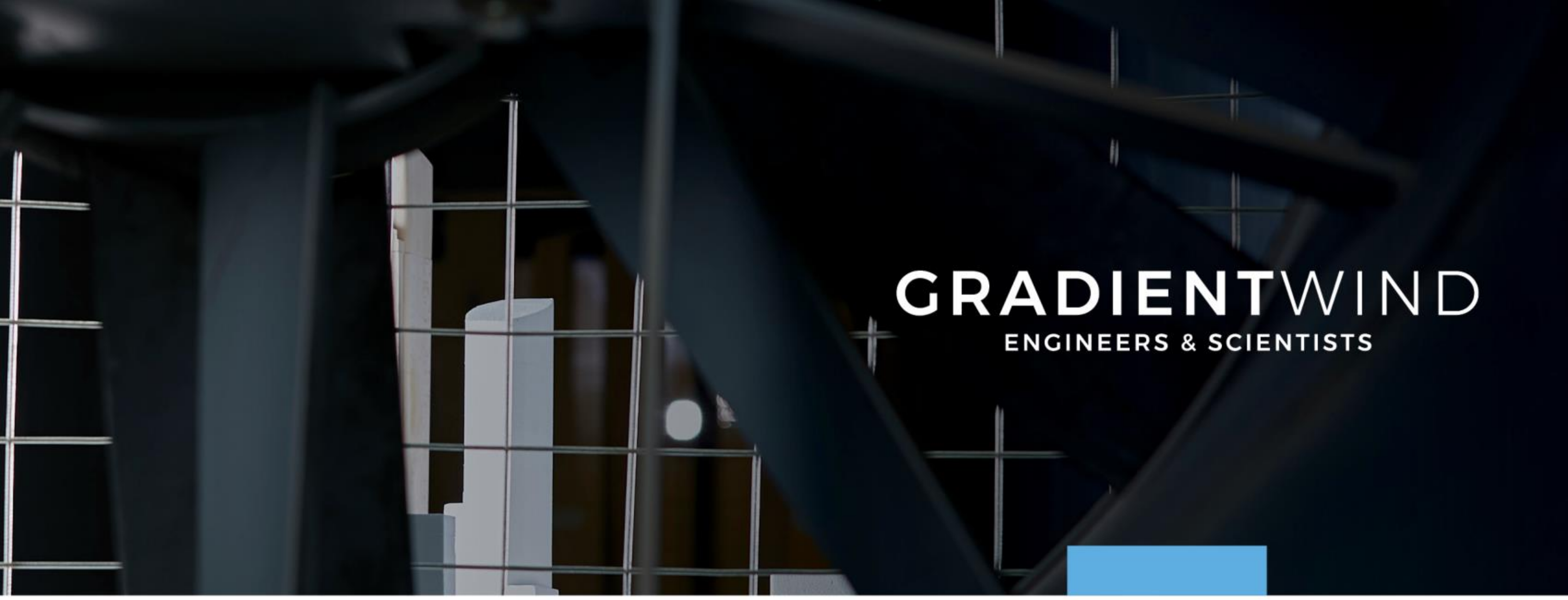
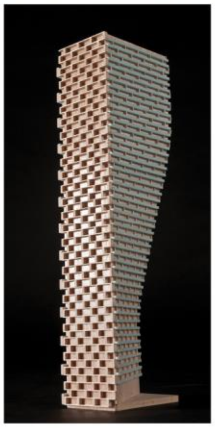
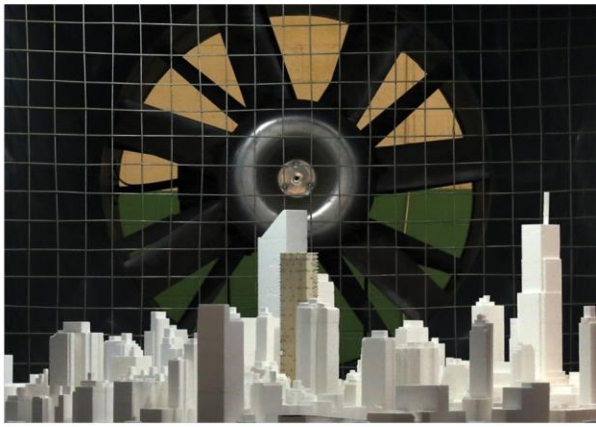


PEDESTRIAN LEVEL WIND STUDY

7 St. Dennis Drive and 10 Grenoble Drive
Toronto, Ontario

Report: 22-109-PLW





July 5, 2022

PREPARED FOR
Osmington Gerofsky Development Corp
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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment application requirements for the proposed multi-building development located at 7 St. Dennis Drive and 10 Grenoble Drive in Toronto, Ontario (hereinafter referred to as “subject site” or “proposed development”). Our mandate within this study is to investigate pedestrian wind comfort and safety 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 sixteen (16) 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 according to City of Toronto wind comfort and safety criteria. A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-18B, and is summarized as follows:

1) Most grade-level 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, transit stops, in the vicinity of building access points, parking lot, and relocated parking entrances are considered acceptable. One exception is described as follows:

    a. Conditions over the potential park along the north of the subject site are predicted to be suitable for sitting in the western portion and standing in the eastern portion during the typical use period. To extend sitting conditions over the eastern portion of the park, it is recommended that landscaping features such as wind screens, topographical berms, and/or coniferous plantings in dense arrangements be installed around sensitive areas.

2) Conditions over the Level 2 amenity terrace serving Tower 1 are predicted to be suitable for sitting during the typical use period, which are considered acceptable according to the comfort criteria.

3) Conditions over the Level 2 amenity terrace serving Towers 2 to 4 are predicted to be suitable for a mix of sitting and standing.

a. To extend sitting conditions over the amenity terrace, it is recommended that landscaping features such as wind barriers or coniferous plantings in dense arrangements be installed around sensitive areas. Additionally, it is recommended that wind barriers, typically glazed, be installed along the west perimeter of the amenity space.

4) The introduction of the proposed building is predicted to improve conditions over the amenity terrace serving the neighbouring development at 25 St. Dennis Drive.

5) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected over the subject site. 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.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Osmington Gerofsky Development Corp to undertake a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment application requirements for the proposed multi-building development located at 7 St. Dennis Drive and 10 Grenoble Drive in Toronto, Ontario (hereinafter referred to as "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind comfort and safety 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.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Toronto wind comfort and safety criteria, architectural drawings for the proposed development prepared by architectsAlliance, in June 2022, surrounding street layouts and existing and approved future building massing information obtained from the City of Toronto, recent satellite imagery, and experience with numerous similar developments in Toronto and elsewhere.

2. TERMS OF REFERENCE

The subject site is located at 7 St. Dennis Drive and 10 Grenoble Drive in Toronto; situated at the southeast intersection of St. Dennis Drive and Don Mills Road. St. Dennis Drive is situated to the north of the subject site, Don Mills Road is to the west, a new street (currently unnamed) is to the east, Grenoble Drive is to the southeast, and Gateway Boulevard is to the south of the subject site. Throughout this report, St. Dennis Drive is considered project north.

The development comprises four proposed residential towers and two existing buildings; Tower 1 is situated to the northwest, Tower 2 is to the northeast, Tower 3 is to the east, and Tower 4 is to the southeast of the subject site. Towers 2 to 4 rise above a shared two-storey podium. Tower 1 is served by three below-grade parking levels, and Towers 2-4 share three below-grade parking levels. Each of the four towers includes a mechanical penthouse comprising two levels. The existing 17-storey residential building at 10 Grenoble Drive, comprising a planform consisting of two adjacent rectangles connected by a corner, is situated to the west of Towers 3 and 4. The ramp providing access to underground parking for the existing building at 10 Grenoble Drive will be relocated to the southwest corner of the existing building. The existing building at 7 St. Dennis Drive has a similar layout as the existing building at 10 Grenoble Drive and is situated along the west of the subject site. The ramp providing access to underground parking for the existing building at 7 St. Dennis Drive will be relocated to the southwest corner of the existing building. A potential park is situated along the north of the subject site between Tower 1 and the existing building at 10 Grenoble Drive.

Tower 1 rises to 52-storeys above a two-storey podium comprising a nominally "L" shaped planform, with its long axis-oriented to the east. The ground floor includes main entrances to the west and at the northwest corner, shared building support spaces and elevator cores to the north, indoor amenity at the east and the northeast corner, and loading spaces and shared building support spaces to the south. Access to underground parking is provided by a ramp at the southwest corner of Tower 1 via a new private street from St. Dennis Drive. The mezzanine level includes mechanical space to the north, indoor amenity at the northeast corner, and is open to below from the east clockwise to the northwest. Level 2 comprises a nominally rectangular planform and is reserved for mechanical space to the north and indoor amenity throughout the remainder of the level. This level is also served by an outdoor amenity terrace on all elevations. Levels 3 to 52 comprise a rectangular planform and are reserved for residential use.

Tower 2 rises to 46-storeys and comprises a nominally rectangular planform with its long axis-oriented to the northwest. The ground floor includes a main entrance to the southeast, indoor amenity to the west, shared building support spaces to the northwest, indoor amenity to the north, a main entrance to the northeast, indoor amenity to the south, and central elevator cores. The mezzanine level is reserved for indoor amenity with a machine room to the northwest and is open to below from the northeast clockwise to the southwest. Level 2 comprises a rectangular planform with an inset at the northwest corner and is reserved for indoor amenity space. Levels 3 to 46 comprise a rectangular planform and are reserved for residential use. Access to the podium rooftop amenity terrace is provided at Level 2.

Tower 3 rises to 34-storeys and comprises a nominally rectangular planform with its long axis-oriented to the south. The ground floor comprises a "T"-shaped planform and includes main entrances at the southeast and southwest corners, loading space and shared building support spaces to the north, and central elevator cores. The mezzanine level is reserved for bike storage and is open to below at the north and south. Level 2 is reserved for indoor amenity space. The podium includes an opening to the laneway below which extends from the new street to the east of the subject site to Grenoble Drive. Levels 3 to 34 comprise a rectangular planform and are reserved for residential use. Access to the podium rooftop amenity terrace is provided at Level 2.

Tower 4 rises to 42-storeys and comprises a nominally rectangular planform with its long axis-oriented to the east. The ground floor includes loading space and indoor amenity to the north, main entrances to the east and at the southeast corners, and central elevator cores. Access to the shared underground parking levels of Towers 2 to 4 is provided by a ramp to the west of Tower 4 via the new private street which extends from the new street to the east of the subject site to Grenoble Drive. The mezzanine level is reserved for bike storage and is open to below to the north and southeast. Level 2 comprises a rectangular planform with an inset at the northwest corner and is reserved for indoor amenity. Levels 3 to 42 comprise a rectangular planform and are reserved for residential use. Access to the podium rooftop amenity terrace is provided at Level 2.

The shortest distance between the podia serving Tower 1 and Tower 2 is approximately 116 metres (m), while the shortest distance between the towers above the podia, is approximately 120.4 m. The shortest distance between Tower 2 and Tower 3 above the connected podia is approximately 35.4 m, while the shortest distance between Tower 3 and Tower 4 above the connected podia, is approximately 30.3 m.

Regarding wind exposures, the near-field surroundings (defined as an area falling within a 200 m radius of the subject site) include a mix of low- and mid-rise residential buildings from the north clockwise to the east, a church and school to the southeast, a mid-rise building and a low-rise shopping centre to the south, and open space and the Ontario Science Centre to the west. To the immediate southeast of the subject site, the 44-storey development at 25 St. Dennis Drive has been approved for rezoning by the City of Toronto. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) comprise a mix of green spaces along the East and West Branches of the Don River and low-rise residential and commercial developments with isolated mid- and high-rise developments in all compass directions. Notably, the Don River West Branch flows from the northwest to the south approximately 1.4 km to the south of the subject site where it merges with the East Branch which flows from the northeast to the southwest of the subject site.

Figure 1A illustrates the subject site and surrounding context, representing the proposed massing scenario, while Figure 1B illustrates the subject site and surrounding context, representing the existing massing scenario. The existing massing scenario includes both the existing massing as well as future developments which have been approved by the City of Toronto. Figures 2A-2H illustrate the computational models used to conduct the study.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind comfort and safety conditions at key areas within and surrounding the subject site; (ii) identify areas where 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 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 Toronto area wind climate, and synthesis of computational data with City of Toronto wind criteria[1]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

[1] Toronto, *Pedestrian Level Wind Study Terms of Reference Guide*, 2022
https://www.toronto.ca/wp-content/uploads/2022/03/8f9c-CityPlanning-ToR-Wind-Guide.pdf

4.1 Computer-Based Context Modelling

A computer based PLW 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 in Mississauga, Ontario. 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 proposed 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 subject site for 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a diameter of 960 m.

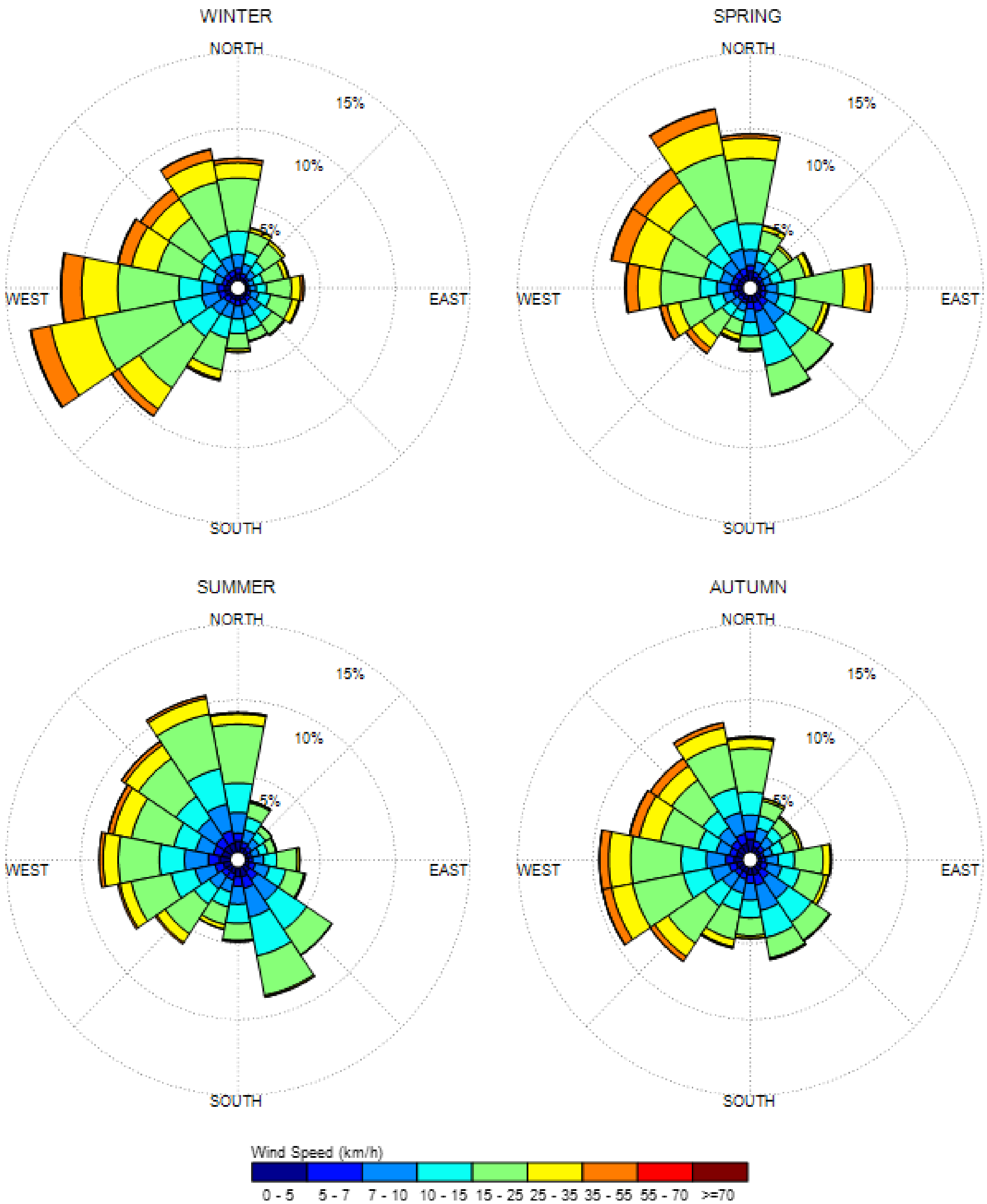
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. 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 wind flow simulation technique are presented in Appendix A.

4.3 Historical Wind Speed and Direction Data

A statistical model for winds in Toronto was developed from approximately 40 years of hourly meteorological wind data recorded at Lester B. Pearson International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (i.e., between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the City of Toronto wind criteria. Specifically, the spring season is defined as March through May, the summer season is defined as June through August, the autumn season is defined as September through November, and the winter season is defined as December through February, inclusive.

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 kilometers per hour (km/h). Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The preferred wind speeds and directions can be identified by the longer length of the bars. For Toronto, the most common winds occur for westerly wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional preference and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
LESTER B. PEARSON INTERNATIONAL AIRPORT, MISSISSAUGA, 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 Criteria – City of Toronto

Pedestrian wind comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (i.e., temperature and relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Since both mean and gust wind speeds affect pedestrian comfort, their combined effect is defined in the City of Toronto Pedestrian Level Wind Study Terms of Reference Guide. Specifically, the criteria are defined as a Gust Equivalent Mean (GEM) wind speed, which is the greater of the mean wind speed or the gust wind speed divided by 1.85.

The wind speed ranges 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. Four pedestrian comfort classes and corresponding gust wind speed ranges are used to assess pedestrian comfort: (1) Sitting; (2) Standing; (3) Walking; and (4) Uncomfortable. Specifically, the comfort classes, associated wind speed ranges, and limiting criteria are summarized as follows:

1) **Sitting:** GEM wind speeds no greater than 10 km/h occurring at least 80% of the time would be considered acceptable for sedentary activities, including sitting.

2) **Standing:** GEM wind speeds no greater than 15 km/h occurring at least 80% of the time are acceptable for activities such as standing, strolling or more vigorous activities.

3) **Walking:** GEM wind speeds no greater than 20 km/h occurring at least 80% of the time are acceptable for walking or more vigorous activities.

4) **Uncomfortable:** Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

Regarding wind safety, gust wind speeds greater than 90 km/h, occurring more than 0.1% of the time on an annual basis (based on wind events recorded for 24 hours a day), are classified as dangerous. From calculations of stability, it can be shown that gust wind speeds of 90 km/h would be the approximate threshold wind speed that would cause an average elderly person in good health to fall.

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 GEM wind speeds of 10 km/h were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if GEM wind speeds of 20 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 criteria 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 subject 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 typical windiest desired comfort classes are summarized on the following table. Depending on the programming of a space, the desired comfort class may differ from this table.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Walking
Public Sidewalk / Bicycle Path	Walking
Outdoor Amenity Space	Sitting (Typical Use Period)
Café / Patio / Bench / Garden	Sitting (Typical Use Period)
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting (Typical Use Period)
Garage / Service Entrance	Walking
Parking Lot	Walking
Vehicular Drop-Off Zone	Walking

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-10B, which illustrate conditions for the proposed and existing massing scenarios. Similarly, conditions over the Level 2 common amenity terrace serving Tower 1 are illustrated in Figures 11A-D, while conditions over the Level 2 common amenity terrace serving Towers 2 to 4 are illustrated in Figures 12A-D. Figures 14A-17B illustrate conditions over the rooftop amenity terrace serving the neighbouring building at 25 St. Dennis Drive. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the various comfort classes noted in Section 4.4. Wind conditions suitable for sitting are represented by the colour blue, standing by green, and walking by yellow; uncomfortable conditions are represented by the colour orange.

Wind conditions over the common amenity terraces are also reported for the typical use period, which is defined as May to October, inclusive. Figures 13A-B and Figures 18A-B illustrate wind comfort conditions for the common amenity terraces serving the proposed development and 25 St. Dennis Drive, respectively, consistent with the comfort classes in Section 4.4. Pedestrian wind conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks and Transit Stops along St. Dennis Drive: Following the introduction of the proposed development, the nearby public sidewalk areas along St. Dennis Drive are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for standing during the spring and winter, with a small region of walking near the northeast of the subject site during the spring and winter. Conditions over the nearby transit stops along St. Dennis Drive are predicted to be suitable for standing, or better, throughout the year. The noted conditions are considered acceptable according to the comfort criteria.

Wind conditions over the sidewalks along St. Dennis Drive with the existing massing are predicted to be mostly suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the spring and autumn, and suitable for standing during the winter. While the introduction of the proposed development produces slightly windier conditions in comparison to existing conditions, wind comfort conditions with the proposed development are considered acceptable.

Sidewalks and Transit Stops along Don Mills Road: Conditions over the nearby public sidewalk areas along Don Mills Road for both massing scenarios are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for standing during the spring and winter. Conditions over the nearby transit stops along Don Mills Road are predicted to be suitable for sitting during the summer, becoming suitable for standing during the remaining three seasons. The noted conditions are considered acceptable according to the comfort criteria.

Tower 1 - Building Access: Conditions in the vicinity of building access points serving Tower 1 are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable according to the comfort criteria.

New Private Street and Parking Lot West of Tower 1: Following the introduction of the proposed development, conditions over the new private street situated to the west of Tower 1 are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming mostly suitable for standing during the spring and winter. Conditions over the parking lot to the west of the existing building are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the spring and autumn, and suitable for standing during the winter. The noted conditions are considered acceptable according to the comfort criteria.

Relocated Parking Entrance Serving 7 St. Dennis Drive: Conditions over the relocated parking entrance serving 7 St. Dennis Drive, situated to the southwest of the existing building, are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the remaining three seasons. The noted conditions are considered acceptable according to the comfort criteria.

Potential Park along North of Subject Site: Conditions over the potential park along the north of the subject site are predicted to be suitable for sitting in the western portion and standing in the eastern portion during the typical use period. To extend sitting conditions over the eastern portion of the park, it is recommended that landscaping features such as wind screens, topographical berms, and/or coniferous plantings in dense arrangements be installed around sensitive areas. The noted conditions, and any associated mitigation, will be confirmed for the future Site Plan Control submission.

Sidewalks along New Street East of Subject Site: Conditions along the nearby public sidewalk areas along the new street to the east of the subject site are predicted to be suitable for a mix of sitting and standing throughout the year. The noted conditions are considered acceptable according to the comfort criteria.

Sidewalks along Grenoble Drive: Following the introduction of the proposed development, the nearby public sidewalk areas along Grenoble Drive are predicted to be mostly suitable for sitting during the summer and autumn, becoming suitable for a mix of sitting and standing during the spring and winter. The noted conditions are considered acceptable according to the comfort criteria.

Wind conditions over the sidewalks along Grenoble Drive with the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming mostly suitable for standing during the remaining three seasons. Notably, the introduction of the proposed development is predicted to improve comfort levels along Grenoble Drive, in comparison to existing conditions. The noted wind conditions are considered acceptable according to the comfort criteria.

Sidewalks along New Private Street West of Towers 2 to 4: Conditions along the nearby public sidewalk areas along the new private street to the west of Towers 2 to 4 are predicted to be suitable for standing throughout the year with a small region of walking conditions to the west of Tower 3 during the winter. The noted conditions are considered acceptable according to the comfort criteria.

Relocated Parking Entrance Serving 10 Grenoble Drive: Conditions over the relocated parking entrance serving 10 Grenoble Drive, situated to the southwest of the existing building, are predicted to be suitable for a mix of sitting and standing throughout the year. The noted conditions are considered acceptable according to the comfort criteria.

Tower 2 - Building Access: Conditions in the vicinity of building access points serving Tower 2 are predicted to be suitable for sitting throughout the year. The noted conditions are considered acceptable according to the comfort criteria.

Tower 3 - Building Access: Conditions in the vicinity of building access points along the east elevation of Tower 3 are predicted to be suitable for sitting throughout the year. Conditions in the vicinity of the building access point along the west elevation are predicted to be suitable for sitting during the summer, becoming suitable for a mix of sitting and standing during the remaining three seasons. The noted conditions are considered acceptable according to the comfort criteria.

Tower 4 - Building Access: Conditions in the vicinity of building access points along the south elevation of Tower 4 are predicted to be suitable for sitting throughout the year. Conditions in the vicinity of the building access points along the east elevation are predicted to be suitable for sitting during the summer, autumn, and winter, becoming suitable for a mix of sitting and standing during the spring. The noted conditions are considered acceptable according to the comfort criteria.

5.2 Wind Comfort Conditions – Common Amenity Terraces

Tower 1 - Level 2 Amenity Terrace: Conditions over the Level 2 amenity terrace serving Tower 1 are predicted to be suitable for sitting during the typical use period, as illustrated in Figure 13A. The noted conditions are considered acceptable according to the comfort criteria.

Tower 2 – Level 2 Amenity Terrace: Conditions over the Level 2 amenity terrace serving Towers 2 to 4 are predicted to be suitable for a mix of sitting and standing during the typical use period, as illustrated in Figure 13B. To extend sitting conditions over the amenity terrace, it is recommended that landscaping features such as wind barriers or coniferous plantings in dense arrangements be installed around sensitive areas. Additionally, it is recommended that wind barriers, typically glazed, be installed along the west perimeter of the amenity space. The noted conditions, and any associated mitigation, will be confirmed for the future Site Plan Control submission.

Neighbouring Common Amenity Terrace at 25 St. Dennis Drive: For both massing scenarios, wind conditions over the neighbouring common amenity terrace serving 25 St. Dennis Drive are predicted to be suitable for a mix of sitting and standing during the typical use period. Notably, a PLW study was completed on December 12, 2018, by Theakston Environmental[2], for the 25 St. Dennis Drive development which recommended a mitigation plan for the terrace. Importantly, since the introduction of the proposed building is predicted to improve conditions over the amenity terrace, the mitigation plan recommended by Theakston Environmental is expected to be effective for the scenarios considered in the present study.

[2] Theakston Environmental, *Microclimatic Analysis – Addendum Letter*, 2018
https://secure.toronto.ca/AIC/index.do?folderRsn=cFuf8cp1tWcrkqV1Fe0Ofg%3D%3D

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no pedestrian areas within or surrounding the subject site are expected to experience conditions that could be considered dangerous, as defined in Section 4.4.

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 subject 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. CONCLUSIONS AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 of this report and illustrated in Figures 3A-18B. Based on computer simulations using the CFD technique, meteorological data analysis of the Toronto wind climate, City of Toronto wind comfort and safety criteria, and experience with numerous similar developments in Toronto and elsewhere, the study concludes the following:

1) Most grade-level 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, transit stops, in the vicinity of building access points, parking lot, and relocated parking entrances are considered acceptable. One exception is described as follows:

    a. Conditions over the potential park along the north of the subject site are predicted to be suitable for sitting in the western portion and standing in the eastern portion during the typical use period. To extend sitting conditions over the eastern portion of the park, it is recommended that landscaping features such as wind screens, topographical berms, and/or coniferous plantings in dense arrangements be installed around sensitive areas.

2) Conditions over the Level 2 amenity terrace serving Tower 1 are predicted to be suitable for sitting during the typical use period, which are considered acceptable according to the comfort criteria.

3) Conditions over the Level 2 amenity terrace serving Towers 2 to 4 are predicted to be suitable for a mix of sitting and standing.

    a. To extend sitting conditions over the amenity terrace, it is recommended that landscaping features such as wind barriers or coniferous plantings in dense arrangements be installed around sensitive areas. Additionally, it is recommended that wind barriers, typically glazed, be installed along the west perimeter of the amenity space.

4) The introduction of the proposed building is predicted to improve conditions over the amenity terrace serving the neighbouring development at 25 St. Dennis Drive.

5) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected over the subject site. 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
July 5, 2022
PROVINCE OF ONTARIO

David Huitema, M.Eng.
Junior Wind Scientist

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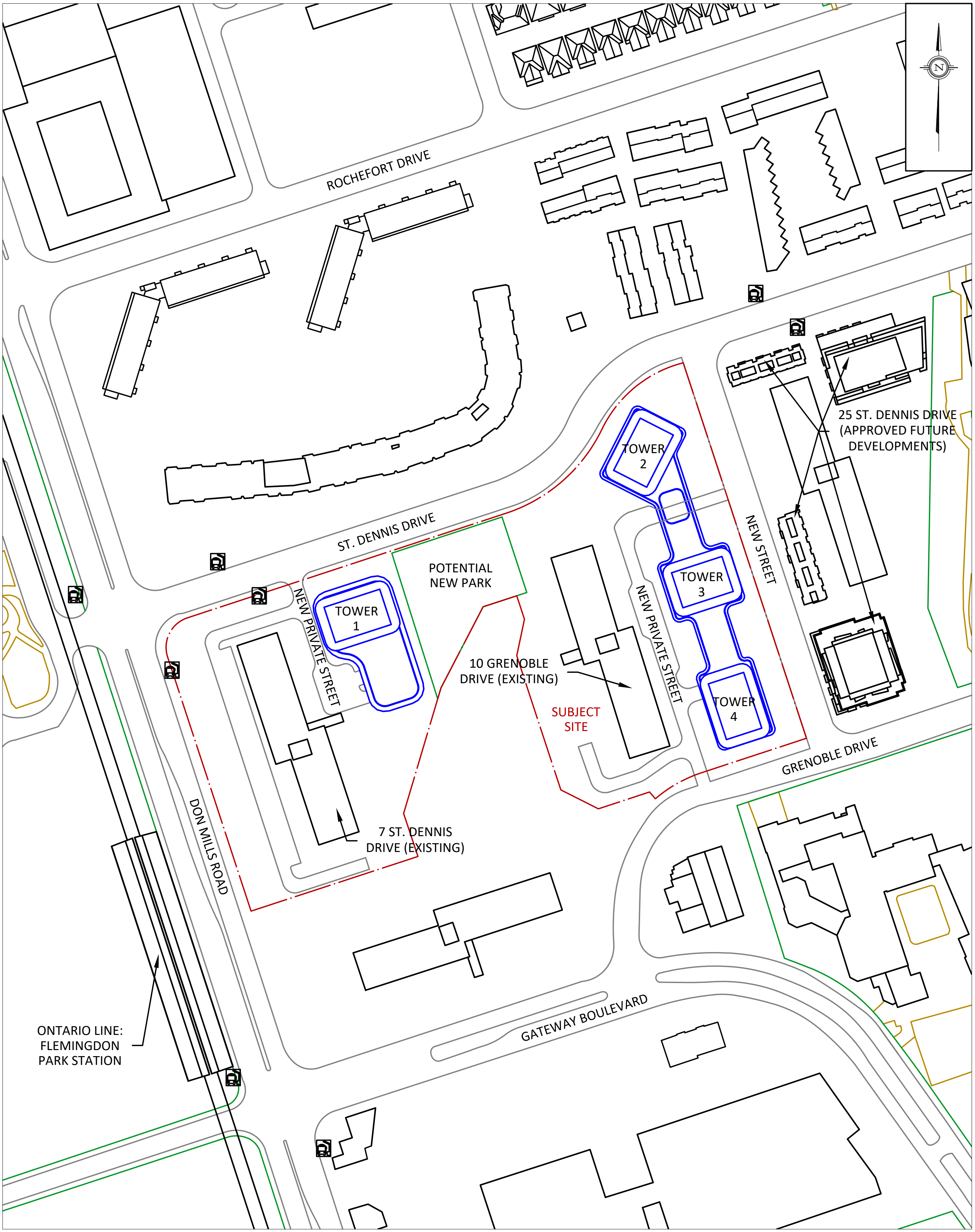
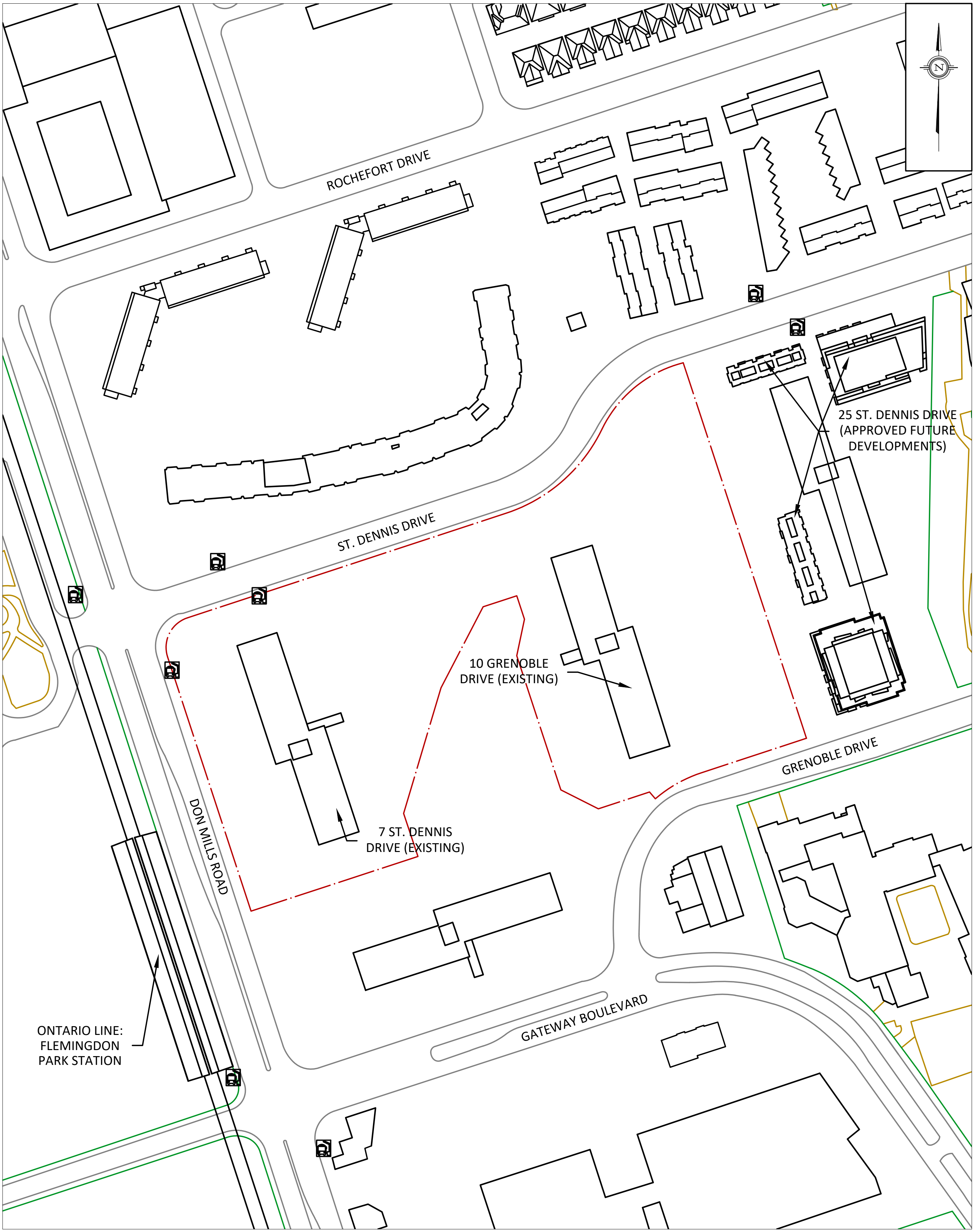
Senior Wind Engineer



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 7 ST. DENNIS DRIVE & 10 GRENOBLE DRIVE, NORTH YORK PEDESTRIAN LEVEL WIND STUDY			DESCRIPTION: FIGURE 1A: PROPOSED MASSING SITE PLAN AND SURROUNDING CONTEXT
	SCALE: 1:2500	DRAWING NO. 22-109-PLW-1A		
	DATE: JULY 4, 2022	DRAWN BY: S.K.		



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PROJECT: 7 ST. DENNIS DRIVE & 10 GRENOBLE DRIVE, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2500	DRAWING NO.: 22-109-PLW-1B	
DATE: JULY 4, 2022	DRAWN BY: S.K.	

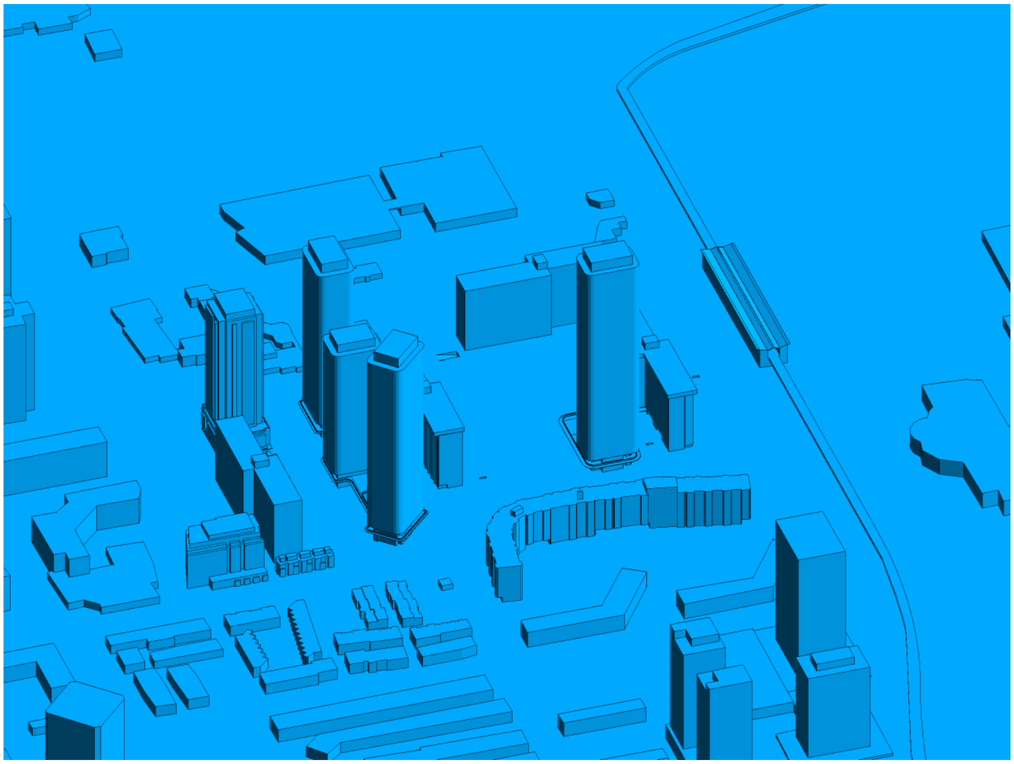


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED DEVELOPMENT, NORTH PERSPECTIVE

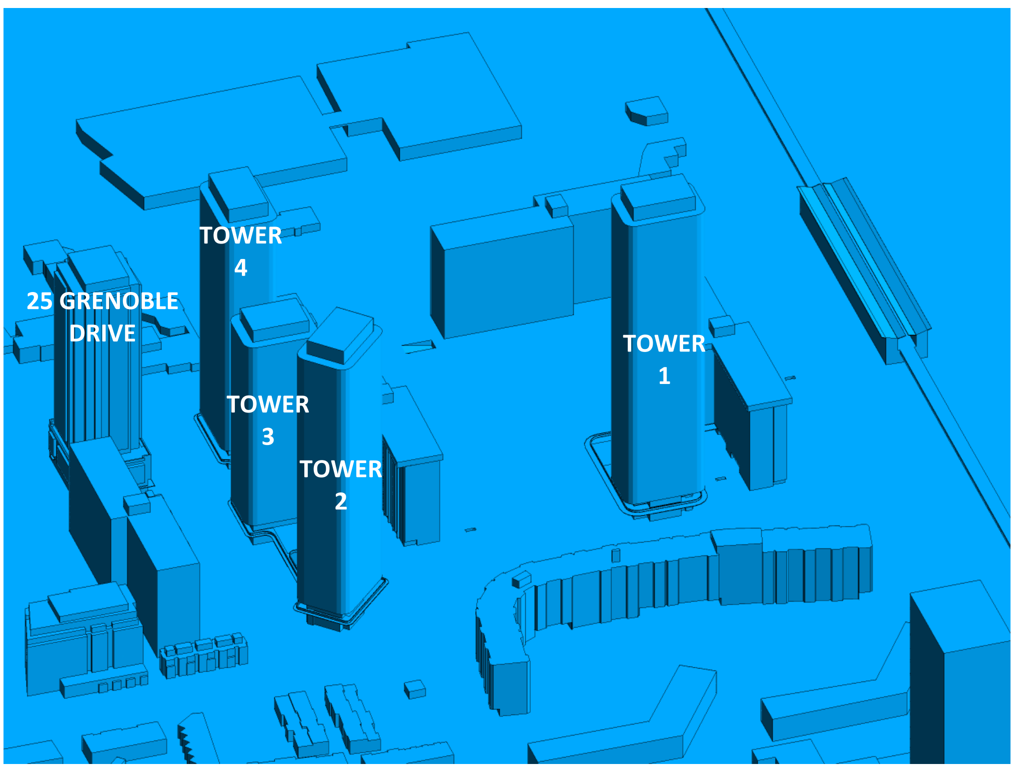


FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

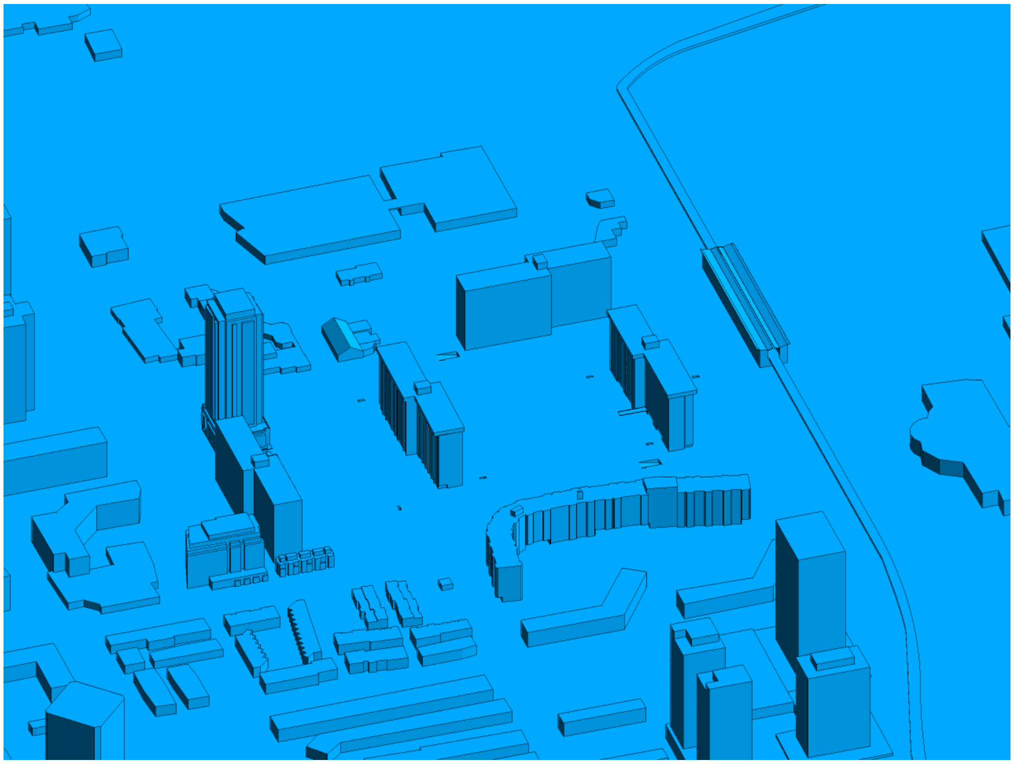


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

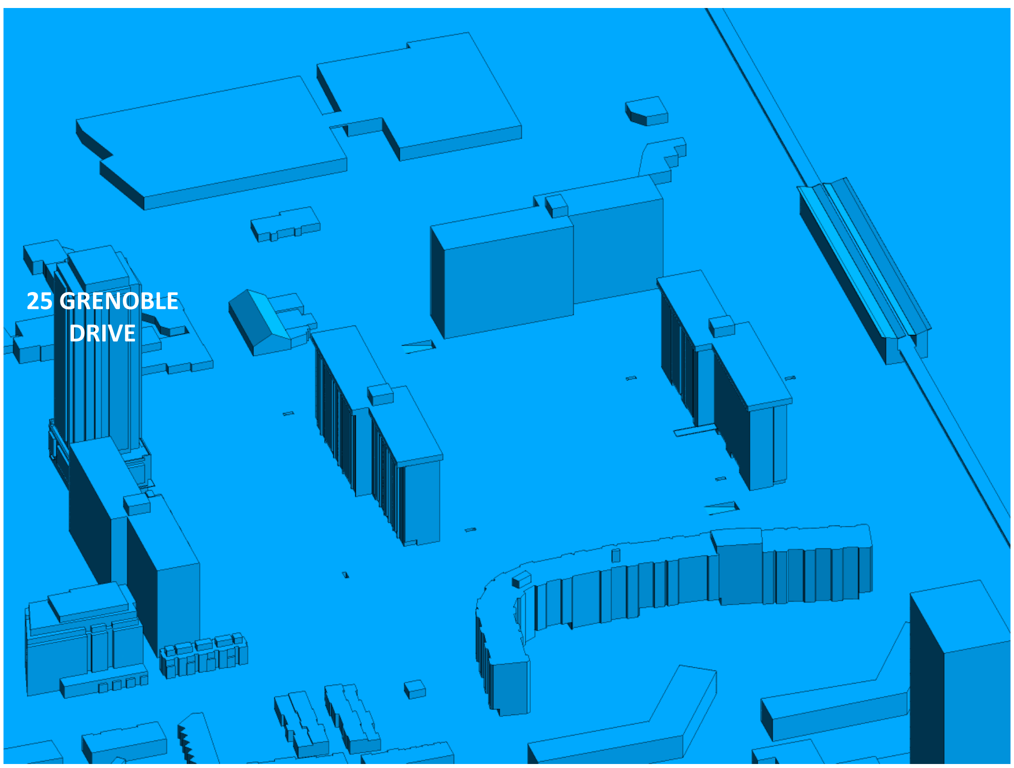


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

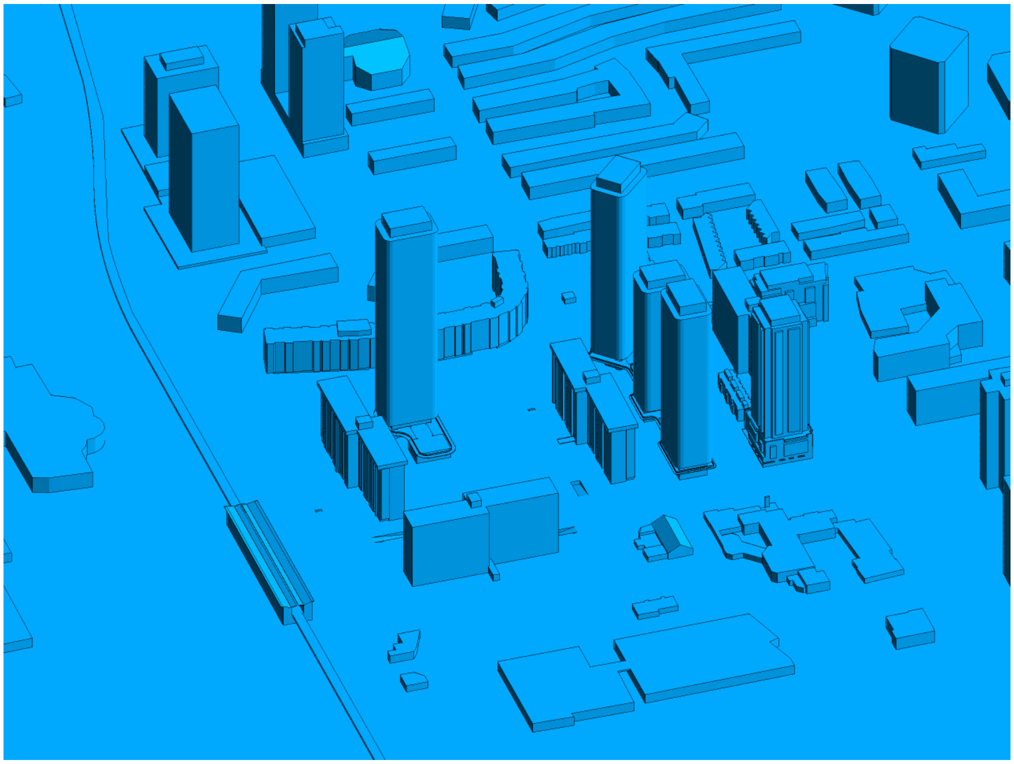


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED DEVELOPMENT, SOUTH PERSPECTIVE

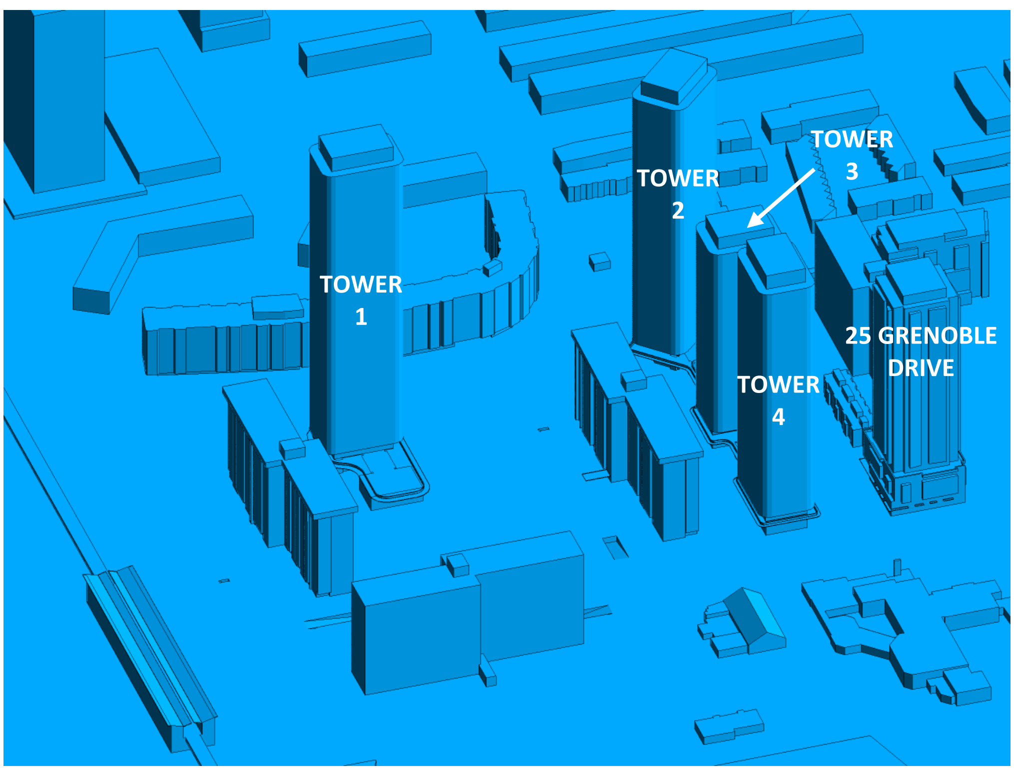


FIGURE 2F: CLOSE-UP VIEW OF FIGURE 2F

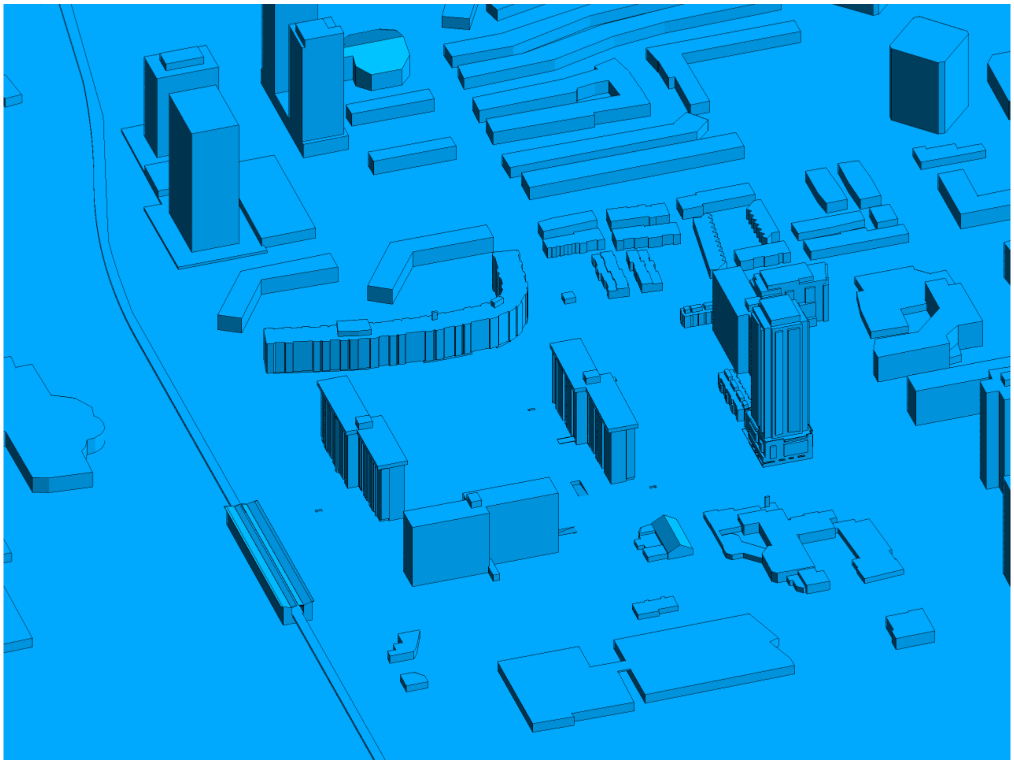


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

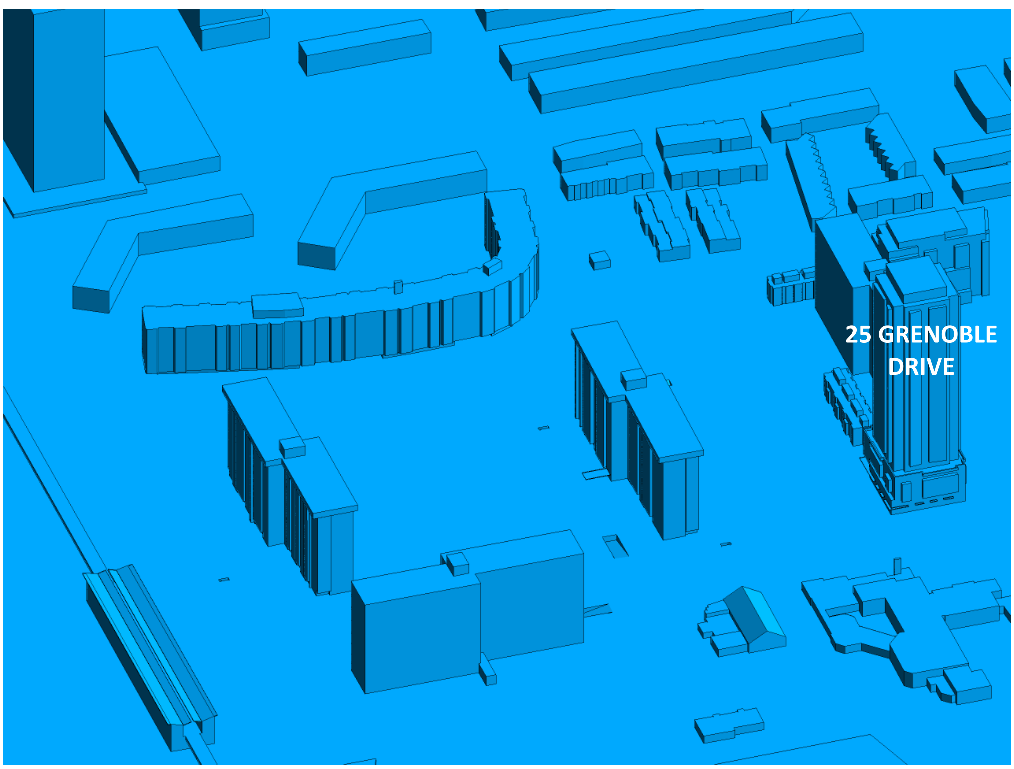


FIGURE 2H: CLOSE-UP VIEW OF FIGURE 2G

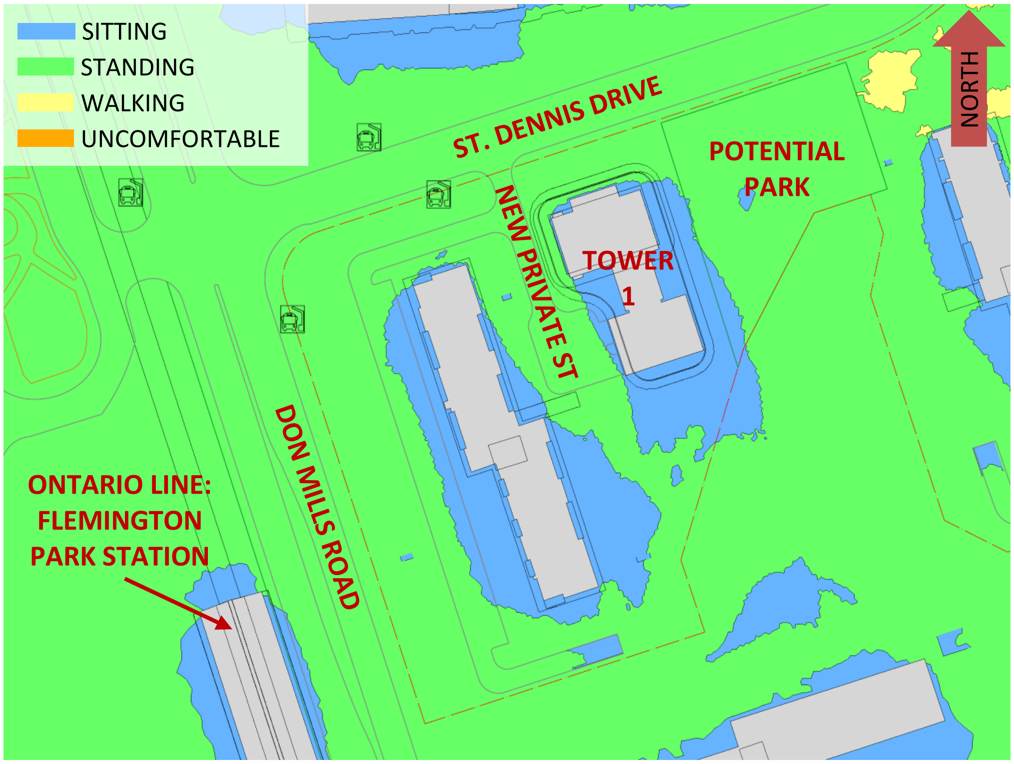


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (WEST)

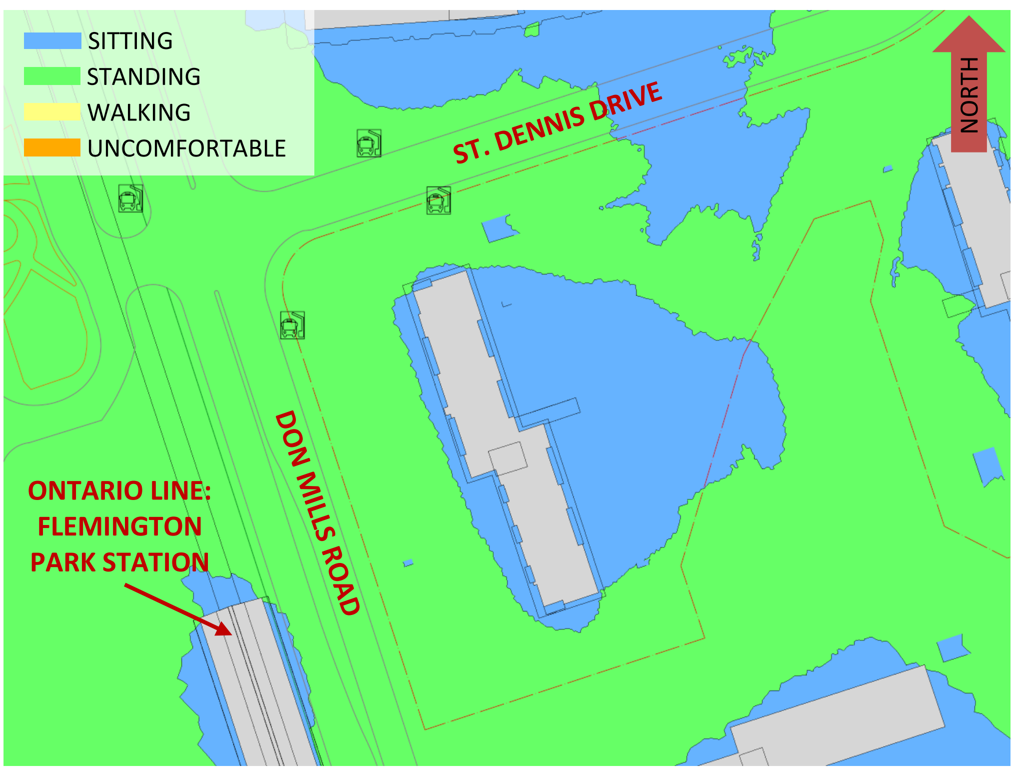


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (WEST)

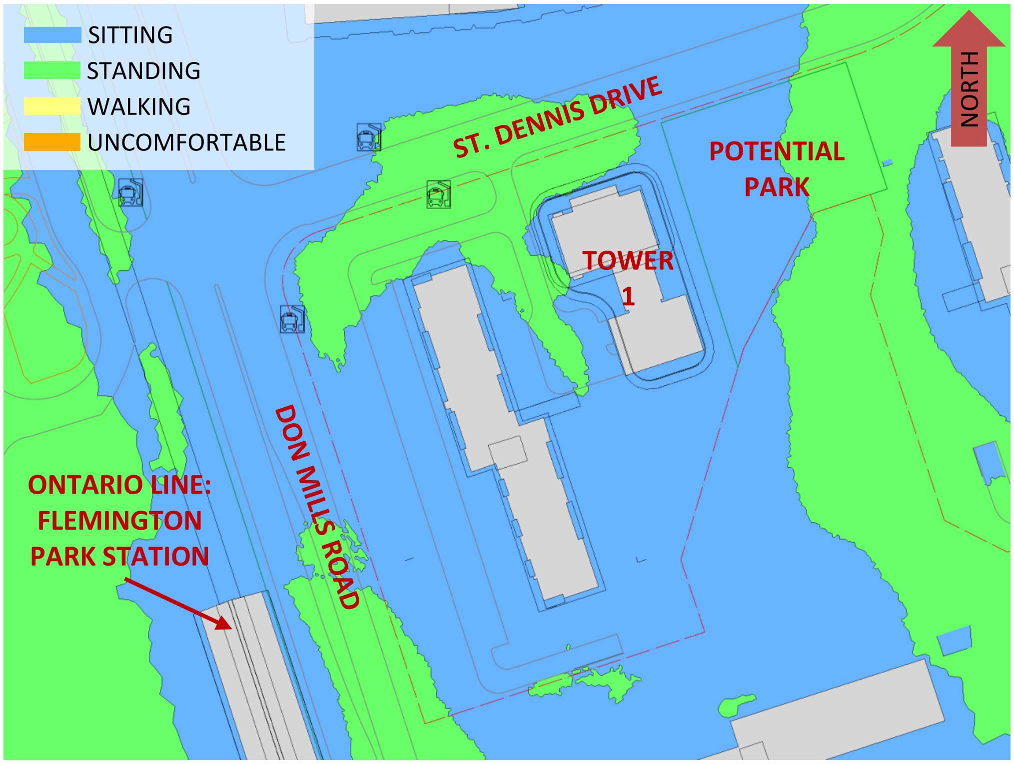


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (WEST)

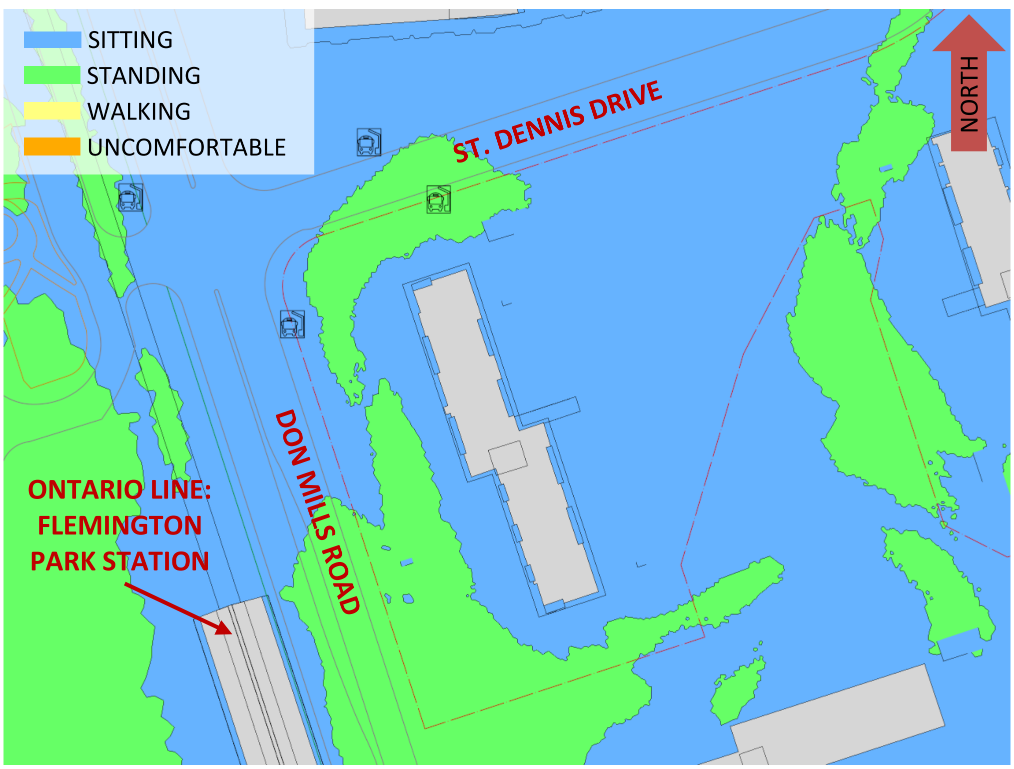


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (WEST)

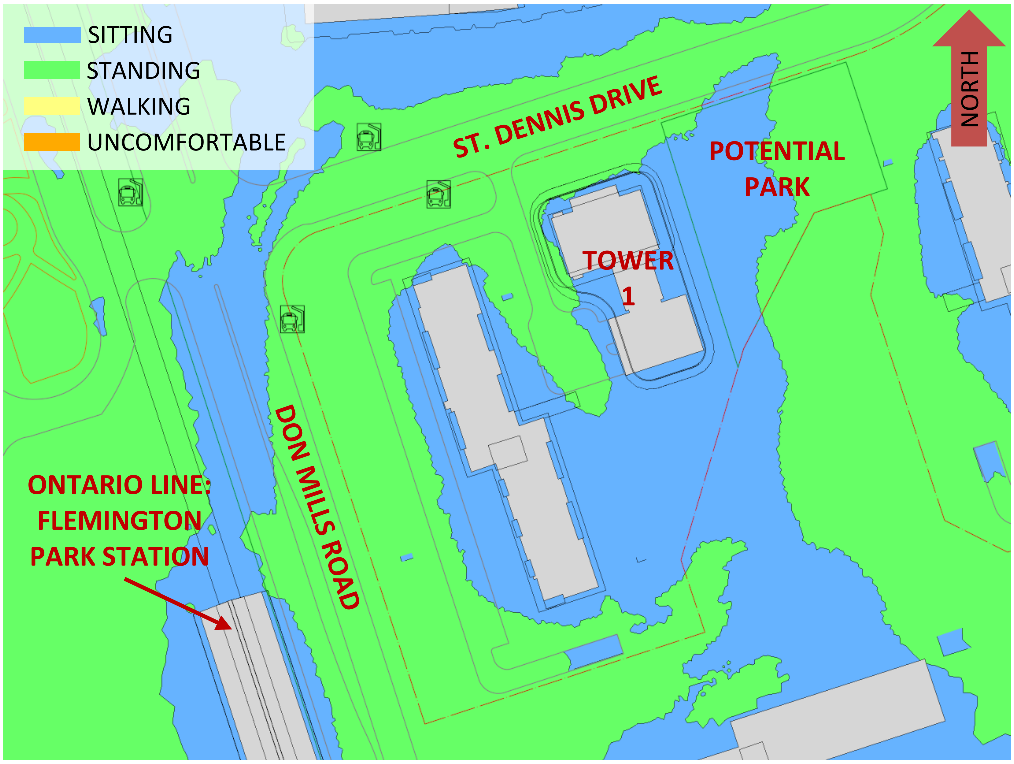


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (WEST)

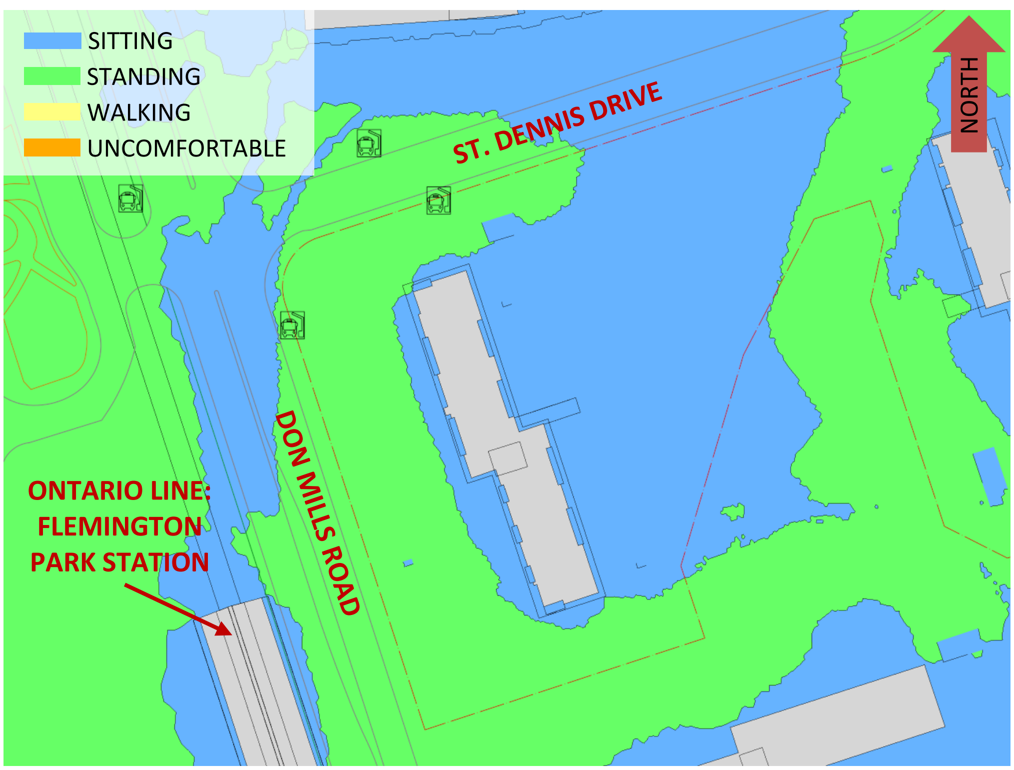


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (WEST)

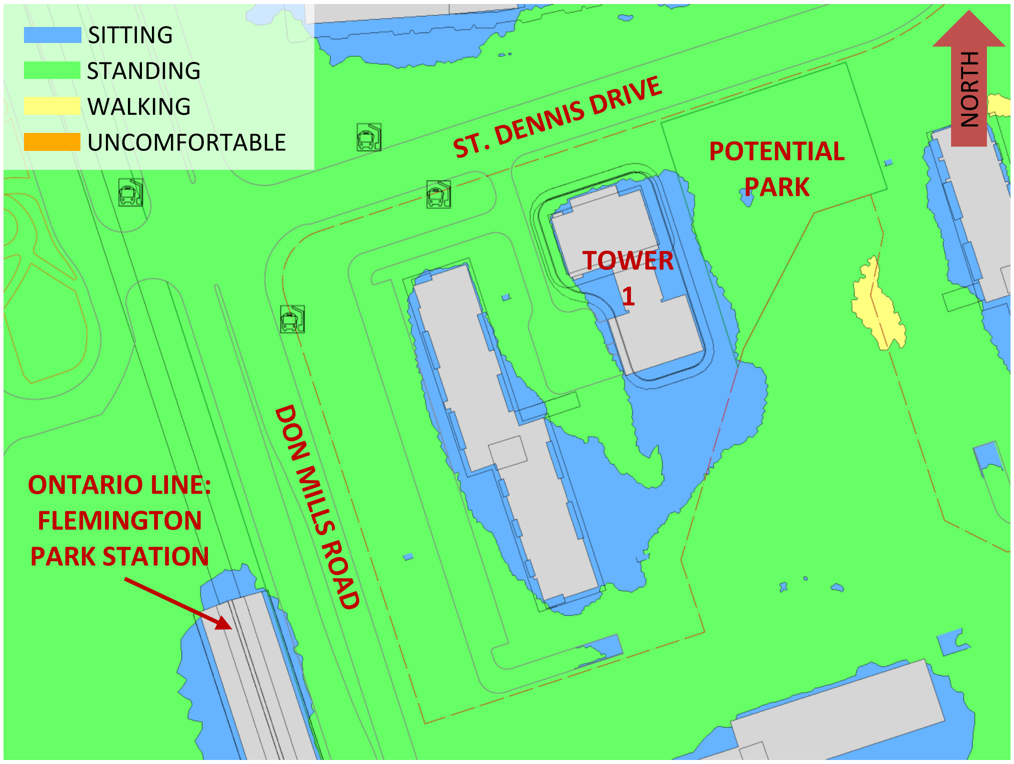


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (WEST)

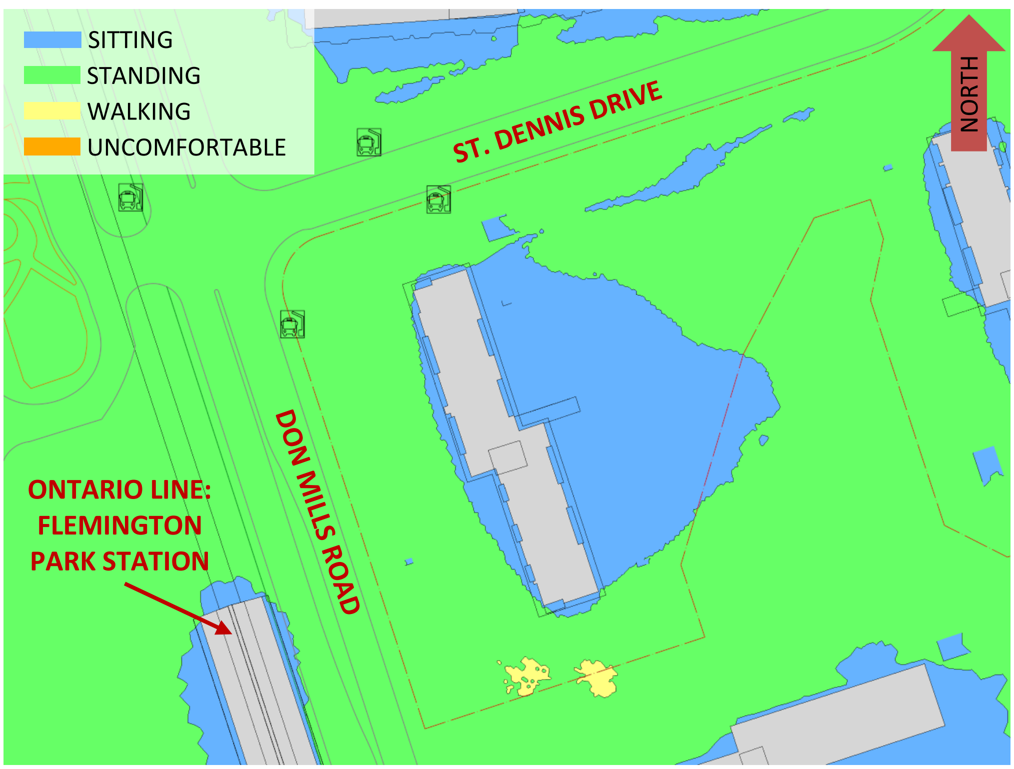


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (WEST)

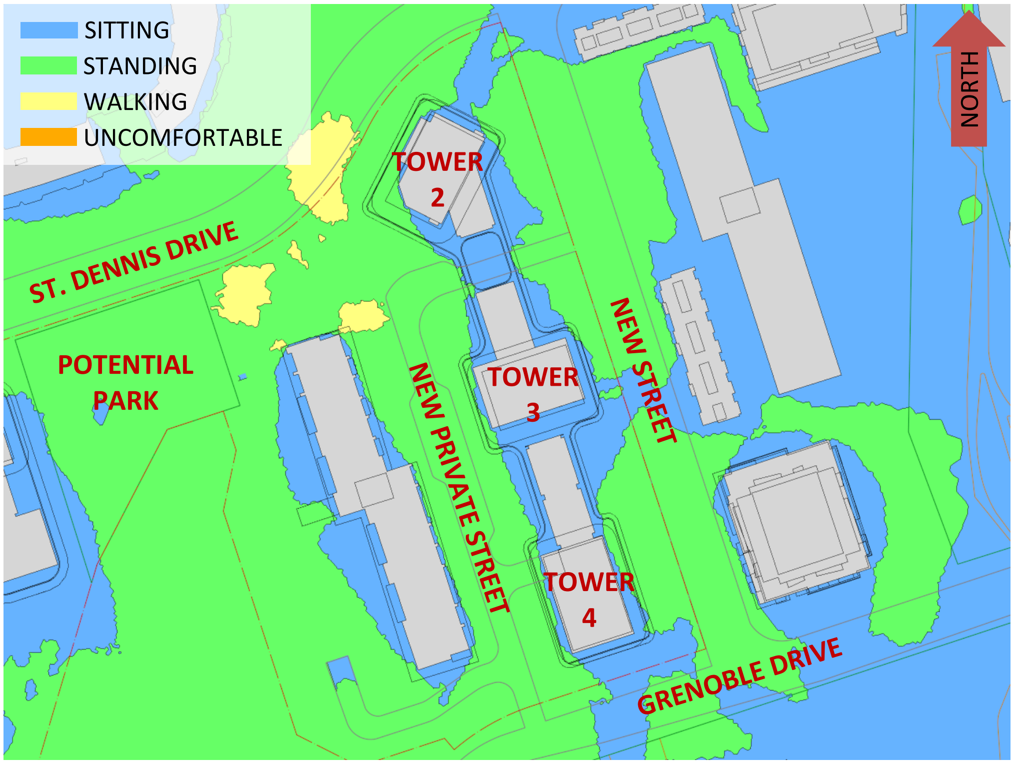


FIGURE 7A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (EAST)

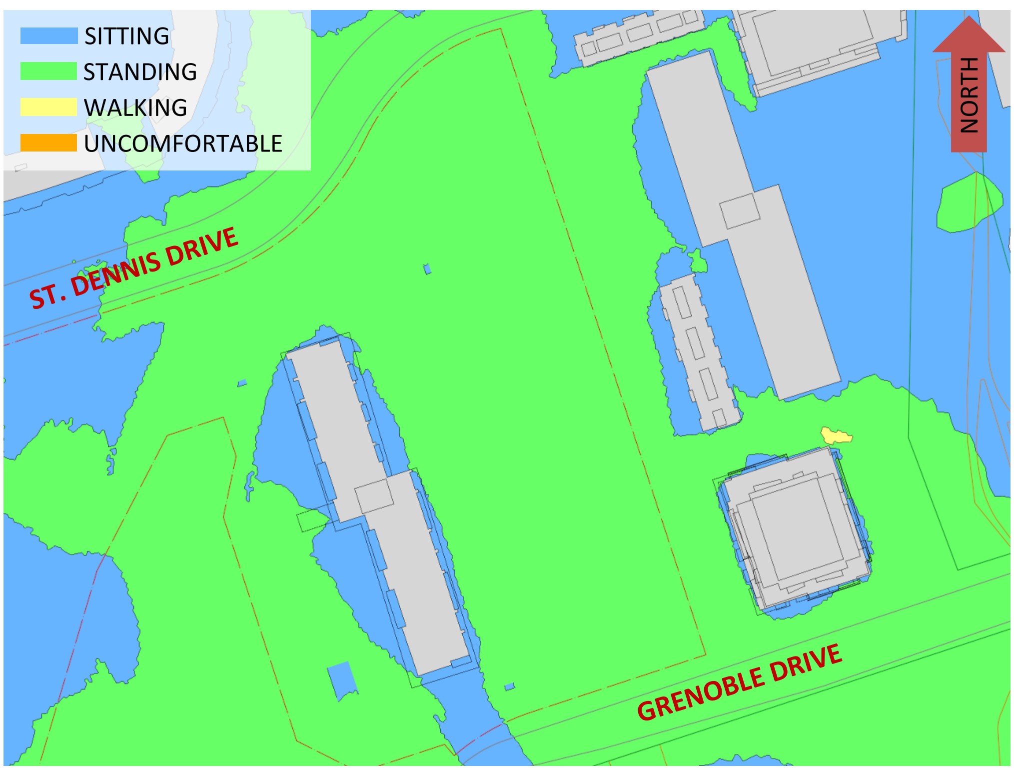


FIGURE 7B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (EAST)

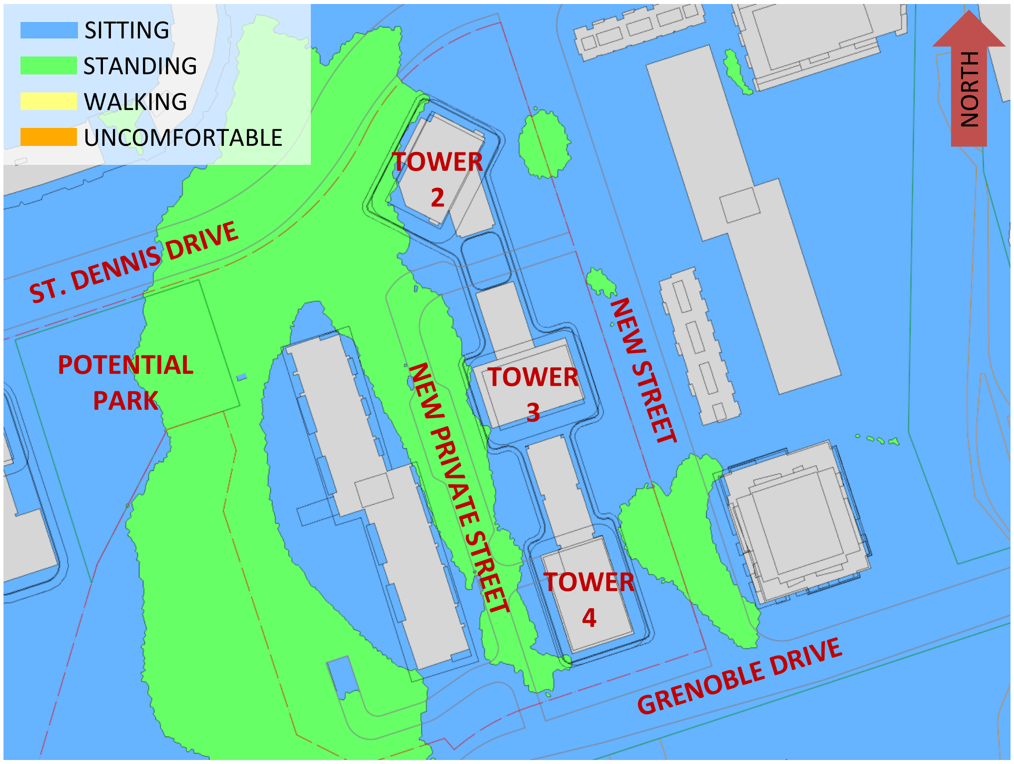


FIGURE 8A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (EAST)

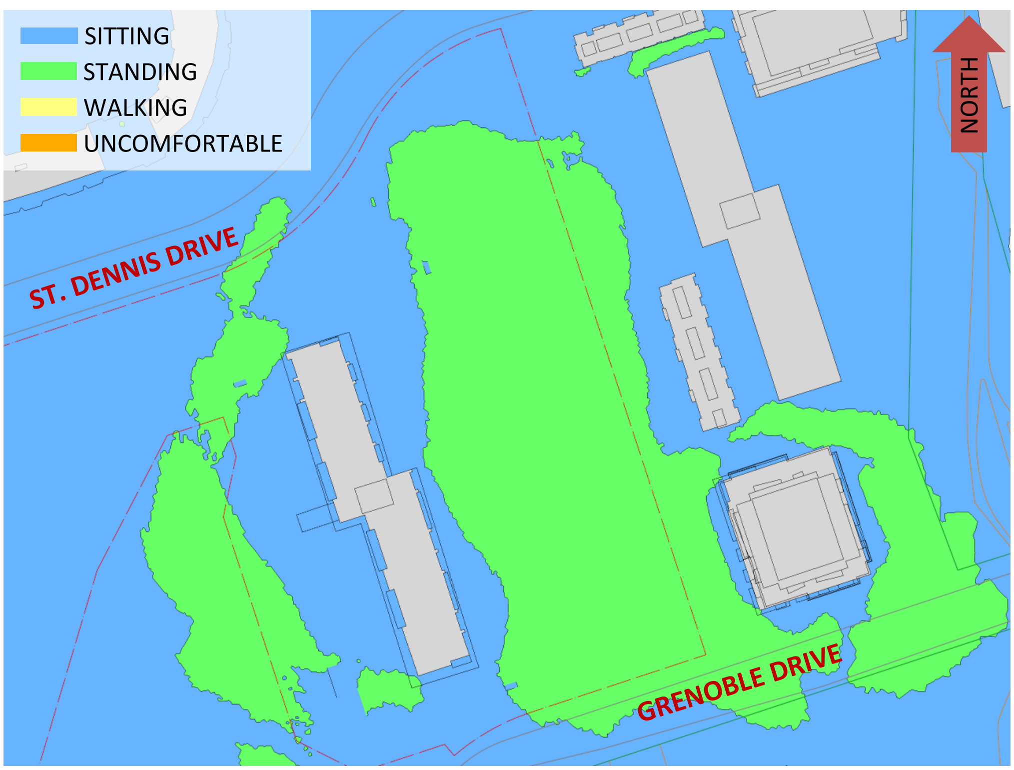


FIGURE 8B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (EAST)

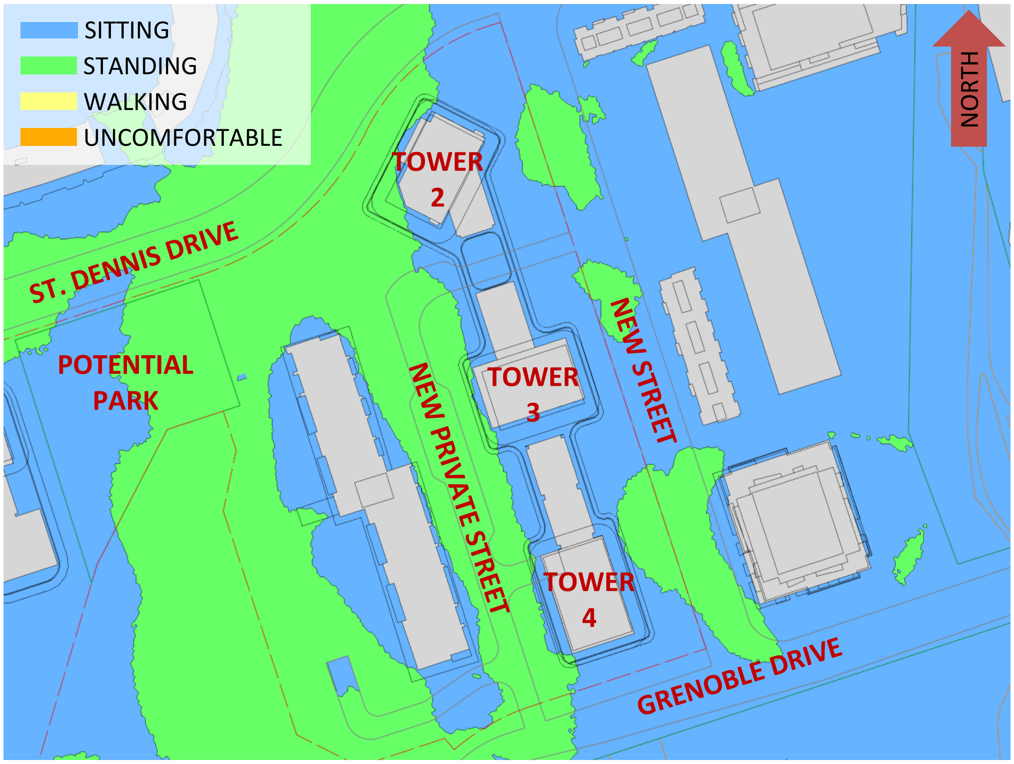


FIGURE 9A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (EAST)

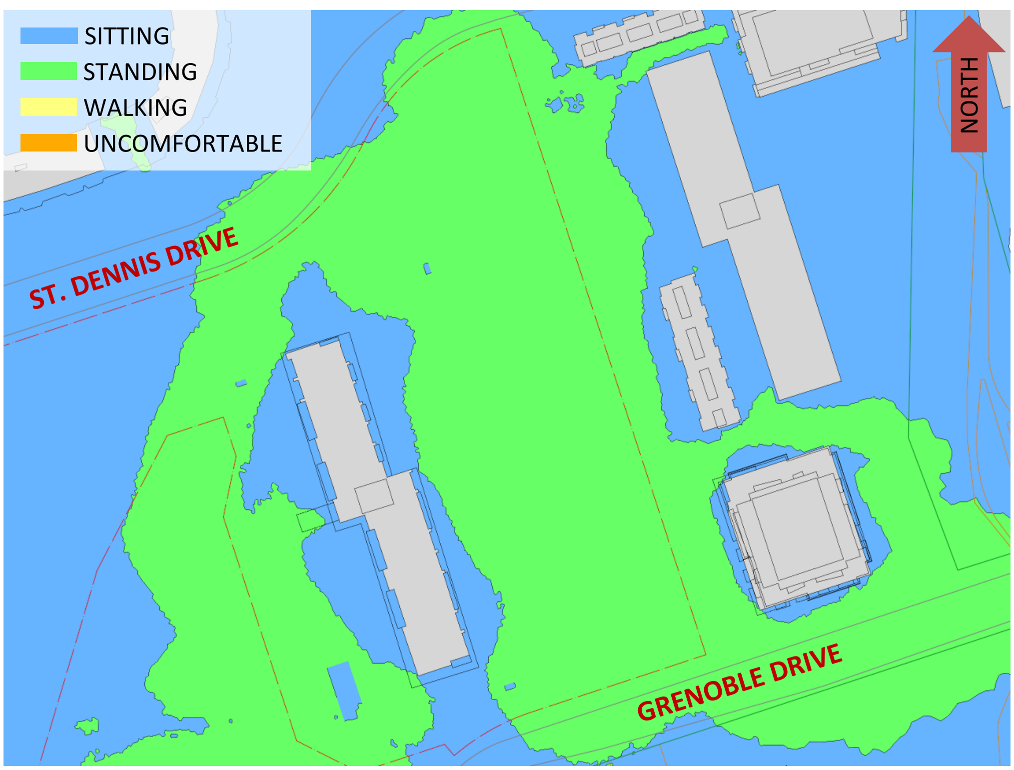


FIGURE 9B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (EAST)

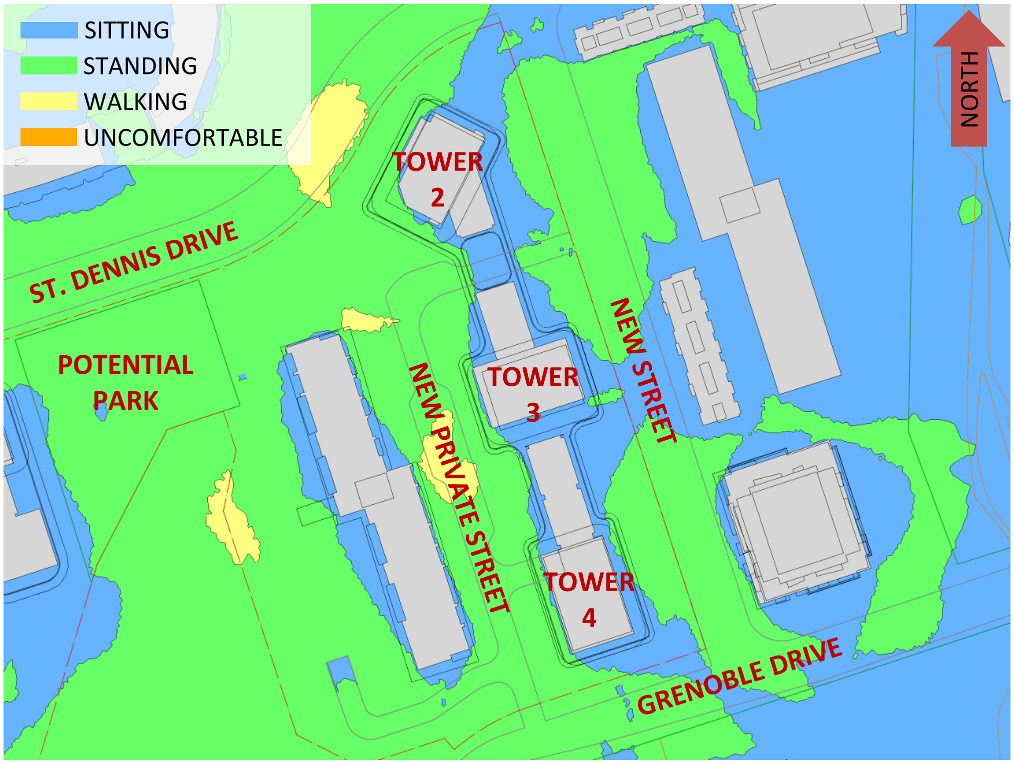


FIGURE 10A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED DEVELOPMENT (EAST)

FIGURE 10B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING (EAST)

FIGURE 11A: SPRING – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWER 1)

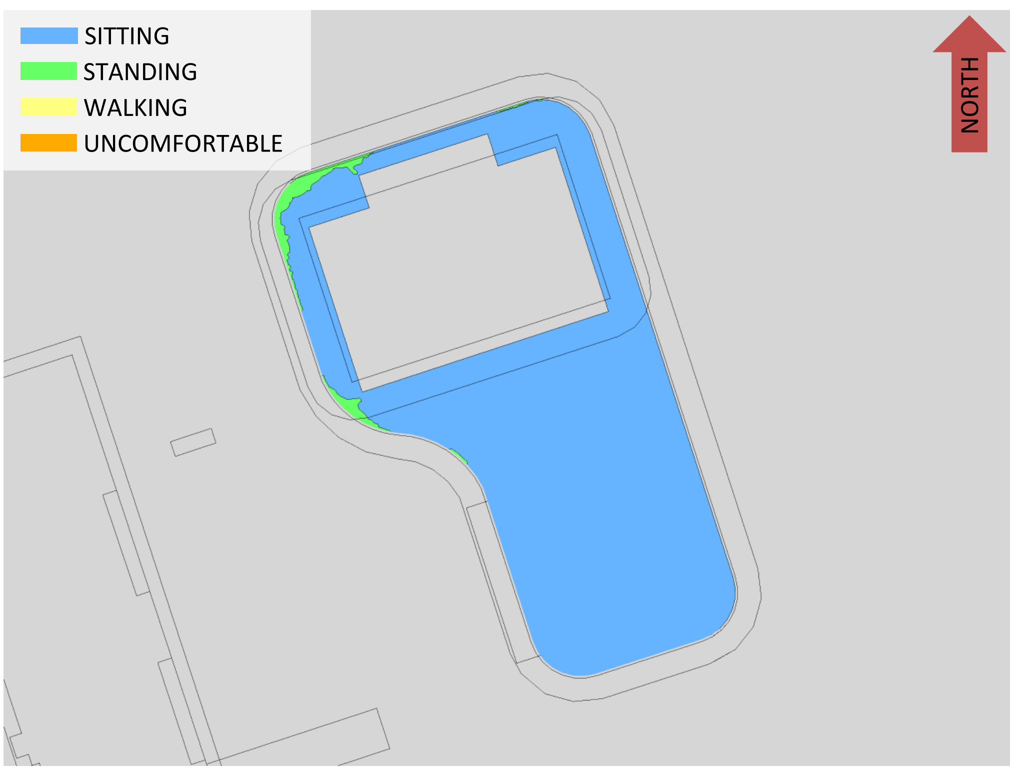


FIGURE 11B: SUMMER – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWER 1)

FIGURE 11C: AUTUMN – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWER 1)

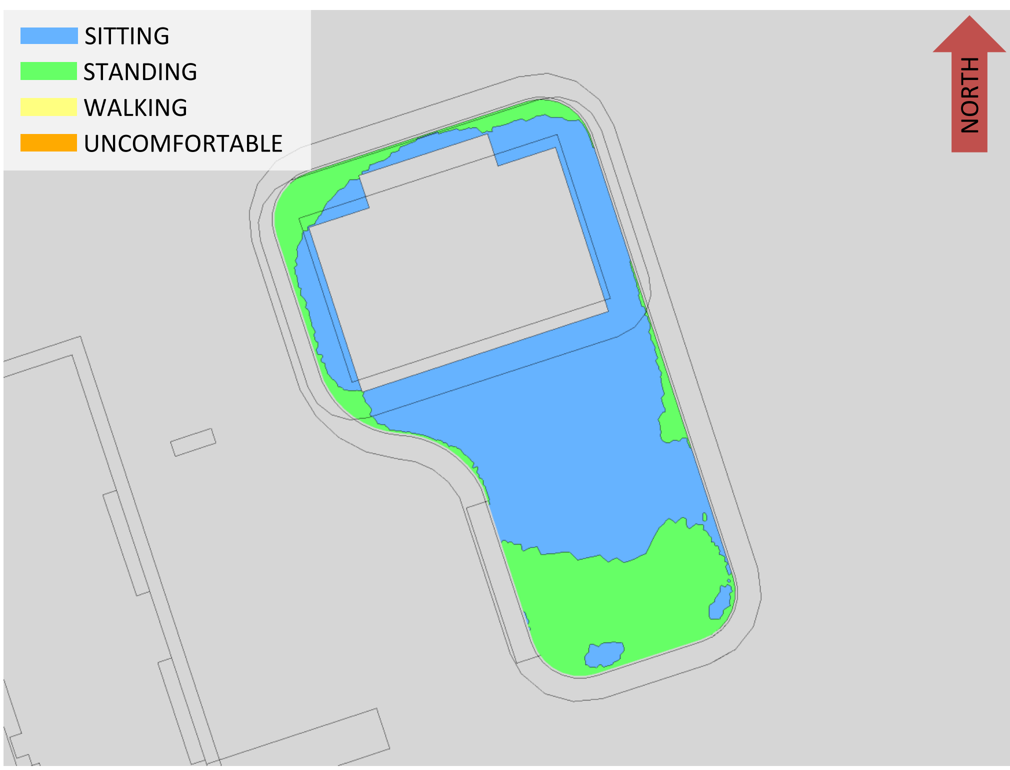


FIGURE 11D: WINTER – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWER 1)

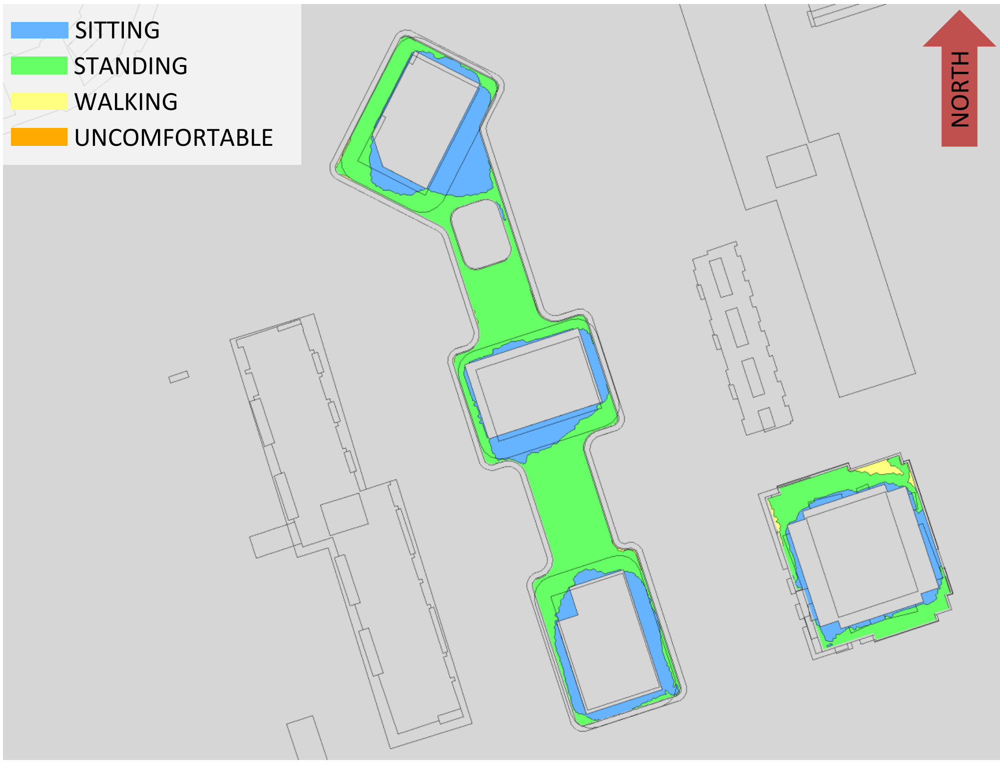


FIGURE 12A: SPRING – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWERS 2-4)

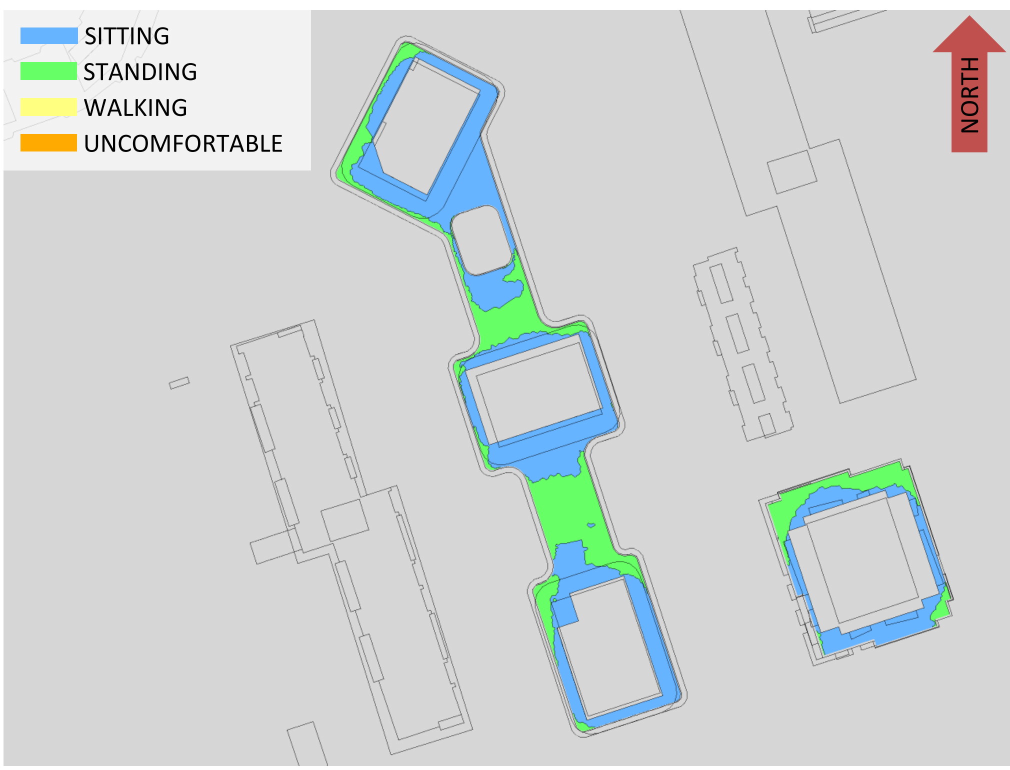


FIGURE 12B: SUMMER – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWERS 2-4)

FIGURE 12C: AUTUMN – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWERS 2-4)

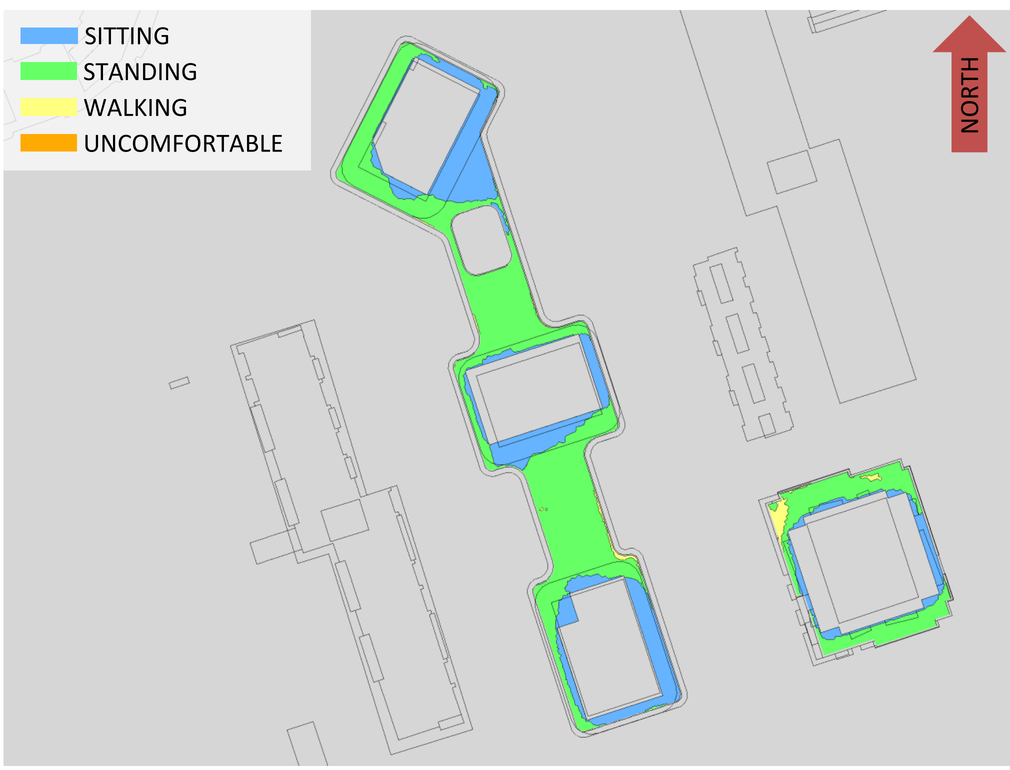


FIGURE 12D: WINTER – WIND COMFORT, LEVEL 2 AMENITY TERRACE (TOWERS 2-4)

FIGURE 13A: TYPICAL USE PERIOD – LEVEL 2 AMENITY TERRACE (TOWER 1)

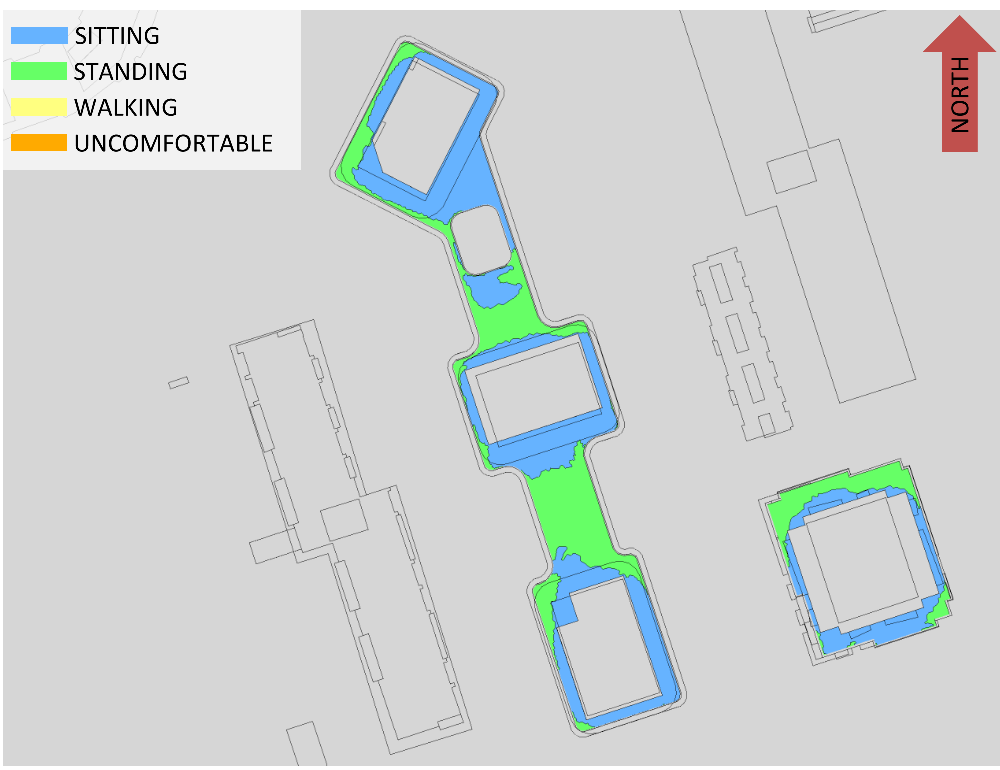


FIGURE 13B: TYPICAL USE PERIOD – LEVEL 2 AMENITY TERRACE (TOWERS 2-4)

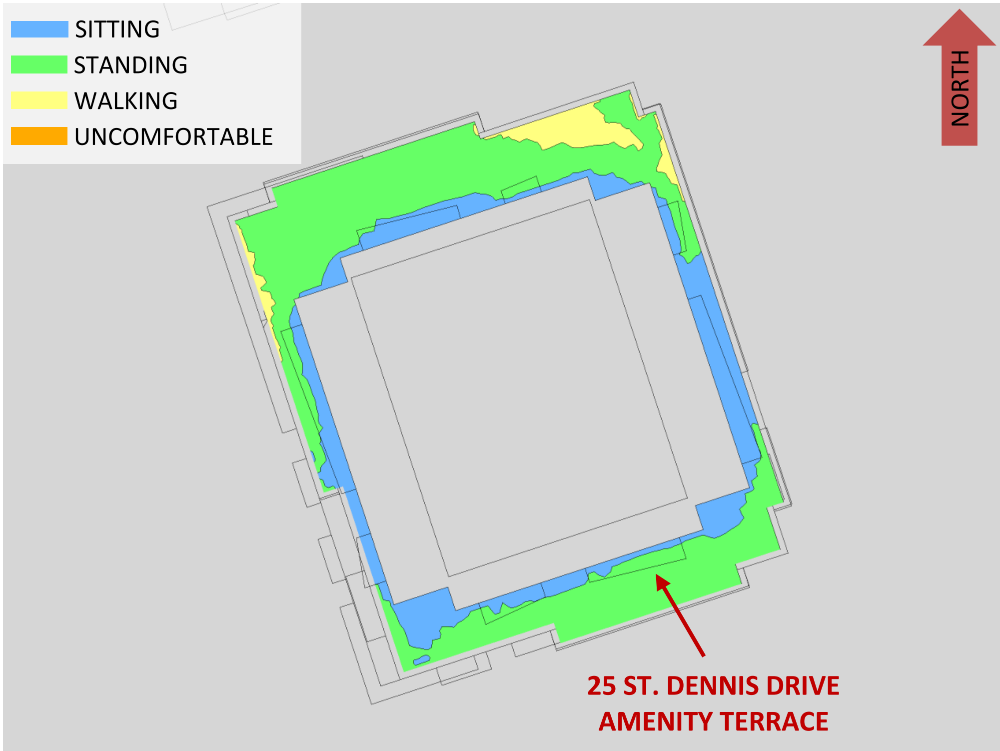


FIGURE 14A: SPRING – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – PROPOSED MASSING

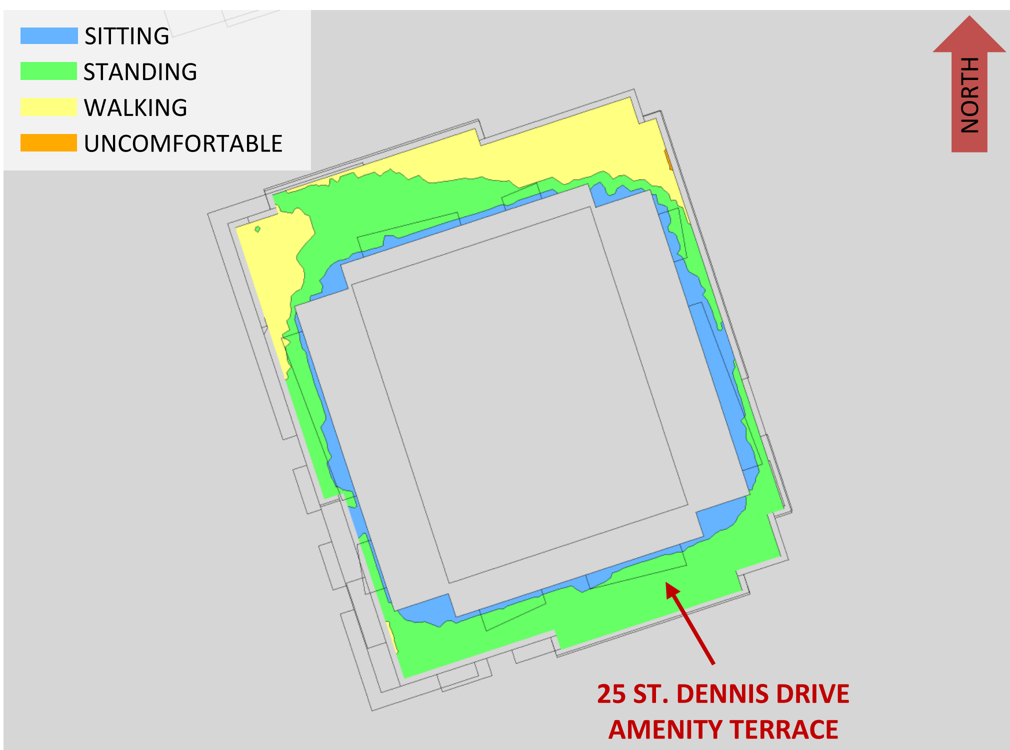


FIGURE 14B: SPRING – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – EXISTING MASSING

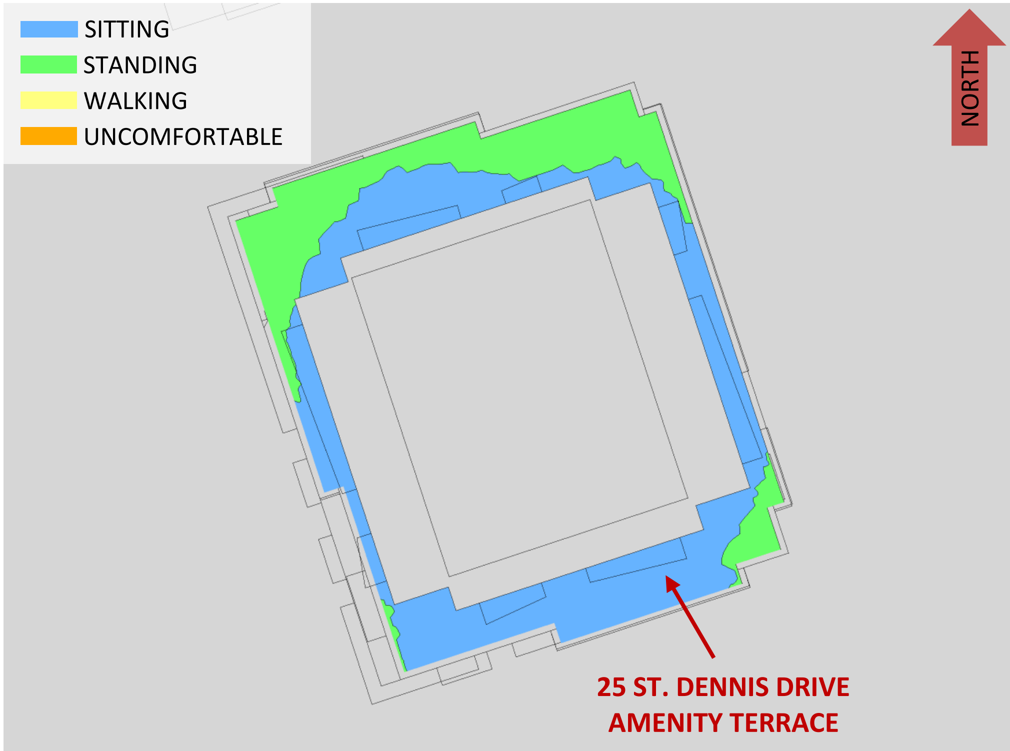


FIGURE 15A: SUMMER – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – PROPOSED MASSING

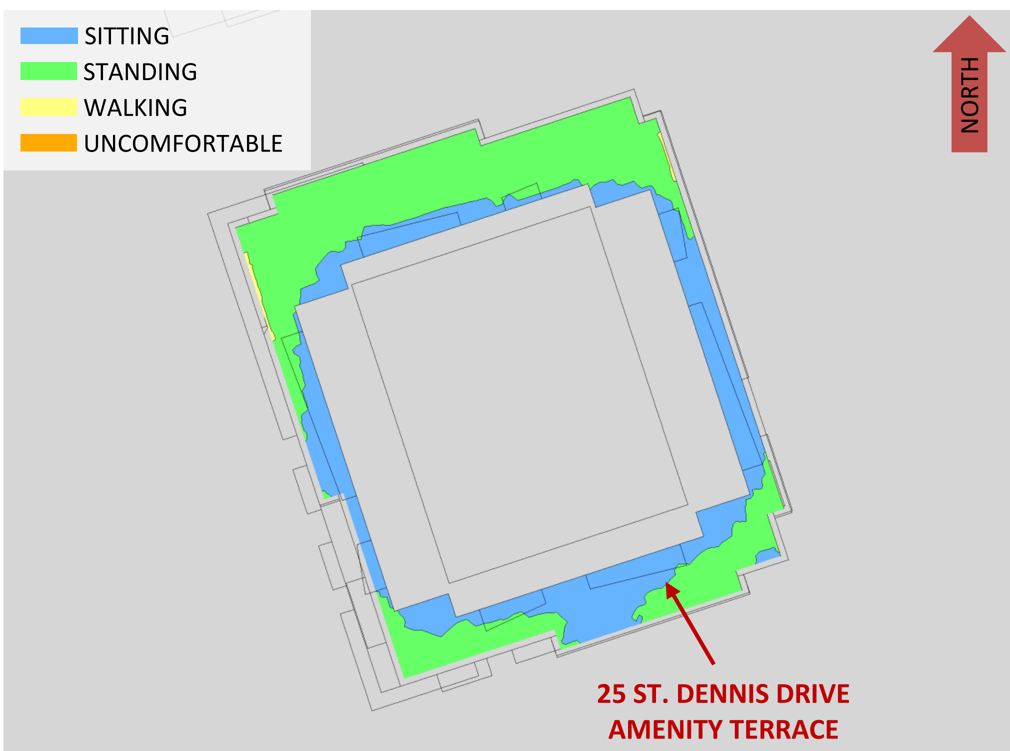


FIGURE 15B: SUMMER – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – EXISTING MASSING

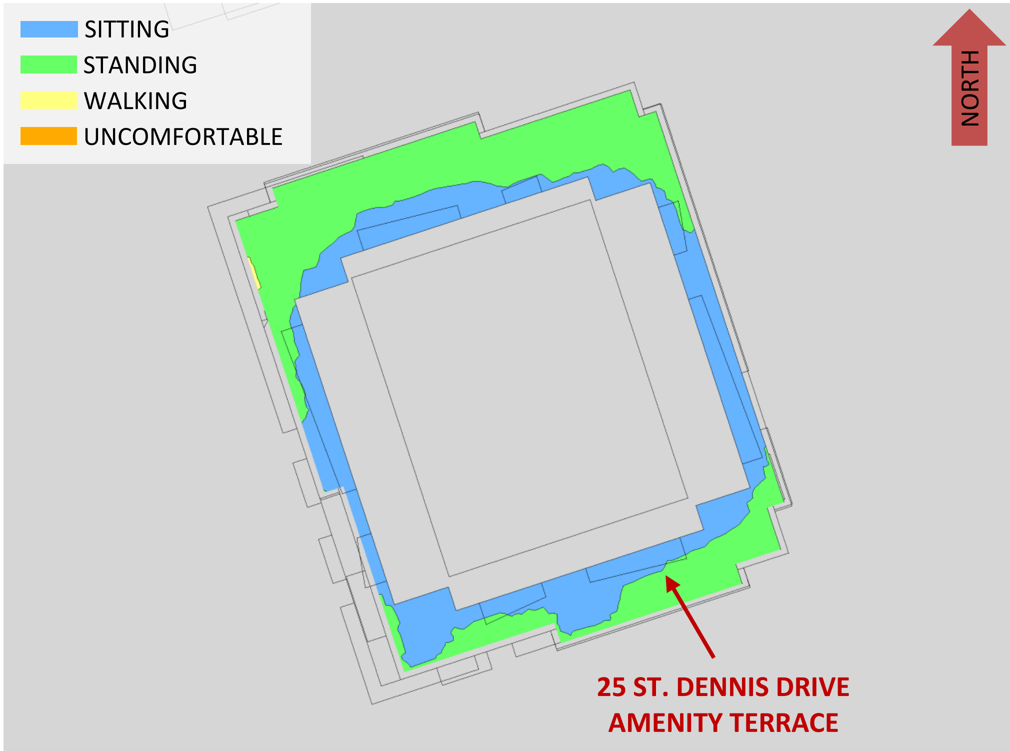


FIGURE 16A: AUTUMN – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – PROPOSED MASSING

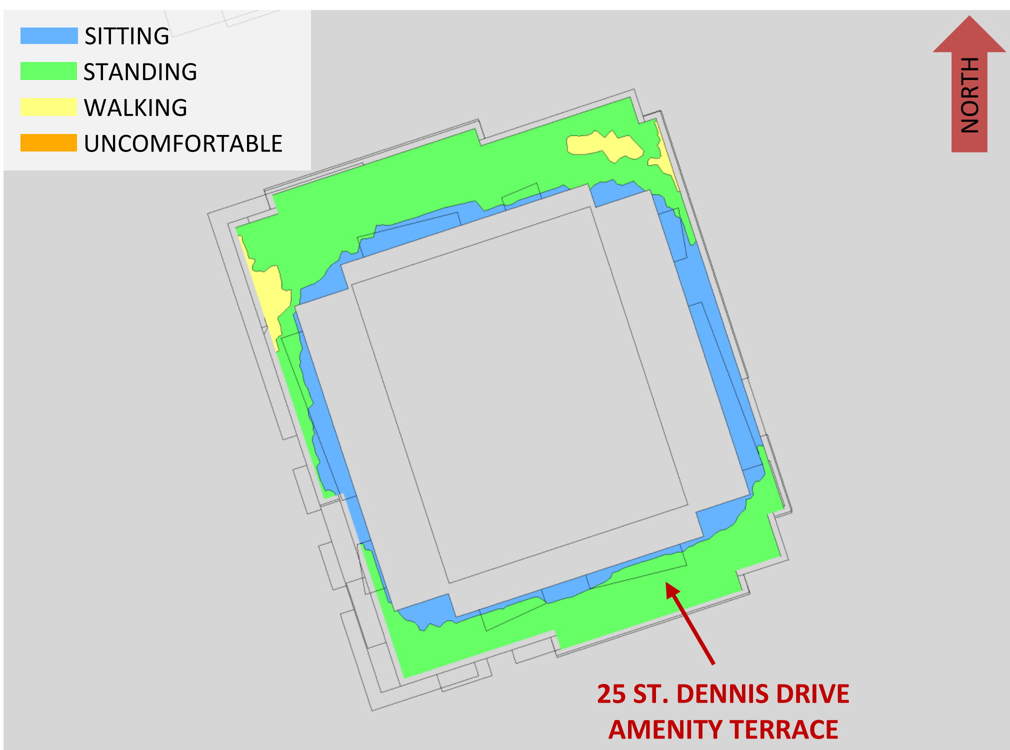


FIGURE 16B: AUTUMN – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – EXISTING MASSING

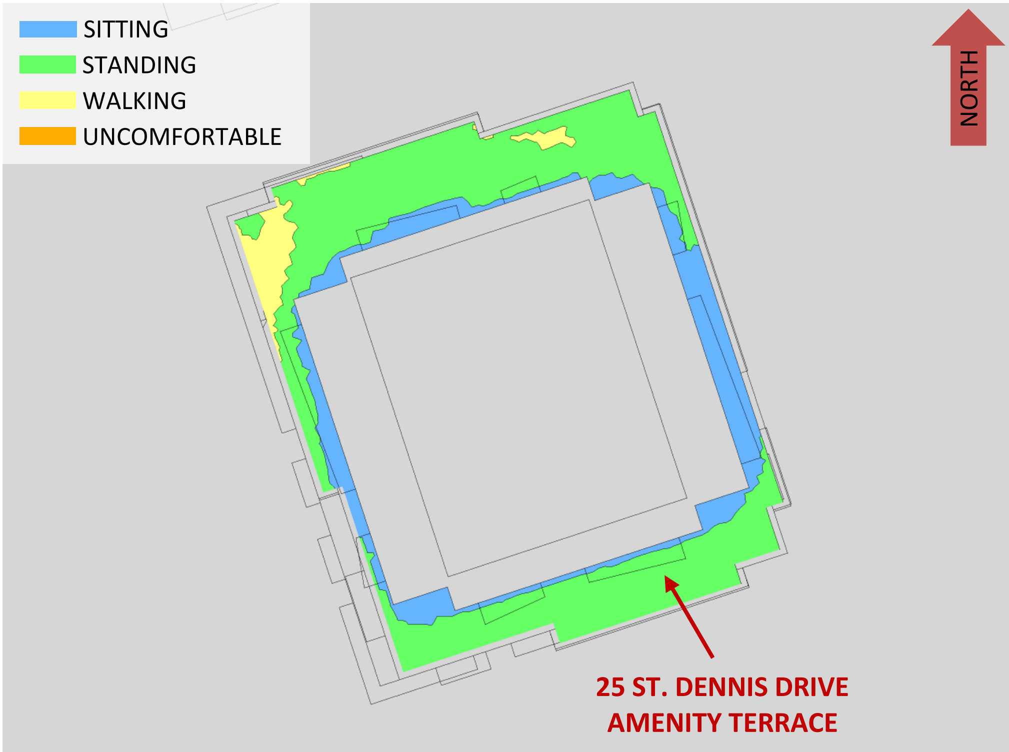


FIGURE 17A: WINTER – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – PROPOSED MASSING

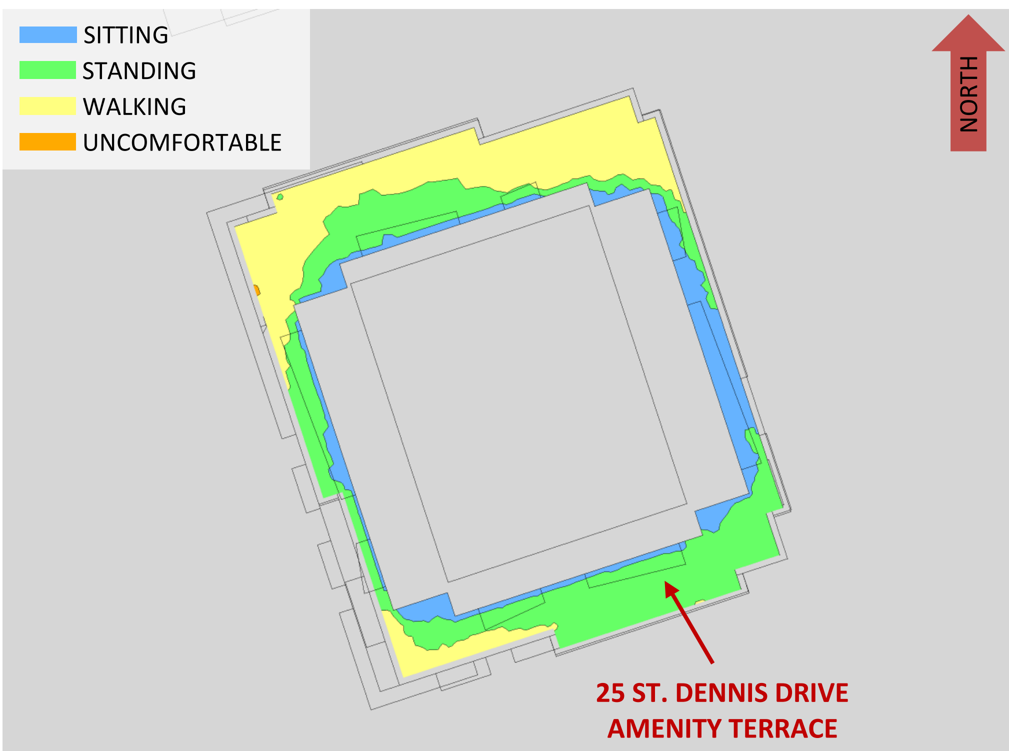


FIGURE 17B: WINTER – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – EXISTING MASSING

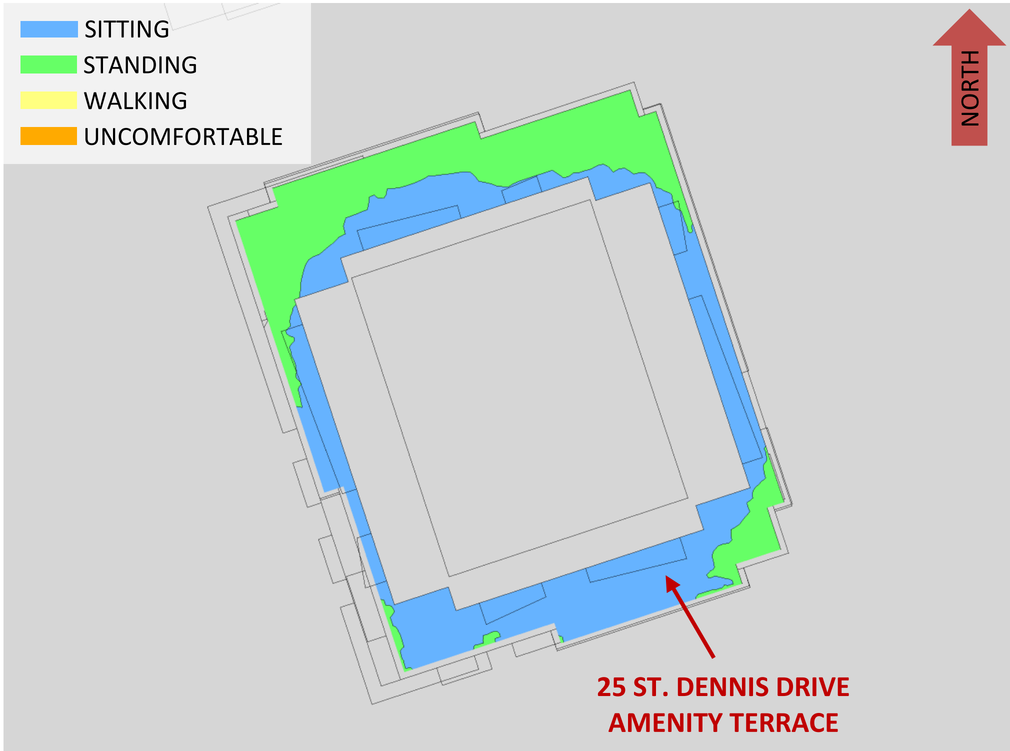


FIGURE 18A: TYPICAL USE PERIOD – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – PROPOSED MASSING

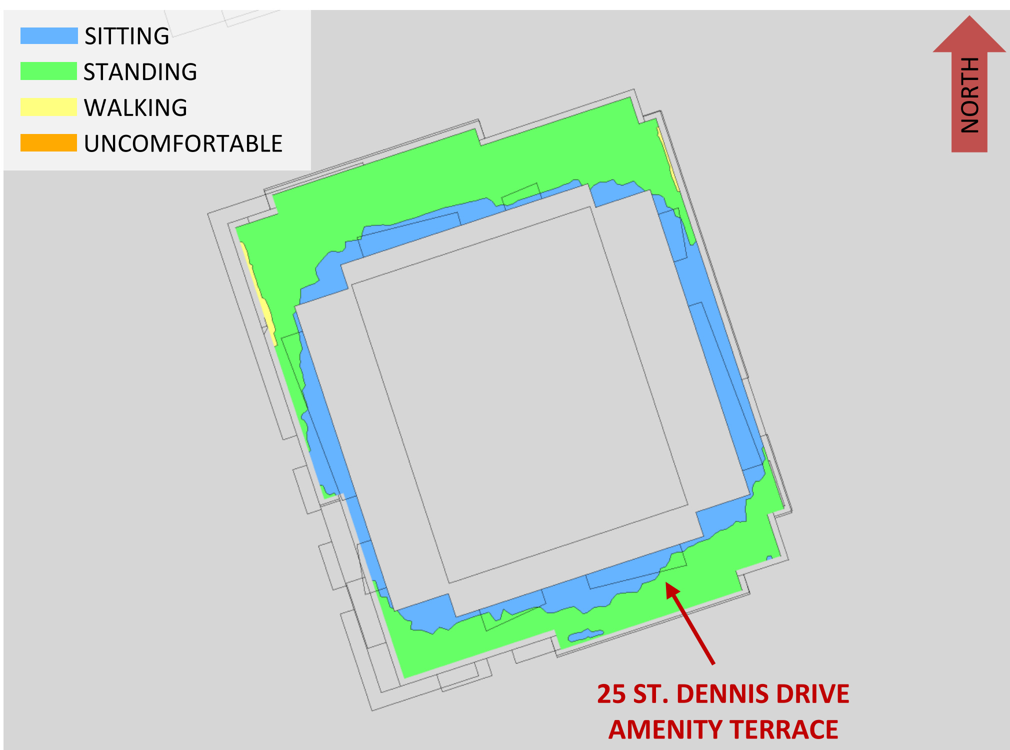
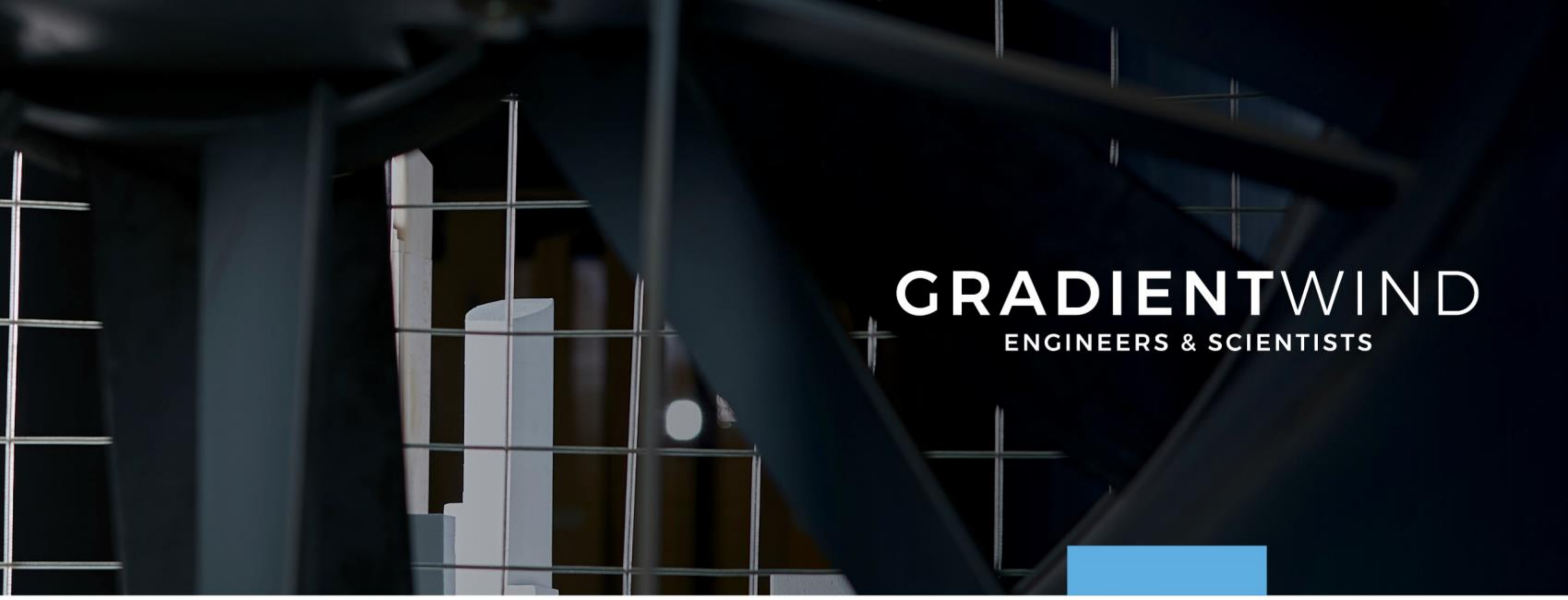
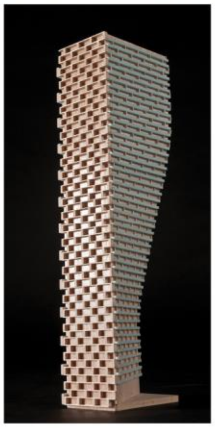
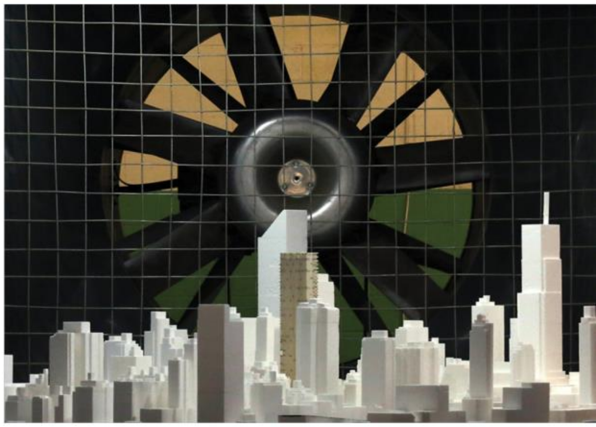


FIGURE 18B: TYPICAL USE PERIOD – WIND COMFORT, 25 ST. DENNIS AMENITY TERRACE – EXISTING MASSING







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, 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	0.23
22.5	0.26
45	0.24
67.5	0.23
90	0.22
112.5	0.22
135	0.23
157.5	0.23
180	0.23
202.5	0.24
225	0.22
247.5	0.23
270	0.22
292.5	0.21
315	0.24
337.5	0.23

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).

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

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

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 Engineering Symposium, IWES 2003*, Taiwan, 2003.