



# CAMBRIDGE MILL TOWERS

CAMBRIDGE, ON

PEDESTRIAN WIND ASSESSMENT FOR ZBLA

PROJECT #2002970

OCTOBER 14, 2020

## SUBMITTED TO

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# 1. INTRODUCTION



RWDI was retained to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed Cambridge Mill Towers project in Cambridge, Ontario. This effort is intended to inform good design and has been conducted in support of the Zoning By-Law Amendment Application for the project.

The site for the proposed project is located on Grand River, north of Simcoe Street and west of Water Street N (Image 1). The project consists of a 37-storey condominium tower and 28-storey hotel tower sharing a 3-storey podium (Image 2). A seven-storey parking garage is also proposed southeast of the intersection of Water Street N and Simcoe Street, that has been considered in this assessment.

Key outdoor areas of interest include the main entrance, walkways and access to Grand River, podium roof terrace, and sidewalks on nearby streets. These areas are shown on floor plans in Images 3a and 3b.



**Image 1: Aerial View of the Existing Site and Surroundings**



**Image 2: Project Rendering, View from Southwest**

# 1. INTRODUCTION

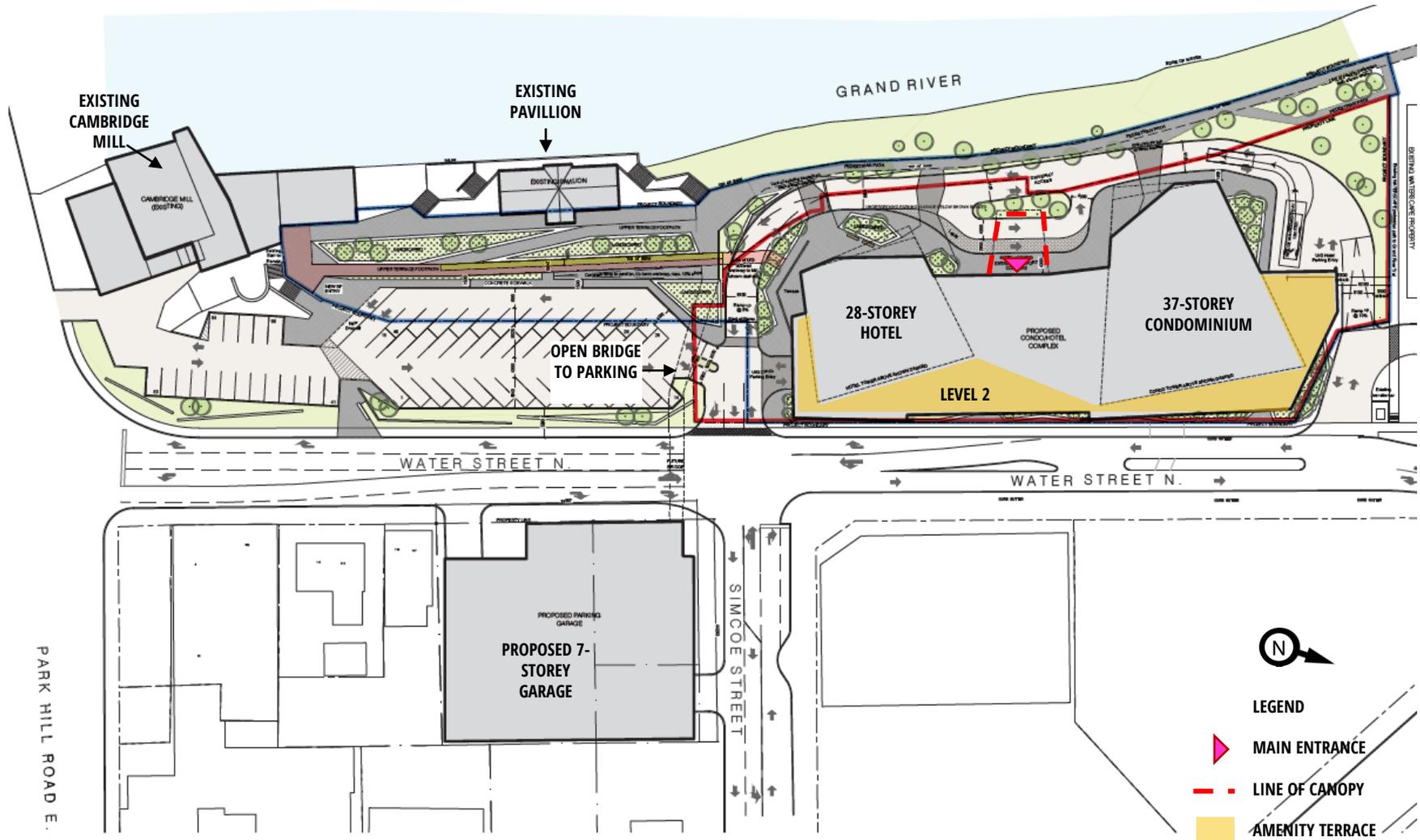


Image 3a: Context Plan (Received March 12, 2020)

# 1. INTRODUCTION

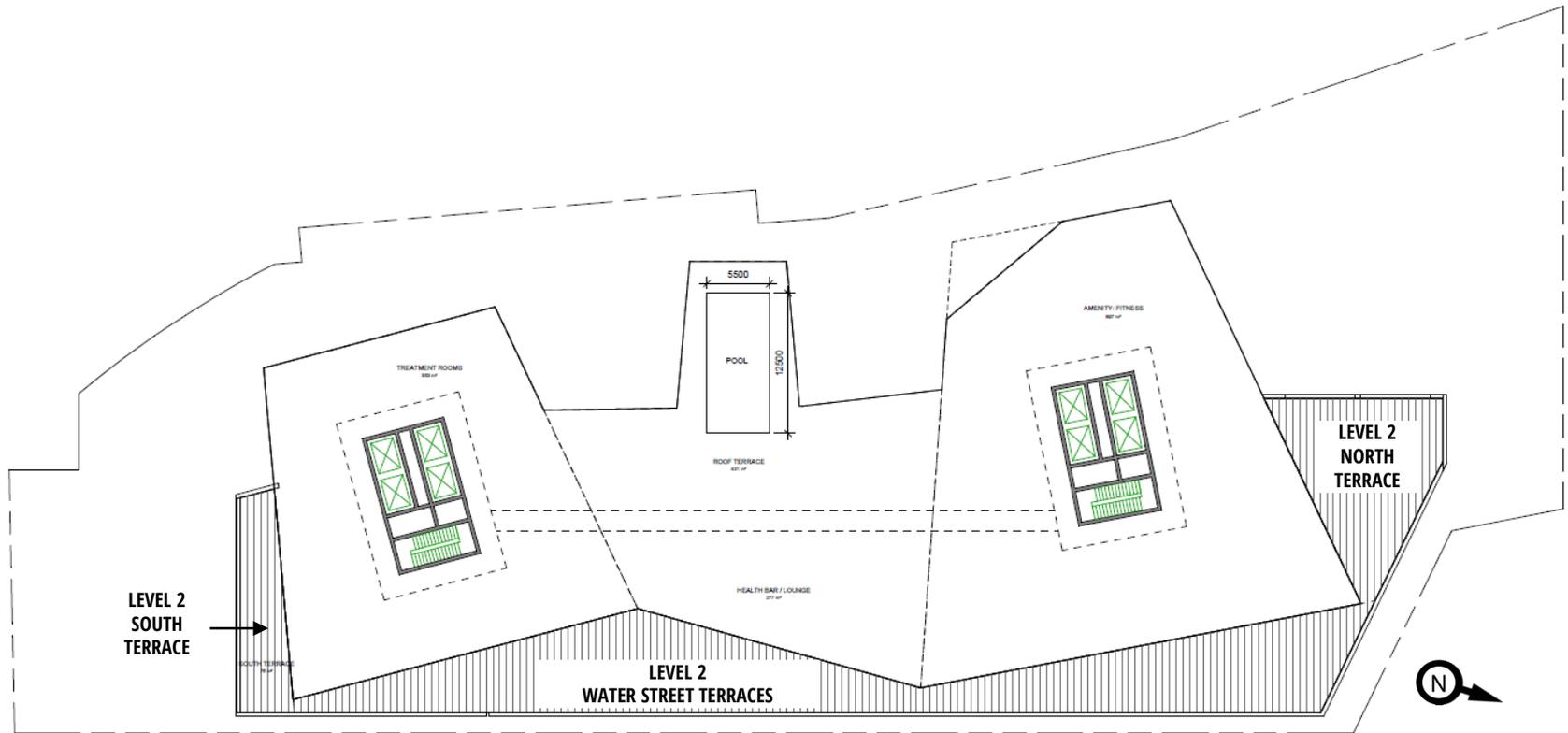


Image 3b: Level 2 Floor Plan (Received September 29, 2020)

## 2. METHODOLOGY



Predicting wind speeds and occurrence frequencies is complex. It involves the combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate.

Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's assessment is based on the following:

- E-model provided by MartinSimmons, on March 12, 2020 and updated design information provided on September 29 and October 9, 2020;
- Use of RWDI's proprietary software (*WindEstimator*<sup>1</sup>) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- A review of the regional long-term meteorological data from Waterloo International Airport;
- Wind-tunnel study and desktop assessments of other projects in Cambridge and the surrounding area; and,
- RWDI's engineering judgement and knowledge of wind flows around buildings<sup>2, 3</sup>.

Note that other microclimate issues such as those relating to cladding and structural wind loads, door operability, building air quality, noise, vibration, etc. are not part of the scope of this assessment.

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1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004*, Nashville, Tennessee.
  2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
  3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

### 3. METEOROLOGICAL DATA



Meteorological data from Waterloo Region International Airport for the period from 1987 to 2017 were used as a reference for wind conditions in the area.

The distributions of wind frequency and directionality for summer (May through October) and winter (November through April) seasons are shown in the wind roses to the right. When all winds are considered, winds from the southwest through northwest directions are predominant, with frequent winds also from the east. The wind roses indicate a greater frequency of strong winds (red and yellow bands) in the winter.

Strong winds of a mean speed greater than 30 km/h measured at the airport (red and yellow bands) occur for 1.9% and 7.1% of the time during the summer and winter seasons, respectively. These winds potentially could be the source of uncomfortable or even unsafe wind conditions, depending upon the site exposure and development design.

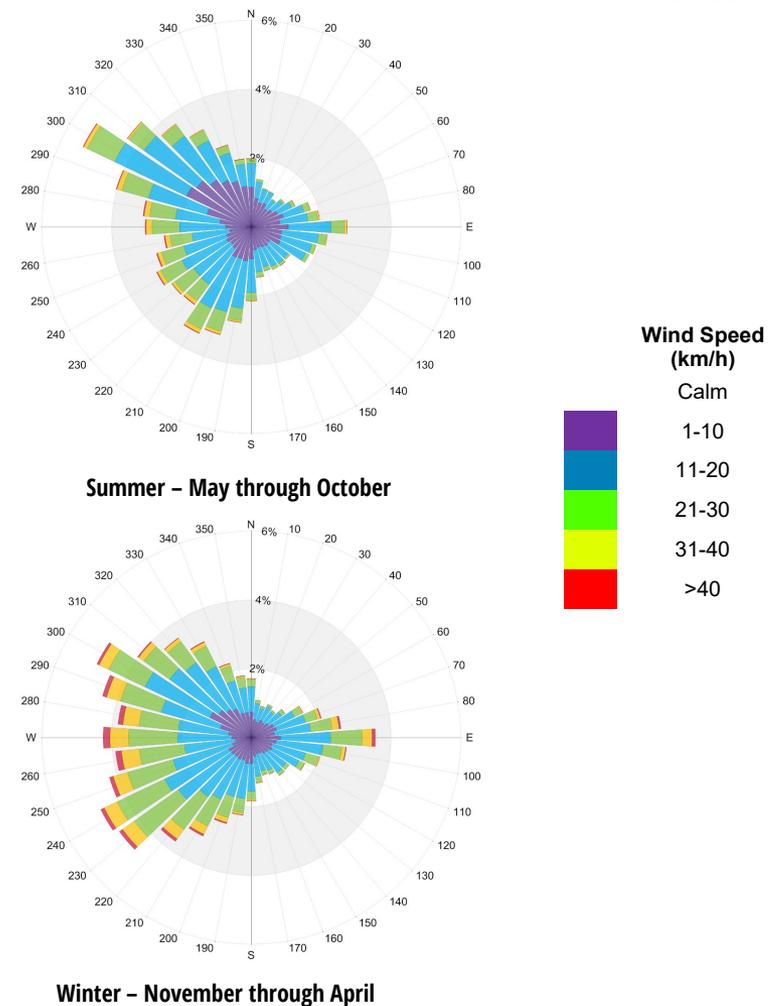


Image 4: Directional Distribution of Winds Approaching Waterloo International Airport (1988 to 2018)

## 4. WIND CRITERIA



The RWDI pedestrian wind criteria are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities, building designers and the city planning community. The criteria are as follows:

### 4.1 Safety Criterion

Excessive gust can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**90 km/h**) occur more than **0.1%** of the time or 9 hours per year, the wind conditions are considered severe.

### 4.2 Pedestrian Comfort Criteria

Wind comfort can be categorized by typical pedestrian activities:

**Sitting ( $\leq 10$  km/h):** Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

**Standing ( $\leq 14$  km/h):** Gentle breezes suitable for main building entrances and bus stops.

**Strolling ( $\leq 17$  km/h):** Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

**Walking ( $\leq 20$  km/h):** Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

**Uncomfortable:** The comfort category for walking is not met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated mean wind speeds are expected for at least four out of five days (**80% of the time**). Wind control measures are typically required at locations where winds are rated as uncomfortable or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks and walkways; lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger, and calm wind speeds suitable for sitting are desired in areas where passive activities are anticipated, such as outdoor seating and lounging areas on the terraces.

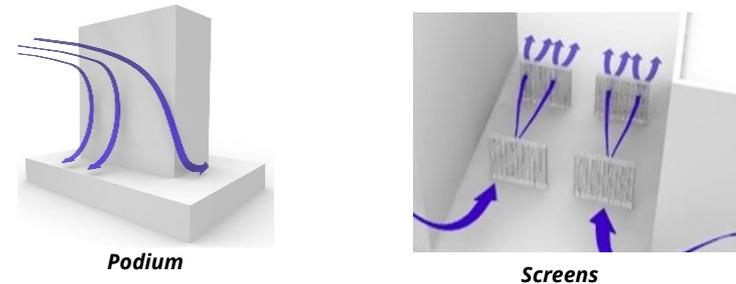
# 5. RESULTS AND DISCUSSION



## 5.1 Wind Flow Around Buildings

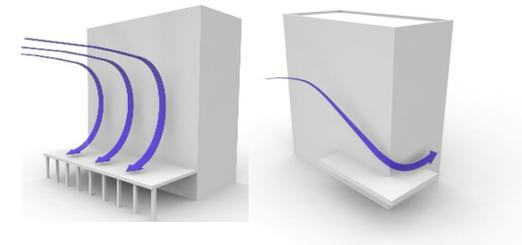
Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level (Downwashing). These winds subsequently move around exposed building corners, causing a localized increase in wind activity due to Corner Acceleration (Images 5). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.

Design details such as large tower step-back from a podium edge, deep canopies close to ground level, wind screens / tall trees with dense underplanting, etc. (Image 6) 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 prc

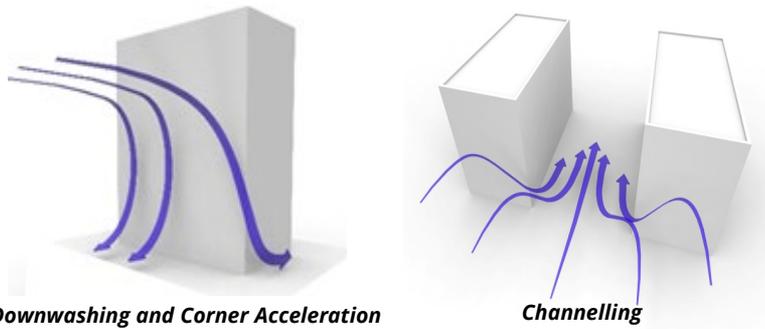


**Podium**

**Screens**



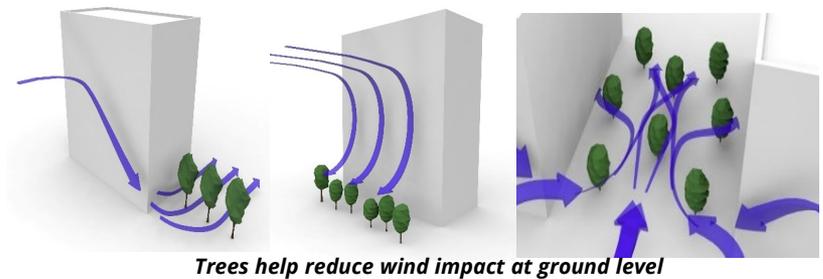
**Canopy**



**Downwashing and Corner Acceleration**

**Channelling**

**Image 5: General Wind Flow Mechanisms**



**Trees help reduce wind impact at ground level**

**Image 6: Examples of Common Wind Control Measures**

# 5. RESULTS AND DISCUSSION



## 5.2 Existing Scenario

The project site is bordered by Grand River on the west, and generally surrounded by low-rise suburban neighbourhoods. Two tall buildings (of the order of 13 storeys) exist immediately to the north. The site is fairly exposed to the prevailing winds due to the riverfront location and low surroundings. The site is also subjected to winds redirected by the existing tall buildings to the north.

Currently, wind conditions on the site and surrounding sidewalks are considered comfortable for standing or strolling in the summer, and for strolling or walking in the winter, with the higher wind speeds in the range occurring closer to and around the taller buildings. Wind speeds exceeding the safety criterion are expected at the north end of the site near the existing tall building.

## 5.3 Proposed Scenario

The proposed towers are taller than buildings in the surrounding area (Image 2) and are expected to cause downwashing and channeling of winds due to their height and proximity to each other and the neighbouring towers. The development design incorporates several features that are considered favourable for wind control, as follows (refer to Image 7):

- The towers are oriented such that their narrow facades face the southwest direction where the predominant winds approach from, and the wider facades are flanked by the low podium.

- The low podium will capture winds downwashed by the northern and southern facades and help reduce the severity of wind impact at grade.
- The shorter and narrower hotel tower, which will have a lesser impact on wind conditions relative to the larger tower, is located on the south side of the development close to significant pedestrian areas at grade.
- The pool deck overhang above the main entrance/porte cochere is favourable for reducing downwashing impacts in that area.
- The angular recessed massing at ground level and the recess around the tower perimeter (Image 7) will help break wind accelerations.
- The site is proposed to be landscaped extensively with trees, which is important for wind control in the summer when outdoor use is frequent..

These features will help moderate the potential wind impacts at ground level. Taking these factors into account, the expected wind conditions at key areas of interest are presented graphically in Image 8 and discussed in th

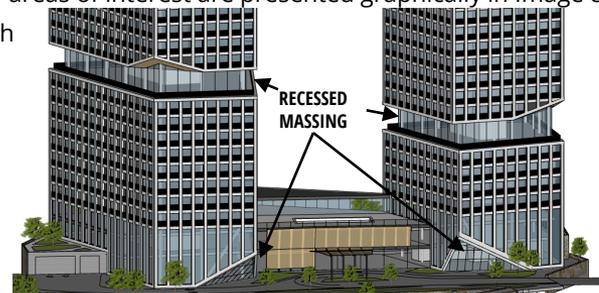


Image 7: Wind-responsive massing (Rendering received March 12, 2020)

# 5. RESULTS AND DISCUSSION



  
COMFORT CATEGORIES

-  Sitting / Standing
-  Strolling / Walking
-  Uncomfortable

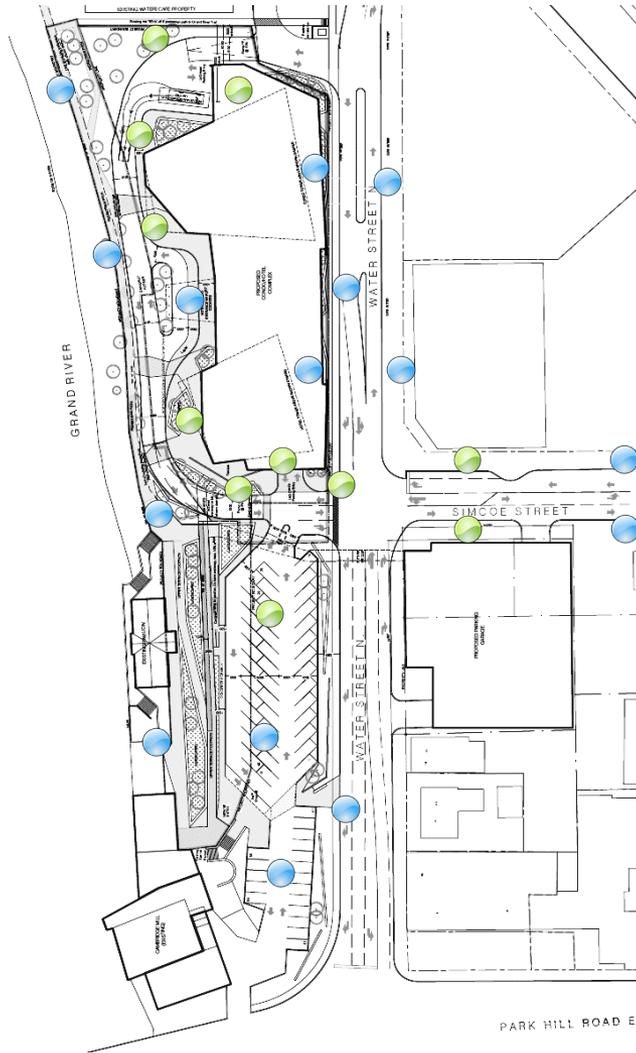


Image 8a: Predicted Wind Conditions - Summer

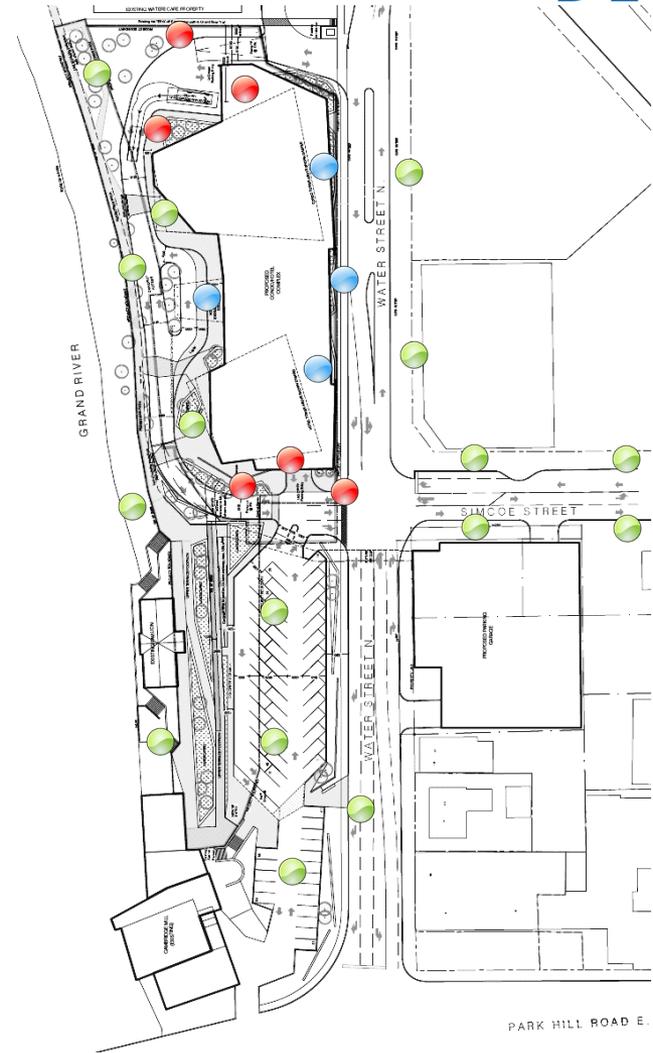


Image 8b: Predicted Wind Conditions - Winter

## 5. RESULTS AND DISCUSSION



### 5.3.1 Wind Safety

Predominant winds from the northwest and southwest quadrants will be redirected by the towers around it. High wind gusts with the potential for exceeding the safety criterion is predicted at ground level around the northwest and southwest corners of the development, along the south side of the condo tower and in the alley between the hotel tower and the existing development to the north.

### 5.3.2 Main Entrances

Main entrances and porte cochere are located on the west side, facing Grand River (Image 3). The large canopy and recessed location of the entrance protects it from major wind impacts. Wind conditions are predicted to be comfortable for standing in the summer and winter, which is ideal for an entrance use.

### 5.3.3 Other Grade Level Areas

The wind impact of the project is not predicted to be notable beyond the sidewalks immediately across the street from the project site and the parking lot to the south. Wind conditions in all other areas at grade level immediately surrounding the project, including the walkways on the west side and the parking lot to the south, are predicted to be generally comfortable for standing or strolling in the summer and strolling or walking in the winter.

The highest wind speeds are predicted around the northwest corner and along the south side of the podium, where conditions are expected

to be comfortable for walking in the summer and uncomfortable in the winter.

The addition of the proposed landscaping with large and dense trees is expected to lower the wind speeds in the walkway areas near the tree clusters by one comfort category, to be similar to existing conditions. The riverfront is also far enough upwind of the towers that the area would not be severely impacted by them. Note that deciduous trees are not effective for wind control in the winter when they are bare. The design team may consider incorporating conifers in the landscape design so as to extend this wind control benefit into the shoulder seasons and possibly winter as well.

### 5.3.4 Wind Control Measures for Ground Level

While dense trees may be effective for wind control in the summer, wind-resistant conifers or wind screens are required around the building corners to diffuse the acceleration of strong winds in the winter. If feasible, consider extending the podium extension on the north and south sides to the west side of the towers as well to capture downwash and reduce impacts at grade. Alternatively, wide canopies along the west façade of the towers, wrapping around to the north and south may also be considered. Examples of these features are shown in Image 9.

It is recommended that the wind impact of the project be quantified through a wind tunnel study so as to confirm the frequency of high wind activity and thereby the need and level of wind mitigation efforts.

# 5. RESULTS AND DISCUSSION

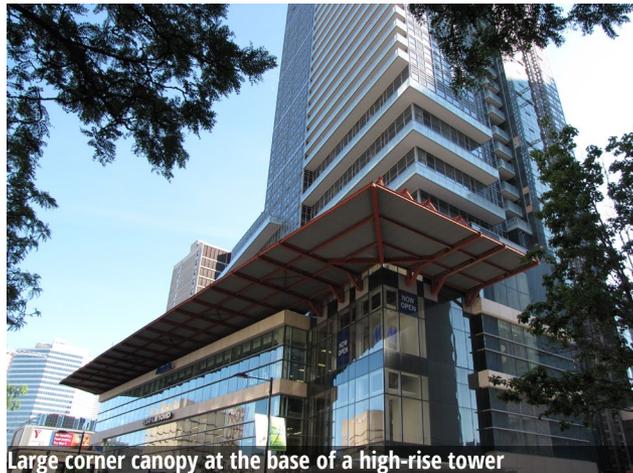
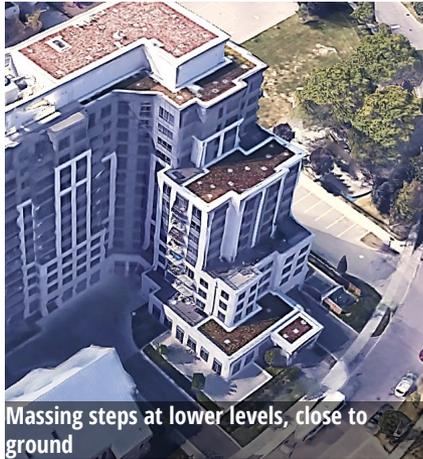


Image 9: Examples of Wind Control Measures at Building Corners

## 5. RESULTS AND DISCUSSION



### 5.3.5 Level 2 Roof Terrace

The podium roof terrace is located on the east side of the towers and wraps around to the north and south. As such, a majority of the terrace is downwind of the towers as well as the Level 2 podium massing connecting the towers, whereby it will be protected from the predominant winds approaching over the river.

Wind conditions on the east portion of the terrace is predicted to be comfortable for sitting or standing in the summer and winter as shown in Image 8.

On the north and south ends, conditions will be windier and meet the criteria for strolling or walking in the summer months as these areas will be subject to flows being redirected by the towers. In the winter conditions will likely be unsuitable for pedestrian use; this may not be a concern as the terrace is unlikely to be used in the winter.

It is recommended that the guardrails on the west edge of the terrace be raised to be at least 2 m tall to reduce exposure to winds approaching the site and overhead canopies be considered on the north and south ends to reduce the impact of downwash. See examples in Image 10. These measures are expected to help reduce wind speeds at the north and south ends.

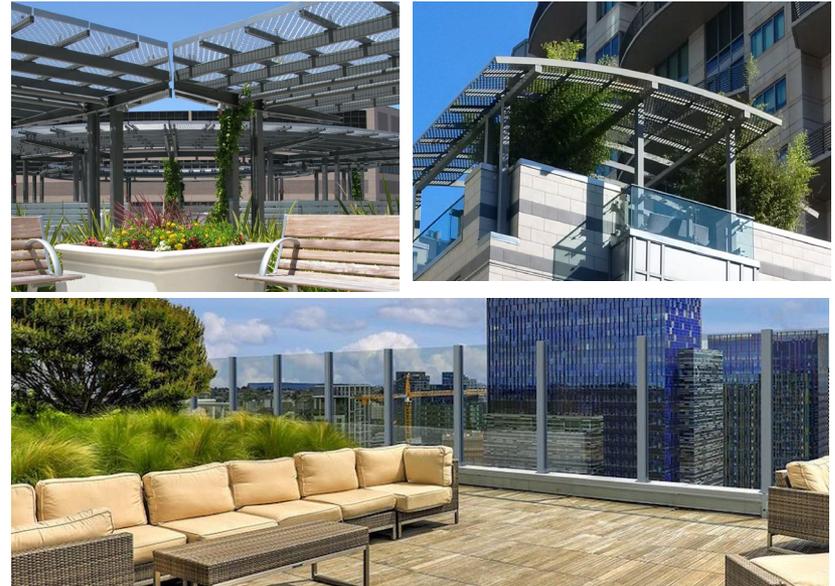


Image 10: Examples of Wind Control Features on Terraces

## 6. SUMMARY



RWDI was retained to provide an assessment of the potential pedestrian level wind conditions on and around the proposed Cambridge Mill Towers in Cambridge, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar projects in Cambridge and the surroundings area, and screening-level modelling.

Our findings are summarized as follows:

- The project site is exposed to the prevailing winds in the area due to the riverfront location, and subject to wind impacts of the existing tall buildings to the north.
- The existing conditions are comfortable for pedestrian use in general; however high wind activity with the potential for exceeding the safety criterion is expected at the north end of the site.
- The proposed massing design incorporates several features that are favourable for reducing the potential wind impact of a tall building (discussed in Section 5.3).
- Wind conditions at the main entrances are expected to be comfortable for sitting or standing throughout the year, which is appropriate.
- Wind conditions at the riverfront walkways, parking lots and most areas on the sidewalks around the project are predicted to be appropriate for the expected pedestrian activity.
- High wind activity is expected around the north and south ends and western corners of the development. These conditions can potentially exceed the recommended safety criterion, particularly in the winter.
- Wind speeds on the east side of the Level 2 terrace are expected to be appropriate for passive activities. Conditions on the north and south ends of the terrace are predicted to be windy for passive use.
- Wind control measures have been suggested for all concerned areas where the wind activity expected is higher than desirable.
- Wind tunnel testing is recommended in order to confirm and quantify the level of wind activity and optimize the wind control efforts required. RWDI can help design the layout of wind control features as the design advances.

## 7. APPLICABILITY OF RESULTS



The assessment presented in this report are for the proposed Cambridge Mill Towers and are based on the design drawings listed in the table below. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

File Name	File Type	Date Received (mm/dd/yyyy)
19047 200221 Cambridge Mill - Design Package	PDF	03/12/2020
2020311 Sketch Model with context	SKP	03/12/2020
19047 ZONING MODEL_DRAFT VIEWS - Sheet - A203 - FIRST FLOOR PLAN	PDF	09/29/2020
19047 ZONING MODEL_DRAFT VIEWS - Sheet - A204 - SECOND FLOOR PLAN	PDF	09/29/2020
19047 ZONING MODEL_Project FFEs_R2 200925	PDF	09/29/2020
200908 Site plan	PDF	10/09/2020