Vipac Engineers and Scientists Limited
279 Normanby Rd, Port Melbourne, VIC 3207, Australia
Private Bag 16, Port Melbourne, VIC 3207, Australia
t. +61 3 9647 9700 | **e.** melbourne@vipac.com.au
w. www.vipac.com.au | A.B.N. 33 005 453 627 | A.C.N. 005 453 627

853 Pacific Highway Pty Ltd ATF 2017 PHC Unit Trust

8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood

Wind Impact Assessment

30N-21-0418-TNT-21701-2

19 October 2021

Job Title:	8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood
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853 Pacific Highway Pty Ltd ATF 2017 PHC Unit Trust Australia **Contact:** Michael Andrijic **Tel:** 0422 601 805	Vipac Engineers and Scientists Limited 279 Normanby Rd, Port Melbourne, VIC 3207, Australia **Tel:** +61 3 9647 9700

Author:	Sophie Lamande 19 October 2021	Senior Engineer
Reviewer:	Eric Yuen 19 October 2021	Wind Team Leader
Issued By:	Sophie Lamande 19 October 2021	Senior Engineer

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Rev. 00	Original issue	23 Sep 21	
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Rev. 02	Plans updated	18 Oct 21	S. Lamande

EXECUTIVE SUMMARY

853 Pacific Highway Pty Ltd ATF 2017 PHC Unit Trust commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at 8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood**.** This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed development were provided by **PDB Architects** in October 2021. The findings of this study can be summarized as follows:

- With the proposed design, the adjacent footpaths would be expected to have wind levels within the walking comfort criterion.
- The wind conditions near the main entrance areas would be expected to be within the criterion for standing comfort.
- The wind conditions in the Level 2 communal terraces would be expected to be within the recommended walking comfort criterion.
- With the proposed design **and recommended wind control measures**, the wind conditions in the apartment balconies would be expected to be within the criterion for walking.

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.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. 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 scaled wind tunnel study in the detail design stage to verify the predictions and determine the optimal wind controls, wherever necessary.

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1 Introduction

853 Pacific Highway Pty Ltd ATF 2017 PHC Unit Trust commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at **8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood, NSW.** This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The site of proposed development is bounded by Pacific Hwy to the west, Wilson St to the north, O' Brien St to the south and the railway tracks to the east (see Figure 1). The proposed development consists of two towers on a common podium with an overall building height of 87.6 m from the ground level (Figure 2). The surrounding developments within a 3km radius are low density suburban dwellings and forested parklands (Figure 3).

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level public areas and access-ways adjacent to the development as proposed. No wind tunnel testing has been carried out for this development 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 development. These serve as a valid reference for the prediction of wind effects for this development. Empirical data for typical buildings in boundary layer flows has also been used to estimate likely ground level wind conditions adjacent to the proposed development [2] & [3].

Drawings of the proposed development were provided by **PDB Architects** in **October 2021** as listed in Appendix C of this report.

Figure 1: Aerial view of the proposed development site at 8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood.

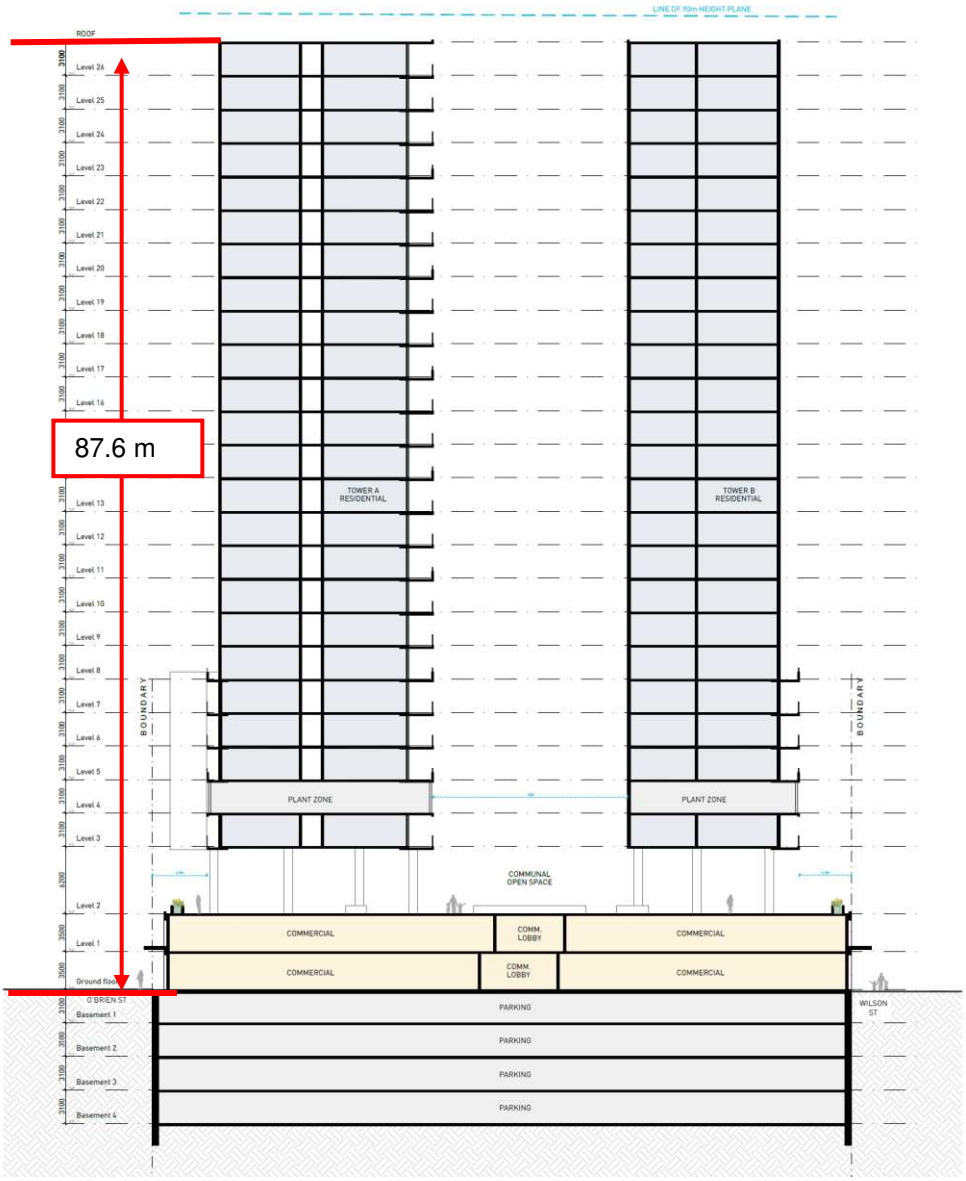


Figure 2: Typical section of the proposed development

2 Analysis Approach

When considering whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, Vipac considers 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 public areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations around a site 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. For cases where Vipac predicts that a location would not meet its appropriate comfort criterion we may recommend the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

2.1 Site Exposure

The proposed development is predominantly surrounded within a 3 km radius by suburban housing and low-density residential developments and forested parklands. Therefore, for the current study, the site of the proposed development is considered to be Terrain Category 3 for all wind directions [1] (see Figure 3).

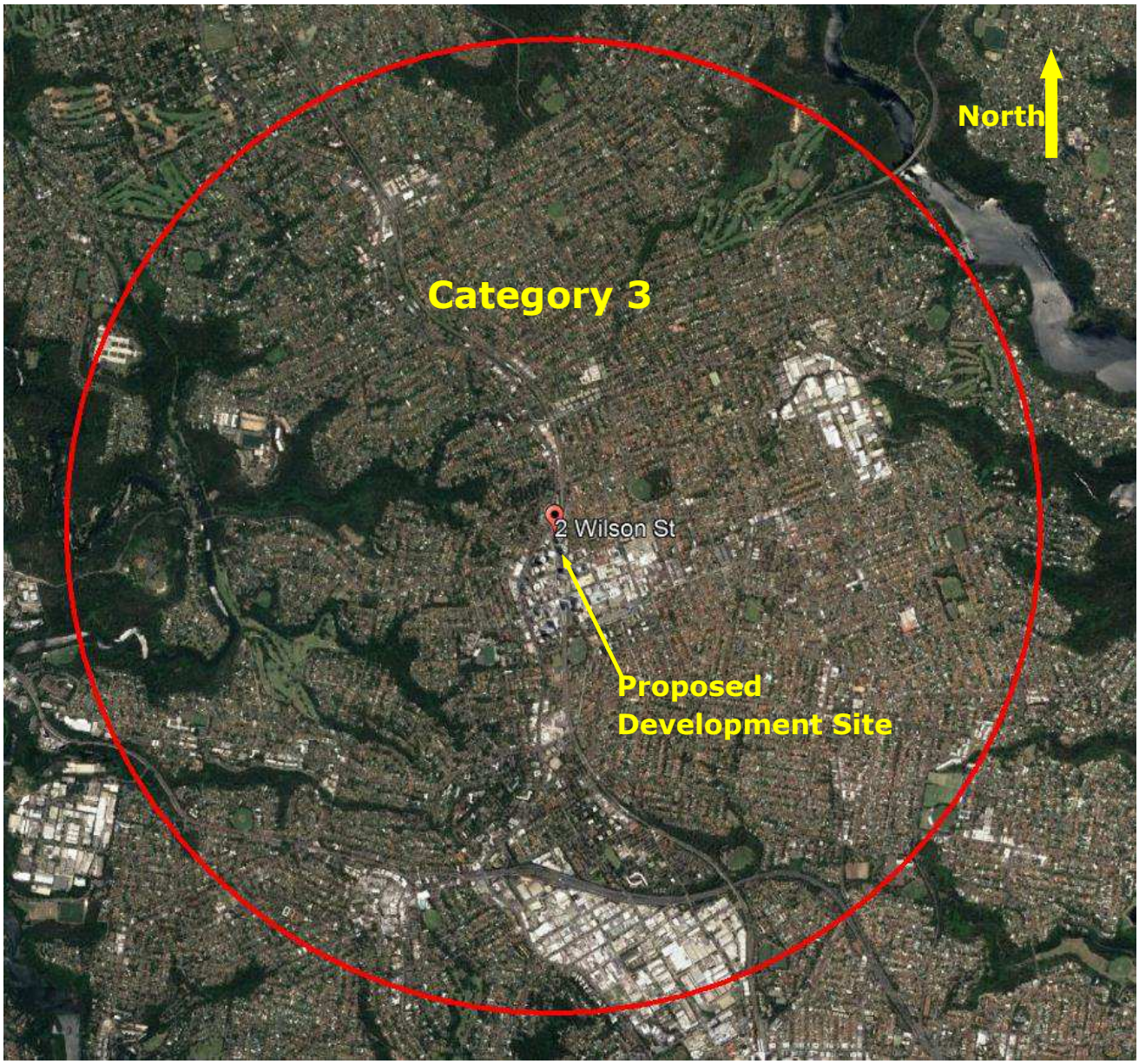


Figure 3: Assumed terrain categories for wind speed estimation.

2.2 Regional Wind Climate

The mean and gust wind speeds have been recorded in the Sydney area for 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 Sydney city sites 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 south to north-westerly directions, followed by south, then North Easterly directions.

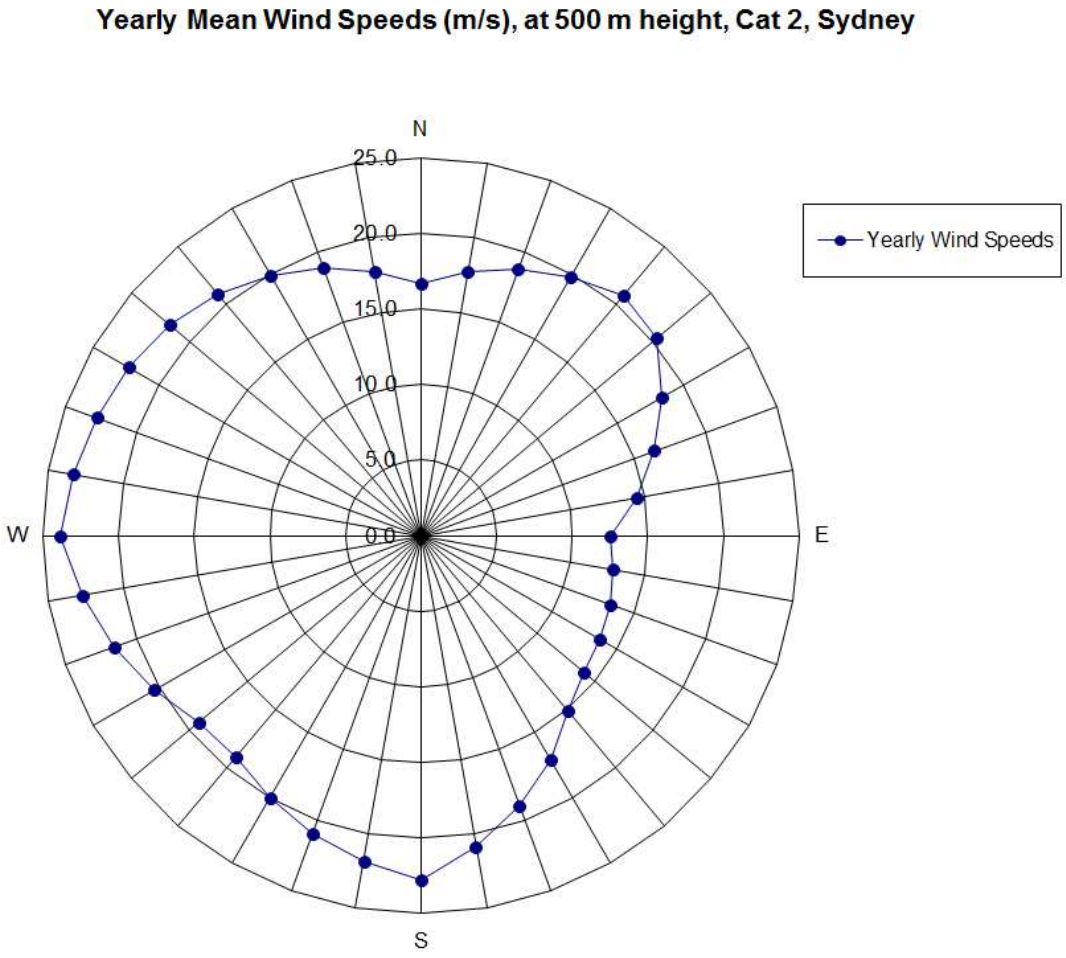


Figure 4: Directional Distribution of Annual Return Period Maximum Mean Hourly Wind Velocities (m/s) at gradient height in Sydney.

2.3 Building Geometry and Orientation

The ground level plan of the proposed development is shown in Figure 5. The site covers an approximate 80 m by 65 m diamond plan with the long side running N - S direction.

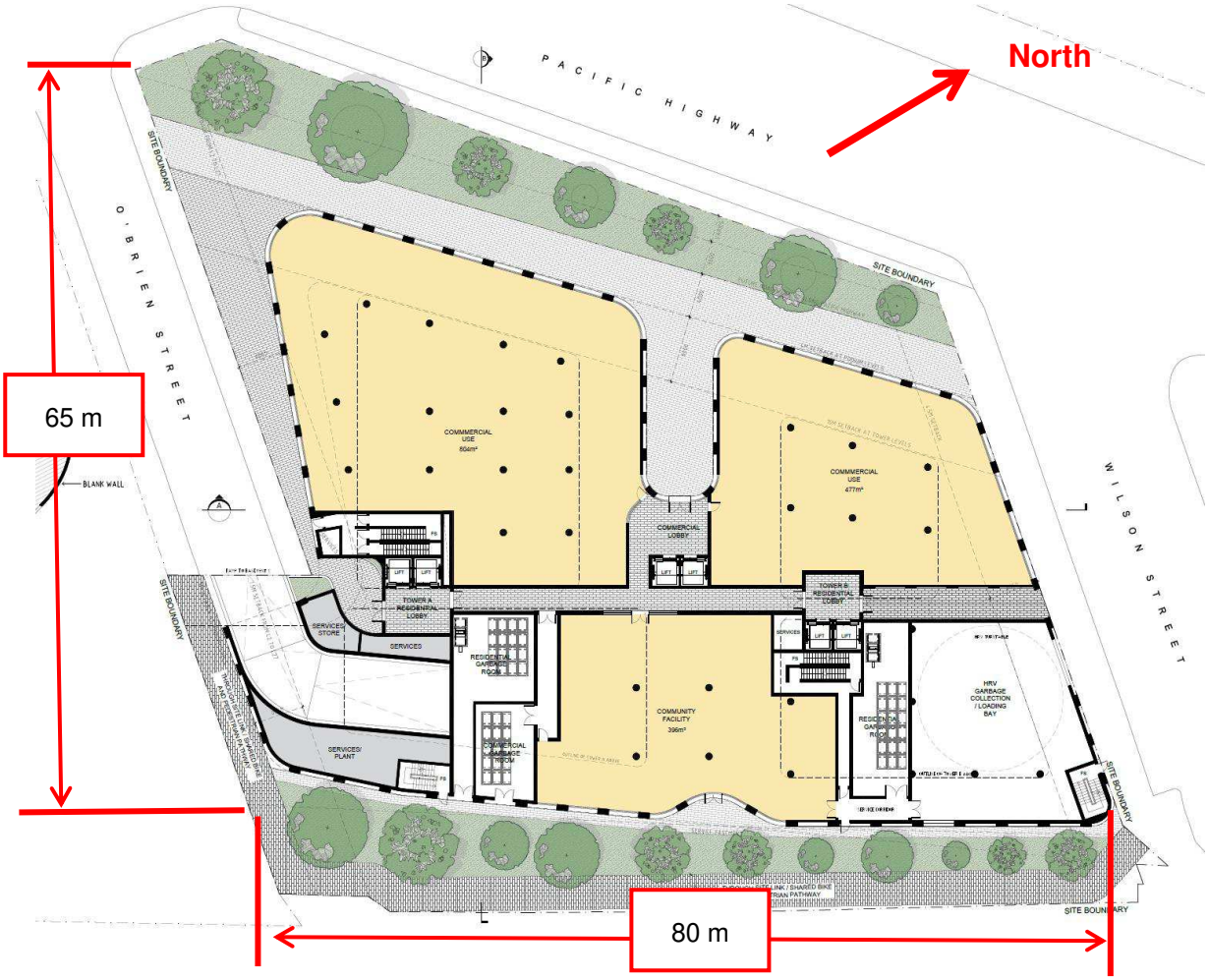


Figure 5: Ground level plan of the proposed development.

2.4 Flow Interactions with Adjacent Developments

The buildings immediately adjacent to the proposed development site, with their approximate heights are shown in Figure 6.

The proposed development is surrounded by some high rise buildings in south sectors, future high rise building in the adjacent site to the north and low rise buildings in other directions.

The prevailing winds are from the west and the south sectors. The ground level areas are sheltered by neighbouring buildings for southerly and some northerly winds; it is relatively exposed to the prevailing winds for west/northwest sector over the roof of the 1-2 storey buildings across the intersection of Pacific Hwy, Wilson St and O' Brien St.

Figure 6 : A 3D perspective view of the immediately adjacent buildings

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 characterized by the annual maximum gust wind speeds. Most patrons would 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 (shown in Table 1). If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be considered as unacceptable.

Table 1: Recommended Wind Comfort and Safety Gust Criteria

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 (see Table 2) 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.

Table 2: Recommended Wind Comfort and Safety Mean Criteria

Mean Speed in 0.1% of 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

2.6 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

The following table lists the specific areas adjacent to the development and the corresponding recommended criteria. These are shown in Figure 7 to Figure 9.

Table 5: Recommended application of criteria

Area	Specific location	Recommended Criteria
Public Footpaths and Access ways	Around the proposed development on O' Brien St, Wilson St and Pacific Hwy and (Figure 7)	Walking
Building entrances	Entrances on Wilson St and O' Brien St (Figure 7)	Standing
Terrace/balconies	Communal terrace on the podium rooftop Balconies on Levels 2 -26 of the tower (Figure 8 and Figure 9)	Walking (refer the discussion below)

2.6.1 Apartment Balcony and Rooftop areas Recommended Criterion Discussion

Vipac recommends as a minimum that apartment 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 Sydney 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.

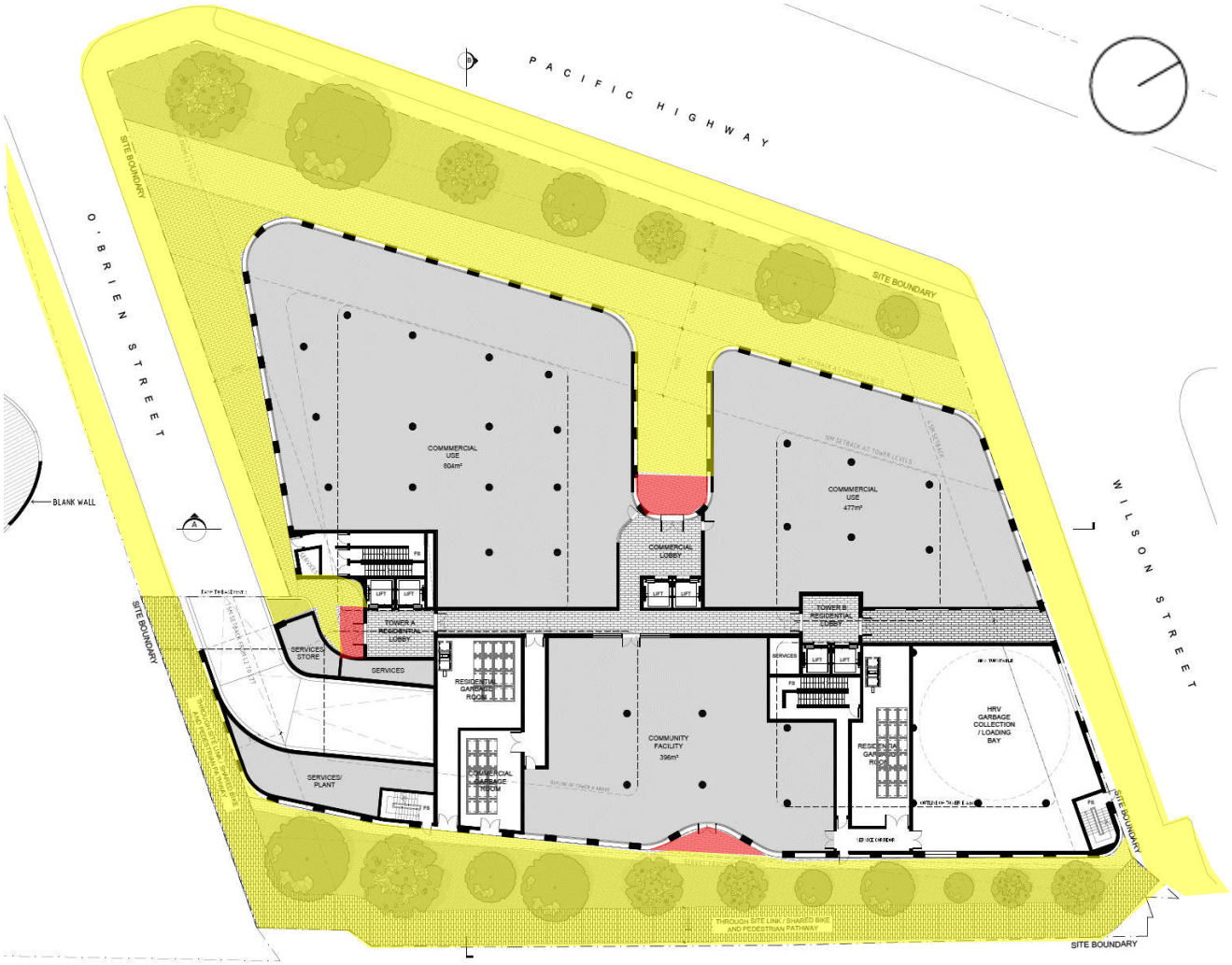
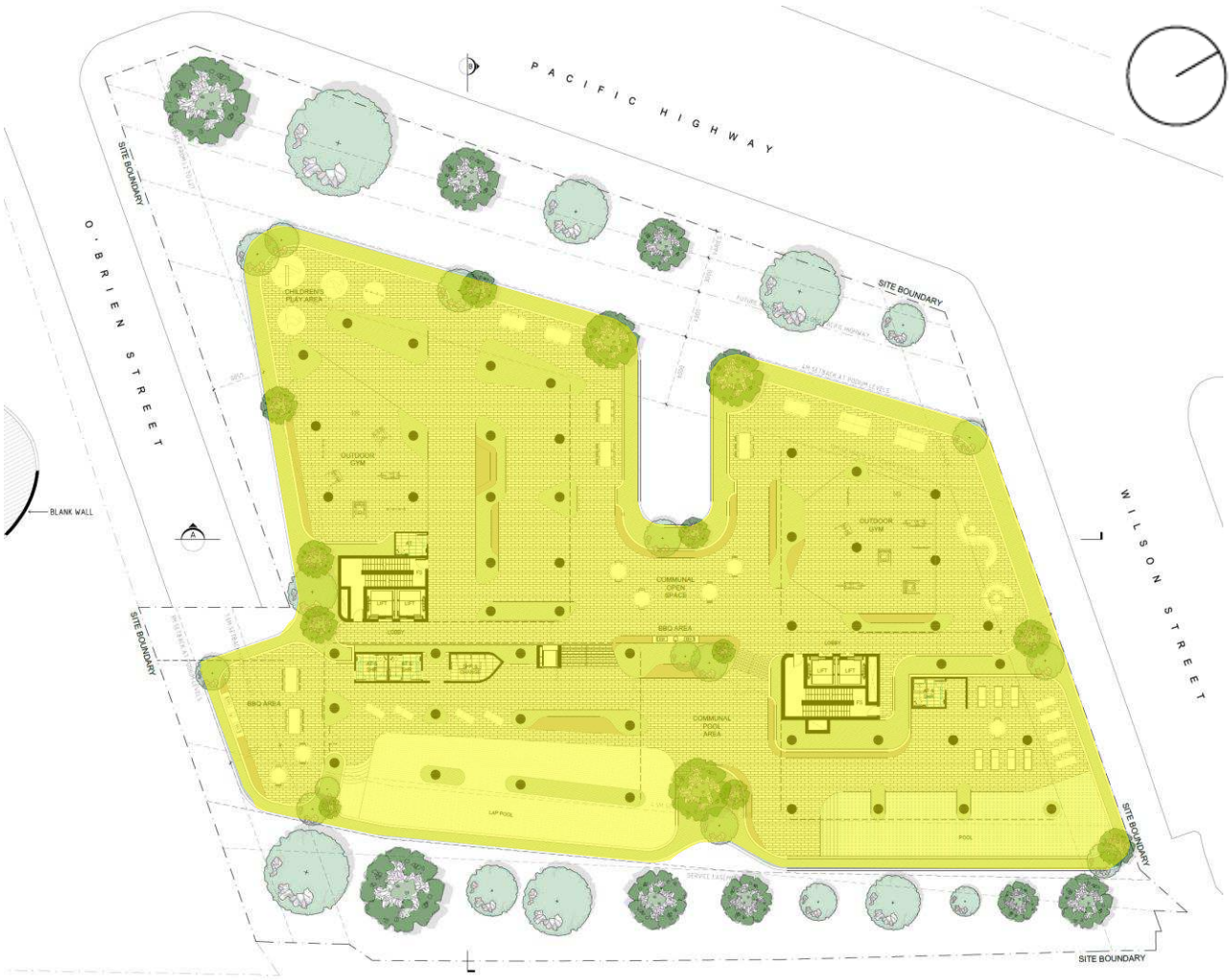


Figure 7: Ground floor plan of the proposed development with the recommended wind criteria overlaid.



Recommended to fulfil
Walking

Figure 8: Plans of Levels 2 plan of the proposed development with the recommended wind criteria overlaid.

3 Pedestrian Level Wind Effects

3.1 Discussion

The proposed design incorporates some wind mitigating features, including the following:

- Tower setbacks at podium level;
- Rounded building corners;
- Some inset balconies on the tower facades;

Ground Floor

Wind conditions at the footpath areas along Pacific Hwy are relatively exposed to westerly winds; however, due to the setback design, it is not expected that wind levels in this area would exceed the criterion for walking. The footpath at other streetscapes would also be expected to have wind conditions within the recommended walking comfort criterion.

The main entrances of the building are well set back within the building envelope and would be not expected to experience wind levels in excess of the criterion for standing comfort.

Level 2 Communal Terrace

The outdoor communal area on Level 2 has large areas beneath the towers that will be shielded well from downwash effects. This area is protected from direct winds from the southern sector by the taller buildings in that direction. The balustrades and landscaping would also be expected to provide shielding to the terrace areas. It is expected that the terrace would be within the recommended walking comfort criterion with the proposed design.

Balconies General

Whilst wind conditions on the balconies of the proposed development will frequently be acceptable for outdoor recreation, during moderate to strong winds, conditions in these areas may exceed human comfort criteria. Balcony 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.

The balconies on the western side of the towers and the north east corner balconies of the northern tower are relatively large and exposed to the high prevailing winds. We expect that at level 22 to level 26 these elevated wind conditions would be expected to exceed the recommended walking comfort criterion. Vipac recommends incorporating wintergarden designs (ie. Incorporate sliding windows/louvers so that the balconies can be enclosed) for these balconies which would achieve improved wind environment for these areas. These recommendations are shown in Figure 10.

3.2 Recommendations

After careful consideration of the areas at the base of the proposed development, Vipac predicts that the proposed development will present some changes to existing wind conditions in adjacent ground level areas. However, it would be not expected to have wind levels in exceeding of the recommended comfort criteria in the ground level or on the communal terraces on Level 2.

However, Vipac predicts that some apartment balconies at Level 22 to 26 would be expected to have some elevated wind conditions. Incorporating wintergarden designs (ie. Incorporate sliding windows/louvers so that the balconies can be enclosed) for these balconies has been recommended. (Figure 10).

Furthermore, as a general statement, common to all developments of this height, educating occupants about wind conditions at high-level terraces/balconies during high-wind events and tying down lightweight furniture are highly recommended.

Figure 10: Recommended wind control measures for the large balcony on levels 22-26

4 Conclusions

An assessment of the likely wind conditions at pedestrian level of the proposed development at **8 Wilson Street, Chatswood (Lot 1/DP1189541) & 849-859 Pacific Highway and 2 Wilson Street, Chatswood, NSW** has been made.

Vipac has carefully considered the form and exposure of the proposed development, nominated criteria for various public areas according to their function and referred to past experience to produce our opinion of likely wind conditions. Based on this assessment, the following conclusions are drawn:

- With the proposed design, the adjacent footpaths would be expected to have wind levels within the walking comfort criterion.
- The wind conditions near the main entrance areas would be expected to be within the criterion for standing comfort.
- The wind conditions in the Level 2 communal terraces would be expected to be within the recommended walking comfort criterion.
- With the proposed design and recommended wind control measures, the wind conditions in the apartment balconies would be expected to be within the criterion for walking.

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.

The assessments provided in this report have been made based on experience of similar situations in Sydney and around the world. 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 scaled wind tunnel study in the detail design stage to verify the predictions and determine the optimal wind controls, wherever necessary.

This Report Has Been Prepared

For

853 Pacific Highway Pty Ltd ATF 2017 PHC Unit Trust

By

VIPAC ENGINEERS & SCIENTISTS LTD.

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

Received in October 2021

Name	Date modified
211014_Wilson St_Yield Table.pdf	15/10/2021 10:53 AM
PP098 - BASEMENT 2-4 PLAN-B.pdf	15/10/2021 10:53 AM
PP099 - BASEMENT 1 PLAN-B.pdf	15/10/2021 10:53 AM
PP100 - GROUND FLOOR-B.pdf	15/10/2021 10:53 AM
PP101 - LEVEL 1-B.pdf	15/10/2021 10:53 AM
PP102 - LEVEL 2 LANDSCAPE PLAN-B.pdf	15/10/2021 10:53 AM
PP103 - LEVEL 3-8 TYPICAL FLOOR-B.pdf	15/10/2021 10:53 AM
PP104 - LEVEL 9-26 TYPICAL FLOOR-B.pdf	15/10/2021 10:53 AM
PP200 - SECTION A-B.pdf	15/10/2021 10:53 AM
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