CERMAK
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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT

Wind Assessment for:

2 FIGTREE DRIVE

Sydney Olympic Park, Australia

Prepared for:

Mirvac Projects

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05/08/15	Minor amendments	GSW	GSW	GSW

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Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Mirvac Projects to provide an opinion based assessment of the impact of the proposed development at 2 Figtree Drive, Sydney Olympic Park, Figure 1, on the pedestrian level local wind environment in and around the proposed development.

The proposed development consists of a new residential precinct with a common single storey podium and four towers rising approximately 20 to 50 m above ground level. To the north and west of the site is a mix of large stadia and office buildings while to the immediate north-east is a row of relatively isolated high-rise towers, Figure 1. Bicentennial Park and suburban areas are located to the east and south. The site slopes from north-west to south-east.

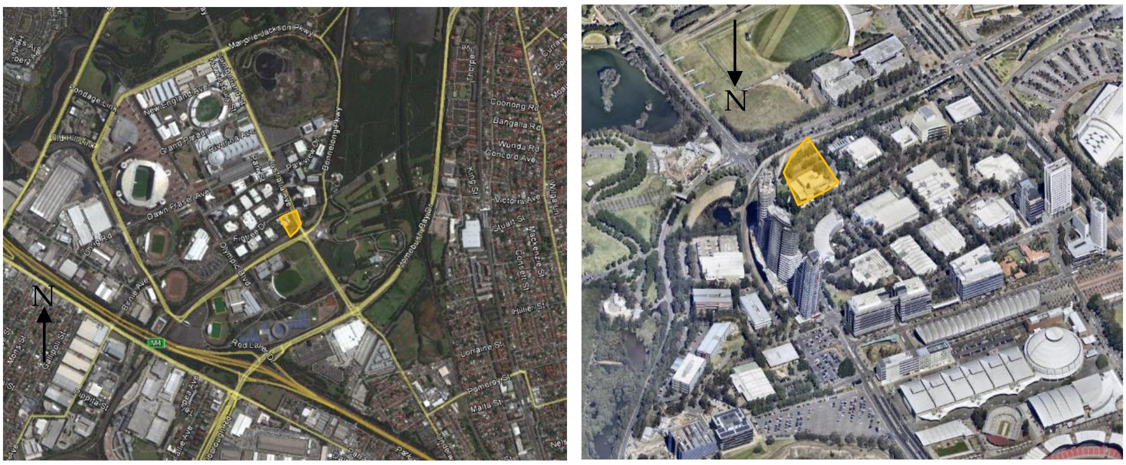

Figure 1: Location of the proposed development (Google Earth and Near Map, 2014)

Bankstown Wind Climate

The proposed development lies approximately 11 km to the north-east of Bankstown Airport Bureau of Meteorology anemometer. The wind rose for Bankstown airport is shown in Figure 2. The Bureau of Meteorology anemometer at Homebush Bay is closer to the site, but is known to be directionally influenced by surrounding buildings, topography, and landscaping hence the readings are unreliable for pedestrian level wind comfort analysis. The prevailing strong winds at Bankstown come from the south-east and west quadrants.

Winds from the south-east, which tend to be cold, are often caused by frontal systems that can last several days and occur throughout the year. Winds from the west tend to be 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. The prevailing wind directions associated with rain are from the south and west quadrants.

The summer sea breezes that in coastal Sydney from the north-east have decreased in magnitude on reaching Sydney Olympic Park about 20 km from the coast.

This wind assessment is focused on these prevailing wind directions.

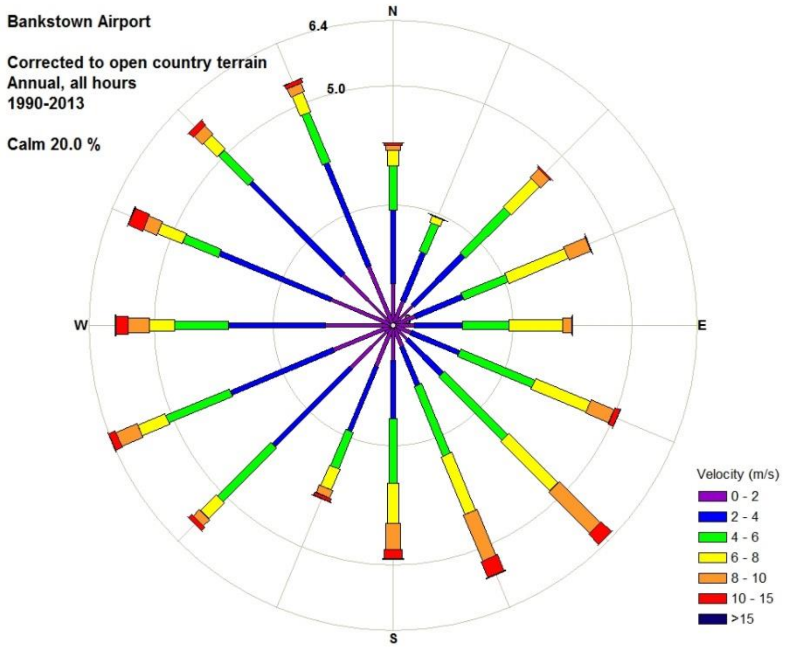

Figure 2: Wind rose for Bankstown Airport corrected to open country terrain

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.

Neither the Auburn Council development control plan (DCP) or the Sydney Olympic Park Master Plan 2030 have specific wind assessment criteria. 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.

From a wind perspective, Bankstown Airport is relatively mild, with an average wind speed at 10 m reference height of approximately 3 m/s (6 kt, 11 kph), and five percent of the time the mean wind speed is approximately 8.5 m/s (17 kt, 31 kph). Converting the five percent of the time mean wind speed to typical pedestrian level at the site using Standards Australia (2011) would result in about 5.4 m/s (11 kt, 20 kph). Comparing this with the comfort criteria of Table 1 indicates that pre-existing winds at any Bankstown location with a similar built environment surrounding the proposed development site would be classified as acceptable for pedestrian standing. Specific building massing of the proposed development and their 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.

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.

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 corners 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 shows wind at mid and upper levels on a building is accelerated substantially around the corners of the building. When balconies are located on these corners they are likely to be breezy, and will be used less by the owner due to the regularity of stronger winds. Owners quickly become familiar with when and how to use their balconies. If the corner balconies are deep enough, articulated, or have regular partition privacy fins then local calmer conditions can exist.

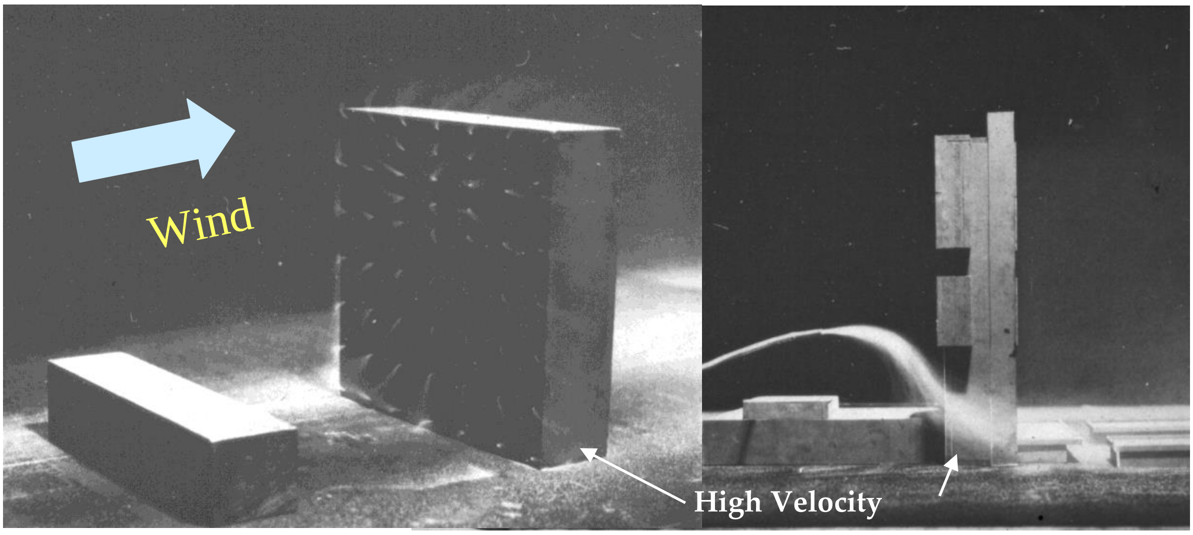

Figure 3: Flow visualisation around a tall building

Environmental Wind Assessment

The proposed development is located to the south-east of Sydney Olympic Park, Figure 1. The proposed development consists of four residential buildings ranging from approximately 20 to 50 m above the lowest ground level to the top of plant, Figure 4. The buildings are generally prismatic in plan form. Development floor plans are shown in Figure 5 and Figure 6 indicating the main entrances and podium outdoor areas. Topography surrounding the site generally slopes from north-west to south-east.

In general, the wind climate around Sydney Olympic Park is relatively mild and all the areas around the development are expected to be classified as suitable for use as a main public accessway from a comfort perspective. The wind flow patterns in and around the development are complex and will be highly sensitive to wind direction.

Due to the lack of shielding from upstream buildings to the south-east, wind from this direction east will stagnate on the exposed façades and accelerate down and around the windward corners creating local windier conditions from downwash, Figure 7. The downwash flow is not expected to be an issue for the south side where the articulation and podium roof will redirect the flow thereby protecting pedestrians. Wind conditions along Australia Avenue, close to the south-east corner of the south-east tower 15-storey tall, are likely to experience strong wind conditions during strong wind events from the south. These are expected to be accentuated with the local topography rising to the north, and the presence of the tall towers to the north-east impacting on the local wind flow pattern. Wind conditions here are expected to be suitable for pedestrian walking from a comfort perspective and approach the acceptable limit from a safety perspective. The setback of the building from the existing pavement and the established landscaping will offer some protection to pedestrians in this area.

Figure 4: North and east elevations of the proposed development

Winds from the west are directed more to the corner of the building thereby reducing downwash flow, Figure 8. Pressure driven flow will create a steady local jet of air between the western buildings. This type of pressure driven flow induces strong winds between any closely spaced buildings with the windiest conditions where the towers are closest together. The spacing is such that the flow between the towers will be constant rather than turbulent. There will be some calmer areas as marked, which is where any outdoor residential podium recreational areas would be recommended to be placed.

The Linear Park and public spaces to the south of the site would be most affected by winds from the north-east quadrant accelerating around the development, and from the south-west being channelled along the face of the towers. Winds from the north-east tend to be relatively light at this distance from the coast and from the south-west the wind near ground level would be dissipated by the existing mature trees. The local wind conditions will improve with distance from the building corners. The wind conditions in this area would be expected to be acceptable for the intended use.

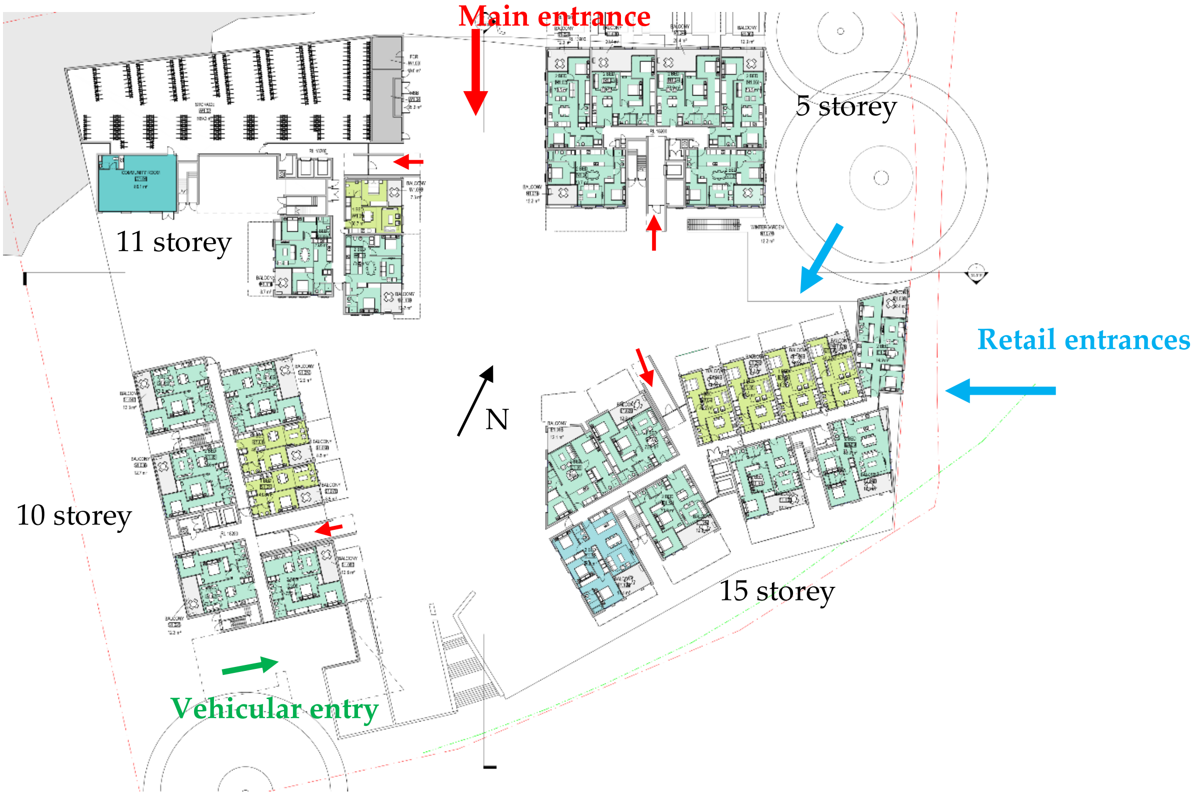

Figure 5: Main and retail entrances at ground level

Figure 6: Mid-rise floor plans

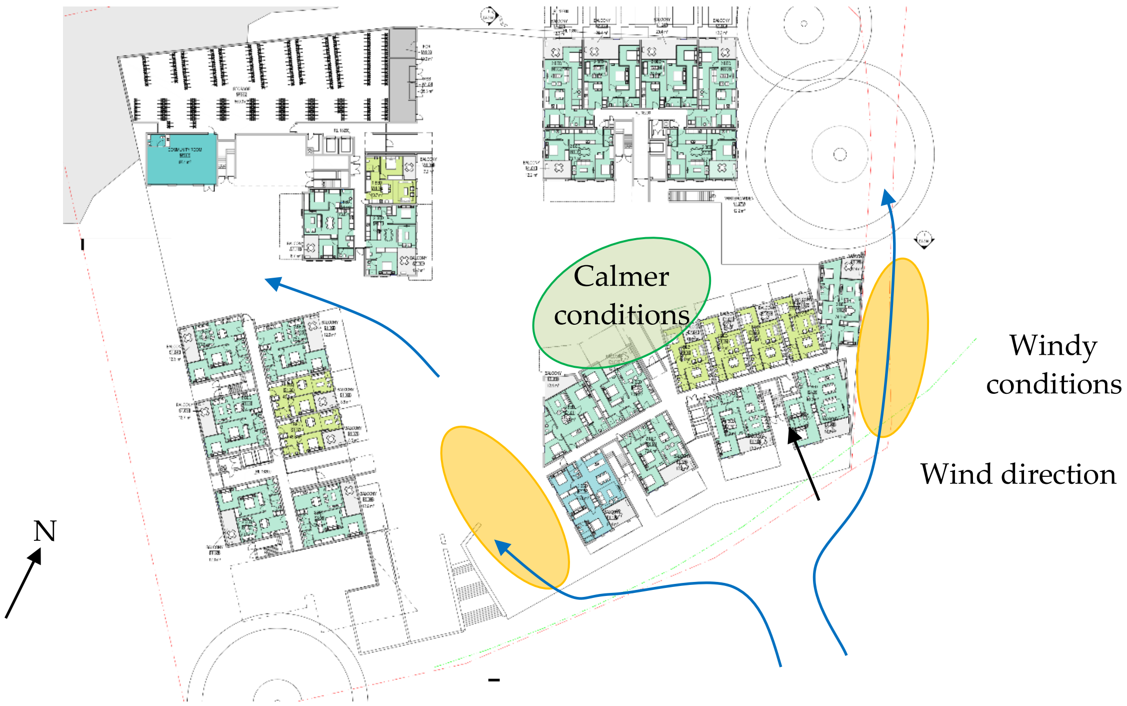

Figure 7: Flow patterns for winds from the south-east

Figure 8: Flow patterns for winds from the west

Serviceability considerations

The main entrances to the residential tower are reasonably well located from a wind perspective having access from the courtyard area, and are located away from the building corners with a recessed door.

With reference to Figure 7, prevailing wind from the south-east are expected to create steady, horizontal wind flow along the frontage to Australia Avenue. Any retail entrances along Australia Avenue may have issues with swinging doors slamming during strong wind events. It is recommended automated sliding doors be used at these entrances to avoid potential issues.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact on the local wind environment of the proposed development at 2 Figtree Drive, Sydney Olympic Park. From a comfort perspective, wind conditions around the site are expected to be suitable for use as a public accessway without any additional wind mitigation measures.

Wind-tunnel testing would be required to quantify and confirm the qualitative advice described in this assessment report.

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).