



PEDESTRIAN WIND ENVIRONMENT STATEMENT
10-14 FORBES ROAD, APPLECROSS, PERTH

WE212-02F01(REV0)- WS REPORT

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the proposed development located at 10-14 Forbes Road, Applecross and presents an opinion on the likely impact of the proposed design 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 Perth region; namely the easterly, south-west, 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 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.

The results of this assessment indicate that the development is relatively exposed due to the minimal shielding from the three prevailing wind directions affecting the site; east, south-west, and west. As a result, there are expected adverse wind effects within certain areas of the development. It is expected that suitable wind conditions can be achieved through all trafficable areas within and around the site with the treatments recommended in this report, which are summarised below:

- Inclusion of densely foliating evergreen trees along the pedestrian footpath areas and shrubs within the planter areas along the southern and western aspects.
- An impermeable awning above the south-west ground floor seating area.
- A baffle screen design within the through site link on the ground floor.
- An awning over the exposed balcony areas on Level 1 and 2.
- Recommended strategic dense evergreen planting at perimeter corners on Levels 1 and 2.
- Recommended inclusion of screens (1.5m to 2.0m in height) around the protruding balcony areas at the north-western aspect on Levels 2 and 3.
- Inclusion of impermeable screening (2.0m to full-height) along one aspect of the corner balcony areas on Level 13-14, with an impermeable balustrade along the perimeters.
- Retention of proposed densely foliating evergreen landscaping, and ensure these areas are non-trafficable on Level 15.
- Inclusion of perimeter 1.5-2m high screening around the playground area on Level 15.

- Inclusion of a full-height screen on the north-western corner of the building form, around the designated deck area on Level 15.
- Inclusion of perimeter 1.5-2m high screening encompassing the western aspect of the pool and deck area.

It should be noted that for any tree planting and landscaping to be effective as a wind ameliorative device, the species selected should be of an evergreen variety and densely foliating. Trees should be planted in clusters with interlocking canopies to help absorb the wind as a tree in isolation can be impacted by stronger wind conditions.

Wind tunnel testing is recommended to be undertaken to assess the wind conditions within and around the subject development. This will provide a quantitative analysis of the wind conditions and determine the extent of the abovementioned wind mitigation treatments to ensure suitable wind conditions are achieved.

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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 has been 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 has been 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 development site is located at 10-14 Forbes Road, Applecross. The site is bounded by Forbes Road to the west, Kishorn Road to the south, and low-rise residential and retail to the north and east. The site is predominantly surrounded by low-rise residential/retail buildings, with the Swan River lying further to the east, north, and west. A survey of the land topography indicates there are no major elevation changes in the region surrounding the site, only a gentle slope down towards Swan River to the east. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The proposed development is a mixed-use building comprising of retail and commercial space on Ground and Level 1, with residential apartments above, and amenities on Level 15. The overall height of the development is sixteen floors inclusive of Ground.

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:

- Pedestrian footpaths along Forbes Road and Kishorn Road,
- Ground floor seating and trafficable areas,
- Balcony and podium areas on Levels 1-2,
- Private balcony areas on Levels 3-14,
- Communal balcony areas on Level 4, 7, 10, 13,
- Outdoor communal areas on Level 15.



Figure 1: Aerial Image of the Site Location

3 REGIONAL WIND

The Perth region is governed by three principal wind directions, and these can potentially affect the subject development. These winds prevail from the east, south-west 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 an analysis of wind rose data obtained by the Bureau of Meteorology from Perth Airport, from 1944 to 2006.

Table 1 Principal Time of Occurrence of Winds for Perth

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

A directional plot of the annual and 5% exceedance winds for the Perth region, and the frequency of the winds are shown in Figure 2. Again, this plot has been produced based on an analysis of recorded wind speed data obtained from Perth Airport, from 1944 to 2006.

As shown in Figure 2, the easterly winds are the most frequent for the Perth region, and are also the strongest. The south-westerly winds occur most frequently during the warmer months of the year for the Perth region, and hence are usually welcomed within outdoor areas. South-westerly winds are also similar strength to the westerly winds, but not as strong as the easterly events. The south-westerly and westerly winds typically occur during the afternoon periods.

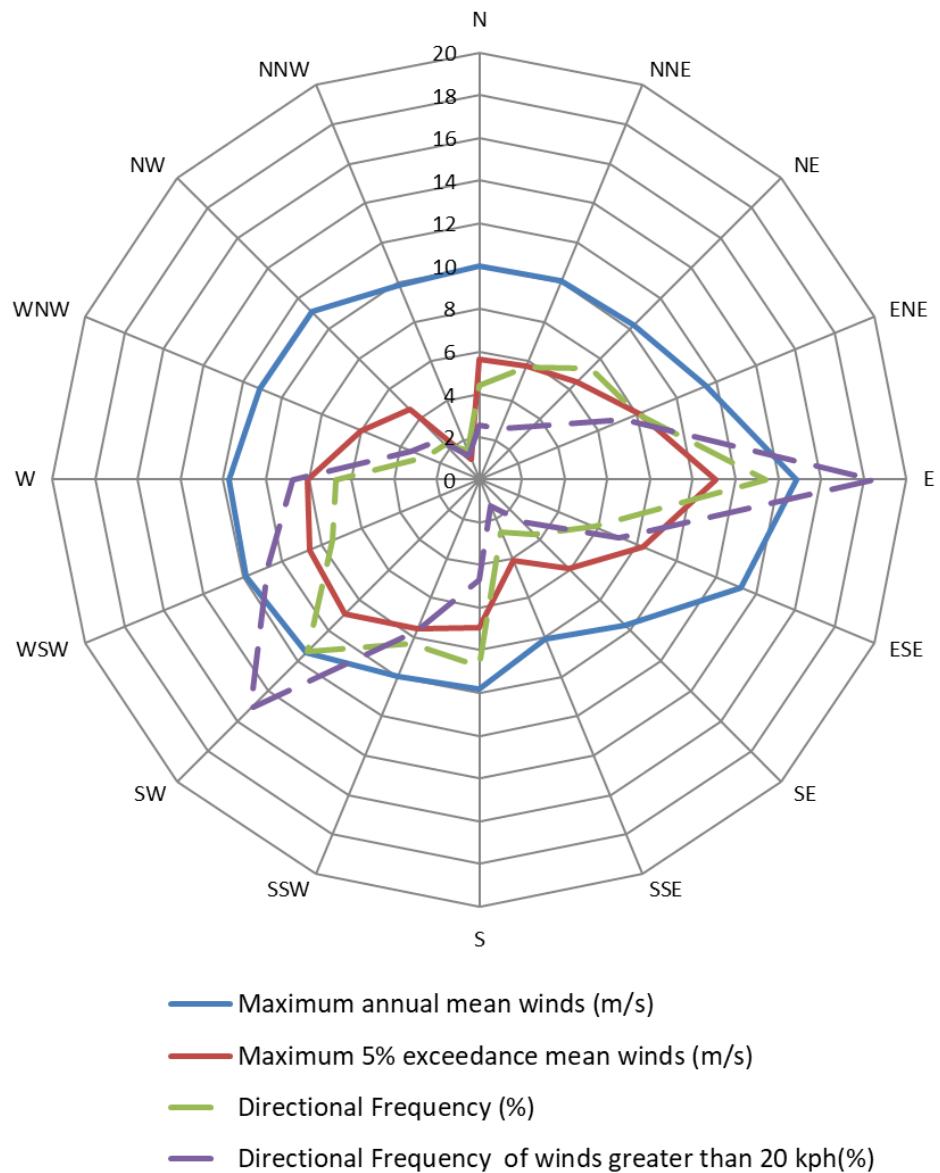


Figure 2: Annual and 5% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence, for the Perth Region (referenced to 10m above ground in standard open terrain)

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.

The comfortable walking criterion typically applies to thoroughfares and walkways, where the primary use is for circulation. Based on the abovementioned research, this comfort criterion is approximately 7.5m/s with a 5% probability of exceedance.

The short duration exposure criterion typically applies to cafés, waiting areas, or other stationary uses where the duration of stay is typically an hour or less. Based on the abovementioned research, this comfort criterion is approximately 5.5m/s with a 5% probability of exceedance.

The long duration exposure criterion typically applies to outdoor dining, outdoor theatres or other stationary uses where the duration of stay is typically greater than an hour. Based on the

abovementioned research, this comfort criterion is approximately 3.5m/s with a 5% probability of exceedance.

The safety criterion based on the abovementioned research is an annual 3second gust wind speed of 23m/s. This is to ensure that an unexpected wind event does not cause a person to lose their balance.

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.

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.

For tree planting and landscaping to be effective as a wind ameliorative device, the species selected should be of an evergreen variety and densely foliating. Trees and shrubs should be planted in clusters with interlocking canopies to help absorb the wind as a tree in isolation can be impacted by stronger wind conditions.

The ground plane will be used primarily for circulation. However there are potential seating areas at the south-west ground floor area. The recommended criterion for wind conditions for the circulation area is 7.5m/s with a 5% probability of exceedance, whereas the proposed short duration seating areas will need to satisfy a more stringent comfort criterion of 5.5m/s with a 5% probability of exceedance. Although this assessment is of a qualitative nature, the abovementioned criteria are considered when assessing the wind environment impacts.

The extent and positioning of the discussed treatments can be determined by wind tunnel testing at a later stage of the development.

5.1 Ground Level Areas

The wind conditions for the various pedestrian footpaths in close proximity to the tower are expected to be stronger than the existing conditions due to the height of the development in relation to the surrounding buildings. The tower is expected to capture the prevailing easterly, south-westerly and westerly winds and direct them downwards toward the ground. The downwash winds have the potential to corner accelerate around the building corners after interacting with the ground level.

The tower has a unique planform which has the potential to assist in disturbing the downwash winds as they interact with the building façade. The tower setback from the boundary and the Level 2 podium areas along the northern and eastern aspects is expected to reduce the impact of the downwash winds onto the neighbouring areas. The lack of a setback along the southern and western aspect is expected to allow the tower to capture the prevailing westerly and south-westerly winds and potentially downwash on to the pedestrian accessible ground areas. It is recommended to include an impermeable awning above the seating area long the southern aspect to prevent adverse downwash effects affecting the comfort of pedestrian and residents using the outdoor space.

The seating area located at the south-west aspect of the development may be exposed to the prevailing easterly and westerly winds directly, due to the east-west alignment of Kishorn Road combined with minimal shielding. Due to the close proximity of the seating area to the building corner the direct winds are likely to accelerate around the corner, resulting in adverse wind conditions. These areas can be shielded with the inclusion of densely foliating evergreen trees and shrubs around the perimeter of the seating area within the planter zones. Similarly, localised portable screening could be implemented by café owners.

The main lobby location within the planform assists in shielding pedestrians from downwash winds and from the prevailing easterly winds. However, the adjacent through site link consists of entries at the southern and western aspects, which have the potential to result in pressure driven flow and funnelling of the predominant westerly and south-westerly winds. It is recommended to consider a baffle screen design within the through site link to mitigate any funnelling effects.

5.2 Balcony Areas

Level 1 and 2 consists of several balcony areas which are directly exposed to the building form above. These areas have the potential to be exposed to the downwash winds from the tower. It is recommended to consider awnings over these spaces to mitigate any adverse downwash wind effects. It is recommended to retain the impermeable balustrades around the balcony perimeters and strategic dense evergreen shrub planting at the corner perimeters.

The majority of the private balconies on Levels 3-14 are only exposed to winds on a single aspect and hence are expected to be suitable for their intended use. These balconies will also benefit from the setback design within the planform. The corner balconies on Levels 3-12 are also noted to be recessed within the planform, however they have the potential to be exposed to wrap around winds due to minimal shielding of the predominant winds. It is recommended to retain the impermeable balustrades around the balcony perimeters.

The Level 2 and 3 north-west corner balconies consists of an area protruding out from the planform. The extended areas are expected to be exposed to the predominant westerly and south-westerly winds side streaming around the building corner. It is recommended to include impermeable screens (1.5m to 2.0m in height) around the protruding area.

The larger corner balconies located on Levels 13 and 14 are expected to be exposed to the direct prevailing winds and corner accelerating winds. To ensure comfortable wind conditions within the north-eastern and south-eastern balcony areas on Levels 13 and 14 it is recommend to include impermeable screens (2.0m to full height) along the northern and southern balcony perimeters, respectively.

The centrally located communal balconies on Levels 4, 7, 10, 13 are only exposed on a single aspect and are expected to be suitable for their intended use. The central communal balconies

located on Level 13 however are also potentially exposed to downwash winds. It is recommended to consider the implementation of awnings over these spaces.

Furthermore, it is recommended to retain the impermeable balustrades around the balcony perimeters.

5.3 Level 15 Communal Area

The Level 15 outdoor communal area is exposed on all aspects, except towards the south-west. The development does not receive any benefit from shielding. The outdoor areas are exposed to all three prevailing winds. These winds can impact the communal balcony areas directly, side-stream along the external façade and accelerate around the corner of the development.

The playground area is expected to be exposed to both the predominant easterly winds and south-westerly winds, which will side-stream and accelerate around the building form.

The pool and deck area are exposed to the predominant easterly, south-westerly and westerly winds. These winds are expected to funnel between the Level 15 and Level 16 floor slab, resulting in adverse winds locally within the deck area. The winds are also expected to side-stream and accelerate around the north-west corner of the building form.

Densely foliating evergreen landscaping is recommended to be retained within the designated planter areas around the perimeter of Level 15. These landscaped areas are to be non-trafficable to ensure no treatments are necessary for these areas.

For the playground area, perimeter screening with a height of 1.5-2.0m is recommended to mitigate the adverse wind effects expected in this area.

It is recommended that a full height screen be implemented at the north-western corner of the building form, wrapping around to the northern side of the deck area. Similarly, perimeter screening of a height of 1.5-2.0m is recommended to encompass the western aspect of the pool and deck area. The screening recommendations can be glazed to preserve the view of the surroundings.

Wind tunnel testing is recommended to be undertaken to assess the wind conditions within and around the subject development. This will provide a quantitative analysis of the wind conditions and determine the extent of the abovementioned wind mitigation treatments to ensure suitable wind conditions are achieved.

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