AIR QUALITY ASSESSMENT
KOGARAH PUBLIC SCHOOL UPGRADE

NSW Department of Education

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Prepared by
Todoroski Air Sciences Pty Ltd
Suite 2B, 14 Glen Street
Eastwood, NSW 2122
Phone: (02) 9874 2123
Fax: (02) 9874 2125
Email: info@airsciences.com.au

Air Quality Assessment
Kogarah Public School Upgrades

DOCUMENT CONTROL

Prepared by	Reviewed by
PH (CAQP)	EA

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1 INTRODUCTION

This air quality assessment has been prepared to support the Review of Environmental Factors (REF) being prepared on behalf of the New South Wales (NSW) Department of Education (DoE) for the proposed Kogarah Public School upgrade (the activity).

The purpose of the REF is to assess the potential environmental impacts of the activity prescribed by *State Environmental Planning Policy (Transport and Infrastructure) 2021* (T&I SEPP) as "development permitted without consent" on land carried out by or on behalf of a public authority (NSW DoE) under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The activity is to be undertaken pursuant to Chapter 3, Part 3.4, Clause 3.37 of the T&I SEPP.

This document has been prepared in accordance with the *Guidelines for Division 5.1 assessments* (the Guidelines) by the Department of Planning, Housing and Infrastructure (DPHI) as well as the *Addendum guidelines for schools*. The purpose of this report is to assess the potential for air quality impacts associated with the proposed Project.

This air quality 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**) with consideration of the NSW Department of Planning (DoP) document *Development Near Rail Corridors and Busy Roads – Interim Guideline* (**NSW DoP, 2008**).

This report incorporates the following aspects:

- A background to the Project and description of the proposed site;
- A review of the existing meteorological and air quality environment surrounding the site;
- A description of the dispersion modelling approach and emission estimation used to assess potential air quality impacts specific to this location; and,
- Presentation of the predicted results and discussion of the potential air quality impacts.

2 PROJECT SETTING AND DESCRIPTION

Kogarah Public School is located at 24B Gladstone Street, Kogarah and contains a site area of 1.644ha per Detail Survey. The school is accommodated within the following allotments:

- Lots 1-3 DP 999122;
- Lot 1 DP 179779
- Lot 1 DP 667959
- Lot 2 DP 175247; and
- Lot A DP 391026.

The site is irregular in shape with existing vehicular access and the car park provided from Gladstone Street along the southwestern boundary. Pedestrian access is provided from Gladstone Street and Princes Highway. The site accommodates eight (8) permanent buildings and number of modular school buildings with play areas largely confined to the centre and northeastern portions of the site.

Development surrounding the site includes:

- North: Residential flat building at 71 Regent Street, retail tenancies orientated to Princes Highway(39-43 Princes Highway) and a smaller residential flat building at No 41 Princes Highway;
- East: Princes Highway and further to a mix of commercial and mid-rise residential development;
- South: St Paul's Church complex comprising St Paul's Childcare Centre, St Paul's Anglican Church and a residential flat building located at 24-30 Gladstone Street; and
- West: A mix of single dwelling and residential flat building development with Regent Street beyond.

The site is zoned SP2 Educational Establishment in accordance with Georges River Local Environmental Plan 2021 (GRLEP).

An aerial image of the site is provided in **Figure 2-1**.

Figure 2-1: Aerial image of the site

The proposed Kogarah Public School upgrade works include the following:

- Demolition of existing playground facilities and Covered Outdoor Learning Area (COLA) in addition to footings and services associated with former demountable buildings;
- Tree removal;
- Construction of a new three storey Classroom building and attached amenities facilities;
- Construction of a single storey Hall with attached Covered Outdoor Learning Area;
- New pedestrian pathway connections providing access throughout the site;
- Service upgrades; and
- Site landscaping works.

Any works relating to the existing demountables will be undertaken via a separate planning pathway.

An extract of the proposed Site Plan is provided at **Figure 2-2**.

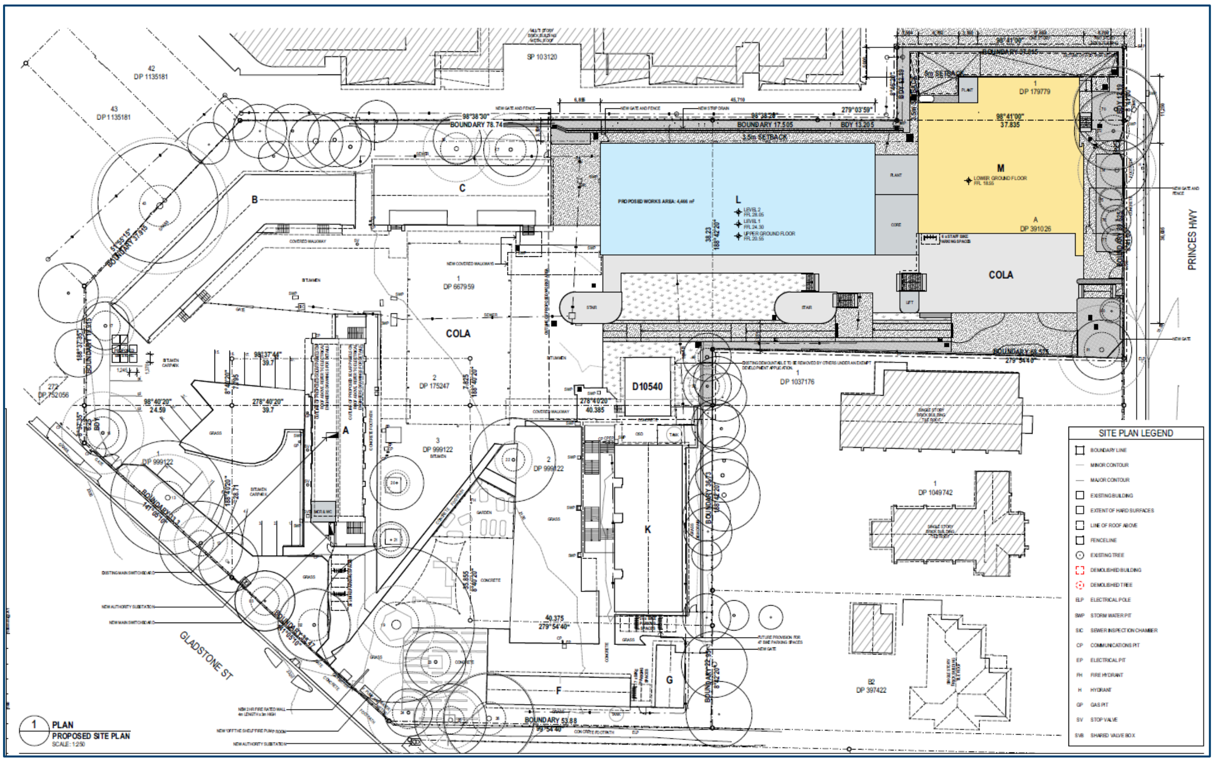

Figure 2-2: Indicative site plan

The main source of potential air emissions which can impact on the Project includes from the proposed construction activities and from traffic emissions associated with vehicles travelling on Princes Highway and, to a lesser extent, on the surrounding key streets such as Gladstone Street and Regent Street.

Figure 2-3 presents the location of these street relative to the Project.

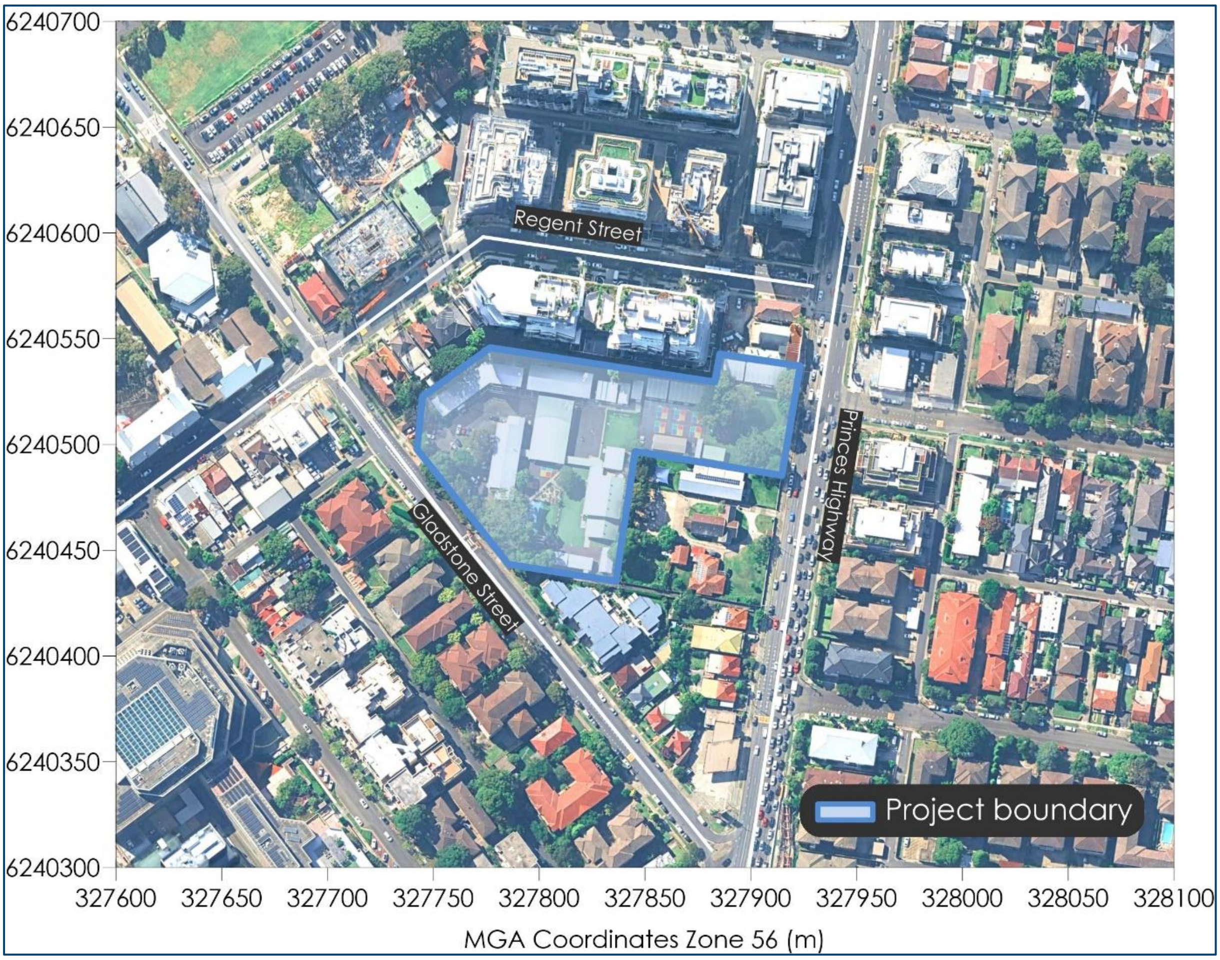

Figure 2-3: Project location

3 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 criteria are set to protect the most sensitive persons in the community, including young children.

Table 3-1 summarises the key air quality goals that are relevant to this assessment as it relates to traffic emissions, as outlined in the NSW EPA document *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA, 2022**) and the National Environment Protection (Ambient Air Quality) Measure (NEPM) (**NEPC, 2021**).

Particulate matter ($PM_{2.5}$) and nitrogen dioxide (NO_2) are considered to be the critical pollutants with regard to potential impacts from traffic emissions.

Whilst there are many pollutants from traffic emissions, where the criteria for these pollutants are met the criteria for other pollutants would also be met. Note that the NSW EPA impact assessment criteria for $PM_{2.5}$ and NO_2 are applied to the cumulative level in ambient air (including background levels) whereas the criteria for other potential pollutants are not.

Table 3-1: Relevant standards for air pollutants

Pollutant	Averaging period	Criteria		Impact
		NSW EPA[1]	NEPM[2]	
$PM_{2.5}$	24 hour	25 µg/m³	25 µg/m³	Cumulative
	Annual	8 µg/m³	8 µg/m³	Cumulative
NO_2	1 hour	164 µg/m³	164 µg/m³	Cumulative
	Annual	31 µg/m³	31 µg/m³	Cumulative

[1]NSW EPA (2022) [2]NEPC (2021)

An alternative criterion for consideration is set out in **Appendix A**. This proposed criterion is based on the work conducted by **Capon and Wright (2019)** and our understanding of its practicable implementation per the NSW EPA Approved Methods. This assessment has adopted a $PM_{2.5}$ incremental annual average criterion of 0.5 µg/m³ to assess against local road emissions from vehicle movements.

4 EXISTING ENVIRONMENT

This section describes the existing environment including the climate and ambient air quality in the area surrounding the Project.

4.1 Local climatic conditions

Long-term climatic data obtained from the closest Bureau of Meteorology (BoM) automatic weather station (AWS) with available data Sydney Airport AMO (Site No. 066037) were analysed to characterise the local climate in the proximity of the Project. The Sydney Airport AMO AWS is located approximately 4 kilometres (km) northeast of the Project.

Table 4-1 and **Figure 4-1** present a summary of data from the Sydney Airport AMO AWS collected over a 60-to-95-year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 26.7 degrees Celsius (°C) and July is the coldest month with a mean minimum temperature of 7.4°C.

Rainfall decreases during the latter half of the year, with an annual average rainfall of 1096.3 millimetres (mm) over 96.2 days. The data indicate June is the wettest month with an average rainfall of 124.1mm over 8.8 days and September is the driest month with an average rainfall of 59.8mm over 6.8 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 61% in October to 74% in June. Mean 3pm relative humidity levels range from 49% in August to 63% in February.

Wind speeds exhibit diurnal and seasonal variations with wind speeds at 9am and 3pm. Mean 9am wind speeds range from 12.6 kilometres per hour (km/h) in May to 16.3 km/h in October. Mean 3pm wind speeds range from 17.1 kilometres per hour in May to 25.3 km/h in November.

Table 4-1: Monthly climate statistics summary – Sydney Airport AMO

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (°C)	26.7	26.5	25.4	23.0	20.2	17.7	17.2	18.5	20.8	22.8	24.2	26.0	22.4
Mean min. temp. (°C)	19.0	19.2	17.7	14.4	11.1	8.8	7.4	8.4	10.7	13.4	15.6	17.7	13.6
Rainfall													
Rainfall (mm)	94.7	118.3	122.9	107.6	97.3	124.1	71.8	74.8	59.8	71.3	81.0	73.0	1096.3
No. of rain days (≥1mm)	8.3	8.7	9.5	8.4	8.3	8.8	6.7	6.7	6.8	7.9	8.3	7.8	96.2
9am conditions													
Mean temp. (°C)	22.4	22.3	21.1	18.2	14.6	11.9	10.8	12.5	15.7	18.4	19.9	21.6	17.4
Mean R.H. (%)	70	73	73	71	73	74	71	65	62	61	64	66	69
Mean W.S. (km/h)	14.4	13.8	12.9	12.9	12.6	13.4	13.3	14.4	15.5	16.3	16.0	14.8	14.2
3pm conditions													
Mean temp. (°C)	24.8	24.8	23.9	21.7	19.0	16.6	16.1	17.2	19.0	20.7	22.1	23.9	20.8
Mean R.H. (%)	60	63	61	59	58	57	52	49	51	54	56	58	57
Mean W.S. (km/h)	24.1	23.0	21.0	19.3	17.1	17.8	18.2	20.8	23.1	24.6	25.3	25.2	21.6

Source: **Bureau of Meteorology (2025)**
R.H. – Relative Humidity, W.S. – wind speed

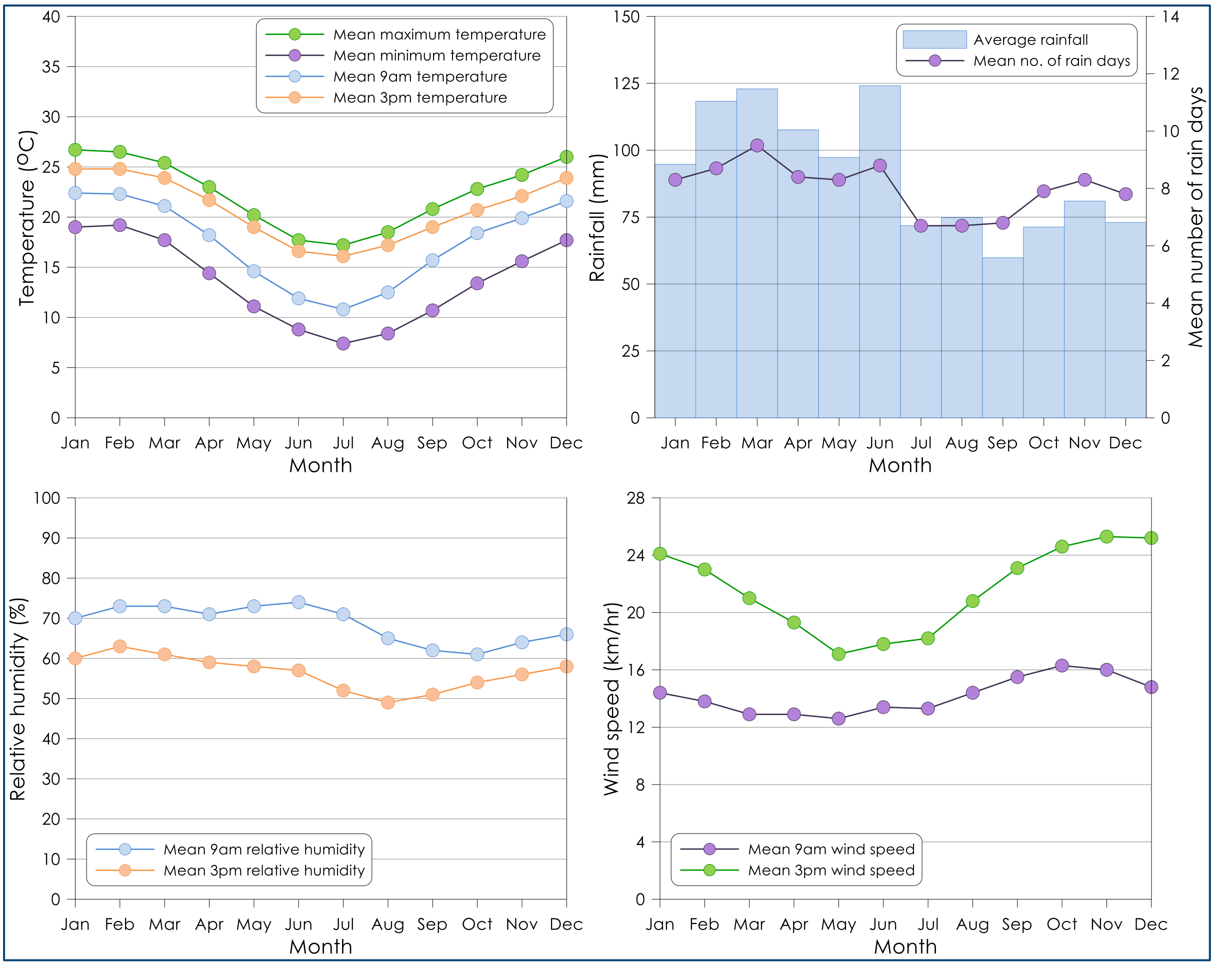

Figure 4-1: Monthly climate statistics summary – Sydney Airport AMO

4.2 Local meteorological conditions

Annual and seasonal windroses for the BoM weather station at Sydney Airport AMO are presented in **Figure 4-2** for the 2024 calendar period.

The 2024 calendar year was selected as the meteorological year for the dispersion modelling based on an analysis of data trends in meteorological data recorded and appropriate monitoring data for the area as outlined in **Appendix B**.

Strong winds are generally experienced in the area due to its proximity to the coast. Winds from the northwest quadrant are typically weaker than winds from other directions. On an annual basis, the winds are varied with the highest portion originating from the northwest and south.

In summer, winds are typically from the northeast and southeast quadrants, with dominant winds from the northeast and south. The autumn distribution is similar to the annual distribution with a high portion of winds from the northwest. During winter, winds are typically from the southwest and northwest quadrants, with winds from the northwest most frequent. Spring has similar distribution to the annual distribution, however, indicates a slightly higher portion of north-northeast winds.

The windroses show a wind distribution pattern that is typical of the expected patterns for this area considering the location of the station.

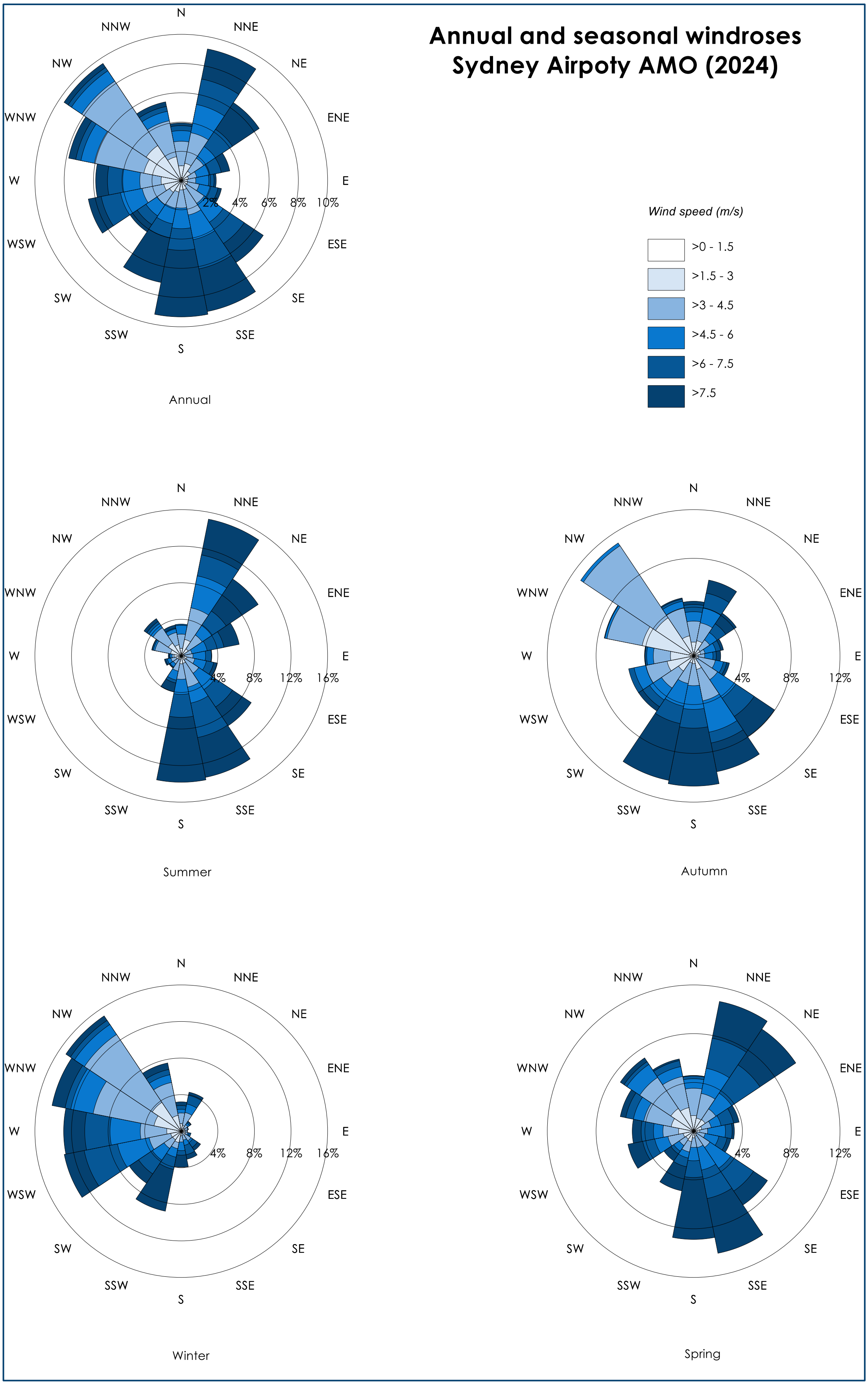

Figure 4-2 : Annual and seasonal windroses – Sydney Airport AMO (2024)

4.3 Local air quality monitoring

The main sources of air pollutants in the area are emissions from surrounding industrial and commercial operations and from other anthropogenic activities such as motor vehicle exhaust.

Available data from the nearest air quality monitor operated by the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) at Earlwood was used to quantify the existing background level for the assessed pollutants at the Project site. The Earlwood monitoring site is located approximately 5km north of the site.

4.3.1 $PM_{2.5}$ monitoring

A summary of the available $PM_{2.5}$ data from 2020 to 2024 is presented in **Table 4-2** and **Figure 4-3**. These data include levels measured during all extraordinary event days. Extraordinary event days are characterised as those days influenced by exceptional events such as bushfires, dust storms and hazard reduction burns.

A review of **Table 4-2** indicates that the annual average $PM_{2.5}$ concentrations were below the relevant criterion of 8µg/m^3 for the review period. The maximum 24-hour average $PM_{2.5}$ concentrations were found to exceed the relevant criterion of 25µg/m^3 for all years of the review period except in 2022 and 2024.

There was a significant increase in the frequency of exceedances of the 24-hour average $PM_{2.5}$ criterion in the 2019/ 2020 summer, primarily due to smoke associated with the widespread bushfires occurring at the time (refer to **Figure 4-3**). In 2021 and 2023, several days in the Sydney region were impacted by smoke from hazard reduction burns. These periods are considered to be exceptional event days and are not representative of the underlying background level.

Table 4-2: Summary of $PM_{2.5}$ levels from Earlwood monitoring station (µg/m^3)

Year	Annual average	Criterion
2020	8.0	**8**
2021	6.6	**8**
2022	5.2	**8**
2023	7.1	**8**
2024	6.6	**8**
Year	**Maximum 24-hour average**	**Criterion**
2020	**85.1**	**25**
2021	**31.0**	**25**
2022	17.2	**25**
2023	**92.2**	**25**
2024	18.3	**25**

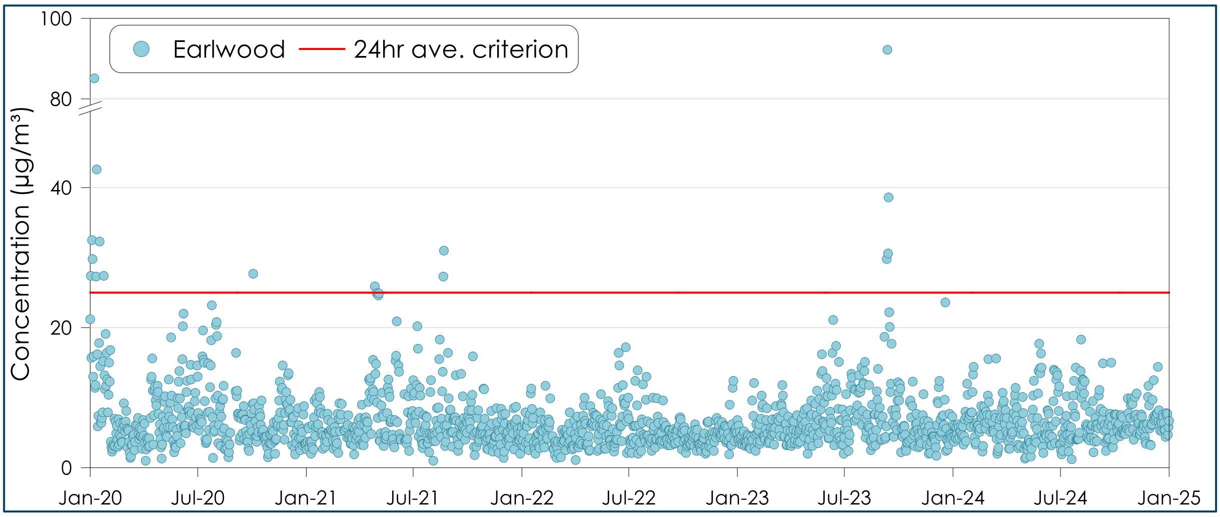

Figure 4-3: 24-hour average $PM_{2.5}$ concentrations (ug/m³)

4.3.2 NO_2 monitoring

A summary of the available NO_2 data from 2020 to 2024 is presented in **Table 4-3** and **Figure 4-4**. The data in **Table 4-3** include levels measured during all extraordinary event days.

The data indicate that the annual average NO_2 and maximum 1-hour average NO_2 levels are below the relevant criterion at the monitoring station for the period reviewed. The normal seasonal variation can be seen in **Figure 4-4** with NO_2 levels increasing during the colder months and decreasing during the warmer months.

Table 4-3: Summary of NO_2 levels from Earlwood monitoring station (µg/m³)

Year	Annual average	Criterion
2020	18.5	**31**
2021	18.5	**31**
2022	16.4	**31**
2023	18.5	**31**
2024	16.4	**31**
Year	**Maximum 1-hour average**	**Criterion**
2020	82.0	**164**
2021	80.0	**164**
2022	67.7	**164**
2023	84.1	**164**
2024	77.9	**164**

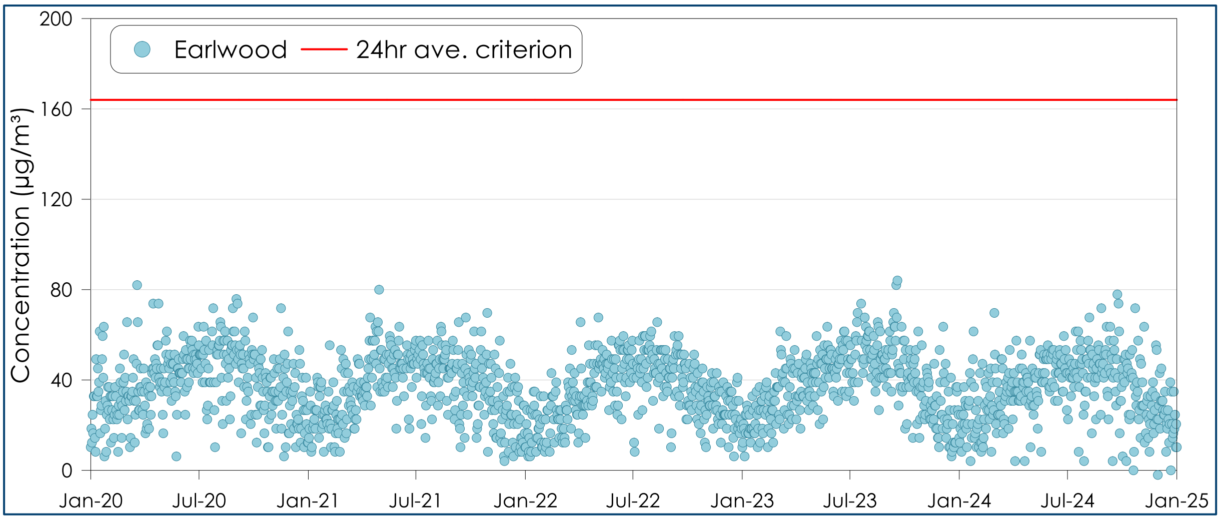

Figure 4-4: 1-hour daily maximum NO_2 concentrations (ug/m³)

4.3.3 Estimated background levels

As outlined above, there are no readily available site-specific monitoring data, and therefore the background air quality levels from the DCCEEW monitor at Earlwood were used to represent the background levels for the Project as it is located in a similar urban environment.

The data collected during the 2024 calendar period, which correspond to the period of representative meteorological data used in the modelling has been applied.

The background air quality levels applied in this assessment are summarised in **Table 4-4**.

Table 4-4: Summary of background levels

Pollutant	Background level	Units
24-hour average $PM_{2.5}$	18.3	µg/m³
Annual average $PM_{2.5}$	6.6	µg/m³
1-hour average NO_2	77.9	µg/m³
Annual average NO_2	16.4	µg/m³

5 CONSTRCUTION ACTIVITIES

Air emissions are expected to arise from the likely construction activities sociated with the proposed activity, including minor earthworks and site preparation, vehicles travelling on-site for material delivery, and building construction. Emission rates will vary daily, depending on the stage and type of activities, with peak times generating more air emissions. These dust sources are temporary in nature and will only occur during the construction period.

The potential air emissions associated with the construction activities are expected to be easily managed with good operational practices.

To ensure dust generation is adequately controlled during the construction period and the potential for off-site impacts is reduced, appropriate (operational and physical) mitigation measures will be implemented as necessary. The suggested dust mitigation measures to apply during construction are outlined in the following section.

The school will remain operational during the construction phase, and any emissions generated from these activities have the potential to affect both the indoor and outdoor environments. However, given the scale, nature, and timeline of the construction activities, these impacts are expected to be low risk.

Proactive measures are recommended to be implemented to minimise exposure, including, but not limited to:

- Closing classroom windows and doors during dust-generating activities to reduce indoor exposure;
- Restricting access to classrooms or areas close to construction activities during certain stages of the construction schedule to limit exposure;
- Limiting high impact activities (e.g. excavation, heavy vehicle movements) to times when the school is less active, such as outside school hours or during holiday periods;
- Monitoring weather conditions and halting construction operations during adverse conditions where dust levels cannot be adequately managed (e.g. periods of high winds resulting in visible dust spreading across the school grounds); and,
- Communicating with the school to provide timely updates on construction schedules, high-activity periods, and any additional measures being taken to mitigate dust impacts.

Furthermore, the proposed activity is situated on the far eastern side of the school, away from the primary areas where students are likely to be most active. This distance, combined with the proactive mitigation measures, is expected to further reduce the risk of exposure to potential air impacts, ensuring a low overall risk.

5.1 Mitigation measures for construction activities

Specific air quality mitigation measures will depend on the actual nature of the activity. General mitigation measures for construction activities as presented in the Institute of Air Quality Management (IAQM) document *Guidance on the assessment of dust from demolition and construction* (**IAQM, 2024**) are provided in **Table 5**.

All reasonable and feasible mitigation measures relevant for the construction activities outlined in **Table 5** are recommended to be implemented for the proposal to minimise the risk of dust impacts occurring.

Table 5: Summary of potential mitigation measures during construction phase

Activity	Mitigation measure
Communications	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
	Display the head or regional office contact information.
Dust management	Develop and implement a Construction Dust Management Plan (DMP).
Site Management	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
	Make the complaints log available to the local authority when asked.
	Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.
Monitoring	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked.
	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked
	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
	Establish real-time PM_{10} continuous monitoring in locations surrounding the construction activity. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.
Site layout	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
	Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period.
	Avoid site runoff of water or mud.
	Keep site fencing, barriers and scaffolding clean using wet methods.
	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on-site. If they are being re-used on-site cover as described below.
	Cover, seed or fence stockpiles to prevent wind whipping.
Operating vehicle/machinery and sustainable travel	Ensure all vehicles switch off engines when stationary - no idling vehicles.
	Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
	Impose and signpost a maximum-speed-limit of 25km/h on surfaced and 15km/h on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate).
Operations	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
	Use enclosed chutes and conveyors and covered skips.
	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.

Activity	Mitigation measure
	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.
Waste management	Do not burn waste materials.
Construction	Avoid scabbling (roughening of concrete surfaces) if possible.
	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
Trackout	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
	Avoid dry sweeping of large areas.
	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
	Record all inspections of haul routes and any subsequent action in a site log book.
	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable.

6 TRAFFIC EMISSIONS

6.1 Modelling methodology

The CAL3QHCR roadway pollution model, in conjunction with the Weather Research and Forecasting Model (WRF) was used to determine the impact associated with vehicle emissions on surrounding roadways.

Surrounding local roads, such as Gladstone Street and Regent Street, were included in the model along with vehicles travelling along Princes Highway.

6.2 Meteorological modelling

The centre of analysis for the WRF modelling used is 327800mE and 6240500mS. The simulation involved an outer grid with 9km grid spacing, with two nested grids with 3km and 1km grid spacing.

Figure 6-1 presents the annual and seasonal windroses from the WRF data extract at a location representative of the Project site. The windroses are generally comparable to those at Sydney Airport AMO (see **Figure 4-2**), and overall, the WRF modelling reflect the expected wind distribution patterns of the Project area. This determination is based on the available measured data and the anticipated terrain effects on the prevailing winds.

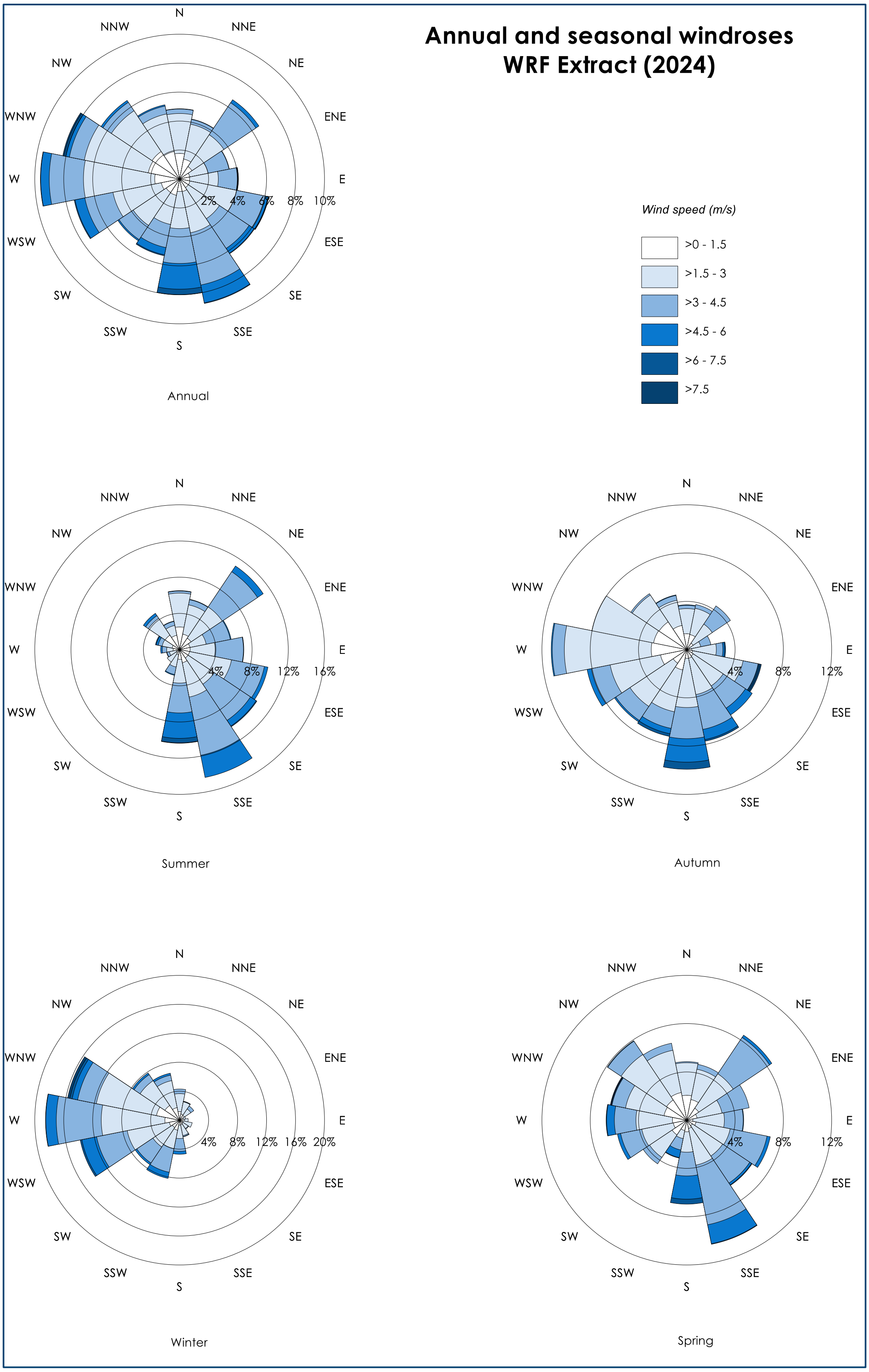

Figure 6-1: Annual and seasonal windroses from WRF Extract

6.3 Emission estimation

The measured daily traffic volumes and traffic profiles were obtained from the Transport for NSW (TfNSW) Traffic Volume Viewer traffic counter stations 7132 and 23015 on the Princes Highway (**TfNSW, 2025**).

Traffic counter station 7132 is located approximately 0.95km north of the site and records Annual Average Daily Traffic (AADT) volumes for northbound traffic. Traffic counter 23015 is located approximately 0.7km south of the site and recorded both northbound and southbound AADT volumes for a short campaign period.

Analysis of traffic counter 23015 data indicates similar volumes of northbound and southbound traffic, which is assumed to also apply to the traffic counter 7132 location, along with its diurnal profile.

To estimate the AADT traffic along the Princes Highway, AADT volumes from traffic counter station 7132 were doubled to account for traffic in both directions, using the diurnal profile from the traffic counter 23015. As a conservative measure, an additional 20% increase in annual average traffic volume was applied to account for a potential future increase in traffic.

For traffic travelling along Gladstone Street and Regent Street, an assumed AADT of approximately 20% of the traffic volume along Princes Highway has been applied.

Hourly NO_x and $PM_{2.5}$ emission rates for free-flowing traffic were obtained from the Transport for NSW Roadside Air Quality Screening Tool (RAQST) (**TfNSW, 2024**) for the 2026 vehicle fleet year and default traffic mix.

Table C-1 in **Appendix C** provides the hourly vehicle profiles for Princes Highway, Gladstone Street and Regent Street that were applied in the model.

A summary of the AADT volumes and emission rates applied in the modelling is presented in **Table 6-1**.

Table 6-1: Summary of modelling parameters

Road	Type	AADT	Grade (%)	NOx (g/vehicle/km)	$PM_{2.5}$ (g/vehicle/km)
Princes Highway	Commercial arterial	43,147	0.4	0.4	0.02
			-0.4	0.35	0.02
Gladstone Street	Residential	8,629	2.9	0.47	0.03
			-2.9	0.21	0.02
Regent Street	Residential	8,629	3.3	0.47	0.03
			-3.3	0.19	0.02

Idling emission rates for heavy duty diesel vehicles included in the modelling are 33.763g/hr for NOx and 1.1g/hr for $PM_{2.5}$.

As per the RAQST user guide, for sufficiently low values of NO_x, (all values in this case), a conservative 50% of the NO_x was assumed to be NO_2.

6.4 Modelled receptors

Representative receptors for the purpose of modelling have been selected along the proposed building at the most impacted point from vehicle emissions.

Figure 6-2 present the approximate locations used in the assessment to represent the most impacted points at the Project.

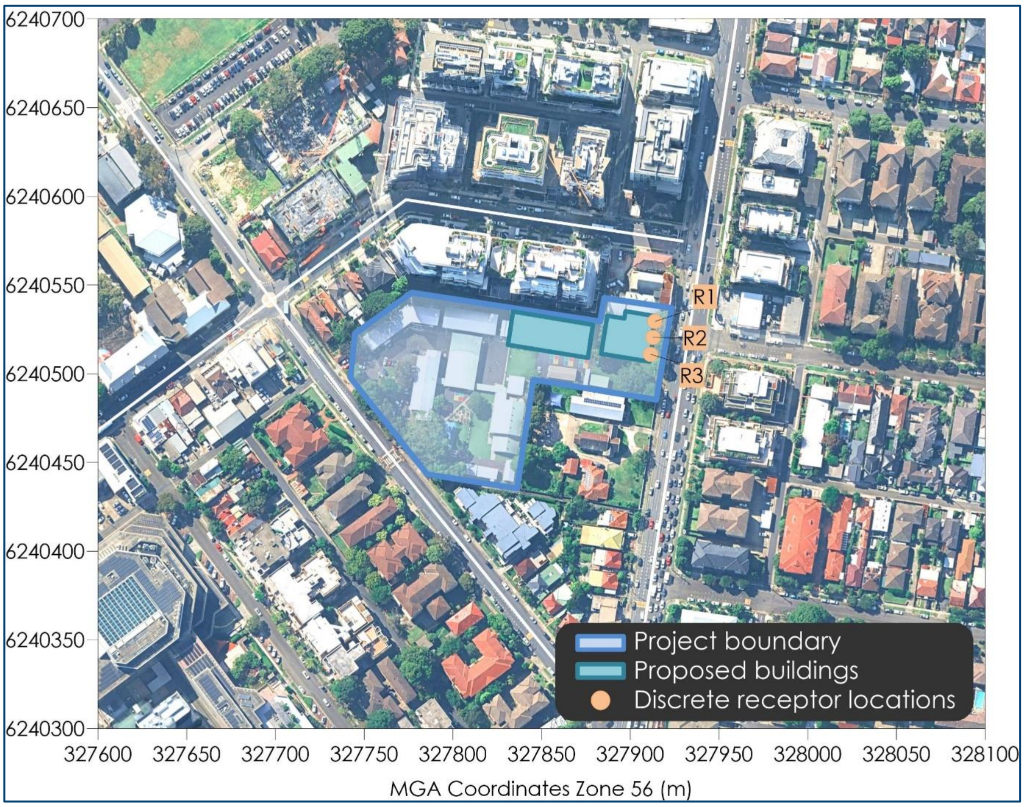

Figure 6-2: Modelled receptor locations

6.5 Dispersion modelling results

Table 6-2 present the predicted incremental and cumulative pollutant impacts at the Project site. **Figure 6-4** to **Figure 6-6** present pollutant concentration isopleths showing the spatial distribution of the predicted incremental impacts for the assessed pollutants.

The results in **Table 6-2** indicate the predicted cumulative 24-hour average and annual average $PM_{2.5}$ and 1-hour and annual average NO_2 levels do not exceed the relevant criteria. We note that annual average $PM_{2.5}$ are also predicted to be below the alternative criterion of 0.5µg/m^3.

Therefore, it is determined that the road traffic emissions would not lead to any unacceptable level of harm or impact at the site of the Project.

Table 6-2: Predicted incremental and cumulative impacts at the Project (µg/m^3)

Receptor ID	Maximum incremental impact (µg/m^3)				Cumulative impact (µg/m^3)			
	24-hour average $PM_{2.5}$	Annual average $PM_{2.5}$	1-hour average NO_2	Annual average NO_2	24-hour average $PM_{2.5}$	Annual average $PM_{2.5}$	1-hour average NO_2	Annual average NO_2
	Impact assessment criteria							
	-	*0.5	-	-	25	8	164	31
R1	1.0	0.4	60.5	7.5	19.3	7.0	138.4	23.9
R2	0.9	0.4	60.3	7.3	19.2	7.0	138.2	23.7
R3	0.9	0.4	54.2	6.9	19.2	7.0	132.1	23.3

*Incremental annual average $PM_{2.5}$ criterion

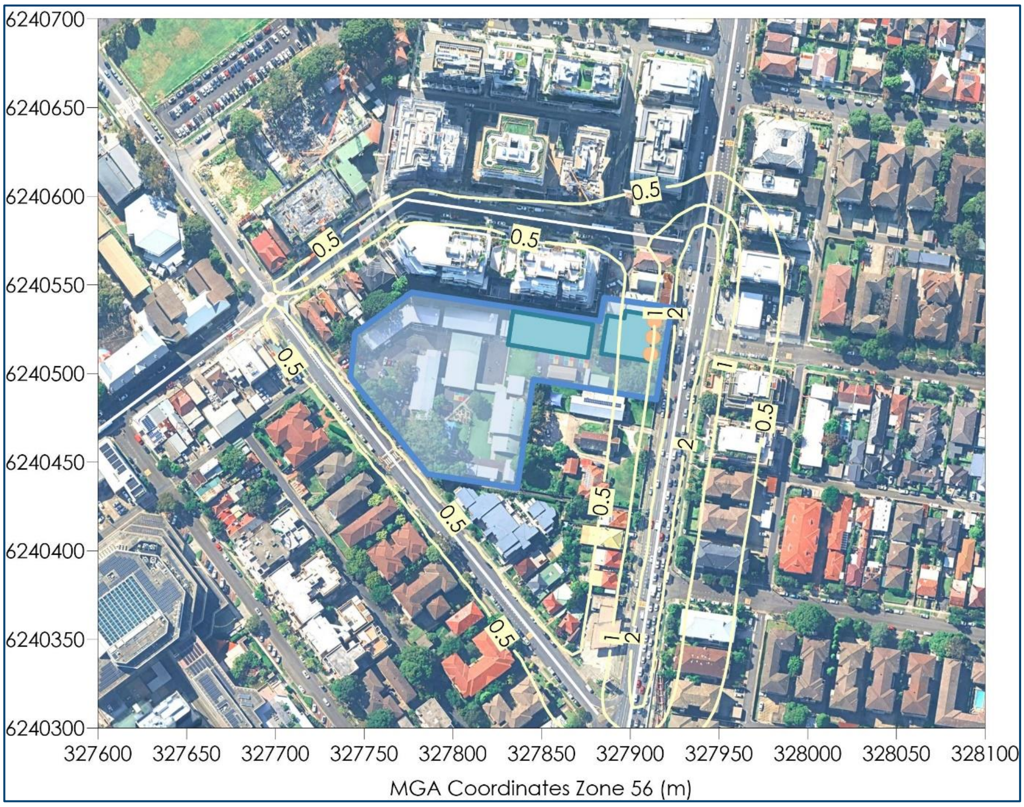

Figure 6-3: Predicted incremental 24-hour average $PM_{2.5}$ concentrations (µg/m³)

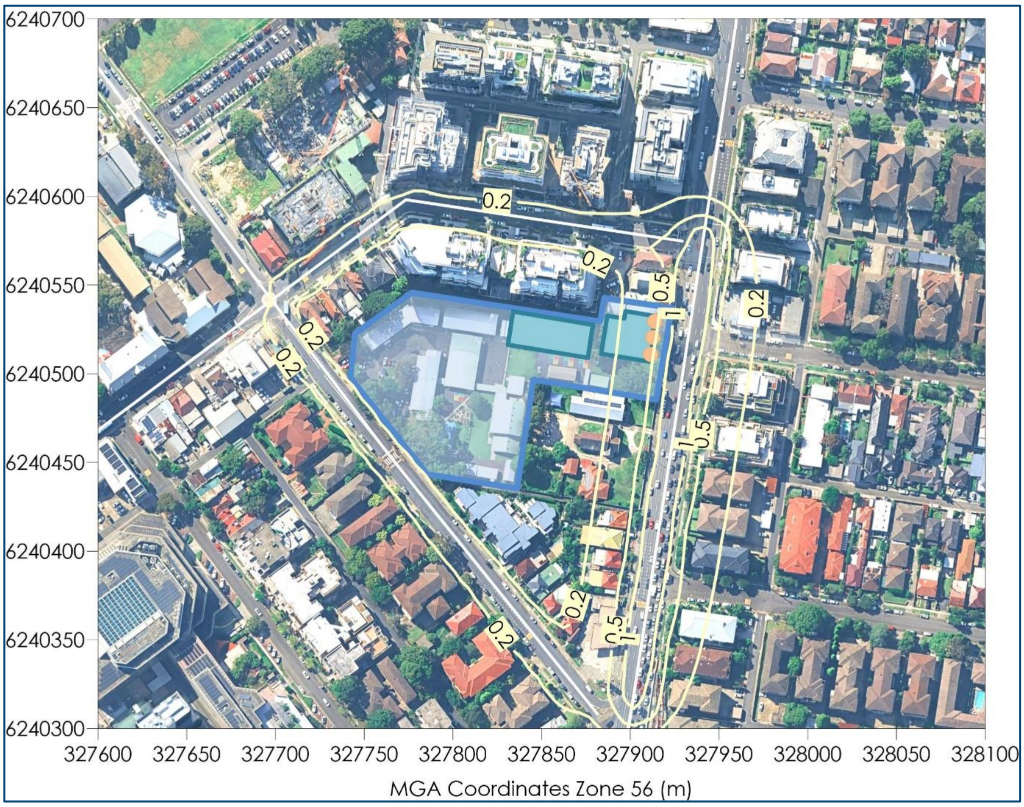

Figure 6-4: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³)

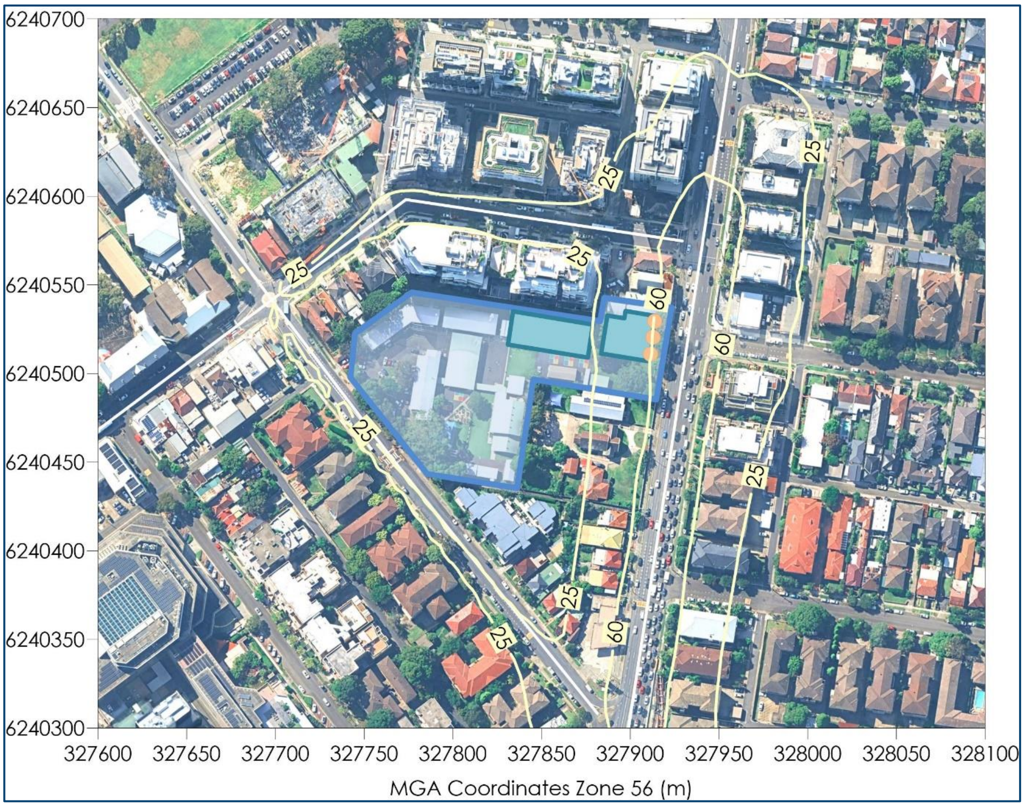

Figure 6-5: Predicted incremental 1-hour average NO_2 concentrations (µg/m³)

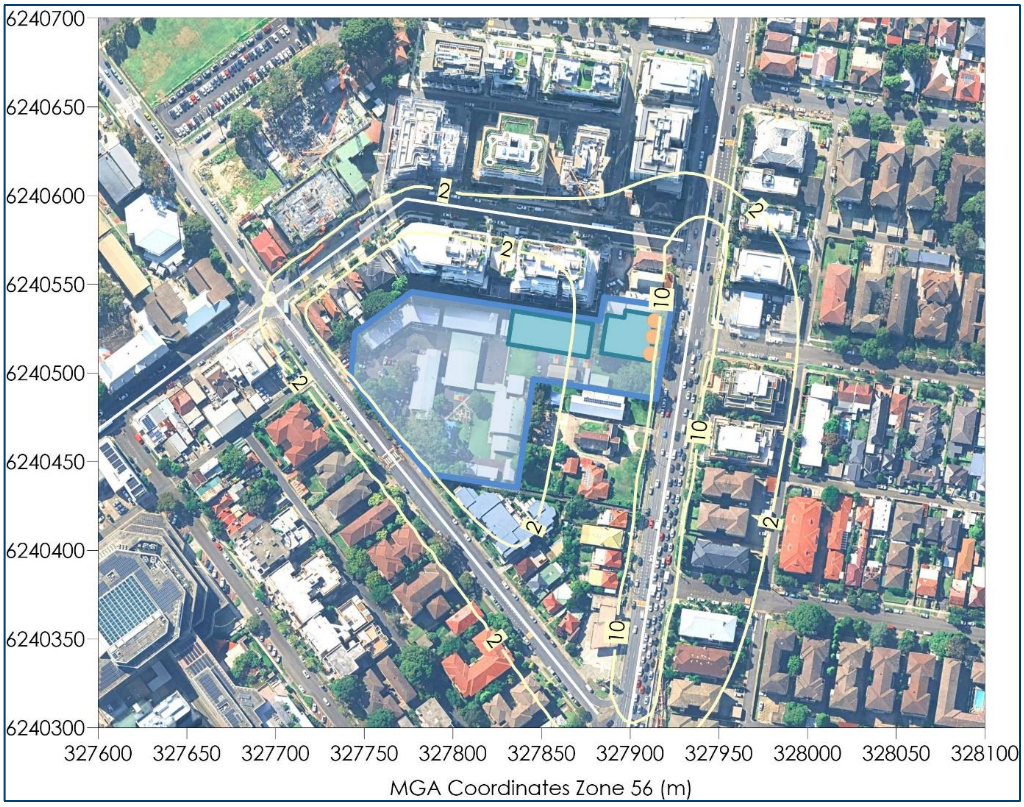

Figure 6-6: Predicted incremental annual average NO_2 concentrations (µg/m³)

6.6 Mitigation measures for traffic emissions

The results in **Table 6-2** show that the Project is predicted to experience pollutant levels below the relevant criteria for each of the assessed pollutants at the Project. The maximum predicted incremental levels for most of the traffic pollutants were found to be a relatively small fraction of the background levels recorded at the DCCEEW monitoring sites in the 2024 calendar year.

Therefore, the greatest potential risk to the air quality and health of the children and staff at the Project would likely result from sources outside of the vicinity of the Project, i.e. fluctuations in the prevailing regional level of air pollution under abnormal conditions such as during dust storms or bush fires when high pollution levels would occur across the region. All properties, including the Project, would be subject to these levels on high air pollution days.

In NSW, the DCCEEW monitors background pollutant concentrations for ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, PM_{10} and $PM_{2.5}$ at various monitoring sites around Sydney. The data recorded at these sites are used to create daily email and SMS forecasts and alerts for Sydney.

This service is free and anyone can subscribe to receive the forecasts or alerts via an email or SMS alert system which sends warning messages when the regional Air Quality Index is forecast to be high. The forecasts arrive at approximately 4pm on the day prior.

As the only likely air quality impact on the Project would be due to a poor air quality days (across the region), it is recommended that the Project subscribe to the forecasts and alerts, and use them as part of the day to day management of the Project operations.

For days on which the NSW DCCEEW issues a “poor” or worse forecast or alert for Sydney, the Project should limit outdoor activities to ensure that exposure of staff and children to air pollutants is minimised. However, this would only be necessary if the forecast or alert is relevant to Kogarah.

This can be verified on the DCCEEW website should the forecast or alert be "poor" or worse (see https://www.airquality.nsw.gov.au/sydney-forecast).

Measures should also be taken to reduce the risk of pollutant exposure from local incidents such as fires, and potentially the emissions from any new neighbouring operations.

A proposed Air Quality Management Plan for the Project is presented in **Table 6-3**.

Table 6-3: Air quality management plan for the Project

Daily Air Quality Management Plan	
Potential Hazard	**Daily Air Quality Monitoring**
Elevated regional air pollution (Bushfire, dust storm, smog event etc.)	1. To monitor air quality, permanently subscribe to free daily AQI forecast and alerts from NSW EPA; https://www.airquality.nsw.gov.au/subscribe-to-air-quality-updates 2. Check email and/or phone for the next day's forecast at approximately 4 pm each day.
Potential Hazard	**Air Quality Management Actions**
AQI Forecast: Poor, Very Poor or Hazardous. (This occurs when at least one of the AQI pollutants is forecast to reach the relevant criteria level at any of the Sydney monitoring sites.) Maximum level of exposure to children and staff.	If AQI Forecast: is Poor, Very Poor or Hazardous: 1. Check the "Regional AQI" for the Sydney monitoring sites. https://www.airquality.nsw.gov.au/central-west-sydney 2. If the "Regional AQI' is greater than 100, this activates a trigger for the following changes to operational measures: a. Close windows and doors to reduce unnecessary flow of air into the Project; b. If possible, limit outdoor activities.
Local air pollution incident, such as a fire nearby (**Provided there is no threat to safety. Safety takes priority**).	1. Close windows and doors to reduce unnecessary flow of air into the Project; 2. Limit outdoor activities.
New neighbouring operation is proposed with significant potential for air pollutant emissions.	Seek that Council reviews the appropriateness of the neighbouring proposal and if it approves the proposal, that it includes a requirement to mitigate air pollution which may impact the Project (see below for examples of Council approval requirements).
New neighbouring operation produces significant air pollutant emissions on an ongoing basis.	Seek Council to enforce its approval requirements on the neighbouring operation, for example; 1. To reduce emissions and impacts to a level that does not impact upon the Project; 2. To pay costs to design and relocate the Project's air intake duct; 3. To pay costs to design and install filtration on the Project's air intake. **Commence air quality monitoring program**
Significant increase (e.g. doubling) in traffic volumes on the adjacent roads	Check traffic counts each 10th year of operation. Where traffic counts on the main road adjacent to the Project, are double that assessed; **Commence air quality monitoring program**
The AQMP is to be reviewed every 10 years, or following the completion of a triggered air quality monitoring sampling period.	

In accordance with the *Development Near Rail Corridors and Busy Roads – Interim Guideline* (**NSW DoP, 2008**), best practices can be implemented through modifications, retrofitting, and operational changes to reduce exposure to traffic related air pollution.

As this is an existing school, careful consideration has been given to the available best practice measures in the design. The air quality modelling assessment indicates compliance with the applicable air quality criteria. Nevertheless, additional best practice recommendations for existing schools have been incorporated.

These include converting the existing demountable classroom and outdoor play areas located closest to the Princes Highway into an indoor sports hall and a covered outdoor learning area (COLA). The COLA will function as an overflow area for assemblies, where students may be seated. These areas will be used less frequently than the existing demountable classrooms.

The existing vegetation on the school's road-facing boundary would be retained to assist with reducing air pollution intake. Where possible, it is suggested to increase the vegetation density along this boundary.

Overall, these changes are not expected to result in poorer air quality conditions compared to the existing site conditions and may provide potential improvements.

7 SUMMARY AND CONCLUSIONS

This study has assessed the potential for air quality impacts associated with traffic emissions to impact upon the proposed upgrades to the Kogarah Public School at Kogarah.

Air dispersion modelling was used to predict the potential for cumulative air quality impacts at the Project site due to the effects of traffic emissions from nearby roads. The modelling uses conservative assumptions to predict the impacts and accounts for future growth in traffic volumes. The results show that all pollutant levels at the Project would be within the relevant EPA impact assessment criteria.

Overall, the assessment demonstrates that the Project design and location is adequate to ensure no adverse impacts above criteria would arise once it is developed.

8 REFERENCES

Bureau of Meteorology (2025)

Climate statistics for Australian locations, Bureau of Meteorology website, accessed February 2025. http://www.bom.gov.au/climate/averages

Capon and Wright (2019)

"An Australian incremental guideline for particulate matter ($PM_{2.5}$) to assist in development and planning decisions" Published December 2019. Authors: Capon and Wright. https://doi.org/10.17061/phrp2941928

NSW DoP (2008)

"Development Near Rail Corridors and Busy Roads – Interim Guideline", NSW Department of Planning, 2008.

IAQM (2024)

"Guidance on the assessment of dust from demolition and construction", Institute of Air Quality Management, January 2024

NEPC (2021)

"National Environment Protection (Ambient Air Quality) Measure", National Environment Protection Council, June 2023.

NSW EPA (2022)

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

TfNSW (2024a)

Assessing air quality impacts from surface roads – The Roadside Air Quality Screening Tool (RAQST), Transport for NSW website, accessed February 2024.
Assessing air quality impacts from surface roads | Transport for NSW

TfNSW (2024b)

"Traffic Volume Viewer", Transport for NSW, accessed March 2025. https://maps.transport.nsw.gov.au/egeomaps/traffic-volumes/index.html#/?z=6

Appendix A

Consideration of Alternative Criterion for $PM_{2.5}$ Incremental Annual Average

In the Public Health Research & Practice journal "*An Australian incremental guideline for particulate matter ($PM_{2.5}$) to assist in development and planning decisions*" by Capon and Wright (Capon & Wright 2020), a set of criteria for incremental annual average $PM_{2.5}$ is set out based on the authors estimates for increased risk of premature mortality due to an increase of $PM_{2.5}$. It is noted that the health outcome of risk of premature mortality relates to a shortening of a life as a result of exacerbation of pre-existing disease or the development of disease over a lifetime. **Table A-1** shows the proposed criteria and categories for different incremental annual $PM_{2.5}$ concentration levels.

Table A-1: Incremental annual average $PM_{2.5}$

Incremental annual average $PM_{2.5}$ concentration (µg/m³)	Increased risk of mortality	Risk acceptability and suggested interpretation
0–0.02	<1 in 1 000 000	**Negligible**
0.02–0.17	1 in 1 000 000–1 in 100 000	**Acceptable** Development needs to show use of best practice with consideration of reasonable and feasible measures to reduce pollutant load
0.17–1.7	1 in 100 000–1 in 10 000	**Tolerable** Only if best practice is proven and reasonable, and feasible measures have been demonstrated. At this level, costly interventions are now considered reasonable and feasible, that would not have been in the acceptable range
>1.7	>1 in 10 000	**Unacceptable**

Source: **Capon and Wright, 2019**

This guideline however is not specific to childcare centres and has been prepared as general guidance to consider the potential ranges of pollutant concentrations that may result in a change in health outcomes in a population from any type of development, including roads. It is thus crucial to understand the limitations inherent in the guideline when adapting it for assessing childcare centres near roads.

The limitations that should be considered include:

- The values are based on data about the risk of premature mortality obtained from epidemiological studies from large urban populations (i.e. cities of millions of people), and the risks are relevant to those populations as a whole, not individuals or small groups of people, or more specifically children at a childcare centre only. It is noted that the large urban populations evaluated in these studies include a range of land uses and variable exposures including those adjacent to existing roads, ranging from small roads to large highways (and other transportation routes).
- The values apply to a lifetime exposure, not just say weekdays for up to six years for the hours spanning a little either side of working hours, as might be experienced by children present in a childcare centre.
- The range of values in each categories spans an order of magnitude in the risks of premature mortality, for example, the upper range of the acceptable risk of 0.17 µg/m³ is based on a 1:100,000 risk of premature mortality, and the upper range of the tolerable risk of 1.7 µg/m³ is based on a 1:10,000 risk of premature mortality.

From a health perspective, incremental $PM_{2.5}$ concentrations that are based on <1:10,000 risk of premature mortality are not considered to be unacceptable and for a very small population would not be expected to result in adverse effects.

Practical limitations of applying the criteria when considering pollutant level near roads are that the upper range of the acceptable risk is generally only achievable for small local traffic roads, such as quiet cul-de-sacs, where child care centres are unlikely to be viable due to other factors such as noise or traffic congestion impacts in quiet neighbourhoods, and that the upper range of the tolerable risk is higher than the pollutant level near almost any major road, and it is essentially unlimited, and would allow a child care centre to be located at the edge of Australia's largest motorways, where clearly, this is not a desirable outcome.

Thus, within the acceptable range of the criteria in Table A-1, there are few viable "acceptable locations" in urban areas, and essentially no constraints on locations near almost any road within the "tolerable range" when considering traffic pollution. This makes the criteria in Table A-1 impractical for deciding what is or is not a reasonable location, or what degree of mitigation is necessary. For example, it is generally not practicable to achieve the low end of the tolerable range (or the upper value in the acceptable range) in many locations, irrespective of the controls applied.

The guideline and the NSW EPA document Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales (**NSW EPA, 2022**) both seek that development within the 1:1,000,000 to 1: 10,000 risk categories require best practice (see Table 15, in Section 7.3 of **NSW EPA, 2022**).

Thus, a value less than the upper end of the tolerable range would be practical.

A suitable value must be practical and protective of the health of children. One must consider that children are a sensitive subgroup of the population to health impacts from $PM_{2.5}$ (and traffic pollution in general) (Sacks et al. 2011). Because the criteria ranges relate to the impact on a large population where children would be a small fraction of the affected population, a lower criteria value than in the guide is needed to protect the health of children given they are more sensitive to impacts that the general population.

On the other hand, the criteria are based on a lifetime of exposure whereas children would be present during the working hours of a childcare centre, generally weekdays for up to 6 years for a number of hours spanning before and after typical working hours. However, the maximum traffic impacts also occur during the times children would be present, meaning that the exposure when at the childcare centre to such pollution is generally likely to be higher than when at home. Traffic pollution levels are generally somewhat lower on weekends also. This factor would allow for some less stringency in the criteria, but tempered by the higher levels of exposure that arise at the times the children are at a childcare centre.

In our opinion, using a risk value up to 2/3 of the tolerable range value (i.e. an upper limit of 1: 33,333 risk of premature mortality) results in a practical criterion that would be adequately protective of children's health and achievable by implementing best practice controls in higher risk situations near busy, major roads (consistent with the requirements for such considerations in the childcare centre guideline). It should be noted that this is not a criterion that is proposed for or should be considered for policy development, for example when evaluating government policies to reduce motor vehicle emissions such as improving public transport or improving fuel quality, rather it is a criterion for use when deciding whether the impacts upon children at a proposed new or modified childcare centre would be reasonable or not.

A 1:33,333 risk category results in an incremental annual average $PM_{2.5}$ criterion of **0.5 µg/m³**. Incremental means due to only the emissions from the road. It is important to understand that the risk of harm arises due to the additional exposure above the prevailing background level of pollution in the area.

Table A-2 below sets out the risk of premature mortality and the criterion corresponding with that level of risk. The table indicates that the criterion of **0.5 µg/m³** corresponds with a premature mortality risk value up to 2/3 of the range of risk within the tolerable range.

Table A-2: Mortality risk associated with incremental increases in $PM_{2.5}$ exposure

Incremental annual average $PM_{2.5}$ concentration (µg/m³)	Increased risk of mortality
1.7	1 in 10,000
0.5	**1 in 33,333**
0.34	1 in 50,000
0.26	1 in 66,666
0.17	1 in 100,000
0.017	1 in 1,000,000

Appendix B
Selection of Meteorological Year

TODOROSKI AIR SCIENCES | info@airsciences.com.au | 02 9874 2123

Selection of meteorological year

A statistical analysis of the latest five contiguous years of meteorological data compared with the long-term climate data from the nearest BoM weather station with suitable available data, Sydney Airport AMO, is presented in **Table B-1**.

The standard deviation of the latest five years of meteorological data spanning 2020 to 2024 was analysed against the available measured wind speed, temperature and relative humidity. The analysis indicates that the 2023 and 2024 dataset are closest to the mean for wind speed, 2022 is closest for the mean for temperature, and 2020 closest for relative humidity.

Table B-1: Statistical analysis results for Sydney Airport AMO

Year	Wind speed	Temperature	Relative humidity	Score
2020	0.8	0.7	2.6	4.1
2021	0.8	0.5	3.4	4.7
2022	0.9	0.4	4.6	5.9
2023	0.7	0.9	4.3	5.9
2024	0.7	0.9	2.8	4.4

Further analysis of ambient air quality monitoring data for 2020 indicates that this year was affected by widespread bushfire events and is not representative of normal background levels. Based on the score-weighting analysis, the next closest year is 2024 and was found to be most representative.

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2024 year compared with the mean of the 2020 to 2024 data set. The 2024 data appear to be reasonably well aligned with the mean data.

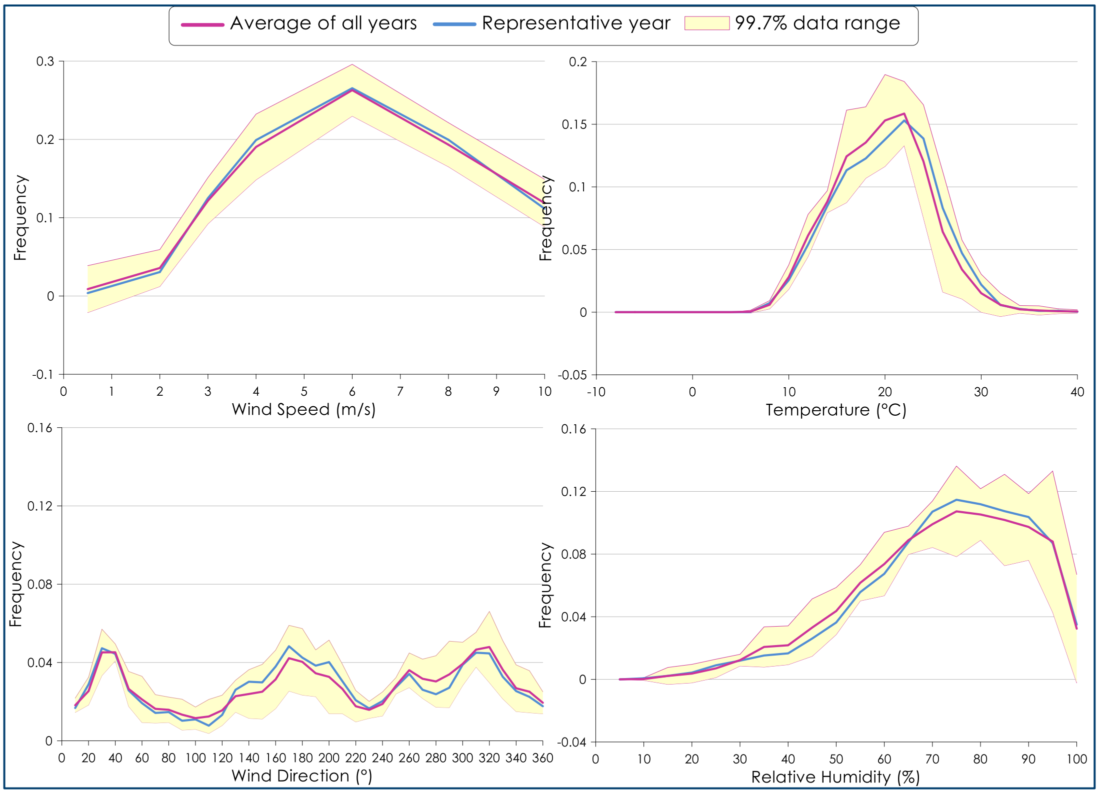

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix C

Diurnal Traffic Profiles

Table C-1: Diurnal traffic profiles – Number of vehicles per hour

Hour of day	Princes Highway		Gladstone Street		Regent Street	
	Northbound	Southbound	Northbound	Southbound	Eastbound	Westbound
0	146	296	29	59	29	59
1	93	165	19	33	19	33
2	85	114	17	23	17	23
3	114	96	23	19	23	19
4	282	106	56	21	56	21
5	962	238	192	48	192	48
6	1829	509	366	102	366	102
7	1860	687	372	137	372	137
8	1740	916	348	183	348	183
9	1600	964	320	193	320	193
10	1273	1124	255	225	255	225
11	1212	1234	242	247	242	247
12	1193	1315	239	263	239	263
13	1168	1308	234	262	234	262
14	1102	1460	220	292	220	292
15	1108	1719	222	344	222	344
16	1105	1872	221	374	221	374
17	1187	1901	237	380	237	380
18	1035	1690	207	338	207	338
19	757	1106	151	221	151	221
20	596	826	119	165	119	165
21	500	782	100	156	100	156
22	382	647	76	129	76	129
23	242	500	48	100	48	100