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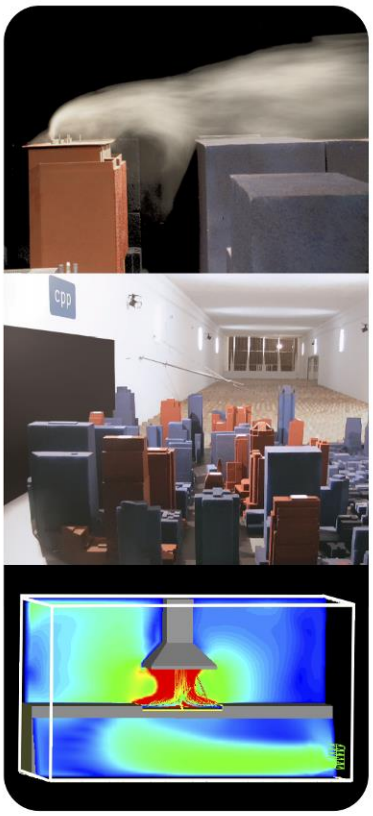
FINAL REPORT



Wind Assessment for:

ST LEONARDS HEALTH ORGANISATIONS RELOCATION – SHOR

St Leonards, Australia

Prepared for:

NSW Health Infrastructure

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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

REPORT INTRODUCTION

This report supports a State Significant Development Application (SSDA) submitted to the Department of Planning and Environment pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the St Leonards Health Organisation Relocation (SHOR) Project at the Royal North Shore Hospital (RNSH).

The SSD Application relates to the Concept Plan Approval for the Royal North Shore Hospital, St Leonards which was approved in April 2007 (MP 06_0051). This application is SSD by way of Ministerial declaration pursuant to Section 89(C) of the EP&A Act, the order for which was published on 13 October 2017.

This proposal relates specifically to the construction of a new building on the south-western edge (identified as site 4A under the Concept Plan) of the RNSH Campus. Uses proposed include health-related commercial uses, retail and a child care centre.

This report has been prepared having regard to the Secretary's Environmental Assessment Requirements issued for the project.

BACKGROUND

The subject site is located within the hospital grounds of RNSH, and is identified as Site 4a, within Precinct 4.
The site forms part of a wider Concept Plan approval for the redevelopment and renewal of RNSH (MP 06_0051). On 13 April 2007, approval was granted for a Concept Plan, including proposed building envelopes (height, bulk, scale), associated GFA and land use, site preparatory works, and road networks. The Concept Plan proposed staged renewal of the entire campus through the nomination of eight precincts and a six-stage construction and delivery strategy. Since concept approval, redevelopment of the following buildings has been completed:

- Kolling Institute Research Building;
- Acute Services Building;
- Clinical Services Building;
- Community Services Building; and
- Multi-Storey Car Park with capacity for 567 spaces.

Under the Concept plan, the subject site is identified as Precinct 4, comprising of Site 4a and Site 4b. Approval for demolition of existing buildings currently located on Precinct 4 and adjoining areas of the RNSH Campus was obtained as part of a Review of Environmental Factors (REF) under Part 5 of the *EP&A Act* 1979, dated August 2016. The Part 5 approval also included regrading of land for landscaping purposes and some landscaping works. Other works that have been carried out on site, and were covered under the REF include refurbishment of the existing buildings (Building 33, 35, 36 and the Douglas Building) and other civil infrastructure upgrades.
The Concept Plan has undergone several modifications, with the most recent modification relating to the subject site. Modification 7 (MP 06_0051 MOD 7 - Modification to Concept Plan building footprint in Precinct 4a) was lodged on December 2016 and approved by the DP&E on 20 July 2017. The 2

modification amended the building footprint originally approved for Site 4a under the Concept Plan and consolidated the commercial floor plate design, allowing a more efficient commercial floor plate and an improved design response for the site.

OVERVIEW OF PROPOSED DEVELOPMENT

This SSD Application seeks approval for works proposed to Precinct 4 (Site 4A and Site 4B) and some adjoining public domain grounds. Specifically, consent is sought for the following:

- Construction of a 10-storey building with a total GFA of 30,977 m2 comprising of the following uses:

– 28,615 m2 of health-related employment generating uses;

– 658m² lobby;

– 241m2 café;

– 902 m2 child care facility;

– 561m² basement storage and miscellaneous.

- Construction of 2 basement levels with 115 car parking spaces and 1 car wash bay;

Subdivision of the existing land parcel into the following additional allotments:

– Proposed Lot 41 (Area 8,049 m2);

– Proposed Lot 42 (Area 64 m2); and

– Proposed Lot 40 (Residue Lot comprising the RNS hospital precinct)

- Improved east-west connectivity of the 4A+4B precinct through an at grade pedestrian access way interconnecting Herbert Street (east) to Reserve street (west);
- Creation of an additional easement along the southern alignment of the site for unrestricted vehicular access; and
- Associated public domain and landscaping works.

THE SITE

The RNSH Campus is situated approximately 6.5 km north of Sydney CBD and 3 km south west of Chatswood. The RNSH precinct is located within Willoughby City Council LGA, less than 200 metres from St Leonards Station.

The subject site (Precinct 4) is located at the southern edge of the RNSH Campus with direct frontage to Reserve Road (west of the site).

The land is owned by the Health Administration Corporation. Precinct 4 currently forms a part of the Royal North Shore Hospital campus, legally described as Lot 210 under DP 1172133. Total site area of the existing campus is 11.38 hectares.

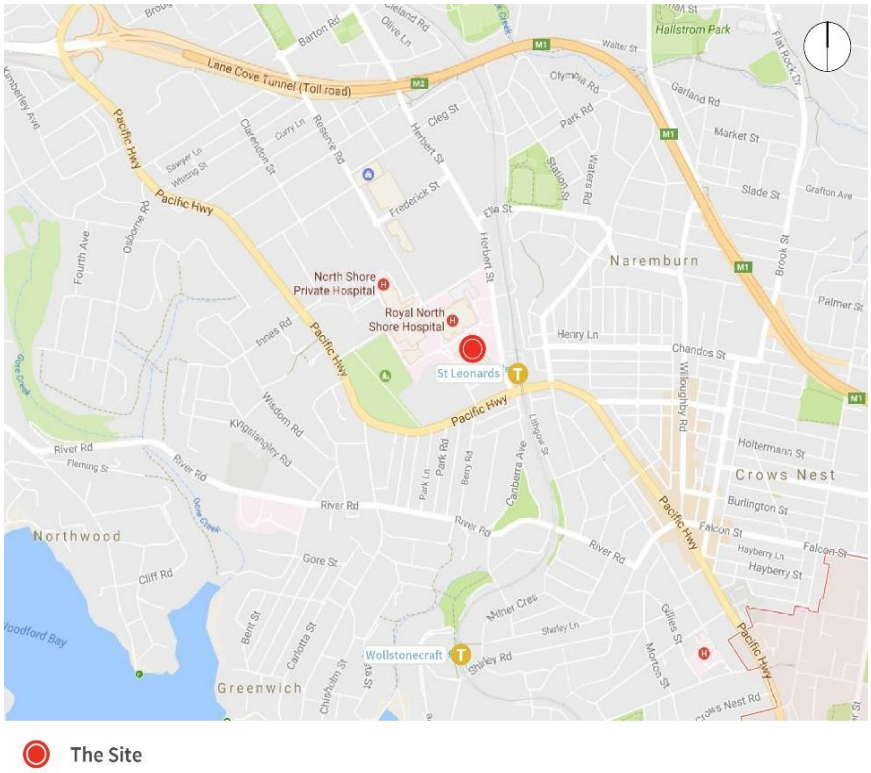

Figure 1 – Site Location Context Plan*Source: Ethos Urban*

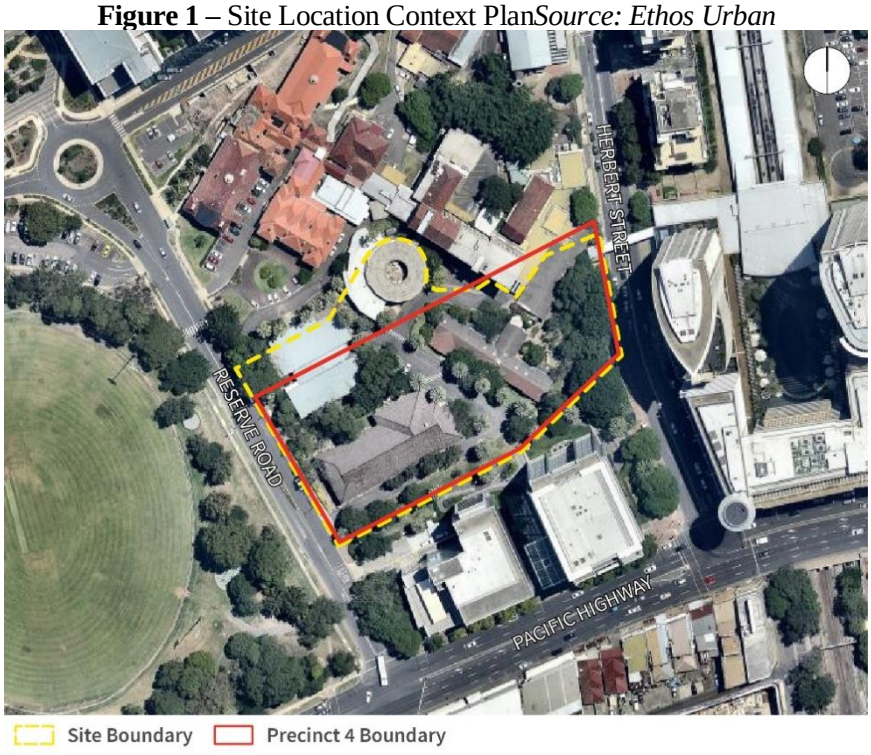

Figure 2 – Project Aerial Plan. *Source: Ethos Urban*

Figure 3: Proposed Precinct Plan. *Source: BVN*

Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by NSW Health Infrastructure to provide an opinion based assessment of the impact of the proposed St Leonards Health Organisations Relocation (SHOR) development at Royal North Shore Hospital (RNSH), St Leonards, on the pedestrian level local wind environment.

The site is located on the RNSH campus, approximately 4.5 km to the north west of the Sydney CBD, Figure 4. The proposed development consists of a single building approximately 50 m in height with rectangular planform, Figure 5

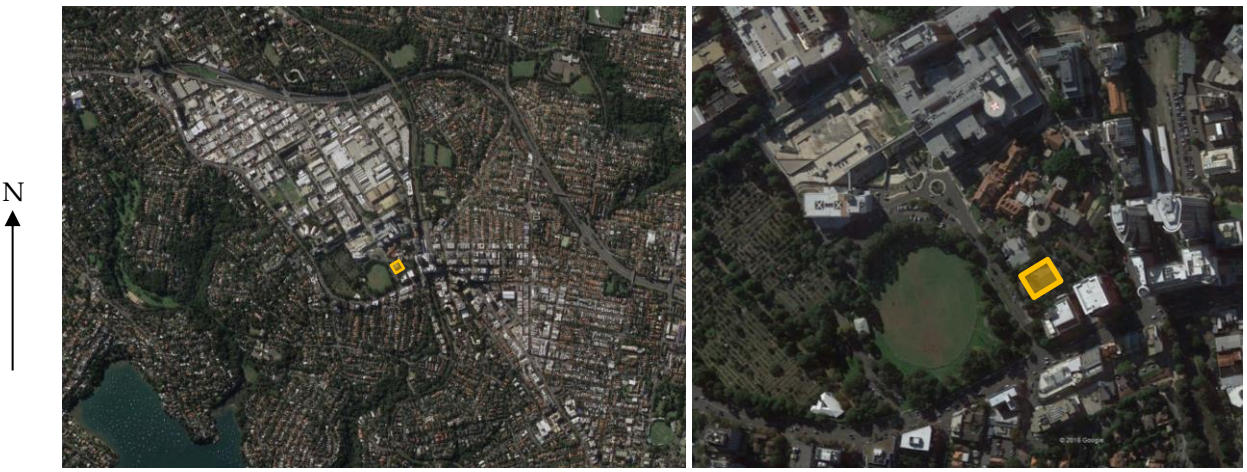

Figure 4: Location of the proposed development (L), close-up view of site (R) (Google Earth, 2016)

Figure 5: Perspective render of proposed development, viewed from the south-west

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 6. It is noted from Figure 6 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.

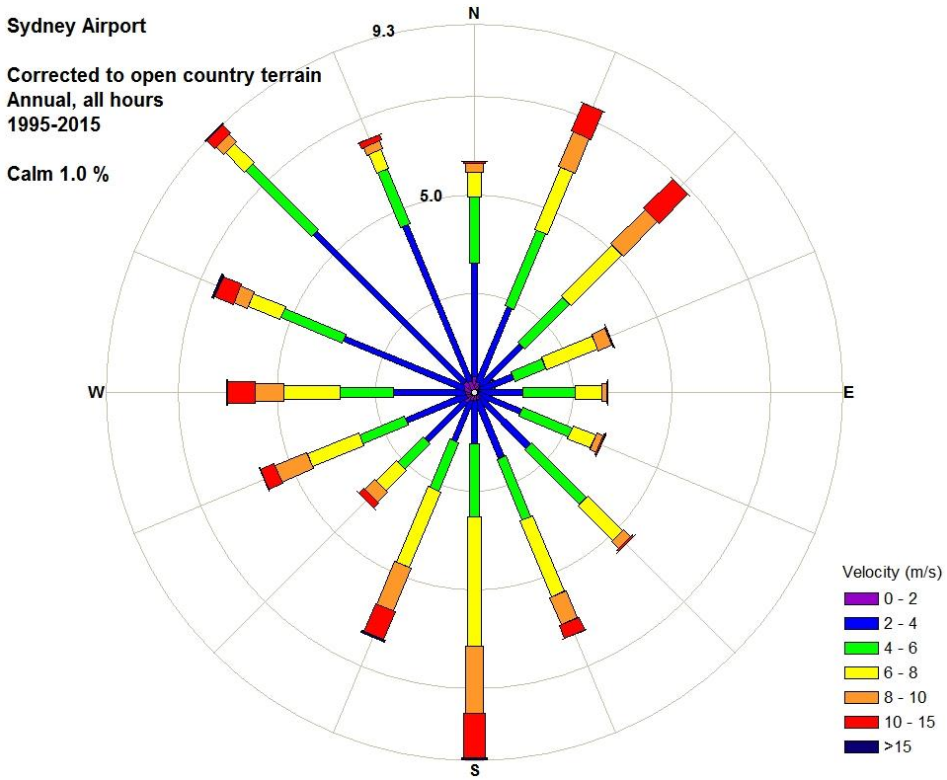

Figure 6: Wind rose of direction and speed for Sydney Airport

Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 7; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 7 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.

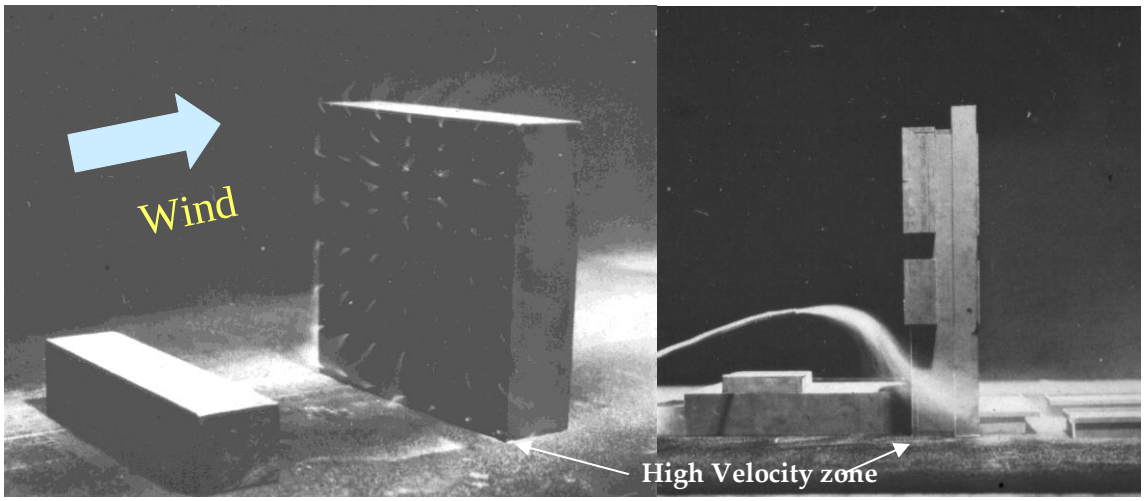

Figure 7: Flow visualisation around a tall building

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 details of the Secretary's Environmental Assessment Requirements (SEAR's) in terms of wind assessment criteria for this development are currently unknown. The current Willoughby City Council (2006) Development Control Plan (DCP) has no specific wind controls for the area, but makes reference to the criteria of Melbourne (1978), which specify a maximum wind speed of 16 m/s for footpaths and access ways and 13 m/s for short exposure stationary activities. This is a maximum 3 s gust wind speed in an hour, occurring for 0.1% of the year from each direction. The short exposure

wind speed would be classified as suitable for pedestrian standing activities such as window shopping and is a comfort rather than a safety criterion.

From Figure 6, the 0.1% mean wind speed measured at 10 m above ground for all directions is about 16.5 m/s. Converting this to a mean and gust wind event at pedestrian level in a built-up environment in accordance with Standards Australia (2011) would result in a wind speed of 10.5 and 20.5 m/s respectively, which is evidently greater than the 13 m/s in the DCP.

The work of Melbourne (1978), uses this infrequent wind event as an estimator of the general wind conditions at a site. To combat this limitation, the current 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.

Assessment using the Lawson criteria generally provides a similar classification to the Willoughby DCP, however also provides additional information regarding the serviceability of the wind climate.

Table 1: Pedestrian comfort criteria for various activities

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.

Environmental Wind Assessment

The building is to be located at the southern edge of the hospital grounds on Reserve Road. The site is surrounded by low to medium-rise structures to the west and south-west, with several medium to high-rise developments to the immediate south and in the St Leonards CBD to the east. The relatively open region of Gore Hill Park is to the immediate south-west. The development is situated on the topographical feature of Gore Hill, with a moderate decline to Sydney Harbour to the south and south-west and a ridge to the immediate north-west at the location of the Acute Services hospital building. The proposed development is of approximately rectangular planform, Figure 8. Established dense trees of height 10-30 m surround the site to the south, east, and west, Figure 4. Buildings of

similar height and massing to the subject development are proposed for hospital campus sites to the immediate east and north-east, Figure 9. The proposed building features ground floor outdoor areas along the south and west perimeters, and a first-floor balcony at the southernmost corner of the building, Figure 8.

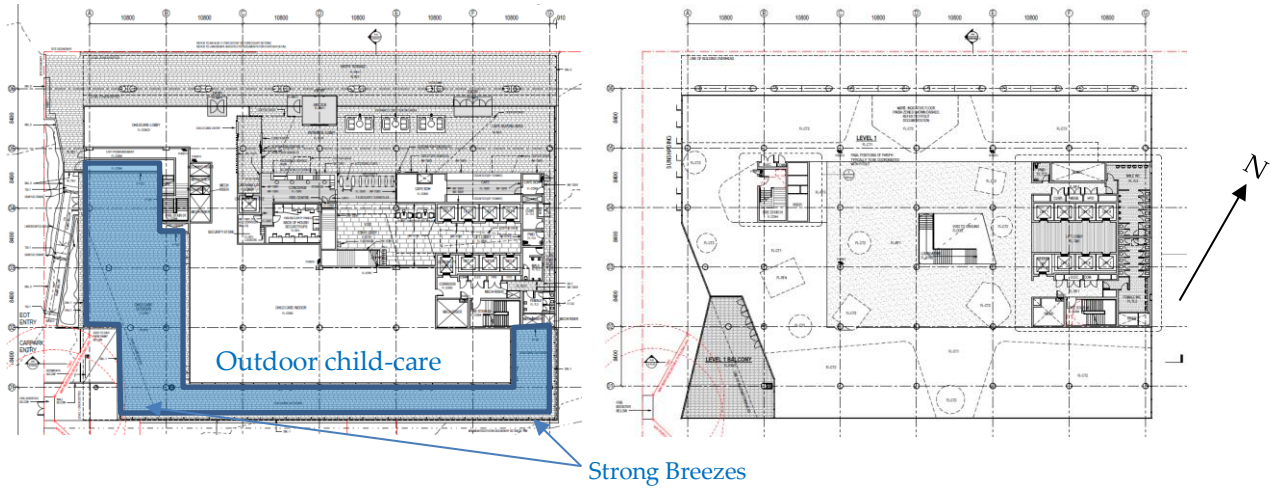

Figure 8: Ground (L) and Level 1 (R) plans of proposed development

Winds from the north-east

The local topography to the north, general massing of the St. Leonards CBD, and the additional shielding from the proposed neighbouring buildings on sites 4b and 5a, Figure 9, are expected to provide significant shielding to the subject development for winds approaching from the north-east. Existing and planned landscape planting along the eastern boundary of the site will further assist in improving wind conditions at the ground plane. Winds approaching from the north-east will impinge approximately normal to the narrow eastern façade of the proposed building, generating some downwash and accelerated flow around the building corners. The undercroft outdoor area on the ground floor will likely experience strong breezes close to the easternmost corner, Figure 8 (L). If calmer conditions are required here, solid or porous, permanent or temporary vertical screening elements, or approximately 2 m high balustrades could be incorporated.

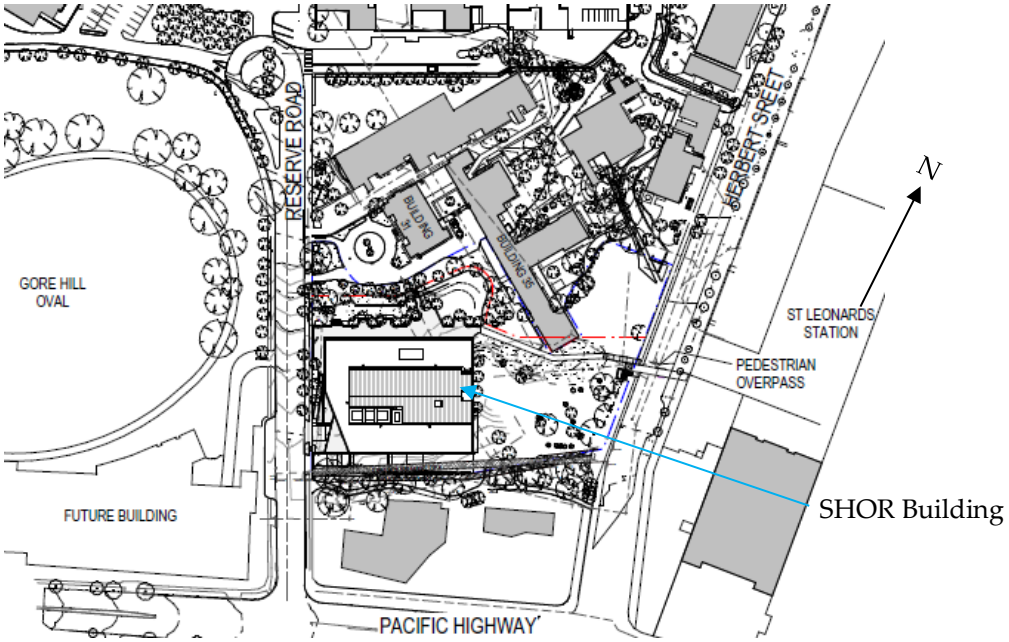

Figure 9: Site plan showing approved masterplan for RNSH Campus

Winds from the south

Winds from the south will be slightly accelerated as they approach the site over the local topography. The oblique orientation of the upper façade is expected to limit the amount of downwash flow generated by encouraging the flow to pass around the building horizontally. The neighbouring buildings to the south are of a similar height to the proposed development, and their proximity would provide significant shielding from winds from this direction. Some channelling is expected to occur along Reserve Road, producing breezes parallel to the south-western façade. The outdoor child-care area at the southern corner and along the west façade of the proposed building is relatively exposed to direct breezes from this direction, though will be protected from strong downwash flows by the first-floor balcony. Increasing the height of the perimeter balustrade around the area would be suggested if long-term stationary use of the entire space is expected, however the articulated shape of the childcare outdoor area will allow calm conditions to exist at some locations for the majority of wind directions.

Winds from the west

Winds from the west approach the subject site over the relatively open expanse of Gore Hill oval and adjacent memorial cemetery. The orientation of the proposed building with the corner pointing into the wind, is expected to encourage horizontal flow around the façade reducing the amount of downwash. Winds from the west would be directed along the northern colonnade and forecourt area parallel to the façade and expand into doorways when opened. Locations close to the façade are protected from downwash by the undercroft design.

The main entry is well located from a wind perspective, being away from the building edges and underneath the overhanging first and second floors. The entry lobby protruding into the colonnade is beneficial to reduce the potential for internal flows. The two-door two airlock would likely reduce the likelihood of flow jets penetrating into the lobby, though its effectiveness could be improved by staggering the doors, orienting the sliding doors at right angles to one another, or using a revolving door. The need for effective airlocks on doors is dependent on the expected level of foot traffic and the requirement for calm spaces in their vicinity, such as for café seating. For airlock doors, the inner door should be orientated such that the jet is directed away from waiting, or working areas in the lobby. Existing and planned trees along the western site boundary would marginally improve the wind conditions at pedestrian level on the western terrace and forecourt from the existing conditions.

Balcony

The proposed development features a balcony on the first floor, facing directly south. Winds from the southern quadrant are expected to generate relatively windy conditions at this location, and horizontal elements such as an awning or localised screens, as well as landscaping around the perimeter, would be recommended. As the balcony is partly recessed from the façade line, calm conditions are likely to exist over some of the space for most of the time. Including a full-height screen along the east section of the balcony as shown in Figure 10 would significantly increase the size of the calm area, if required.

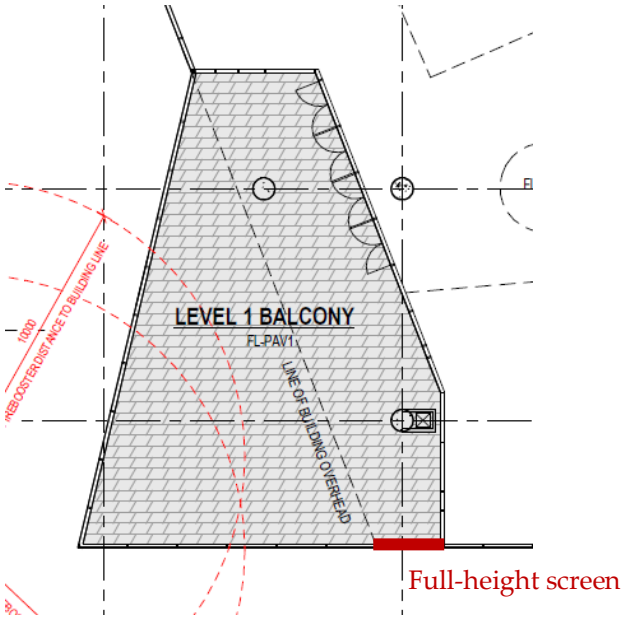

Figure 10: Level 1 balcony detail

Summary

Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind conditions at the majority of locations around the site would be classified as suitable for pedestrian standing under Lawsons comfort criteria. Some locations close to the building corners or relatively exposed to prevailing strong wind directions would be expected to be classified as suitable for pedestrian walking. All locations would be expected to pass the distress criterion. The wind conditions would be expected to meet the intended use of the spaces around the development.

Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion based assessment of the impact of the proposed SHOR development at RNSH, St. Leonards, on the local wind environment. Our summary assessment of the proposed development is as follows:

The proposed development is of a similar height to most of surrounding buildings. It is expected that the proposed building will have a marginal effect on local wind conditions, increasing the wind speed for some directions, and providing shelter for others. Shielding from neighbouring developments and topography, combined with significant existing and planned landscape planting, will limit the impact of the proposed development. On average, the wind conditions around the site would be expected to remain similar to existing conditions, with the pedestrian level wind environment for the majority of locations being classified as suitable for pedestrian standing or walking, and all locations passing the distress criterion. Permanent or temporary amelioration measures would be suggested at outdoor recreation spaces close to building corners and on the first floor balcony if long term stationary activities are intended for these locations. Wind tunnel testing would be required to quantify the advice provided herein.

References

Willoughby City Council (2006), Willoughby Development Control Plan (WDCP)

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.