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**Date:** April 13, 2018

**To:** United Burlington Retail Portfolio Inc.
986 St. Clair Avenue West
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**Re:** **Pedestrian Wind Assessment**
**5353 Lakeshore Road**
**Burlington, Ontario**
**Novus Project #17-0408**






**Novus Team:**

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# TABLE OF CONTENTS

1.0 Introduction ..... 2
1.1 Existing Development ..... 2
1.2 Proposed Development ..... 4
1.3 Areas of Interest ..... 4
2.0 Approach ..... 6
2.1 Methodology ..... 6
2.2 Wind Climate ..... 8
3.0 Pedestrian Wind Criteria ..... 9
4.0 Results ..... 10
4.1 Existing Wind Conditions ..... 10
4.2 Proposed Development Building Entrances & Walkways 10
4.3 Amenity Terraces ..... 14
4.4 Surrounding Sidewalks ..... 14
4.5 Wind Safety ..... 15
5.0 Conclusions & Recommendations ..... 16
6.0 Assessment Applicability ..... 16
7.0 References ..... 17
Appendix A ..... 18

# 1.0 INTRODUCTION

Novus Environmental Inc. (Novus) was retained by United Burlington Retail Portfolio Inc. to conduct a pedestrian wind assessment for the 5353 Lakeshore Road development in Burlington, Ontario. This report is in support of the Official Planning Amendment (OPA) and Zoning By-Law Amendment (ZBA) application for the project.

## 1.1 Existing Development

The proposed development is located at 5353 Lakeshore Road, between Kenwood Avenue and Hampton Heath Road. The site is currently occupied by a one storey commercial building with a large parking lot. **Figure 1** provides an aerial view of the immediate study area. Novus also reviewed Google Earth images dated May and June 2017; images are included in **Figures 2a** through **2d**.

Immediately surrounding the site are low-rise residential buildings to the southwest through northwest, as well as to the north and northeast. To the north is the Skyway Arena and Park. To the east is Burloak Park, while to the southeast and south there are mid-rise residential building along Lake Ontario. Beyond the immediate surroundings there are low-rise residential buildings to the southwest through northwest through northeast, with Lake Ontario to the east through south.

Approved developments and developments under construction in the surrounding area would be included as existing surroundings for the analysis. No such developments were found within a 500m radius of the proposed development.




**Figure 1: Aerial view of existing site and surroundings**
*Credit: Google Earth Pro™, dated October 9, 2016*

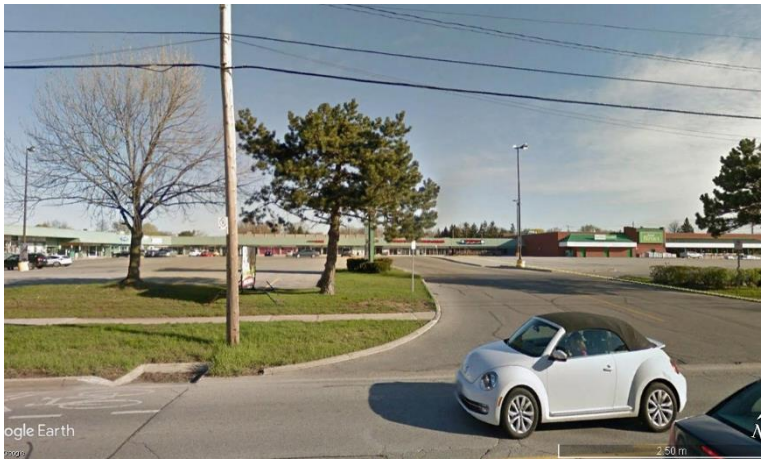


**Figure 2a: Looking northwest at existing site**



**Figure 2b: Looking northwest along Hampton Heath Road**

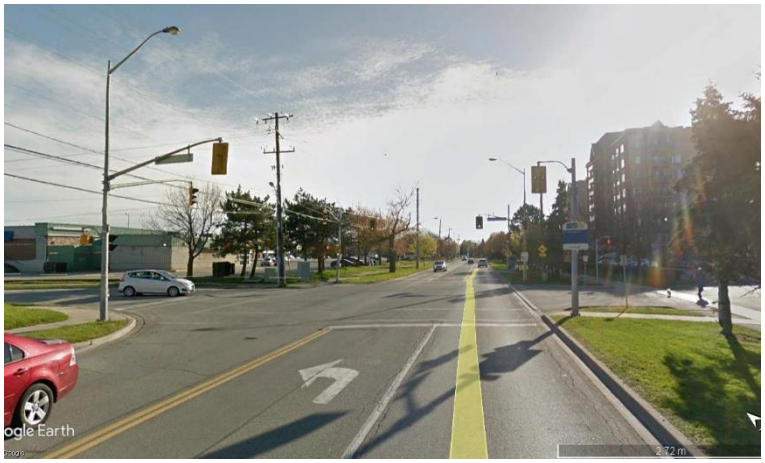


**Figure 2c: Looking northeast along Lakeshore Road**

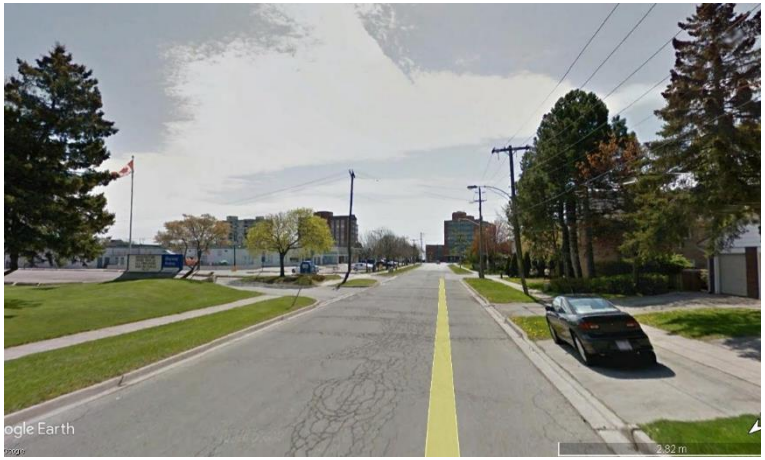


**Figure 2d: Looking southeast along Kenwood Avenue**

## 1.2 Proposed Development

The proposed development includes five phases. These include:

- **Phase 1:** A six-storey residential building at the northwest corner of the site (Block B).
- **Phase 2:** A one-storey restaurant (Block A), as well as two towers atop a six-storey podium. The towers are 14-storeys (Block E) and 18-storeys (Block F) in total height. These are located at the southwest corner of the site.
- **Phase 3:** A one-storey grocery store connected to a four-storey retail/office building (Block I) at the northeast corner of the site.
- **Phase 4:** Two towers atop a four-storey podium (Blocks C and D). The towers are each 11-storeys, and located along the north edge of the site.
- **Phase 5:** Two towers atop a six-storey podium. The towers are 18 (Block G) and 10-storeys (Block H) tall, and are located at the southeast corner of the site.

A 3D view of the proposed development is shown in **Figure 3**.



**Figure 3: 3D View of 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 two transit stops in the vicinity, along Hampton Heath Road.

Around the development, there are outdoor amenity spaces at grade as well as at the podium level between Blocks C and D, Blocks E and F and Blocks G and H. Areas of interest for pedestrian wind comfort are shown in **Figure 4**.

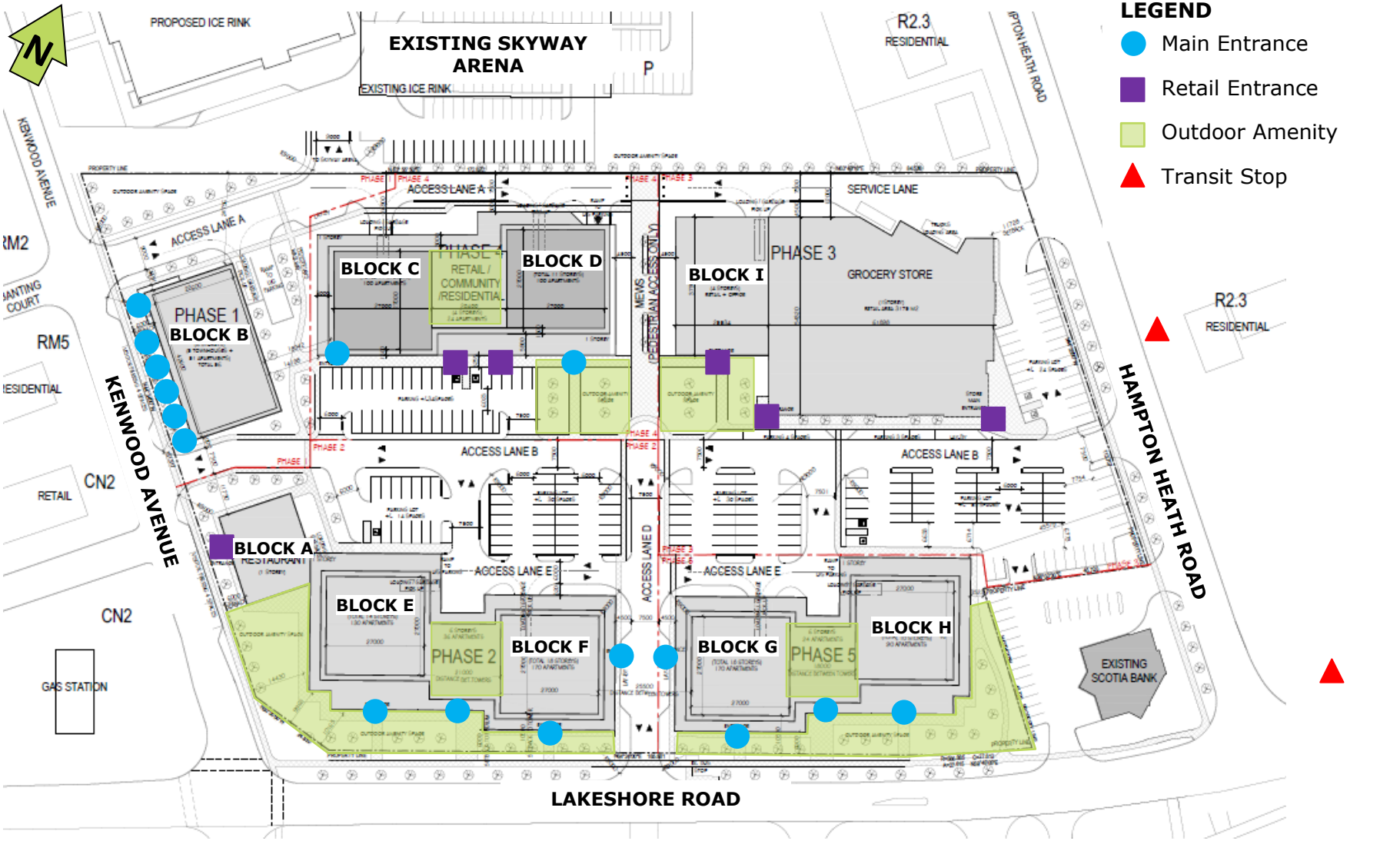



**Figure 4: Areas of Interest**

# 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 Cynthia Zahoruk Architects on February 1st and 27th, 2018. A view of the 3D model used in the computer wind comfort analysis is shown in **Figure 5**. This model included surrounding buildings within approximately 450 m from the study site. 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.

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.

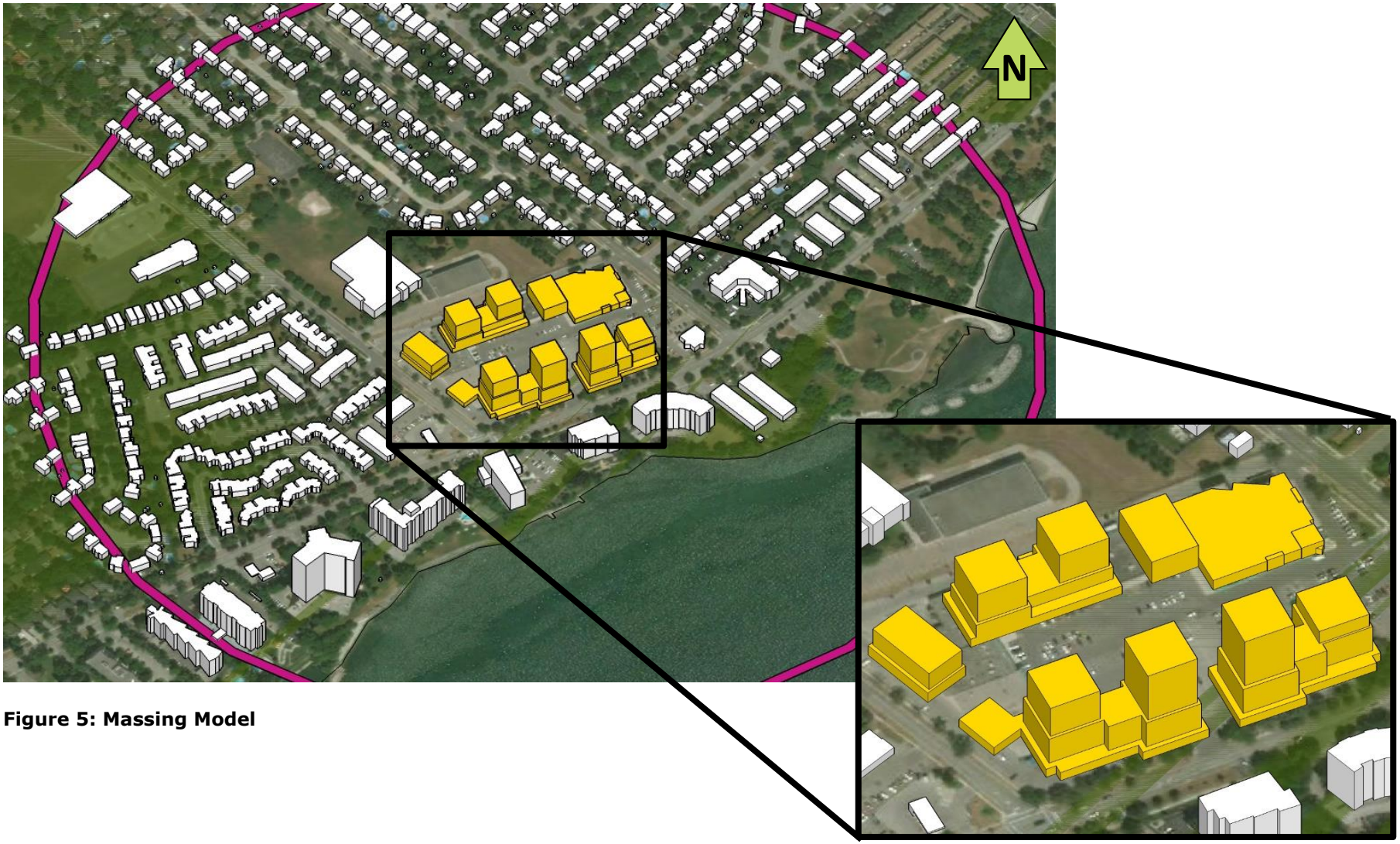



**Figure 5: Massing Model**

## 2.2 Wind Climate

Wind data recorded at Burlington Piers for the period of 1991 to 2015 were obtained and analysed to create a wind climate model for the seasonal extremes. 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 winds approaching from the southwest through west 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 building massing/alignment. 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 north-easterly and easterly directions. All wind speeds and directions were included in the wind climate model.

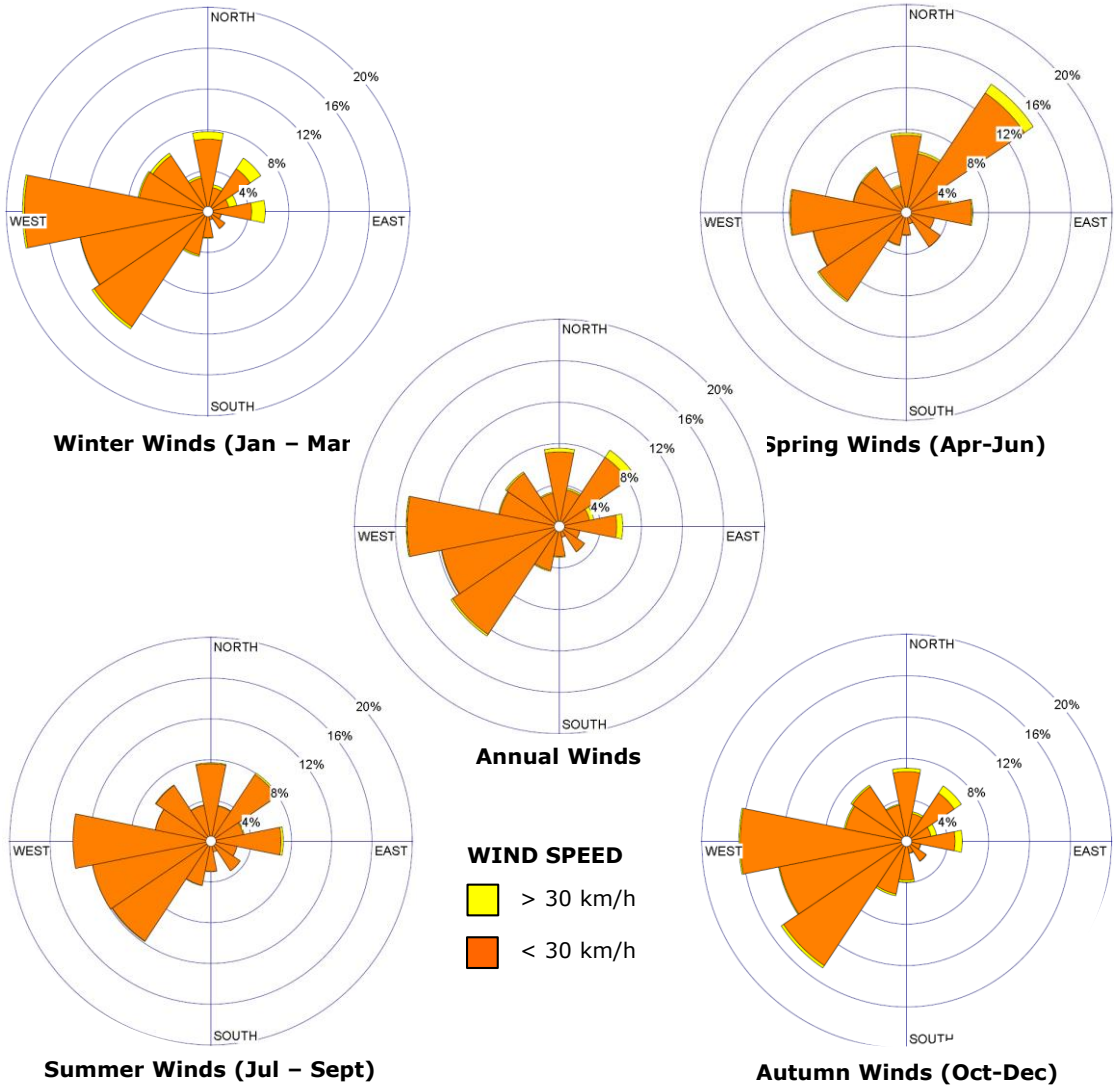



**Figure 6: Wind Roses for Burlington Piers Station (1991-2015)**

## 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**. Very roughly, 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 based on those developed at the Boundary Layer Wind Tunnel Lab of the University of Western Ontario, 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. The 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.

**Table 1: Wind Comfort Criteria**

| Activity | Comfort Ranges for Mean Wind Speed Exceeded 5% of the Time | | Description of Wind Effects |
|---|---|---|---|
| Sitting | 0 to 14 km/h | 0 to 4 m/s | • Light wind felt on face<br>• Leaves rustle |
| Standing | 0 to 22 km/h | 0 to 6 m/s | • Hair is disturbed, clothing flaps<br>• Light leaves and twigs in motion<br>• Wind extends lightweight flag |
| Leisurely Walking | 0 to 29 km/h | 0 to 8 m/s | • Moderate, raises dust, loose paper<br>• Hair disarranged<br>• Small branches move |
| Fast Walking | 0 to 36 km/h | 0 to 10 m/s | • Force of wind felt on body<br>• Trees in leaf begin to move<br>• Limit of agreeable wind on land |
| Uncomfortable | > 36 km/h | > 10 m/s | • Small trees sway<br>• Umbrella use becomes difficult |

**Table 2: Wind Safety Criterion**

| Activity | Safety Criterion Mean Wind Speed Exceeded Once Per Year (0.01%) | | Description of Wind Effects |
|---|---|---|---|
| Any [1] | 72 km/h | 20 m/s | • Difficult to walk straight<br>• Wind noise on ears unpleasant |

[1] Equivalent to the "Fair Weather Location" criterion of UWO's Criteria, which applies to frequently accessed areas.

# 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 assessment does not account for the presence of mature trees, thus wind comfort conditions for months when foliage is present could be better than those predicted.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. For example, for public sidewalks, wind comfort suitable for **leisurely walking** would be desirable year-round. For main entrances and transit stops, wind conditions conducive to **standing** would be preferred throughout the year, but can be difficult to achieve in regions where winter winds are inherently harsh. For amenity spaces, wind conditions suitable for **sitting** and/or **standing** are generally desirable during the summer months. The most stringent category of **sitting** is considered appropriate for cafes and dedicated seating areas, while for public parks **sitting** and/or **standing** would be appropriate in the summer.

## 4.1 Existing Wind Conditions

In the Existing Configuration, wind conditions on the proposed site are conducive to sitting or standing throughout the year (**Figures 7a** and **8a**). Wind conditions on the surrounding sidewalks, including Lakeshore Road, Kenwood Avenue and Hampton Heath Road, are comfortable for leisurely walking or better throughout the year.

At the nearby transit stops, wind conditions are also comfortable for sitting or standing throughout the year (**Figures 7a** and **8a**).

## 4.2 Proposed Development Building Entrances & Walkways

At all residential and retail entrances to the various buildings on site, wind conditions are comfortable for sitting or standing throughout the year (**Figures 9a** and **9b**).

In the various amenity spaces at grade-level, wind conditions are comfortable for sitting in the summer and sitting or standing during the winter (**Figures 9a** and **9b**).

On the walkways surrounding the proposed site, wind conditions are comfortable for leisurely walking or better throughout the year.

These wind conditions are considered suitable for the intended usage.

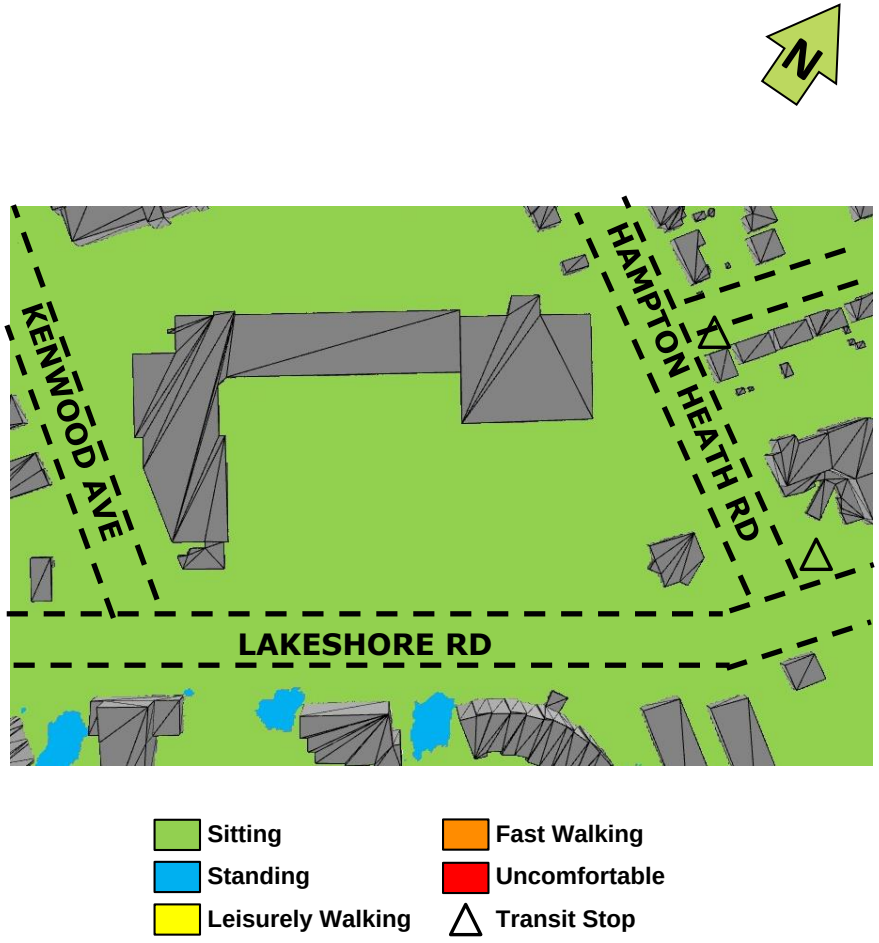



**Figure 7a: Existing Conditions – Grade Level – Summer**




**Figure 7b: Proposed Conditions – Grade Level – Summer**

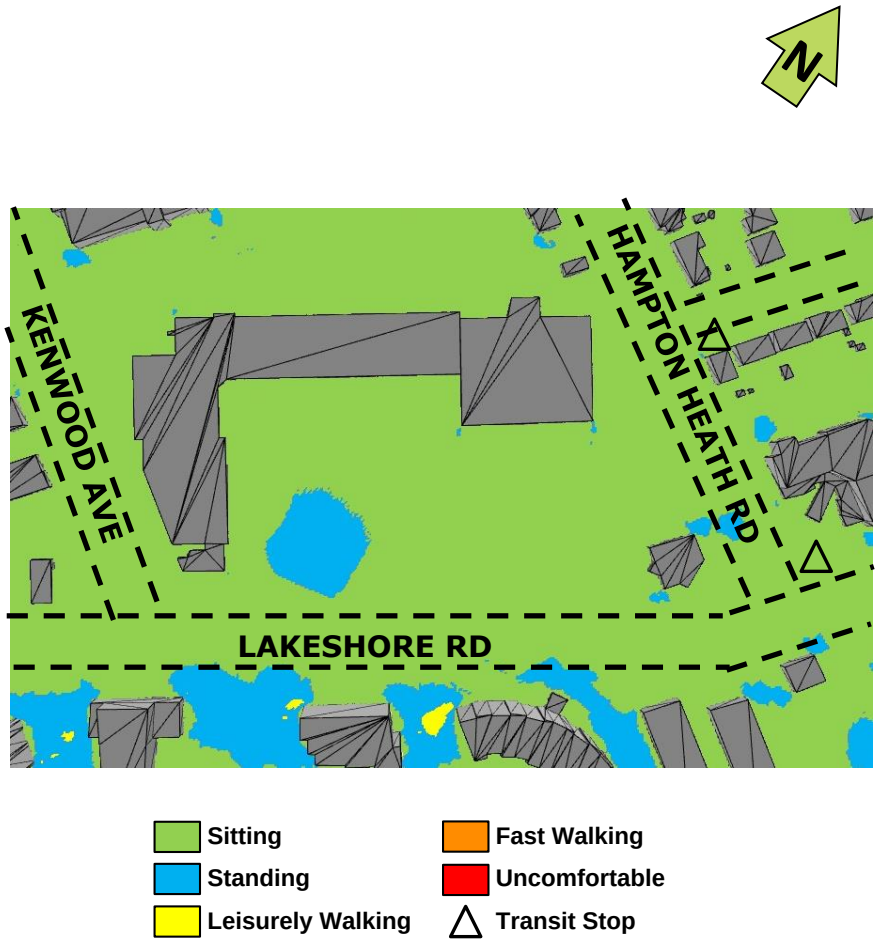



**Figure 8a: Existing Conditions – Grade Level – Winter**




**Figure 8b: Proposed Conditions – Grade Level – Winter**

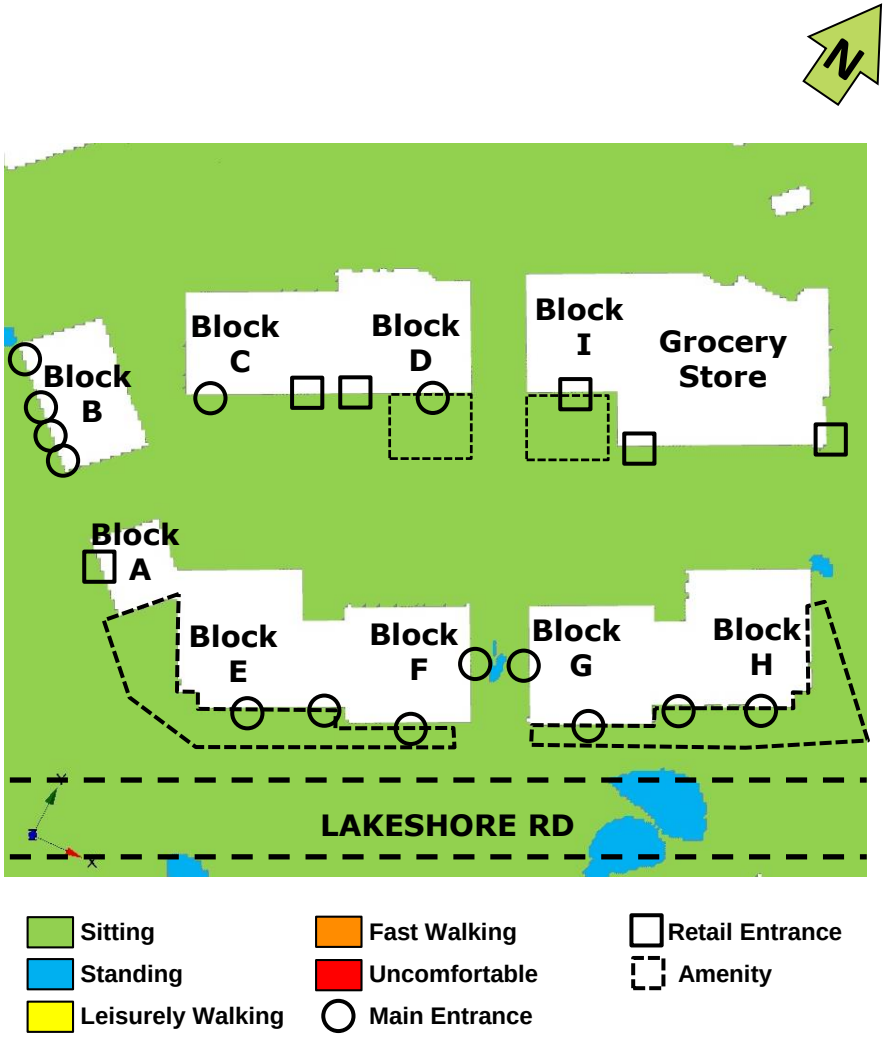



**Figure 9a: Proposed Conditions – Grade Level – Summer**

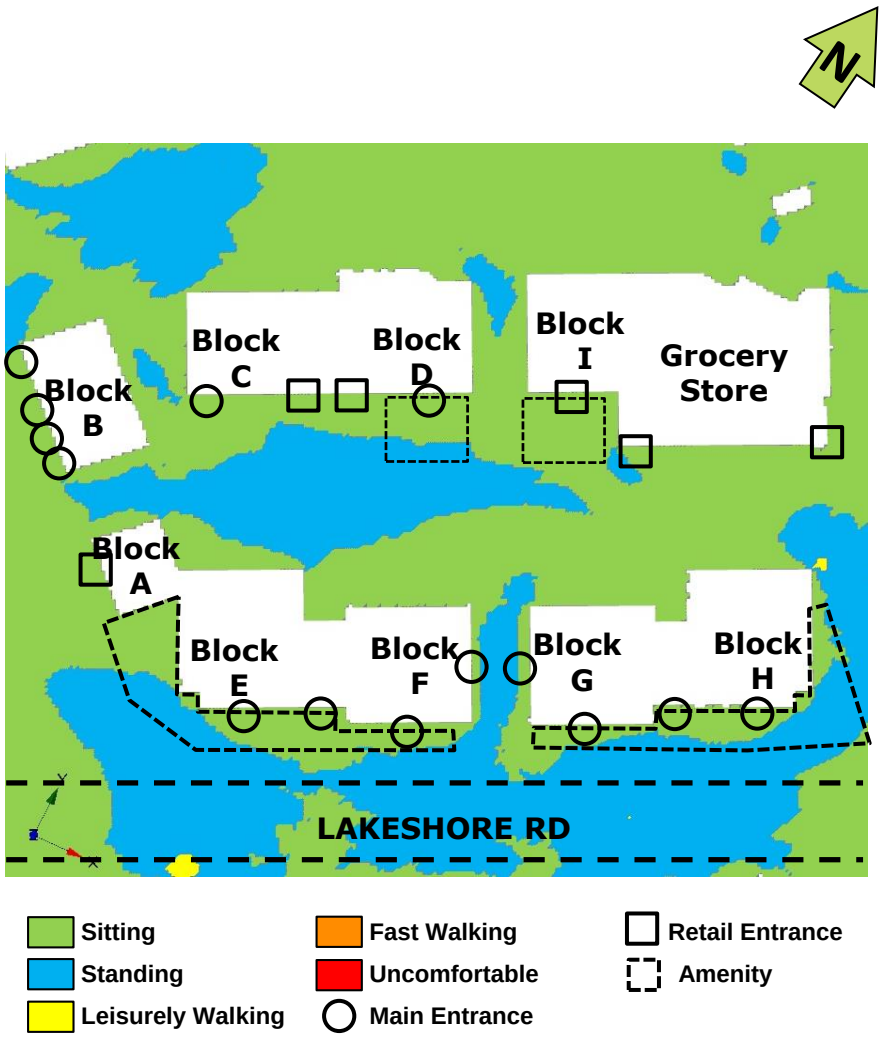



**Figure 9b: Proposed Conditions – Grade Level – Winter**

## 4.3 Amenity Terraces (Podium & Roofs)

At the above grade amenity terraces between Blocks C and D, Blocks E and F wind conditions are comfortable for sitting during the summer. On the terrace between Blocks E and F, wind conditions are comfortable sitting or standing in the summer. On this terrace, we recommend placing local screening around seating areas, or including a vertical wind screen around the perimeter of the terrace to provide protection from channeling wind flows.

During the winter, wind conditions on the terrace between Blocks C and D are comfortable for sitting or standing. On the other two terraces, wind conditions in the winter are comfortable for sitting or standing, except along the northern edge, where wind conditions are conducive to leisurely walking. It is anticipated this space will not be used during the winter season, therefore these wind conditions are not a concern.

## 4.4 Surrounding Sidewalks

Wind conditions on the surrounding sidewalks in the Proposed Configuration are generally similar to the Existing Configuration. On Lakeshore Road, Kenwood Avenue and Hampton Heath Road, wind conditions are conducive to leisurely walking or better throughout the year (**Figures 7b** and **8b**).

At the nearby transit stops, wind conditions remain comfortable for sitting or standing throughout the year.

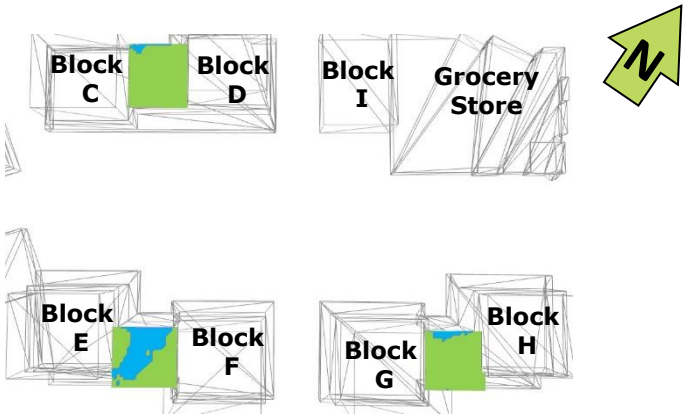



**Figure 10a: Wind Conditions on Above Grade Terraces Proposed – Summer**

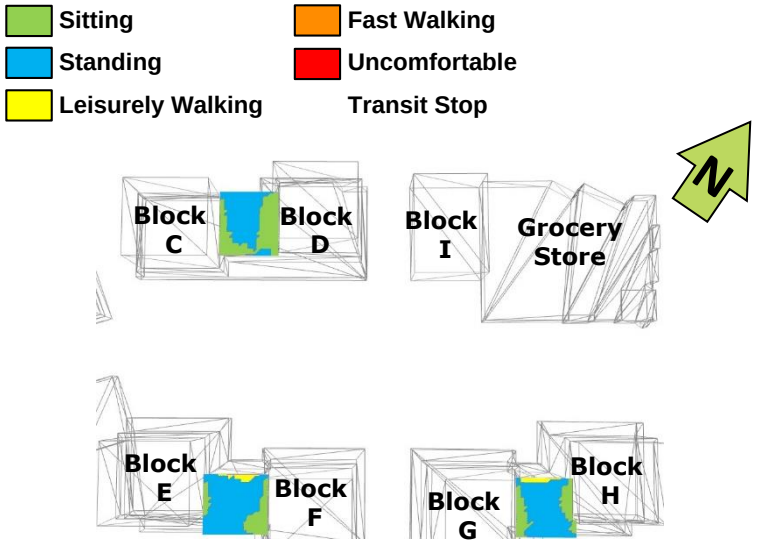



**Figure 10b: Wind Conditions on Above Grade Terraces Proposed – Winter**

## 4.5 Wind Safety

The wind safety criterion is met at grade level in both the Existing and Proposed Configurations.

However, the wind safety criterion is not met on the above-grade terrace between Blocks E and F at the southwest corner (**Figure 11**). We recommend placing a vertical wind screen around the perimeter of this terrace (as mentioned in **Section 4.3**), to provide shelter from winds channeling through this space. Management should also consider limiting access to this terrace during the winter season, when wind flows are strong.

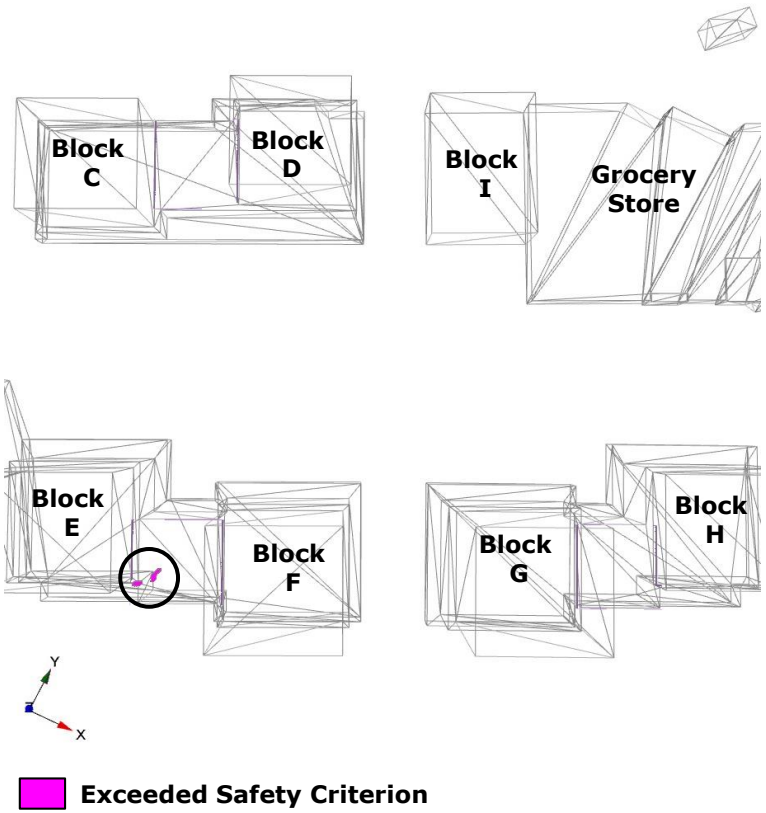



**Figure 11: Wind Safety – Proposed Configuration – Grade Level - Annual**

## 6.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 5353 Lakeshore Road have been assessed through numerical modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is met in all grade-level areas. However, it is not met on the podium terrace between Blocks E and F. Wind mitigation measures have been recommended.
- Wind conditions at all entrances, exits, grade-level amenity spaces, and walkways are suitable for the intended usage.
- In the above-grade amenity spaces, wind conditions are generally suitable for the intended usage. Recommendations have been provided for the terrace between Blocks E and F.
- On the sidewalks surrounding the proposed development, as well as at the transit stops, wind conditions are generally similar between the Existing and Proposed Configurations. These wind conditions are suitable for the intended usage.
- Additional testing can be conducted at the detailed design stage to ensure that the recommended mitigation measures are sufficient.

## 7.0 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 Novus.

Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,
**Novus Environmental Inc.**





Jenny Vesely, P. Eng.
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Tahrana Lovlin, MAES, P.Eng.
Specialist - Microclimate

## 7.0 REFERENCES

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# Appendix A

Pedestrian Wind Comfort Analysis

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

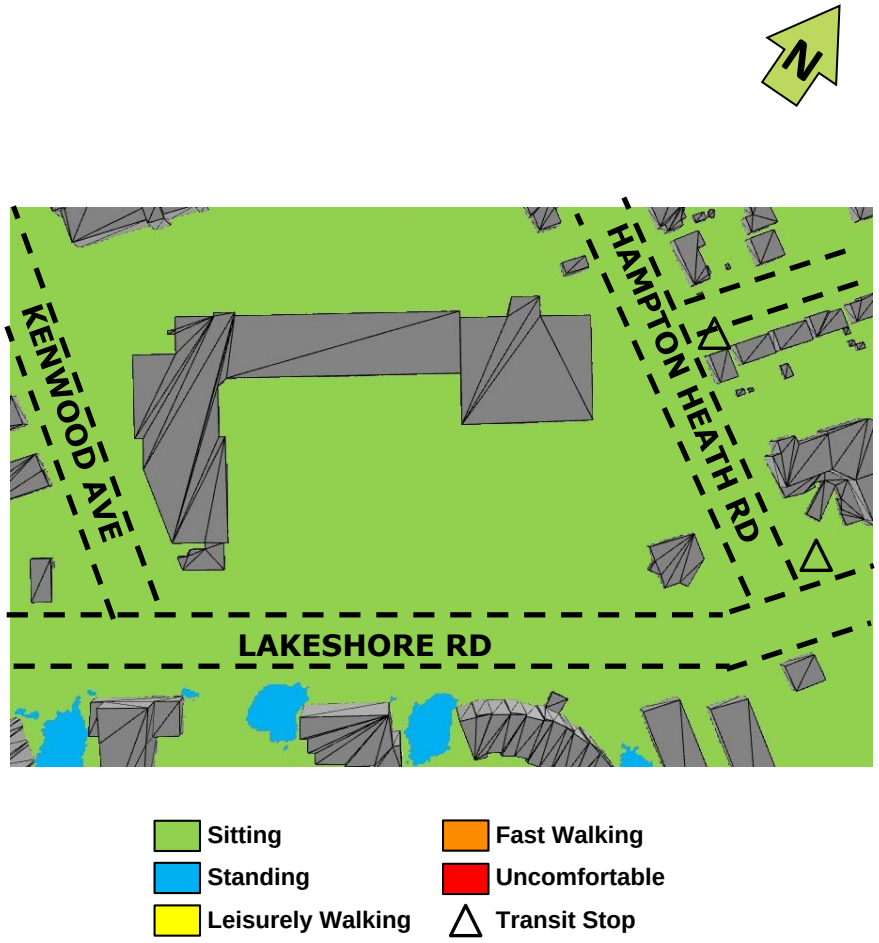



**Figure A1a: Existing Configuration – Grade – Spring**




**Figure A1b: Proposed Configuration – Grade – Spring**

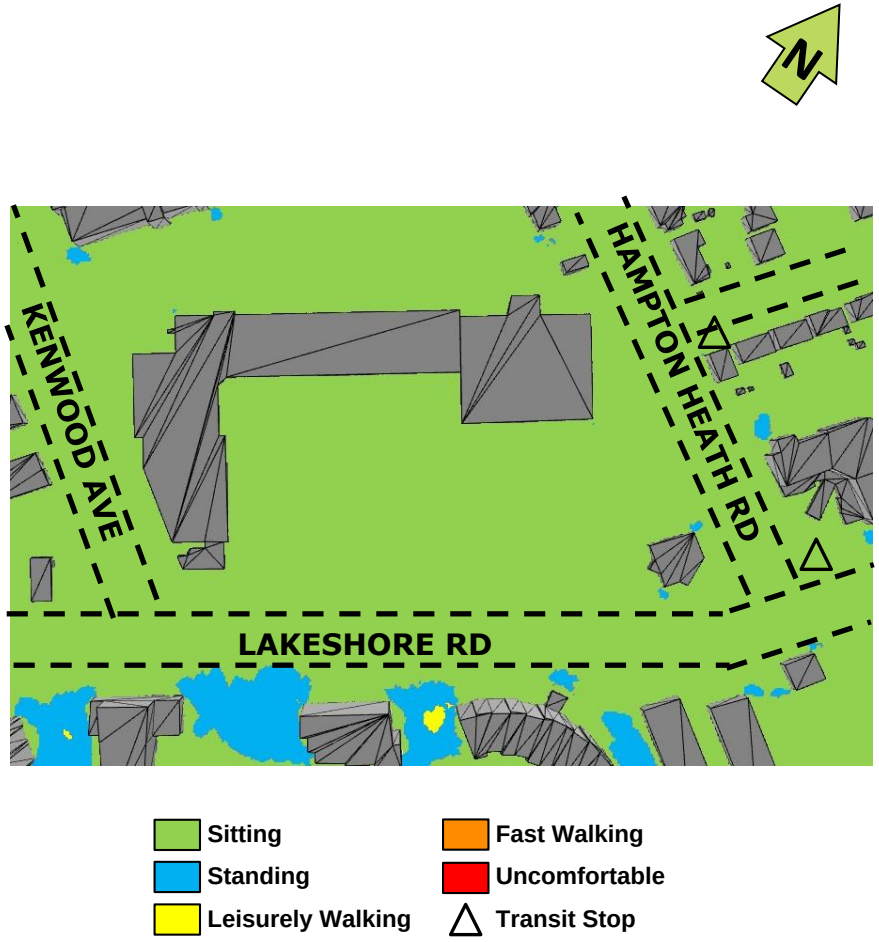



**Figure A2a: Existing Configuration – Grade – Autumn**

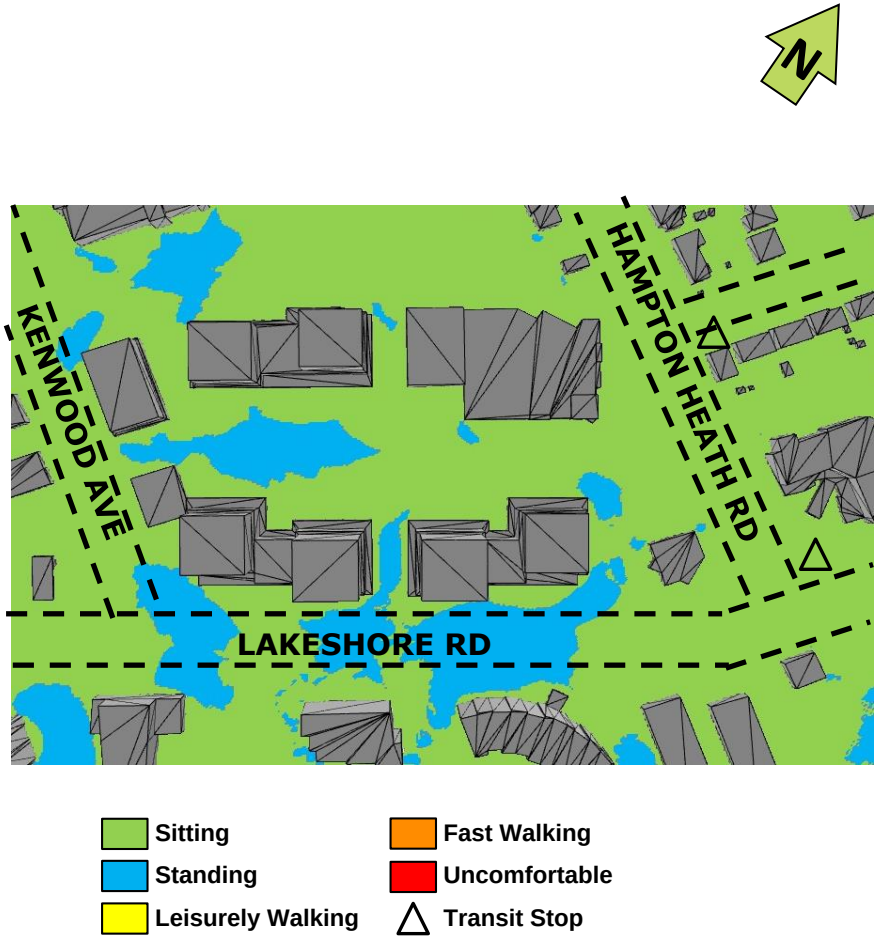



**Figure A2b: Proposed Configuration – Grade – Autumn**