REPORT

KALAR APARTMENTS

NIAGARA FALLS, ONTARIO

PEDESTRIAN WIND STUDY
RWDI # RWDI # 2306234
December 13, 2023

SUBMITTED TO

2131595 Ontario Inc.
c/o Dan Perri
2762 McSherry Lane
Fonthill, Ontario, L0S 1E6

SUBMITTED BY

Hang You, M.E.Sc.
Technical Coordinator
Hang.You@rwdi.com

Timothy Wiechers, M.Sc.
Senior Technical Coordinator
Tim.Wiechers@rwdi.com

Scott Bell, GSC
Project Manager
Scott.Bell@rwdi.com

RWDI
600 Southgate Drive
Guelph, Ontario, N1G 4P6
T: 519.823.1311 x2245
F: 519.823.1316

EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed Kalar Apartments project in Niagara Falls, Ontario (Image 1). The assessment was based on the wind-tunnel testing conducted for the proposed development under the Existing and Proposed configurations of the site and surroundings (Image 2), in accordance with the requirements in the *pedestrian level wind study terms of reference guide for Niagara Region*. The results were analysed using wind records from Niagara Falls International Airport and evaluated against the Wind Criteria for Pedestrian Comfort and Safety specified in the Guide. The criteria description is appended to this report to assist with interpretation of the results. The predicted wind conditions are presented in Figures 1A through 2B, and Table 1, and are summarized as follows:

- Wind comfort conditions across the existing site are appropriate for general sidewalk usages throughout the year.
- With the proposed development in place, wind conditions on and around the site are expected to be suitable for the intended usages at all locations in the summer and most locations in the winter. Uncomfortable wind conditions may be experienced through the channel between the two towers, as well as around several building corners in the winter.
- Wind speeds on the above-grade terraces are predicted to be comfortable for general passive usages in the summer. Higher winds are anticipated in the winter, which might still be acceptable since the outdoor amenity will likely be occupied less frequently during the colder months.
- Positively, the pedestrian wind safety criterion is met at all locations assessed in both test configurations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed Kalar Apartments project in Niagara Falls, Ontario. This report presents the project objectives, approach, the main results from RWDI's assessment and provides conceptual wind control measures, where necessary. Our Statement of Limitations as it pertains to this study can be found in Section 4 of this report.

1.1 Project Description

The proposed development site is located on the south side of McLeod Road at 7302 Kalar Road (Image 1). The project is a 412-unit apartment development that will consist of two residential buildings: a southerly 15-storey tower and a northerly 13-storey tower.

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 appropriate criteria for gauging wind comfort and safety in pedestrian areas. The assessment focused on critical pedestrian areas, including building entrances, public sidewalks and walkways, as well as outdoor amenity terraces.

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), and

B - Proposed: Proposed project with existing surroundings (Image 2B).

The wind tunnel model included all relevant surrounding buildings and topography within an approximate 360 m radius around 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 80 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. The placement of wind measurement locations was based on our experience and understanding of the pedestrian usage for this 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.

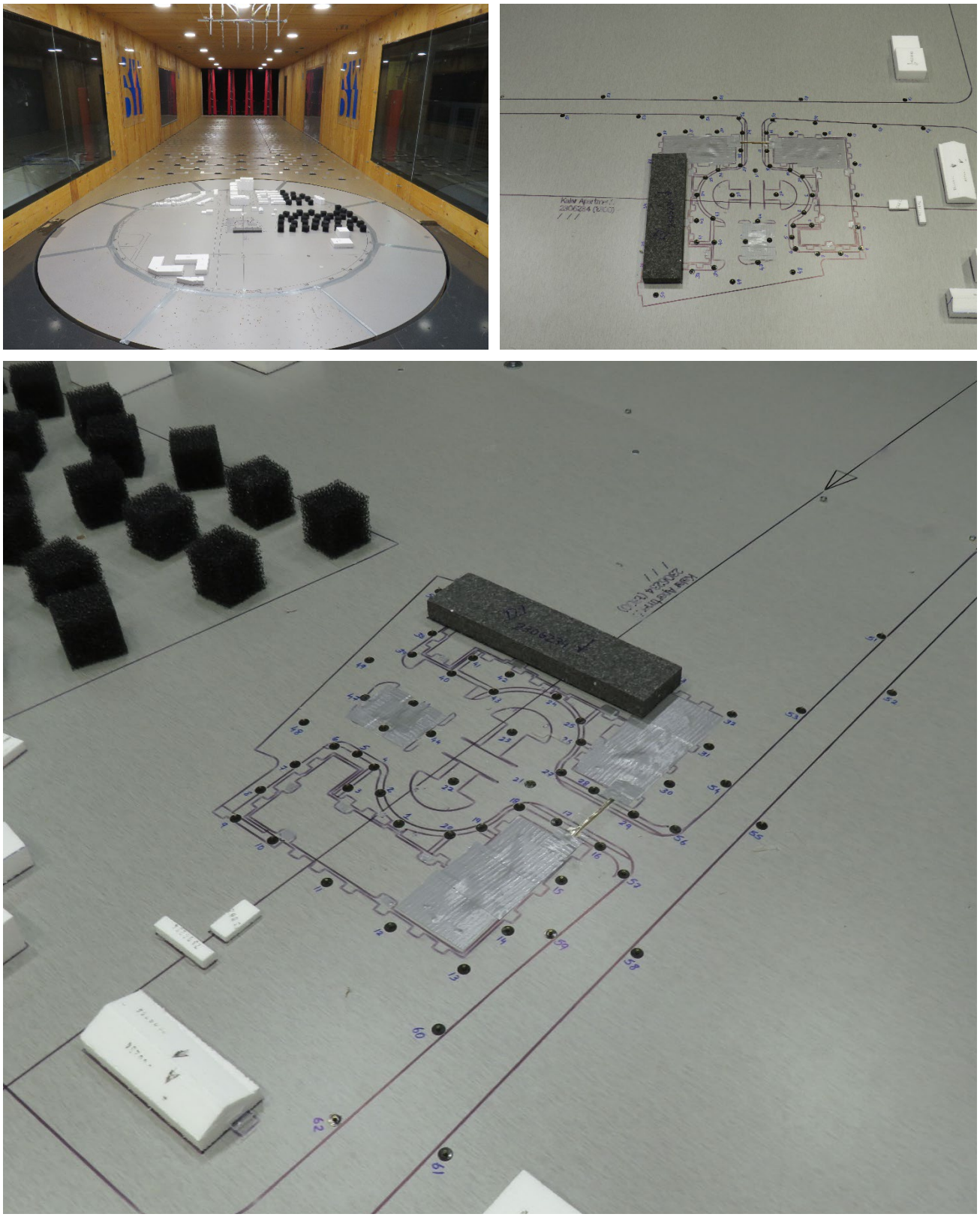
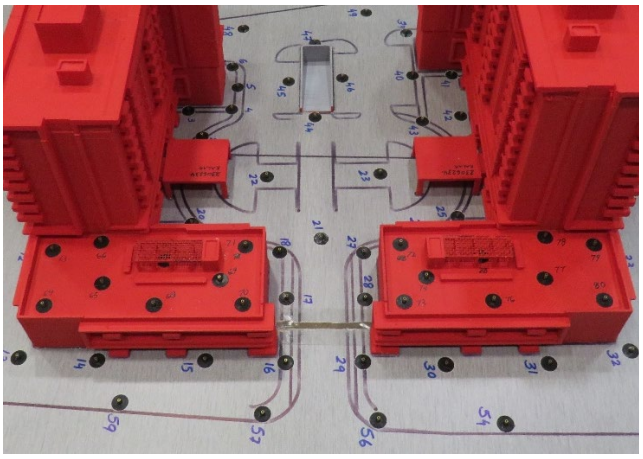


Image 2A: Wind Tunnel Study Model – Existing Configuration



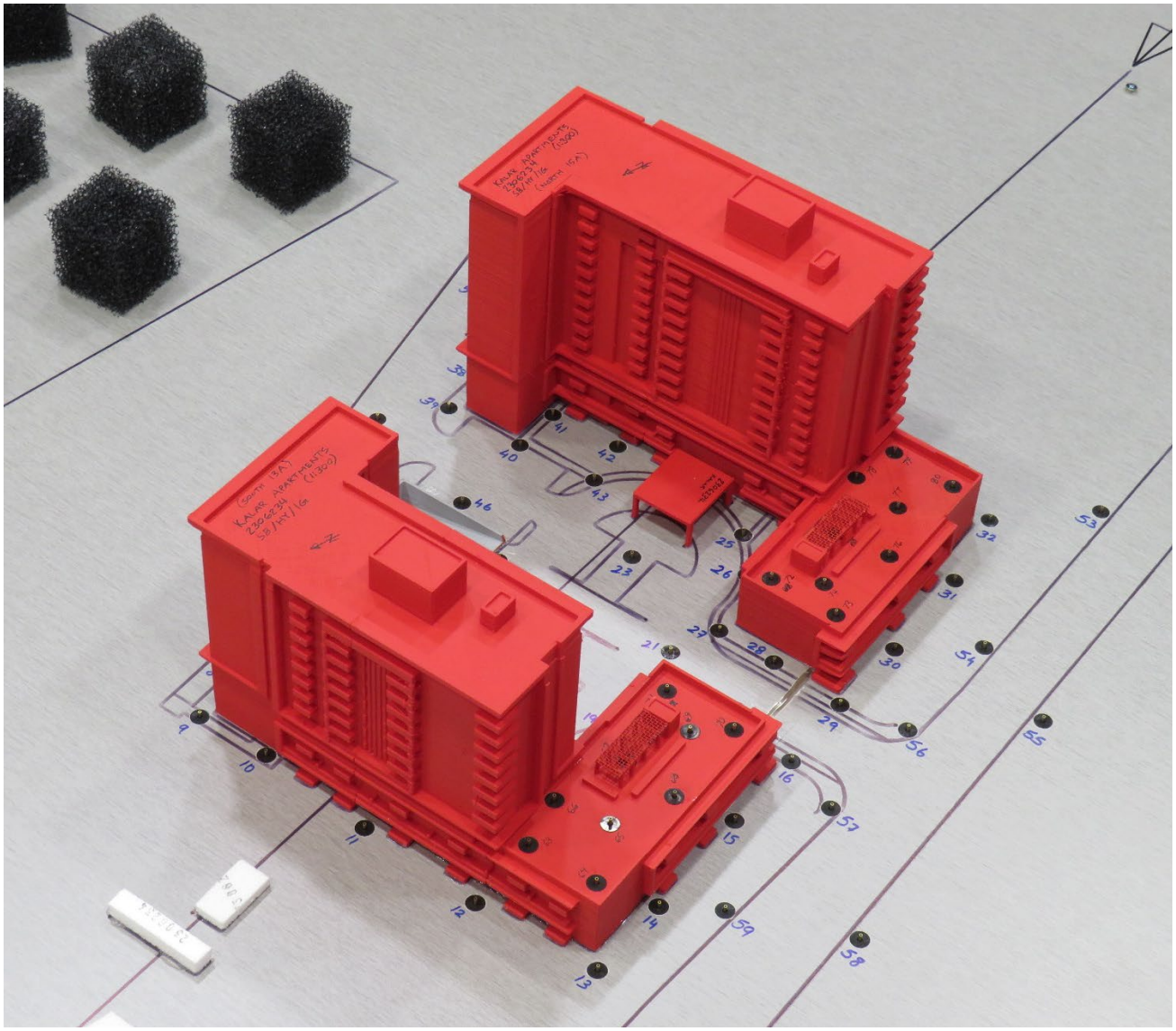
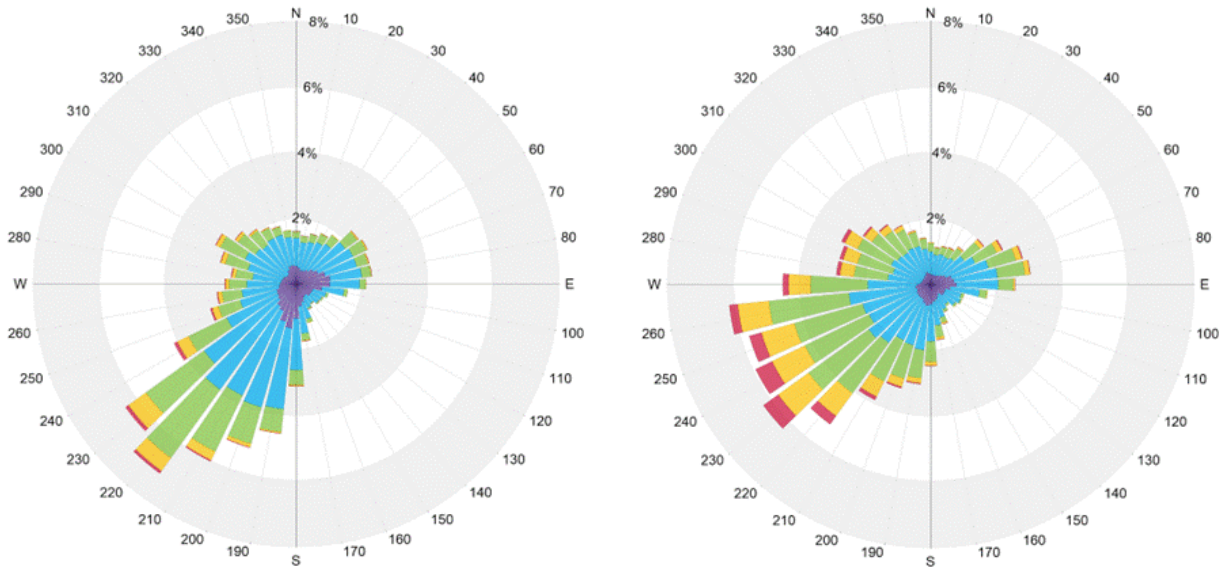


Image 2B: Wind Tunnel Study Model – Proposed Configuration

2.2 Wind Climate Data

Wind statistics recorded at Niagara Falls International Airport between 1991 and 2021, 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 southwest directions are predominant in both the summer and winter 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 3.9 % and 12.8% of the time during the summer and winter seasons, respectively, and they are primarily from the southwest directions.

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 wind criteria for pedestrian comfort and safety.



Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	10.4	5.9
1-10	23.4	16.1
11-20	42.6	36.3
21-30	19.7	28.9
31-40	3.3	9.8
>40	0.6	3.0

Image 3: Directional Distribution of Winds Approaching Niagara Falls International Airport between 1991 and 2021

2.3 Pedestrian Wind Criteria for Niagara Region

Based on pedestrian level wind study terms of reference guide for Niagara Region (dated July 2022), the public realm, streetscapes and public/private outdoor open spaces related to the existing and proposed buildings are to be comfortable for their intended use. The table below describes the minimum criteria for specific locations. The criteria deal with comfort and safety of pedestrians:

Comfort: Commonly experienced wind speeds have been categorized into ranges based on the activity level of a person that the winds would be conducive to. Lower wind speeds are desirable for passive activities and active pedestrians would be tolerant of higher wind speeds.

Safety: It is important to assess wind conditions in the pedestrian realm from a safety perspective as strong wind gusts can deter safe pedestrian use of outdoor spaces. Wind speeds associated with wind gusts are infrequent but deserve special attention due to their potential impact on pedestrian safety.

Comfort Category	GEM Speed (km/h)	Minimum Occurrence (% of Time)	Description	Area of Application
Sitting	≤ 10	80	Light breezes desired for outdoor seating areas where one can read a paper without having it blown away.	Park benches, restaurant and café seating, balconies, amenity terraces, children's areas, etc. intended for relaxed, and usually seated activities.
Standing	≤ 15	80	Gentle breezes suitable for passive pedestrian activities where a breeze may be tolerated	Main entrances, bus-stops, dog areas, and other outdoor areas where seated activities are not expected.
Walking	≤ 20	80	Relatively high speeds that can be tolerated during intentional walking, running and other active movements.	Sidewalks, parking lots, alleyways, and areas where pedestrian activity is primarily for walking.
Uncomfortable	> 20	20	Strong winds, considered a nuisance for most activities.	Not acceptable in areas with pedestrian access.

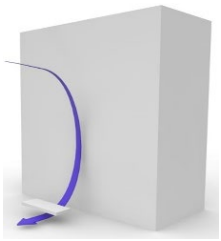
NOTES:
1) Gust Equivalent Mean (GEM) speed = maximum of either mean speed or gust speed/1.85. The gust speed can be measured directly from wind tunnel or estimated as mean speed + (3 x RMS speed).
2) Comfort calculations are to be based on wind events recorded between 6:00 and 23:00 daily.

Safety Criterion	Gust Speed (km/h)	Minimum Occurrence Annual	Description	Area of Application
Exceeded	> 90	0.1% (9 hours in a year)	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.	Not acceptable in any area of interest.

NOTES:
3) Safety calculations are to be based on wind events recorded for 24 hours a day

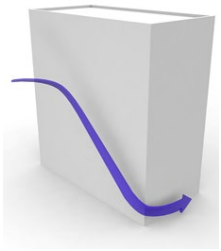
2.4 General Wind Flow Mechanisms

In the discussion of wind conditions, reference is made to the following wind flow mechanisms (Image 4):



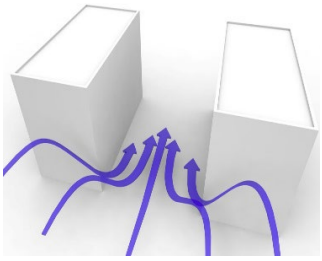
DOWNWASHING

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.



CORNER ACCELERATION

When wind moves around the buildings a localized increase in the wind activity or corner acceleration can be expected around the exposed building corners at pedestrian level. The effect is intensified when the wind approaches at an oblique angle to a tall façade and are deflected down and around the exposed corners.



CHANNELLING EFFECT

Wind flow tends to accelerate through the space between buildings, under bridges or in passages through buildings due to channelling effect caused by the narrow gap. The effect is intensified if the channel is aligned with the predominant wind direction.

Image 4: General Wind Flow Mechanisms

If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity. Design details such as setting back a tall tower from the edges of a podium, deep canopies close to ground level, wind screens, tall trees with dense landscaping, etc. (Image 5) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

Podium/tower setback, canopy, landscaping and wind screens (left to right)

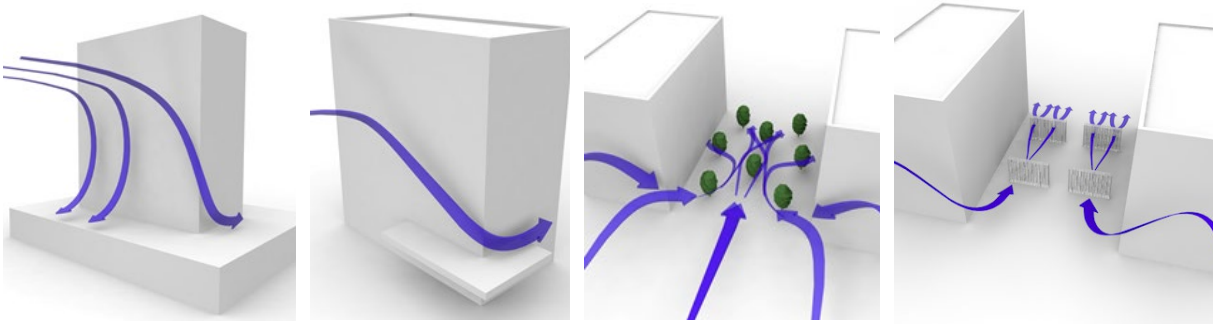


Image 5: Common Wind Control Measures

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown in Figures 1A through 2B, located in the Figures section of this report. These conditions and the associated wind speeds are also presented in Table 1, located in the Tables section of this report. In general, 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. Wind speeds comfortable for sitting are preferred for areas intended for passive activities, such as the Level 4 roof terraces.

Positively, wind speeds that meet the safety criterion are predicted at all locations for all configurations assessed.

The following is a detailed discussion of the suitability of the predicted wind conditions for the anticipated pedestrian use of each area of interest.

3.1 Existing Configuration

Calm wind activity is observed around the existing site in the summer, with conditions comfortable for sitting or standing at all locations (see Figure 1A). During the winter, although higher wind speeds are experienced around the site due to seasonally stronger winds, wind speeds at all locations are suitable for walking or lower (Figure 2A), which are considered appropriate for the intended pedestrian usage.

3.2 Proposed Configuration

With the proposed development in place, wind speeds are expected to increase compared to the existing conditions, which is typical with the addition of taller buildings in a low-rise environment. These localized increases in wind speeds are the result of building-induced wind flows, causing downwashing and corner accelerating flows, as well as channeling effects through the passage between the two buildings (Figure 4).

3.2.1 Grade Level (Locations 1 through 62)

The main entrances of the proposed buildings are situated at Locations 1 and 24 in Figures 1B and 2B, and they are positively located in sheltered zones created by the “C”-shaped building massing’s and large overhead canopies. As a result, wind conditions at both entrances are expected to be appropriate year-round.

During the summer, wind conditions around the site are generally expected to be comfortable for sitting or standing at most areas. Higher wind speeds comfortable for walking are predicted at several building corners and through the passage between the two buildings (yellow locations in Figure 1B). These locations are considered appropriate for walkway uses.

In the winter months, wind conditions comfortable for standing or walking are expected at most locations around the two buildings (see Figure 2B). Uncomfortable wind conditions are anticipated in localized areas at exposed building corners (Locations 13, 32, and 36 in Figure 2B), and locations along the passage between the two buildings (Locations 21, 29, and 44 in Figure 2B). It may be noted that the wind speeds at all of these locations, with the exception of Location 13, are predicted to be marginally uncomfortable (i.e., 1 to 2 km/h over the threshold for the

'walking' criteria, see Table 1) and are located in areas around the development that will not have frequent pedestrian access. Thus, these elevated wind speeds may not be of major concern.

Due to prevailing southwesterly winds downwashing off the west building façade and accelerating around the northwest building corner, the highest wind speeds are anticipated at Location 13 (see Table 1). It is understood that pedestrian access near Location 13 is limited, however, localized wind control features can be considered by the design team to improve wind conditions near this corner. These features may include soft and/or hard landscaping features that are at least 2 m tall. It is necessary for vegetation to be marcescent or coniferous to offer adequate wind sheltering during the winter season. Examples of these wind control features are presented in Image 7 for reference purposes. Such wind control features can also be considered in other areas of higher-than-desired wind activity.

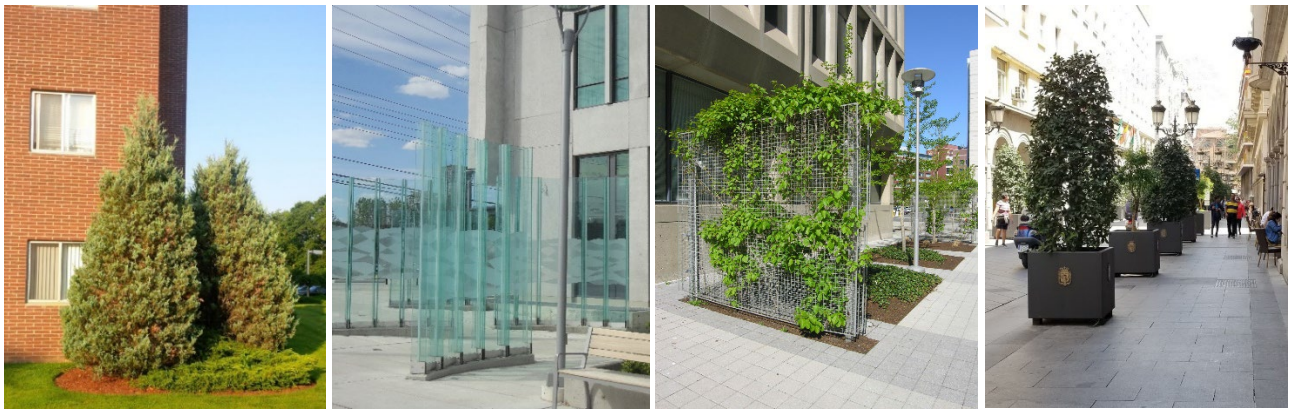


Image 6: Design Strategies for Wind Control at Grade Level

3.2.2 Rooftop Terraces (Locations 62 through 80)

During the summer, wind conditions at the rooftop amenity terraces are predicted to be comfortable for sitting or standing (Figure 1B). These conditions are considered acceptable for general passive patron uses; however, speeds comfortable for sitting are ideal for prolonged periods of relaxed use and seating if such activities are programmed. Wind speeds can be further improved with the addition of the landscaping elements such as shrubs or screens that are at least 2 m tall placed around seating areas to create low-wind zones for patrons.

During the winter, due to seasonally stronger winds, wind speeds comfortable for standing or walking are mostly expected on these terraces (Figure 2). These elevated wind speeds may not be of significant concern due to the reduced occupancy of outdoor amenities in the cold winter months.

4 STATEMENT OF LIMITATIONS

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. ("RWDI") for 2131595 Ontario Inc. ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

Design Assumptions

RWDI confirms that the pedestrian wind assessment (the "**Assessment**") discussed herein was performed by RWDI in accordance with generally accepted professional standards at the time when the Assessment was performed and in the location of the Project. No other representations, warranties, or guarantees are made with respect to the accuracy or completeness of the information, findings, recommendations, or conclusions contained in this Report. This report is not a legal opinion regarding compliance with applicable laws.

The findings and recommendations set out in this report are based on the following information disclosed to RWDI. Drawings and information listed below were received from Peter J. Lesdow Architects and used to construct the scale model of the proposed development **("Project Data**")

File Name	File Type	Date Received (dd/mm/yyyy)
Kalar - 20230927 - 1 - Site	dwg	26/09/2023
Kalar - 20230927 - 2 - Building	dwg	26/09/2023
Kalar - 20230927 - 3 - Model	dwg	26/09/2023

The recommendations and conclusions are based on the assumption that the Project Data and Climate Data are accurate and complete. RWDI assumes no responsibility for any inaccuracy or deficiency in information it has received from others. In addition, the recommendations and conclusions in this report are partially based on historical data and can be affected by a number of external factors, including but not limited to Project design, quality of materials and construction, site conditions, meteorological events, and climate change. As such, the conclusions and recommendations contained in this report do not list every possible outcome.

The opinions in this report can only be relied upon to the extent that the Project Data and Project Specific Conditions have not changed. Any change in the Project Data or Project Specific Conditions not reflected in this report can impact and/or alter the recommendations and conclusions in this report. Therefore, it is incumbent upon the Client and/or any other third party reviewing the recommendations and conclusions in this report to contact RWDI in the event of any change in the Project Data and Project Specific Conditions in order to determine whether any such change(s) may impact the assumptions upon which the recommendations and conclusions were made.

5 REFERENCES

1. ASCE Task Committee on Outdoor Human Comfort (2004). *Outdoor Human Comfort and Its Assessment*, 68 pages, American Society of Civil Engineers, Reston, Virginia, USA.

2. Williams, C.J., Hunter, M.A. and Waechter, W.F. (1990). "Criteria for Assessing the Pedestrian Wind Environment," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.36, pp.811-815.

3. Williams, C.J., Soligo M.J. and Cote, J. (1992). "A Discussion of the Components for a Comprehensive Pedestrian Level Comfort Criteria," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.41-44, pp.2389-2390.

4. Soligo, M.J., Irwin, P.A., and Williams, C.J. (1993). "Pedestrian Comfort Including Wind and Thermal Effects," *Third Asia-Pacific Symposium on Wind Engineering*, Hong Kong.

5. Soligo, M.J., Irwin, P.A., Williams, C.J. and Schuyler, G.D. (1998). "A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects," *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.77&78, pp.753-766.

6. Williams, C.J., Wu, H., Waechter, W.F. and Baker, H.A. (1999). "Experiences with Remedial Solutions to Control Pedestrian Wind Problems," *Tenth International Conference on Wind Engineering*, Copenhagen, Denmark.

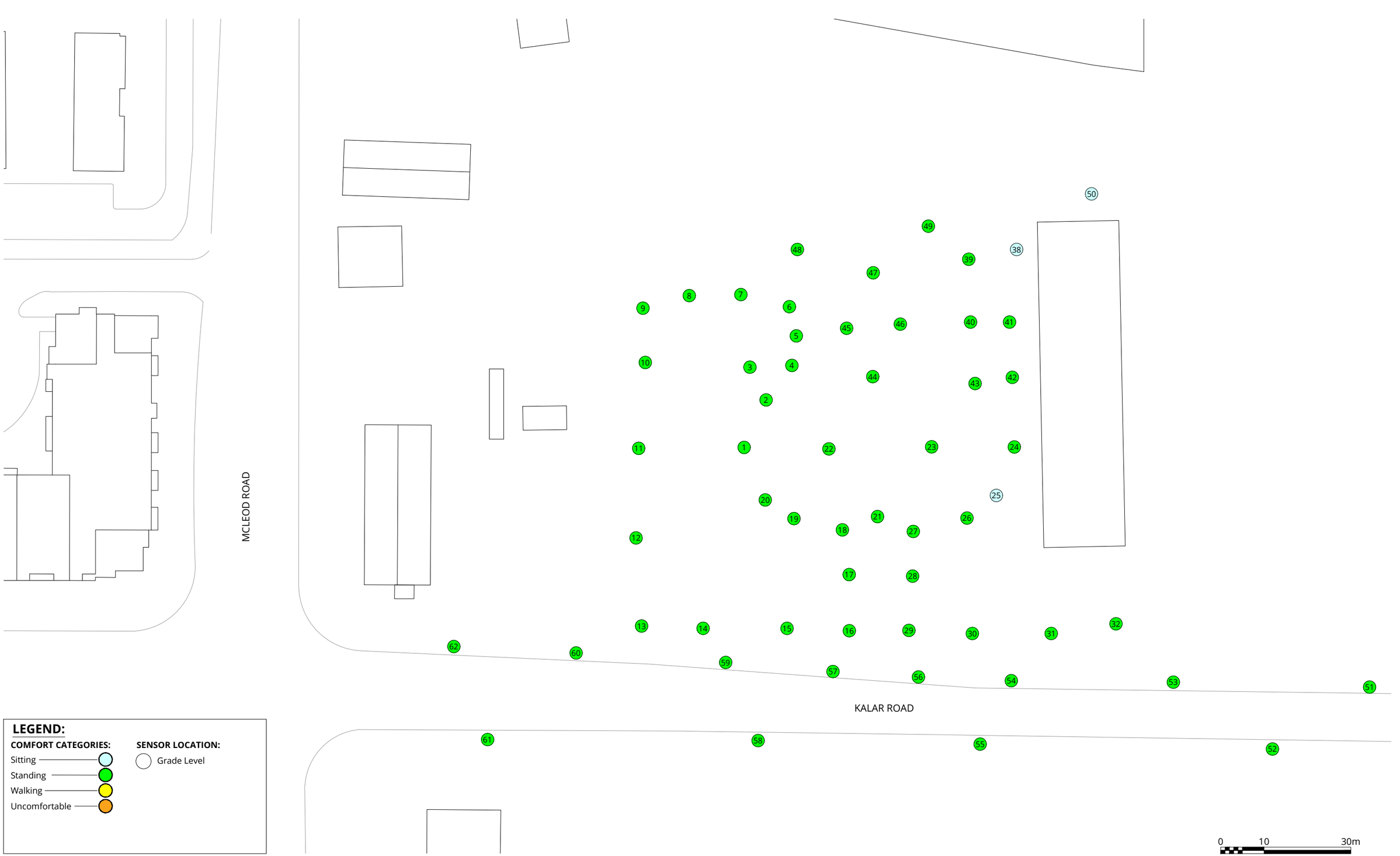
7. Lawson, T.V. (1973). "Wind Environment of Buildings: A Logical Approach to the Establishment of Criteria", *Report No. TVL 7321*, Department of Aeronautic Engineering, University of Bristol, Bristol, England.

8. Durgin, F. H. (1997). "Pedestrian Level Wind Criteria Using the Equivalent average", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol. 66, pp.215-226.

9. Wu, H. and Kriksic, F. (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, Vol.104-106, pp.397-407.

10. Wu, H., Williams, C.J., Baker, H.A. and Waechter, W.F. (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.

FIGURES



LEGEND:

COMFORT CATEGORIES:

- Sitting
- Standing
- Walking
- Uncomfortable

SENSOR LOCATION:

- Grade Level

Pedestrian Wind Comfort Conditions

Existing Configuration

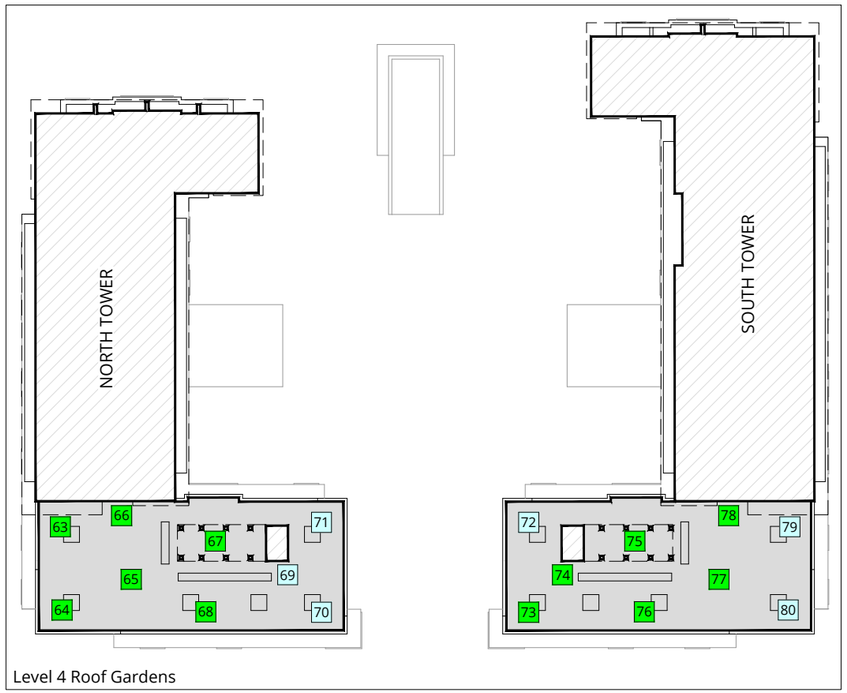
Summer (May to October, 6:00 to 23:00)

Kalar Apartments - Niagara Falls, ON

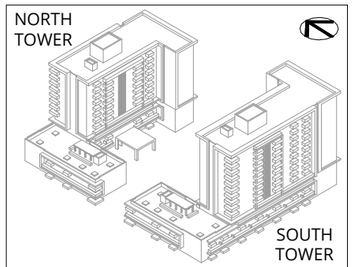
True North

Project #2306234

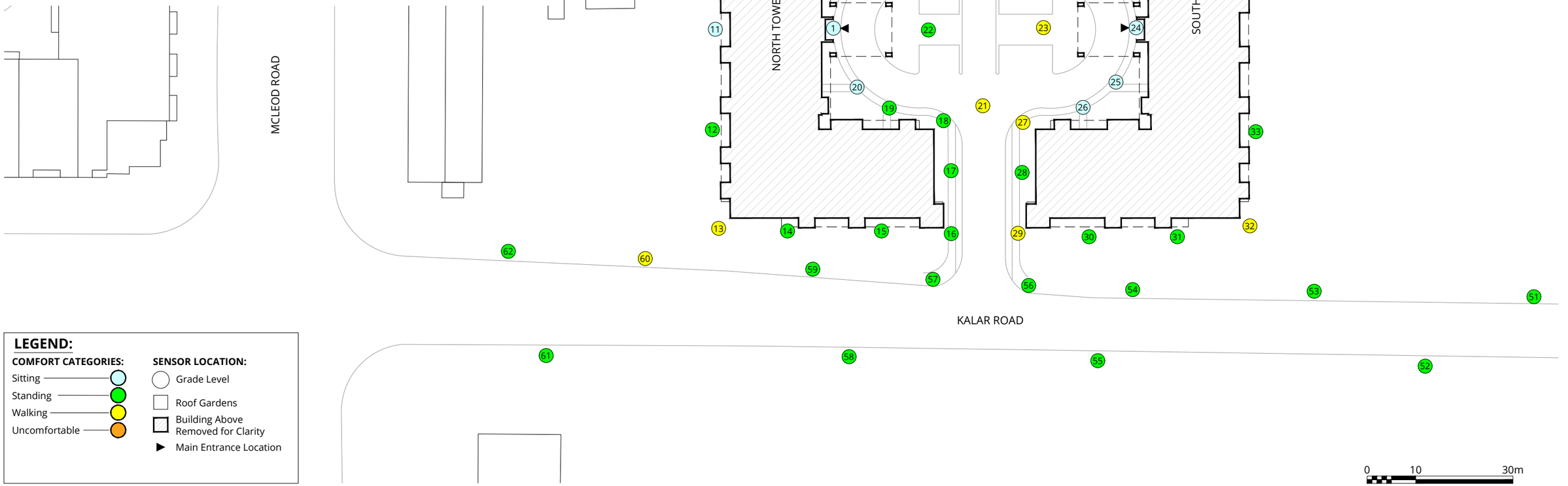
Drawn by:	GRE	Figure:	1A
Approx. Scale:	1:800		
Date Revised:	Oct. 27, 2023		



Level 4 Roof Gardens



Isometric View of Buildings



LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

SENSOR LOCATION:
- Grade Level
- Roof Gardens
- Building Above Removed for Clarity
- Main Entrance Location

0 10 30m

Pedestrian Wind Comfort Conditions

Proposed Configuration

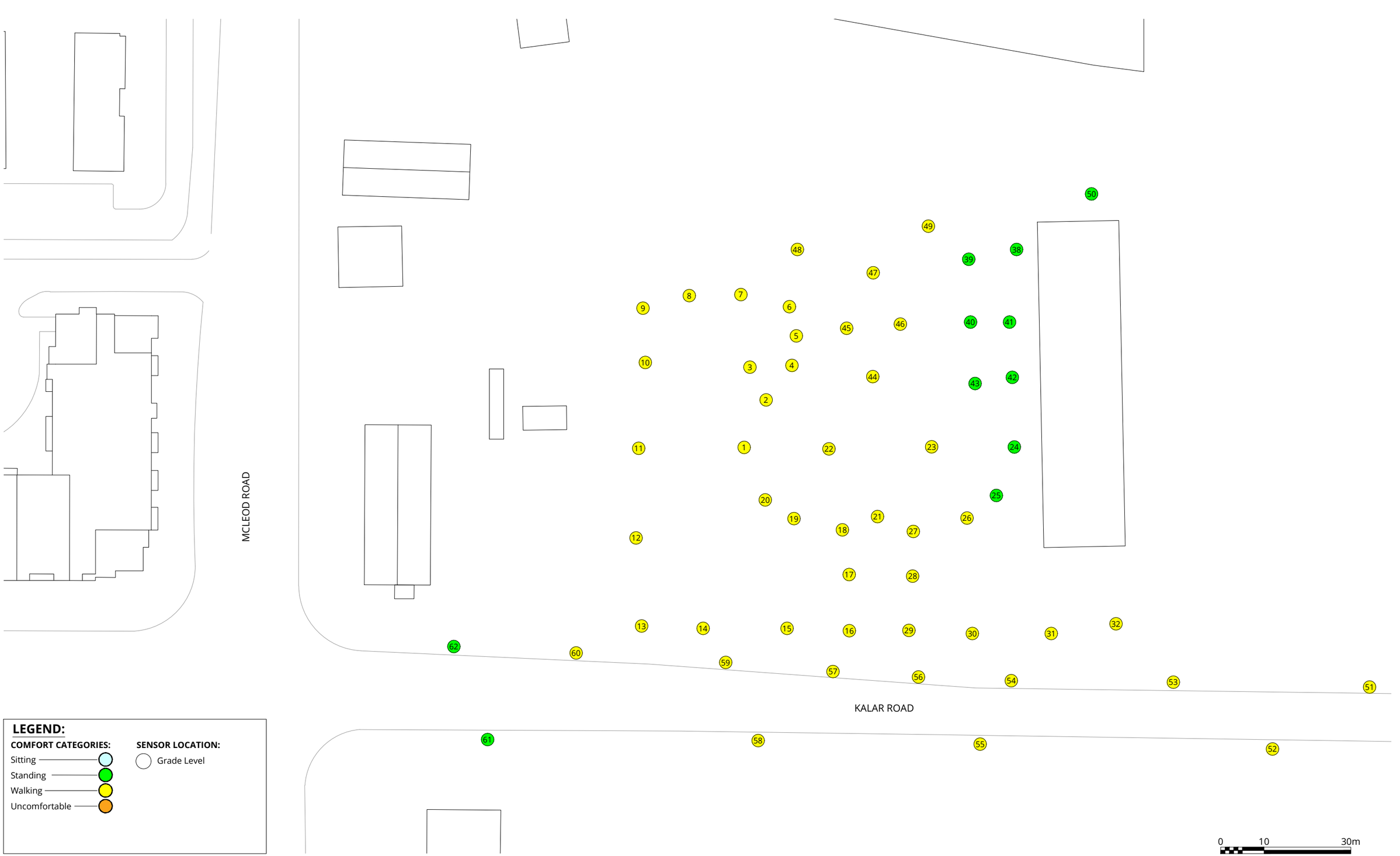
Summer (May to October, 6:00 to 23:00)

Kalar Apartments - Niagara Falls, ON

True North

Project #2306234

Drawn by:	GRE	Figure:	1B
Approx. Scale:	1:800		
Date Revised:	Oct. 27, 2023		



LEGEND:

COMFORT CATEGORIES:

- Sitting
- Standing
- Walking
- Uncomfortable

SENSOR LOCATION:

- Grade Level

0 10 30m

Pedestrian Wind Comfort Conditions

Existing Configuration

Winter (November to April, 6:00 to 23:00)

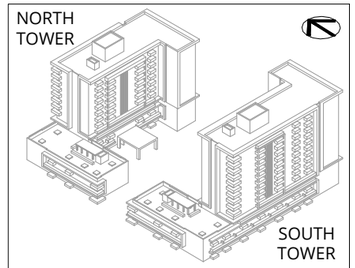
Kalar Apartments - Niagara Falls, ON

True North

Project #2306234

Drawn by:	GRE	Figure:	2A
Approx. Scale:	1:800		
Date Revised:	Oct. 27, 2023		

Level 4 Roof Gardens



Isometric View of Buildings

LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

SENSOR LOCATION:
- Grade Level
- Roof Gardens
- Building Above Removed for Clarity
- Main Entrance Location

0 10 30m

Pedestrian Wind Comfort Conditions

Proposed Configuration

Winter (November to April, 6:00 to 23:00)

Kalar Apartments - Niagara Falls, ON

True North

Project #2306234

Drawn by:	GRE	Figure:	2B
Approx. Scale:	1:800		
Date Revised:	Oct. 27, 2023		

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	56	Pass
	Proposed	9	Sitting	10	Sitting	44	Pass
2	Existing	13	Standing	17	Walking	56	Pass
	Proposed	9	Sitting	12	Standing	53	Pass
3	Existing	13	Standing	17	Walking	56	Pass
	Proposed	7	Sitting	9	Sitting	36	Pass
4	Existing	13	Standing	17	Walking	56	Pass
	Proposed	16	Walking	19	Walking	73	Pass
5	Existing	13	Standing	17	Walking	58	Pass
	Proposed	15	Standing	19	Walking	78	Pass
6	Existing	13	Standing	16	Walking	56	Pass
	Proposed	15	Standing	19	Walking	72	Pass
7	Existing	13	Standing	17	Walking	57	Pass
	Proposed	9	Sitting	10	Sitting	41	Pass
8	Existing	13	Standing	17	Walking	56	Pass
	Proposed	9	Sitting	10	Sitting	43	Pass
9	Existing	14	Standing	17	Walking	57	Pass
	Proposed	12	Standing	16	Walking	57	Pass
10	Existing	13	Standing	17	Walking	58	Pass
	Proposed	10	Sitting	12	Standing	49	Pass
11	Existing	14	Standing	18	Walking	59	Pass
	Proposed	10	Sitting	14	Standing	53	Pass
12	Existing	14	Standing	18	Walking	58	Pass
	Proposed	12	Standing	17	Walking	76	Pass
13	Existing	14	Standing	18	Walking	58	Pass
	Proposed	19	Walking	24	Uncomfortable	83	Pass
14	Existing	13	Standing	17	Walking	57	Pass
	Proposed	12	Standing	14	Standing	62	Pass
15	Existing	14	Standing	17	Walking	59	Pass
	Proposed	11	Standing	12	Standing	49	Pass
16	Existing	14	Standing	17	Walking	56	Pass
	Proposed	13	Standing	17	Walking	59	Pass
17	Existing	14	Standing	18	Walking	60	Pass
	Proposed	13	Standing	17	Walking	65	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	14	Standing	18	Walking	59	Pass
	Proposed	13	Standing	16	Walking	59	Pass
19	Existing	13	Standing	17	Walking	57	Pass
	Proposed	11	Standing	13	Standing	55	Pass
20	Existing	13	Standing	17	Walking	58	Pass
	Proposed	10	Sitting	11	Standing	43	Pass
21	Existing	13	Standing	17	Walking	57	Pass
	Proposed	17	Walking	21	Uncomfortable	69	Pass
22	Existing	14	Standing	18	Walking	58	Pass
	Proposed	14	Standing	16	Walking	62	Pass
23	Existing	13	Standing	17	Walking	58	Pass
	Proposed	17	Walking	20	Walking	78	Pass
24	Existing	11	Standing	14	Standing	54	Pass
	Proposed	7	Sitting	9	Sitting	35	Pass
25	Existing	10	Sitting	14	Standing	55	Pass
	Proposed	9	Sitting	11	Standing	51	Pass
26	Existing	13	Standing	17	Walking	59	Pass
	Proposed	9	Sitting	11	Standing	49	Pass
27	Existing	13	Standing	17	Walking	57	Pass
	Proposed	16	Walking	19	Walking	72	Pass
28	Existing	14	Standing	17	Walking	57	Pass
	Proposed	11	Standing	14	Standing	54	Pass
29	Existing	14	Standing	17	Walking	57	Pass
	Proposed	17	Walking	21	Uncomfortable	74	Pass
30	Existing	13	Standing	17	Walking	55	Pass
	Proposed	12	Standing	14	Standing	59	Pass
31	Existing	14	Standing	17	Walking	57	Pass
	Proposed	12	Standing	14	Standing	54	Pass
32	Existing	14	Standing	17	Walking	58	Pass
	Proposed	17	Walking	21	Uncomfortable	72	Pass
33	Existing	-	-	-	-	-	-
	Proposed	11	Standing	15	Standing	67	Pass
34	Existing	-	-	-	-	-	-
	Proposed	11	Standing	14	Standing	61	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	-	-	-	-	-	-
	Proposed	14	Standing	17	Walking	71	Pass
36	Existing	-	-	-	-	-	-
	Proposed	19	Walking	21	Uncomfortable	79	Pass
37	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	12	Standing	52	Pass
38	Existing	10	Sitting	14	Standing	55	Pass
	Proposed	11	Standing	13	Standing	54	Pass
39	Existing	11	Standing	15	Standing	58	Pass
	Proposed	15	Standing	18	Walking	65	Pass
40	Existing	11	Standing	15	Standing	55	Pass
	Proposed	12	Standing	16	Walking	61	Pass
41	Existing	11	Standing	14	Standing	56	Pass
	Proposed	8	Sitting	11	Standing	43	Pass
42	Existing	11	Standing	14	Standing	56	Pass
	Proposed	9	Sitting	12	Standing	49	Pass
43	Existing	11	Standing	15	Standing	54	Pass
	Proposed	12	Standing	16	Walking	63	Pass
44	Existing	14	Standing	17	Walking	60	Pass
	Proposed	18	Walking	22	Uncomfortable	78	Pass
45	Existing	13	Standing	16	Walking	57	Pass
	Proposed	17	Walking	20	Walking	74	Pass
46	Existing	13	Standing	16	Walking	59	Pass
	Proposed	14	Standing	18	Walking	64	Pass
47	Existing	13	Standing	17	Walking	61	Pass
	Proposed	10	Sitting	12	Standing	49	Pass
48	Existing	13	Standing	17	Walking	59	Pass
	Proposed	16	Walking	20	Walking	86	Pass
49	Existing	12	Standing	16	Walking	57	Pass
	Proposed	16	Walking	20	Walking	73	Pass
50	Existing	10	Sitting	11	Standing	46	Pass
	Proposed	17	Walking	19	Walking	75	Pass
51	Existing	14	Standing	18	Walking	62	Pass
	Proposed	14	Standing	18	Walking	62	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	14	Standing	17	Walking	58	Pass
	Proposed	14	Standing	17	Walking	57	Pass
53	Existing	14	Standing	17	Walking	57	Pass
	Proposed	14	Standing	17	Walking	55	Pass
54	Existing	14	Standing	18	Walking	59	Pass
	Proposed	13	Standing	14	Standing	55	Pass
55	Existing	14	Standing	18	Walking	59	Pass
	Proposed	13	Standing	15	Standing	55	Pass
56	Existing	14	Standing	18	Walking	58	Pass
	Proposed	13	Standing	15	Standing	59	Pass
57	Existing	14	Standing	17	Walking	57	Pass
	Proposed	12	Standing	14	Standing	53	Pass
58	Existing	14	Standing	18	Walking	59	Pass
	Proposed	13	Standing	15	Standing	55	Pass
59	Existing	14	Standing	17	Walking	57	Pass
	Proposed	12	Standing	13	Standing	52	Pass
60	Existing	13	Standing	17	Walking	57	Pass
	Proposed	16	Walking	19	Walking	63	Pass
61	Existing	13	Standing	14	Standing	55	Pass
	Proposed	14	Standing	15	Standing	61	Pass
62	Existing	12	Standing	15	Standing	50	Pass
	Proposed	13	Standing	15	Standing	54	Pass
63	Existing	-	-	-	-	-	-
	Proposed	13	Standing	15	Standing	60	Pass
64	Existing	-	-	-	-	-	-
	Proposed	11	Standing	14	Standing	56	Pass
65	Existing	-	-	-	-	-	-
	Proposed	15	Standing	20	Walking	77	Pass
66	Existing	-	-	-	-	-	-
	Proposed	11	Standing	12	Standing	51	Pass
67	Existing	-	-	-	-	-	-
	Proposed	11	Standing	16	Walking	60	Pass
68	Existing	-	-	-	-	-	-
	Proposed	12	Standing	14	Standing	52	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	-	-	-	-	-	-
	Proposed	10	Sitting	13	Standing	49	Pass
70	Existing	-	-	-	-	-	-
	Proposed	8	Sitting	10	Sitting	44	Pass
71	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	12	Standing	45	Pass
72	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	12	Standing	48	Pass
73	Existing	-	-	-	-	-	-
	Proposed	12	Standing	14	Standing	56	Pass
74	Existing	-	-	-	-	-	-
	Proposed	14	Standing	18	Walking	69	Pass
75	Existing	-	-	-	-	-	-
	Proposed	15	Standing	20	Walking	75	Pass
76	Existing	-	-	-	-	-	-
	Proposed	15	Standing	18	Walking	68	Pass
77	Existing	-	-	-	-	-	-
	Proposed	14	Standing	19	Walking	75	Pass
78	Existing	-	-	-	-	-	-
	Proposed	11	Standing	13	Standing	62	Pass
79	Existing	-	-	-	-	-	-
	Proposed	9	Sitting	11	Standing	47	Pass
80	Existing	-	-	-	-	-	-
	Proposed	10	Sitting	13	Standing	52	Pass

Season	Months	Hours
Summer	May - October	6:00 - 23:00 for comfort
Winter	November - April	6:00 - 23:00 for comfort
Annual	January - December	0:00 - 23:00 for safety
Configurations		
Existing	Existing site and surroundings	
Proposed	Project with existing surroundings	

Comfort Speed (km/h)	
(20% Seasonal Exceedance)	
≤ 10	Sitting
11 - 15	Standing
16 - 20	Walking
> 20	Uncomfortable

Safety Speed (km/h)	
(0.1% Annual Exceedance)	
≤ 90	Pass
> 90	Exceeded