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Date: March 18, 2022

To: Tenblock
30 Soudan Ave., Suite 200
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Re: Pedestrian Wind Assessment
48 Grenoble Drive
Toronto, ON
SLR Project #241.30416.00000

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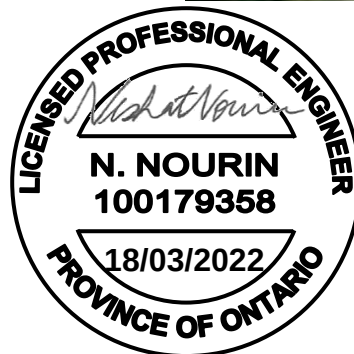


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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Tenblock to conduct a pedestrian wind assessment for the proposed development at 48 Grenoble Drive in Toronto, Ontario. This report is in support of the combined Zoning Bylaw Amendment (ZBA) and Site Plan Control (SPA) application for the development.

1.1 Existing Site

The proposed development is located at the northwest corner of the intersection of Grenoble Drive and Deauville Lane. The site is currently occupied by a nine-storey residential building, which will be demolished.

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 2020; some of these images are included in **Figures 2a** through **2d**.

Immediately surrounding the site is a slab apartment building to the northwest, mid-rise community and residential building to the north through east, a high-rise apartment building to the south and Grenoble Public School to the southwest. Beyond the immediate surroundings there are primarily high-rise and mid-rise buildings in all directions.

Typically, developments with Site Plan Control approval and/or those currently under construction within a 500 m radius are included as existing surroundings. For this assessment, the following developments were included based on the City's request: 25 St. Dennis Drive (ZBA approved) and 7-11 Rochefort Drive (ZBA submitted).

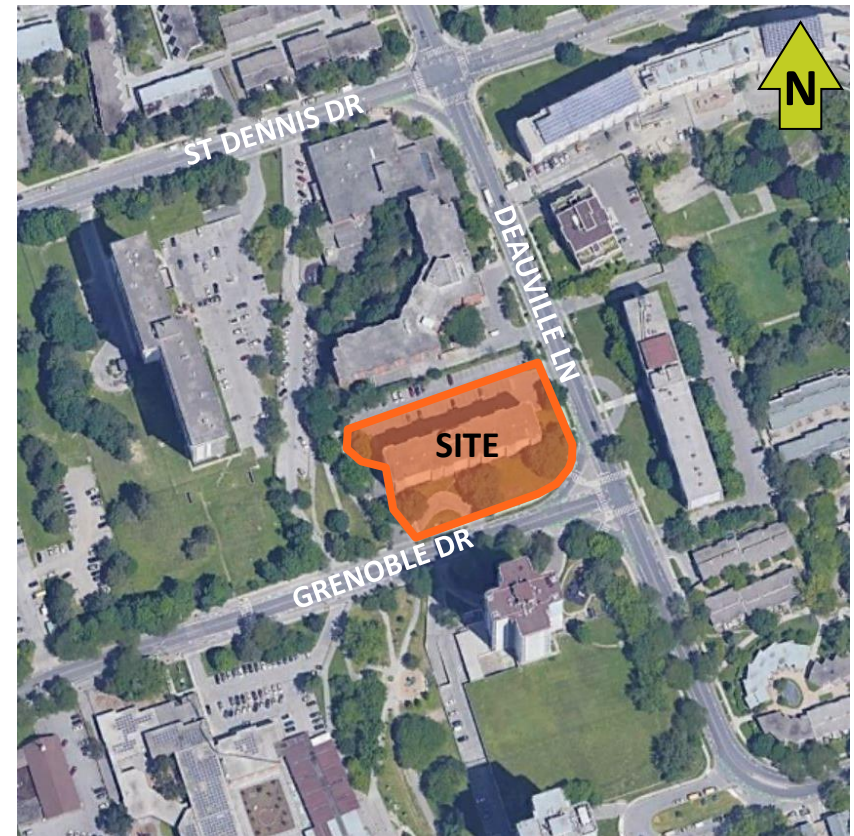


Figure 1: Aerial view of existing site & surroundings

Credit: Google Earth Pro, dated 6/22/2019



Figure 2a: Along Grenoble Drive looking east (site to the left)



Figure 2c: Along Deauville Lane looking northwest (Site to the left)



Figure 2b: Along Deauville Lane looking southeast (Site to the right)



Figure 2d: Along St. Dennis Drive looking west

1.2 Proposed Development

The proposed development will require the demolition of the existing nine-storeys residential building, to allow for the construction of two towers atop a six-storeys podium. The East Tower is 43-storeys, for a total height of 144 m including the mechanical penthouse. The West Tower is 41-storeys, for a total height of 137 m including the mechanical penthouse.

Figure 3 shows a section of the proposed development.

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. There are several transit stops along Deauville Lane and St. Dennis Drive, within the project vicinity.

The main residential entrance to the East Tower is located on the east facade and the main residential entrance to the West Tower is located along the south facade of the proposed development. The main entrance to the podium is located between the two towers along the south facade of the building. There are several secondary entrances and exits located along the north, south, east and west sides of the building. At grade level, parkland dedication area is located to the west of the proposed development, and a Privately owned publicly accessible space (POPS) is located at the intersection of Grenoble and Deauville. In addition, there are outdoor amenity terraces at ground level to the rear of the development between the two towers and on the podium roof at Level 7. On-site areas of interest are shown in **Figures 4a** and **4b**.

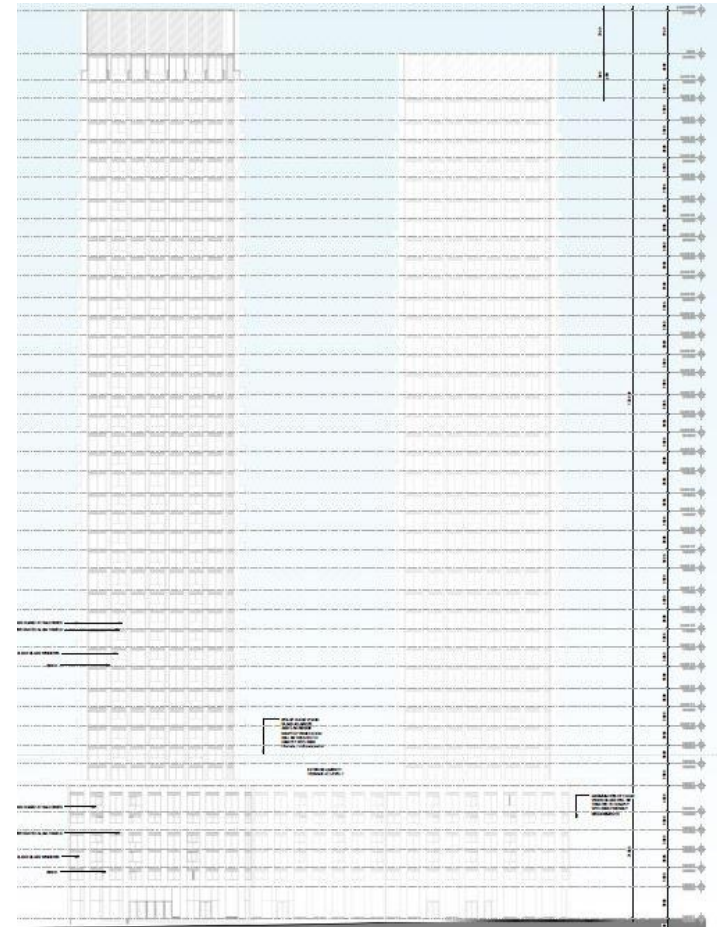
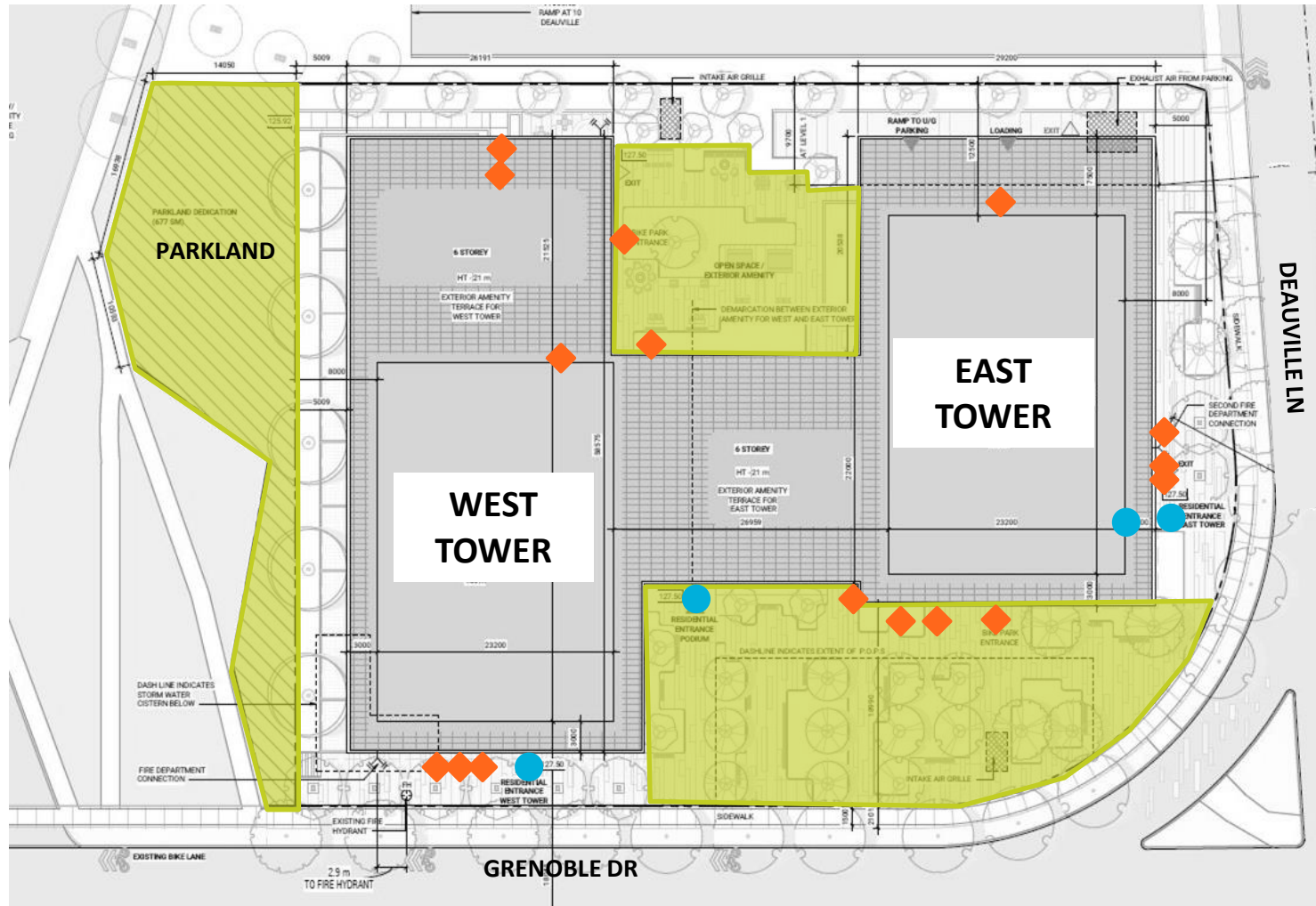


Figure 3: South elevation of proposed development

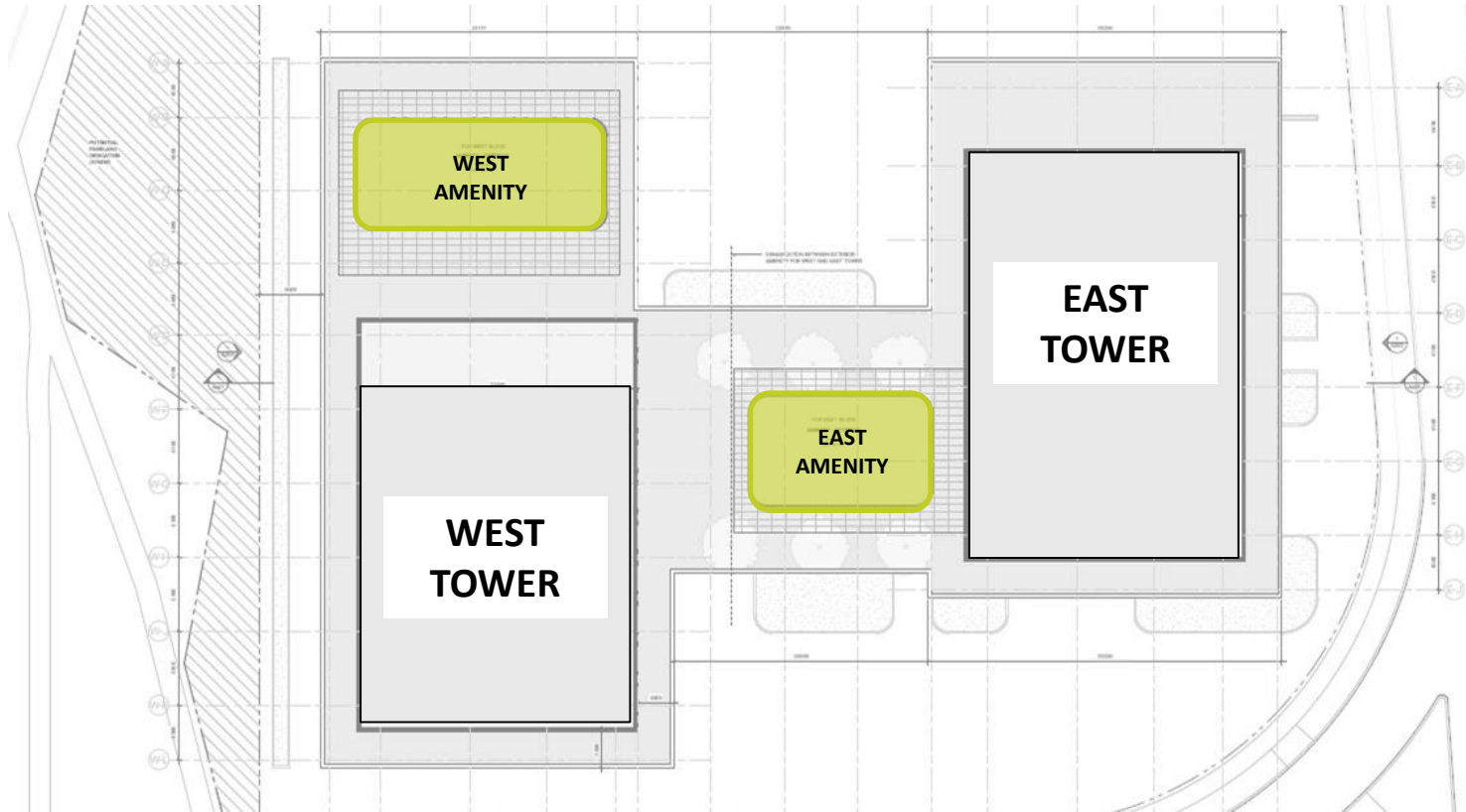
Credit: Diamond Schmitt



LEGEND

- Main Entrance
- ◆ Secondary Entrance / Exit
- Open Space at-grade

Figure 4a: Areas of Interest - Grade



LEGEND

 Outdoor Amenity Space

Figure 4b: Areas of Interest – Level 7

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 or with alternative built forms.

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 Diamond Schmitt on February 4 and 22, 2022. A view of the 3D model used in the computer wind comfort analysis is shown in **Figure 5**. 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 and City-approved surroundings.
- **Proposed Configuration:** Proposed development with existing and City-approved 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 four seasons: Winter (January to March), Spring (April to June), Summer (July to September), and Autumn (October to December). However, only the seasonal extremes of summer and winter are discussed within the report. The results of the analysis for spring and autumn can be found in **Appendix A**.

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.

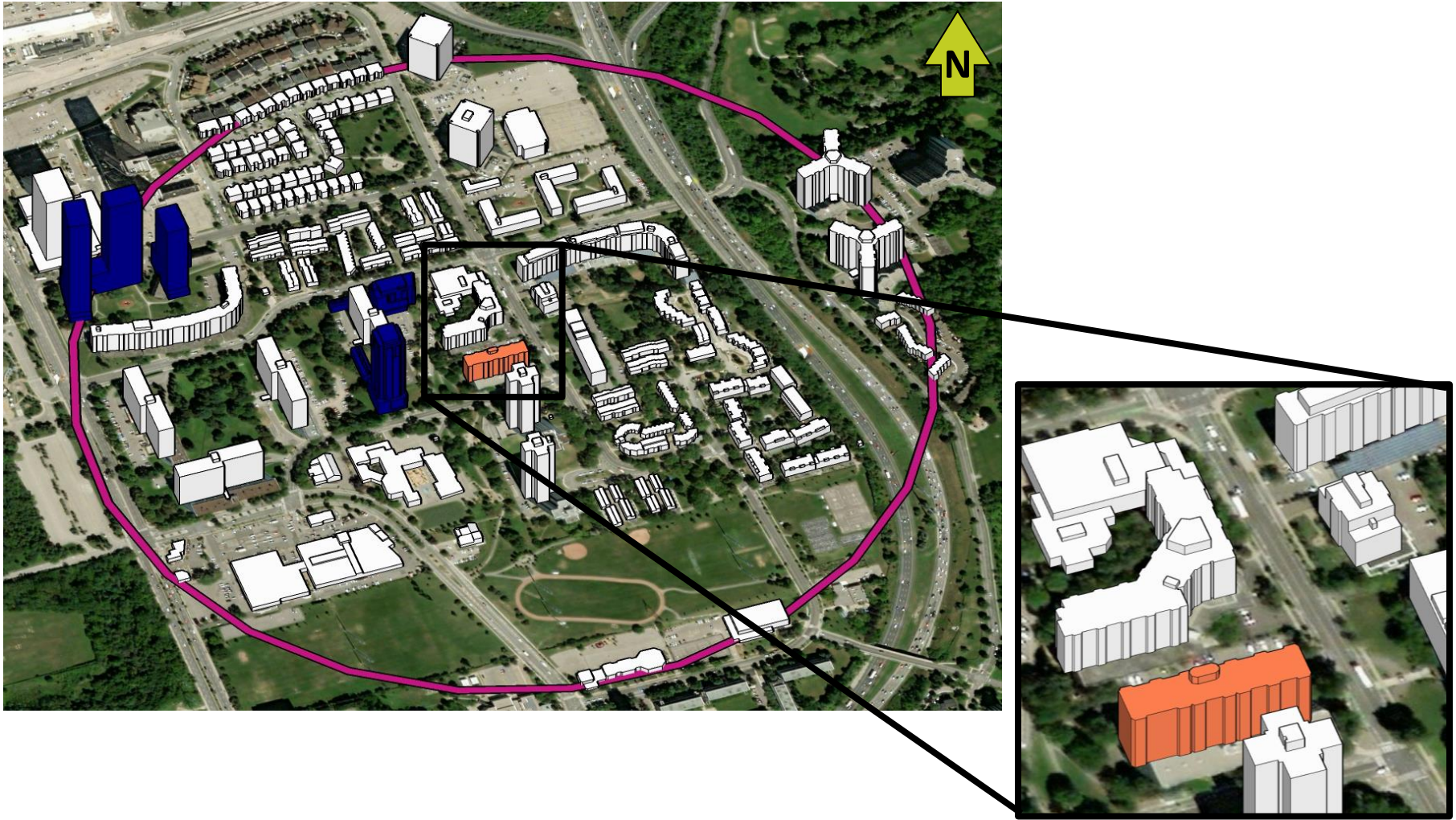


Figure 5a: Massing Model – Existing Configuration

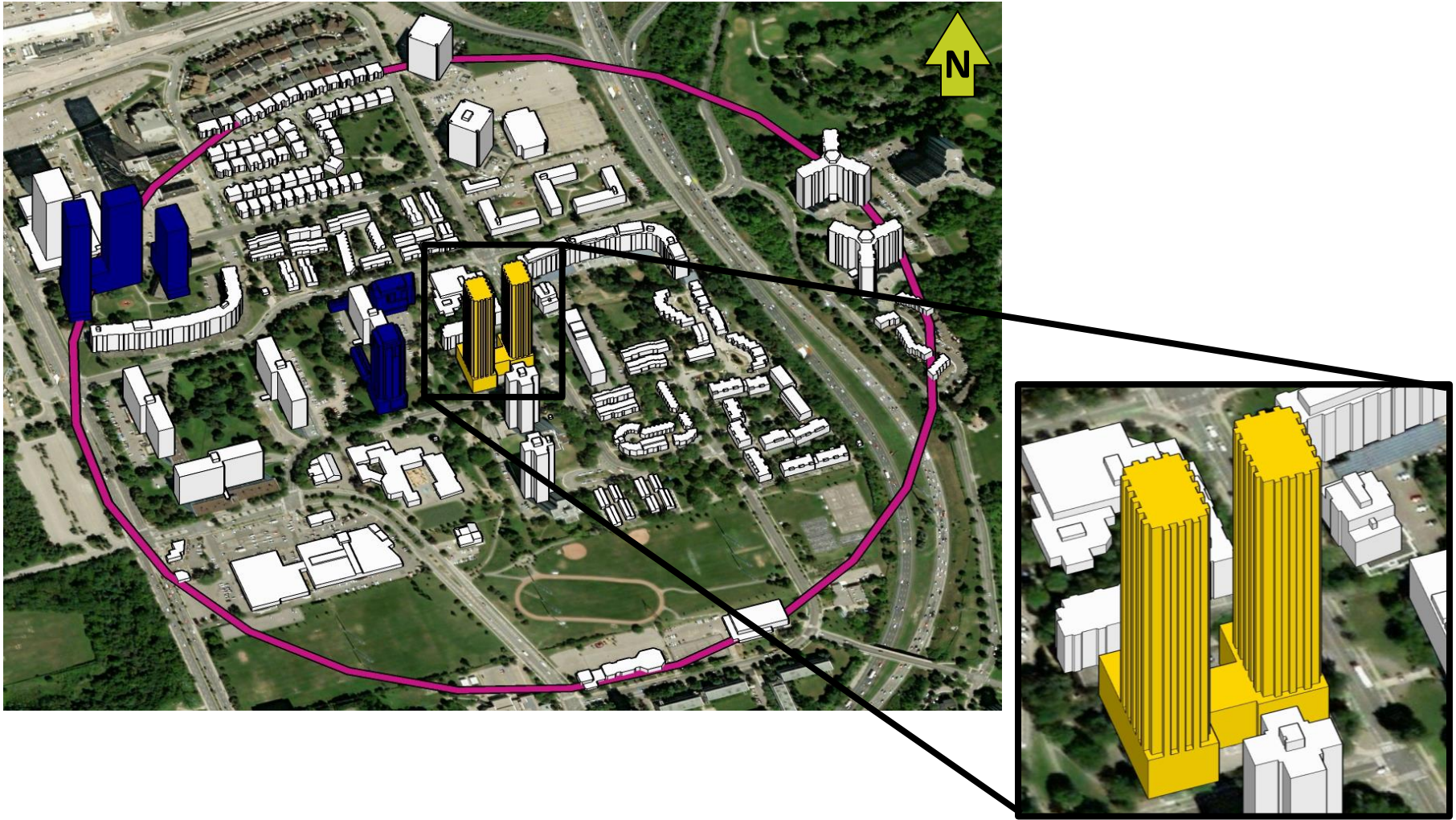


Figure 5b: Massing Model – Proposed Configuration

2.2 Wind Climate

Wind data recorded at Toronto Pearson International Airport for the period of 1991 to 2020 were obtained and analysed 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 northerly through westerly directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year.

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 northwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.

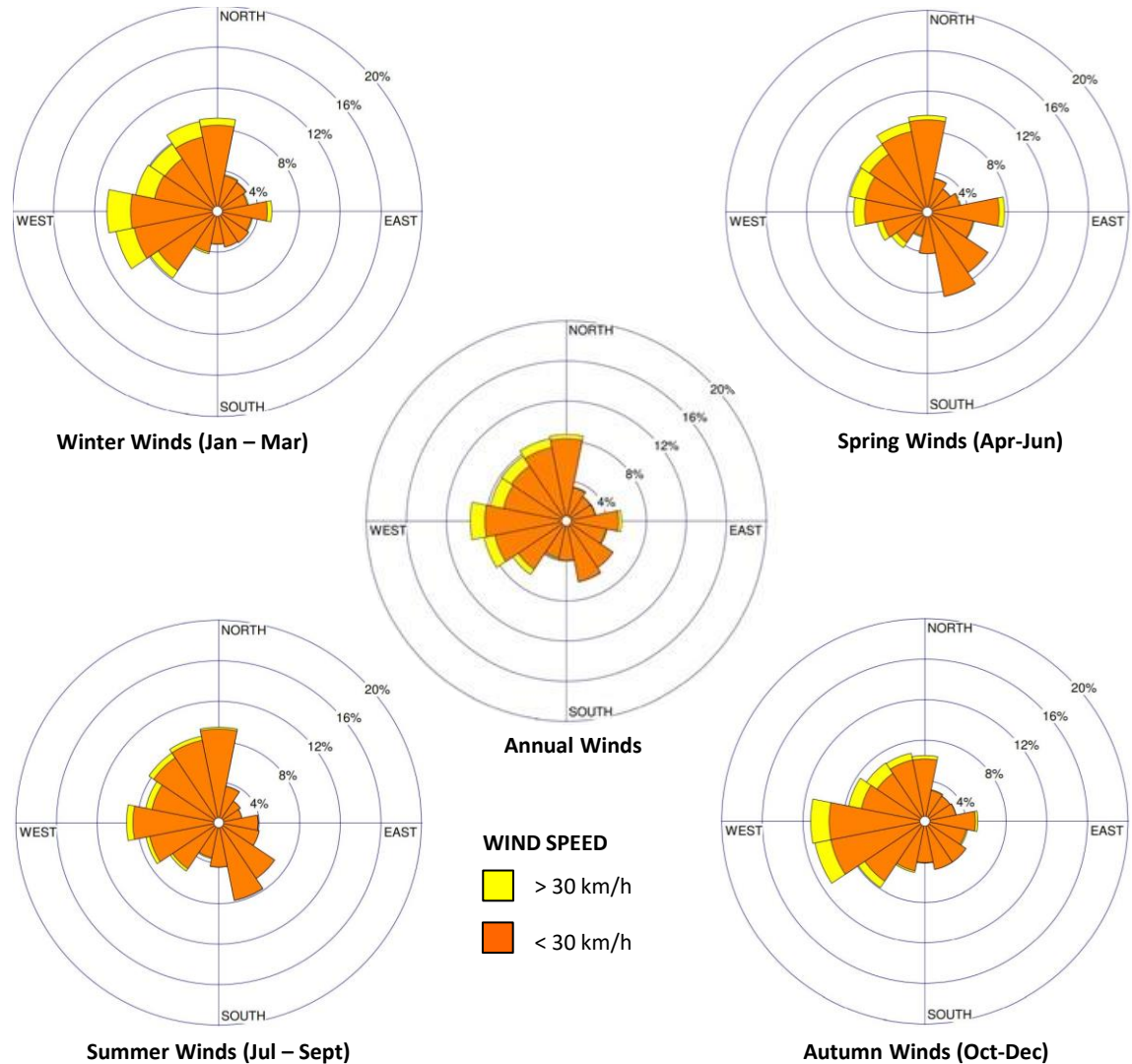


Figure 6: Wind Roses for Toronto Pearson International Airport (1991-2020)

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 comfort criteria, which are based on certain predicted hourly mean wind speeds being exceeded 5% of the time, are summarized in **Table 1**. Generally, this is equivalent to a wind event of several hours duration occurring about once per week.

The criterion for wind safety in the table is based on hourly mean wind speeds that are exceeded once per year (approximately 0.01% 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**.

The criteria for wind comfort and safety used in this assessment are similar to those developed at the Boundary Layer Wind Tunnel Lab of Western University, together with building officials in London, England. They are broadly based on the Beaufort Scale and on previous criteria that were originally developed by Davenport. Similar criteria are used by the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory for pedestrian wind study projects located around the globe. For a list of references, describing the criteria and history of its development see **Section 7.0**.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for Mean Wind Speed Exceeded 5% of the Time		Description of Wind Comfort
Sitting	0 to 14 km/h	0 to 4 m/s	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper comfortably.
Standing	0 to 22 km/h	0 to 6 m/s	Gentle breezes suitable for main building entrances and transit stops.
Leisurely Walking	0 to 29 km/h	0 to 8 m/s	Moderate breezes suitable for walking along pedestrian thorough fares.
Fast Walking	0 to 36 km/h	0 to 10 m/s	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 36 km/h	> 10 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 Mean Wind Speed Exceeded Once Per Year (0.01%)		Description of Wind Effects
Any	72 km/h	20 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 represent the seasonal extremes of best and worst case. **Appendix A** presents the wind comfort conditions for spring and autumn. 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 B** presents the wind safety conditions on an annual basis.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, in 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 leisurely walking are desirable year-round but may not be feasible in the winter. Wind conditions of fast 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 or standing year-round (**Figures 7a** and **8a**).

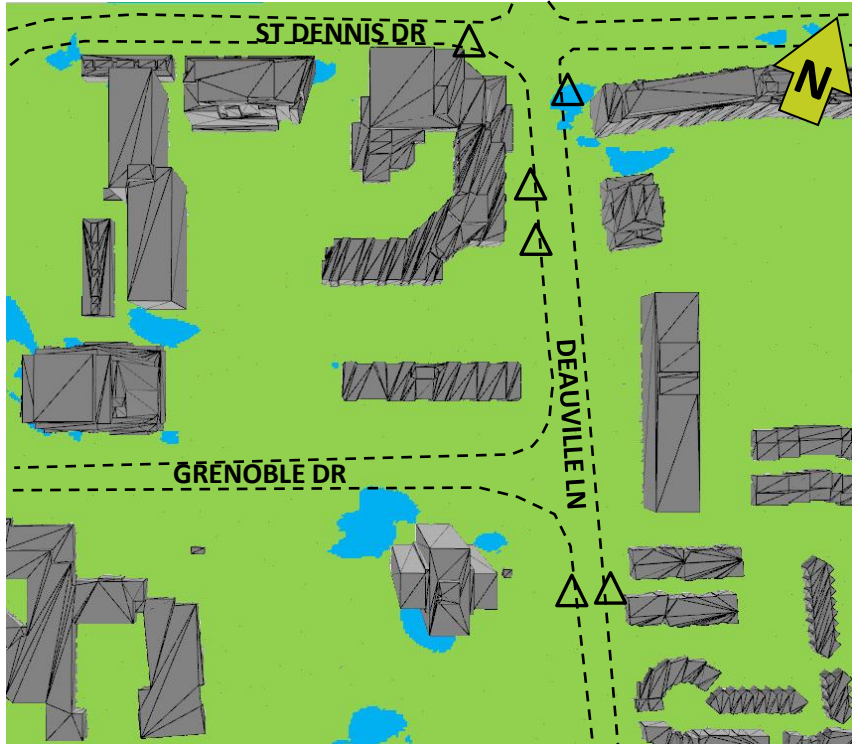
In the Proposed Configuration, wind conditions on-site are predicted to be comfortable for sitting or standing in the summer (**Figure 7b**). During the winter months, similar wind conditions are predicted, with the exception of a few building corners, where wind conditions conducive to leisurely walking are expected (**Figure 8b**). These conditions are considered suitable for the intended use.

Wind conditions at the main entrances and all other secondary entrances and exits are predicted to be comfortable for sitting or standing throughout the year, which is considered suitable for the intended use (**Figures 9a** and **9b**).

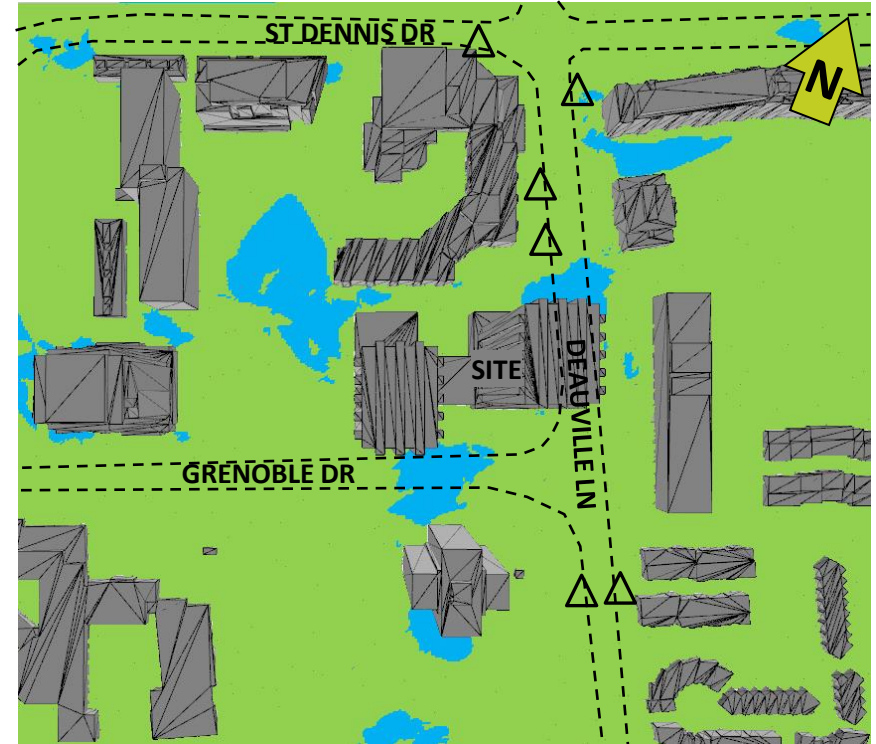
4.2 Open Space at-grade

In the parkland, on the west side of the proposed development, wind conditions are anticipated to be comfortable for sitting or standing the summer (**Figure 9a**). During the winter months, wind conditions are predicted to be comfortable for leisurely walking or better, which is windier than desired for passive activities (**Figure 9b**). We suggest including marcescent landscaping and/or vertical wind screens (i.e., fences) near the north and west edges of the parkland.

Wind conditions in the proposed POPS area near the intersection of Grenoble Drive and Deauville Lane, and the amenity space between the towers at grade are generally predicted to be comfortable for sitting or standing year-round, which is considered suitable for the intended use (**Figures 9a** and **9b**).



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



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

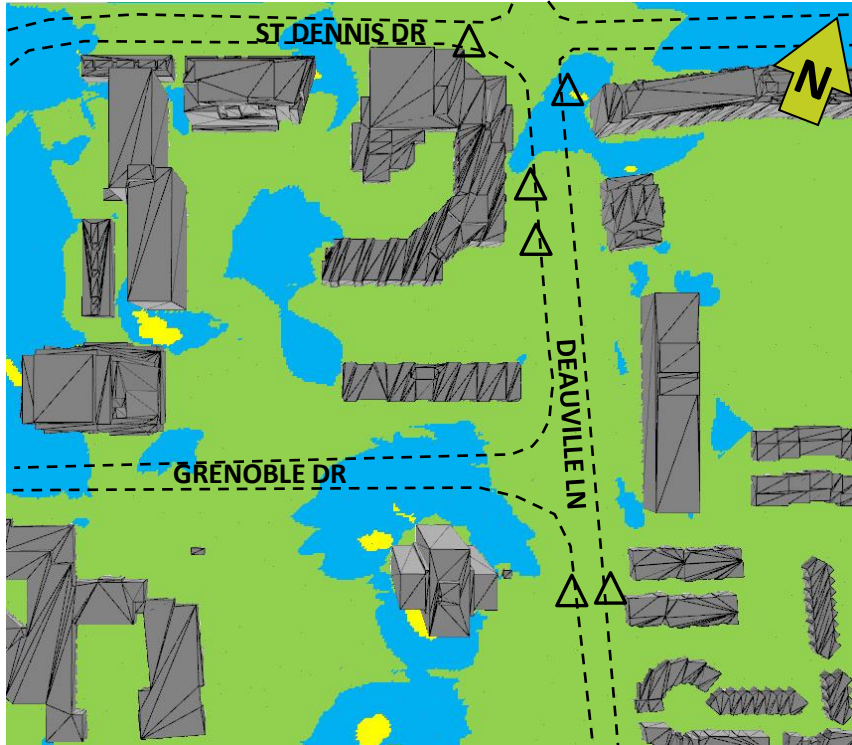


Figure 8a: Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

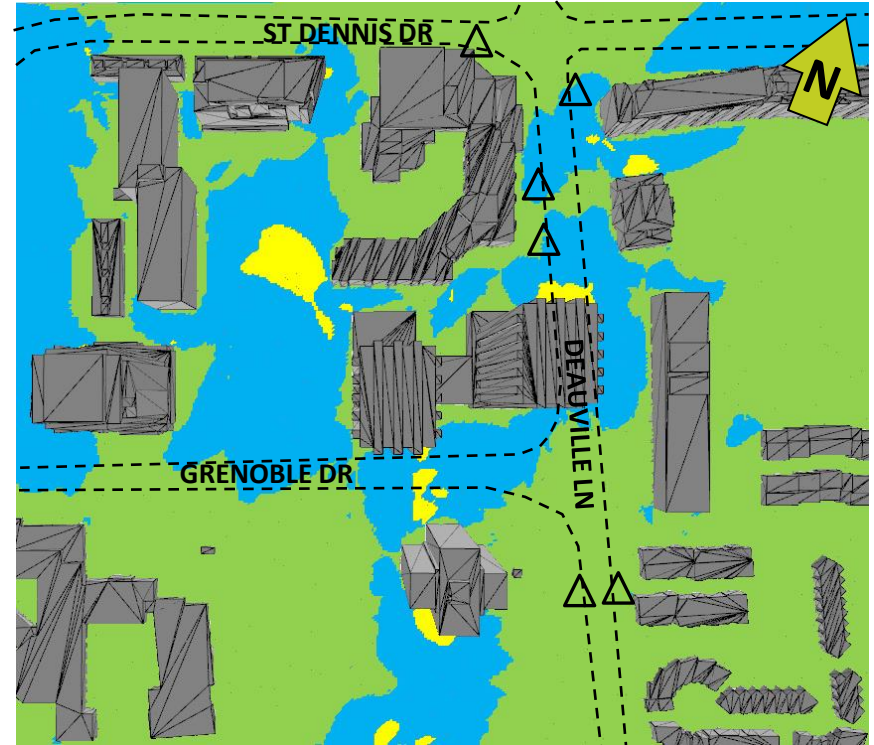


Figure 8b: Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

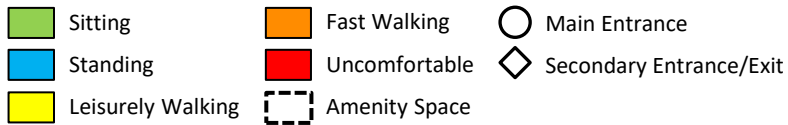
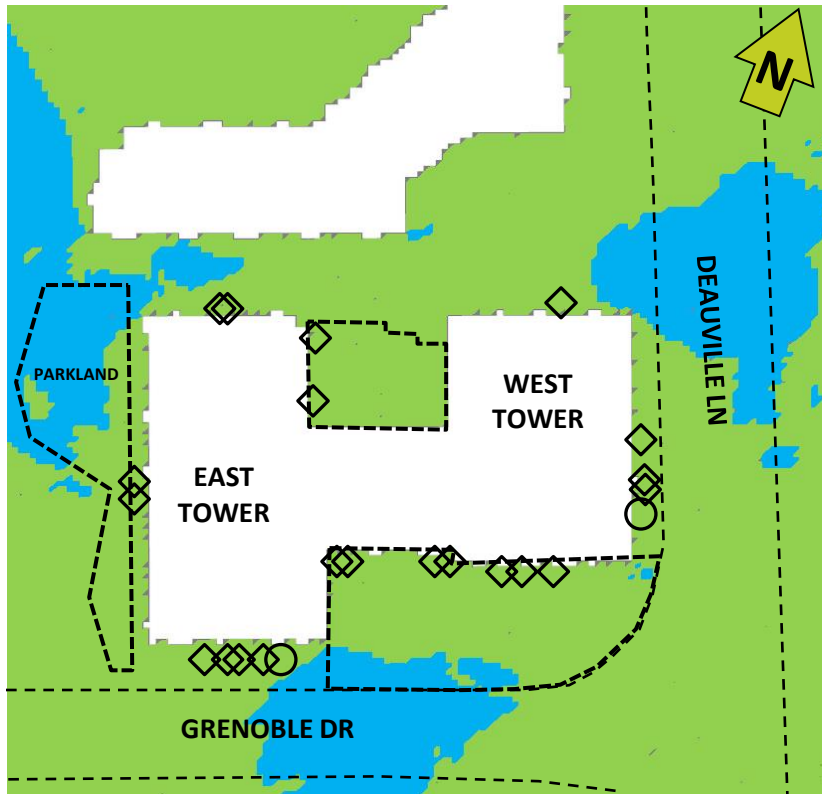


Figure 9a: Proposed Configuration – Pedestrian Wind Comfort Summer – Building Entrances & Walkways

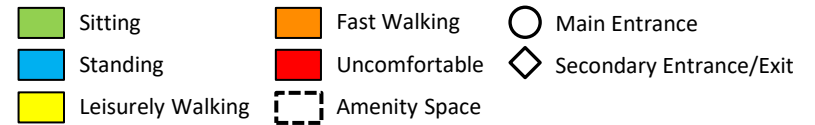
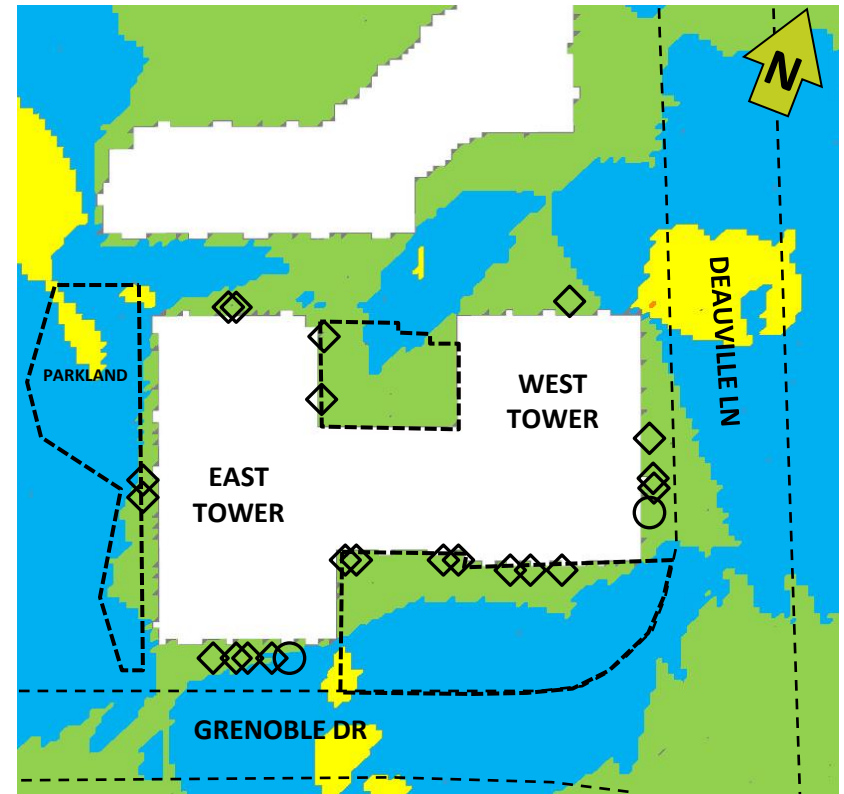


Figure 9b: Proposed Configuration – Pedestrian Wind Comfort Winter – Building Entrances & Walkways



Figure 10a: Proposed Configuration – Pedestrian Wind Comfort
Summer – Amenity Terraces – Level 7

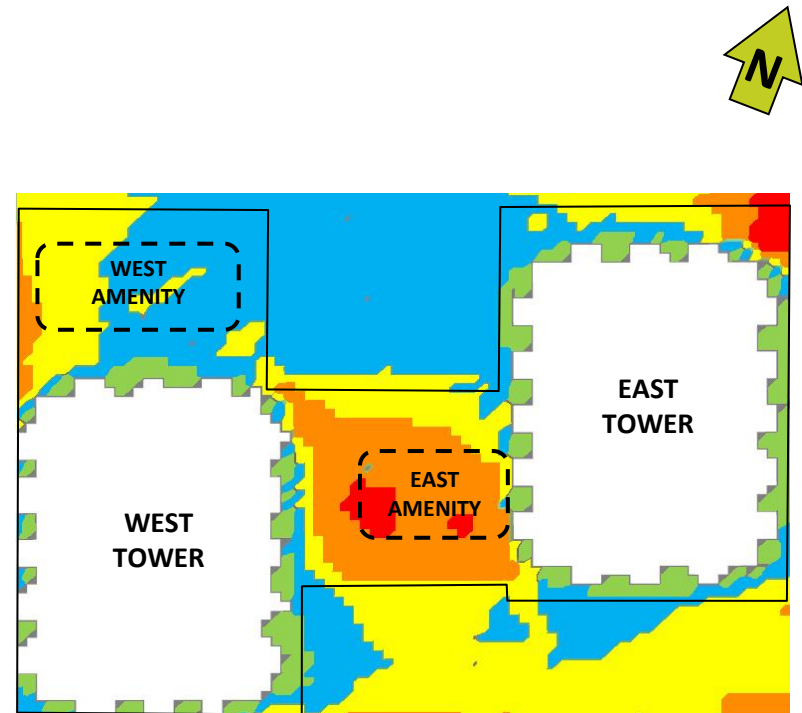


Figure 10b: Proposed Configuration – Pedestrian Wind Comfort
Winter – Amenity Terraces – Level 7

4.3 Amenity Terraces

At Level 7, wind conditions in the west amenity terrace are predicted to be comfortable for leisurely walking or better throughout the year (**Figures 10a and 10b**). Wind conditions on the east amenity terrace are generally predicted to be comfortable for fast walking or better year-round. Uncomfortable wind conditions are predicted on portions of the east terrace during the winter (**Figure 10b**). These conditions are considered windier than desired for passive activities.

Strong wind flows on the amenity terraces are due to overall exposure of the development to the northwesterly and westerly winds. Winds from the northwest downwash off the East Tower's facade and are intercepted by the podium. In addition, for the east amenity terrace, these wind flows channel through the gap between the towers, creating local accelerations. We recommend adding tall perimeter screens (minimum 2.2 m in height) around the edges of both terraces. For the east terrace, additional wind control measures in the form of pergolas, trellises and/or vertical wind screens should be considered for seating areas. SLR can work with the design team to refine these wind control measures prior to the next submission.

4.4 Surrounding Sidewalks

Existing wind conditions along the sidewalks of Grenoble Drive, Deauville Lane and St. Dennis Drive are expected to be comfortable for leisurely walking or better year-round. Wind conditions at the transit stops along Deauville Lane and St. Dennis Drive are expected to be comfortable for sitting or standing throughout the year (**Figures 7a and 8a**).

With the proposed development in place, wind conditions are predicted to remain suitable for leisurely walking or better throughout the year on the surrounding sidewalks. Wind conditions at the nearby transit stops are expected to remain similar to the existing wind conditions (**Figures 7b and 8b**).

These wind conditions are satisfactory for the anticipated use.

4.5 Wind Safety

The wind safety criterion is predicted to be met at all areas, at grade and above grade, on an annual basis for both the Existing and Proposed Configurations (**Appendix B**).

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 48 Grenoble Drive in Toronto have been assessed through computational fluid dynamics modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met at all areas on-site and surrounding the development in both the Existing and Proposed Configurations.
- At grade, Wind conditions on most of the site, including entrances, are generally expected to be suitable for the intended use year-round. Wind control measures are suggested for potential parkland area to the west to address windier than desired conditions in the winter months.
- The amenity terraces at Level 7 are predicted to be windier than desired for passive activities. Wind control measures are recommended on the terraces.
- On the sidewalks surrounding the proposed development, wind conditions are suitable for the intended use.

6.0 ASSESSMENT APPLICABILITY

This assessment is based on computer modeling techniques and provides a qualitative overview of the pedestrian wind comfort conditions on and surrounding the proposed development site. Any subsequent alterations to the design may influence these findings, possibly requiring further review by SLR. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,

SLR Consulting (Canada) Ltd.



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Specialist – Microclimate

7.0 REFERENCES

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Appendix A

Pedestrian Wind Comfort Analysis

Spring (April – June) and Autumn (October – December)

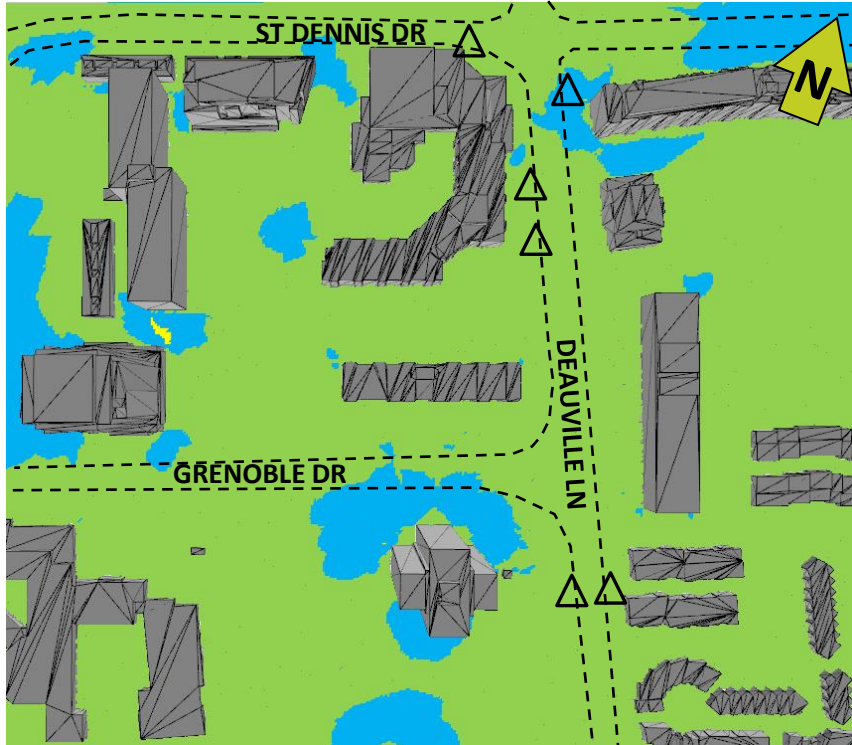


Figure A1a: Existing Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas

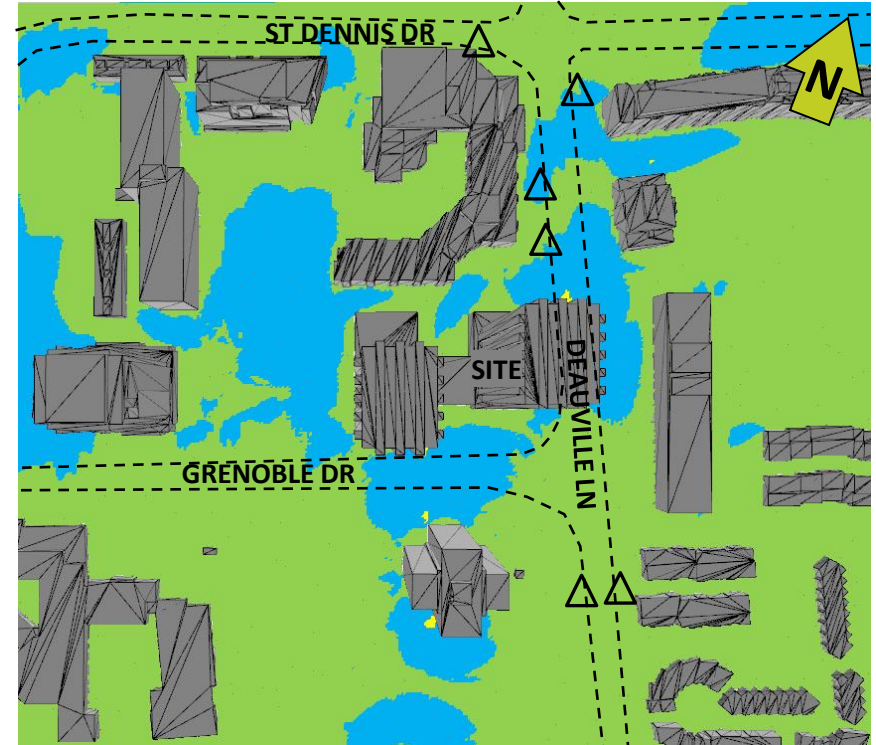
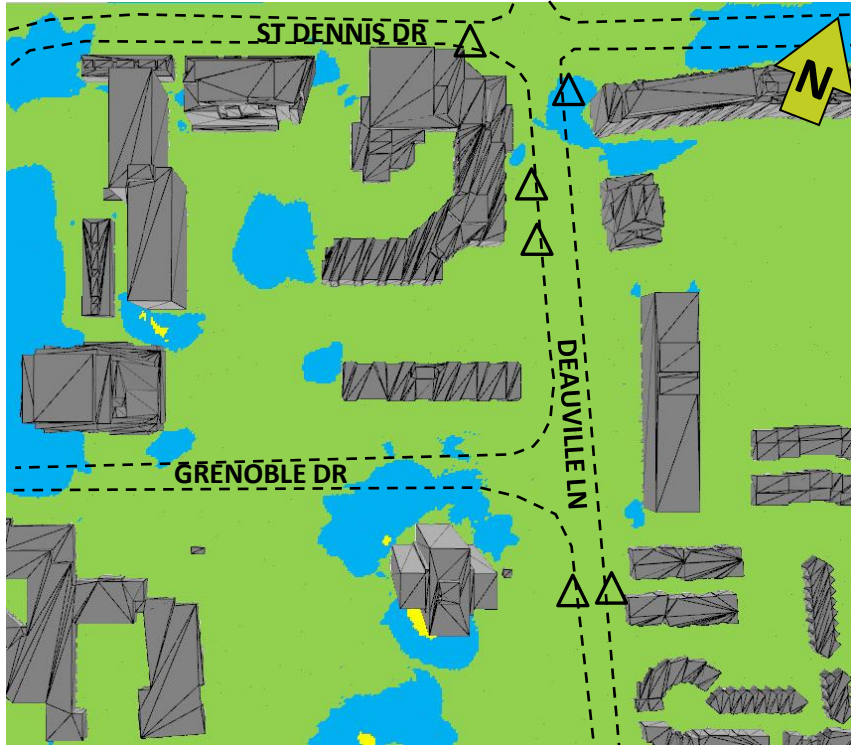
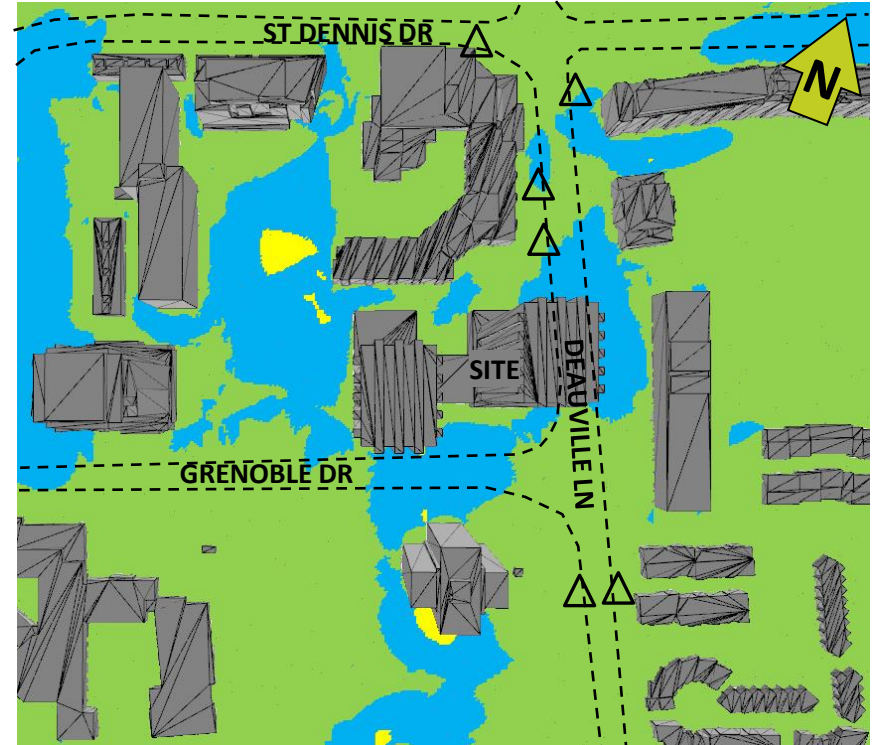


Figure A1b: Proposed Configuration – Pedestrian Wind Comfort Spring – On-site & Surrounding Areas



**Figure A2a: Existing Configuration – Pedestrian Wind Comfort
Autumn – On-site & Surrounding Areas**



**Figure A2b: Proposed Configuration – Pedestrian Wind Comfort
Autumn – On-site & Surrounding Areas**

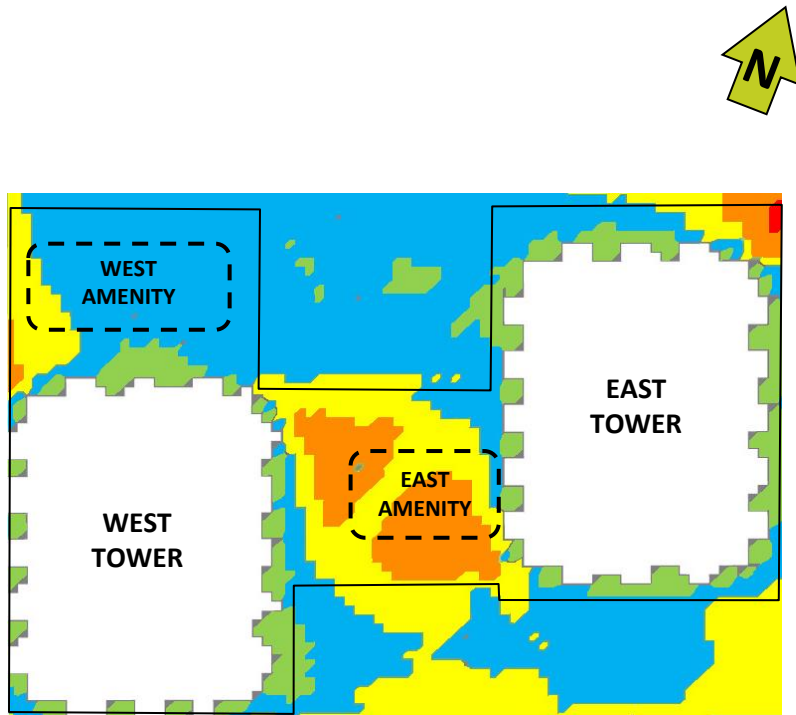


Figure A3a: Proposed Configuration – Pedestrian Wind Comfort
Spring – Amenity Terraces – Level 7

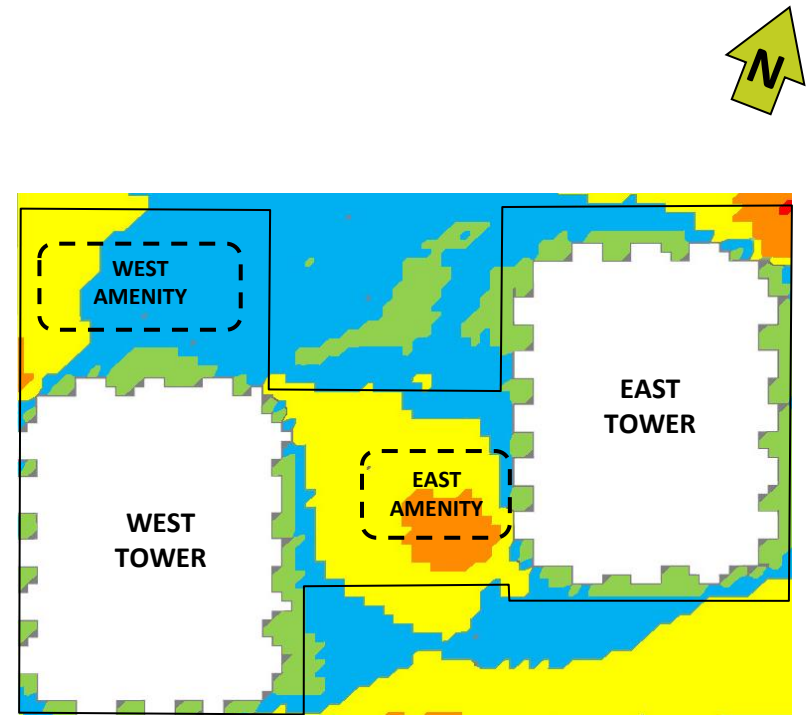
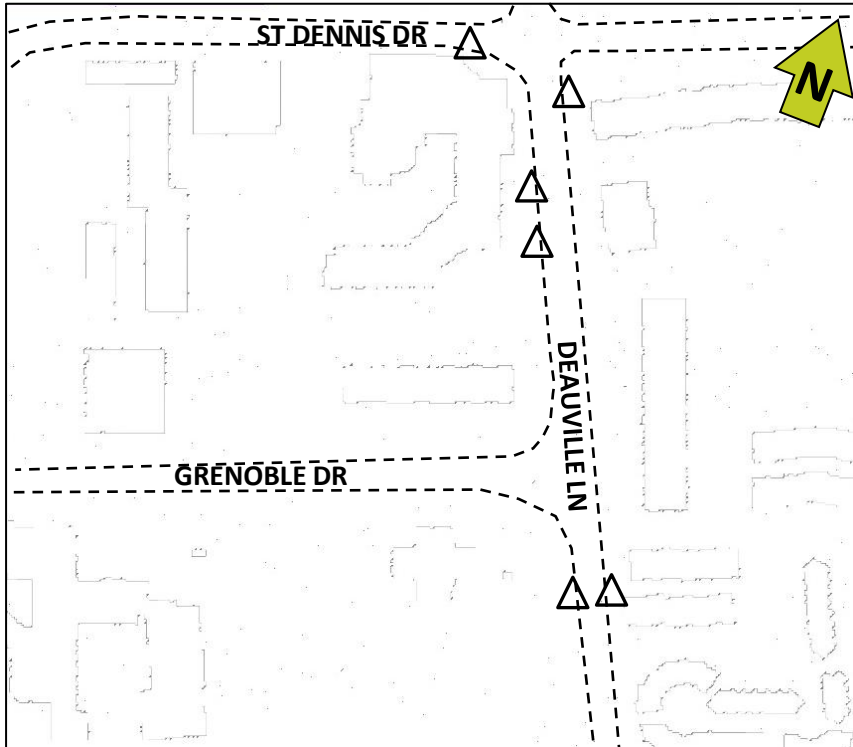


Figure A3b: Proposed Configuration – Pedestrian Wind Comfort
Autumn – Amenity Terraces – Level 7

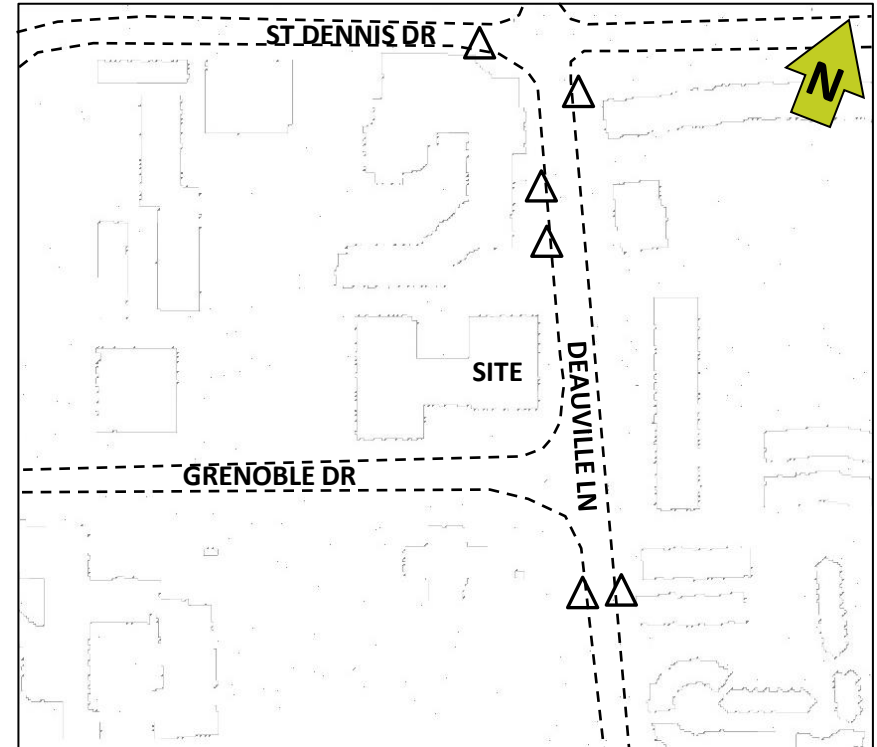
Appendix B

Pedestrian Wind Safety Analysis

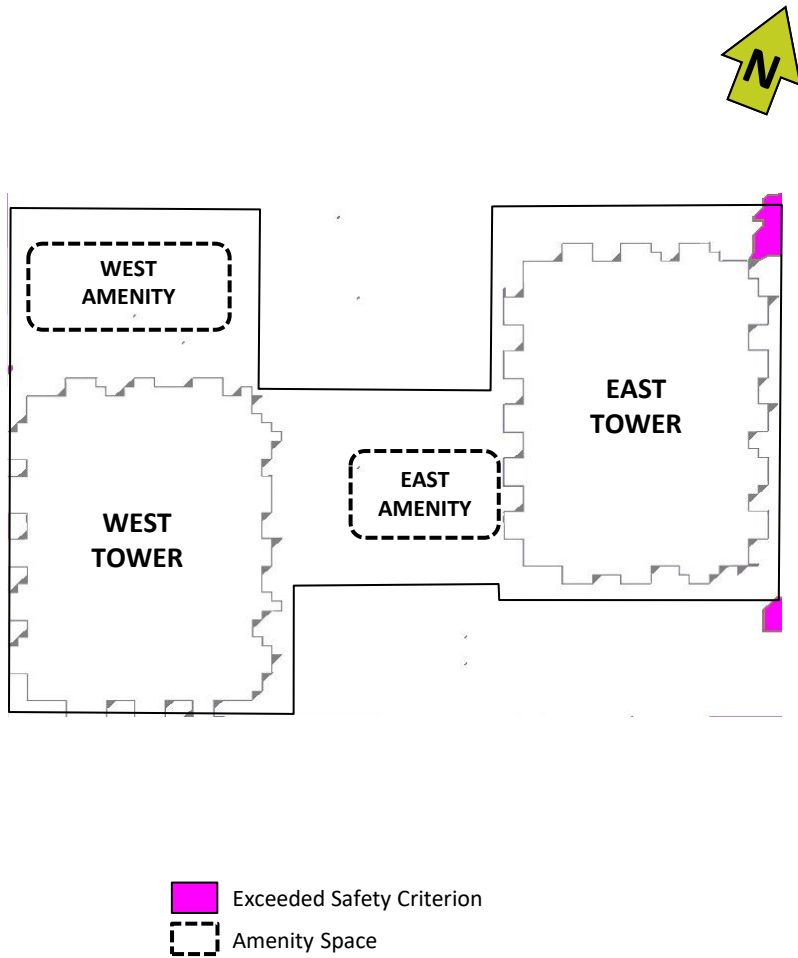
Annual



**Figure B1a: Existing Configuration – Wind Safety
Annual – On-site & Surrounding Areas**



**Figure B1b: Proposed Configuration – Wind Safety
Annual – On-site & Surrounding Areas**



**Figure B2a: Proposed Configuration – Pedestrian Wind Comfort
Summer – Amenity Terraces – Level 7**