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Date: February 27, 2025

Re: Pedestrian Wind Assessment
Barrel Yards Development
Waterloo, ON
SLR Project #241.30613.00002



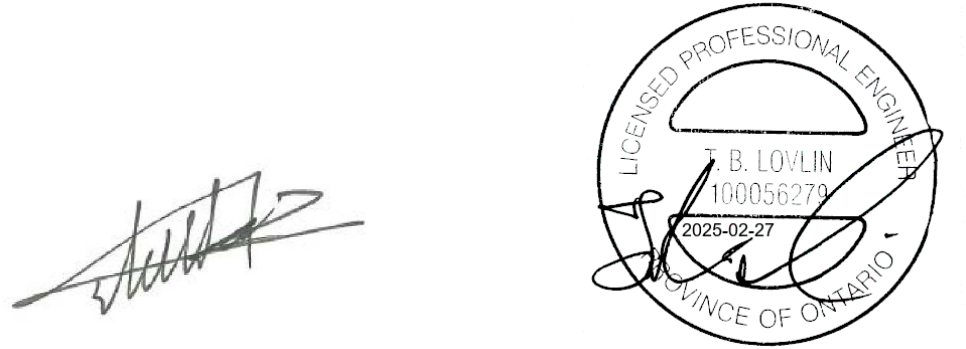
Credit: Turner Fleischer

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1.0 Introduction

SLR Consulting (Canada) Ltd. (SLR) was retained by Auburn Developments to conduct a pedestrian wind assessment for the proposed Barrel Yards Development in Waterloo, Ontario. This report is in support of the Official Plan Amendment (OPA) and Zoning Bylaw Amendment (ZBA) planning application for the development.

1.1 Existing Development

The proposed development is located at the northwest corner of the Father David Bauer Drive and Erb Street West intersection. The proposed buildings are an addition to the existing development. Figure 1 provides an aerial view of the immediate study area. A site visit was conducted by SLR on January 8, 2025. Several images of the site and surroundings are included in Figures 2a through 2d.

Immediately surrounding the site from the southeast through southwest are low-rise residential buildings, with a parking lot and Waterloo Park to the north. From west through north, the site is surrounded by the earlier phases of the Barrel Yards Development, which consists of mid to high-rise residential buildings. Beyond the immediate surroundings are low to mid-rise residential and commercial buildings in all directions. There is a commercial high-rise building in the extended surroundings to the northeast.

Typically, developments with Site Plan Approval (SPA) within a 500 m radius are included as existing surroundings. For this proposed development, there were no SPA-approved developments identified within the analysis radius. SLR confirmed this assumption with the design team.

Note, when referring to wind directions True North will be utilized. Project North will be utilized when referring to building features. Project North is approximately 35° counter-clockwise from True North.



Figure 1: Aerial view of existing site & surroundings
Credit: Esri, Maxar, Earthstar Geographics, and the GIS User Community (Image Date May 1, 2020)



Figure 2a: Looking southwest along Erb Street West



Figure 2b: Looking west at the site



Figure 2c: Looking northeast along Erb Street West



Figure 2d: Looking south at the site

1.2 Proposed Development

The proposed development comprises three buildings:

- Buildings F and G are 31-storey tall towers atop a six-storey podium. The buildings are approximately 118 m tall, including the mechanical penthouses. They are located along the east side of the site along Father David Bauer Drive.
- Building K is an 18-storey building, that is approximately 70 m tall and is centrally located on site.

A rendering of the proposed development is shown in Figure 3.

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 entrance to Buildings F and G is centrally located on the west facade of the building, and the main entrances to Building K are located on the south and north facades of the building. There are numerous secondary entrances and exits throughout the development. There are also eight retail entrances on the east facade of the podium of Buildings F and G along Father David Bauer Drive. There is an outdoor amenity space at grade located east of Building K. These areas of interest are shown in Figure 4a. Also, there are outdoor amenity terraces at the Level 7 podium of Buildings F and G, as well as on the penthouse level of Building K, as shown in Figure 4b.

Off-site areas of interest include two nearby transit stops along Erb Street West.



Figure 3: 3D rendering of the proposed development
Credit: Turner Fleischer

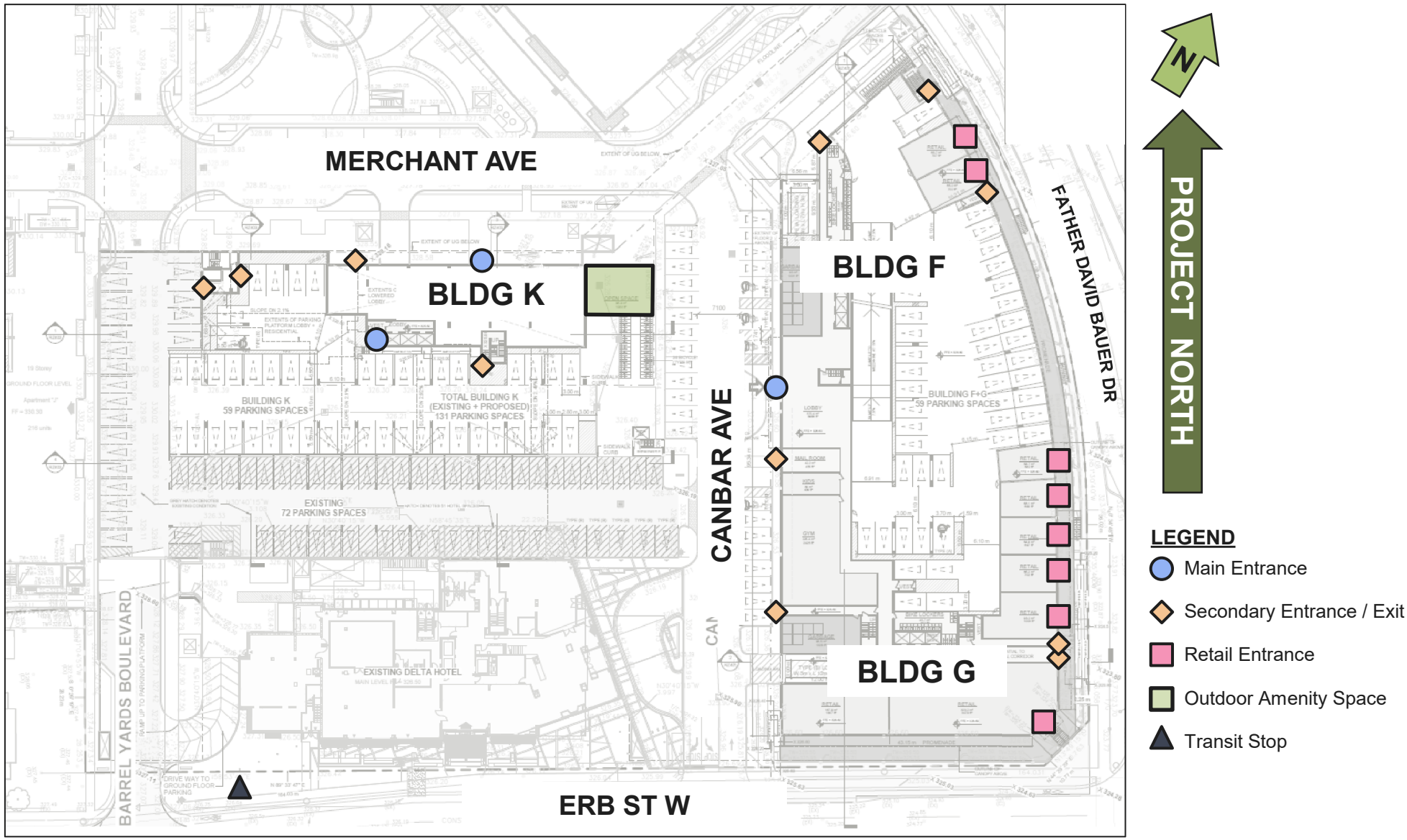


Figure 4a: Areas of interest – Grade level & Floor 2 (Building K)
Credit: Turner Fleischer

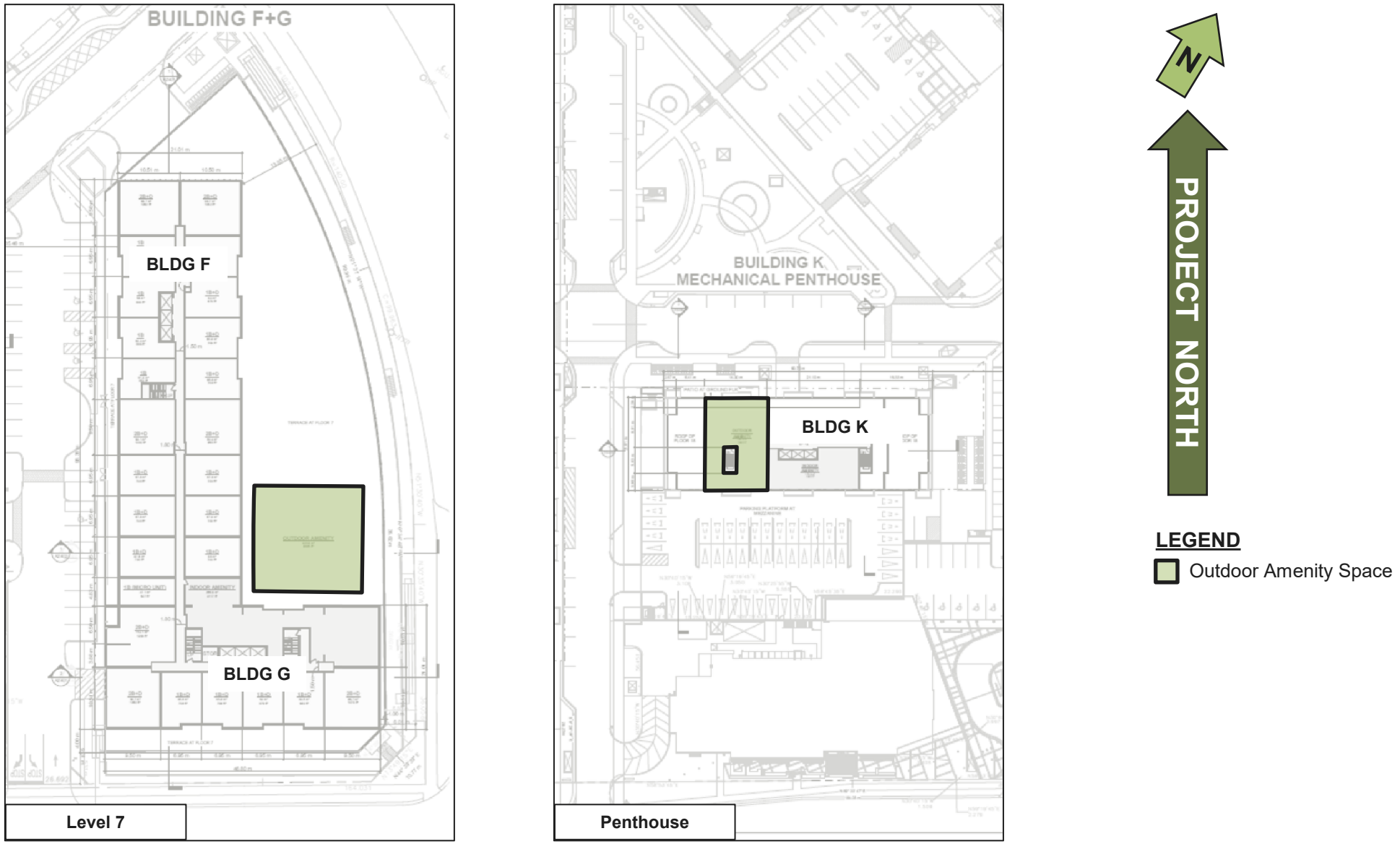


Figure 4b: Areas of interest – Above grade levels
Credit: Turner Fleischer

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, as well as an architectural drawing set, were provided by Turner Fleischer on November 27, 2024, and January 9, 2025, respectively. The simulations were performed using CFD software by Meteodyn Inc. and were conducted on January 21, 2025.

The 3D space throughout the modelled area (500 m radius from the proposed development) 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 modelled 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 3D model used in the wind comfort analysis for each configuration is 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.

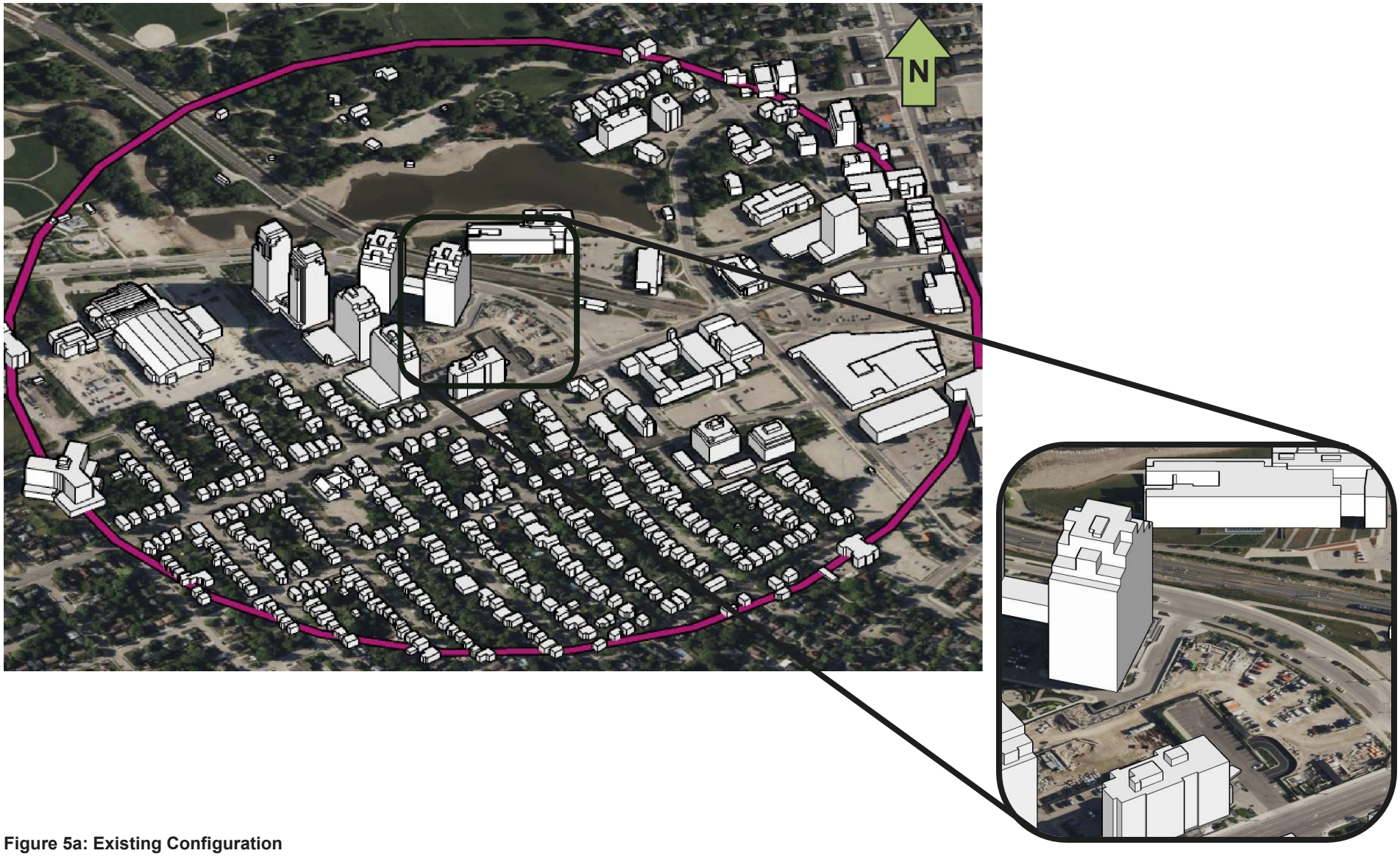


Figure 5a: Existing Configuration

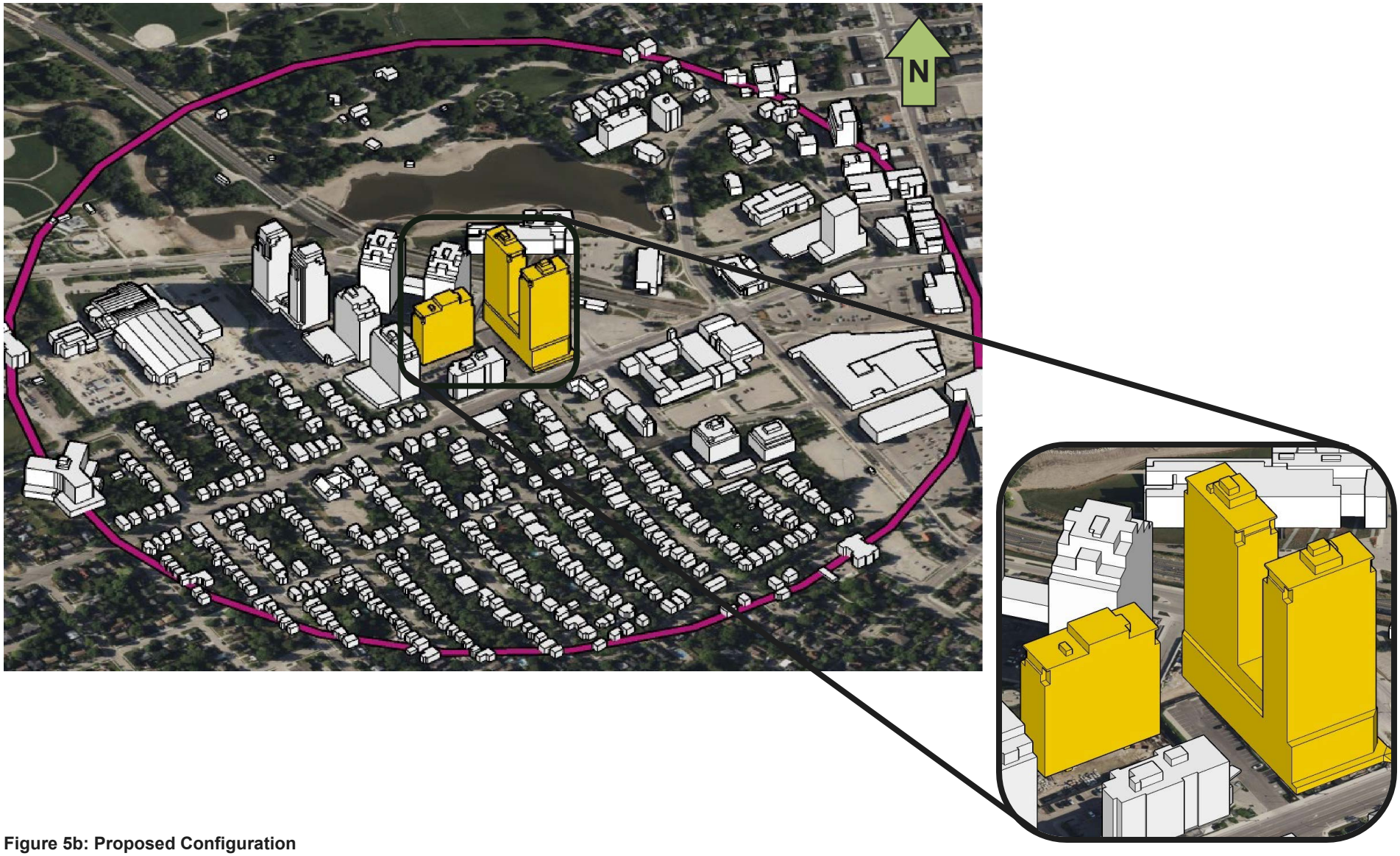


Figure 5b: Proposed Configuration

2.2 Wind Climate

Wind data recorded at Waterloo International Airport for the period of 1993 to 2020 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 winds approaching from the southwest through northwest and east 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, as well as from the east. All wind speeds and directions were included in the wind climate model.

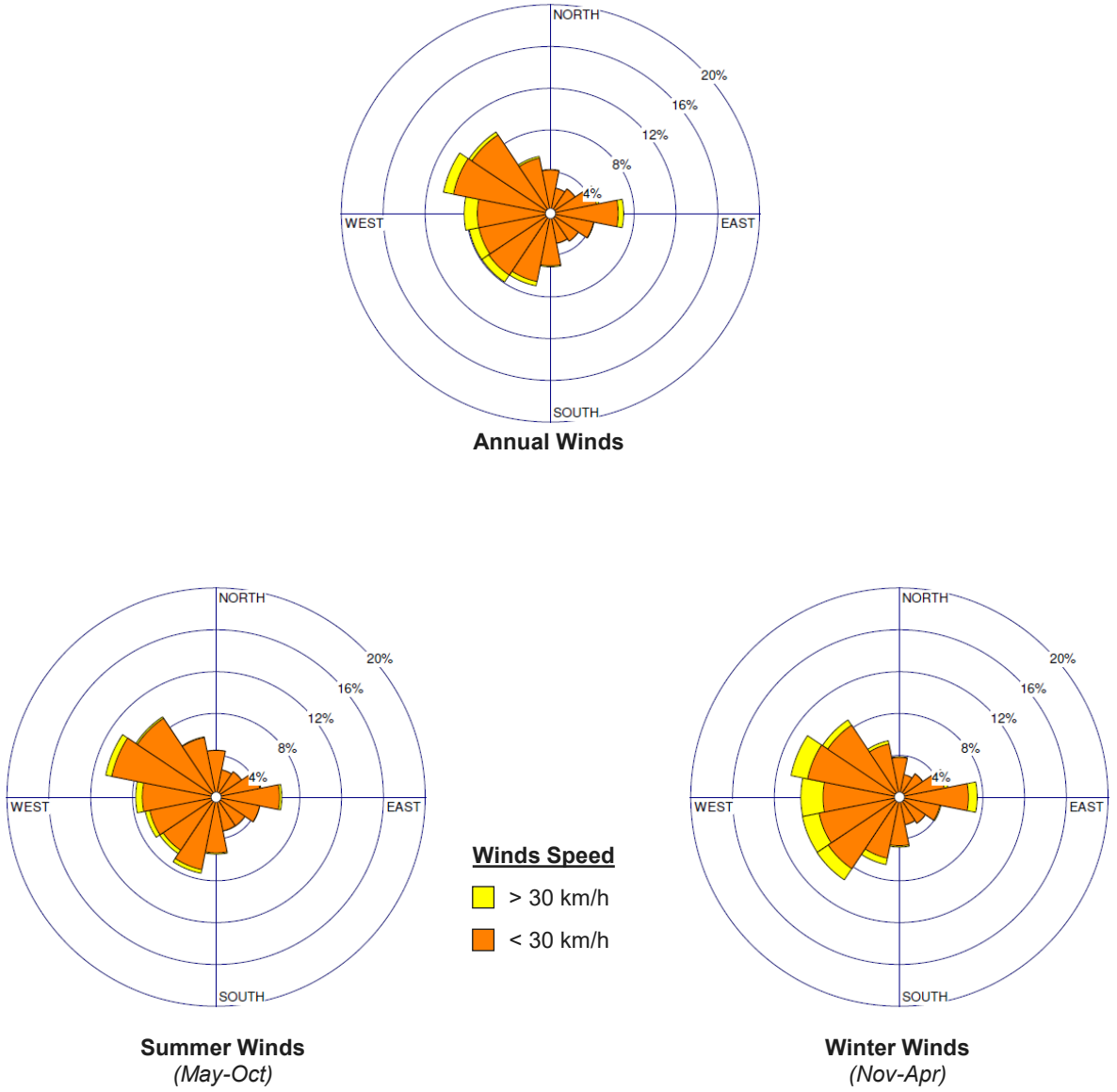


Figure 6: Wind roses for Waterloo International Airport (1993-2020)

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 are provided by the City of Waterloo, in the document *Terms of Reference: Wind Study (June 30, 2023).* The comfort criteria, which are 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 6:00 am and 11:00 pm. 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 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

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 11b present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. 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 conditions 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 generally expected to be comfortable for sitting in the summer (Figure 7a) and sitting or standing in the winter (Figure 8a).

In the Proposed Configuration, with the addition of the proposed development, on-site wind conditions are generally expected to continue to be suitable for standing or better year-round (Figures 7b and 8b). Wind conditions at the main entrance of Buildings F and G, as well as the main entrances of Building K, are expected to be suitable for standing or better throughout the year (Figures 9a and 9b). Wind conditions at the secondary entrances and exits as well as at the retail entrances on the promenade around Buildings F and G are anticipated to be suitable for standing or better throughout the year (Figures 9a, 9b, 10a, and 10b).

These wind conditions are considered appropriate for the intended use.

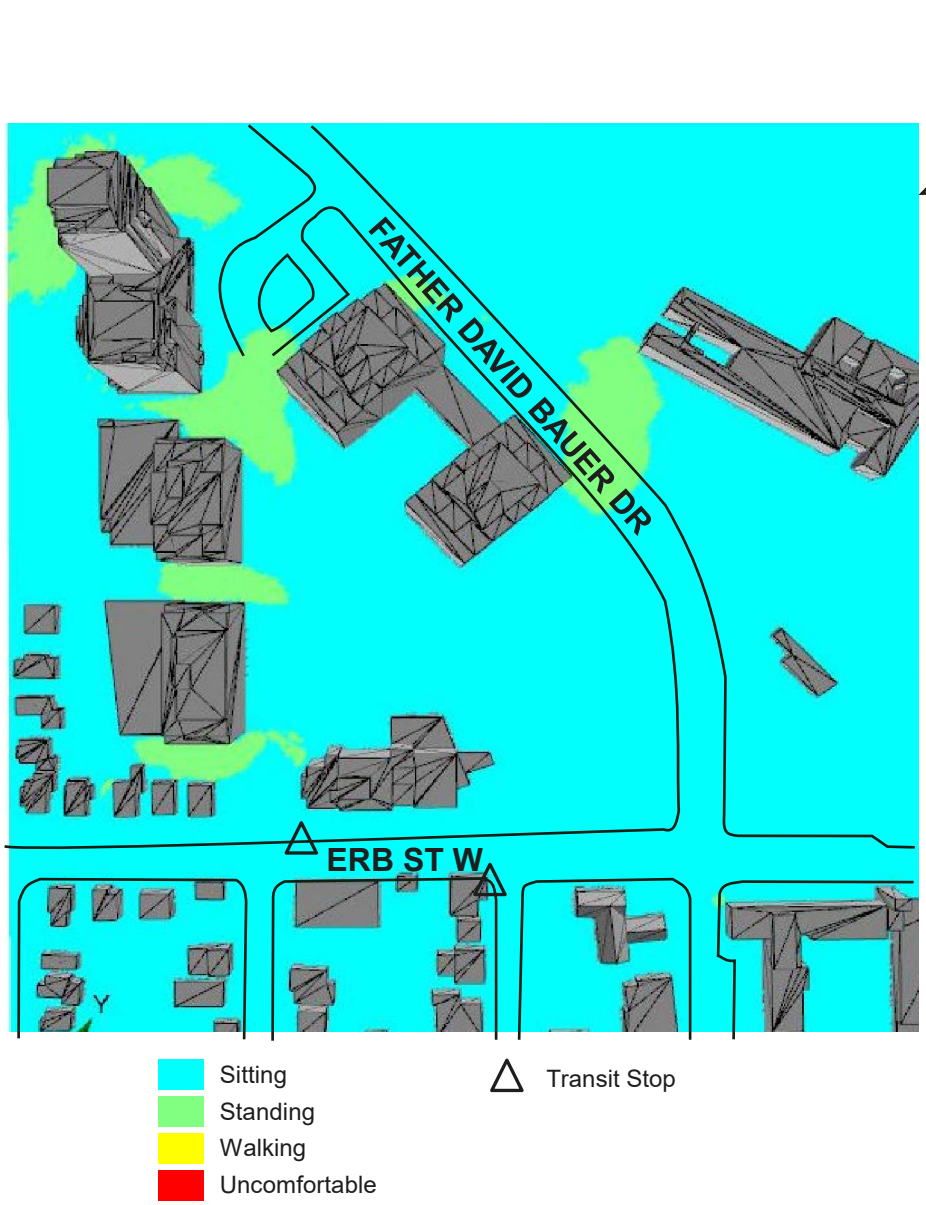


Figure 7a: Existing Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

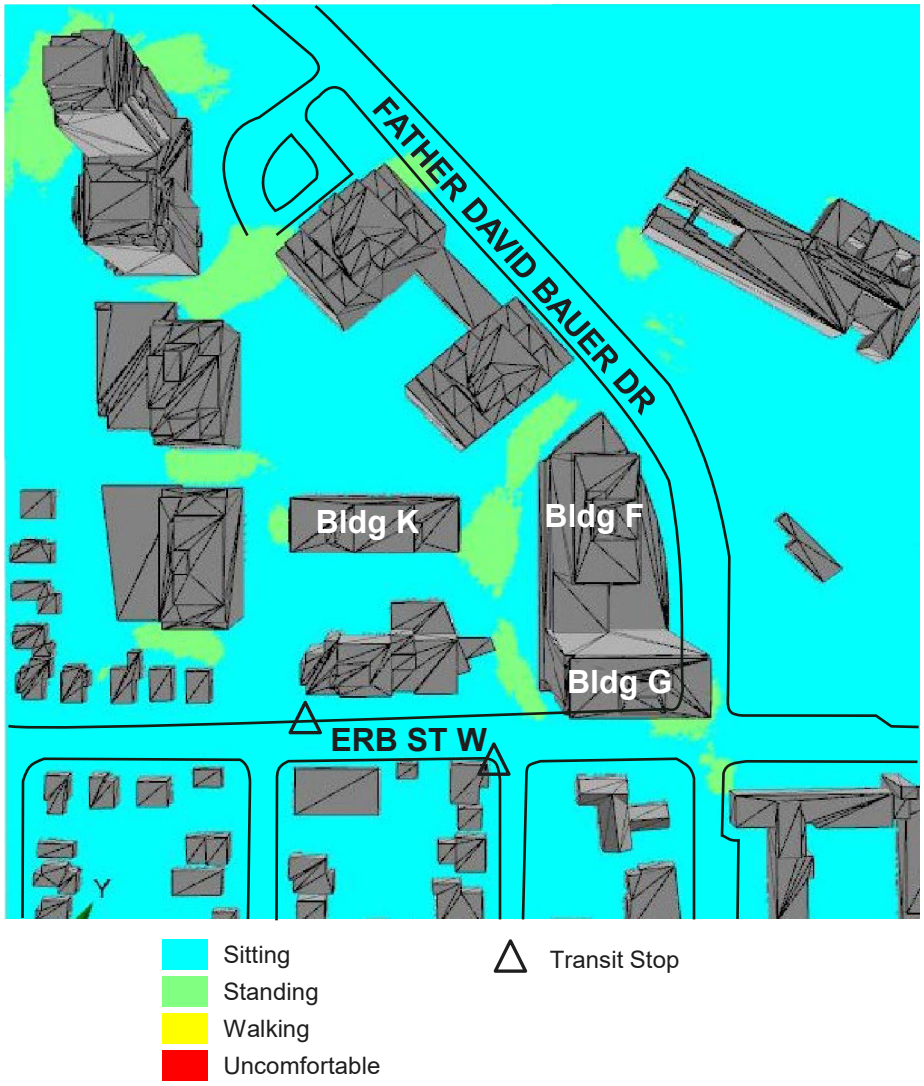


Figure 7b: Proposed Configuration – Pedestrian Wind Comfort Summer – On-site & Surrounding Areas

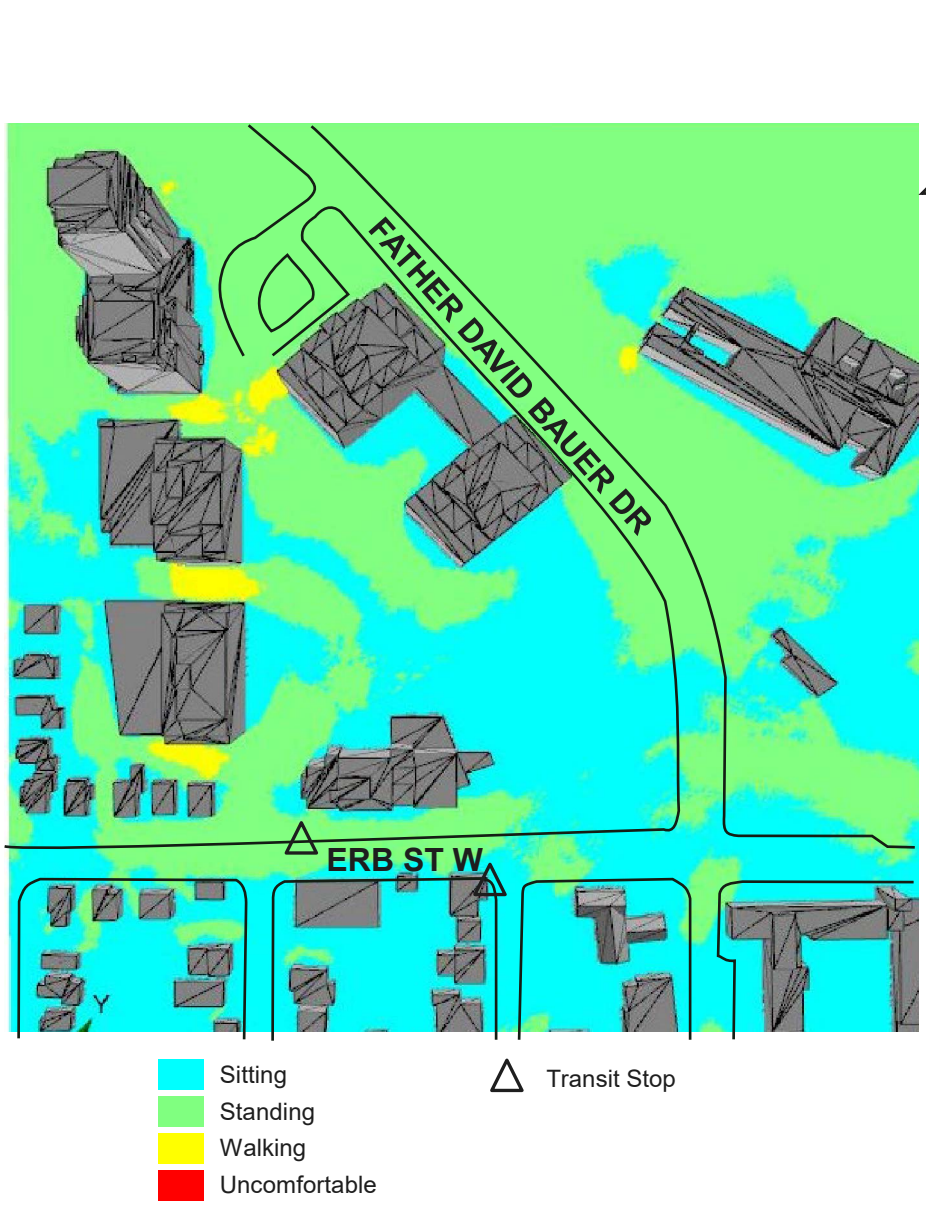


Figure 8a: Existing Configuration – Pedestrian Wind Comfort Winter – On-site & Surrounding Areas



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

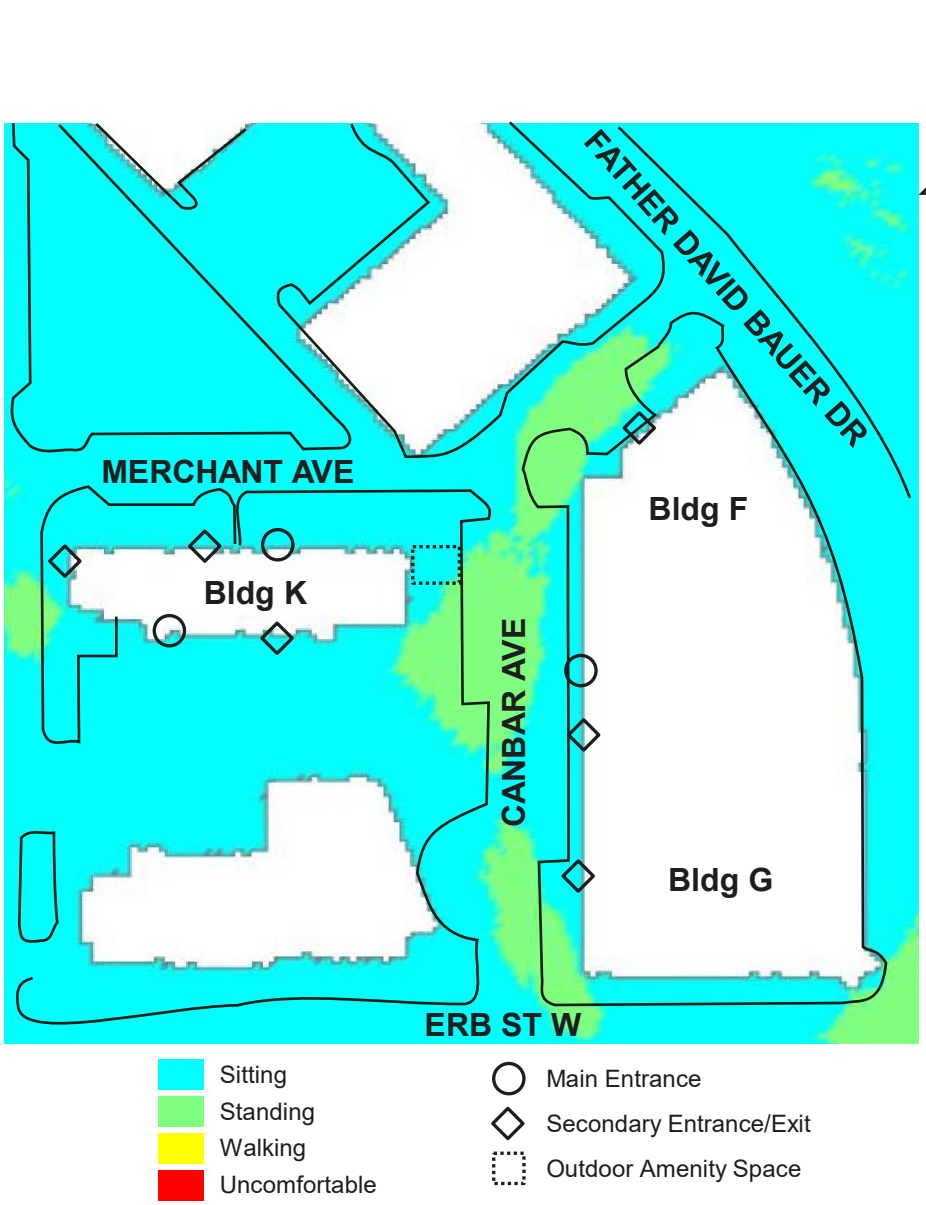


Figure 9a: Proposed Configuration – Pedestrian Wind Comfort Summer – Building Entrances & Walkways

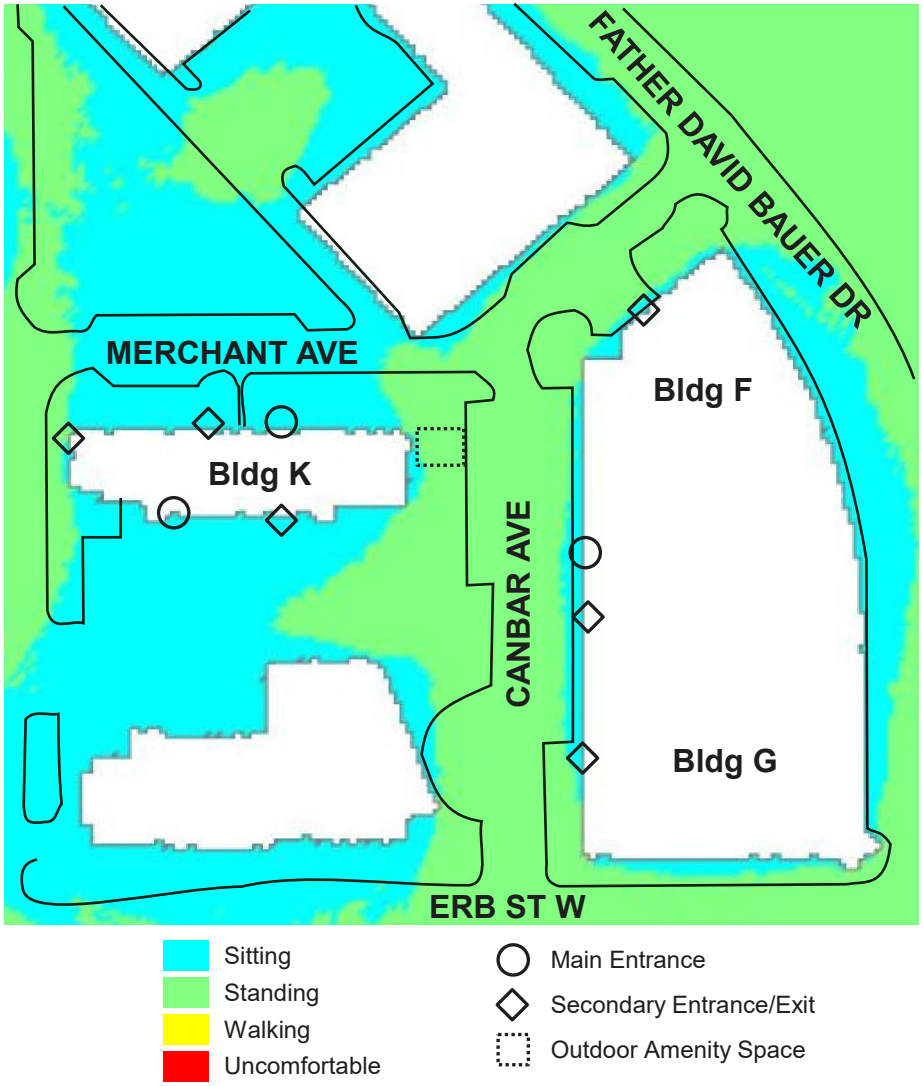


Figure 9b: Proposed Configuration – Pedestrian Wind Comfort Winter – Building Entrances & Walkways

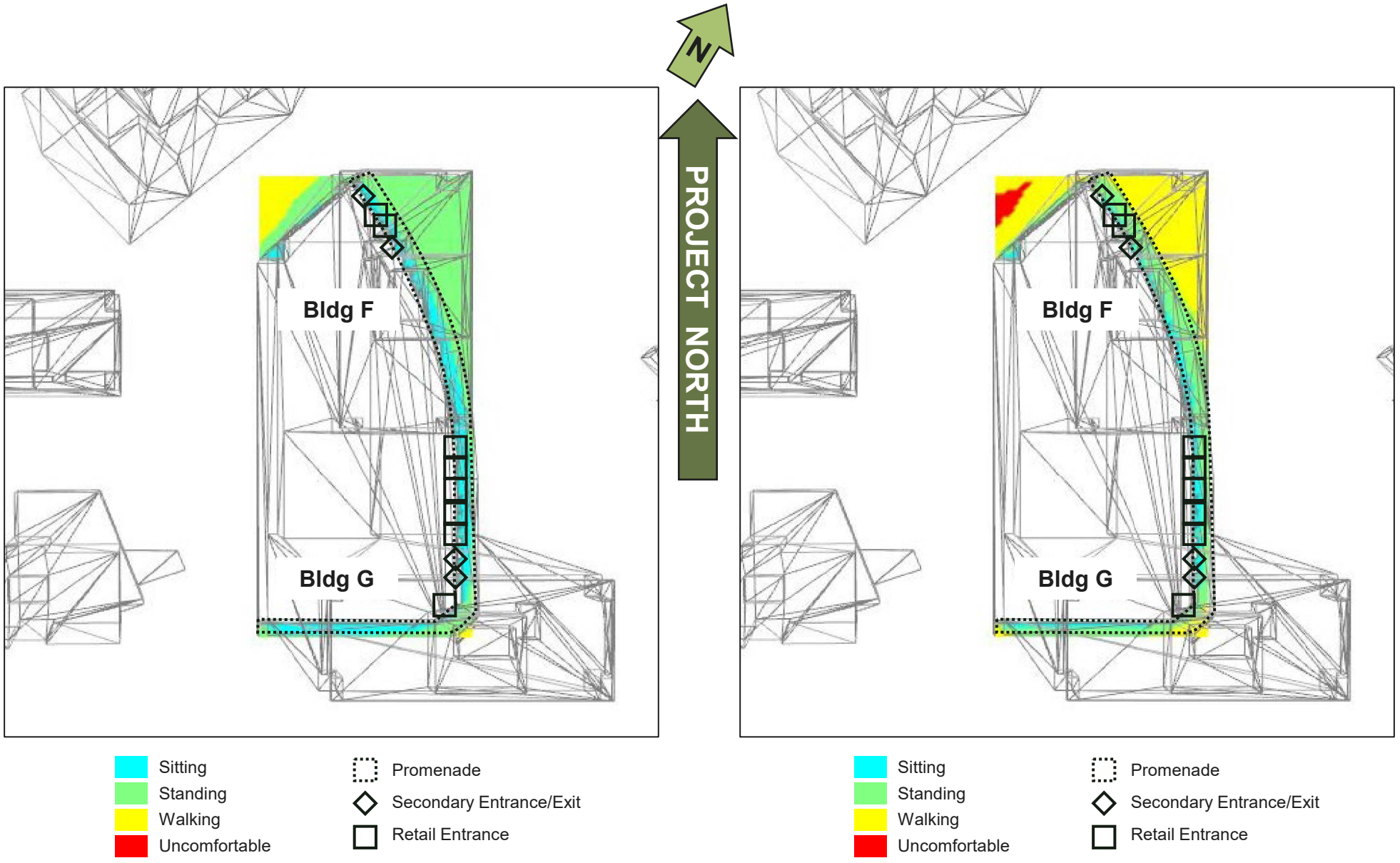


Figure 10a: Proposed Configuration – Pedestrian Wind Comfort Summer – Promenade of Buildings F and G

Figure 10b: Proposed Configuration – Pedestrian Wind Comfort Winter – Promenade of Buildings F and G

4.2 Outdoor Amenity Spaces

In the outdoor amenity space east of Building K along Canbar Avenue, wind conditions are predicted to be comfortable for sitting in the summer (Figure 8a), and for standing in the winter (Figure 8b). These wind conditions are considered appropriate for the intended use.

Wind conditions on the Level 7 outdoor amenity of Buildings F and G are expected to be suitable for standing in the summer (Figure 11a), which is suitable for the intended use. During the winter, wind conditions are anticipated to be suitable for walking or better (Figure 11b). These wind conditions are considered acceptable, as the area will be used infrequently in the winter.

Wind conditions on the penthouse level amenity terrace of Building K are mostly expected to be suitable for walking in the summer (Figure 11a), and uncomfortable in the winter (Figure 11b). To improve wind conditions in the summer season, recommendations are discussed in Section 4.4.

4.3 Surrounding Sidewalks

Existing wind conditions on the sidewalks surrounding the site are generally expected to be comfortable for sitting or standing in the summer (Figure 7a) and for walking or better in the winter (Figure 8a). In the Proposed Configuration, wind conditions comfortable for sitting or standing are anticipated in the summer, while in the winter wind conditions are expected to be conducive to walking or better (Figures 7b and 8b). These wind conditions are considered appropriate.

In both the Existing and Proposed Configurations, wind conditions at the nearby transit stops along Erb Street West are predicted to be comfortable for sitting in the summer (Figures 7a and 8a) and sitting or standing in the winter (Figures 7b and 8b), which is considered appropriate.

4.4 Wind Safety

In the Existing Configuration, the wind safety criterion is expected to be met in all areas, except for two off-site areas in the extended surroundings at the northeast corner of the Cooperage Buildings, as well as the northwest corner of The Onyx Buildings (Figure B1a in Appendix B).

In the Proposed Configuration, the wind safety criterion was generally predicted to be met in all areas at grade on an annual basis. The exceptions remain at the northeast corner of the Cooperage Buildings, as well as the northwest corner of The Onyx Buildings (Figure B1b in Appendix B). There is also the potential for the safety criterion to be exceeded around the northeast corner of Buildings F and G on the promenade, as well as on the penthouse level outdoor amenity terrace of Building K (Figures B2a and B2b in Appendix B).

The exceedance around the northeast corner at the promenade is the result of the strong westerly winds that are intercepted at higher elevations by the building and redirected to grade (known as downwashing flow). These winds then accelerate around the northeast corner of the building. To improve wind safety in this area, we recommend installing wind screens around the northeast corner of the podium at grade, to disrupt the accelerating wind flows around that corner.

The exceedance of the safety criterion on the penthouse level outdoor amenity terrace is due to the overall exposure of the terrace to the strong prevailing winds that occur at higher elevations. To improve wind safety on this terrace, we recommend installing tall wind screens around the perimeter of the terrace, to provide local shelter from the winds.



Figure 11a: Proposed Configuration – Pedestrian Wind Comfort Summer – Amenity Terraces

Figure 11b: Proposed Configuration – Pedestrian Wind Comfort Winter – Amenity Terraces

5.0 Conclusion & Recommendations

The pedestrian wind conditions predicted for the proposed Barrel Yards development in Waterloo have been assessed through qualitative CFD modelling techniques. Based on the results of our assessment, the following conclusions have been reached:

- The wind safety criterion is generally expected to be met in most areas assessed in the Existing Configuration. In the Proposed Configuration, the wind safety criterion is generally expected to be met in most areas assessed. The exceptions include the existing concerns at the Onyx and Cooperage, as well as at the northeast corner of Buildings F and G on the promenade. The safety criterion is also predicted to be exceeded in the penthouse level of Building K. Recommendations are provided.
- Wind conditions in the Existing Configuration are expected to be suitable for the intended use throughout the year, including the nearby sidewalks and transit stops.
- With the proposed development in place, wind conditions are anticipated to be suitable for the intended use year-round, including all building entrances and exits, the outdoor amenity at grade, nearby sidewalks and transit stops.
- Wind conditions on the Level 7 amenity terrace of Buildings F and G are anticipated to be suitable for the intended use. Windier than desired wind conditions are expected in the penthouse amenity terrace of Building K. Recommendations are provided.
- We recommend confirming these wind conditions through quantitative wind tunnel analysis as the project progresses to the SPA stage. SLR will work with the design team to help develop appropriate wind control measures, where necessary.

6.0 Statement of Limitations

This report has been prepared by SLR Consulting (Canada) Ltd. (SLR) for Auburn Developments (Client) in accordance with the scope of work and all other terms and conditions of the agreement between such parties. SLR acknowledges and agrees that the Client may provide this report to government agencies, interest holders, and/or Indigenous communities as part of project planning or regulatory approval processes. Copying or distribution of this report, in whole or in part, for any other purpose other than as aforementioned is not permitted without the prior written consent of SLR.

Any findings, conclusions, recommendations, or designs provided in this report are based on conditions and criteria that existed at the time work was completed and the assumptions and qualifications set forth herein.

This report may contain data or information provided by third party sources on which SLR is entitled to rely without verification and SLR does not warranty the accuracy of any such data or information.

Nothing in this report constitutes a legal opinion nor does SLR make any representation as to compliance with any laws, rules, regulations, or policies established by federal, provincial territorial, or local government bodies, other than as specifically set forth in this report. Revisions to legislative or regulatory standards referred to in this report may be expected over time and, as a result, modifications to the findings, conclusions, or recommendations may be necessary.

Appendix A

Pedestrian Wind Safety Analysis
Annual

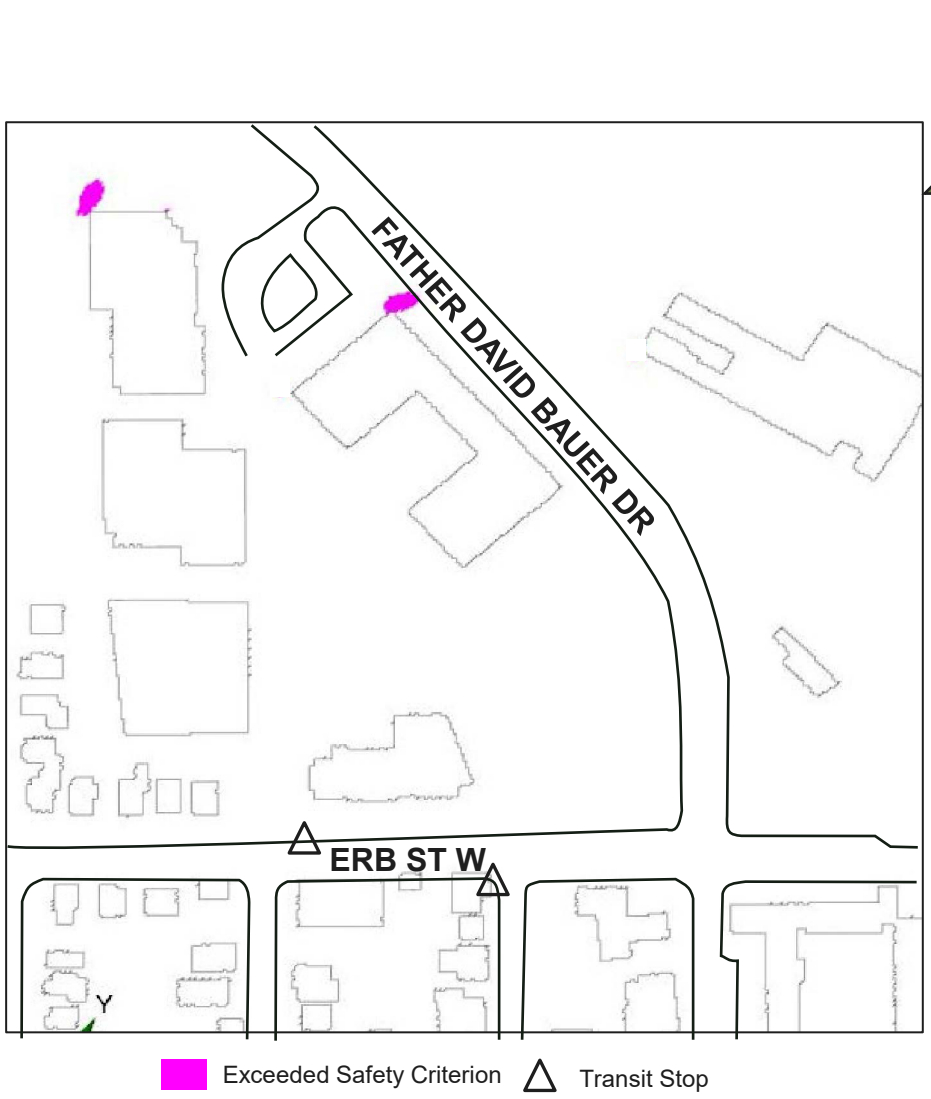


Figure A1a: Existing Configuration – Wind Safety Annual – On-site & Surrounding Areas

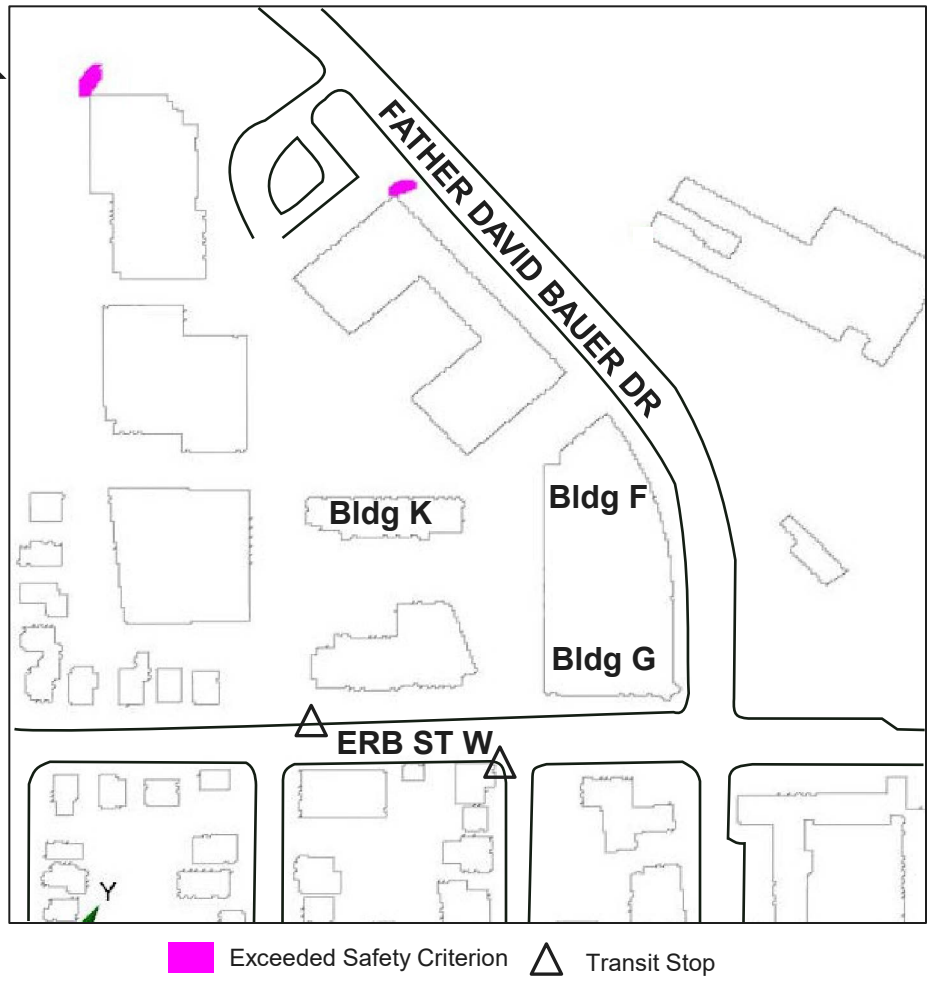


Figure A1b: Proposed Configuration – Wind Safety Annual – On-site & Surrounding Areas

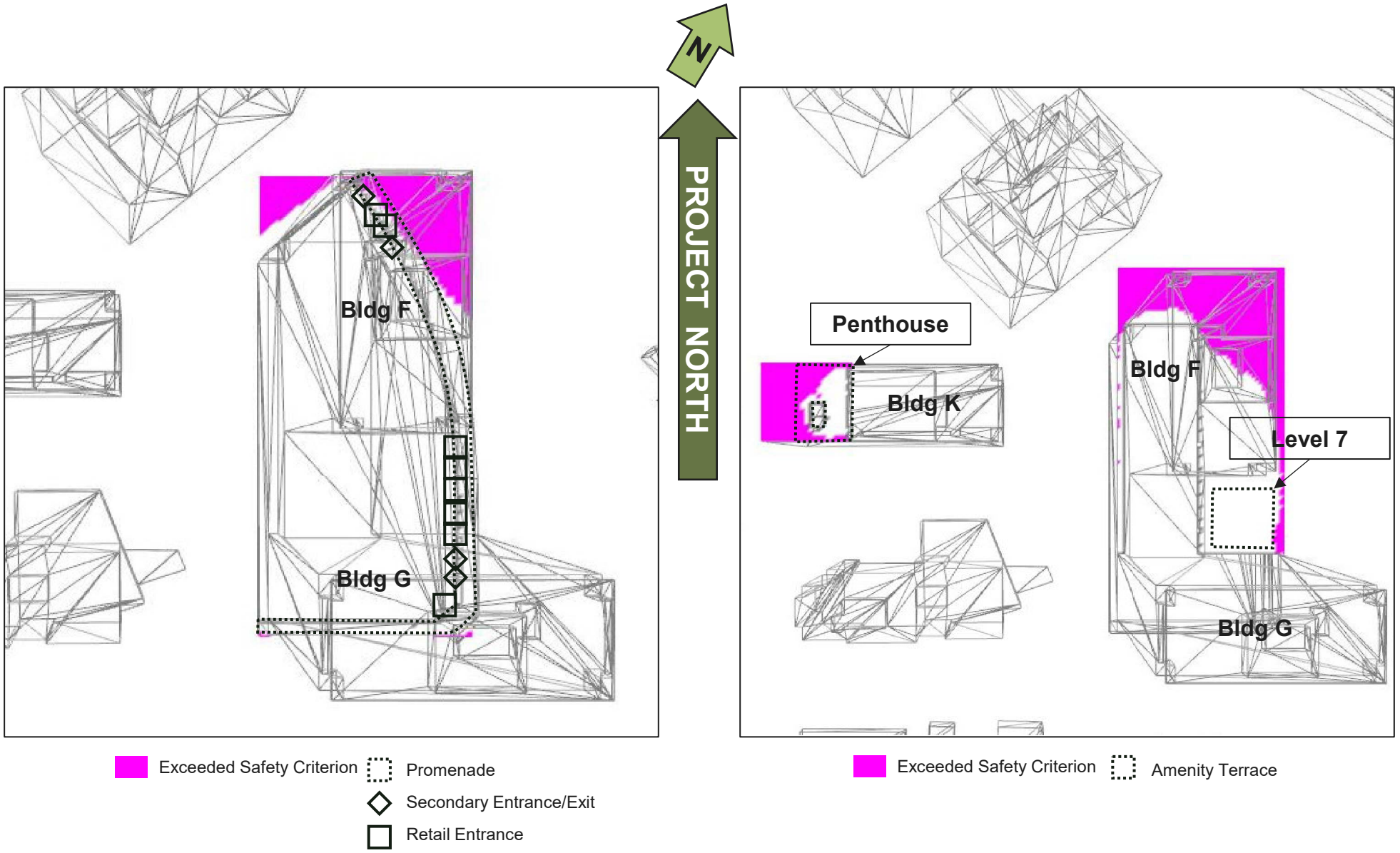


Figure A2a: Proposed Configuration – Wind Safety Annual– Promenade of Buildings F and G

Figure A2b: Proposed Configuration – Wind Safety Annual– Amenity Terraces