REPORT

SANDALWOOD SQUARE

MISSISSAUGA, ONTARIO

PEDESTRIAN WIND STUDY
RWDI # 1902102
March 27, 2019

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained to conduct a pedestrian wind assessment for the proposed Sandalwood Square redevelopment in Mississauga, 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 and safety conditions are predicted as shown on site plans in **Figures 1A** through **3B**, while the associated wind speeds are listed in **Table 1**. These results can be summarized as follows:

- In general, wind conditions around the existing site are comfortable for the intended pedestrian use throughout the year, with increased wind activity occurring during the winter season.
- With the addition of the Sandalwood Square development (Phase I), wind activity immediately around the site is expected to increase throughout the year. Wind conditions during the summer are generally predicted to be appropriate for the anticipated pedestrian use, however, during the winter, uncomfortable wind conditions are predicted at several locations around the site.
- Improved wind conditions on and around the site can be achieved through the use of wind control measures such as soft and hard landscaping features as described in the report.

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1 INTRODUCTION

RWDI was retained to conduct a pedestrian wind assessment for the proposed Sandalwood Square redevelopment project in Mississauga, ON. This report presents the project objectives, background and approach, and discusses the 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 at the intersection of Bristol Road East and Hurontario Street. It consists of a mixed-use development and includes two residential towers (Tower A: 25-storey and Tower B: 16-storey) connected with a 5-storey podium.

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 the building entrances and adjacent sidewalks

Image 1: Site Plan – 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 1:400 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 approximately 480 m 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 61 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 a 10-degree increment. 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, and reviewed by the owner.

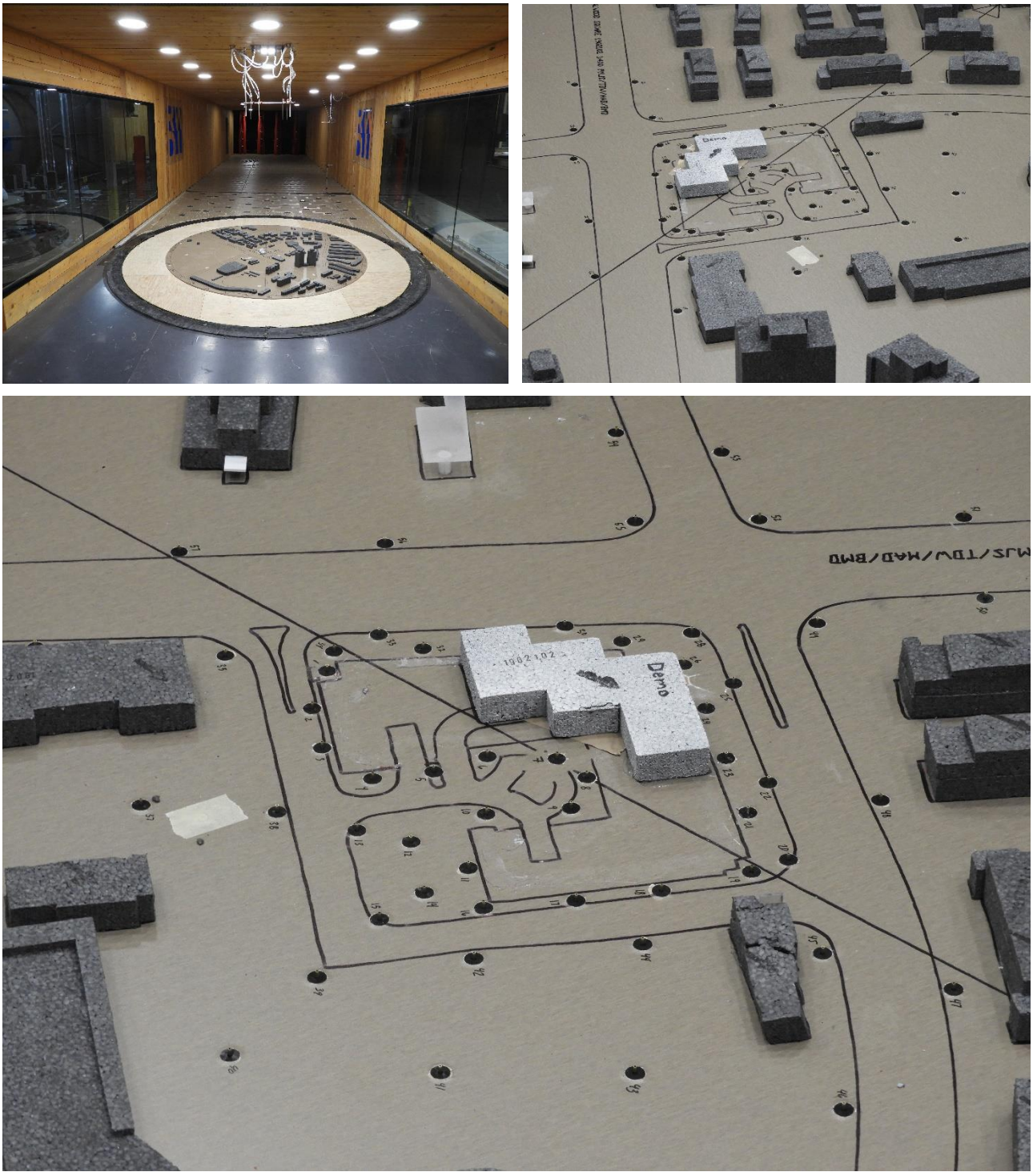


Image 2A: Wind Tunnel Study Model – Existing Configuration

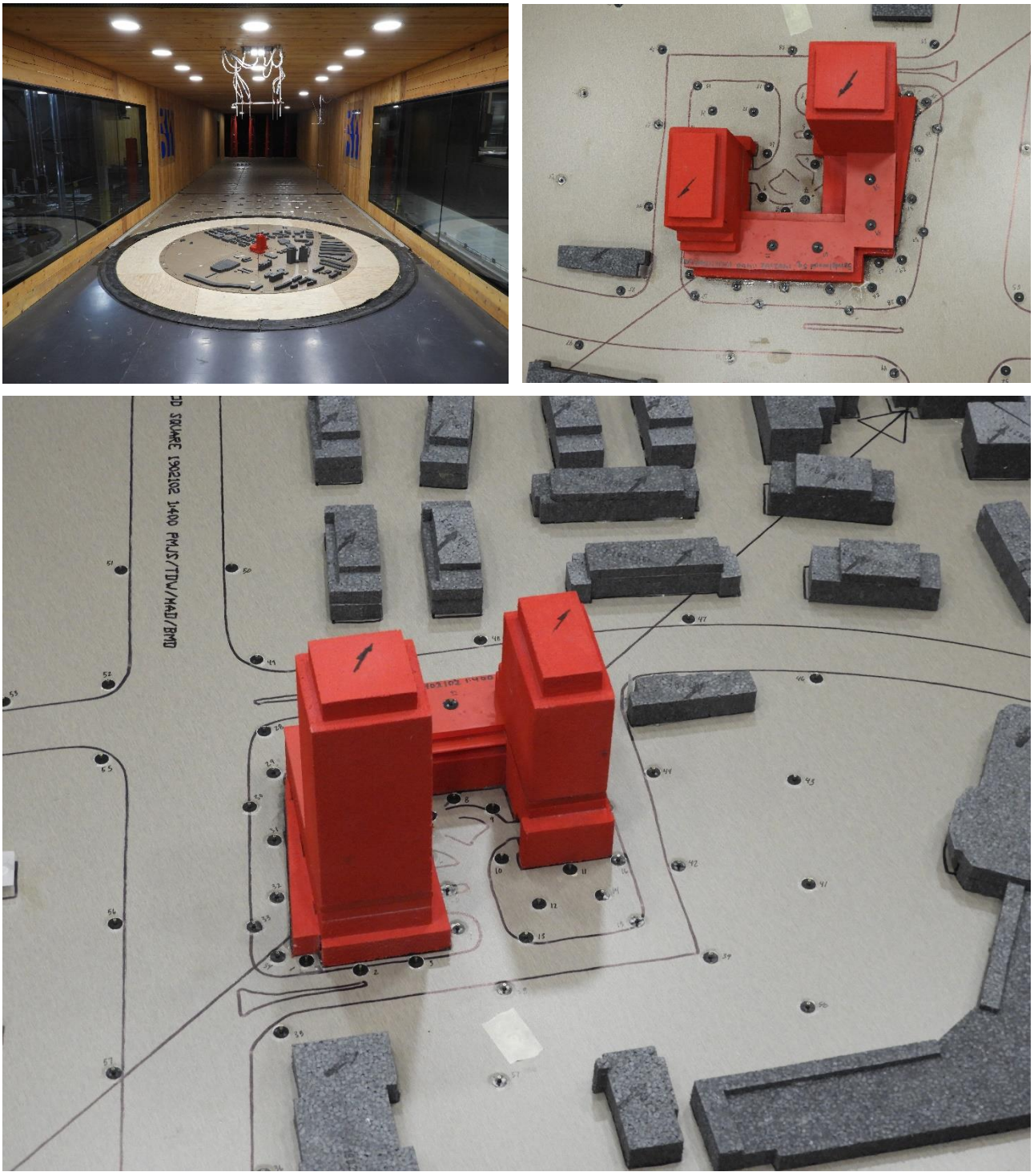
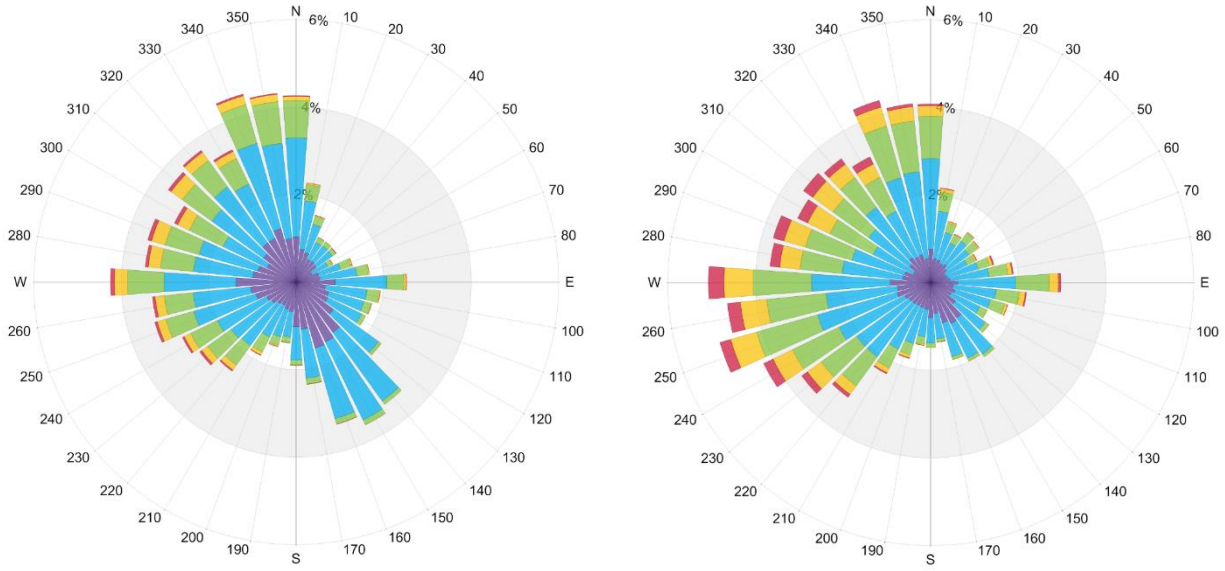


Image 2B: Wind Tunnel Study Model – Proposed Configuration

2.2 Meteorological Data

Wind statistics recorded at Toronto Pearson International Airport between 1987 and 2017, 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 through north directions are predominant during both summer and winter. During the winter season, the prevailing winds from the east direction are also frequent, as indicated by the wind roses. The southeast winds are frequent in the summer, but typically of low wind speeds. Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur for 4.6% and 11.1%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 wind criteria for pedestrian comfort and safety.



Summer (May – October) **Winter (November – April)**

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	6.0	4.0
1-10	32.0	23.0
11-20	42.2	40.1
21-30	15.2	21.8
31-40	3.7	7.9
>40	0.9	3.2

Image 3: Directional Distribution of Winds Approaching Toronto Pearson International Airport From 1987 to 2017

2.3 Mississauga Pedestrian Wind Criteria

The Mississauga pedestrian wind criteria, developed in June 2014, are specified in the Urban Design Terms of Reference; "Pedestrian Wind Comfort and Safety Studies". The following defines the criterion 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 and bus stops
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 most activities, and wind mitigation is typically recommended

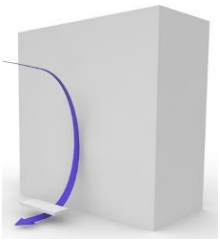
Notes:
(1) GEM speed = max (mean speed, gust speed/1.85);
(2) GEM speeds listed above are based on a seasonal exceedance of 20% of the time between 6:00 and 23:00.

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.

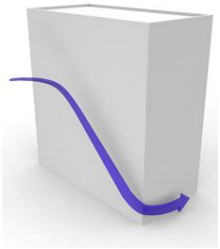
2.4 Generalized Wind Flows

In our discussion of wind conditions, reference is 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.



CORNER ACCELERATION

When winds approach at an oblique angle to a tall façade and are deflected down, a localized increase in the wind activity or corner acceleration can be expected around the exposed building corners at pedestrian level.

Image 4: Generalized Wind Flows

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 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.

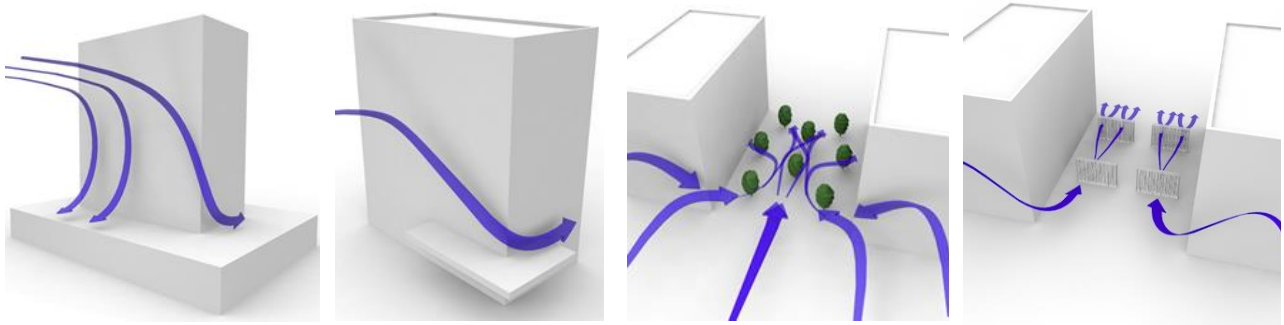


Image 5: Common Wind Control Measures – Podium/Tower Setback, Canopy, Landscaping, and Windscreens (Left to Right)

3 RESULTS AND DISCUSSION

The predicted wind conditions are shown on a site plan in **Figures 1A** through **3B** 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.

3.1 Grade Level (Locations 1 through 57)

Wind conditions comfortable for walking or strolling 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 outdoor amenity spaces, during the summer.

3.1.1 Existing Configuration

Moderate wind speeds around the existing site are observed during the summer (May to October) with conditions generally comfortable for standing pedestrian use (**Figure 1A**). In the winter (November to April), increased wind speeds around the existing site are experienced due to seasonally stronger winds, with conditions generally comfortable for walking pedestrian use (**Figure 2A**). These conditions are considered appropriate for the intended use of the areas throughout the year.

Wind speeds meet the pedestrian safety criterion at all locations for the existing configuration (**Figure 3A**).

3.1.2 Proposed Configuration

Main Entrance Locations

Main entrances of the proposed building are situated near Locations 8 and 23, with secondary retail entrances near Locations 31 and 32 in **Figures 1B**, **2B**, and **3B**. During the summer, wind speeds around the entrances are expected to be comfortable for standing which is appropriate for the intended usage, however, during the winter, higher than desired wind speeds, comfortable for walking, are anticipated at Locations 8, 23, and 32 (**Figure 2B**). The conditions at the entrance Locations 23 and 32 are mainly due to direct exposure to the prevailing winds, while the entrance at Location 8 is exposed to the southwesterly winds accelerating down the west façade of Tower B and being redirected towards this entrance.

Improvement to the wind conditions at these entrance locations can be achieved by installing localized wind control measures such as wind screens placed upwind of the entrances (Locations 23 and 32) and on both sides of the entrance at Location 8. In addition, a canopy at these entrances will provide overhead protection from downwashing winds. Examples of these localized measures around entrances is shown in **Image 6**. An alternative wind control measure is to recess the entrances into the building façades, if feasible (**Image 7**). The recommended locations for the wind screens is provided in **Image 9**.

Image 6: Examples of Canopies (Above) and Windscreens (Below) Used at Building Entrances

Image 7: Examples of Recessed Entrances

Walkways and Sidewalks

The addition of the proposed Sandalwood Square (Phase I) development is expected to increase wind activity immediately around the site throughout the year relative to the existing conditions (**Figures 1B and 2B**).

In the summer, wind conditions around the site and surrounding sidewalks are predominately suitable for walking or standing pedestrian use (**Figure 1B**). These conditions are considered acceptable for the anticipated usage. In

the winter, wind conditions are predominately suitable for walking pedestrian use (**Figure 2B**). However, due to the site's general exposure to strong southwesterly through northwesterly prevailing winds and their interaction with the proposed development, uncomfortable wind conditions are anticipated at several locations to the south, east, and north of the site (Locations 2, 4, 5, 19, 20, 33, 34, 38, and 44 in **Figure 2B**).

Wind speeds are anticipated to exceed the pedestrian safety criterion at four locations around the proposed development (Locations 2, 12, 13, 44 in **Figure 3B**).

To help reduce wind speeds in areas of high wind activity, RWDI recommends that vertical wind screen elements (2.5 to 3 m tall and approximately 80% solid) be positioned at various locations around the site. These wind screens will help to reduce prevailing wind speeds and accelerating wind flows around the north and south corners of the proposed development. Examples of winds screens are shown in **Image 8** and their recommended locations are provided in **Image 9**.

Image 8: Examples of Vertical Wind Screens

In addition to wind screens, a corner wrapping canopy at the north corner of the proposed development can help reduce downwashing and accelerating winds off Tower B. This will help reduce wind speeds at Locations 19, 20, and 44 where uncomfortable wind conditions are anticipated (**Figure 2B**). At Locations 4 and 5, RWDI suggests implementing overhead protection such as canopies and trellises to reduce downwashing and accelerating winds off Tower A, if feasible. Furthermore, it is anticipated that wind conditions at Locations 38 and 44 will be improved by the wind control measures located upwind.

Grade-Level Outdoor Amenity Space

The wind conditions for the grade-level outdoor amenity space are predicted to be mainly suitable for walking or standing pedestrian use during the summer, with increased wind activity generally classified as walking or uncomfortable during the winter (Locations 10, 12, 13, 15, and 16 in **Figure 1B** and **2B**). These conditions are considered higher than desired for passive pedestrian usage and stem from winds accelerating around the south corner of the proposed development as well as accelerating between the two towers and reaching this area. To help improve wind conditions, staggered wind screens throughout the west area of the amenity space and an overhead trellis above Location 10 are recommended, as shown in **Image 9**. Soft landscaping during the summer will also help reduce wind activity in the area.

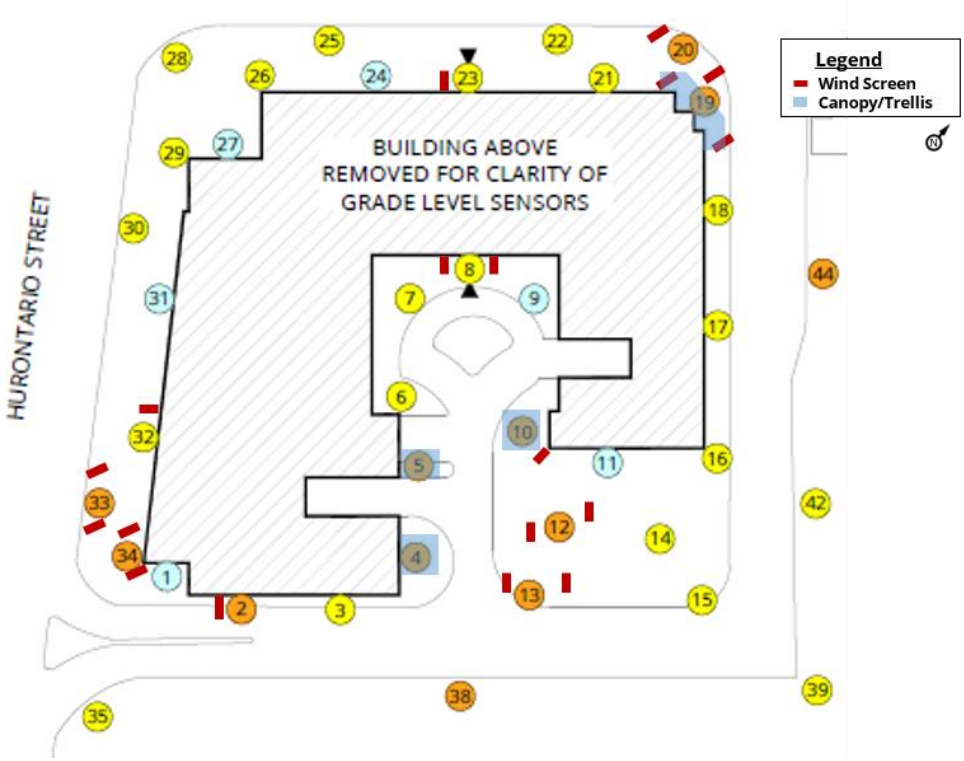


Image 9: Suggested Grade-Level Wind Control Measures

4 APPLICABILITY OF RESULTS

The drawings and information listed below were received from RioCan Real Estate Investment Trust and were used to construct the scale model of the proposed Sandalwood Square. The wind conditions presented in this report pertain to the proposed as detailed in the architectural design drawings listed in the table 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.

File Name	File Type	Date Received (dd/mm/yyyy)
18039-ARCH-TF-WIP-Sandalwood_Square (2019-02-20)	.rvt	20/02/2019

FIGURES

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

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by:	ck	Figure:	1A
Approx. Scale:	1:1500		
Date Revised:	Mar. 25, 2019		

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

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by:	ck	Figure:	1B
Approx. Scale:	1:1500		
Date Revised:	Mar. 27, 2019		

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

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by: ck	Figure: 2A
Approx. Scale:	1:1500
Date Revised:	Mar. 25, 2019

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

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by:	ck	Figure:	2B
Approx. Scale:	1:1500		
Date Revised:	Mar. 27, 2019		

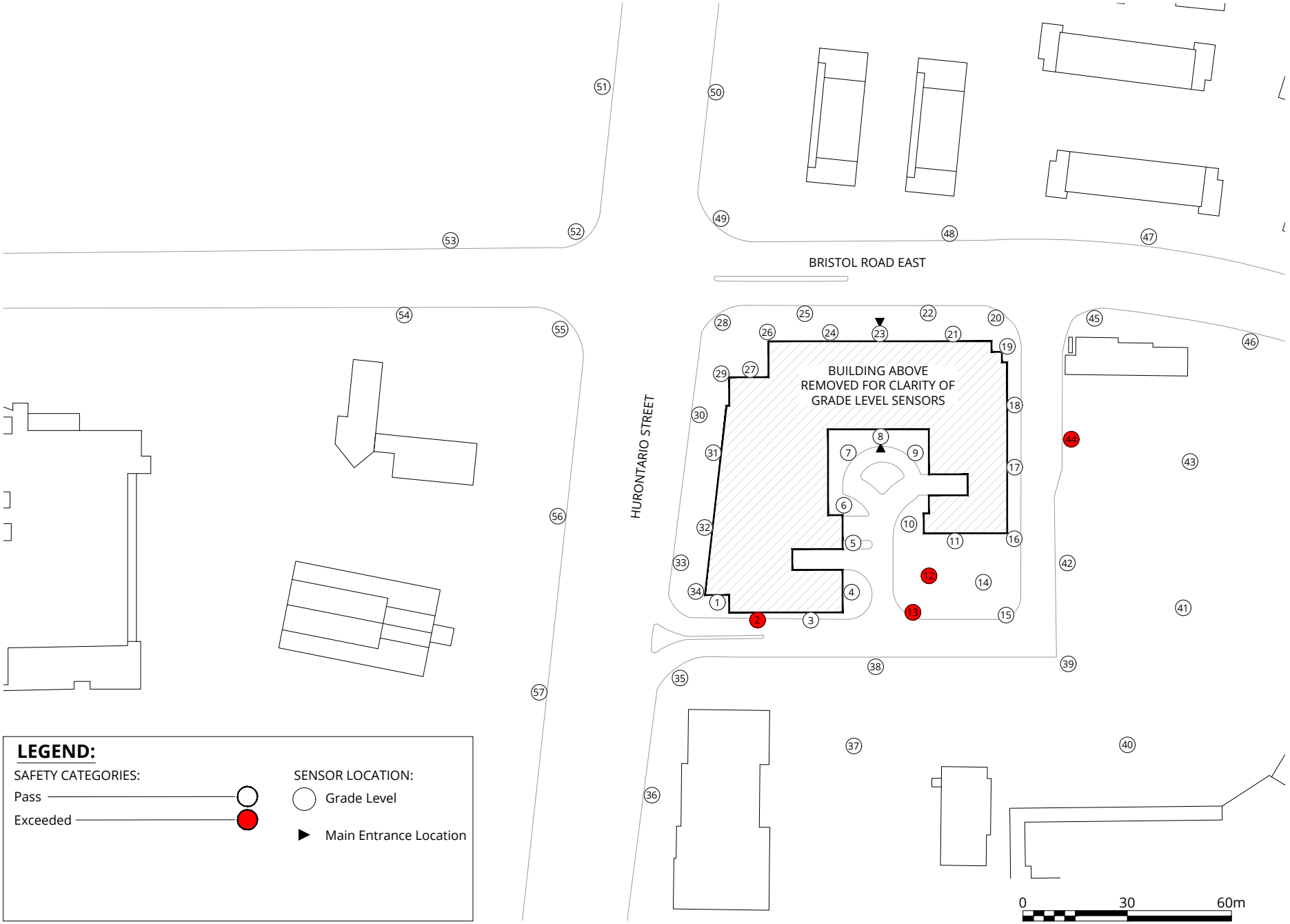
Pedestrian Wind Safety Conditions
Existing Configuration
Annual (January to December, 0:00 to 23:00)

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by:	ck	Figure:	3A
Approx. Scale:	1:1500		
Date Revised:	Mar. 25, 2019		



Pedestrian Wind Safety Conditions

Proposed Configuration

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

Sandalwood Square - Mississauga, ON

True North

Project #1902102

Drawn by:	ck	Figure:	3B
Approx. Scale:	1:1500		
Date Revised:	Mar. 27, 2019		

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	14	Standing	17	Walking	66	Pass
	Proposed	11	Standing	14	Standing	65	Pass
2	Existing	13	Standing	16	Walking	65	Pass
	Proposed	18	Walking	23	Uncomfortable	99	Exceeded
3	Existing	13	Standing	16	Walking	64	Pass
	Proposed	16	Walking	19	Walking	77	Pass
4	Existing	12	Standing	15	Standing	58	Pass
	Proposed	17	Walking	21	Uncomfortable	84	Pass
5	Existing	12	Standing	15	Standing	58	Pass
	Proposed	18	Walking	22	Uncomfortable	89	Pass
6	Existing	12	Standing	13	Standing	55	Pass
	Proposed	14	Standing	17	Walking	67	Pass
7	Existing	9	Sitting	11	Standing	44	Pass
	Proposed	13	Standing	17	Walking	83	Pass
8	Existing	10	Sitting	12	Standing	48	Pass
	Proposed	14	Standing	18	Walking	84	Pass
9	Existing	12	Standing	14	Standing	52	Pass
	Proposed	12	Standing	14	Standing	57	Pass
10	Existing	13	Standing	15	Standing	58	Pass
	Proposed	18	Walking	21	Uncomfortable	84	Pass
11	Existing	14	Standing	17	Walking	64	Pass
	Proposed	11	Standing	12	Standing	49	Pass
12	Existing	13	Standing	16	Walking	64	Pass
	Proposed	19	Walking	24	Uncomfortable	91	Exceeded
13	Existing	14	Standing	16	Walking	62	Pass
	Proposed	20	Walking	25	Uncomfortable	98	Exceeded
14	Existing	14	Standing	17	Walking	65	Pass
	Proposed	15	Standing	17	Walking	71	Pass
15	Existing	14	Standing	16	Walking	63	Pass
	Proposed	16	Walking	20	Walking	78	Pass
16	Existing	14	Standing	16	Walking	62	Pass
	Proposed	16	Walking	18	Walking	70	Pass
17	Existing	13	Standing	16	Walking	61	Pass
	Proposed	13	Standing	16	Walking	72	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	12	Standing	15	Standing	57	Pass
	Proposed	13	Standing	16	Walking	75	Pass
19	Existing	12	Standing	15	Standing	57	Pass
	Proposed	18	Walking	23	Uncomfortable	88	Pass
20	Existing	13	Standing	15	Standing	58	Pass
	Proposed	18	Walking	22	Uncomfortable	82	Pass
21	Existing	13	Standing	16	Walking	66	Pass
	Proposed	14	Standing	18	Walking	76	Pass
22	Existing	13	Standing	16	Walking	65	Pass
	Proposed	16	Walking	19	Walking	76	Pass
23	Existing	14	Standing	17	Walking	74	Pass
	Proposed	13	Standing	16	Walking	62	Pass
24	Existing	13	Standing	15	Standing	62	Pass
	Proposed	13	Standing	15	Standing	60	Pass
25	Existing	13	Standing	16	Walking	61	Pass
	Proposed	16	Walking	20	Walking	76	Pass
26	Existing	13	Standing	15	Standing	58	Pass
	Proposed	17	Walking	20	Walking	78	Pass
27	Existing	10	Sitting	11	Standing	47	Pass
	Proposed	10	Sitting	12	Standing	50	Pass
28	Existing	14	Standing	17	Walking	61	Pass
	Proposed	16	Walking	19	Walking	77	Pass
29	Existing	12	Standing	14	Standing	55	Pass
	Proposed	15	Standing	18	Walking	72	Pass
30	Existing	12	Standing	15	Standing	59	Pass
	Proposed	15	Standing	17	Walking	70	Pass
31	Existing	12	Standing	14	Standing	60	Pass
	Proposed	13	Standing	15	Standing	61	Pass
32	Existing	14	Standing	17	Walking	69	Pass
	Proposed	14	Standing	17	Walking	69	Pass
33	Existing	14	Standing	18	Walking	68	Pass
	Proposed	17	Walking	21	Uncomfortable	79	Pass
34	Existing	14	Standing	17	Walking	66	Pass
	Proposed	19	Walking	23	Uncomfortable	85	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	14	Standing	16	Walking	61	Pass
	Proposed	16	Walking	20	Walking	74	Pass
36	Existing	11	Standing	13	Standing	54	Pass
	Proposed	13	Standing	15	Standing	66	Pass
37	Existing	12	Standing	14	Standing	58	Pass
	Proposed	14	Standing	17	Walking	69	Pass
38	Existing	13	Standing	16	Walking	61	Pass
	Proposed	17	Walking	21	Uncomfortable	86	Pass
39	Existing	13	Standing	16	Walking	64	Pass
	Proposed	15	Standing	18	Walking	74	Pass
40	Existing	12	Standing	14	Standing	60	Pass
	Proposed	12	Standing	15	Standing	64	Pass
41	Existing	13	Standing	16	Walking	63	Pass
	Proposed	14	Standing	17	Walking	69	Pass
42	Existing	13	Standing	16	Walking	63	Pass
	Proposed	16	Walking	18	Walking	74	Pass
43	Existing	13	Standing	15	Standing	60	Pass
	Proposed	14	Standing	17	Walking	73	Pass
44	Existing	13	Standing	15	Standing	60	Pass
	Proposed	17	Walking	21	Uncomfortable	91	Exceeded
45	Existing	12	Standing	14	Standing	58	Pass
	Proposed	16	Walking	20	Walking	86	Pass
46	Existing	12	Standing	15	Standing	64	Pass
	Proposed	15	Standing	19	Walking	78	Pass
47	Existing	12	Standing	14	Standing	59	Pass
	Proposed	13	Standing	16	Walking	68	Pass
48	Existing	12	Standing	14	Standing	57	Pass
	Proposed	15	Standing	18	Walking	68	Pass
49	Existing	15	Standing	18	Walking	67	Pass
	Proposed	14	Standing	17	Walking	68	Pass
50	Existing	14	Standing	17	Walking	65	Pass
	Proposed	14	Standing	16	Walking	61	Pass
51	Existing	16	Walking	19	Walking	68	Pass
	Proposed	16	Walking	19	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
52	Existing	16	Walking	20	Walking	71	Pass
	Proposed	15	Standing	18	Walking	66	Pass
53	Existing	16	Walking	20	Walking	71	Pass
	Proposed	15	Standing	19	Walking	67	Pass
54	Existing	16	Walking	20	Walking	71	Pass
	Proposed	15	Standing	19	Walking	69	Pass
55	Existing	15	Standing	18	Walking	65	Pass
	Proposed	13	Standing	16	Walking	56	Pass
56	Existing	14	Standing	17	Walking	65	Pass
	Proposed	16	Walking	19	Walking	75	Pass
57	Existing	14	Standing	17	Walking	64	Pass
	Proposed	15	Standing	17	Walking	70	Pass

Seasons		Hours
Summer	May - October	6:00 - 23:00 for comfort
Winter	November - April	0:00 - 23:00 for safety

Configurations	
Existing	Without the proposed development
Proposed	With the proposed development

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