Appendix H
Pedestrian and Wind Environment Report

PEDESTRIAN WIND ENVIRONMENT STATEMENT

58 ANDERSON ST, CHATSWOOD

WE213-02F01(REV0)- WS REPORT

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the proposed development located at 58 Anderson 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 by Drew Dickson Architects (received 21 September 2020). 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, such as an awning over the main entry, setback from the site boundary, landscaping on the ground level and elevated areas, tower setback from the podium edge, impermeable balustrades, and a rooftop canopy. However, some of the outdoor trafficable areas remain exposed to adverse wind effects such as accelerating flows around the corners of the building, direct wind effects due to the lack of shielding from neighbouring developments, side-stream wind effects along the building façade, downwash wind effects off the building façade or funnelling wind effects between the podium and tower component of the development.

It is expected that the potentially adverse wind effects identified in the report can be improved with the inclusion/retention of the following treatment strategies:

Ground Level

- Densely foliating street trees and landscaping along the Anderson St and Wilson Street frontages of the site.
- Impermeable awning above the main entrance along the Anderson Street frontage of the site.

Level 2 Commercial Outdoor Area

- Full-height screen along the western perimeter edge.

Level 3 Residential Communal Open Space

- Screening around the perimeter of the outdoor trafficable areas.

- Impermeable awning extending from the base of the tower form.
- Densely foliating landscaping such as trees and/or shrubs.
- Localised mitigation measures such as screens, pergolas, shrubs/hedges for short duration stationary activities.

Level 4 Commercial Balconies

- Full-height screen along the western perimeter edge of northern corner balcony.
- Full-height screen along the southern perimeter edge of the south-eastern corner balcony.

Level 5-13 Private Balconies

- Full-height screen along the western perimeter edge of northern corner balconies.
- Full-height screen along the southern perimeter edge of the south-eastern corner balconies.

Level 14 Rooftop Terrace Communal Outdoor Space

- Screening around the perimeter of the outdoor trafficable areas.
- Strategic densely foliating landscaping, pergolas, and/or localised screening

Note that the recommended trees and landscaping should be of a densely foliating evergreen variety to maintain its effectiveness throughout the year. It is also recommended to have impermeable balustrades.

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.

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. Wind tunnel testing can be undertaken at a later, more detailed design stage to quantitatively assess the wind conditions on the outdoor trafficable areas within and around the site.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The development site is located at 58 Anderson Street, Chatswood and is bounded by Anderson Street to the east, Wilson Street to the south and the Northern Railway Line to the west. The development site is located at the juncture between the residential and CBD precinct of Chatswood. Towards the south are the medium to high-rise buildings of the Chatswood CBD with low-rise residential housing along the remaining boundaries. A survey of the local land topography indicates a generally rise to the west with a sudden drop at the site boundary due to the Northern Railway Line. An aerial image of the site and the surroundings is shown in Figure 1.

The development site is comprised of a singular 15-storey high mixed-use building with commercial tenancies proposed on the lower levels, with residential tenancies on the upper levels. The existing site is a 2-storey residential building.

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

- The Ground Level trafficable areas along Anderson Street and Wilson Street.
- The Commercial Outdoor Area on Level 2.
- The Residential Communal Open Space on Level 3.
- Commercial balconies on Level 4.
- Private balconies on Levels 5-13.
- The Communal Outdoor Space on Level 14 Rooftop Terrace.

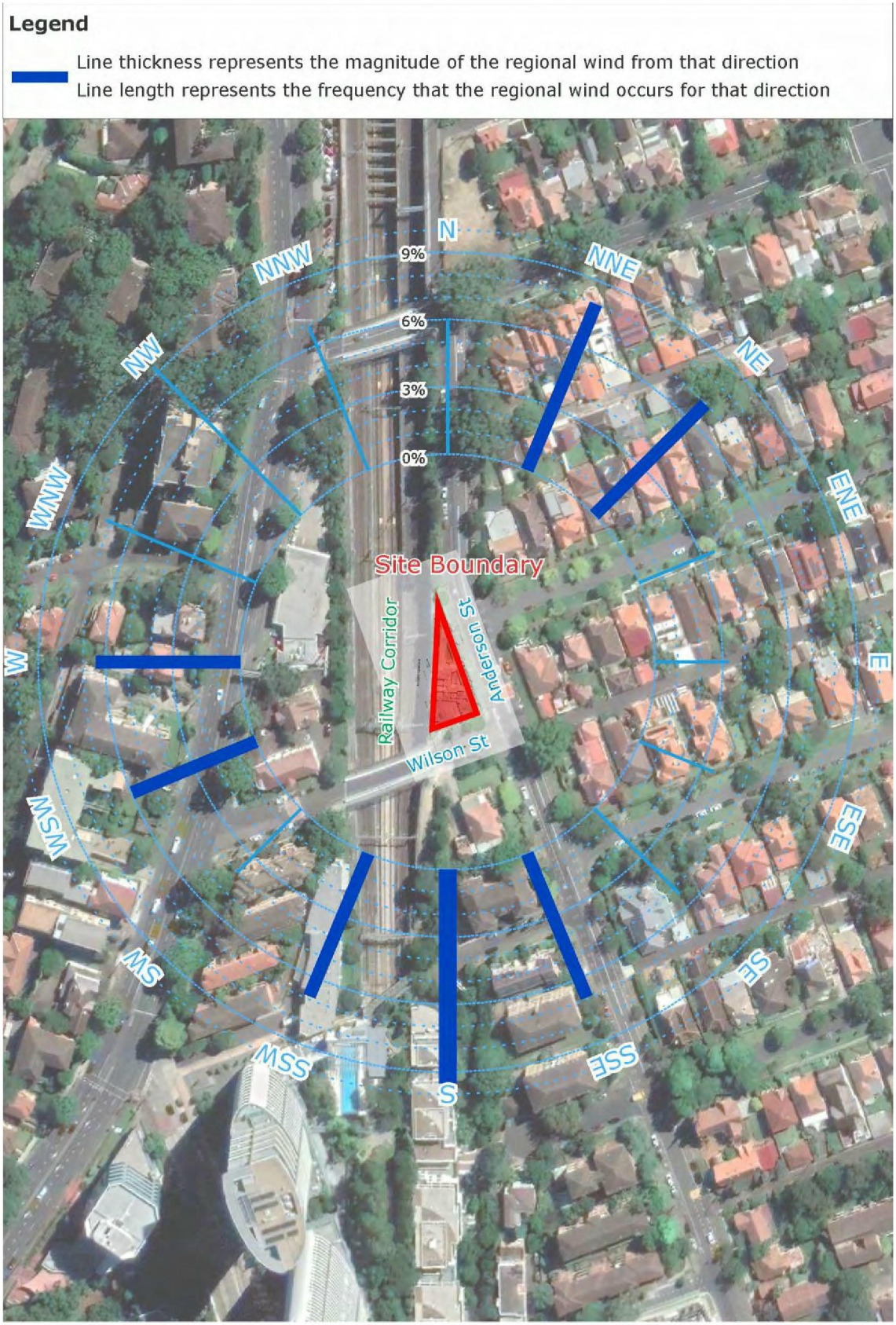

Figure 1: Aerial Image of the Site Location and Prevailing Wind Directions

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 at 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 the winds over a standard open terrain at a height of 10m above ground level. Figure 2 shows a summary of this analysis in the form of a directional plot of the annual and 5% exceedance mean winds for the Sydney region. The frequency of occurrence of these winds is also shown in Figure 2.

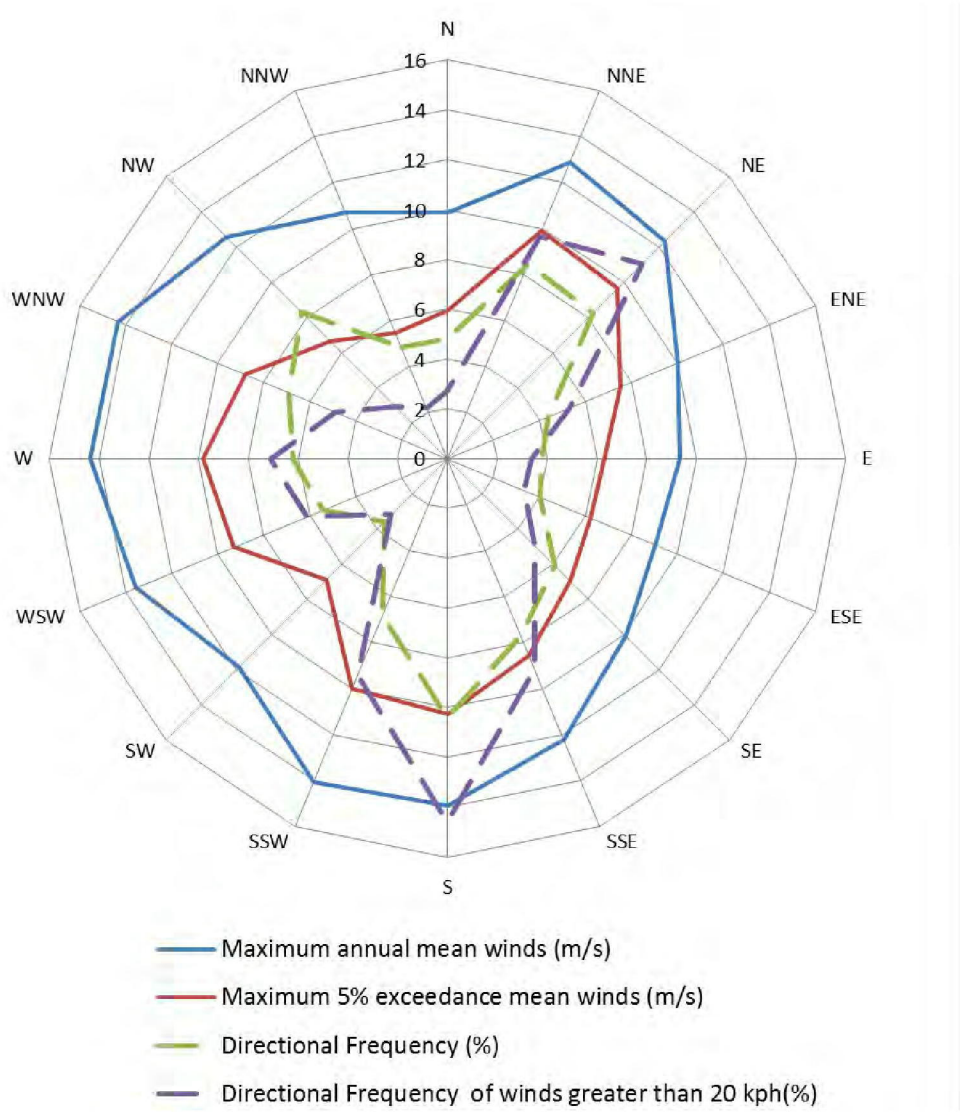

Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region

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 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 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 the Appendix section.

For this assessment, the wind comfort criterion that were considered as part of this assessment were the following:

- Comfortable Walking Criterion (7.5m/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 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.
- Long Exposure Criterion (3.5m/s with a 5% probability of exceedance) for stationary activities longer than an hour, e.g. outdoor cinemas, outdoor fine dining etc.

Although this assessment is of a qualitative nature, the abovementioned comfort criteria are considered when assessing the wind environment impacts. All areas are also assessed with consideration of the 23m/s annual gust criterion for safety.

5.1 Ground Level Trafficable Areas

The pedestrian footpath along the Anderson Street frontage of the site benefits from the shielding provided by the subject development from the prevailing westerly winds. However due to the north to south alignment of Anderson Street and low-rise neighbouring developments, it is exposed to the direct southerly and north-easterly winds. It should be noted that this is an existing wind condition for the site, and the inclusion of the subject development is not expected to significantly adversely affect the wind conditions along the pedestrian footpath due to the tower setback from the podium, and the podium setback from the footpath. Hence the wind conditions along the pedestrian footpath are expected to be similar to the existing site conditions.

The proposed outdoor trafficable area around the main entrance along the Anderson Street frontage of the site is exposed to similar adverse wind effects mentioned above for the

pedestrian footpath. Due to its close proximity to the building edge, it is also exposed to potential side-stream wind effects along the podium façade and down-wash wind effects off the podium façade. The wind conditions can be enhanced with the retention of the proposed impermeable awning above the main entrance to mitigate the potential downwash wind effects and densely foliating vegetation such as trees or shrubs/hedge planting within the landscaped areas along the northern and southern boundary of the main entry.

The pedestrian footpath at the corner of Anderson Street and Wilson Street is expected to be a hot spot for adverse winds due to the prevailing north-easterly and southerly winds that accelerate around the corner. A wind screen extending east from the façade at the south-eastern corner is expected to reduce this wind effect. The pedestrian footpath near the northern corner of the building form can also be affected by the westerly prevailing winds. The substation and surrounding landscaping can help to mitigate this effect. To further improve conditions, a porous façade can be incorporated on the western aspect, such as at the visitor bicycle parking area, to reduce the corner acceleration effect.

The pedestrian footpath along the rest of the Wilson Street frontage of the site benefits from the shielding provided by the subject development to the prevailing north-easterly winds. However due to the low-rise neighbouring developments, it is exposed to the direct southerly and westerly winds. It should be noted that this is an existing wind condition for the site. The tower setback from the podium is expected to reduce the downwash effect and the inclusion of the proposed densely foliating street trees is expected to be effective in enhancing the local wind conditions along the pedestrian footpath, hence it is recommended to be retained.

5.2 Level 2 Commercial Outdoor Area

The Level 2 Commercial Outdoor Area located on the northern corner of the development is exposed to direct wind effects due to the lack of shielding from the surrounding upstream buildings, side-stream wind effects along the tower facade and accelerating flows around the corner of the tower. It is recommended a full-height screen is included along the western perimeter edge of this outdoor area, with impermeable balustrades along the remaining perimeter edges to mitigate these adverse wind effects.

5.3 Level 3 Residential Communal Open Space

The Level 3 Residential Communal Open Space is exposed to the direct north-easterly, southerly, and westerly prevailing winds. While the lift core is expected to provide marginal levels of direct shielding, the wind is expected to downwash from the tower form, and funnel between the gap between the Level 3 and 4 slabs.

It is recommended that impermeable screens around the perimeter of the communal open space and/or an awning around the perimeter of the base of the tower form be implemented to

address the expected downwash. Note the inclusion of effective wind mitigating devices such as localised screening, pergolas, and densely foliating vegetation within and around areas intended for short duration stationary activities such as outdoor seating is expected to be effective in further enhancing the localised wind conditions.

5.4 Level 4 Commercial Balconies

The commercial balcony located on the northern corner of the development is exposed to direct wind effects due to the lack of shielding from the surrounding upstream buildings, side-stream wind effects along the tower facade and accelerating flows around the corner of the tower. It is recommended a full-height screen is included along the western perimeter edge of this balcony, with impermeable balustrades along the remaining perimeter edges to mitigate these adverse wind effects.

The commercial balcony located on the south-eastern corner of the development is shielded from the westerly prevailing winds due to the building form itself. However, it is exposed to the prevailing north-easterly and southerly winds accelerating around the corner of the building form and is expected to cause adverse wind conditions on the balcony. It is recommended that a full-height screen is implemented along the southern perimeter edge of this balcony, with impermeable balustrades along the remaining perimeter edges to mitigate these adverse wind effects.

5.5 Level 5-13 Private Balconies

The private balconies located on the northern corner of the development are exposed to direct wind effects due to the lack of shielding from the surrounding upstream buildings, side-stream wind effects along the tower facade and accelerating flows around the corner of the tower. It is recommended full-height screens are included along the western perimeter edge of the private balconies, with impermeable balustrades along the remaining perimeter edges to mitigate these adverse wind effects.

The private balconies located on the south-eastern corner of the development are shielded from the westerly prevailing winds due to the building form itself. However, it is exposed to the prevailing north-easterly and southerly winds accelerating around the corner of the building form and is expected to cause adverse wind conditions on these balconies. It is recommended that full-height screens be implemented along the southern perimeter edge of these balconies, with impermeable balustrades along the remaining perimeter edges to mitigate these adverse wind effects.

The use of loose glass-tops and light-weight sheets or covers (including loose BBQ lids) is not recommended on the upper level balconies (or communal terraces) unless it is securely attached to the balcony or terrace floor slab.

5.6 Level 14 Rooftop Terrace Communal Outdoor Space

The Rooftop Terrace Communal Outdoor Space located on Level 14 is exposed to the prevailing north-easterly, southerly, and westerly winds. The Communal Room and lift core provide some direct shielding from the southerly and westerly prevailing winds, while the roof above aids in the mitigation of upwash wind effects from reattaching onto the trafficable areas.

However, to mitigate the direct wind impacts due to its height and exposure above the nearby surrounding buildings, it is suggested that the perimeter screens be approximately 2m high in order to directly shield to trafficable areas. The size and extent of the screens can be developed further at a later more detailed design stage. Note the inclusion of effective wind mitigating devices such as localised screening, pergolas, and densely foliating vegetation within and around areas intended for short duration stationary activities such as outdoor seating is expected to be effective in further enhancing the localised wind conditions.

6 REFERENCES

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7 APPENDIX – WIND EFFECTS GLOSSARY

7.1 Downwash and Upwash Effects

The downwash wind effect occurs when wind is deflected down the building's windward facade causing accelerated wind speeds 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 A1. This can also lead to recirculating flow in the presence of a shorter upstream building, causing the local ground level wind flow to move towards 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.

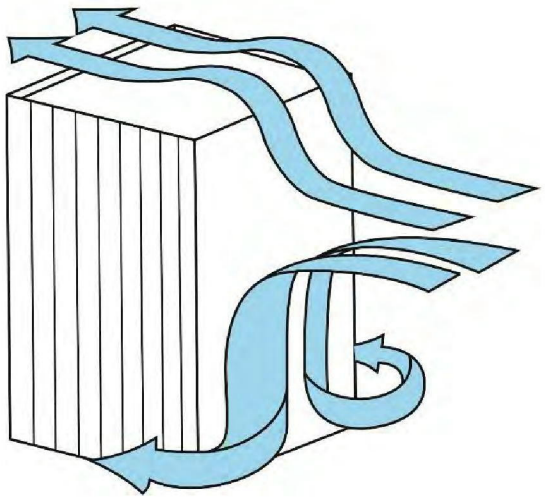

Figure A1: Downwash Leading to Corner Wind Effect, and Upwash Effects

7.2 Funnelling/Venturi Effect

Funnelling effects occur when the wind interacts with two or more buildings which are located adjacent to each other and the building form design results in a bottleneck, as shown in Figure A2. This can cause the wind to be forced 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.

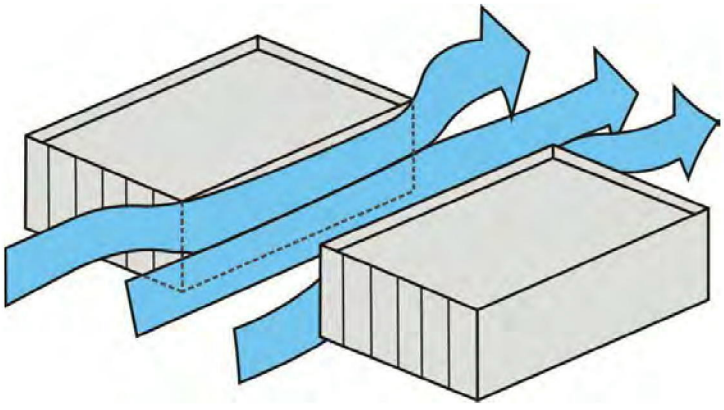

Figure A2: Funnelling/Venturi Wind Effect

7.3 Gap Effect

The gap effect occurs in small openings in the façade that are open to wind on opposite faces, as seen in Figure A3. 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.

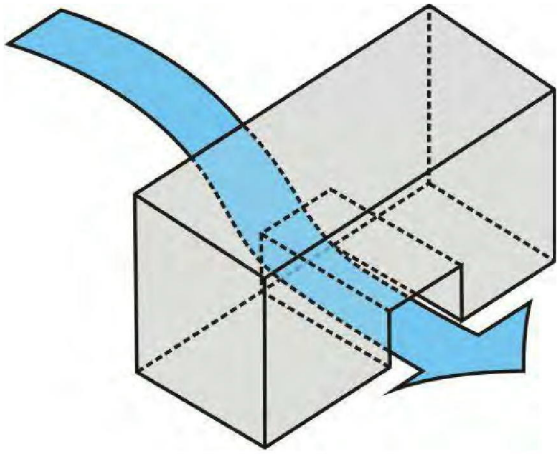

Figure A3: Gap Wind Effect

7.4 Sidestream and Corner Effects

The sidestream effect is due to a gradual accumulation of winds 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 A4

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.

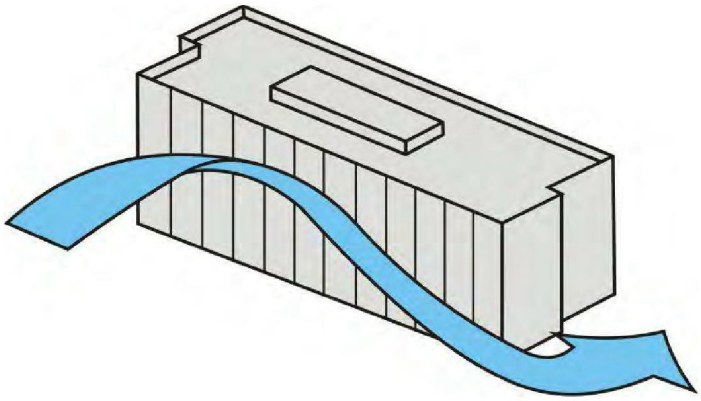

Figure A4: Sidestream and Corner Wind Effect

7.5 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.