PEDESTRIAN WIND ENVIRONMENT STATEMENT

871-877 PACIFIC HIGHWAY, CHATSWOOD

WE300-01F02(REV0)- WS REPORT

JUNE 22, 2018

Prepared for:

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DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
June 15, 2018	Initial.	0	JG	SWR	HK
June 22, 2018	Update Exec. Summary and Discussion	1	JG	SWR	BU

EXECUTIVE SUMMARY

This report is in relation to the planning proposal for the development located at 871-877 Pacific Highway, Chatswood and presents an opinion on the likely impact of the proposed design on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; namely the north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposed development was carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the concept architectural drawings (Sketch Proposal) prepared by PBD Architects received on the 8th of June, 2018. No wind tunnel tests have been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects. Note that the service station site (879 Pacific Highway) directly to the north is a potential development site and has been considered by the project architects as a possible future development site. This report presents an analysis of the wind activities considering the proposed development, however it also addresses the effect of the wind activities with the inclusion of the future proposed development to the north.

The results of this assessment indicate that the site is generally exposed to the prevailing north-easterly and westerly winds, with provisional shielding of the southerly winds due to the close proximity of the Chatswood CBD. A number of the outdoor trafficable areas are potentially exposed to a variety of adverse wind effects due to the interaction of the prevailing winds with the built form; detailed further within the report. These include exposure to direct wind effects from the prevailing wind directions, accelerating flows around the corners of the building and down-wash wind effects off the building facade. The use of effective wind mitigation strategies in the design such as recessing private outdoor balconies into the building footprint assists in providing shielding to these areas.

It is expected that suitable wind conditions can be achieved for all trafficable outdoor areas with the inclusion of these recommended treatments which are summarised as follows:

Ground Level:

- Inclusion of an impermeable awning over the pedestrian footpath areas along the Pacific Highway, Wilson Street and eastern frontage of the site.
- Inclusion of densely foliating evergreen tree planting at strategic locations around the site.
- Recommended inclusion of an impermeable awning and/or screens within the through site link if the 879 Pacific Highway site is redeveloped.

Podium Communal Open Space:

- Inclusion of impermeable awning extending from the tower over the communal open areas, with consideration for an awning extending to the perimeter of the podium over the communal pool open space.
- Retention of all planter boxes with densely foliating evergreen shrub planting and tree planting up to a height of 2–4m.
- Inclusion of 1.5m high impermeable balustrades along the perimeter of the podiums of both towers.
- Recommended inclusion of operating doors along the perimeters of the communal room.

Private Balconies:

- Inclusion of impermeable balustrades along the perimeter edges of the various private balconies and terraces of the development.
- Consideration of proposed full-height privacy screens along one aspect of the various private corner balconies of the development.

Elevated and Roof Terraces:

- Inclusion of 1.5m high impermeable parapet along the perimeter edges of the terraces of the development.
- Recommended retention of the perimeter planter boxes with hedge planting of a combined height of 1.5-1.8m immediately behind the parapet and retention of densely foliating evergreen tree planting up to a height of 2–4m.

With the inclusion of the abovementioned recommendations in the design, it is expected that wind conditions for the various trafficable outdoor areas within and around the development to be acceptable for their intended uses.

The use of lightweight furniture (e.g. loose glass tops, lightweight sheets or covers, loose BBQ lids etc.) is not recommended on the high-rise outdoor terraces and balconies. If lightweight furniture is to be used, it is recommended to securely attach it to the balcony or terrace floor slab.

Due to the overall massing of the subject development, the height of the building form and the exposure of the development to the prevailing winds, wind tunnel testing is recommended to be undertaken at a later detailed design stage to verify the wind conditions and enable more detailed feedback and design of the proposed and potential wind mitigation measures. This will provide a quantitative analysis of the wind conditions and determine the requirement for wind mitigation measures, including the size and extent of treatments to ensure suitable conditions are provided for the trafficable areas throughout the development.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The proposed development site is located at 871-877 Pacific Highway, Chatswood and is bounded by Pacific Highway to the west, Wilson Street to the south and the railway line to the east. Immediately surrounding the site is a service station to the north, low-rise residential to the east, south and west. The site is generally encompassed by low to mid-rise residential housing, with Chatswood CBD located directly to the south consisting of mid to high-rise towers. Further away from the site to the south-east is Westfield's Chatswood Shopping Centre. A survey of the local land topography indicates that the site is on a crest and that there is a general rise towards the site from the north and south along Pacific Highway. An aerial image of the site and the surroundings is shown in Figure 1.

The proposed development is comprised of a residential tower with an overall height of 25 storeys above the ground level. Car-parking is provided within six basement levels and with vehicular access provided off Wilson Street.

The critical trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects are summarised as follows:

- The pedestrian footpath areas located along the Pacific Highway, Wilson Street and along the boundary of the Rail line of the site.
- The podium floor communal areas.
- The private balconies.

  Elevated and roof terraces.

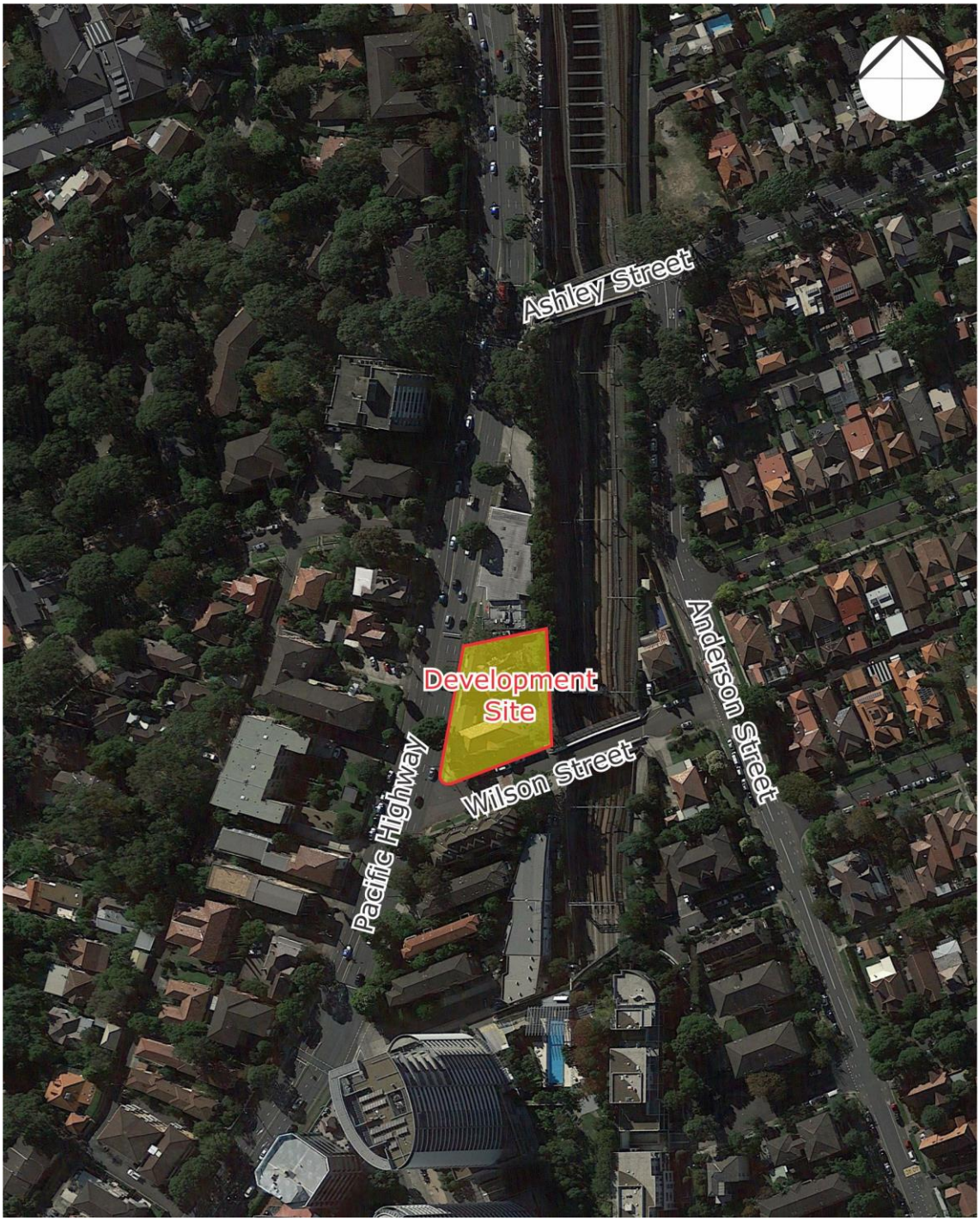

Figure 1: Aerial Image of the Site Location

2 WIND CLIMATE OF THE SYDNEY REGION

The Sydney region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1995 to 2016). From this analysis, a directional plot of the annual and weekly recurrence winds for the Sydney region is also determined, as shown in Figure 2. The frequency of occurrence of these winds is also shown in Figure 2.

As shown in Figure 2, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Sydney region, and hence are usually welcomed within outdoor areas since they are typically not as strong as the southerly or westerly winds.

Table 1: Principal Time of Occurrence of Winds for Sydney

Month	Wind Direction		
	North-Easterly	Southerly	Westerly
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	

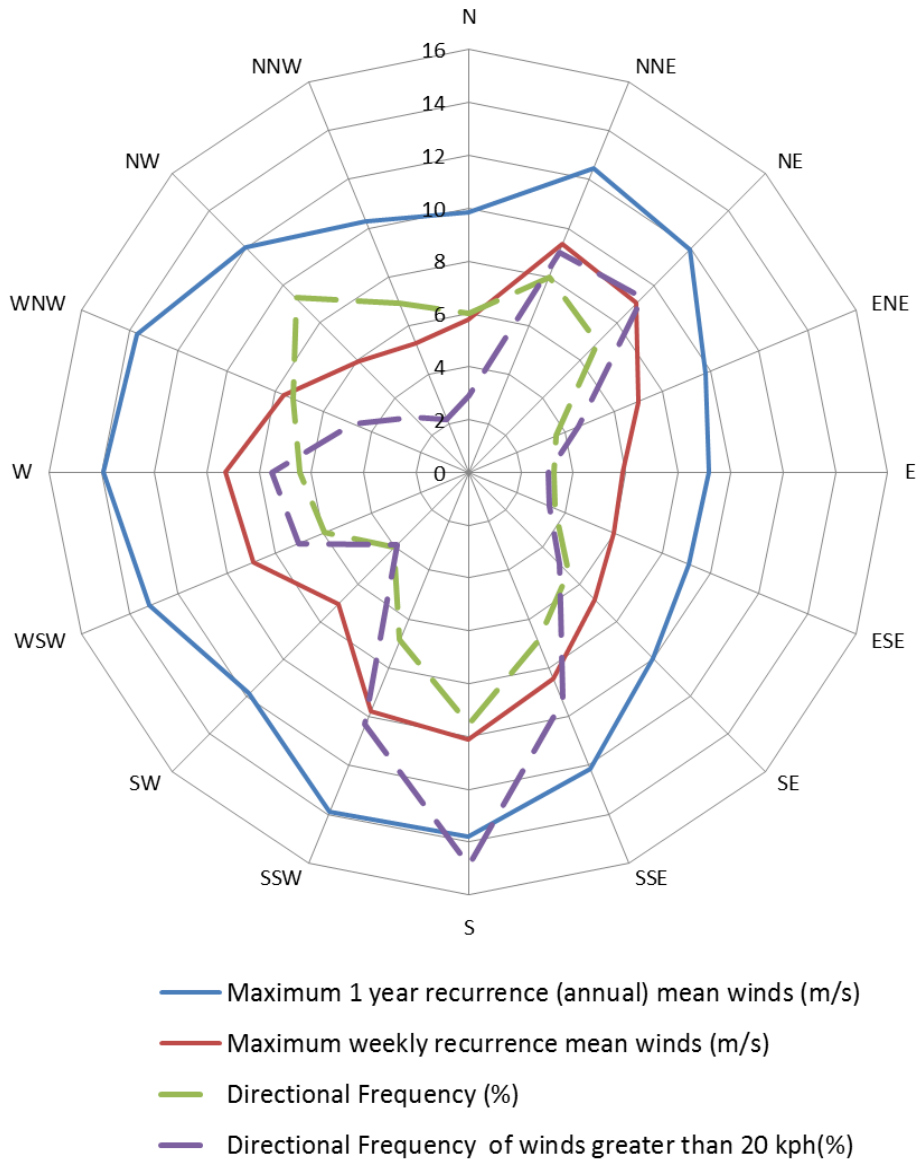

Figure 2: Directional Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (for the annual and weekly return periods, referenced to standard open terrain at a height of 10m above ground)

3 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as Davenport, Lawson, Melbourne, Penwarden, etc, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements in Australia.

The following table is an example, which was developed by Penwarden in 1975, and describes the effects of various wind intensities on people. Note that the applicability column relates to the indicated wind conditions occurring frequently. Higher ranges of wind speeds can be tolerated for rarer events.

Table 1: Summary of Wind Effects on People (Penwarden, 1975)

Type of Winds	Mean Wind Speed (m/s)	Effects	Applicability
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for Stationary, long exposure activities such as in outdoor restaurants, landscaped gardens and open air theatres.
Light breeze	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	5.5 - 7.9	Raises dust, dry soil and loose paper. Hair disarranged.	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.	Acceptable for areas where there is little pedestrian activity or for fast walking.
Near gale	13.9 - 17.1	Inconvenience felt when walking.	
Gale	17.2 - 20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use (rather than referencing specific wind speeds). Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

4 RESULTS AND DISCUSSION

The expected wind conditions are discussed in the following sub-sections of this report for the various critical trafficable outdoor areas within and around the subject development for each of the three predominant wind directions for the Sydney region. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, their overall heights and bulk, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report.

Due to the overall massing of the subject development, the height of the building form and the exposure of the development to the prevailing winds, wind tunnel testing is recommended to be undertaken at a later detailed design stage to verify the wind conditions and enable more detailed feedback and design of the proposed and potential wind mitigation measures. This will provide a quantitative analysis of the wind conditions and determine the requirement for wind mitigation measures, including the size and extent of treatments to ensure suitable conditions are provided for the trafficable areas throughout the development.

4.1 Ground Level Outdoor Trafficable Areas

The pedestrian footpath areas along the Pacific Highway, Wilson Street and the railway reserve are aligned with the three prevailing wind directions for the region and could potentially be affected by these direct winds. Minimal shielding of the north-easterly and westerly winds could potentially result in these winds interacting with the building form resulting in localised adverse wind conditions at the building corners due to wrap around effects. Similarly, the north-easterly winds may potentially side stream along the eastern aspect of the podiums impacting the footpath areas along the boundary of the railway reserve areas as well as the potential for. The site benefits from provisional shielding of the southerly winds due to the high-rise developments located to the south of the site. However, there is the potential for the southerly winds to travel along the corridor of the railway line impacting the pedestrian footpath areas along the eastern aspect.

Due to the substantial height of this development the pedestrian footpath area located along the eastern frontage is subject to potential downwash from the north-easterly winds. The minor proposed tower offset from the podium on the western and southern aspects are not expected to provide adequate mitigation for the ground level area.

Incorporating densely foliating evergreen tree planting around the site will assist with mitigating direct winds, as well as incorporating an impermeable awning over the pedestrian footpath areas to assist in mitigating downwash effects. Note that all planting should be densely foliating and evergreen to ensure their effectiveness in wind mitigation year-round. Wind tunnel testing is highly recommended for this area to establish the severity of the wind conditions, and to formulate effective wind mitigation strategies.

4.2 Podium Open Space

The podium communal spaces located on the tower is exposed to the prevailing winds with some shielding provided from the southerly winds due to the high-rise towers located south of the site.

Direct flow from the prevailing westerly winds have the potential to impact the western communal outdoor area and the northern pool outdoor area. Similarly, the direct flow of the north-easterly and westerly winds are expected to interact with the tower façade above and downwash onto the communal pool area. Due to the height of the development there is the potential for the westerly winds to downwash from the tower onto the podium and recirculate into the communal rooms on the western aspect.

The inclusion of an impermeable awning over these exposed areas is expected to assist in shielding the area from downwash effects. It is recommended to consider operable bifold doors along the perimeters of the outdoor communal room such that the spaces can be managed according to the wind conditions.

Inclusion of 1.5m high impermeable balustrades along the perimeter of the podiums and planter boxes with densely foliating evergreen tree planting up to a height of 2–4m around the perimeter is expected to assist in mitigating these adverse winds.

4.3 Various Private Balconies

Wind conditions for the majority of the private balconies of the subject development are expected to be suitable for their intended use. This is due to the majority of the private balconies being exposed to winds on a single aspect as well as benefitting from the setback design.

The private balconies located on the corners of the tower however are potentially exposed to accelerating flows around the corners of the tower and direct wind effects from the prevailing wind directions for Sydney.

Impermeable balustrades are recommended to be incorporated along all private balconies of the towers. Balconies located on the corners of the towers are expected to experience suitable wind conditions with the inclusion of impermeable balustrades for the lower levels of the towers. However, provision should be made for further screening on the corner balconies for the upper levels of the development as wind conditions are likely to be strong, due to the decrease in shielding and generally higher wind speeds. Full height screens should be considered/implemented along one of the aspects of the corner balconies.

The use of lightweight furniture (e.g. loose glass tops, lightweight sheets or covers, loose BBQ lids etc.) is not recommended on the high-rise outdoor terraces and balconies. If lightweight furniture is to be used, it is recommended to securely attach it to the balcony or terrace floor slab.

4.4 Elevated and Roof Terraces

Provision should be made for further screening on the corner terraces for the upper levels of the development as wind conditions are likely to be strong, due to the decrease in shielding and generally higher wind speeds. Similarly, the roof terraces are exposed to all the direct prevailing winds.

Incorporating an impermeable 1.5m high parapet around the perimeter of the terrace areas is expected to assist in mitigating these adverse winds. In addition to the parapet, the retention of the perimeter planter boxes with hedge planting of a combined height of 1.5-1.8m immediately behind the parapet and retention of densely foliating evergreen tree planting up to a height of 2–4m around the perimeter is expected to assist in mitigating these direct winds.

The use of lightweight furniture (e.g. loose glass tops, lightweight sheets or covers, loose BBQ lids etc.) is not recommended on the high-rise outdoor terraces and balconies. If lightweight furniture is to be used, it is recommended to securely attach it to the balcony or terrace floor slab.

4.5 Wind Effects with Inclusion of Future Development to the North

While consideration has been made for the wind effects on the proposed development site, the potential future development of the service station site (879 Pacific Highway) directly to the north introduces possible adverse wind conditions that will need to be considered.

With the construction of the two towers an east-west through site link will be introduced to allow for pedestrian access across the sites. The through site link aligns with the predominant westerly winds, which is expected to generate funnelling effects. The predominant north-easterly winds have the potential to interact with the north tower, resulting in the downwash of winds along the eastern façade which will funnel into the through site link.

Similarly, the prevailing north-easterly winds may potentially side stream along the eastern aspect of the podiums impacting the footpath areas along the railway reserve as well as the potential for these winds to funnel between the two building forms. The potential funnelling of the predominant north-easterly and westerly winds will result in adverse wind conditions being experienced on the northern outdoor pool area of the development.

Consideration to incorporate dense landscaping combined with wind deflective elements such as screens and an awning should be considered for the space between the two towers to assist with any funnelling and downwash effects. The inclusion of an impermeable awning over the outdoor podium pool area is expected to assist in shielding the area from downwash effects.

All recommendations mentioned in Section 4.1 to 4.4 should also be incorporated into the final design to address any adverse wind conditions.