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Ardex Warehouse and Manufacturing Facility

Air Quality Impact Assessment

Addressee(s):	The Trust Company (Australia) Limited
Report Reference:	21.1137.FR1V3
Date:	5 November 2021

Quality Control

Study	Status	Prepared	Checked	Authorised
INTRODUCTION	Final	Northstar	GCG	MD
THE PROPOSAL	Final	Northstar	GCG	MD
LEGISLATON, REGULATION AND GUIDANCE	Final	Northstar	GCG	MD
EXISTING CONDITIONS	Final	Northstar	GCG	MD
METHODOLOGY	Final	Northstar	GCG	MD
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Report Status

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Final Authority

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

Martin Doyle **5th November 2021**

Non-Technical Summary

The Trust Company (Australia) Limited has engaged Northstar Air Quality Pty Ltd to perform an air quality impact assessment (AQIA), to support State Significant Development (SSD 25725029). State Significant Development 25725029 seeks approval to construct, fit out and operate a manufacturing facility and associated warehouse facility at 657-769 Mamre Road, Kemps Creek (proposed Lot 12) which will be occupied and operated by Ardex (the Proposal).

The Proposal site is located within the broader Kemps Creek Warehouse, Logistics and Industrial Facilities Hub at 657-769 Mamre Road, Kemps Creek, NSW (approved as State Significant Development 9522).

A dispersion modelling exercise has been performed to assess the potential impacts of the development at all off-site locations. Emissions of particulate matter associated with the storage of powdered materials, and emitted during the powder and liquid manufacturing process, were subject to modelling. Even with the inclusion of conservative background air quality concentrations, the impacts of the development are shown to not result in any exceedances of the relevant air quality criteria.

Given the quantity of earthworks proposed, a review of the construction phase risk assessment performed for the broader Kemps Creek Warehouse, Logistics and Industrial Facilities Hub has been reviewed. Risks associated with earthworks have the potential to be large, resulting in a high risk of dust soiling and health impacts. Nevertheless, impacts could easily be managed through the implementation of a considered Construction Dust Management Plan.

This report meets the requirements of the Secretary's Environmental Assessment Requirements for the proposed warehouse and manufacturing facility, as identified below.

Issue	Requirement	Addressed
Air Quality and Odour (SEARs)	A quantitative assessment of the potential air quality, dust and odour impacts of the development (construction and operation) on sensitive receivers, in accordance with relevant Environment Protection Authority guidelines and details of proposed mitigation, management and monitoring measures.	Section 6 and Section 7
Air Quality and Odour (NSW EPA)	Potential air and odour quality impacts due to construction and operation • Proposed measures in place to manage odours from the storage of highly chemicals. A sensitive receptor includes a location where people work – thus clarification on the nearest sensitive receptor is required. Adjacent premises must be considered required when assessing project air impacts. • Benchmark proposed air pollution control and mitigation measures against best available practice.	Section 6 and Section 7

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Units Used in the Report

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

Common Abbreviations

Abbreviation	Term
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
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEC	Department of Environment and Conservation
DPI&E	Department of Planning, Industry and Environment
EETM	emission estimation technique manual
EPA	Environmental Protection Authority
m^{-2}	per square metre
m^{-3}	per cubic metre
$mg \cdot m^{-3}$	milligram per cubic metre of air
$mg \cdot Nm^{-3}$	milligram per normalised cubic metre of air

Abbreviation	Term
$\mu g \cdot m^{-3}$	microgram per cubic metre of air
mE	metres East
$month^{-1}$	per month
mS	metres South
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
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SSD	State Significant Development
TAPM	The Air Pollution Model
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VKT	vehicle kilometres travelled
WSEA	Western Sydney Employment Area

1. INTRODUCTION

The Trust Company (Australia) Limited has engaged Northstar Air Quality Pty Ltd (Northstar) to perform an air quality impact assessment (AQIA), to support State Significant Development (SSD 25725029). SSD 25725029 seeks approval to construct, fit out and operate a manufacturing facility and associated warehouse facility at 657-769 Mamre Road, Kemps Creek (proposed Lot 12) which will be occupied and operated by Ardex (the Proposal).

The Proposal site is located within the broader Kemps Creek Warehouse, Logistics and Industrial Facilities Hub at 657-769 Mamre Road, Kemps Creek, NSW (approved as SSD 9522).

This AQIA adopts a consistent approach to that presented in the supporting documentation for the Kemps Creek Warehouse, Logistics and Industrial Facilities Hub (SSD 9522), presents an assessment of the risks to local air quality associated with the construction and operation of the Proposal, and presents a range of recommended mitigation measures, to minimise those impacts where required and relevant.

1.1. Secretary's Environmental Assessment Requirements

NSW Department of Planning, Industry and Environment (DPIE) issued the Secretary's Environmental Assessment Requirements (SEARs) for the Proposal on 3 September 2021. Those requirements related to air quality are presented in **Table 1** which also includes the relevant sections of the report in which they have been addressed.

Table 1 Secretary's Environmental Assessment Requirements (SSD 25725029)

Issue	Requirement	Addressed
Air Quality and Odour (SEARs)	A quantitative assessment of the potential air quality, dust and odour impacts of the development (construction and operation) on sensitive receivers, in accordance with relevant Environment Protection Authority guidelines and details of proposed mitigation, management and monitoring measures.	Section 6 and Section 7
Air Quality and Odour (NSW EPA)	Potential air and odour quality impacts due to construction and operation • Proposed measures in place to manage odours from the storage of highly chemicals. A sensitive receptor includes a location where people work – thus clarification on the nearest sensitive receptor is required. Adjacent premises must be considered required when assessing project air impacts. • Benchmark proposed air pollution control and mitigation measures against best available practice.	Section 6 and Section 7

1.2. Purpose of the Report

The purpose of this report is to examine and identify whether the impacts of the construction and operation of the Proposal may adversely affect local air quality.

To allow assessment of the level of risk associated with the Proposal in relation to air quality, the AQIA has been performed in accordance with and with due reference to:

- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (NSW EPA, 2016);
- Technical Framework - Assessment and Management of Odour from Stationary Sources in NSW (NSW DEC, 2006);
- Technical Notes - Assessment and Management of Odour from Stationary Sources in NSW (NSW DEC, 2006);
- *Protection of the Environment Operations Act* 1997;
- Protection of the Environment Operations (Clean Air) Regulation 2010; and
- State Environmental Planning Policy (Western Sydney Employment Area) 2009.

1.3. Scope of Assessment

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

2. THE PROPOSAL

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

2.1. Environmental Setting

The Proposal Site is located at 657-769 Mamre Road, Kemps Creek, NSW and is located within the Local Government Area (LGA) of Penrith. A map showing the location of the Proposal Site is provided in **Figure 1** below.

Figure 1 Proposal Site location

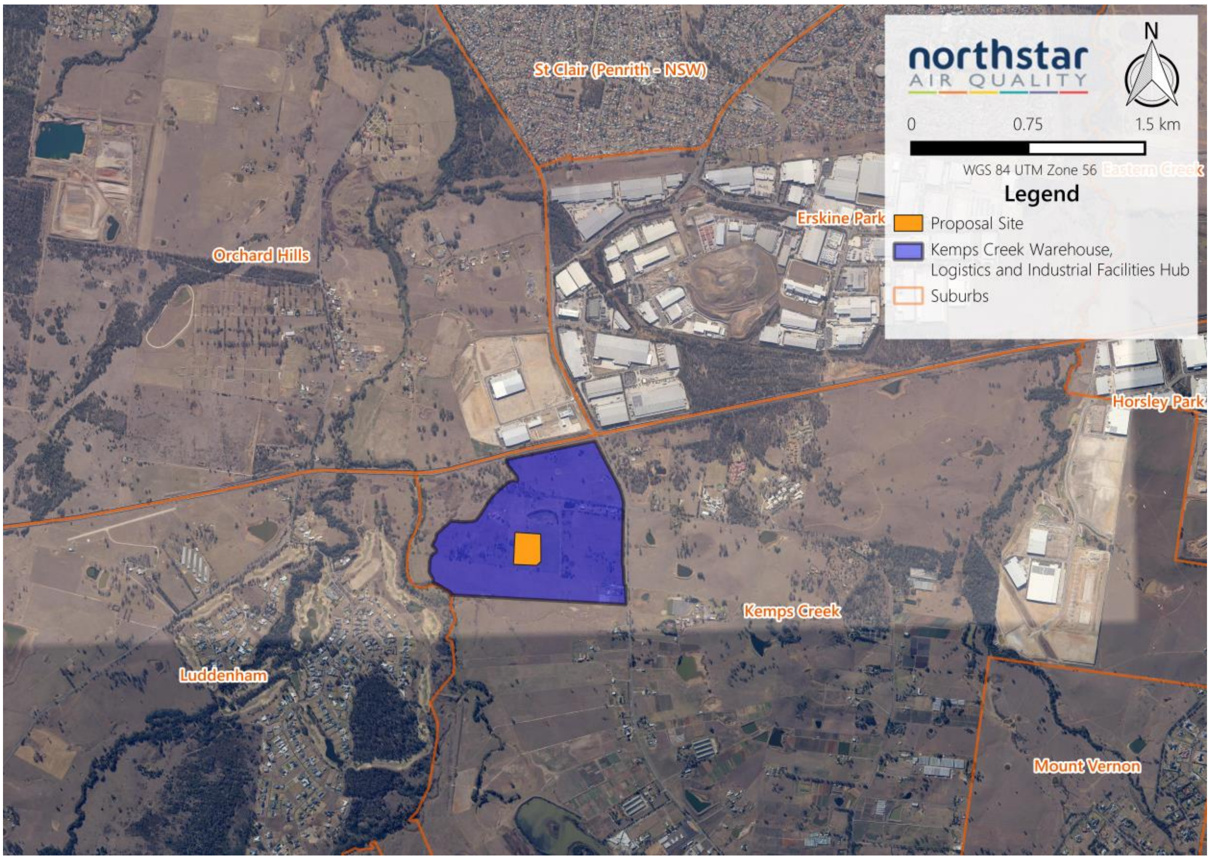


Image courtesy of Google Maps

The closest residential property is approximately 110 metres (m) from the Proposal boundary to the south, with the closest major residential area 1.8 kilometres (km) to the north (see **Section 4.1**). It is anticipated that industrial receptor locations would be located immediately beyond the boundary of the Proposal Site.

A full description of the sensitivity of the surrounding land, and the identification of discrete receptor locations used in the AQIA, is provided in full in **Section 4.1**.

2.2. Overview

The Proposal Site would be occupied by Ardex, which is a manufacturer and supplier of products which include renders, screeds, floor levelling and adhesive products, decorative surface finishes, mortars used in repair applications, tile adhesives, grouts, silicone products, waterproofing membranes, primers, bonding agents and additives, sealants, sealers, sound proofing systems, a range of "natural stone" products, and a range of tools used for flooring and wall applications. Ardex sells to wholesalers, tilers and other building trades as well as into the retail market, in particular under the Dunlop brand. No sale of products is proposed from the Proposal Site.

The Proposal Site will include offices, research and development laboratory, warehouse storage of raw materials and packaging, distribution of packed products, and manufacturing of powder and liquid products. Powder manufacturing will involve the use of dry powder batching, mixing and bagging processes where most batching is completed via an automated process with some manual dosing into industrial mixers, and then followed by semi-automatic bagging and palletising. The activities will primarily consist of mixing non-flammable and non-combustible powdered chemicals (including cement, limestone and sand) to produce saleable products for the construction industry.

Liquid manufacturing will involve the use of liquid batching, mixing and filling processes, where most batching is completed via a semi-automated process with manual dosing into various industrial mixers. The activities will primarily consist of mixing and filling water dispersed polymers (emulsion/latex) with or without non-combustible fillers, silicon packing, as well as water dispersion of epoxy resins to produce saleable products for the construction industry. There will be some limited batching of flammable goods under controlled conditions, including use and mixing of solvents which will be below SEPP 33 thresholds.

2.2.1. Powder Manufacturing

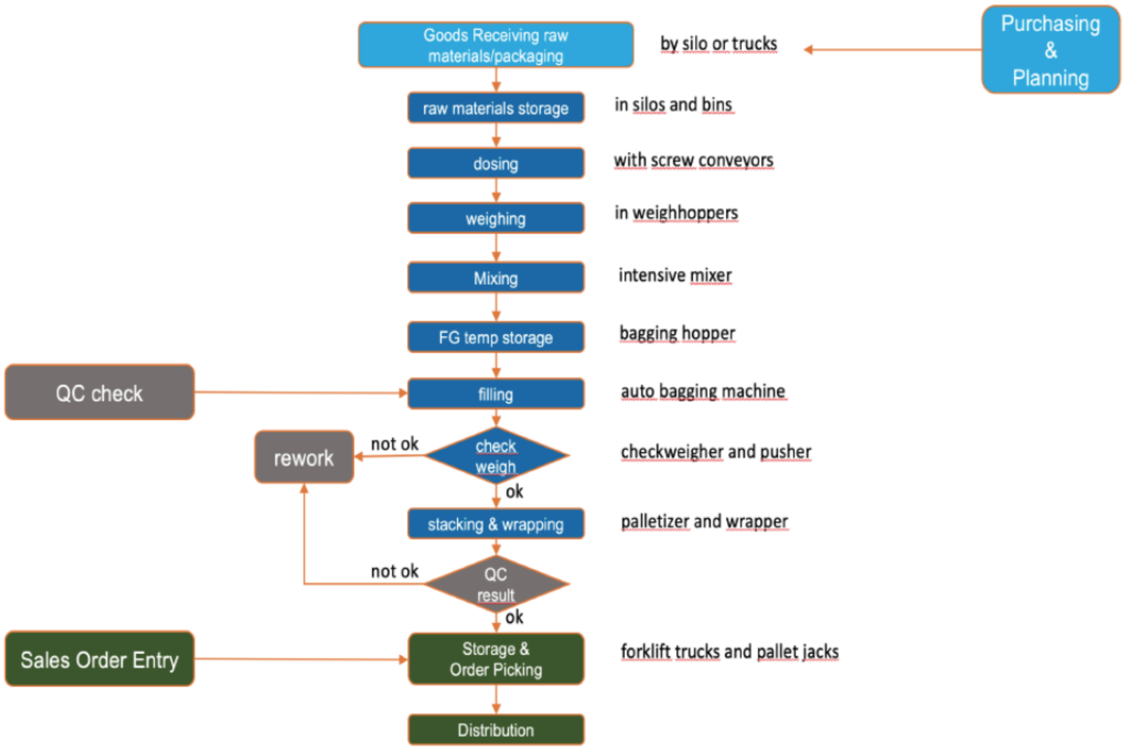
Powder manufacturing will involve the use of dry powder batching, mixing and bagging processes where most batching is completed via an automated process with some manual dosing into industrial mixers, then followed by semi-automatic bagging and palletising. The activities will primarily consist of mixing non-flammable and non-combustible powdered chemicals (including cement, limestone and sand) to produce saleable products for the construction industry. The design of the new powder manufacturing facility will include a state-of-the-art production process based on a uniquely designed vertical tower plant layout, that utilises the force of gravity in the production cycle. The proposed process incorporates an innovative design to improve quality, productivity, process reliability and energy efficiency. Maximum capacity of the plant will be 48 000 tonnes per annum (tpa) based on a 24/7 operation.

Tower heights of 22 m and 38 m for the vertical powder plant has been proposed rather than the older, less efficient horizontal powder plants or "Split-tower" plants, which are around 12 m – 25 m in height. Vertical tower plants are now standard for Ardex's facilities across the world. There are significant advantages in using the vertical powder plant as opposed to the horizontal powder plant, including:

- More energy efficient – the horizontal powder plant uses more than double the electricity for the same production output when compared to the vertical powder plant. This results in significant reductions in carbon emissions, and a significantly reduced load on local electrical transmission infrastructure.
- Reduced noise & dust emissions – the improved design of the vertical plant results in reduced noise & dust emissions from the powder plant line.
- The vertical powder plant also requires less cleaning and less maintenance than the horizontal powder plant, and overall is considered the superior plant option.
- Reduced manufacturing footprint by way of a consolidated footprint.

A process flow diagram of the powder manufacturing process is presented in **Figure 2**.

Figure 2 Powder manufacturing process flow chart



2.2.2. Liquids Manufacturing

A new liquid mixing and packing plant is proposed that will produce 25 000 tpa, operating on a 24/7 basis.

Liquid manufacturing will involve the use of liquid batching, mixing and filling processes, where most batching is completed via a semi-automated process with manual dosing into various industrial mixers. The activities will primarily consist of mixing and filling water dispersed polymers (emulsion/latex) with or without non-combustible fillers, silicon packing, as well as water dispersion of epoxy resins to produce saleable products for the construction industry. The new manufacturing facility is designed to achieve high efficiency, increased production volumes, high quality standards, and the ability to manufacture more complex product formulations.

A list of chemicals to be used in liquids manufacturing has been provided by the Applicant. None of those chemicals has been identified as being particularly odorous. All chemicals are stored in line with the Applicant's Hazardous Area Verification Dossier:

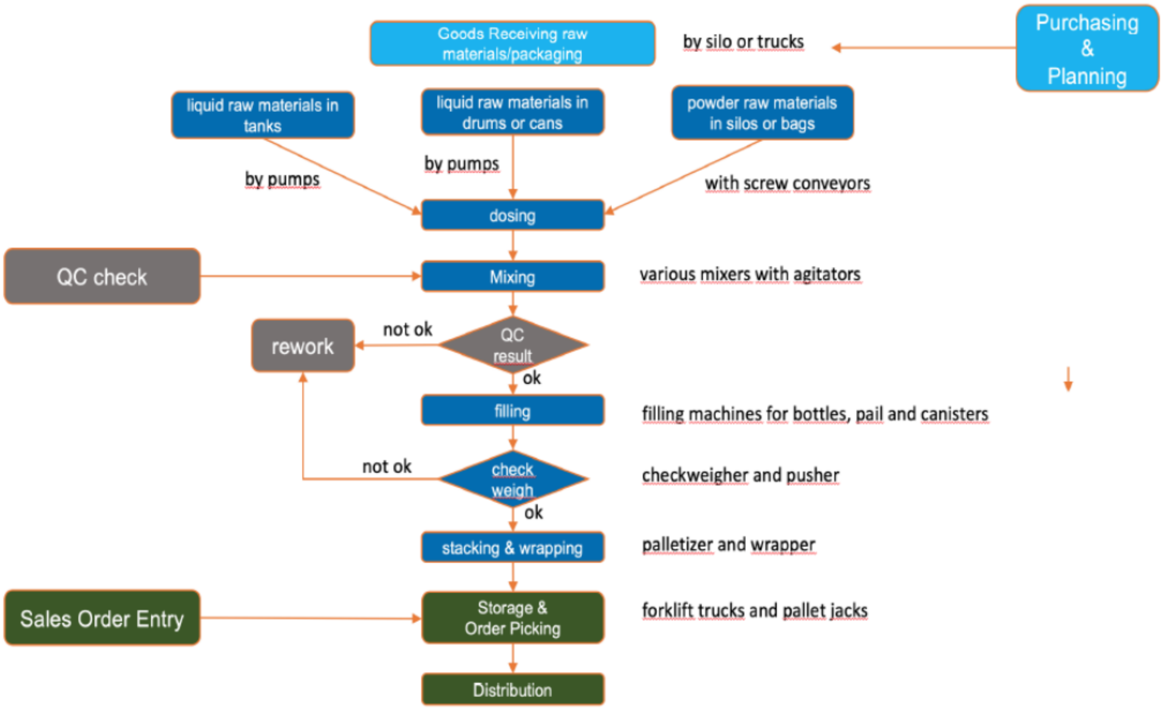
> ***"Raw material flammable liquids and corrosive substances are stored in dedicated DG cabinets within the manufacturing area. All DG cabinets are compliant with the relevant sections of the applicable standard (AS1940 for flammable liquids and AS3780 for corrosive substances). Procedures are used for the transfer and loading of flammable liquids to mixers. Spill kits are also located adjacent to the flammable liquids handling areas to commence immediate spill clean up in the event of an accidental release".***

The volumes of chemicals storage (i.e. up to 250 kilogram (kg) drums) would not necessitate external storage, and the management of odours/fumes is performed using local fume extraction and/or respiratory masks worn by operators.

Air quality issues associated with odour have not been considered further within this report.

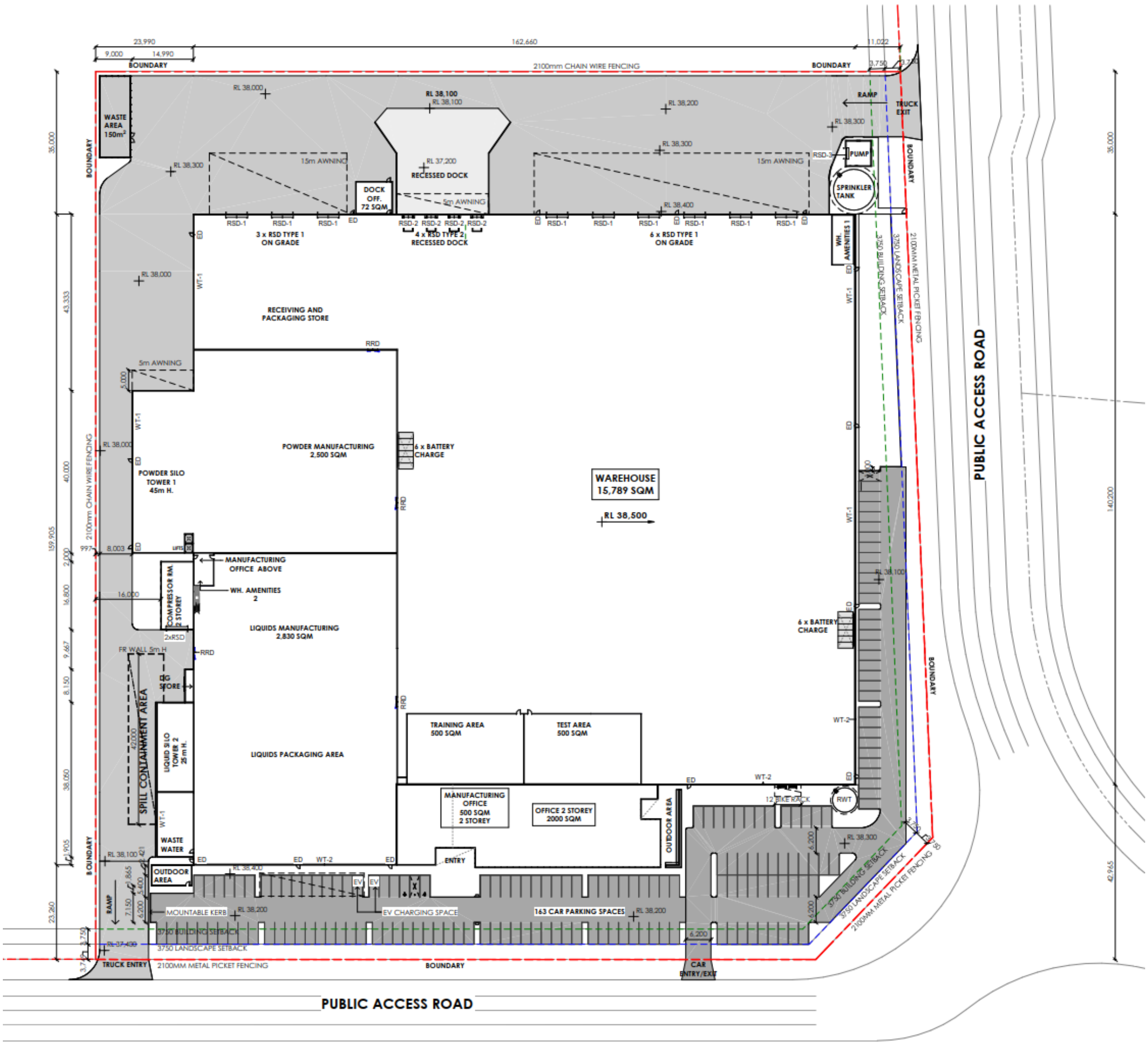
A process flow diagram of the liquid manufacturing process is presented in **Figure 3**.

Figure 3 Liquid manufacturing process flow chart



A layout of the Proposal Site is provided in **Figure 4**.

Figure 4 Proposal Site layout



Source: PACE Architects

2.2.3. Emissions Controls

The powder manufacturing process uses sand, cement, calcium carbonate and other powdered raw materials in products, and the liquids manufacturing process uses sand, calcium carbonate and other powdered raw materials in its products, which are purchased from external suppliers. These bulk materials will be unloaded on the western side of the facility and transported directly into the Powder Tower silos (50 t to 100 t capacity). These materials will be transferred from supply tankers directly into the storage silos via pressurised and sealed pipework.

Powdered raw materials that are supplied in 1 000 kg bags will be transferred by hoist into smaller silos (2 t – 6 t). Minor quantities of other powdered raw material (20 kg – 25 kg bags) will be manually added using a purpose-built loading station, equipped with dust extraction to ensure internal dust levels are maintained below occupational health limits. Ardex has an occupational hygiene monitoring programme to ensure worker safety.

Four dust collectors are also located on key processes including dosing, mixing, weighing and bagging. Emissions from the dust collectors are emitted via a filter externally to the building. Information provided by the Applicant indicates that the emission concentration of total particulate matter through each filter would be <5 $mg{\cdot}Nm^{-3}$, with an emission flow of 21 000 $Nm^3{\cdot}hr^{-1}$ through a 600 mm exhaust at 13 m above ground level (AGL), and 1 m above roof level (ARL). An example of the filter unit is presented below in **Figure 5**.

Figure 5 Example of filter on powder and liquid manufacturing lines

Emissions associated with the filling of the silo tower are controlled through the use of SILOTOP® dust collectors. The system is based on a pulse jet poly-pleat filter assembly with differential pressure monitoring before and after the filters which is used to determine when filters need to be maintained.

Information provided by the Applicant indicates that the emission concentration of total particulate matter through each SILOTOP® filter would be <10 $mg \cdot Nm^{-3}$. Airflow through each filter is associated with the volume of silo filling. Conservatively, it has been assumed that the silos would be filled each year with 48 000 t of materials associated with powder manufacturing, and 25 000 t of materials associated with liquids manufacturing. Assuming a material density of 1.51 $t \cdot m^{-3}$ (similar to Portland cement), and silo filling one hour per day, the exhaust flow through all silo filters would be 132 $m^3 \cdot h^{-1}$. Note that the calculated emission rate for all emission points has been assumed to occur on each and every hour of the year.

It is noted that the performance of all filters to be used at the Proposal site is presented as potential maximum emission concentration limits. The emission control system is anticipated to perform significantly in excess (i.e. better) of the values quoted within this assessment.

2.3. Identification of Potential Emissions to Atmosphere

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

2.3.1. Construction Phase

Construction of all roads and buildings has previously been approved as part of SSD 9522. In the AQIA that supported that SSD, a construction dust risk assessment was performed which identified that, without any mitigation measures applied, the site would represent a low risk to offsite dust impacts. A range of management and mitigation measures were identified within that AQIA which were appropriate for a low-risk site, with the detail of those measures to be included within a Construction Air Quality Management Plan (CAQMP).

It is understood that the Proposal includes earthworks activities including 6 900 m^3 of cut, and 16 570 m^3 of fill (approximately 60 000 t). The AQIA provided to support SSD 9522 adopted a risk assessment approach to construction activities, adapting 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)[1].

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

That approach assessed the potential magnitude of earthworks activities, which was categorised as 'large' (the highest category available). The sensitivity of the area to dust impacts and health impacts was classified as 'low' (taking into account those receptors within a specified screening distance). Given that a number of industrial receptors would potentially be in closer proximity during construction of the Proposal, these sensitivities would change, in line with the IAQM method, to be 'medium' for both dust impacts and health impacts (assuming a high sensitivity industrial receptor location within the screening distances of 350 m from the site boundary, 50 m from the construction route, and 500 m from the site entrance). Earthworks (and construction and track-out) would therefore be categorised as 'high' risk activities, associated with the Proposal.

Taking into account those risks, a CAQMP for the Proposal would be prepared which would include:

- Air quality standards.
- Key performance indicators.
- A description of air quality monitoring.
- Emission control measures.
- A contingency plan.
- A training plan.
- A non-compliance, corrective and preventive action plan.
- A complaint handling procedure.
- Detail of records to be kept regarding air quality.

That CAQMP would be implemented and adhered to during the construction of the Proposal. No further discussion of air quality impacts or management associated with the construction phase of the Proposal is presented within this report. The range of mitigation measures to be employed as part of the construction activities would be implemented commensurate with a 'high' risk site (as determined through the performance of the risk assessment discussed above) and would include a range of industry standard measures.

2.3.2. Operational Phase

During the operation of the Proposal, the following activities are anticipated to result in potential emissions to air:

- Movement of vehicles around the internal roadways of the Proposal Site on paved road surfaces;
- Diesel combustion emissions from the consumption of diesel fuel, in the truck movements importing and exporting materials. The potential emissions would include particulate matter (as PM_{10} and $PM_{2.5}$) and oxides of nitrogen (NO_X), including nitrogen dioxide (NO_2). There would additionally be some less significant emissions of carbon monoxide (CO), sulphur dioxide (SO_2) and air toxics (including benzene and 1,3-butadiene) but for the purposes of this assessment, it is comfortably assumed that the principal gaseous pollutant would be NO_X.

- Emissions of particulate matter from the powder and liquid manufacturing components of the facility including:
  - Receipt of powdered materials via tanker, and transfer to storage silo.
  - Dosing, weighing, mixing, and bagging of products.

  Note that these emissions are controlled as described in **Section 2.2.3**.
- Emissions of gaseous pollutants/odour from the liquid manufacturing component of the facility including:
  - Receipt of liquid materials by silo or trucks and storage in tanks.
  - Dosing and mixing, and filling of bottles, pails and canisters.

  Note that these emissions are controlled as described in **Section 2.2.3**.

In relation to vehicle traffic, the traffic impact assessment (TIA) (Ason, 2021) identifies that a total of 350 vehicles (280 light vehicles, 70 heavy vehicles) would access the Proposal Site each day. This represents approximately half of the traffic volumes assumed in the TIA for SSD 9522 for a development of this size within the broader development. Given the volumes of heavy vehicles visiting the Proposal Site, the nature of the trafficked routes (bitumen/hardstand), the lack of vehicle idling (enacted through a zero-idling policy), the regular sweeping of any external hardstand areas, and cleaning of off-site areas which experience the unlikely event of material spillage, it is considered that the potential for air quality impacts associated with wheel-generated dust or fuel combustion emissions on any off-site location is low.

Air quality impacts associated with process emissions associated with particulate matter only are considered in this AQIA.

3. LEGISLATION, REGULATION AND GUIDANCE

State air quality guidelines adopted by the NSW EPA, are published in the *'Approved Methods for the Modelling and Assessment of Air Pollutants in NSW'* (the Approved Methods (NSW EPA, 2016)), which has been consulted during the preparation of this AQIA.

3.1. Ambient Air Quality Standards

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 National Health and Medical Research Council (NHMRC), National Environment Protection Council (NEPC), Department of Environment (DoE), World Health Organisation (WHO), and Australian and New Zealand Environment and Conservation Council (ANZECC)). Where relevant to this AQIA (coincident with the potential emissions identified in **Section 2.3**), the criteria have been adopted as set out in Section 7.1 of NSW EPA (2017) which are presented in **Table 2** below.

Table 2 NSW EPA air quality standards and goals

Pollutant	Averaging period	Units[e]	Criterion	Notes
Particulates (as PM_{10})	24 hours	$\mu g \cdot m^{-3}$ [a]	50	Numerically equivalent to the AAQ NEPM[b] standards and goals.
	1 year	$\mu g \cdot m^{-3}$	25	
Particulates (as $PM_{2.5}$)	24 hours	$\mu g \cdot m^{-3}$	25	
	1 year	$\mu g \cdot m^{-3}$	8	
Particulates (as TSP)	1 year	$\mu g \cdot m^{-3}$	90	
Particulates (as dust deposition)	1-year[c]	$g \cdot m^{-2} \cdot month^{-1}$	2	Assessed as insoluble solids as defined by AS 3580.10.1
	1-year[d]	$g \cdot m^{-2} \cdot month^{-1}$	4	

Notes: **(a):** micrograms per cubic metre of air **(b):** National Environment Protection (Ambient Air Quality) Measure
(c): Maximum increase in deposited dust level **(d):** Maximum total deposited dust level
(e) Gas volumes are expressed at 25 °C (298 K) and at an absolute pressure of 1 atmosphere (101.325 kPa)

3.2. NSW Government Air Quality Planning

NSW EPA has formed a comprehensive strategy with the objective of driving improvements in air quality across the State. This comprises several drivers, including:

- Legislation: formed principally through the implementation of the *Protection of the Environment Operations Act* 1997, and the Protection of the Environment Operations (Clean Air) Regulations

2010. The overall objective of this legislative instruments is to achieve the requirements of the National Environment Protection (Ambient Air Quality) Measure;

- Clean Air for NSW: The 10-year plan for the improvement in air quality;
- Inter-agency Taskforce on Air Quality in NSW: a vehicle to co-ordinate cross-government incentives and action on air quality;
- Managing particles and improving air quality in NSW; and
- Diesel and marine emission management strategy.

In regard to the relevance of the NSW Government's drive to improve air quality across the State and this AQIA, it is imperative that this Proposal demonstrates leadership in the development of the NSW economy (in terms of activity and employment) and concomitantly not cause a detriment in achieving its objectives.

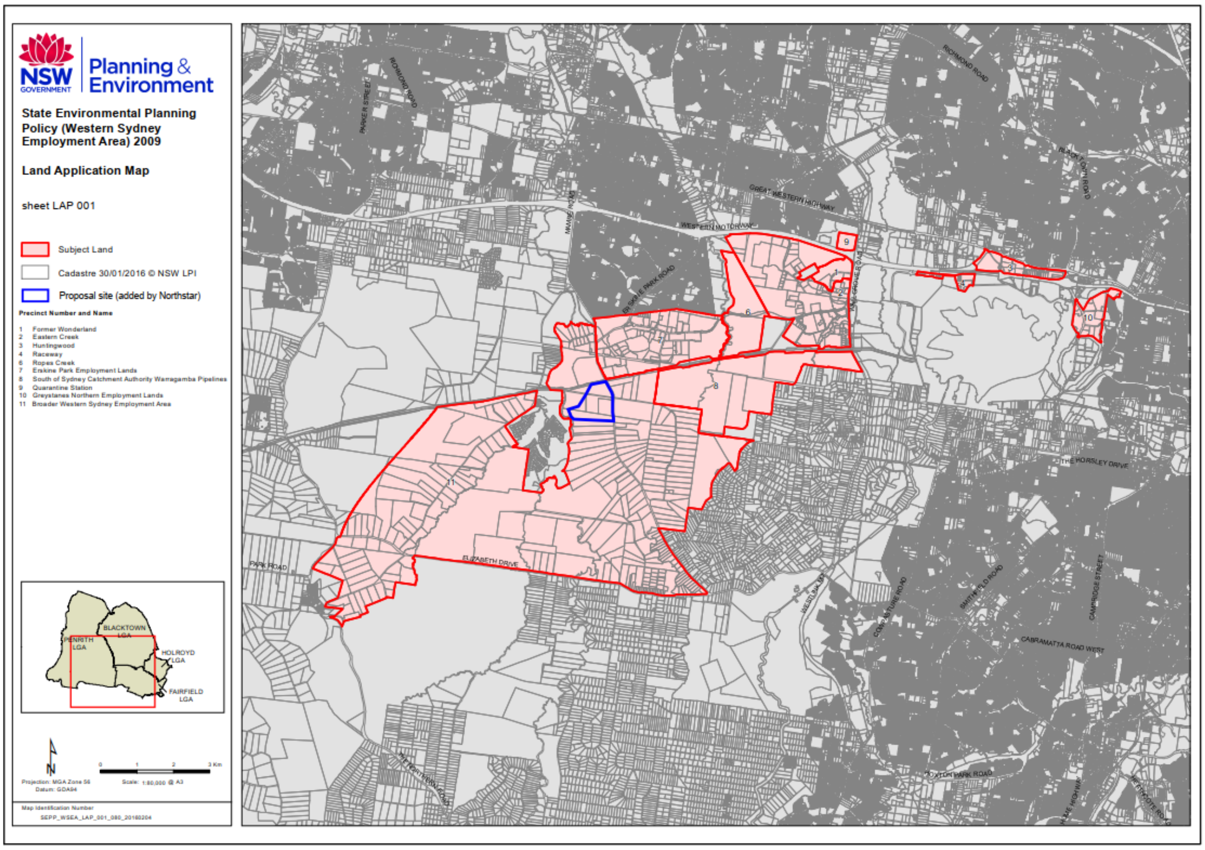
3.3. State Environmental Planning Policy (Western Sydney Employment Area) 2009

State Environmental Planning Policy (Western Sydney Employment Area) 2009 (the WSEA SEPP) aims to protect and enhance the Western Sydney Employment Area for employment purposes. The WSEA SEPP aims to:

- promote economic development and the creation of employment in the Western Sydney Employment Area, by providing for development including major warehousing, distribution, freight transport, industrial, high technology and research facilities;
- provide for the co-ordinated planning and development of land in the Western Sydney Employment Area;
- rezone land for employment or environmental conservation purposes;
- improve certainty and regulatory efficiency by providing a consistent planning regime for future development and infrastructure provision in the Western Sydney Employment Area;
- ensure that development occurs in a logical, environmentally-sensitive and cost-effective manner and only after a Development Control Plan (including specific development controls), has been prepared for the land concerned;
- conserve and rehabilitate areas that have a high biodiversity or heritage or cultural value, in particular areas of remnant vegetation.

The Western Sydney Employment Area covers the area shown in **Figure 6** on P22. The location of the Proposal Site is also shown (as added by Northstar), indicating that the entirety of the site is located within the area covered by the WSEA SEPP and therefore the requirements and aims of the WSEA SEPP apply to the Proposal Site.

Figure 6 Western Sydney Employment Area – Land application map



Source: New South Wales Government (https://legislation.nsw.gov.au/#/view/EPI/2009/413/maps) SEPP_WSEA_LAP_001_080_20160204, and adapted by Northstar Air Quality

4. EXISTING CONDITIONS

4.1. Surrounding Land Sensitivity

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 noted that the assessment criteria applied to particulates is over a 24-hour period, and as such the predicted impacts need to be interpreted at commercial and industrial receptor locations with care. It is considered to be atypical for a person to be at those locations for a complete 24-hour period and as such, the exposure risks at those locations would be over-estimated by the modelling assessment.

It has been requested by NSW EPA within the SEARs (refer **Table 1**):

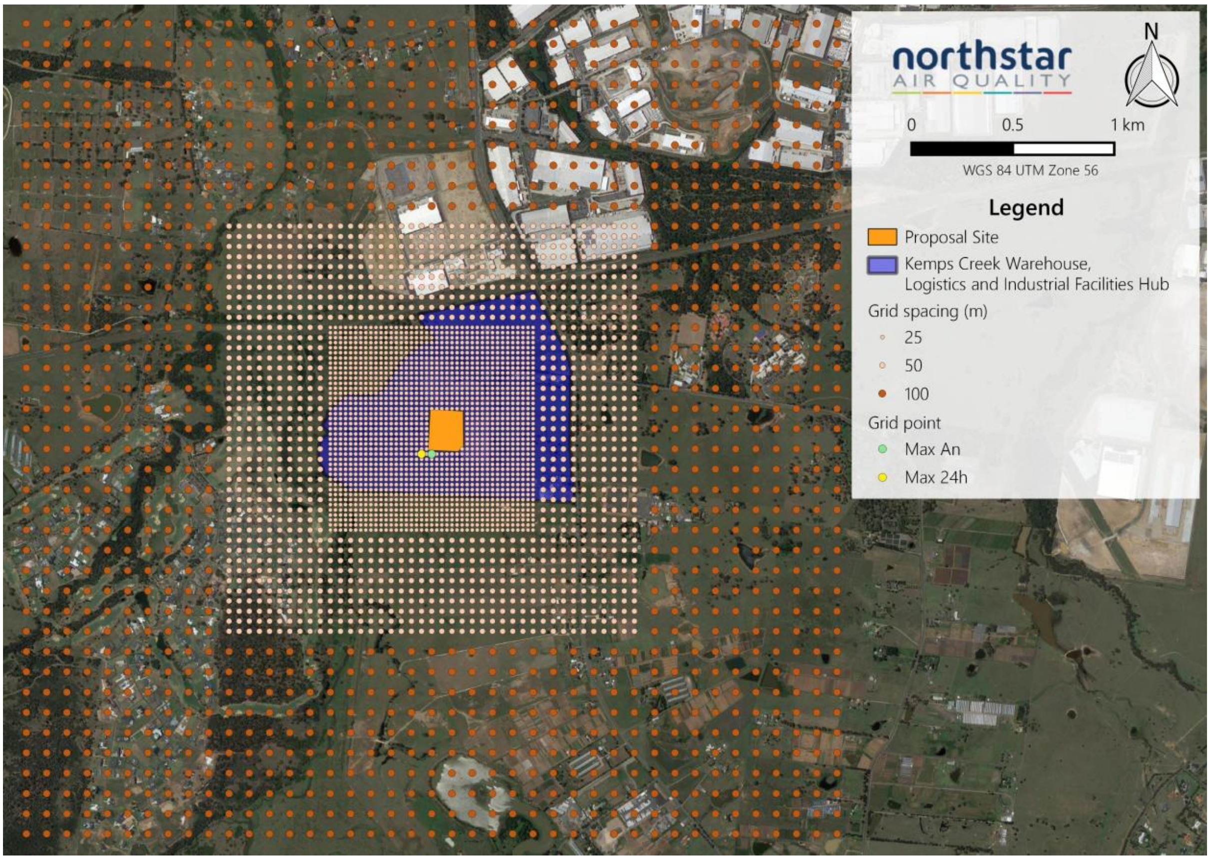
> *"A sensitive receptor includes a location where people work – thus clarification on the nearest sensitive receptor is required. Adjacent premises must be considered required when assessing project air impacts."*

Given that the exact location of adjacent sensitive receptors is currently unknown, a conservative approach has been adopted within this AQIA which provides predicted impacts at off-site locations on a uniform grid within an approximately 2 km radius of the Proposal Site. A nested grid of receptors has been generated centred on the Proposal Site, with the innermost grid covering a 1 km × 1 km area, with a grid spacing of 25 m, the middle grid covering a 2 km × 2 km area, with a grid spacing of 50 m, and the outermost grid covering a 4 km × 4 km area, with a grid spacing of 100 m.

Figure 7 presents the receptors included in the modelling assessment. For clarity, all of these individual receptor points are considered to be 'sensitive receptors' for the purposes of this assessment.

The yellow and green grid points indicated on **Figure 7** identify the offsite locations at which the maximum impacts are predicted. These are discussed further in **Section 6**.

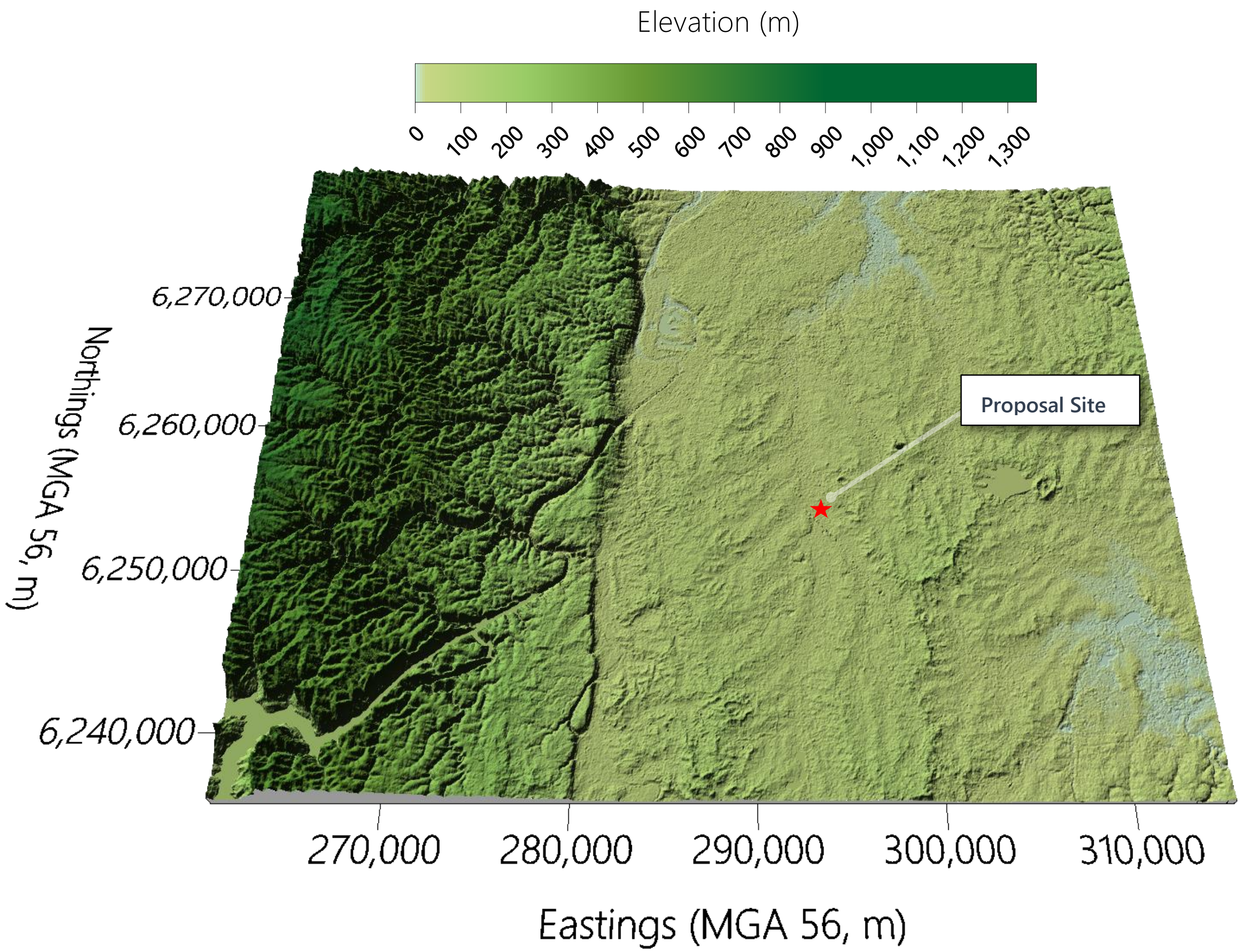
Figure 7 Receptors including in dispersion modelling



4.2. Topography

The elevation of the Proposal Site is approximately 60 m to 70 m Australian Height Datum (AHD). The topography between the Proposal Site and nearest sensitive receptor locations, is uncomplicated. A 3-dimensional representation of the topography surrounding the Proposal Site is presented in **Figure 8** overleaf.

Figure 8 Three-dimensional representation of topography surrounding the Proposal Site



Source: Northstar Air Quality

Note: MGA – Map Grid of Australia

4.3. 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). Meteorology is also measured by the NSW Department of Planning, Industry and Environment (DPI&E) at a number of Air Quality Monitoring Station (AQMS) surrounding the Proposal Site (refer **Section 4.4** on P28 of this Report).

To provide a characterisation of the meteorology which would be expected at the Proposal Site, a meteorological modelling exercise has also been performed.

A summary of the inputs and outputs of the meteorological modelling assessment, including validation of those outputs is presented in **Appendix A**.

Seven meteorological stations are located within a 17 km radius of the Proposal Site (BoM and DPI&E operated). A summary of the relevant AWS is provided in **Table 3** below (listed by proximity) and also displayed in **Figure 9** overleaf.

Table 3 Details of meteorological monitoring surrounding the Proposal Site

Site Name	Source	Approximate Location (UTM)		Approximate Distance
		mE	mS	km
St Marys AQMS	DPI&E	293 170	6 258 083	3.9
Horsley Park Equestrian Centre AWS – Station # 67119	BoM	301 710	6 252 290	7.9
Badgerys Creek AWS – Station # 67108	BoM	289 920	6 246 951	8.3
Bringelly AQMS	DPI&E	293 028	6 244 518	9.7
Prospect AQMS	DPI&E	306 744	6 258 645	13.5
Penrith Lakes AWS – Station # 67113	BoM	284 866	6 266 510	15.2
Liverpool AQMS	DPI&E	306 439	6 243 322	16.5

Figure 9 Meteorological monitoring stations surrounding the Proposal Site

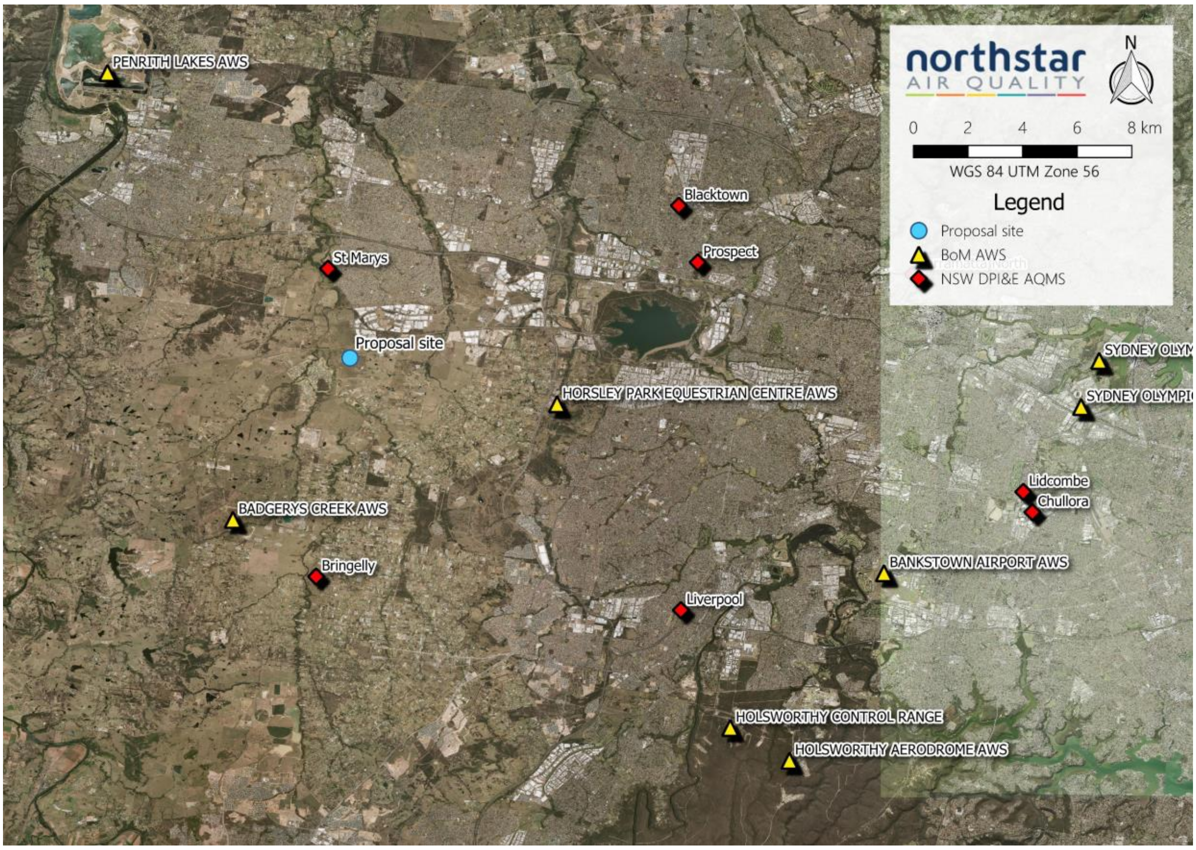


Image courtesy of Google Earth

The meteorological conditions measured at the identified meteorological stations, are presented in **Appendix A**.

It is considered that St Marys AQMS is most likely to represent the conditions at the Proposal Site, based upon its proximity and lack of significant topographical features between the two locations. The wind roses presented in **Appendix A** indicate, that from 2013 to 2017, winds at St Marys AQMS show similar wind distribution patterns across the years assessed, with a predominant south-westerly wind direction.

The majority of wind speeds experienced at St Marys AQMS over the 5-year period, 2013 to 2017, are generally in the range <0.5 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from a south-westerly direction. Winds of this speed are not frequent, occurring <0.1 % of the observed hours over the 5-year period, at St Marys. Calm winds (<0.5 $m \cdot s^{-1}$) occur during 32.5 % of hours on average across the 5-year period.

Given the wind distributions across the years examined, data for the year 2014 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied. Reference should be made to **Appendix A** for further details.

4.4. Air Quality

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

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

The Proposal Site is located proximate to a number of AQMS operated by NSW DPI&E. These locations (listed by proximity) are briefly summarised in **Table 4** and presented in **Figure 9** (P27).

Table 4 Closest DPI&E AQMS to the Proposal Site

AQMS Location	Data Availability	Distance to Site (km)	Screening Parameters			
			2014 Data	Measurements		
				PM_{10}	$PM_{2.5}$	TSP
St Marys	1992 - 2018	3.9	✓	✓	×	×
Bringelly	1992 - 2018	9.7	✓	✓	×	×
Prospect	2007 - 2018	13.5	✓	✓	×	×
Liverpool	1988 - 2018	16.5	✓	✓	✓	×

Note: A Ozone (O_3) data used to assist in the conversion of predicted NO_X concentrations to NO_2

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

Appendix B provides a detailed assessment of the background air quality monitoring data collected at the St Marys AQMS. As $PM_{2.5}$ was not measured at St Marys in 2014, the data for $PM_{2.5}$ has been taken from the Liverpool AQMS, being the next proximate operating AQMS location with the available data.

It is noted that none of the AQMS, measure Total Suspended Particulate (TSP) which is of relevance to the expected emissions from the Proposal Site. Based upon long-term historic monitoring data, a numerical relationship between TSP and PM_{10} has been established for the Sydney Metropolitan region. Based upon these data a relationship between ambient concentrations of TSP : PM_{10} of 2.0551 : 1 is used to approximate background annual average TSP concentrations. This relationship is established and is used frequently to approximate background annual average TSP concentrations in similar locations (see **Appendix B**).

The impact assessment criteria used for deposited dust (see **Table 2** on P20) are presented as (i) a cumulative deposition rate of 4 $g{\cdot}m^{-2}{\cdot}month^{-1}$ and (ii) a discrete deposition rate of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$. In lieu of a background deposition rate to derive a cumulative rate, the incremental impact assessment criterion (2 $g{\cdot}m^{-2}{\cdot}month^{-1}$) will be used. This is a commonly adopted approach when background deposition rates are not available.

A detailed summary of the background air quality is presented in **Appendix B**, and a summary of the air quality monitoring data and assumptions used in this assessment are presented in **Table 5**.

Table 5 Summary of background air quality used in the AQIA

Pollutant	Ave Period	Measured Value	Notes
Particles (as TSP) (derived from PM_{10})	Annual $\mu g{\cdot}m^{-3}$	34.4	Estimated on a TSP:PM_{10} ratio of 2.0551 : 1
Particles (as PM_{10}) (St Marys)	24-hour $\mu g{\cdot}m^{-3}$	Daily Varying	The 24-hour maximum for PM_{10} in 2014 was 45.0 $\mu g{\cdot}m^{-3}$
	Annual $\mu g{\cdot}m^{-3}$	16.7	
Particles (as $PM_{2.5}$) (Liverpool)	24-hour $\mu g{\cdot}m^{-3}$	Daily Varying	The 24-hour maximum for $PM_{2.5}$ in 2014 was 24.3 $\mu g{\cdot}m^{-3}$
	Annual $\mu g{\cdot}m^{-3}$	8.6	
Dust deposition	Annual $g{\cdot}m^{-2}{\cdot}month^{-1}$	2.0	Difference in NSW DPI&E maximum allowable and incremental impact criterion

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

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 local air quality is presented in **Section 6** (on P31).

An EIS is currently being prepared for SSD 10101987 (Kemps Creek Data Centre), which is located immediately to the south of the Proposal site, and within the Kemps Creek Warehouse, Logistics and Industrial Facilities Hub. No detailed AQIA to support that SSD is available on the NSW Government Major Projects website at the time of writing, and no specific commentary can be provided regarding the potential for cumulative impacts with the Proposal. However, in broad terms, emissions of air pollutants associated with the operation of a data centre development are likely to be sporadic, and related to the requirement for emergency power generation, and in this specific case, diesel fuelled power generation. As indicated in the scoping report,

> ***It is noted, that the generators are for standby emergency backup power only and would be used only when required; thereby, the potential air quality impacts associated with the operational phase would be considerably low.***

Emissions of nitrogen dioxide (NO_2) are likely to be the limiting factor for a data centre development, rather than impacts associated with particulate matter, and the potential for cumulative impacts to occur with the Proposal is low, given that emissions of NO_2 from the Proposal would be limited to vehicles.

During construction of the data centre, the scoping report indicates that air quality would be managed through appropriate dust mitigation measures, and again, the potential for cumulative impacts is considered to be low, and manageable.

5. METHODOLOGY

5.1. Dispersion Modelling

A dispersion modelling assessment has been performed using the NSW EPA approved CALPUFF Atmospheric Dispersion Model. The modelling has been performed in CALPUFF 2-dimensional (2-D) mode. Given the flat (uncomplex) terrain and the proximity of the receptors to the Proposal Site, a detailed assessment using a 3-D meteorological dataset is not warranted.

The 2-D meteorological dataset has been developed using The Air Pollution Model (TAPM, v 4.0.5) (see **Appendix A** for further information).

An assessment of the impacts of the operation of activities at the Proposal Site has been performed, which characterises the likely day-to-day (and hour-to-hour) operation, approximating average operational characteristics which are appropriate to assess against longer term (annual average) and shorter term (24-hr) criteria for emissions to air.

The modelling scenario provides an indication of the air quality impacts of the operation of activities at the Proposal Site. Added to these impacts, are background air quality concentrations (where available and discussed in **Section 4.4** and **Appendix B**) which represent the air quality which may be expected within the area surrounding the Proposal Site, without the impacts of the Proposal itself.

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

5.2. Emissions Estimation

The estimation of emissions from a process is typically performed using direct measurement or through the application of factors, which appropriately represent the processes under assessment. This assessment has adopted emissions data as provided by the Applicant which is discussed in **Section 2.2.3**. The emissions inventory for the Proposal is presented in **Appendix C**.

For the purposes of this assessment, emissions of total particulate matter are assumed to constitute TSP, with PM_{10} emissions accounting for 34 % of TSP emissions (as per USEPA AP-42 for concrete batching), and $PM_{2.5}$ emissions accounting for 10 % of PM_{10} emissions.

6. IMPACT ASSESSMENT

This section presents the results of the dispersion modelling assessment and uses the following terminology:

- **Incremental impact** – relates to the concentrations predicted as a result of the operation of the Proposal in isolation.
- **Cumulative impact** – relates to the concentrations predicted as a result of the operation of the Proposal PLUS the background air quality concentrations discussed in **Section 4.4** (on P28).

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

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

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

6.1. Particulate Matter

Results are presented in this section for the predictions of particulate matter (TSP, PM_{10}, $PM_{2.5}$ and dust deposition). The averaging periods associated with the criteria for these pollutants is 24-hour and annual averages, as specified in **Table 2**. Results are presented for the off-site location at which the maximum impact is predicted.

6.1.1. Annual Average TSP, PM_{10} and $PM_{2.5}$

The predicted annual average particulate matter concentrations (as TSP, PM_{10} and $PM_{2.5}$) resulting from the Proposal operations are presented in **Table 18**.

The results indicate that predicted incremental concentrations of TSP, PM_{10} and $PM_{2.5}$ at all off-site locations are low estimated as less than (<) 3.1 % of the annual average TSP criterion, < 3.9 % of the annual average PM_{10} criterion and < 0.4 % of the $PM_{2.5}$ criterion).

The addition of existing background concentrations (refer **Section 4.4**) results in predicted cumulative concentrations of annual average TSP being < 41.3% and annual average PM_{10} being < 70.7 % of the relevant criteria, at the most affected receptor locations.

The existing adopted annual average $PM_{2.5}$ background concentration, is shown to be in exceedance of the relevant criterion, even without the operation of the Proposal added. Examination of the predicted $PM_{2.5}$ impacts which would result from the operation of the Proposal, indicates that these concentrations are predicted to be ≤ 0.1 $\mu g \cdot m^{-3}$ at all surrounding off-site locations and no additional exceedances of the annual average criteria are predicted.

The performance of the Proposal does not in itself result in any exceedances of the annual average particulate matter impact assessment criteria.

Table 6 Predicted annual average TSP, PM_{10} and $PM_{2.5}$ concentrations

Receptor	Annual Average Concentration ($\mu g \cdot m^{-3}$)								
	TSP			PM_{10}			$PM_{2.5}$		
	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact	Incremental Impact	Background	Cumulative Impact
Max. off-site	2.8	34.3	37.1	1.0	16.7	17.7	<0.1	8.6	8.7
Criterion	-	90		-	25		-	8	

Contour plots of annual average TSP, PM_{10} or $PM_{2.5}$ are not presented in this report, given the minor contribution from the Proposal at the nearest relevant sensitive receptors.

6.1.2. Annual Average Dust Deposition Rates

Table 7 presents the annual average dust deposition predicted as a result of the operations at the Proposal Site. An assumed background dust deposition of 2 $g \cdot m^{-2} \cdot month^{-1}$ is presented in **Table 7**, although comparison of the incremental concentration with the incremental criterion of 2 $g \cdot m^{-2} \cdot month^{-1}$ is also valid (as discussed within **Section 4.4**). In either case, the resulting conclusions drawn are identical. Annual average dust deposition is predicted to meet the criteria at all off-site receptors surrounding the Proposal Site where the predicted impacts are ≤ 13.3 % of the incremental criterion at receptor locations.

No contour plot of annual average dust deposition is presented, given the minor contribution from the Proposal at the nearest sensitive receptors.

The performance of the Proposal does not result in any exceedances of the annual average dust deposition impact assessment criteria.

Table 7 Predicted annual average dust deposition

Receptor	Annual Average Dust Deposition ($g \cdot m^{-2} \cdot month^{-1}$)		
	Incremental Impact	Background	Cumulative Impact
Max. off-site	0.3	2.0	2.3
Criterion	2.0	-	4.0

6.1.3. Maximum 24-Hour PM_{10} and $PM_{2.5}$

Table 8 presents the maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations predicted to occur at off-site receptors, as a result of the Proposal operations. Note that no background concentrations are included within this table. The predicted incremental concentration of PM_{10} and $PM_{2.5}$, are demonstrated to contribute 18.6 % to the 24-hour PM_{10} criterion and 3.7 % of the 24-hour $PM_{2.5}$ criterion.

It is noted that these predictions are based on performance specifications / emission limit guarantees for the air pollution control equipment, and impacts are anticipated to be significantly lower in practice.

Table 8 Predicted maximum incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations

Receptor	Maximum 24-hour Concentration ($\mu g \cdot m^{-3}$)	
	PM_{10}	$PM_{2.5}$
Max. off-site	9.4	0.9
Criterion	50	25

The following tables present the predicted maximum 24-hour average PM_{10} and $PM_{2.5}$ concentrations resulting from the operation of the Proposal, with background included. Results are presented for the off-site receptor at which the highest incremental PM_{10} and $PM_{2.5}$ impacts have been predicted (see **Figure 7**).

The left side of the tables show the predicted concentration on days with the highest cumulative impacts (typically driven by the days of the highest contemporaneous background), and the right side shows the total predicted cumulative impact on days with the highest predicted incremental concentrations. The results are presented in this manner, consistent with section 11 of the Approved Methods (NSW EPA, 2016).

Importantly, the results indicate that:

- the Proposal is not predicted to result in any exceedances of the maximum 24-hour PM_{10} and $PM_{2.5}$ criteria; and
- when considering the maximum modelled incremental 24-hour PM_{10} and $PM_{2.5}$ impact from the Proposal at any off-site location, this would not result in an exceedance of the relevant criterion.

A contour plot of the incremental contribution to the 24-hour average PM_{10} concentration during Proposal operations is presented in **Figure 10**.

Table 9 Summary of contemporaneous impact and background – PM_{10}

Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$)			Date	24-hour average PM_{10} concentration ($\mu g \cdot m^{-3}$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
6/08/2014	0.3	45.0	45.3	27/05/2014	9.4	24.1	33.5
23/05/2014	1.8	43.0	44.8	9/09/2014	9.0	8.2	17.2
10/02/2014	<0.1	43.7	43.8	29/07/2014	7.5	9.7	17.2
17/12/2014	0.2	37.9	38.1	31/07/2014	7.4	11.9	19.3
31/12/2014	<0.1	37.1	37.2	29/04/2014	7.4	13.5	20.9
10/05/2014	2.9	33.9	36.8	15/02/2014	6.6	16.8	23.4
11/02/2014	<0.1	36.5	36.6	27/06/2014	6.5	13.2	19.7
6/10/2014	4.7	31.7	36.4	4/12/2014	6.0	12.1	18.1
4/10/2014	1.5	32.6	34.1	23/06/2014	5.7	9.6	15.3
27/05/2014	9.4	24.1	33.5	15/03/2014	5.7	14.7	20.4
These data represent the highest Cumulative Impact 24-hour PM_{10} predictions (outlined in red) as a result of the operation of the project.				These data represent the highest Incremental Impact 24-hour PM_{10} predictions (outlined in blue) as a result of the operation of the project.			

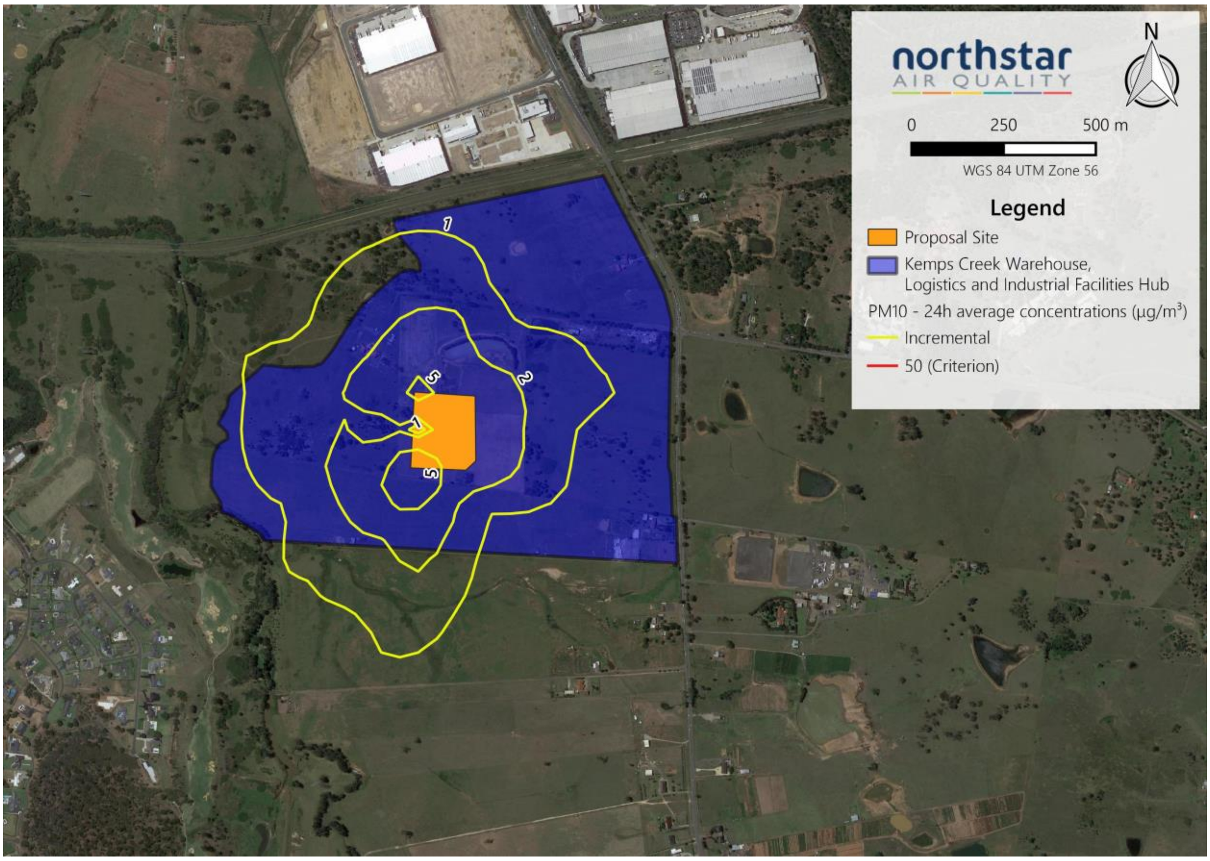
Table 10 Summary of contemporaneous impact and background – $PM_{2.5}$

Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$)			Date	24-hour average $PM_{2.5}$ concentration ($\mu g \cdot m^{-3}$)		
	Incremental Impact	Background	Cumulative Impact		Incremental Impact	Background	Cumulative Impact
3/07/2014	<0.1	24.3	24.4	27/05/2014	0.9	12.4	13.3
12/10/2014	0.2	21.3	21.5	9/09/2014	0.9	7.7	8.6
6/08/2014	<0.1	20.7	20.8	29/07/2014	0.8	4.8	5.6
8/07/2014	<0.1	20.3	20.4	31/07/2014	0.7	4.2	4.9
18/05/2014	<0.1	20.1	20.2	29/04/2014	0.7	6.4	7.1
9/08/2014	<0.1	19.5	19.6	15/02/2014	0.7	8.6	9.3
4/07/2014	<0.1	19.3	19.4	27/06/2014	0.6	11.8	12.4
10/05/2014	0.3	18.8	19.1	4/12/2014	0.6	7.2	7.8
26/05/2014	0.1	18.9	19.0	23/06/2014	0.6	14.4	15.0
5/08/2014	<0.1	18.3	18.4	15/03/2014	0.6	5.1	5.7
These data represent the highest Cumulative Impact 24-hour $PM_{2.5}$ predictions (outlined in red) as a result of the operation of the Proposal.				These data represent the highest Incremental Impact 24-hour $PM_{2.5}$ predictions (outlined in blue) as a result of the operation of the Proposal.			

The performance of the Proposal does not result in any exceedances of the maximum 24-hour average particulate matter impact assessment criteria.

A contour plot of the predicted incremental 24-hour PM_{10} concentrations associated with the Proposal is presented in **Figure 10**.

Figure 10 Incremental 24-hour PM_{10} concentrations



Note Criterion = 50 µg·m^{-3} (cumulative)

7. MITIGATION AND MONITORING

7.1. Mitigation

Based on the findings of the air quality impact assessment, it is considered that the level of activity being performed at the Proposal Site, would result in minor incremental impacts at all surrounding off-site receptor locations.

The mitigation measures proposed represent best practice and are in use at other facilities operated by the Applicant.

The mitigation measures included within this assessment (namely dust collectors and filters) should be regularly inspected and reviewed to ensure their efficacy is maintained, including a daily check of the filter differential pressure readings. The performance of the system could also be checked through the performance of emissions testing which would also allow validation of the assumptions adopted in this AQIA.

7.2. Monitoring

Given the discussion presented above, taking into consideration the minor incremental contribution of the Proposal to air quality impacts in the surrounding area, no air quality monitoring is required or proposed, for either the construction phase or the operational phase.

8. CONCLUSION

The Trust Company (Australia) Limited has engaged Northstar to perform an AQIA, to support SSD 25725029, which seeks approval to construct, fit out and operate a manufacturing facility and associated warehouse facility at 657-769 Mamre Road, Kemps Creek (proposed Lot 12) which will be occupied and operated by Ardex (the Proposal).

The Proposal site is located within the broader Kemps Creek Warehouse, Logistics and Industrial Facilities Hub at 657-769 Mamre Road, Kemps Creek, NSW (approved as SSD 9522).

A dispersion modelling exercise has been performed to assess the potential impacts of the development at all off-site locations. Emissions of particulate matter associated with the storage of powdered materials, and emitted during the powder and liquid manufacturing process, were subject to modelling. Even with the inclusion of conservative background air quality concentrations, the impacts of the development are shown to not result in any exceedances of the relevant air quality criteria.

Given the quantity of earthworks proposed, a review of the construction phase risk assessment performed for the broader Kemps Creek Warehouse, Logistics and Industrial Facilities Hub has been reviewed. Risks associated with earthworks have the potential to be large, resulting in a high risk of dust soiling and health impacts. Nevertheless, impacts could easily be managed through the implementation of a considered Construction Dust Management Plan.

Conclusion: It is demonstrated that the operation of the Proposal does not cause any exceedances of the Air Quality Criteria.

It is respectfully suggested that the SSD should not be refused on the grounds of air quality issues.

9. REFERENCES

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Appendix A

Meteorology

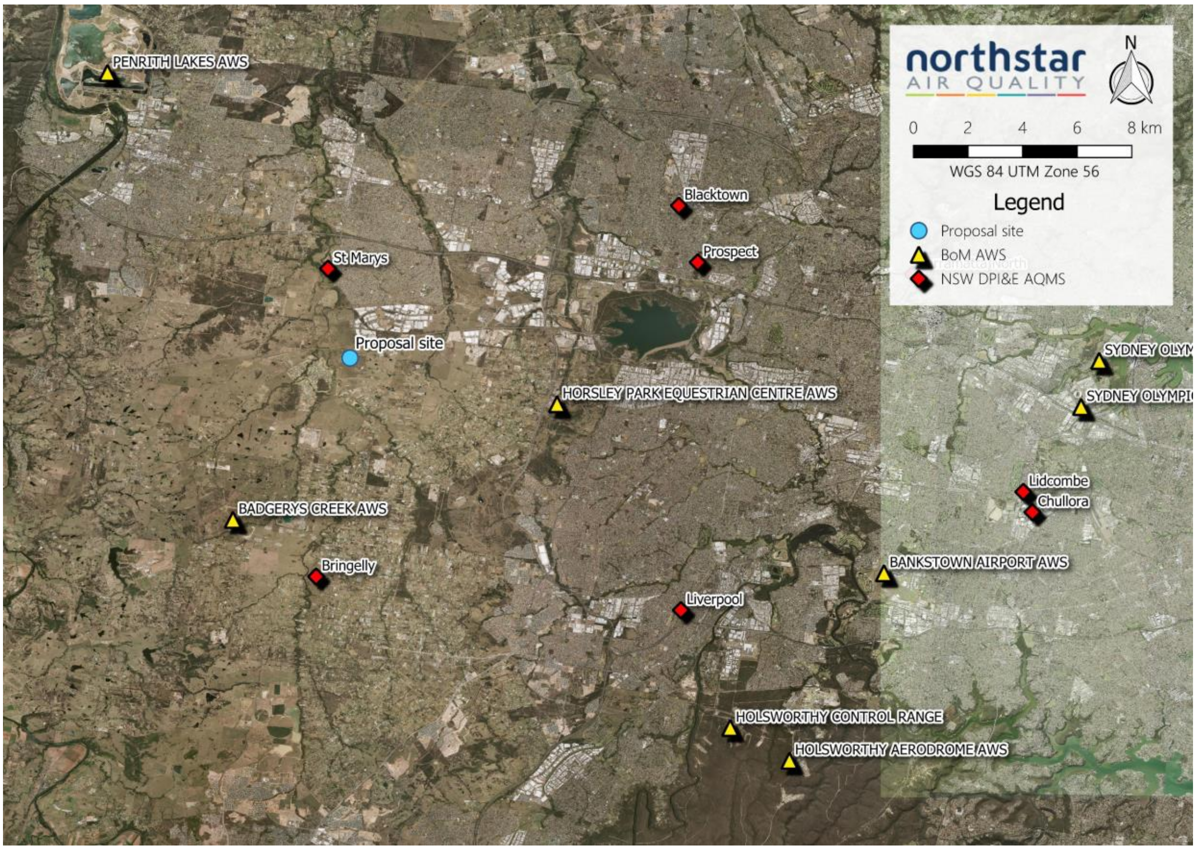
As discussed in **Section 4.3** a meteorological modelling exercise has been performed to characterise the meteorology of the Proposal Site in the absence of site specific measurements. The meteorological monitoring has been based on measurements taken at a number of surrounding automatic weather stations (AWS) operated by the Bureau of Meteorology (BoM). Meteorology is also measured by the NSW Department of Planning, Industry and Environment (DPI&E) at a number of Air Quality Monitoring Station (AQMS) surrounding the Proposal Site (refer **Section 4.4**).

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

Table A1 Details of the meteorological monitoring surrounding the Proposal Site

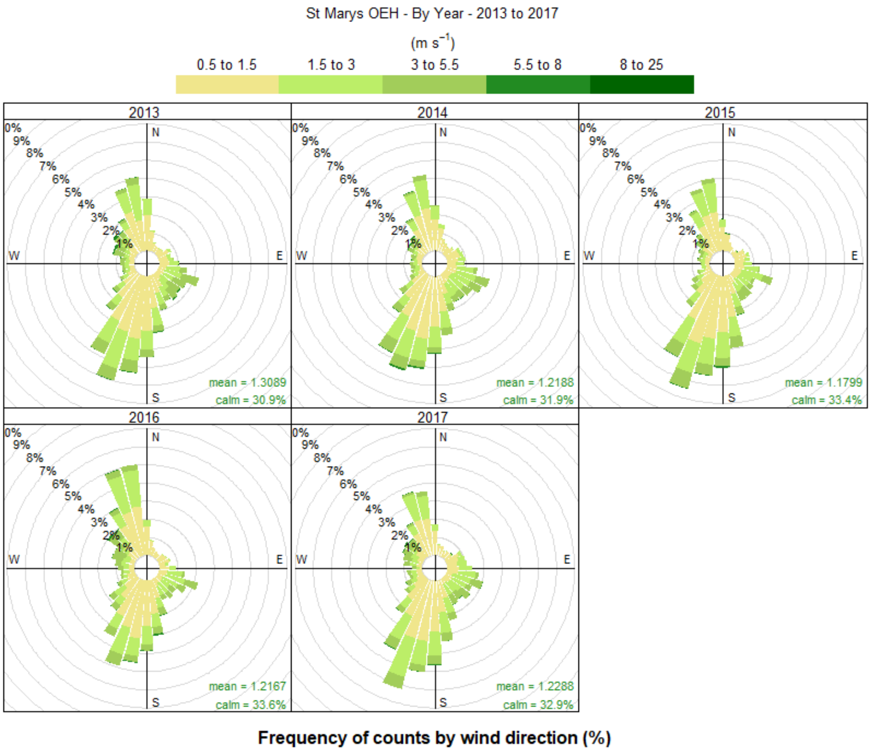
Site Name	Source	Approximate Location (UTM)		Approximate Distance
		mE	mS	km
St Marys AQMS	DPI&E	293 170	6 258 083	3.9
Horsley Park Equestrian Centre AWS – Station # 67119	BoM	301 710	6 252 290	7.9
Badgerys Creek AWS – Station # 67108	BoM	289 920	6 246 951	8.3
Bringelly AQMS	DPI&E	293 028	6 244 518	9.7
Prospect AQMS	DPI&E	306 744	6 258 645	13.5
Penrith Lakes AWS – Station # 67113	BoM	284 866	6 266 510	15.2
Liverpool AQMS	DPI&E	306 439	6 243 322	16.5

Figure A1 Meteorological and air quality monitoring surrounding the Proposal Site



Meteorological conditions at St Marys AQMS was chosen for further investigation due to its location relative to the Proposal Site. This site has been examined to determine a 'typical' or representative dataset for use in dispersion modelling. Annual wind roses for the most recent 5 years of data (2013 to 2017) are presented in **Figure A2.**

Figure A2 Annual wind roses 2013 to 2017, St Marys AQMS



The wind roses indicate that from 2013 to 2017, winds at St Marys AQMS show similar patterns across the years, with a predominant south-westerly wind direction.

The majority of wind speeds experienced at St Marys AQMS over the 5-year period, 2013 to 2017 are generally in the range <0.5 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from a south westerly direction. Winds of this speed are not frequent, occurring <0.1 % of the observed hours over the 5-year period, at St Marys. Calm winds (<0.5 $m \cdot s^{-1}$) occur during 32.5 % of hours on average across the 5-year period.

Given the wind distributions across the years examined, data for the year 2014 has been selected as being appropriate for further assessment, as it best represents the general trend across the 5-year period studied.

Presented in **Figure A3** are the annual wind rose for the 2013 to 2017 period and the year 2014 and in **Figure A4** the annual wind speed distribution for St Marys AQMS. These figures indicate that the distribution of wind speed and direction in 2014 is very similar to that experienced across the longer-term period.

It is concluded that conditions in 2014 may be considered to provide a suitably representative dataset for use in dispersion modelling.

Figure A3 Annual wind roses 2013 to 2017, and 2014 – St Marys AQMS

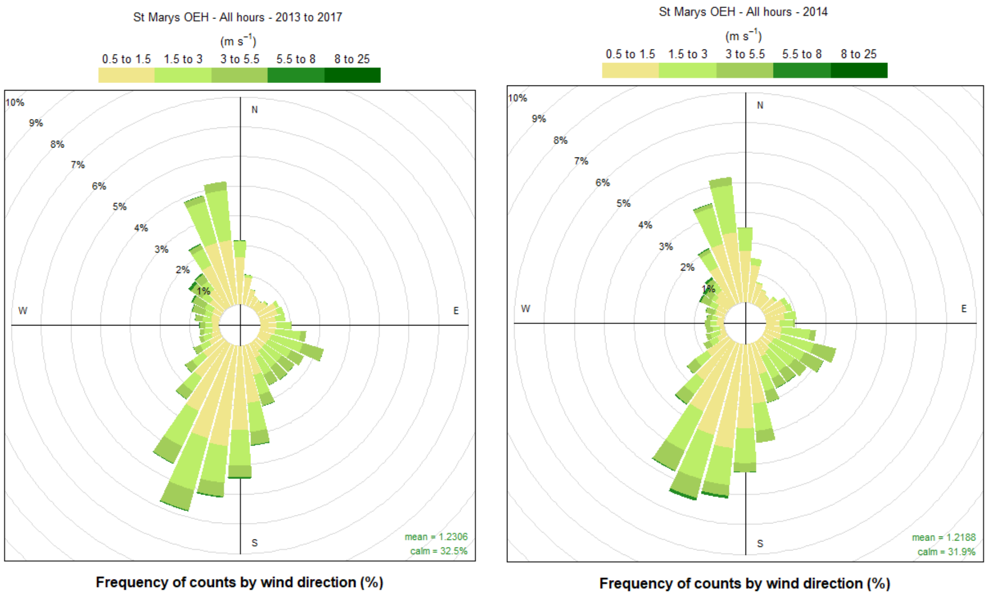
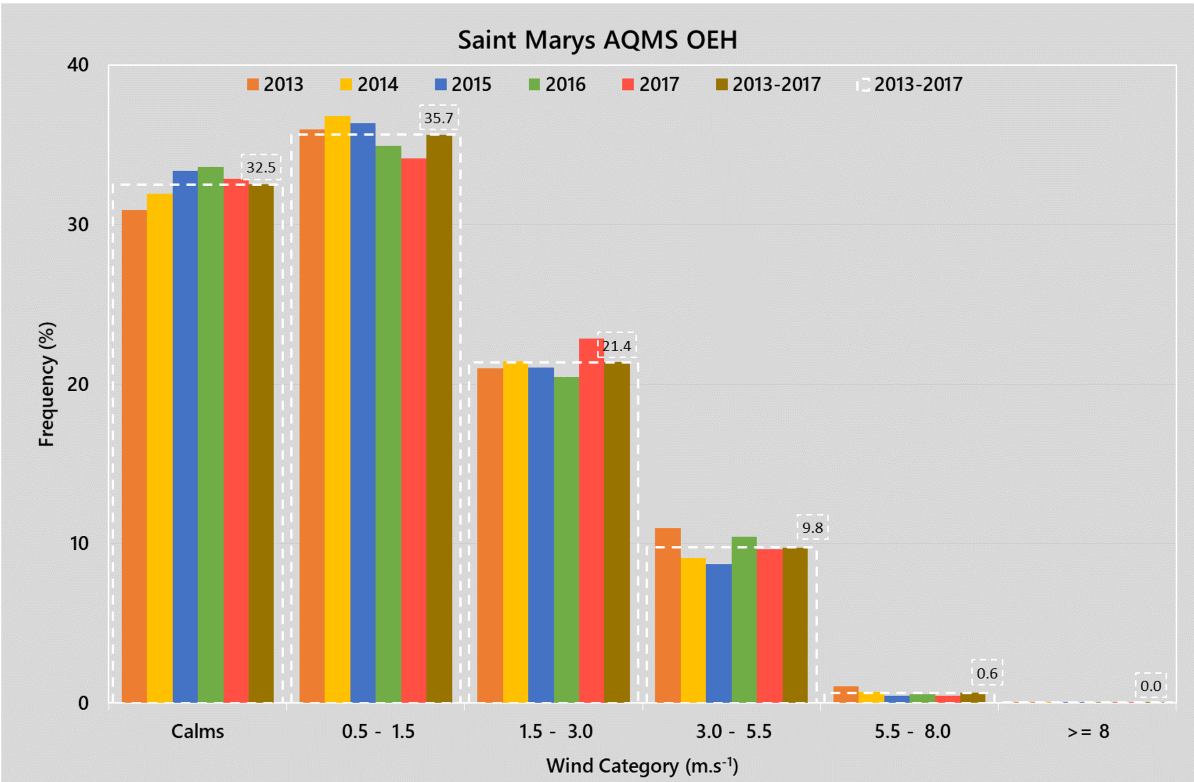


Figure A4 Annual wind speed distribution – St Marys AQMS



Meteorological Processing

The BoM and DPI&E 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 model in a format suitable for using in the CALPUFF dispersion model (refer **Section 5.1)**.

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

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

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

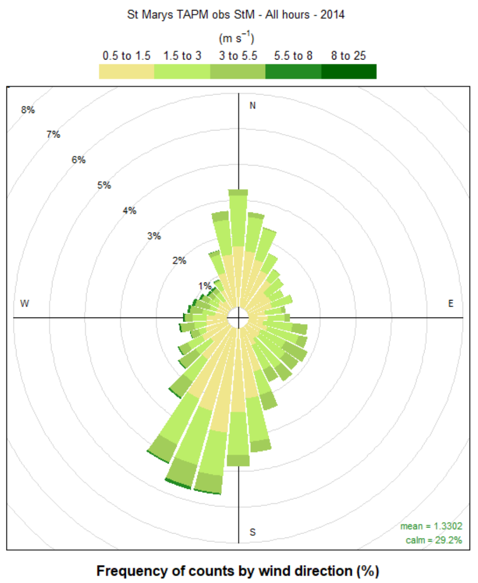
Table A2 Meteorological parameters used for this study

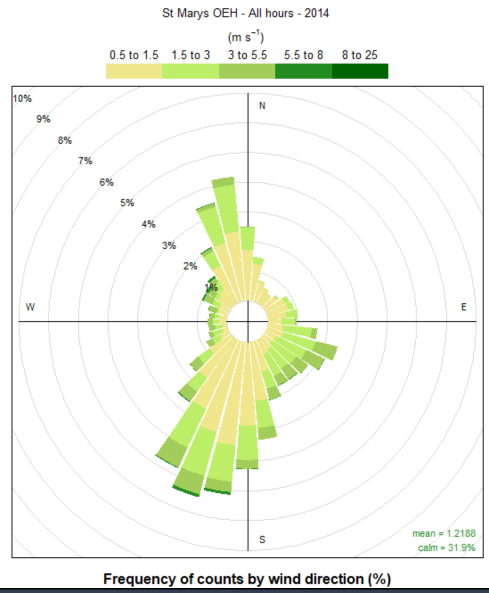
TAPM v 4.0.5	
Modelling period	1 January 2014 to 31 December 2014
Centre of analysis	293 235 mE, 6 258 700 mN (UTM Coordinates)
Number of grid points	35 × 35 × 35
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Terrain	AUSLIG 9 second DEM
Data assimilation	St Marys AQMS DPI&E

A comparison of the TAPM generated meteorological data, and that observed at the St Marys AQMS, is presented in **Figure A5**. A comparison of the TAPM generated meteorological data, and that observed at Badgerys Creek AWS was also compared to further validate the model and is presented in **Figure A5.** These data generally compare well at both sites, which provides confidence that the meteorological conditions modelled as part of this assessment are appropriate.

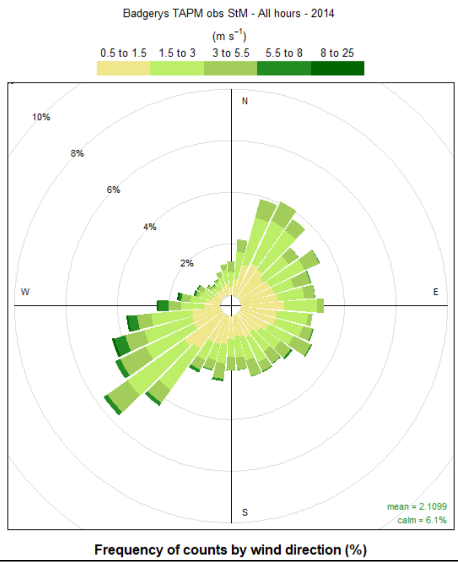
Figure A5 Modelled and observed meteorological data – St Marys AQMS & Badgerys Creek AWS, 2014

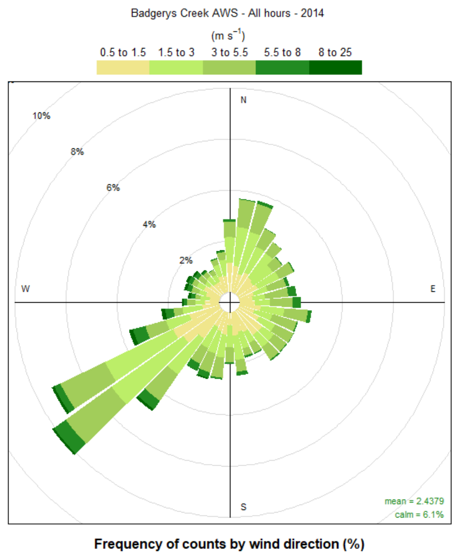
TAPM generated windrose	Observations at St Marys





TAPM generated windrose	Observations at Badgerys Creek



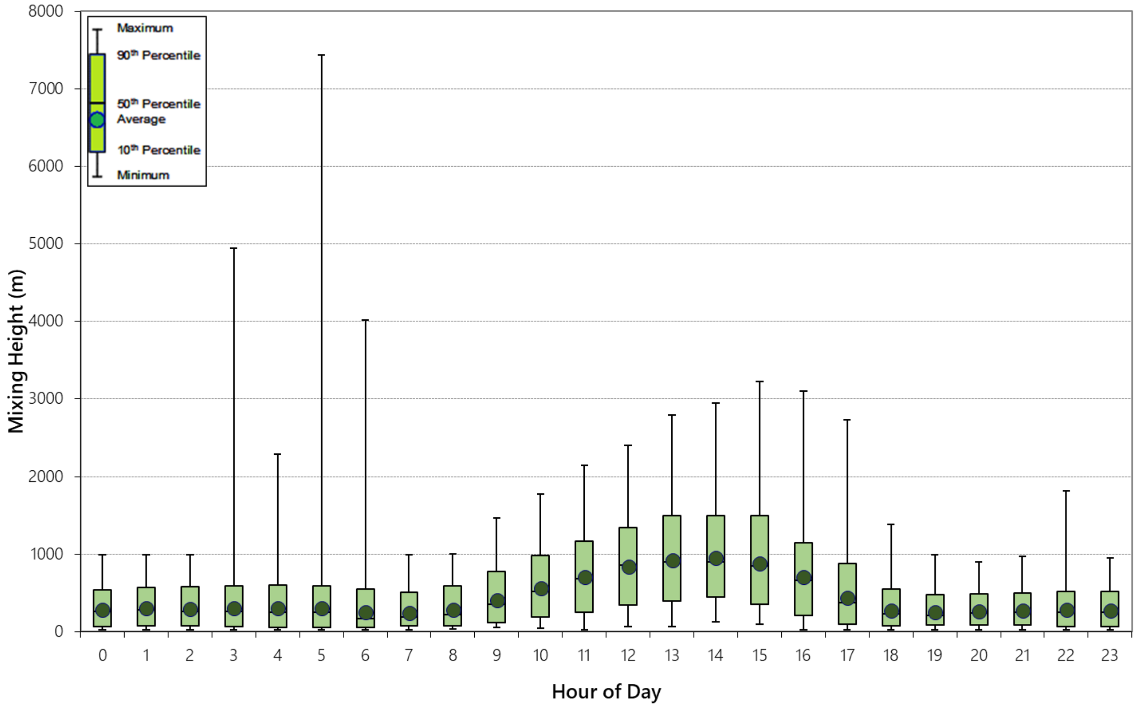


As generally required by the NSW EPA the following provides a summary of the modelled meteorological dataset. Given the nature of the pollutant emission sources at the Proposal Site, detailed discussion of the humidity, evaporation, cloud cover, katabatic air drainage and air recirulation potential of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

Diurnal variations in maximum and average mixing heights predicted by TAPM at the Proposal Site during 2014 period are illustrated in **Figure A6**.

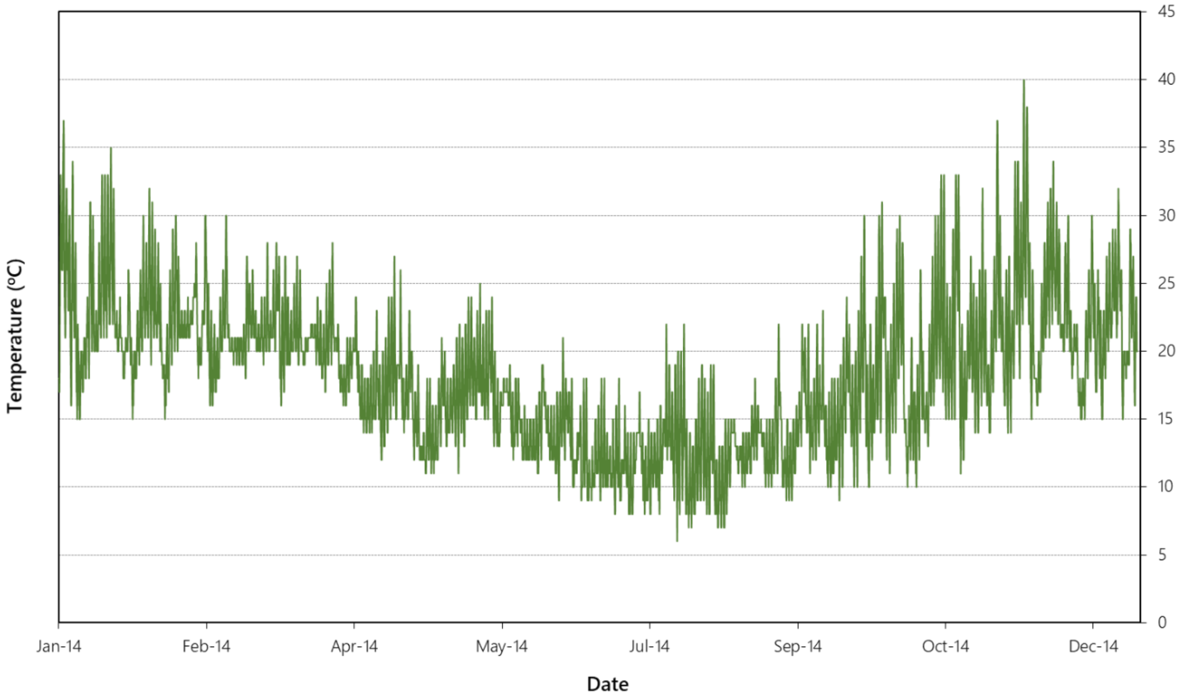
As expected, an increase in mixing height during the morning is apparent, arising due to the onset of vertical mixing following sunrise. Maximum mixing heights occur in the mid to late afternoon, due to the dissipation of ground based temperature inversions and growth of the convective mixing layer.

Figure A6 Predicted mixing height – Proposal Site 2014



The modelled temperature variations predicted at the Proposal Site during 2014 are presented in **Figure A7**.

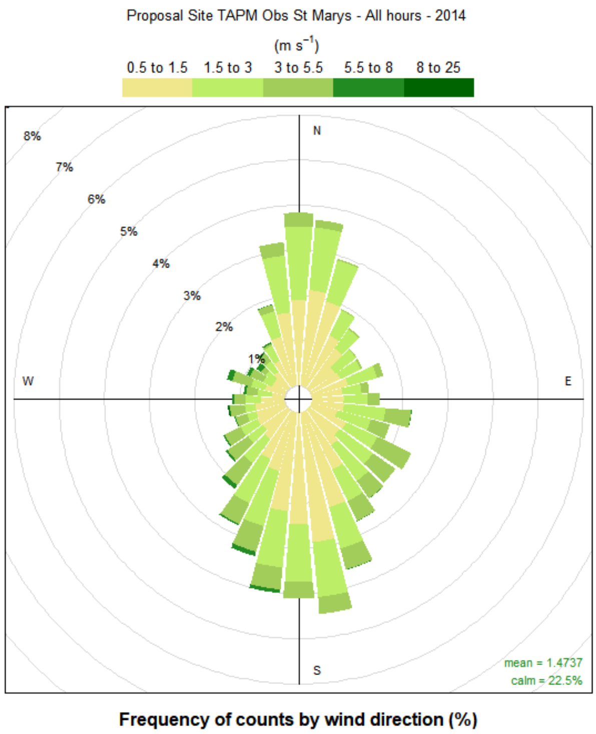
Figure A7 Predicted temperature – Proposal Site 2014



The maximum temperature of 40°C was predicted on 23 November 2014 and the minimum temperature of 6°C was predicted on 29 July, 2014.

The modelled wind speed and direction at the Proposal Site during 2014 are presented in **Figure A8**.

Figure A8 Predicted wind speed and direction – Proposal Site 2014



Appendix B

Background Air Quality Data

Air quality is not monitored at the Proposal Site and therefore air quality monitoring data measured at a representative location has been adopted for the purposes of this assessment. Determination of data to be used as a location representative of the Proposal Site and during a representative year can be complicated by factors which include:

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

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPI&E) at four air quality monitoring station (AQMS) within a 17 km radius of the Proposal Site. Details of the monitoring performed at these AQMS is presented in **Table B1** and **Figure 9**.

Table B1 Details of Closest AQMS Surrounding the Site

AQMS Location	Data Availability	Distance to Site (km)	Screening Parameters			
			2014 Data	Measurements		
				PM_{10}	$PM_{2.5}$	TSP
St Marys	1992 - 2018	3.9	✓	✓	×	×
Bringelly	1992 - 2018	9.7	✓	✓	×	×
Prospect	2007 - 2018	13.5	✓	✓	×	×
Liverpool	1988 - 2018	16.5	✓	✓	✓	×

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

St Marys, in 2014 was not measuring $PM_{2.5}$ hence the next most appropriate AQMS containing $PM_{2.5}$ for the year 2014 was taken, which is Liverpool AQMS.

Summary statistics are for PM_{10} and $PM_{2.5}$ data are presented in **Table B2**.

Table B2 PM_{10} and $PM_{2.5}$ statistics 2014

AQMS	St Marys	Liverpool
Year	2014	2014
Pollutant	PM_{10}	$PM_{2.5}$
Averaging Period	24-hour	24-hour
Data Points (number)	362	355
Mean (µg·m^{-3})	16.7	8.6
Standard Deviation (µg·m^{-3})	6.9	3.9
Skew[1]	1.0	1.0
Kurtosis[2]	1.4	0.9
Minimum (µg·m^{-3})	4.6	2.7
Percentiles (µg·m^{-3})		
1	6.1	3.0
5	8.1	3.8
10	8.9	4.5
25	11.4	5.7
50	15.4	7.6
75	21.0	10.8
90	25.3	14.4
95	28.6	16.1
97	31.8	17.4
98	33.6	18.9
99	38.1	20.2
Maximum	45.0	24.3
Data Capture (%)	99.2	97.3

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

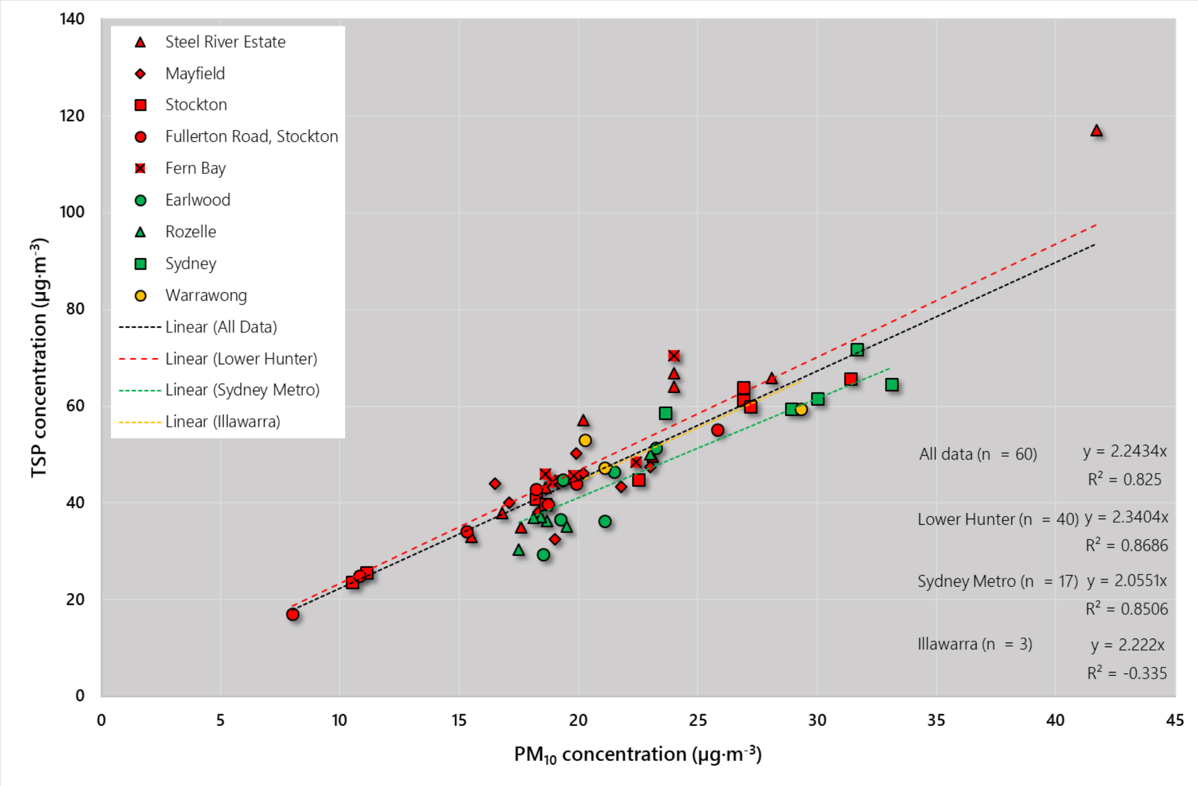
2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Concentrations of TSP are not measured by the NSW DPI&E at any AQMS surrounding the Proposal Site. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in **Figure B1**.

The analysis concludes that, on the basis of the measurements collected across NSW between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.0551 : 1 (i.e. PM_{10} represents ~48 % of TSP) is appropriate to be applied to measurements in the Sydney Metropolitan area.

In the absence of any more specific information, this ratio has been adopted within this AQIA. These estimates have not been adjusted for background exceedances.

Figure B1 Co-located TSP and PM_{10} Measurements, Lower Hunter, Sydney Metro and Illawarra



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 $g \cdot m^{-2} \cdot month^{-1}$).

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at St Marys and Liverpool in 2014 are presented in **Figure B2** and **Figure B3**, respectively.

Figure B2 PM$_{10}$ Measurements, Prospect 2014

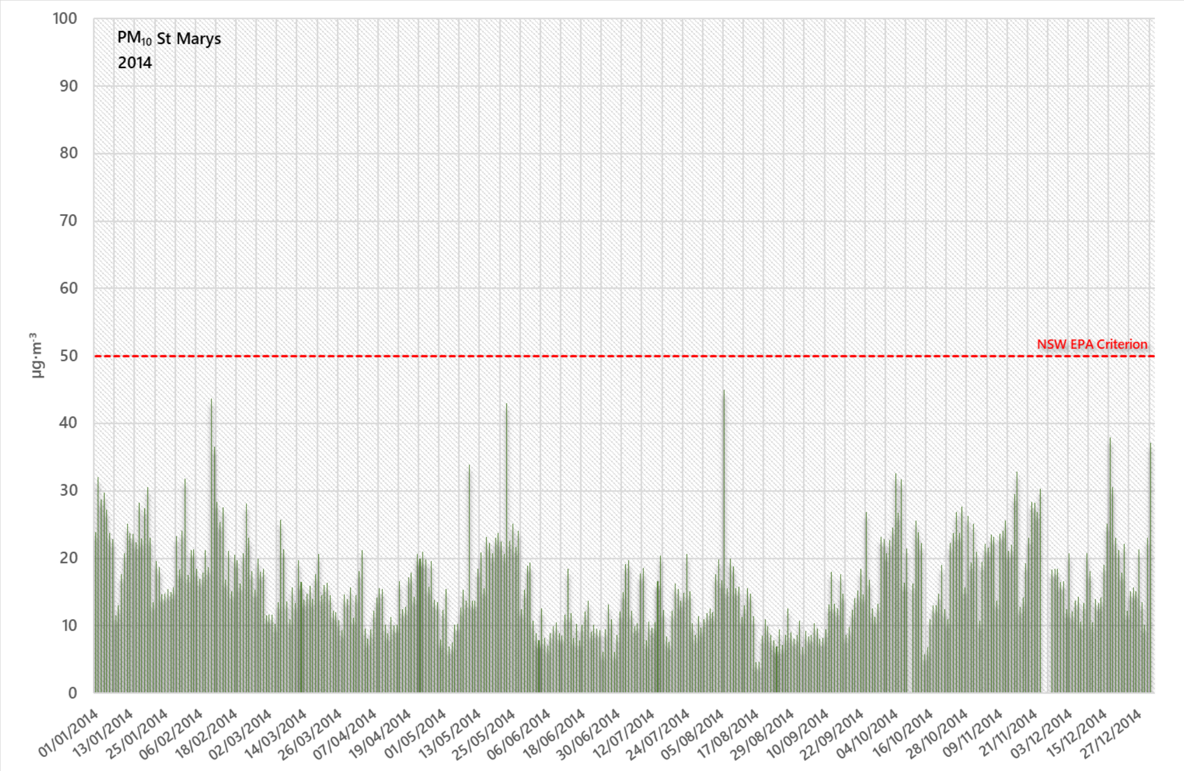
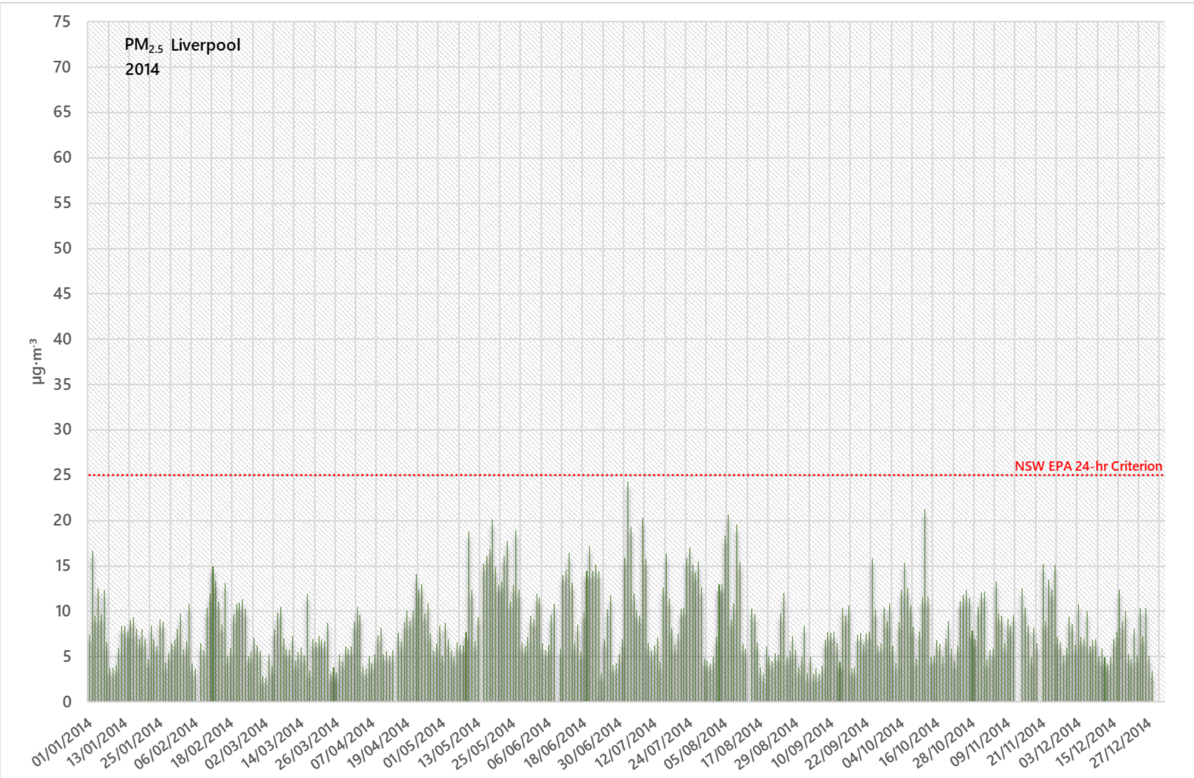


Figure B3 PM$_{2.5}$ Measurements, Liverpool 2014



Appendix C

Emissions Inventory

Table C1 Emissions Inventory

Emission Source	Emission Concentration			Units	Activity Rate	Units	Emission ($kg \cdot yr^{-1}$)			Emission ($kg \cdot hr^{-1}$)		
	TSP	PM_{10}	$PM_{2.5}$				TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Powder silo loading	10	3.4	0.34	$mg \cdot Nm^{-3}$	132	$Nm^3 \cdot hr^{-1}$	11.6	3.9	0.4	0.001	0.00045	0.00005
Dust collector 1 (powder)	5	1.7	0.17	$mg \cdot Nm^{-3}$	21000	$Nm^3 \cdot hr^{-1}$	919.8	312.7	31.3	0.105	0.0357	0.00357
Dust collector 2 (powder)	5	1.7	0.17	$mg \cdot Nm^{-3}$	21000	$Nm^3 \cdot hr^{-1}$	919.8	312.7	31.3	0.105	0.0357	0.00357
Dust collector 3 (powder)	5	1.7	0.17	$mg \cdot Nm^{-3}$	21000	$Nm^3 \cdot hr^{-1}$	919.8	312.7	31.3	0.105	0.0357	0.00357
Dust collector 4	5	1.7	0.17	$mg \cdot Nm^{-3}$	21000	$Nm^3 \cdot hr^{-1}$	919.8	312.7	31.3	0.105	0.0357	0.00357