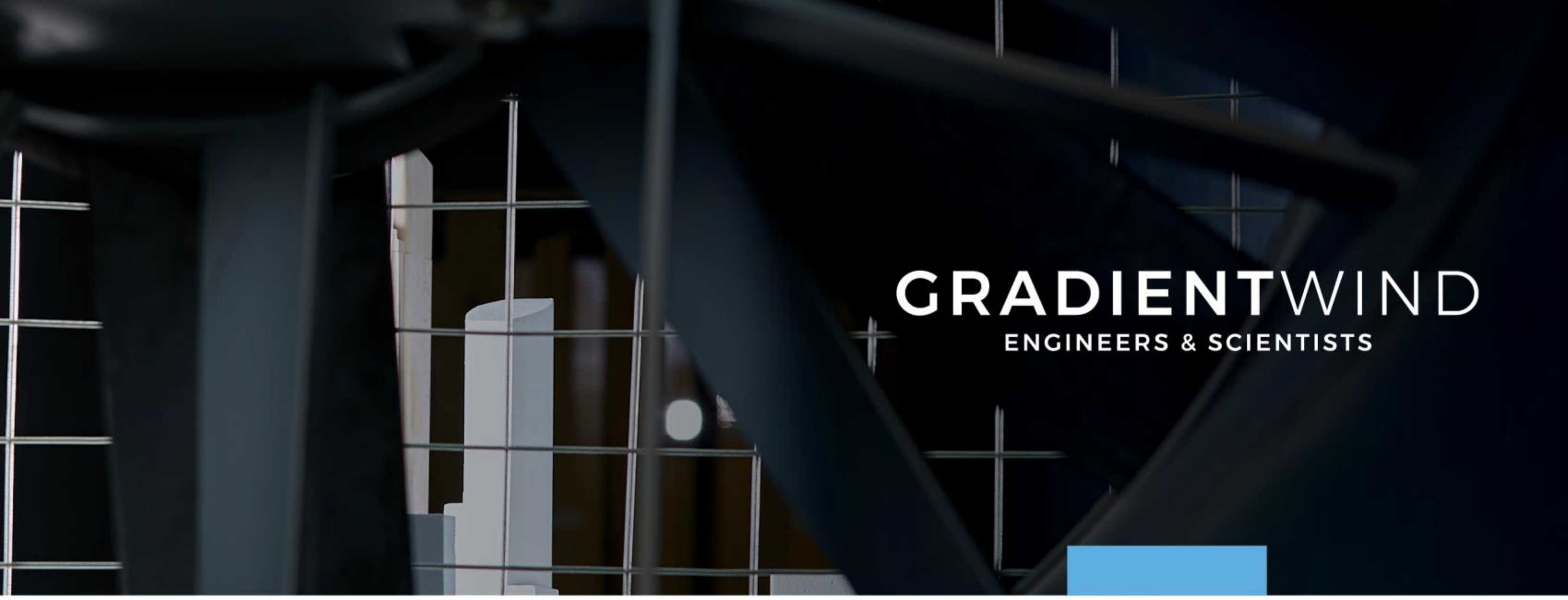
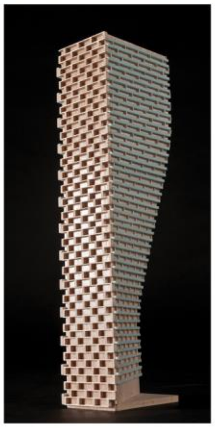
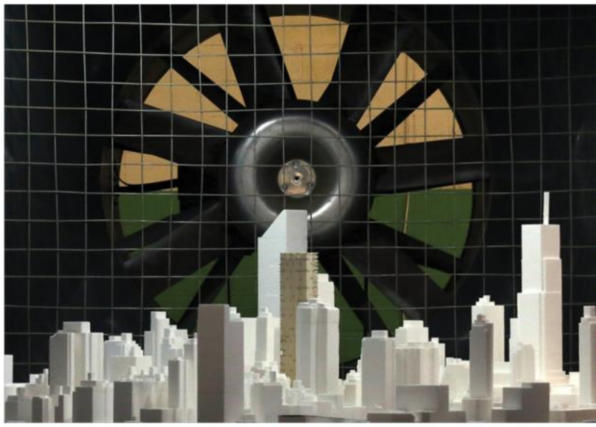


PEDESTRIAN LEVEL WIND STUDY

550 Ontario Street South
Milton, Ontario

Report: 21-134-PLW





November 1, 2021

PREPARED FOR
2613708 Ontario Inc.
c/o Korsiak Urban Planning
206-277 Lakeshore Road East
Oakville, ON L6J 1H9

PREPARED BY
Daniel Davalos, MESc., Junior Wind Scientist
Steven Hall, M.A.Sc., P.Eng., Senior Wind Engineer

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment and Zoning By-law Amendment application requirements for the proposed development located at 550 Ontario Street South in Milton, Ontario (hereinafter referred to as the “subject site” or “proposed development”). Our mandate within this study is to investigate wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for selected wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site. A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-9B, and is summarized as follows:

1) While the introduction of the proposed development is predicted to generally increase winds at grade, most areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, surface parking areas, amenity spaces, and building access points are considered acceptable, without the need for mitigation. Exceptions are as follows:

    a. During the winter, there is a small region on the east sidewalk along Ontario Street South, near the existing gas station, where conditions may occasionally be considered uncomfortable for walking. Specifically, conditions are predicted to be suitable for walking at least 77% of the winter, where the target is at least 80%. Since these conditions are close to the target, the conditions may be considered satisfactory.

    b. During the winter, there is a region over the sidewalk along Derry Road between Buildings 1 and 2 and a region near the southwest corner of the subject site where conditions may occasionally be considered uncomfortable for walking. Specifically, conditions are predicted to be suitable for walking at least 76% of the winter. Importantly,

the region between Buildings 1 and 2 is located over the vehicular access to the underground garage, where pedestrian activity is expected to be limited, and the associated conditions may be considered acceptable. Since the conditions near the southwest corner of the subject site are close to the target of 80%, the conditions may be considered satisfactory.

c. Westerly and northeasterly winds are predicted to accelerate within the passageway beneath the podium of Building 1, which is 3 m wide, creating windy conditions. Specifically, conditions during the winter are predicted to be suitable for walking at least 77% of the winter. Experience with similar passageways has shown that conditions are expected to be improved by increasing the width of the passageway to 3 times the height of the passageway. Regardless, since these conditions are close to the target, the conditions may be considered satisfactory.

d. Additionally, conditions near the northeast corner of the development are predicted to experience occasional strong wind gusts, which may have the potential to create unsafe conditions.

e. Conditions over the above regions will be investigated and confirmed in collaboration with the design team for the subsequent Site Plan Control application via wind tunnel testing of a physical scale model of the subject site in its surroundings.

2) Conditions over the Level 2 amenity terrace serving the commercial roof of Building 2are predicted to be suitable for sitting throughout the typical use period, which is acceptable.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site at grade level or over the amenity terraces, except the one location mentioned in 1(d) above. These conditions near the northeast corner of Building 1 will be confirmed in the wind tunnel for the Site Plan Control application to ensure conditions are safe for pedestrians. During extreme weather events, (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Korsiak Urban Planning, on behalf of 2613708 Ontario Inc., to undertake a pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment and Zoning By-law Amendment application requirements for the proposed development located at 550 Ontario Street South in Milton, Ontario (hereinafter referred to as the "subject site" or "proposed development"). Our mandate within this study is to investigate wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, architectural drawings provided by KNYMH Inc, in August 2021, surrounding street layouts and existing and approved future building massing information obtained from the Town of Milton, and recent site imagery.

2. TERMS OF REFERENCE

The proposed development is situated on a rectangular parcel of land at the northwest intersection of Ontario Street South and Derry Road. Throughout this report, the Derry Road elevation is referred to as the south elevation.

550 Ontario Street South, East Perspective (KNYMH Inc.)

The proposed development comprises three buildings: Building 1 is situated at the southeast corner of the subject site and includes a 24-storey tower atop a 6-storey podium, Building 2 is situated at the southwest corner of the subject site and includes a 19-storey tower atop a 5-storey podium, and Building 3 is situated at the northwest corner of the subject site and rises to a height of 4-storeys.

Above two levels of shared below-grade parking, the ground floor of Building 1 has an 'L-shaped' planform and includes a residential lobby at the southeast corner, commercial space along the northeast, residential and amenity space along the southwest, and shared support spaces throughout the remainder of the floorplan. Access to below-grade parking is provided by a ramp at the southwest corner of Building 1 via Derry Road. At Level 7, the building steps back from the north and west, and the tower rises with a rectangular planform to level 24. Levels 2 through 24 are reserved exclusively for residential occupancy.

Above the shared below-grade parking, the ground floor of Building 2 has an 'L-shaped' planform and includes a residential lobby along the east, commercial space at the southwest corner, residential space along the northwest, and shared support spaces throughout the remainder of the floorplan. At Level 2, there is a cut-in at the southwest corner to accommodate a commercial rooftop amenity space. At Level 5, the building steps back from the north elevation, and at Level 6, the building steps back from the north and west, and the tower rises with a rectangular planform to level 19. Level 2 includes commercial, residential, and amenity space, while Levels 3 through 24 are reserved exclusively for residential occupancy.

Above the shared below-grade parking, the ground floor of Building 3 has a rectangular planform and includes a residential lobby and amenity space along the south elevation, and residential and shared support spaces throughout the remainder of the floorplan. The building maintains a constant planform to Level 4. Levels 2 through 4 are reserved exclusively for residential occupancy.

Regarding wind exposures, the near-field surroundings of the proposed development (defined as an area within a 200-metre (m) radius of the subject site) are characterized by suburban low-rise massing from the west clockwise to the north, by low-rise commercial massing from the north clockwise to the northeast, by a future planned high-rise development from the northeast clockwise to the east-southeast and by a mixture of low-rise massing and the open exposure of Sixteen Mile Creek for the remaining compass directions. Notably, Sixteen Mile Creek flows northwest to southeast approximately 100 m to the southwest of the subject site. The future planned high-rise development to the east (Town of Milton File # 24T-17001/M) comprises three apartment buildings ranging from 16 to 25-storeys and five 3-storey townhouses. While this development has not received formal approval, and is subject to change, it has been included in this study, as it is anticipated to strongly influence the winds in the area. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) are characterized by a mix of low-rise suburban massing and green space in all directions. Notably, Milton Community Park is located approximately 550 m to the south-southeast, the Milton GO Station is located approximately 1.9 km to the north-northwest, and Mill Pond is located approximately 2 km to the west-northwest of the subject site.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, respectively, while Figures 2A-2F illustrate the computational models used to conduct the study. The existing massing scenario includes the existing massing as well as any changes which have been approved by the Town of Milton. Additionally, the future development to the southeast of the intersection of Derry Road and Ontario Street (Town of Milton File # 24T-17001/M) has been included in the existing massing.

3. OBJECTIVES

The principal objectives of this study are to: (i) determine pedestrian level wind comfort and safety conditions at key outdoor areas; (ii) identify areas where future wind conditions may interfere with the intended uses of outdoor spaces; and (iii) recommend suitable mitigation measures, where required.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on CFD simulations of wind speeds across the subject site within a virtual environment, meteorological analysis of the Greater Toronto Area (GTA) wind climate which is representative of Milton, and synthesis of computational data with industry-accepted guidelines[1]. The following sections describe the analysis procedures, including a discussion of the comfort guidelines.

[1] Town of Milton, *Guidelines for the Preparation of a Wind Study Report*

4.1 Computer-Based Context Modelling

A computer-based PLW wind study was performed to determine the influence of the wind environment on pedestrian comfort over the subject site. Pedestrian comfort predictions, based on the mechanical effects of wind, were determined by combining measured wind speed data from CFD simulations with statistical weather data obtained from Lester B. Pearson International Airport.

The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the subject site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly more conservative (i.e., windier) wind speed values.

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 13 wind directions and two massing scenarios, as noted in Section 2. The CFD simulation models were centered on the subject site, complete with surrounding massing within a radius of approximately 480 m.

Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds on a continuous measurement plane 1.5 m above local grade and the common amenity terrace were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. The gradient height represents the theoretical depth of the boundary layer of the earth’s atmosphere, above which the mean wind speed remains constant. Further details of the CFD wind flow simulation technique are presented in Appendix A.

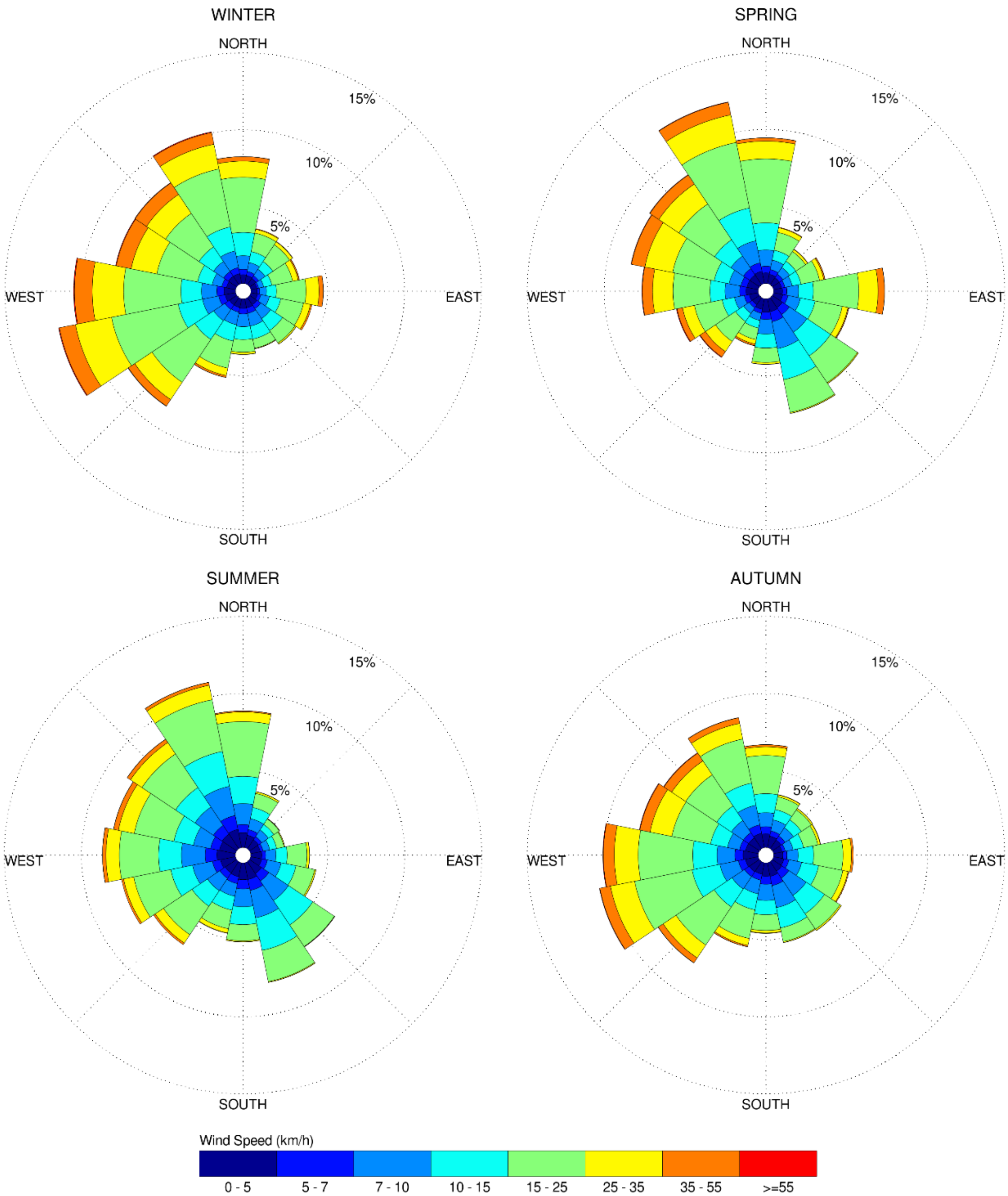
4.3 Historical Wind Speed and Direction Data

A statistical model for winds in the Greater Toronto Area (GTA) was developed from approximately 40 years of hourly wind data recorded at Lester B. Pearson International Airport (hereinafter "Pearson Airport") and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed for each month of the year to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns.

The statistical model of the wind climate in the GTA, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in km/h. Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction shows the frequency distribution of wind speeds for each wind direction during the measurement period. The preferred wind speeds and directions can be identified by the longer length of the bars. For the GTA, representative of the subject site in Milton, the most common winds concerning pedestrian comfort occur from the southwest clockwise to the north, as well as those from the east. The directional preference and relative magnitude of the wind speed varies somewhat from season to season, with the summer months displaying the calmest winds relative to the remaining seasonal periods.

As Milton lies approximately halfway between the Pearson Airport in Mississauga and the John C. Munro Airport in Hamilton, an analysis of wind speeds at John C. Munro Airport was also undertaken. For Hamilton, the most common winds concerning pedestrian comfort occur from the south clockwise to the west, as well as from the northeast, while the overall wind speeds are slightly higher than those in Mississauga. Since the Pearson Airport has a similar orientation to Lake Ontario as Milton, as well as a similar exposure to the northwest, the results using the Pearson Airport data are presented in this report.

SEASONAL DISTRIBUTION OF WIND
LESTER B. PEARSON INTERNATIONAL AIRPORT, MISSISSUAGA, ONTARIO



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in km/h, measured at 10 m above the ground.

4.4 Pedestrian Comfort and Safety Guidelines

Pedestrian comfort and safety guidelines are based on the mechanical effects of wind without consideration of other meteorological conditions (i.e., temperature, relative humidity). The comfort guidelines assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Four pedestrian comfort classes are based on 20% non-exceedance gust wind speed ranges, which include (i) Sitting; (ii) Standing; (iii) Walking; and (iv) Uncomfortable. More specifically, the comfort classes and associated gust wind speed ranges are summarized as follows:

(i) **Sitting** – A gust wind speed no greater than 16 km/h is considered acceptable for sedentary activities, including sitting.

(ii) **Standing** – A gust wind speed greater than 16 km/h but no greater than 22 km/h is considered acceptable for activities such as standing or leisurely strolling.

(iii) **Walking** – A gust wind speed greater than 22 km/h but no greater than 30 km/h is considered acceptable for walking or more vigorous activities.

(iv) **Uncomfortable** – A gust wind speed greater than 30 km/h is classified as uncomfortable from a pedestrian comfort standpoint. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this comfort class.

The pedestrian safety wind speed guideline is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of greater than 90 km/h is classified as dangerous. The wind speeds associated with the above categories are gust wind speeds. The gust speeds, and equivalent mean speeds, are selected based on 'The Beaufort Scale', presented on the following page, which describes the effects of forces produced by varying wind speed levels on objects. Gust speeds are included because pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

THE BEAUFORT SCALE

Number	Description	Gust Wind Speed (km/h)	Description
2	Light Breeze	9-17	Wind felt on faces
3	Gentle Breeze	18-29	Leaves and small twigs in constant motion; wind extends light flags
4	Moderate Breeze	30-42	Wind raises dust and loose paper; small branches are moved
5	Fresh Breeze	43-57	Small trees in leaf begin to sway
6	Strong Breeze	58-74	Large branches in motion; Whistling heard in electrical wires; umbrellas used with difficulty
7	Moderate Gale	75-92	Whole trees in motion; inconvenient walking against wind
8	Gale	93-111	Breaks twigs off trees; generally impedes progress

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if wind speeds of 16 km/h were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting or more sedentary activities. Similarly, if 30 km/h at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As these guidelines are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

Once the pedestrian wind speed predictions have been established throughout the site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the desired comfort classes, which are dictated by the location type for each region (i.e., a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their desired comfort classes are summarized on the following page.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Standing / Walking
Public Sidewalks / Pedestrian Walkways	Walking
Outdoor Amenity Spaces	Sitting / Standing
Cafés / Patios / Benches / Gardens	Sitting / Standing
Transit Stops	Sitting / Standing
Transit Stops (with Shelter)	Sitting / Standing / Walking
Public Parks	Sitting / Standing / Walking
Garage / Service Entrances	Walking
Vehicular Drop-Off Zones	Standing / Walking
Laneways / Loading Zones	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, which illustrate seasonal wind conditions at grade level for the proposed and existing massing scenarios, and Figures 7A-7D, which illustrate seasonal wind conditions over the common amenity terrace of the proposed development. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the comfort classes in Section 4.4. Conditions suitable for sitting are represented by the colour green, standing by yellow, and walking by blue, while uncomfortable conditions are represented by the colour magenta. Additionally, Figure 8 illustrates contours indicating the percentage of the winter that conditions at grade are predicted to be suitable for walking.

Wind conditions over the common amenity terrace are also reported for the typical use period, which is defined as May to October, inclusive. Figure 9A illustrates wind comfort conditions, consistent with the comfort classes in Section 4.4, while Figure 9B illustrates contours indicating the percentage of time the amenity terraces are predicted to be suitable for sitting. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalk and Building Entrances along Ontario Street South: Following the introduction of the proposed development, the sidewalk along Ontario Street South is predicted to be suitable for a mix of sitting, standing, and walking during the summer, becoming suitable for a mix of standing and walking throughout the remainder of the year. During the winter, small regions may occasionally be considered uncomfortable for walking, as illustrated in Figure 6A. Specifically, there is a small region on the east sidewalk, near the existing gas station, where conditions are predicted to be suitable for walking at least 77% of the time, as illustrated in Figure 8A. Since these conditions are close to the target of 80% of the time, the conditions may be considered satisfactory.

Conditions near the northeast corner of the development are predicted to experience occasional strong wind gusts, which may have the potential to create unsafe conditions. These conditions will be confirmed in collaboration with the design team for the future Site Plan Control submission via wind tunnel testing of a physical scale model of the subject site in its surroundings.

Owing to the protection provided by the building façade, conditions in the vicinity of building entrances along Ontario Street South are considered acceptable for sitting during the summer and autumn, becoming suitable for standing, or better, during the spring and winter. The noted conditions in the vicinity of building entrances are considered acceptable according to the comfort guidelines in Section 4.4.

Conditions over the Ontario Street South sidewalk with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for mostly standing during the autumn, and suitable for a mix of standing and walking during the spring and winter. While the introduction of the proposed development results in windier conditions along the Ontario Street South sidewalk in comparison to existing conditions, wind conditions with the proposed massing are nevertheless considered satisfactory.

Sidewalk and Building Entrances along Derry Road: Following the introduction of the proposed development, the sidewalk along Derry Road is predicted to be suitable for a mix of sitting, standing, and walking during the summer, becoming mostly suitable for standing and walking during the spring and autumn, and suitable for walking during the winter. During the winter, small regions may occasionally be considered uncomfortable for walking, as illustrated in Figure 6A. In particular, there is a region near the southwest corner of the subject site and an area between Buildings 1 and 2 where conditions are predicted to be suitable for at least 76% of the winter, as illustrated in Figure 8A. Importantly, the region between Buildings 1 and 2 is located over the vehicular access to the underground garage, where pedestrian activity is expected to be limited, and the associated conditions may be considered acceptable. Since the conditions near the southwest corner of the subject site are close to the target of 80% of the time, the conditions may be considered satisfactory. These conditions will be confirmed in collaboration with the design team for the future Site Plan Control submission via wind tunnel testing of a physical scale model of the subject site in its surroundings.

Owing to the protection provided by the building façade, conditions in the vicinity of building entrances along Derry Road are considered acceptable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. The noted conditions in the vicinity of building entrances are considered acceptable according to the comfort guidelines in Section 4.4.

Conditions over the Derry Road sidewalk with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for mostly standing during the autumn, and suitable for a mix of standing and walking during the spring and winter. While the introduction of the proposed development results in windier conditions along the Derry Road sidewalk in comparison to existing conditions, conditions with the proposed massing are nevertheless considered satisfactory.

Laneway along North Elevation of Building 1: Conditions over the laneway along the north elevation of Building 1 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of standing and walking throughout the remainder of the year. The noted conditions are considered acceptable according to the comfort guidelines in Section 4.4.

Drop Off Area, Sidewalk, and Building Entrances along Northwest of Building 1: Conditions over the drop off area and sidewalk along the northwest of Building 1 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of sitting, standing, and walking during the spring and autumn, and suitable for a mix of standing and walking during the winter. In the vicinity of building entrances along the northwest of Building 1, conditions are predicted to be suitable for sitting during the spring, summer, and autumn, becoming suitable for standing, or better, during the winter. The noted conditions are considered acceptable according to the comfort guidelines in Section 4.4.

It should be noted that there is a small region at the northwest corner of Building 1 where winds are predicted to channel between Buildings 1 and 2 and conditions are predicted to be uncomfortable for walking during the three colder seasons. However, this region is intended to accommodate landscaping features, and is not intended to accommodate pedestrian activity, and is therefore considered acceptable.

Drop Off Area, Sidewalk, and Building Entrances along Northeast of Building 2: Conditions over the drop off area and sidewalk along the northeast of Building 2 are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for a mix of sitting, standing, and walking throughout the remainder of the year. In the vicinity of the primary building entrances along the northeast of Building 2, conditions are predicted to be suitable for sitting throughout the year, while conditions in the vicinity of secondary building entrances are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for walking, or better, during the spring and winter. The noted conditions are considered acceptable according to the comfort guidelines in Section 4.4.

Drop Off Area, Sidewalk, and Building Entrances along South Elevation of Building 3: Conditions over the drop off area and sidewalk along the south elevation of Building 3 are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for a mix of sitting, standing, and walking during the spring and winter. In the vicinity of primary building entrances along the south elevation of Building 3, conditions are predicted to be suitable for sitting throughout the year, while conditions in the vicinity of secondary building entrances are predicted to be suitable for standing, or better, during the summer, becoming suitable for walking, or better, throughout the remainder of the year. The noted conditions are considered acceptable according to the comfort guidelines in Section 4.4.

East-West Passageway beneath Podium of Building 1: Westerly and northeasterly winds are predicted to accelerate within the passageway beneath the podium of Building 1, which is 3 m wide, creating windy conditions. Overall conditions are predicted to be suitable for a mix of standing and walking during the summer, becoming suitable for walking throughout the remainder of the year. During the winter, conditions may occasionally be considered uncomfortable for walking. Specifically, conditions are predicted to be suitable for walking at least 77% of the time, as illustrated in Figure 8A. Experience with similar passageways has shown that conditions are expected to be improved by increasing the width of the passageway to 3 times the height of the passageway. Regardless, since these conditions are close to the target of 80% of the time, the conditions may be considered satisfactory. These conditions will be confirmed in collaboration with the design team for the future Site Plan Control submission via wind tunnel testing of a physical scale model of the subject site in its surroundings.

5.2 Wind Comfort Conditions – Common Amenity Terrace

Commercial Roof Amenity Terrace, Building 2, Level 2: Conditions over the Level 2 amenity terrace serving the commercial roof of Building 2 are predicted to be suitable for sitting during the typical use period. The noted conditions are considered acceptable according to the comfort guidelines in Section 4.4.

5.3 Wind Safety

The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site at grade level or over the amenity terraces, except the one location mentioned in Section 5.1. These conditions near the northeast corner of Building 1 will be confirmed in the wind tunnel for the Site Plan Control application to ensure conditions are safe for pedestrians. During extreme weather events, (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

5.4 Applicability of Results

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the subject site. Future changes (i.e., construction or demolition) of these surroundings may cause changes to the wind effects in two ways, namely: (i) changes beyond the immediate vicinity of the subject site would alter the wind profile approaching the site; and (ii) development in proximity to the subject site would cause changes to local flow patterns.

Regarding primary and secondary building access points, wind conditions predicted in this study are only applicable to pedestrian comfort and safety. As such, the results should not be construed to indicate wind loading on doors and associated hardware.

6. SUMMARY AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 of this report and illustrated in Figures 3A-9B. Based on computer simulations using the CFD technique, meteorological data analysis, and experience with numerous similar developments, the study concludes the following:

1) While the introduction of the proposed development is predicted to generally increase winds at grade, most areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, surface parking areas, amenity spaces, and building access points are considered acceptable, without the need for mitigation. Exceptions are as follows:

    a. During the winter, there is a small region on the east sidewalk along Ontario Street South, near the existing gas station, where conditions may occasionally be considered uncomfortable for walking. Specifically, conditions are predicted to be suitable for walking at least 77% of the winter, where the target is at least 80%. Since these conditions are close to the target, the conditions may be considered satisfactory.

    b. During the winter, there is a region over the sidewalk along Derry Road between Buildings 1 and 2 and a region near the southwest corner of the subject site where conditions may occasionally be considered uncomfortable for walking. Specifically, conditions are predicted to be suitable for walking at least 76% of the winter. Importantly, the region between Buildings 1 and 2 is located over the vehicular access to the underground garage, where pedestrian activity is expected to be limited, and the associated conditions may be considered acceptable. Since the conditions near the southwest corner of the subject site are close to the target of 80%, the conditions may be considered satisfactory.

    c. Westerly and northeasterly winds are predicted to accelerate within the passageway beneath the podium of Building 1, which is 3 m wide, creating windy conditions. Specifically, conditions during the winter are predicted to be suitable for walking at least 77% of the winter. Experience with similar passageways has shown that conditions are expected to be improved by increasing the width of the passageway to 3 times the height of the passageway. Regardless, since these conditions are close to the target, the conditions may be considered satisfactory.

d. Additionally, conditions near the northeast corner of the development are predicted to experience occasional strong wind gusts, which may have the potential to create unsafe conditions.

e. Conditions over the above regions will be investigated and confirmed in collaboration with the design team for the subsequent Site Plan Control application via wind tunnel testing of a physical scale model of the subject site in its surroundings.

2) Conditions over the Level 2 amenity terrace serving the commercial roof of Building 2are predicted to be suitable for sitting throughout the typical use period, which is acceptable.

3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site at grade level or over the amenity terraces, except the one location mentioned in 1(d) above. These conditions near the northeast corner of Building 1 will be confirmed in the wind tunnel for the Site Plan Control application to ensure conditions are safe for pedestrians. During extreme weather events, (e.g., thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

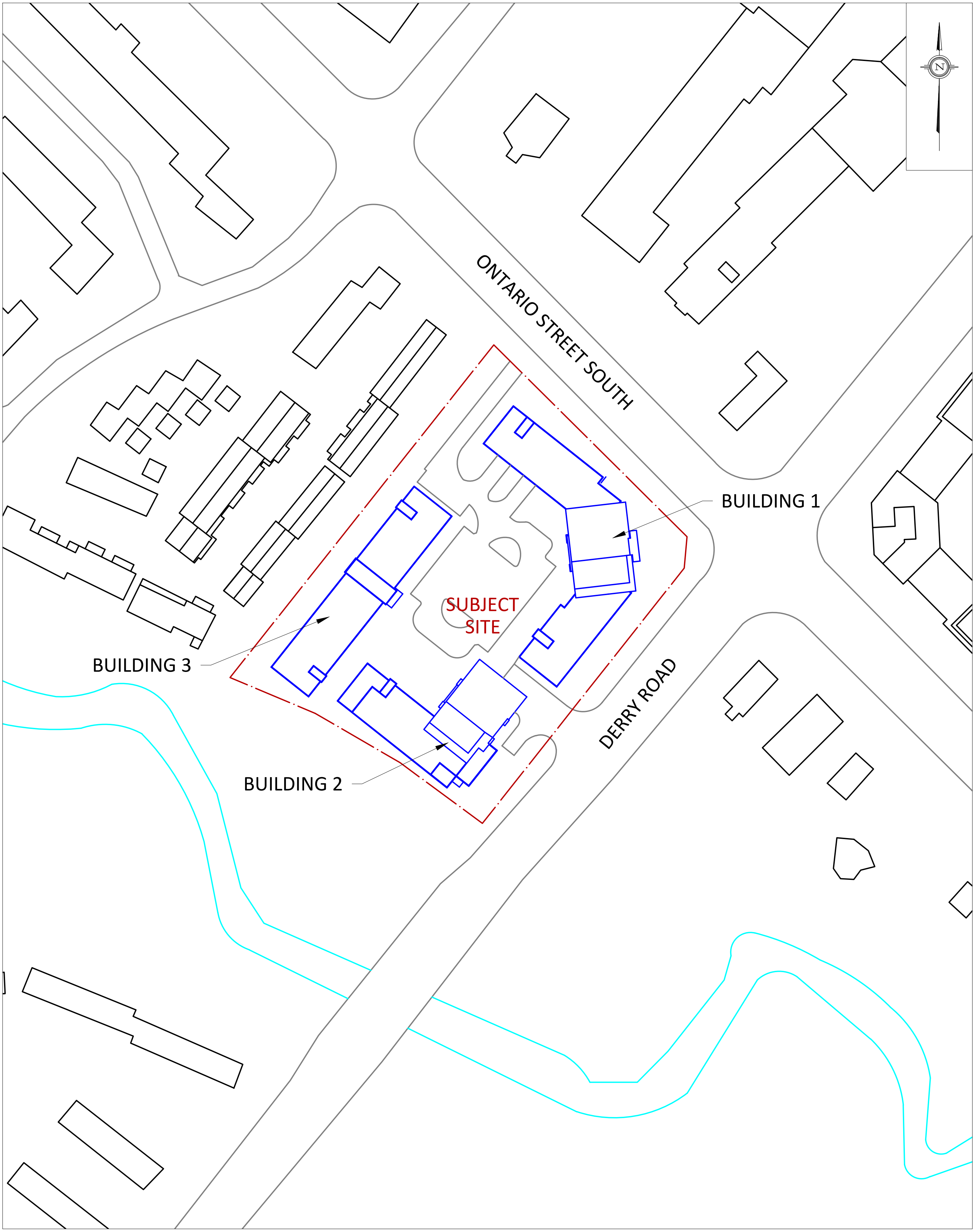
Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
S. R. HALL
100197168
Nov 1, 2021
PROVINCE OF ONTARIO

Daniel Davalos, MESc.
Junior Wind Scientist

Steven Hall, M.A.Sc., P.Eng.
Senior Wind Engineer



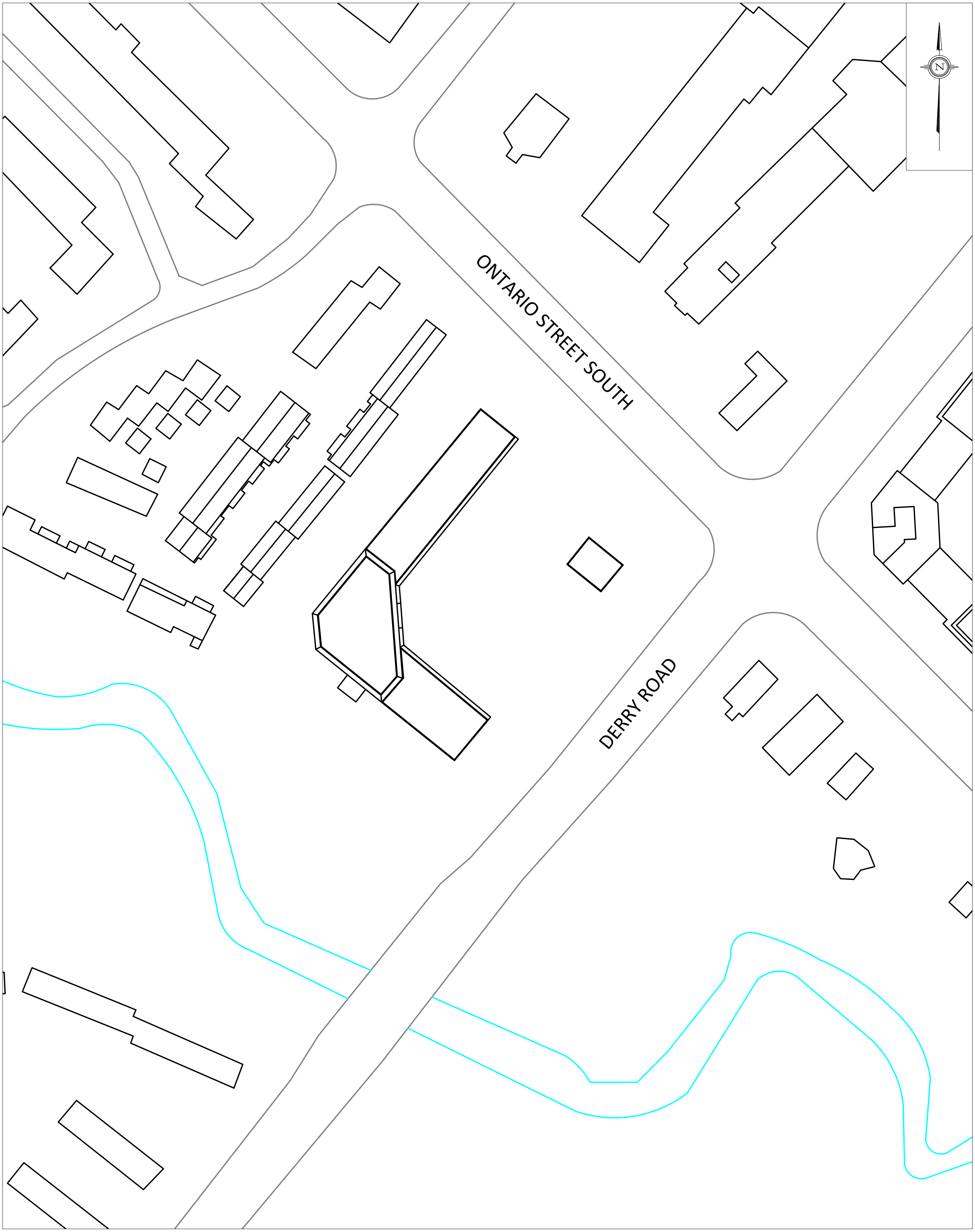
GRADIENTWIND
ENGINEERS & SCIENTISTS

127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	550 ONTARIO STREET SOUTH, MILTON PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	21-134-PLW-1A
DATE	NOVEMBER 1, 2021	DRAWN BY	O.R.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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PROJECT	550 ONTARIO STREET SOUTH, MILTON PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	21-134-PLW-1B
DATE	NOVEMBER 1, 2021	DRAWN BY	O.R.

DESCRIPTION

FIGURE 1B:
EXISTING SITE PLAN AND SURROUNDING CONTEXT

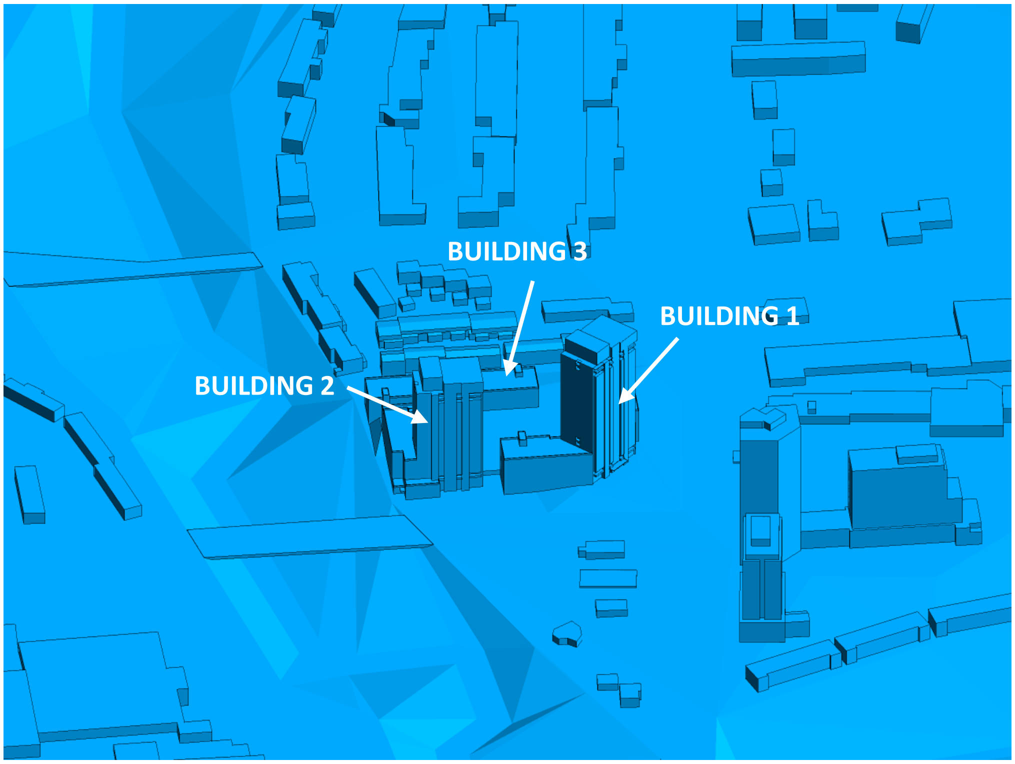


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTHEAST PERSPECTIVE

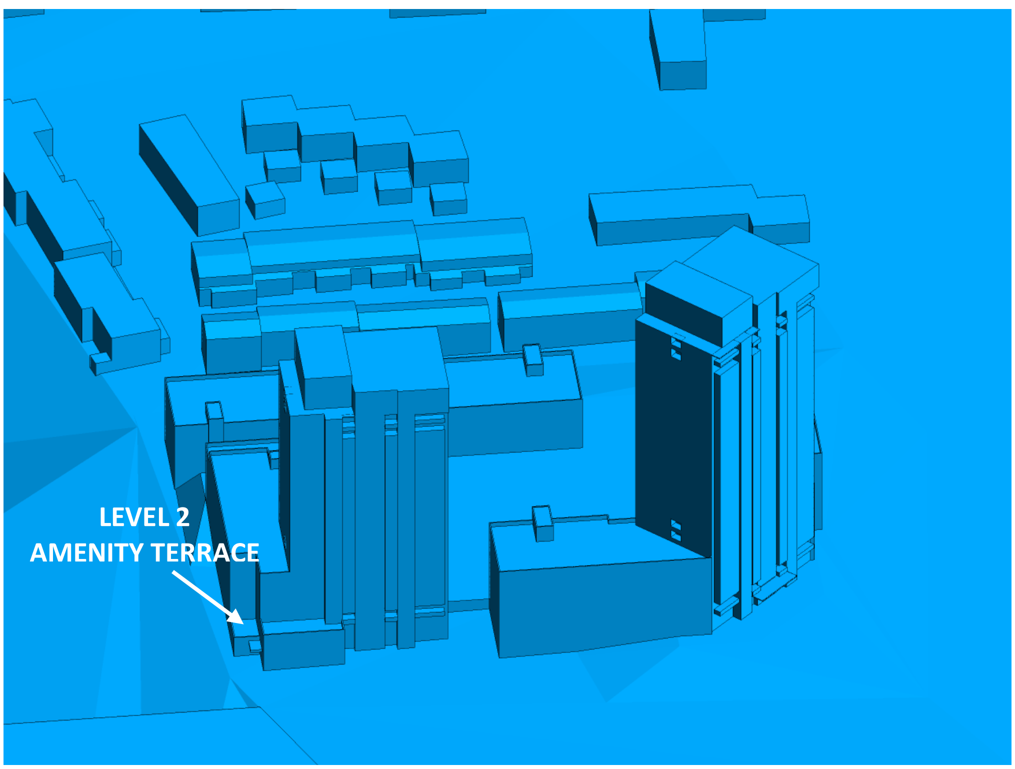


FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

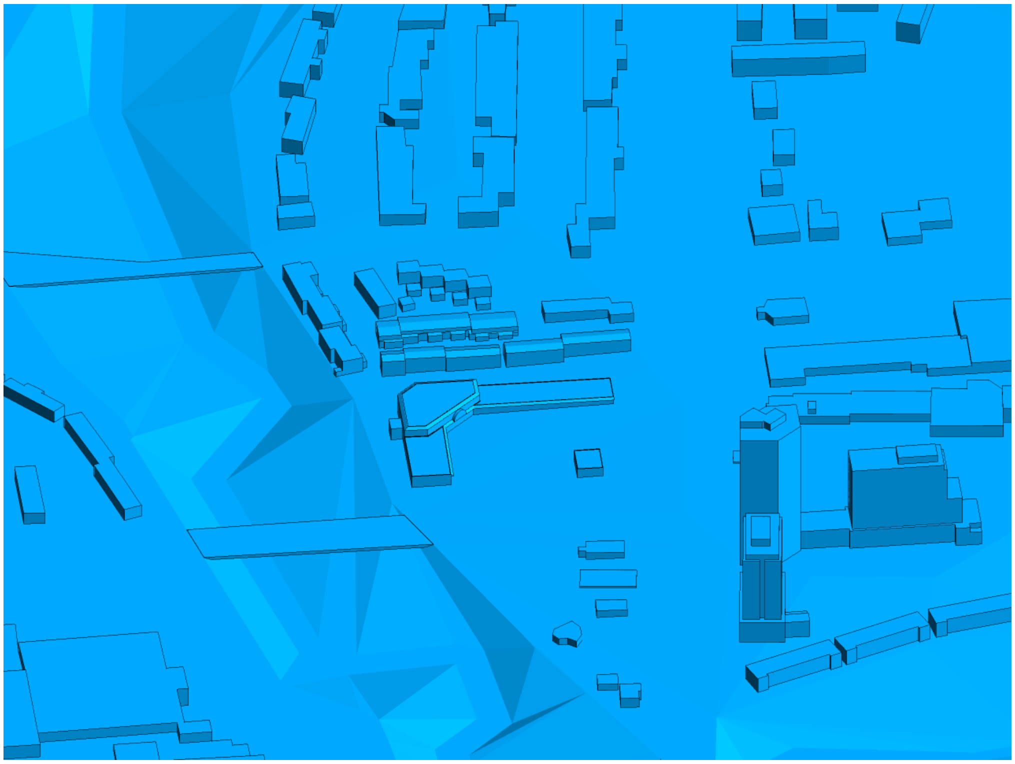


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTHEAST PERSPECTIVE

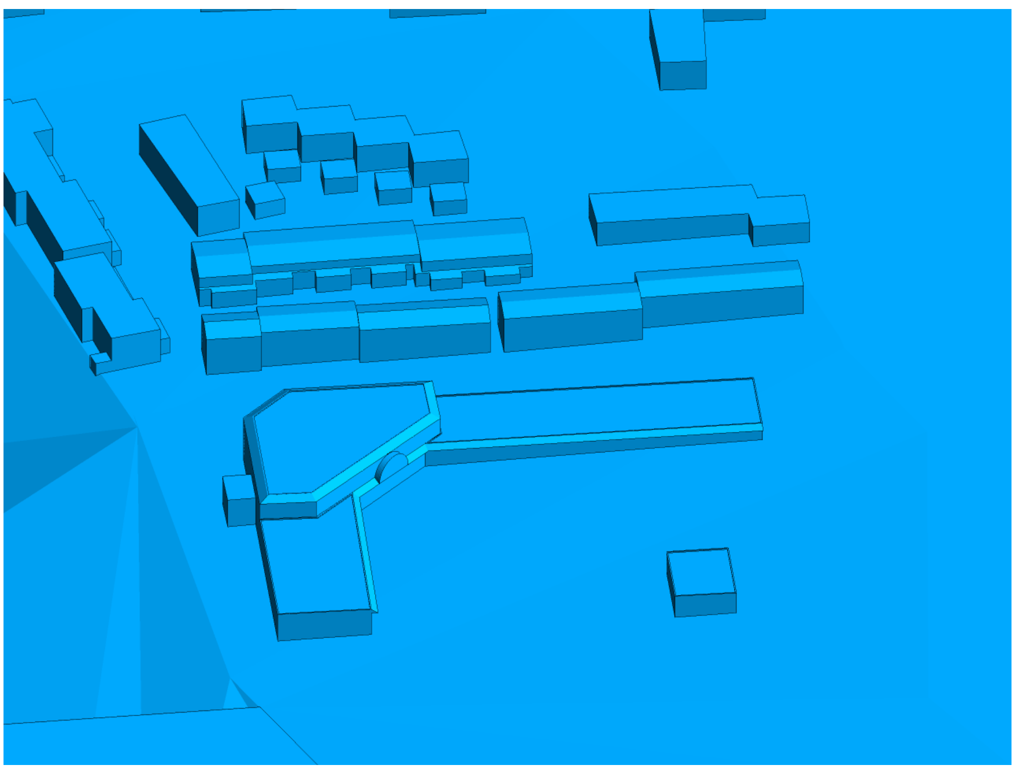


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

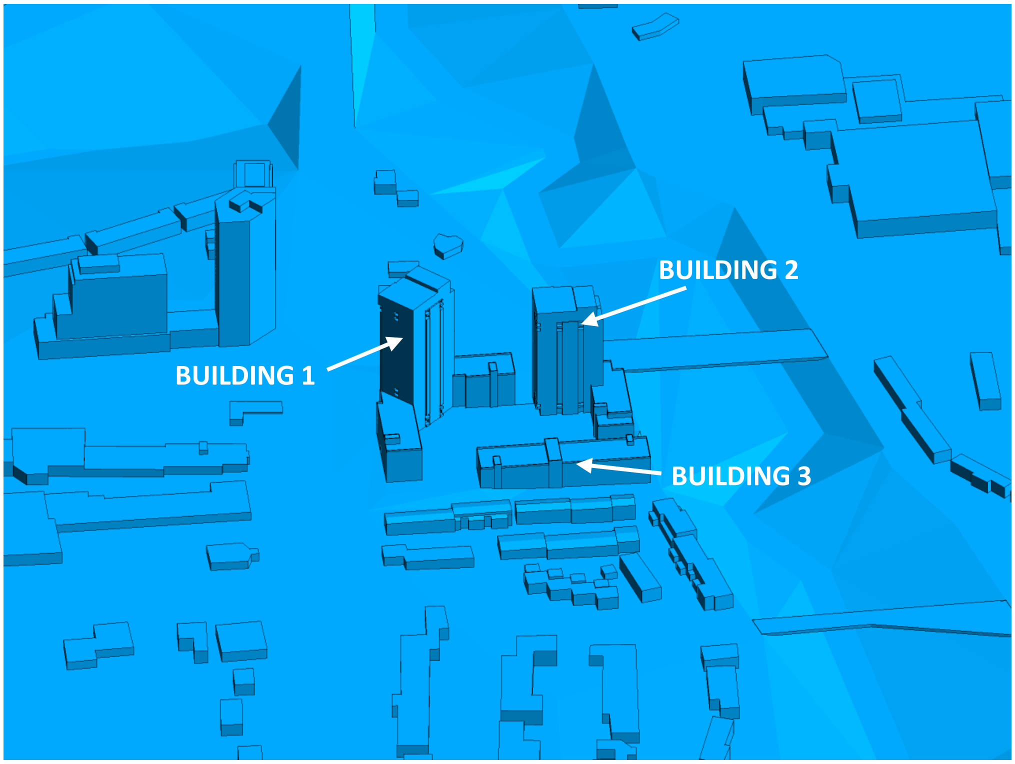


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTHWEST PERSPECTIVE

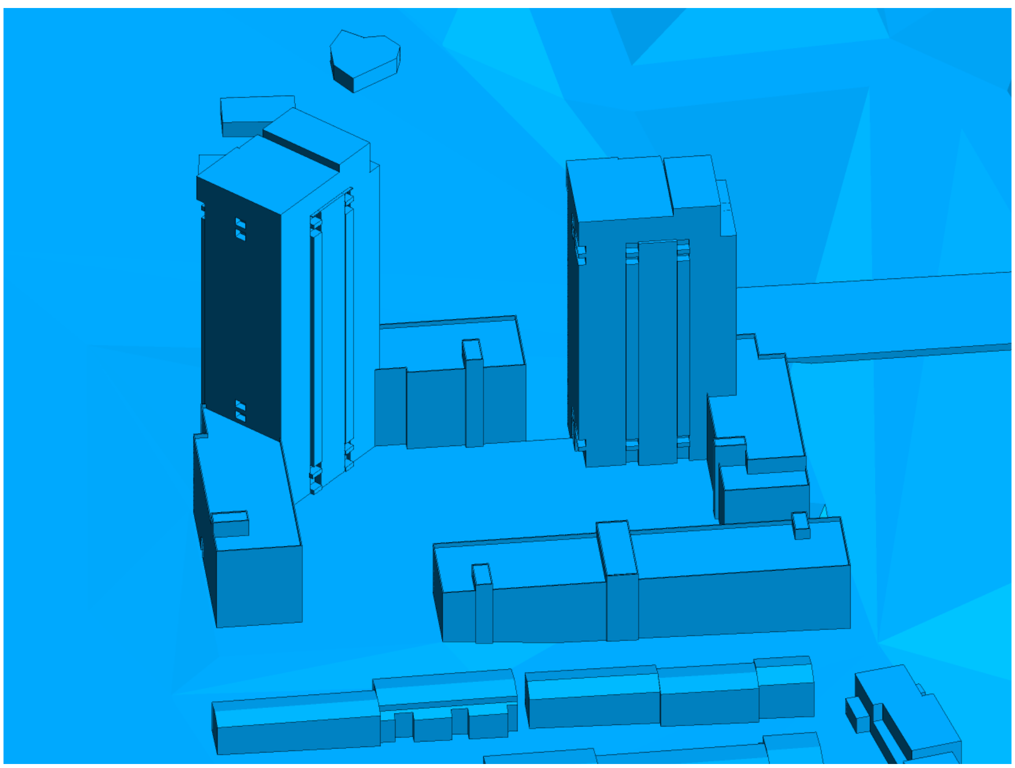


FIGURE 2F: CLOSE-UP VIEW OF FIGURE 2E

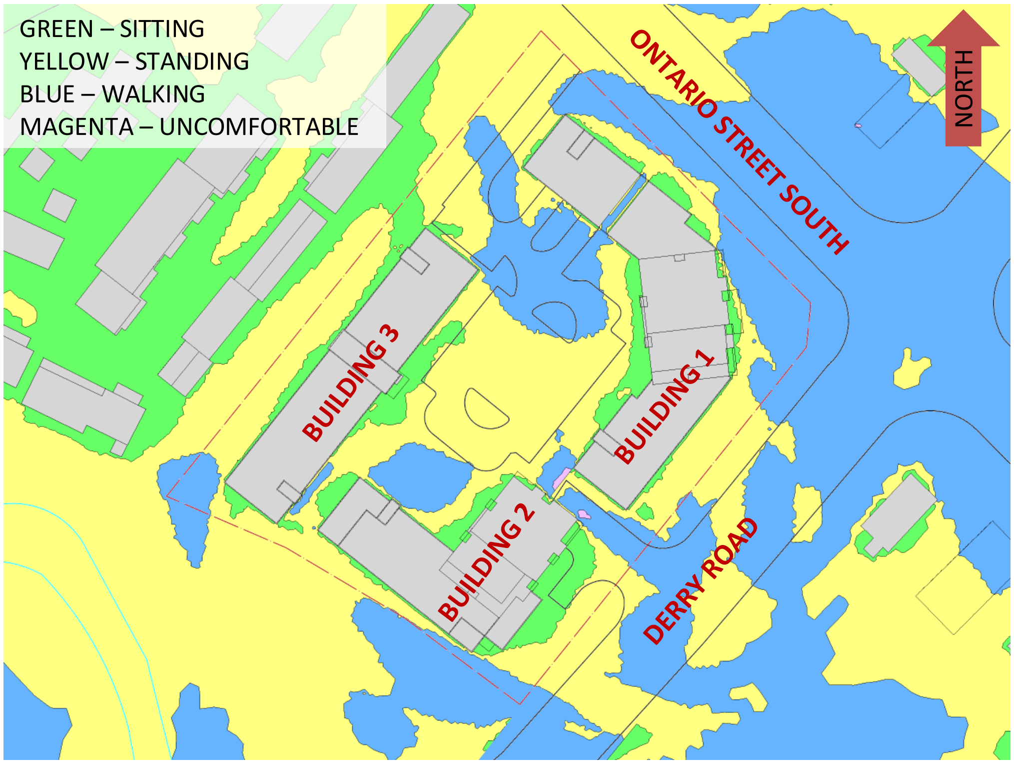


FIGURE 3A: SPRING – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

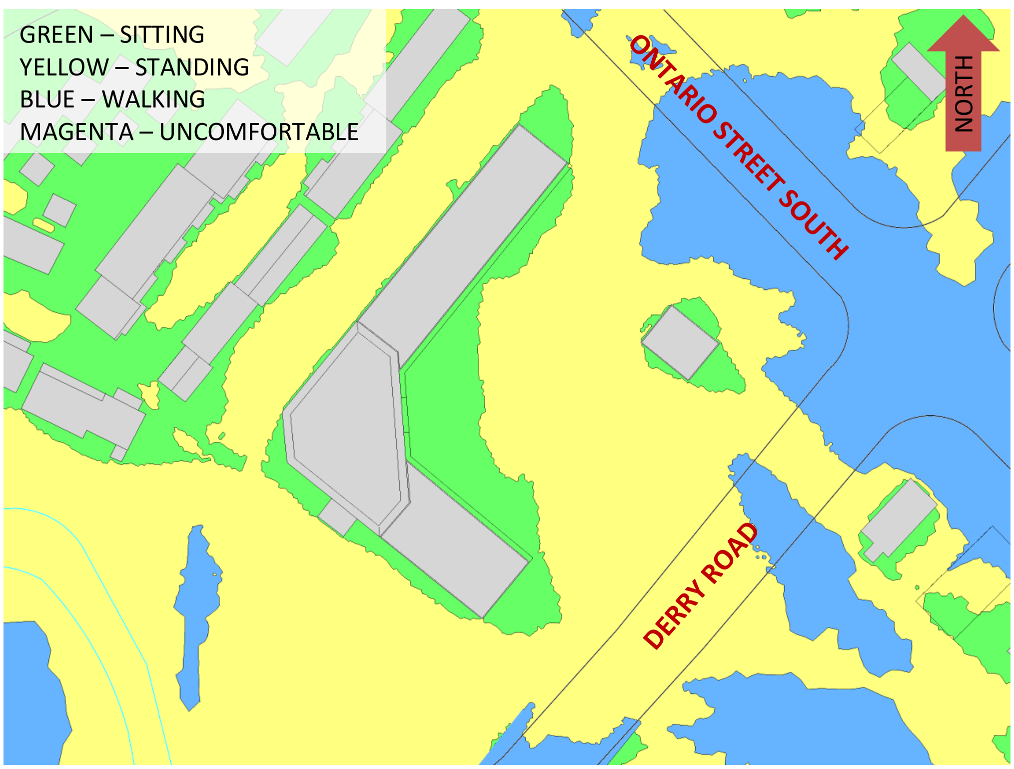


FIGURE 3B: SPRING – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

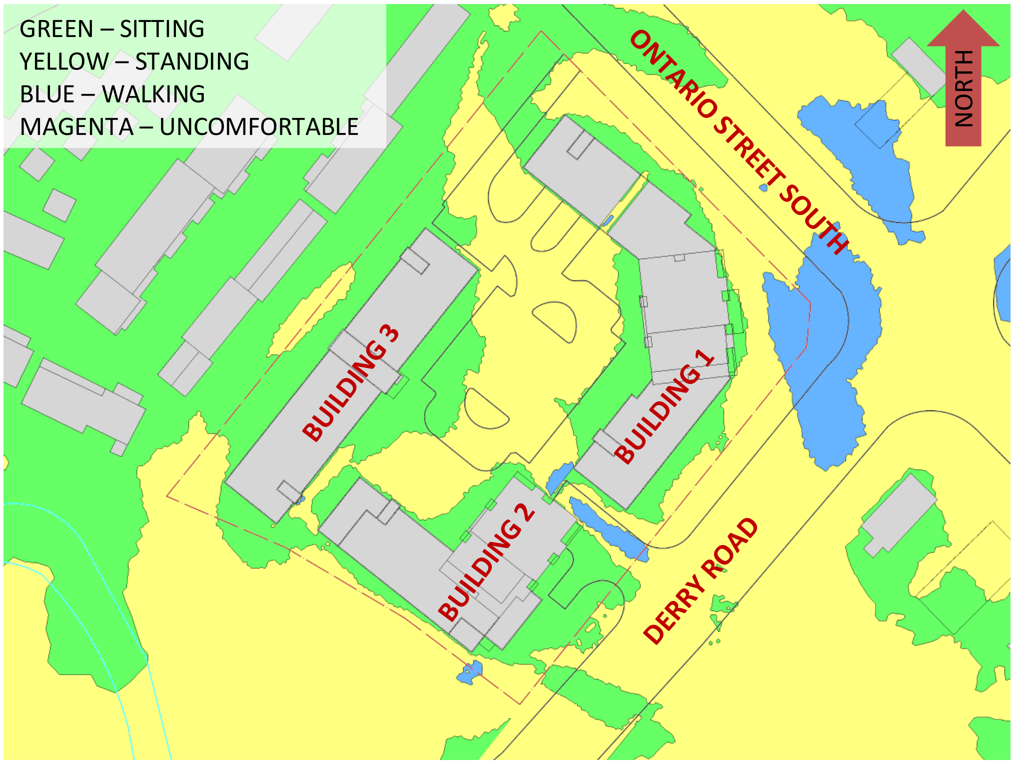


FIGURE 4A: SUMMER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

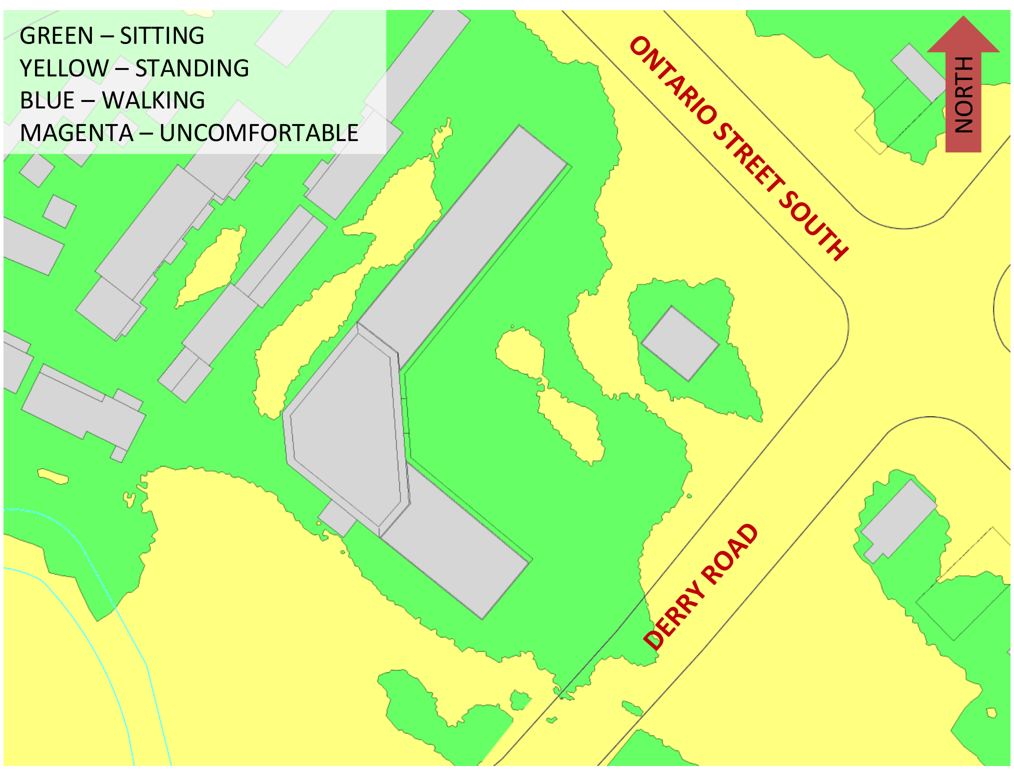


FIGURE 4B: SUMMER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

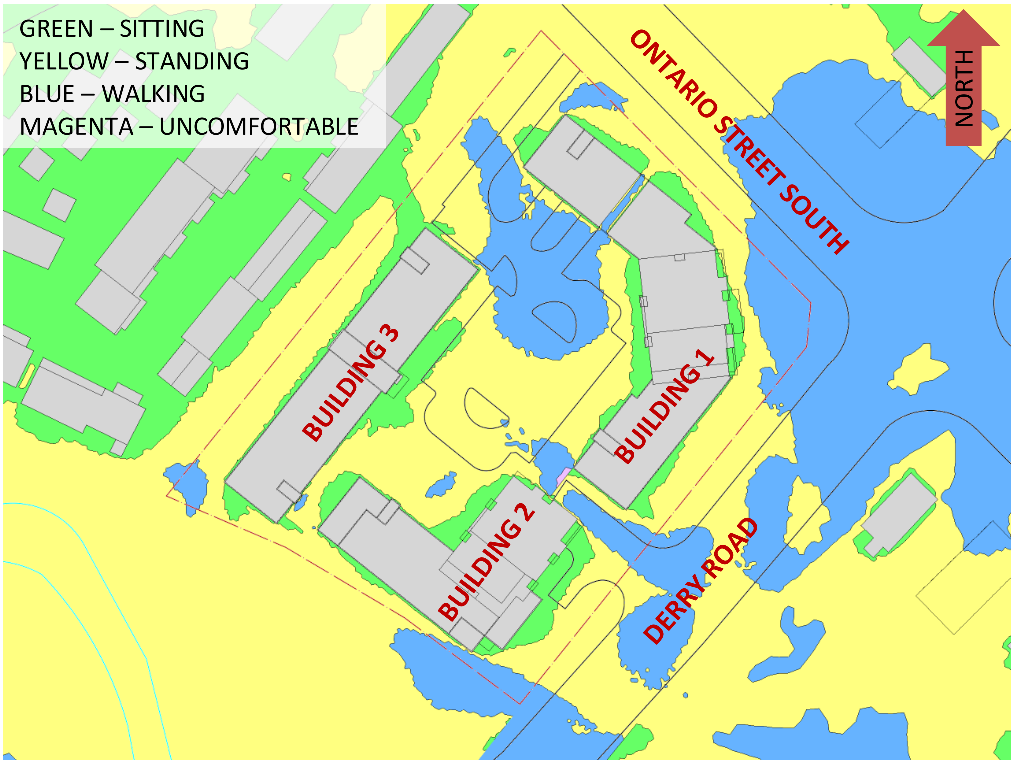


FIGURE 5A: AUTUMN – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

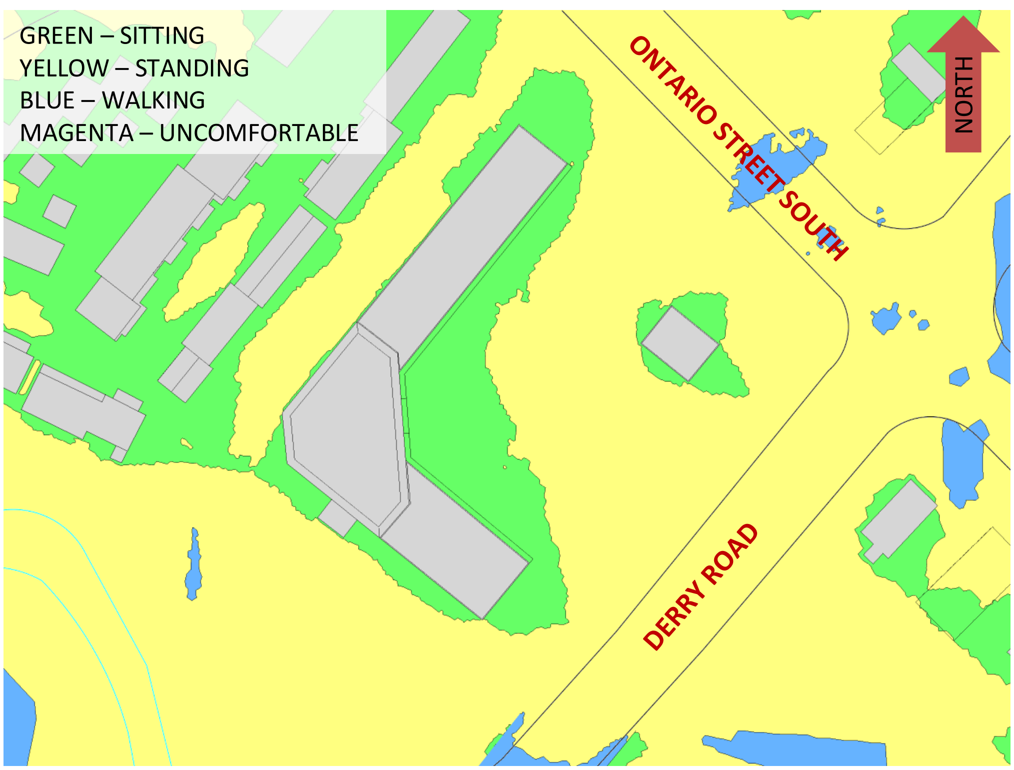


FIGURE 5B: AUTUMN – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

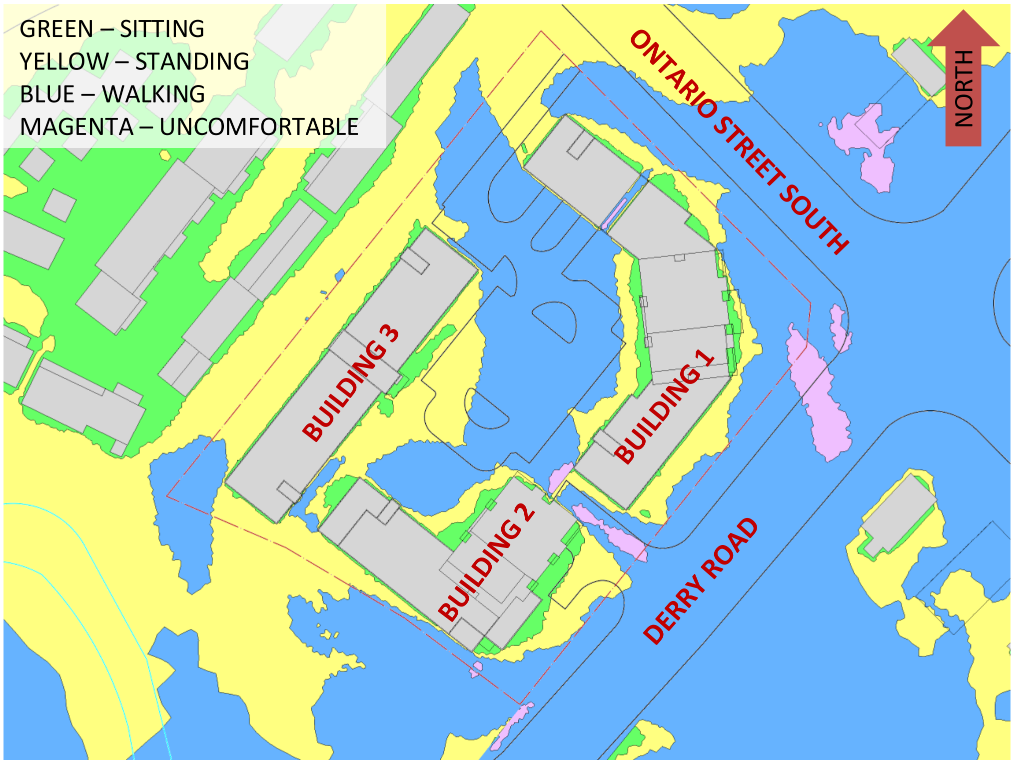


FIGURE 6A: WINTER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

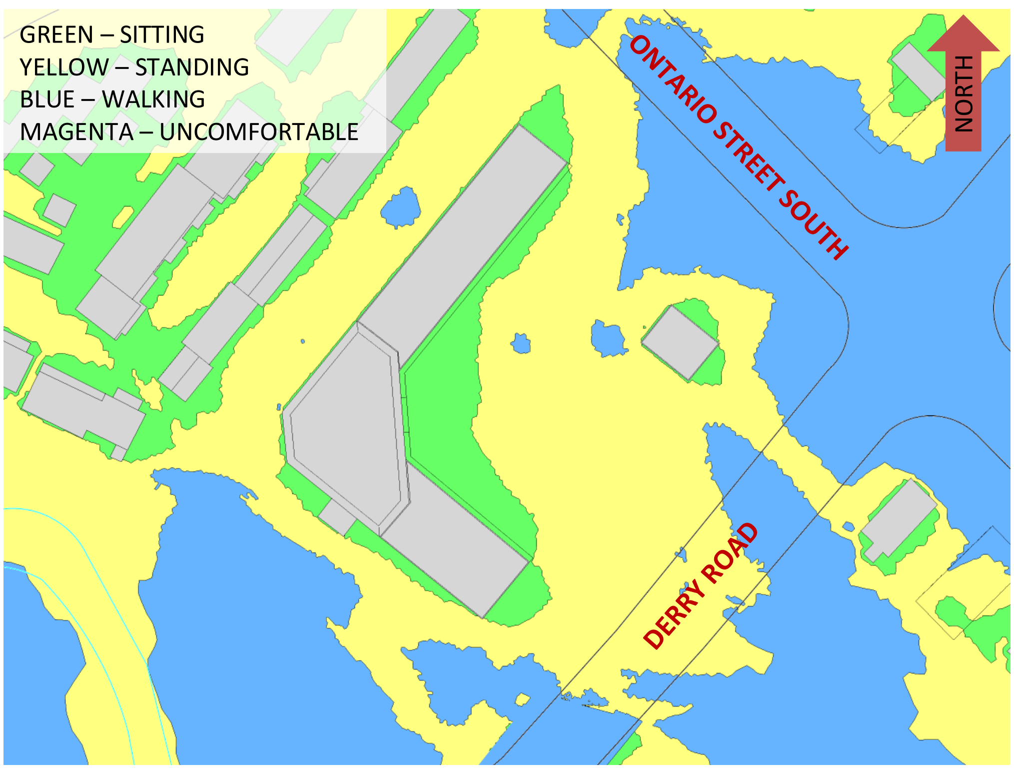


FIGURE 6B: WINTER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

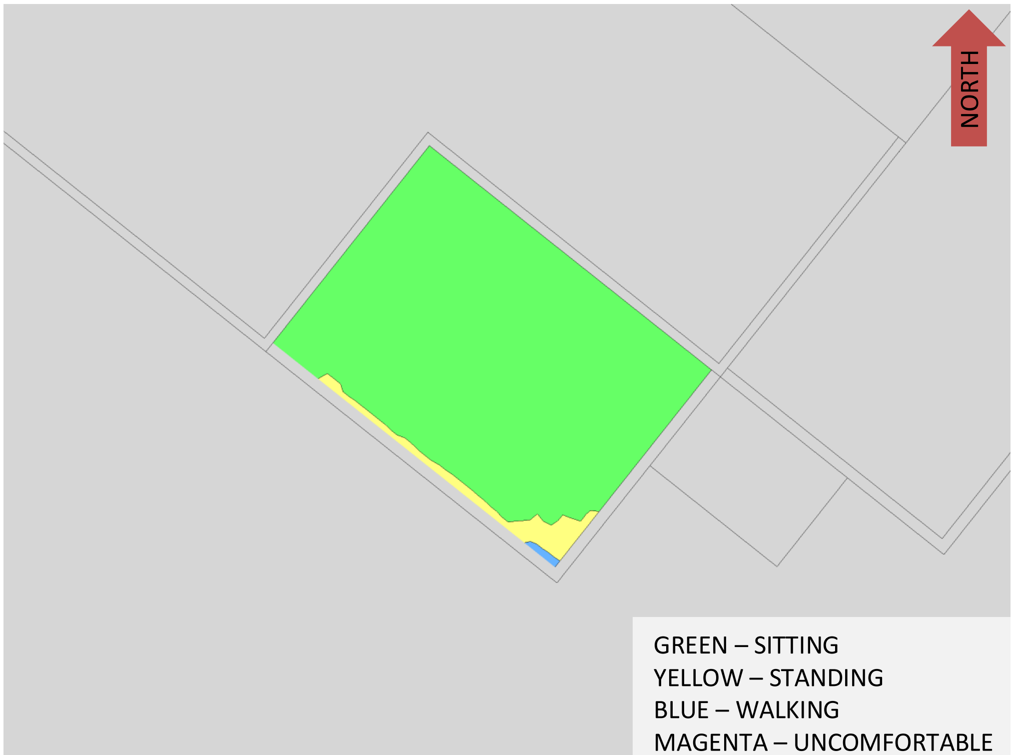


FIGURE 7A: SPRING – WIND COMFORT CONDITIONS, LEVEL 2 AMENITY TERRACE

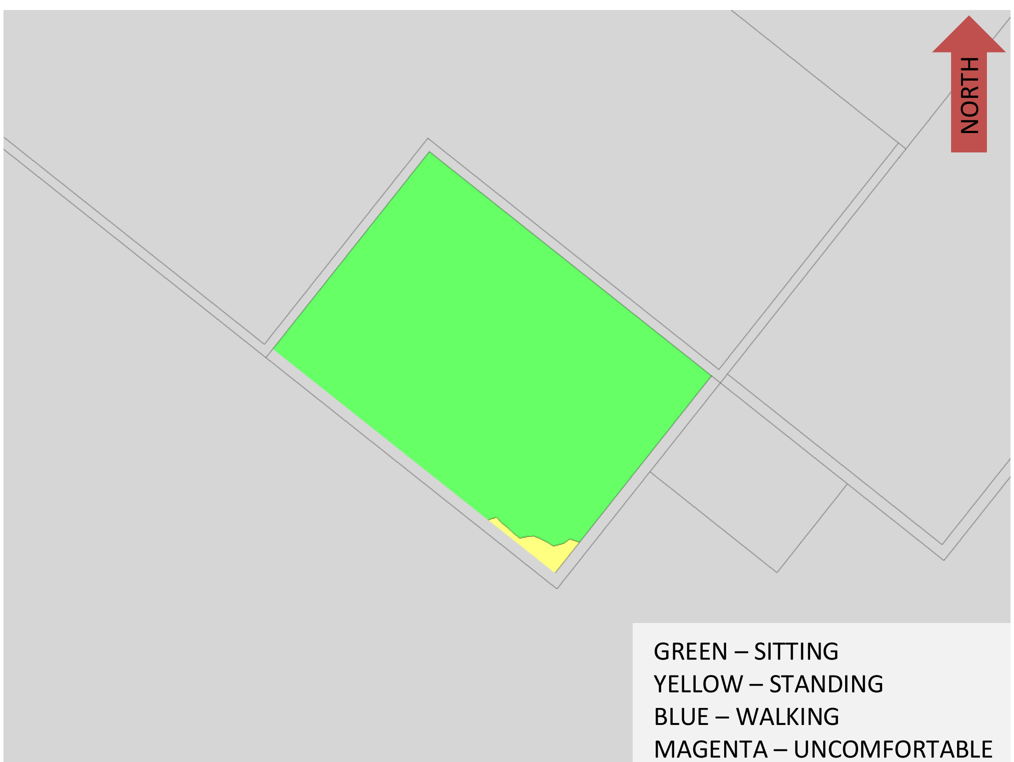


FIGURE 7B: SUMMER – WIND COMFORT CONDITIONS, LEVEL 2 AMENITY TERRACE

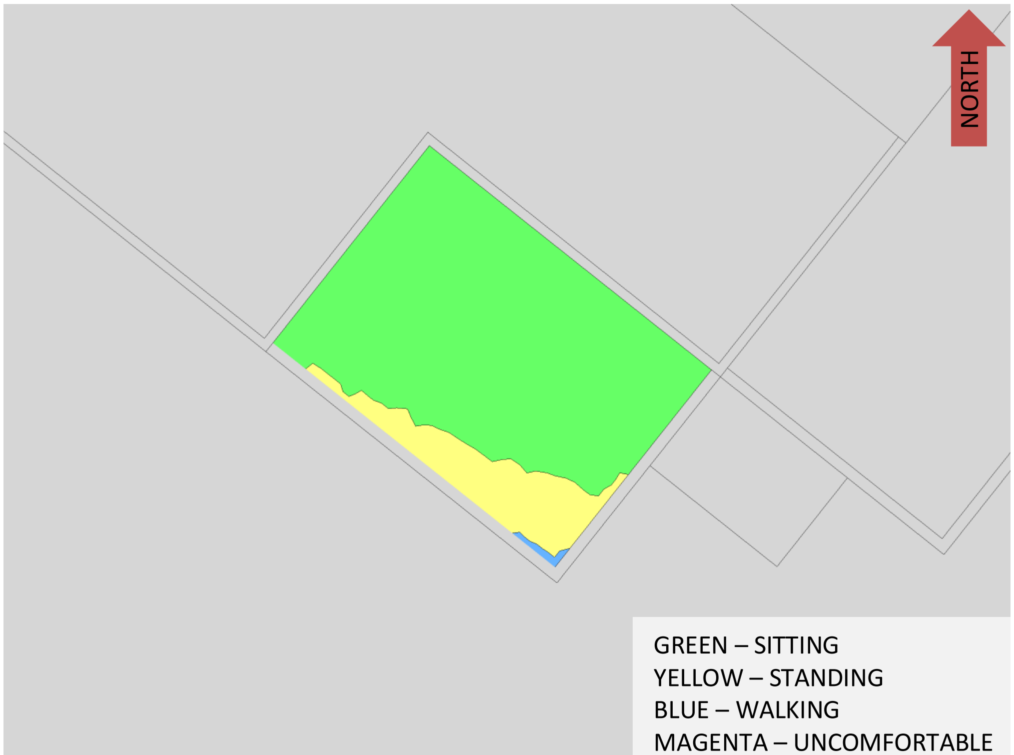


FIGURE 7C: AUTUMN – WIND COMFORT CONDITIONS, LEVEL 2 AMENITY TERRACE

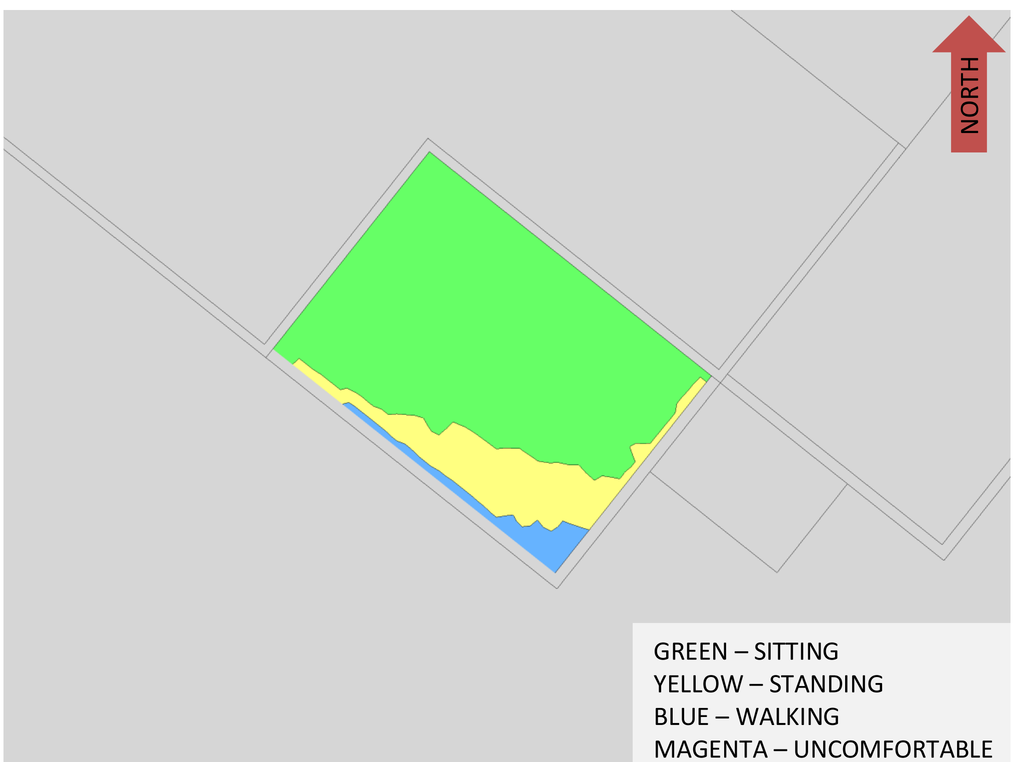


FIGURE 7D: WINTER – WIND COMFORT CONDITIONS, LEVEL 2 AMENITY TERRACE

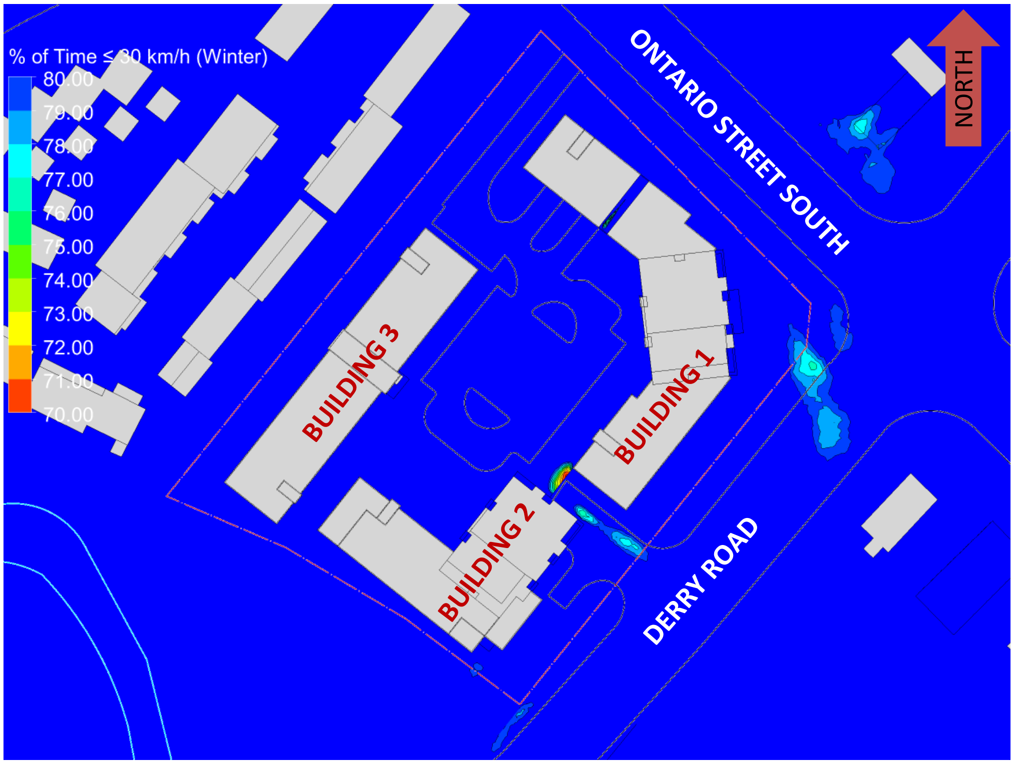


FIGURE 8: WINTER –% OF TIME SUITABLE FOR WALKING, GRADE LEVEL

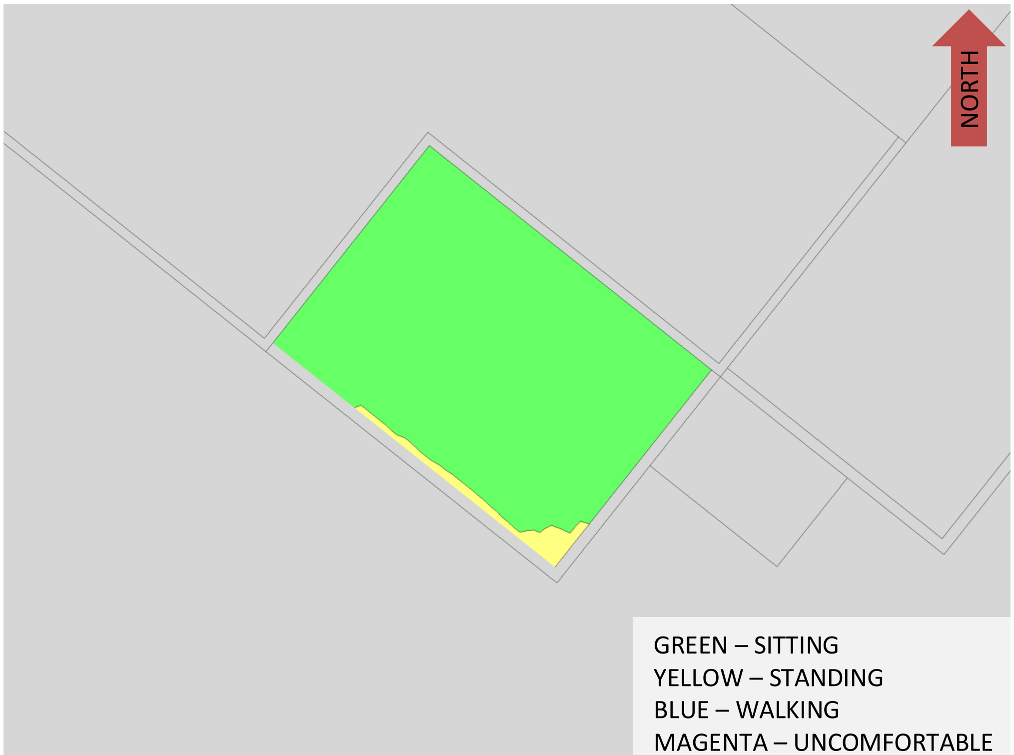


FIGURE 9A: TYPICAL USE PERIOD – WIND COMFORT, LEVEL 2 AMENITY TERRACE

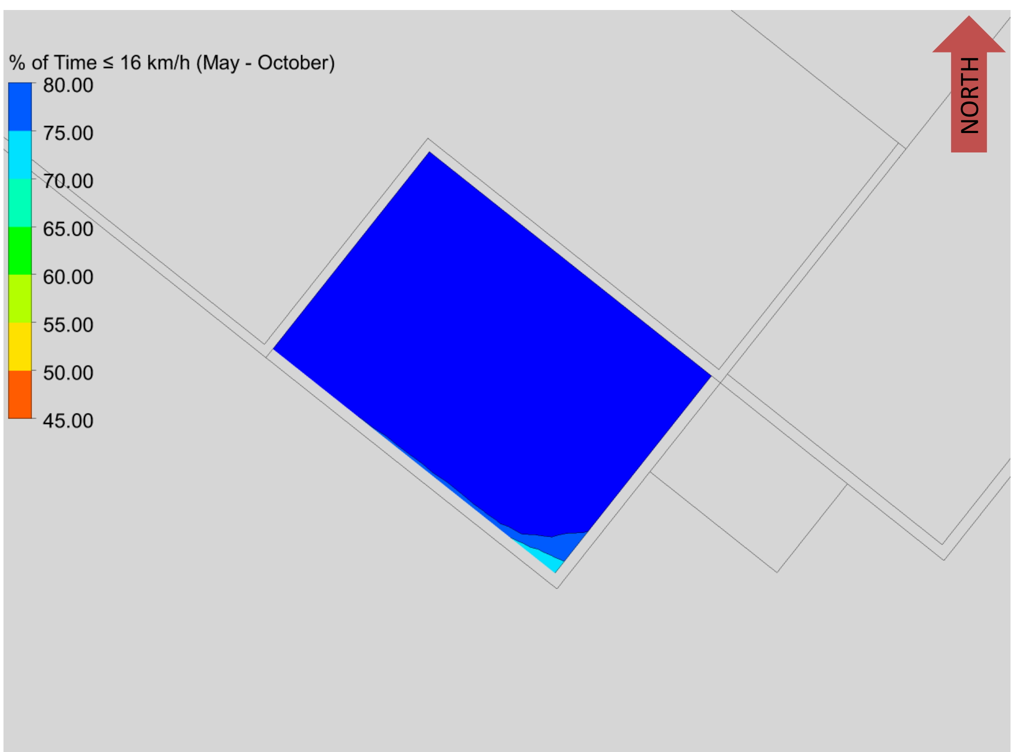
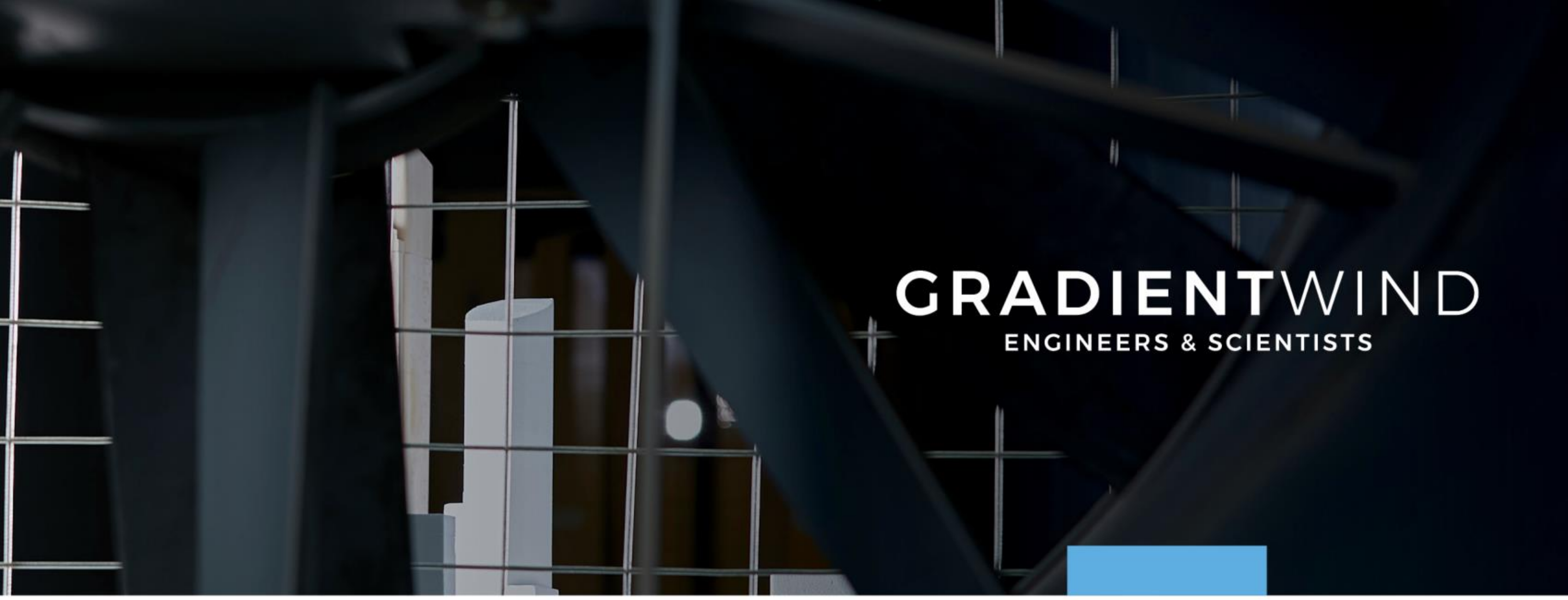
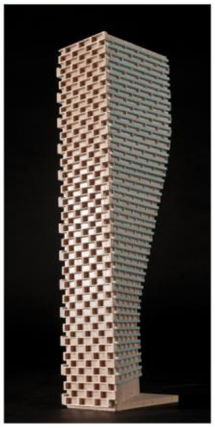
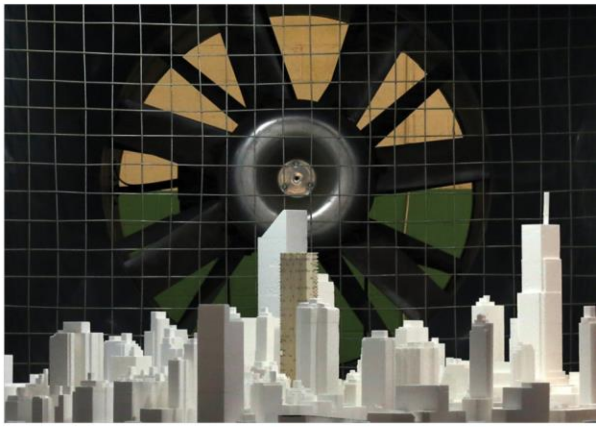


FIGURE 9B: % OF TIME SUITABLE FOR SITTING CORRESPONDING TO FIGURE 9A







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

The atmospheric boundary layer (ABL) is defined by the velocity and turbulence profiles according to industry standard practices. The mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed [1], [2].

$$U = U_g \left(\frac{Z}{Z_g}\right)^{\alpha} \qquad \text{Equation (1)}$$

where, $\boldsymbol{U}$ = mean wind speed, $\boldsymbol{U_g}$ = gradient wind speed, $\boldsymbol{Z}$ = height above ground, $\boldsymbol{Z_g}$ = depth of the boundary layer (gradient height), and α is the power law exponent.

For the model, U_g is set to 6.5 metres per second (m/s), which approximately corresponds to the 50% mean wind speed for Toronto based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

Z_g is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α is determined based on the upstream exposure of the far-field surroundings (i.e., the area that is not captured within the simulation model).

Table 1 presents the values of α used in this study, while Table 2 presents several reference values of α. When the upstream exposure of the far-field surroundings is a mixture of multiple types of terrain, the α values are a weighted average with terrain that is closer to the subject site given greater weight.

TABLE 1: UPSTREAM EXPOSURE (ALPHA VALUE) VS TRUE WIND DIRECTION

Wind Direction (Degrees True)	Alpha Value (α)
0	0.24
40	0.23
60	0.23
80	0.21
125	0.19
175	0.21
205	0.22
220	0.23
235	0.23
250	0.23
265	0.23
285	0.23
310	0.24

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

Upstream Exposure Type	Alpha Value (α)
Open Water	0.14-0.15
Open Field	0.16-0.19
Light Suburban	0.21-0.24
Heavy Suburban	0.24-0.27
Light Urban	0.28-0.30
Heavy Urban	0.31-0.33

The turbulence model in the computational fluid dynamics (CFD) simulations is a two-equation shear-stress transport (SST) model, and thus the ABL turbulence profile requires that two parameters be defined at the inlet of the domain. The turbulence profile is defined following the recommendations of the Architectural Institute of Japan for flat terrain [3].

$$I(Z) = \begin{cases} 0.1\left(\frac{Z}{Z_g}\right)^{-\alpha-0.05}, & Z > 10 \text{ m} \\ 0.1\left(\frac{10}{Z_g}\right)^{-\alpha-0.05}, & Z \leq 10 \text{ m} \end{cases}$$ Equation (2)

$$L_t(Z) = \begin{cases} 100 \text{ m}\sqrt{\frac{Z}{30}}, & Z > 30 \text{ m} \\ 100 \text{ m}, & Z \leq 30 \text{ m} \end{cases}$$ Equation (3)

where, ***I*** = turbulence intensity, L_t = turbulence length scale, ***Z*** = height above ground, and α is the power law exponent used for the velocity profile in Equation (1).

Boundary conditions on all other domain boundaries are defined as follows: the ground is a no-slip surface; the side walls of the domain have a symmetry boundary condition; the top of the domain has a specified shear, which maintains a constant wind speed at gradient height; and the outlet has a static pressure boundary condition.

REFERENCES

[1] P. Arya, "Chapter 10: Near-neutral Boundary Layers," in *Introduction to Micrometeorology*, San Diego, California, Academic Press, 2001.

[2] S. A. Hsu, E. A. Meindl and D. B. Gilhousen, "Determining the Power-Law WInd Profile Exponent under Near-neutral Stability Conditions at Sea," vol. 33, no. 6, 1994.

[3] Y. Tamura, H. Kawai, Y. Uematsu, K. Kondo and T. Okhuma, "Revision of AIJ Recommendations for Wind Loads on Buildings," in *The International Wind Engieering Symposium, IWES 2003*, Taiwan, 2003.