



PEDESTRIAN WIND ENVIRONMENT STATEMENT

LOT 3003 (DP1184498), THORNTON, PENRITH

WD459-03F02(REV2)- WS REPORT

MARCH 22, 2017

Prepared for:

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DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
March 17, 2017	Initial.	0	AFM	TR	TR/MC
March 21, 2017	Updated name of development stage.	1	AFM	TR	TR/MC
March 22, 2017	Revised drawings.	2	AFM	TR	TR/MC

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EXECUTIVE SUMMARY

This report is in relation to the proposed development, located at Lot 3003 (DP1184498), Thornton, Penrith, 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 winds from three predominant wind sectors for the Penrith region; north to northeast, south to south-east and west. The analysis of the wind effects relating to the subject development is 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 Crone Architects, received in March, 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. 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 wind tunnel testing of the subject development will need to be undertaken in order to verify the conditions within and around the site and the extent of the recommended treatments.

The results of this assessment indicate that the site will benefit from the moderate shielding provided by the neighbouring buildings adjoining the site for the westerly and north-easterly winds as well as from the relatively dense building morphology a short distance to the south from the site. The future stages of the subject development will also provide some shielding for winds from the north-easterly directions. However, until the proposed future stages of the development are constructed, the site will be partially exposed to winds from north-north-east. Also, wind conditions at the ground level pedestrian entrances located on the northern and eastern aspects of the building may require some form of amelioration until the northern part of the development is constructed. However once the construction of the aforementioned northern part is completed, there is potential for the prevailing north-easterly, south to south-easterly and westerly winds to be funnelled through the space at the Ground Level between the subject development and the future northern part of the subject development. Although the partial shielding afforded by the existing buildings upstream in the south and east directions is expected to provide some protection for pedestrians at street level, these winds may cause adverse effects in the vicinity of roof top terrace recreational areas on Level 5.

To mitigate the abovementioned wind effects, the following in-principal treatments are recommended:

Ground Level

- Planting of trees capable of growing to a height of 4m with a 4m wide canopy along the communal space to the north of the site. These trees should be of an evergreen variety with densely foliating, interlocking canopies.

- Planting of trees capable of growing to a height of 6m with a 6m wide canopy along the eastern boundary of the site. These trees should be of an evergreen variety with densely foliating, interlocking canopies.
- Either a 2m high screen adjacent to the proposed seating area at the north-eastern corner of the site or a 4m high impermeable screen immediately north of the seating area.

Level 5 Recreational Areas

- Inclusion of a 1.2m high 30% porous screen and 2m high shrub planting adjacent to the western boundary of the pool deck area. These shrubs should be of a densely foliating evergreen variety.
- Inclusion of 2m high 30% porous screens along the boundaries of the barbeque and garden pavilions located at the south-western corner of Level 5.
- Planting of trees capable of growing to a height of 4m with a 4m wide canopy along the boundaries of the barbeque and garden pavilions located at the south-western corner of Level 5. These trees should be of an evergreen variety with densely foliating, interlocking canopies.

Note that further landscaping at Level 5 will further enhance wind conditions within the recreational areas at this level.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for all trafficable outdoor areas within and around the development will be acceptable for their intended uses. However, note that extent of these recommended treatments can only be verified through wind-tunnel testing.

1 DESCRIPTION OF THE PROPOSED DEVELOPMENT AND SURROUNDS

The proposed development site is located in Penrith, bounded by Lord Sheffield Circuit to the east, Penrith train station to the south and the Penrith station north side car park and its access roads to the west. The development site is largely exposed from the north through to north-northeast sector due to the presence of flat terrain within currently vacant lots. However, the subject development will eventually benefit from the shielding provided by the future stages of the subject development (which involves a building that is to be constructed to the immediate north of the site). Further away from the site to the south and east lies relatively dense building morphology consisting mostly of low rise residential or commercial buildings, with the exception of the relatively high-rise developments that are currently being constructed to the east of the development site (Lots 3006, 3007, 3008, 3009 and 3010) and the 7 storey office building (2-6 Station Street) as well as the 19 storey commercial building (being constructed at 121-127 Henry Street) located across the Penrith train station to the south of the site.

A survey of the local land topography around the site indicates that the terrain within the development site is relatively flat. An aerial image of the site and the local surroundings is shown in Figure 1.

The subject development is a 6 storey mix-use building, consisting of retail spaces at the Ground Level, commercial spaces at Level 1, and various types of residential apartments across Levels 2 to 5. While all the levels of the development feature car park spaces, the two basement levels (Basement 01 and Basement 02) consists of fully equipped car parks. Level 5 of the development features a raised 25m lap swimming pool with a deck area, landscape regions, a barbeque spot and a number of community garden areas with seating.

The critical trafficable outdoor areas associated with the proposed development, which are the focus for pedestrian wind effects in this assessment, are detailed as follows:

- Ground level pedestrian entrances and walkways around the various frontages of the development.
- The rooftop terraces at Level 5 of the development consisting of a swimming pool (with a pool deck), landscaped areas, a barbeque spot and community gardens.
- The various private balconies throughout the development.

Our assessment and recommendations also account for the potential impact of the future stages of the subject development. These consist of the similar height podium located north of the subject phase of the development as well as two towers, one over the south-eastern section of the subject building and another over the north-eastern section of the future northern part of this development precinct.



Figure 1: Aerial Image of the Proposed Development Site

2 REGIONAL WIND CLIMATE FOR PENRITH

The Penrith region is governed by three principle wind directions, and these can potentially affect the subject development. These winds prevail from the north to northeast, south to south-east and west directions. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1. This summary is based on an analysis of wind rose data obtained by the Bureau of Meteorology from Penrith lakes AWS between 1995 and 2010. The wind roses are attached in the appendix of this report.

For the Penrith region, the north to north-easterly winds occur most frequently during the warmer months of the year. They are typically not as strong as the southerly winds, and are usually welcomed within outdoor areas since they typically occur when it can be quite warm during the summer. The south to south-easterly winds are by far the most frequent wind for the Penrith region, and are also the strongest. Westerly winds occur most frequently during the winter season for the Penrith region. These are usually a cold wind since they occur during the winter, and hence can be a cause for discomfort for outdoor areas.

Table 1: Principal Time of Occurrence of Winds for Penrith

<i>Month</i>	<i>Wind Direction</i>		
	<i>North to North-Easterly</i>	<i>South to South-Easterly</i>	<i>Westerly</i>
<i>January</i>		X	
<i>February</i>		X	
<i>March</i>	X	X	
<i>April</i>	X	X	
<i>May</i>	X		
<i>June</i>		X	X
<i>July</i>			X
<i>August</i>	X		X
<i>September</i>	X		X
<i>October</i>	X	X	
<i>November</i>	X	X	
<i>December</i>	X	X	

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 also 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.

Table 2: 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.

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 affecting the various trafficable outdoor areas within and around the subject development are discussed in the following sub-sections of this report for the three predominant wind directions for the Penrith region; north to northeast, south to southeast and west directions. 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 forms, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report, and the extent of the treatments recommended below will need to be verified through wind tunnel testing.

4.1 Site Location

The proposed development site is located in Penrith, bounded by Lord Sheffield Circuit to the east, Penrith train station to the south and the Penrith station north side car park building and its access roads to the west. While the development site is currently exposed to winds from the north to north-east sector, shielding will eventually be provided by the proposed future stages of the subject development (which involves a building that is to be constructed to the immediate north of the site). Further away from the site to the south and east lies relatively dense building morphology consisting mostly of low rise residential or commercial buildings, with the exception of the relatively high-rise developments that are currently being constructed to the east of the development site (Lots 3006, 3007, 3008, 3009 and 3010) and the 7 storey office building (2-6 Station Street) as well as the 19 storey commercial building (being constructed at 121-127 Henry Street) located across the Penrith train station to the south of the site. The subject development is expected to benefit from the moderate shielding provided by these buildings and the aforementioned urban development regions located further away from the site to the south and east. However, until the future stage involving the development to the north of the subject development is constructed, the site is exposed to winds from north to north-east sector. These winds may cause adverse effects in the vicinity of roof top terrace recreational areas on Level 5 as well as around the ground level pedestrian entrances located on the northern and eastern aspects of the building.

In addition, once the future north phase of the development is completed, there is potential for the prevailing north-easterly, south to south-easterly and westerly winds to be funnelled through the space at the Ground Level between the subject development and the future northern part of the subject development. Furthermore, the exposure of a large portion of the building façade along western boundary may result in the westerly winds being captured and downwashed across the Ground Level (although there are no trafficable areas at the Ground Level along the western aspect of the development).

4.2 Ground Level

The Ground Level areas on the northern aspect of the site will eventually benefit from the shielding of direct prevailing winds in the north to north-east direction, provided by the future northern stage of the subject development. However, once this northern phase has been completed, there would be the potential for the north-easterly, south to south-easterly and westerly winds to be funnelled through the communal space at the Ground Level between the subject development and the future northern part of the subject development. In order to mitigate the potentially adverse wind effects on the site at the Ground Level, it is recommended that the following treatments are included in the final design:

- Planting of trees capable of growing to a height of 4m with a 4m wide canopy along the communal space to the north of the site, as shown in Figure 2. These trees should be of an evergreen variety with densely foliating, interlocking canopies.
- Planting of trees capable of growing to a height of 6m with a 6m wide canopy along the eastern boundary of the site, as shown in Figure 2. These trees should be of an evergreen variety with densely foliating, interlocking canopies.
- Either a 2m high screen adjacent to the proposed seating area at the north-eastern corner of the site or a 4m high impermeable screen immediately north of the seating area, as indicated in Figure 2.

4.3 Level 5 Recreational Roof Areas

The recreations areas (including the swimming pool, pool deck, barbeque spot, community gardens and landscaped seating areas) on Level 5 of the development are exposed to direct prevailing winds from the south to southeast and the west. To ameliorate the potential for any adverse wind effects caused by these prevailing winds, it is recommended that the following in-principal treatments, indicated in Figure 3, are incorporated in to the final design:

- Inclusion of a 1.2m high 30% porous screen and 2m high shrub planting adjacent to the western boundary of the pool deck area. These shrubs should be of a densely foliating evergreen variety.
- Inclusion of 2m high 30% porous screens along the boundaries of the barbeque and garden pavilions located at the south-western corner of Level 5.
- Planting of trees capable of growing to a height of 4m with a 4m wide canopy along the boundaries of the barbeque and garden pavilions located at the south-western corner of Level 5. These trees should be of an evergreen variety with densely foliating, interlocking canopies.

4.4 Private Balconies

Wind conditions within the various private balconies of the development benefit from the building façade being recessed in to the building form and the effective use of blade walls. The inclusion of the proposed balustrades along the perimeter of the balconies is expected to further enhance the wind conditions. Hence these features are recommended to be retained in the final design of the development.

With the inclusion of the abovementioned recommendations in the final design, it is expected that wind conditions for all trafficable outdoor areas within and around the development will be acceptable for their intended uses. However, note that extent of these recommended treatments will need to be verified through wind-tunnel testing.

Treatments Legend

-  Recommended tree planting (4m high with 4m wide canopy)
-  Recommended tree planting (6m high with 6m wide canopy)
-  Recommended 4.0m high impermeable screen
(or)
-  Recommended 2.0m high impermeable screen



Figure 2: Recommended Treatments (Ground Level)

Treatments Legend

-  Recommended tree planting (4m high with 4m wide canopy)
-  Recommended 2.0m high hedge planting
-  Recommended 1.2m high 30% porous screen
-  Recommended 2.0m high 30% porous screen

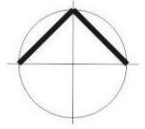


Figure 3: Recommended Treatments (Level 5)

APPENDIX A - WIND ROSE FOR THE PENRITH REGION

Rose of Wind direction versus Wind speed in km/h (15 Sep 1995 to 30 Sep 2010)

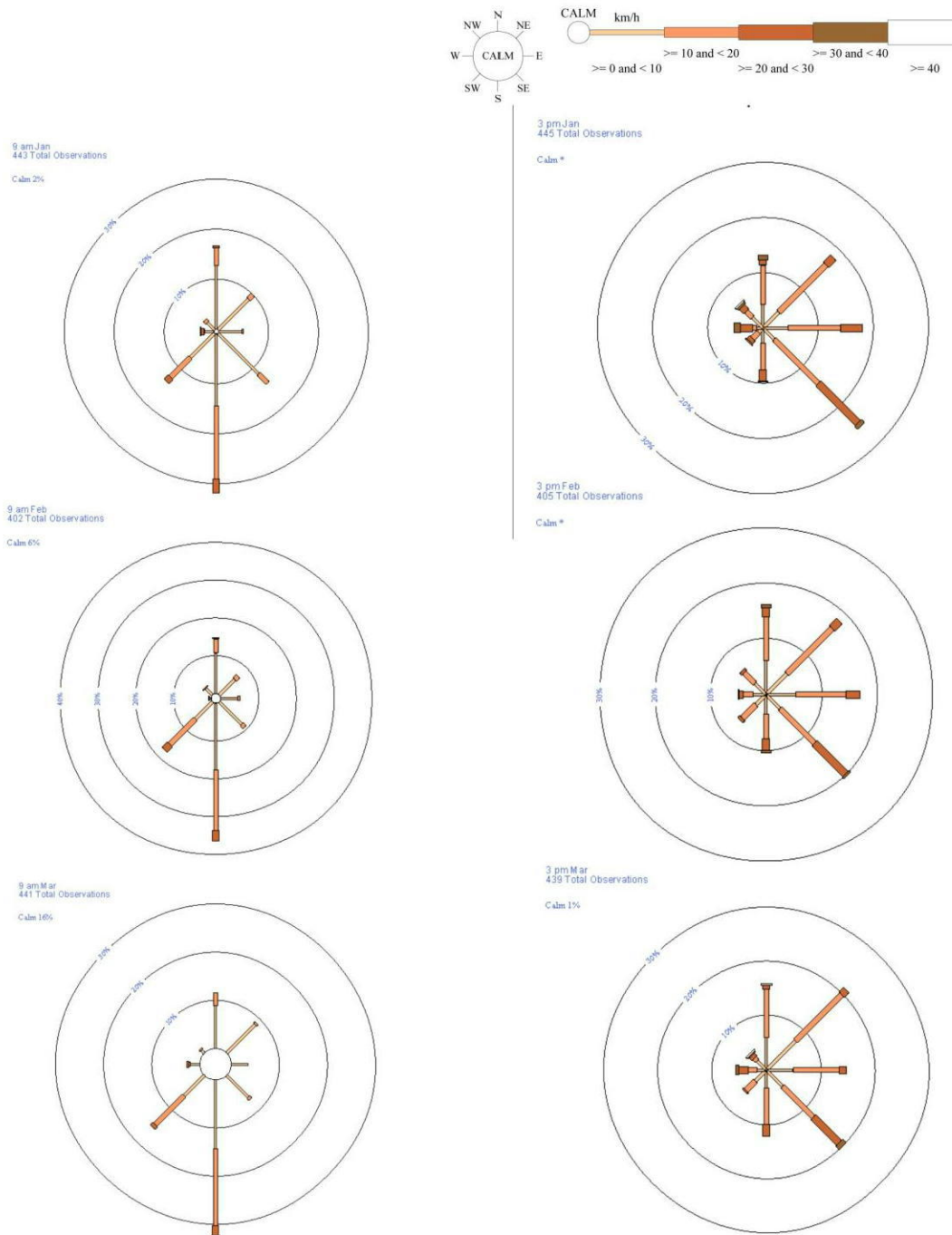
Custom times selected, refer to attached note for details

PENRITH LAKES AWS

Site No: 067113 • Opened Aug 1995 • Still Open • Latitude: -33.7195° • Longitude: 150.6783° • Elevation 24.m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.



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Rose of Wind direction versus Wind speed in km/h (15 Sep 1995 to 30 Sep 2010)

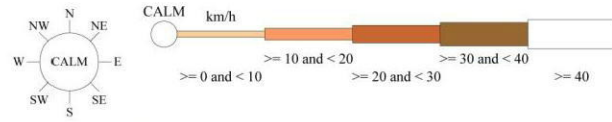
Custom times selected, refer to attached note for details

PENRITH LAKES AWS

Site No: 067113 • Opened Aug 1995 • Still Open • Latitude: -33.7195° • Longitude: 150.6783° • Elevation 24.m

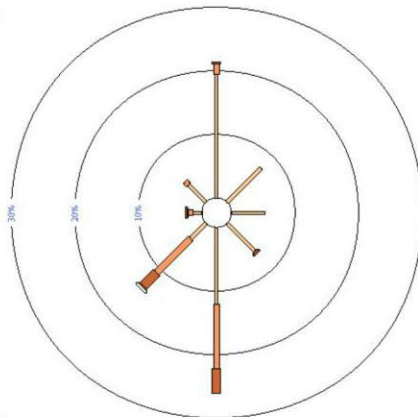
An asterisk (*) indicates that calm is less than 0.5%.

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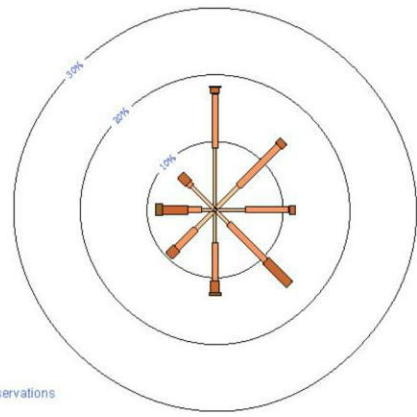
9 am Apr
436 Total Observations

Calm 11%



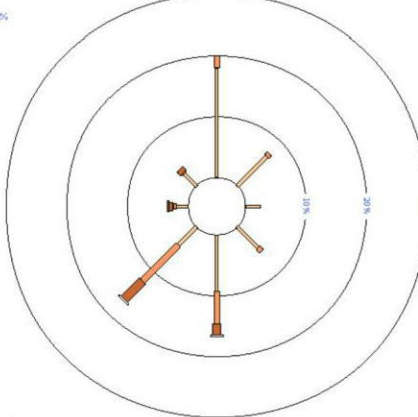
3 pm Apr
437 Total Observations

Calm 1%



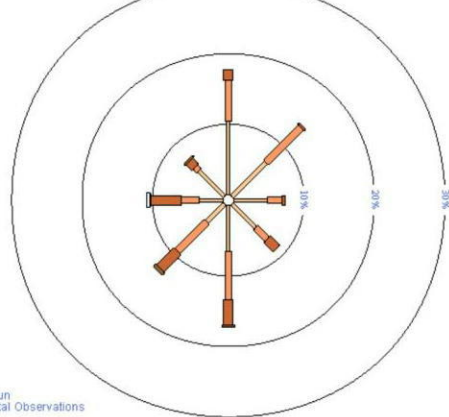
9 am May
444 Total Observations

Calm 22%



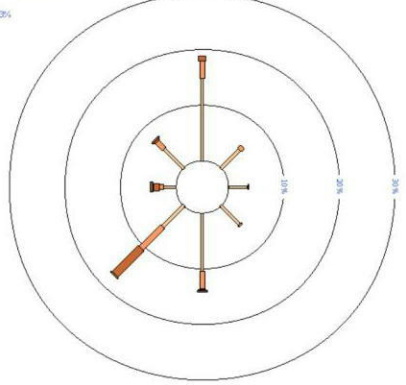
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442 Total Observations

Calm 4%



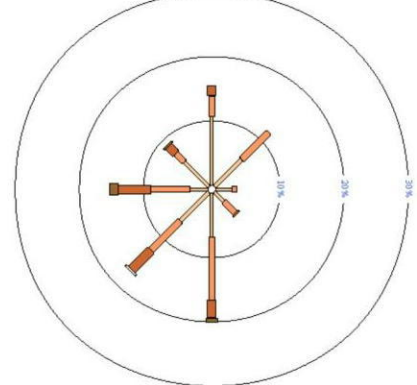
9 am Jun
440 Total Observations

Calm 22%



3 pm Jun
439 Total Observations

Calm 3%



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Rose of Wind direction versus Wind speed in km/h (15 Sep 1995 to 30 Sep 2010)

Custom times selected, refer to attached note for details

PENRITH LAKES AWS

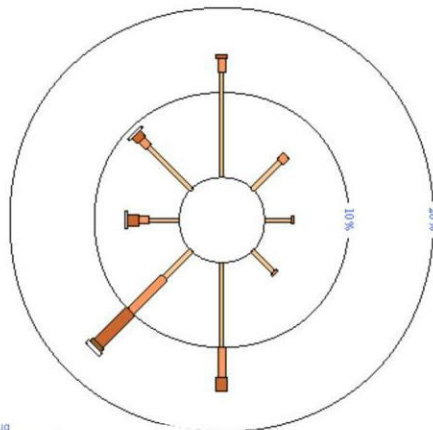
Site No: 067113 • Opened Aug 1995 • Still Open • Latitude: -33.7195° • Longitude: 150.6783° • Elevation 24.m

An asterisk (*) indicates that calm is less than 0.5%.

Other important info about this analysis is available in the accompanying notes.

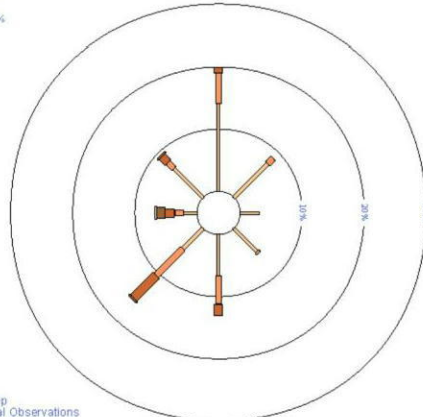
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442 Total Observations

Calm 25%



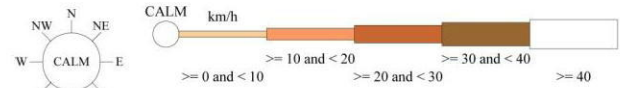
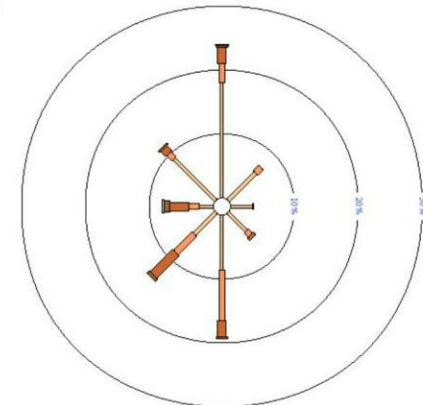
9 am Aug
448 Total Observations

Calm 17%



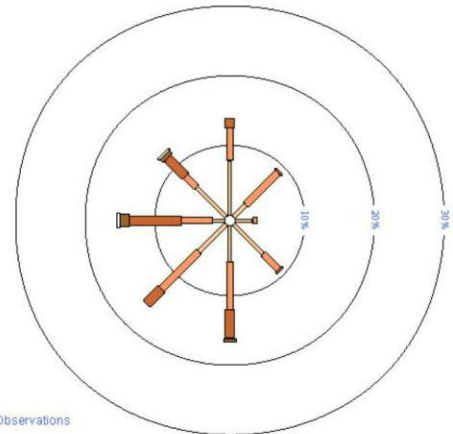
9 am Sep
442 Total Observations

Calm 7%



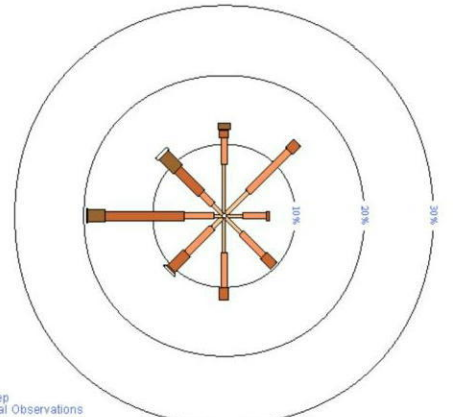
3 pm Jul
447 Total Observations

Calm 4%



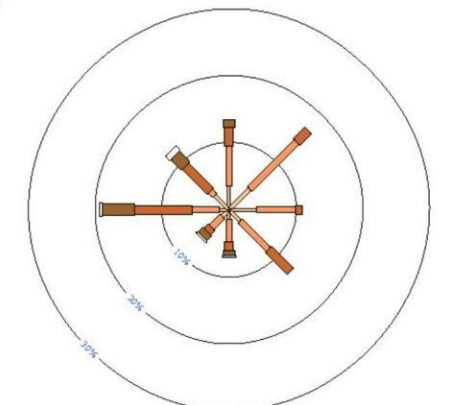
3 pm Aug
439 Total Observations

Calm 2%



3 pm Sep
444 Total Observations

Calm 1%



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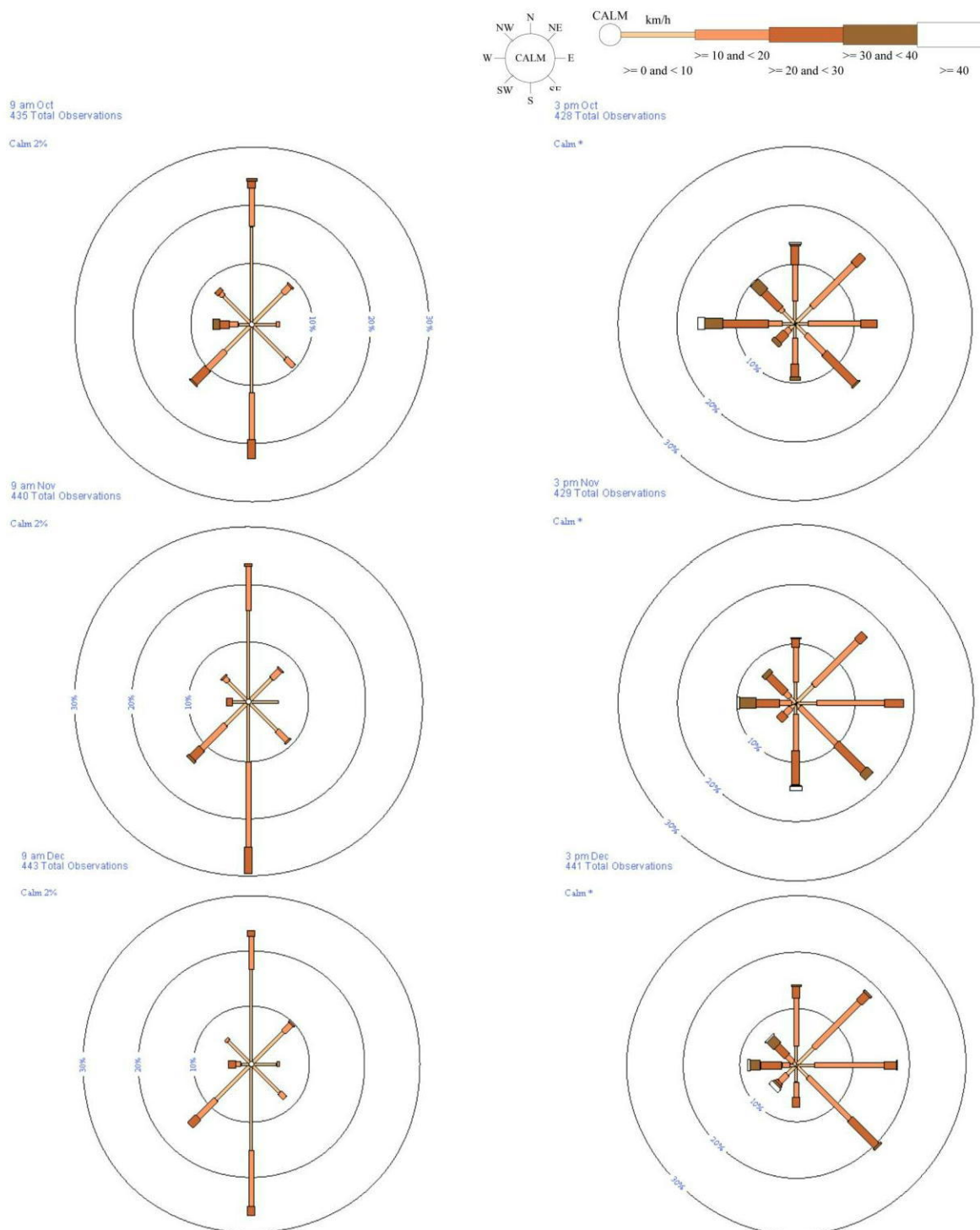
Custom times selected, refer to attached note for details

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