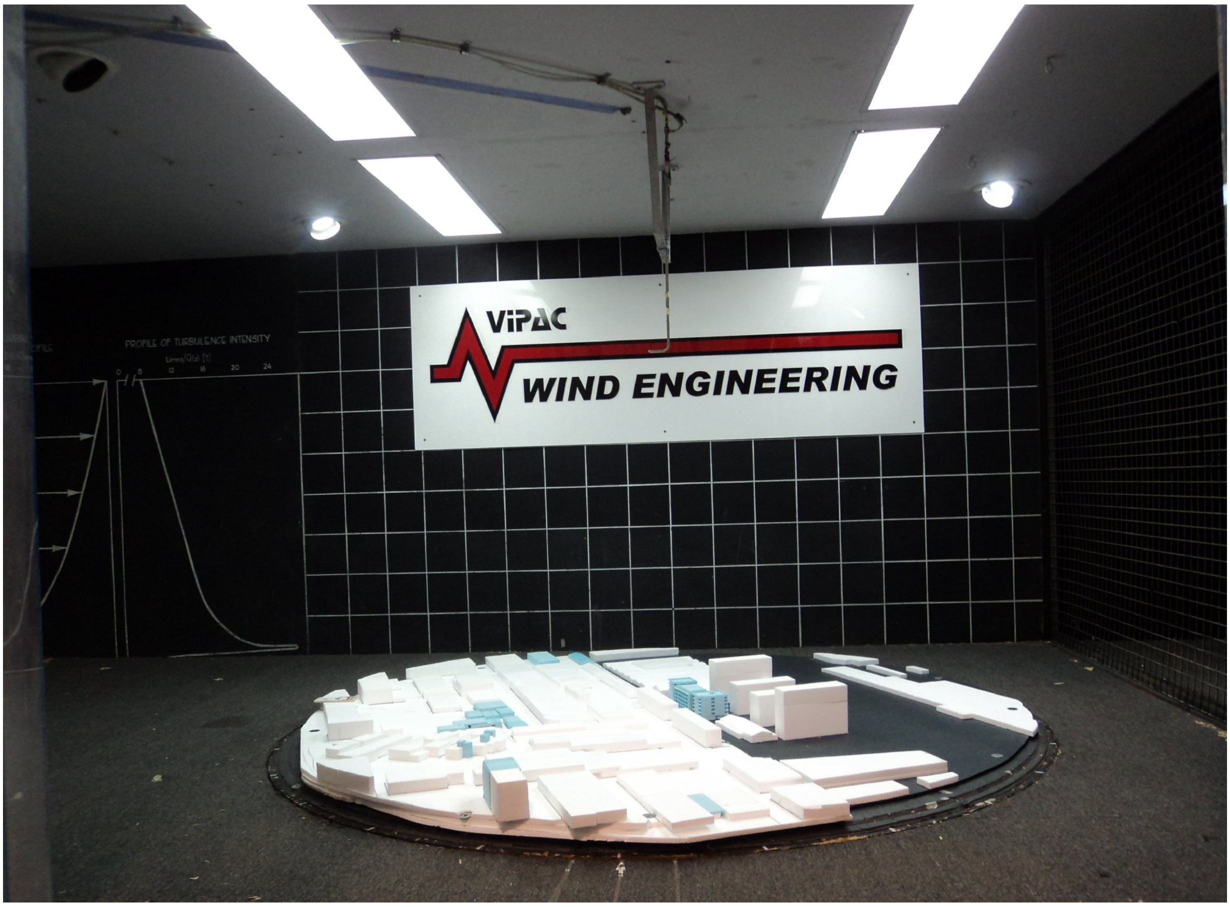
City West Housing Pty Ltd

D4 North Eveleigh Affordable Housing, Eveleigh, NSW

Pedestrian Level Winds - Wind Tunnel Test



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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd (**VIPAC**) has been commissioned by **City West Housing Pty Ltd** to perform an assessment of pedestrian level winds for the proposed development at **Site D4 North Eveleigh Affordable Housing, Eveleigh, NSW**.

This study examines the wind effects expected adjacent to the proposed development, based on **1:250** scale-model wind tunnel testing. The model was constructed to drawings supplied by **Architectus Group Pty Ltd**. A list of the drawings used to construct the model is provided in Appendix B of this report.

All testing was carried out in the Boundary Layer Wind Tunnel Facility of Vipac Engineers & Scientists Ltd in Melbourne during March 2013.

The subject building and surrounding developments covering a circular area of a 312 m radius were modelled at **1:250 scale.** The approaching mean and turbulent flows of the Terrain Category 3 Atmospheric Boundary Layer were modelled based on Australia Standard AS 1170.2-2011.

The findings of this study are, with the proposed designs without any landscaping:

- The development will satisfy the criterion for safety at all locations.

Vipac recommended and tested the following wind mitigation measures:

- Additional trees on the west and east side of the proposed development.
- Set back of 1 m for the entrance on the southeast side or installation of a 1 m wide by 2 m high windscreen at the east side of the entrance.

The above wind mitigation measures are incorporated in the updated ground level design dated 8 March and the landscaping design dated 14 March 2013. Hence with the proposed designs:

- Wind conditions adjacent to the proposed development will satisfy the criterion for **walking** along the footpath and other pedestrian areas.
- Wind conditions will satisfy the criterion for **standing** in the building entrance areas.
- All balconies and the rooftop terrace will likely to satisfy the recommended walking criterion, however, as a general statement for any high-rise development, educating occupants about wind conditions at open terrace areas during high-wind events and tying down loose lightweight furniture are highly recommended.

There are some wind-quiet areas suitable for seating activity (Locations 10 to 13 and 31) and the area around Location 31 can be used for outdoor cafes.

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1. INTRODUCTION

Vipac Engineers & Scientists Ltd (VIPAC) has been commissioned by **City West Housing Pty Ltd** to carry out an assessment of pedestrian wind effects for the proposed development at **Site D4 North Eveleigh Affordable Housing, Eveleigh, NSW**.

1.1. Site of the Proposed Development

The proposed development consists of 6 storeys and is part of the redevelopment of the former Eveleigh Carriageworks Site. The redevelopment site is bounded by Wilson Street to the north, train tracks to the south, the existing buildings to the east, and existing residential housing to the west (see Figure 1). The blue rectangle in Figure 1 shows the area of the entire redevelopment; with the concept plan shown in Figure 2. The development site considered in this study (D4) is in the centre of the redevelopment as shown in Figure 2, surrounded by the proposed redevelopment buildings (4-12 storeys) and an existing clothes store to the west. A satellite view of the proposed development site with the surroundings within an approximately 1 km radius is shown in Figure 3. The site is located approximately 3.5km SSW of the Sydney CBD. The south elevation of the development is shown in Figure 4 and the ground level plans of the development are shown in Figure 5.

Figure 1: An image of the site of the proposed Stage 2 of the Woodgrove Shopping Centre in Melton, Victoria

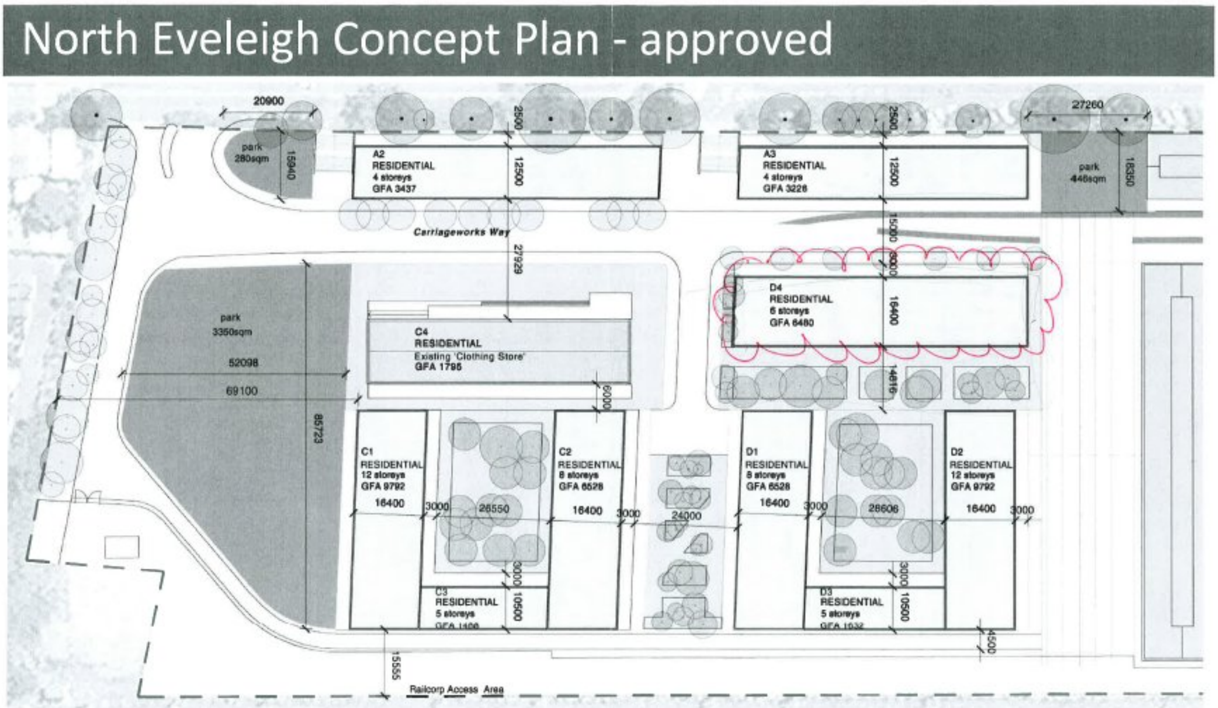


Figure 2: Concept plan of the redevelopment of the former Eveleigh Carriageworks site. The development considered in this study is circled in red

This report details the pedestrian level wind assessment results of the tests carried out on a **1:250** scale model of the proposed development in Vipac's Boundary Layer Wind Tunnel in Melbourne. The results show the wind effects in ground level public areas and the upper level terrace of the development as proposed. All tests were conducted in Vipac's Boundary Layer Wind Tunnel Laboratory in Melbourne during February 2013.

The pedestrian wind environment study of the development was conducted using Omni-directional pressure sensor techniques to predict wind velocities. The study investigated safety and comfort in ground level pedestrian access-ways nearby the project. These areas were assessed against the recommended safety and comfort criteria. The building entrances were also tested and assessed against the recommended standing criterion. Rooftop terrace was tested and assessed against the walking criterion (see Section 3.1.1).

The test model of the proposed development was constructed based on the drawings supplied by **Architectus Group Pty Ltd**. Figure 6 to Figure 8 show the 1:250 scale model in the wind tunnel. A list of all the drawings used for model construction is enclosed in the Appendix B of this report.

Figure 3: Satellite image of the site of the proposed development of D4 North Eveleigh Affordable Housing, Eveleigh, NSW

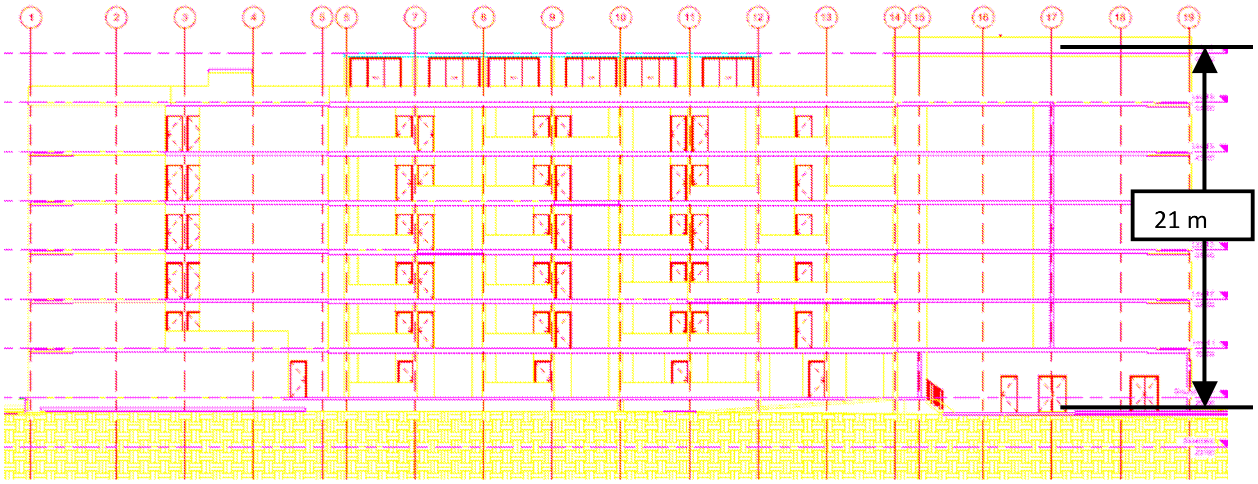


Figure 4: South elevation of the proposed development at site D4 of the redevelopment

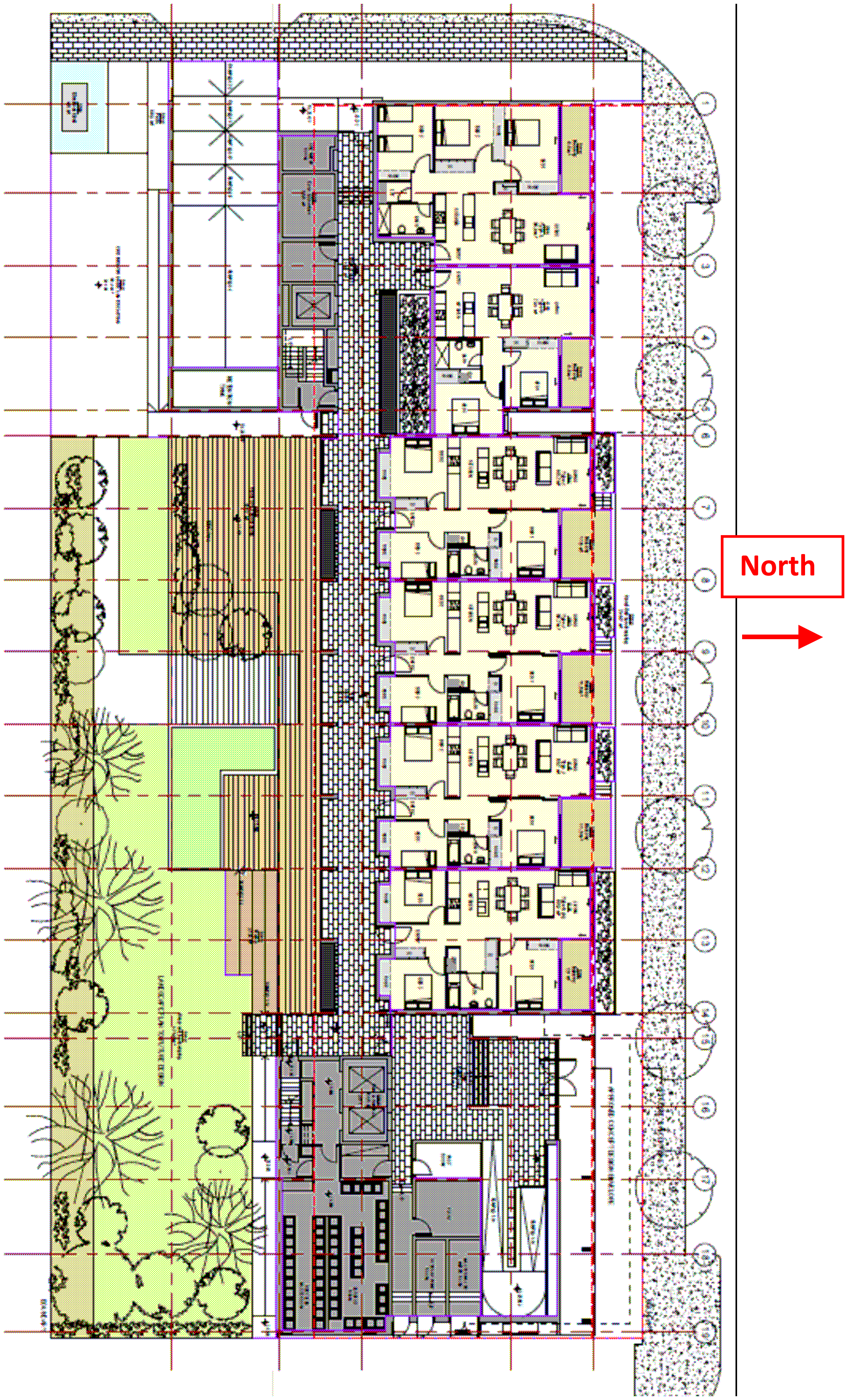


Figure 5: Ground floor plan of the proposed development at site D4 of the redevelopment (The plan is updated with wind tunnel test findings)

Figure 6: Overall view of the 1:250 scale model of the proposed development in the wind tunnel

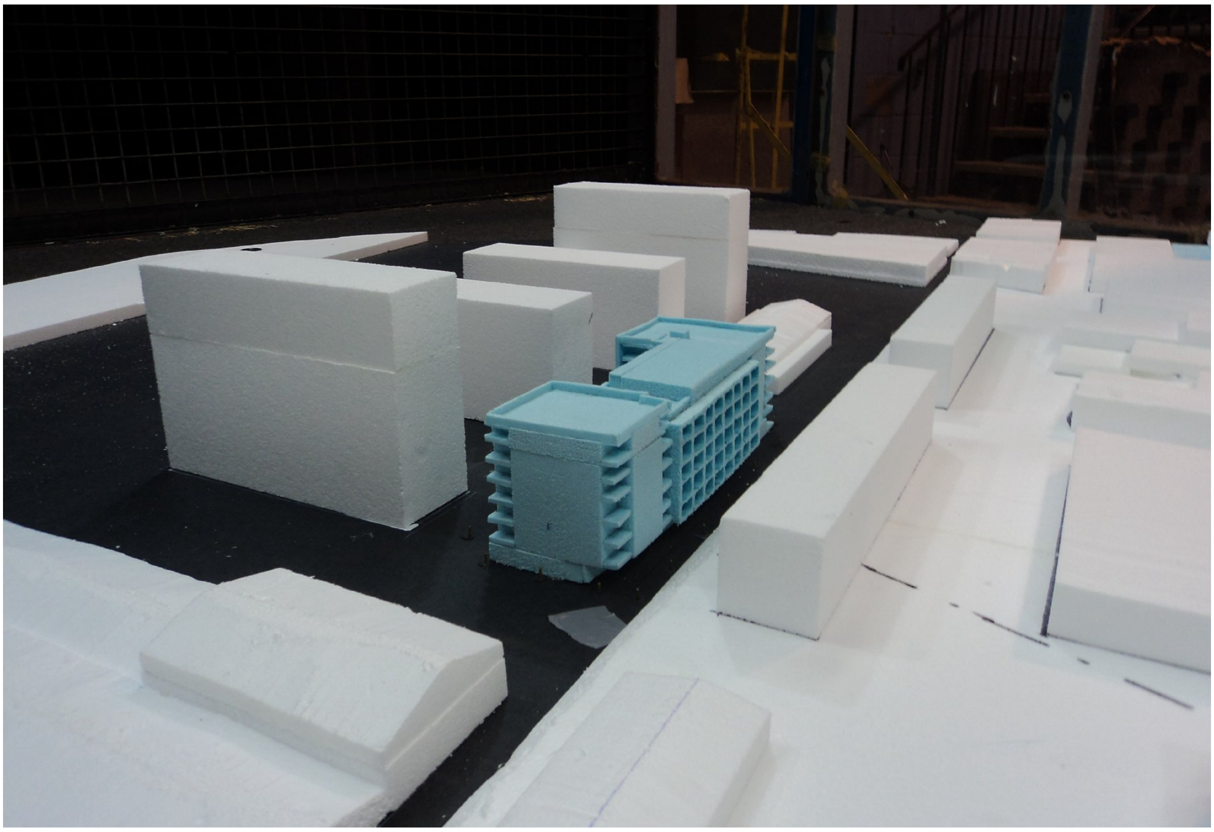


Figure 7: Close up view from southwest of the 1:250 model in the wind tunnel

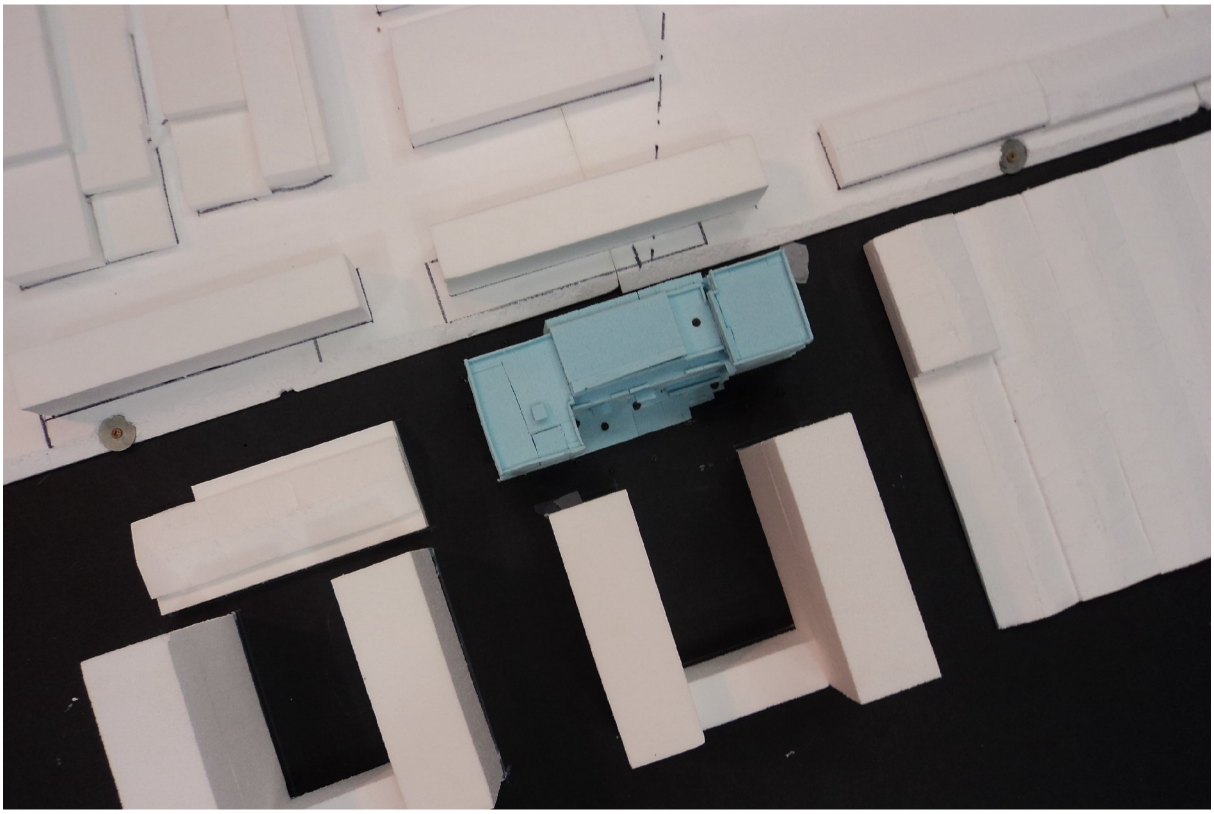


Figure 8: Top view of the 1:250 model in the wind tunnel

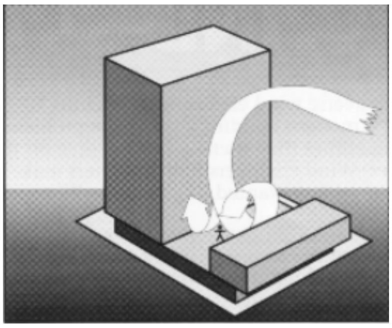
1.2. Environmental Wind Effects

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.

Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast moving wind at higher elevations downwards.

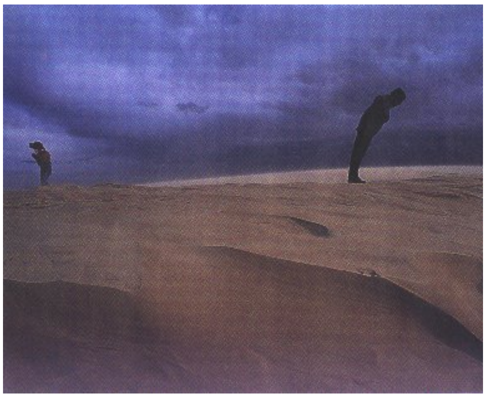


Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known "street canyon" effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



2. REGIONAL WIND CLIMATE

The mean and gust wind speeds have been recorded in the Sydney area for over 30 years. These data have been analysed and the directional probability distribution of wind speeds have been determined. The directional distribution of hourly mean wind speed at the gradient height, with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 9. The wind data at this free stream height is common to all Sydney sites and may be used as a reference to assess ground level wind conditions at the redevelopment site.

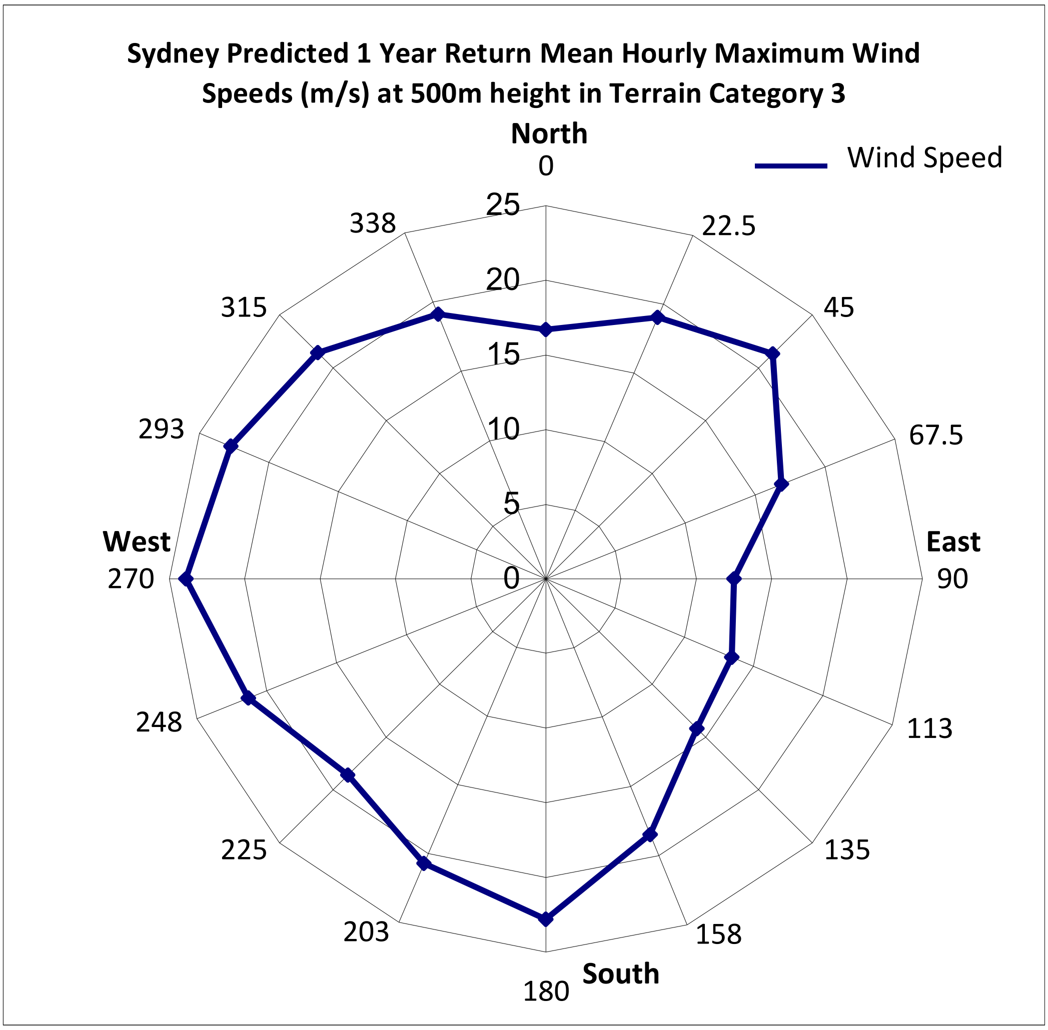


Figure 9: Directional Distribution of Annual Return Period Mean Hourly Wind Velocities (m/s) at the gradient Height for Sydney

3. ASSESSMENT CRITERIA

Vipac's assessment criteria for pedestrian wind comfort are based on some consensus of international opinion. A set of annual maximum peak 3-second gust velocities is derived from meteorological data for the geographical location under consideration, for each wind direction to be assessed. For all of these possible wind directions and speeds, the regions where each of the wind speed criteria may be exceeded are then considered.

Most people will consider a site unacceptable for a given activity if the mean and/or gust velocities in that area during the annual maximum wind event exceed the annual maximum wind speed criterion for that activity. The site would also be likely to be considered excessively windy for that activity during more moderate winds.

The threshold *gust* velocity criteria are:

Table 1: Recommended Wind Comfort and Safety *Gust* Criteria

Annual Maximum Gust Speed	Result on Perceived Pedestrian Comfort
>23m/s	Unsafe (frail pedestrians knocked over)
<16m/s	Acceptable for **walking** (steady steps for most pedestrians)
<13m/s	Acceptable for **standing** (window shopping, vehicle drop off, queuing)
<11m/s	Acceptable for **sitting** (outdoor cafés, gardens, park benches)

In a similar manner, a set of hourly mean velocity criteria with a 1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold *mean* velocity criteria are:

Table 2: Recommended Wind Comfort and Safety *Mean* Criteria

Mean wind speed exceeded 1% of the time	Result on Perceived Pedestrian Comfort
>15m/s	Unsafe (frail pedestrians knocked over)
<10m/s	Acceptable for **walking** (steady steps for most pedestrians)
<7m/s	Acceptable for **standing** (window shopping, vehicle drop off, queuing)
<5m/s	Acceptable for **sitting** (outdoor cafés, gardens, park benches)

The Beaufort Scale is an empirical measure that related the wind speed to observed conditions on the land and sea. Table 3 describes the categories of the Beaufort Scale. The comparison between these observed conditions and the comfort criteria described above can be found in Table 4.

Table 3: Beaufort Scale - empirical measure relating wind speed to observed conditions on land

Beaufort Number	Descriptive Term	Mean Hourly Wind Speed at 1.75 m height (m/s)	Specification for Estimating Speed
0	Calm	0-0.1	
1	Light Air	0.1-1.0	No noticeable wind
2	Light Breeze	1.1-2.3	Wind felt on face
3	Gentle Breeze	2.4-3.8	Hair disturbed, clothing flaps, newspapers difficult to read
4	Moderate Breeze	3.9-5.5	Raises dust and loose paper; hair disarranged
5	Fresh Breeze	5.6-7.5	Force of wind felt on body, danger of stumbling when entering a windy zone
6	Strong Breeze	7.6-9.7	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, sideways wind force about equal to forwards wind force, wind noise on ears unpleasant
7	Near Gale	9.8-12.0	Inconvenience felt when walking
8	Gale	12.1-14.5	Generally impedes progress, great difficulty with balance in gusts
9	Strong Gale	14.6-17.1	People blown over

Table 4: Comparison between Mean comfort criteria and the observed conditions

Comfort Criteria	Beaufort Scale Equivalent
Safety	>9 – Strong Gale
Walking	5 – Fresh Breeze
Standing	4-5 – Moderate to Fresh Breeze
Sitting	<4 – Moderate Breeze

3.1. Applicable Criteria

The following table lists the specific recommended criteria for the various areas of the proposed development. These are shown in more detail in **Figure 10** and 11.

Table 5: Recommended Application of the Criteria

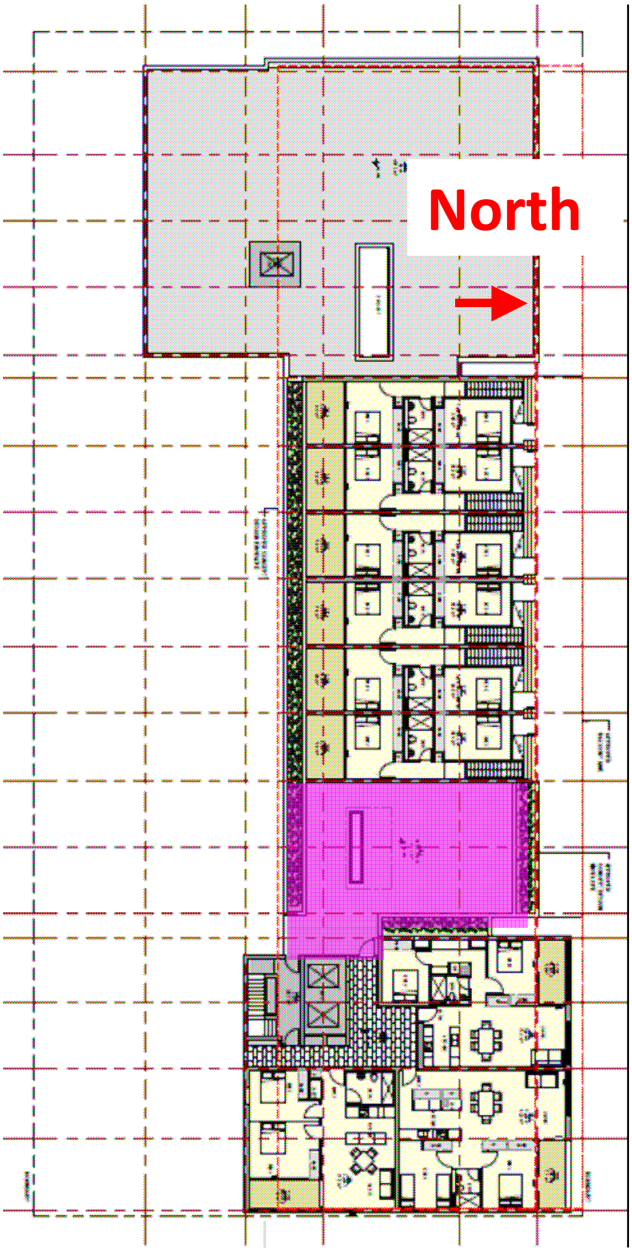
Area	Recommended Criteria
Footpaths	Recommended to fulfil **walking**
Building Entrances	Recommended to fulfil **standing**
Balconies/Terraces	Recommended to fulfil **walking (see the discussion below)**

Balcony/Rooftop Terrace Recommended Criterion Discussion

Vipac recommend as a minimum that the rooftop terrace/apartment balcony areas meet the criterion for walking since:

- the use of these areas is optional,
- many similar developments in Sydney and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.

Vipac wish to clearly state that meeting the walking criterion on elevated recreation areas will be no guarantee that occupants will find wind conditions in these areas acceptable.



Recommended to fulfil walking

Figure 10: Schematic plan view of the proposed development with the recommended wind criteria overlaid at the 6th level

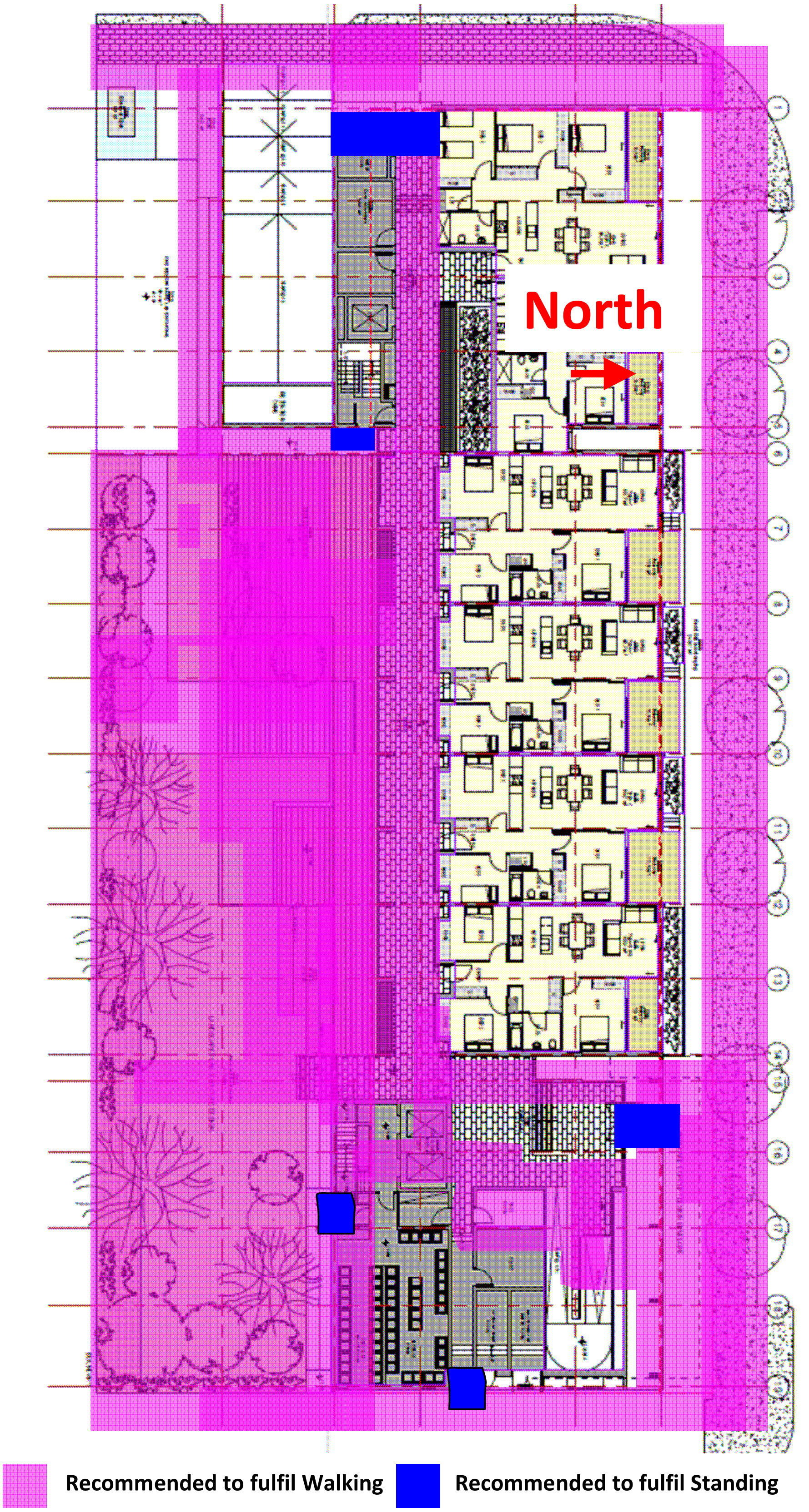


Figure 11: Schematic plan view of the eastern side of the proposed development with the recommended wind criteria overlaid at the ground level

4. WIND TUNNEL SIMULATION

4.1. Similarity Requirements

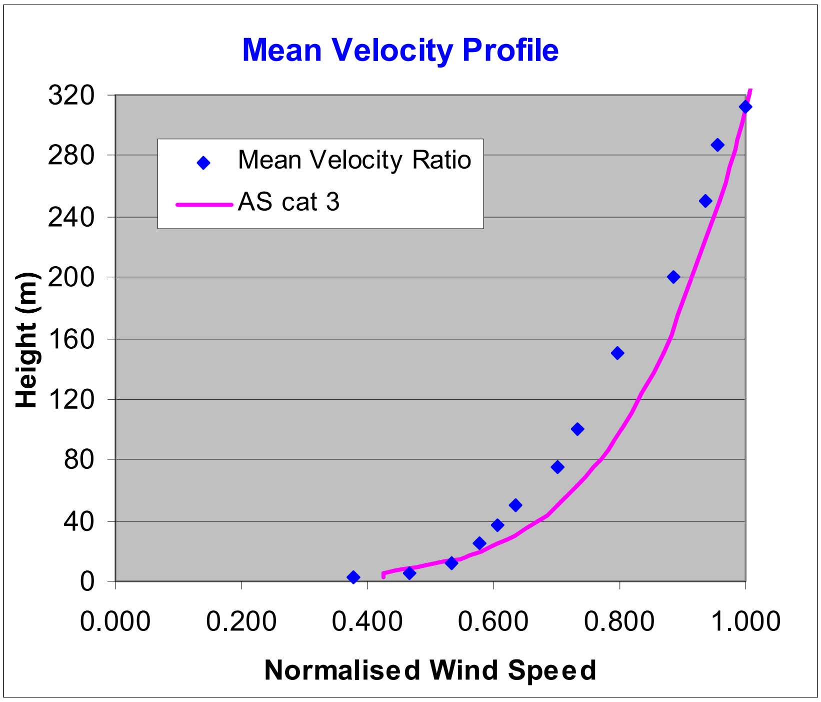
The validity of wind tunnel testing relies on the similarity between model and full-scale parameters. This requires undistorted length scaling (ie. geometric similarity), similarity of flow parameters (ie. kinematic similarity) and finally similarity of pressures and forces.

Complete similarity is usually impossible to obtain because of the competing requirements of the various non-dimensional parameters, (eg. Reynolds Number, Rosby Number and Richardson Number). Some requirements (i.e. Reynolds Number equality) can be waived for sharp edged structures immersed in a neutrally stable atmospheric boundary layer and geometric and kinematic similarity suffice. These are the requirements specified in Section C1.4, AS/NZS 1170.2 Supplement 1: 2011 [4] and are employed in this study.

4.2. Approach Wind Simulation

The wind effects tests were carried out in the 3m wide × 2m tall × 16m long Boundary Layer Wind Tunnel at Vipac Engineers and Scientists Ltd in Melbourne. The Boundary Layer Wind Tunnel is designed to simulate the flow incident on a proposed development by modelling the upstream terrain characteristic roughness. To this end, an estimate of the upstream terrain properties for the development has been made and reproduced in the wind tunnel.

The approaching mean and turbulent flows of the Terrain Category 3 Atmospheric Boundary Layer were modelled based on Australia Standard AS 1170.2-2011 (Figure 2). The wind tunnel calibration velocity and turbulence intensity profiles for Terrain Category 3 are shown in Figure 12. These represent the wind velocity and turbulence intensity profile approaching the model of the development. Closer to the ground the wind moves more slowly but with increased turbulence. The simulated approach is indicative of full-scale planetary boundary layer velocity and turbulence intensity profiles.



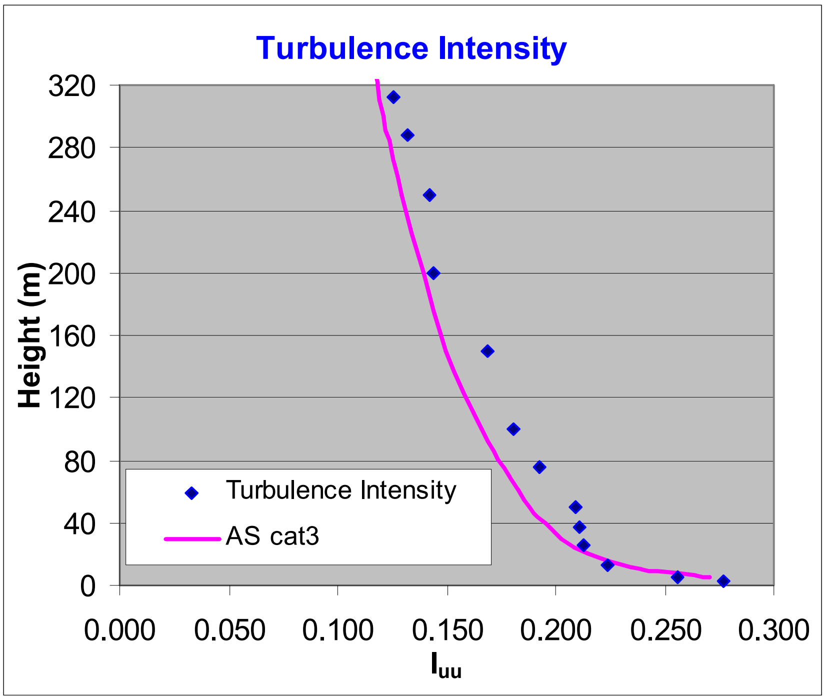


Figure 12: Mean Velocity and Turbulence Intensity Profiles for Terrain Category 3 (1:250 scale)

5. TEST PROCEDURE

The pedestrian level wind environment in the footpaths, entrances and the rooftop terrace of the proposed development were assessed using Omni-directional pressure sensor tests (point method).

5.1. Omni Directional Pressure Sensors

Velocity measurements were made using Irwin sensors (Omni directional pressure sensors) installed at several locations on the ground level footpath areas, entrances and rooftop terrace areas of the proposed development. The test was initially conducted without any landscaping. The proposed landscaping was then included in some areas where the recommended criteria were exceeded. Additional wind mitigation measures were then included in order to ensure all areas met the recommended wind speeds.

The distribution of Irwin sensors has allowed the determination of the variation in velocity sufficient to capture the changes in velocity distribution that can typically occur over such areas. The resolution of measurement locations is in accordance with that prescribed in the Wind Tunnel Testing Quality Assurance Manual of the Australasian Wind Engineering Society.

PVC tubes with 1.5 mm internal diameter linked the Irwin sensors to pressure transducer device using a tuned arrangement to prevent harmonic fluctuations.

Velocity measurements were obtained at 10° wind azimuth increments starting from 0° (north) for a full 360° circle. The sampling time is determined based on the similarity criteria and corresponds to a total time of one hour in full scale. Statistical analysis was carried out on the signals for the mean and standard deviation. All velocity coefficients derived from the wind tunnel were converted to velocities by integrating the data with the Melbourne wind climate and corresponding to a 1-year return period design wind speeds.

A total of 31 sensors were used in order to provide a quantitative measure of the ground level wind speeds at various locations around the footpaths. One sensor was installed on the rooftop terrace. The sensor locations are shown in Figure 13 and Figure 14 below.

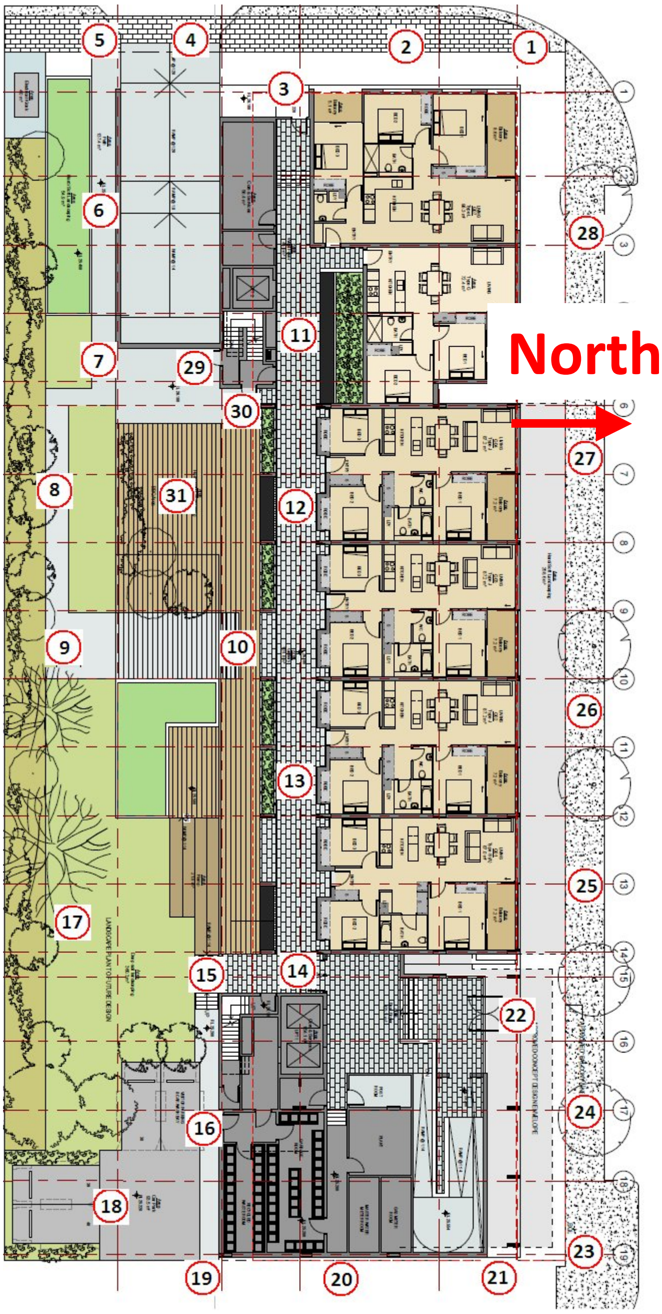


Figure 13: Sensor Locations and Numbers – ground floor of the development

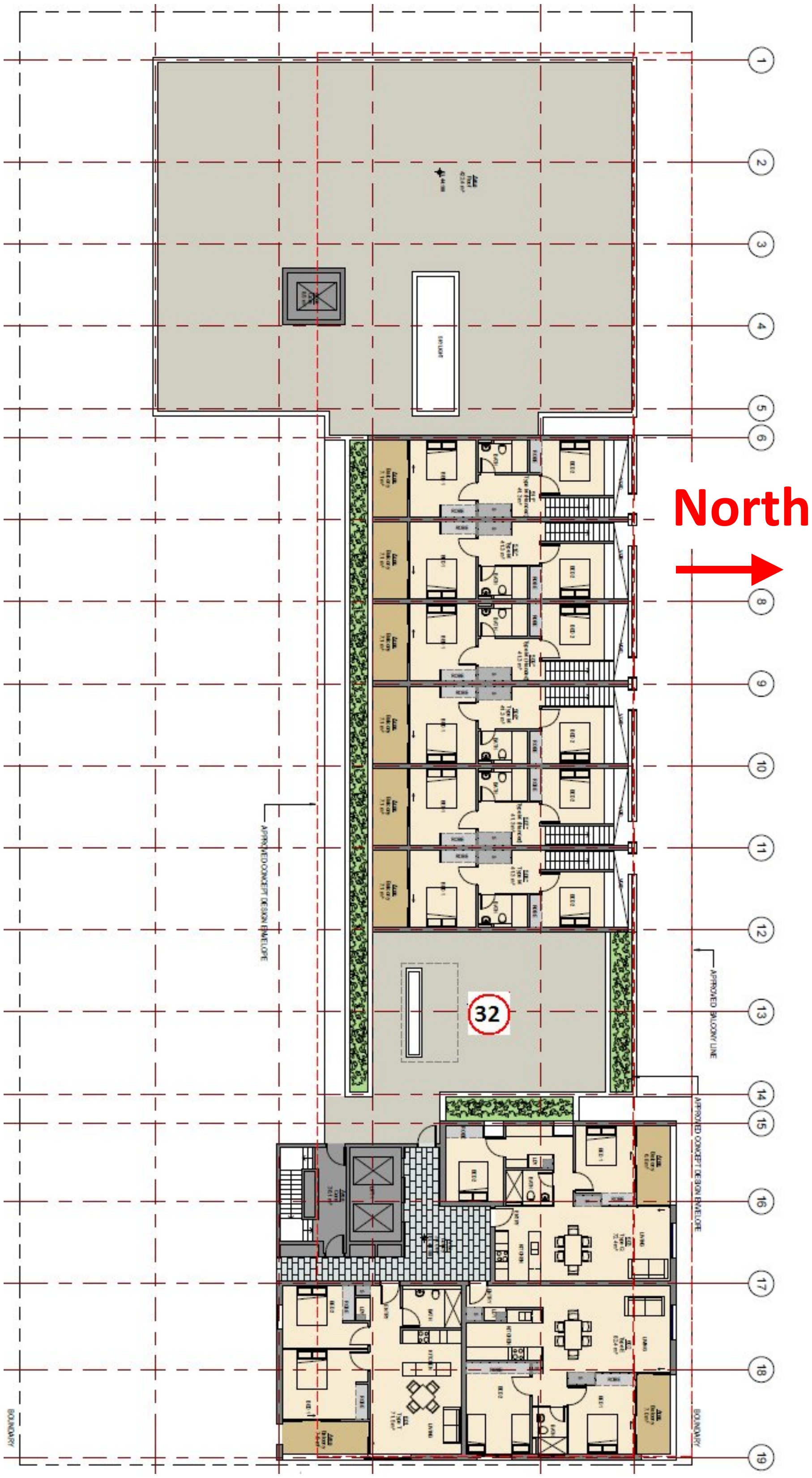


Figure 14: Sensor Locations and Numbers – Level 6

6. WIND TUNNEL TEST RESULTS

6.1. Omni Directional Pressure Sensor Test

The pedestrian wind environment in the footpaths, entrances and rooftop terrace areas was assessed using Omni directional pressure sensor tests. These results are presented as polar plots for the gust wind speeds and are shown in Appendix C of this report. Figure 15 shows an example of these plots. In the figure, the colour circles represent the velocities for the different criteria and the dark blue data points represent the test predicted gust velocity for the 36 directions.

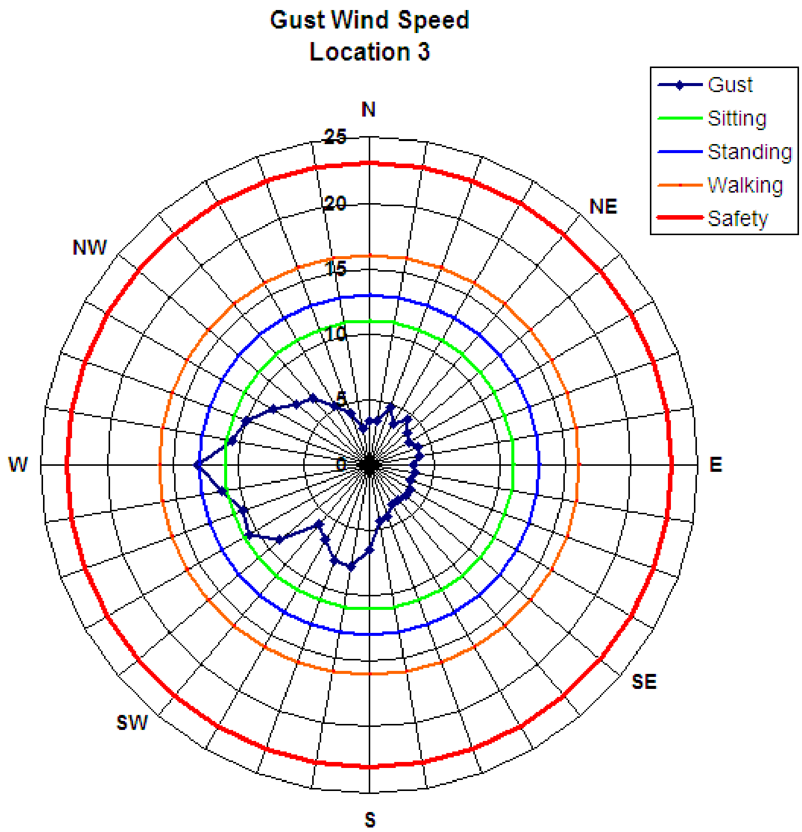


Figure 15: Polar plot showing the wind gust compared with safety and other comfort criteria

Initially, the test was conducted without landscape plantings. After these results were analysed, the areas that exceeded the recommended criteria were retested with the proposed landscaping and other additional wind control measures, in order to mitigate these adverse effects. Refer to Section 7 for details.

The aerodynamic interactions around the proposed development show an influence on ground level wind conditions adjacent to the proposed development. The locations and size of higher wind speeds are highly dependent on wind directions. Corner acceleration is the main contributing factor to the higher wind speeds at these locations.

Based on the tests conducted, the areas of concern were determined. Appropriate mitigation measures are proposed for each of these locations.

7. DISCUSSION OF WIND EFFECTS

The wind tunnel tests revealed that in some locations the wind conditions are likely to be exceeding the recommended criteria, for specific wind directions.

Without landscaping all locations are within the safety criterion. There are some wind-quiet areas suitable for seating activities (Locations 10 to 13 and Location 31) and the area around Location 31 can be used for outdoor cafes.

The wind conditions are likely to exceed the recommended walking criterion at the four corners of the proposed development (Locations 1,5, 19 and 21). Wind conditions at Locations 7 - 9, 17 – 19, 24 and 28 also exceeded the walking criterion (see Figure 16). Location 16 would likely to have wind conditions to exceed the recommended standing criterion (see Figure 167). These mostly occur during westerly, southerly and northeast winds, which are the prevailing wind directions for the site. These adverse effects are due mainly to the corner acceleration and direct exposure to the winds.

The **proposed landscaping** close to the problem areas was then included as per Figure 18. **Additional trees** were also added at the building corners (Figure 18). This landscaping reduced all locations to within the recommended criteria except for the entrance area of Location 16 (indicated in Figure 18) which requires further wind control measures.

In order to reduce the wind levels at **Location 16** to within the recommended standing criterion, additional wind control measures were required (refer to Figure 167 and Figure 18). Figure19 shows a comparison between the wind speeds seen at this location with and without the wind control measures (1m wide and 2 m high windscreen at the east side of the entrance). This wind control measure can be replaced by 1 m set back entrance design (similar to the entrance of Location 3), which is highly recommended. A picture of the test set up with the landscaping and other wind mitigation measures in place is shown in Figure 0.

Figure 16: Highlighted areas that exceed the recommended walking criterion *without the proposed landscaping*

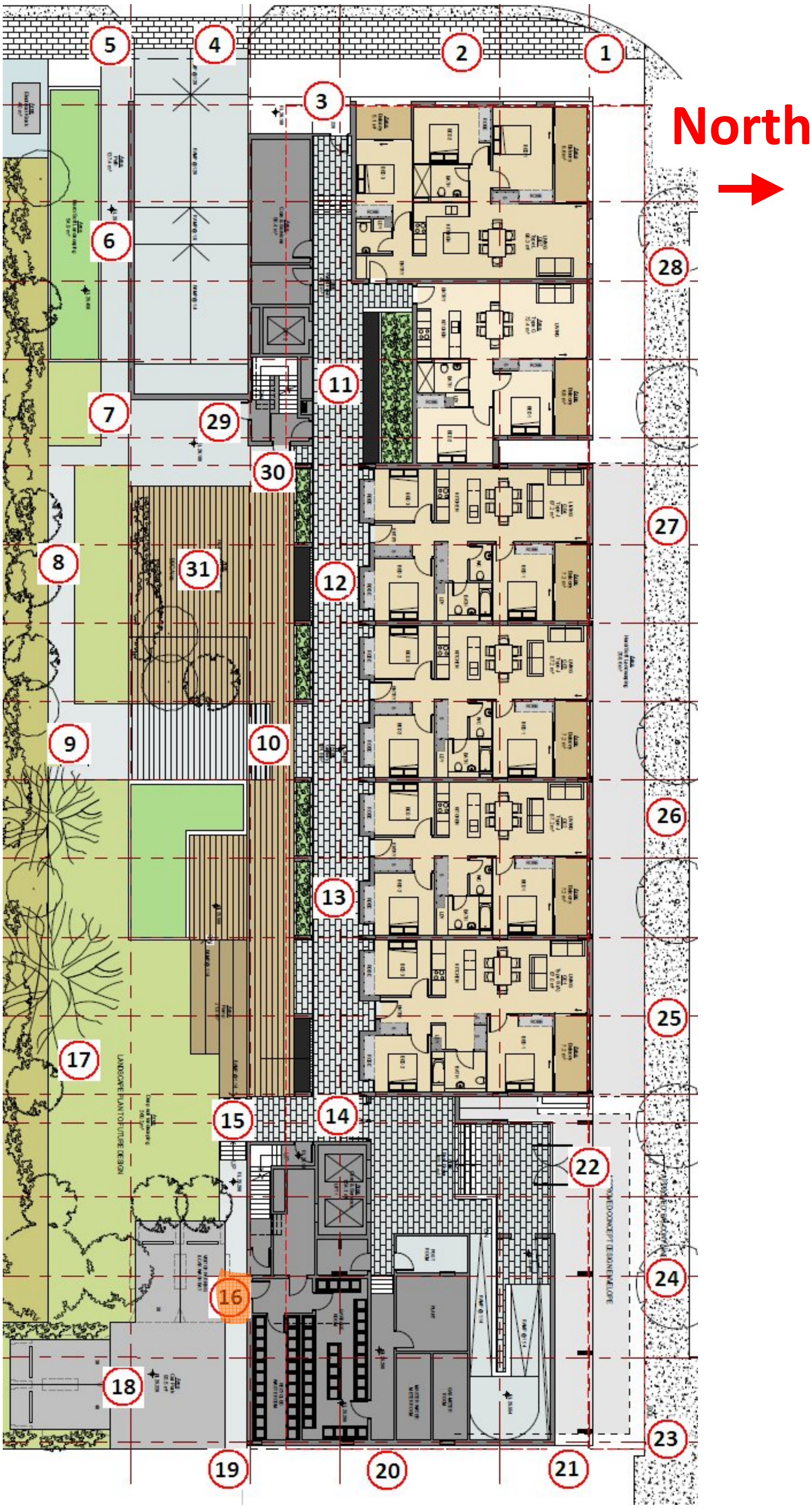


Figure 17: Highlighted areas that exceed the recommended Standing criterion *without wind control measures*

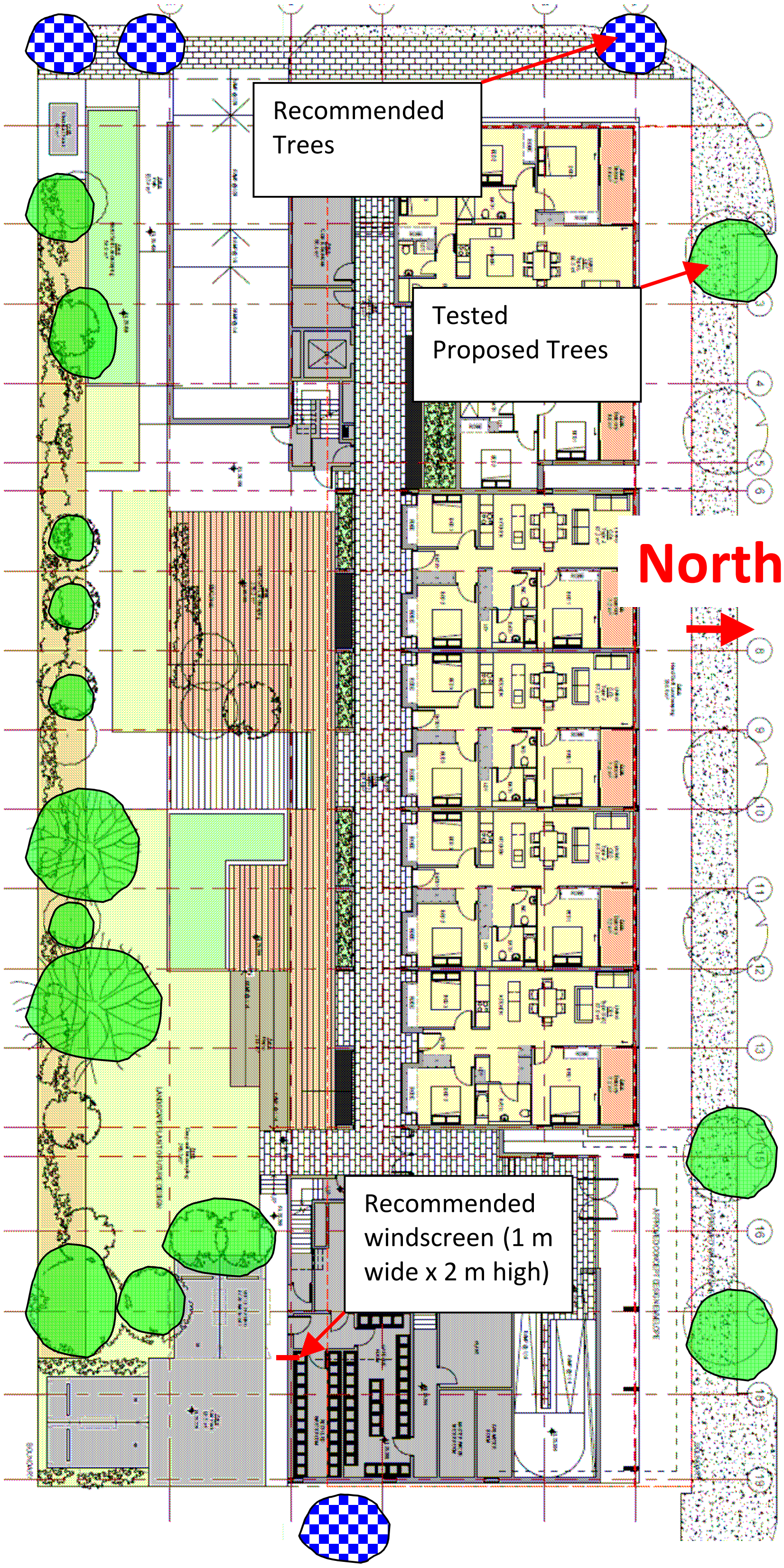


Figure 18: Proposed and recommended landscaping and windscreen that was included in the testing in order to reduce wind speeds to within the recommended criteria.

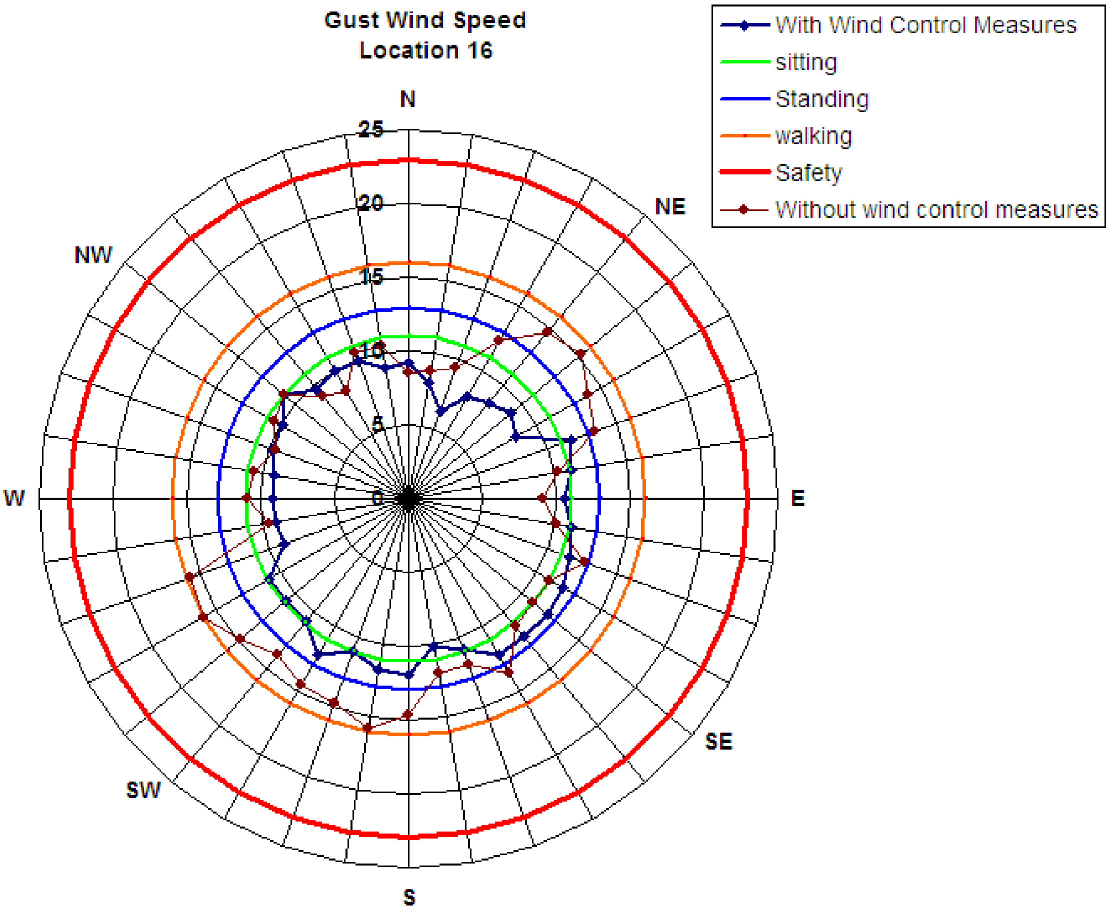


Figure 19: Polar plot comparing the wind conditions at Location 16 with and without wind control measures

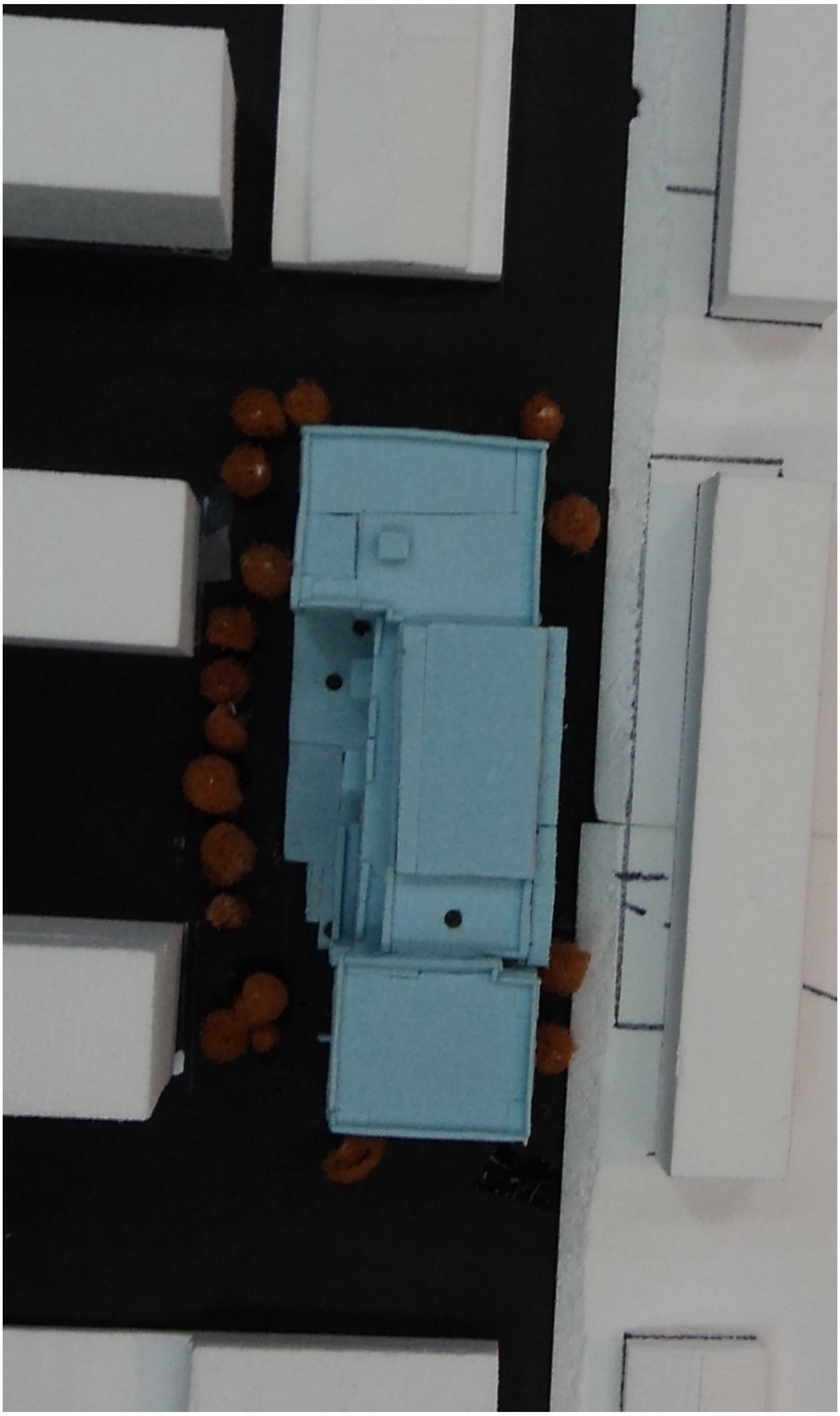


Figure 20: Test picture with the proposed and recommended landscaping

7.1. Recommendations

Tests indicated that examined areas except (Locations 1, 5, 16 and 19) satisfied the recommended criteria with the proposed design and landscaping. Therefore, the following **additional** wind mitigation measures are recommended for the proposed development:

- Additional trees are recommended for the building corners at Locations 1, 5, and 19. These trees are shown in Figure 18.
- 1 m set back design for the entrance area at Location 16 or a 1 m wide and 2 m high windscreen at the east side of the entrance (shown in Figure 18).

The set back entrance suggestion for location 16 has been incorporated in the updated design (see Figure 21). The car park areas at Location 18 are changed to landscaped areas in the updated design. The recommended landscaping (trees) at the west end of the project is also included.

One recommended and tested tree at the southeast corner of the building cannot be proposed because the location is in the hardstand outside the property boundary. Further analysis was carried out for wind conditions at Location 19.

Taking the probability distribution of wind from each direction and integrating the values using up-crossing method, the predicted wind speed at Location 19 just touches the walking criterion boundary (16 m/s). Thus it will be within the walking criterion under the landscaping condition shown in Figure 21.

Therefore, with these changes the proposed development will have wind conditions that satisfy the recommended criteria.

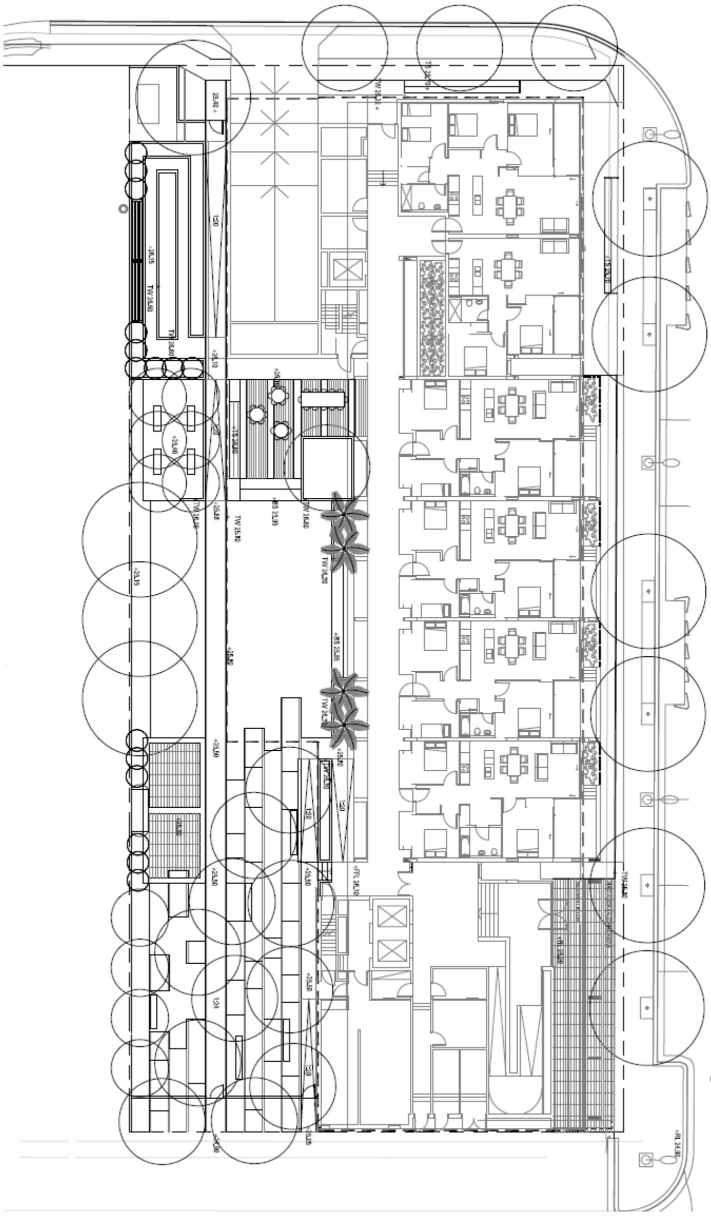


Figure 21 Updated ground floor plan incorporated with wind tunnel test findings

8. CONCLUSIONS

Vipac carried out the wind tunnel testing of pedestrian level wind effects for the proposed development at **Site D4 North Eveleigh Affordable Housing, Eveleigh, NSW**.

Wind conditions were assessed based on internationally accepted comfort and safety criteria. Based on the test results, the following conclusions are drawn:

With the proposed designs, without any landscaping:

- The development will satisfy the criterion for safety at all locations.

Vipac recommended and tested the following wind mitigation measures:

- Additional trees on the west and east side of the proposed development.
- Set back of 1 m for the entrance at southeast side or installation of a 1 m wide by 2 m high windscreen at the east side of the entrance.

The above wind mitigation measures are incorporated in the updated ground level design (see Figure 21). Hence with the proposed designs:

- Wind conditions adjacent to the proposed development will satisfy criterion for **walking** along the footpath and other pedestrian areas.
- Wind conditions will satisfy criterion for **standing** in the building entrance areas.
- All balconies and the rooftop terrace will likely to satisfy the recommended walking criterion, however, as a general statement for any high-rise development, educating occupants about wind conditions at open terrace areas during high-wind events and tying down loose lightweight furniture are highly recommended.

There are some wind-quiet areas suitable for seating activity (Locations 10 to 13 and 31) and the area around Location 31 can be used for outdoor cafes.

This report has been prepared

for

Pacific Echo Pty Ltd

by

Vipac Engineers & Scientists Ltd

9. REFERENCES

1) Australian/New Zealand Standard 1170.2:2011, Wind actions

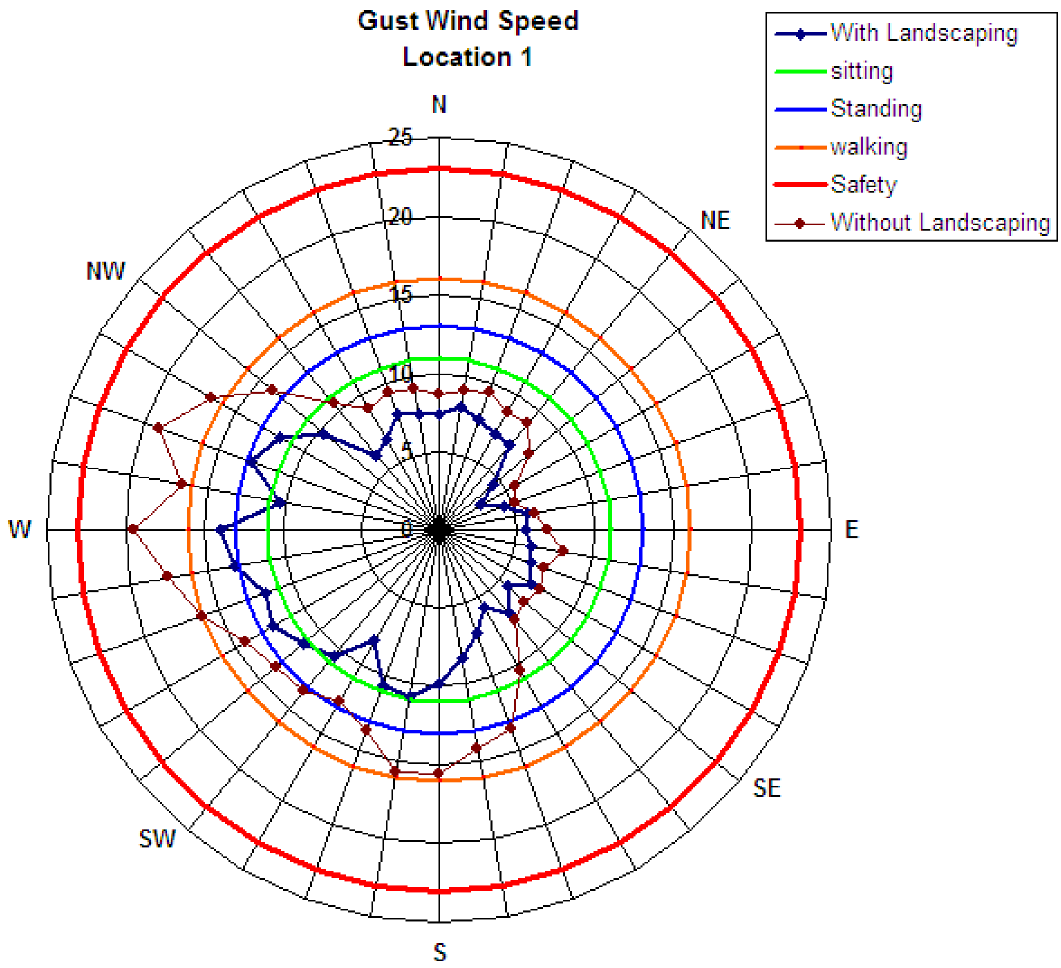
2) Melbourne, W. H., “Criteria for Environmental Wind Conditions”, Jour. Industrial Aerodynamics, Vol. 3, 241-249,1978

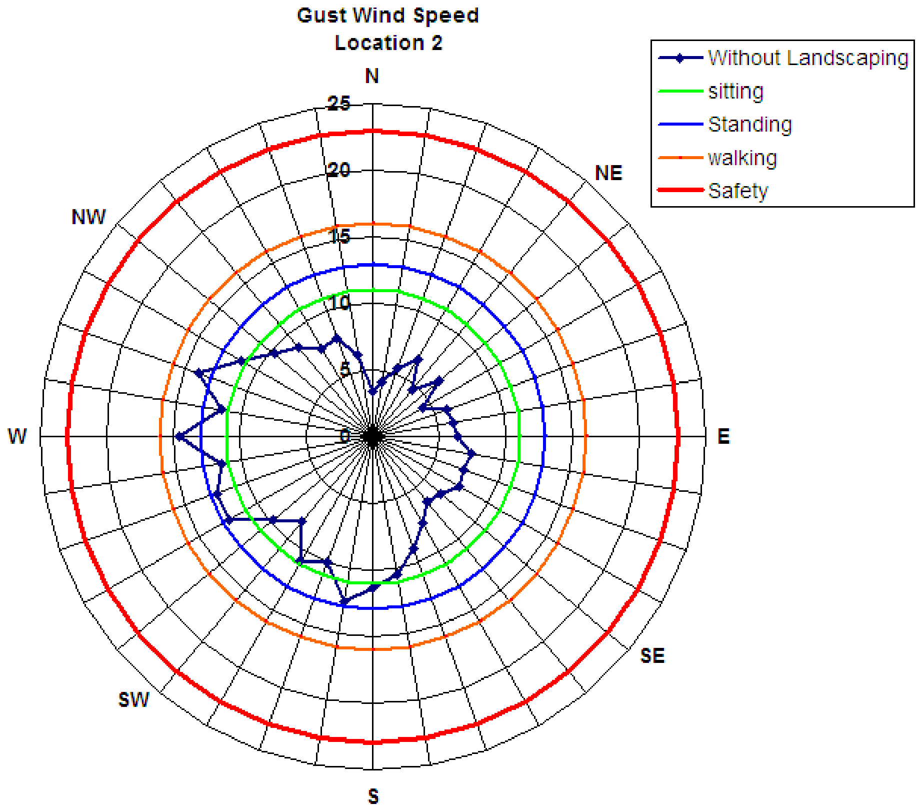
3) Australian Wind Engineering Society, “Cladding Pressure and Environmental Wind Studies” Quality Assurance Manual, 1994

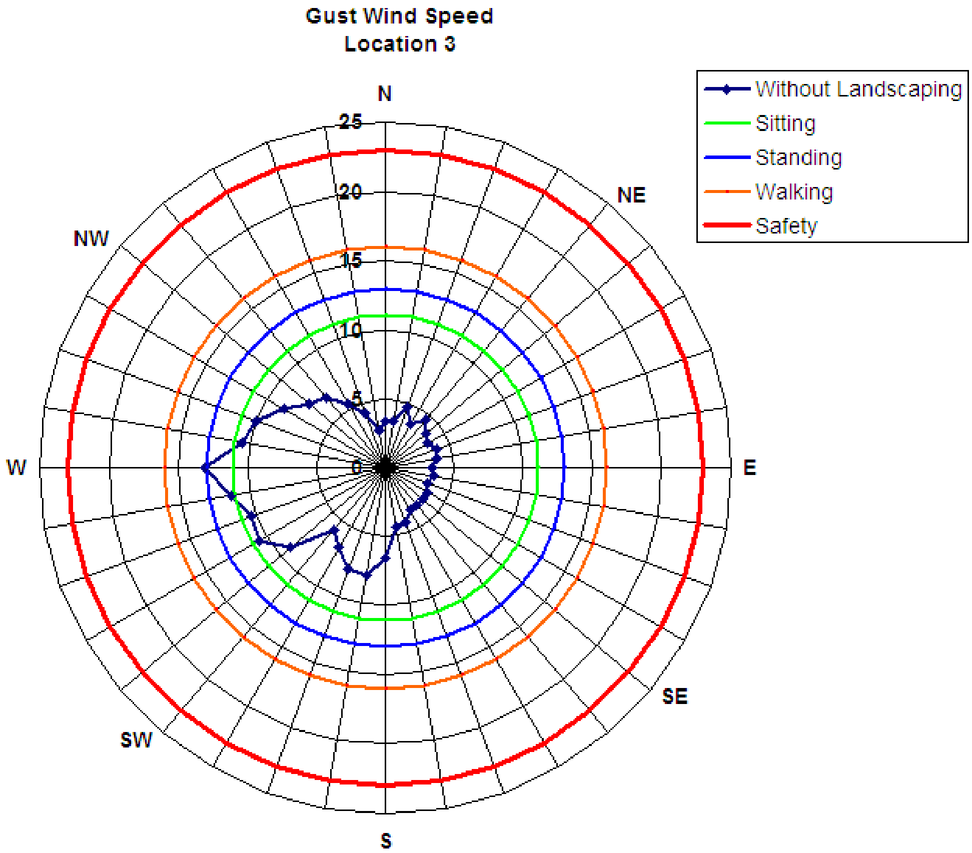
4) AS/NZS 1170.2 Supplement 1: 2011

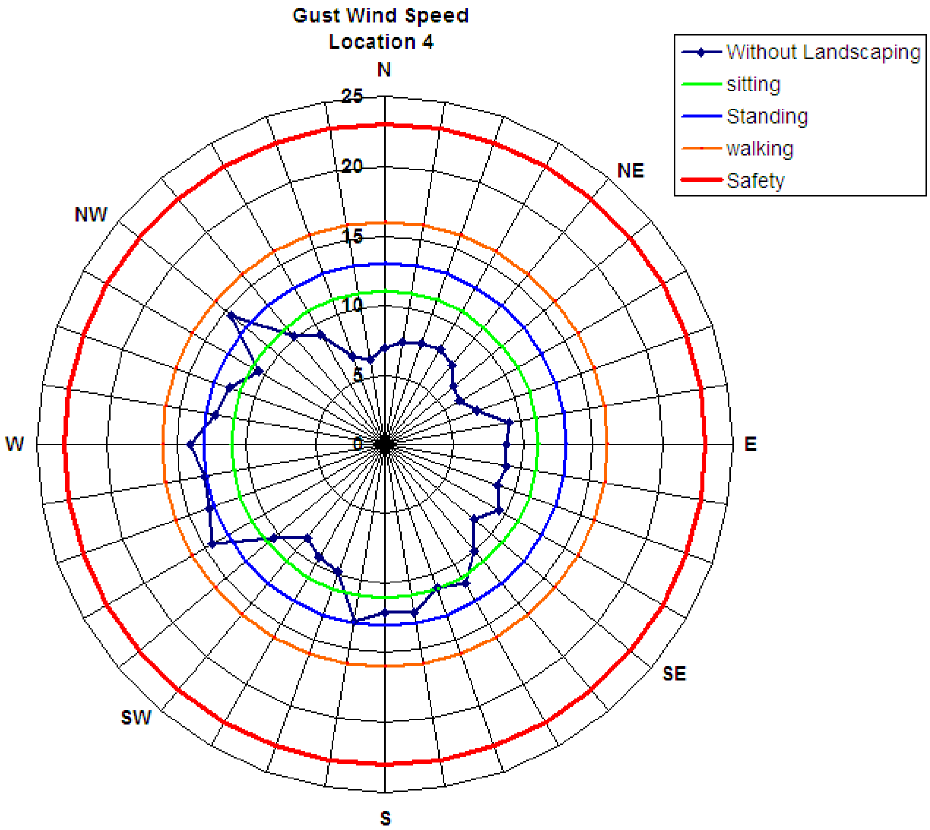
APPENDIX A – POLAR PLOT FOR WIND SPEEDS AT ALL LOCATIONS

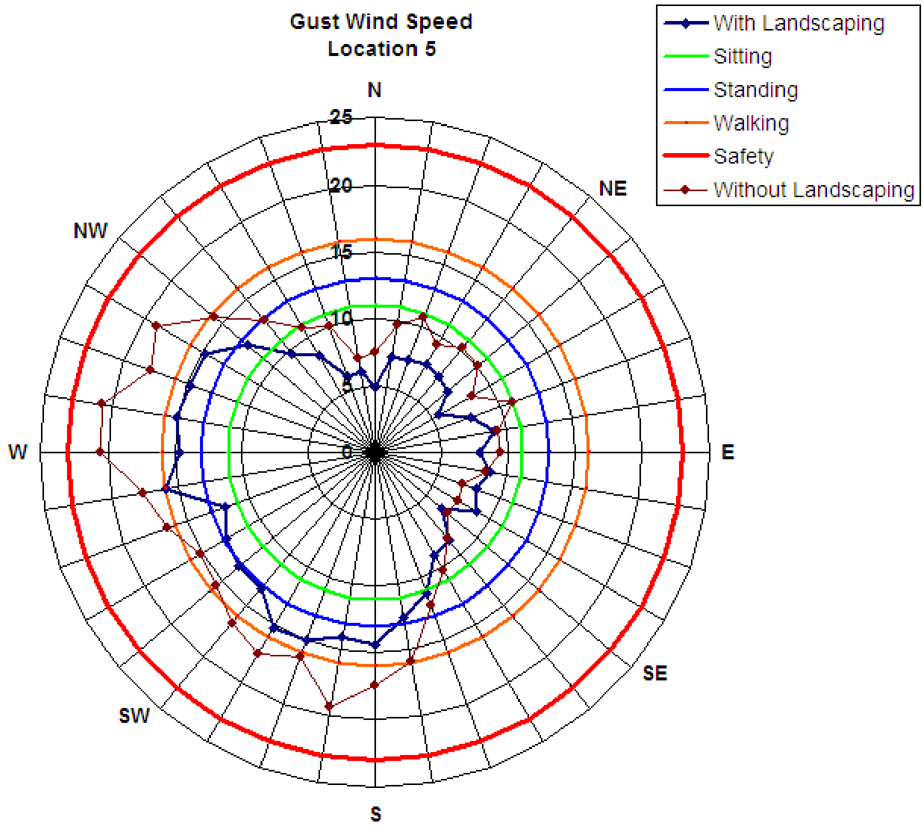
Note: Gust wind speeds for all test locations are presented only.

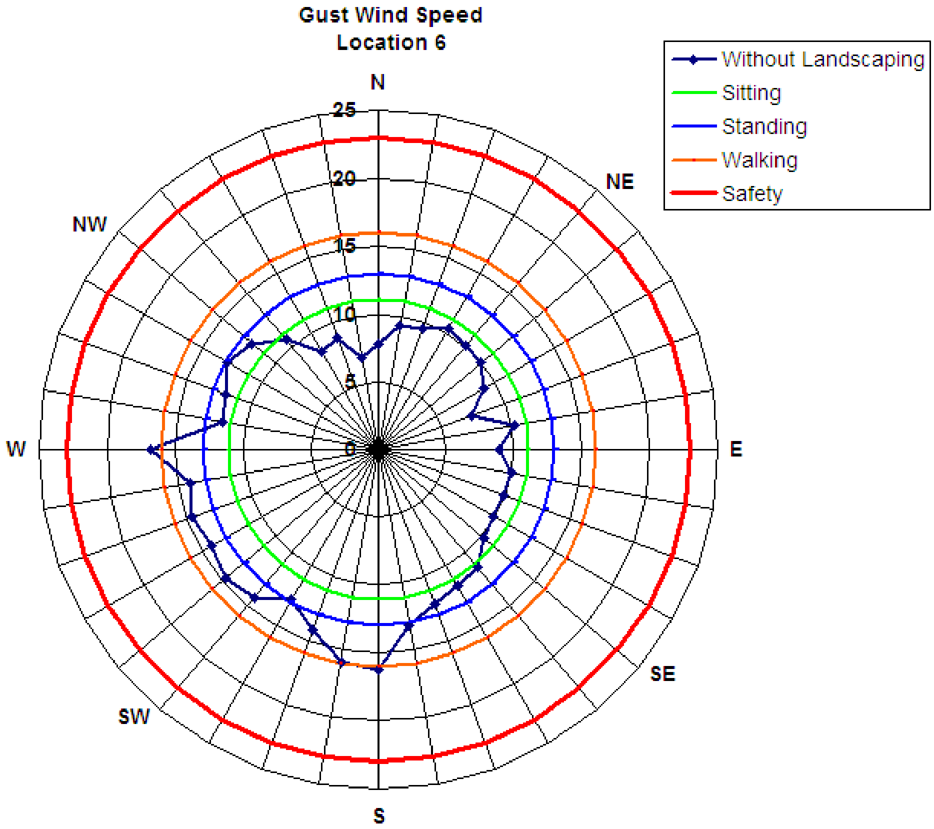


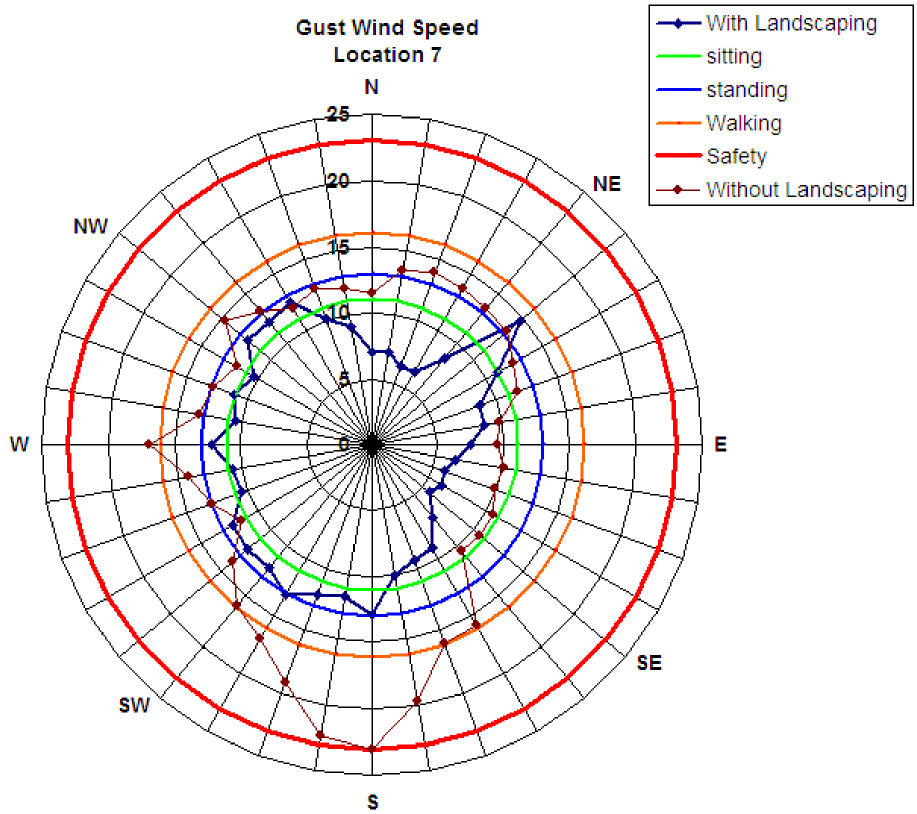

Gust Wind Speed
Location 2
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Without Landscaping
sitting
Standing
walking
Safety

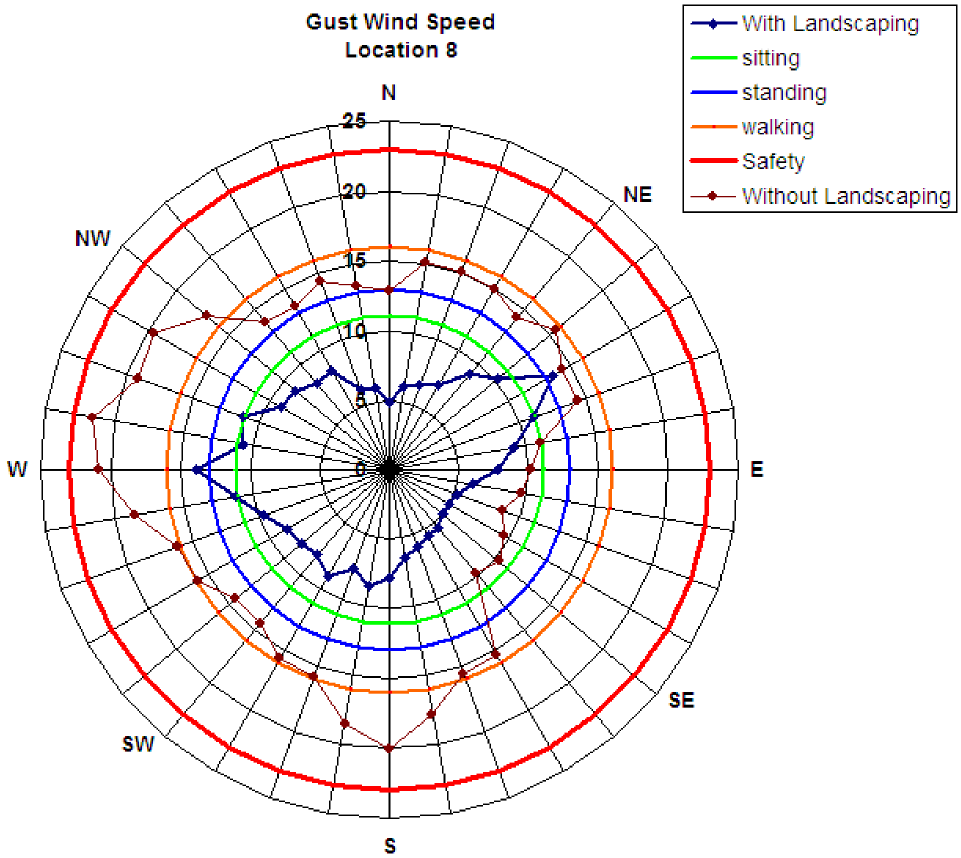

Gust Wind Speed
Location 3
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0
Without Landscaping
Sitting
Standing
Walking
Safety

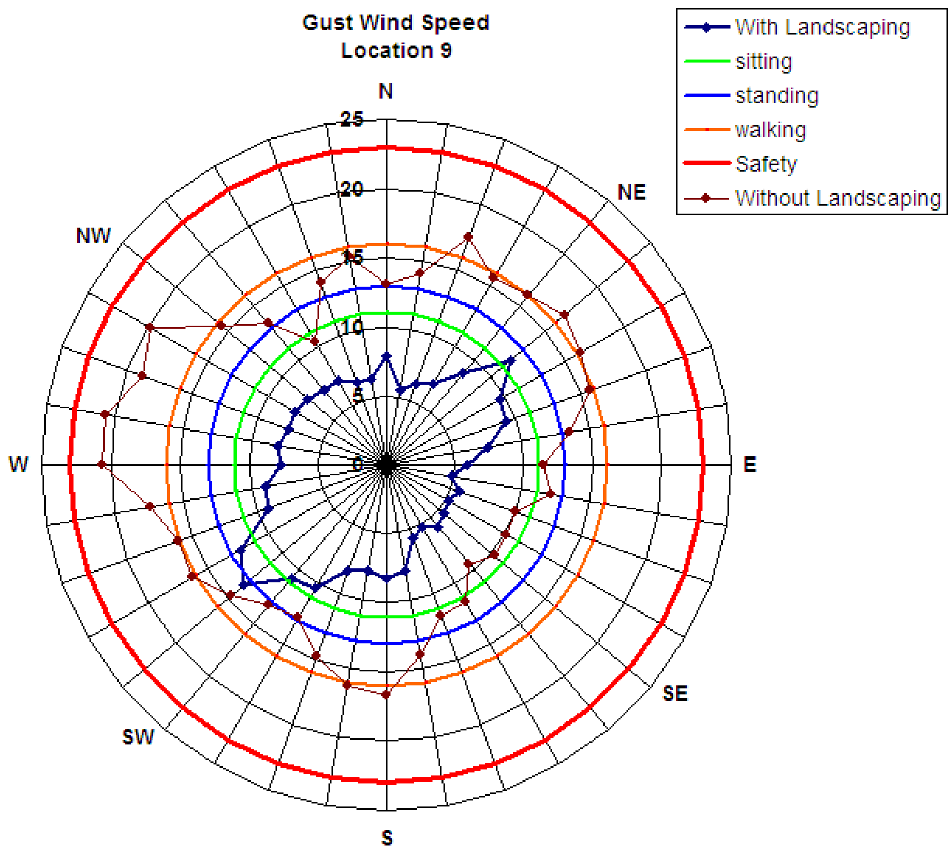

Gust Wind Speed
Location 4
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25
Without Landscaping
sitting
Standing
walking
Safety

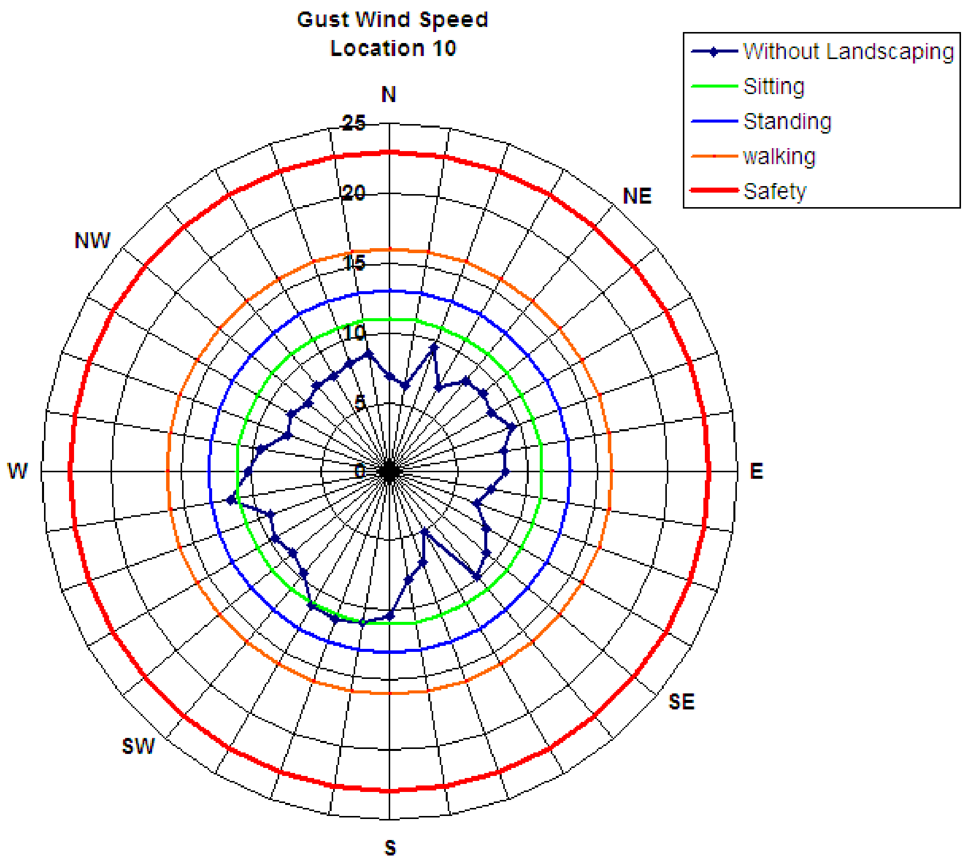

Gust Wind Speed
Location 5
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25
With Landscaping
Sitting
Standing
Walking
Safety
Without Landscaping

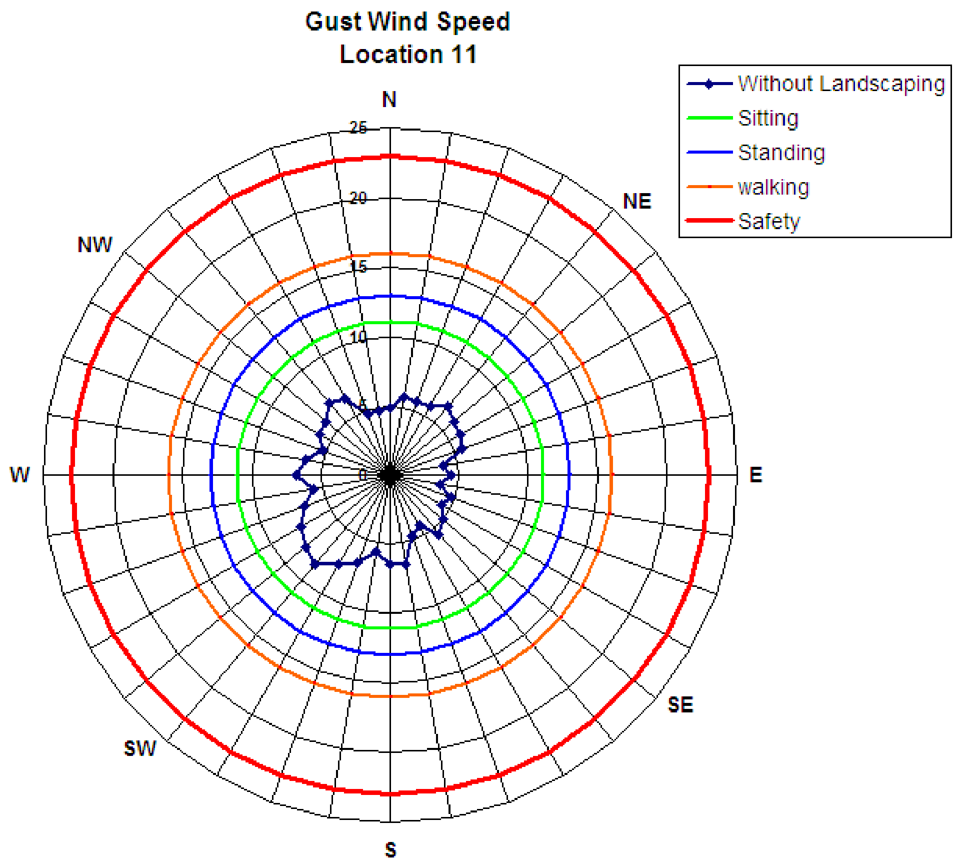

Gust Wind Speed
Location 6
Without Landscaping
Sitting
Standing
Walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

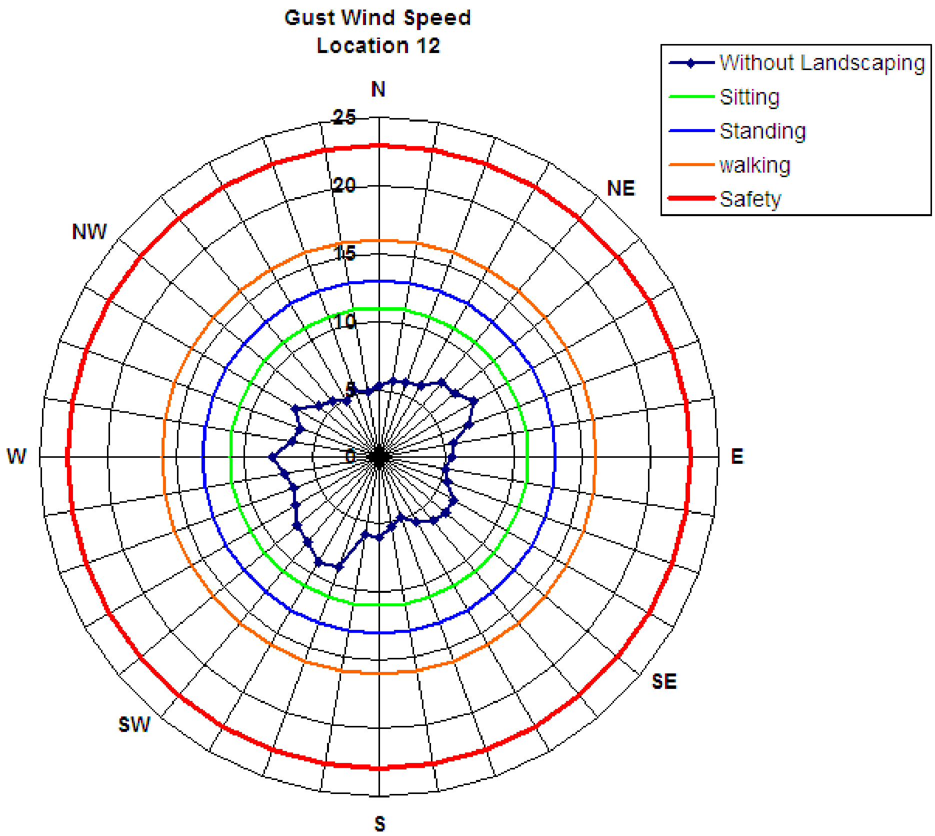

Gust Wind Speed
Location 7
With Landscaping
sitting
standing
Walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

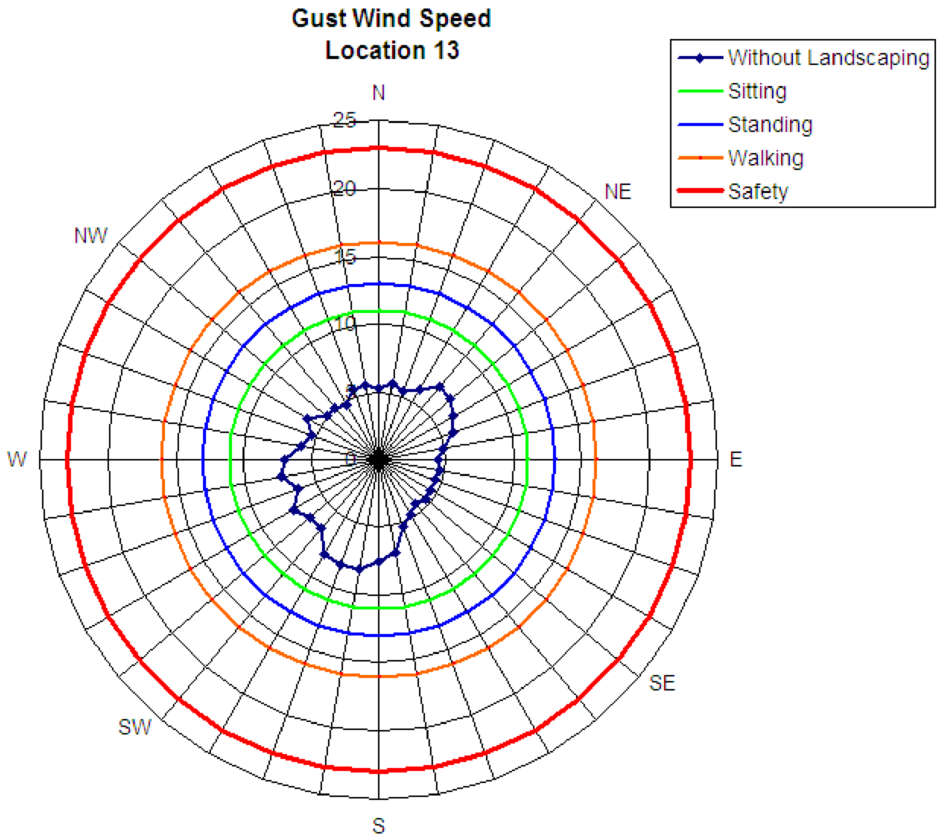

Gust Wind Speed
Location 8
With Landscaping
sitting
standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25


Gust Wind Speed
Location 9
With Landscaping
sitting
standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25

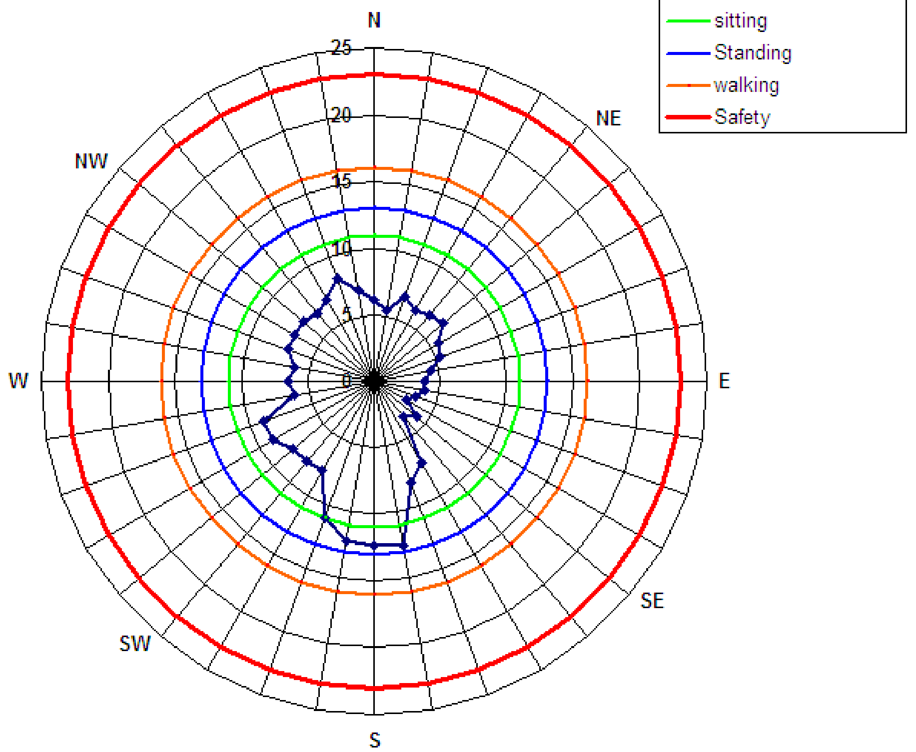

Gust Wind Speed
Location 10
Without Landscaping
Sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0


Gust Wind Speed
Location 11
Without Landscaping
Sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

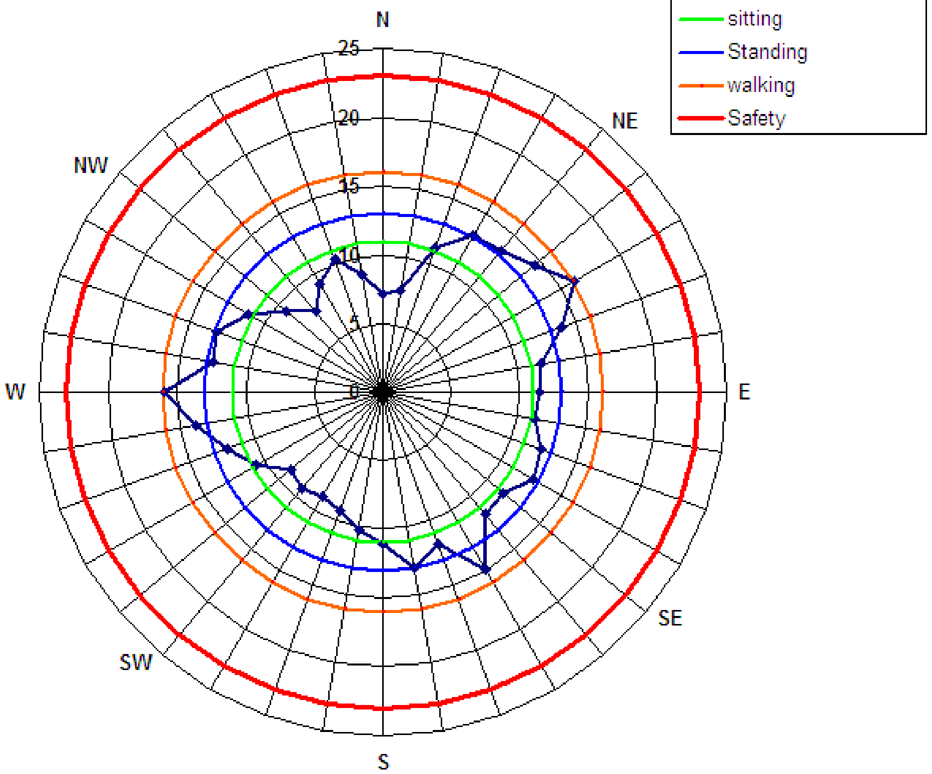

Gust Wind Speed
Location 12
Without Landscaping
Sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

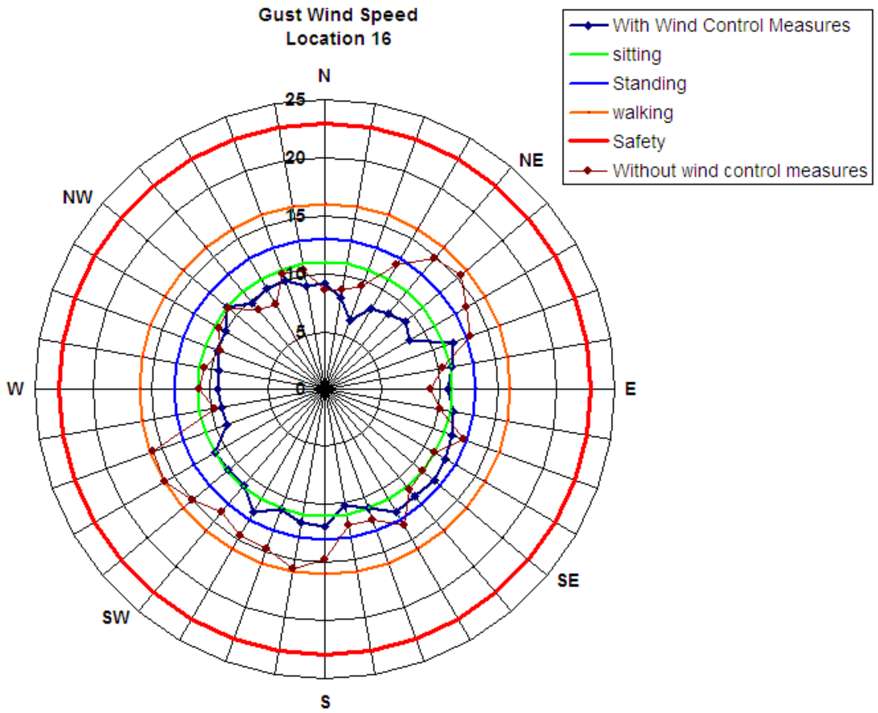

Gust Wind Speed
Location 13
Without Landscaping
Sitting
Standing
Walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

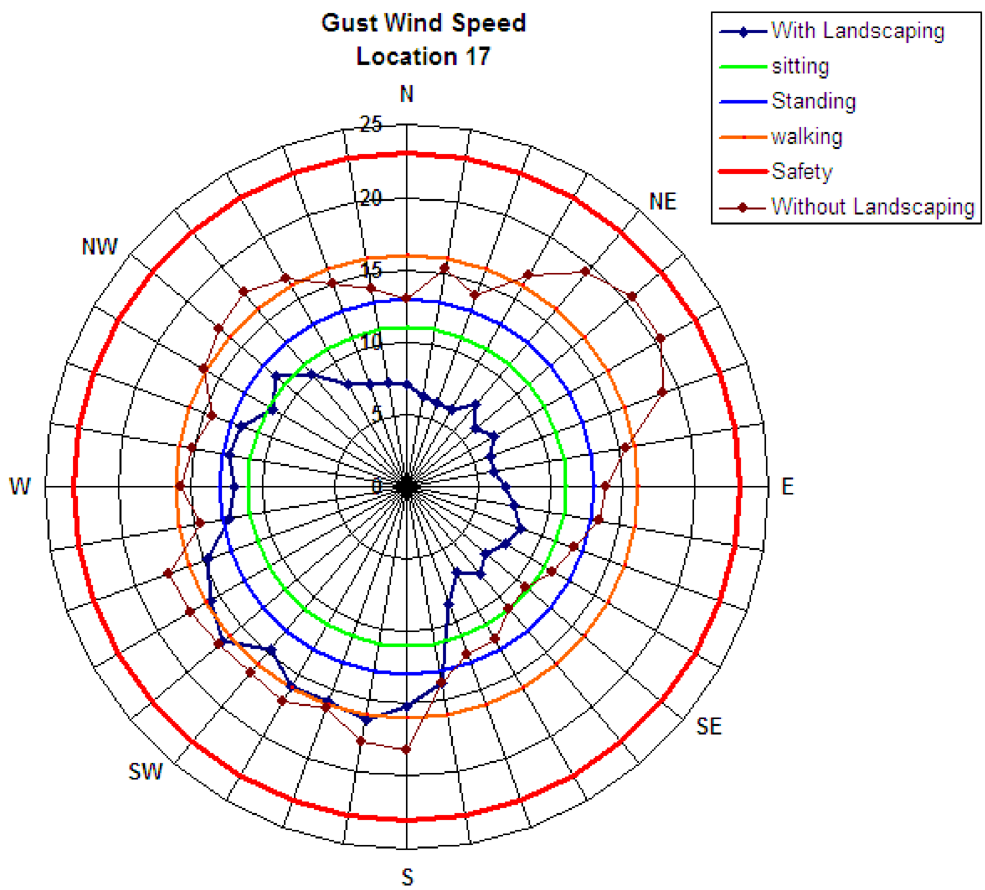
Gust Wind Speed
Location 14

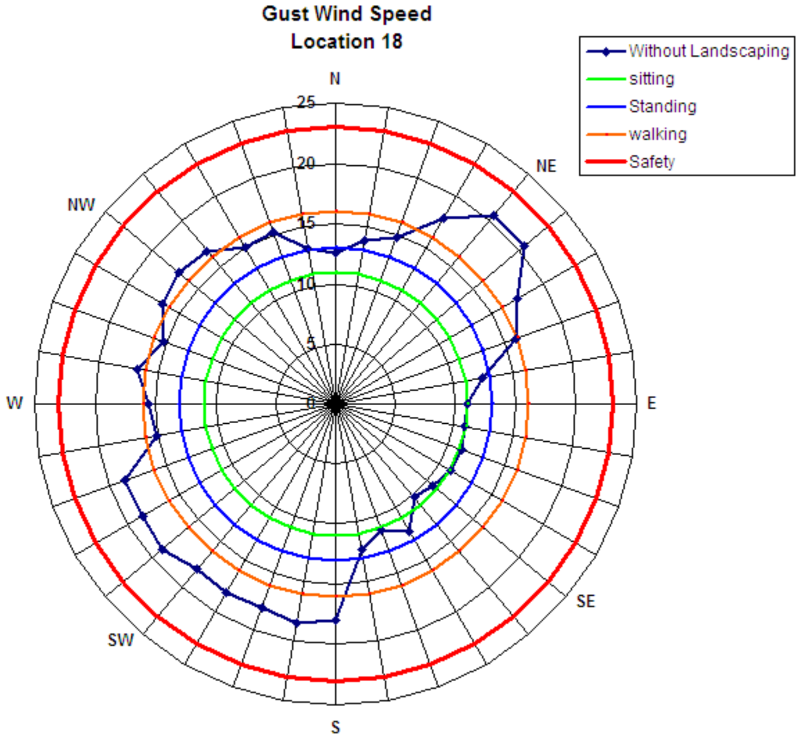


Gust Wind Speed
Location 15

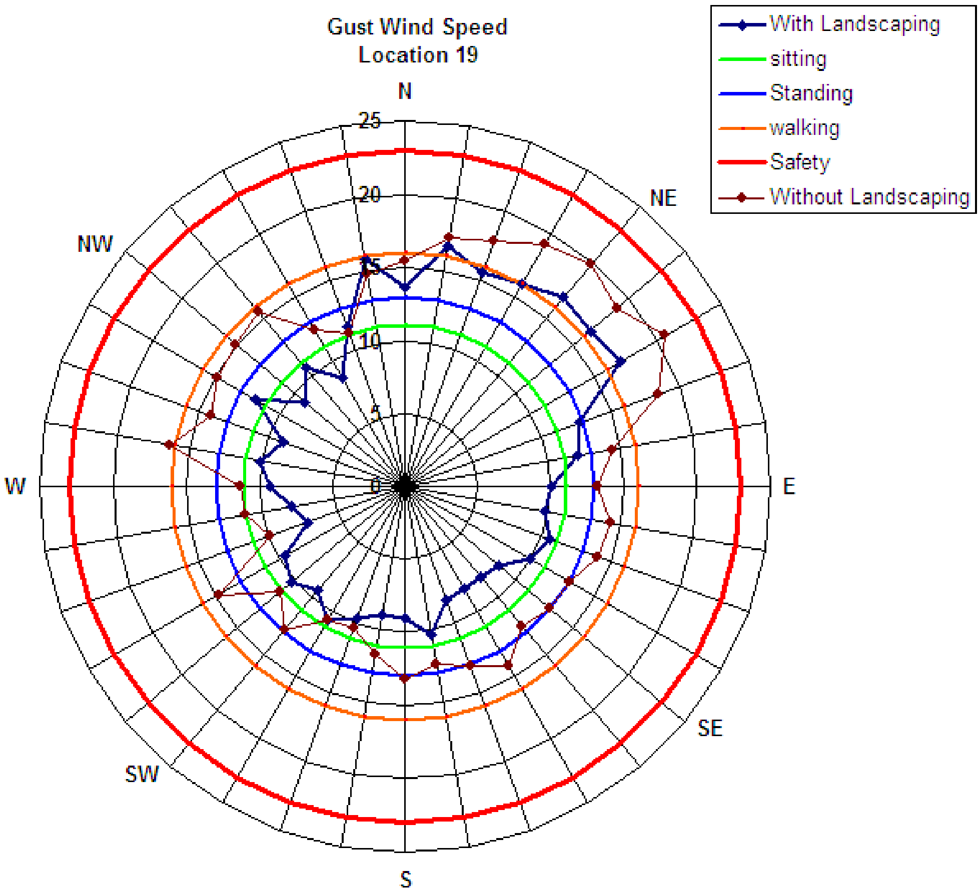


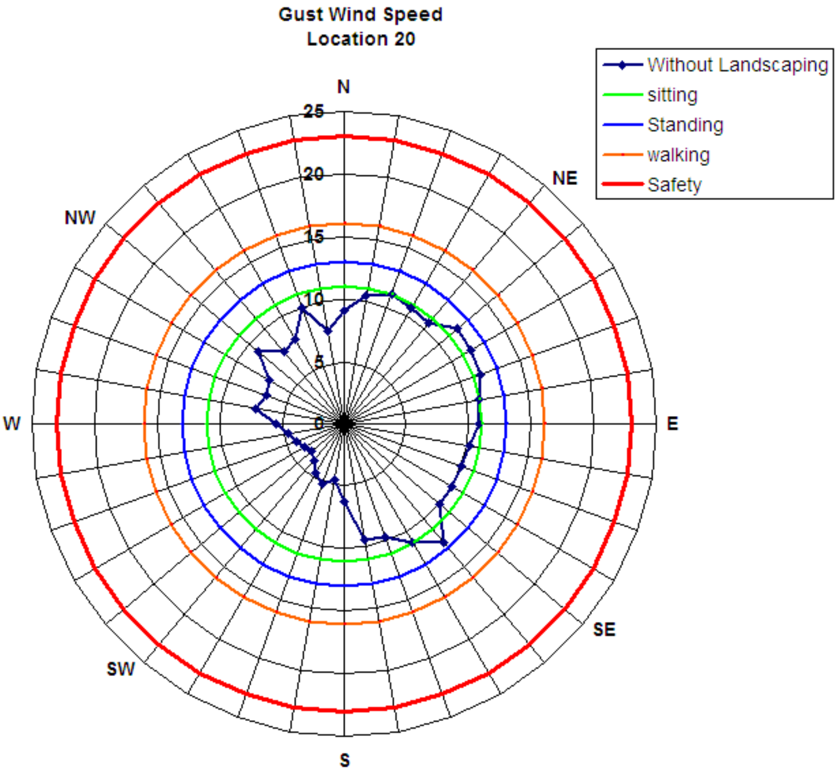

Gust Wind Speed
Location 16
With Wind Control Measures
sitting
Standing
walking
Safety
Without wind control measures
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

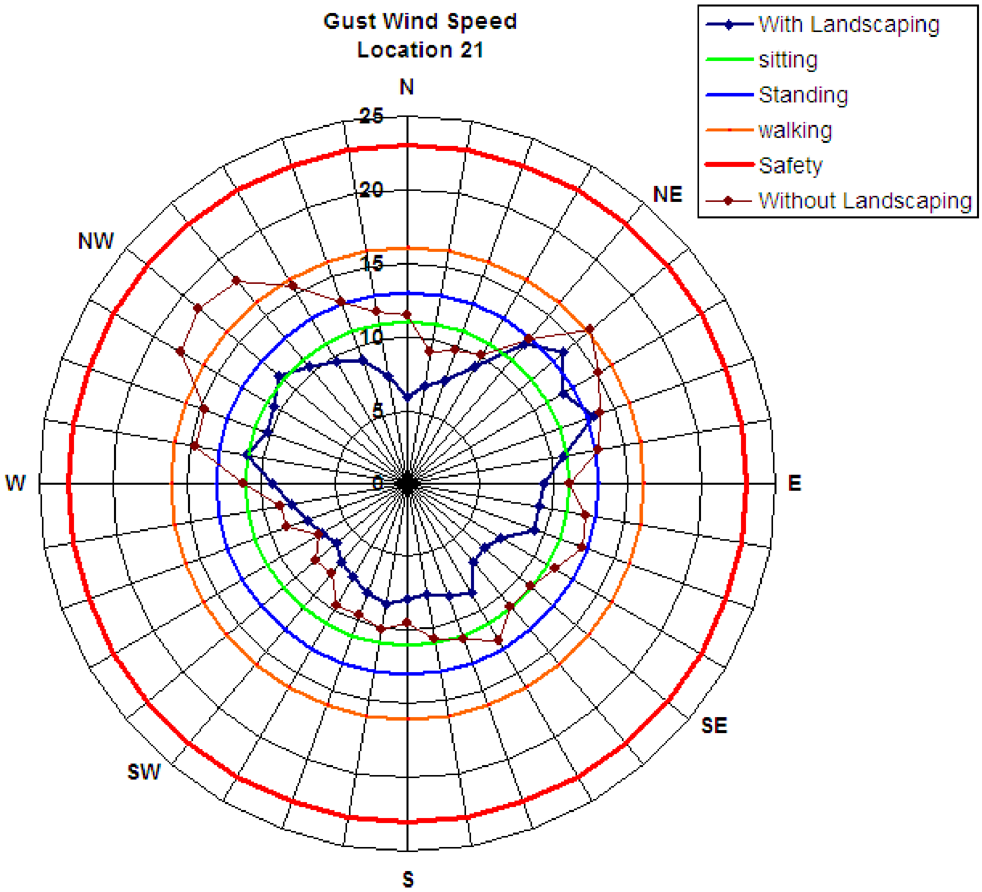

Gust Wind Speed
Location 17
With Landscaping
sitting
Standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

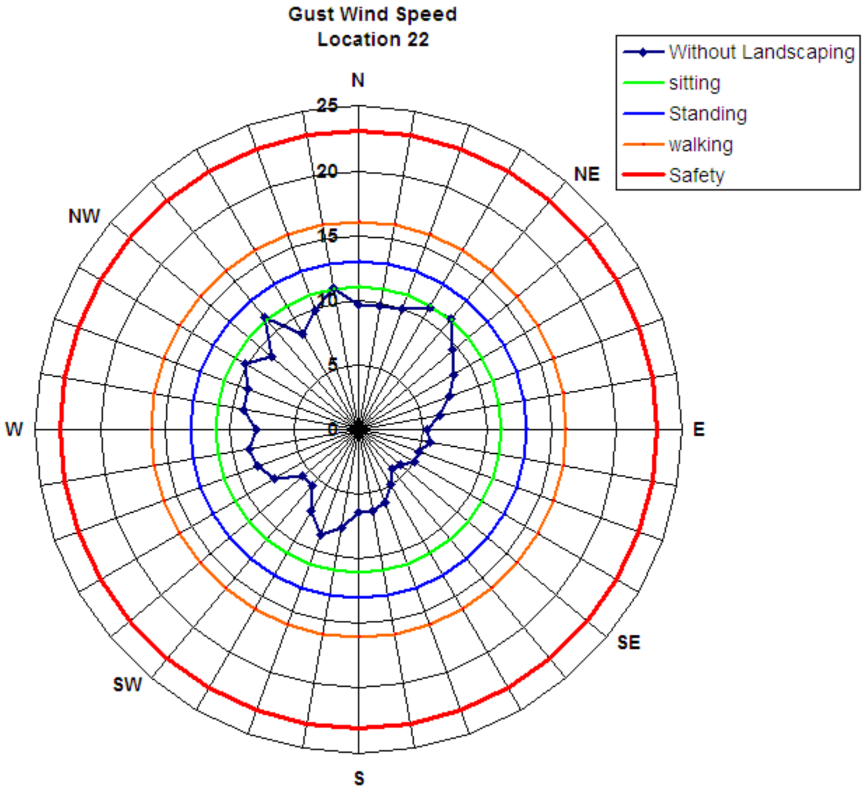


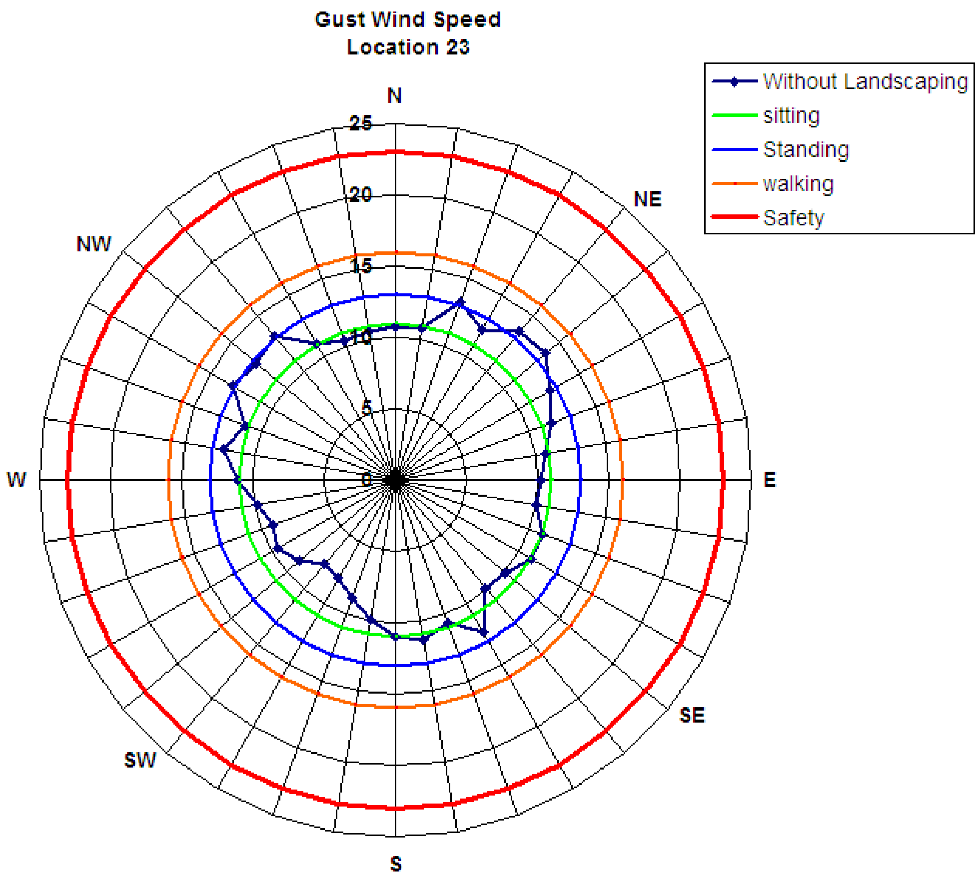
Note: For Location 18, test results were the wind speeds at the previously proposed car park areas. With updated design (landscaped areas) the wind speeds will be within the walking criterion.

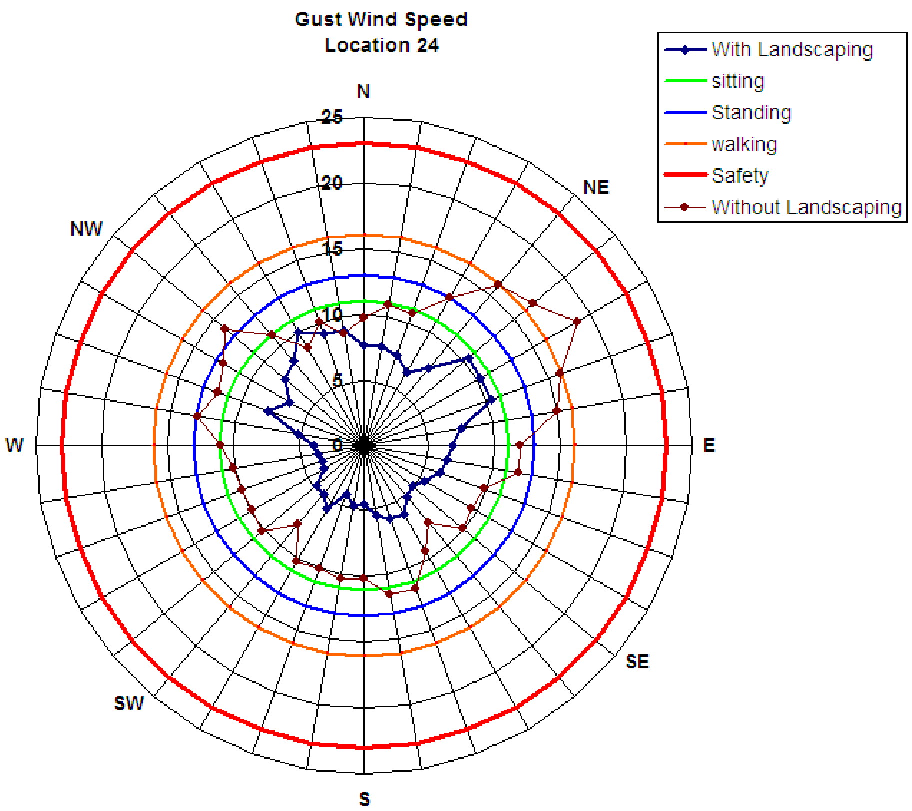


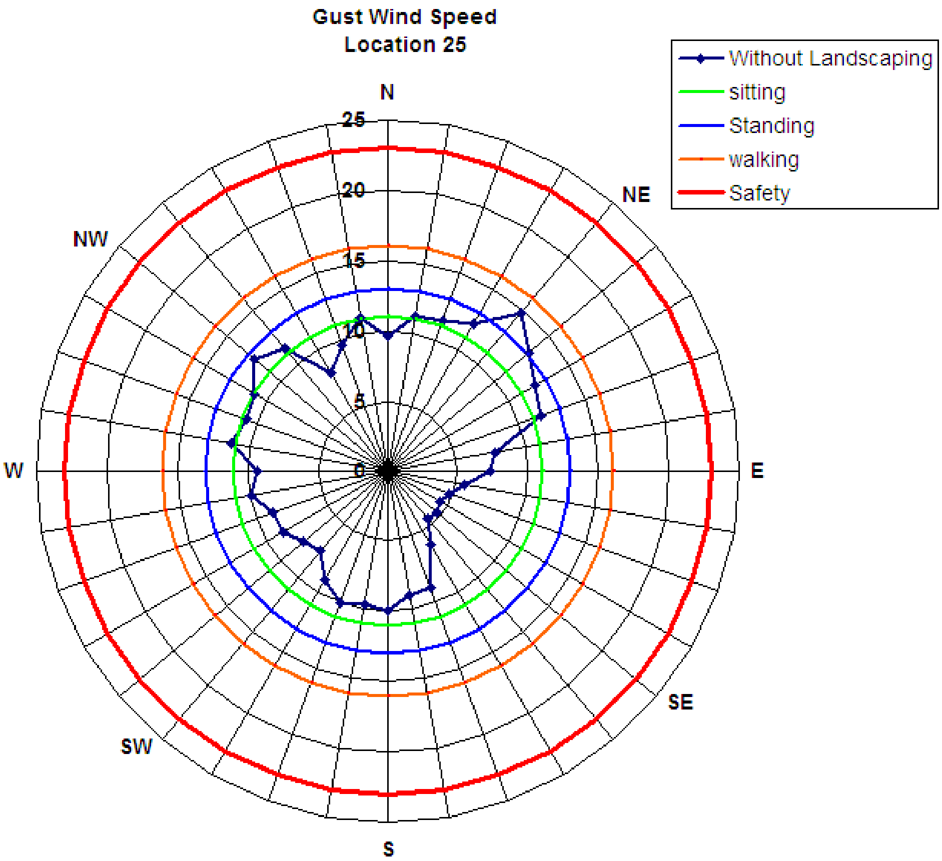

Gust Wind Speed
Location 20
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

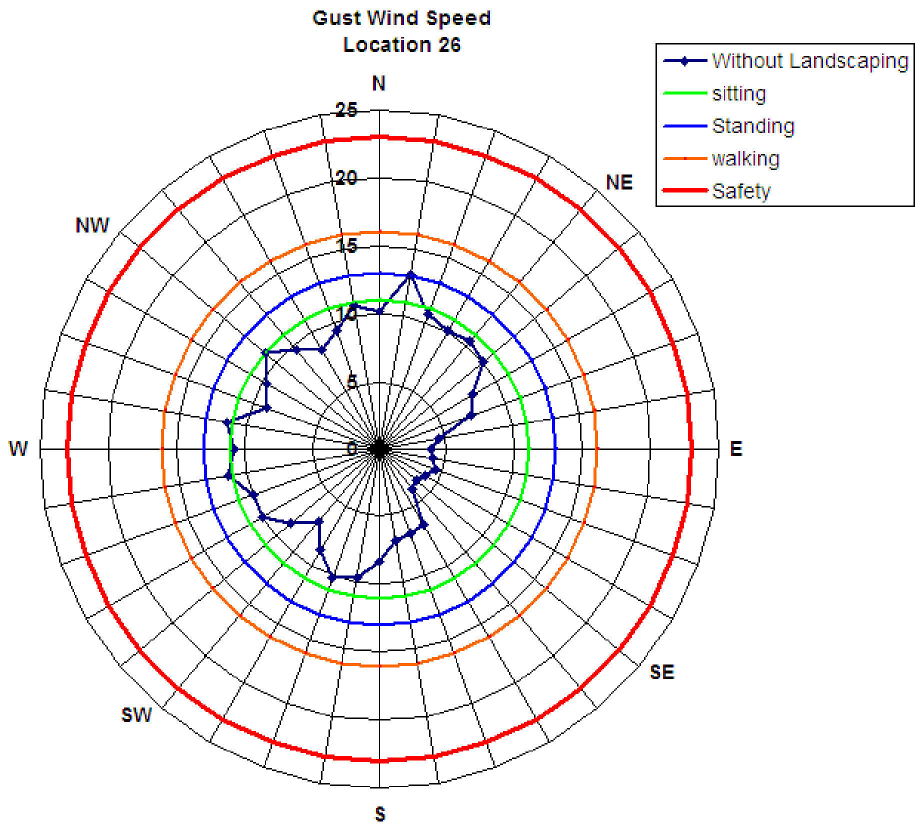

Gust Wind Speed
Location 21
With Landscaping
sitting
Standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

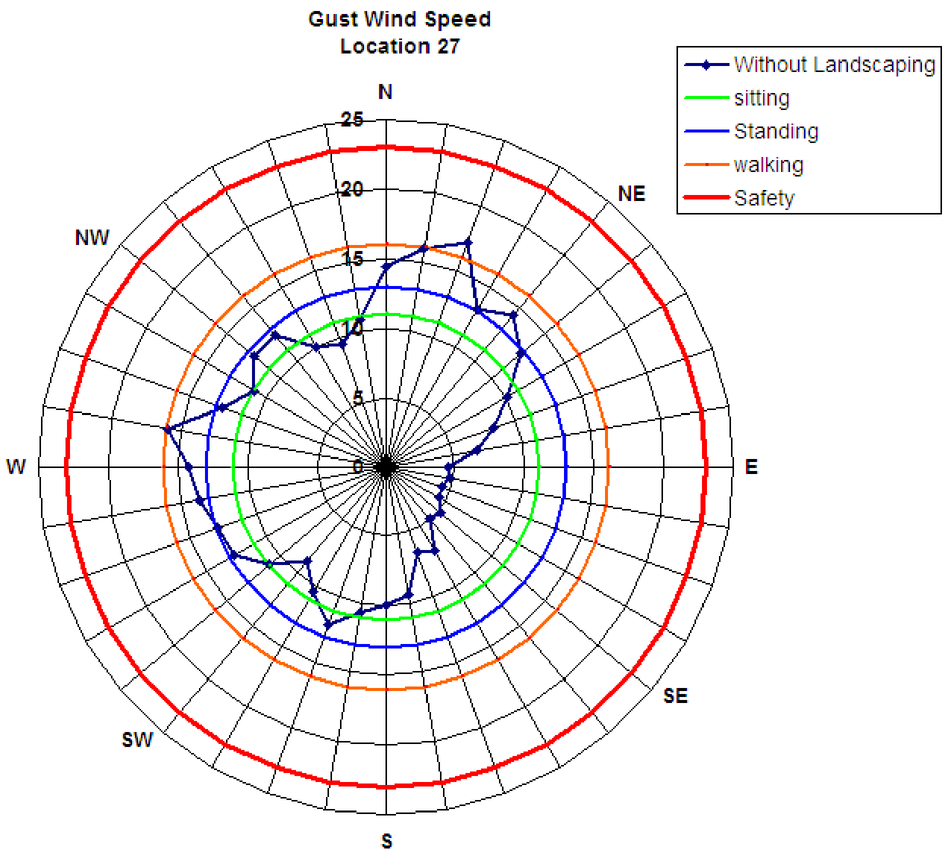

Gust Wind Speed
Location 22
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25

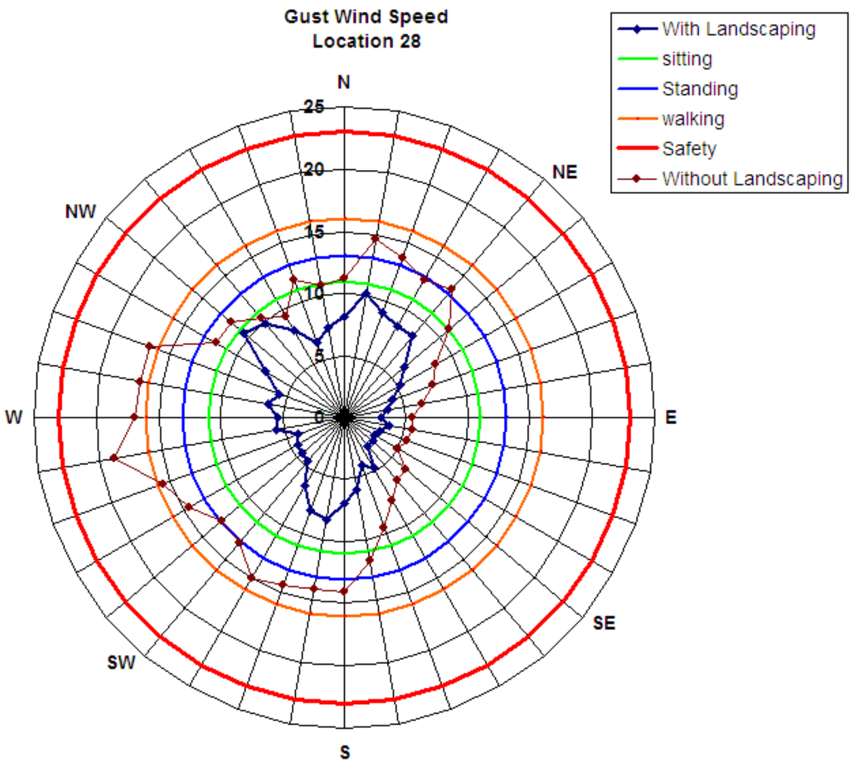

Gust Wind Speed
Location 23
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25

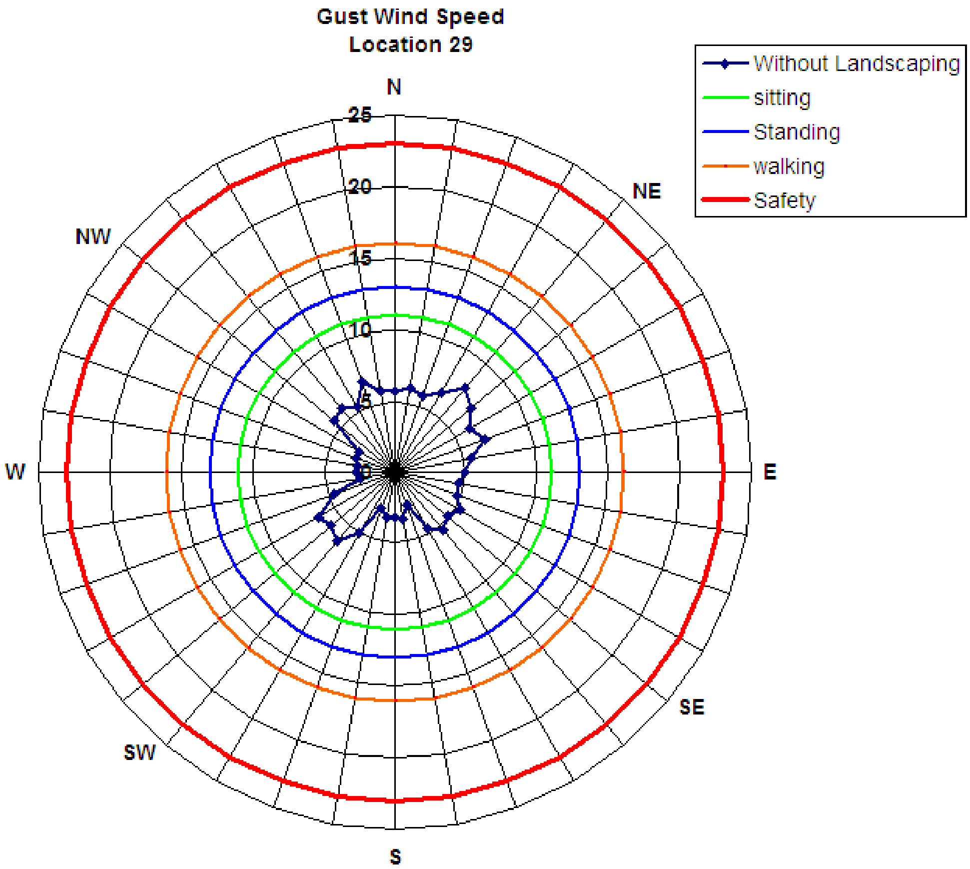

Gust Wind Speed
Location 24
With Landscaping
sitting
Standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

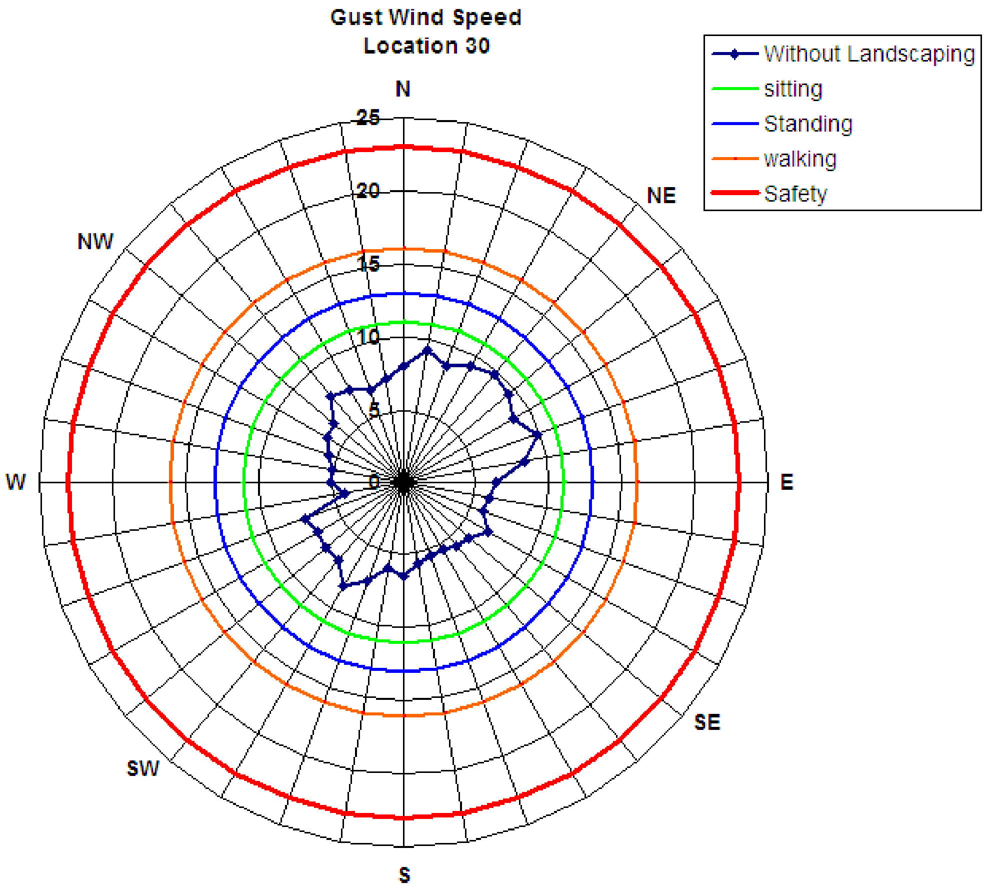

Gust Wind Speed
Location 25
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

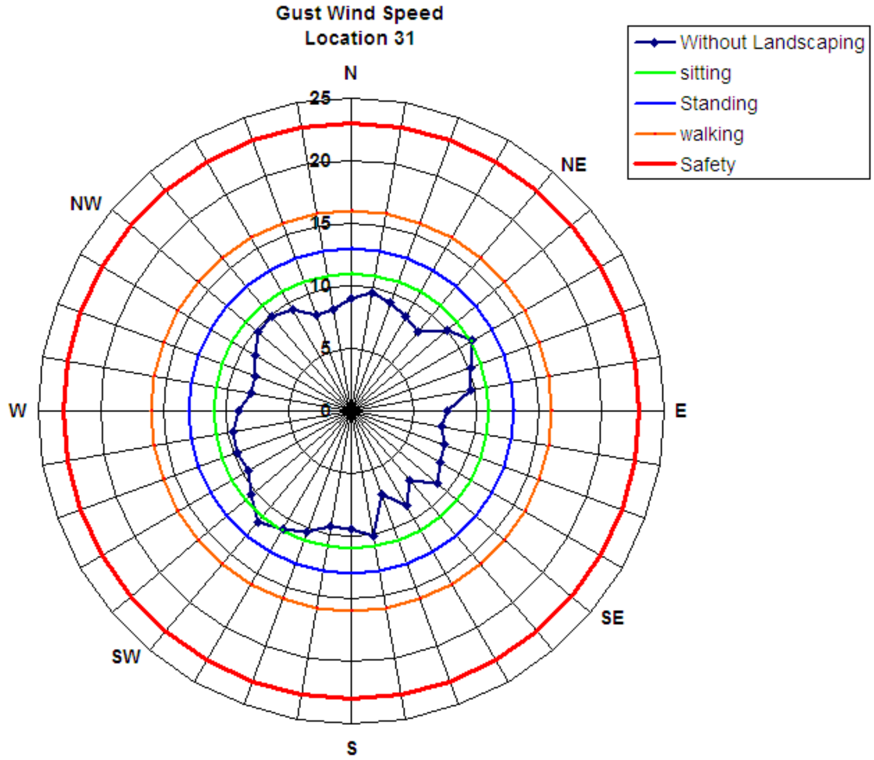

Gust Wind Speed
Location 26
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0

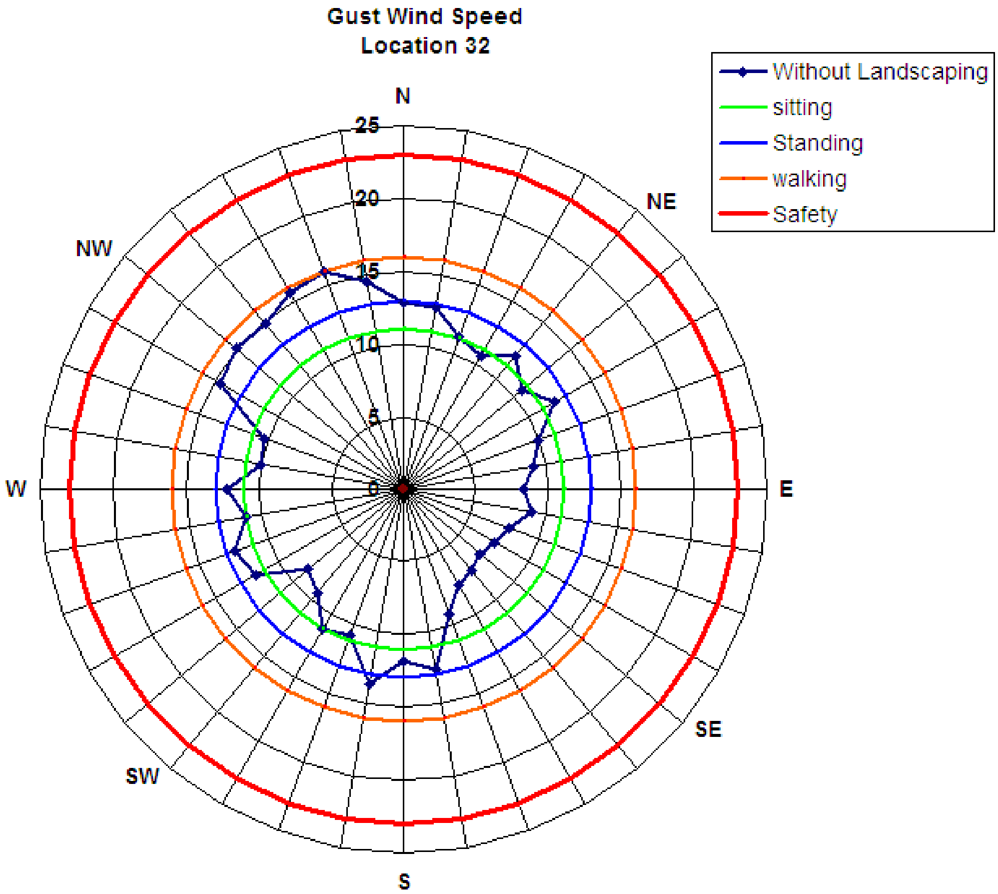

Gust Wind Speed
Location 27
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0


Gust Wind Speed
Location 28
With Landscaping
sitting
Standing
walking
Safety
Without Landscaping
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25


Gust Wind Speed
Location 29
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25


Gust Wind Speed
Location 30
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0


Gust Wind Speed
Location 31
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
25
20
15
10
5
0


Gust Wind Speed
Location 32
Without Landscaping
sitting
Standing
walking
Safety
N
NE
E
SE
S
SW
W
NW
0
5
10
15
20
25

APPENDIX B - DRAWING LIST

Updated Drawings:

Name	Size	Type	Date Modified
13-108_NthEveleigh_Ground_...	257 KB	Adobe Acrobat Doc...	14/03/2013 1:25 PM
13-108_NthEveleigh_Roof_13...	225 KB	Adobe Acrobat Doc...	14/03/2013 1:25 PM
13-108_X_L_Landscape_Ground	3,787 KB	DWG TrueView Dra...	14/03/2013 1:25 PM
2013.03.11	2,892 KB	WinRAR ZIP archive	13/03/2013 8:28 AM
120312Reviewed_30N-13-00...	1,967 KB	Adobe Acrobat Doc...	13/03/2013 11:42 AM
DA01-001 - Basement Plan	196 KB	Adobe Acrobat Doc...	8/03/2013 5:02 PM
DA01-002 - Ground Floor	520 KB	Adobe Acrobat Doc...	8/03/2013 4:59 PM
DA01-003 - Level 1	258 KB	Adobe Acrobat Doc...	8/03/2013 4:27 PM
DA01-004 - Level 2	273 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA01-005 - Level 3	268 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA01-006 - Level 4	259 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA01-007 - Level 5	286 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA01-008 - Level 6	208 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA02-001 - North Elevation	445 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA02-003 - East Elevation	323 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM
DA02-004 - West Elevation	309 KB	Adobe Acrobat Doc...	8/03/2013 4:28 PM

Drawings used in model construction:

Name	Size	Type	Date Modified
Cross Section	140 KB	DWG TrueView Dra...	2/28/2013 2:39 PM
Cross Section	60 KB	Adobe Acrobat Doc...	2/28/2013 2:36 PM
East Elevation	97 KB	DWG TrueView Dra...	2/28/2013 2:41 PM
East Elevation	197 KB	Adobe Acrobat Doc...	2/28/2013 2:35 PM
Longitudinal Section	170 KB	DWG TrueView Dra...	2/28/2013 2:39 PM
Longitudinal Section	72 KB	Adobe Acrobat Doc...	2/28/2013 2:37 PM
North Elevation	149 KB	DWG TrueView Dra...	2/28/2013 2:40 PM
North Elevation	222 KB	Adobe Acrobat Doc...	2/28/2013 2:33 PM
SD100 - Site Plan	102 KB	Adobe Acrobat Doc...	2/27/2013 3:23 PM
SD101 - Basement Plan	123 KB	Adobe Acrobat Doc...	2/27/2013 3:23 PM
SD101-Basement Plan	439 KB	DWG TrueView Dra...	2/27/2013 3:32 PM
SD102 - Ground Floor	372 KB	Adobe Acrobat Doc...	2/27/2013 3:23 PM
SD102-Ground Floor	610 KB	DWG TrueView Dra...	2/27/2013 3:33 PM
SD103 - Level 1	169 KB	Adobe Acrobat Doc...	2/27/2013 3:23 PM
SD103-Level 1	429 KB	DWG TrueView Dra...	2/27/2013 3:33 PM
SD104 - Level 2	177 KB	Adobe Acrobat Doc...	2/27/2013 3:23 PM
SD104-Level 2	422 KB	DWG TrueView Dra...	2/27/2013 3:33 PM
SD105 - Level 3	168 KB	Adobe Acrobat Doc...	2/27/2013 3:24 PM
SD105-Level 3	425 KB	DWG TrueView Dra...	2/27/2013 3:34 PM
SD106 - Level 4	162 KB	Adobe Acrobat Doc...	2/27/2013 3:24 PM
SD106-Level 4	305 KB	DWG TrueView Dra...	2/27/2013 3:34 PM
SD107 - Level 5	179 KB	Adobe Acrobat Doc...	2/27/2013 3:24 PM
SD107-Level 5	437 KB	DWG TrueView Dra...	2/27/2013 3:34 PM
SD108 - Level 6	140 KB	Adobe Acrobat Doc...	2/27/2013 3:24 PM
SD108-Level 6	233 KB	DWG TrueView Dra...	2/27/2013 3:35 PM
South Elevation	124 KB	DWG TrueView Dra...	2/28/2013 2:40 PM
South Elevation	226 KB	Adobe Acrobat Doc...	2/28/2013 2:34 PM
West Elevation	101 KB	DWG TrueView Dra...	2/28/2013 2:41 PM
West Elevation	162 KB	Adobe Acrobat Doc...	2/28/2013 2:35 PM