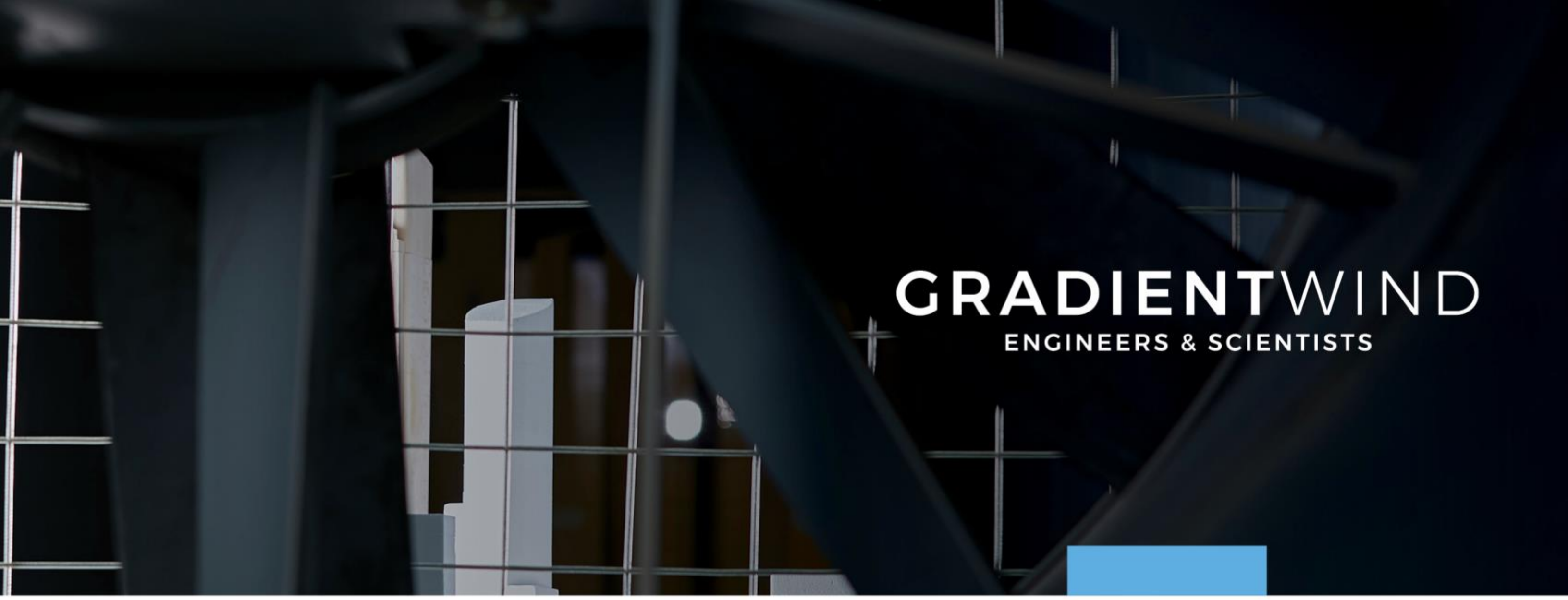
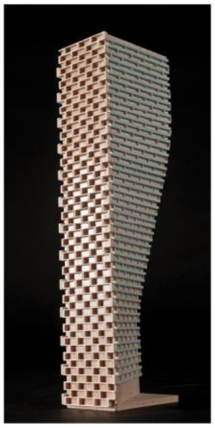


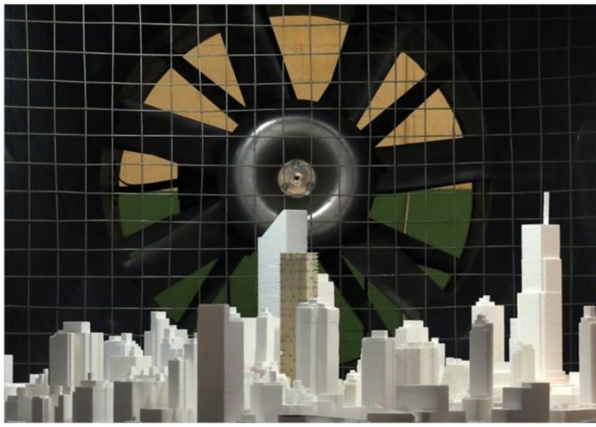
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

Pickering Design Centre
Block A
Pickering, Ontario

Report: 20-305-PLW





March 25, 2022

PREPARED FOR
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EXECUTIVE SUMMARY

This report describes a comparative pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBLA) application submission requirements for Block A of a proposed multi-phase building development located in Pickering, Ontario. 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 necessary and practical.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, architectural drawings provided by Turner Fleischer Architects Inc in December 2020, surrounding street layouts and existing and approved future building massing information obtained from the City of Pickering, and recent site imagery.

This PLW study considers three massing scenarios: (i) Existing, including the approved Metropia site to the northeast; (ii) Proposed, including existing and approved massing, as well as the proposed building (Block A); and (iii) Future, including all buildings shown in the master plan for the site as well as the buildings planned for the Smart Centres site to the north.

A complete summary of the predicted wind conditions is provided in Section 5 of this report and illustrated in Figures 3A-10B. Based on computer simulations using the CFD technique, meteorological data analysis, and experience with similar developments, the study concludes the following:

1) Conditions at grade are expected to become windier following the introduction of the subject site, as is expected when introducing a tall building(s) into a low-rise setting. For most areas surrounding the subject site, conditions are predicted to be windiest under the proposed massing scenario (Figures 3B, 4B, 5B, and 6B) while the completion of the planned future developments in the area (future massing scenario, Figures 3A, 4A, 5A, and 6A) is expected to increase wind comfort levels on and around the subject site, compared to the proposed massing scenario.

2) Conditions over the surrounding sidewalks are predicted to be mostly suitable for walking, or better, throughout the year under the future massing scenario. Conditions under the proposed massing scenario, which excludes the planned surrounding developments, are predicted to be

windier; areas along the sidewalks are predicted to become uncomfortable during the spring and winter seasons. Nevertheless, since the areas are expected to become more developed in the near future, the noted conditions may be considered acceptable.

a. The expected improvements to pedestrian wind comfort in the future massing scenario are a result of the generalized increase in wind blockage in the area, which leads to lower wind speeds and greater turbulence. The specific geometry of the planned surrounding massing is of secondary importance; similar improvements in wind comfort can be expected should minor changes be made to the planned surrounding buildings.

3) Conditions in the vicinity of the primary building entrance, located near the centre of the south elevation, are predicted to be suitable for sitting throughout the year, which is acceptable. Since conditions near building entrances along the north elevation are predicted to be somewhat windy, we recommend recessing the entrances by a minimum of 1.5 metres into the north façade.

4) Conditions along the private driveway and drop-off area, to the south of building, are predicted to be suitable for walking, or better, throughout the year-round, which is acceptable.

5) Conditions within the proposed public park to the east of the subject site and within the landscaped area to the northeast of the proposed building are predicted to be suitable for standing during the summer season under the future massing scenario and suitable for walking, or better, during the remaining three seasons. Conditions under the proposed massing scenario are predicted to be suitable for walking, or better, during the spring, summer, and autumn seasons, while winter conditions may exceed the walking comfort class for some areas.

a. A mitigation strategy will be required to provide conditions suitable for sitting during the typical use period of late spring to early autumn. Mitigation may include wind barriers along the perimeter of the area (solid or high-solidity wind screens and/or coniferous plantings in dense arrangements). Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

6) The site includes two amenity areas, both of which will require mitigation to ensure conditions suitable for sitting during the typical use period. Mitigation will be considered for the SPA submission based on a detailed PLW study via wind tunnel testing on a physical scale model of the subject site in its surroundings.

   a. Conditions within the outdoor amenity terrace on the podium roof (Level 7), between buildings A1 and A2, are predicted to be suitable for a mix of sitting and standing during the summer and autumn seasons under both the proposed and future massing scenarios, and suitable for walking, or better, during the spring and winter seasons. Conditions under the future massing scenario are predicted to be noticeably calmer than under the proposed massing scenario.

   b. The elevated amenity terrace will require a mitigation strategy to achieve conditions suitable for sitting during the typical use period. Mitigation may include raised perimeter guards along the north and south of the terrace, canopies extending from the buildings, and/or wind barriers inboard of the perimeter to protect designated seating areas. Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

   c. Conditions within the outdoor amenity at grade, to the south of the proposed building, are predicted to be mostly suitable for standing during the summer season under both the proposed and future massing scenarios, although conditions under the future massing scenario are predicted to be slightly calmer. During the autumn season, the area is predicted to be mostly suitable for standing under the future massing scenario and mostly suitable for walking under the proposed massing scenario. The area is also predicted to be mostly suitable for walking under the proposed and future massing scenarios during the spring and winter seasons. Mitigation measures similar to those noted in item 5(a) will be required and explored for the future Site Plan Control application submission.

7) 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 or over the amenity terrace at Level 7. 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.

8) 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.

Addendum: The PLW study was completed based on architectural drawings prepared by Turner Fleischer Architects Inc. in December 2020[1]. Updated drawings were distributed to the consultant team in March 2022[2], which include a 7-storey common podium serving buildings A1 and A2 in Block A; the original design included a common 6-storey podium. Buildings A1 and A2 are unchanged at 31 storeys between the two noted drawing sets. Additionally, the master plan for the remainder of the property is largely unchanged between the two drawing sets. The results and recommendations provided in this study for the original massing (December 2020) are expected to be representative of the current massing.

[1] Turner Fleischer Architects Inc., '*1775 Pickering Parkway – 06.037RZ',* [Dec 18, 2020]
[2] Turner Fleischer Architects Inc., '*1775 Pickering Parkway – 06.037RZ',* [Feb 25, 2022]

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Pickering Ridge Lands Inc. to undertake a pedestrian level wind (PLW) study to satisfy concurrent Official Plan Amendment (OPA) and Zoning By-law Amendment (ZBLA) application submission requirements for Block A of a proposed multi-phase building development located in Pickering, Ontario. 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 necessary and practical.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, architectural drawings provided by Turner Fleischer Architects Inc., in December 2020, surrounding street layouts and existing and approved future building massing information obtained from the City of Pickering, and recent site imagery.

2. TERMS OF REFERENCE

The subject site is part of a master planned development bordered by Brock Road to the west, Pickering Parkway to the north, Notion Road to the east, and Highway 401 to the south. Block A, the subject of this study, is located at the western extent of the site, along Brock Road. A proposed public road will run along the north of Block A.

Rendering of Planned Building, Northeast Perspective (Courtesy of Turner Fleischer Architects Inc)

Block A comprises two 31-storey buildings (referred to as buildings ‘A1’ and ‘A2’), which share a kinked 6-storey podium. At grade, the podium includes retail, lobby, and building services space. Commercial entrances are located along the north elevation, while the primary residential entrance is located near the centre of the south elevation. An outdoor amenity area will be located to the south of the building. The building maintains a consistent floorplate from Levels 2-6, where the building steps back from the west and east elevations. The podium rises to Level 7, and the roof area between buildings A1 and A2 is served by an amenity terrace.

The buildings, which have square floorplates, include private balconies along the full height of their north and south elevations, and private terraces from Levels 8-15 along the east and west elevations. The buildings A1 and A2 are served by a mechanical penthouse above Level 31.

The master plan for the remainder of the property includes six additional high-rise buildings with a total of 10 high-rise towers of between 20 and 43 storeys. The buildings include 5- and 7-storey podia. A public park is proposed within the centre of the property, to the east of Block A. To the northeast of the property, an approved development (Metropia Notion Road) will include 3- and 4-storey townhouses along the south side of Pickering Parkway. To the north of the subject site, another master-planned development has been proposed (First Simcha Shopping Centres Limited, and Calloway REIT (Pickering) Inc. (Smart Centres)), which includes 14 buildings with heights ranging between 13 and 127 metres (m).

This study will consider three massing scenarios: (i) Existing, including the approved Metropia site to the northeast; (ii) Proposed, including existing and approved massing, as well as the proposed building (Block A); and (iii) Future, including all buildings shown in the master plan for the site as well as the buildings planned for the Smart Centres site to the north.

Regarding wind exposures, the near-field surroundings of the subject site in the Existing and Proposed scenarios (defined as an area falling within a 200-m radius of the site) comprise an 8-storey building to the west and a mix of low-rise buildings and open land elsewhere. Under the Future scenario, the area to the east of the site will become highly developed and include several high-rise buildings. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) include primarily low-rise buildings and open land in all directions, in addition to the dense proposed massing to the north (Smart Centres).

Site plans drawings for the noted three massing scenarios are illustrated in Figures 1A, 1B, and 1C, respectively, while Figures 2A-2F illustrate the computational models used to conduct the study.

3. OBJECTIVES

The principal objectives of this study are to: (i) determine comparative 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 Pickering area wind climate, and synthesis of computational data with industry-accepted guidelines. The following sections describe the analysis procedures, including a discussion of the comfort guidelines.

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 proposed development 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 stronger wind speeds.

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 12 wind directions and three massing scenarios, as noted in Section 2. The CFD simulation models were centered on the subject site, complete with surrounding massing within a diameter of approximately 840 m.

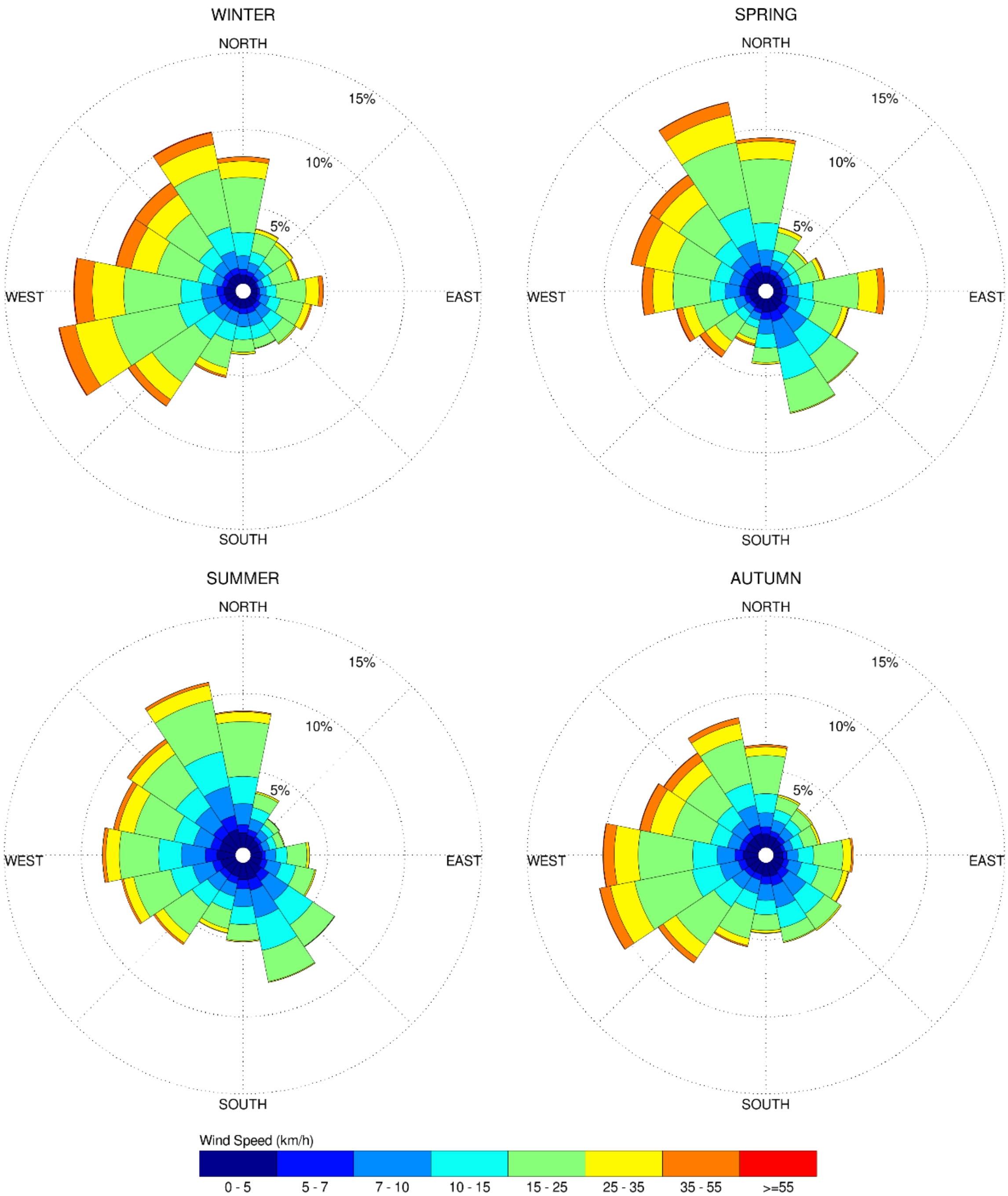
Mean and peak wind speed data obtained over the study site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds on a continuous measurement plane 1.5 m above local grade and above elevated amenity terraces were referenced 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 and around Toronto, representative of Pickering, was developed from approximately 40 years of hourly wind data recorded at Lester B. Pearson International 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 Toronto area wind climate, 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 Toronto, representative of Pickering, 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.

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 80% 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 mean gust speed ranges are selected based on 'The Beaufort Scale', which describes the effect of forces produced by varying wind speeds on levels on objects.

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
Plazas	Sitting / Standing / Walking
Transit Stops	Sitting / Standing
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-6C, which illustrate seasonal wind conditions at grade level for the future, proposed, and existing massing scenarios. Figures 7A-10B illustrate seasonal wind conditions on the elevated amenity terrace at Level 7 for the future and proposed massing scenarios. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site. The colour contours indicate predicted regions of the various comfort classes noted in Section 4.4. Wind conditions suitable for sitting are represented by the colour green, standing by yellow, and walking by blue; uncomfortable conditions are represented by the colour magenta.

5.1 Wind Comfort Conditions – Grade Level

In general, conditions at grade are expected to become windier following the introduction of the proposed building massing, as is expected when introducing a tall building(s) into a low-rise setting. For most areas surrounding the subject site, conditions are predicted to be windiest under the proposed massing scenario (Figures 3B, 4B, 5B, and 6B), while the completion of the planned future developments in the area (future massing scenario, Figures 3A, 4A, 5A, and 6A) is expected to increase wind comfort within the subject site.

Brock Road: The sidewalks along Brock Road are predicted to be suitable for standing during the summer under the existing massing scenario (Figure 4C) and are expected to remain mostly suitable for standing under the future scenario (Figure 4A, with all proposed surrounding developments completed). However, under the proposed massing scenario (Figure 4B), wind conditions are predicted to be suitable for a mix of standing and walking during the summer season.

During the autumn season, conditions are expected to become mostly suitable for walking under both the proposed and future massing scenarios, while existing conditions are predicted to be suitable for a mix of standing and walking.

During the spring season, parts of the sidewalk along Brock Road are predicted to be uncomfortable under the proposed massing scenario (Figure 3B); however, these regions will achieve the walking comfort guideline under the future massing scenario (Figure 3A). Conditions are predicted to be suitable for a mix of standing and walking under the existing massing scenario (Figure 3C).

During the winter season, conditions are expected to be mostly suitable for walking under the future massing scenario, although conditions under the proposed massing scenario are expected to be uncomfortable over much of the sidewalk. Existing wind comfort conditions are predicted to be suitable for a mix of standing and walking.

Although conditions are predicted to be uncomfortable along the sidewalk during the spring and winter seasons under the proposed massing scenario, conditions under the future massing scenario are predicted to be suitable for walking, or better, throughout the year. The expected improvements to pedestrian wind comfort in the future scenario are a result of the generalized increase in wind blockage in the area, which leads to lower mean wind speeds and greater turbulence at grade. The specific geometry of the planned surrounding massing is of secondary importance; similar improvements in wind comfort can be expected should minor changes be made to the planned surrounding building heights and configurations. The noted conditions may therefore be considered acceptable.

Proposed Public Roads: The proposed public roads, to the north and east of the subject site, are predicted to be suitable for standing under the future massing scenario during the summer season, and suitable for a mix of standing and walking under the proposed massing scenario. The public roads are predicted to be suitable for walking during the remaining colder seasons under the future scenario, while parts of the sidewalks are expected to be uncomfortable under the proposed massing scenario during the spring and winter seasons. The existing area, which currently includes a driveway, is predicted to be suitable for a mix of sitting and standing throughout the year.

Although conditions are predicted to be uncomfortable along parts of the sidewalks during the two colder seasons under the proposed massing scenario, conditions under the future massing scenario are predicted to be suitable for walking, or better, throughout the year. The expected improvements to pedestrian wind comfort in the future massing scenario are a result of the generalized increase in wind blockage in the area, which leads to lower wind speeds and greater turbulence at grade. The specific geometry of the planned surrounding massing is of secondary importance; similar improvements in wind comfort can be expected should minor changes be made to the surrounding building heights and configurations. The noted conditions may therefore be considered acceptable.

Building Entrances: Conditions in the vicinity of the main entrance, at the centre of the south elevation, are predicted to be suitable for sitting throughout the year under both the proposed and future massing scenarios. The entrance is protected from prominent winds by the massing of the subject site itself. The noted conditions are considered acceptable.

The areas near the secondary and commercial entrances, along the north elevation, are predicted to be suitable for standing or walking during the colder seasons, for both the proposed and future massing scenarios. In particular, the proposed commercial entrance near the centre of the north elevation, where the façade transitions to the southeast, is predicted to be suitable for walking during the spring, autumn, and winter seasons, and may be uncomfortable during the winter season under the proposed massing scenario. To provide more comfortable conditions in the immediate vicinity of the building entrances, we recommend recessing the entrances along the north elevation by a minimum of 1.5 m into the façade.

Private Driveway and Drop-Off Area, South of Building: The area to the south of the proposed building is predicted to be suitable for a mix of sitting and standing during the summer season, and suitable for walking, or better, during the remaining three colder seasons. Conditions are somewhat calmer under the future massing scenario as compared to the proposed scenario. Existing conditions within this area, which currently includes a parking lot and driveway, are predicted to be suitable for a mix of sitting and standing during the summer season, and mostly suitable for standing during the remaining three colder seasons. The noted conditions are considered acceptable for the intended uses on a seasonal basis.

Grade Level Outdoor Amenity, Proposed Public Park, and Landscaped Area, Northeast of Building: The outdoor amenity to the south of the proposed building is predicted to be mostly suitable for standing during the summer season under both the proposed and future massing scenarios, although conditions under the future massing scenario are predicted to be slightly calmer. During the autumn season, the area is predicted to be mostly suitable for standing under the future massing scenario and mostly suitable for walking under the proposed massing scenario. During the spring and winter seasons, the area is predicted to be mostly suitable for walking under the proposed and future massing scenarios.

The west end of the future public park, near the subject site, is predicted to be suitable for standing during the summer season under the future massing scenario, and suitable for a mix of standing and walking under the proposed massing scenario. During the autumn season, conditions are predicted to be suitable for a mix of standing and walking under the future massing scenario, and suitable for walking under the proposed massing scenario. Conditions are predicted to be suitable for walking, or better, over most of the area during the spring and winter seasons under both the proposed and future massing scenarios. During the winter season, conditions under the proposed massing scenario may approach the upper limit of the walking comfort class; conditions over a small area at the southwest of the park may be uncomfortable.

The landscaped area to the northeast of the proposed building is predicted to be suitable for standing during the summer season under the future massing scenario, and suitable for a mix of standing and walking under the proposed massing scenario. Conditions are predicted to be suitable for walking, or better, during the spring and autumn seasons. During the winter season, conditions are expected to continue to be suitable for walking under the future massing scenario but may exceed the walking comfort class under the proposed massing scenario.

A mitigation strategy will be required to provide conditions suitable for sitting during the typical use period of late spring to early autumn in the three noted areas. Mitigation may include wind barriers along the perimeter of the area (solid or high-solidity wind screens and/or coniferous plantings in dense arrangements). Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

5.2 Wind Comfort Conditions – Amenity Terrace, Level 7

Conditions within the outdoor amenity terrace on the roof of the podium at Level 7, between building A1 and A2, are predicted to be suitable for a mix of sitting and standing during the summer and autumn seasons under both the proposed and future massing scenarios, and suitable for walking, or better, during the spring and winter seasons. Conditions under the future scenario are predicted to be noticeably calmer than those under the proposed massing scenario.

The amenity terrace will require a wind mitigation strategy to achieve conditions suitable for sitting during the typical use period. Mitigation may include raised perimeter guards along the north and south of the terrace, canopies extending from the buildings, and/or wind barriers inboard of the perimeter to protect designated seating areas. Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

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 or over the amenity terrace at Level 7. 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 study 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 site would alter the wind profile approaching the site; and (ii) development in proximity to the site would cause changes to local flow patterns. In general, development in urban centers creates reduction in the mean wind speeds and localized increases in the gustiness of the wind.

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-10B. Based on computer simulations using the CFD technique, meteorological data analysis, and experience with similar developments, the study concludes the following:

1) Conditions at grade are expected to become windier following the introduction of the subject site, as is expected when introducing a tall building(s) into a low-rise setting. For most areas surrounding the subject site, conditions are predicted to be windiest under the proposed massing scenario (Figures 3B, 4B, 5B, and 6B) while the completion of the planned future developments in the area (future massing scenario, Figures 3A, 4A, 5A, and 6A) is expected to increase wind comfort levels on and around the subject site, compared to the proposed massing scenario.

2) Conditions over the surrounding sidewalks are predicted to be mostly suitable for walking, or better, throughout the year under the future massing scenario. Conditions under the proposed massing scenario, which excludes the planned surrounding developments, are predicted to be windier; areas along the sidewalks are predicted to become uncomfortable during the spring and winter seasons. Nevertheless, since the areas are expected to become more developed in the near future, the noted conditions may be considered acceptable.

a. The expected improvements to pedestrian wind comfort in the future massing scenario are a result of the generalized increase in wind blockage in the area, which leads to lower wind speeds and greater turbulence. The specific geometry of the planned surrounding massing is of secondary importance; similar improvements in wind comfort can be expected should minor changes be made to the planned surrounding buildings.

3) Conditions in the vicinity of the primary building entrance, located near the centre of the south elevation, are predicted to be suitable for sitting throughout the year, which is acceptable. Since conditions near building entrances along the north elevation are predicted to be somewhat windy, we recommend recessing the entrances by a minimum of 1.5 m into the north façade.

4) Conditions along the private driveway and drop-off area, to the south of building, are predicted to be suitable for walking, or better, throughout the year-round, which is acceptable.

5) Conditions within the proposed public park to the east of the subject site and within the landscaped area to the northeast of the proposed building are predicted to be suitable for standing during the summer season under the future massing scenario and suitable for walking, or better, during the remaining three seasons. Conditions under the proposed massing scenario are predicted to be suitable for walking, or better, during the spring, summer, and autumn seasons, while winter conditions may exceed the walking comfort class for some areas.

   a. A mitigation strategy will be required to provide conditions suitable for sitting during the typical use period of late spring to early autumn. Mitigation may include wind barriers along the perimeter of the area (solid or high-solidity wind screens and/or coniferous plantings in dense arrangements). Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

6) The site includes two amenity areas, both of which will require mitigation to ensure conditions suitable for sitting during the typical use period. Mitigation will be considered for the SPA submission based on a detailed PLW study via wind tunnel testing on a physical scale model of the subject site in its surroundings.

a. Conditions within the outdoor amenity terrace on the podium roof (Level 7), between buildings A1 and A2, are predicted to be suitable for a mix of sitting and standing during the summer and autumn seasons under both the proposed and future massing scenarios, and suitable for walking, or better, during the spring and winter seasons. Conditions under the future massing scenario are predicted to be noticeably calmer than under the proposed massing scenario.

b. The elevated amenity terrace will require a mitigation strategy to achieve conditions suitable for sitting during the typical use period. Mitigation may include raised perimeter guards along the north and south of the terrace, canopies extending from the buildings, and/or wind barriers inboard of the perimeter to protect designated seating areas. Mitigation will be considered for the Site Plan Control application submission based on wind tunnel testing of a physical scale model of the subject site in its surroundings.

c. Conditions within the outdoor amenity at grade, to the south of the proposed building, are predicted to be mostly suitable for standing during the summer season under both the proposed and future massing scenarios, although conditions under the future massing scenario are predicted to be slightly calmer. During the autumn season, the area is predicted to be mostly suitable for standing under the future massing scenario and mostly suitable for walking under the proposed massing scenario. The area is also predicted to be mostly suitable for walking under the proposed and future massing scenarios during the spring and winter seasons. Mitigation measures similar to those noted in item 5(a) will be required and explored for the future Site Plan Control application submission.

7) 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 or over the amenity terrace at Level 7. 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.

8) 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.

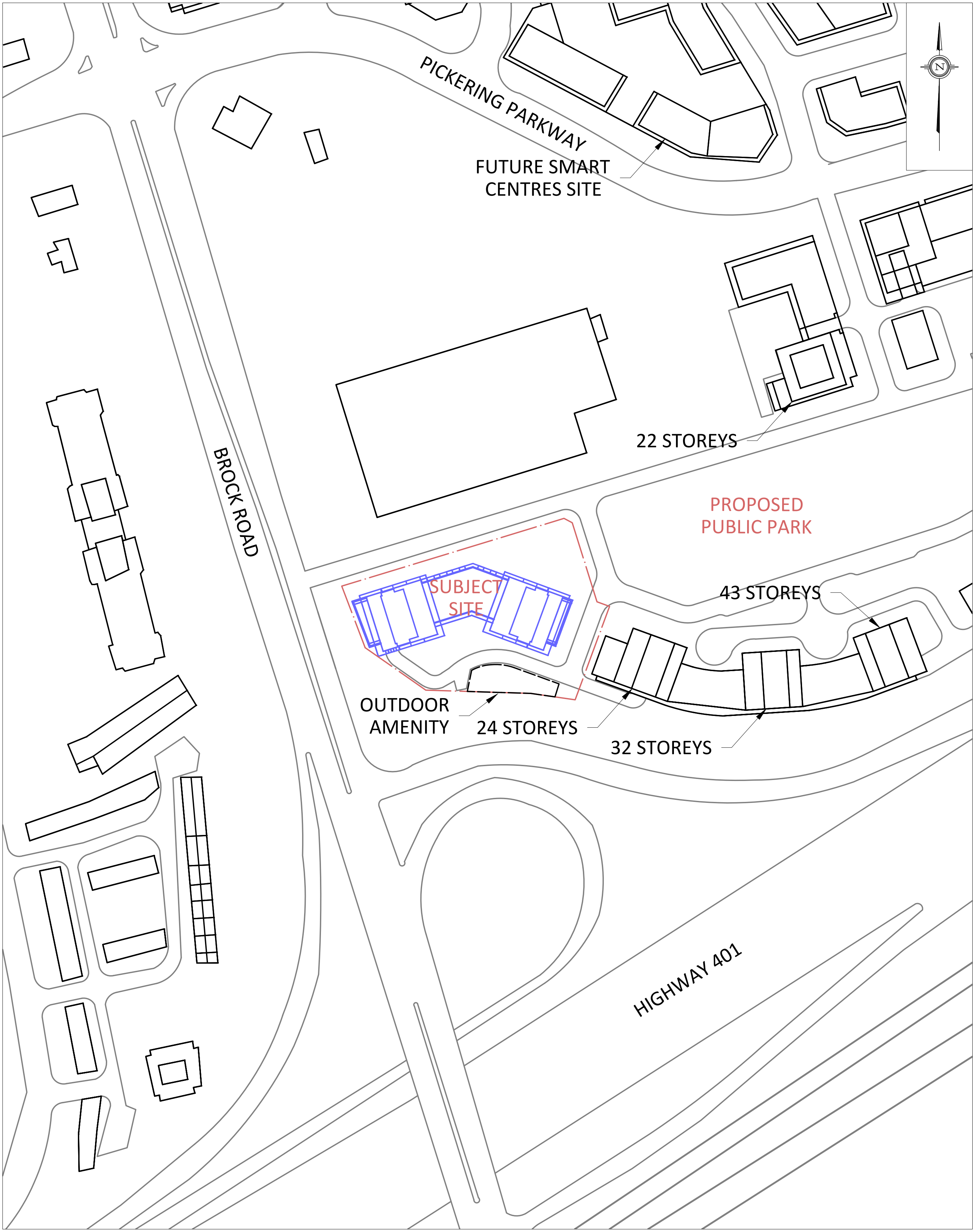
Sincerely,

Gradient Wind Engineering Inc.

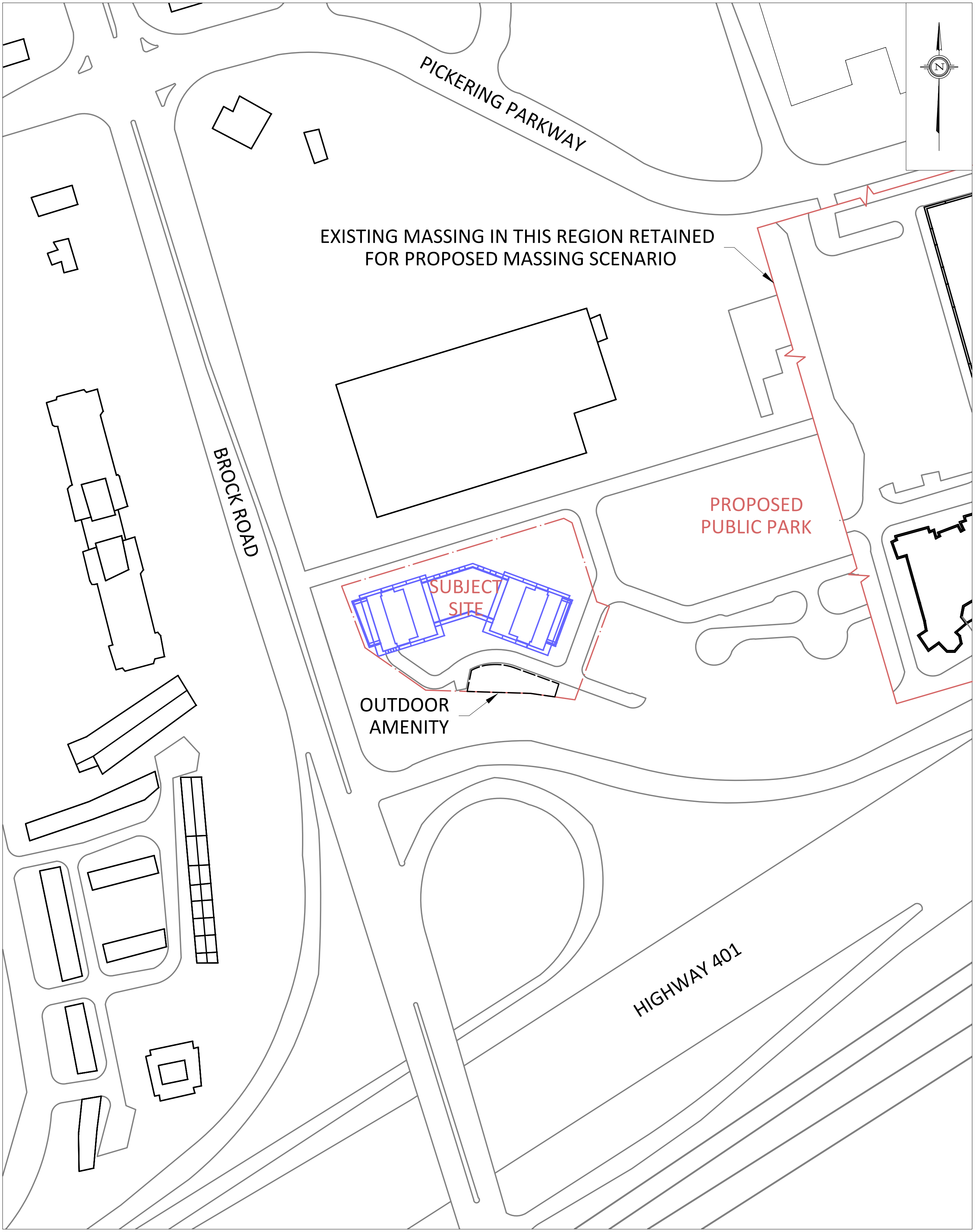
LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
100158495
Mar 25, 2022
PROVINCE OF ONTARIO

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

Justin Ferraro, P.Eng.
Principal



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: PICKERING DESIGN CENTRE, BLOCK A, PICKERING PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: FUTURE MASSING SITE PLAN AND SURROUNDING CONTEXT
	SCALE: 1:2500	DRAWING NO.: 20-305-PLW-1A	
	DATE: JANUARY 25, 2021	DRAWN BY: O.R.	



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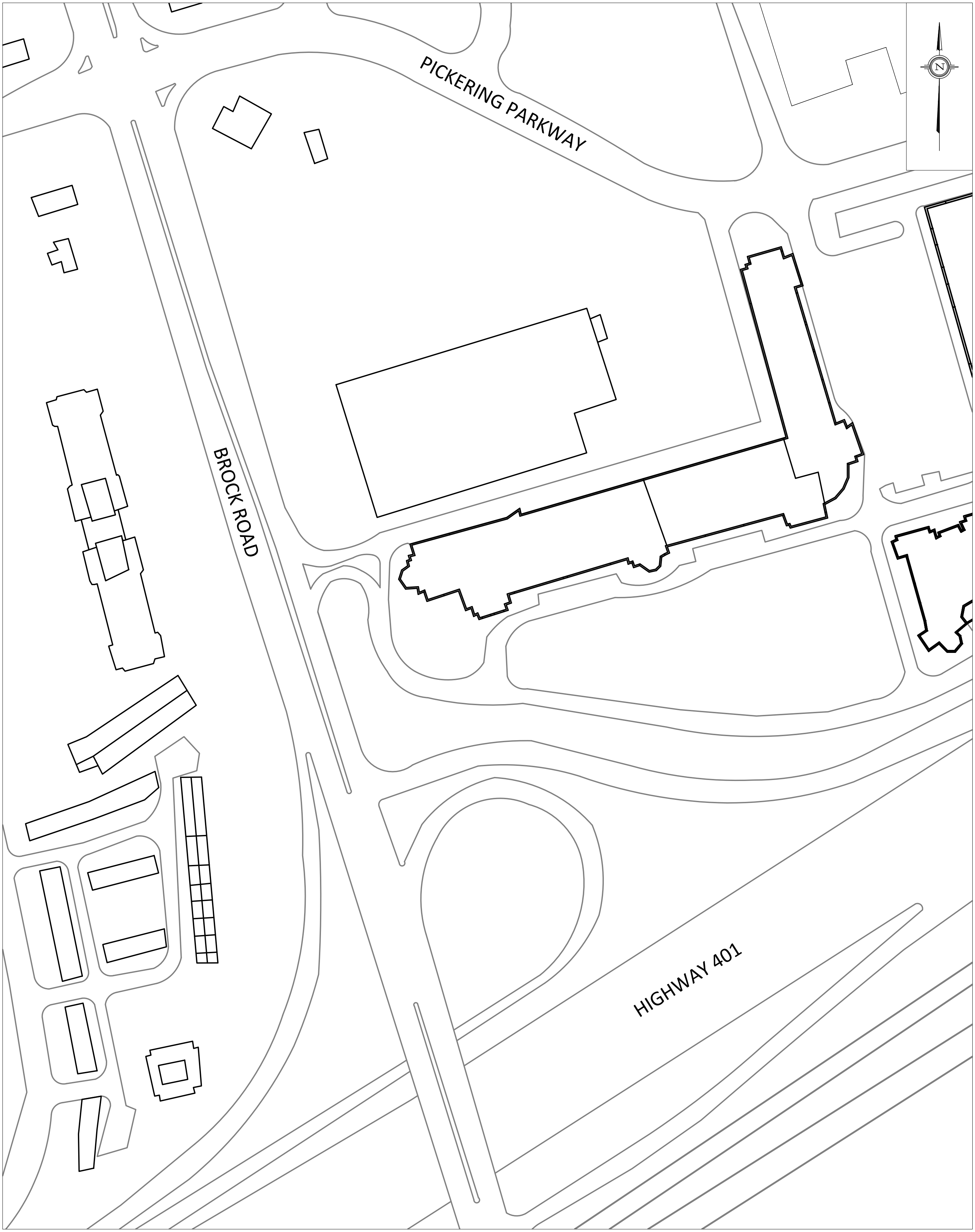
PROJECT	PICKERING DESIGN CENTRE, BLOCK A, PICKERING PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1B: PROPOSED MASSING PLAN AND SURROUNDING CONTEXT
SCALE	1:2500	DRAWING NO. 20-305-PLW-1B	
DATE	JANUARY 25, 2021	DRAWN BY O.R.	



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PROJECT	PICKERING DESIGN CENTRE, BLOCK A, PICKERING PEDESTRIAN LEVEL WIND STUDY
SCALE	1:2500
DRAWING NO.	20-305-PLW-1C
DATE	JANUARY 25, 2021
DRAWN BY	O.R.
DESCRIPTION	FIGURE 1C: EXISTING MASSING SITE PLAN AND SURROUNDING CONTEXT

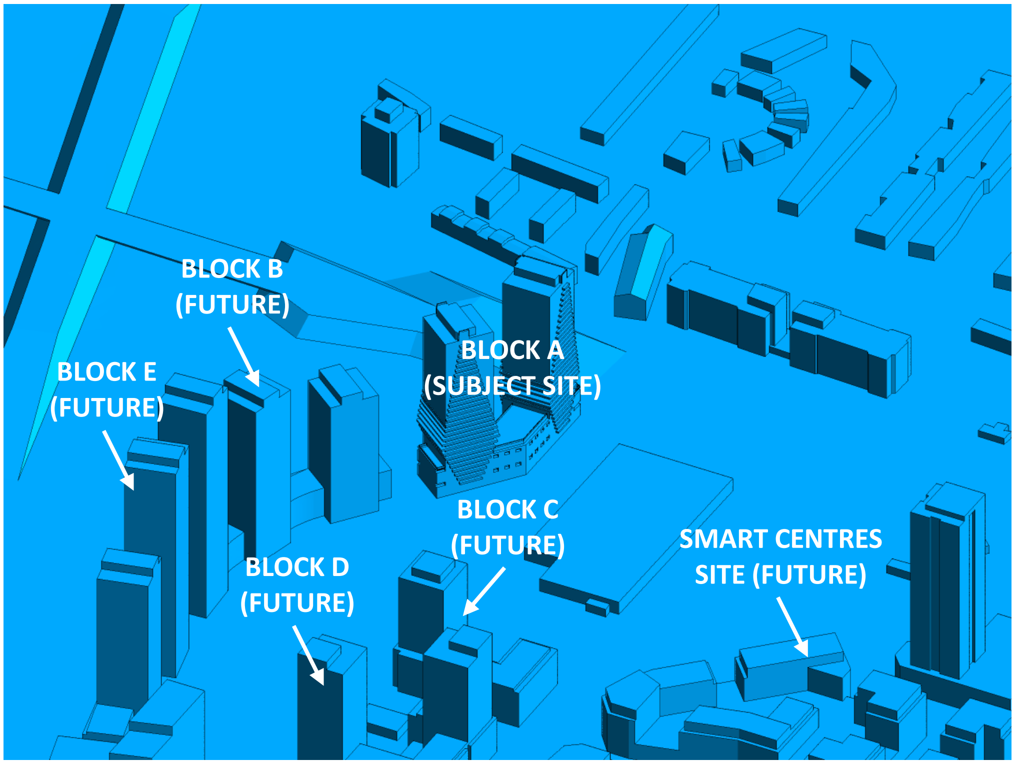


FIGURE 2A: COMPUTATIONAL MODEL, FUTURE MASSING, NORTHEAST PERSPECTIVE

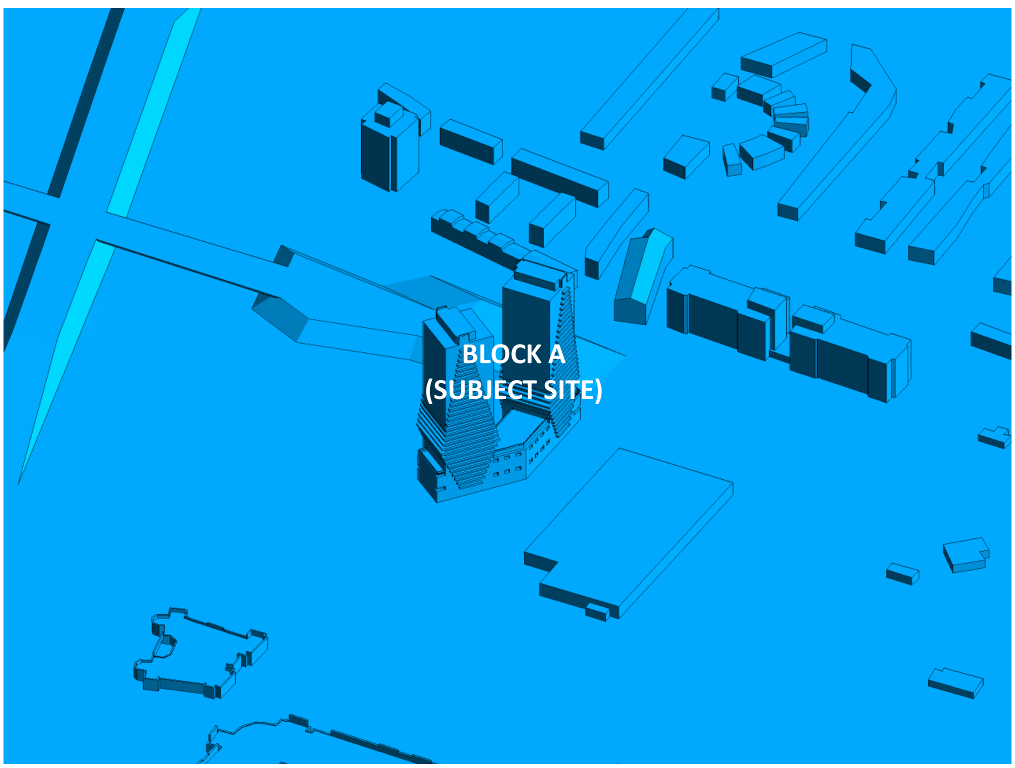


FIGURE 2B: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTHEAST PERSPECTIVE

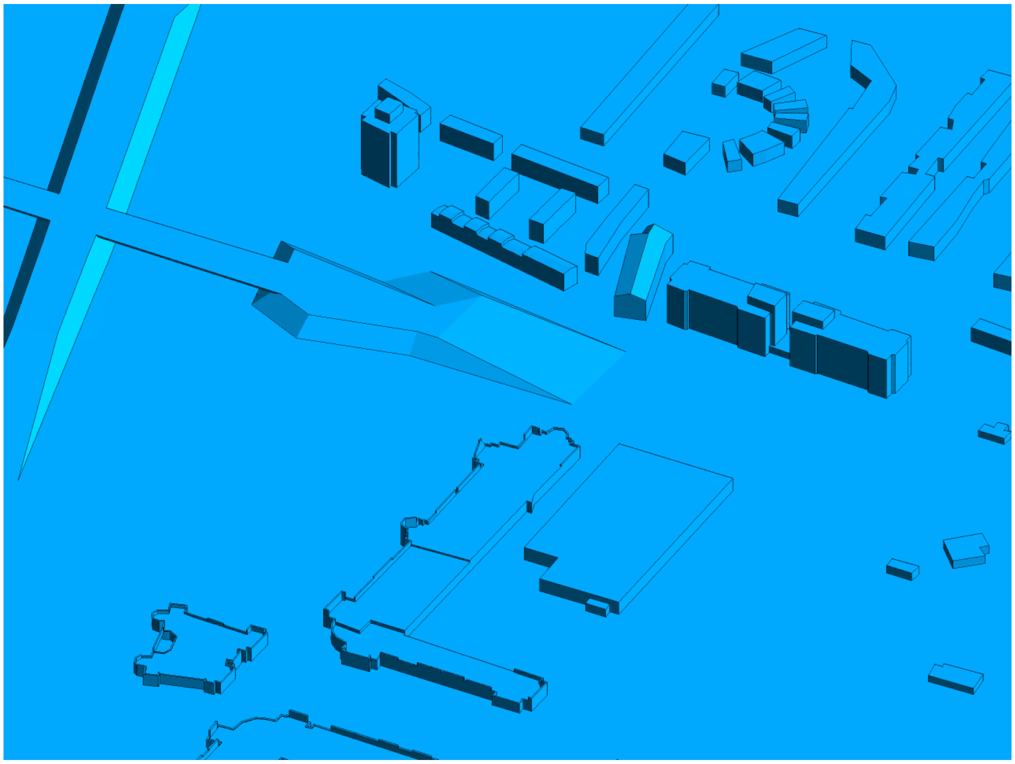


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTHEAST PERSPECTIVE

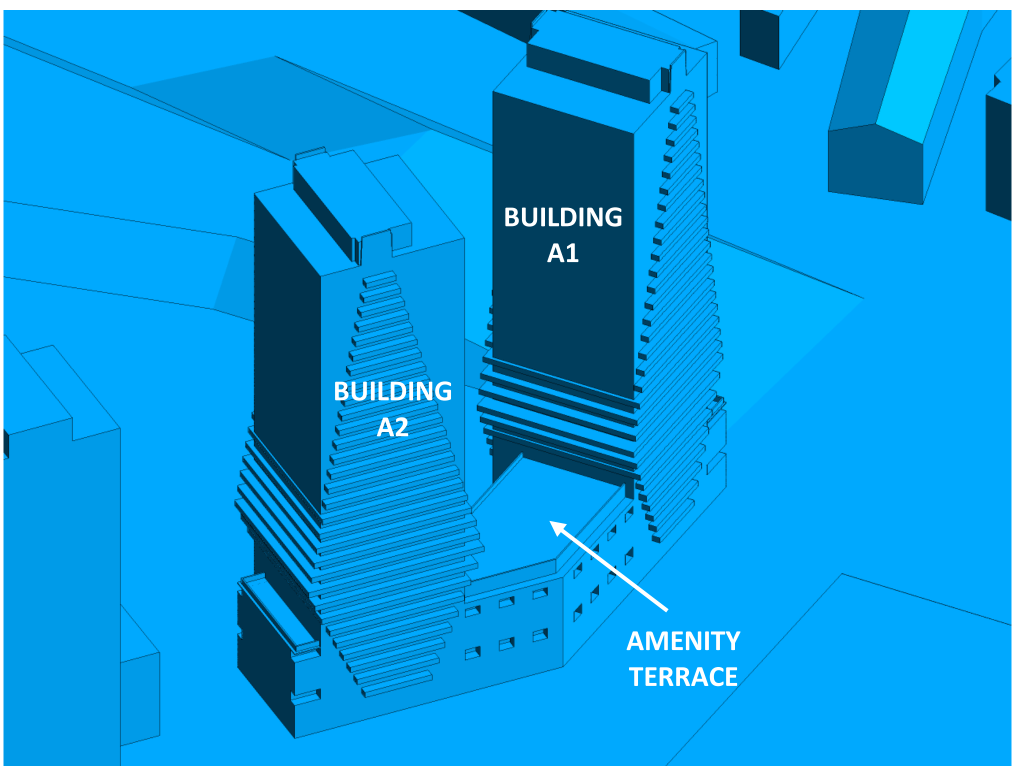


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2A

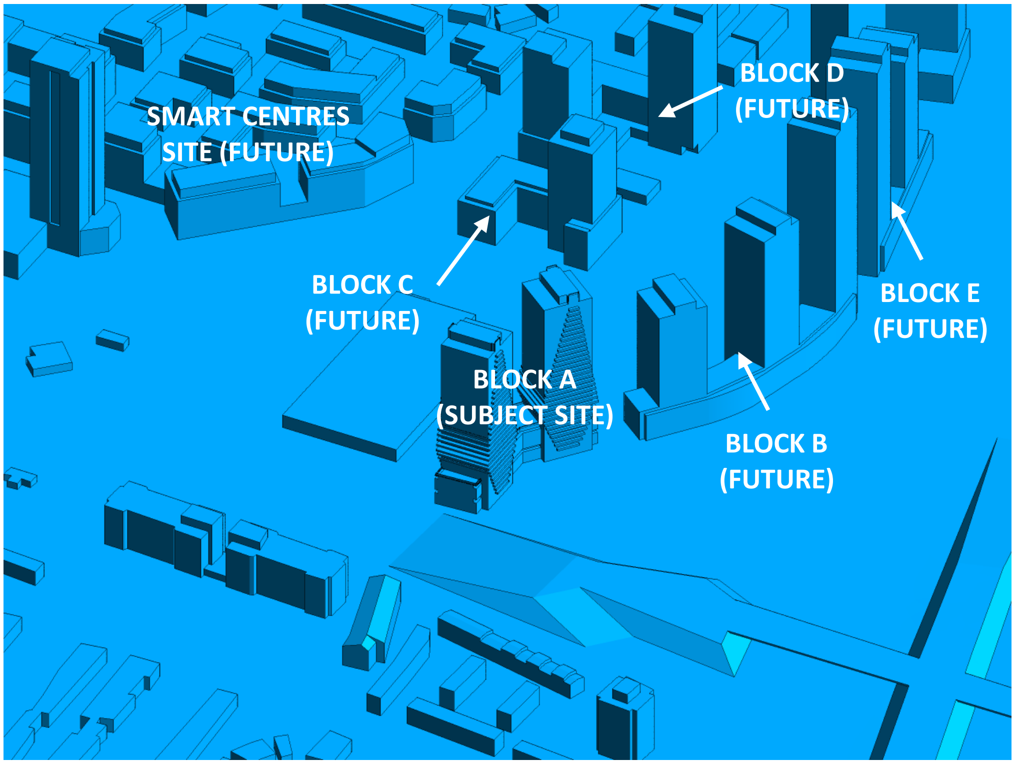


FIGURE 2E: COMPUTATIONAL MODEL, FUTURE MASSING, SOUTHWEST PERSPECTIVE

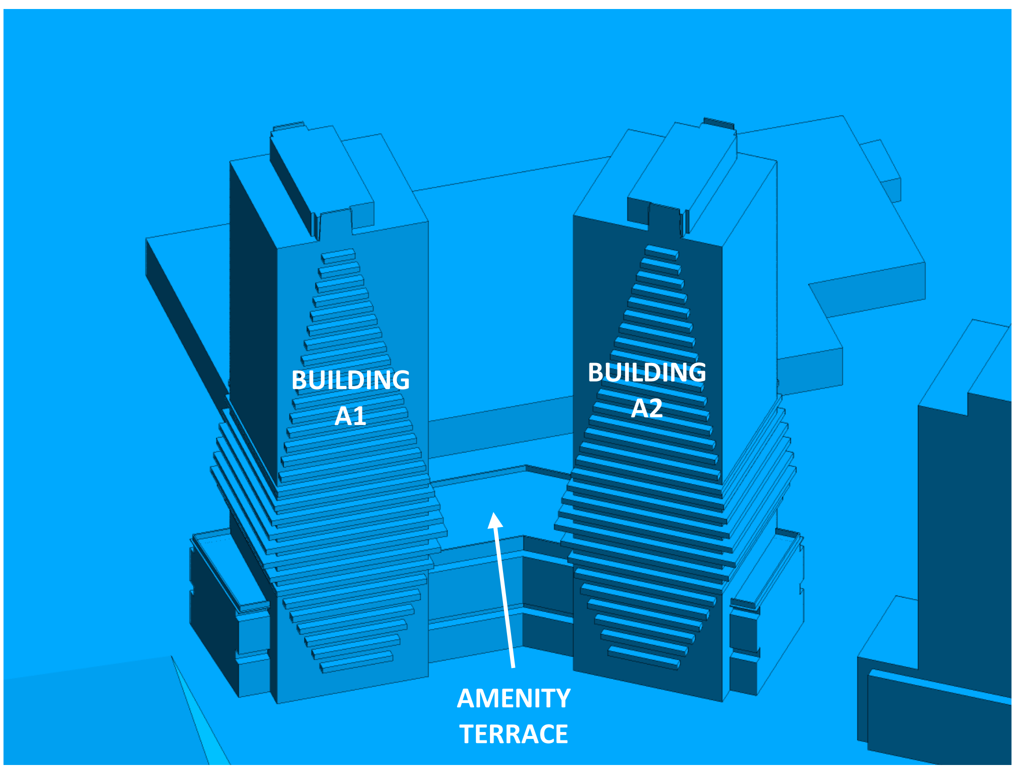


FIGURE 2F: COMPUTATIONAL MODEL, FUTURE MASSING, SOUTH PERSPECTIVE (CLOSE-UP)

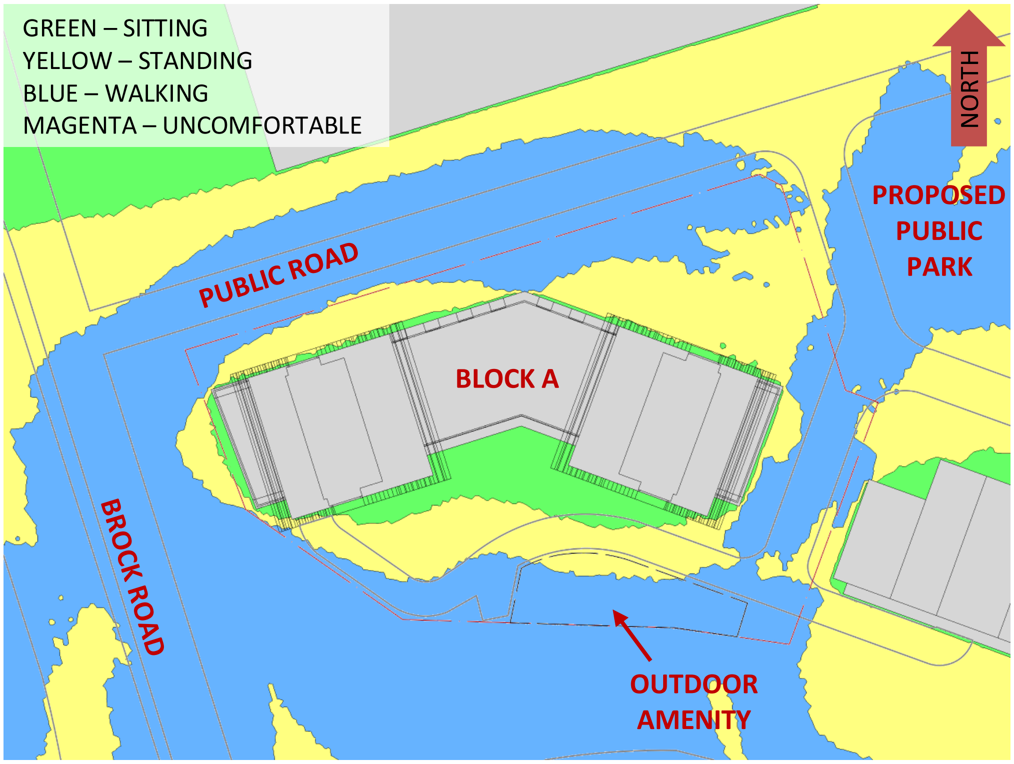


FIGURE 3A: SPRING – FUTURE MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

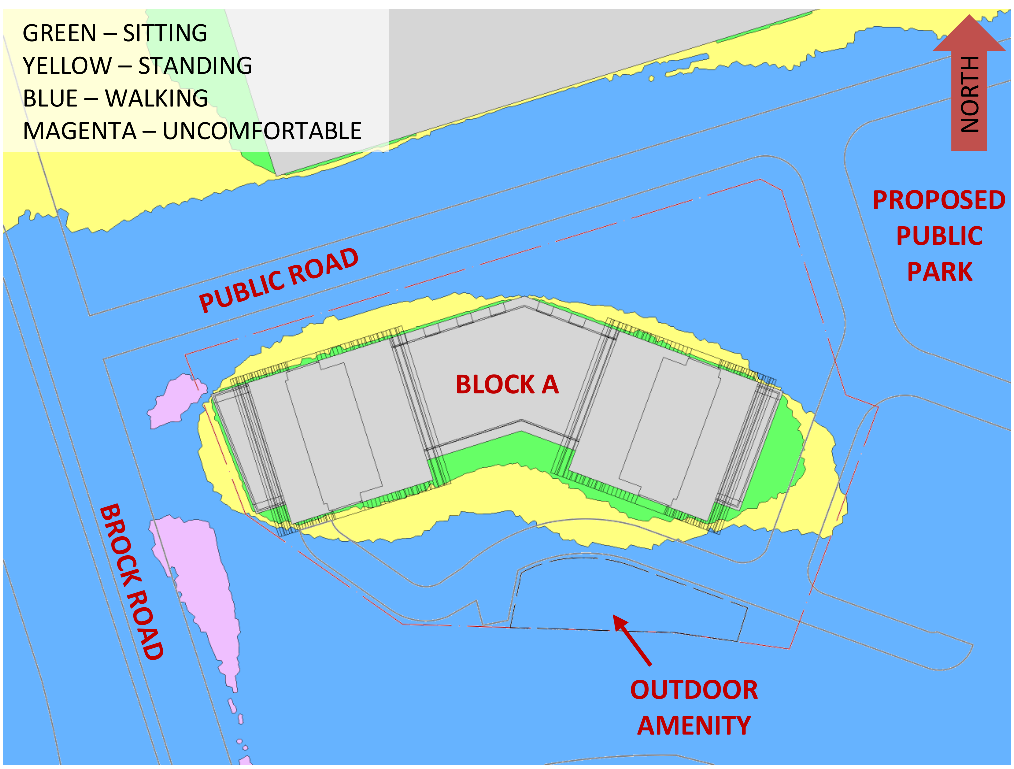


FIGURE 3B: SPRING – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

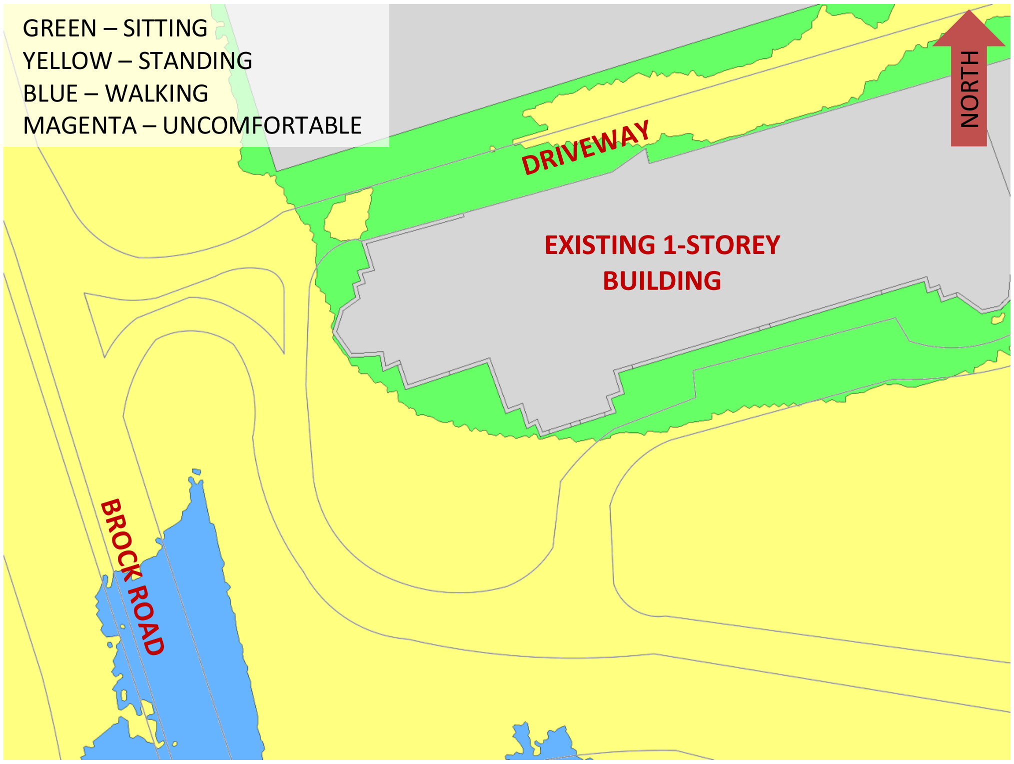


FIGURE 3C: SPRING – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

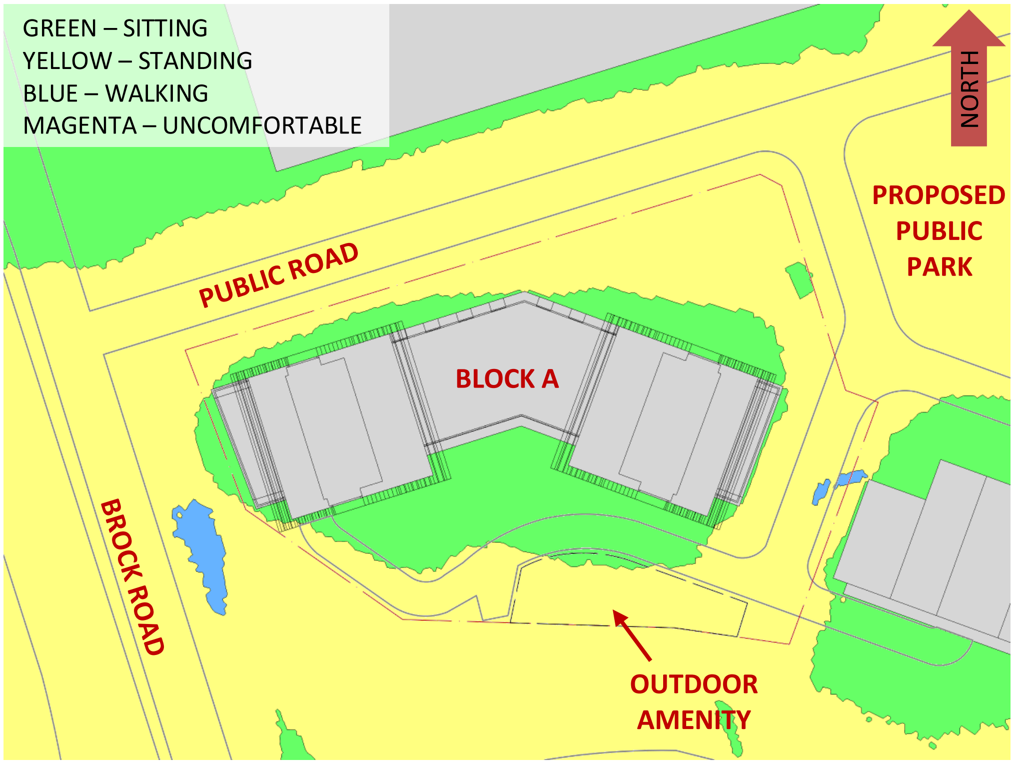


FIGURE 4A: SUMMER – FUTURE MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

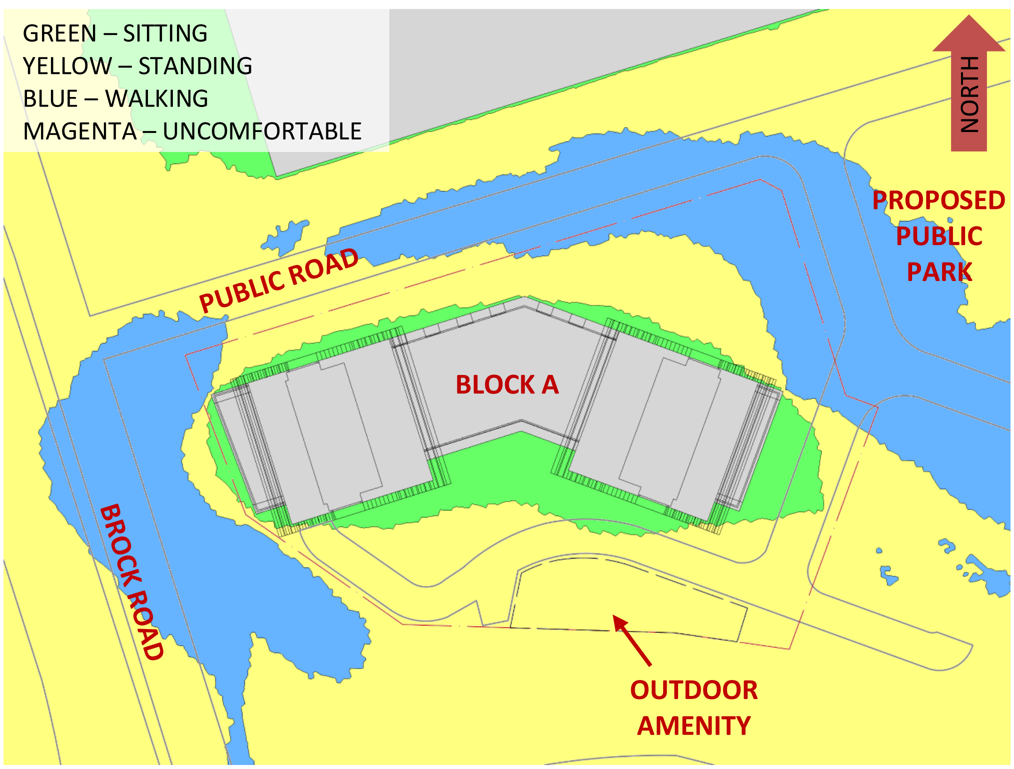


FIGURE 4B: SUMMER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

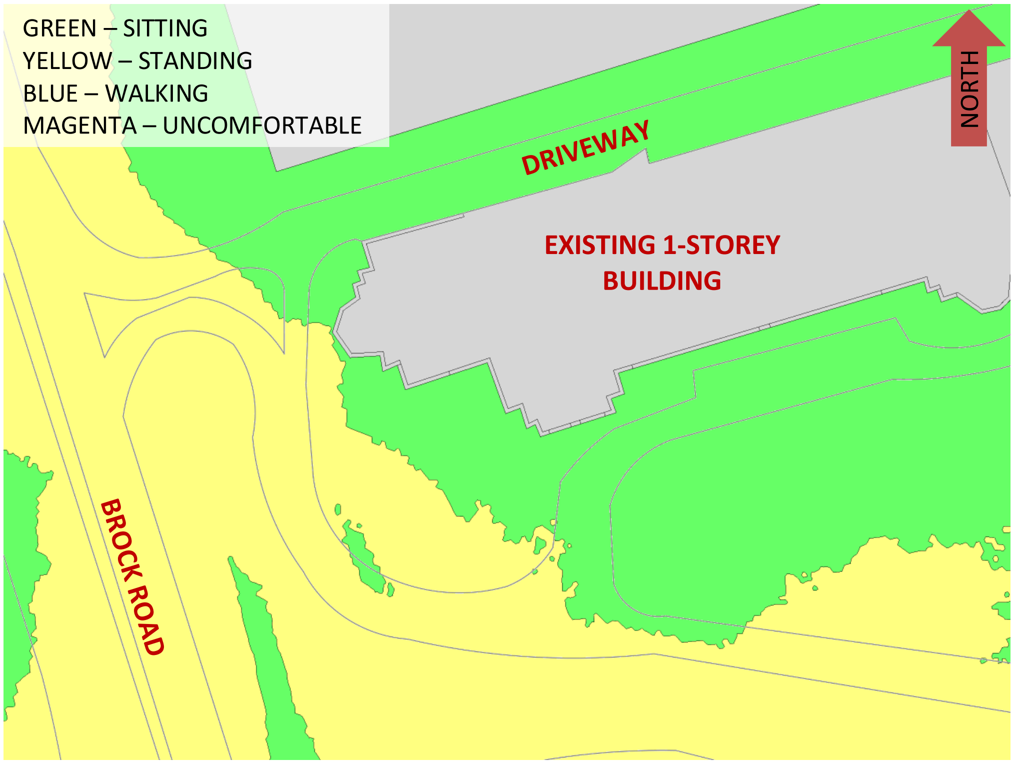


FIGURE 4C: SUMMER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

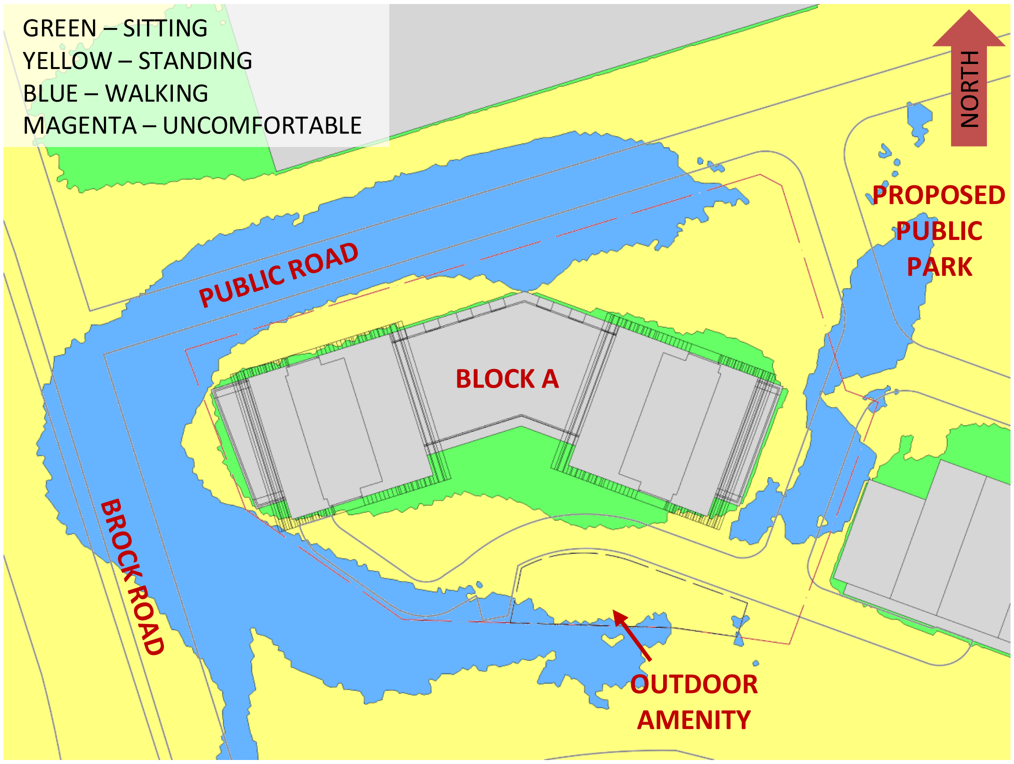


FIGURE 5A: AUTUMN – FUTURE MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

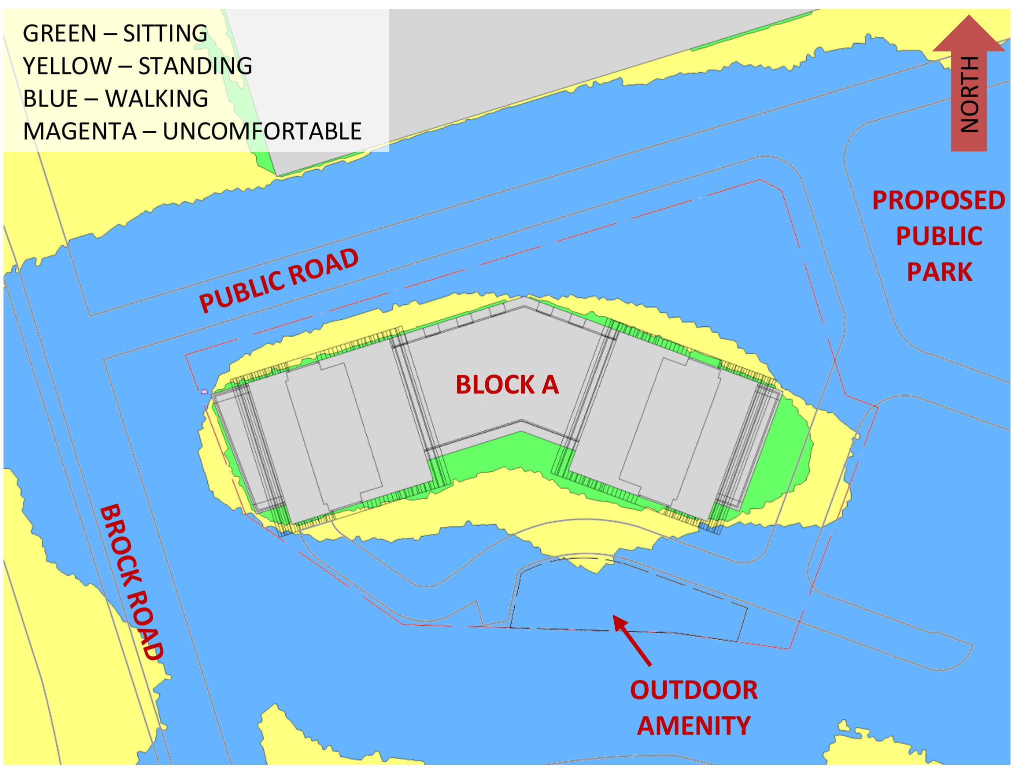


FIGURE 5B: AUTUMN – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

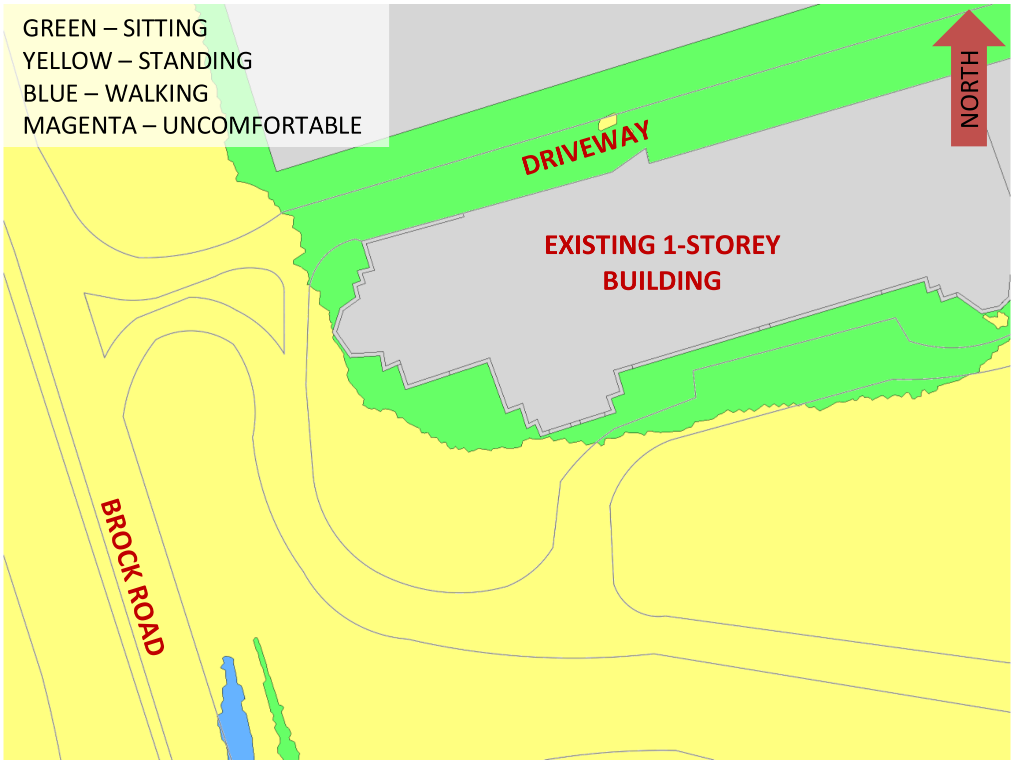


FIGURE 5C: AUTUMN – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

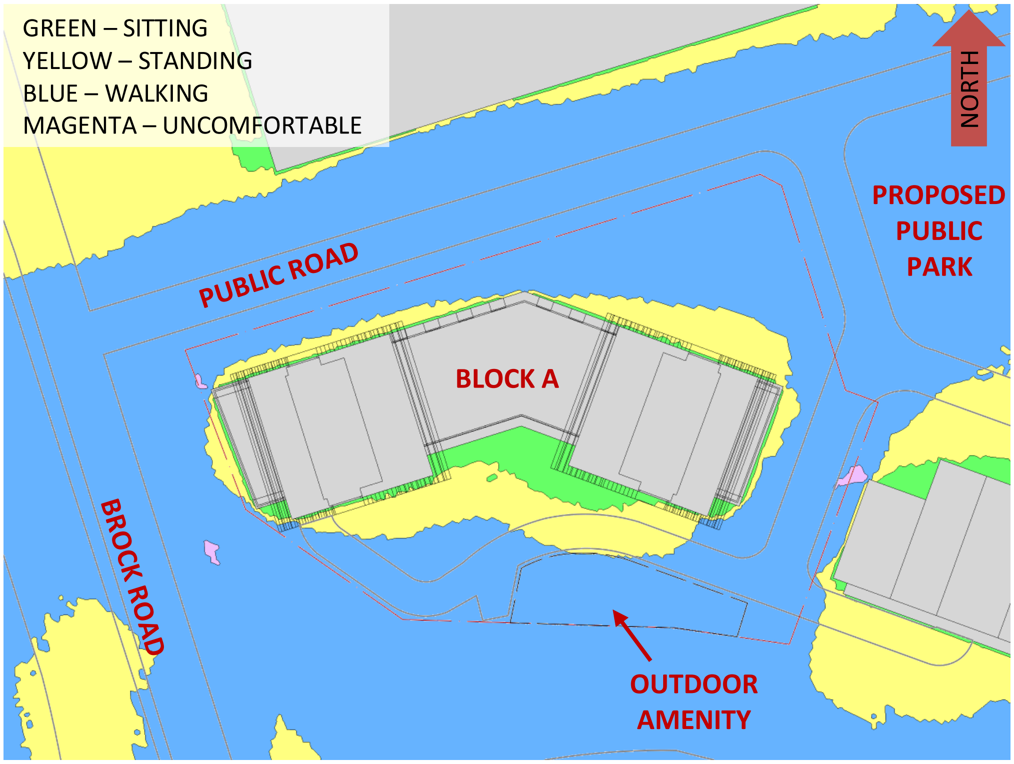


FIGURE 6A: WINTER – FUTURE MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

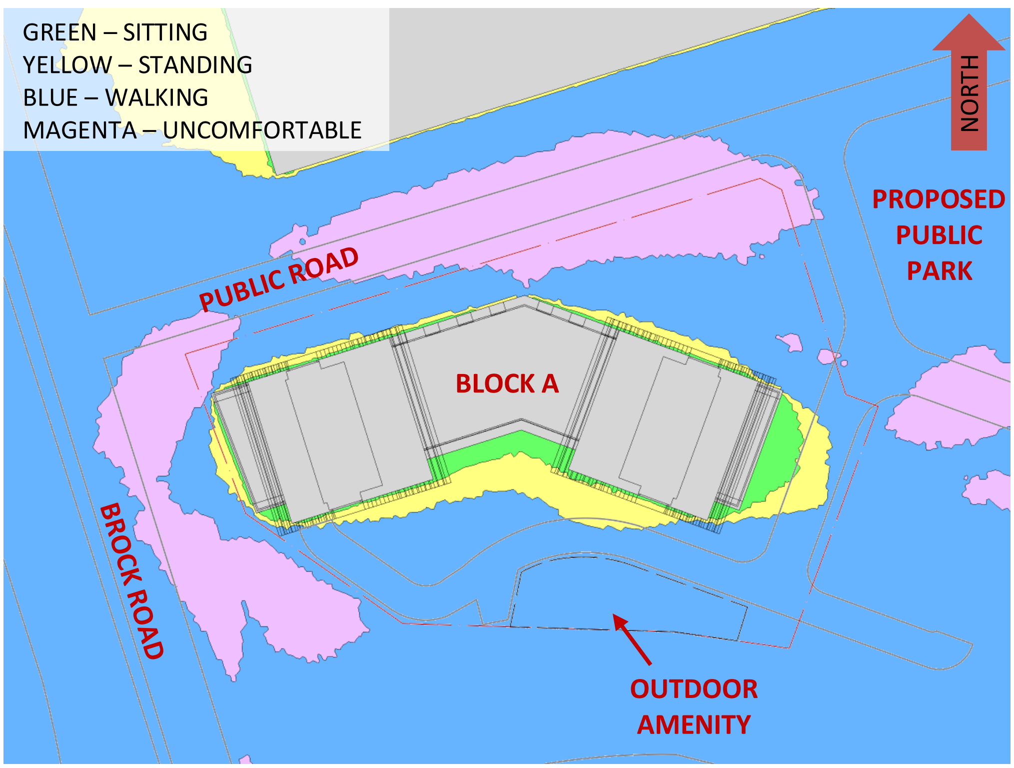


FIGURE 6B: WINTER – PROPOSED MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

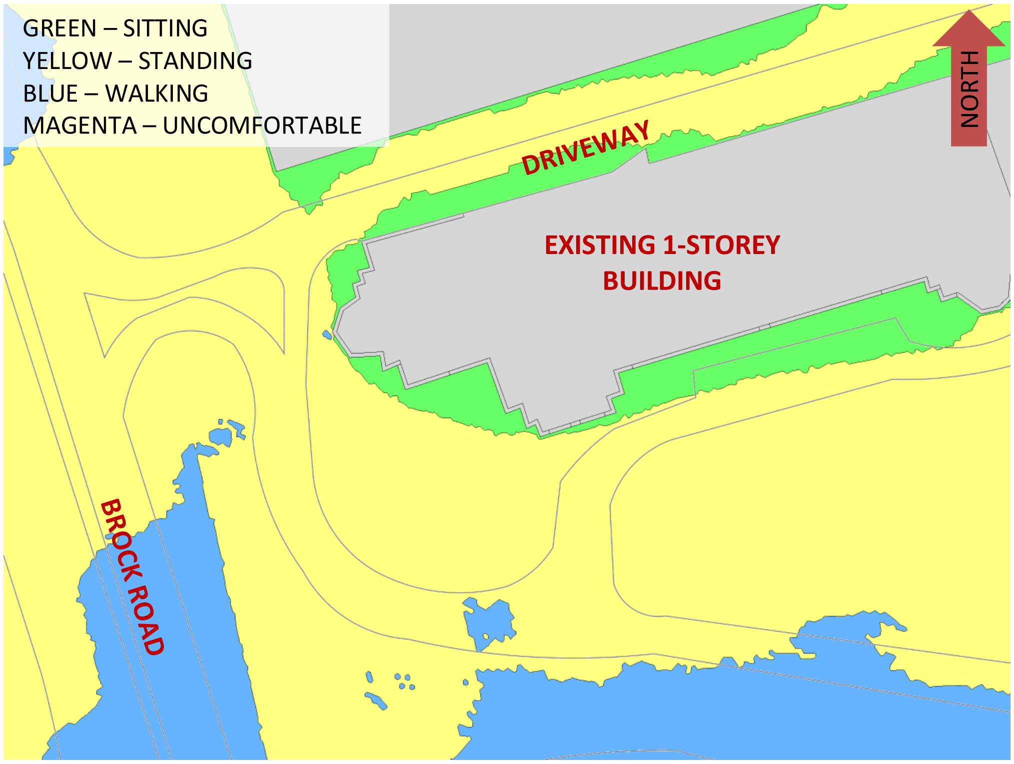


FIGURE 6C: WINTER – EXISTING MASSING – WIND COMFORT CONDITIONS, GRADE LEVEL

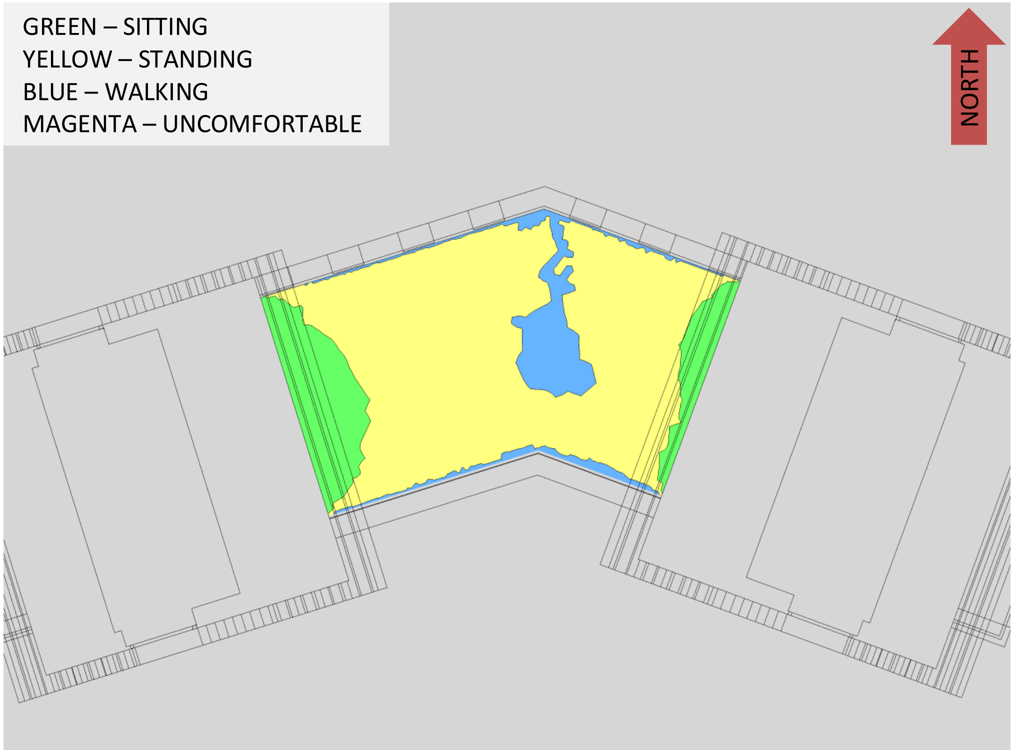


FIGURE 7A: SPRING – FUTURE MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

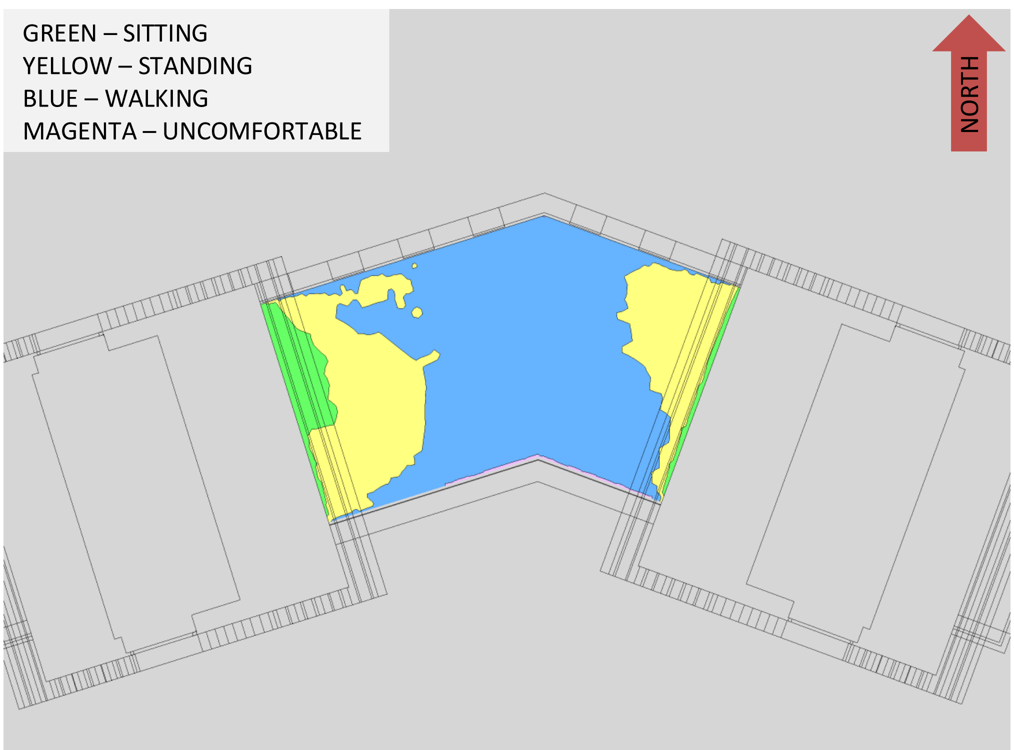


FIGURE 7B: SPRING – PROPOSED MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

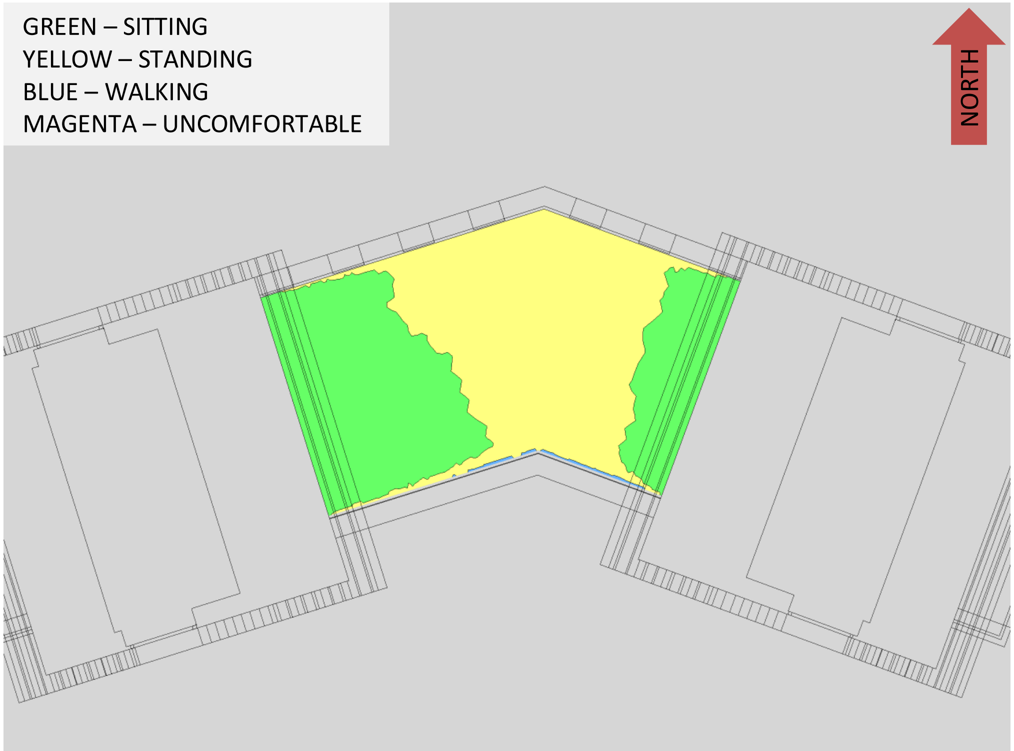


FIGURE 8A: SUMMER – FUTURE MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

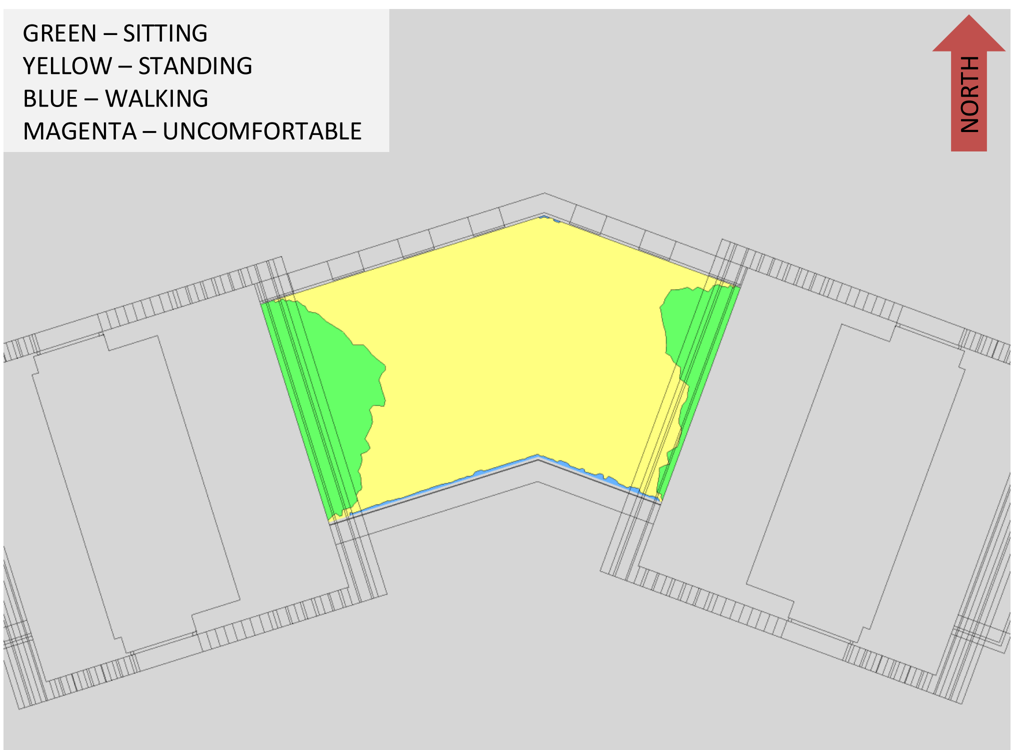


FIGURE 8B: SUMMER – PROPOSED MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

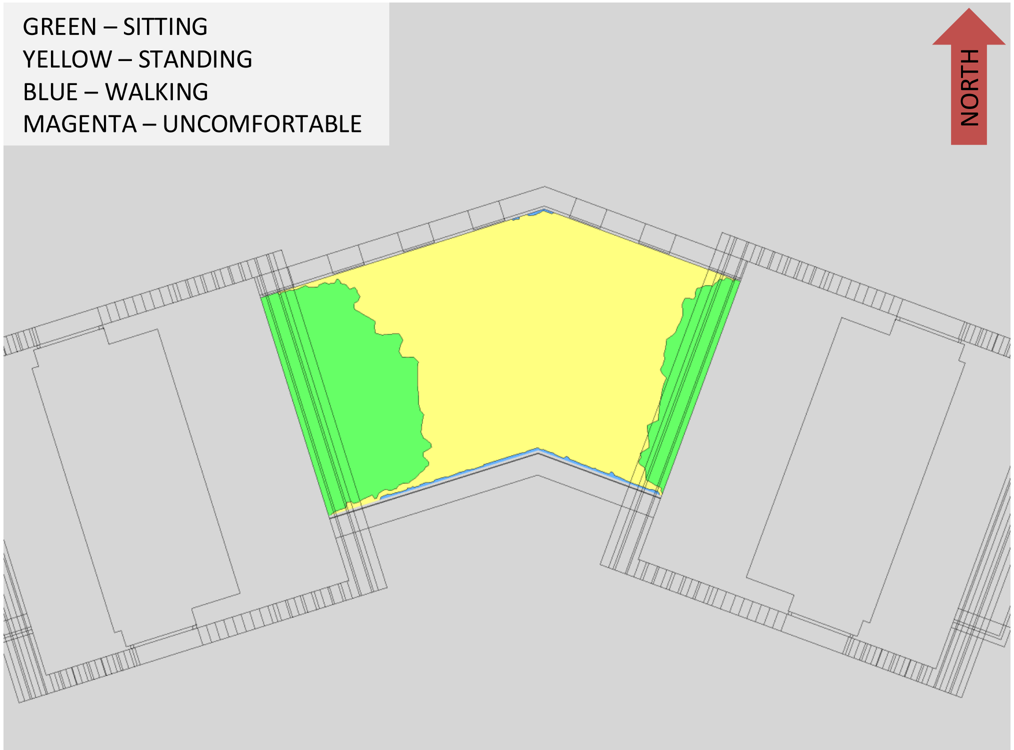


FIGURE 9A: AUTUMN – FUTURE MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

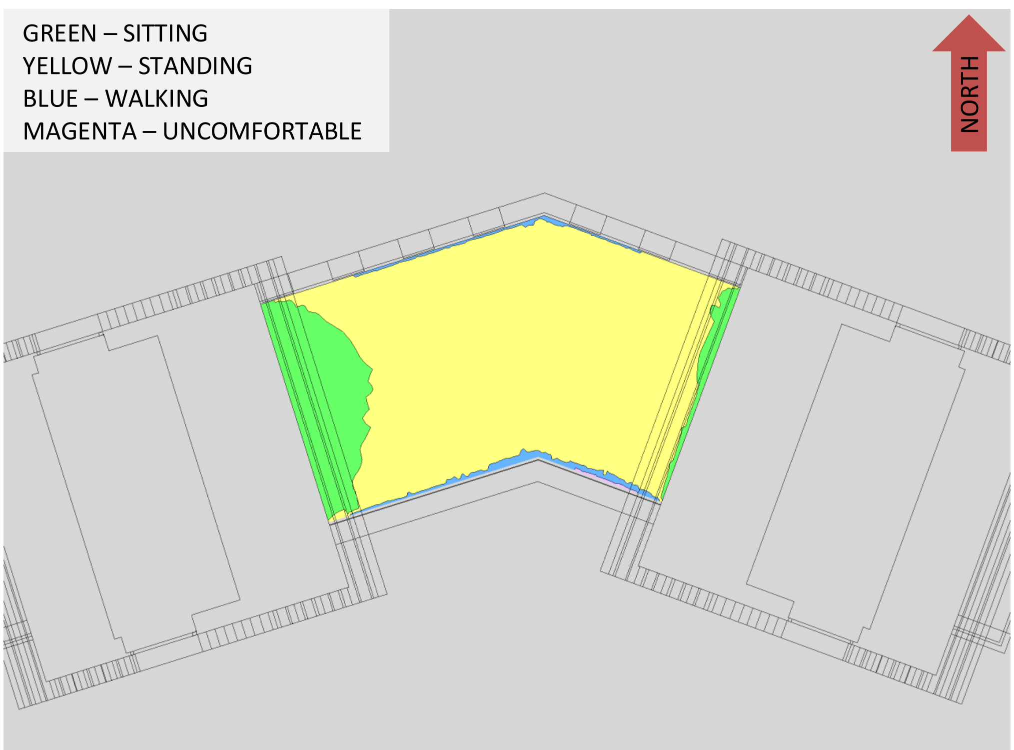


FIGURE 9B: AUTUMN – PROPOSED MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

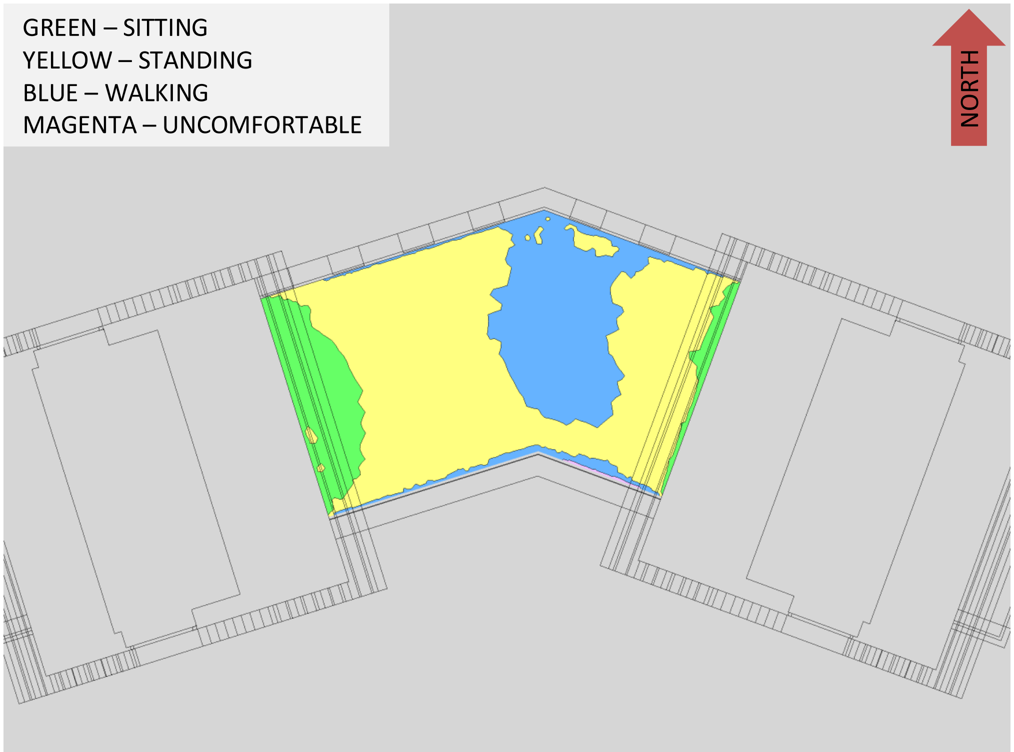


FIGURE 10A: WINTER – FUTURE MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE

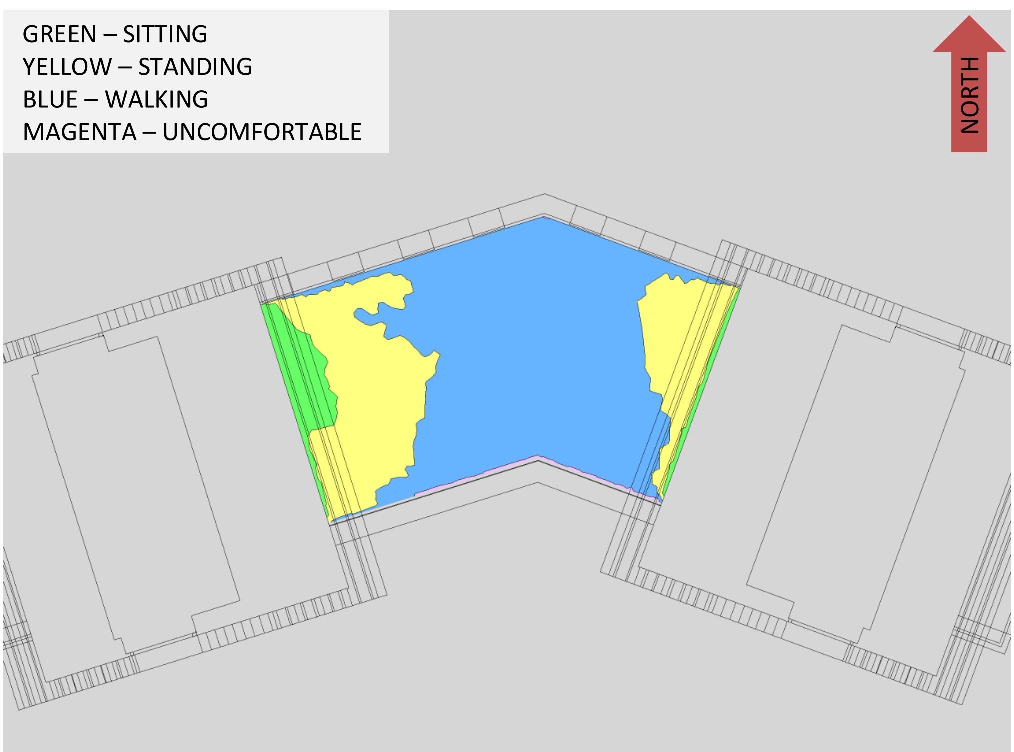
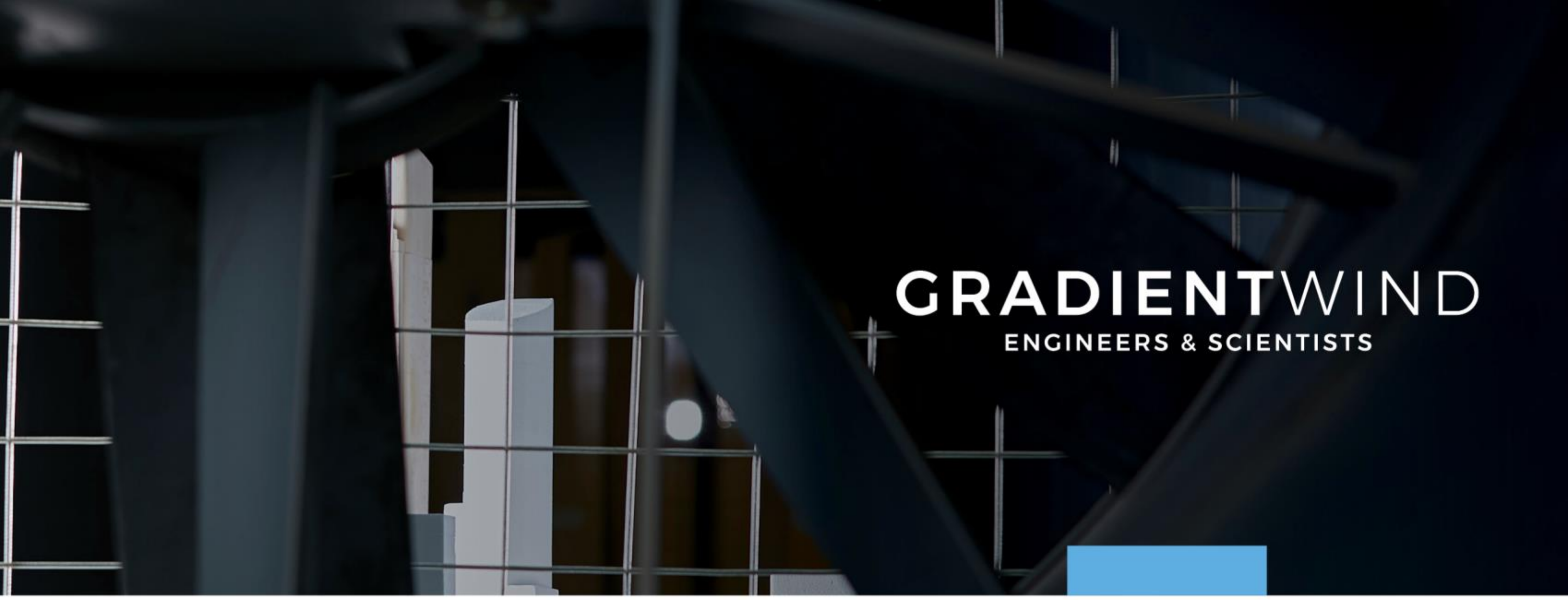
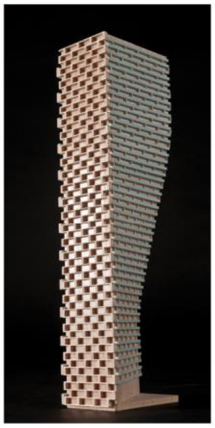
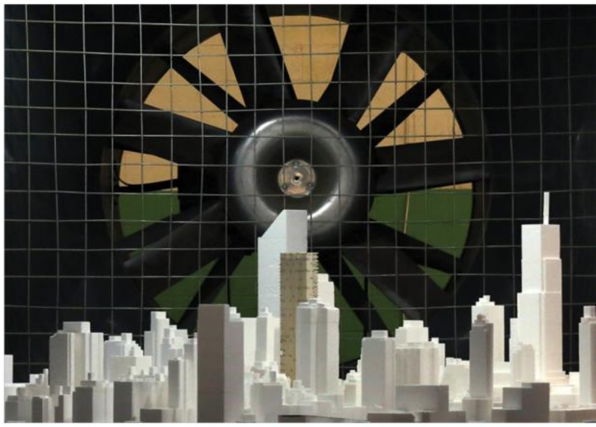


FIGURE 10B: WINTER – PROPOSED MASSING – WIND COMFORT, LEVEL 7 AMENITY TERRACE







APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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 it 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	0.22
40	0.23
97	0.21
136	0.21
170	0.23
210	0.23
237	0.23
258	0.24
278	0.23
300	0.22
322	0.22
341	0.22

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].

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

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