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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT

Wind Assessment for:

TENANCY 5, OVERSEAS PASSENGER TERMINAL

Sydney, Australia

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DESCRIPTION OF THE PROPOSAL AND HOURS OF OPERATION

TENANACY 5, OVERSEAS PASENGER TERMINAL, CIRCULAR QUAY

Description of the Proposal

The project seeks to use Tenancy 5 as an indoor and outdoor restaurant and bar (incorporating a micro-brewery) as detailed below:

- fitout, alterations and additions of Levels 1 & 2 for use as a restaurant and bar,
- external amendments to the OPT building including:
  - replacement of existing glazing on the northern and eastern elevations, with new window and door openings,
  - new ground floor terrace treatment and additional outdoor seating areas,
  - new Level 1 balcony on the western elevation, and
  - new outdoor decks on Level 1 on the east and north elevations and within the tower drum providing additional outdoor seating,
- new retractable awning/sun shading structure to proposed outdoor seating areas,
- landscaping of outdoor areas, and
- new micro-brewery within a pod structure located outside the OPT building.

Proposed Hours of Operation

1. The proposal seeks development consent for the following hours of operation (internal and external areas):
   - 6:00 am to 12:00 midnight Sunday to Thursday inclusive
   - 6:00 am Friday to 1:00 am Saturday
   - 6:00 am Saturday to 1:00 am Sunday
   - 6.00 am to 2.00 am on January 1
2. The current and proposed hours of operation under the existing On Premises Liquor License (as amended to apply to the proposed licensed area of the entire tenancy) including:

Standard Trading Hours (Internal and External Areas)

- 10:00 am to 12:00 midnight 7 days a week; and

Additional Trading Hours on Public Holidays (Internal and External Areas)

- Good Friday – 12 noon – 10:00 pm
- Christmas Day 12:00 noon – 10:00 pm
- December 31 – 6:00 am to 2:00 am on January 1

Proposed Entertainment

Live music in accordance with the Plan of Management and Noise Report (limited generally to amplified music consisting of solo or duos and excluding a designated or purpose built dance floor and DJs).

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Ridgemill to provide an opinion based assessment of the impact of the proposed Tenancy 5 development, at the north end of the Overseas Passenger Terminal, Circular Quay, on the pedestrian level local wind environment in and around the site.

The proposed development is located toward the north-west extent of Circular Quay, adjacent to the Sydney Harbour Bridge, Figure 1. The site is surrounded by low to medium rise buildings to the south and west quadrants, and is exposed to Sydney Harbour to the north-east. Topography surrounding the site is relatively flat, with the terrain rising to the west and the approach to the Harbour Bridge.

Figure 1: Location of the proposed development (Google Earth, 2016)

Sydney Wind Climate

To enable a qualitative assessment of the wind environment, the wind frequency and direction information measured by the Bureau of Meteorology at a standard height of 10 m at Sydney Airport from 1995 to 2015 have been used in this analysis, Figure 2. The anemometer is located about 10 km to the south of the site and is considered representative of the wind conditions at the site. It is noted from Figure 2 that strong prevailing winds are organised into three main groups which centre at about north-east, south, and west. This wind assessment is focused on these prevailing strong wind directions.

Strong summer winds occur mainly from the south quadrant and the north-east. Winds from the south are associated with large synoptic frontal systems and generally provide the strongest gusts during summer. Moderate intensity winds from the north-east tend to bring cooling relief on hot summer afternoons typically lasting from noon to dusk. These are small-scale temperature driven effects; the larger the temperature differential between land and sea, the stronger the breeze.

Winter and early spring winds typically occur from the south and west quadrants. West quadrant winds provide the strongest winds affecting the area throughout the year and are large scale synoptic events that can be hot or cold depending on inland conditions.

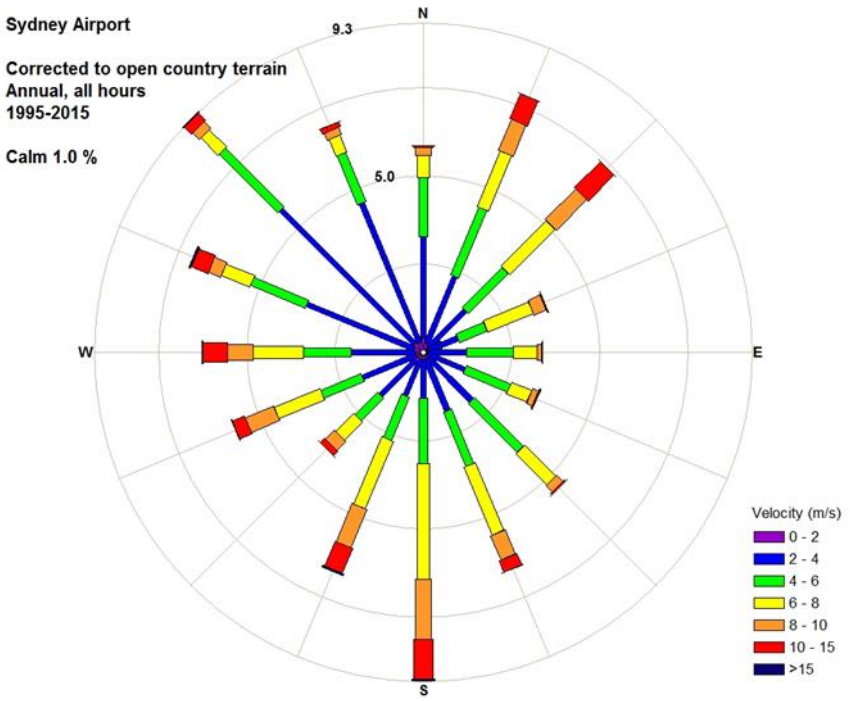

Figure 2: Wind rose showing probability of time of wind direction and speed for Sydney Airport

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. Downwash will occur on buildings of all heights, but the vertical component is dictated by the height to width ratio 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.

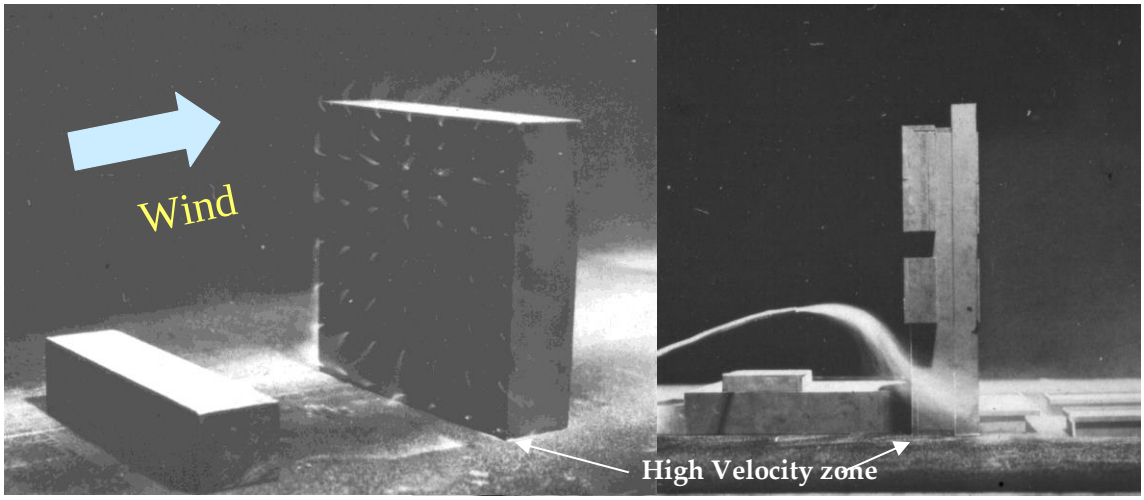

Figure 3: Flow visualisation around a tall building

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 deeper the horizontal element generally 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. For long buildings relative to their height the flow around the corners will generally be horizontal.

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. Over the years, a number of researchers have added to the knowledge of wind effects on pedestrians by suggesting criteria for comfort and safety. Because pedestrians will tolerate higher wind speeds for a smaller period of time than for lower wind speeds, these criteria provide a means of evaluating the overall acceptability of a pedestrian location. A location can further be evaluated for its intended use, such as for an outdoor café or footpath.

The current City of Sydney (2012) DCP specifies wind effects not to exceed 16 m/s, in neighbouring streets. There are few locations in Sydney that would meet this criterion without some shielding to improve the wind conditions. From discussions with Council this is a once per annum gust wind speed similar to the wind criteria in City of Sydney 2004 DCP, but is meant to be interpreted as a comfort level criterion and is not intended to be used as a distress requirement. The once per annum gust wind speed criterion used in the City of Sydney (2012) DCP is based on the work of Melbourne (1978), and the 16 m/s level is classified as generally acceptable for use as a main public accessway. This criterion gives the once per annum wind speed, and uses this as an estimator

of the general conditions at a site, which may be more relevant to the success of the development. To combat this limitation, this study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress. The limiting criteria are defined for both a mean and gust equivalent mean (GEM) wind speed. 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 ongoing findings using the criteria, and clients who have issues with strong wind, a more stringent criterion is required for outdoor dining style activities and a value of 2 m/s for 5% of the time is recommended for such intended use. As the 5% of the time wind speed recorded at the airport is about 9 m/s, and even with the benefits of shielding from suburban buildings compared with the airport, most locations in the Sydney region require some level of shielding to meet the criterion.

Assessment using the Lawson criteria provides a similar classification as using the once per annum gust, which is the basis of the City of Sydney (2011) DCP, however also provides information regarding the serviceability wind climate.

Table 1: Pedestrian comfort criteria for various activities

Comfort (maximum of mean or gust equivalent mean ($GEM^{+\cdot}$) wind speed exceeded 5% of the time)	
< 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 (maximum of mean or GEM wind speed exceeded 0.022% of the time)	
<15 m/s	not to be exceeded more than two times per year (or one time per season) for general access
<20 m/s	not to be exceeded more than two times per year (or one time per season) where only able bodied people would be expected; frail or cyclists would not be expected

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.

Environmental Wind Assessment

The proposed development is located on the north-west corner of Circular Quay, and is predominantly surrounded by low to mid rise buildings. The proposed development involves the installation of a raised micro-brewery pod, with outdoor bar beneath, to the west of the site, and decks on the first level along the north and east facades, Figure 4.

In this area of the prevailing winds from the south are decelerated by the overall massing of the Sydney CBD, with the majority of flow from this direction being brought to ground level in the form of downwash and channelled along streets running north-south, and around the city through Darling Harbour and along Macquarie Street. As the channelled flow reaches Circular Quay it expands and

decelerates. With Tenancy 5 being located on the leeward side of the Overseas Passenger Terminal for winds from the south, the proposed changes would not be expected to affect the wind conditions at the site.

Wind conditions for winds from the west are dominated by the topography to the west of the site, and the blockage presented by the Sydney Harbour Bridge approach, which assists in shielding the site from these winds. The massing of the bridge approach acts to elevate the approaching flow away from ground level, and combined with the drop in elevation between the bridge approach and the site causes the flow to decelerate. The introduction of the raised micro-brewery to the site, with outdoor bar beneath, would be expected to cause an increase in wind speed under the micro-brewery pod, as flow is accelerated through the constricted opening. To reduce this effect and provide local amelioration to patrons, a solid wall could be extended from the rear of the bar to the base of the micro-brewery to eliminate this flow path. The awning above the north deck would be expected to decrease any potential for downwash onto the deck.

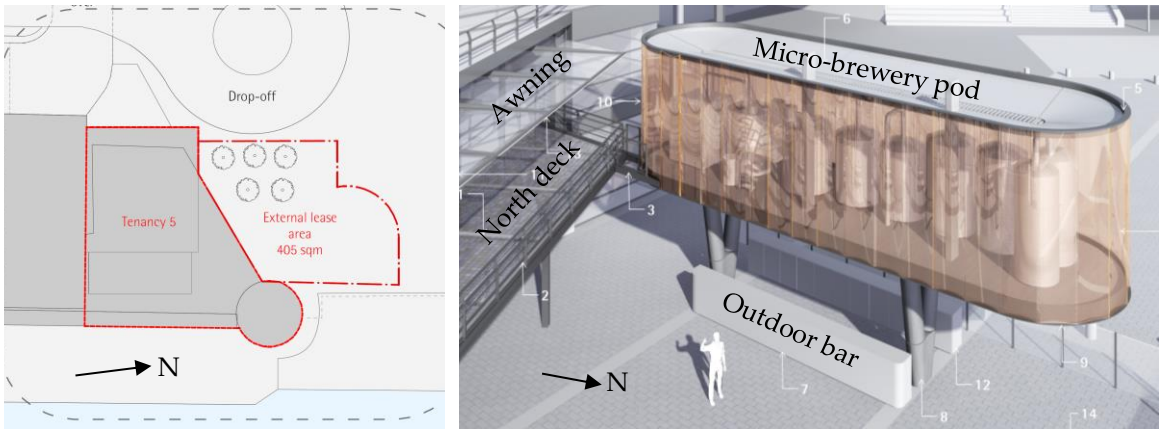

Figure 4: Plan view of site (L) and perspective view of micro-brewery (R)

Winds from the north-east approaching the site are unimpeded crossing the harbour, and will stagnate in the enclosed courtyard type space formed by the micro-brewery, Figure 5, creating relatively calm conditions compared with the existing wind conditions in this area. The positive pressure generated in this courtyard area, relative to the lower pressure on the west side of the Overseas Passenger Terminal, would be expected to drive horizontal flow between the buildings, and under the raised micro-brewery creating windier conditions for the outdoor bar and seating at this location, and the west end of the northern deck, Figure 5. The decks on the eastern façade of the proposed development, Figure 6, are exposed to the winds from the north-east. The 1.4 m high balustrade of the southernmost deck would be expected to provide some shielding for patrons close to the glazing, while the 1.8 m balustrade on the corner deck should effectively shield patrons from these direct winds, although circulation in the wake of the balustrade will still exist. The operable glazing is considered a good design feature to allow control of potential internal pressure driven flows.

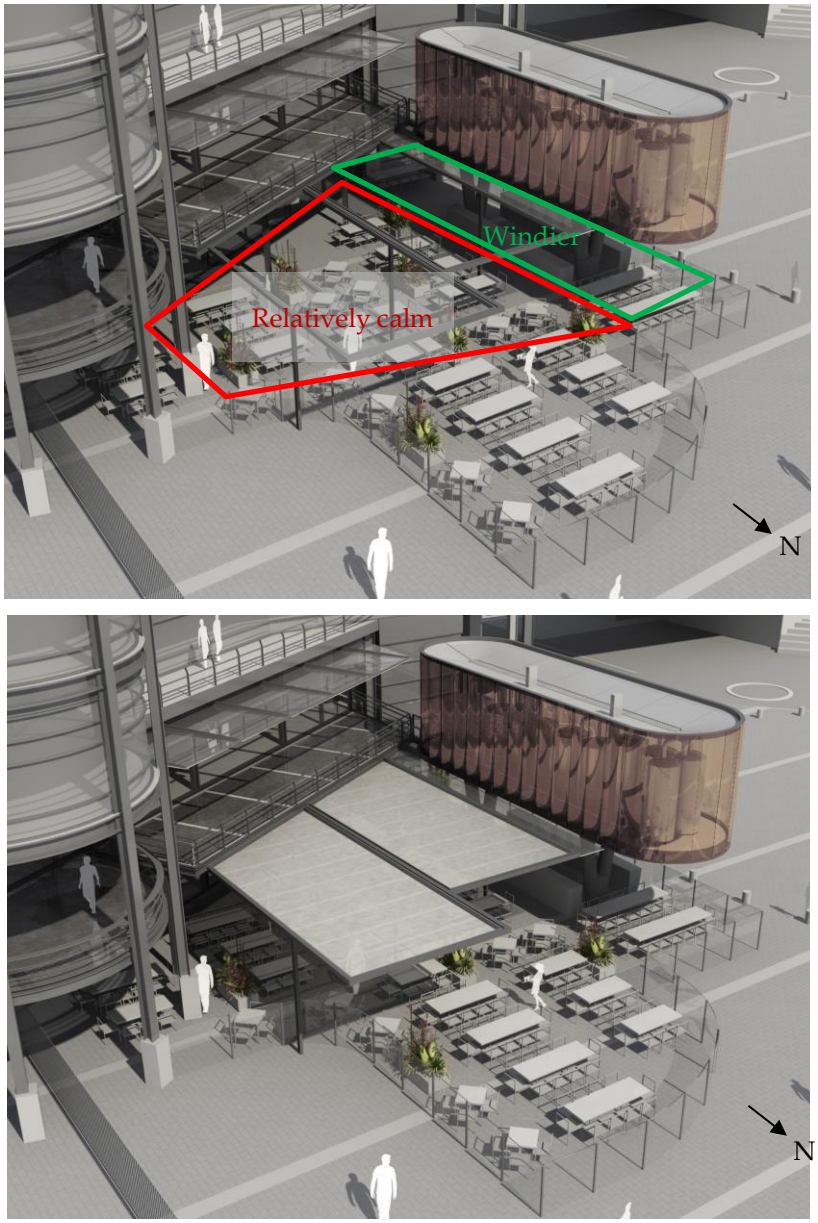

Figure 5: Rendering of proposed development viewed from the north-east with sunshades retracted (T) and extended (B)

If the sun shades in Figure 5 are extended, the flow path beneath the micro-brewery will be restricted, mitigating the windy conditions in this region. According to manufacture specifications, the sun shades can withstand winds up to 25 m/s, and so would only require retraction during extreme wind events. For winds from the north-east, the site has the unusual unique benefit of the shielding provided by large international cruise ships berthed at the Terminal, Figure 1. Depending on their size and exact location relative to the site, would typically shield the site from winds from the north-east. Overall it would be expected that for winds from the north-east the wind conditions for the majority of

the site will be similar or slightly better than existing conditions, with the potential for accelerated flow beneath the proposed micro-brewery.

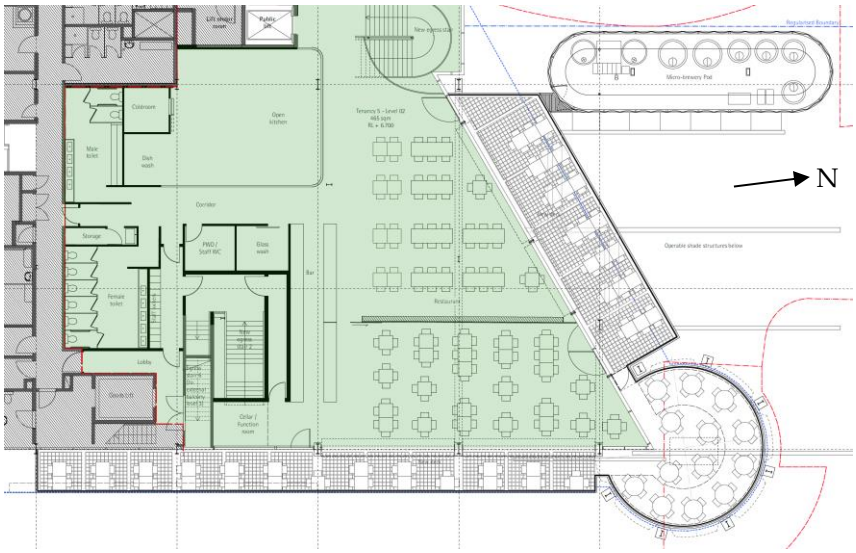

Figure 6: Level 2 plan of proposed development

Integrating the wind conditions with direction, the wind conditions around the site are expected to remain similar to existing conditions as suitable for pedestrian standing or walking conditions in accordance with the Lawson comfort criteria. All locations are expected to pass the safety criterion. For outdoor dining activities, a 5% of the time mean wind speed of 2 m/s is desired to ensure sufficient usage for commercial viability, and for café style activities the 5% of time mean wind speed would be 4 m/s. Wind speeds above this lower level will disturb light objects and blow papers, or napkins from tables; a wind speed of about 2.5 m/s is required to blow the froth from a cappuccino. Reference to previous wind tunnel testing conducted in the Circular Quay area, indicates that most of the open precinct would be classified as suitable for pedestrian standing where for 5% of the time a mean wind speed of 6 m/s would be exceeded. In these locations a wind speed of less than 2 m/s, would occur for approximately 50% of the time, and for 4 m/s for 85% of the time. To improve the serviceability wind amenity to this level, significant enclosing of the space, or the ability to close the space, would be required, which is typically provided by drop-down screening for restaurants.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed Tenancy 5 development at the Overseas Passenger Terminal on the local wind environment. Our summary assessment of the proposed development is as follows:

Wind conditions around the site are not expected to be affected significantly by the proposed development. On average, the wind conditions around the site would be expected to be similar or slightly calmer than existing conditions with the pedestrian level wind environment for most locations

being classified as suitable for pedestrian standing or walking with reference to the Lawson criterion, and that all locations would pass the distress criterion. It is considered that the design would meet the intended use of the space for pedestrian comfort and safety. Wind-tunnel testing would be recommended to quantify the wind conditions in the outdoor seating areas, particularly for locations close to the micro-brewery.

References

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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.

Melbourne, W.H., (1978), Criteria for environmental wind conditions, *J. Industrial Aerodynamics*, **3**, 241-249.