# 1842 KING STREET EAST

## HAMILTON, ON

## PEDESTRIAN WIND ASSESSMENT

PROJECT #2004825
APRIL 16, 2021

### SUBMITTED TO

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# 1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions around the proposed development at 1842 King Street East in Hamilton, Ontario. This effort is intended to inform good design and has been conducted in support of Zoning By-Law Amendment Application for the project.

The project site is located between King Street East and Lawrence Road, on the west side of Rosedale Avenue (Image 1). The site is currently occupied by a large one-storey building, parking lots and green lawns. The immediate surroundings include low buildings in all directions, with several multi-level residential buildings across Lawrence Road to the south. Taller buildings exist a few blocks to the east and the escarpment is located to the southwest (Image 1).


**Image 1: Aerial View of the Existing Site and Surroundings** (Credit: Google Earth)

The proposed development consists of four 12-storey, L-shaped residential buildings and four 4-storey stacked townhouses (Image 2). Pedestrian areas of interest include public sidewalks, building entrances, drop-off areas, pedestrian mews, and amenity spaces on the ground and Level 2.

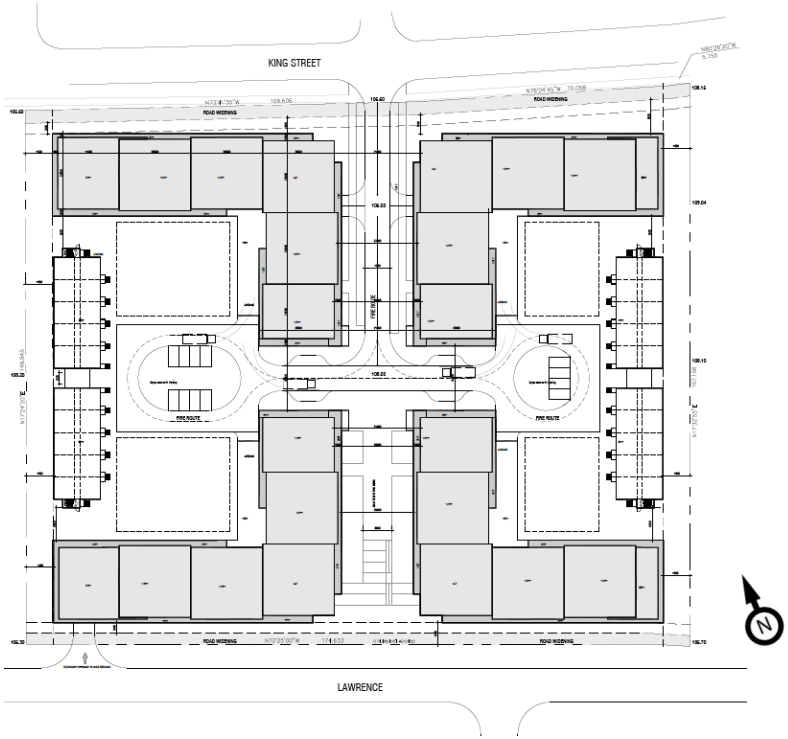



**Image 2: Site Plan of the Proposed Project**

# 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:

- Design drawings dated February 19, 2021 and received by RWDI on March 8, 2021;
- A review of the regional long-term wind data from John C. Munro Hamilton International Airport;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies undertaken by RWDI for projects in the Hamilton area and around the world;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- RWDI Criteria for pedestrian wind comfort and safety, which are adapted by the City of Hamilton.

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

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. WIND DATA

Wind data from John C. Munro Hamilton International Airport for the period from 1990 to 2019 were used as a reference for wind conditions in the area as this is the nearest station to the site with long-term, hourly wind data. term, hourly wind data. The directional distributions of wind speeds and frequency for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 3.

When all winds are considered, winds from the southwest and northeast quadrants are predominant throughout the year.

Strong winds of a speed greater than 30 km/h measured at the airport (red and yellow bands in Image 3) occur more often in the winter than in the summer season. They are from the southwest and northeast directions. These winds could be the source of uncomfortable or severe wind conditions, depending upon the site exposure and development design.

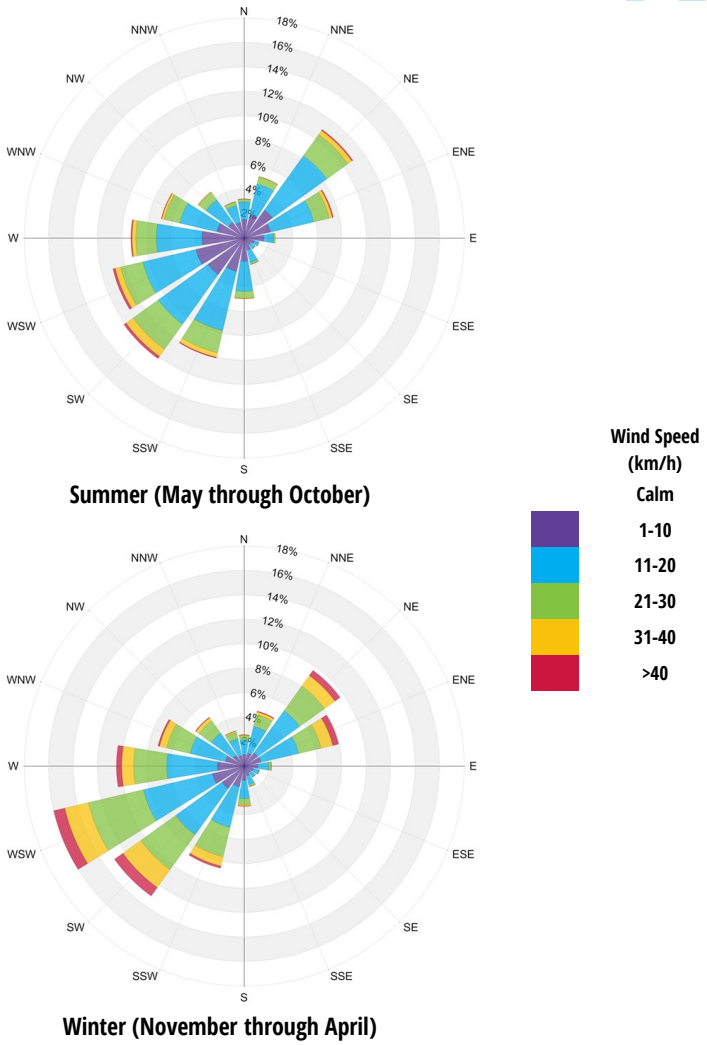



**Image 3: Directional Distribution of Winds Approaching John C. Munro Hamilton International Airport (1990 to 2019)**

# 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, including the City of Hamilton. The criteria are as follows:

## 4.1 Safety Criterion

Pedestrian safety is associate with excessive gust that 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 (≤ 10 km/h)**: Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

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

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

**Walking (≤ 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., 1.5m above grade or the concerned floor level), typically lower than those recorded in the airport (10m 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, drop-off areas and pedestrian mews where pedestrians may linger, and calm wind speeds suitable for sitting are desired in areas where passive activities are anticipated, such as the outdoor amenity spaces, especially during the summer.

# 5. RESULTS AND DISCUSSION

## 5.1 Wind Flow Around Buildings

Buildings that are taller than their surroundings tend to intercept and redirect winds around them. The mechanism in which winds are directed down the height of a building is called Downwashing. These flows subsequently move around exposed building corners, causing a localized increase in wind activity due to Corner Acceleration. When two buildings are situated side by side, wind flow tends to accelerate through the space between the buildings due to Channelling Effect. Stepped building facades and tower setbacks are positive design features to reduce the direct wind impact on the ground. These flow patterns are schematically illustrated in Image 4.

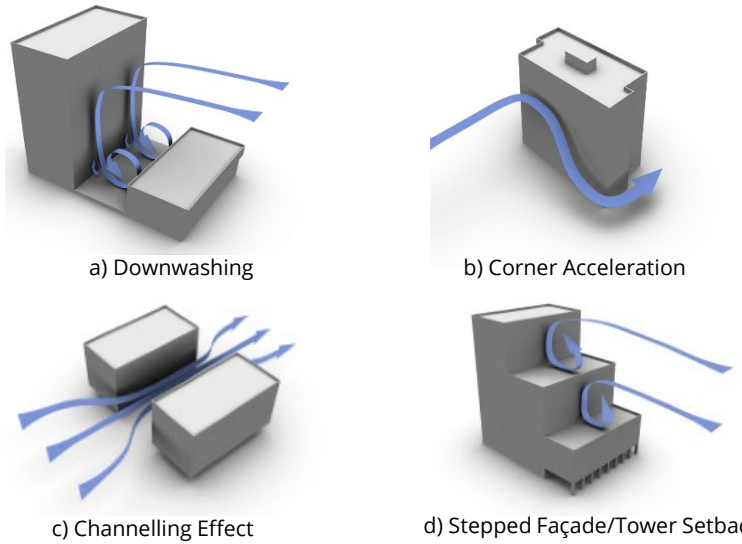



**Image 4: Generalized Wind Flows**

## 5.2 Existing Scenario

The existing building on the project site is one storey, surrounded by dense buildings in all directions. As such, there is no significant structure on site that would deflect ambient winds down to the ground to cause adverse wind impacts.

The site location is another reason for the favourable wind conditions. As shown in Image 5, the site is approximately 0.3 km from Niagara Escarpment, which has a more than 85 m raise in this area and covered by dense landscaping. In addition, the site is approximately 4.7 km from the lake to the northeast. The speeds of the prevailing winds from both the southwest and northeast directions are expected to be reduced considerably on the current project site, creating a calmer microclimate when compared to the downtown or other areas in Hamilton. Also note that John C. Munro Hamilton International Airport, where the reference wind speeds are obtained (Image 3), is located to the distant southwest of the site and at an elevation higher than the project site.

Currently, wind conditions on and around the site are considered comfortable for sitting or standing in the summer and for strolling or walking in the winter. Overall, wind conditions exceeding the safety criterion are not expected on or around the site under the existing scenario.

# 5. RESULTS AND DISCUSSION

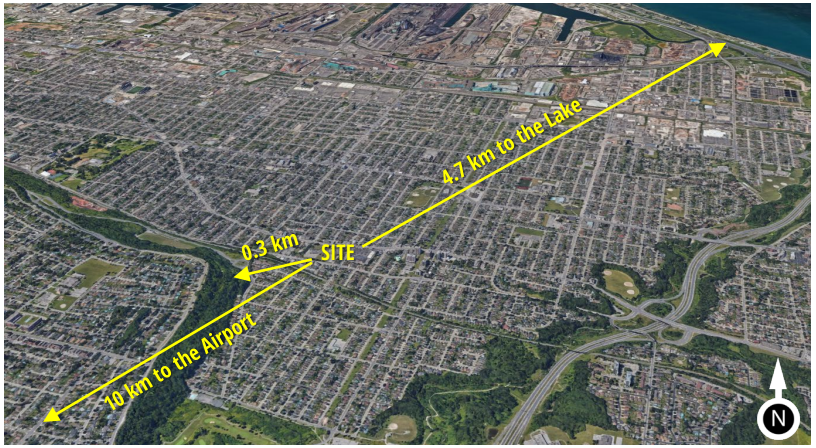



**Image 5: Site Location and Local Topography**

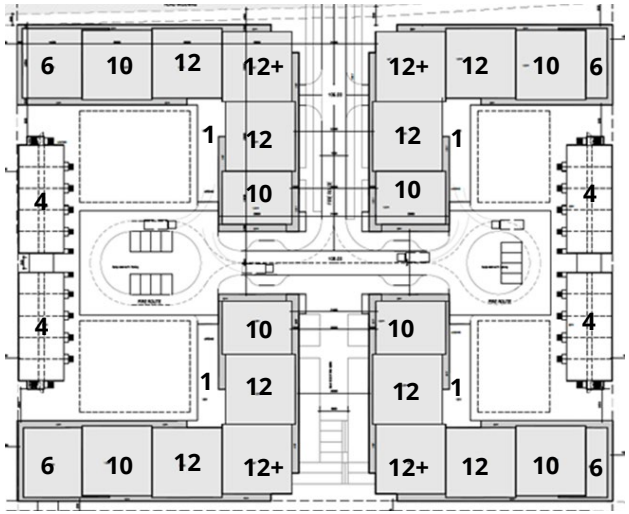



**Image 6: Storey Numbers plus Small Setbacks at the 4th Floor around Each Tower**

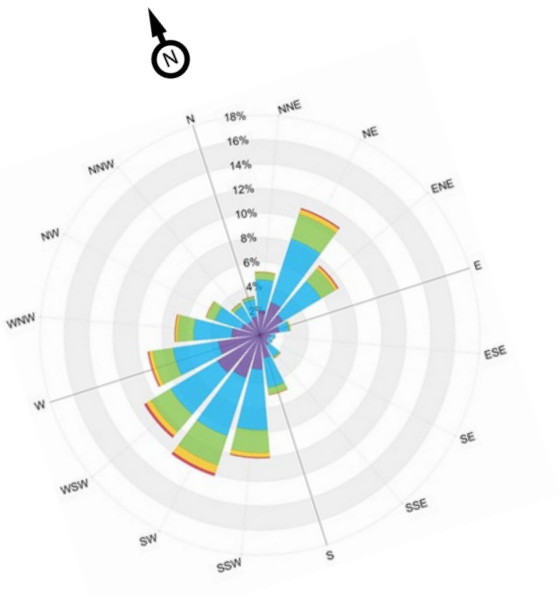
## 5.3 Proposed Scenario

Although the proposed buildings are considerably taller than their immediate surroundings, each tower is designed with a stepped profile from 12 storeys plus a mechanical penthouse at the corner to 10 storeys and 6 storeys along its wings - see storey numbers shown in Image 6. Each building also sets back slightly at the 4th floor in all directions. In addition, the proposed drop-off areas, building entrances and amenity spaces are largely sheltered by the proposed towers and townhouses.

Together with the favourable location of the project, it is our opinion that the wind safety criterion will be met in all pedestrian areas at grade as well as on the Level 2 amenity terraces.

The following subsections provide a detailed discussion of the potential wind comfort conditions around the project. The expected wind comfort conditions are shown in Images 7a and 7b for the summer and winter seasons, respectively.

# 5. RESULTS AND DISCUSSION




**WIND CATEGORIES**

- Sitting / Standing
- Strolling / Walking
- Uncomfortable

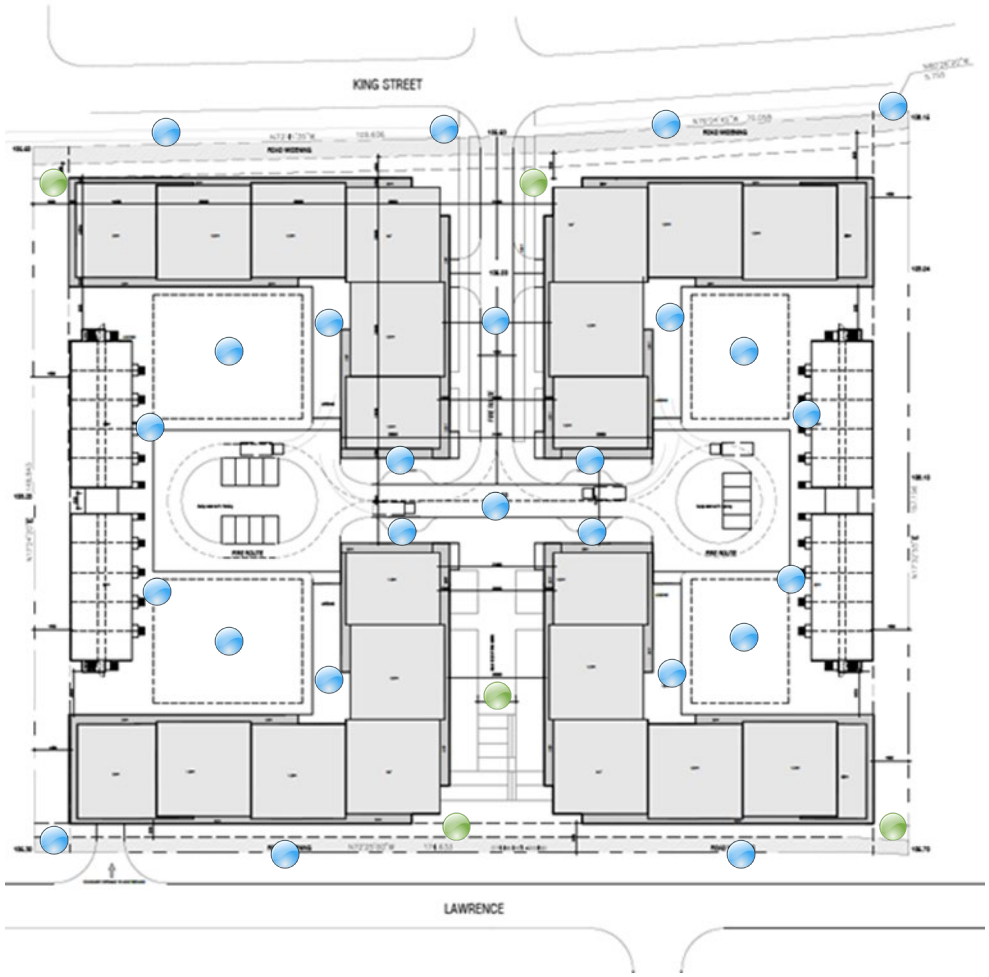
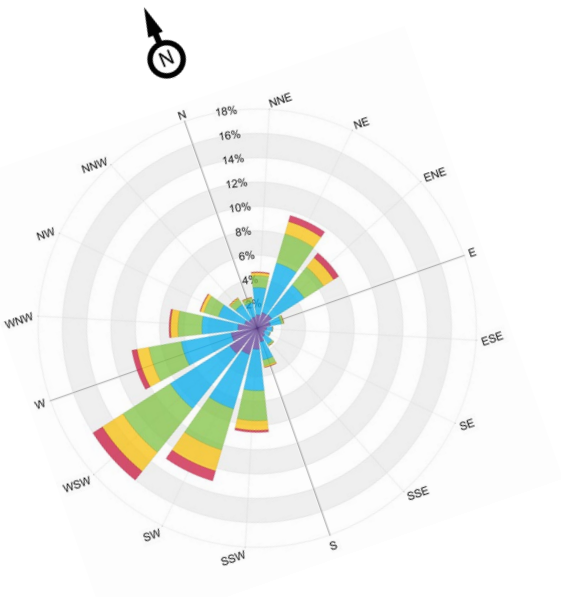



**Image 7a: Predicted Wind Conditions - Summer**

# 5. RESULTS AND DISCUSSION




**WIND CATEGORIES**

- Sitting / Standing
- Strolling / Walking
- Uncomfortable


**Image 7b: Predicted Wind Conditions - Winter**

# 5. RESULTS AND DISCUSSION

As shown in Image 7a, the summer wind conditions are predicted to be comfortable for sitting or standing for all pedestrian areas, including the main entrances, sidewalks and amenity spaces. Higher wind speeds comfortable for strolling or walking are expected around the exposed building corners, but they are generally considered appropriate for the intended uses. In the winter (Image 7b), the wind speeds around the exposed tower corners may become uncomfortable from time to time, while wind conditions along other sidewalks and walkways are predicted to be comfortable for strolling or walking.

## 5.3.1 Main Entrances

The main entrances to the proposed towers are located on the north and south building façades at the centre of the project site (Image 8). They are recessed from the overhangs above and from the extruding "A/L" massing at the corners. There might be winds channelling between the proposed towers, but the prevailing southwest and northeast winds are largely blocked by the buildings along the perimeter of the site before reaching this central area. Wind speeds at these entrance are predicted to be appropriate in the summer (Image 7a), but slightly higher than desired in the winter (Image 7b).

For wind control, another building element can be added at the other end of the south or north façade, similar to the "A/L" massing, if feasible (see green boxes in Image 8). Alternatively, local wind screens/planters can be placed on both sides of the entrances (blue lines in Image 8) to improve user comfort and door operability – see Image 9 for examples.

Suitable wind conditions are expected at all townhouse entrances throughout the year, as indicated in Images 7a and 7b.


**Image 8: Locations of Potential Wind Control Strategies for Entrances**

**Image 9: Examples of Planters and Screens for Entrances**

### 5.3.2 Exposed Building Corners

Wind conditions on adjacent sidewalks and walkways are generally predicted to be suitable for their intended use throughout the year (Images 7a and 7b). However, increased wind speeds are expected around the exposed building corners and they may become uncomfortable in the winter (red dots in Image 7b). These conditions are primarily caused by the accelerations of the prevailing southwest and northeast winds around the corners (Image 4b).

Typical wind control solutions, if feasible, may include chamfered/curved/re-entrant corners, dense coniferous landscaping, corner canopies and wind screens in order to diffuse accelerating winds and/or keep pedestrians away from these corners. Examples of wind control features for these corners are provided in Image 10 for reference. Wind tunnel testing could be conducted at a later design stage to quantify these wind conditions and to determine the need and extent of wind control solutions.

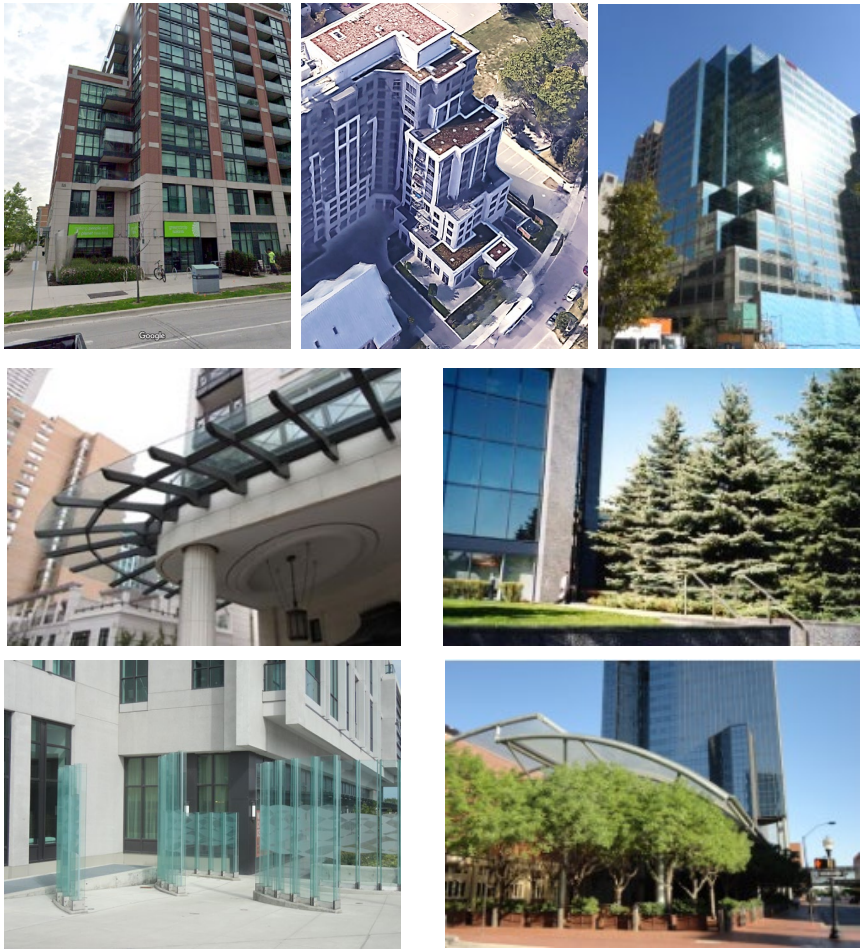


**Image 10: Wind Control Examples for Building Corners**

### 5.3.3 Amenity Spaces

Low wind speeds comfortable for sitting or standing are predicted in the summer for all amenity spaces and landscaped areas at grade and Level 2 (Image 7a). Slightly higher wind speeds are acceptable in the winter (Image 7b) due to reduced usage of outdoor spaces during the colder months.

The only exception is the proposed pedestrian mews along the space between the two southern towers. The accelerating southwest winds (Image 11) may induce wind speeds that are higher than desired for pedestrian sitting or standing in the summer. In addition to the above-discussed wind control measures for the tower corners, local landscaping can be considered for designated seating areas along the space. They may induce planters, screens, trellises and so on – see photos in Image 12 for examples.

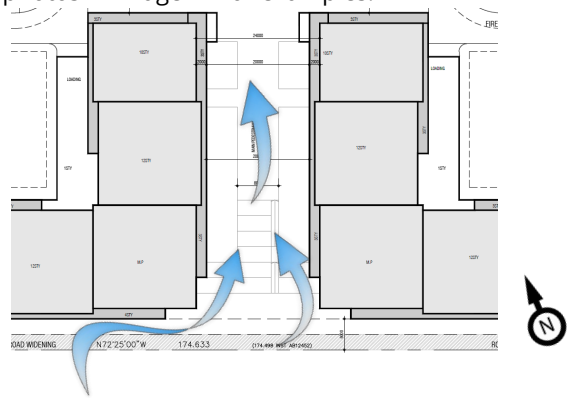



**Image 11: Southwesterly Winds Accelerating into Pedestrian Mews**

**Image 12: Examples of Wind Control Features for Pedestrian Mews**

# 6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed project at 1842 King Street East in Hamilton, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surroundings, our experience with wind tunnel testing of similar projects, and screening-level modelling of wind flows around the proposed buildings.

Our findings can be summarized as follows:

- The project site is located adjacent to the Escarpment and away from the lake. The proposed four towers have L-shaped design and stepped profiles. With these positive features in place, wind speeds on and around the site are expected to meet the wind safety criterion and no significant wind impact is expected on the surrounding areas.
- Suitable wind conditions are expected in the summer and winter seasons for most pedestrian areas, including building entrances, sidewalks and amenity spaces at grade and Level 2.
- Wind speeds around the exposed tower corners may become uncomfortable in the winter months. Higher-than-desired wind speeds are also expected along the south portion of the pedestrian mews, and at the main entrances to the tower in the winter.
- Conceptual wind control measures are discussed for these windy areas. Wind tunnel testing could be conducted at a later design stage to quantify the level and frequency of high wind activity, confirm the need for wind control features and to optimize mitigation efforts.

# 7. APPLICABILITY OF RESULTS

The assessment presented in this report is for the proposed project at 1842 King Street East, based on the information 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) |
|---|---|---|
| 1804.20. - 1842 King - concept plans - Feb.19.2021 | PDF | 03/08/2021 |