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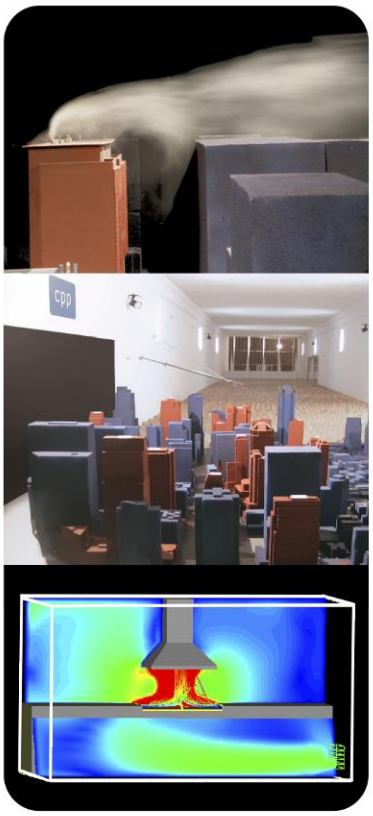
WIND ENGINEERING AND AIR QUALITY CONSULTANTS

FINAL REPORT



Wind Assessment for:

INNER SYDNEY HIGH SCHOOL

Surry Hills, Australia

Prepared for:

NSW Department of Education

c/-

FJMT

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June 2017

CPP Project: 11355

DOCUMENT VERIFICATION

Date	Revision	Prepared by	Checked by	Approved by
21/04/17	Initial release for review	TXE	GSW	GSW
03/05/17	Client requested updates	TXE	TXE	TXE
07/06/17	Client requested updates	TXE	TXE	TXE

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

Client Provided Text

1.1 Introduction

The NSW Department of Education (DoE) are preparing a State Significant Development Application (SSD 16_7610) for the development of a new 'inner Sydney high school' located at the corner of Cleveland and Chalmers Street, Surry Hills (the 'site'), identified as 244 Cleveland Street, Surry Hills.

The new inner Sydney High School is proposed to accommodate up to 1200 students to take enrolment pressure off surrounding high schools exceeding student capacity, and accommodate future population growth within City of Sydney Local Government Area (LGA). The high school will contain high quality learning, collaborative learning spaces and associated facilities.

Specifically, this proposal seeks development consent for the following works at the site:

- Internal reconfiguration and refurbishment of the existing heritage listed buildings on the site to create:
  - Collaborative learning hubs with a combination of enclosed and open spaces;
  - Amenities and support areas; and
  - Workplaces and lounge spaces for teachers and administrative staff.
- Construction of a 13 storey plus basement and roof level (approximately 52.5m from Chalmers Street), multi-purpose school building, containing:
  - Collaborative learning hubs with a combination of enclosed and open spaces;
  - Library;
  - Staff workplaces;
  - Student canteen;
  - Indoor gymnasium and other indoor recreation and performance spaces;
  - Ancillary outdoor learning and recreational areas.
- Associated site landscaping and public domain improvements; and
- Augmentation and construction of ancillary infrastructure and utilities as required.

1.2 Background

The population of Sydney is forecast to grow by over one million people in the next 10 years and a significant number will reside in or close to the Sydney CBD in new residential developments in areas such as Green Square, Central to Eveleigh precinct, Barangaroo, Central Square, the Bays Precinct and Ultimo. This growth in inner Sydney suburbs is occurring rapidly, putting significant pressure on public infrastructure, including transport, health services and education.

The DoE has a legislative responsibility to provide teaching spaces to meet demand in all areas across NSW. A new Inner Sydney high school is to be built on Cleveland Street, Surry Hills to meet this demand. Cleveland Street Intensive English High School currently occupies the site. A new facility is being constructed for Cleveland Street Intensive English High School on a site already owned by the DoE at Alexandria.

The Cleveland Street site will be redeveloped to create a new future focused high-rise school with a mix of new and refurbished buildings. The heritage of the site is a major consideration for the design of the new campus. A design excellence competition has been completed with the winning architects, Francis-Jones Morehen Thorp (FJMT) continuing to progress the design for the school. The new inner Sydney high school is expected to open in 2020.

The new inner Sydney high school will offer:

- Facilities that are readily accessible and flexible to meet the demands of an evolving curriculum in line with future-focused learning principles.
- Flexible and well connected teaching and learning spaces that enable a variety of teaching and learning practices.
- Spaces that are engaging and supportive for students and teachers.
- Technology-rich settings with an emphasis on mobility and flexibility.
- A healthy and environmentally sustainable environment.
- Innovative, connected outdoor spaces that enable play and collaborative learning.
- Connected open space, creating a welcoming and accessible school with indoor and outdoor teaching and learning opportunities.

No buildings of heritage significance are proposed to be demolished as part of the redevelopment.

The new teaching spaces will incorporate principles of energy efficiency and ecologically sustainable development (ESD). This includes:

- Passive design principles
- Thermal performance and comfort.
- Natural lighting.
- Water recycling management.

Works are as illustrated in detail in the Architectural Design Statement as prepared by FJMT.

Response to SEARS

This report addresses the following item of the SEARS requirements:

Detail amenity impacts including solar access, acoustic impacts, visual privacy, view loss, overshadowing and wind impacts.

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by FJMT to provide an opinion based assessment of the impact of the proposed inner Sydney high school development on the pedestrian level local wind environment.

The site is located approximately 2 km to the south of the Sydney CBD, on the corner of Cleveland and Chalmers Streets, Figure 1. The subject of this assessment is a proposed articulated podium structure and tower building of approximately 52.5 m maximum height above Chalmers Street ground level, Figure 2. The development also incorporates existing buildings and landscaping. This report is based on a site visit, knowledge of the local wind climate, results of wind tunnel testing at nearby sites, and planned features of the proposed development.

Figure 1: Location of the proposed development (L), Aerial view of site (R) (Google Earth, 2017)

Figure 2: CGI render of proposed development

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 2016 have been used in this analysis, Figure 3. The Sydney Airport anemometer is located approximately 6 km to the south of the subject site and is considered representative of prevailing wind conditions. It is noted from Figure 3 that strong prevailing winds are organised into three main groups which centre about the north-east, south, and west quadrants. 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.

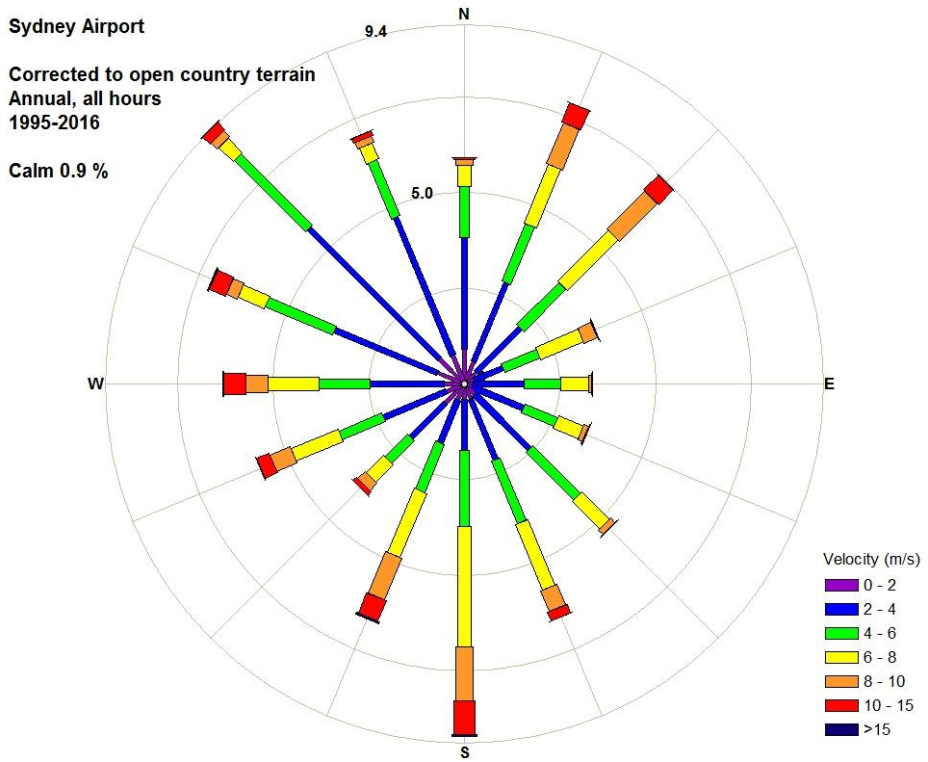

Figure 3: Wind rose of direction and speed for Sydney Airport

Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 4; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 4 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.

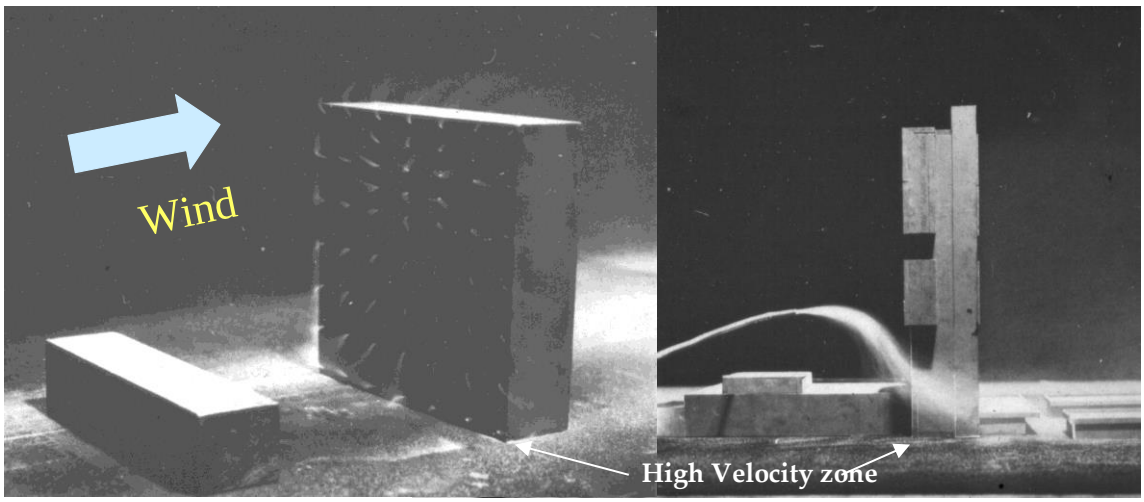

Figure 4: Flow visualisation around a tall building

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.

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 streets adjoining the site are therefore subject to a maximum wind speed of 16 m/s under the current City of Sydney DCP (2012). From discussions with Council this is a once per annum gust wind speed, intended to be interpreted as a comfort rather than a distress or safety requirement. Wind speed criteria stipulated by Council are based on the work of Melbourne (1978), which considers the 3 s gust wind speeds in an hour for pedestrian comfort based on the intended use of an area, occurring 0.1% of the time for any wind direction. These criteria are limited as a relatively infrequent gust event may not adequately characterise the general conditions at the site. To address this limitation, the wind assessment criteria used in the current study are also based upon the research of Lawson (1990), 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 speeds 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. The level and severity of these comfort categories can vary based on individual preference, so calibration to the local wind environment for all wind directions is recommend when evaluating with Lawson ratings.

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 development site is bounded by Cleveland Street to the south and Chalmers street to the east. To the north and west is the relatively open region of Prince Alfred Park and the adjacent train line. Surrounding buildings are primarily low-rise, with a maximum height on the order of 5-6 storeys. Topography surrounding the site is predominantly flat from a wind perspective.

The proposed development will comprise a 13-storey tower made up of articulated elements, with several open levels, Figure 5. A portion of the new building will project above surrounding structures. The primary areas of interest from a pedestrian wind perspective are the pedestrian thoroughfares and entrances along Cleveland and Chalmers Streets and in Prince Alfred Park.

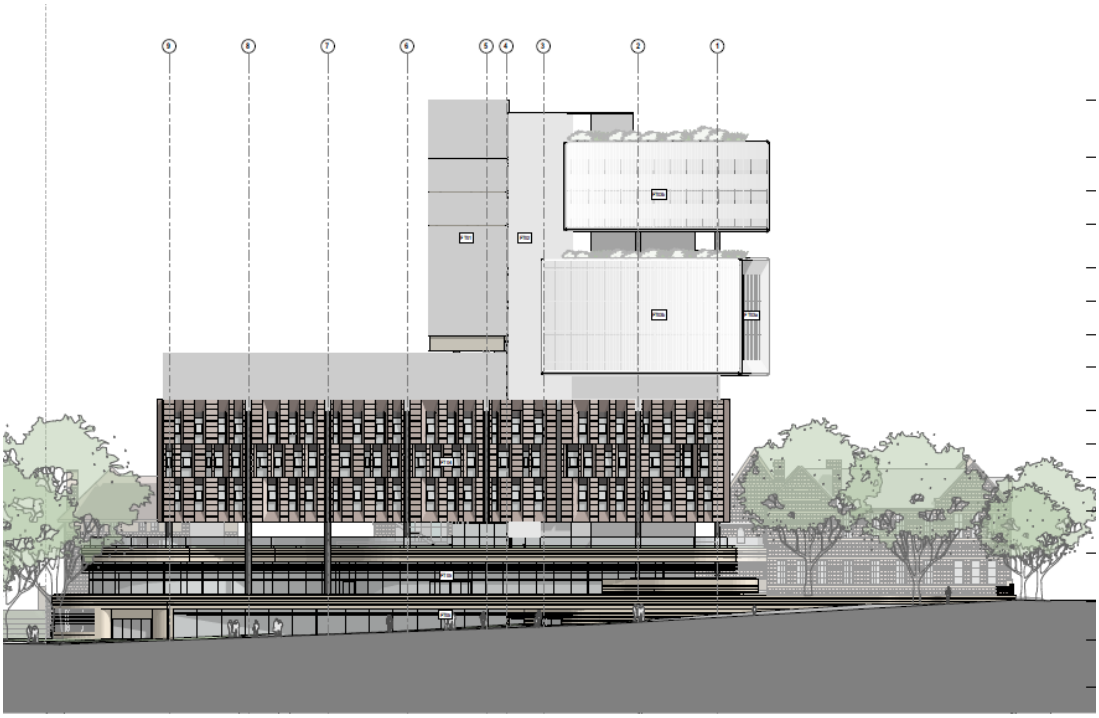

Figure 5: West elevation of proposed development

Winds from the north-east

Winds from the north-east approach the subject site over a region of densely spaced low-rise developments. Wind conditions along Chalmers Street are not likely to be affected by the proposed development due to the setback of the tower mass from this frontage. Wind conditions at the north-western corner boundary of the site are expected to be slightly worse during winds from this direction, though will be ameliorated by existing trees and landscaping, as well as well as the terraced design of the podium building.

Winds from the south

The neighbouring development on the southern side of Cleveland Street will offer some protection from strong winds from this direction. There will be some channelling of winds from the south along Chalmers Street, however wind conditions along this frontage are not expected to change significantly from the existing, due to the set-back of the tower from Chalmers Street. Downwash flow from the narrow façade of the tower is expected to be largely redirected before reaching ground level by the lower levels and existing buildings, resulting in slightly stronger wind conditions in Price Alfred Park. Relatively strong breezes would be expected close to the south-west corner of the tower.

Winds from the west

Winds from the west approach over the open area of Prince Alfred Park. Winds from this direction will impinge orthogonally on the wide face of the tower. The open levels would be expected to reduce the amount of downwash by venting the flow through the building. Stronger wind conditions would be expected at locations close to the windward corners of the development. In particular, the area close to the ground floor colonnade to the south of the tower is likely to experience relatively high wind speeds, as it is unprotected from downwash effects. The setback of the tower from the podium edge will once again limit wind impacts at the ground plane for most other locations. Existing large trees along Cleveland Street would provide additional protection to pedestrians and also encourage relatively mild conditions at the site during winds from the west.

Summary

Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind conditions at the site would be only slightly affected by the massing of the proposed development relative to the existing. It is expected that the majority of locations around the site would be classified as suitable for pedestrian standing or pedestrian walking under the Lawson criteria. All locations would meet the safety and distress criterion.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed inner Sydney high school development, Sydney on the local wind environment. Our summary assessment of the proposed development is as follows:

The proposed development projects above surrounding structures, and will therefore have an effect on local wind conditions, increasing flow velocities for some wind directions and providing shelter for others. Due to the open levels, the setback of the tower from the lower levels to the north, east and west, and the presence of existing low-rise buildings along the pedestrian street frontages,

the proposed development is expected to have only a marginal effect on the local wind conditions at pedestrian level. The proposed development is not likely to cause significant impacts in terms of pedestrian use of surrounding areas. On average, wind conditions around the site would be expected to be similar to the existing, with the pedestrian level wind environment at the majority of locations meeting the criteria for pedestrian walking or standing under Lawson. All locations would be expected to pass the distress criterion. Quantification of the wind environment around the development is not considered necessary due to the relatively minor impact of the proposed development on pedestrian wind conditions.

References

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

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.