



PEDESTRIAN WIND ENVIRONMENT STATEMENT
173-179 WALKER STREET & 11-17 HAMPDEN STREET,
NORTH SYDNEY

WD816-05F01(REV1)- WS REPORT

AUGUST 7, 2020

Prepared for:

Avenor

Level 17, 9 Castlereagh Street,
Sydney, NSW 2000

WINDTECH Consultants Pty Ltd

Head Office: 607 Forest Road, Bexley, NSW 2207, Australia

P +61 2 9503 0300 **E** reception@windtechglobal.com **W** www.windtechconsult.com

Sydney | Dubai | Hong Kong | London | Melbourne | Mumbai | New York | Singapore

DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
August 4, 2020	Revision of WD816-04 WS Report for latest design scheme.	0	AC	SR	HK
August 7, 2020	Update for revised podium plan	1	AC	SR	AC

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EXECUTIVE SUMMARY

This report is in relation to the proposed development located at 173-179 Walker Street & 11-17 Hampden Street, North Sydney and presents an opinion on the likely impact of the proposed design scheme on the local wind environment on 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 latest architectural drawings. No wind tunnel testing was 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.

The results of this assessment indicate that the subject development benefits from shielding provided by the subject and neighbouring buildings. There are, however, several outdoor trafficable areas within and around the subject development precinct that are potentially exposed to a variety of adverse wind effects due to the interaction of the prevailing winds with the built form as detailed further within the report. It is expected that the wind effects identified in the report can be ameliorated with the consideration of the following treatment strategies into the detailed design of the development:

Ground Floor Outdoor Trafficable Areas

- Densely foliating street trees along the Walker Street and Hampden Street frontages of the precinct; in particular around the corners of the building.
- Densely foliating vegetation such as trees or shrubs/hedge planting along the eastern boundary of the communal open space fronting the M1 Motorway; in particular around the exposed corners.
- It is recommended to retain the recessed tower form to minimise the impact of downwashed southerly and westerly winds. It is also recommended to include impermeable awnings along the Walker Street and Hampden Street frontages of the precinct.
- Densely foliating vegetation such as trees or shrubs/hedge planting within and around the Hampden Street Pocket Park; in particular along the northern and eastern boundaries of the park.
- Localised screening, pergolas or densely foliating vegetation such as trees or shrubs/hedge planting within and around the remaining areas of the communal open

space; in particular areas intended for short duration stationary activities such as outdoor seating etc. Such areas should be positioned away from the building corners.

- It is also recommended to include densely foliating vegetation such as trees or shrubs/hedge planting along the building entry and link to Residents Garden off the Walker Street. This is intended to reduce the impact of funnelling westerly winds that might spill into the Residents Garden.

Communal Upper Level Terraces

- 2m high impermeable screens along the exposed perimeter edges of the various rooftop terraces.
- Localised screening, pergolas or densely foliating vegetation such as trees or shrubs/hedge planting within and around various rooftops; in particular areas intended for short duration stationary activities such as outdoor seating etc.
- Restrict areas intended for short duration stationary activities such as outdoor seating, away from the corner areas of the building.

Private Balconies (Design Advice)

- High impermeable inter-tenancy screens for adjacent balconies.
- Impermeable balustrades, especially for higher level balconies.
- Protruding single aspect balconies – Blade walls or operable louver screens along one or both of the exposed shorter perimeter edges of the balconies.
- Corner private balconies – Blade walls or operable louver screens along one or both of the exposed perimeter edges of the balconies.
- As a general note, the use of loose glass-tops and light-weight sheets or covers (including loose BBQ lids) is not appropriate on high-rise outdoor balconies or terraces. Lightweight furniture is not recommended unless it is securely attached to the balcony or terrace floor slab.

Due to the overall massing of the subject development and the complexity of the building form and surrounding developments, wind tunnel testing is recommended to be undertaken as part of the detailed design phase. This will provide a quantitative assessment of the wind conditions and determine the size and extent of the treatments required to ensure suitable wind conditions are achieved for all outdoor pedestrian accessible locations within and around the development

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1 INTRODUCTION

An opinion on the likely impact of the proposed design on the local wind environment affecting pedestrians within the critical outdoor areas within and around the subject development is presented in this report. The analysis of wind effects relating to the proposed development was carried out in the context of the predominant wind directions for the region, building morphology of the development and nearby buildings, and local land topography. The conclusions of this report are drawn from our extensive experience in the field of wind engineering and studies of wind environment effects.

No wind tunnel testing was undertaken for this assessment. Hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection, and any recommendations in this report are made only in-principle.

2 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The proposed development precinct is located in North Sydney, bounded by Walker Street to the west, Hampden Street to the north, M1 Motorway to the east, and medium to high rise buildings varying up to 21 storeys to the south. Across Walker Street to the west of the subject development is an 18-storey apartment building (Belvedere, 138 Walker Street). In addition, several 2-storey residential heritage buildings are located along Walker Street and Hampden Street to west and north of the development site. Further away from the precinct to the north and east are predominantly low to mid-rise residential buildings and single to double storey housing units. St Leonards Park is situated to the north of the subject development beyond the block. Further away from the precinct to the west through to south are predominantly medium to high-rise buildings. A survey of the land topography indicates a general rise in elevation towards the southern and western directions. An aerial image of the subject precinct and the local surroundings is shown in Figure 1.

The proposed reference massing scheme of the proposed development consists of a total of 29 storey high tower located at the corner of the Hampden Street and Walker Street. The tower massing is situated on top of a 2-3 storey podium that is shared by an adjacent 8-storey tower along Hampden Street. An additional 8 storey high tower is located along the Walker Street frontage and is separated from the primary tower massing through an entry path to the proposed high amenity residential garden. The critical outdoor trafficable areas associated within the proposed development which are the focus of this assessment with regards to wind effects are detailed as follows:

- Ground floor pedestrian accessible areas along the Walker Street and Hampden Street frontages of the precinct including the Hampden Street Pocket Park and the communal Residents Garden.
- Private Upper Level Terraces.
- Private Balconies.



Figure 1: Aerial Image of the Site Location

3 REGIONAL WIND

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, directional probabilities of exceedance and directional wind speeds for the region are determined. The directional wind speeds and corresponding directional frequencies of occurrence are presented 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 the Sydney Region

Month	North-Easterly Winds	Southerly Winds	Westerly Winds
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	

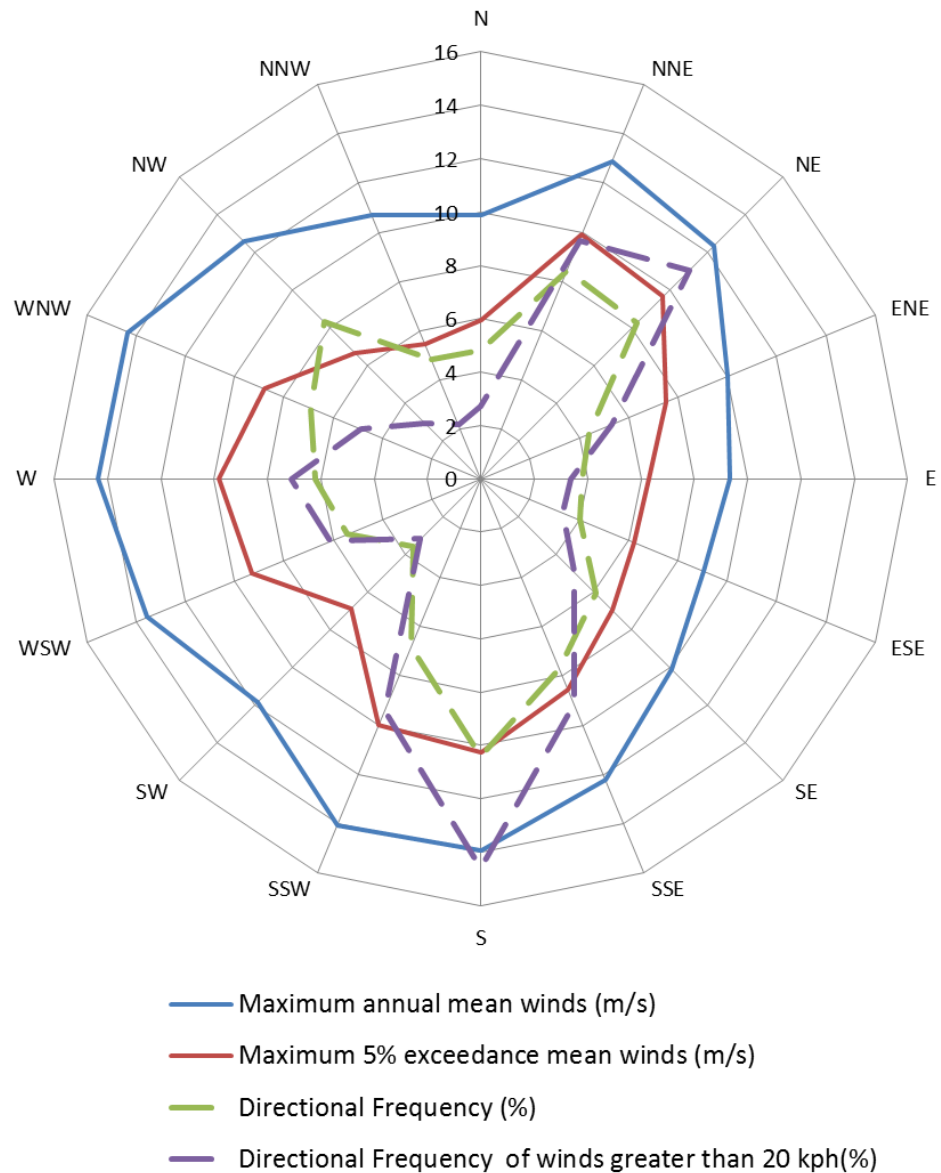


Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (referenced to 10m above ground in standard open terrain)

4 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 A.G. Davenport, T.V. Lawson, W.H. Melbourne, and A.D. Penwarden, 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.

For example, A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table 2 presents the modified Beaufort scale. Note that the effects listed in this table refers to wind conditions occurring frequently over the averaging time (a probability of occurrence exceeding 5%). Higher ranges of wind speeds can be tolerated for rarer events.

Table 2: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Mean Wind Speed (m/s)	Effects
Calm	0	Less than 0.3	Negligible.
Calm, light air	1	0.3 – 1.6	No noticeable wind.
Light breeze	2	1.6 – 3.4	Wind felt on face.
Gentle breeze	3	3.4 – 5.5	Hair is disturbed, clothing flaps, newspapers difficult to read.
Moderate breeze	4	5.5 – 8.0	Raises dust, dry soil and loose paper, hair disarranged.
Fresh breeze	5	8.0 – 10.8	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.8 – 13.9	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant.
Near gale	7	13.9 – 17.2	Inconvenience felt when walking.
Gale	8	17.2 – 20.8	Generally impedes progress, difficulty balancing in gusts.
Strong gale	9	Greater than 20.8	People blown over.

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. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

5 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. 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, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report.

The ground level areas around the development will be used primarily for circulation for which the recommended criterion for wind conditions is 7.5m/s with a 5% probability of exceedance. However, some areas are expected to be used for seating areas such as parks and elevated terrace. For these areas, a more stringent comfort criterion of 5.5m/s with a 5% probability of exceedance is considered. Although this assessment is of a qualitative nature, the abovementioned criteria are considered when assessing the wind environment impacts.

5.1 Ground Floor Outdoor Trafficable Areas

The various outdoor trafficable areas within and around the subject development precinct benefit from the shielding provided by the subject and surrounding buildings from direct wind effects when these buildings are located upstream of the prevailing wind directions. However, the outdoor trafficable areas are also potentially exposed to a variety of adverse wind effects due to the interaction of the prevailing winds with the built form detailed as follows:

- The pedestrian footpaths along the Walker Street frontage are potentially exposed to the prevailing southerly winds due to the north-south alignment of Walker Street. Though, this is an existing wind condition for the precinct, the inclusion of the subject building may induce additional side-streaming wind effects along the building facade. In addition, the southerly and westerly winds can also downwash off the façade of the towers and impact the ground level areas along the Walker Street and the Residents Garden. The recessed tower form atop the podium is expected to reduce the impact of these downwashed winds. The pedestrian footpath areas around the corner intersection of Walker Street and Hampden Street is also expected to be exposed to the accelerating flows around the corner of the building from the north-easterly and southerly directions.
- The pedestrian footpath and Pocket Park along the Hampden Street frontage are potentially exposed to the prevailing north-easterly winds as it travels over the M1 Motorway and around the low-rise buildings to the north of the precinct. Similarly, these areas are somewhat exposed to reattachment flows from the westerly direction as the prevailing wind travels over neighbouring buildings along Walker Street. It should be noted that these are existing wind conditions for the precinct, however the

inclusion of the subject building may induce side-streaming wind effects along the building façade due to the westerly winds.

- The communal Residents Garden is shielded from the prevailing southerly and westerly winds by the subject development and neighbouring buildings. However, the Residents Garden is exposed to the north-easterly winds that can funnel in and adversely impact these areas.
- The building entry and link to the Residents Garden off Walker Street is also exposed to the prevailing westerly winds that can downwash off the façade of the development and funnel through this area.

It is expected that the potential adverse wind effects identified above can be mitigated with the consideration of the following treatment strategies into the design of the development:

- Densely foliating street trees along the Walker Street and Hampden Street frontages of the precinct; in particular around the corners of the building.
- Densely foliating vegetation such as trees or shrubs/hedge planting along the eastern boundary of the communal open space fronting the M1 Motorway; in particular around the exposed corners.
- It is recommended to retain the recessed tower form to minimise the impact of downwashed southerly and westerly winds. It is also recommended to include impermeable awnings along the Walker Street and Hampden Street frontages of the precinct.
- Densely foliating vegetation such as trees or shrubs/hedge planting within and around the Hampden Street Pocket Park; in particular along the northern and eastern boundaries of the park.
- Localised screening, pergolas or densely foliating vegetation such as trees or shrubs/hedge planting within and around the remaining areas of the communal open space; in particular areas intended for short duration stationary activities such as outdoor seating etc. Such areas should be positioned away from the building corners.
- It is also recommended to include densely foliating vegetation such as trees or shrubs/hedge planting along the building entry and link to Residents Garden off the Walker Street. This is intended to reduce the impact of funnelling westerly winds that might spill into the Residents Garden.

Due to the overall massing of the subject development and the complexity of the building form, wind tunnel testing is recommended to be undertaken as part of the detailed design phase. This will provide a quantitative analysis of the wind conditions and determine the size and extent of the treatments required to ensure suitable wind conditions are achieved at all outdoor pedestrian accessible locations within and around the development.

5.2 Communal Upper Level Terraces

The upper level communal terraces of the subject development are intended for short exposure activities. These areas are potentially exposed to a variety of adverse wind effects due to the interaction of the prevailing winds with the built form, and are detailed as follows:

- Direct wind effects, particularly the southerly and north-easterly winds, are expected to impact the northern outdoor terrace areas due to the lack of shielding provided by surrounding buildings.
- The prevailing southerly winds can accelerate around the southern aspect of the 29-storey tower and impact the northern outdoor terrace space.
- The prevailing winds are also expected to accelerate around the corners of the building onto the various rooftop areas.
- Prevailing winds can also funnel between the towers and impact the southern upper level terrace area.

It is expected that the potential adverse wind effects identified above can be mitigated with the consideration of the following treatment strategies into the design of the development:

- 2m high impermeable screens along the exposed perimeter edges of the various rooftop terraces.
- Localised screening, pergolas or densely foliating vegetation such as trees or shrubs/hedge planting within and around various rooftops; in particular areas intended for short duration stationary activities such as outdoor seating etc.
- Restrict areas intended for short duration stationary activities such as outdoor seating, away from the corner areas of the building.

5.3 Private Balconies

The proposed massing scheme does not indicate the location or extent of the outdoor balconies for the various residential apartments within the development. However, this section includes a commentary on best-practice design principles for balconies that should be considered in the design of the development.

- Wind conditions for single aspect private balconies along the main building facades that are recessed into the build form are expected to be suitable for their intended uses as it limits the ability for the prevailing winds to side-stream across them. Conversely, single aspect private balconies that are protruding on the main building facades are susceptible to side-stream wind effects. The protruding balconies are also potentially exposed to direct wind effects on the upper floor levels where the surrounding buildings offer little to no shielding to the prevailing winds.

- Corner private balconies are exposed to the prevailing winds accelerating around the corners of the building as well as potentially direct wind effects on the upper floor levels where the surrounding buildings offer little to no shielding to the prevailing winds. Larger corner private balconies that wrap around and extend further along the building façade are also potentially exposed to side-stream winds travelling along the building façade and reattaching onto the balconies.

To ensure suitable wind conditions are achieved within the various private balconies, the following treatment strategies are recommended to be considered in the design of the development:

- High impermeable inter-tenancy screens for adjacent balconies.
- Impermeable balustrades, especially for higher level balconies.
- Protruding single aspect balconies – Blade walls or operable louver screens along one or both of the exposed shorter perimeter edges of the balconies.
- Corner private balconies – Blade walls or operable louver screens along one or both of the exposed perimeter edges of the balconies.
- As a general note, the use of loose glass-tops and light-weight sheets or covers (including loose BBQ lids) is not appropriate on high-rise outdoor balconies or terraces. Lightweight furniture is not recommended unless it is securely attached to the balcony or terrace floor slab.

Nonetheless, due to the overall height of the subject development relative to the surrounding buildings, and the exposure of the development to the prevailing winds, it is recommended to verify the effectiveness of these suggested treatment strategies by wind tunnel testing at a more detailed design stage.

6 REFERENCES

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