PEDESTRIAN WIND ENVIRONMENT STATEMENT

15 ELLIS STREET & 753 PACIFIC HIGHWAY, CHATSWOOD

WD726-01F02(REV3)- WS REPORT

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Prepared for:

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the proposed development located at 15 Ellis Street & 753 Pacific Highway, Chatswood 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, Revised Plans (16/5/18) which have been prepared by Architecture Urbaneia, received October 2018. 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 the subject development is relatively exposed to the prevailing southerly and westerly prevailing wind directions, with provisional shielding of the north-easterly winds due to the close proximity of the Chatswood CBD. A number of outdoor trafficable areas are potentially exposed to adverse wind effects due to the interaction of the prevailing winds with the built form. These include direct wind effects from the prevailing wind directions, accelerating flows around the building corners and down-wash wind effects off the building façade. The use of effective mitigation strategies in the design such as recessed balcony designs and podium setbacks will assist in providing mitigation to adverse winds.

It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the design of the development:

Ground Level

- The inclusion of densely foliating trees along the Pacific Highway and Ellis Street frontage.
- It is possible that due to the proposed setback design of the upper levels that conditions would be acceptable. Provisions should be made to consider an awning along the Pacific Highway and Ellis Street to assist with down-wash effects.

Level 2

- Provisions should be made to consider an awning over the northern and western terrace areas.

- Recommended inclusion of a 1.8-2.0m high screen along the western end of the northern terrace area.
- Recommended retention of the proposed landscaping along the northern, eastern and western aspect. The proposed shrubs should be of a densely foliating evergreen species and capable of growing to a height of at least 1m above a 0.5m planter box.

Level 4

- Provisions should be made to consider an awning over the eastern and southern terrace areas.
- Recommended retention of the proposed landscaping along the eastern aspect. The proposed shrubs should be of a densely foliating evergreen species and capable of growing to a height of at least 1m above a 0.5m planter box.

Level 14 and 15

- Recommended inclusion of a 1.8-2.0m high screen/louvres along the eastern and western end of the terrace areas. Note: full height louvres included on the eastern aspect are recommended to be orientated in a south-east to north-west direction. Full height louvres are included on the western aspect are recommended to be orientated in a north-east to south-west direction.
- Recommended retention of the proposed landscaping along the southern aspect. The proposed shrubs should be of a densely foliating evergreen species and capable of growing to a height of at least 1m above a 0.5m planter box.

Level 16

- Recommended retention of the proposed landscaping along the southern aspect. The proposed shrubs should be of a densely foliating evergreen species and capable of growing to a height of at least 1m above a 0.5m planter box.
- Recommended that the full height louvres located on the western aspect be orientated in a north-east to south-west direction to mitigate the westerly winds.

Private Balconies

- Recommended that full-height screens/louvres be included along the shorter aspect of the south-west balcony areas.
- Impermeable balustrades to be incorporated along the perimeter of all the private balcony areas.

Further wind tunnel testing is being undertaken as part of the detailed design phase of the subject development. This will provide a quantitative analysis of the wind conditions within and around the development and verify the effectiveness of the recommended treatments.

CONTENTS

1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development has been carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing has been undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The development site is located at 15 Ellis Street & 753 Pacific Highway, Chatswood. The site is bounded by Crispe Lane to the east, Ellis Street to the south, Pacific Highway to the west and a mid-rise building to the north. To the north of the site is a mix of mid-rise and high-rise commercial buildings. The site is bounded by a mixture of low-rise and mid-rise residential buildings to the east, south and west. Chatswood Park is also located in close proximity to the east of the site.

A survey of the local land topography indicates that there is at downward slope in the terrain from north to south. Similarly, the terrain slopes downward from west to east across the site. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The proposed residential development consists of 5 Basement levels and 18 Floor levels inclusive of the Ground level. Ground and Level 1 consists of commercial spaces. Levels 2 to 15 is assigned for residential use. Level 16 is assigned for residential amenities, including a pool, and common area.

The building has an almost rectangular planform with a tiered setback design. The critical trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are detailed as follows:

- The pedestrian footpath along Crispe Lane, Ellis Street and Pacific Highway
- Level 2 Terrace area
- Level 4 Terrace area
- Level 14 and 15 Terrace area
- Level 16 Communal Terrace area
- All private balconies and terraces throughout the development

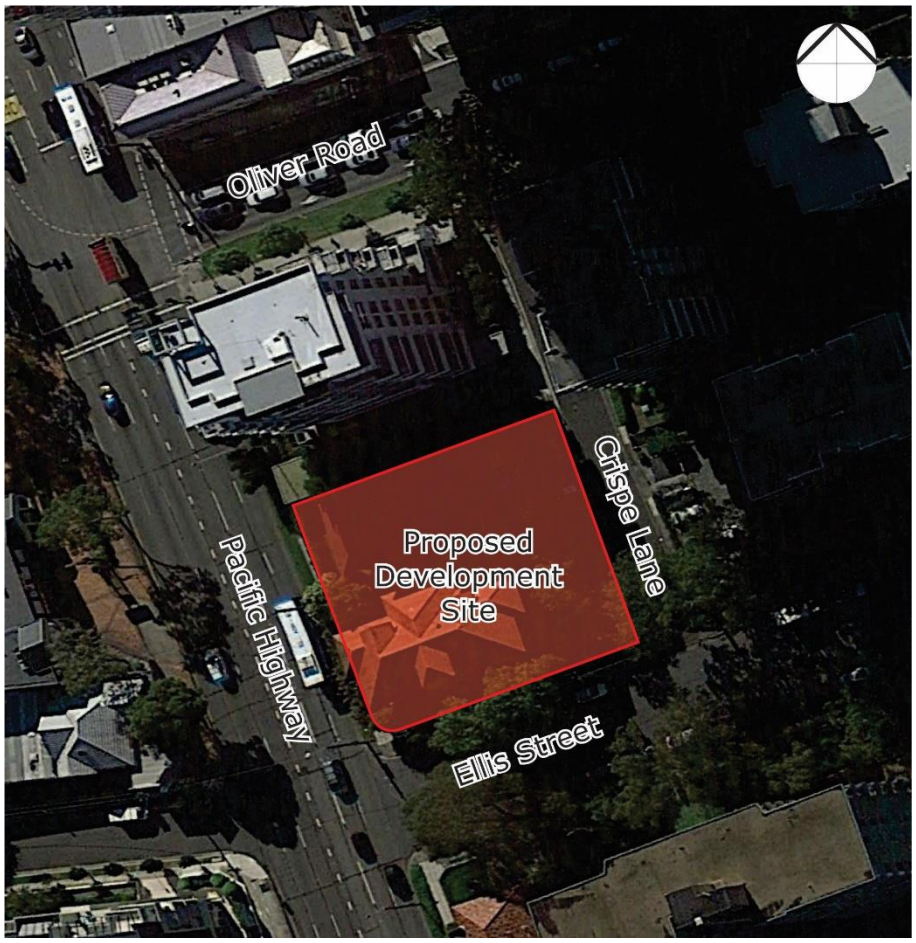

Figure 1: Aerial Image of the Site Location

3 REGIONAL WIND

The Sydney region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1995 to 2016). From this analysis, directional probabilities of exceedance and directional wind speeds for the region are determined. The directional wind speeds and corresponding directional frequencies of occurrence are presented in Figure 2.

As shown in Figure 2, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, 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 Sydney region, and hence are usually welcomed within outdoor areas since they are typically not as strong as the southerly or westerly winds.

Table 1: Principal Time of Occurrence of Winds for the Sydney Region

Month	North-Easterly Winds	Southerly Winds	Westerly Winds
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	

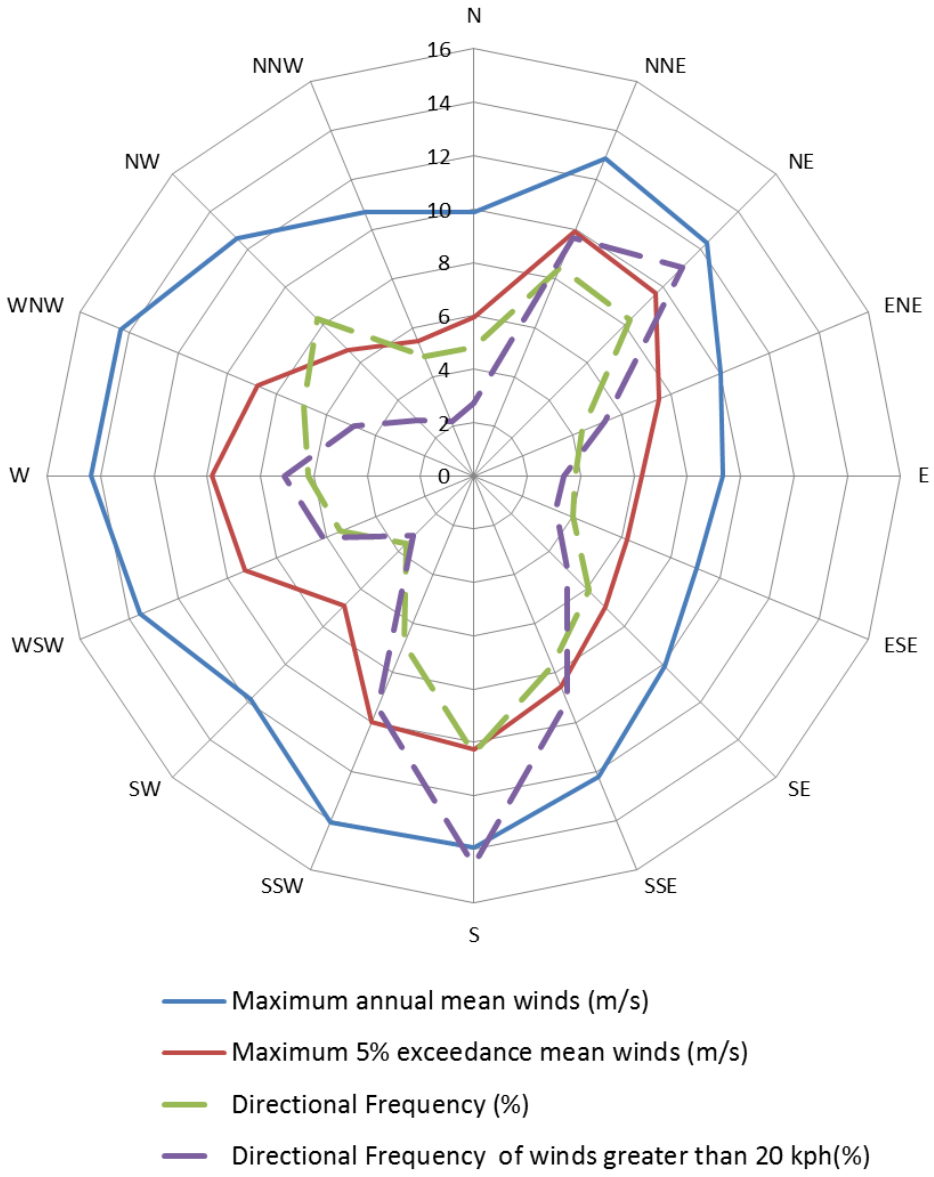

Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (referenced to 10m above ground in standard open terrain)

4 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 2 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 2: 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.

It should be noted that wind speeds can only be accurately quantified with a wind tunnel study. 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 (rather than referencing specific wind speeds). Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

5 RESULTS AND DISCUSSION

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.

5.1 Ground Level Pedestrian Accessible Areas

The prevailing winds for the Sydney region are the north-easterly, southerly and westerly winds. The site is generally shielded from the winds approaching from the north and north-east due to the mid to high rise buildings. However, the southerly and westerly winds have the potential to impact the site due to the limited shielding from these directions.

Due to the height of the development there is the potential for the predominant winds to be captured by the tower and downwash towards the pedestrian footpath areas. The ground level areas will benefit from the Level 2 northern and western aspect setback, and the Level 4 eastern and southern setback. The setback design is expected to assist in disturbing the prevailing winds from downwashing off the tower façade above. The wind conditions along the pedestrian footpath area on Crispe Lane are expected to benefit from the general shielding of the north-easterly winds due to the built-up form of the surrounding mid and high rise buildings and the setback design of the tower.

Due to the alignment of the Pacific Highway and Freeman Road it is expected that these predominant winds will be directed towards the pedestrian footpath areas of the site. Similarly, there is the potential for the westerly and southerly winds to be captured by the façade, side-stream and accelerate around the south-western corner of the development. Consideration should be made to incorporate a ground level awning along the southern and western aspects to assist with any downwashed winds. It is recommended to retain the existing street trees and proposed ground level trees and landscaping. The trees should be of a dense evergreen species capable of growing to a height of at least 3-5m with a minimum of a 3m wide canopy. The proposed shrubs should be of an evergreen densely foliating species and capable of growing to a height of at least 1-1.2m above a 0.5m planter box.

5.2 Level 2 Terrace Areas

Due to the height of the development there is the potential for the predominant north-easterly and westerly winds to be captured by the tower and downwash towards the Level 2 private

terrace areas. The site benefits from some degree of shielding of the north-easterly winds due to the built-up form of the surrounding mid and high rise buildings.

The predominant westerly winds have the potential to be captured by the western façade, due to limited shielding, and downwash towards the private terrace areas. Concurrently, the westerly winds have the potential to funnel between the development and the site to the north, resulting in potential adverse wind conditions along the northern terrace area.

Consideration should be made to incorporate an awning over the northern and western Level 2 terrace areas to assist with mitigating down wash effects. Similarly, it is recommended to incorporate a 1.8-2.0m high screen along the western end of the northern terrace area to assist with mitigating the westerly and southerly winds that have the potential to funnel along the northern terrace area.

It is recommended to retain the proposed landscaping plan along the perimeter as outlined in the Level 2 floor plan. The proposed shrubs should be of an evergreen densely foliating species and capable of growing to a height of at least 1m above a 0.5m planter box.

5.3 Level 4 Terrace Areas

Similar to Level 2 recommendations, the height of the development has the potential for the predominant north-easterly and southerly winds to be captured by the tower and downwash towards the Level 4 private terrace areas. The site benefits from some degree of shielding of the north-easterly winds due to the built-up form of the surrounding mid and high rise buildings. The predominant southerly winds have the potential to be captured by the southern façade, due to limited shielding, and downwash towards the private terrace areas. Consideration should be made to incorporate an awning over the eastern and southern Level 4 terrace areas to assist with mitigating down wash effects.

It is recommended to retain the proposed landscaping plan along the perimeter as outlined in the Level 4 floor plan. The proposed shrubs should be of an evergreen densely foliating species and capable of growing to a height of at least 1m above a 0.5m planter box.

5.4 Level 14 and 15 Terrace Areas

The Level 14 and 15 terrace areas are exposed to the southerly and westerly winds which have the potential to directly impact these areas, due to limited shielding. These winds have the potential to cause adverse wind conditions due to corner accelerating winds at the south-east and south-west corners. It is recommended to retain the proposed landscaping plan along the southern perimeter as outlined in the floor plans. The proposed shrubs should be of an evergreen densely foliating species and capable of growing to a height of at least 1m above a 0.5m planter box.

Consideration should be made to incorporate 1.8-2.0m high screens/louvres along the eastern and western ends of the Level 14 and 15 terrace areas to assist in mitigating the westerly and southerly winds. If full height louvres are included on the eastern aspect it is recommended they be orientated in a south-east to north-west direction. If full height louvres are included on the western aspect then it is recommended they be orientated in a north-east to south-west direction.

5.5 Level 16 Communal Area

The Level 16 Communal area benefits from the inclusion of full height adjustable louvres located on the northern and western perimeter and the inclusion of a full height screen along the eastern perimeter. It is recommended that the full height louvres located on the western aspect be orientated in a north-east to south-west direction to mitigate the westerly winds from accelerating around the south-western building corner.

The Communal area is exposed to the predominant southerly winds, due to limited shielding. The southerly winds are expected to stagnate within the area, due to the single aspect design.

It is recommended to retain the proposed landscaping plan along the southern perimeter as outlined in the Level 16 floor plan. The proposed shrubs should be of an evergreen densely foliating species and capable of growing to a height of at least 1m above a 0.5m planter box.

5.6 Residential Private Balconies

A number of private balconies from Levels 2-13 benefit from the recessed design into the tower form as well as the inclusion of full height louvres, which is beneficial. The south-west corner balconies on Levels 3-13 are exposed to the prevailing winds from the southerly and westerly directions. The prevailing westerly winds have the potential to accelerate across the balcony areas. It is recommended that full-height screens/louvres be included along the shorter aspect of the balcony areas, therefore transforming the space into a single aspect design. If full height louvres are included along the shorter aspect of the south-west balconies then it is recommended they be orientated in a north-east to south-west direction.

It is recommended that impermeable balustrades be incorporated along the perimeter of all the private balcony areas.

Further wind tunnel testing is being undertaken as part of the detailed design phase of the subject development. This will provide a quantitative analysis of the wind conditions within and around the development and verify the effectiveness of the recommended treatments.

6 REFERENCES

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