ENVIRONMENTAL WIND SPEED MEASUREMENTS ON A WIND TUNNEL MODEL OF THE FESTIVAL PLAZA TOWER 2, ADELAIDE

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SUMMARY

Wind tunnel tests have been conducted on a 1/400 scale model of the Proposed Festival Plaza Tower 2 Development, Adelaide. The model of the Development within surrounding buildings and with no existing or future street trees, was tested in a simulated upstream boundary layer of the natural wind to determine likely environmental wind conditions. These wind conditions have been related to the freestream mean wind speed at a reference height of 300m and compared with criteria developed for the Adelaide.

For the Proposed Configuration, wind conditions for most Test Locations in the streetscapes surrounding the development have been shown to pass the walking comfort criterion; with many Test Locations also passing the standing comfort criterion.

The wind conditions at certain Test Locations in the Adelaide Festival Plaza Precinct (Test Locations 24 and 31) have been shown to be above the walking comfort criterion. It is noted that the wind conditions for the Proposed Configuration have been shown to be comparable to those of the Existing Configuration at those test locations in the Adelaide Festival Plaza Precinct, indicating the Proposed Festival Plaza Tower 2 Development has no significant influence at these locales.

On the south side of the development (Test Locations 45 and 47) conditions were shown to also be above the walking comfort criterion and a 3m wide canopy would be required on the south side of the development to improve the wind conditions to pass the pedestrian safety and walking comfort criteria as a minimum. It is noted that such a canopy has already been considered and is shown in the current DA drawings.

The wind conditions at the designated outdoor dining areas associated with adjacent retail tenancies at ground level have been shown to improve significantly to achieve the

recommended sitting comfort criterion with the use of local screening around these areas for wind mitigation.

The wind conditions at the main entrances on ground level of the development have been shown to pass the standing comfort criterion, satisfying the suggested criterion for building entrances.

Solid wind break screens would be required at the main entrance on the podium at Level 1 (Test Location 58) in order to satisfy the recommended standing comfort wind conditions for building entrances.

The wind conditions on the proposed dining areas on the podium at Level 1 (Test Location 56) pass the standing comfort criterion and have been shown to benefit from the inclusion of an increase in the balustrade height adjacent to the proposed seating areas which allows the sitting comfort criterion to be satisfied. The conditions at the additional locations on this level (Test Locations 57, 59, 60 and 61) were shown to achieve the walking and standing comfort criteria. An improvement in the wind conditions at these locations would be expected to be realised with the use of additional screening, landscaping features and canopy elements (already shown on current drawings). Such mitigation measures should be developed and tested for effectiveness with further wind tunnel testing.

The wind conditions for the Proposed Configuration on the terrace at Level 4 have been shown to satisfy the standing comfort and pedestrian safety criteria.

The Existing Configuration wind conditions at a number of Test Locations have been included for comparison.

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ENVIRONMENTAL WIND SPEED MEASUREMENTS
FESTIVAL PLAZA TOWER 2 DEVELOPMENT, ADELAIDE

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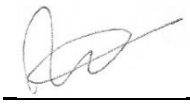

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1. INTRODUCTION

The proposed development at Adelaide Festival Plaza Precinct, Adelaide, will be an office building approximately 160m high and situated on the west side of King William Road, as shown in Figure 1.

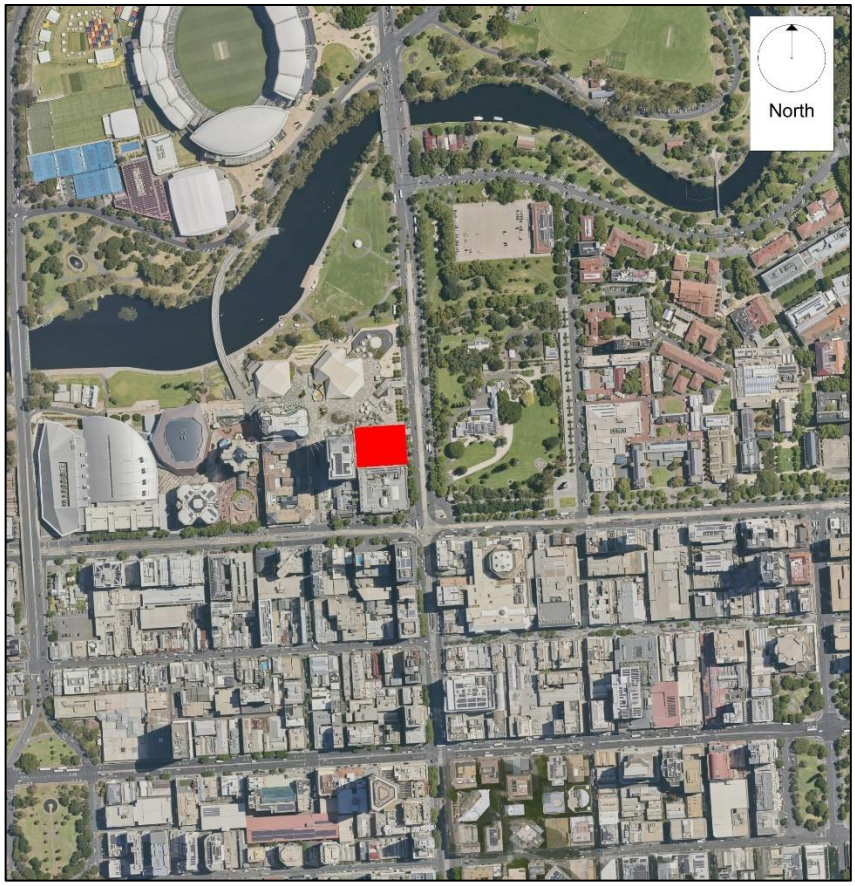

Figure 1: Location of the proposed development at Adelaide Festival Plaza Precinct in Adelaide.

A wind tunnel model study was commissioned by Walker Corporation to investigate the environmental wind effects of the proposed development and, if necessary, to develop wind amelioration features to achieve conditions satisfying the recommended environmental wind criteria. This study was undertaken in the MEL Consultants' 400kW Boundary Layer Wind Tunnel during March 2025.

2. ENVIRONMENTAL WIND CRITERIA

The advancement of wind tunnel testing techniques, using large boundary layer flows to simulate the natural wind, has facilitated the prediction of wind speeds likely to be induced around a development. To assess whether the predicted wind conditions are likely to be acceptable or not, some forms of criteria are required. The PlanSA Planning and Design Code does not recommend a particular set of criteria for pedestrian wind comfort or safety. In this study, the internationally recognised comfort and safety criteria specified in the Victorian Planning Schemes will be utilised and these criteria are defined as follows:

Unsafe wind conditions means the hourly maximum 3 second gust which exceeds 20 metres/second from any wind direction considering at least 16 wind directions with the corresponding probability of exceedance percentage.

Comfortable wind conditions means a mean wind speed from all wind directions combined with probability of exceedance less than 20% of the time, equal to or less than:

- 3 metres/second for **sitting areas**
    - Sitting criterion: generally acceptable for stationary, long exposure activities such as dining at outdoor restaurants or theatres.
- 4 metres/second for **standing areas**
    - Standing criterion: generally acceptable for stationary short exposure activities such as window shopping, standing or sitting in plazas.
- 5 metres/second for **walking areas**
    - Walking criterion: generally acceptable for walking in urban and suburban areas.

Mean wind speed means the maximum of:

- Hourly mean wind speed, or
- Gust equivalent mean wind speed (3 second gust wind speed divided by 1.85)

The above comfort criteria are pass/fail criteria which assess the integrated probability of all wind directions to determine whether a location passes or fails the threshold criterion. The safety criterion is a pass/fail criterion based upon exceedance of the wind speed for

any one wind direction. For completeness, this report will provide data for each Test Location as a function of wind direction in Appendix A.

The Victorian Planning Schemes do not provide any methodology or worked example as how to obtain the 'from all wind directions combined'. Therefore, to obtain the probability for all wind directions combined we will apply the methodology described in Melbourne (1978) to determine the probability for all wind directions. The Guidelines use the definition of mean wind speed as based on the hourly wind speed so the probabilities will be determined from the hourly wind data for an applicable automatic weather station for the City of Adelaide (Adelaide Airport). The probability data used have been corrected for the approach terrain at the location of the automatic weather station and referenced to 10m in Terrain Category 2. This is the standard reference height of AS/NZS1170.2:2021.

2.1 Suggested Pedestrian Comfort Criteria.

The Proposed Festival Plaza Tower 2 Development will be mainly an office building with retail stores at ground level and a terrace at Level 4. The main entrances will be on the north and west sides of the development.

The following wind criteria are suggested for the surrounding streetscapes:

- Pedestrian transit areas — Walking Comfort Criterion
- Building/Tenancy entrances — Standing Comfort Criterion
- Outdoor Terraces — Walking Comfort Criterion*
- Outdoor Seating area (e.g café) — Sitting Comfort Criterion

* The wind conditions on terraces have been recommended to satisfy the walking comfort criterion as these spaces could be considered elective when external wind conditions would be perceived as acceptable for the desired activity.

The activation of the public realm external to the site would depend on the existing wind conditions in the streetscapes that are often beyond the control of the proposed development. For cases where the existing wind conditions in the public realm external to the site are on or above the walking criterion, then the proposed development should not have any adverse wind effects in these areas.

All locations must satisfy the pedestrian safety criterion.

3. MODEL AND EXPERIMENTAL TECHNIQUES

A 1/400 scale model of the Proposed Festival Plaza Tower 2 Development was constructed from digital information provided by JPW and received up to 24th February 2025.

The scale model of the Development was inserted into a proximity model with significant surrounding buildings, including any under construction out to a minimum radius of 300m. The building model was tested in a model of the natural wind generated by flow over roughness elements augmented by vorticity generators at the beginning of the wind tunnel working section. The basic natural wind model was for flow over suburban terrain roughness, terrain category 3, as shown in Figure 2. The surrounding wind tunnel model modified the approach wind model for the presence of the surrounding buildings.

The techniques used to investigate the environmental wind conditions and the method of determining the local criteria are given in detail in Reference 2. In these tests measurements in the Development areas are inside separated regions and peak velocity squared ratios were required to make conclusions about likely wind conditions. In summary, measurements were made of the peak gust wind velocity with a hot wire anemometer at various stations and expressed as a squared ratio with the mean wind velocity at a scaled reference height of 300m. This gives the peak velocity squared ratio

$$\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$$

Wind tunnel velocity measurements were made for an equivalent 1 hour period in full scale and filtered to provide an equivalent full scale 3 second gust wind speed. Photographs of the model as tested in the wind tunnel are shown in Figures 3 and 4.

4. DISCUSSION OF RESULTS

Velocity measurements were made at various locations around the Proposed Festival Plaza Tower 2 Development for different wind directions at 22.5° intervals. As discussed in Section 2, the Victorian Planning Schemes wind comfort criteria are pass/fail criteria based on an assessment of the probability for all wind directions combined. The wind comfort criteria for sitting, standing and walking are given in percentage for which a given mean wind speed is exceeded. A test location will pass the sitting, standing and walking criteria if the percentage for which a given mean wind speed is exceeded is below 20%. Therefore, to assess the wind conditions the exceedances will be presented in tabular form in Tables 1 – 8 and colour coded; green for below 20% exceedance, orange for above 20% exceedance and green or red for passing/failing the safety criterion respectively. For completeness these data are also provided in Appendix A as a function of wind direction and compared with the pedestrian criteria for gust wind speeds.

The Proposed Configuration, is as outlined in the digital information provided by JPW and received up to 24th February 2025. The Existing Configuration is defined as the current vacant site. This study did not include or rely on existing or proposed street trees for wind mitigation. The Test Locations for the Proposed Festival Plaza Tower 2 Development are shown in Figures 5a to 5c. The ground level Test Locations are in accordance with the minimum investigation radius required by the Australian Wind Engineering Society Guidelines. The following Sections detail the results for the various areas tested.

4.1 Summary of Discussion

A summary of wind comfort criteria satisfied at each Test Location in the surrounding streetscapes, on the podium at Level 1 and on the terrace at Level 4 have been summarised using a colour code system in the following figures:

- Figures 6 Existing Configuration
- Figures 7a to 7c Proposed Configuration
- Figures 8a and 8b Proposed Configuration with wind mitigation strategies

Different colours have been used to represent the wind criteria achieved at the respective Test Locations.

4.2. King William Road

The wind conditions for the Proposed Configuration along King William Road (Test Locations 1-13) have been shown to pass the walking comfort criterion as a minimum. The criteria achieved at these Test Locations have been presented in Table 1 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A2 to A5). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 1: Pedestrian Wind Comfort and Safety – King William Road

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s)	Standing (4m/s)	Walking (5m/s)					
		%	%	%	m/s		Pass/Fail	m/s	Pass/Fail
1	Proposed Configuration	23.4%	7.4%	1.7%	3.2	Walking	Pass	11.6	Pass
	Existing Configuration	25.4%	9.9%	2.9%	3.3	Walking	Pass	12.5	Pass
2	Proposed Configuration	28.6%	11.9%	3.9%	3.5	Walking	Pass	14.0	Pass
	Existing Configuration	27.3%	11.8%	4.3%	3.4	Walking	Pass	12.3	Pass
3	Proposed Configuration	34.7%	16.9%	6.9%	3.8	Walking	Pass	14.8	Pass
	Existing Configuration	30.2%	13.8%	5.7%	3.5	Walking	Pass	14.2	Pass
4	Proposed Configuration	18.7%	5.7%	1.3%	2.9	Walking	Pass	11.3	Pass
	Existing Configuration	20.5%	7.6%	2.4%	3.0	Walking	Pass	13.4	Pass
5	Proposed Configuration	35.5%	19.3%	9.2%	4.0	Walking	Pass	17.5	Pass
	Existing Configuration	26.0%	12.3%	4.7%	3.4	Walking	Pass	14.2	Pass
6	Proposed Configuration	45.3%	26.8%	13.8%	4.5	Walking	Pass	16.3	Pass
	Existing Configuration	31.8%	15.0%	5.9%	3.7	Walking	Pass	14.9	Pass
7	Proposed Configuration	46.3%	28.4%	15.9%	4.6	Walking	Pass	19.6	Pass
	Existing Configuration	22.6%	9.1%	2.9%	3.2	Walking	Pass	12.2	Pass
8	Proposed Configuration	42.9%	27.3%	17.4%	4.7	Walking	Pass	17.0	Pass
	Existing Configuration	30.0%	15.6%	7.4%	3.6	Walking	Pass	14.9	Pass
9	Proposed Configuration	49.4%	31.1%	17.7%	4.8	Walking	Pass	16.5	Pass
	Existing Configuration	35.8%	20.3%	10.5%	4.0	Walking	Pass	15.8	Pass
10	Proposed Configuration	37.2%	20.9%	11.3%	4.1	Walking	Pass	15.5	Pass
	Existing Configuration	27.5%	13.3%	5.6%	3.4	Walking	Pass	13.6	Pass
11	Proposed Configuration	39.8%	21.3%	10.9%	4.1	Walking	Pass	17.0	Pass
	Existing Configuration	27.7%	12.9%	5.6%	3.4	Walking	Pass	13.1	Pass
12	Proposed Configuration	25.8%	11.0%	3.6%	3.3	Walking	Pass	13.5	Pass
	Existing Configuration	23.0%	8.6%	2.2%	3.2	Walking	Pass	11.7	Pass
13	Proposed Configuration	19.9%	8.6%	3.4%	3.0	Walking	Pass	12.8	Pass
	Existing Configuration	17.2%	5.8%	1.8%	2.9	Walking	Pass	10.9	Pass

4.3. North Terrace

The wind conditions for the Proposed Configuration along North Terrace (Test Locations 14-19) have been shown to pass the walking comfort criterion; with many test Locations also passing the standing comfort criterion. The criteria achieved at these Test Locations have been presented in Table 2 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A6 and A7). It is noted that at the Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 2: Pedestrian Wind Comfort and Safety – North Terrace

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s) %	Standing (4m/s) %	Walking (5m/s) %	m/s		Pass/Fail	m/s	Pass/Fail
14	Proposed Configuration	42.2%	24.7%	12.8%	4.3	Walking	Pass	14.9	Pass
	Existing Configuration	33.2%	16.9%	7.8%	3.8	Walking	Pass	13.1	Pass
15	Proposed Configuration	21.7%	7.8%	2.5%	3.1	Walking	Pass	11.1	Pass
	Existing Configuration	16.8%	4.5%	0.9%	2.8	Walking	Pass	9.5	Pass
16	Proposed Configuration	15.3%	4.4%	0.9%	2.7	Walking	Pass	9.8	Pass
	Existing Configuration	15.9%	4.5%	0.9%	2.8	Walking	Pass	9.5	Pass
17	Proposed Configuration	33.7%	15.0%	5.9%	3.7	Walking	Pass	14.7	Pass
	Existing Configuration	30.7%	14.2%	6.2%	3.6	Walking	Pass	14.1	Pass
18	Proposed Configuration	29.9%	12.1%	4.3%	3.5	Walking	Pass	14.6	Pass
	Existing Configuration	28.5%	10.8%	3.2%	3.4	Walking	Pass	12.4	Pass
19	Proposed Configuration	23.7%	10.9%	4.5%	3.2	Walking	Pass	14.5	Pass
	Existing Configuration	22.8%	10.6%	4.3%	3.2	Walking	Pass	14.8	Pass

4.4. Station Road

The wind conditions for the Proposed Configuration along Station Road (Test Locations 20-23) have been shown to pass the walking comfort criterion. The wind conditions have been shown to be similar to those of the Existing Configuration, indicating the Proposed Festival Plaza Tower 2 Development has little adverse impact on wind conditions along this street. The criteria achieved at these Test Locations have been presented in Table 3 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figure A8). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 3: Pedestrian Wind Comfort and Safety – Station Road

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s) %	Standing (4m/s) %	Walking (5m/s) %	m/s		Pass/Fail	m/s	Pass/Fail
20	**Proposed Configuration**	51.1%	32.5%	18.1%	4.9	Walking	Pass	18.2	Pass
	Existing Configuration	50.1%	30.8%	16.7%	4.7	Walking	Pass	19.0	Pass
21	**Proposed Configuration**	49.1%	29.0%	15.4%	4.6	Walking	Pass	15.5	Pass
	Existing Configuration	45.9%	25.6%	12.8%	4.4	Walking	Pass	16.8	Pass
22	**Proposed Configuration**	49.0%	29.7%	16.0%	4.7	Walking	Pass	17.9	Pass
	Existing Configuration	46.6%	28.4%	15.8%	4.6	Walking	Pass	16.8	Pass
23	**Proposed Configuration**	38.1%	20.5%	11.1%	4.0	Walking	Pass	16.2	Pass
	Existing Configuration	39.6%	21.5%	11.4%	4.1	Walking	Pass	15.3	Pass

4.5. Adelaide Festival Plaza Precinct

The wind conditions for the Proposed Configuration in the Adelaide Festival Plaza Precinct (Test Locations 24-38) have been shown to pass the walking comfort criterion, with the exception of Test Locations 24 and 31 which have been shown to exceed the walking comfort criterion and with conditions at Test Location 31 failing the pedestrian safety criterion. Wind mitigation measures for these locations are currently being reviewed and developed by Walker in a separate exercise.

It is noted that the wind conditions have been shown to be comparable to the Existing Configuration at these test locations, indicating the Proposed Festival Plaza Tower 2 Development has no significant influence at these locales. The criteria achieved at these Test Locations have been presented in Table 4 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A9 to A12). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 4: Pedestrian Wind Comfort and Safety – Adelaide Festival Plaza Precinct

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s) %	Standing (4m/s) %	Walking (5m/s) %	m/s		Pass/Fail	m/s	Pass/Fail
24	Proposed Configuration	55.4%	37.6%	23.8%	5.4	Walking	Fail	16.7	Pass
	Existing Configuration	56.9%	38.9%	24.8%	5.4	Walking	Fail	17.7	Pass
25	Proposed Configuration	46.2%	30.2%	17.8%	4.8	Walking	Pass	17.4	Pass
	Existing Configuration	49.4%	31.2%	17.7%	4.8	Walking	Pass	17.3	Pass
26	Proposed Configuration	34.4%	17.3%	7.2%	3.8	Walking	Pass	14.2	Pass
	Existing Configuration	35.0%	18.0%	7.7%	3.9	Walking	Pass	14.6	Pass
27	Proposed Configuration	27.7%	11.8%	4.9%	3.4	Walking	Pass	15.8	Pass
	Existing Configuration	25.8%	11.2%	4.9%	3.3	Walking	Pass	14.8	Pass
28	Proposed Configuration	33.0%	15.3%	6.7%	3.7	Walking	Pass	15.2	Pass
	Existing Configuration	36.9%	18.5%	8.7%	3.9	Walking	Pass	17.0	Pass
29	Proposed Configuration	39.9%	21.0%	9.3%	4.1	Walking	Pass	15.7	Pass
	Existing Configuration	40.7%	22.8%	11.3%	4.2	Walking	Pass	16.3	Pass
30	Proposed Configuration	43.2%	25.1%	13.0%	4.4	Walking	Pass	18.0	Pass
	Existing Configuration	45.6%	28.1%	15.3%	4.6	Walking	Pass	17.2	Pass
31	Proposed Configuration	46.4%	29.1%	16.8%	4.7	Standing	Fail	21.7	Fail
	Existing Configuration	54.7%	37.7%	24.5%	5.4	Walking	Fail	22.7	Fail
32	Proposed Configuration	44.8%	27.7%	15.2%	4.6	Walking	Pass	19.9	Pass
	Existing Configuration	41.0%	22.2%	10.4%	4.1	Walking	Pass	15.9	Pass
33	Proposed Configuration	48.1%	29.6%	16.5%	4.7	Walking	Pass	19.6	Pass
	Existing Configuration	46.4%	28.6%	15.4%	4.6	Walking	Pass	19.0	Pass
34	Proposed Configuration	46.7%	28.3%	16.9%	4.7	Walking	Pass	19.4	Pass
	Existing Configuration	42.5%	25.5%	14.8%	4.5	Walking	Pass	18.4	Pass
35	Proposed Configuration	40.7%	22.6%	11.8%	4.2	Walking	Pass	19.4	Pass
	Existing Configuration	30.3%	12.6%	4.3%	3.5	Walking	Pass	13.0	Pass
36	Proposed Configuration	32.9%	16.7%	6.9%	3.8	Walking	Pass	15.1	Pass
	Existing Configuration	31.4%	13.9%	4.7%	3.6	Walking	Pass	14.1	Pass
37	Proposed Configuration	38.1%	21.7%	11.6%	4.1	Walking	Pass	18.6	Pass
	Existing Configuration	20.3%	7.2%	2.2%	3.0	Walking	Pass	13.9	Pass
38	Proposed Configuration	49.3%	30.9%	17.0%	4.8	Walking	Pass	18.3	Pass
	Existing Configuration	39.2%	21.8%	10.6%	4.1	Walking	Pass	16.8	Pass

4.6. Adjacent to the development

The wind conditions for the Proposed Configuration at Test Locations adjacent to development (Test Locations 34-40), have been shown to pass the walking comfort criterion as a minimum, with the exception of Test Locations 45 and 47 which have been shown to fail the walking comfort and pedestrian safety criteria respectively. However, it has been demonstrated that incorporating a 3m wide canopy in the design at the south east corner of the development (Refer to green canopy in Figure 8a) would improve the wind conditions significantly at Test Locations 45 to achieve the walking comfort. Additionally, an extension of this canopy along the laneway, as shown by the purple canopy in Figure 8a, provides mitigation of the wind conditions at Test Location 47 to achieve the standing comfort criterion. Such a canopy has already been considered and is represented in the DA drawings.

At potential locations for outdoor seating (Test Locations 40, 41, 47 and 49), the use of local screening (solid, and of typical height of 1.5m) around these areas for wind mitigation would be effective in achieving the sitting comfort criterion thereby satisfying the recommended wind conditions for outdoor seating.

The criteria achieved at these Test Locations have been presented in Table 5 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A13 to A15). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 5: Pedestrian Wind Comfort and Safety – Adjacent to development

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s) %	Standing (4m/s) %	Walking (5m/s) %	m/s		Pass/Fail	m/s	Pass/Fail
39	Proposed Configuration	34.5%	16.7%	7.3%	3.8	Walking	Pass	15.7	Pass
	Existing Configuration	40.7%	21.4%	9.5%	4.1	Walking	Pass	15.6	Pass
40	Proposed Configuration	45.4%	25.6%	12.8%	4.4	Sitting	Fail	16.5	Pass
41	Proposed Configuration	27.3%	13.4%	6.7%	3.4	Sitting	Fail	15.3	Pass
42	Proposed Configuration	28.1%	15.0%	8.3%	3.5	Standing	Pass	16.6	Pass
43	Proposed Configuration	33.1%	17.0%	8.7%	3.8	Walking	Pass	16.0	Pass
	Existing Configuration	25.4%	11.6%	4.2%	3.3	Walking	Pass	12.1	Pass
44	Proposed Configuration	23.9%	11.1%	4.5%	3.2	Standing	Pass	14.3	Pass
45	Proposed Configuration	58.3%	41.0%	27.2%	5.7	Walking	Fail	19.9	Pass
	Existing Configuration	33.1%	16.7%	7.2%	3.8	Walking	Pass	14.1	Pass
	with 3m wide canopy	48.2%	28.6%	14.7%	4.6	Walking	Pass	16.7	Pass
46	Proposed Configuration	27.5%	15.1%	8.6%	3.5	Standing	Pass	19.5	Pass
	Existing Configuration	27.1%	10.2%	3.0%	3.3	Walking	Pass	11.8	Pass
47	Proposed Configuration	50.5%	31.2%	18.3%	4.8	Walking	Pass	18.9	Pass
	with 3m wide canopy	33.7%	16.5%	6.4%	3.8	Walking	Pass	13.7	Pass
48	Proposed Configuration	40.4%	22.2%	10.7%	4.2	Walking	Pass	13.9	Pass
	Existing Configuration	18.2%	6.6%	2.5%	2.9	Walking	Pass	14.4	Pass
49	Proposed Configuration	42.6%	24.8%	12.4%	4.3	Sitting	Fail	14.3	Pass

4.7. Neighbouring Premises

The wind conditions for the Proposed Configuration in the Neighbouring Premises (Test Locations 50-55), have been shown to pass the walking comfort criterion as a minimum. The criteria achieved at these Test Locations have been presented in Table 6 as well as the data for the Existing Configuration.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A16 and A17). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 6: Pedestrian Wind Comfort and Safety – Neighbouring Premises

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s)	Standing (4m/s)	Walking (5m/s)					
		%	%	%	m/s		Pass/Fail	m/s	Pass/Fail
50	**Proposed Configuration**	25.6%	10.9%	4.2%	3.3	Walking	Pass	12.2	Pass
	Existing Configuration	33.1%	15.5%	6.5%	3.7	Walking	Pass	14.2	Pass
51	**Proposed Configuration**	31.9%	14.7%	5.3%	3.6	Walking	Pass	14.6	Pass
	Existing Configuration	36.6%	15.9%	5.4%	3.8	Walking	Pass	14.6	Pass
52	**Proposed Configuration**	39.7%	22.7%	11.8%	4.2	Walking	Pass	15.8	Pass
	Existing Configuration	35.3%	18.5%	8.6%	3.9	Walking	Pass	14.2	Pass
53	**Proposed Configuration**	24.4%	10.1%	3.2%	3.2	Walking	Pass	12.0	Pass
	Existing Configuration	20.7%	8.3%	2.5%	3.0	Walking	Pass	11.7	Pass
54	**Proposed Configuration**	41.3%	26.1%	15.5%	4.5	Walking	Pass	17.3	Pass
	Existing Configuration	29.6%	15.9%	7.4%	3.6	Walking	Pass	14.6	Pass
55	**Proposed Configuration**	29.7%	15.6%	7.6%	3.6	Standing	Pass	14.5	Pass
	Existing Configuration	28.0%	12.6%	4.5%	3.5	Walking	Pass	13.1	Pass

4.9. Podium at Level 1

The wind conditions for the Proposed Configuration on the podium at Level 1 (Test Locations 56-61), have been shown to pass the walking comfort criterion as a minimum. However, the drawings indicated potential locations for outdoor seating at Test Location 56 and a main entrance at Test Location 58. Therefore, it has been demonstrated that solid screens near Test Locations 56 and 58 (Refer Figure 8b) would be effective in achieving the sitting comfort criterion thereby satisfying the recommended wind conditions for outdoor seating and building entrance. The criteria achieved at these Test Locations have been presented in Table 7.

The conditions at the additional location on the level (Test Locations 59 – 61) were shown to achieve the walking and standing comfort criteria. Should an improvement in the wind conditions at these locations be required, then additional screening, landscaping features and canopy elements (already shown on current drawings) would be expected to provide a beneficial mitigation effect. Such mitigation measures should be developed and tested for effectiveness with further wind tunnel testing.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figures A18 and A19). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 7: Pedestrian Wind Comfort and Safety – Podium at Level 1

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s) %	Standing (4m/s) %	Walking (5m/s) %	m/s		Pass/Fail	m/s	Pass/Fail
56	**Proposed Configuration**	23.8%	9.0%	3.3%	3.2	Sitting	Fail	14.9	Pass
	with solid screen	16.4%	5.9%	2.2%	2.8	Sitting	Pass	13.8	Pass
57	**Proposed Configuration**	53.3%	33.6%	19.1%	4.9	Walking	Pass	15.8	Pass
58	**Proposed Configuration**	46.2%	27.6%	14.5%	4.5	Standing	Fail	14.8	Pass
	with solid screen	16.0%	5.3%	1.0%	2.7	Standing	Pass	9.4	Pass
59	**Proposed Configuration**	45.3%	25.0%	12.3%	4.3	Walking	Pass	15.0	Pass
60	**Proposed Configuration**	41.3%	20.7%	8.4%	4.0	Walking	Pass	14.3	Pass
61	**Proposed Configuration**	27.5%	11.0%	3.7%	3.4	Walking	Pass	12.3	Pass

4.10. Terrace at Level 4

The wind conditions for the Proposed Configuration on the Terrace at Level 4 (Test Locations T1-T3) have been shown to pass the standing comfort criterion as a minimum, with Test Location T2 also passing sitting comfort criterion. The criteria achieved at these Test Locations have been presented in Table 8.

The wind conditions as a function of wind direction based on the gust criteria developed for Adelaide are presented in Appendix A (Figure A20). It is noted that at each Test Location the directional specific wind conditions may be higher than those of the tabulated results for certain incident wind directions.

Table 8: Pedestrian Wind Comfort and Safety – Terrace at Level 4

Configuration		Wind Criteria							
		Comfort						Safety	
		Yearly exceedence of given wind speed			Mean wind speed (exceeded 20% of year)	Recommended criterion	Result (compared against Recommended criterion)	Peak wind speed (of all wind directions)	Result (compared against Safety wind speed of 20m/s)
		Sitting (3m/s)	Standing (4m/s)	Walking (5m/s)					
		%	%	%	m/s		Pass/Fail	m/s	Pass/Fail
T1	**Proposed Configuration**	34.9%	18.3%	8.8%	3.9	Walking	Pass	14.0	Pass
T2	**Proposed Configuration**	15.8%	8.8%	4.5%	2.6	Walking	Pass	13.5	Pass
T3	**Proposed Configuration**	26.4%	13.9%	7.2%	3.4	Walking	Pass	13.1	Pass

5. CONCLUSIONS

Wind tunnel tests have been conducted on a 1/400 scale model of the Proposed Festival Plaza Tower 2 Development, Adelaide. The model of the Development within surrounding buildings and with no existing or future street trees, was tested in a simulated upstream boundary layer of the natural wind to determine likely environmental wind conditions. These wind conditions have been related to the freestream mean wind speed at a reference height of 300m and compared with criteria developed for the Adelaide.

For the Proposed Configuration, wind conditions for most Test Locations in the streetscapes surrounding the development have been shown to pass the walking comfort criterion; with many Test Locations also passing the standing comfort criterion.

The wind conditions at certain Test Locations in the Adelaide Festival Plaza Precinct (Test Locations 24 and 31) have been shown to be above the walking comfort criterion. It is noted that the wind conditions for have been shown to be comparable to the Existing Configuration at those test locations in the Adelaide Festival Plaza Precinct, indicating the Proposed Festival Plaza Tower 2 Development has no significant influence at these locales.

On the south side of the development (Test Locations 45 and 47) conditions were shown to also be above the walking comfort criterion and a 3m wide canopy would be required on the south side of the development to improve the wind conditions to pass the pedestrian safety and walking comfort criteria as a minimum. It is noted that such a canopy has already been considered and is shown in the current DA drawings.

The wind conditions at the designated outdoor dining areas associated with adjacent retail tenancies at ground level have been shown to improve significantly to achieve the recommended sitting comfort criterion with the use of local screening around these areas for wind mitigation.

The wind conditions at the main entrances on ground level of the development have been shown to pass the standing comfort criterion, satisfying the suggested criterion for building entrances.

Solid wind break screens would be required at the main entrance on the podium at Level 1 (Test Location 58) in order to satisfy the recommended standing comfort wind conditions for building entrances.

The wind conditions on the proposed dining areas on the podium at Level 1 (Test Location 56) pass the standing comfort criterion and have been shown to benefit from the inclusion of an increase in the balustrade height adjacent to the proposed seating areas which allows the sitting comfort criterion to be satisfied. The conditions at the additional locations on this level (Test Locations 57, 59, 60 and 61) were shown to achieve the walking and standing comfort criteria. An improvement in the wind conditions at these locations would be expected to be realised with the use of additional screening, landscaping features and canopy elements (already shown on current drawings). Such mitigation measures should be developed and tested for effectiveness with further wind tunnel testing.

The wind conditions for the Proposed Configuration on the terrace at Level 4 have been shown to satisfy the standing comfort and pedestrian safety criteria.

The Existing Configuration wind conditions at a number of Test Locations have been included for comparison.

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MEL Consultants Pty Ltd

J. Kostas
MEL Consultants Pty Ltd

6. REFERENCES

1. W. H. Melbourne, Criteria for environmental wind conditions, Journal of Industrial Aerodynamics, Volume 3, 1978, pp. 241-249
2. W. H. Melbourne, Wind environment studies in Australia, Journal of Industrial Aerodynamics, Volume 3, 1978, pp. 201-214

FIGURES

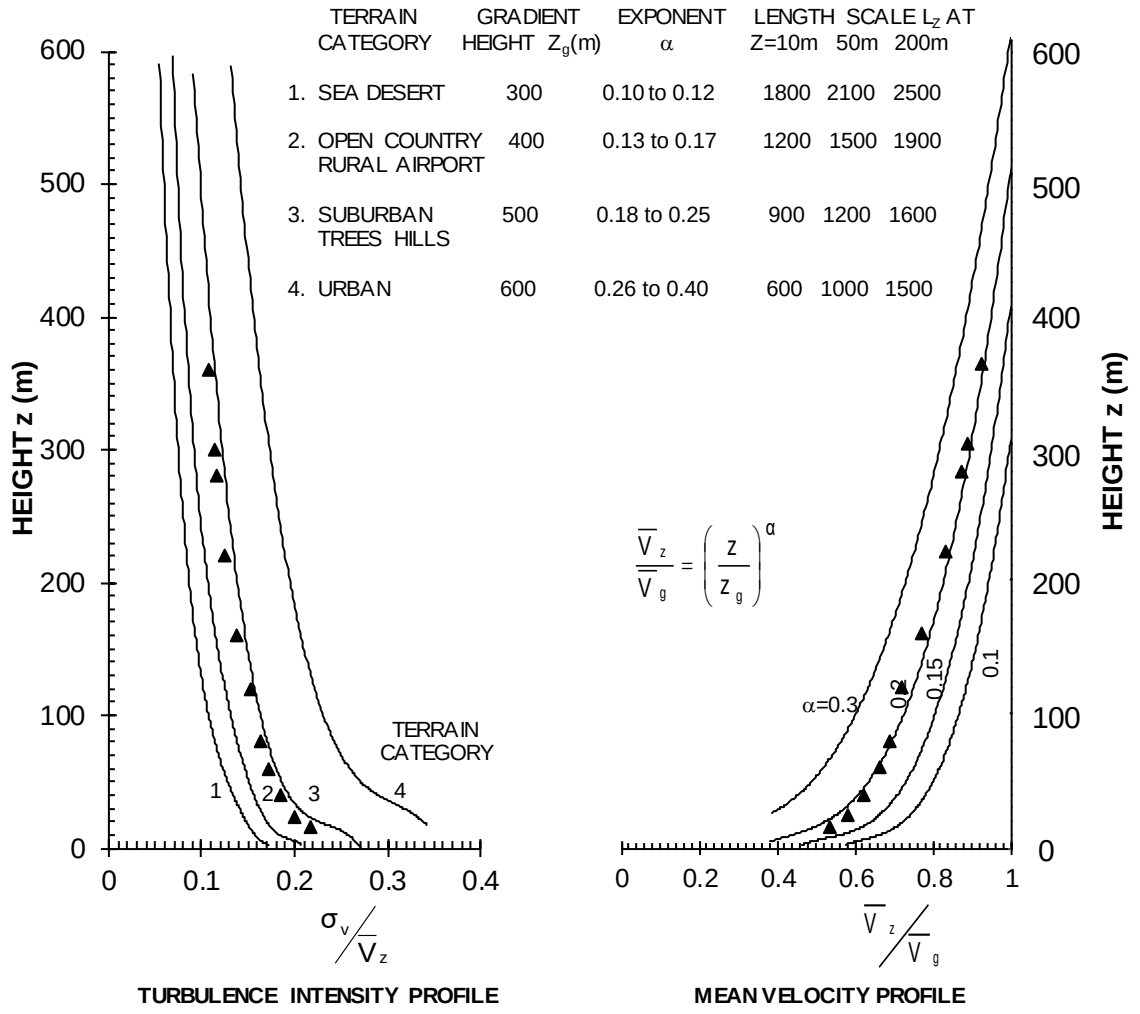


Figure 2 - 1/400 scale TC3 boundary layer turbulence intensity and mean velocity profiles and spectra in the MEL Consultants Boundary Layer Wind Tunnel 5m x 2.4m working section, scaled to full scale dimensions

Figure 3 – Close-up view from the southeast of the 1/400 scale Proposed Festival Plaza Tower 2 Development in the wind tunnel

Figure 4 – View from the northwest of the 1/400 scale Proposed Festival Plaza Tower 2 Development in the wind tunnel.

Figure 5a - Test Locations in the surrounding streetscapes for the Proposed Festival Plaza Tower 2 Development.

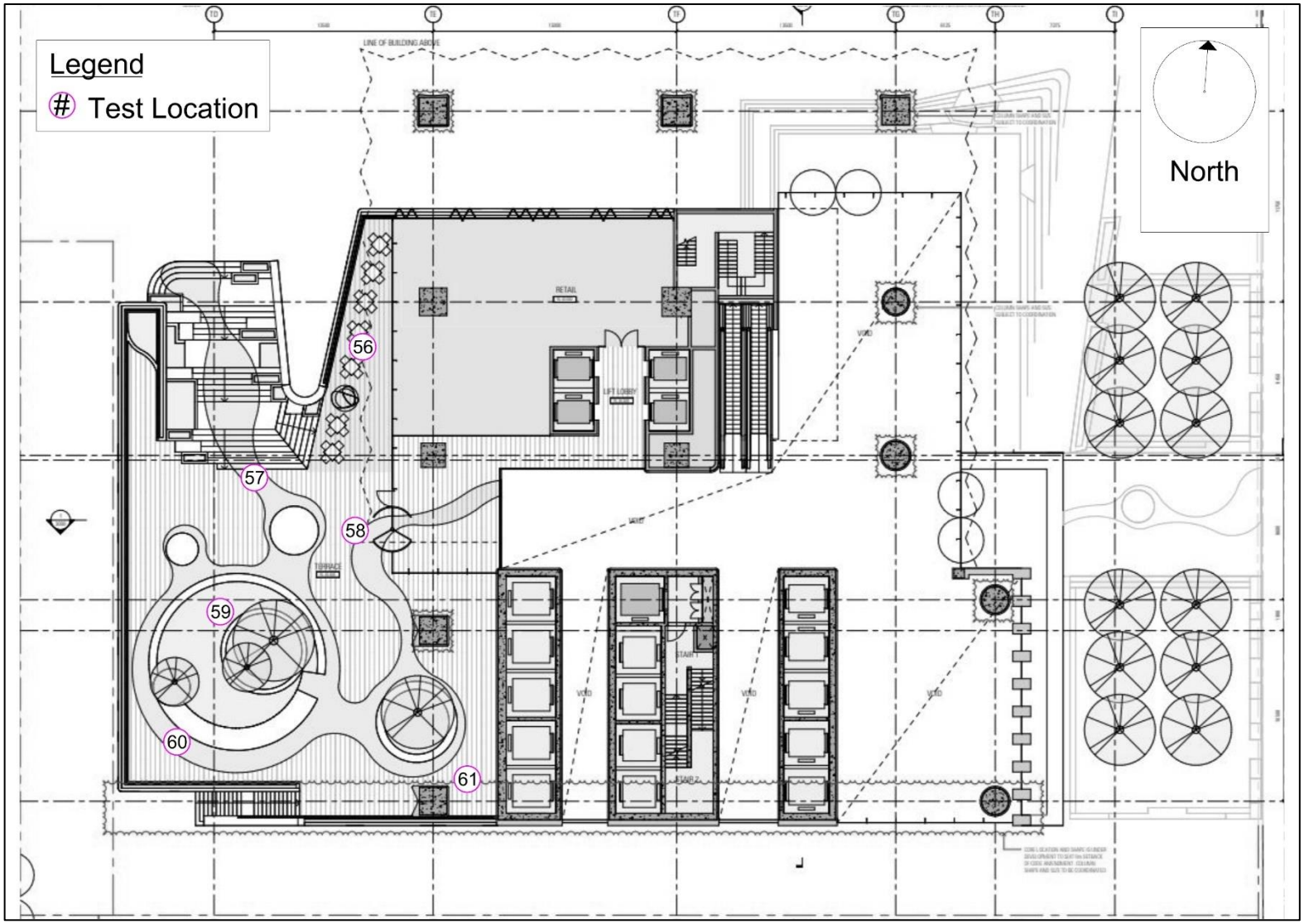


Figure 5b - Test Locations on the podium at Level 1 of the Proposed Festival Plaza Tower 2 Development.

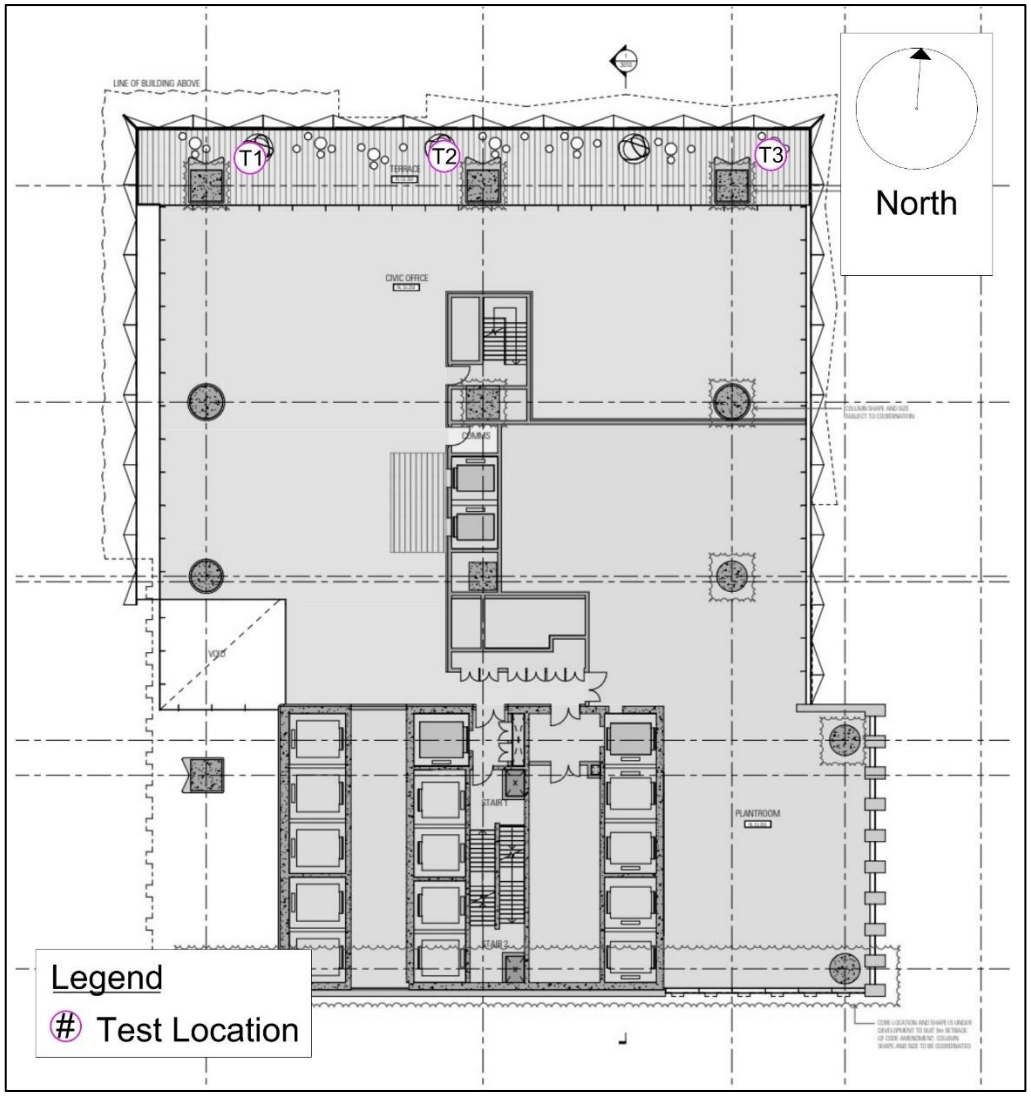


Figure 5c - Test Locations on the terrace at Level 4 of the Proposed Festival Plaza Tower 2 Development

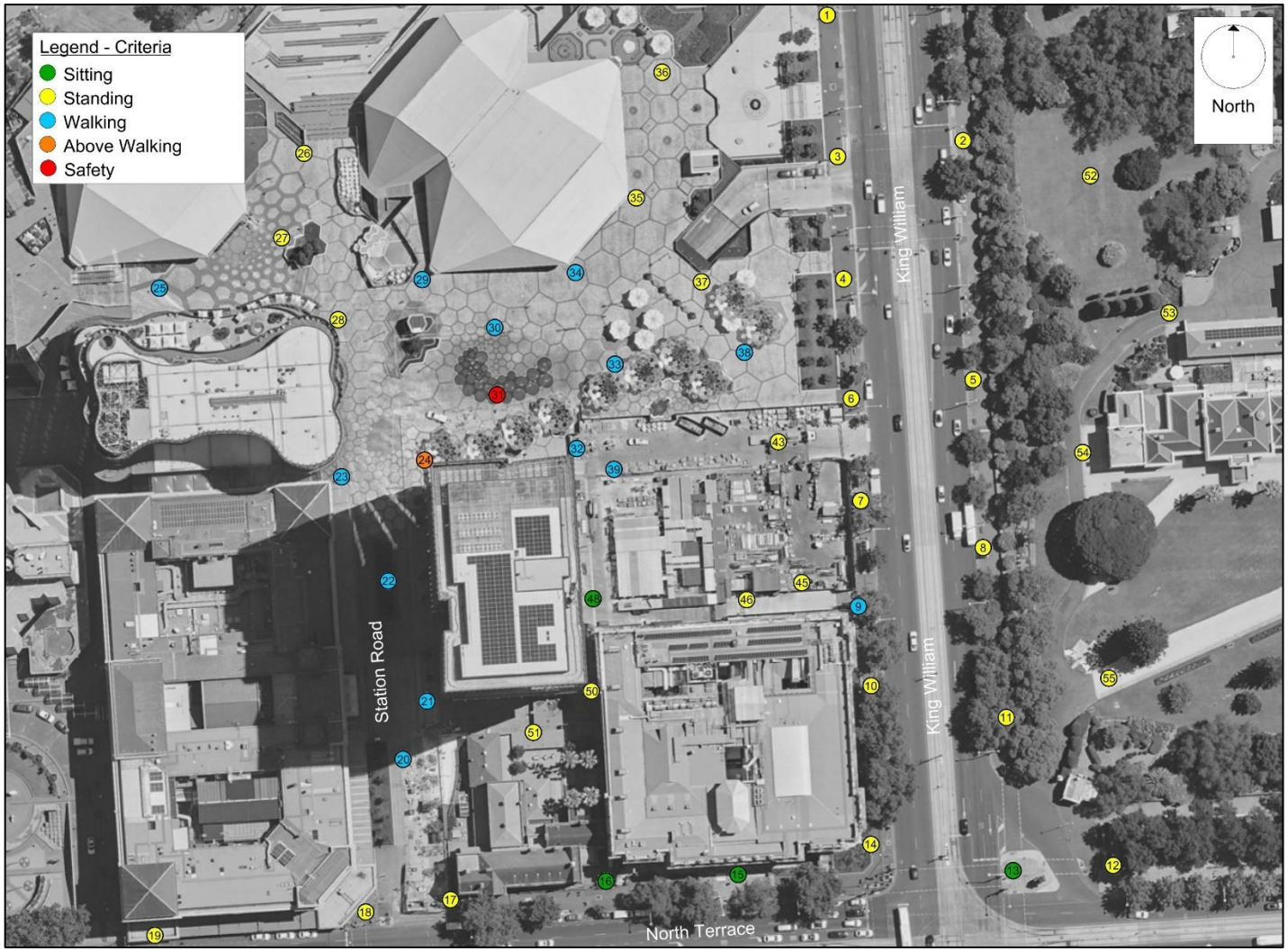


Figure 6 - Summary of wind conditions at Ground Level Test Locations in the surrounding streetscapes for the Proposed Festival Plaza Tower 2 Development for the Existing Configuration.

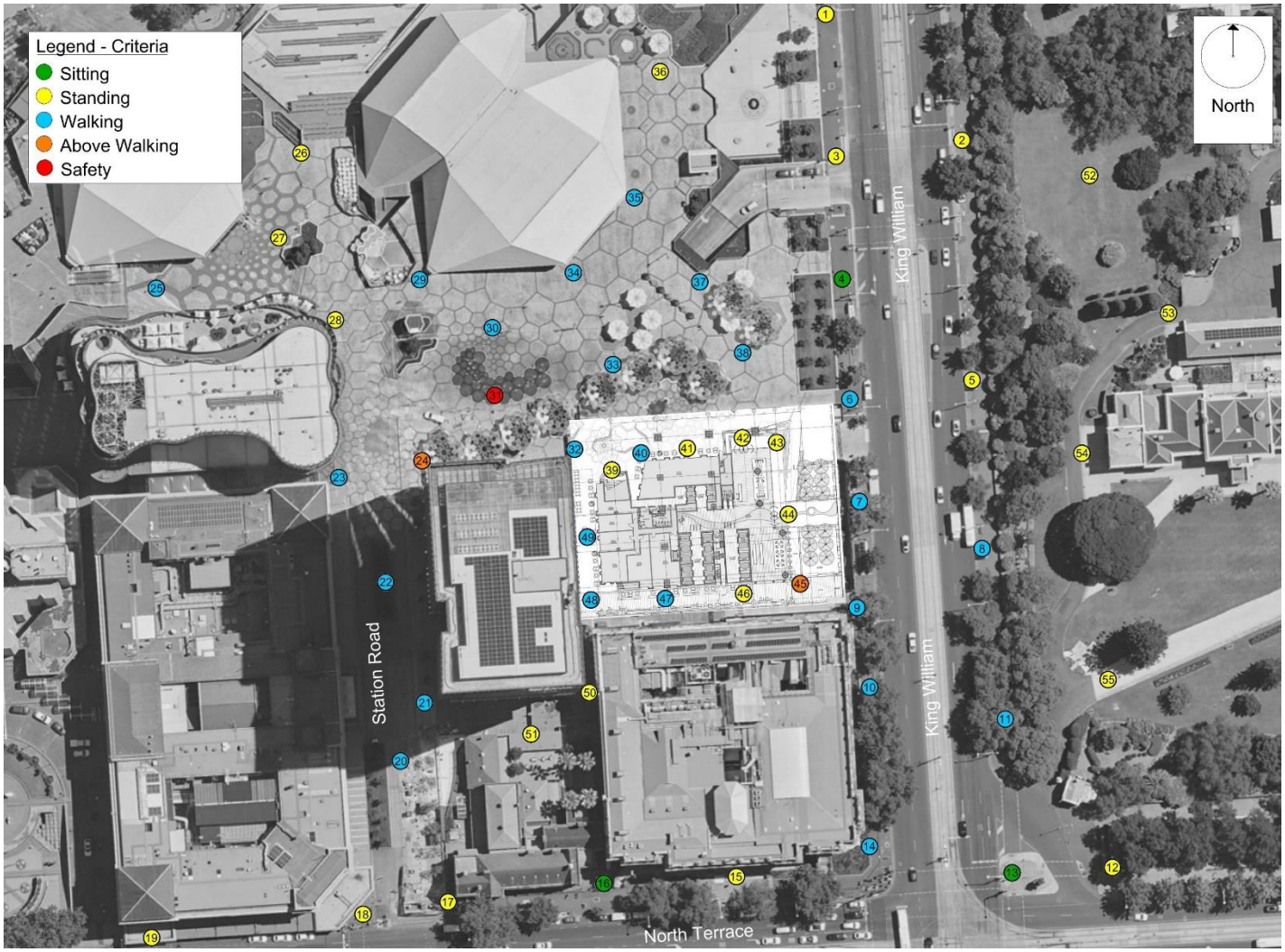


Figure 7a - Summary of wind conditions at Ground Level Test Locations in the surrounding streetscapes for the Proposed Festival Plaza Tower 2 Development for the Proposed Configuration.

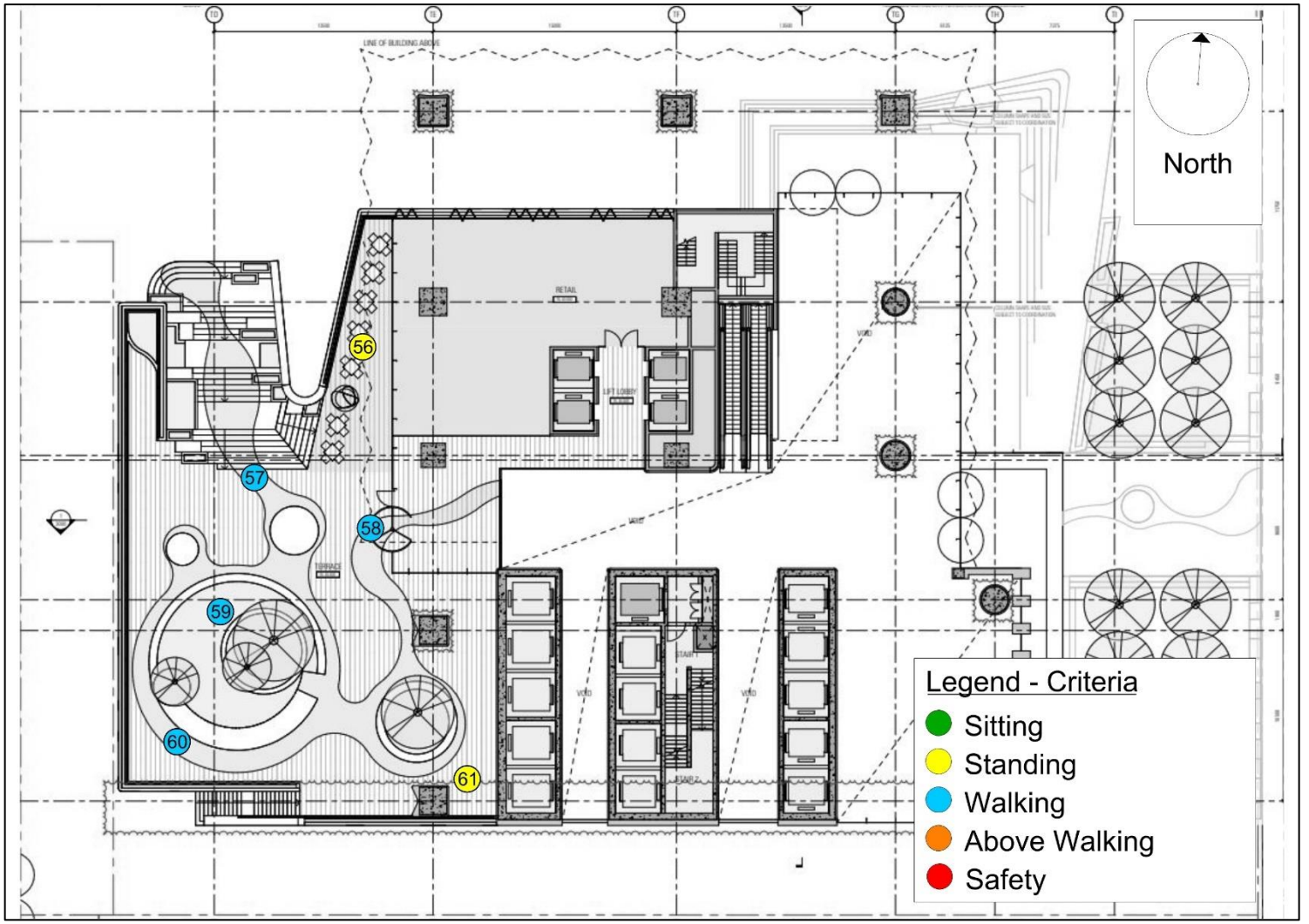


Figure 7b - Summary of wind conditions at the podium Test Locations at Level 1 of the Proposed Festival Plaza Tower 2 Development for the Proposed Configuration.

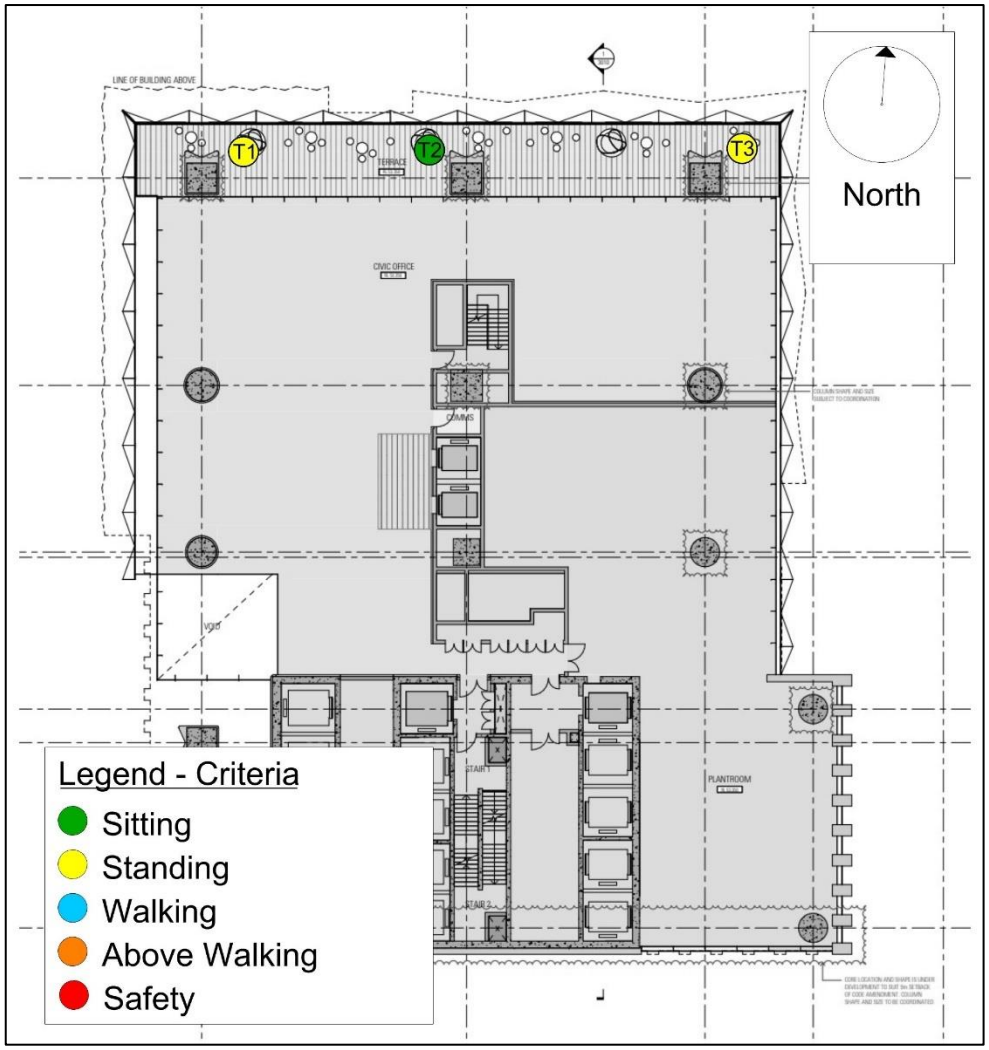


Figure 7c - Summary of wind conditions at the terrace Test Locations at Level 4 of the Proposed Festival Plaza Tower 2 Development for the Proposed Configuration.

Figure 8a - Summary of wind conditions at Ground Level Test Locations in the surrounding streetscapes for the Proposed Festival Plaza Tower 2 Development for the Proposed Configuration with wind mitigation strategies.

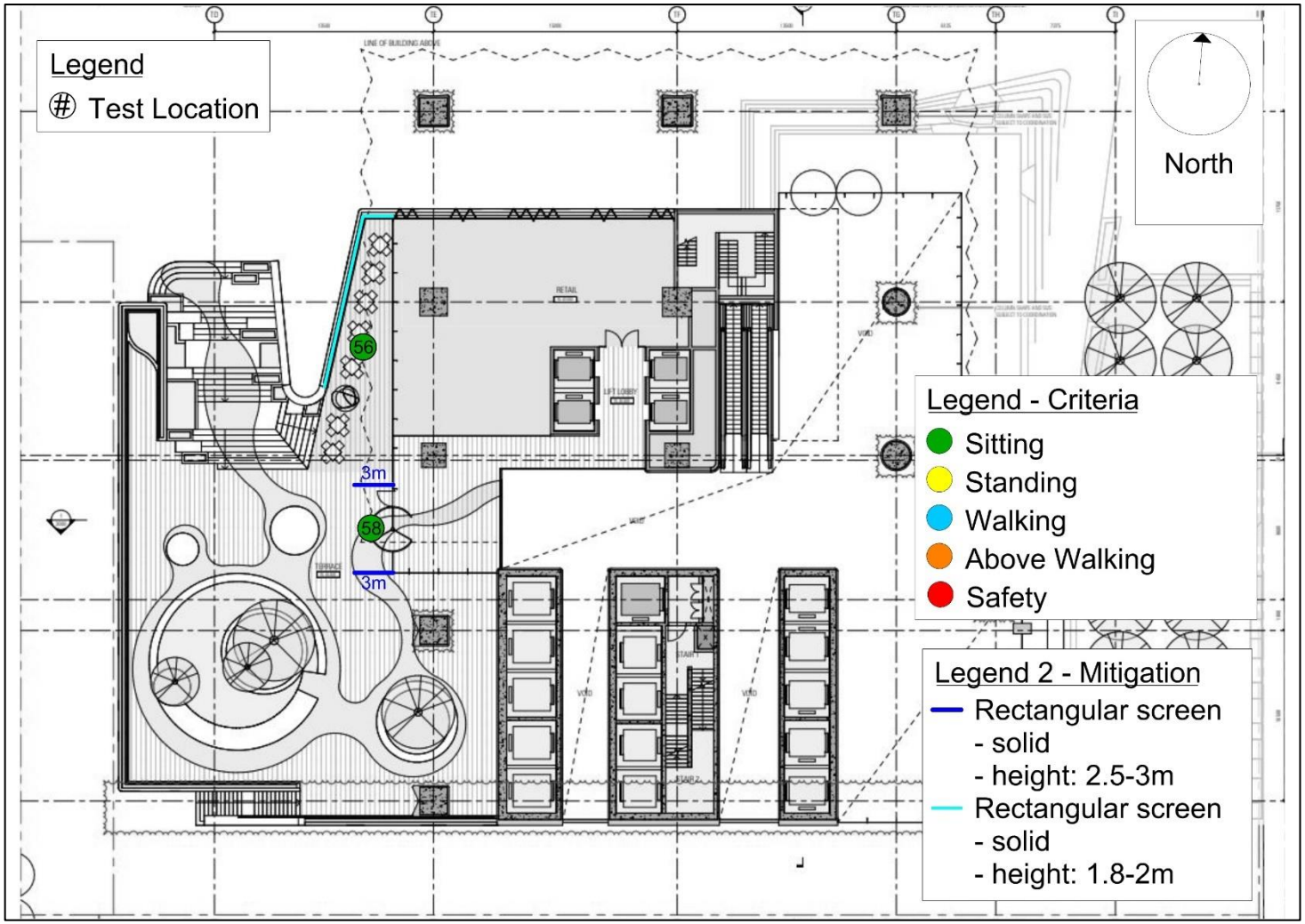
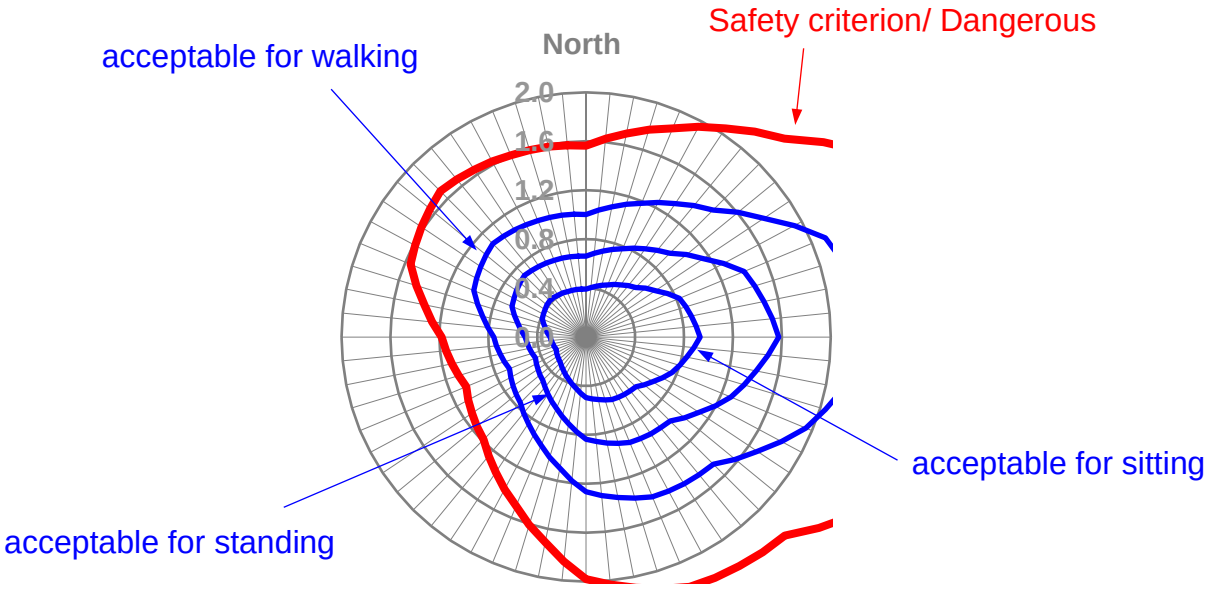


Figure 8a - Summary of wind conditions at Ground Level Test Locations in the surrounding streetscapes for the Proposed Festival Plaza Tower 2 Development for the Proposed Configuration with wind mitigation strategies.

APPENDIX A – TEST LOCATION 3 SECOND GUST WIND CRITERIA PLOTS AS A FUNCTION OF WIND DIRECTION



$$\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$$

Figure A1 - Environmental wind criteria for City of Adelaide as a function of wind direction based on a 3 second gust

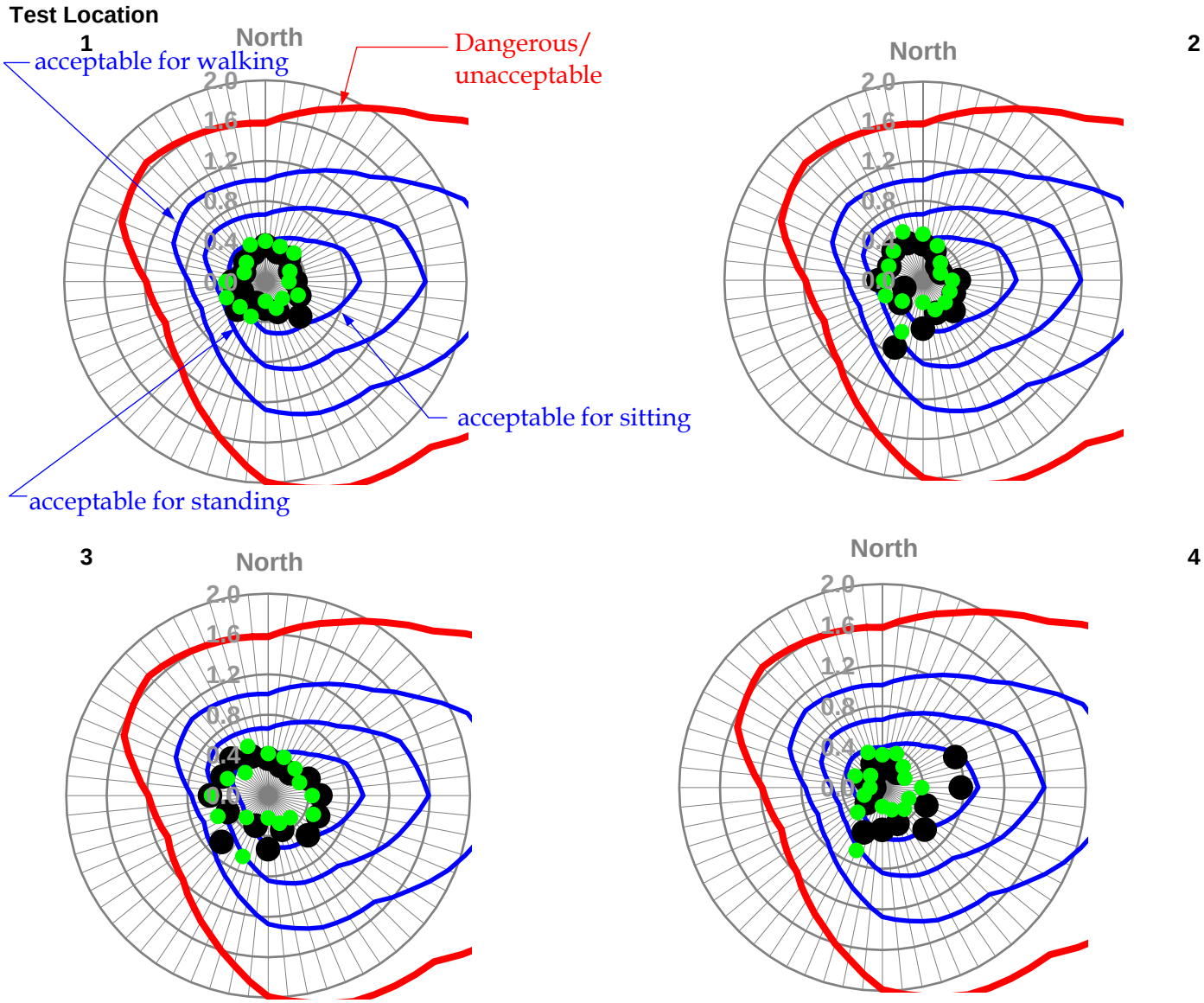


Figure A2 - King William Road

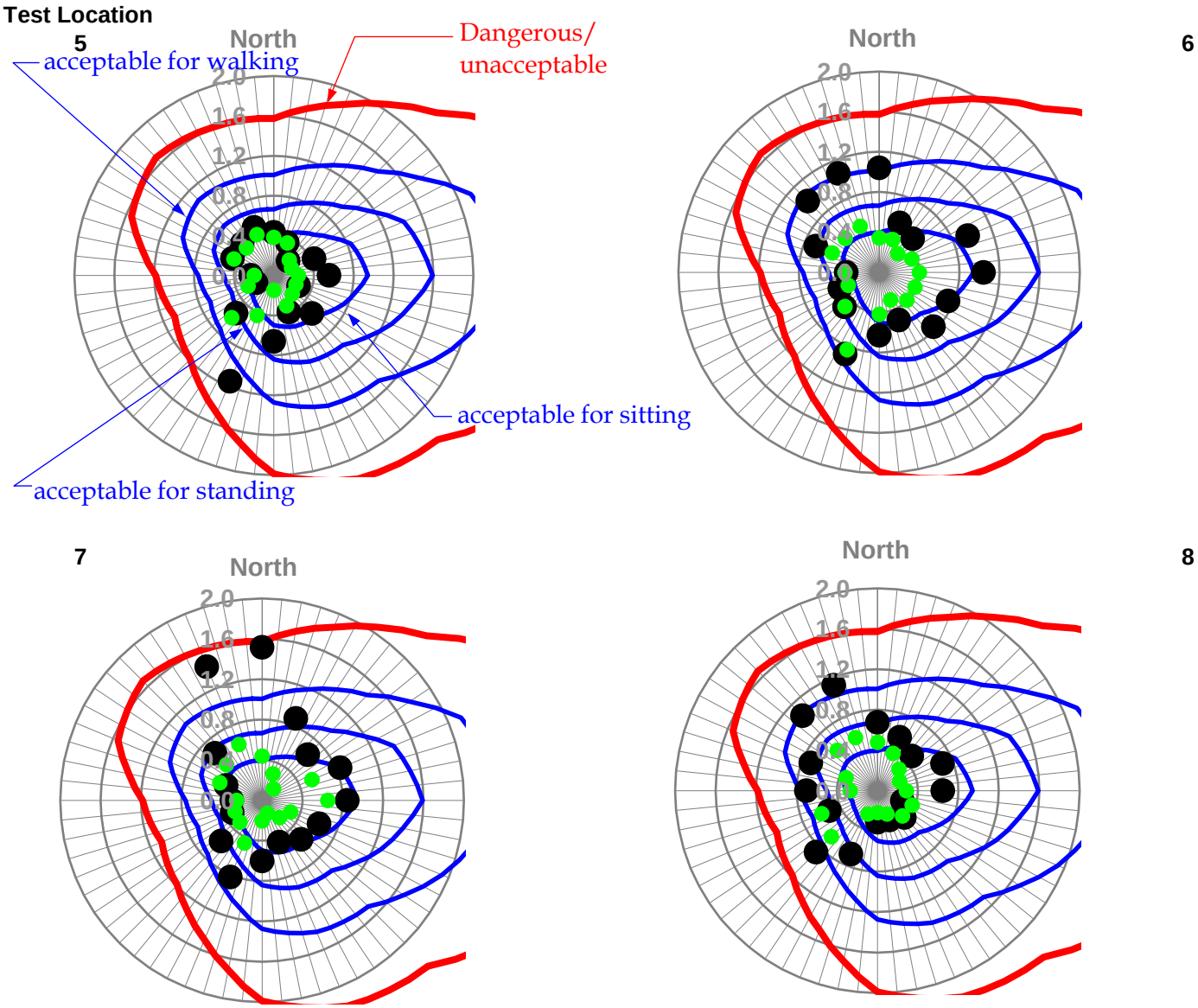
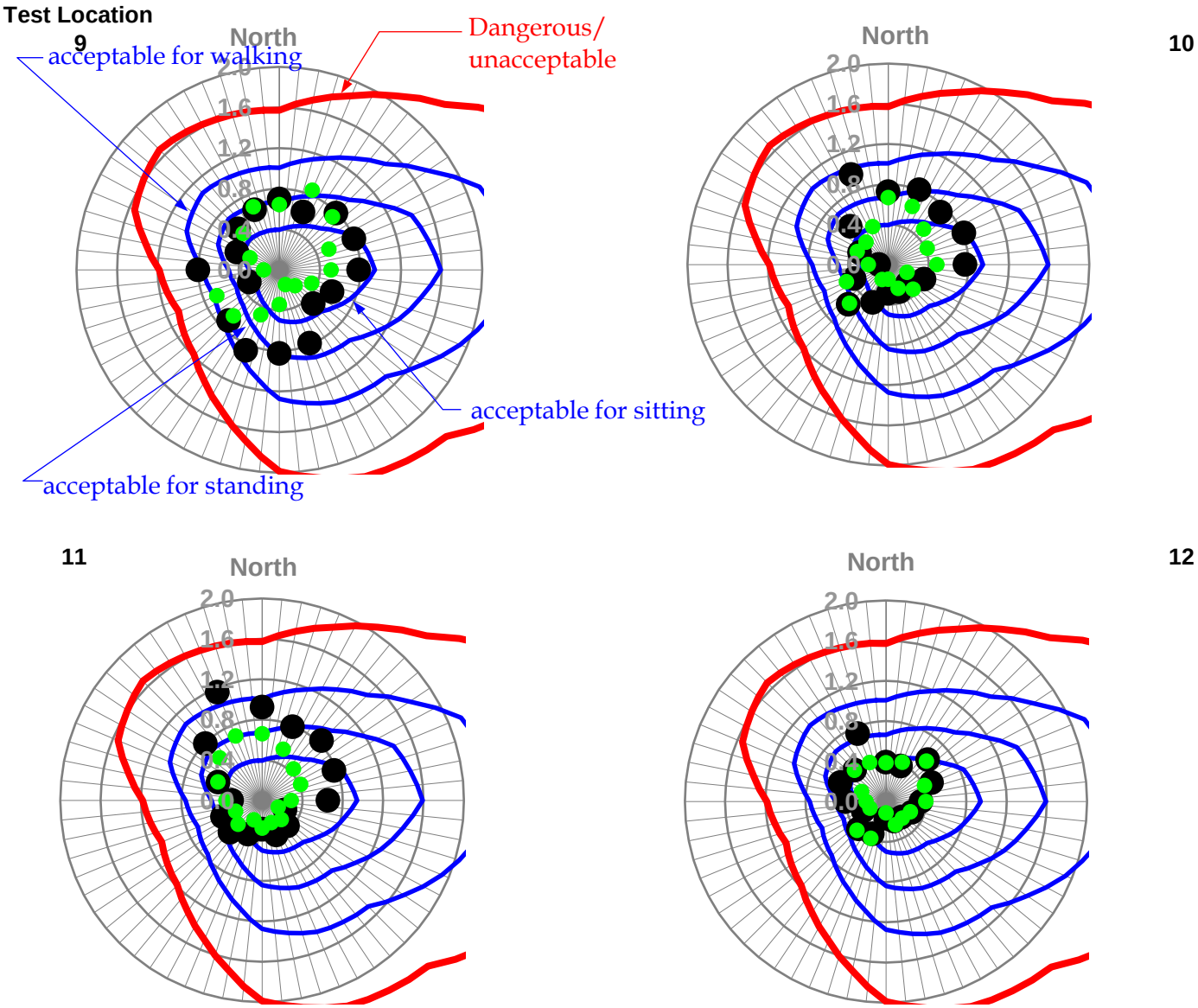


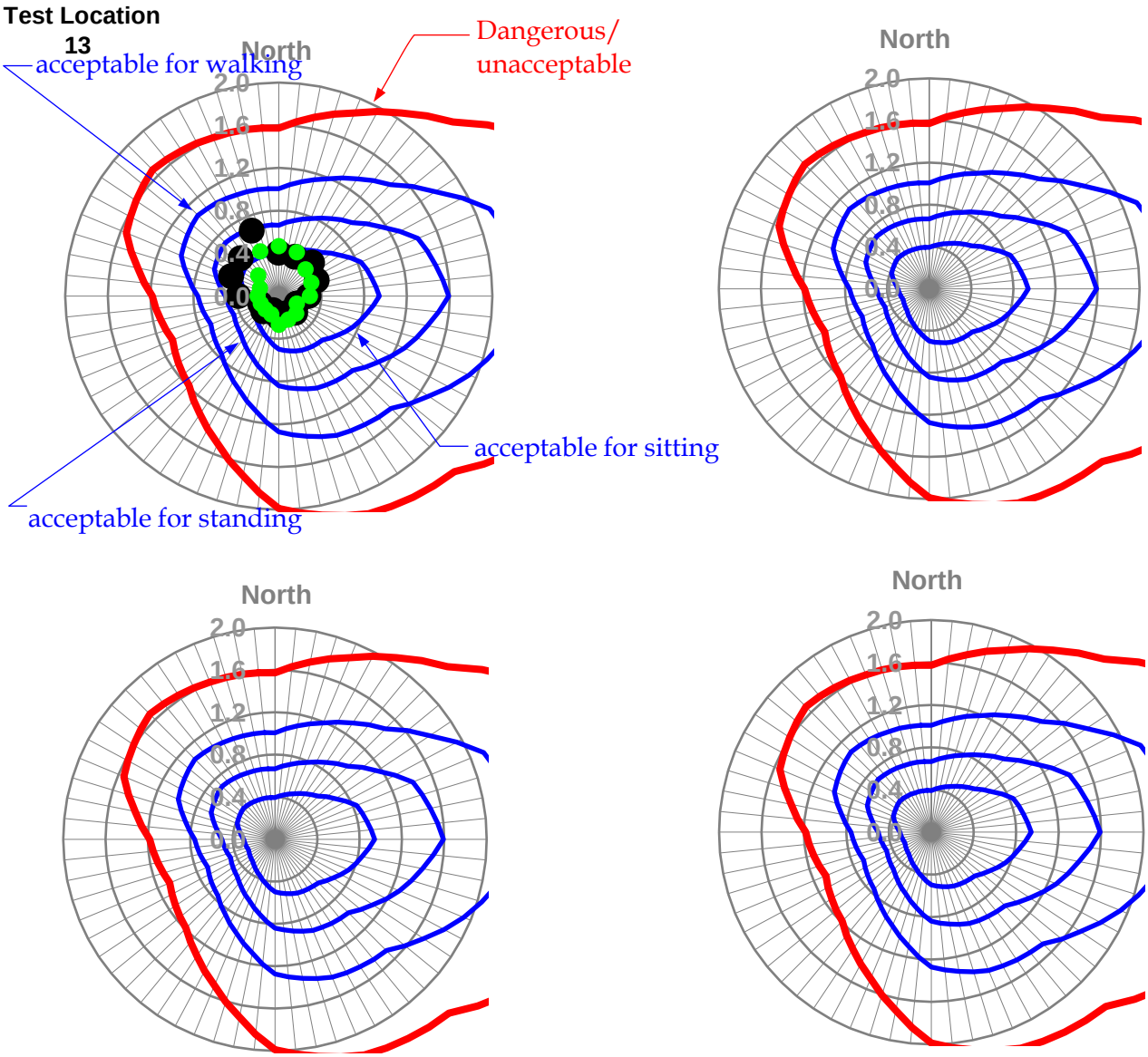
Figure A3 - King William Road [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration
Existing Configuration

Figure A4 - King William Road [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration
Existing Configuration

Figure A5 - King William Road [CONTINUED]

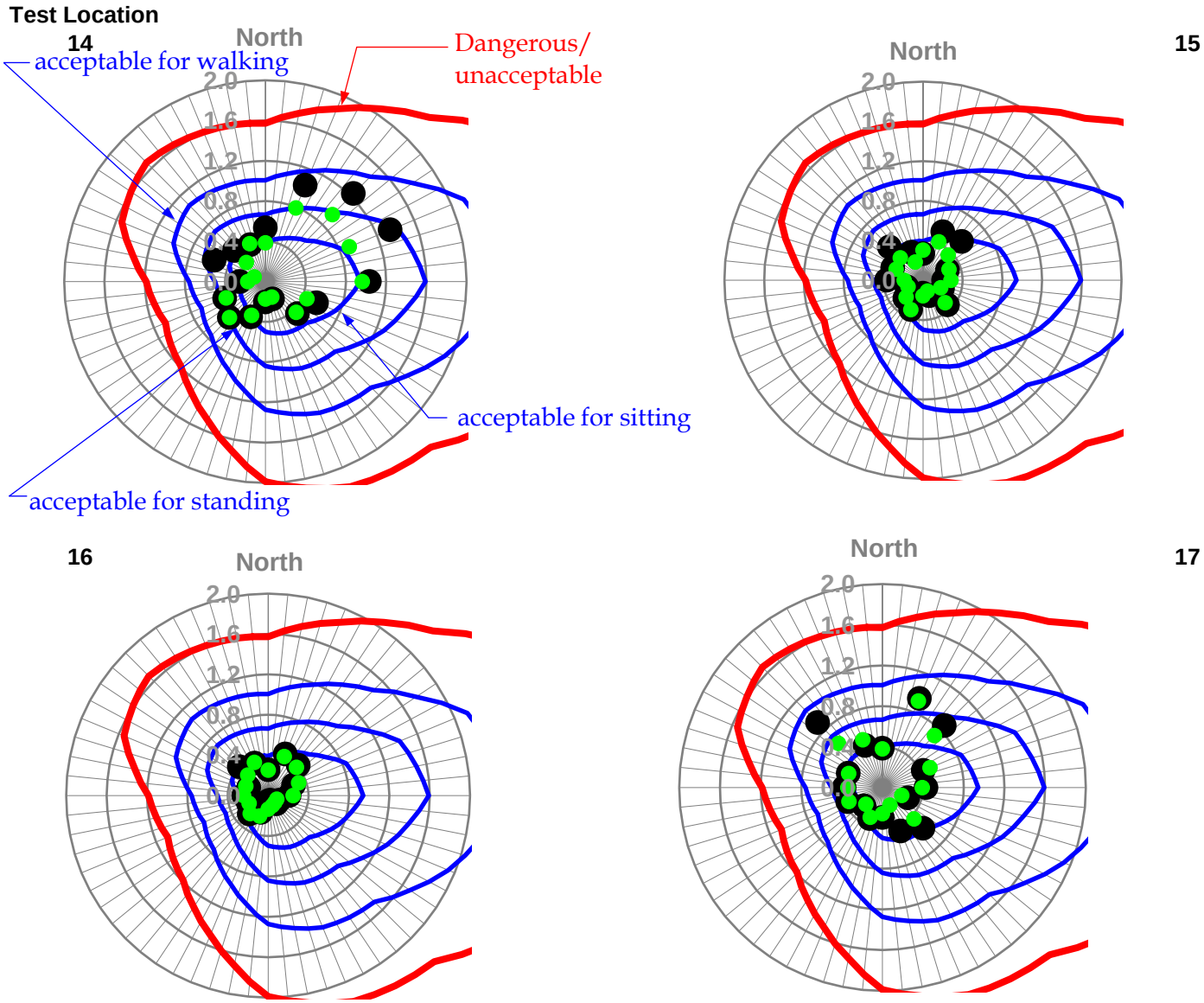


Figure A6 - North Terrace

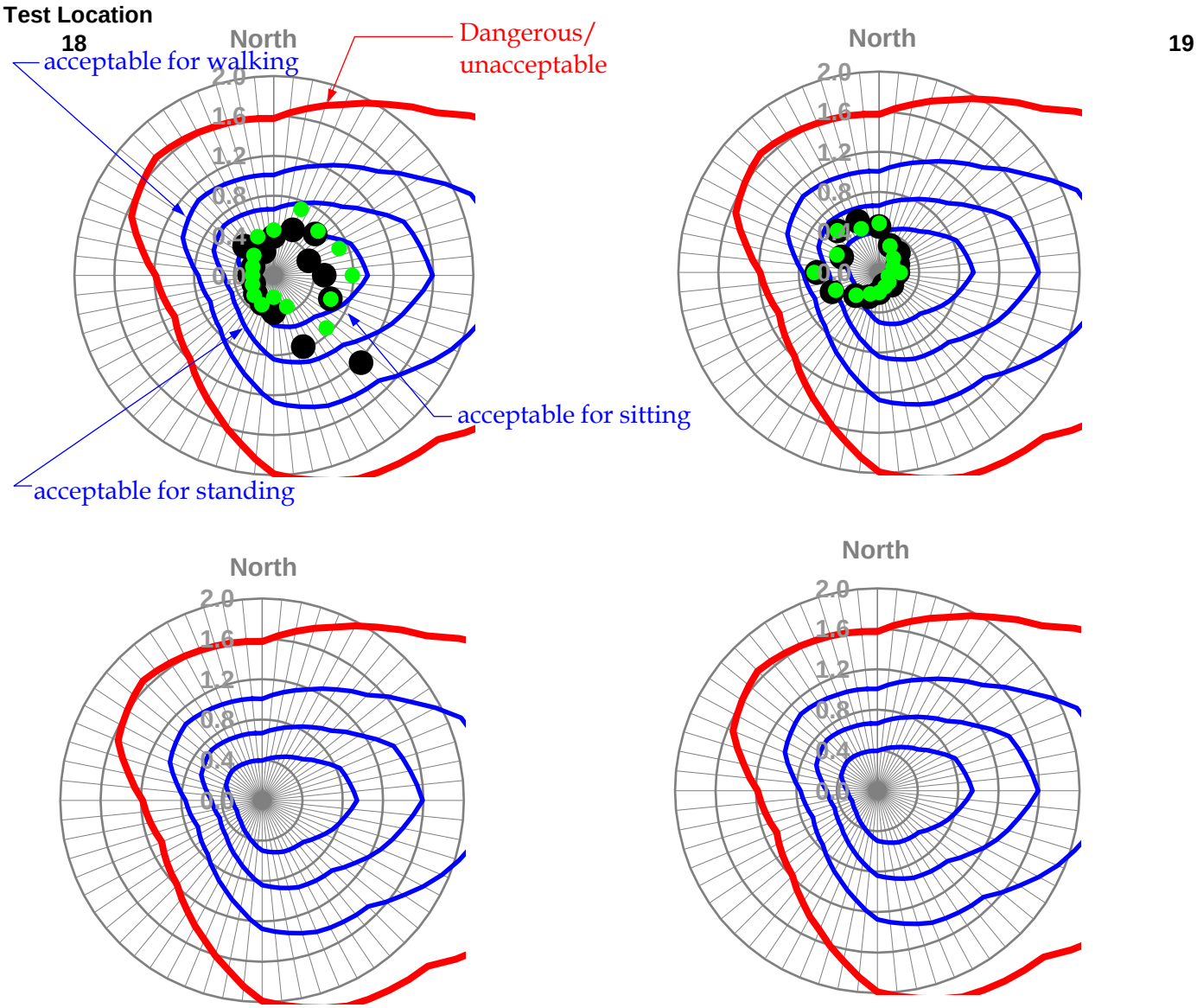


Figure A7 - North Terrace [CONTINUED]

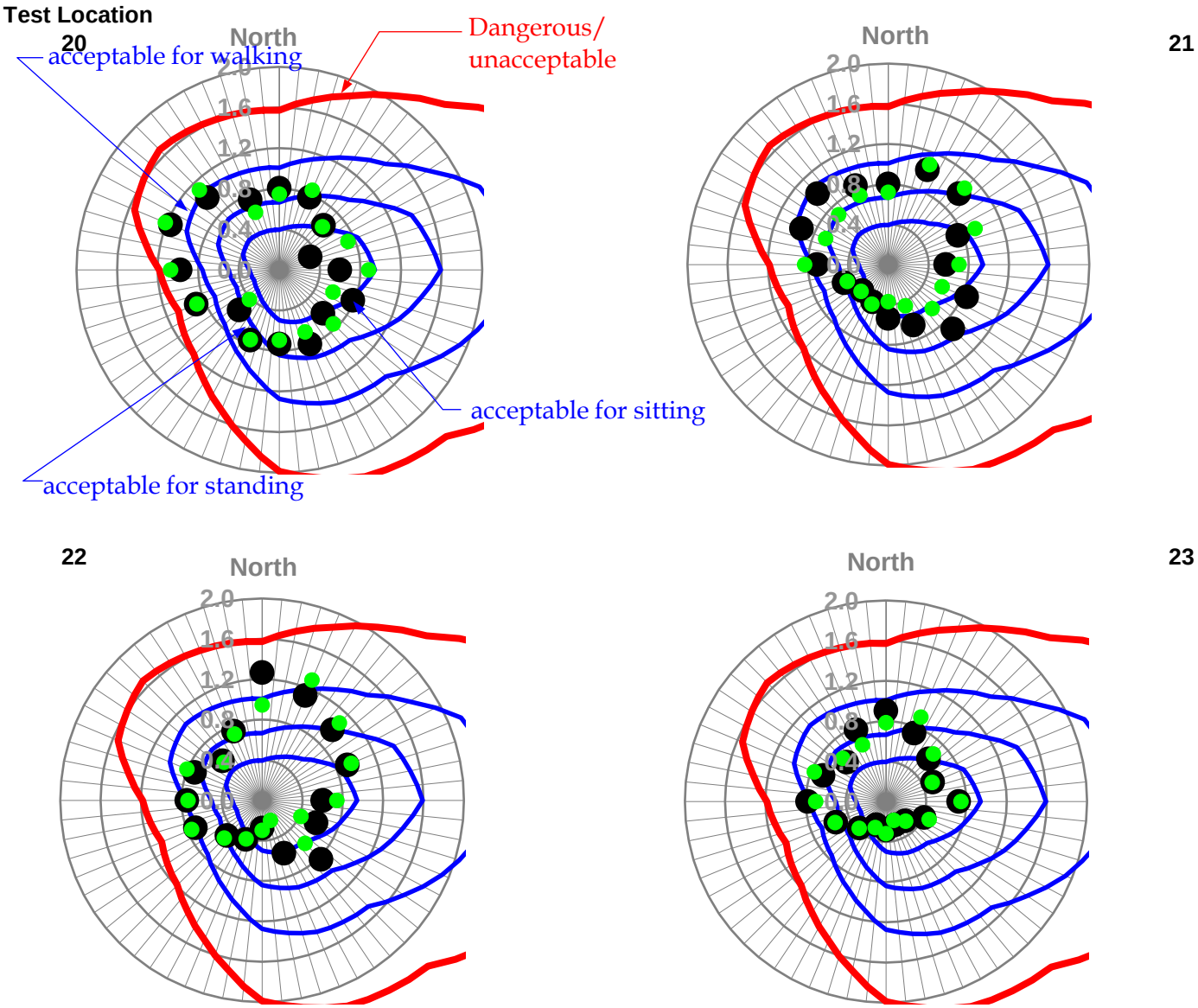


Figure A8 - Station Road

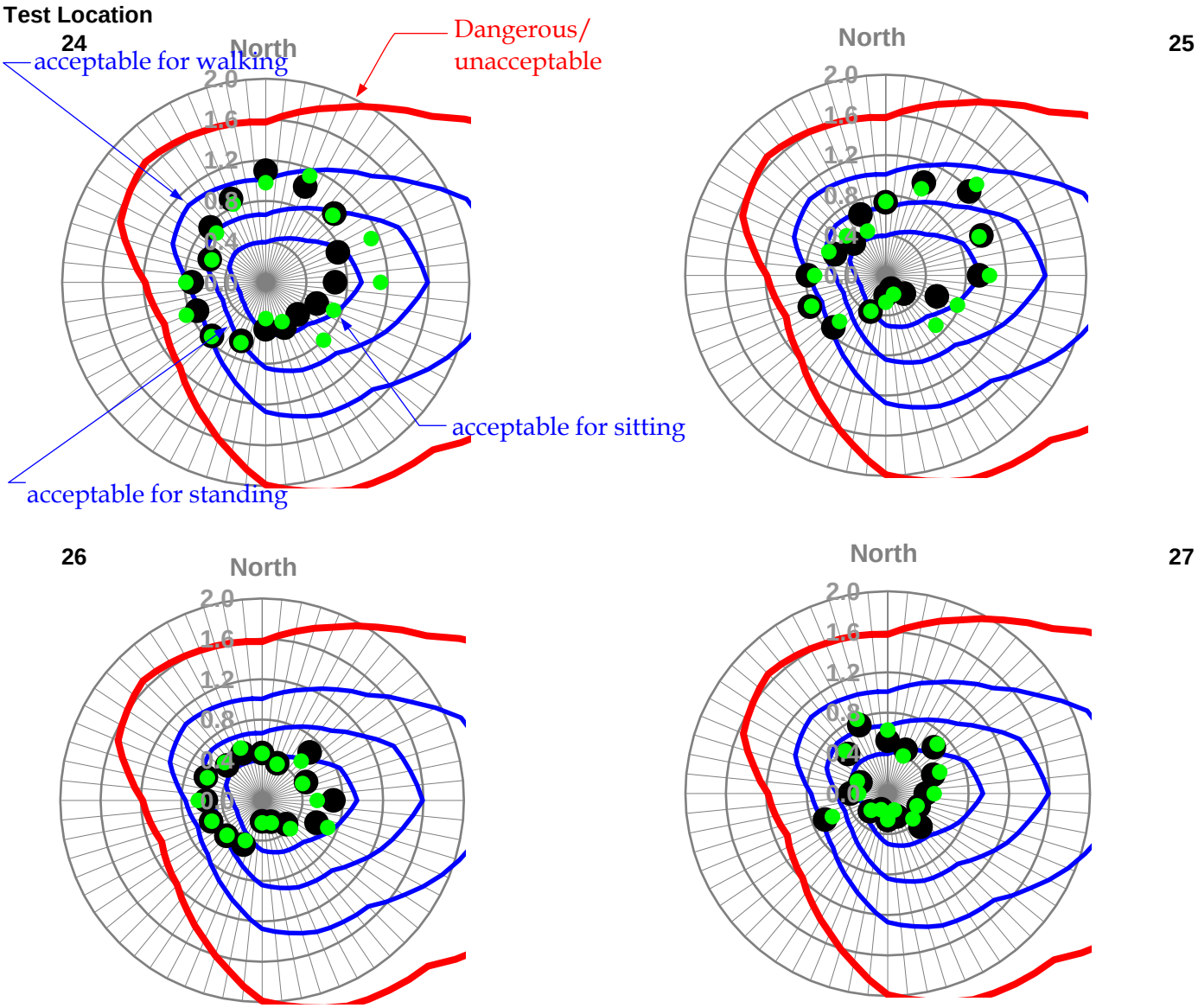
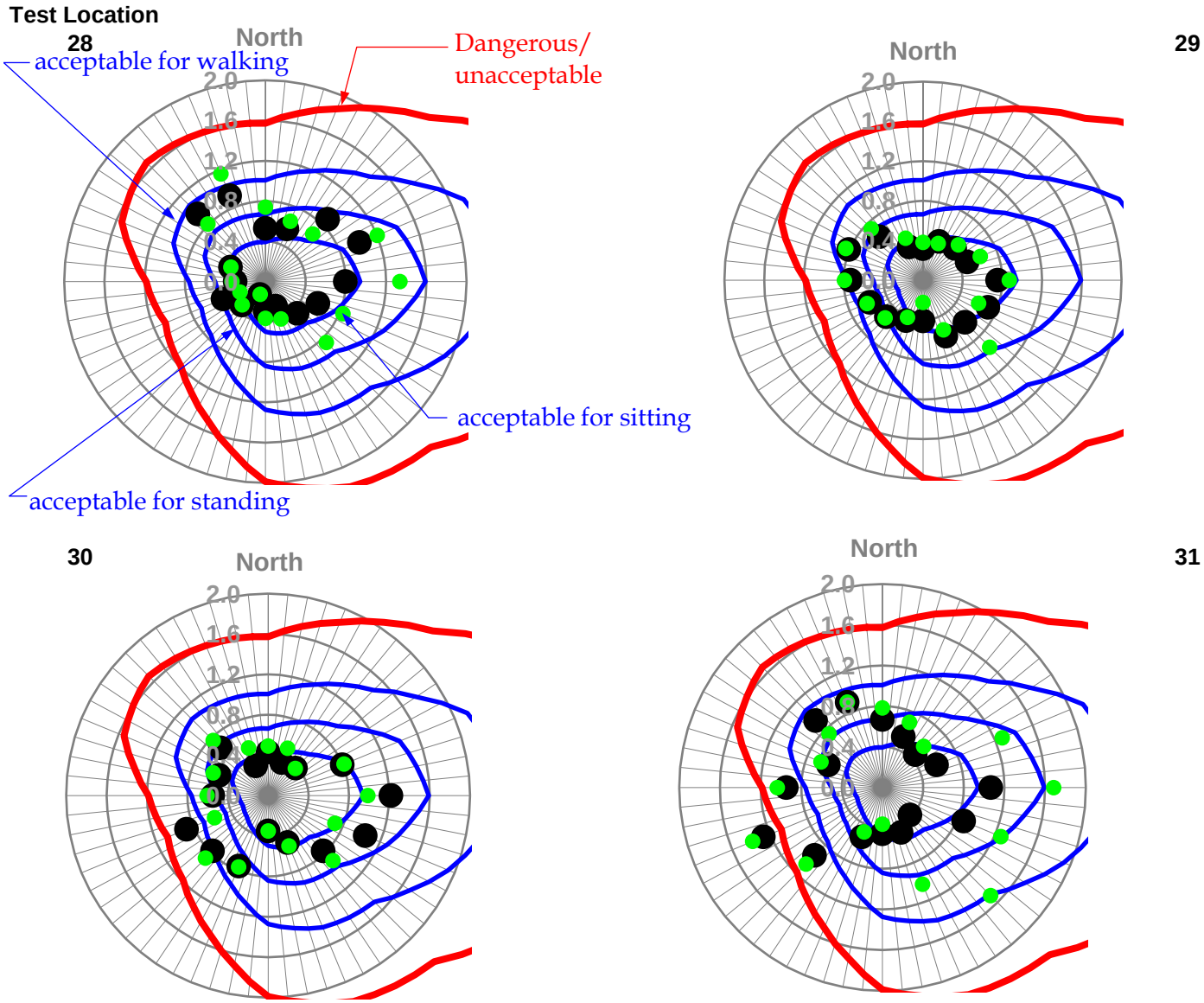


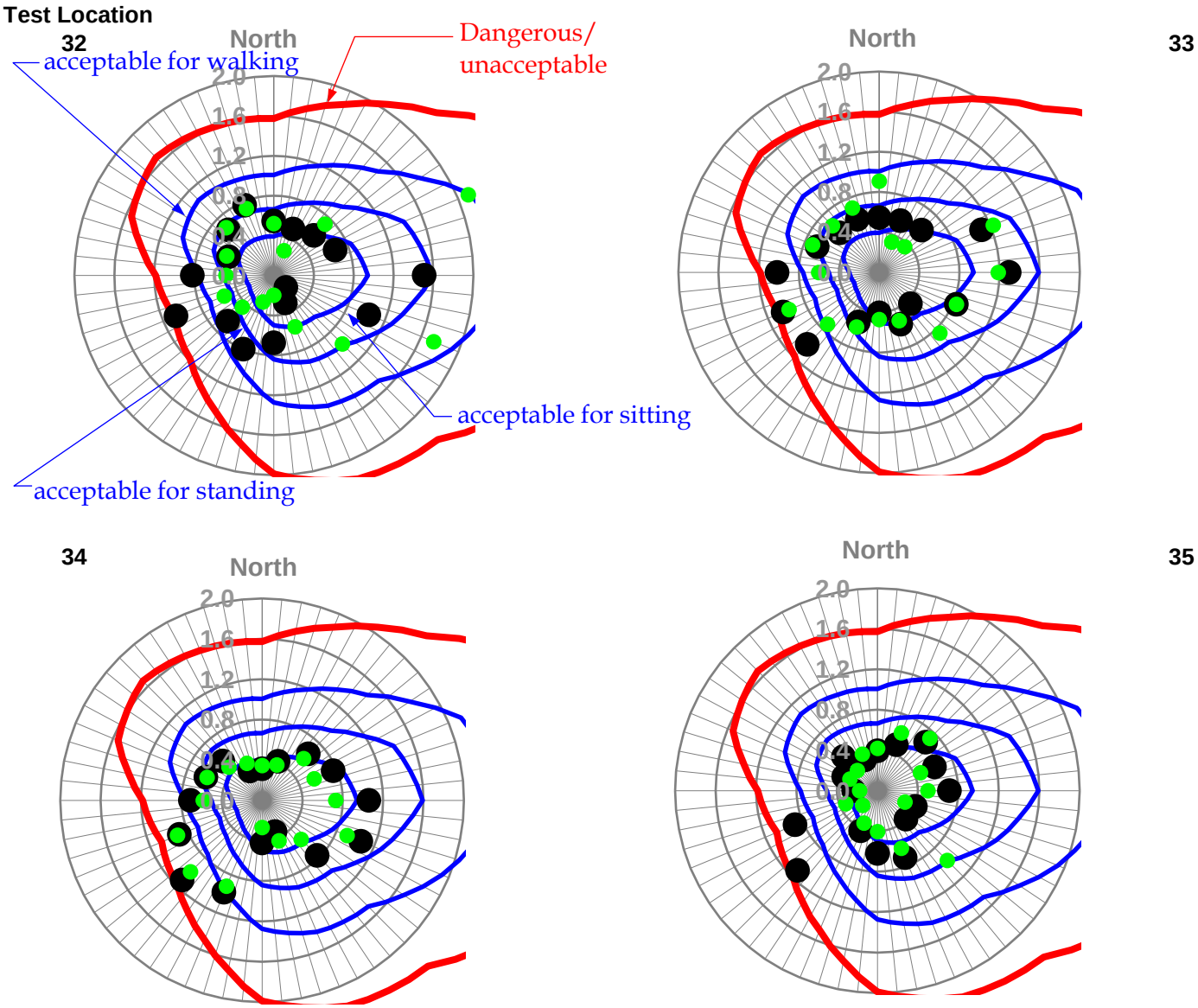
Figure A9 - Adelaide Festival Plaza Precinct



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration ●
Existing Configuration ●

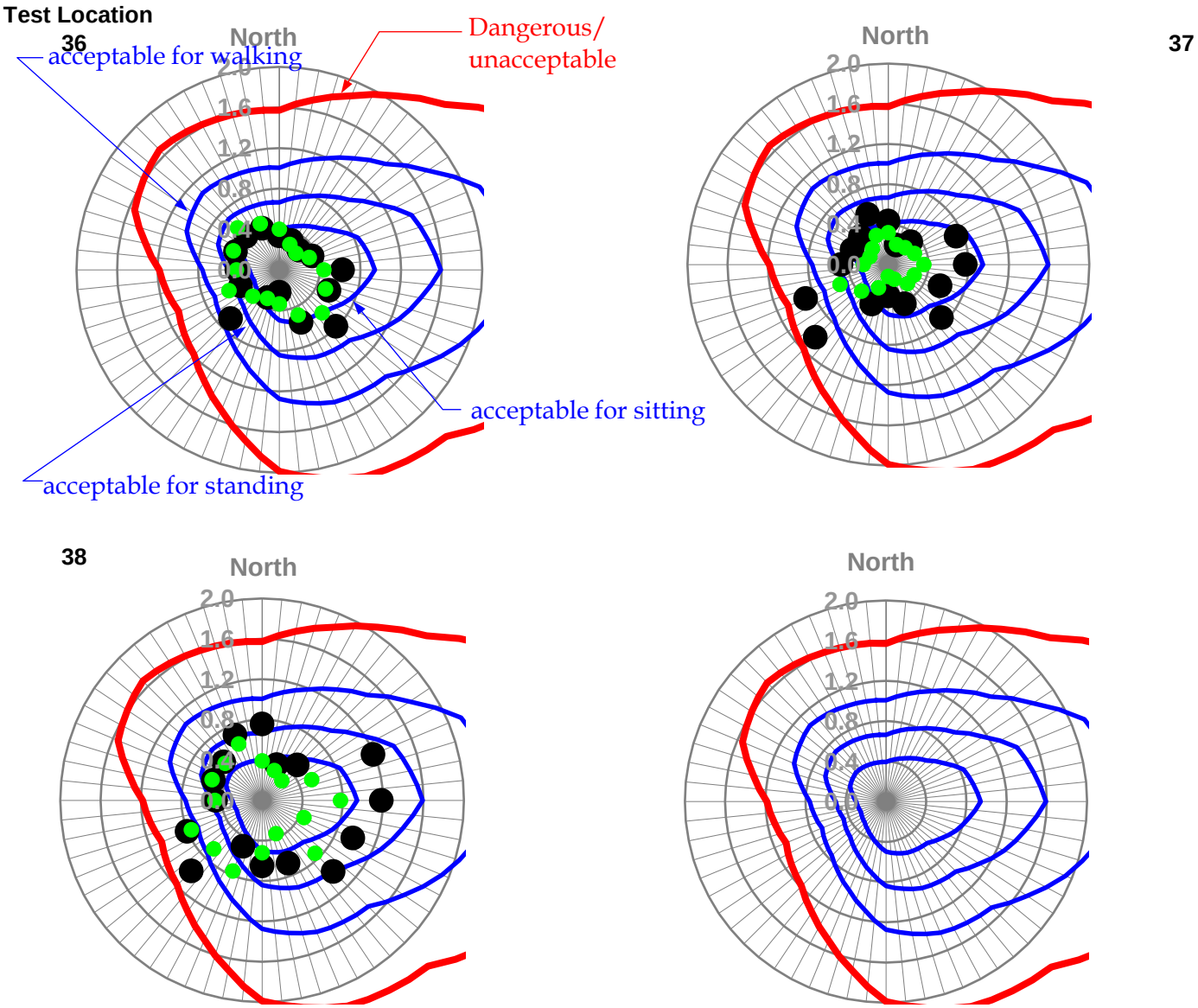
Figure A10 - Adelaide Festival Plaza Precinct [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration
Existing Configuration

Figure A11 - Adelaide Festival Plaza Precinct [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration ●
Existing Configuration ●

Figure A12 - Adelaide Festival Plaza Precinct [CONTINUED]

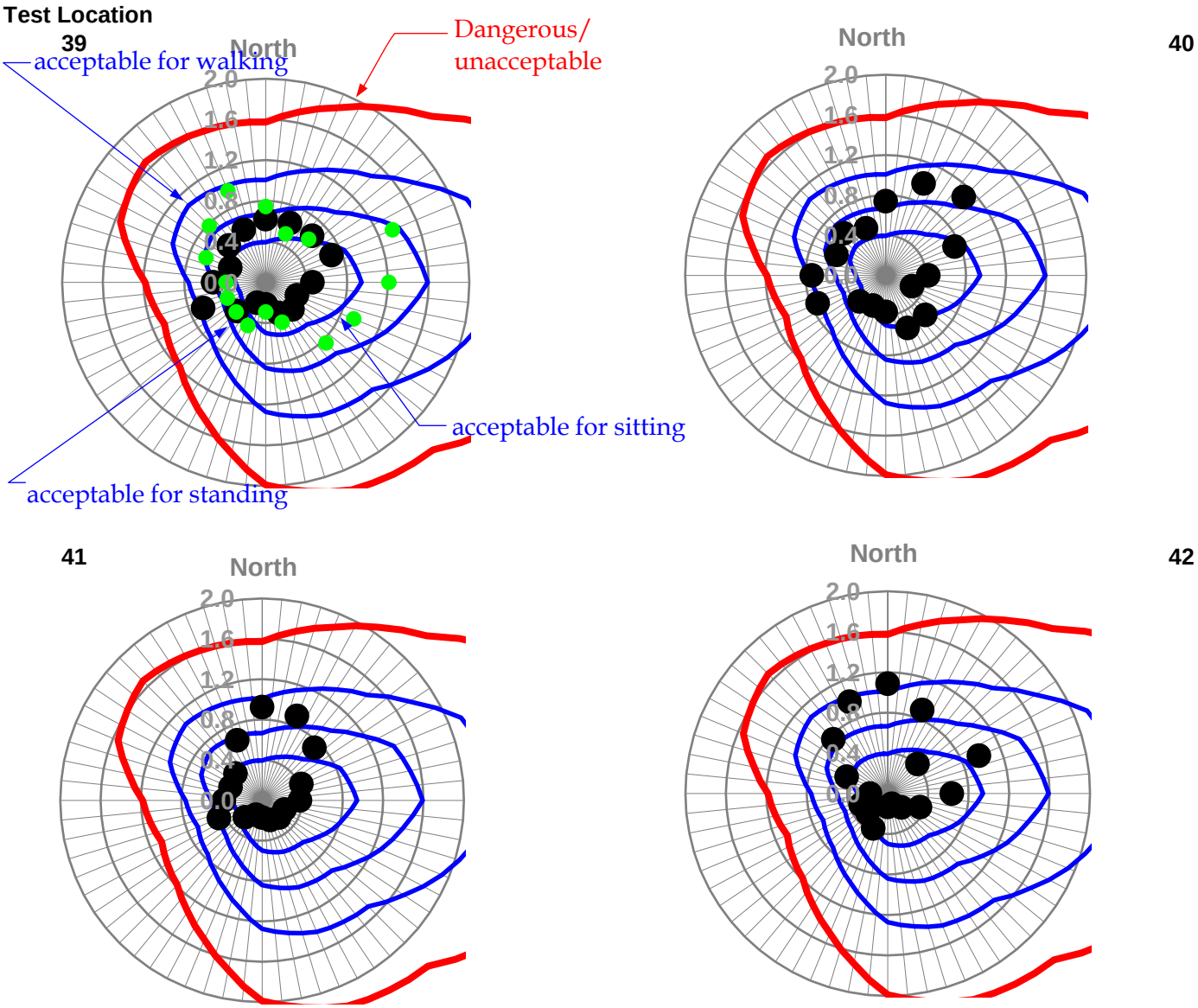
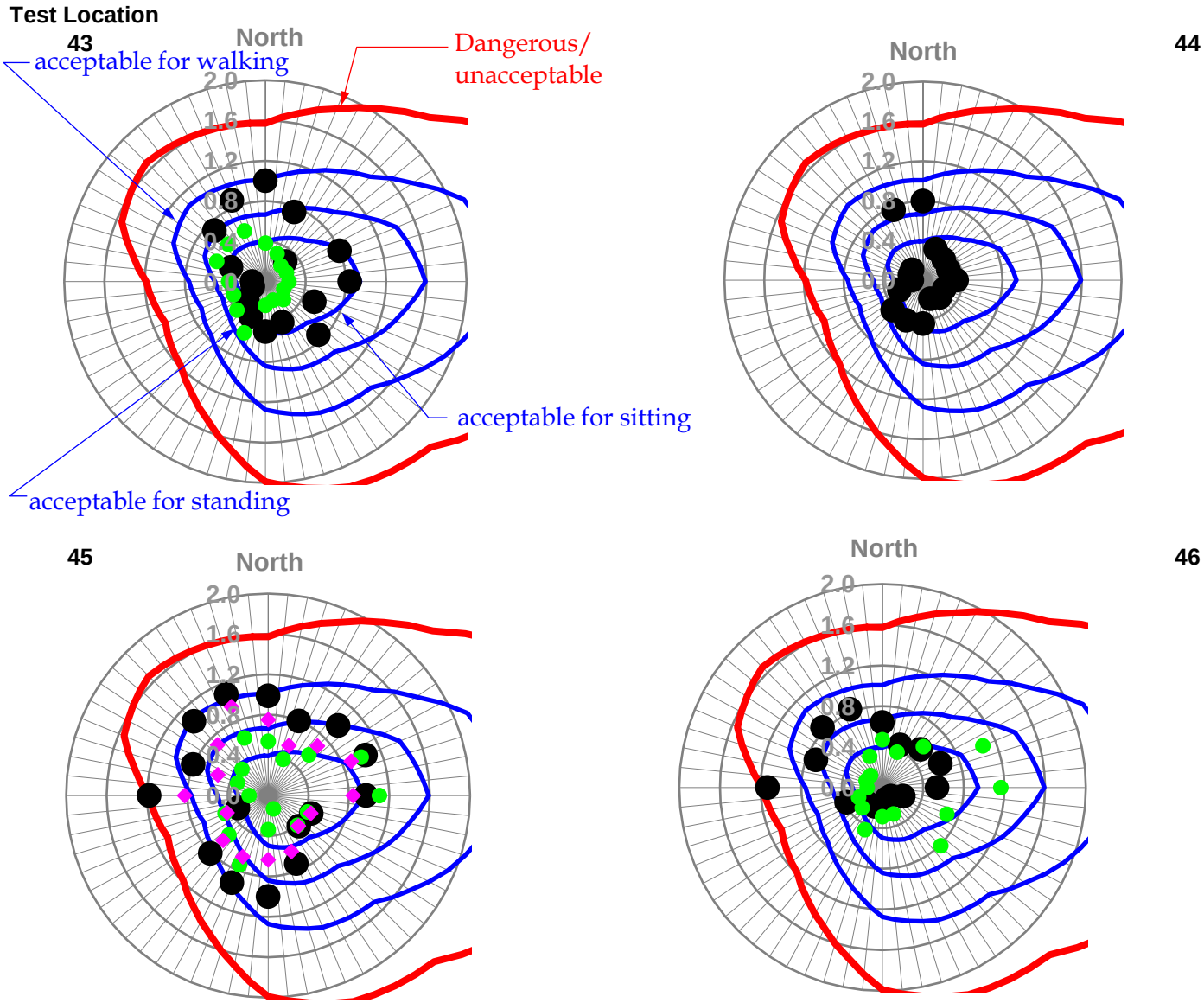


Figure A13 - Adjacent to the development



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration	●
Existing Configuration	●
Proposed Configuration with 3m wide canopy	◆

Figure A14 - Adjacent to the development [CONTINUED]

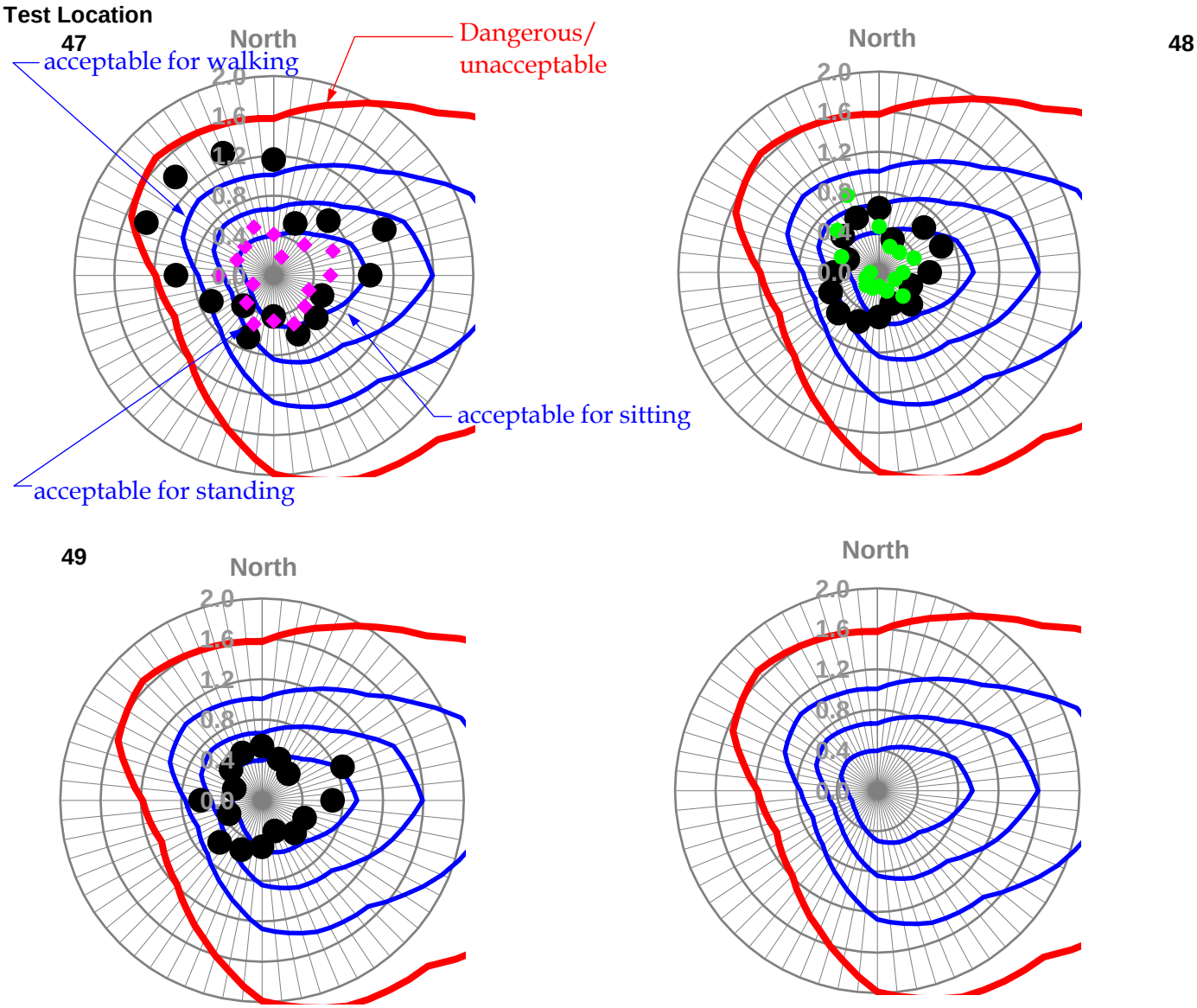
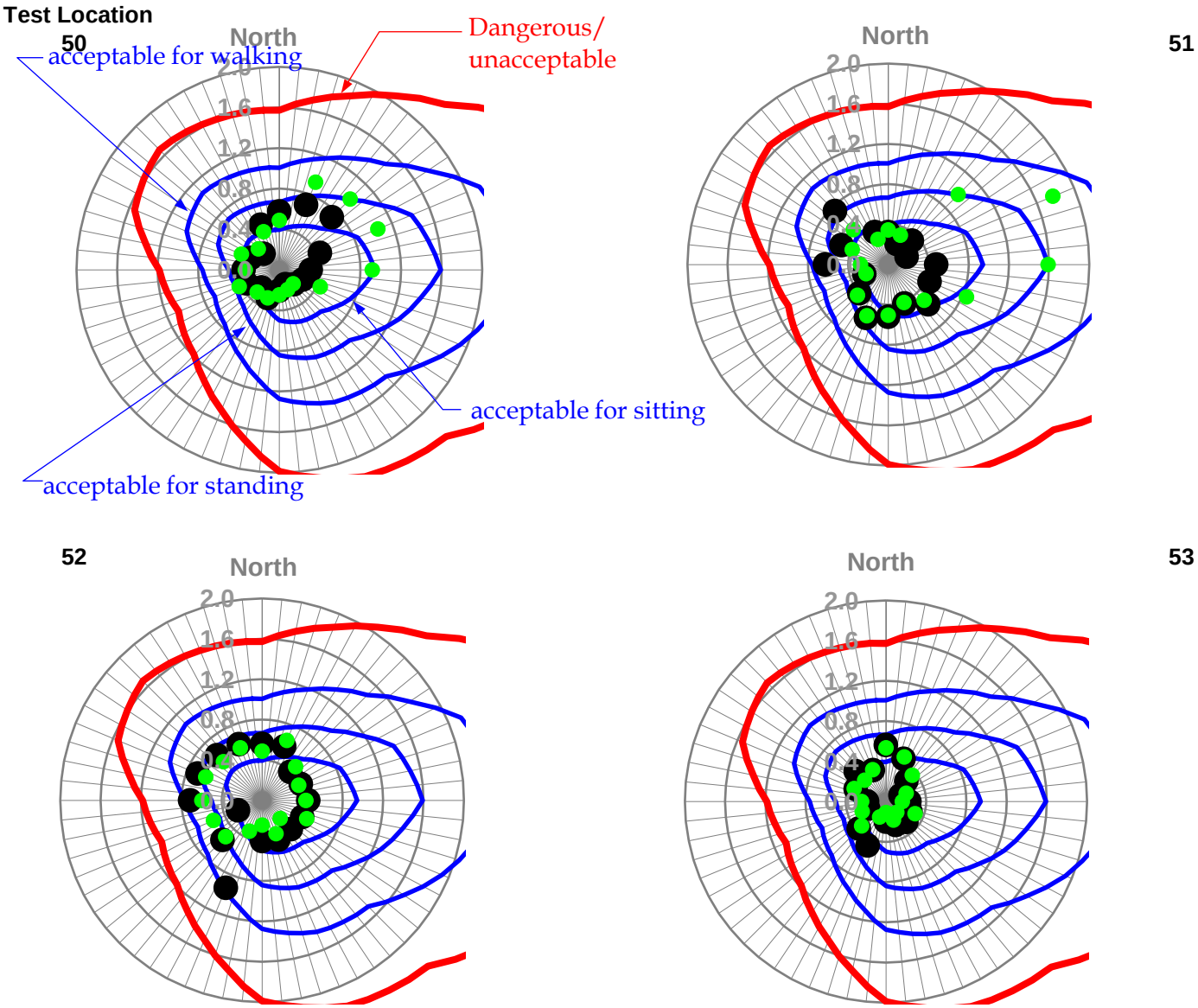


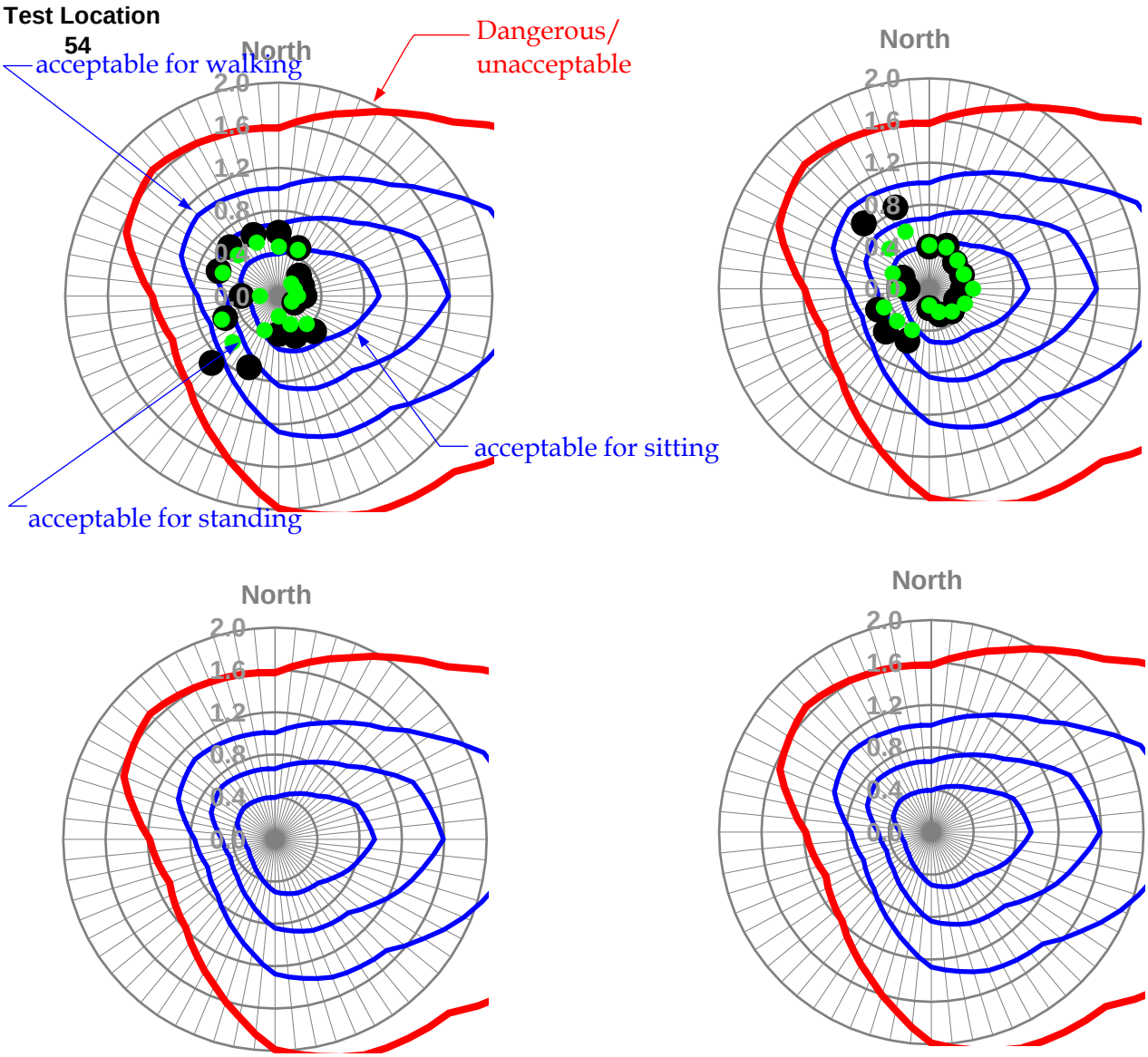
Figure A15 - Adjacent to the development [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration
Existing Configuration

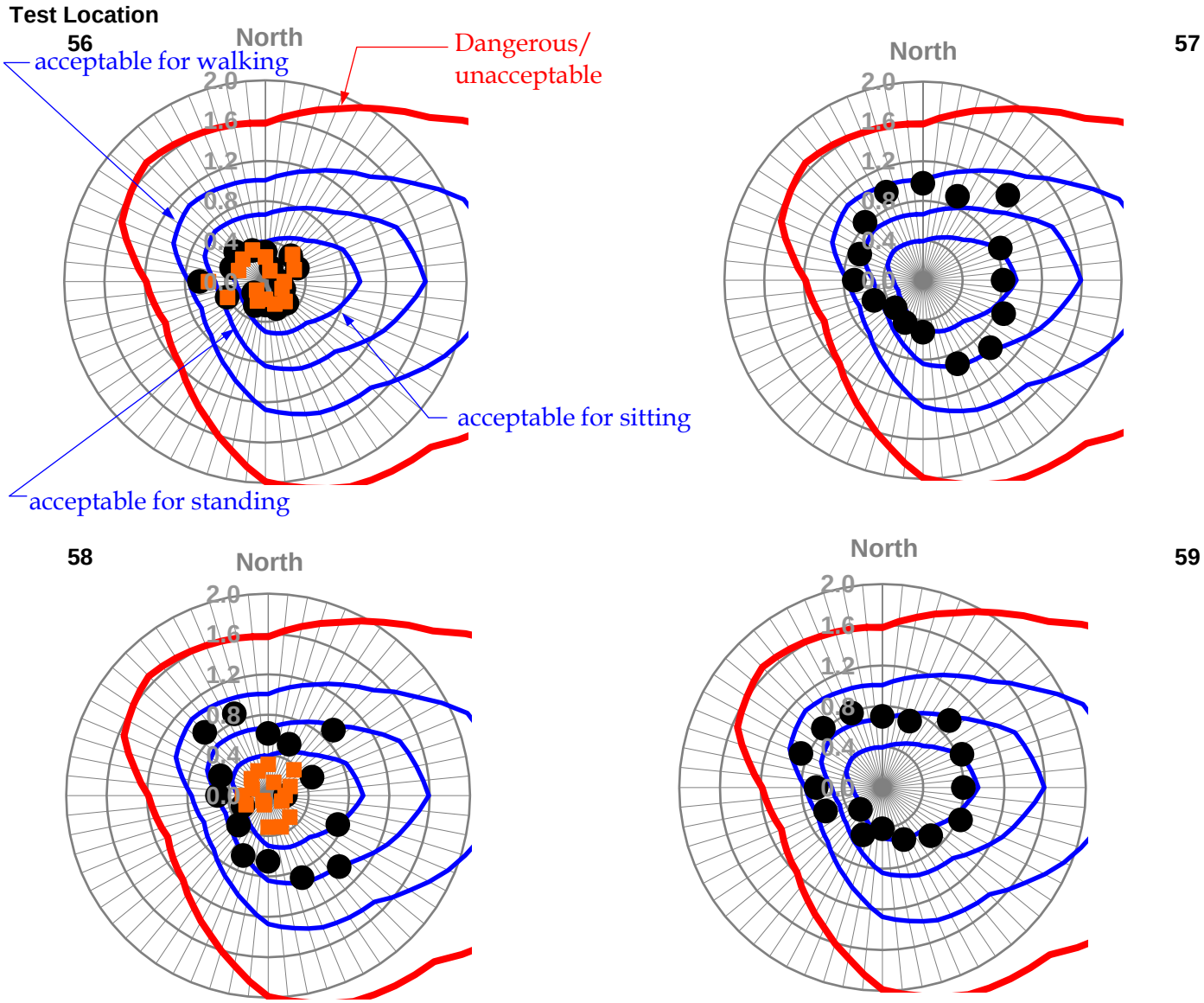
Figure A16 - Neighbouring Premises



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration
Existing Configuration

Figure A17 - Neighbouring Premises [CONTINUED]



Peak velocity squared ratio $\left|\frac{\hat{V}_{local}}{\bar{V}_{300m}}\right|^2$ *as a function of wind direction*

Proposed Configuration ●
Proposed Configuration with solid screen ■

Figure A18 - Podium at Level 1

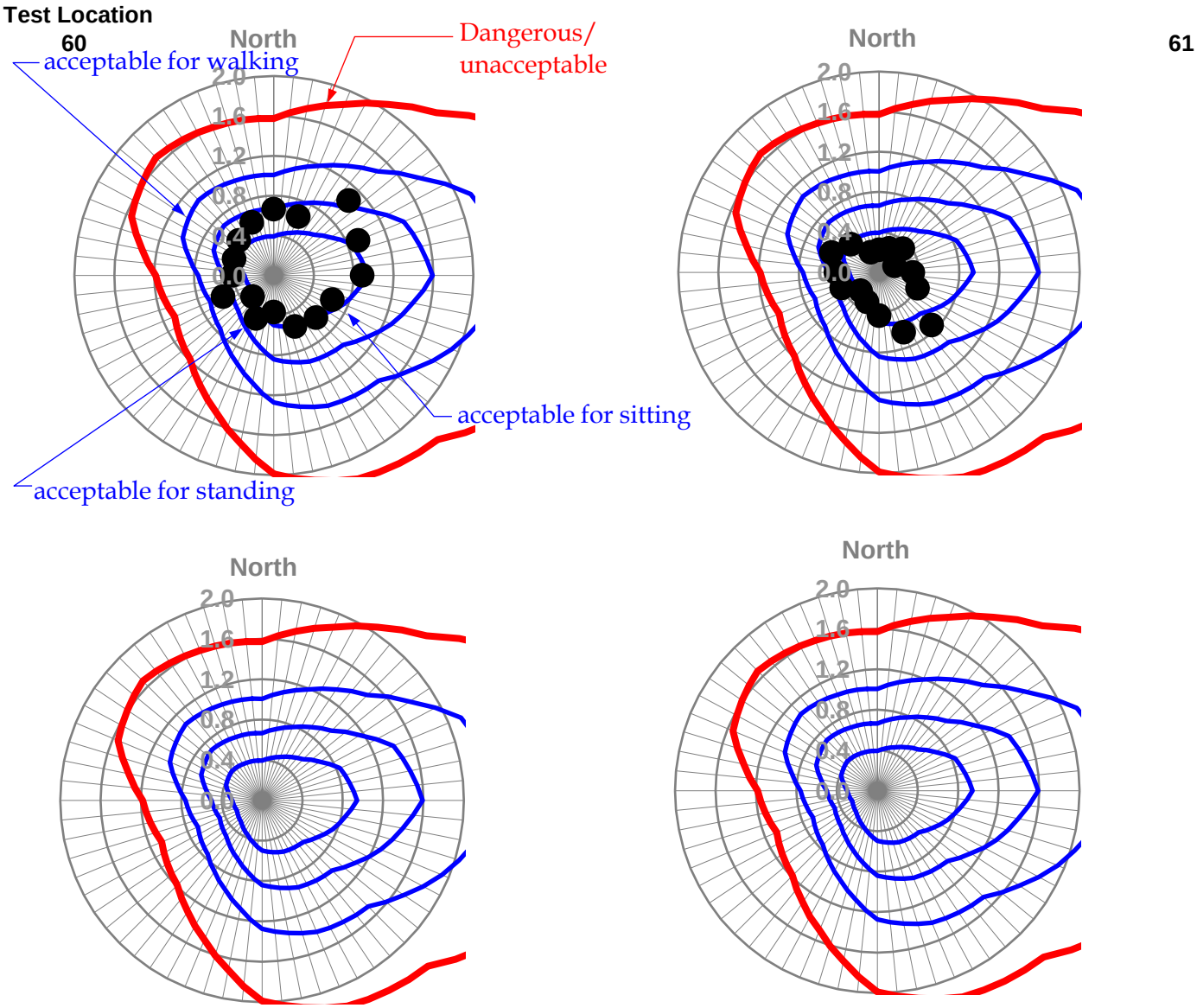


Figure A19 - Podium at Level 1 [CONTINUED]

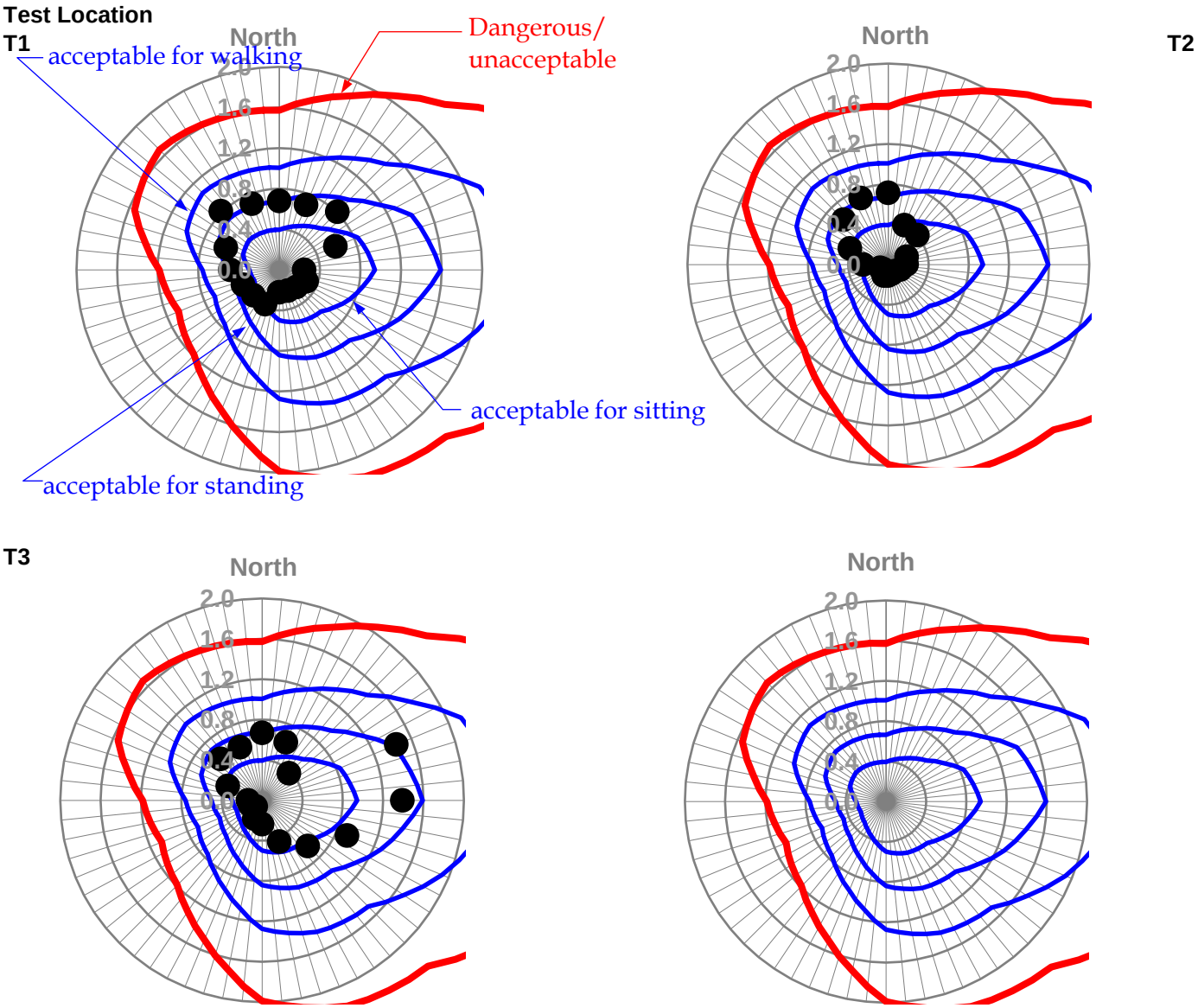


Figure A20 - Level 4 Terraces