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Horsley Drive Business Park, Lot 3 Air Quality Impact Assessment

Addressee(s):	Frasers Property Industrial Constructions Pty Ltd
Report Reference:	17.1012.FR1V2
Date:	19 December 2016

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Quality Control

Study	Status	Prepared by	Checked by	Authorised by
INTRODUCTION	Final	Northstar Air Quality	GCG/PS	MD
THE PROPOSAL	Final	Northstar Air Quality	GCG/PS	MD
LEGISLATION, REGULATION AND GUIDANCE	Final	Northstar Air Quality	GCG/PS	MD
EXISTING CONDITIONS	Final	Northstar Air Quality	GCG/PS	MD
METHODOLOGY	Final	Northstar Air Quality	GCG/PS	MD
CONSTRUCTION IMPACT ASSESSMENT	Final	Northstar Air Quality	GCG/PS	MD
OPERATIONAL IMPACT ASSESSMENT	Final	Northstar Air Quality	GCG/PS	MD
GREENHOUSE GAS ASSESSMENT	Final	Northstar Air Quality	GCG/PS	MD
CONCLUSION	Final	Northstar Air Quality	GCG/PS	MD

Report Status

Northstar References		Report Status	Report Reference	Version
Year	Job Number	(Draft: Final)	(Rx)	(Vx)
17	1012	F	R1	V2
Based upon the above, the specific reference for this version of the report is:				**17.1012.FR1V2**

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.

MDoyle | **Martin Doyle** | **19 December 2016**

EXECUTIVE SUMMARY

Frasers Property Industrial Constructions Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform an air quality impact assessment and greenhouse gas assessment for the construction and operation of a proposed warehouse/distribution centre and industrial facility (The Proposal) to be located at Lot 3 of the Horsley Drive Business Park on the corner of Horsley Drive and Cowpasture Road, Wetherill Park, NSW.

As required by the Secretary's Environmental Assessment Requirements, an assessment of the air quality impacts at private properties during the construction and operation of the development has been performed.

A qualitative (risk based) assessment of the potential construction impacts has been performed which is based on an adapted UK Institute of Air Quality Management approach. This assessment has indicated that pre-mitigated risks are anticipated to be 'low' and that the application and implementation of a number of management measures would ensure that any impacts would be 'not significant'.

A quantitative dispersion modelling assessment has been performed to assess the potential impacts of the proposed operation of the Lot 3 development on the surrounding private properties. The assessment has used meteorological data and air quality data from the year 2013 to maintain consistency with a number of other air quality assessments performed at the Horsley Drive Business Park over the preceding 18 to 24 months. The assessment identified the emissions which would be likely to be due to the Proposal and those that would be likely due to all other approved Lots at the Horsley Drive Business Park.

The results of the assessment indicate that the operation of the Proposal would not result in any significant changes to the air quality environment or exceedances of air quality criteria with all relevant air quality criteria being achieved with the exception of annual average $PM_{2.5}$ concentrations. Background (i.e. existing) $PM_{2.5}$ concentrations already exceed the annual average criterion in the region and the operation of the Lot 3 development is shown to result in low (<2.5%) contributions to the criterion. The Lot 3 development would not be the major source of particulate matter in the region.

Taking into account the operation of all other Lots at the Horsley Drive Business Park which have already been approved (Lots 1, 2, 4 and 5), and with the addition of the operations at Lot 3, it has been demonstrated that these operations can be able to be performed without a detrimental impact to the air quality environment of the area. The Horsley Drive Business Park as a whole has been shown to be able to operate without any significant changes to the air quality environment or exceedances of air quality criteria, with the exception of annual average $PM_{2.5}$ concentrations. The operation of the Horsley Drive Business Park has been shown to contribute up to 8.75% of the annual average $PM_{2.5}$ criterion and is not anticipated to be a significant contributor to particulate matter concentrations in the area.

An assessment of energy use on site has indicated that this would represent <0.0001% of Australian greenhouse gas emissions in 2014. Emissions may be further minimised by introducing a number of energy efficiency measures and Frasers Property Industrial Constructions Pty Ltd is targeting six-star Green Star Design and As-Built v1.1 rating from the Green Building Council of Australia for the development, ensuring efficient energy usage.

Contents

Tables

Figures

Appendices

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed buy 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 is presented as 50 $\mu g \cdot m^{-3}$ and not 50 $\mu g/m^3$; and,
- 0.2 kilograms per hectare per hour is presented as 0.2 kg·ha-1·hr-1 and not 0.2 kg/ha/hr.

Common Abbreviations

Abbreviation	Term
ABS	Australian Bureau of Statistics
AHD	Australian height datum
AQIA	Air quality impact assessment
AQMS	Air quality monitoring station
BoM	Bureau of Meteorology
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EETM	Emission estimation technique manual
EPA	Environmental Protection Authority
GIS	Geographical information system
GHG	Greenhouse gas
HDBP	Horsley Drive Business Park
$mg{\cdot}m^{-3}$	Milligram per cubic metre of air
$mg{\cdot}Nm^{-3}$	Milligram per normalised cubic metre of air
MW	Megawatt
$\mu g{\cdot}m^{-3}$	Microgram per cubic metre of air
NCAA	National Clean Air Agreement
NEPM	National Environment Protection Measure
NO	Nitric oxide
NO_X	Oxides of nitrogen
NO_2	Nitrogen dioxide
O_3	Ozone
OEH	NSW Office of Environment and Heritage
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
ppb	Parts per billion
ppm	Parts per million

Abbreviation	Term
SO_X	Oxides of sulphur
SO_2	Sulphur dioxide
SVOC	Semi-volatile organic compound
TAPM	The Air Pollution Model
TSP	Total suspended particulates
TVOC	Total volatile organic compounds
TWA	Time weighted average
US EPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1. INTRODUCTION

Frasers Property Industrial Constructions Pty Ltd (Frasers) has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an air quality impact assessment (AQIA) and greenhouse gas (GHG) assessment for the construction and operation of a proposed warehouse/distribution centre and industrial facility (the Proposal) to be located at Lot 3 of the Horsley Drive Business Park (HDBP [the Proposal site]). The Proposal site is located on the corner of Horsley Drive and Cowpasture Road, Wetherill Park, NSW.

The AQIA and GHG assessment form a part of the overall Environmental Impact Statement (EIS) for the Proposal.

The Environmental Planning and Assessment Act 1979 (EP&A Act) forms the statutory framework for planning approval and environmental assessment in NSW. The development qualifies as State Significant Development (SSD) under *State Environmental Planning Policy (State and Regional Development) 2011* due to its location with land covered by *State Environmental Planning Policy (Western Sydney Parklands) 2009* and capital investment value.

1.1. Secretary's Environmental Assessment Requirements

NSW Department of Planning and Environment (DPE) issued Secretary's Environmental Assessment Requirements (SEARs) for the Project in September 2016. **Table 1** identifies the SEARs relevant to this Air Quality Assessment report and the relevant sections of the report in which they have been addressed.

Table 1 Secretary's Environmental Assessment Requirements (SSD 16_7917)

Issue	Requirement	Addressed
Air Quality	Including: • an assessment of the air quality impacts at private properties during construction and operation of the development, in accordance with relevant Environment Protection Authority guidelines; and, • details of any mitigation, management and monitoring measures required to prevent and/or minimise emissions.	Section 1 to Section 7
Greenhouse Gas and Energy Efficiency	Including: • an assessment of the energy use on site and demonstrate what measures would be implemented to ensure the proposal is energy efficient.	Section 8

The policies, guidelines and plans identified within the SEARs as they relate to air quality include:

- Protection of the Environment Operations (Clean Air) Regulation 2002.
- Approved Methods for the Modelling and Assessment of Air Quality in NSW (DEC).
- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC).

No policies, guidelines and plans are stated in relation to greenhouse gas and energy efficiency.

Additional guidelines which have been consulted during the preparation of this document include:

- Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW' (March 2011).
- Assessment Methodology for Nitrogen Dioxide as an Air Pollutant (August 2015).
- Review of Cumulative Air Impact Assessment Methodologies for NSW (August 2015).

It is noted that the documents identified above do not represent current NSW EPA policy (which is outlined in the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW), but the studies have been commissioned by the NSW EPA to assist with evaluating the current air quality assessment framework and methodologies adopted in NSW. Where elements of this work have been adopted within this assessment, and derogations from NSW EPA policy are made, these are clearly identified and justified.

2. THE PROPOSAL

The following provides a description of the Proposal.

2.1. Environmental Setting

The Proposal is located on Lot 3 of the Horsley Drive Business Park, which itself is located at the corner of Horsley Drive and Cowpasture Road, Wetherill Park, NSW. The Proposal would occupy an area of approximately 4.4 hectares (ha) of land within easy access to Sydney's primary motorways (the M7, M4 and M5). The Proposal site is located within the Local Government Area (LGA) of Fairfield.

Approvals have previously been granted for the construction and operation of similar facilities within the HDBP, including those outlined in **Table 2**. The Lot numbers referred to within this report are those outlined within the Masterplan for the broader development (refer **Appendix C**).

Table 2 Status of Horsley Drive Business Park – September 2016

Lot	Use / Description	Area (m^2)	Status
1	Warehouse 1A Office 1A Warehouse 1B Office 1B	7,840 560 5,207 560	Approved (DA 18.1/2014)
2	Warehouse 2A Office 2A Warehouse 2B Office 2B	9,315 550 8,355 550	Decision pending (SSD 7564)
3	**Warehouse 3A** **Office 3A** **Warehouse 3B** **Office 3B**	**13,690** **550** **8,690** **550**	**This assessment**
4	Warehouse (Nick Scali) Office (Nick Scali) Warehouse 4 Office 4	12,000 700 6,700 550	Approved (DA 325.1/2016)
5	Warehouse (Martin Brower) Office (Martin Brower)	15,427 3,132	Approved (SSD 7078)

Note: Lot numbers relate to those assigned to the Masterplan and outlined in **Appendix C**

Demolition and earthworks activities have previously been approved for the entire HDBP (SSD 5169) and construction activities on Lots 1 and 5 are currently complete.

2.2. Overview and Purpose

The Proposal seeks to provide warehouse, distribution and light industrial facilities. The design of the HDBP allows B-Double truck access from Cowpasture Road onto Burilda Close (constructed as part of the HDBP). Each Lot includes warehouse and office areas with car parking and recessed and/or flush B-Double truck docks.

The final tenant of Lot 3 is not currently known, although this assessment has made a number of assumptions relating to the operation of the Proposal which are outlined in full in **Section 7**.

2.3. Construction

Construction of the Proposal would involve the laying of hardstand and erection of the warehouse and office structures. As previously noted, any demolition or earthworks have been previously approved and do not form part of this application.

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

- Concrete supply trucks and pumps.
- Concrete supply agitator trucks.
- Cranes.
- Light vehicles.
- Drills.
- Pneumatic hand or power tools.
- Prime movers.
- Commercial vans.
- Cherry pickers.

Assessment of the potential impacts upon local air quality resulting from construction activities is presented in **Section 6**.

2.4. Operation

Operation of the Proposal would involve the delivery, storage and despatch of goods, and elements of light industrial activity (depending on the final tenant). Traffic movements related to the operation of the Proposal may include private cars, commercial delivery vans and B-Double trucks. The Proposal includes a total of 19 truck docks (10 for Warehouse 3A and nine for Warehouse 3B).

Assessment of the potential impacts upon local air quality resulting from operational activities is presented in **Section 7**.

3. LEGISLATION, REGULATION AND GUIDANCE

3.1. Federal Air Quality Standards

3.1.1. National Environment Protection (Ambient Air Quality) Measure

The *National Environment Protection (Ambient Air Quality) Measure* (Ambient Air Quality NEPM) was promulgated in July 1998 and established ambient air quality standards for six key pollutants across Australia, and provides a standard method for monitoring and reporting on air quality. Air quality standards and performance monitoring goals for the six key air pollutants include:

- Carbon monoxide (CO);
- Lead (Pb);
- Nitrogen dioxide (NO_2);
- Particles (particulate matter with an aerodynamic equivalent diameter of 10 microns (µm) or less (PM_{10});
- Photochemical oxidants, as ozone (O_3); and,
- Sulphur dioxide (SO_2).

The Ambient Air Quality NEPM was varied in July 2003 to include advisory reporting standards for fine particulate matter with an aerodynamic equivalent diameter of 2.5 microns (µm) or less ($PM_{2.5}$) and in February 2016, introducing varied standards for PM_{10} and $PM_{2.5}$. The air quality standards and goals as set out in the (revised) Ambient Air Quality NEPM are presented in **Table 3**.

Table 3 National Environment Protection (Ambient Air Quality) Measure standards and goals

Pollutant	Averaging period	Criterion	Allowable exceedances per year
Carbon monoxide	8 hour	9.0 ppm [(a)]	1 day a year
Nitrogen dioxide	1 hour	0.12 ppm	1 day a year
	1 year	0.03 ppm	None
Ozone	1 hour	0.1 ppm	1 day a year
Sulphur dioxide	1 hour	0.2 ppm	1 day a year
	1 day	0.08 ppm	1 day a year
	1 year	0.02 ppm	None
Particulates (as PM_{10})	1 day	50 $\mu g \cdot m^{-3}$	None
	1 year	25 $\mu g \cdot m^{-3}$	None
Particulates (as $PM_{2.5}$)	1 day	25 $\mu g \cdot m^{-3}$	None
	1 year	8 $\mu g \cdot m^{-3}$	None
Lead	1 year	0.5 $\mu g \cdot m^{-3}$	None

Notes a: Parts per million (1x 10^{-6})

3.1.2. National Environment Protection (Air Toxics) Measure

The *National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) was promulgated in December 2004 and includes the following pollutants:

- Benzene;
- Benzo(a)pyrene as a marker for polycyclic aromatic hydrocarbons;
- Formaldehyde;
- Toluene; and,
- Xylenes (as total of *ortho-*, *meta-* and *para-* isomers).

The air quality standards and goals as set out in the Air Toxics NEPM are presented in **Table 4**.

Table 4 National Environment Protection (Air Toxics) Measure standards and goals

Pollutant	Averaging period	Criterion	Goal
Benzene	1 year[(a)]	0.003 ppm	8-year goal is to gather sufficient data nationally to facilitate development of a standard.
Benzo(a)pyrene as a marker for Polycyclic Aromatic Hydrocarbons	1 year[(a)]	0.3 ng·m^{-3}	
Formaldehyde	1 day[(b)]	0.04 ppm	
Toluene	1 day[(b)]	1 ppm	
	1 year[(a)]	0.1 ppm	
Xylenes (as total of ortho, meta and para isomers)	1 day[(b)]	0.25 ppm	
	1 year[(a)]	0.2 ppm	

Notes (a): For the purposes of this Measure the annual average concentrations are the arithmetic mean concentrations of 24-hour monitoring results.

(b) For the purposes of this Measure monitoring over a 24-hour period is to be conducted from midnight to midnight.

The 24-hour monitoring investigation levels in **Table 4** have been derived from health-based guidelines of shorter averaging periods.

- For formaldehyde the health based guideline is 0.08 ppm for a 1-hour averaging period;
- For toluene the health based guideline is 4 ppm for a 6-hour averaging period; and
- For xylene the health based guideline is 1 ppm for a 30-minute averaging period.

3.1.3. National Clean Air Agreement

The National Clean Air Agreement (NCAA) was agreed by Australia's Environment Ministers on 15 December 2015. The NCAA establishes a framework and work plans for the development and implementation of various policies aimed at improving air quality across Australia. In regard to air quality standards with relevance to this report, the Initial Work Plan sets an objective to:

- Vary the Ambient Air Quality NEPM (see **Section 3.1.1**) in regard to PM_{10} and $PM_{2.5}$ standards;
- Review the Ambient Air Quality NEPM in regard to SO_2, NO_2 and O_3 standards;
- Review the Fuel Quality Standards Act (2000); and,
- Review the need for the Air Toxics NEPM and the National Environment Protection (Diesel Vehicle Emissions) Measure (Diesel Vehicles NEPM).

Of relevance to the standards adopted as the relevant benchmarks for the performance of the Proposal, the previous standards were augmented by an annual average PM_{10} concentration standard of 25 $\mu g \cdot m^{-3}$, and the advisory reporting standards for $PM_{2.5}$ considered as standards. It is further likely that the 24-hour average PM_{10} concentration standard will be made more stringent from the current value of 50 $\mu g \cdot m^{-3}$, although it is currently not possible to determine the revised standard for that metric.

3.2. NSW Air Quality Standards

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) 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 and WHO).

The criteria specified in the Approved Methods are the defining ambient air quality criteria for NSW, and are considered to be appropriate for the setting.

Table 5 NSW EPA air quality standards and goals

Pollutant	Averaging period	Criterion		Notes
		ppb[a]	µg·m^{-3}	
Sulphur dioxide (SO_2)	10 minutes	250	712	
	1 hour	200	570	Numerically equivalent to the AAQ NEPM[d] standards and goals. AAQ NEPM allows exceedance of 1-hour standard on one day per year.
	24 hours	80	228	
	1 year	20	60	
Nitrogen dioxide (NO_2)	1 hour	120	246	Numerically equivalent to the AAQ NEPM[d] standards and goals. AAQ NEPM allows exceedance of 1-hour standard on one day per year.
	1 year	30	62	
Particulates (as PM_{10})	24 hours	-	50	Numerically equivalent to the AAQ NEPM[d] standards and goals.
	1 year	-	25	
Particulates (as $PM_{2.5}$)	24 hours	-	25	Not currently officially adopted by NSW EPA in the Approved Methods but expected to be adopted in due course.
	1 year	-	8	
TSP	1 year	-	90	
		g·m^2·month^{-1}	g·m^2·month^{-1}	
Deposited dust	1 year	2[e]	4[f]	Assessed as insoluble solids as defined by AS 3580.10.1
		ppm[b]	mg·m^{-3}	
Carbon monoxide (CO)	15 minutes	87	100	
	1 hour	25	30	
	8 hours	9	10	Numerically equivalent to the AAQ NEPM[d] standards and goals. AAQ NEPM allows exceedance of 8-hour standard on one day per year.

Notes: (a): Parts per billion (1x 10^{-9})
(b): Parts per million (1x 10^{-6})
(c): micrograms per cubic metre of air
(d): National Environment Protection (Ambient Air Quality) Measure
(e): Maximum increase in deposited dust level
(f): Maximum total deposited dust level

3.3. Pollutants Considered within this Assessment

Based on the anticipated schedule of construction and operation as discussed in **Section 2**, emissions of particulate matter and combustion products resulting from the operation of vehicles at the Proposal site would be expected.

Impacts from vehicle sources are generally associated with pollutants such as lead (Pb), SO_2, NO_2, CO and particulate matter (PM_{10} and $PM_{2.5}$). Emissions during construction activities are most likely associated with particulate matter (PM_{10} and $PM_{2.5}$) including the coarser particulate fraction, TSP.

Removal of lead additives in fuel since 2002 in Australia have resulted in major improvements in ambient lead concentrations. The major source is now industrial facilities and a review of the National Pollutant Inventory for 2014/2015 indicates that no industrial source of lead is present within a radius of 2 km of the Proposal site.

The amount of SO_2 in air is at acceptable low levels in most Australian towns and cities. While SO_2 concentrations in air are not generally a problem in Australia, fuel standards have significantly reduced sulphur levels in fuels and reduced the levels in air even further. The highest concentrations of SO_2 in the air are found around petrol refineries, chemical manufacturing industries, mineral ore processing plants and power stations[1].

Carbon monoxide concentrations even in close proximity to heavily trafficked roadside locations are shown to consistently meet the required air quality criteria. Measurements made at a location within 11 m from Parramatta Road as part of the WestConnex development indicated that concentrations next to the road with >74,000 annual average daily traffic flow were less than 25% of the 8-hour criterion [2].

Emissions of air toxics resulting from the Proposal are not likely to be significant.

Ambient concentrations of air toxics, lead, CO and SO_2 are considered to be low risk pollutants in this context and are not considered further. Based on experience with Proposals of this type, the pollutants which are generally shown to represent a constraint are particulate matter (mainly due to high existing concentrations) and nitrogen dioxide (a combination of existing concentrations near roadside locations and incremental contributions from Proposal operations).

[1] http://www.environment.gov.au/protection/publications/factsheet-sulfur-dioxide-so2

[2] http://www.westconnex.com.au/library/air_quality/index.html

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

4.1.1. Discrete Receptor Locations

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It is important to note that the selection of discrete receptor locations is not intended to represent a fully inclusive selection of all sensitive receptors across the study area. The location selected should be considered to be representative of its location, and may be reasonably assumed to be representative of the immediate environs. In some instances, several viable receptor locations may be identified in a small area, for example a school neighbouring a medical centre. In this instance the receptor closest to the potential sources to be modelled would generally be selected and would be used to assess the risk to other sensitive land uses in the area. It is further noted that in addition to the identified 'discrete' receptor locations, the entire modelling area is gridded with 'uniform' receptor locations (see **Section 4.1.2**) that are used to plot out the predicted impacts, and as such the accidental non-inclusion of a location sensitive to changes in air quality does not render the AQIA invalid.

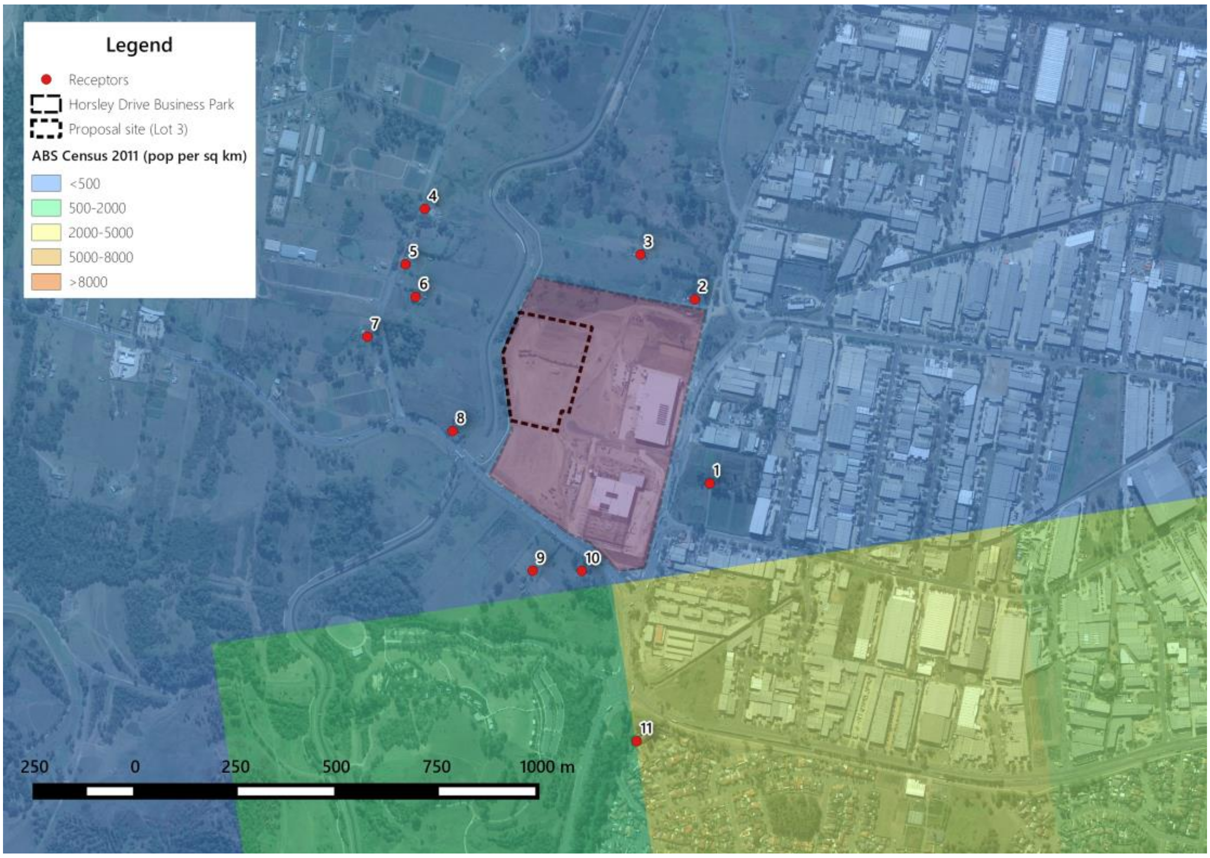
To ensure that the selection of discrete receptors for the AQIA are reflective of the locations in which the population of the area surrounding the Proposal site actually reside, population density data has been examined. Population density data based on the 2011 census have been obtained from the Australian Bureau of Statistics (ABS) for a 1 square kilometre (km^2) grid, covering mainland Australia (ABS, 2014). 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 uses the following categories to analyse population density ($persons \cdot km^{-2}$):

- 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 are presented in **Figure 1**. The Proposal site is located in an area of generally very low population (as defined by the ABS). Low, medium and high population densities are observed predominantly to the south and east of the Proposal site which correspond with the suburb of Bossley Park.

Figure 1 Population density and selected sensitive receptors surrounding the Proposal site



A number of residential receptor locations have been identified in previous studies of air quality impacts relating to the HDBP (SLR 2015, 2016). For consistency and transparency, these receptors have been adopted for use within this AQIA and are presented in **Table 6**. **Figure 1** identifies that the receptors are located in areas representative of the range of population densities which are observed surrounding the site and are therefore appropriate. It is noted that no receptor locations are identified within the industrial area to the northwest of the Proposal site in Wetherill Park. Impacts due to nuisance dust may be applicable to those locations, primarily as a result of construction activities, and those potential impacts have been addressed within **Section 6** of this AQIA.

Table 6 represents the discrete receptor locations that have been identified as part of this study (see **Figure 1**). The table 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 than the general population.

Table 6 Discrete sensitive receptor locations used in the study

Rec	Location	Land Use	Location (m, Australian Map Grid, zone 56)	
			Easting	Northing
1	189-203 Cowpasture Road, Wetherill Park	Residential	303,750	6,252,826
2	144-154 Cowpasture Road, Wetherill Park	Residential	303,703	6,253,280
3	132-142 Cowpasture Road, Wetherill Park	Residential	303,566	6,253,388
4	70-84 Ferrers Road, Horsley Park	Residential	303,027	62,534,90
5	46-56 Ferrers Road, Horsley Park	Residential	302,982	6,253,352
6	34-44 Ferrers Road, Horsley Park	Residential	303,009	6,253,272
7	31-37 Ferrers Road, Horsley Park	Residential	302,891	6,253,171
8	1,570 The Horsley Drive, Horsley Park	Residential	303,108	6,252,942
9	1538 The Horsley Drive, Abbotsbury	Residential	303,314	6,252,601
10	1532 The Horsley Drive, Abbotsbury	Residential	303,436	6,252,603
11	9 Derwent Place, Bossley Park	Residential	303,581	6,252,185

4.1.2. Uniform Receptor Locations

Additional to the sensitive receptors identified in **Section 4.1.1**, a grid of uniform receptor locations has been used in the AQIA to allow presentation of contour plots of predicted impacts.

4.2. 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 must also be assessed. This 'background' air quality will vary depending on the pollutants to be assessed, and can often be characterised by using appropriate air quality monitoring data.

Air quality monitoring is performed by the NSW Office of Environment and Heritage (OEH) at four air quality monitoring stations (AQMS) within an approximate 15 km radius of the Proposal site. Details of these stations are presented in **Table 7** and are illustrated in **Figure 2**.

Table 7 Details of AQMS surrounding the Proposal site

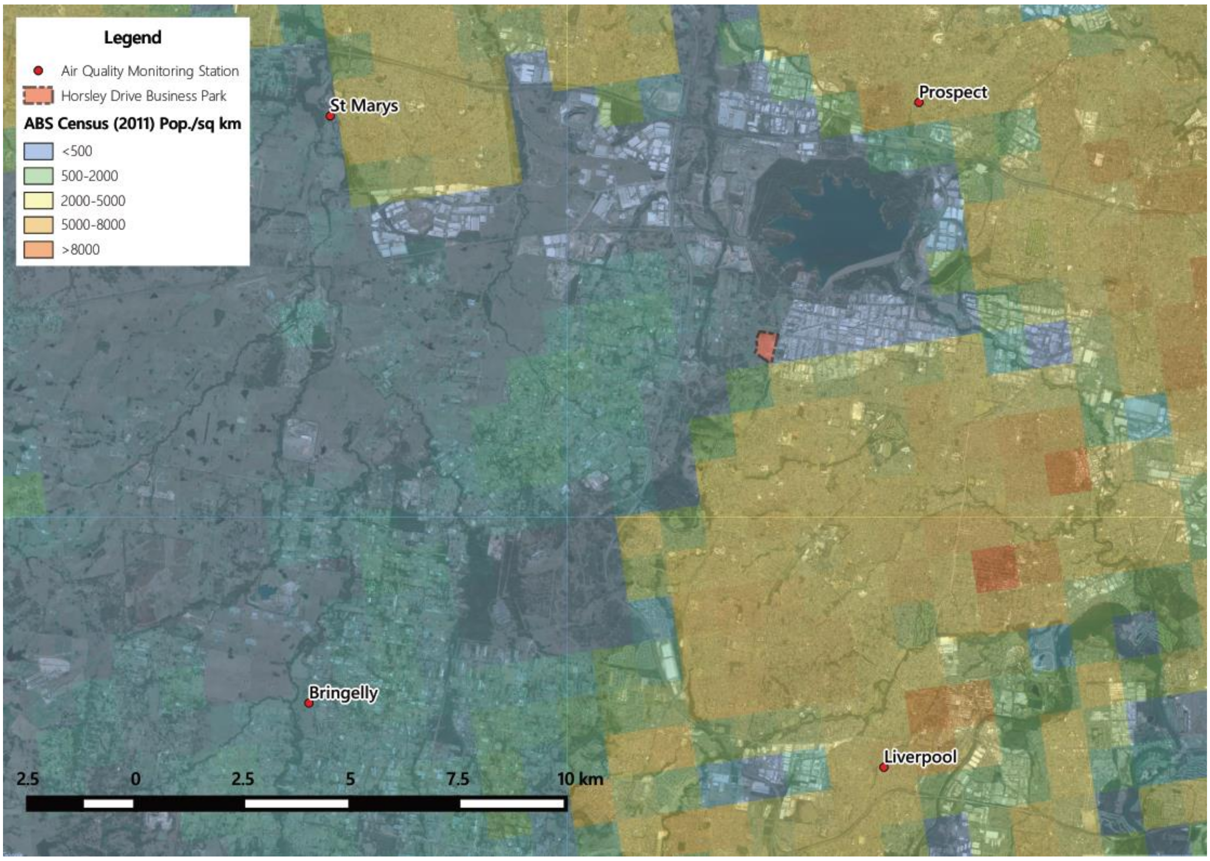
AQMS	Distance / Direction from Proposal site	Location (km, Australian Map Grid, zone 56)		Parameters Measured	AQMS Commissioned
		Easting	Northing		
Prospect	~6.5 km / NE	306.9	6,258.7	Ozone (O_3) NO, NO_2, NO_X CO Fine particles (by nephelometry) Fine particles (PM_{10} using a TEOM) Wind speed, direction and sigma theta Ambient temperature Relative humidity Solar radiation	2007
Liverpool	~10 km / SE	306.4	6,243.3	Ozone (O_3) NO, NO_2, NO_X CO Fine particles (by nephelometry) Fine particles (PM_{10} and $PM_{2.5}$ using a TEOM) Wind speed, direction and sigma theta Ambient temperature Relative humidity Solar radiation	1990
St Marys	~11.5 km / NW	293.2	6,258.1	Ozone (O_3) NO, NO_2, NO_X Fine particles (by nephelometry) Fine particles (PM_{10} using a TEOM) Wind speed, direction and sigma theta Ambient temperature Relative humidity	1992
Bringelly	~13.2 km / SW	293.0	6,244.5	Ozone (O_3) NO, NO_2, NO_X SO_2 Fine particles (by nephelometry) Fine particles (PM_{10} using a TEOM) Wind speed, direction and sigma theta Ambient temperature Relative humidity	1992

Note: TEOM – Tapered Element Oscillating Microbalance

Data for the five-year period 2011 to 2015 for all four AQMS presented in **Table 7** are provided in **Appendix A**. Data for the year 2013 has been selected for use within this assessment, to maintain consistency with the previous assessments performed at the HDBP (SLR 2015, 2016). The meteorology selected is also consistent with 2013 conditions as reported in SLR (2015,2016). An assessment of the representative nature of conditions experienced in 2013 against longer term averages is presented in SLR (2016).

The AQIA for Lot 2 of the HDBP (SSD 7564) (SLR, 2016) adopted air quality data collected at the St Marys AQMS as an appropriate representation of background air quality which would be experienced at the Proposal site. Examination of **Figure 2**, which also presents the population density surrounding each AQMS, supports the use of St Marys data given the similarities in surrounding population densities (and by inference residential pollutant emission sources) and proximity to transport corridors.

Figure 2 AQMS surrounding the Proposal site



Air quality data for NO_2 and PM_{10} is available for the St Marys AQMS for the year 2013, although no data for $PM_{2.5}$ or CO are available for this station. In lieu of these data, measurements taken at the Liverpool AQMS have been used within this assessment. These data are also shown from **Figure 2** to be measured in a location of population density which is not dissimilar to (and may even be greater than) the Proposal site, and may therefore provide an appropriate (or even conservative) approximation of the concentrations of those pollutants when compared to the environment surrounding the Proposal site.

Concentrations of TSP are not measured by the NSW OEH at the AQMS surrounding the Proposal site. A detailed discussion of the relationship between TSP and PM_{10} concentrations in the Newcastle and Illawarra regions is presented in SLR (2016) which concludes that the derivation of a broad TSP:PM_{10} ratio of 2.4 : 1 (i.e. PM_{10} represents 41% of TSP) is appropriate for the area surrounding the Proposal site. In the absence of any more specific information, this ratio has been adopted within this AQIA.

Similarly, no dust deposition data is available for the area surrounding the Proposal site. The incremental impact criterion of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ as outlined within the Approved Methods has been adopted which effectively provides a background deposition level of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ (the total allowable deposition being 4 $g{\cdot}m^{-2}{\cdot}month^{-1}$).

A summary of the background air quality adopted for use within this AQIA is presented in **Table 8**.

Table 8 Background air quality data adopted for use within the AQIA

Pollutant	Averaging Period	Maximum Concentration	Source
NO_2	1 hour	75.9 $\mu g{\cdot}m^{-3}$	St Marys AQMS 2013
	Annual	10.7 $\mu g{\cdot}m^{-3}$	
TSP	Annual	38.4 $\mu g{\cdot}m^{-3}$	Estimated on a TSP:PM_{10} ratio of 2.4 : 1 (SLR, 2016)
PM_{10}	24 hours	93.0 $\mu g{\cdot}m^{-3}$	St Marys AQMS 2013
	Annual	16.0 $\mu g{\cdot}m^{-3}$	
$PM_{2.5}$	24 hours	73.8 $\mu g{\cdot}m^{-3}$	Liverpool AQMS 2013
	Annual	9.4 $\mu g{\cdot}m^{-3}$	
Dust deposition	Annual	2 $g{\cdot}m^{2}{\cdot}month^{-1}$	Difference in NSW OEH maximum allowable and incremental impact criterion

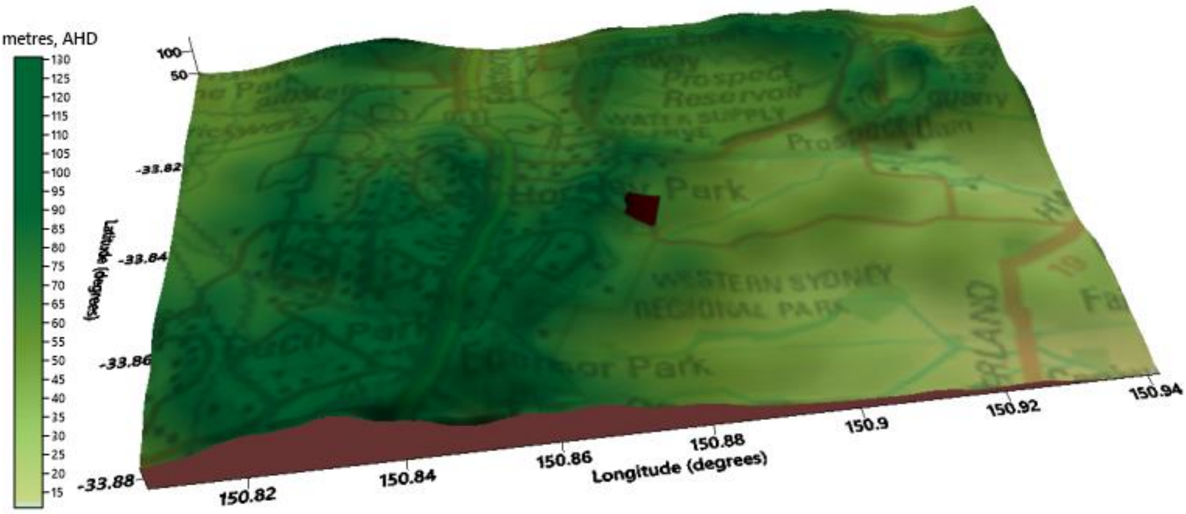
It is noted from **Table 8** and **Appendix A** that concentrations of particulate matter (24-hour average PM_{10} and $PM_{2.5}$ and annual average $PM_{2.5}$) exceeded the relevant air quality criteria as detailed in **Table 5** in 2013. Such exceedances in 2013 were generally attributable to the NSW bushfire emergency of October and early November 2013. The five highest 24-hour average PM_{10} concentrations measured at the St Marys AQMS in 2013 were highly likely to be directly attributable to the NSW bushfire emergency from examination of comments from NEPM compliance reports for other AQMS nearby (St Marys is not a NEPM compliance station for PM_{10}). Increased $PM_{2.5}$ concentrations are also identified through examination of NEPM compliance reports for 2013 to be due to bushfire events in October / November 2013.

The AQIA has been performed to assess the contribution of the Proposal to the air quality of the surrounding area. A full discussion of how the Proposal impacts upon the air quality, including the contribution during such 'exceptional events' is presented in **Section 6**.

4.3. Topography

The topography of the area surrounding the Proposal site ranges from 15 m Australian Height Datum (AHD) to approximately 130 m AHD. The Proposal site is located at an elevation of approximately 70 m AHD. The topography of the Proposal site is level, having been levelled as part of the earthworks operations.

Figure 3 3-Dimensional representation of topography surrounding Proposal site



Note: Proposal site shown in centre of figure represents the HDBP as a whole

4.4. 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). A summary of the relevant monitoring site and the parameters measured at the monitoring sites is provided in **Table 9**.

Table 9 Details of the Meteorological Monitoring Surrounding the Proposal Site

Site Name	Approximate Location (Latitude, Longitude)		Site Commissioned
	˚S	˚E	
Penrith Lakes AWS - Station # 67113	33.72	150.68	August 1995
Badgery's Creek AWS - Station # 67108	33.90	150.73	October 1995
Horsley Park Equestrian Centre - Station # 67119	33.85	150.86	September 1997

To maintain consistency with a number of previous air quality assessments performed for Lots at the HDBP (SLR 2015, 2016), meteorological conditions in the year 2013 have been used to represent 'typical' conditions. Discussion is provided in SLR (2016) which provides comparison of the conditions experienced in 2013 against a 5-year dataset. It was concluded that conditions in 2013 may be considered to provide a suitably representative dataset for use in dispersion modelling.

4.5. Meteorological Processing for the AQRA

The BoM data adequately covers 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 models 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.

TAPM is known to predict less calm wind conditions than is usually recorded in the data from a monitoring station. TAPM may assimilate actual local wind observations to optimise the model solution. In this case, data from three surrounding AWS have been assimilated into the TAPM model run. The parameters used in TAPM modelling are presented in **Table 10**.

Table 10 Meteorological Parameters used for this Study (TAPM v 4.0.5)

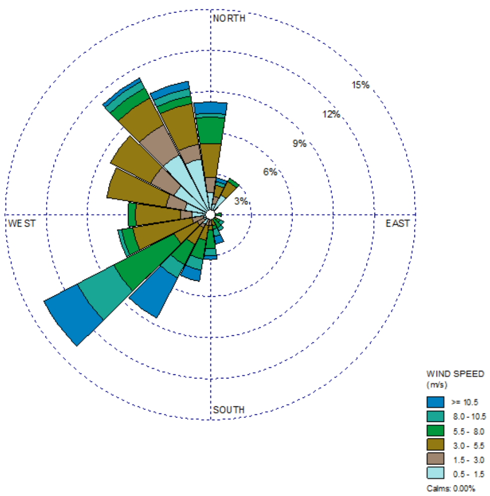
Modelling period	1 January 2013 to 31 December 2013
Centre of analysis	295,309 mE, 6,255,681 mN (UTM Coordinates)
Number of grid points	40 × 40 × 25
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	Penrith Lakes AWS (Station # 67113) Badgery's Creek AWS (Station # 67108) Horsley Park Equestrian Centre AS (Station # 67119)

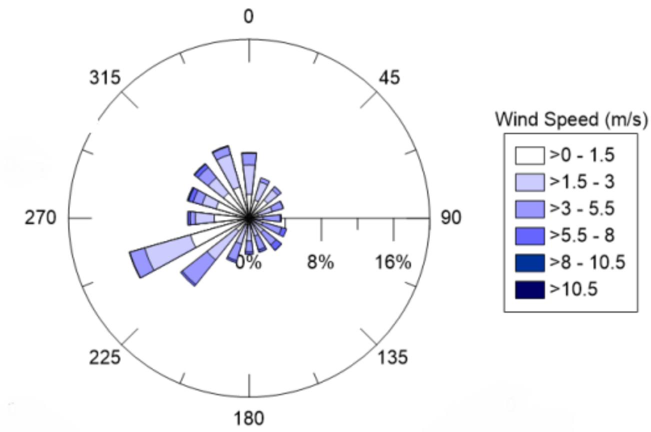
Note: Identical TAPM parameters to SLR (2016) to maintain consistency

No further processing of meteorological data has been performed. The dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF atmospheric dispersion model. The modelling has been performed in CALPUFF 2-dimensional mode. Given the relatively small distances between the sources and receptors, the uncomplicated terrain and the characteristics of the emission sources (minimal buoyancy / vertical velocity), a detailed assessment using a 3-dimensional meteorological dataset is not warranted. A comparison of the TAPM generated meteorological data, and that generated using the CALMET model (for use in SLR [2016]) is presented in **Figure 3**. These data compare well, and the comparison of modelled meteorology and measured data as presented in SLR (2016) provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

Figure 3 Modelled meteorological data – Proposal site

TAPM generated windrose	TAPM & CALMET generated windrose





SLR (2016)

5. METHODOLOGY

The methodologies adopted for the assessment of the construction phase risk assessment and the operational phase risk assessment are discussed in detail below.

5.1. Construction Phase – Risk Assessment Methodology

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 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)[3].

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 3**.

[3] www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Figure 3 Construction Phase Impact Risk Assessment Methodology (derived from IAQM)

Step 1
- SCREENING
- A simple screening step accounting for seperation distance between the sources and the receptors

Step 2
- RISK FROM CONSTRUCTION ACTIVITIES
- Assess risk from activities based on the scale and nature of the works, which determines the potential dust emission magnitude

Step 3
- SENSITIVITY OF RECEPTORS
- Assess risk of dust effects from activities based on the sensitivity of the area surrounding dust-generating activities

Step 4
- RISK ASSESSMENT (PRE-MITIGATION)
- Based upon Steps 2 and 3, determine risks associated with the construction activities

Step 5
- IDENTIFY MITIGATION
- Based upon the risks assessed at Step 4, identify appropriate mitigation measures to control the risks

Step 6
- RISK ASSESSMENT (POST-MITIGATION)
- Based upon the mitigation measures identified at Step 5, reassess risk

The assessment approach is detailed in **Appendix B**.

5.2. Operational Phase - Quantitative 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 mode. Given the relatively small distances between the sources and receptors, the uncomplicated terrain and the characteristics of the emission sources (minimal buoyancy / vertical velocity), a detailed assessment using a 3-dimensional meteorological dataset is not warranted.

An assessment of the impacts of the operation of activities at Lot 3 has been performed, with a further assessment of the impacts of operation of all Lots at the HDBP on the air quality at surrounding receptor locations (a cumulative assessment). The following scenarios have been assessed:

- **The Proposal (Lot 3, typical):** The likely day-to-day operation of Lot 3 activities, approximating average operational characteristics which are appropriate to assess against longer term criteria (24-hour and annual average).
- **The Proposal (Lot 3, worst case):** The potential 'worst case' operation of Lot 3 activities, representing a situation where peak truck idling may occur. The outputs of this scenario are considered to be appropriate to compare against short term (1-hour) criteria only (i.e NO_2).
- **HDBP (Lots 1-5, typical):** As per The Proposal (Lot 3, typical) but replicated for all Lots (Lots 1 to 5) at the HDBP.
- **HDBP (Lots 1-5, worst case):** As per The Proposal (Lot 3, worst case) but replicated for all Lots (Lots 1 to 5) at the HDBP. The outputs of this scenario are considered to be appropriate to compare against short term (1-hour) criteria only (i.e NO_2).

The modelling scenarios provide an indication of the air quality impacts of the operation of activities at Lot 3 and the broader HDBP. Added to these impacts are background air quality concentrations (discussed in **Section 4.2**) which represent the air quality which may be expected within the area surrounding the Proposal site, without the impacts of the Proposal (or HDBP) itself.

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

5.2.1. Emissions Estimation

Traffic generation

Traffic generation rates for the Proposal have been calculated using the NSW Roads and Maritime Services (RMS) Guide to Traffic Generating Development (2002). Numbers of daily and peak hour vehicle trips associated with warehouses (section 3.10.2) and office and commercial activities (section 3.5) are provided within the guide, based upon the gross floor area (GFA) of the development. These rates are presented in **Table 11**.

Table 11 Traffic generation rates (RMS, 2002)

Use	Daily vehicle trips per 100 m^2	Peak hour vehicle trips per 100 m^2
Warehouse	4	0.5
Office and Commercial	10	2

Daily and peak hour trips anticipated for Lots 1 to 5 at the HDBP are presented in **Table 12**. It is noted that this assessment considers the impacts of the Lot 3 development, although traffic generation rates for other Lots are important in the assessment of cumulative impacts (scenarios 2 and 4).

Table 12 Traffic generation rates for HDBP

Lot	Use	Gross Floor Area (m^2)	Daily vehicle generation rate	Peak hour vehicle generation rate
Lot 1	Warehouse 1A	7,840	314	39
	Office 1A	560	56	11
	Warehouse 1B	5,207	208	26
	Office 1B	560	56	11
Lot 2	Warehouse 2A	9,315	373	47
	Office 2A	550	55	11
	Warehouse 2B	8,355	334	42
	Office 2B	550	55	11
Lot 3 ***The Proposal***	**Warehouse 3A**	**13,740**	**550**	**69**
	Office 3A	**500**	**50**	**10**
	Warehouse 3B	**8,740**	**350**	**44**
	Office 3B	**500**	**50**	**10**
Lot 4	Warehouse (Nick Scali)	12,000	480	60
	Office (Nick Scali)	700	70	14
	Warehouse 4	6,700	268	34
	Office 4	550	55	11
Lot 5	Warehouse (Martin Brower)	15,427	617	77
	Office (Martin Brower)	3,132	313	63

Given the proposed/potential use of Lot 3 (and all other Lots) as a warehouse / distribution centre and industrial facility, a number of heavy vehicles would visit the Proposal site. The number of heavy vehicles visiting the site each day has been calculated assuming that the percentage of heavy vehicles in peak hour traffic would be 10% and in all other hours would represent 40% of traffic (SLR, 2016).

For example, warehouse 3A is expected to receive 550 vehicles per day with 69 vehicles in the peak hour (see **Table 12**). 10% of vehicles in the peak hour are expected to be heavy vehicles (7 vehicles). For the remaining 23 hours of the day, 40% of the vehicles are expected to be heavy vehicles (40% of (550-69) = 192 vehicles). Total heavy vehicles visiting the site each day would therefore be 199 (7 in peak hour and 192 across all other hours). The balance of vehicles visiting the site would be commercial vans and passenger vehicles.

In the assessment of impacts associated with the typical operation of the Proposal, and representative of the impacts to be compared against 24-hour and annual average air quality criteria, these vehicles (and vehicles associated with the office facilities) can be assumed to be evenly spread across each hour of the day. An approximation of the likely vehicle movements during a 'worst case' hour needs to be made to allow assessment against the 1-hr criterion (for NO_2).

Each facility has been designed with a number of heavy vehicle bays. It is unlikely, but not inconceivable that each of these bays could be occupied by a heavy vehicle at any one time and this assumption provides the basis for the assessment of potential worst case hourly impacts. The heavy vehicle generation rates calculated for Lot 3 and the HDBP as a whole are presented in **Table 13**.

Table 13 Heavy vehicle generation rates for HDBP

Lot	Use	Number of Heavy Vehicle bays	Heavy Vehicles per day	Heavy Vehicle bays occupied per hour (average)	Heavy Vehicle bays occupied per hour (peak)
Lot 1	Warehouse 1A	9	114	5	9
	Warehouse 1B	4	208	3	4
Lot 2	Warehouse 2A	8	135	6	8
	Warehouse 2B	8	121	5	8
Lot 3 ***The Proposal***	**Warehouse 3A**	**10**	**199**	**8**	**10**
	Warehouse 3B	**9**	**127**	**5**	**9**
Lot 4	Warehouse (Nick Scali)	20	174	7	20
	Warehouse 4	7	97	4	7
Lot 5	Warehouse (Martin Brower)	29	224	9	29

Vehicles visiting the Proposal site would either be travelling to/from the car park or heavy vehicle bays, or idling at the heavy vehicle bays. An estimate of the vehicle kilometres travelled each day associated with each Lot is presented in **Table 14**. This distance is taken from the roundabout on Cowpasture Road to the furthest point of each Lot.

Table 14 Daily vehicle kilometres travelled for HDBP

Lot	Use	Round trip distance (km)	Daily vehicle generation rate	VKT/day[(a)]
Lot 1	Warehouse 1A	0.6	314	194.4
	Office 1A		56	34.7
	Warehouse 1B	0.4	208	91.6
	Office 1B		56	24.6
Lot 2	Warehouse 2A	1.0	373	357.7
	Office 2A		55	52.8
	Warehouse 2B	0.8	334	260.7
	Office 2B		55	42.9
Lot 3 *The Proposal*	**Warehouse 3A**	**1.3**	**550**	**703.5**
	Office 3A		**50**	**64.0**
	Warehouse 3B	**1.1**	**350**	**377.6**
	Office 3B		**50**	**54.0**
Lot 4	Warehouse (Nick Scali)	0.7	480	336.0
	Office (Nick Scali)		70	49.0
	Warehouse 4	1.0	268	262.6
	Office 4		55	53.9
Lot 5	Warehouse (Martin Brower)	0.7	617	432.0
	Office (Martin Brower)		313	219.2

Note: (a): VKT = vehicle kilometres travelled

Emission factors

Estimation of emissions associated with vehicle movements at the Proposal site have been sourced from a number of documents:

- Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks (USEPA, 2008)[4].

[4] Updated from the 2004 USEPA document adopted by SLR (2016). The factors used in this assessment were adopted by Ramboll Environ for the SIMTA Moorebank Intermodal EIS (http://simta.com.au/wordpress/wp-content/uploads/2016/06/Appendix-G_-AQIA.pdf)

- AP-42 Section 13.2.1 Paved Roads (USEPA, 2011).
- Average In-Use Emissions from Heavy-Duty Trucks (USEPA, 2008).
- Trends in Motor Vehicle and their Emissions (NSW Government, 2014).

These documents provide information on the rates of pollutant emissions from either tailpipe or via the action of vehicles travelling on road surfaces in grams per hour ($g \cdot hr^{-1}$) or grams per kilometre ($g \cdot km^{-1}$). The emission factors adopted for this assessment are presented in **Table 15**. The emission rate for particulate generation by action of vehicles on road surface (USEPA, 2011) uses the following emission rate equation:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

Where: E = particulate emission factor (units of $g \cdot VKT^{-1}$)

k = particle size multiplier for size range

sL = road surface silt content (grams per square metre [$g \cdot m^{-2}$])

W = average weight of vehicle (tons)

Values of k appropriate for each particulate size fraction (TSP, PM10 and PM2.5) have been taken from the USEPA (2006) documentation. Road surface silt loading (sL) has been assumed to be 0.06 $g \cdot m^{-2}$ (a baseline identified in the USEPA, 2011 documentation for a road with 5,000 to 10,000 vehicles movements per day) and an average vehicle weight of 68.9 tonnes for heavy vehicle and 4.9 tonnes for passenger vehicles has been adopted. Appropriate conversions from tons to tonnes have been made within the emission factor equation (*1.110231).

Table 15 Emission factors adopted

Emission source	Activity	Units	Emission Factor				
			CO	NO_X	TSP	PM_{10}	$PM_{2.5}$
Heavy vehicle – tailpipe emissions	Travelling[a]	$g \cdot km^{-1}$	3.719	13.861	-	0.352	0.325
	Idling[b]	$g \cdot hr^{-1}$	25.628	33.763	-	1.196	-
Passenger vehicle – tailpipe emissions[c]	Petrol	$g \cdot km^{-1}$	1.0	-	-	0.0045	0.0045
	Diesel	$g \cdot km^{-1}$	0.5	0.23	-	0.0045	0.0045
Heavy vehicle – road surface emissions[d,e]	-	$g \cdot km^{-1}$	-	-	18.72	3.59	0.87
Passenger vehicle – road surface emissions[d,f]	-	$g \cdot km^{-1}$			1.28	0.25	0.06

Notes:
(a) Average In-Use Emissions from Heavy-Duty Trucks (USEPA, 2008)
(b) Idling Vehicle Emissions for Passenger Cars, Light-Duty Trucks, and Heavy-Duty Trucks (USEPA, 2008)
(c) Trends in Motor Vehicle and their Emissions (NSW Government, 2014)
(d) AP-42 Section 13.2.1 Paved Roads (USEPA, 2011)
(e) Assuming silt loading of 0.06 $g \cdot m^{-2}$ and average vehicle weight of 68.9 tonnes
(f) Assuming silt loading of 0.06 $g \cdot m^{-2}$ and average vehicle weight of 4.9 tonnes

Calculated emissions

Based on the traffic generation rates and emission factors discussed in the preceding sections, estimates of pollutant emissions anticipated as a result of the operation of the Proposal have been made. These estimates are presented in **Table 16** and **Table 17** for 'typical' operations (Scenario 1 and 3) and in **Table 19** for 'worst case' operations (Scenario 2 and 4). For worst case operations, it has been assumed that no vehicle movements would occur, as all bays would be full.

Table 16 Emission rates associated with vehicle movement (typical operations)

		Lot	Emission Rate (kg·hr^{-1})			
			NO_X	TSP	PM_{10}	$PM_{2.5}$
Horsley Drive Business Park		Lot 1	0.062	0.226	0.045	0.012
		Lot 2	0.133	0.487	0.097	0.026
	The Proposal	**Lot 3**	**0.233**	**0.849**	**0.169**	**0.045**
		Lot 4	0.129	0.472	0.094	0.025
		Lot 5	0.093	0.349	0.069	0.018

Table 17 Emission rates associated with vehicle idling (typical operations)

		Lot	Emission Rate (kg·hr^{-1})			
			NO_X	TSP	PM_{10}	$PM_{2.5}$
Horsley Drive Business Park		Lot 1	0.266	-	0.009	0.009
		Lot 2	0.360	-	0.013	0.012
	The Proposal	**Lot 3**	**0.459**	**-**	**0.016**	**0.015**
		Lot 4	0.381	-	0.013	0.0124
		Lot 5	0.315	-	0.011	0.010

Note: No TSP emission rate for heavy vehicle idling

Table 18 Emission rates associated with vehicle movement (worst case operations)

		Lot	Emission Rate ($kg \cdot hr^{-1}$)
			NO_X
Horsley Drive Business Park		Lot 1	0.0001
		Lot 2	0.0002
	The Proposal	Lot 3	0.0002
		Lot 4	0.0002
		Lot 5	0.0004

Note: No heavy vehicle movements assumed for worst-case hour – all vehicles assumed to be idling in bays. Passenger vehicles only

Table 19 Emission rates associated with vehicle idling (worst case operations)

		Lot	Emission Rate ($kg \cdot hr^{-1}$)
			NO_X
Horsley Drive Business Park		Lot 1	0.439
		Lot 2	0.540
	The Proposal	Lot 3	0.641
		Lot 4	0.912
		Lot 5	0.979

5.2.2. Emissions Sources

The emission rates calculated in **Section 5.2.1** have been divided between a number of sources, depending on the Lot with which they are associated. Emissions source spacing for road sources was calculated to be approximately 30 m, a quarter of the distance between the sources and nearest receptor (120 m). The total number of sources is represented in **Table 20**.

Table 20 Number of emission sources included in modelling assessment

Lot	Number of Sources	
	Road	Bays[(a)]
1	10	13
2	15	16
3	21	19
4	15	27
5	11	29

Note: (a) Number of sources emitting from bays varies according to the average or peak scenario being assessed (refer **Table 13**)

6. CONSTRUCTION IMPACT ASSESSMENT

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

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 and track-out [demolition and earthworks have previously been approved]). The definitions used to screen receptors, determine receptor sensitivity and the magnitude of impacts are all presented in **Appendix B.**

6.1. Screening Based on Separation Distance

The footprint of the site which has been cleared is approximately 4.4 ha and the Proposal involves no demolition work.

Given that earthworks have been completed, the construction phase would involve the establishment of hard standing on a significant proportion of the cleared area of the site and the construction of the warehouse/office structures. It has been assumed that the height of the structures would be 12.2 m resulting in a total building volume of 279,990 m^3.

The assumed supply route around the site during construction works may be up to 800 m in total length.

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

- 350 m from the boundary of the site;
- 500 m from the site entrance; and,
- 50 m from the route used by construction vehicles on public roads.

Table 21 presents the identified discrete sensitive receptors, with the corresponding distances as compared to the screening criteria. **Figure 4** presents the screening distances for the Proposal.

Table 21 Construction Phase Impact Screening Criteria Distances

Rec#	Location	Land Use	Screening Distances (m)		
			Proposal Site boundary (350m)	Proposal site entrance (500m and 100m)	Construction route (50m)
1	189-203 Cowpasture Road, Wetherill Park	Residential	480	480	95
2	144-154 Cowpasture Road, Wetherill Park	Residential	320	540	95
3	132-142 Cowpasture Road, Wetherill Park	Residential	260	550	260
4	70-84 Ferrers Road, Horsley Park	Residential	360	750	630
5	46-56 Ferrers Road, Horsley Park	Residential	340	650	520
6	34-44 Ferrers Road, Horsley Park	Residential	310	490	370

Rec#	Location	Land Use	Screening Distances (m)		
			Proposal Site boundary (350m)	Proposal site entrance (500m and 100m)	Construction route (50m)
7	31-37 Ferrers Road, Horsley Park	Residential	340	510	300
8	1,570 The Horsley Drive, Horsley Park	Residential	150	320	30
9	1538 The Horsley Drive, Abbotsbury	Residential	350	360	130
10	1532 The Horsley Drive, Abbotsbury	Residential	350	360	30
11	9 Derwent Place, Bossley Park	Residential	900	910	100

With reference to **Table 21** and **Figure 4**, a number of sensitive receptors are noted to be within the screening distance boundaries and therefore require further assessment. As shown within **Figure 4**, the screening distances also cover a small area of the industrial area to the east of Cowpasture Road.

Figure 4 Construction Phase Impact Sensitivity Screening

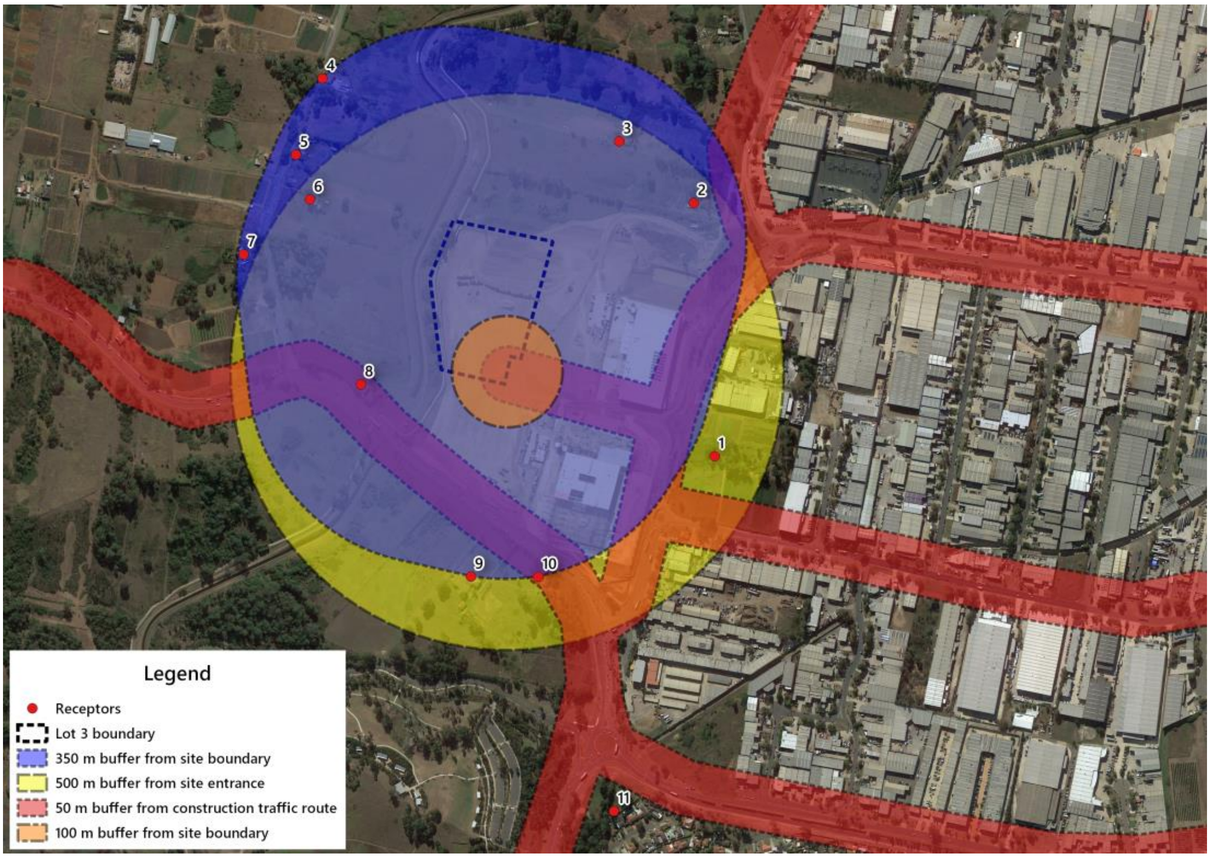


Table 22 Application of Step 1 Screening

Construction Impact	Screening Criteria	Step 1 Screening	Comments
Demolition	350 m from boundary 500 m from site entrance	Screened	Demolition previously completed or not required
Earthworks	350 m from boundary 500 m from site entrance	Screened	Earthworks previously completed
Construction	350 m from boundary 500 m from site entrance	Not screened	A number of receptors within the screening distance boundaries
Trackout	100 m from site entrance	Screened	Receptors beyond screening distances
Construction Traffic	50 m from roadside	Not screened	Receptors 8 & 10 near to potential construction route. Other receptors (not numbered) located along potential construction routes.

6.2. Impact Magnitude

The development of the site would require the construction of buildings and structures with an estimated aggregated building volume of approximately 279,990 m^3.

The assumed supply route around the site during construction works may be up to 800 m in total length.

Based upon the above assumptions and the assessment criteria presented in **Appendix B**, the dust emission magnitudes are as presented in **Table 23**.

Table 23 Construction Phase Impact Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude
Demolition	n/a
Earthworks and enabling works	n/a
Construction	large
Trackout	n/a
Construction traffic routes	large

6.3. Sensitivity of Receptors

6.3.1. Receptor Sensitivity

Based on the criteria listed in **Appendix B**, the sensitivity of the potentially impacted receptors surrounding the Proposal site is concluded to be *high* for health impacts and for dust soiling, based upon the following assumption:

- The receptor locations include residential properties where people may reasonably be expected to be present for eight to 24-hours.

Medium sensitivity receptors are also identified to the east of Cowpasture Road, in locations where people are anticipated to be employed (as opposed to residing). Given that the highest sensitivity receptors would tend to define the level of control required to minimise impacts, it is considered that these sensitivity receptors are appropriately considered for both health and dust soiling effects.

6.3.2. Sensitivity of an Area

Using the classifications shown in **Appendix B**, the sensitivity of the surrounding area to health effects and dust soiling may be identified. The assumed existing background annual average PM_{10} concentrations (as measured at St Marys) are reported in **Section 4.2**. The annual average PM_{10} concentration as measured at St Marys in 2013 was 16.0 $\mu g \cdot m^{-3}$, which provides the sensitivity of the area as: *low* for dust health impacts and *low* for dust soiling impacts.

6.4. Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as 'low' for dust soiling, and 'low' for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 23**, the resulting risk of air quality impacts (without mitigation) is as presented in **Table 24**.

Table 24 Risk of Air Quality Impacts from Construction Activities

Impact	Sensitivity of Area	Dust Emission Magnitude					Preliminary Risk				
		Demolition	Earthworks	Construction	Track-out	Construction Traffic	Demolition	Earthworks	Construction	Track-out	Construction Traffic
Dust Soiling	low	n/a	n/a	large	n/a	large	n/a	low	n/a	n/a	low
Human Health	low	n/a	n/a	large	n/a	large	n/a	low	n/a	n/a	low

The risks summarised in **Table 24** that there is a *low* risk of adverse dust soiling and human health impacts at all properties if no mitigation measures were to be applied to control emissions associated with construction activities and construction traffic.

6.5. Identified Mitigation

Table 25 lists the relevant mitigation measures recommended as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a *low* 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 25 Site-Specific Management Measures

Identified Mitigation		Low
1	Communications	
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
1.2	Display the head or regional office contact information.	H
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D
2	Site Management	
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H

Identified Mitigation		Low
2.2	Make the complaints log available to the local authority when asked.	H
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	H
3	Monitoring	
3.1	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
3.2	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
4	Preparing and Maintaining the Site	
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	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
4.4	Avoid site runoff of water or mud.	H
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D
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
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D
5	Operating Vehicle/Machinery and Sustainable Travel	
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	H
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	H
5.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable	H
5.4	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph 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
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

Identified Mitigation		Low
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.	D
7	Waste Management	
7.1	Avoid bonfires and burning of waste materials.	H
8	Measures Specific to Construction	
8.1	Avoid scabbling (roughening of concrete surfaces) if possible	D
8.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	D
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
8.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	N
9	Measures Specific to Track-Out	
9.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D
9.2	Avoid dry sweeping of large areas.	D
9.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D
9.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
9.5	Record all inspections of haul routes and any subsequent action in a site log book.	D
9.6	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D

Notes D = desirable, H = highly recommended.

6.6. 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 limited size of the Proposal site, no demolition activities or earthworks, residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be 'not significant'.

7. OPERATIONAL IMPACT ASSESSMENT

The methodology used to assess operational phase impacts is discussed in **Section 5.2**. This section presents the results of the dispersion modelling assessment and uses the following terminology:

- Incremental impact (Proposal) – relates to the concentrations predicted as a result of the operation of the Proposal (Lot 3 only) in isolation.
- Cumulative impact (Proposal) – relates to the concentrations predicted as a result of the operation of the Proposal (Lot 3 only) PLUS the background air quality concentrations discussed in **Section 4.2**.
- Incremental impact (HDBP) – relates to the concentrations predicted as a result of the operation of all Lots at the HDBP in isolation.
- Cumulative impact (HDBP) – relates to the concentrations predicted as a result of the operation of all Lots at the HDBP PLUS the background air quality concentrations discussed in **Section 4.2**.

The results are presented in this manner to allow examination of the likely impact of the Proposal in isolation for assessment as required through the planning process and the impacts when part of the broader HDBP development. It is acknowledged that the operation of the Proposal (Lot 3) in isolation would not occur, but results are provided to allow identification of those impacts.

Contour plots are provided for the predicted incremental concentrations of 24-hour PM_{10} and $PM_{2.5}$. No contour plots are provided for any other pollutant/averaging periods primarily given the low incremental contributions, or as NO_2 concentrations resulting from calculated transformations (NO_X to NO_2) cannot be shown.

7.1. Particulate Matter

7.1.1. Annual Average

The predicted annual average particulate matter concentrations resulting from the operation of The Proposal are presented in **Table 26**. The predictions provide an assessment of the impact which would be experienced should the Proposal operate independently of the other Lots within the HDBP.

The results indicate that predicted incremental concentrations of PM_{10} and $PM_{2.5}$ are low (<2% of the annual average PM_{10} criterion and 2.5% of the $PM_{2.5}$ criterion). The addition of existing background PM_{10} concentrations (refer **Section 4.2**) results in predicted concentrations of annual average PM_{10} being 55% of the relevant criterion.

Addition of an appropriate background concentration of $PM_{2.5}$ results in an exceedance of the relevant criterion at all receptor locations. However, these exceedences are driven by the high (and already exceeding) background annual average $PM_{2.5}$ concentrations rather than by the (low) marginal contribution from the Proposal itself.

Table 26 Predicted annual average PM_{10} and $PM_{2.5}$ concentrations – The Proposal

Rec	Annual Average PM_{10} Concentration ($\mu g \cdot m^{-3}$)				Annual Average $PM_{2.5}$ Concentration ($\mu g \cdot m^{-3}$)			
	Incr. Impact (Proposal)	% (incr. / crit.)	B/G	Cumulative Impact (Proposal)	Incr. Impact (Proposal)	% (incr. / crit.)	B/G	Cumulative Impact (Proposal)
1	0.5	1.7%	16.0	**16.5**	0.2	2.5%	9.4	9.6
2	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
3	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
4	<0.1	<0.3%	16.0	**<16.1**	<0.1	<1.2%	9.4	<9.5
5	<0.1	<0.3%	16.0	**<16.1**	<0.1	<1.2%	9.4	<9.5
6	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
7	<0.1	<0.3%	16.0	**<16.1**	<0.1	<1.2%	9.4	<9.5
8	0.2	0.7%	16.0	**16.2**	0.1	1.2%	9.4	9.5
9	0.2	0.7%	16.0	**16.2**	0.1	1.2%	9.4	9.5
10	0.3	1%	16.0	**16.3**	0.1	1.2%	9.4	9.5
11	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
Criteria				30.0				8.0

Note: Incr = Increment, B/G = Background, crit = criterion

Presented in **Table 27** are the predicted annual average PM_{10} and $PM_{2.5}$ concentrations anticipated from the operation of the HDBP as a whole (Lots 1 to 5) with the inclusion of background concentrations. Incremental annual average particulate concentrations are shown to be minor (7% of the PM_{10} criterion and <9% of the $PM_{2.5}$ criterion). Addition of existing background PM_{10} concentrations results in compliance with the annual average PM_{10} criterion although exceedance of the annual average $PM_{2.5}$ criterion is demonstrated, due to already exceeding background concentrations.

Table 27 Predicted annual average PM_{10} and $PM_{2.5}$ concentrations – HDBP

Receptor	Annual Average PM_{10} Concentration ($\mu g{\cdot}m^{-3}$)				Annual Average $PM_{2.5}$ Concentration ($\mu g{\cdot}m^{-3}$)			
	Incr. Impact (HDBP)	% (incr. / crit.)	B/G	Cumulative Impact (HDBP)	Incr. Impact (HDBP)	% (incr. / crit.)	B/G	Cumulative Impact (HDBP)
1	2.1	7%	16.0	**18.1**	0.7	8.8%	9.4	10.1
2	0.3	1%	16.0	**16.3**	0.1	<1.2%	9.4	9.5
3	0.2	0.7%	16.0	**16.2**	0.1	<1.2%	9.4	9.5
4	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
5	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
6	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
7	0.1	0.3%	16.0	**16.1**	<0.1	<1.2%	9.4	<9.5
8	0.3	1%	16.0	**16.3**	0.1	<1.2%	9.4	9.5
9	0.5	1.7%	16.0	**16.5**	0.2	2.5%	9.4	9.6
10	0.9	3%	16.0	**16.9**	0.3	3.7%	9.4	9.7
11	0.3	1%	16.0	**16.3**	0.1	1.2%	9.4	9.5
Criteria				30.0				8.0

Note: Incr = Increment, B/G = Background, crit = criterion

Presented in **Table 28** are the predicted annual average TSP concentrations anticipated from the operation of The Proposal and the HDBP as a whole (Lots 1 to 5) with the inclusion of background concentrations. Incremental annual average TSP concentrations are shown to be minor (<10% of the criterion) and additional of existing background concentrations results in compliance with the criterion.

Table 28 Predicted annual average TSP concentrations – The Proposal and HDBP

Receptor	Annual Average TSP Concentration ($\mu g \cdot m^{-3}$)							
	Incr. Impact (Proposal)	% (incr. / crit.)	B/G	Cumulative Impact (Proposal)	Incr. Impact (HDBP)	% (incr. / crit.)	B/G	Cumulative Impact (HDBP)
1	2.3	2.6%	38.4	**39.7**	9.3	10.3%	38.4	**47.7**
2	0.5	0.5%	38.4	**38.9**	1.3	1.4%	38.4	**39.7**
3	0.4	0.4%	38.4	**38.8**	0.9	1.0%	38.4	**39.3**
4	0.2	0.2%	38.4	**38.6**	0.4	0.4%	38.4	**38.8**
5	0.2	0.2%	38.4	**38.6**	0.4	0.4%	38.4	**38.8**
6	0.3	0.3%	38.4	**38.7**	0.5	0.5%	38.4	**38.9**
7	0.2	0.2%	38.4	**38.6**	0.4	0.4%	38.4	**38.8**
8	0.7	0.8%	38.4	**39.1**	1.2	1.3%	38.4	**39.6**
9	0.8	0.9%	38.4	**39.2**	2.1	2.3%	38.4	**40.5**
10	1.2	1.3%	38.4	**39.6**	3.5	3.9%	38.4	**41.9**
11	0.4	0.4%	38.4	**38.8**	1.2	1.3%	38.4	**39.6**
Criteria				90.0				90.0

Note: Incr = Increment, B/G = Background, crit = criterion

7.1.2. Maximum 24-hour Average

The predicted maximum incremental 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of The Proposal and the HDBP as a whole are presented in **Table 29**.

Table 29 Predicted maximum 24-hour PM_{10} & $PM_{2.5}$ concentrations – The Proposal and HDBP

Receptor	Maximum 24-hour PM_{10} Concentration ($\mu g \cdot m^{-3}$)				Maximum 24-hour $PM_{2.5}$ Concentration ($\mu g \cdot m^{-3}$)			
	Incr. Impact (Proposal)	% (incr. / crit.)	Incr. Impact (HDBP)	% (incr. / crit.)	Incr. Impact (Proposal)	% (incr. / crit.)	Incr. Impact (HDBP)	% (incr. / crit.)
1	3.5	7.0%	12.9	25.8%	1.1	4.4%	4.1	16.4%
2	0.5	1.0%	1.5	3.0%	0.2	0.8%	0.6	2.4%
3	0.5	1.0%	1.7	3.4%	0.2	0.8%	0.6	2.4%
4	0.4	0.8%	0.8	1.6%	0.2	0.8%	0.3	1.2%
5	0.6	1.2%	1.3	2.6%	0.2	0.8%	0.5	2.0%
6	0.8	1.6%	1.6	3.2%	0.3	1.2%	0.6	2.4%
7	0.8	1.6%	1.6	3.2%	0.3	1.2%	0.5	2.0%
8	1.4	2.8%	2.9	5.8%	0.5	2.0%	1.0	4.0%
9	1.1	2.2%	3.0	6.0%	0.4	1.6%	1.1	4.4%
10	1.7	3.4%	4.6	9.2%	0.6	2.4%	1.8	7.2%
11	0.7	1.4%	1.7	3.4%	0.3	1.2%	0.7	2.8%

Note: Incr = Increment, crit = criterion

The predicted concentrations are presented in **Table 29** without the addition of background concentrations. As discussed **Section 4.2**, concentrations of 24-hour average PM_{10} and $PM_{2.5}$ were shown to be heavily influenced during October and November in 2013 by 'exceptional events', particularly bushfires.

There are methods which can be adopted to take into account those exceptional events. The first is the removal of any PM concentration which is considered to be associated with an exceptional event. The addition of incremental concentrations would then be performed to identify the cumulative impact outside of those periods. The other method is to demonstrate that no additional exceedances of the relevant criterion would result from the operation of the Proposal and that is the method which has been adopted within this assessment.

Presented in **Figure 5** and **Figure 6** are the predicted cumulative 24-hour average PM_{10} concentrations resulting from operation of the Proposal and the HDBP as a whole, respectively, at Receptor 1 (the worst impacted receptor location). It is demonstrated that two exceedances of the 24-hour PM_{10} criterion were measured in 2013 without the Proposal (or HDBP), and two would be anticipated once the Proposal or HDBP are operational. No additional exceedances of the 24-hour PM_{10} criterion would be anticipated as a result of either the Proposal or HDBP operation.

Presented in **Figure 7** are the predicted incremental PM_{10} concentrations resulting from The Proposal and HDBP operations.

Figure 5 24-hour average PM_{10} concentrations – Receptor 1 (The Proposal)

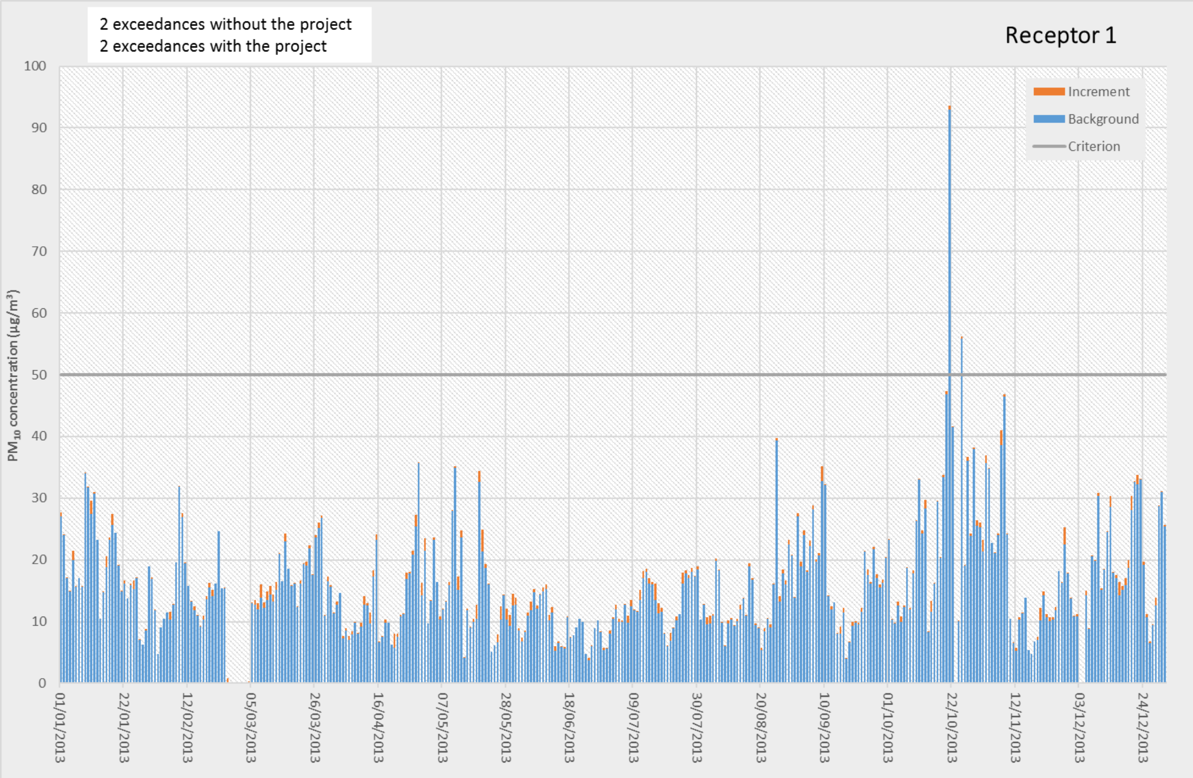


Figure 6 24-hour average PM_{10} concentrations – Receptor 1 (HDBP)

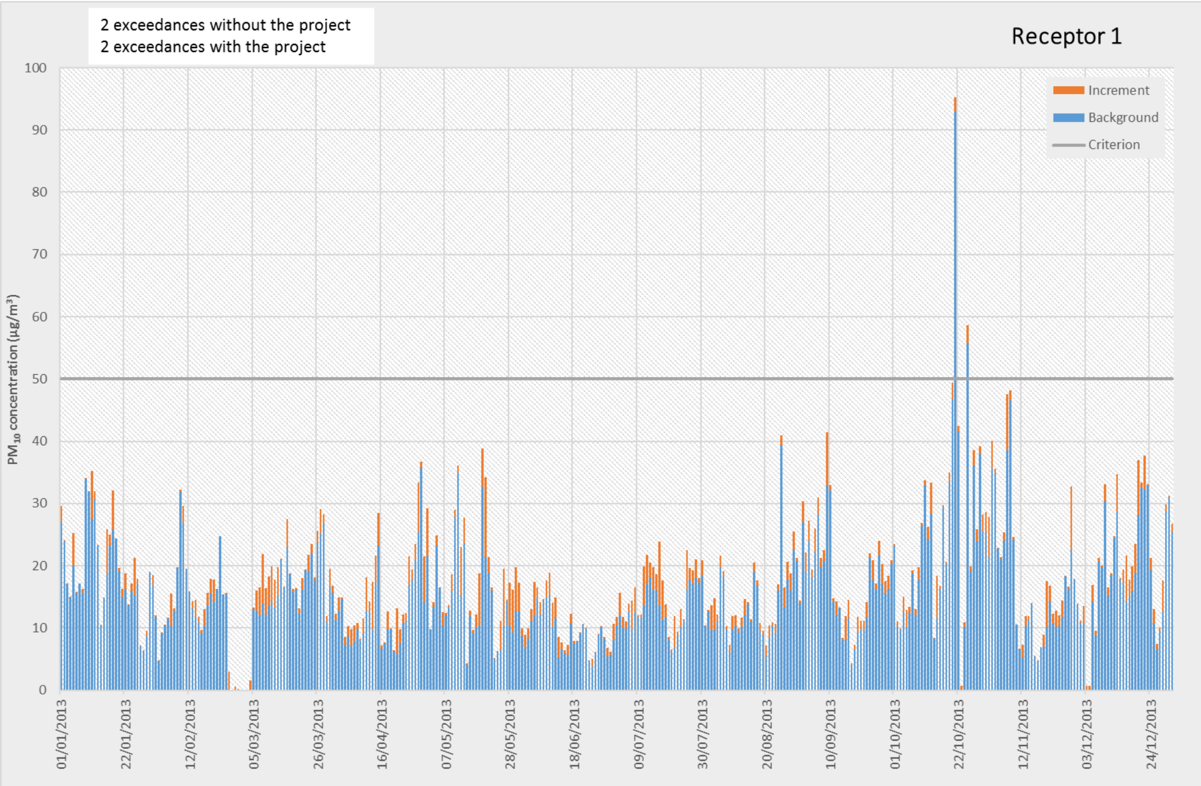
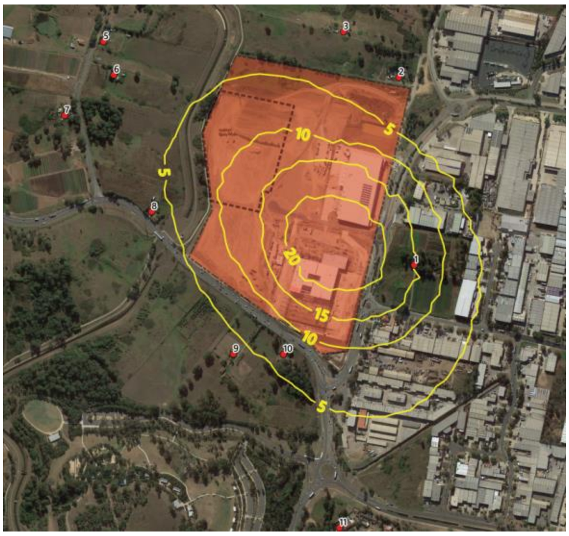


Figure 7 Incremental 24-hour average PM_{10} concentrations

The Proposal

Horsley Drive Business Park



Note: units - µg·m^{-3}

Similarly, presented in **Figure 8** and **Figure 9** are the predicted cumulative 24-hour average $PM_{2.5}$ concentrations resulting from operation of The Proposal and the HDBP as a whole, respectively, at Receptor 1 (the worst impacted receptor location). It is demonstrated that two exceedances of the 24-hour PM_{10} criterion were measured in 2013 without The Proposal (or HDBP), and two would be anticipated once the Proposal is operational. One additional exceedance is likely to be experienced when considering the operation of the HDBP as a whole although examination of data indicates that the HDBP would contribute <0.5 $\mu g{\cdot}m^{-3}$ to the predicted exceedance which would be dominated by existing background concentrations rather than the operation of the HDBP.

Presented in **Figure 10** are the predicted incremental $PM_{2.5}$ concentrations resulting from The Proposal and HDBP operations.

Figure 8 24-hour average $PM_{2.5}$ concentrations – Receptor 1 (The Proposal)

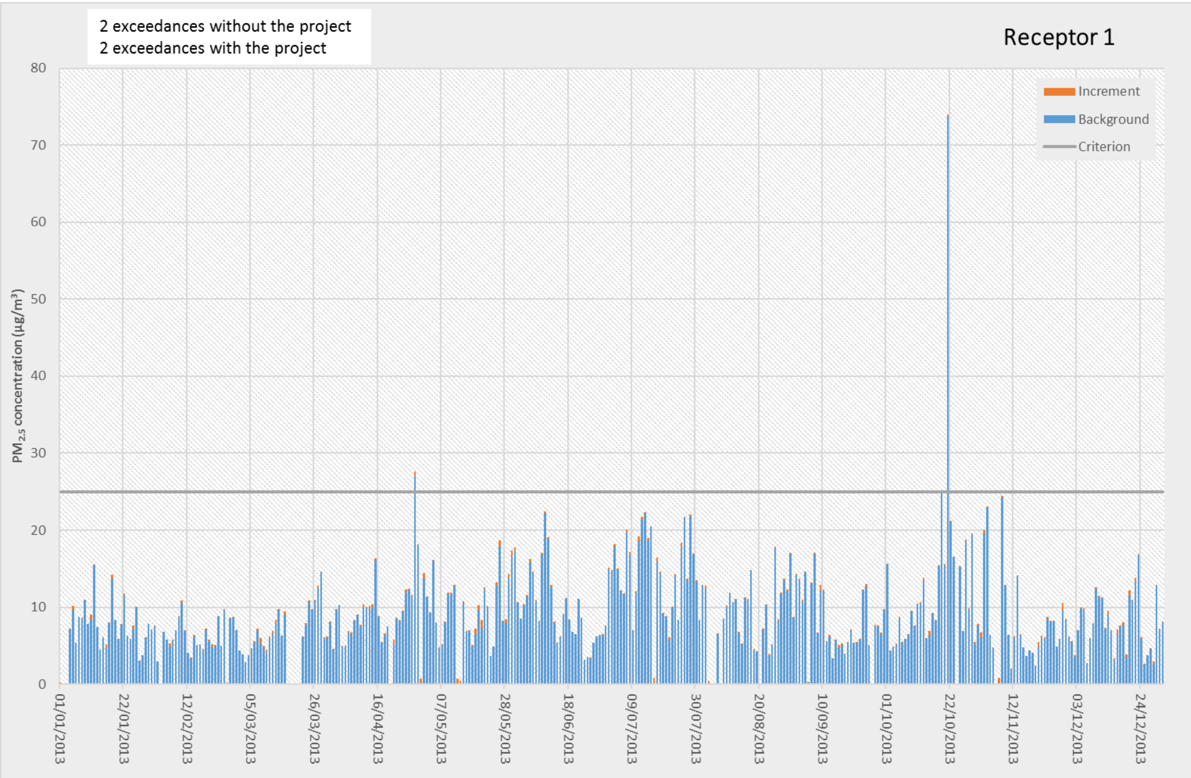


Figure 9 24-hour average $PM_{2.5}$ concentrations – Receptor 1 (HDBP)

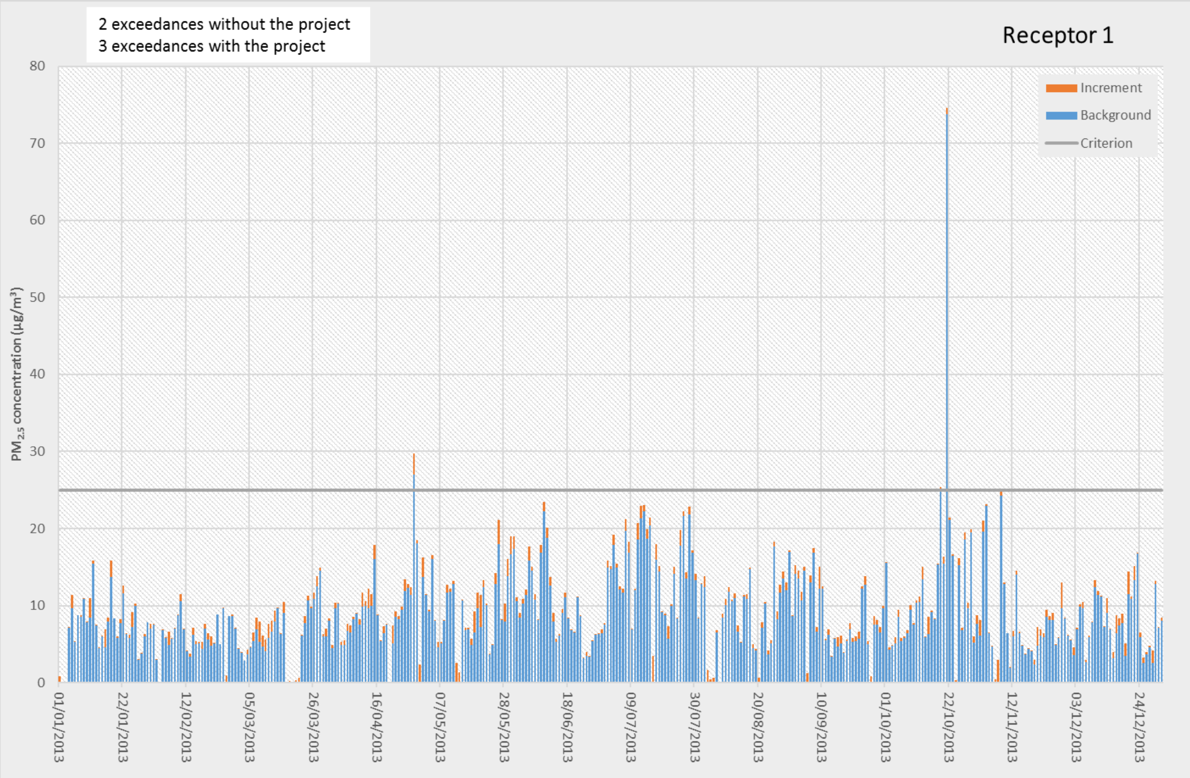
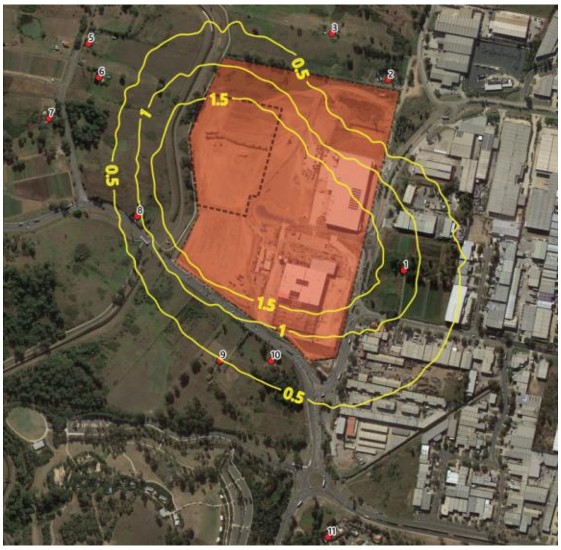
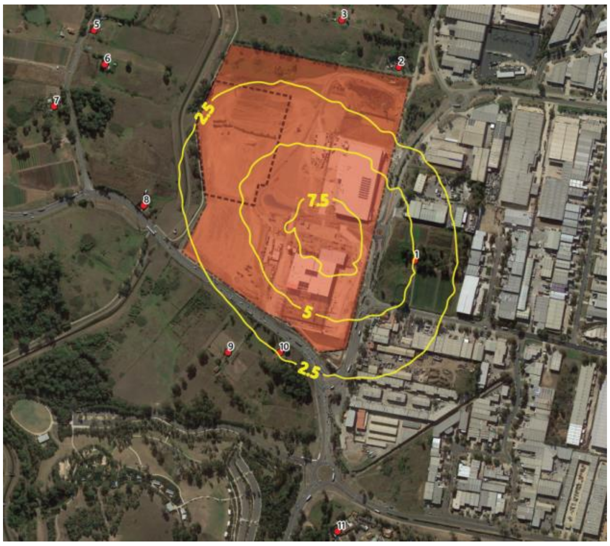


Figure 10 Incremental 24-hour average $PM_{2.5}$ concentrations

The Proposal



Horsley Drive Business Park



Note: units - $\mu g{\cdot}m^{-3}$

7.2. Nitrogen Dioxide

As described in **Section 5.2.1**, emissions of NO_X have been calculated with subsequent ground level concentrations predicted using dispersion modelling techniques. Given that NO_X is a mixture of NO_2 and nitric oxide (NO), conversion of NO_X predictions to NO_2 concentrations is required. Within this assessment, the Ozone Limiting Method (OLM) has been adopted and is in accordance with method 2 as outlined in the Approved Methods. For calculation of annual average NO_2 concentrations, the annual average ozone concentration measured at the St Marys AQMS has been used. In the assessment of maximum 1-hour concentrations of NO_2, the daily maximum ozone concentration contemporaneous to the hourly NO_X predictions during that day has been used within the OLM calculation.

7.2.1. Annual Average

Predictions of annual average NO_2 concentrations resulting from operation of The Proposal and the HDBP as a whole are presented in **Table 30**.

Table 30 Predicted annual average NO_2 concentrations – The Proposal and HDBP

Receptor	Annual Average NO_2 Concentration ($\mu g \cdot m^{-3}$)							
	The Proposal				HDBP			
	Incr. Impact	% (incr. / crit.)	B/G	Cumulative Impact	Incr Impact	% (incr. / crit.)	B/G	Cumulative Impact
1	2.1	3.4%	9.5	**11.6**	9.6	15.5%	9.5	**19.1**
2	0.7	1.1%	9.5	**10.2**	2.2	3.5%	9.5	**11.7**
3	0.6	1.0%	9.5	**10.1**	1.4	2.3%	9.5	**10.9**
4	0.2	0.3%	9.5	**9.7**	0.5	0.8%	9.5	**10.0**
5	0.3	0.5%	9.5	**9.8**	0.6	1.0%	9.5	**10.1**
6	0.4	0.6%	9.5	**9.9**	0.8	1.3%	9.5	**10.3**
7	0.3	0.5%	9.5	**9.8**	0.6	1.0%	9.5	**10.1**
8	0.9	1.5%	9.5	**10.4**	1.8	2.9%	9.5	**11.3**
9	0.9	1.5%	9.5	**10.4**	3.3	5.3%	9.5	**12.8**
10	1.4	2.3%	9.5	**10.9**	5.5	8.9%	9.5	**15.0**
11	0.5	0.8%	9.5	**10.0**	1.5	2.4%	9.5	**11.0**
Criteria				62.0				62.0

Note: Incr = Increment, B/G = Background, crit = criterion

All predictions are well below (<31%) of the criterion at all receptors, even when taking into account the existing background concentration and the operation of the HDBP as a whole.

7.2.2. Maximum 1-hour Average

Predictions of maximum 1-hour NO_2 concentrations resulting from operation of the Proposal and the HDBP as a whole are presented in **Table 31**.

Table 31 Predicted 1-hour maximum NO_2 concentrations – The Proposal and HDBP

Receptor	1-hour Maximum NO_2 Concentration ($\mu g \cdot m^{-3}$)							
	The Proposal				HDBP			
	Incr. Impact	% (incr. / crit.)	B/G	Cumulative Impact	Incr. Impact	% (incr. / crit.)	B/G	Cumulative Impact
1	45.7	18.6%	36.9	**82.6**	84.6	34.4%	26.7	**111.3**
2	41.7	17.0%	30.8	**72.4**	79.6	32.4%	32.8	**112.4**
3	51.8	21.1%	22.6	**89.3**	71.7	29.1%	26.7	**98.4**
4	57.0	23.2%	32.8	**89.8**	64.9	26.4%	32.8	**97.7**
5	45.5	18.5%	24.6	**70.1**	95.2	38.7%	24.6	**119.8**
6	68.6	27.9%	39.0	**107.6**	82.0	33.3%	39.0	**120.9**
7	39.0	15.9%	39.0	**78.0**	71.4	29.0%	39.0	**110.3**
8	73.9	30.0%	43.1	**146.6**	94.3	38.3%	39.0	**133.3**
9	51.1	20.8%	34.9	**86.0**	82.7	33.6%	30.8	**113.5**
10	59.6	24.2%	41.0	**100.6**	123.3	50.1%	36.9	**160.2**
11	15.5	6.3%	22.6	**38.0**	66.2	26.9%	43.1	**109.3**
Criteria				246.0				246.0

Note: Incr = Increment, B/G = Background, crit = criterion

All predictions are below (~65%) of the criterion at all receptors, even when taking into account the existing background concentration and the operation of the HDBP as a whole.

The maximum cumulative 1-hour maximum NO_2 concentration predicted was 160.2 $\mu g \cdot m^{-3}$ at Receptor 10 at 8 pm on 9 October 2013. Presented in **Figure 11** is the representation of the distribution of NO_2 during that hour across the surrounding area.

Figure 11 Cumulative 1-hour maximum NO_2 concentration (8 pm, 9th October 2013)

Note: units - µg·m^{-3}

8. GREENHOUSE GAS ASSESSMENT

The SEARs for the Proposal (refer **Section 1.1**) require that a Greenhouse Gas and Energy Efficiency Assessment is performed, which includes an assessment of the energy use on site and a demonstration of the measures which would be implemented to ensure the Proposal is energy efficient.

The GHG accounting and reporting principles adopted within this GHG assessment are based on the following financial accounting and reporting standards:

- Australian Government Department of the Environment, Australian National Greenhouse Accounts, National Greenhouse Accounts Factors, August 2015 (DoE, 2015);
- The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) GHG Protocol: A Corporate Accounting and Report Standard (WRI, 2004);
- ISO 14064-1:2006 (Greenhouse Gases – Part 1: Specification with guidance at the organisation level for quantification and reporting of GHG emissions and removal;
- ISO 14064-2:2006 (Greenhouse Gases – Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of GHG emission reductions or removal enhancements); and,
- ISO 14064-3:2006 (Greenhouse Gases – Part 3: Specification with guidance for the validation and verification of GHG assertions) guidelines (internationally accepted best practice).

Further detail is provided in **Section 8.1**.

8.1. Methodology

8.1.1. Emission Types

The Australian Government Department of the Environment (DoE) document, "National Greenhouse Accounts Factors" Workbook (NGA Factors) (DoE, 2015) defines two types of GHG emissions (see **Table 32**), namely 'direct' and 'indirect'. This assessment considers both direct emissions and indirect emissions resulting from Proposal construction and operation.

Table 32 Greenhouse gas emission types

Emission Type	Definition
Direct	Produced from sources within the boundary of an organisation and as a result of that organisation's activities (e.g. consumption of fuel in on-site vehicles)
Indirect	Generated in the wider economy as a consequence of an organisation's activities (particularly from its demand for goods and services), but which are physically produced by the activities of another organisation (e.g. consumption of purchased electricity).

Note: Adapted from NGA Factors Workbook (DoE, 2015)

8.1.2. Emission Scopes

The NGA Factors (DoE, 2015) identifies two 'scopes' of emissions for GHG accounting and reporting purposes as shown in **Table 33**.

Table 33 Greenhouse gas emission scopes

Emission Scope	Definition
Scope 1	Direct (or point-source) emission factors give the kilograms of carbon dioxide equivalent (CO_2-e) emitted per unit of activity at the point of emission release (i.e. fuel use, energy use, manufacturing process activity, mining activity, on-site waste disposal, etc.). These factors are used to calculate Scope 1 emissions.
Scope 2	Indirect emission factors are used to calculate Scope 2 emissions from the generation of the electricity purchased and consumed by an organisation as kilograms of CO_2-e per unit of electricity consumed. Scope 2 emissions are physically produced by the burning of fuels (coal, natural gas, etc.) at the power station.

Note: Adapted from NGA Factors Workbook (DoE, 2015)

A third scope of emissions, Scope 3 Emissions, are also recognised in some GHG assessments. The Greenhouse Gas Protocol (GHG Protocol) (WRI, 2004) defines Scope 3 emissions as "other indirect GHG emissions":

> *"Scope 3 is an optional reporting category that allows for the treatment of all other indirect emissions. Scope 3 emissions are a consequence of the activities of the company, but occur from sources not owned or controlled by the company. Some examples of Scope 3 activities are extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services."*

Scope 3 emissions have not been considered within this assessment

8.1.3. Source Identification and Boundary Definition

The geographical boundary set for the GHG assessment covers the Proposal site and does not include the transport of materials to and from the Proposal site (as defined above). Emissions associated with Proposal construction and all associated mobile plant and equipment are not included in this assessment, as the ongoing energy efficiency of the Proposal operation is considered to be of greater concern.

All Scope 1 and Scope 2 within the defined boundary have been identified and reported as far as possible.

8.1.4. Emission Source Identification

The GHG emission sources associated with the operation of the Proposal have been identified through review of the proposed activities as described in **Section 2.4**.

The activities/operations being performed as part of the Proposal which have the potential to result in emissions of GHG are presented in **Table 34**.

Table 34 Greenhouse gas emission sources

Proposal Component	Scope	Emission Source Description
Consumption of purchased electricity	2	Emissions due to fossil fuel combustion in power station

No scope 1 emissions associated with the consumption of unleaded fuel, diesel fuel or natural gas are anticipated during the operation of the warehouse. Fuel would be combusted in vehicles using the Proposal (i.e. heavy good vehicles etc.) although this assessment is concerned with the energy efficiency of the Proposal site rather than the transportation of goods and materials.

8.1.5. Emissions Estimation

Emissions of GHG from the source identified in **Table 34** have been calculated using activity data for the source per annum (i.e. kWh electricity) and the relevant emission factor for each source.

The assumptions used in the calculation of activity data for the emission source are presented in **Section 4.5.1**. Emission factors are presented in **Section 4.5.2**.

Activity Data

The assumptions are outlined in **Table 35**.

Table 35 Calculated activity data

Proposal Component	Assumptions	Activity	Units
Consumption of purchased electricity	Based on information provided by Frasers	177,998	kWh

Emission Factors

Emissions factors used for the assessment of GHG emissions associated with the construction and operation of the Proposal have been sourced from the NGA Factors (DoE, 2015) (refer to **Table 36**).

Table 36 Greenhouse gas emission factors

Emission Scope	Emission Source	Emission Factor
Scope 2	Electricity (NSW)	0.84 kg CO_2-e·kWh^{-1}

8.2. Assessment Outcomes

8.2.1. Quantification of Greenhouse Gas Emissions

Based on the activity data for the operation of the Proposal and the emission factor as outlined in **Section 8.1.5**, annual GHG emissions have been calculated and are presented in **Table 37**.

Indirect (Scope 2) emissions are calculated to be minor with emissions during operations anticipated to be 149.5 t CO_2-e per year.

Table 37 Calculated proposal GHG emissions

Emission Scope	Emission Source	GHG Emissions (t CO_2-e per annum)
Scope 2	Purchased electricity consumption	149.5
	TOTAL Scope 2	**149.5**

8.2.2. Greenhouse Gas Emissions in Context

A comparison of the calculated GHG emissions associated with the Proposal and the NSW and Australia total emissions in 2014 is presented **Table 38**.

These data indicate that the op of the Proposal in its entirety would contribute up to 0.0001% of NSW total GHG emissions and less than 0.0001% of Australian total GHG emissions in 2014.

Table 38 Proposal GHG emissions in context

Proposal Phase	Emissions (t CO_2-e per annum)		
	Proposal	NSW (2014)	Australia (2014)
		Total 130,115,670	Total 525,202,270
Operation	149.5	0.0001 %	<0.0001 %

8.3. Discussion

The GHG assessment indicates that during Proposal operation, emissions are likely to be small and contribute up to 0.0001% of the NSW 2014 emission total.

Emissions may be further minimised by introducing a number of energy efficiency measures. Frasers is targeting six-star Green Star Design and As-Built v1.1 rating from the Green Building Council of Australia for the Proposal. The key initiatives that relate to the sustainability performance of the Proposal site are outlined in **Table 39**.

Table 39 Key initiatives for six-star Green Star Proposal

Energy	
Building fabric	10% improvement on BCA – double glazing, increased façade and roof insulation
Translucent sheeting	10% of warehouse roof
Hot water system	Heat pump (air source or geothermal)
Office heating and cooling	Geothermal – reverse cycle ducted
Office outside air	Min 50% increase on OA
Lighting – office	LED with individual control
Lighting – warehouse	LED with daylight control
Lighting – external	LED with time clock control
Renewable energy	Solar PV system (100 kW)
Energy storage	Customer dependent
Electric vehicle charging	Included
Water	
Water fixtures	5 & 6 star WELS rated
Recycled water	Rainwater for 80%+ irrigation and toilet flushing
Fire test water recycling	80%+ of fire test water recycled
Sub-metering	Electricity and water with web based monitoring system
Commissioning	Commissioning manager and plan

Note: taken from SLR (2016)

9. CONCLUSION

Frasers Property Industrial Constructions Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform an air quality impact assessment and greenhouse gas assessment for the construction and operation of a proposed warehouse/distribution centre and industrial facility (The Proposal) to be located at Lot 3 of the Horsley Drive Business Park on the corner of Horsley Drive and Cowpasture Road, Wetherill Park, NSW.

As required by the Secretary's Environmental Assessment Requirements, an assessment of the air quality impacts at private properties during the construction and operation of the development has been performed.

A qualitative (risk based) assessment of the potential construction impacts has been performed which has indicated that pre-mitigated risks are anticipated to be 'low'. The application and implementation of a number of management measures would ensure that any impacts would be 'not significant'.

A quantitative dispersion modelling assessment has been performed to assess the potential impacts of the proposed operation of the Lot 3 development on the surrounding private properties. The results of that assessment indicate that the operation would not result in any significant changes to the air quality environment or exceedances of air quality criteria with all relevant air quality criteria being achieved with the exception of annual average $PM_{2.5}$ concentrations. Background (i.e. existing) $PM_{2.5}$ concentrations already exceed the annual average criterion in the region and the operation of the Lot 3 development is shown to result in low (<2.5%) contributions to the criterion. The Lot 3 development would not be the major source of particulate matter in the region.

Taking into account the operation of all other Lots at the Horsley Drive Business Park which have already been approved (Lots 1, 2, 4 and 5), and with the addition of the operations at Lot 3, it has been demonstrated that these operations can be able to be performed without a detrimental impact to the air quality environment of the area. The Horsley Drive Business Park as a whole has been shown to be able to operate without any significant changes to the air quality environment or exceedances of air quality criteria, with the exception of annual average $PM_{2.5}$ concentrations. The operation of the Horsley Drive Business Park has been shown to contribute up to 8.75% of the annual average $PM_{2.5}$ criterion and is not anticipated to be a significant contributor to particulate matter concentrations in the area.

An assessment of energy use on site has indicated that this would represent <0.0001% of Australian greenhouse gas emissions in 2014. Emissions may be further minimised by introducing a number of energy efficiency measures and Frasers Property Industrial Constructions Pty Ltd is targeting six-star Green Star Design and As-Built v1.1 rating from the Green Building Council of Australia for the development, ensuring efficient energy usage.

10. REFERENCES

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APPENDIX A

Pollutant	Ave. Period	Criterion	Prospect					Liverpool				
			2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
SO_2 µg·m^{-3}	1 hr	570	40.0	34.3	57.2	54.3	77.2	-	-	-	-	-
			7%	6%	10%	10%	14%	-	-	-	-	-
	24 hrs	228	8.6	8.6	11.4	14.3	8.6	-	-	-	-	-
			4%	4%	5%	6%	4%	-	-	-	-	-
	1 yr	60	1.8	2.2	2.2	1.9	1.6	-	-	-	-	-
			3%	4%	4%	3%	3%	-	-	-	-	-
NO_2 µg·m^{-3}	1 hr	246	1.8	2.2	2.2	1.9	1.6	94.3	94.3	114.8	90.2	123.0
			33%	42%	41%	39%	44%	38%	38%	47%	37%	50%
	1 yr	62	80.0	102.5	100.5	96.4	108.7	94.3	94.3	114.8	90.2	123.0
			34%	34%	35%	34%	35%	32%	29%	37%	34%	32%
CO mg·m^{-3}	8 hr	10	2.1	2.3	2.0	1.6	1.9	3.0	2.4	2.6	2.8	2.3
			21%	23%	20%	16%	19%	30%	24%	26%	28%	23%
PM_{10} µg·m^{-3}	24 hr	50	41.5	38.7	**81.8**	44.3	**68.7**	**68.8**	42.5	**98.5**	40.8	**68.6**
			83%	77%	**164%**	89%	**137%**	**138%**	85%	**197%**	82%	**137%**
	1 yr	30	15.8	17.2	19.2	17.6	17.6	18.1	19.8	21.0	19.1	18.5
			53%	57%	64%	59%	59%	60%	66%	70%	64%	62%
$PM_{2.5}$ µg·m^{-3}	24 hr	25	-	-	-	14.0	**29.6**	**38.0**	24.9	**73.8**	24.3	**32.2**
			-	-	-	56%	**118%**	**152%**	100%	**295%**	97%	**129%**
	1 yr	8	-	-	-	7.5	**8.2**	5.9	**8.5**	**9.4**	**8.6**	**8.5**
			-	-	-	94%	**103%**	74%	**107%**	**117%**	**108%**	**106%**

<50% of relevant criterion	50% to 100% of relevant criterion	**≥100% of relevant criterion**

Pollutant	Ave. Period	Criterion	St Marys					Bringelly				
			2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
SO_2 µg·m^{-3}	1 hr	570	-	-	-	-	-	31.5	42.9	31.5	25.7	20.0
			-	-	-	-	-	6%	8%	6%	5%	4%
	24 hrs	228	-	-	-	-	-	5.7	5.7	5.7	8.6	2.9
			-	-	-	-	-	3%	3%	3%	4%	1%
	1 yr	60	-	-	-	-	-	0.3	0.5	0.7	0.6	0.3
			-	-	-	-	-	0%	1%	1%	1%	0%
NO_2 µg·m^{-3}	1 hr	246	73.8	88.2	75.9	63.6	65.6	59.5	77.9	75.9	51.3	55.4
			30%	36%	31%	26%	27%	24%	32%	31%	21%	23%
	1 yr	62	73.8	88.2	75.9	63.6	65.6	59.5	77.9	75.9	51.3	55.4
			19%	18%	17%	13%	13%	16%	17%	15%	14%	13%
CO mg·m^{-3}	8 hr	10	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
PM_{10} µg·m^{-3}	24 hr	50	**73.9**	34.3	**93.0**	45.0	**53.0**	**86.0**	40.1	**97.2**	**42.6**	**57.0**
			148%	69%	**186%**	90%	**106%**	**172%**	80%	**194%**	**85%**	**114%**
	1 yr	30	14.7	14.5	16.0	16.7	15.0	15.9	15.7	17.0	16.6	15.8
			49%	48%	53%	56%	50%	53%	52%	57%	55%	53%
$PM_{2.5}$ µg·m^{-3}	24 hr	25	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-
	1 yr	8	-	-	-	-	-	-	-	-	-	-
			-	-	-	-	-	-	-	-	-	-

<50% of relevant criterion	50% to 100% of relevant criterion	≥100% of relevant criterion

APPENDIX B - 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. The adaptions made by Northstar Air Quality from the IAQM published methodology are:

- an amended criterion representing the annual average PM_{10} criterion relevant to Australia rather than the UK;
- 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 five 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,
- 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	• < 10,000 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
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

Activity	Large	Medium	Small
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 Receptors

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 sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- In the case of PM_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Receptor Sensitivity

Individual receptors are classified as having high, medium or low sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects 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 Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
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.*
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 Surrounding Area

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

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant, the season during which the works 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

Health Impacts

A modified version of the IAQM guidance for assessing the *sensitivity of an area* to health impacts is shown in the table overleaf. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (i.e. an annual average of 30 $\mu g \cdot m^{-3}$ for PM_{10}), the IAQM method has been adapted by Northstar Air Quality.

This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area,* professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area, and if relevant the season during which the works 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.

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

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

(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'.

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

Receptor sensitivity	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 dust emission magnitude from Step 2 and the sensitivity categories from Step 3 are then used in the matrices shown in the tables below for earthworks / construction, demolition, and trackout / construction traffic to determine the risk category with no mitigation applied.

Risk of dust impacts from earthworks and construction activities

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

Risk of dust impacts from demolition activities

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

Risk of dust impacts from trackout (within 100m of construction site entrance) and construction traffic (from construction site entrance to origin)

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

Step 5 – Identify Mitigation

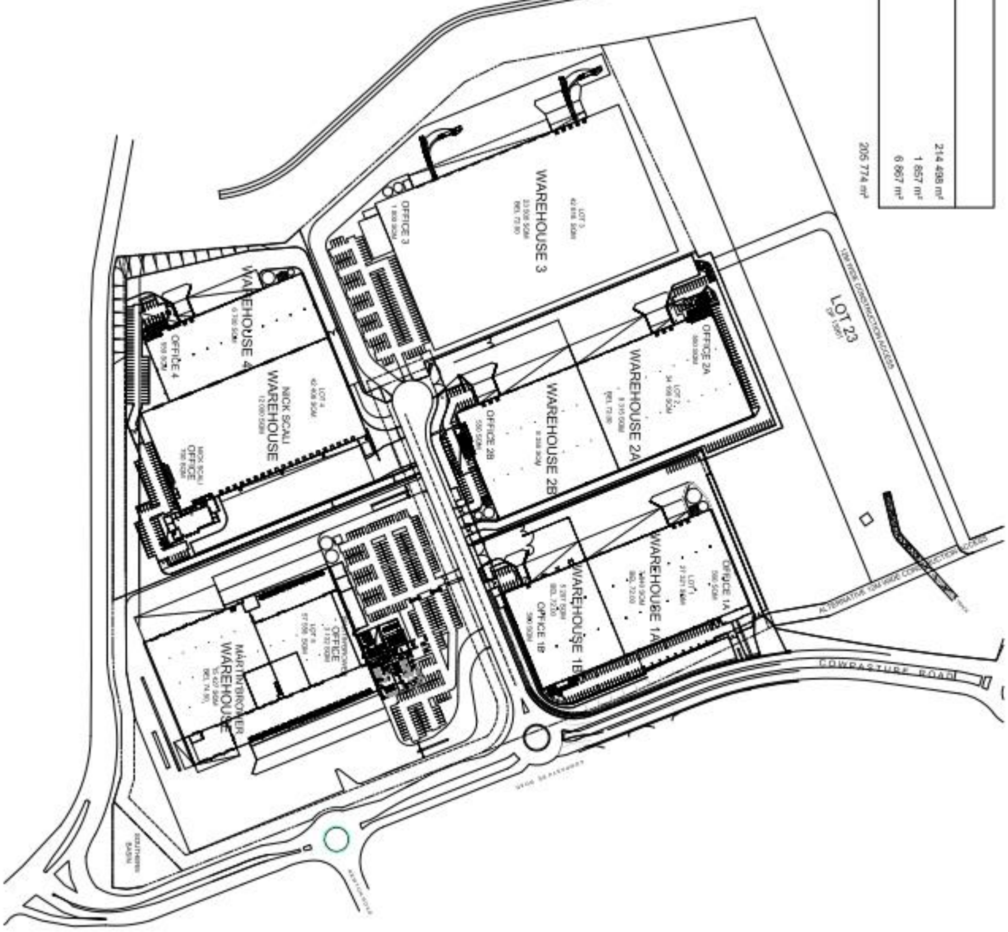
Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low, medium or high risk site.

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

APPENDIX C – HORSLEY DRIVE BUSINESS PARK – MASTERPLAN

DEVELOPMENT AREAS	
GROSS SITE AREA	214 498 m²
SOUTHERN BASIN	1 857 m²
INTERNAL ROAD WORKS	6 867 m²
NET DEVELOPABLE SITE AREA	205 774 m²



DEVELOPMENT AREAS

STAGE 1	LOT 1	27 321 m²		
	WAREHOUSE 1A		7 840 m²	
	OFFICE 1A (MEZZANINE)		560 m²	
				8 400 m²
	WAREHOUSE 1B		5 207 m²	
	OFFICE 1B (MEZZANINE)		560 m²	
				5 767 m²
STAGE 2	LOT 2	34 538 m²		
	WAREHOUSE 2A		9 315 m²	
	OFFICE 2A		550 m²	
				9 865 m²
	WAREHOUSE 2B		8 355 m²	
	OFFICE 2B (MEZZANINE)		550 m²	
				8 905 m²
	LOT 3	43 951 m²		
	WAREHOUSE 3		23 500 m²	
	OFFICE 3 (2 STOREY)		1 000 m²	
				24 500 m²
	LOT 4	42 406 m²		
	WAREHOUSE (NICK SCALI)		12 000 m²	
	OFFICE (NICK SCALI)		700 m²	
				12 700 m²
	WAREHOUSE 4		6 700 m²	
	OFFICE 4 (MEZZANINE)		550 m²	
				7 250 m²
STAGE 1	LOT 5	57 558 m²		
	WAREHOUSE (MARTIN BROWER)		15 427 m²	
	OFFICE (MARTIN BROWER)		3 132 m²	
				18 559 m²
	TOTAL	205 774 m²	95 946 m²	
	EFFICIENCY		46.6 %	

NOTE
BULK EARTHWORKS LEVELS + RETAINING WALL HEIGHTS ARE APPROXIMATE ONLY.
EXTERNAL ROAD WORKS BY OWNER SHOWN SHADED.

FRASERS PROPERTY

SYDNEY
LEVEL 3
1C Homebush Bay Drive
Rhodes
NSW 1670
TEL: 02 9767 2000 FAX: 02 9767 2903

HORSLEY DRIVE BUSINESS PARK
CORNER OF HORSLEY DRIVE & COWPASTURE ROAD

MASTER PLAN

SCALE
SCALE 1:500 @ A1
JOB
MP - WSPT - FS - 16
DATE
20.03.16
REV
A