WINDTECH

# PEDESTRIAN WIND ENVIRONMENT STATEMENT

## CREMORNE PATHWAYS SENIOR LIVING, 50-88 PARAWEEN STREET AND 59-67 GERARD STREET, CREMORNE NSW 2090

WH584-01F02(REV2)- WS REPORT

JUNE 28, 2023

Prepared for:

Skermanic Pty Ltd

40 Chandos Street, St Leonards, NSW 2065

# DOCUMENT CONTROL

| Date | Revision History | Issued Revision | Prepared By (initials) | Instructed By (initials) | Reviewed & Authorised by (initials) |
|---|---|---|---|---|---|
| May 25, 2023 | Initial. | 0 | JAF | SWR | GC |
| June 9, 2023 | Updated with new architectural drawings and treatments plan | 1 | JAF | SWR | GC |
| June 28, 2023 | Cover page and site description update | 2 | JAF | SWR | GC |
| | | | | | |
| | | | | | |
| | | | | | |

*The work presented in this document was carried out in accordance with the Windtech Consultants Quality Assurance System, which is based on International Standard ISO 9001.*
*This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.*
*This document is prepared for our Client's particular requirements which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Windtech Consultants. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.*

# EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of the Cremorne Pathways Senior Living development, located in Cremorne, 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 08 June2023). 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 proposed dense landscaping and planting evergreen vegetation wherever possible in areas to the west.
- Building 1:
    - Inclusion of 1.2m impermeable intertenancy balustrades on Level 3 southern balconies.
    - Retention of proposed raised vegetation around the seating areas on the roof terrace ensuring a minimum height of 1.5m or inclusion of 1.5 high impermeable balustrade.
- Building 2:
    - Retention of the 1.5m high impermeable balustrades on the Level 3 corner balcony.
- Building 3:
    - Retention of the 1.5m high impermeable balustrades on the Level 3 corner balcony.
    - Inclusion of full height impermeable screens on the western side of the south-western balconies on Levels 1-2.
    - Retention of proposed raised vegetation around the seating areas on the roof terrace ensuring a minimum height of 1.5m or inclusion of 1.5m high impermeable balustrade.

- Building 4:
    - Inclusion of full height impermeable screens on the eastern and western sides of each balcony on the northern aspect on Levels 1-7.
    - Inclusion of full height impermeable screens on the southern side of the Levels 1-6 south-western corner balconies.
    - Inclusion of a 1.6m impermeable balustrades around the south-western balcony on Level 7 and densely foliating shrubs or hedges within the proposed landscaping zone around the balcony.
    - Retention of the standard height impermeable balustrade on all levels.
    - Retention of proposed raised vegetation around the seating areas on the roof terrace ensuring a minimum height of 1.5m or inclusion of 1.5m high impermeable balustrade.

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 50-88 Parraween Street and 59-67 Gerrard Street, Cremorne, and is bounded by Parraween Street to the south-east, Gerrard Street to the north-west, and mid-rise residential buildings to the north-east and south-west. The buildings surrounding the subject development are predominately low to mid-rise residential and commercial buildings.

A survey of the land topography indicates steep inclines around the site, with the terrain rising mainly from the north, east and south directions.

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 1-2 storey residential buildings. The proposed development consists of four residential buildings with heights of 3 stories for Buildings 1-3, and 8 storeys for Building 4.

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 consisting of communal open space and pedestrian footpath.
- Private balconies and terraces on Buildings 1-4.


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.

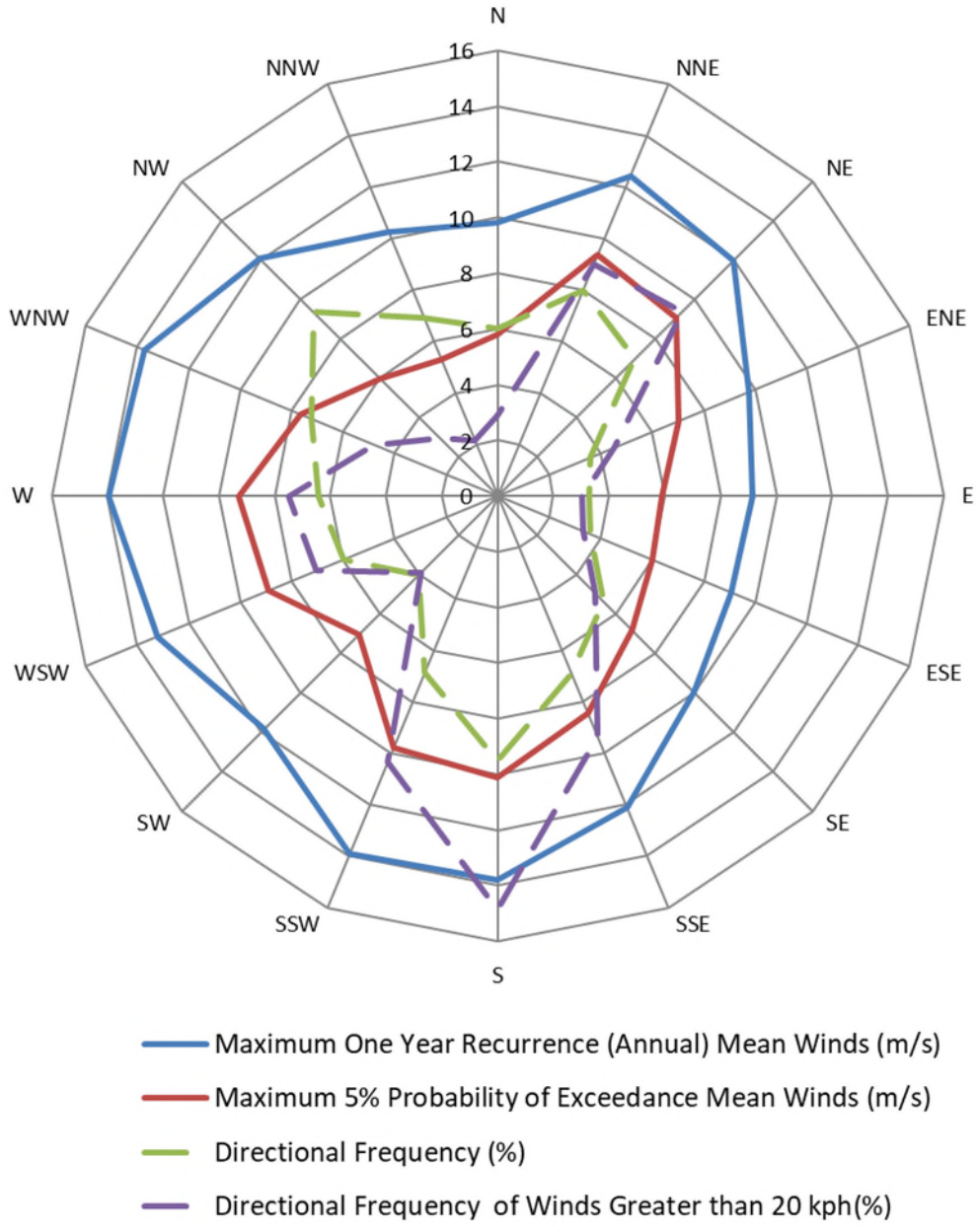


Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Sydney Region

# 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:

- 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.

- Sitting (Long Exposure) (3.5m/s to 4m/s with a 5% probability of exceedance)
  for stationary activities longer than an hour, e.g. outdoor cinemas, outdoor fine dining 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 wind conditions along the Parraween Street footpath are expected to be similar to the existing wind conditions and acceptable for comfortable walking due to shielding provided by the subject and neighbouring buildings. The inclusion of densely foliating vegetation in the form of trees or shrubs/hedges within the proposed deep soil landscape zones as indicated in the architectural drawings and landscaping plans is expected to be effective in wind mitigation and enhancing the local wind conditions. The through site links are expected to be susceptible to funnelling winds from all three prevailing directions between the buildings. However, with the retention of the proposed vegetation, wind effects of concern will be mitigated. Hence, they are recommended to be retained in the final design of the development.

The wind conditions along the Gerard Street footpath are also expected to be suitable for walking conditions. Potential north-easterly and westerly winds can downwash of the northern façade of Building 4. However, due to the building setback from the footpath and the vegetation proposed, the wind conditions on the footpath are expected to be similar to the existing conditions.

The main communal open space on ground level is located to the east of Building 3 and incorporates significant landscaping around the perimeter. The perimeter landscaping shields this area from the prevailing

north-easterly, southerly, and westerly prevailing winds. The pergola above the seating areas can also mitigate any potential downwash effects from Building 3, however the porosity of the pergola is recommended to be between 30-35% for it be an effective wind mitigation measure. Given the height of Building 3, no severe downwash is expected, and therefore this modification is optional. It should also be noted that as the westerly winds are a predominately winter wind, it is recommended that the proposed trees to the west are of an evergreen variety to remain effective through the year. The abovementioned treatments are shown in Figure 3 below.

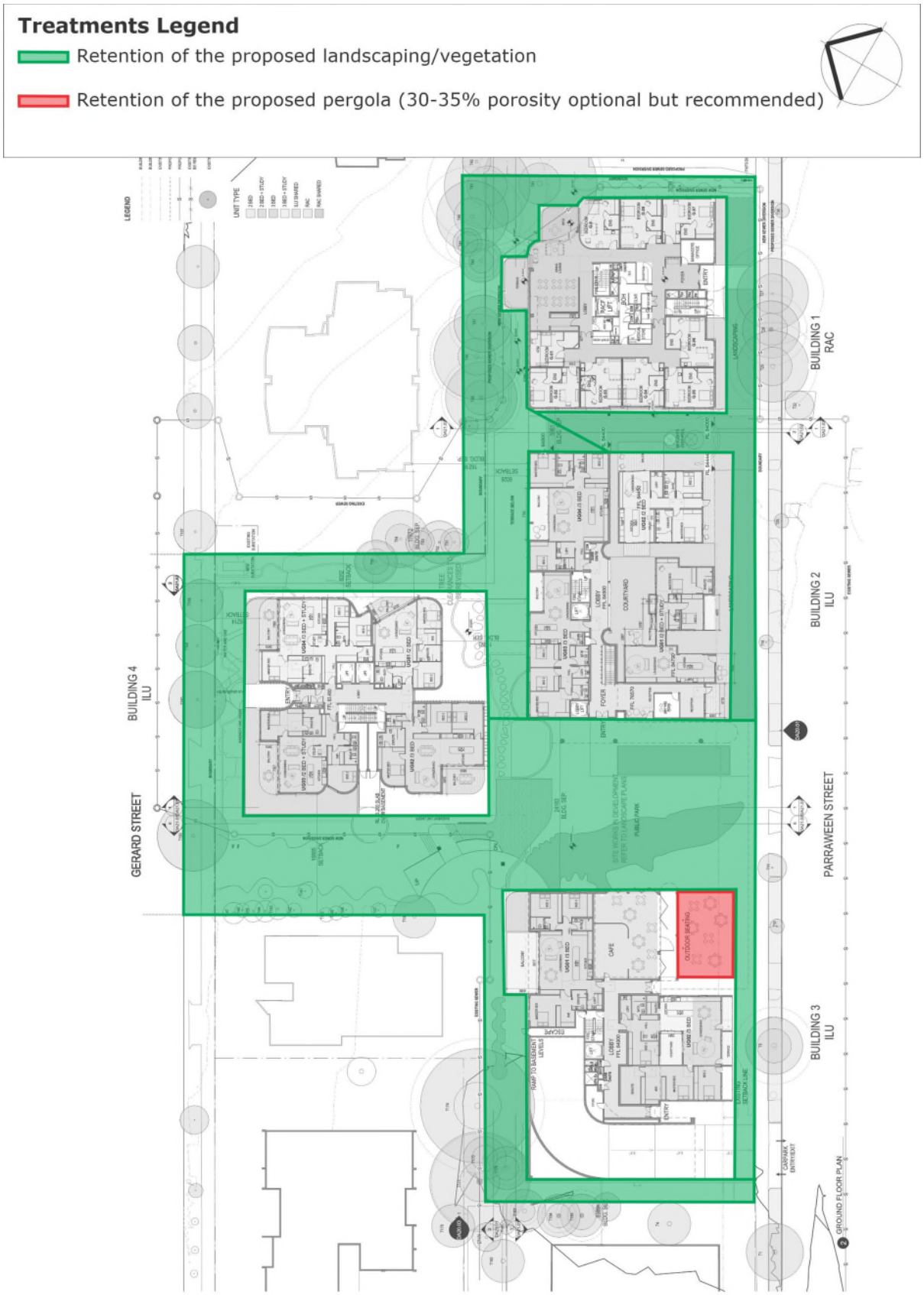
Treatments Legend
Retention of the proposed landscaping/vegetation
Retention of the proposed pergola (30-35% porosity optional but recommended)
BUILDING 1
RAC
BUILDING 2
ILU
BUILDING 3
ILU
BUILDING 4
ILU
GERARD STREET
PARRAWEEN STREET
GROUND FLOOR PLAN

Figure 4: Recommended Treatment for Ground Level

## 5.2 Private Balconies and Terraces

The development site is elevated above the distant surrounding buildings, and as a result, the speed of the prevailing winds is expected to increase as it approaches the site from the north, south, and west. However, most of the balconies of the development are expected to be suitable for their intended use due to the shielding provided by the proposed and neighbouring buildings. Furthermore, the proposed design incorporates effective wind mitigation features such as the overall recessed design for most of the balconies and the inclusion of full height screens/walls as shown on the western corner balcony on Building 2. Hence, these features are recommended to be retained in the final design. Note that is recommended to replace the proposed standard height railing on the balconies with impermeable balustrades preferably or ensuring that the porosity of those railing is no more than 30%.

However, additional treatments on some more wind-prone balconies are recommended to ensure that those balconies will be suitable for their intended use. The wide southern aspect balconies on Building 1 are exposed to the prevailing southerly winds which is expected to sidestream along those balconies. Although shielding is provided by neighbouring buildings and vegetation, additional treatment is recommended with emphasis on the upper levels. It is recommended to include 1.2m intertenancy balustrades on Level 3 balconies to break up any potential sidestreaming southerly winds (See Figure 4a). The seating area on the roof terrace is expected to be suitable for its intended uses with the retention of the proposed surrounding raised planter vegetation whose height should be at least 1.5m, alternatively a 1.5m impermeable balustrade can be included (See Figure 4d). Please note that some of the winds deflected by the edge planter boxes/balustrades may reattach within the terrace, hence it is recommended to retain the proposed landscaping centrally to further protect the seating areas.

The south-western balconies on Building 3 are exposed to the prevailing southerly and westerly winds. Those winds are expected to sidestream and corner accelerate along those balconies. Therefore, it is recommended to include full height impermeable screens along the western edges of the balconies (See Figure 4a). The rooftop trafficable area is also expected to be suited for pedestrian comfort with surrounding 1.5m raised planter vegetation or similar height impermeable balustrade (See Figure 4d).

Due to the relative height and exposure of Building 4 above the surrounding buildings, the balconies may experience adverse wind conditions. The north-western and north-eastern corner balconies of Building 4 are exposed to the prevailing north-easterly and westerly winds. Those wind are expected to sidestream along the building façade then accelerate around the corners through those balconies. Similar impact from the southerly winds is expected on the north-western corner balconies on Levels 4-7 which make it one of the most wind-prone balconies in the development. The south-western corner balconies on Building 4 are exposed to the westerly and southerly prevailing winds (mainly on Levels 4-7). To mitigate the aforementioned wind effects, it is recommended to include full height impermeable screens on the eastern and western sides of each balcony on the northern aspect and retain the proposed standard height impermeable balustrades (See Figure 4a).

Full height impermeable screens are also recommended to be included on the southern end of the south-western corner balconies on Levels 1-6 (See Figure 4a). Note that the south-western balcony on Level 7 of Building 4 is susceptible to upwashed winds from the southerly and westerly winds. The inclusion densely foliating

vegetation within the proposed landscaping zone around this balcony is recommended to assist in reducing the impact of the upwashed winds. The installation of a full height screen on the western edge of the balcony is also recommended to protect the balcony against westerly corner accelerating winds (See Figure 4c). Similar to Buildings 1&3, the rooftop terrace trafficable area is suitable for pedestrian comfort with surrounding 1.5m raised planter vegetation or similar height impermeable balustrade (See Figure 4d).

The south-western corner balcony on Level 3 of Building 2 is susceptible mainly to upwashed winds coming from the southerly and westerly directions. Similar wind effects are expected on the full walk around balcony on Level 3 of Building 3. It is recommended to retain the proposed 1.5m balustrade to ensure that the upwashed winds are deflected away from the proposed seating areas on those balconies (See Figure 4b).


Treatments Legend
Inclusion of full height impermeable screens (All Levels)
Inclusion of 1.2m intertenancy balustrades (Level 3)
Retention of standard height impermeable balustrade (All Levels)
BUILDING 1
RAC
BUILDING 2
ILU
BUILDING 4
ILU
BUILDING 3
ILU
1 LEVEL02-FLOOR PLAN

Figure 4a: Recommended Treatment for typical balconies

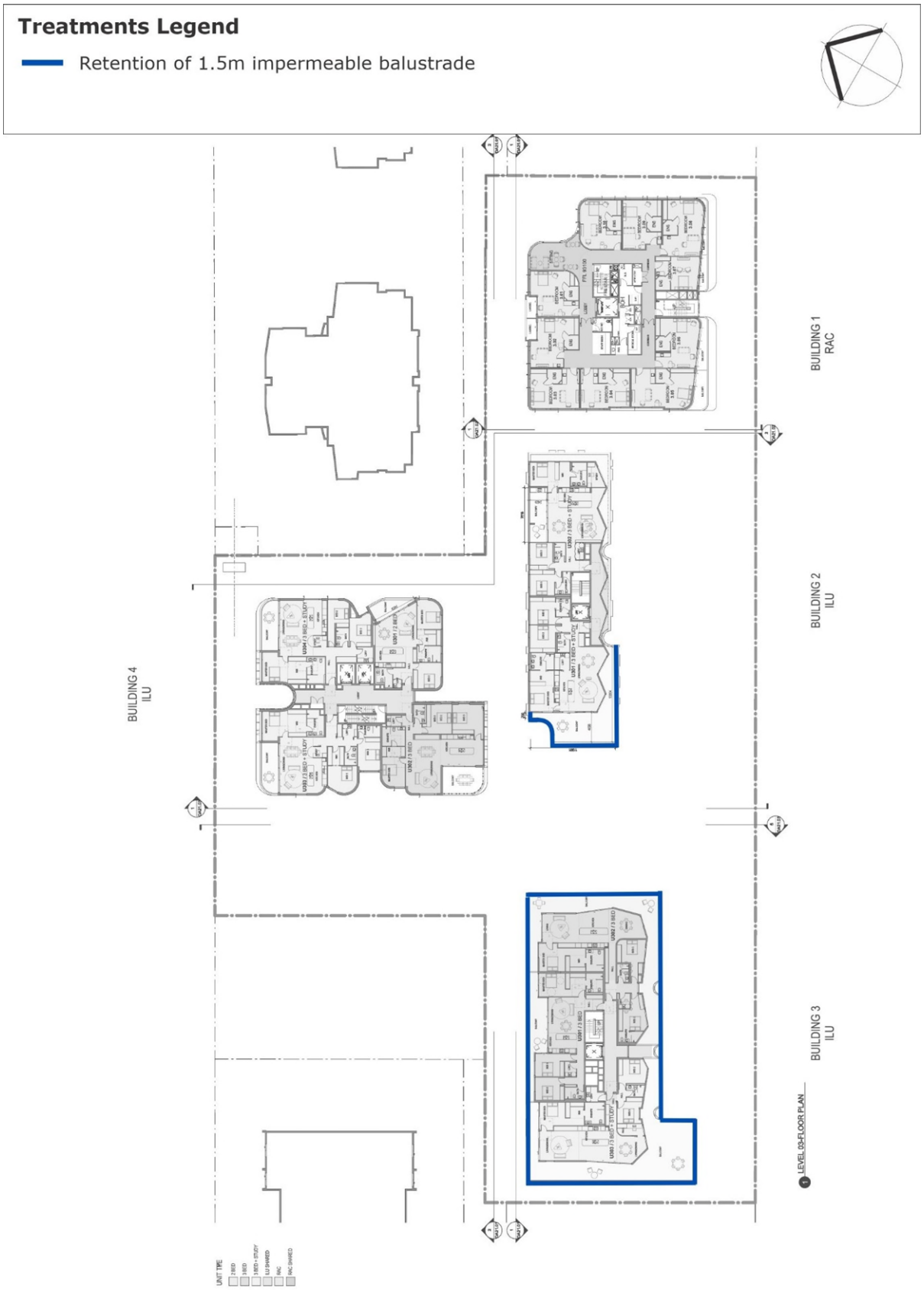
Treatments Legend
Retention of 1.5m impermeable balustrade
BUILDING 1
RAC
BUILDING 2
ILU
BUILDING 3
ILU
BUILDING 4
ILU
LEVEL 09-FLOOR PLAN
UNIT TYPE

Figure 4b: Recommended Treatment for Level 3

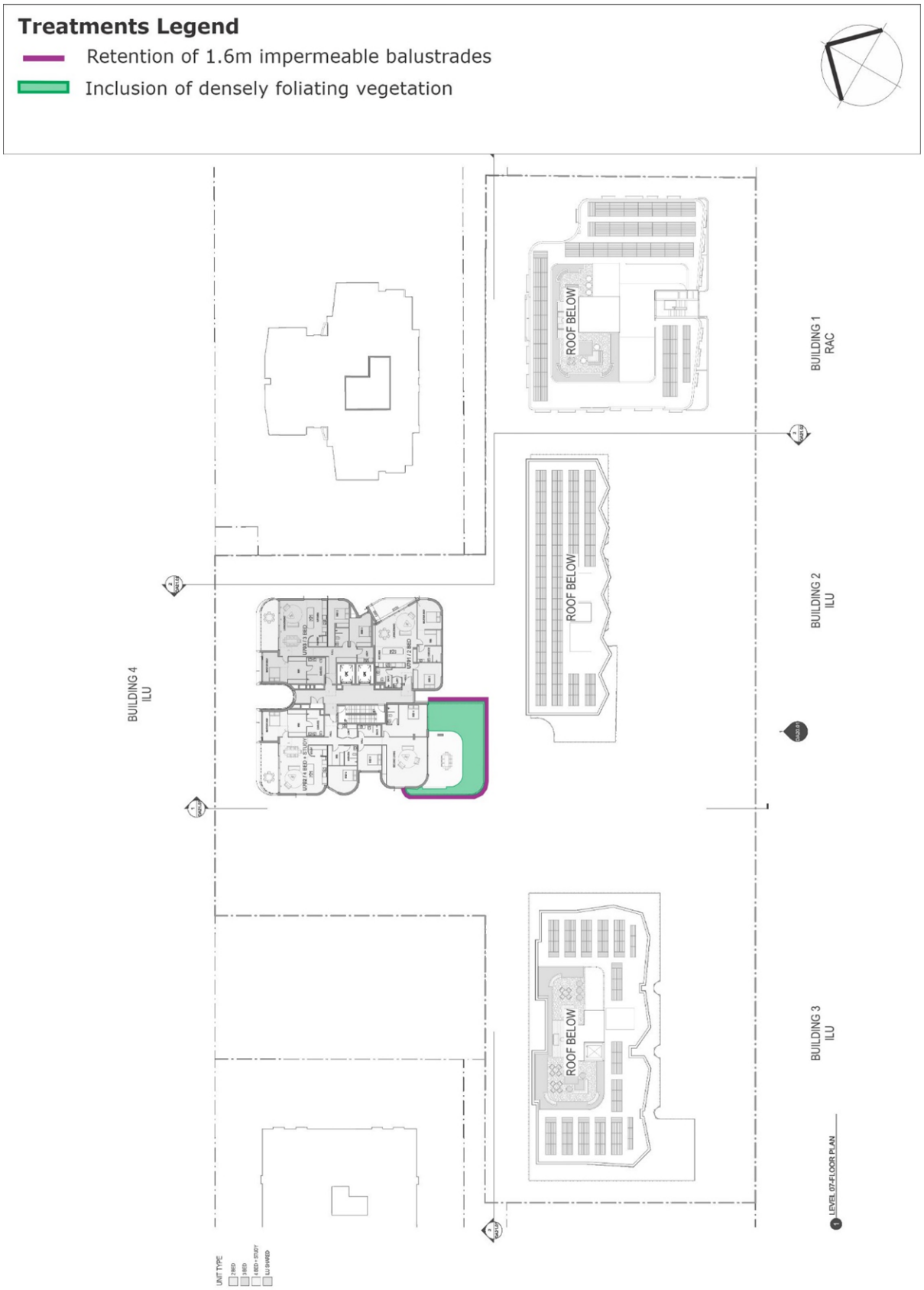
Treatments Legend
Retention of 1.6m impermeable balustrades
Inclusion of densely foliating vegetation
ROOF BELOW
BUILDING 1
RAC
ROOF BELOW
BUILDING 2
ILU
BUILDING 4
ILU
ROOF BELOW
BUILDING 3
ILU
LEVEL 07-FLOOR PLAN
UNIT TYPE

Figure 4c: Recommended Treatment for Level 7

**Treatments Legend**

Retention of the proposed raised planter vegetation (1.5m total height) **OR** inclusion of 1.5m impermeable balustrade

Retention of proposed landscaping elements

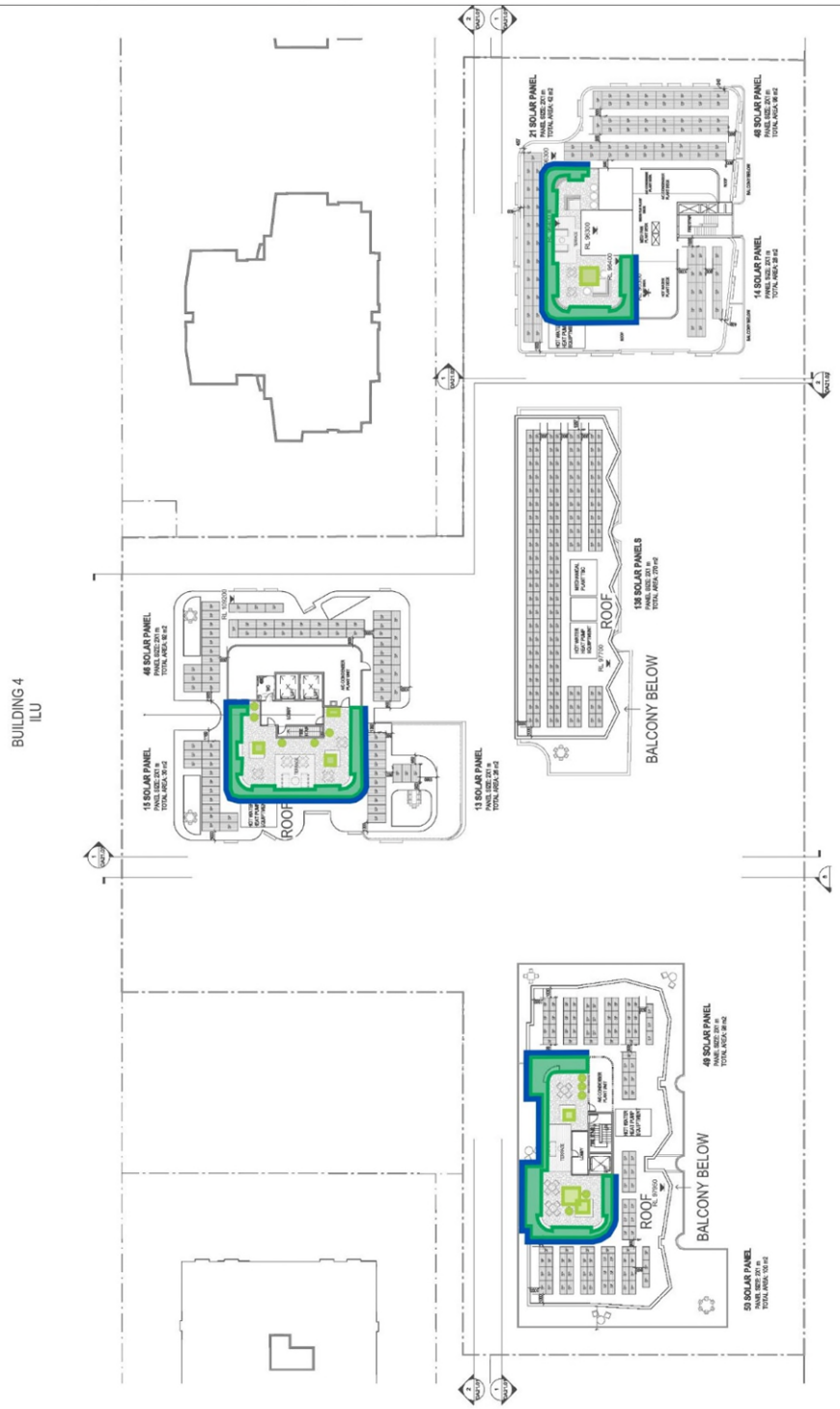

Figure 4d: Recommended Treatment for Roofs

# 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.

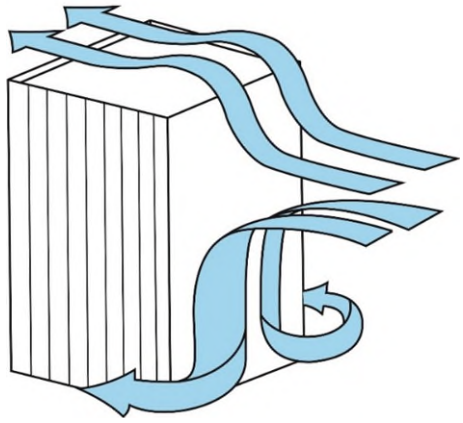

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

## 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.

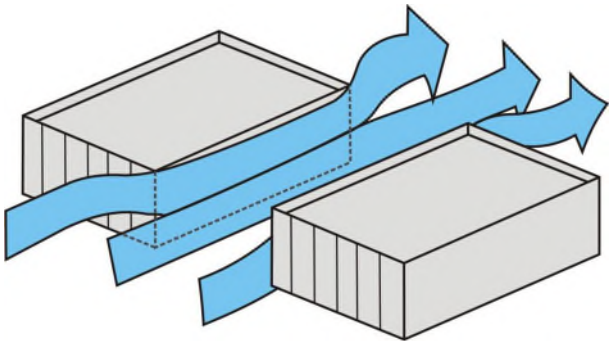

Figure A.2: Funnelling/Venturi Wind Effect

## 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.

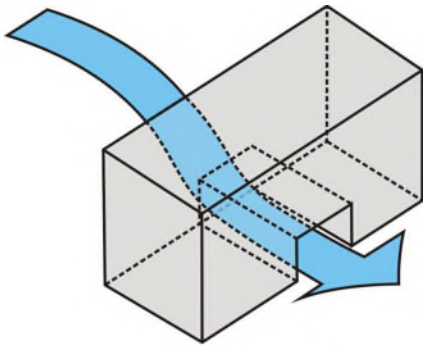

Figure A.3: Gap Wind Effect

## 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.

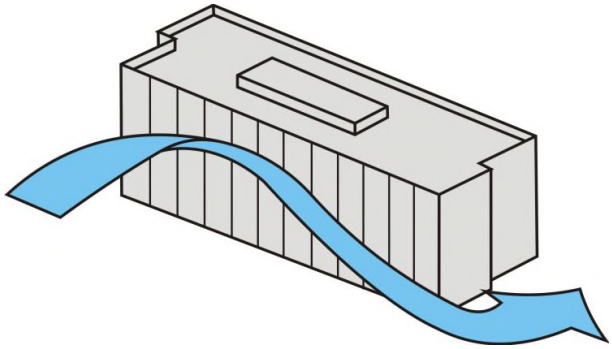

Figure A.4: Sidestream and Corner Wind Effect

## 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.