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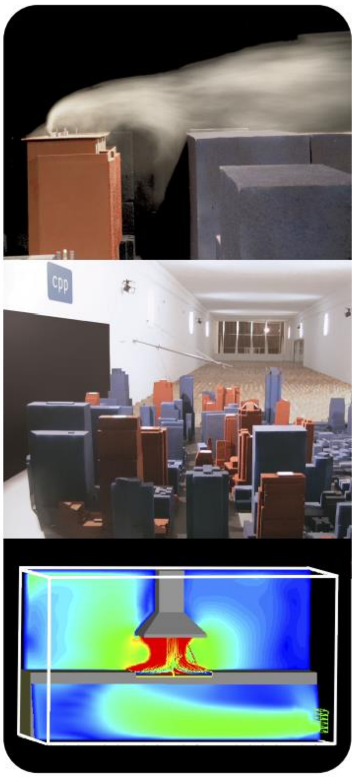
Draft Report



Qualitative Wind Assessment for:

HIGH STREET

Stage 1

Penrith, NSW 2750, Australia

Prepared for:

Toga Group

Level 5, 45 Jones Street

Ultimo, NSW 2007

Australia

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CPP Project: 11310

Prepared by:

Andrew Nguyen, Project Engineer

Joe Paetzold, Engineering Manager

CPP

Unit 2, 500 Princes Highway
St. Peters, NSW 2044, Australia

info-syd@cppwind.com
www.cppwind.com

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. PREAMBLE (CLIENT PROVIDED)

The site is located at 87-91 Union Road / 634-368 High Street in Penrith (Site 1). Toga has another site at 640-652 High Street Penrith (Site 2) which will be progressed in a separate Development Application. Toga's sites are dissected by John Tipping Grove which is a council owned road. This document has been prepared for the Development Application on Site 01, 87-91 Union Road / 634-368 High Street Penrith.

The proposed development comprises of residential buildings, retail and associated parking. Buildings 1 and 2 are joined together by a common ground floor podium, underground basement and podium car parking areas. Thus, both residential buildings are considered to be a united building under a single DA.

The development application subject to these proceedings is amended by way of changes detailed below:

a) Podium - reduction in the scale of the podium from 5 storeys to 4 storeys in the middle section and 2 storeys at the northern and southern ends; decrease in the number of car parking spaces provided within the podium; increased 'sleeving' of car parking provided in the podium with apartments; and enhanced articulation.
b) Basement - increased basement car parking from 1 to 3 levels.
c) Ground level - enhanced activation of the ground floor through relocation of the through site pedestrian link, redistributing and enlarging commercial floorspace, providing stepped sitting edges to the western colonnade facing John Tipping Grove, and increased landscaping.
d) Levels 1 to 3 – increased activation and connection to ground level through additional apartments and enhanced design of communal open space area.
e) Towers - reduction in the height of Tower 2 from 37 to 35 storeys, reduction in height of Tower 1 from 14 storeys to 13 storeys, and redesign to increase building articulation.

The proposed development DA20/0148 seeks consent for a mixed-use development comprising two towers of 35 and 13 storeys located above a part 4 and part 2 storey podium providing 357 residential dwellings with ground level commercial tenancies, 3 levels of basement car parking, a new public road and associated site works on the land at 634-638 High Street and 87-93 Union Road, Penrith NSW.

2. INTRODUCTION

Cermak Peterka Petersen Pty. Ltd. has been engaged by Toga Group to provide a qualitative assessment of the impact of Stage 1 of the proposed High Street development on the pedestrian level wind conditions in and around the site.

The development site is located in Penrith, and is surrounded by low- to medium-rise buildings to the east of Mulgoa Road, such as with Westfield Shopping Centre, and relatively open terrain to the west of Mulgoa Road, Figure 1. The current proposed development comprises 2 medium-rise residential towers, Building 1 and 2, with heights of approximately 49 m and 120 m above ground level respectively, Figure 2. The buildings also share a five-storey podium accommodating retail and carpark spaces. As it is taller than most surrounding structures and landscape, the proposed development is expected to have some impact on the local wind conditions, as discussed in this report.

Figure 1: Aerial view of the proposed development site (Google Earth, 2016).

Figure 2: West elevation of Buildings 1 and 2 (SJB architects, 2021)

3. PENRITH WIND CLIMATE

The development site lies approximately 19 km to the south-west of the Richmond Airport Bureau of Meteorology anemometer. 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 Richmond Airport from 1980 to 2016 were considered in the assessment. The wind rose for Richmond Airport is shown in Figure 3 and is considered to be representative of prevailing winds at the site due to locally similar topographies. It is noted from Figure 3 that strong wind events tend to come from the west quadrant. These are present throughout the year but are most frequent in spring and winter. Winds from the north-east and south-west quadrants are frequent, but usually light in intensity. In coastal Sydney, winds from the north-east tend to be summer sea breezes and bring welcome relief on summer days but dissipate with distance from the coast and are significantly diminished in the Penrith region. This wind assessment is focused on these prevailing wind directions.

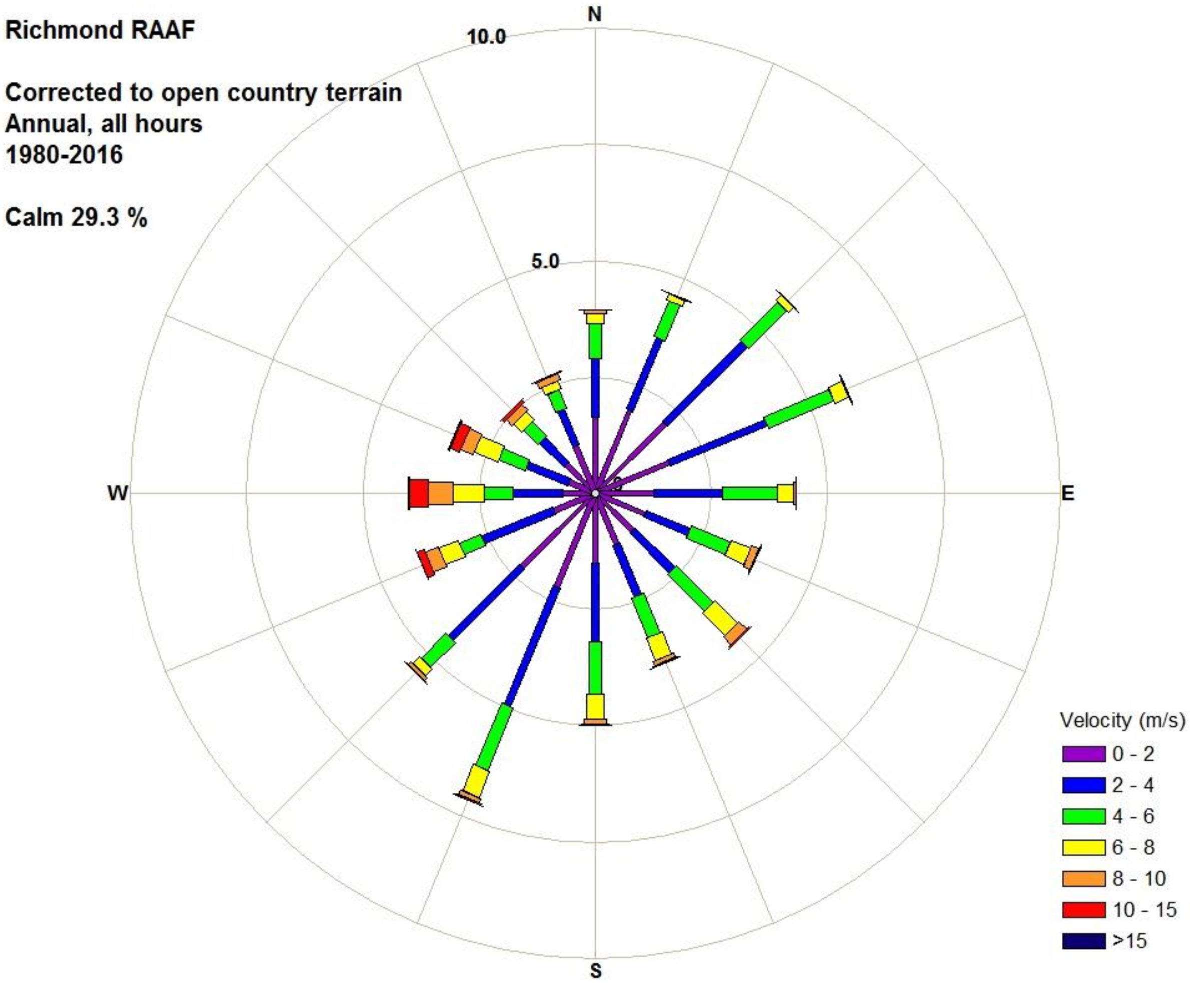

Figure 3: Wind rose for Richmond Airport.

4. 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.

CPP has not sighted specific wind assessment criteria for new developments in the Penrith City Council DCP (2014) for the region. Notwithstanding, this study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress/safety. The benefits of these from a comfort perspective is that the 5% of the time event is appropriate for a precinct to develop a reputation from the general public. 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.

Table 1: Pedestrian comfort criteria for various activities

Comfort (max. 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/Safety (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 an hourly 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.

5. ENVIRONMENTAL WIND ASSESSMENT

The development site will be exposed to winds from most directions, particularly from the west over the open terrain where winds are strongest in the region. Several wind flow mechanisms such as downwash and channelling flow are described in Appendix 1. Topography surrounding the site is relatively flat from a wind perspective.

The ground floor plan is shown in Figure 4, showing the Stage 1 development boundary, commercial spaces and outdoor open areas; this report outlines the qualitative assessment conducted on Stage 1 of the development only.

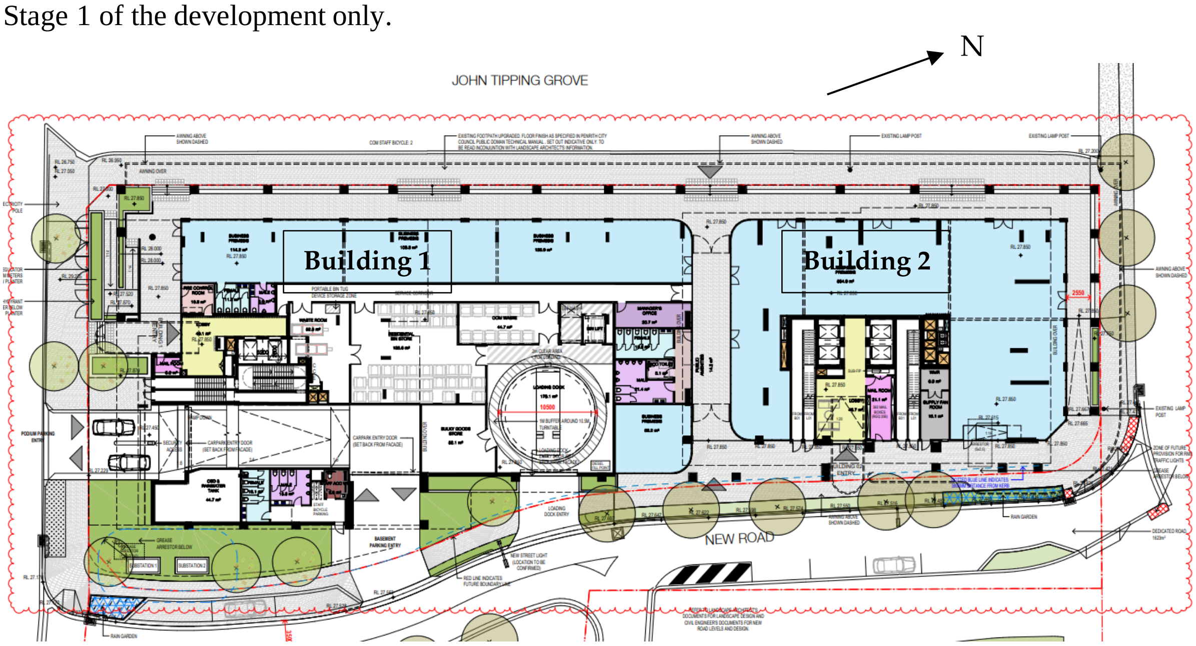

Figure 4: Ground floor plan of the proposed Stage 1 development (SJB architects, 2021)

Ground Plane

Winds from the West

Winds from the west quadrant will flow over the relatively open terrain to the west of the site, reaching the proposed buildings mostly unimpeded. Due to their relative orientations, winds from the west would impinge the proposed buildings at their western corners, encouraging wind to flow around the buildings while reducing the quantity of downwash onto ground level, while winds from the west-north-west to north-west would approach close to orthogonal to the façade of the towers and generate downwash flow particularly from the taller Building 2. The slight setback along the north-western perimeter of the podium, in addition to the proposed awning, will assist with containing and redirecting a portion of any downwash from the building's facades away from ground level.

Architectural drawings indicate an open-space area and multiple entrances around the south-western corner on ground level. Strong wind flow is expected closer to the building corners and it would be advised that, if intended, stationary type activities are located away from these areas. Any dense landscaping proposed along John Tipping Grove will assist with shielding the exposed areas from approaching winds from the west.

The through-site link connecting John Tipping Grove and the 'new road' to the east of the site, Figure 4, is expected to experience incidental pressure-driven wind flows which could sporadically affect the business entrances. Dominant entry configurations and the need for airlocks can be investigated during detailed design and wind tunnel testing.

Winds from the North-East

With inspection of Figure 3, winds from the north-east tend to occur more frequently than winds from the west, however will subside as they flow over the many low-rise buildings before reaching the development site. Upon reaching the site, the winds will impinge on the north-east corners of the proposed buildings allowing winds to flow around and reduce downwash from their facades. A small quantity of any downwash generated would be contained and diverted away from ground level by the podium setbacks with the ground level awning providing additional protection for the area underneath. Some of the flow encountering the podium massing may be accelerated past the north-eastern entrance door and into the undercroft region of Building 2, though this is not expected to cause a significant impact.

John Tipping Grove is aligned with the south-west and north-east direction, allowing north-easterly winds to easily flow through the space. Landscaping in combination with local vertical screening or barriers perpendicular to the wind flow can provide small areas of calm behind them where outdoor stationary activities will benefit from a comfort perspective.

Winds from the South-West

Winds from the south-west will channel along John Tipping Grove before expanding in the northern end. A combination of landscape plantings and local vertical screening would be recommended for any outdoor café-style seating areas proposed in the Grove. Winds from the south-west also have the potential to downwash from the southern façade of Building 1, generating accelerated flow around the south-west corner on ground level. and the recessed nature of the business entrances evident in the architectural drawings along with the indicated landscaping would assist in minimising the impact on the area near the entrances. The lower third of Building 2 is shielded from winds from the south-west by Building 1, however the top two thirds are exposed. As a result, downwash flow would be expected on the southern façade of the tower, which would primarily impact the podium rooftop and be deflected at height, so it would not significantly affect the ground level wind conditions.

Podium Rooftop

Podium rooftops tend to be windy particularly near building corners due to downwash. Depending on the intended use of the spaces on the rooftop, local amelioration would be recommended. The open communal space between Buildings 1 and 2 is relatively exposed to prevailing winds from the west that will channel between the buildings, Figure 5. Full-height balustrades along the western boundary can offer shielding for a small area behind the balustrade up to its height during strong wind events from the west. Vertical screening can create similar local calm areas in other locations on the podium, in combination with landscaping and plantation boxes. Small, protected areas resembling booths or cabanas will provide similar local, calmer areas.

For winds from the south-west, the downwash from Building 2 would cause windy conditions in the northern part of the communal space particularly near the corners of the building. The indicated landscaping, raised planter boxes and pergolas assist in minimising the impact on patrons using this space.

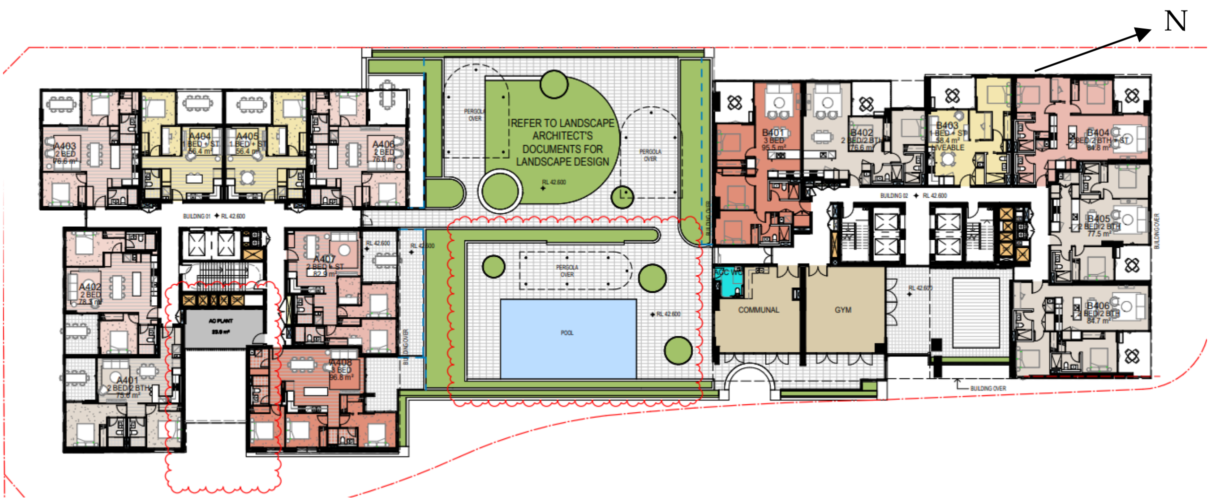

Figure 5: Plan view of the podium rooftop (Level 4)

Balconies

Balconies located on building corners or protruding from the façade are typically more exposed to cross-winds than inset balconies. The screens on all corner balconies of Building 2 semi-enclose the space of the corner balconies, allowing calm conditions to exist for a large portion of time. Corner balconies on building 1 include partial screening on one side providing for mild wind conditions on a part of all balconies. Over time, residents tend to learn to determine the usability of their balconies based on the seasonal weather conditions.

Lawson Summary

Integrating over all wind directions, wind conditions at most locations in and around the development site are expected to be rated at a pedestrian standing Lawson comfort level, with areas near building corners expected to be rated at a pedestrian walking level. Local treatment discussed in this section would be recommended to help improve local conditions in areas intended for outdoor seating or dining style activities. All areas in and around the development site would be expected to satisfy the Lawson safety/distress criterion.

6. CONCLUSIONS

Cermak Peterka Petersen Pty. Ltd. has provided a qualitative assessment of the impact of Stage 1 of the proposed High Street project on the local wind environment in and around the development site. Being taller than most surrounding structures, the proposed buildings are exposed to winds from most directions and will moderately influence the local wind environment. Wind conditions around the development are expected to be mostly classified as suitable for pedestrian standing style activities from a Lawson comfort perspective and pass the Lawson distress/safety criterion at most locations. Local mitigation treatment would be recommended for areas intended for outdoor dining activities.

To quantify the wind conditions around the site against the Lawson comfort and safety criterion, a wind-tunnel test would be recommended. This can be conducted during further design stages and can address any further local mitigation for areas in which the intended use may require calmer conditions.

7. 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).

APPENDIX 1: WIND FLOW MECHANISMS

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 6; 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 6, 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 7 shows the wind at mid and upper levels on a building being 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.

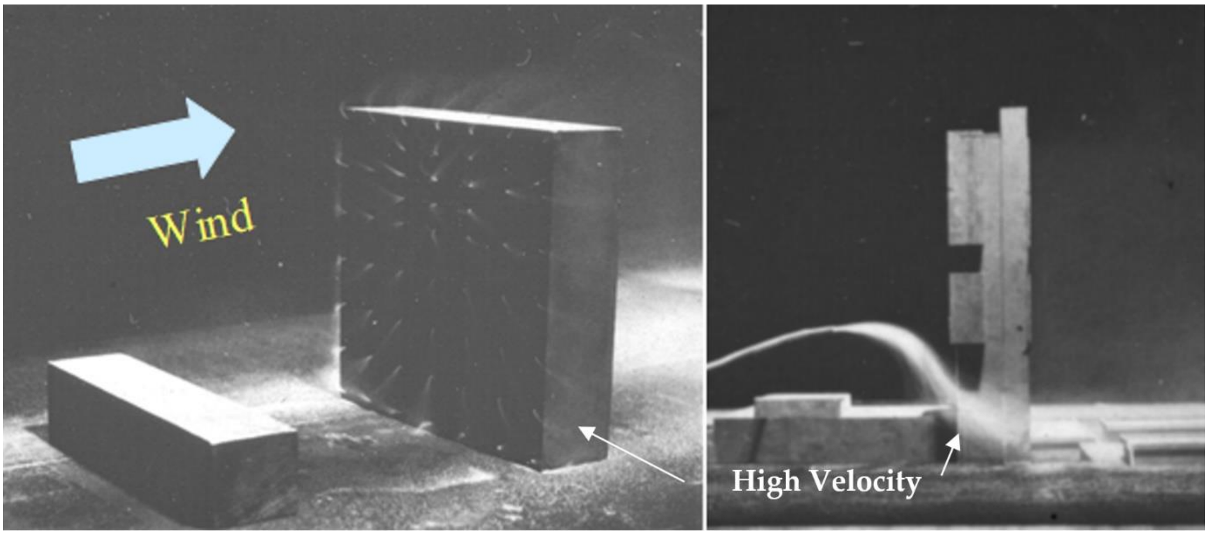

Figure 6: Flow visualisation around a tall building.

Figure 7: Visualisation through corner balconies (left) and channelling between buildings (right).