AIR QUALITY ASSESSMENT

GLENMORE PARK EAST

Solve Property on behalf of Nergl Developments Pty Ltd

14 September 2023

Job Number 23081626

Prepared by

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Air Quality Assessment
Glenmore Park East

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1 INTRODUCTION

Todoroski Air Sciences has prepared this report for Solve Property on behalf of Nergl Developments Pty Ltd. This report presents an assessment of the potential air quality impacts associated with the proposed Planning Proposal for Glenmore Park East, New South Wales (NSW) (hereafter referred to as the Project).

The Project involves rezoning the site to allow for a development of more urban residential and non-residential uses. This report investigates the potential for air quality impacts to arise at the Project site due to air emission sources and provides recommendations on the design elements in the Master Plan for the site.

This air quality impact assessment has been prepared in general accordance with the NSW Environment Protection Authority (EPA) document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**).

To assess the potential air quality impacts associated with the Project, this report incorporates the following aspects:

- A background and description of the Project;
- A review of the existing meteorological and air quality conditions of the Project site;
- A review of the modelling approach used to assess potential air quality impacts;
- Analysis the predicted results and a discussion of the potential air quality impacts; and,
- Planning considerations and recommendations.

1.1 Project background

The Project site is currently zoned C4 Environmental Living, R2 Low Density Residential, SP2 Infrastructure and RE1 Public Recreation under the Penrith Local Environment Plan (PLEP) 2010. Land within the Project site is currently utilised for rural residential lifestyle properties, with part of the precinct having been approved for a 17-lot rural residential subdivision in 2005.

The proposed Master Plan provides for approximately 1,710 new homes, offering a diverse range of housing options to meet the needs of a changing community. These new homes include approximately 242 traditional detached homes (with an average site area of 320 square meters (m^2)), 182 smaller attached terraces (with an average site area of 240m^2), and 1,286 (1, 2 and 3 bedroom) apartments (with an average size of 90m^2). The proposal also commits to providing a minimum of 5% affordable housing on the site, in collaboration with a Community Housing Provider, surpassing Penrith City Council's target of 3% affordable housing applied in other locations.

Furthermore, the proposed Master Plan accommodates a range of non-residential uses in the Project site, including mixed-use retail spaces, childcare facilities, medical services, food and beverage establishments, a fresh food market, specialty shops, restaurants and cafes, entertainment venues, offices, and a hotel for short-term accommodation supporting visitors and the requirements of nearby defence industry partners. The site will also feature 14.425 hectares (ha) of public open space (including bushland and riparian corridors), 1.02ha of communal open space and 2.935ha of avoided land[1] which is to be partly utilised for flooding, drainage and landscape purposes

The precinct is connected through a series of pathways and cycleways with the integration of public transport at its core, reducing the reliance on private cars and promoting sustainable transportation options. This focus on urban sustainability is not limited to transport alone and will be a core consideration for buildings within the precinct.

1.2 Vision

Glenmore Park East is the welcoming gateway for residents and visitors moving between Western Sydney Airport and the Penrith Local Government Area. This sustainable and liveable precinct fosters an inclusive and engaged community, whilst providing new housing choices that cater for the needs of a diverse and growing Western Parkland City. Glenmore Park East proudly embraces its ties to the land, its biodiversity, and its stunning vistas of the Blue Mountains.

The Glenmore Park East Master Plan achieves the vision through sustainable transportation, connectivity, and community development.

Location and Connectivity: Glenmore Park East's strategic location makes it accessible to both the Western Sydney Airport and the Penrith CBD. It is also adjacent to Orchard Hills and benefits from a new Metro system connecting Western Sydney to Sydney City. This connectivity is essential for the area's growth and accessibility.

[1] As identified and defined in the Cumberland Plain Conservation Plan

Sustainable Transportation: The precinct prioritises walking, cycling, and public transport, which aligns with Council's sustainability goals. Promoting these modes of transportation will reduce dependence on cars and help create a more environmentally friendly community.

Street Design: Streets are designed to be perpendicular to the contours of the land. This design not only creates an attractive public domain but also minimises the impact of housing in sloping land. The intention is to create a visually appealing and walkable neighbourhood.

Block Layout: The layout of the blocks is designed to maximise permeability through a network of streets, paths, and building separation. This layout encourages easy access to key destinations, such as The Northern Road (with bus stops) and open space areas including the new 2ha Hilltop Park.

Mixed-Use Development: The Northern Road frontage is envisioned as a mixed-use area with active ground floor uses including (but not limited to) hotel, medical facilities, child care, entertainment, fresh food market, and apartments above. This mixed-use approach will contribute to a vibrant streetscape and offer convenience to residents. A walkable and bike-friendly environment encourages residents to shop, dine, and work close to home.

Eat Street: The Eat Street serves as the food and beverage destination for members of the community and visitors. The area is designed for mixed-use development, including shops, restaurants, and apartments, creating a focal point for the community.

Housing Diversity: The vision emphasises the importance of housing diversity, with a mix of housing types and price points. This approach aims to create a well-rounded community that accommodates a range of residents and lifestyles.

Natural Environment: The plan acknowledges the significance of natural watercourses and drainage channels, advocating for their retention, celebration, or enhancement. This approach aligns with principles of biodiversity and sustainable landscaping. The precinct also recognises and retains significant areas of Cumberland Plain woodland which is embedded as a key element of the design.

Open Space: The vision aims to optimise open space, making it multipurpose and accessible for various activities. The Transgrid easement which passes through the site and connects the precinct to the wider Glenmore Park community, is identified as an opportunity for informal sports fields, urban agriculture, and cycleways.

Community Engagement: The plan encourages development that engages and links with riparian zones and natural habitats. It envisions community gardens to provide fresh produce and shared paths for residents and visitors to enjoy nature, culture and artistic expression.

1.3 Local setting

The Project site comprises of a 47.95ha parcel of land bounded by the recently upgraded The Northern Road to the east, Glenmore Parkway to the north, Bradley Street to the south and the existing Glenmore Park neighbourhood to the west.

The site is located 10 kilometres (km) to the north of the new 24-hour Western Sydney International Airport and 5km south of the Penrith CBD and is centrally located within the Western Parkland City. The precinct is surrounded by the existing the stages of the Glenmore Park Estate (stages 1-3), Penrith Golf

Course to the north, the state led Orchard Hills master planned precinct to the east and the Defence Establishment Orchard Hills to the southeast. The precinct is approximately 1km south of the M4 freeway and approximately 5km west of the new Orchard Hills Metro Station which is currently under construction.

Figure 1-1 presents the location of the Project area.

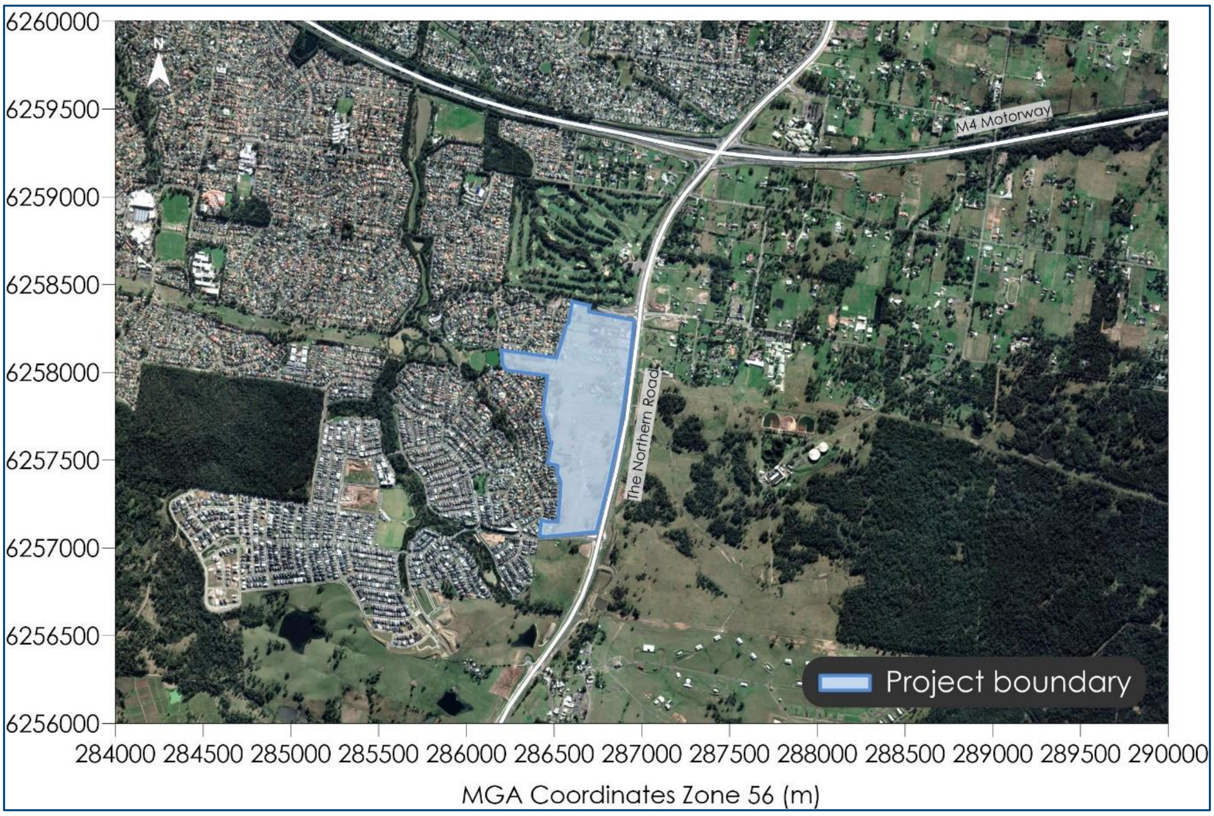


Figure 1-1: Local setting

1.4 Local topography

Figure 1-2 presents a representative three-dimensional visualisation of the terrain features surrounding the Project area.

The local topography of the eastern portion of the Precinct is relatively flat with the terrain becoming more undulating to the west and northwest. The terrain features of the surrounding area influence the local wind distribution patterns and flows which are important for the dispersion and propagation of air quality and odour emissions.

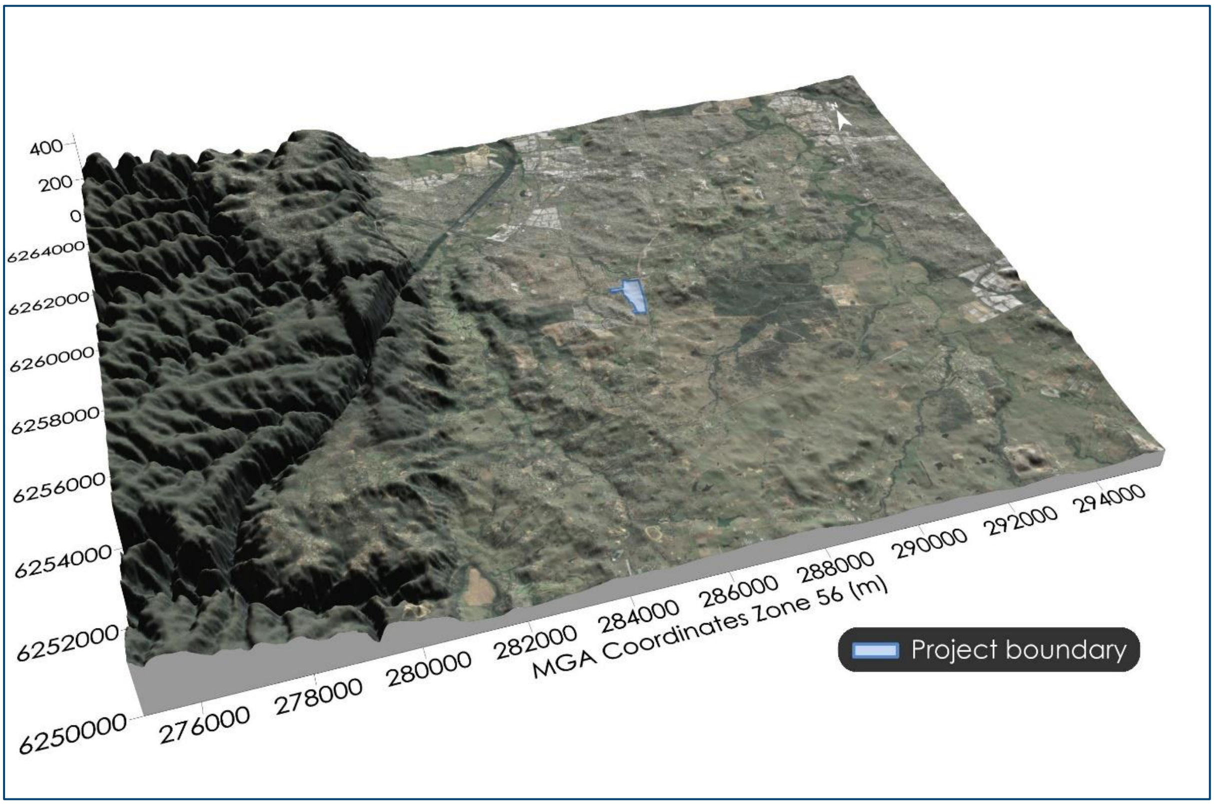


Figure 1-2: Representative visualisation of the local topography

1.5 Master Plan

The Master Plan is shown in **Figure 1-3** and forms the basis of the Planning Proposal. The Planning Proposal seeks to change the current areas zoned C4 Environmental Living and SP2 Infrastructure to a combination of the following zones:

- R2 – Low Density Residential
- R3 – Medium Density Residential
- MU1 – Mixed Use
- E1 – Local Centre
- SP2 - Infrastructure
- RE1 – Public Recreation
- C2 – Environmental Conservation

The Planning Proposal also proposes the introduction of various controls and provisions, including minimum lot sizes, building height restrictions, consideration of scenic and landscape values, maximum lot yield, additional permitted uses, urban release area designation, and flexible boundaries between certain zones, to ensure that the statutory framework is in place to deliver the proposed Master Plan.

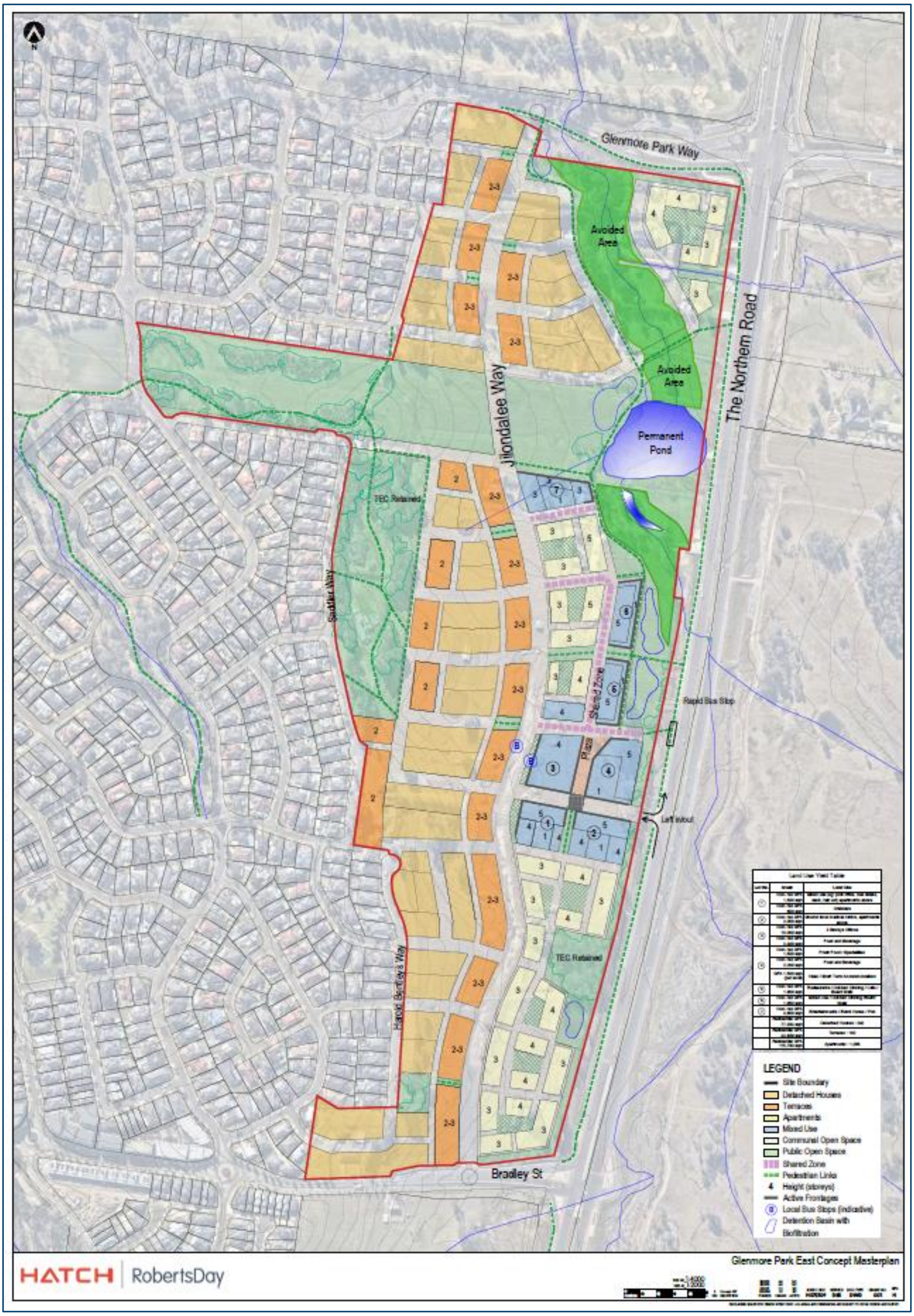


Figure 1-3: Glenmore Park East Master Plan

2 AIR QUALITY CRITERIA

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The sections below identify the likely air emissions generated by activities surrounding the Project and the applicable air quality criteria.

2.1 NSW EPA Impact Assessment Criteria

Table 2-1 summarises the air quality goals that are relevant to this assessment as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**).

Table 2-1: NSW EPA air quality impact assessment criteria

Pollutant	Averaging Period	Percentile	Criterion
Particulate matter ≤10µm (PM_{10})	Annual	100	25 µg/m³
	24 hour	100	50 µg/m³
Particulate matter ≤2.5µm ($PM_{2.5}$)	Annual	100	8 µg/m³
	24 hour	100	25 µg/m³
Nitrogen dioxide (NO_2)	1 hour	100	164 µg/m³
	Annual	100	31 µg/m³
Carbon monoxide (CO)	1 hour	100	30 mg/m³
	8 hours	100	10 mg/m³
Volatile Organic Compounds (VOCs) – as benzene	1-hour	100	29 µg/m³

Source: **NSW EPA, 2022**

µm = micrometre µg/m³ = micrograms per cubic metre g/m²/month = grams per square metre per month

2.2 Odour emissions

Table 2-2 presents the odour impact assessment criteria as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (**NSW EPA, 2022**).

The criteria considers the population densities of specific areas and is based on a 99th percentile of dispersion model predictions calculated as 1-second averages (nose-response time). Odour concentrations are used and are defined in odour units (OU). The number of odour units represents the number of times that the odour would need to be diluted to reach a level that is just detectable to the human nose. Thus by definition, odour less than one odour unit (1 OU), would not be detectable to most people.

Table 2-2: Odour impact assessment criteria for complex mixtures of odorous air pollutants (nose-response-time average, 99th percentile)

Population of affected community	Impact assessment criteria for complex mixtures of odorous air pollutants (OU)
Urban (≥~2000) and/or schools and hospitals	2.0
~500	3.0
~125	4.0
~30	5.0
~10	6.0
Single rural residence (≤~2)	7.0

Source: **NSW EPA, 2022**

3 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and meteorological conditions in the area surrounding the Project.

3.1 Local climatic conditions

Long-term climatic data from the Bureau of Meteorology (BoM) weather station at Penrith Lakes Automatic Weather Station (AWS) (Site No. 067113) were analysed to characterise the local climate in the proximity of the Project. The weather station at Penrith Lakes AWS is located approximately 9km north-northwest of the Project.

Table 3-1 and **Figure 3-1** present a summary of data from the Penrith Lakes AWS collected over an approximate 14 to 28-year period for the various meteorological parameters.

The data indicate that, on average, January is the hottest month with a mean maximum temperature of 31.0°C, and July is the coldest month with a mean minimum temperature of 5.4°C.

Rainfall peaks during the summer months and declines during the winter months, with an annual average rainfall of 740.0 mm over 73.8 days. The data show February is the wettest month with an average rainfall of 119.7 mm over 8.3 days, and August is the driest month with an average rainfall of 30.0 mm over 3.4 days.

Humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am humidity levels range from 60% in October to 85% in June. Mean 3pm humidity levels vary from 40% in September to 55% in June.

As expected, wind speeds during the warmer months have a greater spread between the 9am and 3pm conditions compared to the colder months. The mean 9am wind speeds range from 7.2 km/h in May to 10.6 km/h in October. The mean 3pm wind speeds vary from 12.2 km/h in May to 18.4 km/h in September.

Table 3-1: Monthly climate statistics summary – Penrith Lakes AWS

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	31.0	29.6	27.5	24.7	21.2	18.2	18.0	20.0	23.3	25.8	27.5	29.6	24.7
Mean min. temp. (°C)	18.7	18.5	16.8	13.2	9.3	6.8	5.4	6.1	9.3	12.3	14.9	17.0	12.4
Rainfall													
Rainfall (mm)	94.4	119.7	110.5	48.8	36.3	46.4	38.3	30.0	31.7	57.0	84.0	63.2	740.0
No. of rain days (≥1mm)	7.8	8.3	8.9	5.6	4.3	5.6	4.3	3.4	4.9	5.6	7.8	7.3	73.8
9am conditions													
Mean temp. (°C)	22.3	21.7	19.7	17.6	13.8	10.5	9.6	11.7	15.8	18.5	19.6	21.4	16.8
Mean R.H. (%)	73	79	80	76	81	85	83	72	64	60	68	69	74
Mean W.S. (km/h)	9.3	9.2	7.7	8.1	7.2	7.7	7.4	8.7	10.5	10.6	10.4	9.3	8.8
3pm conditions													
Mean temp. (°C)	29.0	27.7	26.1	23.3	19.8	17.1	16.6	18.6	21.7	23.7	25.3	27.6	23.0
Mean R.H. (%)	47	53	52	49	52	55	50	41	40	41	46	45	48
Mean W.S. (km/h)	15.7	14.3	13.7	13.2	12.2	12.7	13.5	16.5	18.4	18.0	17.4	16.4	15.2

Source: **BoM, 2023**

°C = degrees Celsius mm = millimetres % = percent km/h = kilometres per hour

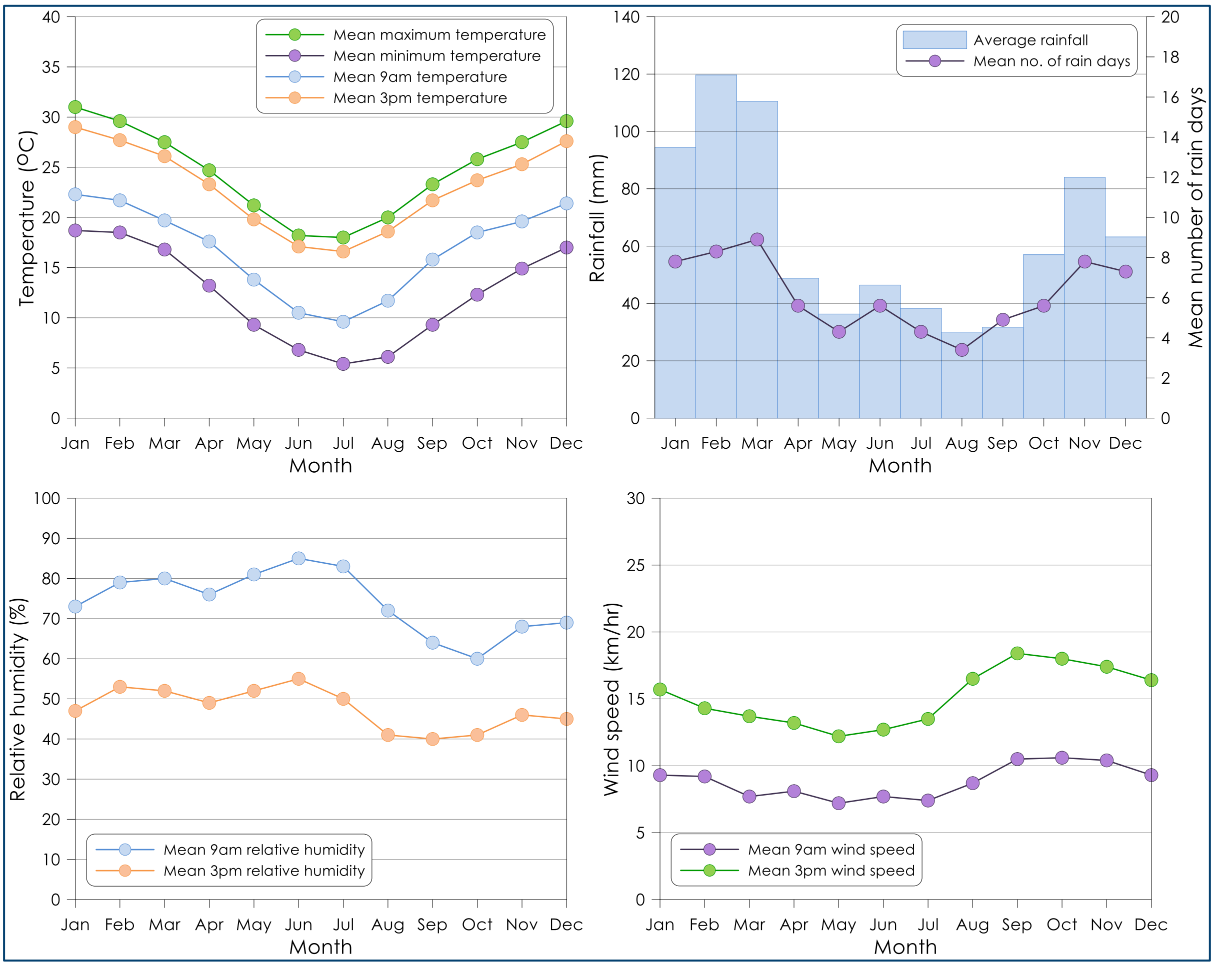


Figure 3-1: Monthly climate statistics summary – Penrith Lakes AWS

3.2 Local meteorological conditions

Annual and seasonal windroses for the Penrith Lakes AWS during the 2018-2022 period are presented in **Figure 3-2**.

On an annual basis, winds typically occur along a south-southwest to north-northeast axis. In summer, winds from the south-southwest are most dominant. The autumn distribution is similar to the annual distribution with a high proportion of winds originating from the south-southwest and south. In winter, winds typically range from the south-southwest to the north (clockwise) with few winds from the east. During spring, winds are more variable from the other directions and predominately arise from the south-southwest and south.

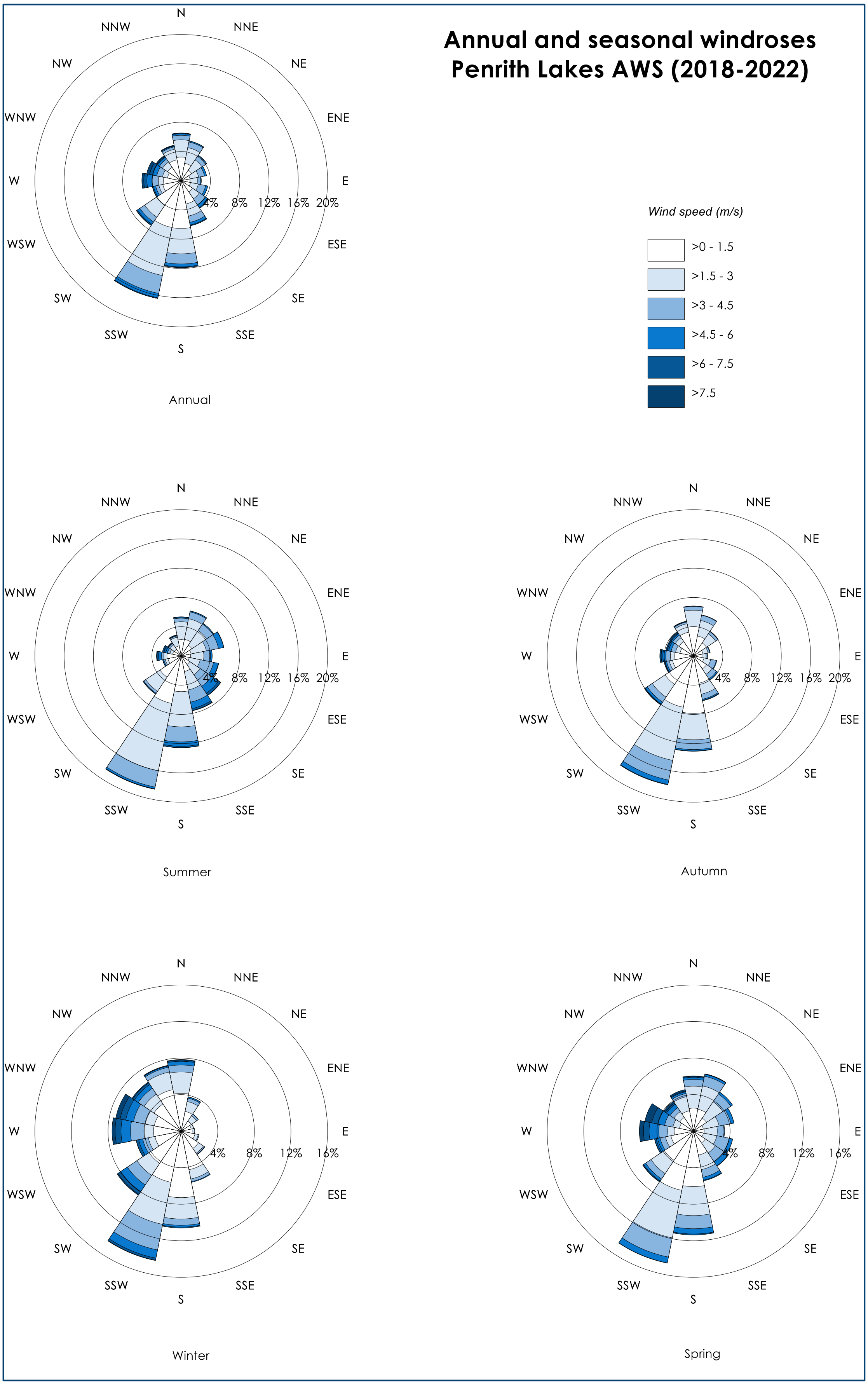


Figure 3-2 : Annual and seasonal windroses – Penrith Lakes AWS (2018-2022)

3.3 Local air quality

The main sources of air pollutants in the wider area surrounding the Project include industrial and commercial operations and local anthropogenic activities such as wood heaters and motor vehicle exhaust.

This section reviews the available ambient air quality monitoring data sourced from the nearest air quality monitors operated by the New South Wales (NSW) Department of Planning and Environment (DPE) at Penrith, St Marys Bringelly and Liverpool. **Figure 3-3** shows the approximate location of each of the monitoring stations with reference to the Project.

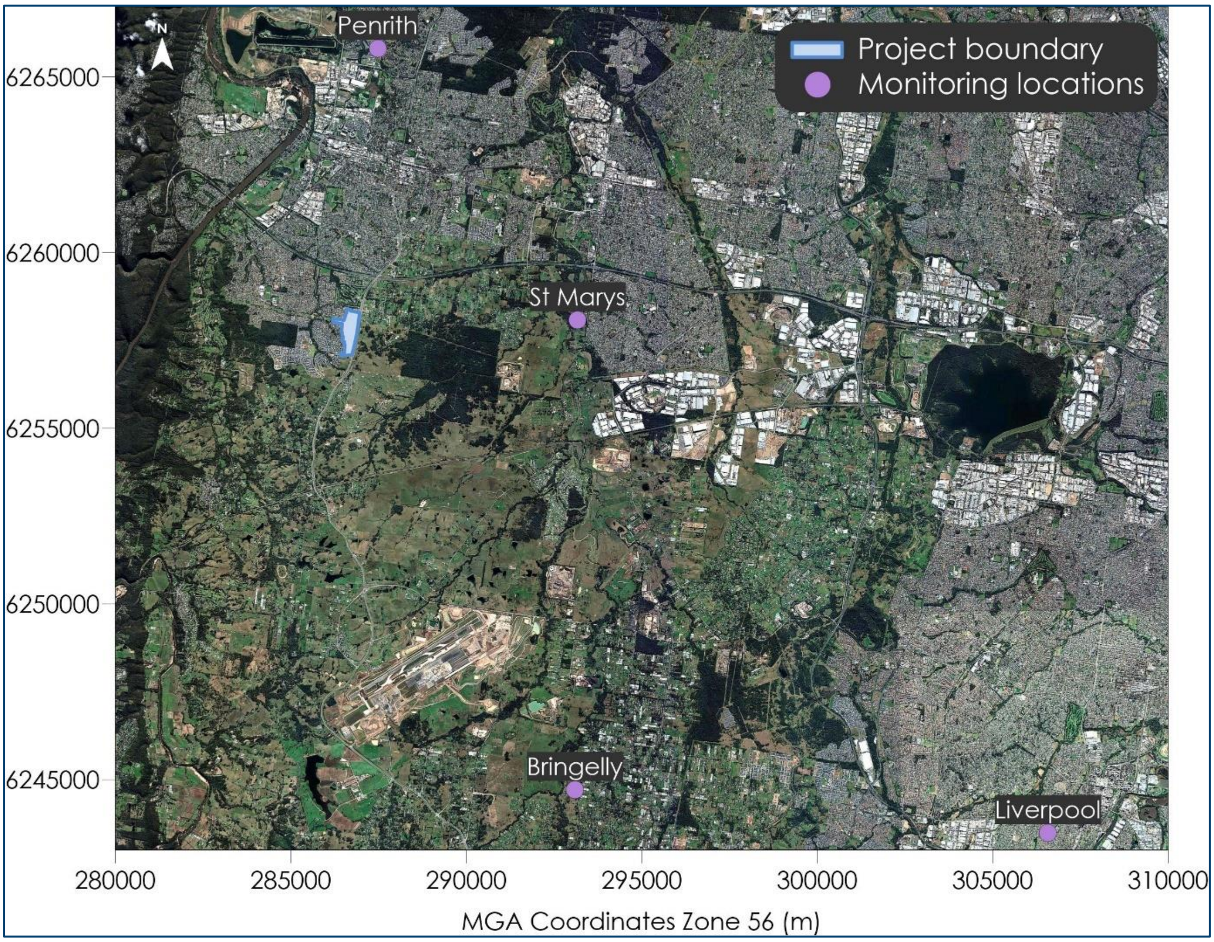


Figure 3-3: Location of DPE air quality monitors

3.3.1 PM_{10} monitoring

A summary of the available PM_{10} monitoring data from 2018 to August 2023 for the DPE monitoring stations is presented in **Table 3-2**. Recorded 24-hour average PM_{10} concentrations are presented in **Figure 3-4**.

A review of **Table 3-2** indicates that the annual average PM_{10} concentrations for the monitoring stations were below the relevant criterion of 25µg/m³ for all years of the review period, except for Liverpool in

2019. The maximum 24-hour average PM_{10} concentrations were found to exceed the relevant criterion of 50µg/m^3 on occasion for all years of the review period, with the exception of 2022 and 2023.

Figure 3-4 shows the monitors reviewed generally following similar trends with regional events recorded at all monitoring stations. The high PM_{10} concentration recorded at the monitors from November 2019 to January 2020 is attributed to wildfires and the drought period affecting NSW.

Table 3-2: Summary of PM_{10} levels from monitoring stations (µg/m^3)

Year	Liverpool	Bringelly	St Marys	Penrith [1]	Criterion
	Annual average				
2018	24.2	21.2	19.4	-	**25**
2019	**27.7**	23.6	24.7	-	**25**
2020	20.8	18.3	18.9	-	**25**
2021	18.1	15.3	16.2	16.7	**25**
2022	14.6	12.1	12.0	13.8	**25**
Year	**Maximum 24-hour average**				**Criterion**
2018	**101.5**	**92.9**	**100.5**	-	**50**
2019	**178.9**	**134**	**159.8**	-	**50**
2020	**195.1**	**241.8**	**260.3**	38.1	**50**
2021	**82.8**	**69**	**54.9**	**73.5**	**50**
2022	36.1	28.7	29.7	30.5	**50**
2023 [2]	43.4	31.9	34.2	28.9	**50**

- Insufficient data, [1] data available from July 2020, [2] data available till August 2023

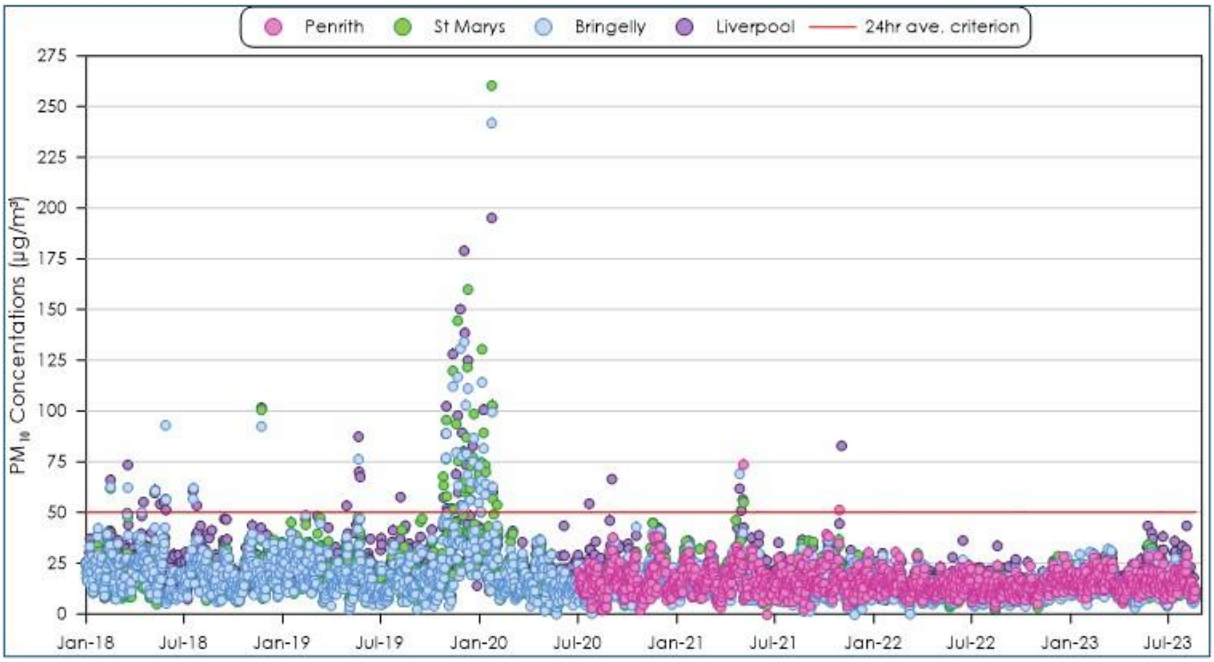


Figure 3-4: 24-hour average PM_{10} concentrations

3.3.2 $PM_{2.5}$ monitoring

A summary of the available data from 2018 to August 2023 for the DPE monitoring stations is presented in **Table 3-3**. Recorded 24-hour average $PM_{2.5}$ concentrations are presented in **Figure 3-5**.

Table 3-3 indicates that the annual average $PM_{2.5}$ concentrations were above the annual average criterion of 8µg/m^3 for during 2018-2020 at the Liverpool monitor, during 2019 and 2020 at the Bringelly monitor and during 2019 at the St Marys monitor. The maximum 24-hour average $PM_{2.5}$ concentrations at all monitoring station were found to be above the relevant criterion of 25µg/m^3 on occasion for all years with the exception of 2022 and 2023. Similar to the PM_{10} monitoring data, the mass bushfires affecting NSW in 2019 and 2020 are seen in the $PM_{2.5}$ monitoring data in **Figure 3-5**.

Table 3-3: Summary of $PM_{2.5}$ levels from monitoring stations (µg/m³)

Year	Liverpool	Bringelly	St Marys	Penrith [1]	Criterion
	Annual average				
2018	**10.1**	8.0	7.8	-	**8**
2019	**12.8**	**11.3**	**9.8**	-	**8**
2020	**9.1**	**8.5**	7.6	-	**8**
2021	7.9	7.2	5.8	7.9	**8**
2022	5.5	5.1	3.9	5.8	**8**
Year	**Maximum 24-hour average**				**Criterion**
2018	**45.4**	**55.6**	**80.5**	**-**	**25**
2019	**156**	**178**	**88.3**	**-**	**25**
2020	**73.6**	**78.1**	**82.5**	24.2	**25**
2021	**52.2**	**57.4**	**40.3**	**72.5**	**25**
2022	21.9	17.8	12.6	22.2	**25**
2023 [1]	22.1	20.2	16.2	24.8	**25**

- Insufficient data, [1] Data available from July 2020, [2] data available till August 2023

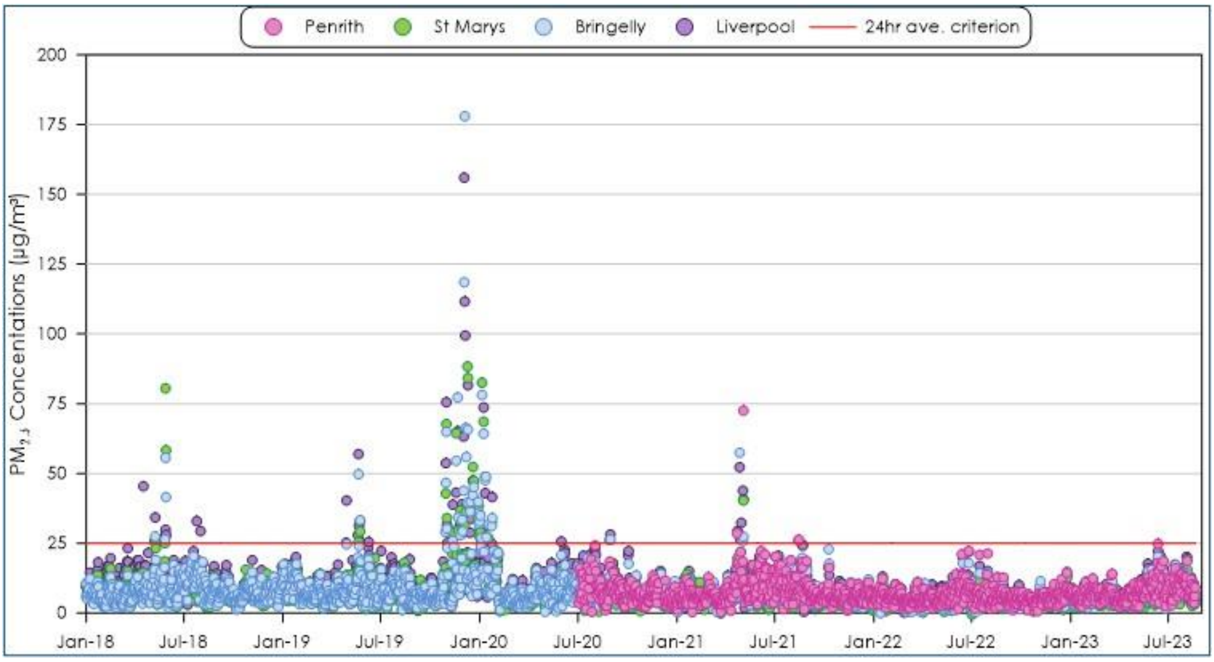


Figure 3-5: 24-hour average $PM_{2.5}$ concentrations

3.3.3 NO_2 monitoring

Figure 3-6 presents the daily 1-hour average maximum NO_2 concentrations from the DPE monitoring stations available for 2018 to 2023.

The ambient air quality monitoring data include emissions from all sources such as industrial and commercial facilities as well as other various combustion sources. The monitoring data recorded are well below the NSW EPA 1-hour average goal of 164µg/m^3 during the review period. The monitoring data shows a seasonal trend with NO_2 concentrations highest during cooler months.

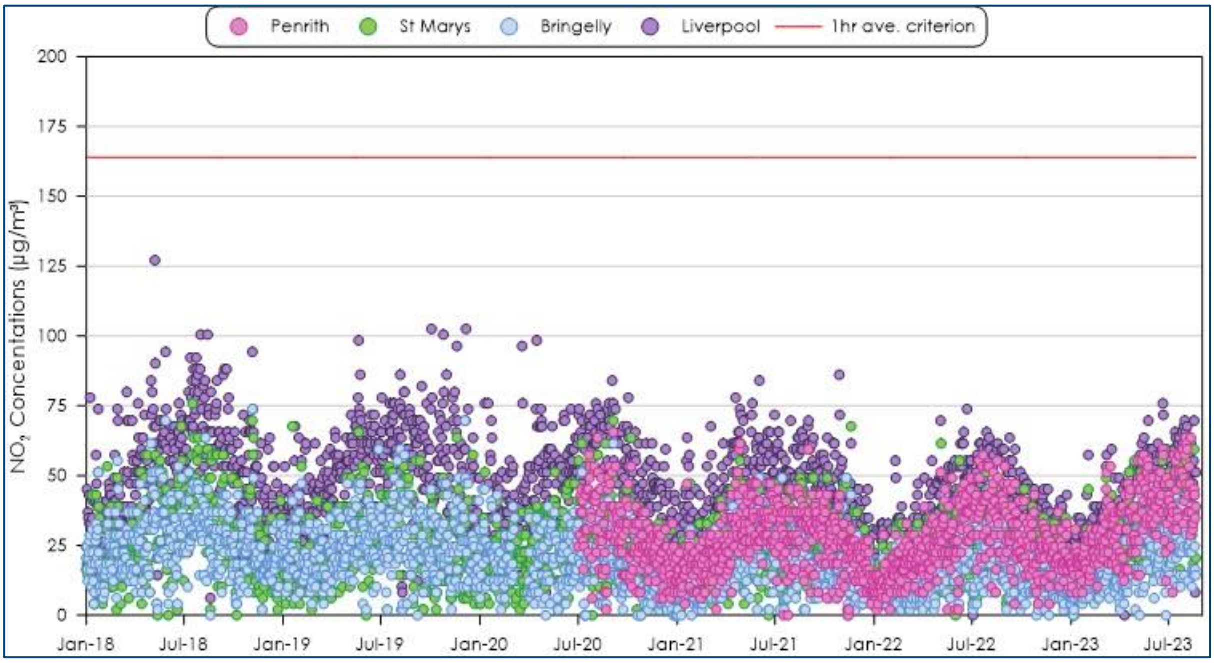


Figure 3-6: Daily 1-hour average maximum NO_2 concentrations

3.4 Emission sources

The key air emission sources that may have the potential to generate some form of air quality or odour emissions identified surrounding the Project area are shown in **Figure 3-7**.

These operations include a mix of industries such as a water filtration plant, a landscape storage and supply business, a poultry farm and from road traffic emissions travelling along The Northern Road. Potential air and odour emissions associated with each of the operations are variable and are unique to the type of the operation.

The Orchard Hills Water Filtration plant is not considered to be a source of any significant odour emissions as the facility filters drinking water.

The landscape storage and supply business is relatively small and would have suitable dust mitigation measures and thus is expected to have a low potential for any impacts beyond its boundary.

The poultry farm is identified by the existing poultry sheds from the available aerial/ satellite imagery. It has been identified that the poultry sheds had ceased operating long ago and have no known existing use rights. The poultry farm is thus not a source of odour.

Air emissions arising from traffic travelling along The Northern Road has the potential to impact on the Project area. These emissions arise from engine exhaust and also brake and tyre wear. A review of recent air quality modelling is conducted to evaluate the actual extent of any impact that would arise from The Northern Road for the Project area.

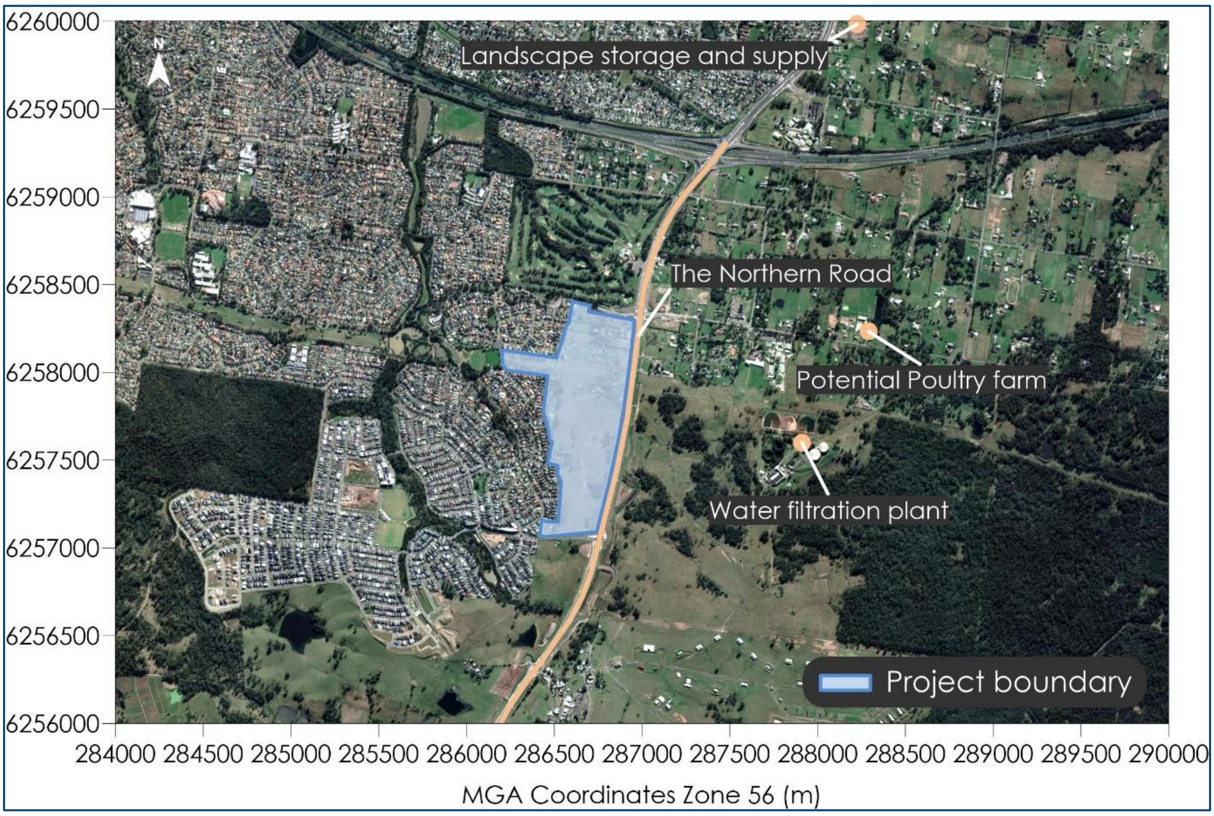


Figure 3-7: Key air emission sources

4 AIR QUALITY ASSESSMENT

Potential air quality impacts associated with traffic travelling along The Northern Road is assessed in *The Northern Road Upgrade, Glenmore Parkway to Jamison Road Air Quality Technical Study* (**Jacobs, 2016**) conducted as part of recent upgrades. The predictions in this air quality technical study have been used to infer impacts at the Project site.

4.1 Modelling approach

To assess the potential air quality impacts associated with traffic traveling along The Northern Road, the air quality technical study applied a quantitative assessment approach using the Roads and Maritime Tool for Roadside Air Quality (TRAQ) model. Models for the following assessment scenarios were developed:

- Scenario 1: Existing road, year of opening (2021)
- Scenario 2: Proposed upgrade, year of opening (2021)
- Scenario 3: Existing road, future year (2031)
- Scenario 4: Proposed upgrade, future year (2031).

For the purposes of this assessment, the modelling predictions for Scenario 4 have been analysed as they represent the most likely scenario to align with the Project.

The modelling in the air quality technical study considered concept upgrade arrangements, measured and forecast traffic data (volumes, composition and speeds), worst case meteorological conditions (wind speed of one metre per second (m/s); an atmospheric stability class of F, stable nighttime conditions; 15 degrees Celsius) and generic vehicle fleet exhaust emissions from the emissions databases built into the TRAQ model.

A range of road segments are also assessed in the air quality technical study. "Segment 7 – The Northern Road south of Glenmore Parkway" would include the Project area and modelling predictions are presented for the nearest and typical distances to surrounding receivers which are approximately 30 metres (m) and 50m, respectively.

4.2 Modelling predictions

The modelling predictions for Segment 7 in Scenario 4 as presented in the air quality technical study is summarised in **Table 4-1**.

The predicted results show that minimal incremental effects would arise at the receiver locations due to traffic travelling along The Northern Road. The predicted cumulative results indicate that the receiver locations are predicted to experience levels below the relevant criteria for the assessed pollutants with the exception of annual average $PM_{2.5}$, which is a result of the applied background already being above the relevant assessment criteria.

Table 4-1: Summary of model predictions for Segment 7 in Scenario 4

Receiver	$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)		NO_2 (µg/m³)		CO (mg/m³)		VOC (µg/m³)
	24-hr ave.	Ann. ave.	24-hr ave.	Ann. ave.	1-hr ave.	Ann. ave.	1-hr ave.	8-hr ave.	1-hr ave.
	Incremental impact								
Nearest – 30m	3.8	1.6	3.8	1.6	10.2	2.0	0.4	0.3	0.4
Typical – 50m	2.7	1.0	1.0	1.0	7.2	1.4	0.3	0.2	0.2
	Background levels								
	16.8	**8.7**	29.4	15.9	68.4	9.0	2.5	1.7	2.6
	Cumulative impact								
Nearest – 30m	20.6	**10.3**	33.2	17.5	78.6	11.0	2.9	2.0	3.0
Typical – 50m	19.5	**9.7**	30.4	16.9	75.6	10.4	2.8	1.9	2.8
Criteria	**25**	**8**	**50**	**25**	**164**	**32**	**30**	**10**	**29**

Source: **Jacobs (2016)**

The air quality technical study noted that the predicted impacts associated with the 'existing road' scenarios (i.e. Scenario 1 and 3) are not materially different from the future scenarios (Scenario 2 and 4). The presented cumulative annual averaged $PM_{2.5}$ concentrations which are above the relevant assessment criteria due to existing elevated local background concentrations at surrounding receivers, will vary interannually due to regional influences as seen in the ambient monitoring data (see **Table 3-3**) with minimal constant impacts from localised sources such as the traffic travelling on The Northern Road.

Noting that the shift to electric vehicles is accelerating and state and federal government policy to encourage such vehicles it is reasonable to consider what effect this may have on future emissions. Electric vehicles do not generate any NO_2 emissions and have lower particulate emissions relative to fuel powered vehicles, so it is reasonable to expect that NO_2 impacts from traffic will reduce more rapidly than particulate emissions in the foreseeable future. Hence it is considered reasonable to apply the particulate criteria for annual average $PM_{2.5}$ as the most relevant metric to assess the impacts from traffic.

Based on the modelling predictions in the air quality technical study all sensitive land uses should be avoided or designed to manage within the approximate 30m from The Northern Road (i.e., residential, school, childcare activities etc) including activities where humans may be regularly present for prolonged periods (e.g. a full workday). The zone is suitable for traveling through, or for generally unattended plant (e.g., electrical, storm water, sewage infrastructure), or as an air quality buffer zone.

5 DISCUSSION AND RECOMMENDATIONS

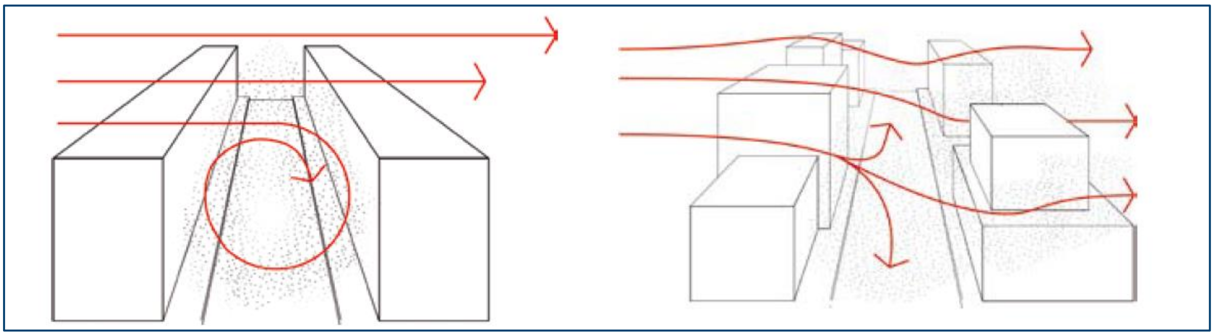
The Master Plan presented in **Figure 1-3** generally provides a 30m buffer distance to the proposed sensitive land uses. For any sensitive land uses proposed within this zone, it recommended that they are designed with consideration of the potential air quality impacts form the traffic travelling along The Northern Road. It is also recommended that a detailed air quality assessment be conducted for each of these sensitive uses to ensure there are no potential air quality impacts due to the traffic travelling along The Northern Road.

Some potential opportunities to further improve air quality due to road traffic within the Project area are discussed below.

The building design and urban form is a constraint if the buildings are designed as vertical structures with minimal setback from a roadway. For example, a flat vertical façade to the street and continuous glass windows can result in roadway canyoning which prevents the air emissions from dispersing into a large volume of air before reaching people. An example of this effect is demonstrated in the left-hand side of diagram in **Figure 5-1**.

An ideal building design and urban form incorporates a discontinuous façade which allows for cross wind flows around and between buildings. Adding laneways, widening laneways and preventing buildings being built out to the limits of the lot will assist with air flows (refer to right-hand side of diagram in **Figure 5-1**).

The Master Plan presented in **Figure 1-3** indicates the longest façade along The Northern Road is approximately 50-60m with regular breaks to allow airflow and would minimise the likelihood of roadway canyoning effects.



Source: **NSW Department of Planning (2008)**

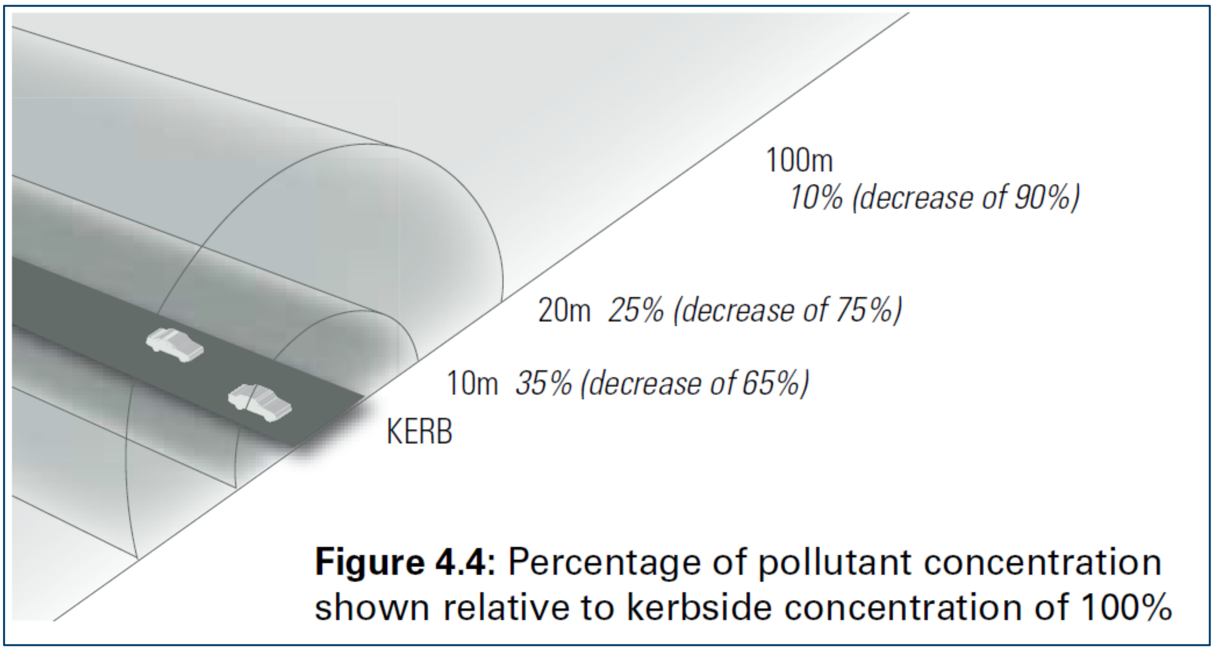
Figure 5-1: Roadway canyons (left) vs. better designed buildings (right) and the effect on winds and air pollutant dispersion

Orientation of buildings to provide adequate air flow around the building and design buildings to encourage air flow in a particular direction e.g. away from outdoor living areas (this can be aided by road orientation and block size and shapes). Avoid construction of dead-end courtyards or long narrow spaces perpendicular to the prevailing winds where air can lay dormant and stagnate.

Consider air conditioning and ventilation with apartment buildings having non-opening windows on the roadway side of the building and could duct cleaner air into the building from the far side, and out to the roadway side.

Allowing for a suitable setback from the roadway increases the separation distance between the source (road traffic) and the receiver (residential dwelling), assists with minimising air quality impacts from traffic. An example of how separation distance influences traffic emissions is shown in **Figure 5-2**. Setbacks can be incorporated by increasing footpath width, vegetative buffers, and via building design features such as a podium.

A terraced setback of the upper levels of a building, resulting in a pyramid building shape or "V" formation along a roadway increases the volume of air the traffic pollution can disperse through and also the space for noise to dissipate into. A terraced setback would also allow additional light to reach the street surface and encourage trees and ventilation.



Source: **NSW Department of Planning (2008)**

Figure 5-2: Percentage of pollutant concentration shown relative to kerbside concentration of 100%

Increasing the amount of vegetation and especially larger trees will result in an improvement of air quality as trees absorb air pollution. Increased vegetation will also generally lead to a significantly improved public perception of improved air quality levels, with foliage also acting to block the line of sight of the source.

6 SUMMARY AND CONCLUSIONS

This assessment has investigated the potential for air quality impacts on the Project site due to surrounding air quality sources.

The assessment finds that there are several potential air emissions sources in the surrounding area, which include a mix of industries such as a water filtration plant, a landscape storage and supply business, a poultry farm and from road traffic emissions travelling along The Northern Road. All of the sources are found to have minimal impact on the Project site with the exception of the traffic travelling along The Northern Road which has been assessed further.

The modelling predictions in *The Northern Road Upgrade, Glenmore Parkway to Jamison Road Air Quality Technical Study* (**Jacobs, 2016**) were reviewed to determine the potential air quality impacts at the Project site. The review found that minimal incremental effects would arise at the receiver locations and the predicted cumulative results would be below the relevant criteria for the assessed pollutants with the exception of annual average $PM_{2.5}$, which is a result of the applied background already being above the relevant assessment criteria.

This analysis of the Master Plan indicates that there is generally suitable separation distance between The Northern Road and the sensitive land uses at the Project site. Recommendations have been made to assist with minimising the impact of these air emissions sources.

7 REFERENCES

Bureau of Meteorology (2023)

Climate statistics for Australian locations, Bureau of Meteorology website, accessed September 2023. http://www.bom.gov.au/climate/averages

Jacobs (2016)

The Northern Road Upgrade, Glenmore Parkway to Jamison Road Air Quality Technical Study, prepared for NSW Roads and Maritime Services by Jacobs, August 2016

NSW Department of Planning (2008)

"Development Near Rail Corridors and Busy Roads – Interim Guideline", prepared by the NSW Government Department of Planning (DoP), 2008.

NSW EPA (2022)

"Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales", NSW Environment Protection Authority, September 2022.