AIR QUALITY IMPACT ASSESSMENT
CRESCENT PARKLANDS
SSD-70283710: 1 CRESENT STREET, HOLROYD

Tiberius (Holroyd) Pty Ltd (ABN 61 061 131 959) atf
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Air Quality Impact Assessment
Crescent Parklands
SSD-7028371: 1 Cresent Street, Holroyd

DOCUMENT CONTROL

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GLOSSARY AND ABBREVIATIONS

Background levels	Existing concentration of pollutants in the ambient air.
CAL3QHCR	A refined dispersion model developed by the US Environmental Protection Agency (EPA) to predict air pollution concentrations from roadway sources.
Cumulative impact	The total impact due to an emission source (or group of sources) with background levels.
Diffuse source	Activities that are generally dominated by fugitive area or volume-source emissions, which can be relatively difficult to control.
Dispersion modelling	Modelling by computer to mathematically simulate the effect on plume dispersion under varying atmospheric conditions; used to calculate spatial and temporal fields of concentrations and particle deposition due to emissions from various source types.
Incremental impact	The impact due to an emission source (or group of sources) in isolation, i.e. without including background levels.
µg	Mass in micrograms.
m^3	Volume in cubic metres.
NO_2	Nitrogen dioxide.
NO_x	Oxides of nitrogen, including NO and NO_2.
$PM_{2.5}$	Particulate matter less than 2.5 µm in aerodynamic equivalent diameter.
SEARs	Secretary's Environmental Assessment Requirements
Sensitive receptor	A location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area.
SSDA	State Significant Development Application
WRF	The Weather Research and Forecasting model is a sophisticated numerical weather prediction system used to atmospheric research and operation forecasting.

EXECUTIVE SUMMARY

This air quality impact assessment report has been prepared by Todoroski Air Sciences to accompany a State Significant Development Application (SSDA) for a proposed mixed-use precinct located at 1 Crescent Street, Holroyd (the site).

As part of the Land and Environment Court (LEC) proceedings for the Concept Development Application (DA2023/0178) on the subject site, a precursor for the proposed detailed mixed-use precinct, Cumberland City Council (Council) as part of their Statement of Facts and Contentions the following concerns related to air quality:

> ***Air Quality***
>
> *The subject site is next to the M4 and Woodville Road and has a public access to parklands. It is recommended that an air quality assessment be carried out.*
>
> ***Recommendation***
>
> *The applicant is to provide the following additional information to enable assessment of the proposal:*
>
> …
>
> *3. A suitably qualified air quality professional should prepare an air quality assessment report to demonstrate that proposed site can meet air quality standards in accordance with Work Health and Safety Act 2011, the Work Health and Safety Regulation 2017, the EPA's Ambient Air Monitoring Guidance Note (January 2022), the EPA's Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (January 2022) and the Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline (2008). The air quality assessment report should provide recommendations for construction or operation management tools if busy roads impact the air quality for the proposed development.*

While not required by the Secretary's Environmental Assessment Requirements (SEARs), this report has also been prepared to address this request by Council for an Air Quality Impact Assessment.

The primary source of air pollution affecting the site is traffic emissions from nearby roadways. The key pollutants of concern are particulate matter with equivalent aerodynamic diameters of 2.5µm or less ($PM_{2.5}$) and nitrogen dioxide (NO_2), which have the greatest potential impacts from traffic emissions and are the focus of this assessment.

Prevailing winds in the area primarily come from the west-southwest, with additional flow from the northwest and southeast quadrants throughout the year. Overall, ambient air quality in the region is generally good, though it is occasionally influenced by regional events such as bushfires and hazard reduction burns.

To predict potential impacts on the site, air dispersion modelling of traffic emissions from surrounding roadways was conducted. The CAL3QHCR roadway pollution model, in conjunction with the Weather

Research and Forecasting (WRF) model, was used to assess vehicle emissions' effects. Traffic volumes from **Todoroski Air Sciences** (**2015**) were considered representative of future conditions and applied along the same road sections. Hourly NO_x and $PM_{2.5}$ emission rates were obtained from the Transport for NSW Roadside Air Quality Screening Tool (RAQST) (**TfNSW, 2024**).

The modelling results were evaluated at specific assessment locations representing open spaces and future residences. Predictions showed that the predicted cumulative 1-hour and annual average NO_2 levels remain below the relevant criteria, indicating the Project site and design are appropriate. The site layout also incorporates a sufficient setback from the motorway, aligning with best practices to ensure air quality standards are met at all key receptor areas.

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1 INTRODUCTION

This air quality impact assessment report has been prepared by Todoroski Air Sciences to accompany a State Significant Development Application (SSDA) for a proposed mixed-use precinct located at 1 Crescent Street, Holroyd (the site).

This report has been prepared to assess the potential for air quality impacts due to vehicle emissions on nearby roadways.

As part of the Land and Environment Court (LEC) proceedings for the Concept Development Application (DA2023/0178) on the subject site, a precursor for the proposed detailed mixed-use precinct, Cumberland City Council (Council) as part of their Statement of Facts and Contentions the following concerns related to air quality:

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While not required by the Secretary's Environmental Assessment Requirements (SEARs), this report has also been prepared to address this request by Council for an Air Quality Impact Assessment.

This report addresses the condition in the Transport and Infrastructure State Environmental Planning Policy (SEPP) Section 2.119 as follows:

> (2) *The consent authority must not grant consent to development on land that has a frontage to a classified road unless it is satisfied that—*
>
> …
>
> *(c) the development is of a type that is not sensitive to traffic noise or vehicle emissions, or is appropriately located and designed, or includes measures, to ameliorate potential traffic noise or vehicle emissions within the site of the development arising from the adjacent classified road.*

2 SITE CONTEXT

2.1 Site description

The land to which this SSDA relates is located at 1 Crescent Street, Holroyd (**the site**). The site is legally described as Lot 700 in Deposited Plan 1241836.

The site comprises an irregularly shaped allotment with an area of 37,877 square metres (m^2) and has a primary frontage to Crescent Street to the south and a frontage to Woodville Road to the east. The northern boundary of the site adjoins the Holroyd Sportsground with the M4 Motorway beyond.

The site is located in the Cumberland Local Government Area (**LGA**) and is currently vacant and cleared after WesTrac ceased operations of an industrial facility at the site in early 2018. The site contains existing scattered pockets of landscaped vegetation, predominately located along the site's southern and eastern boundaries to Crescent Street and Woodville Road.

The site is bounded by Parramatta Road/Church Street/Woodville Road intersection to the northeast, Woodville Road to the east and Crescent Street to the south. The northern frontage of the site faces the Holroyd Sportsground and the M4 Motorway beyond. It is noted that the eastern portion of the site fronting Woodville Road has been identified for potential future acquisition by Transport of NSW for future planned intersection upgrades to Woodville/Parramatta Road/M4.

The main source of potential air emissions which can impact on the outdoor areas is identified as traffic emissions associated with vehicles travelling on the nearby M4 Motorway, Church Street, Woodville Road, Crescent Street, and Parramatta Road.

A Location plan including the site is provided in **Figure 2-1** and an aerial photograph in **Figure 2-2**.

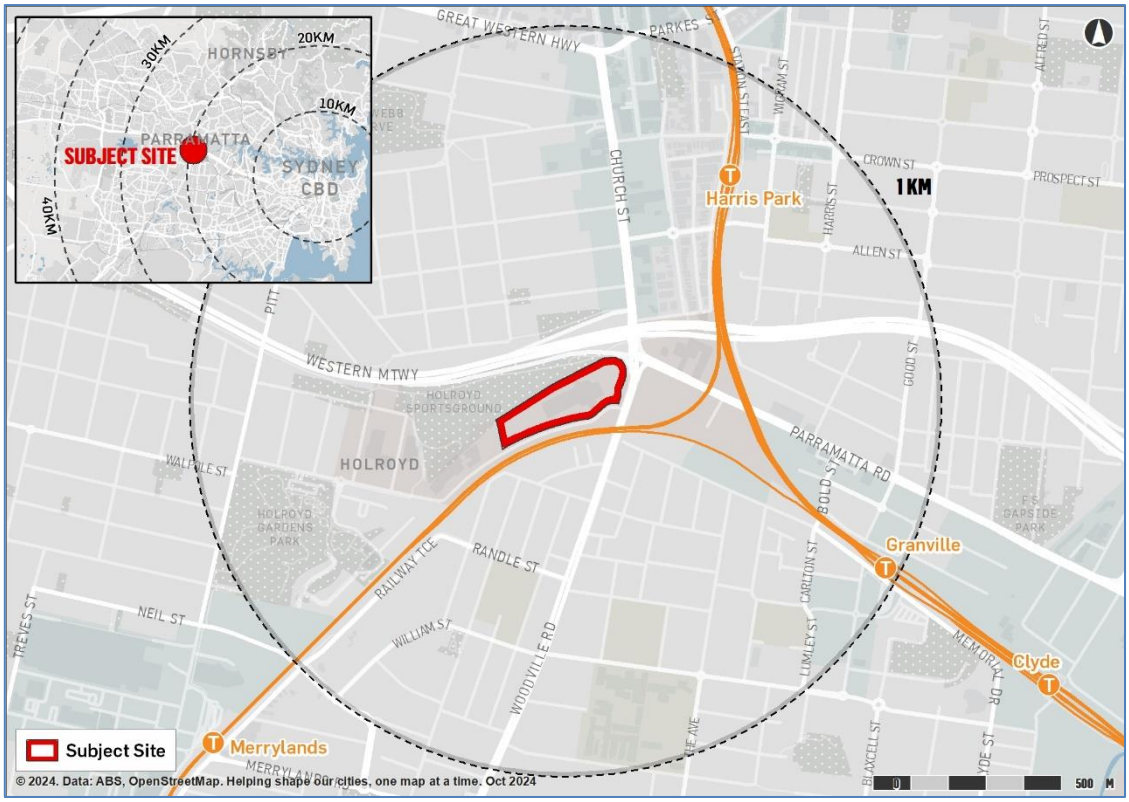

Figure 2-1: Location plan

Figure 2-2: Aerial photograph

3 PROPOSED DEVELOPMENT

The vision for the project is to deliver a new mixed-use precinct that fosters a dynamic live-work-play lifestyle. This precinct will feature a diverse range of housing options, including affordable housing, all complemented by expansive public open spaces. Retail and commercial uses will also be integrated, establishing a new, local destination that encourages community engagement and interaction.

The proposal broadly seeks approval for an SSDA for a mixed-use precinct with public open spaces comprising the following components:

- Site establishment works, tree removal, site preparation, earthworks and excavation, services augmentation, and remediation works.
- Development of seven residential buildings comprising four shop top housing buildings and three residential flat buildings as outlined below:
  - Buildings 1-3 are integrated with an eastern mixed-use podium building, while Building 4 is situated above mixed residential / commercial space, offering shop-top housing.
  - Buildings 5-7 consist of residential flat buildings.
- Delivery of 15% of the total floor space as affordable housing to be distributed across each of the 7 residential buildings.
- Approximately 134,000m^2 total floor space comprising:
  - A total of 2,500m^2 retail GFA and 5,000m^2 commercial GFA.
  - Communal amenity facilities for residents.
  - Building services areas.
- Activation of Crescent Street through a mix of amenity areas and pockets of open space.
- Shared car parking for Buildings 1-3 and the commercial and retail tenancies within the podium.
- Shared car parking for Buildings 4 to 7 on the lower ground levels and within the above ground parking structures adjoining Buildings 5 and 6.
- The widening of Crescent Street and upgrades to Crescent Street and Woodville Road intersection.
- Landscaping and accompanying place making works including:
  - Public open space, hard and soft landscape works.
  - Ground and rooftop communal open space.
  - Publicly accessible through-site links.

- At grade car parking for the park, forecourt and retail areas.
- Vehicle access via a new internal publicly accessible road and vehicle accessway.
- New pedestrian footpaths and access arrangements to the site.
- Café tenancy within park-side structure.

- Staged completion of a public park.

Indicative site layouts for the ground floor, Level 2 and Level 7 are presented in **Figure 3-1** to **Figure 3-3**, respectively.

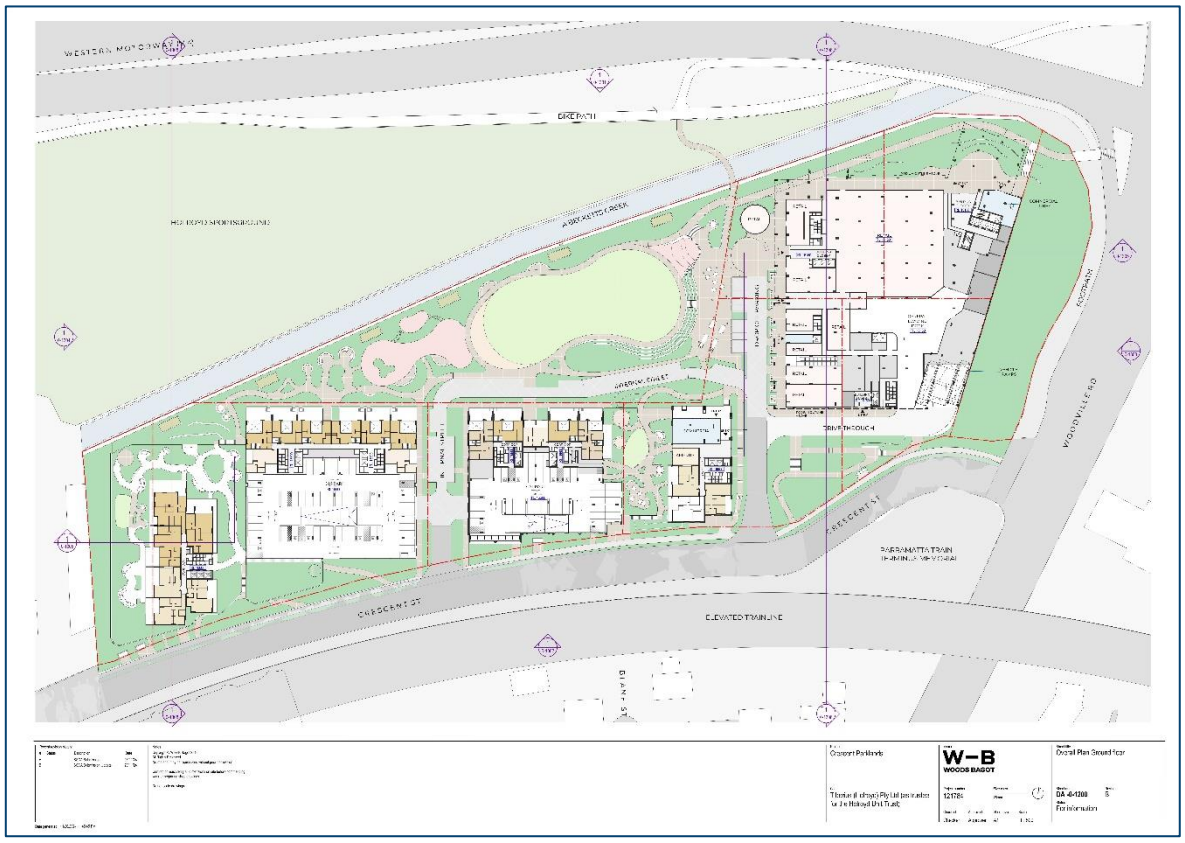

Figure 3-1: Indicative site layout – Ground floor

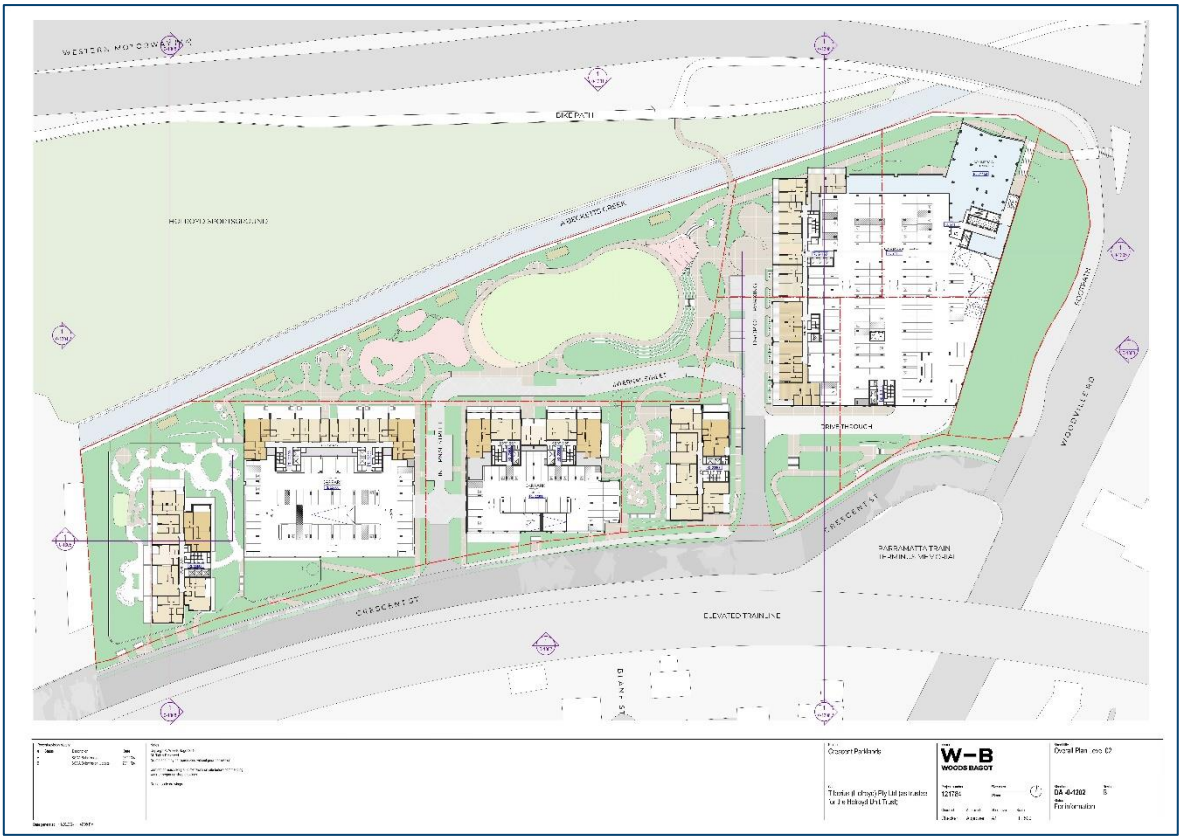

Figure 3-2: Indicative site layout – Level 2

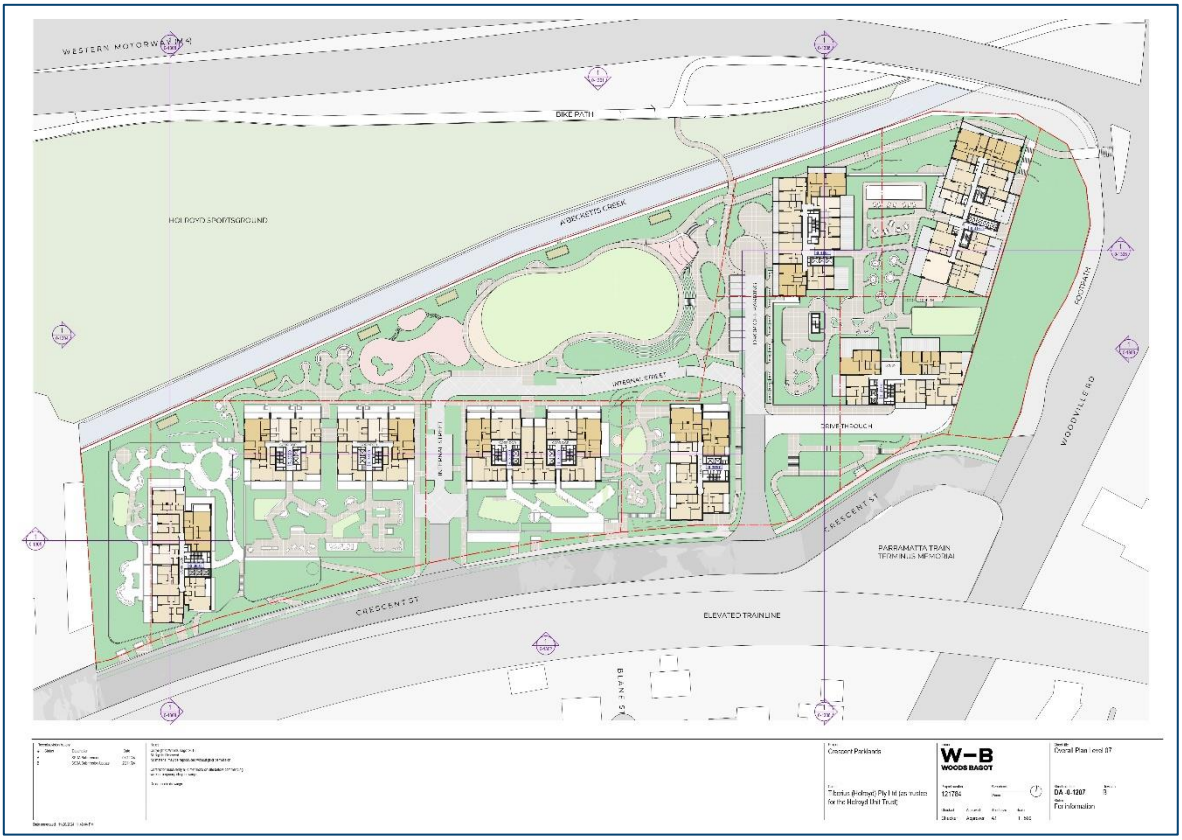

Figure 3-3: Indicative site layout – Level 7

4 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.

The key source of air pollution at the site would be associated with traffic emissions from the nearby roadways. Particulate matter with equivalent aerodynamic diameters of 2.5µm or less ($PM_{2.5}$) and nitrogen dioxide (NO_2) are the critical pollutants with regard to potential impacts from traffic emissions.

Table 4-1 summarises the key 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**) and the National Environment Protection (Ambient Air Quality) Measure (NEPM) (**NEPC, 2021**).

Whilst there are many pollutants from traffic, where the criteria for these pollutants are met, the criteria for other pollutants would also be met. Such pollutants include PM_{10}, carbon monoxide, sulphur dioxide, benzene and toluene. We note these pollutants were assessed in the previous report, *Air Quality Impact Study for Mixed Use Development at 1 Crescent Street,* Holroyd (**Todoroski Air Sciences, 2015**), and the results showed that concentrations of these pollutants from the nearby roads would be well below the NSW EPA impact assessment criteria.

The criteria for $PM_{2.5}$ and NO_2 have been updated in the NSW EPA Approved Methods since the previous report, therefore these pollutants are the focus of this assessment. 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 4-1: Relevant standards for air pollutants

Pollutant	Averaging period	Goal		Impact
		NSW EPA	NEPM	
$PM_{2.5}$	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

µg/m³ - micrograms per metre cubed

We note that air quality standards in the Work Health and Safety Act 2011 and the Work Health and Safety Regulation 2017 are much higher (i.e. much more lenient or much less stringent) than the NSW EPA impact assessment criteria which have been applied to assess the impacts at the Site. If compliance with the EPA criteria is achieved, then the site air quality will also meet the workplace requirements.

5 EXISTING ENVIRONMENT

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

5.1 Local climatic conditions

Long-term climatic data obtained from the closest Bureau of Meteorology (BoM) weather station with available data at Parramatta North (Masons Drive) (Site No. 066124) were analysed to characterise the local climate in the proximity of the Project. The Parramatta North weather station is located approximately 4.6km north of the Project.

Table 5-1 and **Figure 5-1** present a summary of data from the Parramatta North weather station collected over a 23-to-56-year period for the various meteorological parameters.

The data indicate that January is the hottest month with a mean maximum temperature of 28.6 degrees Celsius (ºC) and July is the coldest month with a mean minimum temperature of 6.3ºC.

Rainfall decreases during the cooler months, with an annual average rainfall of 984.9 millimetres (mm) over 90.6 days. The data indicate that February is the wettest month with an average rainfall of 128.2mm over 9.2 days and September is the driest month with an average rainfall of 50.2mm over 5.9 days.

Relative humidity levels exhibit variability over the day and seasonal fluctuations. Mean 9am relative humidity ranges from 62% in October to 80% in March. Mean 3pm relative humidity levels range from 46% in August and September to 60% in May.

Wind speeds exhibit diurnal and seasonal variations with lower speeds at 9am compared to 3pm. Mean 9am wind speeds range from 6.4 kilometres per hour (km/h) in February and March to 9.8 km/h in September and October. Mean 3pm wind speeds range from 9.3 km/h in May to 15.6 km/h in November.

Table 5-1: Monthly climate statistics summary – Parramatta North (Masons Drive) weather station

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature													
Mean max. temp. (ºC)	28.6	27.9	26.3	23.9	20.7	17.8	17.5	19.1	21.8	24.0	25.5	27.6	23.4
Mean min. temp. (ºC)	17.7	17.6	15.9	12.9	9.9	7.5	6.3	7.1	9.3	12.0	14.1	16.2	12.2
Rainfall													
Rainfall (mm)	103.5	128.2	124.7	88.1	66.9	89.3	50.8	55.5	50.2	70.1	83.7	71.7	984.9
No. of rain days (≥1mm)	9.1	9.2	10.2	7.1	6.9	7.5	5.6	5.2	5.9	7.6	8.6	7.7	90.6
9am conditions													
Mean temp. (ºC)	22.5	22.0	20.5	18.0	14.5	11.7	10.8	12.5	15.8	18.6	19.7	21.7	17.4
Mean R.H. (%)	74.0	79.0	80.0	76.0	79.0	78.0	75.0	67.0	63.0	62.0	69.0	70.0	73.0
Mean W.S. (km/h)	7.3	6.4	6.4	6.7	6.7	7.2	7.7	9.1	9.8	9.8	8.4	8.1	7.8
3pm conditions													
Mean temp. (ºC)	26.8	26.3	24.7	22.3	19.2	16.6	16.2	17.8	20.0	21.9	23.6	25.7	21.8
Mean R.H. (%)	57.0	59.0	59.0	58.0	60.0	59.0	55.0	46.0	46.0	49.0	54.0	55.0	55.0
Mean W.S. (km/h)	14.5	13.0	12.2	10.8	9.3	10.4	10.6	13.2	15.2	14.9	15.6	15.4	12.9

Source: **Bureau of Meteorology (2023)**

R.H. – Relative Humidity, W.S. – wind speed

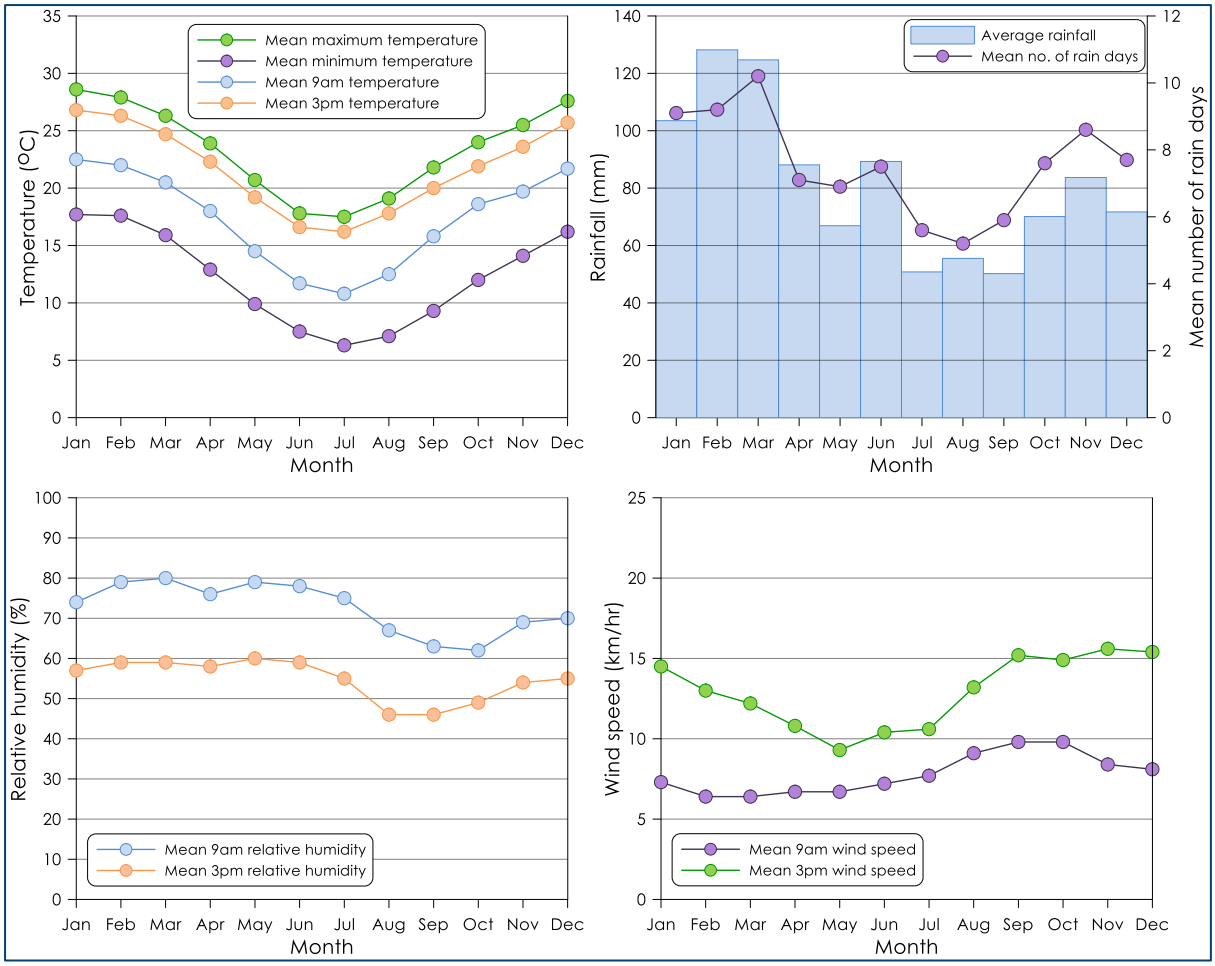

Figure 5-1: Monthly climate statistics summary – Parramatta North (Masons Drive) weather station

5.2 Local meteorological conditions

Annual and seasonal windroses for the BoM weather station at Bankstown Airport automatic weather station (AWS) are presented in **Figure 5-2** for the 2020 calendar period.

The 2020 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 A**.

Analysis of the annual wind distribution shows that winds predominantly occur from the west-southwest, followed by the northwest and southeast quadrants. In summer, winds occur primarily from the southeast quadrant. The autumn windrose indicates winds mostly occurring from the west-southwest, followed by the northwest and southeast quadrants. In winter, winds occur from the west-southwest to the north-northwest (clockwise). The spring wind distribution follows a similar pattern to the annual windrose with a higher proportion of winds from the east-northeast.

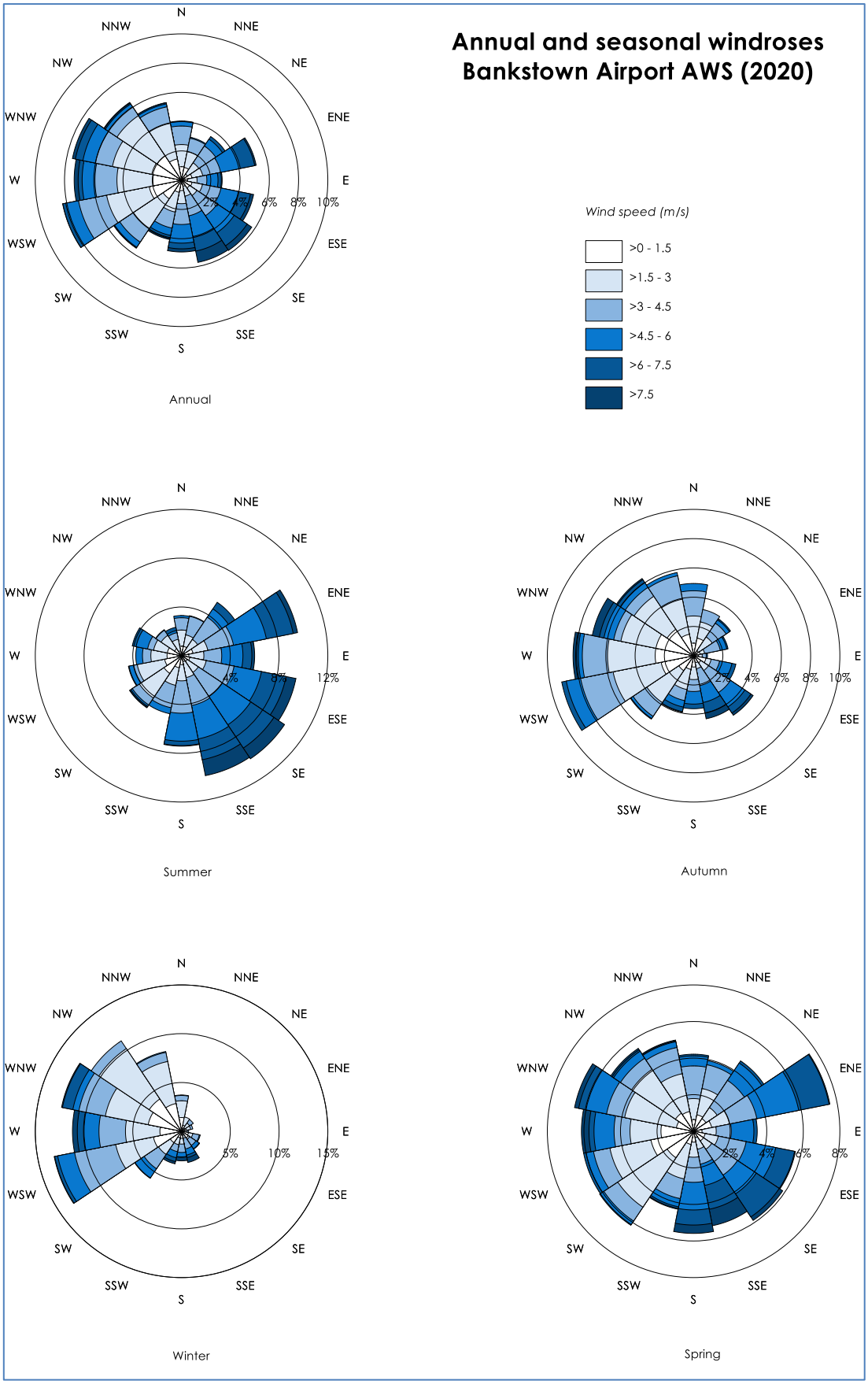

Figure 5-2 : Annual and seasonal windroses – Bankstown Airport AWS (2020)

5.3 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 monitors operated by the NSW DCCEEW at Parramatta North and Prospect were used to quantify the existing background level for the assessed pollutants at the Project site. The Parramatta North and Prospect monitoring sites are located approximately 3.3km north-northwest and 9.1km west-northwest, respectively.

5.3.1 $PM_{2.5}$ monitoring

A summary of the available $PM_{2.5}$ data for the DCCEEW monitoring stations from 2018 to 2023 is presented in **Table 5-2** and **Figure 5-3**. 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 5-2** indicates that the annual average $PM_{2.5}$ concentrations at all monitoring stations were above the relevant criterion of 8µg/m^3 in 2018, 2019 and 2020.

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 2023.

It is noted that there was a significant increase in the frequency of exceedances of the 24-hour average $PM_{2.5}$ criterion in the 2019/ 2020 summer, predominately due to smoke associated with the widespread bushfires occurring at this time (refer to **Figure 5-3**). The results in 2018 appears to be influenced by dry, drought conditions which lead to more dust in the air.

In 2020, there were several days where the Sydney region was impacted by smoke from bushfires and are considered to be exceptional event days and are not representative of the underlying background level. As a result, the adopted background levels used to assess cumulative impacts for $PM_{2.5}$ are based on excluding measurements recorded as extraordinary event days and discussed further in **Section 4.3.3**.

Table 5-2: Summary of $PM_{2.5}$ levels from monitoring stations (µg/m^3)

Year	Parramatta North	Prospect	Criterion
	Annual average		
2018	**9.2**	**8.5**	**8**
2019	**10.5**	**11.9**	**8**
2020	**8.2**	**8.6**	**8**
2021	6.6	6.9	**8**
2022	5.2	5.3	**8**
2023	6.6	7.4	**8**
Year	**Maximum 24-hour average**		**Criterion**
2018	**42.1**	**47.5**	**25**
2019	**130.1**	**134.1**	**25**
2020	**72.9**	**70.8**	**25**
2021	**27.4**	**37.3**	**25**
2022	16.9	18.2	**25**
2023	24.0	29.6	**25**

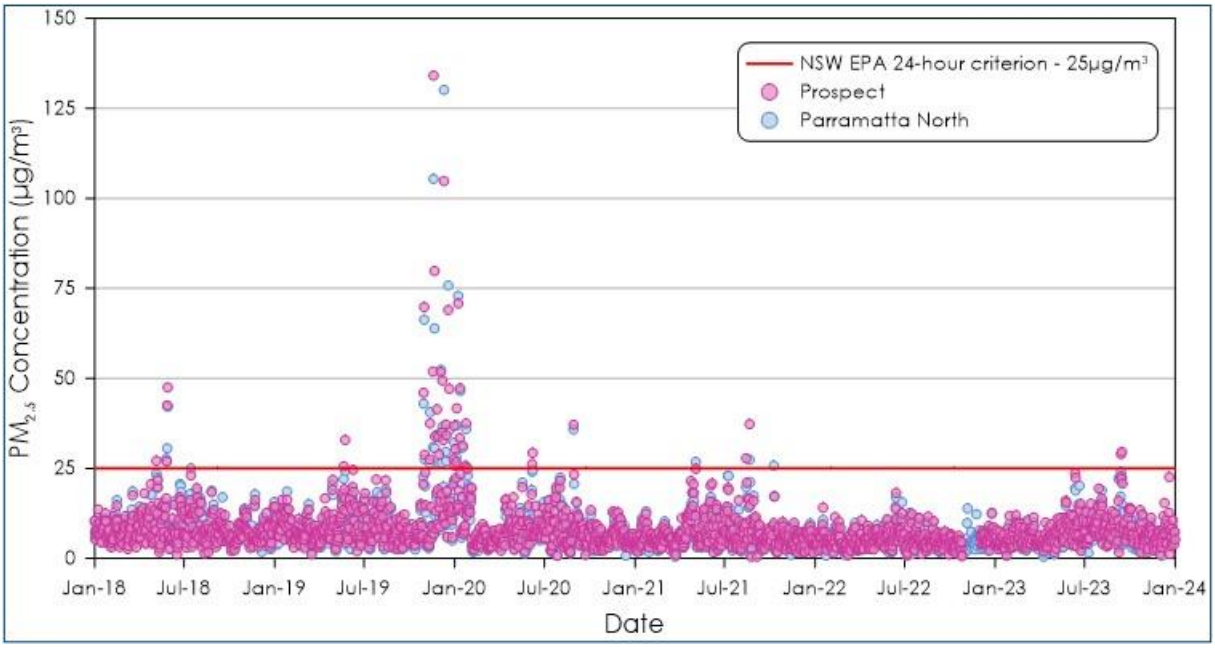

Figure 5-3: 24-hour average $PM_{2.5}$ concentrations (ug/m³)

5.3.2 NO_2 monitoring

A summary of the available NO_2 data for the DCCEEW monitoring stations from 2018 to 2023 is presented in **Table 5-3** and **Figure 5-4**.

The data in **Table 5-3** 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 all stations for the period reviewed. The normal seasonal variation can be seen in **Figure 5-4** with NO_2 levels increasing during the colder months and increasing during the warmer months. The levels are higher during the 2018 and 2019 period which was characterised by drought and bushfires.

Table 5-3: Summary of NO_2 levels from monitoring stations (µg/m³)

Year	Parramatta North	Prospect	Criterion
	Annual average		
2018	22.6	18.5	**31**
2019	20.5	18.5	**31**
2020	14.4	14.4	**31**
2021	14.4	14.4	**31**
2022	14.4	12.3	**31**
2023	16.4	16.4	**31**
Year	**Maximum 1-hour average**		**Criterion**
2018	131.2	104.6	**164**
2019	143.5	100.5	**164**
2020	75.9	88.2	**164**
2021	96.4	88.2	**164**
2022	69.7	86.1	**164**
2023	94.3	100.5	**164**

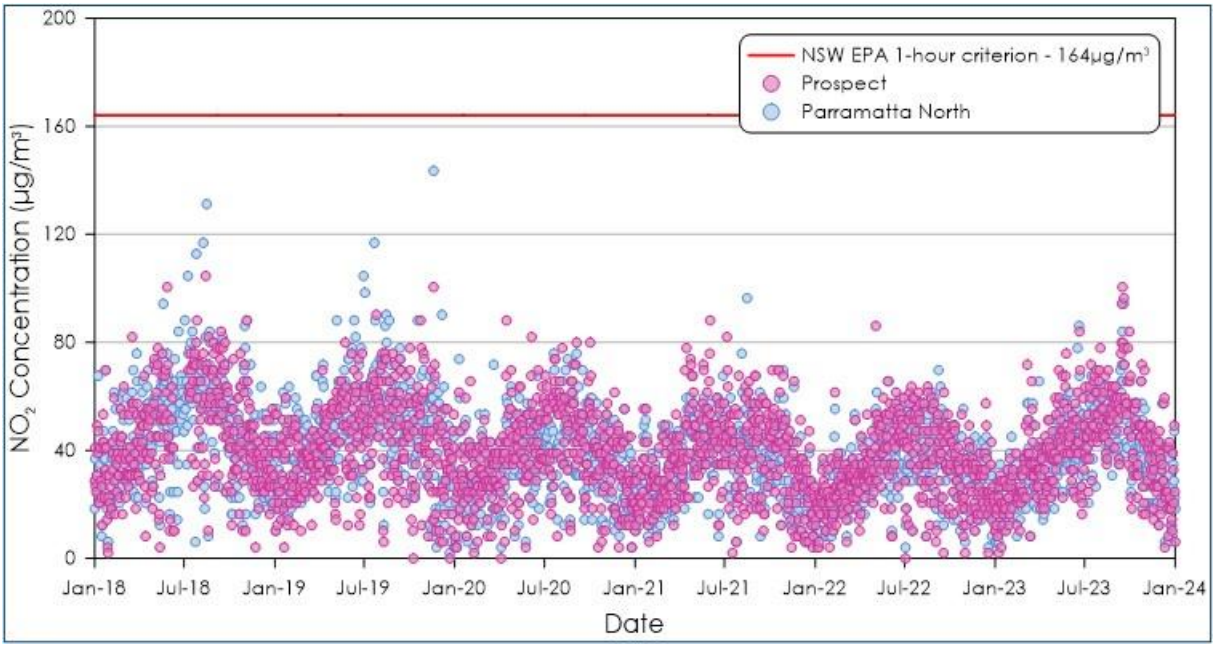

Figure 5-4: 1-hour daily maximum NO_2 concentrations (ug/m³)

5.3.3 Estimated background levels

As outlined above, there are no readily available site-specific monitoring data, and therefore the background air quality levels from the closest DCCEEW monitor at Parramatta North were used to represent the background levels for the Project.

The data collected during the 2020 calendar period, which correspond to the period of representative meteorological data used in the modelling has been applied. For the background $PM_{2.5}$ annual average, the measured levels are above the applicable criterion of 8µg/m³ with a level of 8.2µg/m³ and applying this level in an assessment would result in an exceedance regardless of the contribution of the modelled sources. As such, the exceptional event days during this period have been excluded to calculate an $PM_{2.5}$ annual average background level of 7.1µg/m³. The calculated annual average is considered representative and noting that it is higher than more recent periods, i.e. 2021 and 2022, which were significantly affected by bushfires.

The background air quality levels applied in this assessment are summarised in **Table 5-4**.

Table 5-4: Summary of background levels

Pollutant	Background level	Units
24-hour average $PM_{2.5}$	Daily varying	µg/m³
Annual average $PM_{2.5}$	7.1*	µg/m³
1-hour average NO_2	75.9	µg/m³
Annual average NO_2	14.4	µg/m³

*Excluding extraordinary event days

6 DISPERSION MODELLING APPROACH

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**) and consideration of the Department of Planning's Development Near Rail Corridors and Busy Roads – Interim Guideline (**NSW Department of Planning, 2008**).

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.

6.2 Meteorological modelling

The centre of analysis for the WRF modelling used is 315198mE and 6255010mN. The simulation involved an outer grid of 450km with 15km 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 location representative of the Project site. The windroses are generally comparable to those at Bankstown Airport AWS (see **Figure 5-2**), 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.

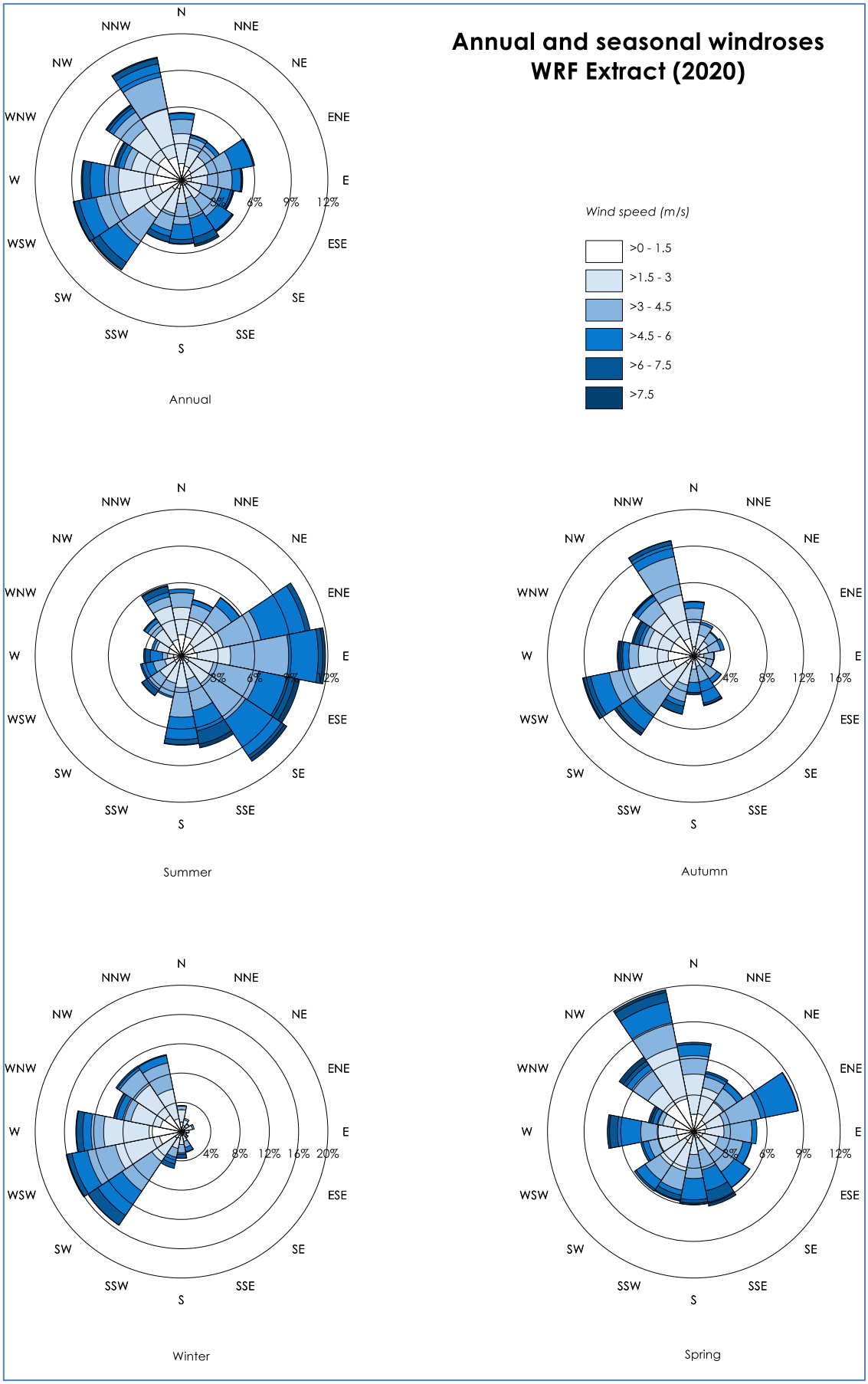

Figure 6-1: Annual and seasonal windroses from WRF extract

6.3 Emission estimation

Traffic numbers from the *Air Quality Impact Study for Mixed Use Development at 1 Crescent Street, Holroyd* (**Todoroski Air Sciences, 2015**) and *the SSD-70283710: 1 Crescent Street, Holroyd Transport Impact Assessment* (**TTPP, 2024**) were reviewed to confirm their suitability. It is noted that the traffic numbers in both reports account for future traffic volumes.

NSW toll road traffic data is published periodically by Transurban at each toll point for all major roads (**Transurban, 2023**) in 15-minute increments for each quarter. The data from the Church Street entry and exit toll point have been reviewed to estimate the potential traffic volume travelling on the M4 past the Project site and area compared with the traffic numbers used in **Todoroski Air Sciences** (**2015**).

The AADT numbers are summarised in **Table 6-1**.

Table 6-1: Comparison of traffic volumes for M4 (AADT)

Location	2022 calendar year	Modelled in previous assessment*
M4 (Eastbound)	46,690	61,902
M4 (Westbound)	49,254	61,915

***Todoroski Air Sciences (2015)**

The diurnal traffic volumes modelled in **Todoroski Air Sciences** (**2015**) are greater than the actual traffic volumes for the M4 Church Street entry/ exit toll point in 2022. Therefore, the traffic volumes modelled in **Todoroski Air Sciences** (**2015**) are considered to still be representative of potential future traffic volumes and have been used in this assessment. The same road sections have also been modelled in this assessment.

Traffic numbers in **TTPP (2024)** were compared with the traffic numbers in **Todoroski Air Sciences** (**2015**) for similar road sections and found to be less conservative. Therefore, for the purpose of this assessment the traffic volumes in **Todoroski Air Sciences** (**2015**) have been used.

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 6-2 outlines the estimated emission rates for free-flow traffic for each assessed roadway.

Table 6-2: Free flow emissions factors (g/vehicle/km)

Road	Road type	Grade (%)	NOx	$PM_{2.5}$
Walpole	Arterial	2.6	0.89	0.05
		-2.6	0.4	0.03
Crescent	Arterial	1.0	0.72	0.03
		-1.0	0.51	0.03
Woodville	Commercial Arterial	1.9	1.00	0.05
		-1.9	0.51	0.03
Church	Commercial Arterial	3.3	1.14	0.05
		-3.3	0.4	0.03
Parramatta	Commercial Arterial	0.2	0.76	0.03
		-0.2	0.71	0.03
M4 Ramp	Highway/ Freeway	1.3	0.71	0.03
M4	Highway/ Freeway	1.2	1.34	0.05
		-1.2	0.72	0.03

Idling emission rates for vehicles are 7.29 g/h/vehicle for NO_X and 0.24 g/h/vehicles for $PM_{2.5}$.

6.4 Assessment locations

Modelling predictions are assessed in detail at specific assessment locations representative of the open spaces and future residences. The assessment locations are shown in **Figure 6-2**.

Outlines of the residential building at the site are shown and colour coded for the storey. Below the residential levels on the Eastern buildings, there is only commercial space and carparking. **Table 6-3** provides a summary of the discrete receptors considered in this assessment.

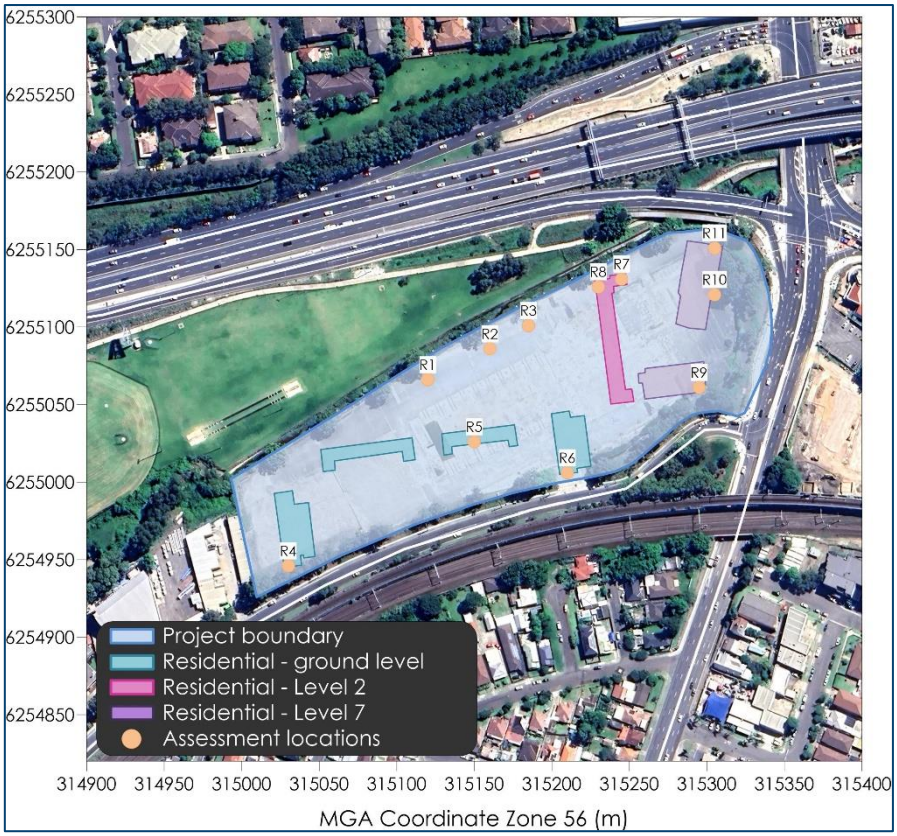

Figure 6-2: Assessment locations

Table 6-3: Summary of discrete receptors

Receptor ID	X coordinate (m)	Y coordinate (m)	Height above ground level (m)	Description
R1	315120	6255066	0	Ground Floor - outdoor area
R2	315160	6255086	0	Ground Floor - outdoor area
R3	315185	6255101	0	Ground Floor - outdoor area
R4	315030	6254946	0	Ground Floor - residential
R5	315150	6255026	0	Ground Floor - residential
R6	315210	6255006	0	Ground Floor - residential
R7	315245	6255131	10.5	Level 2 - residential
R8	315230	6255126	10.5	Level 2 - residential
R9	315295	6255061	27.7	Level 7 - residential
R10	315305	6255121	27.7	Level 7 - residential
R11	315305	6255151	27.7	Level 7 - residential

7 DISPERSION MODELLING RESULTS

Table 7-1 presents the predicted incremental and cumulative pollutant impacts at the Project site.

The results in **Table 7-1** indicate the predicted cumulative annual average $PM_{2.5}$ and the 1-hour and annual average NO_2 levels do not exceed the relevant criteria. The predicted cumulative 24-hour average $PM_{2.5}$ results require a more detailed contemporaneous assessment which is set out in the next section.

The predicted cumulative results indicate that the assessed location is predicted to experience levels below the applicable EPA criteria. 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 7-1: Predicted incremental and cumulative impacts at the Project (µg/m³)

	Maximum incremental impact (µg/m³)				Cumulative impact (µg/m³)		
Receptor ID	**24-hour average $PM_{2.5}$**	**Annual average $PM_{2.5}$**	**1-hour average NO_2**	**Annual average NO_2**	**Annual average $PM_{2.5}$**	**1-hour average NO_2**	**Annual average NO_2**
Criteria					**8**	**164**	**31**
R1	1.0	0.4	36.6	3.4	7.5	112.5	17.8
R2	1.1	0.4	39.2	3.8	7.5	115.1	18.2
R3	1.2	0.5	42.0	4.2	7.6	117.9	18.6
R4	0.6	0.3	25.4	2.2	7.4	101.3	16.6
R5	0.8	0.3	29.3	2.8	7.4	105.2	17.2
R6	0.8	0.4	32.2	3.2	7.5	108.1	17.6
R7	1.2	0.5	44.8	4.6	7.6	120.7	19.0
R8	1.2	0.5	44.1	4.4	7.6	120.0	18.8
R9	0.7	0.3	26.1	2.3	7.4	102.0	16.7
R10	0.7	0.3	22.0	2.6	7.4	97.9	17.0
R11	0.8	0.3	22.1	2.6	7.4	98.0	17.0

Figure 7-1 to **Figure 7-12** present pollutant concentration isopleths showing the spatial distribution of the predicted incremental impacts associated with the assessed roadways for each pollutant at different levels.

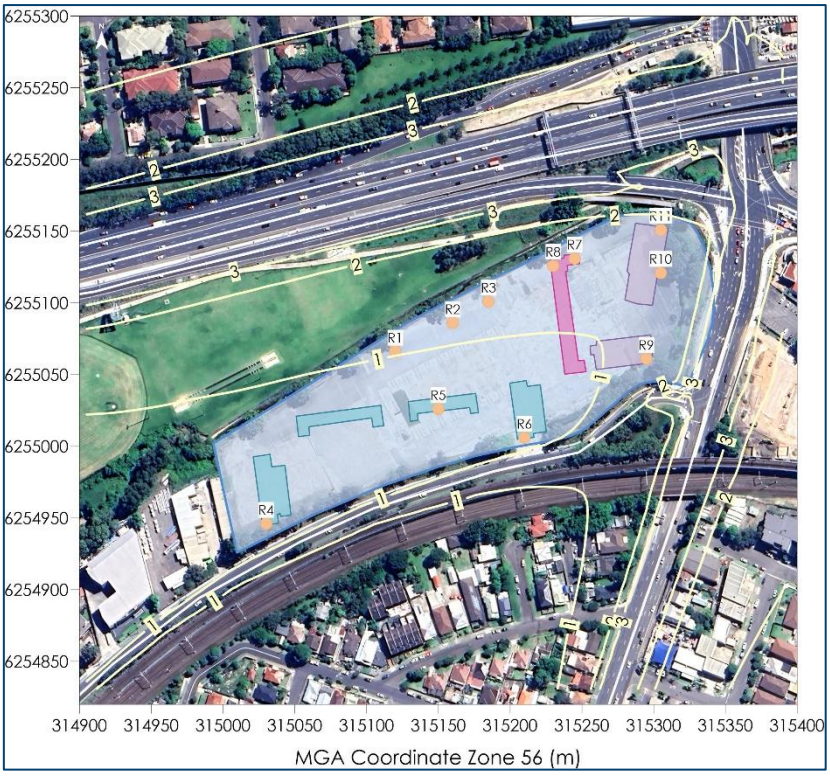

Figure 7-1: Predicted incremental 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Ground floor

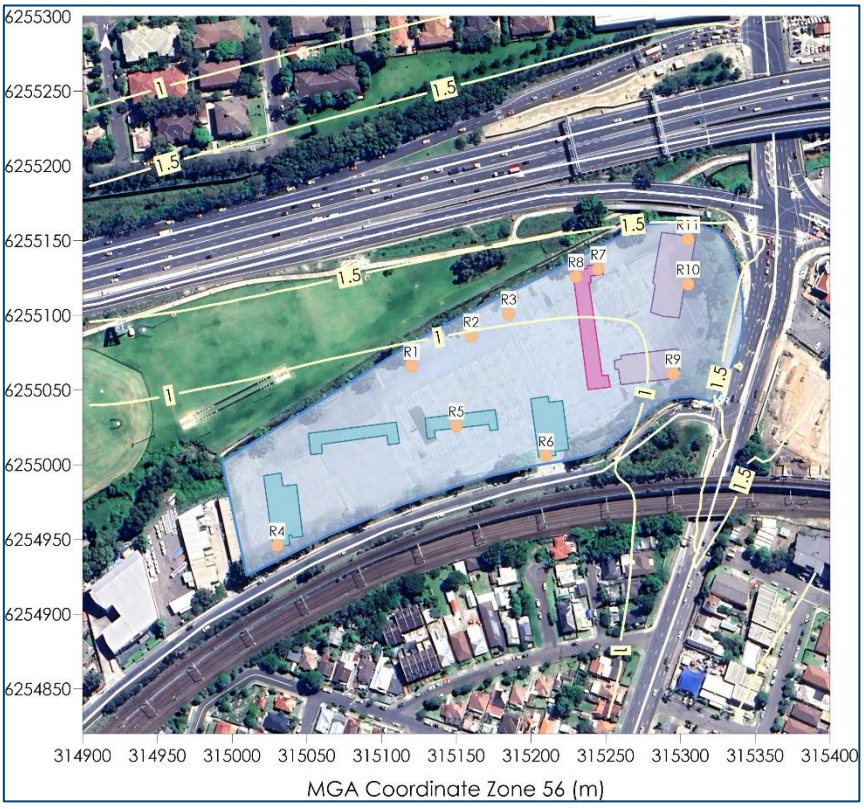

Figure 7-2: Predicted incremental 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Level 2

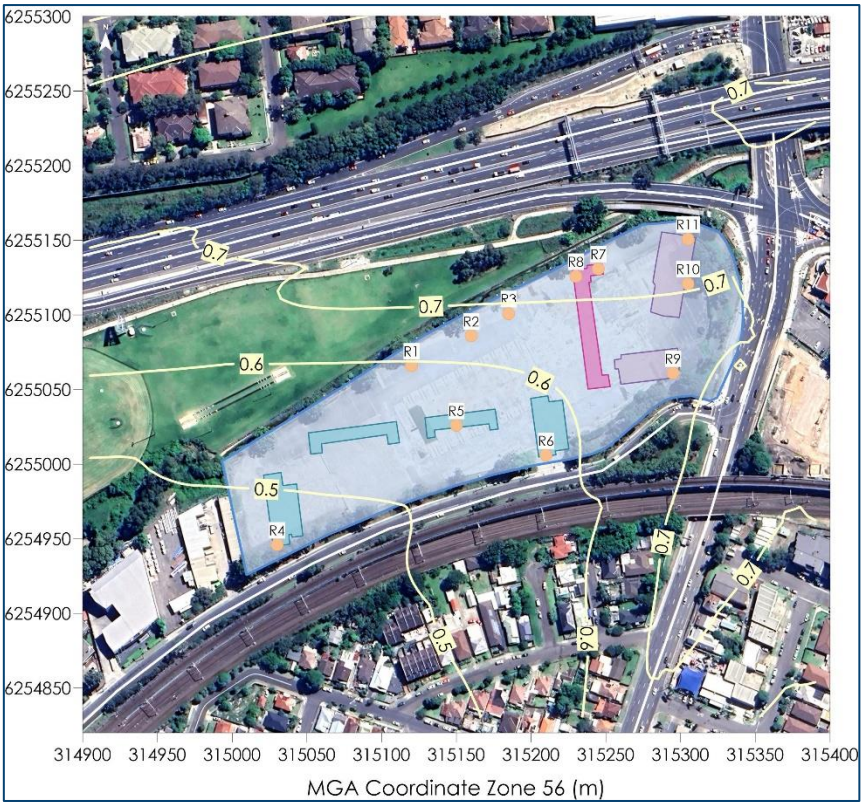

Figure 7-3: Predicted incremental 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Level 7

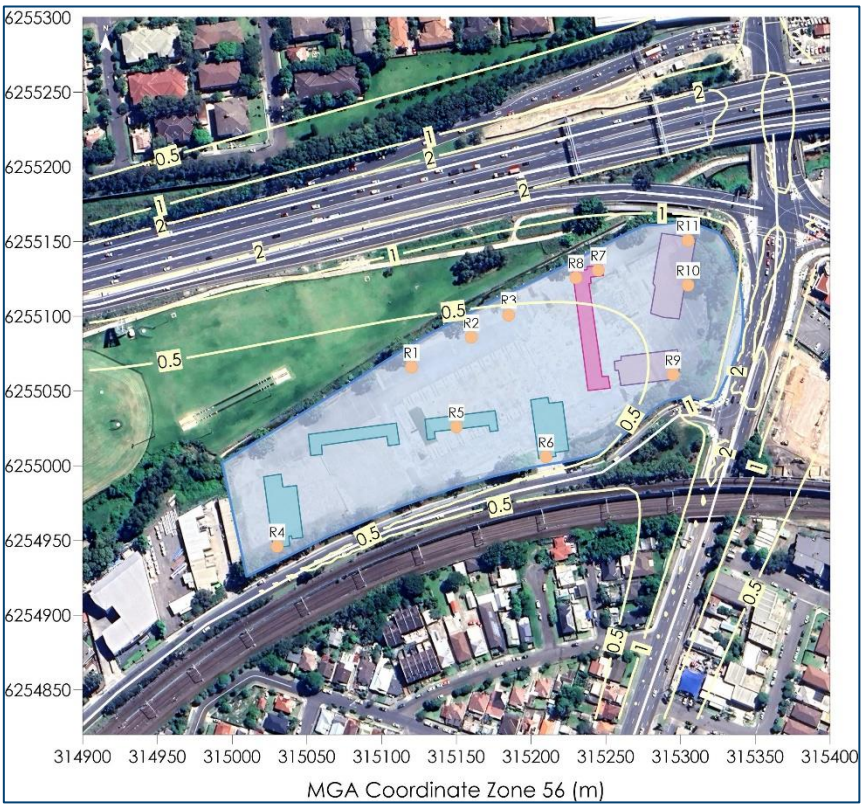

Figure 7-4: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Ground floor

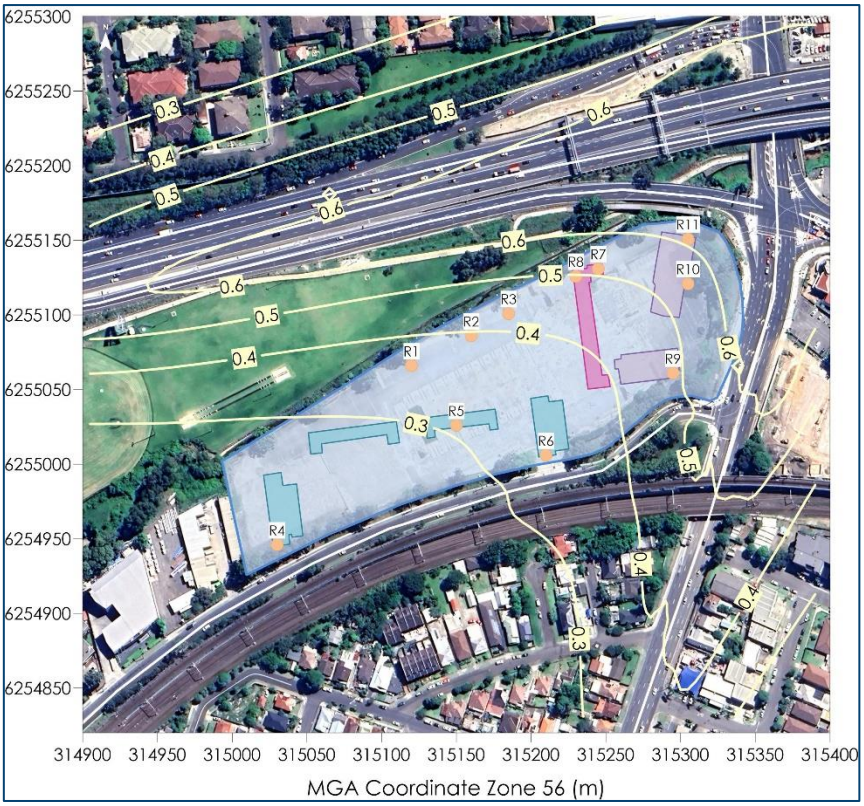

Figure 7-5: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Level 2

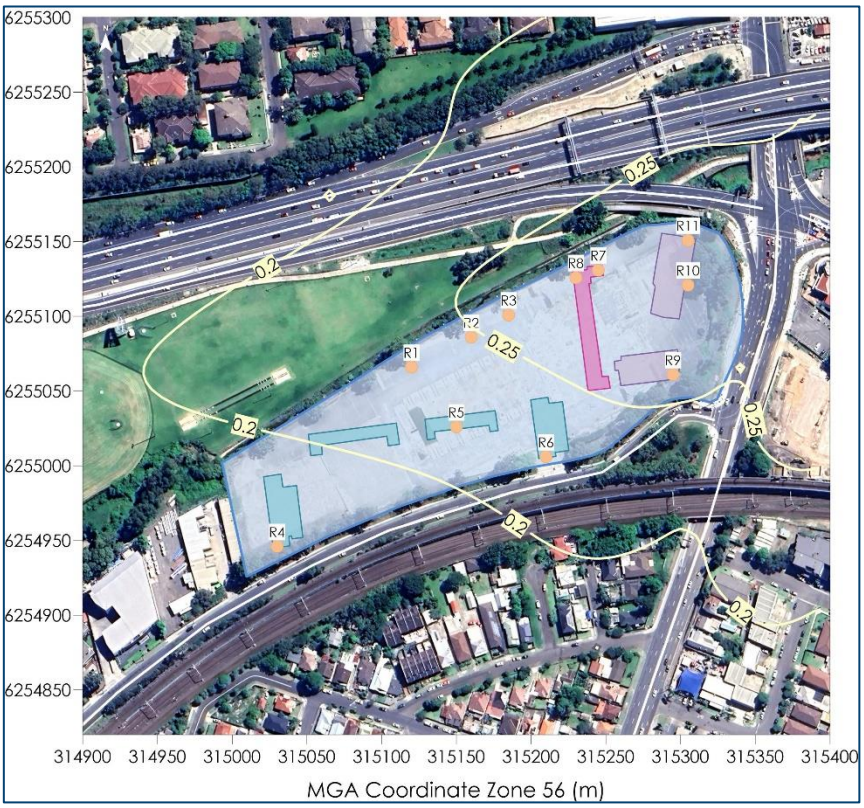

Figure 7-6: Predicted incremental annual average $PM_{2.5}$ concentrations (µg/m³) – Level 7

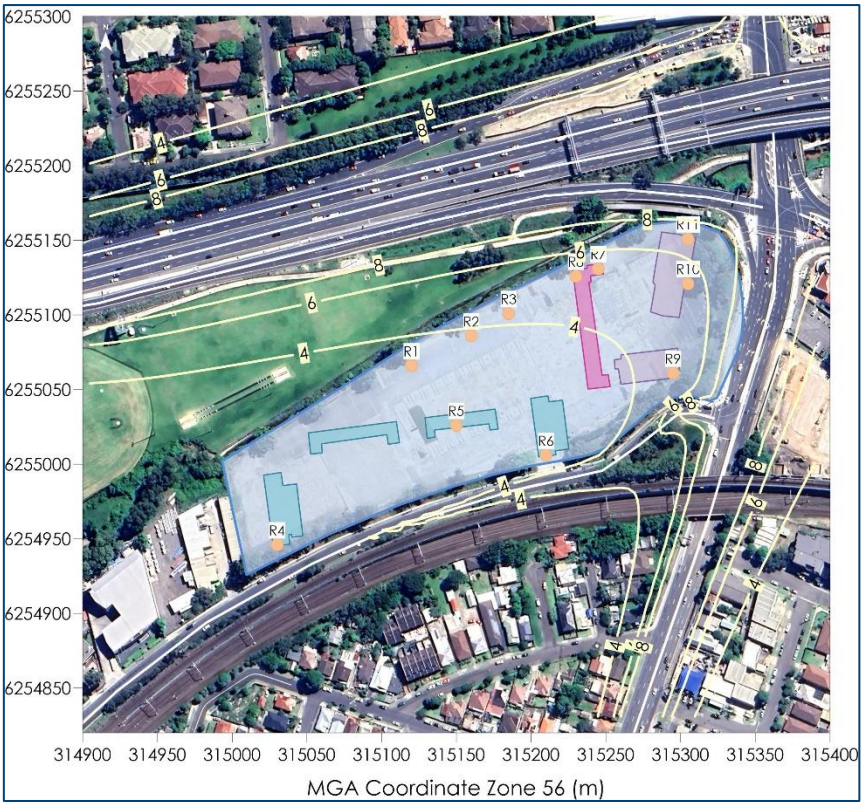

Figure 7-7: Predicted incremental annual average NO_2 concentrations (µg/m³) – Ground floor

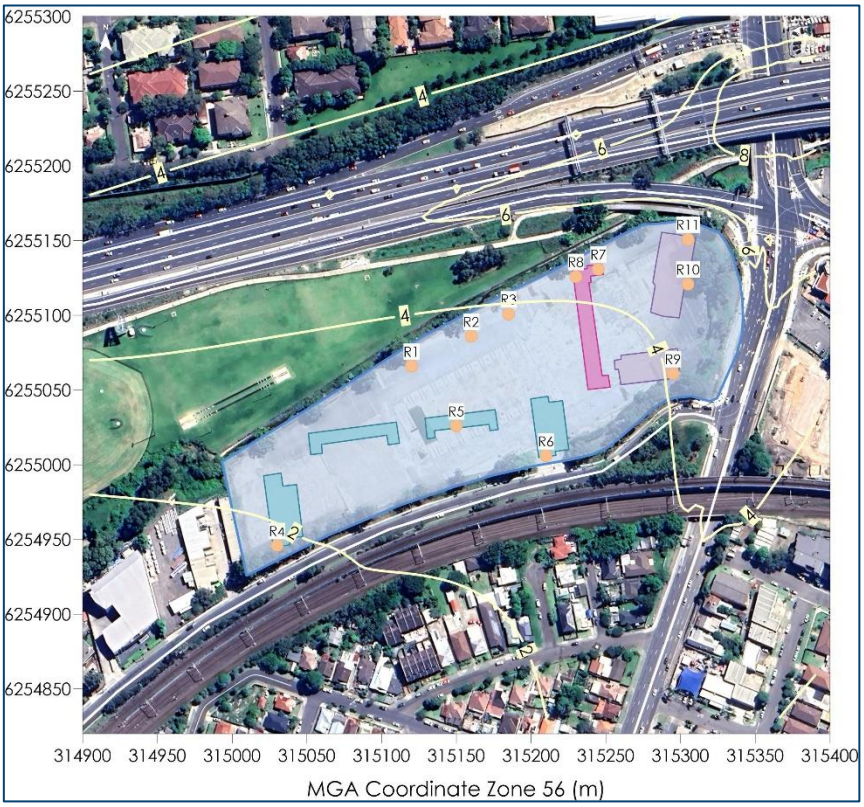

Figure 7-8: Predicted incremental annual average NO_2 concentrations (µg/m³) – Level 2

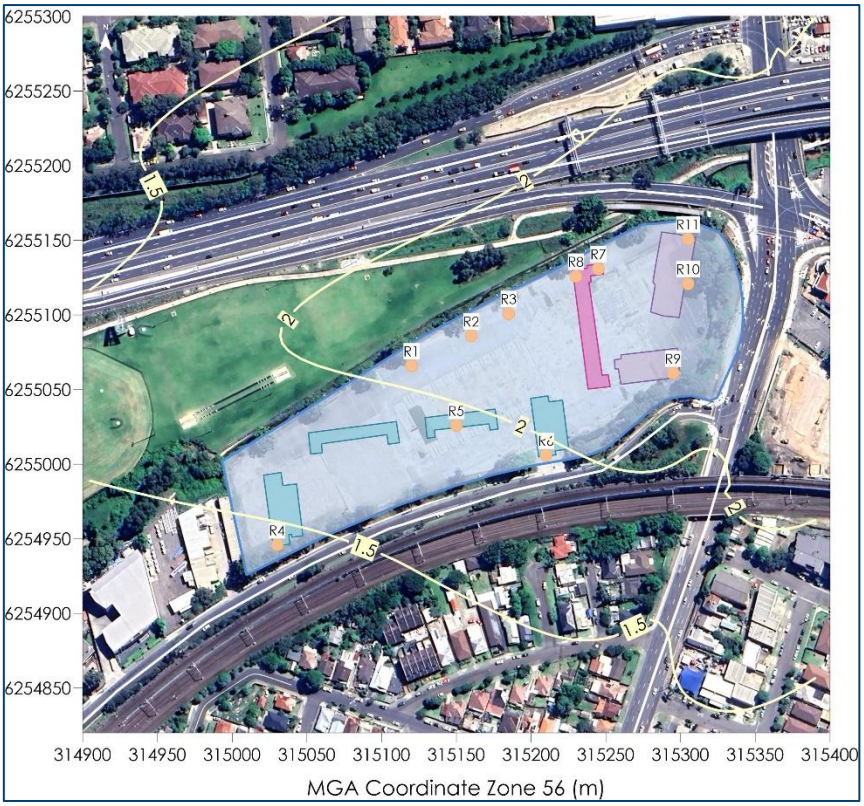

Figure 7-9: Predicted incremental annual average NO_2 concentrations (µg/m³) – Level 7

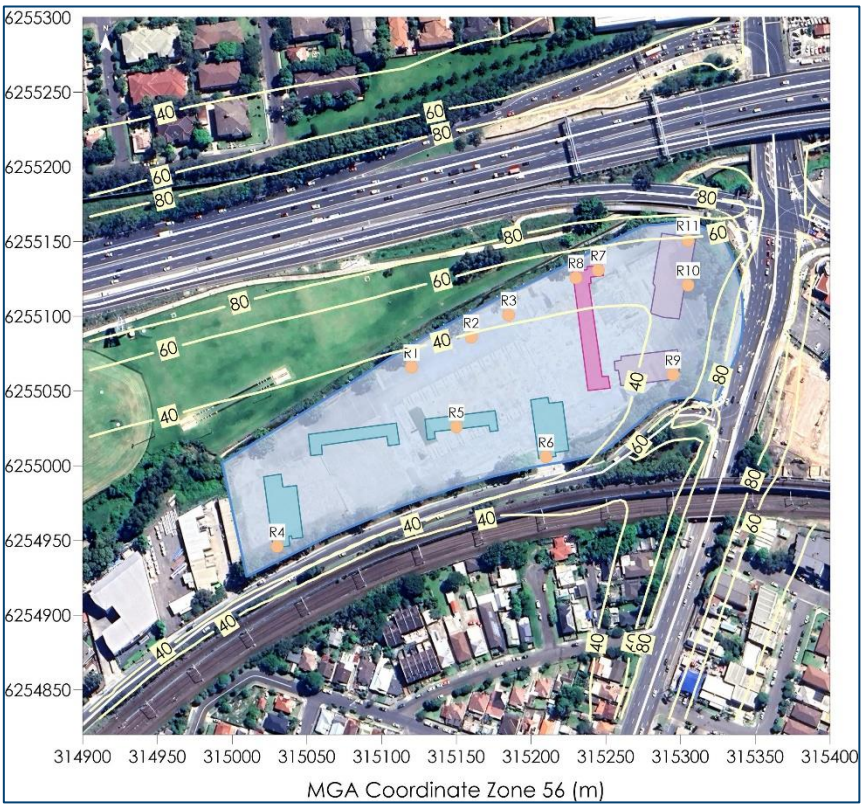

Figure 7-10: Predicted incremental 1-hour average NO_2 concentrations (µg/m³) – Ground floor

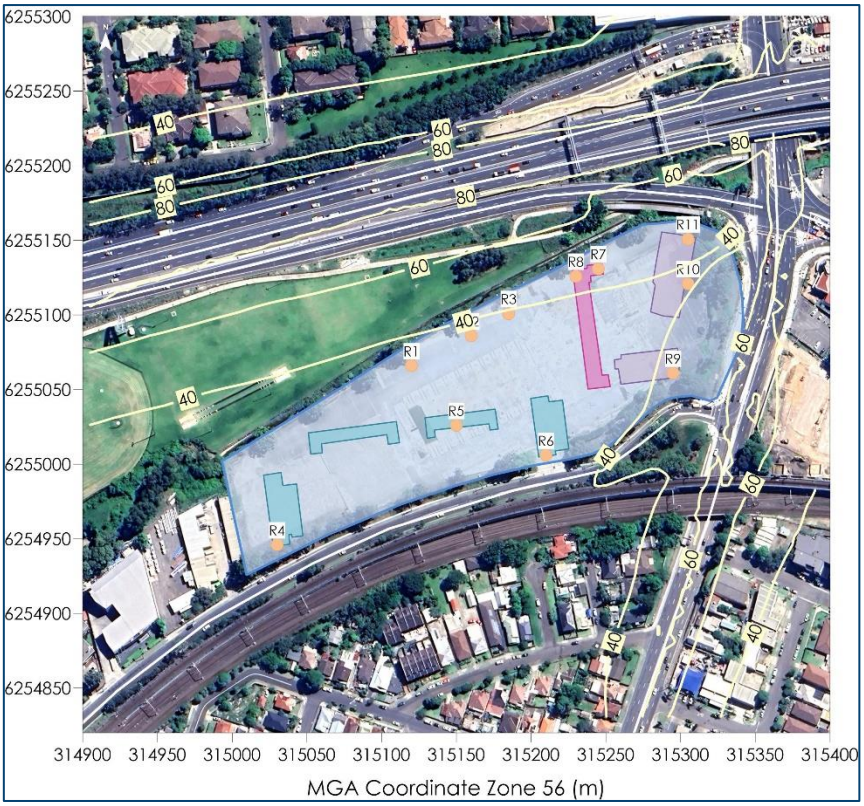

Figure 7-11: Predicted incremental 1-hour average NO_2 concentrations (µg/m³) – Level 2

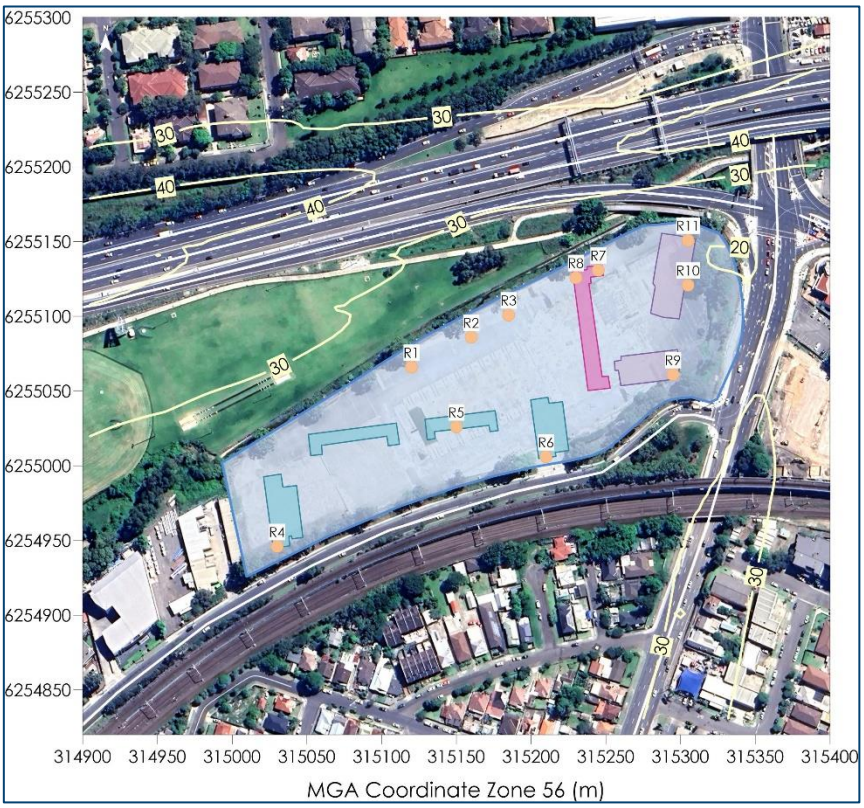

Figure 7-12: Predicted incremental 1-hour average NO_2 concentrations (µg/m³) – Level 7

7.1 Assessment of Cumulative 24-hour average $PM_{2.5}$ Concentrations

When assessing the cumulative 24-hour average impacts based on model predictions an assessment of cumulative 24-hour average $PM_{2.5}$ impacts was undertaken in accordance with the requirements for a contemporaneous assessment per Section 11.2 of the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (**NSW EPA**, **2022**).

As shown in **Section 5.3.1**, maximum 24-hour average background levels of $PM_{2.5}$ have at times reached the 24-hour average criteria levels. Due to this, the "Level 1 assessment – Maximum impact" would not be appropriate for assessing the potential cumulative 24-hour average impacts, given that the background levels can already be above criteria on some days. In such situations, the "Level 2 assessment - Contemporaneous impact and background approach" was applied to assess potential impacts for $PM_{2.5}$.

In simple terms, the Level 2 contemporaneous assessment involves matching one year of 24-hour average ambient air quality monitoring data with the corresponding road traffic level predicted using the same day's weather data to account for the spatial and temporal variation in background levels on each day.

The results indicate that the addition of road traffic emissions to the background levels does not increase the number of days above criteria at R2, R5 and R11 (noting that bushfires and other extraordinary events regularly exceed criteria). There were days above the 24-hour average criterion at R7 for $PM_{2.5}$ on the 6 and 7 June 2020, when the state experienced successive temperature inversions resulting in a widespread winter wood smoke event resulting in multiple exceedances of the daily $PM_{2.5}$ standard across NSW (**DPIE, 2021**). As such, these days are considered to be extraordinary events which are not representative of the prevailing background levels.

Table 7-2 provides a summary of the findings from the Level 2 assessments for the assessment locations representative of residential areas for 24-hour average $PM_{2.5}$. The details of the contemporaneous assessment are provided in **Appendix B**.

Table 7-2: NSW EPA contemporaneous assessment - maximum number of additional days above 24-hour average criterion (extraordinary events such as bushfires etc removed)

Receptor	$PM_{2.5}$
R2	0
R5	0
R7	0
R11	0

Time series plot of the predicted cumulative 24-hour average $PM_{2.5}$ concentrations for Receptor R2, R5, R7 and R11 are presented in **Figure 7-13** and **Figure 7-14**. The orange bars in the figures represent the contribution from the modelled traffic emissions and the blue bars represent the applied background levels. It is clear from the figures that traffic emissions have a relatively small influence at the assessed receptor locations, indicating suitable setbacks from these sources of pollution.

Figure 7-13: 24-hour cumulative $PM_{2.5}$ concentrations for R2 and R5

Figure 7-14: 24-hour cumulative $PM_{2.5}$ concentrations for R7 and R11

8 SUMMARY AND CONCLUSIONS

This study has assessed the potential for air quality impacts associated with traffic emissions to impact upon the proposed mixed-use development at 1 Crescent Street, Holroyd.

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.

The assessment also demonstrates that the Project site and design is suitable and that there is a sufficient setback to avoid any unacceptable levels of air quality. The design has also specifically maximised the setback from the motorway of all key receptor areas per best practice.

Thus, no unacceptable adverse impacts from the construction and operation of the proposed development are expected, and no mitigation measures are required.

9 REFERENCES

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

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TTPP (2024)

"SSD-70283710: 1 Cresent Street, Holroyd Transport Impact Assessment", prepared for Tiberius (Holroyd) Pty ltd (ABN 61 061 131 959) atf the Holroyd Unit Trust (ABN 42 891 308 354) by The Transport Planning Partnership [TTPP], October 2024.

Appendix A

Selection of Meteorological Year

Selection of meteorological year

A statistical analysis of the latest seven contiguous years of meteorological data compared with the long-term climate data from the BoM weather station with suitable available data, Bankstown Airport AWS, is presented in **Table A-1**.

The standard deviation of the latest seven years of meteorological data spanning 2016 to 2022 was analysed against the available measured wind speed, temperature, and relative humidity. The analysis indicates that the 2020, 2021 and 2022 datasets are closest to the mean for wind speed, 2021 and 2022 area closest to the mean for temperature and 2020 is the closest to the mean for relative humidity. On the basis of a score weighting analysis, 2020 was found to be most representative.

Table A-1: Statistical analysis results for Bankstown Airport AWS

Year	Wind speed	Temperature	Relative humidity	Score
2016	0.5	0.9	5.4	6.8
2017	0.5	0.9	4.8	6.2
2018	0.6	0.9	6.1	7.6
2019	0.4	0.9	5.1	6.4
2020	0.3	0.6	2.7	3.6
2021	0.3	0.5	3.7	4.4
2022	0.3	0.5	5.2	6.0

Figure A-1 shows the frequency distributions for wind speed, wind direction, temperature and relative humidity for the 2020 year compared with the mean of the 2016 to 2022 data set. The 2020 data appear to be reasonably well aligned with the mean data.

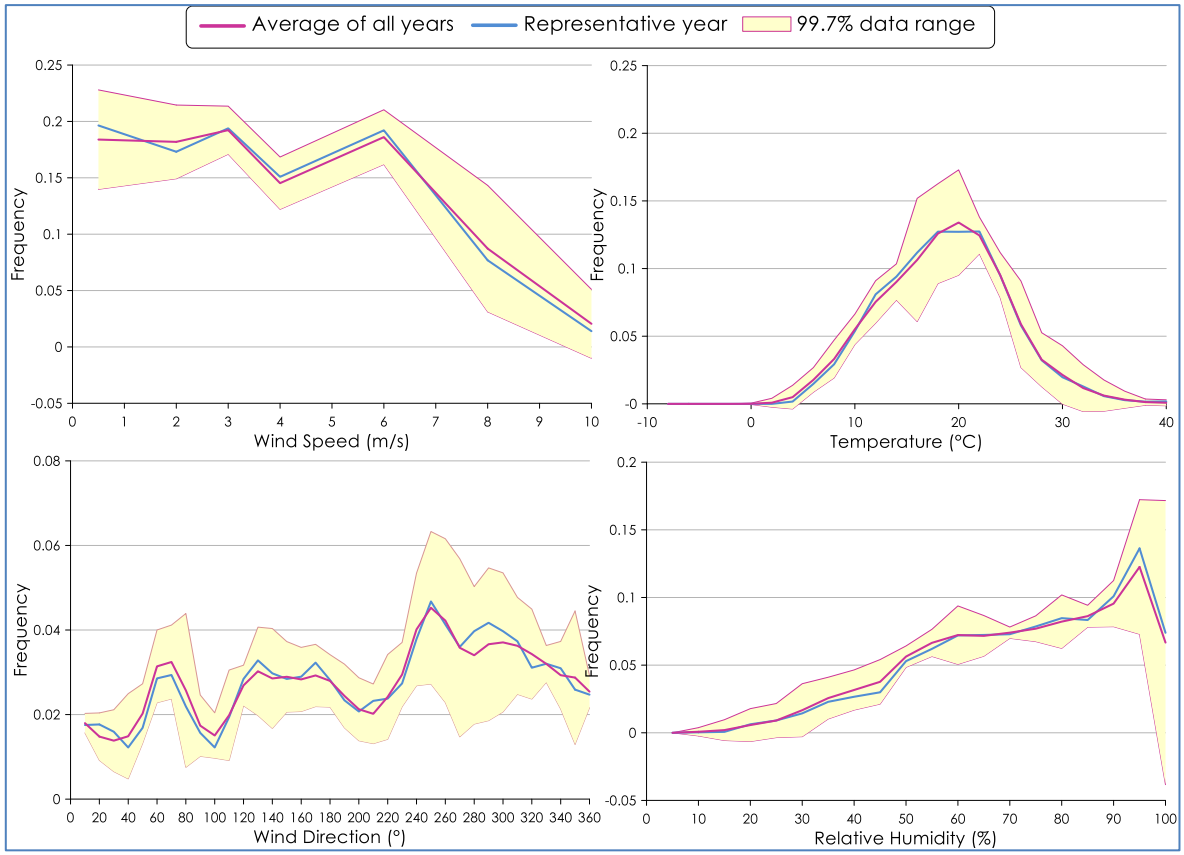

Figure A-1: Frequency distributions for wind speed, wind direction, temperature and relative humidity

Appendix B

Contemporaneous 24-hour $PM_{2.5}$ analysis

Further detail regarding 24-hour average $PM_{2.5}$ analysis

The analysis below provides a cumulative 24-hour $PM_{2.5}$ impact assessment in accordance with the NSW EPA Approved Methods; refer to the worked example on Page 50 to 51 of the Approved Methods.

The background level is the ambient level at the DCCEEW Parramatta North monitoring station.

The increment is the predicted level to occur at the assessed receptor due to the road traffic.

The total is the sum of the background level and the predicted level. The totals may have minor discrepancies due to rounding.

The left half of the table examines the cumulative impact during the periods of highest background levels and the right half of the table examines the cumulative impact during the periods of highest contribution from the roadways.

Exceptional event days as documented in the *New South Wales Annual Compliance Report 2020* (**DPIE, 2021**) have been included in the tables.

The green shading represents days ranked per the highest background level but below the criteria.

The blue shading represents days ranked per the highest predicted increment level but below the criteria.

The orange shading represents days where the measured background level is already over the criteria.

Any value above the $PM_{2.5}$ criterion of 25µg/m^3 is in **bold red.**

Table B-1: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – R2

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/01/2020	**72.9***	0.1	**73.0**				
12/01/2020	**46.5***	0.2	**46.7**				
5/01/2020	**37***	0.1	**37.1**				
24/01/2020	**35.9**	0.3	**36.2**				
29/08/2020	**35.8**	0.8	**36.6**				
17/01/2020	**30.8***	0.0	**30.8**				
11/01/2020	**30.7***	0.1	**30.8**				
4/01/2020	**28.1***	0.4	**28.5**				
2/01/2020	**27.3***	0.2	**27.5**				
23/01/2020	**25.8**	0.3	**26.1**				
7/06/2020	24.6*	0.2	24.8	13/06/2020	ND	1.0	1.0
6/06/2020	24.1*	0.9	25.0	19/06/2020	ND	1.0	1.0
27/01/2020	23	0.4	23.4	6/05/2020	9.2	0.9	10.1
2/08/2020	22.5	0.8	23.3	11/07/2020	13.1	0.9	14.0
3/01/2020	21.3*	0.5	21.8	10/06/2020	8.2	0.9	9.1
1/01/2020	21.1*	0.2	21.3	12/08/2020	8.9	0.9	9.8
17/05/2020	21.1	0.1	21.2	30/06/2020	15.7	0.9	16.6
13/01/2020	20.7*	0.4	21.1	6/06/2020	24.1*	0.9	25.0
30/08/2020	20.7	0.6	21.3	15/04/2020	14.1	0.9	15.0
29/01/2020	20.1	0.2	20.3	27/05/2020	6.3	0.9	7.2

*Exceptional event day, ND = no data

Table B-2: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – R5

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/01/2020	**72.9***	0.1	**73.0**				
12/01/2020	**46.5***	0.2	**46.7**				
5/01/2020	**37***	0.1	**37.1**				
24/01/2020	**35.9**	0.3	**36.2**				
29/08/2020	**35.8**	0.6	**36.4**				
17/01/2020	**30.8***	0.1	**30.9**				
11/01/2020	**30.7***	0.2	**30.9**				
4/01/2020	**28.1***	0.3	**28.4**				
2/01/2020	**27.3***	0.3	**27.6**				
23/01/2020	**25.8**	0.2	**26.0**				
7/06/2020	24.6*	0.2	24.8	13/06/2020	ND	0.8	0.8
6/06/2020	24.1*	0.6	24.7	19/06/2020	ND	0.7	0.7
27/01/2020	23	0.4	23.4	27/05/2020	6.3	0.7	7.0
2/08/2020	22.5	0.7	23.2	6/05/2020	9.2	0.7	9.9
3/01/2020	21.3*	0.5	21.8	12/08/2020	8.9	0.7	9.6
1/01/2020	21.1*	0.2	21.3	14/08/2020	12.5	0.7	13.2
17/05/2020	21.1	0.2	21.3	11/07/2020	13.1	0.7	13.8
13/01/2020	20.7*	0.4	21.1	2/08/2020	22.5	0.7	23.2
30/08/2020	20.7	0.4	21.1	15/04/2020	14.1	0.7	14.8
29/01/2020	20.1	0.2	20.3	30/06/2020	15.7	0.7	16.4

*Exceptional event day, ND = no data

Table B-3: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – R7

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/01/2020	**72.9***	0.2	**73.1**				
12/01/2020	**46.5***	0.2	**46.7**				
5/01/2020	**37***	0.2	**37.2**				
24/01/2020	**35.9**	0.4	**36.3**				
29/08/2020	**35.8**	1.0	**36.8**				
17/01/2020	**30.8***	0.1	**30.9**				
11/01/2020	**30.7***	0.2	**30.9**				
4/01/2020	**28.1***	0.5	**28.6**				
2/01/2020	**27.3***	0.4	**27.7**				
23/01/2020	**25.8**	0.3	**26.1**				
7/06/2020	24.6*	0.4	**25.0**	27/05/2020	6.3	1.2	7.5
6/06/2020	24.1*	1.2	**25.3**	11/07/2020	13.1	1.2	14.3
27/01/2020	23	0.5	23.5	13/06/2020		1.2	1.2
2/08/2020	22.5	1.1	23.6	6/05/2020	9.2	1.2	10.4
3/01/2020	21.3*	0.7	22.0	19/06/2020		1.2	1.2
1/01/2020	21.1*	0.3	21.4	6/06/2020	24.1*	1.2	**25.3**
17/05/2020	21.1	0.3	21.4	1/08/2020	16.4	1.2	17.6
13/01/2020	20.7*	0.6	21.3	30/06/2020	15.7	1.1	16.8
30/08/2020	20.7	0.7	21.4	10/06/2020	8.2	1.1	9.3
29/01/2020	20.1	0.3	20.4	14/04/2020	11.6	1.1	12.7

*Exceptional event day, ND = no data

Table B-4: Cumulative 24-hour average $PM_{2.5}$ concentration (µg/m³) – R11

Ranked by Highest to Lowest Background Concentration				Ranked by Highest to Lowest Predicted Incremental Concentration			
Date	Measured background level	Predicted increment	Total cumulative 24-hr average level	Date	Measured background level	Predicted increment	Total cumulative 24-hr average level
8/01/2020	**72.9***	0.2	**73.1**				
12/01/2020	**46.5***	0.1	**46.6**				
5/01/2020	**37***	0.1	**37.1**				
24/01/2020	**35.9**	0.3	**36.2**				
29/08/2020	**35.8**	0.5	**36.3**				
17/01/2020	**30.8***	0.2	**31.0**				
11/01/2020	**30.7***	0.1	**30.8**				
4/01/2020	**28.1***	0.1	**28.2**				
2/01/2020	**27.3***	0.2	**27.5**				
23/01/2020	**25.8**	0.1	**25.9**				
7/06/2020	24.6*	0.3	24.9	1/08/2020	16.4	0.8	17.2
6/06/2020	24.1*	0.6	24.7	27/05/2020	6.3	0.7	7.0
27/01/2020	23	0.4	23.4	2/08/2020	22.5	0.7	23.2
2/08/2020	22.5	0.7	23.2	12/07/2020	11.8	0.7	12.5
3/01/2020	21.3*	0.4	21.7	11/07/2020	13.1	0.6	13.7
1/01/2020	21.1*	0.2	21.3	13/05/2020	14	0.6	14.6
17/05/2020	21.1	0.3	21.4	14/04/2020	11.6	0.6	12.2
13/01/2020	20.7*	0.3	21.0	6/06/2020	24.1*	0.6	24.7
30/08/2020	20.7	0.3	21.0	13/08/2020	10.7	0.6	11.3
29/01/2020	20.1	0.2	20.3	6/05/2020	9.2	0.6	9.8

*Exceptional event day