



# PEDESTRIAN WIND ENVIRONMENT STATEMENT

# 52 ALFRED STREET, MILSONS POINT

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Prepared for:

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## **EXECUTIVE SUMMARY**

This report is in relation to the proposed development located at 52 Alfred Street, Milsons Point and presents an opinion on the likely wind conditions affecting the various trafficable 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; north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the subject 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 architectural drawings which have been prepared by Koichi Takada Architects, received September 2017. 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. Note that any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

The results of this assessment indicate that adverse wind conditions are expected along the outdoor trafficable areas of the subject development. The pedestrian footpath areas along Alfred Street and Glen Street are exposed to the predominant southerly and north-easterly winds. There is the potential for pressure driven flow of the north-easterly winds along the thoroughfare between the retail tenancy areas due to the entry/exit located on two different aspects of the building.

Due to the east-west alignment of the southern aspect through site link the seating areas may be potentially exposed to the direct westerly winds. The westerly winds have the potential to funnel between the subject development and the southern neighbouring building resulting in adverse wind conditions. Similarly, the westerly winds have the potential to down wash off the western building façade and funnel down towards the through site link. The presence of nearby buildings provides some benefits from shielding of the predominant southerly and westerly winds.

The Level 03 private terraces located on the eastern aspect have the potential to be impacted by the prevailing north-easterly winds. The outdoor private terrace areas on Levels 14 to Level 17 are susceptible to accelerated flows around the corners of the development due to the exposure to the pre-dominant north-easterly winds, potentially resulting in adverse wind conditions. The roof viewing deck areas are potentially exposed to prevailing north-easterly, westerly and southerly winds due to limited shielding from surrounding buildings.

Some areas throughout the development are potentially exposed to adverse wind effects. The following treatment recommendations are made to mitigate these potential wind effects:

Ground Level:

- Inclusion of proposed tree planting along Alfred Street. These trees should be of a densely foliating evergreen species to ensure year-round wind mitigation, and capable of growing to a height of 3-5m with a minimum of a 4m wide canopy.
- Retention of proposed Ground Level awning on eastern and southern aspect.
- Recommended inclusion of an awning along the southern aspect to cover the staircase
- Recommended inclusion of full height screen (25 30% porous) at western end of seating area.
- Inclusion of 1.2 1.5 metre high localised mobile screens along the southern retail seating areas.
- Recommended inclusion of full-height screen at the eastern entrance area adjacent to the seating area.
- Inclusion of 1.8 metre impermeable screen along the northern aspect and along the partition of each private terrace on the western aspect.
- Inclusion of 2.0 3.0 metre high impermeable screen on the southern end of the private terrace, located on the western aspect of the subject development.
- Retention of proposed impermeable balustrade along the western perimeter of the private terraces, located on the western aspect of subject development.

#### Level 3:

- Inclusion of full-height impermeable screen on the eastern private terraces.
- Retention of proposed impermeable screen along the perimeter of the southern private terrace.

#### Level 14:

- Inclusion of full-height impermeable screens on the northern end of the private terraces.
- Retention of proposed impermeable balustrades along the perimeter of the private terraces.

#### Level 15:

- Retention of proposed impermeable screen along the perimeter of the private terrace.
- Retention of proposed hedge planting along the perimeter of the public terrace. For the proposed landscaping to be effective at ensuring comfortable wind conditions, the

shrubs should be of a densely foliating evergreen species capable of growing to height of at least 1 metre above a 1 metre high planter box.

#### Level 16:

- Retention of proposed impermeable screen along the perimeter of the private and public terrace.
- Retention of proposed hedge planting along the perimeter of the public terrace. For the proposed landscaping to be effective at ensuring comfortable wind conditions, the shrubs should be of a densely foliating evergreen species capable of growing to height of at least 1 metre above a 1 metre high planter box.
- Inclusion of full-height impermeable screens along the northern and southern aspect of the terrace located at the north-east corner.

#### Level 17:

Option 1:

 Inclusion of 2 metre high impermeable balustrade along the perimeter of the public terrace.

#### Option 2:

 Inclusion of hedge planting along the perimeter of the terrace. For the proposed landscaping to be effective at ensuring comfortable wind conditions, the shrubs should be of a densely foliating evergreen species capable of growing to height of at least 1 metre above a 1 metre high planter box.

#### Roof:

• Retention of proposed impermeable balustrade along the perimeter of the viewing deck.

The treatment recommendations provided above are provided as input design guidance. With the inclusion of the abovementioned recommendations within the final design of the development, it is expected the wind conditions for all outdoor trafficable within and around the development will be acceptable for its intended uses. Note that the inclusion of additional densely foliating vegetation such as trees or shrubs/hedge planting is expected to further enhance the localised wind conditions within and around the subject development site. The extent of the potential wind effects due to the prevailing north-easterly and southerly winds and the treatments recommended should be investigated in further detail through wind tunnel testing to ensure suitable pedestrian wind conditions.

# **1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS**

The proposed development site is located at 52 Alfred Street, Milsons Point and is bounded by Alfred Street to the east and Glen Street to the west. The site is predominantly surrounded by low to mid rise commercial/residential buildings to the north and south. Directly east of the site lies Bradfield Park Bowling Green, Milsons Point Railway Station and low rise buildings. To the west of the site lies low rise buildings followed by Lavender Bay. Further from the site lies North Sydney CBD and residential areas to the north, east and west, as well as Darling Harbour and Sydney CBD to the south.

A survey of the local land topography indicates an uphill rise across the site towards the north along Alfred Street. Along Glen Street the land topography slopes down from the south towards the site, and then slopes up with a large gradient to the north after the site. An aerial image of the site and the surroundings is shown in Figure 1.

The proposed development consists of 22 Levels inclusive of Ground Floor and four Basement Levels, with a Roof viewing deck Level. Pedestrian access to the development is provided off Alfred Street and Glen Street, with a through site link along the southern aspect, and vehicular access via Glen Street. The critical trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are detailed as follows:

- Lower Ground and Ground Level pedestrian footpaths within and around the development.
- Ground Level seating areas on the eastern and southern aspect of the development.
- Outdoor terrace areas and Roof viewing deck.



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.

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

Table 1: Principal Time of Occurrence of	of Winds for Sydney
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Figure 2: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10-minute mean observations from Kingsford Smith Airport from 1995 to 2016, corrected to open terrain at 10m) 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 (exceeded approximately once per week on average). Higher ranges of wind speeds can be tolerated for rarer events.

Type of Winds	Mean Wind Speed (m/s)	Effects	Applicability	
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for stationary,	
Light breeze	1.6 - 3.3	Wind felt on face.	long exposure activities such as in outdoor restaurants, landscaped	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	gardens and open air theatres.	
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.	

#### Table 2: Summary of Wind Effects on People (Penwarden, 1975)

It should be noted that wind speeds can only be accurately quantified with a wind tunnel study. 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 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 was considered, and important features taken into account include the distances between the building form, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report. It should be noted that no wind tunnel testing has 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.

#### 4.1 Lower Ground and Ground Level Pedestrian Accessible Areas

The seating areas located along the eastern aspect of the site is exposed to the direct northeasterly and southerly winds. Due to the limited shielding of the predominant north-easterly winds there is the potential for these winds to accelerate around the south-eastern corner of the subject development and funnel along the through site link. Similarly, the predominant southerly winds have the potential to travel along Alfred Street and side-stream across the outdoor seating area along the eastern aspect.

It is recommended to retain the proposed tree planting along Alfred Street, as indicated in Figure 7a. Note that for the proposed tree planting to be effective at ensuring comfortable wind conditions for pedestrians, the trees should be of a dense evergreen species to ensure year-round wind mitigation, and capable of growing to a height of 3-5m with a minimum of a 4m wide canopy. It is also recommended to retain the Ground Level awning along the eastern and southern aspects of the development, as indicated in Figure 3a, so to help ameliorate the north-easterly winds down-washing off the subject development and causing adverse wind conditions along the seating areas.

Due to the east-west alignment of the southern aspect through site link the seating areas may be potentially exposed to the direct westerly winds. The westerly winds have the potential to funnel between the subject development and the southern neighbouring building resulting in adverse wind conditions. Similarly, the westerly winds have the potential to down wash off the western building façade and funnel down towards the through site link.

It is recommended to include an awning along the southern aspect to cover the staircase, as indicated in Figure 3a, to prevent the predominant westerly winds from directly impacting and down washing on to the through site link seating areas. It is recommended to include a full height porous screen (25-30% porosity) at the western end of the seating area, such that it meets the awning above, as indicated in Figure 3a. Furthermore, it is recommended that localised mobile screening 1.2-1.5m high be included along the seating areas, which can be implemented by the patrons in the case of adverse wind conditions.

The thoroughfare between the retail tenancy areas may be potentially exposed to adverse wind conditions due to the entry/exit located on two different aspects of the building, which will result in a pressure driven flow. The north-easterly winds have the potential to induce pressure driven flow through the walkway. It is recommended to install a full height screen at the eastern entrance area adjacent to the seating area, as shown in Figure 3a, so to assist in reducing the pressure driven flow along the walkway.

Alternatively, sliding doors could be installed at the entry/exit. Similarly, the operability of the sliding doors if exposed to strong pressures should be considered.

#### 4.2 Outdoor Terrace Areas

The Ground level outdoor private terrace areas located on the western aspect are potentially exposed to westerly winds down-washing off the western façade of the development. It is recommended to include 1.8m high impermeable screens along the northern perimeter of the outdoor private terrace as well as along the terrace partitions. A 2-3m high impermeable screen is recommended along the southern perimeter of the outdoor private terrace.

The Level 3 private terraces located on the eastern aspect have the potential to be impacted by the prevailing north-easterly winds. These winds have the potential to accelerate around the south-eastern corner of the development and funnel through the southern corridor between the subject development and southern neighbouring site. It is recommended to include full-height impermeable screens between each terrace such that they are only exposed to wind from a single aspect, as shown in Figure 3b.

The private terraces located on the eastern and southern aspects of the development on Levels 14 - 16 are exposed to the prevailing north-easterly winds. These areas receive moderate shielding of the prevailing southerly and westerly winds from the subject development itself and the southern neighbouring site. The south-eastern corner terraces on Levels 14 – 16 are potentially exposed to accelerated north-easterly winds travelling around the south-eastern building corner. It is recommended to retain the impermeable balustrades along the perimeter of the private terrace areas as shown in Figure 3c. It is expected that with the inclusion of the balustrade that the private terrace areas will satisfy the wind speed safety criteria. However, for the intended use of the terraces it is recommended to install a full height screen along the northern end of the terrace, as indicated in Figure 3c.

The Level 16 private terrace located on the eastern aspect is exposed to the direct northeasterly winds. It is recommended to include a full-height impermeable screen along the northern and southern edge of the terrace, as shown in Figure 3e, such that the area becomes a single aspect terrace. Similarly, it is recommended to retain the hedge planting along the perimeters of the Level 15 and Level 16 terrace areas as shown in Figures 3d and 3e, respectively. It should be noted that for the proposed landscaping to be effective at ensuring comfortable wind conditions, the shrubs should be of a densely foliating evergreen species capable of growing to a height of at least 1.0m above a 1.0m high planter box. The Level 17 public terrace area is exposed to the direct north-easterly due to minimal shielding and is susceptible to the prevailing southerly and westerly winds. It is recommend to include a 2.0m high impermeable screen or densely foliating evergreen hedges capable of growing to height of at least 1.0m above a 1.0m high planter box along the perimeter of the terrace, as indicated in Figure 3f and 3g to assist in ameliorating any adverse wind effects. It is also recommended to retain the proposed impermeable balustrades on all outdoor public and private terrace is recommended to further mitigate any adverse wind conditions.

The extent of the potential wind effects due to the north-easterly and southerly winds and the treatments recommended should be investigated in further detail through wind tunnel testing to ensure the wind conditions are suitable for the patrons.

## 4.3 Roof Viewing Deck

The Roof Level viewing deck is exposed to the prevailing north-easterly, southerly and westerly winds. Given the limited shielding from neighbouring buildings it is expected that the deck will experience adverse wind conditions. It is recommended to retain the 2.0m high impermeable balustrade along the perimeter of the viewing deck area, as shown in Figure 3h to mitigate any adverse wind conditions.





Figure 3a: Recommended Treatments – Ground Level



Inclusion of full height impermeable screen.



Figure 3b: Recommended Treatment – Level 03



Retention of proposed impermeable balustrade.

Inclusion of full height impermeable screen.



Figure 3c: Recommended Treatment – Level 14



Figure 3d: Recommended Treatments – Level 15

#### Legend

- Retention of proposed impermeable balustrade.
  Inclusion of full height impermeable screen.





Figure 3e: Recommended Treatments – Level 16



Figure 3f: Recommended Treatments – Level 17 (Option 1)



Figure 3g: Recommended Treatment – Level 17 (Option 2)



Figure 3h: Recommended Treatment – Roof