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Date: November 9, 2022

Re: **Pedestrian Wind Assessment**
Rangeview Estates Development
Master Plan
Mississauga, Ontario
SLR Project #241.30662.00000

Prepared by

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Delta Urban to conduct a pedestrian wind assessment for the proposed Rangeview Estates development in Mississauga, Ontario. This report is in support of the Master Plan application for the development.

1.1 Existing Development

The Rangeview Estates Development Master Plan includes the redevelopment of the blocks encompassed by Lakeshore Road East to the north, Hydro Road to the east, and East Avenue to the west. The site is currently occupied by low-rise commercial and light industrial buildings. Figure 1 provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated May and September 2021. Several images of the site and surroundings are included in Figures 2a through 2d.

Immediately surrounding the site are low-rise commercial buildings to the northwest and north along Lakeshore Road, Sunflower Garden Park and the waterfront trail to the northeast and east, Lakeview Park, Douglas Kennedy Park and the Lakeview Water Treatment Plant buildings to the south and Waterworks Park to the west. Beyond the immediate surroundings are low-rise residences to the southwest through west to north, the Lakeview Wastewater Treatment Plant to the east and Lake Ontario the south. There is outdoor amenity and park space, as well as the Waterfront Trail.

Typically, developments with Site Plan Control approval and/or those currently under construction within a 500 radius are included as existing surroundings. For this assessment, the proposed Lakeview development which is immediately south and east of the Rangeview Estates development was included. While the development application is under review, it was included given the size and potential influence on the project site.

Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 6/27/2019

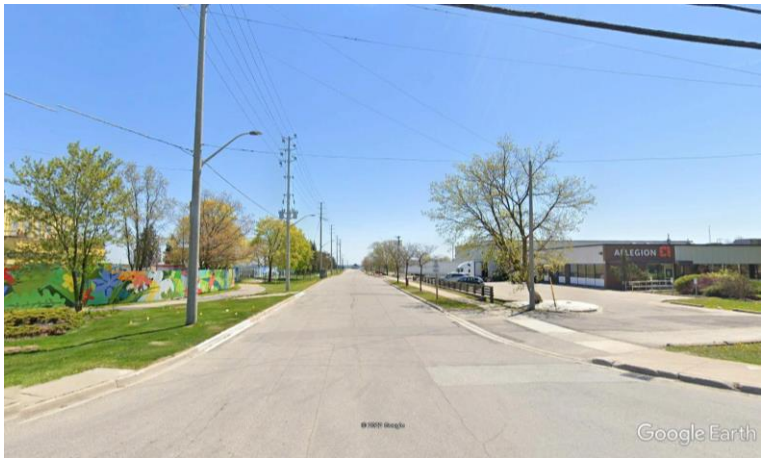


Figure 2a: Hydro Road, looking south

Figure 2b: East Avenue, looking south

Figure 2c: Lakeshore Road East, looking northeast

Figure 2d: Lakeshore Road East, looking southwest

1.2 Proposed Development

The proposed development includes 47 low-rise buildings and 29 mid to high-rise buildings across approximately 28 hectares. The development also includes several parks. A 3D model of the proposed development is shown in Figure 3. Our understanding is no building on the site would exceed 15 storeys in height.

As the development is in the Master Plan stages, building details such as entrances, exits and outdoor amenity spaces have not been confirmed. SLR has provided recommendations regarding entrance and amenity locations in Section 4.3 based on the results of the analysis.

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 Lakeshore Road East in the vicinity of the proposed development. On-site areas of interest are shown in Figure 4.

Figure 3: 3D Model of proposed development

Figure 4: Areas of interest
credit: Bousfields Inc.

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 Delta Urban on September 12, 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 Lakeview Development, which has submitted applications for an Official Plan Amendment (OPA), Zoning Bylaw Amendment (ZBA) and Draft Plan of Subdivision was included given its size and potential to influence wind conditions on the 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.

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

- **Proposed Configuration:** Proposed Rangeview Estates development with existing surroundings.
- **Future Configuration:** Proposed Rangeview Estates development with existing surroundings and Future Lakeview development.

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.

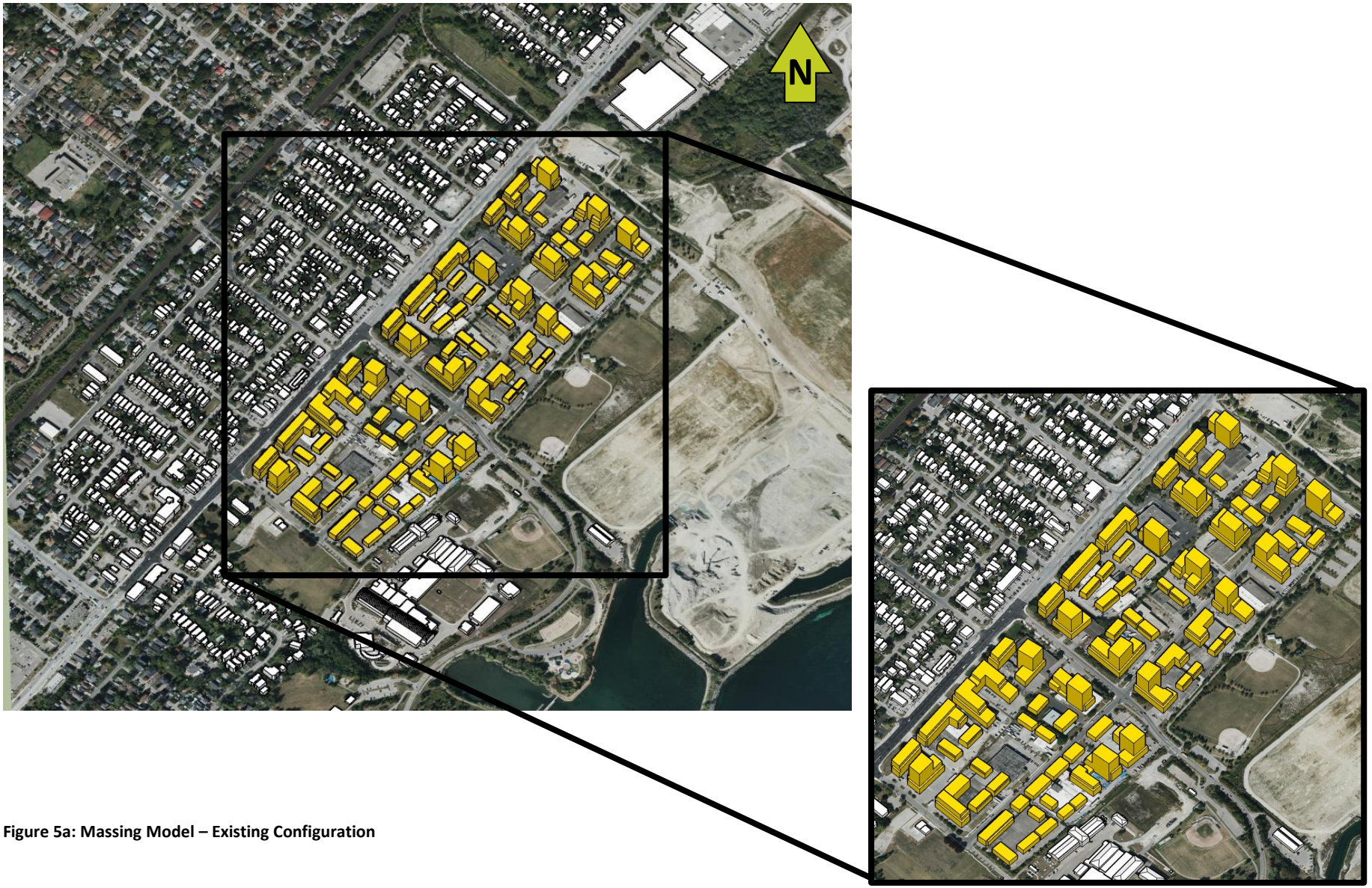


Figure 5a: Massing Model – Existing Configuration

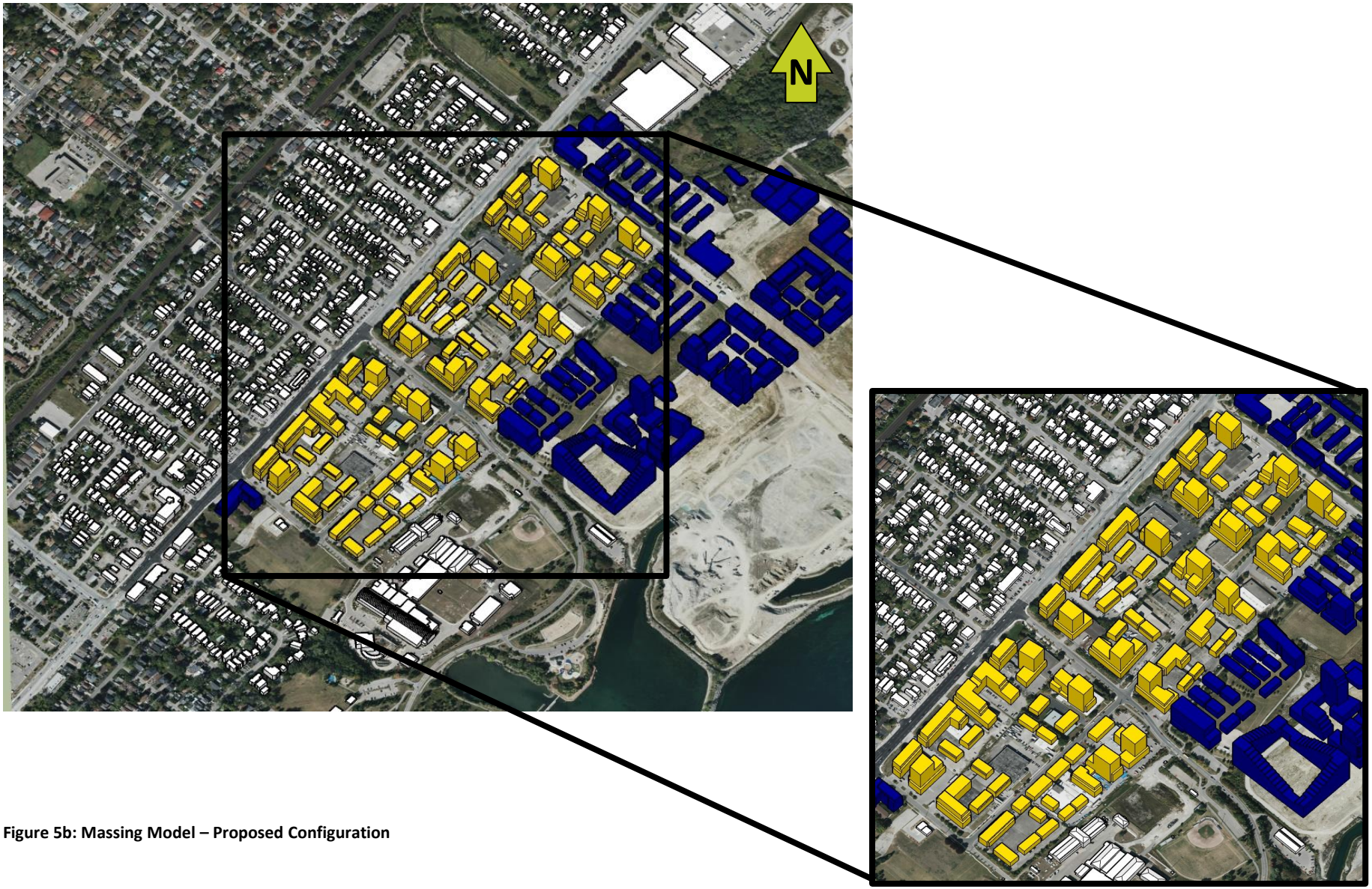


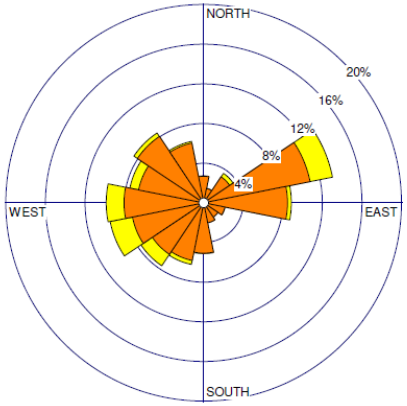
Figure 5b: Massing Model – Proposed Configuration

2.2 Wind Climate

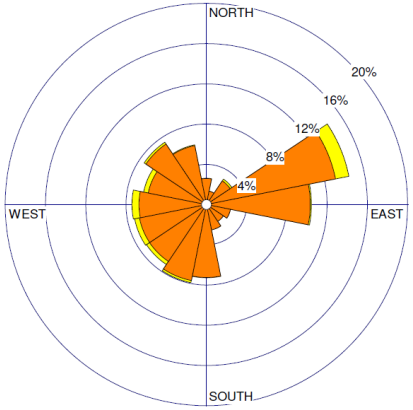
Wind data recorded at Billy Bishop Toronto City Airport for the period of 1991 to 2020 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 6. These diagrams illustrate the percentage of time wind blows 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 westerly and east-northeasterly 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 westerly and east-northeasterly directions. All wind speeds and directions were included in the wind climate model.

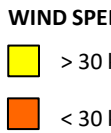
The seasonal wind roses show daytime hours only from 6:00am to 11:00pm, while the annual wind rose shows all hours.

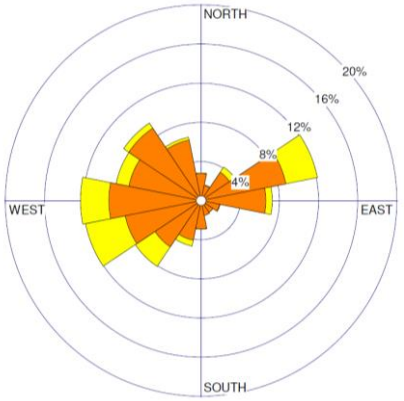


Annual Winds



Summer Winds (May - Oct)





Autumn Winds (Nov - Apr)

Figure 6: Wind Roses for Billy Bishop Toronto City 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 criteria utilized for this analysis is provided by the City of Mississauga, in the document *Urban Design Terms of Reference – Pedestrian Wind Comfort and Safety Studies* (June 2014). 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 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 without having it blown away.
Standing	0 to 15 km/h	0 to 4.2 m/s	Gentle breezes suitable for main building entrances and bus stops.
Walking	0 to 20 km/h	0 to 5.6 m/s	Moderate 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 8b 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, 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 walking 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. 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 Proposed Configuration

With the proposed Rangeview Estates development in place, wind conditions on the site are generally expected to be comfortable for sitting or standing throughout the year (Figures 7a and 7b). This includes in the various outdoor park spaces and along sidewalks and walkways throughout the site. Similar wind conditions are predicted to occur at the various transit stops along Lakeshore Road. There is a small area at the northeast corner of the site that is predicted to be comfortable for walking in the winter.

Overall, these wind conditions are considered suitable for the intended use.

4.2 Future Configuration

With both the proposed Rangeview Estates development and future Lakeview development in place, wind conditions on the site are predicted to be comfortable for sitting or standing throughout the year (Figures 8a and 8b). This includes in the various outdoor park spaces and along sidewalks and walkways throughout the site. Similar wind conditions are predicted to occur at the various transit stops along Lakeshore Road.

The predicted wind conditions in the Future Configuration are similar to the Proposed Configuration and considered suitable for the intended use.

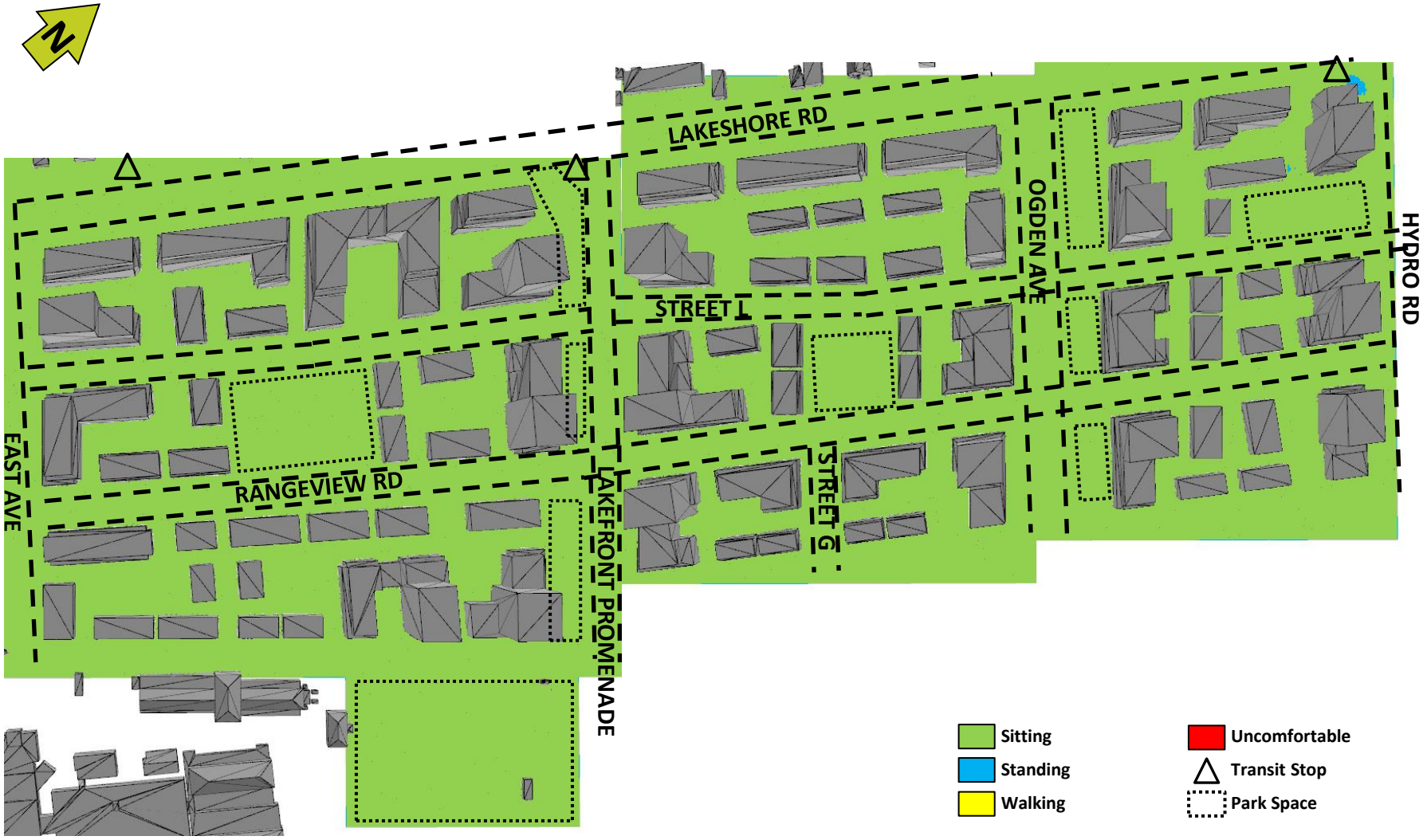


Figure 7a: Proposed Configuration – Pedestrian Wind Comfort – Summer Season – On Site

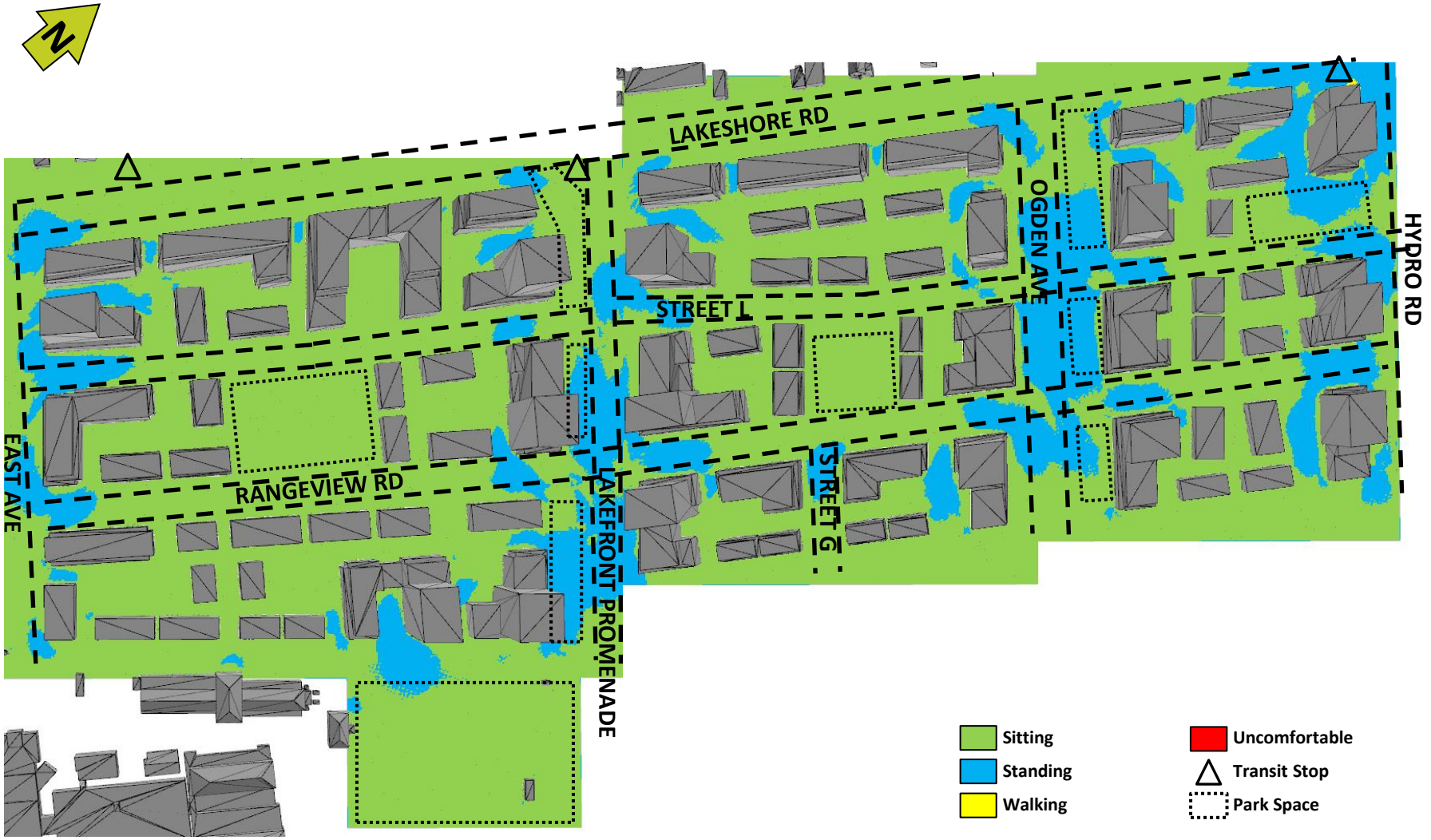


Figure 7b: Proposed Configuration – Pedestrian Wind Comfort – Winter Season – On Site

Figure 8a: Future Configuration – Pedestrian Wind Comfort –Summer Season – On Site

Figure 8b: Future Configuration – Pedestrian Wind Comfort – Winter Season – On Site

4.3 Entrance and Above Grade Amenity Locations

As the project is currently in the Master Planning phase, building details such as entrances, exits and above grade amenity spaces have not yet been determined.

Overall, the predicted wind conditions on the site are favourable in both the Proposed and Future Configurations. When locating building entrances, we recommend they be placed a minimum of 5 m away from building corners to avoid localized wind accelerations.

When locating above-grade amenity locations, we recommend placing them to the north and west of the towers, to provide shelter from the predominant southerly and northeasterly winds.

As the application moves forward, more detailed site-specific analyses can be undertaken to confirm wind conditions and the necessity of additional wind mitigation features.

4.4 Wind Safety

The wind safety criterion is predicted to be met in both the Proposed and Future Configurations in all areas at grade-level (Appendix A).

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed Rangeview Estates Development Master Plan in Mississauga 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 walkways and park spaces, are expected to be suitable for the intended usage year-round.
- On the sidewalks and transit stops surrounding the proposed development, wind conditions are expected to be suitable for the intended usage.
- The wind safety criterion is predicted to be met at all locations surrounding the development in both the Proposed and Future Configurations.
- As the application moves forward, more detailed site-specific analyses can be undertaken to confirm wind conditions and the necessity of additional wind mitigation features.

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 Delta Urban, 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 Mississauga 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.

This report has been prepared in a manner generally accepted by professional consulting principles and practices for the same locality and under similar conditions. No other representations or warranties, expressed or implied, are made.

Opinions and recommendations contained in this report are based on conditions that existed at the time the services were performed and are intended only for the client, purposes, locations, time frames and project parameters as outlined in the Scope or Work and agreement between SLR and the Client. The data reported, findings, observations and conclusions expressed are limited by the Scope of Work. SLR is not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. SLR does not warranty the accuracy of information provided by third party sources.

7.0 REFERENCES

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Appendix A

Pedestrian Wind Safety Analysis

Annual

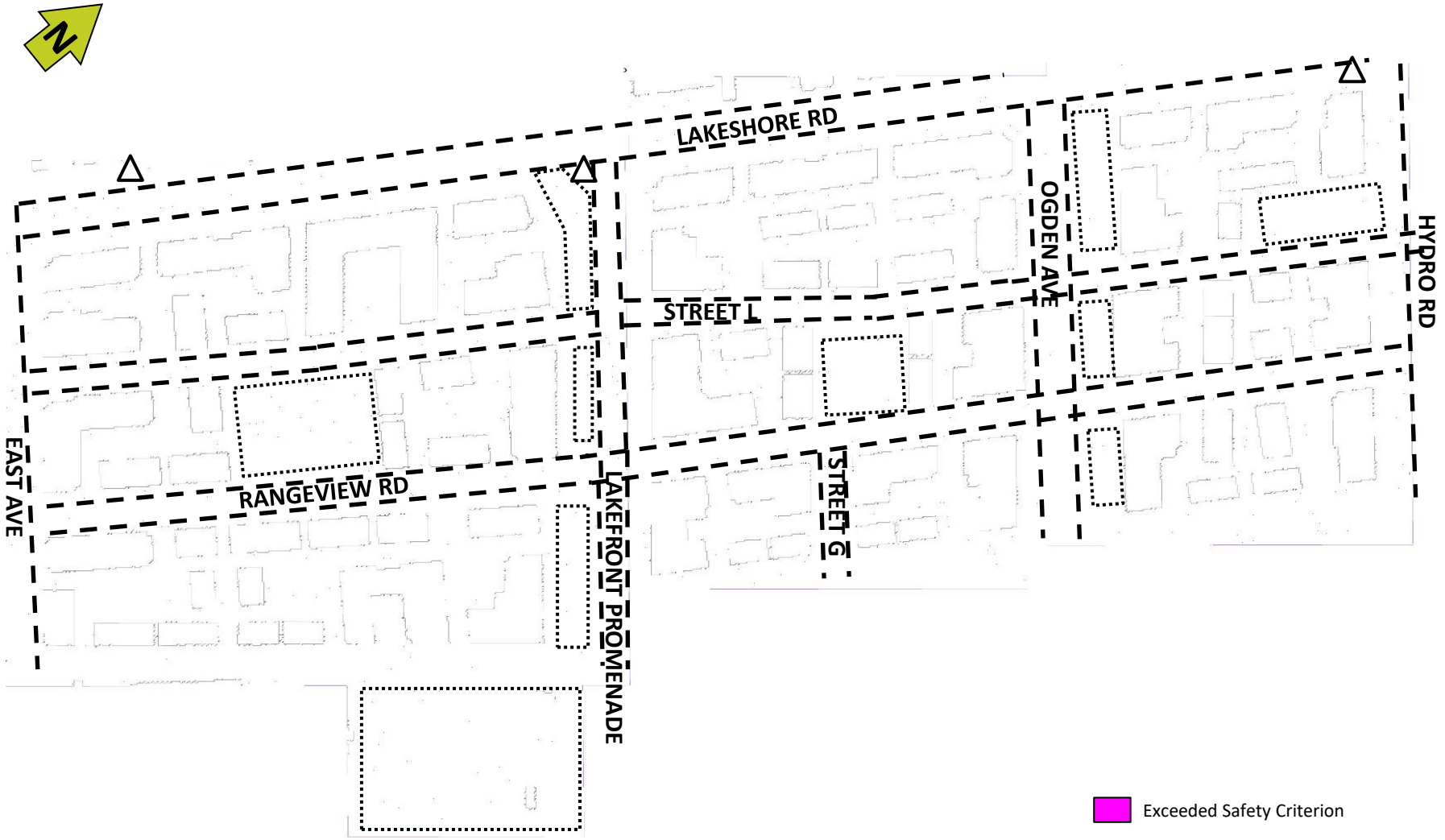

Figure A1: Proposed Configuration – Pedestrian Safety Annual – On Site

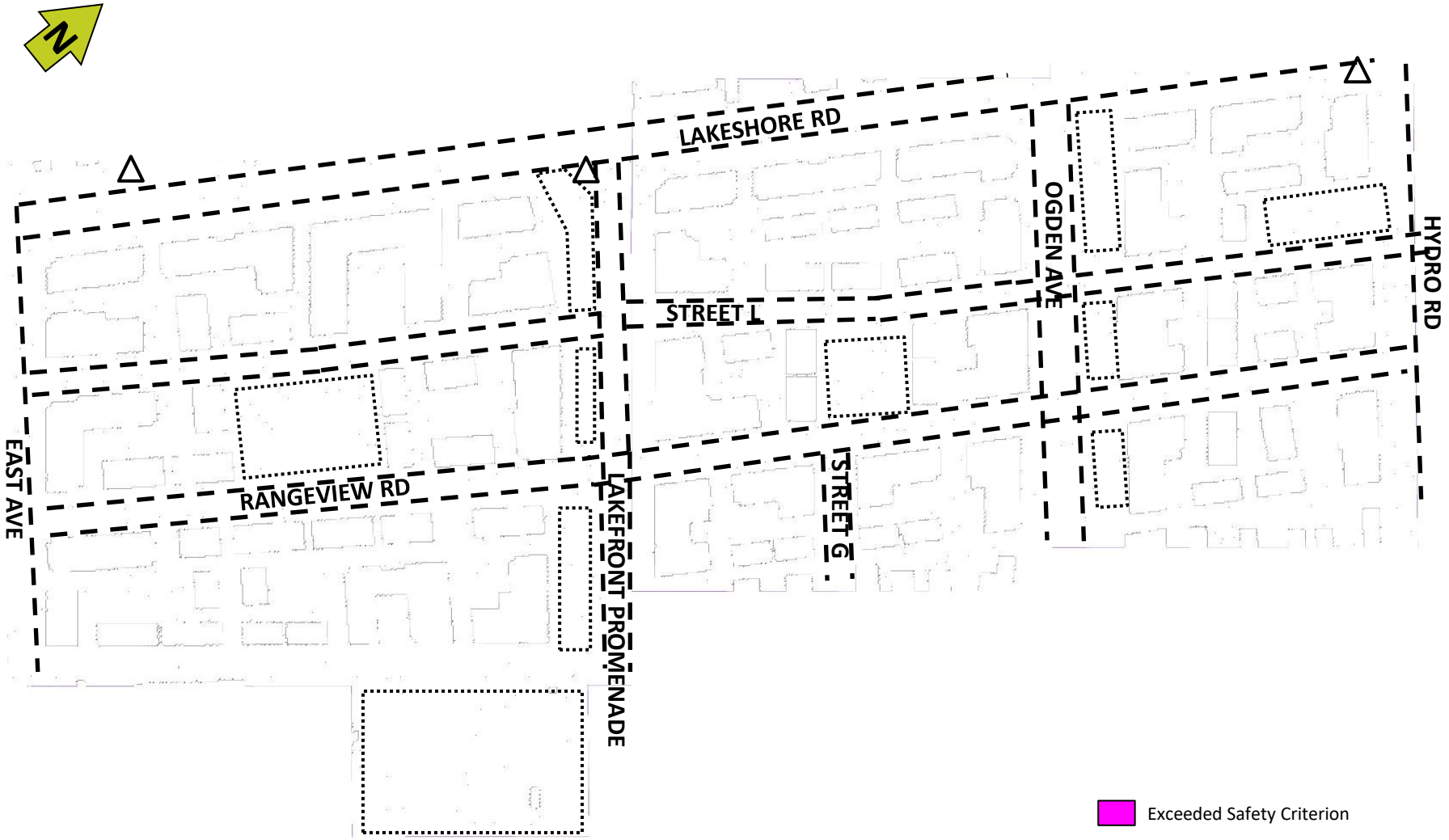

Figure A2: Future Configuration – Pedestrian Safety Annual – On Site