This document has been prepared on behalf of **Snack Brands Australia** by:

Northstar Air Quality Pty Ltd,

Suite 1504, 275 Alfred Street, North Sydney, NSW 2060

www.northstarairquality.com | Tel: +61 (02) 9071 8600

Snack Brands Australia

Air Quality & Odour Impact Assessment

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Quality Control

Study	Status	Prepared	Checked	Authorised
INTRODUCTION	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
THE PROPOSAL	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
EXISTING CONDITIONS	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
METHODOLOGY	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
CONSTRUCTION PHASE RISK ASSESSMENT	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
OPERATIONAL PHASE IMPACT ASSESSMENT	Final	Northstar	MD, ML, NI, FM, MH, EB, KR	GCG
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Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

G Graham 23 August 2021

Non-Technical Summary

Northstar Air Quality Pty Ltd has been commissioned by Snack Brands Australia to prepare an air quality and odour assessment for the construction and operation of a food manufacturing facility at 14 Distribution Drive, Orchard Hills.

The Proposal will be fitted out for the purposes of food manufacturing to be distributed by the Snack Brands Australia from the distribution centre located adjacent to the Proposal site at 2 Distribution Drive, Orchard Hills.

This Air Quality and Odour Impact Assessment has been prepared to address the likely risks and impacts associated with the construction and operation of the Proposal.

The construction phase assessment concludes that should a range of appropriate and standard control measures be applied, the residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be '*negligible*' for all activities.

The operational phase assessment has been performed using process-specific emissions measured at existing operations at the Snack Brands Australia Smithfield and Blacktown facilities and applied to the proposed activities at the Proposal site and uses a dispersion modelling assessment to predict off site impacts of emissions from the commercial kitchen, gas-fired boilers, and wastewater treatment plant. The Air Quality Impact Assessment does not predict any non-compliance (exceedance) of the relevant impact assessment criteria at any identified receptor location.

A range of management and control measures have been recommended including an emissions monitoring program to measure emissions at the proposed Orchard Hills site within three months of operating, and also the implementation of a series of additional controls to offer effective air quality management.

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Units Used in the Report

All units presented in the report follow International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol. *For example*, 50 micrograms per cubic metre would be expressed as 50 $\mu g{\cdot}m^{-3}$ and not 50 $\mu g/m^3$.

Common Abbreviations

Abbreviation	Term
AADT	annual average daily traffic
ABS	Australian Bureau of Statistics
AQIA	air quality impact assessment
AQMS	air quality monitoring station
BoM	Bureau of Meteorology
CO	carbon monoxide
DPI&E	Department of Planning, Industry and Environment
EPA	Environmental Protection Authority
LEV	local exhaust ventilation
m^2	square metre
m^3	cubic metre
$\mu g{\cdot}m^{-3}$	microgram per cubic metre of air
mE	metres East
mS	metres South
NO_X	oxides of nitrogen
NO_2	nitrogen dioxide
OCU	odour control unit
OLM	ozone limiting method
OU	odour unit
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
SEARS	Secretary's Environmental Assessment Requirements
TSP	total suspended particulates
UTM	Universal Transverse Mercator
VOC	volatile organic compounds

1. INTRODUCTION

Northstar Air Quality Pty Ltd has been commissioned by Snack Brands Australia (SBA, the Applicant) to prepare an air quality and odour impact assessment (AQIA) for the construction and operation of a food manufacturing facility (the Proposal) at 14 Distribution Drive, Orchard Hills (the Proposal site).

The Proposal will be fitted out for the purposes of food manufacturing to be distributed by the Applicant from the distribution centre located adjacent to the Proposal site at 2 Distribution Drive, Orchard Hills.

1.1. Purpose of the Report

The purpose of this report is to examine and identify potential air quality risks associated with the construction and operation of the Proposal and identify mitigation and monitoring requirements commensurate with those anticipated potential impacts.

This AQIA report has been prepared to assess the risks and impacts associated with the construction and operation of the Proposal.

To allow an assessment of the level of risk associated with the construction of the Proposal a risk assessment has been performed in accordance with published guidance.

To assess the impacts associated with the operation of the proposal, a quantitative dispersion modelling assessment has been performed to predict the anticipated emissions from the operation of the Proposal, as required by the SEARS (see **Section 1.2**).

1.2. Compliance with SEARs

During April 2021, on behalf of Snack Brands Australia, a request for Secretary's Environmental Assessment Requirements (SEARs) was submitted to the NSW DPI&E (WillowTree Planning, 2021). During May 2021, DPI&E prepared the SEARs which contains the requirements for the various components of environmental assessment (DPI&E, 2021), including air quality.

Those requirements are reproduced in **Table 1** below, which additionally provides the relevant sections of this report that specifically addresses those requirements:

Table 1 Compliance with SEARs

Requirement	Report Sections
Air quality and odour – including: – a quantitative assessment of the potential air quality, dust and odour impacts of the development in accordance with relevant Environment Protection Authority guidelines	Potential air quality and odour emissions sources are identified in **Section 2.3**. The impact assessment methodology adopted (with justification) is presented in **Section 5**, The impact assessment results are presented in **Section 6** and **Section 7**.
– the details of buildings and air handling systems and strong justification for any material handling, processing or stockpiling external to buildings	A description of the Proposal is provided in **Section 2**.
– details of proposed mitigation, management and monitoring measures.	**Section 8** provides a summary of the identified mitigation, management and monitoring recommendations

1.3. Scope of Assessment

This report presents information and data that summarises and characterises the existing environmental conditions and identifies the potential emissions to air associated with the construction and operation of the Proposal. The report examines the potential risk of off-site impacts and identifies appropriate mitigation measures that would be required to reduce those potential impacts.

The report provides a significant range of recommendations for mitigation, management and monitoring to address any areas of uncertainty.

The justification for the adopted risk assessment methodology for the construction phase of the development is provided in **Section 5.1**. The adopted IAQM construction dust methodology (IAQM, 2014) has been widely used for similar projects in NSW and Australia. The principal driver for that risk-assessment methodology is the identified constraint for modelling due to the inherent variability in those construction activities.

A dispersion modelling assessment has been performed to predict impacts associated with the operation of the Proposal, in accordance with relevant NSW guidelines (NSW EPA, 2017).

2. THE PROPOSAL

The following provides a description of the context, location, and scale of the Proposal, and a description of the processes and development activities on site. It also identifies the potential for emissions to air associated with the Proposal.

2.1. Environmental Setting

The Proposal site occupies land identified as Lot 10 in Deposited Plan (DP) 271141, commonly known as 14 Distribution Drive, Orchard Hills. The Proposal site and the adjacent distribution centre also operated by the Applicant are presented in **Figure 1**.

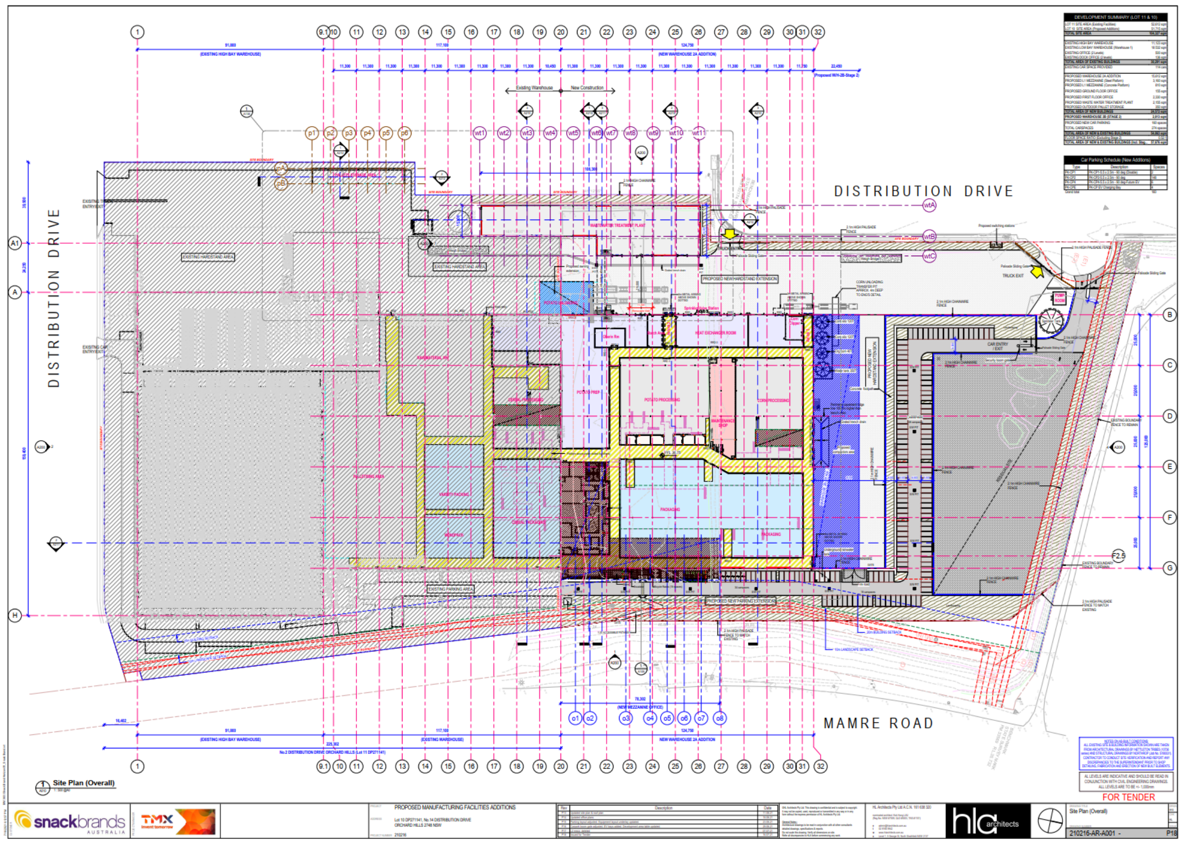
The Proposal site occupies an area of approximately 51 711 square metres (m^2) and has a 203 metre (m) frontage to Distribution Drive to the west.

The location and surrounding environment of the Proposal site is presented in **Figure 1** and the site layout is illustrated in **Figure 2** as reproduced from drawing HLA-AR-A001, P18, dated 16/07/21.

Figure 1 Aerial view of the Proposal site

Source: Northstar Air Quality

Figure 2 Proposal site layout



Source: Snack Brands Australia (HLA-AR-A001, P18)

2.2. Overview and Purpose

The Applicant has proposed to develop a food manufacturing facility with associated office space and car parking at the Proposal site located adjacent to a distribution centre also operated by the Applicant (refer **Section 2.1**). Currently, the Applicant manufactures food products in two facilities located in Blacktown and Smithfield prior to being transported to the distribution centre. The facility at the Proposal site is intended to consolidate the operations of the two existing facilities into one facility in Orchard Hills, which is proposed to be operational 24 hours a day, seven days a week.

The food products anticipated to be manufactured at the Proposal site would primarily comprise potato and corn products such as deep-fried chips.

The relevant areas of the existing and proposed development are as summarised in **Table 2**.

Table 2 Existing and proposed development details

Component	Units	Value
Lot 11 Site area (existing facilities)	m^2	52 612
Lot 10 Site area (proposed facilities)	m^2	51 715
Total site area	m^2	104 327
Existing high bay warehouse	m^2	11 123
Existing low bay warehouse (warehouse 1)	m^2	18 532
Existing office (2 levels)	m^2	500
Existing dock office (2 levels)	m^2	136
Total area of existing buildings	m^2	30 291
Existing car spaces provided	no.	114
Proposed warehouse 2A addition	m^2	15 612
Proposed L1 mezzanine	m^2	3 160
Proposed L2 mezzanine	m^2	810
Proposed ground floor office	m^2	155
Proposed first floor office	m^2	2 330
Proposed wastewater treatment plant	m^2	2 155
Proposed outdoor pallet storage	m^2	350
Total area of new buildings	m^2	24 572
Proposed warehouse 2B (Stage 2)	m^2	2 813
Proposed new car spaces	no.	160
Total car spaces	no.	274
Total area of new and existing buildings	m^2	57 676

The structure at the Proposal site is expected to occupy a total area of 24 572 square metres (m^2) with the proposed alteration to the existing structure being considered in the construction dust risk assessment.

The food manufacturing activities at the Proposal site will operate process lines for the processing and packing of potato and corn products and is anticipated to include:

- Receival of raw materials (i.e. potatoes and corn);
- Storage and handling of raw materials;
- Processing of raw materials such as peeling and slicing;
- Cooking food products:
    - Potatoes will be cooked in an oil fryer;
    - Corn will be dried in an oven and then cooked in an oil fryer.

- Packaging and distributing the final product;
- Accumulating, storing and disposing of food wastes and food-preparation wastes; and
- Onsite wastewater treatment.

2.3. Identification of Potential Emissions to Atmosphere

As specified in the **Section 1.1** this assessment report addresses the potential impacts associated with the construction and operational phases of the Proposal. Briefly the activities that may generate emissions to air during the development phases include:

- **Construction phase:** The construction phase will involve bulk earthworks comprising cut and fill activities and the construction of a warehouse structure with associated office space and car parking.
- **Operational phase**: The operational phase will involve the manufacturing of food products, specifically the production of deep-fried potato and corn products.

Given the nature of the Proposal described above, emissions to air would be likely to be generated as described below.

2.3.1. Construction Phase

Construction of the Proposal would involve no substantive demolition activities (other than the demolition of a single wall) but will comprise bulk earthworks (cut and fill), building and construction of pavements and hardstand, and construction of a new warehouse and associated offices.

An indicative list of plant and equipment that may be used during the construction of the Proposal includes:

- Excavators;
- Front End Loaders;
- Graders;
- Light vehicles;
- Heavy vehicles;
- Drills;
- Pneumatic hand or power tools;
- Cranes;
- Commercial vans; and
- Cherry pickers..

Emissions to atmosphere associated with the above construction activities relate to construction dust (particulates) which, if not adequately controlled, may be experienced in the surrounding areas as an amenity impact (such as visible dust plumes, dust soiling and dirt track-out onto surrounding roads) and as health impacts.

Construction phase dust emissions tend to be larger size particulates, typically in the range of 30 microns (µm) to 10 µm, and particles of this size are typically experienced as amenity impacts rather than health impacts.

With regard to emissions from road traffic, the assessment considers the potential impact of emissions associated with the construction and operational phases. Where changes to construction and/or operational traffic is significant, a quantitative assessment is typically performed. Operational phase traffic emissions are discussed in **Section 2.3.2**.

Road traffic exhaust emissions may include a range of air pollutants, including particulate matter (as PM_{10} and $PM_{2.5}$) and oxides of nitrogen (NO_X), including nitrogen dioxide (NO_2). There would additionally be some less significant emissions of carbon monoxide (CO), sulphur dioxide (SO_2) and volatile organic compounds (VOCs) (including benzene and 1,3-butadiene).

In regard to construction traffic, it has been assumed that an estimated 50 – 100 vehicles may be required during peak hours during the construction period due to the large volume of the proposed structure (refer **Section 2.2**).

In relation to pollutant emissions associated with construction phase vehicle traffic, reference is made to the guidance used to assess construction phase impacts (IAQM, 2014) which states:

> *"Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed. For site plant and on-site traffic, consideration should be given to the number of plant/vehicles and their operating hours and locations to assess whether a significant effect is likely to occur. For site traffic on the public highway, if it cannot be scoped out (for example by using the EPUK's criteria), then it should be assessed using the same methodology and significance criteria as operational traffic impacts. The impacts of exhaust emissions from on-site plant and site traffic are not considered further in this Guidance."*

In relation to construction traffic, any impacts are not likely to be significant and are not considered to warrant a quantitative assessment.

To minimise impacts of traffic during construction, construction traffic would be managed through controls imposed through the Construction Environment Management Plan, including the Construction Traffic Management Plan.

The methodology used to assess the risk of construction phase emissions is introduced in **Section 5.1** and provided in greater detail in **Appendix C**, and the assessment of risk is provided in **Section 5** and the identification of construction mitigation measures are identified in **Section 8.1.2**.

2.3.2. Operational Phase

During the operation of the Proposal, the following activities have been identified to potentially result in potential emissions to air:

- **Road traffic emissions**: road traffic exhaust emissions from the movement of vehicles in and out of the Proposal site on paved road surfaces. These are associated with vehicles performing delivery tasks, and cars for workers in the office spaces;
- **Vehicle idling emissions**: road traffic exhaust emissions from vehicles idling at delivery and loading bays;
- **Commercial kitchen emissions**: emissions from food manufacturing activities at the Proposal site, which are largely extracted and ducted to after-burning waste heat boilers prior to discharge to atmosphere;
- **Boiler emissions**: emissions from the operation of gas-fired boilers, operated for the purpose of generating hot water for cooking purposes (e.g. cooking corn); and
- **Wastewater emissions**: emissions from wastewater treated prior to discharge from the Proposal site.

Note: It is noted that the Proposal only includes provision for outdoor pallet storage and does not include any outside material processing.

Road Traffic Emissions

In regard to operational traffic, estimated daily traffic flows during operation of the Proposal are provided in the scoping report (WillowTree Planning, 2021). The report estimates the Proposal site may generate up to 1 190 daily traffic movements during the operational phase of the Proposal.

Estimating the contribution of the Proposal site to existing annual average daily traffic (AADT) flows on the local road network has been performed based on measured 2021 traffic flows on Elizabeth Drive, Abbotsbury (RMS traffic counter 64022) which is the closest traffic counter location to the Proposal site. The calculated AADT flows on surrounding roads during operation, including the addition of the flows associated with the Proposal are anticipated to be approximately 30 772 vehicles.

To evaluate the significance of the estimated changes in operational traffic flows, reference has been made to the Environmental Protection UK (EPUK) document "*Development Control: Planning for Air Quality (2010 Update)*" (EPUK, 2010) which has been referenced in lieu of any identified NSW or Australian guidance. The guidance provides threshold criteria for evaluating the significance of changes in traffic, as a traffic flow change of more than 5 % to 10 % on roads with AADT of >10 000 vehicles required to be assessed through quantitative methods (i.e. dispersion modelling).

The criteria outlined in EPUK (2010) provide a screening (i.e. qualitative) level of assessment which considers the potential for adverse air quality impacts based on traffic flows. As estimated in the scoping report, the anticipated changes in traffic account for approximately 3.9 % of existing traffic flow, and therefore do not exceed that threshold. Based on this screening approach it is not considered likely that the impacts associated with the Proposal would lead to significant changes in the existing traffic flow or adverse impacts during the operational phase. In accordance with the adopted guidance, the qualitative assessment screens that potential risk and a quantitative assessment is not considered to be warranted.

Potential impacts of operational phase traffic emissions would be managed through the Operational Environment Management Plan, including a Traffic Management Plan.

Vehicle Idling Emissions

Idling emissions may vary from road traffic emissions by nature of the operation of the truck engines. Vehicle engines delivering goods to the Proposal site will typically be hot, as they will have completed the journey from their point of origin. Hot idling engines will tend to heat further whilst idling due to the low rate of air drawn through the radiator, and correspondingly emissions of NO_X will tend to increase. As the engines are hot and consuming low rates of fuel, emissions of CO and PM will similarly tend to decrease.

Standard practice is for stationary vehicles to switch off engines once in position for loading / unloading.

Emissions from idling emissions have not been assessed as part of this AQIA and may be managed effectively through the control measures outlined in **Section 8.3**.

Commercial Kitchen Emissions

The Proposal includes the operation of commercial kitchen activities including the manufacturing of potato and corn products and the commercial kitchen process is outlined in **Section 2.2**. Emissions from a commercial kitchen will vary rapidly and significantly in composition depending on the cooking processes being used. From an environmental perspective, emissions to atmosphere from kitchen exhaust ventilation systems are typically associated with odour and particulates (i.e. smoke).

Cooking processes may also give rise to emissions of a range of air pollutants associated with the combustion of fuel including NO_X, CO, CO_2 and a range of organics including VOCs, semi-volatile organic compounds (SVOC) and aldehydes. Generally, these pollutants may become a potential hazard to health within poorly ventilated kitchen spaces, and controlled extraction from kitchen exhaust ventilation systems provides control to the potential for exposure of workers. Emissions of these pollutants at the rates anticipated from commercial kitchens is not considered to be significant from an environmental perspective.

Odour is a complex mix of solid particles, aerosols and liquid droplets, and odour is an aggregated proxy measure for the control of all contributing solid phase and liquid phase emissions. The emissions of smoke and odour are generally inter-related, and in some cooking processes are so associated that they can be regarded as symptomatic of a general lack of exhaust treatment and control. In this context, the control of smoke is considered to be an intrinsic component of effective odour control as exposure to emissions of smoke may illicit an olfactometric response as well as an exposure to gaseous phase emissions. Effective odour control therefore must provide adequate control of smoke (particulates). Minor odour emissions may also be produced through the cleaning of kitchen areas.

With reference to the NPI *Emission Estimation Techniques Manual for Snack Foods Roasting and Frying Industry* (NPI, 1999), it is noted that the principal emissions to air from batch frying would include VOCs, and PM_{10}. These emissions would be experienced as odour and smoke.

In total, there will be 17 commercial kitchen emission sources to be operated as part of the Proposal, all of which will be discharged to atmosphere via short discharge stacks located at a height of 3 m above roof height. A number of these sources will have odour control provided by a series of after burning waste heat boilers to thermally oxidise emissions, and a subsequent heat exchanger for the recovery of heat prior to discharge to atmosphere.

Kitchen odour emissions are considered as part of this AQIA.

Boiler Emissions

The operation of the gas-fired boilers is expected to generate emissions of combustion pollutants. Information regarding the boiler specifications at the Proposal site have been provided by the Applicant and are reproduced in **Appendix F**. The emission estimation is presented in **Section 5.2.2** and **Appendix E**.

Emissions of combustion gas emissions (as NO_X) from the boilers are considered as part of this AQIA. Emissions of other pollutants (including CO, VOC) from gas-fired boilers are comparatively low compared to NO_X, and particulate emissions are extremely low and therefore the assessment of NO_X is an appropriate benchmark for those emissions.

WWTP Emissions

Wastewater at the Proposal site will be treated in a wastewater treatment plant (WWTP) prior to discharge. Wastewater emissions are generally associated with odour and are therefore experienced as amenity impacts at sensitive receptors.

The WWTP is expected to comprise a small batch reactor, including mechanisms for filtration, separation and bio-absorption prior to discharge through commercial trade waste agreement to foul sewer.

The previous odour impact assessment report (GHD, 2020) presents emissions data from the following existing WWTP sources at the Blacktown facility, which are anticipated to be replicated at the Proposal site:

- Balance tank
- Settling tank 1
- Settling tank 2
- Settling tank 3
- Dissolved Air Flotation (DAF) tank

Those sources and measured odour emission rates have been adopted in this study and are presented in **Section 5.2.3**and **Appendix E**.

Odour emissions from the WWTP have been assessed as part of this AQIA. It is noted that whilst the commercial kitchen and the WWTP both emit "odour" they are sufficiently different in character to assess individually.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1. NSW EPA Approved Methods

State air quality guidelines adopted by the NSW EPA are published in the *'Approved Methods for the Modelling and Assessment of Air Quality in NSW'* (the Approved Methods (NSW EPA, 2017)) which has been consulted during the preparation of this assessment report.

The Approved Methods lists the statutory methods that are to be used to model and assess emissions of criteria air pollutants from stationary sources in NSW. Section 7.1 of the Approved Methods clearly outlines the impact assessment criteria for the Proposal.

The criteria listed in the Approved Methods are derived from a range of sources (including NHMRC, NEPC, DoE and WHO).

3.1.1. Nitrogen Dioxide

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW. The standards adopted to protect members of the community from health impacts in NSW, relevant to this assessment, are presented in **Table 3**.

Table 3 NSW EPA air quality standards and goals

Pollutant	Averaging period	Criterion µg·m^{-3} (a)	Notes
Nitrogen dioxide (NO_2)	1 hour	246	Numerically equivalent to the AAQ NEPM(b) standards and goals.
	1 year	62	

Notes: (a): micrograms per cubic metre of air
(b): National Environment Protection (Ambient Air Quality) Measure

3.1.2. Odour

In relation to odour, experience gained through odour assessments from proposed and existing facilities in NSW indicates 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). Therefore, the Odour Technical Framework (DECC, 2006) recommends that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 OU. In modelling and assessment terms, this is expressed as the 99th percentile value, as a nose response time average (approximately one second).

Odour assessment criteria need to consider the range in sensitivities to odours within the community to provide additional protection for individuals with a heightened response to odours. This is addressed in the Technical Framework (DECC, 2006) and the Approved Methods (NSW EPA, 2017) by setting a population dependant odour assessment criterion, and in this way, the odour assessment criterion allows for population size, cumulative impacts, anticipated odour levels during adverse meteorological conditions and community expectations of amenity.

A summary of odour performance goals for various population sizes, as referenced in the Approved Methods (NSW EPA, 2017) is shown in **Table 4**. This table shows that in situations where the population of the affected community lies between 125 and 500 people, an odour assessment criterion of 4 OU at the nearest residence (existing or any likely future residences) is to be used. For isolated residences, an odour assessment criterion of 7 OU is appropriate.

Table 4 NSW EPA odour impact criterion

Population of affected community	Complex mixture of odours (OU)
Urban area (≥2000)	2.0
500 – 2000	3.0
125 – 500	4.0
30 – 125	5.0
10 – 30	6.0
Single residence (≤2)	7.0

Source: The Odour Technical Notes, DECC 2006

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", but manage odour impacts to an acceptable level.

The term 'offensive odour' is defined within the POEO Act as:

> *an odour:*
>
> *(a) that, by reason of its strength, nature, duration, character or quality, or the time at which it is emitted, or any other circumstances:*
>
> > *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
> >
> > *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
>
> *(b) that is of a strength, nature, duration, character or quality prescribed by the regulations or that is emitted at a time, or in other circumstances, prescribed by the regulations.*

Given the mixed land uses around the Proposal site, two odour impact criteria have been adopted:

- 7 OU at all receptor locations; and

- 2 OU at all residential receptor locations.

The adoption of the two criteria is considered to be appropriate given the surrounding industrial land uses and the distance to proximate residential uses (see **Section 4.1**), and "*considers the range of sensitivities to odour of the receiving environment*" (DECC, 2006).

3.2. Protection of the Environment Operations Act

The *Protection of the Environment (Operations) Act* 1997 (POEO) is applicable to scheduled activities in NSW. Chapter 5, Part 5.4, Section 128 relates to the control of air emissions (emphasis added).

128 Standards of air impurities not to be exceeded

(1) The occupier of any premises must not carry on any activity, or operate any plant, in or on the premises in such a manner as to cause or permit the emission at any point specified in or determined in accordance with the regulations of air impurities in excess of—

(a) the standard of concentration and the rate, or

(b) the standard of concentration or the rate,

prescribed by the regulations in respect of any such activity or any such plant.

(1A) Subsection (1) applies only to emissions (point source emissions) released from a chimney, stack, pipe, vent or other similar kind of opening or release point.

(2) The occupier of any premises must carry on any activity, or operate any plant, in or on the premises by such practicable means as may be necessary to prevent or minimise air pollution if—

(a) in the case of point source emissions—neither a standard of concentration nor a rate has been prescribed for the emissions for the purposes of subsection (1), or

(b) the emissions are not point source emissions…

Section 129 provides the requirements for the control of emissions of odour from licenced activities.

129 Emission of odours from premises licensed for scheduled activities

(1) The occupier of any premises at which scheduled activities are carried on under the authority conferred by a licence must not cause or permit the emission of any offensive odour from the premises to which the licence applies…

The Snack Brands facilities in Smithfield and Blacktown are both scheduled activities, under Schedule 1, Part 1.2 "general agricultural processing", with a capacity of greater than 30 000 tonnes per year.

With reference to the POEO Public Register maintained by the NSW EPA, it is noted that Snack Brands holds 2no. Environmental Protection Licences (EPL), which are summarised in **Table 5**.

Table 5 EPL summary

Licence	Facility	Activity	Licenced Discharge Points	Discharge Limits
21202	Smithfield Snack Brands	General agricultural processing >30-100kT pa processing capacity	• EPA1 PC42 Fryer • EPA2 Fryer UPC2 • EPA3 Fryer KF • EPA4 Extrusion Ovens • EPA5 HX Discharge • EPA6 KF Fryers	TSP 50 mg·Nm^{-3} VOC 40 mg·Nm^{-3} (EPA1-4)
21243	Blacktown Snack Brands	General agricultural [processing >30-100kT pa processing capacity	• EPA1 PC42 Fryer • EPA2 KF Fryers • EPA3 UPC Fryers • EPA4 Starch Recovery Burner	TSP 50 mg·Nm^{-3} VOC 40 mg·Nm^{-3} (EPA1-4)

3.3. Protection of the Environment (Clean Air) Regulation

The *Protection of the Environment (Clean Air) Regulation* 2010 sets standards of concentration for emissions to air from both scheduled and non-scheduled activities. For the operation of the after burning waste heat boilers at the Proposal Site, the POEO (Clean Air) Regulation provides general standards of concentration for scheduled premises which are presented in **Table 6** for the pollutants of relevance to this assessment. Similarly, Schedule 4 provides standards relevant to the operation of the gas-fired boilers.

Table 6 POEO (Clean Air) Regulation – General standards of concentration

Air Impurity	Plant	Standard of Concentration (Group 6)
Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	POEO CAR Schedule 2: afterburner	350 mg·m^{-3}
	POEO CAR Schedule 4: any boiler operating on gas	350 mg·m^{-3}
Carbon monoxide (CO)	POEO CAR Schedule 2: afterburner	125 mg·m^{-3}
	POEO CAR Schedule 4: Any stationary reciprocating internal combustion engine using a gaseous fuel	125 mg·m^{-3}
Total volatile organic compounds (TVOC)	POEO CAR Schedule 2: afterburner	40 mg·m^{-3}
	POEO CAR Schedule 4: Any stationary reciprocating internal combustion engine using a gaseous fuel	40 mg·m^{-3}

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

4.1.1. Land Use Zoning

The land use surrounding the Proposal site is zoned within the Local Government Area (LGA) of Penrith. The land occupied by the Proposal site is currently zoned as IN1 (General Industrial). Lands to the north and west are zoned as RU2 (Rural Landscape) and E2 (Environmental Conservation) and lands to the east are zoned as SP2 (Infrastructure). The closest residential land use (R2, low density residential) is located approximately 1 km to the north of the Proposal site as illustrated in **Figure 3**.

4.1.2. Discrete Receptor Locations

To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Proposal site reside, population-density data has been examined. Population-density data based on the 2016 census, have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2017). Using a Geographical Information System (GIS), the locations of sensitive receptor locations, have been confirmed with reference to their population densities.

For clarity, the ABS use the following categories to analyse population density (persons·km^{-2}):

- Very high >8 000
- High >5 000
- Medium >2 000
- Low >500
- Very low <500
- No population 0

Using ABS data in a GIS, the population density of the area surrounding the Proposal site is presented in **Figure 4**.

The Proposal site and receptors are located in an area of 'low' population density (500-2 000 persons·km^{-2}), which would be expected given the largely industrial activities of the immediate area.

In accordance with the requirements of the NSW EPA, several receptors have been identified and the receptors adopted for use within this AQIA are presented in **Table 7**. This selection is derived from the information presented in **Figure 3** and **Figure 4**.

Table 7 is not intended to represent a definitive list of sensitive land uses, but a cross section of available locations, that are used to characterise larger areas, or selected as they represent more sensitive locations, which may represent people who are more susceptible to changes in air pollution.

Table 7 Receptor locations

Rec	Location(1)	Land use	Location (UTM)	
			mE	mS
R1	11-19 Distribution Drive, Orchard Hills	Industrial	293 911	6 255 253
R2	10-12 Distribution Drive, Orchard Hills	Industrial	293 950	6 255 170
R3	6-8 Distribution Drive, Orchard Hills	Industrial	293 975	6 255 053
R4	11-19 Distribution Drive, Orchard Hills	Industrial	293 672	6 255 123
R5	7-9 Distribution Drive, Orchard Hills	Industrial	293 988	6 254 840
R6	573-577 Mamre Road, Orchard Hills(2)	Residential	294 069	6 255 506
R7	45-59 Sarah Andrews Close, Erskine Park	Industrial	294 241	6 255 268
R8	35-44 Sarah Andrews Close, Erskine Park	Industrial	294 443	6 254 963
R9	654-674 Mamre Road, Kemps Creek	Residential	294 648	6 254 693
R10	657-703 Mamre Road, Kemps Creek	Residential	294 494	6 254 519
R11	579A Mamre Road, Orchard Hills	Residential	293 256	6 255 186
R12	1-27 Sarah Andrews Close, Erskine Park	Industrial	294 428	6 255 271
R13	15-23 Quarry Road, Erskine Parke	Industrial	294 252	6 255 666
R14	25-31 Mandalong Close, Orchard Hills	Residential	293 850	6 255 892
R15	65-73 Mandalong Close, Orchard Hills	Residential	293 516	6 255 809
R16	108 Pine Creek Circuit, St Clair	Residential	294 057	6 256 579

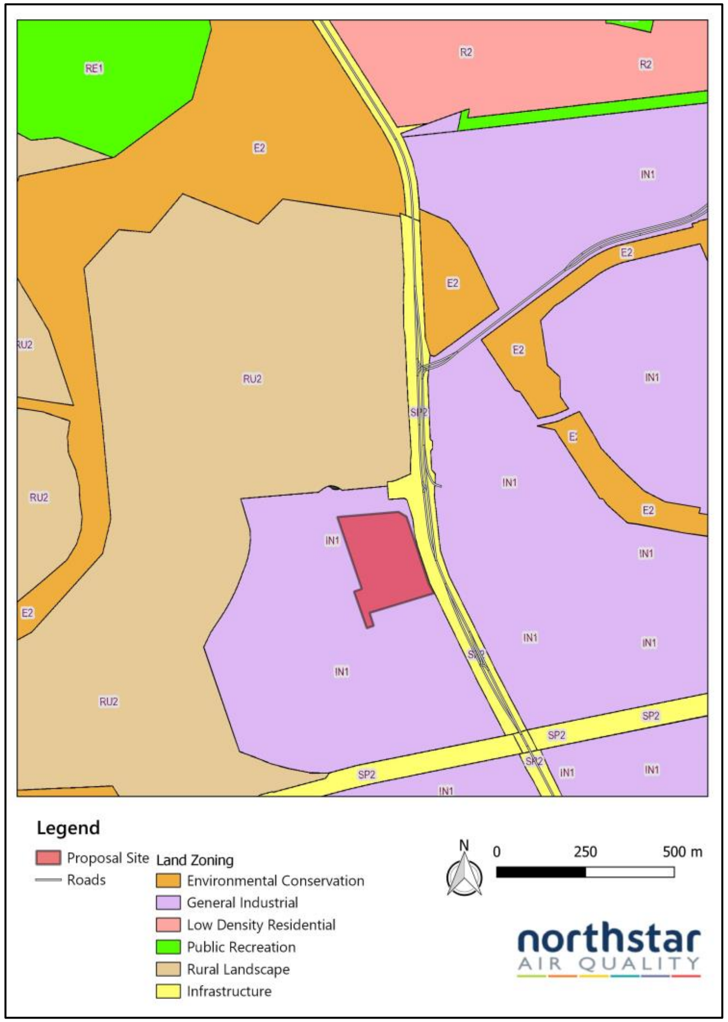
Note: (1) The requirements of this AQIA may vary from the specific requirements of other studies, and as such the selection and naming of receptor locations, may vary between technical reports. This does not affect or reduce the validity of those assumptions.

(2) R6 is not currently occupied and is owned by Altis Property Partners Pty Ltd. It is understood that the intention is to develop that land in the short to medium term and that Altis Property Partners Pty Ltd support the development of the new manufacturing facility proposed by the Applicant.

The closest residential property is receptor 6 (R6) (see **Figure 6** note (2) above), is located approximately 74 m from the Proposal site boundary to the north, on Mamre Road, Orchard Hills.

The site is bounded by an existing warehouse and is also in close proximity to other industrial development towards the east, south and west, with residential areas to the north and northwest.

Figure 3 Current land use zoning



Source: Northstar Air Quality

Figure 4 Population density and sensitive receptors surrounding the Proposal site

Source: Image courtesy of Google Maps and data sourced from the ABS

4.2. Meteorology

The meteorology experienced within an area, can govern the generation (in the case of wind-dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. The meteorological conditions surrounding the Proposal site have been characterised using data collected by the Australian Government Bureau of Meteorology (BoM) at a number of surrounding Automatic Weather Stations (AWS).

To provide a characterisation of the meteorology which would be expected at the Proposal site, a meteorological modelling exercise has also been performed. A summary of the inputs and outputs of the meteorological modelling assessment, including validation of those outputs is presented in **Appendix A**.

Meteorological monitoring data from Horsley Park Equestrian Centre AWS for the period 2016 to 2020 has been assessed in this study as it is most likely to represent the conditions at the Proposal site, based upon its proximity and lack of significant topographical features between the two locations.

Based on the wind distributions across the years examined (see **Appendix A**), data for the year 2017 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied.

4.3. Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location, will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant, should also be assessed. These 'background' (sometimes called 'baseline') air quality conditions will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The Proposal site is located proximate to a number of air quality monitoring stations (AQMS) operated by DPIE. These locations (listed by proximity) are discussed in **Appendix B**.

The closest active AQMS is noted to be located at St Marys and is generally considered to be the monitoring location most reflective of the conditions at the Proposal site.

Appendix B provides a detailed assessment of the background air quality monitoring data collected at the St Marys AQMS.

A summary of the air quality monitoring data and assumptions used in this assessment are presented in **Table 8**.

Table 8 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Units	Measured Value	Notes
Nitrogen dioxide (NO_2) (St Marys)	1-hour	µg·m^{-3}	69.6	Hourly maximum 1-hr average in 2017
	Annual		8.0	Annual average in 2017

Note: Reference should be made to **Appendix B**

Given the nature of the immediate area, it has been assumed that the presence of odours of a similar nature to those associated with the Proposal are negligible.

For the purposes of the construction dust risk assessment, an annual mean PM_{10} concentration of 19.1 µg·m^{-3} as measured between 2016 and 2020 at the St Marys AQMS in has been adopted, as required by the adopted methodology.

The AQIA has been performed to assess the contribution of the Proposal to the air quality of the surrounding area, and to ensure that no additional exceedances of the air quality criteria are experienced as a result of the operation of the Proposal. A full discussion of how the Proposal impacts upon the air quality is presented in **Section 5** and **Section 7**.

5. METHODOLOGY

5.1. Construction Phase

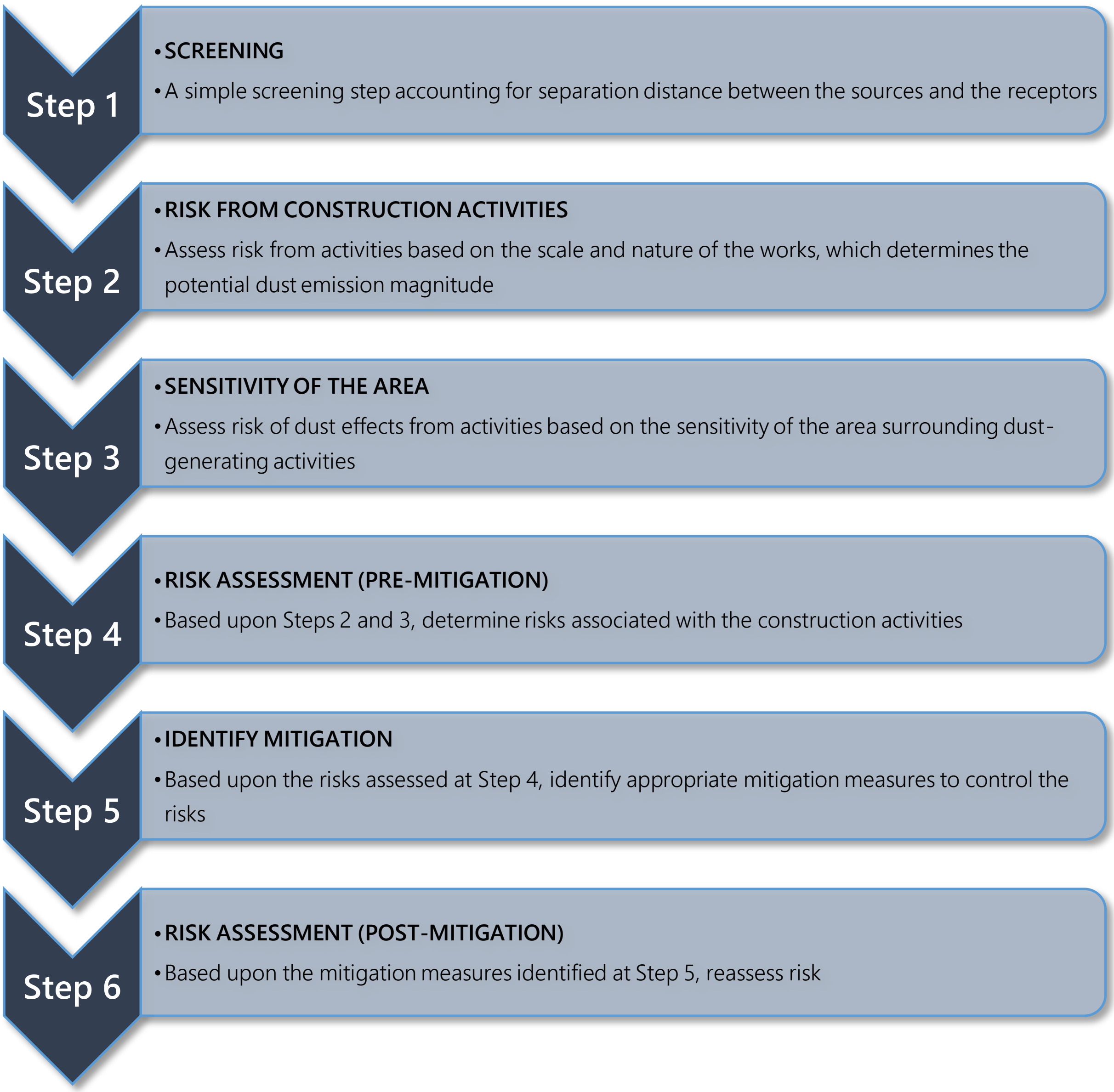
Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled (or 'fugitive') emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts. Localised engine-exhaust emissions from construction machinery and vehicles may also be experienced but given the very minor scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

Modelling of dust from construction Proposals is generally not considered appropriate, as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly, depending upon local conditions. In lieu of a modelling assessment, the construction-phase impacts associated with the Proposal have been assessed using a risk-based assessment procedure. The advantage of this approach is that it determines the activities that pose the greatest risk, which allows the Construction Environmental Management Plan (CEMP) to focus controls to manage that risk appropriately and reduce the impact through proactive management.

For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM, 2014). Reference should be made to **Appendix C** for the methodology.

Briefly, the adapted method uses a six-step process for assessing dust impact risks from construction activities, and to identify key activities for control, as illustrated in **Figure 5** (overleaf).

Figure 5 Construction phase impact risk assessment methodology



The assessment approach, as illustrated above in **Figure 5**, is detailed in **Appendix C**. Steps 1-4 (up to the "risk assessment (pre-mitigation)" are addressed in **Section 5**. Step 5 "identify mitigation" and Step 6 "risk assessment (post mitigation)" are discussed in **Section 8**.

5.2. Operational Emissions

Operational phase emissions associated with the emission sources identified in **Section 2.3** have been assessed through the performance of a dispersion modelling assessment.

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the relatively small distances between the sources and nearest receptors, the uncomplicated terrain between the sources and receptors, a detailed assessment using a 3-dimensional (3-D) meteorological dataset is not warranted. The meteorology relevant to this AQIA is presented in **Appendix A**.

An assessment of the impacts of the operation of activities at the Proposal site has been performed which characterises the likely day-to-day operation of the Proposal site, approximating average and maximum operational characteristics which are appropriate to assess against longer term (annual average) and shorter term (1-hour) criteria, respectively.

The modelling scenarios provide an indication of the air quality impacts of the operation of activities at the Proposal site. Added to these impacts are background air quality concentrations (where relevant and available as discussed in **Section 4.3** and **Appendix B**) which represent the air quality which may be expected within the area surrounding the Proposal site, without the impacts of the Proposal itself.

The following provides a description of the determination of appropriate emissions of air pollutants resulting from the operation of the Proposal.

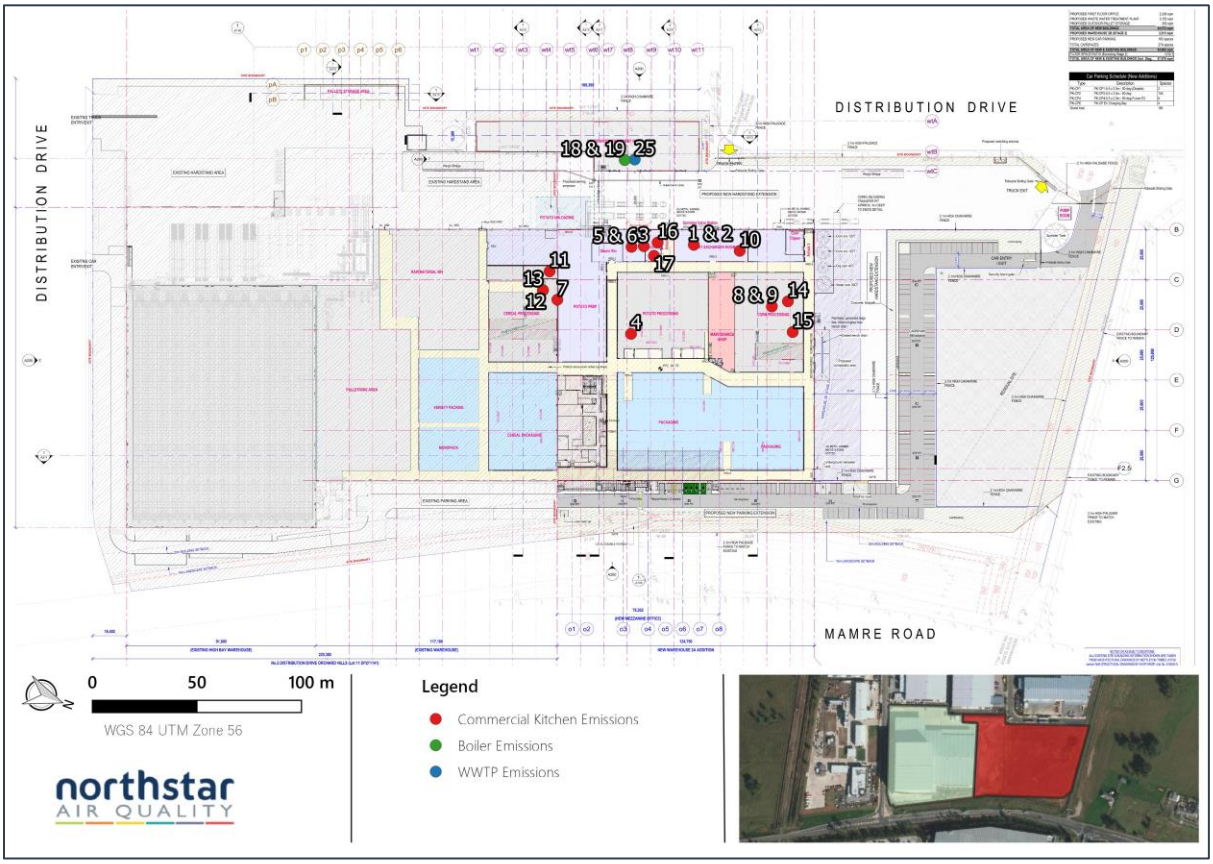
As discussed in **Section 2.3**, the emissions from the following sources have been quantitatively assessed:

- **Commercial kitchen emissions**: emissions from food manufacturing activities at the Proposal site, which are largely extracted and ducted to after-burning waste heat boilers prior to discharge to atmosphere;
- **Boiler emissions**: emissions from the operation of gas-fired boilers, operated for the purpose of generating hot water for cooking purposes (e.g. cooking corn); ad
- **Wastewater emissions**: emissions from wastewater treated prior to discharge from the Proposal site.

These are discussed sequentially in the **Sections 5.2.1**, **5.2.2** and **5.2.3** respectively.

The locations of the above sources are illustrated in **Figure 6**. Commercial kitchen emissions are designated emission point identifiers (ID) 1-17 (shown in red), boiler emissions 18-19 (shown in green) and WWTP emissions as 25 (shown in blue).

Figure 6 Location of assessed emission points



5.2.1. Commercial Kitchen Emissions

The emissions from the various commercial kitchen emission sources have been quantified through reference to a previous odour assessment report performed at the Blacktown facility (GHD, 2020). An excerpt from the 2020 odour assessment report providing a succinct summary of the odour emission rates in that study is provided below in **Figure 7**. It is noted that the previous odour assessment report also identified that a number of sources were emitting odour at rates higher than the specification parameters for two sources (named as “PC-42” and “UPC-2”), which are reproduced in **Figure 8**.

The naming used (e.g. “PC-42”, UPC-1” etc) relate to the type of fryers and ovens used at SBA Smithfield and SBA Blacktown.

The data presented is relevant to this AQIA as a number of those sources will be relocated to the Proposal site, and a number of other sources are considered by the Applicant to be sufficiently similar that the emissions data has been prescribed as “equivalent”. These data assumptions are discussed further in the recommended monitoring requirements in **Section 8.3**.

Figure 7 Summary of odour sampling results (Blacktown) (GHD, 2020) (table 3-2)

Source name	Odour concentration (OU)	Flow rate (m³/min)	Velocity (m/s)	Odour emission rate (OU/min)	Temperature (C)
Ektimo (R008085 issued 28/10/19) – Report provided in Appendix A					
PC-42	1700	240	6.6	410,000	144
UPC-1	8800	42	4.8	370,000	91
Roof vent	810	*See note 1*			
UPC-2	1900	125	15	240,000	163
ORLA (7043/ORLA/01 issued 07/01/20) – Report provided in Appendix B					
UPC-2	165	109	13.5	17,940	154
UPC-2	151	109	13.54	16,440	155
ORLA (7081A/ORLA/01 issued 22/07/20) – see note 2,3 – **Report provided in Appendix C**					
PC-42	470	239	6.2	112,320	133
PC-42	330	239	6.2	79,320	133
UPC-2	720	113	13.9	82,020	159
UPC-2	610	113	13.9	69,060	159
ORLA (7082A/ORLA/01 issued 30/07/20)– Report provided in Appendix D					
KF-3	6800	15	4.5	101,280	57.5
KF-3	6330	15	4.5	94,320	57.5
Ektimo (R009359 issued 27/08/20) – see note 2,3 – **Report provided in Appendix E**					
PC-42	750	240	6.2	180,000	133
PC-42	800	240	6.2	190,000	133
UPC-2	1700	114	13.9	190,000	159
UPC-2	1400	114	13.9	160,000	159

1. Flow rate and temperature measurements were not taken from this source. Flow rate measurements are to be estimated for each roof vent based on equipment supplier commissioning data.
2. Odour sampling presented in each report were carried out on the same day, simultaneously on 07/07/20. Whilst the samples were taken simultaneously there is still some significant difference between the result, suggesting some difference solely associated with laboratory analysis procedures (olfactometry) by each party (Ektimo, ORLA).
3. Flow rate and temperature measurements for these samples were taken by ORLA only with Ektimo adopting the ORLA flow rates in their analysis of the data. Some minor difference is presented associated with units presented in each result and rounding.

Figure 8 Summary of measured verses specification parameters for PC-42 and UPC-2 (Blacktown) (GHD, 2020) (table 3-3)

Data source	Velocity (m/s)	Odour emission rate (OU/min)	Temperature (C)
PC-42			
Average of sampling data	6.3	194,328	135
Specification	6.1	46,440	150
UPC-2			
Average of sampling data	13.9	110,780	158
Specification	13.5	22,000	170

For this assessment, a range of process-specific emission reports have been referenced, of measurements made on plant and processes operating at SBA Smithfield and SBA Blacktown, including the data presented in **Figure 7** and **Figure 8** for the following kitchen sources, comprising a range of fryers and ovens:

- PC-42 (odour control);
- UPC-1 (no odour control);
- UPC-2 (with odour control);

- KF (odour control); and
- Corn oven 1 (odour control).

These process-specific measurements have been used to represent the anticipated emissions from the Proposal site, and this approach is considered to be appropriate given that a number of those production lines will be relocated to the Proposal site from those existing operations.

Discussions with the Applicant has determined where an "equivalence" can be realistically made between existing and new plant, which is illustrated in **Table 9**.

e.g. ID1 in **Table 9** is for a new fryer nominated as "UPC4" at the Proposal site, which has been assumed to be represented by the "equivalence" monitoring data for UPC-2 (see **Figure 7** and **Figure 8**).

e.g. ID7 in **Table 9** is for a new fryer nominated as "Jumpys" at the Proposal site, which has been assumed to be represented by the "equivalence" monitoring data for KF-3 (see **Figure 7** and **Figure 8**).

Essentially this is using the process emissions data that is available and applying that as proxy values for sources without emissions data. This data gap is discussed further in **Section 8.3**. It is noted that the new plant would generally be considered to have better performance standards than older plant.

A summary of the commercial kitchen emission sources, its "equivalence", location, and whether it is to be relocated from Blacktown, Smithfield or is new plant, is summarised in **Table 9**.

Table 9 Commercial kitchen emission sources assessed

ID	Heat Exchanger (HX)	Process	Equivalence	Co-ordinates		Notes
				mE	mS	
1	1	UPC 4	upc-2	294,034	6,255,223	New
2	1	UPC 3	upc-2	294,034	6,255,223	New
3	2	UPC 2	upc-2	294,042	6,255,201	Existing Blacktown
4	3	UPC 1	upc-1	294,084	6,255,209	Existing Blacktown
5	4	UPC 1	upc-1	294,045	6,255,195	Existing Blacktown
6	5	UPC 1	upc-1	294,045	6,255,195	Existing Blacktown
7	6	Jumpys	kf-3	294,081	6,255,171	Existing Smithfield
8	7	Corn 1 EIT	upc-2	294,049	6,255,268	Existing Smithfield
9	8	Corn 2 1070	upc-2	294,049	6,255,268	New
10	9	PC 50	upc-2	294,029	6,255,245	New
11	10	Pellet	upc-2	294,069	6,255,163	New
12	Nil	Cereal oven 1	oven	294,079	6,255,163	New
13	Nil	Cereal oven 2	oven	294,079	6,255,163	Existing Smithfield
14	Nil	Corn oven 1	oven	294,044	6,255,275	New
15	Nil	Corn oven 2	oven	294,057	6,255,282	Existing Smithfield

ID	Heat Exchanger (HX)	Process	Equivalence	Co-ordinates		Notes
				mE	mS	
16	Nil	Starch Dryer 1	oven	294,039	6,255,206	Existing Blacktown
17	Nil	Starch Dryer 2	oven	294,045	6,255,207	Existing Smithfield

The emission inventory is presented in **Appendix E**.

5.2.2. Boiler Emissions

The proposal includes the installation and operation of 2 no. Fulton Vantage 2 MW gas-fired condensing boilers (VTG-6000, or equivalent). The specification for the boilers is presented in **Appendix F**. The specification provides a flue gas flow rate of 1 272 standard cubic feet per minute (SCFM), and an emission guarantee of NO_X of <30 parts per million (ppm), CO of <50 ppm and VOC 0.015 $kg \cdot hr^{-1}$.

It is noted that boiler emissions have been assessed as NO_2. Experience shows that the most stringent parameter of compliance from boilers is short-term emissions of NO_X assessed as NO_2, and compliance with that criterion may be considered to represent compliance with all other criteria.

A summary of the boiler emission source, location, and whether it is to be relocated from Blacktown, Smithfield or is new plant, is summarised in **Table 10**.

Table 10 Boiler emission sources assessed

ID	Heat Exchanger (HX)	Process	Equivalence	Co-ordinates		Notes
				mE	mS	
18	Nil	Boiler 1	Boiler	294005	6255183	New
19	Nil	Boiler 2	Boiler	294005	6255183	New

The emission inventory is presented in **Appendix D**.

5.2.3. WWTP Emissions

A wastewater treatment plant (WWTP) is proposed to be operated as part of the Proposal.

A summary of the measured odour emission rates from the 5 no. sources are presented in table 3-4 of (GHD, 2020) are replicated in **Figure 9**.

Figure 9 Summary of WWTP odour emissions (Blacktown) (GHD, 2020) (table 3-4)

Source name	Source ID	Area (m^2)	Odour flux ($OU/m^2/min$)	Emission rate (OU/min)	Comment
WWTP - Balance tank	W1	57	27	1,539	-
WWTP - settling tank 1	W2a	6.2	27	167	Assumption that odour flux rate from settling tanks is equivalent to that measured at the balance tank.
WWTP - settling tank 2	W2b	6.2	27	167	
WWTP - settling tank 3	W2c	6.2	27	167	
WWTP - DAF	W3	16	29	464	Modelled as a volume source at DAF building with height 4.3 m.

The five sources are proposed to be located within the area shown as "WWTP" on **Figure 2**. Each source will be vented by provision of a local exhaust ventilation (LEV) system to an odour control unit (OCU), such as a carbon filter unit, prior to discharge to atmosphere through a dedicated controlled discharge point (#25).

A nominal odour abatement efficacy of 90 % has been applied to the aggregated WWTP emissions, which is considered to be appropriate for such a device. This data gap is discussed further in **Section 8.3**. A nominal discharge velocity of 10 $m{\cdot}s^{-1}$ at 25 °C has been assumed, which can be achieved with an estimated flow rate of 4.71 $m^3{\cdot}min^{-1}$ with an internal diameter at point of discharge of 0.1 m.

A summary of the WWTP emission source, location, and whether it is to be relocated from Blacktown, Smithfield or is new plant, is summarised in **Table 11**.

Table 11 WWTP emission sources assessed

ID	Heat Exchanger (HX)	Process	Equivalence	Co-ordinates		Notes
				mE	mS	
25	Nil	WWTP (OCU)	WWTP	294,005	6,255,183	New

The emission inventory is presented in **Appendix E**.

5.2.4. Short Term Impacts

The evaluation of odour impacts requires the estimation of short or peak concentrations on the time scale of less than one hour, and dispersion model outputs are limited by the resolution of the input meteorological data (1-hour). Dispersion models therefore need to be supplemented to accurately simulate atmospheric dispersion of odours and the instantaneous perception of odours by the human nose. The prediction of peak concentrations from estimates of ensemble means can be obtained from a ratio between extreme short-term concentration and longer-term averages. Properly defined peak-to-mean ratios (P/M60) depend upon the type of source, atmospheric stability and distance downwind. The NSW EPA recommended factors for estimating peak concentrations for various source types in different atmospheric conditions are presented in **Table 12** (NSW EPA, 2017). These factors have been adopted within this assessment, as appropriate.

Table 12 Factors for estimating peak odour concentrations

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

5.2.5. Cumulative Assessment of Odour

As identified in **Section 2.3**, the emissions from commercial kitchen processes and from the WWTP may include odorous emissions, which are subject to assessment in this report. The potential odour emissions from the commercial kitchen and the WWTP have both been assessed but assessed discretely from each other.

Reference is made to the Technical Framework for the assessment and management of odour from stationary sources in NSW (DECC, 2006), which states (p20):

> ***To ensure that odour impacts are maintained within acceptable levels, odour emissions from an activity should be assessed against the glc criteria. Where several activities with similar odour character will result in a cumulative impact, the total of the odour emissions from all contributing activities needs to be considered.***

Odour emissions from the commercial kitchen processes and the WWTP are not considered to be similar in character or nature and have been assessed independently. Both have been assessed and evaluated in a consistent and appropriate manner, but not as a cumulative impact as the odour impacts are not additive.

5.2.6. NO_X to NO_2 Reactions

The emission rates of oxides of nitrogen (NO_X) have been modelled as nitrogen dioxide (NO_2). Approximately 90 % - 95 % of NO_X from a combustion process will be emitted as NO, with the remaining 5 % - 10 % emitted directly as NO_2. Over time and after the point of discharge, NO in ambient air will be transformed by secondary atmospheric reactions to form NO_2, and this reaction often occurs at a considerable distance downwind from the point of emission, and by which time the plume will have dispersed and diluted significantly from the concentration at point of discharge.

Air quality impact assessments need to account for the conversion of NO to NO_2 to enable a comparison against the air quality criterion for NO_2. To perform this, various techniques are common, which are briefly outlined below:

- **100% conversion**: the most conservative assumption is to assume that 100% of the total NO_X emitted is discharged as NO_2, and that further reactions do not occur.
- **Jansen method**: where the location is represented by good monitoring data for NO and NO_X, the empirical relationship between NO and NO_2 may be used to derive 'steady state' relationships.
- **Ozone limiting method**: this method uses contemporaneous ozone data to estimate that rate at which NO is oxidised to NO_2 hour-on-hour using an established relationship.

This AQIA has adopted the conservative 100 % NO_X to NO_2 conversion method.

6. CONSTRUCTION PHASE RISK ASSESSMENT

The methodology used to assess construction phase risk is discussed in **Section 5.1** and **Appendix C**.

Briefly, after 'Step 1 Screening' (which excludes those receptors that are sufficiently distanced from construction phase activities to not warrant further assessment) *risk* is determined by the product of *receptor sensitivity* and the identified *magnitude of impacts* associated with the construction phase activities (construction, track-out, demolition and earthworks (as applicable)). The definitions used to screen receptors, determine receptor sensitivity and the magnitude of impacts are all presented in **Appendix C**.

6.1. Screening Based on Separation Distance

The screening criteria applied to the identified sensitive receptors, are whether they are located in excess of:

- 50 m from the route used by construction vehicles on public roads.
- 350 m from the boundary of the site.
- 500 m from the site entrance.
- Track-out is assumed to affect roads up to 100 m from the site entrance.

Further to the above distance-based screening criteria, the construction activities are screened by the required construction activities.

Table 13 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

Table 13 Construction phase impact screening criteria distances

Rec	Location	Land Use	Screening Distance (m)		
			Boundary (350m)	Site Entrance (500m)	Construction route (50m)
R1	11-19 Distribution Drive, Orchard Hills	industrial (medium)	53	60	51
R2	10-12 Distribution Drive, Orchard Hills	industrial (medium)	20	128	60
R3	6-8 Distribution Drive, Orchard Hills	industrial (medium)	56	246	150
R4	11-19 Distribution Drive, Orchard Hills	industrial (medium)	298	330	61
R5	7-9 Distribution Drive, Orchard Hills	industrial (medium)	266	459	161
R7	45-59 Sarah Andrews Close, Erskine Park	industrial (medium)	81	291	7
R8	35-44 Sarah Andrews Close, Erskine Park	industrial (medium)	355	594	138
R9	654-674 Mamre Road, Kemps Creek	residential	691	922	461
R10	657-703 Mamre Road, Kemps Creek	residential	753	949	522
R11	579A Mamre Road, Orchard Hills	residential	694	704	476
R12	1-27 Sarah Andrews Close, Erskine Park	industrial (medium)	254	477	187
R13	15-23 Quarry Road, Erskine Parke	industrial (medium)	287	475	99
R14	25-31 Mandalong Close, Orchard Hills	residential	477	603	299
R15	65-73 Mandalong Close, Orchard Hills	residential	555	672	628
R16	108 Pine Creek Circuit, St Clair	residential	1 146	1 285	5 10

Note: R6 is not currently occupied and is owned by Altis Property Partners Pty Ltd. It is understood that the intention is to develop that land in the short to medium term and that Altis Property Partners Pty Ltd support the development of the new manufacturing facility proposed by the Applicant.

With reference to **Table 13**, sensitive receptors are noted to be within the screening distance thresholds and therefore require further risk assessment as summarised in **Table 14**.

Table 14 Application of Step 1 Screening

Construction Impact	Screening Criteria	Step 1 Screening	Comments
Demolition	350 m from boundary 500 m from site entrance	Not screened	Receptors identified within the screening distance
Earthworks	350 m from boundary 500 m from site entrance		
Construction	350 m from boundary 500 m from site entrance		
Trackout	100 m from site entrance		
Construction Traffic	50 m from roadside		

6.2. Impact Magnitude

The footprint of the Proposal site (the area affected) is estimated as being approximately 5.17 hectares (ha) in area.

As the Proposal will involve the demolition of a single adjoining wall, it is estimated that the Proposal will generate less than 20 000 m^3 of demolition waste, but may be performed at any time in the year and may involve materials with high dust potential. The total earthwork for the Proposal site area is 57 676 m^2.

As discussed in **Section 2.3.1**, an estimated 50 – 100 construction vehicles may be required at peak hours during construction works. Construction vehicles have been assumed to access the site from Distribution Drive.

Based upon the above assumptions and the assessment criteria presented in **Appendix C**, the dust emission magnitudes are as presented in **Table 15**.

Table 15 Construction phase impact categorisation of dust emission magnitude

Activity	Dust Emission Magnitude
Demolition	Medium
Earthworks and enabling works	Large
Construction	Large
Track-out	Large
Construction traffic routes	Large

6.3. Sensitivity of an Area

6.3.1. Land Use Value

The assessment criteria as described in **Section 6.1**, including the conditions pertaining to *land use value* of the area surrounding the Proposal site, is provided in detail in **Appendix C** of this report.

The maximum *land use value* across the identified receptors has been taken forward to be conservative. It is concluded to be *high* for health impacts and for dust soiling.

6.3.2. Sensitivity of an Area

The assessment criteria as described in **Section 6.1**, including the conditions pertaining to *sensitivity of the area* surrounding the Proposal site, is provided in detail in **Appendix C** of this report.

The assumed existing background annual average PM_{10} concentrations, as measured at St Marys AQMS (see **Section 4.3**) was 19.1 µg·m^{-3}, which, along with the land use value calculated above, classifies the sensitivity of the area as *high* for health effects and *low* for dust soiling effects.

6.4. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as *low* for dust soiling, and *high* for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 15**, the resulting risk of air quality impacts (without mitigation) is as presented in **Table 16**.

Table 16 Pre-mitigated risk of air quality impacts from construction activities

Impact	Sensitivity of Area	Dust Emission Magnitude					Pre-mitigated Risk				
		Demolition	Earthworks	Construction	Track-out	Const. Traffic	Demolition	Earthworks	Construction	Track-out	Const. Traffic
Dust Soiling	Low	Med.	Large	Large	Large	Large	Low	High	High	High	High
Human Health	High	Med.	Large	Large	Large	Large	Med.	High	High	High	High

Note: med. = medium

The risks summarised in **Table 16** show that there is a *high* pre-mitigated risk of both dust soiling and human health impacts associated with construction activities if no mitigation measures were to be applied to control emissions associated with construction-phase activities.

The risk assessment therefore provides recommendations for construction phase mitigation, which are presented in **Section 8.1.2**.

7. OPERATIONAL PHASE IMPACT ASSESSMENT

The methodology used to assess operational phase impacts is discussed in **Section 5**. This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Incremental impact – relates to the concentrations predicted as a result of the operation of the Proposal in isolation.
- Cumulative impact – relates to the concentrations predicted as a result of the operation of the Proposal PLUS the background air quality concentrations discussed in **Section 4.3**.

The results are presented in this manner to allow examination of the likely impact of the Proposal in isolation and the contribution to air quality impacts in a broader sense.

In the presentation of results, the tables included shaded cells which represent the following:

Model prediction	Pollutant concentration / deposition rate less than the relevant criterion	Pollutant concentration / deposition rate equal to, or greater than the relevant criterion

The meteorological year adopted within dispersion modelling is 2017, as discussed in **Section 4.2** and **Appendix A**.

7.1. Commercial Kitchen Emissions

Presented in **Table 17** are the 99th percentile 1-second average odour concentrations predicted at the surrounding receptor locations, as a result of the Proposal operation of the commercial kitchen emission sources. The predicted 99th percentile 1-second nose response time odour concentrations are compared against the relevant odour assessment criterion, as discussed in **Section 3**.

Table 17 Commercial kitchen emissions: predicted 99th percentile odour concentrations

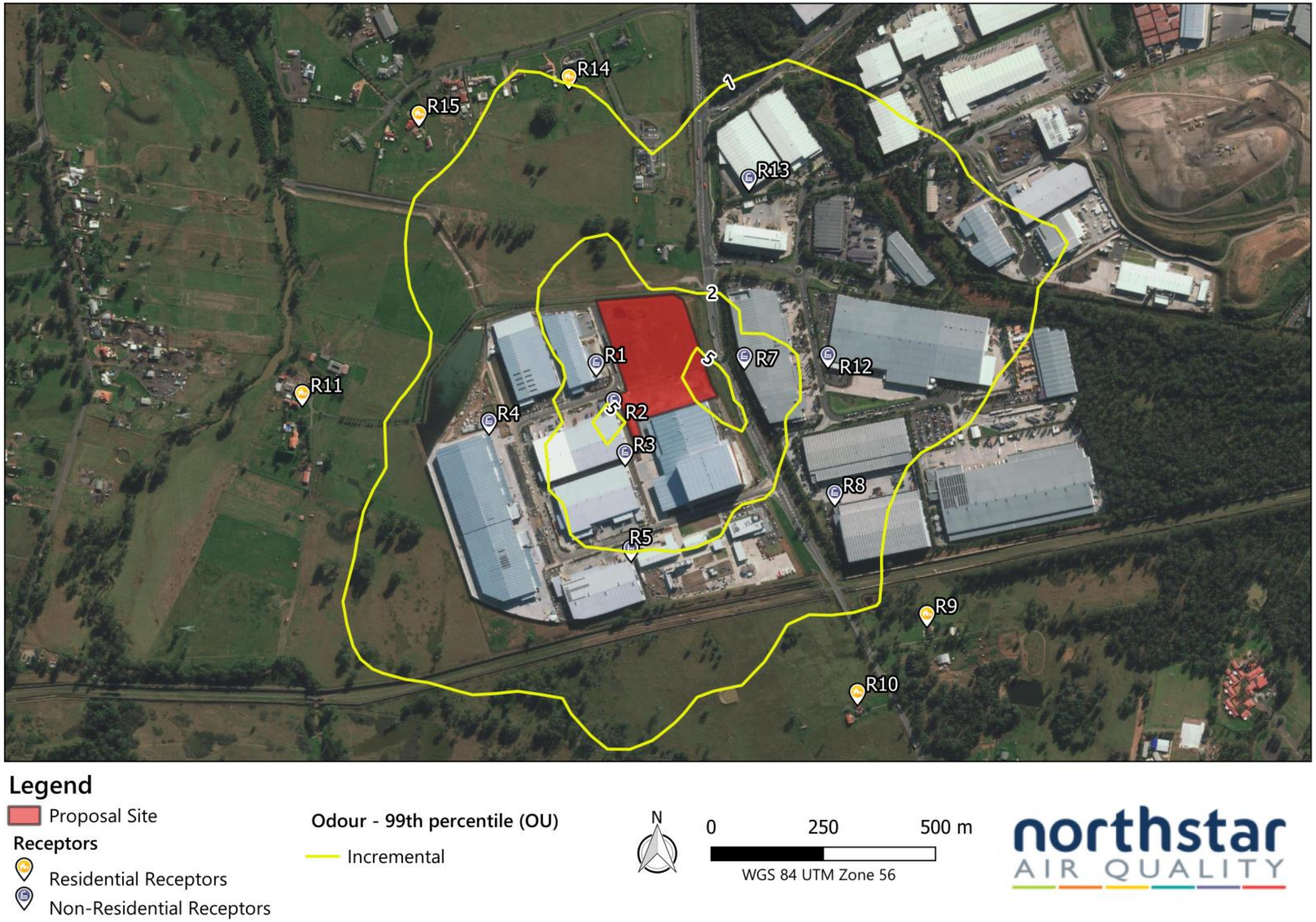
Receptor	Land use	99.9th percentile 1-second average odour (OU)		
		Incremental Impact	Criterion	Compliance / Non-compliance
R1	Industrial	3.4	7	Compliance
R2	Industrial	5.6	7	Compliance
R3	Industrial	4.0	7	Compliance
R4	Industrial	1.5	7	Compliance
R5	Industrial	1.7	7	Compliance
R6	Residential	1.6	2	Compliance
R7	Industrial	4.4	7	Compliance
R8	Industrial	1.3	7	Compliance
R9	Residential	0.9	2	Compliance
R10	Residential	0.7	2	Compliance
R11	Residential	0.8	2	Compliance
R12	Industrial	1.9	7	Compliance
R13	Industrial	1.4	7	Compliance
R14	Residential	1.0	2	Compliance
R15	Residential	0.8	2	Compliance
R16	Residential	0.4	2	Compliance

Note: R6 is not currently occupied and is owned by Altis Property Partners Pty Ltd. It is understood that the intention is to develop that land in the short to medium term and that Altis Property Partners Pty Ltd support the development of the new manufacturing facility proposed by the Applicant.

The results in **Table 17** indicate that the anticipated odour emissions from the commercial kitchen processes are not anticipated to cause offensive odour impacts, as determined by the criteria identified in **Section 3.1**.

A concentration contour plot of predicted 99th percentile odour impacts is provided in **Figure 10**.

Figure 10 Commercial kitchen emissions: predicted 99th percentile 1-second odour impacts



7.2. Boiler Emissions

Results are presented in this section for the predictions of nitrogen dioxide (NO_2). The averaging periods associated with the criteria for these pollutants is 1-hour and an annual average, as specified in **Table 3**. The emissions adopted for this scenario reflect the operational profile of the Proposal over those averaging periods.

The conversion of NO_X to NO_2 has been assumed to be in accordance with Method 1 of the NSW EPA Approved Methods (section 8.1.2 of (NSW EPA, 2017), assuming a 100 % conversion from NO_X to NO_2. A Level 1 assessment has been performed which uses the maximum hourly model predictions of NO_X and the maximum hourly measured NO_2 concentration at the St Marys AQMS in 2017 (see **Section 4.3**). Presented in **Table 18** are the predicted 1-hour and annual average incremental and cumulative NO_2 concentrations at the surrounding receptor locations.

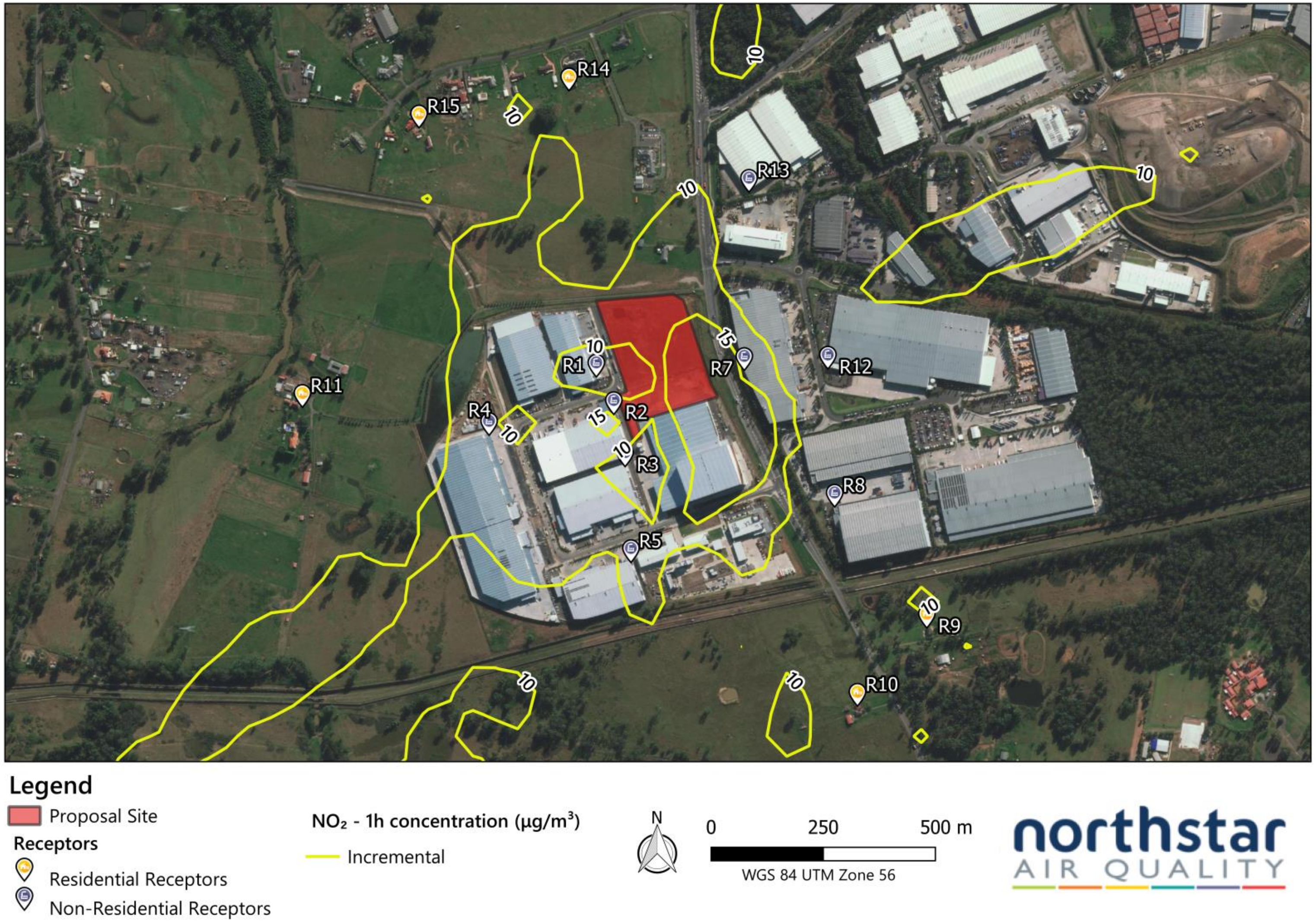
Table 18 Boiler emissions: predicted 1-hour and annual average NO_2 concentrations

Rec.	Nitrogen dioxide (NO_2) concentration ($\mu g \cdot m^{-3}$)						Compliance / non-compliance
	1-hour			Annual Average			
	Increment	Background	Cumulative	Increment	Background	Cumulative	
R1	8.1	69.6	77.7	0.1	8.0	8.1	Compliance
R2	15.1	69.6	84.7	1.0	9.0	10.0	Compliance
R3	7.5	69.6	77.1	0.5	10.0	10.5	Compliance
R4	10.9	69.6	80.5	0.1	11.0	11.1	Compliance
R5	10.5	69.6	80.1	0.2	12.0	12.2	Compliance
R6	11.6	69.6	81.2	0.3	13.0	13.3	Compliance
R7	15.7	69.6	85.3	1.0	14.0	15.0	Compliance
R8	7.6	69.6	77.2	0.1	15.0	15.1	Compliance
R9	7.9	69.6	77.5	0.1	16.0	16.1	Compliance
R10	9.0	69.6	78.6	0.1	17.0	17.1	Compliance
R11	10.0	69.6	79.6	0.1	18.0	18.1	Compliance
R12	8.1	69.6	77.7	0.2	19.0	19.2	Compliance
R13	8.1	69.6	77.7	0.3	20.0	20.3	Compliance
R14	9.2	69.6	78.8	0.1	21.0	21.1	Compliance
R15	7.7	69.6	77.3	0.1	22.0	22.1	Compliance
R16	6.8	69.6	76.4	<0.1	23.0	23.0	Compliance
Criterion	-	**246**		-	**62**		

Note: R6 is not currently occupied and is owned by Altis Property Partners Pty Ltd. It is understood that the intention is to develop that land in the short to medium term and that Altis Property Partners Pty Ltd support the development of the new manufacturing facility proposed by the Applicant.

The results presented in **Table 18** do not predict any exceedance of the 1-hour or annual average NO_2 criteria. A contour plot of the predicted maximum 1-hour incremental NO_2 impact is presented in **Figure 11**.

Figure 11 Predicted maximum incremental 1-hour NO_2 impacts



7.3. WWTP Emissions

Presented in **Table 19** are the 99th percentile 1-second average odour concentrations predicted at the surrounding receptor locations, as a result of the Proposal operation of the WWTP sources, treated by an OCU and discharged in a controlled discharge point located 3 m above the roof of the building. The predicted 99th percentile 1-second nose response time odour concentrations are compared against the relevant odour assessment criterion, as discussed in **Section 3**.

Table 19 WWTP emissions: predicted 99th percentile odour concentrations

Receptor	Land use	99.9th percentile 1-second average odour (OU)		
		Incremental Impact	Criterion	Compliance / Non-compliance
R1	Industrial	<0.1	7	Compliance
R2	Industrial	<0.1	7	Compliance
R3	Industrial	<0.1	7	Compliance
R4	Industrial	<0.1	7	Compliance
R5	Industrial	<0.1	7	Compliance
R6	Residential	<0.1	2	Compliance
R7	Industrial	<0.1	7	Compliance
R8	Industrial	<0.1	7	Compliance
R9	Residential	<0.1	2	Compliance
R10	Residential	<0.1	2	Compliance
R11	Residential	<0.1	2	Compliance
R12	Industrial	<0.1	7	Compliance
R13	Industrial	<0.1	7	Compliance
R14	Residential	<0.1	2	Compliance
R15	Residential	<0.1	2	Compliance
R16	Residential	<0.1	2	Compliance

Note: R6 is not currently occupied and is owned by Altis Property Partners Pty Ltd. It is understood that the intention is to develop that land in the short to medium term and that Altis Property Partners Pty Ltd support the development of the new manufacturing facility proposed by the Applicant.

The results in Table 19 indicate that the anticipated odour emissions from the WWTP are not anticipated to cause offensive odour impacts, as determined by the criteria identified in **Section 3.1**.

Given the very low predicted impacts, no plot of predicted odour impacts from the WWTP is provided.

8. DISCUSSION AND CONCLUSIONS

8.1. Discussion – Construction Phase

8.1.1. Assessed Risk (Pre-Mitigation)

The potential impacts associated with construction phase activities has been performed using a risk-based assessment procedure.

The published procedure, assesses risk associated with various construction-phase activities, including demolition, earthworks, construction and track-out. The identified risks are summarised in **Section 6.4**, and the mitigation measures identified to manage that risk are presented in **Section 8.1.2**.

8.1.2. Identified Mitigation

To manage the risks, the identified mitigation measures presented in **Table 20** are anticipated to be implemented in the Construction Environmental Management Plan (CEMP)[1].

The following represents a selection of recommended mitigation measures recommended by the IAQM methodology for a *high* risk site for construction and construction traffic. A detailed review of the recommendations would be performed once details of the construction phase are available.

Table 20 lists the relevant mitigation measures identified, and have been presented as follows:

- **N** = not required (although they may be implemented voluntarily).
- **D** = desirable (to be considered as part of the Construction Environment Management Plan (CEMP) but may be discounted if justification is provided).
- **H** = highly recommended (to be implemented as part of the CEMP and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

Table 20 Site-specific management measures

Identified Mitigation		Unmitigated Risk
1	Communications	High
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H

[1] https://www.planning.nsw.gov.au/~/media/Files/DPE/Guidelines/guideline-for-the-preparation-of-environmental-management-plans-2004.ashx?la=en

Identified Mitigation		Unmitigated Risk
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 relevant regulatory bodies.	H
2	**Site Management**	**High**
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
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	H
3	**Monitoring**	**High**
3.1	Undertake 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 100m of site boundary.	H
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, 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
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	H
4	**Preparing and Maintaining the Site**	**High**
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 they are at least as high as any stockpiles on site.	H

Identified Mitigation		Unmitigated Risk
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	H
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	H
5	**Operating Vehicle/Machinery and Sustainable Travel**	**High**
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
5.4	Impose and signpost a maximum-speed-limit of 25 $km \cdot h^{-1}$ on surfaced and 15 $km \cdot h^{-1}$ on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	H
5.4	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	H
5.5	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	H
6	**Operations**	**High**
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H
6.3	Use enclosed chutes and conveyors and covered skips	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	H
7	**Waste Management**	**High**
7.1	Avoid bonfires and burning of waste materials.	H

Identified Mitigation		Unmitigated Risk
8	Measures Specific to Demolition	Medium
8.1	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
8.2	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
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	D
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	D
8.7	Only remove the cover in small areas during work and not all at once	D
9	Measures Specific to Construction	High
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	H
9.2	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	H
9.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	H
9.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	D
10	Measures Specific to Track-Out	High
10.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	H
10.2	Avoid dry sweeping of large areas.	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	H
10.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H

Identified Mitigation		Unmitigated Risk
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
10.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	H
10.9	Access gates to be located at least 10 m from receptors where possible.	H
11	**Specific Measures to Construction Traffic (adapted)**	**High**
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
8.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	H

Notes D = desirable (to be considered), H = highly recommended (to be implemented), N = not required (although can be voluntarily implemented)

8.1.3. Residual Risk (Post-Mitigation)

For almost all construction activity, the adapted methodology 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.

Given the size of the Proposal site, the distance to sensitive receptors, the activities to be performed and the identified mitigation measures, the residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be '*negligible*' for all activities.

8.2. Discussion – Operational Phase

Based upon the assumptions presented in the report, the operation of the Proposal is not anticipated to result in any exceedances (i.e. non-compliance) of the impact assessment criteria for odour or NO_2.

In terms of odour, emissions from the commercial kitchen operations and the WWTP have been assessed discretely, as is appropriate for two odour sources of distinct character and nature. However, for assurance, it is also noted that the aggregation of the discrete impacts at all receptors from both sources would not give rise to any predicted exceedance of the odour assessment criteria.

Two odour criteria have been adopted for this assessment, as is appropriate for the varying levels of amenity to be expected across the assessment domain. The level of amenity expected at sensitive locations (for examples schools and hospitals) is naturally greater than would be expected at land designated for industrial uses. To reflect this, the 2 OU criterion has been applied to receptors at residential land uses (as is commonly required by NSW EPA) and 7 OU at industrial receptor locations. 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). Therefore, the Odour Technical Framework (DECC, 2006) recommends that, as a design goal, no individual be exposed to ambient odour levels of greater than 7 OU. It is therefore appropriate for the benchmark to be set at this level across the commercial / industrial land uses.

It is noted that the level of odour performance at the Proposal site is significantly better than currently operated at SBA Smithfield and Blacktown, by way of more kitchen odour being controlled through waste heat boilers, and the installation of newer plant on some lines. It is noted that between July 2014 to September 2020, the Blacktown facility received only three odour complaints over that 6-year period and investigation of these complaints found that only one may have been directly associated with the facility (GHD, 2020).

It is therefore considered that the risk of off-site offensive odour is unlikely, however a range of odour monitoring and management measures are proposed in **Section 8.3**.

8.3. Recommendations

8.3.1. Construction Phase

The site-specific management measures outlined in **Section 8.1.2** identify a number of monitoring methods to reduce air quality impacts experienced by proximate receptors. These methods are listed below:

- Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to visibly observe dust levels, record inspection results, and make the log available to the local authority upon request. This should include periodic inspection of dust soiling on off-site surfaces such as street furniture, cars and windowsills within 100 m of site boundary.
- Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to Council when requested.
- Increase the frequency of site inspections by the nominated accountable person when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Record all inspections of haul routes and any subsequent action in a site logbook.
- 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.
- 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 logbook.

8.3.2. Operational Phase

This AQIA has utilised process-specific emissions data measured at the SBA Smithfield and Blacktown operations. Where relevant, those data have been adopted for the comparable processes at the Proposal site, and where insufficient data is held by the Applicant to quantify emissions, advice has been taken to establish conservative equivalence to fill any data gaps.

It is therefore recommended that DPIE consider a recommendation to impose a Condition for the Applicant to perform an emission testing program in accordance with the requirements of the EPL which will be required for the Proposal site. It is recommended that this would include periodic testing of:

- odour emissions from the various commercial kitchen processes;
- odour emissions from the WWTP components and odour control efficacy testing of the OCU; and
- nitrogen dioxide emissions testing from the 2 no. 2 MW gas-fired condensing boilers.

It is recommended that the emissions testing program is commissioned and performed within the first three months of operation (post-commissioning).

It is further recommended that the emission testing reports are reviewed by a suitably qualified and experienced reviewer, and a clear summary is provided to DPIE, including a comparison of measured emission rates with those assumed in this AQIA. If there is significant variation, it is recommended that a further AQIA is performed to re-evaluate performance and provide additional recommendations for emission control if required.

A range of additional recommendations relating to air emission control are proposed, including:

- **Operational Environmental Management Plan**: The Applicant is recommended to develop an Operational Environmental Management Plan (OEMP) to address air emissions (including odour) with commitments for routine inspection of the LEV, fans and waste heat boiler operation to ensure adequate odour control is maintained
- **Daily odour observations**: Perform and record daily fence-line odour observations at relevant downwind boundary locations for at least the first three months of operation to ensure adequate odour control is achieved, and implement a management plan to manage any identified offensive odour;
- **Odour complaint procedure**: The Applicant should maintain and operate an environmental complaint procedure that includes suitable provision to record details of any odour complaints. The odour complaint procedure and associated complaint forms will be maintained in a proper fashion by management and will be made available for inspection by DPIE upon request. An example odour complaint form is appended to this report which may be used, or adapted for that purpose as required; and
- **No vehicle idling policy**: The Applicant should adopt a 'no idling' policy of all delivery vehicles at the Proposal site to minimise the potential of exhaust emissions from delivery vehicles.

8.4. Conclusions

Northstar Air Quality was engaged by Snack Brands Australia, to perform an AQIA for the construction and operation of a foods manufacturing warehouse.

Construction phase activities will involve earthworks, construction works and associated vehicle traffic. The associated risks of impacts from earthworks, construction, track-out and construction traffic have been assessed using the published guidance in *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM) and adapted by Northstar Air Quality for use in Australia. This methodology has been used in a similar context in numerous other similar AQIA studies.

That assessment showed there to be a high risk of dust soiling and health impacts during all construction activity. Based upon that assessment, a range of mitigation measures are recommended to ensure that short-term impacts associated with construction activities are minimised. Furthermore, the assessment has assumed that construction activities across the entire Proposal site would be performed at one time, where in reality the construction activities may be staged.

The operational phase impact assessment has been performed using process-specific emission measurements measured at existing operations at SBA Smithfield and Blacktown and applied to the proposed activities at the Proposal site.

The assessment has been performed in accordance with the Approved Methods (NSW EPA, 2016) and associated guidance (DECC, 2006) as required by the SEARs (see **Table 1**).

The assessment does not predict any non-compliance (exceedance) of the relevant impact assessment criteria at any identified receptor location.

A range of management and control measures have been recommended including a recommendation for an emissions monitoring program to measure emissions at the Proposal site within three months of operating, and also to implement a series of additional controls to offer effective air quality management.

9. REFERENCES

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Appendix A

Meteorology

As discussed in **Section 4.2** the meteorology surrounding the Proposal site has been observed to characterise the existing conditions of the area. The meteorological monitoring has been based on measurements taken at a number of surrounding automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM).

A summary of the relevant monitoring sites is provided in **Table A1** and also displayed in **Figure A1**.

Table A1 Details of the meteorological monitoring surrounding the Proposal site

Site Name	Approximate Location (UTM)		Approximate Distance
	mE	mS	km
Horsley Park Equestrian Centre AWS - Station # 67119	301 708	6 252 298	7.9
Badgerys Creek AWS - Station # 67108	289 907	6 246 949	9.1
Penrith Lakes AWS – Station # 67113	284857	6 266 521	14.8

Figure A1 Location AWS relevant to the Proposal site

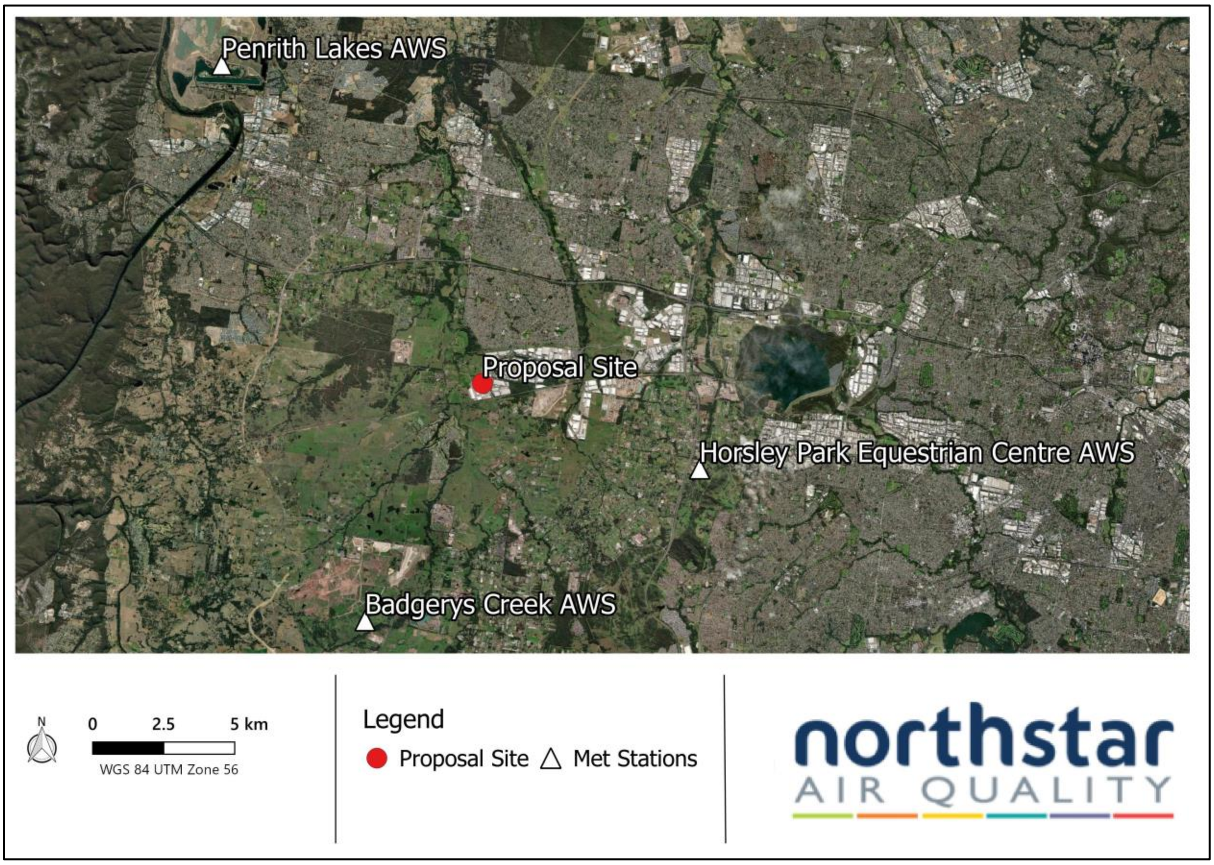
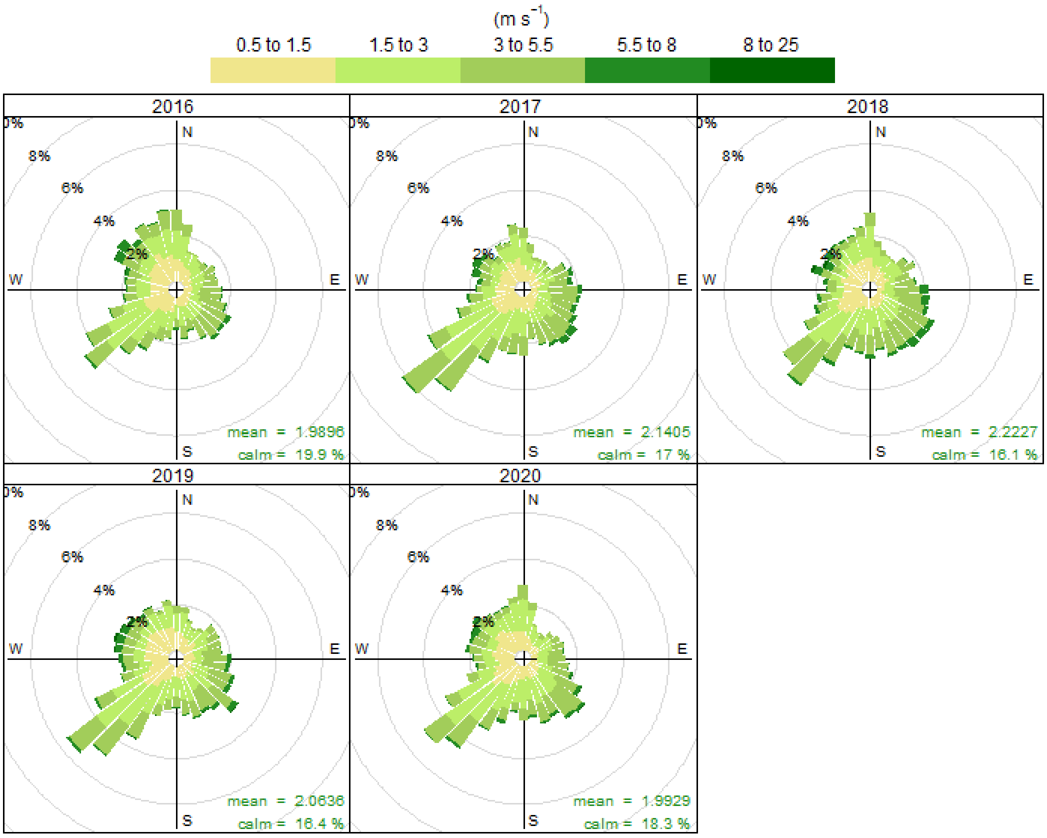


Image courtesy of Google Earth

Meteorological conditions at Horsley Park Equestrian Centre AWS was chosen for further investigation due to its location relative to the Proposal site. This site has been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent 5 years of data (2016 to 2020) are presented in **Figure A2.**

Figure A2 Annual wind roses 2016 to 2020, Horsley Park Equestrian Centre AWS



Frequency of counts by wind direction (%)

The wind roses indicate that from 2016 to 2020, winds at Horsley Park Equestrian Centre AWS show similar patterns across the years, with a predominant south-easterly wind direction.

The majority of wind speeds experienced at the Horsley Park Equestrian Centre AWS between 2016 and 2020 are generally in the range 1.5 meters per second ($m{\cdot}s^{-1}$) to 5.5 $m{\cdot}s^{-1}$ with the highest wind speeds (greater than 8 $m{\cdot}s^{-1}$) occurring from south-easterly, south-westerly and north-westerly directions. Winds of this speed are rare and occur during 0.3 % of the observed hours during the years. Calm winds (<0.5 $m{\cdot}s^{-1}$) prevail and occur more than 18 % of hours across the years.

Given the similarities in the wind distribution across the years examined, data for the year 2017 has been selected for further assessment. Presented in **Figure A3** are the annual wind rose for the 2016 to 2020 period and the year 2017 and in **Figure A4** the annual wind speed distribution for Horsley Park Equestrian Centre AWS. These figures indicate that the distribution of wind speed and direction in 2017 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2017 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure A1 Annual wind roses 2016 to 2020, and 2017 Horsley Park Equestrian Centre AWS

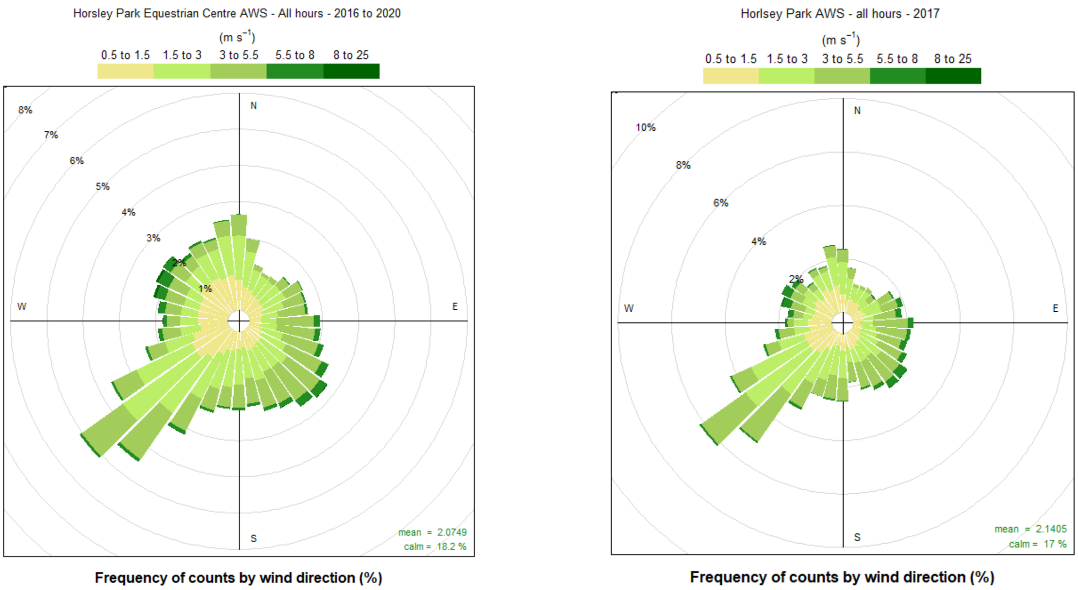
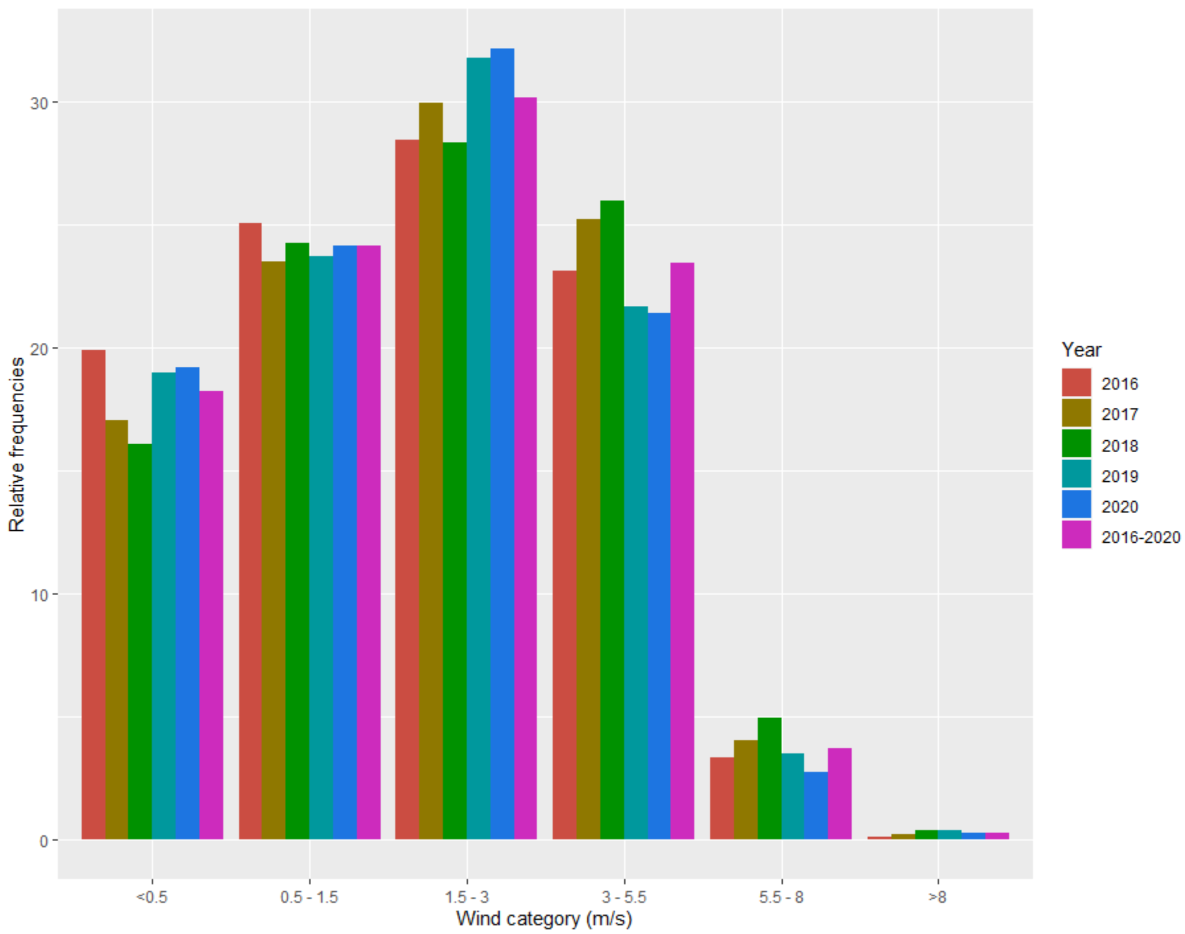


Figure A2 Annual wind speed distribution 2016 to 2020, Horsley Park Equestrian Centre AWS



Meteorological Processing

The BoM and DPIE data adequately addresses the issues of data quality assurance, however it is limited by its location compared to the Proposal site. To address these uncertainties, a multi-phased assessment of the meteorology data has been performed.

In absence of any measured onsite meteorological data, site representative meteorological data for this proposal was generated using the TAPM meteorological model in a format suitable for using in the CALPUFF dispersion model.

Meteorological modelling using The Air Pollution Model (TAPM, v 4.0.5) has been performed to predict the meteorological parameters required for CALPUFF. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a prognostic model which may be used to predict three-dimensional meteorological data and air pollution concentrations.

TAPM 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.

The parameters used in TAPM modelling are presented in **Table A2**.

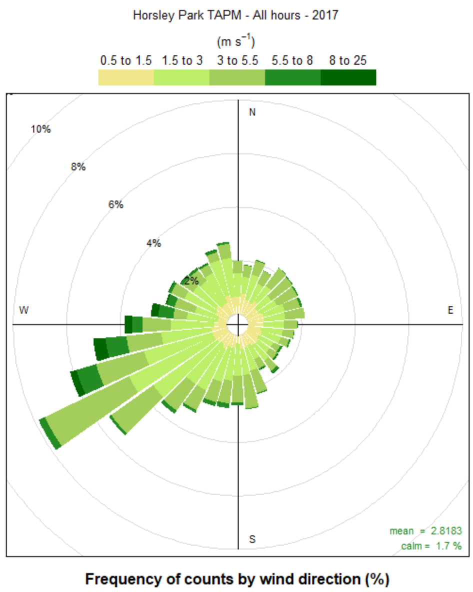
Table A2 Meteorological parameters used for this study

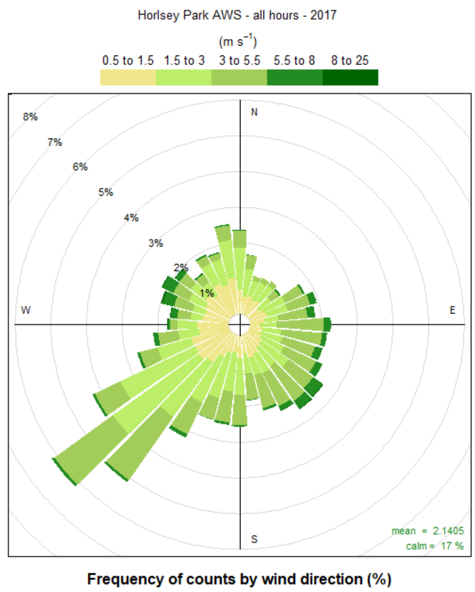
TAPM v 4.0.5	
Modelling period	1 January 2017 to 31 December 2017
Centre of analysis	295,708 mE, 6,251,357 mN (UTM Coordinates)
Number of grid points	25 × 25 × 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	-

A comparison of the TAPM generated meteorological data, and that observed at the Horsley Park Equestrian Centre AWS, is presented in **Figure A5**.

Figure A5 Modelled and observed meteorological data – Horsley Park Equestrian Centre 2017

TAPM generated windrose	Observations at Horsley Park Equestrian Centre AWS



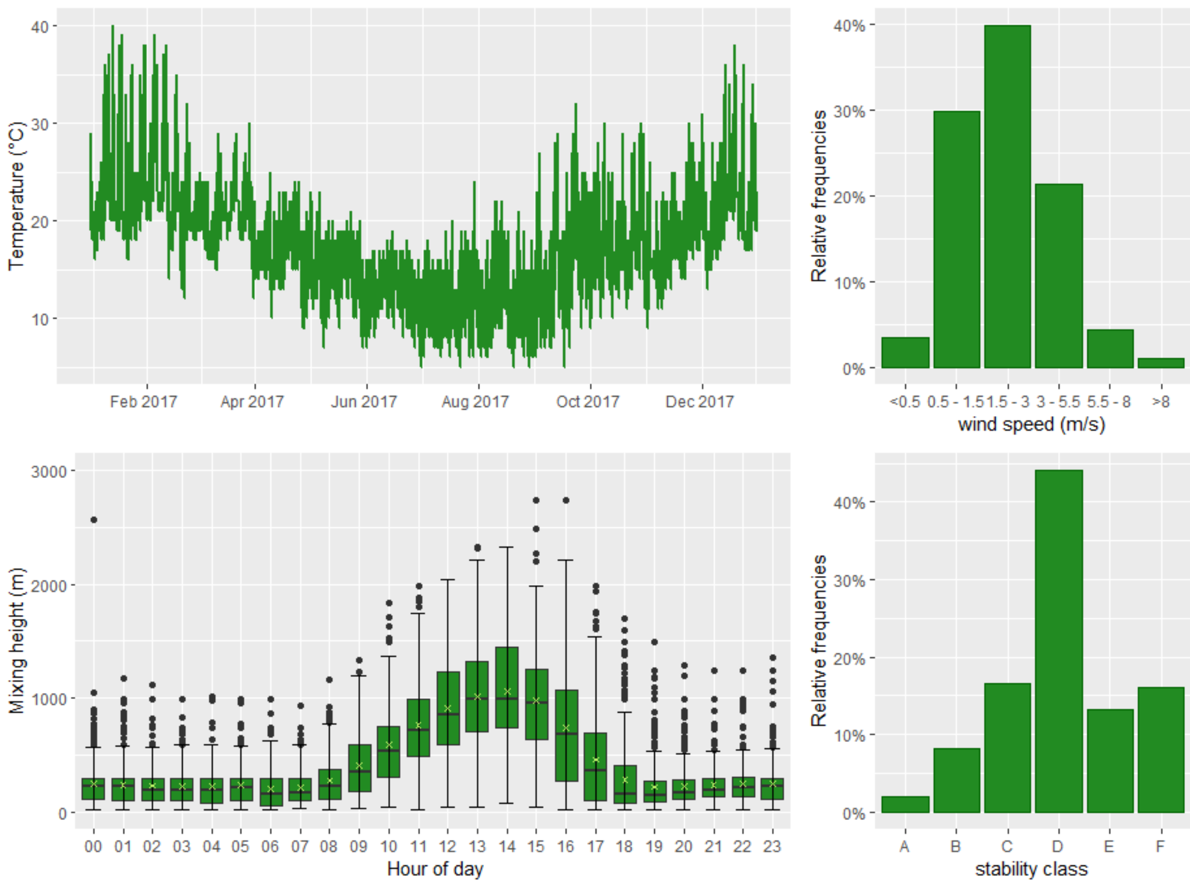


As generally required by the NSW EPA the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Proposal site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirculation potential of the Proposal site has not been provided. Details of the predictions of wind speed and direction, mixing height and temperature at the Proposal site are provided in **Figure A6**.

As expected, an increase in 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 growth of the convective mixing layer.

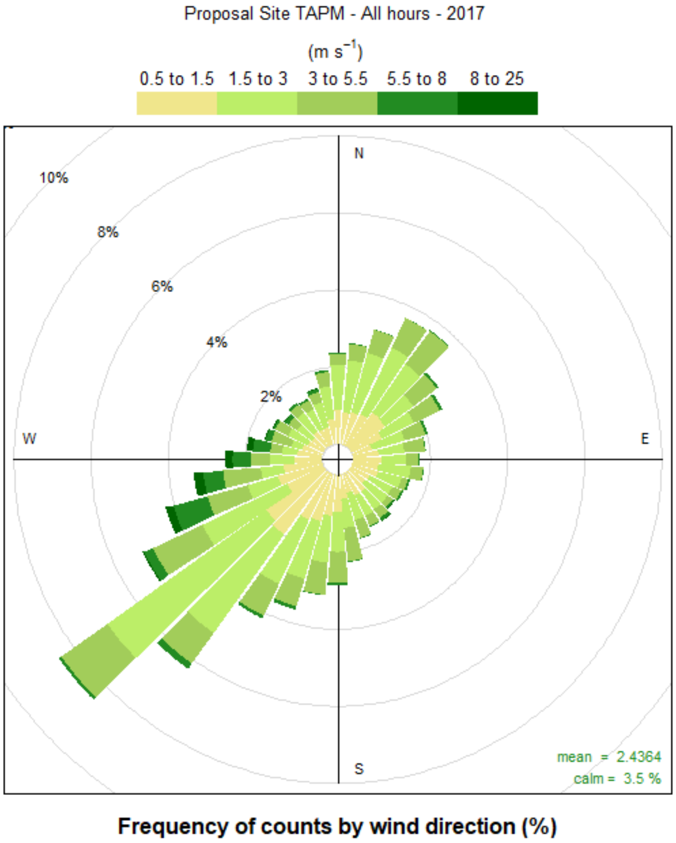
The modelled temperature variations predicted at the Proposal site during 2017 are presented in **Figure A6**. The maximum temperature of 40°C was predicted on 13 January 2017 and the minimum temperature of 5°C was predicted on 20 August 2017.

Figure A6 Annual temperature, mixing height and wind speed distribution – Proposal site 2017



The modelled wind speed and direction at the Proposal site during 2017 are presented in **Figure A7**.

Figure A7 Predicted wind speed and direction – Proposal site 2017



Appendix B

Background Air Quality Data

Determination of data to be used as a location representative of the Proposal site and during a representative year can be complicated by factors which include:

- the sources of air pollutant emissions around the Proposal site and representative AQMS; and
- the variability of particulate matter concentrations (often impacted by natural climate variability).

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPIE) at three air quality monitoring station (AQMS) within a 14 km radius of the Proposal site. Details of the monitoring performed at these AQMS is presented in **Table B1**.

Table B1 Details of closest AQMS surrounding the site

AQMS Location	Data Availability	Distance to Site (km)	Screening Parameters				
			2017 Data	Measurements			
				PM_{10}	$PM_{2.5}$	TSP	NO_2
St Marys	1992 - 2020	2.8	✓	✓	✓	×	✓
Bringelly	1992 - 2020	10.6	✓	✓	✓	×	✓
Prospect	2007 - 2020	13.0	✓	✓	✓	×	✓
Blacktown (Decommisioned)	Decommissioned	13.2	×	×	×	×	×

Based on the sources of AQMS data available and their proximity to the Proposal site, St Marys was selected as the source of air quality data for use in this assessment.

Summary statistics are for $PM_{10,}$ $PM_{2.5}$ and NO_2 data for the site for the year 2017 (consistent with the selected meteorological period) are presented in **Table B2**.

Note: data for PM_{10} and $PM_{2.5}$ are provided for context only.

The hourly varying NO_2 data recorded at St Marys in 2017 is presented in **Figure B2**.

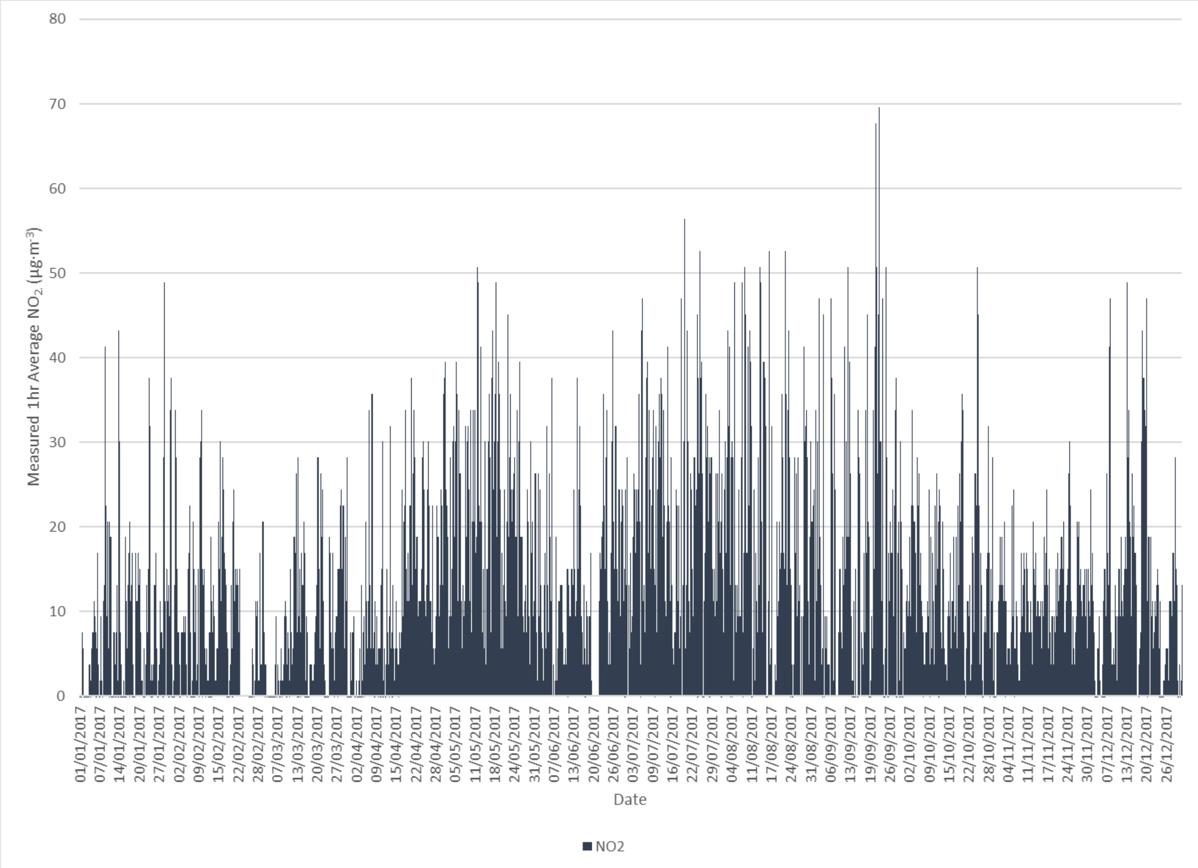
Table B2 Summary of Background Air Quality Data (St Marys 2017)

Pollutant	PM_{10} (µg·m^{-3})	$PM_{2.5}$ (µg·m^{-3})	NO_2 (µg·m^{-3})
Averaging Period	24-Hour	24-Hour	1-Hour
Data Points (number)	360	360	8141
Mean	16.2	7.0	8.0
Standard Deviation	7.0	4.1	9.1
Skew[1]	*+1.1*	*+2.9*	*+1.6*
Kurtosis[2]	*+1.7*	*+13.8*	*+3.7*
Minimum	4.0	1.2	-3.8
Percentiles (µg·m^{-3})			
1	5.3	1.8	-3.8
5	7.6	2.9	-1.9
10	8.9	3.3	0.0
25	11.5	4.6	1.9
50	14.6	6.2	5.6
75	20.0	8.3	11.3
90	26.1	10.7	20.7
95	29.5	12.8	26.3
97	32.6	17.0	30.1
98	34.5	21.1	33.8
99	35.7	23.9	39.5
Maximum	49.8	38.2	69.6
Data Capture (%)	98.63%	98.63%	92.93%

Notes: **1:** Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.

2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Figure B2 NO2 Measurements, St Marys 2017



Appendix C

Construction Phase Risk Assessment Methodology

Provided below is a summary of the risk assessment methodology used in this assessment. It is based upon IAQM (2016) *Guidance on the assessment of dust from demolition and construction* (version 1.1), and adapted by Northstar Air Quality.

Adaptions to the Published Methodology Made by Northstar Air Quality

The adaptions made by Northstar Air Quality from the IAQM published methodology are:

- **PM_{10} criterion:** an amended criterion representing the annual average PM_{10} criterion relevant to Australia rather than the UK;
- **Nomenclature:** a change in nomenclature from “receptor sensitivity” to “land use value” to avoid misinterpretation of values attributed to “receptor sensitivity” and “sensitivity of the area” which may be assessed as having different values;
- **Construction traffic:** the separation of construction vehicle movements as a discrete risk assessment profile from those associated with the ‘on-site’ activities of demolition, earthworks and construction. The IAQM methodology considers four risk profiles of: “demolition”, “earthworks”, “construction” and “trackout”. The adaption by Northstar Air Quality introduces a fifth risk assessment profile of “construction traffic” to the existing four risk profiles; and,
- **Tables:** minor adjustments in the visualisation of some tables.

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 would require assessments for most developments.

Step 2 – Risk from Construction Activities

Step 2 of the assessment provides “dust emissions magnitudes” for each of the dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles) and construction traffic.

The magnitudes are: Large; Medium; or Small, with suggested definitions for each category as follows:

Dust Emission Magnitude Activities

Activity	Large	Medium	Small
Demolition			
- total building volume*	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <20 000 m^3
- demolition height	• > 20m AGL	• 10 m and 20 m AGL	• <10 m AGL
- onsite crushing	• yes	• no	• no
- onsite screening	• yes	• no	• no
- demolition of materials with high dust potential	• yes	• yes	• no
- demolition timing	• any time of the year	• any time of the year	• wet months only
Earthworks			
- total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
- soil types	• potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size	• moderately dusty soil type (e.g. silt)	• soil type with large grain size (e.g. sand
- heavy earth moving vehicles	• >10 heavy earth moving vehicles active at any time	• 5 to 10 heavy earth moving vehicles active at any one time	• <5 heavy earth moving vehicles active at any one time
- formation of bunds	• >8m AGL	• 4m to 8m AGL	• <4m AGL
- material moved	• >100 000 t	• 20 000 t to 100 000 t	• <20 000 t
- earthworks timing	• any time of the year	• any time of the year	• wet months only
Construction			
- total building volume	• 100 000 m^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
- piling	• yes	• yes	• no
- concrete batching	• yes	• yes	• no
- sandblasting	• yes	• no	• no
- materials	• concrete	• concrete	• metal cladding or timber
Trackout (within 100 m of construction site entrance)			
- outward heavy vehicles movements per day	• >50	• 10 to 50	• <10
- surface materials	• high potential	• moderate potential	• low potential
- unpaved road length	• >100m	• 50m to 100m	• <50m

Activity	Large	Medium	Small
Construction Traffic (from construction site entrance to construction vehicle origin)			
Demolition traffic - total building volume	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <10 000 m^3
Earthworks traffic - total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
Earthworks traffic - soil types	• potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size	• moderately dusty soil type (e.g. silt)	• soil type with large grain size (e.g. sand)
Earthworks traffic - material moved	• >100 000 t	• 20 000 t to 100 000 t	• <20 000 t
Construction traffic - total building volume	• 100 000 m^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
Total traffic - heavy vehicles movements per day when compared to existing heavy vehicle traffic	• >50% of heavy vehicle movement contribution by Proposal	• 10% to 50% of heavy vehicle movement contribution by Proposal	• <10% of heavy vehicle movement contribution by Proposal

Step 3 – Sensitivity of the Area

Step 3 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 land use values have to dust deposition and human health impacts;
- The proximity and number of those receptors locations;
- In the case of PM10, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Land Use Value

Individual receptor locations may be attributed different land use values based on the land use of the land, and may be classified as having high, medium or low values relative to dust deposition and human health impacts (ecological receptors are not addressed using this approach).

Essentially, land use value is a metric of the level of amenity expectations for that land use.

The IAQM method provides guidance on the land use value with regard to dust soiling and health effects and is shown in the table below. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

IAQM Guidance for Categorising Land Use Value

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
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). *Examples: Residential properties, hospitals, schools and residential care homes.*	• 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). *Examples: Office and shop workers, but would generally not include workers occupationally exposed to PM_{10}.*	• Locations where human exposure is transient. *Examples: Public footpaths, playing fields, parks and shopping street.*

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
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. *Examples: Dwellings, museums, medium and long term car parks and car showrooms.*	• 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. *Examples: Parks and places of work.*	• 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: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*

Sensitivity of the Area

The assessed land use value (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 would take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Sensitivity of the Area - Health Impacts

For high land use values, the method takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account, and professional judgement may be used to determine alternative sensitivity categories, taking into account the following:

- 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 / seasonal meteorological data;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Land Use Value	Annual Mean PM_{10} Concentration ($\mu g \cdot m^{-3}$)	Number of Receptors[a]	Distance from the Source (m)[b]				
			<20	<50	<100	<200	<350
High	>30	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	26 – 30	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	22 – 26	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	≤22	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Note: (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. In the case of high sensitivity areas 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.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Sensitivity of the Area - Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in the table below

IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Land Use Values	Number of receptors[a]	Distance from the source (m)[b]			
		<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: (a) Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Step 4 - Risk Assessment (Pre-Mitigation)

The matrices shown for each activity determine the risk category with no mitigation applied.

Risk of dust impacts from demolition activities

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Demolition**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Risk of dust impacts from earthworks

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Earthworks**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from construction activities

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Construction**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from trackout (within 100m of construction site entrance)

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Trackout**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from construction traffic (from construction site entrance to origin)

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Construction Traffic**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 5 – Identify 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.

The identified mitigation measures are presented as follows:

- **N** = not required (although they may be implemented voluntarily)
- **D** = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided);
- **H** = highly recommended (to be implemented as part of the CEMP, and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The table below presents the complete mitigation table, not that assessed as required for any specific project or activity:

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
1	Communications			
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N	H	H
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	H	H
1.2	Display the head or regional office contact information.	H	H	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D	H	H
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	H	H
2.2	Make the complaints log available to the local authority when asked.	H	H	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	H	H
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N	N	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
3	Monitoring			
3.1	Undertake 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 100m of site boundary.	D	D	H
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked.	H	H	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	H	H
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	N	H	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	H	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	H	H	H
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	D	H	H
4.4	Avoid site runoff of water or mud.	H	H	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D	H	H
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	D	H	H
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D	H	H
5	Operating Vehicle/Machinery and Sustainable Travel			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H	H	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H	H	H
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
5.4	Impose and signpost a maximum-speed-limit of 25 km·h^{-1} on surfaced and 15 km·h^{-1} on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	D	D	H
5.4	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N	H	H
5.5	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N	D	H
6	**Operations**			
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	H	H	H
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	H	H	H
6.3	Use enclosed chutes and conveyors and covered skips	H	H	H
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	H	H	H
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D	H	H
7	**Waste Management**			
7.1	Avoid bonfires and burning of waste materials.	H	H	H
8	**Measures Specific to Demolition**			
8.1	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	D	H
8.2	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	H	H
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H	H	H
8.4	Bag and remove any biological debris or damp down such material before demolition.	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N	D	H
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N	D	H
8.7	Only remove the cover in small areas during work and not all at once	N	D	H
9	Measures Specific to Construction			
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	D	D	H
9.2	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	H	H
9.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	H
9.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	N	D	D
10	Measures Specific to Track-Out			
10.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D	H	H
10.2	Avoid dry sweeping of large areas.	D	H	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H	H	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	H	H
10.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	N	H	H
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D	H	H
10.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	N	H	H
10.9	Access gates to be located at least 10 m from receptors where possible.	N	H	H
11	Specific Measures to Construction Traffic (adapted)			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H	H	H

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	H
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	H	H
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H	H	H
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	H	H

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

The objective of the mitigation is to manage the construction phase risks to an acceptable level, and therefore it is assumed that application of the identified mitigation would result in a *low* or *negligible* residual risk (post mitigation)

Appendix D

Example Odour Complaint Record

Complainant Contact Details			
Date and time complaint received			
Contact details for complainant			
Complaint Details			
Date and time start	/ / : am|pm		
Date and time stop	/ / : am|pm		
Location(s) of the odour			
Description of the odour			
Persistence *see note 1*	☐ Constant ☐ Intermittent		
Intensity (odour) *see note 2*	☐ 6 extremely strong	☐ 4 strong	☐ 2 weak
☐ generally ☐ at its worst	☐ 5 very strong	☐ 3 distinct	☐ 1 very weak
Prevailing weather conditions at the time of the complaint			
General description (dry, rain, windy, still etc)			
Temperature			
General wind direction *see note 3*			
General wind strength *see note 4*			
Operational details, actions, resolution			
Operations during complaint			
Identified causes			
Actions taken			
Cause resolved	☐ Yes ☐ No		
Follow up required	☐ Yes ☐ No		
Complainant informed of outcome	☐ Yes ☐ No		
Signed			
Date	/ /		

Notes

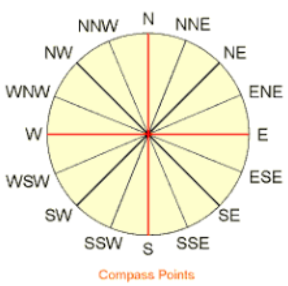
1. Persistence. Please record the descriptor that best describes the extent of the observation:

- Constantly: air quality impact was observed virtually constantly between the stated start and stop times
- Intermittently: odour was observed intermittently between the stated start and stop times

2. Odour Intensity. Using the scale below, estimate how intense the odour was generally or at its worst (as appropriate)

6	**Extremely strong:** Overpowering odour triggering a physical reaction (i.e. gaging, eyes watering etc.) or an involuntary action (i.e. turning away from odour, covering nose etc.).	3	**Distinct:** Mid way between a weak and strong odour, this is a clearly defined odour, immediately recognisable and tolerable.
5	**Very strong:** A strong odour that may initiate an involuntary action that you subsequently control. Odour is barely tolerable and exposure is uncomfortable	2	**Weak:** This is a clearly defined odour (i.e. without uncertainty/guessing), immediately recognisable but not yet strong enough to be considered distinct and readily tolerable.
4	**Strong:** A clearly defined odour that is immediately recognisable and is tolerable but mildly uncomfortable.	1	**Very weak:** A very faint odour. The VDI definition of a very weak odour requires the odour to be clearly defined without uncertainty or guessing involved.

3. Wind Direction.



4. Wind Strength

0	Calm	Calm. Smoke rises vertically
1	Light air	Wind motion visible on smoke
2	Light breeze	Wind felt on exposed skin. Leaves rustle.
3	Gentle breeze	Leaves and smaller twigs in constant motion
4	Moderate breeze	Dust and loose paper raised. Small branches move
5	Fresh breeze	Moderate branches move. Small trees begin to sway.
6	Strong breeze	Large branches in motion. Overhead wires whistle. Umbrella use is difficult. Empty rubbish bins tip.
7+	Near gale	Wind effects greater than above

Appendix E

Emission Estimation

Table D1: Commercial Kitchen Emission Estimation

ID	HX	Location		Process		Measured								Specification			As modelled		
						Conc.	Flow		Velocity	CSA	ID	OER	Temp	Velocity	OER	Temp	OER	Velocity	ID
		mE	mS	Name	Equivalence	OU	$m^3.min^{-1}$	$m^3.s^{-1}$	$m.s^{-1}$	m^2	m	$OU.min^{-1}$	degC	$m.s^{-1}$	$OU.min^{-1}$	degC	$OU.s^{-1}$	$m.s^{-1}$	m
1	1	294,034	6,255,223	UPC 4	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
2	1	294,034	6,255,223	UPC 3	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
3	2	294,042	6,255,201	UPC 2	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
4	3	294,084	6,255,209	UPC 1/3	upc-1	8800	14	0.233	4.8	0.049	0.249	123333	91	8.0	n/a	91	4728	8.0	0.33
5	4	294,045	6,255,195	UPC 2/3	upc-1	8800	14	0.233	4.8	0.049	0.249	123333	91	8.0	n/a	91	4728	8.0	0.33
6	5	294,045	6,255,195	UPC 3/3	upc-1	8800	14	0.233	4.8	0.049	0.249	123333	91	8.0	n/a	91	4728	8.0	0.33
7	6	294,081	6,255,171	Jumpys	kf-3	6565	15	0.250	4.5	0.056	0.266	97800	58	8.0	n/a	58	3749	8.0	0.20
8	7	294,049	6,255,268	Corn 1 EIT	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
9	8	294,049	6,255,268	Corn 2 1070	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
10	9	294,029	6,255,245	PC 50	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
11	10	294,069	6,255,163	Pellet	upc-2	949	114	1.898	13.9	0.136	0.416	110780	158	13.5	22000	170	843	13.5	0.42
12	Nil	294,079	6,255,163	Cereal oven 1	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03
13	Nil	294,079	6,255,163	Cereal oven 2	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03
14	Nil	294,044	6,255,275	Corn oven 1	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03
15	Nil	294,057	6,255,282	Corn oven 2	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03
16	Nil	294,039	6,255,206	Starch dryer 1	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03
17	Nil	294,045	6,255,207	Starch dryer 2	oven	240	0.28	0.005	2.5	0.002	0.049	3700	301	8.0	n/a	301	142	8.0	0.03

Note: 1 where OER exceeds the plant specification (see **Figure 4**), the plant specification data has been applied.

2 P/M60 factor of 2.3 applied to the "as modelled" OER

Figure 4: Summary of measured verses specification parameters for PC-42 and UPC-2 (Blacktown) (GHD,2020, table 3-3) (see **Section 2.3.3**)

Data source	Velocity (m/s)	Odour emission rate (OU/min)	Temperature (C)
PC-42			
Average of sampling data	6.3	194,328	135
Specification	6.1	46,440	150
UPC-2			
Average of sampling data	13.9	110,780	158
Specification	13.5	22,000	170

Table D2: Boiler Emissions

ID	Location		Flow			Temp	Conc		ER	Velocity	CSA
	mE	mS	SCFM	$Nm^3.min^{-1}$	$Am^3.s^{-1}$	degC	ppm	$mg.Nm^{-3}$	$g.s^{-1}$	$m.s^{-1}$	m^2
18	294005	6255183	1272	33.185	0.938	190	30	61.6	0.034	9.4	0.36
19	294005	6255183	1272	33.185	0.938	190	30	61.6	0.034	9.4	0.36

Table D3: WWTP Emissions

ID	Location		Type	Name	Area	OER_u		CF	OER_c	Velocity	CSA	ID
	mE	mS			m^2	$OU.m^2.min^{-1}$	$OU.min^{-1}$	%	$OU.s^{-1}$	$m.s^{-1}$	m^2	m
20	293968	6255203	area	Balance tank	57	27	1539	n/a	n/a	n/a	n/a	n/a
21	293974	6255188	area	Settling tank 1	6.2	27	167	n/a	n/a	n/a	n/a	n/a
22	293979	6255171	area	Settling tank 2	6.2	27	167	n/a	n/a	n/a	n/a	n/a
23	293985	6255152	area	Settling tank 3	6.2	27	167	n/a	n/a	n/a	n/a	n/a
24	293991	6255134	vol	DAF	16	29	464	n/a	n/a	n/a	n/a	n/a
25	293991	6255134	point	WWTP	n/a	n/a	2504	90%	9.6	10.0	0.008	0.1

Note: 1 P/M60 factor of 2.3 applied to the "as modelled" OER

2 OERu (uncontrolled odour emission rate). OERc (controlled odour emission rates).

Appendix F

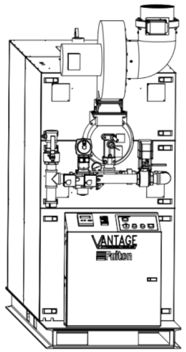
Boiler Specifications

Fulton

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000



Standard Controls and Features

- Fully Condensing Ultra-High Efficiency Design
- Suitable for Variable Primary Applications
- 160 PSIG Maximum Allowable Working Pressure
- 210°F Maximum Allowable Working Temperature
- Factory Recommended Maximum Setpoint 190°F
- Direct Spark Ignition
- UV Flame Scanner
- Industrial Power Burner
- LMV3 Linkageless Burner Management System
- SKP25 Combination Gas Valve & Regulator
- Temperature Load Controller
- Low Water Cut Off Probe with Manual Reset
- High and Low Gas Pressure Switches
- NEMA 1 Enclosure and Electrical Panel
- Automatic Reset High Limit Aquastat
- Manual Reset High Limit Aquastat (200°F Max)
- Outlet Water Temperature Sensor
- Ventless Gas Train Utilizing Vent Limiters
- 120VAC Controls Circuit Transformer
- Emergency Stop (E-Stop) Contacts

Trim Kit Items (Shipped Loose)

- ASME Safety Relief Valve (60, 100, 125, 160 PSIG Options)
- Pressure & Temperature Gauge
- Installation and Operation Manual
- Touch Up Spray Paint
- Rubber Air Intake Coupling
- Socket and Adapter (One Per Project)

Listings & Compliance

- ASME Section IV Code, "H" Stamp
- UL-795 Certified
- CSD-1 & CSA Controls and Fuel Train
- XL GAPS Compliant, Supersedes IRI
- FM Compliant Fuel Train Components
- AHRI Certified to BTS-2000
- Control Panel Wired in a UL 508 Facility

Factory Installed Options

- ☐ Modbus Communication Protocol
- ☐ BACnet Integration
- ☐ LonWorks Integration
- ☐ Locking Electrical Panel Door
- ☐ Dual Fuel Natural Gas & Propane Capability
- ☐ NFPA 85 Gas Train
- ☐ Second Low Water Cut Off
- ☐ Alarm Horn and Silence Switch
- ☐ External Device Safety Interlock
- ☐ General Alarm Relay
- ☐ Isolation Valve Control Relay
- ☐ Circulator Control Relay
- ☐ Boiler Status Relay
- ☐ Boiler Start/Stop Relay

Field Installed Options

- ☐ Multiple Boiler Condensate Drain Trap
- ☐ Single Boiler Condensate Drain Trap
- ☐ Condensate pH Neutralization Kit
- ☐ 120VAC Motorized Isolation Valve Relay for Variable Primary Systems
- ☐ Second Low Water Cut Off
- ☐ Fused External Disconnect

Information provided in this document is based on standard boiler configurations. Alternate or custom configurations may result in deviations. Due to continuous product improvement, Fulton reserves the right to change specifications and/or dimensions without notice.

Fulton

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000

Capacities
(Applies to elevations up to 2,000 ft)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Rated Input at High Fire	BTU/hr	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000
	kW	586	879	1,172	1,465	1,758
Rated Output (BTS-2000)	BTU/hr	1,918,000	2,889,000	3,876,000	4,630,000	5,640,000
	Boiler HP	57	86	116	138	168
	kW	562	847	1,136	1,357	1,653
AHRI Thermal Efficiency	%	95.7	96.3	96.9	92.6	94.0

Note: Capacities listed are for Standard Natural Gas. Fully modulating burner; turndown ratio up to 5:1 on Natural Gas; up to 3:1 on HD5 Propane.

Connection Sizes
(Reference End Assembly Drawing for Connection Type)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Boiler Supply Water Outlet	inches	4	4	6	6	6
	mm	101.6	101.6	152.4	152.4	152.4
Boiler Return Water Inlet	inches	4	4	6	6	6
	mm	101.6	101.6	152.4	152.4	152.4
Flue Gas Condensate Drain	inches	1	1	1	1	1
	mm	25.4	25.4	25.4	25.4	25.4
Boiler Pressure Vessel Drain	inches	2	2	2	2	2
	mm	51	51	51	51	51
Natural Gas Train Inlet	inches	1-1/2	2	2	2-1/2	2-1/2
	mm	38.1	51	51	63.5	63.5
Combustion Air Inlet (ID)	inches	8	10	12	12	12
	mm	203	254	305	305	305
Flue Gas Exhaust (ID)	inches	10	12	14	14	14
	mm	254	305	356	356	356

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000

Weights and Volume (Typical for standard equipment)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Dry Weight	lbs	3,800	5,300	6,600	6,900	10,800
	kg	*1,724*	*2,404*	*2,994*	*3,130*	*4,899*
Operating Weight	lbs	5,100	7,100	8,900	9,200	14,800
	kg	*2,314*	*3,221*	*4,037*	*4,173*	*6,713*
Shipping Weight	lbs	4,250	5,825	7,200	7,475	11,500
	kg	*1,928*	*2,642*	*3,266*	*3,391*	*5,216*
Pressure Vessel Water Volume	Gallons	147	215	275	275	480
	Liters	*556*	*814*	*1,041*	*1,041*	*1,817*

Water/Flow Requirements (Specifications apply to 100% water systems)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Typical Flow Rate at Rated Output 20°F ΔT	GPM	192	289	387	463	564
	LPM	*727*	*1,094*	*1,465*	*1,753*	*2,135*
Water Side Pressure Drop at Rated Output 20°F ΔT	PSI	0.9	1.0	2.6	4.8	5.6
	kPa	*6.2*	*6.9*	*17.9*	*33.1*	*38.6*
Maximum Delta-T	°F	100	100	100	100	100
	°C	*44.4*	*44.4*	*44.4*	*44.4*	*44.4*
Minimum Flow Rate (See Note)	GPM	N/A	N/A	N/A	N/A	N/A
	LPM	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*
Maximum Flow Rate (See Note)	GPM	N/A	N/A	N/A	N/A	N/A
	LPM	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

Note: A low or zero flow situation will not harm the heat exchanger or pressure vessel, however the system will require proper flow to heat the building and prevent nuisance high limit trips at the boiler.

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000

Fuel Requirements (At rated input, Natural Gas)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Natural Gas Consumption (1,000 BTU/FT^3)	SCFH	2,000	3,000	4,000	5,000	6,000
	M^3/hr	*56.6*	*85.0*	*113.3*	*141.6*	*170.0*
Minimum Natural Gas Pressure	in W.C.	14	14	14	14	18
	kPa	*3.5*	*3.5*	*3.5*	*3.5*	*4.4*
Maximum Natural Gas Pressure	in W.C.	42	42	42	42	42
	kPa	*10.5*	*10.5*	*10.5*	*10.5*	*10.5*

Fuel Requirements (At rated input, Propane)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Propane Consumption (2,500 BTU/FT^3)	SCFH	800	1,200	1,600	2,000	2,400
	M^3/hr	*22.7*	*34.0*	*45.3*	*56.6*	*68.0*
Minimum Propane Pressure	in W.C.	17	17	17	17	28
	kPa	*4.2*	*4.2*	*4.2*	*4.2*	*6.9*
Maximum Propane Pressure	in W.C.	28	28	28	28	42
	kPa	*7.0*	*7.0*	*7.0*	*7.0*	*10.5*

Note: Vantage boilers are factory configured for fuel type. Consult your local Fulton Representative for information.

Electrical Requirements (Applies to standard configuration)

Vantage Model		VTG-2000			VTG-3000			VTG-4000			VTG-5000			VTG-6000		
Electrical Supply	volts	208	230	460	208	230	460	208	230	460	208	230	460	208	230	460
	Ø	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Hz	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*	*60*
Full Load Amps (FLA)	Amps	13	10	5	16	13	7	22	19	10	29	26	13	29	26	13
Blower Motor	HP		2			3			5			7.5			7.5	

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000

Venting Requirements

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Combustion Air Intake Flow Rate	SCFM	391	587	782	978	1,173
Flue Gas Exhaust Flow Rate	SCFM	424	636	848	1,060	1,272
	ACFM	*563*	*838*	*1,117*	*1,407*	*1,688*
Minimum Allowable Draft Pressure	in WC	-0.04	-0.04	-0.04	-0.04	-0.04
	kPa	*-0.010*	*-0.010*	*-0.010*	*-0.010*	*-0.010*
Maximum Allowable Draft Pressure	in WC	+0.35	+0.35	+0.35	+0.35	+0.35
	kPa	*+0.087*	*+0.087*	*+0.087*	*+0.087*	*+0.087*

Note: Reference the Installation and Operation Manual for complete venting requirements including certifications, temperatures, materials, common combustion air intake, and common flue gas exhaust requirements. Data based on Natural Gas operation.

Emissions

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
NO_x	ppm	< 100	< 100	< 100	< 100	< 30
CO_2	%	8.0 - 10	8.0 - 10	8.0 - 10	8.0 - 10	8.0 - 10
Volatile Organic Compounds (VOCs)	lb/hr	0.0110	0.0165	0.0220	0.0275	0.0330
	kg/hr	*0.0050*	*0.0075*	*0.0100*	*0.0125*	*0.0150*
CO	ppm	< 50	< 50	< 50	< 50	< 50

Notes:

- NO_x and CO are stated at a 3% O_2 correction.
- Will vary based on site specific factors and operating parameters.
- Calculations based on EPA PM10 AP42 standard.
- Emissions data is typical for standard natural gas operation. Emissions are not guaranteed on fuels other than standard natural gas.
- Site specific conditions will determine the appropriate CO_2 settings for each application.
- Jacket losses: 0.2% of output at maximum capacity, IAW ASHRAE Standard 103-2007.

Technical Data

Vantage Hydronic Condensing Boilers

Models: VTG-2000, VTG-3000, VTG-4000, VTG-5000, VTG-6000

Minimum Clearances

(Local codes may supersede Fulton requirements)

Vantage Model		VTG-2000	VTG-3000	VTG-4000	VTG-5000	VTG-6000
Front (Required)	inches	36	36	36	36	36
	mm	*914*	*914*	*914*	*914*	*914*
Rear (Recommended)	inches	24	24	24	24	24
	mm	*610*	*610*	*610*	*610*	*610*
Top (Recommended)	inches	24	24	24	24	24
	mm	*610*	*610*	*610*	*610*	*610*
Sides (Required)	inches	1	1	1	8	1
	mm	*25*	*25*	*25*	*203*	*25*