Attachment B26(d)

Pedestrian Wind Environment Study Part 4 – Waterloo Estate (South) – Land and Housing Corporation

8 ASSESSMENT

This section will address study requirements 19.3, 19.4, 19.5, 19.6 and 19.7 by providing a detailed review of the wind tunnel conditions obtained from the wind tunnel test of the Waterloo South massing model.

Wind tunnel testing of the Waterloo South massing model was undertaken to identify the wind conditions and the findings used to devise wind amelioration strategies, outlined in Section 8.1. For areas not achieving appropriate wind conditions, treatments have been formulated and tested in the wind tunnel to ensure their effectiveness, outlined in Section 8.2. These treatments could be in the form of wind deflective elements such as screens, awnings, etc or vegetation that is already proposed for the site in the Tree Retention plan.

8.1 Ground Level Results

The results of the wind tunnel study are summarised in Table 7a. The wind speed criteria that the wind conditions should achieve at each study point location are also listed in Table 7a and shown on marked-up plans in Figure 10a – 10g. The results for all study points locations can be seen in the form of directional wind speed plots presented in Figures 11a – 11g.

Table 7b summarises the results of the study points with the inclusion of the treatment strategies. Appendix A consists of directional wind speed plots for all the study point locations for the Waterloo South massing with and without the inclusion of treatments.

Due to the relatively low to mid rise developments surrounding Waterloo South, the site receives limited shielding and is exposed to the predominant north-easterly, westerly and southerly winds for the region. The scattered nature of the proposed low to high rise towers of Waterloo South, as well as the close proximity of the Lots is seen to help stagnate and disrupt strong wind flow conditions and adverse funnelling through the laneways. The proposed setbacks are beneficial in providing a disturbance to downwash winds from the tower forms above.

The staggered alignment of the laneways is beneficial in minimising the potential for funnelling effects of the predominant winds. The landscaping intended to be maintained through the tree retention plan is expected to further assist in filtering the winds flowing throughout the site.

Localised corners at various Lots have been noted to experience corner accelerating winds resulting in wind conditions that exceed the comfort and/or safety criteria. These wind conditions are due to the interaction of the prevailing winds with the development built-form. The location of longer duration areas at the corners of buildings places them in an area where there is a high potential for adverse winds. Appropriate treatments can be implemented adjacent to the building corners to assist.

Strategic treatments are investigated in Section 8.2 to ameliorate the wind conditions for the proposed sites. Further wind tunnel testing of the Waterloo South ground level and elevated areas is recommended to be undertaken during the design development stage to further verify the suitability of specific areas for their intended purpose/usage.

Table 7a: Wind Tunnel Results Summary (Without the inclusion of treatments)

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Point 01	6.0	11%	Fail	24	22	Pass	Fail
Existing		11%	Fail		22	Pass	Fail
Point 02	6.0	16%	Fail	24	21	Pass	Fail
Existing		14%	Fail		21	Pass	Fail
Point 03	6.0	3%	Pass	24	17	Pass	Pass
Existing		8%	Fail		18	Pass	Fail
Point 04	6.0	3%	Pass	24	17	Pass	Pass
Existing		4%	Pass		17	Pass	Pass
Point 05	6.0	6%	Fail	24	18	Pass	Fail
Existing		2%	Pass		15	Pass	Pass
Point 06	6.0	5%	Pass	24	16	Pass	Pass
Existing		1%	Pass		14	Pass	Pass
Point 07	6.0	6%	Fail	24	17	Pass	Fail
Existing		5%	Pass		19	Pass	Pass
Point 08	8.0	1%	Pass	24	19	Pass	Pass
Point 09	8.0	1%	Pass	24	18	Pass	Pass
Point 10	8.0	1%	Pass	24	16	Pass	Pass
Point 11	8.0	9%	Fail	24	22	Pass	Fail
Existing		0%	Pass		13	Pass	Pass
Point 12	8.0	1%	Pass	24	17	Pass	Pass
Existing		0%	Pass		13	Pass	Pass
Point 13	8.0	2%	Pass	24	21	Pass	Pass
Existing		0%	Pass		12	Pass	Pass
Point 14	8.0	1%	Pass	24	19	Pass	Pass
Existing		0%	Pass		16	Pass	Pass
Point 15	8.0	0%	Pass	24	16	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Existing		0%	Pass		16	Pass	Pass
Point 16	8.0	0%	Pass	24	16	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 17	8.0	0%	Pass	24	12	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 18	8.0	2%	Pass	24	20	Pass	Pass
Point 19	8.0	1%	Pass	24	20	Pass	Pass
Existing		0%	Pass		13	Pass	Pass
Point 20	8.0	1%	Pass	24	19	Pass	Pass
Point 21	8.0	2%	Pass	24	19	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 22	8.0	0%	Pass	24	17	Pass	Pass
Existing		0%	Pass		12	Pass	Pass
Point 23	8.0	0%	Pass	24	16	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 24	8.0	0%	Pass	24	15	Pass	Pass
Existing		0%	Pass		12	Pass	Pass
Point 25	8.0	0%	Pass	24	15	Pass	Pass
Point 26	8.0	1%	Pass	24	18	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 27	8.0	2%	Pass	24	20	Pass	Pass
Existing		1%	Pass		19	Pass	Pass
Point 28	8.0	4%	Pass	24	21	Pass	Pass
Existing		0%	Pass		15	Pass	Pass
Point 29	8.0	3%	Pass	24	20	Pass	Pass
Point 30	8.0	8%	Pass	24	22	Pass	Pass
Existing		0%	Pass		16	Pass	Pass
Point 31	8.0	0%	Pass	24	15	Pass	Pass
Point 32	8.0	1%	Pass	24	19	Pass	Pass
Existing		0%	Pass		18	Pass	Pass
Point 33	8.0	2%	Pass	24	20	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Existing		0%	Pass		18	Pass	Pass
Point 34	8.0	0%	Pass	24	16	Pass	Pass
Existing		0%	Pass		18	Pass	Pass
Point 35	8.0	1%	Pass	24	19	Pass	Pass
Point 36	8.0	0%	Pass	24	15	Pass	Pass
Point 37	8.0	0%	Pass	24	13	Pass	Pass
Point 38	8.0	4%	Pass	24	21	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 39	8.0	1%	Pass	24	15	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 40	8.0	3%	Pass	24	20	Pass	Pass
Existing		1%	Pass		19	Pass	Pass
Point 41	8.0	2%	Pass	24	18	Pass	Pass
Existing		1%	Pass		17	Pass	Pass
Point 42	8.0	1%	Pass	24	17	Pass	Pass
Point 43	8.0	1%	Pass	24	17	Pass	Pass
Existing		0%	Pass		18	Pass	Pass
Point 44	8.0	1%	Pass	24	19	Pass	Pass
Existing		1%	Pass		20	Pass	Pass
Point 45	8.0	9%	Fail	24	21	Pass	Fail
Point 46	8.0	11%	Fail	24	22	Pass	Fail
Existing		1%	Pass		18	Pass	Pass
Point 47	8.0	3%	Pass	24	19	Pass	Pass
Existing		0%	Pass		16	Pass	Pass
Point 48	8.0	0%	Pass	24	17	Pass	Pass
Point 49	8.0	11%	Fail	24	23	Pass	Fail
Existing		1%	Pass		17	Pass	Pass
Point 50	8.0	3%	Pass	24	21	Pass	Pass
Existing		1%	Pass		17	Pass	Pass
Point 51	8.0	4%	Pass	24	22	Pass	Pass
Existing		0%	Pass		16	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Point 52	8.0	3%	Pass	24	23	Pass	Pass
Point 53	8.0	1%	Pass	24	17	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 54	8.0	3%	Pass	24	19	Pass	Pass
Point 55	8.0	0%	Pass	24	13	Pass	Pass
Point 56	8.0	0%	Pass	24	15	Pass	Pass
Point 57	8.0	1%	Pass	24	17	Pass	Pass
Existing		0%	Pass		12	Pass	Pass
Point 58	8.0	3%	Pass	24	20	Pass	Pass
Point 59	8.0	0%	Pass	24	17	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 60	8.0	0%	Pass	24	13	Pass	Pass
Point 61	8.0	0%	Pass	24	10	Pass	Pass
Point 62	8.0	3%	Pass	24	21	Pass	Pass
Point 63	8.0	1%	Pass	24	19	Pass	Pass
Point 64	8.0	0%	Pass	24	15	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 65	8.0	3%	Pass	24	19	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 66	8.0	1%	Pass	24	17	Pass	Pass
Point 67	8.0	4%	Pass	24	19	Pass	Pass
Point 68	8.0	1%	Pass	24	18	Pass	Pass
Existing		1%	Pass		20	Pass	Pass
Point 69	8.0	28%	Fail	24	30	Fail	Fail
Existing		8%	Fail		22	Pass	Fail
Point 70	8.0	1%	Pass	24	18	Pass	Pass
Point 71	8.0	2%	Pass	24	19	Pass	Pass
Point 72	8.0	3%	Pass	24	19	Pass	Pass
Existing		0%	Pass		15	Pass	Pass
Point 73	8.0	1%	Pass	24	17	Pass	Pass
Point 74	8.0	1%	Pass	24	16	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Point 75	8.0	9%	Pass	24	22	Pass	Pass
Existing		1%	Pass		18	Pass	Pass
Point 76	8.0	5%	Pass	24	23	Pass	Pass
Existing		0%	Pass		17	Pass	Pass
Point 77	8.0	0%	Pass	24	10	Pass	Pass
Point 78	8.0	5%	Pass	24	23	Pass	Pass
Point 79	8.0	0%	Pass	24	12	Pass	Pass
Point 80	8.0	15%	Fail	24	30	Fail	Fail
Point 81	8.0	1%	Pass	24	20	Pass	Pass
Point 82	8.0	4%	Pass	24	21	Pass	Pass
Existing		1%	Pass		18	Pass	Pass
Point 83	8.0	0%	Pass	24	14	Pass	Pass
Point 84	8.0	2%	Pass	24	20	Pass	Pass
Existing		0%	Pass		17	Pass	Pass
Point 85	8.0	1%	Pass	24	18	Pass	Pass
Existing		1%	Pass		20	Pass	Pass
Point 86	8.0	1%	Pass	24	17	Pass	Pass
Point 87	8.0	4%	Pass	24	25	Fail	Fail
Point 88	8.0	2%	Pass	24	21	Pass	Pass
Point 89	8.0	2%	Pass	24	17	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 90	8.0	0%	Pass	24	14	Pass	Pass
Point 91	8.0	3%	Pass	24	21	Pass	Pass
Point 92	8.0	1%	Pass	24	19	Pass	Pass
Existing		1%	Pass		19	Pass	Pass
Point 93	8.0	2%	Pass	24	20	Pass	Pass
Point 94	8.0	2%	Pass	24	20	Pass	Pass
Point 95	8.0	16%	Fail	24	27	Fail	Fail
Existing		1%	Pass		16	Pass	Pass
Point 96	8.0	2%	Pass	24	20	Pass	Pass
Existing		1%	Pass		16	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Point 97	8.0	1%	Pass	24	18	Pass	Pass
Point 98	8.0	2%	Pass	24	18	Pass	Pass
Existing		1%	Pass		20	Pass	Pass
Point 99	8.0	9%	Fail	24	21	Pass	Fail
Point 100	8.0	1%	Pass	24	17	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 101	8.0	14%	Fail	24	23	Pass	Fail
Existing		1%	Pass		16	Pass	Pass
Point 102	8.0	2%	Pass	24	19	Pass	Pass
Existing		1%	Pass		19	Pass	Pass
Point 103	8.0	2%	Pass	24	19	Pass	Pass
Point 104	8.0	0%	Pass	24	17	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 105	8.0	2%	Pass	24	21	Pass	Pass
Point 106	8.0	1%	Pass	24	17	Pass	Pass
Point 107	8.0	0%	Pass	24	14	Pass	Pass
Point 108	8.0	1%	Pass	24	17	Pass	Pass
Point 109	8.0	3%	Pass	24	18	Pass	Pass
Existing		1%	Pass		16	Pass	Pass
Point 110	8.0	0%	Pass	24	14	Pass	Pass
Point 111	8.0	0%	Pass	24	14	Pass	Pass
Existing		2%	Pass		19	Pass	Pass
Point 112	8.0	1%	Pass	24	18	Pass	Pass
Point 113	8.0	1%	Pass	24	18	Pass	Pass
Existing		1%	Pass		18	Pass	Pass
Point 114	8.0	19%	Fail	24	24	Pass	Fail
Existing		1%	Pass		18	Pass	Pass
Point 115	8.0	5%	Pass	24	20	Pass	Pass
Existing		1%	Pass		18	Pass	Pass
Point 116	8.0	9%	Fail	24	22	Pass	Fail
Existing		1%	Pass		18	Pass	Pass

Study Point	GEM (5% exceedance)			Annual Gust			Final Result
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade	
Point 117	8.0	1%	Pass	24	20	Pass	Pass
Existing		2%	Pass		19	Pass	Pass
Point 118	8.0	2%	Pass	24	20	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 119	8.0	1%	Pass	24	17	Pass	Pass
Existing		8%	Fail		23	Pass	Fail
Point 120	8.0	4%	Pass	24	21	Pass	Pass
Existing		1%	Pass		19	Pass	Pass
Point 121	8.0	2%	Pass	24	22	Pass	Pass
Existing		3%	Pass		23	Pass	Pass
Point 122	8.0	4%	Pass	24	21	Pass	Pass
Existing		0%	Pass		14	Pass	Pass
Point 123	8.0	2%	Pass	24	22	Pass	Pass
Existing		0%	Pass		13	Pass	Pass
Point 124	8.0	0%	Pass	24	15	Pass	Pass
Existing		0%	Pass		16	Pass	Pass
Point 125	8.0	1%	Pass	24	21	Pass	Pass
Existing		6%	Fail		25	Fail	Fail

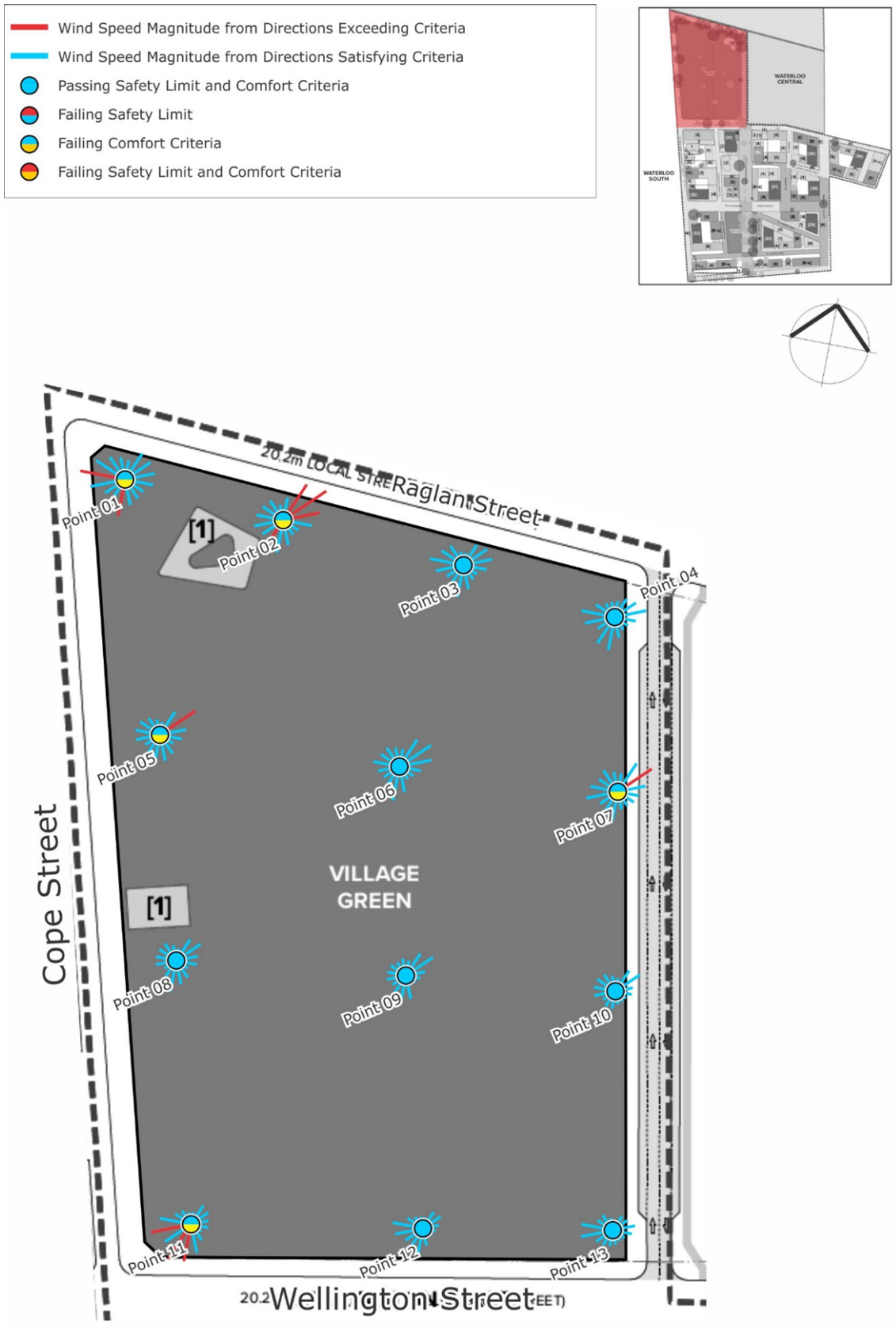

Figure 11a Wind Directionality Plots – Lot A, B, C
(without treatments applied)

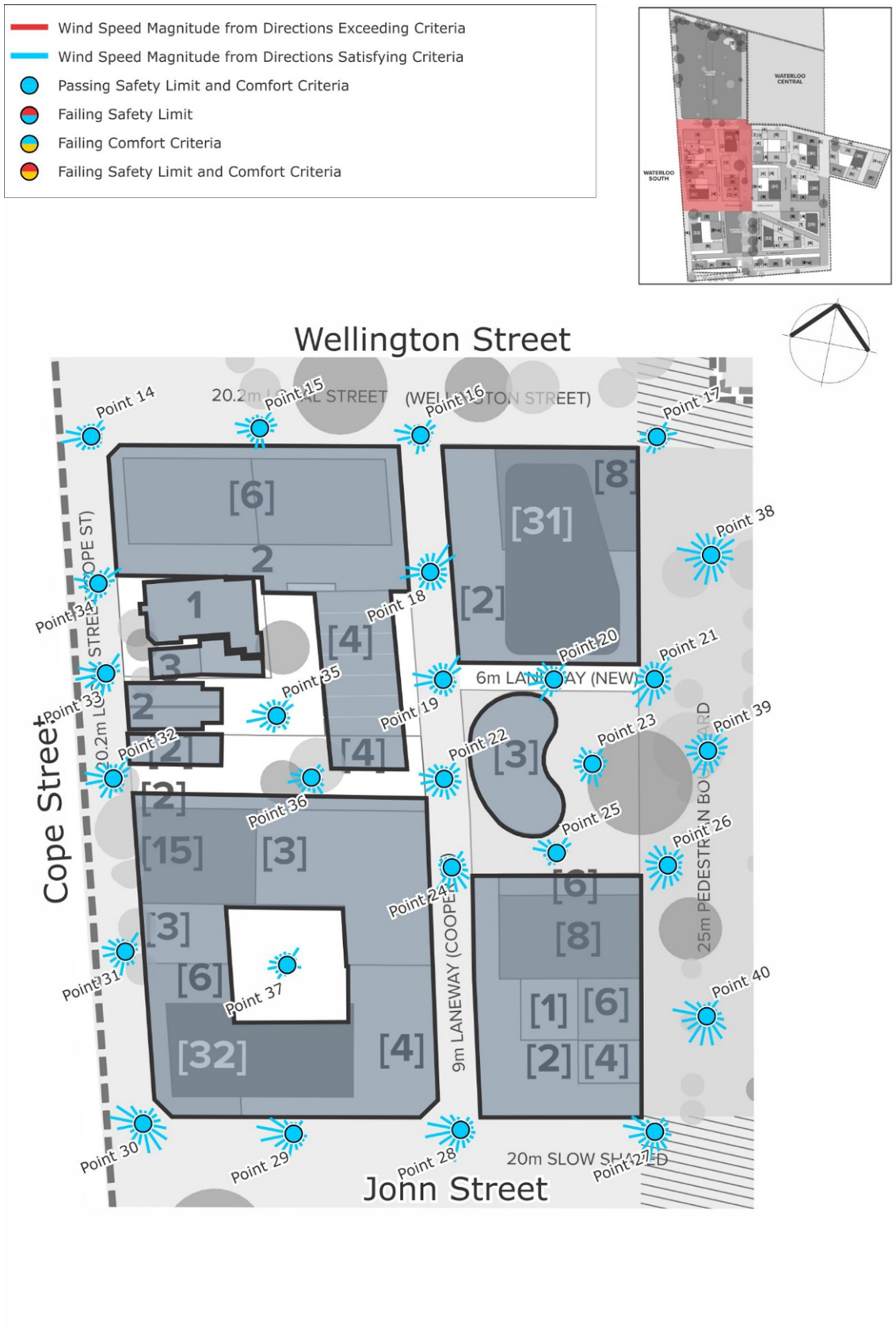

Figure 11b: Wind Directionality Plots – Lot D and E
(without treatments applied)

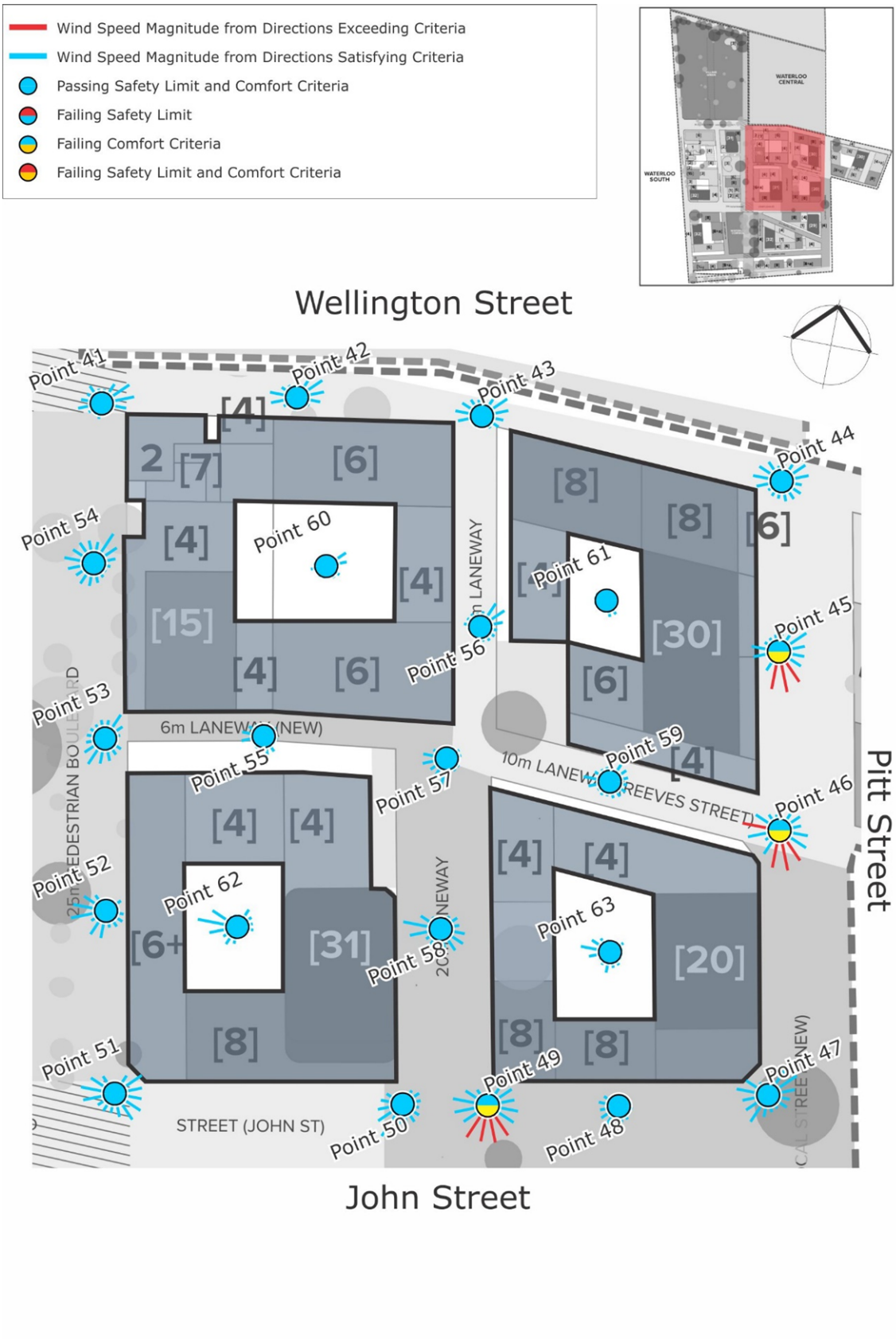

Figure 11c: Wind Directionality Plots – Lot F and Village Green (without treatments applied)

Figure 11d: Wind Directionality Plots – Lot H, I, J and K (without treatments applied)

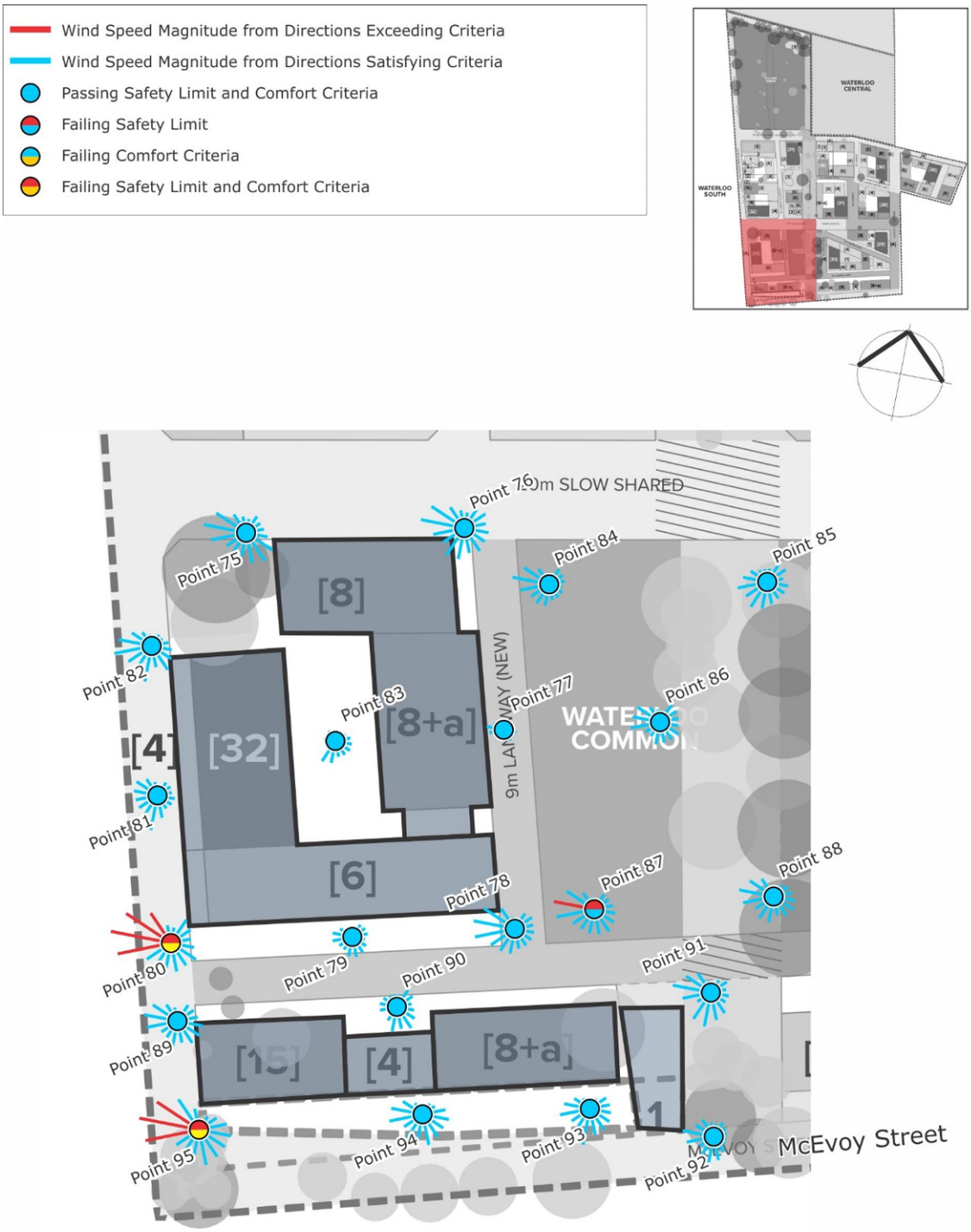

Figure 11e: Wind Directionality Plots – Lot L, M, Q and R
(without treatments applied)

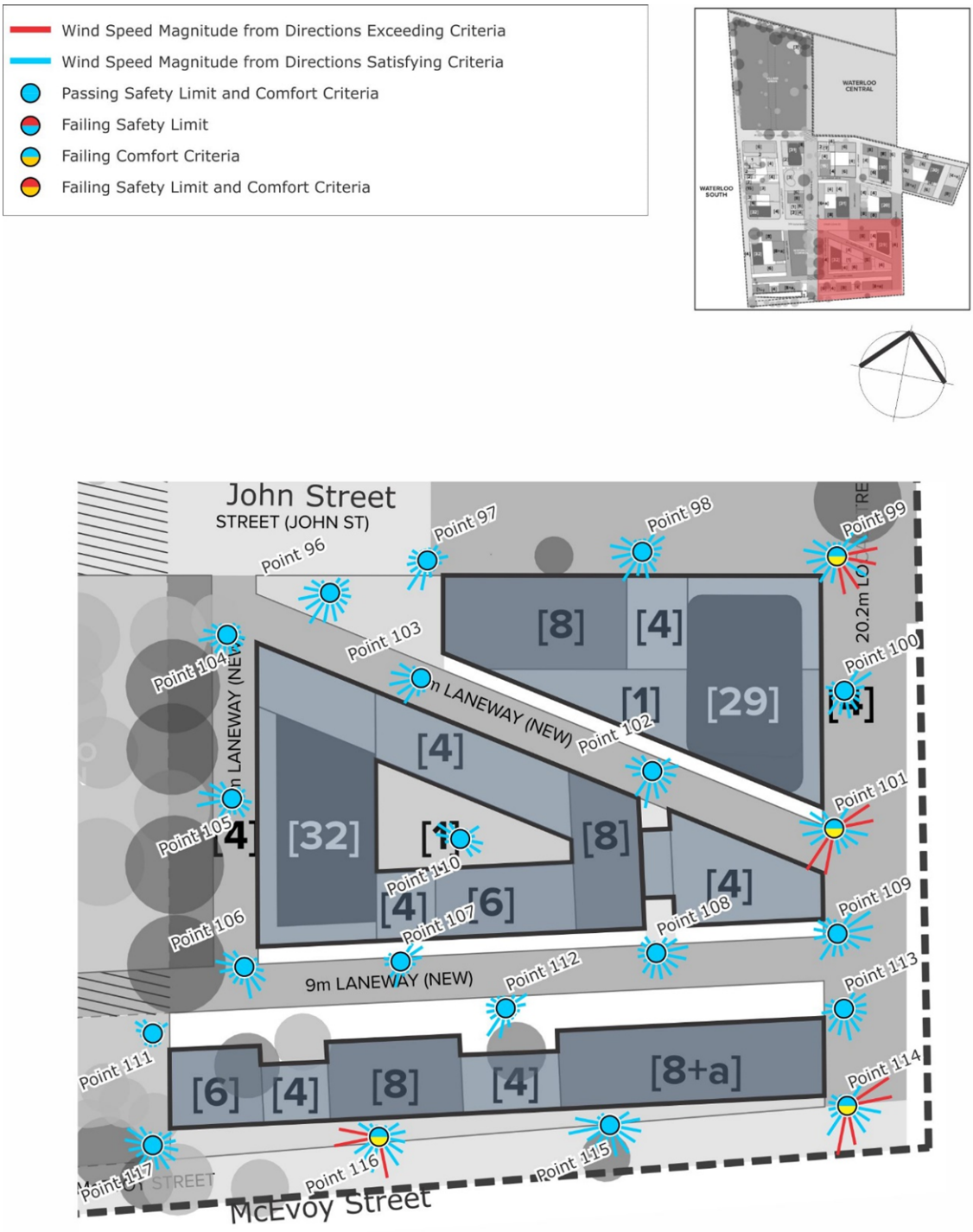

Figure 11f: Wind Directionality Plots – Lot N, O, P, S and T
(without treatments applied)

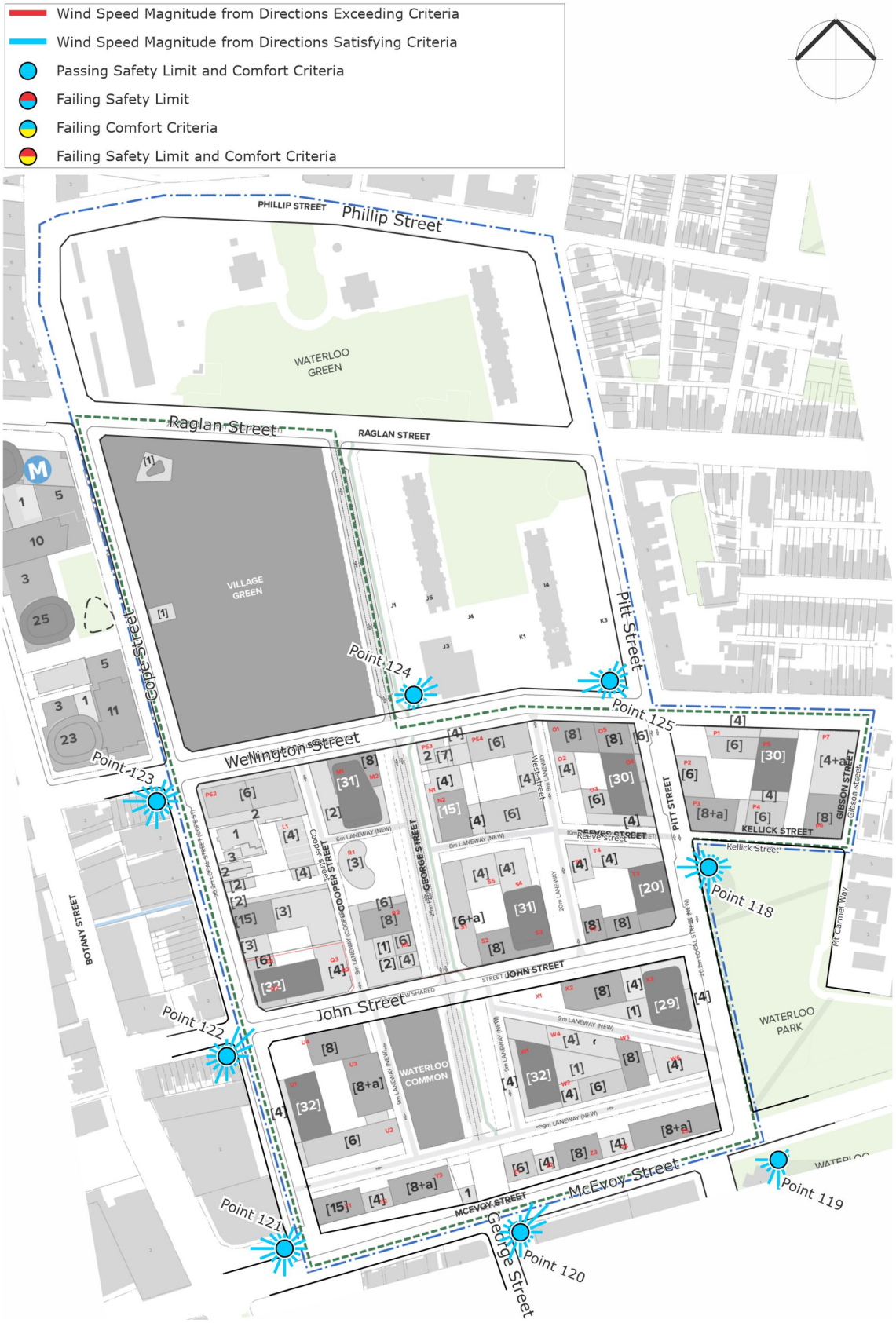

Figure 11g: Wind Directionality Plots – Surrounding Areas (without treatments applied)

8.2 Proposed Treatments

The results of the study indicate that treatments are required at particular locations to achieve the desired criteria for pedestrian comfort and safety. The recommended treatments, which have been tested in the wind tunnel are summarised as follows:

- Recommended wrap around awning on western and southern aspects of Building Q1, as shown in Figure 12a.
- Recommended wrap around awning on western and southern aspects of Building U2, as shown in Figure 12b.
- Recommended wrap around awning on western and southern aspects of Building Y1, as shown in Figure 12b.
- Recommended chamfering of south-east building corner on Building Z5, as shown in Figure 12c.
- Recommended wrap around awning on eastern and southern aspects of Building Z5, as shown in Figure 12c.
- Recommended porous screen at north-west corner of Building U4, as shown in Figure 12b.
- Retention of trees as noted in tree retention plan (No.: 17018, Dwg.: 710.3, dated: 18.2.20).

With the inclusion of these recommended treatments to the proposed Waterloo South masterplan, the results of the study indicate that the ground level wind conditions within and around the precinct satisfy the pedestrian comfort and safety criteria. The proposed building and tower forms, podium setbacks, and Lot layouts combined with the recommended treatments demonstrates that acceptable wind comfort and safety conditions are met for all areas. Table 7b summarises the results of the study points with the inclusion of the treatment strategies.

Furthermore, the Waterloo South masterplan with the inclusion of the recommended treatments indicates that a majority of pedestrian footpaths, public areas and communal spaces within and around the Lots satisfy the Standing criteria. This includes the majority of the Village Green and sections of Waterloo Common.

For specific areas to achieve the Sitting criteria, further treatments would be required to be implemented, which would be investigated during a detailed design stage to develop strategic treatments via wind tunnel testing. The location of areas to meet the Sitting criteria near building corners places them in an area where there is the high potential for adverse winds to occur. The treatments could be in the form of additional localised screening (impermeable or porous), densely foliating tree and/or hedge planting or mobile/operable screens, which are

recommended to be implemented adjacent to areas that are intended to be used for short or long duration activities.

Further wind tunnel testing of the Waterloo South ground level and elevated areas is recommended to be undertaken during the design development stage to further verify the suitability of the areas for their intended usage/purpose.

Figure 12a: Recommended Treatments – Lot L, M, PS, R and Q

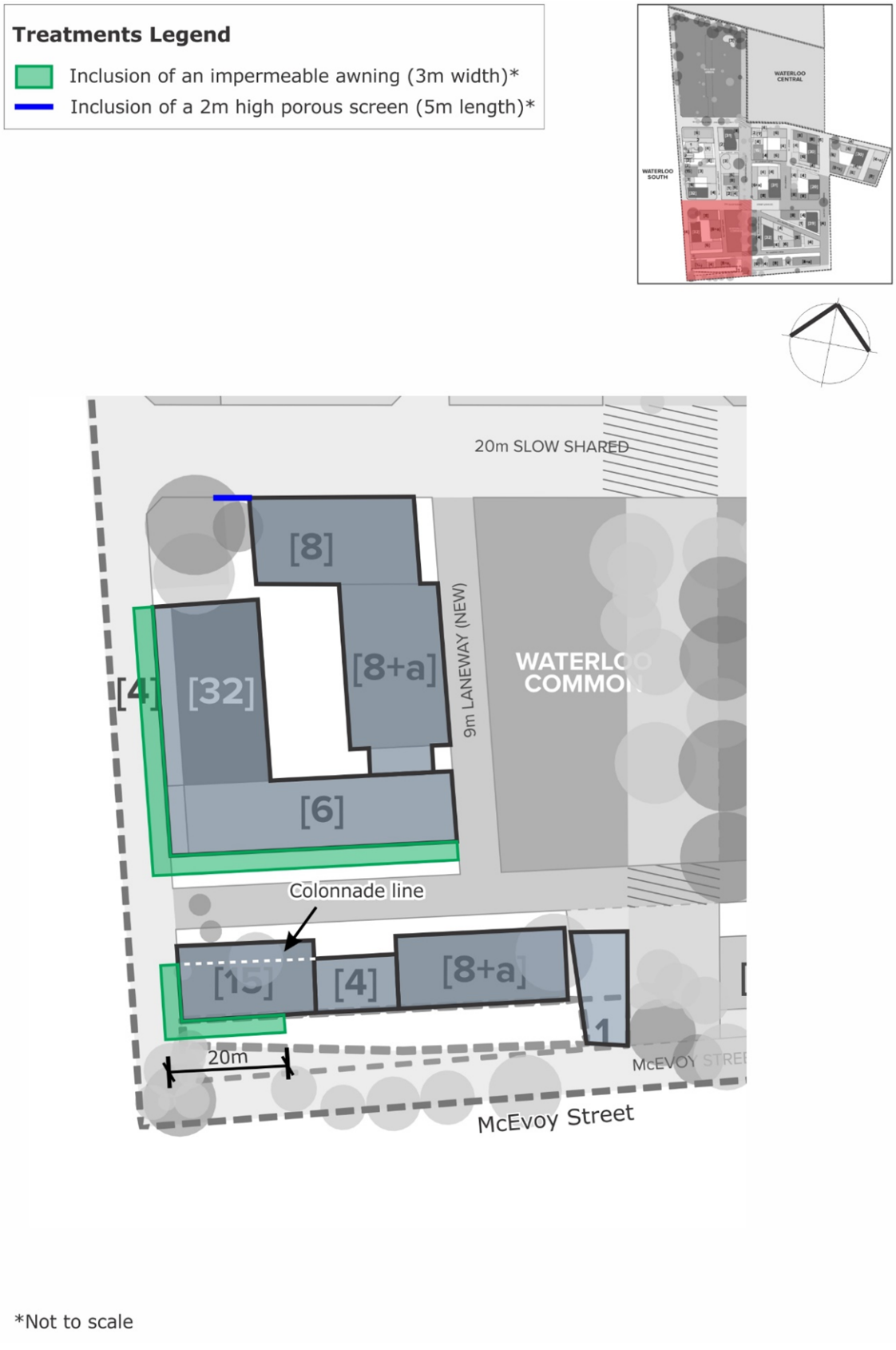

Figure 12b: Recommended Treatments – Lot U and Y

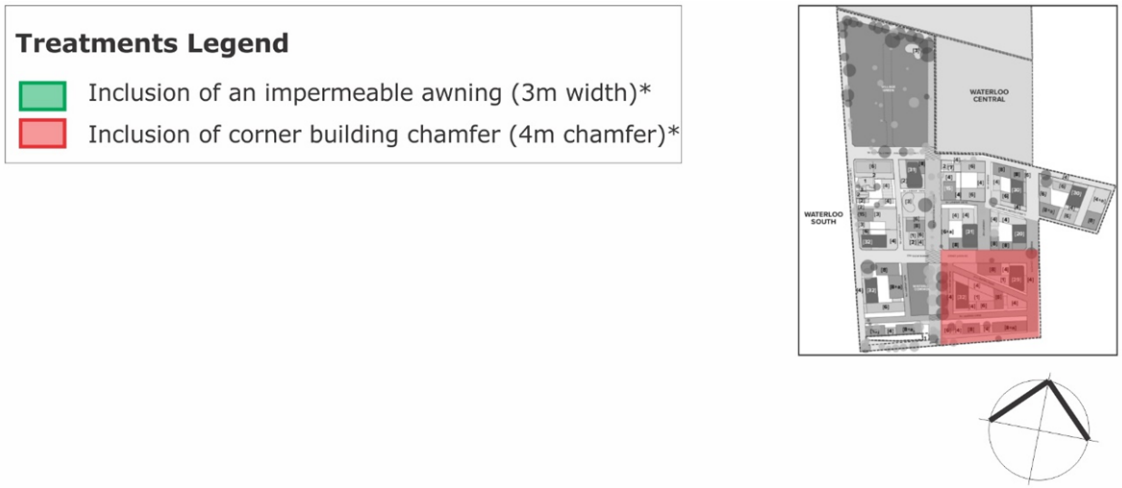

Figure 12c: Recommended Treatments – Lot W, X and Z

8.3 Ground Level Treatment Results

The recommended treatments have been tested in the wind tunnel. The results of the wind conditions for the study points exceeding the comfort and/or safety criteria with the inclusion of the treatments are summarised in Table 7b. The wind speed criteria that the wind conditions should achieve at each study point location are also listed in Table 7b. For study points that did not require a treatment strategy the description in Table 7b has been left blank intentionally and the results translated from Table 7a.

Appendix A consists of directional wind speed plots for all the study point locations for the Waterloo South massing with and without the inclusion of treatments.

The results for study points locations can be seen in the form of directional wind speed plots presented in Figures 13a – 13g.

Table 7b: Wind Tunnel Results Summary (With the inclusion of treatments)

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 01	6.0	4%	Pass	24	16	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		11%	Fail		22	Pass	Fail	
Point 02	6.0	5%	Pass	24	15	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		14%	Fail		21	Pass	Fail	
Point 03	6.0	3%	Pass	24	17	Pass	Pass	
Existing		8%	Fail		18	Pass	Fail	
Point 04	6.0	3%	Pass	24	17	Pass	Pass	
Existing		4%	Pass		17	Pass	Pass	
Point 05	6.0	1%	Pass	24	13	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		2%	Pass		15	Pass	Pass	
Point 06	6.0	5%	Pass	24	16	Pass	Pass	
Existing		1%	Pass		14	Pass	Pass	
Point 07	6.0	2%	Pass	24	15	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		5%	Pass		19	Pass	Pass	
Point 08	8.0	1%	Pass	24	19	Pass	Pass	
Point 09	8.0	1%	Pass	24	18	Pass	Pass	
Point 10	8.0	1%	Pass	24	16	Pass	Pass	
Point 11	8.0	0%	Pass	24	16	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Existing		0%	Pass		13	Pass	Pass	With inclusion of Existing and Retained Trees
Point 12	8.0	1%	Pass	24	17	Pass	Pass	
Existing		0%	Pass		13	Pass	Pass	
Point 13	8.0	2%	Pass	24	21	Pass	Pass	
Existing		0%	Pass		12	Pass	Pass	
Point 14	8.0	1%	Pass	24	19	Pass	Pass	
Existing		0%	Pass		16	Pass	Pass	
Point 15	8.0	0%	Pass	24	16	Pass	Pass	
Existing		0%	Pass		16	Pass	Pass	
Point 16	8.0	0%	Pass	24	16	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 17	8.0	0%	Pass	24	12	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 18	8.0	2%	Pass	24	20	Pass	Pass	
Point 19	8.0	1%	Pass	24	20	Pass	Pass	
Existing		0%	Pass		13	Pass	Pass	
Point 20	8.0	1%	Pass	24	19	Pass	Pass	
Point 21	8.0	2%	Pass	24	19	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 22	8.0	0%	Pass	24	17	Pass	Pass	
Existing		0%	Pass		12	Pass	Pass	
Point 23	8.0	0%	Pass	24	16	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 24	8.0	0%	Pass	24	15	Pass	Pass	
Existing		0%	Pass		12	Pass	Pass	
Point 25	8.0	0%	Pass	24	15	Pass	Pass	
Point 26	8.0	1%	Pass	24	18	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 27	8.0	2%	Pass	24	20	Pass	Pass	
Existing		1%	Pass		19	Pass	Pass	
Point 28	8.0	4%	Pass	24	21	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Existing		0%	Pass		15	Pass	Pass	
Point 29	8.0	3%	Pass	24	20	Pass	Pass	
Point 30	8.0	4%	Pass	24	21	Pass	Pass	Awning along Western and Southern façade of LOT Q
Existing		0%	Pass		16	Pass	Pass	
Point 31	8.0	0%	Pass	24	15	Pass	Pass	
Point 32	8.0	1%	Pass	24	19	Pass	Pass	
Existing		0%	Pass		18	Pass	Pass	
Point 33	8.0	2%	Pass	24	20	Pass	Pass	
Existing		0%	Pass		18	Pass	Pass	
Point 34	8.0	0%	Pass	24	16	Pass	Pass	
Existing		0%	Pass		18	Pass	Pass	
Point 35	8.0	1%	Pass	24	19	Pass	Pass	
Point 36	8.0	0%	Pass	24	15	Pass	Pass	
Point 37	8.0	0%	Pass	24	13	Pass	Pass	
Point 38	8.0	4%	Pass	24	21	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 39	8.0	1%	Pass	24	15	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 40	8.0	3%	Pass	24	20	Pass	Pass	
Existing		1%	Pass		19	Pass	Pass	
Point 41	8.0	2%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		17	Pass	Pass	
Point 42	8.0	1%	Pass	24	17	Pass	Pass	
Point 43	8.0	1%	Pass	24	17	Pass	Pass	
Existing		0%	Pass		18	Pass	Pass	
Point 44	8.0	1%	Pass	24	19	Pass	Pass	
Existing		1%	Pass		20	Pass	Pass	
Point 45	8.0	2%	Pass	24	20	Pass	Pass	With inclusion of Existing and Retained Trees
Point 46	8.0	5%	Pass	24	22	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		1%	Pass		18	Pass	Pass	
Point 47	8.0	3%	Pass	24	19	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Existing		0%	Pass		16	Pass	Pass	
Point 48	8.0	0%	Pass	24	17	Pass	Pass	
Point 49	8.0	1%	Pass	24	17	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		1%	Pass		17	Pass	Pass	
Point 50	8.0	3%	Pass	24	21	Pass	Pass	
Existing		1%	Pass		17	Pass	Pass	
Point 51	8.0	4%	Pass	24	22	Pass	Pass	
Existing		0%	Pass		16	Pass	Pass	
Point 52	8.0	3%	Pass	24	23	Pass	Pass	
Point 53	8.0	1%	Pass	24	17	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 54	8.0	3%	Pass	24	19	Pass	Pass	
Point 55	8.0	0%	Pass	24	13	Pass	Pass	
Point 56	8.0	0%	Pass	24	15	Pass	Pass	
Point 57	8.0	1%	Pass	24	17	Pass	Pass	
Existing		0%	Pass		12	Pass	Pass	
Point 58	8.0	3%	Pass	24	20	Pass	Pass	
Point 59	8.0	0%	Pass	24	17	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 60	8.0	0%	Pass	24	13	Pass	Pass	
Point 61	8.0	0%	Pass	24	10	Pass	Pass	
Point 62	8.0	3%	Pass	24	21	Pass	Pass	
Point 63	8.0	1%	Pass	24	19	Pass	Pass	
Point 64	8.0	0%	Pass	24	15	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 65	8.0	3%	Pass	24	19	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 66	8.0	1%	Pass	24	17	Pass	Pass	
Point 67	8.0	4%	Pass	24	19	Pass	Pass	
Point 68	8.0	1%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		20	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 69	8.0	2%	Pass	24	20	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		8%	Fail		22	Pass	Fail	
Point 70	8.0	1%	Pass	24	18	Pass	Pass	
Point 71	8.0	2%	Pass	24	19	Pass	Pass	
Point 72	8.0	3%	Pass	24	19	Pass	Pass	
Existing		0%	Pass		15	Pass	Pass	
Point 73	8.0	1%	Pass	24	17	Pass	Pass	
Point 74	8.0	1%	Pass	24	16	Pass	Pass	
Point 75	8.0	5%	Pass	24	22	Pass	Pass	Inclusion of porous screen - 5m length x 2m height adjacent Building U4
Existing		1%	Pass		18	Pass	Pass	
Point 76	8.0	5%	Pass	24	23	Pass	Pass	
Existing		0%	Pass		17	Pass	Pass	
Point 77	8.0	0%	Pass	24	10	Pass	Pass	
Point 78	8.0	5%	Pass	24	23	Pass	Pass	
Point 79	8.0	0%	Pass	24	12	Pass	Pass	
Point 80	8.0	3%	Pass	24	20	Pass	Pass	Awning along Western and Southern façade of LOT U
Point 81	8.0	1%	Pass	24	20	Pass	Pass	
Point 82	8.0	4%	Pass	24	21	Pass	Pass	
Existing		1%	Pass		18	Pass	Pass	
Point 83	8.0	0%	Pass	24	14	Pass	Pass	
Point 84	8.0	2%	Pass	24	20	Pass	Pass	
Existing		0%	Pass		17	Pass	Pass	
Point 85	8.0	1%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		20	Pass	Pass	
Point 86	8.0	1%	Pass	24	17	Pass	Pass	
Point 87	8.0	0%	Pass	24	17	Pass	Pass	Awning along Western and Southern façade of LOT U
Point 88	8.0	2%	Pass	24	21	Pass	Pass	
Point 89	8.0	2%	Pass	24	17	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 90	8.0	0%	Pass	24	14	Pass	Pass	
Point 91	8.0	3%	Pass	24	21	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 92	8.0	1%	Pass	24	19	Pass	Pass	
Existing		1%	Pass		19	Pass	Pass	
Point 93	8.0	2%	Pass	24	20	Pass	Pass	
Point 94	8.0	2%	Pass	24	20	Pass	Pass	
Point 95	8.0	0%	Pass	24	16	Pass	Pass	Wrap around awning along Western Façade and part of Southern of Building Y1
Existing		1%	Pass		16	Pass	Pass	
Point 96	8.0	1%	Pass	24	16	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		1%	Pass		16	Pass	Pass	
Point 97	8.0	1%	Pass	24	18	Pass	Pass	
Point 98	8.0	2%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		20	Pass	Pass	
Point 99	8.0	1%	Pass	24	18	Pass	Pass	With inclusion of Existing and Retained Trees
Point 100	8.0	1%	Pass	24	17	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 101	8.0	3%	Pass	24	17	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		1%	Pass		16	Pass	Pass	
Point 102	8.0	2%	Pass	24	19	Pass	Pass	
Existing		1%	Pass		19	Pass	Pass	
Point 103	8.0	2%	Pass	24	19	Pass	Pass	
Point 104	8.0	0%	Pass	24	17	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 105	8.0	2%	Pass	24	21	Pass	Pass	
Point 106	8.0	1%	Pass	24	17	Pass	Pass	
Point 107	8.0	0%	Pass	24	14	Pass	Pass	
Point 108	8.0	1%	Pass	24	17	Pass	Pass	
Point 109	8.0	3%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		16	Pass	Pass	
Point 110	8.0	0%	Pass	24	14	Pass	Pass	
Point 111	8.0	0%	Pass	24	14	Pass	Pass	
Existing		2%	Pass		19	Pass	Pass	
Point 112	8.0	1%	Pass	24	18	Pass	Pass	

Study Point	GEM (5% exceedance)			Annual Gust			Final Result	Description of Treatment
	Criterion (m/s)	Results (%)	Grade	Criterion (m/s)	Results (m/s)	Grade		
Point 113	8.0	1%	Pass	24	18	Pass	Pass	
Existing		1%	Pass		18	Pass	Pass	
Point 114	8.0	2%	Pass	24	19	Pass	Pass	Awning along Eastern and part of Southern Façade and chamfer of Building Z5
Existing		1%	Pass		18	Pass	Pass	
Point 115	8.0	5%	Pass	24	20	Pass	Pass	
Existing		1%	Pass		18	Pass	Pass	
Point 116	8.0	0%	Pass	24	13	Pass	Pass	With inclusion of Existing and Retained Trees
Existing		1%	Pass		18	Pass	Pass	
Point 117	8.0	1%	Pass	24	20	Pass	Pass	
Existing		2%	Pass		19	Pass	Pass	
Point 118	8.0	2%	Pass	24	20	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 119	8.0	1%	Pass	24	17	Pass	Pass	
Existing		8%	Fail		23	Pass	Fail	
Point 120	8.0	4%	Pass	24	21	Pass	Pass	
Existing		1%	Pass		19	Pass	Pass	
Point 121	8.0	2%	Pass	24	22	Pass	Pass	
Existing		3%	Pass		23	Pass	Pass	
Point 122	8.0	4%	Pass	24	21	Pass	Pass	
Existing		0%	Pass		14	Pass	Pass	
Point 123	8.0	2%	Pass	24	22	Pass	Pass	
Existing		0%	Pass		13	Pass	Pass	
Point 124	8.0	0%	Pass	24	15	Pass	Pass	
Existing		0%	Pass		16	Pass	Pass	
Point 125	8.0	1%	Pass	24	21	Pass	Pass	
Existing		6%	Fail		25	Fail	Fail	

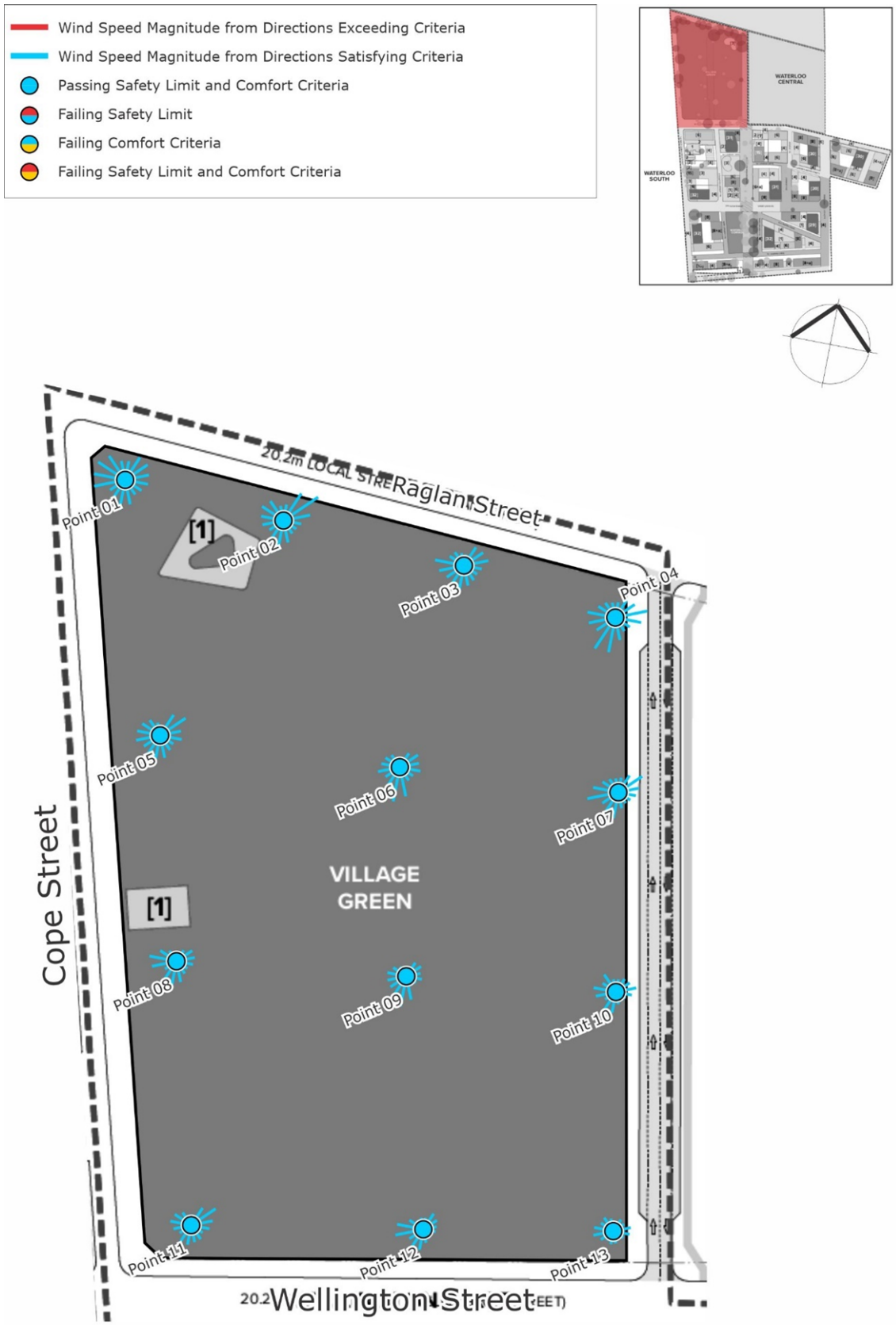

Figure 13a Wind Directionality Plots – Village Green
(with treatments applied)

Figure 13b: Wind Directionality Plots – Lot L, M, PS, R and Q (with treatments applied)

Figure 13c: Wind Directionality Plots – Lot PS, O, S and T
(with treatments applied)

Figure 13d: Wind Directionality Plots – Lot P
(with treatments applied)

Figure 13e: Wind Directionality Plots – Lot U and Y
(with treatments applied)

Figure 13f: Wind Directionality Plots – Lot W, X and Z
(with treatments applied)

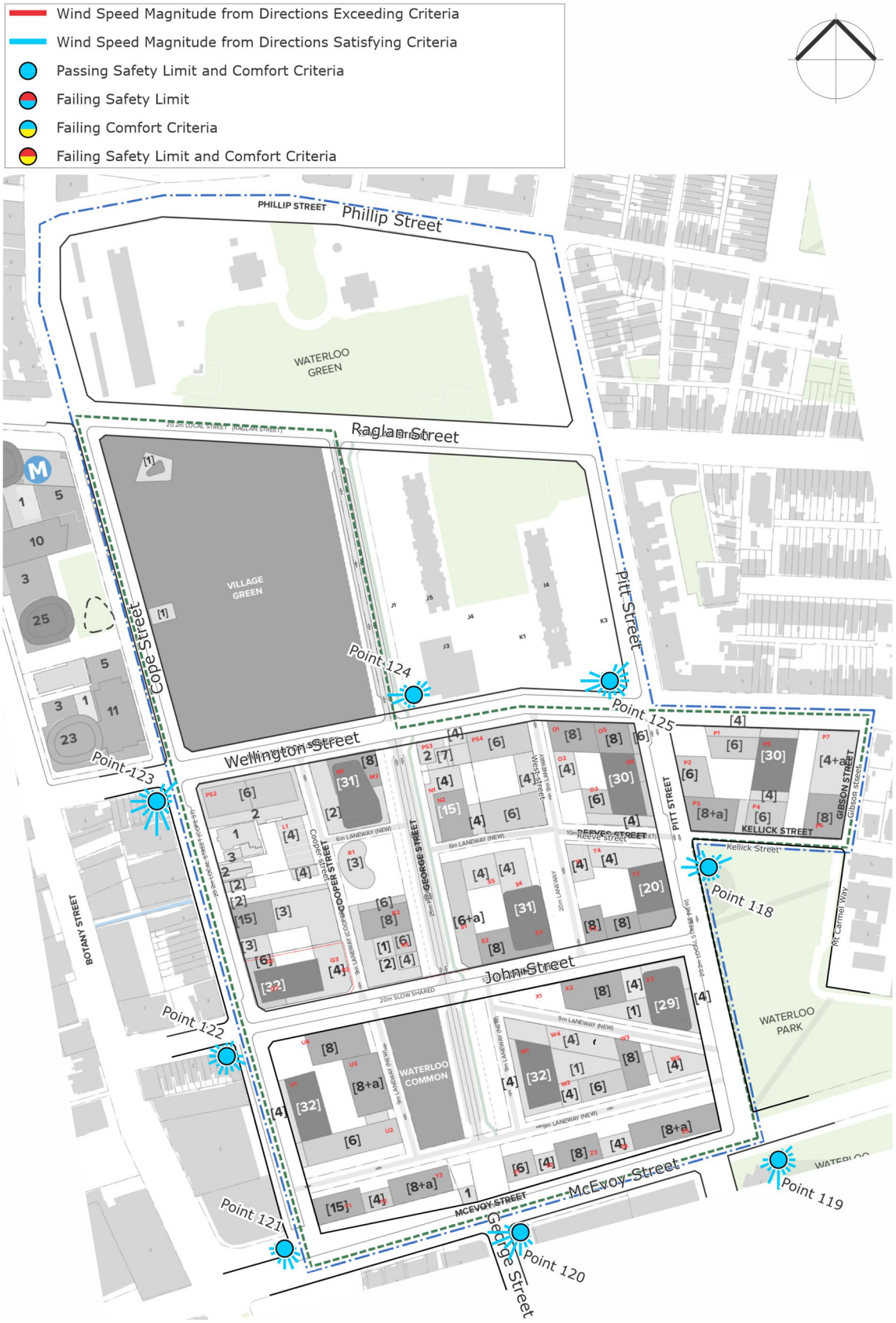

Figure 13g: Wind Directionality Plots – Lot U, V, W, X, Y and Z (with treatments applied)

9 CONCLUSION

This report presents the results of a detailed investigation into the wind environment conditions for the proposed Waterloo South development site. The wind conditions for the existing site and proposed massing model of Waterloo South were tested at critical ground level locations within and around the site.

Wind tunnel 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 16 wind directions at 22.5 degree increments. Testing was carried out using a 1:400 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 600m. The testing procedures were based on the guidelines set out in the Australasian Wind Engineering Society Quality Assurance Manual (AWES-QAM-1-2017), ASCE 7-10 (Chapter C31), and CTBUH (2013).

Peak gust and mean wind speeds were measured at selected critical outdoor trafficable locations within and 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, respectively.

The existing site wind conditions were measured with the incorporation of the existing site developments. Wind tunnel testing allowed for a baseline wind case for the existing site conditions of the proposed development precinct to be established, taking into account the prevailing wind directions for the area, as well as the local topographical effects of the terrain and the surrounding buildings of the proposed site. An assessment of the wind conditions was made and the information used by the design team to coordinate a massing model.

Wind tunnel testing of the proposed Waterloo South masterplan was undertaken, based on the drawing package prepared by the project architect Turner, received February 2020. The results of the study indicate that wind conditions for the majority of trafficable outdoor locations within and around the development will be suitable for their intended uses. Areas where the comfort and/or safety criteria were exceeded additional treatments have been incorporated into the design. The recommended treatments, which have been tested in the wind tunnel are summarised as follows:

- Recommended wrap around awning on western and southern aspects of Building Q1.
- Recommended wrap around awning on western and southern aspects of Building U2.
- Recommended wrap around awning on western and southern aspects of Building Y1.

- Recommended chamfering of south-east building corner on Building Z5.
- Recommended wrap around awning on eastern and southern aspects of Building Z5.
- Recommended porous screen at north-west corner of Building U4.
- Retention of trees as noted in tree retention plan (No.: 17018, Dwg.: 710.3, dated: 18.2.20)

Comparison between the existing site wind conditions and the proposed Waterloo South indicate that a majority of areas are similar to the existing site conditions. The proposed building and tower forms, podium setbacks, and Lot layouts combined with the recommended treatments demonstrates that the ground level wind conditions satisfy both the comfort and safety criteria.

Further wind tunnel testing of the ground level and elevated areas within the proposed Waterloo South will be investigated during the design development stage to further verify the suitability of the areas for their intended purpose.

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