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Commercial-in-Confidence

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Dear Gilead

Air Quality Study Requirements - Riverwood LAHC

1.0 Introduction

NSW Land and Housing Corporation (LAHC) has engaged AECOM to prepare an Air Quality Study to support the planning proposal for the Riverwood Estate State Significant Precinct (SSP). This report has been prepared to address the relevant Study Requirements for the Riverwood Estate SSP as issued by the Department of Planning, Industry and Environment (DPIE) dated December 2020.

2.0 Background

The Riverwood Renewal project provides an opportunity to revitalise the Riverwood social housing estate into an integrated mixed-use precinct that will deliver a mix of social and private dwellings. The revitalisation of the Riverwood Estate offers the government the opportunity to renew aging social housing whilst significantly improving this area, and the quality of life for residents.

AECOM and a consultant team have worked with LAHC to prepare a master plan for the redevelopment of the site that will replace the existing dwellings, provide for additional private dwellings, new streets and parks and community uses. The proposed master plan consists of approximately 3,900 social and private dwellings, buildings ranging between 3 and 12 storeys and local open spaces – Roosevelt Park and Play Street and neighbourhood parks.

3.0 Study Area

The Riverwood Estate SSP (the Study Area) is an area of 30ha and is located within the Canterbury Bankstown LGA. The Study Area contains a large area of government-owned land (16.7ha owned by LAHC) and is of state importance in achieving key government policy objectives, particularly renewing social housing and increasing housing supply.

The Study Area is bound by Belmore Road to the east, the M5 Motorway to the north, Salt Pan Reserve to the west and Killara Avenue to the south. The majority of the site is located within walking distance, approximately 5-15 minutes, from the Riverwood Station. The site is also serviced by local bus route (944) providing connections to key centres including Bankstown, Hurstville, Mortdale, Roselands and Campsie.

The Study Area comprises social housing dwellings, private dwellings and land owned by Canterbury Bankstown Council. A diverse range of dwelling types, including three-storey walk-up apartment buildings, studio apartments, free-standing cottages and nine-storey apartment buildings is located within the study area. The Study Area and is presented in **Figure 1**.

Figure 1 - Study Area (yellow shaded area (sourced from LAHC)

4.0 Study Requirements

Riverwood Estate SSP study requirements were released by the Department of Planning and Environment in December 2020. As part of the key study requirements under Section 2, dot point 5, the following requirements was listed:

> *Given the proximity of the M5 Motorway and nearby industrial land uses, outline the acoustic and air quality impacts of the proposal and the mitigation measures to ensure a high standard of amenity for future residents. The State Environmental Planning Policy (Infrastructure) 2007 and the Development Near Rail Corridors and Busy Roads – Interim Guideline must be addressed.*

To address this requirement, a qualitative desktop Air Quality Study has been undertaken which examined a range of factors and guidelines to allow a qualitative judgement on whether there may be potential impacts associated with the M5 motorway or other nearby industrial land uses.

5.0 Scope of Works

The scope items which were addressed in this study include the following:

- A review into relevant air quality legislation in NSW that may applies to the proposed development.

- An analysis of existing air quality conditions close to the proposed precinct development site using air quality monitoring data from the surrounding area.
- Confirmation of local meteorological conditions to understand how dispersion maybe affected by local conditions.
- Analysis of the potential for reverse amenity impacts due to the construction of the housing within the precent.
- Identification of potential mitigation measures that may be required for the RRP.

The scope of works in the dot points listed above are discussed in the following sections.

6.0 Legislation review

Key policies and guidelines that were addressed for this study are:

- ***State Environmental Planning Policy (Infrastructure) 2017***. This document was referenced in the Key Study requirements released for the Riverwood Estate SSP. The aim of this document is to facilitate the delivery of infrastructure across the state by defining a range of development matters including the assessment of development adjacent to particular types if infrastructure development (development adjacent to road corridors in this situation).
- ***Development Near Rail Corridors and Busy Roads – Interim Guideline, 2008***. This document lists a range of measures that need to be considered and possibly implemented for developments to be constructed close to busy roads. This document outlines factors that may impact upon the proposal as well as possible design considerations and mitigation measures to be considered for the project.
- ***Approved Method for the Modelling and Assessment of Air Pollutants in NSW, 2017***. This document was generally referenced as a source of factors needing to be considered when assessing air quality projects. It was not explicitly followed due to the nature of the qualitative assessment not requiring dispersion modelling but was used as a general guidance document.

The first two documents listed above were listed in the RRP project assessment requirements and are discussed in detail in the following sections.

State Environmental Planning Policy (Infrastructure) 2017

The following requirements of the Infrastructure SEPP have been identified as relevant to the project and therefore need to be addressed in this study.

Division 17, Subdivision 2 Clause 101 (Development with frontage to classified road) 1(b) states the objective of the clause is:

- *to prevent or reduce the potential impact of traffic noise and vehicle emission on development adjacent to classified roads;*

The requirement that the consent authority must not grant consent to development on land that has a frontage to a classified road unless it is satisfied that Division 17, Subdivision 2 Clause 101 (Development with frontage to classified road) 2(c) has also been considered:

- *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.*

The implication of these clauses are that a development must not be approved unless it can be demonstrated that the development is either not likely to be sensitive to vehicle emissions (which in this development is not the case given it is a residential development) or that the development has been designed to ameliorate vehicle emissions within the site.

The following sections outline the recommended measures that are needed to satisfy these clauses.

Development Near Rail Corridors and Busy Roads – Interim Guideline

The “Development Near Rail Corridors and Busy Roads – Interim Guideline” defines that air quality should become a design consideration when the site is:

- Within 10 metres of a congested collector road (traffic speeds of less than 40 km/hr at peak hour) or a road grade > 4% or heavy vehicle percentage flows > 5%,
- Within 20 metres of a freeway or main road (with more than 2500 vehicles per hour, moderate congestions levels of less than 5% idle time and average speeds of greater than 40 km/hr),
- Within 60 metres of an area significantly impacted by existing sources of air pollution (road tunnel portals, major intersection / roundabouts, overpasses or adjacent major industrial sources), or
- As considered necessary by the approval authority based on consideration of site constraints, and associated air quality issues.

The Riverwood Estate SSP is located with a frontage onto the M5 motorway corridor, which has a traffic flow of approximately 161,000 vehicles per day[1] (measured as annual average daily traffic or AADT). The Riverwood Estate SSP boundary is situated approximately 45 m from the edge of the M5 roadway, and as such does not trigger the requirements for design considerations. However, given that the traffic flow on the M5 is significantly higher than the trigger traffic flow referenced above (2500 AADT) and has the potential for slow congested traffic, it is recommended that the design considerations be included in the development planning.

The recommended design considerations that should be considered when designing the Riverwood Estate SSP include:

- Minimising the formation of urban street canyons by having buildings of different heights, interspersed with open spaces can aid in promoting air flow. Urban Street Canyons can form when a street is flanked by buildings on both sides which has the potential to reduce pollution dispersion increasing the potential for higher pollution concentrations. Setting back the upper levels of multi-levelled buildings can also minimise build-up of air pollution.
- When planning the site, it is recommended to use broad scale site planning principles to determine the position of certain buildings and their orientation to pollution sources. Areas such as bedrooms, outdoor spaces, childcare centres, hospitals and other sensitive uses should be located as far as is practical from a pollution source such as a road.
- For any development adjacent to roadway emission sources, openable windows should be considered in the design process i.e. openable windows not positioned adjacent to the source of pollution. When mechanical ventilation is favoured or proposed, the air intakes should be positioned so as to maximise the distance between the intake and the road as well as facing away from the source of pollution.
- Landscaping is a relevant design consideration that could include vegetative screens, barriers and earth mounds as a way to minimise any harmful impacts on local ambient air quality.

7.0 Factors Affecting Pollution Dispersion Around Roadways

There are a range of factors affecting dispersion of pollution from a roadways source. The main parameters that are relevant to this study are:

- Existing air quality;
- Meteorology;
- Terrain; and
- Existing sources of pollution.

The following sections analyse these factors in terms of their potential influence of air pollution dispersion around the study area.

[1] Traffic data sourced from the Charting Transport website: https://chartingtransport.com/2012/03/03/traffic-volumes-on-australian-toll-roads/

7.1 Existing Air Quality

The vehicle exhaust pollutants of most concern to the overall air quality in Sydney are nitrogen dioxide (NO_2) and particulate matter as PM_{10} and $PM_{2.5}$. Other pollutants such as carbon monoxide (CO) are also present in vehicle exhaust emission but are not typically experienced in concentrations high enough beyond road edges to be of concern.

The New South Wales Government operate a network of air quality monitoring stations in the Sydney basin. The nearest stations to the Study Area are at Chullora (6 km to the north), Earlwood (8 km to the north east) and Liverpool (13 km to the west). The stations are located well away from major roads and provide a good indication of background pollutant concentrations for the Study Area.

Short term pollutant concentrations (1-hour or 24-hour average) measured at Earlwood, Chullora, and Liverpool are presented in the following figures. Short term 1-hour average NO_2 concentrations are presented for 2016 to 2019 in **Figure 2**. The highest 1-hour average concentrations at any of the sites was well below the NSW criteria. This shows that away from major roads theirs is little impact from NO_2 concentration in Sydney.

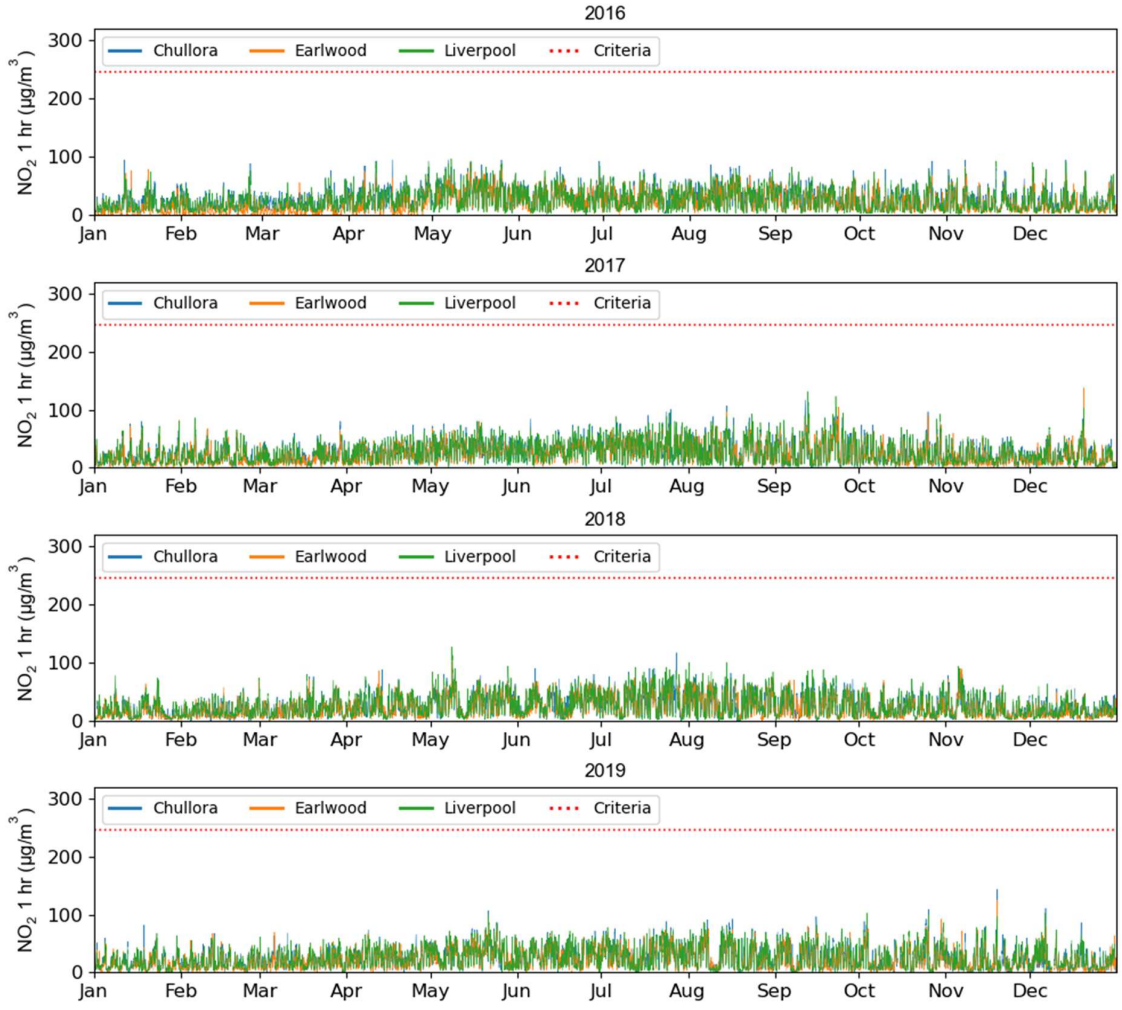

Figure 2 1-hour average NO_2 at Earlwood, Chullora and Liverpool – 2016 to 2019

Short term 24-hour PM_{10} concentrations are presented for 2016 to 2019 in **Figure 3**. Between the start of 2016 and October 2019 were typical in terms of expected PM_{10} concentrations with infrequent exceedances of the criteria. In general, the three stations follow a similar pattern of days with elevated concentrations, suggesting that high PM_{10} concentrations are due to regional events rather than from localised sources.

Due to prolonged drought, dust storms and bushfires, there was a progressive increase in the number of days with elevated concentrations in late 2019. The multiple exceedances of the criteria caused by smoke from the 2019 bushfires can be seen in the chart during November and December 2019.

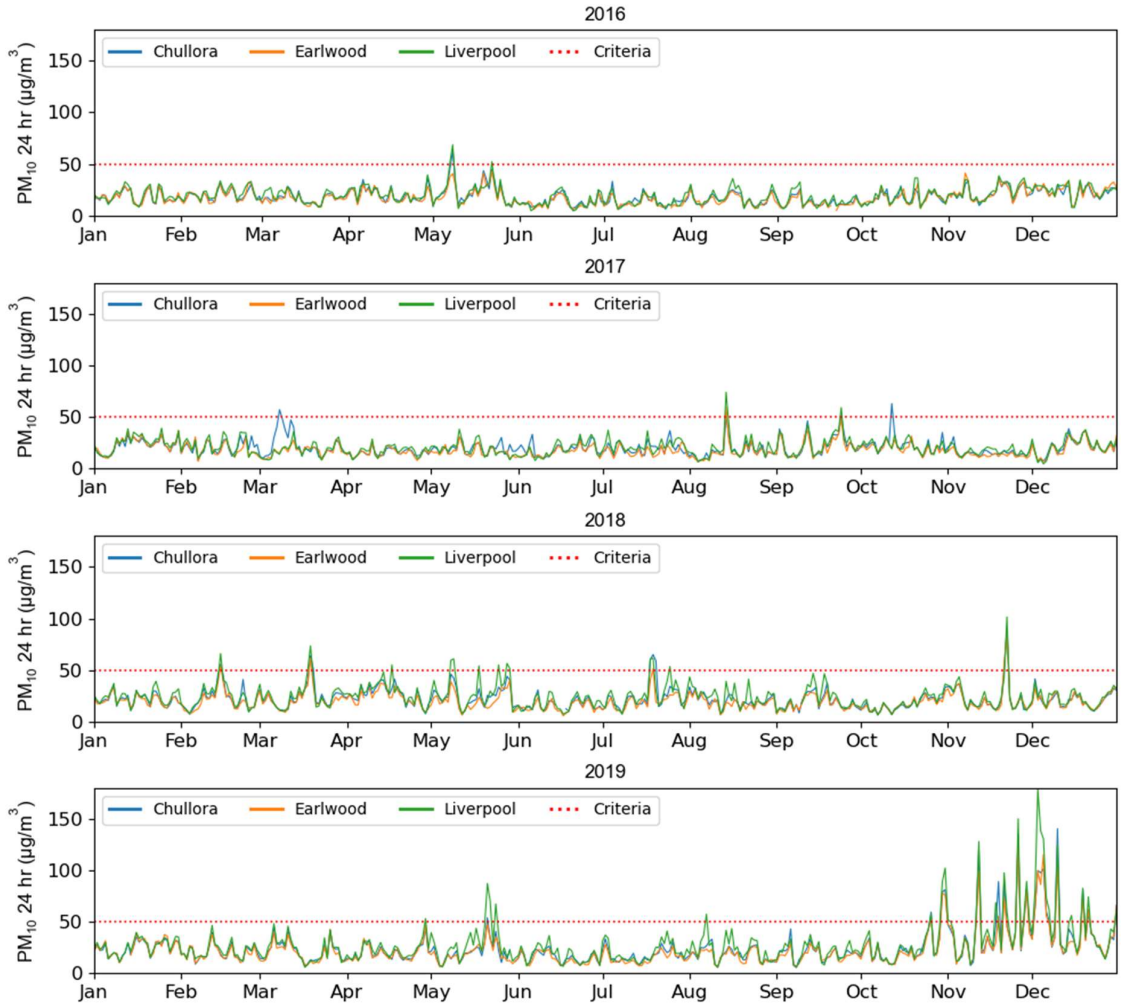

Figure 3 24-hour average PM_{10} at Earlwood, Chullora and Liverpool – 2016 to 2019

Short-term 24-hour $PM_{2.5}$ concentrations are presented for 2016 to 2019 in **Figure 4**. The pattern is quite similar to PM_{10} with typical concentrations apparent until around October 2019. The impacts of bushfire smoke can be seen in November and December 2019. Apart from an obvious period in March 2017 when only Chullora exceeded the criteria, elevated $PM_{2.5}$ concentrations followed a similar pattern at each station, suggesting regional pollution events were responsible for periods of elevated concentrations.

Figure 4 24-hour average PM_{10} at Chullora, Earlwood and Liverpool – 2016 to 2019

A summary of long-term annual average measurements from 2010 to 2019 for the three stations are presented in **Figure 5**, **Figure 6** and **Figure 7**, respectively.

Figure 5 show that annual average NO_2 concentrations are well below the NSW objective at all three stations for every year.

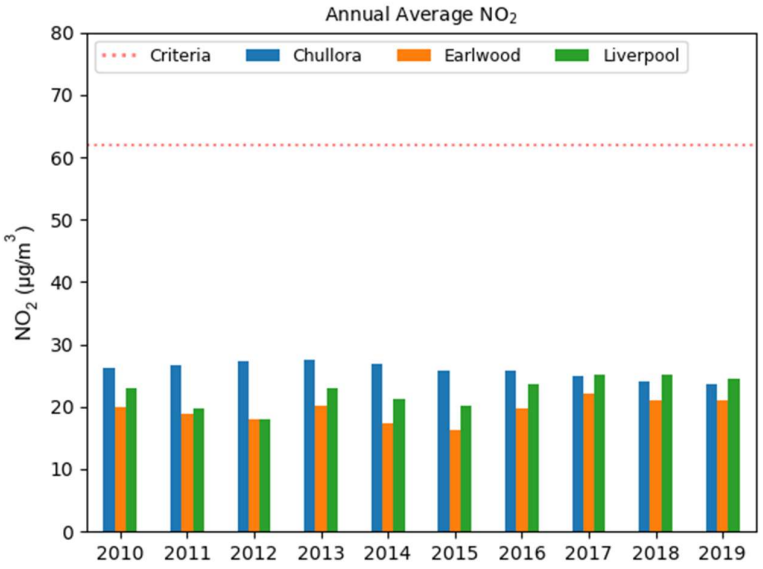

Figure 5 Annual average NO_2 at Chullora, Earlwood and Liverpool – 2010 to 2019

Annual average PM_{10} concentrations presented in **Figure 6** were below the NSW criteria at all three stations except in 2019. The elevated particulate concentrations during November and December 2019 (seen in **Figure 3**) were high enough to raise the annual average above the criteria.

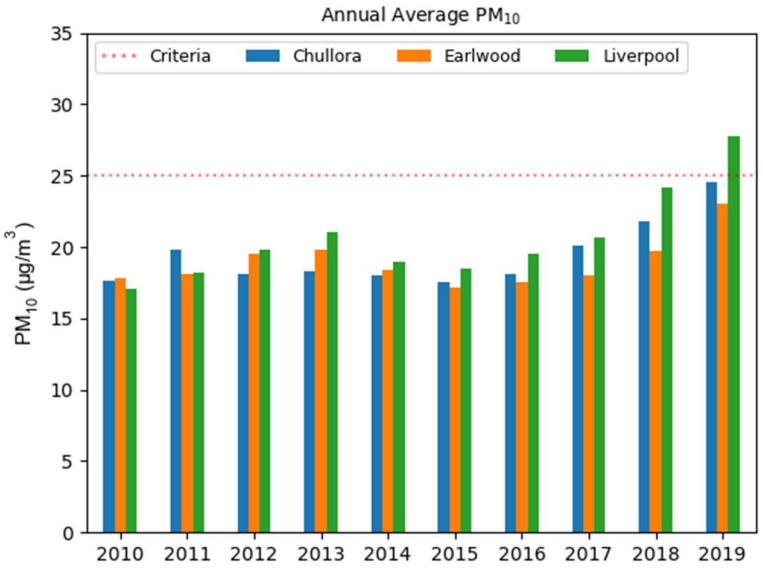

Figure 6 Annual average PM_{10} at Chullora, Earlwood and Liverpool – 2010 to 2019

Annual average $PM_{2.5}$ concentrations presented in **Figure 7** show concentrations approaching or exceeding the NSW criteria at all three stations since 2013. The elevated $PM_{2.5}$ concentrations in 2019 were caused primarily by raised dust events and bushfire smoke in November and December (seen in **Figure 4**).

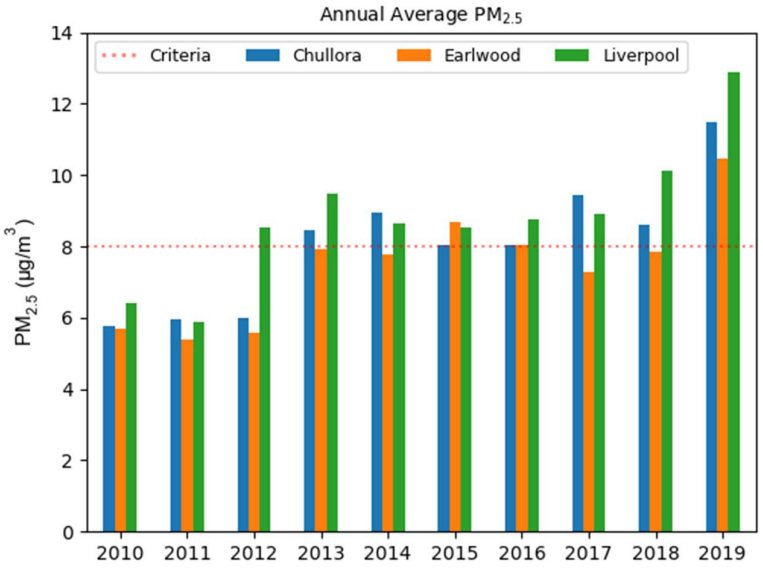

Figure 7 Annual average $PM_{2.5}$ at Chullora, Earlwood and Liverpool – 2010 to 2019

The background pollutant concentrations presented in this section are considered representative of what could be expected for the Study Area.

7.2 Meteorology

Meteorology defines the direction of pollution transport along with the rate of mixing and hence dispersion in the atmosphere. An analysis of the meteorology aids in the understanding of whether pollution from a source is likely to influence a particular development.

The Bureau of Meteorology (BoM) operates a network of monitoring stations around the state. Local meteorological data was taken from the two monitoring locations closest to the Study Area; Bankstown Airport and Canterbury Racecourse in order to gain a good indication of the general wind conditions at Riverwood Estate.

Historical meteorological data including average temperatures, rainfall and wind speed were obtained for both BoM stations.

Figure 8 shows the wind roses for annual wind conditions and day/night winds by season recorded at Bankstown Airport.

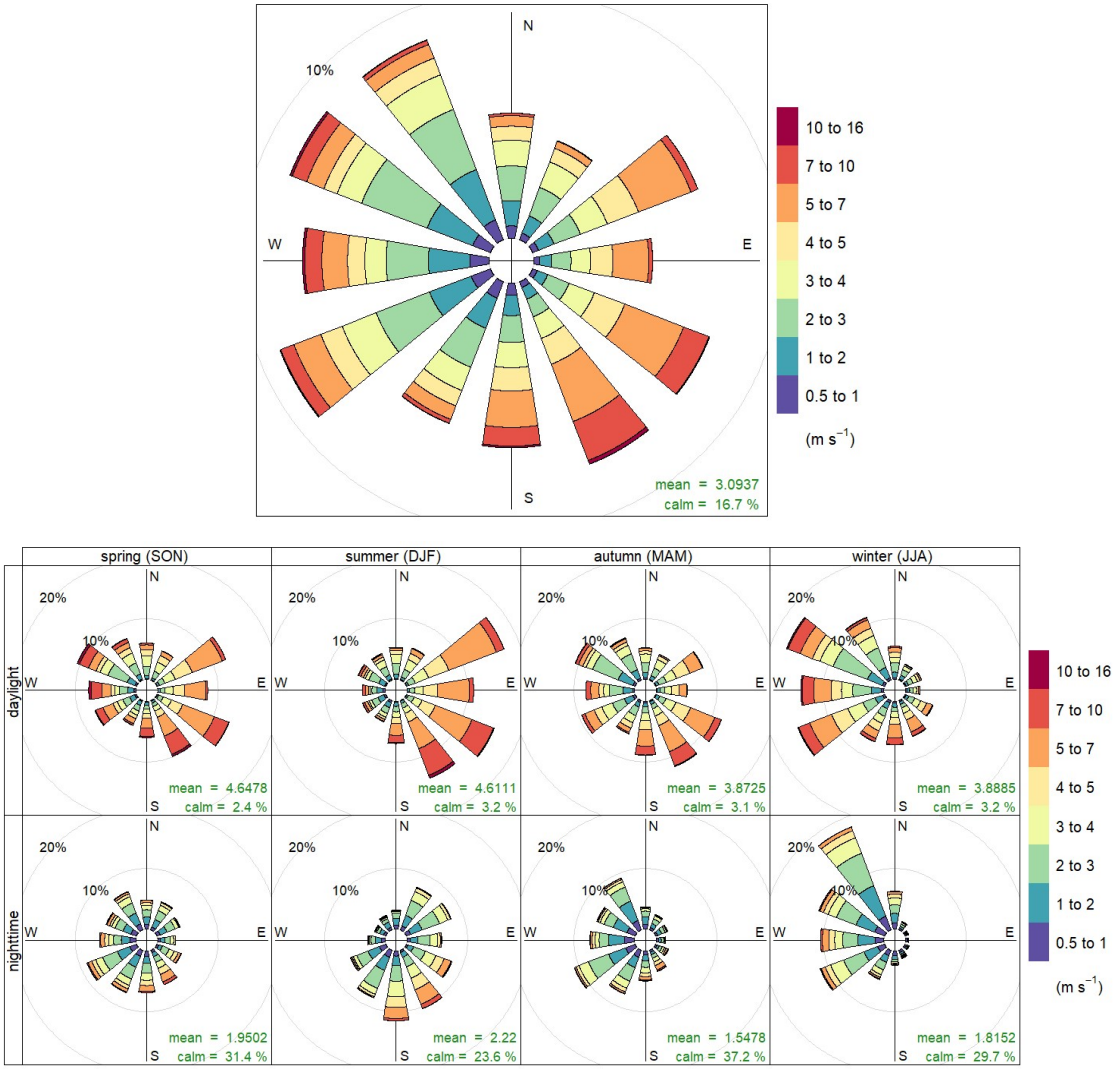

Figure 8 - Annual wind rose (top) and day/night winds by season (bottom) - Bankstown Airport; 1998 – 2019

On an annual basis, winds at Bankstown Airport can be expected from all directions, although northwest, southwest and southeast winds are most frequent. Winds from the north, northwest and northeast that may blow pollutants from the M5 Motorway towards the study area blow about 17 % of the time (the top three rays of the wind rose at top in **Figure 8**). Calm conditions (wind speeds less than 0.5 m/s) are experienced about 17 % of the time.

Summer daytime hours are dominated by easterly winds, while winter daytimes are dominated by westerly winds. Daytimes hours in spring and autumn show a transition between the summer and winter patterns with winds from all directions. Daytime calm conditions (wind speeds less than 0.5 m/s) are consistent throughout the year.

Night-time winds are typically lighter than daytime, with most calms occurring at night. Night-time winds in summer blow mostly from the south, southeast and northeast. Night-time winds in winter blow mostly form the west and northwest. Autumn has the highest frequency of night-time calm conditions (37 %), whilst summer experiences the least (24 %).

Figure 9 shows the wind roses for annual wind conditions and day/night winds by season recorded at Canterbury Racecourse.

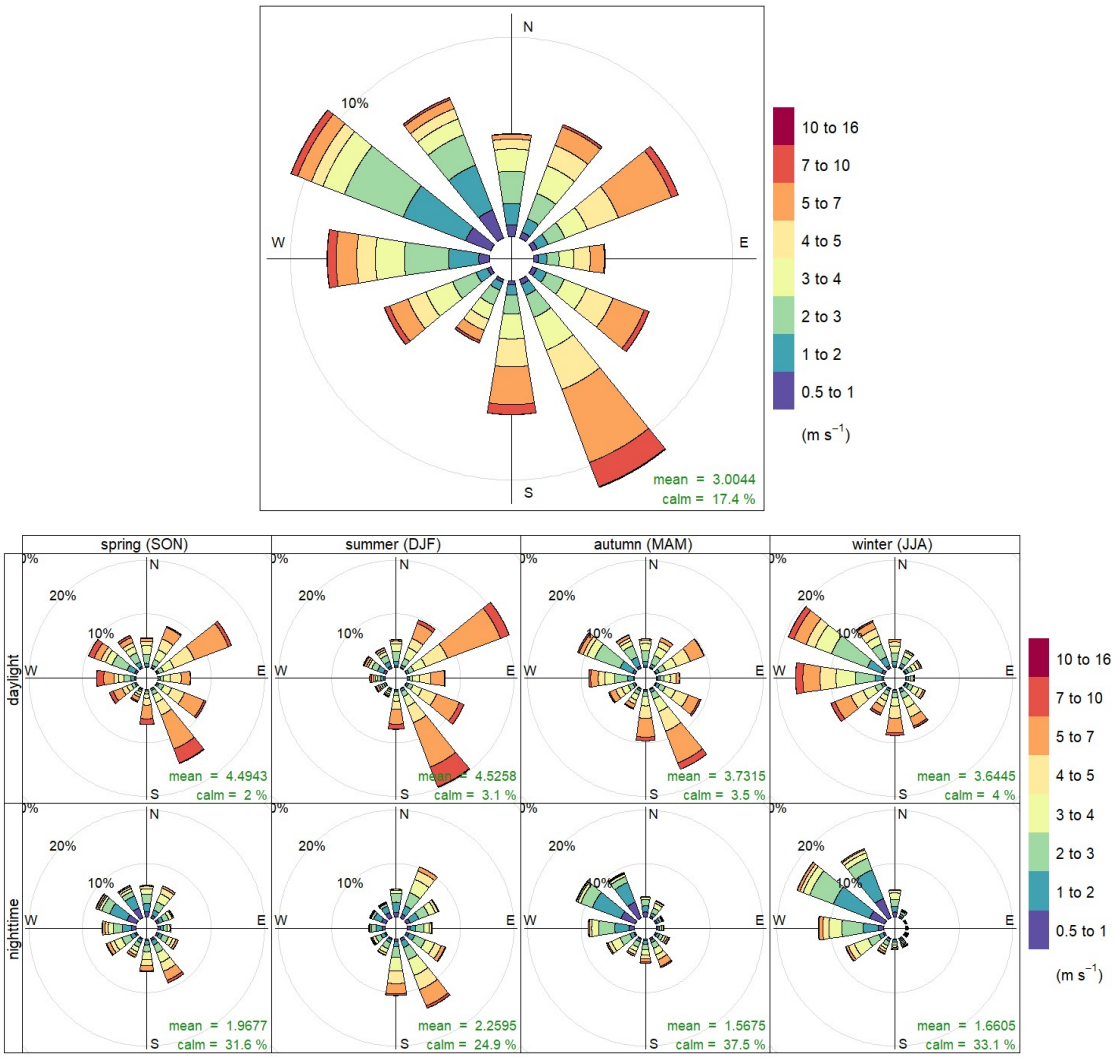

Figure 9 - Annual wind rose (top) and day/night winds by season (bottom) s - Canterbury Racecourse; 1998 – 2019

Overall, winds at Canterbury Racecourse follow a very similar trend to those at Bankstown Airport with only minor differences in wind patterns. Winds from the north, northwest and northeast that may blow pollutants from the M5 Motorway towards the study area blow about 16 % of the time

As Riverwood is located about halfway between the Bankstown Airport and Canterbury Racecourse stations, winds would be expected to be very similar to those measured at both BoM stations.

Monthly average temperature and rainfall data for Bankstown Airport and Canterbury Racecourse are provided in **Figure 10** and **Figure 11** respectively. The two locations are very similar as expected, given they are only about 11 kilometres apart. Summer minimum and maximum temperatures range from about 17-18 ^{o}C to 27-29 ^{o}C in summer and 5-7 ^{o}C to 17-19 ^{o}C in winter.

Rainfall is fairly consistent across the year at both sites with slightly higher rainfall falling in the first half of the year. The highest monthly rainfall is around 100-110 mm falling in February at both sites, and June at Canterbury.

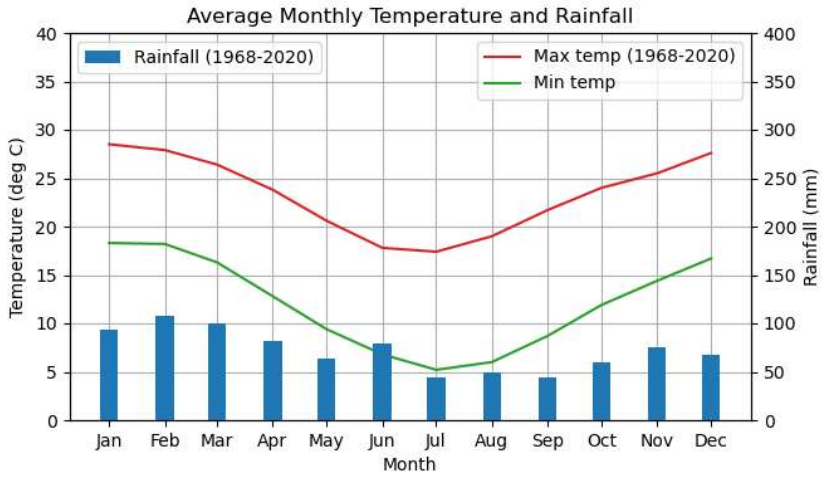

Figure 10 Monthly averages temperature and rainfall – Bankstown Airport

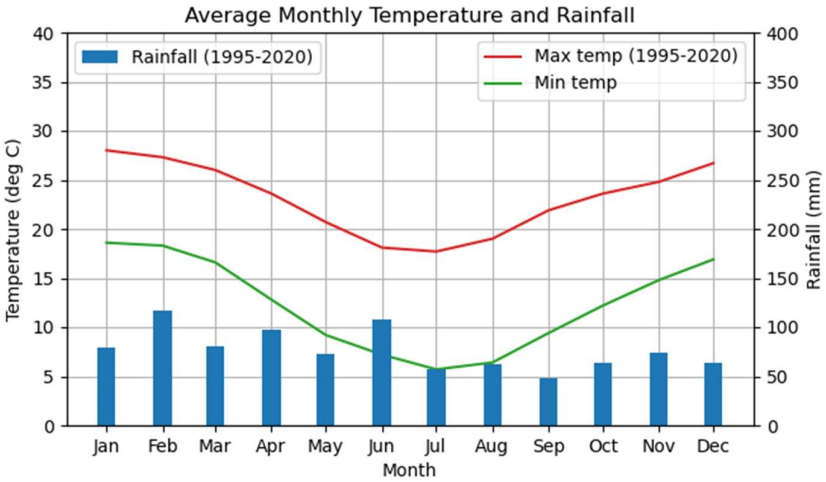

Figure 11 Monthly averages temperature and rainfall – Canterbury Racecourse

Based upon the typical wind conditions and the location of the Study Area to the M5 motorway it is observed that winds typically blow pollution from the motorway, away from or parallel to the study area. A small proportion (up to about 17 %) of the winds (from the northwest, north and northeast) blow towards the study area, suggesting that meteorological conditions will have minimal impact upon the movement of vehicle emissions toward the Study Area. As such the site is deemed appropriately located to minimise air quality impacts from motorway vehicle emissions in terms of meteorological conditions.

7.3 Terrain

The Riverwood Estate is situated in the southern hinterland of the Sydney basin. The terrain is generally flat with slightly undulating terrain sloping down to the west and Salt Pan creek. The local relief between the motorway and the development is minor and is not expected to influence air quality dispersion.

7.4 Land Use

The Study Area is situated in an area dominated by residential areas to the north (across the M5), south and east. No sources of pollution other than minor road traffic would be expected in these areas.

A commercial industrial development is situated to the west across Salt Pan Creek and the Salt Pan reserve. The commercial industrial area is dominated by small to medium scale commercial outlets

and is not expected to contribute pollution to an extent that cumulative impacts would be considered likely at the study area.

There is a noise barrier along the southern side of the motorway and an existing 35 m wide shelterbelt established between the M5 motorway with trees up to around 20 m in height. Both the noise wall and shelterbelt would be expected to generate some air turbulence and therefore assist dispersion of pollution from the motorway as it moves towards the study area.

8.0 Project Master Plan and Air Quality

The building layout in the concept master plan is presented in **Figure 2**.

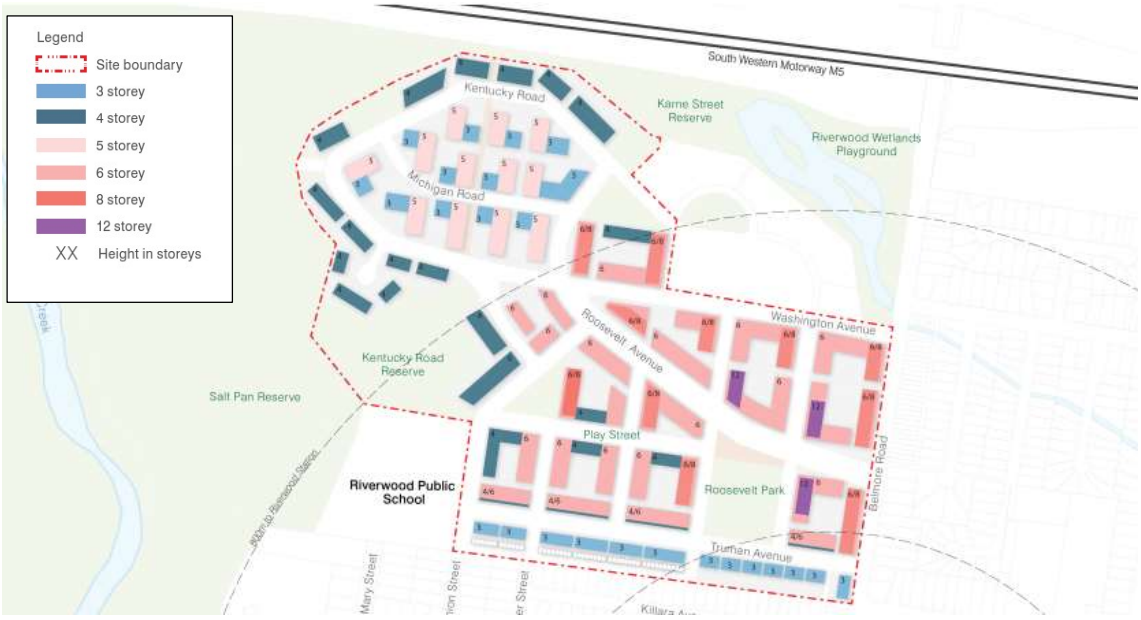

Figure 12 - Riverwood Renewal building diagram – source Architectus 2020

The building layout shows that most buildings are planned to be six storeys or lower, with eleven 8-storey buildings and three 12-storey towers. The buildings in the northernmost part of the master plan nearest to the M5 Motorway are all three, four or five storeys and are not aligned such that any urban street canyon effects are likely. Air flow is this area is likely to be conducive to rapid dispersion of any pollutants that do enter the Study Area from the motorway.

Air flow between the taller buildings (6-storeys and above), and in particular within the internal courtyards between these buildings, may not be as conducive to rapid dispersion as near the lower buildings. However, gaps in between the buildings have been designed on at least two opposing sides of the courtyards, which should allow winds to past though and assist mixing of air in these locations. The taller buildings are also located a minimum of 240 m from the M5 road edge. Pollutants from the M5 are likely to have dispersed to near-background levels by the time they reach the taller buildings and therefore urban street canyon effects are not considered likely.

No significant sources of air pollution on site as part of the master plan were identified.

Overall, the master plan is feasible from an air quality perspective and pollutants from the M5 motorway are not expected to adversely impact the development.

9.0 Recommended Mitigation Measures

Although the proximity of the development does not trigger the expectation of mitigation measures and design consideration, it is considered prudent to list measures that may be included in the design of the development to minimise the potential for air quality impacts. When design features cannot eliminate an impact sufficiently, certain measures can be employed to mitigate many impacts. For buildings this primarily consists of internal ventilation options such as:

- Natural Ventilation through open windows to ensure pollution does not accumulate within a building. This presents the simplest and cheapest option to provide air flow throughout a building as it relies on natural pressure and temperature differences between the inside and outside of the building. However, when windows must be kept closed other ventilation systems can be utilised.
- Passive Acoustic ventilation is an option where ventilators are installed to maintain external airflow without the impact of external noise sources.
- Mechanical Ventilation may be considered where windows need to be kept closed and involves circulation of fresh air into the building using ducts and fans. This is an option to be considered as a means to 'treat' air through filtration (e.g. carbon filters) as it enters the building. Mechanical ventilation air inlet ports should be positioned as far from the source of pollution as is practical i.e. in this case to the south of the buildings.

Any adopted ventilation systems must meet the requirements of the Building Code of Australia and Australian Standard 1668 – *The use of ventilation and air conditioning in buildings*.

10.0 Conclusion

The main aim of this Air Quality investigation, was to address the requirements as identified by the "State Environmental Planning Policy (Infrastructure) 2007 / 2017" i.e. to prevent or minimise the impact of vehicle emissions on the study area given the proximity of the M5 motorway and nearby industrial land uses.

The location of the site and the master plan is such that further design considerations and mitigation measures are not considered to be required. However, the proximity to the M5 Motorway suggests that some degree of due diligence design consideration or mitigation be considered to ameliorate any potential impacts due to emissions from the M5 Motorway.

The general dispersion parameters such as meteorology, terrain and surrounding land use demonstrated that due to the general wind conditions of the area blowing parallel to or away from the Study Area and the lack of any complex terrain or additional sources of pollution, the site is adequately located to minimise air quality impacts as a result of vehicle emissions.

Yours faithfully

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