

1250 GORDON STREET

GUELPH, ON

PEDESTRIAN WIND STUDY

RWDI # 2002369

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SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed 1250 Gordon Street in Guelph, ON (Image 1). Based on our wind-tunnel testing for the proposed development under the Existing and Proposed configurations (Images 2A and 2B), and the local wind records (Image 3), the potential wind comfort conditions are predicted as shown on site plans in Figures 1A through 2B, while the associated wind speeds are listed in Table 1. These results can be summarized as follows:

- Wind speeds that meet the pedestrian wind safety criterion are predicted at all areas assessed.
- Existing wind conditions on and around the site are generally comfortable for pedestrian use throughout the year.
- With the addition of the project, wind conditions during the summer are predicted to be comfortable for the intended use at all grade level areas. During the winter months, seasonally stronger wind speeds are expected to result in increased wind activity at the west corner of Building 1 and areas between the two buildings with conditions predicted to be uncomfortable.
- During the summer, wind conditions on the Level 2 terrace area are expected to be comfortable for passive pedestrian use. Elevated wind activity on the terrace in the winter may not be a concern as the area would be used less frequently during that time.



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Table 1: Pedestrian Wind Comfort and Safety Conditions

1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed 1250 Gordon Street in Guelph, ON. This report presents the project objectives, approach and the main results from RWDI's assessment and provides conceptual wind control measures, where necessary.

1.1 Project Description

The project (site shown in Image 1) is located on the northeast side of Gordon Street near the corner of Edinburgh Road South and Gordon Street. The project consists of two 10-storey residential buildings with underground parking.

1.2 Objectives

The objective of the study was to assess the effect of the proposed development on local conditions in pedestrian areas on and around the study site and provide recommendations for minimizing adverse effects, if needed. This quantitative assessment was based on wind speed measurements on a scale model of the project and its surroundings in one of RWDI's boundary-layer wind tunnels. These measurements were combined with the local wind records and compared to RWDI criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including building entrances and public sidewalks.



Image 1: Aerial View of Site and Surroundings (Photo Courtesy of Google™ Earth)



2 BACKGROUND AND APPROACH

2.1 Wind Tunnel Study Model

To assess the wind environment around the proposed project, a 1:300 scale model of the project site and surroundings was constructed for the wind tunnel tests of the following configurations:

- A - Existing: Existing site with existing surroundings (Image 2A),
- B - Proposed: Proposed project with existing surroundings (Image 2B).

The wind tunnel model included all relevant surrounding buildings and topography within an approximately 360m radius of the study site. The wind and turbulence profiles in the atmospheric boundary layer beyond the modelled area were also simulated in RWDI's wind tunnel. The wind tunnel model was instrumented with 73 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 1.5 m above local grade in pedestrian areas throughout the study site. Wind speeds were measured for 36 directions in 10-degree increments. The measurements at each sensor location were recorded in the form of ratios of local mean and gust speeds to the mean wind speed at a reference height above the model. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this site.

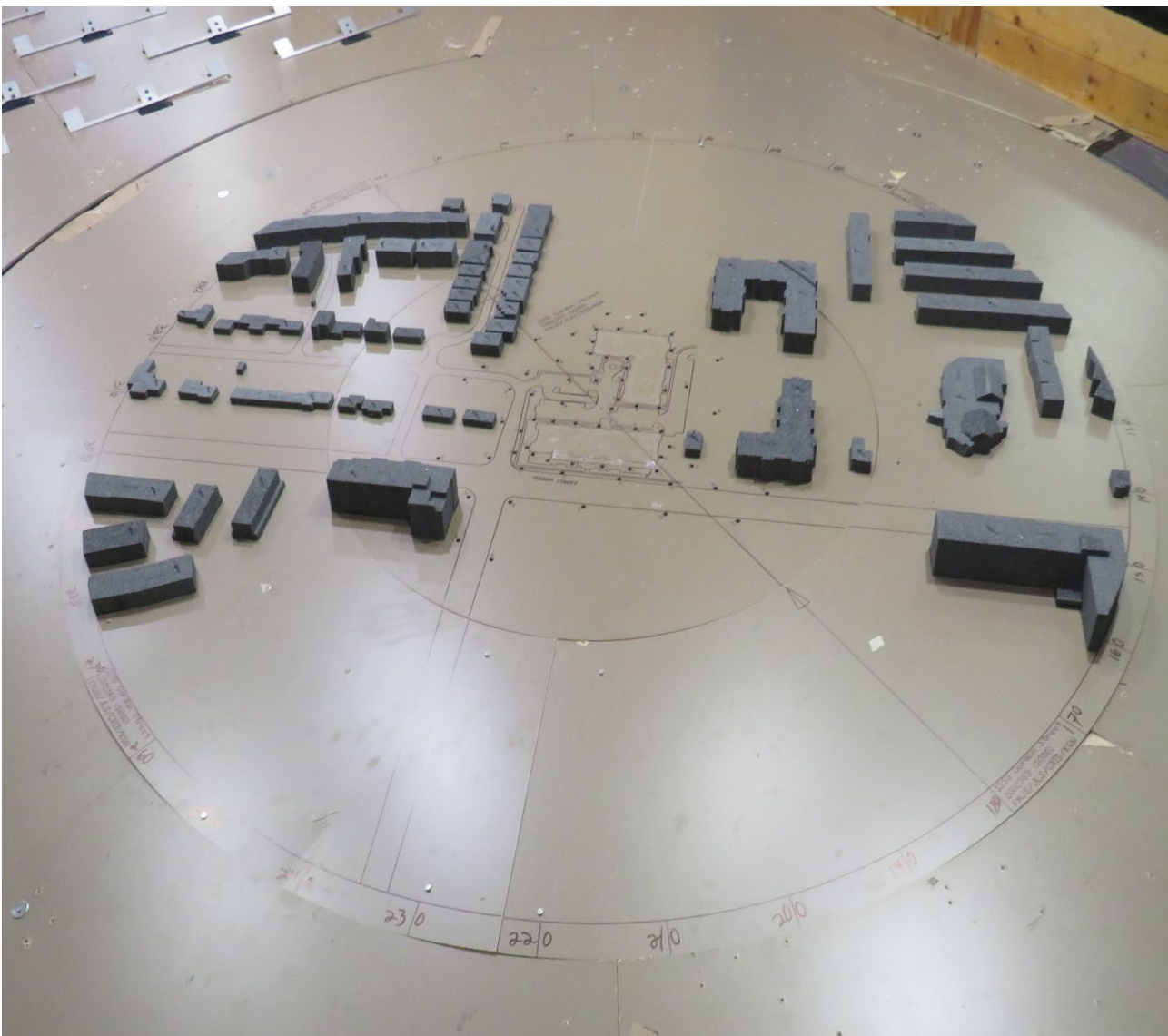
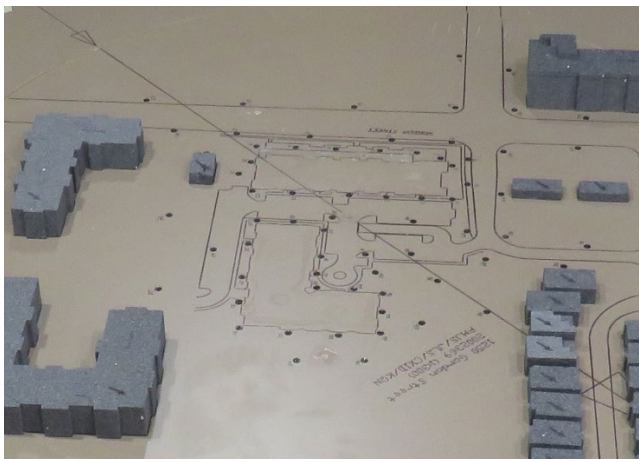


Image 2A: Wind Tunnel Study Model – Existing Configuration

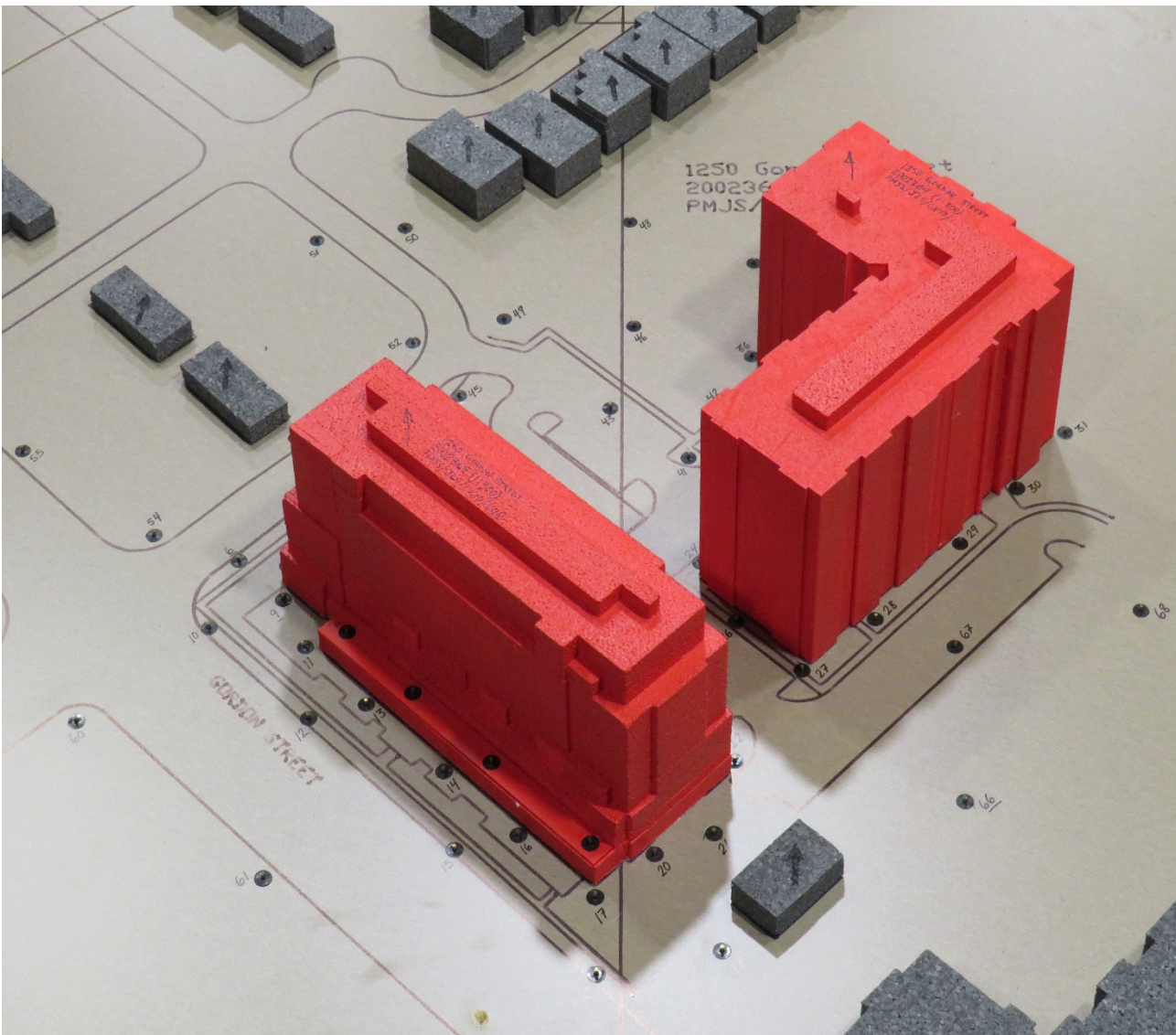
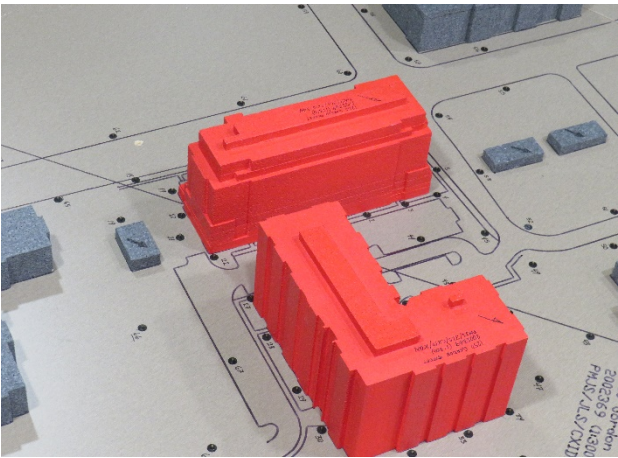


Image 2B: Wind Tunnel Study Model – Proposed Configuration

2.2 Meteorological Data

As required by the City of Guelph as per their Terms of Reference for Wind Studies (dated May 2019), wind statistics recorded at the Region of Waterloo International Airport were used as this is the nearest weather station with long-term reliable wind data. Wind statistics recorded at Waterloo International Airport between 1990 and 2020, inclusive, were analyzed for the Summer (May through October) and Winter (November through April) seasons. Image 3 graphically depicts the directional distributions of wind frequencies and speeds for these two seasons. Winds from the east and southwest through northwest are predominant throughout the year, as indicated by the wind roses. Strong winds of a mean speed greater than 30 km/h, measured at the airport (at an anemometer height of 10 m), occur for 2.5% and 8.1% of the time during the summer and winter seasons, respectively.

Wind statistics were combined with the wind tunnel data to predict the frequency of occurrence of full-scale wind speeds. The full-scale wind predictions were then compared with the City of Guelph's wind criteria for pedestrian comfort and safety (see Section 2.3).

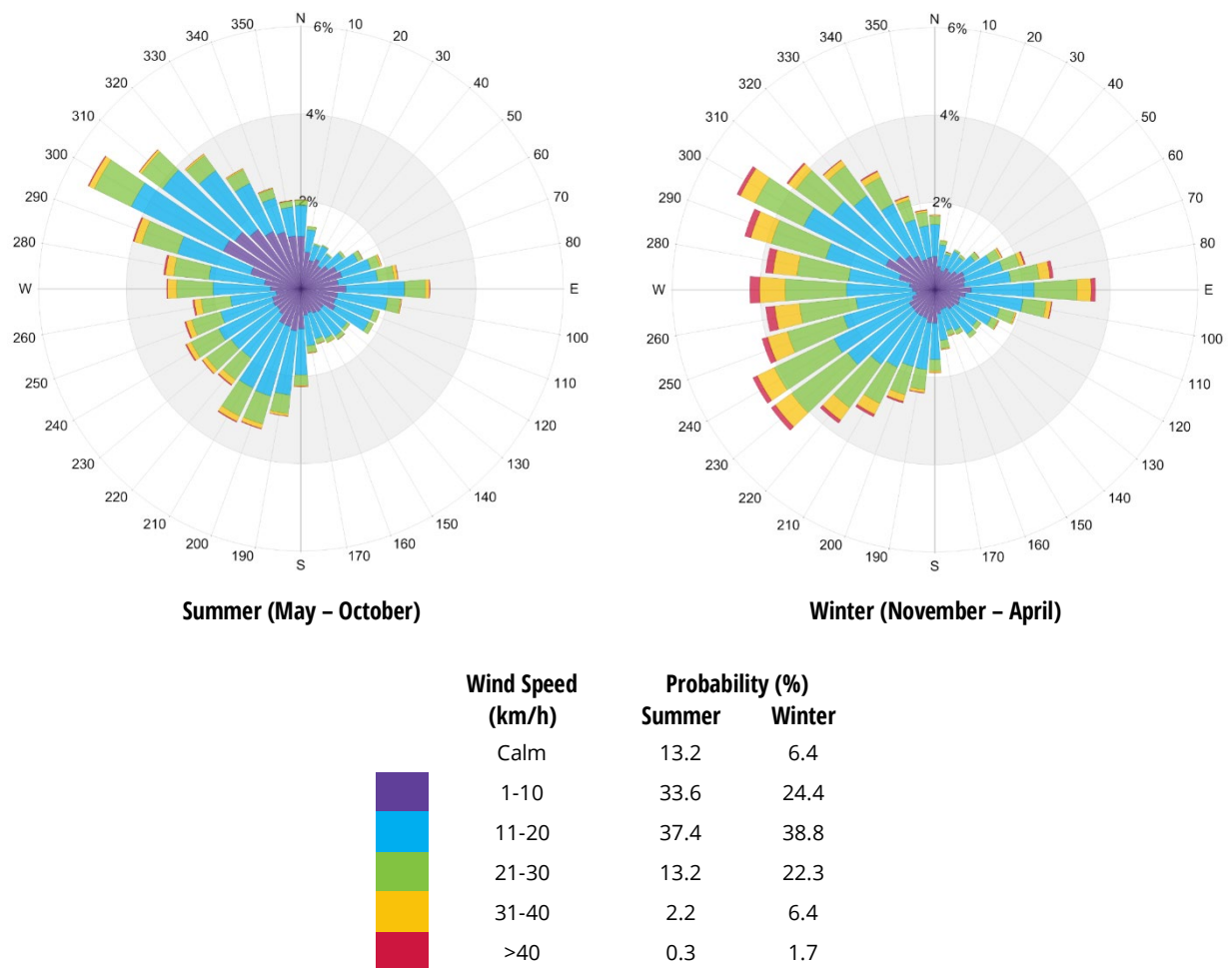


Image 3: Directional Distribution of Winds Approaching Waterloo International Airport between 1990 and 2020

2.3 City of Guelph Pedestrian Wind Criteria

The pedestrian wind criteria are outlined in the City of Guelph's "Pedestrian Level Wind Studies Terms of Reference", dated May 2019. The following defines the criteria in detail.

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	≤ 15	Gentle breezes suitable for main building entrances, bus stops, plazas, and other places where pedestrians may linger
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run, or cycle without lingering
Uncomfortable	> 20	Strong winds of this magnitude are considered a nuisance for all pedestrian activities, and wind mitigation is typically recommended

Notes:

- (1) $GEM\ Speed = \max (Mean\ Speed, Gust\ Speed/1.85)$ and $Gust\ Speed = Mean\ Speed + 3 \cdot RMS\ Speed$;
- (2) Wind conditions are considered to be comfortable if the predicted GEM speeds are within the respective thresholds for at least 80% of the time between 6:00 and 23:00. Nightly hours between 0:00 and 5:00 are excluded from the wind analysis for comfort since limited usage of outdoor spaces is anticipated; and,
- (1) Instead of standard four seasons, two periods of summer (May to October) and winter (November to April) are adopted in the wind analysis, because in a climate such as that found in **Guelph**, there are distinct differences in pedestrian outdoor behaviours between these time periods.

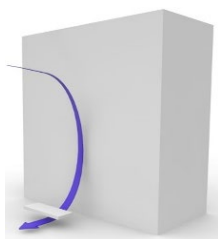
Safety Criterion	Gust Speed (km/h)	Description
Exceeded	> 90	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

Notes:

- (1) Based on an annual exceedance of 9 hours or 0.1% of the time for 24 hours a day; and,
- (2) Only gust speeds need to be considered in the wind safety criterion. These are usually rare events but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.

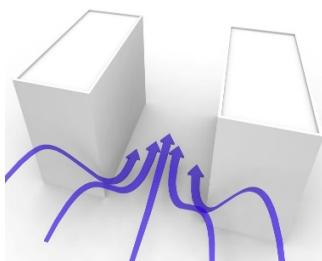
2.4 Generalized Wind Flows

In our discussion of wind conditions, reference may be made to the following generalized wind flows (Image 4):



DOWNWASHING

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.



CHANNELING EFFECT

When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to channeling effect caused by the narrow gap.

Image 4: Generalized Wind Flows

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown on site plans in Figures 1A through 2B located in the “Figures” section of this report. These conditions and the associated wind speeds are also represented in Table 1, located in the “Tables” section of this report. The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area of interest.

Wind speeds that meet the wind safety criterion are anticipated at all areas assessed.

3.1 Grade Level (Locations 1 through 69)

Wind conditions comfortable for walking are appropriate for sidewalks and walkways as pedestrians will be active and less likely to remain in one area for prolonged periods of time. Lower wind speeds conducive to standing are preferred at main entrances where pedestrians are apt to linger.

3.1.1 Existing Configuration

Wind conditions on and around the existing project site are generally comfortable for standing or sitting in the summer (Figure 1A) and walking or standing in the winter (Figure 2A) which is appropriate for the intended pedestrian use.



3.1.2 Proposed Configuration

With the addition of the proposed development, wind speeds slightly increase. During the summer, wind speeds are expected to be mostly comfortable for sitting or standing in most areas, while localized areas experience walking conditions (see Figure 1B). These conditions are considered suitable for the intended usage of the areas on and around the site including the main entrances (Locations 1, 7, 8 & 38).

During the winter, conditions are predicted to be windier than in the summer, with wind speeds comfortable for walking or standing at most areas around the site (Figure 2B). These conditions are considered appropriate for the use of the areas around the site. Appropriate conditions are also expected at all main entrances during the winter. Uncomfortable wind conditions are anticipated at a few localized areas including an area along Street A, to the northwest of Building 1 (Location 6) and at the area between Buildings 1 and 2 (Locations 22 and 24). Mitigation locations and examples of wind control measures are shown in Image 5 & 6.

High windspeeds to the northwest of the site are due to southwesterly winds downwashing (Image 4) off the north and west façades of Building 1 and accelerating at the ground. To reduce this effect, we recommend installing a canopy around the northwest corner to help redirect winds (see Image 6). In addition, coniferous or marcescent street trees along the north and west sidewalks, will help to disperse winds flowing to the street below. High wind speeds at the area between the two buildings (Location 22 and 24) are primarily due to exposure to westerly winds channelling through the area (Image 4). The addition of dense coniferous or marcescent planters to the north of locations 22 and 24 will help to diffuse wind flowing through these areas, alternatively windscreens placed north of these locations will help to diffuse uncomfortable conditions. Mitigation locations and examples of wind control measures are shown in Image 5 & 6.

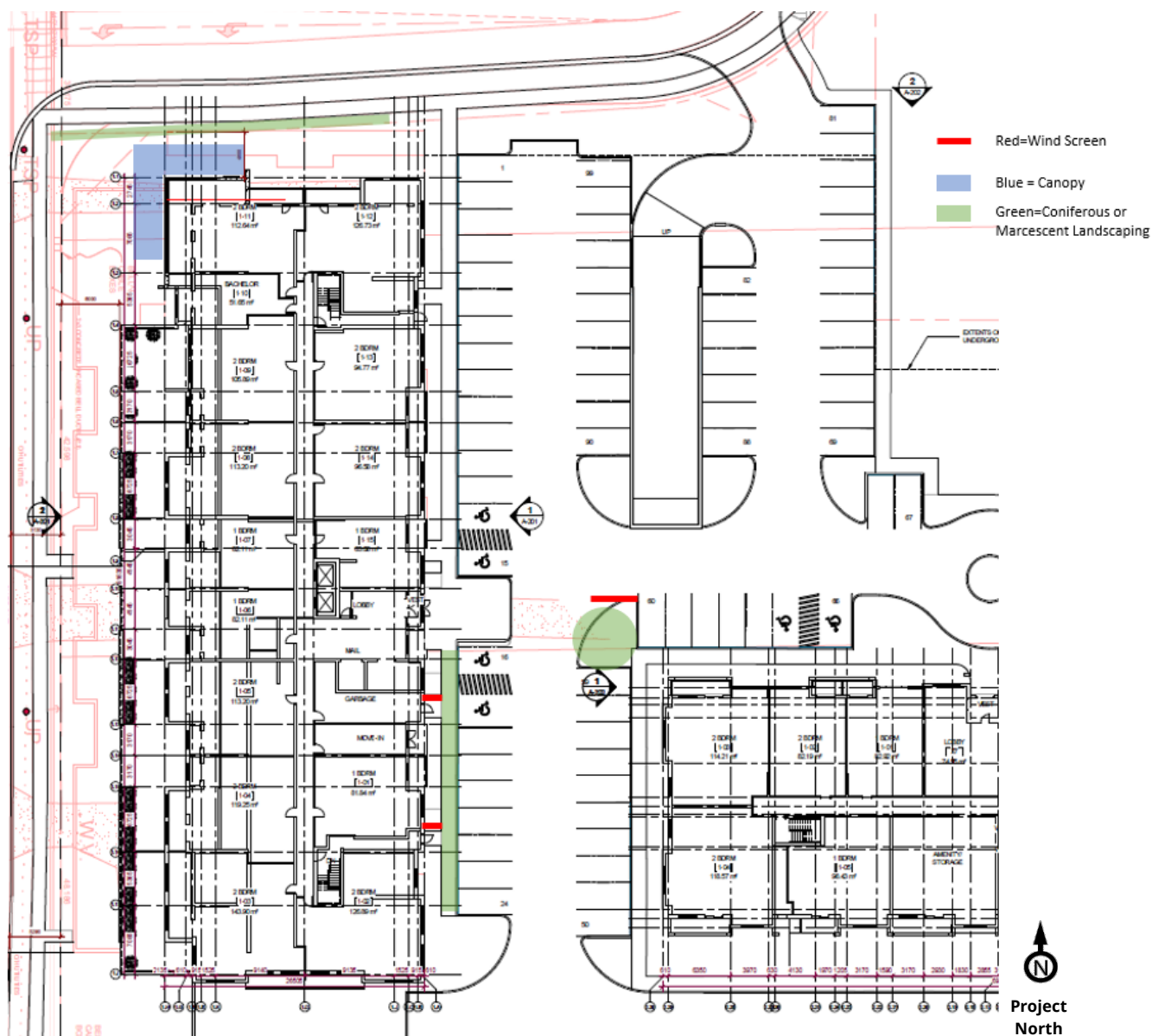


Image 5: Areas of recommended mitigation



Image 6: Examples of Canopies, wind Screens and Coniferous Landscaping

3.2 Above-Grade Levels (Locations 70 through 73)

It is generally desirable for wind conditions on terraces intended for passive activities to be comfortable for sitting or standing more than 80% of the time in the summer. During the winter, the area would not be used frequently, and increased wind activity would be considered appropriate.

During the summer, wind speeds on the Level 2 terrace (Locations 70 through 73 in Figure 1B) are predicted to be suitable for sitting or standing which is appropriate for passive activities.

In the winter, wind speeds slightly increase due to seasonally stronger winds during this season but may be considered acceptable as the terrace level would not be frequently used during this time.

4 APPLICABILITY OF RESULTS

The wind conditions presented in this report pertain to the model of the 1250 Gordon Street constructed using the drawings and information listed below. Should there be any design changes that deviate from this list of drawings, the wind condition predictions presented may change. Therefore, if changes in the design are made, it is recommended that RWDI be contacted and requested to review their potential effects on wind conditions.

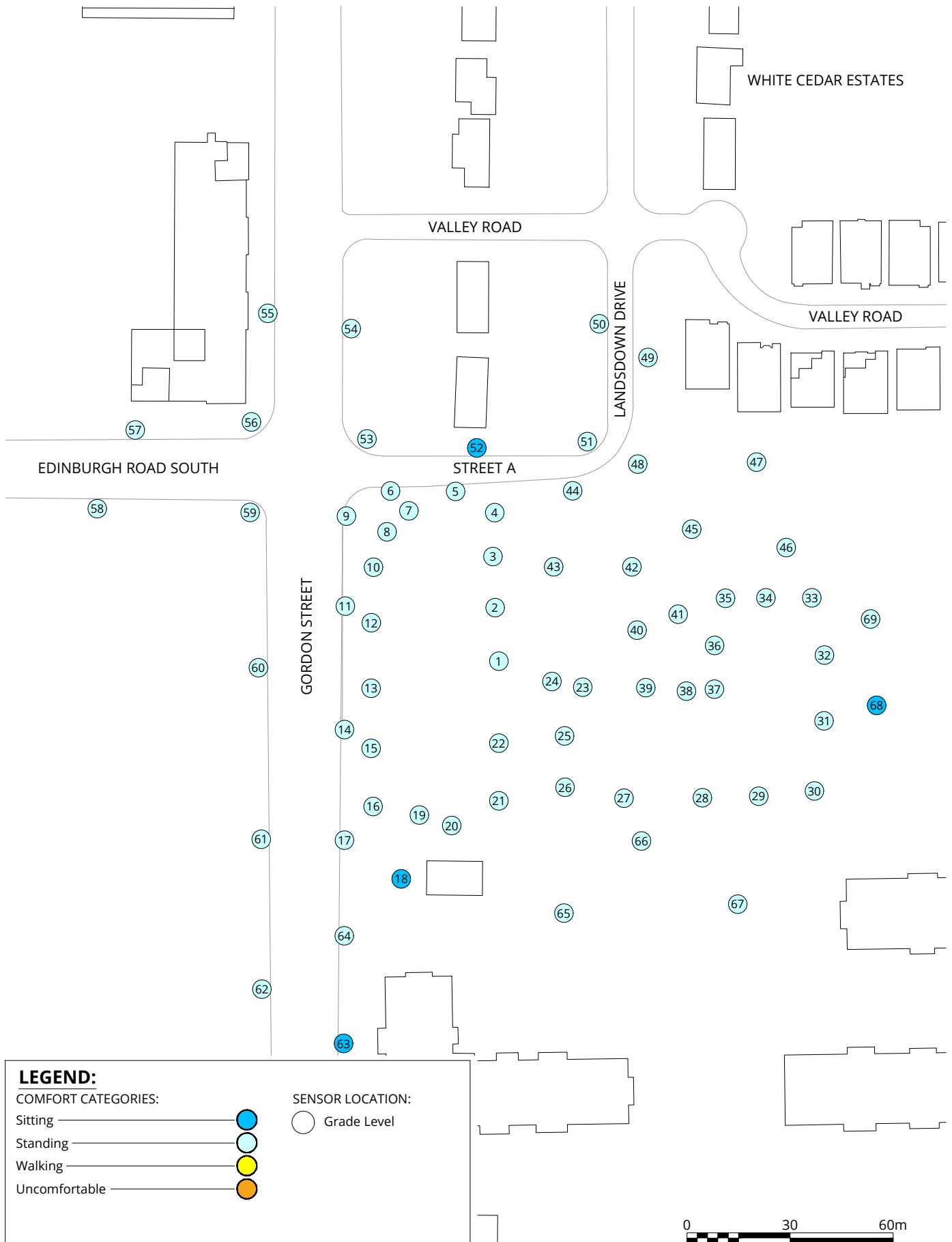
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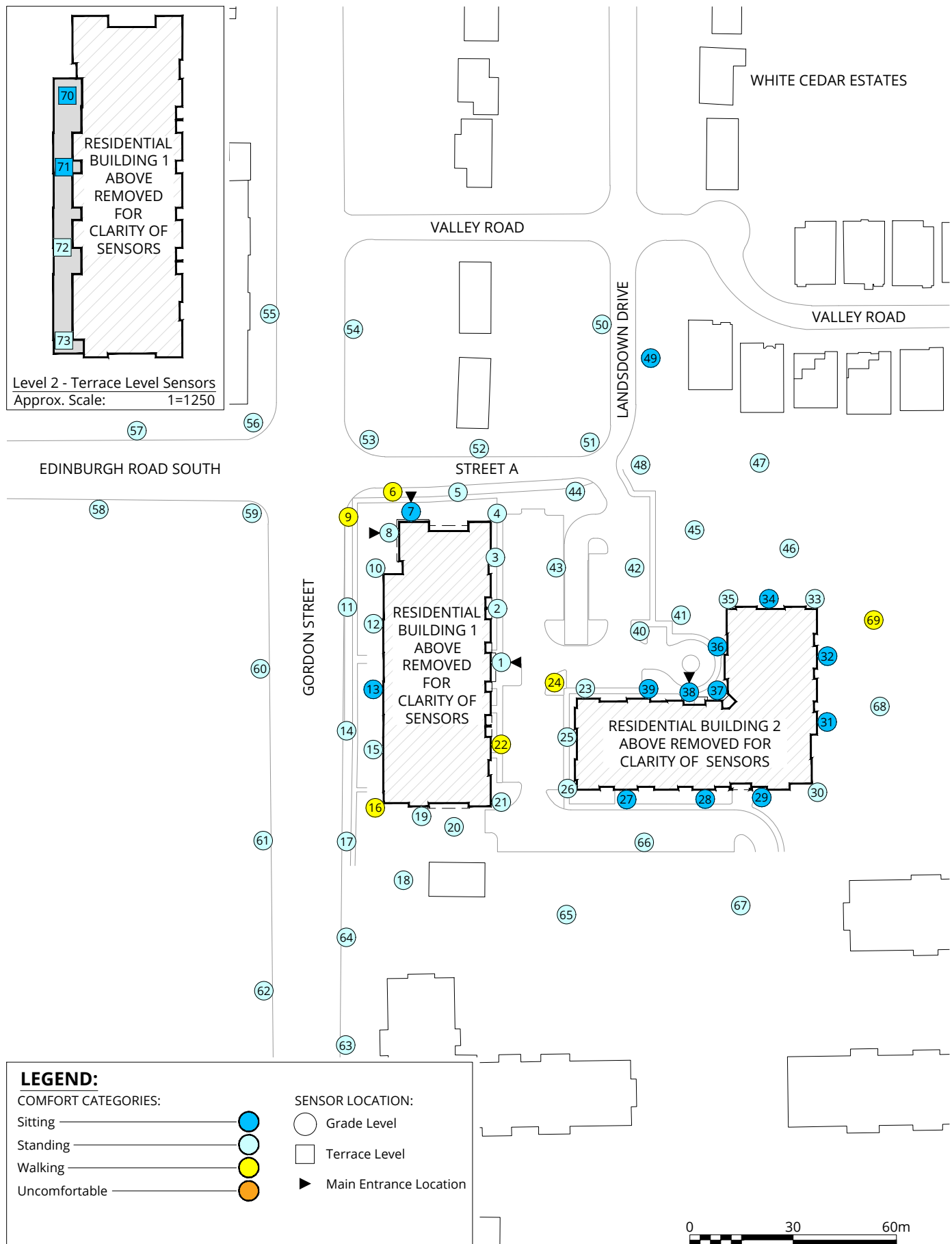





FIGURES

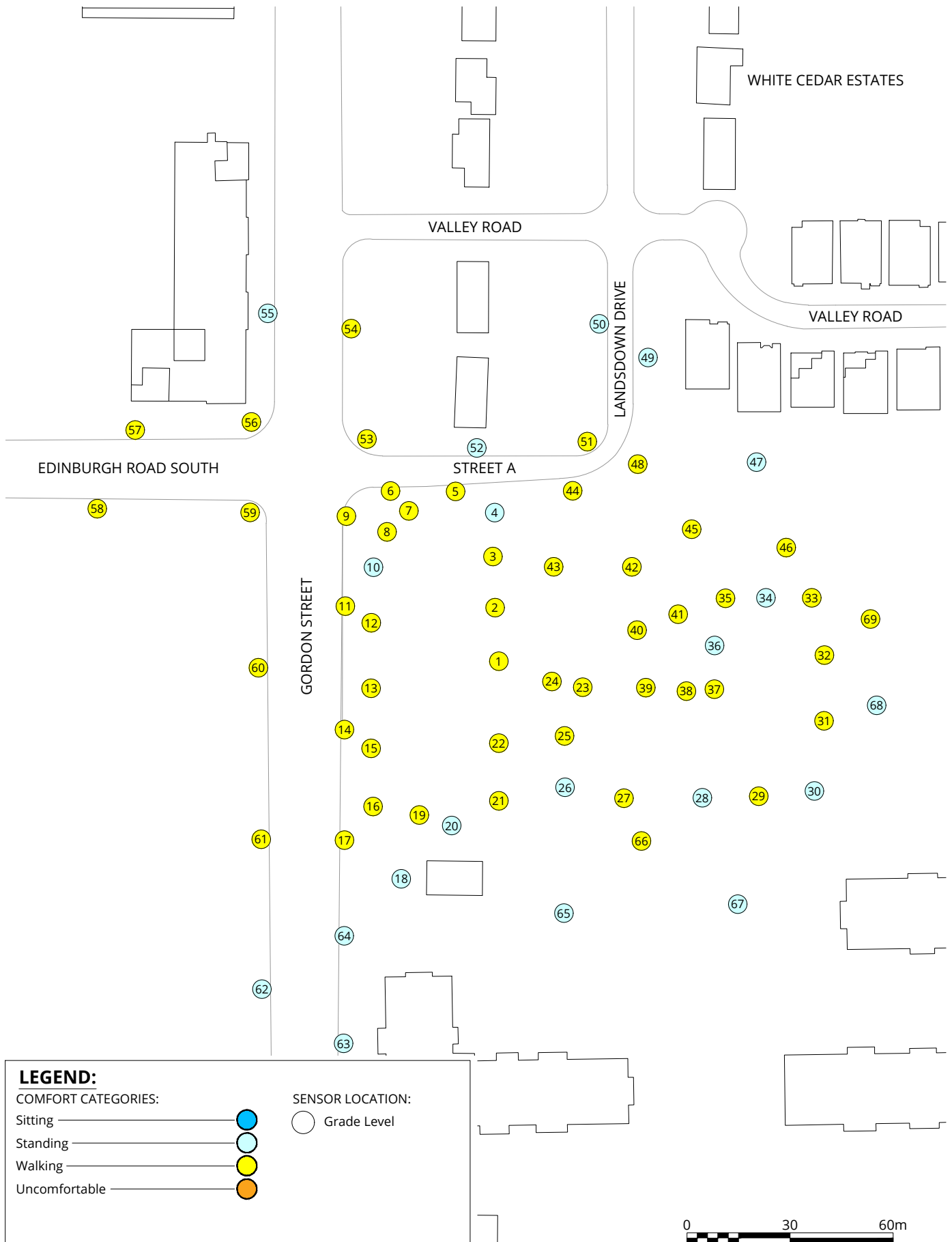





Pedestrian Wind Comfort Conditions Existing Configuration Summer (May to October, 6:00 to 23:00) 1250 Gordon Street - Guelph, ON	Project North True North  	Drawn by: DF	Figure: 1A	
		Approx. Scale:	1:1500	
		Date Revised:	Jul. 9, 2021	

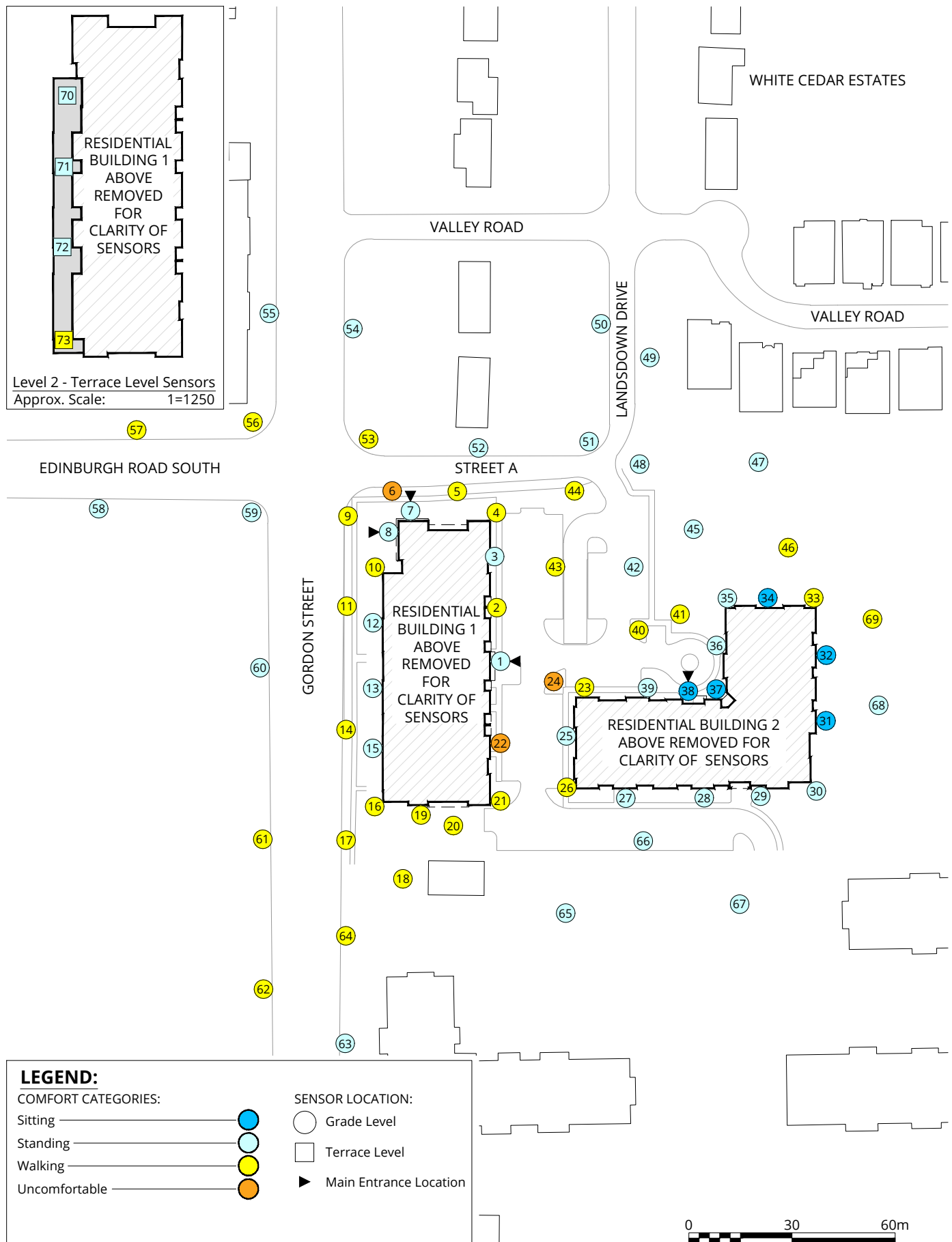
Project #2002369






Pedestrian Wind Comfort Conditions Proposed Configuration Summer (May to October, 6:00 to 23:00) 1250 Gordon Street - Guelph, ON	Project North True North   Project #2002369	Drawn by: DF	Figure: 1B	
		Approx. Scale: 1:1500		
		Date Revised: Jul. 9, 2021		



Pedestrian Wind Comfort Conditions Existing Configuration Winter (November to April, 6:00 to 23:00) 1250 Gordon Street - Guelph, ON	Project North True North   Project #2002369	Drawn by: DF	Figure: 2A	
		Approx. Scale: 1:1500		
		Date Revised: Jul. 9, 2021		



Pedestrian Wind Comfort Conditions Proposed Configuration Winter (November to April, 6:00 to 23:00) 1250 Gordon Street - Guelph, ON	Project North True North   Project #2002369	Drawn by: DF	Figure: 2B	
		Approx. Scale: 1:1500		
		Date Revised: Jul. 9, 2021		

TABLES

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
1	Existing	13	Standing	17	Walking	64	Pass
	Proposed	12	Standing	15	Standing	71	Pass
2	Existing	13	Standing	16	Walking	65	Pass
	Proposed	13	Standing	16	Walking	71	Pass
3	Existing	13	Standing	16	Walking	62	Pass
	Proposed	12	Standing	15	Standing	63	Pass
4	Existing	12	Standing	15	Standing	59	Pass
	Proposed	15	Standing	18	Walking	77	Pass
5	Existing	12	Standing	16	Walking	64	Pass
	Proposed	13	Standing	17	Walking	76	Pass
6	Existing	13	Standing	16	Walking	66	Pass
	Proposed	17	Walking	21	Uncomfortable	82	Pass
7	Existing	14	Standing	17	Walking	70	Pass
	Proposed	8	Sitting	11	Standing	51	Pass
8	Existing	14	Standing	17	Walking	66	Pass
	Proposed	12	Standing	15	Standing	61	Pass
9	Existing	14	Standing	17	Walking	67	Pass
	Proposed	16	Walking	19	Walking	73	Pass
10	Existing	12	Standing	15	Standing	60	Pass
	Proposed	13	Standing	16	Walking	67	Pass
11	Existing	14	Standing	17	Walking	65	Pass
	Proposed	14	Standing	17	Walking	67	Pass
12	Existing	13	Standing	16	Walking	63	Pass
	Proposed	11	Standing	14	Standing	56	Pass
13	Existing	13	Standing	16	Walking	60	Pass
	Proposed	10	Sitting	13	Standing	56	Pass
14	Existing	14	Standing	17	Walking	61	Pass
	Proposed	15	Standing	18	Walking	78	Pass
15	Existing	13	Standing	16	Walking	58	Pass
	Proposed	11	Standing	15	Standing	66	Pass
16	Existing	13	Standing	16	Walking	59	Pass
	Proposed	16	Walking	20	Walking	79	Pass
17	Existing	13	Standing	16	Walking	57	Pass
	Proposed	15	Standing	19	Walking	74	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
18	Existing	10	Sitting	13	Standing	51	Pass
	Proposed	12	Standing	16	Walking	76	Pass
19	Existing	12	Standing	16	Walking	59	Pass
	Proposed	13	Standing	17	Walking	84	Pass
20	Existing	11	Standing	14	Standing	55	Pass
	Proposed	14	Standing	18	Walking	75	Pass
21	Existing	12	Standing	16	Walking	60	Pass
	Proposed	14	Standing	18	Walking	72	Pass
22	Existing	13	Standing	17	Walking	65	Pass
	Proposed	17	Walking	21	Uncomfortable	78	Pass
23	Existing	13	Standing	16	Walking	61	Pass
	Proposed	13	Standing	17	Walking	77	Pass
24	Existing	13	Standing	16	Walking	62	Pass
	Proposed	17	Walking	21	Uncomfortable	83	Pass
25	Existing	13	Standing	16	Walking	62	Pass
	Proposed	12	Standing	14	Standing	70	Pass
26	Existing	12	Standing	15	Standing	57	Pass
	Proposed	13	Standing	16	Walking	73	Pass
27	Existing	13	Standing	16	Walking	64	Pass
	Proposed	10	Sitting	12	Standing	59	Pass
28	Existing	12	Standing	15	Standing	58	Pass
	Proposed	9	Sitting	11	Standing	53	Pass
29	Existing	13	Standing	16	Walking	63	Pass
	Proposed	10	Sitting	11	Standing	55	Pass
30	Existing	12	Standing	15	Standing	57	Pass
	Proposed	13	Standing	15	Standing	60	Pass
31	Existing	12	Standing	16	Walking	60	Pass
	Proposed	8	Sitting	10	Sitting	47	Pass
32	Existing	12	Standing	16	Walking	59	Pass
	Proposed	8	Sitting	10	Sitting	53	Pass
33	Existing	13	Standing	16	Walking	63	Pass
	Proposed	14	Standing	18	Walking	77	Pass
34	Existing	12	Standing	15	Standing	59	Pass
	Proposed	8	Sitting	10	Sitting	45	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
35	Existing	13	Standing	16	Walking	63	Pass
	Proposed	11	Standing	14	Standing	67	Pass
36	Existing	12	Standing	15	Standing	58	Pass
	Proposed	9	Sitting	12	Standing	53	Pass
37	Existing	13	Standing	16	Walking	62	Pass
	Proposed	5	Sitting	7	Sitting	31	Pass
38	Existing	13	Standing	16	Walking	60	Pass
	Proposed	8	Sitting	10	Sitting	46	Pass
39	Existing	13	Standing	16	Walking	63	Pass
	Proposed	10	Sitting	13	Standing	61	Pass
40	Existing	13	Standing	17	Walking	65	Pass
	Proposed	13	Standing	17	Walking	76	Pass
41	Existing	13	Standing	16	Walking	62	Pass
	Proposed	14	Standing	17	Walking	79	Pass
42	Existing	13	Standing	17	Walking	65	Pass
	Proposed	12	Standing	15	Standing	68	Pass
43	Existing	13	Standing	16	Walking	62	Pass
	Proposed	14	Standing	17	Walking	77	Pass
44	Existing	13	Standing	17	Walking	67	Pass
	Proposed	13	Standing	17	Walking	75	Pass
45	Existing	13	Standing	16	Walking	63	Pass
	Proposed	12	Standing	15	Standing	63	Pass
46	Existing	12	Standing	16	Walking	63	Pass
	Proposed	13	Standing	17	Walking	70	Pass
47	Existing	11	Standing	14	Standing	57	Pass
	Proposed	12	Standing	15	Standing	68	Pass
48	Existing	13	Standing	16	Walking	63	Pass
	Proposed	11	Standing	14	Standing	64	Pass
49	Existing	12	Standing	14	Standing	57	Pass
	Proposed	10	Sitting	13	Standing	51	Pass
50	Existing	12	Standing	15	Standing	57	Pass
	Proposed	11	Standing	14	Standing	55	Pass
51	Existing	13	Standing	16	Walking	62	Pass
	Proposed	12	Standing	15	Standing	69	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
52	Existing	9	Sitting	11	Standing	49	Pass
	Proposed	11	Standing	14	Standing	63	Pass
53	Existing	14	Standing	17	Walking	69	Pass
	Proposed	13	Standing	17	Walking	68	Pass
54	Existing	13	Standing	16	Walking	61	Pass
	Proposed	12	Standing	15	Standing	61	Pass
55	Existing	12	Standing	15	Standing	64	Pass
	Proposed	11	Standing	13	Standing	55	Pass
56	Existing	14	Standing	16	Walking	66	Pass
	Proposed	14	Standing	17	Walking	63	Pass
57	Existing	15	Standing	20	Walking	80	Pass
	Proposed	13	Standing	18	Walking	74	Pass
58	Existing	14	Standing	17	Walking	62	Pass
	Proposed	12	Standing	15	Standing	60	Pass
59	Existing	13	Standing	17	Walking	64	Pass
	Proposed	12	Standing	15	Standing	56	Pass
60	Existing	13	Standing	17	Walking	62	Pass
	Proposed	12	Standing	14	Standing	63	Pass
61	Existing	13	Standing	16	Walking	59	Pass
	Proposed	13	Standing	16	Walking	59	Pass
62	Existing	12	Standing	15	Standing	54	Pass
	Proposed	13	Standing	16	Walking	58	Pass
63	Existing	10	Sitting	13	Standing	53	Pass
	Proposed	11	Standing	13	Standing	58	Pass
64	Existing	12	Standing	15	Standing	55	Pass
	Proposed	13	Standing	16	Walking	62	Pass
65	Existing	11	Standing	14	Standing	56	Pass
	Proposed	11	Standing	15	Standing	62	Pass
66	Existing	12	Standing	16	Walking	61	Pass
	Proposed	12	Standing	14	Standing	65	Pass
67	Existing	12	Standing	15	Standing	56	Pass
	Proposed	12	Standing	15	Standing	63	Pass
68	Existing	9	Sitting	11	Standing	46	Pass
	Proposed	13	Standing	15	Standing	73	Pass

Table 1: Pedestrian Wind Comfort and Safety Conditions

Location	Configuration	Wind Comfort				Wind Safety	
		Summer		Winter		Annual	
		Speed (km/h)	Rating	Speed (km/h)	Rating	Speed (km/h)	Rating
69	Existing	13	Standing	17	Walking	73	Pass
	Proposed	16	Walking	20	Walking	82	Pass
70	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	12	Standing	52	Pass
71	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	13	Standing	53	Pass
72	Existing	-	-	-	-	-	-
	Proposed	11	Standing	13	Standing	60	Pass
73	Existing	-	-	-	-	-	-
	Proposed	13	Standing	16	Walking	75	Pass

Season	Months	Hours	Comfort Speed (km/h)		Safety Speed (km/h)
Summer	May - October	6:00 - 23:00 for comfort	(20% Seasonal Exceedance)		(0.1% Annual Exceedance)
Winter	November - April	6:00 - 23:00 for comfort	≤ 10	Sitting	≤ 90 Pass
Annual	January - December	0:00 - 23:00 for safety	11 - 15	Standing	> 90 Exceeded
Configurations					
Existing	Existing site and surroundings		16 - 20	Walking	
Proposed	Proposed Project with existing surroundings		> 20	Uncomfortable	