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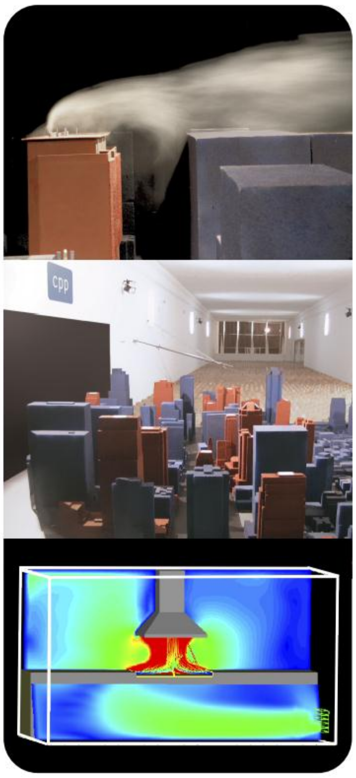
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:
PRINCE OF WALES HOSPITAL NCCC + AATC – STAGE 2
Randwick, Australia
CPP Project: 6809
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Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Health Infrastructure to provide an opinion based assessment of the impact of the proposed Prince of Wales Nelune Comprehensive Cancer Centre and Australian Advanced Treatment Centre - Stage 2, Randwick on the pedestrian level local wind environment in and around the proposed development.

The site is located in Randwick at the corner of Avoca and High Street. The site is surrounded by low and mid-rise residential and hospital campus buildings, Figure 1. There is undulating terrain surrounding the site, including a steady downhill slope to the east towards the coastline, which is approximately 2 km from the site.

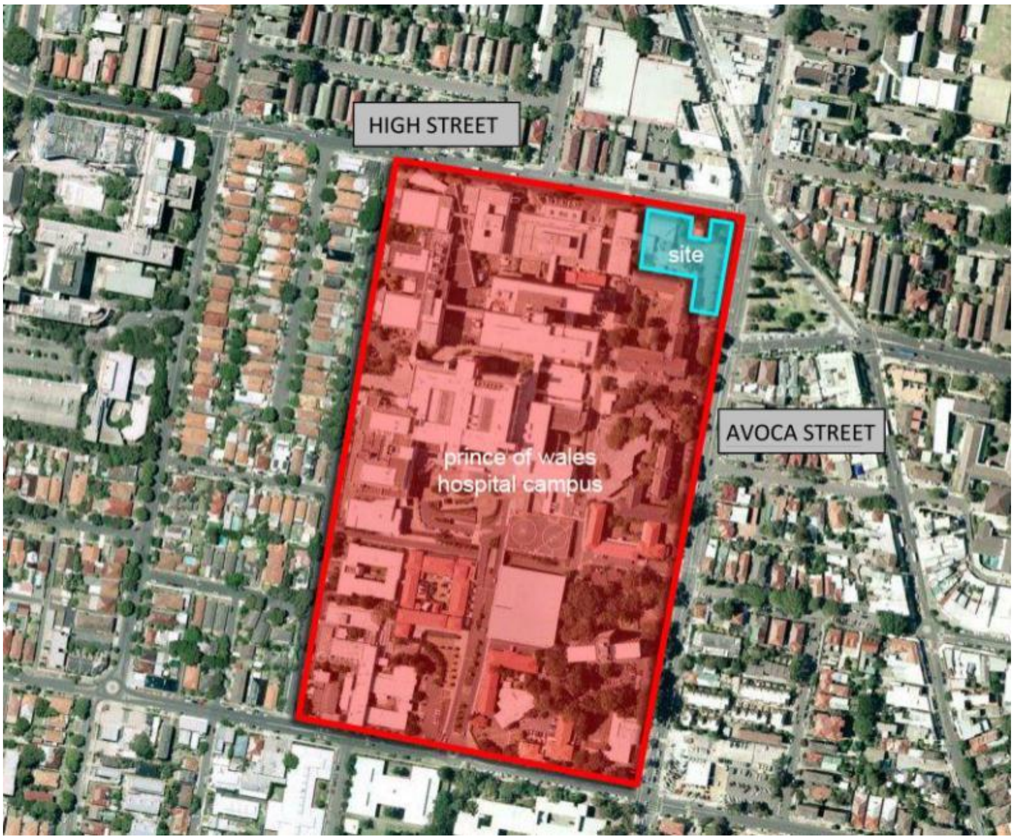

Figure 1: Location of the proposed Stage 2 site.

Sydney Wind Climate

The proposed development lies approximately 7 km to the north-east of Sydney Airport Bureau of Meteorology anemometer. The wind rose for the airport is shown in Figure 2 and is considered to be representative of prevailing winds at the site. It is evident that the prevailing winds for coastal Sydney come from the north-east, south, and west. Winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days. Winds from the south tend to be cold and tend to be associated with frontal systems that can last several days and occur throughout the year. Winds from the west are the strongest of the year and are associated with large weather patterns and thunderstorm activity. These winds occur throughout the year and can be cold or warm depending on the inland conditions.

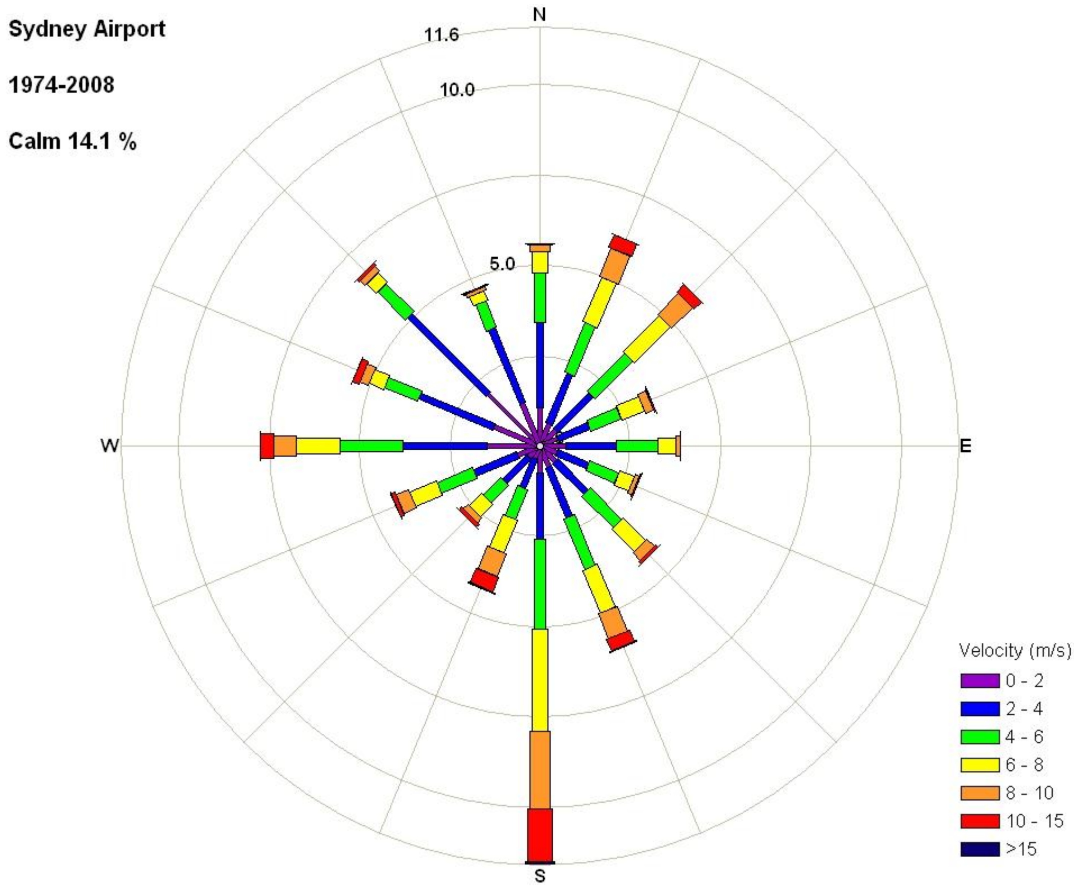

Figure 2: Wind rose for Sydney Airport

Environmental Wind Speed Criteria

It is generally accepted that wind speed and the rate of change of wind velocity are the primary parameters that should be used in the assessment of how wind affects pedestrians. Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

The wind assessment criteria used in this study are based upon the research of Lawson (1990), which is described in Table 1 for both pedestrian comfort and distress. The benefits of these criteria over many in the field are that they use both a mean and gust equivalent mean (GEM) wind speed to assess the suitability of specific locations. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the GEM wind speeds define when the wind gusts cause discomfort.

Table 1: Pedestrian comfort criteria for various activities

Comfort (maximum wind speed exceeded 5% of the time)	
<2 m/s	Outdoor dining
2 - 4 m/s	Pedestrian sitting (considered to be of long duration)
4 - 6 m/s	Pedestrian standing (or sitting for a short time or exposure)
6 - 8 m/s	Pedestrian walking
8 - 10 m/s	Business walking (objective walking from A to B or for cycling)
> 10 m/s	Uncomfortable
Distress (max. wind speed exceeded 0.022% of the time, twice per annum)	
<15 m/s	General access area
15 - 20 m/s	Acceptable only where able bodied people would be expected; no frail people or cyclists expected
>20 m/s	Unacceptable

The wind speed is either a mean wind speed or a gust equivalent mean (GEM) wind speed. The GEM wind speed is equal to the 3 s gust wind speed divided by 1.85.

Sydney is relatively windy, with an average wind speed at 10 m reference height of approximately 4 m/s (8 kt, 14 kph), and five percent of the time the mean wind speed is in excess of 9.5 m/s (18 kt, 34 kph). Converting the five percent of the time wind speed to typical pedestrian level at the site would result in about 6.0 m/s (12 kt, 22 kph). Comparing this with the comfort criteria of Table 1, the locale would be acceptable for pedestrian walking; hence any recreational outdoor activity requiring calmer wind conditions would require significant shielding from prevailing wind directions. The specific building massing of the proposed development and its interaction with approaching wind flows will dictate the actual wind environment at the site and the resulting wind acceptability levels; these are explored in detail below.

Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 3; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 3 smoke is being released into the wind flow to allow the wind speed, turbulence, and direction to be visualised. The image on the left shows smoke being released across the windward face, and the image on the right shows smoke being released into the flow at about third height in the centre of the face.

Techniques to mitigate the effects of downwash winds on pedestrians include the provision of horizontal elements, the most effective being a podium to divert the flow away from pavements and building entrances. Awnings along street frontages perform a similar function and the larger the horizontal element the more effective it will be in diverting the flow.

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side.

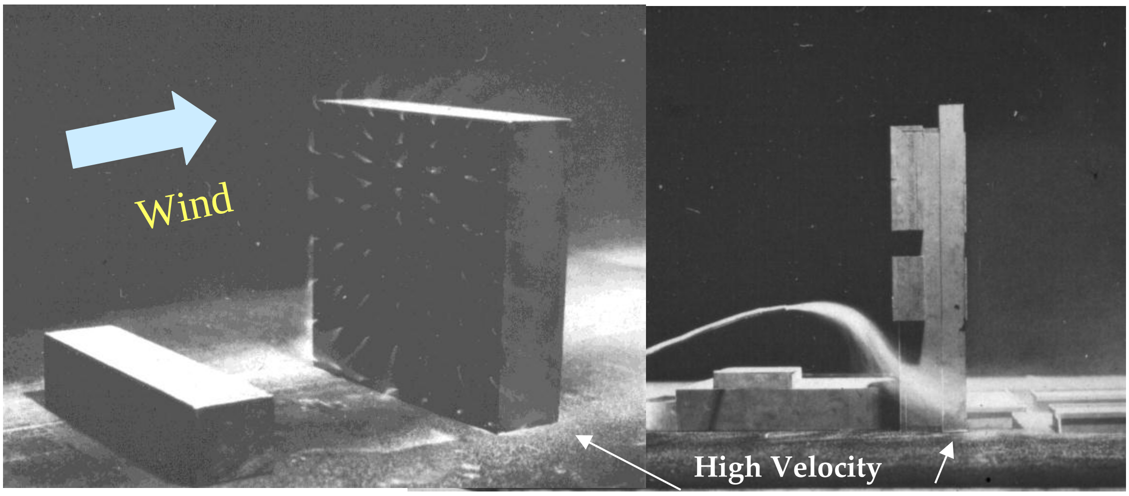

Figure 3: Flow visualisation around a tall building

Environmental Wind Assessment

The proposed development is located to the north-east of the existing Prince of Wales Hospital campus, Figure 4. The proposed development consists of a mid-rise building of prismatic form rising approximately 39 m above ground level, Figure 6. The Level 2 ground floor plan is shown in Figure 7.

The proposed development is generally surrounded by residential, commercial, and hospital buildings. In the immediate vicinity there are several existing hospital buildings in the south-west quadrant, a small park to the east and commercial buildings to the north, Figure 4. Building 3 to the west of the development is approximately 12 m tall and will be linked to the proposed construction. The existing Parkes Building immediately to the south-west and the Nurses and Medical Services building at 66 High Street to the north are of comparable height to the proposed development. The building is relatively exposed to winds from the prevailing directions. Topography surrounding the site is undulating and sloping downhill to the east towards the coastline, which is approximately 2km from the site.

Winds from the north-east will tend to stagnate against the east façade creating downwash that will accelerate through the undercroft area to the south-east. The presence of the Edmund Blackett Building and the sunken courtyard, will offer protection to pedestrians and the wind conditions through this area are expected to be acceptable for pedestrian walking. The main entrance located in the undercroft area will be windy, but the porous screens flanking the entry bridge will offer protection to pedestrians. Winds from the north-east will tend to bring beneficial summer cooling to the development and will be evident in the sunken courtyard area with reasonable circulation in this space.

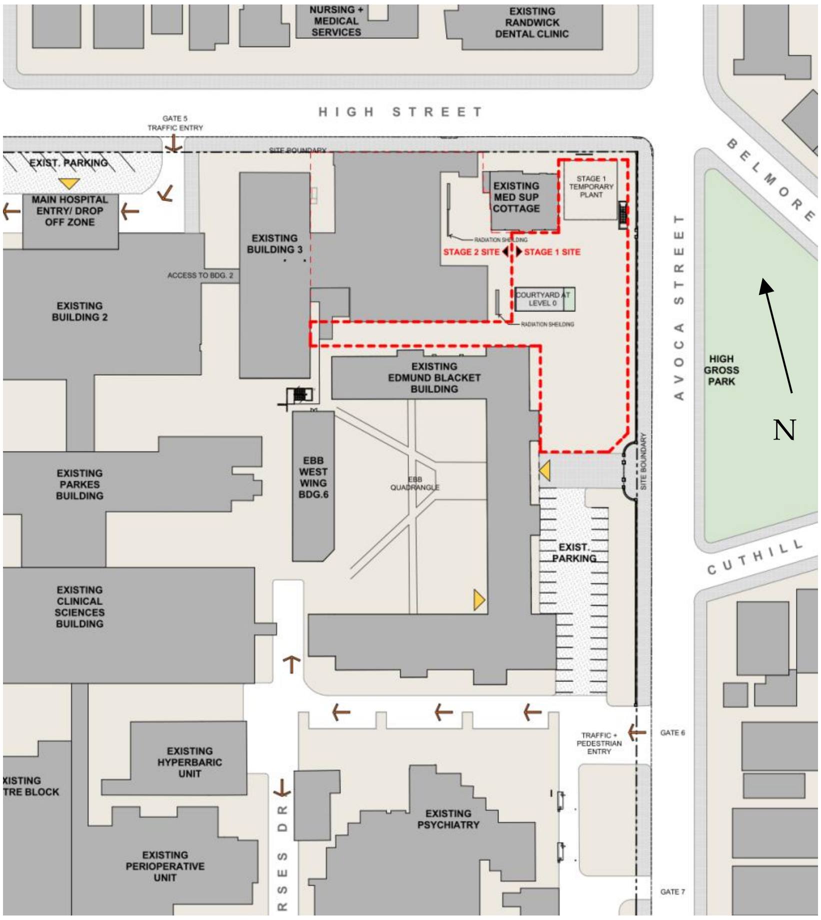

Figure 4: Site plan of the proposed Stage 2 development and surrounding existing developments

Figure 5 : Height relationship of proposed development with adjacent existing developments viewed from the east (ground level is approximately RL 64 m at proposed development site).

a) b) c) d)

Figure 6: North (a), east (b), south (c) and west (d) elevations of the proposed building

Winds from the south will stagnate on the exposed south façade creating downwash, and accelerated flow around the southern corners will produce local windier conditions at ground level, Figure 7. The connection to the existing Building 3 will help mitigate ground level winds on the west side of the proposed development.

The undercroft to the east will attract more flow producing windy conditions through the undercroft area with the fastest flow being closest to the building. The void over the sunken courtyard will offer protection to the pedestrian access levels, but will experience strong circulation. The pedestrian access to the main entrance at Level 02 to the east of the sunken courtyard is expected to be suitable for pedestrian walking. The porous section to the main entry bridge over the sunken courtyard is a good design feature from a wind perspective as it offers protection and avoids pedestrians being exposed to a sudden change of wind speed.

Figure 7: Ground level floor plan of the proposed development

During winds from the west, downwash wind will be directed towards ground level, and accelerate around the western corners of the building. There will be some channelling between the proposed development and the shorter existing Edmund Blacket Building to the south of the development; this area is expected to be suitable as an accessway, although any alfresco dining areas planned for the courtyard between these buildings would require amelioration, such as local screens, to produce a suitable wind environment. There will be a similar local increase in wind speeds to the north side of the development along High Street associated with downwash from the proposed building combined with channelling between the proposed building and 66 High Street, Figure 5. Although windy, this area is expected to meet the distress criterion and be classified as suitable for pedestrian walking activities. To ameliorate any adverse wind conditions, higher density planting could be included toward the north-west corner of the building, or an awning over the Level 2 courtyard to the north-west of the building wrapping into High Street, to disperse accelerating flows.

The main entry is located adjacent to the undercroft area to the east of the proposed development, and conditions at the entry are expected to be windy. Notwithstanding, porous screening or high density planting are recommended in the vicinity of the main entry to mitigate the impact of stronger north-east and southerly winds and ensure suitable wind amenity. Potential amelioration measures can be investigated and their effectiveness validated during the detailed design stage.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact on the local wind environment of the proposed NCCC and AATC Stage 2 development at the Prince of Wales Hospital in Randwick. With the recommendations contained in the body of this report, wind conditions around the site are expected to be generally suitable for use as a public accessway. Amelioration measures are recommended in the vicinity of the main entry to improve the local wind amenity, and can be addressed during the detailed design stage.

References

Lawson, T.V., (1990), The Determination of the wind environment of a building complex before construction, *Department of Aerospace Engineering, University of Bristol*, Report Number TVL 9025.

Standards Australia (2011), *Australian/New Zealand Standard, Structural Design Actions, Part 2: Wind Actions* (AS/NZS1170 Pt.2).