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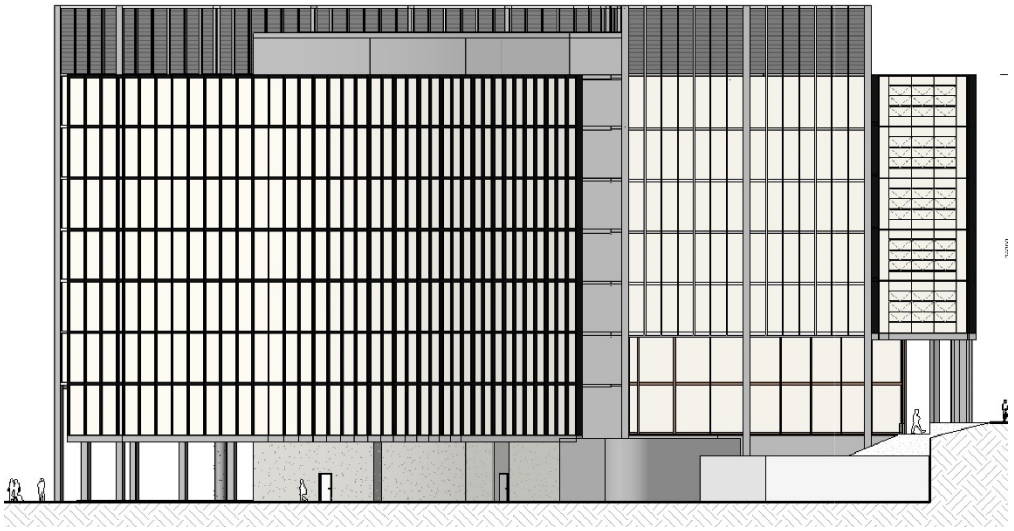

PEDESTRIAN WIND ENVIRONMENT STATEMENT

1A CONSTITUTION AVENUE, CANBERRA

WI336-01F02(REV0)- WS REPORT

FEBRUARY 13, 2024

Prepared for:

CANBERRA INTERNATIONAL AIRPORT

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the 1A Constitution Avenue, located in Canberra, 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 northerly, north-westerly, 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 25 January 2024). 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:
    - Retention of the building setback on Ground Level along the northern, western, and southern aspects.
    - Retention of the proposed trees on the southern aspects of Ground Level.
    - Inclusion of additional densely foliating evergreen trees (ensuring a height and width of 3-5m) on the western aspects of Ground 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, of the architectural drawings provided (received 25 January 2024 as shown in Table 1), and any recommendations in this report are made only in-principle.

Table 1: List of Architectural Drawings Referenced

Drawing Name	Drawing Number	Date
Layout Plan - Ground Level Plan	A03.00G	25/01/2024
Layout Plan - Basement 01 Plan	A03.0B1	25/01/2024
Layout Plan - Basement 02 Plan	A03.0B2	25/01/2024
Layout Plan - Level 01 Plan	A03.001	25/01/2024
Layout Plan - Level 02 Plan	A03.002	25/01/2024
Layout Plan - Level 03-07 Plan	A03.003	25/01/2024
Layout Plan - Level 8 Plant	A03.008	25/01/2024
Layout Plan - Roof Plan	A03.009	25/01/2024
North & East Elevations	A09.000	25/01/2024
South & West Elevations	A09.001	25/01/2024
Section - East - West	A10.000	25/01/2024
Section - North - South	A10.001	25/01/2024

2 DESCRIPTION OF DEVELOPMENT AND SURROUNDINGS

The site is located at 1A Constitution Avenue and is bounded by Vernon Circle to the west, Constitution Avenue to the south, and Theatre Lane to the north and east. The buildings surrounding the subject development are predominately low to mid rise commercial buildings located north to south-east, and open land on the west and south.

A survey of the land topography indicates a gradual slope towards the south-west, with an elevation change of roughly 5m along the south elevation.

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 open land. The proposed development is 8 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 trafficable areas.

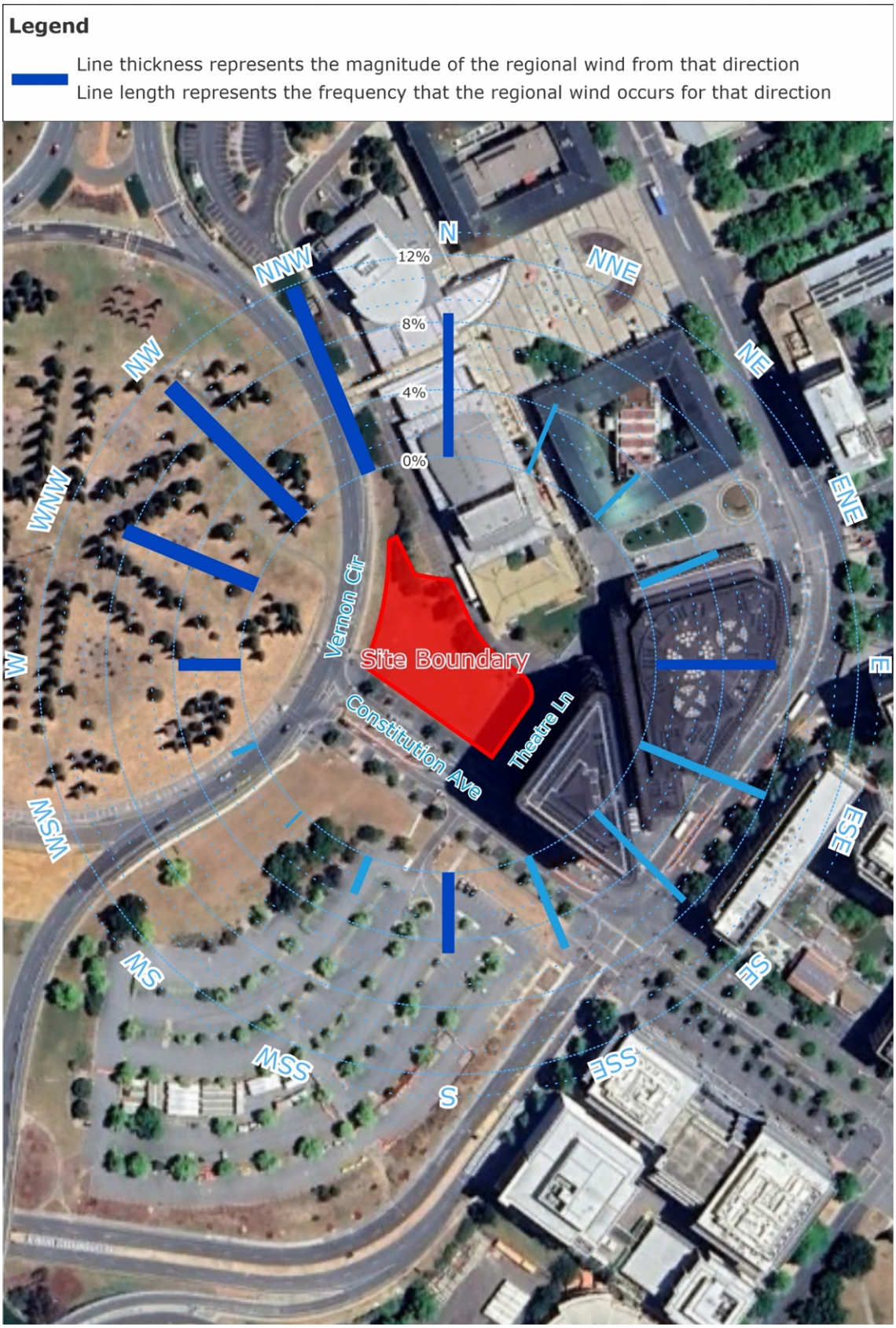

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

3 REGIONAL WIND

The Canberra region is governed by three principal wind directions that can potentially affect the subject development. These winds prevail from the north, north-west 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 Canberra Airport by the Bureau of Meteorology (recorded from 2010 to 2022). 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.

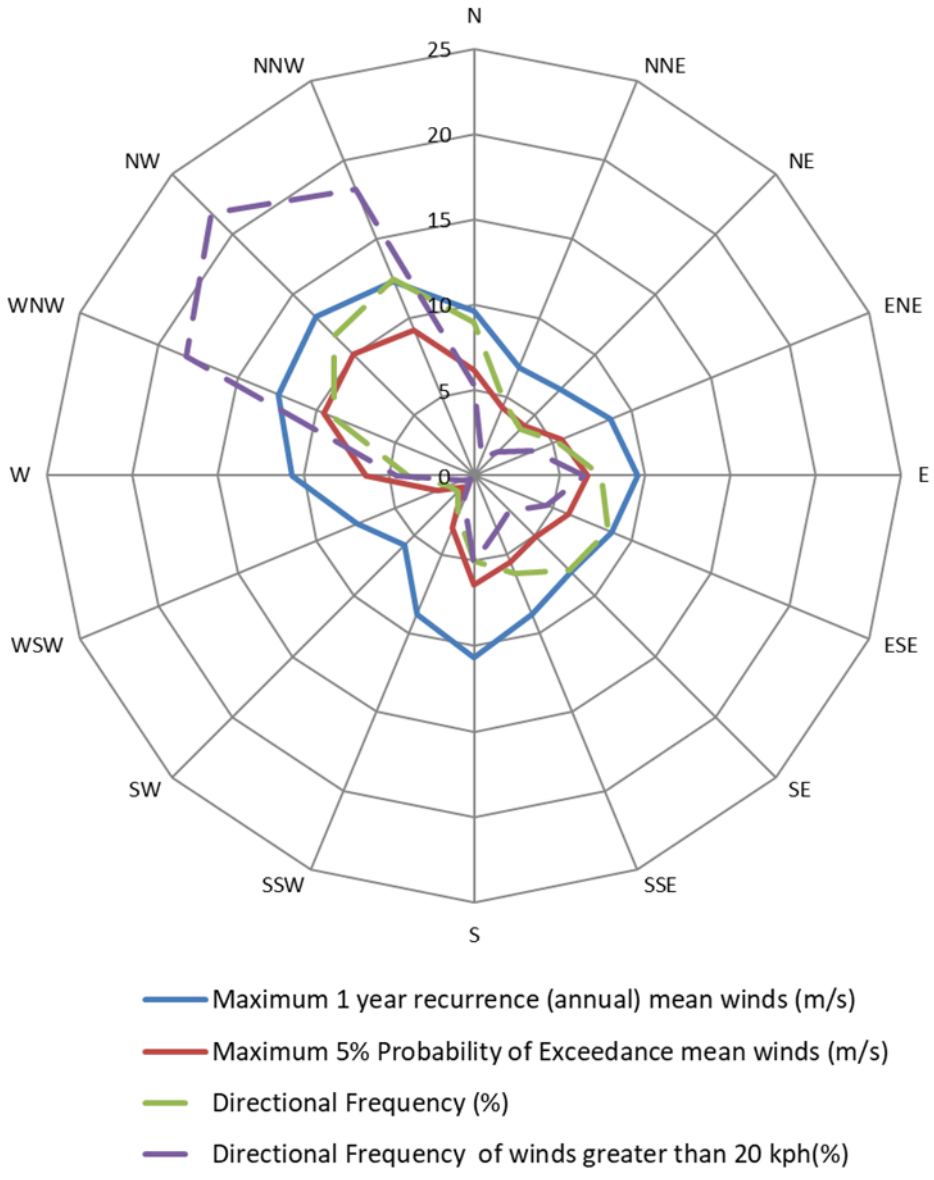

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Canberra Region

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 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 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:

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

- Standing (Short Exposure) Criterion (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 above wind comfort levels are derived from the 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 Ground Level trafficable areas are exposed to the prevailing northerly, north-westerly and westerly winds. The proposed development benefits from minor shielding from the northerly winds due to the buildings located north of the development. The winds coming from the northerly direction are expected to funnel between the proposed development and the adjacent 'Theatre Centre' building. However, this funnelling effect is not expected to have a major impact along the eastern aspects of the Ground Level areas and thus the area is expected to remain suitable for its intended use. Additionally, some downwash onto the Ground Level areas is expected from the northerly winds on the northern façade of the development. It is recommended to retain the building setback on Ground Level along the northern aspect to help mitigate this downwash effect. The north-westerly and westerly winds are expected to impact the western and southern aspect of the Ground Level areas mainly in the form of direct flow along Constitution Avenue. The westerly winds are also expected to impact the eastern façade of the 'Constitution Place' tower and downwash onto Knowles Place and Theatre Lane near the south-eastern aspect of the proposed development. To help mitigate these adverse wind affects, it is recommended to retain the setback on Ground Level along the western, southern, and eastern aspects. Additionally, it is also recommended to retain the proposed trees and to include the additional densely foliating evergreen trees (ensuring a height and width of 3-5m) to further improve the wind conditions from the prevailing north-westerly and westerly winds. The abovementioned treatments are shown in Figure 3 below.

With the above treatments incorporated into the design, it is expected that the wind environment in the trafficable ground level areas surrounding the development will meet the required safety and comfort criteria and be suitable for their intended use.

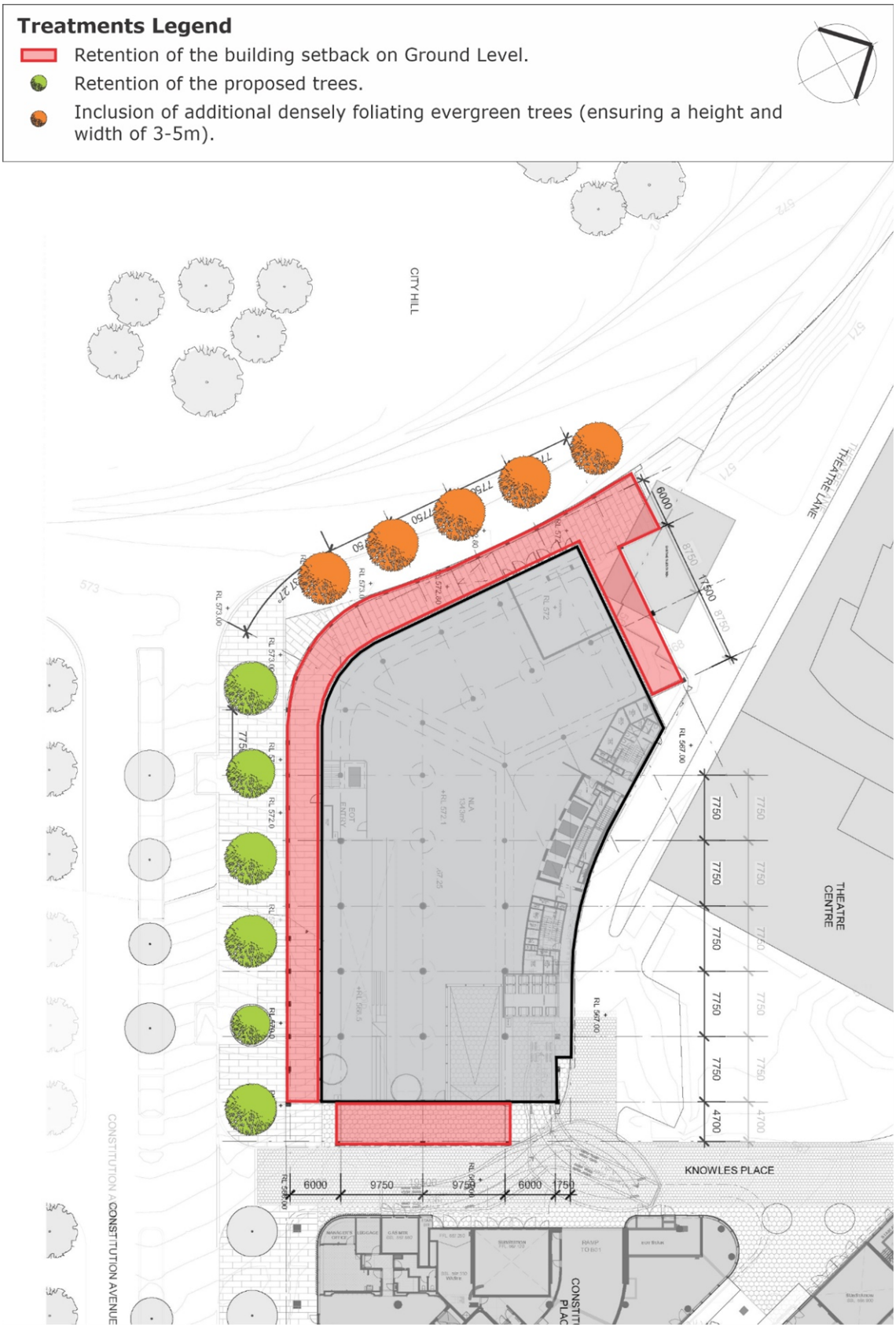

Figure 3: Recommended Treatment for the Ground Level

6 REFERENCES

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions". Colloquium on Building Climatology, Stockholm.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1980, "Wind Effects on Buildings - Volume 1, Design Applications". Applied Science Publishers Ltd, Ripple Road, Barking, Essex, England.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions". *Journal of Wind Engineering and Industrial Aerodynamics*, vol. 3, pp241-249.

Penwarden, A.D. (1973). "Acceptable Wind Speeds in Towns", Building Science, vol. 8: pp259–267.

Penwarden, A.D., Wise A.F.E., 1975, "Wind Environment Around Buildings". Building Research Establishment Report, London.

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.

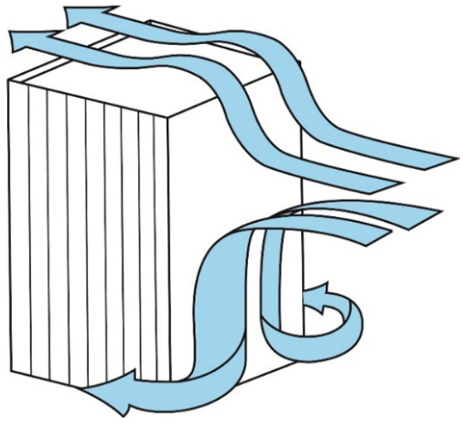

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

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.

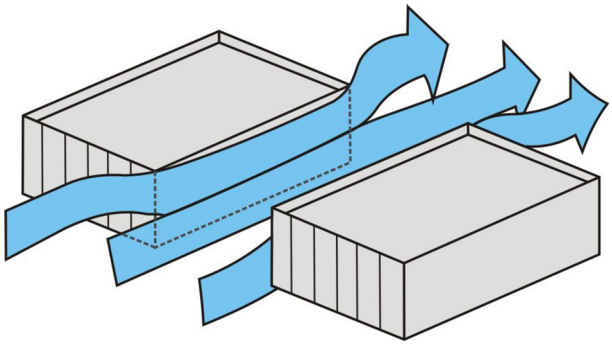

Figure A.2: Funnelling/Venturi Wind Effect

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.

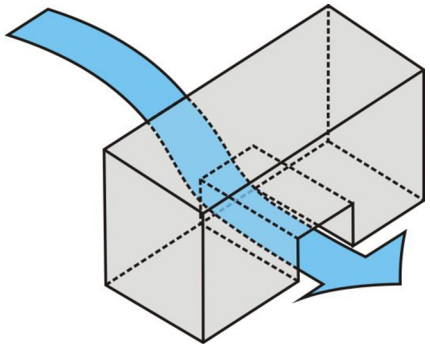

Figure A.3: Gap Wind Effect

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.

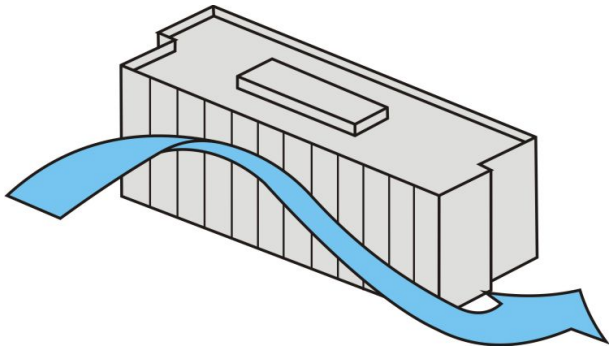

Figure A.4: Sidestream and Corner Wind Effect

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.