REPORT

NIAGARA FALLS ICE SCULPTURE ART HOTEL

NIAGARA FALLS, ONTARIO

PEDESTRIAN WIND STUDY
RWDI # 2304618
October 13, 2023

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed Niagara Falls Ice Sculpture Art Hotel in Niagara Falls, ON. The assessment was based on the wind-tunnel testing conducted for the proposed development under the Existing, Proposed and Future configurations of the site and surroundings. The results were analysed using the regional wind climate records and evaluated against the Niagara Region Pedestrian Wind Criteria for pedestrian comfort (pertaining to common wind speeds conducive to different levels of human activity) and pedestrian safety (pertaining to infrequent but strong gusts that could affect a person's footing). The predicted wind conditions are presented in Figures 1A through 3C, and Table 1, and are summarized as follows:

- The existing wind conditions on and round the site are expected to be suitable for the intended use and meet the wind safety criterion.

- With the proposed building, canopies, screens and landscaping in place, suitable wind conditions are predicted for the main entrances for both the summer and winter seasons.

- The predicted wind conditions are generally appropriate in the summer, except two isolated areas around building corners, where wind speeds may be uncomfortable from time to time.

- An increased number of uncomfortable locations is predicted around building corners and along sidewalks on and around the site during the winter. The wind safety limit is expected to be exceeded at five locations and additional wind control solutions should be developed at later design stages.

- Wind conditions under the Future configuration are predicted to be similar to those for the Proposed configuration.

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1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed Niagara Falls Ice Sculpture Art Hotel in Niagara Falls, ON. This report presents the project objectives, approach and 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 bordered by Bender Street, Palmer Avenue and Falls Avenue (Highway 420), with Ontario Avenue through the middle of the site (Image 1). The development will consist of a 17-storey mixed-use building for approximately 75 m in height. The proposed building has trapezoid floor plans and stepped facades, with a large opening along at grade Ontario Avenue.

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 parking spaces.

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), and,

C - Future: Proposed project with existing and future surroundings (Image 2C).

The wind tunnel model included all relevant surrounding buildings and topography within an approximate 360m 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 66 specially designed wind speed sensors to measure mean and gust speeds at a full-scale height of approximately 1.5m 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.

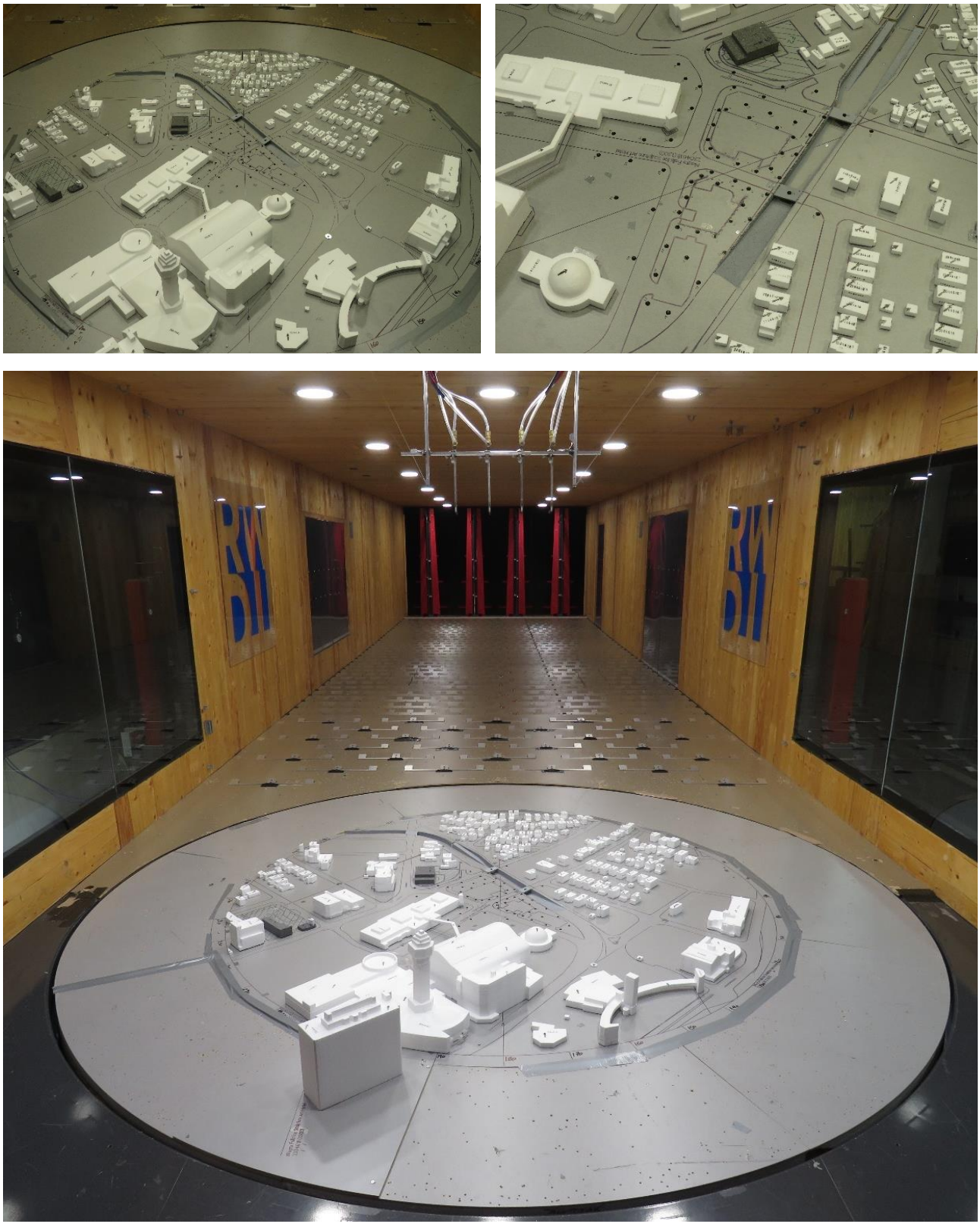


Image 2A: Wind Tunnel Study Model – Existing Configuration

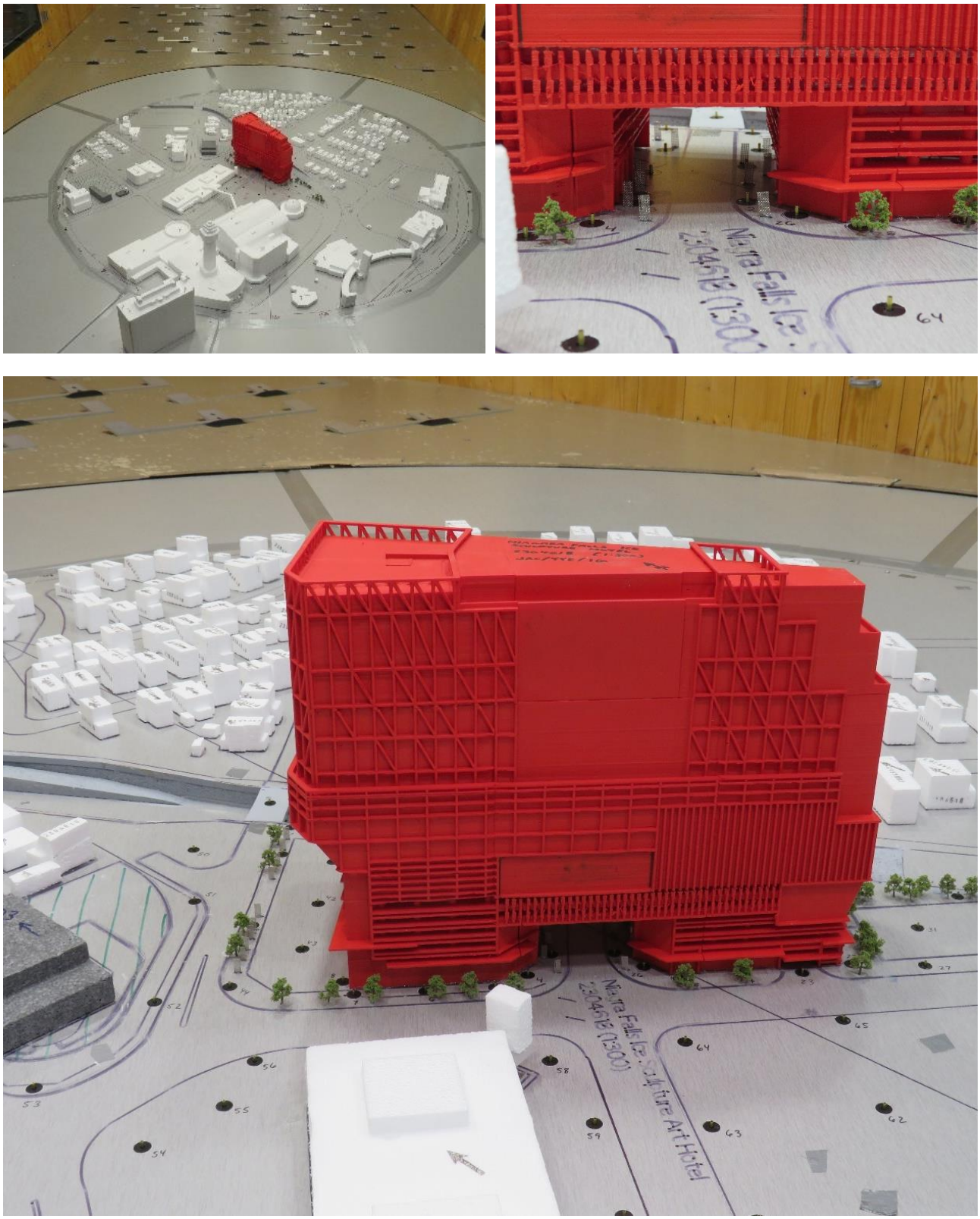


Image 2B: Wind Tunnel Study Model – Proposed Configuration

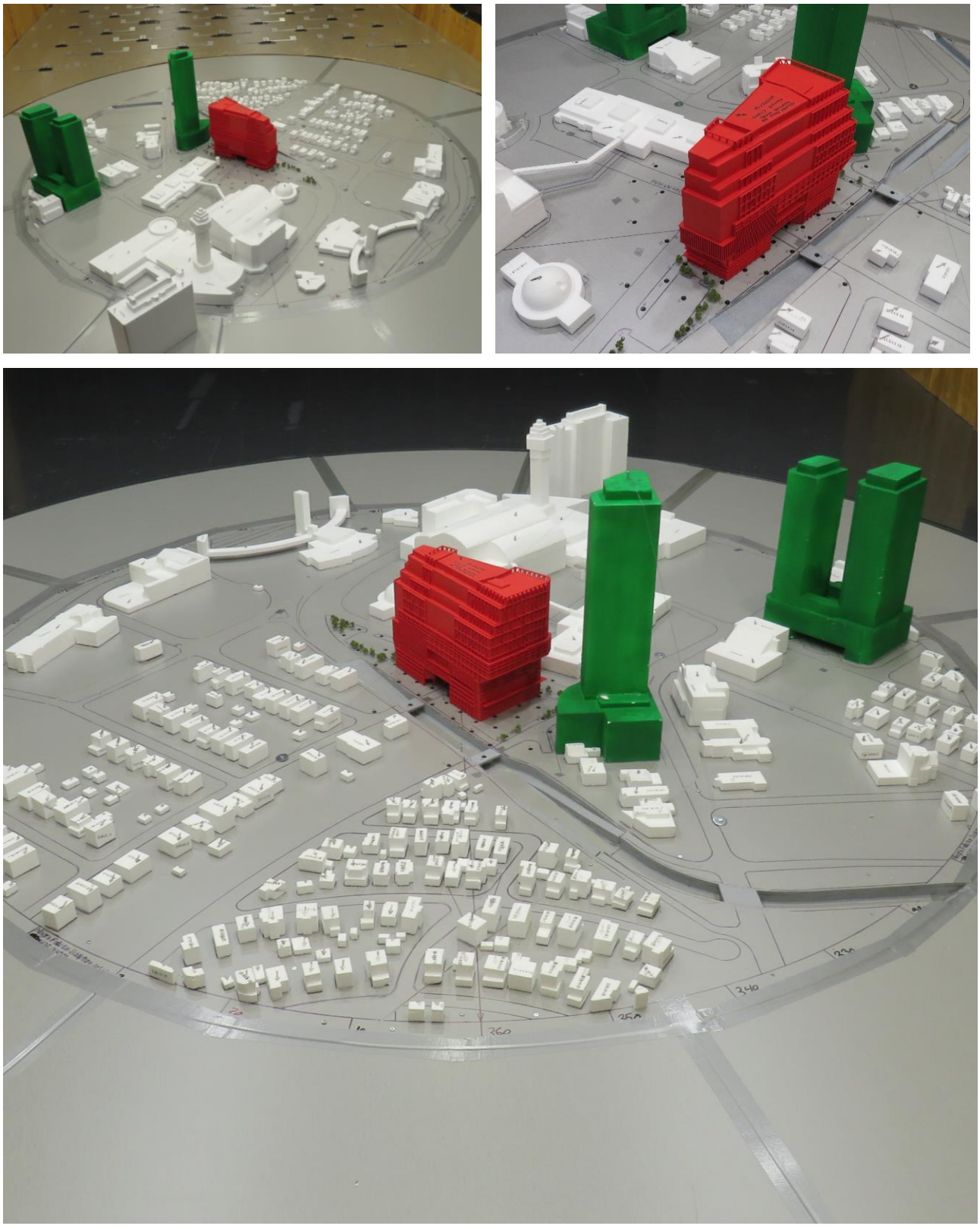
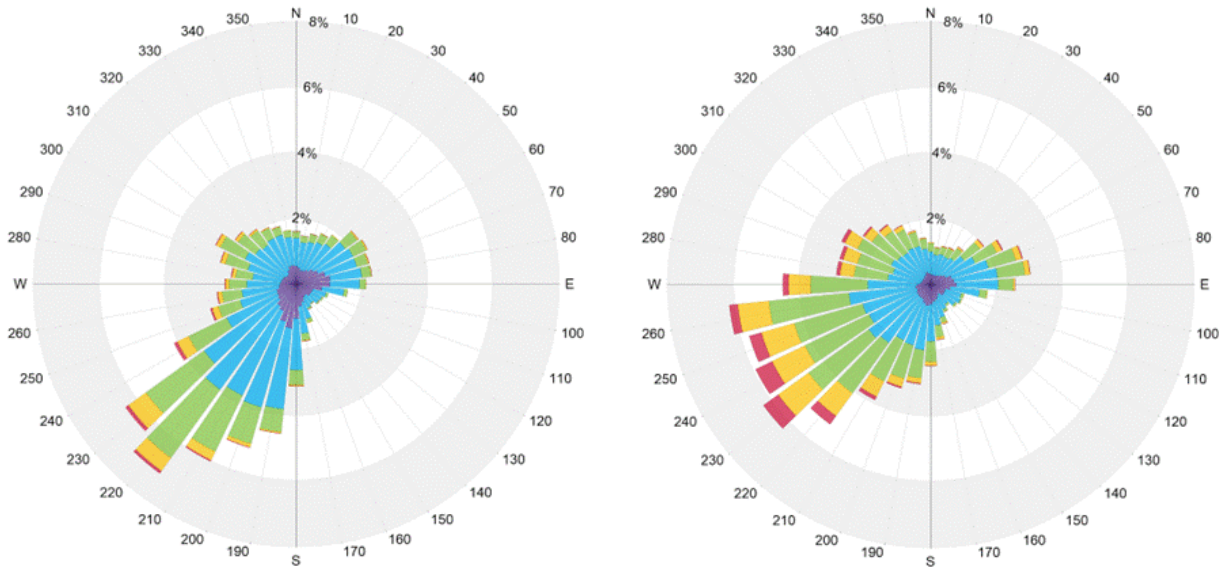


Image 2C: Wind Tunnel Study Model – Future Configuration

2.2 Meteorological Data

Wind statistics recorded at Niagara International Airport in NY 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 quadrant are predominant throughout the year as indicated by the wind roses, with secondary winds from the northeast and northwest quadrants. 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 direction.

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, NY 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

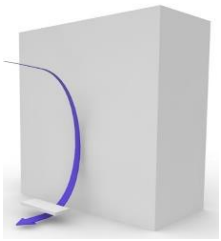
NOTES:
1) Gust Equivalent Mean (GEM) speed = maximum of either mean speed or gust speed/1.85. The gust speed can be measured directly from wind tunnel or estimated as mean speed + (3 x RMS speed).
2) Comfort calculations are to be based on wind events recorded between 6:00 and 23:00 daily.

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

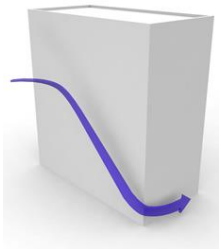
2.4 General Wind Flow Mechanisms

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



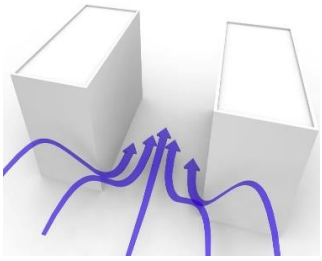
DOWNWASHING

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)

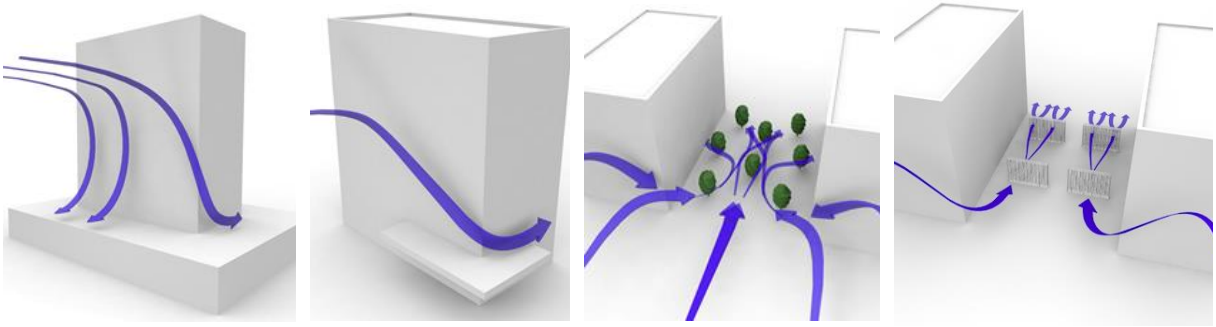


Image 5: Common Wind Control Measures

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown on site plans in Figures 1A through 3C located in the "Figures" section of this report and the associated wind speeds are presented 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**.**

3.1 Existing Configuration

The existing wind conditions on and round the site are expected to be generally comfortable standing throughout the year, with a few locations comfortable for sitting in the summer (Figure 1A) and for walking in the winter (Figure 2A).

The wind safety criterion is met at all test locations under the Existing configuration (Figure 3A).

3.2 Proposed Configuration

With the proposed building, canopies, screens and landscaping in place, the predicted wind conditions are appropriate in the summer, except two isolated areas around building corners where wind speeds are rated uncomfortable (Locations 2 and 22 in Figure 1B). Wind conditions are comfortable for sitting and suitable for main entrances in the summer (Locations 1, 5 and 8 in Figure 1B).

Suitable wind conditions comfortable for standing are found in the winter around the main entrances (Figure 2B). However, an increased number of uncomfortable locations is predicted around building corners and along sidewalks on and around the site (Figure 2B), due to seasonally stronger wind speeds in the winter.

The wind safety limit is expected to be exceeded at five locations (Locations 22, 32, and 41 through 43 in Figure 3B). Additional wind control solutions should be developed at later design stages.

3.3 Future Configuration

Future buildings are located to the north and northwest of the site, as shown in Image 2C. Wind conditions under the Future configuration (Figures 1C, 2C and 3C) are predicted to be similar to those for the Proposed configuration (Figure 1B, 2B and 3B).

4 STATEMENT OF LIMITATIONS

Limitations

This report was prepared by Rowan Williams Davies & Irwin, Inc. ("RWDI") for TAES Architects 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 TAES Architects Inc and used to construct the scale model of the proposed development **("Project Data**").

File Name	File Type	Date Received (dd/mm/yyyy)
BENDER ST NIAGARA FALL 2023-04-14 FOOTPRINT REVISED	pdf	25/04/2023
T2019_Bender St_Niagara Falls 20230313	skp	25/04/2023
A-001a	dwg	12/05/2023
Niagara Hotel	pdf	12/05/2023
T2019025 Bender St Niagara Fall_20230615	pdf	06/07/2023
T2019_Bender St_Niagara Falls 20230609	skp	21/08/2023

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.

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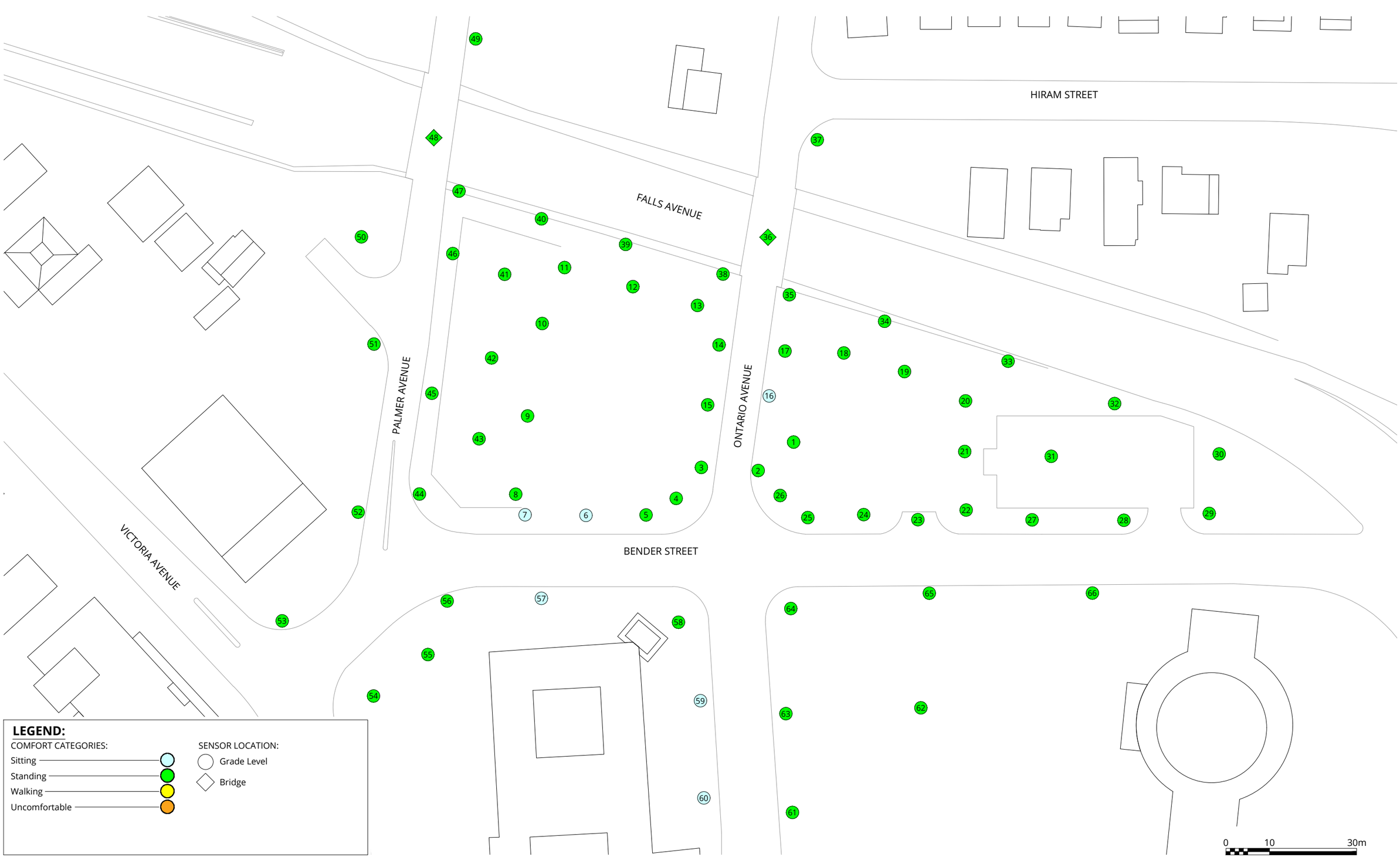
10. Wu, H., Williams, C.J., Baker, H.A. and Waechter, W.F. (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.

FIGURES



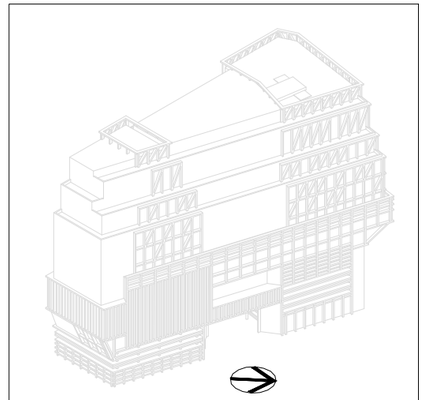
Pedestrian Wind Comfort Conditions
Existing Configuration
Summer (May to October, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

Drawn by: ALJM	Figure: 1A
Approx. Scale:	1:800
Date Revised:	Jul. 31, 2023



Isometric View of Building

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

3000 mm

3000 mm

1500 mm

1500 mm

0 10 30m

LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

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

MITIGATION:
- Marcescent Tree (6m Tall)
- Solid Canopy
- 30% Porous Wind Screen (3.5m Tall, 1.35m Wide)

Pedestrian Wind Comfort Conditions
Proposed Configuration
Summer (May to October, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

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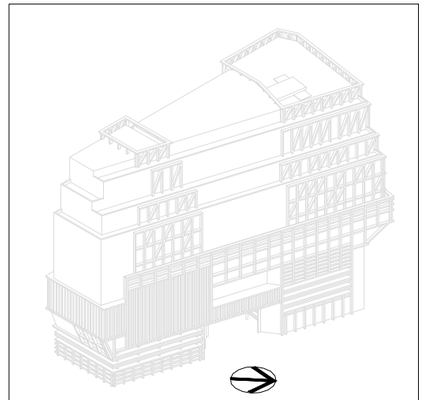

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

FUTURE BUILDING

3000 mm

3000 mm

1500 mm

1500 mm

LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

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

MITIGATION:
- Marcescent Tree (6m Tall)
- Solid Canopy
- 30% Porous Wind Screen (3.5m Tall, 1.35m Wide)

0 10 30m

Pedestrian Wind Comfort Conditions
Future Configuration
Summer (May to October, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

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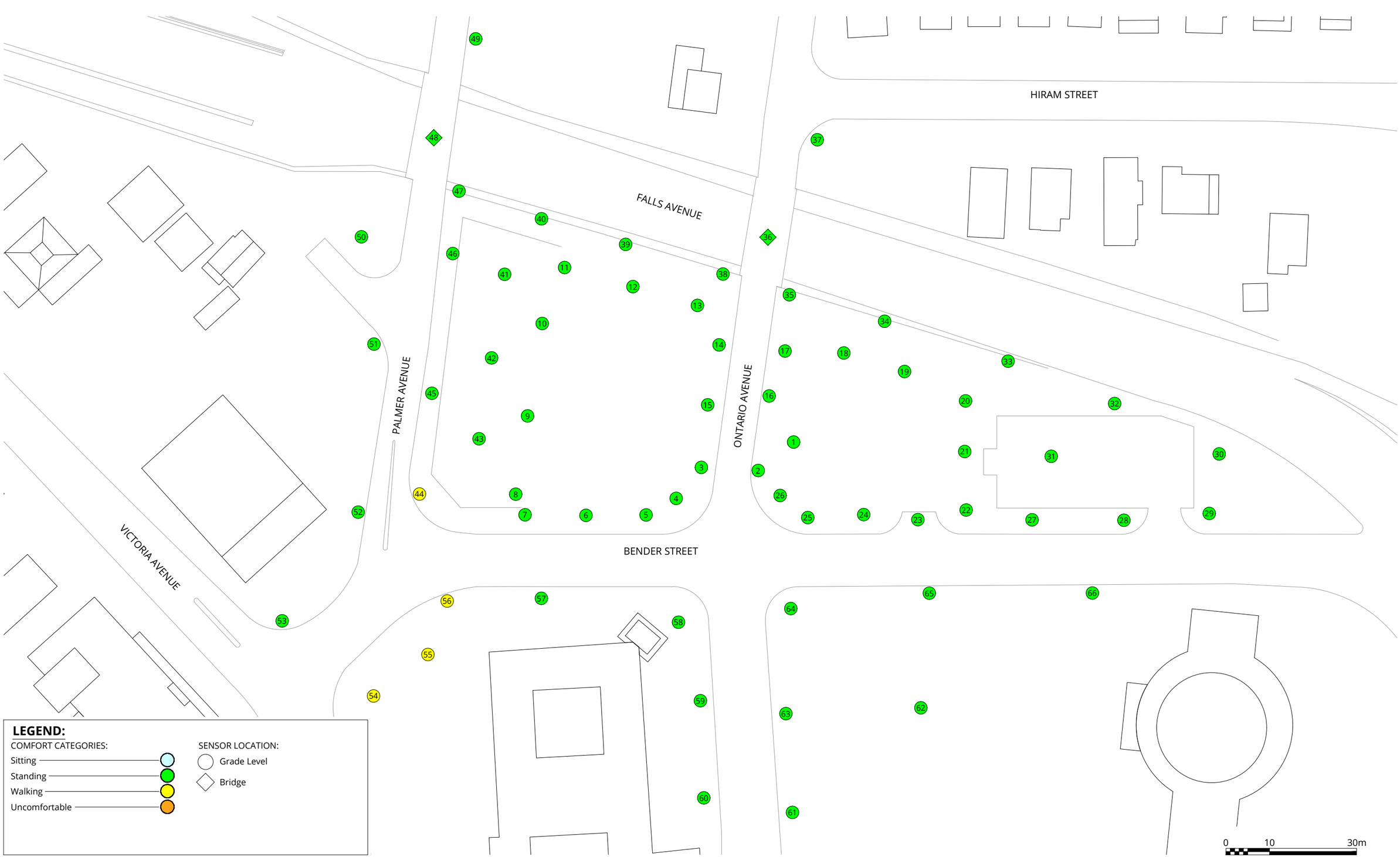

Pedestrian Wind Comfort Conditions
Existing Configuration
Winter (November to April, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

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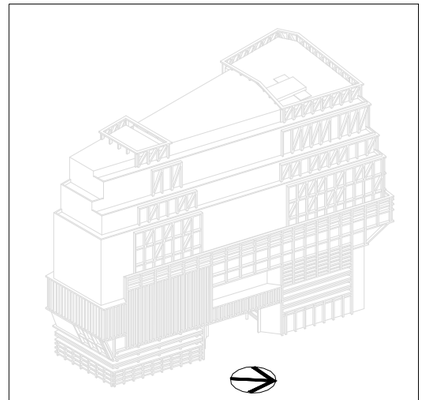

Isometric View of Building

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

3000 mm

3000 mm

1500 mm

1500 mm

0 10 30m

LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

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

MITIGATION:
- Marcescent Tree (6m Tall)
- Solid Canopy
- 30% Porous Wind Screen (3.5m Tall, 1.35m Wide)

Pedestrian Wind Comfort Conditions
Proposed Configuration
Winter (November to April, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

Drawn by:	GRE	Figure:	2B
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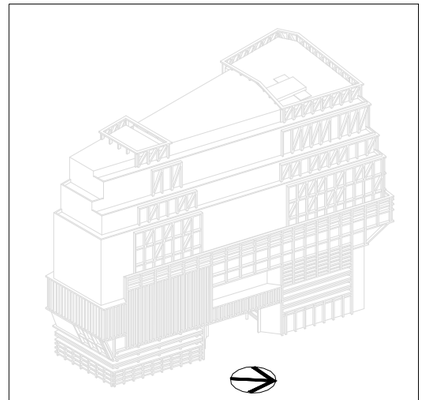
Date Revised:	Oct. 4, 2023		



Isometric View of Building

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

FUTURE BUILDING

3000 mm

3000 mm

1500 mm

3000 mm

1500 mm

0 10 30m

LEGEND:

COMFORT CATEGORIES:
- Sitting
- Standing
- Walking
- Uncomfortable

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

MITIGATION:
- Marcescent Tree (6m Tall)
- Solid Canopy
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Pedestrian Wind Comfort Conditions
Future Configuration
Winter (November to April, 6:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

Drawn by:	GRE	Figure:	2C
Approx. Scale:	1:800		
Date Revised:	Oct. 4, 2023		

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

LEGEND:

SAFETY CATEGORIES:
- Acceptable
- Exceeded

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

0 10 30m

Pedestrian Wind Safety Conditions

Existing Configuration

Annual (January to December, 0:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

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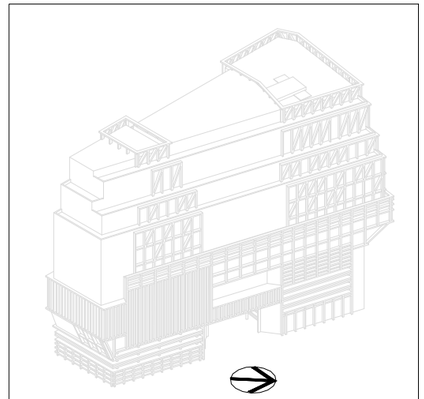
Date Revised:	Jul. 31, 2023



Isometric View of Building

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FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

3000 mm

3000 mm

1500 mm

1500 mm

0 10 30m

LEGEND:

SAFETY CATEGORIES:
- Acceptable
- Exceeded

SENSOR LOCATION:
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MITIGATION:
- Marcescent Tree (6m Tall)
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- 30% Porous Wind Screen (3.5m Tall, 1.35m Wide)

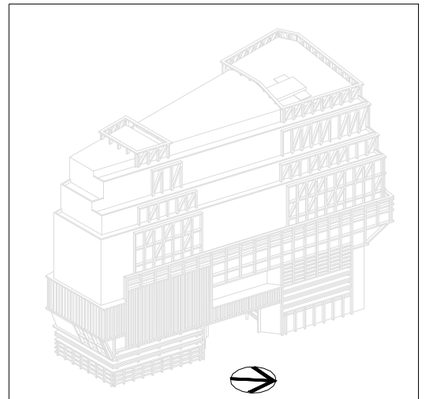
Pedestrian Wind Safety Conditions
Proposed Configuration
Annual (January to December, 0:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

Drawn by:	GRE	Figure:	3B
Approx. Scale:	1:800		
Date Revised:	Oct. 4, 2023		


Isometric View of Building

HIRAM STREET

FALLS AVENUE

PALMER AVENUE

ONTARIO AVENUE

VICTORIA AVENUE

BENDER STREET

FUTURE BUILDING

3000 mm

3000 mm

1500 mm

3000 mm

1500 mm

LEGEND:

SAFETY CATEGORIES:
- Acceptable
- Exceeded

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

MITIGATION:
- Marcescent Tree (6m Tall)
- Solid Canopy
- 30% Porous Wind Screen (3.5m Tall, 1.35m Wide)

0 10 30m

Pedestrian Wind Safety Conditions
Future Configuration
Annual (January to December, 0:00 to 23:00)

Niagara Falls Ice Sculpture Art Hotel - Niagara Falls, ON

True North

Project #2304618

Drawn by:	GRE	Figure:	3C
Approx. Scale:	1:800		
Date Revised:	Oct. 4, 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	12	Standing	14	Standing	52	Pass
	Proposed	9	Sitting	11	Standing	50	Pass
	Future	10	Sitting	12	Standing	50	Pass
2	Existing	12	Standing	14	Standing	53	Pass
	Proposed	21	Uncomfortable	27	Uncomfortable	85	Pass
	Future	21	Uncomfortable	25	Uncomfortable	82	Pass
3	Existing	12	Standing	14	Standing	52	Pass
	Proposed	20	Walking	26	Uncomfortable	90	Pass
	Future	20	Walking	25	Uncomfortable	86	Pass
4	Existing	11	Standing	14	Standing	50	Pass
	Proposed	12	Standing	16	Walking	61	Pass
	Future	12	Standing	15	Standing	60	Pass
5	Existing	11	Standing	13	Standing	49	Pass
	Proposed	10	Sitting	13	Standing	52	Pass
	Future	10	Sitting	13	Standing	58	Pass
6	Existing	10	Sitting	13	Standing	49	Pass
	Proposed	10	Sitting	12	Standing	47	Pass
	Future	10	Sitting	12	Standing	49	Pass
7	Existing	10	Sitting	13	Standing	49	Pass
	Proposed	19	Walking	23	Uncomfortable	85	Pass
	Future	19	Walking	21	Uncomfortable	84	Pass
8	Existing	11	Standing	14	Standing	52	Pass
	Proposed	10	Sitting	13	Standing	55	Pass
	Future	12	Standing	15	Standing	65	Pass
9	Existing	11	Standing	14	Standing	49	Pass
	Proposed	10	Sitting	13	Standing	53	Pass
	Future	14	Standing	17	Walking	70	Pass
10	Existing	11	Standing	14	Standing	52	Pass
	Proposed	11	Standing	16	Walking	65	Pass
	Future	13	Standing	16	Walking	66	Pass
11	Existing	12	Standing	14	Standing	52	Pass
	Proposed	10	Sitting	11	Standing	61	Pass
	Future	10	Sitting	12	Standing	64	Pass
12	Existing	11	Standing	14	Standing	50	Pass
	Proposed	7	Sitting	8	Sitting	39	Pass
	Future	8	Sitting	9	Sitting	53	Pass
13	Existing	12	Standing	15	Standing	53	Pass
	Proposed	10	Sitting	11	Standing	46	Pass
	Future	10	Sitting	12	Standing	52	Pass
14	Existing	12	Standing	14	Standing	52	Pass
	Proposed	18	Walking	23	Uncomfortable	80	Pass
	Future	18	Walking	22	Uncomfortable	76	Pass
15	Existing	11	Standing	14	Standing	51	Pass
	Proposed	17	Walking	21	Uncomfortable	78	Pass
	Future	17	Walking	20	Walking	76	Pass
16	Existing	10	Sitting	13	Standing	47	Pass
	Proposed	17	Walking	22	Uncomfortable	77	Pass
	Future	17	Walking	21	Uncomfortable	74	Pass
17	Existing	12	Standing	15	Standing	54	Pass
	Proposed	14	Standing	18	Walking	64	Pass
	Future	14	Standing	17	Walking	62	Pass
18	Existing	11	Standing	14	Standing	52	Pass
	Proposed	6	Sitting	7	Sitting	36	Pass
	Future	7	Sitting	7	Sitting	41	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
19	Existing	12	Standing	15	Standing	54	Pass
	Proposed	8	Sitting	9	Sitting	39	Pass
	Future	8	Sitting	9	Sitting	40	Pass
20	Existing	11	Standing	14	Standing	51	Pass
	Proposed	14	Standing	15	Standing	70	Pass
	Future	14	Standing	15	Standing	68	Pass
21	Existing	12	Standing	15	Standing	53	Pass
	Proposed	14	Standing	15	Standing	68	Pass
	Future	14	Standing	15	Standing	65	Pass
22	Existing	12	Standing	15	Standing	52	Pass
	Proposed	22	Uncomfortable	28	Uncomfortable	94	Exceeded
	Future	22	Uncomfortable	27	Uncomfortable	92	Exceeded
23	Existing	12	Standing	15	Standing	54	Pass
	Proposed	13	Standing	17	Walking	62	Pass
	Future	12	Standing	15	Standing	61	Pass
24	Existing	12	Standing	15	Standing	52	Pass
	Proposed	11	Standing	15	Standing	58	Pass
	Future	11	Standing	14	Standing	57	Pass
25	Existing	12	Standing	15	Standing	54	Pass
	Proposed	11	Standing	14	Standing	54	Pass
	Future	10	Sitting	13	Standing	53	Pass
26	Existing	11	Standing	14	Standing	52	Pass
	Proposed	12	Standing	14	Standing	53	Pass
	Future	11	Standing	14	Standing	52	Pass
27	Existing	12	Standing	15	Standing	52	Pass
	Proposed	20	Walking	25	Uncomfortable	84	Pass
	Future	19	Walking	24	Uncomfortable	82	Pass
28	Existing	11	Standing	15	Standing	52	Pass
	Proposed	19	Walking	25	Uncomfortable	87	Pass
	Future	19	Walking	23	Uncomfortable	85	Pass
29	Existing	11	Standing	14	Standing	51	Pass
	Proposed	15	Standing	20	Walking	75	Pass
	Future	15	Standing	18	Walking	72	Pass
30	Existing	11	Standing	14	Standing	53	Pass
	Proposed	17	Walking	22	Uncomfortable	83	Pass
	Future	16	Walking	21	Uncomfortable	78	Pass
31	Existing	12	Standing	15	Standing	52	Pass
	Proposed	18	Walking	22	Uncomfortable	83	Pass
	Future	18	Walking	21	Uncomfortable	80	Pass
32	Existing	12	Standing	15	Standing	55	Pass
	Proposed	20	Walking	26	Uncomfortable	101	Exceeded
	Future	20	Walking	25	Uncomfortable	100	Exceeded
33	Existing	12	Standing	15	Standing	55	Pass
	Proposed	14	Standing	15	Standing	62	Pass
	Future	14	Standing	15	Standing	60	Pass
34	Existing	11	Standing	14	Standing	53	Pass
	Proposed	10	Sitting	11	Standing	45	Pass
	Future	9	Sitting	11	Standing	45	Pass
35	Existing	12	Standing	15	Standing	54	Pass
	Proposed	15	Standing	20	Walking	72	Pass
	Future	15	Standing	18	Walking	68	Pass
36	Existing	12	Standing	14	Standing	55	Pass
	Proposed	17	Walking	22	Uncomfortable	84	Pass
	Future	17	Walking	21	Uncomfortable	81	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
37	Existing	12	Standing	15	Standing	57	Pass
	Proposed	15	Standing	19	Walking	74	Pass
	Future	13	Standing	16	Walking	65	Pass
38	Existing	12	Standing	15	Standing	55	Pass
	Proposed	12	Standing	15	Standing	59	Pass
	Future	13	Standing	15	Standing	61	Pass
39	Existing	11	Standing	14	Standing	52	Pass
	Proposed	11	Standing	13	Standing	67	Pass
	Future	11	Standing	13	Standing	60	Pass
40	Existing	12	Standing	14	Standing	52	Pass
	Proposed	18	Walking	26	Uncomfortable	86	Pass
	Future	17	Walking	22	Uncomfortable	78	Pass
41	Existing	12	Standing	15	Standing	54	Pass
	Proposed	19	Walking	26	Uncomfortable	94	Exceeded
	Future	20	Walking	24	Uncomfortable	95	Exceeded
42	Existing	12	Standing	14	Standing	54	Pass
	Proposed	18	Walking	22	Uncomfortable	99	Exceeded
	Future	21	Uncomfortable	26	Uncomfortable	104	Exceeded
43	Existing	12	Standing	15	Standing	57	Pass
	Proposed	19	Walking	23	Uncomfortable	106	Exceeded
	Future	24	Uncomfortable	28	Uncomfortable	105	Exceeded
44	Existing	13	Standing	16	Walking	59	Pass
	Proposed	17	Walking	20	Walking	89	Pass
	Future	19	Walking	24	Uncomfortable	82	Pass
45	Existing	12	Standing	14	Standing	54	Pass
	Proposed	13	Standing	16	Walking	63	Pass
	Future	15	Standing	18	Walking	76	Pass
46	Existing	12	Standing	14	Standing	51	Pass
	Proposed	15	Standing	19	Walking	66	Pass
	Future	15	Standing	18	Walking	68	Pass
47	Existing	11	Standing	14	Standing	49	Pass
	Proposed	15	Standing	19	Walking	66	Pass
	Future	14	Standing	17	Walking	61	Pass
48	Existing	11	Standing	14	Standing	50	Pass
	Proposed	15	Standing	19	Walking	73	Pass
	Future	14	Standing	16	Walking	61	Pass
49	Existing	12	Standing	15	Standing	55	Pass
	Proposed	15	Standing	19	Walking	75	Pass
	Future	14	Standing	17	Walking	71	Pass
50	Existing	12	Standing	14	Standing	52	Pass
	Proposed	17	Walking	20	Walking	79	Pass
	Future	17	Walking	20	Walking	81	Pass
51	Existing	11	Standing	13	Standing	48	Pass
	Proposed	17	Walking	21	Uncomfortable	76	Pass
	Future	22	Uncomfortable	25	Uncomfortable	87	Pass
52	Existing	12	Standing	15	Standing	56	Pass
	Proposed	17	Walking	21	Uncomfortable	71	Pass
	Future	20	Walking	25	Uncomfortable	83	Pass
53	Existing	12	Standing	15	Standing	58	Pass
	Proposed	13	Standing	15	Standing	61	Pass
	Future	15	Standing	20	Walking	76	Pass
54	Existing	13	Standing	17	Walking	61	Pass
	Proposed	13	Standing	16	Walking	57	Pass
	Future	13	Standing	17	Walking	66	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
55	Existing	14	Standing	18	Walking	63	Pass
	Proposed	12	Standing	15	Standing	53	Pass
	Future	12	Standing	16	Walking	60	Pass
56	Existing	13	Standing	17	Walking	61	Pass
	Proposed	16	Walking	18	Walking	73	Pass
	Future	16	Walking	19	Walking	68	Pass
57	Existing	9	Sitting	11	Standing	42	Pass
	Proposed	18	Walking	22	Uncomfortable	89	Pass
	Future	17	Walking	20	Walking	86	Pass
58	Existing	12	Standing	14	Standing	54	Pass
	Proposed	16	Walking	19	Walking	72	Pass
	Future	14	Standing	16	Walking	62	Pass
59	Existing	10	Sitting	13	Standing	47	Pass
	Proposed	14	Standing	16	Walking	68	Pass
	Future	13	Standing	15	Standing	63	Pass
60	Existing	10	Sitting	13	Standing	51	Pass
	Proposed	12	Standing	14	Standing	57	Pass
	Future	11	Standing	13	Standing	51	Pass
61	Existing	12	Standing	15	Standing	57	Pass
	Proposed	13	Standing	15	Standing	59	Pass
	Future	12	Standing	15	Standing	56	Pass
62	Existing	12	Standing	15	Standing	55	Pass
	Proposed	17	Walking	21	Uncomfortable	83	Pass
	Future	16	Walking	19	Walking	80	Pass
63	Existing	11	Standing	14	Standing	53	Pass
	Proposed	15	Standing	17	Walking	72	Pass
	Future	14	Standing	16	Walking	69	Pass
64	Existing	12	Standing	15	Standing	52	Pass
	Proposed	13	Standing	16	Walking	60	Pass
	Future	12	Standing	14	Standing	56	Pass
65	Existing	12	Standing	15	Standing	52	Pass
	Proposed	16	Walking	21	Uncomfortable	75	Pass
	Future	16	Walking	20	Walking	73	Pass
66	Existing	11	Standing	15	Standing	54	Pass
	Proposed	18	Walking	23	Uncomfortable	86	Pass
	Future	18	Walking	22	Uncomfortable	85	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	
Future	Project with future 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