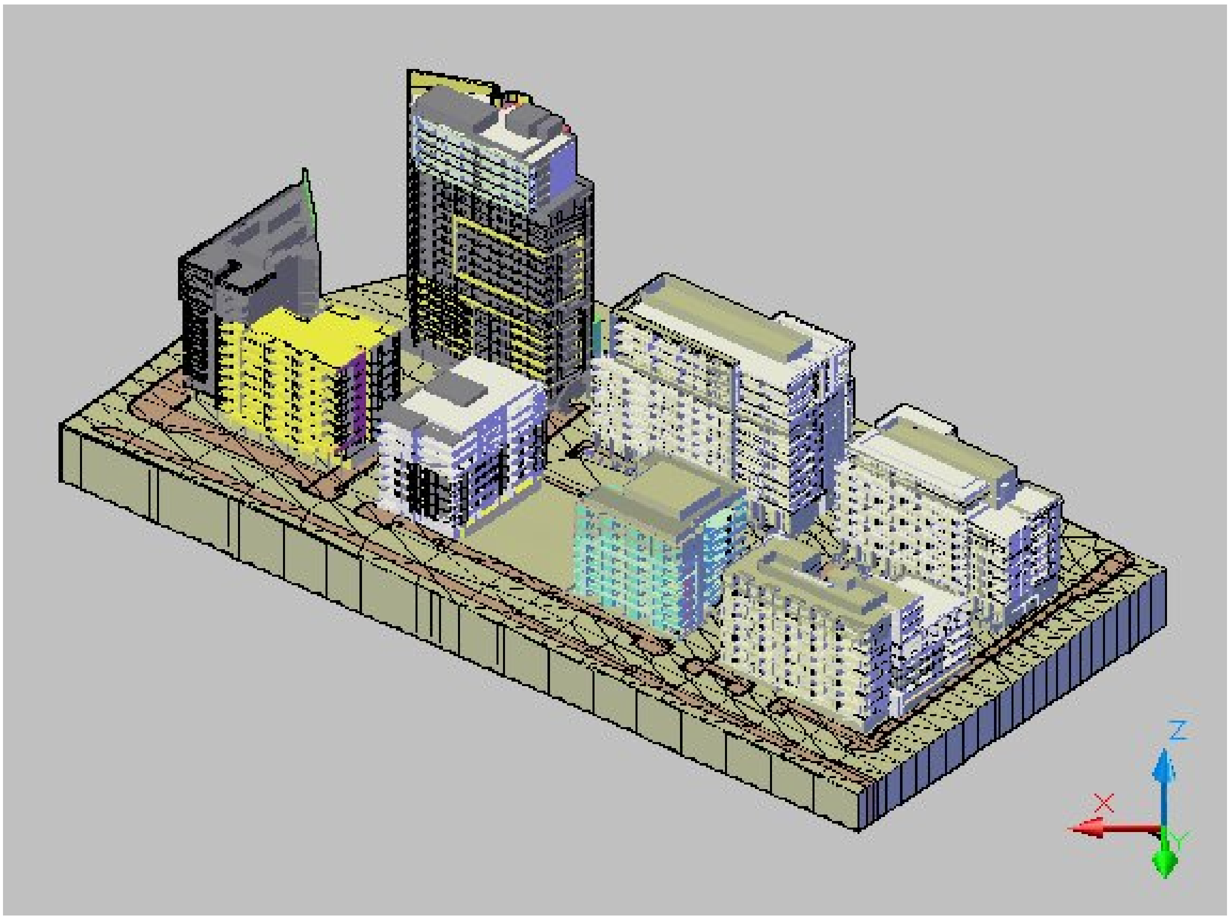
Stamford Property Services

Macquarie Park Village Update

Wind Effect Statement



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Revision No.	Date Issued	Reason/Comments
0	22 Nov 2012	Updated from 30B-10-0478-TNT-598430-6
1	18 Jan 2013	Building heights updated
2	19 June 2013	Design updated

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Stamford Property Services to prepare a wind assessment report of the proposed Macquarie Village, 110-114 Herring Road, Macquarie Park, NSW based on the updated drawings dated June 2013. The previous wind effect statement was made by Vipac in 2012. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The updated drawings of the proposed development were supplied by Stamford Property Services dated 6 June 2013. They are listed in Appendix C.

The findings of this study can be summarised as follows:

- The proposed development would not generate wind conditions in excess of the criterion for safety.
- The wind conditions on ground level footpath areas would be within the criterion of acceptability for walking.
- The wind conditions at building entrances would be within the criterion of acceptability for standing.

In conclusion, it is considered likely that the ground level areas adjacent to the proposed development would not experience wind conditions in excess of the recommended criteria. Design recommendations have been made to further evaluate the detail of proposed plantations, balconies and awnings.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing can be in error. Vipac recommends a wind tunnel test at the detail design stage.

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1. INTRODUCTION

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by Stamford Property Services to prepare a wind assessment report for the proposed Macquarie Village Development at 110-114 Herring road, Macquarie Park, NSW.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level public areas and access-ways in and adjacent to the development as proposed. No wind tunnel testing has been carried out for this development. Vipac has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed development. These serve as some valid references for the prediction of wind effects. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely ground level wind conditions adjacent to the proposed development [2, 3].

Drawings of the proposed development were supplied to Vipac by Stamford Property Services. A list of the drawings used in this desktop study is provided in Appendix C.

2. ANALYSIS APPROACH

In assessing whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, Vipac has considered the following points:

- Site characteristics, including the geometry and orientation of the proposed development;
- The regional wind climate;
- The interaction of predicted flows with adjacent developments;
- The exposure of the proposed development to wind;
- Comparison of generated wind speeds against the accepted assessment criteria as determined by the intended use of the public areas.

2.1. Site description

The proposed development site is located at the corner of Epping Road and Herring Road in North Ryde. The development is currently located in the middle of existing low-rise buildings typically not above 2 storeys (see Figure 1). The development is comprised of 7 medium rise residential towers of various heights, with orientations as shown on the site layout (Figure 2). Two 3-dimensional views of the site are also shown in Figure 3 and Figure 4.

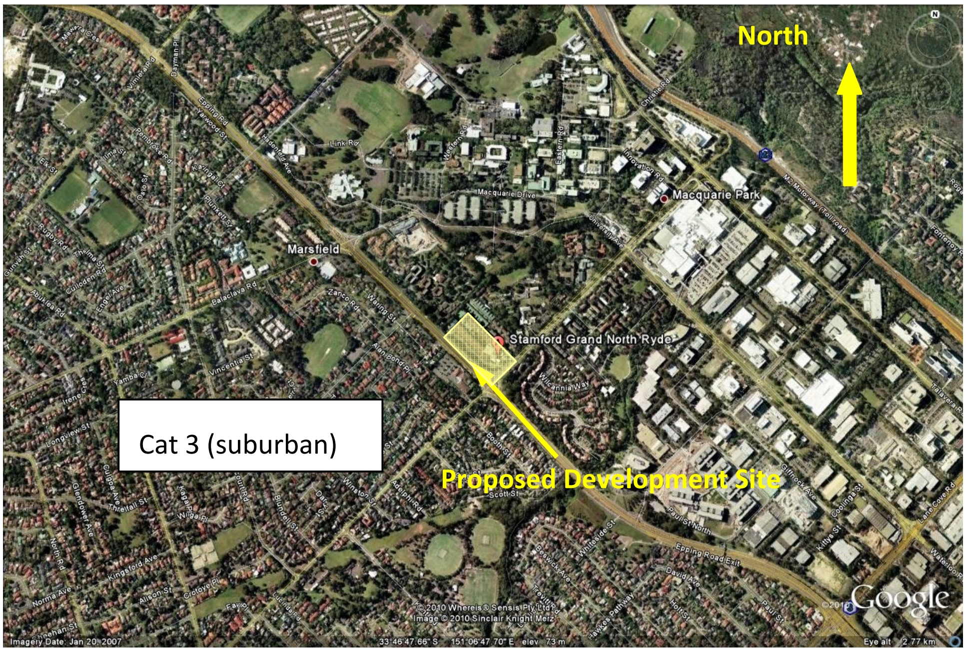


Figure 1: Site location and surrounding terrain

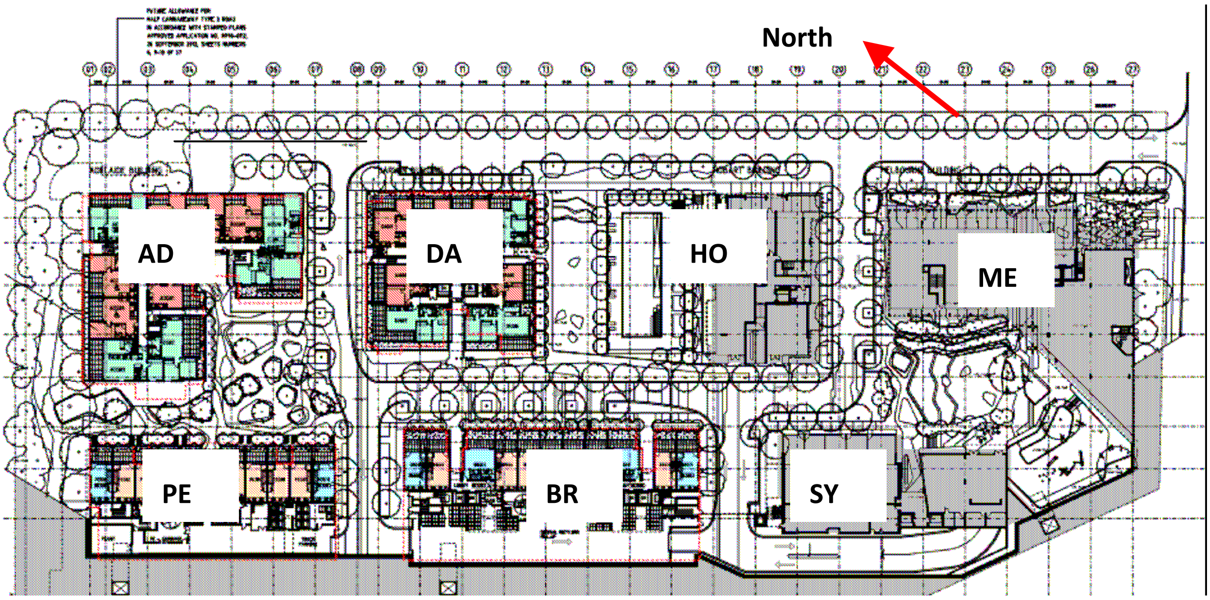


Figure 2: Proposed Site Layout

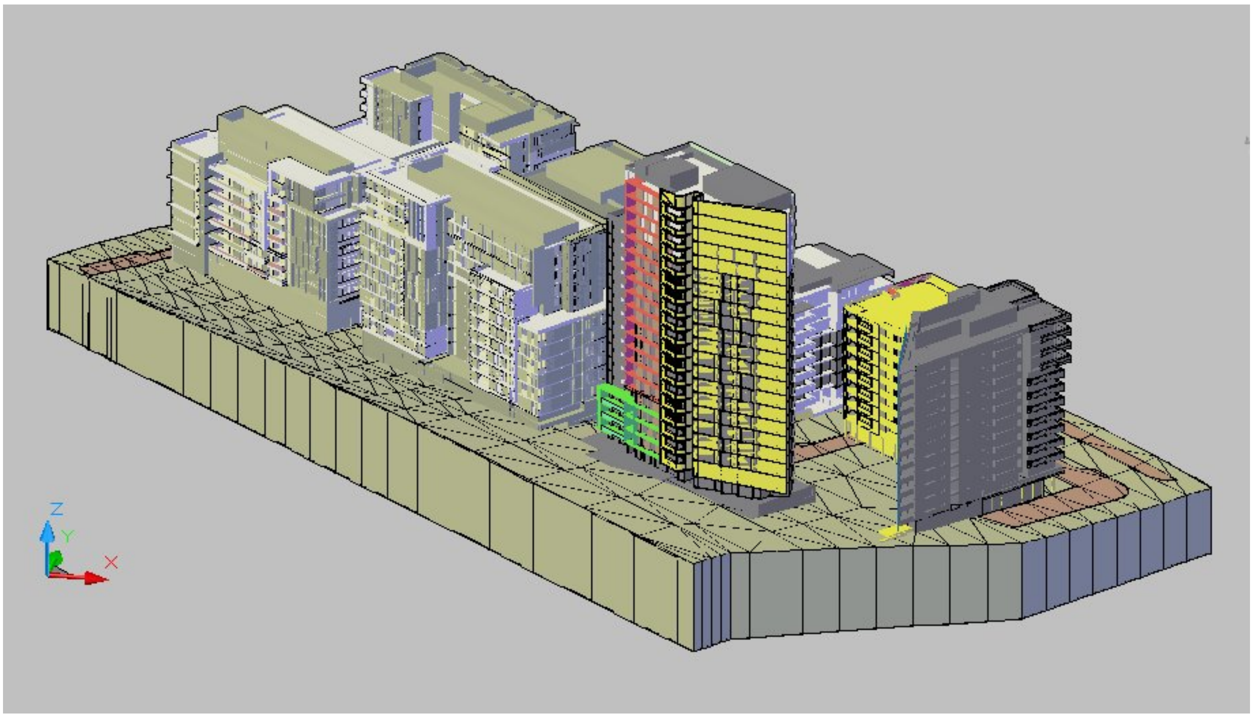


Figure 3: The proposed Development (Southwest view)

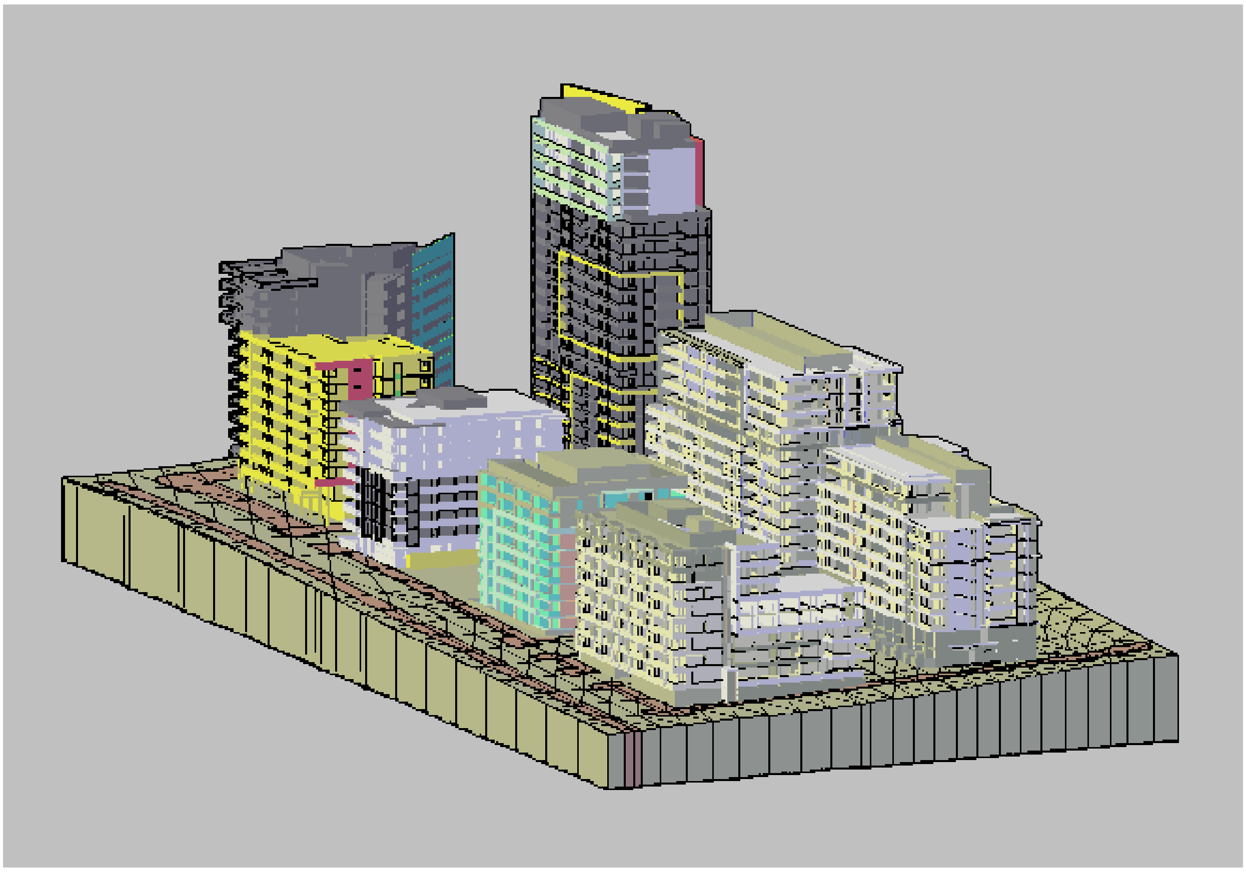


Figure 4: The proposed Development (Northeast view)

The heights of the building from ground level are as follows:

- Building Adelaide (AD) - 29.2m
- Building Perth (PE) - 35.7m
- Building Darwin (DA) - 29.2m
- Building Hobart (HO) - 30.3m
- Building Brisbane (BR) - 45.2m
- Building Melbourne (ME) - 45.5m
- Building Sydney (SY) - 73.7m

2.2. Regional wind climate

Wind speeds have been recorded at Sydney Airports for over 30 years. This data has been analyzed and a composite directional probability distribution of the wind speeds at the site have been determined. Calculations have been made that allow for the prediction of the wind environment that exists above the earth's boundary layer. This level is described as the Gradient height. The directional distribution of hourly mean wind speed at the gradient height, with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 5.

The distribution indicates that the strongest winds above Sydney are from the West, South, Northwest, Northeast and Southwest directions. This is factored into the assessment. The wind data at this free stream height can be considered to be common to all Sydney sites and is used as a reference to assess ground level wind conditions at this site.

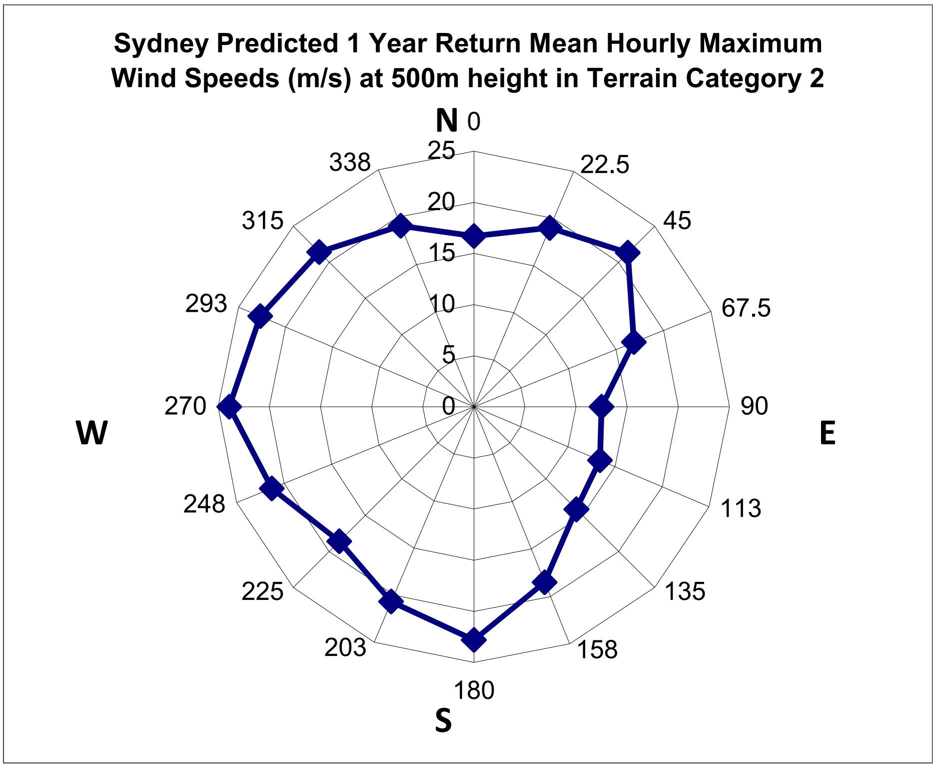


Figure 5: Directional Distribution of Annual Return Period Mean Hourly Wind Velocities (m/s) at Gradient Height for Sydney.

2.3. Flow interactions with adjacent developments

Figures 1, 3 and 4 show the proposed development and immediately surrounding buildings. It is noted that the proposed buildings are higher than the immediately surrounding buildings. Thus the proposed buildings will become a wind catcher, especially for the north side of buildings Sydney and Perth.

However, the proposed buildings have balconies, which tends to break a smooth flow and reduce the high wind speed at ground level.

2.4. Site exposure

There are low-rise developments surrounding the site in all directions. As the proposed development will be above the existing buildings it will be directly exposed to wind from all directions.

Therefore, considering the immediate surroundings and upstream terrain, the site of the proposed development is assumed to be terrain Category 3 (Suburban) from all directions (see Figure 1).

2.5. Assessment criteria

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterised by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity. If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be voted as unacceptable.

In a similar manner, a set of hourly mean velocity criteria with a 1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed Development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold ***gust velocity*** criteria and threshold ***mean velocity*** criteria are listed in Table 1.

Table 1: Recommended Wind Comfort and Safety

Annual Maximum Mean	Annual Maximum Gust	Result on Perceived Pedestrian Comfort
>15m/s	>23m/s	Unsafe (frail pedestrians knocked over)
<10m/s	<16m/s	Acceptable for Walking (steady steps for most pedestrians)
<7m/s	<13m/s	Acceptable for Standing (window shopping, vehicle drop off, queuing)
<5m/s	<11m/s	Acceptable for Sitting (outdoor cafés, pool areas, gardens)

Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices, landscaping and/or local building geometry modifications to achieve the desired comfort rating may be recommended. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

With regard to the above and the intended use of the various external areas we recommend the following criteria as detailed in Table 2. Figure 6 through to Figure 12 show the plan view of ground level areas with the criteria overlaid.

Table 2: Recommended application of criteria

Site Location	Recommended Criteria
Public Footpaths	Acceptable for Walking
Building Entrances	Acceptable for Standing

Evaluations of balconies are not included in this report.

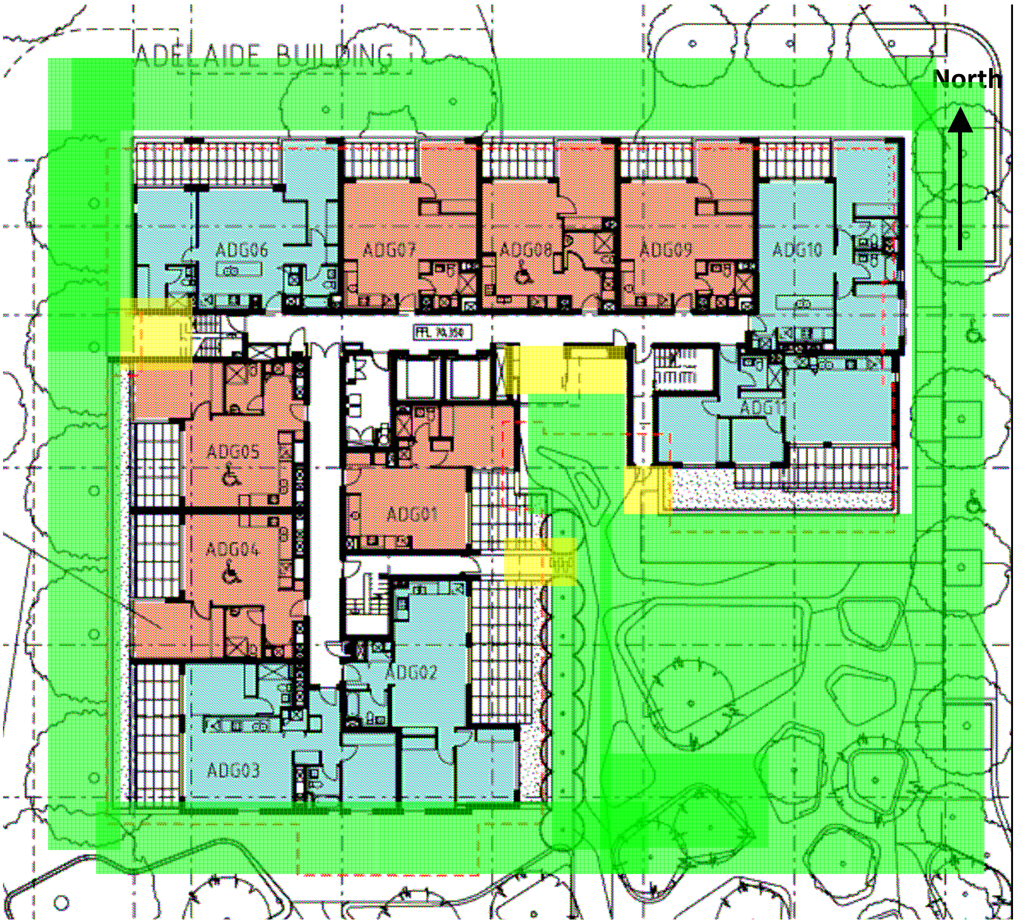


Figure 6: Schematic plan view of the proposed Building Adelaide with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

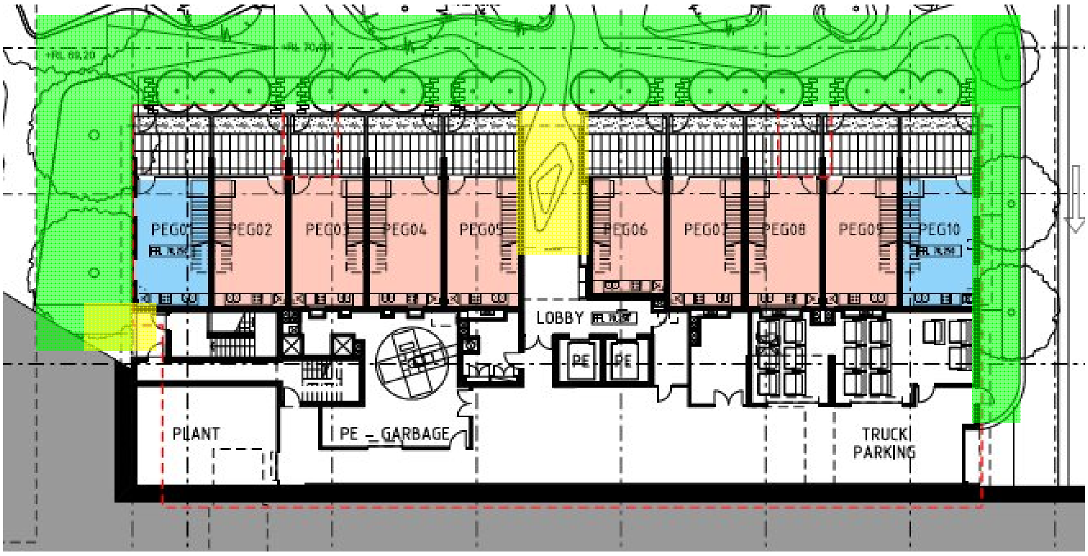


Figure 7: Schematic plan view of the proposed Building Perth with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

Figure 8: Schematic plan view of the proposed Building Darwin with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

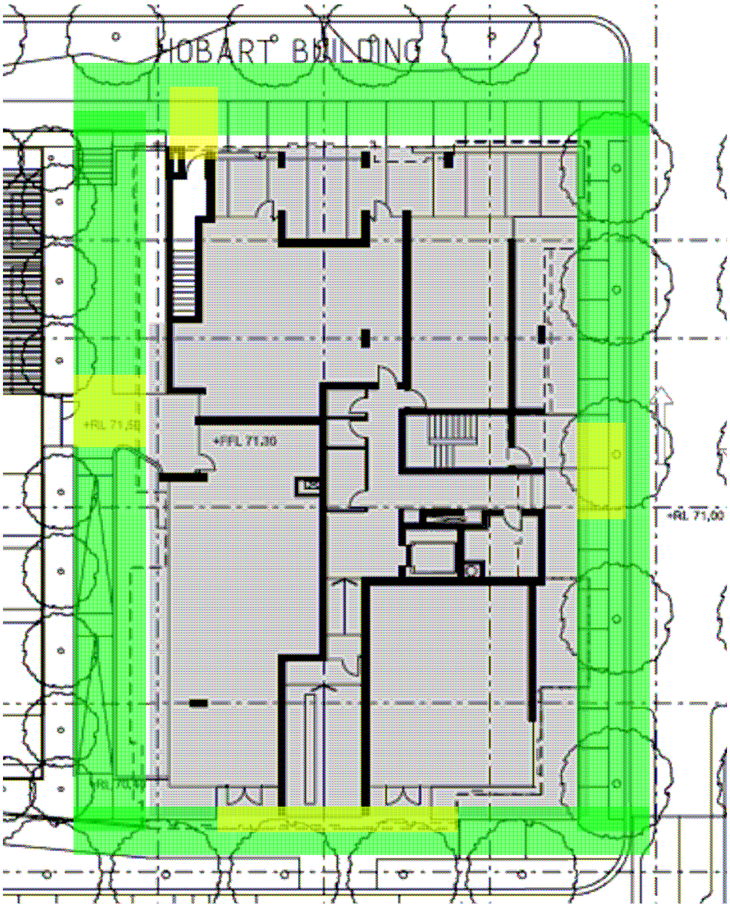


Figure 9: Schematic plan view of the proposed Building Hobart with the recommended wind criteria overlaid on adjacent ground level areas.

(green)	Recommended Acceptable for Walking
(yellow)	Recommended Acceptable for Standing

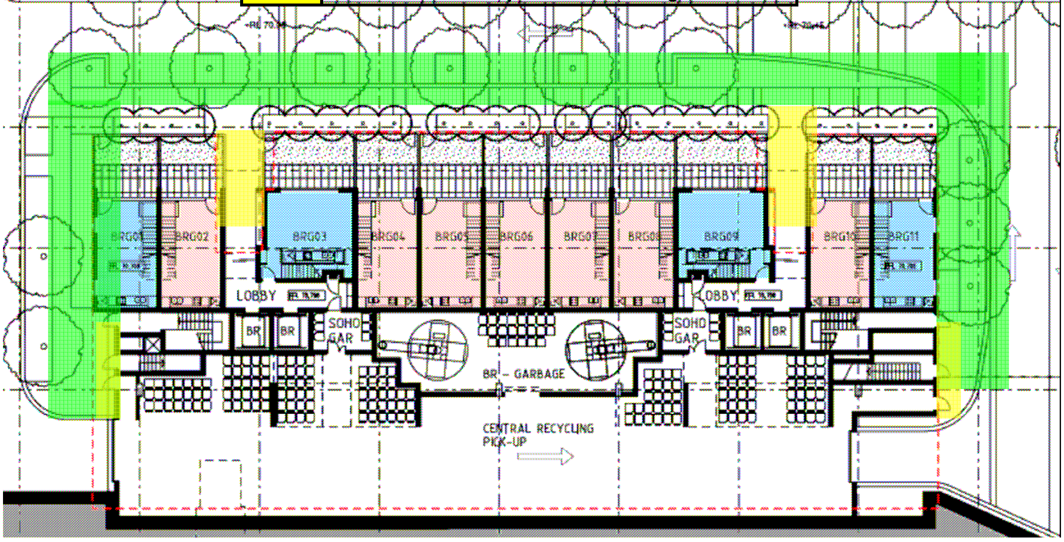


Figure 10: Schematic plan view of the proposed Building Brisbane with the recommended wind criteria overlaid on adjacent ground level areas.

(green)	Recommended Acceptable for Walking
(yellow)	Recommended Acceptable for Standing

Figure 11: Schematic plan view of the proposed Building Melbourne with the recommended wind criteria overlaid on adjacent ground level areas.

(green)	Recommended Acceptable for Walking
(yellow)	Recommended Acceptable for Standing

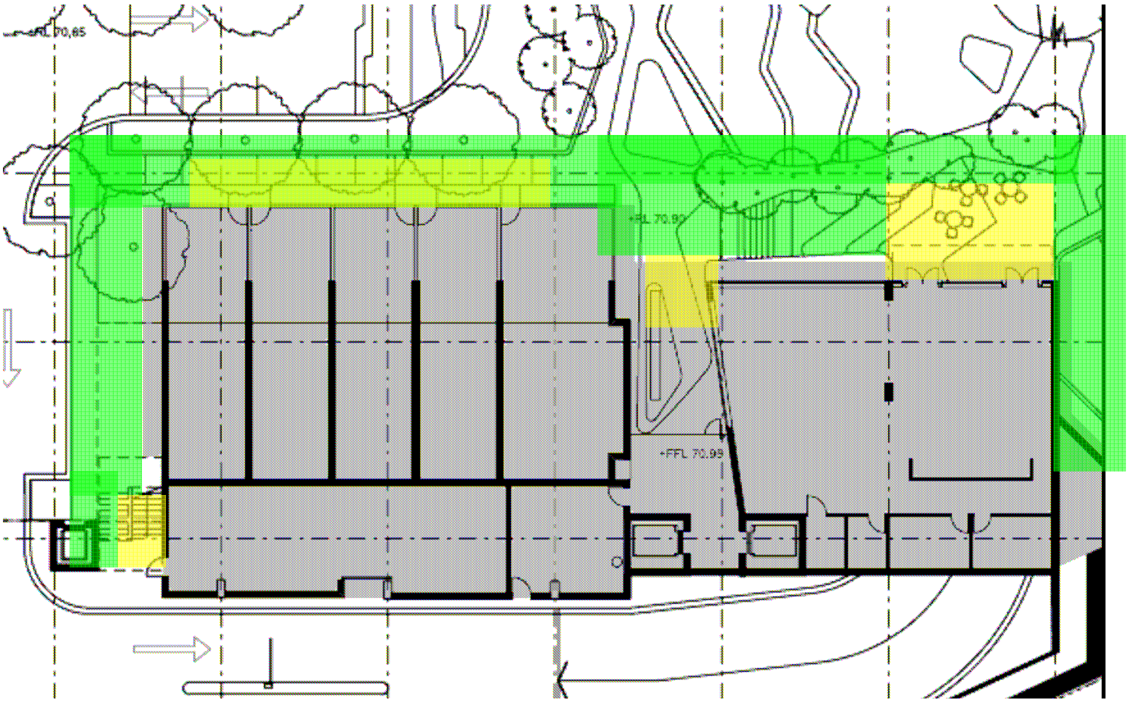


Figure 12: Schematic plan view of the proposed Building Sydney with the recommended wind criteria overlaid on adjacent ground level areas.

	Recommended Acceptable for Walking
	Recommended Acceptable for Standing

Figure 13: Schematic plan view of the proposed development with the recommended wind criteria overlaid on southwest side ground level areas.

	Recommended Acceptable for Walking

3. PEDESTRIAN LEVEL WIND EFFECTS ASSESSMENT

The wind structure interactions at the proposed development for wind approaching from various directions are as follows:

3.1. Wind approaching from Northeast

The Northeast direction is a strong wind direction for Sydney. The buildings Adelaide, Darwin, Hobart and Melbourne will catch this wind directly. The one year hourly wind speed will reach 11 - 13 m/s at 10m height. The expected wind flow pattern for this wind is shown in Figure 5.

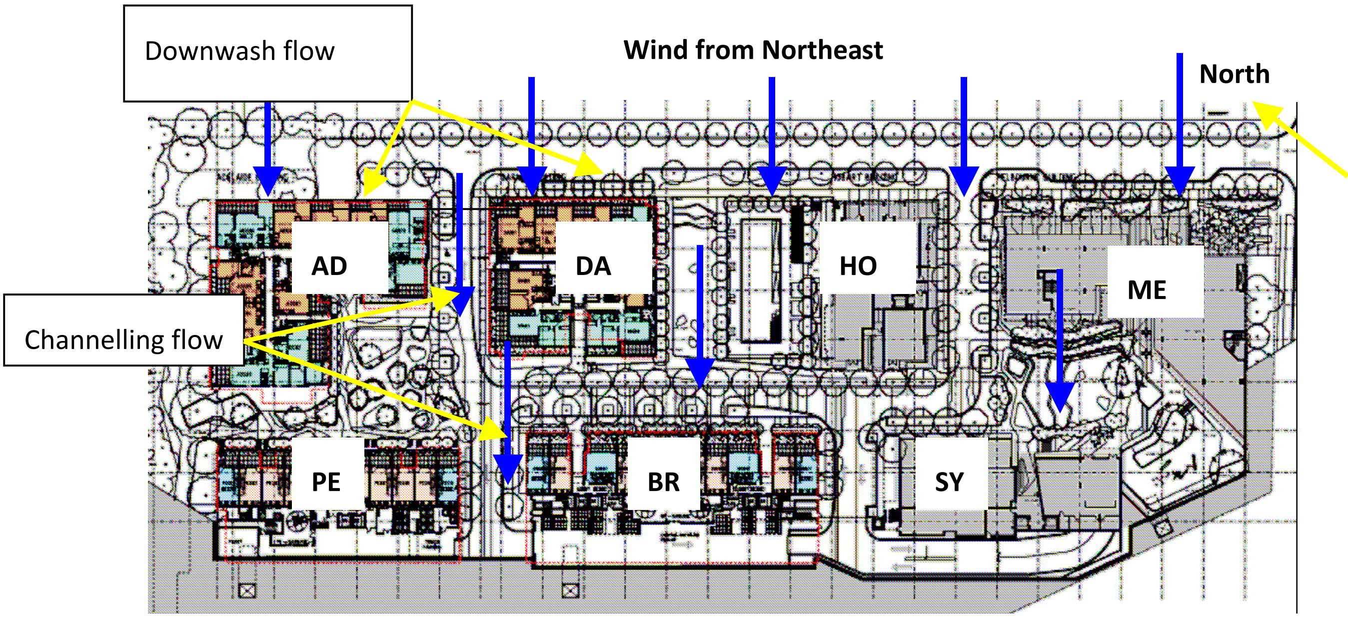


Figure 14: Northeast flow and interaction with the development and expected effect.

The northeast winds flow on the north facades of Buildings Adelaide, Darwin, Hobart and Melbourne produce downwash effects at the ground level. The wind speeds at the ground level are not expected to be strong due to the balconies on the north facades, which will help break down and dissipate the wind energy before reaching the ground level.

There will be a channelling flow on the footpath between the Buildings Adelaide and Darwin, Hobart and Melbourne (Figure 14). The flow in these areas without wind mitigation is expected to accelerate. The proposed plantations on the windward side are expected to reduce the wind speed due to the channelling flow. However, the effectiveness of any wind control mechanism would need to be validated during the detail design stage.

3.2. Wind approaching from southwest

The wind approaching from the Southwest direction for Sydney is also strong. The once a year wind speed (hourly mean) will reach 12 - 15 m/s at a 10m height. The wind at the ground level will be accelerated by downwash and channelling flows as shown in Figure 15. The downwash flows are expected on the entire south facing buildings. These flows will be minimized at ground level by the balconies on the south face of the buildings and awnings above building entrances.

The channelling flow created by southwest flow will be between Buildings Perth and Brisbane; and Buildings Brisbane and Sydney. The channelling flow from these directions may exceed the walking criterion without wind controlling mechanisms. Plantations on the southeast and southwest boundaries of the development are expected to slow down the wind at pedestrian level. Channelling flow is expected in the gap between Building Brisbane and Sydney as well as between Buildings Perth and Brisbane. However, the wind speed in these area expected to be within walking criterion considering the width of the gap and the proposed plantations.

The wind from the south will have an effect on building corners by creating corner accelerations without wind mitigation. However, rough facade surfaces, such as the addition of balconies and plantation on the southeast and southwest boundaries is expected to mitigate these corner accelerations at ground level.

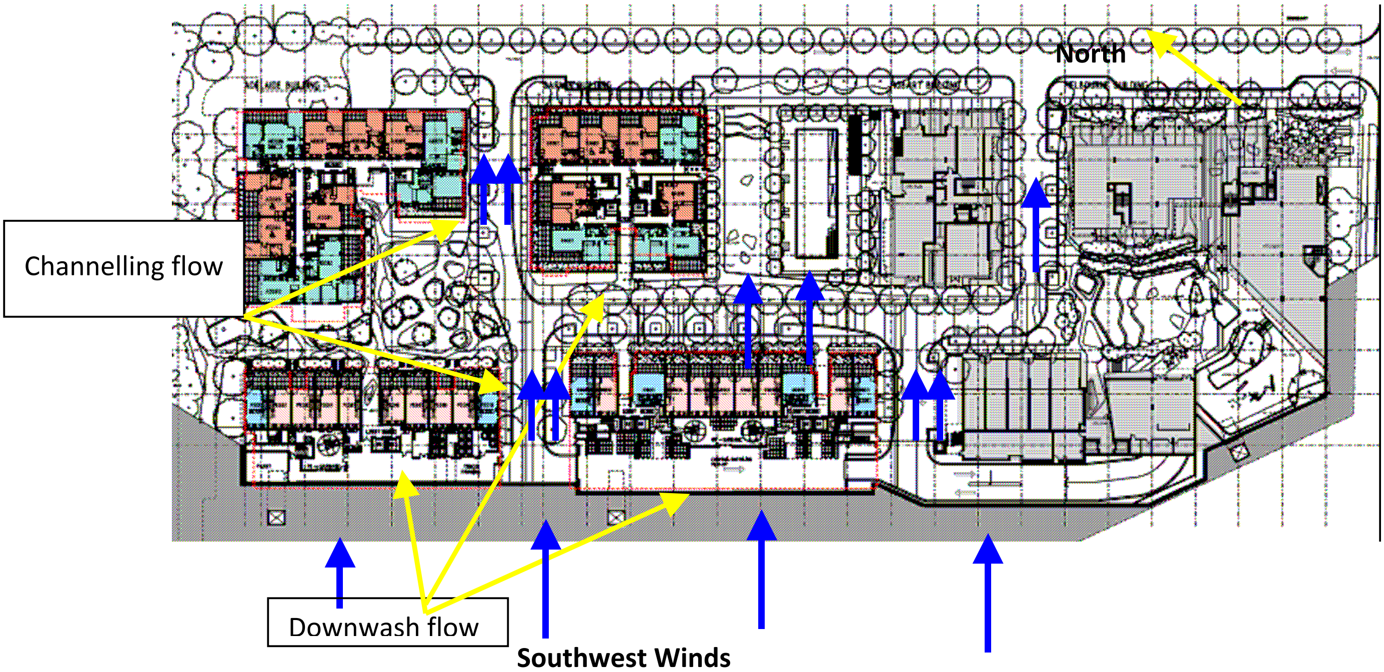


Figure 15: Southwest flow and interaction with the development and expected effect.

3.3. *Wind approaching from West*

The wind approaching from the West (the strongest in magnitude), does so at an angle where the corner acceleration becomes important as shown in Figure 16. The wind speed at these locations can be reduced by using plantations close to the corner to avoid the direct wind flow to the corner of the building at ground level.

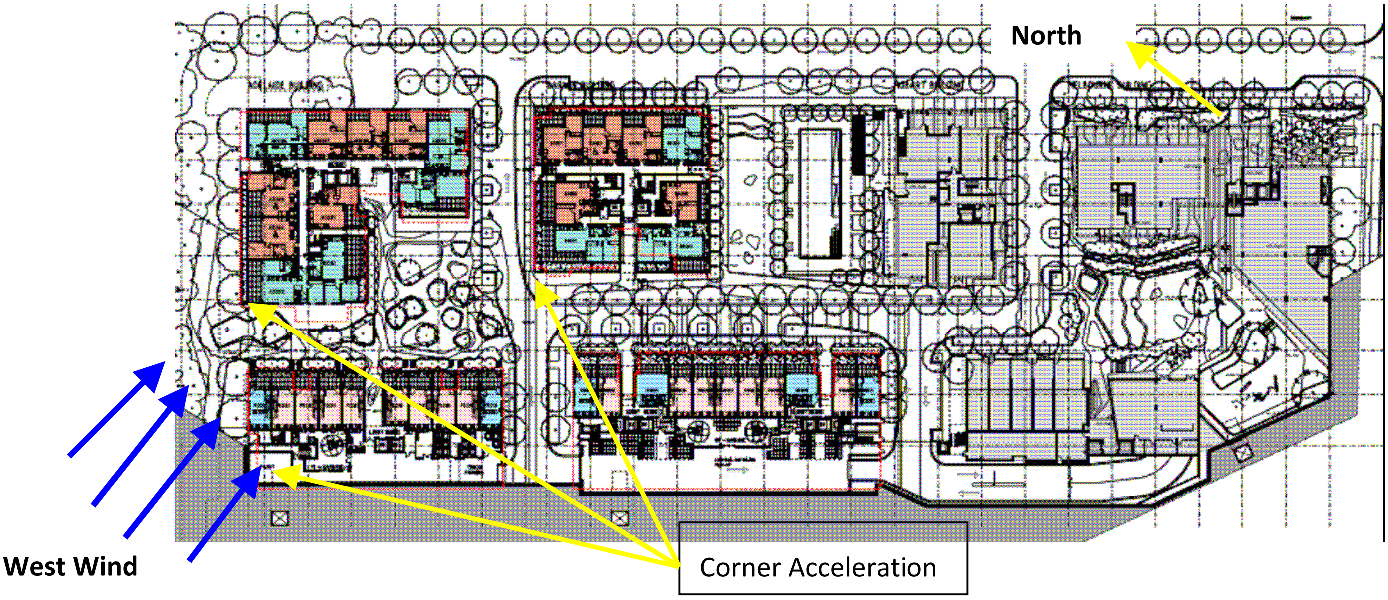


Figure 16: West flow and interaction with the development and expected effect.

3.4. *Wind approaching from North and South*

The wind approaching from the north and south will accelerate under the cantilever which projects out and connects buildings Brisbane and Sydney (Figure 17). However, the proposed plantation to the north and south of the cantilever will slow down the wind. The wind under the cantilever is not expected to exceed the walking criterion.

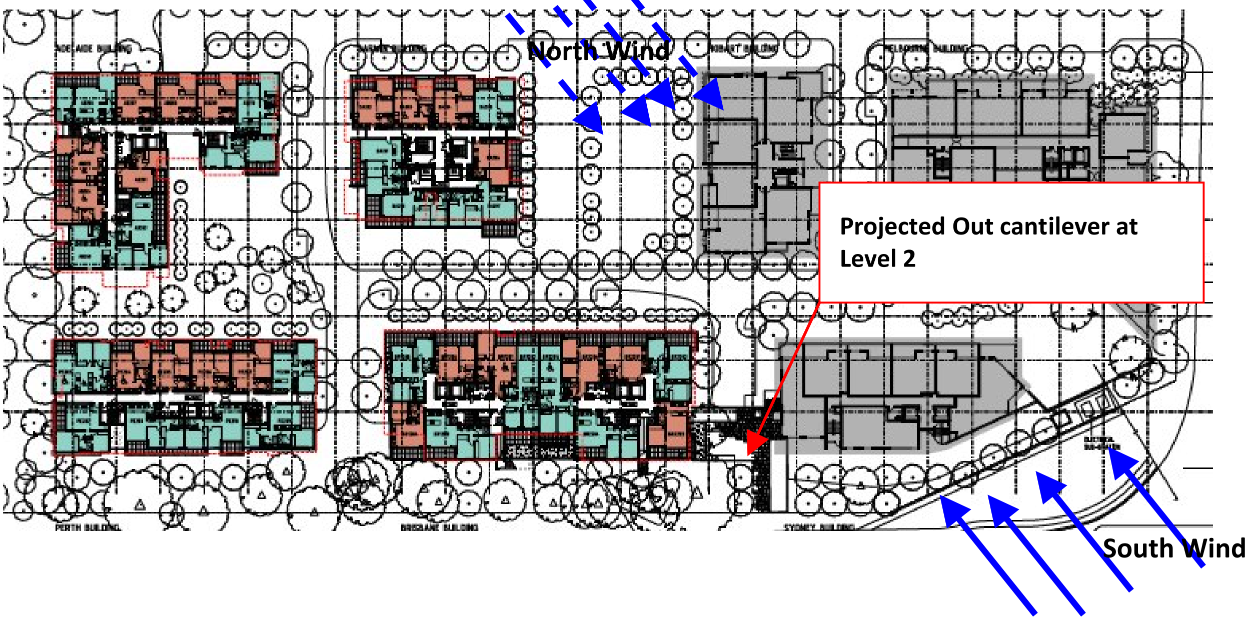


Figure 17: North and south flow and interaction with the cantilevers and expected effect.

4. RECOMMENDATIONS

4.1. Ground level areas

Vipac has carefully considered the nearby ground level public areas at the base of the proposed development and predicts that the proposed development is not likely generate wind conditions in excess of the recommended criteria with the proposed design and landscape plantings. Design recommendations have been made to further evaluate the detail of proposed plantations and awnings.

5. CONCLUSION

An appraisal of the likely wind conditions adjacent to the proposed Macquarie Village Development, 110-114 Herring road, Macquarie Park has been made.

Vipac have carefully considered the flow structures likely to be generated by the proposed development that would affect ground level areas. From this analysis, it is considered likely that the ground level areas adjacent to the proposed development would not experience wind conditions in excess of the recommended criteria. Design recommendations have been made to further evaluate the detail of proposed plantations, balconies and awnings.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing can be in error. Vipac recommends a wind tunnel test at the detail design stage.

This Report has been Prepared

For

Stamford Property Services

By

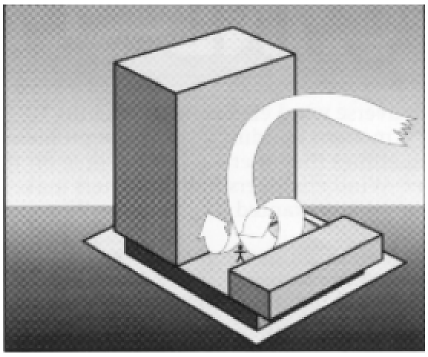
VIPAC ENGINEERS & SCIENTISTS LTD.

APPENDIX A – TERMINOLOGY OF ENVIRONMENTAL WINDS

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a ***wind velocity profile***. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



Downwash – refers to a flow of air down the exposed (the upwind) face of a tower. A tall tower can deflect downwards a fast moving wind from higher elevations.

Corner Accelerations – when wind flows around the corner of a building, parcels of air closer to the façade travel longer distances and tend to speed up relative to those parcels in the freely flowing stream.

Flow separation – when wind flowing along a surface meets a discontinuity, like a corner or a step, it may detach from that surface. The resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Coastal and open water frontage may have such exposure.

APPENDIX B - REFERENCES

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2002

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

APPENDIX C – DRAWING LIST

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