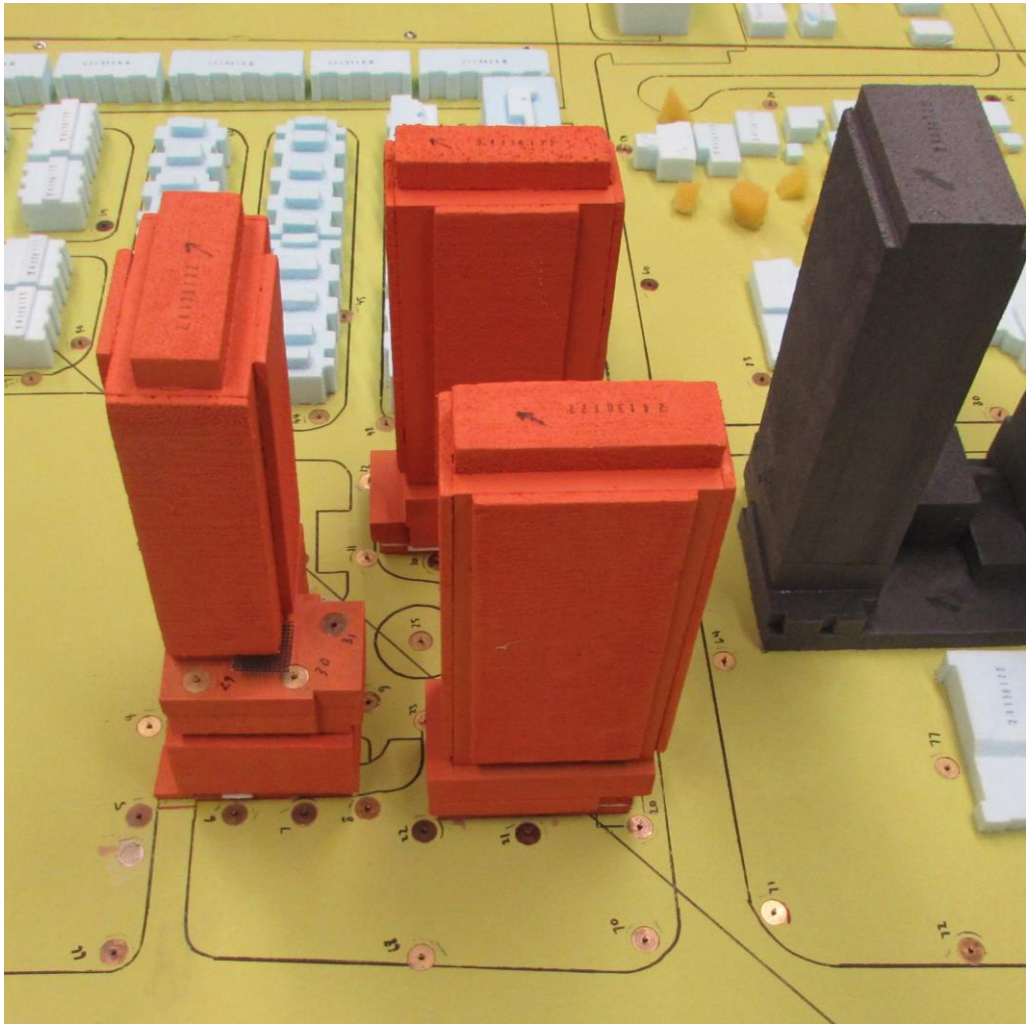
100 Stone Road West, Suite 201
Guelph, Ontario, N1G 5L3
226.706.8080 | www.slrconsulting.com

Date: February 28, 2023

Re: **Pedestrian Wind Study**
1120 Cooke Boulevard
Burlington, ON
SLR Project #241.30122.00000



Prepared by

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For

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Version	Date
Draft 0.1	February 13, 2023
Final 1.1	February 23, 2023
Final 1.2	February 28, 2023

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by ADI Development Group to conduct a pedestrian wind study for the 1120 Cooke Boulevard in Burlington, Ontario. This report is in support of the Zoning Bylaw Amendment (ZBA) resubmission application for the development. SLR previously conducted a wind tunnel study of the proposed development for the initial ZBA submission in June 2021.

1.1 Existing Site

The proposed development is located at 1120 Cooke Boulevard, at the northeast corner of the intersection of Waterdown Road and Masonry Court in Burlington. The site is currently unoccupied. Figure 1 provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated July 2022. Some of these images are included in Figures 2a through 2d.

Immediately surrounding the site is an aggregate business to the south through west, a water reservoir to the northwest, low and mid-rise residential buildings to the northeast, with low-rise commercial buildings and their parking lots to the east and southeast. Beyond the immediate surroundings there are low-rise residential buildings to the northeast through south to southwest, with farmland to the west through north. Lake Ontario is located approximately 1.0 km to the southeast.

Typically, developments under construction and those with Site Plan Approval (SPA) are included as existing surroundings for the analysis. For this study developments included: 101 Masonry Court, and 1085 Clearview Avenue. In addition, the following developments were included per the City's instructions: 35 - 71 Plains Road East, 1025 Cooke Boulevard, 35-71 Plains Road, 1029-1033 Waterdown Road, and 1062-1074 Cooke Boulevard.



Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 10/4/2022



Figure 2a: Looking northwest along Cooke Boulevard at the site



Figure 2b: Looking northeast along Masonry Court (site on left)



Figure 2c: Looking northwest along Waterdown Road (site on right)



Figure 2d: Looking southeast along Waterdown Road

1.2 Proposed Development

The proposed development includes three buildings:

- Building A is 34-storeys tall and located on top of an 'L' shaped 12-storey podium at the northwest corner of the site.
- Building B is 30-storeys tall and is located on the east edge of the site atop a 'L' shaped six-storey podium.
- Building C is also 32-storeys tall and located on the west edge of the site, on top of a 'L' shaped six-storey podium.

Figure 3 shows the physical model 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 two transit stops along Waterdown Road, south of the proposed development. The main residential entrances to Building A are located on the east and west facades, with secondary entrances and exits on the west side of the building. The main residential entrances to Building B are located on the east and west facades, with retail entrances near the southwest and southeast corners of the building, and secondary entrances and exits on the west and east facades. For Building C, the main residential entrance is near the northeast corner, with retail entrances near the southeast corner and secondary entrances and exits on the west facade. The on-site areas are shown in Figure 4a.

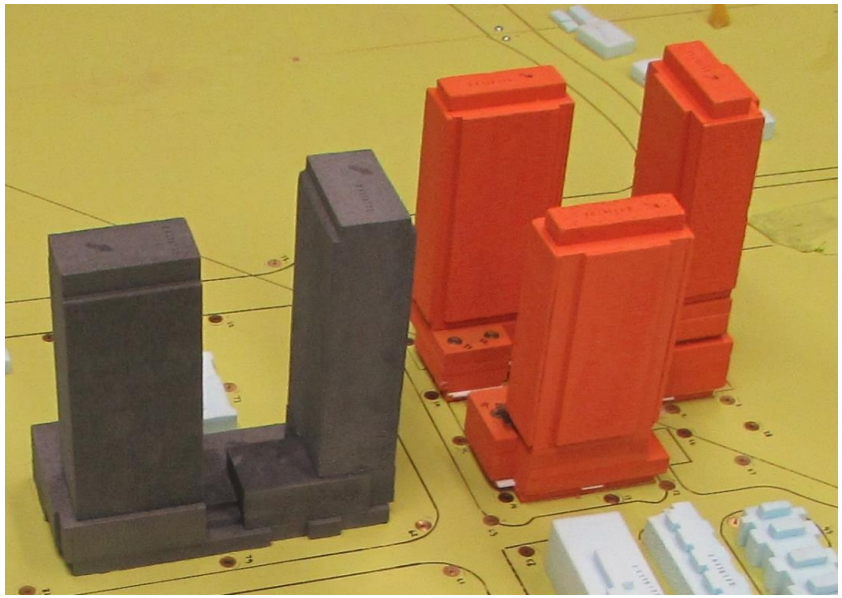


Figure 3: Proposed development in wind tunnel (orange buildings)

Amenity terraces associated with the new development are located on Level 13 of Building A and Level 7 of Buildings B and C. At grade level, there are outdoor amenity areas between Buildings A and C, as well as along the west side of Building B. There is also a plaza between Buildings B and C on the south edge of the site. These areas are shown in Figures 4a and 4b.

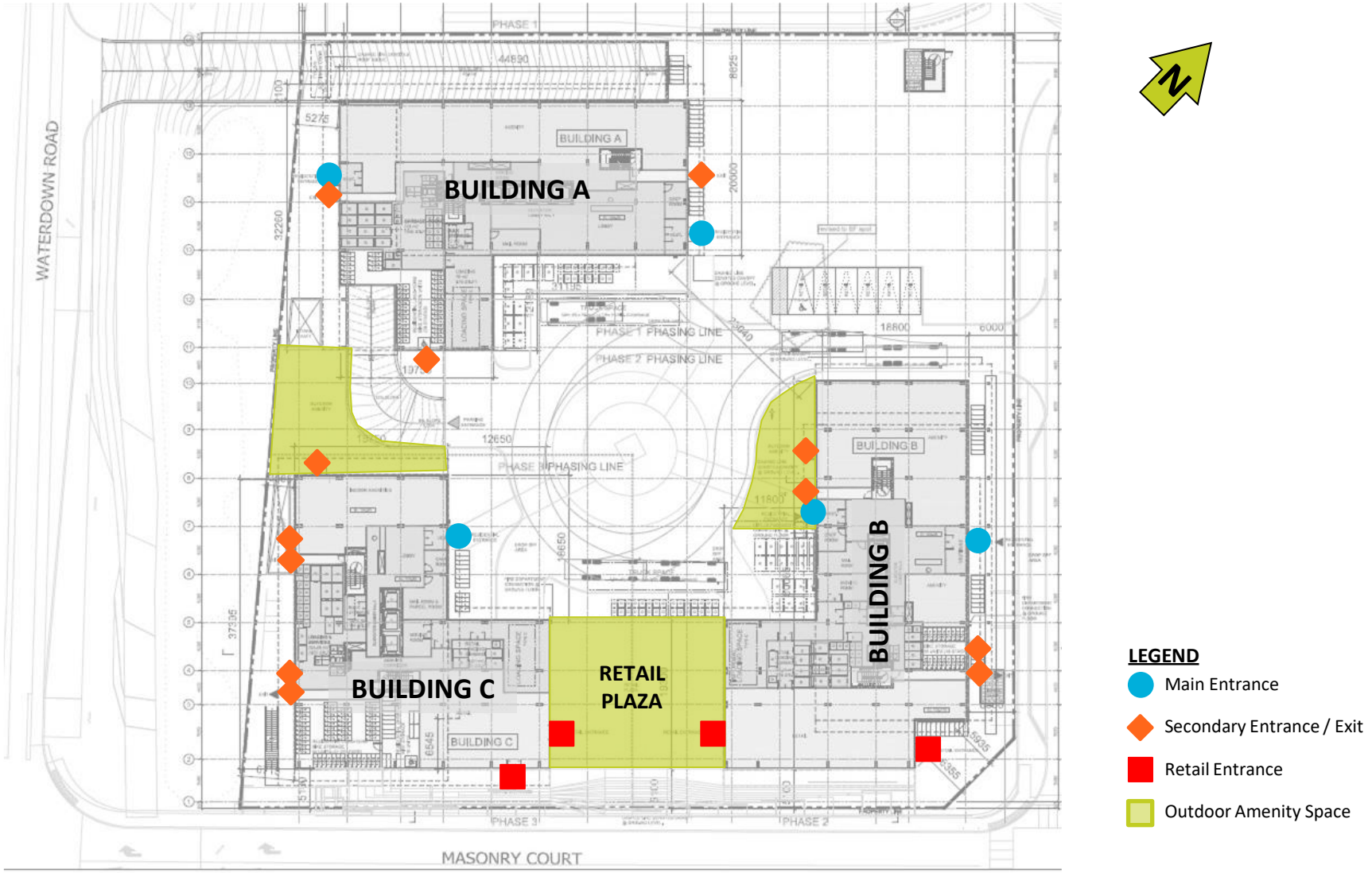


Figure 4: Areas of Interest

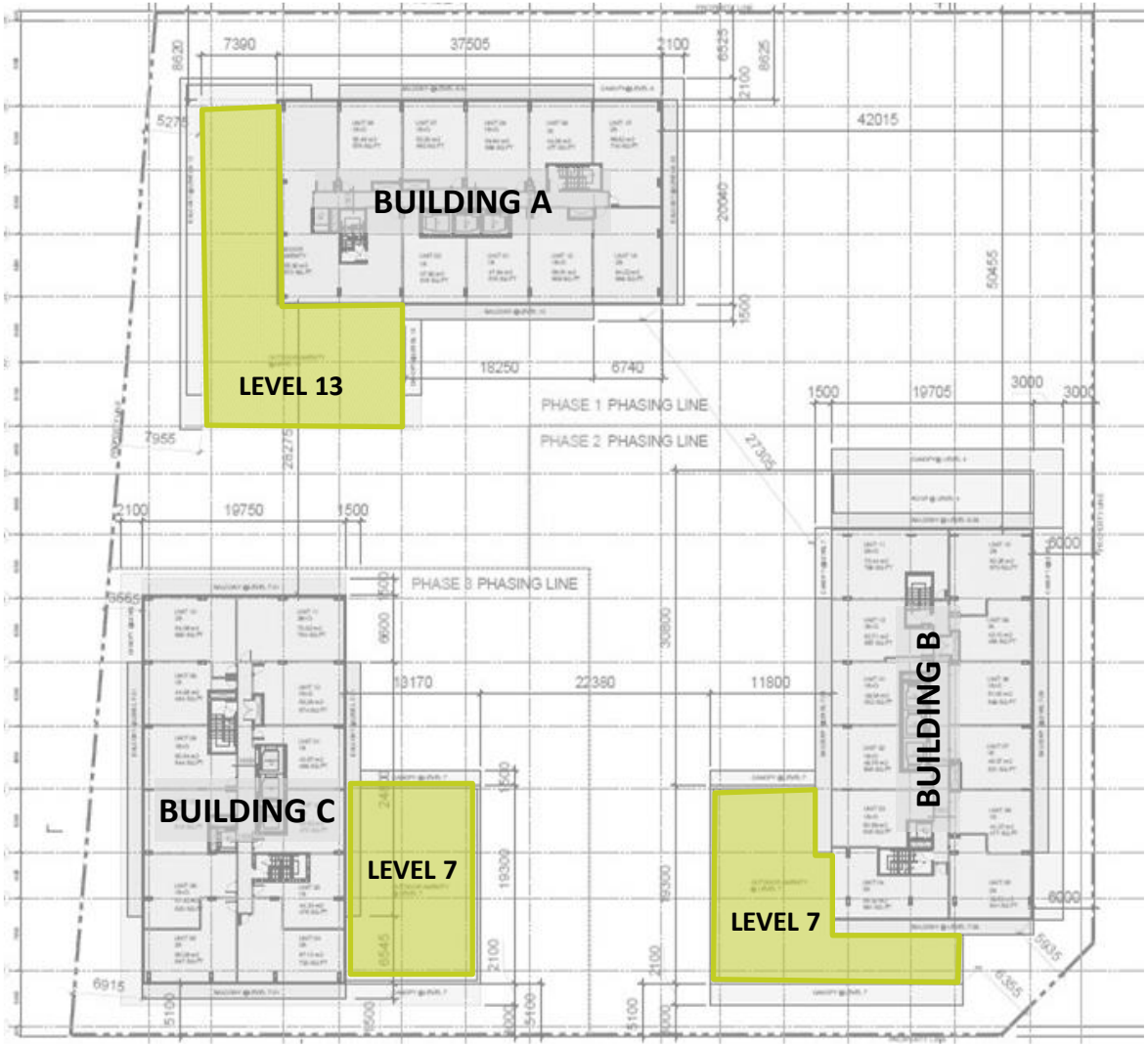


Figure 4: Areas of Interest – Above Grade Amenity

2.0 APPROACH

The objective of the wind tunnel study is to assist the design team and City Planning officials in making informed decisions about the building form considered and its influence on pedestrian comfort. This quantitative analysis involves the construction of a physical model of the development and surrounding features that influence wind flow. The physical model is instrumented with probes and tested in a wind tunnel. Afterwards, the wind tunnel data are combined with regional meteorological data; this analysis is then compared to the relevant wind criteria and standards in order to determine how appropriate the wind conditions are for the intended pedestrian usage.

2.1 Scale Model Construction

A 1:400 scale model of the 1120 Cooke Boulevard Development was constructed based on up-to-date drawing information received by SLR on February 1, 2023.

The proximity model of the surrounding area was built in block form for a radius of approximately 480 m from the site centre. As existing buildings surrounding the site will influence wind characteristics, existing buildings, buildings with Site Plan Approval (SPA), and those requested by the City were included in the model for both the Existing and Proposed Configurations. Information regarding which approved developments to include within the existing surrounds was determined using the City of Burlington website, as well as discussion with the design team. A list of the approved surrounding development applications was provided to the City Planner for review and comment. Grade differences within the limits of the model were found to be minor, thus the site was modeled as flat.

SLR tested two configurations in the wind tunnel. The descriptions are below:

- **Existing Configuration:** Existing site with existing and approved future surroundings.
- **Proposed Configuration:** proposed development with existing and future approved surroundings.

Photographs of the wind tunnel model showing both the Existing and Proposed Configurations are included in **Figures 5a** and **5b**.

2.2 Wind Tunnel

Wind tunnel tests were conducted in the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory at the University of Western Ontario. The upstream test section of the wind tunnel included generic roughness blocks and turbulence-generating spires to modify the wind flow approaching the model. These features develop characteristics of the wind flow that are similar to the actual site. The test model is rotated on a turn-table to simulate different wind directions with the upstream terrain being changed as appropriate to reflect the various upwind conditions encountered around the site.

The test model was equipped with 85 omni-directional probes to record wind speed at the pedestrian-level (approximately 1.5 m above grade). The orientation of the model was rotated in 10° intervals on the turn-table to permit measurement of wind speed at each probe location for 36 wind directions. The wind tunnel data were then combined with the wind climate model for this region to predict the occurrence of wind speeds in the pedestrian realm and compare against wind criteria for comfort and safety.





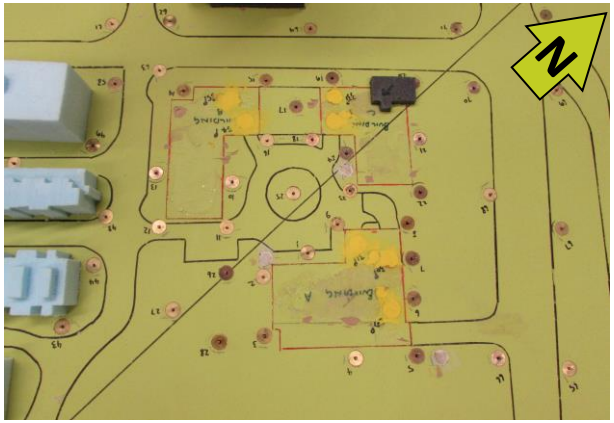


Figure 5a: Existing Configuration





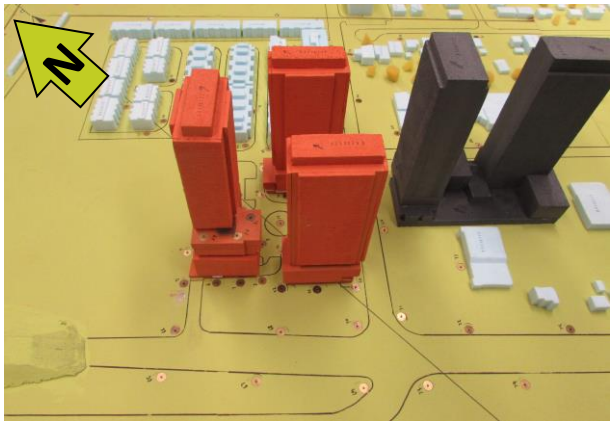


Figure 5b: Proposed Configuration

WIND CLIMATE

Wind data recorded at John C. Munro International Airport in Hamilton for the period of 1993 to 2019 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 and northeast quadrants are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year. The seasonal wind roses show daytime winds, from 6:00 – 23:00, while the annual wind rose shows all hours.

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 southwest and northeast quadrants. All wind speeds and directions were included in the wind climate model.

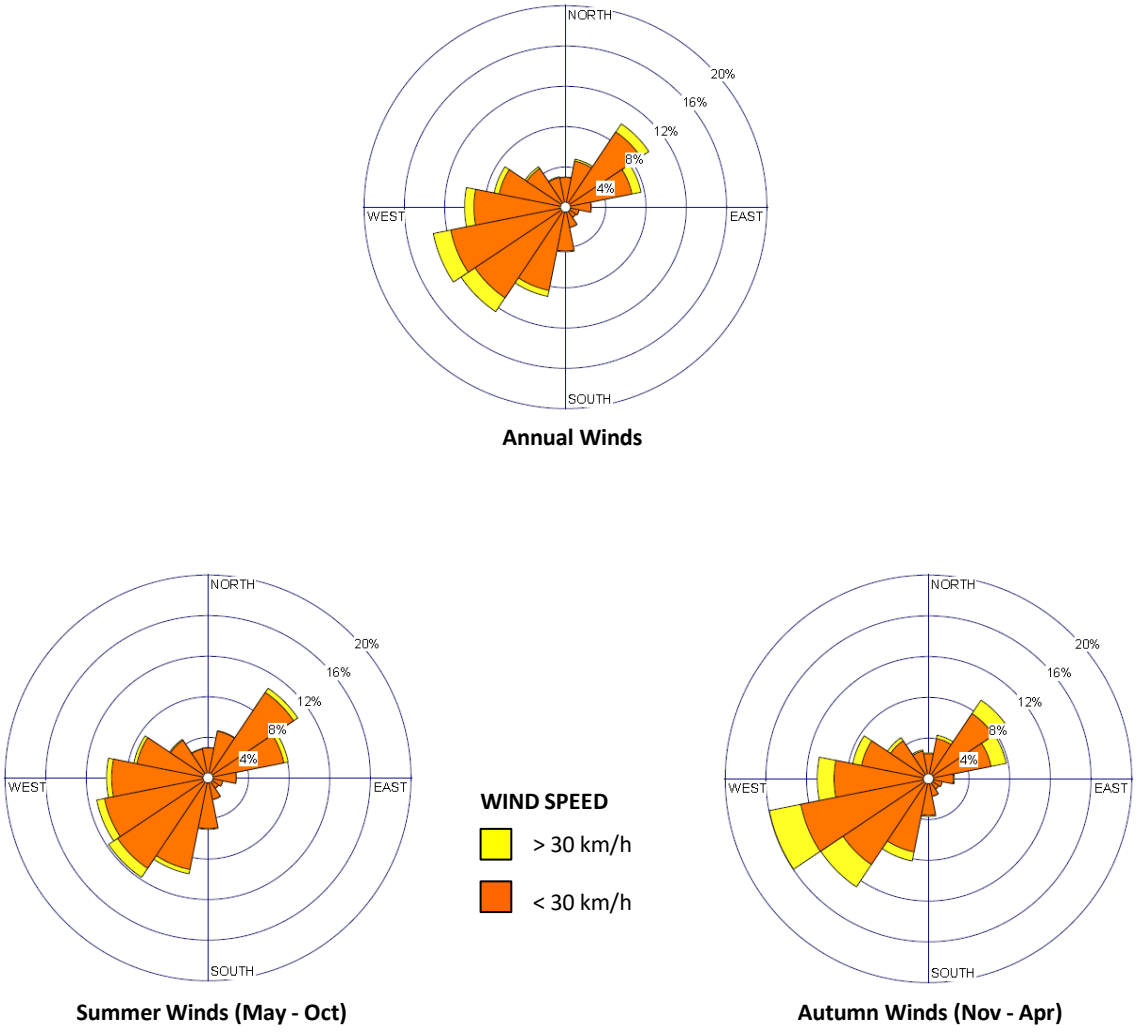


Figure 6: Wind Roses for John C. Munro International Airport (1993-2019, 6am–11pm)

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 Burlington, in the document *Pedestrian Level Wind Study Guidelines and Terms of Reference (June 2020).* 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 comfortably.
Standing	0 to 14 km/h	0 to 3.9 m/s	Gentle breezes suitable for main building entrances and transit stops.
Leisurely Walking	0 to 17 km/h	0 to 4.7 m/s	Moderate breezes suitable for walking along pedestrian thorough fares.
Fast Walking	0 to 20 km/h	0 to 5.6 m/s	Strong 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 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. The "comfort zones" shown are based on an integration of wind speed and frequency for all 36 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. The annual wind safety conditions are presented in Figures 11a and 11b for the Existing and Proposed Configurations. Full detailed results for the summer and winter can be found in Appendix A.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. For example, for public sidewalks, wind comfort suitable for **fast 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 parks **sitting** and/or **standing** would be appropriate in the summer.

Note, Project North is approximately 42° counter-clockwise from True North. When referring to the building, Project North is used; when referring to wind directions, True North is used.

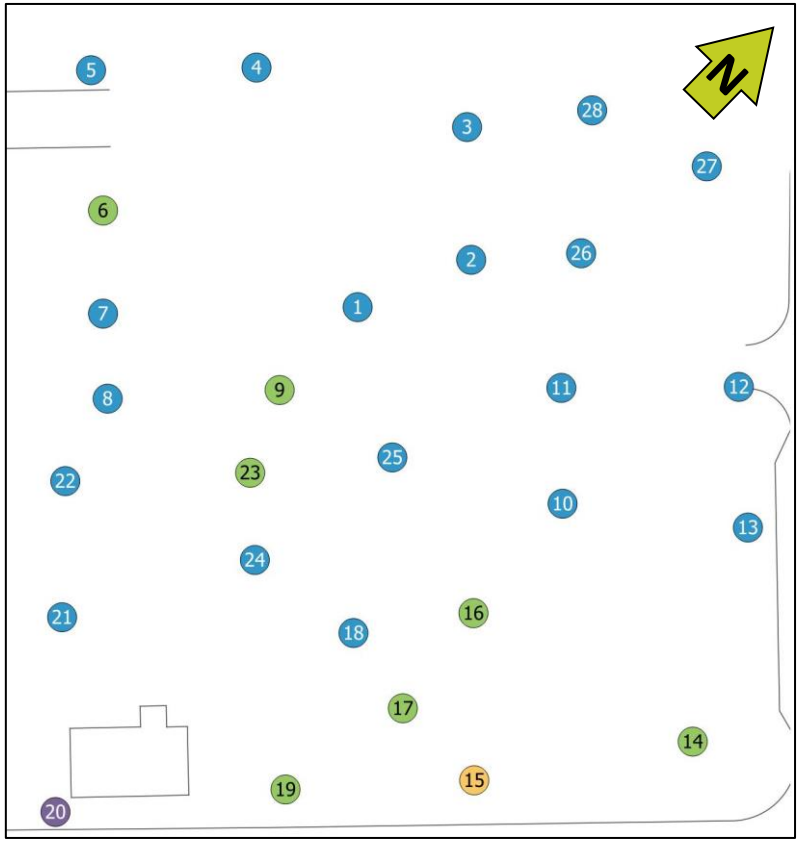
4.1 Building Entrances & Walkways (Locations 1-28)

Existing wind conditions on-site are suitable for sitting or standing in the summer. In the winter, wind conditions are conducive to fast walking or better. Uncomfortable wind conditions occur near the south end of the site (Locations 15, 17 and 19), during winter months (Figure 8a).

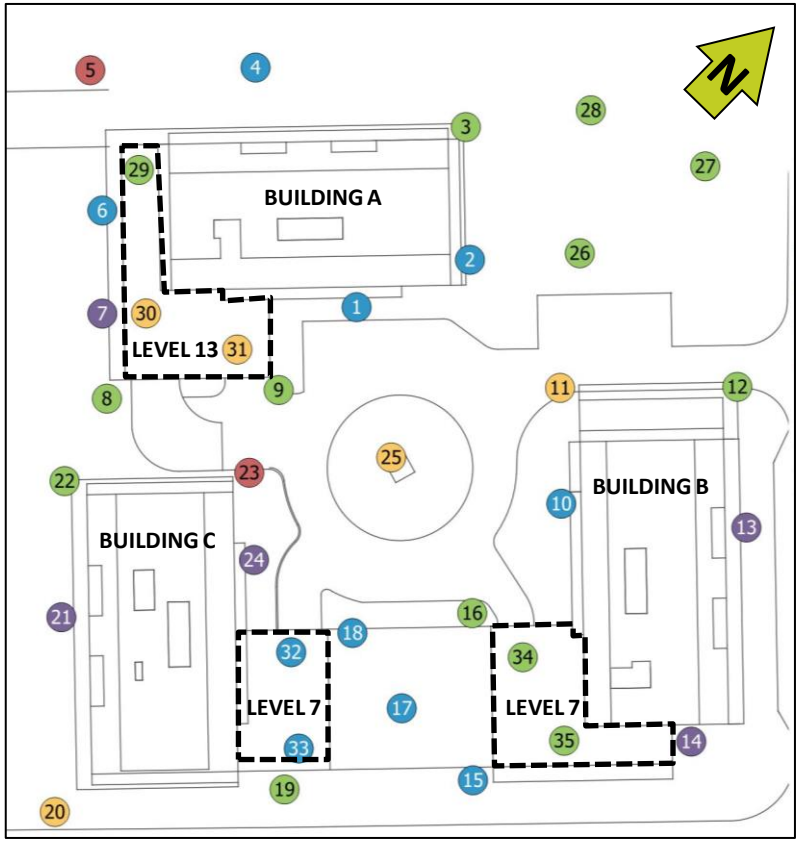
In the Proposed Configuration, wind conditions on-site are generally comfortable for leisurely walking or better in the summer (Figure 7b). The exceptions are at the northwest corner of Building B (Location 11), the southwest corner of Building C (Location 20) and on the central driveway (Location 24) where wind conditions are conducive to fast walking in the summer (Figure 7b). Also, uncomfortable wind conditions occur at the northwest corner of Building A (Location 5) and the northeast corner of Building B (Location 23) in the summer.

During the winter, wind conditions are generally suitable for fast walking or better on-site (Figure 8b). However, wind conditions are uncomfortable near building corners, in the area to the west of Building A and in the central area between Buildings A and C (Locations 3, 5, 8, 9, 11, 12, 16, 20, 23, 25, 27 and 28 in Figure 8b).

At the residential entrances to Building A (Locations 2 and 6), wind conditions are comfortable for standing in the summer and leisurely walking or better in the winter. At the residential entrances to Building B (Locations 10 and 13), wind conditions are comfortable for standing or sitting throughout the year. For Building C, wind conditions at the main entrance (Location 24) are comfortable for standing year-round. These conditions are considered suitable for the intended use (Figures 7b and 8b).



PROJECT NORTH



Predicted Comfort Classes

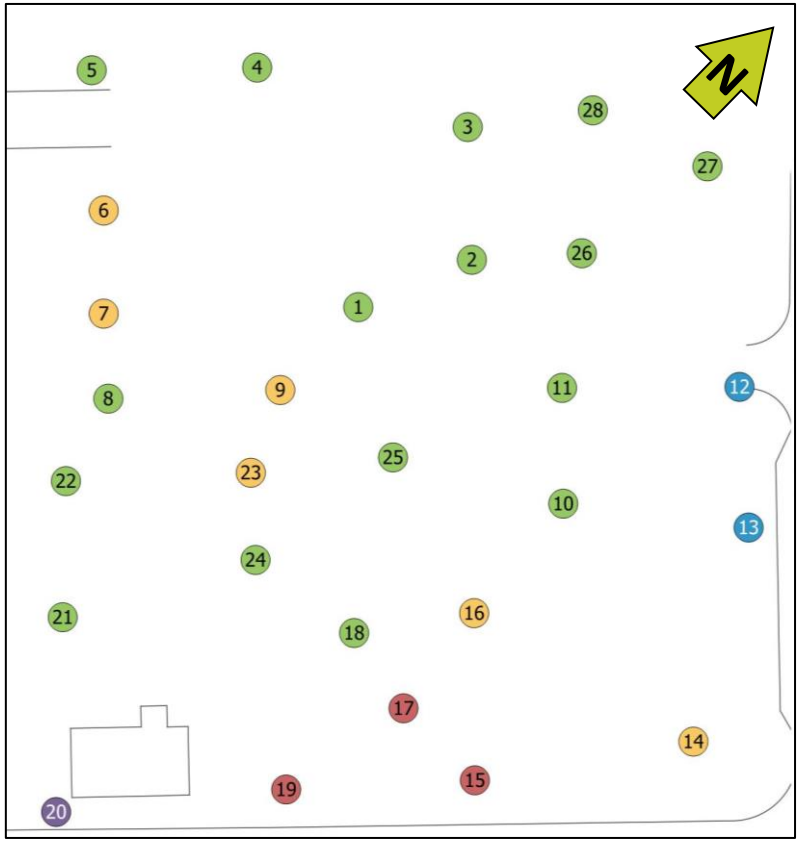
# Sitting	# Leisurely Walking	# Uncomfortable
# Standing	# Fast Walking	Amenity Space

Notes:

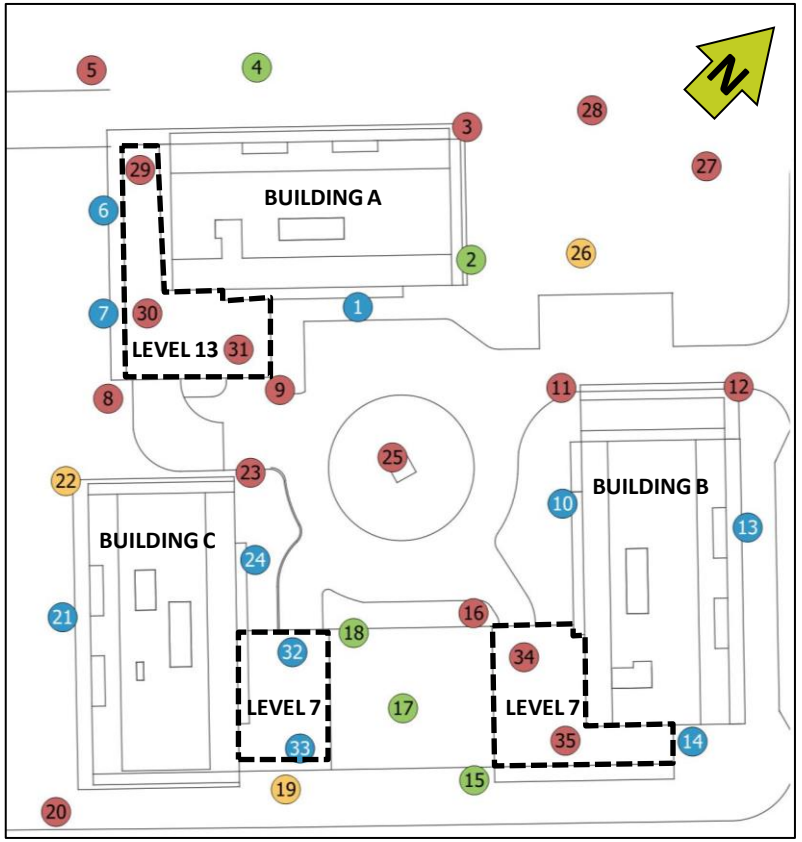
1) Not to scale.
2) Pedestrian level wind sensor location (#)
3) Diagram may be divided by levels (e.g., Grade, Amenity Floors, etc.).

Figure 7a: Existing Configuration – Pedestrian Wind Conditions – On-site Summer

Figure 7b: Proposed Configuration – Pedestrian Wind Conditions – On-site Summer



PROJECT NORTH



Predicted Comfort Classes

# Sitting	# Leisurely Walking	# Uncomfortable
# Standing	# Fast Walking	Amenity Space

Notes:

1) Not to scale.
2) Pedestrian level wind sensor location (#)
3) Diagram may be divided by levels (e.g., Grade, Amenity Floors, etc.).

Figure 8a: Existing Configuration – Pedestrian Wind Conditions – On-site Winter

Figure 8b: Proposed Configuration – Pedestrian Wind Conditions – On-site Winter

At the south retail entrance of Building B (Location 14), wind conditions are conducive to sitting or standing throughout the year. At the south retail entrance of Building C (Location 19), wind conditions are comfortable for fast walking or better year-round, which is windier than desired for an entrance.

Wind conditions in the outdoor amenity space at grade for Building B (Location 10) and at the retail plaza (Location 17) are generally comfortable for standing or leisurely walking throughout the year.

Recommendations to improve local wind conditions are provided in Section 5.0.

4.2 Outdoor Amenity Terraces (Locations 29-35)

On Building A, wind conditions on the Level 13 terrace (Locations 29 through 31) are comfortable for leisurely walking or fast walking in the summer. During the winter, wind conditions are uncomfortable on this terrace (Figure 7b).

At the Level 7 terrace of Building B (Locations 34 and 35), wind conditions are comfortable for leisurely waking in the summer (Figure 7b) and uncomfortable in the winter months (Figure 8b).

Additional recommendations on localized wind mitigation measures are provided in Section 5.0.

At the Level 7 terrace of Building C (Locations 32 and 33), wind conditions are comfortable for standing throughout the year (Figures 7b and 8b). These wind conditions are considered suitable for the intended use.

4.3 Surrounding Sidewalks (Locations 36-85)

Existing wind conditions on the nearby sidewalks of Masonry Court, Cooke Boulevard, Waterdown Road and Clearview Avenue are comfortable for fast walking or better throughout the year (Figures 9a and 9b). Wind conditions are uncomfortable in a few areas along Masonry Court and Cooke Boulevard in both the summer (Location 81 in Figure 9a) and winter (Locations 61, 62, 63 and 81 in Figure 9b). At the nearby transit stops, wind conditions are suitable for standing throughout the year (Locations 72 and 73 in Figures 9a and 9b).

In the Proposed Configuration, wind conditions on the surrounding sidewalks generally remain comfortable for fast walking or better year-round (Figures 10a and 10b). However, wind conditions are uncomfortable in a few areas along Masonry Court (Locations 62,63 and 64) and Cooke Boulevard (Location 81) during the winter months (Figure 10b). Wind conditions at the nearby transit stops remain comfortable for standing year-round (Figure 10b).

4.4 Wind Safety

In the Existing Configuration, the wind safety criterion is met in all areas on and surrounding the existing site (Figure 11a).

In the Proposed Configuration, the wind safety criterion is met in all areas on and surrounding the site at grade. On the amenity terraces, the safety criterion is met at all areas except the south half of the Level 13 terrace of Building A (Locations 30 and 31 in Figure 11b).

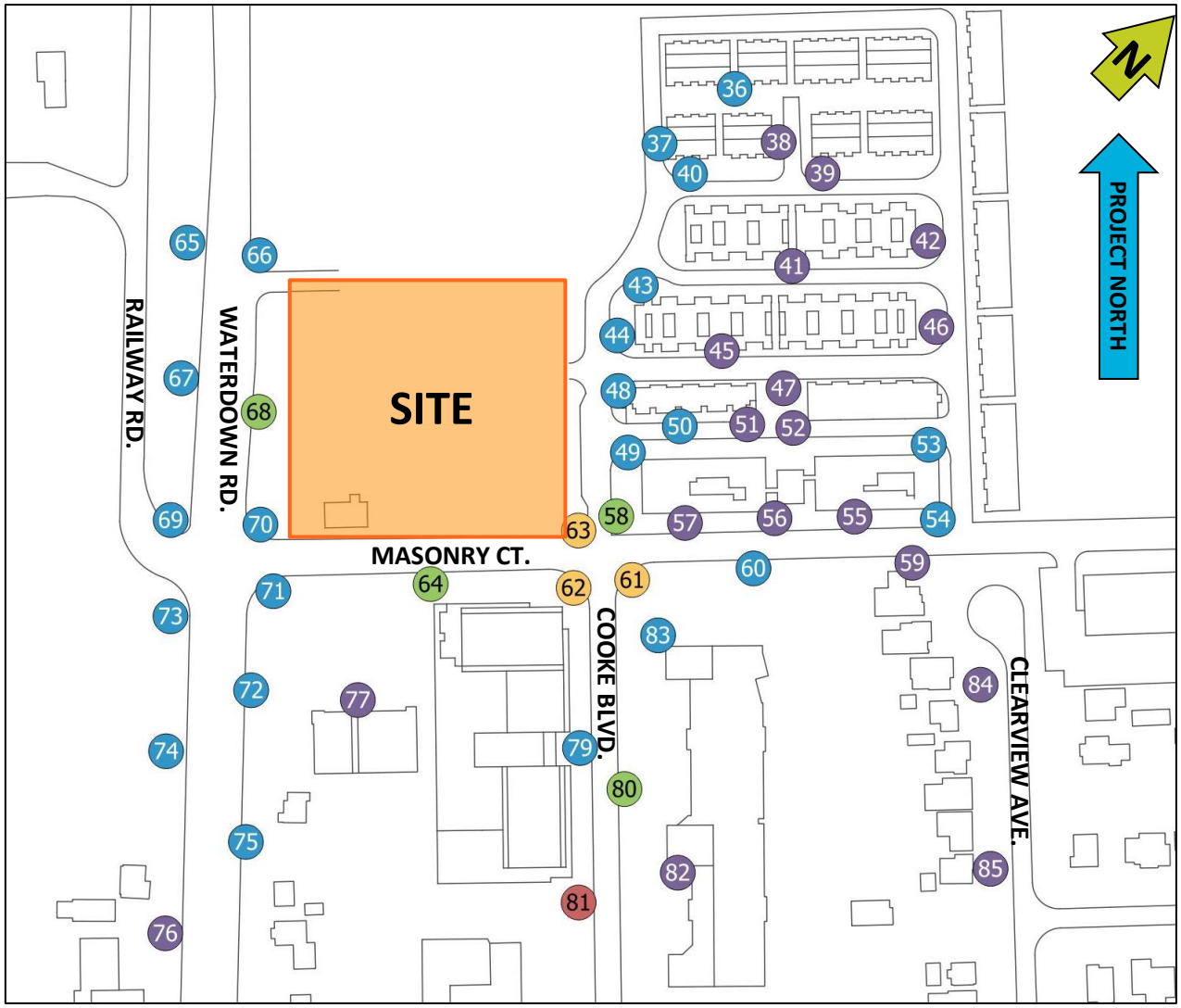


Figure 9a: Existing Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Summer



Predicted Comfort Classes

- (#) Sitting
- (#) Standing
- (#) Leisurely Walking
- (#) Fast walking
- (#) Uncomfortable

Notes:

1) Not to scale.

2) Pedestrian level wind sensor location (#)

Figure 9b: Existing Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Winter

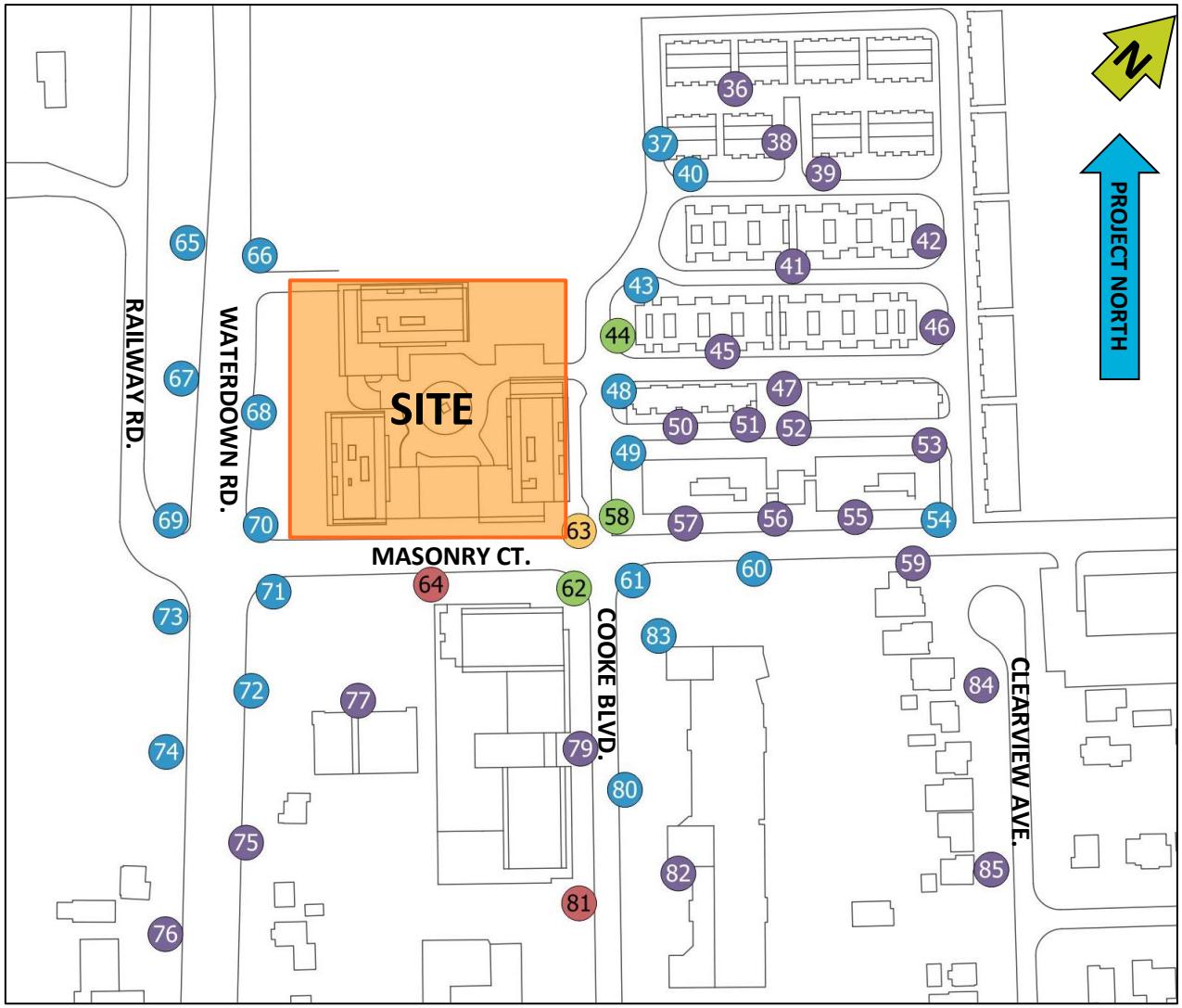


Figure 10a: Proposed Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Summer

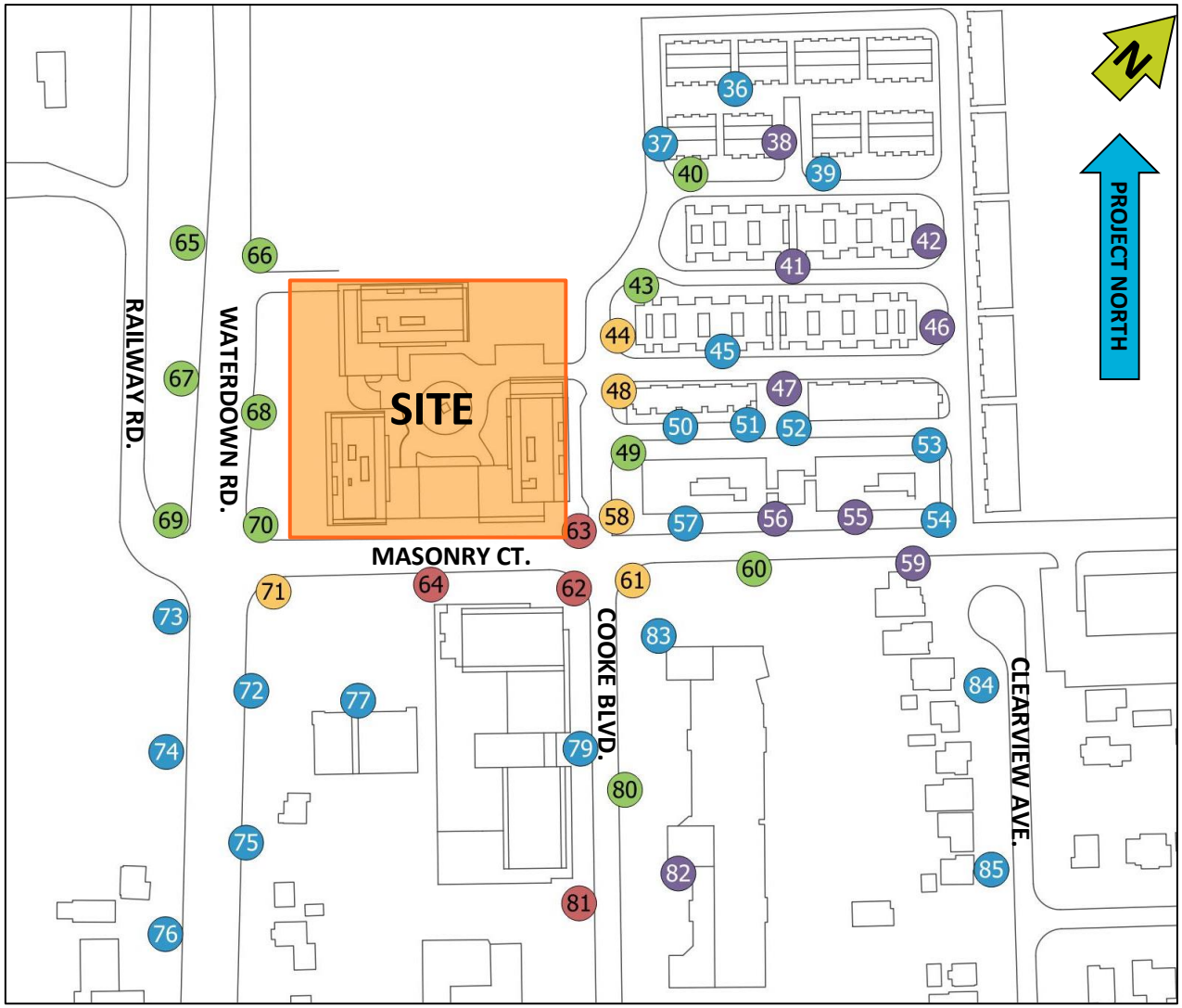
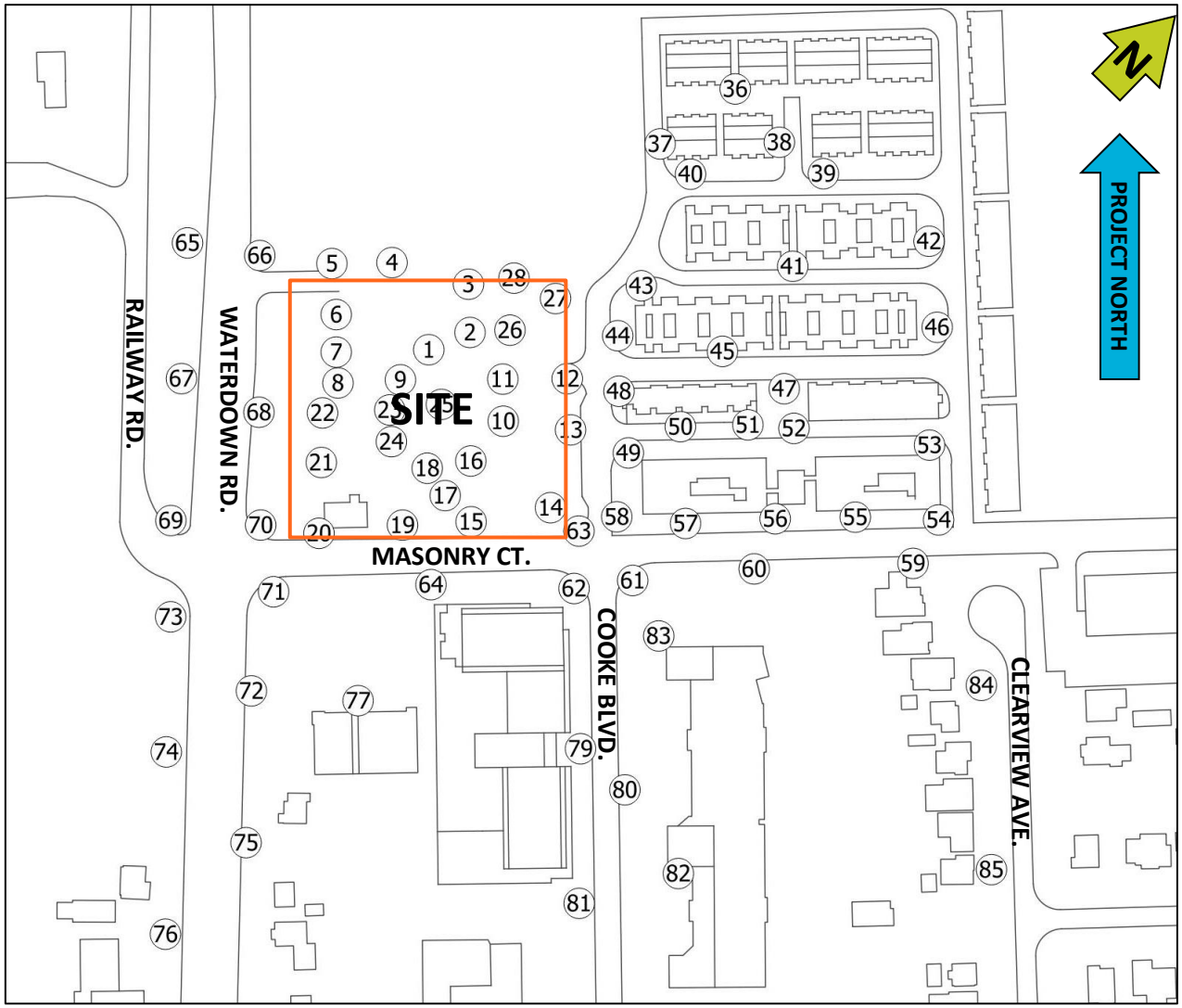


Figure 10b: Proposed Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks – Winter



Safety:

Fail

Notes:

1) Not to scale.

2) Pedestrian level wind sensor location (#)

Figure 11a: Existing Configuration – Pedestrian Wind Safety – Annual

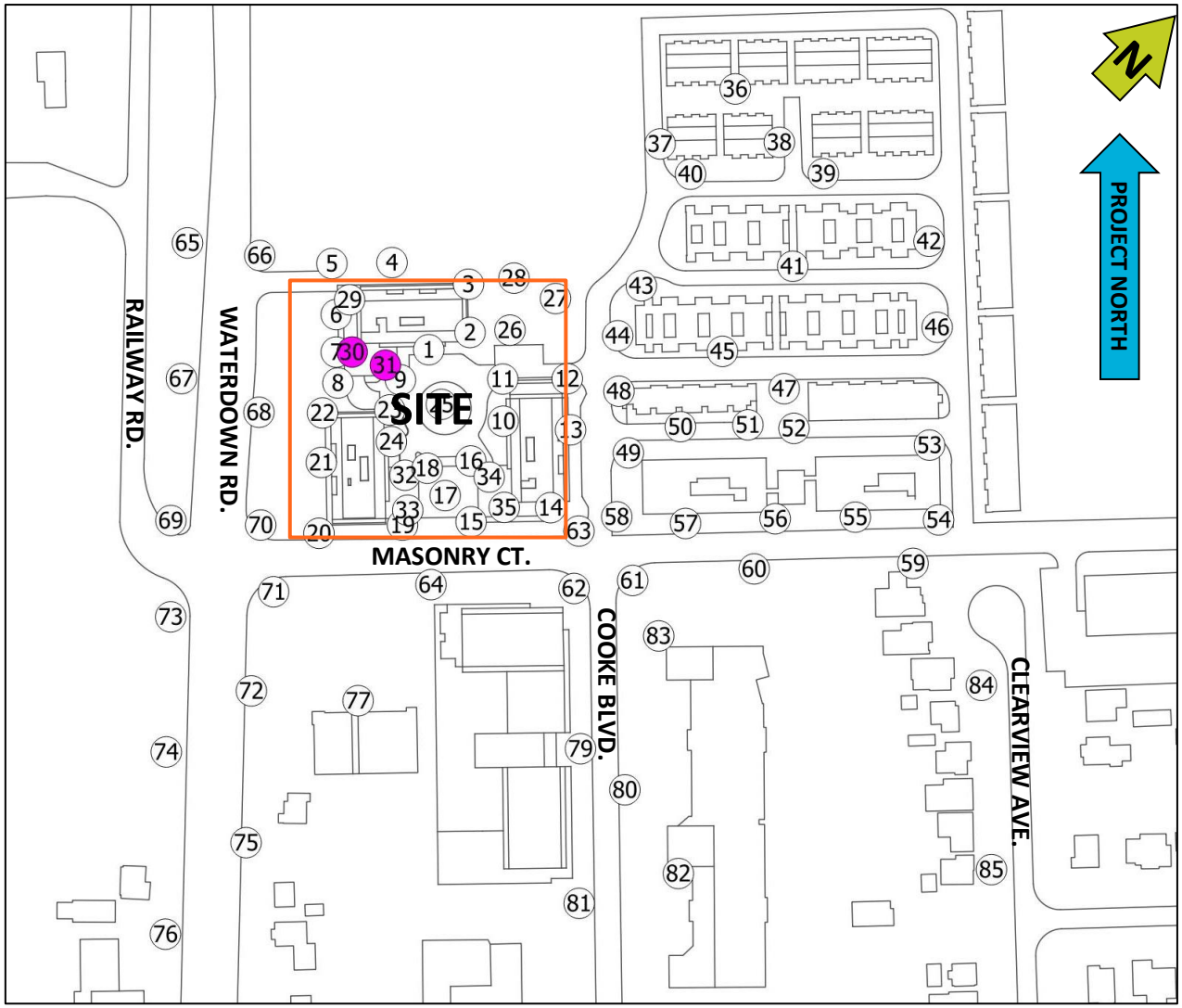


Figure 11b: Proposed Configuration – Pedestrian Wind Safety – Annual

5.0 RECOMMENDATIONS FOR MITIGATION

Strong wind flows on-site are due to the overall exposure of the development to the prevailing northeasterly and southwesterly winds. These wind downwash off the building facades and accelerate at grade around the three buildings. The southwesterly wind also channel through the gap between Building A and C, creating local wind accelerations in the central portion of the site.

Some general design guidance includes:

- Building entrances should be located a minimum of 5 m away from corners to avoid the effect of local wind accelerations. For exposed entrances, vertical wind screens (minimum 2.2 m tall) should be placed on both sides of the entrance. Alternatively, the entrances should be recessed from the main facade for wind protection.
- To improve wind conditions in the open spaces (i.e., Locations 24, 27, 28) architectural features (i.e., wind screens, etc.) should be considered. A tall vertical perimeter screen and/or fence along the north and west edges of the site would aid in improving local wind conditions in these areas.

A conceptual plan with suggested wind control features are shown in **Figure 12a**. Additional mitigation measures may need to be considered based on the intended activities.

To improve wind conditions on the terraces, we recommend including vertical screens (minimum 2.2 m tall) along the edges of the terraces. In addition, vertical screens and/or partitions, as well as horizontal features such as trellises or pergolas should be considered around seating areas for overall enhancement of the wind comfort conditions.

Examples of wind control measures are shown in **Figure 12b**. SLR will work the design team to determine practical and effective mitigation measures prior to the next planning submission.

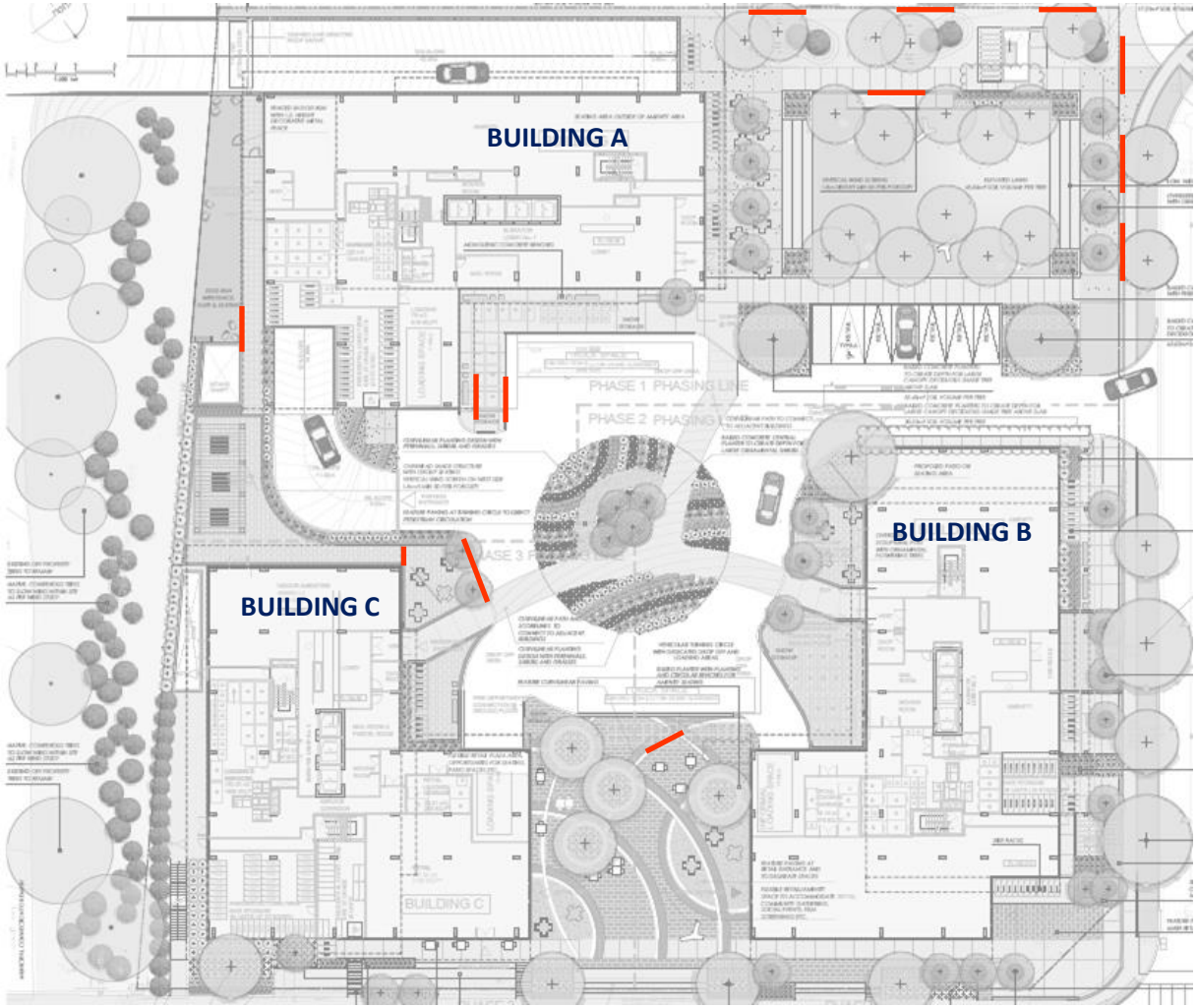


Figure 12a: Conceptual Wind Mitigation Plan

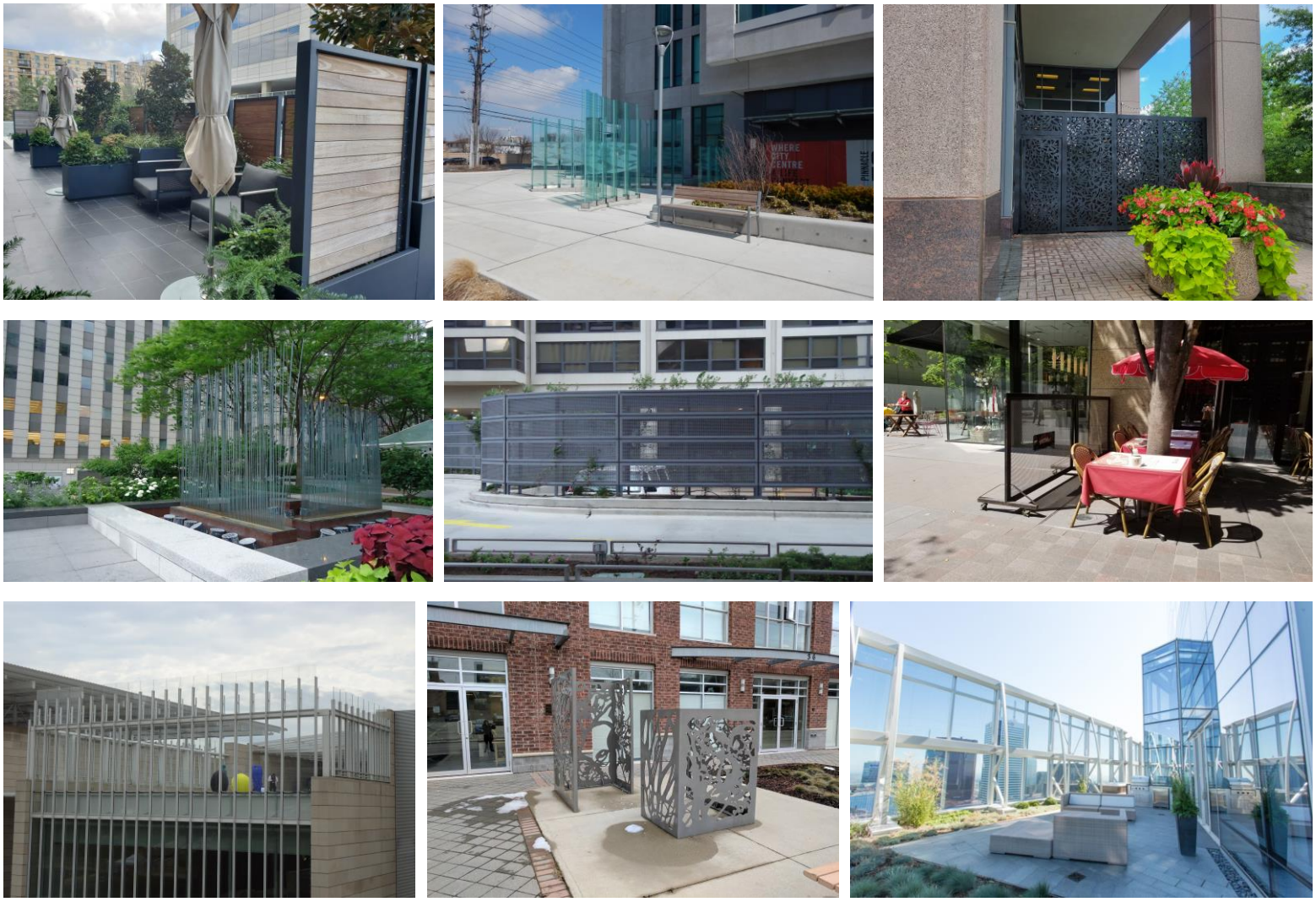


Figure 12b: Examples of wind screens/ architectural features

6.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 1120 Cooke Boulevard in Burlington have been assessed through wind tunnel modeling techniques. Based on the results of our study, the following conclusions have been reached:

- In the Existing Configuration wind conditions at grade are generally suitable for the intended use except some localized uncomfortable areas near the south end of the site. The wind safety criterion was met in all areas.
- In the Proposed Configuration, the wind safety criterion is met at all areas at grade level. The safety criterion is exceeded on the Level 13 terrace of Building A.
- In the Proposed Configuration, wind conditions at most of the entrances are suitable for the intended use. Wind control measures are recommended for building corners, select entrances and some on-site amenity areas at grade.
- Wind conditions along the nearby sidewalks are generally similar between the Existing and Proposed Configurations.
- Wind conditions at the proposed terraces are generally windier than desired for passive activities in the winter. Wind mitigation measures are recommended.
- SLR will work with he design team to refine effective wind control measure prior to next submission.

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 ADI Development Group , 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 Burlington 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.

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8.0 REFERENCES

Alan G. Davenport Wind Engineering Group, “Wind Tunnel Testing: A General Outline” May 2007.

Blocken, B., and J. Carmeliet (2004) “Pedestrian Wind Environment around Buildings: Literature Review and Practical Examples” *Journal of Thermal Environment and Building Science*, 28(2).

Cochran, L. (2004) “Design Features to Change and/or Ameliorate Pedestrian Wind Conditions” ASCE Structures Conference 2004.

Davenport, A.G. (1972) "An Approach to Human Comfort Criteria for Environmental Wind Conditions", *Colloquium on Building Climatology*, Stockholm, September 1972.

Durgin, F.H. (1997) “Pedestrian level wind criteria using the equivalent average” *Journal of Wind Engineering and Industrial Aerodynamics* 66.

Isyumov, N. and Davenport, A.G., (1977) “The Ground Level Wind Environment in Built-up Areas”, Proc. of 4th Int. Conf. on Wind Effects on Buildings and Structures, London, England, Sept. 1975, Cambridge University Press, 1977.

Isyumov, N., (1978) “Studies of the Pedestrian Level Wind Environment at the Boundary Layer Wind Tunnel Laboratory of the University of Western Ontario”, *Jrnl. Industrial Aerodynamics*, Vol. 3, 187-200, 1978.

Irwin, P.A. (2004) “Overview of ASCE Report on Outdoor Comfort Around Buildings: Assessment and Methods of Control” ASCE Structures Conference 2004.

Kapoor, V., Page, C., Stefanowicz, P., Livesey, F., Isyumov, N., (1990) “Pedestrian Level Wind Studies to Aid in the Planning of a Major Development”, *Structures Congress Abstracts*, American Society of Civil Engineers, 1990.

Koss, H.H. (2006) “On differences and similarities of applied wind criteria” *Journal of Wind Engineering and Industrial Aerodynamics* 94.

Soligo, M.J., P.A., Irwin, C.J. Williams, G.D. Schuyler (1998) “A Comprehensive Assessment of Pedestrian Comfort Including Thermal Effects” *Journal of Wind Engineering and Industrial Aerodynamics* 77/78.

Stathopoulos, T., H. Wu and C. Bedard (1992) “Wind Environment Around Buildings: A Knowledge-Based Approach” *Journal of Wind Engineering and Industrial Aerodynamics* 41/44.

Stathopoulos, T., and H. Wu (1995) “Generic models for pedestrian-level winds in built-up regions” *Journal of Wind Engineering and Industrial Aerodynamics* 54/55.

Wu, H., C.J. Williams, H.A. Baker and W.F. Waechter (2004) “Knowledge-based Desk-top Analysis of Pedestrian Wind Conditions”, ASCE Structures Conference 2004.

Appendix A

Pedestrian Wind Comfort & Safety Tables

INTERPRETATION OF RESULTS

Table B1 below illustrates the wind comfort and safety criteria. The table provides the hourly mean wind speeds being exceeded 20% of the time for comfort for each of the four seasons for each configuration. It also categorizes the wind speeds as either sitting, standing, leisure walking, fast walking or uncomfortable. In addition, the table provides the gust wind speed exceeded 0.1% of the time annually.

For instance, at Location 1 there is not data in the Existing Configuration, while in the Proposed Configuration, wind conditions are suitable for sitting in the summer and standing in the winter.

At Location 3, wind conditions are suitable for sitting year-round in the Existing Configuration. In the Proposed Configuration, wind conditions are suitable for fast walking in the summer and are uncomfortable in the winter. In addition, the safety criteria is exceeded on an annual basis at Location 3 in the Proposed Configuration.

The categories are summarized in Table B2.

Table B1: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		Mean Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
1	Existing			35.7
1	Proposed	9.8	16.2	45.3
2	Existing	15.6	20.2	75.8
2	Proposed	17.2	26.0	87.6
3	Existing	8.9	7.0	42.9
3	Proposed	18.3	22.5	92.4

Table B2: Categories

Criteria	Speed
Sitting	10
Standing	14
Leisurely Walking	17
Fast Walking	20
Uncomfortable	20
Safety	90

Table B1-1: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
1	Existing	13.3	16.7	53.2
1	Proposed	11.1	13.8	48.9
2	Existing	11.8	14.6	47.7
2	Proposed	12.0	14.2	57.0
3	Existing	11.9	14.7	47.3
3	Proposed	16.9	21.3	78.9
4	Existing	12.7	15.8	50.2
4	Proposed	12.1	15.0	56.7
5	Existing	12.9	15.8	51.6
5	Proposed	21.3	26.3	88.9
6	Existing	14.5	17.9	53.7
6	Proposed	11.5	13.3	57.9
7	Existing	13.7	17.1	55.4
7	Proposed	9.7	12.2	51.7
8	Existing	12.0	14.9	56.4
8	Proposed	15.8	20.9	69.7
9	Existing	14.3	17.8	56.8
9	Proposed	15.8	20.2	71.0
10	Existing	13.4	16.8	58.2
10	Proposed	10.3	13.0	51.9

Table B1-2: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
11	Existing	12.1	15.0	49.3
11	Proposed	18.4	22.6	72.1
12	Existing	11.0	13.4	46.8
12	Proposed	16.5	20.0	76.1
13	Existing	10.7	13.1	47.4
13	Proposed	8.8	10.9	46.9
14	Existing	15.1	17.8	69.8
14	Proposed	9.6	12.2	55.7
15	Existing	18.3	22.1	79.7
15	Proposed	14.0	16.7	69.2
16	Existing	14.7	17.9	69.6
16	Proposed	16.3	20.2	71.2
17	Existing	16.8	20.4	77.7
17	Proposed	12.6	16.1	57.9
18	Existing	12.1	14.6	74.4
18	Proposed	13.5	16.8	60.1
19	Existing	16.9	20.4	68.9
19	Proposed	16.6	19.8	72.5
20	Existing	7.7	9.2	40.1
20	Proposed	17.2	23.5	75.8

Table B1-3: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
21	Existing	12.4	15.0	58.5
21	Proposed	9.2	11.6	54.5
22	Existing	12.6	15.4	60.7
22	Proposed	14.4	17.2	69.4
23	Existing	14.3	17.6	64.3
23	Proposed	20.2	26.5	81.0
24	Existing	12.8	15.7	63.7
24	Proposed	8.4	10.3	40.0
25	Existing	13.6	16.7	63.4
25	Proposed	17.5	22.2	76.1
26	Existing	12.1	15.2	51.5
26	Proposed	15.0	17.6	72.4
27	Existing	11.6	14.6	49.1
27	Proposed	16.4	20.8	70.7
28	Existing	11.5	14.3	44.8
28	Proposed	16.6	20.8	67.6
29	Existing			
29	Proposed	16.2	20.1	87.9
30	Existing			
30	Proposed	19.0	26.6	91.3

Table B1-4: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
31	Existing			
31	Proposed	19.4	25.7	103.4
32	Existing			
32	Proposed	11.3	13.3	69.3
33	Existing			
33	Proposed	11.0	13.1	54.8
34	Existing			
34	Proposed	15.6	20.2	78.1
35	Existing			
35	Proposed	15.9	20.5	80.7
36	Existing	10.6	13.0	43.8
36	Proposed	9.9	12.6	45.7
37	Existing	10.3	13.5	52.1
37	Proposed	10.4	14.0	57.5
38	Existing	7.3	9.3	33.2
38	Proposed	7.5	9.5	33.9
39	Existing	9.7	12.5	48.8
39	Proposed	9.6	12.6	50.4
40	Existing	11.4	14.6	59.8
40	Proposed	11.3	15.2	66.6

Table B1-5: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
41	Existing	8.0	9.9	34.7
41	Proposed	7.8	9.8	35.6
42	Existing	7.6	9.3	38.7
42	Proposed	7.5	9.3	40.8
43	Existing	12.3	15.9	57.8
43	Proposed	11.1	15.7	64.6
44	Existing	10.0	13.0	52.0
44	Proposed	14.9	19.6	64.9
45	Existing	9.1	11.3	40.0
45	Proposed	8.1	10.4	38.6
46	Existing	8.3	10.4	41.5
46	Proposed	8.1	9.9	40.9
47	Existing	7.6	9.5	35.4
47	Proposed	7.6	9.7	36.1
48	Existing	11.6	14.2	55.4
48	Proposed	14.0	17.7	62.2
49	Existing	12.2	15.7	66.9
49	Proposed	11.4	14.1	54.1
50	Existing	11.7	14.8	54.7
50	Proposed	9.4	11.7	45.8

Table B1-6: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
51	Existing	10.0	12.6	46.6
51	Proposed	8.4	10.6	46.8
52	Existing	8.9	11.2	41.8
52	Proposed	7.9	10.1	39.1
53	Existing	10.2	13.3	51.4
53	Proposed	8.9	11.5	44.7
54	Existing	11.7	14.6	48.8
54	Proposed	10.1	12.0	44.0
55	Existing	7.1	8.9	37.2
55	Proposed	7.8	9.3	35.9
56	Existing	7.8	9.7	34.5
56	Proposed	8.0	9.5	36.5
57	Existing	9.7	12.0	44.8
57	Proposed	8.2	10.1	41.3
58	Existing	15.7	20.0	57.6
58	Proposed	14.3	17.6	64.3
59	Existing	8.3	10.9	48.1
59	Proposed	7.7	9.7	36.5
60	Existing	11.6	14.7	51.3
60	Proposed	11.2	14.2	52.8

Table B1-7: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
61	Existing	17.6	23.1	69.9
61	Proposed	13.9	17.8	70.8
62	Existing	19.7	25.1	71.1
62	Proposed	15.8	20.3	69.3
63	Existing	18.4	22.8	75.7
63	Proposed	18.0	21.9	76.6
64	Existing	16.3	19.9	67.0
64	Proposed	20.5	26.3	78.7
65	Existing	12.6	15.5	52.7
65	Proposed	12.1	14.4	51.6
66	Existing	12.7	15.6	52.1
66	Proposed	13.4	15.8	56.7
67	Existing	13.2	16.6	54.1
67	Proposed	11.4	14.5	60.0
68	Existing	14.6	18.2	54.7
68	Proposed	13.7	16.6	65.6
69	Existing	12.0	14.8	45.8
69	Proposed	11.7	14.6	57.2
70	Existing	10.9	13.3	46.3
70	Proposed	12.3	15.7	57.9

Table B1-8: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
71	Existing	11.0	13.3	48.9
71	Proposed	13.2	17.1	59.0
72	Existing	10.7	12.9	54.0
72	Proposed	10.4	12.8	49.3
73	Existing	10.4	12.7	44.3
73	Proposed	10.5	13.0	51.1
74	Existing	10.4	13.0	47.6
74	Proposed	10.2	12.9	47.1
75	Existing	10.3	12.4	54.9
75	Proposed	9.9	12.2	48.6
76	Existing	9.2	10.9	49.6
76	Proposed	8.8	10.6	45.3
77	Existing	8.8	10.6	48.9
77	Proposed	8.4	10.5	39.1
78	Existing			
78	Proposed			
79	Existing	11.0	13.3	56.4
79	Proposed	10.0	12.1	55.7
80	Existing	14.4	17.6	67.1
80	Proposed	12.5	15.2	66.0

Table B1-9: Pedestrian Wind Conditions

Location	Configuration	Wind Comfort		Wind Safety
		GEM Speed Exceeded 20% of the Time (km/h)		Gust Speed Exceeded 0.1% of the Time (km/h)
		Summer	Winter	
81	Existing	21.0	27.1	83.0
81	Proposed	20.9	26.8	82.6
82	Existing	8.5	11.0	44.9
82	Proposed	7.7	10.0	44.0
83	Existing	12.5	15.9	53.9
83	Proposed	10.2	12.7	49.7
84	Existing	8.8	10.8	41.0
84	Proposed	8.5	10.2	41.8
85	Existing	9.5	11.3	43.2
85	Proposed	9.7	11.2	43.2