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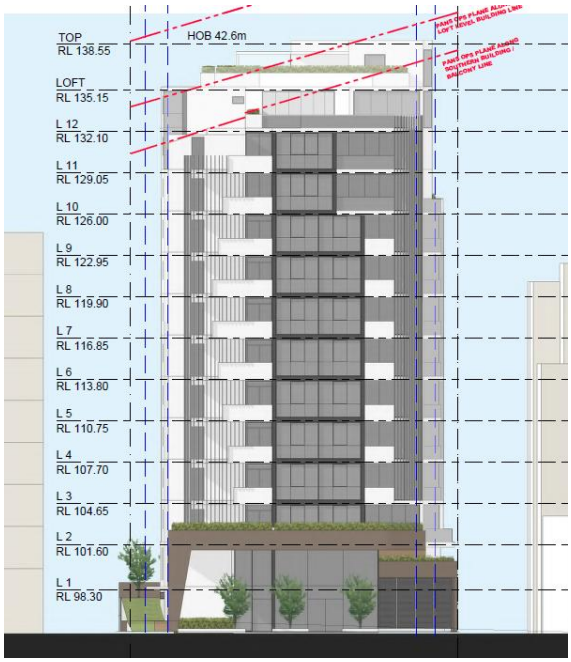

WIND IMPACT ASSESSMENT REPORT

3 ELLIS ST , CHATSWOOD

WG647-01F02(REV0)- WS REPORT

OCTOBER 29, 2021

Prepared for:

MPG AU Pty Ltd

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DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
October 29, 2021	Final	0	ALG	TR	TR

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the apartment development, located at 3 Ellis Street, Chatswood, on the local wind environment at the critical outdoor areas within and around the subject site. The effect of wind activity has been examined for the three predominant wind directions for the region, namely the north-easterly, southerly, and westerly winds. The analysis of the wind effects relating to the proposed development have been 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 of the architectural drawings provided (received 27 October 2021). 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 development has incorporated several design features and wind mitigating strategies and is expected to be suitable for the intended use for the majority of the outdoor trafficable areas. However, there are some areas that are likely to be exposed to stronger 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 trafficable areas:
    - Planting of 2 small evergreen trees either side of the commercial entry.
- Level 2 north-eastern balcony:
    - 2m high impermeable door.
- Level 10 north-eastern balcony:
    - 2m high impermeable door.
- Level 12:
    - Densely foliating evergreen shrubs along the western edge of the southern balcony.
    - Use of impermeable balustrades.
- Roof Terrace:
    - Dense evergreen hedge planting within proposed planter box along the perimeter of the terrace, minimum 1.5m height above that level.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development will be suitable for their intended uses, and that the wind speeds will satisfy the applicable criteria for pedestrian comfort and safety.

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 DEVELOPMENT AND SURROUNDINGS

The site is located at 3 Ellis Street, Chatswood, and is bounded by Ellis Street to the south, Frank Channon Walk to the east, immediately adjacent to the site is an eight storey apartment to the west and north-east, and a nine storey apartment to the north-west. Further away, the buildings surrounding the subject development are a mixture of low-rise and mid-rise residential and commercial buildings, with a few high-rise commercial buildings to the north.

A survey of the land topography indicates a gradual slope upwards towards the north-west, however, there are no major elevation changes in the area immediately surrounding the site.

An aerial image of the subject site and the local surroundings is shown in Figure 1, with the frequency and magnitude of the prevailing winds is superimposed for each wind direction.

The existing site consists of 4 storey residential building. The proposed development is 14 storeys high.

The critical outdoor trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are listed as follows:

- Ground Level areas and pedestrian footpath.
- Communal Open Space on Level 1.
- Private balconies.
- Roof terrace.

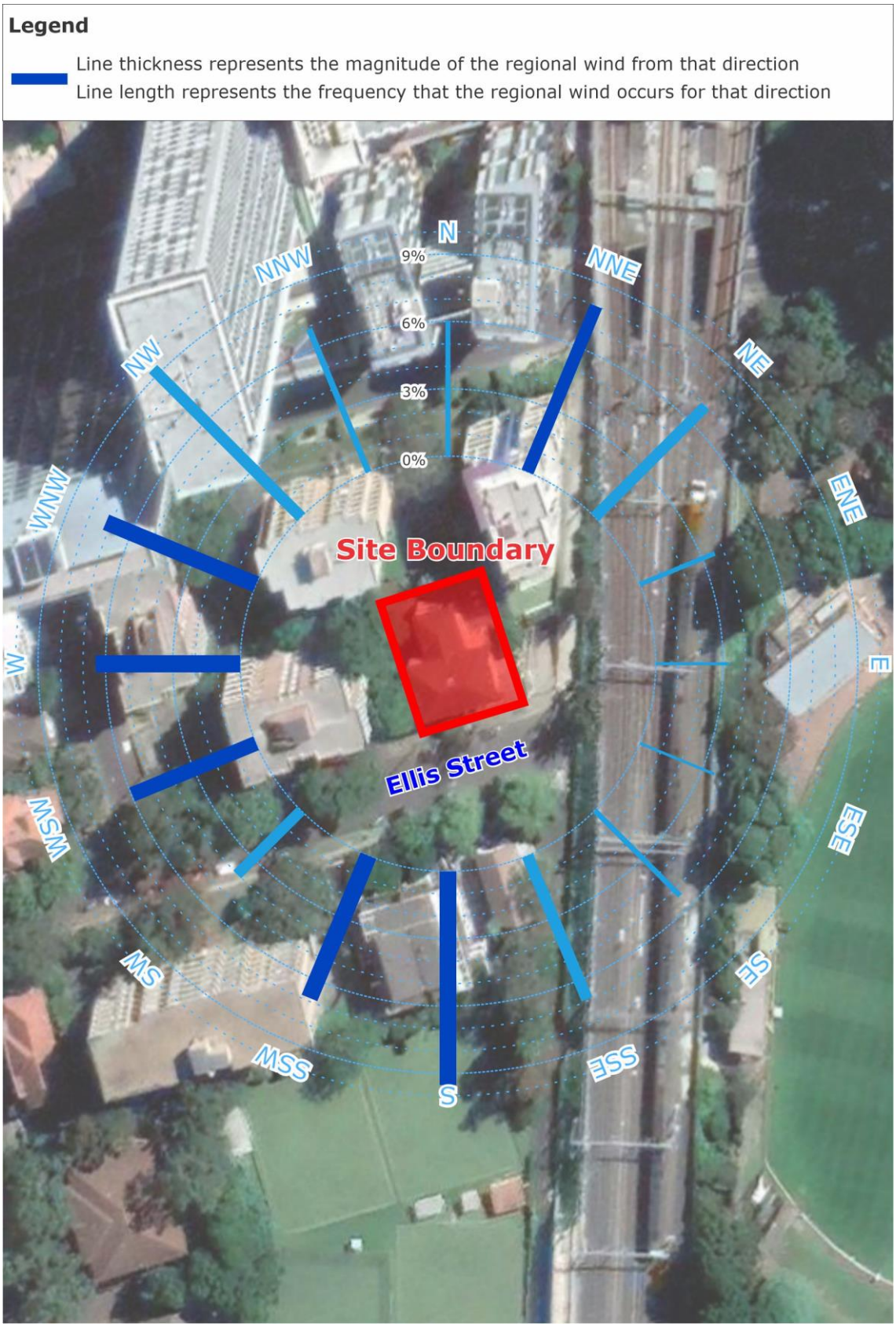

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The Sydney region is governed by three principal wind directions that can potentially affect the subject development. These winds prevail from the north-east, south, and west. These wind directions were determined from an analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained from the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1995 to 2016). The data has been corrected to represent winds over standard open terrain at a height of 10m above ground level. The results of this analysis are presented in Figure 2 in the form of a directional plot of the annual and 5% exceedance mean winds for the region. The frequency of occurrence of these winds is also shown in Figure 2.

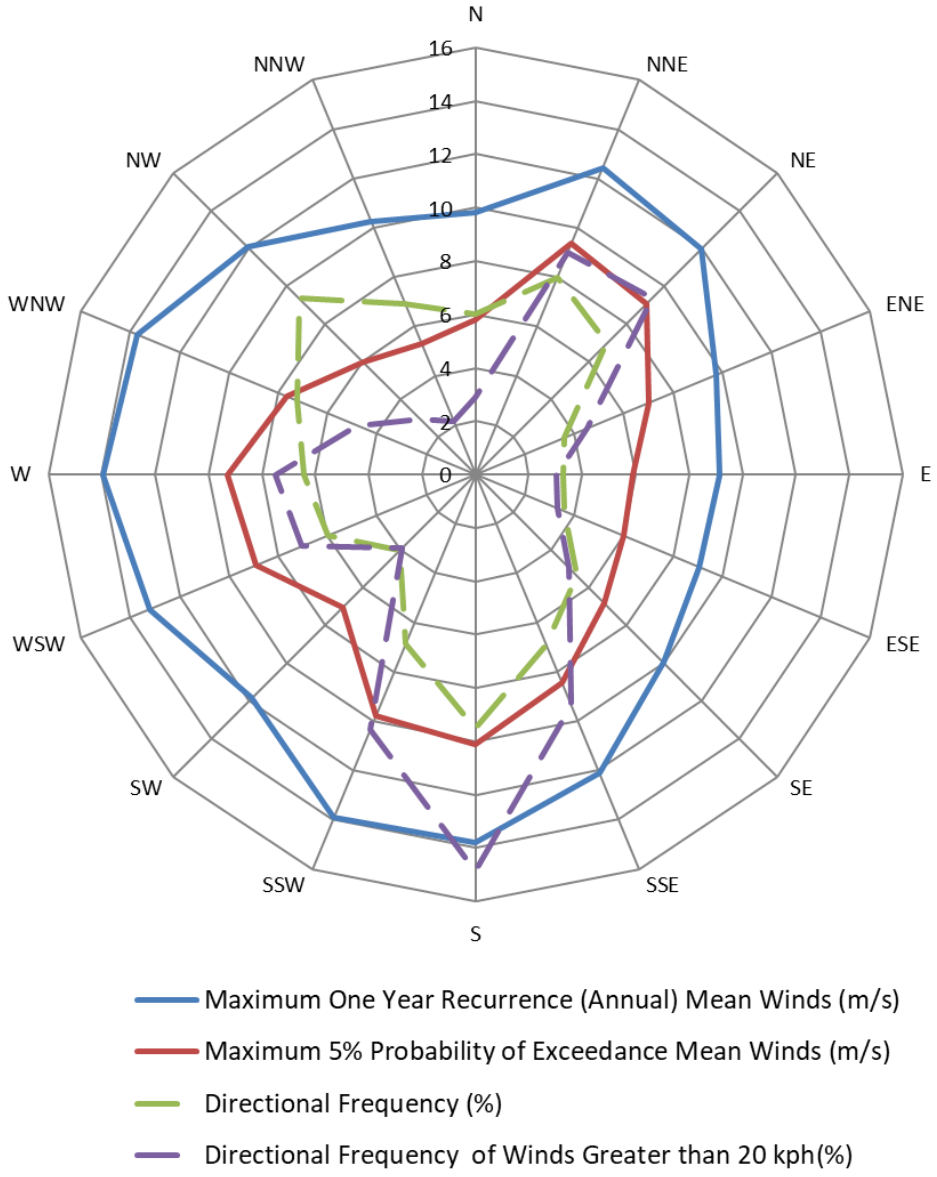

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Sydney Region

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 1 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 1: 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 affecting this particular development 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. 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 affecting the development 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. A glossary of the different wind effects described in this report included in Appendix A.

For this assessment, the wind speed criteria for pedestrian comfort that are considered are listed as follows:

- Comfortable Walking Criterion (7.5m/s to 8m/s with a 5% probability of exceedance) for general circulation and pedestrian thoroughfares, e.g. footpaths, private balconies/terraces, through-site links etc.

- Short Exposure Criterion (5.5m/s to 6m/s with a 5% probability of exceedance) for stationary activities generally less than an hour, e.g. waiting areas, communal terraces, main entries, café seating etc.

Note that the lower end of the above ranges reflect the Davenport (1972) criteria and the upper end of these ranges reflect a modified Lawson (1975) criteria. Although this assessment is qualitative in nature, the abovementioned criteria for pedestrian comfort are considered when assessing the wind environment impacts. However, all areas are also assessed with consideration to a pedestrian safety criterion of 23m/s for the annual maximum gust.

5.1 Ground Level Areas

The westerly winds are expected to be side-streamed by the adjacent building to the west of the subject site. However, this effect is expected to be ameliorated by the existing large trees upstream on Ellis Street. The subject development is partially shielded from the westerly winds by the adjacent 8-level building and will not impact ground level conditions as a result.

The pedestrian footpath along Ellis Street is generally shielded from the north-easterly by the upstream buildings. This location is exposed to the prevailing southerly winds. It is expected that some downwash effects would be partly mitigated by the recessed design of the southern façade. To provide improved amenity for the entry to the commercial tenancy and the main entry to the building, it is recommended to plant a small densely foliating evergreen tree, capable of growing to a height of 2 to 3m, either side of the commercial entry as indicated in Figure 3.

The pedestrian footpath and turfed lawn on the eastern aspect of the development are directly exposed to the southerly prevailing winds. The subject development will not adversely impact the current wind conditions. It is noted that a wall and line of planting currently lines the southern edge of the lawn area, this is expected to provide the necessary protection from the southerly winds. The proposed development will not adversely impact the wind conditions in the lawn area.

This location receives partial shielding from the north-easterly prevailing winds from the neighbouring apartment to the north-east which separates the flow from this location as seen in Figure 8.

The pedestrian footpaths along the northern and western aspects of the development are shielded from the north-easterly and westerly prevailing winds from the neighbouring developments to the north and west, respectively. The recommended tree planning shown in Figure 3 below for the south-eastern corner of the base of the tower will also assist in ameliorating the site impact form the north-easterly winds at that corner.

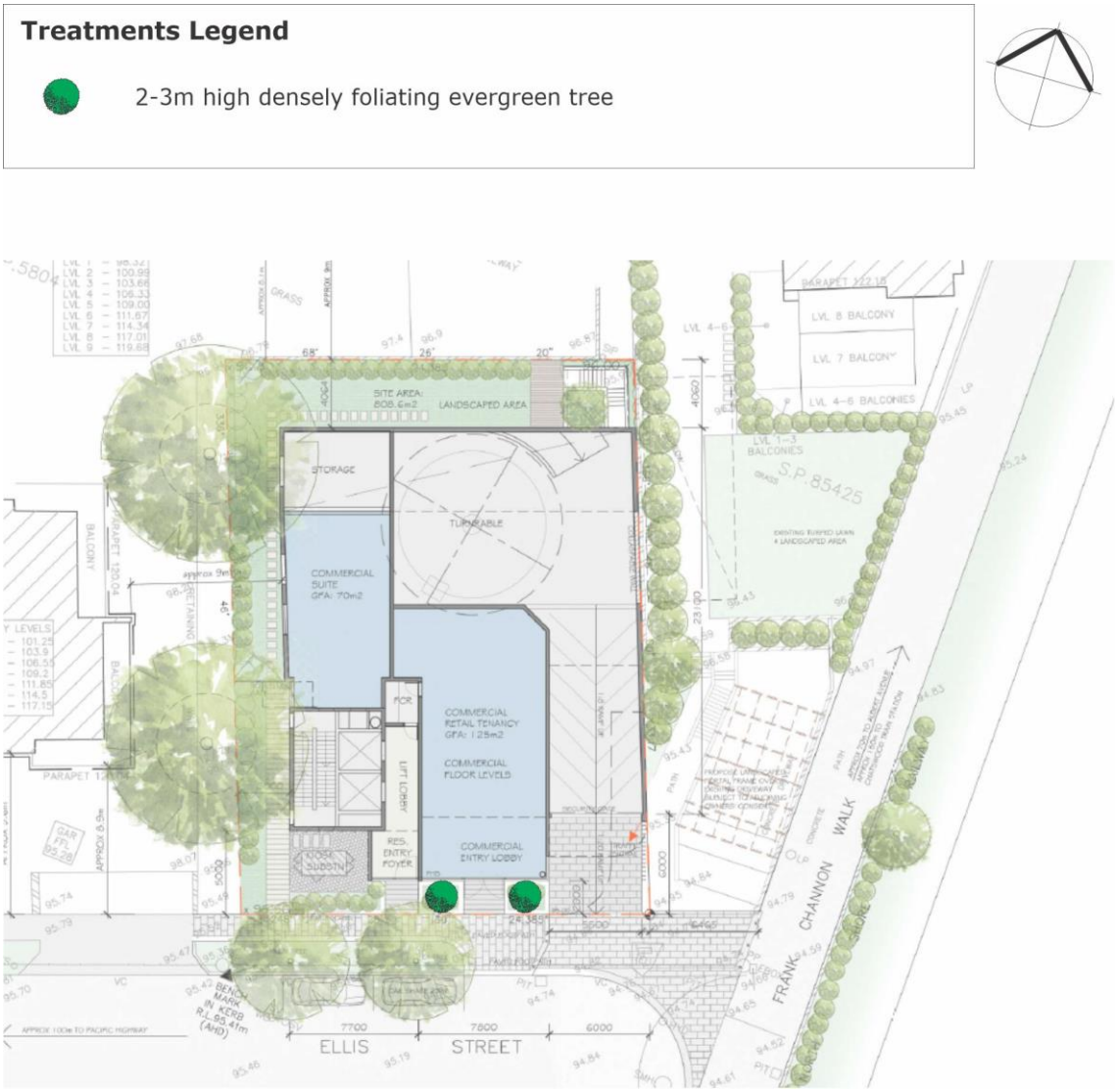

Figure 3: Recommended Treatment for the Ground Level

5.2 Communal Open Space

The Communal Open Space is located on the northern aspect of Level 1 and the proposed plan incorporates significant landscaping around the northern, eastern, and western perimeter. The proposed planting within the landscaping zones should be of an evergreen species and densely foliating to provide year-round protection. The communal space is shielded from the prevailing southerly winds due to the location within the built form, as well as the prevailing north-easterly winds due to the neighbouring development.

5.3 Private Balconies

The majority of balconies on the development are expected to be suitable for their intended use due to the inclusion of various wind mitigation features such as impermeable balustrades, proposed perimeter planting and exposure to a single aspect. In particular, a majority of balconies on the southern aspect are recessed on the western side. Furthermore, the neighbouring developments will provide shielding for balconies on Level 9 and below from the prevailing westerly winds with partial shielding of the north-easterly prevailing winds which will only impact the eastern aspect.

The wrap-around balconies on Level 2 and Level 10 at the north-eastern corner is potentially exposed to the north-easterly prevailing winds. As the balcony is exposed to two aspects there is the potential for the north-easterly wind to accelerate around the corner, creating adverse conditions. A door is recommended at this location to mitigate this effect as seen in Figures 4 and 5. It is crucial that this door opens to the south to maximise its effect or be of a bifold design.

The balcony on the southern aspect of Level 12 is exposed to the westerly and southerly prevailing winds. The inclusion of impermeable balustrades around the perimeter will assist in shielding the balcony from the southerly prevailing winds. It is recommended that the landscaping on the western aspect include 1.5m high densely foliating evergreen shrubs to mitigate the westerly prevailing winds.

5.4 Roof Terrace

The roof terrace is exposed to all prevailing wind directions due to the limited shielding from the neighbouring properties. The terrace receives partial shielding of the north-easterly prevailing winds from the built form of the loft located at the north-eastern aspect of the floor plan. It is recommended that the proposed perimeter planting is retained and consist of densely foliating evergreen hedges/shrubs to provide mitigation throughout the year. The total height of the hedges and planter box should be at least 1.5m from the floor slab.

Figure 4: Recommended Treatment for Level 2 Balconies

Figure 5: Recommended Treatment for Level 10 Balconies

Figure 6: Recommended Treatment for the Level 12 Balconies

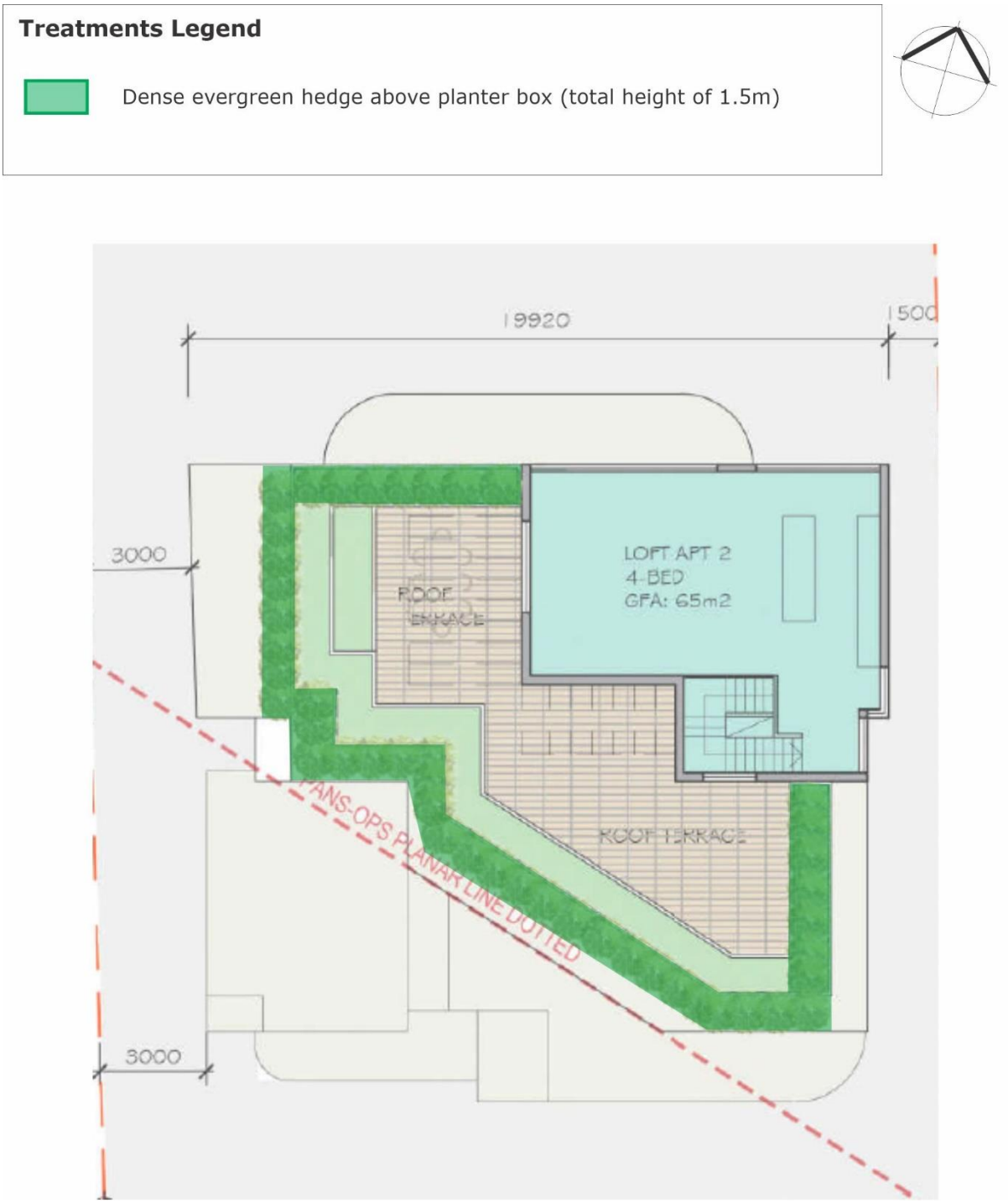

Figure 7: Recommended Treatment for the Roof Terrace

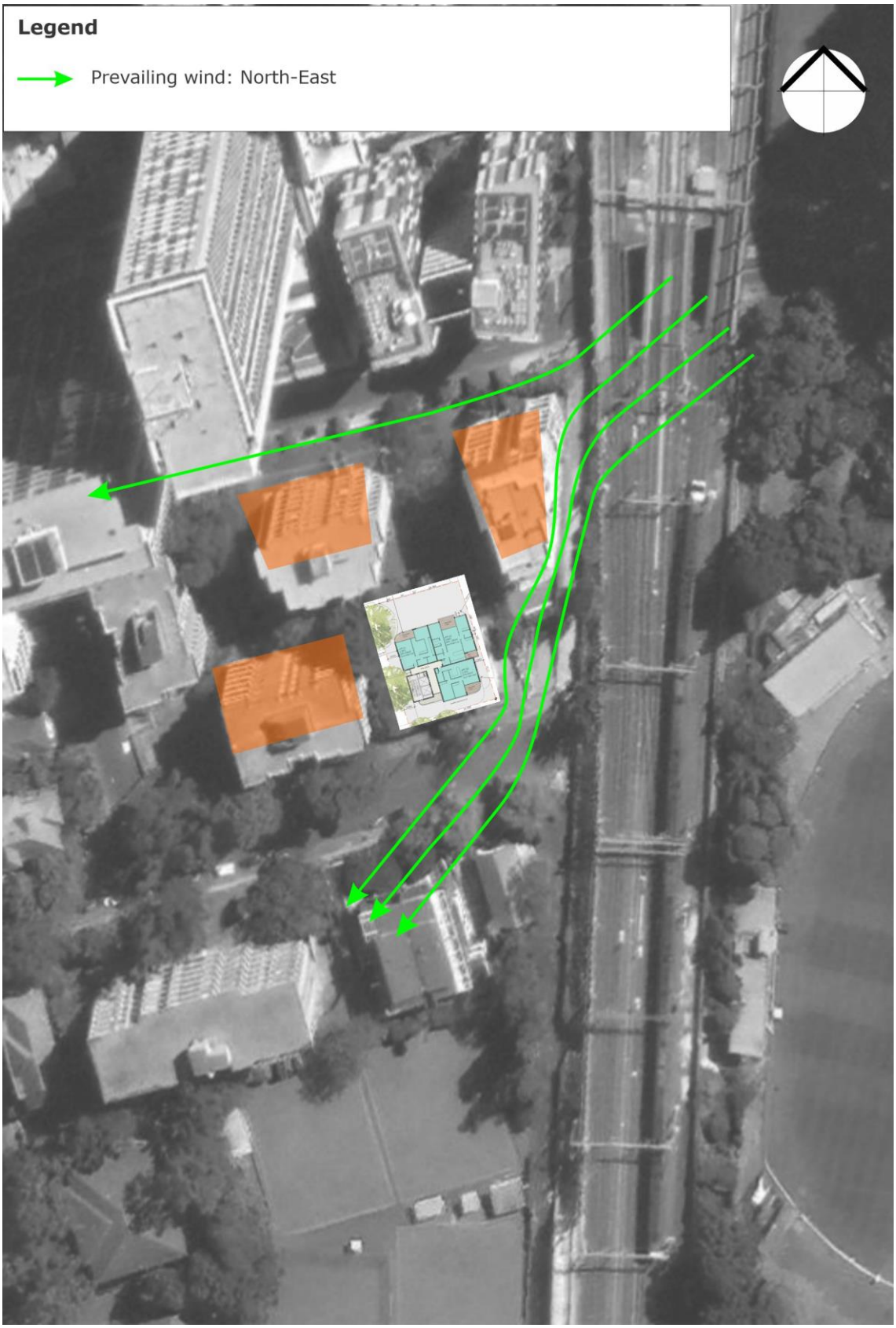

Figure 8: Flow Diagram for the Prevailing North-Easterly Winds

Figure 9: Flow Diagram for the Prevailing Westerly Winds

Figure 10: Flow Diagram for the Prevailing Southerly Winds

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APPENDIX A WIND EFFECTS GLOSSARY

A.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the windward face of a building, causing accelerated winds at pedestrian level. This can lead to other adverse effects as corner acceleration as the wind attempts to flow around the building, as seen in Figure A.1.

This can also lead to recirculating flow in the presence of a shorter upstream building, causing local ground level winds to move back into the prevailing wind.

The upwash effect occurs near upper level edge of a building form as the wind flows over the top of the building. This has the potential to cause acceleration of winds near the leading edge, as well as potentially reattaching onto the roof area. This effect causes wind issues particularly near the leading edges of tall building and on the rooftop areas if there is sufficient depth along the wind direction. Upwash is more apparent in taller towers and podia.

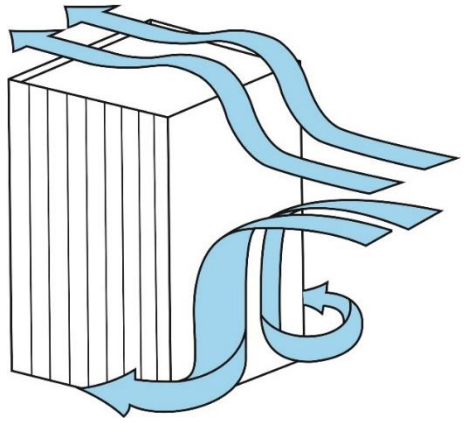

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

A.2 Funnelling/Venturi Effect

Funnelling occurs when the wind interacts with two or more buildings which are located adjacent to each other, which results in a bottleneck, as shown in Figure A.2. This causes the wind to be accelerated through the gap between the buildings, resulting in adverse wind conditions and pedestrian discomfort within the constricted space. Funnelling effects are common along pedestrian links and thoroughfares generally located between neighbouring buildings that have moderate gaps between them.

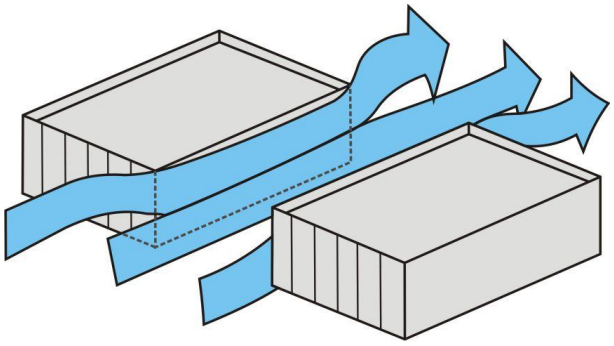

Figure A.2: Funnelling/Venturi Wind Effect

A.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A.3. This can involve a combination of funnelling and downwash effects. Presenting a small gap in the façade on the windward aspect as the easiest means through which the wind can flow through can result in wind acceleration through this gap. The pressure difference between the windward façade and the leeward façade also tends to exacerbate the wind flow through this gap.

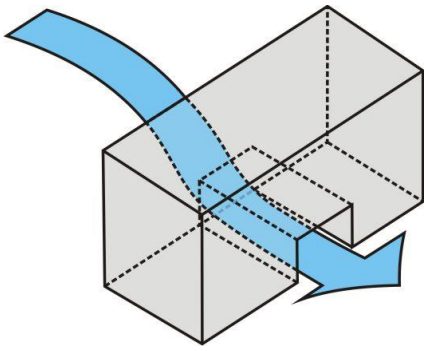

Figure A.3: Gap Wind Effect

A.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of wind shearing along the building façade that eventuates in an acceleration corner effect. The flow is parallel to the façade and can be exacerbated by downwash effects as well, or due to corner effect winds reattaching on the façade.

This is shown in Figure A.4. The corner refers to the acceleration of wind at the exterior vertical edge of a building, caused by the interaction of a large building massing with the incident wind, with the flow at the corner being accelerated due to high pressure differentials sets up between the windward façade and the orthogonal aspects. It can be further exacerbated by downwash effects that build up as the flow shears down the façade.

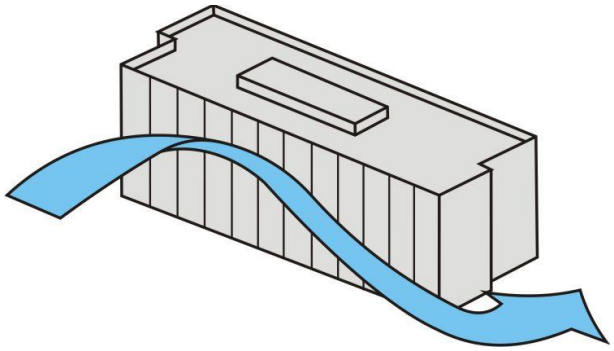

Figure A.4: Sidestream and Corner Wind Effect

A.5 Stagnation

Stagnation in a region refers to an area where the wind velocity is significantly reduced due to the effect of the flow being impeded by the bluff body. For a particular prevailing wind direction, this is typically located near the middle of the windward face of the building form or over a short distance in front of the windward face of a screen or fence. Concave building shapes tend to create an area of stagnation within the cavity, and wind speeds are generally low in these areas.