PEDESTRIAN WIND ENVIRONMENT STATEMENT

389 PACIFIC HIGHWAY, CROWS NEST

WG223-01F02(REV2)- WS REPORT

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EXECUTIVE SUMMARY

This report presents an opinion on the likely impact of The Crow development located at 389 Pacific Highway, Crows Nest, 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 massing drawings provided by Woods Bagot (received 1 November 2022). 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:

- Awning or tree planting along Hume Street frontage.
- Localised planter boxes or screens around seating areas.
- Canopy or landscaping over laneway openings.
- Landscaping within and around the Level 5 pool deck and residential amenities terrace.
- Wind screening around the Level 5 pool deck and residential amenities terrace.
- End screens for corner balconies.

With the consideration 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

This Planning Proposal seeks to amend the NSLEP 2013, by way of the following:

- Amend the maximum building height to establish a split height control over the site.
- Establish a maximum floor space ratio control of 7.5:1; and
- Establish a minimum non-residential floor space ration control of 2:1.

The Planning Proposal seeks to unlock the potential of the site as an amalgamated landholding, to deliver a high-quality mixed-use development opposite the Crows Nest Metro Station; a location envisioned for increased density under the St Leonards/Crows Nest Plan 2036 (SLCN Plan). The future redevelopment will create enhanced commercial floor space and a mix of residential dwellings in a strategically valuable location.

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 389 Pacific Highway, in Crows Nest. The site is bounded by Pacific Highway to the north-east and Hume Street to the south-east. Bounding the site to the north-west is a 4-5 storey building, and low-rise residential buildings to the south-west. Further from the site are predominantly low-rise residential buildings to the south and west, with mid to high-rise commercial buildings to the north and east.

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.

A survey of the local land topography indicates a slope down towards the west and north-west which is expected to increase the wind speeds from the westerly sector as it approaches the site.

The existing site consists of low-rise commercial buildings (approximately 3 storeys). The proposed development is approximately 86.86m in total height. The neighbouring over station development is located directly to the north-east and east of the site and is currently under construction. Possible future residential developments is expected to the south-west of the site, up to approximately 4 storeys in height.

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 pedestrian footpaths along Pacific Highway, and Hume Street.
- Ground Level through-site link, connecting Pacific Highway and Hume Street.
- F&B Terrace on Podium Level 01, and Terraces on Podium Levels 02/03.
- Residential amenities space on Level 05.
- Private balconies.

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.

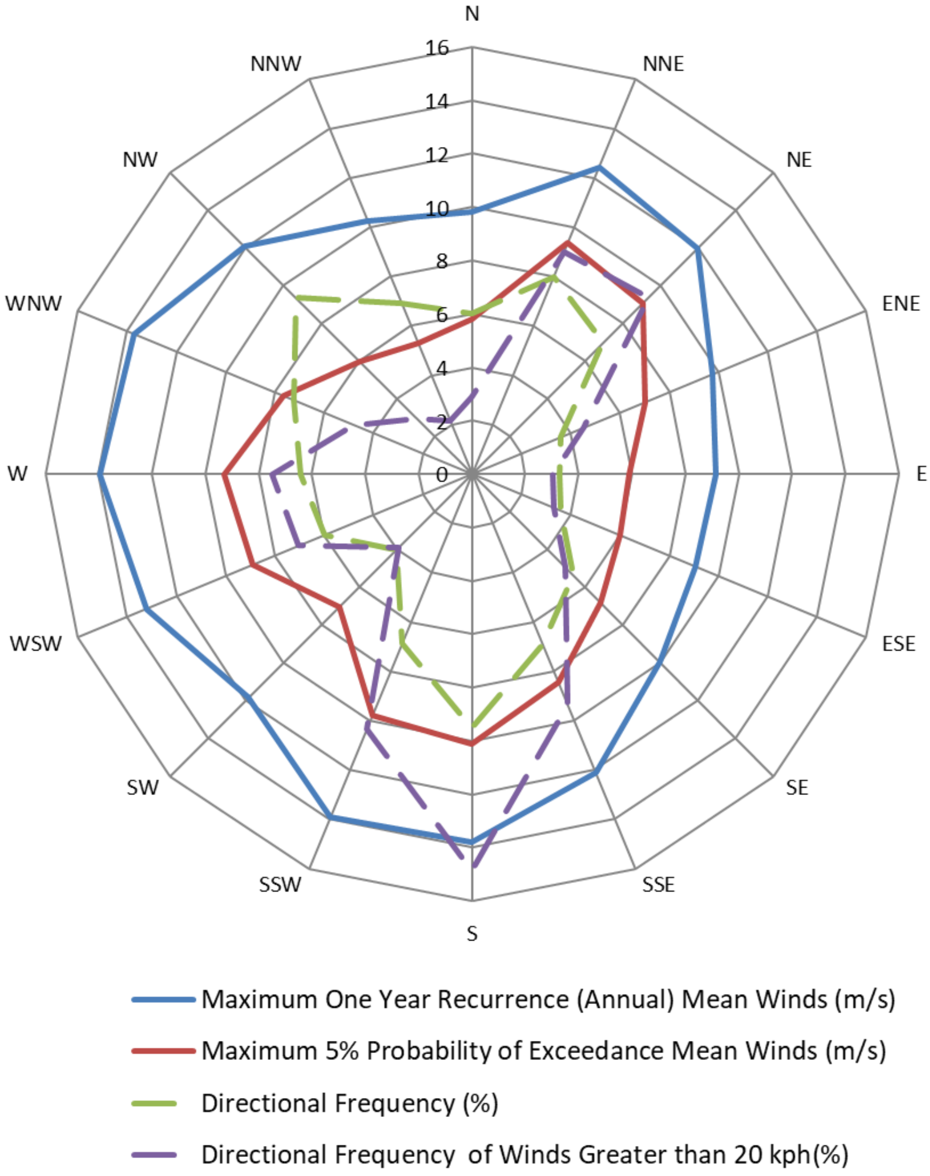

Figure 2: Directional Annual and 5% Exceedance Hourly Mean Wind Speeds (referenced to 10m height in standard open terrain), and Frequencies of Occurrence, for the Sydney Region

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 (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 (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.

- Long Exposure Criterion (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 is 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 Footpaths

The Pacific Highway frontage is expected to be significantly shielded from the prevailing north-easterly winds by the neighbouring over station development, and from the westerly prevailing winds by the subject development itself. The southerly winds are expected to impact the Hume Street façade, downwash and subsequently corner accelerate and flow along the Pacific Highway footpath. Hume Street is also exposed to the prevailing westerly winds, which are expected to accelerate as it flows up the hill, and sidestream along this aspect. This, however, is an existing effect, and is not expected to be exacerbated by the inclusion of the subject development.

The subject development incorporates a significant tower setback from the edge of the podium, which is expected to reduce the downwash effect from the tower form. However, due to the lack of shielding from the southerly direction and the height of the podium itself, horizontal screening in the form of an awning or a line of densely foliating trees with interlocking canopies is recommended to be implemented along Hume Street. It is recommended that the horizontal screening is wrapped around the corner of the building in order to reduce the effect of the downwash combined with corner acceleration. With the inclusion of these recommendations, it is expected that the wind conditions along the footpaths along Pacific Highway and Hume Street will be suitable for walking comfort.

To further improve conditions for longer duration stationary activities for potential active frontages, strategies such as localised portable operator-controlled screening, planter boxes, additional awnings etc. can be considered, with the size and extent to be quantified at a more detailed design stage.

5.2 Ground Level Through-Site Link

The Ground Level through-site link connects Pacific Highway to Hume Street through the middle of the development site, around the Anchor Retail block. The laneway is significantly shielded from the north-easterly winds by the over station development. The right-angled turn in the flow path is expected to reduce the effect of funnelling due to the southerly prevailing winds. However, it is still expected that some funnelling/gap effect will occur due to the southerly and westerly prevailing winds. The westerly direct wind impact to this area is expected to be reduced with the inclusion of future developments to the south-west.

A canopy or densely foliating evergreen landscaping near the western opening of the laneway is expected to mitigate the downwash and subsequent funnelling from the westerly prevailing winds. The previously recommended horizontal screening measures along Hume Street is also expected to reduce the funnelling impact to the Hume Street laneway entry. It is expected that with the inclusion of the above recommendations, the through-site link can be suitable for short duration station activities.

Further improvement to the wind conditions in the laneway can be in the form of staggered landscaping or baffle screens can be considered at a more detailed design stage.

5.3 Podium Level 01 F&B Terrace and Level 02/03 Terraces

The F&B Terrace on Level 01, and the outdoor terraces on Level 02 and 03 are situated on the western aspect of the development and benefits significantly from shielding from the north-easterly and southerly prevailing winds by the development itself. The westerly prevailing winds are expected to downwash from the tower form and impact this area. However, since this westerly wind is expected to largely stagnate in this area, the overall impact is likely to be reduced.

Landscaping or localised canopies, awnings, pergolas etc. can be implemented for these terraces to improve the conditions within each of these areas and mitigate the downwash effect. Due to the prevalence of the westerly winds during winter, it is recommended that the landscaping within these areas are of a densely foliating, evergreen species to remain effective throughout the year.

5.4 Level 05 Residential Amenities Space

The Level 05 Residential Amenities Space is shielded from the prevailing north-easterly and southerly winds by the over station development and the building core respectively.

However, the southerly and westerly winds are expected to downwash from the tower form, and funnel between the tower overhang and the residential amenities space. It is recommended that landscaping and screening is implemented throughout the outdoor trafficable areas to mitigate this effect. Perimeter screening is also recommended to further improve the wind conditions within this area for the intended short duration stationary activities. These recommendations can be optimised at a later more detailed design stage through wind tunnel testing.

5.5 Private Balconies

The majority of the balconies of the development are expected to be suitable for their intended use due to various design features such as being recessed into the building form, impermeable balustrades and full height inter-tenancy screens. These features should be retained in the final design.

However, corner balconies are prone to corner acceleration effects due, particularly closer to the top of the tower due to its height and exposure above the surroundings. Full-height end screens is recommended to be considered for the corner balconies in order to mitigate any potential adverse corner acceleration effects.

6 REFERENCES

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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.

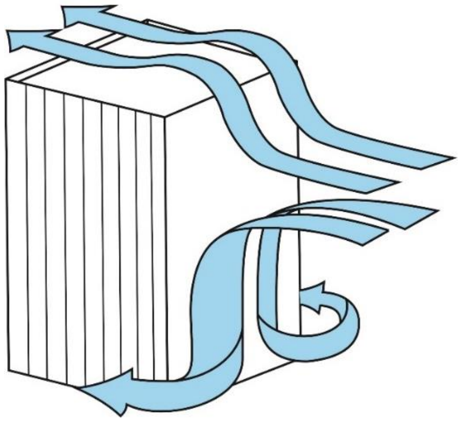

Figure A.1: Downwash Leading to Corner Wind Effect, and Upwash Effects

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.

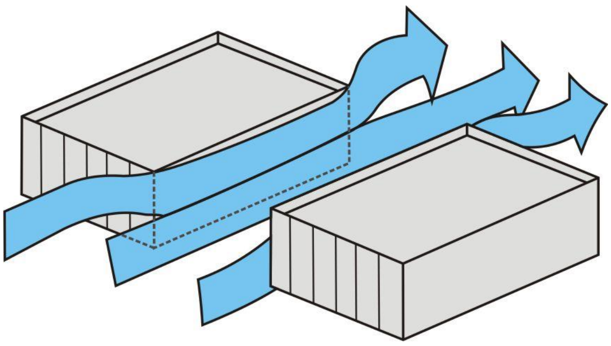

Figure A.2: Funnelling/Venturi Wind Effect

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.

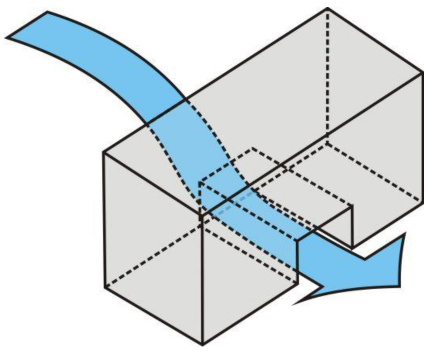

Figure A.3: Gap Wind Effect

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.

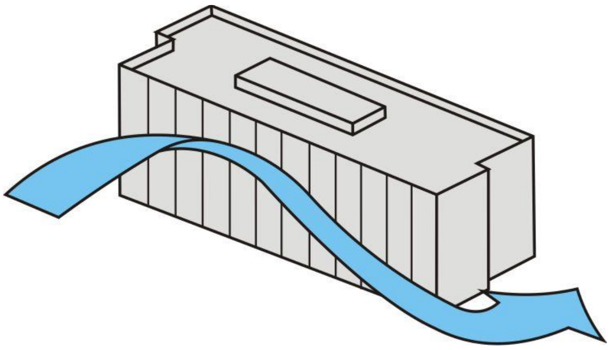

Figure A.4: Sidestream and Corner Wind Effect

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.