23.5
		Annual	7.8
NO_2	Earlwood	1-hour	94
		Annual	19.2
CO	Rozelle	1-hour	1,150
		8-hours	805
SO_2	Randwick	1-hour	55.0
		24-hours	10.5
		Annual	2.6

5 DISPERSION MODELLING

5.1 Meteorological Modelling

5.1.1 TAPM

No meteorological observation data is available for the site. Therefore, site-specific meteorological data was generated using a prognostic model. The prognostic model used was The Air Pollution Model (TAPM), developed and distributed by the Commonwealth Scientific and industrial Research Organisation (CSIRO).

TAPM is an incompressible, non-hydrostatic, primitive equations prognostic model with a terrain-following vertical coordinate for three-dimensional simulations. It predicts the flows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of large scale meteorology provided by synoptic analyses. TAPM benefits from having access to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic scale meteorological analyses for various regions around the world.

The prognostic modelling domain was centred at 33.91° S, 151.19° E and involved four nesting grids of 30 km, 10 km, 3 km and 1km with 41 grids in the lateral dimensions and 25 vertical levels.

The TAPM model included assimilation of wind data collected at Sydney Airport during 2015.

5.1.2 AERMET

The TAPM results, including predictions of wind speed, wind direction, temperature, humidity, cloud cover, solar radiation, and rainfall, were used as inputs to AERMET – AERMOD's meteorological pre-processor. AERMET uses the TAPM data, along with land use data, to calculate mixing heights and velocity scaling parameters.

5.2 Dispersion Modelling

5.2.1 AERMOD

The dispersion model chosen for this assessment was AERMOD – the US EPA regulatory Gaussian plume air dispersion model.

AERMOD is a steady state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts. It includes treatment of both surface and elevated sources, and both simple and complex terrain.

AERMOD is accepted by NSW EPA for use in air quality impact assessments.

5.2.2 NO_X Transformation

In most combustion sources, high-temperature chemical processes cause the nitrogen in the fuel air mixture to oxidise, creating various 'oxides of nitrogen' or NO_X. Nitric oxide (NO) makes up the majority of NO_X emissions from engines, with NO_2 typically making up 5-10% of the NO_X percentage.

When NO enters the plume, it reacts with atmospheric ozone (O_3) and is converted to NO_2. There is a number of accepted methods to model the transformation of NO_x to NO_2, ranging from very simple to rather complex.

This assessment makes use of the US EPA's Ozone Limiting Method (OLM) to predict ground level concentration of NO_2. The OLM assumes that all the available atmospheric O_3 will react with NO in the plume until either all of the O_3 or all the NO is used up.

Hourly background concentrations of O_3 and NO_2 are used to implement the OLM for each hour of the modelling run according to the following equation:

$$NO_{2,total} = 0.1 \times NO_{X,predicted} + MIN\left\{0.9 \times NO_{X,predicted}\ OR\ \left(\frac{46}{48}\right) \times O_{3,background}\right\} + NO_{2,background}$$

5.2.3 Building Wake Effects

A number of large buildings are located on and nearby the Project site. Since air emissions from the Proposal will be via point sources, building wake effects are relevant to this assessment. Buildings on and nearby the Project site have been included in the dispersion model, and the BPIP PRIME algorithm has been used to capture building wake effects.

5.2.4 Sub 1-hour concentration

Dispersion models typically predict ground level concentrations at time intervals of one hour or more. To predict sub 1-hour pollutant concentrations, the following power-law, recommended by EPA Victoria (EPA Victoria, 1986), has been used:

$$C_{\tau_2} = C_{\tau_1}\left(\frac{\tau_1}{\tau_2}\right)^{0.2}$$

Where:

C_{τ_2} = concentration for averaging period 2

C_{τ_1} = concentration for averaging period 1

τ_1 = averaging period 1 (minutes)

τ_2 = averaging period 2 (minutes)

5.2.5 VOC Speciation

Table 5-1 presents a typical VOC speciation profile for diesel exhausts, as presented in the *Air Emissions Inventory for the Greater Metropolitan region in New South Wales* (EPA, 2008). Predicted ground level concentrations of total VOCs are multiplied by the values in Table 5-1 to predict the concentrations of individual pollutants.

Table 5-1 VOC Speciation Profile – Diesel Exhaust

Air Toxic	% of VOC
1,3 butadiene	0.402
Acetaldehyde	3.813
Benzene	1.067

Air Toxic	% of VOC
Formaldehyde	9.857
Xylenes	0.384
Toluene	0.469
PAH	1.653

5.2.6 Peak to Mean Ratios

To account for the time-averaging limitations of the dispersion model, peak-to-mean ratios have been incorporated into all odour flux rates in accordance with the Approved Methods. Peak-to-mean ratios for various source types, as prescribed by the Approved Methods, are presented in Table 5-2.

Table 5-2 Peak-to-mean ratios

Source type	Pasquill-Gifford stability class	P/M60	
		Near-field	Far-field
Area	A,B,C,D	2.5	2.3
	D,E	2.3	1.9
Line	A-F	6	6
Surface wake-free point	A,B,C	12	4
	D,E,F	25	7
Tall wake-free point	A,B,C	17	3
	D,E,F	35	6
Wake-affected point	A-F	2.3	2.3
Volume	A-F	2.3	2.3

Note: * Ratio of peak 1-second average concentrations to mean 1-hour average concentrations.

6 EMISSIONS TO AIR

The following section presents the estimated emissions of air pollutants associated with the operation of the Proposal. Additionally, a conservative estimate of the worst-case odour emissions is presented.

6.1 Pollutant Release Parameters

A ventilation system will be installed in the building to ensure that air pollutants are released via exhaust vents on the roof and not as fugitive releases through external doors. The parameters of the ventilation system relevant to dispersion modelling are summarised in Table 6-1.

Table 6-1 Ventilation Exhaust Parameters

Vent	Location (UTM)		Height	Diameter	Exit Velocity	Exit
	X (m)	X (m)	(m)	(m)	(m/s)	Temperature
Fan 1	332,556	6,246,245	13.0	1.0	5.0	Ambient
Fan 2	332,519	6,246,269	13.0	1.0	5.0	Ambient
Fan 3	332,607	6,246,280	13.0	1.0	5.0	Ambient

The data in Table 6-1 reflect a preliminary design of the ventilation system. Some of these details, such as the exact locations of the exhaust vents, have changed slightly throughout the development of the concept design and could change further throughout the detailed design phase. These changes are likely to be minor and are not expected to significantly influence off-site air quality impacts associated with the development. Notwithstanding, additional dispersion modelling should be conducted, based on the final design, to ensure that off-site air quality impacts associated with the development are consistent with those presented herein.

6.2 Emissions During Normal Operations

During normal day-to-day operations, diesel exhaust emissions would be the primary source of air pollutants. Within the facility, several items of mobile plant would be operating in addition to trucks associated with the transfer of material to and from the Site. Operating details for mobile plant and trucks are presented in Table 6-2.

Table 6-2 Sources of Diesel Emissions

Source	Quantity	Details
Truck	171 per day Up to 10 in building at once	Up to 15min on site, mostly idling fuel consumption 4.0 L/h
Loader	1	Model: JCB 436 Power = 129 kW
8t Forklift	1	Model: Linde H80D Power = 85 kW
4t Forklift	1	Model: Linde H45D Power = 55 kW

Pollutant emissions for the plant items in Table 6-2 have been estimated from emission factors in the National Pollutant Inventory (NPI) *Emission estimate technique manual for combustion engines* (NPI, 2008) and are summarised in Table 6-3.

Table 6-3 Emission Rates – per Item

Plant Item	Emission Rate (Per Item) (kg/hr)					
	PM_{10}	$PM_{2.5}$	NO_X	CO	SO_2	VOC
Truck	0.0083	0.0077	0.1364	0.0583	0.0001	0.0062
Loader	0.0774	0.0710	0.9675	0.3999	0.0005	0.0903
8t Forklift	0.0204	0.0187	0.2550	0.1054	0.0001	0.0238
4t Forklift	0.0132	0.0121	0.1650	0.0682	0.0001	0.0154

6.2.1 Worst-case Hourly Emissions

To assess air quality impacts against criteria with averaging periods of 1 hour or less, worst-case hourly emissions have been estimated on the basis that all mobile plant is operating continuously and that 10 trucks remain idling inside the building. This approach provides a very conservative estimate of worst-case hourly emissions; particularly since each truck would typically remain on site for no more than approximately 15-minutes. The estimated worst-case hourly emissions are summarised in Table 6-4.

Table 6-4 Worst-case Hourly Emissions

Plant Item	Emission Rate (g/s)					
	PM_{10}	$PM_{2.5}$	NO_X	CO	SO_2	VOC
Trucks (x10)	0.02308	0.02136	0.37889	0.16189	0.00027	0.01722
Loader	0.02150	0.01971	0.26875	0.11108	0.00014	0.02508
8 tonne Forklift	0.00567	0.00519	0.07083	0.02928	0.00004	0.00661
4 tonne forklift	0.00367	0.00336	0.04583	0.01894	0.00002	0.00428
Total	**0.05391**	**0.04962**	**0.76431**	**0.32119**	**0.00047**	**0.05319**

6.2.2 Typical Daily Emissions

To assess air quality impacts against 24-hour and annual average criteria, emission rates for mobile plant have been reduced by 50% compared to worst-case 1-hour conditions to reflect their typical usage over a 24-hour period. Additionally, truck exhaust emissions are calculated on the basis that 171 trucks access the site per day and spend up to 15-minute idling within the building. The estimated daily emissions are summarised in Table 6-5.

Table 6-5 Typical Daily Emissions

Plant Item	Emission Rate (g/s)					
	PM_{10}	$PM_{2.5}$	NO_X	CO	SO_2	VOC
Trucks	0.00411	0.00380	0.06749	0.02884	0.00005	0.00307
Loader	0.01075	0.00985	0.13438	0.05554	0.00007	0.01254
8 tonne Forklift	0.00283	0.00260	0.03542	0.01464	0.00002	0.00331
4 tonne forklift	0.00183	0.00168	0.02292	0.00947	0.00001	0.00214
Total	**0.01953**	**0.01794**	**0.26020**	**0.10849**	**0.00015**	**0.02105**

6.3 Odour Emissions

As outlined in Section 3.2, waste received by the facility is generally clean and not odorous. However, on occasion, incoming loads may be contaminated. In these situations, the contaminated load will be removed from the facility as quickly as possible.

To assess the likelihood of a contaminated load resulting in off-site nuisance odour impacts, it is assumed that a large load (20 tonnes) of putrescible waste is unloaded on the floor of the facility.

An AQIA for the Veolia Banksmeadow Waste Transfer Station (Wilkinson Murray, 2014) established a relationship between odour emissions and the amount of putrescible waste inside a transfer building. This relationship predicts an emission rate of 114 $OU.m^3/s$ per tonne of putrescible waste inside a transfer building.

In the unlikely event that a large (20 tonne) load of putrescible waste was unloaded onto the floor of the facility, the total odour emission rate would be 2,280 $OU.m^3/s$.

7 ASSESSMENT OF IMPACTS

This section presents the dispersion modelling results and discussed the likely off-site air quality impacts associated with the operation of the Proposal.

7.1 Criteria Pollutants

7.1.1 Particulate Matter (PM_{10} and $PM_{2.5}$)

The predicted ground level concentrations of PM_{10} and $PM_{2.5}$ associated with the operation of the proposal are presented in Table 7-1.

The results indicate compliance with the PM_{10} impact assessment criteria at all receptors.

The results indicate compliance with the $PM_{2.5}$ impact assessment criteria at all receptors, except the adjacent childcare centre where both the 100th percentile 24-hour average and the annual average concentration exceed the criteria and in the nearby parklands where the annual average concentration exceeds the criterion at the most affected location.

The 100th percentile 24-hour average $PM_{2.5}$ concentrations are calculated by adding the maximum 24-hour average concentration from the dispersion modelling results to the maximum ambient 24-hour concentration. This approach tends to be very conservative as it assumes that the maximum incremental and background concentrations occur over the same 24-hour period.

To further investigate the potential air quality impacts at the childcare centre, a contemporaneous assessment of 24-hour average $PM_{2.5}$ concentrations has been conducted. The contemporaneous assessment involves adding the existing background concentration, as observed at the Earlwood AQMS, to the predicted incremental concentration for each day of the simulation.

Figure 7-1 presents the results of the contemporaneous assessment of 24-hour average $PM_{2.5}$ concentrations at the childcare centre. The contemporaneous assessment shows that the contribution of the Proposal to total $PM_{2.5}$ concentrations is very low, and that the Proposal does not result in additional exceedances of the impact assessment criterion. Therefore, in accordance with the Approved Methods, no further mitigation of $PM_{2.5}$ emissions from the Proposal is warranted.

The predicted incremental annual average $PM_{2.5}$ concentrations at the childcare centre and the park are 0.7 $\mu g/m^3$ and 0.4 $\mu g/m^3$, respectively. These values represent 8.75% and 5% of the impact assessment criterion, respectively. However, due to the existing ambient concentration being 97.5% of the impact assessment criterion, these small incremental concentrations result in predicted exceedances of the impact assessment criterion. As demonstrated in the contemporaneous assessment for the childcare centre, the incremental increase in $PM_{2.5}$ due to the Proposal would be largely indistinguishable from the existing background; therefore, specific measures to mitigate $PM_{2.5}$ impacts are not warranted. It is also noted that vehicle emissions have been calculated assuming that trucks remain idling while on site. Therefore, it is recommended that all staff and customers are encouraged to limit idling of vehicles and turn-off engines where practicable. Additionally, signage should be displayed within the building to encourage engines to be turned off where practicable.

Contour plots of incremental 24-hour average PM_{10} and $PM_{2.5}$ are presented in Appendix A.

7.1.2 NO_2, SO_2 and CO

The predicted ground level concentrations of NO_2 associated with the operation of the Proposal are presented in Table 7-1. The results demonstrate compliance with the impact assessment criteria at all receptors.

A Contour plot of incremental 1-hour average NO_2 is presented in Appendix A.

The predicted ground level concentrations of SO_2 and CO associated with the operation of the Proposal are presented in Table 7-2. The results demonstrate compliance with the impact assessment criteria at all receptors.

7.2 VOC

The predicted ground level concentrations of individual VOC associated with diesel exhausts are presented in Table 7-3. The results demonstrate compliance with the impact assessment criteria for all identified VOC.

Table 7-1 Predicted Ground Level Concentrations – PM_{10}, $PM_{2.5}$, NO_2

Receptor	PM_{10}				$PM_{2.5}$				NO_2			
	24-hour		Annual		24-hour		Annual		1-hour		Annual	
	Increment	Total	Increment	Total	Increment	Total	Increment	Total	Increment	Total	Increment	Total
Goal	**50 µg/m³**		**25 µg/m³**		**25 µg/m³**		**8 µg/m³**		**246 µg/m³**		**60 µg/m³**	
Childcare	2.8	43.1	0.8	20.6	2.5	**26.0**	0.7	8.5	96.3	115.1	6.3	20.9
Sydney Road Residences	0.3	40.6	0.1	19.9	0.3	23.8	0.1	7.9	45.3	100.6	1.0	15.5
Campbell Street Residences	0.1	40.4	0.0	19.8	0.1	23.6	0.0	7.8	22.9	100.0	0.3	14.8
Euston Road Residences	0.7	41.0	0.1	19.9	0.7	24.2	0.1	7.9	47.2	101.5	1.0	15.5
Parkland	1.8	42.1	0.4	20.2	1.7	25.2	0.4	8.2	112.5	127.6	3.8	18.3

Table 7-2 Predicted Ground Level Concentrations – CO, SO_2

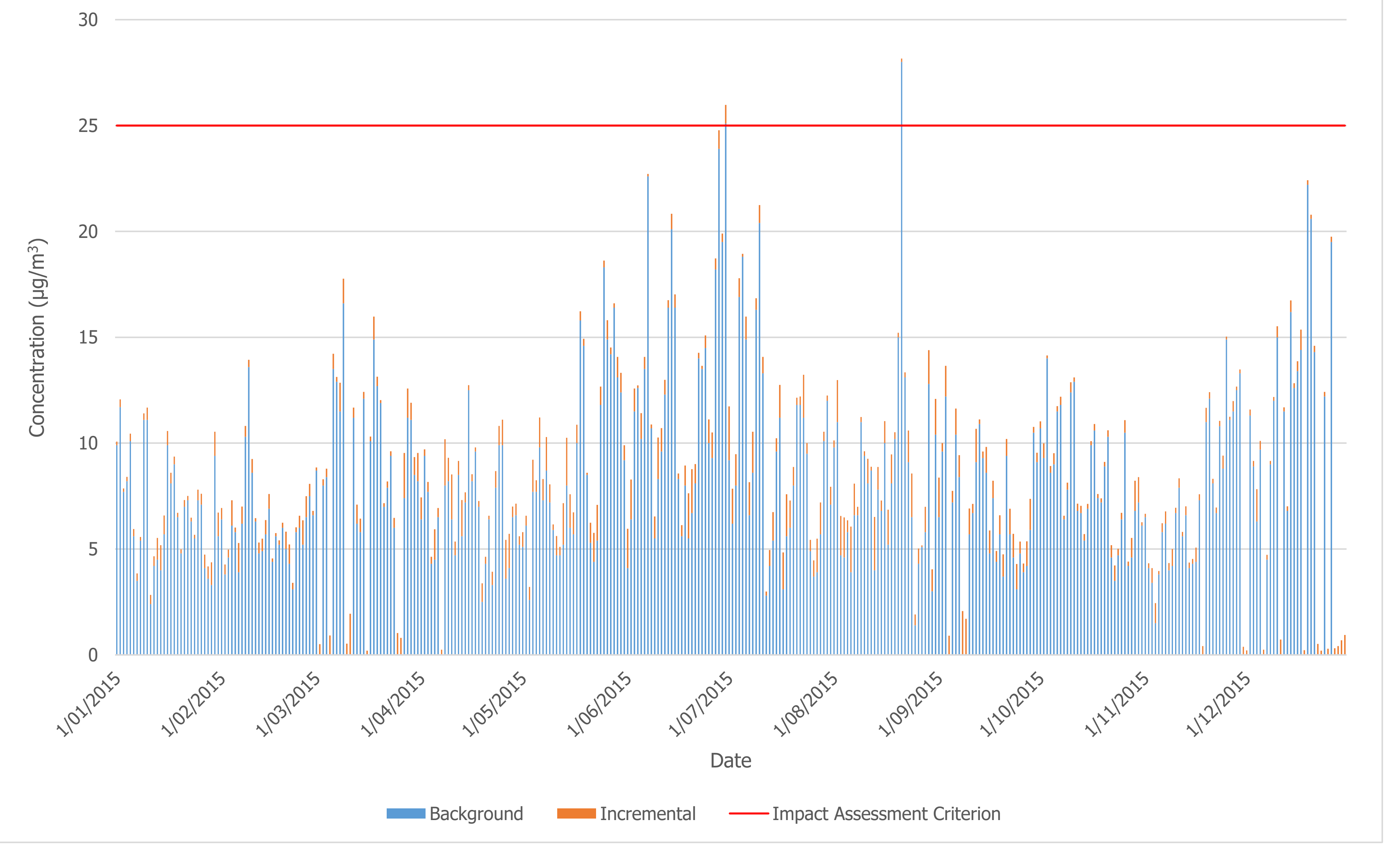
Receptor	CO					SO_2						
	15-minute	1-hour		8-hour		10-minute	1-hour		24-hour		Annual	
	Total	Increment	Total	Increment	Total	Total	Increment	Total	Increment	Total	Increment	Total
Goal	**100,000 µg/m³**	**30,000 µg/m³**		**10,000 µg/m³**		**712 µg/m³**	**570 µg/m³**		**228 µg/m³**		**60 µg/m³**	
Childcare	1992.1	359.7	1509.7	89.6	894.6	79.5	0.5	55.5	0.02	10.5	0.006	2.6
Sydney Road Residences	1642.7	94.9	1244.9	13.8	818.8	78.9	0.1	55.1	0.00	10.5	0.001	2.6
Campbell Street Residences	1567.2	37.7	1187.7	7.4	812.4	78.8	0.1	55.1	0.00	10.5	0.000	2.6
Euston Road Residences	1664.8	111.7	1261.7	23.5	828.5	78.9	0.2	55.2	0.01	10.5	0.001	2.6
Parkland	1906.0	294.5	1444.5	70.2	875.2	79.3	0.4	55.4	0.01	10.5	0.003	2.6

Table 7-3 Predicted Ground Level Concentrations – VOC

Receptor	1,3 butadiene	Acetaldehyde	Benzene	Formaldehyde	Xylenes	Toluene	PAH
	1-hour	1-hour	1-hour	1-hour	1-hour	1-hour	1-hour
Goal	**0.029 mg/m^3**	**0.04 mg/m^3**	**0.02 mg/m^3**	**0.0004 mg/m^3**	**0.042 mg/m^3**	**0.36 mg/m^3**	**0.19 mg/m^3**
Childcare	2.40E-04	2.27E-03	6.36E-04	5.87E-03	2.29E-04	2.79E-04	9.85E-04
Sydney Road Residences	6.32E-05	6.00E-04	1.68E-04	1.55E-03	6.04E-05	7.37E-05	2.60E-04
Campbell Street Residences	2.51E-05	2.38E-04	6.66E-05	6.15E-04	2.40E-05	2.93E-05	1.03E-04
Euston Road Residences	7.43E-05	7.05E-04	1.97E-04	1.82E-03	7.10E-05	8.67E-05	3.06E-04
Parkland	1.96E-04	1.86E-03	5.20E-04	4.81E-03	1.87E-04	2.29E-04	8.06E-04
Max off-site [a]	2.52E-04	2.39E-03	6.70E-04	6.19E-03	2.41E-04	2.94E-04	1.04E-03

a. Maximum off-site impact occurs at x=332,513; y=6,246,222.

Figure 7-1 Contemporaneous $PM_{2.5}$ Assessment at Childcare Centre



7.3 Odour

The predicted 99th percentile peak odour concentrations at nearby receptors, due to the rare scenario of a significantly contaminated load of incoming material, are presented in Table 7-4. The results indicate compliance with the impact assessment criterion.

Table 7-4 Predicted 99th percentile peak odour concentrations

Receptor	Predicted peak odour concentration (OU/m^3)	Impact assessment criterion (OU/m^3)
Childcare	1.5	2.0
Sydney Road Residences	0.2	
Campbell Street Residences	0.1	
Euston Road Residences	0.3	
Parkland	0.8	

An odour contour plot is presented in Appendix A.

8 CONCLUSION

Wilkinson Murray Pty Limited has been engaged by Build Run Repair, on behalf of Visy, to prepare an Air Quality Impact Assessment (AQIA) for a proposed Dry Recyclables Facility (DRF) at 112 Euston Road, Alexandria

This AQIA has been prepared to address the relevant SEARs in relation to the preparation of the Environmental Impact Statement (EIS) for the project, and was conducted in general accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

This AQIA assesses potential off-site air quality impacts from the combined operation of stage 1 and stage 2 of the development.

The AERMOD dispersion modelling system has been used to predict ground level concentrations of air pollutants, including odour, at sensitive off-site receptors.

The modelling results generally demonstrate compliance with the applicable impact assessment criteria. Due to high existing ambient $PM_{2.5}$ concentrations, the predicted total annual average $PM_{2.5}$ concentrations at two nearby receptors exceed the impact assessment criterion. However, as shown in the contemporaneous assessment of 24-hour average $PM_{2.5}$ impacts, the operation of the Proposal has a very small contribution to total $PM_{2.5}$ concentrations at nearby sensitive receptors.

APPENDIX A

CONTOUR PLOTS

Figure A-1 Contour Plot: Incremental 24-hour PM_{10}

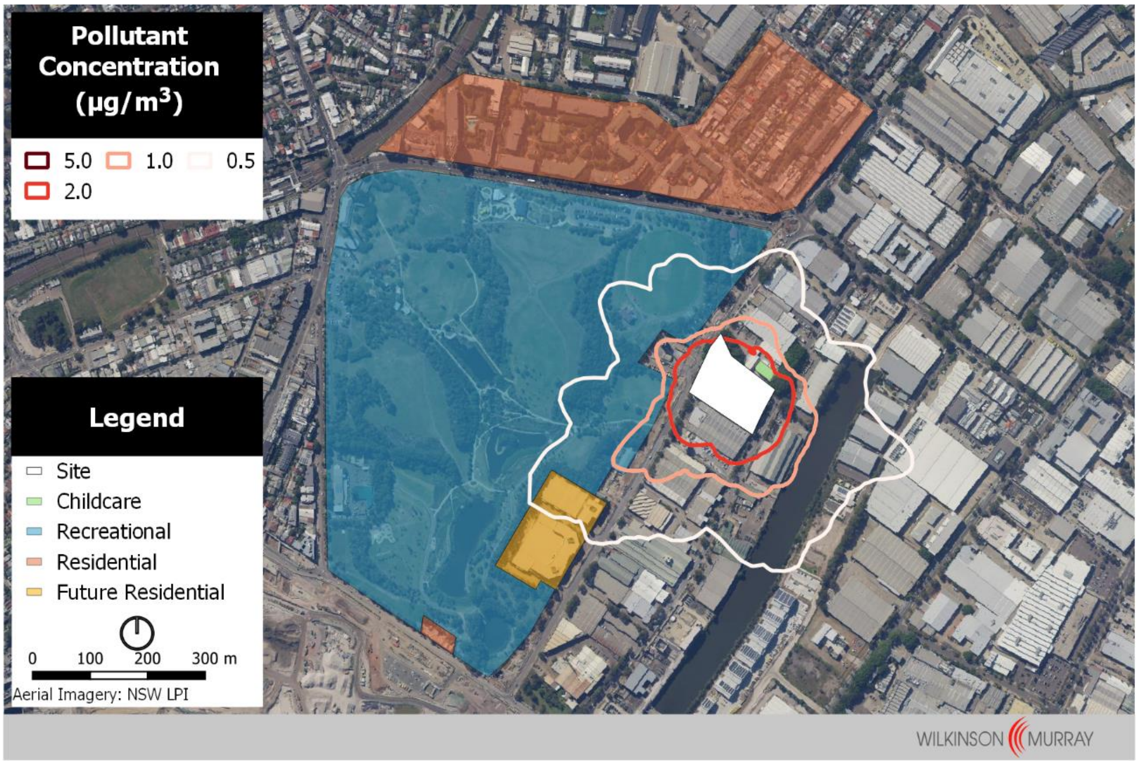


Figure A-2 Contour Plot: Incremental 24-hour $PM_{2.5}$

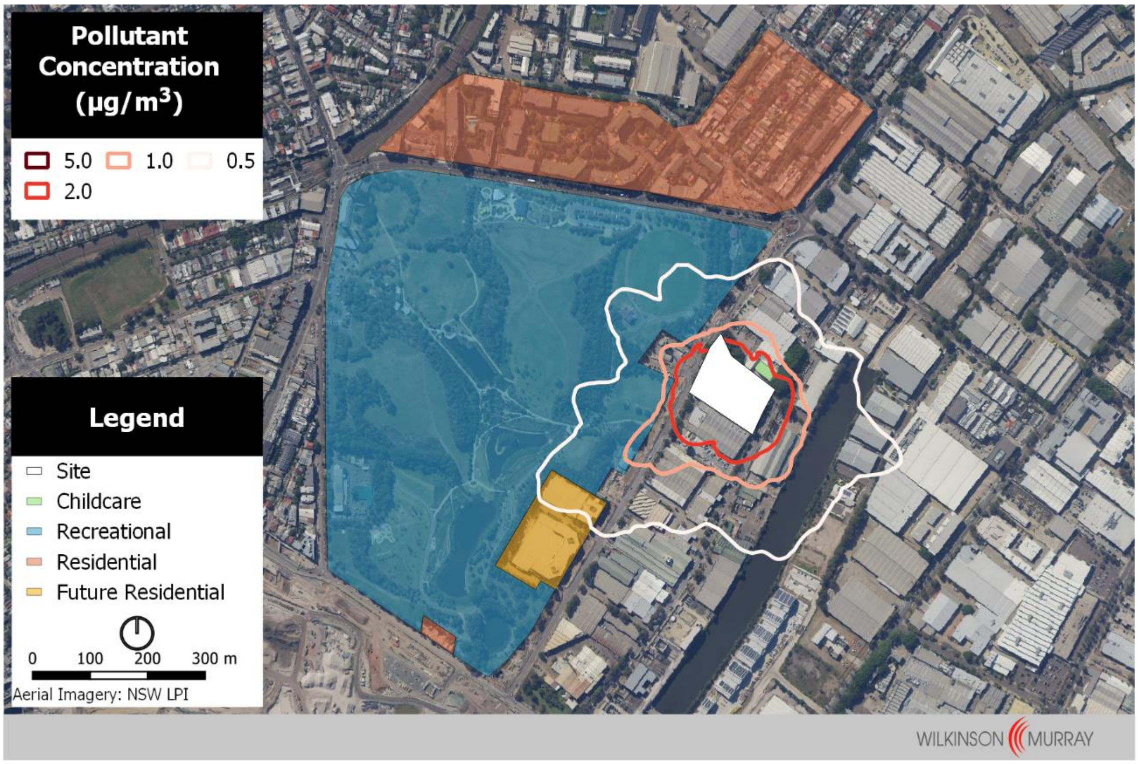


Figure A-3 Contour Plot: Incremental 1-hour NO_2

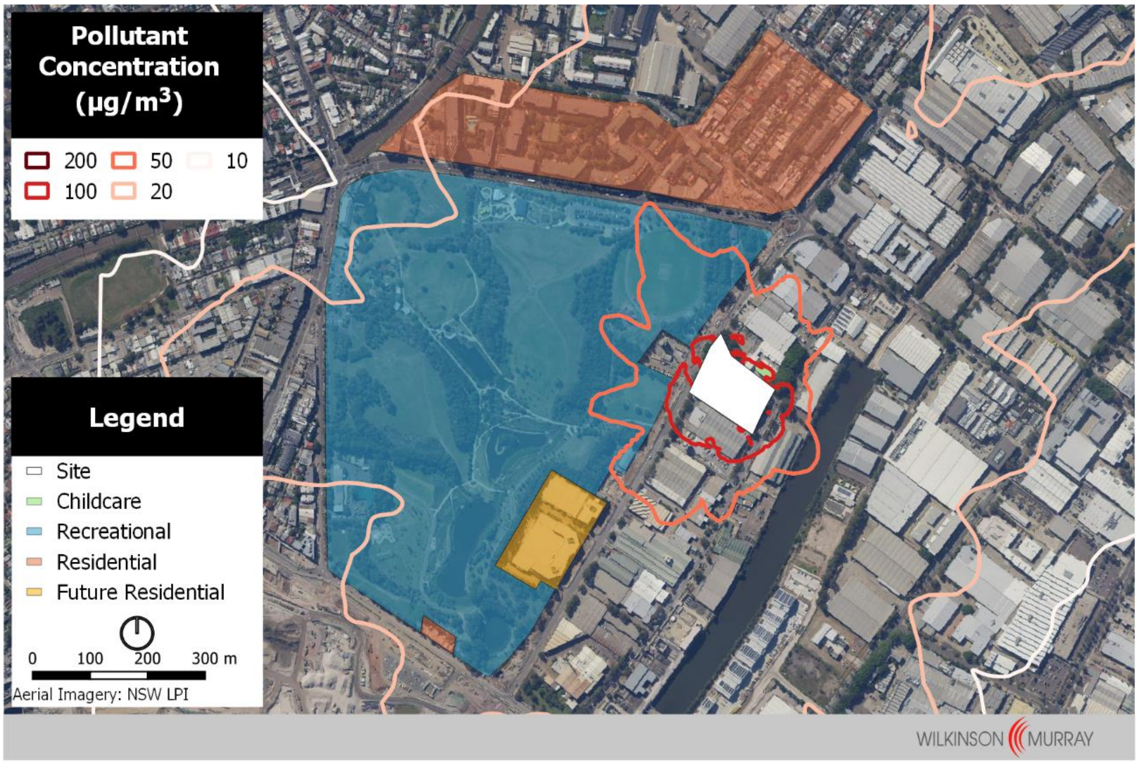


Figure A-4 Contour Plot: Odour