PEDESTRIAN WIND ENVIRONMENT STATEMENT

SANTA SOPHIA CATHOLIC COLLEGE

WE759-01F02(REV4)- WS REPORT

MAY 10, 2019

Prepared for:

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DOCUMENT CONTROL

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1 INTRODUCTION

This Pedestrian Wind Environment Statement has been prepared by Windtech Consultants on behalf of the Catholic Education Diocese of Parramatta c/TSA Management Pty Ltd (the Applicant).

It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD 18_9772) for the new Santa Sophia Catholic College on the corner of Fontana Drive and the future road 'B', between Red Gables Road and Fontana Drive, in Box Hill North (the site).

The new school will cater for approximately 1,920 primary and secondary school students, inclusive of a 60 student Catholic Early Learning Centre. The school will have 130 full-time equivalent staff.

The proposal seeks consent for approximately 15,000sqm of floor space across a part five and part six storey building. The building will present as three main hubs connected by terraced courtyards and garden spaces.

The school will include:

- Catholic Early learning centre for 60 students;
- General Learning Spaces for years Kindergarten to 12;
- Community Hub – knowledge centre and cafe;
- Creative Hub – art and applied science;
- Performance Hub – multipurpose hall and music, dance and drama spaces;
- Professional Hub – administrative space;
- Research Hub – science and fitness;
- Associated site landscaping and open space including a fence and sporting facilities;
- Bus drop off from Fontana Drive;
- Pick-up and drop-off zone from future road 'B';
- Pedestrian access points from Red Gables Road north, Fontana Drive and future road 'B';
- Staff parking for 110 vehicles provided off site in an adjacent location;
- Short term parking for pick up and drop off for Catholic Early Learning Centre from Red Gables Road; and
- Digital and non-digital signage to the school.

The purpose of this Pedestrian Wind Environment Statement is to present an opinion on the likely impact of the proposed design on the local wind environment on the critical outdoor areas within and around the subject development.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The subject development site is located in Box Hill North and will be part of a wider development plan for the precinct that is still in the initial stages of construction. When complete, the surrounding buildings are expected to be primarily low-rise and thus are not expected to provide significant shielding to the subject development site. Proposed buildings include a sporting field to the west and a shopping complex to the south east.

The subject development will be located at the corner of Red Gables Road (existing) and Fontana Drive (under construction) and will comprised of three buildings (Building North, Building Central and Building South), which range between four and five storeys in height. The buildings will be connected by elevated Open Play Spaces. Each building features complicated curved extremities, with the south-eastern hub of Building Central being particularly complex.

The Plaza is a communal space located between Building North and Building Central on Level 00 and is the main entry point of the development. It features cafes, classrooms, the Main Hall and a large Open Play Area. The Plaza will be accessible via two passageways along Fontana Drive, one passageway along Road B and the Plaza to the east. Trafficable areas on the elevated levels are characterised by curved Open Play Spaces which wrap around the classrooms and interconnect. Access between levels is primarily provided by stairways. Building North features a basketball court and a fitness centre on the Level 04.

The Open Play Spaces and Building North Level 04 are the focus of this assessment.

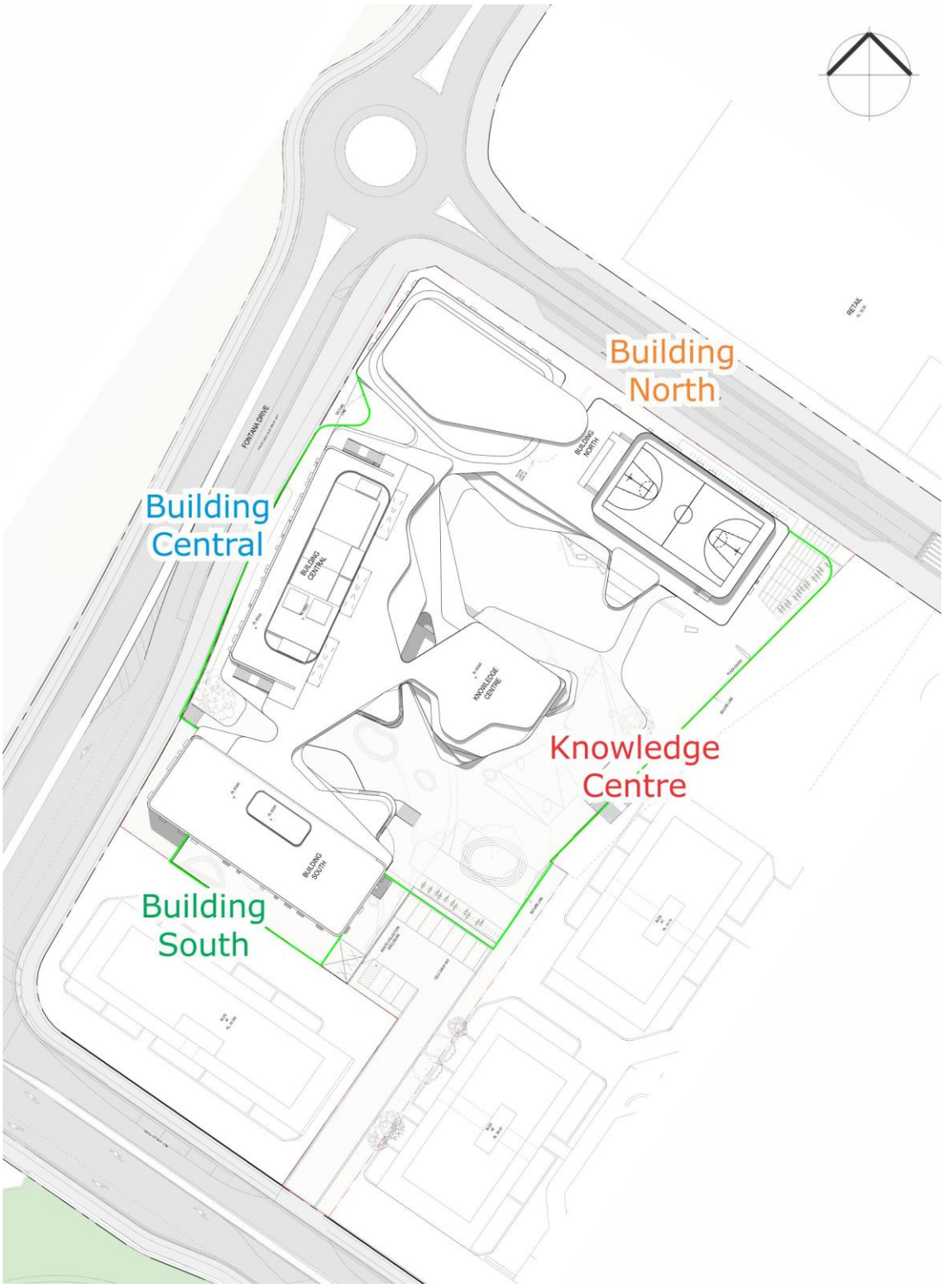

Figure 1: Site Plan

3 RESPONSE TO SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

This Pedestrian Wind Environment Statement is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD 18_9772. This table identifies the relevant SEARs requirement/s and corresponding reference/s within this report.

Table 1: Secretary's Environmental Assessment Criteria

SEARS – Environmental Amenity	Item Discussed in:
Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing and wind impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.	Section 6

4 EXECUTIVE SUMMARY

This report is in relation to the proposed outdoor play spaces for the Santa Sophia Catholic College development in Box Hill North, and presents an opinion on the likely impact of the proposed design on the local wind environment on the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; namely the north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposed development was carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the latest architectural drawings. No wind tunnel testing has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that it is expected that safe and comfortable wind conditions can be achieved for all outdoor trafficable areas within and around the site. However, some areas of the subject development are relatively exposed to the three prevailing wind directions affecting the site. As a result, some sections of the elevated Open Play Spaces and Level 04 of Building North may not meet the comfort criteria for their intended uses. It is expected that the wind effects identified in the report can be ameliorated with the consideration of treatment strategies in designing Open Play Spaces and Level 04 of Building North. These include landscaping, perimeter or local screening, relocation of wind sensitive areas away from wind hot spots, or managing periods of high winds by bringing children or teaching staff inside. It is important to note that these treatment suggestions are given in-principle. The most appropriate treatment strategy can be further developed at a more detailed design stage through wind tunnel testing due to the complex building form and its interaction with the prevailing winds. The wind tunnel testing will be able to confirm quantitatively the magnitude and probability of wind conditions in various areas of the development meeting a designated criteria, in order to better inform the design and appropriate treatment strategy.

CONTENTS

5 REGIONAL WIND

The north-western Sydney region is governed by two principal wind directions, and these can potentially affect the subject development. These winds prevail from the southerly sector and the westerly sector. The north-easterly winds are not very strong, however, they have a high frequency of occurrence, and have been taken into consideration.

A summary of the principal time of occurrence of these winds is presented in Table 2 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological recording station located at Kingsford Smith Airport by the Bureau of Meteorology.

Table 2: Principal Time of Occurrence of Winds for the Sydney Region

Month	Wind Direction		
	North-Easterly	Southerly	Westerly
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	

The southerly winds are by far the most frequent wind for the north-western Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the north-western Sydney region, and are typically not as strong as the southerly or westerly winds.

Figures 2 below show the frequencies and magnitudes of winds observed at the meteorological recording stations located at Sydney Airport and Richmond Airport respectively between 6am and 10pm. The data has been corrected to represent winds in standard open terrain at a height of ten metres above ground.

The maximum annual mean wind plots show the maximum winds averaged over a 1 hour period for a 1 year return period for each wind direction. The 5% exceedance mean wind plots

show that 95% of winds for the region are within the indicated wind speed threshold for each wind direction (ie: 5% of mean winds exceed this threshold). The directional frequency plots show the percentage of wind events that have been recorded from each wind direction. The directional frequency of winds greater than 20kph plots show the percentage of wind events greater than 20kph that have been recorded for each wind direction.

Comparing the two figures, it is observed that the predominant north-easterly, southerly and westerly winds are prevalent in both. This is characteristic of the wind conditions throughout the Sydney Basin. Differences can largely be attributed to local topographic conditions. For example, the greater influence of north-easterly winds in Figure 2a can be attributed to the proximity of Sydney Airport to the coastline.

Furthermore, the probability of exceedance of the wind speeds for each direction has been summarised in Figures 3 below, for three different wind speeds. These wind speeds correspond to the comfort criteria outlined in Section 6, which vary depending on the intended use of the space by pedestrians.

Note that typically the most significant local wind effects within/around a development are caused by the development itself and the surrounding buildings, as well as topographic effects. Hence the wind speeds observed locally will usually be significantly different to that of the overall regional wind speeds observed at the nearest meteorological recording station.

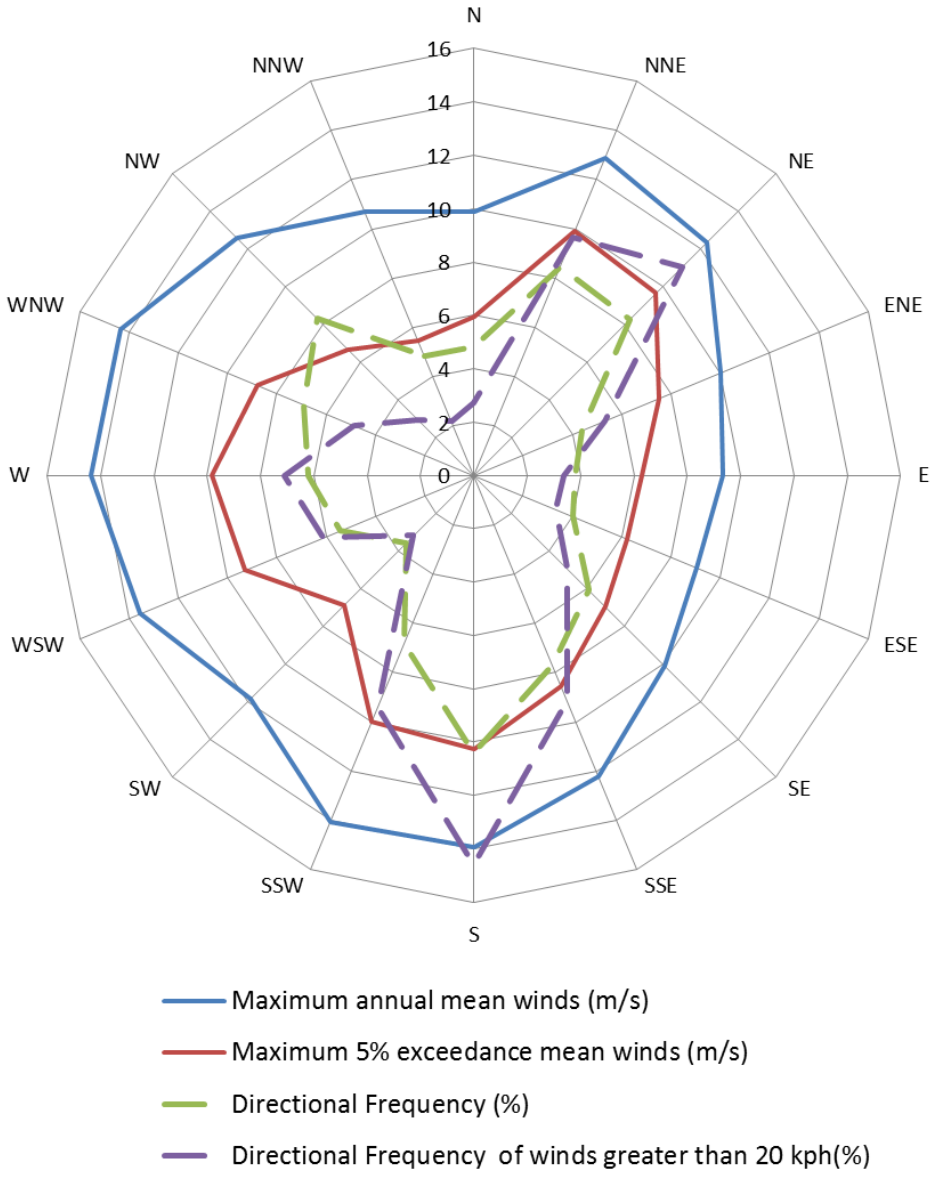

Figure 2a: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence (from 6am to 10pm), for the Sydney Region (referenced to 10m above ground in standard open terrain)

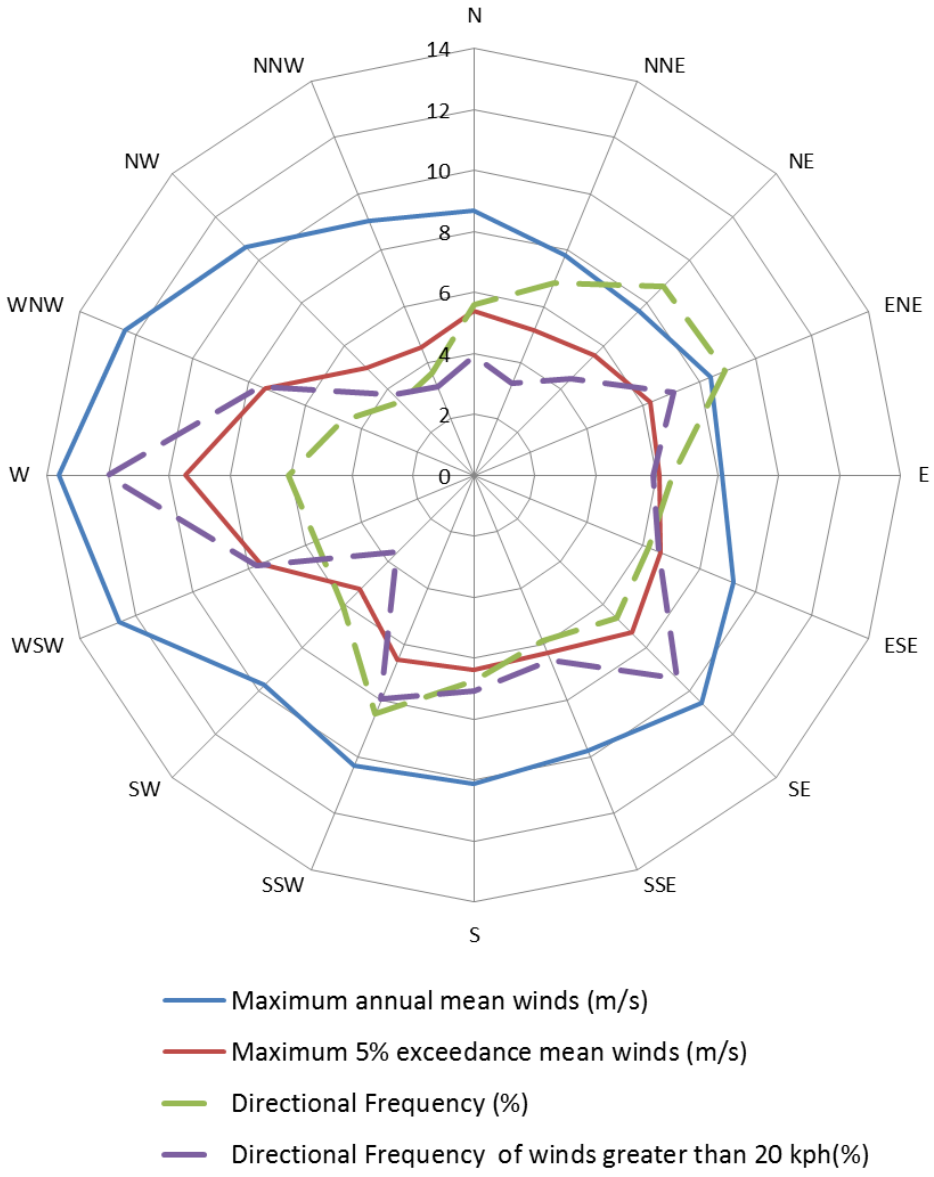

Figure 2b: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence (from 6am to 10pm), for the Richmond Region (referenced to 10m above ground in standard open terrain)

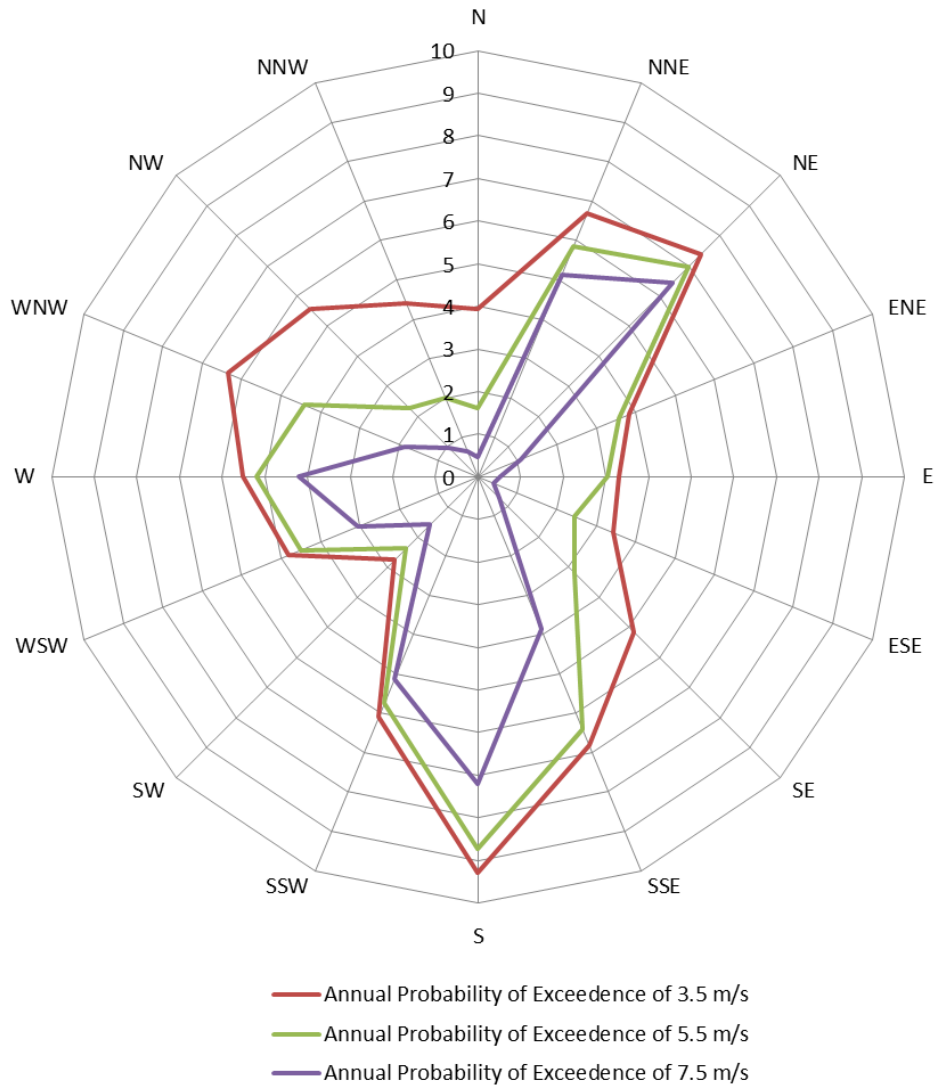

Figure: 3a Annual Percentage Probability of Exceedance of Selected Wind Speeds (from 6am to 10pm) for the Sydney Region (referenced to 10m above ground in standard open terrain)

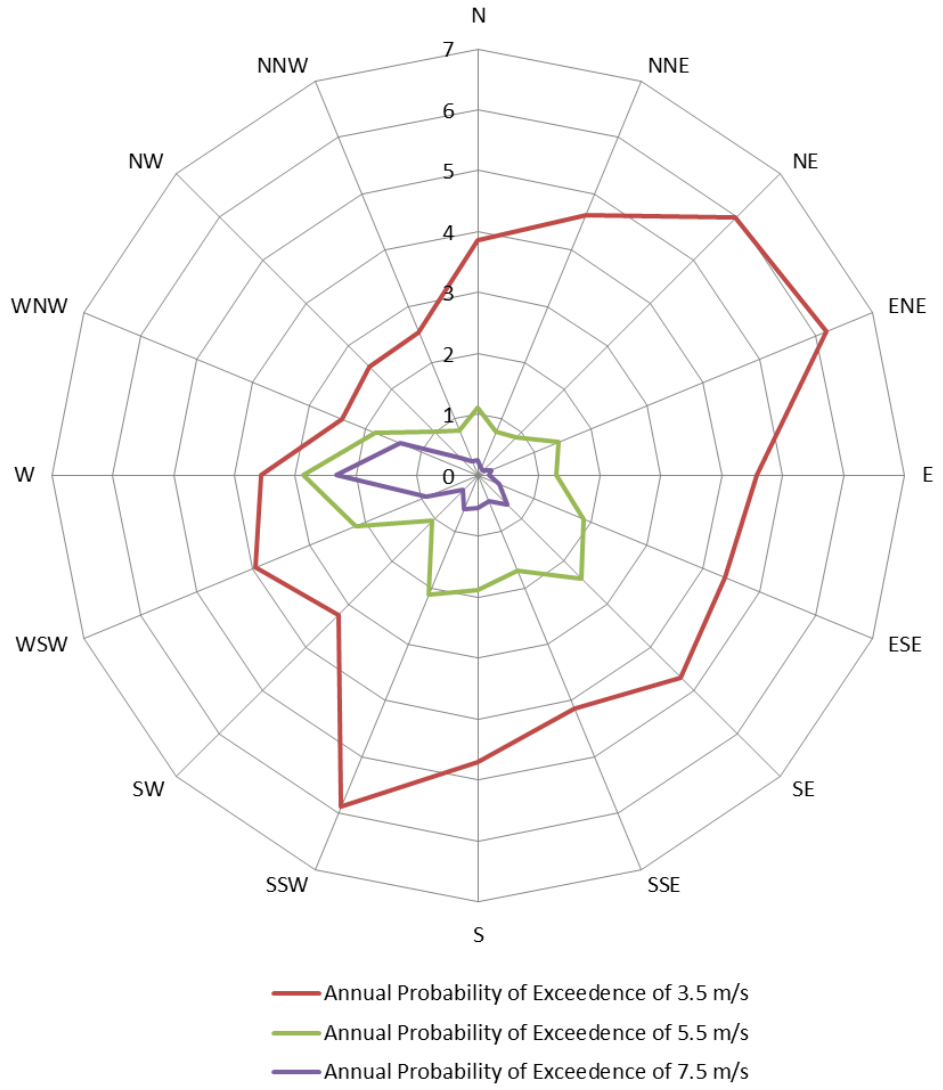

Figure 3b: Annual Percentage Probability of Exceedance of Selected Wind Speeds (from 6am to 10pm) for the Richmond Region (referenced to 10m above ground in standard open terrain)

6 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 3 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 3: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

The thoroughfares between these Open Play Spaces should meet the comfortable walking criterion. Areas where potential seating is proposed, for example, will need to be able to meet a more stringent comfort criterion to maximise the usability of the space for a greater amount of time throughout the year. It is expected that a short or long exposure comfort criterion would be most suitable for the outdoor play areas.

The comfortable walking criterion typically applies to thoroughfares and walkways, where the primary use is for circulation. Based on the abovementioned research, this comfort criterion is approximately 7.5m/s with a 5% probability of exceedance.

The short duration exposure criterion applies to stationary uses such as outdoor play and recreational activities or waiting areas where the duration of stay is typically an hour or less. Based on the abovementioned research, this comfort criterion is approximately 5.5m/s with a 5% probability of exceedance.

The long duration exposure criterion applies to stationary uses such as outdoor teaching activities or outdoor assemblies where the duration of stay is typically greater than an hour. Based on the abovementioned research, this comfort criterion is approximately 3.5m/s with a 5% probability of exceedance.

The safety criterion based on the abovementioned research is an annual gust wind speed of 23m/s. This is to ensure that an unexpected wind event does not cause a person to lose their balance.

It should be noted that wind speeds can only be accurately quantified with a wind tunnel study to the complex interaction of the wind with the building form. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use.

Any recommendations in this report are made only in-principle to meet these expected criteria and are based on our extensive experience in the study of wind environment effects.

7 WIND EFFECTS

The expected wind conditions are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report.

7.1 North-Easterly Sector Winds

The north-easterly winds prevail throughout the summer months, and impact the site directly. These winds are expected to accelerate around the southern corners of all three buildings. It is expected that winds entering the development via the south-eastern opening will funnel between Building South and Building Central, and Building North and Building Central. Directly impacting winds are expected to cause funnelling at the passageway that runs through Building North, affecting the open play space. Directly impacting winds are expected to cause adverse wind conditions at the basketball court and fitness centre on Level 04 of Building North.

Figure 4: North-Easterly Wind Flow and Hotspots

7.2 Southerly Sector Winds

The southerly sector winds primarily approach from the south and south-east throughout most of the year. Corner accelerations are expected to occur at the southern corners of all three buildings, as well as the northern corner of Building South. Winds are expected to wrap around Building South and the southern hub Building Central, causing funnelling between Building South and Building Central, and Building North and Building Central. These conditions are expected to be further exacerbated by down washing winds from the south-eastern facades of Building South and Building Central. Directly impacting winds are expected to cause adverse wind conditions at the basketball court on Level 04 of Building North.

Figure 5: Southerly Wind Flow and Hotspots

7.3 Westerly Winds

Westerly winds typically occur during the winter months of the year for the North-Western Sydney region. These winds are particularly undesirable due to the negative impact upon the human perception of comfort as a result of the cooler winds. It is anticipated that certain areas of the development may be susceptible to undesirable wind effects as a result of these winds.

Corner accelerations are expected to occur at the northern corner of Building North. This is expected to cause adverse wind effects for the area and for the pedestrian footpath along Road B. The conditions at the pedestrian footpath along Road B may be made worse by down washing winds from the north-western façade of Building North. Corner accelerations are also expected to occur at the southern corner of Building South.

Funnelling is expected to occur in the passageways between Building North and Building Central, and Building South and Building Central. Directly impacting winds are expected to cause adverse wind conditions at the fitness centre on Level 04 of Building North.

Figure 6: Westerly Wind Flow and Hotspots

8 RECOMMENDATIONS

8.1 Level 00 and Level 1 Open Play Spaces

The lower level Open Play Spaces will be exposed to southerly winds wrapping and accelerating around the Knowledge Centre, funnelling westerly winds in the passageway between Building North and Building Central and funnelling of north-easterly winds at the passage that runs through Building North. It is expected that the wind conditions in these hot spots may not meet the comfort criteria for comfortable walking. Treatments in the form of planting or screening can be determined at a more detailed design stage by undertaking wind tunnel testing to optimise the treatments.

8.2 Elevated Open Play Spaces

The majority of the Elevated Open Play Spaces are expected to be meet the short duration exposure or comfortable walking criteria. However, due to the exposure the prevailing winds funnelling between the buildings and directly impacting the large Open Play Spaces, some localised areas may experience wind conditions that does not meet the criteria for long duration activities such as classes, where sensitivity towards wind is heightened.

In these instances, landscaping can be investigated at a more detailed design stage. Examples of this include densely foliating evergreen trees and planter boxes can be distributed throughout the elevated Open Play Spaces. This would be effective when located at corners that are prone to high accelerations and in areas of longer duration stay such as outdoor teaching areas and seating areas.

Treatment solutions such as screens along the perimeter of the eastern side of the Open Play Spaces between Building South and Building Central and between Building North and Building Central can be investigated at a more detailed design stage through wind tunnel testing.

Treatment strategies such as screens or planting may be required for the western side of the Open Play Spaces for the passageway that runs through Building North, as well as at the eastern corner of Building South and at the western corner of Building North. Other treatment measures such as impermeable balustrades can further improve conditions.

Locating the more wind sensitive seating areas away from the corners of buildings, or managing windy periods by bringing children and teaching staff inside is also an appropriate strategy. Wind tunnel testing can be performed to confirm the magnitude and probability of exceedance of the criteria, and optimise the size and extent of the abovementioned treatments, if they are found to be required.

8.3 Building North – Level 4

The outdoor trafficable spaces of Level 4 on Building North are expected to meet the comfort criteria for short duration activities such as outdoor play activities. Wind treatments are expected to be required for these spaces. These can be in the form of screens or planting

placed along the perimeter of the Open Play Spaces on the Level 4 of Building North, which can be further investigated and optimised at a more detailed design stage.

8.4 Other General Recommendations

Due to the complex form of the building, wind tunnel testing is recommended at a more detailed design stage to quantify the wind conditions and confirm their suitability for their intended uses. Where the conditions are not expected to meet the desired criteria, treatment strategies can be optimised during the detailed design phase. The general recommendations below is a guide for the development of treatment strategies.

For tree planting/landscaping to be effective as a wind mitigation device, the species should be of a densely foliating evergreen variety to ensure year-round effectiveness, particularly for the areas that are expected to be impacted by westerly winds, which prevail during the winter months. Trees should also be planted in clusters with interlocking canopies to effectively absorb incident winds. In sensitive areas or hotspots where strong winds are expected, mature trees should be used as immature trees have difficulty establishing themselves in strong wind conditions. If immature trees are initially planted, the inclusion of porous screens around these tree plantings, or temporary wind screens is recommended to provide some wind mitigation while the trees develop and also provide some protection as the trees establish.

Conditions can be further improved through the use of low level vegetation such as shrubs/hedges or planter boxes. When utilised below a tree canopy, they provide protection from low level winds, especially for more sensitive areas where longer duration activities are expected. In general, landscaping can help mitigate adverse wind conditions caused by winds directly impacting an area, or side-streaming winds by slowing the winds upstream.

In areas where stronger winds are expected, as abovementioned in the report, wind screens may be required. These can be in the form of impermeable screens, porous screens, signage, artwork etc. which are strategically located to mitigate winds at a particular location. In areas where longer duration stay is expected such as seating areas, or outdoor teaching spaces, additional localised screening or planting may be required. The location of these areas at the corners of buildings places them in an area where there is a high potential for adverse winds.

Through site links where the prevailing wind tend to funnel through can incorporate bends, planting or screens in order to mitigate funnelling effects between building massings. This tends to reduce the severity of winds affecting a particular area by redirecting it around obstacles, and thus reducing the wind speed.

It is expected that safe and comfortable wind conditions can be achieved for all outdoor trafficable areas within and around the site with appropriate treatment strategies, the exact size and extent of which can be optimised at a more detailed design stage through wind tunnel testing.

9 REFERENCES

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