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Date: December 16, 2022

Re: **Pedestrian Wind Assessment – Draft**
58 York Boulevard
Hamilton, Ontario
SLR Project #241.V30598.00000

Prepared by

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Belmont Equity (58 York) Hamilton Inc. to conduct a pedestrian wind assessment for the proposed 58 York Boulevard project in Hamilton, Ontario. This report is in support of the Site Plan Approval (SPA) application for the development.

1.1 Existing Development

The proposed development is located at the northeast corner of York Boulevard and Park Street North and is currently occupied by a parking lot. Figure 1 provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated October 2021. Several images of the site and surroundings are included in Figures 2a through 2d.

Immediately surrounding the site are parking lots, low-rise residential buildings, and mid-rise commercial buildings. Beyond the immediate surroundings, low-rise and mid-rise residential and commercial buildings are situated to the north of the site and mid-rise and high-rise residential commercial buildings, including the downtown Hamilton core, are situated to the southeast through southwest.

As per the Terms of Reference: Pedestrian Level Wind Study for Downtown Hamilton, developments under construction should be included as existing surroundings. No developments were identified as under construction in the area surrounding the site, therefore only existing buildings were included in the assessment.

Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 10/10/2021

Figure 2a: Looking northeast at the site

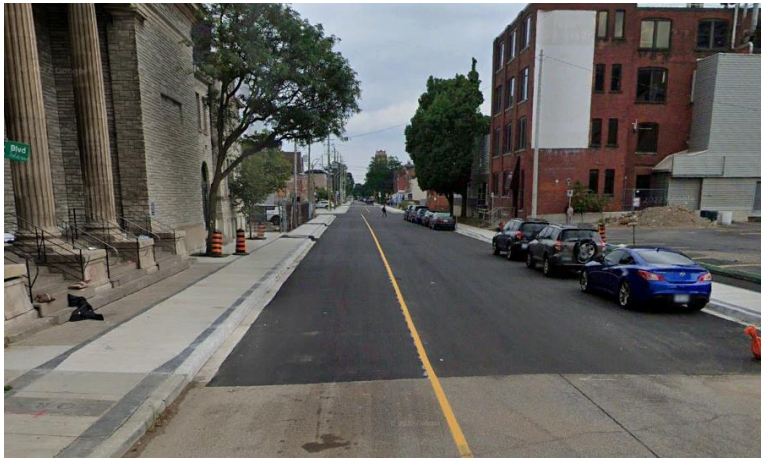


Figure 2b: Looking north along Park Street North

Figure 2c: Looking west along York Boulevard

Figure 2d: Looking east along York Boulevard

1.2 Proposed Development

The proposed development consists of a 28-storey tower plus mechanical penthouse with a four-storey podium (Figure 3). The main entrance is situated at the southwest corner of the building, near the intersection of York Boulevard and Park Street North, with three secondary entrances located along York Boulevard and another two secondary entrances along Park Street North.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically these include sidewalks, main entrances, transit stops, plazas and parks. On-site areas of interest are shown in Figure 4.

Jackson Square is located to the south of the site, across York Boulevard, and there is a transit stop at the southwest corner of the intersection of York Boulevard and Park Street North. There is also an outdoor amenity terrace on the podium roof (i.e., Level 5).

Figure 3: Rendering of proposed development
(Image courtesy of Belmont Equity (58 York) Hamilton Inc.)

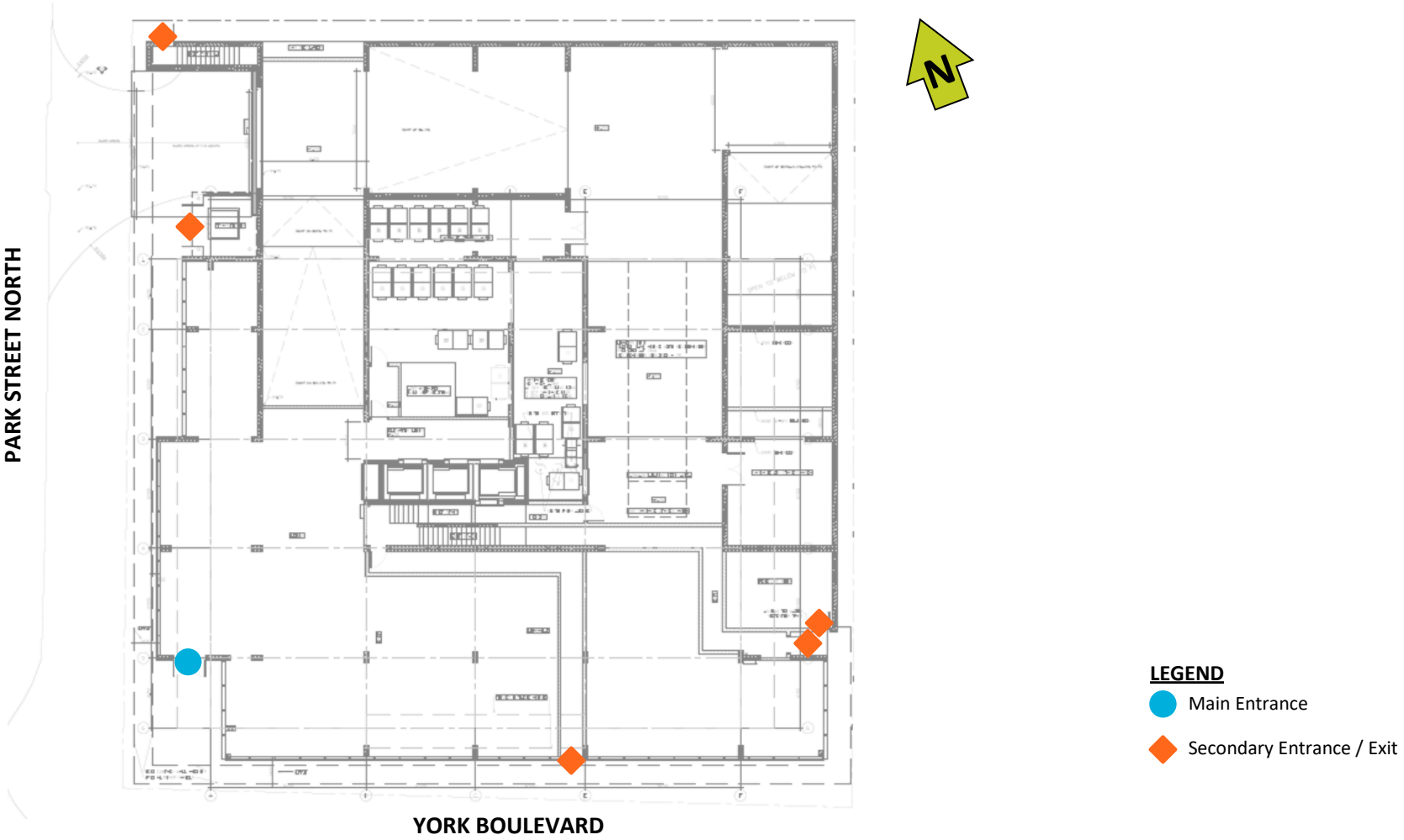


Figure 4: Areas of interest – Grade level

2.0 APPROACH

A screening-level assessment was conducted using computational fluid dynamics (CFD). As with any simulation, there are some limitations with this modeling technique, specifically in the ability to simulate the turbulence, or gustiness, of the wind. Nonetheless, CFD analysis remains a useful tool to identify potential wind issues, especially when assessing mean wind speeds. This CFD-based mean wind speed assessment employs a comparable analysis methodology to that used in wind tunnel testing. The results of CFD modeling are also an excellent means of readily identifying relative changes in wind conditions associated with different site configurations.

2.1 Methodology

Wind comfort conditions for areas of interest were predicted on and around the development site to identify potentially problematic windy areas. A 3D model of the proposed development, as well as floor plans and elevations, were provided by Belmont Equity Partners on November 17, 2022. A view of the 3D model used in the computer wind comfort analysis are shown in Figures 5a and 5b. This model included surrounding buildings within 500 m from the study site centre. The simulations were performed using CFD software by Meteodyn Inc.

The entire 3D space throughout the modeled area is filled with a three-dimensional grid. The CFD virtual wind tunnel calculates wind speed at each one of the 3D grid points. The upstream "roughness" for each test direction is adjusted to reflect the various upwind conditions and wind characteristics encountered around the actual site. Wind flows for a total of 16 compass directions were simulated. Although wind speeds are calculated throughout the entire modeled area, wind comfort conditions were only plotted for a smaller area immediately surrounding the proposed development.

SLR assessed two configurations for comparison purposes. The descriptions are as follows:

- **Existing Configuration:** Existing site with existing surroundings.
- **Proposed Configuration:** Proposed development with existing surroundings.

A view of two configurations are shown in Figures 5a and 5b.

Wind flows were predicted for both the existing site, as well as with the proposed development for comparison purposes. The CFD-predicted wind speeds for all test directions and grid points were then combined with historical wind climate data for the region to predict the occurrence of wind speeds in the pedestrian realm, and to compare against wind criteria for comfort and safety; these results are shown in the various wind flow images. The analysis of wind conditions is undertaken for two seasons: Winter (November to April) and Summer (May to October).

Results are presented through discussion of the wind conditions along major streets and the areas of interest. The comfort criteria are based on predictions of localized wind forces combined with frequency of occurrence. Climate issues that influence a person's overall "thermal" comfort, (e.g., temperature, humidity, wind chill, exposure to sun or shade, etc.) are not considered in the comfort rating.

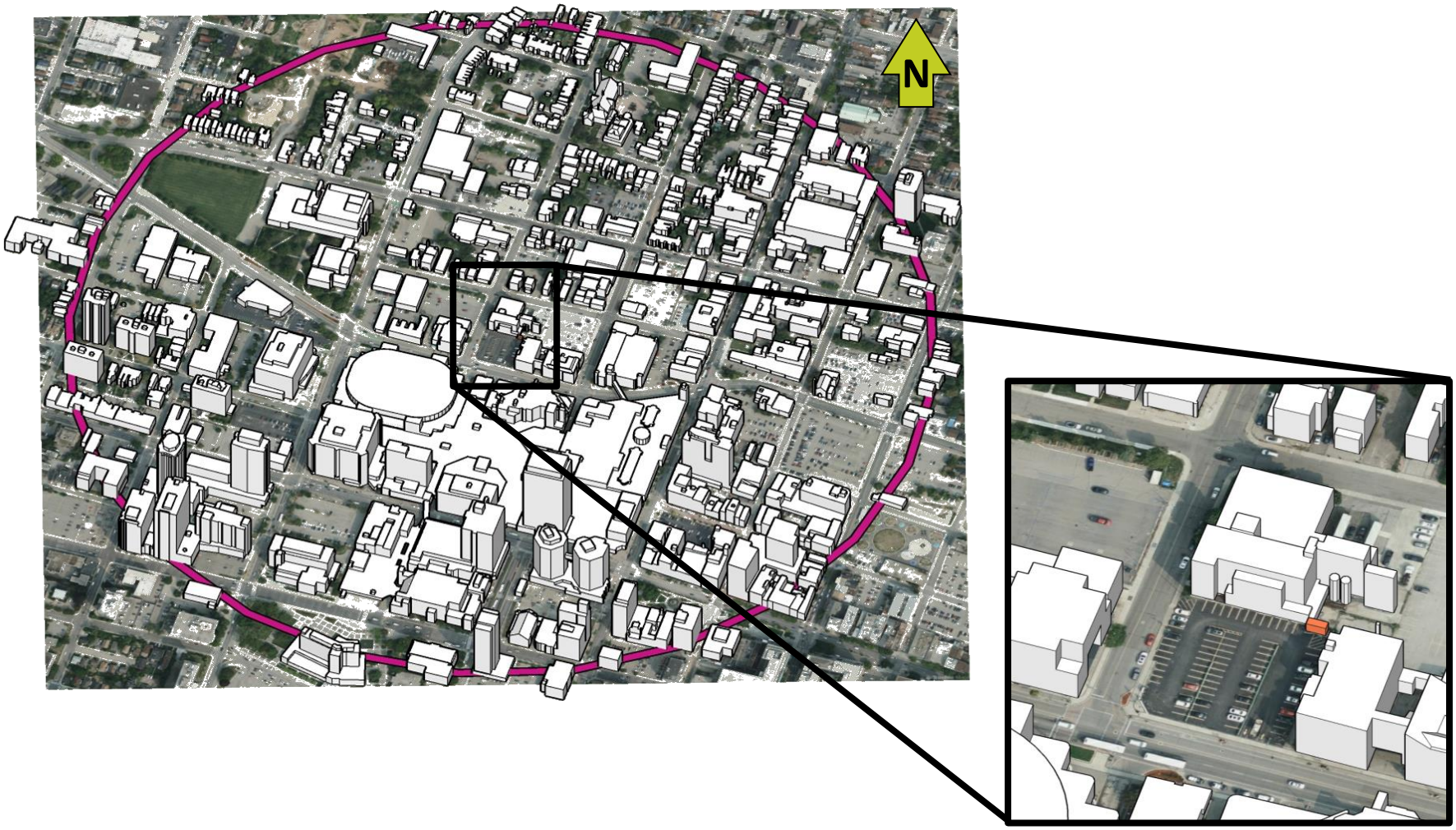


Figure 5a: Massing Model – Existing Configuration

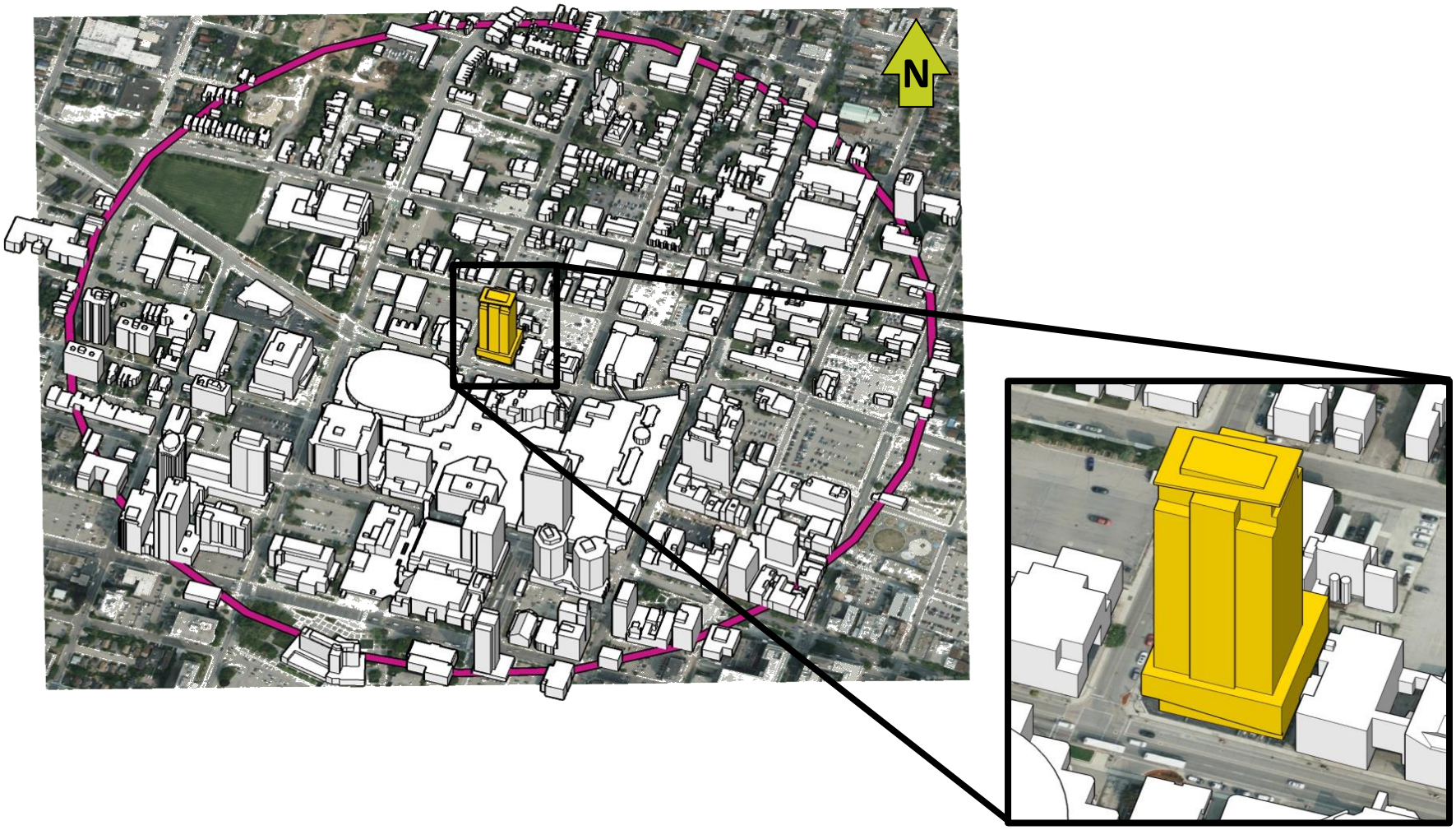
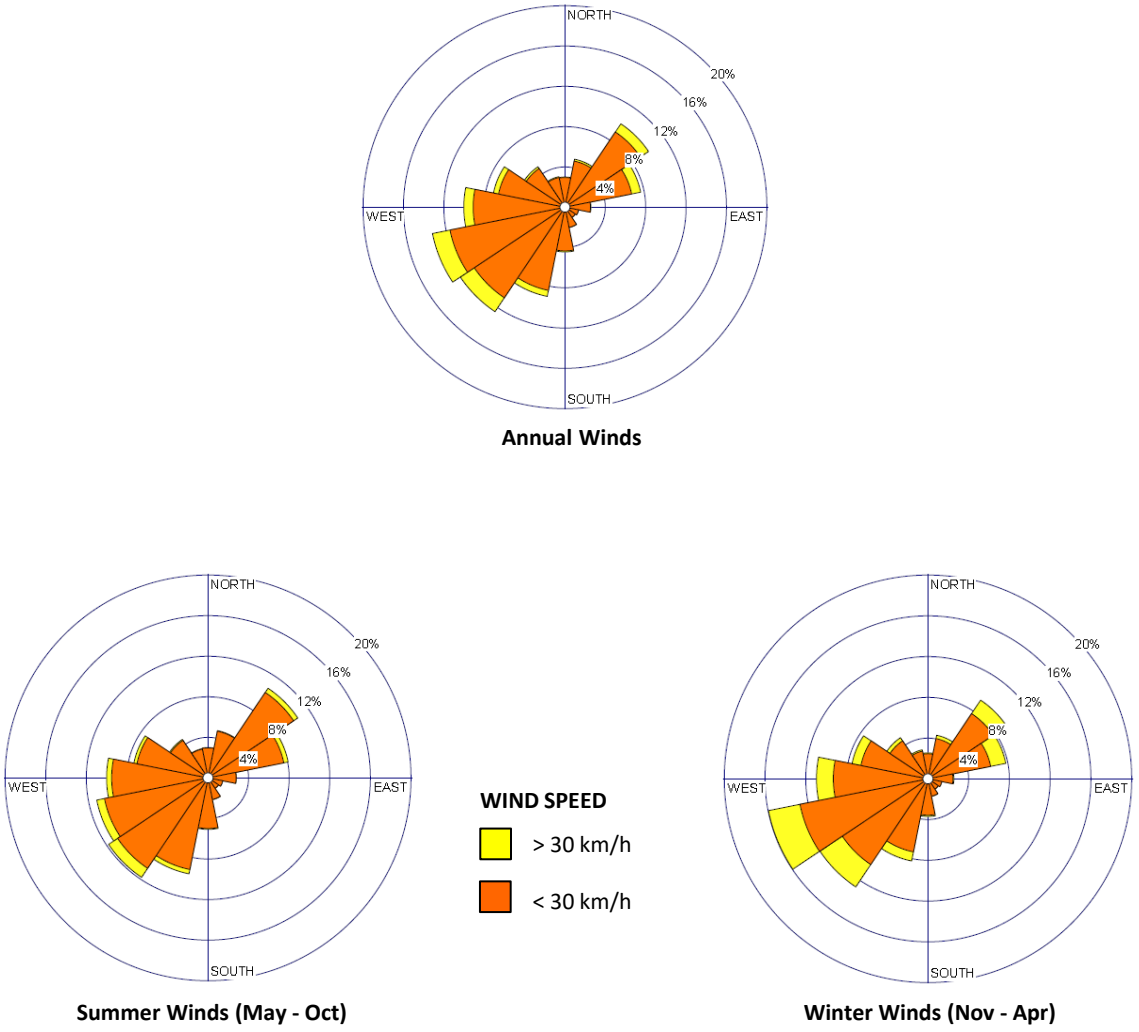


Figure 5b: Massing Model – Proposed Configuration

2.2 Wind Climate

Wind data recorded at John C. Munro International Airport in Hamilton for the period of 1993 to 2021 were obtained and analyzed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 6. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the southwest and northeast quadrants are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year. The seasonal wind roses show daytime winds, from 6:00 – 23:00, while the annual wind rose shows all hours.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in Figure 6 also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the southwest and northeast quadrants. All wind speeds and directions were included in the wind climate model.



Annual Winds

Summer Winds (May - Oct)

Winter Winds (Nov - Apr)

Figure 6: Wind Roses for John C. Munro International Airport (1993 to 2021).

3.0 PEDESTRIAN WIND CRITERIA

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The criteria utilized for this analysis is provided by the City of Hamilton, in the document *Terms of Reference – Pedestrian Level Wind Study for Downtown Hamilton* (March 2018). The comfort criteria, which is based on certain predicted hourly gust-equivalent mean (GEM) wind speeds being exceeded 20% of the time, are summarized in **Table 1**. By allowing for a 20% exceedance, it assumes wind speeds will be comfortable for the corresponding activity at least four out of five days. The comfort criteria consider only daytime hours, between 6:00am and 11:00pm. GEM is defined as the maximum of mean wind speed or the gust wind speed divided by 1.85.

The criterion for wind safety in the table is based on hourly gust wind speeds that are exceeded nine hours per year (approximately 0.1% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in **Table 2**.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for GEM Wind Speed Exceeded 20% of the Time		Description of Wind Comfort
Sitting	0 to 10 km/h	0 to 2.8 m/s	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper comfortably.
Standing	0 to 14 km/h	0 to 3.9 m/s	Gentle breezes suitable for main building entrances and transit stops.
Strolling	0 to 17 km/h	0 to 4.7 m/s	Moderate breezes suitable for walking along pedestrian thorough fares.
Walking	0 to 20 km/h	0 to 5.6 m/s	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 20 km/h	> 5.6 m/s	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Activity	Safety Criterion Gust Wind Speed Exceeded Once Per Year (0.1%)		Description of Wind Effects
Any	90 km/h	25 m/s	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 RESULTS

Figures 7a through 10b present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These typically represent the seasonal extremes of best and worst case. The “comfort zones” shown are based on an integration of wind speed and frequency for all 16 wind directions tested with the seasonal wind climate model. The presence of mature trees can lead to wind comfort levels that are marginally more comfortable than shown, during seasons when foliage is present. Appendix A presents the wind safety conditions on an annual basis and Appendix B presents wind flow vectors around vertical slices of the proposed building.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, it some climates these may be difficult to achieve in the winter due to the overall climate. For sidewalks, walkways and pathways, wind comfort suitable for strolling are desirable year-round but may not be feasible in the winter. The presence of benches on a sidewalk, which are an optional use, does not change the overall wind comfort requirement for sidewalk. Wind conditions of walking are satisfactory for loading areas, laneways, and a limited portion of a sidewalk, considering exposure is brief for pedestrians. For main entrances, transit stops, and public amenity spaces such as parks and playgrounds, wind conditions conducive to standing are preferred throughout the year. For on-site amenity areas, wind conditions suitable for sitting or standing are desirable during the summer, with stronger wind flows, conducive to leisurely walking, tolerated in the winter. The most stringent category of sitting is desirable during the summer for dedicated seating areas, such as patios, where calmer wind is expected for the comfort of patrons.

4.1 Building Entrances & Walkways

Existing wind conditions on the site are expected to be comfortable for sitting throughout the year (Figures 7a and 8a).

With the addition of the proposed development, wind conditions on the site are comfortable for sitting or standing throughout the year (Figures 7b and 8b). This includes the main entrance and all secondary entrances to the building (Figures 9a and 9b). These wind conditions are considered appropriate for the intended use.

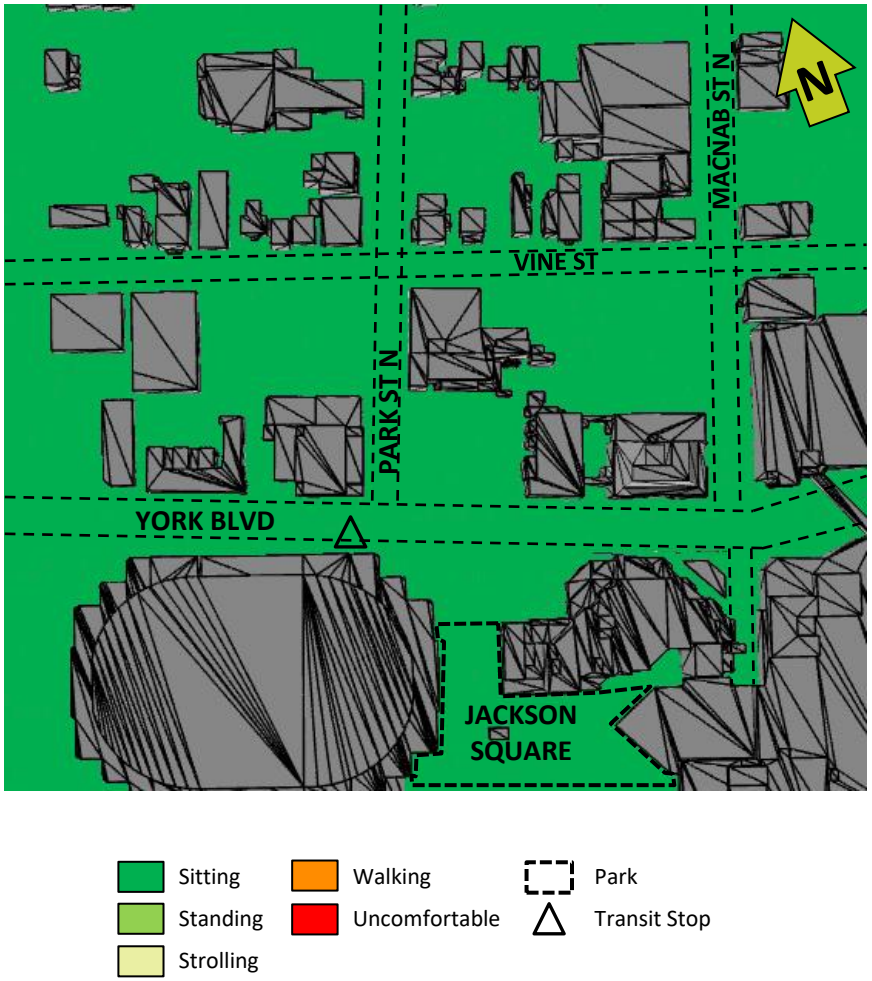


Figure 7a: **Existing Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas**

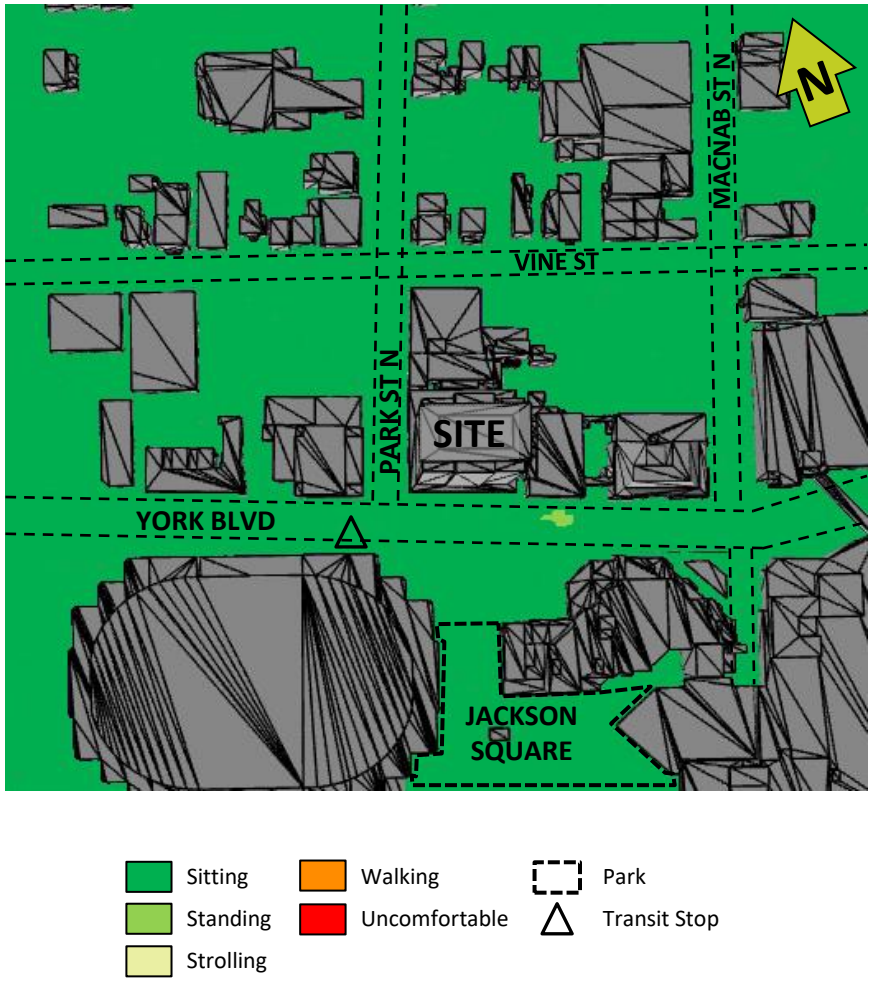


Figure 7b: **Proposed Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas**

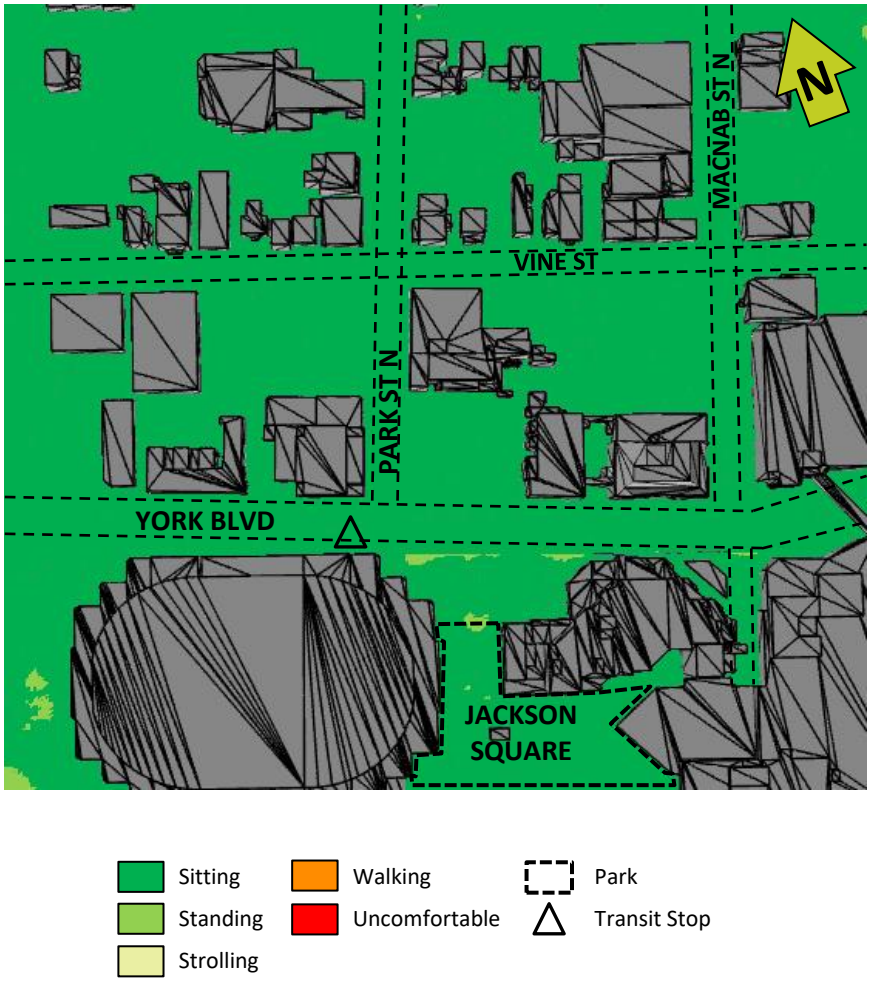


Figure 8a: Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

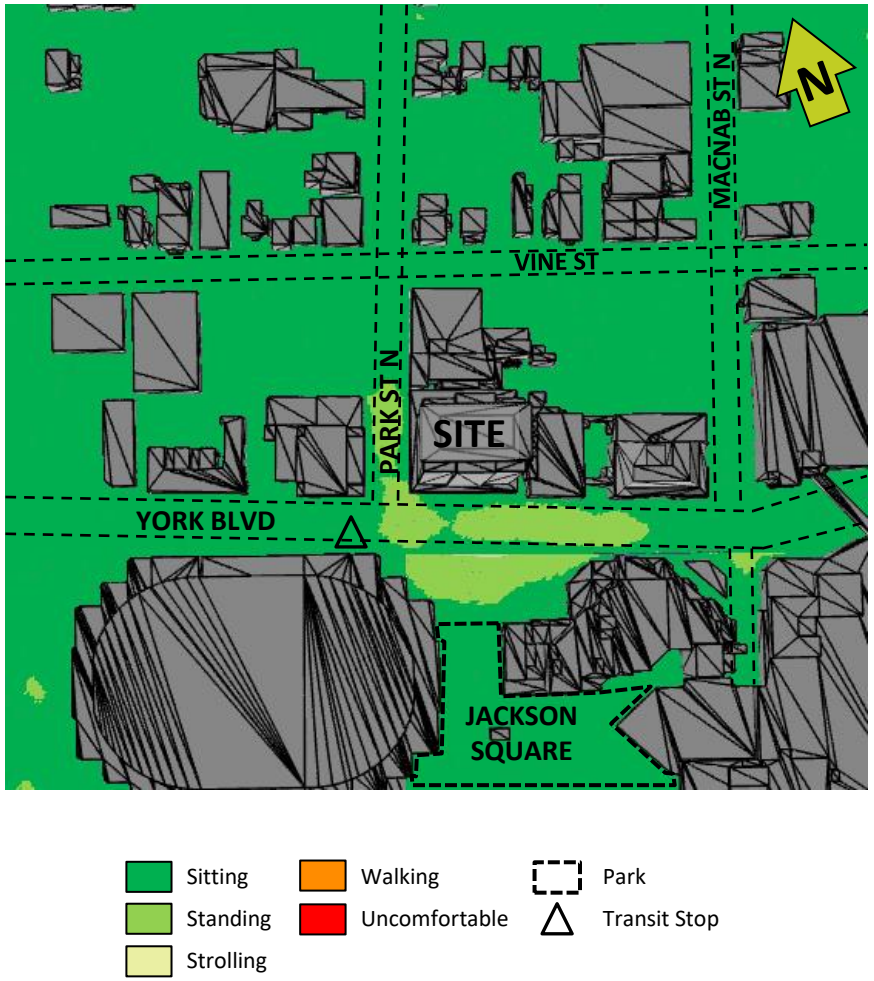


Figure 8b: Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

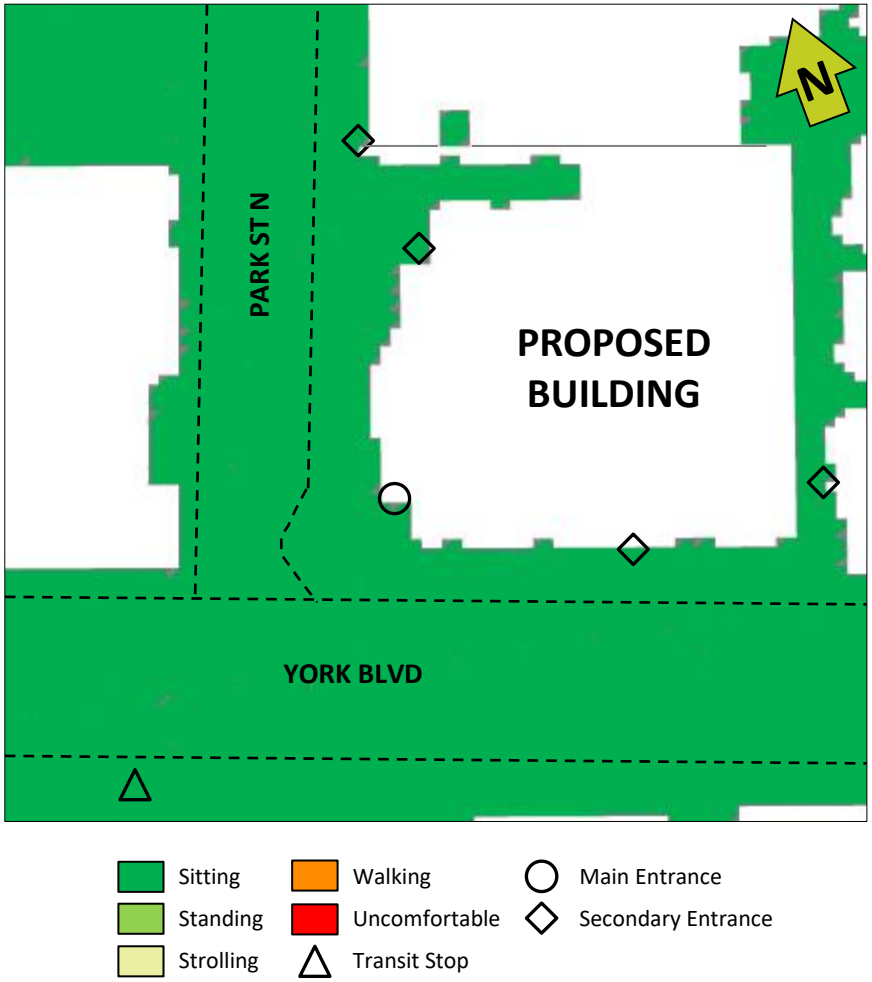


Figure 9a: **Proposed Configuration – Pedestrian Wind Comfort Summer – Building Entrances & Walkways**

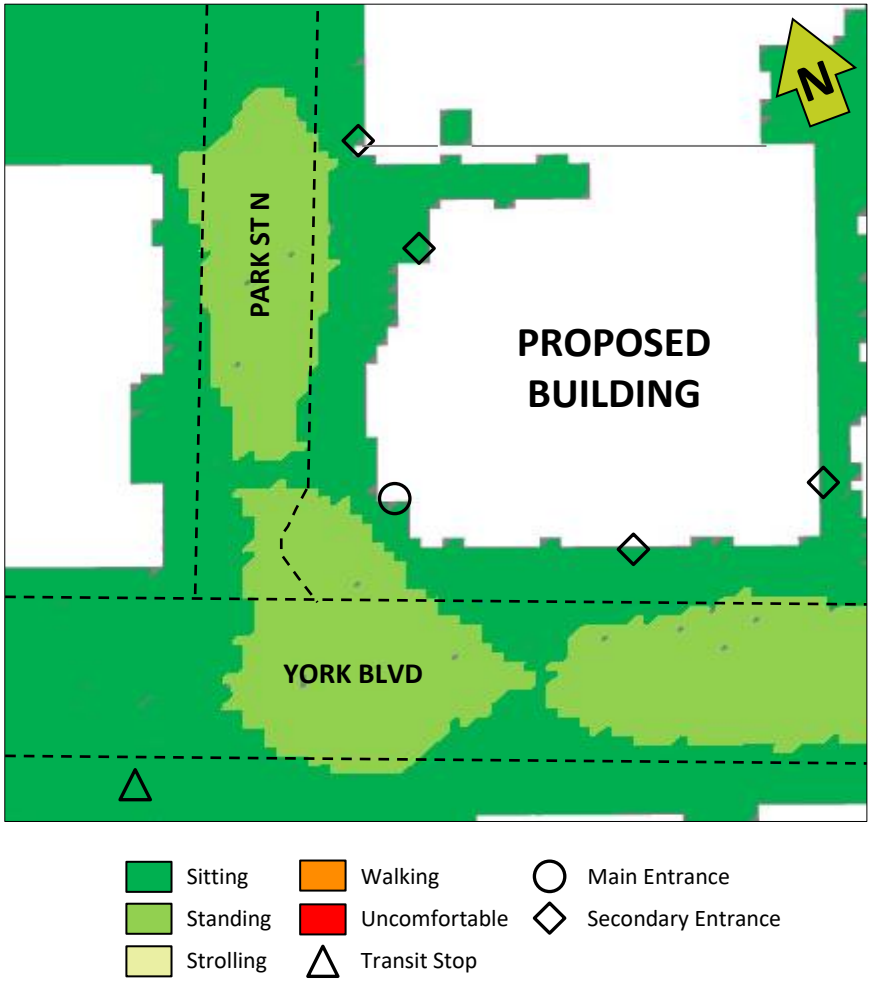


Figure 9b: **Proposed Configuration – Pedestrian Wind Comfort Winter – Building Entrances & Walkways**

4.2 Outdoor Amenity Terrace

In the Proposed Configuration, wind conditions on the Level 5 outdoor amenity terrace are expected to be comfortable for sitting or standing in the summer (Figure 10a). In the winter, wind conditions are predicted to be conducive to strolling or better (Figure 10b).

4.3 Surrounding Sidewalks

Wind conditions on sidewalks surrounding the site are generally expected to be comfortable for sitting throughout the year in both configurations, which is appropriate. In the winter and for the Proposed Configuration, sidewalks close to the site, along York Boulevard and Park Street North, are predicted to be comfortable for standing or strolling, which is still suitable for the intended use of those spaces.

Similarly, wind conditions at the nearby transit stop, at the southwest corner of the intersection of York Boulevard and Park Street North, are anticipated to be comfortable for sitting or standing throughout the year and remain largely unchanged between the Existing and Proposed configurations.

4.4 Wind Safety

The wind safety criterion is expected to be met in both the Existing and Proposed Configurations on site, including the outdoor amenity terrace, as well as on the surrounding sidewalks.

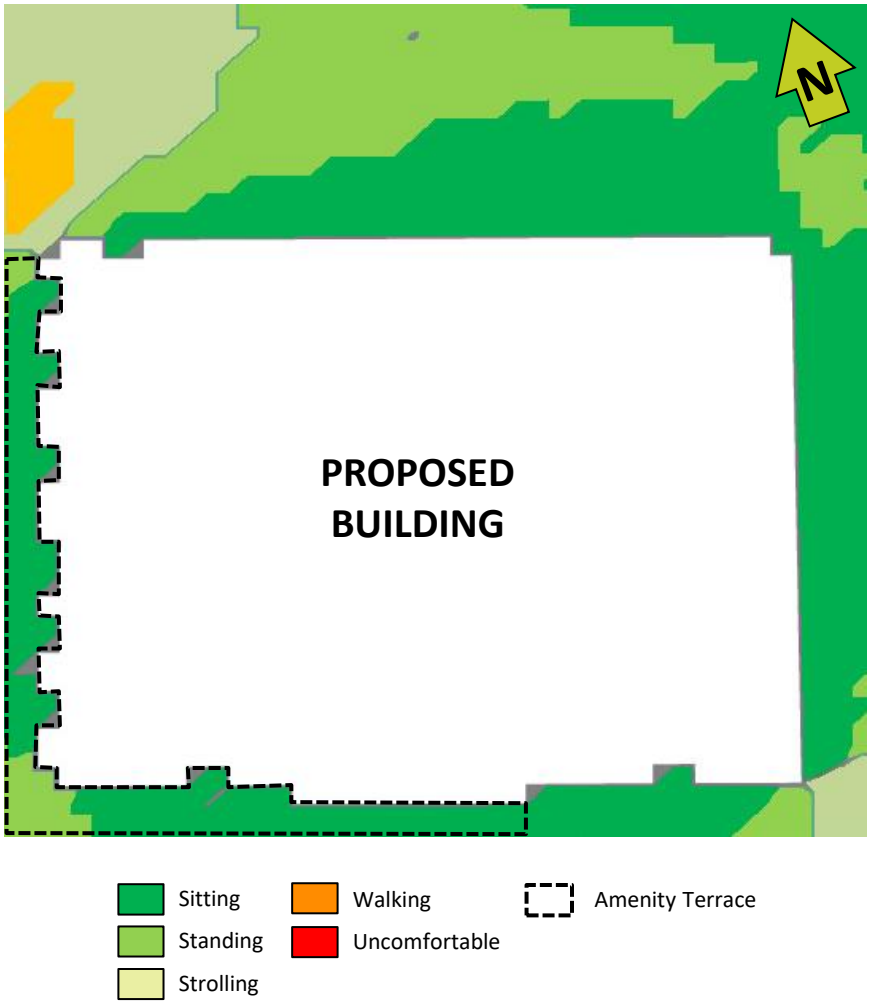


Figure 10a: Proposed Configuration – Pedestrian Wind Comfort Summer – Outdoor Amenity Terrace

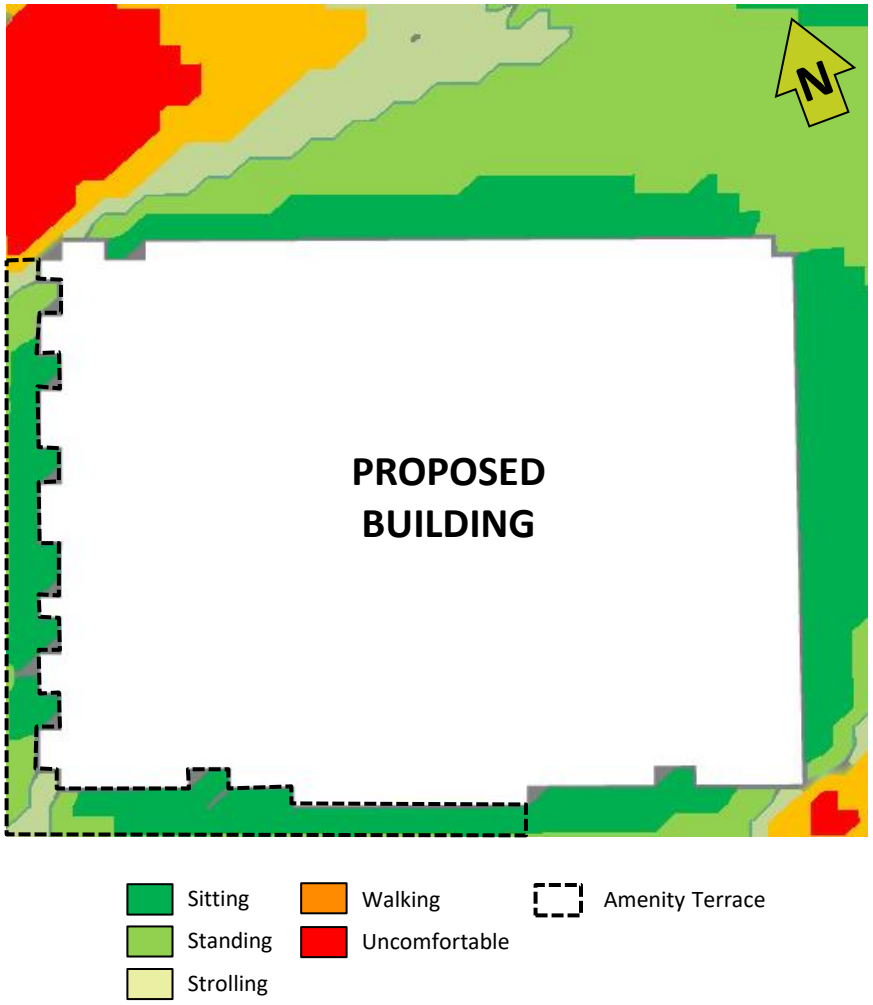


Figure 10b: Proposed Configuration – Pedestrian Wind Comfort Winter – Outdoor Amenity Terrace

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 58 York Boulevard have been assessed through computational fluid dynamics modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- Wind conditions on the site, including entrances and outdoor amenity spaces, are expected to be suitable for the intended use year-round.
- On the sidewalks surrounding the proposed development, wind conditions are predicted to be suitable for the intended use in the Proposed Configuration.
- The wind safety criterion is anticipated to be met at all areas on and surrounding the development in both the Existing and Proposed Configuration.

6.0 LIMITATIONS OF LIABILITY

This report has been prepared and the work referred to in this report has been undertaken by SLR Consulting (Canada) Ltd. (SLR) for Belmont Equity (58 York) Hamilton Inc., hereafter referred to as the "Client". It is intended for the sole and exclusive use of the Client. The report has been prepared in accordance with the Scope of Work and agreement between SLR and the Client. Other than by the Client and the City of Hamilton in their role as land use planning approval authorities, copying or distribution of this report or use of or reliance on the information contained herein, in whole or in part, is not permitted unless payment for the work has been made in full and express written permission has been obtained from SLR.

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7.0 REFERENCES

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Appendix A

Pedestrian Wind Safety Analysis

Annual

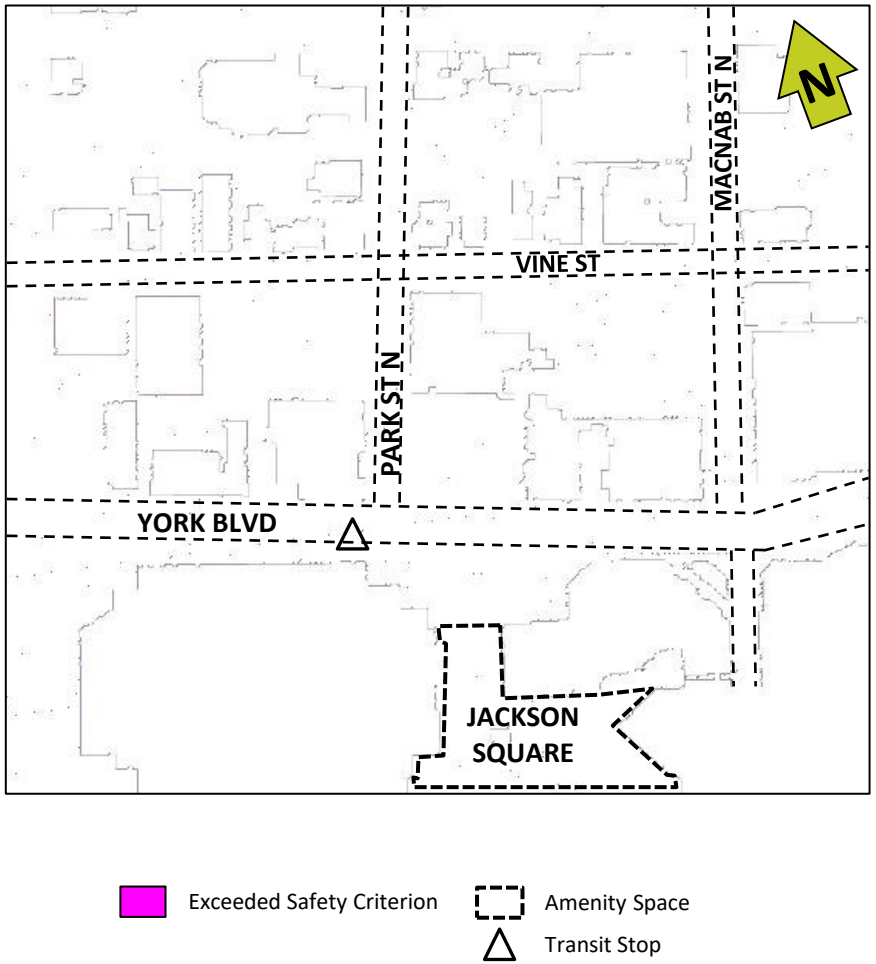

Figure A1a: Existing Configuration – Wind Safety Annual – On-site & Surrounding Areas

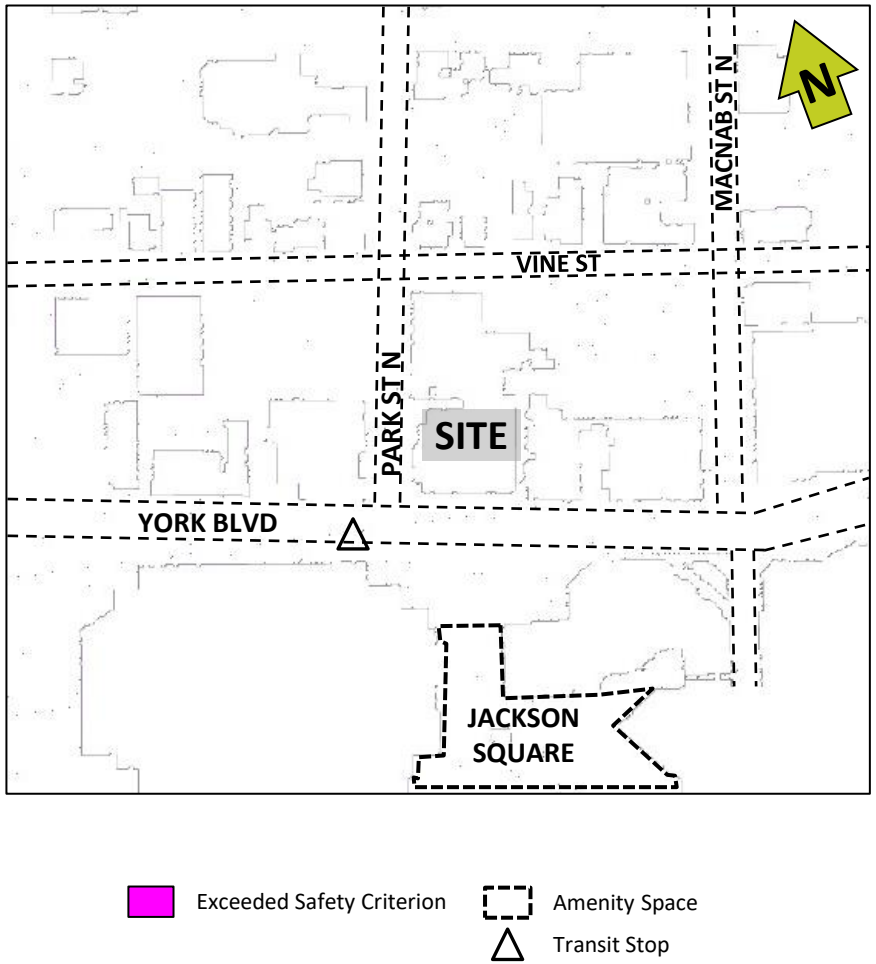

Figure A1b: Proposed Configuration – Wind Safety Annual – On-site & Surrounding Areas

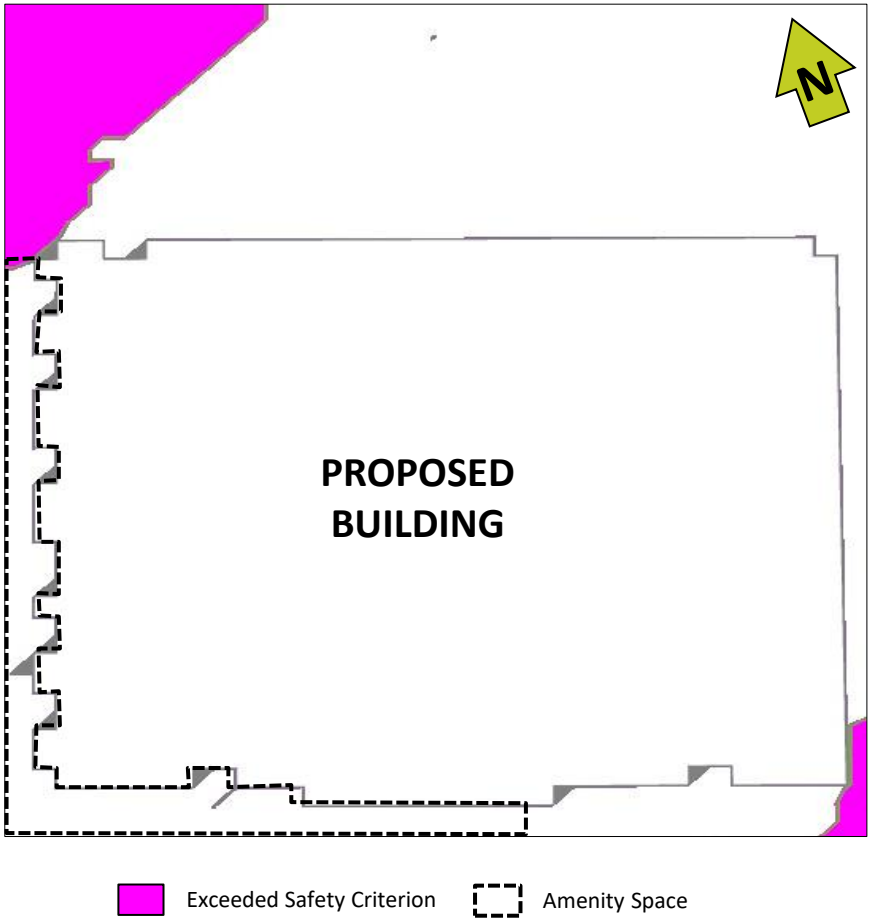

Figure A2: Proposed Configuration – Wind Safety Annual – Outdoor Amenity Terrace

Appendix B

Wind Flow Vectors – Proposed Configuration

Vertical Slices

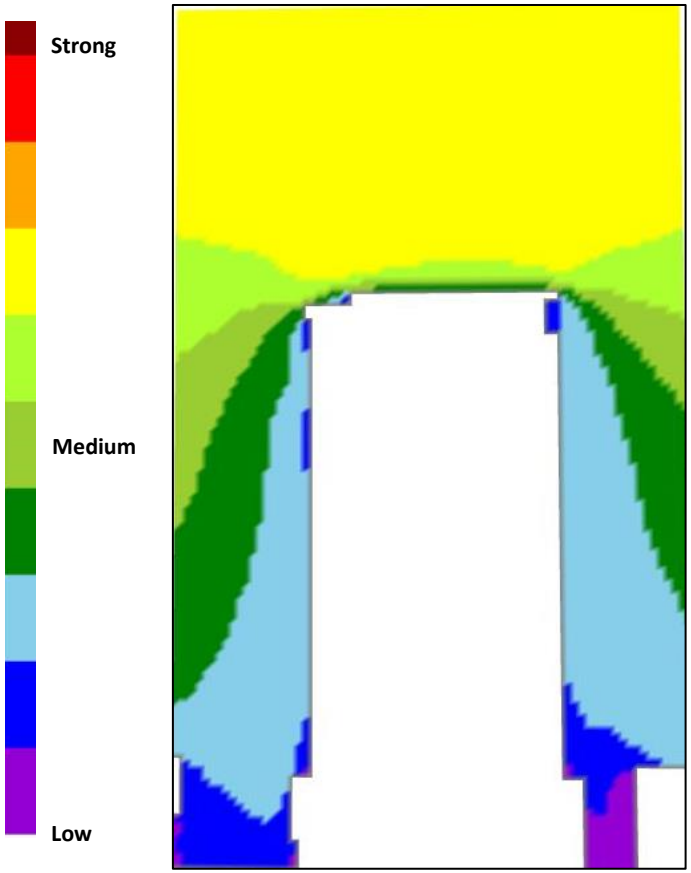

Figure B1: **Proposed Configuration – Vertical Slice Wind Flow Contours – South Elevation**

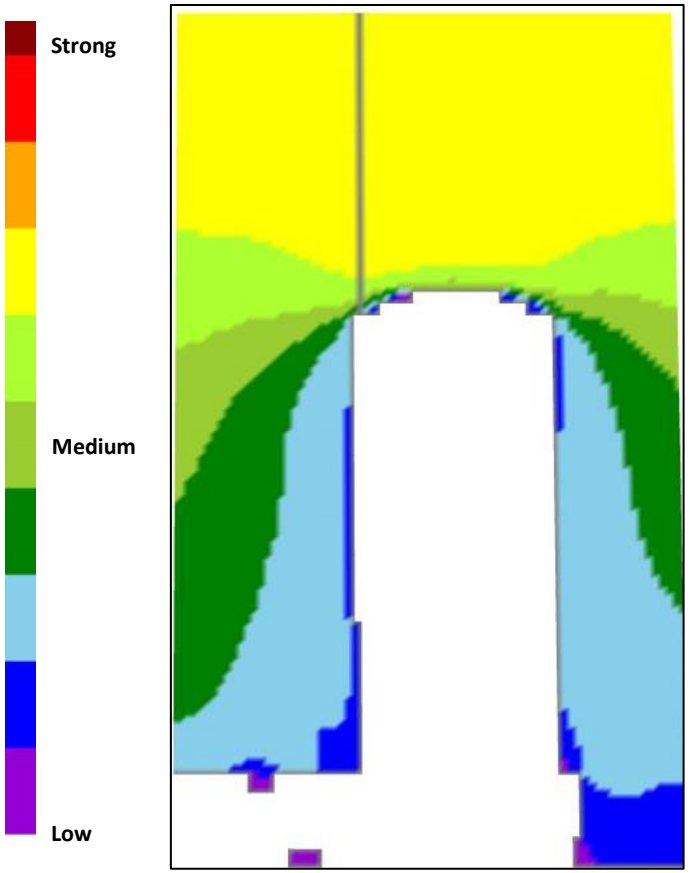

Figure B2: **Proposed Configuration – Vertical Slice Wind Flow Contours – West Elevation**