

FRASERS PROPERTY GROUP

IVANHOE ESTATE, MACQUARIE PARK

STAGE ONE DEVELOPMENT APPROVAL AIR QUALITY ASSESSMENT

OCTOBER 2018



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Ivanhoe Estate, Macquarie Park
Stage One Development Approval
Air Quality Assessment

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TABLE OF CONTENTS

	EXECUTIVE SUMMARY	III
1	INTRODUCTION	4
1.1	OBJECTIVE	4
1.2	SCOPE OF WORKS	4
1.3	SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS.....	4
2	PROJECT BACKGROUND.....	6
2.1	OVERVIEW OF THE PROPOSED DEVELOPMENT	6
3	POTENTIAL POLLUTANTS AND EMISSIONS SOURCES.....	8
3.1	CONSTRUCTION PHASE	8
3.1.1	POLLUTANTS OF CONCERN	8
3.2	OPERATIONAL PHASE	8
3.2.1	POLLUTANTS OF CONCERN	8
4	ASSESSMENT CRITERIA.....	9
5	BACKGROUND ENVIRONMENT	10
5.1	SITE DESCRIPTION	10
5.2	SENSITIVE RECEPTORS	11
5.2.1	SENSITIVITY OF RECEPTORS.....	12
5.3	LOCAL METEOROLOGY.....	12
5.3.1	WIND SPEED AND DIRECTION.....	12
5.3.2	RAINFALL AND TEMPERATURE	13
5.4	AMBIENT AIR QUALITY	14
5.4.1	PARTICULATE MATTER	15
5.5	TRAFFIC VOLUMES	16
6	QUALITATIVE AIR QUALITY ASSESSMENT	18
6.1	CONSTRUCTION.....	18
6.2	OPERATION	19
6.2.1	CHILDCARE CENTRE	19
6.2.2	VEHICLE EXHAUST FROM ADJACENT ROADS	20
6.2.3	INTERNAL ROAD NETWORK	20
6.2.4	BASEMENT CAR PARK EXHAUST DISCHARGE POINTS	21

6.2.5	RESTAURANTS AND CAFES	21
7	MITIGATION OPTIONS.....	22
7.1	CONSTRUCTION.....	22
7.2	OPERATION	22
7.2.1	BASEMENT CAR PARK DISCHARGE POINTS	22
8	CONCLUSION.....	23
9	LIMITATIONS	24
	BIBLIOGRAPHY.....	25

EXECUTIVE SUMMARY

WSP Australia Pty Ltd was engaged by Frasers Property Australia to conduct an air quality assessment for Stage 1 of the Ivanhoe Estate mixed-use residential development, a State Significant Development. The air quality assessment was required to meet the Department of Planning Stage 1 Secretary's Environmental Assessment Requirements, dated 12 December 2017. In addition, the report was prepared to support a Development Application submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The scope of works included the following:

- Review of the development (construction and operation), and identification of any pollutants of concern.
- Review of meteorological data and characterisation of background environment.
- Qualitative air quality assessment for construction and operation of the proposed development.
- Identification of necessary mitigation measures.

After completion of the above works, WSP Australia Pty Ltd has made the following conclusions:

- Emissions of NO₂, SO₂, CO, particulate matter and nuisance dust associated with demolition and construction activities are unlikely to impact on nearby sensitive receptors. This is due to the types of construction activities planned, the favourable background environmental conditions, and the distance of sensitive receptors to the site. Any dust issues that are to arise will be controlled with mitigation measures.
- There is a low risk of air quality impacts on sensitive receptors located within and around Ivanhoe Estate during operation of Stage 1. This is due to the lack of pollution-generating activities within the precinct, the favourable background environmental conditions, the distance of sensitive receptors from major roads, effective screening from major roads, and the use of appropriate car park and kitchen exhaust ventilation systems.

1 INTRODUCTION

This report supports a Development Application for Stage 1 of the Ivanhoe Estate redevelopment, a State Significant Development (SSD), submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). It has been prepared by WSP Australia Pty Limited for Aspire Consortium on behalf of NSW Land and Housing Corporation.

1.1 OBJECTIVE

The objective of this report was:

- to undertake an air quality assessment meeting the Secretary's Environmental Assessment Requirements,
 - To qualitatively determine if construction activities associated with the development will impact upon the surrounding sensitive receptors,
 - To qualitatively determine if sensitive receptors within the proposed development will be affected by air quality impacts from the surrounding environment or from operational activities associated with the development,
-

1.2 SCOPE OF WORKS

The scope of this assessment included:

- A description of the environmental setting surrounding the project site, including a review of meteorological conditions, traffic conditions, existing land uses and ambient air quality.
 - The identification of potential sources of emissions which may affect air quality as a result of the construction of Stage 1.
 - The identification of potential sources of emission which may operationally affect Stage 1.
 - A qualitative air quality assessment for construction and operation of the proposed development,
 - The identification of necessary mitigation measures.
-

1.3 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Stage 1 Secretary's Environmental Assessment Requirements (SEARs), dated 12 December 2017, requires the submission of an air quality assessment with the DA. The SEARS identify the policies and guidelines to be considered within this assessment, and essentially form its terms of reference. The relevant SEAR for air quality is extracted below. The sections of this report which address each element of the SEARs are summarised in Table 1.1.

EXTRACT FROM STAGE 1 SEARS, 12 DECEMBER 2017

Recommendation no. 22 – Air Quality and Odour

The EIS shall include an Air Quality Impact Assessment. The assessment must be prepared in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2005 ('the Approved Methods') and must consider the requirements of the Protection of the Environment Operations (Clean Air) Regulation 2010. The key air quality issues that must be covered in the assessment include, where applicable:

- The identification of the pollutants of concern including dust and odours
- The identification and assessment of all relevant fugitive and point source emissions
- Proposed air quality management and monitoring procedures during the works.

Table 1.1 SEARs requirements and corresponding sections

REQUIREMENT / POLICY / REGULATION	SECTION OF THIS REPORT
Assessment in accordance with the Approved Methods	Section 4
Assessment in accordance with the Protection of the Environment Operations (Clean Air) Regulation 2010	Section 6
Identification of the pollutants of concern including dust and odours	Section 3
Identification and assessment of all relevant fugitive and point source emissions	Section 3 (identification) and Section 6 (assessment)
Proposed air quality management and monitoring procedures during the works.	Section 7

2 PROJECT BACKGROUND

In September 2015, the Ivanhoe Estate was rezoned by DPE as part of the Macquarie University Station (Herring Road) Priority Precinct, to transform the area into a vibrant centre that benefits from the available transport infrastructure and the precinct's proximity to jobs, retail and education opportunities within the Macquarie Park corridor.

The Ivanhoe Estate is currently owned by NSW Land and Housing Corporation and comprises 259 social housing dwellings. The redevelopment of the Ivanhoe Estate is part of the NSW Government Communities Plus program, which seeks to deliver new communities where social housing blends with private and affordable housing, with good access to transport, employment, improved community facilities and open space.

The Communities Plus program seeks to leverage the expertise and capacity of the private and non-government sectors. As part of this program, Aspire Consortium, comprising Frasers Property Australia and Mission Australia Housing, were selected as the successful proponent to develop the site in July 2017.

In September 2017, DPE issued the Secretary's Environmental Assessment Requirements for a comprehensive Masterplan application that will establish the framework for the staged redevelopment of the site. This Development Application for Stage 1 of the Ivanhoe Estate redevelopment represents the first stage of detailed works pursuant to the Ivanhoe Estate Masterplan.

2.1 OVERVIEW OF THE PROPOSED DEVELOPMENT

The proposed Stage 1 Development Application seeks consent for the first stage of detailed works within the Ivanhoe Estate, pursuant to the Ivanhoe Estate Masterplan under Section 4.22 of the EP&A Act. The Masterplan establishes the planning and development framework against which this Stage 1 Development Application will be assessed.

The Stage 1 Development Application seeks approval for:

- site preparation works, including tree removal, demolition, and earthworks across the Ivanhoe Estate;
- the provision and augmentation of utilities and services infrastructure across the Ivanhoe Estate;
- the construction of all internal roads including public domain within the road reserves, and the bridge crossing and road connection to Lyonpark Road;
- the consolidation of existing lots and subdivision of the Ivanhoe Estate to reflect the revised road layout, open space, and provide superblocks corresponding to the Masterplan;
- the construction and use of Buildings A1 and C1 comprising residential uses (including social housing), a childcare centre, and retail tenancies.

An image of the Masterplan, identifying Buildings A1 and C1 and illustrating the road network, is provided in Figure 2.1 below.

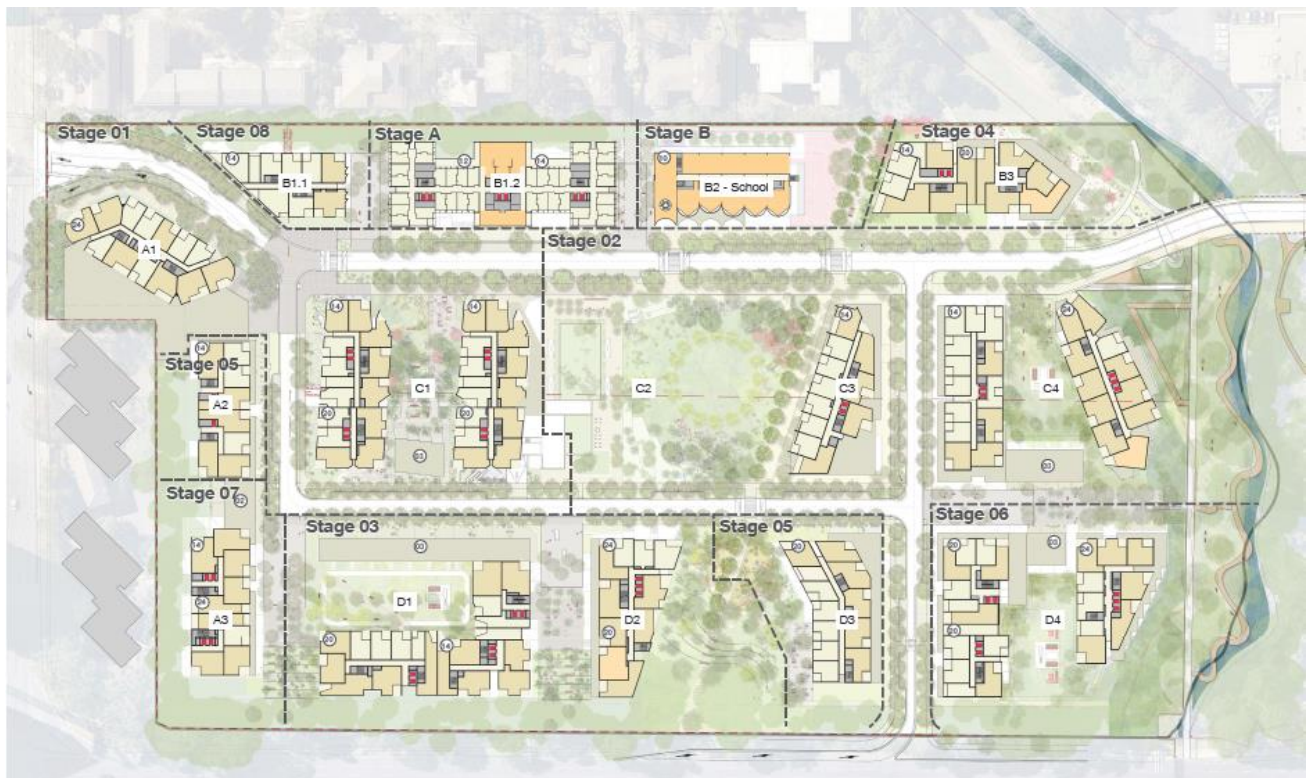


Figure 2.1 Ivanhoe Estate Masterplan (Stage 1)

3 POTENTIAL POLLUTANTS AND EMISSIONS SOURCES

The following section outlines the potential pollutants of concern and emissions sources associated with the construction and operation of Stage 1 of the Ivanhoe development.

3.1 CONSTRUCTION PHASE

During the construction of Stage 1 of the Ivanhoe Estate, the following activities will take place:

- site preparation works, including tree removal, demolition, and earthworks across the Ivanhoe Estate,
- bulk excavation of the site to ground relative level,
- the provision and augmentation of utilities and services infrastructure across the Ivanhoe Estate,
- the construction of all internal roads including public domain within the road reserves, and the bridge crossing and road connection to Lyonpark Road,
- the construction and use of Buildings A1 and C1 comprising residential uses (including social housing), a childcare centre, and retail tenancies.

3.1.1 POLLUTANTS OF CONCERN

The main air pollutants that can arise during the above construction and demolition works are (IAQM, 2014):

- dust deposition, resulting in the soiling of surfaces,
 - particulate matter (total suspended particulates (TSP), PM₁₀ and PM_{2.5}) from dust-generating construction activities and from vehicle exhaust,
 - Nitrogen dioxide (NO₂), sulfur dioxide, (SO₂), and carbon monoxide (CO) due to exhaust emissions from diesel powered vehicles and equipment used on-site (non-road mobile machinery) and vehicles accessing the site.
-

3.2 OPERATIONAL PHASE

Stage 1 of the Ivanhoe Estate development consists of two multi-storey mixed use buildings with underground car parks and an internal road network. The main activities associated with this development that have the potential to impact air quality include:

- traffic from adjacent roads – Epping Road (south) and Herring Road (north-east),
- traffic from internal road network,
- vehicle exhaust discharged from the underground car parks,
- commercial kitchens associated from cafes and/or restaurants in the retail tenancy sections.

3.2.1 POLLUTANTS OF CONCERN

The main air pollutants that can arise from the above activities include:

- NO₂, SO₂, CO, PM₁₀ and PM_{2.5} due to exhaust emissions from vehicles on internal and adjacent roads,
- odour emissions from commercial kitchens.

4 ASSESSMENT CRITERIA

As required by the SEARs, the assessment criteria for this AQIA have been taken from the Approved Methods, which was updated by the NSW EPA in 2016. The relevant criteria are outlined in Table 4.1 below.

Table 4.1 Impact assessment criteria for relevant air pollutants from the Approved Methods

POLLUTANT	AVERAGING PERIOD	CONCENTRATION	
		ppm	µg/m ³
SO ₂	10 minutes	25	712
	1 hour	20	570
	24 hours	8	228
	Annual	2	60
NO ₂	1 hour	12	246
	Annual	3	62
PM _{2.5}	24 hours	-	25
	Annual	-	8
PM ₁₀	24 hours	-	50
	Annual	-	25
TSP	Annual	-	90
		g/m ² /month ^a	g/m ² /month ^b
Deposited dust	Annual	2	4
		ppm	mg/m ³
CO	15 minutes	87	100
	1 hour	25	30
	8 hours	9	10

As the Approved Methods does not provide assessment criteria for odour, an assessment criterion was taken from the NSW Department of Environment and Conservation (now the OEH) 2006 Technical Framework: Assessment and management of odour from stationary sources in NSW. The criterion is in Odour Units (OU). The detectability of an odour is a sensory property that refers to the theoretical minimum concentration that produces an olfactory response or sensation. This point is called the 'odour threshold' and defines an OU. An odour goal of less than 1 OU would theoretically result in no odour impact being experienced. The criterion for urban areas is presented in Table 4.2 below.

Table 4.2 Odour assessment criterion

POPULATION OF AFFECTED COMMUNITY	ODOUR ASSESSMENT CRITERIA (OU)
Urban area (>2000) and/or schools and hospitals	2.0

5 BACKGROUND ENVIRONMENT

The following section provides an overview of the site setting of the proposed Ivanhoe development. Nearby sensitive receptors, local meteorological conditions, ambient air quality, and adjacent road traffic volumes are assessed.

5.1 SITE DESCRIPTION

The existing Ivanhoe Estate site is located in Macquarie Park near the corner of Epping Road and Herring Road within the Ryde Local Government Area (LGA). The site is approximately 8.2 hectares and currently accommodates 259 social housing dwellings, comprising a mix of townhouse and four storey apartment buildings set around a cul-de-sac street layout. An aerial photo of the site is provided in Figure 5.1 below.

Immediately to the north of the site are a series of four storey residential apartment buildings. On the north-western boundary, the site fronts Herring Road and a lot that is currently occupied by four former student accommodation buildings and is likely to be subject to redevelopment. Epping Road runs along the south-western boundary of the site and Shrimptons Creek, an area of public open space, runs along the south-eastern boundary. Vehicle access to the site is via Herring Road.

Ivanhoe Estate comprised of 17 individual lots owned and managed by the NSW Land and Housing Corporation. The Masterplan site also incorporates adjoining land, being a portion of Shrimptons Creek and part of the commercial site at 2-4 Lyonpark Road. This land is included to facilitate a bridge crossing and road connection to Lyonpark Road.



The Site

To facilitate road extension to Lyonpark Road

Figure 5.1 Ivanhoe Estate site

5.2 SENSITIVE RECEPTORS

Sensitive receptors (SRs) are defined as people or places that may be impacted by air emissions. Examples of sensitive receptors include residential dwellings, schools, hospitals, offices or public recreational areas (NSW EPA 2016).

SRs already in the vicinity of the site may experience air quality impacts as a result of both the construction and operation phase of Stage 1 of the Ivanhoe development.

The nearest existing SRs that may be affected by construction activities include the existing residential and tertiary education buildings around the site. In addition to these, receptors that may experience air quality impacts during the operation of the Ivanhoe development Stage 1 include the mixed-use buildings of A1 and C1. The sensitive receptors are presented in Table 5.1. The SRs are shown on Figure 1, Appendix A

Table 5.1 Sensitive receptors

RECEPTOR	DESCRIPTION	DIRECTION FROM SITE	DISTANCE FROM SITE
SR1	Multi-storey residential buildings located at 112 – 120 Herring Road	north-west	16 m
SR2	Multi-storey residential buildings located at 155 – 159 Herring Road and 5 – 11 Windsor Drive	north-east	8 m
SR3	Tertiary teaching institution located at 122 Herring Road (Morling College)	north	32 m
SR4	Multi-storey residential buildings located at 137 – 143 Herring Road	east and south-east	5 m
SR5	Multi-storey residential buildings located at 1 – 5 Peach Tree Road	north-west	20 m
A1	Proposed mixed-used multi-storey building, including childcare centre on the upper ground floor with capacity for 75 children, open from 7am to 6pm. The childcare centre has outdoor play spaces on both the northern and southern side of A1.	on site	on site
C1	Proposed mixed-use multi-storey residential building	on site	on site

5.2.1 SENSITIVITY OF RECEPTORS

For the purpose of this assessment, the SRs 1, 2, 4 and 5 are considered highly sensitive to both nuisance dust and PM₁₀. This is due to their nature as residences, where people can reasonably be expected to be present for extended periods of time. SR 3 is considered a medium sensitivity receptor.

5.3 LOCAL METEOROLOGY

Local meteorological parameters such as wind speed, wind direction and rainfall will influence whether there is likely to be an impact on air quality as a result of the construction and operation of the Ivanhoe development, particularly in relation to particulate matter. It is impossible to predict what the weather conditions will be when specific construction activities are being undertaken.

In order to characterise the dispersion meteorology of the region surrounding the project, long-term climate records, time-resolved meteorological monitoring data and meteorological modelling for the region were drawn upon, as documented in the following sections.

5.3.1 WIND SPEED AND DIRECTION

Site-representative wind speed and direction data was generated from analysing long term meteorological data from the Bankstown Airport Bureau of Meteorology (BoM) anemometer (located approximately 19 km south of the site) and Sydney Airport BoM anemometer (located approximately 21 km south-east of the site) (CCP, 2018). The coastal region of Sydney receives summer sea breezes from the north-east which dissipate with distance from the coast and are significantly diminished at Bankstown. The project site is located approximately halfway between the Bankstown and

Sydney Airport. Annual wind roses for Bankstown and Sydney airport are provided in Figure 5.2. The ‘superstation’ synthesised annual wind rose is also presented in Figure 5.2.

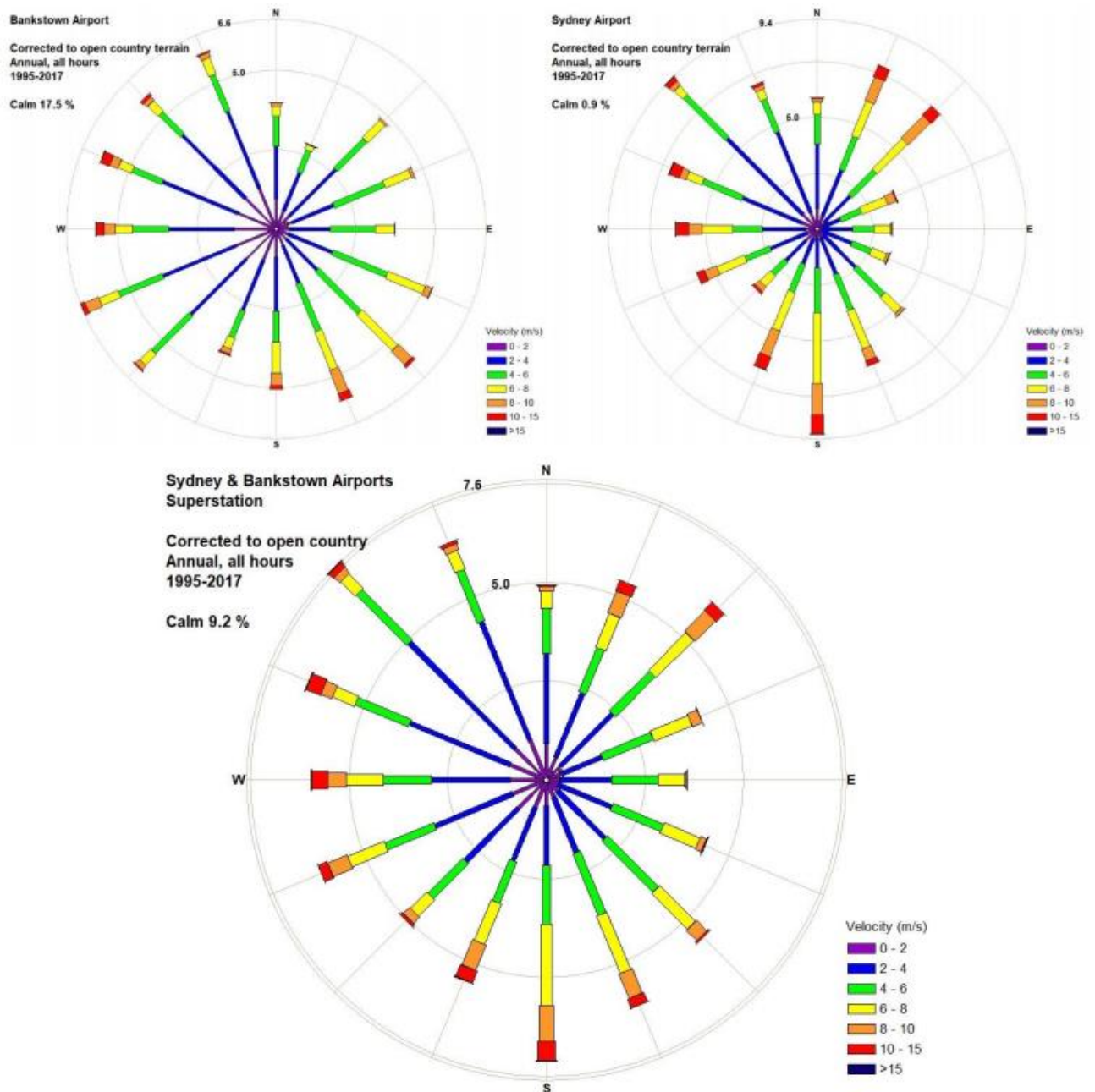


Figure 5.2 Wind roses for Bankstown and Sydney Airports (top), and site-representative superstation (bottom).
Source: CCP, 2018

The above wind rose shows that wind directions are highly varied at the site. Winds from the west tend to be the strongest of the year and are associated with large weather patterns and thunderstorm activity. Winds from the south and south-west are most often associated with rain. Winds from the north-east are occur often throughout the year but tend to be lighter.

5.3.2 RAINFALL AND TEMPERATURE

Rainfall and temperature are relevant to air quality considerations as dust impacts are more likely to occur during drier periods, as rainfall acts as a natural suppressant.

The nearest weather station which records temperature data is the BoM AWS at Sydney Olympic Park Archery Centre (station number 066212). The AWS is located 7.2 km south-west of the site. Rainfall data was taken from the BoM basic weather station at Willandra Village (station number 066156), 450 m west of the site.

Sydney Olympic Park AWS has mild winters and hot summers. Average daily maximums range between 18.4°C in winter and 29.0°C in summer. Average daily minimums range between 6.3°C in winter and 19.2 in summer.

During the period that the Willandra Village station has been operational (1971-1995 and 2003-2017), Willandra Village recorded on average 1113 mm of rainfall per year. January through April are the wettest months of the year. The months of July to October experience the least rainfall.

Long term temperature and rainfall averages are shown on Figure 5.3.

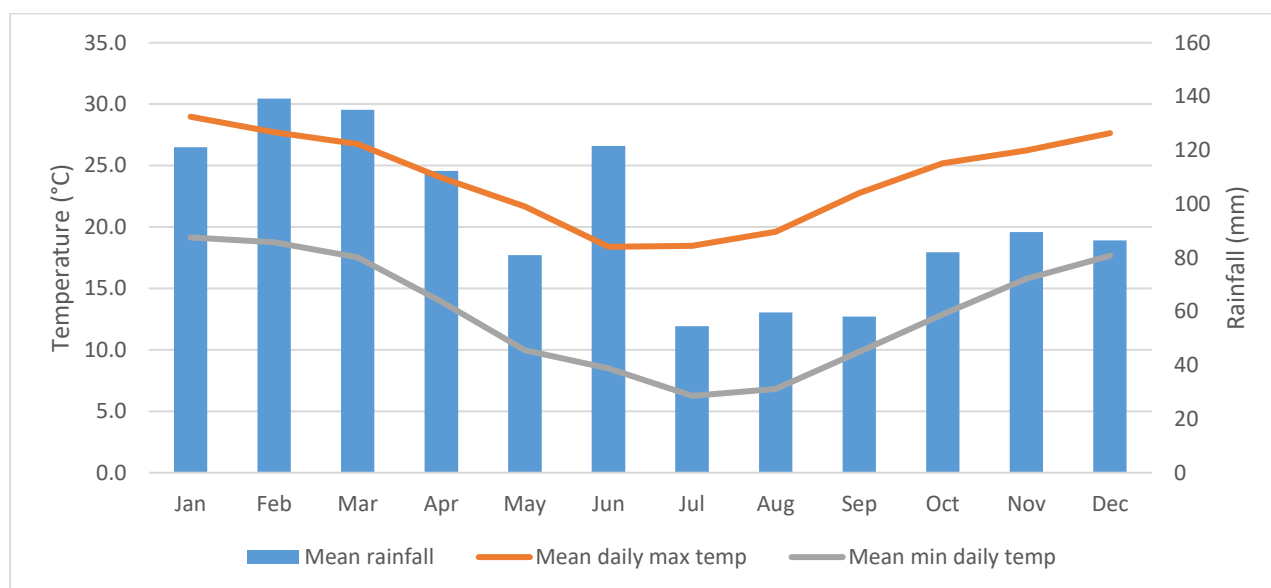


Figure 5.3 Long term mean daily temperature (minimum and maximum) and long term mean monthly rainfall

5.4 AMBIENT AIR QUALITY

A NSW Office of Environment and Heritage (OEH) air quality monitoring station is located at Macquarie University Sport Fields, Culloden Road. 1.7 km north of site. The station was commissioned in 2017, and has been recording data since August of that year. Data from the last five months of 2017 was analysed from this station and is summarised in Table 5.2. Long term air quality data was obtained from Lindfield air quality monitoring station, located in the grounds of the CSIRO Division of Radio Physics, Lindfield, also in a residential area. The station is 3.2 km east of the site and was commissioned in 1994. It recorded data until 2005 and was then recommissioned in 2007. Data from 2008 to 2018 recorded at Lindfield is summarised in Table 5.3.

For each pollutant, the shortest available averaging period for which there was a corresponding assessment criteria (see Table 4.1 above) was analysed. Long term trends are displayed on Figure 5.4.

5.4.1 PARTICULATE MATTER

Table 5.2 Macquarie University (8 August 2017 to 31 December 2017)

MACQUARIE UNIVERSITY	PM ₁₀ (24-hr average)	PM _{2.5} (24-hr average)	NO ₂ (1-hr average)	SO ₂ (24-hr average)	CO (1-hr average)
Min (µg/m ³)	3.5 (3/12/2017)	2.6 (18/08/2017)	0	0	0
Max (µg/m ³)	49.6 (24/09/2017)	24.1 (14/08/2017)	70.76 (25/10/2017)	8.2 (28/12/2017)	814.9 (3/9/2017 and 19/12/2017)
Average (µg/m ³)	15.2	6.4	9.6	1.18	201.1
No. of exceedances of assessment criteria	1	0	0	0	0

Table 5.3 Lindfield (2008 – 2018)

LINDFIELD	PM ₁₀ (24-hr average)	NO ₂ (24-hr average)	SO ₂ (24-hr average)
Min (µg/m ³)	2.3	0	0
Max (µg/m ³)	1596.3 (23/09/2009 – dust storm) 175.7 (16/04/2009)	40.2 (20/8/2009, 2/8/2011, 4/8/2011 and 8/8/2011)	13.3 (22/10/2010)
Average (µg/m ³)	15.1	15.9	1.2
No. of exceedances of assessment criteria	8	0 ^(a)	0

Notes:

(a) As no hourly data was available, the annual concentration criteria was used.

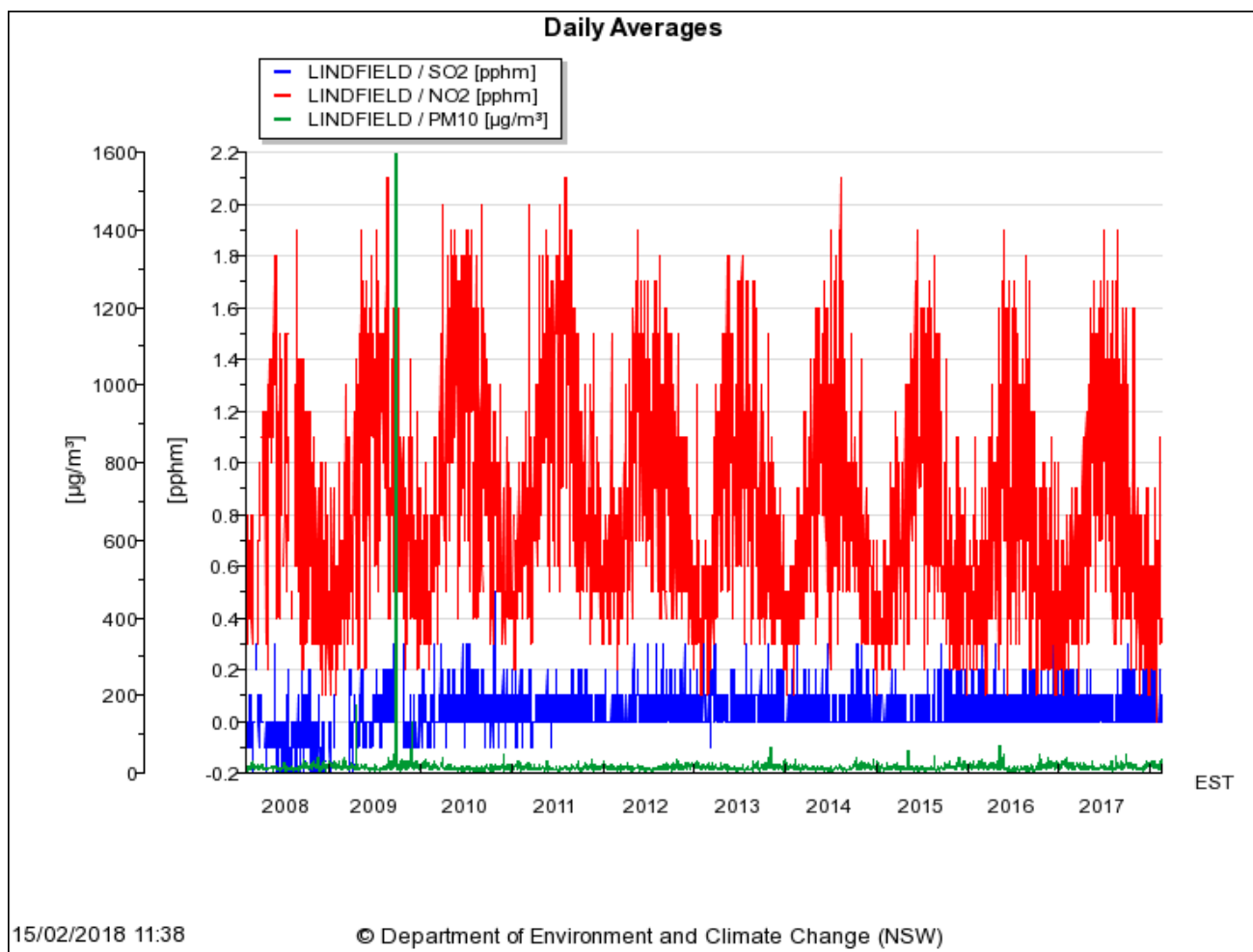


Figure 5.4 Lindfield daily averages for NO₂, SO₂ and PM₁₀ from 2008 to 2018

The above data shows that regional ambient air quality at Macquarie Park and Lindfield is of good quality. Long term trends for NO₂, SO₂ and PM₁₀ show that concentrations have been stable for the past 10 years, with NO₂ exhibiting seasonal fluctuations in concentration (with higher concentrations in summer).

There have been no exceedances of the assessment criteria of any of the assessed pollutants, with the exception of PM₁₀. The two highest exceedances of PM₁₀ were both associated with dust storms. The exceedance on 23 September 2009 was due to a large dust storm generated by gale force winds carrying dust from central Australia which broke dust records in many towns and cities on the east coast of Australia. On 16 April 2009, Widespread dust was blown over Sydney by strong south-westerly winds originating from dust storms in southern NSW (BoM, 2009). Generally, particulate matter concentrations fall well below the assessment criteria of 50 µg/m³.

5.5 TRAFFIC VOLUMES

Traffic volumes are important for assessing any existing air quality impacts that may arise as a result of heavy traffic. Developments adjacent to busy roads may require additional mitigation measures. The average peak hour traffic volumes for the arterial and collector road network within Macquarie Park provided by Ason Group (2018) are shown in Figure 5.5 and Figure 5.6. The data shows that the nearest intersection to the project site (Epping Road and Herring Road) receives a high traffic volume during peak hours. Lane Cove Road and Epping Road are the highest traffic roads, with similar volumes in both directions during peak periods. The NSW Roads and Maritime Services operates permanent vehicle counters on Epping Road (190 m west of Crimea Road, station number 74062), which records around 40,000 vehicles annually.

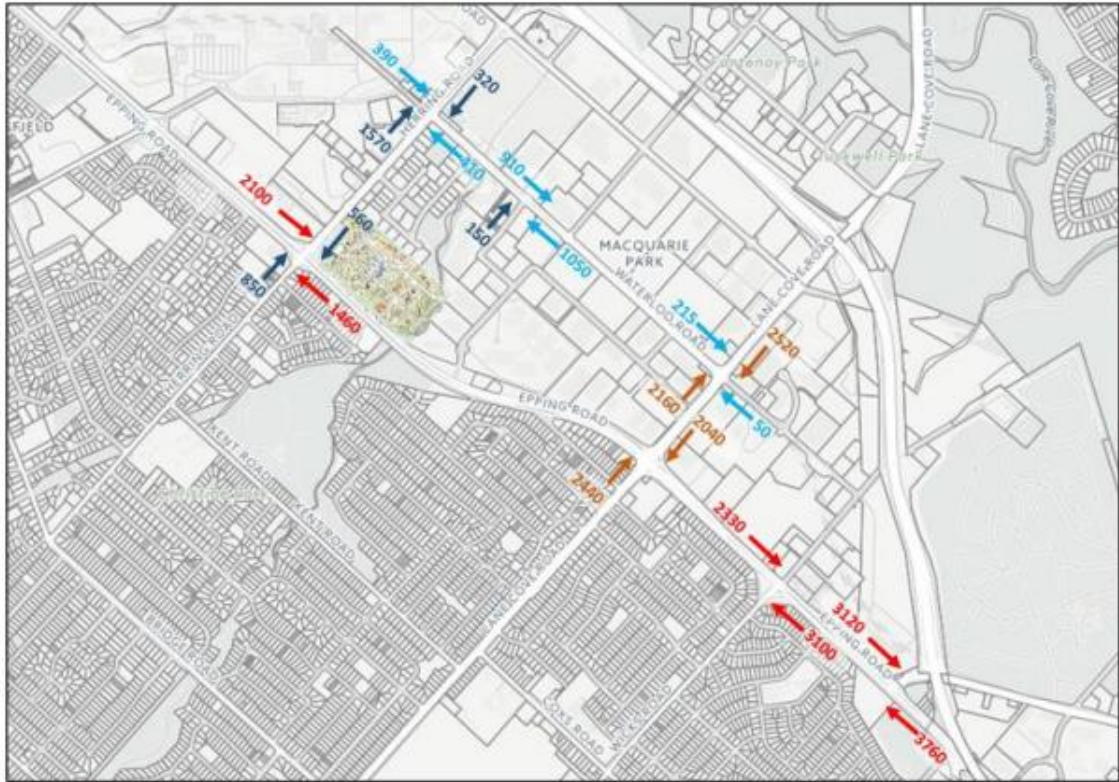


Figure 5.5 Existing AM peak hour traffic volumes (Source: Ason Group, 2018)

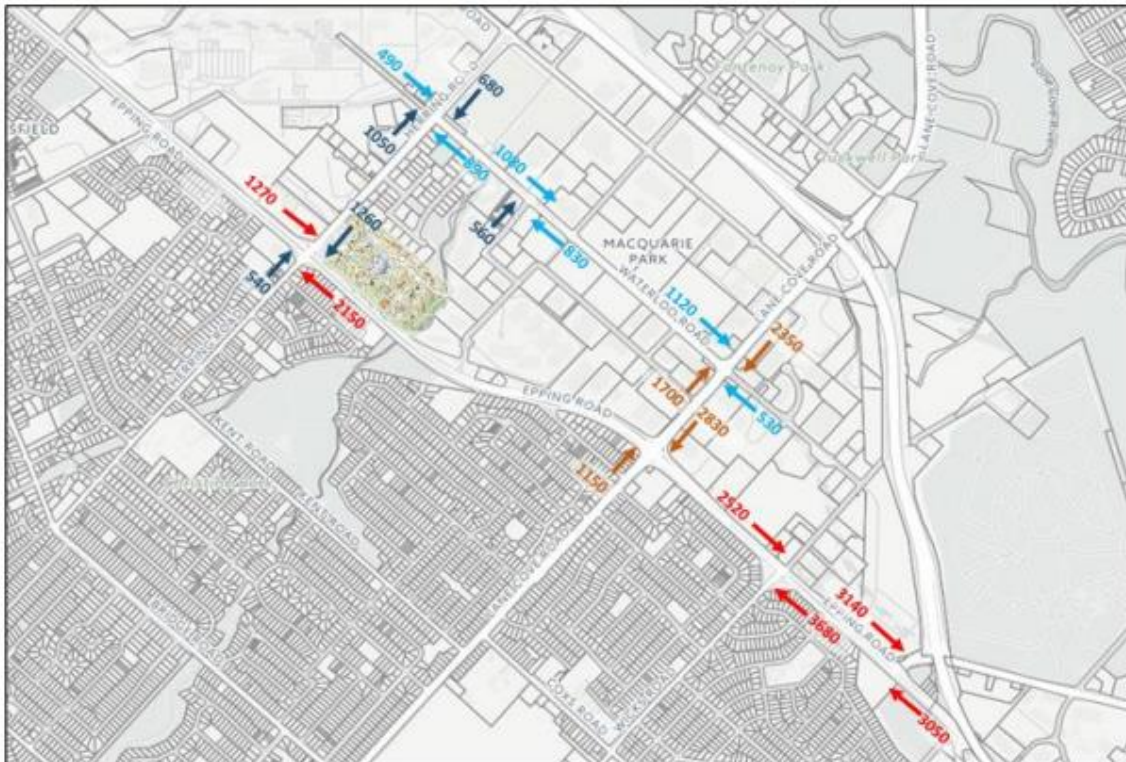


Figure 5.6 Existing PM peak hour traffic volumes (Source: Ason Group, 2018)

The proposed development at Ivanhoe estate is expected to generate between 440 to 540 vehicles per hour during the morning and evening peak periods, spread over the surrounding existing and proposed road network.

6 QUALITATIVE AIR QUALITY ASSESSMENT

This qualitative air quality assessment covers both the construction and operational phases of the Ivanhoe development. The risk that emissions during the construction and operational phases will result in nuisance and/or health impacts on nearby sensitive receptors is related to:

- activities being undertaken and potential pollutants emitted (discussed in section 3),
 - duration of these activities,
 - background air quality (discussed in section 5.4)
 - meteorological conditions (discussed in section 5.3),
 - proximity of receptors to the activities (discussed in section 5.2),
 - sensitivity of the receptors to dust (discussed in section 5.2.1), and
 - adequacy of mitigation measures applied to reduce or eliminate dust emissions (discussed in section 7).
-

6.1 CONSTRUCTION

During the construction phase, potential air quality impacts are associated with the generation of particular matter and gaseous emissions. These are typically emitted from construction equipment and associated vehicular traffic. Areas of concern in relation to air quality from construction of Stage 1 of the Ivanhoe Estate development are:

- Site preparation works including tree removal, earthworks and demolition of existing buildings,
- bulk excavation of the site to ground relative level,
- construction of two large multi-storey buildings (A1 and C1), including basement car park, and
- construction of an internal road network including Shrimpton's Creek bridge and connection to Lyonpark Road.

During all works relating to construction, there is a potential for dust and particulate matter to have a nuisance impact on SRs 1-3 (refer to section 5.2 and Figure 1, Appendix A).

Dust generation may be due to the following activities:

- vehicle movements causing wheel generated dust.
- works associated with upgrades, such as demolition, cutting materials such as concrete slabs or bricks during construction
- loose construction material being transported off-site by localized winds (like stockpiles).
- Excavation for the planned works associated with the basement carpark.

During the construction phase, there is also potential for vehicle exhaust emissions (comprising NO₂, SO₂, CO and particulate matter) from construction-related traffic.

Meteorological conditions (see section 5.3) show that the site typically receives a moderate amount of rainfall, which will aid with dust suppression. Strong westerly winds typical at the site would aid in dissipating air pollutants away from nearby sensitive receptors. The site also receives light north-easterly winds which could transport air pollutants towards SR1 (high sensitivity receptor) and SR3 (medium sensitivity receptor). SR1 is located approximately 20 m from the site boundary, and SR3 is located approximately 60 m from the site boundary. Whilst SR1 is a high sensitivity receptor

located within close proximity to the site, the implementation of adequate dust mitigation measures (discussed in section 7) will ensure that SR1 does not experience negative air quality impacts.

Existing ambient air quality at the site is of good quality, therefore the potential for construction related activities to exacerbate existing air pollutant concentrations to levels above the assessment criteria is considered low.

Given the well-established nature of the site, site preparation works such as clearing and handling of soils or site grading activities will be short-lived and minimal. The likelihood of air quality impacts during construction would also be low, given that activities are localized, and limited to the worksite only. It can therefore be assumed that there will be no significant potential for any dust emissions.

6.2 OPERATION

During the operation of Ivanhoe Estate Stage 1, the main pollutant sources of concern include:

- vehicle exhaust from Epping Road to the south and Herring Road to the north-east,
- vehicle exhaust from the internal road network,
- vehicle exhaust from the basement car parks' exhaust discharge points,
- odours from restaurants or cafes in the retail tenancies of each building.

The above emissions sources are discussed in the following sections. The childcare centre located on the upper ground floor of building A1 is considered the most sensitive receptor during operational phase, and requires further considerations, detailed in section 6.2.1.

6.2.1 CHILDCARE CENTRE

The NSW Department of Planning released a Childcare Planning Guideline in August 2017. It details air quality objectives relevant for childcare centres which are proposed close to external sources of air pollution. The proposed childcare centre's afternoon outdoor play area is 150 m from Epping Road (~40,000 movements per day) and 18 m from Herring Road (no traffic data).

EXTRACT FROM NSW CHILDCARE PLANNING GUIDELINE AUG 2017

Objective: To ensure air quality is acceptable where child care facilities are proposed close to external sources of air pollution such as major roads and industrial development.

C27 Locate child care facilities on sites which avoid or minimise the potential impact of external sources of air pollution such as major roads and industrial development.

C28 A suitably qualified air quality professional should prepare an air quality assessment report to demonstrate that proposed child care facilities close to major roads or industrial developments can meet air quality standards in accordance with relevant legislation and guidelines. The air quality assessment report should evaluate design considerations to minimise air pollution such as:

- creating an appropriate separation distance between the facility and the pollution source. The location of play areas, sleeping areas and outdoor areas should be as far as practicable from the major source of air pollution
- using landscaping to act as a filter for air pollution generated by traffic and industry. Landscaping has the added benefit of improving aesthetics and minimising visual intrusion from an adjacent roadway
- incorporating ventilation design into the design of the facility.

The masterplan shows that the childcare centre's outdoor play areas will be surrounded by vegetative screening to filter for air pollution generated on Herring Road and Epping Road. In addition to vegetative screens, the childcare centre will

be separated from Epping Road by the physical barriers created by existing and future buildings in Ivanhoe Estate. The outdoor play area is also located approximately 160 m from the kerbside of Epping Road, which means that particulate concentrations will be reduced by over 90% from kerbside levels due to dissipation into the atmosphere (NSW Department of Planning, 2008). The risk of air quality impacts from adjacent road traffic at the proposed childcare centre is therefore considered low.

6.2.2 VEHICLE EXHAUST FROM ADJACENT ROADS

The DPE Development near Rail Corridors and Busy Roads Interim Guideline (2008) ('the Interim Guideline') provides guidance on the air quality requirements for developments which are located in or adjacent to rail corridors or busy roads. The guideline details the requirements and implementation of the relevant provisions in the State Environmental Planning Policy (Infrastructure) 2007 ('the Infrastructure SEPP').

The guideline specifies that any development adjacent to a major road, defined as a road which carries an annual average daily traffic (AADT) of more than 40,000 vehicles, is subject to Infrastructure SEPP requirements. Traffic data for Epping Road which runs along the southern border of the proposed Ivanhoe Estate development (approximately 90 m from the perimeter of Stage 1) shows that annual traffic volumes are generally around 40,000 vehicles. The Interim Guideline's recommended design considerations for developments located adjacent to a road corridor are extracted below.

INTERIM GUIDELINES (2008) EXTRACT

Air quality design considerations:

- Minimising the formation of urban canyons that reduce dispersion. Having buildings of different heights interspersed with open areas, and setting back the upper stories of multi-level buildings helps to avoid urban canyons.
- Incorporating an appropriate separation distance between sensitive uses and the road using broad scale site planning principles such as building siting and orientation. The location of living areas, outdoor space and bedrooms and other sensitive uses (such as childcare centres) should be as far as practicable from the major source of air pollution.
- Ventilation design and open-able windows should be considered in the design of development located adjacent to roadway emission sources. When the use of mechanical ventilation is proposed, the air intakes should be sited as far as practicable from the major source of air pollution.
- Using vegetative screens, barriers or earth mounds where appropriate to assist in maintaining local ambient air amenity. Landscaping has the added benefit of improving aesthetics and minimising visual intrusion from an adjacent roadway.

The masterplan (Figure 2.1) shows that effective screens are already incorporated into the design of the Ivanhoe Development. Stage 1 will be separated from Epping road by both vegetative screens and physical screens provided by other buildings. In addition, pollutant concentrations at a distance of 100 m from a major road falls by 90% relative to kerbside levels (NSW Department of Planning, 2008). Due to the effective screening and appropriate distance between the proposed Stage 1 development and Epping Road, potential air quality impacts at the development are considered to be low risk.

6.2.3 INTERNAL ROAD NETWORK

The volume of traffic on the internal road network will be limited to predominately residential traffic, and thus is expected to be low.

6.2.4 BASEMENT CAR PARK EXHAUST DISCHARGE POINTS

There is potential for air quality impacts on the childcare centre afternoon outdoor play area from the A1 basement car park exhaust discharge point. The basement car park for building A1 will consist of 233 car spaces in total. The exhaust discharge point for this car park will be located on the western corner of the site close to Herring Road and just outside the perimeter for the afternoon outdoor play area. It will be located approximately 5.5 m above the outdoor play area courtyard level and will discharge to ambient. The close proximity of the discharge point to the outdoor play area could pose a risk to air quality on days with calm or very light winds, which are not effective at dissipating air pollutants. The discharge point will be designed to be in compliance with Australian Standard AS1668.2 and the air will discharge directly away from the childcare where possible.

In order to ensure that there are no air quality impacts on the outdoor play area from the car park exhaust, further investigation will be undertaken during detailed design and appropriate solutions will be implemented. The exhaust system will also incorporate additional measures as required.

The basement car park for C1 will consist multiple levels and around 400 car spaces in total. Should the discharge point(s) be located close to residential dwellings within building C1, there may be a risk of air quality impacts.

6.2.5 RESTAURANTS AND CAFES

At this stage the future occupants of the retail tenancies located in building A1 and C1 are not known. It is possible that odour emissions from a commercial kitchen may be a concern should a restaurant or café be located in the commercial areas of Stage 1. So long as any commercial kitchens are fitted with appropriate commercial exhaust ventilation systems, which filter and treat discharge in accordance with the relevant Australian Standards (AS) (AS 1668.1:2015, AS 1668.2:2012 and AS 3666.1:2011), there will be a low risk of impacts at local sensitive receptors.

7 MITIGATION OPTIONS

7.1 CONSTRUCTION

Construction activities were assessed as having low potential to generate dust and vehicular emissions during demolition and construction. Any emissions to air are likely to come from vehicle movements, excavation, construction works, and soil and construction materials being stored on site and transported offsite. However, with implementation of a well-practised mitigation management plan, dust issues onsite can be contained and thus controlled to meet air quality objectives.

The following mitigation measures described below will be implemented:

- Vehicles and plant/equipment should be fitted with appropriate emission control equipment and be serviced and maintained in accordance with the manufacturers' specifications.
- Loads comprising loose material entering or leaving a site should be covered.
- Dusty activities should be dampened, particularly during dry weather.
- Drop heights for materials should be minimised to control the fall of materials.
- Cutting of materials such as concrete slabs or bricks should be undertaken with extraction or suppression where possible. Pouring water over material as it is being cut can greatly reduce the amount of dust generated.
- Skips should be securely covered.
- Materials should be removed from site as soon as practicable, or stored on site with appropriate coverings and dampening until removal is possible.

Construction air quality mitigation measures will be developed with the managing contractor leading up to and during the construction phase. The managing contractor is key to the provision to these measures as they will inform the construction processes to be assessed and ensure that all operational and physical noise and vibration mitigation measures will be integrated. A Construction Air Quality Management Plan (CAQMP) should be developed to ensure the above mitigation measures are followed.

7.2 OPERATION

As discussed in section 6.2, air quality impacts on sensitive receptors during the operation of the Ivanhoe Estate Stage 1 development are likely to be minimal. Effective mitigation measures, such as appropriate ventilation systems, vegetative and physical screens, and distance from polluting sources, have already been or will be incorporated into the design of Ivanhoe Estate.

7.2.1 BASEMENT CAR PARK DISCHARGE POINTS

As discussed in section 6.2.4, there is potential for air quality impacts from the basement car park discharge points in both building A1 and C1. Where possible, the basement car park exhaust discharge points should be located as far as practicable from outdoor areas where people are likely to be present for extended periods of time (e.g. the child care centre's afternoon outdoor play area and residential balconies). It will be designed to comply with Australian Standard AS1668.2. WSP also recommends that the proponent undertakes air quality monitoring in the childcare centre's outdoor play areas prior to commencement of childcare centre operations to ensure that the site is not being impacted by vehicle exhaust from the nearby basement car park discharge point.

8 CONCLUSION

An assessment of the potential air quality impacts associated with the proposed construction and operation of Stage 1 of the Ivanhoe Estate development has been conducted in accordance with the relevant SEARs.

The air quality assessment identified and concluded the following:

- Emissions of NO₂, SO₂, CO, particulate matter and nuisance dust associated with demolition and construction activities are considered low risk. This is due to the types of construction activities planned, the favourable background environmental conditions, and the distance of nearby sensitive receptors to the site. Any dust issues that are to arise will be controlled with mitigation measures.
- Air quality impacts on sensitive receptors located within and around Ivanhoe Estate during operation of Stage 1 are likely to be insignificant. This is due to the lack of pollution-generating activities within the precinct, the favourable background environmental conditions, the distance of sensitive receptors from major roads, effective screening from major roads, and the use of appropriate car park and kitchen exhaust ventilation systems.
- There is a carpark exhaust located adjacent to a proposed childcare centre. This exhaust will be designed in accordance with Australian Standard AS1668.2. Initial monitoring for the relevant air pollutants is proposed to ensure there is no impact upon the childcare.

Based on the above, WSP Australia Pty Ltd concludes that air quality impacts associated with the construction and operation of Stage 1 of the Ivanhoe Estate development will be limited.

9 LIMITATIONS

SCOPE OF SERVICES

This environmental site assessment report (the report) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the client and WSP (scope of services). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

In preparing the report, WSP has relied upon data, surveys, analyses, designs, plans and other information provided by the client and other individuals and organisations, most of which are referred to in the report (the data). Except as otherwise stated in the report, WSP has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (conclusions) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. WSP will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

ENVIRONMENTAL CONCLUSIONS

In accordance with the scope of services, WSP has relied upon the data and has not conducted any environmental field monitoring or testing in the preparation of the report. The conclusions are based upon the data and visual observations and are therefore merely indicative of the environmental condition of the site at the time of preparing the report, including the presence or otherwise of contaminants or emissions.

Within the limitations imposed by the scope of services, the assessment of the site and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the client and no other party. WSP assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of WSP or for any loss or damage suffered by any other party in relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

WSP will not be liable to update or revise the report to take into account any events, emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to nor ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

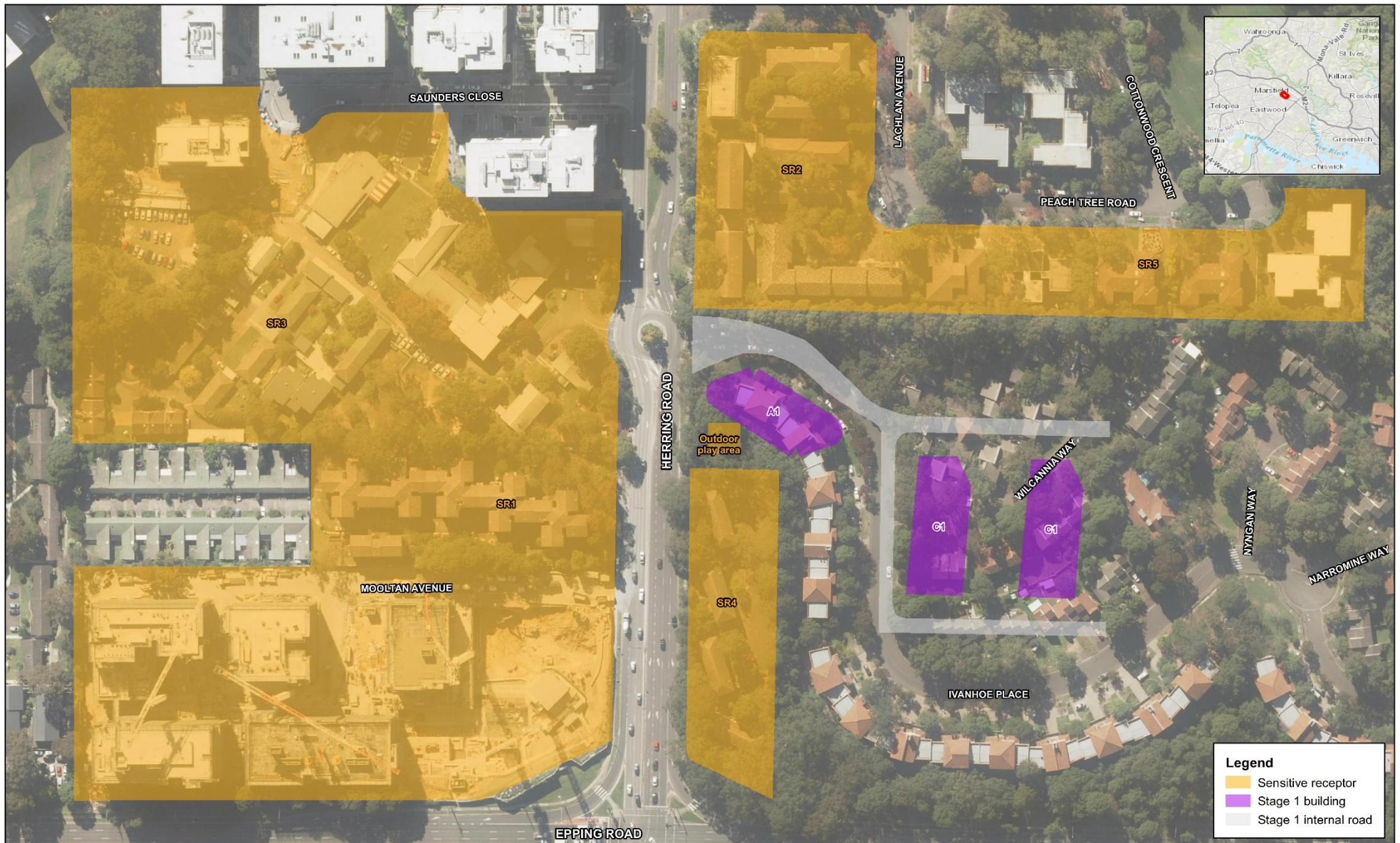
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APPENDIX A

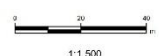
FIGURE





- Legend**
- Sensitive receptor
 - Stage 1 building
 - Stage 1 internal road

Map: PS107138_GIS_001_A2
 Date: 26/03/2018
 Author: MitchellEm
 Approved by: -



Data source: Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
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Citta Property Group

Ivanhoe Estate Stage 1

Figure 1
 Sensitive receptors

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