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Re: Pedestrian Wind Assessment – Final

13030 Lundy's Lane
Thorold, ON

SLR Project #241.030989.00001

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained by Rudanco Hospitality Corporation to conduct a pedestrian wind assessment for the proposed subdivision development at 13030 Lundy's Lane in Thorold, Ontario. This report is in support of the upcoming Draft Plan of Subdivision (DPS) application for the development.

1.1 Existing Site

The proposed subdivision is located at 13030 Lundy's Lane, at the northwest corner of the intersection of Thorold Townline Road and Highway 20 (Lundy's Lane) in Thorold, Ontario. The site is currently occupied by an Express Inn Motel and agricultural lands. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth Pro images dated April and June 2023. Several images of the site and surroundings are included in **Figures 2a** through **2d**.

Immediately surrounding the site are low-rise commercial developments to the south and a mix of croplands and dense landscaping in all other directions, including beyond the immediate surroundings.

Typically, developments with Site Plan Approval (SPA) within a 500 m radius are included as existing surroundings. For this assessment, no such developments are included within the project vicinity.



Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 7/8/2018



Figure 1a: Looking northeast at the site
 Credit: Google Earth Pro, dated April 2021



Figure 1c: Looking north along Thorold Townline Road (Site to the left)
 Credit: Google Earth Pro, dated June 2023



Figure 1b: Looking east along Lundy's Lane
 Credit: Google Earth Pro, dated April 2021



Figure 1d: Looking west along Lundy's Lane
 Credit: Google Earth Pro, dated June 2023

1.2 Proposed Development

The proposed subdivision includes 80 residential blocks. Blocks 74 through 76 are comprised of low- to mid-rise buildings ranging in height from one to 18 storeys. The rest of the blocks include townhouse units, public parks, parking lots, and a stormwater pond. **Figure 3** illustrates a rendering of the proposed subdivision.

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.

The main focus of this assessment are the east and south edges of the site where there are mid-rise and high-rise buildings planned (outlined in **Figure 4**). The Municipality of Niagara (Region) has expressed interest in the pedestrian wind comfort conditions within the pedestrian realm along Thorold Townline Road and Highway 20. Building entrances or exits within the area of interest are shown in **Figure 4**.

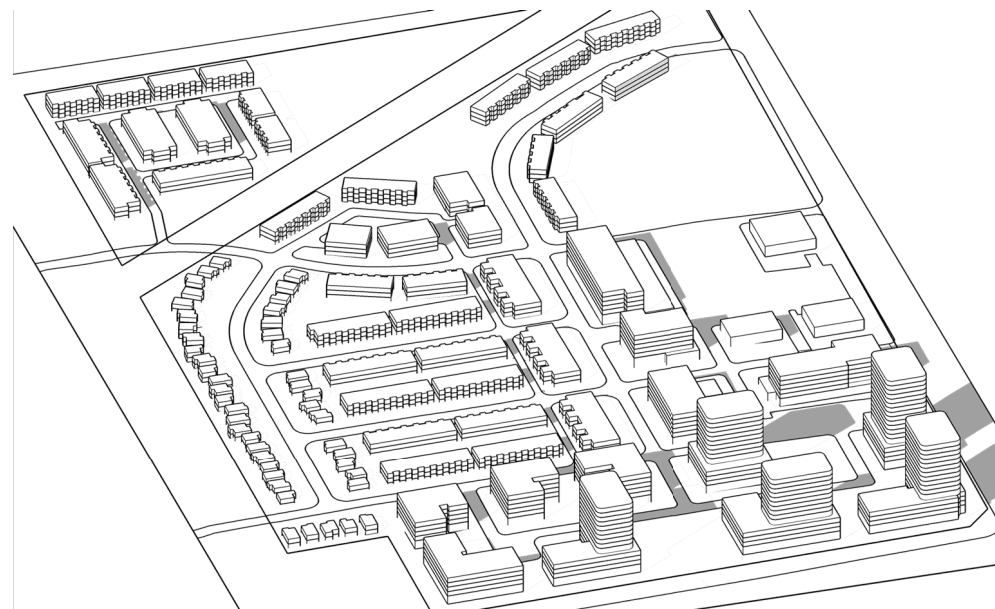


Figure 3: Rendering of the proposed subdivision

Credit: Giannone Petricone Associates Inc. Architects



Figure 3: Site Plan

2.0 Approach

A qualitative assessment was conducted using computational fluid dynamics (CFD). As with any approach, there are some limitations with this analysis technique, specifically in the ability to simulate the turbulence of the wind. Nonetheless, a qualitative CFD analysis is a useful tool to identify potential wind issues, as it employs a comparable analysis methodology to that used in quantitative wind tunnel testing.

2.1 Methodology

Wind comfort conditions were predicted on and around the development site to identify potentially problematic windy areas. A 3D model of the proposed development, was received on October 17, 2023. 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 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 upwind conditions encountered around the site. Wind flows for 16 compass directions were simulated. Although wind speeds are calculated throughout the modeled area, wind comfort conditions were only plotted for a smaller area immediately surrounding the proposed development.

SLR assessed two configurations, for comparison, as follows:

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

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

The CFD-predicted wind speeds for all test directions and grid points were 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. This analysis was conducted for the Existing Configuration and Proposed Configuration. 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) are not considered in the comfort rating.

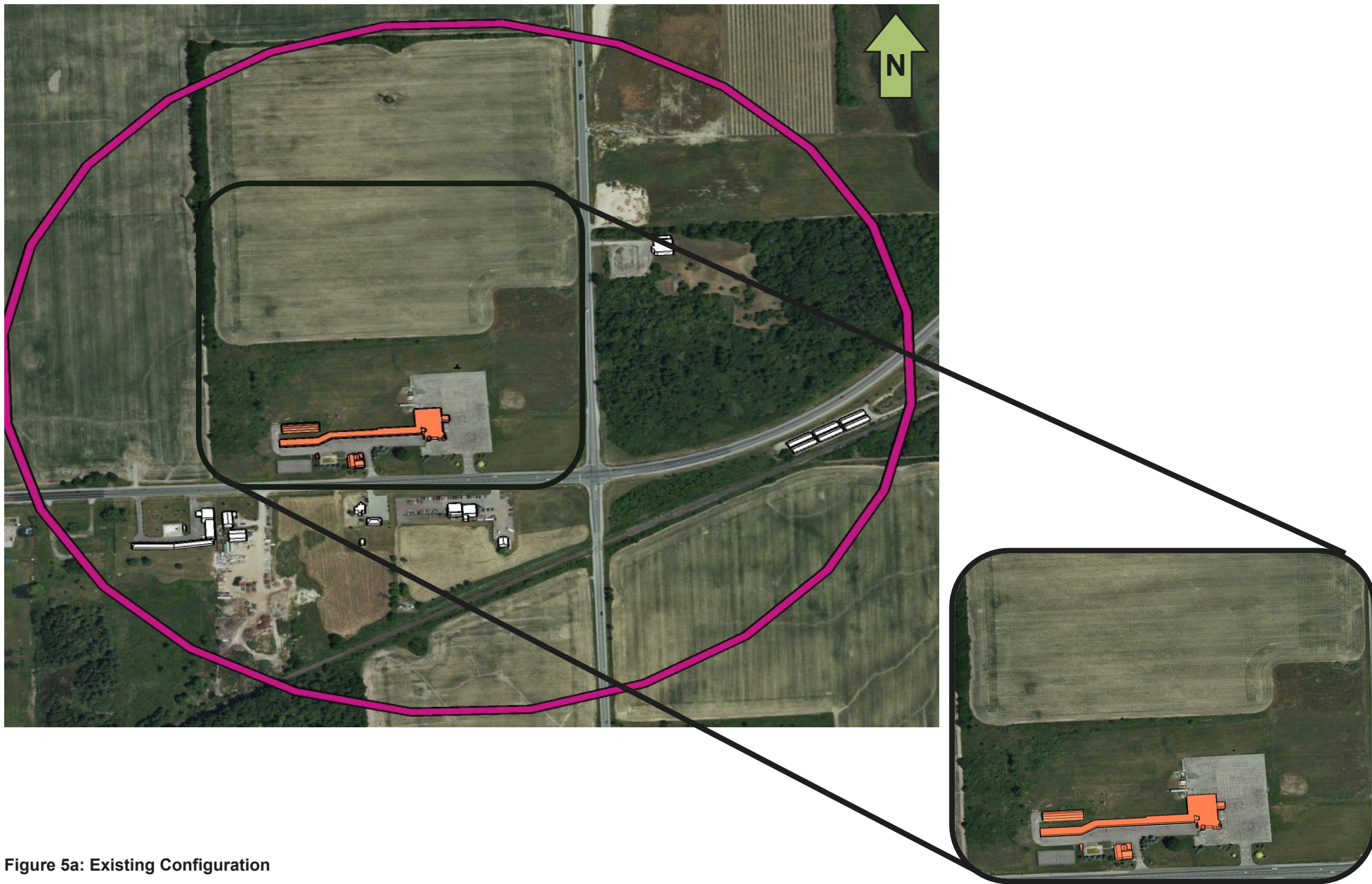


Figure 5a: Existing Configuration

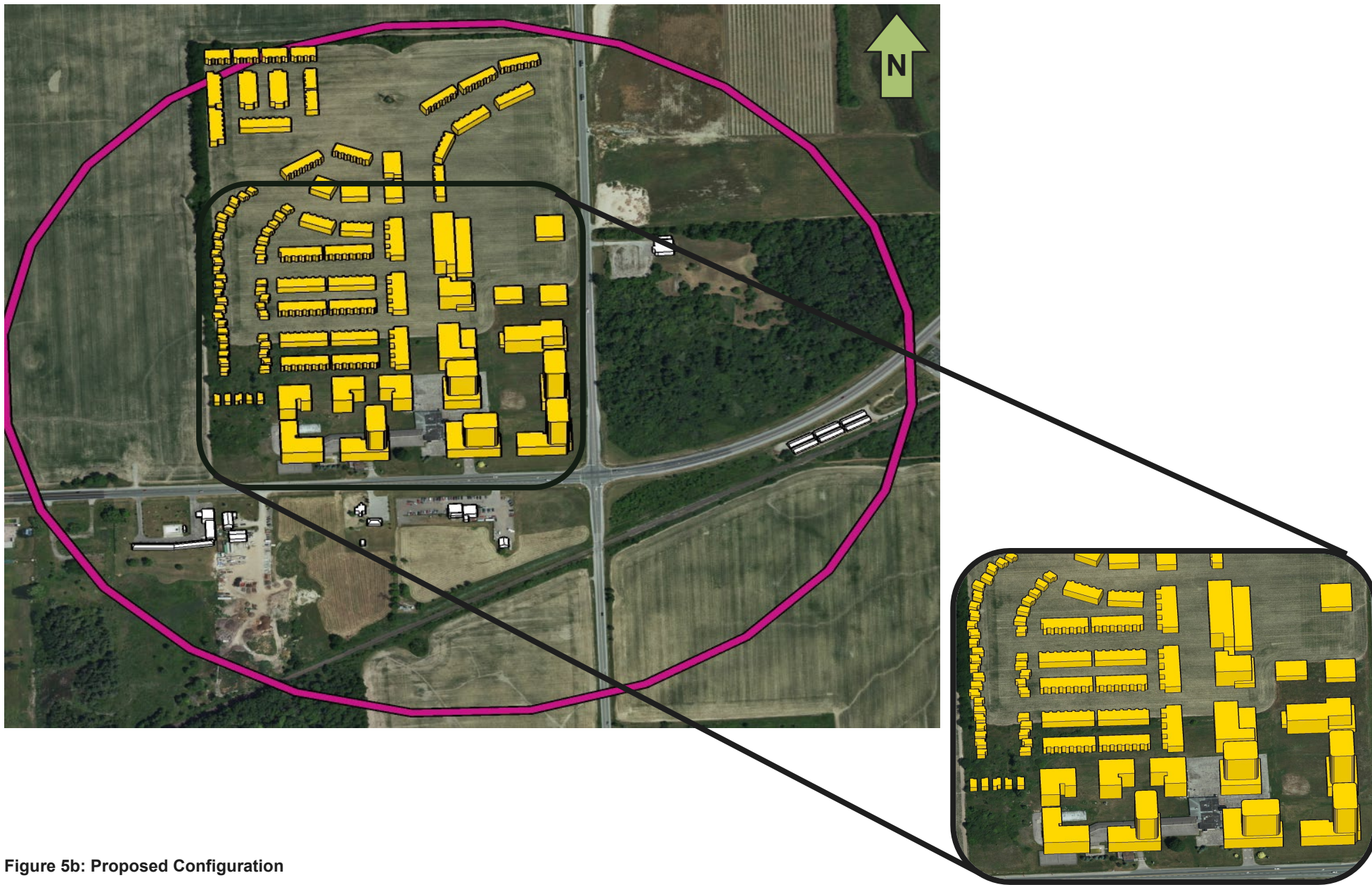


Figure 5b: Proposed Configuration

2.2 Wind Climate

Wind data recorded at Niagara Falls International Airport in Niagara Falls 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 southwest through west 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 southwesterly and westerly sectors. All wind speeds and directions were included in the wind climate model.

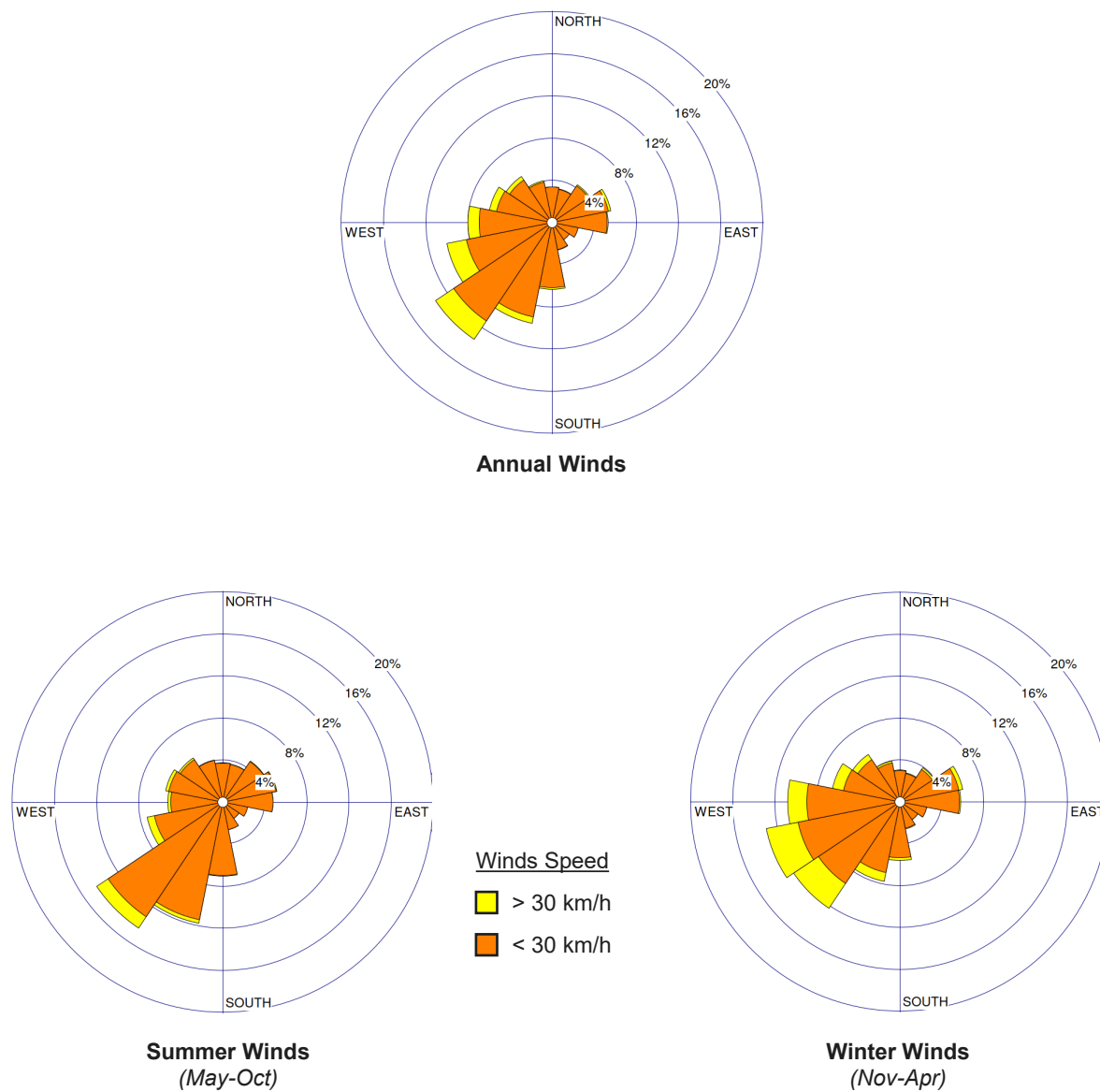


Figure 6: Wind roses for Niagara Falls International Airport (1991-2020)

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 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 either mean wind speed or 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 the criterion is exceeded, wind mitigation measures are advised. The wind safety criterion is shown in **Table 2**.

These criteria are based on the *Pedestrian Level Wind Study Terms of Reference Guide* of the Niagara Region, which came into effect in July of 2022.

Table 1: Wind Comfort Criteria

Comfort Category	GEM Wind Speed Exceeded 20% of the time	Description of Wind Comfort
Sitting	10 km/h	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away.
Standing	15 km/h	Gentle breezes suitable for main building entrances and bus stops.
Walking	20 km/h	Moderate breezes that can be tolerated if one’s objective is to walk, run or cycle without lingering.
Uncomfortable	> 20 km/h	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

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

4.0 Results

Figures 7a through **9b** 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.

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 walking are desirable year-round but may not be feasible in the winter. 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 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 on-site wind conditions are expected to be comfortable for walking or better year-round (**Figures 7a** and **8a**).

In the Proposed Configuration, on-site wind conditions are predicted to be comfortable for walking or better in the summer (**Figure 7b**). During the winter season (**Figure 8b**), similar wind conditions are predicted, with uncomfortable wind conditions at several building corners and in the areas between buildings (i.e., Building 74A, 74C, 74D, 74E, 74F, 76A and 76B).

At the building entrances or exits, wind conditions are generally expected to be comfortable for sitting or standing throughout the year, which is considered suitable for the intended use (**Figures 9a** and **9b**). The exceptions are near the entrances to Buildings 74A, 74E, and 75A, where wind conditions conducive to walking are predicted during the winter months (**Figure 9b**).

Wind control measures are discussed in **Section 5.0**.

4.2 Surrounding Sidewalks

In the Existing Configuration, wind conditions along the shoulders of Thorold Townline Road and Highway 20 (Lundy’s Lane) are expected to be suitable for walking year-round (**Figures 7a** and **8a**).

With the proposed development in place, wind conditions are predicted to remain suitable for walking or better throughout the year on the surrounding road shoulders, which we assume will be sidewalks in the future. The exception is near the intersection of Thorold Townline Road and Highway 20, at the southeast corner of Building 74C, where wind conditions are uncomfortable in the winter (**Figure 8b**).



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

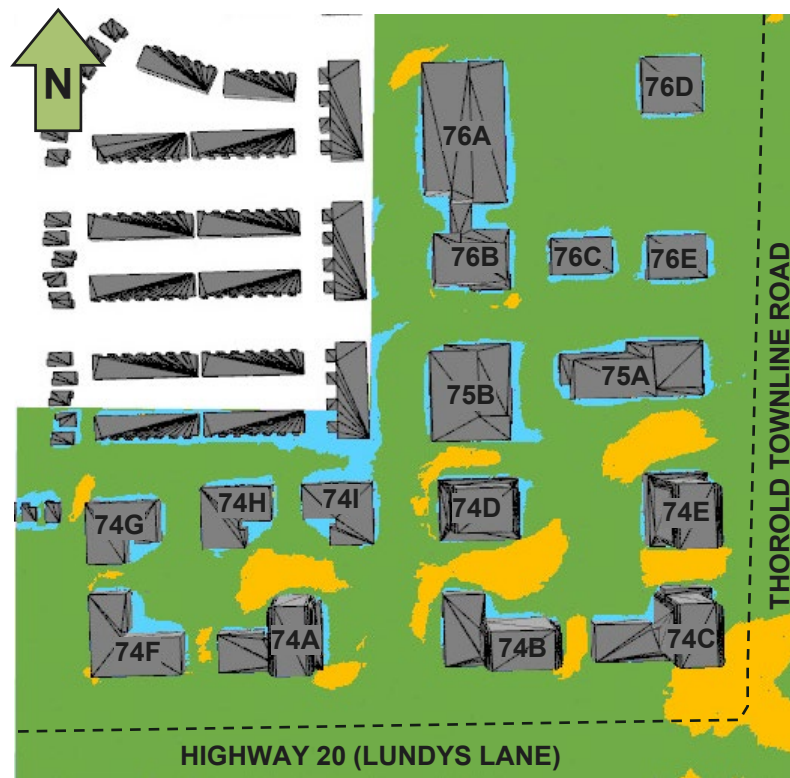


Figure 7b: Proposed Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

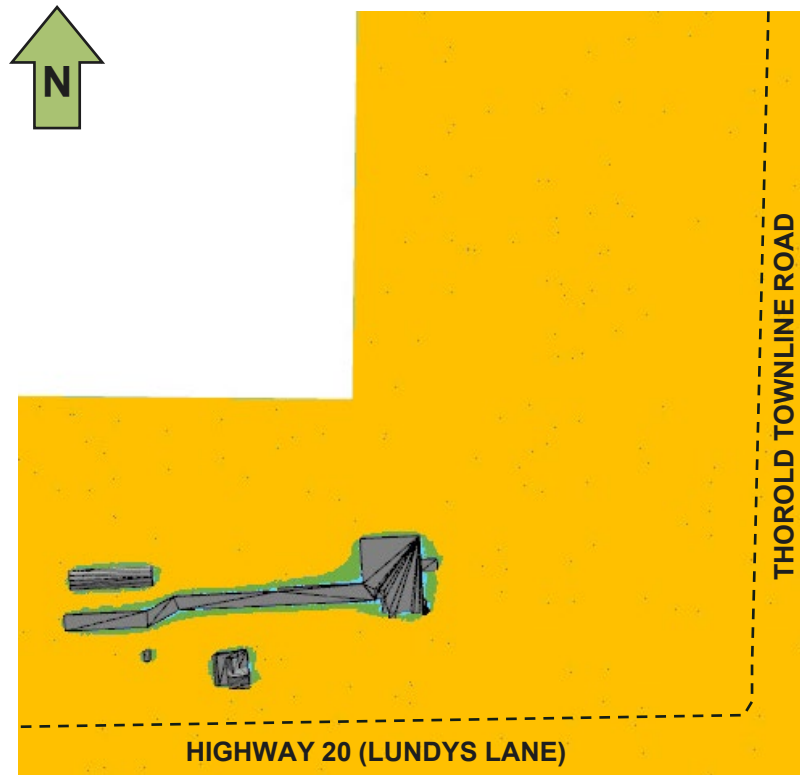


Figure 8a: Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

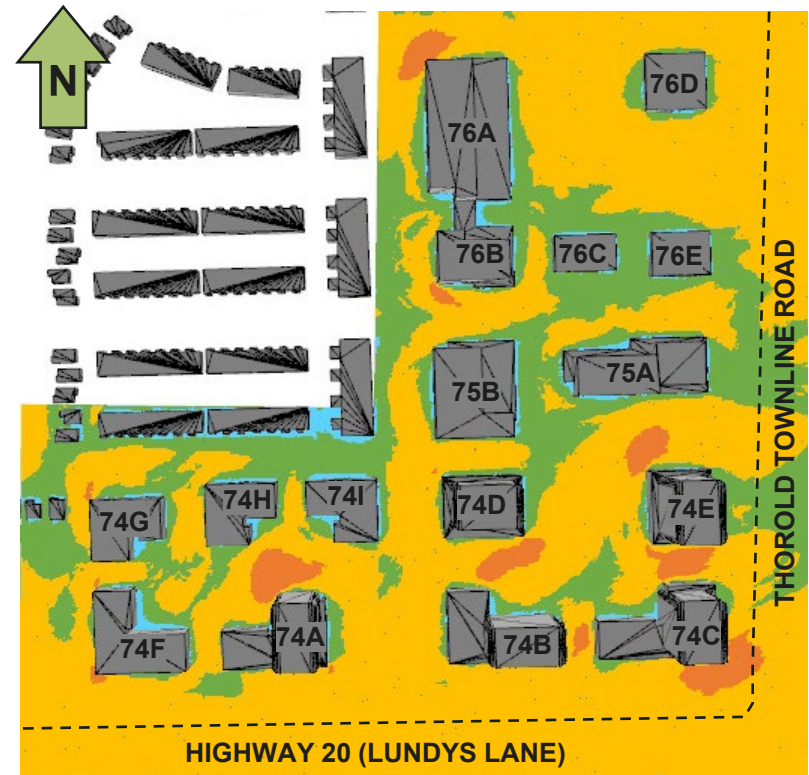


Figure 8b: Proposed Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas

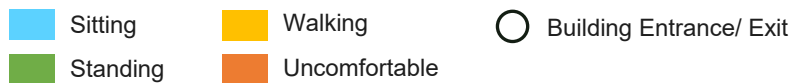
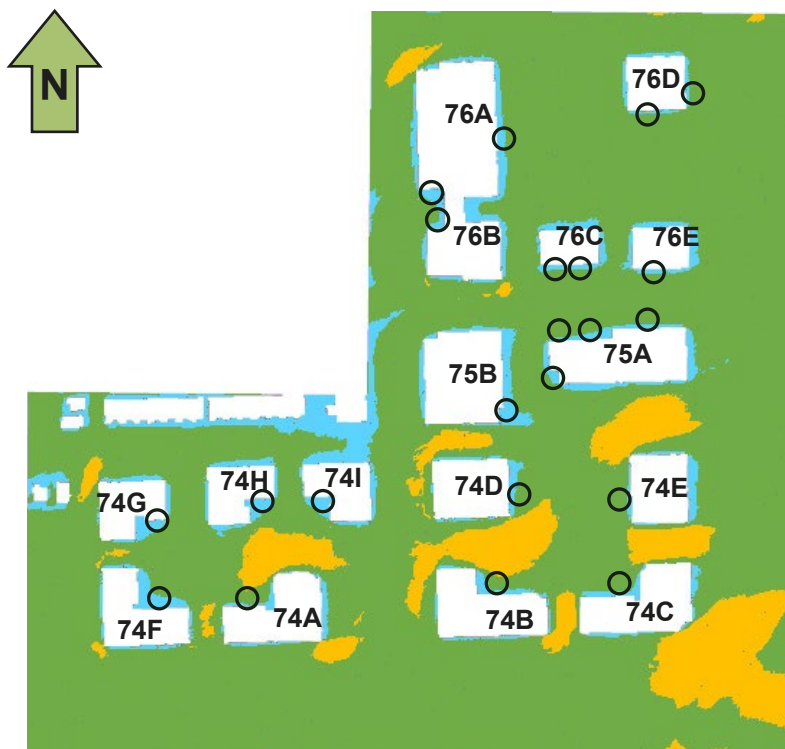


Figure 9a: Proposed Configuration – Pedestrian Wind Comfort
Summer – Building Entrances & Walkways

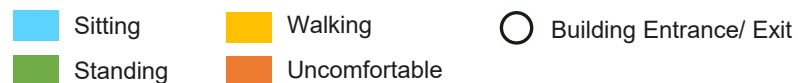
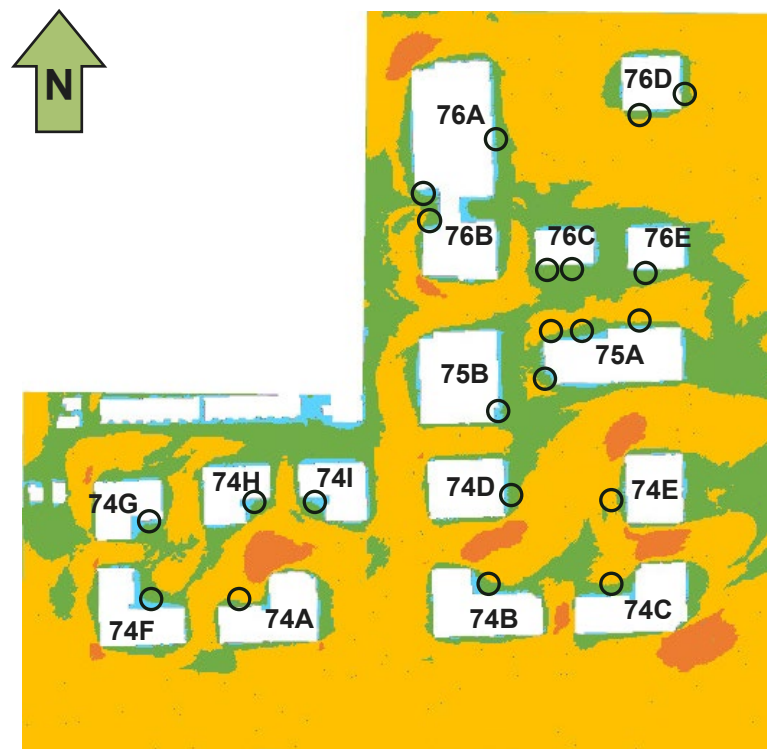


Figure 9b: Proposed Configuration – Pedestrian Wind Comfort
Winter – Building Entrances & Walkways

4.3 Wind Safety

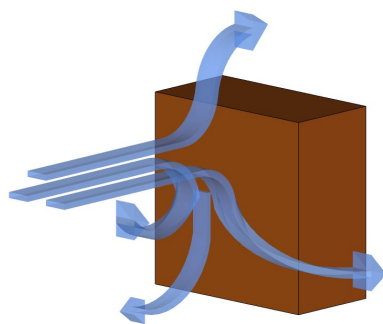
In the Existing Configuration, the wind safety criterion is expected to be met in all on-site and surrounding areas on an annual basis (**Appendix A**).

In the Proposed Configuration, the wind safety criterion is predicted to be met in most of the areas on an annual basis. The exceptions include several building corners and in some areas between the proposed buildings (**Figure A1b**).

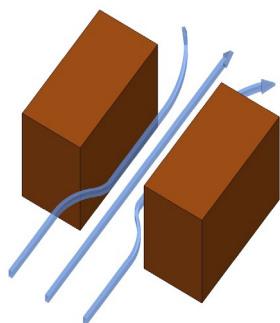
Wind control measures are discussed in **Section 5.0**.

5.0 Wind Control Measures

The strong wind flows on site are due to the overall exposure to the prevailing westerly and southwesterly winds. With no buildings of similar height in the vicinity and given the open nature of the upwind agricultural lands, there are no obstructions to provide shelter from the prevailing winds. Therefore, the strong wind flows that occur at higher elevations are redirected down to grade by the mass of the development, creating local wind accelerations around the base of the buildings. In addition, the prevailing winds channel through the gaps between the proposed buildings, creating accelerated wind flows (see images below).



*Downwashing wind flows
redirected at grade*



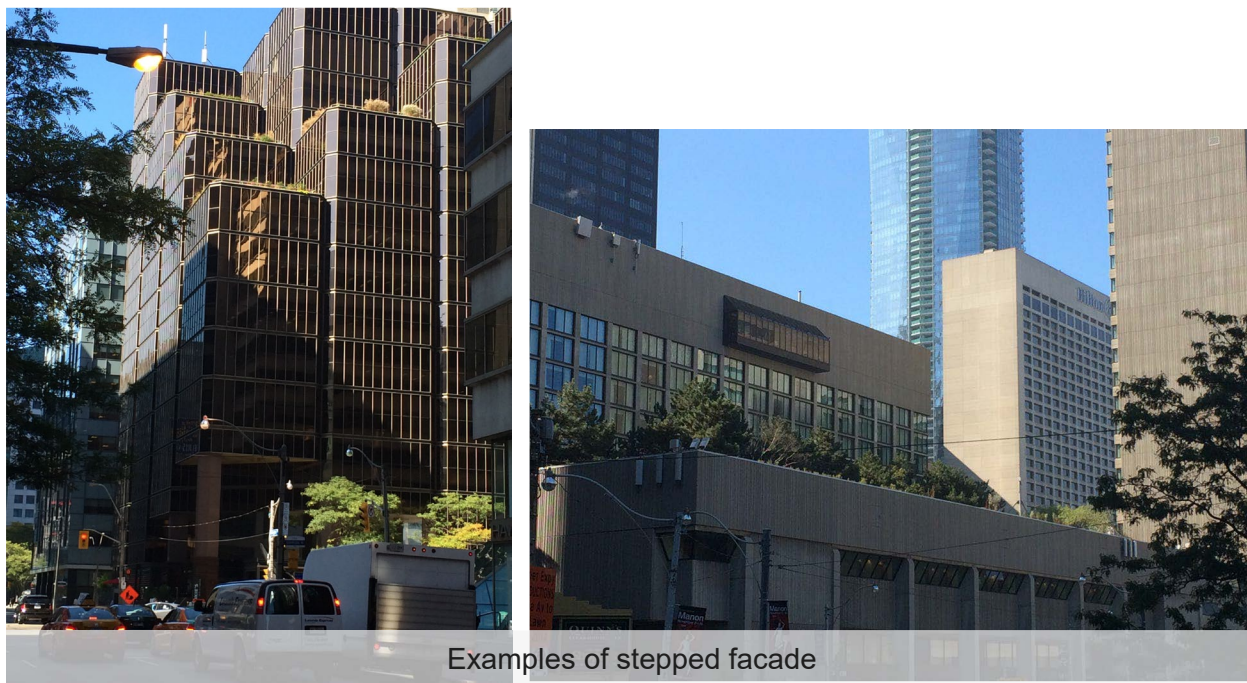
Channeling Flows

To improve wind conditions on the site in the future, the design team should consider the following wind mitigation measures:

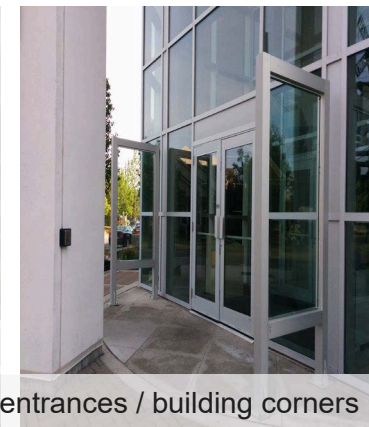
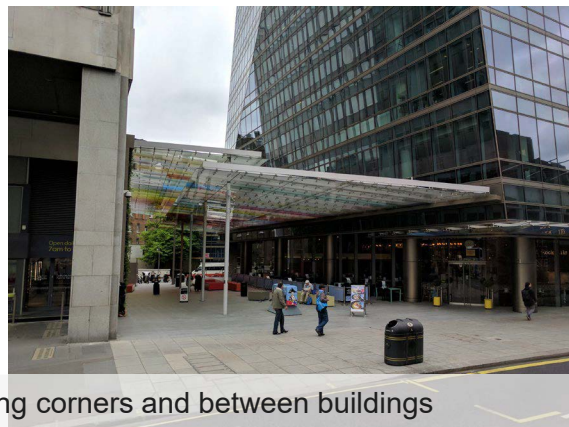
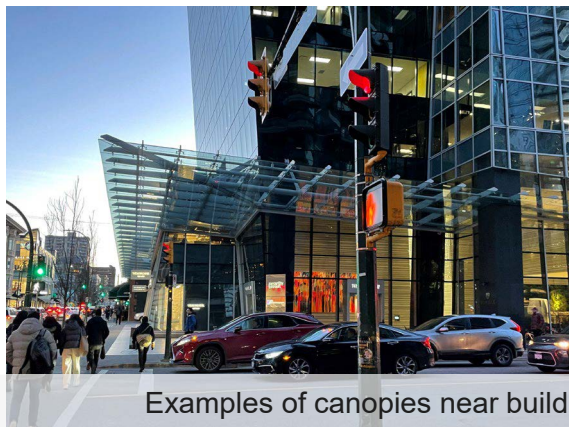
- Stepped building facades, with a minimum step width of 5 m.
- Rounded or chamfered corners.
- Podiums, particularly on the south and west sides of taller elements.

For the building entrances, we recommend locating entrances at least 5 m away from building corners, to remove the doors from the windy areas. In addition, the design team should consider including local wind mitigation features (i.e., canopies, wind screens, etc.) and/or recessing the entrance from the main facade as to provide shelter at the door. Additional local wind mitigation features such as canopies, wind screens, etc. could be considered for local areas on a site-by-site basis.

Figure 10 provides examples of wind control measures. SLR can work with the design team to refine wind control measures prior to the next planning submission.



Examples of stepped facade



Examples of canopies near building corners and between buildings

Examples of wind screens near entrances / building corners

Figure 10: Examples of wind control measures

6.0 Conclusion & Recommendations

The pedestrian wind conditions predicted for the proposed development at 13030 Lundy's Lane in Thorold, Ontario have been assessed through CFD modeling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is predicted to be met at all areas on site and surrounding the site in the Existing Configuration. In the Proposed Configuration, the wind safety criterion is predicted to exceed at several proposed building corners and nearby areas on-site. Wind control measures are recommended.
- On-site wind conditions, including entrances, are generally expected to be suitable for the intended use year-round. Wind control measures are recommended for some on-site areas including building corners and entrances.
- On the road shoulders surrounding the proposed development, wind conditions are generally anticipated to be suitable for the intended use, with the exception of one area near the southeast corner of the site where wind conditions are predicted to be uncomfortable.
- Wind control recommendations are provided. SLR can work with the design team to develop appropriate wind control measures as the design evolves.

7.0 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 Rudanco Hospitality Corporation, 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 by the City of Thorold and Niagara Region 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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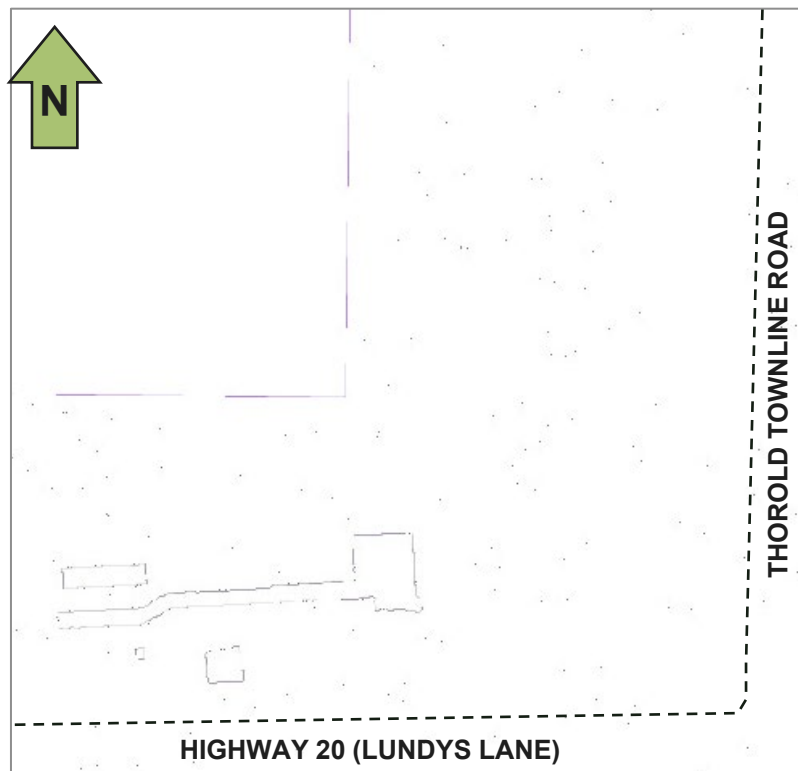
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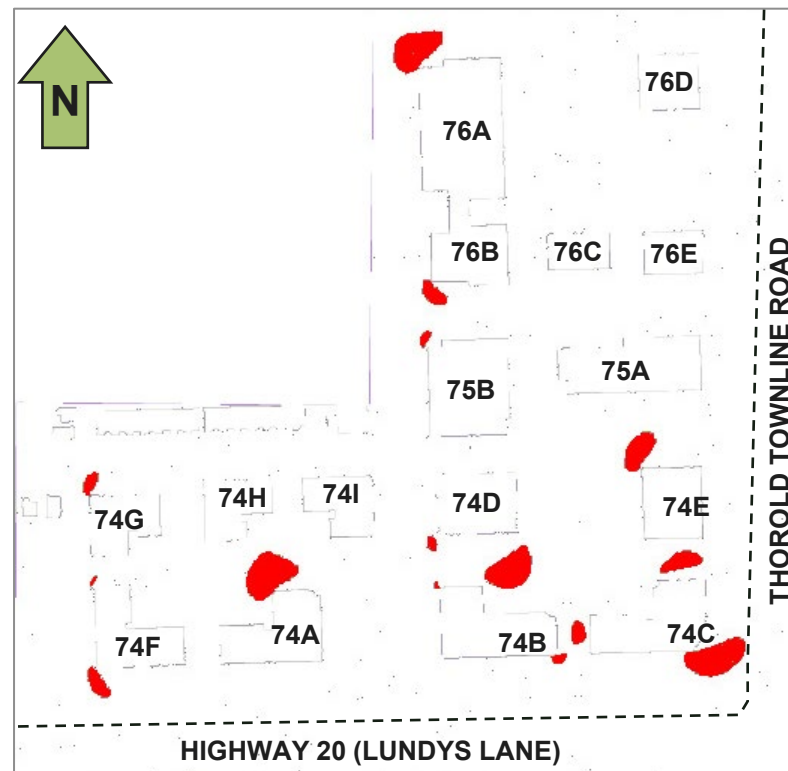
Appendix A

Pedestrian Wind Safety Analysis Annual



■ Exceeded Safety Criterion

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



■ Exceeded Safety Criterion

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