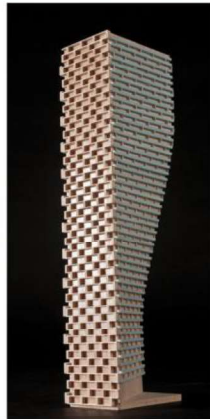


**PEDESTRIAN LEVEL
WIND STUDY**

500 Famille-Côté Avenue
Ottawa, Ontario

Report: 25-152-PLW



February 5, 2026

PREPARED FOR

Batimo développement
6485, rue Doris-Lussier, Bureau 400
Boisbriand, QC J7H 0E8

PREPARED BY

Sunny Kang, B.A.S., Project Coordinator
Justin Denne, M.A.Sc., Junior Wind Scientist
David Huitema, M.Eng., P.Eng., CFD Lead Engineer

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Official Plan Amendment and Zoning By-Law Amendment application submission requirements for the proposed residential development located at 500 Famille-Côté Avenue in Ottawa, Ontario (hereinafter referred to as “subject site” or “proposed development”). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for selected wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site according to City of Ottawa wind comfort and safety criteria. The results and recommendations derived from these considerations are detailed in the main body of the report (Section 5), illustrated in Figures 3A-9, and summarized as follows:

- 1) All 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.
 - a. Conditions over surrounding sidewalks, transit stops, neighbouring surface parking lots, the existing pathway to the south, the proposed drive aisle, surface parking, drop-off area, grade-level terraces, and walkways, and in the vicinity of building access points, are considered acceptable.
- 2) During the typical use period, wind comfort conditions over the common amenity terrace serving the proposed development at Level 5 are predicted to be suitable for a mix of sitting and standing.
 - a. 1.8-m-tall wind screens were included along the perimeter of the terrace, and a 2.5-m-deep canopy extends from the north elevation of the south tower, per the recommendations of the wind consultant.



- b. If required by programming, additional mitigation may comprise inboard mitigation at designated seating areas. The extent of mitigation measures is dependent on the programming of the terrace. Recommendations regarding mitigation are provided in Section 5.2.
- 3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events, (for example, 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.

Addendum: The current study was completed based on architectural drawings prepared by NEUF architect(e)s in September 2025. Updated drawings were distributed to the consultant team in January 2026, which include minor changes to the proposed development. At grade, the central fountain has been replaced with a terrace, and the parking ramp and drive aisle has been relocated from the northwest corner of the South Tower to the southwest corner of the North Tower. Additionally, the wraparound canopy along the west façade of the podium to the north has decreased in depth from 2.5 metres (m) to 2 m. Furthermore, a 2.5-m-deep canopy extending from the south elevation of the North Tower is now located above the common amenity terrace at Level 5, complimenting the canopy along the north elevation of the South Tower. Regardless, the conclusions in the present study remain applicable to the January 2026 massing, with wind conditions at grade predicted to remain suitable for the intended pedestrian uses throughout the year, and targeted mitigation recommended for the Level 5 amenity terrace, as noted in Section 5.2.



TABLE OF CONTENTS

1. INTRODUCTION 1

2. TERMS OF REFERENCE 1

3. OBJECTIVES 2

4. METHODOLOGY 2

4.1 Computer-Based Context Modelling3

4.2 Wind Speed Measurements.....3

4.3 Historical Wind Speed and Direction Data4

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa.....6

5. RESULTS AND DISCUSSION 8

5.1 Wind Comfort Conditions – Grade Level.....9

5.2 Wind Comfort Conditions – Level 5 Common Amenity Terrace11

5.3 Wind Safety11

5.4 Applicability of Results11

6. CONCLUSIONS AND RECOMMENDATIONS 12

FIGURES

APPENDICES

Appendix A – Simulation of the Atmospheric Boundary Layer



1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Batimo développement to undertake a pedestrian level wind (PLW) study to satisfy Official Plan Amendment and Zoning By-Law Amendment application submission requirements for the proposed residential development located at 500 Famille-Côté Avenue in Ottawa, Ontario (hereinafter referred to as “subject site” or “proposed development”). Our mandate within the current study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

Our work is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, City of Ottawa wind comfort and safety criteria, architectural drawings prepared by NEUF architect(e)s in September 2025, surrounding street layouts and existing and approved future building massing information obtained from the City of Ottawa, as well as recent satellite imagery.

2. TERMS OF REFERENCE

The subject site is located at 500 Famille-Côté Avenue in Ottawa, situated on a rectangular parcel of land bounded by Famille-Côté Avenue to the east, an existing pathway to the south, Du Bois Avenue to the southwest, Bilberry Drive to the west, and Jeanne-d’Arc Boulevard to the north. The proposed development comprises a north tower and a south tower, rising to 12 and 14 storeys, respectively, above a common ‘C’-shaped 4-storey podium. Both towers are topped with a mechanical penthouse (MPH). Grade-level terraces are situated at the inner northeast and southeast corners of the ‘C’-shaped planform.

Above the underground parking levels, the ground floor of the proposed development includes a central lobby and common space, with main entrances to the east and west of the lobby, a drop-off area to the east, and residential units throughout the remainder of the level. A 2.5-metre (m) deep wraparound canopy has been included along the west façade of podium to the north, and a 2-m-deep canopy has been added along the east elevation of the podium over the lobby and common space, in coordination with the wind consultant. Surface parking is provided to the west of the subject site, accessible from Bilberry Drive. A drive aisle extending from Bilberry Drive leads to a parking ramp at the northwest corner of the south tower. The podium and tower levels above the ground floor are reserved for residential occupancy. At



Level 5, a central common amenity terrace is located between the two towers and setbacks are located from the east elevation of the podium and from the west elevation of the north tower. In coordination with the wind consultant, the Level 5 terrace includes 1.8-m-tall wind screens along the perimeter of the terrace, as well as a 2.5-m-deep canopy extending from the north elevation of the South Tower to deflect downwashing winds.

The near-field surroundings (defined as an area within 200 m of the subject site) comprise low-rise residential dwellings from the south clockwise to the east, green spaces to the east and south, and a mid-rise long term care building to the southeast. The far-field surroundings (defined as an area beyond the near-field but within a 2-kilometre (km) radius of the subject site) are characterized by a mix of low-rise suburban massing and green spaces in all directions with the Ottawa River flowing from the northwest clockwise to the northeast, approximately 1 km to the north.

Site plans for the proposed and existing massing scenarios are illustrated in Figures 1A and 1B, while Figures 2A-2H illustrate the computational models used to conduct the study. The existing massing scenario includes the existing massing and any developments approved by the City of Ottawa.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind conditions at key areas within and surrounding the development 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 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 Ottawa area wind climate, and synthesis of computational data with City of Ottawa wind comfort and safety criteria¹. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

¹ City of Ottawa Terms of References: Wind Analysis
https://documents.ottawa.ca/sites/documents/files/wind_analysis_tor_en.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 Ottawa Macdonald-Cartier 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 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 480 m. The process was performed for two context massing scenarios, as noted in Section 2.

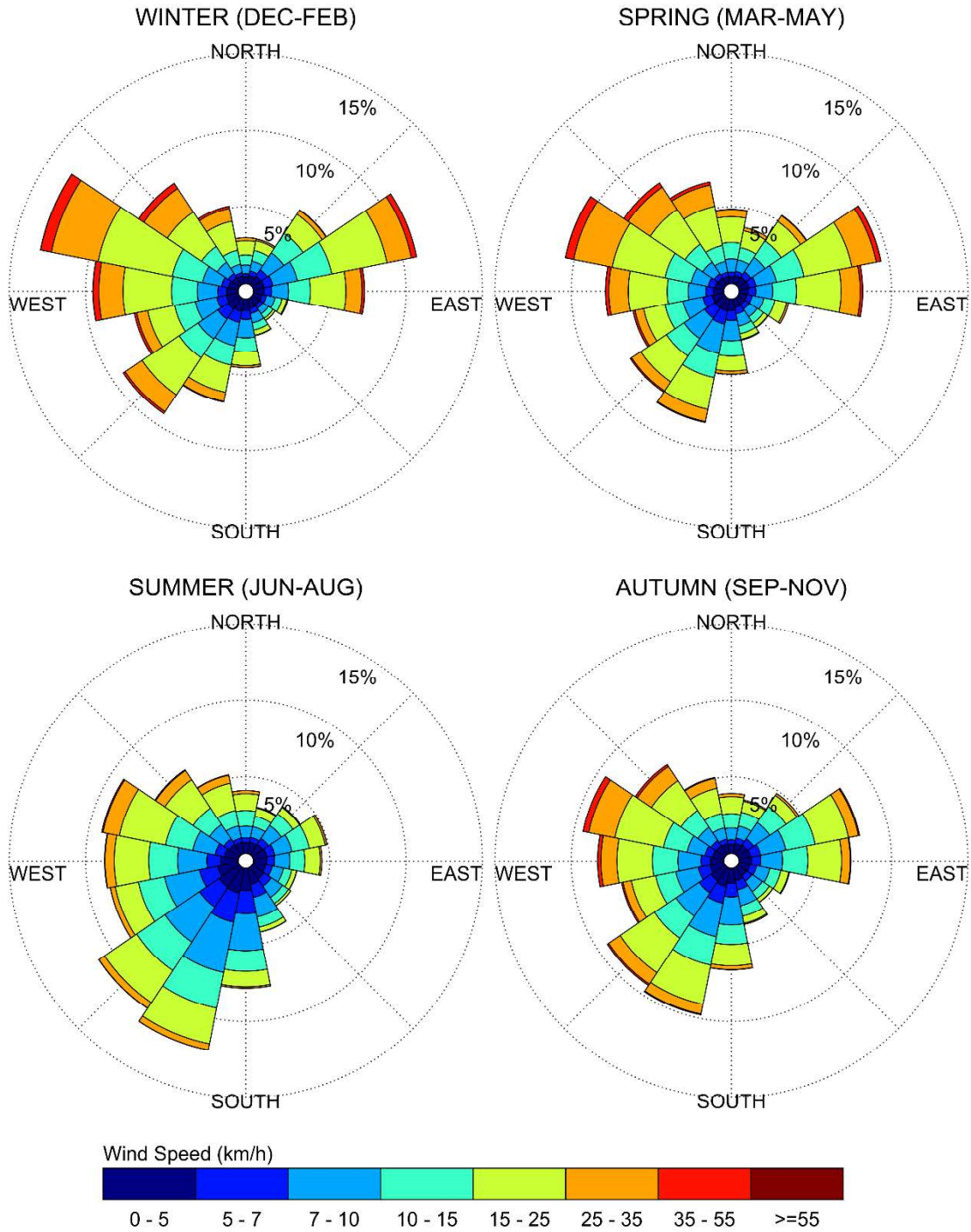
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terrace serving the proposed development at Level 5 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 Ottawa was developed from approximately 40 years of hourly meteorological wind data recorded at Ottawa Macdonald-Cartier International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the 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 Ottawa 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 prominent wind speeds and directions can be identified by the longer length of the bars. For Ottawa, 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 prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



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 Wind Comfort and Safety Criteria – City of Ottawa

Pedestrian wind comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature and relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Five pedestrian comfort classes based on 20% non-exceedance mean wind speed ranges are used to assess pedestrian comfort: (1) Sitting; (2) Standing; (3) Strolling; (4) Walking; and (5) Uncomfortable. The gust speeds, and equivalent mean speeds, are selected based on the Beaufort scale, which describes the effects of forces produced by varying wind speed levels on objects. Wind conditions suitable for sitting are represented by the colour blue, standing by green, strolling by yellow, and walking by orange; uncomfortable conditions are represented by the colour magenta. Specifically, the comfort classes, associated wind speed ranges, and limiting criteria are summarized as follows:

PEDESTRIAN WIND COMFORT CLASS DEFINITIONS

Wind Comfort Class	Mean Speed (km/h)	Description
SITTING	≤ 10	Mean wind speeds no greater than 10 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 16 km/h.
STANDING	≤ 14	Mean wind speeds no greater than 14 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 22 km/h.
STROLLING	≤ 17	Mean wind speeds no greater than 17 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 27 km/h.
WALKING	≤ 20	Mean wind speeds no greater than 20 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 32 km/h.
UNCOMFORTABLE	> 20	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, the pedestrian safety wind speed criterion 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 90 km/h is 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. Notably, 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.

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 a mean wind speed of 10 km/h (equivalent gust wind speed of approximately 16 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 mean wind speed of 20 km/h (equivalent gust wind speed of approximately 32 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 target comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest target comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

TARGET PEDESTRIAN WIND COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Target Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Walking
Public Sidewalk / Bicycle Path	Walking
Outdoor Amenity Space	Sitting / Standing
Café / Patio / Bench / Garden	Sitting / Standing
Transit Stop (Without Shelter)	Standing
Transit Stop (With Shelter)	Walking
Public Park / Plaza	Sitting / Standing
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-6B, which illustrate wind conditions at grade level for the proposed and existing massing scenarios and by Figures 8A-D, which illustrate wind conditions over the common amenity terrace serving the proposed development at Level 5. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4.

Wind comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 7 and 9 illustrate wind comfort conditions at grade level and within the noted amenity terrace serving the proposed development during this period, respectively, consistent with the comfort classes illustrated in Section 4.4.

The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks and Transit Stops along Jeanne-d’Arc Boulevard: Following the introduction of the proposed development, wind comfort conditions over the nearby public sidewalks along Jeanne-d’Arc Boulevard are predicted to be suitable for standing, or better, during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. Conditions in the vicinity of the nearby westbound transit stop to the northwest of the proposed development are predicted to be suitable for sitting throughout the year, while conditions in the vicinity of the remaining nearby transit stops along Jeanne-d’Arc Boulevard are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the autumn, winter, and spring. The noted conditions are considered acceptable.

Conditions along Jeanne-d’Arc Boulevard under the existing massing are predicted to be suitable for standing, or better, throughout the year. While the introduction of the proposed development produces windier conditions over some areas along Jeanne-d’Arc Boulevard, conditions over the nearby westbound transit stop to the northwest are predicted to improve in comparison to existing conditions, and wind comfort conditions with the proposed development are nevertheless considered acceptable.

Sidewalks along Famille-Côté Avenue: Following the introduction of the proposed development, wind comfort conditions over the nearby public sidewalks along Famille-Côté Avenue are predicted to be suitable for standing, or better, throughout the year, with an isolated region suitable for strolling at the intersection of Famille-Côté Avenue and Jeanne-d’Arc Boulevard during the winter and spring. The noted conditions are considered acceptable.

Conditions over the sidewalks along Famille-Côté Avenue under the existing massing are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing throughout the remainder of the year. While the introduction of the proposed development produces modestly windier conditions in comparison to existing conditions, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Sidewalks along Du Bois Avenue and John Holden Way: Prior to and following the introduction of the proposed development, wind conditions over the nearby public sidewalks along Du Bois Avenue and John Holden Way are predicted to be suitable for standing, or better, throughout the year, which is considered acceptable.

Sidewalks and Transit Stops along Bilberry Drive: Prior to and following the introduction of the proposed development, conditions along Bilberry Drive are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the remaining seasons. The noted conditions are considered acceptable.

Existing Pathway South of Subject Site: Following the introduction of the proposed development, wind conditions over the existing pathway to the south of the subject site are predicted to be suitable for mostly sitting during the summer, becoming suitable for mostly standing throughout the remainder of the year. The noted conditions are considered acceptable.

Conditions over the noted pathway under the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remaining months. While the introduction of the proposed development produces slightly windier conditions over the pathway in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable.

Neighbouring Surface Parking Lots: Prior to and following the introduction of the proposed development, conditions over the neighbouring existing surface parking lots to the west and southeast of the subject site are predicted to be suitable for standing, or better, throughout the year. The noted conditions are considered acceptable.

Proposed Grade-Level Terraces: During the typical use period, wind conditions over the terraces at the inner northeast and southeast corners of the proposed development are predicted to be suitable for mostly sitting and are considered acceptable.

Proposed Drive Aisle, Surface Parking, Drop-Off Area, and Walkways: Wind conditions over the proposed drive aisle near the southwest corner of the subject site and the surface parking at grade within the subject site are predicted to be suitable for mostly sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year, while conditions over the drop-off area to the east are predicted to be suitable for sitting throughout the year. Conditions over the walkways within the subject site are predicted to be suitable for a mix of sitting and standing during the summer and autumn, becoming suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable.



Building Access Points: Conditions in the vicinity of the building access points serving the proposed development are predicted to be sitting during the summer and autumn, becoming suitable for standing, or better, during the winter and spring, which is considered acceptable.

5.2 Wind Comfort Conditions – Level 5 Common Amenity Terrace

Wind comfort conditions within the Level 5 terrace are predicted to be suitable for sitting over a majority of the terrace during the typical use period, with a region of conditions suitable for standing. Where conditions are predicted to be suitable for standing, they are also predicted to be suitable for sitting at least 71% of the time during the same period, where the target is 80% to achieve the sitting comfort criterion.

As required by programming, inboard mitigation at designated seating areas within the isolated windier area could take the form of a combination of wind screens, raised plantings, and other common landscape elements such as an overhead canopy with a louvered screen, with the extent of mitigation measures dependent on the programming of the terrace. If required by programming, an appropriate mitigation strategy may be developed in collaboration with the building and landscape architects as the design of the proposed development progresses and the programming of the terrace is defined at the future Site Plan Control application stage.

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 (that is, 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.



6. CONCLUSIONS AND RECOMMENDATIONS

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

- 1) All 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.
 - a. Conditions over surrounding sidewalks, transit stops, neighbouring surface parking lots, the existing pathway to the south, the proposed drive aisle, surface parking, drop-off area, grade-level terraces, and walkways, and in the vicinity of building access points, are considered acceptable.
- 2) During the typical use period, wind comfort conditions over the common amenity terrace serving the proposed development at Level 5 are predicted to be suitable for a mix of sitting and standing.
 - a. 1.8-m-tall wind screens were included along the perimeter of the terrace, and a 2.5-m-deep canopy extends from the north elevation of the south tower, per the recommendations of the wind consultant.
 - b. If required by programming, additional mitigation may comprise inboard mitigation at designated seating areas. The extent of mitigation measures is dependent on the programming of the terrace. Recommendations regarding mitigation are provided in Section 5.2.

- 3) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events, (for example, 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.



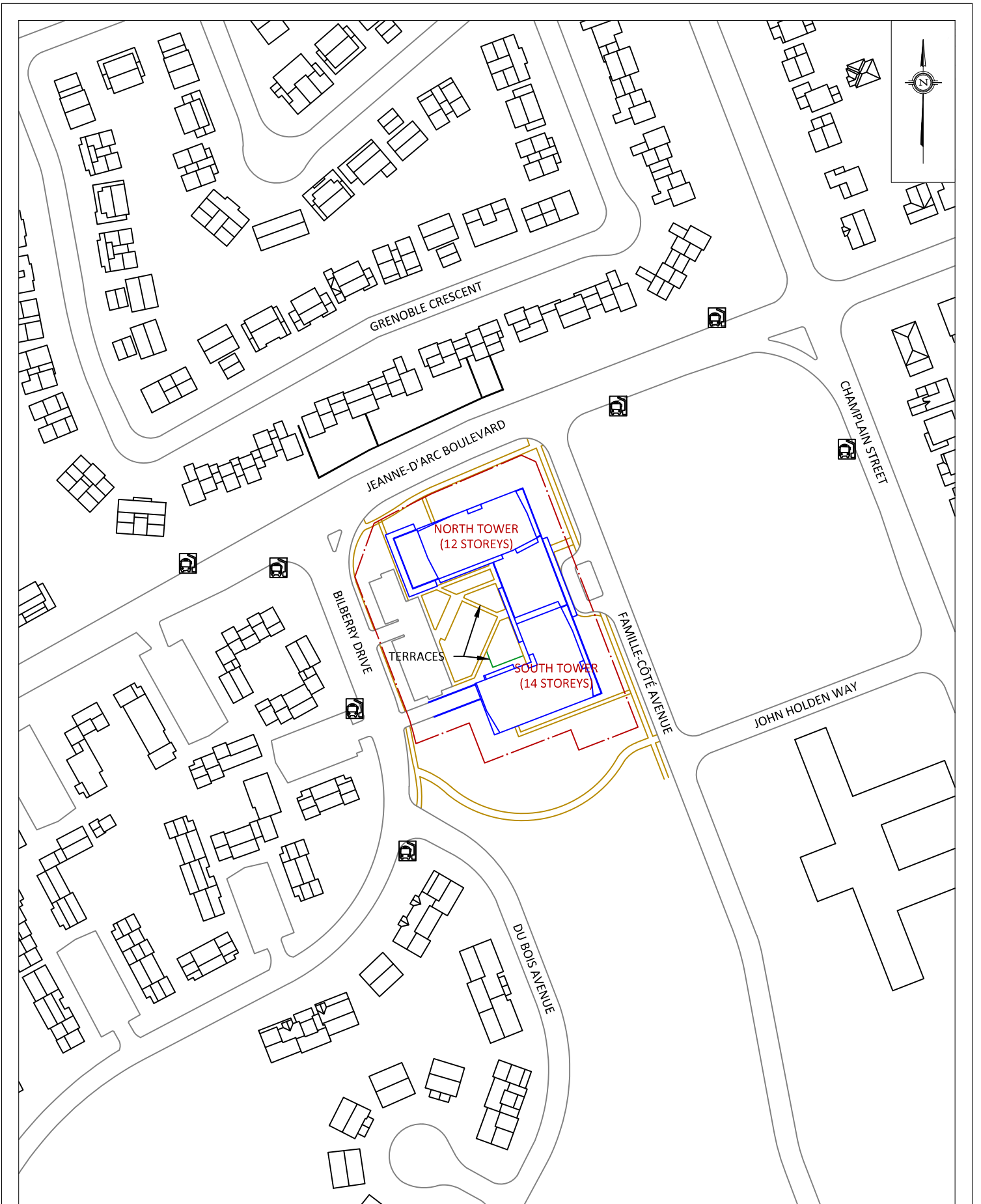
Justin Denne, M.A.Sc.
Junior Wind Scientist



Sunny Kang, B.A.S.
Project Coordinator

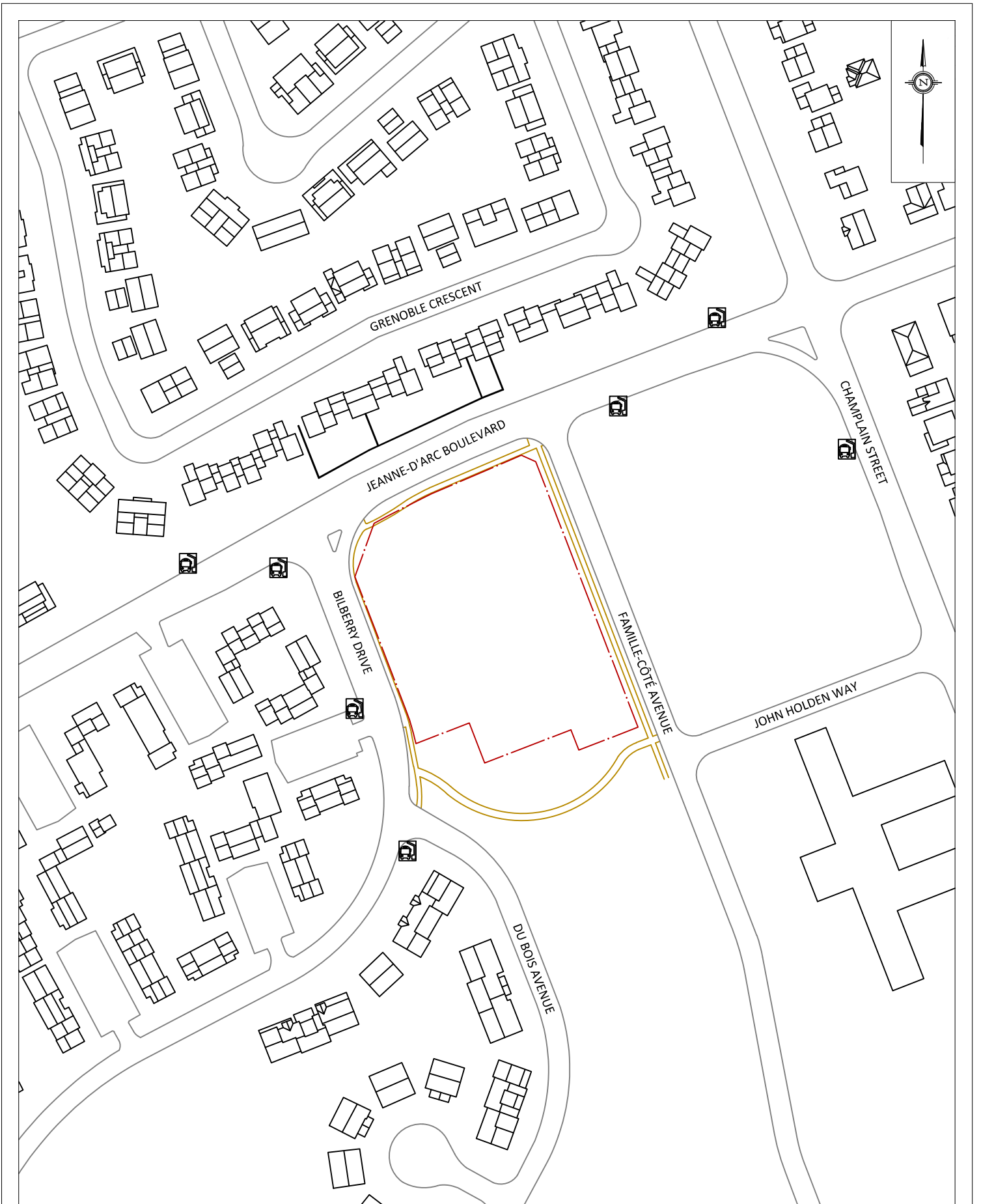


David Huitema, M.Eng., P.Eng.
CFD Lead Engineer



PROJECT	500 FAMILLE-CÔTÉ AVENUE, OTTAWA PEDESTRIAN LEVEL WIND STUDY	
SCALE	1:2000	DRAWING NO. 25-152-PLW-1A
DATE	SEPTEMBER 11, 2025	DRAWN BY S.K.

DESCRIPTION	FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
-------------	--



PROJECT	500 FAMILLE-CÔTÉ AVENUE, OTTAWA PEDESTRIAN LEVEL WIND STUDY	
SCALE	1:2000	DRAWING NO. 25-152-PLW-1B
DATE	SEPTEMBER 11, 2025	DRAWN BY S.K.

DESCRIPTION	FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
-------------	--

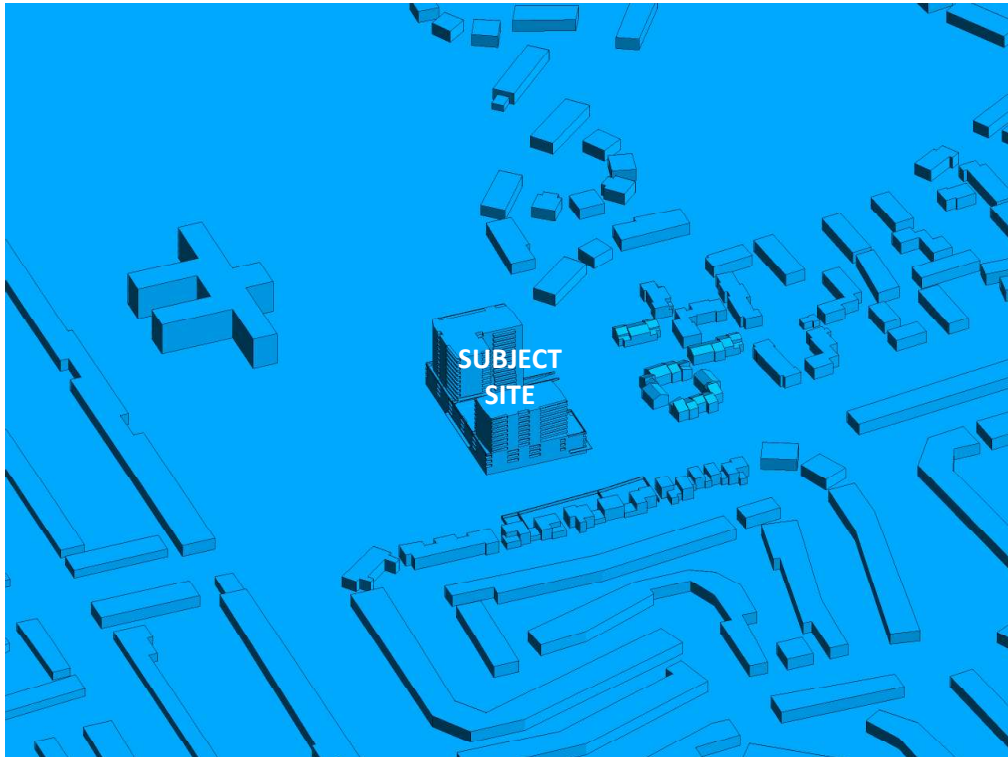


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

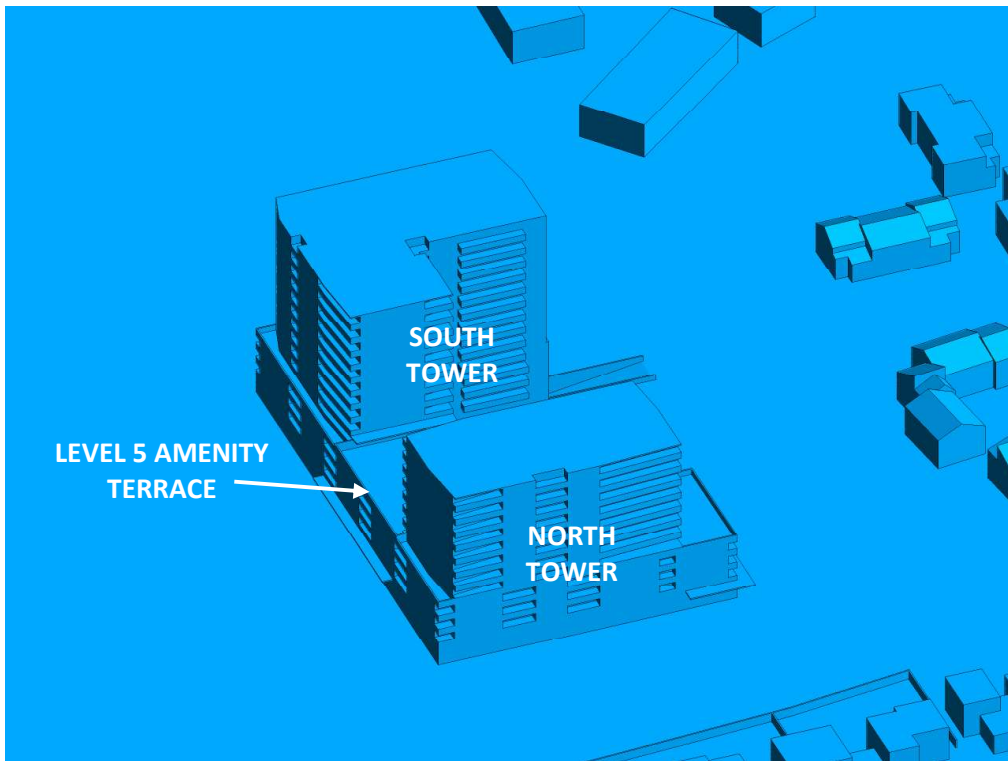


FIGURE 2B: CLOSE UP OF FIGURE 2A



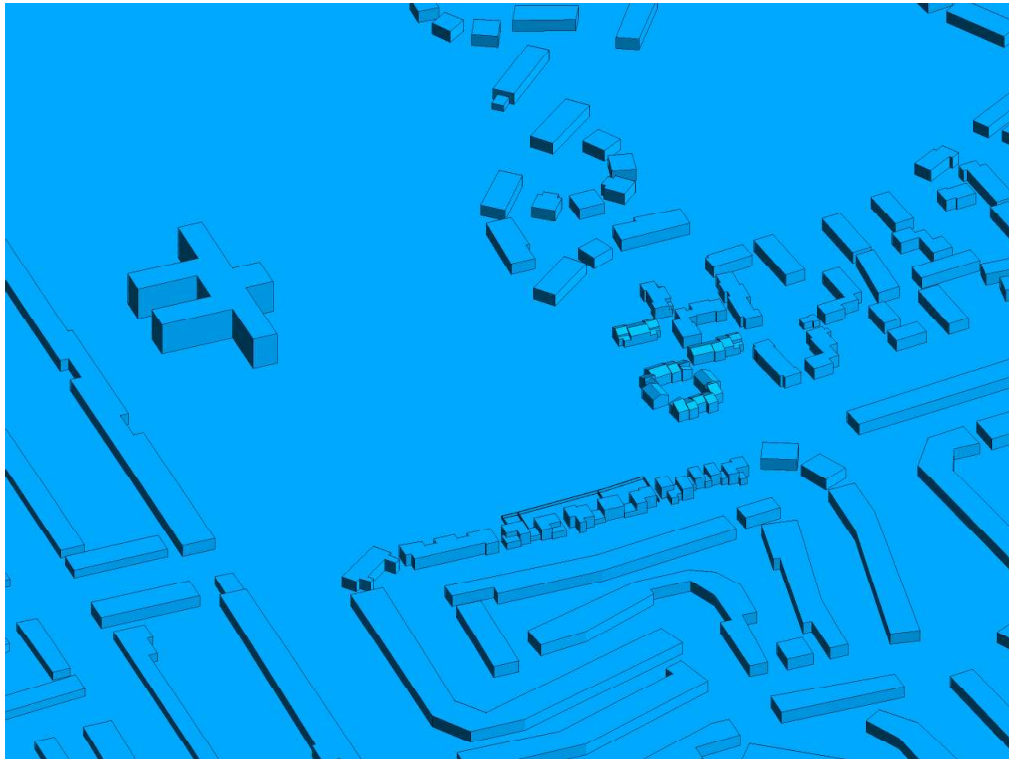


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

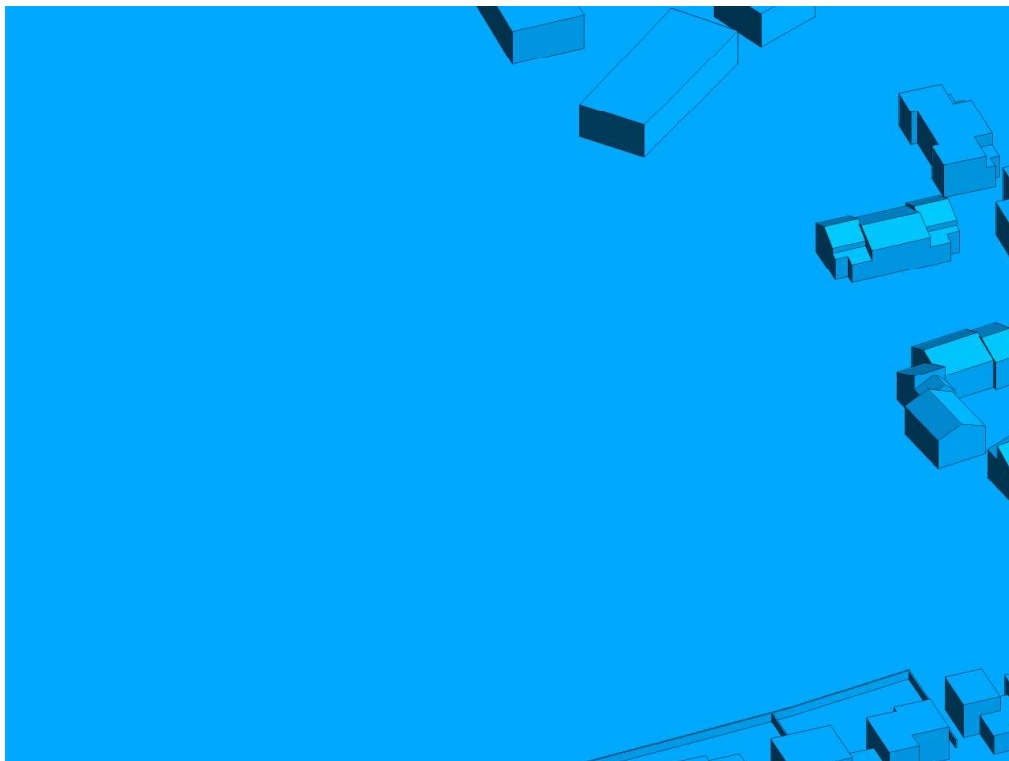


FIGURE 2D: CLOSE UP OF FIGURE 2C



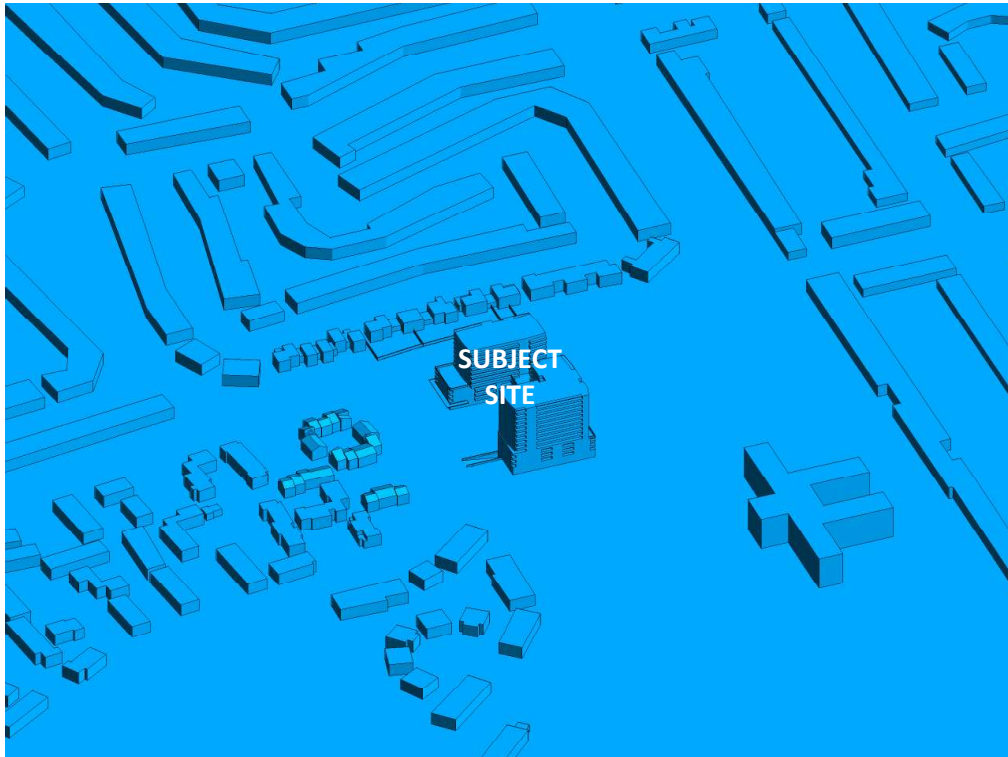


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

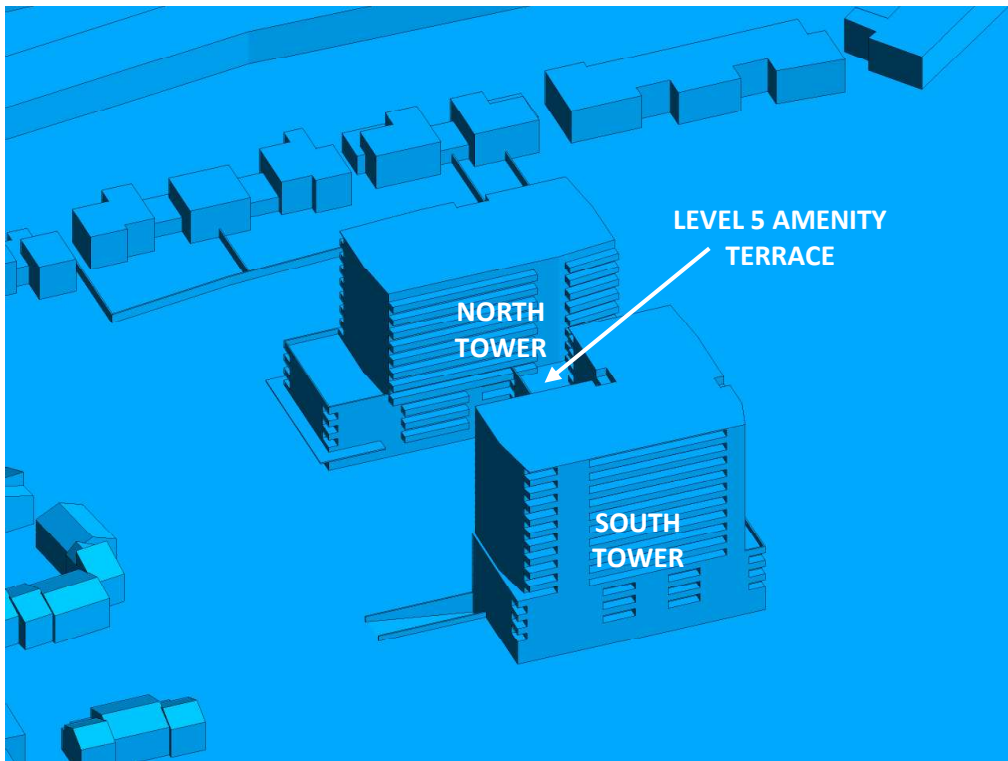


FIGURE 2F: CLOSE UP OF FIGURE 2E



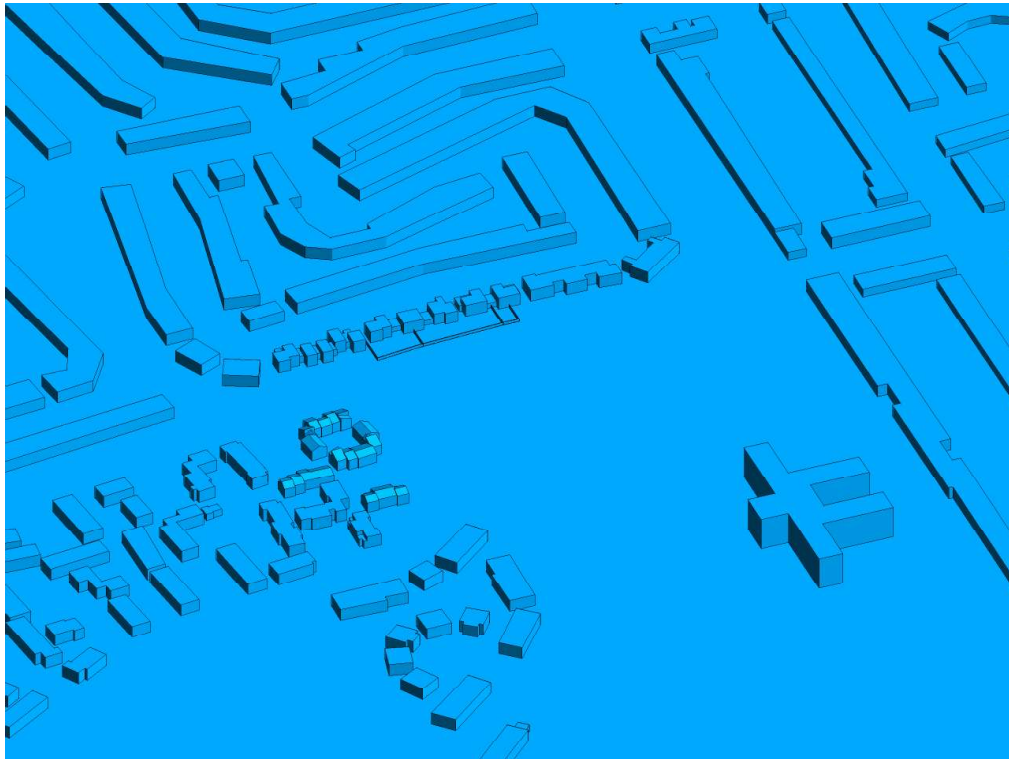


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

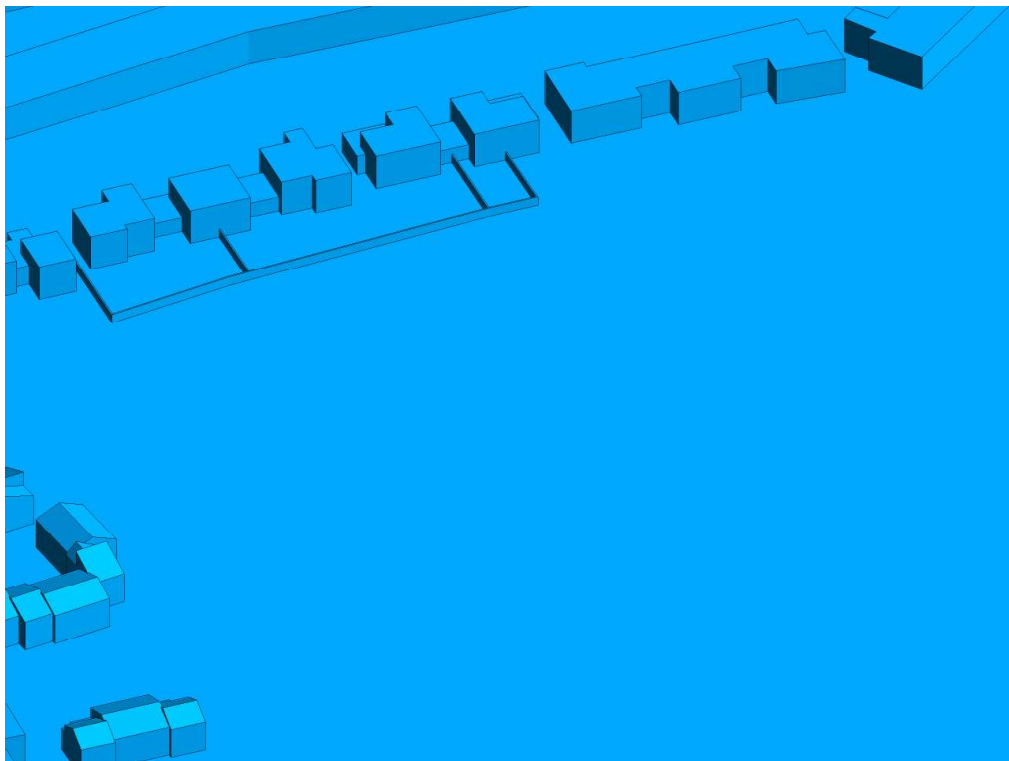


FIGURE 2H: CLOSE UP OF FIGURE 2G



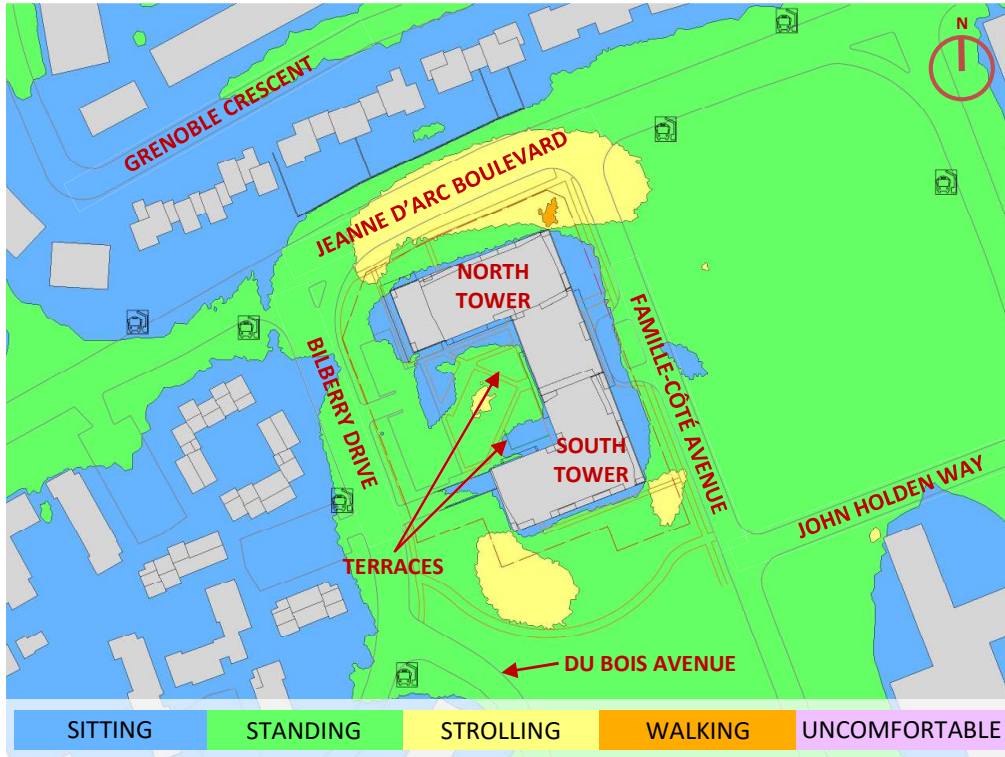


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

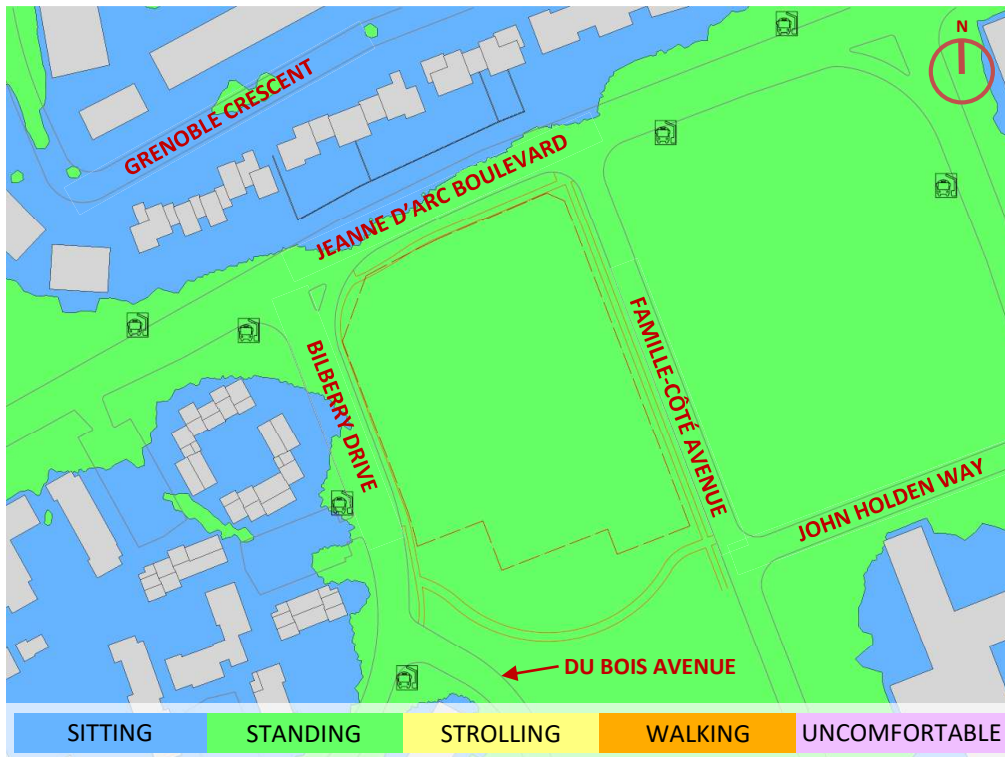


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL– EXISTING MASSING



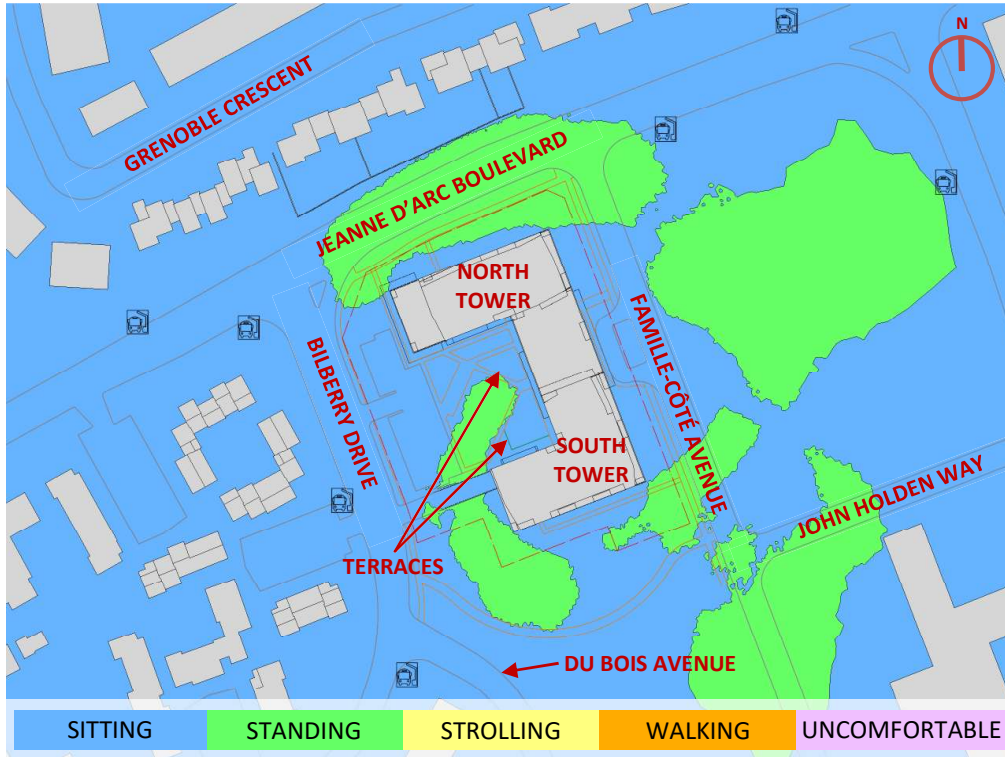


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

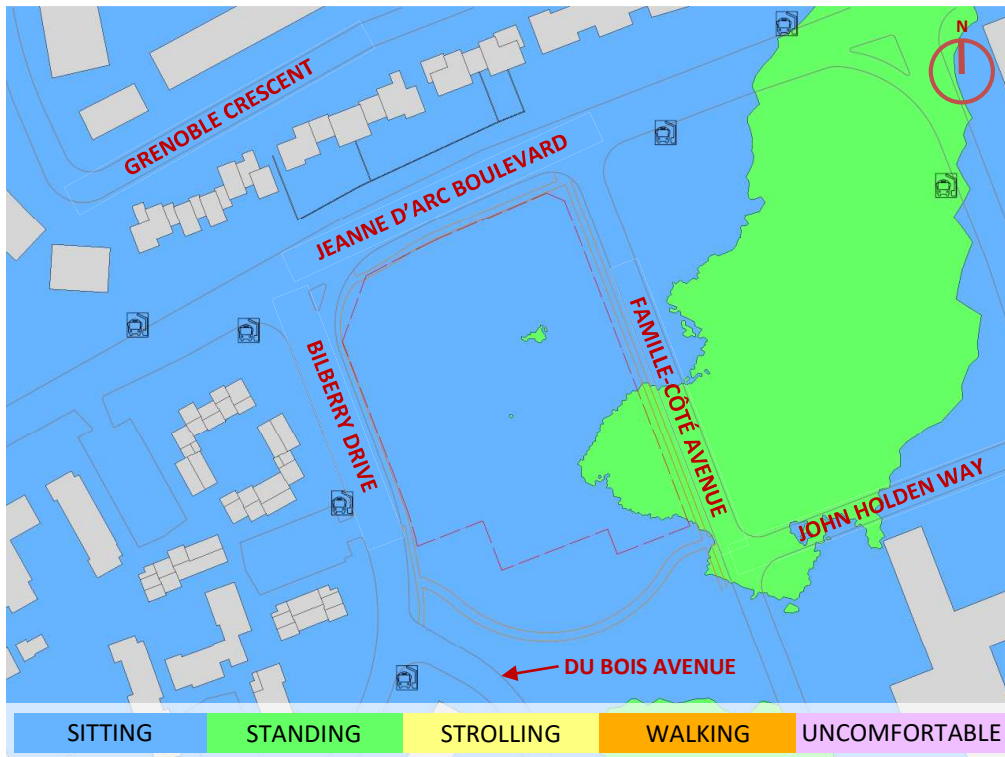


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING



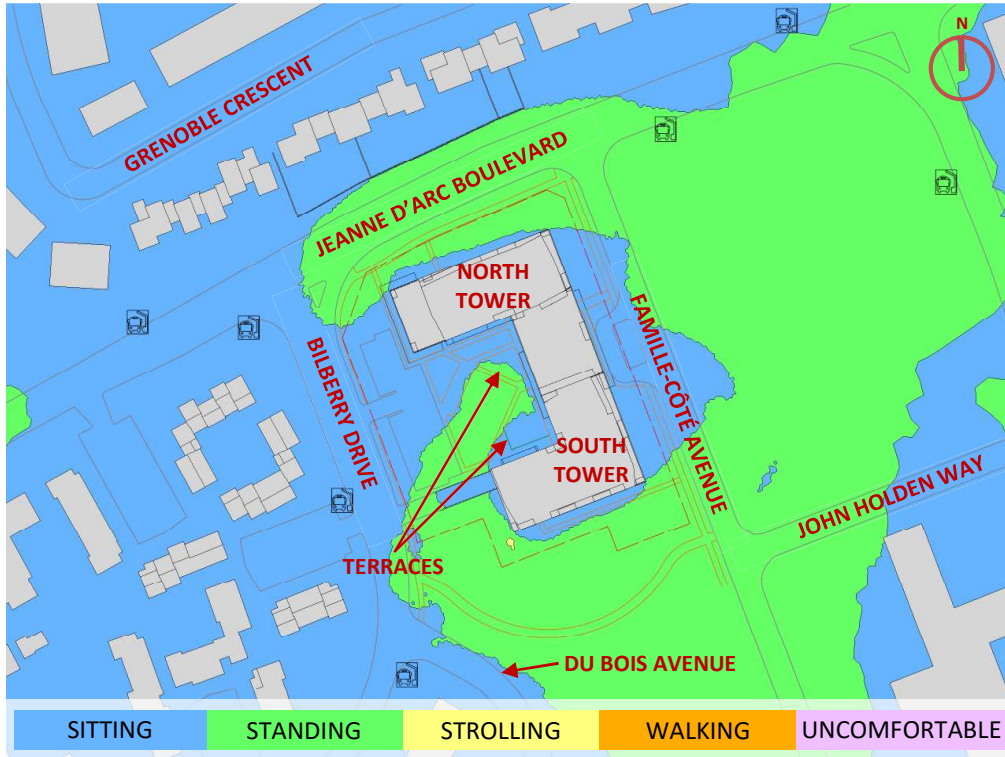


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

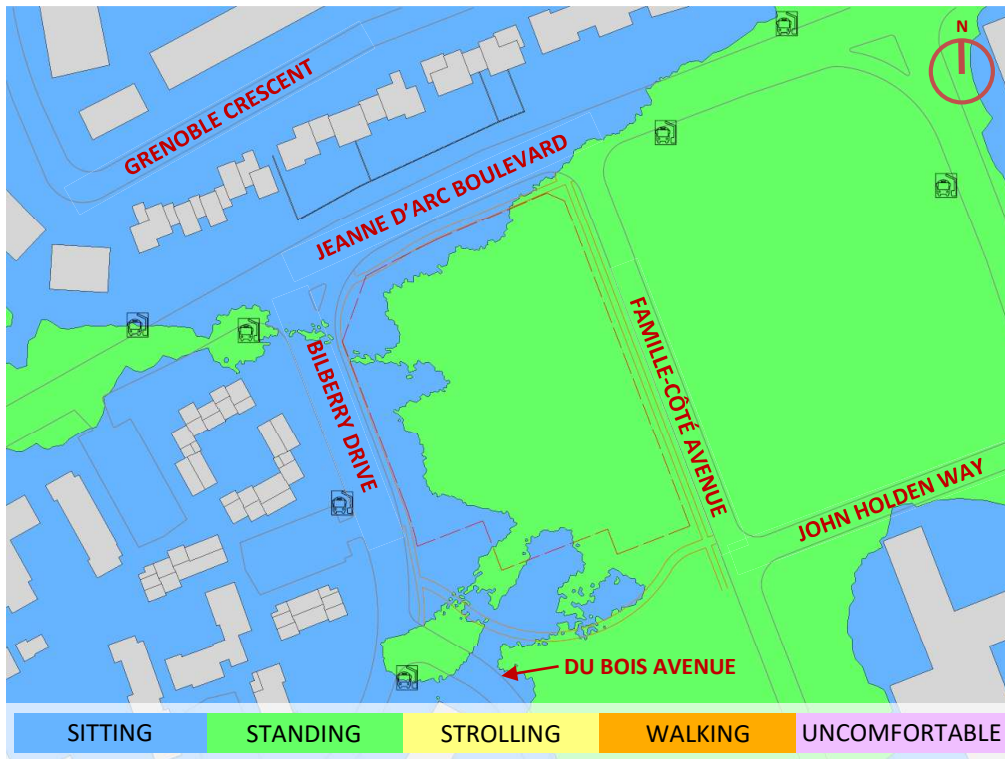


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL– EXISTING MASSING



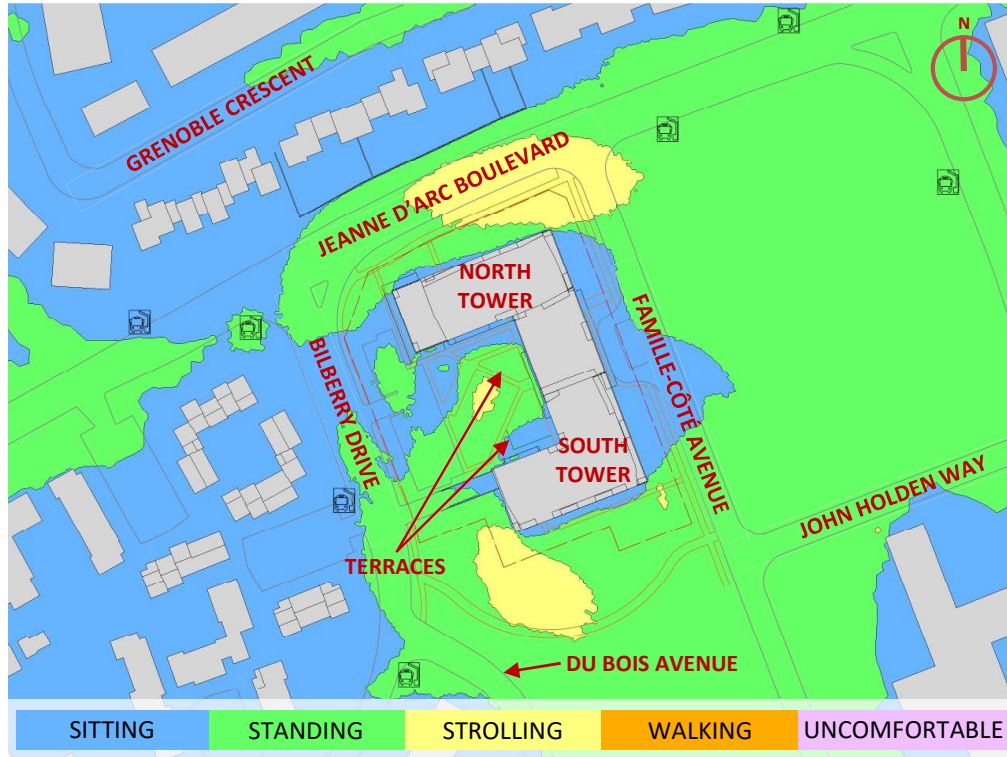


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

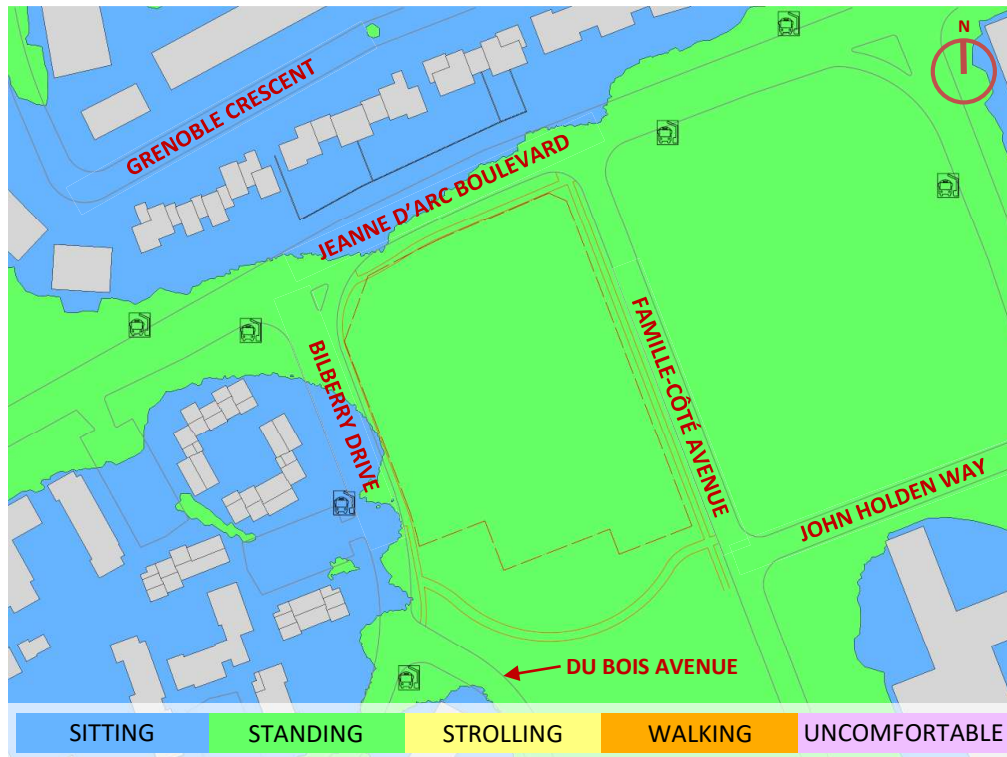


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL– EXISTING MASSING



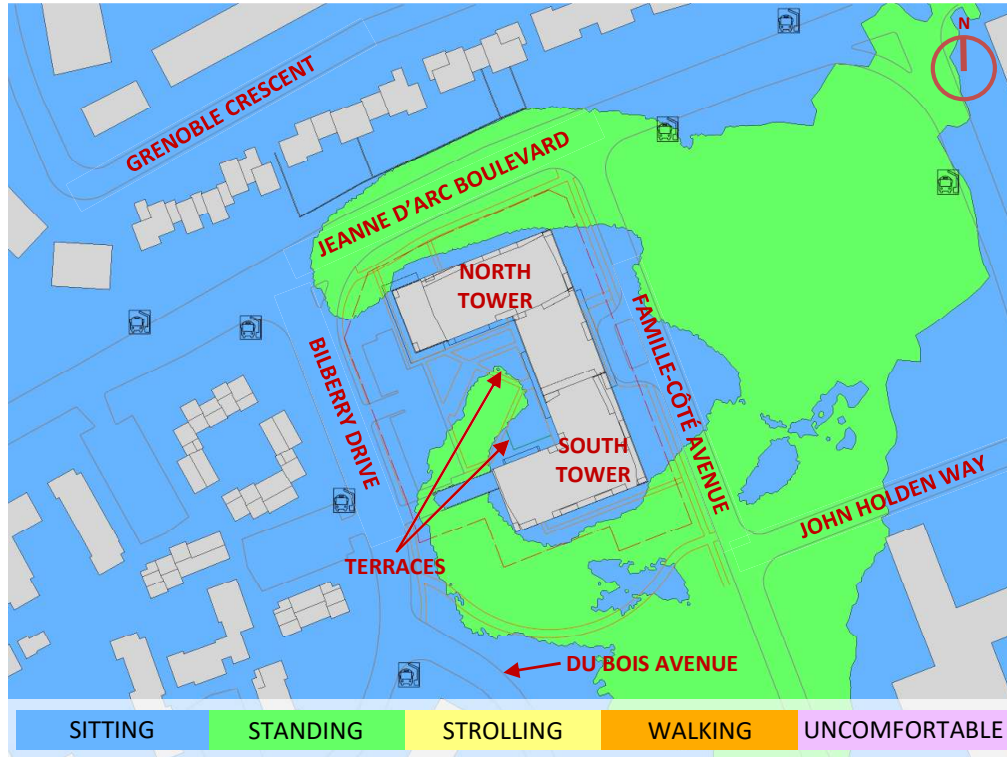
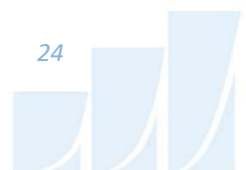


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING



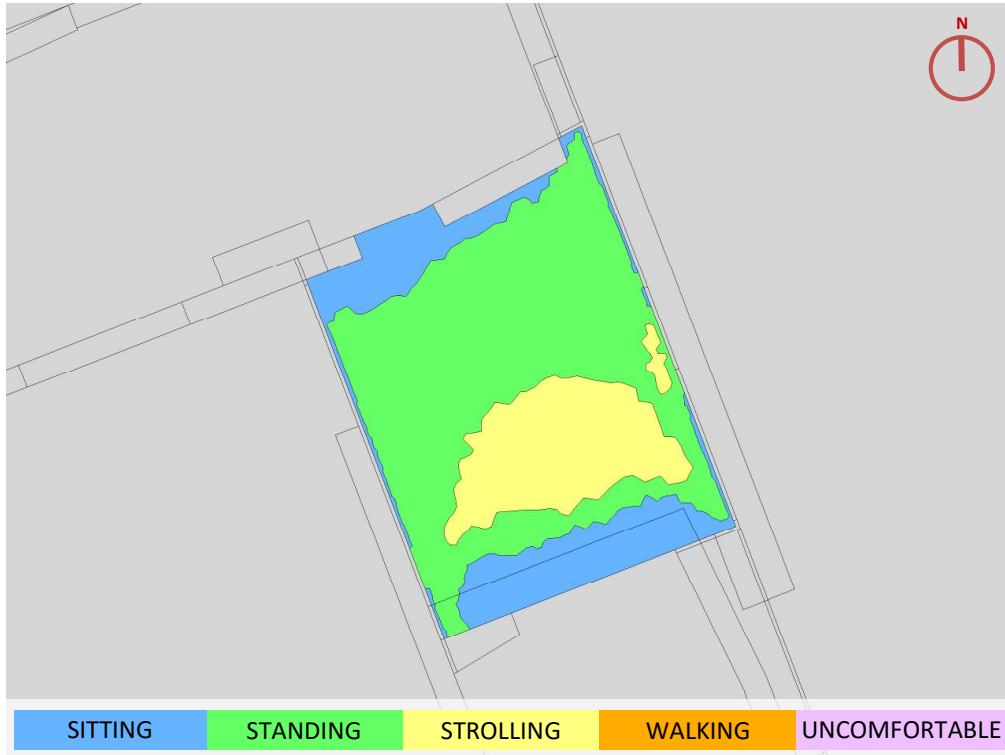


FIGURE 8A: SPRING – WIND COMFORT, LEVEL 5 AMENITY TERRACE

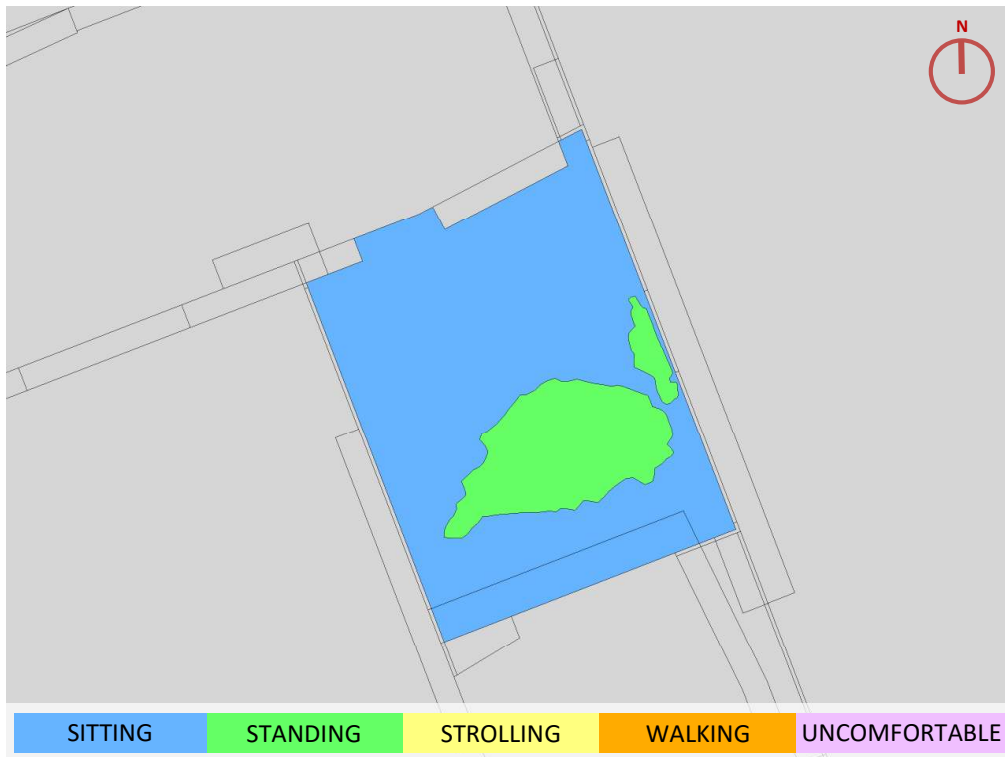


FIGURE 8B: SUMMER – WIND COMFORT, LEVEL 5 AMENITY TERRACE





FIGURE 8C: AUTUMN – WIND COMFORT, LEVEL 5 AMENITY TERRACE

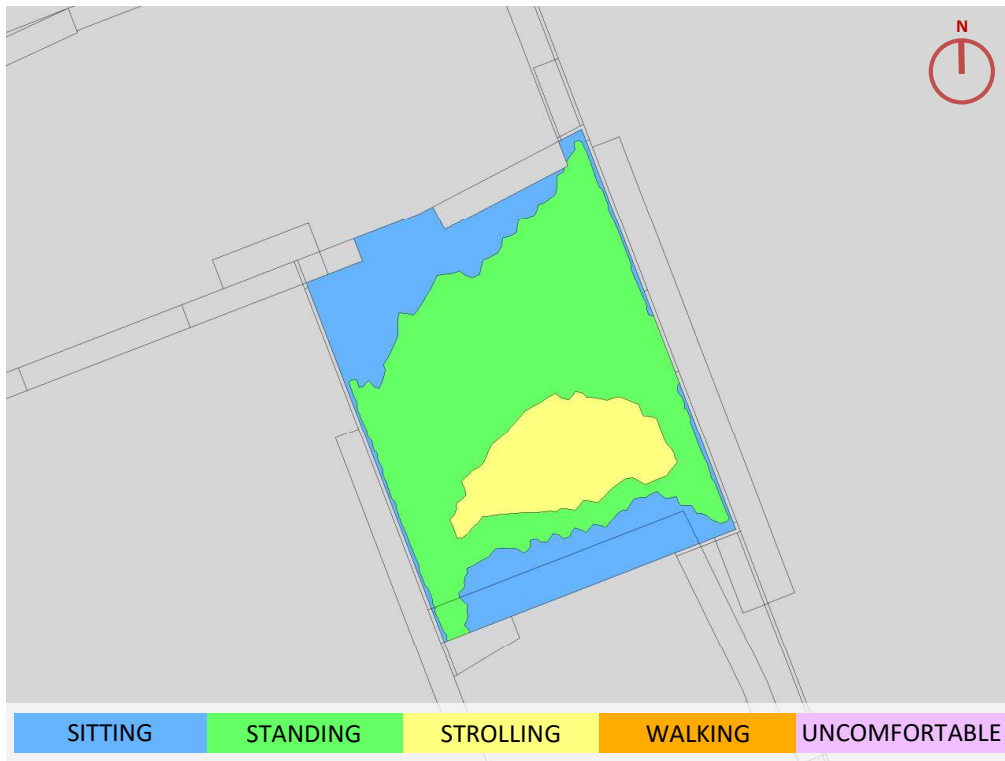


FIGURE 8D: WINTER – WIND COMFORT, LEVEL 5 AMENITY TERRACE

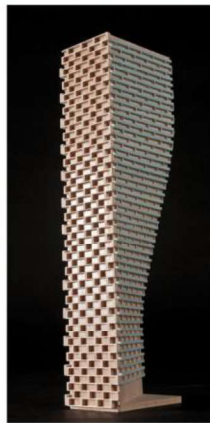




FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, LEVEL 5 AMENITY TERRACE

GRADIENTWIND

ENGINEERS & SCIENTISTS



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).

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

where U = mean wind speed, U_g = gradient wind speed, Z = height above ground, 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 60% mean wind speed for Ottawa 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 (that is, the area that is not captured within the simulation model).

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

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

Wind Direction (Degrees True)	Alpha Value (α)
0	0.17
22.5	0.18
45	0.20
67.5	0.23
90	0.24
112.5	0.23
135	0.23
157.5	0.23
180	0.23
202.5	0.23
225	0.25
247.5	0.25
270	0.23
292.5	0.22
315	0.20
337.5	0.17

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).

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

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

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.