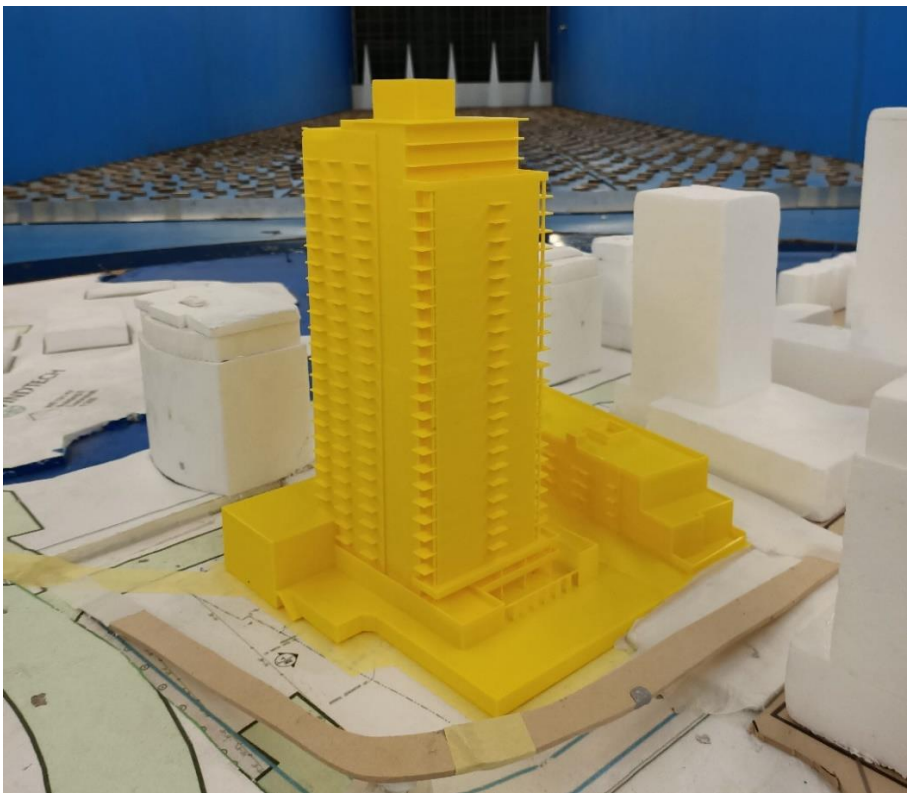

PEDESTRIAN WIND ENVIRONMENT STUDY

BUILDING E, KING'S WHARF PLACE, DARTMOUTH

WE191-07F01(REV2)- WE REPORT

MARCH 23, 2021

Prepared for:

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INTERNAL DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
March 17, 2021	Treatment testing results.	0	HK	JWN/TR	TR
March 19, 2021	Updated recommendations.	1	HK	JWN/TR	TR
March 22, 2021	Summary and figure updates.	2	HK	JWN/TR	TR

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EXECUTIVE SUMMARY

This report presents the results of a detailed investigation into the wind environment impact of the Building E development located at King's Wharf Place, Dartmouth. Testing was performed at Windtech's boundary layer wind tunnel facility. The wind tunnel has a 3.0m wide working section and a fetch length of 14m, and measurements were taken from 36 wind directions at 22.5-degree increments. Testing was carried out using a 1:300 detailed scale model of the development. The effects of nearby buildings and land topography have been accounted for through the use of a proximity model which represents an area with a radius of 375m.

Peak gust and mean wind speeds were measured at selected critical outdoor trafficable locations within the public realm around the subject development. Wind velocity coefficients representing the local wind speeds are derived from the wind tunnel and are combined with a statistical model of the regional wind climate (which accounts for the directional strength and frequency of occurrence of the prevailing regional winds) to provide the equivalent full-scale wind speeds at the site. The wind speed measurements are compared with criteria for pedestrian comfort and safety, based on Gust-Equivalent Mean (GEM) and annual maximum gust winds for the months of May to October (Summer) and November to April (Winter).

The model was initially tested in the wind tunnel without the effect of any forms of wind ameliorating devices such as screens, balustrades, etc., which are not already shown in the architectural drawings. The effect of vegetation was also excluded from the initial testing. In total, three surrounds configurations were tested in the wind tunnel, which are as follows:

- The "existing surrounding buildings scenario" is a snapshot of the current existing site conditions.
- The "proposed surrounding buildings scenario" represents the site at approximately the time of completion of the subject development.
- The "future surrounding buildings scenario" includes the proposed scenario and any other future developments within the proximity model.

It has been shown it is possible to ameliorate the impact of the development on the existing wind conditions noting that the modelling of the existing conditions show some areas already experience strong wind conditions. The necessity, size and extent of the treatment strategy is subject to the location's intended use and existing conditions, and potential adaptation to the local wind conditions, given that this area is coastal and thus is already exposed to relatively strong winds than would not be expected in a built-up city environment.

It is recommended that the suggested treatments are implemented to mitigate wind conditions that exceed the Safety Criterion and are worse than the existing wind conditions (as required by the Regional Centre Land Use By-Law Package A (2019)).

CONTENTS

1 INTRODUCTION

A wind tunnel study has been undertaken to assess wind speeds at selected critical outdoor trafficable areas within the public realm around the subject development. The test procedures followed for this wind tunnel study were based on the guidelines set out in the Australasian Wind Engineering Society Quality Assurance Manual (AWES-QAM-1-2019), ASCE 7-16 (Chapter C31), CTBUH (2013) and the Regional Centre Land Use By-Law Package A (2019).

A scale model of the development was prepared, including the surrounding buildings and land topography. Testing was performed at Windtech's boundary layer wind tunnel facility. The wind tunnel has a 3.0m wide working section and a fetch length of 14m, and measurements were taken from 36 wind directions at 10 degree increments. The wind tunnel was configured to the appropriate boundary layer wind profile for each wind direction. Wind speeds were measured using Dantec hot-wire probe anemometers, positioned to monitor wind conditions at critical outdoor trafficable areas of the development.

The model was tested in the wind tunnel without the effect of any forms of wind ameliorating devices such as screens, balustrades, etc., which are not already shown in the architectural drawings. The effect of vegetation was also excluded from the initial testing. Furthermore, additional testing with the inclusion of the proposed vegetation has been undertaken to examine its effect. The wind speeds measured during testing were combined with a statistical model of the regional wind climate to provide the equivalent full-scale wind speeds at the site. In total, three surrounds configurations were tested in the wind tunnel, which are as follows:

- The "existing surrounding buildings scenario" is a snapshot of the current existing site conditions.
- The "proposed surrounding buildings scenario" represents the site at approximately the time of completion of the subject development.
- The "future surrounding buildings scenario" includes the proposed scenario and any other future developments within the proximity model.

The measured wind speeds were compared against appropriate criteria for pedestrian comfort and safety as proposed in the Regional Centre Land Use By-Law Package A (2019), and treatments have been recommended for any area which was exposed to strong winds that exceeded the safety criterion and was worse than the existing conditions. Note, however, that in accordance with the AWES Guidelines (2014), architectural elements or modifications are used to treat winds which represent an exceedance of the existing wind conditions and exceed the safety limit.

2 WIND TUNNEL MODEL

Wind tunnel testing was carried out using a 1:300 scale model of the development and surroundings. The study model incorporates all necessary architectural features on the façade of the development to ensure an accurate wind flow is achieved around the model, and was constructed using a Computer Aided Manufacturing (CAM) process to ensure that a high level of detail and accuracy is achieved. The effect of nearby buildings and land topography has been accounted for through the use of a proximity model, which represents a radius of 375m from the development site. Photographs of the wind tunnel model are presented in Figures 1. A plan of the proximity model is provided in Figures 2.

Figure 1a: Photograph of the Wind Tunnel Model – Existing Scenario (view from the south)

Figure 1b: Photograph of the Wind Tunnel Model – Existing Scenario (view from the west)

Figure 1c: Photograph of the Wind Tunnel Model – Existing Scenario (view from the north)

Figure 1d: Photograph of the Wind Tunnel Model – Existing Scenario (view from the east)

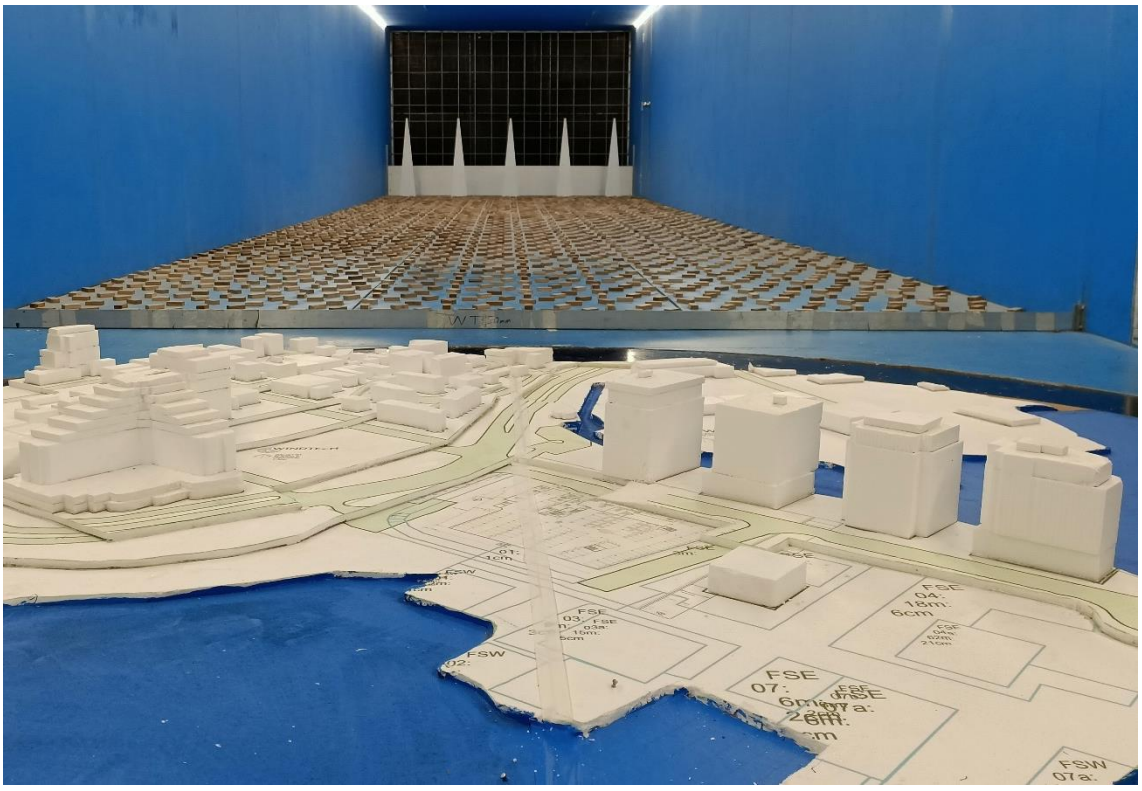

Figure 1e: Photograph of the Wind Tunnel Model – Existing Scenario (view from the south)

Figure 1f: Photograph of the Wind Tunnel Model – Proposed Scenario (view from the south)

Figure 1g: Photograph of the Wind Tunnel Model – Proposed Scenario (view from the west)

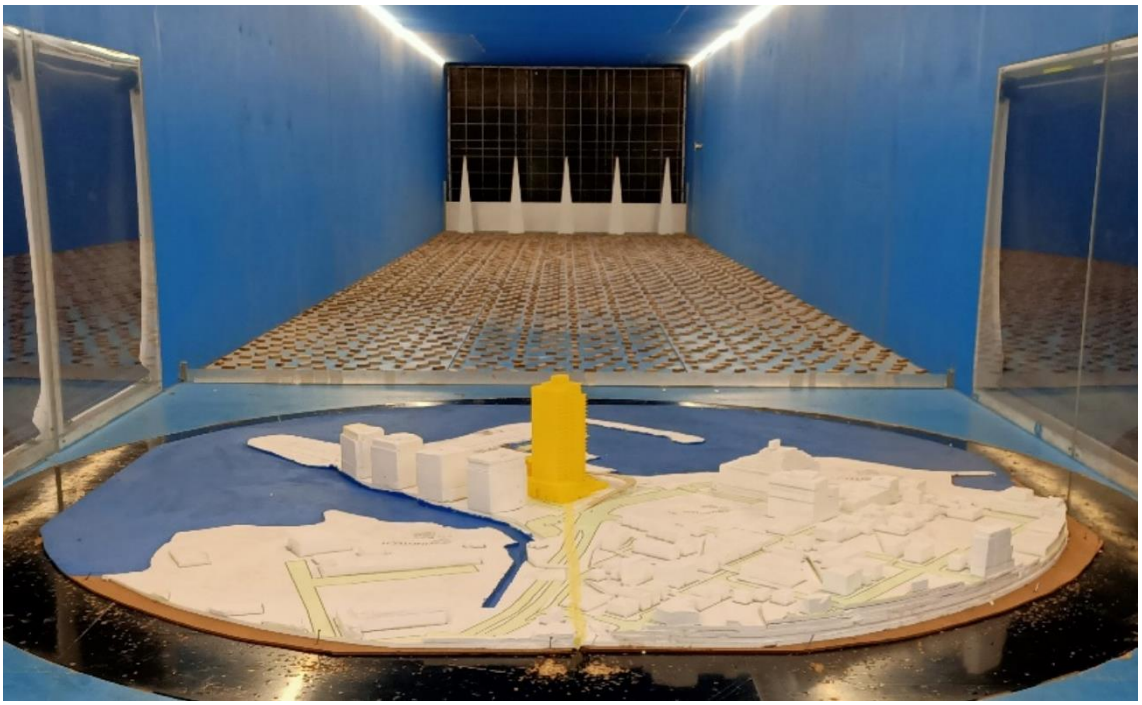

Figure 1h: Photograph of the Wind Tunnel Model – Proposed Scenario (view from the north)

Figure 1i: Photograph of the Wind Tunnel Model – Proposed Scenario (view from the east)

Figure 1j: Photograph of the Wind Tunnel Model – Proposed Scenario (view from the north-west)

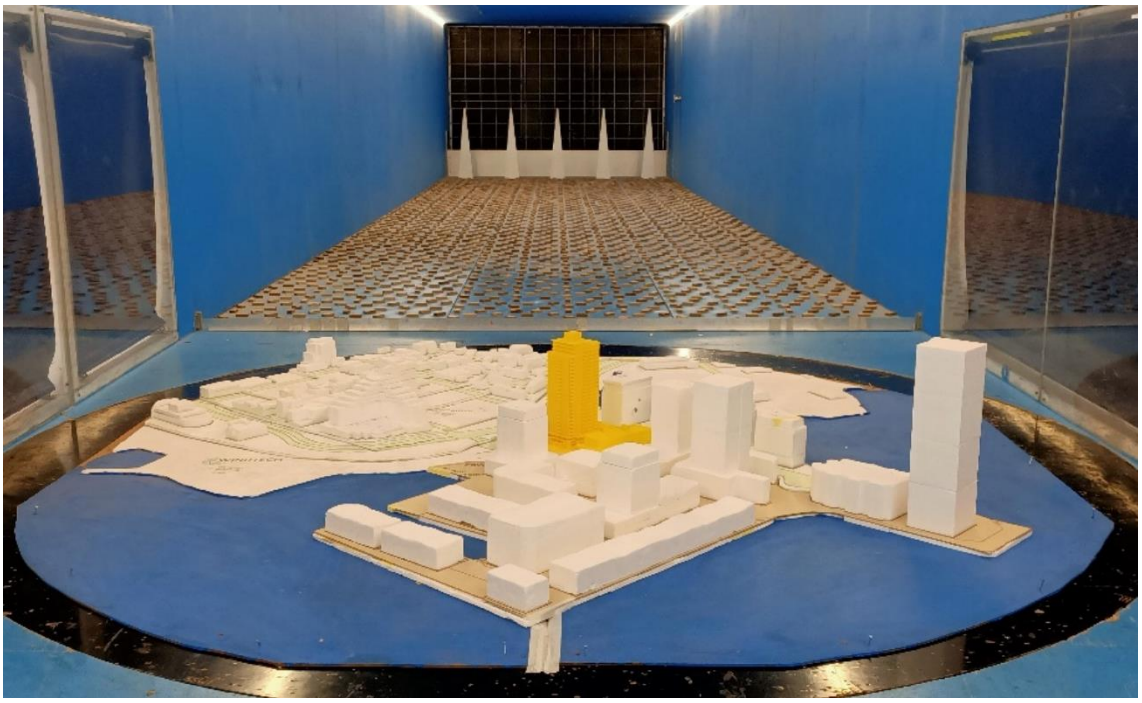

Figure 1k: Photograph of the Wind Tunnel Model – Future Scenario (view from the south)

Figure 1l: Photograph of the Wind Tunnel Model – Future Scenario (view from the west)

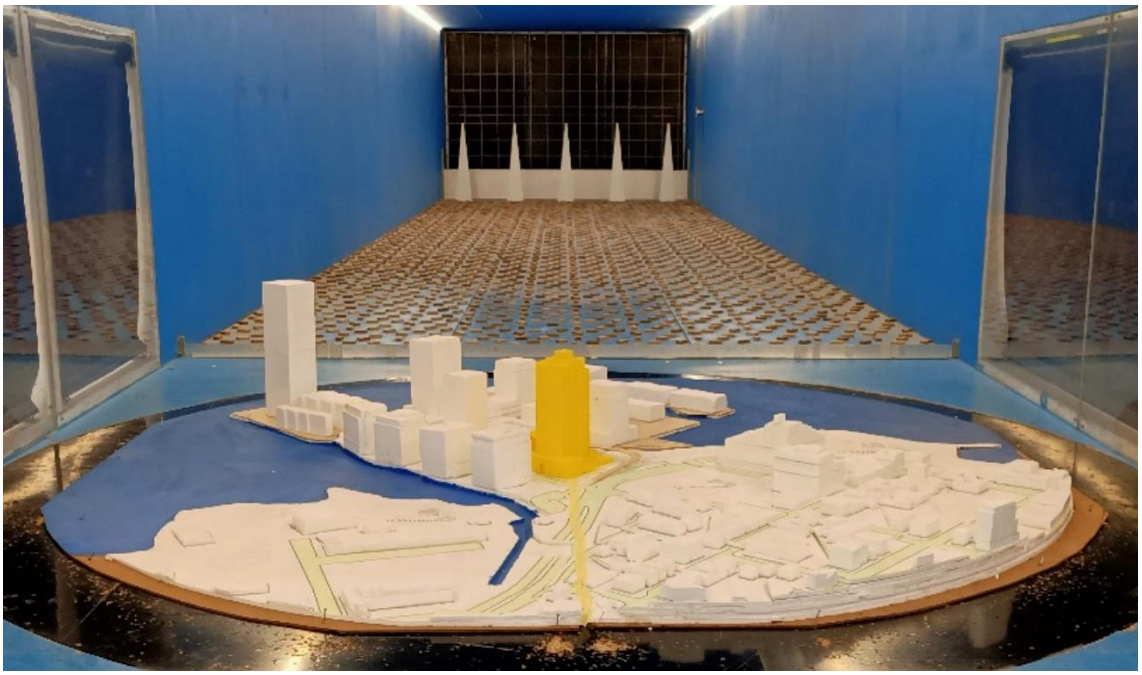

Figure 1m: Photograph of the Wind Tunnel Model – Future Scenario (view from the north)

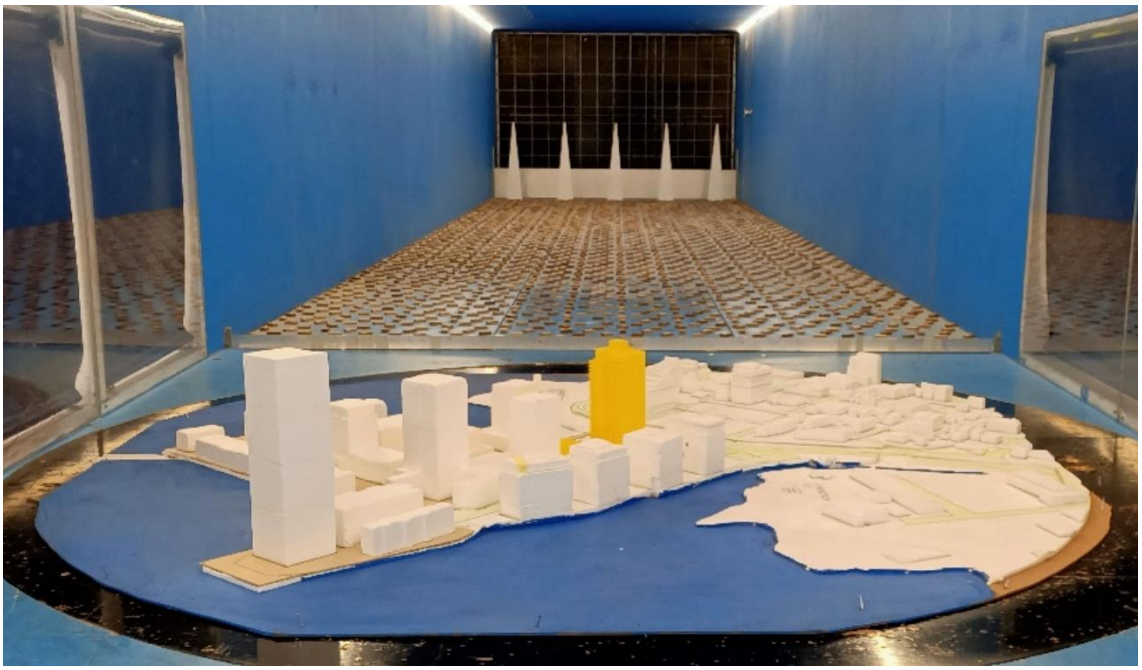

Figure 1n: Photograph of the Wind Tunnel Model – Future Scenario (view from the east)

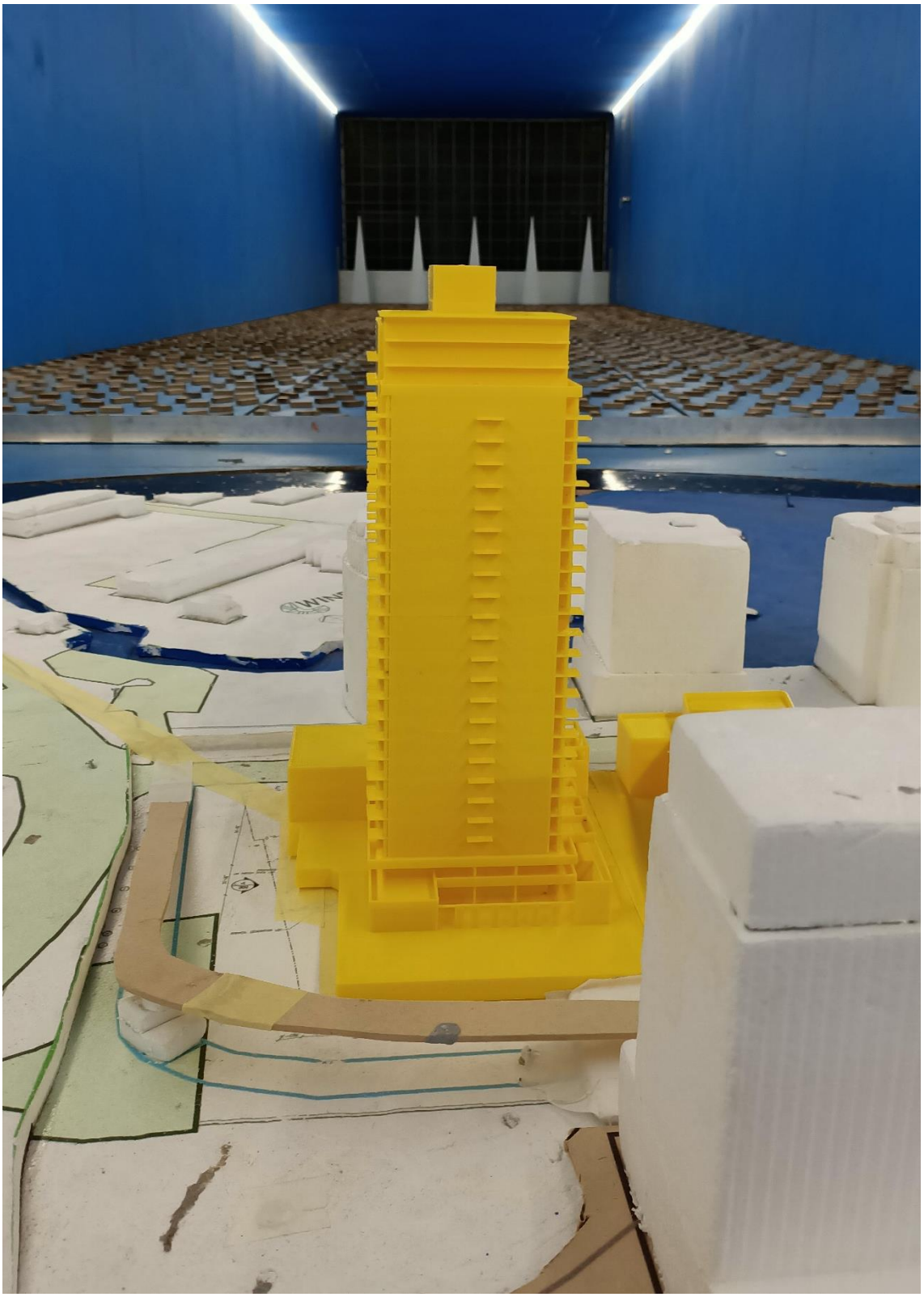

Figure 1o: Photograph of the Wind Tunnel Model – Future Scenario (view from the south-west)

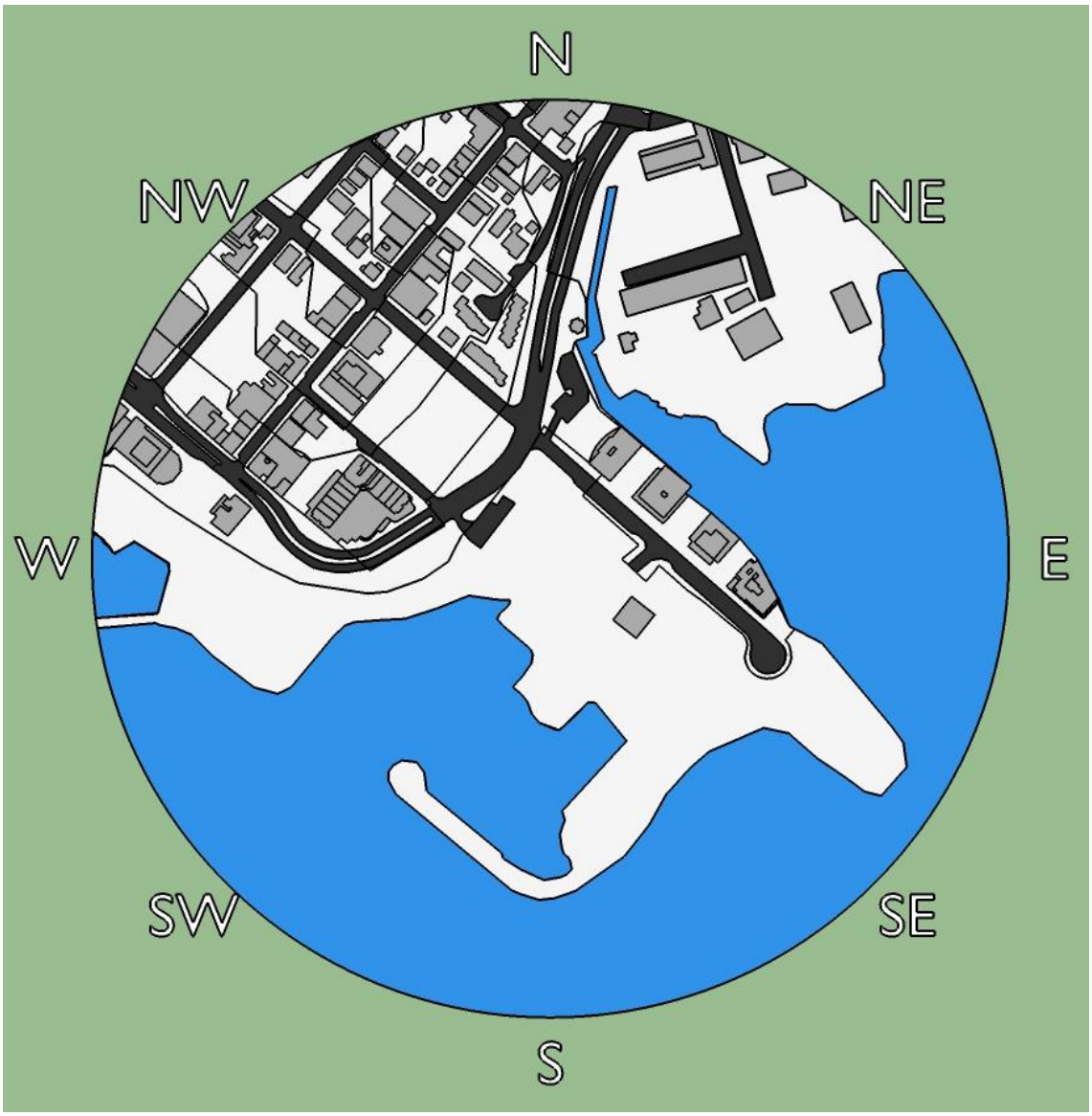

Figure 2a: Proximity Model Plan for the Existing Site Conditions

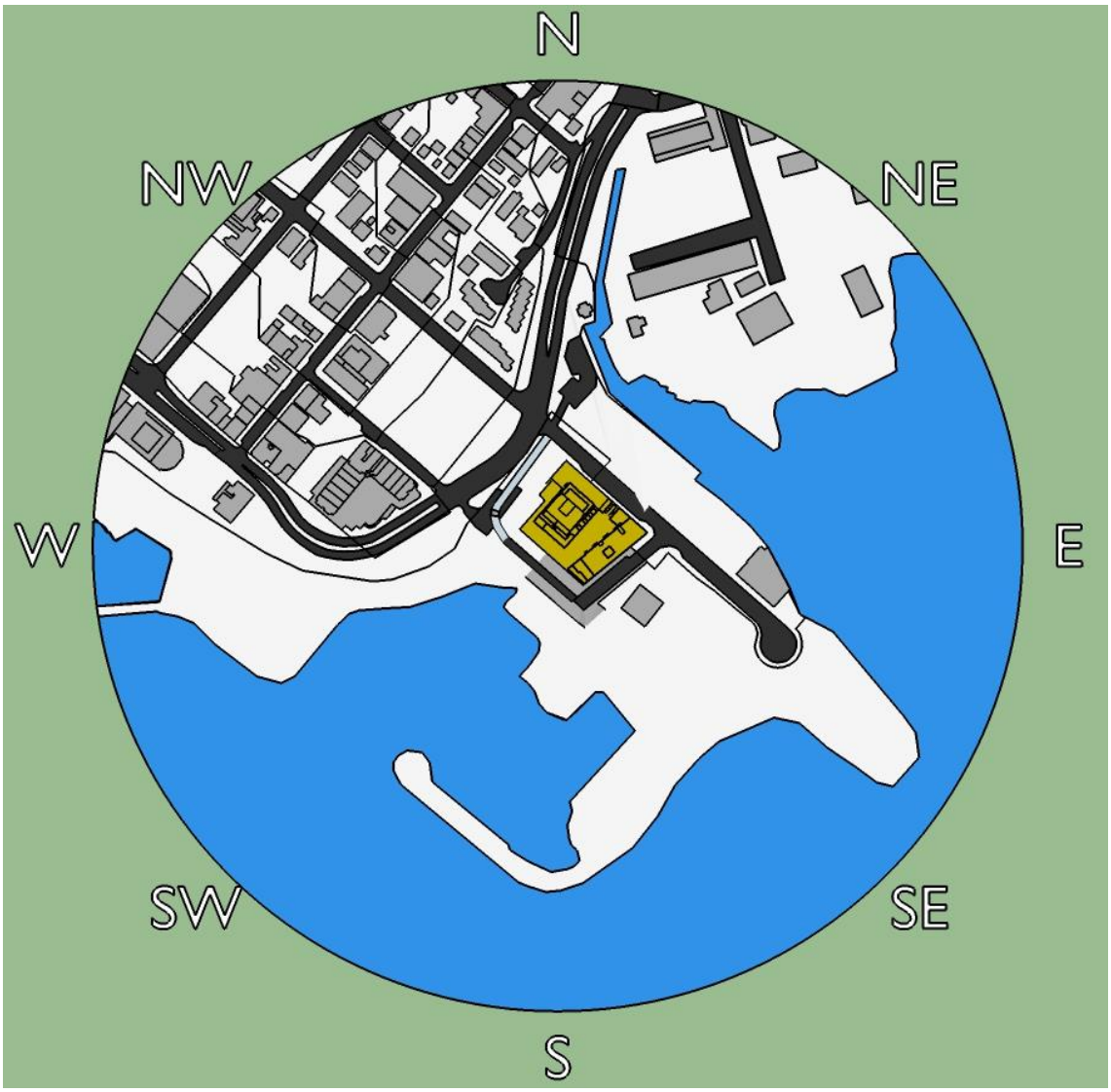

Figure 2b: Proximity Model Plan for the Proposed Site Conditions

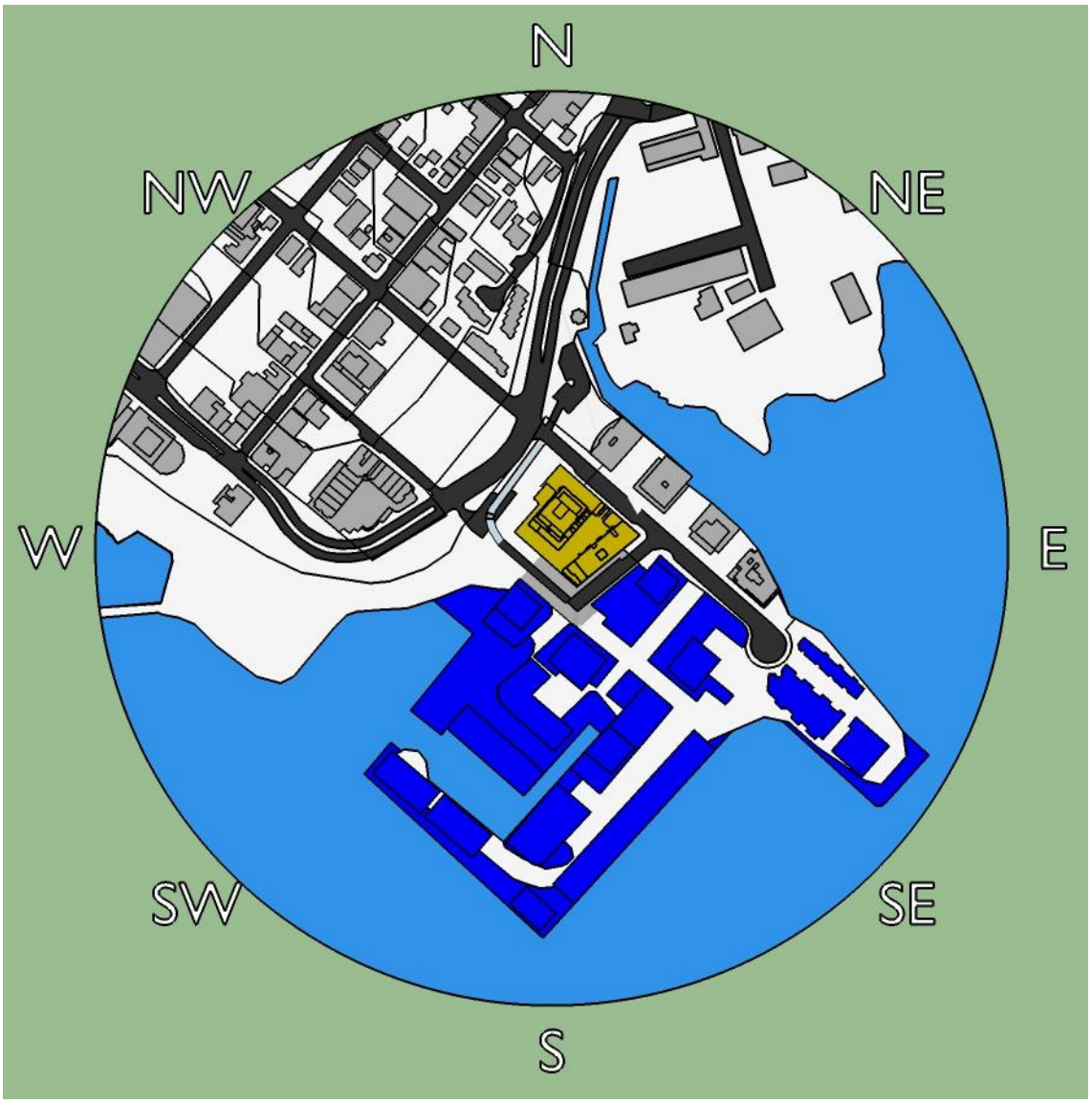

Figure 2c: Proximity Model Plan for the Future Site Conditions

3 BOUNDARY LAYER WIND PROFILES AT THE SITE

The roughness of the surface of the earth has the effect of slowing down the wind near the ground. This effect is observed up to the boundary layer height, which can range between 500m to 3km above the earth's surface depending on the roughness of the surface (ie: oceans, open farmland, etc). Within this range the prevailing wind forms a boundary layer wind profile.

Various wind codes and standards and other publications classify various types of boundary layer wind flows depending on the surface roughness z_0. Descriptions of typical boundary layer wind profiles, based on Deaves & Harris (1978), are summarised as follows:

- Flat terrain (0.002m < z_0 < 0.003m). Examples include inland water bodies such as lakes, dams, rivers, etc, and the open ocean.
- Semi-open terrain (0.006m < z_0 < 0.01m). Examples include flat deserts and plains.
- Open terrain (0.02m < z_0 < 0.03m). Examples include grassy fields, semi-flat plains, and open farmland (without buildings or trees).
- Semi-suburban/semi-forest terrain (0.06m < z_0 < 0.1m). Examples include farmland with scattered trees and buildings and very low-density suburban areas.
- Suburban/forest terrain (0.2m < z_0 < 0.3m). Examples include suburban areas of towns and areas with dense vegetation such as forests, bushland, etc.
- Semi-urban terrain (0.6m < z_0 < 1.0m). Examples include centres of small cities, industrial parks, etc.
- Urban terrain (2.0m < z_0 < 3.0m). Examples include centres of large cities with many high-rise towers, and also areas with many closely spaced mid-rise buildings.

The boundary layer wind profile does not change instantly due to changes in the terrain roughness. It can take many kilometres (at least 100km) of a constant surface roughness for the boundary layer wind profile to achieve a state of equilibrium. Hence an analysis of the effect of changes in the upwind terrain roughness is necessary to determine an accurate boundary layer wind profile at the development site location.

For this study this has been undertaken based on the method given in ESDU-82026:2002. An aerial image showing the surrounding terrain is presented in Figure 3 for a range of 5.0km and 50km from the edge of the proximity model used for the wind tunnel study. The resulting mean and gust terrain and height multipliers at the site location are presented in Table 1, referenced to the study reference height (which is approximately half of the height of the subject development since typically we are most interested in the wind effects at the ground plane). Note that the proximity model accounts for the effect of the near field topographic effects as well as the influence of the local built forms. Details of the boundary layer wind profiles at the site are combined with the regional wind model (see Section 4) to determine the site wind speeds.

Table 1: Approaching Boundary Layer Wind Profile Analysis Summary (at the study reference height)

Wind Sector (degrees)	Terrain and Height Multiplier			Turbulence Intensity	Equivalent Terrain Category
	$k_{tr,T=1hr}$ *(hourly)*	$k_{tr,T=10min}$ *(10min)*	$k_{tr,T=3s}$ *(3sec)*	I_v	*(AS/NZS1170.2:2011 naming convention)*
0	0.66	0.70	1.09	0.214	3.0
30	0.66	0.70	1.09	0.214	3.0
60	0.66	0.70	1.09	0.214	3.0
90	0.72	0.75	1.12	0.191	2.7
120	0.74	0.78	1.14	0.180	2.5
150	0.90	0.93	1.24	0.126	1.3
180	0.84	0.87	1.20	0.146	1.9
210	0.78	0.82	1.17	0.166	2.3
240	0.72	0.76	1.13	0.187	2.6
270	0.74	0.78	1.14	0.181	2.5
300	0.72	0.76	1.13	0.189	2.6
330	0.66	0.70	1.09	0.214	3.0

For each of the 36 wind directions tested in this study, the approaching boundary layer wind profiles modelled in the wind tunnel closely matched the profiles listed in Table 1. Plots of the boundary layer wind profiles used for the wind tunnel testing are presented in Appendix D of this report.

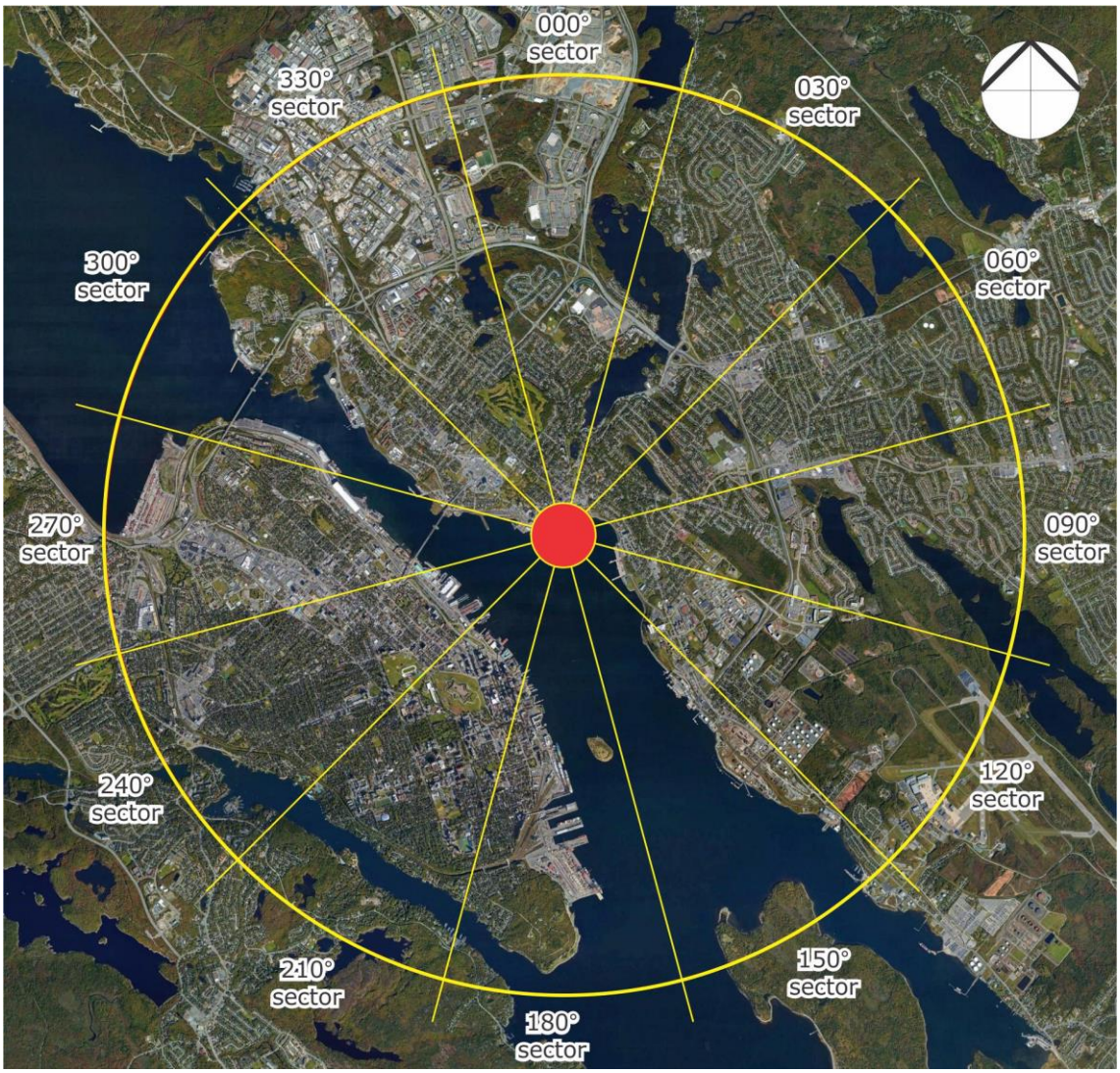

Figure 3a: Aerial Image of the Surrounding Terrain
(radius of 5.0km from the edge of the proximity model, which is coloured red)

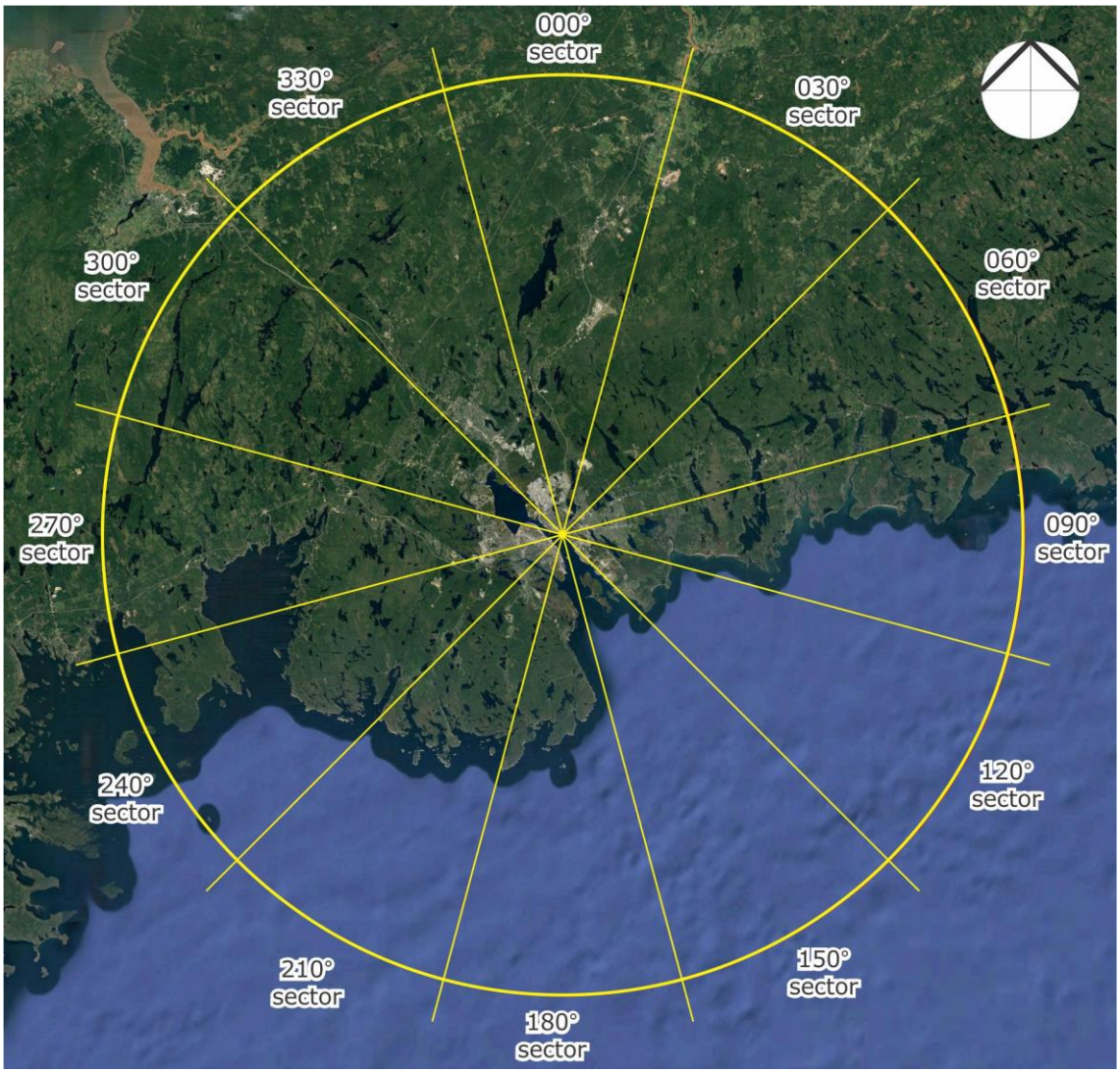

Figure 3b: Aerial Image of the Surrounding Terrain (radius of 50km)

4 REGIONAL WIND MODEL

The regional wind model used in this study was determined from an analysis of measured directional mean wind speeds obtained at the meteorological recording station located at Shearwater Airport in Dartmouth, Nova Scotia. Data was collected from 1971 to 2004 between 6am to 11pm and corrected so that it represents wind speeds over standard open terrain at a height of 10m above ground for each wind direction. From this analysis, directional probabilities of exceedance and directional wind speeds for the region are determined. The directional wind speeds are summarised in Table 2 and are illustrated along with corresponding directional frequencies of occurrence in Figure 4a. The analysis indicates that the strongest winds of the region are mainly governed by the winds from the north-westerly and south-westerly quadrants, which are also the most frequently occurring winds for the region. The easterly winds are the next strongest and frequent winds of the region.

The recurrence intervals examined in this study are for exceedances of 20% (per 90-degree sector) for the pedestrian comfort criteria using Gust-Equivalent Mean (GEM) wind speeds, and annual maximum wind speeds (per 10 degree sector) for the pedestrian safety criterion. Note that the 20% probability wind speeds presented in Table 2 are only used for the directional plots presented in Figure 4a and are not used for the integration of the probabilities.

Seasonal analysis of the wind data has also been carried out to account for the distinct differences in pedestrian outdoor activity during different seasons throughout the year between the hours of 0600 and 2300. For the current analysis, the data has been grouped into two seasons: summer (May to October) and winter (November to April). The directional probabilities of exceedance and directional wind speeds for the two seasons are presented in Figure 4b. Note that the overall wind pattern for the summer and winter seasons are similar to the average wind pattern depicted in Figure 4a. However, the north-westerly winds are more frequent for the winter season whereas the south-westerly winds are more frequent for the summer season.

Table 2: Directional Wind Speeds

(hourly means, referenced to 10m above ground in standard open terrain)

Wind Direction	20% Exceedance (m/s)	Annual Maximum (m/s)
0 (North)	5.7	12.1
10	5.3	11.7
20	5.1	10.9
30	4.6	10.5
40	3.6	10.2
50	2.5	10.1
60	2.8	10.4
70	3.2	11.1
80	4.7	11.9
90 (East)	4.3	12.3
100	4.3	11.9
110	4.4	10.9
120	3.3	10.3
130	3.5	10.1
140	2.9	10.3
150	2.6	10.6
160	2.9	10.8
170	3.9	10.9
180 (South)	3.9	11.1
190	4.2	11.5
200	4.5	12.1
210	4.9	12.6
220	5.0	12.7
230	4.6	12.5
240	4.8	11.8
250	4.8	11.7
260	5.4	12.0
270 (West)	5.5	12.6
280	5.9	13.2
290	6.4	13.2
300	6.5	13.1
310	6.3	12.9
320	6.1	12.3
330	5.9	12.2
340	5.8	12.1
350	5.7	12.4

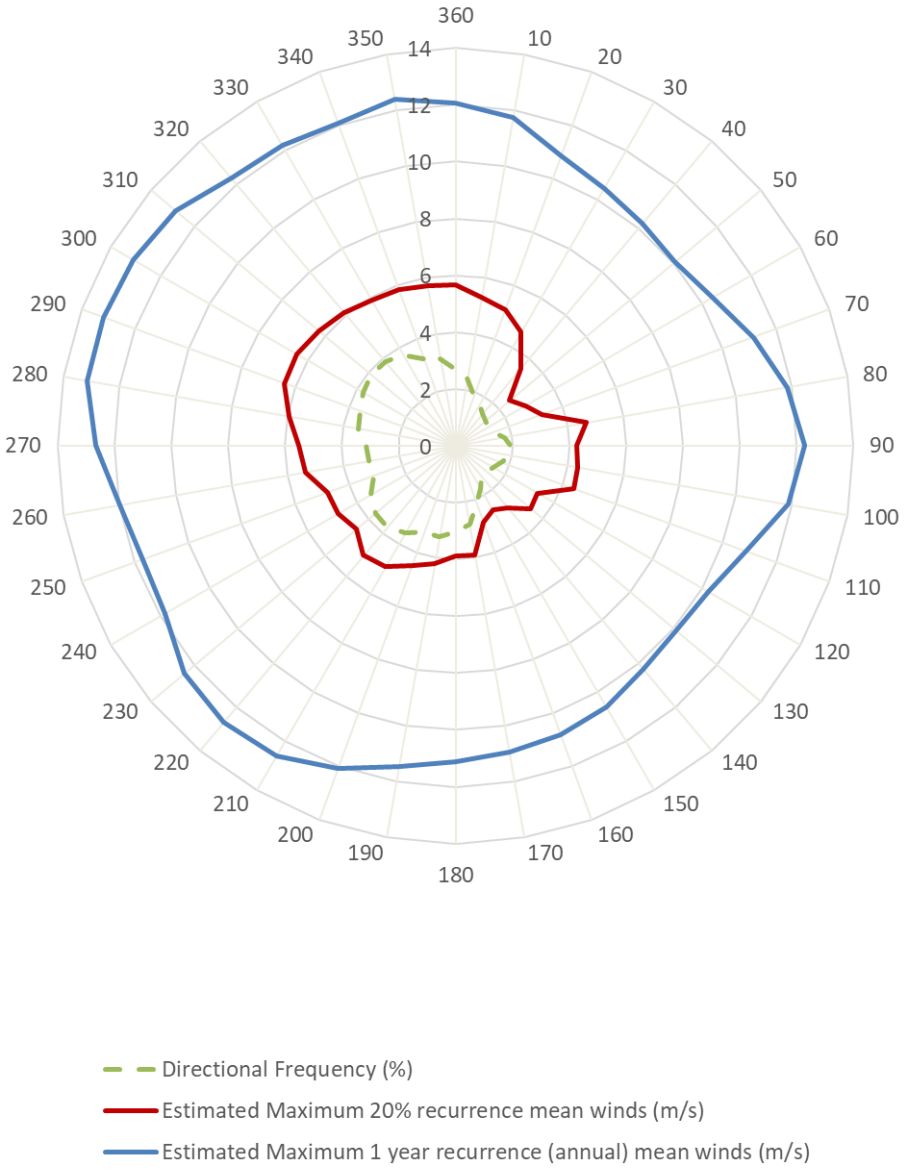

Figure 4a: Annual and 20% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence for the Dartmouth Region (referenced to 10m above ground in standard open terrain)

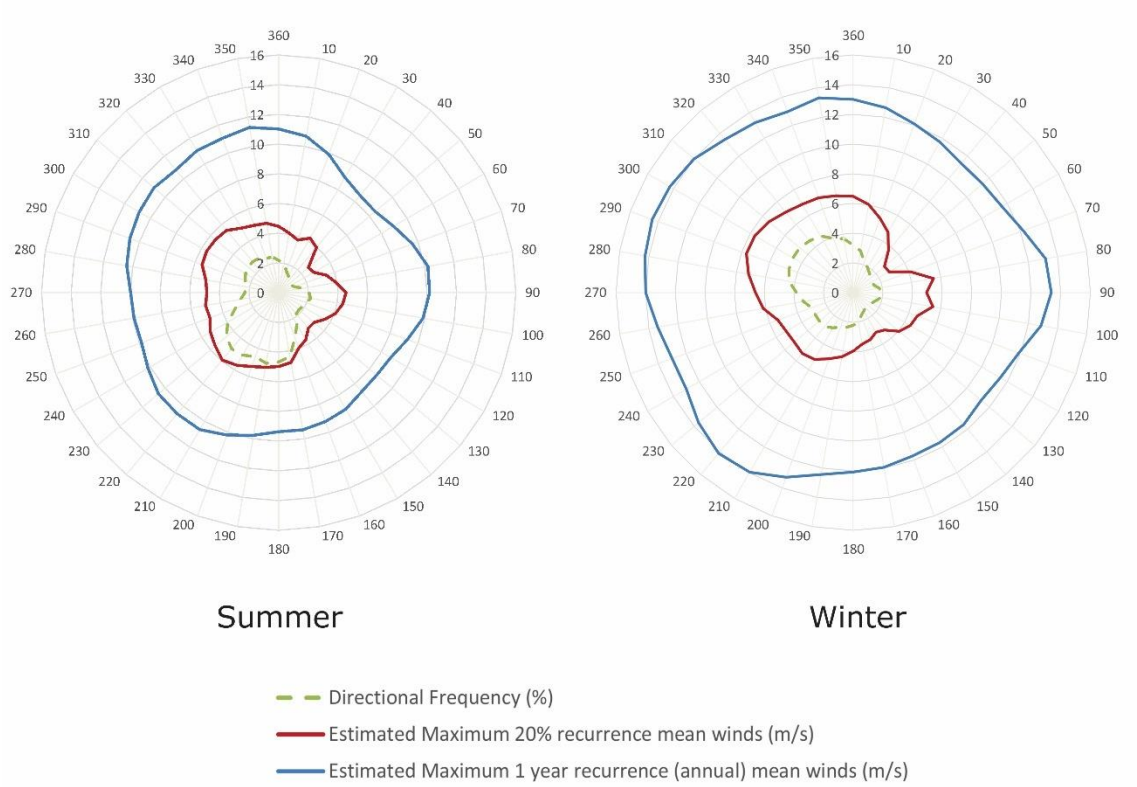

Figure 4b: Annual and 20% Exceedance Hourly Mean Wind Speeds, and Frequencies of Occurrence for the Dartmouth Region for the Summer (Nov-Apr) and Winter Seasons (May-Oct) between 0600 and 2300 (referenced to 10m above ground in standard open terrain)

5 PEDESTRIAN WIND COMFORT AND SAFETY

The acceptability of wind conditions of an area is determined by comparing the measured wind speeds against an appropriate criterion. This section outlines how the measured wind speeds were obtained, the criteria considered for the development, as well as the critical trafficable areas that were assessed and their corresponding criteria designation.

5.1 Measured Wind Speeds

Wind speeds were measured using Dantec hot-wire probe anemometers, positioned to monitor wind conditions at critical outdoor trafficable areas of the development at a full-scale height of 1.5m at the measurement point. The reference mean free-stream wind speed is also measured in the wind tunnel at a full-scale height of 200m and 3m upstream of the study model.

Measurements were acquired for 36 wind directions at 10-degree increments using a sample rate of 1,024Hz. The full methodology of determining the wind speed measurements at the site from the Dantec Hot-wire probe anemometers is provided in Appendix B. Based on the results of the analysis of the boundary layer wind profiles at the site (see Section 3), and incorporating the regional wind model (see Section 4), the data sampling length of the wind tunnel test for each wind direction corresponds to a full-scale sample length ranging between 30 minutes and 1 hour. Research by A.W. Rofail and K.C.S. Kwok (1991) has shown that, in addition to the mean and standard deviation of the wind being stable for sample lengths of 15 minutes or more (full-scale), the peak value determined using the upcrossing method is stable for sample lengths of 30 minutes or more.

5.2 Wind Speed Criteria Used for This Study

For this study the measured wind conditions of the selected critical outdoor trafficable areas are compared against two sets of criteria; one for pedestrian safety, and one for pedestrian comfort. The safety criterion is applied to the annual maximum gust winds, and the comfort criteria is applied to Gust Equivalent Mean (GEM) winds. In accordance with ASCE (2003) and Regional Centre Land Use By-Law Package A (2019), the GEM wind speed is defined as follows:

$$GEM = max\left(\bar{V}, \frac{\hat{V}}{1.85}\right) \tag{5.1}$$

Where:

$\bar{V}$ is the mean wind speed.

$\hat{V}$ is the 3-second gust wind speed.

The measured wind conditions for the various critical outdoor trafficable areas within and around the subject development are compared against the Regional Centre Land Use By-Law Package A (2019). This requires an acceptance of both a safety limit criteria and wind comfort

be achieved for the various outdoor public areas (for hours between 0600 and 2300). The safety criteria states that the gust wind speed must not exceed 25m/s for more than 0.1% of the time from any given wind direction. Furthermore, the criteria for wind comfort is used in conjunction with a maximum GEM wind speed (defined above) and must not exceed more than 20% of the time (probability of exceedance) from all directions combined, measured between 6am and 11pm over the year. Note that the Gust-Equivalent Mean (GEM) criteria, has proven over time, and through field observations, to be the most reliable indicator of pedestrian comfort (Rofail, 2007). A more detailed comparison of published criteria has been provided in Appendix A.

The criteria considered in this study are summarised in Tables 3 and 4 for pedestrian comfort and safety, respectively. The results of the wind tunnel study are presented in the form of directional plots attached in Appendix C of this report. For each study point there is a plot of the GEM wind speeds using the comfort criteria, and a plot for the annual maximum gust wind speeds using the safety criterion.

Table 3: Comfort Criteria (from Regional Centre Land Use By-Law Package A (2019))

Classification	Description	Maximum 20% Exceedance GEM Wind Speed (m/s)
Sitting	Calm or light breezes suitable for outdoor restaurant uses, seating areas, and other amenities. (10km/h)	3.0
Standing	Gentle breezes suitable for main building entrances and bus stops where pedestrians may linger. (14km/h)	4.0
Strolling	Moderate winds appropriate for window shopping and strolling along a downtown street or park. (17km/h)	5.0
Walking	Relatively high speeds that can be tolerated if one's objective is to walk, run, or cycle without much lingering. (20km/h)	5.5

Table 4: Safety Criterion (from Regional Centre Land Use By-Law Package A (2019))

Classification	Description	Annual Maximum Gust Wind Speed (m/s)
Safety	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is required. (90km/h)	25

Some exceptions may be permitted in the application of these wind performance standards. For instance, higher-than-desired wind speeds at outdoor seating areas and building entrances may be acceptable in winter months, due to reduced pedestrian usage, and for areas to which access can readily be controlled during adverse weather conditions.

No wind mitigation is required for existing uncomfortable or unsafe conditions that are not made worse by the proposed development.

5.3 Layout of Study Points

For this study, a total of 37 study point locations in the public realm were selected for analysis in the wind tunnel. The locations of the various study points tested for this study, as well as the target wind speed criteria for the various outdoor trafficable areas of the development, are presented in Figures 5 in the form of marked-up plans. It should be noted that only the most critical outdoor locations of the development have been selected for analysis.

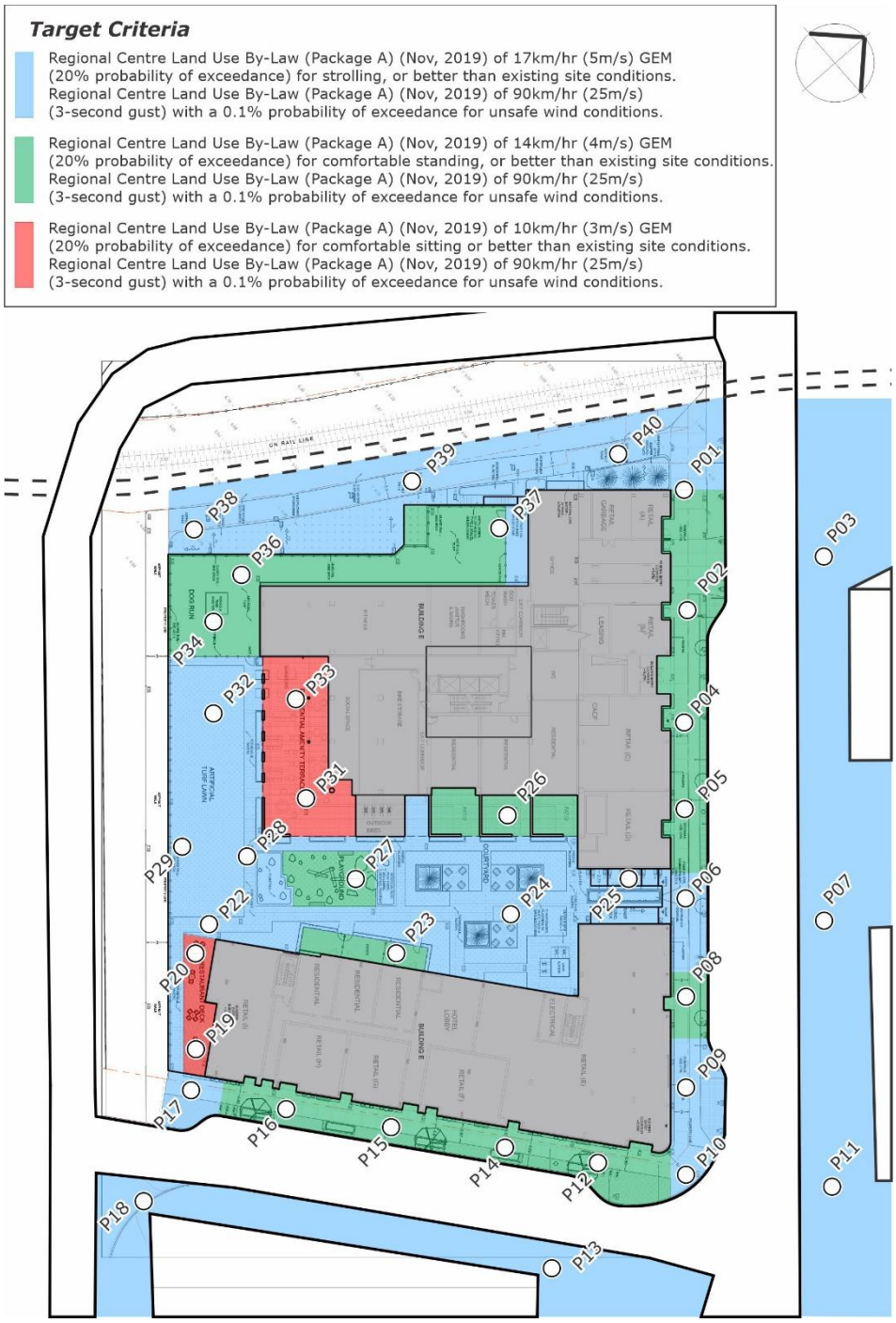

Figure 5a: Study Point Locations and Summer Target Wind Speed Criteria Parking Level 0 and Level 1

Figure 5b: Study Point Locations and Winter Target Wind Speed Criteria
Parking Level 0 and Level 1

6 RESULTS AND DISCUSSION

6.1 Initial Testing Results for Summer Season

The results of the wind tunnel study are presented in the form of directional plots in Appendix C.2 for all study points locations and summarised in Tables 5 and 6 for the Proposed and Future scenarios, respectively, for the summer season. The initial testing did not include the effect of treatments. The results are also shown as wind roses on marked-up plans in Figures 6 and 7 for the two scenarios. The target wind speed criteria that are also listed in Table 5 for each study point location, as well as presented in Figures 5.

The results of the study indicate that the wind conditions for the majority of ground level areas during the summer months will be safe for pedestrian use. There was also a noticeable improvement in wind conditions in the future scenario. However, some areas will experience strong winds which will exceed the relevant criteria for comfort. These conditions have also been compared to the existing conditions to assess the development's impact before and after completion.

Figure 6: Wind Tunnel Results (Summer) – Parking Level 0 and Level 1 Plan
Proposed Site Conditions (results shown without treatments applied)

Figure 7: Wind Tunnel Results (Summer) – Parking Level 0 and Level 1 Plan Future Site Conditions (results shown without treatments applied)

Table 5: Wind Tunnel Results Summary for the Proposed Site Conditions (Summer)

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P01	4.0	47%	Fail	25	26	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		48%	Fail		16	Pass	Fail	
P02	4.0	35%	Fail	25	18	Pass	Fail	Better than or similar to Existing Conditions.
Existing		43%	Fail		20	Pass	Fail	
P03	5.0	28%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		37%	Fail		24	Pass	Fail	
P04	4.0	52%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		40%	Fail		22	Pass	Fail	
P05	4.0	49%	Fail	25	22	Pass	Fail	Better than or similar to Existing Conditions.
Existing		49%	Fail		24	Pass	Fail	
P06	5.0	44%	Fail	25	22	Pass	Fail	Better than or similar to Existing Conditions.
Existing		41%	Fail		23	Pass	Fail	
P07	5.0	49%	Fail	25	25	Pass	Fail	Better than or similar to Existing Conditions at P11.
Existing		39%	Fail		24	Pass	Fail	
P08	4.0	36%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		47%	Fail		19	Pass	Fail	
P09	5.0	31%	Fail	25	22	Pass	Fail	Better than or similar to Existing Conditions.
Existing		29%	Fail		19	Pass	Fail	
P10	5.0	49%	Fail	25	23	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		16%	Pass		18	Pass	Pass	
P11	5.0	33%	Fail	25	25	Pass	Fail	Better than or similar to Existing Conditions.
Existing		42%	Fail		27	Fail	Fail	
P12	4.0	34%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		50%	Fail		25	Pass	Fail	
P13	5.0	15%	Pass	25	17	Pass	Pass	-
Existing		46%	Fail		20	Pass	Fail	
P14	4.0	35%	Fail	25	19	Pass	Fail	Inclusion of proposed landscaping.
Existing		28%	Fail		18	Pass	Fail	
P15	4.0	39%	Fail	25	18	Pass	Fail	Better than or similar to Existing Conditions.
Existing		45%	Fail		20	Pass	Fail	
P16	4.0	37%	Fail	25	18	Pass	Fail	Better than or similar to Existing Conditions.
Existing		46%	Fail		19	Pass	Fail	
P17	5.0	30%	Fail	25	21	Pass	Fail	Inclusion of proposed landscaping.
Existing		19%	Pass		17	Pass	Pass	
P18	5.0	14%	Pass	25	18	Pass	Pass	-
Existing		13%	Pass		16	Pass	Pass	
P19	3.0	26%	Fail	25	13	Pass	Fail	Inclusion of operator controlled localised screening when in use.

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P20	3.0	21%	Fail	25	11	Pass	Fail	Inclusion of operator controlled localised screening when in use.
P22	5.0	28%	Fail	25	21	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P23	4.0	42%	Fail	25	24	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P24	5.0	32%	Fail	25	19	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P25	5.0	46%	Fail	25	26	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P26	4.0	0%	Pass	25	7	Pass	Pass	-
P27	4.0	56%	Fail	25	21	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P28	5.0	27%	Fail	25	17	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P29	5.0	39%	Fail	25	27	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P31	3.0	47%	Fail	25	16	Pass	Fail	Inclusion of operator controlled localised screening when in use.
P32	5.0	41%	Fail	25	27	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P33	3.0	33%	Fail	25	14	Pass	Fail	Inclusion of operator controlled localised screening when in use.
P34	4.0	54%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P36	4.0	55%	Fail	25	27	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P37	4.0	28%	Fail	25	16	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P38	5.0	18%	Pass	25	16	Pass	Pass	-
Existing		8%	Pass		14	Pass	Pass	
P39	5.0	46%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		31%	Fail		19	Pass	Fail	
P40	5.0	24%	Fail	25	22	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		32%	Fail		19	Pass	Fail	

Table 6: Wind Tunnel Results Summary for the Future Site Conditions (Summer)

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P01	4.0	41%	Fail	25	25	Pass	Fail	Better than or similar to Existing Conditions.
Existing		48%	Fail		16	Pass	Fail	
P02	4.0	26%	Fail	25	18	Pass	Fail	Better than or similar to Existing Conditions.
Existing		43%	Fail		20	Pass	Fail	
P03	5.0	20%	Pass	25	21	Pass	Pass	-
Existing		37%	Fail		24	Pass	Fail	
P04	4.0	47%	Fail	25	21	Pass	Fail	Better than or similar to Existing Conditions.
Existing		40%	Fail		22	Pass	Fail	
P05	4.0	48%	Fail	25	21	Pass	Fail	Better than or similar to Existing Conditions.
Existing		49%	Fail		24	Pass	Fail	
P06	5.0	38%	Fail	25	23	Pass	Fail	Better than or similar to Existing Conditions.
Existing		41%	Fail		23	Pass	Fail	
P07	5.0	41%	Fail	25	25	Pass	Fail	Better than or similar to Existing Conditions.
Existing		39%	Fail		24	Pass	Fail	
P08	4.0	34%	Fail	25	19	Pass	Fail	Better than or similar to Existing Conditions.
Existing		47%	Fail		19	Pass	Fail	
P09	5.0	22%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		29%	Fail		19	Pass	Fail	
P10	5.0	29%	Fail	25	21	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		16%	Pass		18	Pass	Pass	
P11	5.0	31%	Fail	25	24	Pass	Fail	Better than or similar to Existing Conditions.
Existing		42%	Fail		27	Fail	Fail	
P12	4.0	41%	Fail	25	19	Pass	Fail	Better than or similar to Existing Conditions.
Existing		50%	Fail		25	Pass	Fail	
P13	5.0	33%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		46%	Fail		20	Pass	Fail	
P14	4.0	43%	Fail	25	20	Pass	Fail	See Figure 10. To be mitigated through future development design.
Existing		28%	Fail		18	Pass	Fail	
P15	4.0	43%	Fail	25	22	Pass	Fail	Better than or similar to Existing Conditions.
Existing		45%	Fail		20	Pass	Fail	
P16	4.0	49%	Fail	25	20	Pass	Fail	Better than or similar to Existing Conditions.
Existing		46%	Fail		19	Pass	Fail	
P17	5.0	33%	Fail	25	20	Pass	Fail	See Figure 10. To be mitigated through future development design.
Existing		19%	Pass		17	Pass	Pass	
P18	5.0	11%	Pass	25	19	Pass	Pass	-
Existing		13%	Pass		16	Pass	Pass	
P19	3.0	29%	Fail	25	13	Pass	Fail	Inclusion of operator controlled localised screening when in use.

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P20	3.0	15%	Pass	25	12	Pass	Pass	-
P22	5.0	16%	Pass	25	21	Pass	Pass	-
P23	4.0	35%	Fail	25	23	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P24	5.0	34%	Fail	25	20	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P25	5.0	42%	Fail	25	24	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P26	4.0	0%	Pass	25	7	Pass	Pass	-
P27	4.0	50%	Fail	25	19	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P28	5.0	35%	Fail	25	19	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P29	5.0	34%	Fail	25	23	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P31	3.0	26%	Fail	25	12	Pass	Fail	Inclusion of operator controlled localised screening when in use.
P32	5.0	38%	Fail	25	25	Pass	Fail	Inclusion of operator controlled localised screening when in use.
P33	3.0	18%	Pass	25	15	Pass	Pass	-
P34	4.0	48%	Fail	25	24	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P36	4.0	55%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P37	4.0	26%	Fail	25	17	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P38	5.0	24%	Fail	25	17	Pass	Fail	See Figure 10. Mitigated with the inclusion of the future parkade.
Existing		8%	Pass		14	Pass	Pass	
P39	5.0	43%	Fail	25	22	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		31%	Fail		19	Pass	Fail	
P40	5.0	20%	Pass	25	21	Pass	Pass	-
Existing		32%	Fail		19	Pass	Fail	

6.2 Initial Testing Results for Winter Season

The results of the wind tunnel study are presented in the form of directional plots in Appendix C.3 for all study points locations and summarised in Tables 7 and 8 for the Proposed and Future scenarios, respectively, for the winter season. The initial testing did not include the effect of treatments. The results are also shown as wind roses on marked-up plans in Figures 8 and 9 for the two scenarios. The target wind speed criteria that are also listed in Table 5 for each study point location, as well as presented in Figures 5.

The results of the study indicate that the wind conditions for the ground level areas during the winter months are stronger than the summer months, and some areas will experience conditions which exceed the relevant criteria for comfort and/or safety. There was still a noticeable improvement in wind conditions in the future scenario. It is noted that the outdoor spaces tend not to be used for any activities other than objective walking, and therefore it was assessed primarily from a pedestrian safety point of view. These conditions have also been compared to the existing conditions to assess the development's impact before and after completion.

Figure 8: Wind Tunnel Results (Winter) – Parking Level 0 and Level 1 Plan
Proposed Site Conditions (results shown without treatments applied)

Figure9: Wind Tunnel Results (Winter) – Parking Level 0 and Level 1 Plan Future Site Conditions (results shown without treatments applied)

Table 7: Wind Tunnel Results Summary for the Proposed Site Conditions (Winter)

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P01	5.5	42%	Fail	25	37	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		32%	Fail		22	Pass	Fail	
P02	5.5	23%	Fail	25	23	Pass	Fail	Better than or similar to Existing Conditions.
Existing		35%	Fail		26	Fail	Fail	
P03	5.5	26%	Fail	25	26	Fail	Fail	Better than or similar to Existing Conditions.
Existing		30%	Fail		32	Fail	Fail	
P04	5.5	48%	Fail	25	29	Fail	Fail	Better than or similar to surrounding Existing Conditions.
Existing		37%	Fail		27	Fail	Fail	
P05	5.5	48%	Fail	25	29	Fail	Fail	Better than or similar to Existing Conditions.
Existing		41%	Fail		30	Fail	Fail	
P06	5.5	49%	Fail	25	26	Fail	Fail	Better than or similar to Existing Conditions.
Existing		43%	Fail		29	Fail	Fail	
P07	5.5	52%	Fail	25	35	Fail	Fail	Better than or similar to Existing Conditions at adjacent P11.
Existing		40%	Fail		31	Fail	Fail	
P08	5.5	37%	Fail	25	24	Pass	Fail	Better than or similar to Existing Conditions.
Existing		36%	Fail		25	Pass	Fail	
P09	5.5	43%	Fail	25	26	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		34%	Fail		25	Pass	Fail	
P10	5.5	51%	Fail	25	27	Fail	Fail	See Figure 10. Minor exceedance of safety limit. Inclusion of proposed landscaping
Existing		23%	Fail		23	Pass	Fail	
P11	5.5	38%	Fail	25	35	Fail	Fail	Better than or similar to Existing Conditions.
Existing		42%	Fail		36	Fail	Fail	
P12	5.5	18%	Pass	25	25	Pass	Pass	-
Existing		44%	Fail		31	Fail	Fail	
P13	5.5	20%	Pass	25	22	Pass	Pass	-
Existing		48%	Fail		26	Fail	Fail	
P14	5.5	18%	Pass	25	24	Pass	Pass	-
Existing		24%	Fail		22	Pass	Fail	
P15	5.5	22%	Fail	25	24	Pass	Fail	Better than or similar to Existing Conditions.
Existing		38%	Fail		25	Pass	Fail	
P16	5.5	20%	Pass	25	24	Pass	Pass	-
Existing		33%	Fail		24	Pass	Fail	
P17	5.5	26%	Fail	25	27	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		31%	Fail		23	Pass	Fail	
P18	5.5	21%	Fail	25	21	Pass	Fail	Better than or similar to Existing Conditions.
Existing		24%	Fail		22	Pass	Fail	
P19	5.5	8%	Pass	25	17	Pass	Pass	-

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P20	5.5	2%	Pass	25	14	Pass	Pass	-
P22	5.5	38%	Fail	25	26	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P23	5.5	45%	Fail	25	31	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P24	5.5	44%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P25	5.5	44%	Fail	25	35	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P26	5.5	0%	Pass	25	9	Pass	Pass	-
P27	5.5	51%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P28	5.5	38%	Fail	25	22	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P29	5.5	47%	Fail	25	35	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P31	5.5	20%	Pass	25	21	Pass	Pass	-
P32	5.5	44%	Fail	25	34	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P33	5.5	7%	Pass	25	18	Pass	Pass	-
P34	5.5	50%	Fail	25	32	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P36	5.5	51%	Fail	25	34	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P37	5.5	14%	Pass	25	22	Pass	Pass	-
P38	5.5	32%	Fail	25	21	Pass	Fail	See Figure 10. Mitigated with the inclusion of the future parkade.
Existing		13%	Pass		18	Pass	Pass	
P39	5.5	46%	Fail	25	33	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		37%	Fail		23	Pass	Fail	
P40	5.5	35%	Fail	25	28	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		37%	Fail		24	Pass	Fail	

Table 8: Wind Tunnel Results Summary for the Future Site Conditions (Winter)

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P01	5.5	39%	Fail	25	34	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		32%	Fail		22	Pass	Fail	
P02	5.5	19%	Pass	25	23	Pass	Pass	-
Existing		35%	Fail		26	Fail	Fail	
P03	5.5	19%	Pass	25	27	Fail	Fail	Better than or similar to Existing Conditions.
Existing		30%	Fail		32	Fail	Fail	
P04	5.5	46%	Fail	25	29	Fail	Fail	Better than or similar to surrounding Existing Conditions.
Existing		37%	Fail		27	Fail	Fail	
P05	5.5	45%	Fail	25	28	Fail	Fail	Better than or similar to Existing Conditions.
Existing		41%	Fail		30	Fail	Fail	
P06	5.5	46%	Fail	25	27	Fail	Fail	Better than or similar to Existing Conditions.
Existing		43%	Fail		29	Fail	Fail	
P07	5.5	44%	Fail	25	34	Fail	Fail	Better than or similar to Existing Conditions at adjacent P11.
Existing		40%	Fail		31	Fail	Fail	
P08	5.5	32%	Fail	25	23	Pass	Fail	Better than or similar to Existing Conditions.
Existing		36%	Fail		25	Pass	Fail	
P09	5.5	32%	Fail	25	24	Pass	Fail	Better than or similar to Existing Conditions.
Existing		34%	Fail		25	Pass	Fail	
P10	5.5	31%	Fail	25	28	Fail	Fail	See Figure 10. Minor exceedance of safety limit. Inclusion of proposed landscaping
Existing		23%	Fail		23	Pass	Fail	
P11	5.5	36%	Fail	25	34	Fail	Fail	Better than or similar to Existing Conditions.
Existing		42%	Fail		36	Fail	Fail	
P12	5.5	24%	Fail	25	25	Pass	Fail	Better than or similar to Existing Conditions.
Existing		44%	Fail		31	Fail	Fail	
P13	5.5	33%	Fail	25	26	Fail	Fail	Better than or similar to Existing Conditions.
Existing		48%	Fail		26	Fail	Fail	
P14	5.5	26%	Fail	25	27	Fail	Fail	See Figure 10. To be mitigated through future development design.
Existing		24%	Fail		22	Pass	Fail	
P15	5.5	28%	Fail	25	29	Fail	Fail	See Figure 10. To be mitigated through future development design.
Existing		38%	Fail		25	Pass	Fail	
P16	5.5	37%	Fail	25	27	Fail	Fail	See Figure 10. To be mitigated through future development design.
Existing		33%	Fail		24	Pass	Fail	
P17	5.5	39%	Fail	25	25	Pass	Fail	See Figure 10. To be mitigated through future development design.
Existing		31%	Fail		23	Pass	Fail	
P18	5.5	18%	Pass	25	24	Pass	Pass	-
Existing		24%	Fail		22	Pass	Fail	

Study Point	GEM (20% exceedance)			Annual Gust			Final Result	Notes/Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
P19	5.5	10%	Pass	25	18	Pass	Pass	-
P20	5.5	2%	Pass	25	14	Pass	Pass	-
P22	5.5	27%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P23	5.5	41%	Fail	25	29	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P24	5.5	44%	Fail	25	25	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P25	5.5	42%	Fail	25	33	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P26	5.5	0%	Pass	25	9	Pass	Pass	-
P27	5.5	41%	Fail	25	22	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P28	5.5	44%	Fail	25	24	Pass	Fail	See Figure 10. Inclusion of proposed landscaping
P29	5.5	41%	Fail	25	30	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P31	5.5	5%	Pass	25	15	Pass	Pass	-
P32	5.5	44%	Fail	25	32	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P33	5.5	6%	Pass	25	20	Pass	Pass	-
P34	5.5	44%	Fail	25	32	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P36	5.5	50%	Fail	25	32	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
P37	5.5	14%	Pass	25	21	Pass	Pass	
P38	5.5	35%	Fail	25	22	Pass	Fail	See Figure 10. Mitigated with the inclusion of the future parkade.
Existing		13%	Pass		18	Pass	Pass	
P39	5.5	43%	Fail	25	28	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		37%	Fail		23	Pass	Fail	
P40	5.5	31%	Fail	25	27	Fail	Fail	See Figure 10. Inclusion of proposed landscaping
Existing		37%	Fail		24	Pass	Fail	

6.3 Treatment Optimisation Testing Results

Treatment optimisation testing was undertaken to examine the effect of different treatments on the wind conditions at selected critical locations. The tested treatment scheme and results summary is shown in Appendix C.1.

Note that these treatments were tested in the wind tunnel to design and optimise the treatment strategy. These are not the final suggested treatments. The final suggested treatments are presented in Section 6.4.

6.4 Conclusion and Suggested Treatments

Based on an assessment of the both the results of the initial testing (Section 6.1 and 6.2) and treatment optimisation testing (Section 6.3), it should be noted that the existing wind conditions are generally strong already due to the site's overall exposure to the prevailing winds. The inclusion of the development has had the effect of creating better conditions in some areas, while shifting the existing prevailing winds to other areas. Some additional treatments are suggested to be included in the final design of the development to further improve conditions.

It has been shown that it is possible to ameliorate the impact of the development on the existing wind conditions noting that the modelling of the existing conditions show some areas already experience strong wind conditions. The necessity, size and extent of the treatment strategy is subject to the location's intended use and existing conditions, and potential adaptation to the local wind conditions, given that this area is coastal and thus is already exposed to relatively strong winds than would not be expected in a built-up city environment.

The following set of in-principle treatment suggestions, as shown in Figure 10, and additionally, the inclusion of proposed densely foliating landscaping in the proposed locations within and around the site, is expected to satisfy the criteria in the public realm, and/or maintain wind conditions similar to the existing wind conditions. The proposed landscaping within and around the site and/or management of outdoor spaces is expected to further minimise the effect of any uncomfortable winds.

In conclusion, wind mitigation is required for locations that exceed the safety criterion and are also worse than the existing conditions (as per the Regional Centre Land Use By-Law Package A (2019)).

It is recommended that the suggested treatments, shown in Figure 10, are implemented into the building design to mitigate wind conditions exceeding the safety criterion. The proposed landscaping within and around the site and/or management of outdoor spaces is expected to further minimise any uncomfortable winds.

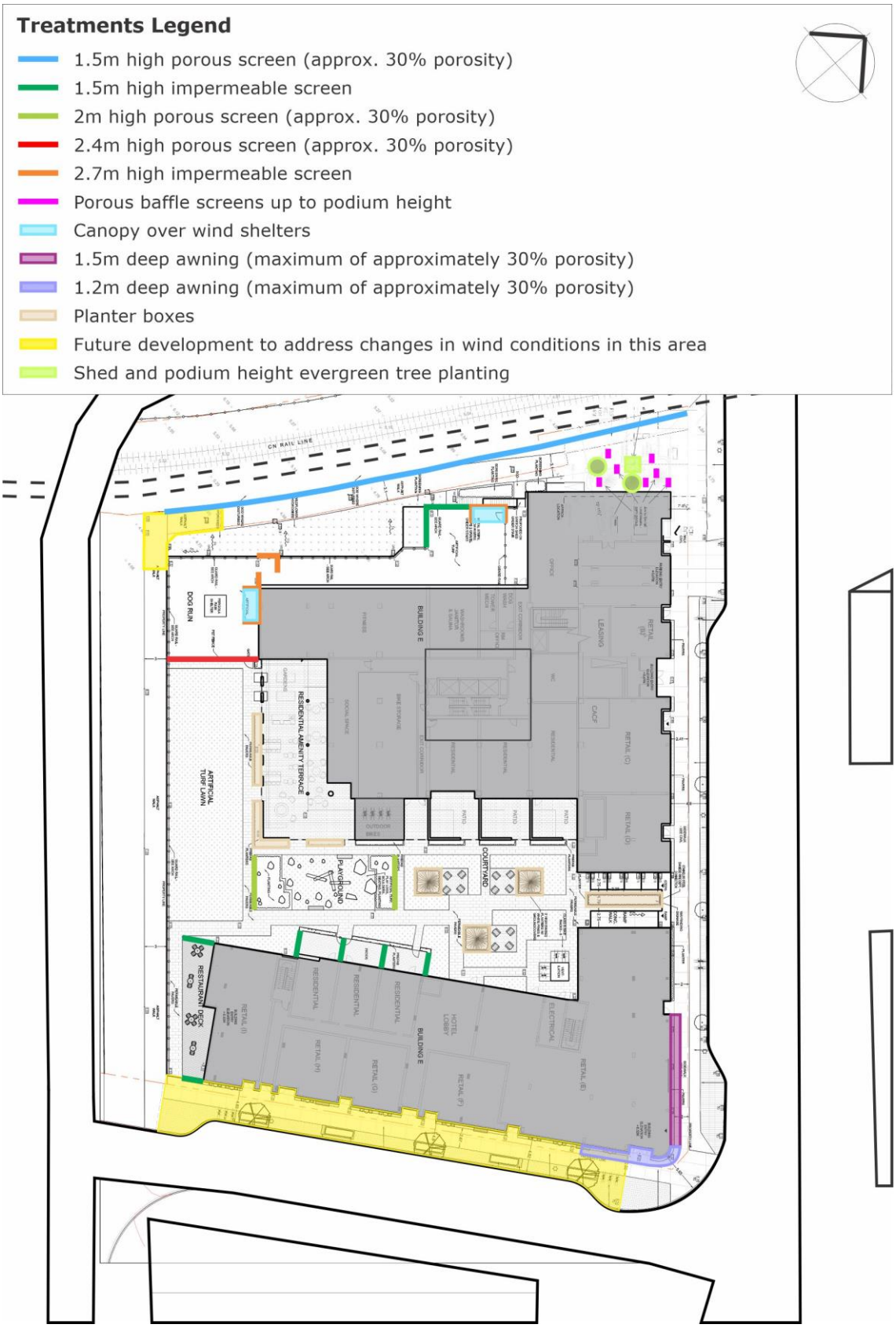

Figure 10: Suggested Treatments (for Safety Criterion Exceedances)

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APPENDIX A PUBLISHED ENVIRONMENTAL CRITERIA

A.1 Wind Effects on People

The acceptability of wind in an area is dependent upon the use of the area. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Quantifying wind comfort has been the subject of much research and many 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. This section discusses and compares the various published criteria.

A.1.1 A.D. Penwarden (1973) Criteria for Mean Wind Speeds

A.D. Penwarden (1973) developed a modified version of the Beaufort scale which describes the effects of various wind intensities on people. Table A.1 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 A.1: Summary of Wind Effects on People (A.D. Penwarden, 1973)

Type of Winds	Beaufort Number	Hourly Mean Wind Speed (m/s)	Effects
Calm	0	0 - 0.25	
Calm, light air	1	0 25 - 1.55	No noticeable wind
Light breeze	2	1.55 - 3.35	Wind felt on face
Gentle breeze	3	3.35 - 5.45	Hair is disturbed, clothing flaps, newspapers difficult to read
Moderate breeze	4	5.45 - 7.95	Raises dust, dry soil and loose paper, hair disarranged
Fresh breeze	5	7.95 – 10.75	Force of wind felt on body, danger of stumbling
Strong breeze	6	10.75 – 13.85	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, wind noise on ears unpleasant
Near gale	7	13.85 – 17.15	Inconvenience felt when walking
Gale	8	17.15 - 20.75	Generally impedes progress, difficulty balancing in gusts
Strong gale	9	20.75 – 24.45	People blown over

A.1.2 A.G. Davenport (1972) Criteria for Mean Wind Speeds

A.G. Davenport (1972) also determined a set of criteria in terms of the Beaufort scale and for various return periods. Table A.2 presents a summary of the criteria based on a probability of exceedance of 5%.

Table A.2: Criteria by A.G. Davenport (1972)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Walking Fast	Acceptable for walking, main public accessways.	7.5 - 10.0
Strolling, Skating	Slow walking, etc.	5.5 - 7.5
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	3.5 - 5.5
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 3.5

A.1.3 T.V. Lawson (1975) Criteria for Mean Wind Speeds

In 1973, T.V. Lawson, while referring to the Beaufort wind speeds of A.D. Penwarden (1973) (as listed in Table A.1), quoted that a Beaufort 4 wind speed would be acceptable if it is not exceeded for more than 4% of the time, and that a Beaufort 6 wind speed would be unacceptable if it is exceeded more than 2% of the time. Later, in 1975, T.V. Lawson presented a set of criteria very similar to those presented in A.G. Davenport (1972) (as listed in Table A.2). These criteria are presented in Table A.3 and Table A.4 for safety and comfort respectively.

Table A.3: Safety Criteria by T.V. Lawson (1975)

Classification	Activities	Annual Mean Wind Speed (m/s)
Safety (all weather areas)	Accessible by the general public.	0 – 15
Safety (fair weather areas)	Private areas, balconies/terraces, etc.	0 – 20

Table A.4: Comfort Criteria by T.V. Lawson (1975)

Classification	Activities	5% exceedance Mean Wind Speed (m/s)
Business Walking	Objective Walking from A to B.	8 - 10
Pedestrian Walking	Slow walking, etc.	6 - 8
Short Exposure Activities	Pedestrian standing or sitting for short times.	4 – 6
Long Exposure Activities	Pedestrian sitting for a long duration.	0 - 4

A.1.4 W.H. Melbourne (1978) Criteria for Gust Wind Speeds

W.H. Melbourne (1978) introduced a set of criteria for the assessment of environmental wind conditions that were developed for a temperature range of 10°C to 30°C and for people suitably dressed for outdoor conditions. These criteria are presented in Table A.5, and are based on maximum gust wind speeds with a probability of exceedance of once per year.

Table A.5: Criteria by W.H. Melbourne (1978)

Classification	Human Activities	Annual Gust Wind Speed (m/s)
Limit for Safety	Completely unacceptable: people likely to get blown over.	23
Marginal	Unacceptable as main public accessways.	16 - 23
Comfortable Walking	Acceptable for walking, main public accessways	13 - 16
Short Exposure Activities	Generally acceptable for walking & short duration stationary activities such as window-shopping, standing or sitting in plazas.	10 - 13
Long Exposure Activities	Generally acceptable for long duration stationary activities such as in outdoor restaurants & theatres and in parks.	0 - 10

A.2 Comparison of the Published Wind Speed Criteria

W.H. Melbourne (1978) presented a comparison of the criteria of various researchers on a probabilistic basis. Figure A.1 presents the results of this comparison, and indicates that the criteria of W.H. Melbourne (1978) are comparatively quite conservative. This conclusion was also observed by A.W. Rofail (2007) when undertaking on-site remedial studies. The results of A.W. Rofail (2007) concluded that the criteria by W.H. Melbourne (1978) generally overstates the wind effects in a typical urban setting due to the assumption of a fixed 15% turbulence intensity for all areas. It was observed in A.W. Rofail (2007) that the 15% turbulence intensity assumption is not real and that the turbulence intensities at 1.5m above ground is at least 20% and in a suburban or urban setting is generally in the range of 30% to 60%.

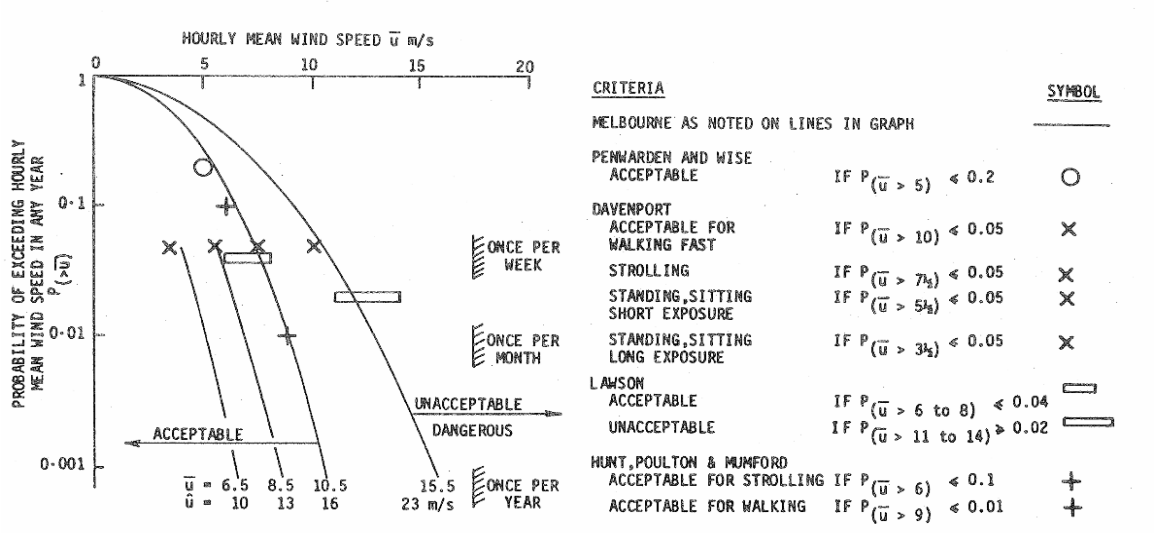


Figure A.1: Comparison of Various Mean and Gust Wind Environment Criteria, assuming 15% turbulence and a Gust Factor of 1.5 (W.H. Melbourne, 1978)

A.3 References relating to Pedestrian Comfort Criteria

Davenport, A.G., 1972, "An approach to human comfort criteria for environmental conditions". Colloquium on Building Climatology, Stockholm.

Davenport, A.G., 1977, "The prediction of risk under wind loading", 2nd International Conference on Structural Safety and Reliability, Munich, Germany, pp511-538.

Lawson, T.V., 1973, "The wind environment of buildings: a logical approach to the establishment of criteria". Bristol University, Department of Aeronautical Engineering.

Lawson, T.V., 1975, "The determination of the wind environment of a building complex before construction". Bristol University, Department of Aeronautical Engineering.

Melbourne, W.H., 1978, "Criteria for Environmental Wind Conditions". Journal of Wind Engineering and Industrial Aerodynamics, vol. 3, pp241-249.

Penwarden, A.D. (1973). "Acceptable Wind Speeds in Towns", Building Science, vol. 8: pp259–267.

Penwarden, A.D., Wise A.F.E., 1975, "Wind Environment Around Buildings". Building Research Establishment Report, London.

Rofail, A.W., 2007, "Comparison of Wind Environment Criteria against Field Observations". 12th International Conference of Wind Engineering, Cairns, Australia.

APPENDIX B DATA ACQUISITION

The wind tunnel testing procedures for this study were based on the guidelines set out in the Australasian Wind Engineering Society Quality Assurance Manual (AWES-QAM-1-2019), ASCE 7-16 (Chapter C31), and CTBUH (2013).

The wind speed measurements for the wind tunnel study were acquired as coefficients by Dantec hot-wire anemometers and converted to full-scale wind speeds using details of the regional wind climate obtained from an analysis of directional wind speed recordings from the local meteorological recording station(s).

B.1 Measurement of the Velocity Coefficients

The study model and proximity model were setup within the wind tunnel which was configured to the appropriate boundary layer profile, and the wind velocity measurements were monitored using Dantec hot-wire probe anemometers at selected critical outdoor locations. The anemometers were positioned at each study location at a full-scale height of approximately 1.5m above ground/slab level. The support of the probe was mounted such that the probe wire was vertical as much as possible to ensure that the measured wind speeds are independent of wind direction along the horizontal plane. In addition, care was taken in the alignment of the probe wire and in avoiding wall-heating effects.

Wind speed measurements were made in the wind tunnel for 36 wind directions, at 10° increments. The output from the hot-wire probes was obtained using a National Instruments 12-bit data acquisition card. The data was acquired for each wind direction using a sample rate of 1024Hz. The sample length was determined to produce a full-scale sample time that is sufficient for this type of study.

The mean, gust and standard deviation velocity coefficients were measured in the wind tunnel. The gust velocity coefficients were also derived for each wind direction from by the following relation:

$$\hat{C}_V = \bar{C}_V + g \cdot \sigma_{C_V} \qquad \text{B.1}$$

Where:

$\hat{C}_V$ is the gust coefficient.

$\bar{C}_V$ is the mean coefficient.

g is the peak factor, taken as 3.0 for a 3s gust and 3.4 for a 0.5s gust.

σ_{C_V} is the standard deviation of coefficient measurement.

B.2 Calculation of the Full-Scale Results

The full-scale results determine if the wind conditions at a study location satisfy the designated criteria of that location. More specifically, the full-scale results need to determine the probability of exceedance of a given wind speed at a study location. To determine the probability of exceedance, the measured velocity coefficients were combined with a statistical model of the local wind climate that relates wind speed to a probability of exceedance. Details of the wind climate model are outlined in Section 4 of the main report.

The statistical model of the wind climate includes the impact of wind directionality as any local variations in wind speed or frequency with wind direction. This is important as the wind directions that produce the highest wind speed events for a region may not coincide with the most wind exposed direction at the site.

The methodology adopted for the derivation of the full-scale results for the maximum gust and the GEM wind speeds are outlined in the following sub-sections.

B.2.1 Maximum Gust Wind Speeds

The full-scale maximum gust wind speed at each study point location is derived from the measured coefficient using the following relationship:

$$V_{study} = V_{ref,RH}\left(\frac{k_{200m,tr,T=1hr}}{k_{RH,tr,T=1hr}}\right)C_V \qquad \text{B.2}$$

Where:

V_{study} is the full-scale wind speed at the study point location, in m/s.

$V_{ref,RH}$ is the full-scale reference wind speed, measured 3m upstream at the study reference height. This value is determined by combining the directional wind speed data for the region (detailed in Section 4) and the upwind terrain and height multipliers for the site (detailed in Section 3).

$k_{200m,tr,T=1hr}$ is the standard deviation of the wind speed.

$k_{RH,tr,T=1hr}$ is the hourly mean terrain and height multiplier at the study reference height (see Section 3).

C_V is the velocity coefficient measurement obtained from the hot-wire anemometer, which is derived from the following relationship:

$$C_V = \frac{C_{V,study}}{C_{V,200m}} \qquad \text{B.3}$$

Where:

$C_{V,study}$ is the coefficient measurement obtained from the hot-wire anemometer at the study point location.

$C_{V,200m}$ is the coefficient measurement obtained from the hot-wire anemometer at the free-stream reference location at 200m height upwind of the model in the wind tunnel.

The value of $\mathrm{V_{ref,RH}}$ varies with each prevailing wind direction. Wind directions where there is a high probability that a strong wind will occur have a higher directional wind speed than other directions. To determine the directional wind speeds, a probability level must be assigned for each wind direction. These probability levels are set following the approach used in AS/NZS1170.2:2011, which assumes that the major contributions to the combined probability of exceedance of a typical load effect comes from only two 45 degree sectors.

B.2.2 Maximum Gust-Equivalent Mean Wind Speeds

The contribution to the probability of exceedance of a specified wind speed (ie: the desired wind speed for pedestrian comfort, as per the criteria) was calculated for each wind direction. These contributions are then combined over all wind directions to calculate the total probability of exceedance of the specified wind speed. To calculate the probability of exceedance for a specified wind speed a statistical wind climate model was used to describe the relationship between directional wind speeds and the probability of exceedance. A detailed description of the methodology is given by T.V. Lawson (1980).

The criteria used in this study is referenced to a probability of exceedance of 5% of a specified wind speed.

B.3 References relating to Data Acquisition

American Society of Civil Engineers (ASCE), ASCE-7-16, 2016, "Minimum Design Loads for Buildings and Other Structures".

Australasian Wind Engineering Society, QAM-1, 2019, "Quality Assurance Manual: Wind Engineering Studies of Buildings", edited by Rofail A.W., *et al*.

Council on Tall Buildings and Urban Habitat (CTBUH), 2013, "Wind tunnel testing of high-rise buildings", CTBUH Technical Guides.

Lawson, T.V., 1980, "Wind Effects on Buildings - Volume 1, Design Applications". Applied Science Publishers Ltd, Ripple Road, Barking, Essex, England.

Standards Australia and Standards New Zealand, AS/NZS 1170.2, 2011, "SAA Wind Loading Standard, Part 2: Wind Actions".

APPENDIX C DIRECTIONAL PLOTS OF WIND TUNNEL RESULTS

C.1 Treatment Optimisation Testing Results

Figure C.1.A: Details of Tested Treatments (Not Final Recommendations)

Proposed Scenario Results (Summer)

Note: Points with no data already meet the safety limit, are similar to existing or involve an alternative solution involving the future development.

Figure C.1.B: Details of Tested Treatments (Not Final Recommendations)

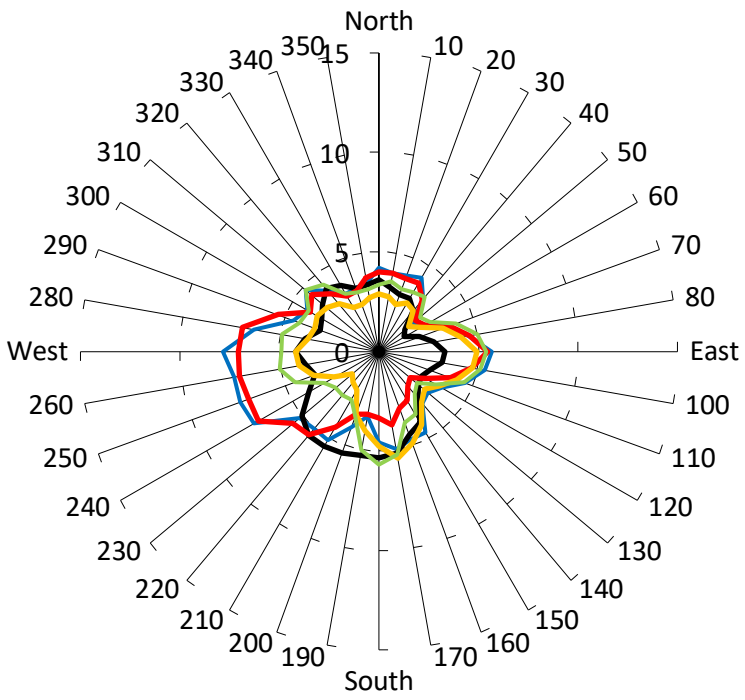
Proposed Scenario Results (Winter)

Note: Points with no data already meet the safety limit, are similar to existing or involve an alternative solution involving the future development.

C.2 Summer Criteria Directional Plots

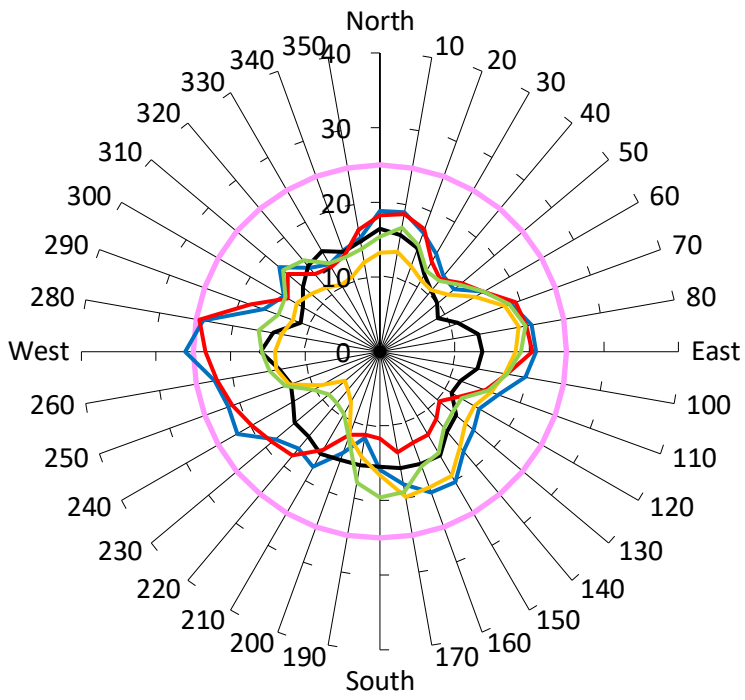
Results for P01

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

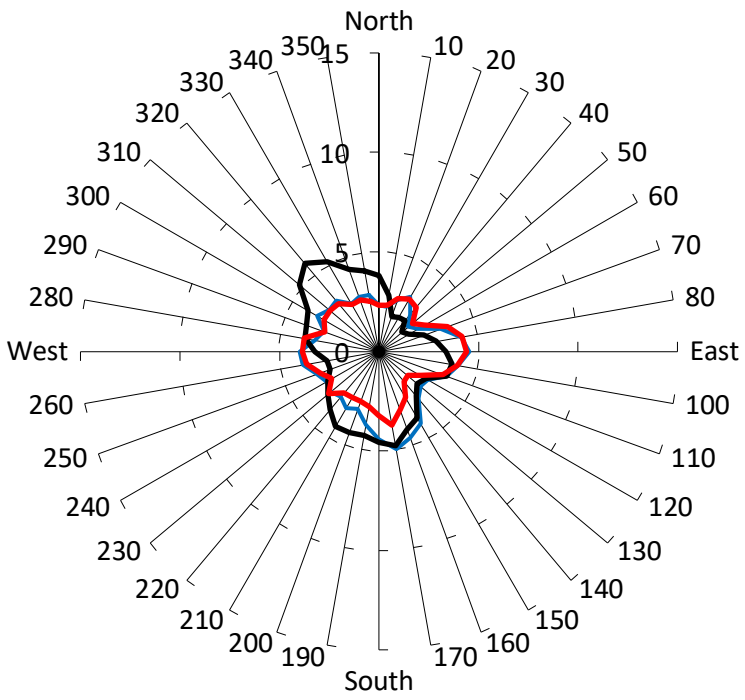


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	47%	26
Existing site conditions. No vegetation or other treatments.	48%	16
With proposed development and future surrounds case. No vegetation or other treatments.	46%	25
WE191-07 Proposed Case with inclusion of treatments (rev0)	37%	20
WE191-06 Future Case with inclusion of 6 full-height wind blades	45%	20

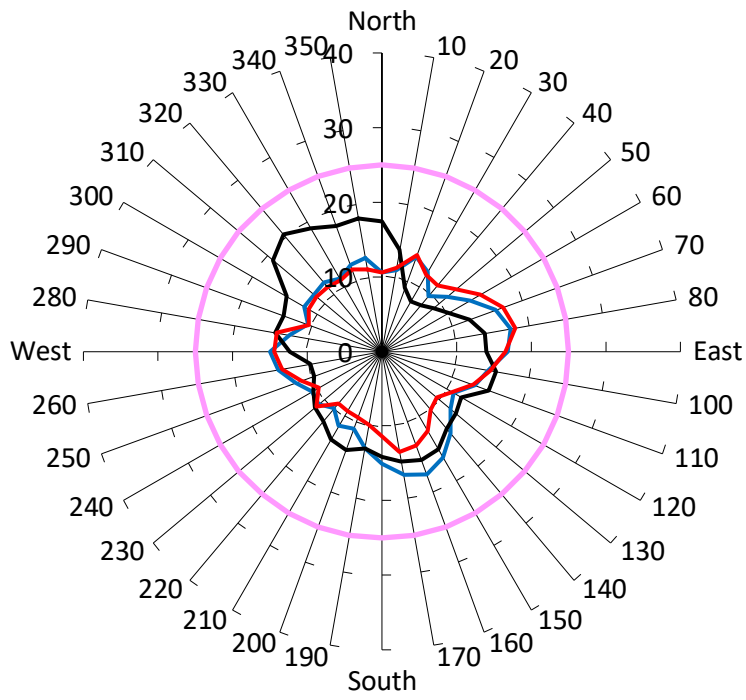
Results for P02

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

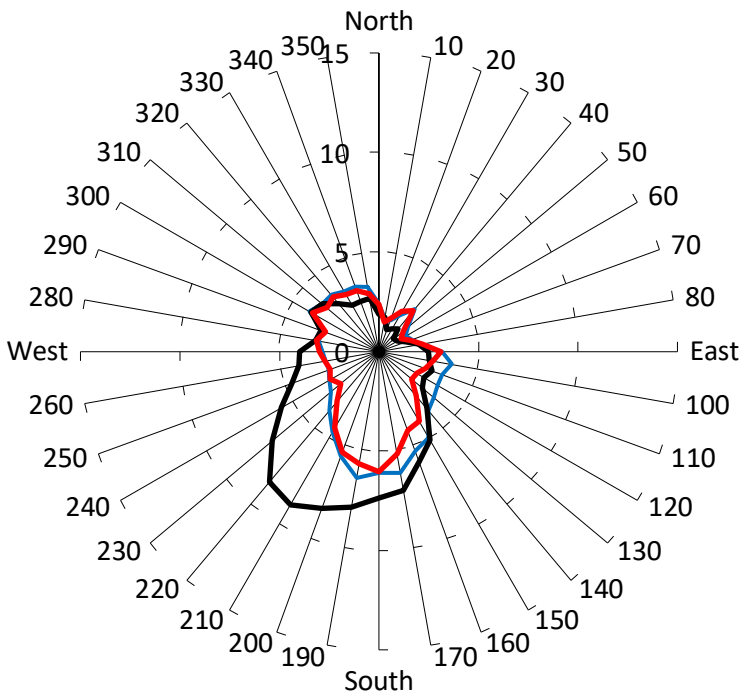


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	35%	18
Existing site conditions. No vegetation or other treatments.	43%	20
With proposed development and future surrounds case. No vegetation or other treatments.	26%	18

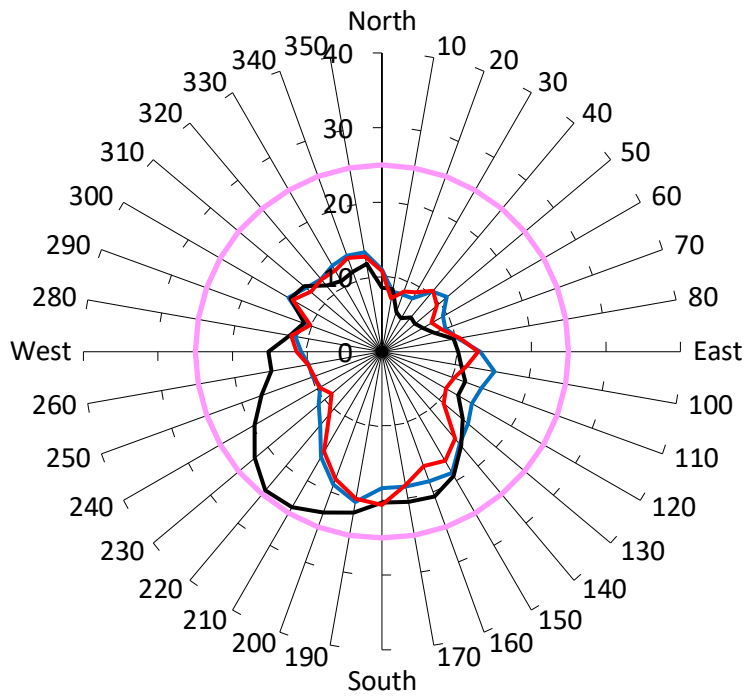
Results for P03

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

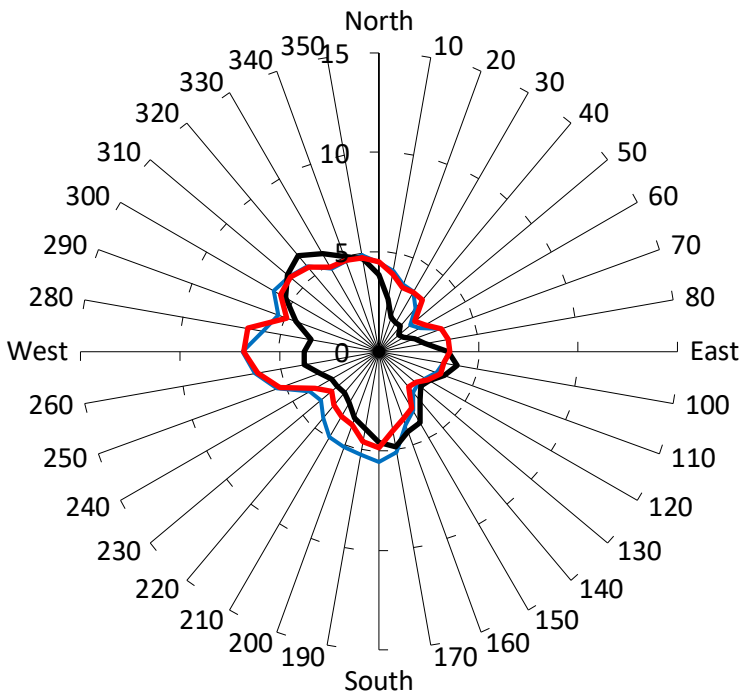


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	28%	20
Existing site conditions. No vegetation or other treatments.	37%	24
With proposed development and future surrounds case. No vegetation or other treatments.	20%	21

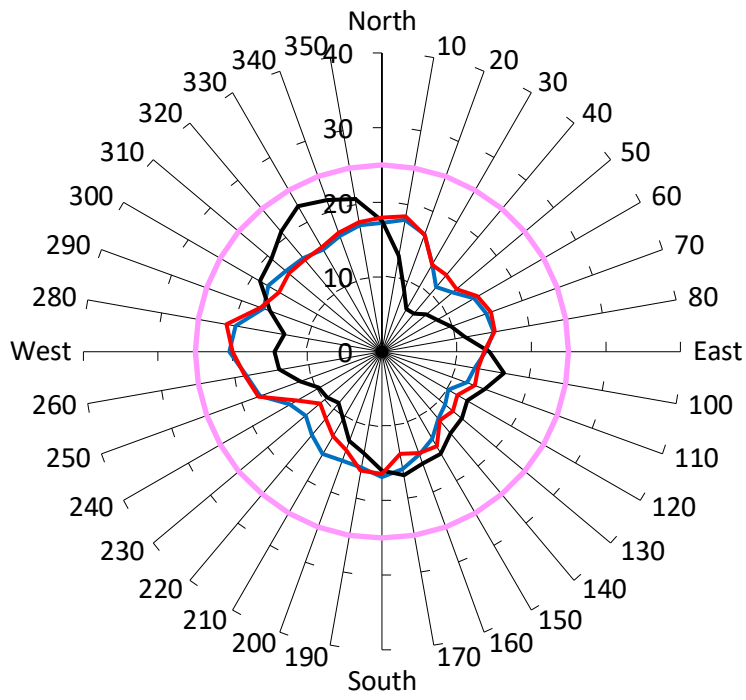
Results for P04

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

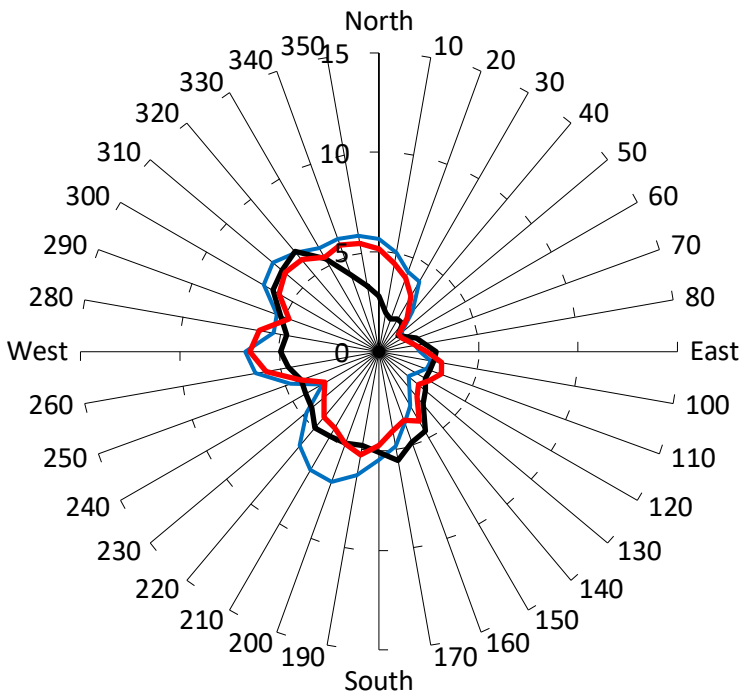


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	52%	20
Existing site conditions. No vegetation or other treatments.	40%	22
With proposed development and future surrounds case. No vegetation or other treatments.	47%	21

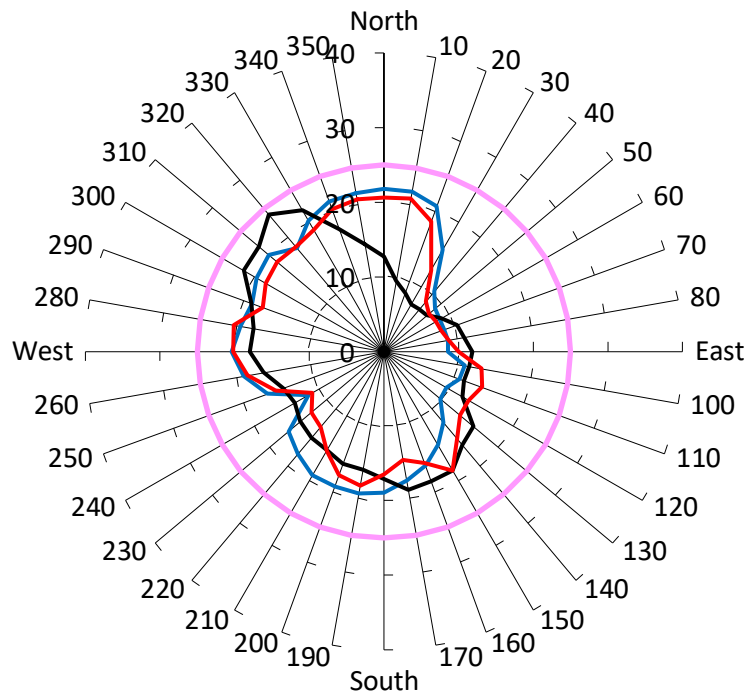
Results for P05

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

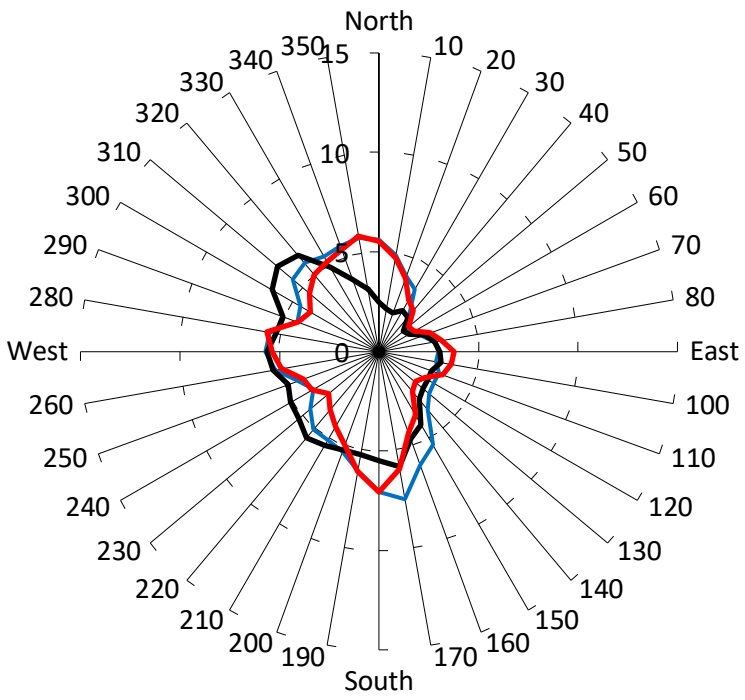


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	49%	22
Existing site conditions. No vegetation or other treatments.	49%	24
With proposed development and future surrounds case. No vegetation or other treatments.	48%	21

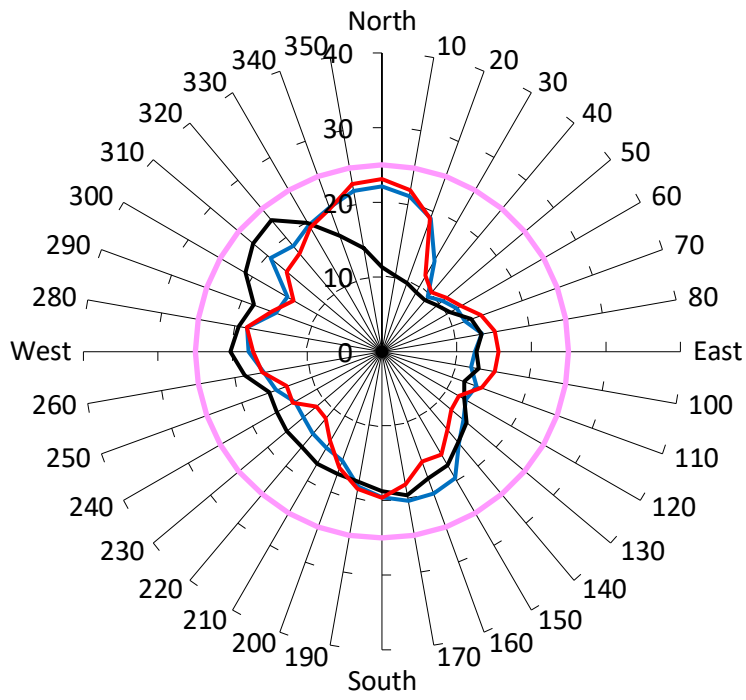
Results for P06

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

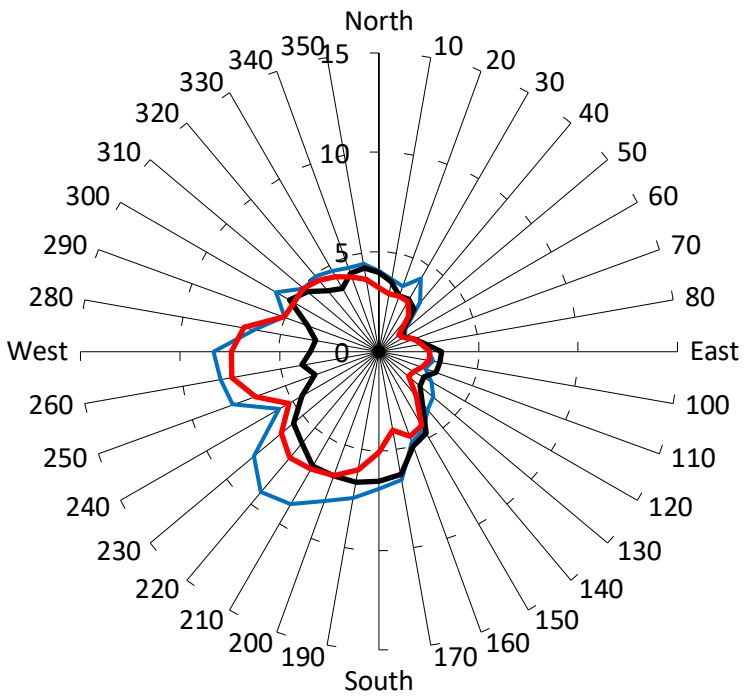


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	44%	22
Existing site conditions. No vegetation or other treatments.	41%	23
With proposed development and future surrounds case. No vegetation or other treatments.	38%	23

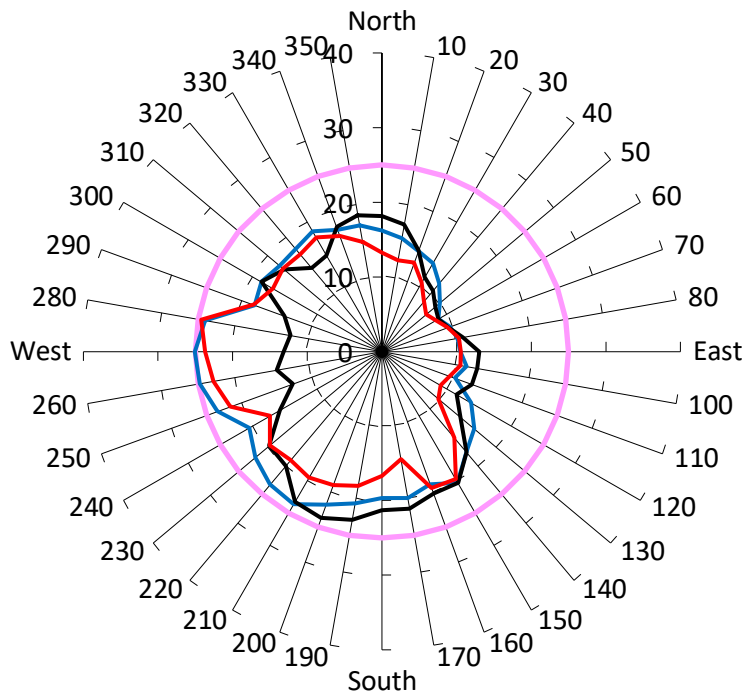
Results for P07

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

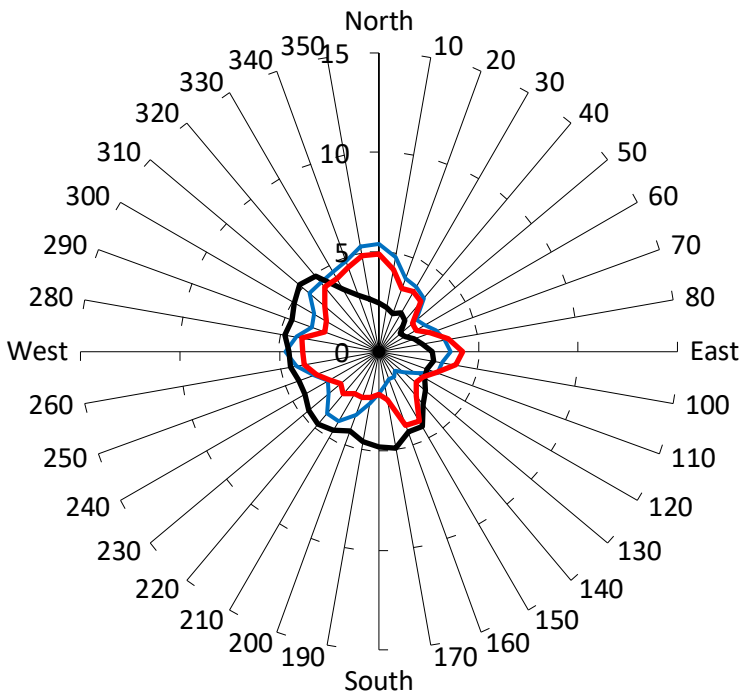


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	49%	25
Existing site conditions. No vegetation or other treatments.	39%	24
With proposed development and future surrounds case. No vegetation or other treatments.	41%	25

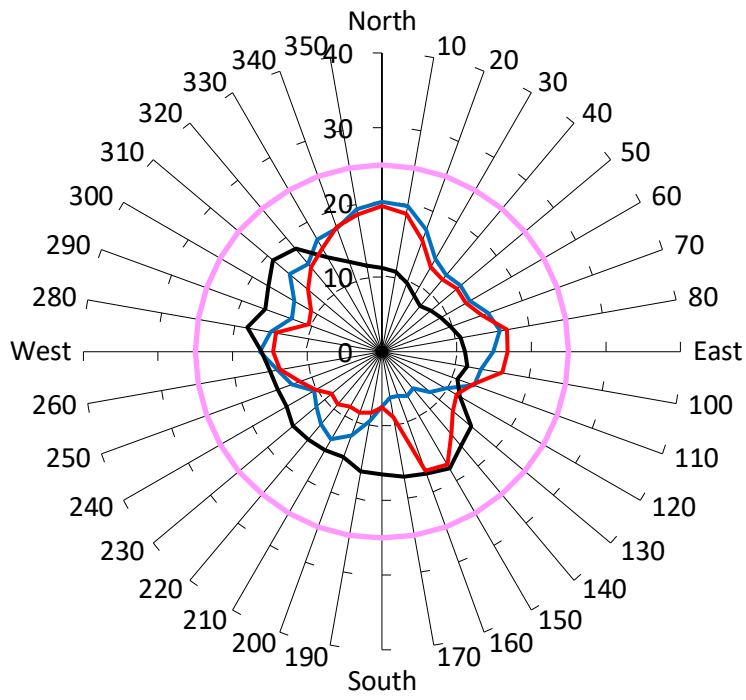
Results for P08

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

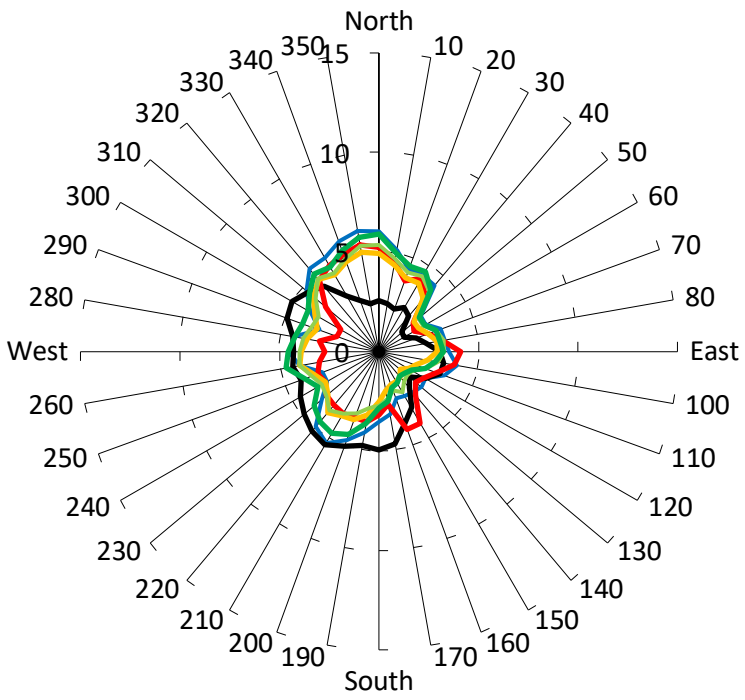


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	36%	20
Existing site conditions. No vegetation or other treatments.	47%	19
With proposed development and future surrounds case. No vegetation or other treatments.	34%	19

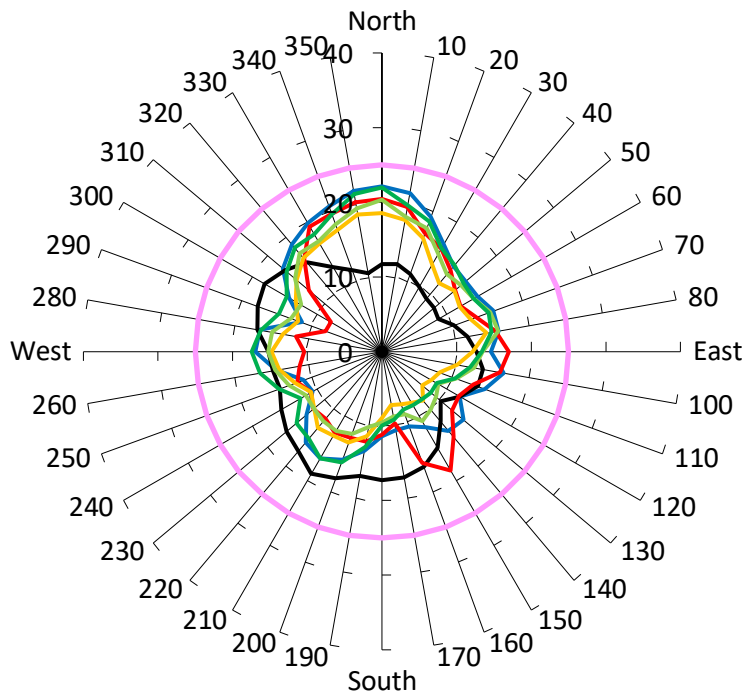
Results for P09

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

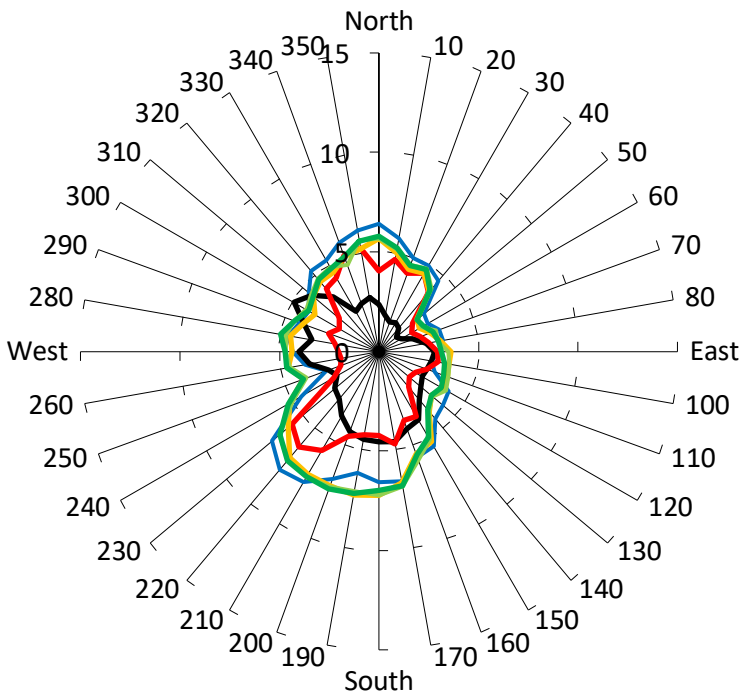


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	31%	22
Existing site conditions. No vegetation or other treatments.	29%	19
With proposed development and future surrounds case. No vegetation or other treatments.	22%	20
WE191-07 Proposed Case with inclusion of treatments (rev0) (2.0m wide awning)	20%	19
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.5m wide awning)	22%	20
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.2m wide awning)	29%	22

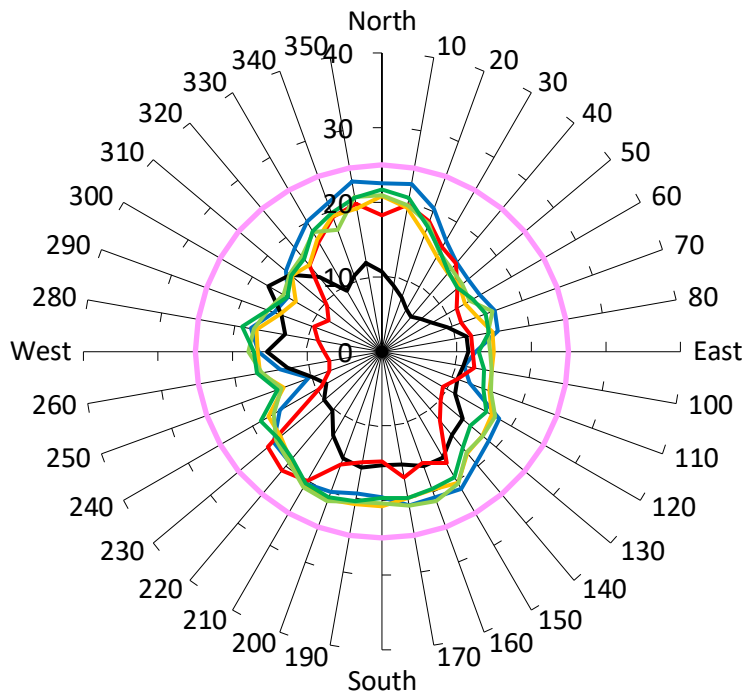
Results for P10

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

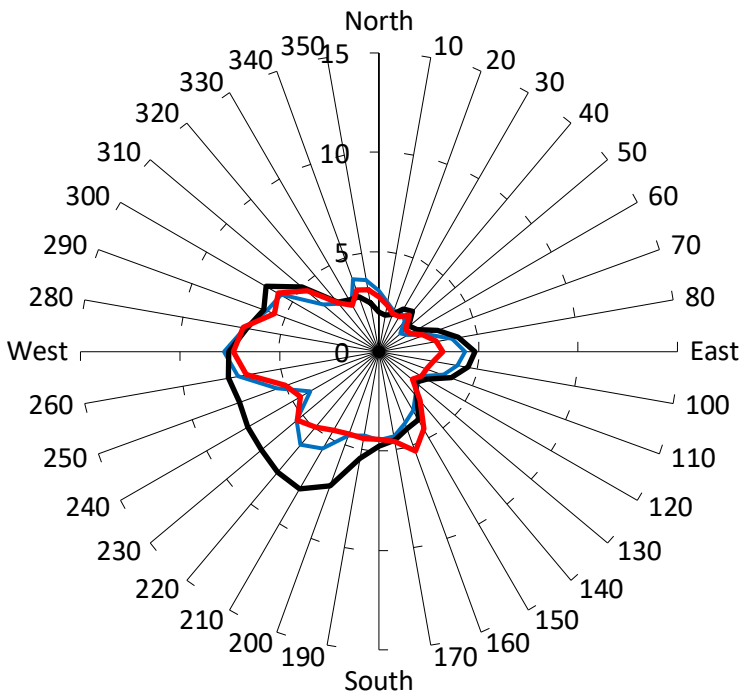


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	49%	23
Existing site conditions. No vegetation or other treatments.	16%	18
With proposed development and future surrounds case. No vegetation or other treatments.	29%	21
WE191-07 Proposed Case with inclusion of treatments (rev0) (2.0m wide awning)	48%	21
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.5m wide awning)	49%	21
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.2m wide awning)	49%	22

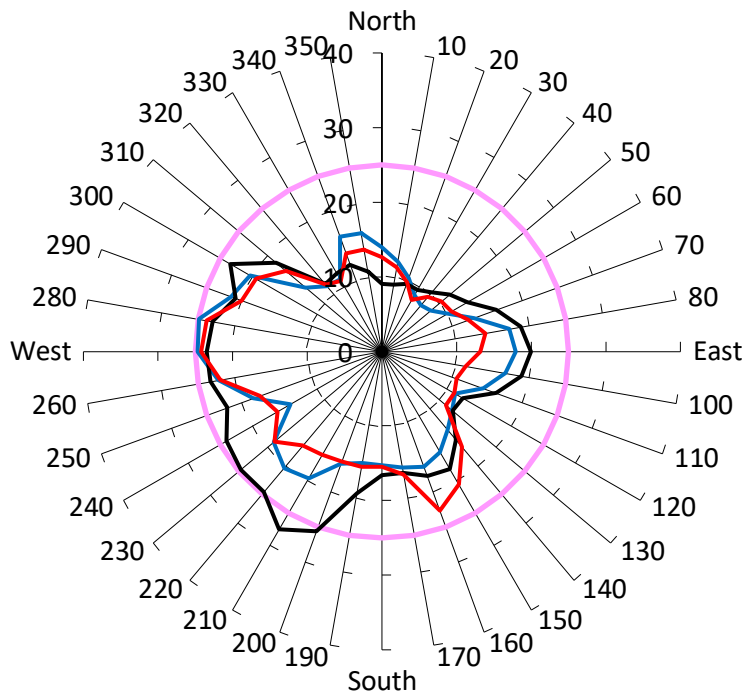
Results for P11

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

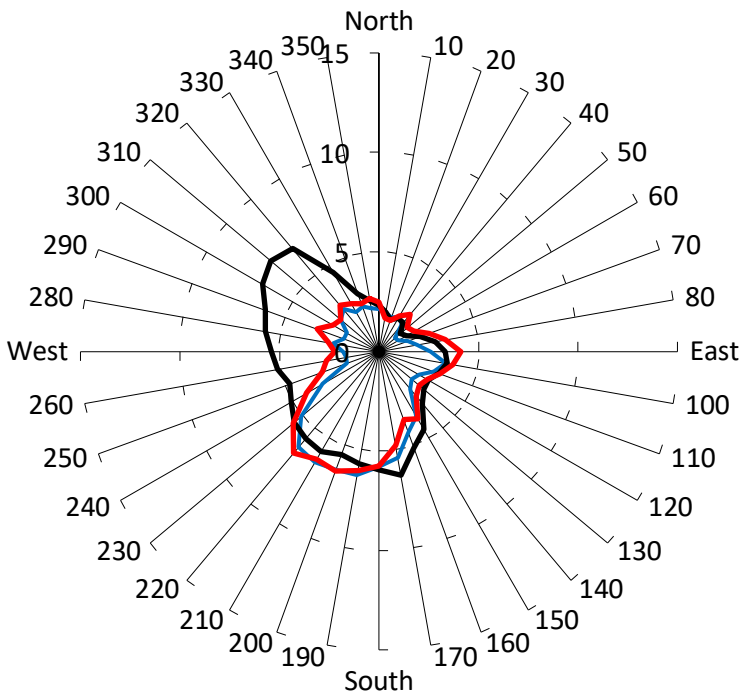


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	33%	25
Existing site conditions. No vegetation or other treatments.	42%	27
With proposed development and future surrounds case. No vegetation or other treatments.	31%	24

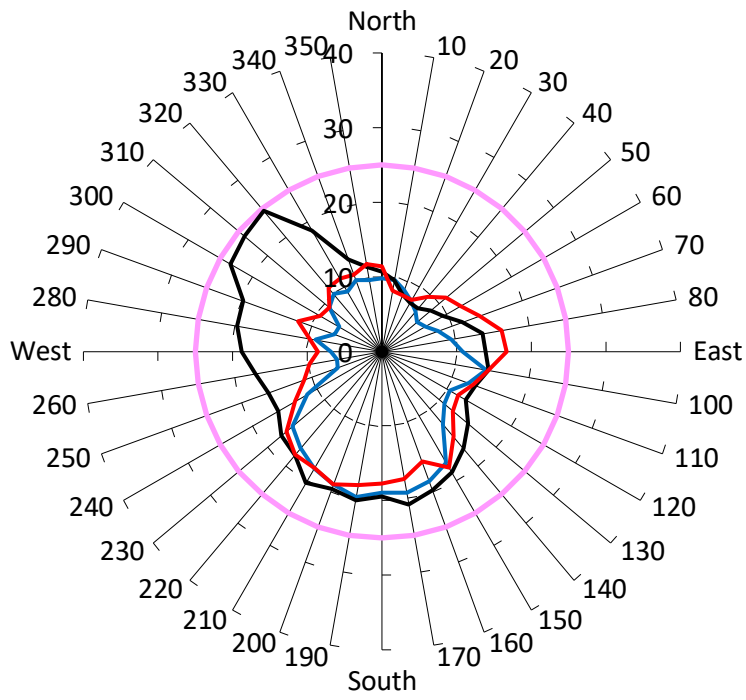
Results for P12

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

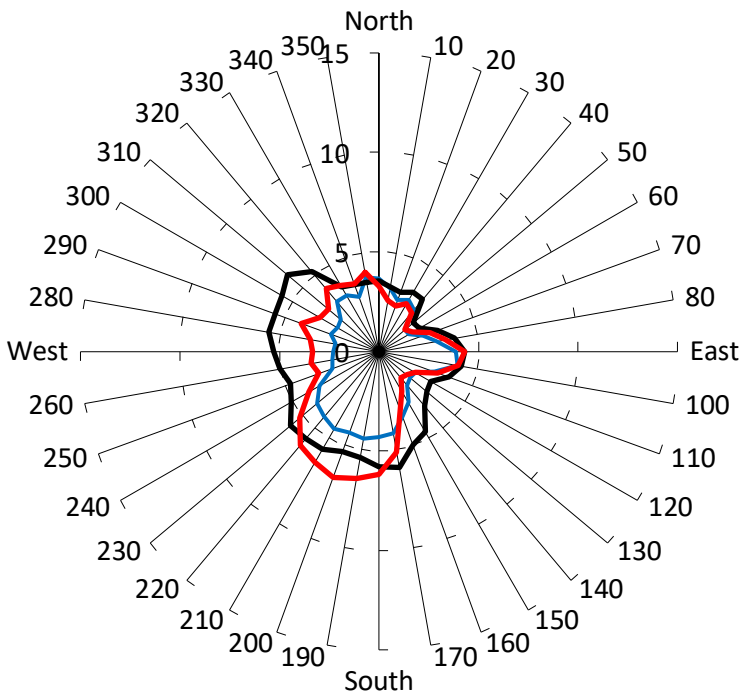


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	34%	20
Existing site conditions. No vegetation or other treatments.	50%	25
With proposed development and future surrounds case. No vegetation or other treatments.	41%	19

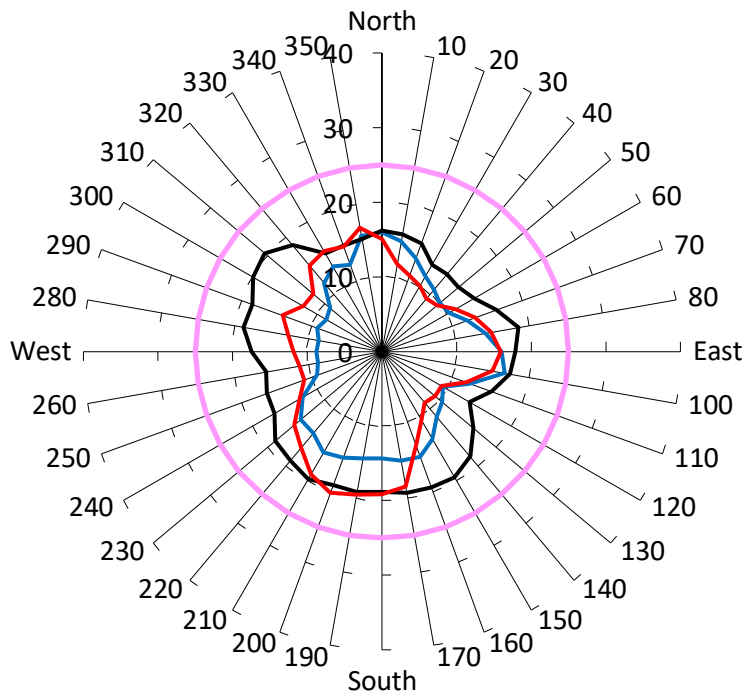
Results for P13

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

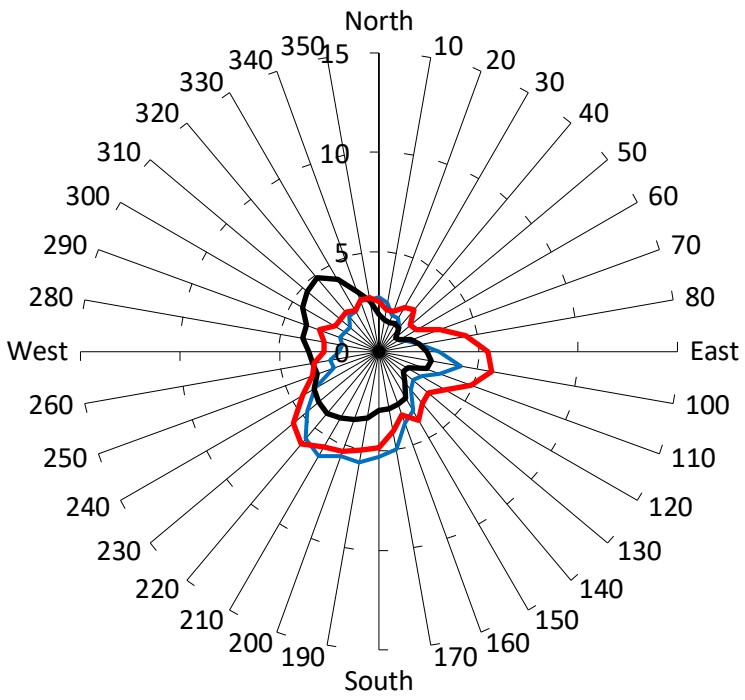


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	15%	17
Existing site conditions. No vegetation or other treatments.	46%	20
With proposed development and future surrounds case. No vegetation or other treatments.	33%	20

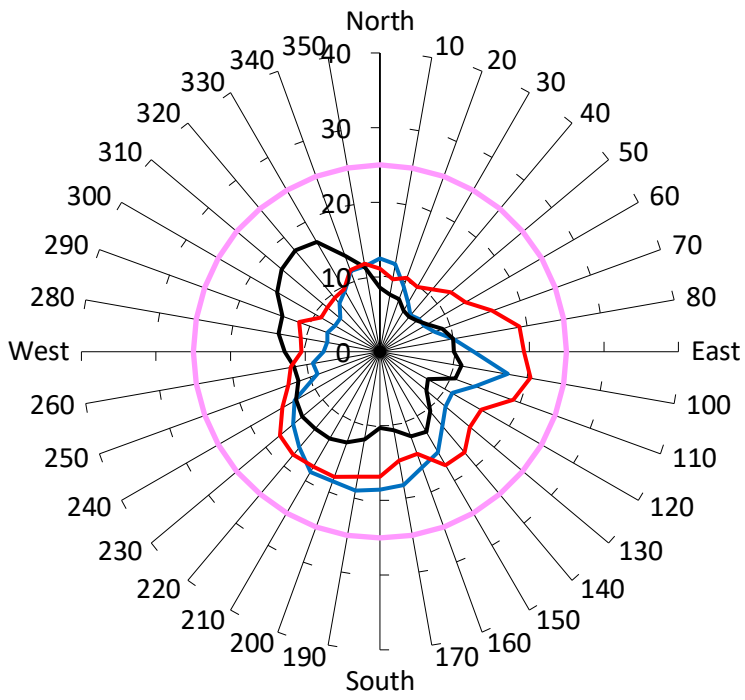
Results for P14

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

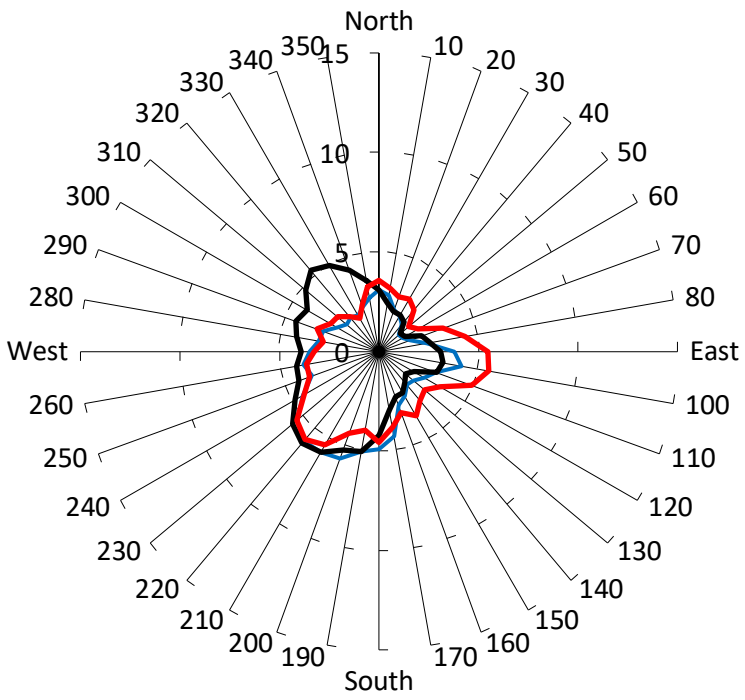


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	35%	19
Existing site conditions. No vegetation or other treatments.	28%	18
With proposed development and future surrounds case. No vegetation or other treatments.	43%	20

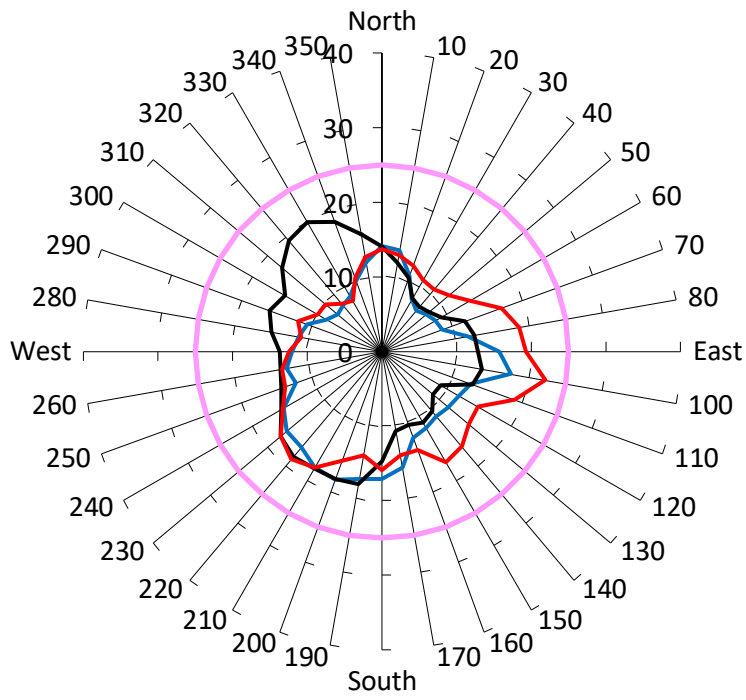
Results for P15

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

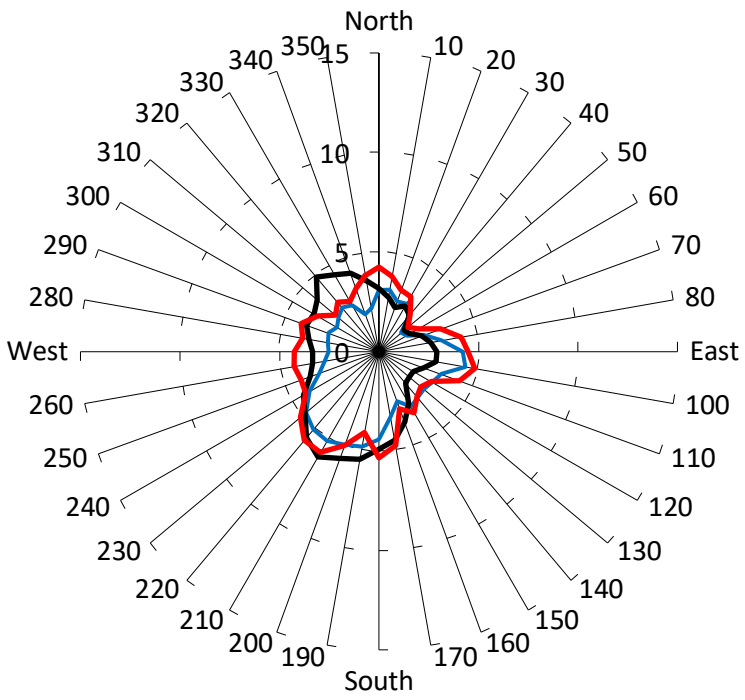


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	39%	18
Existing site conditions. No vegetation or other treatments.	45%	20
With proposed development and future surrounds case. No vegetation or other treatments.	43%	22

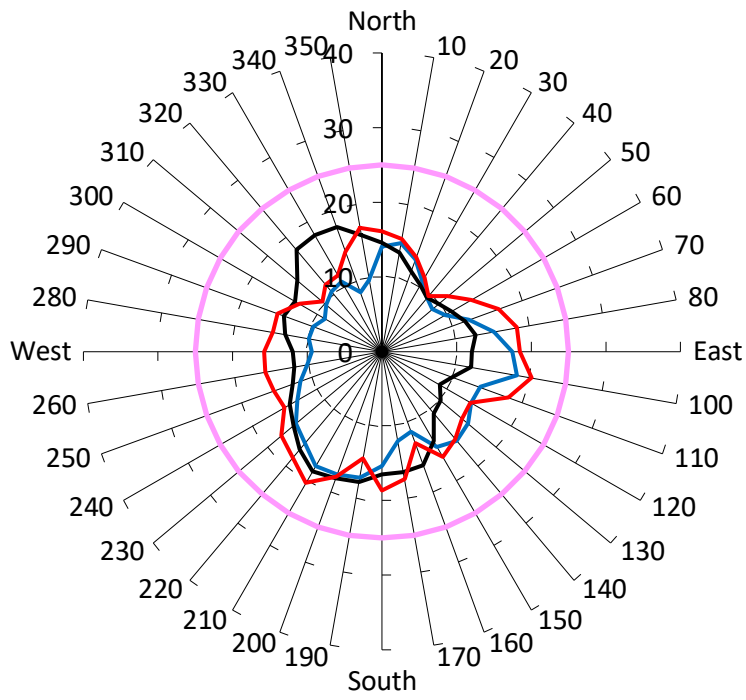
Results for P16

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

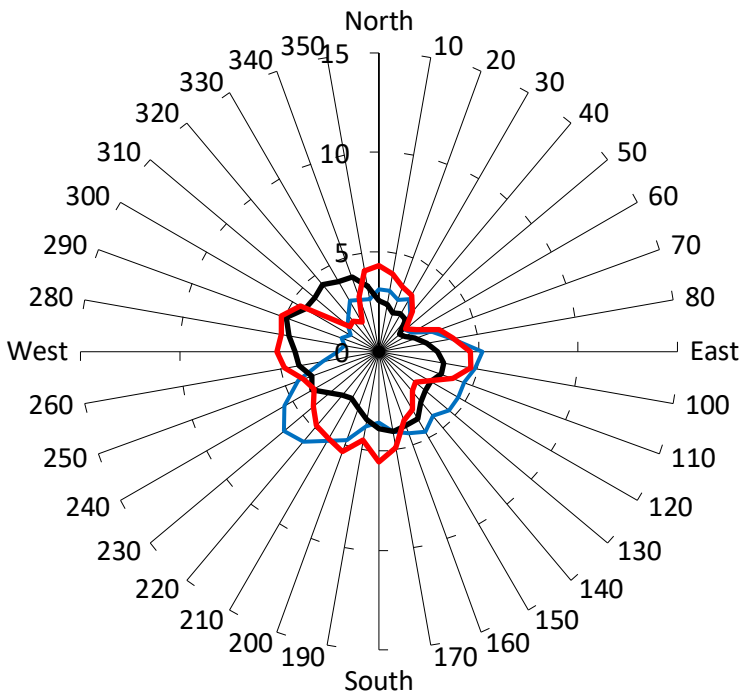


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	37%	18
Existing site conditions. No vegetation or other treatments.	46%	19
With proposed development and future surrounds case. No vegetation or other treatments.	49%	20

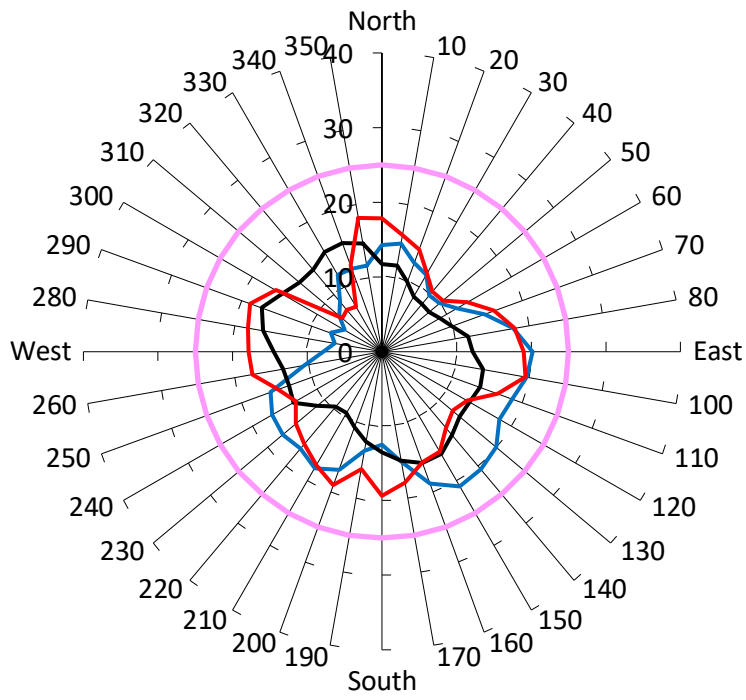
Results for P17

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

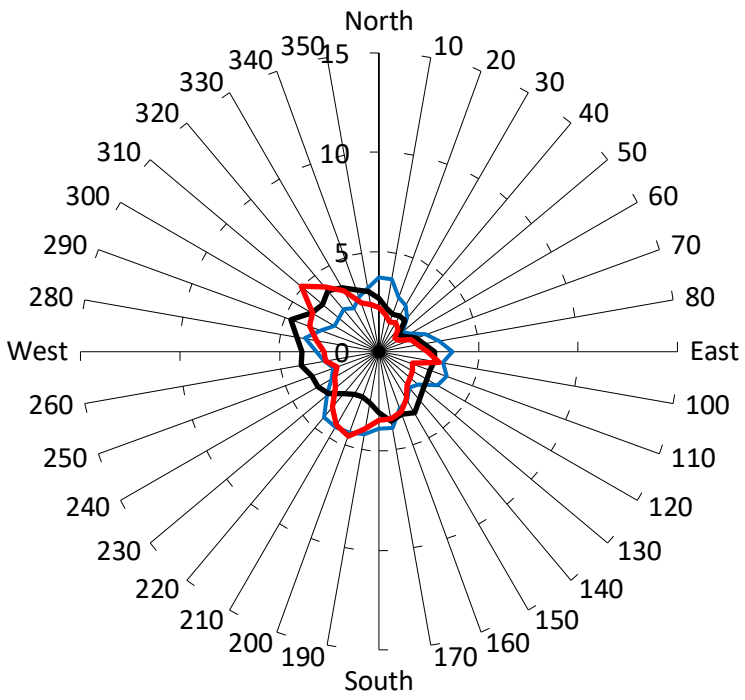


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	30%	21
Existing site conditions. No vegetation or other treatments.	19%	17
With proposed development and future surrounds case. No vegetation or other treatments.	33%	20

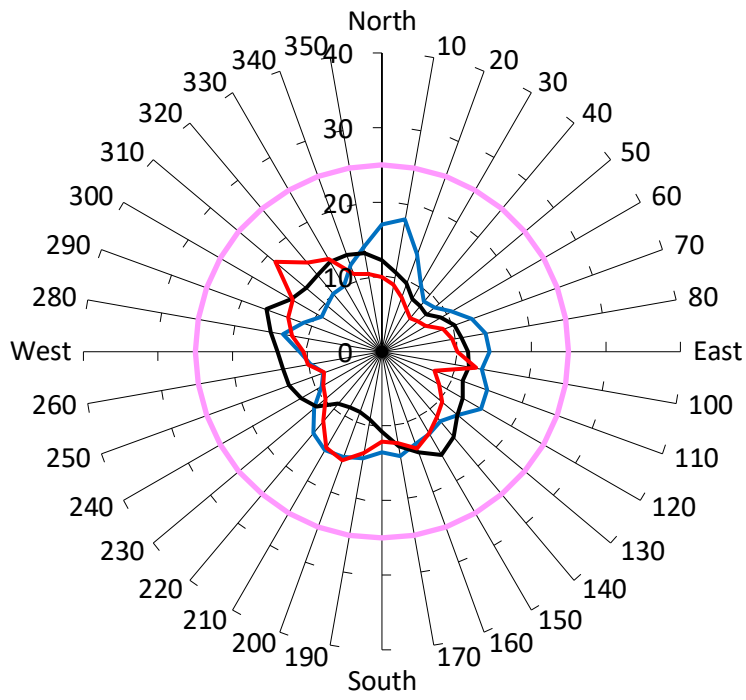
Results for P18

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

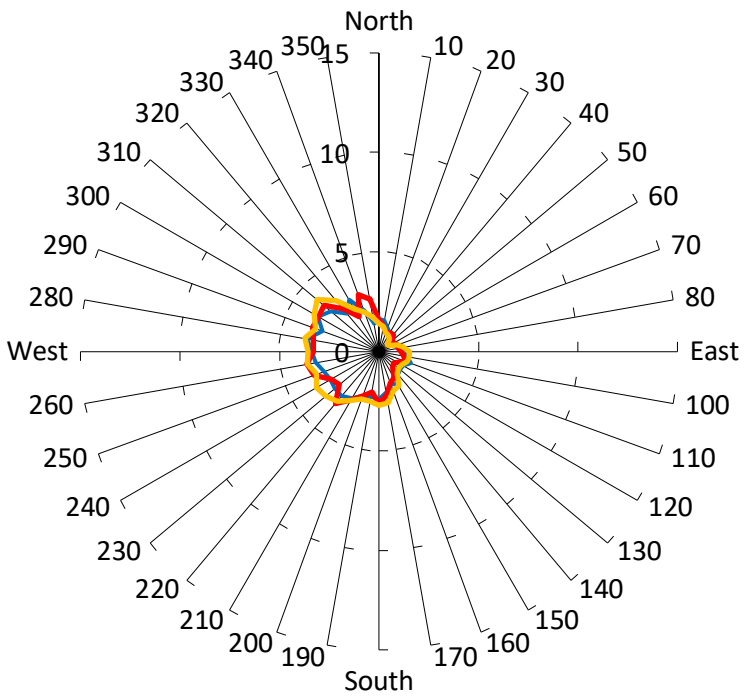


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	14%	18
Existing site conditions. No vegetation or other treatments.	13%	16
With proposed development and future surrounds case. No vegetation or other treatments.	11%	19

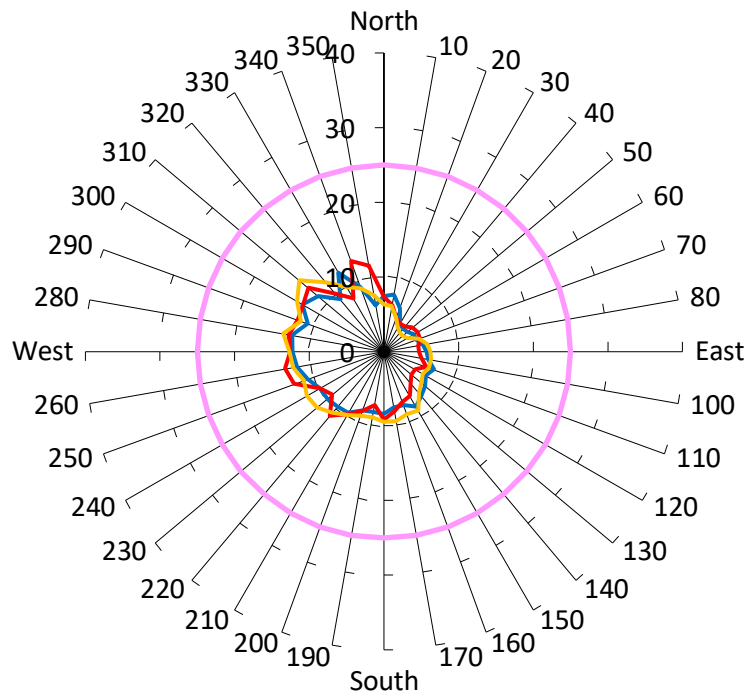
Results for P19

Gust Equivalent Mean (m/s)



Comfort Criteria: 3m/s with 20% probability of exceedence

Maximum Gust (m/s)

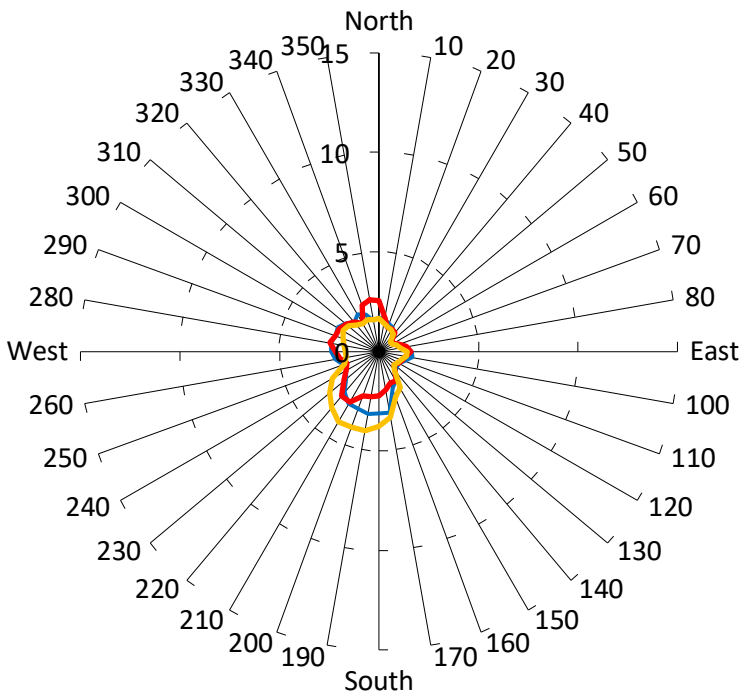


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Sitting Activities (10km/h, 3m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	26%	13
With proposed development and future surrounds case. No vegetation or other treatments.	29%	13
WE191-07 Proposed Case with inclusion of treatments (rev0)	33%	15

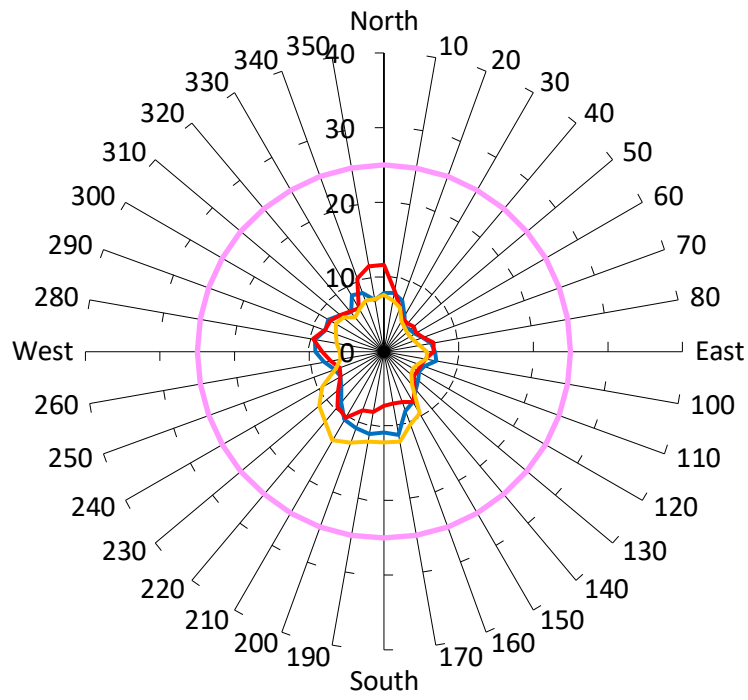
Results for P20

Gust Equivalent Mean (m/s)



Comfort Criteria: 3m/s with 20% probability of exceedence

Maximum Gust (m/s)

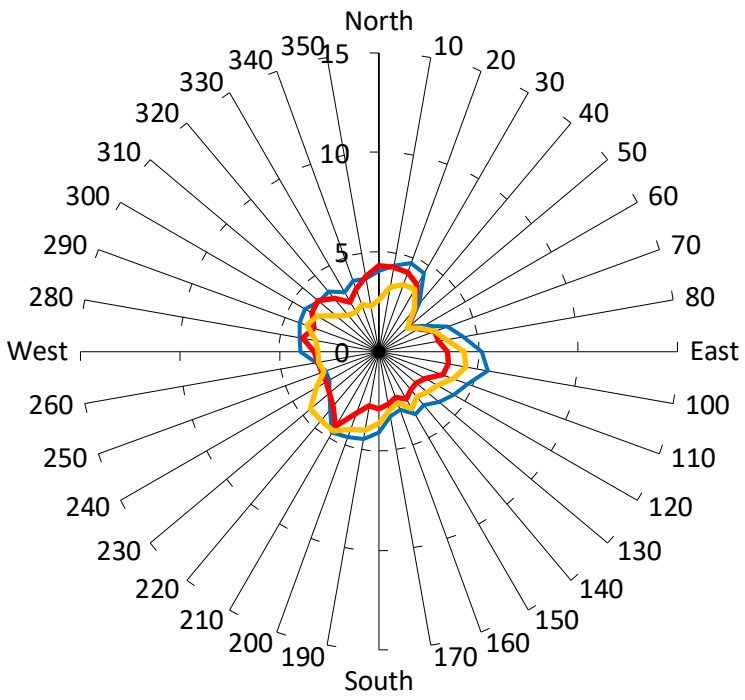


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Sitting Activities (10km/h, 3m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	21%	11
With proposed development and future surrounds case. No vegetation or other treatments.	15%	12
WE191-07 Proposed Case with inclusion of treatments (rev0)	29%	14

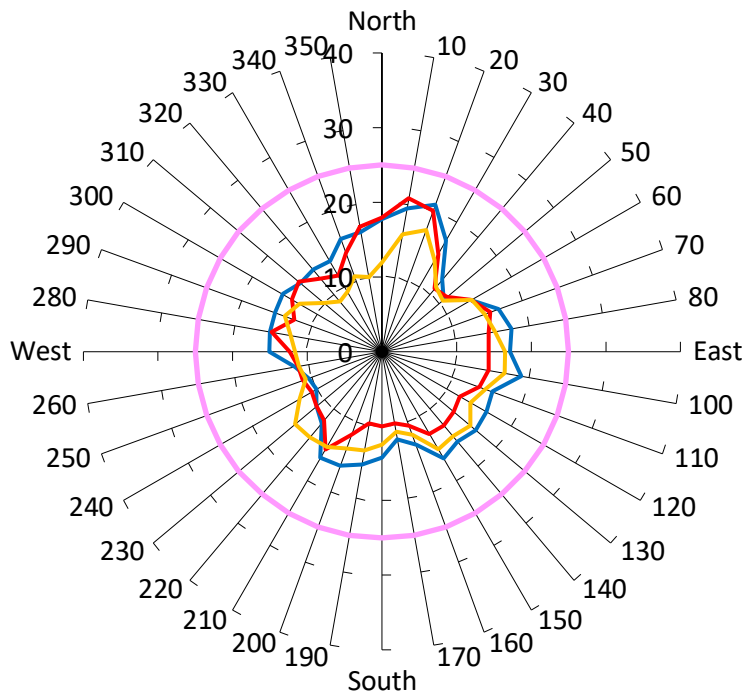
Results for P22

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

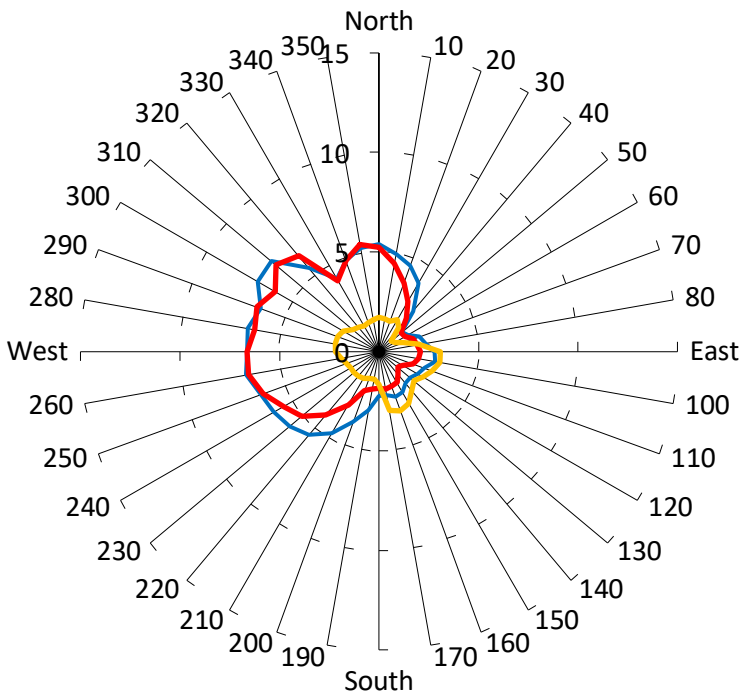


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	28%	21
With proposed development and future surrounds case. No vegetation or other treatments.	16%	21
WE191-07 Proposed Case with inclusion of treatments (rev0)	18%	17

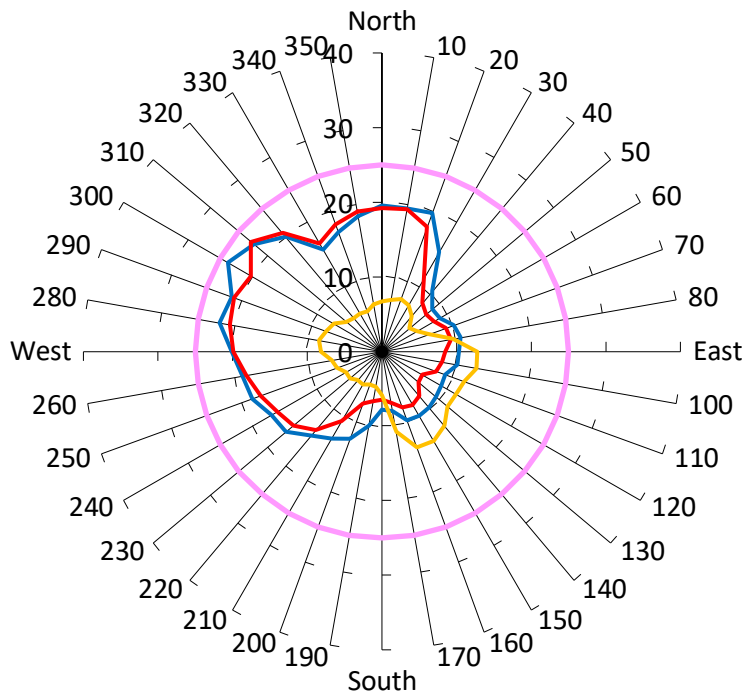
Results for P23

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

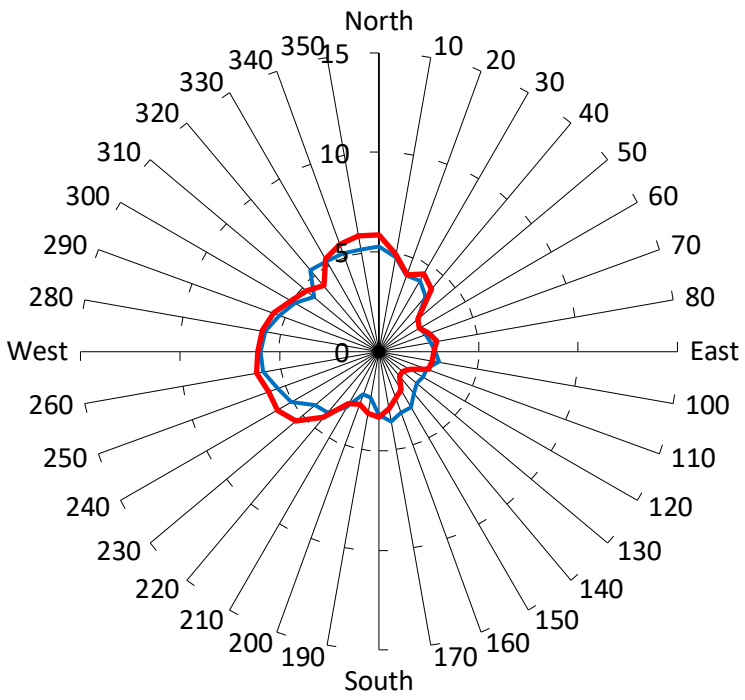


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	42%	24
With proposed development and future surrounds case. No vegetation or other treatments.	35%	23
WE191-07 Proposed Case with inclusion of treatments (rev0)	7%	14

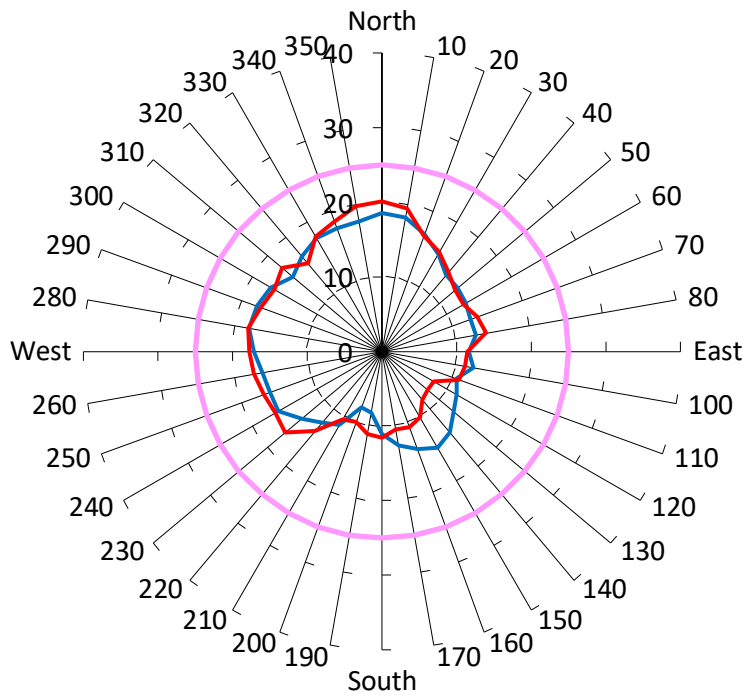
Results for P24

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

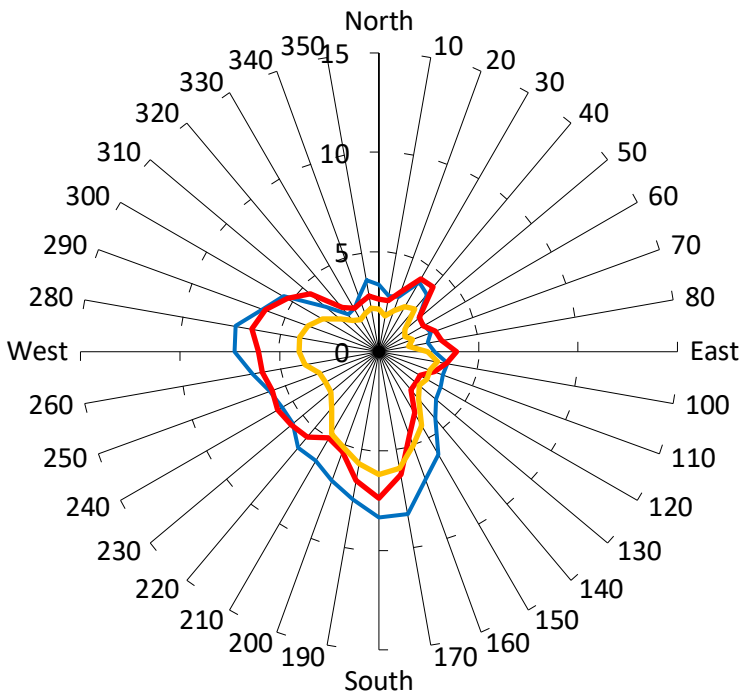


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	32%	19
With proposed development and future surrounds case. No vegetation or other treatments.	34%	20

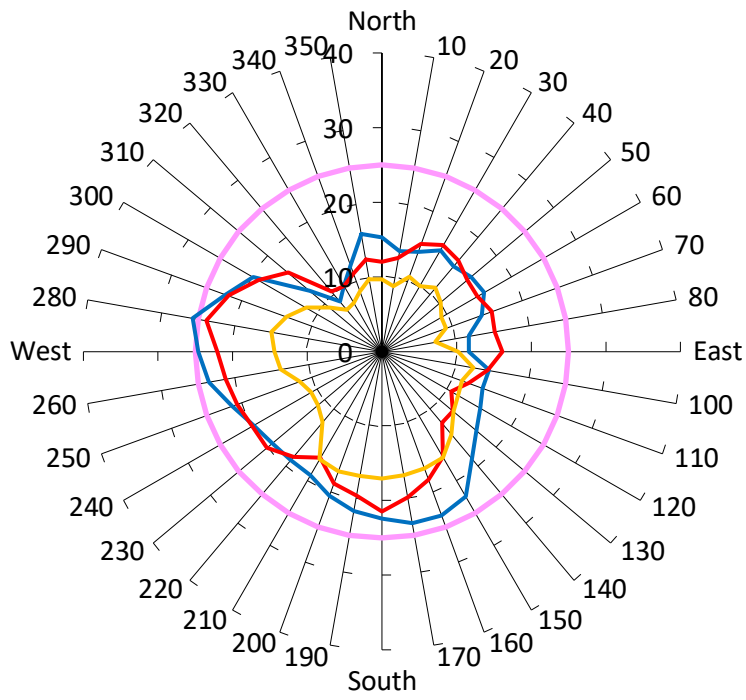
Results for P25

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

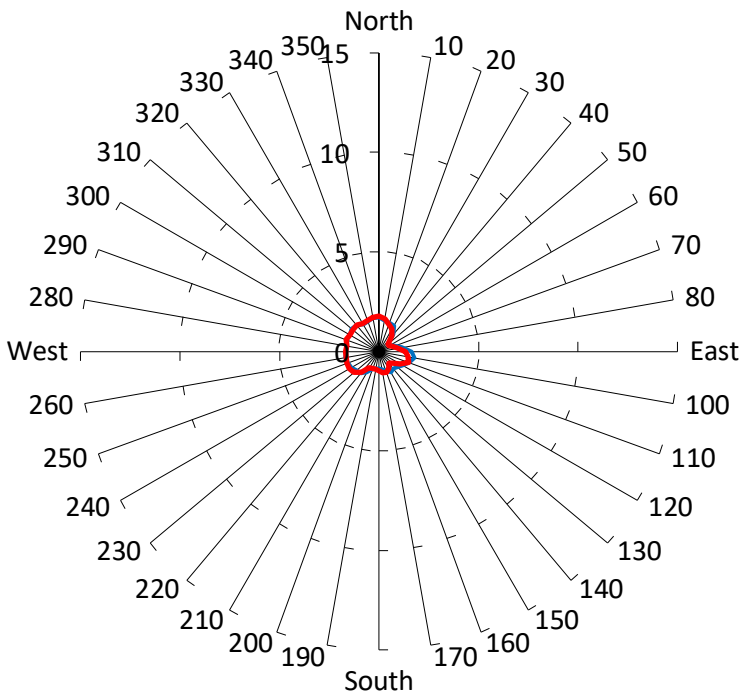


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	46%	26
With proposed development and future surrounds case. No vegetation or other treatments.	42%	24
WE191-07 Proposed Case with inclusion of treatments (rev0)	23%	17

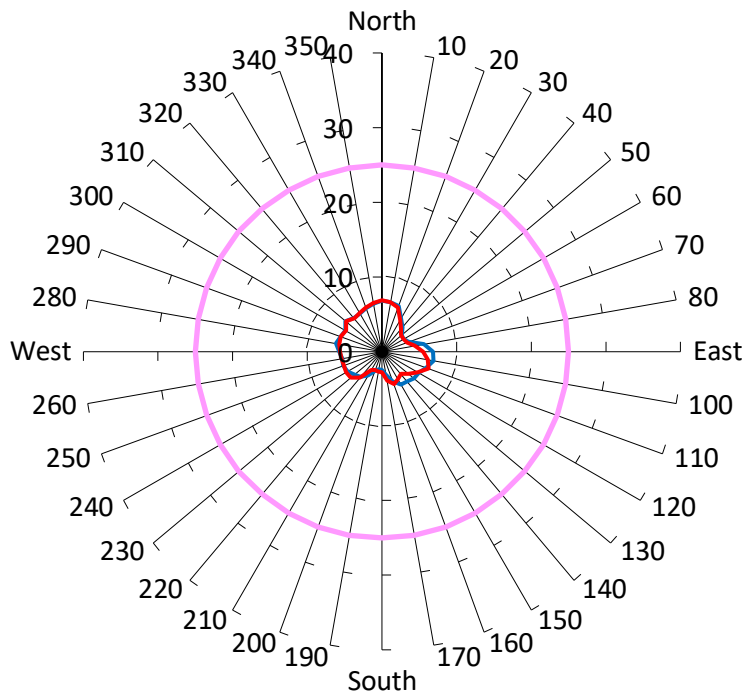
Results for P26

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

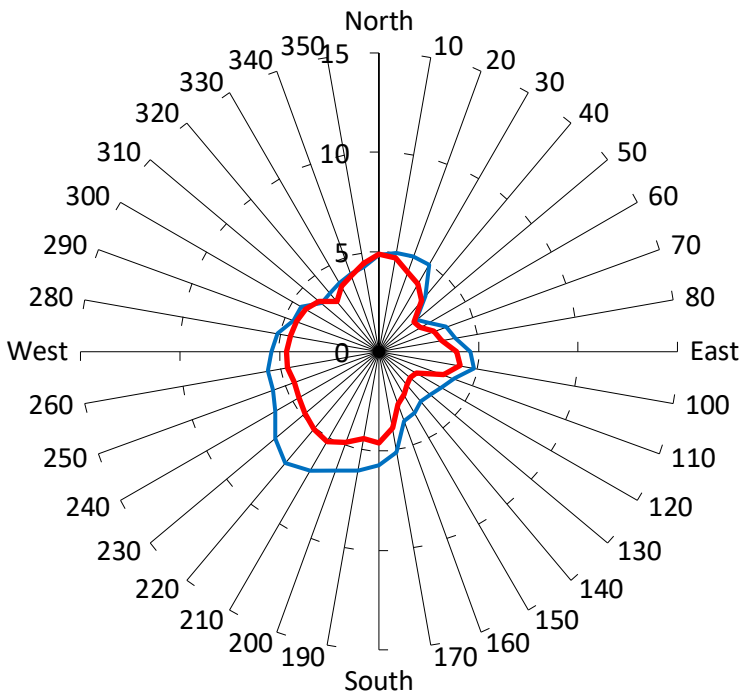


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	0%	7
With proposed development and future surrounds case. No vegetation or other treatments.	0%	7

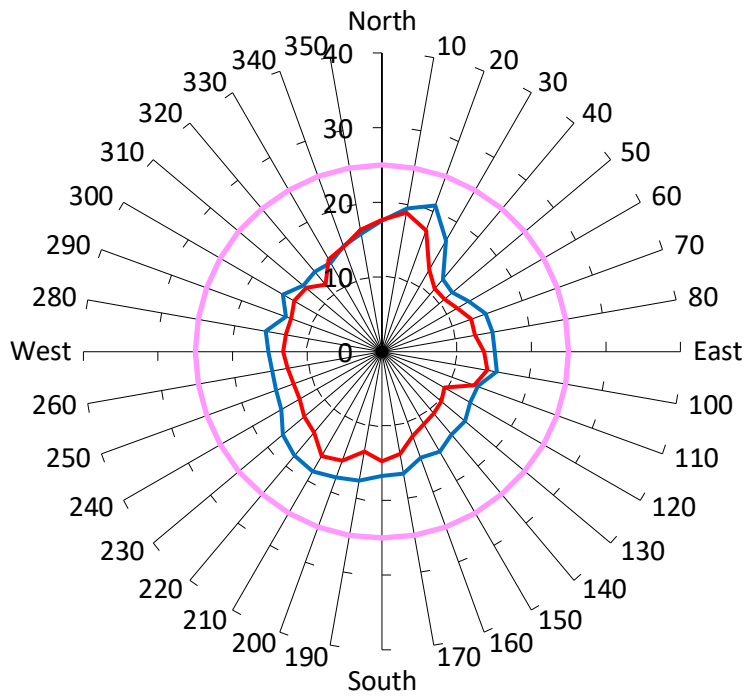
Results for P27

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

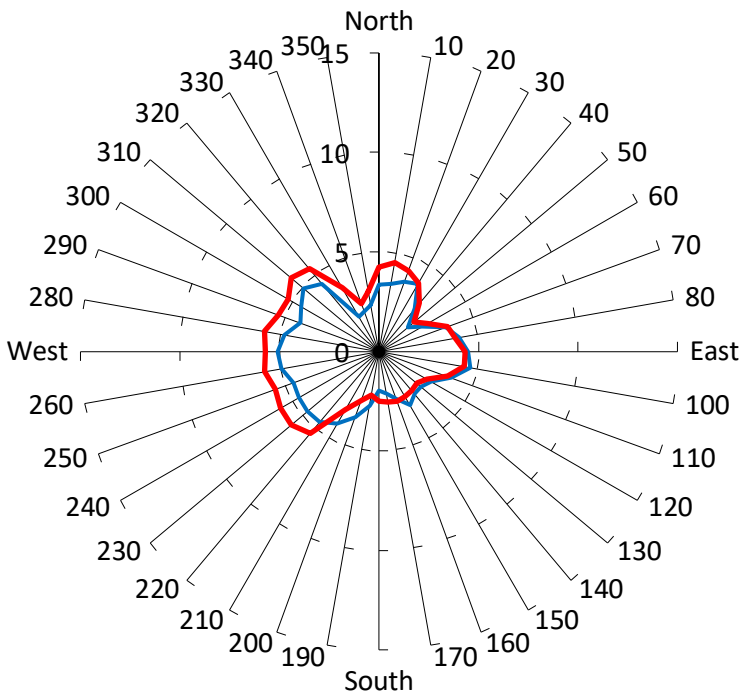


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	56%	21
With proposed development and future surrounds case. No vegetation or other treatments.	50%	19

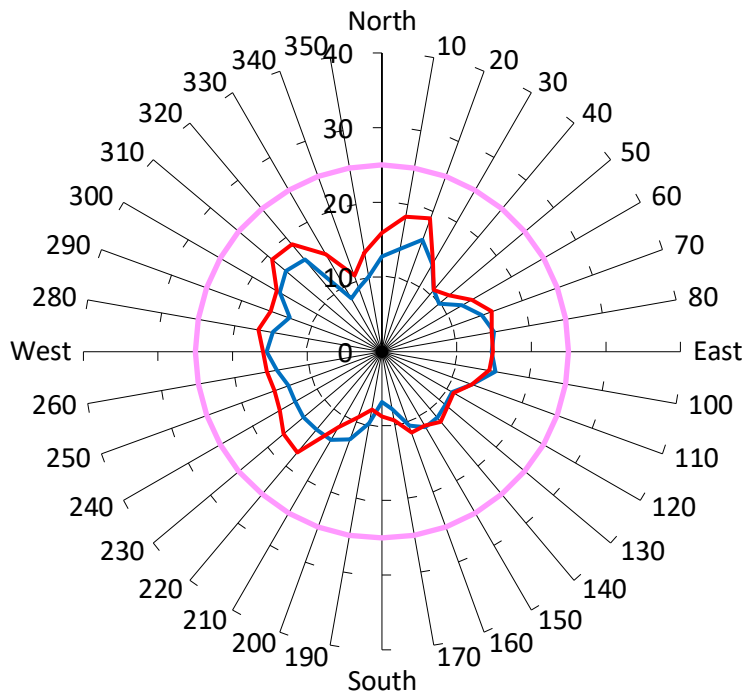
Results for P28

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

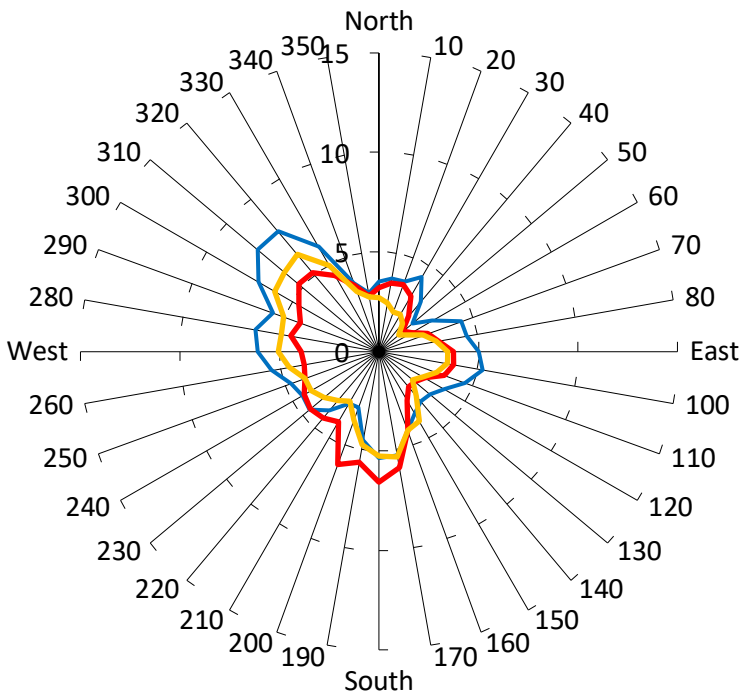


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	27%	17
With proposed development and future surrounds case. No vegetation or other treatments.	35%	19

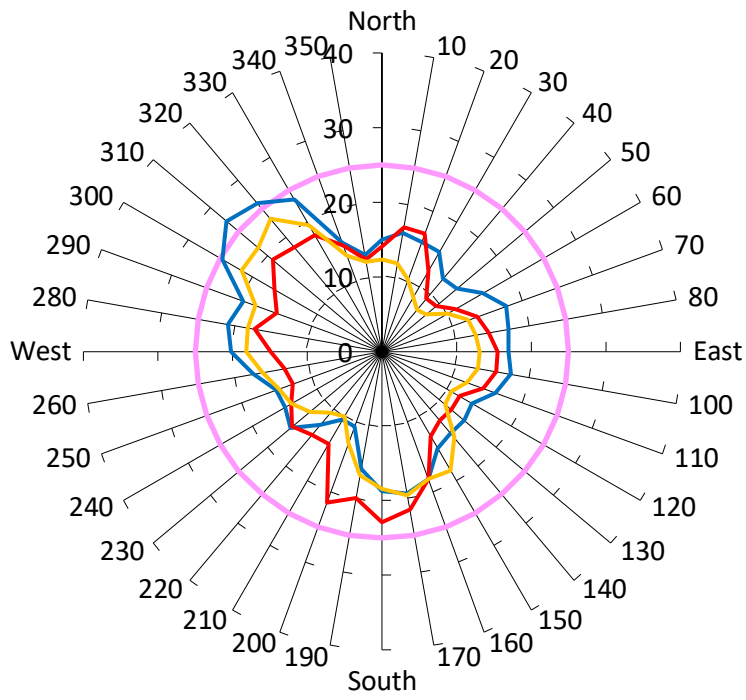
Results for P29

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

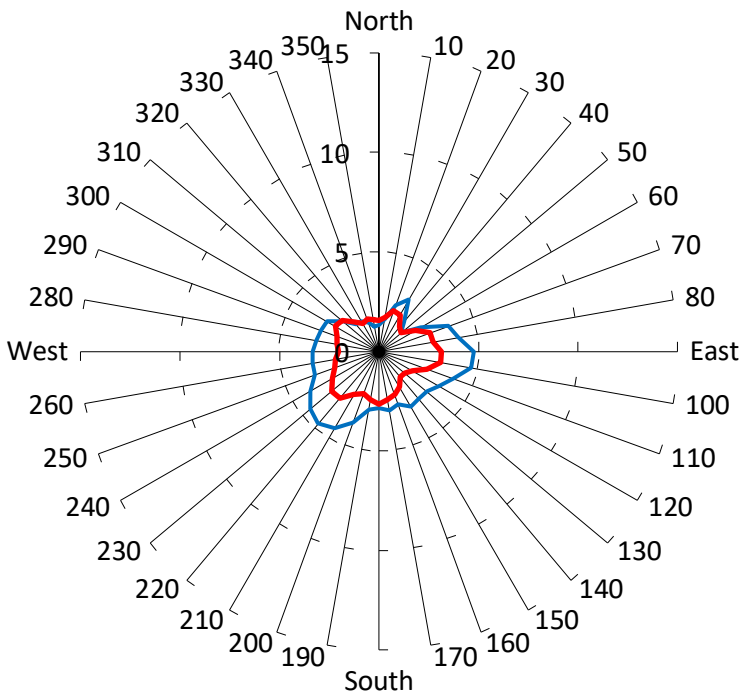


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	39%	27
With proposed development and future surrounds case. No vegetation or other treatments.	34%	23
WE191-07 Proposed Case with inclusion of treatments (rev0)	29%	23

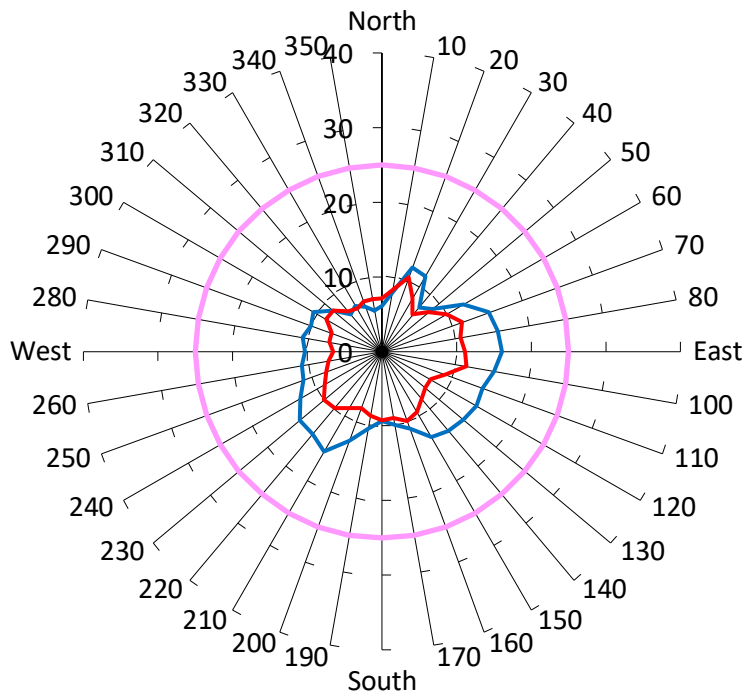
Results for P31

Gust Equivalent Mean (m/s)



Comfort Criteria: 3m/s with 20% probability of exceedence

Maximum Gust (m/s)

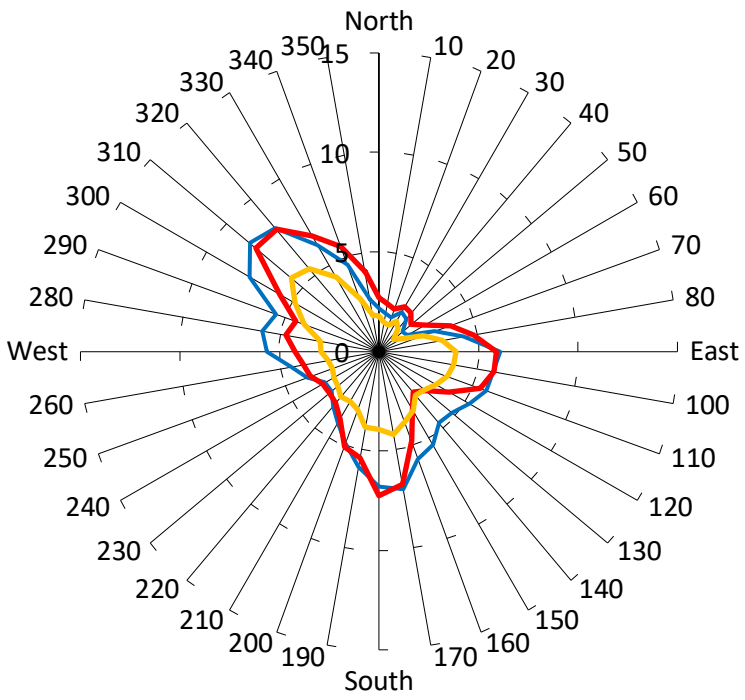


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Sitting Activities (10km/h, 3m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	47%	16
With proposed development and future surrounds case. No vegetation or other treatments.	26%	12

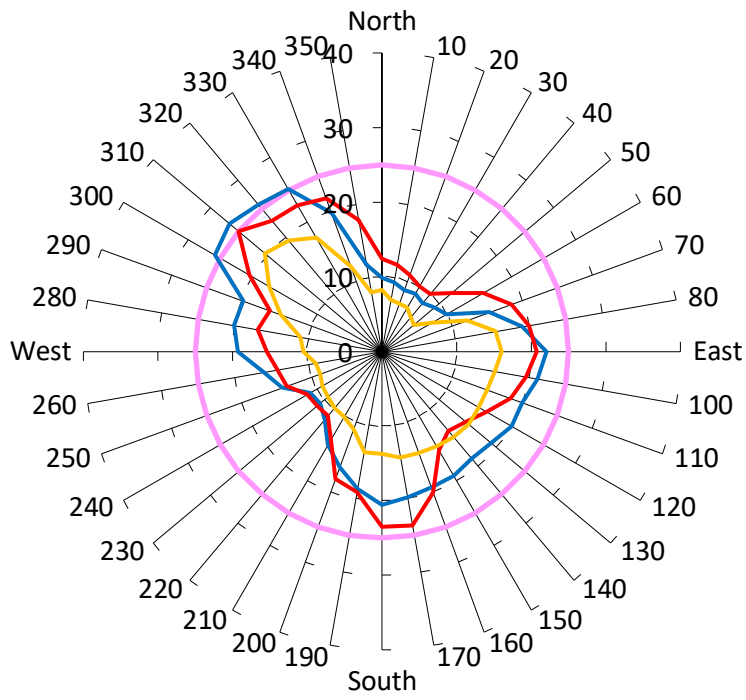
Results for P32

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

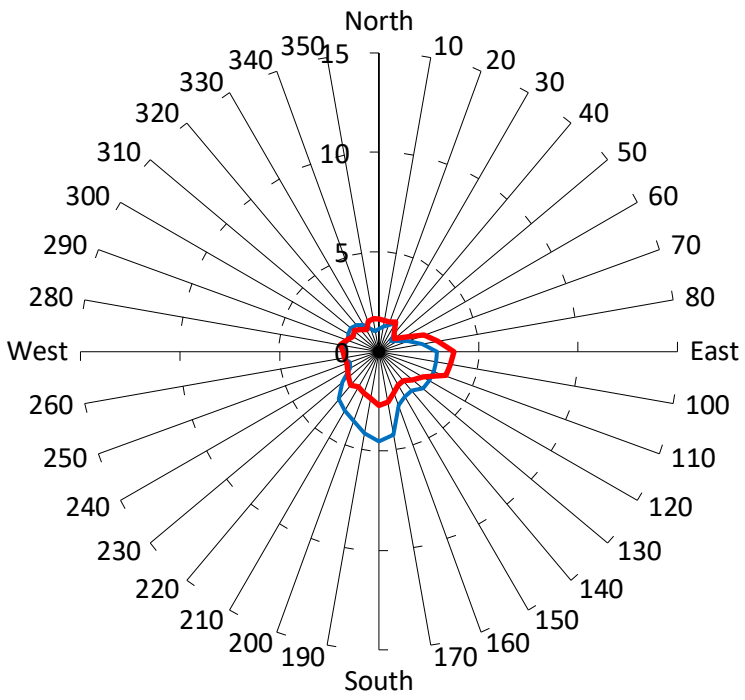


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	41%	27
With proposed development and future surrounds case. No vegetation or other treatments.	38%	25
WE191-07 Proposed Case with inclusion of treatments (rev0)	17%	20

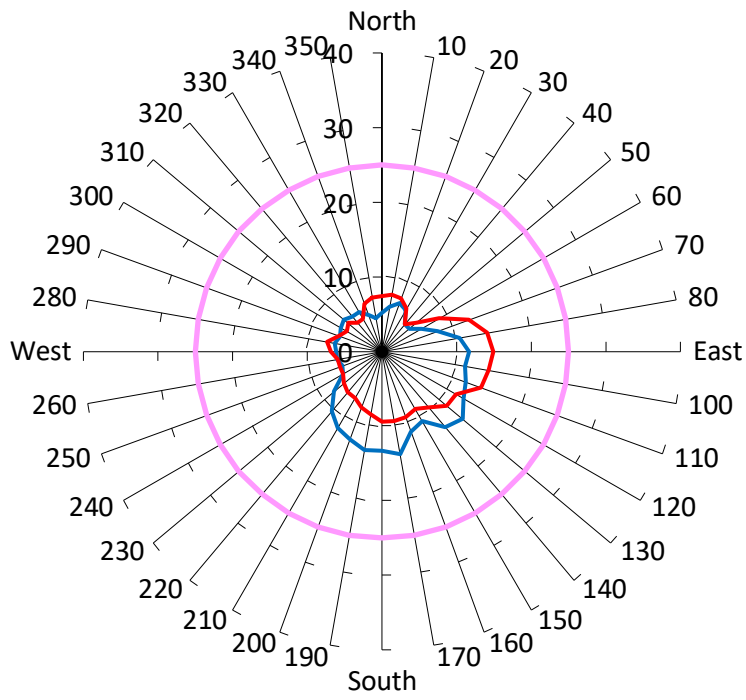
Results for P33

Gust Equivalent Mean (m/s)



Comfort Criteria: 3m/s with 20% probability of exceedence

Maximum Gust (m/s)

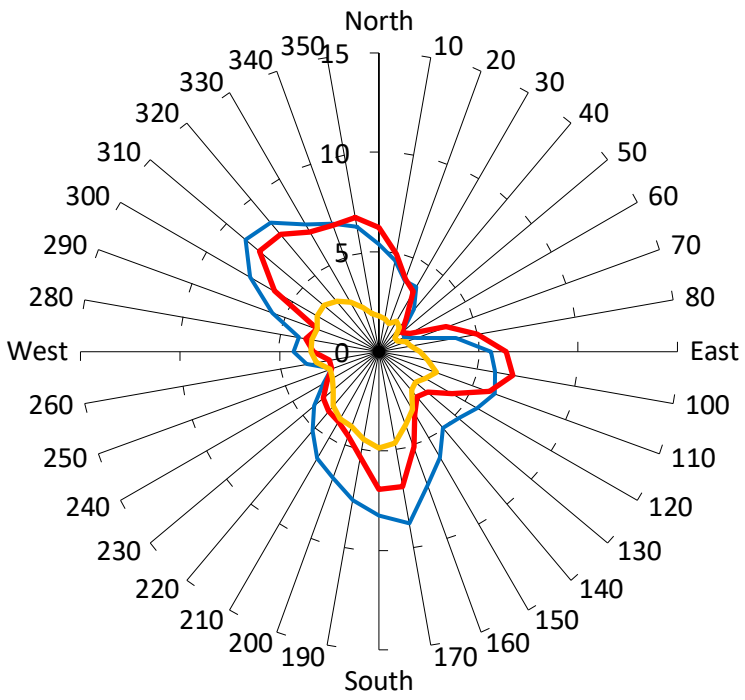


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Sitting Activities (10km/h, 3m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	33%	14
With proposed development and future surrounds case. No vegetation or other treatments.	18%	15

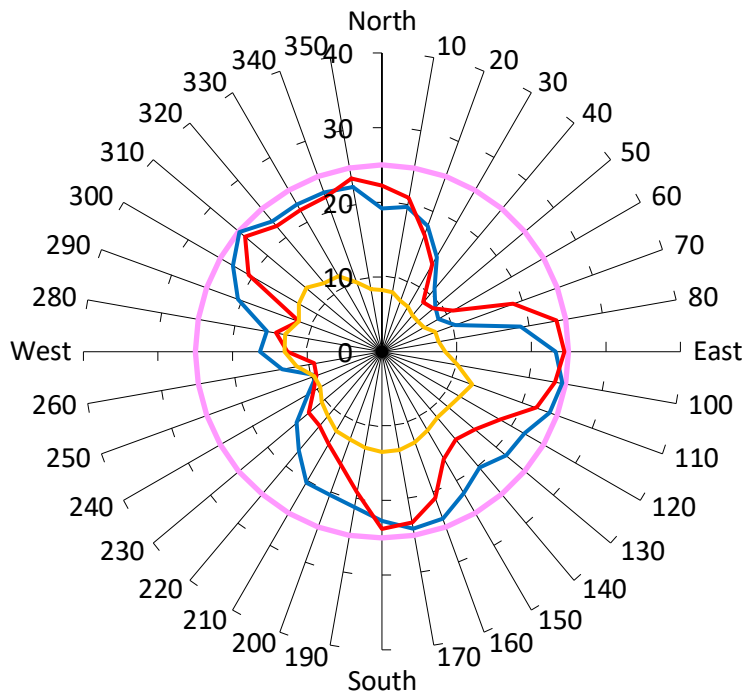
Results for P34

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

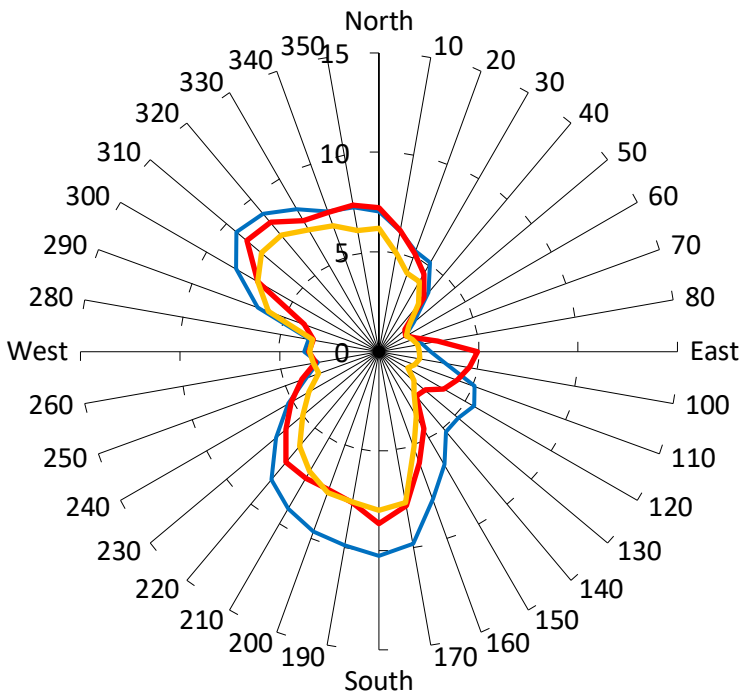


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	54%	25
With proposed development and future surrounds case. No vegetation or other treatments.	48%	24
WE191-07 Proposed Case with inclusion of treatments (rev0)	29%	13

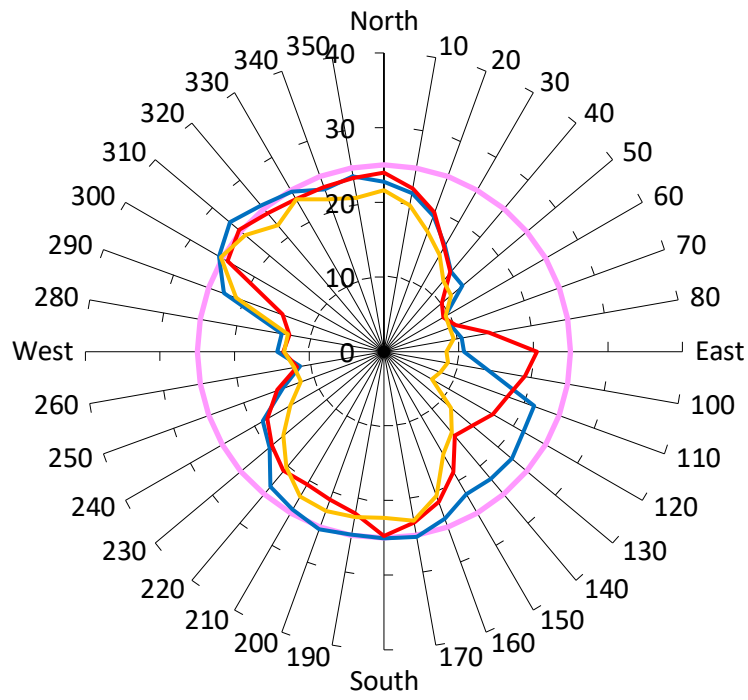
Results for P36

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

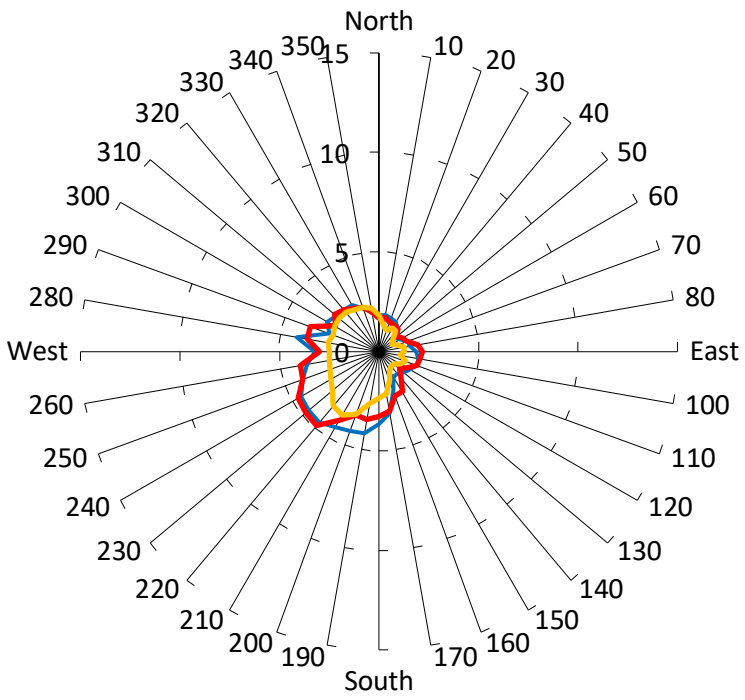


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	55%	27
With proposed development and future surrounds case. No vegetation or other treatments.	55%	25
WE191-07 Proposed Case with inclusion of treatments (rev0)	49%	25

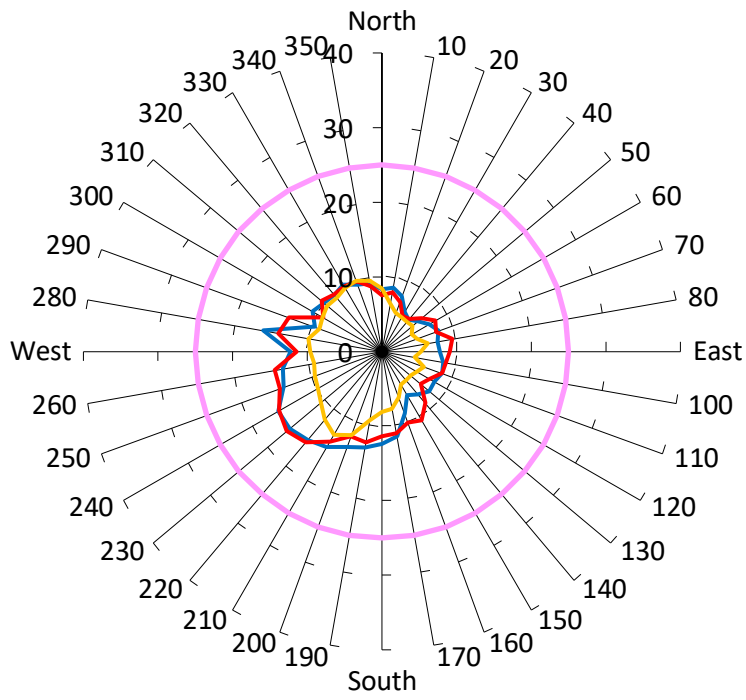
Results for P37

Gust Equivalent Mean (m/s)



Comfort Criteria: 4m/s with 20% probability of exceedence

Maximum Gust (m/s)

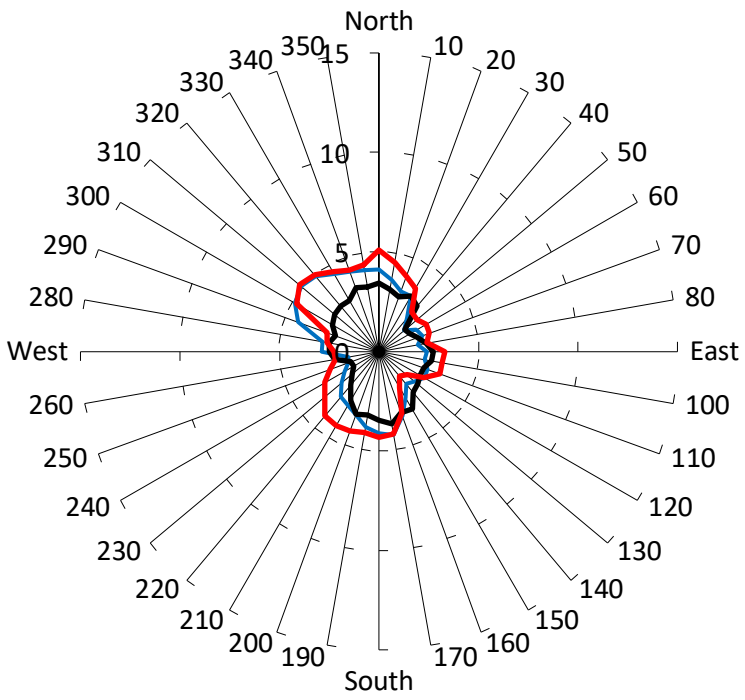


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Comfortable Standing Activities (14km/h, 4m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	28%	16
With proposed development and future surrounds case. No vegetation or other treatments.	26%	17
WE191-07 Proposed Case with inclusion of treatments (rev0)	8%	13

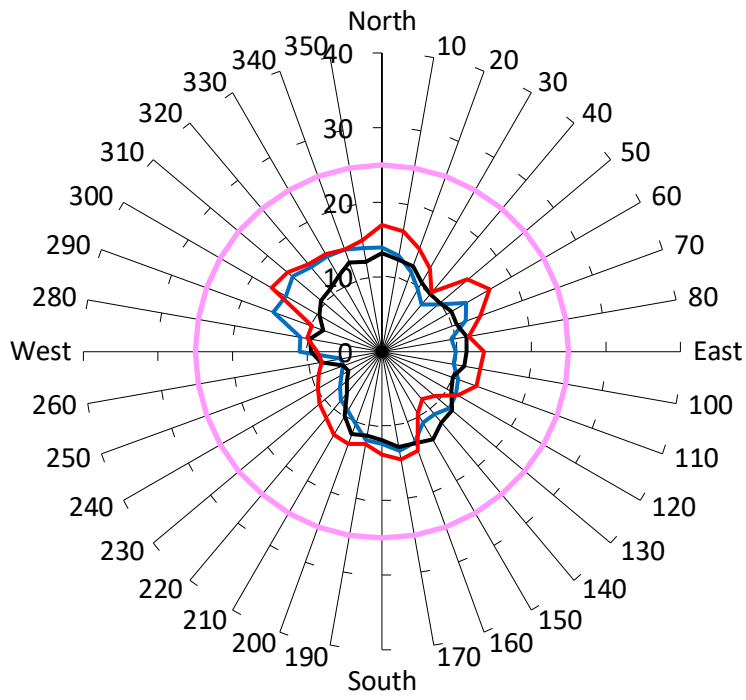
Results for P38

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

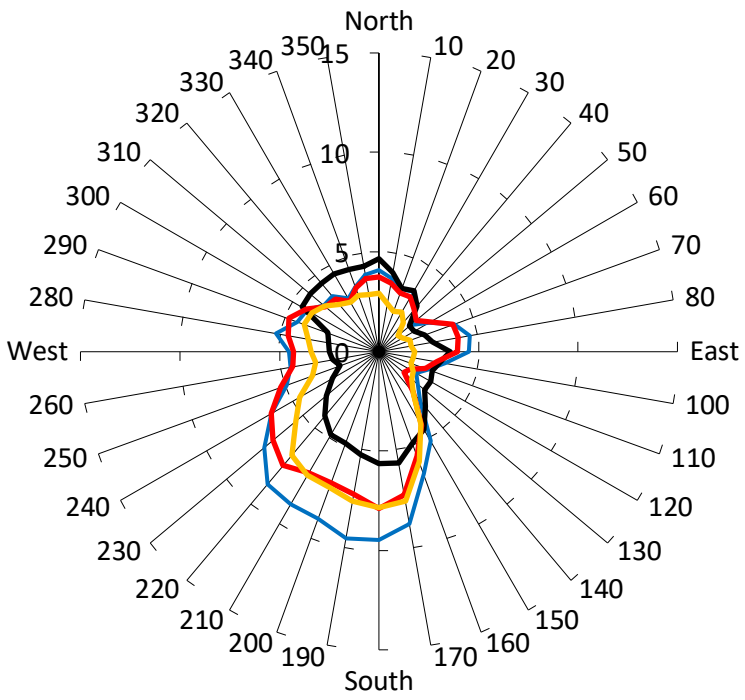


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	18%	16
Existing site conditions. No vegetation or other treatments.	8%	14
With proposed development and future surrounds case. No vegetation or other treatments.	24%	17

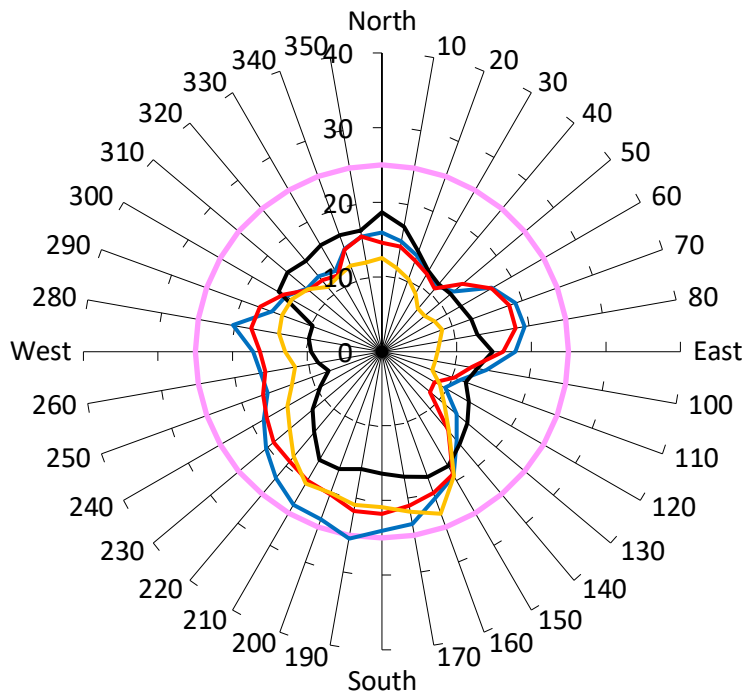
Results for P39

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)

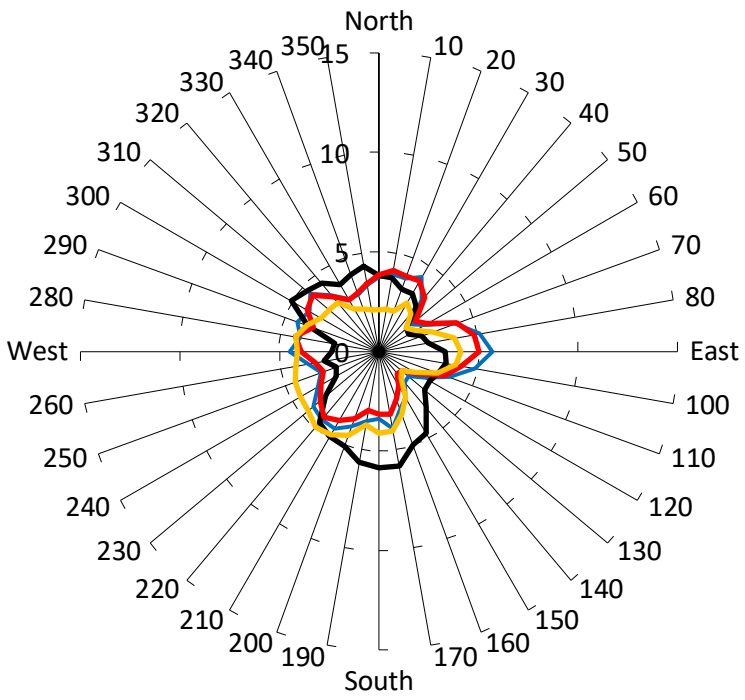


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	46%	25
Existing site conditions. No vegetation or other treatments.	31%	19
With proposed development and future surrounds case. No vegetation or other treatments.	43%	22
WE191-07 Proposed Case with inclusion of treatments (rev0)	33%	23

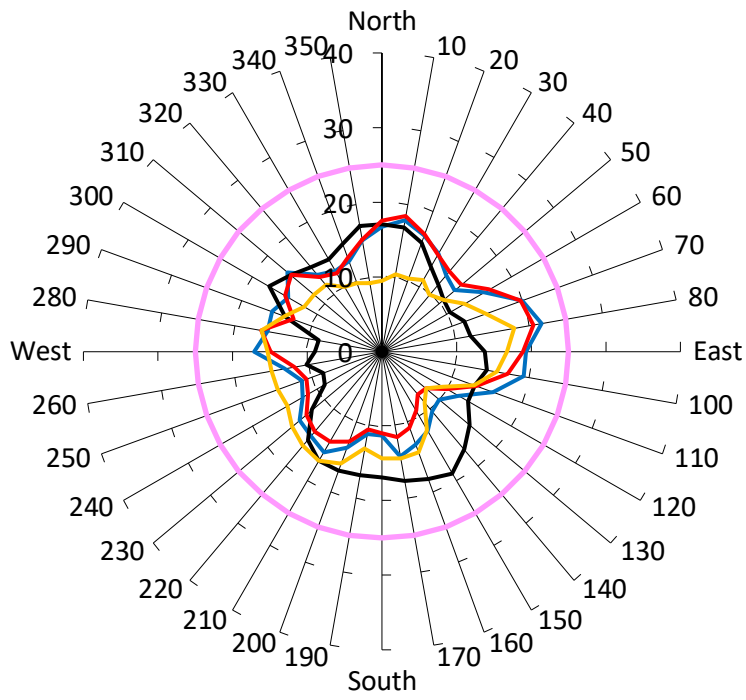
Results for P40

Gust Equivalent Mean (m/s)



Comfort Criteria: 5m/s with 20% probability of exceedence

Maximum Gust (m/s)



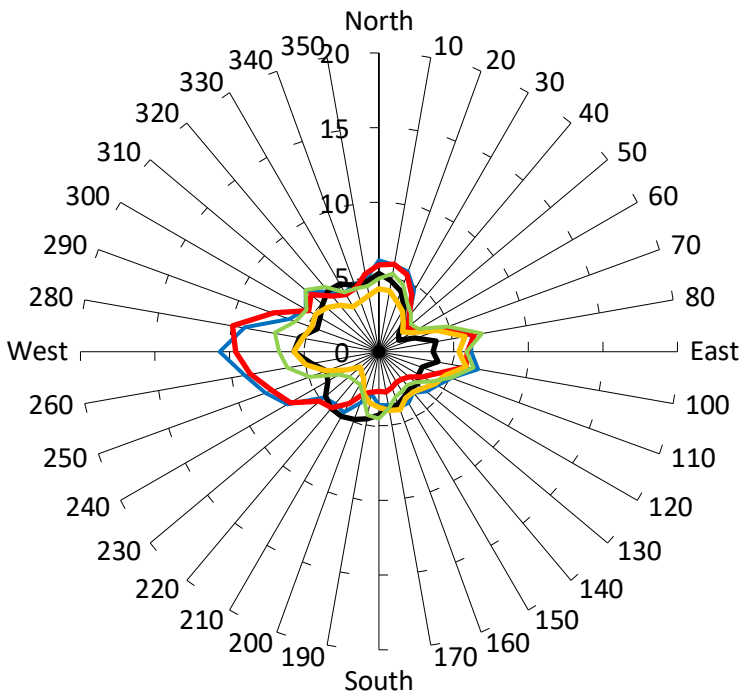
Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Strolling Activities (17km/h, 5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	24%	22
Existing site conditions. No vegetation or other treatments.	32%	19
With proposed development and future surrounds case. No vegetation or other treatments.	20%	21
WE191-07 Proposed Case with inclusion of treatments (rev0)	20%	18

C.3 Winter Criteria Directional Plots

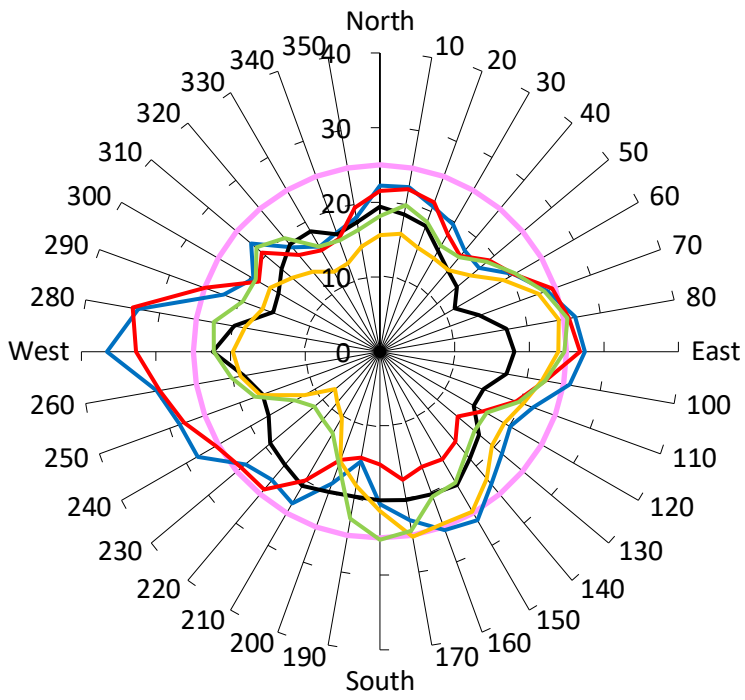
Results for P01

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

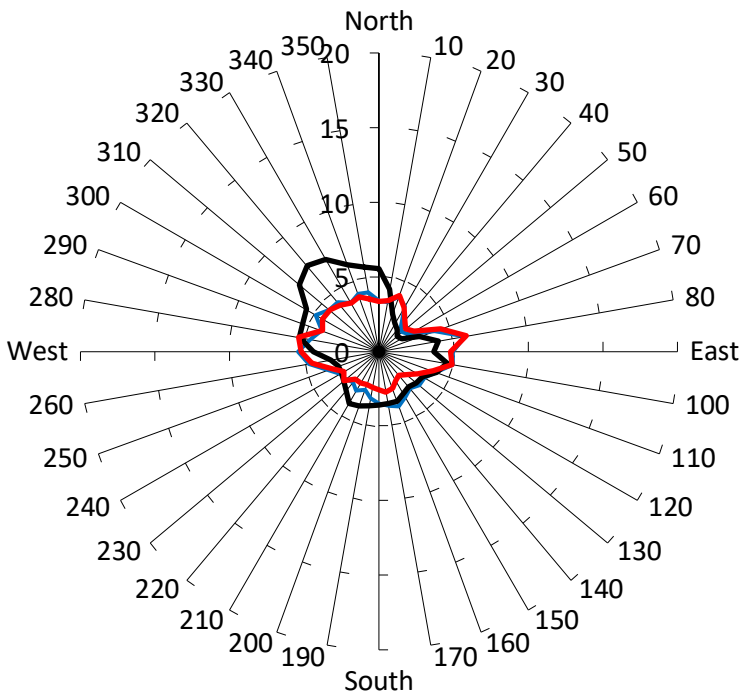


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	42%	37
Existing site conditions. No vegetation or other treatments.	32%	22
With proposed development and future surrounds case. No vegetation or other treatments.	42%	34
WE191-07 Proposed Case with inclusion of treatments (rev0)	26%	25
WE191-06 Future Case with inclusion of 6 full-height wind blades	39%	26

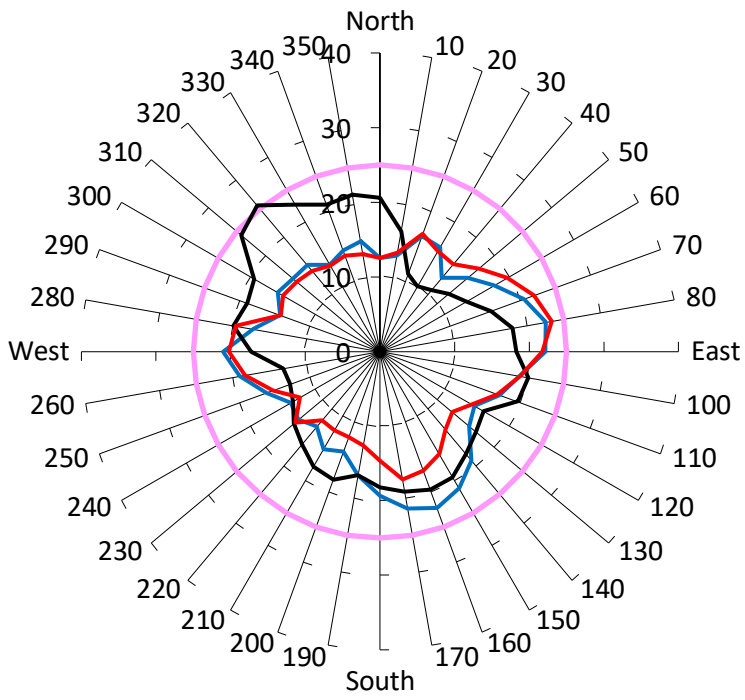
Results for P02

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

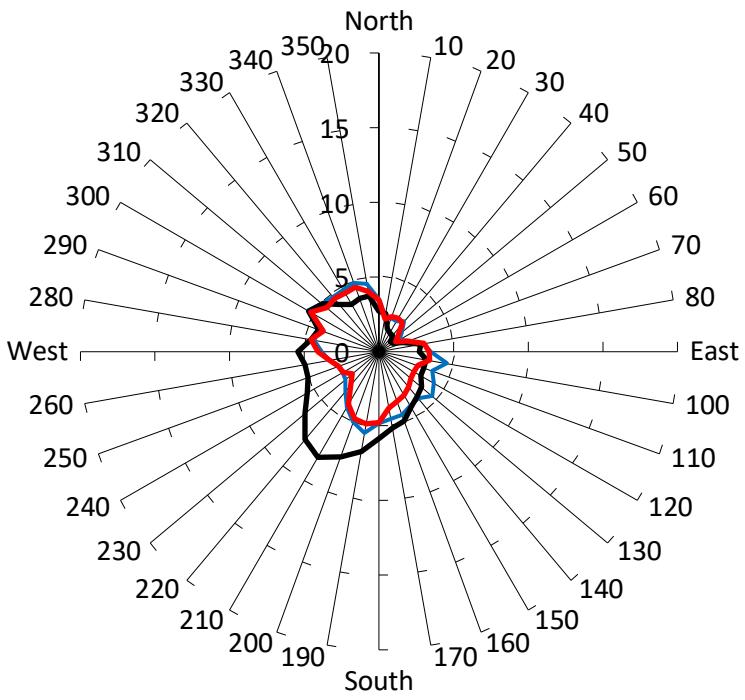


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	23%	23
Existing site conditions. No vegetation or other treatments.	35%	26
With proposed development and future surrounds case. No vegetation or other treatments.	19%	23

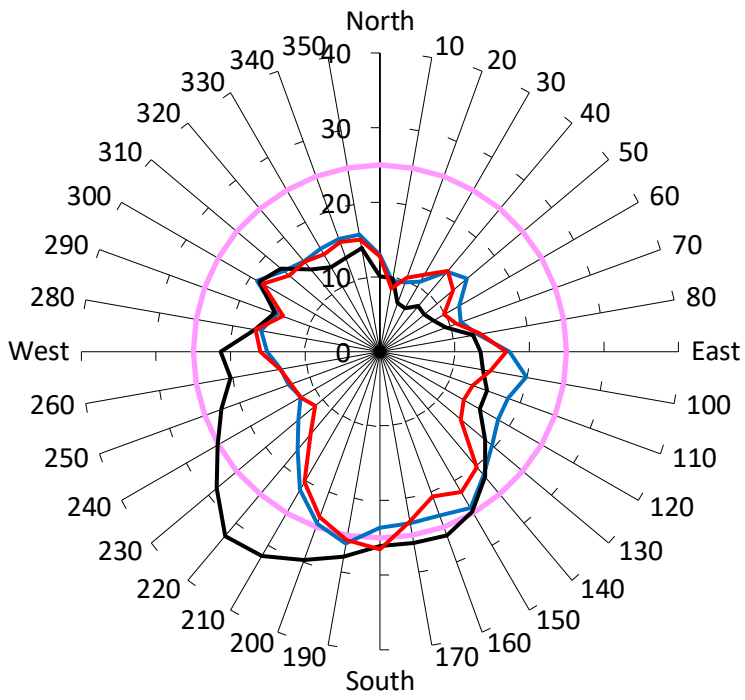
Results for P03

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

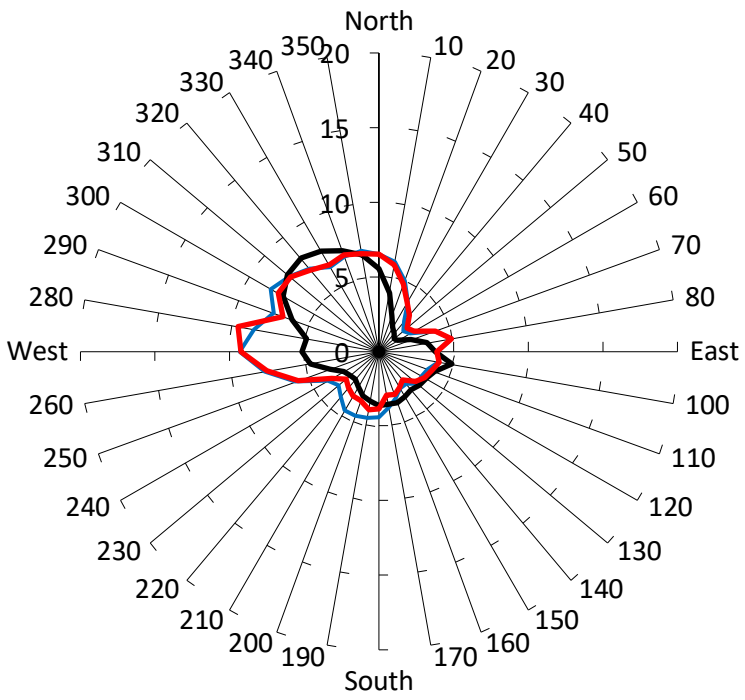


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	26%	26
Existing site conditions. No vegetation or other treatments.	30%	32
With proposed development and future surrounds case. No vegetation or other treatments.	19%	27

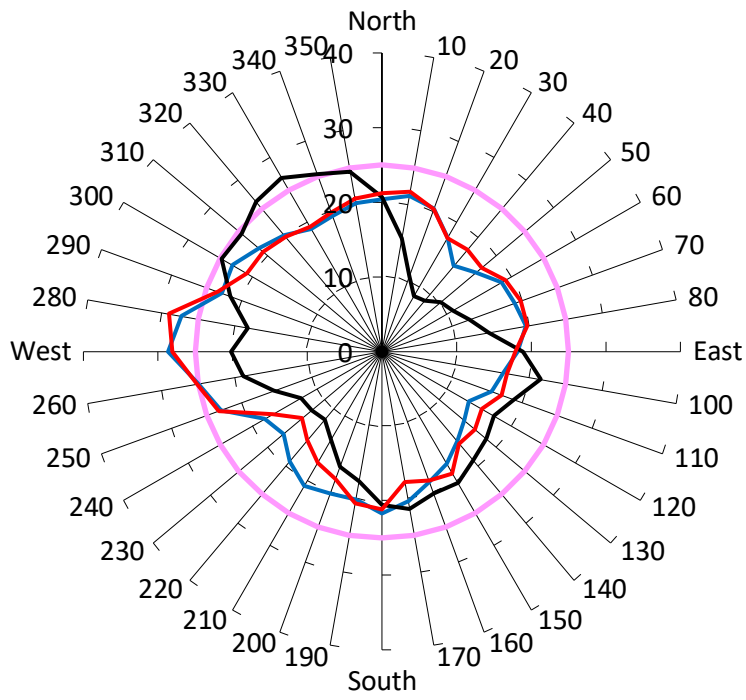
Results for P04

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

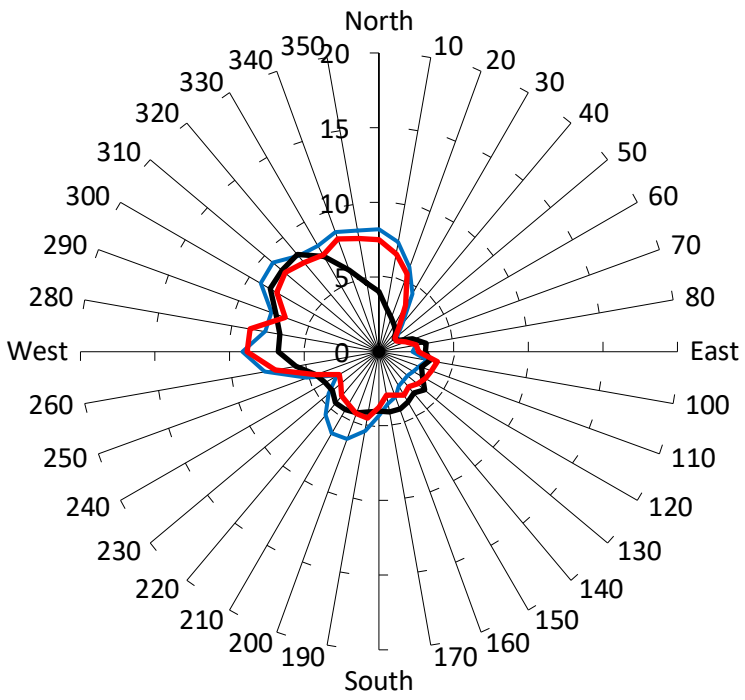


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	48%	29
Existing site conditions. No vegetation or other treatments.	37%	27
With proposed development and future surrounds case. No vegetation or other treatments.	46%	29

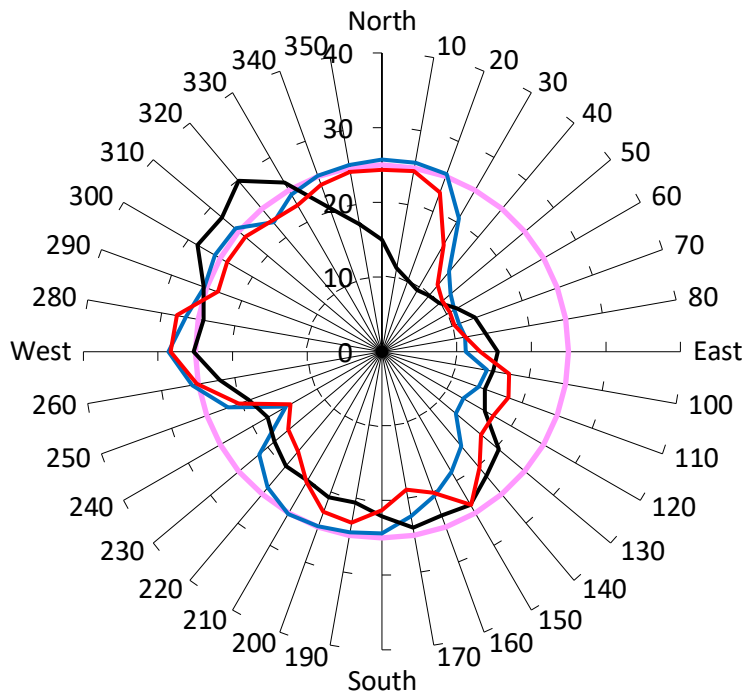
Results for P05

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

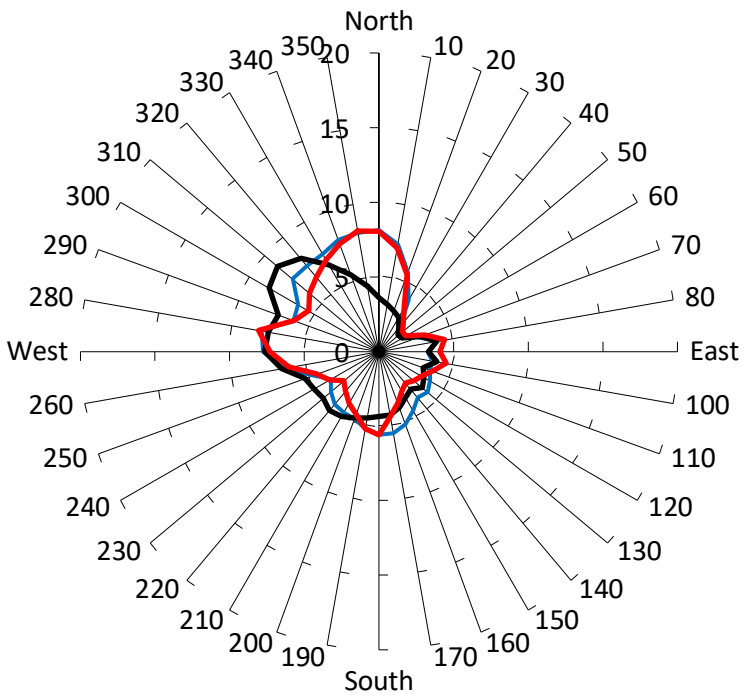


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	48%	29
Existing site conditions. No vegetation or other treatments.	41%	30
With proposed development and future surrounds case. No vegetation or other treatments.	45%	28

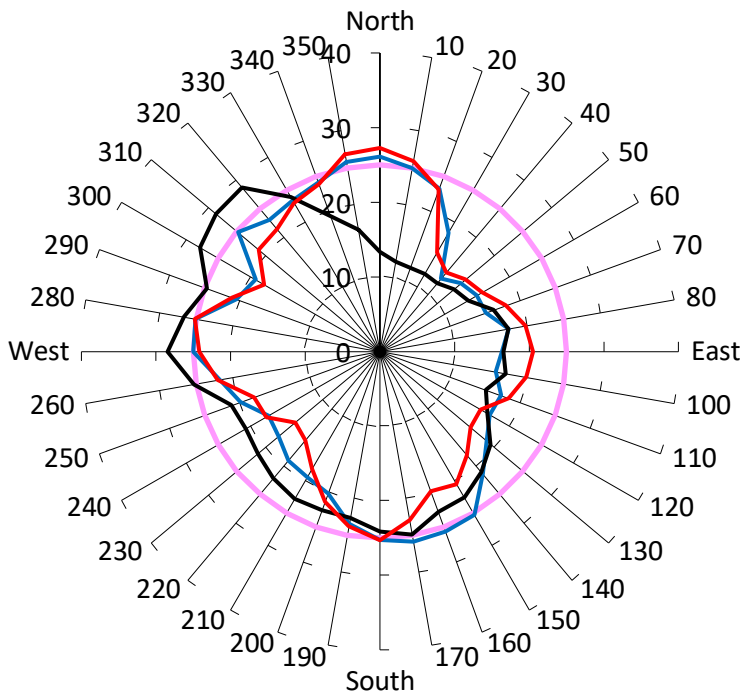
Results for P06

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

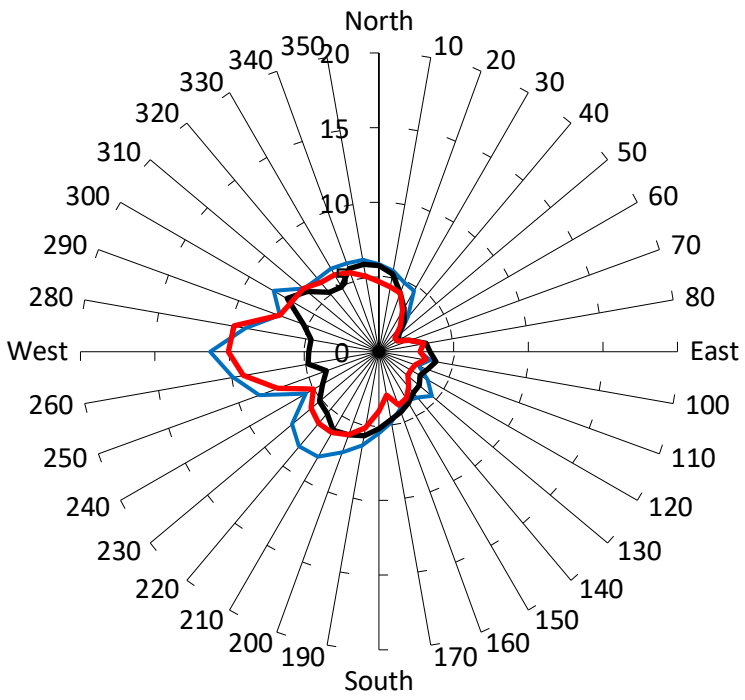


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	49%	26
Existing site conditions. No vegetation or other treatments.	43%	29
With proposed development and future surrounds case. No vegetation or other treatments.	46%	27

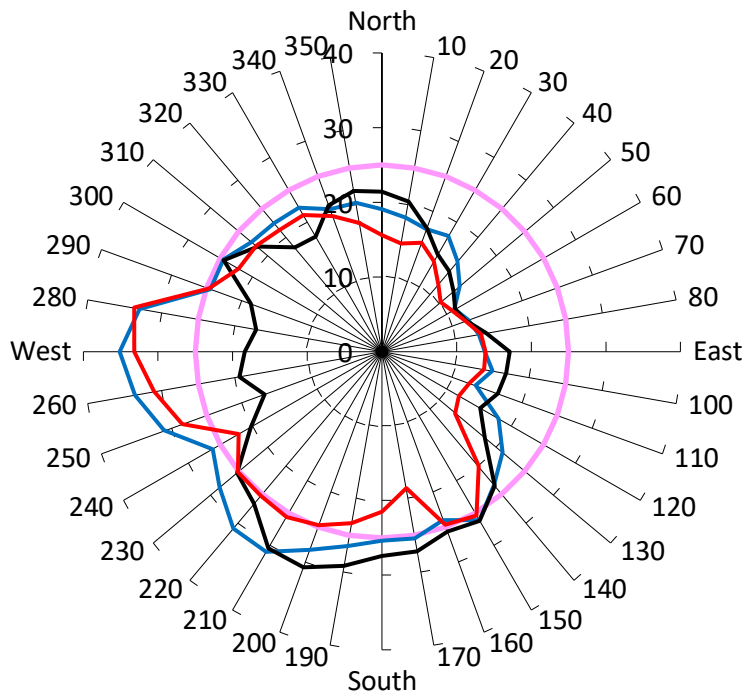
Results for P07

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

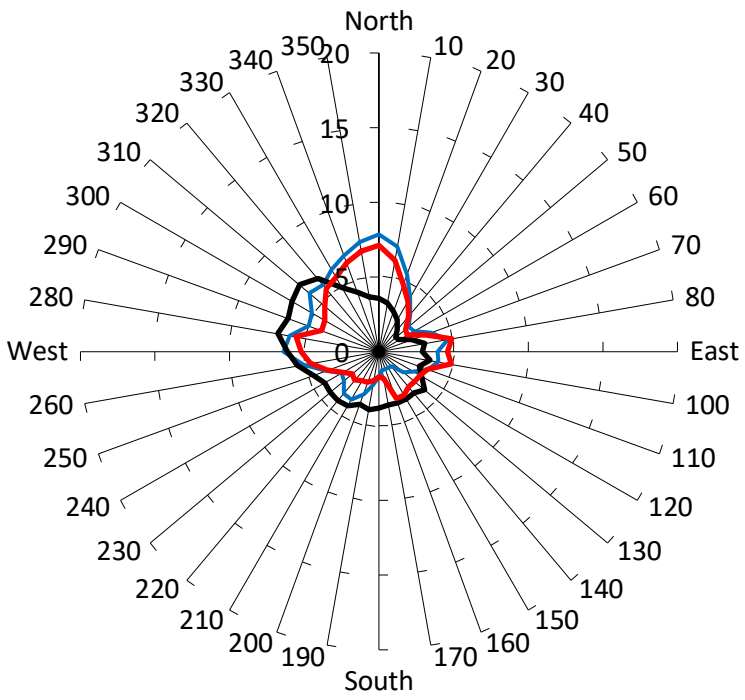


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	52%	35
Existing site conditions. No vegetation or other treatments.	40%	31
With proposed development and future surrounds case. No vegetation or other treatments.	44%	34

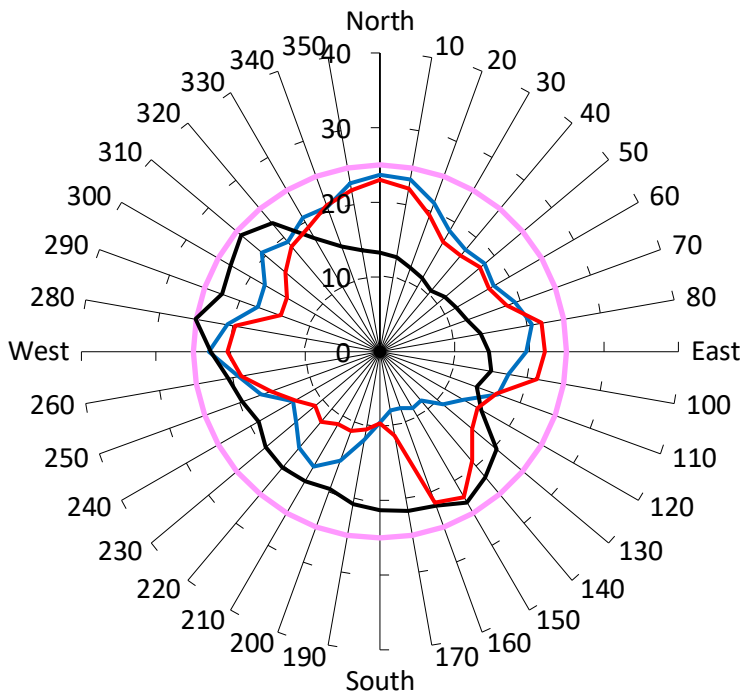
Results for P08

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

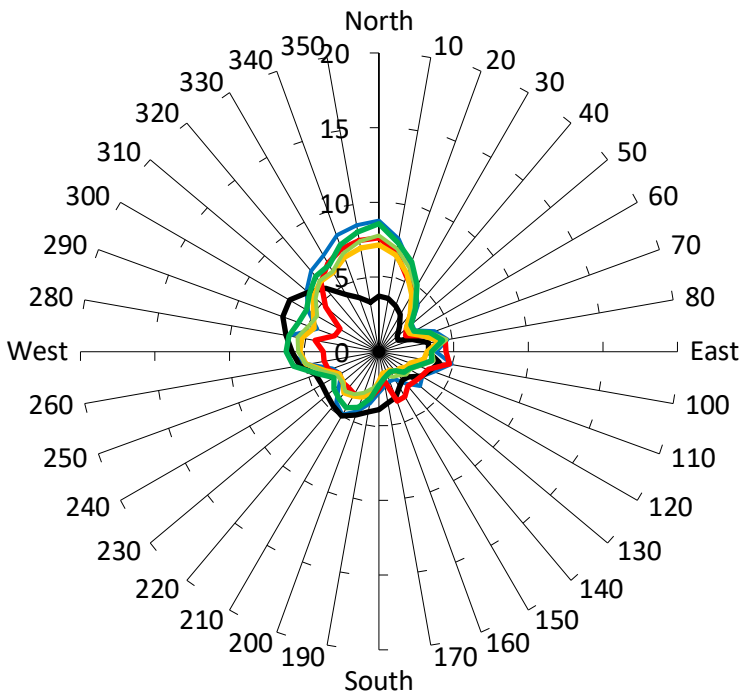


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	37%	24
Existing site conditions. No vegetation or other treatments.	36%	25
With proposed development and future surrounds case. No vegetation or other treatments.	32%	23

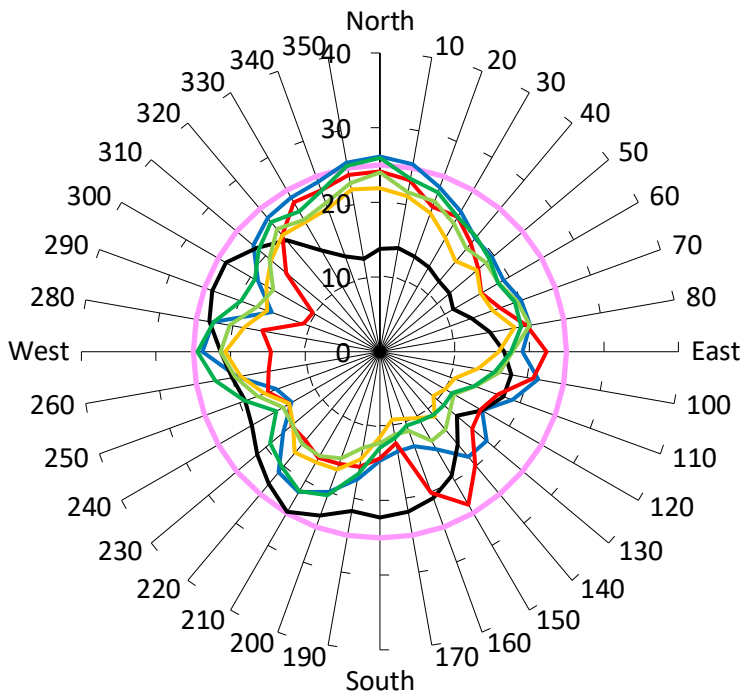
Results for P09

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

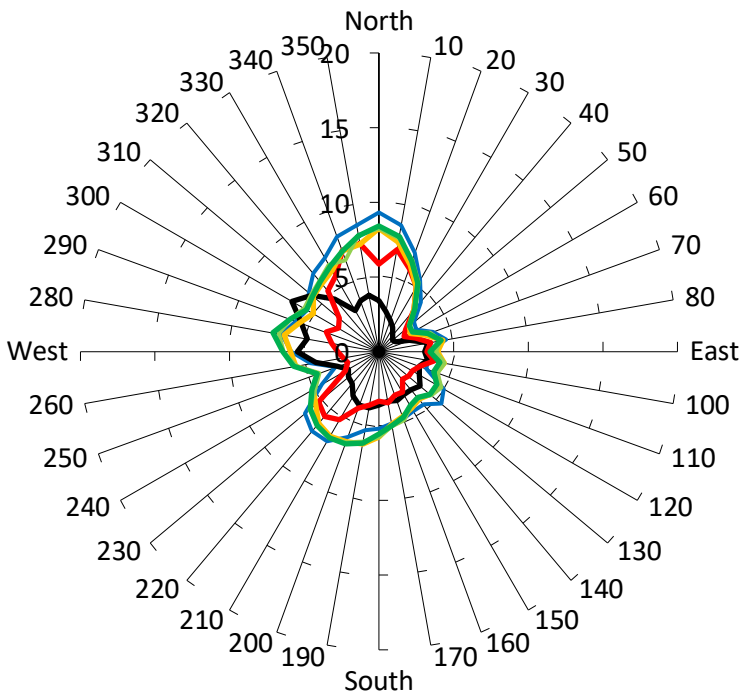


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	43%	26
Existing site conditions. No vegetation or other treatments.	34%	25
With proposed development and future surrounds case. No vegetation or other treatments.	32%	24
WE191-07 Proposed Case with inclusion of treatments (rev0) (2.0m wide awning)	33%	22
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.5m wide awning)	35%	24
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.2m wide awning)	42%	26

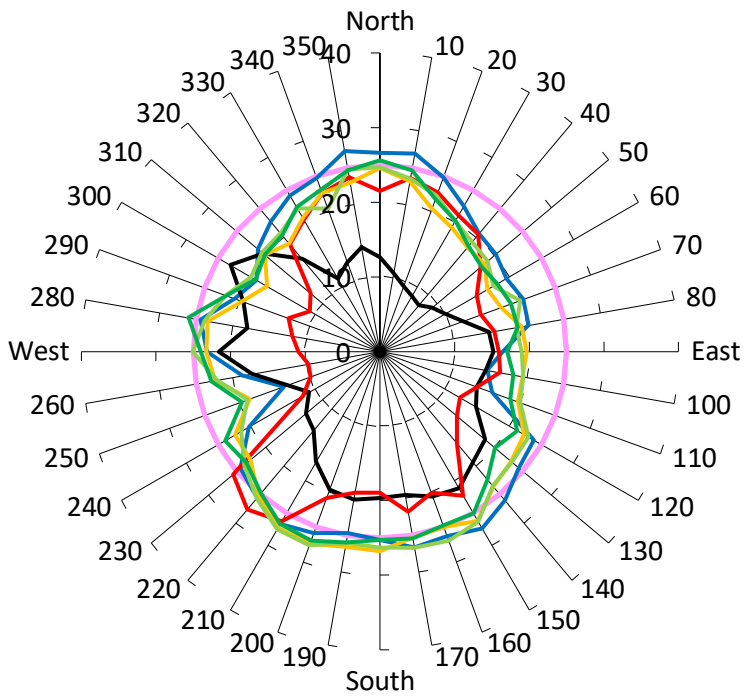
Results for P10

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

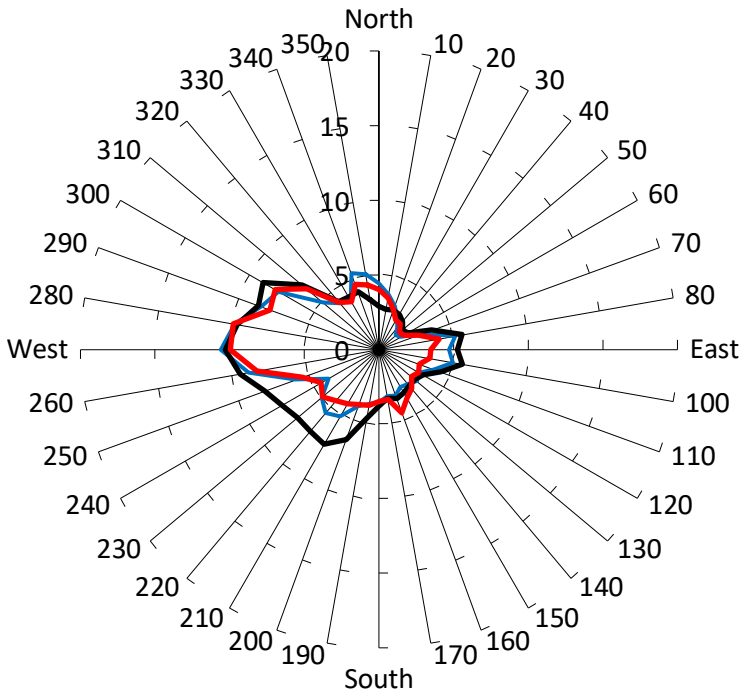


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	51%	27
Existing site conditions. No vegetation or other treatments.	23%	23
With proposed development and future surrounds case. No vegetation or other treatments.	31%	28
WE191-07 Proposed Case with inclusion of treatments (rev0) (2.0m wide awning)	50%	27
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.5m wide awning)	52%	28
WE191-07 Proposed Case with inclusion of treatments (rev0) (1.2m wide awning)	52%	27

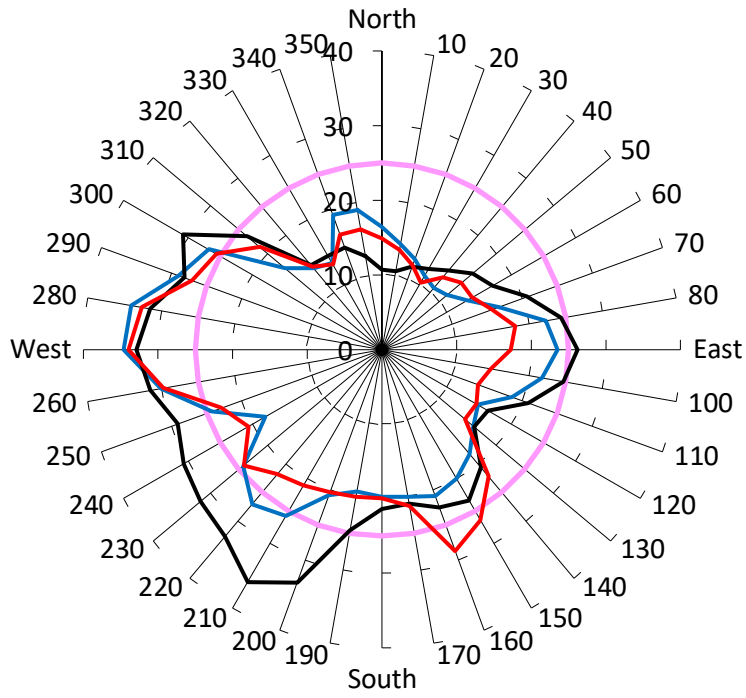
Results for P11

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

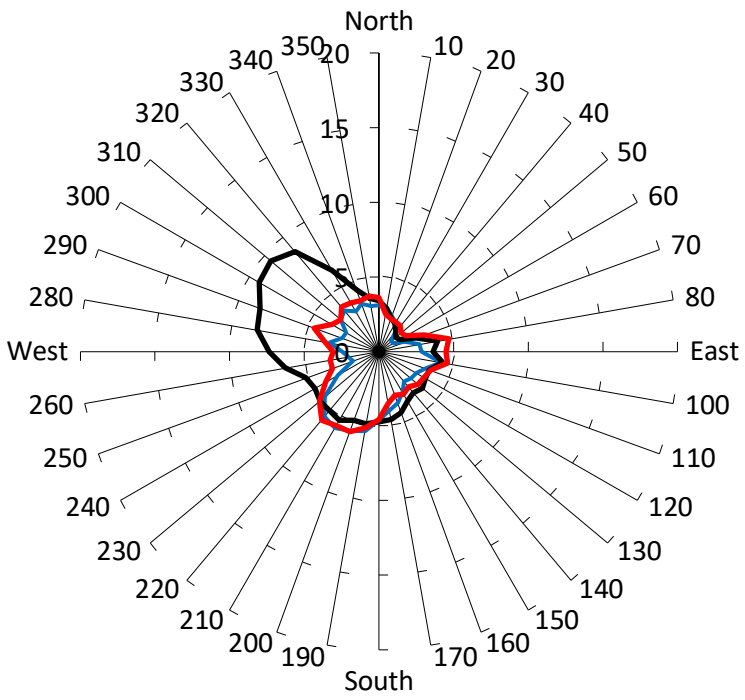


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	38%	35
Existing site conditions. No vegetation or other treatments.	42%	36
With proposed development and future surrounds case. No vegetation or other treatments.	36%	34

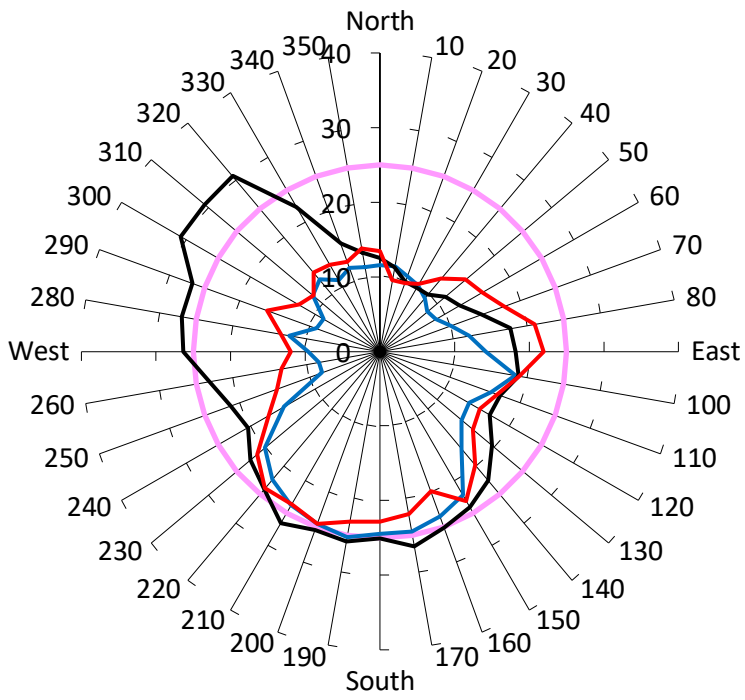
Results for P12

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

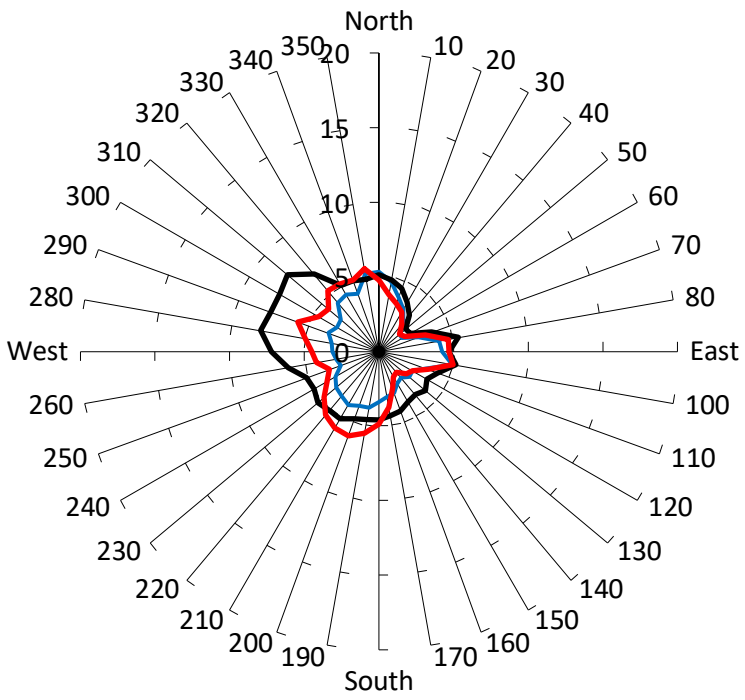


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	18%	25
Existing site conditions. No vegetation or other treatments.	44%	31
With proposed development and future surrounds case. No vegetation or other treatments.	24%	25

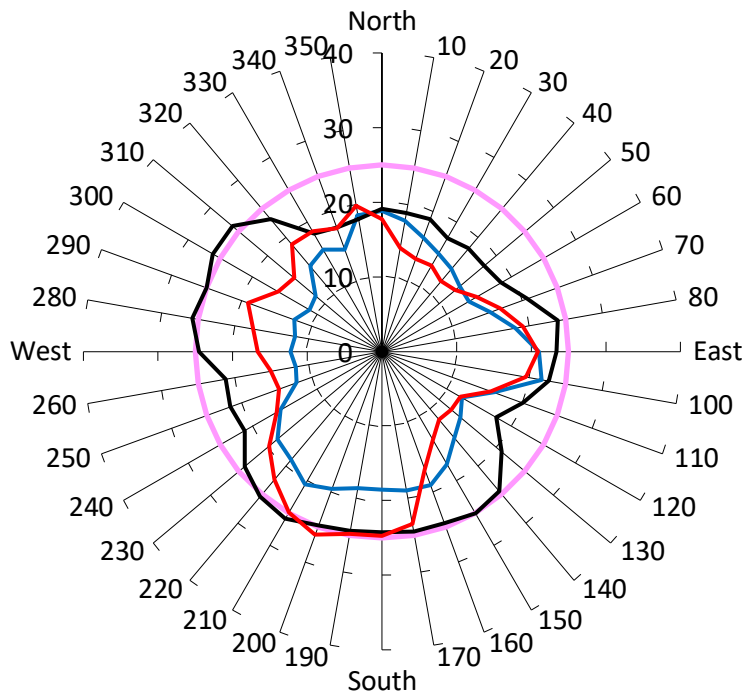
Results for P13

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

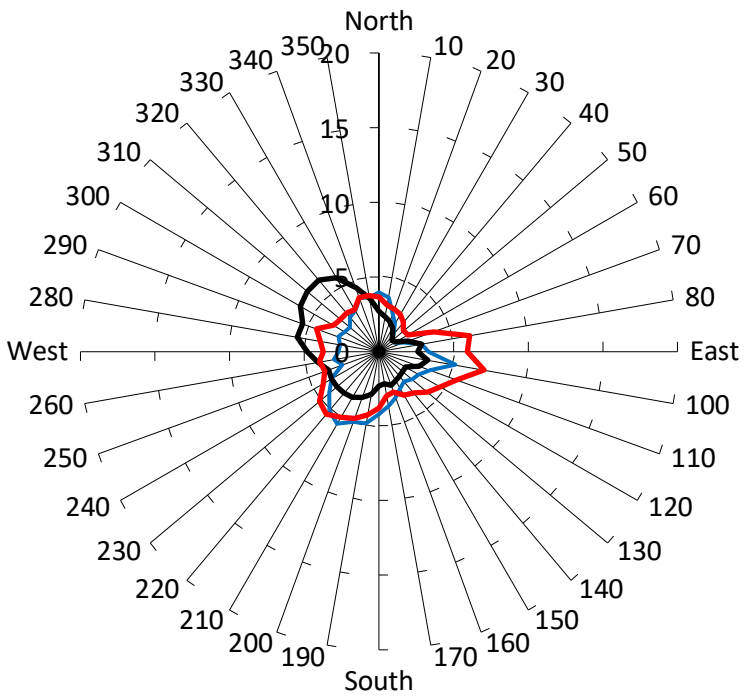


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	20%	22
Existing site conditions. No vegetation or other treatments.	48%	26
With proposed development and future surrounds case. No vegetation or other treatments.	33%	26

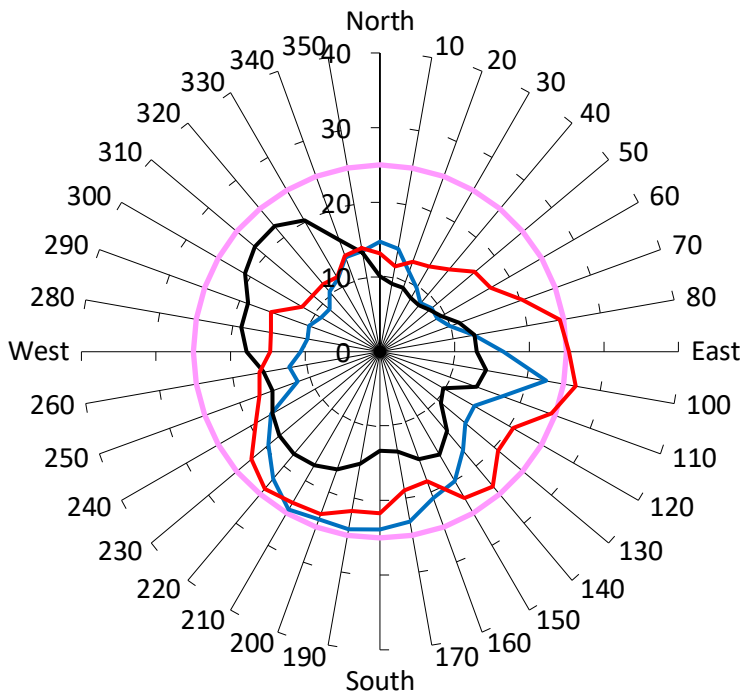
Results for P14

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

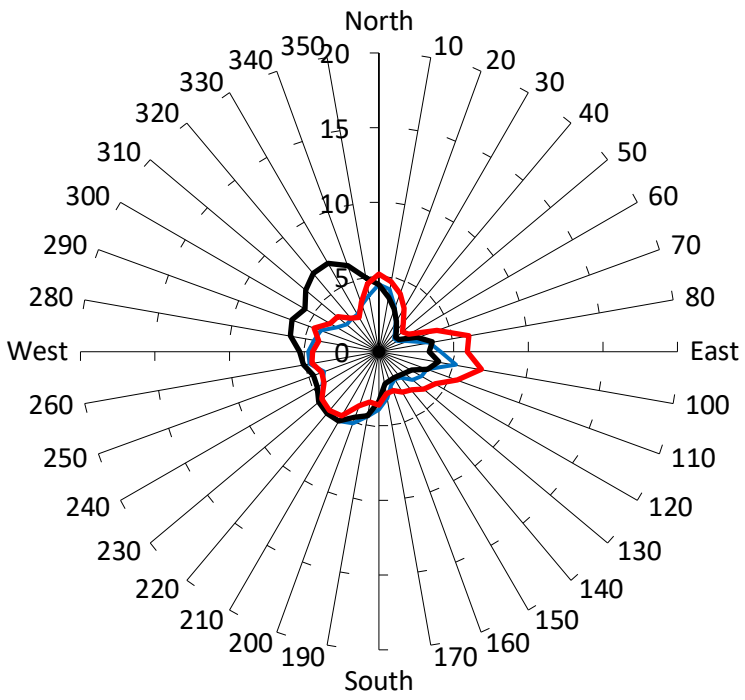


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	18%	24
Existing site conditions. No vegetation or other treatments.	24%	22
With proposed development and future surrounds case. No vegetation or other treatments.	26%	27

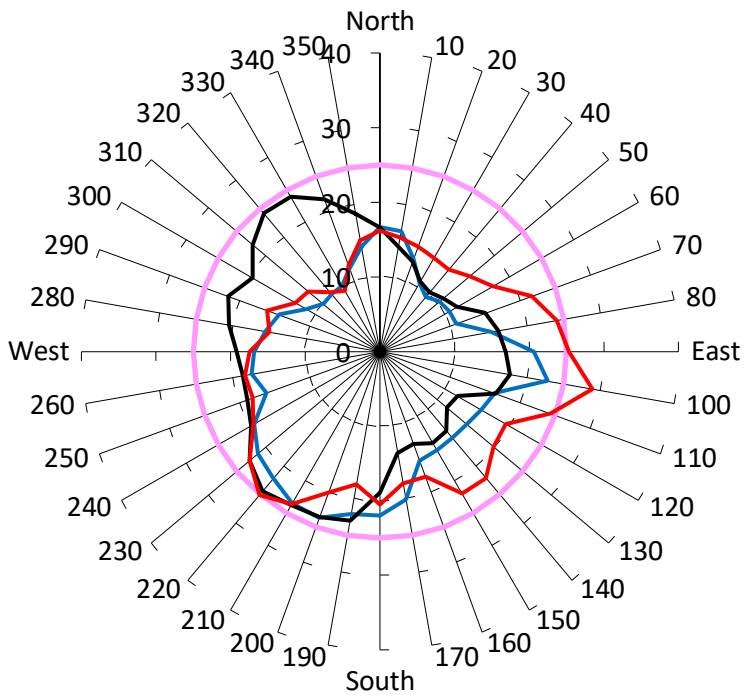
Results for P15

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

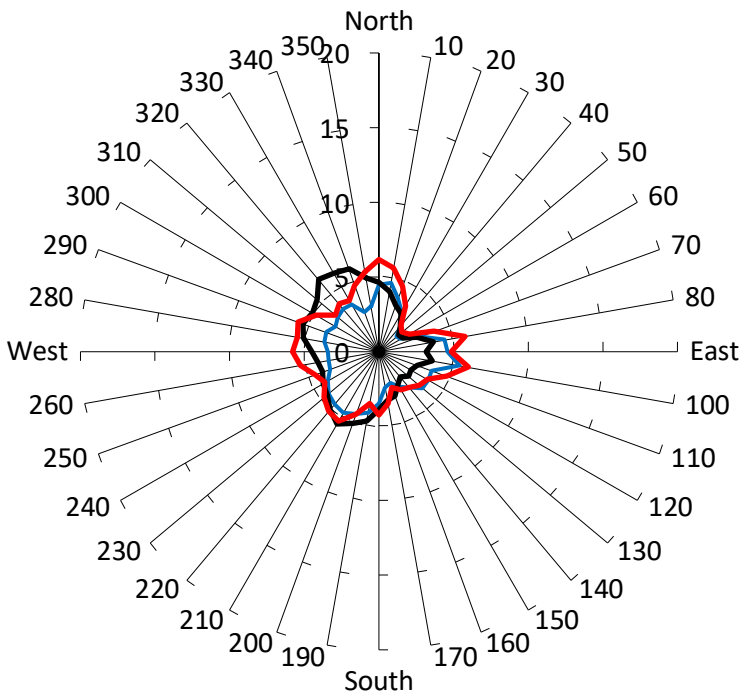


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	22%	24
Existing site conditions. No vegetation or other treatments.	38%	25
With proposed development and future surrounds case. No vegetation or other treatments.	28%	29

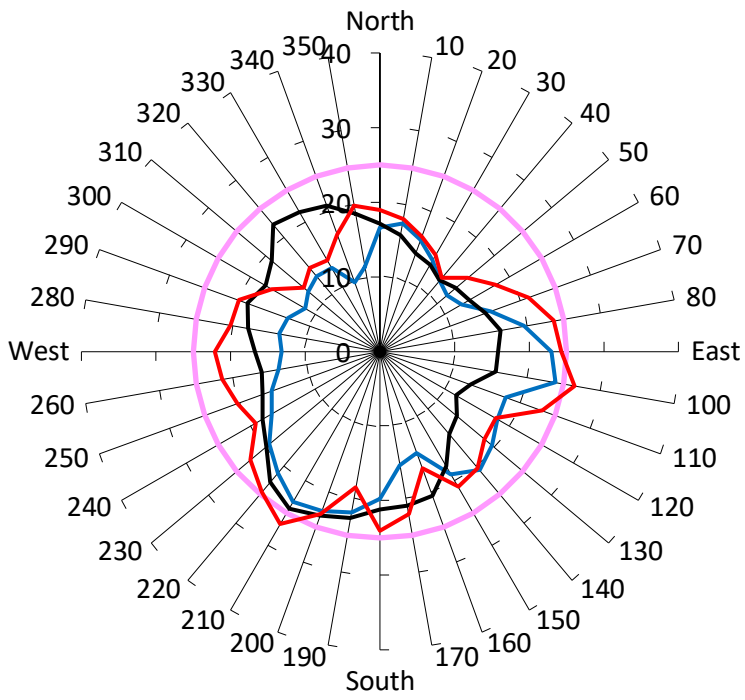
Results for P16

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

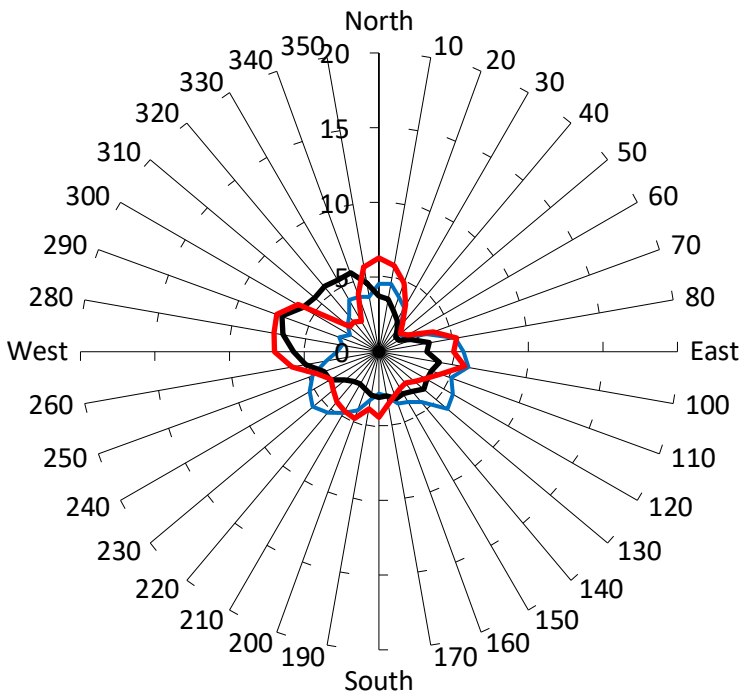


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	20%	24
Existing site conditions. No vegetation or other treatments.	33%	24
With proposed development and future surrounds case. No vegetation or other treatments.	37%	27

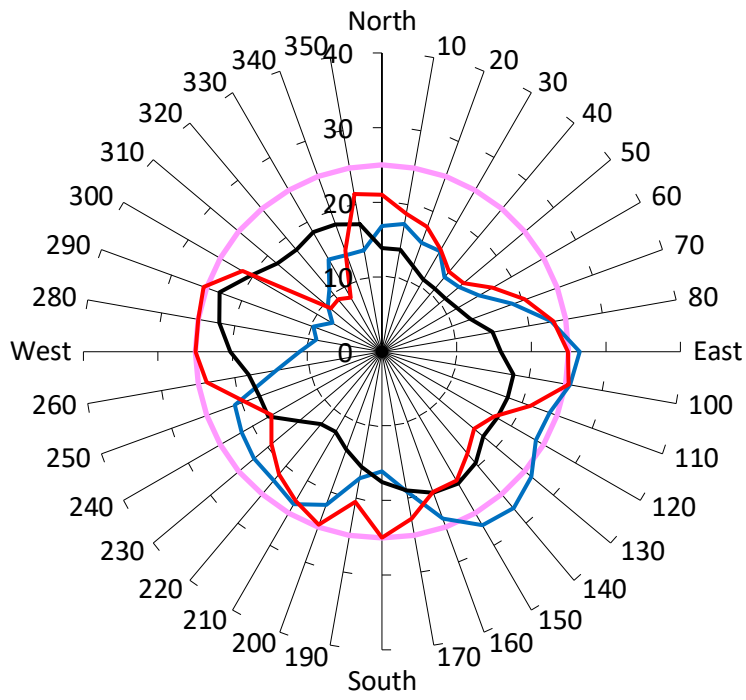
Results for P17

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

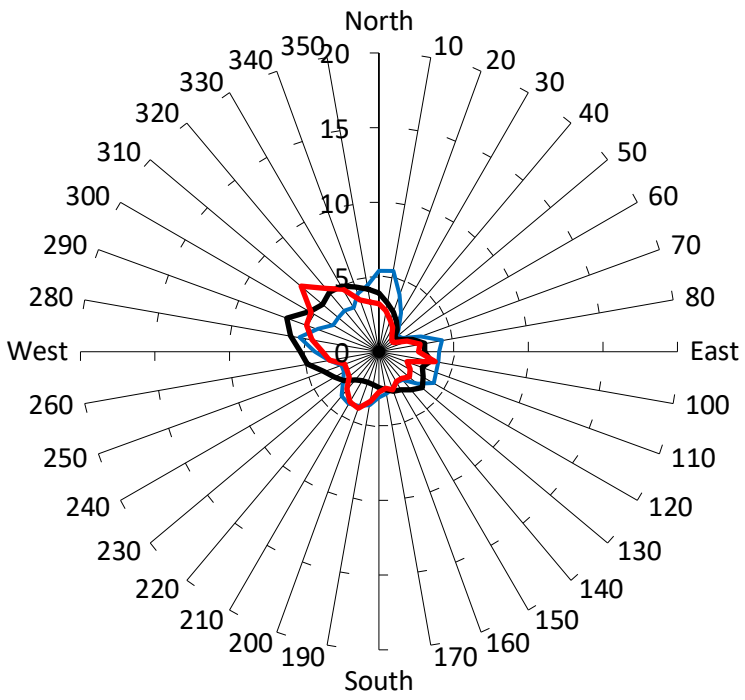


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	26%	27
Existing site conditions. No vegetation or other treatments.	31%	23
With proposed development and future surrounds case. No vegetation or other treatments.	39%	25

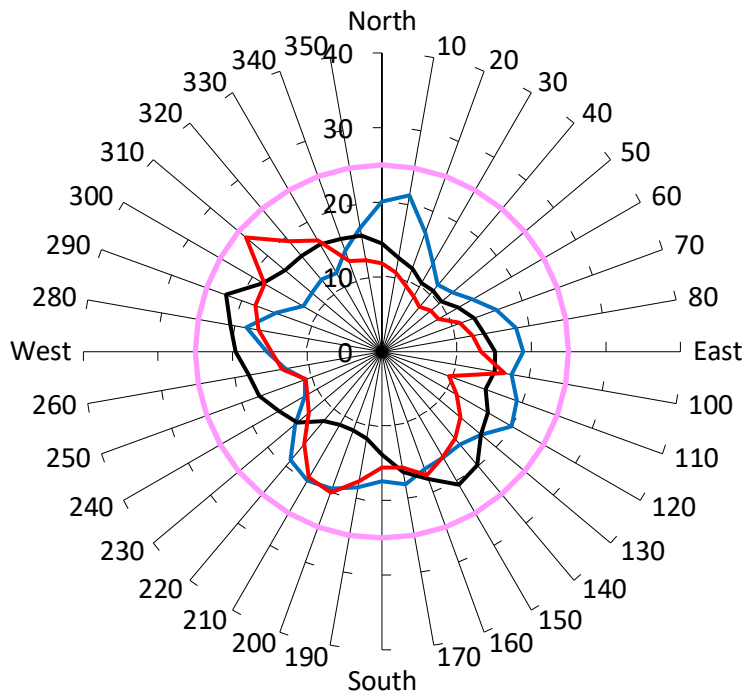
Results for P18

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

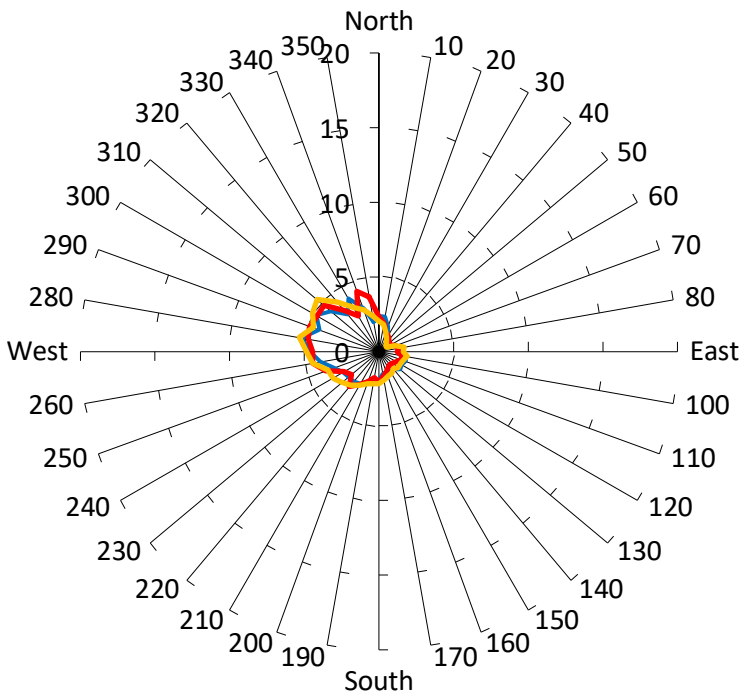


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	21%	21
Existing site conditions. No vegetation or other treatments.	24%	22
With proposed development and future surrounds case. No vegetation or other treatments.	18%	24

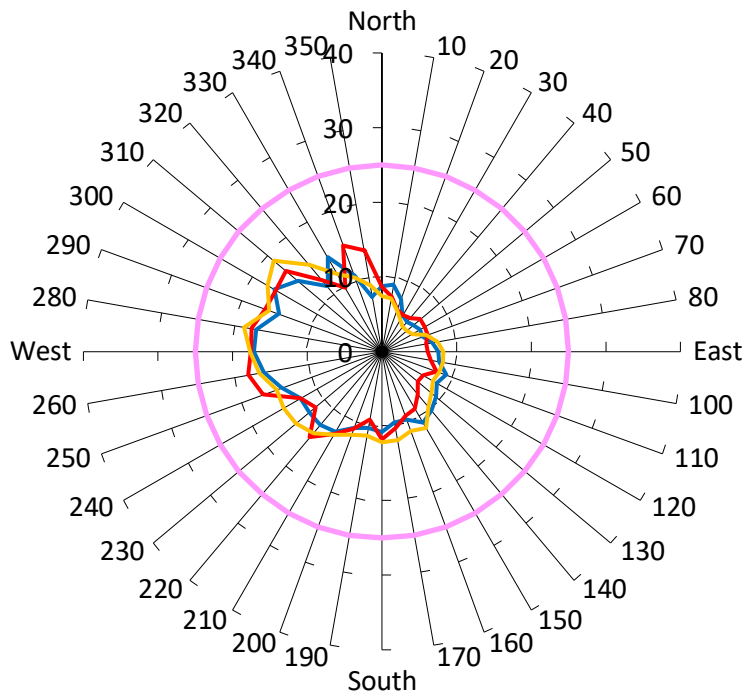
Results for P19

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

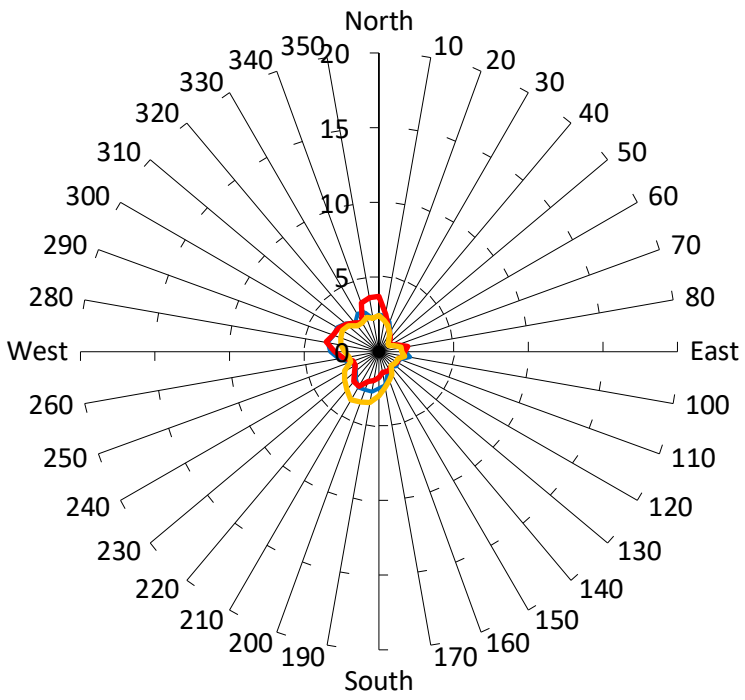


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	8%	17
With proposed development and future surrounds case. No vegetation or other treatments.	10%	18
WE191-07 Proposed Case with inclusion of treatments (rev0)	12%	19

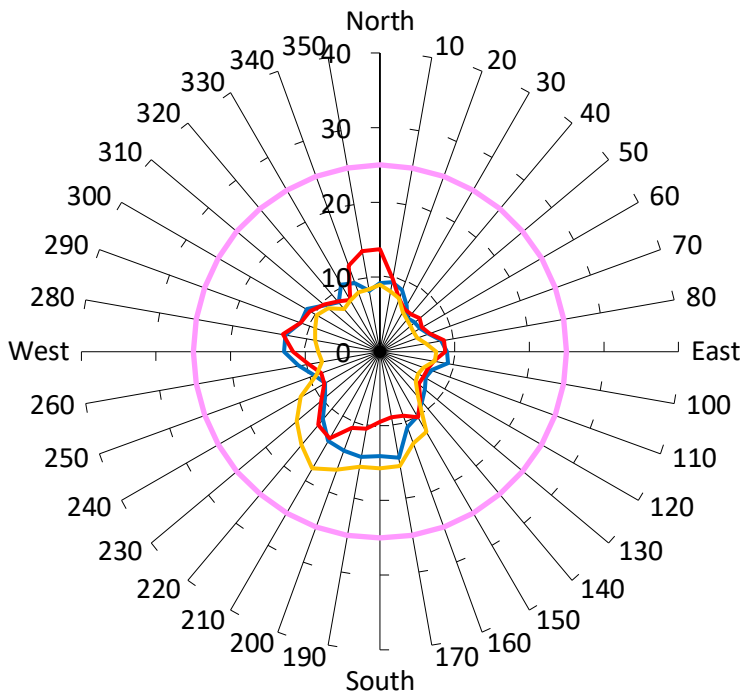
Results for P20

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

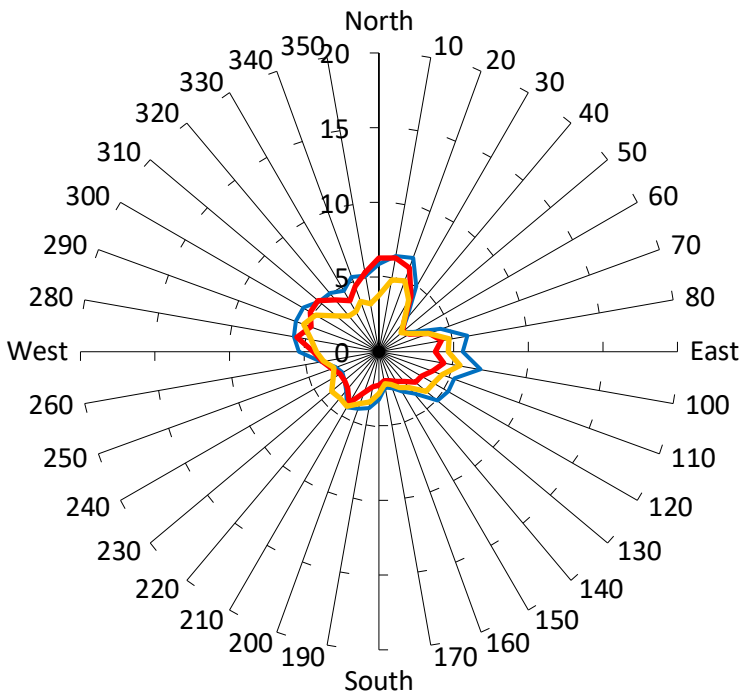


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	2%	14
With proposed development and future surrounds case. No vegetation or other treatments.	2%	14
WE191-07 Proposed Case with inclusion of treatments (rev0)	4%	18

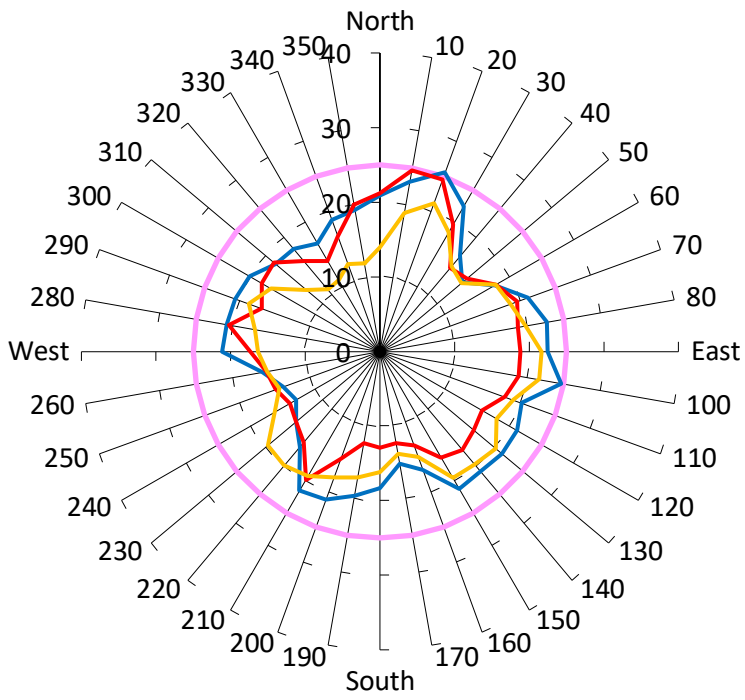
Results for P22

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

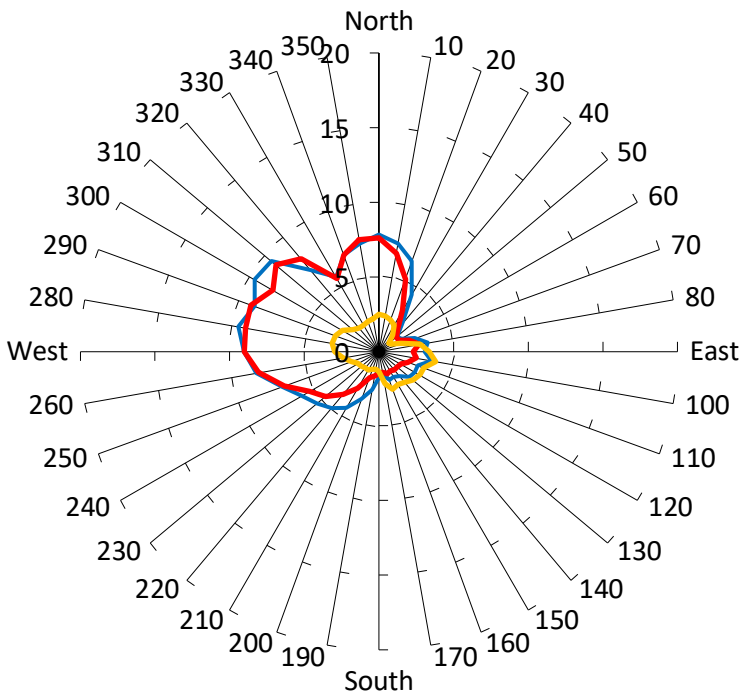


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	38%	26
With proposed development and future surrounds case. No vegetation or other treatments.	27%	25
WE191-07 Proposed Case with inclusion of treatments (rev0)	24%	22

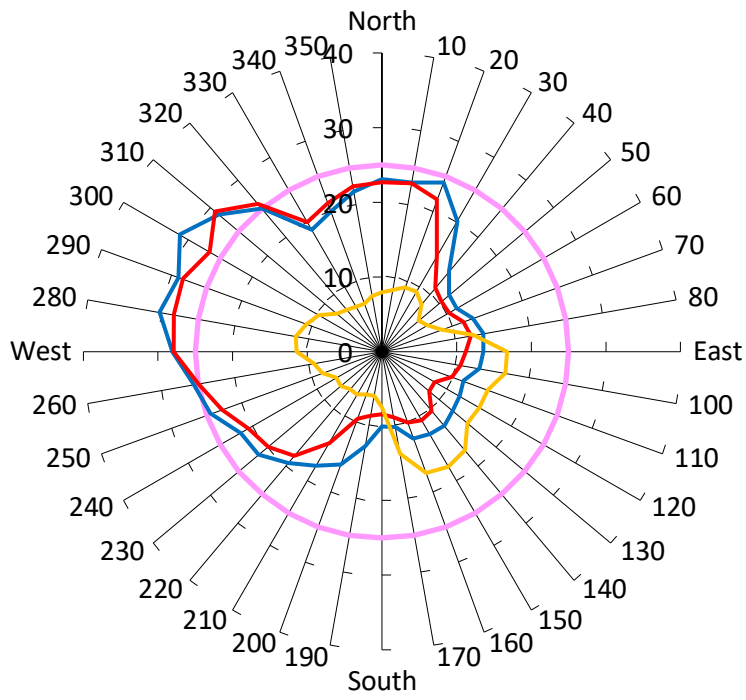
Results for P23

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

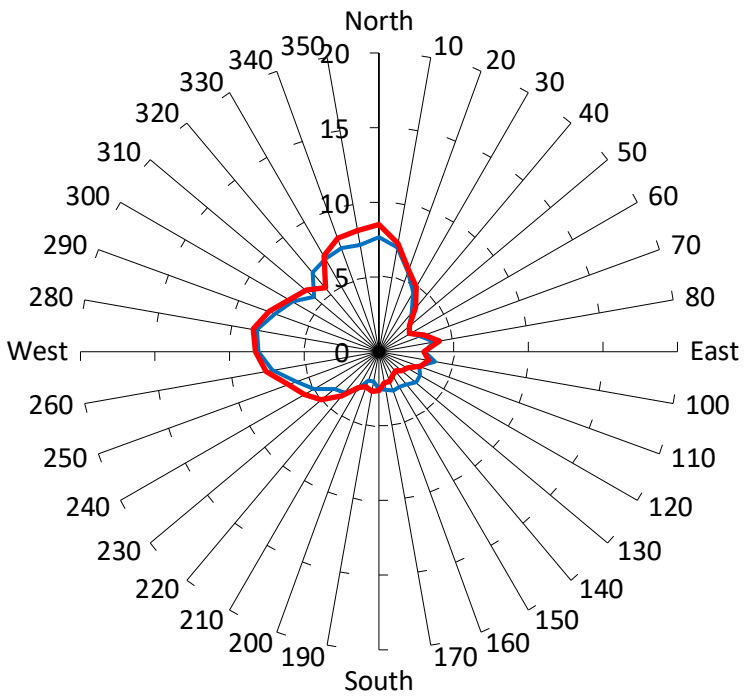


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	45%	31
With proposed development and future surrounds case. No vegetation or other treatments.	41%	29
WE191-07 Proposed Case with inclusion of treatments (rev0)	4%	18

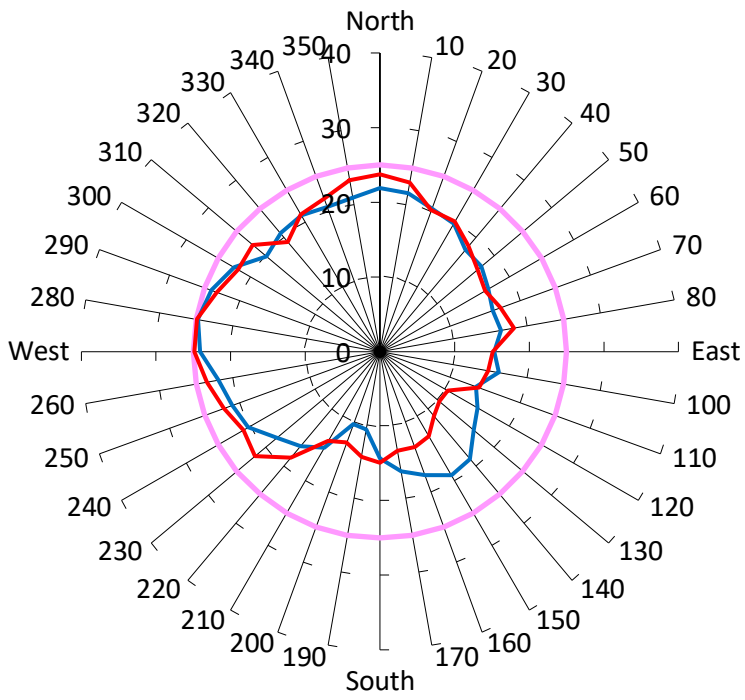
Results for P24

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

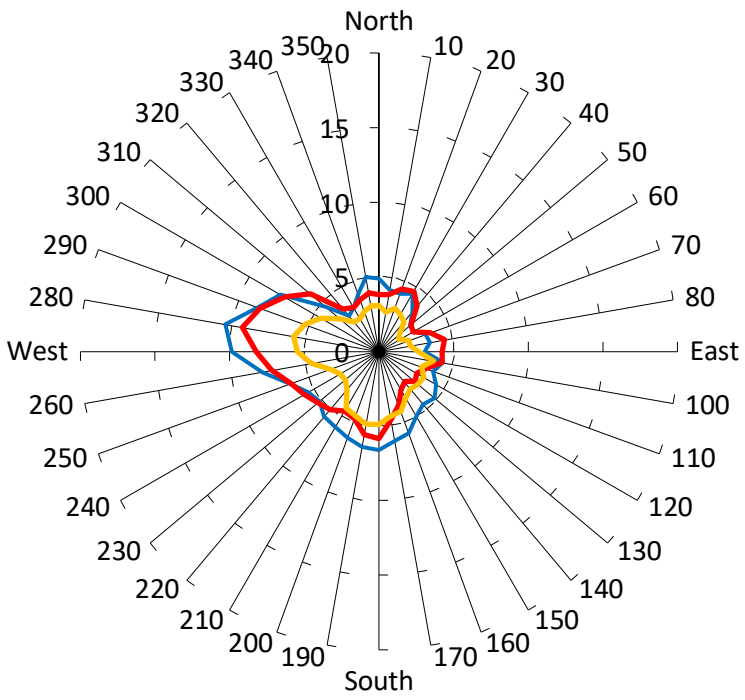


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	44%	25
With proposed development and future surrounds case. No vegetation or other treatments.	44%	25

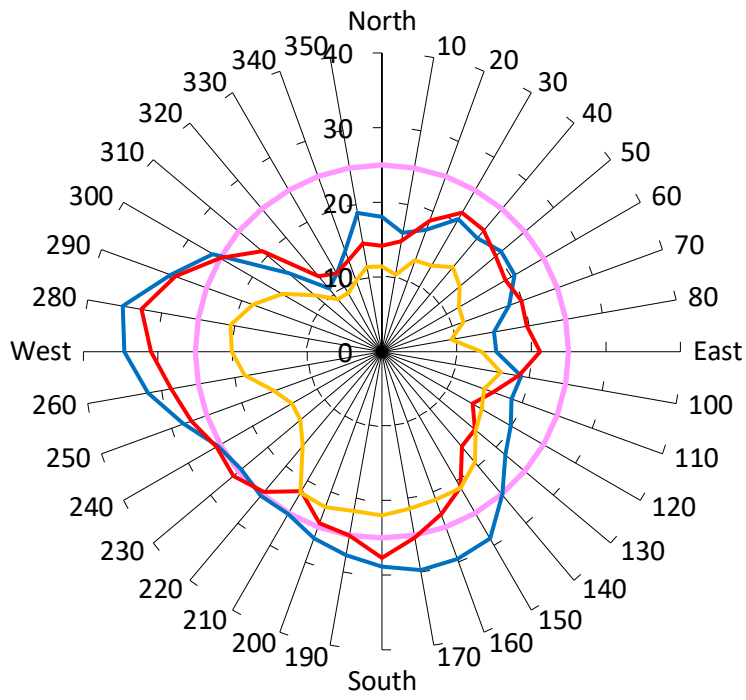
Results for P25

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

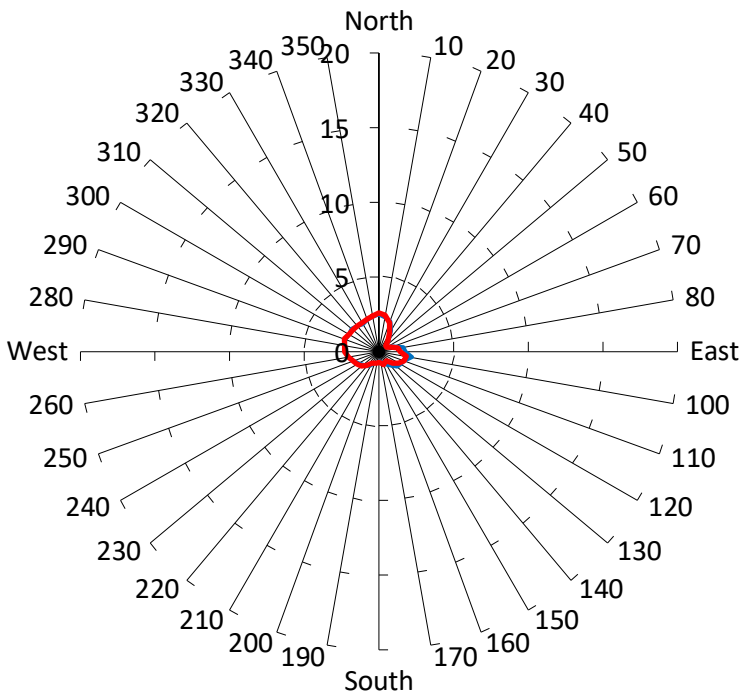


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	44%	35
With proposed development and future surrounds case. No vegetation or other treatments.	42%	33
WE191-07 Proposed Case with inclusion of treatments (rev0)	22%	22

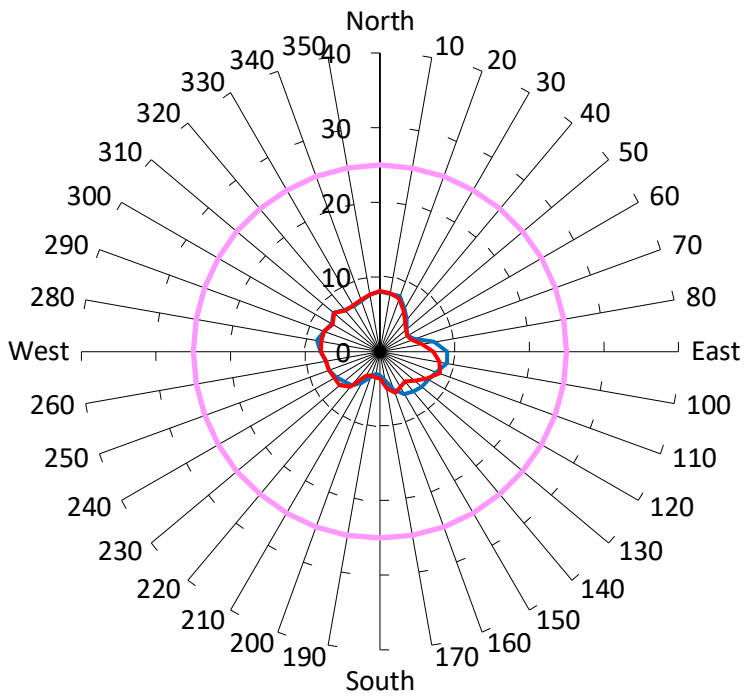
Results for P26

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

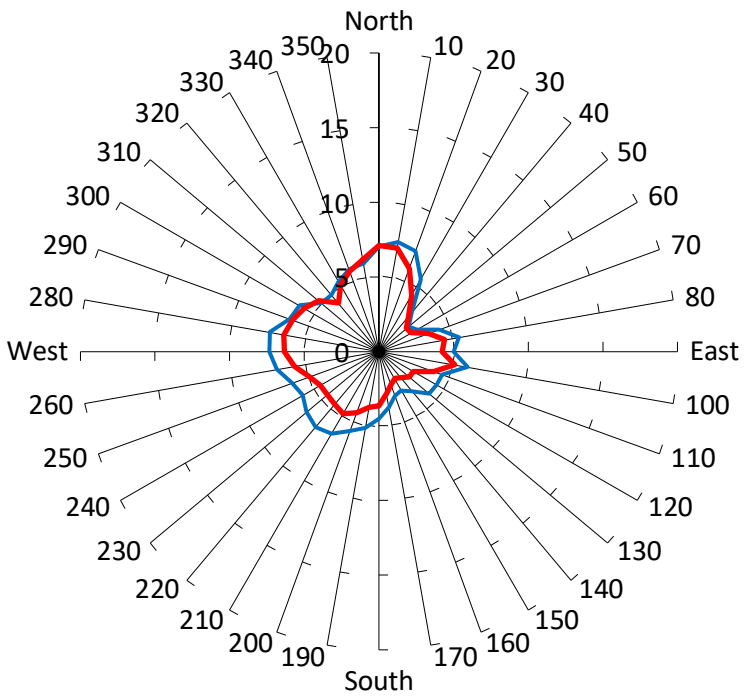


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	0%	9
With proposed development and future surrounds case. No vegetation or other treatments.	0%	9

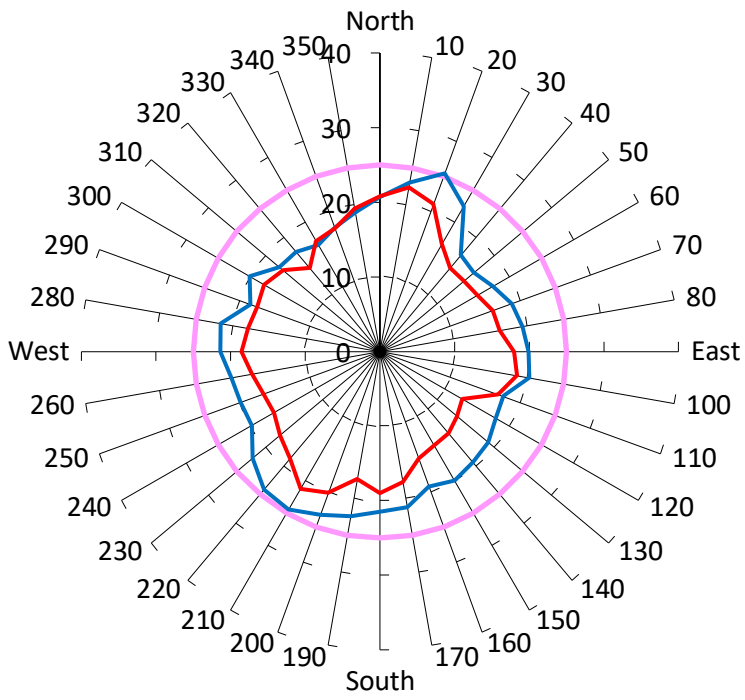
Results for P27

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

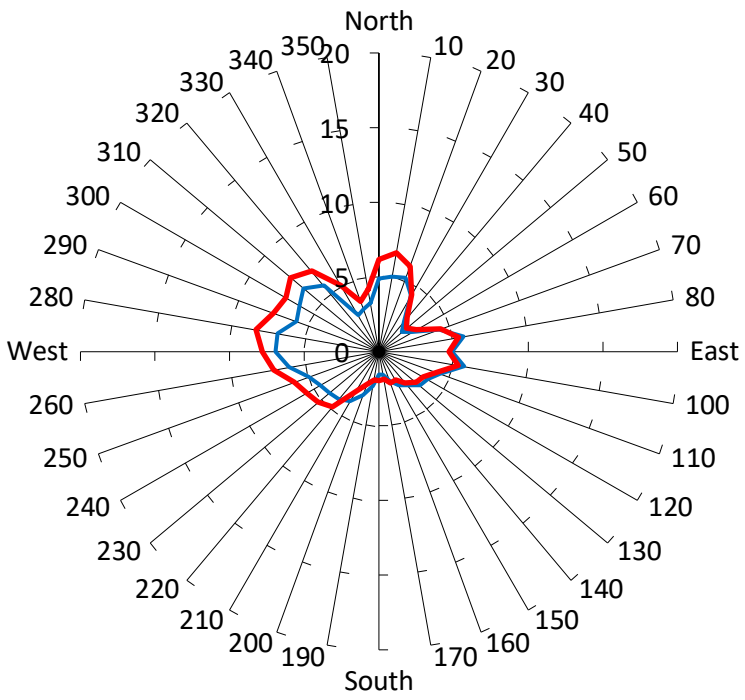


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	51%	25
With proposed development and future surrounds case. No vegetation or other treatments.	41%	22

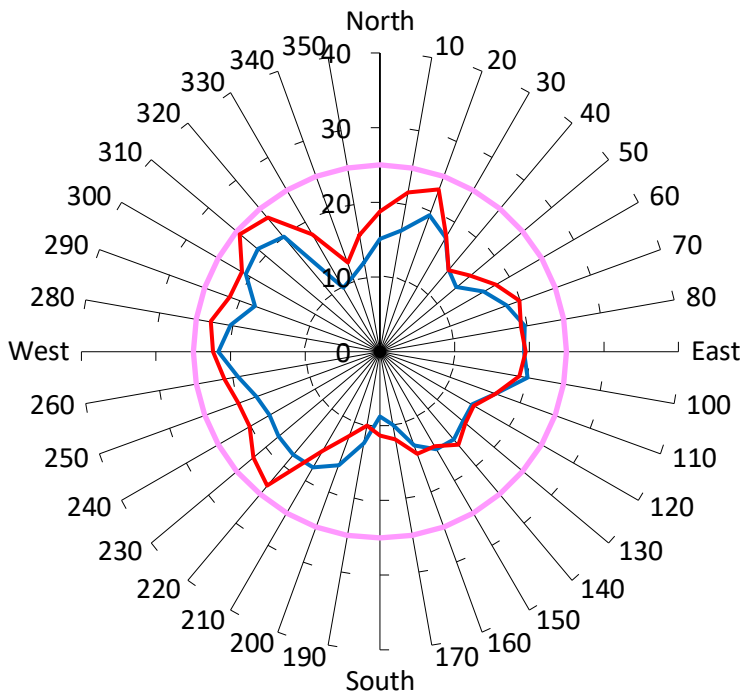
Results for P28

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

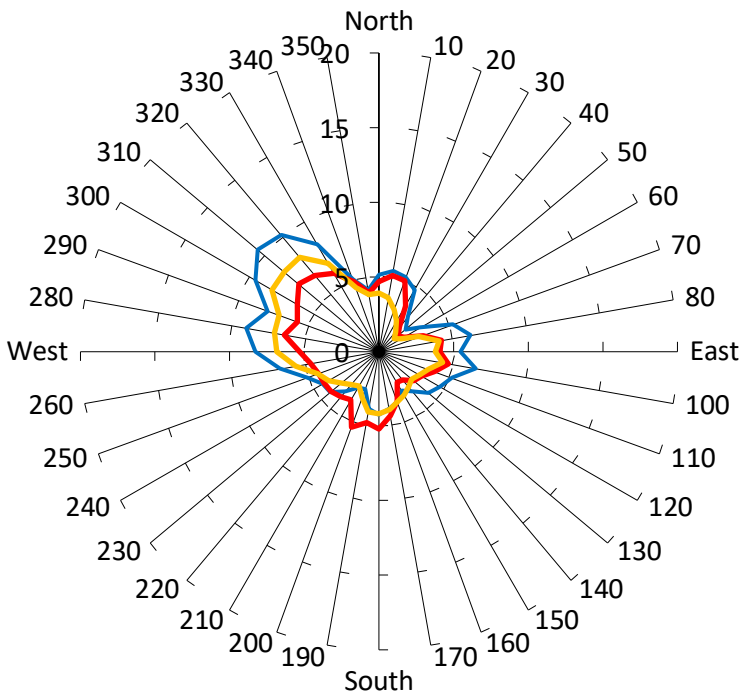


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	38%	22
With proposed development and future surrounds case. No vegetation or other treatments.	44%	24

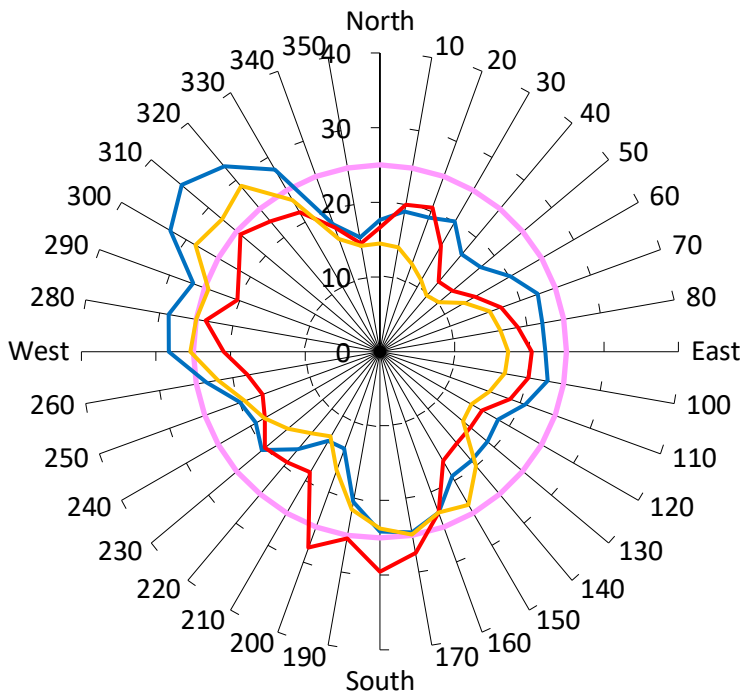
Results for P29

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

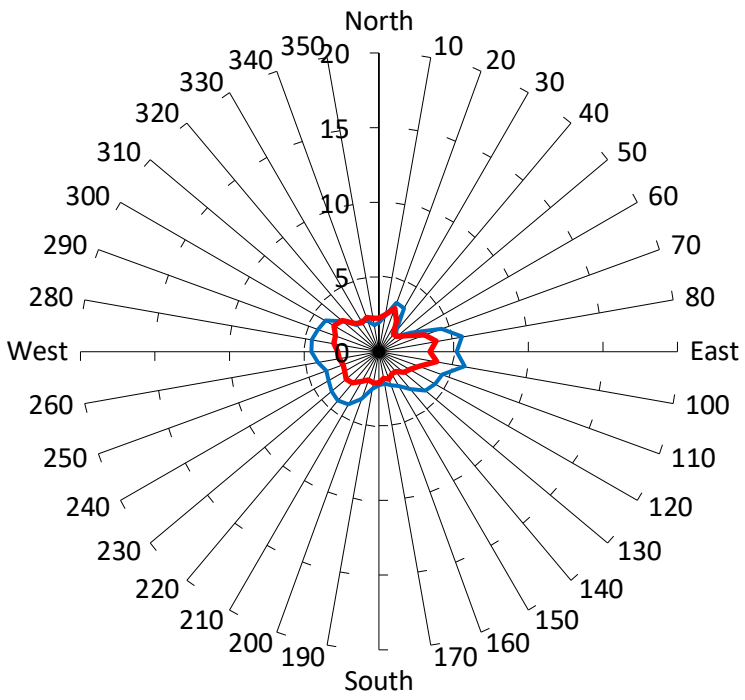


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	47%	35
With proposed development and future surrounds case. No vegetation or other treatments.	41%	30
WE191-07 Proposed Case with inclusion of treatments (rev0)	37%	29

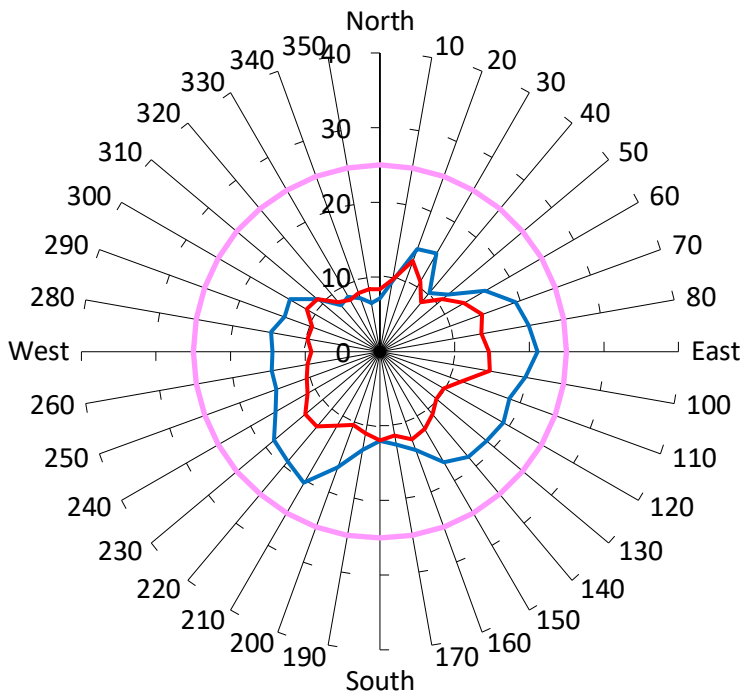
Results for P31

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

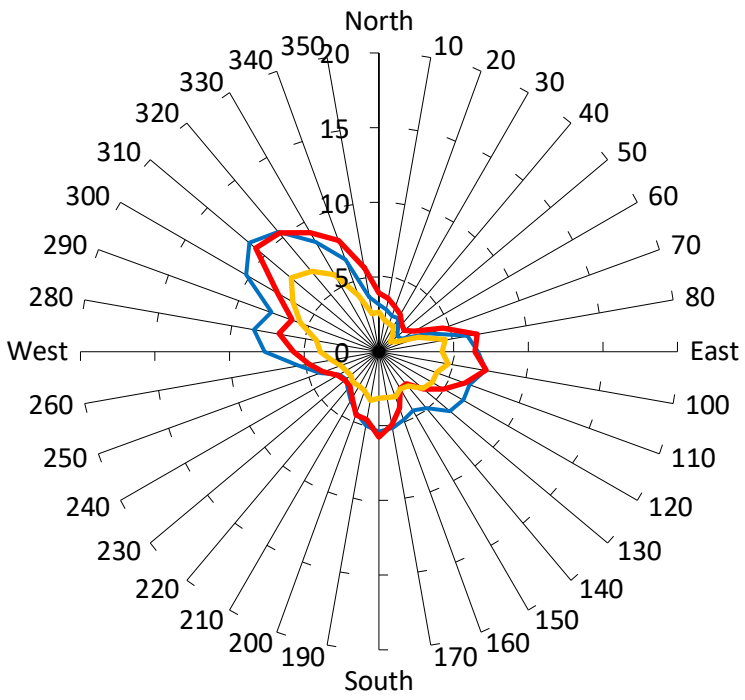


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	20%	21
With proposed development and future surrounds case. No vegetation or other treatments.	5%	15

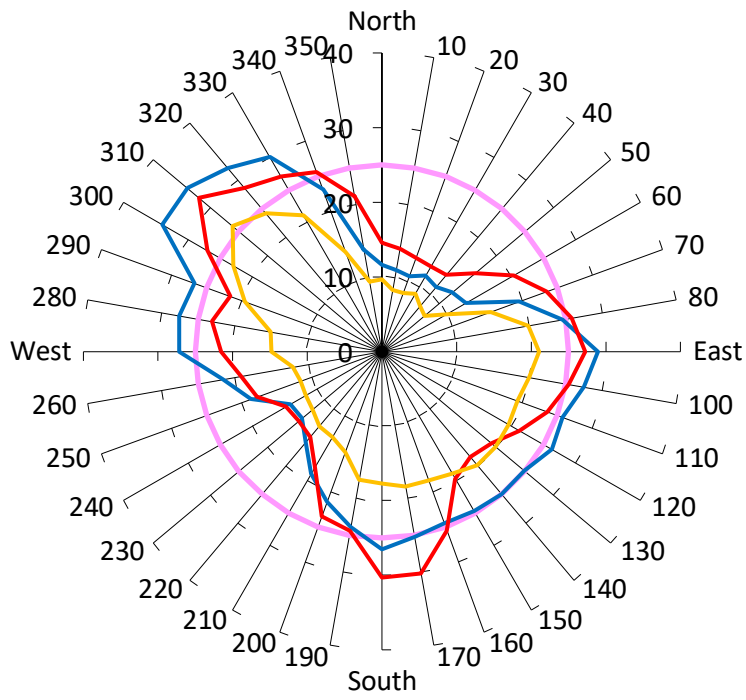
Results for P32

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

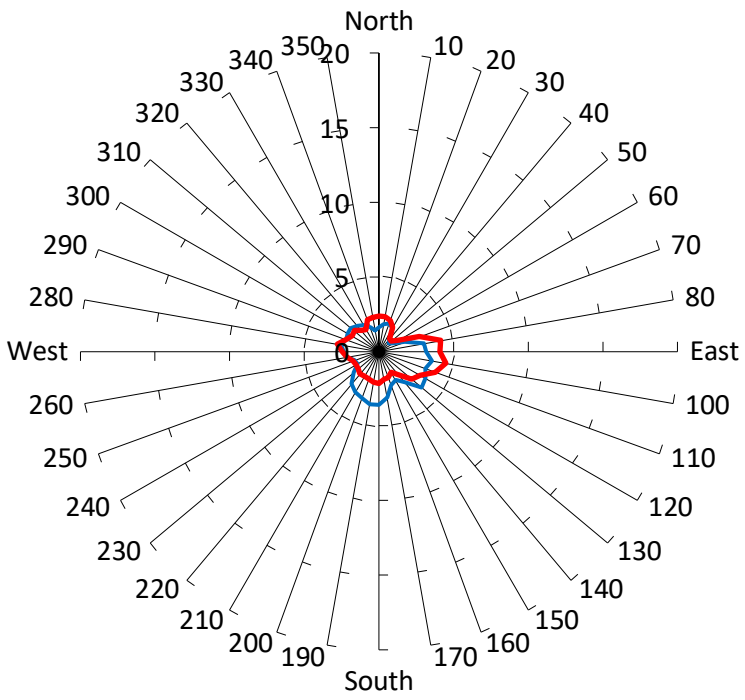


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	44%	34
With proposed development and future surrounds case. No vegetation or other treatments.	44%	32
WE191-07 Proposed Case with inclusion of treatments (rev0)	27%	26

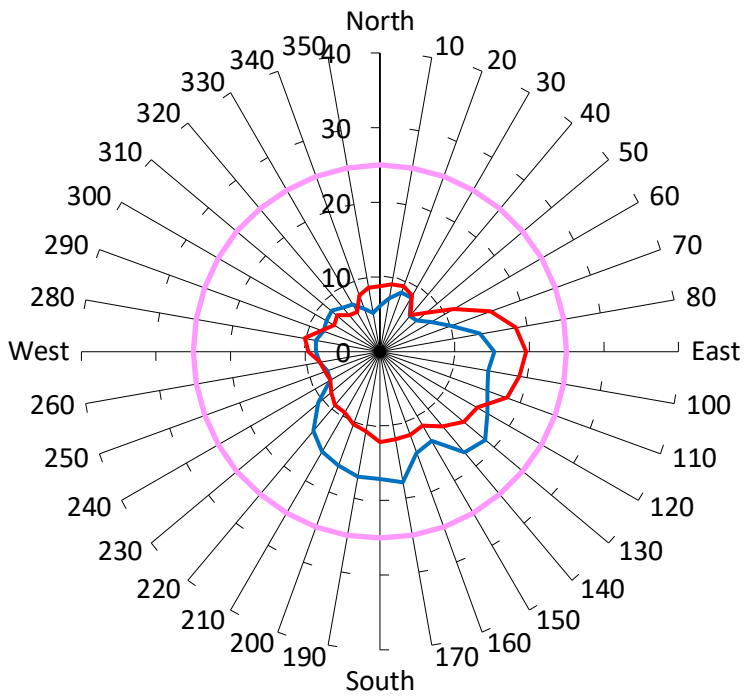
Results for P33

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

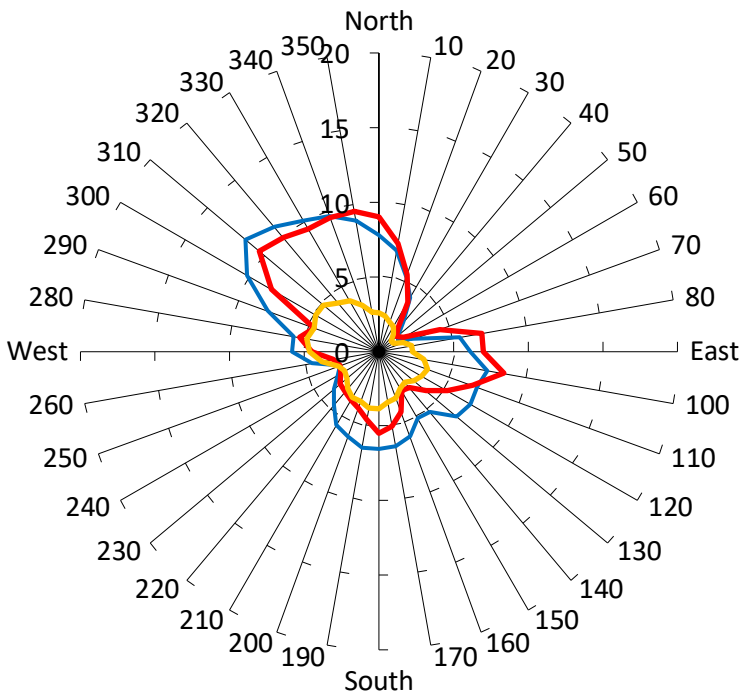


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	7%	18
With proposed development and future surrounds case. No vegetation or other treatments.	6%	20

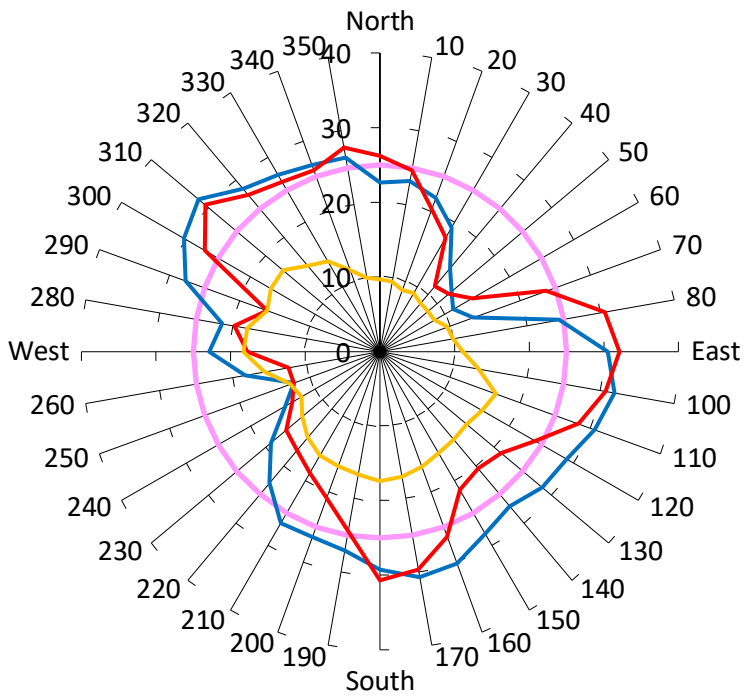
Results for P34

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

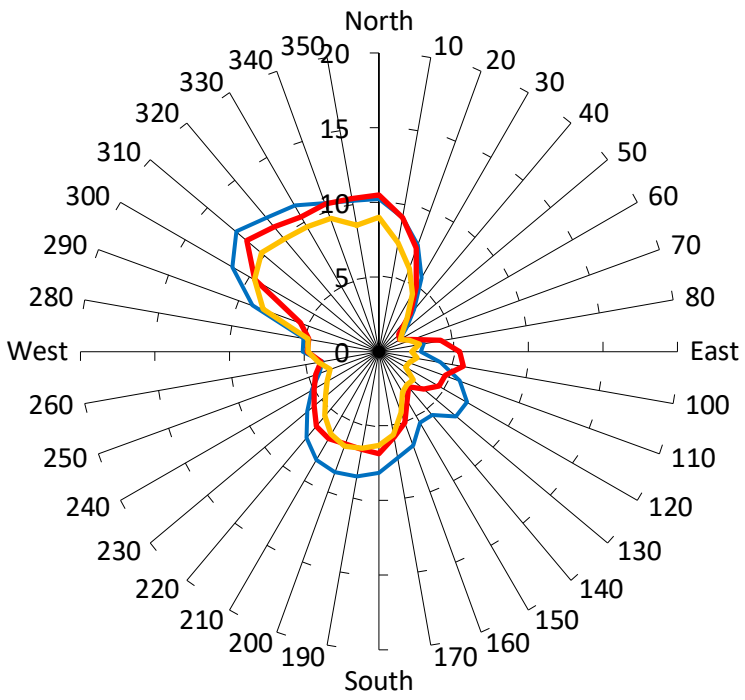


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	50%	32
With proposed development and future surrounds case. No vegetation or other treatments.	44%	32
WE191-07 Proposed Case with inclusion of treatments (rev0)	15%	18

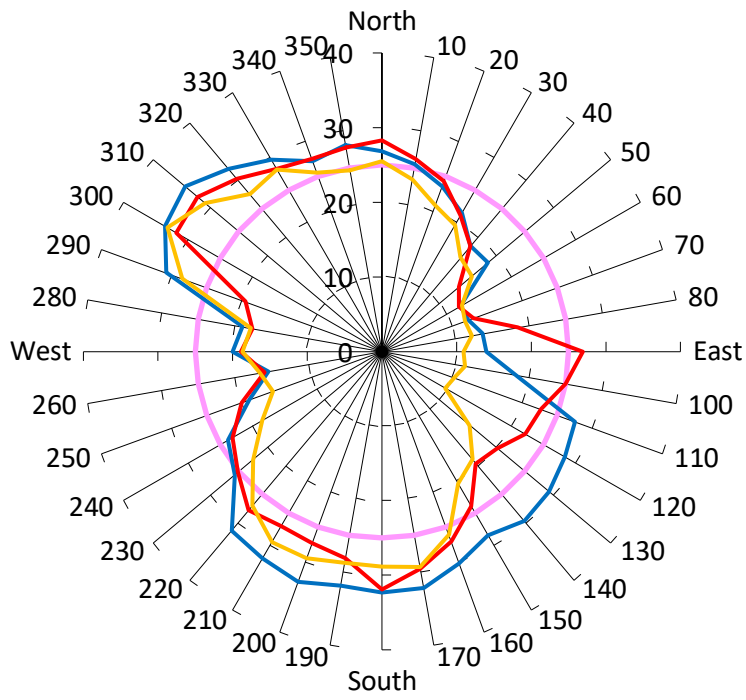
Results for P36

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

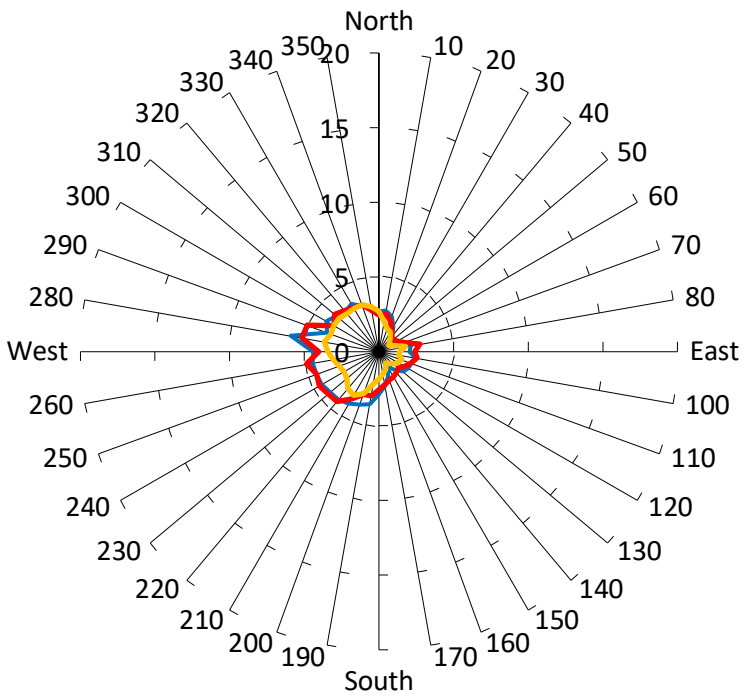


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	51%	34
With proposed development and future surrounds case. No vegetation or other treatments.	50%	32
WE191-07 Proposed Case with inclusion of treatments (rev0)	45%	33

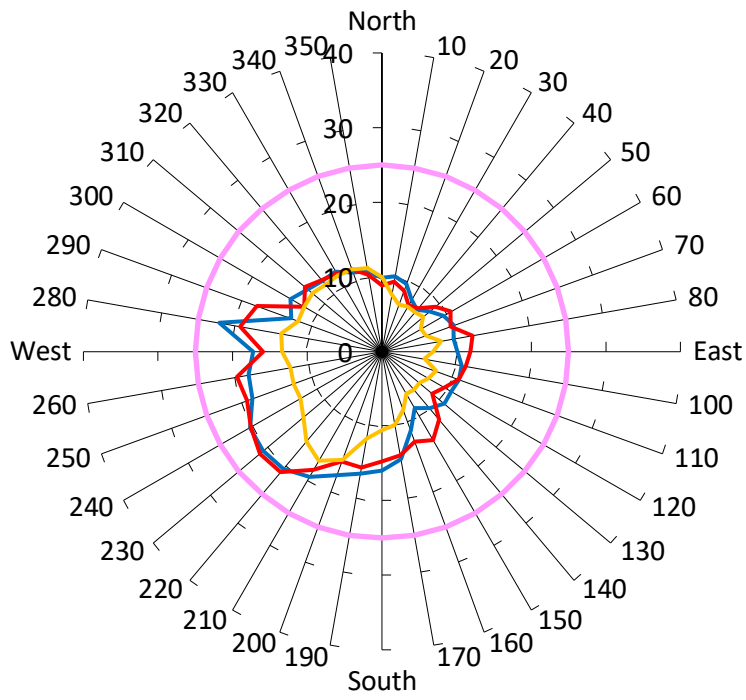
Results for P37

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

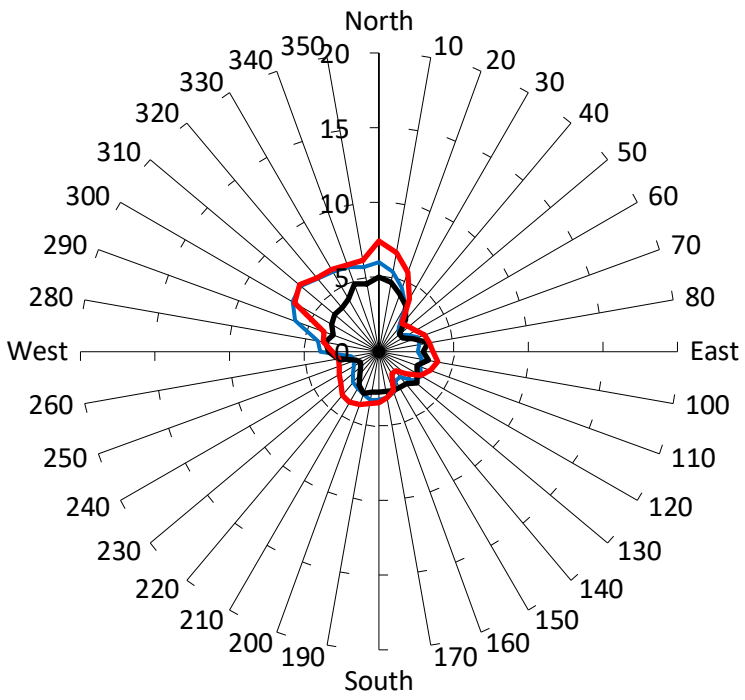


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	14%	22
With proposed development and future surrounds case. No vegetation or other treatments.	14%	21
WE191-07 Proposed Case with inclusion of treatments (rev0)	4%	17

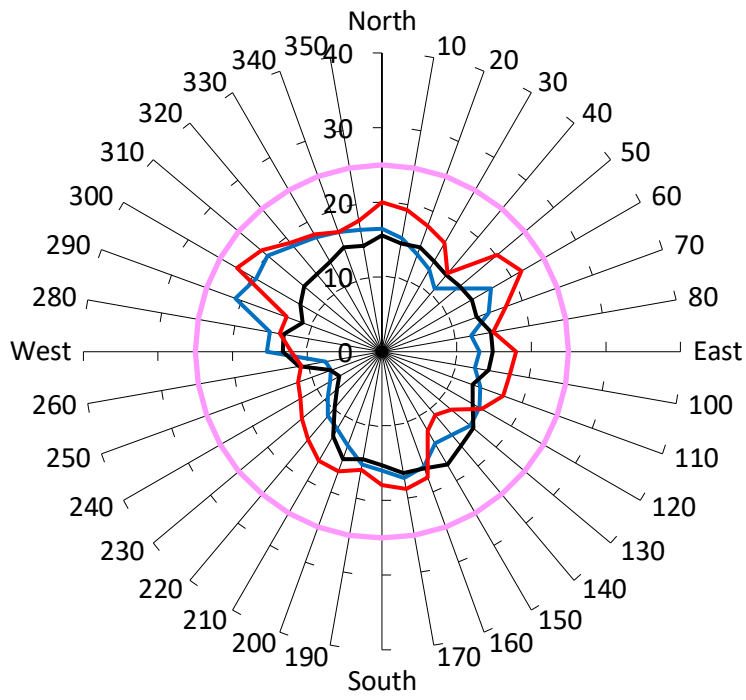
Results for P38

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

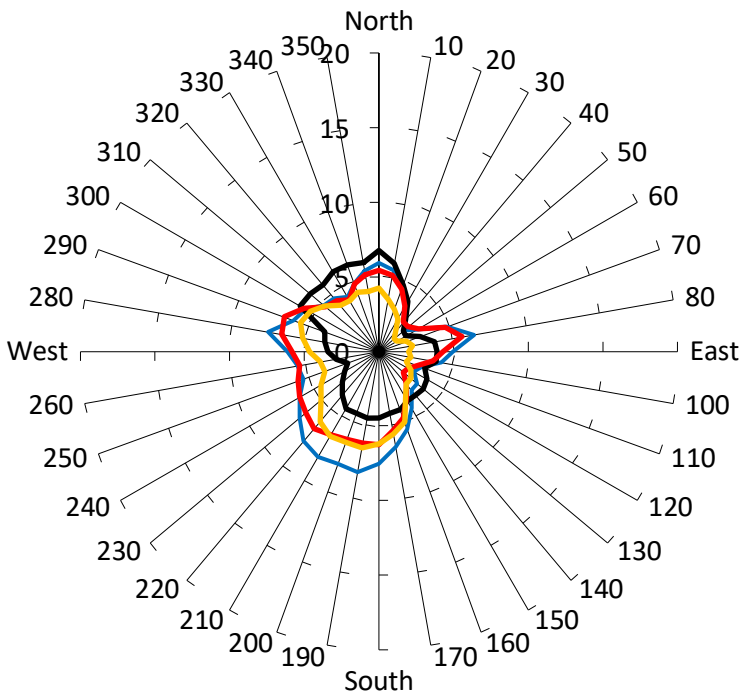


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	32%	21
Existing site conditions. No vegetation or other treatments.	13%	18
With proposed development and future surrounds case. No vegetation or other treatments.	35%	22

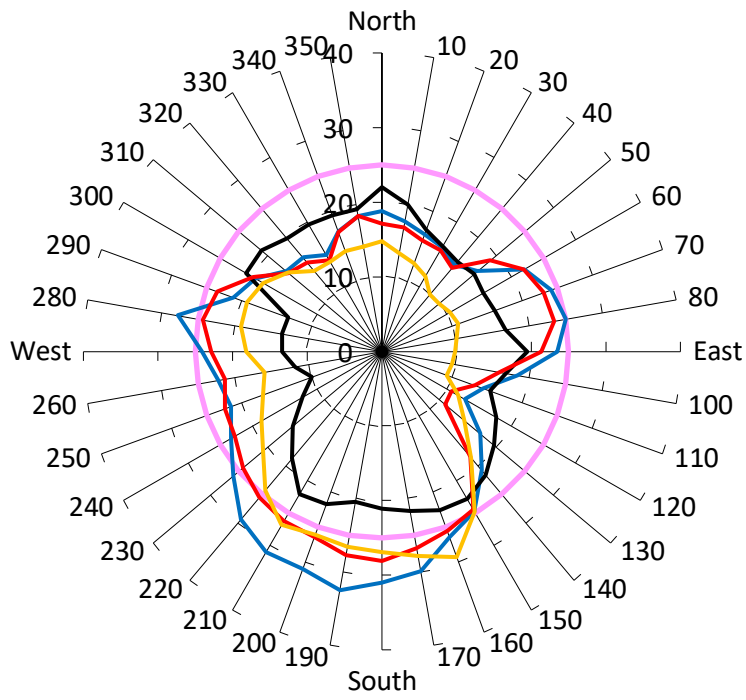
Results for P39

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

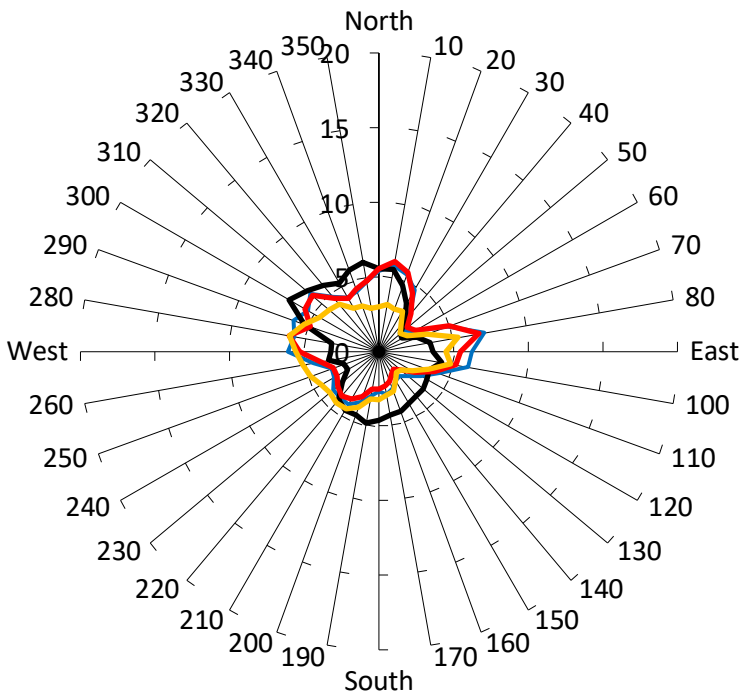


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	46%	33
Existing site conditions. No vegetation or other treatments.	37%	23
With proposed development and future surrounds case. No vegetation or other treatments.	43%	28
WE191-07 Proposed Case with inclusion of treatments (rev0)	28%	29

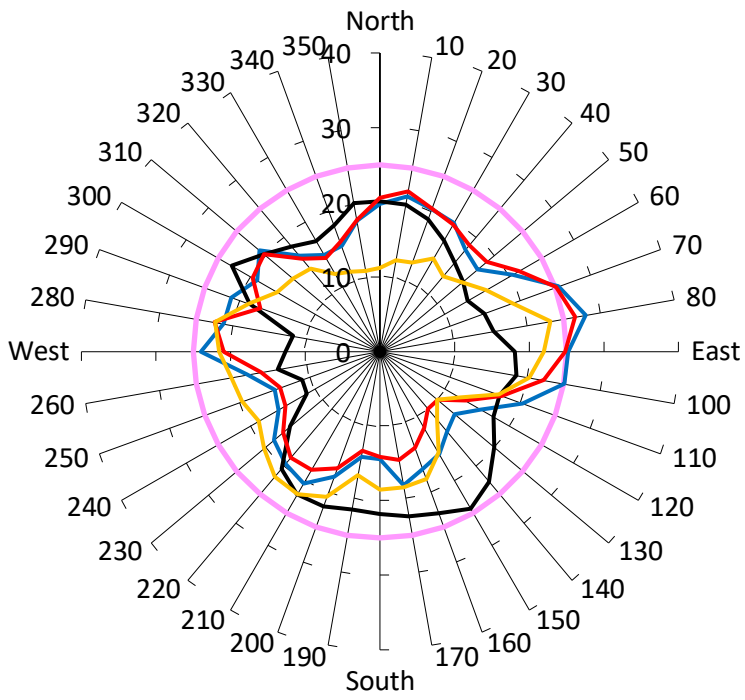
Results for P40

Gust Equivalent Mean (m/s)



Comfort Criteria: 5.5m/s with 20% probability of exceedence

Maximum Gust (m/s)

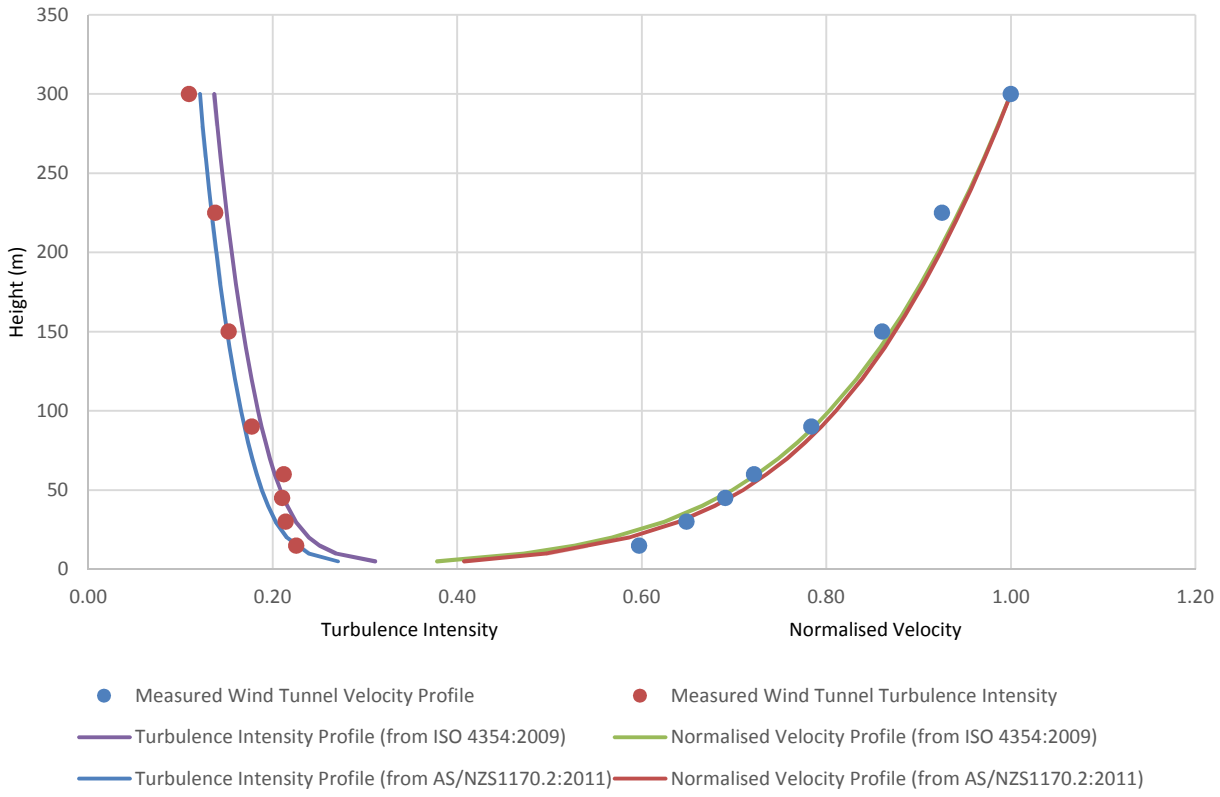


Safety Limit: 25m/s

Description	GEM Prob of Exceed %	Peak Gust m/s
Criterion: Walking Activities (20km/h, 5.5m/s). Safety Limit (90km/h, 25m/s).	20%	25
With proposed development and proposed surrounds case. No vegetation or other treatments.	35%	28
Existing site conditions. No vegetation or other treatments.	37%	24
With proposed development and future surrounds case. No vegetation or other treatments.	31%	27
WE191-07 Proposed Case with inclusion of treatments (rev0)	25%	23

APPENDIX D VELOCITY AND TURBULENCE INTENSITY PROFILES

Mean Velocity and Turbulence Intensity for Suburban/Forest Terrain (0.2m < z0 < 0.3m) (TC3) at a 1:300 Scale



Longitudinal Spectra Density for Suburban/Forest Terrain (0.2m < z0 < 0.3m) (TC3) at a 1:300 Scale