

Pedestrian Wind Environment
Statement
for the proposed
Abercrombie Precinct
Redevelopment, Darlington

March 10, 2011

Report Reference No. WA627-02F02(rev1)- WS Report

Document Control

Revision Number	Date	Revision History	Prepared By (initials)	Reviewed & Authorised By (initials)
0	09/12/2010	Initial	AB	
1	10/03/2011	Update to remove perspective images	KP	

The work presented in this document was carried out in accordance with the Windtech Consultants Pty Ltd Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for our Client's particular requirements which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Windtech Consultants Pty Ltd. This report should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

The information contained herein is for the purpose of wind, thermal and or solar effects only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the scope of this report.

Table of Contents

	Page
1.0 Introduction	4
2.0 Regional Wind Climate for Sydney	4
3.0 Wind Effects on People	6
4.0 Description of the Site and Surrounds	7
5.0 Description of the Proposed Development	10
6.0 Results of the Analysis	11
6.1 Pedestrian Footpaths Around The Site	11
6.1.1 Darlington Lane	11
6.1.2 Codrington Street	11
6.1.3 Abercrombie Street	11
6.2 Ground Level Areas Within The Site	12
6.2.1 Within the South-Western Area of the Site	12
6.2.2 Within the North-Eastern Area of the Site	12
6.2.3 The Two Central Courtyard Areas	12
6.3 Trafficable Roof Terraces	12
6.3.1 Atop the North-Western Component	12
6.3.2 Atop the South-Eastern Component	13
6.3.3 Atop the South-Western Component	13
7.0 Conclusions	14
Appendix: Wind Roses for the Sydney Region	

1.0 Introduction

This report is in relation to the proposed Abercrombie Precinct Redevelopment, located in Darlington, 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 redevelopment.

The effect of wind activity within and around the proposed redevelopment 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 proposal 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 the project architect Woods Bagot, received on December 1, 2010. No wind tunnel tests have been undertaken for the subject development. As such, 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.

2.0 Regional Wind Climate for Sydney

The Sydney region is governed by three principle 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 an analysis of wind rose data obtained by the Bureau of Meteorology from Kingsford Smith Airport between 1939 and 2000. The wind roses are attached in the appendix of this report.

Table 1: Principal Time of Occurrence of Winds for Sydney

Month(s)	Prevailing Wind Direction		
	North-Easterly	Southerly	Westerly
January through to March	X	X	
April		X	X
May through to August			X
September		X	X
October through to December	X	X	

A directional plot of the annual and weekly recurrence winds for the Sydney region is shown in Figure 1 below. The frequency of occurrence of these winds is also shown in Figure 1. This plot has been produced based on an analysis of recorded wind speed data obtained from Sydney Airport from 1939 to 2008.

As shown in Figure 1 of this report, 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. North-easterly winds are also typically not as strong as the southerly or westerly winds.

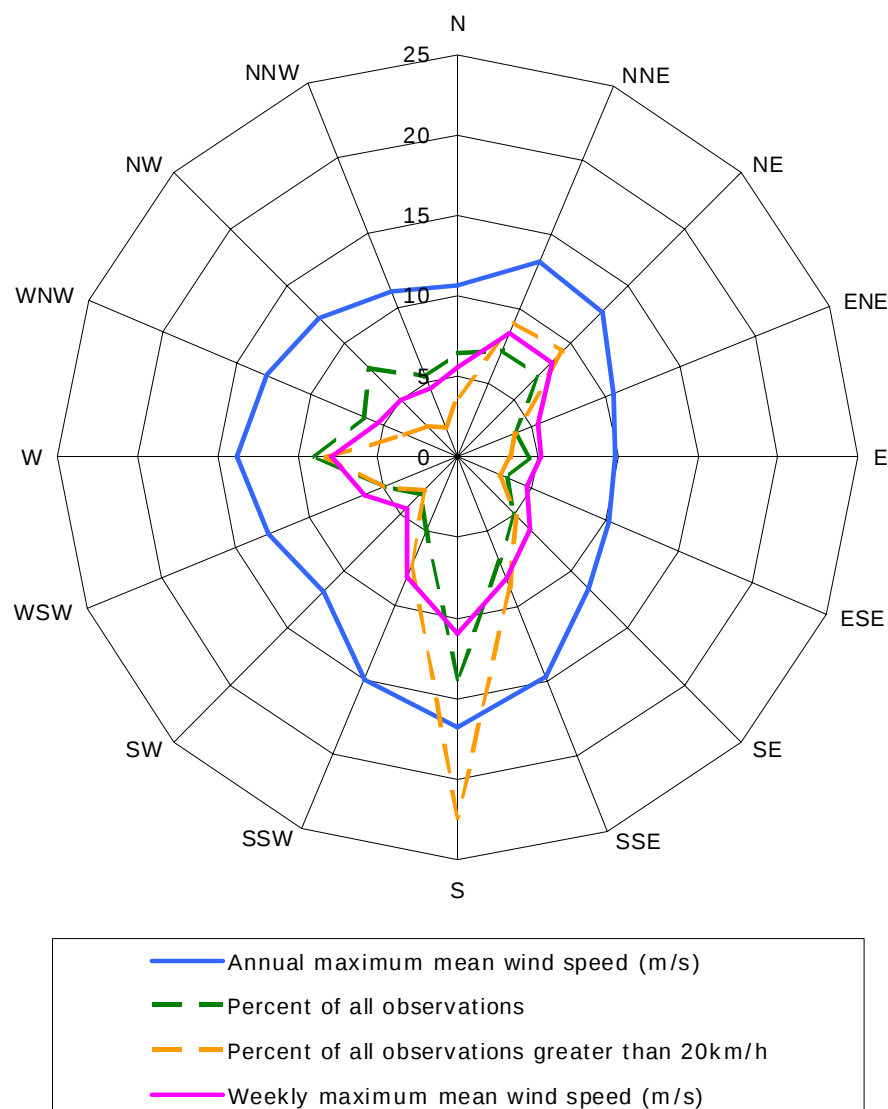


Figure 1: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10 minute mean observations from Kingsford Smith Airport from 1939 to 2008, corrected to open terrain at 10m)

3.0 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.

The following table, developed by Penwarden (1975), 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.

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

Type of Winds	Gust 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.

4.0 Description of the Site and Surrounds

The proposed redevelopment site is located in Darlington and is bound by Abercrombie Street to the south, Codrington Street to the east, and Darlington Lane and the Faculty of Economics and Business building to the north. To the west of the site is the Darlington Public School. The landform in the local vicinity of the site is relatively flat, although there is a general rise across the site to the north-western corner, which is the highest area of the redevelopment site and approximately 1 storey higher than the Abercrombie Street level.

Surrounding the site in most directions is generally residential houses and townhouses, typically ranging in heights of one to three stories above ground. The University of Sydney Faculty of Economics and Business building located to the north of the site has a height of four stories above ground. The other buildings associated with the university nearby the site to the east and north-east typically in heights of one to three storeys above ground.

Generally, the ground level areas of the existing site are quite well shielded from the prevailing winds by the many surrounding buildings and scattered densely foliating trees. Aerial images of the site are shown in Figures 2a to 2e.



Figure 2a: Aerial Image of the Site Location



**Figure 2b: Aerial Image of the Site Location
(view from the north, facing south)**



**Figure 2c: Aerial Image of the Site Location
(view from the east, facing west)**



**Figure 2d: Aerial Image of the Site Location
(view from the south, facing north)**



**Figure 2e: Aerial Image of the Site Location
(view from the west, facing east)**

5.0 Description of the Proposed Development

The proposed redevelopment is for the University of Sydney, and comprises of four main components detailed as follows:

- **North-Western Component:** This component of the development has a height of three stories above ground, and car parking below ground. It comprises a square-shaped building with an open void into a central ground-level landscaped courtyard. This component of the development links across to the South-Eastern Component via an internal corridor on each level. The roof area of this component of the development is to be used as a trafficable landscaped terrace.
- **South-Eastern Component:** This component of the development has a height of three stories above ground. It comprises a mostly square-shaped building with an open void into a central ground-level landscaped courtyard. This component of the development links across to the North-Western Component via an internal corridor on each level. An internal corridor also links this component of the development to the neighbouring Faculty of Economics and Business building to the north on Level 3. The roof area of the South-Eastern Component of the development is to be used as a trafficable landscaped terrace.
- **South-Western Component:** This component of the development has a height of four stories above ground, and is not connected to the other components of the development. The eastern end of the roof area of this component of the development is to be used as a trafficable terrace.
- **Upper Component:** This component of the development has a height of three stories above the roof of the North-Western Component, and a height of four stories above the roof of the South-Eastern Component. It runs across the site with an east-west orientation, on top of the North-Western and South-Eastern components. The roof of the Upper Component is not trafficable. The total height of this component is seven stories above the Abercrombie Street ground level.

6.0 Results of the Analysis

The expected wind conditions are discussed in the following sub-sections of this report for the various outdoor areas within and around the proposed 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 proposed 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.

6.1 Pedestrian Footpaths around the Site

6.1.1 Darlington Lane

The pedestrian footpaths along Darlington Lane are quite well protected from the prevailing winds by the surrounding buildings and trees. The addition of the proposed development is expected to improve wind conditions when the prevailing winds are from the north-east or south, and for westerly prevailing winds the wind conditions are expected to be similar to the existing conditions.

6.1.2 Codrington Street

The pedestrian footpaths along Codrington Street are somewhat exposed to the prevailing southerly winds due to the alignment of the street. The various building setbacks used in the architectural design of the development will be effective in breaking-up southerly winds, and hence down-wash and/or side-streaming effects are not expected to be created by the development. Hence wind conditions along the Codrington Street pedestrian footpaths are expected to remain similar to the existing conditions. Furthermore, note that the proposed street trees along the eastern frontage of the site are expected to further enhance wind conditions when the prevailing wind is from the south.

The Codrington Street pedestrian footpaths are well shielded from the prevailing winds from the north-east and west by the neighbouring buildings, and the addition of the proposed development is expected to further enhance wind conditions when the prevailing winds are from these directions due to the additional shielding.

The corner of Codrington Street and Abercrombie Street is expected to be exposed to potential side-stream effects due to the acute angle of the building design in this area. It is recommended that densely foliating trees be included along both Codrington and Abercrombie Street to mitigate this potential adverse wind effect.

6.1.3 Abercrombie Street

The pedestrian footpaths along Abercrombie Street are somewhat exposed to the prevailing westerly winds due to the alignment of the street. Note that the addition of the proposed development is not expected to have any impact onto the existing wind conditions experienced along these pedestrian footpaths. The inclusion of additional densely foliating trees along the southern frontage of the site is expected to further enhance wind conditions when the prevailing wind is

from the west. However, note that for these trees to be effective in mitigating westerly winds they should be an evergreen species since the prevailing westerly winds tend to occur most frequently during the winter months for the Sydney region.

The Abercrombie Street pedestrian footpaths are well shielded from the prevailing winds from the north-east and south by the neighbouring buildings, and the addition of the proposed development is expected to further enhance wind conditions when the prevailing winds are from these directions due to the additional shielding.

6.2 Ground Level Areas within the Site

6.2.1 Within the South-Western Area of the Site

Wind conditions within the outdoor ground level areas at the south-western end of the site, around the South-Western Component, are expected to be ideal. The proposed building form will provide effective shielding from the prevailing winds, and the addition of any vegetation within this area of the site is expected to further enhance wind conditions. The primary school building to the west of this area will also provide effective shielding from westerly winds coming through the gap between the South-Western and North-Western components of the development.

Note that although the ground level gap through the South-Western Component building, and also the gap between the South-Western and South-Eastern components, are aligned with the prevailing southerly winds, funneling is not expected to be an issue since the building form of the remaining components of the development will effectively block the southerly winds from rushing through these areas.

6.2.2 Within the North-Eastern Area of the Site

Wind conditions within the outdoor ground level area around the north-eastern end of the site (the pedestrian accessway around the existing Faculty of Economics and Business building) are expected to be ideal since it will be well shielded from the prevailing winds by the proposed building form. The addition of any vegetation within this area of the site is expected to further enhance wind conditions.

6.2.3 The Two Central Courtyard Areas

The two central courtyard areas, located within the North-Western and South-Eastern components of the development, are well protected from the prevailing winds. Wind conditions for these areas are expected to be ideal for their intended uses.

6.3 Trafficable Roof Terraces

6.3.1 Atop the North-Western Component

The rooftop terrace areas of the North-Western Component (located either side of the Upper Component) of the proposed development are mostly exposed to the prevailing winds. This is because most of the

surrounding buildings are shorter than this terrace, and hence are not able to provide shielding. However, some shielding will be provided by the Upper Component of the proposed development, which is three stories taller than the roof terrace. The existing Faculty of Economics and Business building will also provide some shielding to the northern roof terrace area from the prevailing north-easterly winds, however since it is only one storey higher than the roof terrace it is not expected to have a significant effect. The triangular-shaped protruding sections of the development scattered around the northern roof terrace will also provide some localised wind amelioration.

To provide adequate wind conditions across all of the trafficable areas of these roof terraces it is recommended to have impermeable balustrades around the perimeter of the terraces, and also include some scattered vegetation (in the form of shrubs or small trees) within the larger open areas of the terraces.

6.3.2 Atop the South-Eastern Component

The rooftop terrace area of the South-Eastern Component of the proposed development is mostly exposed to the prevailing winds. This is because most of the surrounding buildings are shorter than this terrace, and hence are not able to provide shielding. However, some shielding will be provided by the Upper Component of the proposed development, which is four stories taller than the roof terrace. The triangular-shaped protruding sections of the development scattered around the terrace will also provide some localised wind amelioration.

To provide adequate wind conditions across all of the trafficable areas of the roof terraces it is recommended to have impermeable balustrades around the perimeter of the terrace, and also include some scattered vegetation within the larger open areas of the terraces. The scattered vegetation should be in the form of shrubs or small trees. It is noted that the architectural drawings indicate some trees are already proposed for this roof terrace, and adequate wind conditions can be expected to the terrace if these trees are incorporated into the final design.

6.3.3 Atop the South-Western Component

The small rooftop terrace atop the South-Western Component of the proposed development is relatively exposed to the prevailing southerly and westerly winds. The Upper Component of the development will provide shielding from the prevailing north-easterly winds. To achieve adequate wind conditions for this area it is recommended to include an impermeable balustrade around the perimeter of this terrace area, as well as some scattered vegetation in the form of shrubs or small trees.

7.0 Conclusions

An analysis of the wind environment impact with respect to the three principal wind directions for the Sydney region has been completed for the proposed Abercrombie Precinct Redevelopment, located in Darlington. 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 the project architect Woods Bagot, received on December 1, 2010. No wind tunnel tests have been undertaken for the subject redevelopment. As such, 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 study indicate that wind conditions for most of the trafficable outdoor areas within and around the proposed development will be suitable for the intended uses. The various pedestrian footpaths surrounding the site benefit from the shielding provided by the local surrounding buildings and existing street trees, and with the addition of the proposed development the wind conditions are expected to be improved in some areas due to the additional shielding, whilst wind conditions for other areas are expected to remain similar to the existing conditions. The use of building setbacks in the overall form of the development will be effective in ensuring that no adverse wind effects are caused by the development to the local surrounding area. The addition of the proposed street trees along Abercrombie and Codrington Streets is expected to further enhance wind conditions to the pedestrian footpaths in those areas. The inclusion of additional trees at the corner of Codrington and Abercrombie is recommended to mitigate any potentially adverse side-stream effect around the corner due to the acute design of the building.

The outdoor ground level pedestrian areas and central courtyards within the site benefit from the shielding provided by the proposed development, and any vegetation added to these areas is expected to further enhance wind conditions.

The various trafficable roof terraces of the development are relatively exposed to the prevailing winds. Although the Upper Component of the development will provide some shielding from the prevailing winds, to provide adequate wind conditions to these areas it is recommended to include the following:

- Impermeable balustrades on the perimeter of the trafficable areas of all rooftop terraces.
- Scattered vegetation throughout the open areas of the rooftop terraces. This can be in the form of shrubs or small trees. Note that for vegetation to be effective in mitigating adverse westerly winds, they should be of an evergreen species since the westerly winds occur most frequently during the winter months for the Sydney region.

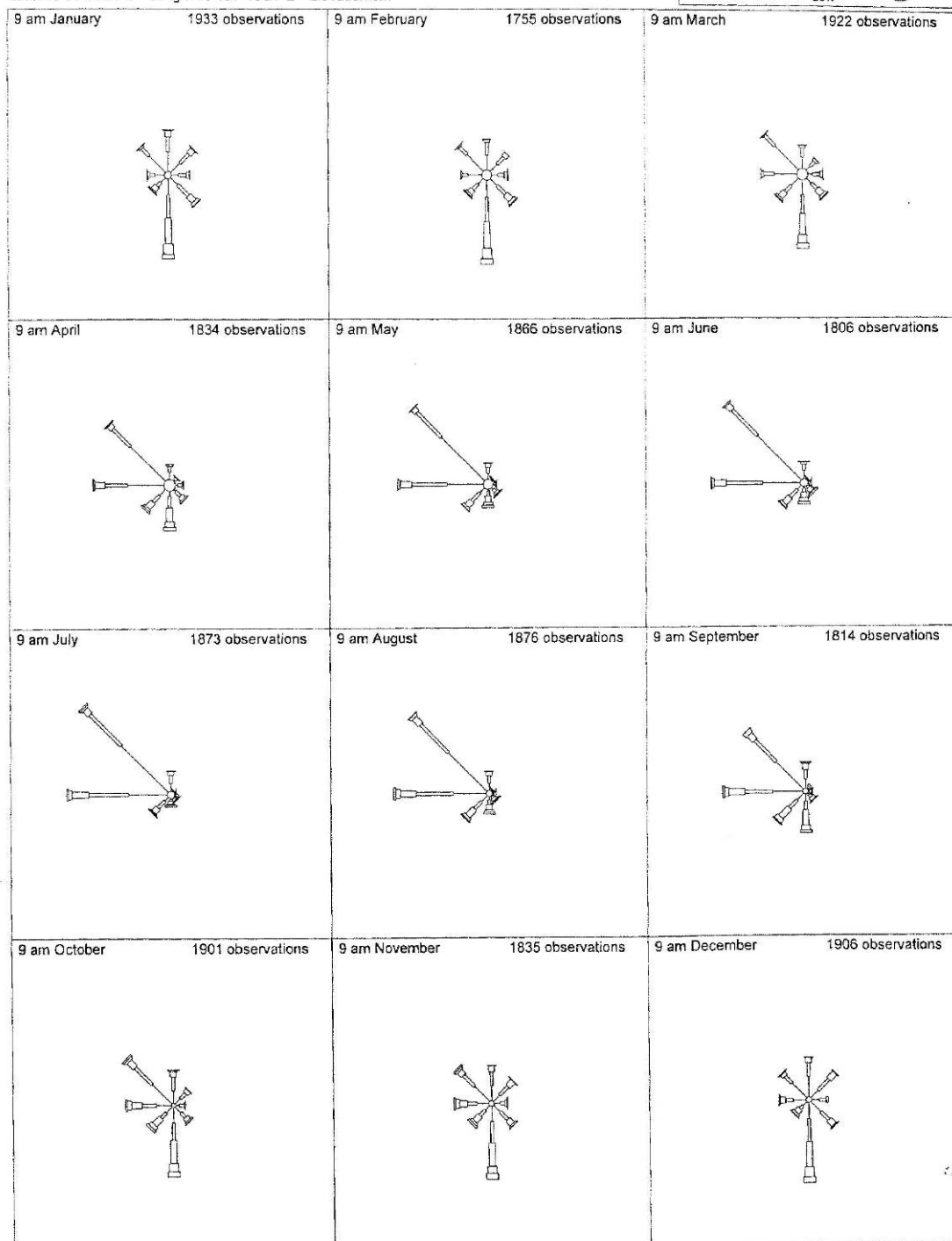
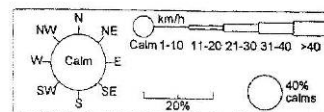
With the inclusion of the abovementioned treatments, wind conditions for all outdoor trafficable areas within and around the proposed development site will be suitable for the intended uses.

Appendix

Wind Roses for the Sydney Region

Wind Roses using available data between 1939 and 2000 for SYDNEY AIRPORT AMO

Site Number 066037 • Locality: SYDNEY AIRPORT • Opened Jan 1929 • Still Open
Latitude 33°56'28"S • Longitude 151°10'21"E • Elevation 6m

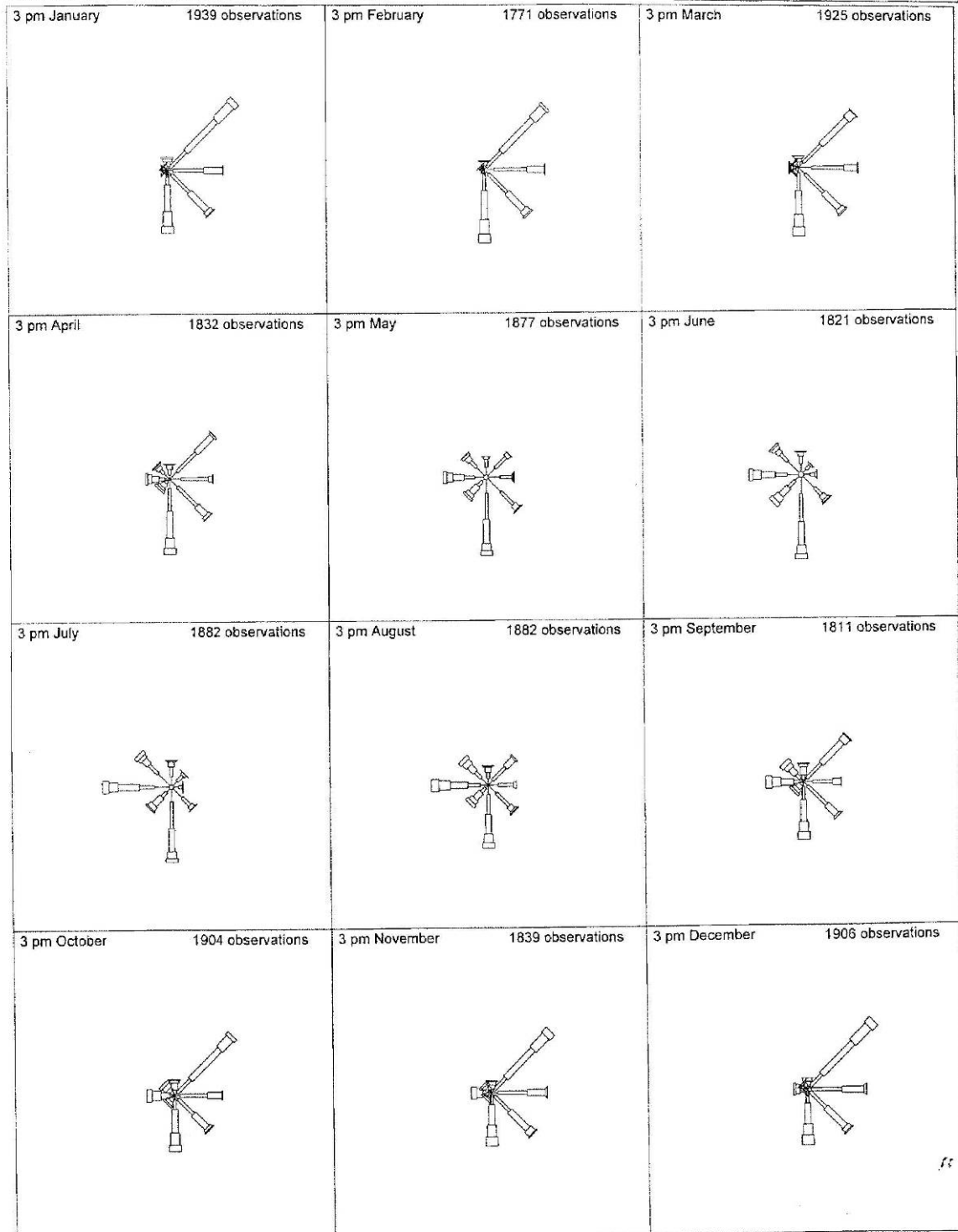
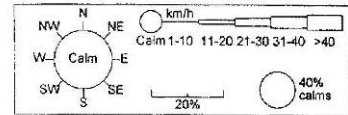


Copyright © Commonwealth of Australia 2000
Prepared by Climate and Consultancy Section in the New South Wales Regional Office of the Bureau of Meteorology
Contact us by fax 02 9296 1567, or by email on regnsw@bom.gov.au
We have taken all due care but cannot provide any warranty nor accept any liability for this information.

Page 1 of 1

Wind Roses using available data between 1939 and 2000 for SYDNEY AIRPORT AMO

Site Number 066037 • Locality: SYDNEY AIRPORT • Opened Jan 1929 • Still Open
Latitude 33°56'28"S • Longitude 151°10'21"E • Elevation 6m



Copyright © Commonwealth of Australia 2000
Prepared by Climate and Consultancy Section in the New South Wales Regional Office of the Bureau of Meteorology
Contact us by fax 02 9296 1567, or by email on regnsw@bom.gov.au
We have taken all due care but cannot provide any warranty nor accept any liability for this information.

Page 1 of 1