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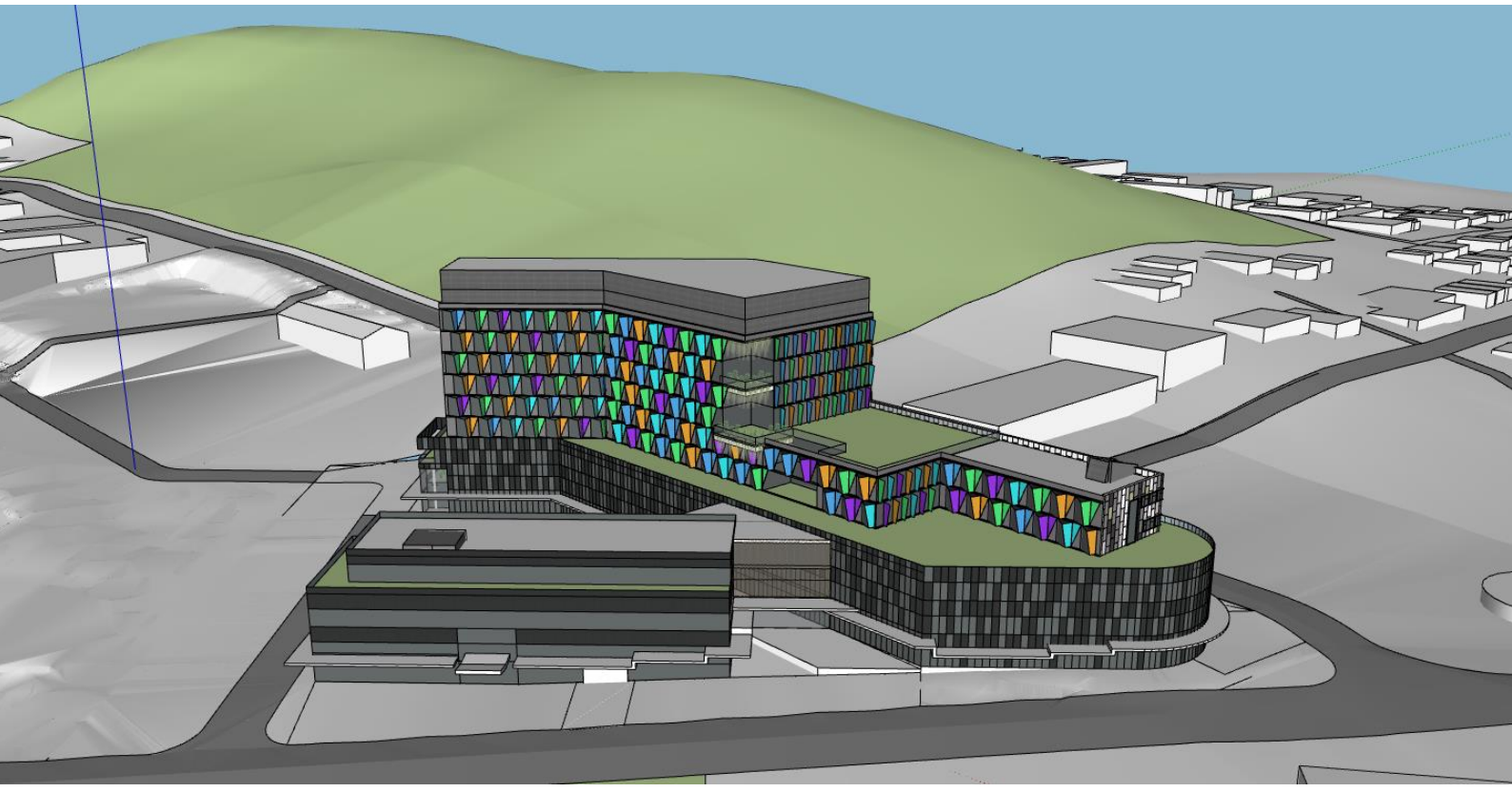
Vipac Engineers & Scientists

AA Crown Holdings Pty Limited

Northside Private Hospital

Wind Impact Assessment



30N-19-0013-TRP-6758374-1

16 July 2019

Report Title: Wind Impact Assessment **Job Title: Northside Private Hospital**	
DOCUMENT NO: 30N-19-0013-TRP-6758374-1 **PREPARED FOR:** AA Crown Holdings Pty Limited 44 O'Connell Street Parramatta NSW 2150 **CONTACT:** John Kilzi **Tel:** +61 2 9922 4500 **Fax:**	**REPORT CODE:** TRP **PREPARED BY:** Vipac Engineers and Scientists Limited 279 Normanby Rd, Port Melbourne, VIC 3207, Australia **Tel:** +61 3 9647 9700 **Fax**: +61 3 9646 4370
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REVIEWED BY: Reviewer: Zhuyun Xu Senior Wind Consultant	Date: 16 Jul 2019
AUTHORISED BY: Sophie Lamande Wind Group Leader	Date:16 Jul 2019

REVISION HISTORY

Revision No.	Date Issued	Reason/Comments
0	12/03/2019	Initial Issue
1	16/07/2019	Plans updated
2		

DISTRIBUTION

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1	Project	
2	Client (PDF Format)	Uncontrolled Copy
3		

KEYWORDS:

EXECUTIVE SUMMARY

AA Crown Holdings Pty Limited commissioned Vipac Engineers and Scientists Pty Ltd to prepare a statement of wind effects for the proposed Northside Private Hospital development. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The assessment addresses the SEARs requirement for wind impact as detailed below:

> *Assess the environmental amenity impacts associated with the proposal, including solar access, acoustic impacts, visual privacy, view loss, overshadowing, lighting impacts and **wind impacts**. A high level of environmental amenity must be demonstrated.*

Drawings of the proposal were supplied to Vipac by **Health Projects International** in July 2019, as described in Appendix C of this report.

The findings of this study can be summarised as follows:

With proposed design:

- wind conditions in the ground level footpath areas would be expected to be within the **walking** comfort criterion.
- wind conditions in the building entrance areas would be expected to exceed the recommended **standing** comfort criterion. We recommend incorporating a canopy over the NW entrance to improve wind conditions in this area.
- The Level 2 & 7 courtyards would be expected to have wind conditions within the recommended **walking** comfort criterion.
- wind conditions at some areas of the Level 3 & 5 courtyards would be expected to exceed the recommended **walking** comfort criterion. We recommend incorporating higher balustrades or landscaping at the perimeter, as well as additional landscaping within the terraces to create pockets sheltered from wind impacts.

As a general statement, educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

With the proposed design and recommended treatments, the development will achieve a high level of amenity, in accordance with the SEARs requirement for wind impact.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around Australia. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. Vipac recommends a wind tunnel test be conducted at the detail design stage to verify the predictions and determine appropriate wind control measures if necessary.

TABLE OF CONTENTS

1 INTRODUCTION

Vipac Engineers and Scientists has been commissioned by AA Crown Holdings Pty Limited to carry out an assessment of the pedestrian wind effects at the ground level and open terraces of the proposed Northside Private Hospital development.

Strong winds in pedestrian areas are frequently encountered in central business districts of cities around the world; including Melbourne, Sydney and Brisbane. Wind characteristics such as the mean speed, turbulence and ambient temperature determine the extent of disturbance to users of pedestrian areas. These disturbances can cause both comfort and safety problems and require careful consideration to mitigate successfully.

The proposal development is a hospital with an approximate height of 48.5 m from street level. The site is bounded by Racecourse Road to the NW, Faunce Street West to the south and existing buildings in the other directions. A satellite image of the proposed development site and north elevation are shown in Figure 1 and Figure 2, respectively.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level footpath areas adjacent to the proposal. No wind tunnel testing has been carried out for the proposal at this stage. Vipac has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed. These serve as a valid reference for the prediction of wind effects. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely wind conditions on the ground level areas of the proposed development [2] & [3].

Drawings of the proposal were supplied to Vipac by **Health Projects International** in July 2019. A list of drawings supplied is provided in Appendix C of this report.

Figure 1: Aerial view of the proposed development site.

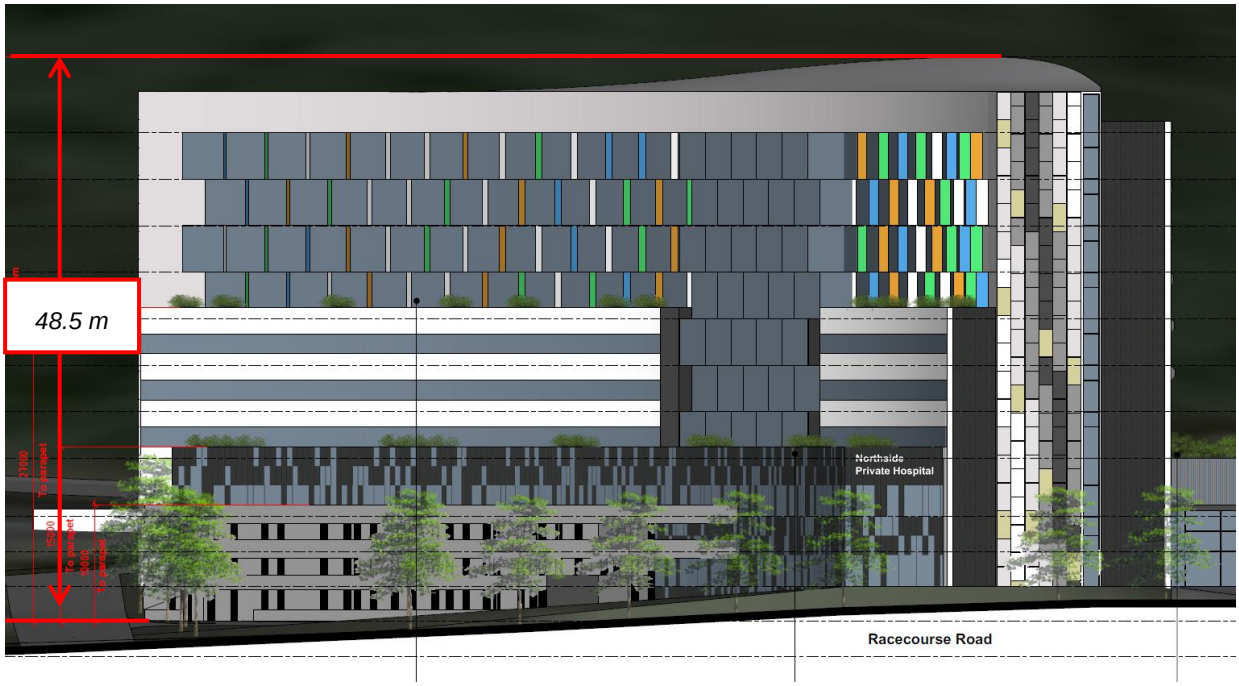

Figure 2: North Elevation of the proposed development (Mar 2019 design).

2 ANALYSIS APPROACH

In assessing whether a proposed development is likely to generate adverse wind conditions in ground level footpath areas, Vipac has considered five main points:

- The exposure of the proposed development to wind
- The regional wind climate
- The geometry and orientation of the proposed development
- The interaction of flows with adjacent developments
- The assessment criteria, determined by the intended use of the areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations of ground level footpath areas may be assessed by predicting the worst annual 3-second wind gust expected at that location. The location may be deemed generally acceptable for its intended use if the annual 3-second gust is within the threshold values noted in Section 2.5. Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating may be recommended.

2.1 SITE EXPOSURE

The proposed development site is located on inclined terrain, sloping up to the south and east and is surrounded within a 3km radius by suburban housing, parkland/forest and some water areas to the south. A satellite image of the site surroundings is shown in Figure 3.

Considering the immediate surroundings and terrain, the site of the proposal is assumed to be within Terrain Category 2 for 150-180 azimuth degrees; Terrain Category 2.5 for 240-350 azimuth degrees; and Terrain Category 3 for all other directions (Figure 3).

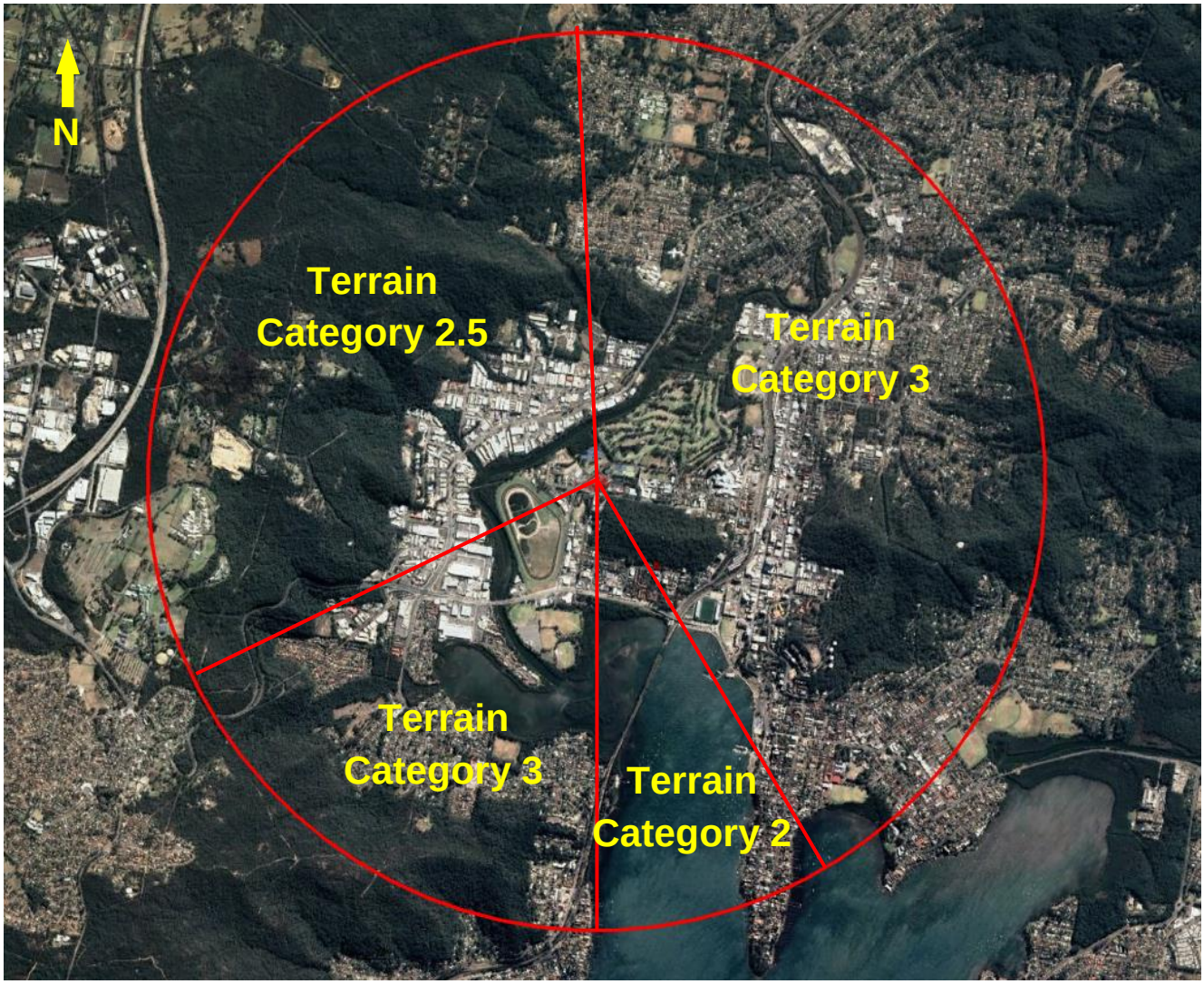

Figure 3: Assumed terrain roughness for wind speed estimation.

2.2 REGIONAL WIND CLIMATE

The mean and gust wind speeds have been recorded at the Gosford weather station WS-061087 area for over 30 years. These data have been analysed and the directional probability distribution of wind speeds have been determined. The directional distribution of hourly mean wind speed at the gradient height, with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 4. The wind data at this free stream height are common to all sites in the nearby Gosford area and may be used as a reference to assess ground level wind conditions at the site. Figure 4 indicates that the stronger winds can be expected from the southeast, south and northwest directions.

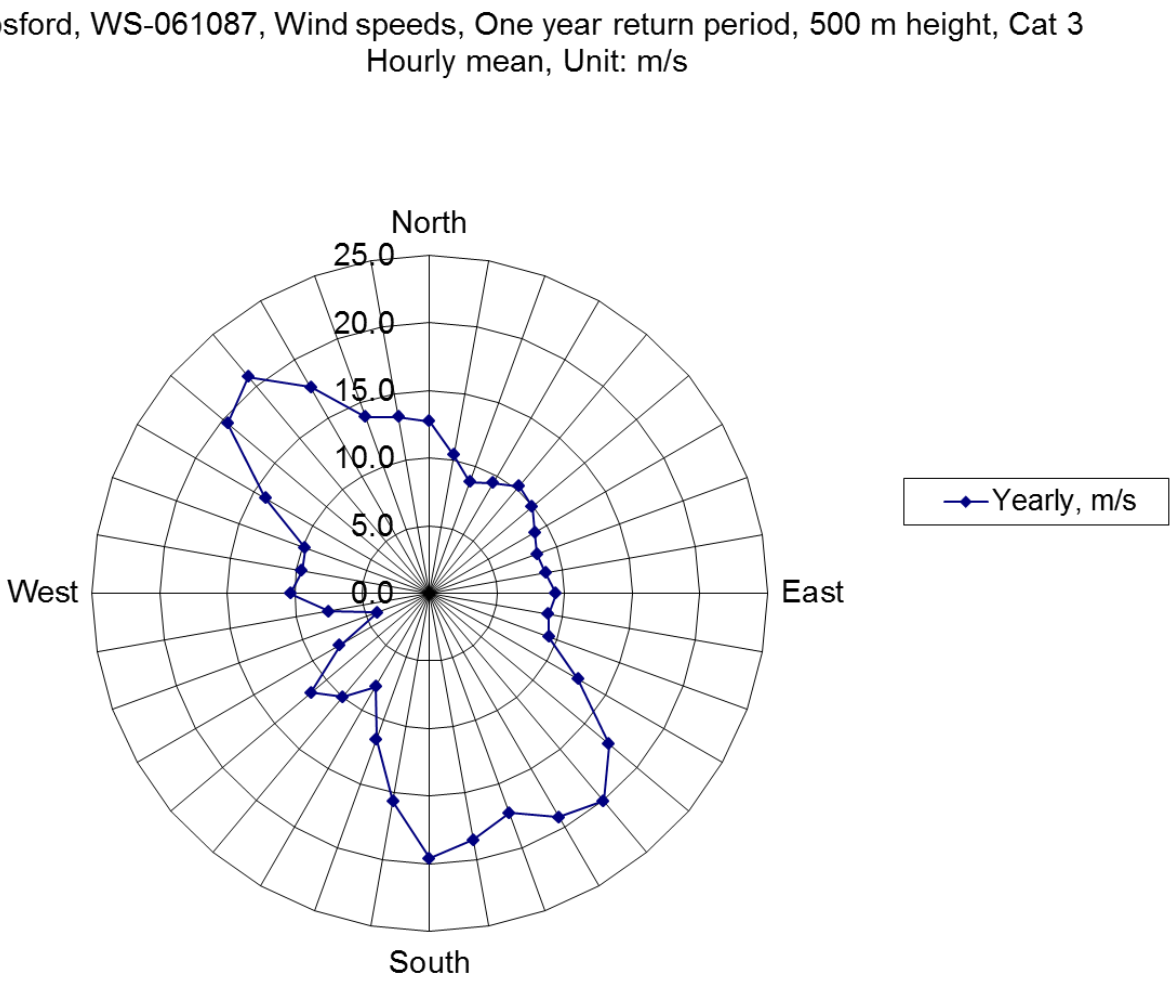

Figure 4: Directional Distribution of Annual Return Period Maximum Mean Hourly Wind Velocities (m/s) at gradient height in Gosford.

2.3 BUILDING GEOMETRY AND ORIENTATION

The site has approximate dimensions of 130 m x 160 m as shown in Figure 5. The building has a maximum height of approximately 48.5 m from street level (Figure 2).

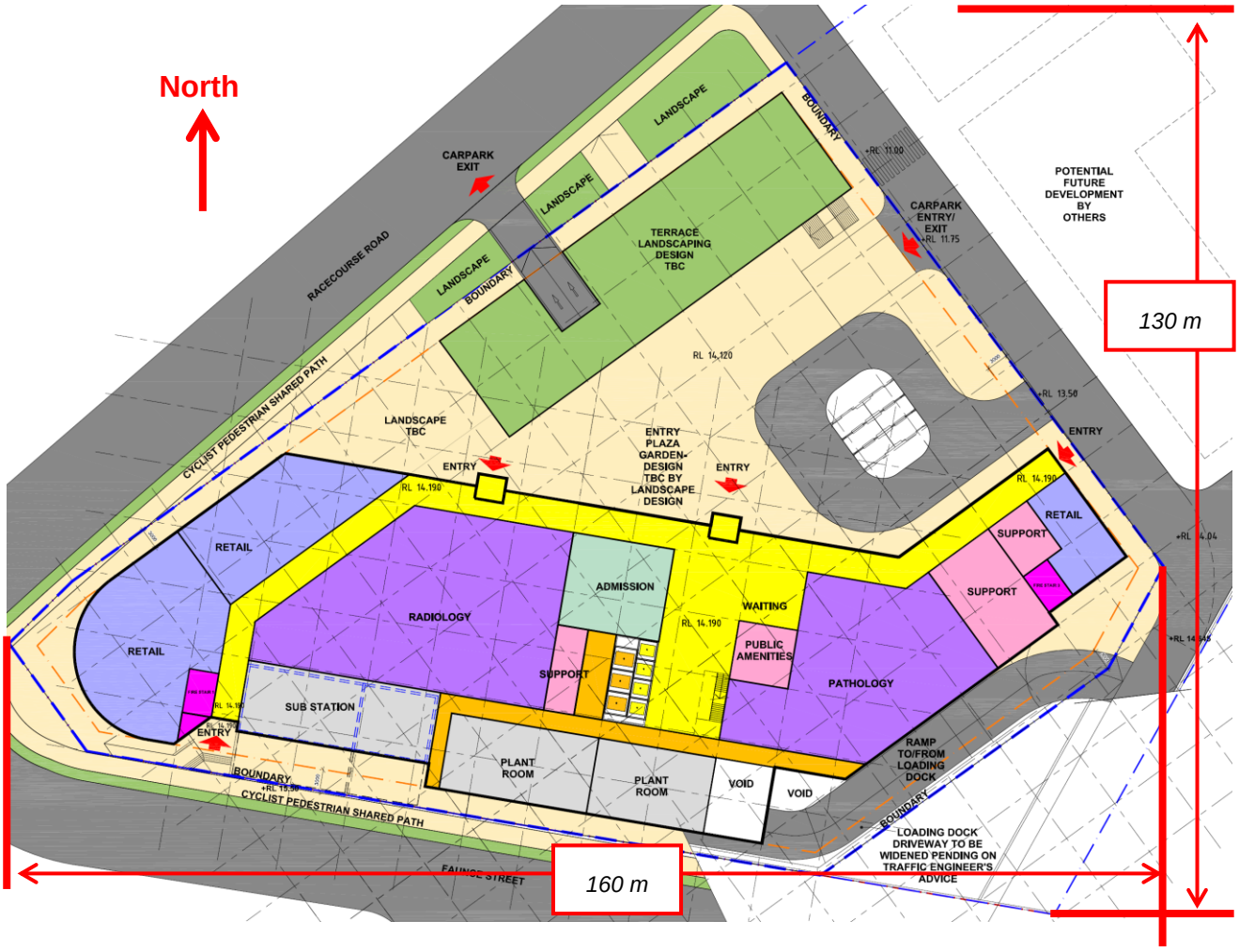

Figure 5: Ground level plan (Stage 1) of the proposed development showing the approximate dimensions.

2.4 FLOW INTERACTIONS WITH ADJACENT DEVELOPMENTS

The immediately adjacent developments are shown in Figure 6. There are buildings varying from 1-2 floors surrounding the site, with the Gosford Racecourse to the southwest of the site.

Figure 6: Immediately adjacent surroundings and their number of floors.

2.5 ASSESSMENT CRITERIA

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterised by the annual maximum gust wind speeds. Most patrons may consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity. If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions may result, and the windiness of the location may be voted as unacceptable.

The threshold gust velocity criteria are:

Table 1: Gust Velocity Criteria - Recommended Wind Speeds for Comfort and Safety

Annual Maximum Gust Speed	**Result on Perceived Pedestrian Comfort**
>23m/s	Unsafe (frail pedestrians knocked over)
<20m/s	Acceptable for **fast walking** (waterfront or particular walking areas)
<16m/s	Acceptable for **walking** (steady steps for most pedestrians)
<13m/s	Acceptable for **standing** (window shopping, vehicle drop off, queuing)
<11m/s	Acceptable for **sitting** (outdoor cafés, gardens, park benches)

In a similar manner, a set of hourly mean velocity criteria with a 0.1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed Development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold mean velocity criteria are:

Table 2: Mean Velocity Criteria - Recommended Wind Speeds for Comfort and Safety

Mean wind speed exceeded 0.1% of the time	**Result on Perceived Pedestrian Comfort**
>15m/s	Unsafe (frail pedestrians knocked over)
<13m/s	Acceptable for **fast walking** (waterfront or particular walking areas)
<10m/s	Acceptable for **walking** (steady steps for most pedestrians)
<7m/s	Acceptable for **standing** (window shopping, vehicle drop off, queuing)
<5m/s	Acceptable for **sitting** (outdoor cafés, gardens, park benches)

The Beaufort Scale is an empirical measure that related the wind speed to observed conditions on the land and sea. Table 3 describes the categories of the Beaufort Scale. The comparison between these observed conditions and the comfort criteria described above can be found in Table 4.

Table 3: Beaufort Scale - empirical measure relating wind speed to observed conditions on land

Beaufort Number	Descriptive Term	Wind Speed at 1.75 m height (m/s)	Specification for Estimating Speed
0	Calm	0-0.1	
1	Light Air	0.1-1.0	No noticeable wind
2	Light Breeze	1.1-2.3	Wind felt on face
3	Gentle Breeze	2.4-3.8	Hair disturbed, clothing flaps, newspapers difficult to read
4	Moderate Breeze	3.9-5.5	Raises dust and loose paper; hair disarranged
5	Fresh Breeze	5.6-7.5	Force of wind felt on body, danger of stumbling when entering a windy zone
6	Strong Breeze	7.6-9.7	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, sideways wind force about equal to forwards wind force, wind noise on ears unpleasant
7	Near Gale	9.8-12.0	Inconvenience felt when walking
8	Gale	12.1-14.5	Generally impedes progress, great difficulty with balance in gusts
9	Strong Gale	14.6-17.1	People blown over

Table 4: Comparison between Mean comfort criteria and the observed conditions

Comfort Criteria	Beaufort Scale Equivalent
Safety	9 – Strong Gale
Walking	5 – Fresh Breeze
Standing	4-5 – Moderate to Fresh Breeze
Sitting	<4 – Moderate Breeze

2.5.1 USE OF ADJACENT PEDESTRIAN OCCUPIED AREAS & RECOMMENDED COMFORT CRITERIA

The following table lists the specific areas adjacent to the proposed development and the corresponding recommended criteria.

Table 5: Recommended application of criteria

Area	Specific location	Recommended Criteria
Public Footpaths, Access ways	Around the building on the ground level, access ways to lobby (Figure 7).	Walking
Building entrances/lobbies	Various sides of the building (Figure 7)	Standing
Terraces/balconies	Level 2, 3, 5, 7 gardens/courtyards	Walking (Refer to discussion below)

2.5.2 TERRACE AREAS RECOMMENDED CRITERION DISCUSSION

Terrace/balconies are located on various levels of the development. Vipac recommends as a minimum that balcony/rooftop terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional;
- many similar developments in Melbourne and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.

However, it should be noted that meeting the walking criterion on elevated recreation areas will be no guarantee that occupants will find wind conditions in these areas acceptable at all times.

Recommended to fulfil Walking *Recommended to fulfil Standing*

Figure 7: Schematic plan view of the ground floor (Stage 2) with recommended wind criteria overlaid

3 PEDESTRIAN LEVEL WIND EFFECTS

3.1 DISCUSSION

Ground Floor

The site of the proposal is relatively exposed to winds approaching from all directions. Considering the wind climate, and building orientation, most entries would be expected to be within the recommended standing comfort criterion. However, it is expected that there will be significant downwash winds at the northwest building entrance. Recommendations have been made in this regard in the following section.

The walkways around the building are expected to have wind environment within the recommended walking comfort criterion.

Gardens/Courtyards

The courtyard on Level 2 is well sheltered and is expected to be well within the recommended comfort criteria with the proposed design.

The courtyards on Level 3 and Level 5 are exposed to the winds from the northwest and south, which are expected to have high velocities exceeding the recommended comfort criterion for walking. Some landscaping or higher balustrades could be incorporated as wind control measures for these areas. Refer to the following section for more details.

The courtyard on Level 7 is also exposed to NW winds; however, considering the smaller area of this terrace, wind conditions are expected to be within the recommended walking comfort criterion with the proposed design.

Wind conditions on the proposed high level terrace areas will frequently be acceptable for outdoor recreation. However, during moderate to strong winds, conditions in these areas may exceed human comfort criteria. Terrace areas on similar developments in many major Australian capital cities typically experience similar elevated wind conditions. High exposure, corner acceleration flows and standing vortices would sometimes preclude these areas from use for outdoor recreation.

3.2 RECOMMENDATIONS

After careful consideration of the areas at the base of the proposal, Vipac predicts that some changes to existing wind conditions in adjacent ground level areas may occur. However, it is expected that the proposal would not generate wind conditions exceeding the walking comfort criterion at the pedestrian level.

However, the NW building entrance may have wind conditions exceeding the recommended comfort criteria. We recommend incorporating an awning over the NW main entrance to shield this area from downwash, as shown in Figure 8. Additionally, we recommend incorporating air lock entries for the hospital lobby to minimise impact of winds on the internal spaces of the building.

The gardens and courtyards on Levels 3 & 5 may have wind conditions exceeding the recommended walking comfort criterion. We recommend incorporating 1.5 m balustrades or landscaping on the perimeter of these spaces, as detailed in Figure 9. Additional landscaping within the gardens and courtyards can be used to create areas of calmer wind conditions suitable for long term stationary sitting or standing activities.

As a general statement, educating occupants about wind conditions at terrace areas during high-wind events and fixing loose, lightweight furniture is highly recommended.

It should be noted that this study is based on experience only and has not utilised any experimental data for the analysis. Vipac recommends wind tunnel testing be undertaken in the detail design phase to verify these predictions and assess any wind control treatments, if necessary.

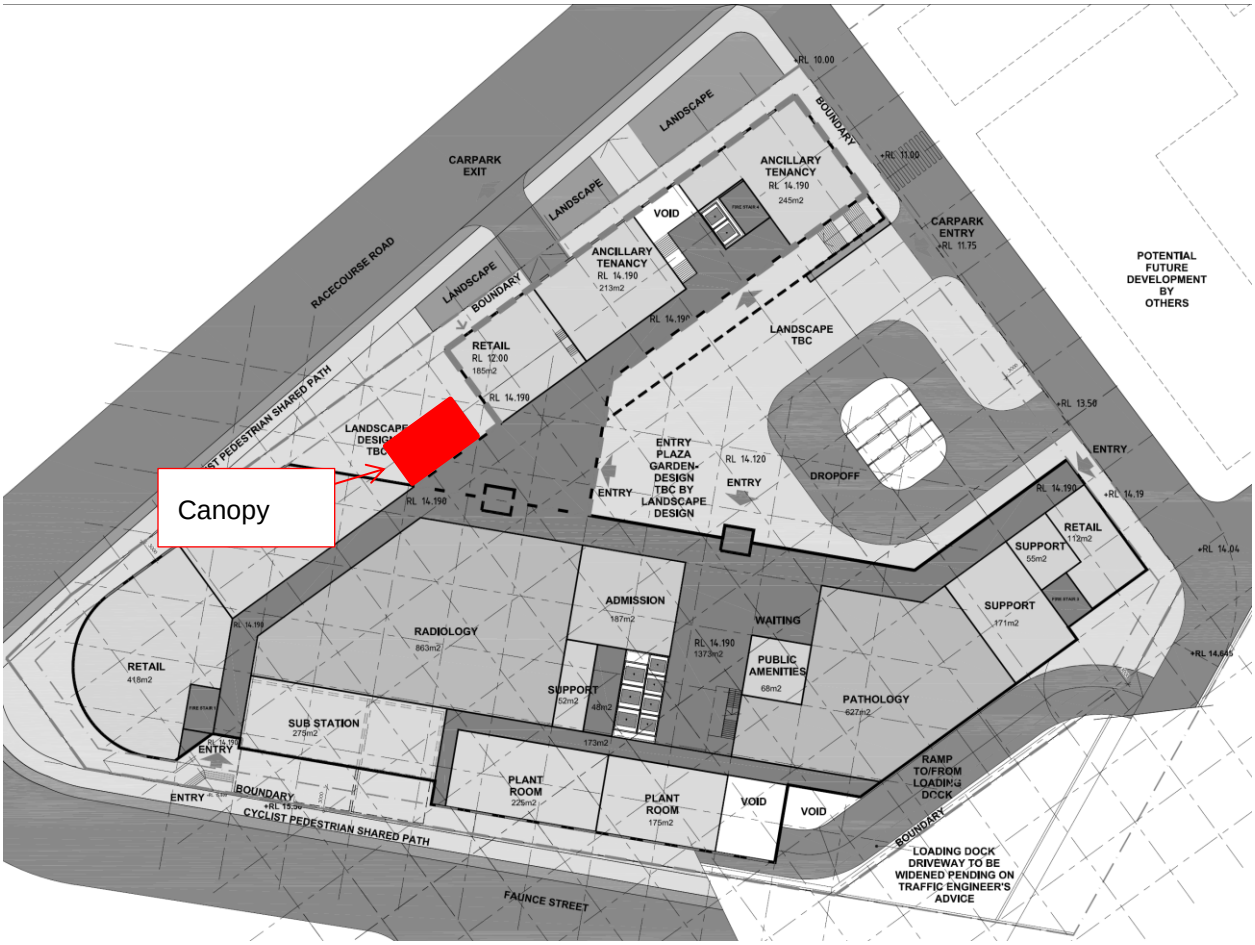

Figure 8: Recommended wind control treatments for the ground floor

Figure 9: Recommended wind control treatments for Level 3 and Level 5

4 CONCLUSIONS

An appraisal of the likely wind conditions at the pedestrian ground level, and terraces of the proposed Northside Private Hospital development has been made.

Vipac has carefully considered the form and exposure of the proposal, nominated criteria for various public areas according to their function and referred to past experience to produce our opinion of likely wind conditions.

The findings of this study can be summarised as follows:

With proposed design:

- wind conditions in the ground level footpath areas would be expected to be within the **walking** comfort criterion.
- wind conditions in the building entrance areas would be expected to exceed the recommended **standing** comfort criterion. We recommend incorporating a canopy over the NW entrance to improve wind conditions in this area.
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With the proposed design and recommended treatments, the development will achieve a high level of amenity, in accordance with the SEARs requirement for wind impact.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around Australia. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. Vipac recommends a wind tunnel test be conducted at the detail design stage to verify the predictions and determine appropriate wind control measures if necessary.

This Report has been Prepared

For

AA Crown Holdings Pty Limited

By

VIPAC ENGINEERS & SCIENTISTS LTD.

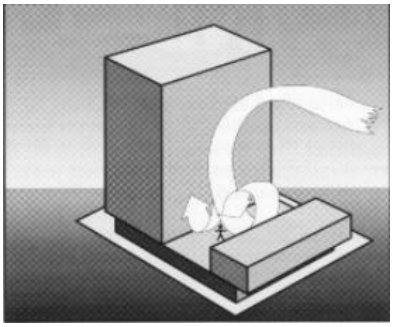
16 July 2019

Appendix A: ENVIRONMENTAL WIND EFFECTS

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



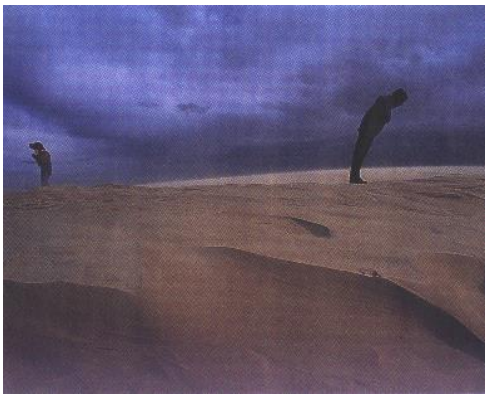
Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast moving wind at higher elevations downwards.

Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



Appendix B: REFERENCES

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2011

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

Appendix C: DRAWING LIST

Drawings Received: ***March 2019***

Name	Date modified
GPH-A-P-1_8	15/07/2019 4:02 PM
GPH-A-P-2_8	15/07/2019 4:02 PM
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