HUNTINGWOOD PROCESSING EXPANSION

Air Quality Assessment

Prepared for:

Charter Hall Holdings Pty Ltd
Level 20, No.1 Martin Place
Sydney
NSW 2000

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Charter Hall Holdings Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by FDC Construction on behalf of Charter Hall Holdings Pty Ltd to undertake an air quality and odour impact assessment of a proposed expansion of the food processing facility (bakery) at 65 Huntingwood Drive, Huntingwood (the Site). The existing facility is occupied by Arnott's Biscuits.

The Planning Secretary's Environmental Assessment Requirements (SEARs) relating to air quality issues for the project are as follows:

> *The EIS must include an assessment of the potential impacts of the proposal (including cumulative impacts) and develop appropriate measures to avoid, mitigate, manage and/or offset these impacts. The EIS must address the following specific matters:*
>
> - ***Air Quality and Odour** – including:*
>   - *a description of all potential sources of odour and emissions during the construction and operational phases of the development;*
>   - *an assessment of the potential air quality, dust and odour impacts of the development in accordance with relevant Environment Protection Authority guidelines; and*
>   - *details of dust control during site preparation and civil works.*

The NSW Environmental Protect Agency has also provided the following guidance for the project:

> *The environmental outcomes of the project should be to ensure:*
>
> - *emissions do not cause adverse impact upon human health or the environment.*
> - *no offensive odours are caused or permitted from the premises.*
> - *emissions of dust from the premises (including material handling, storage, processing, haul roads, transport and material transfer systems) are prevented or minimised*

This report summarises the potential construction and operational air quality impacts associated with the Project and has been prepared to accompany the State Significant Development (SSD) application for the proposal.

1.1 Background

SLR Consulting Australia Pty Ltd (SLR) prepared a qualitative air quality and odour impact assessment for the proposed expansion of the food processing facility (bakery) at 61 Huntingwood Drive, Huntingwood (the Project) in May 2021. This report was updated in August and again in November of 2021 to address comments raised by the NSW Department of Planning, Industry and Environment (DPIE) in relation to the methodology used for the assessment of pollutants.

In December 2021, DPIE concluded that further information is required to clarify matters, with the additional information requested regarding air quality being as follows:

> *"The operational risk assessment methodology used is not supported and a quantitative evidence-based assessment with appropriate dispersion modelling must be used to demonstrate that the development can comply with the relevant air quality criteria and must consider cumulative impacts generated from the sites existing operations. The quantitative assessment must include an assessment of ammonia emissions. This requirement does not apply to the odour impact assessment."*

This report presents the revised air quality and odour impact assessment, which includes a detailed quantitative assessment combustion gas and ammonia emissions from the existing operations as well as the proposed expansion.

1.2 Relevant Policies, Guidelines and Plans

This assessment has been prepared with consideration of the following policies and guidelines:

- *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (NSW EPA, 2017) (the Approved Methods)
- *Approved Methods for the Sampling and Analysis of Air Pollutants in NSW* (NSW DEC, 2005) (the Approved Methods for Sampling)
- *Protection of the Environment Operations Act 1997* (NSW Parliament, 1997)
- *Protection of the Environment Operations (Clean Air) Regulation 2010* (NSW Parliament, 2010)

The Approved Methods outlines the requirements for conducting an air quality impact assessment as follows (also indicated are the relevant sections of this report where the requirements are met):

- Description of local topographic features and sensitive receptor locations (**Section 4.1** and **Section 4.2** respectively)
- Establishment of air quality assessment criteria (**Section 6.2**)
- Analysis of climate and dispersion meteorology for the region (**Section 4.3**)
- Description of existing air quality environment (**Section 4.4**)
- Compilation of a comprehensive emissions inventory for the proposed activities (**Section 8.3.5** and **Appendix D**)
- Completion of atmospheric dispersion modelling and analysis of results (**Section 9.2**)
- Preparation of an air quality impact assessment report comprising the above.

2 Glossary and Abbreviations

Table 1 below shows the glossary of terms and their definitions used in this air quality and odour impact assessment.

Table 1 Glossary

Term	Definition
The Site	Existing and proposed food processing facility at 61 Huntingwood Drive
The Project	The construction of a new facility to expand the operation of the existing facility

Table 2 below shows the abbreviations and their definitions used in this air quality and odour impact assessment.

Table 2 Abbreviations

Term	Definition
AGL	above ground level
AHD	Australian Height Datum
AQMS	Air Quality Monitoring Station
AWS	Automatic Weather Station
BoM	Bureau of Meteorology
CBD	Central Business District
CEMP	Construction Environmental Management Plan
CO	carbon monoxide
DPIE	NSW Department of Planning, Industry and Environment
EES	DPIE's Environment, Energy and Science Group
EPA	NSW Environment Protection Authority
IAQM	Institute of Air Quality Management
IN-1	General industrial (planning zone)
IN-2	Light industrial land (planning zone)
km	kilometres
m/s	metres per second
NH_3	ammonia
NH_4HCO_3,	ammonium bicarbonate
NO_x	oxides of nitrogen
NO_2	nitrogen dioxide
O_3	ozone
OEH	Office of Environment and Heritage
OSD	on-site detention
PM	particulate matter
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
ppb	parts per billion (volume)

Term	Definition
pphm	parts per hundred million (volume)
RE-2	Private recreational (planning zone)
SO_2	sulfur dioxide
VOC	Volatile Organic Compounds
WSP SEPP	State Environmental Planning Policy (Western Sydney Parklands) 2009

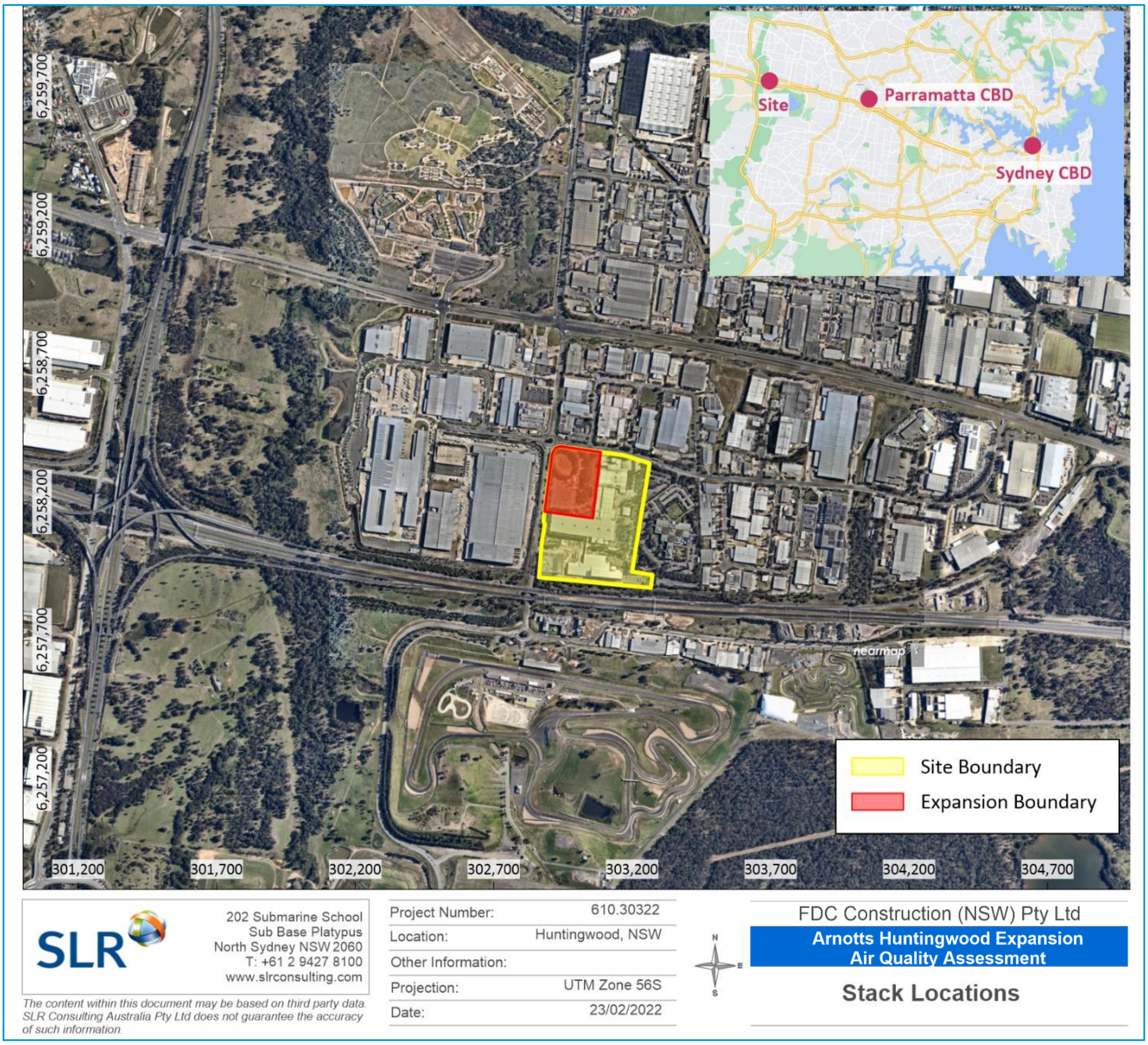
3 Project Description

3.1 Project Location

The proposed expansion is to be located within the existing Arnott's Site at 61 Huntingwood Drive (see **Figure 1**), Lot 1 DP866251, within the Huntingwood Industrial Estate, 32 km west of the Sydney CBD and 12 km west of Parramatta CBD. The Site is situated along the southern boundary of Huntingwood, bordering the Western Motorway (M4) to the south and Huntingwood Drive to the north.

The total area of the Site is 163,933 m^2 (16.4 hectares). The site currently contains three large freestanding industrial buildings, the main 'L-shaped' processing building to the north and two warehouses to the south. The balance of the site includes small ancillary buildings, car parking, loading areas and privately used open space. The north-west corner of the site currently acts as an on-site detention (OSD) basin.

Figure 1 Site Location



3.2 Project Overview

The current operations on the Site involve food processing (bakery) which operates 24 hours a day, seven days a week.

The Project comprises the expansion of the existing food processing operations at the facility, including construction of a new processing building in the northwest corner of the Site (as indicated in **Figure 1**). The facility currently produces approximately 55,000 tonnes of products per year, and the proposed expanded facility is estimated to add a further 13,000 tonnes per year (an increase of approximately 25%). An overview of the Project is provided in **Table 3**.

Table 3 Overview of Proposed Development

Element	Proposed
Site Preparation	• Removal of existing car parking, driveway and ancillary structures. • Vegetation clearing. • Excavation for car park and bulk earthworks and supporting structures. • Drainage connections. • Land stabilisation.
Development summary	• Construction of a new processing facility (24,775 m^2) to the west of the existing building with five new production lines (inclusive of three biscuit/cracker lines and two wafer lines). • Construction of a new ingredient silo building (1,000 m^2) along the Huntingwood Drive frontage. • Construction of a new storage building (270 m^2) to the east of the existing building. • Construction of a new processing building (1,2000 m^2) and ingredient silo building (120 m^2) to the south of the main facility. • Replacement of the existing on-site detention (OSD) basin with an OSD tank below the basement car park. • Landscaped setbacks along both street frontages to screen the new processing facility and loading area.
Access and Parking	• New loading area above two levels of car parking (468 spaces) at the north-west corner of Huntingwood Drive and Brabham Drive. • Trucks will utilise the existing access point adjacent to the eastern boundary of the site. • The existing (westernmost) vehicle access to Huntingwood Drive will be retained and upgraded to provide access to the new basement car park.
Hours of Operation	• The facility will continue to operate 24 hours per day, seven days per week.

The on-site activities associated with the proposed expansion will be similar to those currently undertaken at the Site, namely:

- Raw materials delivery and storage;
- Production and baking of biscuits, crackers and wafers;
- Product packaging;
- Dispatch and distribution; and
- Ancillary office administration.

The proposed ground floor layout shown in **Figure 2** (HLA Architects Drawing No: 200810-DA-003-Q) has been annotated to show the existing and proposed future vehicle routes and mechanical plant locations, and the existing wastewater treatment plant. The existing wastewater treatment plant is understood to have capacity to deal with the additional throughput that would results from the proposed expansion, with no upgrade or modification of this plant proposed.

Vehicular access to the site for light vehicles is via an existing entry and exit driveway (Liberty Road) at the Huntingwood Drive frontage. Separate heavy vehicle access to the site is available from Huntingwood Drive adjacent to the eastern boundary. Heavy vehicle access to the high-bay warehouse is also available from Brabham Drive. After the site expansion, vehicles will move further into the northwestern corner of the site, to access a new ingredients and packaging materials delivery point. The projected increases in traffic movements associated with the expansion are shown in **Table 4**.

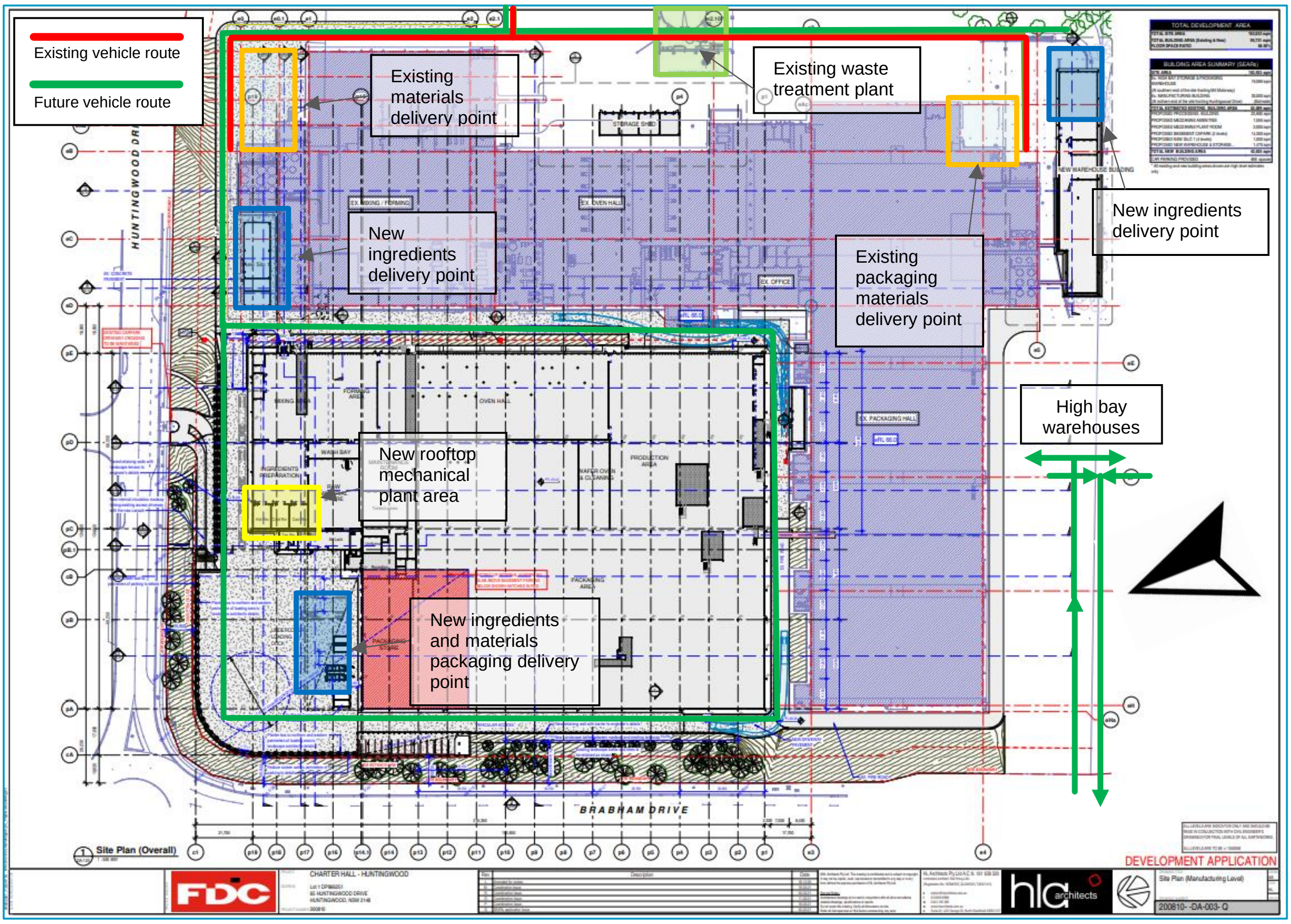
Table 4 Proposed Changes in Daily Vehicle Movements – Operational Phase

Location	Vehicle Type	Approximate Timing	Current Huntingwood Daily Numbers	Expected Additional Daily Numbers Post Project Completion	Total
Raw Materials	Semi-trailer tankers	24 hrs/day	12	3	15
	Semi-trailer	7am – 7pm	8	4	12
	Rigid	7am – 7pm	6	1	7
Waste	Rigid/skip change out	5am – 11pm	6	2	8
	Semi-trailer	7am – 3pm	2	1	3
Packaging Materials	B-Double	7am – 6pm	once/twice per week – no change		
	Semi-trailer	7am – 6pm	7	2	9
	Rigid	7am – 6pm	5	2	7
High Bay Warehouse	B-Double	6am – 10 pm	9	2	11
	Semi-trailer	6am – 10 pm	15	2	17
	Rigid	6am – 10 pm	1	0	1
	Container delivery/collection	6am – 10 pm	4	2	6
Service and Support Vehicles	Courier vans	7am – 5pm	3	1	4
	Engineering and service vans	7am – 5pm	1	0	1
	Deliveries	7am – 5pm	2	1	3
Total Movements			**81**	**23 (30% increase)**	**104**

A ventilation system is being designed for the new processing facility to capture and appropriately vent the oven emissions via dedicated discharge vents located on the roof of the new building. Detailed information on the proposed oven emissions is not available at the time of preparing this report. However, it is understood that a total of 31 new ventilation stacks is expected to be erected, serving the five new production lines.

It is also understood that all new ovens will be similar to the existing ovens in terms of gas throughput. As such, for the purpose of this assessment, SLR has assumed emissions from these new stacks will be similar to that of the existing ovens.

Figure 2 Proposed Development



3.3 Site Inspection

A site visit was performed as part of the air quality and odour assessment to observe the existing operations, identify air emission points and discuss current and proposed air emissions mitigation measures for the Project. During the site visit, the weather was characterised as overcast skies and calm conditions. The facility was fully operational, with normal production and wastewater treatment processes in progress.

Potential sources of air emissions associated with the operation of the facility were identified as follows:

- Odour emissions from the baking and processing of products
- Odour emissions from ingredient storage
- Combustion gas emissions from the operation of the gas fired ovens
- Odour emissions from the treatment of wastewater and storage of sludge
- Products of fuel combustion (including particulates) from onsite vehicle movements; and
- Wheel-generated particulate emissions from onsite vehicle movements.

During the site visit, ‘distinct’ odours could be detected within the boundary of the Site and ‘weak’ odours were detectable within an approximate 100 m radius of the Site boundary. The hedonic tone of these odours ranged from +1 to -1 (‘mildly pleasant’ to ‘mildly unpleasant’). The odours were predominantly characteristic of baking processes. No ‘distinct’ raw material odours or wastewater/sludge odours could be detected except at locations very close to these activities.

During the site visit, no visible dust emissions were observed. The housekeeping at the facility was observed to be of the highest order.

4 Project Setting

4.1 Land Use and Sensitive Receptors

The Site is currently subject to the land use and development control provisions of the *Blacktown Local Environmental Plan 2015*. **Figure 3** illustrates the surrounding land zoning as specified in the *Blacktown Local Environmental Plan 2015* as well as the location of the closest nearby residential receptors. The areas immediately to the east and north of the Site are zoned light industrial (IN-2). A small area of General industrial (IN-1) and Private recreational (RE-2) zones is located immediately south of the Site. Large, unzoned areas located to the south, west and northwest of the Site are subject to State Environmental Planning Policy (Western Sydney Parklands) 2009 (WSP SEPP). Current uses for these areas include motorsports (south), warehousing (west) and parklands (northwest).

The nearest residential areas are located approximately 1.5 km north of the site in Bungarribee. There are industrial receptors on neighbouring lots and Sydney Zoo is located approximately 800 m to the northwest, with the Bungarribee Playground beyond that. A small number of scattered residences are located along Pikes Lane, 1.1 – 1.3 km to the west of the Site. The nearest receivers are shown in **Figure 4** and detailed in **Table 5**. The facility does not have any records of any complaints relating to air quality issues and is not aware of any concerns in the local community regarding odours from the existing operations.

Figure 3 Zoning of Surrounding Land

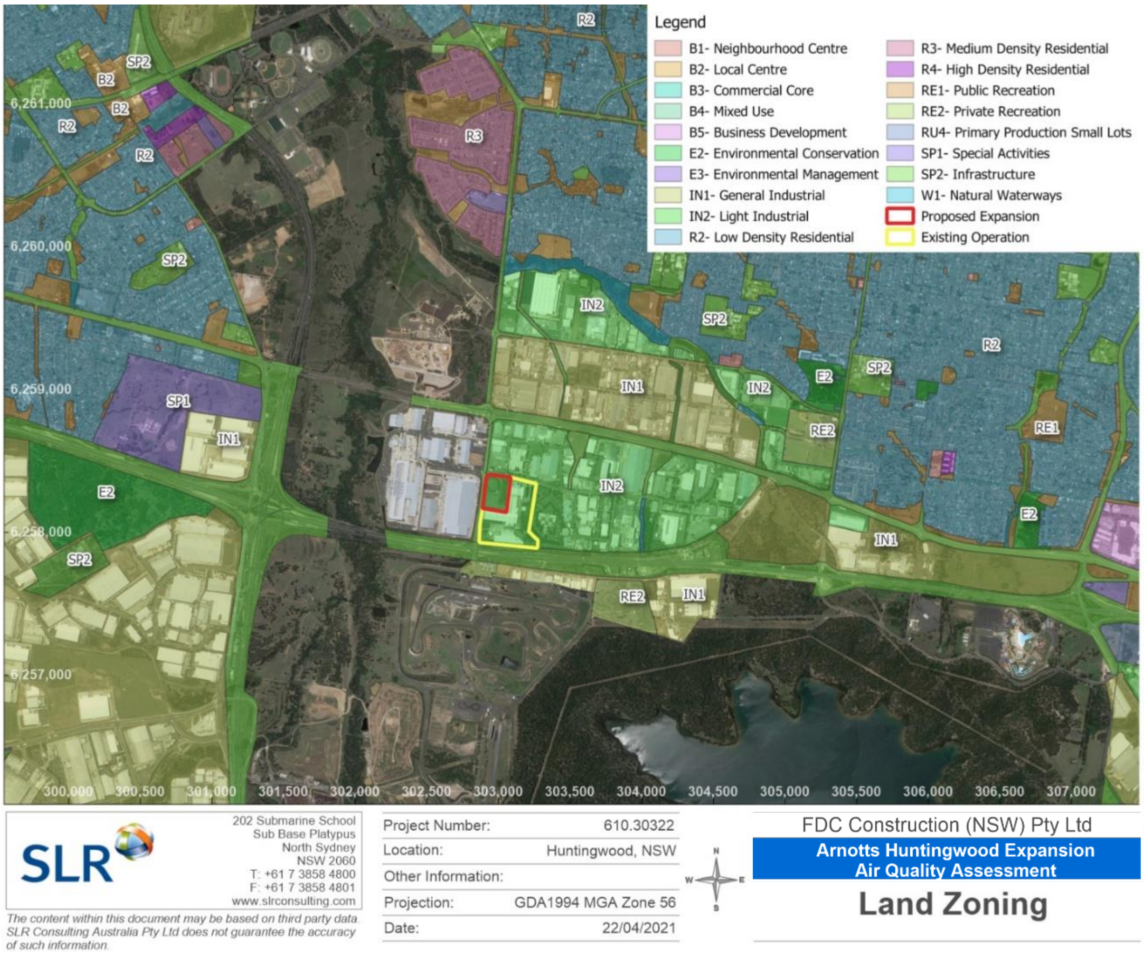
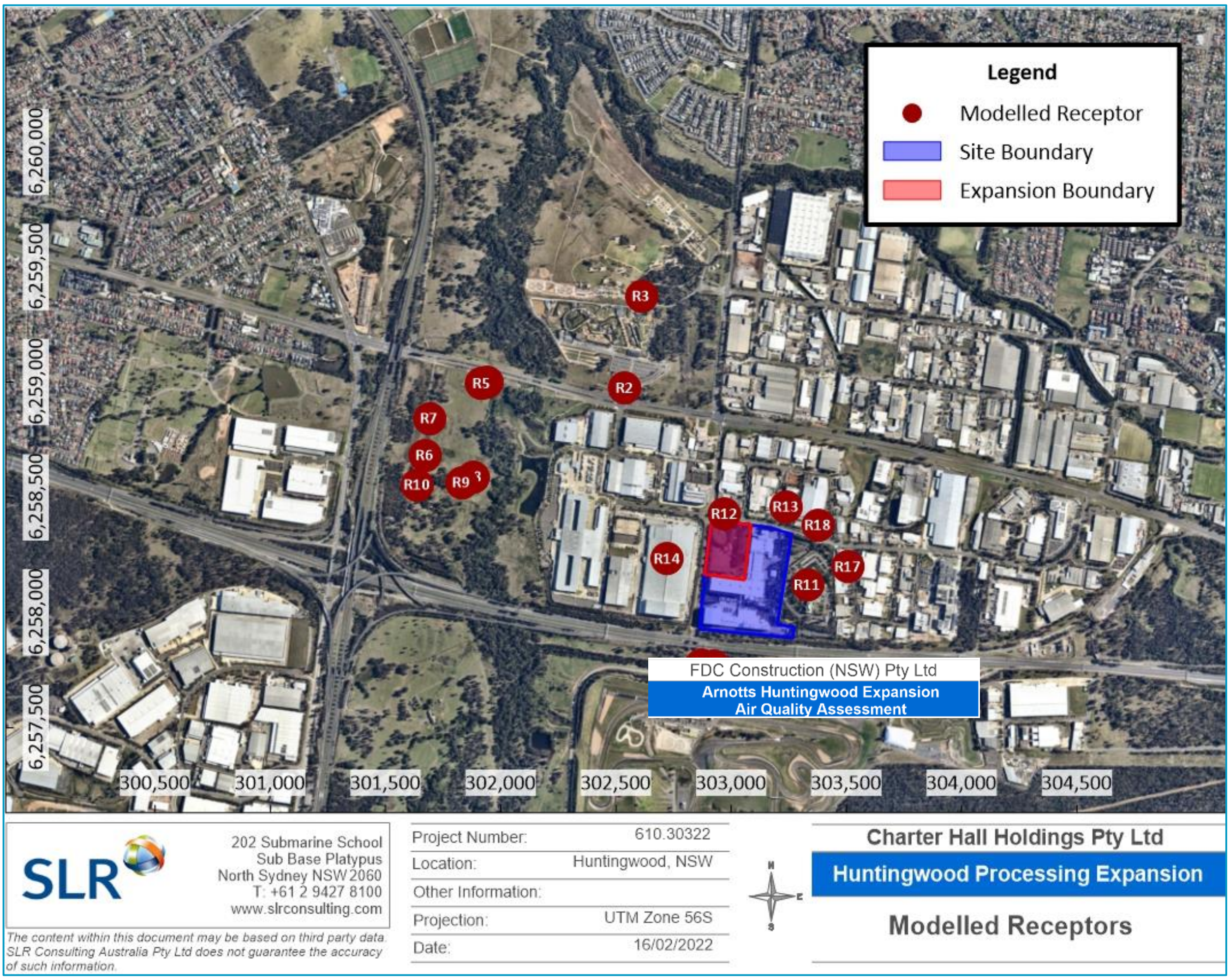


Table 5 Location of the Identified Sensitive Receptors

ID	Easting (m)	Northing (m)	Elevation AHD (m)	Description	Approximate Distance from the Project (m)
R1	302,927	6,257,769	60.6	Alpha Hotel Eastern Creek	400
R2	302,539	6,258,974	51.5	Sydney Zoo	690
R3	302,610	6,259,374	44.8	Bungarribee Playground	1,030
R4	301,940	6,258,998	40.6	Residential Receptor	1,150
R5	301,918	6,258,994	40.4	Residential Receptor	1,170
R6	301,671	6,258,682	43.9	Residential Receptor	1,290
R7	301,690	6,258,843	45.0	Residential Receptor	1,300
R8	301,881	6,258,589	42.0	Residential Receptor	1,050
R9	301,830	6,258,565	43.1	Residential Receptor	1,100
R10	301,638	6,258,555	46.6	Residential Receptor	1,280
R11	303,330	6,258,120	82.9	Endeavour Energy	100
R12	302,972	6,258,428	58.8	Eastern Creek Tavern	30
R13	303,240	6,258,459	68.6	Office	100
R14	302723	6,258,233	55.0	Hunter & Northern Logistics	170
R15	302,869	6,257,772	58.9	Oak Bar and Grill	160
R16	303,425	6,257,663	77.2	Labourpower Recruitment Services	280
R17	303,507	6,258,198	73.1	Office	270
R18	303,377	6,258,379	67.6	DHL Supply Chain	120

Figure 4 Surrounding Receptors



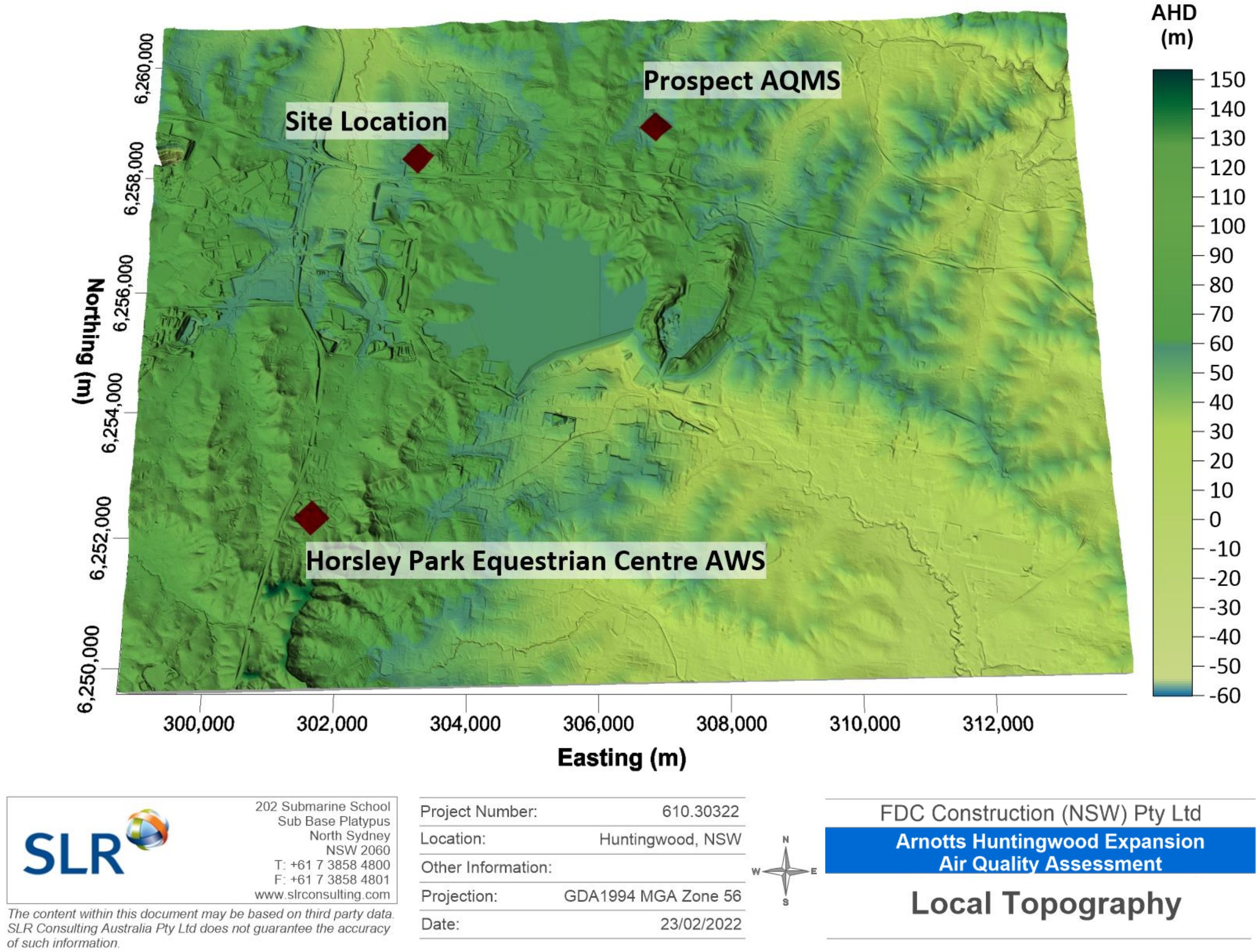
4.2 Local Topography

Topography is important in air quality studies as local atmospheric dispersion can be influenced by night-time katabatic (downhill) drainage flows from elevated terrain or channelling effects in valleys or gullies.

A three-dimensional representation of the region surrounding the Site is shown in **Figure 5**. The topography of the local area ranges from an approximate elevation of 25 m to 195 m Australian Height Datum (AHD).

The topography of the Site and its immediate surrounds is relatively flat, with open areas of land cleared for motorsports to south. The northwestern edge of the Site sits up to approximately 4 m above the surrounding road reserves. The balance of the site is reasonably flat with a slight fall towards the northwest. A large water body (Prospect Reservoir) is located approximately 1.5 km to the southeast.

Figure 5 Local Topographical Features



4.3 Local Meteorological Conditions

Local wind speed and direction influence the dispersion of air pollutants. Wind speed determines both the distance of downwind transport and the rate of dilution as a result of 'plume' stretching. Wind direction, and the variability in wind direction, determines the general path pollutants will follow and the extent of crosswind spreading. Surface roughness (characterised by features such as the topography of the land and the presence of buildings, structures and trees) will also influence dispersion.

The Bureau of Meteorology (BoM) maintains and publishes data from weather stations across Australia. The closest such station recording long term wind speed and wind direction data is the Horsley Park Equestrian Centre AWS (Station ID 67119), located approximately 7 kilometres (km) southwest of the Site. It is noted that considering the relatively complex terrain between the Site and this AWS (see **Figure 5**), wind conditions at the Site may be slightly different from those recorded by the AWS.

Annual and seasonal wind roses for the years 2016-2020 (inclusive), compiled from data recorded by the Horsley Park Equestrian Centre AWS is presented in **Figure 6**. Wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The annual wind rose indicates that the predominant wind directions in the area are from the southwest. Calm wind conditions (wind speed less than 0.5 m/s) were predicted to occur approximately 13.9% of the time throughout the investigated period. The average seasonal wind roses for the years 2016-2020 indicate that:

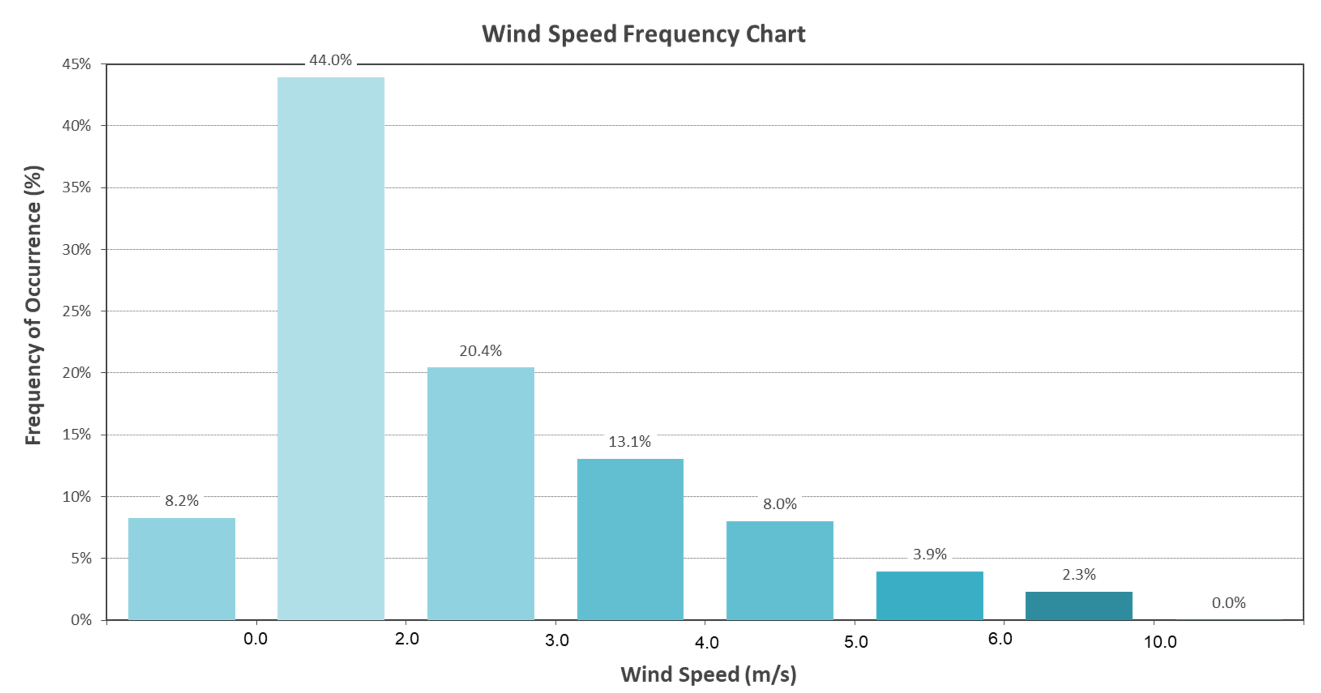
- In summer, winds are mostly gentle (between 1.5 m/s and 5.5 m/s) predominantly from the southeast quadrant, with very few winds from the northwest quadrant. Calms were recorded 12.3% of the time.
- In autumn, winds are light to gentle (between 0.5 m/s and 5.5 m/s) predominantly from the southwest direction, with very few winds from the northeast. Calms were recorded 15.6% of the time.
- In winter, winds are mostly light to gentle (between 0.5 m/s and 5.5 m/s) and are from the southwest direction, with very few winds from the eastern quadrant. Calms were recorded 14.4% of the time.
- In spring, winds are mostly light to gentle (between 0.5 m/s and 5.5 m/s) and blow from all directions with the majority blowing from the southwest. Calms were recorded 13.0% of the time.

As identified in **Section 4.1** the closest existing sensitive receptors are located west, northwest and south of the Site boundary. Winds between the east and south-southeast directions, which would blow air emissions from the Site towards the nearest existing residences and recreation facilities, occur approximately 23% of the time. Winds from the north which would blow air emissions towards the nearby hotel occur only 7% of the time.

Wind erosion of dust from exposed surfaces is usually initiated when wind speeds exceed the threshold friction velocity for a given surface or material, however a general rule of thumb is that wind erosion can be expected to occur above 5 m/s. The frequency of wind speeds for the period of 2016-2020 is presented in **Figure 7**. The plot shows that wind speeds exceeding 5 m/s for the period 2016-2020 at Horsley Park Equestrian Centre AWS occurred approximately 6.2% of the time.

Figure 6 Horsley Park Equestrian Centre AWS Annual and Seasonal Wind Roses 2016-2020

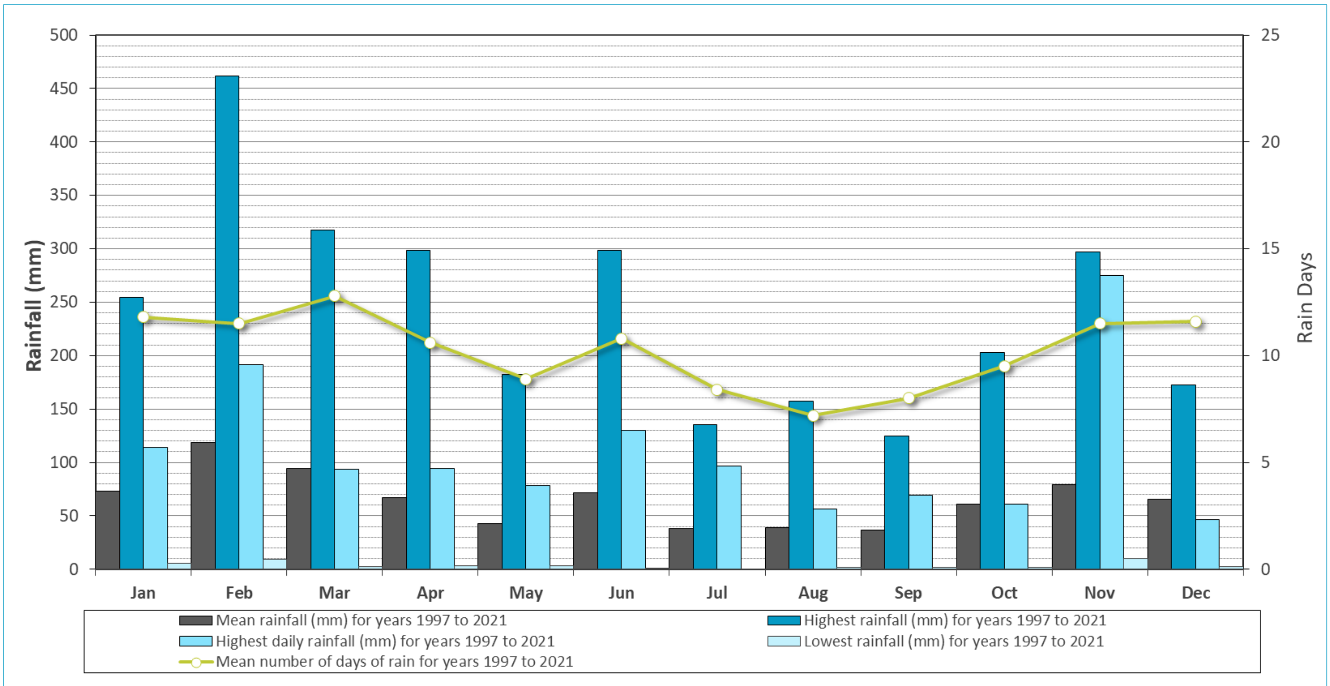
Figure 7 Wind Speed Frequency Chart for Horsley Park Equestrian Centre AWS – 2016-2020



Rainfall

Dry periods (no rainfall) have a greater risk of generating fugitive dust emissions as moisture binds dust particles together. The long-term monthly rainfall averages recorded by the Horsley Park Equestrian Centre AWS rain gauge are shown in **Figure 8**. Generally, rainfall is lowest in the mid-winter to mid spring period.

Figure 8 Long term Mean Rainfall for Horsley Park Equestrian Centre AWS – 2011-2020



4.4 Other Local Air Emission Sources

Other sources of air emissions and odour in the surrounding area with the potential to result in cumulative impacts with emissions from the construction and operation of the expansion, as identified from the site visit and a desktop review of aerial imagery, are as follows:

- Traffic emissions from the surrounding road network, including the M4 Western Motorway (M4) and Westlink (M7), and the Eastern Creek racetrack. There are several logistics/distribution centres in the area which will also generate potentially significant local traffic movements.
- A search of the National Pollutant Inventory (NPI) identified only one industrial facility in the 2148 post code that is located within 1 km of the Site, being the Diageo Australia operations (described as the manufacture and importation of alcoholic (spirits) and non-alcoholic beverages, located 760 m to the northeast). This site reported emissions of volatile organic compounds (VOCs) and therefore has potential for some odour emissions, however they would be of a very different character to those emitted from the existing and proposed operations at the Site. There is not considered to be any potential for cumulative impacts from this facility with air emissions from the Arnott's operations.
- A search of existing Environmental Protection Licences on the EPA website for Huntingwood identified one site, being Cookers Bulk Oil System, located at 2 Healey Circuit, Huntingwood. This site is licenced to receive and store "Used cooking oil only". Any odour emissions from this site would be of a very different character to those emitted from the existing and proposed operations at the Site. There is not considered to be any potential for cumulative impacts from this facility with air emissions from the Arnott's operations.

5 Pollutants of Concern

5.1 Construction Phase

Potential air emissions associated with the construction phase include:

- Fugitive dust emissions from the demolition/construction of buildings and other structures; and
- Products of combustion from construction plant and machinery.

No significant sources or emissions of odour are expected during the construction phase.

5.1.1 Fugitive Dust Emissions

During the construction phase, the potential for dust to be emitted from the Site will be directly influenced by the nature of the activities being performed. Activities that may lead to short-term emissions of dust, include:

- Loading and unloading of materials;
- Wheel-generated dust from trucks travelling along unpaved roads; and
- Wind erosion of exposed surfaces and stockpiles.

These activities will need to be managed appropriately to ensure off-site impacts are minimised (refer **Section 9.1.1**).

Temporary elevation in the emissions of particulate matter and local dust is considered to be inevitable as part of the construction works, particularly where those activities are undertaken during periods of low rainfall and/or windy conditions. The impact of elevated dust emissions is dependent upon the potential for particulates to become and remain airborne prior to being deposited as dust or experienced as an ambient particulate concentration.

The construction works may require up to 16 months to complete. It is noted that dust-generating activities will not be occurring continuously throughout this period.

5.1.2 Products of Combustion

Exhaust emissions from cranes, trucks, plant and other equipment associated with the construction of the Project will be a source of emissions to air during the construction phase.

Considering the size of the nature of the proposed development, air emissions from diesel-powered construction plant and machinery are anticipated to be relatively small compared to the existing background emission levels from vehicles on the surrounding road network.

5.2 Operational Phase

5.2.1 Current Emissions

According to the annual air emission loads reported by the Arnott's Huntingwood facility to the NPI[1], the main emission to air is ammonia, which is associated with the use of ammonium bicarbonate in some products as a leavening agent; when these products are baked, ammonia gas is released causing the goods to rise. The annual emissions of ammonia from the facility are estimated for the purposes of NPI reporting based on the assumption that all ammonium bicarbonate (NH_4HCO_3, with a molecular weight of 79.06 kg/kmol) consumed at the facility is converted to ammonia (NH_3, molecular weight of 17.03 kg/mol). That is:

$$NH_3 \text{ (kg)} = NH_4HCO_3 \text{ (kg)} \times 17.03/79.06$$

The next most significant group of emissions are the key combustion-related pollutants (NO_X, CO, PM_{10}, $PM_{2.5}$, total VOCs and SO_2). A very small portion of these emissions are identified as being fugitive in nature (not discharged via a stack or vent) and are therefore expected to be associated with diesel and LPG combustion in forklifts and other mobile plant, however the vast majority are associated with gas combustion in the baking ovens, boilers and hot water heaters. Very small quantities of metals and individual VOCs are also reported as being emitted, which will be associated with trace emissions from fuel combustion.

The emissions from fuel combustion at the facility are estimated for the purposes of NPI reporting based on the quantities of natural gas, LPG and diesel consumed by the facility over the year (based on purchasing records, gas meter readings etc) and emission factors provided in the relevant NPI Emission Estimation Technique Manual (EETM) for the type of combustion source (e.g. the *NPI EETM for Boilers* or the *EETM for Combustion Engines* etc). These emission factors are developed to provide conservatively high estimates of emissions to address the uncertainties associated with the emission estimates not being based on the engine specifications or emission test results etc.

As discussed in **Section 1.1**, DPIE has requested that a quantitative air dispersion modelling assessment be performed for the operational emissions associated with the Project. As the data available on the NPI database are annual average emission rates (not representative of peak emissions) and the dataset does not contain stack parameters required for a modelling study (stack exhaust temperature and velocity, etc.), , a stack testing program was performed to quantify emissions from selected emissions points in the existing facility. This is discussed further in **Section 8.3**.

5.2.2 Proposed Emissions

Based upon a review of the new activities that are proposed as part of the facility expansion (presented in **Section 3.2**), potential air emission sources associated with the operational phase have been identified as follows:

- Odours from the ovens on the existing and new manufacturing lines;
- Odours from on-site handling and storage of solid and liquid waste;
- Products of combustion from the gas-fired ovens on the existing and new manufacturing lines;
- Increased ammonia emissions associated with an increase in use of ammonium bicarbonate in the existing baking lines; and

[1] 2019/2020 report for Arnott's Biscuits Limited, Arnotts Biscuits Huntingwood - Huntingwood, NSW, http://www.npi.gov.au/npidata/action/load/emission-by-individual-facility-result/criteria/state/NSW/year/2020/jurisdiction-facility/907

- Products of combustion from mobile plant (forklifts etc) and incoming/outgoing delivery trucks.

In addition to odour, particulates are also emitted from bakery operations in the form of fumes. Cooking methods such as solid fuel-fired cooking produce the most significant quantities of particulate matter. There is a very low potential for significant particulate matter emissions from the existing and proposed gas-fired ovens at the Arnott's Site, except under upset operating conditions.

5.2.2.1 Odour

Odour is the principal air emission of concern from the new processing facility and will be primarily generated from the baking processes. There is also the potential for odour emissions from the waste management operations on the Site.

Impacts from odorous air contaminants are often nuisance-related rather than health-related. There are various elements that are commonly regarded as combining to cause odour nuisance, which are listed below and are collectively known as the FIDOL factors:

- *Frequency:* how often the odour occurs;
- *Intensity:* how strong the odour is perceived to be;
- *Duration:* how long the odour is present for;
- *Offensiveness:* how offensive the odour is perceived to be; and
- *Location or Context:* where the person is experiencing the odour.

Other factors may also come into play when assessing odour impacts, such as:

- *Population sensitivity:* any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it may contain.
- *Background level:* whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- *Public expectation:* whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.

Baking Odours

Odorous emissions from bakeries are the result of complex mixtures of odorous VOCs, which are formed in the baking process as a result of chemical reactions between sugars and amino acids in the dough and breakdown of natural fats and oils.

The addition of chocolate manufacturing as part of the expansion will result in a change in the character of the odour emitted from this part of the operations compared to the current situation, however the hedonic tone of the odours can be expected to be pleasant to the vast majority of the population which would have significantly lower annoyance potential than unpleasant/neutral odours.

Odour emissions from bakeries may be effectively managed through the implementation of a combination of physical and management measures. This is discussed further in **Section 10**.

Handling and Storage of Raw Materials and Waste

If not appropriately managed, some raw ingredients delivered to the Site could be a source of odour emissions. Solid and liquid organic waste produced on site also has the potential to be a source of odour emissions. The most effective way to minimise odours from the ingredient and waste storage and handling areas is by ensuring all material is stored at appropriate temperatures and that all areas are well ventilated.

Odour emissions from the ingredient storage and waste storage/treatment areas can be directly released into the atmosphere through openings in the buildings. While not all such emissions can be captured by air extraction systems (e.g. slightly positive pressures are required for chilled warehouse, odour emissions from waste being transferred off site will be emitted directly to atmosphere, etc.), suitable air extraction systems are being designed for all processing and storage areas to ensure odorous air is extracted in compliance with relevant AS and BCA guidelines. Moreover, it is understood that:

- Containment measures for spillages will be provided at appropriate locations to reduce odorous emissions from waste spillages;
- Solid organic waste and general waste will be removed from site for off-site disposal on a daily basis on Monday to Friday; and
- The refrigerated warehouse areas will ensure that all perishable food is kept at an appropriate temperature to avoid spoiling.

Odour emissions from food and waste handling and storage may be effectively managed through the implementation of a combination of physical and management measures. Refer to **Section 10**.

5.2.2.2 Products of Combustion

Gas-Fired Ovens

Emissions associated with the combustion of natural gas in the existing and new ovens will include carbon monoxide (CO) and oxides of nitrogen (NO_x). There will also be very low levels of emission of particulate matter (PM_{10} and $PM_{2.5}$) and volatile organic compounds (VOCs). Emissions of sulfur dioxide (SO_2) from fossil fuel combustion are directly linked to the amount of sulfur in the fuel. As Australian natural gas contains only trace amounts of sulfur, SO_2 emissions from the ovens will be minimal.

The gas consumption for the current facility operations is approximately 15,000 GJ/month of gas in the ovens (equivalent to approximately 12,400 m^3/day, based on a heating value for town gas of 39 MJ/m^3 (DEE, 2017)). This is expected to increase as result of the expansion in proportion to the proposed increase in production capacity. The emissions from the burners on the existing ovens are vented directly to atmosphere via stacks that extend 5 m above the roof of the building (see **Figure 9**), and this will also be the case for the new ovens.

Given the above, it is expected that current combustion product emissions from the site are likely to increase by approximately 25% as a result of the proposed expansion.

Figure 9 Photograph of Existing Bakery Building Showing Oven Stacks

Mobile Plant and Delivery Vehicles

Emissions associated with the combustion of fuel (diesel, petrol, etc.) in mobile plant and delivery/staff/service vehicles will include CO, NO_x, PM_{10} and $PM_{2.5}$, sulfur dioxide (SO_2) and VOCs. The rate and composition of air pollutant emissions from road vehicles is a function of a number of factors, including the type, size and age of the vehicles, the type of fuel combusted, number and speed of vehicles and the road gradient.

Table 4 indicates that the Project will result in a 30% increase in vehicle movements at the Site, giving a total of 69 vehicle movements per day (61 of these being heavy vehicles). To put this into context, the existing morning peak traffic volumes for the surrounding road network are presented in **Table 6**.

Table 6 Morning Peak Traffic Volumes – Surrounding Road Network

Location	Light Vehicle Movements	Heavy Vehicle Movements
Horsley Dr & Cowpasture Rd Roundabout	3,611	313
Cowpasture Rd & The Horsley Dr Signals	3,272	631
Cowpasture Rd & Victoria St Roundabout	1,532	315
Cowpasture Rd & Trivet St Intersection	1,217	109

Source: Ason Group

Given the scale of on-site vehicle parking and proposed increases in delivery truck operations it is considered that the emissions generated due to the combustion of fuel in light and heavy vehicles generated by the Project will be negligible compared to the emissions generated by traffic on the surrounding road network (and the gas-fired ovens and boilers) and do not represent a major increase relative to the current on-Site operations. Therefore, emissions from mobile plant and delivery vehicles have not been considered further in this assessment.

5.2.2.3 Ammonia

Products that will be produced in the new baking lines will not use ammonium bicarbonate as a leavening agent. However, the added capacity may provide opportunity for more of the products containing ammonium bicarbonate to be produced on Line 1. Therefore, while the site throughput is proposed to increase by approximately 25% as a result of the expansion, the consumption of ammonium bicarbonate (and thus ammonia emissions) is expected to increase by only 5%-10% compared to current levels.

6 Regulatory Framework

6.1 Relevant Legislation, Policy and Guidance

The following Air Quality Policy and Guidance documents have been referenced within this assessment and have been used to identify the relevant air quality criteria.

6.1.1 Protection of the Environment Operations (POEO) Act 1997 & Amendment Act 2011

The POEO Act (and Amendment Act 2011) is a key piece of environment protection legislation administered by the NSW Department of Planning, Industry and Environment's Environment, Energy and Science (EES) group which enables the Government to establish instruments for setting environmental standards, goals, protocols and guidelines.

The following sections of the POEO Act are of general relevance to the Site:

- Section 124 and 125 of the POEO Act states that any plant located at a premise (e.g. the oven exhaust fans at the Site) should be maintained in an efficient condition and operated in a proper and efficient manner to reduce the potential for air pollution.
- Section 126 of the POEO Act requires that materials (e.g. raw ingredients and waste storage/disposal at the Site) are managed in a proper and efficient manner to prevent air pollution (e.g. odour).
- Section 128 of the POEO Act states:
    1. The occupier of a premises must not carry out any activity or operate any plant in or on the premises in such a manner to cause or permit the emission at any point specified in or determined in accordance with the regulation of air impurities in excess of [the standard of concentration and/or the rate] prescribed by the regulations in respect of any such activity or any such plant.
    2. Where neither such a standard nor rate has been so prescribed, the occupier of any premises must carry on activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution.

6.1.2 Protection of the Environment Operations (Clean Air) Regulation 2010

The POEO (Clean Air) Regulation 2010 (the Regulation) is the core regulatory instrument for air quality issues in NSW. In relation to industry, the Regulation:

- sets maximum limits on emissions from activities and plant for a number of substances;
- deals with the transport and storage of volatile organic liquids;
- restricts the use of high sulphur liquid fuel; and
- imposes operational requirements for certain afterburners, flares, vapour recovery units and other treatment plant.

Part 5 of the POEO (Clean Air) Regulation 2010 (the Regulation) also deals with emissions of air impurities from activities and plant, and sets maximum limits on emissions for a number of substances (including solid particles and visible smoke) as noted below in **Table 7**, with the limits relevant to the Site highlighted. The standards of concentrations prescribed by Part 5, Division 3 do not apply to plant during start up and shutdown periods, however such emissions are still subject to the requirements of Section 128 (2) of the POEO Act in relation to the prevention and minimisation of air pollution.

Table 7 Schedule 6 Standards of Concentration for (Group C[1]) Non-Scheduled Premises

Air Impurity	Activity	Concentration [2]
Particles	Any activity/ plant	100 mg/m^3
Smoke	Solid fuel is burnt	Ringlemann 1 or 20% opacity
	Liquid fuel is burnt	Ringlemann 1 or 20% opacity

Note 1 Group C: Activity granted DA consent and commenced to operate after 1 September 2005.

Note 2 Reference conditions are: Dry, 273 K, 101.3 kPa for any activity.

6.1.3 NSW Environment Protection Authority Air Quality Policy and Guidance

The EPA is the NSW regulatory authority responsible for air quality regulation and associated activities.

NSW Environment Protection Authority document, *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (hereafter 'the Approved Methods') (EPA 2017), lists the statutory methods for modelling and assessing air pollutants from stationary sources and specifies criteria which reflect the environmental outcomes adopted by the EPA. The Approved Methods are referred to in the POEO (Clean Air) Regulation 2002 for assessment of impacts of air pollutants. The air quality criteria set out in the Approved Methods have been reproduced and discussed in **Section 6.2**.

6.1.4 Odour Technical Framework and Notes

The EPA publications, *Technical Framework: Assessment and management of odour from stationary sources in NSW* and the associated *Technical Notes* (the Odour Policy) (NSW DEC, 2006) provide a policy framework for assessing and managing activities that emit odour and offers guidance on dealing with odour issues.

6.1.5 Local Air Quality Toolkit

The Local Government Air Quality Toolkit (AQ Toolkit) has been developed by the EPA to assist local government in their management of air quality issues and provides guidelines for air quality management and for the use of air pollution control techniques. Relevant AQ Toolkit air quality guidance notes include:

- Dust from urban construction sites (NSW EPA, 2007a);
- Construction sites (NSW EPA, 2007b); and
- Food outlets (NSW EPA, 2007c).

6.1.6 Building Code of Australia and Australian Standards

The Building Code of Australia (BCA) is produced and maintained by the Australian Building Codes Board (ABCB) on behalf of the Australian Government with the aim of efficiently achieving nationally consistent, minimum necessary standards of relevant health and safety, amenity and sustainability objectives. The BCA contains mandatory technical provisions for the design and construction of BCA class buildings.

Australian Standard (AS) 1668.2-2012 *The use of ventilation and air conditioning in building, Part 2: Ventilation design for indoor air contaminant control* sets design requirements for mechanical ventilation systems. Mechanical ventilation is required in enclosures where specific health and ventilation amenity requirements cannot be met by natural means.

Section 3.10.1 states of the AS states "*All exhaust air shall be discharged to atmosphere in such a manner not to cause danger or nuisance to occupants in the building, occupants of neighbouring buildings or members of the public*."

Section 5 of the AS states the following:

- **5.2.2 Exhaust locations**: As far as practicable, exhaust-air intakes used for general exhaust-air collection shall be located on the opposite sides of the enclosure from the sources of make-up air, to ensure that the effluents are effectively removed from all parts of the enclosure.
- **5.3.2.1 General requirements**: The effluent shall be collected as it is being produced, as close as practicable to the source of generation.
- **5.10.1 Air discharges**: Where discharges are deemed to be objectionable (i.e. nuisance related), discharges shall:
  - Be emitted vertically with discharge velocities not less than 5 m/s.
  - Be situated at least 3 m above the roof at point of discharge.
  - Treated to reduce the concentration of contaminants where required.
  - Be emitted to the outside at velocities and in a direction that will ensure, to the extent practicable, a danger to health or a nuisance will not occur.
  - Be situated a minimum separation distance of 6 m (where the airflow rate is ≥ 1,000 L/s) from any outdoor) air intake opening, natural ventilation device or opening, and boundary to an adjacent allotment, except that where the dimensions of the allotment make this impossible, then the greatest possible distance shall apply.

6.2 Ambient Air Quality Criteria

Ambient air quality criteria for the identified pollutants of concern are prescribed by Section 7.1 of the Approved Methods. The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW and are considered to be appropriate for the setting. Those relevant to the identified emission sources at the Project are discussed below.

It is noted that a qualitative (risk-based) assessment has been performed for construction impacts as well as odour impacts during the operational stage, to identify activities that have the potential for off-site air quality impacts if not adequately controlled, so that appropriate mitigation measures can be identified and incorporated into the project design and relevant environmental management plans. Therefore, the Project's compliance with criteria relevant to those activities is not able to be presented as part of this assessment report. As requested by DPIE, the quantitative assessment has been limited to ammonia and combustion gas impacts due to the operation of the gas-fired ovens and boilers. Nevertheless, odour and particulate matter criteria have been included for reference and to assess the existing background air quality in **Section 7**.Odour

Impacts from odorous air contaminants are often nuisance-related rather than health-related. Odour performance goals guide decisions on odour management, but are generally not intended to achieve "no odour".

The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the *odour threshold* and defines one odour unit (ou). An odour goal of less than 1 OU would theoretically result in no odour impact being experienced.

In practice, the character of a particular odour can only be judged by the receiver's reaction to it, and preferably only compared to another odour under similar social and regional conditions. Based on the literature available, the level at which an odour is perceived to be a nuisance can range from 2 ou to 10 ou depending on a combination of the following factors:

- **Odour quality**: whether an odour results from a pure compound or from a mixture of compounds. Pure compounds tend to have a higher threshold (lower offensiveness) than a mixture of compounds.
- **Population sensitivity**: any given population contains individuals with a range of sensitivities to odour. The larger a population, the greater the number of sensitive individuals it contains.
- **Background level**: whether a given odour source, because of its location, is likely to contribute to a cumulative odour impact. In areas with more closely-located sources it may be necessary to apply a lower threshold to prevent offensive odour.
- **Public expectation**: whether a given community is tolerant of a particular type of odour and does not find it offensive, even at relatively high concentrations. For example, background agricultural odours may not be considered offensive until a higher threshold is reached than for odours from a landfill facility.
- **Source characteristics**: whether the odour is emitted from a stack (point source) or from an area (diffuse source). Generally, the components of point source emissions can be identified and treated more easily than diffuse sources. Emissions from point sources can be more easily controlled using control equipment. Point sources tend to be located in urban areas, while diffuse sources are more often located in rural locations.
- **Health effects**: whether a particular odour is likely to be associated with adverse health effects. In general, odours from agricultural activities are less likely to present a health risk than emissions from industrial facilities.

The NSW EPA recommends within the Technical Framework that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 ou. This is based on experience gained through odour assessments from proposed and existing facilities in NSW indicating that an odour performance goal of 7 ou is likely to represent the level below which "offensive" odours should not occur (for an individual with a 'standard sensitivity' to odours).This is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour performance goals need to be designed to take into account the range in sensitivities to odours within the community, and provide additional protection for individuals with a heightened response to odours, using a statistical approach which depends on the size of the affected population. As the affected population size increases, the number of sensitive individuals is also likely to increase, which suggests that more stringent goals are necessary in these situations. In addition, the potential for cumulative odour impacts in relatively sparsely populated areas can be more easily defined and assessed than in highly populated urban areas. It is often not possible, or practical, to determine and assess the cumulative odour impacts of all odour sources that may impact on a receptor in an urban environment. Therefore, the proposed odour performance goals allow for population density, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

The equation used by the NSW EPA to determine the appropriate impact assessment criteria for complex mixtures of odorous air pollutants, as specified in the Odour Framework, is expressed as follows:

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

A summary of the impact assessment criteria given for various population densities, as drawn from the Odour Framework*,* is given in **Table 8**. For areas such as that surrounding the Site, the relevant odour impact assessment criterion set by the Approved Methods for complex mixtures of odorous air pollutants is 2 ou (nose-response-time average, 99th percentile). As noted above, a quantitative odour modelling assessment has not been performed as part of this study, hence compliance with the criterion cannot be demonstrated. As discussed in **Section 4.1**, the facility is not aware of any complaints or concerns from the local community regarding odours from the existing operations.

Table 8 NSW EPA Impact Assessment Criteria for Complex Mixtures of Odorous Air Pollutants

Population of Affected Community (number of receptors)	Impact Assessment Criteria for Complex Mixtures of Odours (ou) (nose-response-time average, 99th percentile)
Urban area (≥ 2000)	2
~500	3
~125	4
~30	5
~10	6
Single residence (≤ 2)	7

6.2.1 Products of Combustion and Fugitive Dust

It is noted that the criteria outlined below present the current ambient air quality criteria adopted by the NSW Government, which are based on the standards set out in the National Environment Protection (Ambient Air Quality) Measure (the AAQ NEPM). On 15 April 2021, The National Environmental Protection Council agreed to vary the AAQ NEPM and on 18 May 2021 the ambient air standards for NO_2 and SO_2 were amended. These changes to the standards for NO_2 and SO_2 include:

- NO_2:
  - The 1-hour standard for NO_2 in the AAQ NEPM is retained, however the numerical value of the standard has been reduced to 80 ppb (previously 120 ppb).
  - The annual standard for NO_2 in the AAQ NEPM is retained, however the numerical value of the standard has been reduced to 15 ppb (previously 30 ppb).
  - The form of both the 1-hour and annual NO_2 standards are as maximum values with no allowable exceedances.
- SO_2:
  - The 1-hour standard for SO_2 in the AAQ NEPM is retained, however the numerical value of the standard has been reduced to 100 ppb (previously 200 ppb).
  - A future 1-hour SO_2 standard of 75 ppb will be implemented from 2025.
  - The 24-hour standard for SO_2 in the AAQ NEPM will be retained, however the numerical value of the standard has been reduced to 20 ppb (previously 80 ppb).
  - No future target for 24-hour average SO_2 concentrations is proposed at this stage.
  - The current annual mean standard for SO_2 has been removed from the AAQ NEPM.
  - The form of both the revised 1-hour and 24-hour SO_2 standards are as maximum values with no allowable exceedances.

It is not yet known if or when the Approved Methods will be amended to reflect the recent changes to the AAQ NEPM and therefore this AQIA considers the NO_2 and SO_2 ambient air quality criteria as published in the Approved Methods and those in the current AAQ NEPM. The AQIA air quality criteria for the pollutants of concern during the operational phase of the Project as outline din the Approved Methods are provided below**.** Predictive modelling output is generally in the form of mass concentrations (mass of pollutant per volume of air) and therefore in this context it is preferable to present these criteria as mass concentrations for consistency.

Carbon Monoxide

CO is an odourless, colourless gas formed from the incomplete burning of fuels. CO bonds to the haemoglobin in the blood and reduces the oxygen carrying capacity of red blood cells, thus decreasing the oxygen supply to the tissues and organs, in particular the heart and the brain.

CO in urban areas results almost entirely from vehicle emissions and its spatial distribution follows that of traffic flow. The highest concentrations are found at the kerbside, with concentrations decreasing rapidly with increasing distance from the road.

The impact assessment criteria specified within the Approved Methods for CO are provided in **Table 9**.

Table 9 Impact Assessment Criteria for Carbon Monoxide (CO)

Pollutant	Averaging Period	Criterion
CO	15-minutes	87 ppm (100 mg/m^3)
	1-hour	25 ppm (30 mg/m^3)
	8-hour	9 ppm (10 mg/m^3)

Note: ppm = parts per million

Oxides of Nitrogen

NO_X is a general term used to describe any mixture of nitrogen oxides formed during combustion. In atmospheric chemistry NO_X generally refers to the total concentration of nitric oxide (NO) and nitrogen dioxide (NO_2).

NO is a colourless and odourless gas that does not significantly affect human health. However, in the presence of oxygen, NO can be oxidised to form NO_2 which can have significant health effects including damage to the respiratory tract and increased susceptibility to respiratory infections and asthma. Long term exposure to NO_2 can lead to lung disease.

NO will be converted to NO_2 in the atmosphere after being emitted. The impact assessment criteria specified within the Approved Methods for NO_2 are provided in **Table 10**.

Table 10 Impact Assessment Criteria for Nitrogen Dioxide (NO_2)

Pollutant	Averaging Period	Criterion
NO_2	1-hour	12 pphm (246 µg/m^3)
	Annual	3 pphm (62 µg/m^3)

Note: pphm = parts per hundred million

Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP).

The annual impact assessment criteria for TSP recommended by the NSW EPA is 90 µg/m^3. The TSP impact assessment criteria was developed before the more recent results of epidemiological studies which suggested a relationship between health impacts and exposure to concentrations of finer particulate matter.

PM_{10} and $PM_{2.5}$ are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

The impact assessment criteria specified within the Approved Methods for suspended particulate matter are provided in **Table 11**.

Table 11 Impact Assessment Criteria for Suspended Particulate Matter

Pollutant	Averaging Period	Criterion
TSP	Annual	90 µg/m^3
PM_{10}	24-hour	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24-hour	25 µg/m^3
	Annual	8 µg/m^3

Deposited Particulate

The criteria presented above are concerned in large part with the health impacts of airborne particulate matter. Nuisance impacts from fugitive dust emissions during the construction phase also need to be considered, mainly in relation to deposited dust.

In NSW, accepted practice regarding the nuisance impact of dust is that dust-related nuisance can be expected to impact on residential areas when annual average dust deposition levels exceed 4 grams per square metre per month (g/m^2/month).

Table 12 presents the impact assessment criteria set out in the Approved Methods for dust deposition, showing the allowable increase in dust deposition level over the ambient (background) level to avoid dust nuisance.

Table 12 EPA Impact Assessment Criteria for Allowable Dust Deposition

Averaging Period	Maximum Increase in Deposited Dust Level	Maximum Total Deposited Dust Level
Annual	2 g/m^2/month	4 g/m^2/month

Source: Approved Methods, EPA 2017

Sulphur Dioxide

SO_2 is a colourless, pungent gas with an irritating smell. When present in sufficiently high concentrations, exposure to SO_2 can lead to impacts on the upper airways in humans (i.e. the noise and throat irritation). SO_2 can also mix with water vapour to form sulphuric acid (acid rain) which can damage vegetation, soil quality and corrode materials.

Main sources of SO_2 in the air are industries that process materials containing sulphur (e.g. wood pulping, paper manufacturing, metal refining and smelting, textile bleaching, wineries etc.). SO_2 is also present in motor vehicle emissions, however since Australian fuels are relatively low in sulphur, high ambient concentrations are not common.

The impact assessment criteria specified within the Approved Methods for SO_2 are provided in **Table 13**.

Table 13 Impact Assessment Criteria for Sulphur Dioxide (SO_2)

Pollutant	Averaging Period	Criteria
SO_2	10-minutes	25 pphm (712 µg/m^3)
	1-hour	20 pphm (570 µg/m^3)
	24-hour	8 pphm (228 µg/m^3)
	Annual	2 pphm (60 µg/m^3)

Note: pphm = parts per hundred million

6.2.2 Ammonia

Ammonia is a colourless gas with a characteristically pungent smell. When present in sufficiently high concentrations, exposure to high concentrations of ammonia in air causes immediate burning of the eyes, nose, throat, and respiratory tract and can result in blindness, lung damage or death. Inhalation of lower concentrations can cause coughing, and nose and throat irritation.

Agricultural activities are the main source of ammonia emissions. Other sources of ammonia include industrial processes, vehicular emissions and volatilisation from soils and oceans.

The human-health based impact assessment criterion specified within the Approved Methods for ammonia is presented in **Table 14**. The odour threshold for ammonia is higher than the Approved Methods criterion, therefore compliance with this criterion would indicate no potential risk of nuisance odour impacts.

Table 14 Impact Assessment Criterion for Ammonia

Pollutant	Averaging Period	Criterion
Ammonia	1-hour	0.46 ppm (0.33 mg/m^3)

Note: ppm = parts per million

Source: Approved Methods, EPA 2017

6.3 Recommended Separation Distances

The application of minimum recommended separation distances (or 'buffer' distances) provides a valuable screening tool to judge whether a detailed assessment is required to evaluate the potential risk of conflicting land uses. Separation distances provide guidance on the appropriate level of separation between a source of emissions and sensitive land uses in order to mitigate the impacts of intended and unintended emissions on people. This approach relies on the knowledge that impacts on the environment generally decrease with increasing distance from the source of emissions. Separation distances are based on an understanding of the types of emissions associated with various industries and their potential impacts on people. These distances can vary based on the scale and size of the industry, location topography, prevailing winds and other factors.

There are no separation guidelines issued by NSW EPA, hence the following sections refer to guidelines set by other regulatory agencies in Australia. These recommended separation distances have been developed to be applied to sensitive uses, such as residential dwellings, schools, hospitals and childcare centres. They are designed to be conservative estimates of potential areas downwind that could be impacted by odour or dust nuisance, air quality health related impacts, noise impacts and/or hazards. They are generally developed based on past experience with these types of operations and the associated monitoring programs, impact assessments and complaints records.

Given that the ambient air quality criteria in all States and Territories are similar, with the overarching ambient air quality standards set out for Australia in the relevant National Environment Protection Measures (covering the common criteria pollutants and key air toxics) also applying nationally, it is considered appropriate to reference separation guidelines from jurisdictions outside of NSW for use as a screening-level assessment to determine whether further, more detailed assessment is warranted.

Australian Capital Territory EPA

The document '*Separation distance guidelines for air emissions*', published by ACT EPA (ACT Government, 2018) includes recommended minimum separation distances for activities identified in **Section 6.3**, as shown in **Table 15**. The guidelines note that these separation distances apply to air emissions only and that certain activities may require further separation for noise emissions.

Table 15 Recommended Separation Distances, ACT EPA

Project Component	Relevant Industry	Activity Notes	Separation Distance (m)
Bakery	Bakery	> 40 tonnes/day < 40 tonnes/day	100 See note ~
Handling and Storage of Food and Waste	NA	NA	NA
Operational Phase Traffic	NA	NA	NA

Source: (ACT Government, 2018)

~ For food and beverage manufacturing where no separation distances are specified. For these cases it is recommended that there be no visible discharge of dust or emission of odours offensive to humans, beyond the boundary of the premises, subject to the adoption of BATEA.

As noted in **Section 3.2**, facility currently produces approximately 55,000 tonnes of products per year, which is projected to increase to around 68,000 tonnes per year after the expansion. On a daily basis (assuming 365 days/year operation), both the current and proposed throughputs are greater than the 40 tonnes/day (tpd) threshold above which the 100 m separation distance recommendation applies.

Victoria EPA

The Victoria EPA document '*Recommended separation distances for industrial residual air emissions*', Publication No. AQ 1518 (EPAV, 2013) includes minimum recommended separation distances for relevant activities identified in **Section 5.2**, as shown in **Table 16**. The Victoria EPA document notes that "*noise, vibration, ambient and hazardous air pollutants have not been considered in the development of this guideline*".

Table 16 Recommended Separation Distances, VIC EPA

Project Component	Relevant Industry	Activity Notes	Separation Distance (m)
Processing facility	Bakery	> 200 tonnes/year < 200 tonnes/year	100 See note *
Handling and storage of food and waste	NA	NA	NA
Operational phase traffic	NA	NA	NA

Source: (EPAV, 2013)

* For food and beverage manufacturing producing less than 200 tonnes of product per year, no separation distances are specified. For these cases, EPA recommends there is no visible discharge of dust or emissions of odours offensive to the senses of human beings, beyond the boundary of the premises.

As outlined above, the throughput of the facility is proposed to increase from approximately 55,000 tonnes/year, to around 68,000 tonnes/year. This is well above the 200 tpy threshold to which the 100 m separation distance applies. Therefore, the 100 m separation distance recommended by the Victoria EPA may be considered applicable to the Project operations.

South Australia EPA

The document '*Evaluation distances for effective air quality and noise management*' published by South Australian EPA (EPA SA, 2016) includes recommended evaluation distances for relevant activities identified in **Section 5.2**, as shown in **Table 17**. As indicated by the document title, these guidelines consider both air quality and noise impacts.

Table 17 Recommended Separation Distances, SA EPA

Project Component	Relevant Industry	Activity Notes	Separation Distance (m)
Processing facility	Bakery	>20 tonnes/week of ingredients	200
Handling and storage of food and waste	NA	NA	NA
Operational phase traffic	NA	NA	NA

Source: (EPA SA, 2016)

Based on the annual production rates noted above, the equivalent weekly throughputs are approximately 1,060 tonnes/week, increasing to 1,310 tonnes/week. Assuming the total ingredient weight is approximately equal to total product weight, the 200 m separation distance recommendation would apply to both current and proposed operations.

Western Australia EPA

In the Western Australia Environmental Protection Authority (WA EPA) policy documentation for minimum recommended separation distances - *Separation distances between Industrial and Sensitive Land Uses* (WA EPA, 2015), the WA EPA makes recommendations for assessing appropriate separation distances where amenity may be reduced for sensitive or incompatible land uses. Sensitive land uses which warrant protection from amenity-reducing off-site effects of industry by maintenance of a separation distance include residential areas and zones, hospitals and schools.

The WA EPA document lists a number of industries with their recommended separation distances and states that where the appropriate separation distance is unable to be provided by the emitter, the impact on neighbouring land uses may be reduced by careful site layout. EPAWA 2015 further states that '*It is not the purpose of a separation distance to 'sterilise' land from development; non-sensitive land uses can be located within the area between the source of emissions and sensitive land use*.'

The WA EPA recommends EPA consultation where site-specific circumstances indicate a lesser separation distance may be appropriate (i.e. where there is no history of complaints arising from residual emissions or where the plant is significantly smaller than that used in the recommendations etc.). A summary of the separation distances specified by WA EPA that may be applicable to the Site is provided in **Table 18**.

Table 18 Recommended Separation Distances, WA EPA

Project Component	Relevant Industry	Activity Notes	Separation Distance (m)
Processing facility	Bakeries	Depending on size	100-200
Handling and storage of food and waste	NA	NA	NA
Operational phase traffic	NA	NA	NA

Source: Appendix 1, (WA EPA, 2015)

In relation to the proposed processing facility, according to the WA EPA document a separation distance of 100 m to 200 m may be applicable depending on the size. However, it is noted that the document does not specify thresholds for the separation distance requirements. Given the scale of the Project, however, a separation distance of 200 m may be considered applicable to the Project.

Summary

In relation to the proposed processing facility, a separation distance of 100 m to 200 m may be considered applicable depending on the referenced document and bakery production capacity. As a conservative measure, a separation distance of 200 m from the Site is considered appropriate for both the current and proposed throughput (ie covers the potential cumulative impacts of the facility after the expansion Project is complete).

No separation distance guidelines directly relevant to the handling and storage of food and waste, or operational phase traffic, were identified.

7 Review of Ambient Air Quality Monitoring Data

The NSW EES maintains a network of air quality monitoring stations (AQMSs) across NSW. The nearest such station is located at Prospect, approximately 3.8 km to the east of the Site (see **Figure 5**).

The Prospect AQMS was commissioned in 2007 and is located in William Lawson Park, Myrtle Street, Prospect. It is situated in a residential area and is at an elevation of 66 m. A number of air pollutants and meteorological variables are currently measured by the Prospect AQMS including:

- NO, NO_2 & NO_X
- SO_2
- PM_{10}
- $PM_{2.5}$
- CO

Air pollutant data recorded by the Prospect AQMS were obtained for the calendar years 2015 – 2020. The data are summarised in **Table 19** (red font/shading indicates an exceedance of the relevant criterion), and are presented graphically in **Figure 10** to **Figure 14**. To be consistent with the annual NSW compliance monitoring reports, the data for gaseous pollutants are presented in parts per hundred million (pphm) or parts per million (ppm), rather than µg/m^3 and mg/m^3.

Table 19 Summary of Prospect AQMS Data (2015 – 2020)

Pollutant	CO	NO_2		SO_2		PM_{10}		$PM_{2.5}$	
Averaging Period	Maximum 1-hour	Maximum 1-hour	Annual	Maximum 1-hour	Annual	Maximum 24-hour	Annual	Maximum 24-hour	Annual
Units	ppm	pphm	pphm	pphm	pphm	µg/m^3	µg/m^3	µg/m^3	µg/m^3
2015	1.9	5.3	1.1	2.7	0.1	68.7	17.6	29.6	8.2
2016	1.6	5.3	1.0	2.1	0.1	110.1	18.9	84.9	8.7
2017	1.6	6.0	1.0	2.3	0.1	61.1	18.9	30.1	7.7
2018	1.3	5.1	0.9	2.5	0.1	113.3	21.9	47.5	8.5
2019	5.5	4.9	0.9	2.1	0.1	182.8	26.0	134.1	11.9
2020	2.1	4.3	0.7	1.8	0.1	245.8	20.2	70.8	8.6
Criterion	**25**	**12**	**3**	**20**	**2**	**50**	**25**	**25**	**8**

Notes:

1 For 2015, one (1) exceedance of the 24-hour average PM_{10} and one (1) exceedance of the 24-hour average $PM_{2.5}$ was recorded.

2 For 2016, four (4) exceedances of the 24-hour average PM_{10} and five (5) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

3 For 2017, one (1) exceedance of the 24-hour average PM_{10} and three (3) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

4 For 2018, eight (8) exceedances of the 24-hour average PM_{10} and four (4) exceedances of the 24-hour average $PM_{2.5}$ were recorded.

5 For 2019, 25 exceedances of the 24-hour average PM_{10} and 25 exceedances of the 24-hour average $PM_{2.5}$ were recorded.

6 For 2020, ten (10) exceedances of the 24-hour average PM_{10} and 13 exceedances of the 24-hour average $PM_{2.5}$ were recorded.

Figure 10 1-Hour Average Ambient CO Concentrations - Prospect AQMS (2015 – 2020)

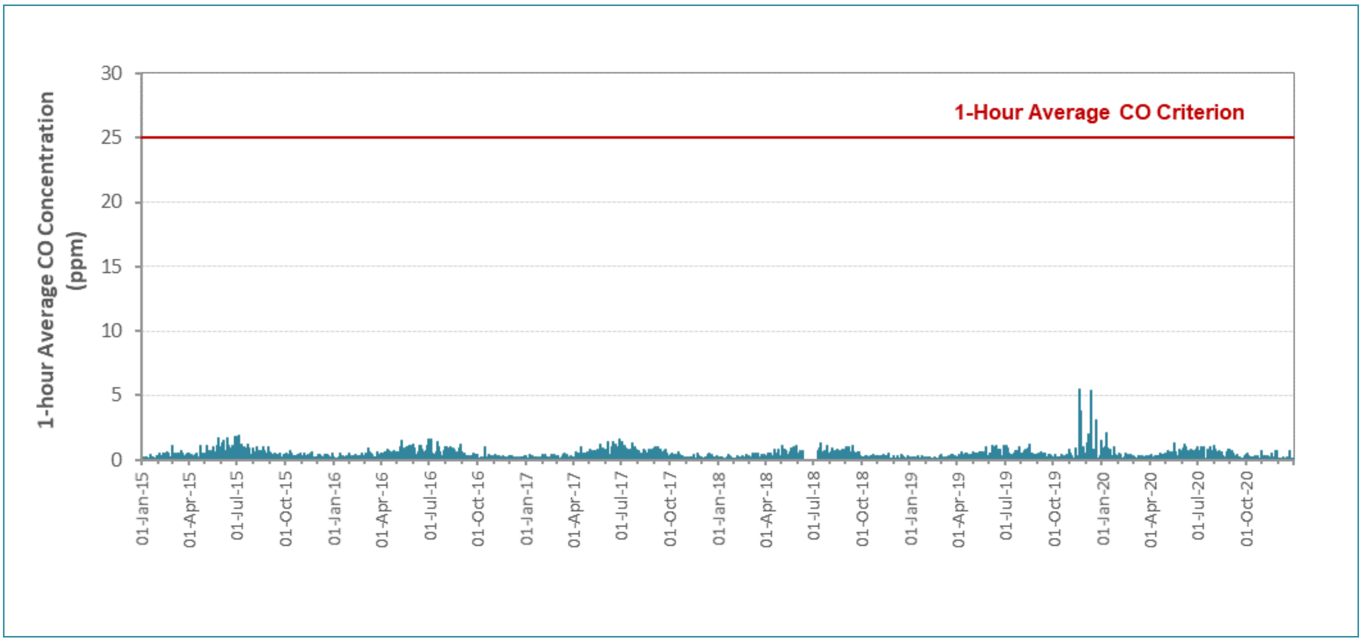


Figure 11 1-Hour Average Ambient NO_2 Concentrations - Prospect AQMS (2015 – 2020)

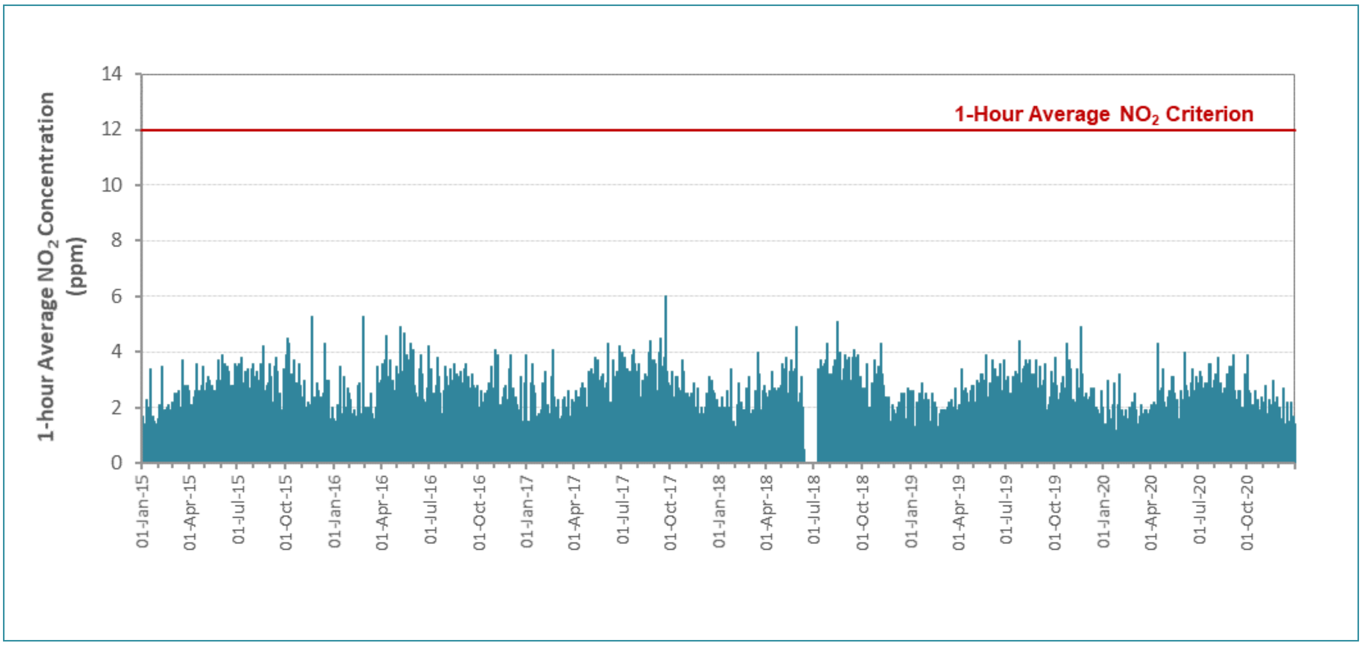


Figure 12 Ambient 1-Hour Average SO_2 Concentrations - Prospect AQMS (2015 – 2020)

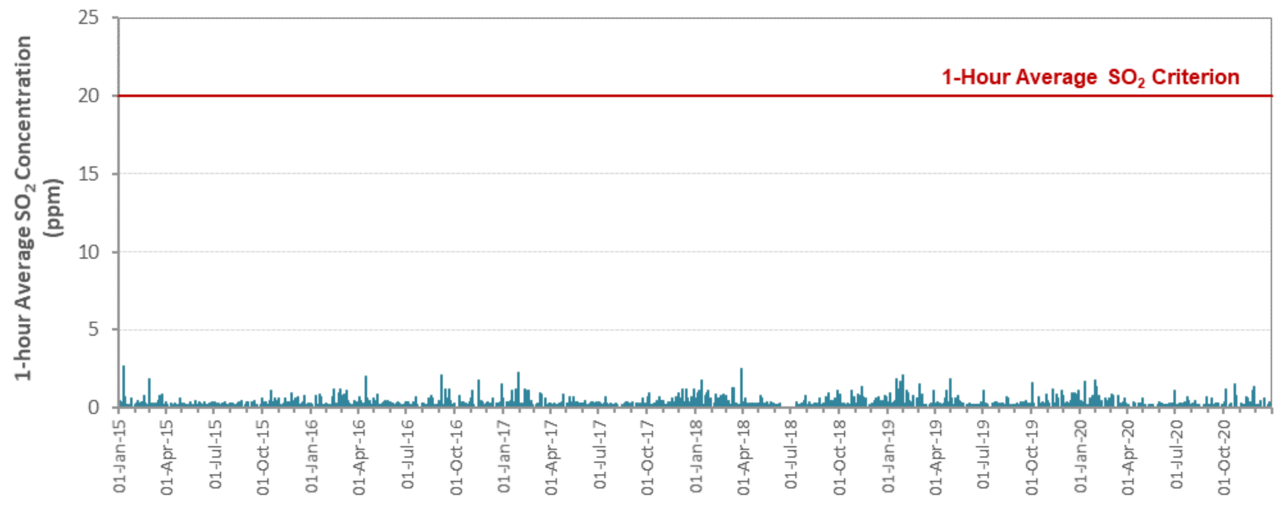


Figure 13 24-Hour Average Ambient PM_{10} Concentrations - Prospect AQMS (2015 – 2020)

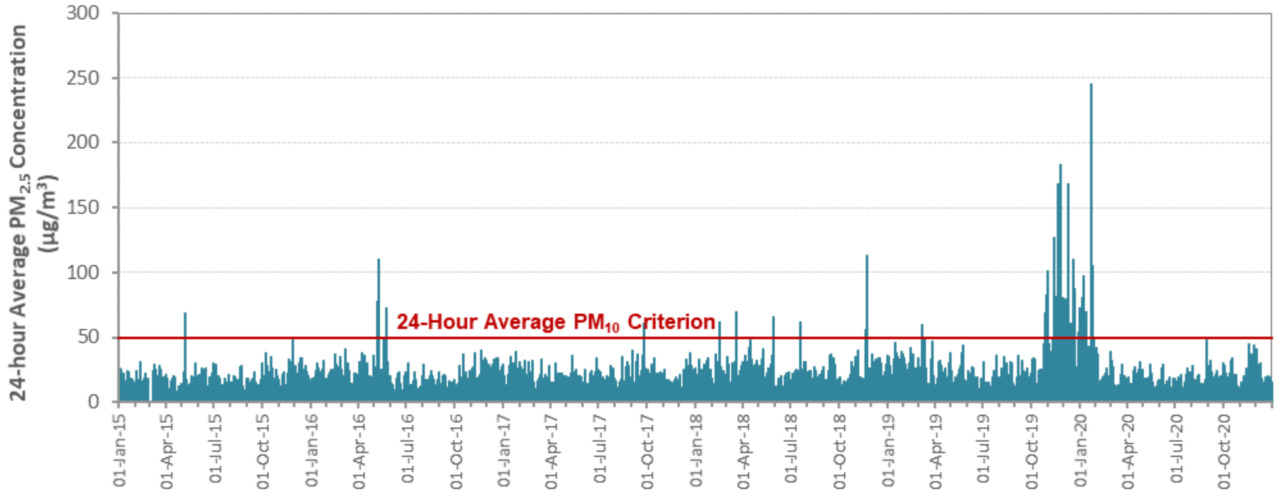
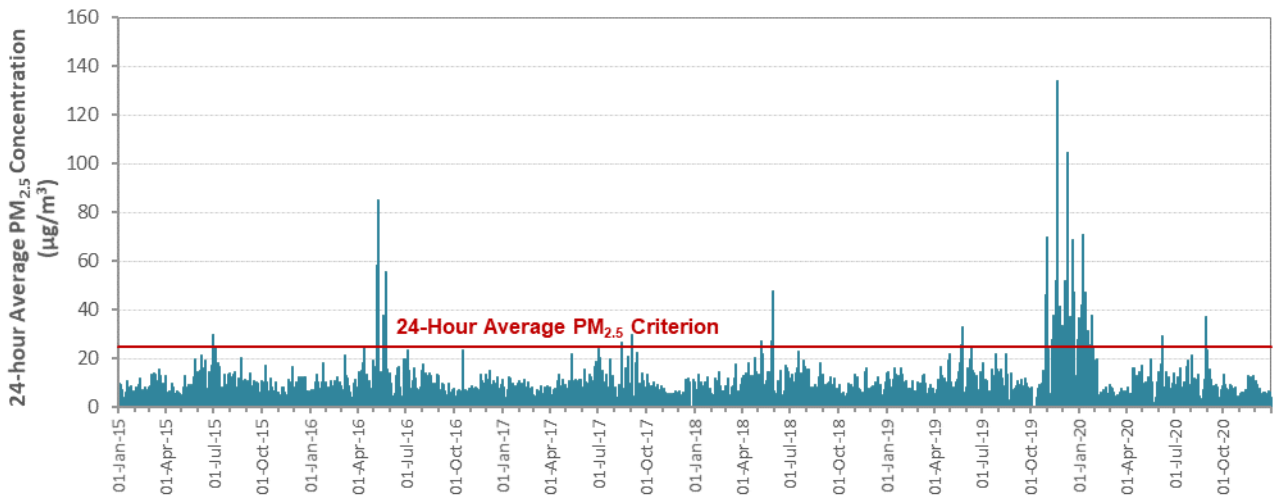


Figure 14 Ambient 24-Hour Average $PM_{2.5}$ Concentrations - Prospect AQMS (2015 – 2020)



A review of the Prospect AQMS data shows that exceedances of the 24-hour average PM_{10} and $PM_{2.5}$ criteria were recorded by the Prospect AQMS in all six years. A review of the available compliance monitoring reports indicates that the exceedances recorded by the Prospect AQMS were primarily due to exceptional events, such as bushfire emergencies, dust storms and hazard reduction burns. The high number of exceedances recorded by the Prospect AQMS in late 2019 and early 2020 was due to the bushfire smoke that affected Sydney and the surrounding areas for a number of weeks over this period.

Exceedances of the annual average $PM_{2.5}$ criterion were also recorded by the Prospect AQMS in in all years investigated except for 2017. Ambient $PM_{2.5}$ concentrations often exceed the annual average criteria set out in the Approved Methods across the Sydney Greater Metropolitan Area. The annual average PM_{10} criterion was only exceeded in 2019, which was primarily due to the abovementioned bushfires in the areas surrounding Sydney in late 2019.

Ambient concentrations of the gaseous pollutants SO_2, NO_2, and CO were all well below the relevant criteria for all years investigated.

8 Assessment Methodology

8.1 Construction Phase Qualitative Impact Assessment

Quantitatively assessing impacts of fugitive dust emissions from construction projects using predictive modelling is seldom considered appropriate, primarily due to the uncertainty in the details of the construction activities, including equipment type, number, location and scheduling, which are unlikely to be available at the time of the assessment. Furthermore, they are also likely to change as construction progresses.

Instead, it is considered appropriate to conduct a qualitative assessment of potential construction related air quality impacts. Potential impacts of dust emissions associated with proposed demolition and construction activities at the Site has been performed based on the methodology outlined in the Institute of Air Quality Management (UK) (IAQM) document, "*Assessment of dust from demolition and construction*" (Holman et al 2014). This guidance document provides a structured approach for classifying construction sites according to the risk of air quality impacts, to identify relevant mitigation measures appropriate to the risk (see **Appendix A** for full methodology).

The IAQM approach has been used widely in Australia for the assessment of air quality impacts from construction projects and the identification of appropriate mitigation measures and has been accepted by regulators across all states and territories for a variety of construction projects.

The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
  - the scale and nature of the works, which determines the potential dust emission magnitude; and
  - the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

It is noted that that accurate information regarding construction activities and equipment are not available at this stage, hence SLR has made conservative assumptions where necessary to assess impacts from construction activities. If these parameters were to be significantly modified, re-assessment of construction impacts is recommended.

8.2 Operational Phase Qualitative Assessment

A risk-based qualitative assessment approach has also been adopted for odour emissions due to the proposed operational activities at the Site as well as air quality impacts due to mobile plant and delivery vehicles (see **Appendix B** for full methodology). Similar to the construction phase air quality assessment, the inputs into the model would for these sources would be subject to a high degree of uncertainty as there is a very high degree of uncertainty associated with quantification of odour emissions from the bakery and waste/food handling. No published emission factors are available for such sources and the emission inventory would need to rely on publicly available odour emissions data measured at other sites, which may handle different types of food and have different management practices. Further, DPIE considered the qualitative assessment of odour impacts to be adequate for the Project and a quantitative assessment of odours has not been requested (refer **Section 1.1**).

The risk-based operational assessment methodology takes account of a range of impact descriptors, including the following:

- **Nature of Impact**: does the impact result in an adverse or beneficial environment?
- **Sensitivity**: how sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: what is the anticipated scale of the impact?

The integration of sensitivity with impact magnitude is used to derive the predicted significance of that change. Given the nature of the operations proposed to be performed, and the limited design data available at the time of preparing this report, it is considered that this approach is appropriate to identify those key activities that have the potential to give rise to off-site air quality impacts, in order that recommended mitigation measures may be identified. If appropriate, these recommendations may include further detailed modelling assessment of key activities to confirm that the proposed mitigation measures will ensure compliance with relevant air quality criteria, once detailed design data is available.

As part of the qualitative risk-based approach adopted for the operational phase odour assessment, published separation distances have been referenced to evaluate the potential risk of conflicting land uses. As there are no separation guidelines issued by NSW EPA, guidelines set by other regulatory agencies in Australia have been reviewed and the most conservative applicable separation distances were adopted for the risk based assessment.

In states where separation distance guidelines are published, the separation distances are typically used as a screening tool to identify if a detailed quantitative assessment is required. As such, these separation distances, which are typically based on quantitative modelling studies, history of complaints and air quality monitoring data are considered to be conservative in nature and overestimate the level of risk associated with emission sources.

8.3 Operational Phase Quantitative Assessment

The assessment of air emissions from the operational phase of the Project has been performed quantitatively through the use of dispersion modelling techniques. Modelling was performed for the following pollutants:

- Nitrogen dioxide (emitted as total oxides of nitrogen)
- Carbon monoxide
- Sulphur dioxide
- Particulate matter (PM_{10} and $PM_{2.5}$)
- Ammonia

Modelling was performed for two operating scenarios, representative of worst-case operations for the current facility and worst-case operations for the proposed expanded facility.

Use of the annual emission rates presented reported by Arnott's to the NPI for these pollutants in the dispersion modelling study is not deemed appropriate, as the annual average data would not allow for meaningful assessment of peak emissions from the Site. Therefore, stack emission testing was performed by NATA accredited laboratory, Ektimo (Accreditation No. 14601) in accordance with the Approved Methods for Sampling in order to obtain NOx, CO, SO_2 and ammonia emissions data appropriate for use in the dispersion modelling study. Ektimo's emission test report is presented in **Appendix D** and a summary of the testing program and results obtained in provided in Section **8.3.1.**

For particulate matter (PM) emissions, which were not monitored, a NOx to PM ratio of 1:0.074, based on emission factors provided in the NPI Emission Estimation Technique Manual for Combustion in Boilers (Department of Environment and Energy, 2011) was used.

8.3.1 Stack Testing Program

To quantify peak NOx, CO, SO_2 and ammonia emissions from the existing production lines, samples were collected from 12 of the existing stacks. This included:

- Four of the eight Line 1 gas fired oven stacks, with a product containing the highest ammonium bicarbonate content (of any product produced at the Site) being baked on the day of testing (Country Cheese). Ammonia emissions during the baking of this product are deemed to be representative of peak ammonia emissions from the Site. Stacks serving different zones of the travelling oven were tested to allow for a more accurate estimation of total emissions from the oven through the baking process,
- Four of the eight Line 4 gas fired oven stacks, with the oven set to the maximum heat setting and gas throughput. Stacks serving different zones of the travelling oven were tested to allow for a more accurate estimation of total emissions from the oven,
- Four gas fired boilers/hot water heater stacks operating under normal conditions.

A summary of the parameters measured at each location is presented in **Table 20** and a summary of the emission testing results is presented in **Table 21**. **Figure 15** illustrates the location of stacks tested as part of the emission testing program.

Table 20 Emission Testing Program

Location	Identification	Test Date	Test Parameters	Test Method
Line 1	Stack A Stack B Stack C Stack D	13 January 2022	Temperature, flow, velocity Ammonia (NH_3) Nitrogen oxides (as NO_2) Carbon monoxide (CO) Sulphur Dioxide (SO_2)	TM-2 USEPA method CTM 27 TM-11 TM-32
Line 4	Stack A Stack B Stack C Stack D	12 January 2022	Temperature, flow, velocity Nitrogen oxides (as NO_2) Carbon monoxide (CO) Sulphur Dioxide (SO_2)	TM-2 TM-11 TM-32
Boilers and Hot Water Heater	HW1 V150 V151 V152	14 January 2022	Temperature, flow, velocity Nitrogen oxides (as NO_2) Carbon monoxide (CO) Sulphur Dioxide (SO_2)	TM-2 TM-11 TM-32

Figure 15 Emission Testing Program - Location of Tested Stacks

Table 21 Emission Testing Results

Location	Date	Stack Diameter	Exhaust Temperature	Exhaust Flowrate		Exit Velocity	Ammonia Emissions		Nitrogen Oxides Emissions		Carbon Monoxide Emissions		Sulphur Dioxide Emissions	
		(m)	(ºK)	m^3/s	Nm^3/s	m/s	mg/Nm^3	g/s	mg/Nm^3	g/s	mg/Nm^3	g/s	mg/Nm^3	g/s
Line 1 - Stack A	13-01-2022	0.3	510	0.34	0.15	4.8	1,100	0.17	59	0.01	600	0.09	< 6	< 0.001
Line 1 - Stack B	13-01-2022	0.3	548	0.41	0.14	5.8	2,800	0.39	130	0.02	470	0.07	< 6	< 0.001
Line 1 - Stack C	13-01-2022	0.3	412	0.29	0.18	4.2	100	0.02	< 4	< 0.001	10	0.002	< 6	< 0.001
Line 1 - Stack D	13-01-2022	0.5	347	1.5	1.1	7.5	2.3	0.00	< 4	< 0.004	< 2	< 0.002	< 6	< 0.007
Line 4 - Stack A	12-01-2022	0.3	487	0.31	0.15	4.4	-	-	17	0.003	97	0.01	< 6	< 0.001
Line 4 - Stack B	12-01-2022	0.3	548	0.36	0.12	5.1	-	-	60	0.01	590	0.07	< 6	< 0.001
Line 4 - Stack C	12-01-2022	0.3	460	0.43	0.19	6.1	-	-	12	0.002	87	0.02	< 6	< 0.001
Line 4 - Stack D	12-01-2022	0.3	331	0.13	0.095	1.8	-	-	< 4	< 0.0004	< 2	< 0.0002	< 6	< 0.001
Hot Water Heater – HW1	14-01-2022	0.37	403	0.56	0.35	5.2	-	-	85	0.03	6.9	0.002	< 6	< 0.002
Boiler - V150	14-01-2022	0.29	435	0.33	0.17	5.0	-	-	52	0.01	6.3	0.001	< 6	< 0.001
Boiler - V151	14-01-2022	0.3	452	0.21	0.1	3.0	-	-	67	0.01	10	0.001	< 6	< 0.001
Boiler - V152	14-01-2022	0.4	410	0.45	0.25	3.6	-	-	81	0.02	< 2	< 0.001	< 6	< 0.002

8.3.2 Selection of Models

Emissions from the Site were modelled using a combination of the TAPM, CALMET and CALPUFF models.

CALPUFF is a transport and dispersion model that ejects "puffs" of material emitted from modelled sources, simulating dispersion and transformation processes along the way. In doing so, it typically uses the fields generated by a meteorological pre-processor CALMET, discussed further below. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain hourly concentration evaluated at selected receptor locations. The CALPOST post-processor is then used to process these files, producing tabulations that summarise results of the simulation for user-selected averaging periods.

8.3.3 Meteorological Modelling

Meteorological mechanisms govern the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. Dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. Pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Oke, 2002).

For this study, a site-representative three-dimensional meteorological dataset was compiled using a combination of the TAPM and CALMET models, as discussed in the following sections.

8.3.3.1 Selection of Modelling Year

Meteorological data recorded over the five-year period 2016-2020 by the Horsley Park Equestrian Centre AWS was analysed to select a worst-case meteorological year in order to provide a conservative air quality impact assessment. An analysis of the wind speed, wind direction, temperature and relative humidity recorded in each of the calendar years aligned well with the five-year average data with no particular years of note, however the year 2016 reported the worst-case combination of low average wind speed and greater number of calms, which generally results in reduced plume dispersion and consequently greater ground level impacts. For this reason, 2016 was chosen for the AQIA (Refer **Appendix C** for details).

8.3.3.2 TAPM

In order to calculate all required meteorological parameters required by the dispersion modelling process, meteorological modelling using The Air Pollution Model (TAPM, v 4.0.4) has been performed. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which can be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM model predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model input to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere.

TAPM model can assimilate actual local wind observations so that they can optionally be included in a model solution. TAPM parameters used for this study, including the data assimilation data used in the TAPM model are presented in **Table 22**. The three dimensional upper air data from the TAPM output was used as input for the diagnostic meteorological model (CALMET).

Table 22 Meteorological Parameters Used for this Study (TAPM v 4.0.4)

Modelling Period	1 January 2016 to 31 December 2016
Centre of analysis	307,970 mE 6,255,311 mS (UTM Coordinates)
Number of grid points	40 × 40 × 35
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Data assimilation	Horsley Park Equestrian Centre AWS Richmond RAAF AWS Sydney Olympic Park AWS Bankstown Airport AWS Prospect AQMS
Terrain	AUSLIG 9 second DEM

8.3.3.3 CALMET

In the simplest terms, CALMET is a meteorological model that develops hourly wind and other meteorological fields on a three-dimensional gridded modelling domain that are required as inputs to the CALPUFF dispersion model. Associated two-dimensional fields such as mixing height, surface characteristics and dispersion properties are also included in the file produced by CALMET. The interpolated wind field is then modified within the model to account for the influences of topography, sea breeze, as well as differential heating and surface roughness associated with different land uses across the modelling domain. These modifications are applied to the winds at each grid point to develop a final wind field. The final hourly-varying wind field thus reflects the influences of local topography and land uses.

CALMET modelling was conducted using the ‘No Obs’ CALMET approach for two domains, an outer domain with a coarse meteorological grid (16 km by 16 km domain with a 100 m grid resolution) and a more refined grid centred over the Site (2.5 km by 2.5 km domain with a 25 m grid resolution). TAPM generated three-dimensional meteorological data were used as the ‘initial-guess’ wind field for both CALMET domains. Local topography and land use information were used to refine the wind field predetermined by the TAPM output.

Table 23 details the parameters used in the meteorological modelling to drive the CALMET model.

Table 23 Meteorological Modelling Parameters - CALMET

Parameter	Data
Coarse Grid	
Modelling period	1st January 2016 to 31st December 2016
Meteorological grid resolution	100 m
Grid southwest corner coordinates	295,150 mE 6250,000 mS (UTM Coordinates)
Initial guess field	TAPM output
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m, 4,000 m)
Data assimilation	None
Refined Grid	
Modelling period	1st January 2016 to 31st December 2016
Meteorological grid resolution	25 m
Grid southwest corner coordinates	303,150 mE 6258.000 mS (UTM Coordinates)
Initial guess field	TAPM output
Vertical resolution (cell heights)	10 (0 m, 20 m, 40 m, 80 m, 160 m, 320 m, 640 m, 1,200 m, 2,000 m, 3,000 m, 4,000 m)
Data assimilation	None

8.3.3.4 Site Representative Meteorological Data

This section presents a summary of the key meteorological conditions predicted by CALMET at the Site.

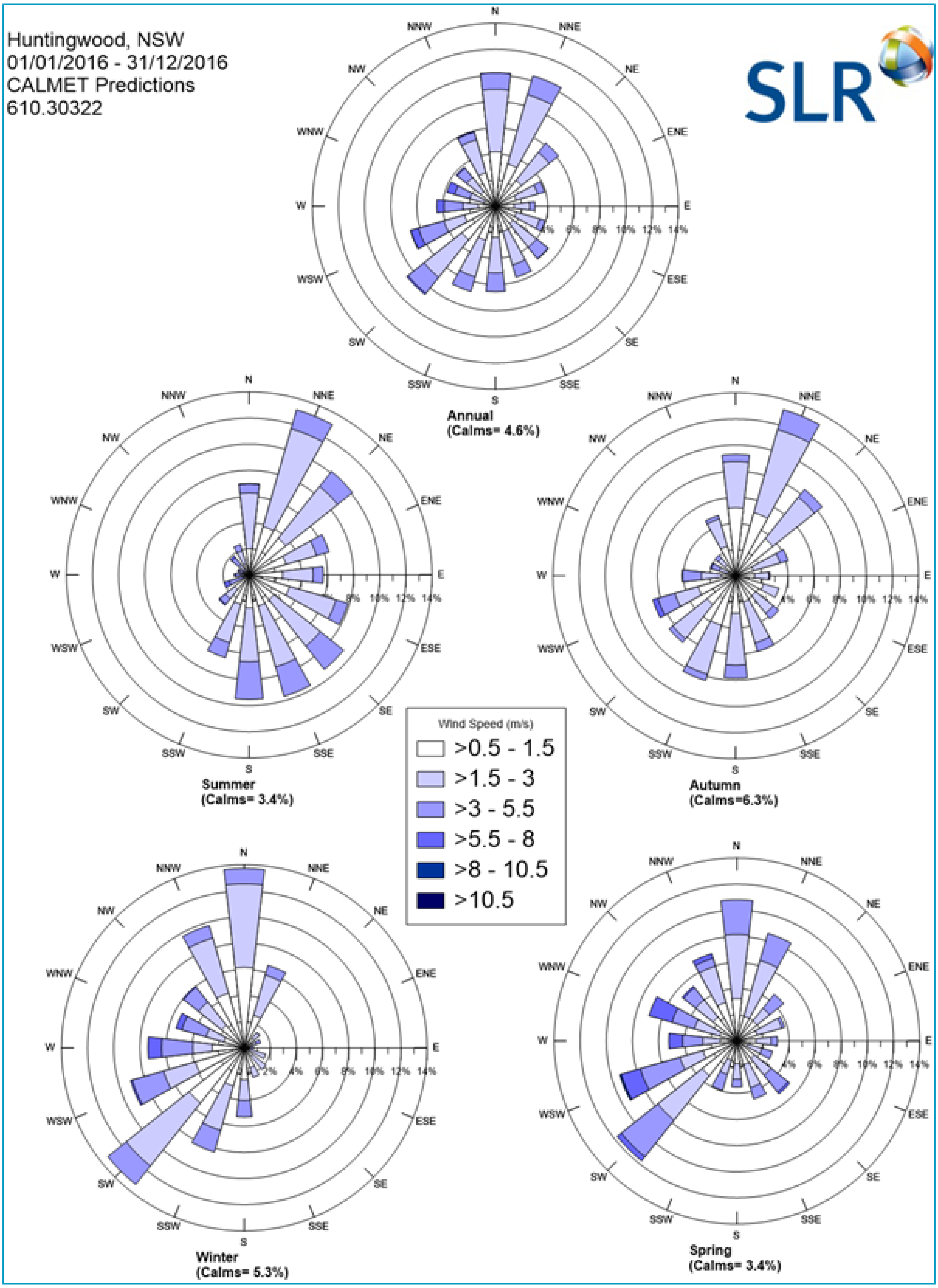
Wind Speed and Direction

A summary of the annual wind behaviour predicted by TAPM/CALMET (refined grid) for the Site is presented in **Figure 16.** Based on the model predictions, the Site experienced light to moderate winds (between 1.5 m/s and 8 m/s), from all directions, but with fewer winds from the western quadrant. Calm wind conditions (wind speeds less than 0.5 m/s) were predicted to occur 4.6% of the time.

The seasonal wind roses indicate that in summer and autumn, winds from the north-northeastern quadrant are predominant, with summer experiencing more southerlies and autumn more southwesterlies. In winter and spring winds predominantly blow from the northern and southwestern quadrants, with very few winds from the eastern quadrant.

The site-representative meteorological dataset contains fewer southwesterly winds than the observations at the Horsely Park Equestrian Centre AWS (see **Figure 6**), and more frequent winds from the northeastern quadrant.

Figure 16 Wind Roses for the Site, as Predicted by CALMET



Atmospheric Stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Gifford-Turner (PGT) assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability as follows:

- A = Extremely unstable conditions
- B = Moderately unstable conditions
- C = Slightly unstable conditions
- D = Neutral conditions
- E = Slightly stable conditions
- F = Moderately stable conditions

The meteorological conditions defining each PGT stability class are shown in **Table 24**.

Table 24 Meteorological Conditions Defining PGT Stability Classes

Surface wind speed (m/s)	Daytime insolation			Night-time conditions	
	Strong	Moderate	Slight	Thin overcast or > 4/8 low cloud	<= 4/8 cloudiness
< 2	A	A - B	B	E	F
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
> 6	C	D	D	D	D

Notes:

Strong insolation corresponds to sunny midday in midsummer in England; slight insolation to similar conditions in midwinter.

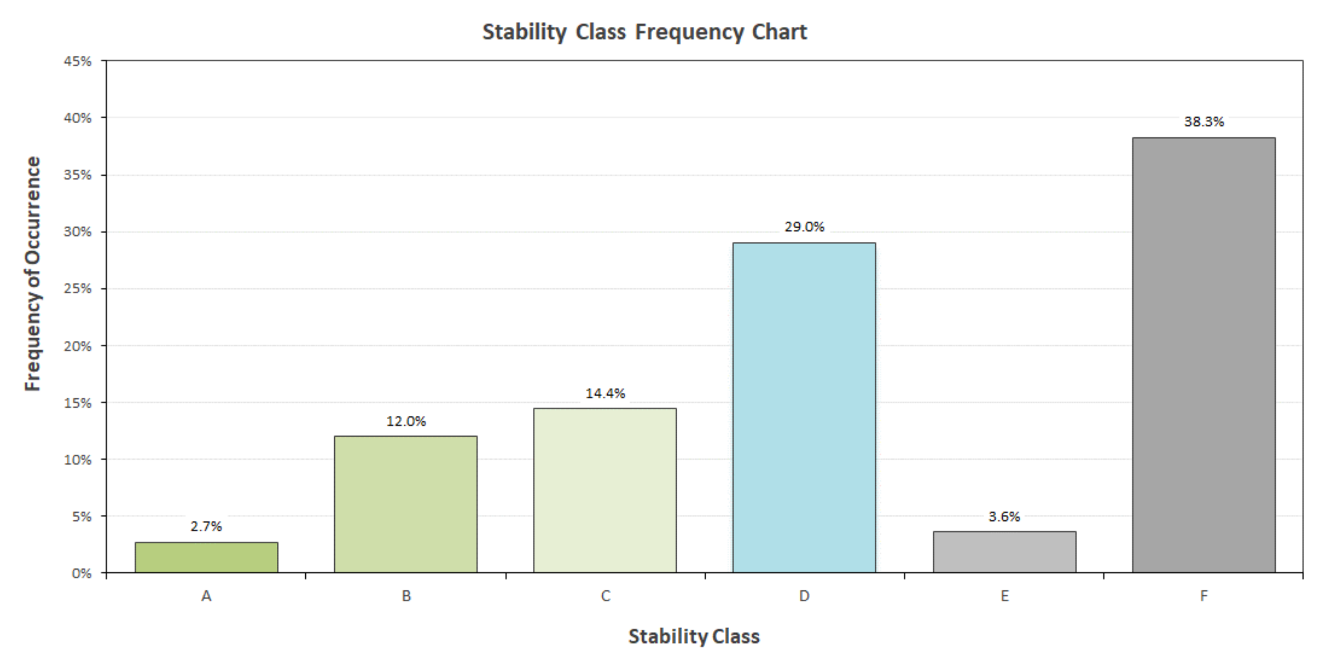
Night refers to the period from 1 hour before sunset to 1 hour after sunrise.

The neutral category D should also be used, regardless of wind speed, for overcast conditions during day or night and for any sky conditions during the hour preceding or following night as defined above.

Source: NOAA, 2018.

The predicted frequency of each stability class at the Site during 2016 is presented in **Figure 17**. The results indicate a high frequency of conditions typical to Stability Class F (Very Stable) and D (Neutral), with a low frequency of very unstable conditions (Stability Class A). Stable conditions occur during the night-time, under low wind speed conditions, which inhibit pollutant dispersion.

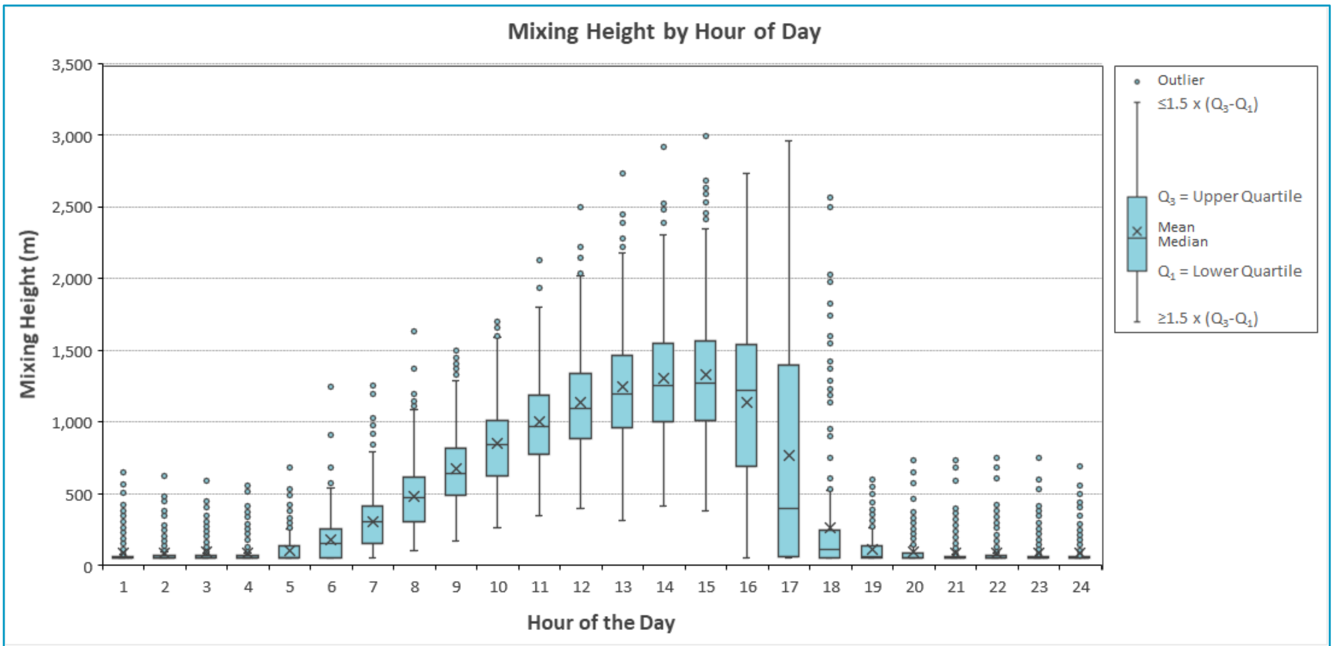
Figure 17 Stability Class Distribution Predicted by CALMET for the Site



Mixing Heights

Diurnal variations in maximum and average mixing heights predicted by CALMET at the Site are illustrated in **Figure 18**. As would be expected, an increase in the mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground-based temperature inversions and the growth of the convective mixing layer.

Figure 18 Mixing Heights Predicted by CALMET for the Site



8.3.4 Plume Dispersion Modelling

8.3.4.1 CALPUFF Model Parameters and Options

A summary of additional CALPUFF modelling options and parameters used for the assessment is provided in **Table 25**.

Table 25 Model Parameters

Parameter	Option
Calculation Type	Concentration
Plume Rise Method	Briggs
Building Downwash	BPIP-PRIME
Gridded Receptors	Nested 4.0 km x 4.0 km; 0 m AGL centred on Site
Gridded Receptor Spacing	100 m to 1,000 m; 150 m from 1,000 m to 2,000 m 300 m from 2,000 m to 4,000 m
Discrete Receptors	Refer **Section 4.1s**

AGL Above ground level

8.3.4.2 Background Pollutant Concentrations

Hourly varying NO_2, PM_{10} and $PM_{2.5}$ concentrations recorded by the Prospect AQMS during the modelling period (2016) were used for the contemporaneous analysis of cumulative ground level concentrations. Cumulative CO and SO_2 impacts were assessed semi-quantitatively given the very low background concentrations in Sydney.

Background concentrations of ammonia were assumed to be negligible, and the incremental impacts predicted for the Project were compared directly against the ambient air quality criterion, in accordance with the Approved Methods.

8.3.4.3 Building Downwash

Building downwash is a phenomenon caused by structures near to pollutant emission sources influencing atmospheric turbulence. Airflow is rapidly mixed to the ground as frictional forces and pressure gradients cause stagnations and eddies to develop in the wake of buildings downwind of elevated sources.

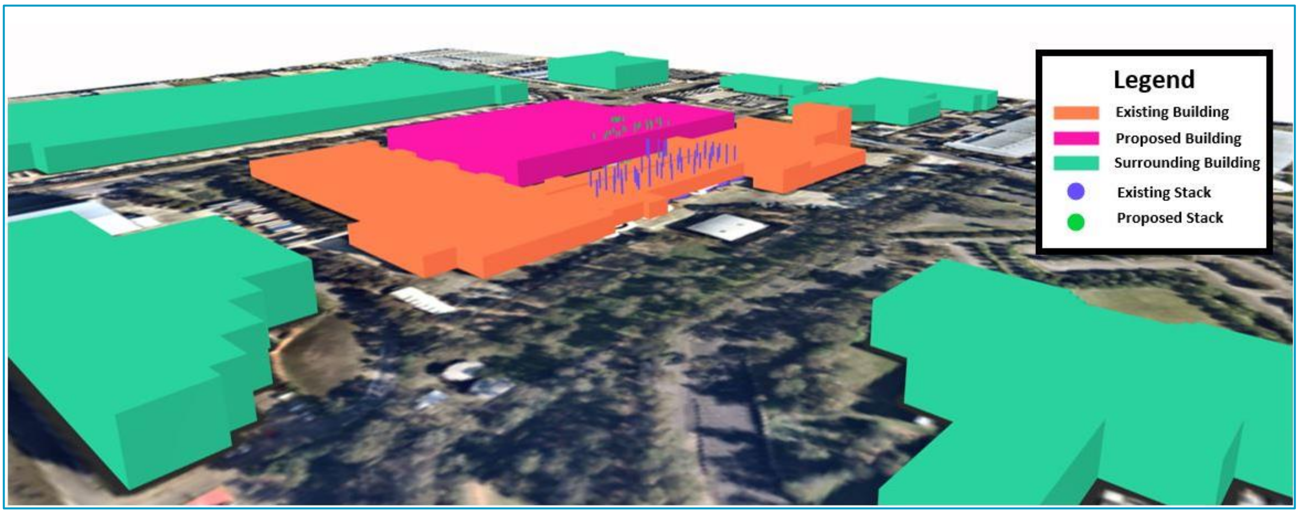
The USEPA has established a Good Engineering Practice (GEP) stack height which is defined as the '*height necessary to ensure that emissions from the stack do not result in excessive concentrations of any air pollutants in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source itself, nearby structures or nearby terrain obstacles*' (USEPA, 1985). The definition of GEP stack height is the building height plus 1.5 times the lesser of the building height or projected building width.

A stack is considered to be wake-affected when the stack and building are located less than five times the lesser of the building height or project building width apart.

CALPUFF contains the *Prime* algorithm which was used to predict building downwash effects. Influencing building dimensions were calculated using the USEPA's Building Profile Input Program (BPIP).

For modelling purposes, proposed and existing Site buildings, as well as enclosures for the existing stacks, were included in the modelling to account for potential building wakes. The relative locations of the sources and buildings are illustrated in **Figure 19**.

Figure 19 Modelled Sources and Buildings



8.3.4.4 NO_x to NO_2 conversion

NO_x emitted from combustion processes mainly consist of NO with a small portion (approximately 10%) of NO_2. In the atmosphere however, NO emitted from the source oxidises to NO_2 in the presence of ozone (O_3) and sunlight as it travels further from the source. The rate of oxidation depends on a number of parameters including the ambient O_3 concentration. The Approved Methods lists the following methods that can be applied to take account the oxidation of NO to NO_2 in estimating downwind NO_2 concentrations at receptor locations.

Method 1 – 100% Conversion

This method is usually used as a screening level assessment and assumes 100% conversion of NO to NO_2 before the plume arrives at the receptor location. Use of this method can significantly over-predict NO_2 concentrations at nearfield receptors. Given the close proximity of sensitive receptors to the Site, the use of Method 1 (100% conversion) is not appropriate.

Method 2 – Ambient Ozone Limiting Method (OLM)

This method assumes that all the available ozone in the atmosphere will react with NO in the plume until either all the O_3 or all the NO is used up. NO_2 concentrations can be estimated by this method using the following equation:

$$[NO_2]_{total} = \{0.1 \times [NO_x]_{pred}\} + MIN\{(0.9) \times [NO_x]_{pred} \text{ or } (46/48) \times [O3]_{bkgd}\} + [NO_2]_{bkgd}$$

Again, given the close proximity of sensitive receptors with short transport and duration periods from the Site, Method 2 could be deemed overly conservative as it assumes that the atmospheric reaction is instantaneous when in reality, the reaction takes place over a number of hours (NSW EPA, 2017).

Method 3 – NO to NO_2 conversion using empirical relationship

An empirical equation for estimating the oxidation rate of NO in power plant plumes dependent on distance downwind from the source and the parameters A and α and has the following form:

$$NO_2 = NO_x \times A(1 - e^{-\alpha x})$$

where *x* is the distance from the source and A and α are classified according to the O_3 concentration, wind speed and season (Janssen, van Wakeren, van Duuran, & Elshout, 1988) as provided in **Table 26.**

Table 26 Classification of Values for A and α by Season

Season	Ozone (ppb)	Wind Speed (m/s)		
		5	15	>15
Winter	40	A = 0.87 α = 0.07	A = 0.87 α = 0.07	A = 0.87 α = 0.15
	30	A = 0.82 α = 0.07	A = 0.83 α = 0.07	A = 0.83 α = 0.07
	20	A = 0.74 α = 0.07	A = 0.74 α = 0.07	A = 0.74 α = 0.07
	10	A = 0.49 α = 0.05	A = 0.49 α = 0.05	A = 0.49 α = 0.05
Spring/Autumn	60	A = 0.85 α = 0.10	A = 0.85 α = 0.15	A = 0.85 α = 0.30
	40	A = 0.80 α = 0.10	A = 0.80 α = 0.10	A = 0.80 α = 0.25
	30	A = 0.74 α = 0.10	A = 0.74 α = 0.10	A = 0.74 α = 0.15
	20	A = 0.635 α = 0.10	A = 0.635 α = 0.10	A = 0.635 α = 0.10
Summer	200	A = 0.93 α = 0.40	A = 0.93 α = 0.65	A = 0.93 α = 0.80
	120	A = 0.88 α = 0.20	A = 0.88 α = 0.35	A = 0.88 α = 0.45
	60	A = 0.81 α = 0.15	A = 0.81 α = 0.25	A = 0.81 α = 0.35
	40	A = 0.74 α = 0.10	A = 0.74 α = 0.15	A = 0.74 α = 0.25
	30	A = 0.67 α = 0.10	A = 0.67 α = 0.10	A = 0.67 α = 0.10

This assessment employs Method 2, adopting O_3 data from the Prospect AQMS, presented in **Figure 20** and summarised **Table 27**, to estimate the incremental and cumulative NO_2 impacts at nearby receptors as a result of the Project emissions. This approach is deemed conservative as it assumes that the atmospheric reaction is instantaneous. In reality, the reaction takes place over a number of hours. This approach will therefore provide a conservative assessment for near field locations at short transport and duration periods from the source.

Figure 20 Prospect AQMS O_3 1-Hour Average Concentrations (2016)

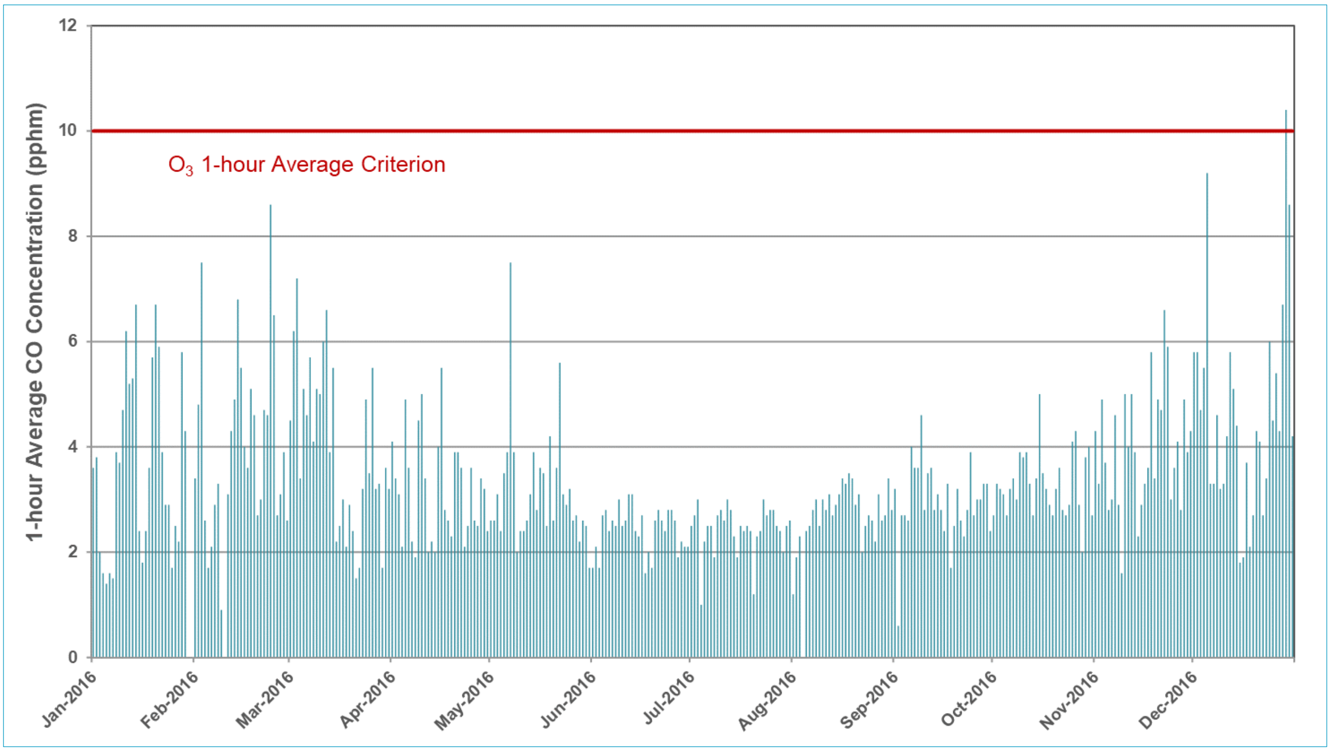


Table 27 O_3 Concentration Summary: Prospect AQMS (2016)

Pollutant	Averaging Period	Units	Maximum Concentration	Criteria
O_3	1-hour	pphm	10.4	10
		µg/m³	204	196

8.3.4.5 Conversion of Averaging Times

For pollutants with short-term (sub-hourly) air quality impact assessment criteria, in the absence of specific guidance in the Approved methods, the short term impacts have been estimated using the formula cited in the *Guidance notes for using the regulatory air pollution model AERMOD in Victoria* (EPAV, 2013) as follows:

$$C_t = C(t_0) \times ({}^{t_0}/_{t})^{0.2}$$

Where

C_t = concentration for the longer time-averaging period

C_0 = concentration for the shorter time-averaging period

t_0 = longer averaging time

t = shorter averaging time

8.3.5 Source Characteristics and Emission Rates

CALPUFF requires a range of inputs to describe the emissions to air for each modelled source.

Potential air emissions and relevant stack parameters for the existing and proposed stacks were estimated based on the stack testing data reported by Ektimo (refer **Section 8.3.1** and **Appendix D**). **Table 28** provides a summary of the stack parameters and emission rates for each of the existing and proposed production lines included in the modelling, as well as gas-fired boiler and hot water heater stacks.

To conservatively represent the peak impacts from the Site, the modelling assumes the following:

- All production lines were assumed to be emitting combustion gases at the rates measured at Line 1 (higher of the two production lines tested). As outlined in **Section 5.2.2**, the site throughput and natural gas usage in the ovens is only proposed to increase by approximately 25% as a result of the expansion. Therefore, the assumption that each of the five proposed production lines emit the same amount of combustion gases as the existing five lines is considered to be a very conservative assumption and will lead to a 300% overestimation of incremental impacts due to the Proposed expansion.
- For particulate matter (PM) emissions, which were not monitored, a NOx to PM ratio of 1:0.074, based on emission factors provided in the NPI *Emission Estimation Technique Manual for Combustion in Boilers* (Department of Environment and Energy, 2011) was used. It is noted that this document provides two sets of emission factors for natural gas fired boilers, namely wall fired and tangential fired. The NOx to PM ratio used relates to wall fires boilers, which is 70% higher (and therefore more conservative) than the NOx to PM ratio calculated from tangential fired boilers.
- For stacks with monitored pollutant levels below the detection limit (as was the case for all SO_2 emissions measurements on all stacks), the concentration was conservatively assumed to be equal to the detection limit. Actual emissions could be far below this concentration.
- Products with highest ammonium bicarbonate content (Country Cheese) will be baked on Line 1 24/7, every day of the year. In reality, products with any ammonium bicarbonate are currently baked on approximately 26 days per year and this is expected to increase to around 29 days per year after the expansion.
- The new oven stack exhausts will be oriented vertically as per the current stacks.

The modelled stack locations are shown in **Figure 21**.

Table 28 Stack Parameters and Emission Rates – Post-Expansion

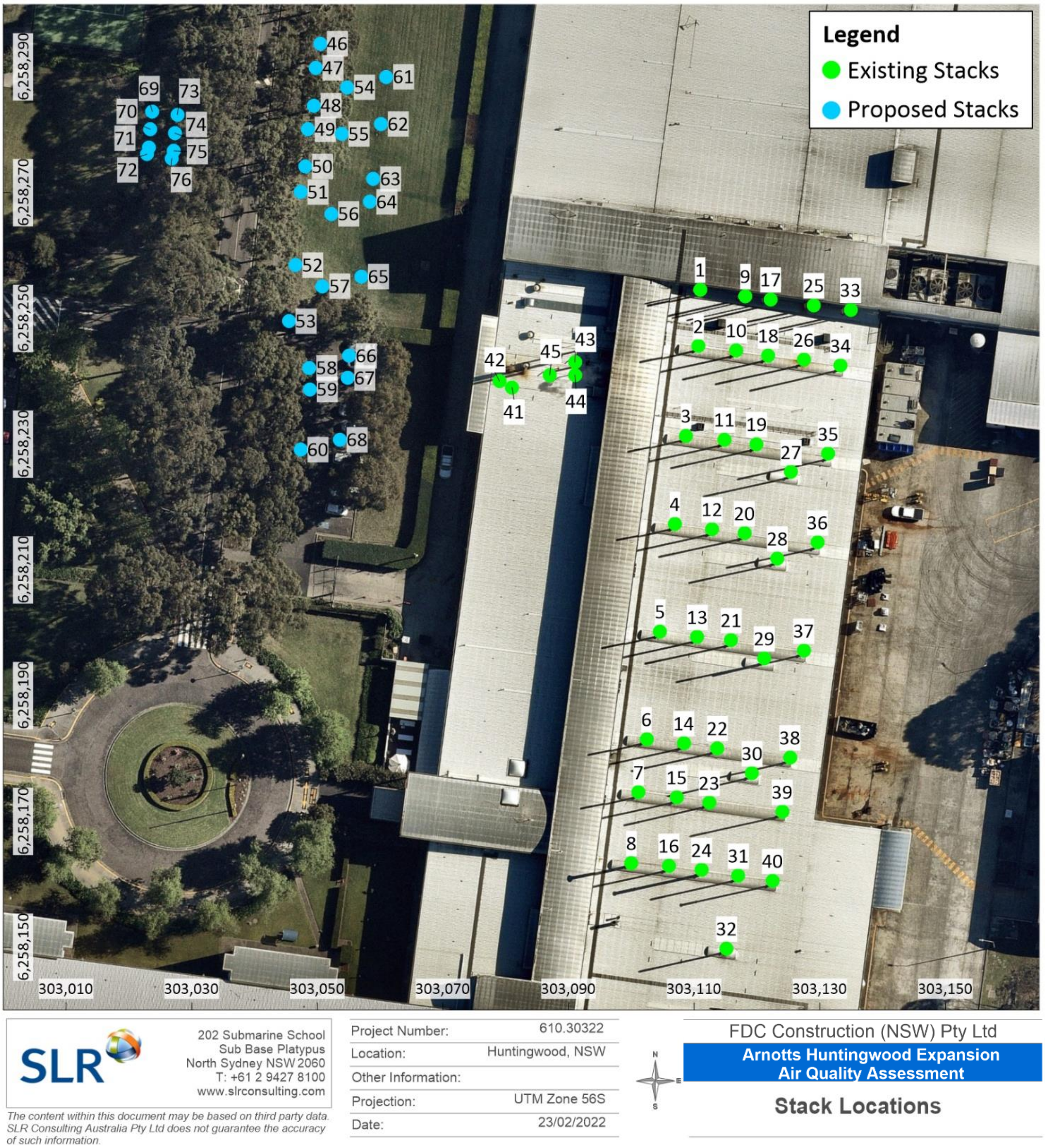
ID	X	Y	Status	Line	Reference Stack	Stack Height	Stack Diameter	Exhaust Velocity	Exhaust Temp.	NOx	CO	Ammonia	SO_2	PM
	m	m				m	m	m/s	°K	g/s	g/s	g/s	g/s	g/s
1	303,111	6,258,255	Existing	Line 1	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	1,100	0.001	0.0007
2	303,111	6,258,246	Existing		Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	1,100	0.001	0.0007
3	303,109	6,258,231	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	2,800	0.001	0.0013
4	303,107	6,258,217	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	2,800	0.001	0.0013
5	303,105	6,258,200	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	2,800	0.001	0.0013
6	303,102	6,258,183	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	100	0.001	0.0001
7	303,101	6,258,174	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	100	0.001	0.0001
8	303,100	6,258,163	Existing		Line 1 - Stack D	16.75	0.50	7.5	347	0.004	0.002	2	0.007	0.0003
9	303,117	6,258,254	Existing	Line 2	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
10	303,117	6,258,245	Existing		Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
11	303,115	6,258,231	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
12	303,113	6,258,216	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
13	303,111	6,258,199	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
14	303,108	6,258,182	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
15	303,107	6,258,174	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
16	303,106	6,258,163	Existing		Line 1 - Stack D	16.75	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
17	303,122	6,258,253	Existing	Line 3	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
18	303,122	6,258,244	Existing		Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
19	303,120	6,258,230	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
20	303,118	6,258,216	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
21	303,116	6,258,199	Existing		Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013

ID	X	Y	Status	Line	Reference Stack	Stack Height	Stack Diameter	Exhaust Velocity	Exhaust Temp.	NOx	CO	Ammonia	SO_2	PM
	m	m				m	m	m/s	°K	g/s	g/s	g/s	g/s	g/s
22	303,114	6,258,182	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
23	303,112	6,258,173	Existing		Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
24	303,111	6,258,162	Existing		Line 1 - Stack D	16.75	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
25	303,127	6,258,253	Existing	Line 4	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
26	303,127	6,258,243	Existing	Line 4	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
27	303,126	6,258,226	Existing	Line 4	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
28	303,123	6,258,212	Existing	Line 4	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
29	303,121	6,258,196	Existing	Line 4	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
30	303,119	6,258,177	Existing	Line 4	Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
31	303,117	6,258,161	Existing	Line 4	Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
32	303,115	6,258,150	Existing	Line 4	Line 1 - Stack D	16.75	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
33	303,133	6,258,252	Existing	Line 5	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
34	303,133	6,258,243	Existing	Line 5	Line 1 - Stack A	16.75	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
35	303,131	6,258,228	Existing	Line 5	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
36	303,130	6,258,214	Existing	Line 5	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
37	303,127	6,258,197	Existing	Line 5	Line 1 - Stack B	16.75	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
38	303,125	6,258,180	Existing	Line 5	Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
39	303,124	6,258,172	Existing	Line 5	Line 1 - Stack C	16.75	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
40	303,122	6,258,161	Existing	Line 5	Line 1 - Stack D	16.75	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
41	303,081	6,258,239	Existing	HW1	HW1	16.75	0.37	5.2	403	0.030	0.002	0	0.002	0.0022
42	303,079	6,258,240	Existing	HW2	HW1	16.75	0.37	5.2	403	0.030	0.002	0	0.002	0.0022
43	303,091	6,258,243	Existing	V150	V150	16.75	0.29	5.0	435	0.009	0.001	0	0.001	0.0007
44	303,091	6,258,241	Existing	V151	V151	16.75	0.30	3.0	452	0.007	0.001	0	0.001	0.0005

ID	X	Y	Status	Line	Reference Stack	Stack Height	Stack Diameter	Exhaust Velocity	Exhaust Temp.	NOx	CO	Ammonia	SO_2	PM
	m	m				m	m	m/s	°K	g/s	g/s	g/s	g/s	g/s
45	303,087	6,258,241	Existing	V152	V152	16.75	0.40	3.6	410	0.020	0.001	0	0.002	0.0015
46	303,050	6,258,294	Proposed	Line 6	Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
47	303,050	6,258,290	Proposed		Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
48	303,049	6,258,284	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
49	303,049	6,258,280	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
50	303,048	6,258,274	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
51	303,047	6,258,270	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
52	303,047	6,258,258	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
53	303,045	6,258,250	Proposed		Line 1 - Stack D	18.00	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
54	303,055	6,258,287	Proposed	Line 7	Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
55	303,054	6,258,279	Proposed		Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
56	303,052	6,258,267	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
57	303,051	6,258,255	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
58	303,049	6,258,242	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
59	303,049	6,258,239	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
60	303,047	6,258,229	Proposed		Line 1 - Stack D	18.00	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
61	303,061	6,258,288	Proposed	Line 8	Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
62	303,060	6,258,281	Proposed		Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
63	303,059	6,258,272	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
64	303,058	6,258,269	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
65	303,057	6,258,257	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
66	303,055	6,258,244	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
67	303,055	6,258,241	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001

ID	X	Y	Status	Line	Reference Stack	Stack Height	Stack Diameter	Exhaust Velocity	Exhaust Temp.	NOx	CO	Ammonia	SO_2	PM
	m	m				m	m	m/s	°K	g/s	g/s	g/s	g/s	g/s
68	303,054	6,258,231	Proposed		Line 1 - Stack D	18.00	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
69	303,024	6,258,283	Proposed	Line 9	Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
70	303,023	6,258,280	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
71	303,023	6,258,277	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
72	303,023	6,258,276	Proposed		Line 1 - Stack D	18.00	0.50	7.5	347	0.004	0.002	0	0.007	0.0003
73	303,028	6,258,282	Proposed	Line 10	Line 1 - Stack A	18.00	0.30	4.8	510	0.009	0.090	0	0.001	0.0007
74	303,027	6,258,279	Proposed		Line 1 - Stack B	18.00	0.30	5.8	548	0.018	0.066	0	0.001	0.0013
75	303,027	6,258,277	Proposed		Line 1 - Stack C	18.00	0.30	4.2	412	0.001	0.002	0	0.001	0.0001
76	303,027	6,258,275	Proposed		Line 1 - Stack D	18.00	0.50	7.5	347	0.004	0.002	0	0.007	0.0003

Figure 21 Existing and Proposed Stack Locations Used in the Modelling Study



8.3.6 Accuracy of Modelling

All atmospheric dispersion models, including CALPUFF, represent a simplification of the many complex processes involved in the dispersion of pollutants in the atmosphere. To obtain good quality results it is important that the most appropriate model is used and the quality of the input data (meteorological, terrain, source characteristics) is adequate.

The main sources of uncertainty in dispersion models, and their effects, are discussed below:

- **Oversimplification of physics:** This can lead to both under-prediction and over-prediction of ground level pollutant concentrations. Uncertainties are greater in Gaussian plume models as they do not include the effects of non-steady-state meteorology (i.e., spatially- and temporally-varying meteorology).
- **Uncertainties in emission rates:** Ground level concentrations are proportional to the pollutant emission rate. In addition, most modelling studies assume constant worst-case emission levels or are based on the results of a small number of stack tests, however operations (and thus emissions) are often quite variable. Accurate measurement of emission rates and source parameters requires continuous monitoring.
- **Uncertainties in wind direction and wind speed**: Wind direction affects the direction of plume travel, while wind speed affects plume rise and dilution of plume. Uncertainties in these parameters can result in errors in the predicted distance from the source of the plume impact, and magnitude of that impact. In addition, aloft wind directions commonly differ from surface wind directions. The preference to use rugged meteorological instruments to reduce maintenance requirements also means that light winds are often not well characterised.
- **Uncertainties in mixing height:** If the plume elevation reaches 80% or more of the mixing height, more interaction will occur, and it becomes increasingly important to properly characterise the depth of the mixed layer as well as the strength of the upper air inversion.
- **Uncertainties in temperature:** Ambient temperature affects plume buoyancy, so inaccuracies in the temperature data can result in potential errors in the predicted distance from the source of the plume impact, and magnitude of that impact.
- **Uncertainties in stability estimates:** Gaussian plume models use estimates of stability class, and 3D models use explicit vertical profiles of temperature and wind (which are used directly or indirectly to estimate stability class for Gaussian models). In either case, uncertainties in these parameters can cause either under-prediction or over-prediction of ground level concentrations. For example, if an error is made of one stability class, then the computed concentrations can be off by 50% or more.

The USEPA makes the following statement in its Modelling Guideline (US EPA, 2005) on the relative accuracy of models:

> *"Models are more reliable for estimating longer time-averaged concentrations than for estimating short-term concentrations at specific locations; and the models are reasonably reliable in estimating the magnitude of highest concentrations occurring sometime, somewhere within an area. For example, errors in highest estimated concentrations of ±10 to 40% are found to be typical, i.e., certainly well within the often quoted factor-of-two accuracy that has long been recognised for these models. However, estimates of concentrations that occur at a specific time and site are poorly correlated with actually observed concentrations and are much less reliable."*

9 Assessment of Air Quality Impacts

9.1 Construction Phase

9.1.1 Fugitive Dust Emissions

The key potential air pollution and amenity issues associated with fugitive dust emissions from the proposed activities during the construction works at the Site are:

- Annoyance due to dust deposition (soiling of surfaces) and visible dust plumes; and
- Elevated suspended particulate concentrations (PM_{10}).

Modelling of dust from construction activities is generally not considered appropriate, as emission rates can vary significantly depending on a combination of the activity and prevailing meteorological conditions (i.e. rainfall and wind speed), which cannot be reliably predicted. The following sections therefore present a qualitative assessment of the potential risks to air quality associated with dust from construction activities at the Project. Details of the IAQM methodology used to perform the risk assessment are provided in **Appendix A**.

Step 1 – Screening Based on Separation Distance

As noted in **Section 4.1**, the nearest existing residential receptors have been identified as being located more than 1 km from the Site boundary. The closest receptor identified that may be sensitive to dust impacts from the construction works, is the hotel located 400 m to the south.

As no potentially sensitive receptors have been identified within 350 m from the boundary of the Site, or within 500 m from the Site entrance, no further assessment is required by the IAQM method.

Mitigation Measures

While no sensitive receptors are located within the IAQM screening distances, best practice dust controls should be applied during the works to minimise potential impacts on the surrounding commercial and industrial activities.

Table 29 lists the mitigation measures designated as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a development shown to have a low risk of adverse impacts. Not all these measures would be practical or relevant to construction works at the Site, so these measures should be reviewed in consultation with the construction contractor or as part of the development of the Construction Environmental Management Plan (CEMP) before their implementation. For almost all construction activities, the IAQM Methods notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

Table 29 Site-Specific Management Measures Recommended by the IAQM

	Activity	
1	**Communications**	
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.2	Display the head or regional office contact information.	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.	D
2	**Site Management**	
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
2.2	Make the complaints log available to the local authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H
3	**Monitoring**	
3.1	Perform daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary.	D
3.2	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority, when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
4	**Preparing and Maintaining the Site**	
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that is at least as high as any stockpiles on site.	H
4.3	Keep site fencing, barriers and scaffolding clean using wet methods.	D
4.4	Cover, seed or fence stockpiles to prevent wind erosion	D
5	**Operating Vehicle/Machinery and Sustainable Travel**	
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
5.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable	H
6	**Operations**	
6.1	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.2	Use enclosed chutes and conveyors and covered skips	H
6.3	Minimise drop heights from loading shovels and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
7	**Waste Management**	

	Activity	
7.1	Avoid bonfires and burning of waste materials.	H
7.2	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
7.3	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	H
8	Construction	
8.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
8.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	D
9	Trackout	
9.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D
9.2	Avoid dry sweeping of large areas.	D
9.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
9.4	Record all inspections of haul routes and any subsequent action in a site log book.	D
9.5	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D

H = Highly recommended; D = Desirable

9.1.2 Products of Fuel Combustion

Ambient air quality monitoring performed in the Sydney area over the last few decades has shown that the city's air quality has typically improved and is continuing to improve. A major driver of this improvement in urban air quality is the fact that newer vehicles produce significantly less emissions than older vehicles. This is in part a result of improvements in the quality and composition of fuels, as well as improved engine designs and fuel efficiency. According to Trends in Motor Vehicles and their Emissions (NSW EPA, 2014) cars built from 2013 onwards emit only 3% of the NO_X emissions compared to vehicles built in 1976, and diesel trucks built from 2011 onwards emit just 8% of the particles emitted by vehicles built in 1996. Therefore, even as Sydney's population, and total vehicle kilometres travelled each year have increased (ABS, 2018) key measures of air pollution have dropped significantly and this trend is expected to continue.

The results from the background air quality concentrations show that the monitored concentrations have been well below the respective criteria for CO, NO_2 and SO_2 for six years running (2015-2020) (see **Section 4.4**).

Given the nature of the construction works, it is considered that the emissions generated due to the combustion of fuel in construction plant and machinery will be of limited duration and small compared to the emissions generated by road traffic on the surrounding road network. Given the short term and low level of emissions of these pollutants from the Site during the construction works, they are considered unlikely to have significant impacts on local air quality and have not been considered any further in this assessment.

9.2 Operational Phase - Qualitative Assessment

9.2.1 Odour Emissions from Baking Operations

As discussed in **Section 5.2.2.1**, odour emissions will occur from activities at the expanded facility. The new processing building is proposed to be equipped with AS and BCA compliant air extraction systems.

As discussed in **Section 6.3**, a conservative recommended separation distance of 200 m between bakery operations and sensitive land uses has been adopted for this study, which is applicable for both the current and proposed operations. This separation distance is to be applied to the distance between the nearest sensitive receptor and the bakery building or exhaust vents (noting that the exhaust vents will be located on the roof of the processing buildings). The nearest residential receptors are located more than 1 km from the Site (see **Figure 22**) which means that the adopted separation distance would be met. It is noted that the hotel located to the south of the Site is also located approximately 400 m from the proposed expansion area and 300 m from the existing processing building and therefore also meets the recommended separation distance.

As discussed in **Section3.3**, during the site visit, SLR staff observed 'distinct' odours within the boundary of the Site, reducing to 'weak' odours within an approximate 100 m radius of the Site boundary. While the relationship between throughput and observed odour levels cannot be assumed to be linear, and the site visit will not be representative of all operating conditions or meteorological conditions, it is considered reasonable to expect that the proposed 25% increase in throughput would be unlikely to result in odours from the facility being detected much further downwind than for current operations. The establishment of baking lines in the northwestern end of the site, however, is likely to mean that odour levels immediately to the northwest of the Site will increase from current levels.

Given the above considerations, the magnitude for nearby sensitive (residential) receptors is predicted to be **negligible** (i.e. Impact is predicted to cause no significant consequences, **Table B2**). Given the **high sensitivity** of the potentially affected receptors and the **negligible magnitude** of the potential odour impact of the processing facility, the potential impact significance for the local receptors is concluded to be of ***neutral significance*** (see **Table 30**).

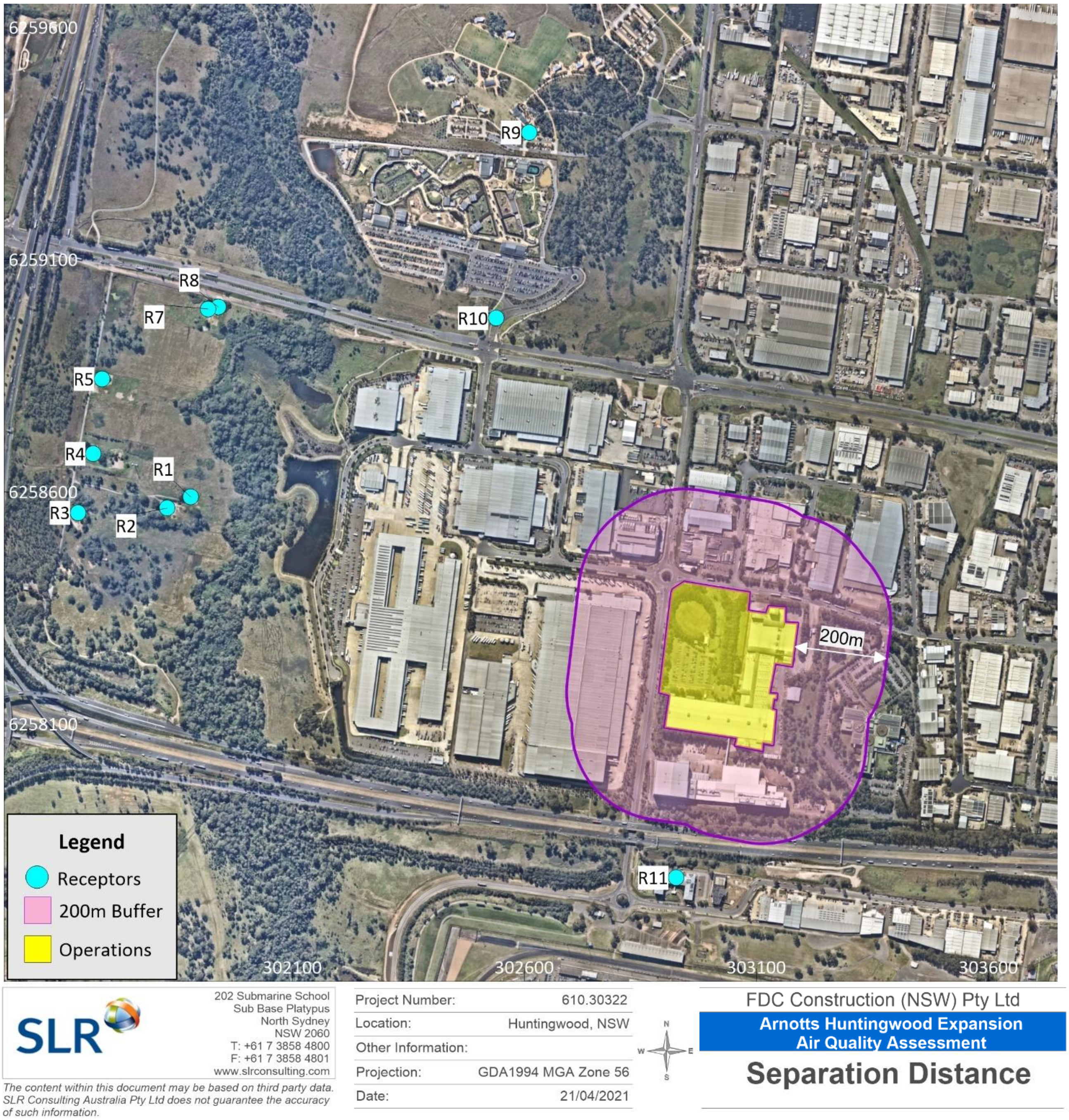
Given their closer proximity to the existing and proposed bakery buildings, the impact magnitude for the surrounding industrial/commercial land uses, particularly for those northwest of the facility, is predicted to be **slight** (i.e. Predicted impact may be tolerated, **Table B2**). Given the **medium sensitivity** of the potentially affected receptors and the **slight magnitude** of the potential odour impact of the expansion compared to existing odour levels, the potential impact significance is concluded to be of ***minor significance*** (also shown in **Table 30**).

Table 30 Risk Assessment of Odour Impacts – Baking Operations

Receptor Type	Sensitivity [Defined by Table B1]	Impact Magnitude [Defined by Table B2]	Impact Significance
Residential/hotel	High	Negligible Magnitude	Neutral Significance
Commercial/industrial	Medium	Slight Magnitude	Minor Significance

Considering the neutral/minor impact significance for receptors due to the facility's expanded operations, additional mitigation measures are not deemed necessary. However, should it be required, further mitigation measures can be put in place to further reduce or remove any impacts (refer to **Section 10**).

Figure 22 Bakery Operations – Separation Distance



9.2.2 Odour Emissions from Handling and Storage of Raw Materials and Waste

As discussed in **Section 5.2.2.1** odour emissions could occur from handling and storage of fresh food and waste on site. All fresh food and waste handling and processing areas are proposed to be equipped with AS and BCA compliant air extraction systems.

By addressing the FIDOL factors, the potential for odour impacts from these sources at the sensitive receptors may be determined, as follows:

- Frequency – The closest residential areas have the potential to experience impacts when winds blow towards the receptors. As outlined in **Section 4.3** winds blowing towards the nearest existing residences and recreational facilities (>800 m away) occur approximately 23% of the time, while winds that would blow air emissions towards the nearby hotel (400 m away) occur only 7% of the time. Given this, and as the Site is a 24/7 operation, it is concluded that there is a medium likelihood that sensitive receptors would be downwind of the Site.
- Intensity – The raw materials and waste storage areas within the Site are proposed to be equipped with BCA and AS compliant ventilation systems which are designed to ensure effective dispersal of emissions. Given the above, and based on observations during the Site visit, the intensity of any odours travelling off-site would likely be very low.
- Duration – the duration of any potential odour impact may last as long as the wind is blowing in the direction of the sensitive receptors. Based on local wind patterns and given the Site is a 24/7 operation, the duration of any odour impact is concluded to be medium.
- Offensiveness – Given organic waste will be removed from site on a daily basis, Monday to Friday, the offensiveness is likely to be low.
- Location – the impact of location on the acceptability of odours from the Site has been accounted for by the receptor sensitivity classification of high (residential) and medium (industrial/commercial).

Further to the above, it is noted that the closest potentially sensitive receptor is located over 400 m away from the new waste storage and warehouse areas.

Given the above considerations, the magnitude of odour is predicted to be of **negligible** magnitude (ie predicted impact may be tolerated, **Table B2**) at both the surrounding industrial/commercial areas as well as the nearest residential areas.

Given the **high sensitivity** of the potentially affected residential receptors and the **negligible magnitude** of the potential odour impact of the handling and storage activities, the potential impact significance for the expanded site at the local residential receptors is concluded to be of ***neutral significance*** (see **Table 31**). Similarly, for the **medium sensitivity** commercial/industrial receptors, the **negligible magnitude** of the potential odour impact of the handling and storage activities is also concluded to be of ***neutral significance***.

The proposed odour mitigation measures for waste management and raw materials handling are listed in **Section 10**.

Table 31 Risk Assessment of Odour Impacts – Handling and Storage of Raw Materials and Waste

Receptor Type	Sensitivity [Defined by Table B1]	Impact Magnitude [Defined by Table B2]	Impact Significance
Residential/hotel	High	Negligible Magnitude	Neutral Significance
Commercial/industrial	Medium	Negligible Magnitude	Neutral Significance

9.3 Operational Phase – Quantitative Assessment

9.3.1 NO_2

Table 32 presents the incremental maximum 1-hour and annual average NO_2 concentrations predicted at the 18 surrounding receptor locations (based on the 1-hour average model predictions) for existing sources along with the combined existing and proposed sources as well as the estimated cumulative (including background) impacts. Isopleth plots of the predicted incremental NO_x concentrations are presented in **Appendix E**.

Table 32 Maximum Predicted NO_2 Concentrations at Surrounding Receptors

Receptor ID	Receptor Type	Incremental Existing Sources		Incremental All Sources		Cumulative (Plus Background)	
		1-Hour	Annual	1-Hour	Annual	1-Hour	Annual
		(µg/m³)					
R1	Sensitive	25	1.2	32	1.8	100	20
R2	Sensitive	12	0.3	19	0.5	99.6	19
R3	Sensitive	9.7	0.2	16	0.4	99.6	19
R4	Sensitive	9.3	0.1	14	0.2	99.6	19
R5	Sensitive	9.3	0.1	14	0.2	99.6	19
R6	Sensitive	6.8	0.1	9.6	0.2	99.6	19
R7	Sensitive	7.7	0.1	12	0.2	99.6	19
R8	Sensitive	7.5	0.1	11	0.2	99.6	19
R9	Sensitive	7.6	0.1	11	0.2	99.6	19
R10	Sensitive	7.0	0.1	9.4	0.2	99.6	19
R11	Commercial/Industrial	57	1.2	64	1.6	99.6	20
R12	Commercial/Industrial	50	2.3	80	4.1	99.6	23
R13	Commercial/Industrial	41	2.2	46	3.2	99.6	22
R14	Commercial/Industrial	19	0.6	32	1.0	99.6	19
R15	Commercial/Industrial	23	1.0	29	1.6	99.9	20
R16	Commercial/Industrial	22	0.5	28	0.7	101	19
R17	Commercial/Industrial	31	0.7	39	1.0	99.6	19
R18	Commercial/Industrial	38	1.8	42	2.3	99.6	21
Criteria							
Approved Methods						**246**	**62**
AAQ NEPM						**164**	**31**

The modelling results show that the predicted cumulative maximum 1-hour and annual average NO_2 concentrations are well below the relevant ambient air quality criteria at all receptor locations modelled. The maximum cumulative 1-hour average NO_2 concentration predicted at all receptors of 100 µg/m^3 relates solely to the highest concentration recorded in the background file, with no measurable contribution from the Project contributing impacts above background during this hour at any of the worst-affected receptor locations. The maximum incremental 1-hour average NO_2 concentrations predicted at these receptors represent up to around 10% of the ambient air quality criterion of 246 µg/m^3 and would not have any potential to give rise to exceedances.

9.3.2 CO

Table 33 presents the maximum incremental 15-minute, 1-hour and 8-hour average CO concentrations predicted at the 18 surrounding receptor locations (based on 1-hour average model predictions) for existing sources along with the combined concentrations from all existing and proposed sources.

Given the insignificant incremental increase of CO predicted at the identified receptors, and low background concentrations (see **Figure 10**), exceedances of the relevant CO criteria due to the operation of the Project are not predicted at any identified surrounding receptor location. Isopleth plots of the predicted incremental CO concentrations are presented in **Appendix E**.

Table 33 Maximum Predicted CO Concentrations at Surrounding Receptors

Receptor ID	Receptor Type	Incremental Existing Sources			Incremental All Sources		
		15-Minutes*	1-Hour	8-Hour	15-Minutes*	1-Hour	8-Hour
		(mg/m^3)					
R1	Sensitive	0.150	0.113	0.034	0.211	0.160	0.061
R2	Sensitive	0.062	0.047	0.033	0.106	0.081	0.059
R3	Sensitive	0.051	0.039	0.022	0.091	0.069	0.030
R4	Sensitive	0.049	0.037	0.022	0.076	0.058	0.030
R5	Sensitive	0.049	0.037	0.020	0.077	0.058	0.032
R6	Sensitive	0.036	0.027	0.024	0.055	0.042	0.037
R7	Sensitive	0.040	0.030	0.022	0.063	0.048	0.035
R8	Sensitive	0.043	0.032	0.020	0.062	0.047	0.034
R9	Sensitive	0.044	0.033	0.017	0.060	0.046	0.030
R10	Sensitive	0.042	0.032	0.208	0.057	0.043	0.267
R11	Commercial/Industrial	0.309	0.235	0.165	0.383	0.290	0.352
R12	Commercial/Industrial	0.244	0.185	0.209	0.559	0.424	0.238
R13	Commercial/Industrial	0.285	0.216	0.067	0.357	0.271	0.108
R14	Commercial/Industrial	0.115	0.087	0.064	0.229	0.174	0.102
R15	Commercial/Industrial	0.126	0.096	0.076	0.211	0.160	0.103
R16	Commercial/Industrial	0.133	0.100	0.086	0.166	0.126	0.119
R17	Commercial/Industrial	0.173	0.131	0.147	0.260	0.197	0.173
R18	Commercial/Industrial	0.222	0.169	0.028	0.302	0.229	0.052
Maximum background					2.6	2.0	1.9
Maximum cumulative impact **					3.2	2.4	2.2
Criteria					**100**	**30**	**10**

* The 1-hour average CO concentrations predicted by the modelling were converted to 15-minute averages using the power law formula.

** Conservatively calculated from the maximum incremental and maximum background, noting that these do not necessarily occur at the same time.

9.3.3 SO_2

Table 34 presents the maximum incremental 10-minute, 1-hour, 24-hour and annual average SO_2 concentrations predicted at the 18 surrounding receptor locations (based on 1-hour average model predictions and assuming that all stacks are emitting at the limit of detection of the sampling) for existing sources along with the combined concentrations from all existing and proposed sources.

Given the conservative assumptions used in the modelling, the very low incremental increase of SO_2 predicted at the identified receptors, and low background concentrations (see **Figure 10**), exceedances of the relevant SO_2 criteria due to the operation of the Project would not be expected at any identified surrounding receptor location. Isopleth plots of the predicted incremental SO_2 concentrations are presented in **Appendix E**.

Table 34 Maximum Predicted SO_2 Concentrations at Surrounding Receptors

Receptor ID	Receptor Type	Incremental Existing Sources				Incremental All Sources			
		10-Minutes*	1-Hour	24-Hour	Annual	10-Minutes*	1-Hour	24-Hour	Annual
		(mg/m³)							
R1	Sensitive	3.7	2.6	1.0	0.15	9.6	6.7	2.3	0.37
R2	Sensitive	2.2	1.5	0.5	0.04	4.5	3.1	1.2	0.09
R3	Sensitive	1.7	1.2	0.4	0.03	3.7	2.6	0.8	0.06
R4	Sensitive	1.5	1.0	0.2	0.02	3.4	2.4	0.5	0.04
R5	Sensitive	1.5	1.1	0.2	0.02	3.4	2.4	0.5	0.04
R6	Sensitive	1.0	0.7	0.2	0.01	2.4	1.7	0.4	0.03
R7	Sensitive	1.3	0.9	0.2	0.01	3.0	2.1	0.5	0.03
R8	Sensitive	1.2	0.8	0.2	0.02	2.7	1.9	0.4	0.04
R9	Sensitive	1.1	0.8	0.2	0.01	2.6	1.8	0.4	0.04
R10	Sensitive	1.0	0.7	0.2	0.01	2.5	1.7	0.4	0.03
R11	Commercial/Industrial	5.2	3.6	1.1	0.09	14.8	10.4	3.6	0.32
R12	Commercial/Industrial	18.2	12.7	4.8	0.60	26.0	18.2	8.1	0.94
R13	Commercial/Industrial	6.0	4.2	1.9	0.26	13.2	9.2	5.5	0.64
R14	Commercial/Industrial	4.9	3.4	1.1	0.08	8.9	6.2	2.2	0.18
R15	Commercial/Industrial	3.9	2.8	0.9	0.14	9.6	6.7	2.0	0.32
R16	Commercial/Industrial	2.2	1.5	0.5	0.04	5.9	4.2	1.4	0.11
R17	Commercial/Industrial	3.7	2.6	0.6	0.06	10.3	7.2	1.7	0.18
R18	Commercial/Industrial	5.9	4.1	1.2	0.14	11.0	7.7	3.3	0.45
Maximum background						86	60	11	1.8
Maximum cumulative impact **						112	78	20	2.7
Criteria						**712**	**570**	**228**	**60**

* The 1-hour average SO_2 concentrations predicted by the modelling were converted to 10-minute averages using the power law formula.

** Conservatively calculated from the maximum incremental and maximum background, noting that these do not necessarily occur at the same time.

9.3.4 Particulate Matter

Table 35 present maximum 24-hour and annual average incremental and cumulative PM_{10} concentrations and **Table 36** presents maximum24-hour and annual average incremental and cumulative $PM_{2.5}$ concentrations predicted at the modelled receptor locations for existing sources, along with the combined existing and proposed sources, as well as the estimated cumulative impacts. Isopleth plots of the predicted incremental PM concentrations are presented in **Appendix E**. Note that the predictions are the same for PM_{10} and $PM_{2.5}$ as it is assumed that all particulate matter from gas combustion is in the $PM_{2.5}$ size fraction.

No exceedances of the annual average PM_{10} criterion is predicted. The exceedances of the annual average $PM_{2.5}$ criteria and the 24-hour PM_{10} and 24-hour $PM_{2.5}$ criteria are due to elevated PM_{10} and $PM_{2.5}$ background concentrations (refer **Section 7**). As discussed in **Section 7**, exceedances of the 24-hour average PM_{10} and $PM_{2.5}$ criteria were recorded by the Prospect AQMS in all six years reviewed and exceedances of the annual average $PM_{2.5}$ criterion were also recorded in in all years investigated except for 2017. Ambient $PM_{2.5}$ concentrations often exceed the annual average criteria set out in the Approved Methods across the Sydney Greater Metropolitan Area and the exceedances recorded by the Prospect AQMS were primarily due to exceptional events, such as bushfire emergencies, dust storms and hazard reduction burns.

In circumstances where the existing ambient air pollutant concentrations exceed the impact assessment criteria, the Approved Methods requires the AQIA to demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity.

While no additional exceedances of the 24-hour PM_{10} and $PM_{2.5}$ criteria are predicted at any residential receptor due to the Project, a single additional exceedance of the 24-hour $PM_{2.5}$ criterion is predicted at R12 (Eastern Creek Tavern) adjacent to the northern site boundary. A review of the timeseries data for this receptor showed that the additional exceedance was predicted for 11 April 2016. The incremental impact due to the project on this day was predicted to be 0.5 $\mu g/m^3$ (only 2% of the criterion). However, the elevated existing background $PM_{2.5}$ concentration of 24.9 $\mu g/m^3$, which is just below the criterion, has led to an additional exceedance of the 24-hour $PM_{2.5}$ criterion for this receptor.

It is noted that due to the nature of this receptor (Commercial/Industrial), it is highly unlikely for people to be present at this location for the entirety of the averaging period (24-hours).

Figure 23 shows the predicted cumulative $PM_{2.5}$ impacts at R12 during one year in descending order and illustrates the relatively small incremental impact at this receptor over background concentrations. A similar trend in data is observed (**Figure 24**) for predicted cumulative $PM_{2.5}$ impacts at the worst effected residential receptor (R1).

Table 35 Maximum Predicted PM_{10} Concentrations at Receptors

Receptor ID	Receptor Type	Incremental Existing Sources		Incremental All Sources		Cumulative (Plus Background)		Additional Exceedances as Result of Project
		Maximum 24-Hour	Annual	Maximum 24-Hour	Annual	Maximum 24-Hour	Annual	
		(µg/m³)						
R1	Sensitive	0.8	0.1	1.1	0.2	111	19	0
R2	Sensitive	0.3	0.02	0.5	<0.1	110	19	0
R3	Sensitive	0.2	0.02	0.4	<0.1	110	19	0
R4	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R5	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R6	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R7	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R8	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R9	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R10	Sensitive	0.1	0.01	0.2	<0.1	110	19	0
R11	Commercial/Industrial	1.5	0.1	1.9	0.1	110	19	0
R12	Commercial/Industrial	2.2	0.2	4.4	0.4	110	19	0
R13	Commercial/Industrial	2.2	0.2	3.0	0.3	110	19	0
R14	Commercial/Industrial	0.6	<0.1	0.9	0.1	110	19	0
R15	Commercial/Industrial	0.7	0.1	1.0	0.1	111	19	0
R16	Commercial/Industrial	0.5	0.04	0.7	0.1	110	19	0
R17	Commercial/Industrial	0.6	0.1	0.7	0.1	110	19	0
R18	Commercial/Industrial	1.4	0.2	1.7	0.2	110	19	0
Criteria						**50**	**25**	**-**

Table 36 Maximum Predicted $PM_{2.5}$ Concentrations at Receptors

Receptor ID	Receptor Type	Incremental Existing Sources		Incremental All Sources		Cumulative (Plus Background)		Additional Exceedances as Result of Project
		Maximum 24-Hour	Annual	Maximum 24-Hour	Annual	Maximum 24-Hour	Annual	
		(µg/m³)						
R1	Sensitive	0.8	0.1	1.1	0.2	86	8.8	0
R2	Sensitive	0.3	0.02	0.5	<0.1	85	8.7	0
R3	Sensitive	0.2	0.02	0.4	<0.1	85	8.7	0
R4	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R5	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R6	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R7	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R8	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R9	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R10	Sensitive	0.1	0.01	0.2	<0.1	85	8.7	0
R11	Commercial/Industrial	1.5	0.1	1.9	0.1	85	8.8	0
R12	Commercial/Industrial	2.2	0.2	4.4	0.4	85	8.9	**1**
R13	Commercial/Industrial	2.2	0.2	3.0	0.3	85	8.9	0
R14	Commercial/Industrial	0.6	<0.1	0.9	0.1	85	8.7	0
R15	Commercial/Industrial	0.7	0.1	1.0	0.1	86	8.8	0
R16	Commercial/Industrial	0.5	0.04	0.7	0.1	85	8.7	0
R17	Commercial/Industrial	0.6	0.1	0.7	0.1	85	8.7	0
R18	Commercial/Industrial	1.4	0.2	1.7	0.2	85	8.8	0
Criteria						**25**	**8**	**-**

Figure 23 Predicted 24-hour $PM_{2.5}$ Concentrations at R12 by Rank

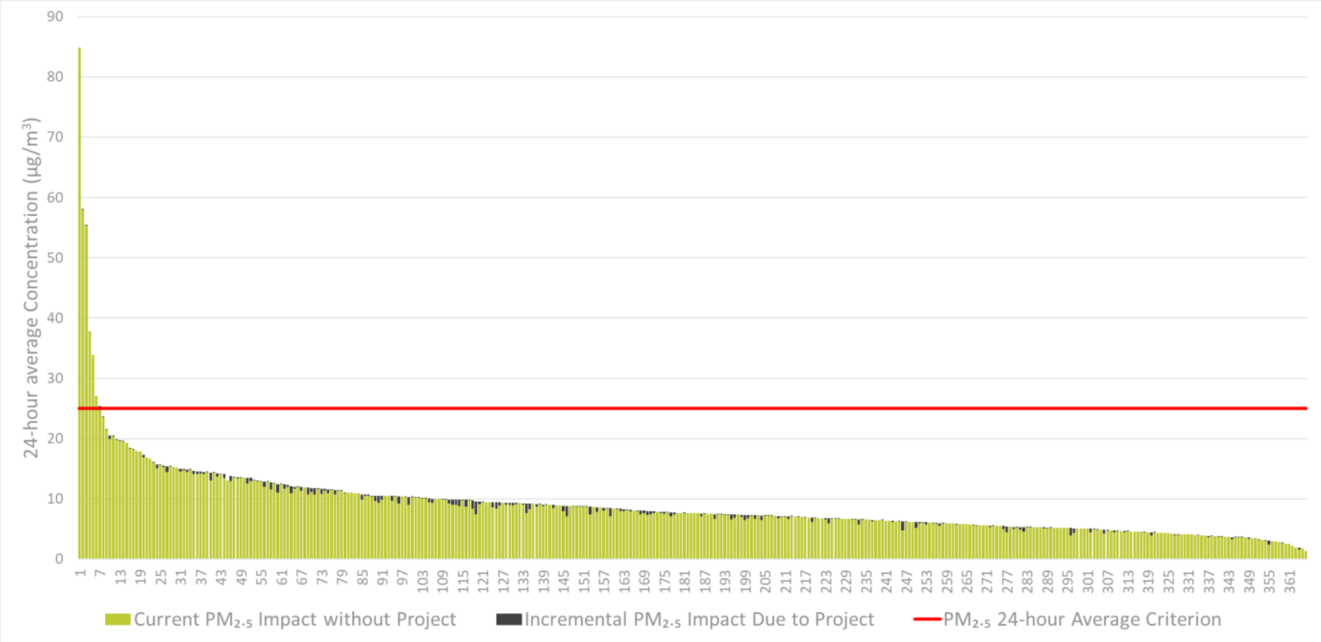
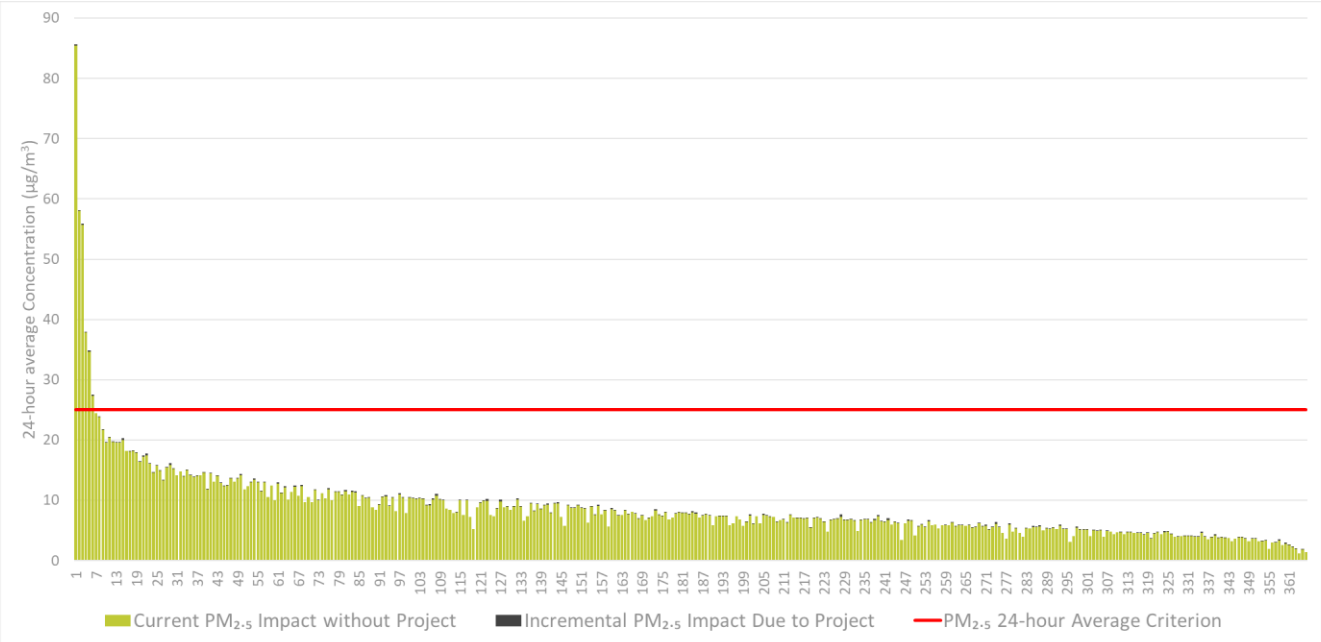


Figure 24 Predicted 24-hour $PM_{2.5}$ Concentrations at R1 by Rank



9.3.5 Ammonia

Table 37 presents the incremental maximum 1-hour average ammonia concentrations predicted at the surrounding discrete receptor locations. It is noted that only the existing processing lines are expected to emit ammonia, although the volume of the products containing ammonium bicarbonate is expected to increase after the expansion by around 5 10%. The modelling results conservatively assume that ammonia is being emitted by these lines continuously 24/7 to ensure that the maximum 1-hour average concentrations output by the model cover all potential worst-case meteorological conditions. Isopleth plots of the predicted incremental ammonia concentrations at these locations are presented in **Appendix E**.

The maximum (99.9th percentile) incremental 1-hour average ammonia concentrations predicted at the modelled receptor locations was 0.172 mg/m^3, which is less than (approximately 50% of) the criterion of 0.33 mg/m^3. The maximum concentration predicted beyond the Site boundary was 0.24 mg/m^3, occurring at the northern boundary of the Site.

Table 37 Maximum Predicted Ammonia Concentrations at Surrounding Receptors

Receptor ID	Receptor Type	Incremental 1-Hour Average Ammonia Concentration (mg/m^3) ^
R1	Sensitive	0.091
R2	Sensitive	0.035
R3	Sensitive	0.030
R4	Sensitive	0.022
R5	Sensitive	0.022
R6	Sensitive	0.019
R7	Sensitive	0.020
R8	Sensitive	0.021
R9	Sensitive	0.020
R10	Sensitive	0.018
R11	Commercial/Industrial	0.17
R12	Commercial/Industrial	0.15
R13	Commercial/Industrial	0.15
R14	Commercial/Industrial	0.059
R15	Commercial/Industrial	0.066
R16	Commercial/Industrial	0.057
R17	Commercial/Industrial	0.091
R18	Commercial/Industrial	0.12
Maximum concentration at/beyond the Site boundary		***0.24***
Criterion		**0.33**

^ 99.9th percentile.

9.3.6 Summary

The dispersion modelling study, which accounted for worst-case proposed operational activities and adopted several conservative assumptions (such as the assumption that the emissions of combustion gases would double when only a 25% increase in fuel consumption is proposed) predicted compliance with the NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$ and ammonia ambient air quality criteria all sensitive receptors modelled. A single additional exceedance of the 24-hour average $PM_{2.5}$ criterion is predicted by the model for an industrial/commercial receptor. This exceedance is primarily due to high background concentrations on the day (see **Section 4.4, Section 9.3.4**), with the incremental impact due to the Project at this industrial/commercial receptor predicted to be only 2% of the criterion on this day.

10 Mitigation Measures and Monitoring

10.1 Existing and Proposed Controls

As outlined in **Section 5.2** a number of mitigation measures have been adopted by the Project. These include the following:

- Discharges of pollutants to the air from the majority of potentially odorous activities (ovens and production areas) will be captured by BCA and AS standard compliant extraction systems and directed to rooftop vents.
- Containment measures for spillages will be provided at appropriate locations in the expansion area to reduce odorous emissions from waste spillages.
- The good housekeeping observed during the site visit will continue to be maintained on all areas of the Site, including regular cleaning of all internal and external areas.
- Organic waste and general waste will be removed from site for off-site disposal on a daily basis, Monday to Friday. In addition:
  - All generated waste will be identified and separated into common material streams or categories at the point of generation for separate collection. This ensures that any waste that has the potential to cause odour emissions is dealt with appropriately.
  - All organic waste will be stored in closed containers and away from direct sun.
  - All putrescible waste materials will be covered during transport.
  - Signage will be provided in waste management and processing areas to provide information relating to general housekeeping requirements and to act as a daily reminder to staff working at the premises.
- The physical controls (including ventilation fans, exhaust stacks, extraction hoods, grease traps, air pollution control devices etc.) are/will be designed to allow for easy and safe cleaning and maintenance. Regular cleaning of physical controls is and will be undertaken as per manufacturer's requirements.

In addition, the capacity of the wastewater treatment plant has been reviewed and has been confirmed as being adequate to treat waste from the expanded operations without any modifications to the plant.

10.2 Additional Recommendations

In order to further reduce the potential for off-site air quality impacts during operation, additional mitigation measures can be put in place. The following outlines a number of possible mitigation measures relevant to the proposed activities at the Site. It is noted that some of these measures are being considered by the detailed design team. Recommended mitigation measures for the construction phase are provided in **Section 9.1.1**.

- As outlined above, BCA/AS standard compliant extraction systems are being designed for the Project in order to extract emissions and discharge them to atmosphere via dedicated discharge vents. Air pollution control devices may be implemented to further reduce emissions where complaints are received in relation to nuisance odour or where prolonged smoke is visible during normal or peak operations (i.e. not during start up or shut down).

- Signage should be displayed to remind drivers to turn off vehicle engines when idling at the Site for longer than 1 minute to minimise exhaust emissions.
- General environmental awareness training should be provided to relevant staff and contractors, including:
  - Potential air quality and odour impacts that may be caused by activity during normal and abnormal circumstances;
  - Prevention of accidental air emissions and actions to be taken when accidental emissions occur;
  - Efficient and appropriate use and maintenance of equipment used on the Site (where relevant to their role); and
  - Procedures for complaint handling.
- All staff and contractors should be instructed to report any undue pollutant release (including odour) and visible emissions from the exhaust vents to the Site manager.
- In order to reduce the company's overall carbon footprint and combustion gas emissions generated by vehicles, it is recommended that commuting to work using sustainable modes of travel (such as public transport, cycling, and car share) be encouraged through the implementation of an incentive scheme and that facilities for cyclists such as bike storage areas, showers and lockers be provided.

10.3 Monitoring

Given the nature and scale of the Project, it is not anticipated that any impacts upon human health or amenity values would be experienced during the construction or operational phases.

Regular site walk overs and boundary inspections are recommended to be performed during the construction phase and ongoing monitoring of air quality is not considered to be required.

11 Conclusions

The main potential sources of air emissions were identified as dust impacts during the construction phase, and odour and products of combustion during the operational phase.

The potential for off-site dust impacts was assessed using a qualitative risk-based approach prescribed by the Institute of Air Quality Management (IAQM). The results of this assessment indicate that dust impacts due to the construction works do not have significant potential to adversely impact on surrounding sensitive land uses.

The risk of off-site odour impacts during the operational stage of the Project was concluded to be low based on the nature and scale of the proposed expansion, lack of any odour complaints regarding existing operations and observations of odours and house-keeping practices during site visits by SLR staff.

The dispersion of oven exhaust emissions due to the operation of both the existing and proposed operations was conservatively modelled using on-site stack test data and site-representative meteorological data in general accordance with the Approved Methods. The results of the modelling study predicted compliance with the NO_2, CO, SO_2, PM_{10}, $PM_{2.5}$ and ammonia ambient air quality criteria all sensitive receptors modelled. A single additional exceedance of the 24-hour average $PM_{2.5}$ criterion is predicted by the model for an industrial/commercial receptor. This exceedance is primarily due to high background concentrations on the day, with the incremental impact due to the Project at this industrial/commercial receptor predicted to be only 2% of the criterion on this day.

It is noted that this study adopts several conservative assumptions (such as the assumption that the emissions of combustion gases would double when only a 25% increase in fuel consumption is proposed) which are likely to have led to an overprediction of potential impacts from the Project. Therefore, SLR concludes that any exceedances of the relevant air quality criteria due to the Project are highly unlikely.

The additional mitigation measures recommended in this report will assist in further reducing the risk of any adverse off-site air quality impacts during the construction and operational phases.

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APPENDIX A

IAQM Construction Assessment Methodology

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located more than 350 m from the boundary of the Site, more than 50 m from the route used by construction vehicles on public roads and more than 500 m from the Site entrance. This step is noted as having deliberately been chosen to be conservative, and will require assessments for most projects.

Step 2a – Assessment of Scale and Nature of the Works

Step 2a of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of soils and dusty materials onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with suggested definitions for each category. The definitions given in the IAQM guidance for earthworks, construction activities and track-out, which are most relevant to this Project, are as follows:

Demolition *(Any activity involved with the removal of an existing structure [or structures]. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time)*:

- ***Large***: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
- ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
- ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.

Earthworks *(Covers the processes of soil-stripping, ground-levelling, excavation and landscaping)*:

- ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.
- ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (e.g. silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.
- ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (e.g. sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.

Construction *(Any activity involved with the provision of a new structure (or structures), its modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, etc)*:

- ***Large***: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.
- ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching.
- ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).

Track-out *(The transport of dust and dirt from the construction / demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network)*:

- ***Large***: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
- ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
- ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

In order to provide a conservative assessment of potential impacts, it has been assumed that if at least one of the parameters specified in the 'large' definition is satisfied, the works are classified as large, and so on.

Step 2b – Risk Assessment

Assessment of the Sensitivity of the Area

- Step 2b of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:
- The specific sensitivities that identified sensitive receptors have to dust deposition and human health impacts
- The proximity and number of those receptors
- In the case of PM_{10}, the local background concentration
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table A-1**. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table A-1 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
Dust soiling	Users can reasonably expect a high level of amenity; or The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land.	Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or The appearance, aesthetics or value of their property could be diminished by soiling; or The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land.	The enjoyment of amenity would not reasonably be expected; or Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land.
	Examples: Dwellings, museums, medium and long term car parks and car showrooms.	*Examples: Parks and places of work.*	*Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*
Health effects	Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day).	Locations where human exposure is transient.
	Examples: Residential properties, hospitals, schools and residential care homes.	*Examples: Office and shop workers, but will generally not include workers occupationally exposed to PM_{10}.*	*Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors. Additional factors to consider when determining the sensitivity of the area include:

- Any history of dust generating activities in the area
- The likelihood of concurrent dust generating activity on nearby sites
- Any pre-existing screening between the source and the receptors
- Any conclusions drawn from analysing local meteorological data which accurately represent the area and if relevant, the season during which the works will take place
- Any conclusions drawn from local topography
- The duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts)
- Any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table A-2**. The sensitivity of the area should be derived for each of activity relevant to the project (i.e. construction and earthworks).

Table A-2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Receptor sensitivity	Number of receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in **Table A-3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 25 µg/m^3 for PM_{10}) the IAQM method has been modified slightly.

- This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:
- Any history of dust generating activities in the area
- The likelihood of concurrent dust generating activity on nearby sites

- Any pre-existing screening between the source and the receptors
- Any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works will take place
- Any conclusions drawn from local topography
- Duration of the potential impact
- Any known specific receptor sensitivities which go beyond the classifications given in this document.

Table A-3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor sensitivity	Annual mean PM_{10} conc.	Number of receptors [a,b]	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 μg/m^3	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 μg/m^3	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 μg/m^3	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 μg/m^3	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	>25 μg/m^3	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	21-25 μg/m^3	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 μg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 μg/m^3	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Notes: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m); noting that only the highest level of area sensitivity from the table needs to be considered.

(b) In the case of high sensitivity receptors with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table A-4** (demolition), **Table A-5** (earthworks and construction) and **Table A-6** (track-out) to determine the risk category with no mitigation applied.

Table A-4 Risk Category from Demolition Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A-5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A-6 Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 3 - Site-Specific Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the Site is a low, medium or high risk site.

Step 4 – Residual Impacts

Following Step 3, the residual impact is then determined after management measures have been considered.

APPENDIX B

Qualitative Operational Assessment Methodology

The risk-based assessment takes account of a range of impact descriptors, including the following:

- **Nature of Impact**: does the impact result in an adverse or beneficial environment?
- **Sensitivity**: how sensitive is the receiving environment to the anticipated impacts? This may be applied to the sensitivity of the environment in a regional context or specific receptor locations.
- **Magnitude**: what is the anticipated scale of the impact?

The integration of receptor sensitivity with impact magnitude is used to derive the predicted **significance** of that change.

Nature of Impact

Predicted impacts may be described in terms of the overall effect upon the environment:

- **Beneficial**: the predicted impact will cause a beneficial effect on the receiving environment.
- **Neutral**: the predicted impact will cause neither a beneficial nor adverse effect.
- **Adverse**: the predicted impact will cause an adverse effect on the receiving environment.

Receptor Sensitivity

Sensitivity may vary with the anticipated impact or effect. A receptor may be determined to have varying sensitivity to different environmental changes, for example, a high sensitivity to changes in air quality, but low sensitivity to noise impacts. Sensitivity may also be derived from statutory designation which is designed to protect the receptor from such impacts.

Sensitivity terminology may vary depending upon the environmental effect, but generally this may be described in accordance with the broad categories outlined in **Table B1**, which has been used in this assessment to define the sensitivity of receptors to air quality impacts.

Table B1 Methodology for Assessing Sensitivity of a Receptor to Air Quality Impacts

Sensitivity	Criteria
Very High	Receptors of very high sensitivity to air pollution (eg dust or odour) such as: hospitals and clinics, retirement homes, painting and furnishing businesses, hi-tech industries and food processing.
High	Receptors of high sensitivity to air pollution, such as: schools, residential areas, food retailers, glasshouses and nurseries, horticultural land and offices.
Medium	Receptors of medium sensitivity to air pollution, such as: farms, outdoor storage, light and heavy industry.
Low	All other air quality sensitive receptors not identified above.

Magnitude of Impact

Magnitude describes the anticipated scale of the anticipated environmental change in terms of how that impact may cause a change to baseline conditions. **Table B2** outlines the methodology used in this assessment to define the magnitude of the identified potential air quality impacts.

Table B2 Methodology for Assessing Magnitude of Impacts

Magnitude	Description
Substantial	Impact is predicted to cause significant consequences on the receiving environment (may be adverse or beneficial)
Moderate	Impact is predicted to possibly cause statutory objectives/standards to be exceeded (may be adverse)
Slight	Predicted impact may be tolerated.
Negligible	Impact is predicted to cause no significant consequences.

Significance of Impact

The risk-based matrix provided below illustrates how the definition of the sensitivity and magnitude interact to produce impact significance.

Table B3 Impact Significance Matrix

	Magnitude Sensitivity	[Defined by Table B2]			
		Substantial Magnitude	**Moderate Magnitude**	**Slight Magnitude**	**Negligible Magnitude**
[Defined by Table B1]	**Very High Sensitivity**	Major Significance	Major/ Intermediate Significance	Intermediate Significance	Neutral Significance
	High Sensitivity	Major/ Intermediate Significance	Intermediate Significance	Intermediate/Minor Significance	Neutral Significance
	Medium Sensitivity	Intermediate Significance	Intermediate/Minor Significance	Minor Significance	Neutral Significance
	Low Sensitivity	Intermediate/Minor Significance	Minor Significance	Minor/Neutral Significance	Neutral Significance

APPENDIX C

Selection of Representative Meteorological Data

SELECTION OF REPRESENTATIVE METEOROLOGICAL DATA

Once emitted to atmosphere, the emissions will:

- Rise according to the momentum and buoyancy of the emission at the discharge point relative to the prevailing atmospheric conditions;
- Be advected from the source according to the strength and direction of the wind at the height which the plume has risen in the atmosphere;
- Be diluted due to mixing with the ambient air, according to the intensity of turbulence; and
- (Potentially) be chemically transformed and/or depleted by deposition processes.

Dispersion is the combined effect of these processes. Dispersion modelling is used as a tool to simulate the air quality effects of specific emission sources, given the meteorology typical for a local area together with the expected emissions. Selection of a year when the meteorological data is atypical means that the resultant predictions may not appropriately represent the most likely air quality impacts. Therefore, in dispersion modelling, one of the key considerations is the representative nature of the meteorological data used.

The year of meteorological data used for the dispersion modelling was selected by reviewing the most recent five years of historical surface observations at Horsley Park Equestrian Centre AWS (2016 to 2020 inclusive) to determine the year that is most representative of average conditions. Wind direction, wind speed and ambient temperature were compared to 5-year averages for the region to determine the most representative year.

Data collected from 2016 to 2020 is summarised in **Figure** C**1** to **Figure C3**. Examination of the data indicates the following:

- **Figure C1** indicates all years are generally similar with a higher frequency of winds from the north, and southwest.
- **Figure C2** indicates that average monthly wind speeds during 2016 were typically lower than the 5-year average wind speeds. Lower wind speeds lead to less effective dispersion of pollutants and as such the use of a data set with lower wind speeds is considered to be conservative.

Analysis of the average windspeeds and frequency of calms indicates that the year 2019 and to a smaller degree 2020 also have lower windspeeds that the five-year average, however, background PM_{10} and $PM_{2.5}$ concentrations for these years is known to be heavily impacted by summer bushfire events. For this reason, 2016 was selected as the representative year of meteorology with which to conduct the plume dispersion modelling.

Figure C1 Frequency of Winds at Horsley Park Equestrian Centre AWS 2016 – 2020

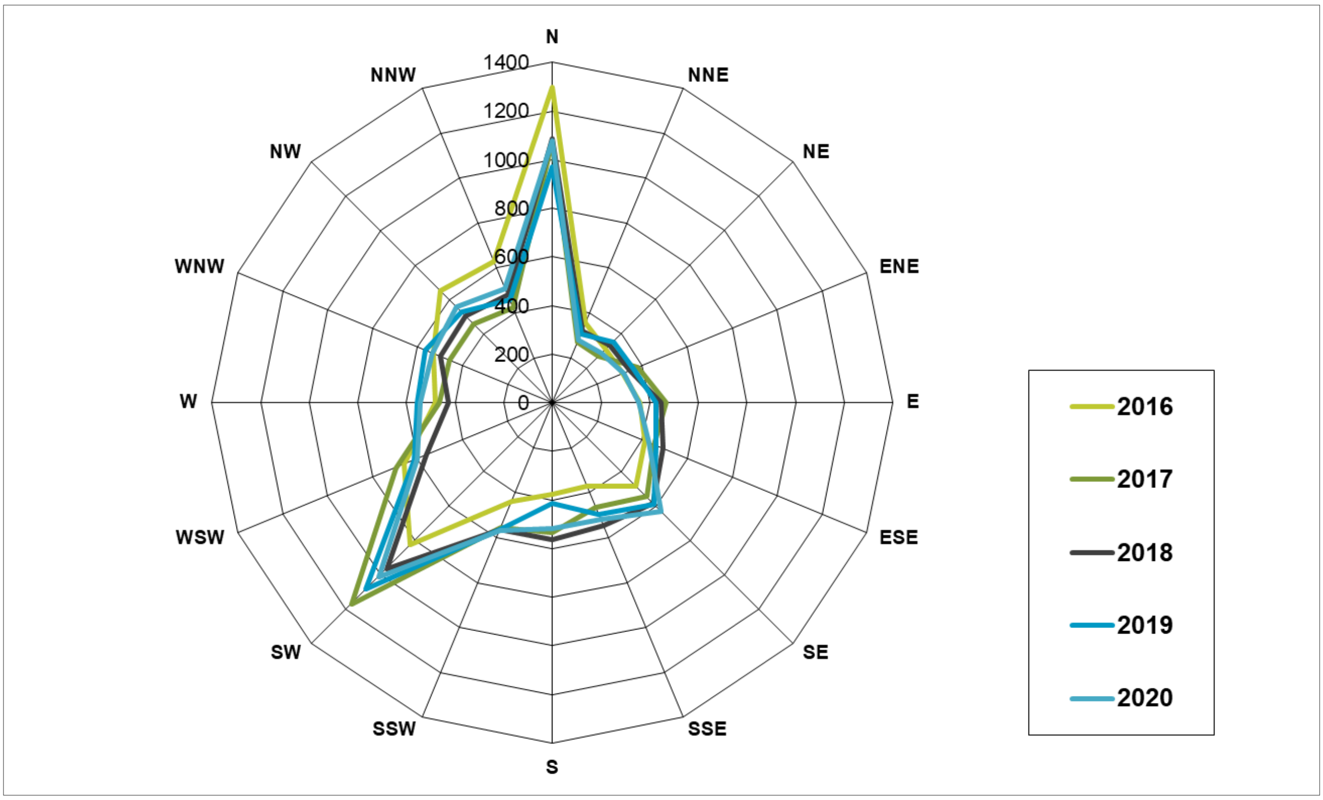
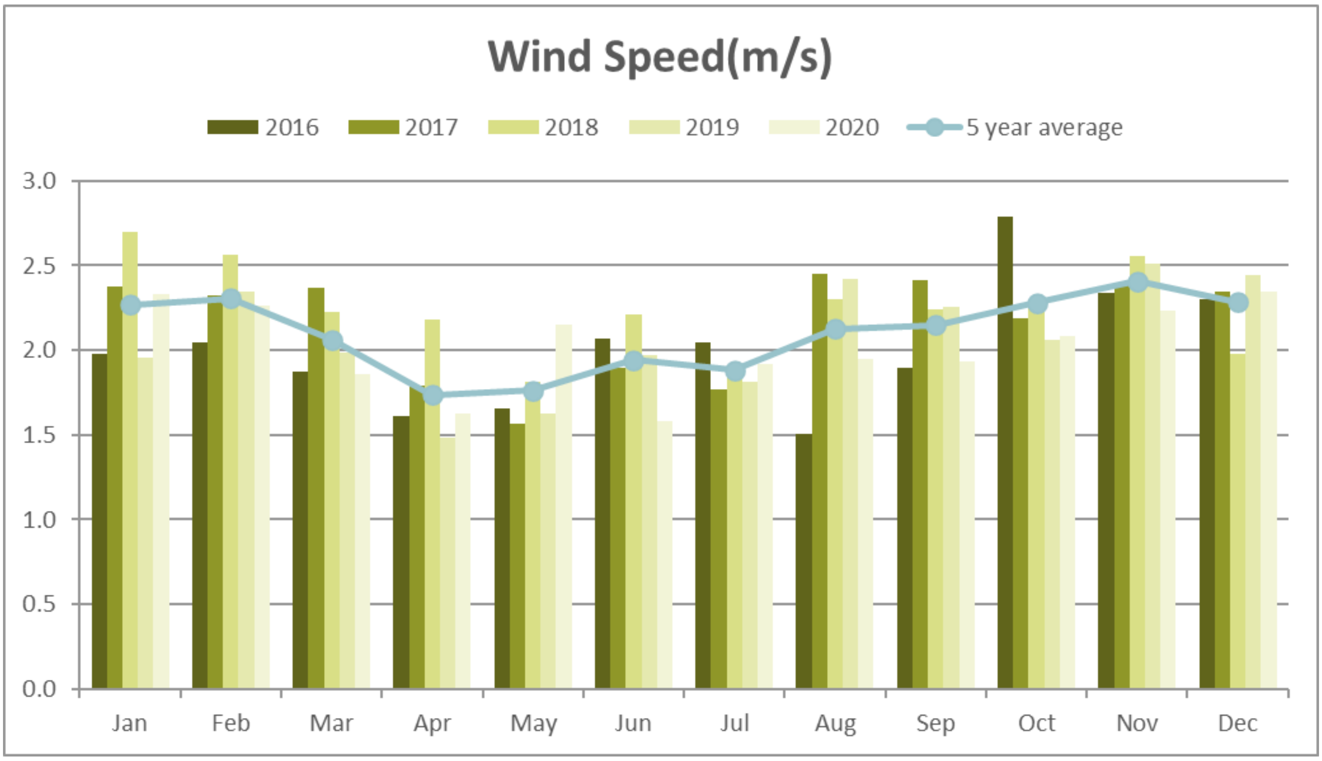


Figure C2 Monthly Average Wind Speed at Horsley Park Equestrian Centre AWS 2016 – 2020



APPENDIX D

Emission Test Report

Ektimo

SLR Consulting Australia Pty Ltd, North Sydney

The Arnott's Group

Emission Testing Report

Report Number R012166-1

Document Information

Template Version 211117

Client Name:	SLR Consulting Australia Pty Ltd
Report Number:	R012166-1
Date of Issue:	18 March 2022
Attention:	Ali Naghizadeh
Address:	Tenancy 202 Submarine School Sub Base Platypus 120 High Street North Sydney NSW 2060
Testing Laboratory:	Ektimo Pty Ltd, ABN 86 600 381 413

Report Authorisation

Graham Edwards
Senior Air Monitoring Consultant

NATA Accredited Laboratory
No. 14601

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports.

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Please note that only numerical results pertaining to measurements conducted directly by Ektimo are covered by Ektimo's terms of NATA accreditation. This does not include comments, conclusions or recommendations based upon the results. Refer to 'Test Methods' for full details of testing covered by NATA accreditation.

Table of Contents

1 Executive Summary

1.1 Background

Ektimo was engaged by SLR Consulting Australia Pty Ltd to perform emission testing a facility owned and operated by The Arnott's Group, located in Huntingwood, NSW.

1.2 Project Objective

The objective of the project was to quantify emissions from twelve (12) discharge points as part of SLR Consulting Australia Pty Ltd's emissions review and dispersion modelling assessment of The Arnott's Group (Huntingwood facility).

Monitoring was performed as follows:

Location	Identification	Test Date	Test Parameters*
Line 4	Stack A	12 January 2022	Nitrogen Oxides (as NO_2), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Carbon Dioxide (CO_2), Oxygen (O_2)
	Stack B		
	Stack C		
	Stack D		
Line 1	Stack A	13 January 2022	Ammonia (NH_3) Nitrogen Oxides (as NO_2), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Carbon Dioxide (CO_2), Oxygen (O_2)
	Stack B		
	Stack C		
	Stack D		
Boiler Unit	HW1	14 January 2022	Nitrogen Oxides (as NO_2), Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Carbon Dioxide (CO_2), Oxygen (O_2)
	V150		
	V151		
	V152		

* Flow rate, velocity, temperature, and moisture were also determined.

All results are reported on a dry basis at STP.

1.3 Results Summary

The results summary below outlines the reported parameters at each location tested within the Arnott's facility from January 12th to January 14th, 2022.

Pollutant	Test date	Units	Line 1			
			Stack A	Stack B	Stack C	Stack D
Ammonia (NH_3)	13-Jan-22	mg/m^3	1100	2800	100	2.3
Nitrogen Oxides (as NO_2)		mg/m^3	59	130	<4	<4
Carbon Monoxide (CO)		mg/m^3	600	470	10	<2
Sulfur Dioxide (SO_2)		mg/m^3	<6	<6	<6	<6
Carbon Dioxide (CO_2)		% v/v	2.4	4.9	0.4	<0.4
Oxygen (O_2)		% v/v	17.3	12	20.3	20.9

Pollutant	Test date	Units	Line 4			
			Stack A	Stack B	Stack C	Stack D
Nitrogen Oxides (as NO_2)	12-Jan-22	mg/m^3	17	60	12	<4
Carbon Monoxide (CO)		mg/m^3	97	590	87	<2
Sulfur Dioxide (SO_2)		mg/m^3	<6	<6	<6	<6
Carbon Dioxide (CO_2)		% v/v	3.2	6	2.1	<0.4
Oxygen (O_2)		% v/v	15.2	10.9	17.5	20.9

Pollutant	Test date	Units	Boiler Unit			
			HW1	V150	V151	V152
Nitrogen Oxides (as NO_2)	14-Jan-22	mg/m^3	85	52	67	81
Carbon Monoxide (CO)		mg/m^3	6.9	6.3	10	<2
Sulfur Dioxide (SO_2)		mg/m^3	<6	<6	<6	<6
Carbon Dioxide (CO_2)		% v/v	5.9	6.4	9.7	9.2
Oxygen (O_2)		% v/v	11.1	9.9	4.1	4.9

2 Results

2.1 Line 1

2.1.1 Stack A

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack A
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		*220107*

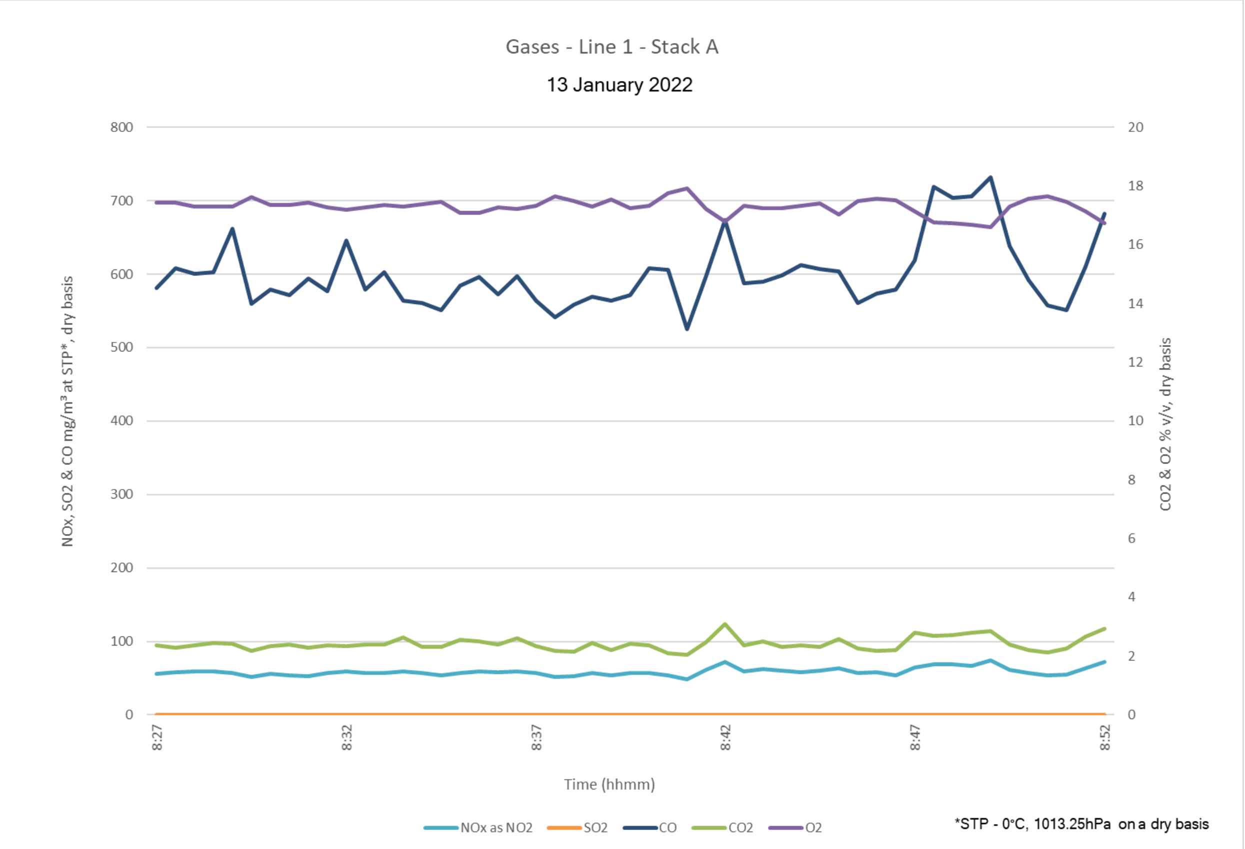
Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	16	
Gas molecular weight, g/g mole	27.4 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.22 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.65	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0800 & 1015	
Temperature, °C	237	
Temperature, K	510	
Velocity at sampling plane, m/s	4.8	
Volumetric flow rate, actual, m³/s	0.34	
Volumetric flow rate (wet STP), m³/s	0.18	
Volumetric flow rate (dry STP), m³/s	0.15	
Mass flow rate (wet basis), kg/hour	800	

Isokinetic Results	Results	
Sampling time	0855-1002	
	Concentration mg/m³	Mass Rate g/min
Ammonia	1100	10
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	107	
Velocity difference, %	-9	

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack A
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	0827 - 0852		0827 - 0852		0827 - 0852	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	59	0.53	48	0.44	74	0.67
Sulfur dioxide	<6	<0.05	<6	<0.05	<6	<0.05
Carbon monoxide	600	5.4	520	4.8	730	6.7
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	2.4		2		3.1	
Oxygen	17.3		16.6		17.9	



2.1.2 Stack B

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack B
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

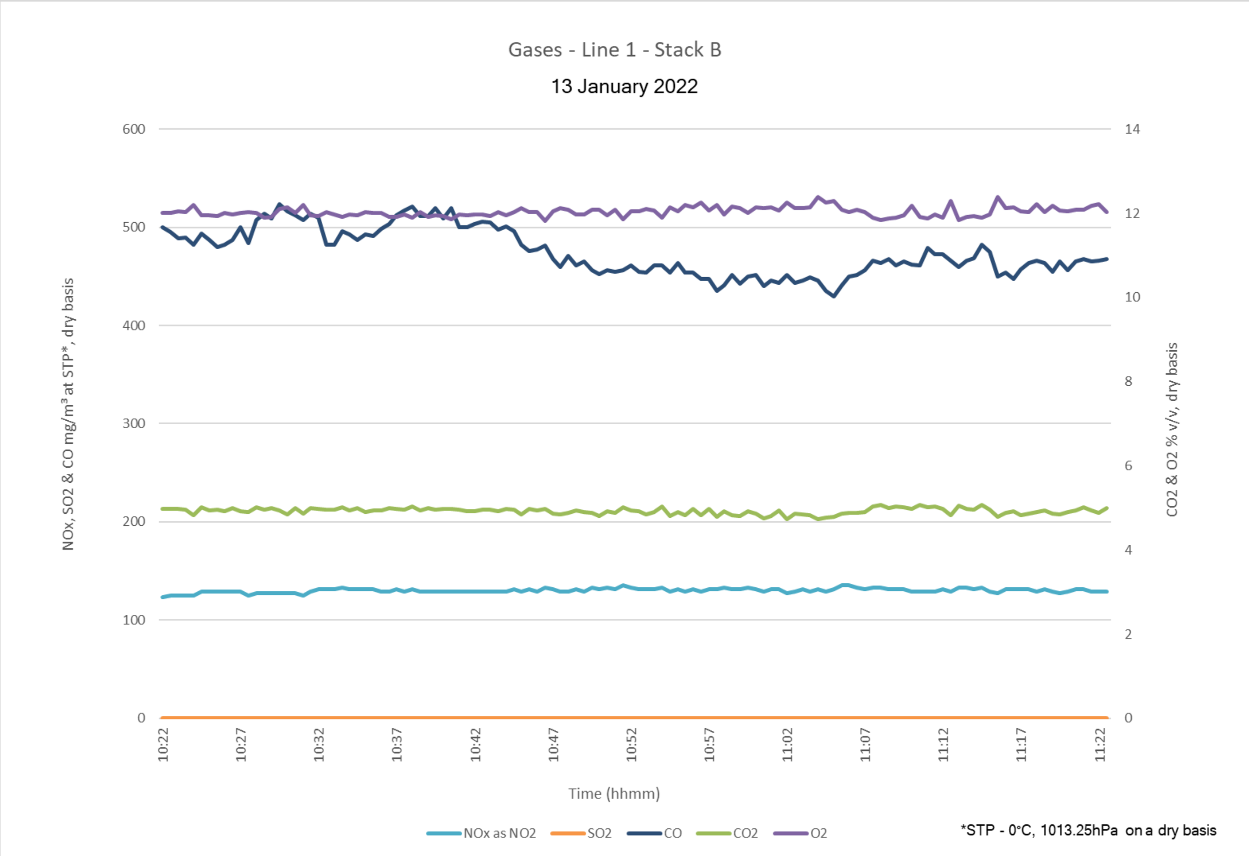
Stack Parameters		
Moisture content, %v/v	33	
Gas molecular weight, g/g mole	25.6 (wet)	29.4 (dry)
Gas density at STP, kg/m³	1.14 (wet)	1.31 (dry)
Gas density at discharge conditions, kg/m³	0.57	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1015 & 1140	
Temperature, °C	275	
Temperature, K	548	
Velocity at sampling plane, m/s	5.8	
Volumetric flow rate, actual, m³/s	0.41	
Volumetric flow rate (wet STP), m³/s	0.2	
Volumetric flow rate (dry STP), m³/s	0.14	
Mass flow rate (wet basis), kg/hour	840	

Isokinetic Results	Results	
Sampling time	1021-1126	
	Concentration mg/m³	Mass Rate g/min
Ammonia	2800	22
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	103	
Velocity difference, %	3	

Ektimo

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack B
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1022 - 1122		1022 - 1122		1022 - 1122	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	130	1.1	120	1	140	1.1
Sulfur dioxide	<6	<0.05	<6	<0.05	<6	<0.05
Carbon monoxide	470	3.9	430	3.5	520	4.3
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	4.9		4.7		5.1	
Oxygen	12		11.8		12.4	



2.1.3 Stack C

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack C
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

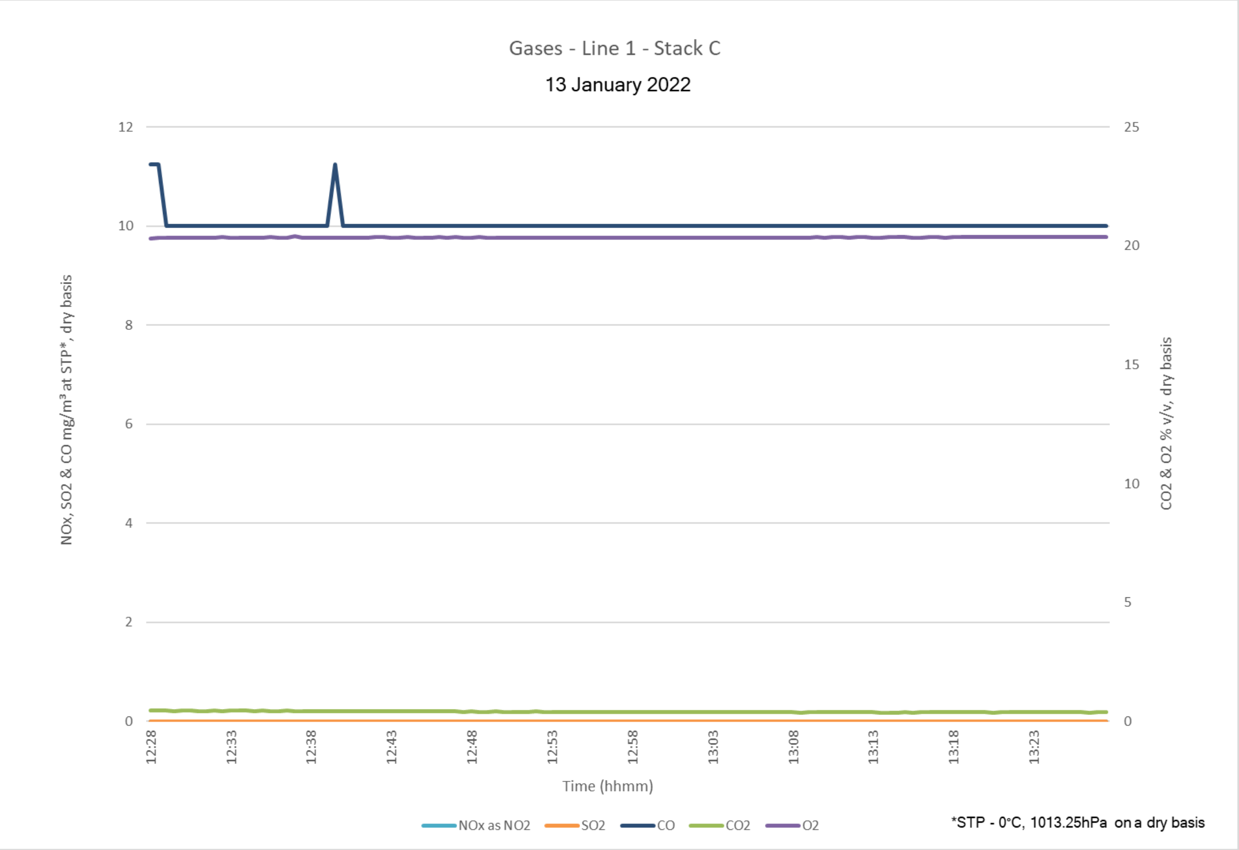
Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	7.3	
Gas molecular weight, g/g mole	28.2 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.26 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	0.83	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1150 & 1340	
Temperature, °C	139	
Temperature, K	412	
Velocity at sampling plane, m/s	4.2	
Volumetric flow rate, actual, m³/s	0.29	
Volumetric flow rate (wet STP), m³/s	0.19	
Volumetric flow rate (dry STP), m³/s	0.18	
Mass flow rate (wet basis), kg/hour	880	

Isokinetic Results	Results	
Sampling time	1227-1335	
	Concentration mg/m³	Mass Rate g/min
Ammonia	100	1.1
Isokinetic Sampling Parameters		
Sampling time, min	64	
Isokinetic rate, %	91	
Velocity difference, %	5	

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack C
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1228 - 1328		1228 - 1328		1228 - 1328	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	<4	<0.05	<4	<0.05	<4	<0.05
Sulfur dioxide	<6	<0.06	<6	<0.06	<6	<0.06
Carbon monoxide	10	0.11	10	0.11	11	0.12
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	0.4		<0.4		0.5	
Oxygen	20.3		20.3		20.4	



2.1.4 Stack D

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack D
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

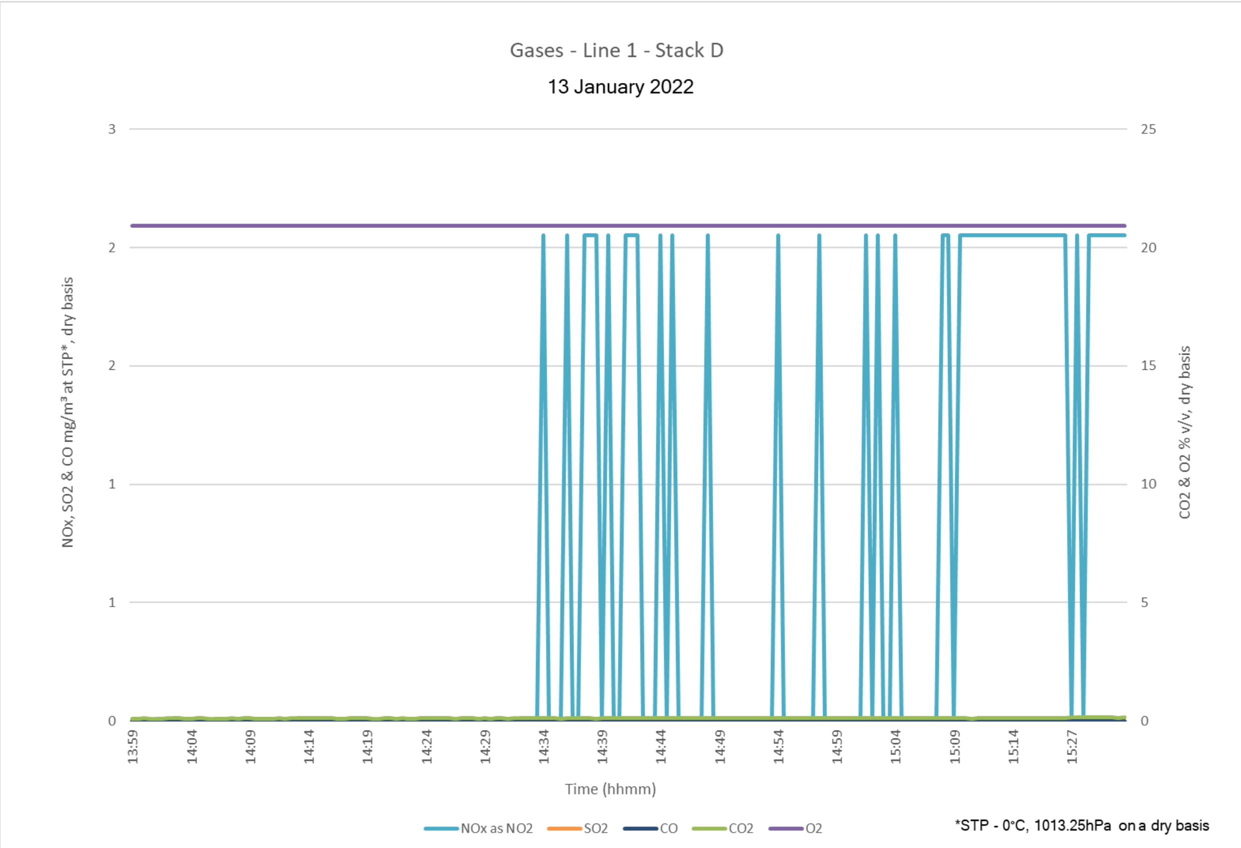
Sampling Plane Details	
Sampling plane dimensions	500 mm
Sampling plane area	0.196 m²
Sampling port size, number & depth	2" BSP (x2), 55 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 12
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	1	
Gas molecular weight, g/g mole	28.9 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.29 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.01	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1330 & 1510	
Temperature, °C	74	
Temperature, K	347	
Velocity at sampling plane, m/s	7.5	
Volumetric flow rate, actual, m³/s	1.5	
Volumetric flow rate (wet STP), m³/s	1.2	
Volumetric flow rate (dry STP), m³/s	1.1	
Mass flow rate (wet basis), kg/hour	5300	

Isokinetic Results	Results	
Sampling time	1400-1502	
	Concentration mg/m³	Mass Rate g/min
Ammonia	2.3	0.16
Isokinetic Sampling Parameters		
Sampling time, min	60	
Isokinetic rate, %	99	
Velocity difference, %	-9	

Date	13/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 1 - Stack D
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1359 - 1531		1359 - 1531		1359 - 1531	
	Concentration	Mass Rate	Concentration	Mass Rate	Concentration	Mass Rate
Combustion Gases	mg/m³	g/min	mg/m³	g/min	mg/m³	g/min
Nitrogen oxides (as NO_2)	<4	<0.3	<4	<0.3	<4	<0.3
Sulfur dioxide	<6	<0.4	<6	<0.4	<6	<0.4
Carbon monoxide	<2	<0.2	<2	<0.2	<2	<0.2
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	<0.4		<0.4		<0.4	
Oxygen	20.9		20.9		20.9	



Ektimo

2.2 Line 4

2.2.1 Stack A

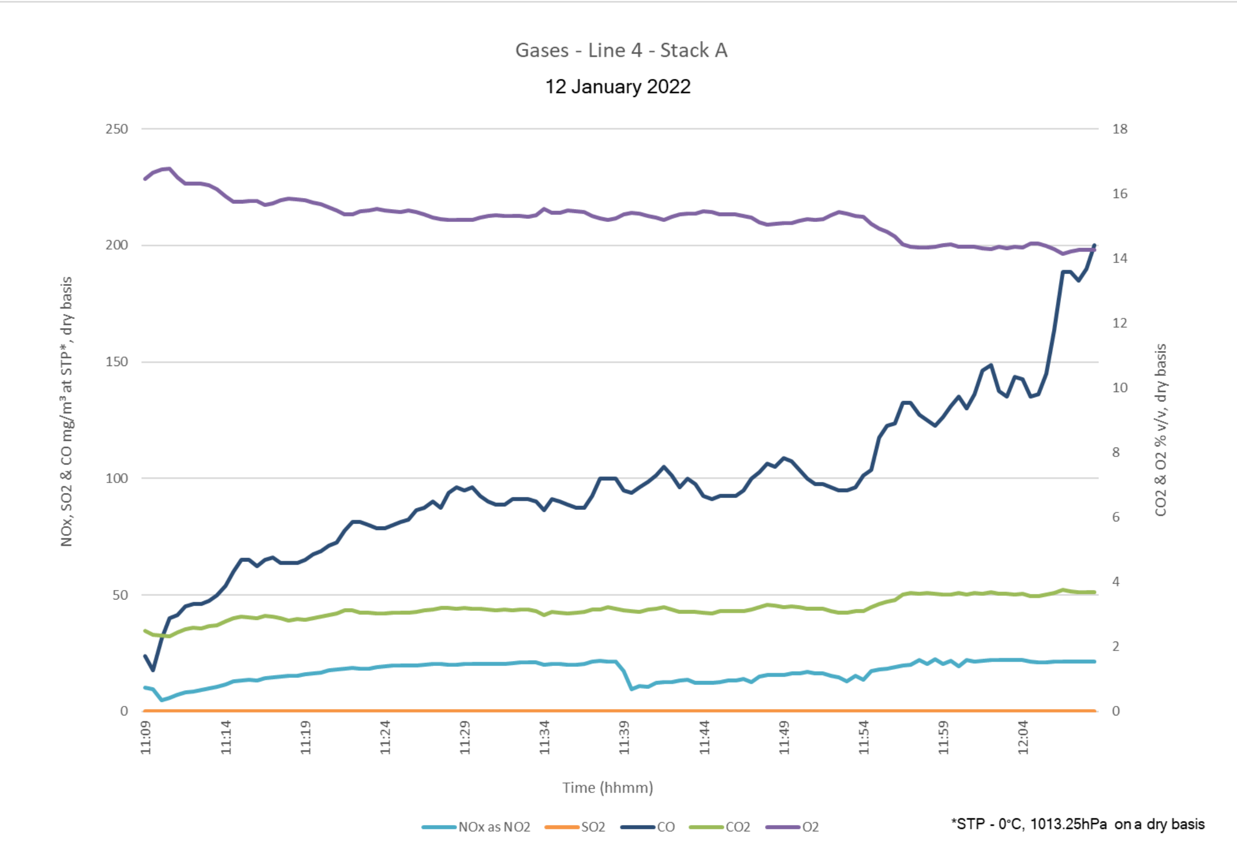
Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack A
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Bend >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	14	
Gas molecular weight, g/g mole	27.6 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.23 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.69	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1050 & 1215	
Temperature, °C	214	
Temperature, K	487	
Velocity at sampling plane, m/s	4.4	
Volumetric flow rate, actual, m³/s	0.31	
Volumetric flow rate (wet STP), m³/s	0.18	
Volumetric flow rate (dry STP), m³/s	0.15	
Mass flow rate (wet basis), kg/hour	780	
Velocity difference, %	-8	

Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack A
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1109 - 1209		1109 - 1209		1109 - 1209	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	17	0.15	4.7	0.042	22	0.2
Sulfur dioxide	<6	<0.05	<6	<0.05	<6	<0.05
Carbon monoxide	97	0.87	17	0.16	200	1.8
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	3.2		2.3		3.8	
Oxygen	15.2		14.1		16.8	



2.2.2 Stack B

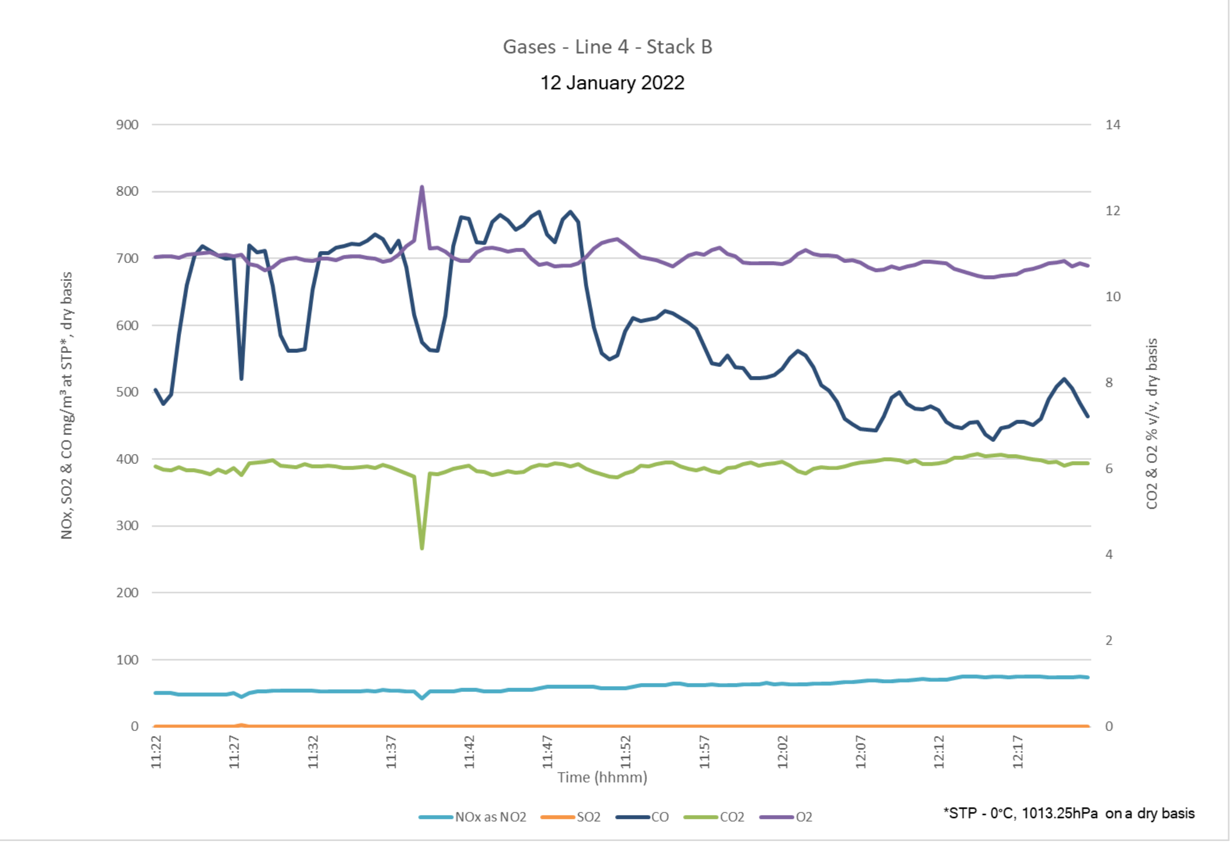
Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack B
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	32	
Gas molecular weight, g/g mole	25.8 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.15 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.57	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1110 & 1235	
Temperature, °C	275	
Temperature, K	548	
Velocity at sampling plane, m/s	5	
Volumetric flow rate, actual, m³/s	0.36	
Volumetric flow rate (wet STP), m³/s	0.18	
Volumetric flow rate (dry STP), m³/s	0.12	
Mass flow rate (wet basis), kg/hour	740	
Velocity difference, %	-7	

Date	12/01/2022	Client	The Arnott's Group
Report	R012166	Stack ID	Line 4 - Stack B
Licence No.	-	Location	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	State	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1122 - 1222		1122 - 1222		1122 - 1222	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	60	0.44	42	0.3	75	0.54
Sulfur dioxide	<6	<0.04	<6	<0.04	<6	<0.04
Carbon monoxide	590	4.3	430	3.1	770	5.6
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	6		4.2		6.3	
Oxygen	10.9		10.5		12.6	



Ektimo

2.2.3 Stack C

Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack C
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

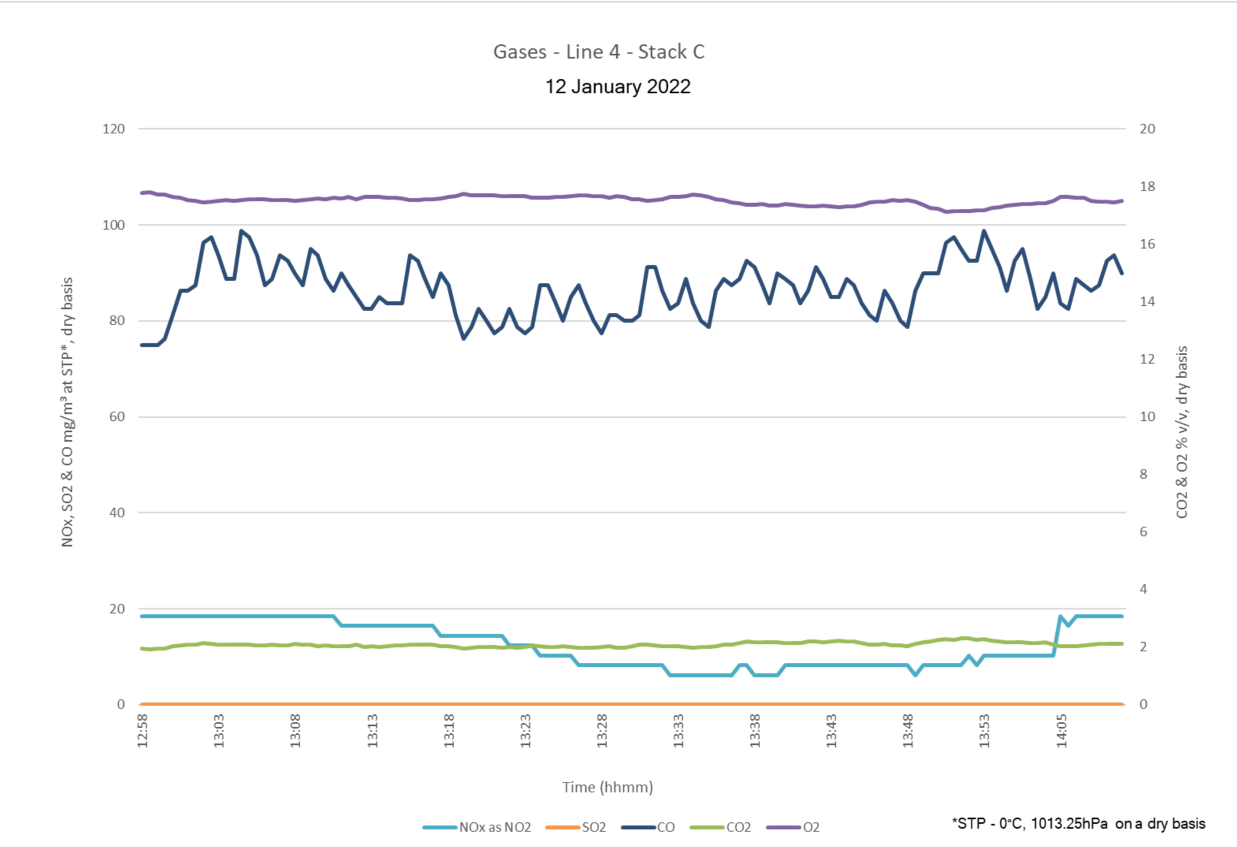
Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Stack Parameters		
Moisture content, %v/v	26	
Gas molecular weight, g/g mole	26.3 (wet)	29.2 (dry)
Gas density at STP, kg/m³	1.17 (wet)	1.30 (dry)
Gas density at discharge conditions, kg/m³	0.70	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1300 & 1415	
Temperature, °C	187	
Temperature, K	460	
Velocity at sampling plane, m/s	6.1	
Volumetric flow rate, actual, m³/s	0.43	
Volumetric flow rate (wet STP), m³/s	0.26	
Volumetric flow rate (dry STP), m³/s	0.19	
Mass flow rate (wet basis), kg/hour	1100	
Velocity difference, %	7	

Ektimo

Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack C
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1258 - 1409		1258 - 1409		1258 - 1409	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	12	0.14	6.2	0.071	18	0.21
Sulfur dioxide	<6	<0.07	<6	<0.07	<6	<0.07
Carbon monoxide	87	1	75	0.86	99	1.1
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	2.1		1.9		2.3	
Oxygen	17.5		17.1		17.8	



2.2.4 Stack D

Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack D
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

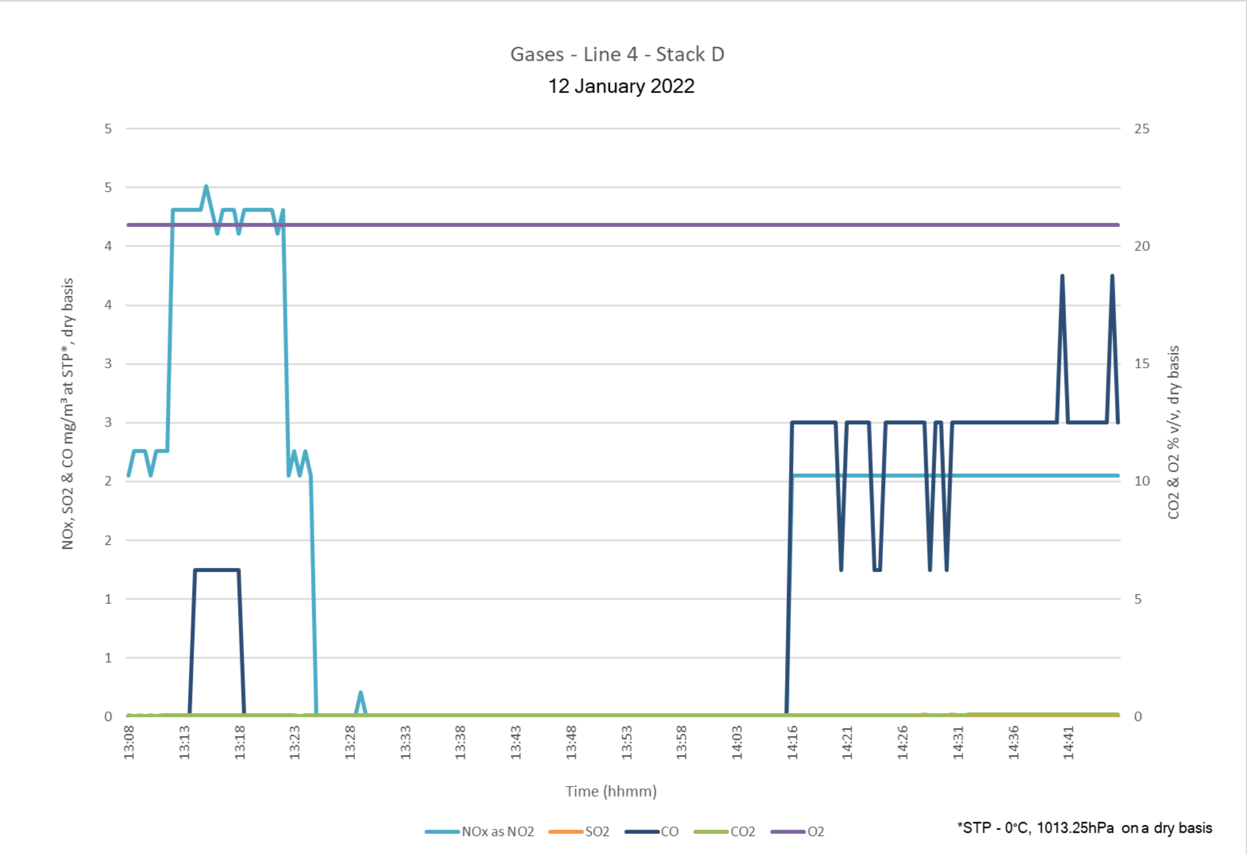
Sampling Plane Details	
Sampling plane dimensions	300 mm
Sampling plane area	0.0707 m²
Sampling port size, number & depth	2" BSP (x2), 57 mm
Access & height of ports	Fixed ladder 10 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter >6 D
No. traverses & points sampled	2 8
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The differential pressure at one or more sampling points is less than 5 Pa

Stack Parameters		
Moisture content, %v/v	12	
Gas molecular weight, g/g mole	27.7 (wet)	29.0 (dry)
Gas density at STP, kg/m³	1.24 (wet)	1.29 (dry)
Gas density at discharge conditions, kg/m³	1.02	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1310 & 1430	
Temperature, °C	58	
Temperature, K	331	
Velocity at sampling plane, m/s	1.9	
Volumetric flow rate, actual, m³/s	0.13	
Volumetric flow rate (wet STP), m³/s	0.11	
Volumetric flow rate (dry STP), m³/s	0.095	
Mass flow rate (wet basis), kg/hour	480	
Velocity difference, %	<1	

Date	12/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Line 4 - Stack D
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Rick Peralta	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1308 - 1445		1308 - 1445		1308 - 1445	
Combustion Gases	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Nitrogen oxides (as NO_2)	<4	<0.02	<4	<0.02	4.5	0.026
Sulfur dioxide	<6	<0.03	<6	<0.03	<6	<0.03
Carbon monoxide	<2	<0.01	<2	<0.01	3.7	0.021
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	<0.4		<0.4		<0.4	
Oxygen	20.9		20.9		20.9	



Ektimo

2.3 Boiler Units

2.3.1 HW1

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - HW1
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details	
Sampling plane dimensions	370 mm
Sampling plane area	0.108 m²
Sampling port size, number	10mm hole
Access & height of ports	Stairs & fixed ladder 12 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter >6 D
No. traverses & points sampled	2 12
Sample plane conformance to AS4323.1 (2021)	Ideal sampling plane

Comments

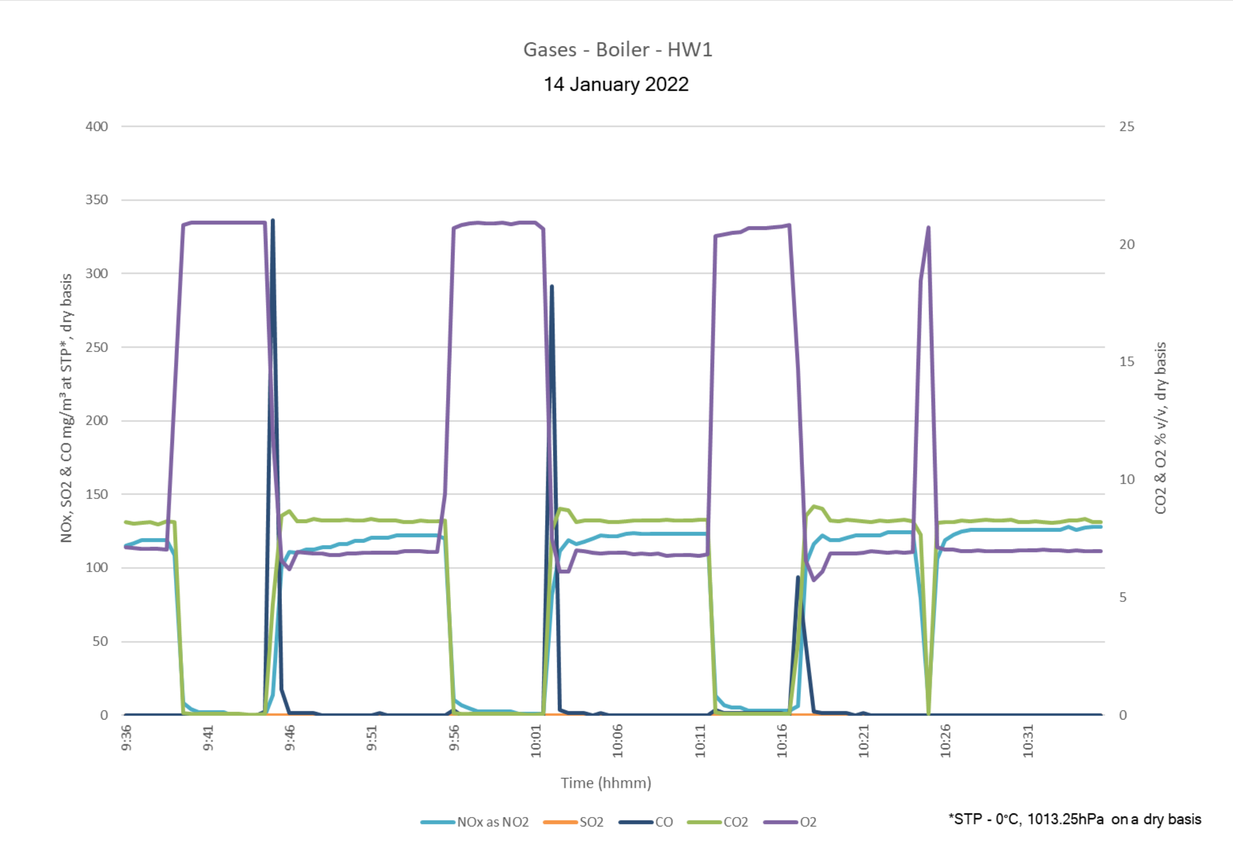
Boiler unit was cycling between operatingand not-operating during the test time.
Stack exit dimensions are required for the velocity data.

Stack Parameters		
Moisture content, %v/v	6.2	
Gas molecular weight, g/g mole	28.8 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.28 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.86	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0925 & 1105	
Temperature, °C	130	
Temperature, K	403	
Velocity at sampling plane, m/s	5.2	
Volumetric flow rate, actual, m³/s	0.56	
Volumetric flow rate (wet STP), m³/s	0.37	
Volumetric flow rate (dry STP), m³/s	0.35	
Mass flow rate (wet basis), kg/hour	1700	
Velocity difference, %	-4	

Ektimo

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - HW1
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	0936 - 1035		0936 - 1035		0936 - 1035	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	85	1.8	<4	<0.09	130	2.7
Sulfur dioxide	<6	<0.1	<6	<0.1	<6	<0.1
Carbon monoxide	6.9	0.15	<2	<0.05	340	7.1
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	5.9		<0.4		8.9	
Oxygen	11.1		5.7		20.9	



Ektimo

2.3.2 V150

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - V150
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details		
Sampling plane dimensions		290 mm
Sampling plane area		0.0661 m²
Sampling port size, number		10mm hole
Access & height of ports	Stairs & fixed ladder	12 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	>2 D
Upstream disturbance	Change in diameter	>6 D
No. traverses & points sampled	2	12
Sample plane conformance to AS4323.1 (2021)		Non-conforming

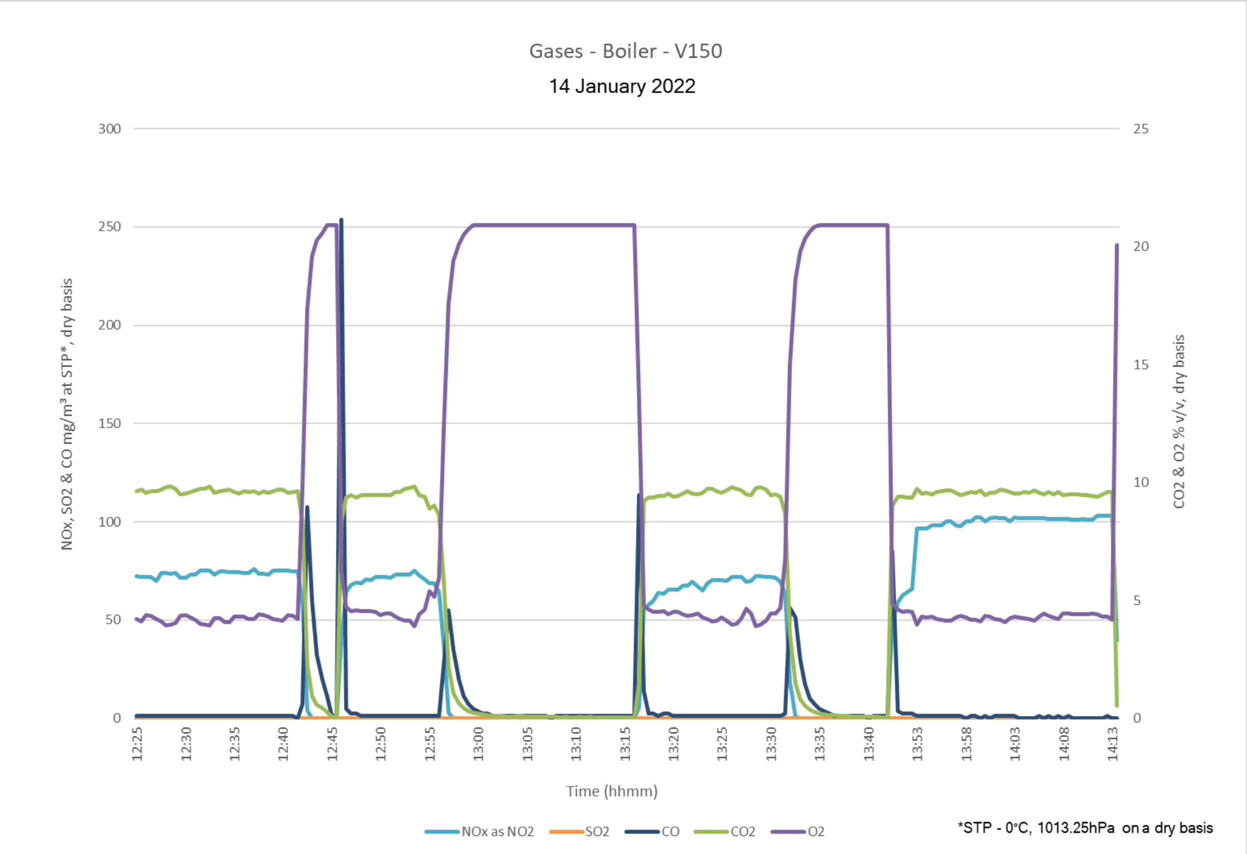
The sampling plane is deemed to be non-conforming due to the following reasons:
The differential pressure at one or more sampling points is less than 5 Pa

Stack Parameters		
Moisture content, %v/v	17	
Gas molecular weight, g/g mole	27.6 (wet)	29.5 (dry)
Gas density at STP, kg/m³	1.23 (wet)	1.32 (dry)
Gas density at discharge conditions, kg/m³	0.77	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	1230 & 1335	
Temperature, °C	162	
Temperature, K	435	
Velocity at sampling plane, m/s	5	
Volumetric flow rate, actual, m³/s	0.33	
Volumetric flow rate (wet STP), m³/s	0.21	
Volumetric flow rate (dry STP), m³/s	0.17	
Mass flow rate (wet basis), kg/hour	910	
Velocity difference, %	9	

Ektimo

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - V150
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1225 - 1413		1225 - 1413		1225 - 1413	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	52	0.54	<4	<0.04	100	1.1
Sulfur dioxide	<6	<0.06	<6	<0.06	<6	<0.06
Carbon monoxide	6.3	0.065	<2	<0.03	250	2.6
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	6.4		<0.4		9.9	
Oxygen	9.9		3.9		20.9	



2.3.3 V151

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - V151
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Sampling Plane Details		
Sampling plane dimensions		300 mm
Sampling plane area		0.0707 m²
Sampling port size, number		10mm hole
Access & height of ports	Stairs & fixed ladder	12 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	>2 D
Upstream disturbance	Change in diameter	>6 D
No. traverses & points sampled	2	12
Sample plane conformance to AS4323.1 (2021)		Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The differential pressure at one or more sampling points is less than 5 Pa

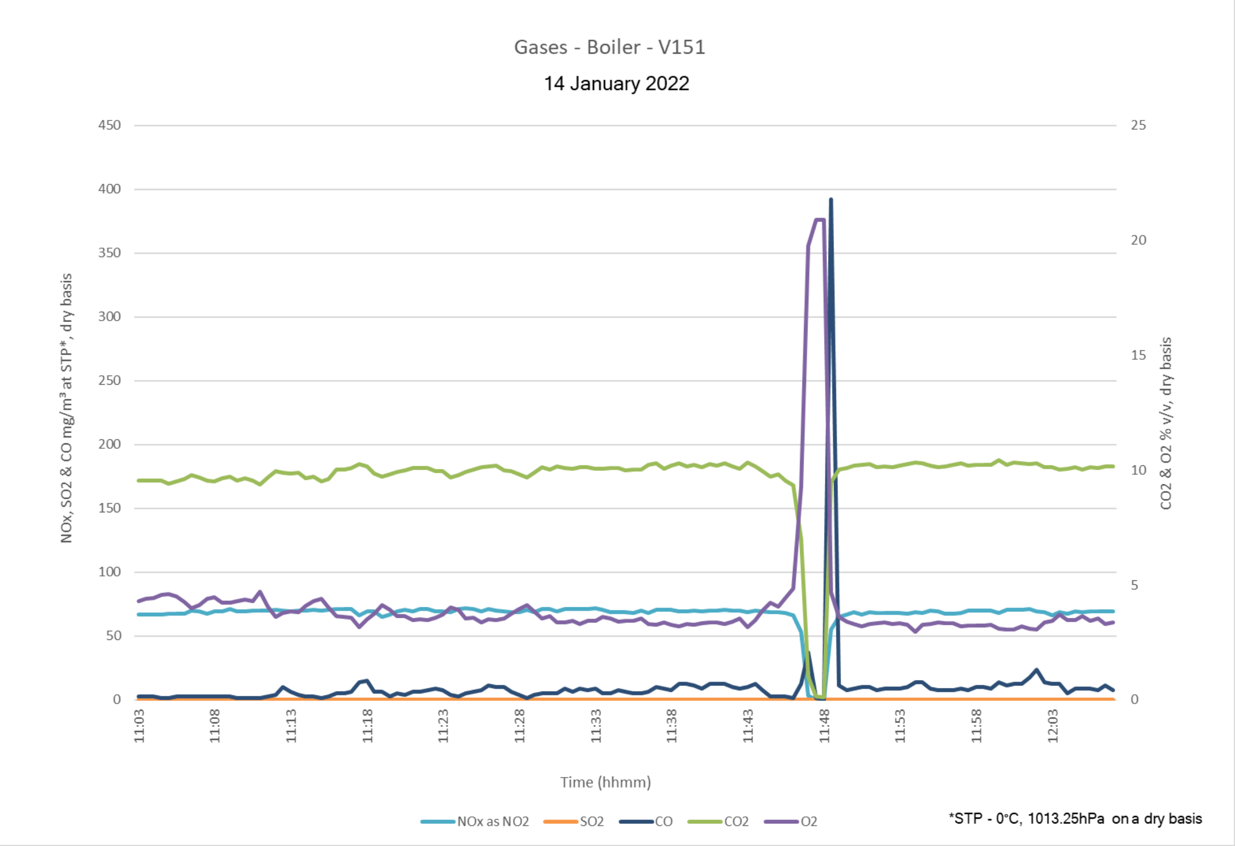
Stack Parameters		
Moisture content, %v/v	18	
Gas molecular weight, g/g mole	27.7 (wet)	29.8 (dry)
Gas density at STP, kg/m³	1.23 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.74	

Gas Flow Parameters	
Flow measurement time(s) (hhmm)	1050 & 1430
Temperature, °C	178
Temperature, K	452
Velocity at sampling plane, m/s	3
Volumetric flow rate, actual, m³/s	0.21
Volumetric flow rate (wet STP), m³/s	0.13
Volumetric flow rate (dry STP), m³/s	0.1
Mass flow rate (wet basis), kg/hour	560
Velocity difference, %	-8

Ektimo

Date	14/01/2022	Client	The Arnott's Group
Report	R012166	Stack ID	Boiler - V151
Licence No.	-	Location	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	State	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	1103 - 1207		1103 - 1207		1103 - 1207	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	67	0.42	<4	<0.03	72	0.45
Sulfur dioxide	<6	<0.04	<6	<0.04	<6	<0.04
Carbon monoxide	10	0.064	<2	<0.02	390	2.4
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	9.7		<0.4		10.4	
Oxygen	4.1		3		20.9	



Ektimo

2.3.4 V152

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - V152
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

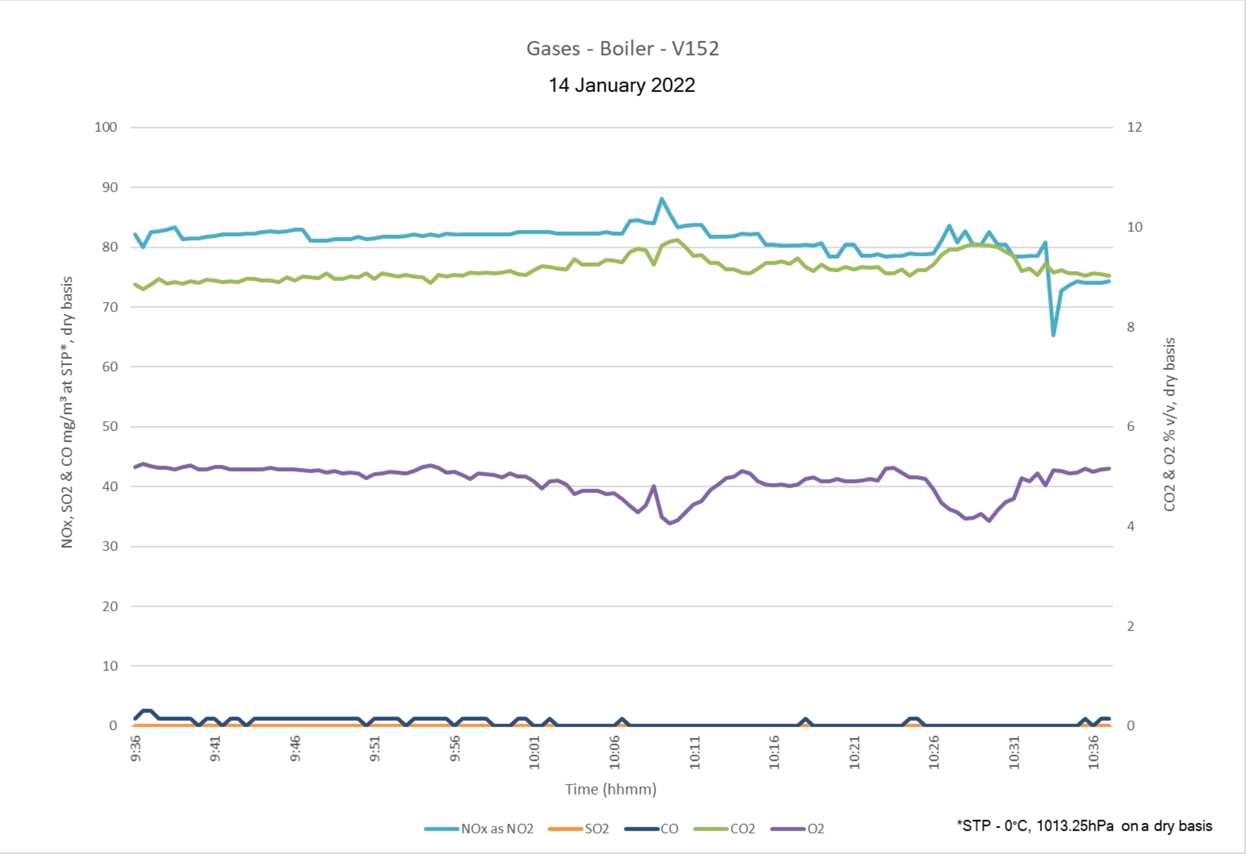
Sampling Plane Details	
Sampling plane dimensions	400 mm
Sampling plane area	0.126 m²
Sampling port size, number	10mm hole
Access & height of ports	Stairs & fixed ladder 12 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit >2 D
Upstream disturbance	Change in diameter >6 D
No. traverses & points sampled	2 12
Sample plane conformance to AS4323.1 (2021)	Non-conforming

The sampling plane is deemed to be non-conforming due to the following reasons:
The differential pressure at one or more sampling points is less than 5 Pa

Stack Parameters		
Moisture content, %v/v	17	
Gas molecular weight, g/g mole	27.8 (wet)	29.8 (dry)
Gas density at STP, kg/m³	1.24 (wet)	1.33 (dry)
Gas density at discharge conditions, kg/m³	0.82	
Gas Flow Parameters		
Flow measurement time(s) (hhmm)	0917 & 1430	
Temperature, °C	136	
Temperature, K	410	
Velocity at sampling plane, m/s	3.6	
Volumetric flow rate, actual, m³/s	0.45	
Volumetric flow rate (wet STP), m³/s	0.3	
Volumetric flow rate (dry STP), m³/s	0.25	
Mass flow rate (wet basis), kg/hour	1300	
Velocity difference, %	-8	

Date	14/01/2022	**Client**	The Arnott's Group
Report	R012166	**Stack ID**	Boiler - V152
Licence No.	-	**Location**	Huntingwood
Ektimo Staff	Graham Edwards/Ish Alam	**State**	NSW
Process Conditions	Please refer to client records.		220107

Gas Analyser Results	Average		Minimum		Maximum	
Sampling time	0936 - 1037		0936 - 1037		0936 - 1037	
	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Combustion Gases						
Nitrogen oxides (as NO_2)	81	1.2	65	0.97	88	1.3
Sulfur dioxide	<6	<0.09	<6	<0.09	<6	<0.09
Carbon monoxide	<2	<0.04	<2	<0.04	2.5	0.037
	Concentration %v/v		Concentration %v/v		Concentration %v/v	
Carbon dioxide	9.2		8.8		9.8	
Oxygen	4.9		4.1		5.3	



3 Plant Operating Conditions

Please refer to Arnott's records for complete process and operating conditions.

4 Test Methods

All sampling and analysis performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request.

Parameter	Sampling Method	Analysis Method	Uncertainty*	NATA Accredited Sampling	NATA Accredited Analysis
Sampling points - Selection	NSW EPA TM-1	NA	NA	✓	NA
Flow rate, temperature and velocity	NSW EPA TM-2	NSW EPA TM-2	8%, 2%, 7%	NA	✓
Moisture content	NSW EPA TM-22	NSW EPA TM-22	19%	✓	✓
Molecular weight	NA	NSW EPA TM-23	not specified	NA	✓
Carbon dioxide	NSW EPA TM-24	NSW EPA TM-24	13%	✓	✓
Carbon monoxide	NSW EPA TM-32	NSW EPA TM-32	12%	✓	✓
Nitrogen oxides	NSW EPA TM-11	NSW EPA TM-11	12%	✓	✓
Oxygen	NSW EPA TM-25	NSW EPA TM-25	13%	✓	✓
Sulfur dioxide	NSW EPA TM-4	NSW EPA TM-4	12%	✓	✓
Ammonia	USEPA CTM 027	Envirolab in-house methods Inorg-093 & Inorg-057	18%	✓	✓‡

220317

* Uncertainties cited in this table are estimated using typical values and are calculated at the 95% confidence level (coverage factor = 2).

‡ Analysis performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 24 January 2022 in report 286751.

5 Deviations From Test Methods

NSW EPA TM-11 is generally performed over a 60-minute period. The sampling period for Line 1 - Stack A has been reduced to 25-minutes due to inconsistencies with the gases data.

6 Quality Assurance/Quality Control Information

Ektimo is accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website www.nata.com.au.

Ektimo is accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025 - Testing. ISO/IEC 17025 - Testing requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Quality Director.

NATA is a member of APAC (Asia Pacific Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through mutual recognition arrangements with these organisations, NATA accreditation is recognised worldwide.

7 Definitions

The following symbols and abbreviations may be used in this test report:

% v/v	Volume to volume ratio, dry or wet basis
~	Approximately
<	Less than
>	Greater than
≥	Greater than or equal to
APHA	American Public Health Association, Standard Methods for the Examination of Water and Waste Water
AS	Australian Standard
BSP	British standard pipe
CARB	Californian Air Resources Board
CEM/CEMS	Continuous Emission Monitoring/Continuous Emission Monitoring System
CTM	Conditional test method
D	Duct diameter or equivalent duct diameter for rectangular ducts
D_{50}	'Cut size' of a cyclone is defined as the particle diameter at which the cyclone achieves a 50% collection efficiency i.e. half of the particles are retained by the cyclone and half pass through it. The D_{50} method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D_{50} of that cyclone and less than the D_{50} of the preceding cyclone.
DECC	Department of Environment & Climate Change (NSW)
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
DWER	Department of Water and Environmental Regulation (WA)
DEHP	Department of Environment and Heritage Protection (QLD)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra-red
ISC	Intersociety Committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
ITE	Individual threshold estimate
Lower bound	When an analyte is not present above the detection limit, the result is assumed to be equal to zero.
Medium bound	When an analyte is not present above the detection limit, the result is assumed to be equal to half of the detection limit.
NA	Not applicable
NATA	National Association of Testing Authorities
NIOSH	National Institute of Occupational Safety and Health
NT	Not tested or results not required
OM	Other approved method
OU	Odour unit. One OU is that concentration of odorant(s) at standard conditions that elicits a physiological response from a panel equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PM_{10}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
$PM_{2.5}$	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PSA	Particle size analysis. PSA provides a distribution of geometric diameters, for a given sample, determined using laser diffraction.
RATA	Relative accuracy test audit
Semi-quantified VOCs	Unknown VOCs (those not matching a standard compound), are identified by matching the mass spectrum of the chromatographic peak to the NIST Standard Reference Database (version 14.0), with a match quality exceeding 70%. An estimated concentration is determined by matching the area of the peak with the nearest suitable compound in the analytical calibration standard mixture.
STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
TM	Test method
TOC	The sum of all compounds of carbon which contain at least one carbon-to-carbon bond, plus methane and its derivatives.
USEPA	United States Environmental Protection Agency
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
Velocity difference	The percentage difference between the average of initial flows and after flows.
Vic EPA	Victorian Environment Protection Authority
VOC	Volatile organic compound. A carbon-based chemical compound with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the given conditions of use. VOCs may contain oxygen, nitrogen and other elements. VOCs do not include carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
XRD	X-ray diffractometry
Upper bound	When an analyte is not present above the detection limit, the result is assumed to be equal to the detection limit.
95% confidence interval	Range of values that contains the true result with 95% certainty. This means there is a 5% risk that the true result is outside this range.

8 Appendix 1: Site Photos

Access Ladder 2nd landing

Access Ladder Ground Level

Ektimo

ektimo.com.au
1300 364 005

MELBOURNE (Head Office)
26 Redland Drive
Mitcham
VIC 3132
AUSTRALIA

SYDNEY
6/78 Reserve Road,
Artarmon
NSW 2064
AUSTRALIA

WOLLONGONG
1/251 Princes Highway
Unanderra
NSW 2526
AUSTRALIA

PERTH
52 Cooper Road
Cockburn Central
WA 6164
AUSTRALIA

BRISBANE
3/109 Riverside Place
Morningside
QLD 4170
AUSTRALIA

APPENDIX E

Isopleth Plots

Figure E1 Predicted 1-Hour Average Incremental NO_X Isopleth Plot

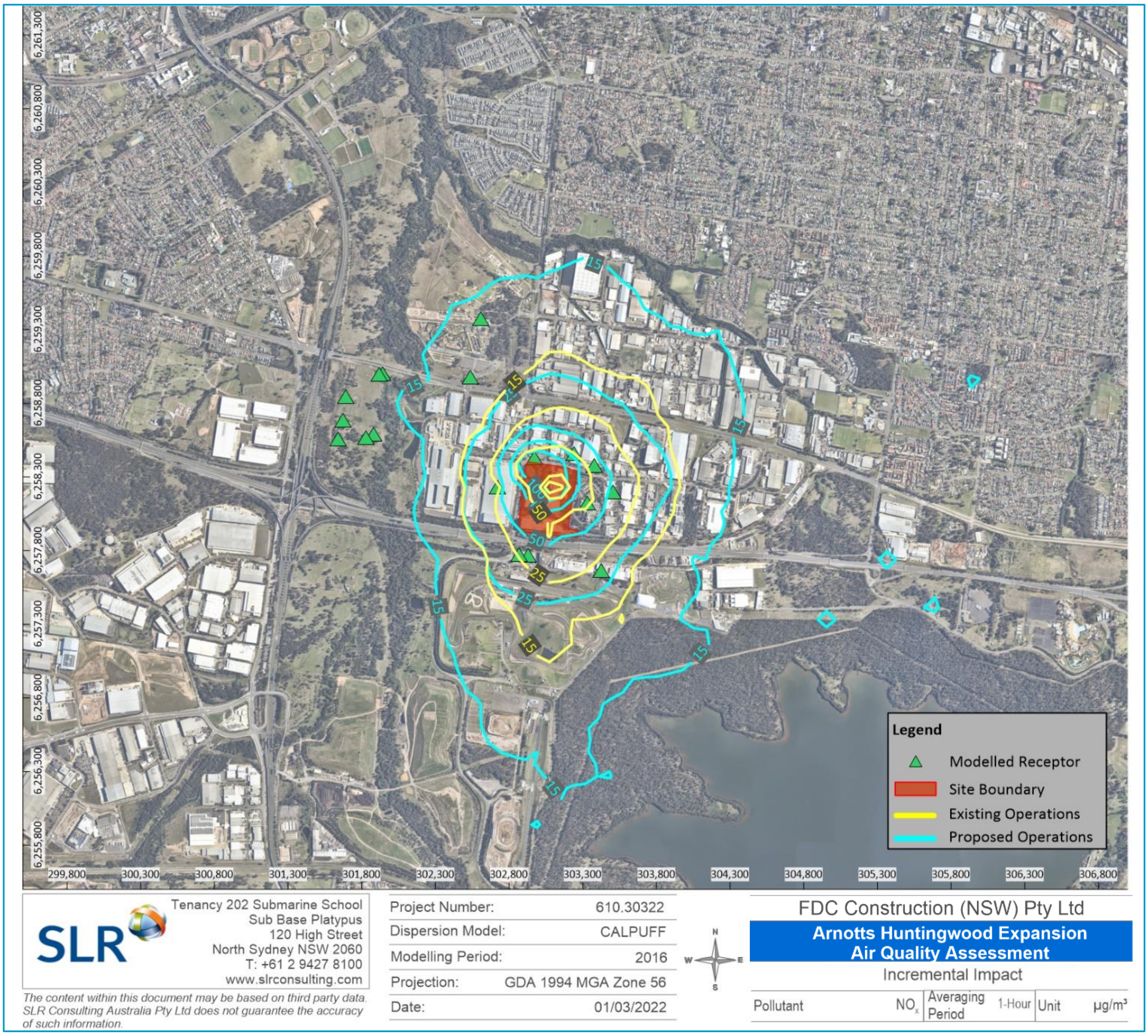


Figure E2 Predicted Annual Average Incremental NO_X Isopleth Plot

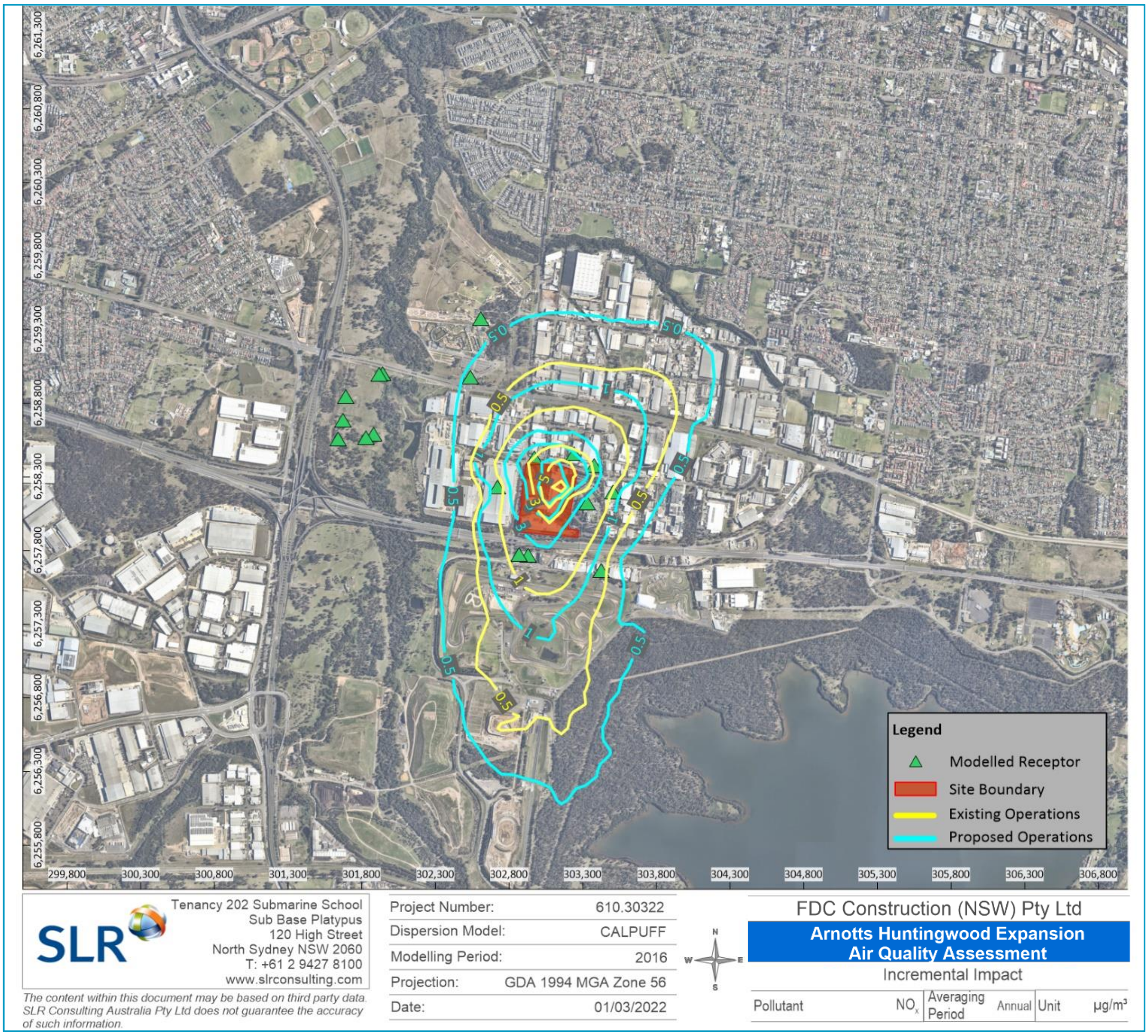


Figure E3 Predicted 1-Hour Average Incremental CO Isopleth Plot

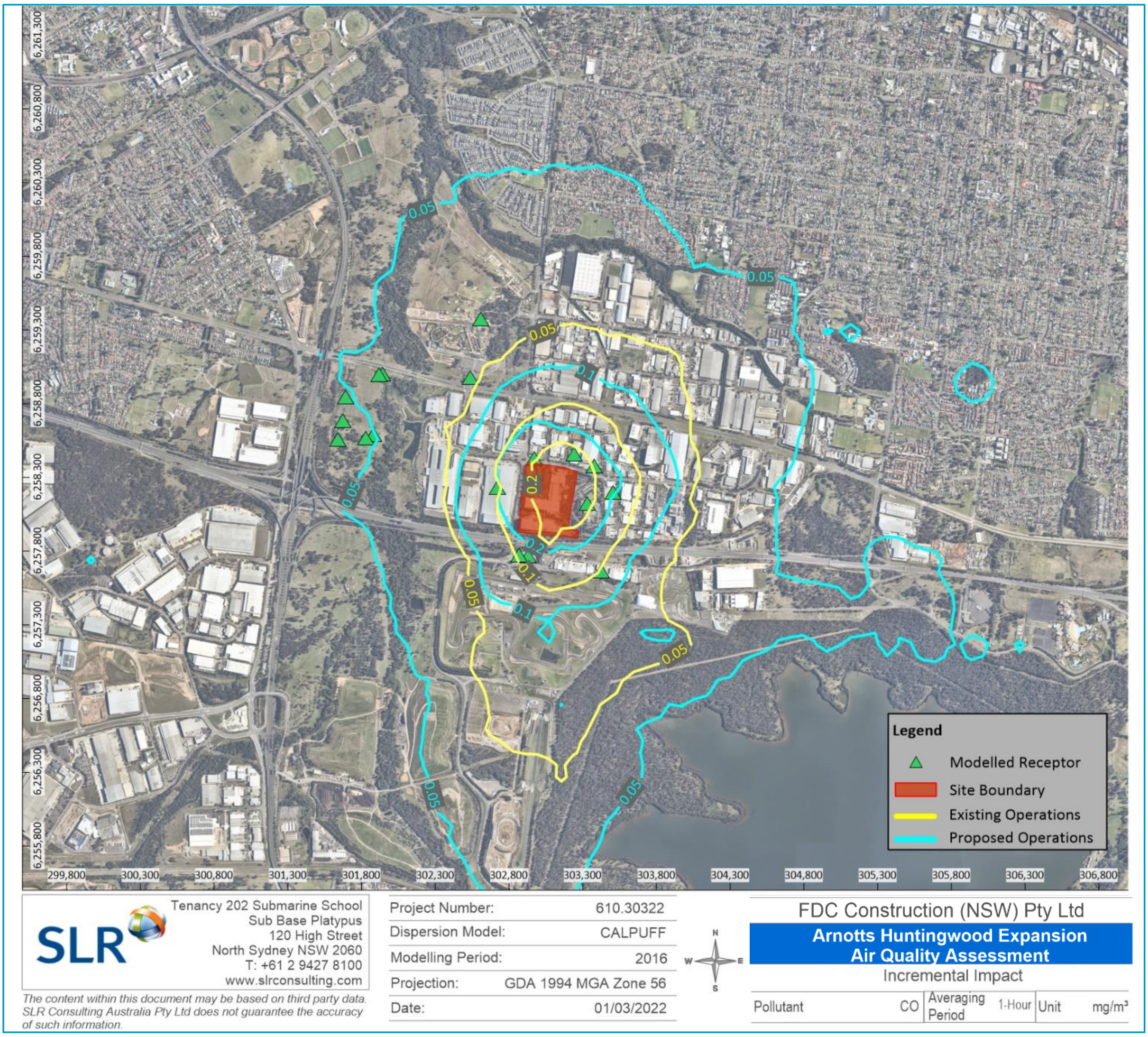


Figure E4 Predicted 8-Hour Average Incremental CO Isopleth Plot

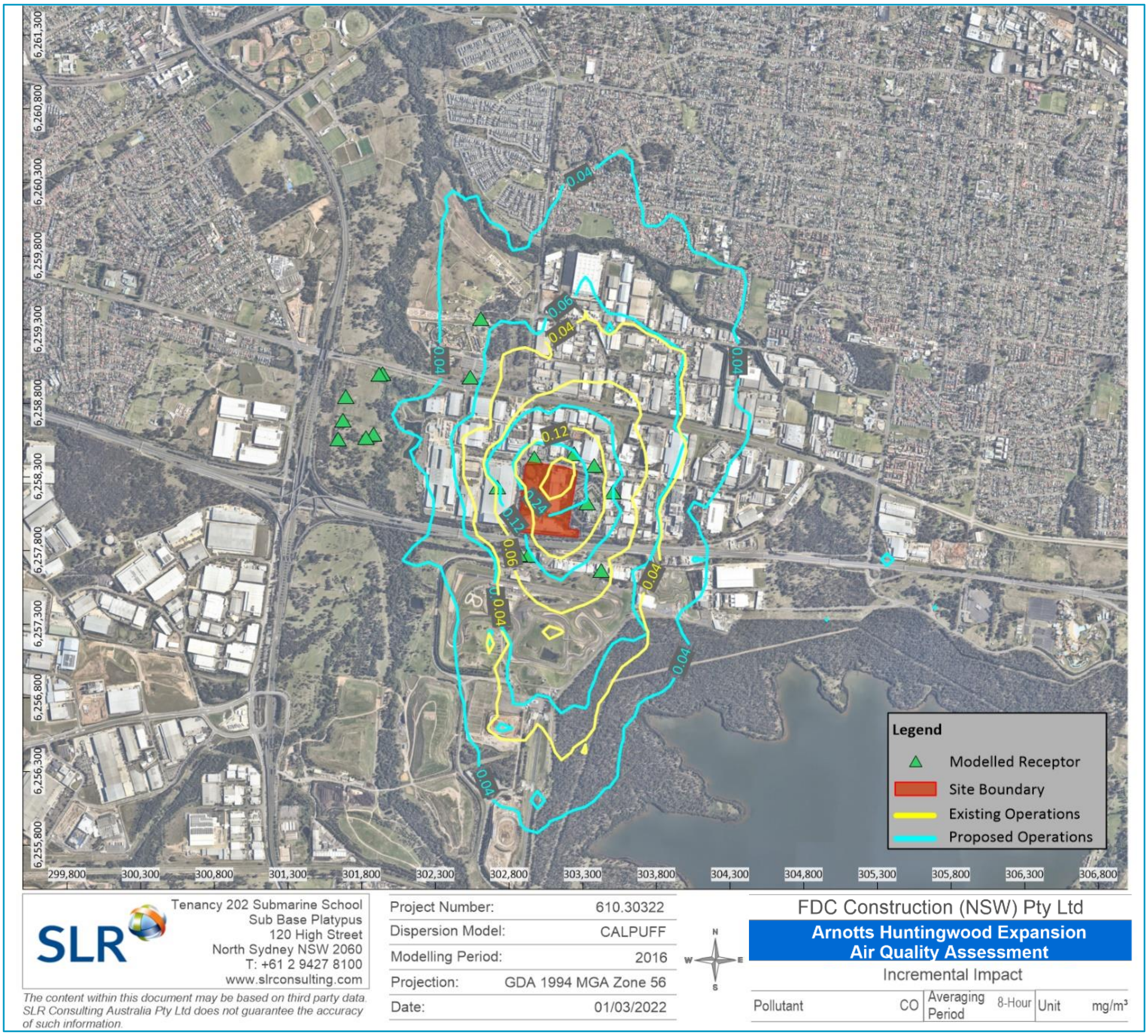


Figure E5 Predicted 1-Hour Average Incremental SO_2 Isopleth Plot

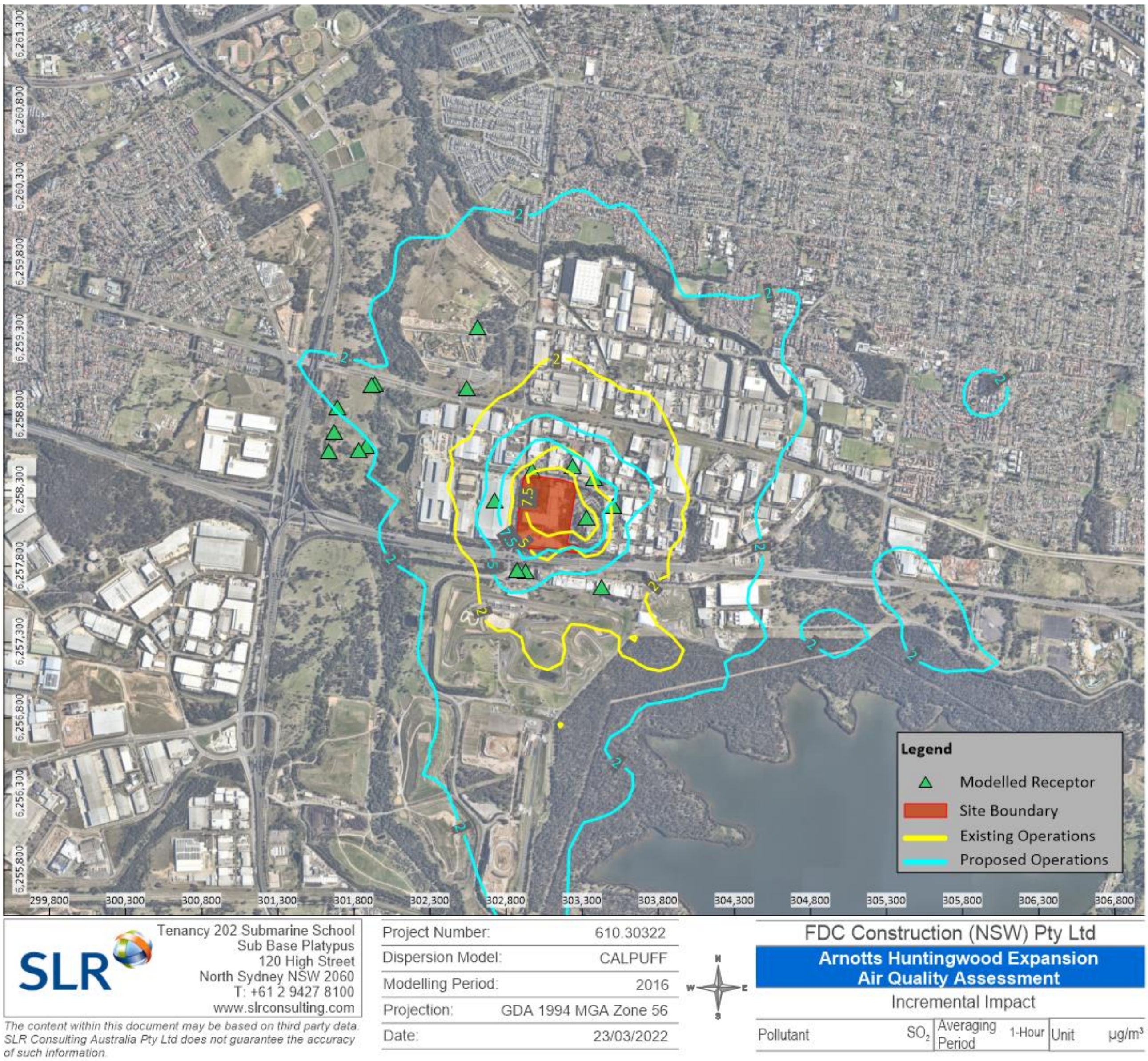


Figure E6 Predicted 24-Hour Average Incremental SO_2 Isopleth Plot

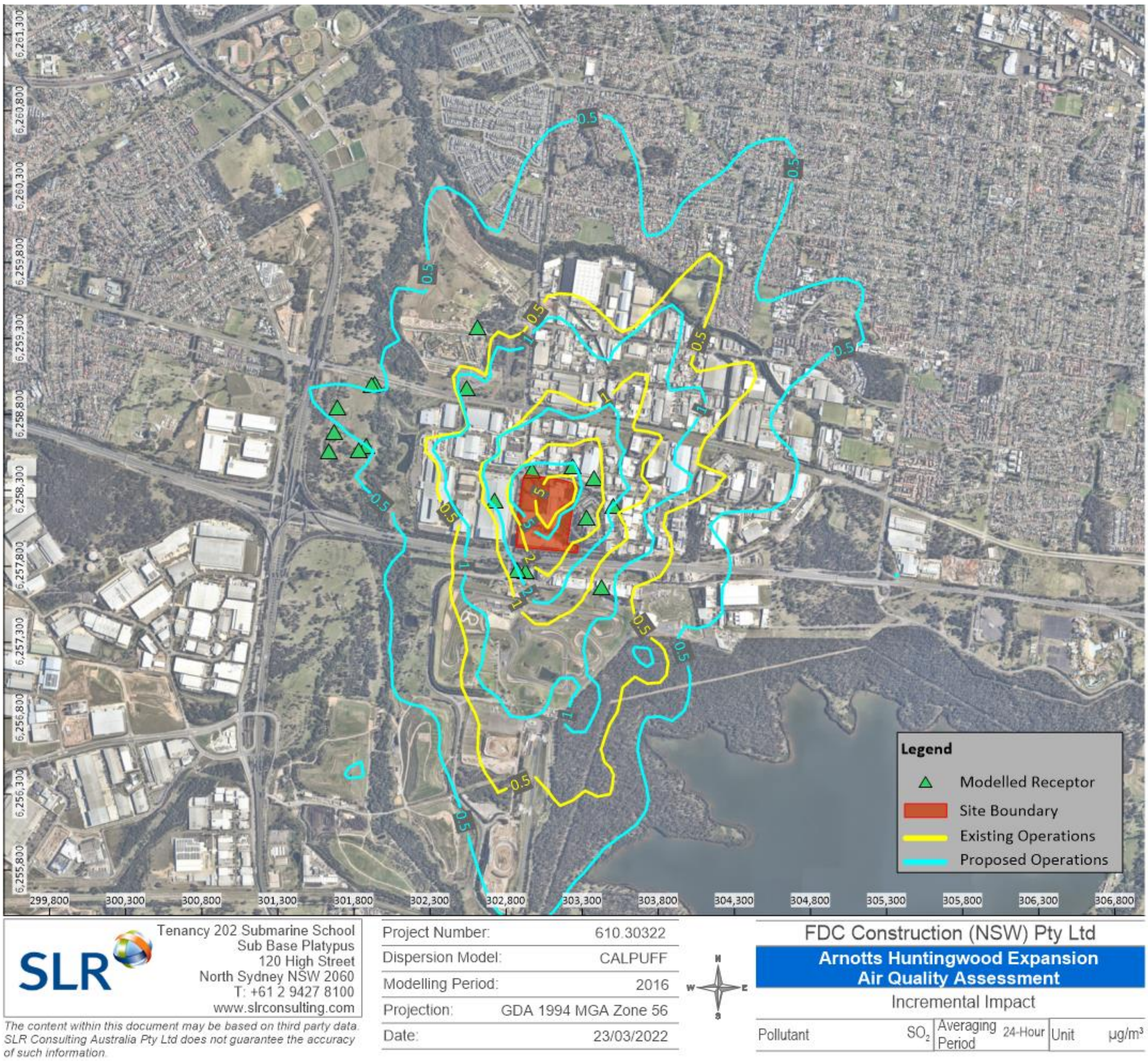
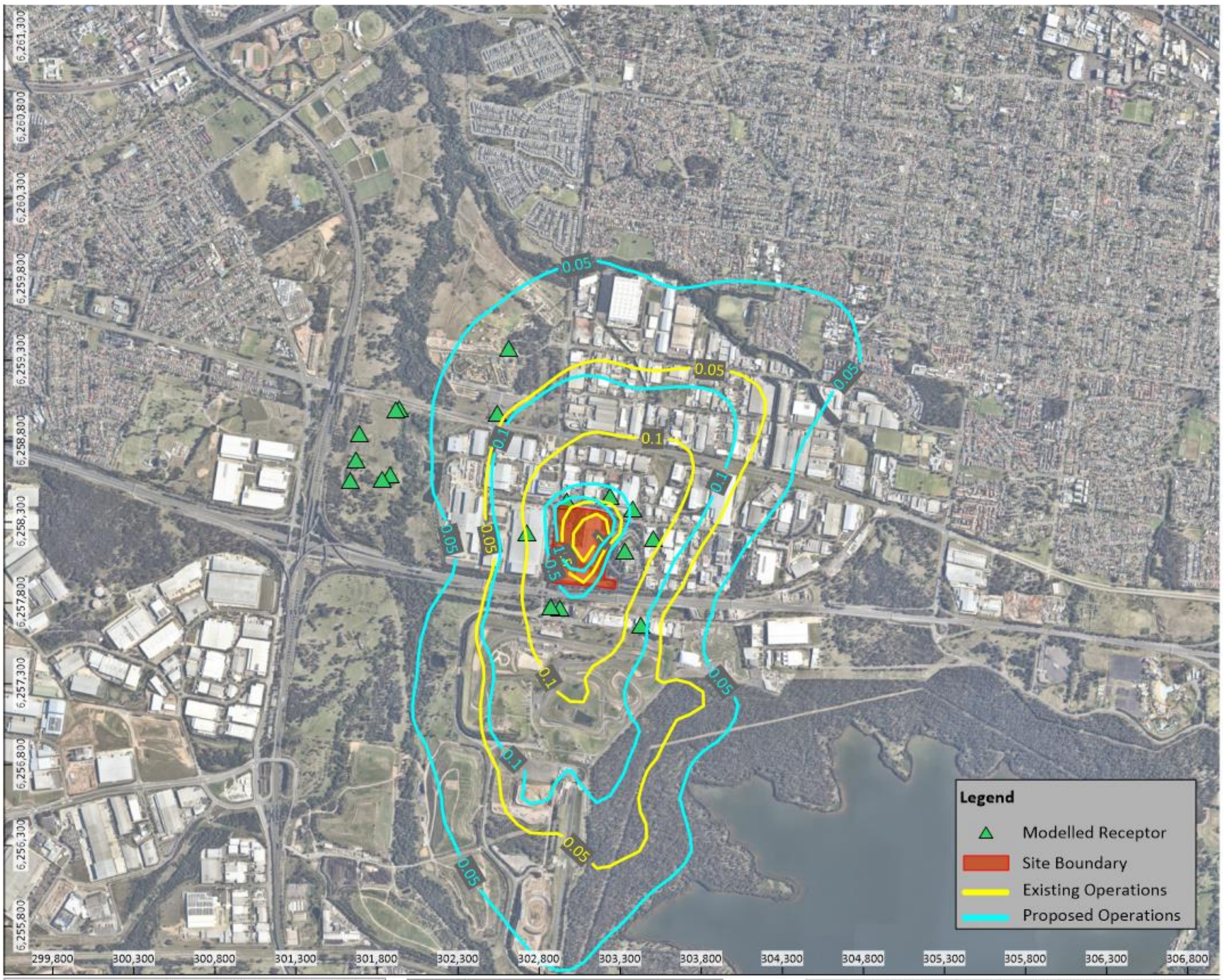


Figure E7 Predicted Annual Average Incremental SO_2 Isopleth Plot



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Project Number:	610.30322
Dispersion Model:	CALPUFF
Modelling Period:	2016
Projection:	GDA 1994 MGA Zone 56
Date:	23/03/2022

FDC Construction (NSW) Pty Ltd

Arnotts Huntingwood Expansion Air Quality Assessment

Incremental Impact

Pollutant	SO_2	Averaging Period	Annual	Unit	µg/m³

Figure E8 Predicted 24-Hour Average Incremental PM Isopleth Plot

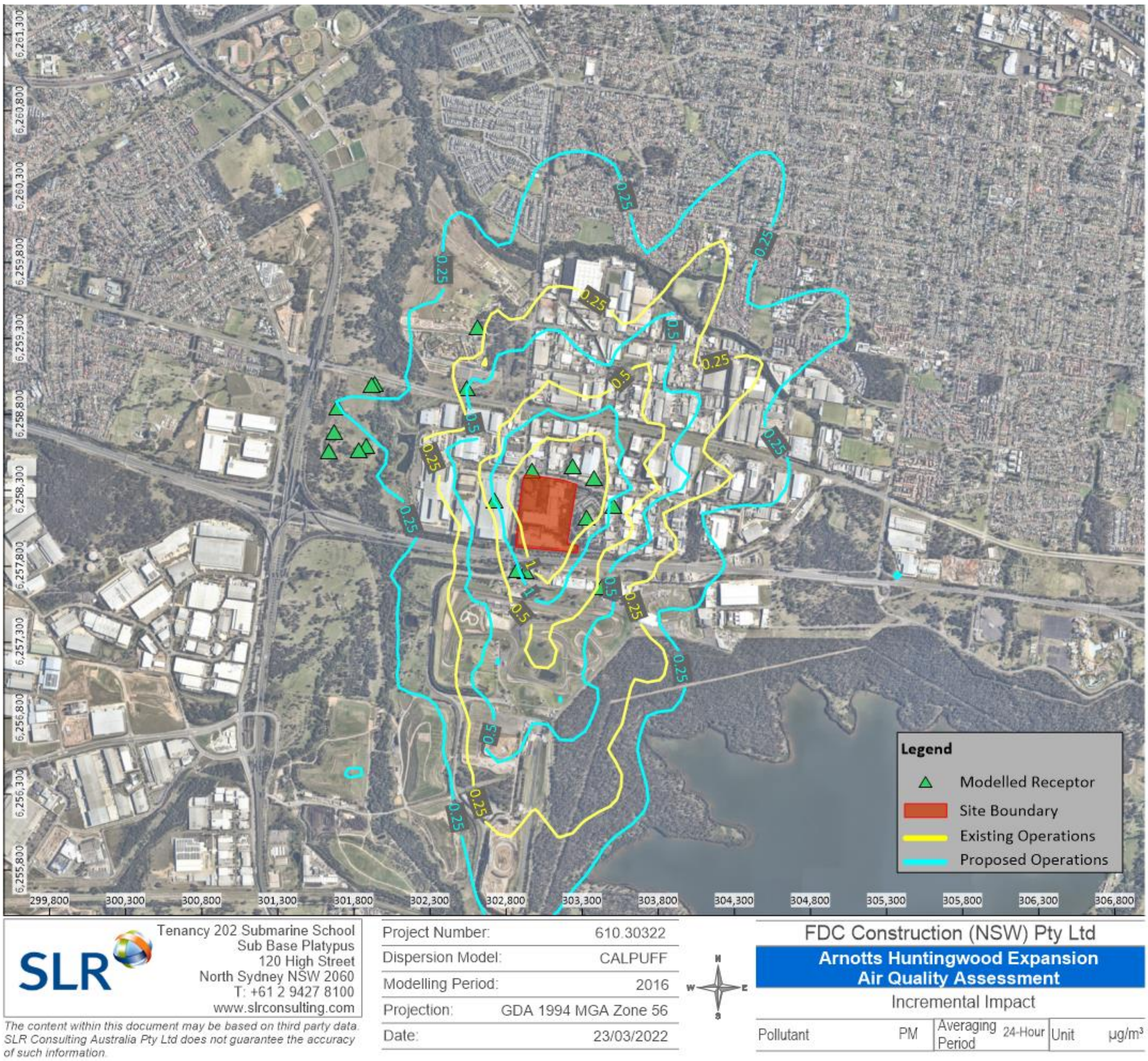


Figure E9 Predicted Annual Average Incremental PM Isopleth Plot

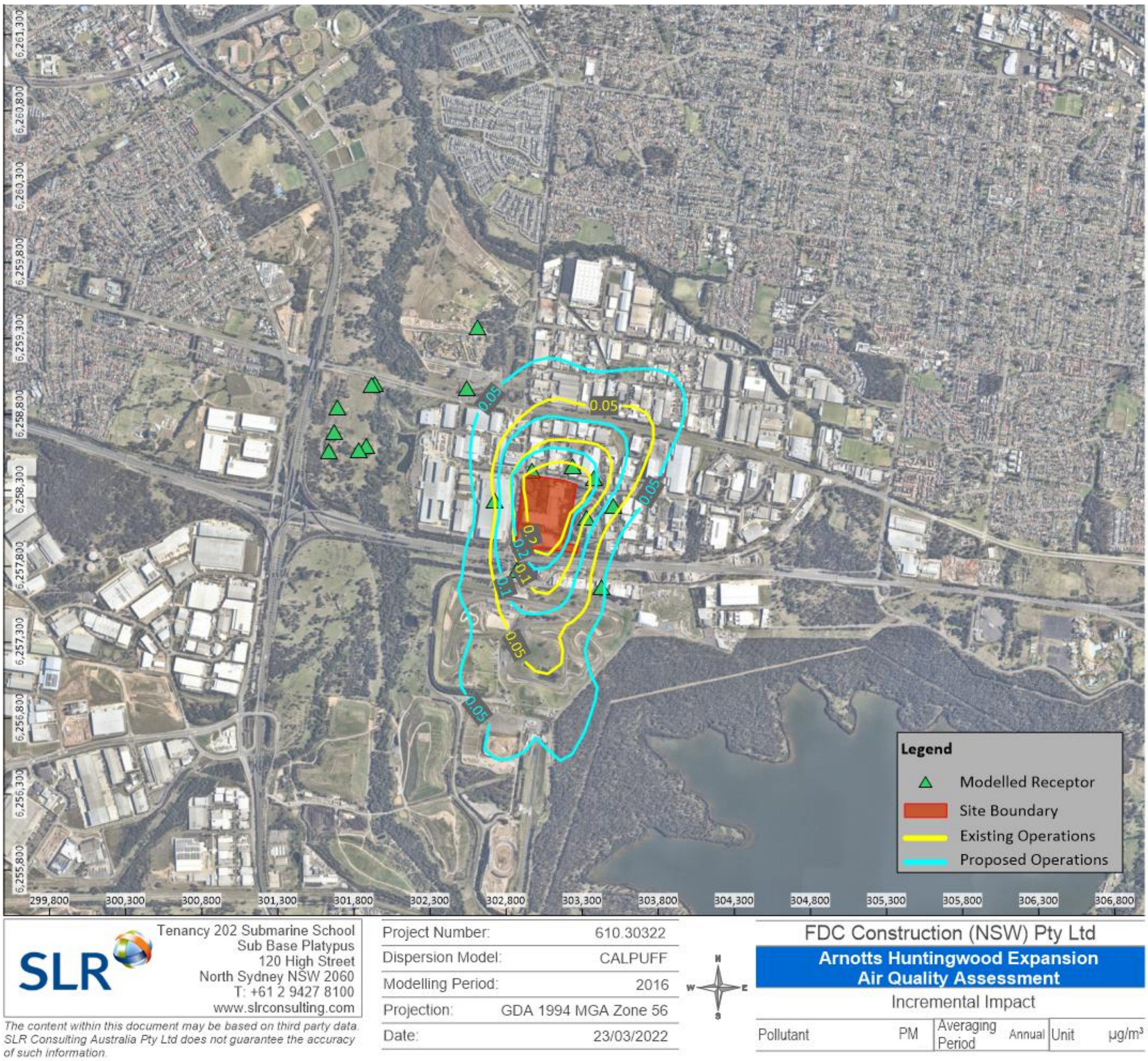
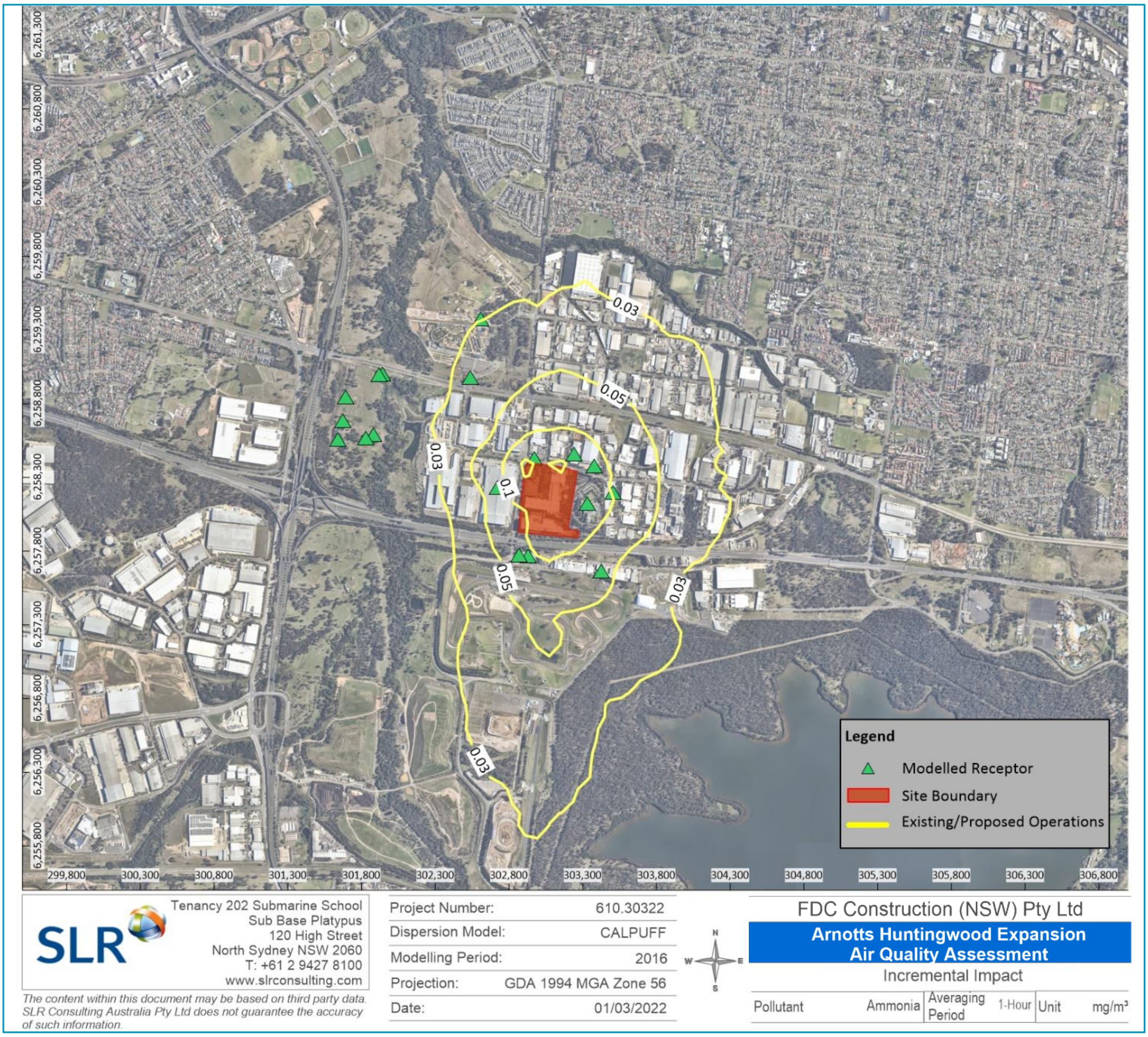


Figure E5 Predicted 1-Hour Average Incremental Ammonia Isopleth Plot



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