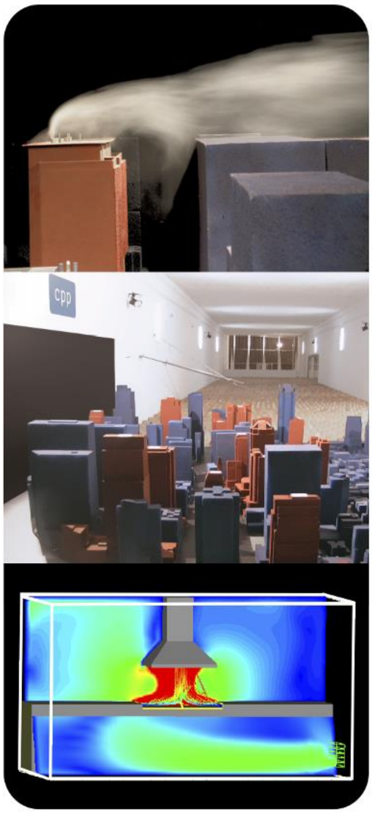
CERMAK
PETERKA
PETERSEN

WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

UTS CENTRAL

Sydney, Australia

Prepared for:

University of Technology Sydney
Facilities Management Unit
Level 19, Building 1
PO Box 123
Ultimo
NSW 2007

July 2015

CPP Project: 8041

DOCUMENT VERIFICATION

Date	Revision	Prepared by	Checked by	Approved by
12/01/15	Draft for review	GSW	MG	GSW
27/01/15	Minor corrections	GSW	GSW	GSW
24/03/15	Update with amended drawings	GSW	GSW	GSW
26/06/15	Update with amended drawings	GSW	GSW	GSW
27/07/15	Minor amendments	GSW	GSW	GSW
31/07/15	Minor amendments	GSW	GSW	GSW

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by the University of Technology Sydney to provide an opinion based assessment of the impact of the proposed development on the wind conditions at pedestrian level in and around the development. This report supports a s75W Modification Application submitted to the Minister for Planning pursuant to Clause 3C of Schedule 6 of the Environmental Planning and Assessment Act 1979 (EP&A Act). The Application relates to the Concept Plan Approval for the University of Technology Sydney (UTS) City Campus Broadway Precinct, which was approved in December 2009 (MP08_0116). More specifically the modification application relates to Building 2 and includes amending the approved building envelope in order to provide additional floors above the approved podium envelope and correspondingly increasing the approved Gross Floor Area (GFA).

The site is located to the south-west of the Sydney CBD bounded by Broadway, and Jones, Thomas, and Harris Streets and is surrounded by low- to high-rise buildings, Figure 1.

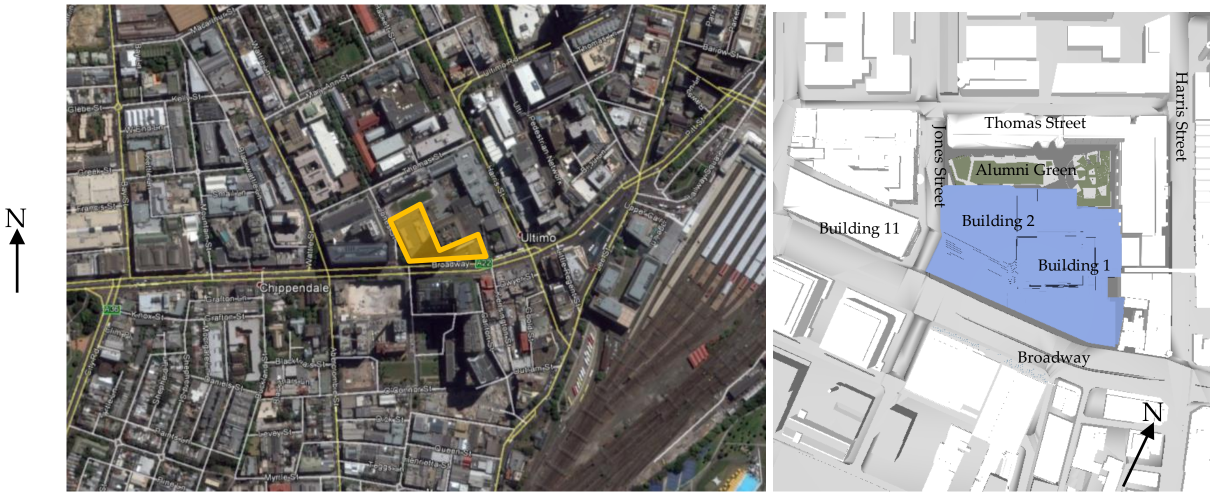


Figure 1: Aerial view of the proposed development (Google Earth, 2014) (L), and site location plan (R)

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 2014 have been used in this analysis, Figure 2. 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.

Strong summer winds occur mainly from the south and north-east quadrants. 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 can be hot or cold depending on the weather patterns over the interior of the continent.

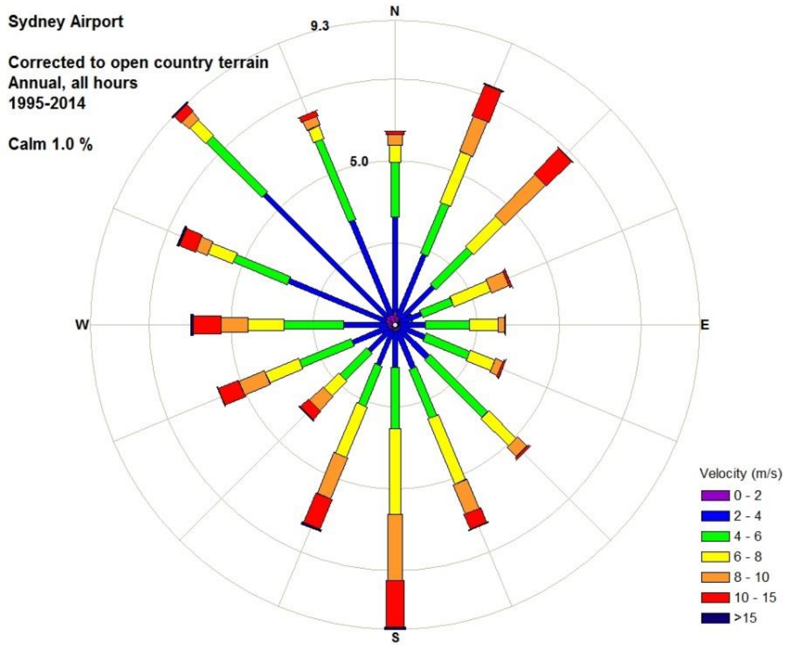


Figure 2: Wind rose of direction and speed for Sydney Airport

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. 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.

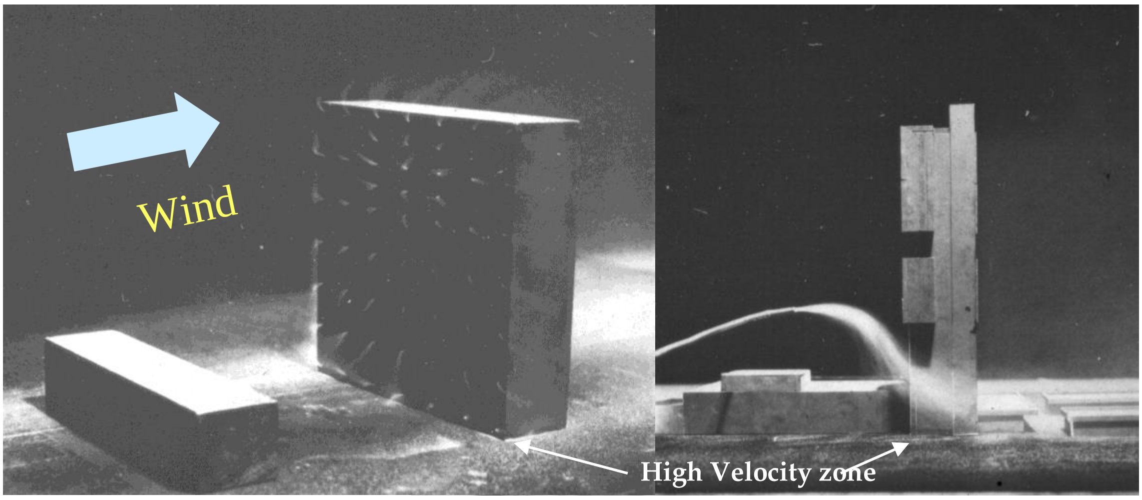


Figure 3: Flow visualisation around a tall building

Techniques to mitigate the effects of downwash winds on pedestrians include the provision of horizontal elements, the most effective being a deep 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.

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, as the area around the site is not classified as an 'active frontage'. There are few locations in Sydney that would meet this criterion without shielding to improve the wind conditions. From discussions with Council this is an infrequent 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 to promote outdoor café style activities and is not intended to be used as a distress requirement. The gust wind speed criterion used in the City of Sydney (2012) DCP is based on the work of Melbourne (1978), and the 10 m/s level is classified as generally acceptable for use for pedestrian sitting.

This criterion gives the wind speed that occurs for about 0.1% of the time, and uses this probability as an estimator of the more general conditions at a site. To overcome this limitation, as well as the once per annum maximum gust wind speed, 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 recommended 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 the city compared with the airport, any location in the city generally requires significant shielding to meet such a criterion.

Comfort (maximum of mean or gust equivalent mean (GEM[+]) 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.

Table 1: Pedestrian comfort criteria for various activities

Assessment using the Lawson criteria provides a similar classification as using the once per annum gust, however also provides information regarding the serviceability wind climate, which is often more important for the usability of the space.

Environmental Wind Assessment

Existing Conditions

It is useful to appreciate the interaction of prevailing Sydney winds with existing buildings through the UTS precinct prior to predicting the wind interaction with the proposed scheme. The wind conditions in this area have been changed with the relatively recent introduction of One Central Park development to the south, and UTS Building 11 to the west. The site is relatively exposed to winds from the west and south at present. Uncomfortable wind conditions are known to occur at some locations throughout the precinct, most noticeably on Broadway in the vicinity of the existing tower building (UTS Building 1) under the action of winds from the west.

Onshore winds from the north-east lose considerable intensity as they pass through the southern Sydney CBD and eastern suburbs. Winds from the north-east are more channelled along Broadway with the inclusion of One Central Park. Winds from the north-east have moderate but prolonged intensity at the site with potential to deliver cooling breezes in the summer months.

Prevailing winds from the west are channelled along Broadway with minimal upstream blockage presented by the wide open roadway extending back to the University of Sydney. The staggered alignment of roads within and surrounding the UTS precinct assist in mitigating the channelling effect in these areas remote from Broadway. Channelling is instigated by downwash from larger buildings on the edge of the development resulting in stronger wind conditions around the base of these buildings, which is expected to occur between Building 11 and the proposed building on the south-east corner of Abercrombie Street and Broadway.

Proposed Conditions

The proposed redevelopment of Building 2 is presented in Figure 4 and Figure 5. The proposed Building 2 rises to a maximum height of approximately 65 m above Jones Street level. The completed height of the proposed building will be slightly taller than the neighbouring Building 11 to the west and similar to the No. 1 Central Park west buildings directly opposite Broadway to the south, Figure 5. The proposed additional floors on Building 2 are set back from the podium edge on all sides by varying amounts with a minimal setback along Jones Street near Broadway.

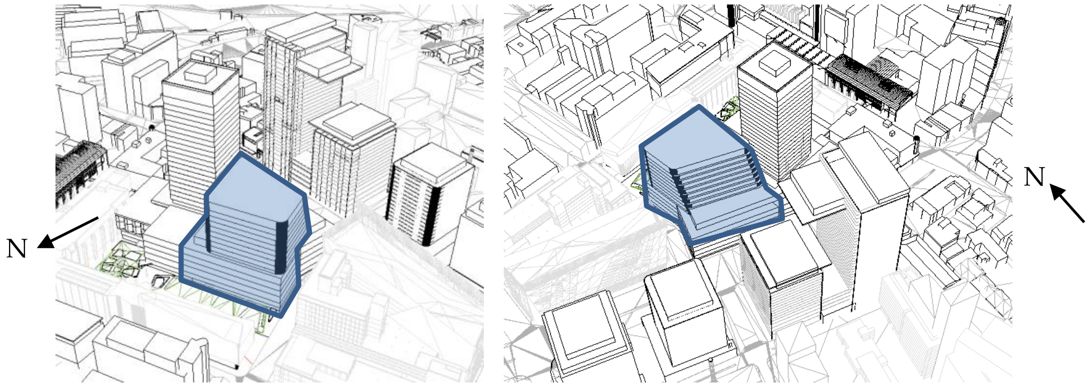


Figure 4: Perspective from the north-west (L) and north-east (R)

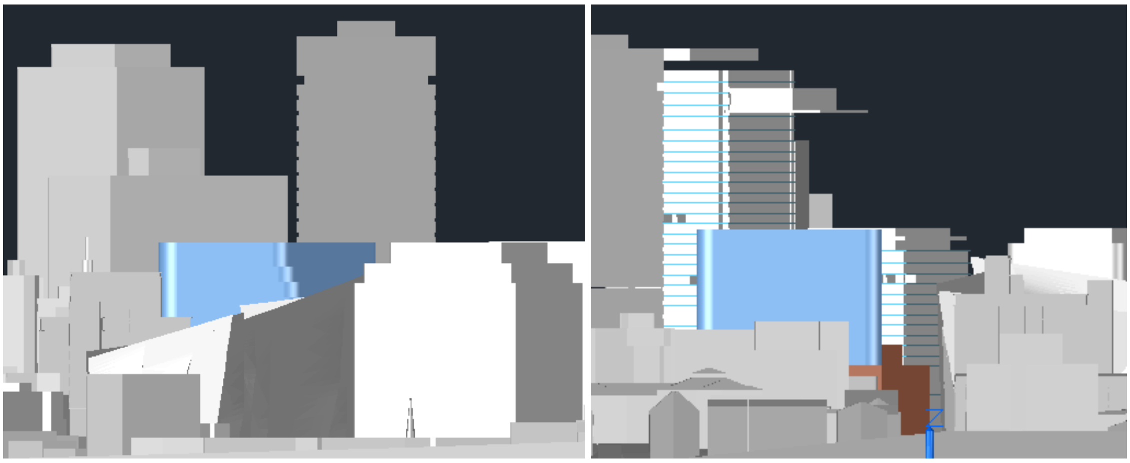


Figure 5: West (L) and north (R) elevation

The proposed Building 2 is well shielded by the city and Building 1 for winds from the north-east. The proximity of the proposed building to Buildings 1 and 11 will encourage a steady jet of flow across the podium roof between Building 1 and along Jones Street. The minimal depth of tower setback from the podium edge to the north is expected to induce downwash to ground level in Alumni Green and along Jones Street. The misaligned building grid pattern is expected to provide some disturbance to the flow.

Winds from the south will be channelled between Buildings 2 and 11along Jones Street. With the completion of the One Central Park Buildings to the west along the south side of Broadway to Abercrombie Street, the winds channelled between these buildings would be expected to reduce in spatial extent resulting in more localised strong, but less gusty flow as the wind is forced between the gaps between the upstream buildings. An additional benefit is the staggered nature of Jones Street to Chippendale Way. The stepped nature of the proposed Building 2 would be expected to divert a portion over the roof, but the angled south face will divert flow along Jones Street. The lack of tower setback to the west is expected to promote some downwash into Jones Street, but this will be tempered by the sizable podium setback to the south. The retention or replacement of trees along Jones Street will slightly assist in providing protection to pedestrians, particularly if the trees are mature and evergreen.

The site is relatively exposed to winds from the west, which are channelled along Broadway. Building 11 is expected to offer some protection and therefore reduce the amount of downwash from the west façade of Building 2. The angled southern face of Building 2 and the provision of the approved proposed extension to Building 1 will assist in ameliorating local wind conditions along Broadway during these wind events. Winds with a more northerly component are expected to reduce the gusty nature of the winds currently experienced along Jones Street while increasing the flow along Abercrombie Street; this is caused by the effect of the compound shape between the three relatively exposed taller buildings, Figure 4(L); for two similar sized buildings spaced a width of a building apart, wind will be accelerated between the buildings; by reducing the size of the gap, more flow will go around the outside of the entire compound shape with only steady pressure-driven flow through the gap.

The main entry to the building from Alumni Green is not expected to have significant wind issues outside of the entrance as they are located remote from the Jones Street corner. If there are other openings into the common ground floor volume it should be appreciated that there will be internal flow based on the external pressure at each of the entrances. This currently occurs in Building 1 where wind can be felt at the door locations, but expands into the volume within about 10-15 m from the inflow doorway. Care should be taken during detailed design to avoid internal flow issues.

It is understood that UTS is proposing to use the roof to the podium and the roof to Level 17 for access. The podium roof area is redirecting any downwash and confining channelled flow. The roof of Level 17 is exposed to accelerated flows from all directions. These areas are expected to be significantly windier than ground level and significant care should be taken during detailed design to ensure that these areas are usable for the intended purpose. It is considered that the roof top areas would probably be acceptable for outdoor stationary activities in excess of 60% of the time and could be used as terraces for casual access when environmental conditions were suitable. If the terraces were to be used for scheduled events, then suitable amelioration would have to be developed during detailed design to increase the level of usage.

Wind conditions at ground level around the proposed development are expected to be suitable for pedestrian walking and pass the distress criterion, with some locations along Broadway and Jones Street approaching or marginally exceeding the distress criterion. Additional amelioration measures would likely be required for any proposed retail areas. To quantify the qualitative advice presented in this report it would be recommended to conduct a wind-tunnel test at the appropriate time during detailed design development of Buildings 1 and 2.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed envelope for the UTS Building 2 development on Broadway, Sydney. Due to the size and location of the proposed building on the block relative to the surrounding buildings, wind conditions at pedestrian level around the site are not expected to be significantly affected by the increase in building massing. Wind conditions at most locations around the site are expected to remain suitable for pedestrian standing and walking from a comfort perspective, and pass the distress criterion. The exception may be wind conditions on Broadway and Jones Street, and to quantify the advice, for a development of this size and location, wind-tunnel testing would be recommended during detailed design development.

References

City of Sydney, (2011), “Central of Sydney Development Control Plan 1996”.

City of Sydney, (2012), “Sydney Development Control Plan 2012”.

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.