

**PEDESTRIAN LEVEL
WIND STUDY**

25 Pickering Place – Phase 1
Ottawa, Ontario

Report: 24-031-PLW



March 20, 2024

PREPARED FOR

25 Pickering Holding Inc.
Colonnade BridgePort
200-16 Concourse Gate
Ottawa, ON K2E 7S8

PREPARED BY

Justin Denne, M.A.Sc., Junior Wind Scientist
David Huitema, M.Eng., Wind Scientist
Justin Ferraro, P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy a Site Plan Control application submission for Phase 1 of the proposed multi-phased development located at 25 Pickering Place 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 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 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-11, and 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 and on-street parking, neighbouring existing surface parking lots, and in the vicinity of building access points, are considered acceptable. The area of interest that is predicted to experience windier conditions is described as follows:
 - a. **Outdoor Amenity Between Buildings 1 and 2:** Wind conditions between Buildings 1 and 2 are predicted to be suitable for strolling, or better, during the summer, with small, isolated regions suitable for walking, becoming suitable for walking, or better, throughout the remainder of the year, including the typical use period (that is, May to October, inclusive). The windiest conditions are situated to the west of Building 2, where a region of uncomfortable conditions is predicted during the winter and spring.



- Specifically, conditions during the winter season within the noted windier region to the west of Building 2 are predicted to be suitable for walking for approximately 78% of the time, representing a 2% exceedance of the walking threshold, while conditions during the spring season within the noted region are predicted to be suitable for walking for at least 77% of the time, representing a 3% exceedance of the walking threshold.
 - Notably, the development of future phases of the masterplan development to the north of the subject site would be expected to help improve wind conditions between Buildings 1 and 2, providing sheltering effects to prevailing winds from the northwest.
 - If feasible in the design of the proposed development, it is recommended that the grade-level outdoor amenity be relocated to the calmer areas predicted to be suitable for sitting during the typical use period, such as to the east of Building 2 or to the south of Buildings 1 and 2, as illustrated in Figure 7.
 - If relocation of the amenity is not feasible, mitigation strategies that may be considered by the design team may include canopies that extend from select podia façades, as well as wind screens at grade that diffuse accelerating winds around building corners. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.
- 2) The common amenity terraces serving Buildings 1 and 2 at their respective MPH Levels were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions within the noted amenity terraces during the typical use period and recommendations regarding mitigation are described as follows:

- a. **Building 1, MPH Level Amenity Terrace:** With the noted 1.8-m-tall perimeter wind screen, conditions with the MPH Level terrace serving Building 1 are predicted to be suitable for a mix of sitting and standing, with conditions predicted to be suitable for sitting to the east and west and standing within the central terrace area, with an isolated region suitable for strolling along the building façade.
 - b. **Building 2, MPH Level Amenity Terrace:** With the noted 1.8-m-tall perimeter wind screen, conditions are predicted to be suitable for sitting over a majority of the MPH Level terrace serving Building 2, with conditions predicted to be suitable for standing to the west.
 - c. To improve comfort levels within the amenity terraces serving Buildings 1 and 2, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.
 - d. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.
- 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.

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 – Common Amenity Terraces12

5.3 Wind Safety12

5.4 Applicability of Results13

6. CONCLUSIONS AND RECOMMENDATIONS 13

FIGURES

APPENDICES

Appendix A – Simulation of the Atmospheric Boundary Layer



1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Colonnade BridgePort on behalf of 25 Pickering Holding Inc. to undertake a pedestrian level wind (PLW) study to satisfy a Site Plan Control application submission for Phase 1 of the proposed multi-phased development located at 25 Pickering Place in Ottawa, Ontario (hereinafter referred to as “subject site” or “proposed development”). Our mandate within this study is to investigate wind conditions within and surrounding the subject site, and to identify areas where 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 Hobin Architecture in February 2024, 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 25 Pickering Place in Ottawa, a masterplan development located to the southeast of the intersection of Pickering Place and Tremblay Road. Phase 1, the focus of the current study, is situated to the south of the masterplan, approximately 130 metres (m) southeast of the noted intersection on a parcel of land bordered by Pickering Place to the west, the future Station Road to the north, an empty lot to the east comprising a future phase of the masterplan development, and a surface parking lot to the south. The proposed development comprises two nominally rectangular residential buildings: Building 1 (28 storeys) and Building 2 (14 storeys), situated to the west and east, respectively, of Phase 1. The buildings include 4-storey podia and are topped with mechanical penthouse (MPH) levels.

Above the underground parking levels, the ground floors of Buildings 1 and 2 include main entrances at the northwest corners and to the north and include residential units throughout the remainder of the level. An outdoor amenity is anticipated to be located between the two buildings. Access to the underground parking is provided by a ramp at the southwest corner of Building 1 via Pickering Place. Buildings 1 and 2 are reserved for residential use at Levels 2-28 and 2-14, respectively. The MPH levels of both buildings are served by common amenity terraces.



The near-field surroundings, defined as an area within 200-metres (m) of the subject site, include green spaces from the west clockwise to the northwest, a mid-rise office building and a surface parking lot to the northwest, and a mix of surface parking lots and empty lots comprising the future phases of the masterplan development from the north clockwise to the east, and surface parking, open lots, and rail tracks in the remaining directions. Notably, the Ottawa Train Station is located to the southwest and the VIA Rail railway extends from the southwest 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 suburban massing in all directions, with isolated mid- and high-rise buildings from the southeast clockwise to the northeast and clusters of high-rise buildings to the southwest and west. The Rideau River flows from the west-southwest to the northwest approximately 1 km to the west.

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 future 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/default/files/torwindanalysis_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 500 m. The process was performed for two context massing scenarios, as noted in Section 2.

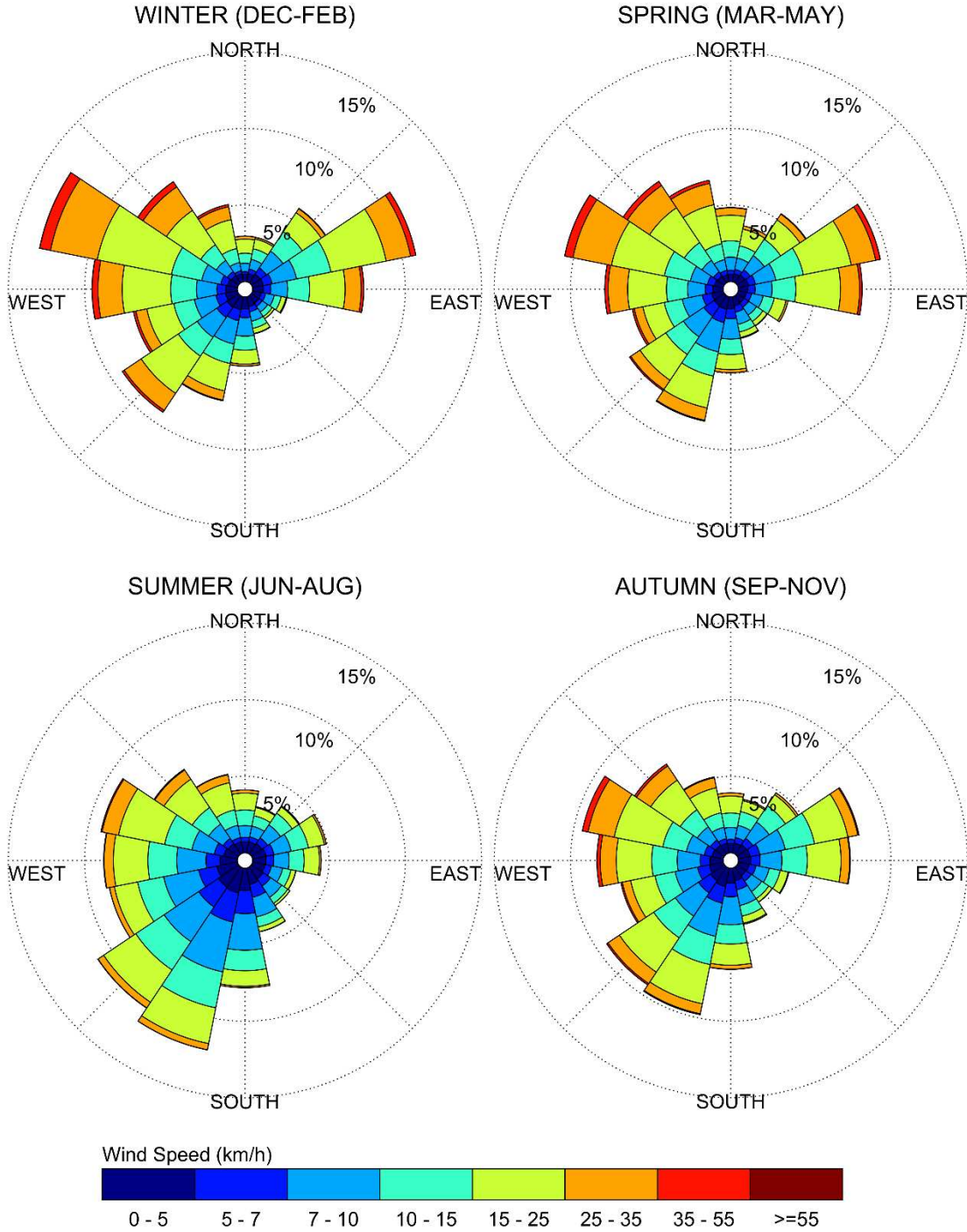
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the MPH Level common amenity terraces serving Buildings 1 and 2 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	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, illustrating wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 8A-8D and 10A-10D which illustrate conditions over the common amenity terraces serving Buildings 1 and 2 at their respective MPH Levels. 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, 9, and 11 illustrate comfort conditions at grade level, over the amenity terrace serving Building 1, and over the amenity terrace serving Building 2, respectively, consistent with the comfort classes 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 along Pickering Place: Following the introduction of the proposed development, conditions over the public sidewalks along Pickering Place are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling throughout the remainder of the year, with isolated regions suitable for walking during the spring. The noted conditions are considered acceptable.

Wind conditions over the public sidewalks along Pickering Place with the existing massing are predicted to be suitable for standing, or better, during the summer, becoming suitable for standing throughout the remainder of the year, with isolated regions suitable for strolling during the spring. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable for public sidewalks.

Sidewalks and Surface Parking along Station Road: Following the introduction of the proposed development, conditions over the public sidewalks and on-street surface parking along Station Road are predicted to be suitable for standing, or better, during the summer and autumn, with isolated regions suitable for strolling, becoming suitable for a mix of standing and strolling during the winter and spring, with isolated regions suitable for walking. The noted conditions are considered acceptable.

Wind conditions over the public sidewalks and on-street surface parking along Station Road with the existing massing are predicted to be suitable for mostly standing, or better, throughout the year, with regions suitable for strolling during the winter and spring. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable along Station Road.

Sidewalks and Surface Parking along Avenue K: Following the introduction of the proposed development, conditions over the public sidewalks and on-street surface parking along Avenue K are predicted to be suitable for mostly standing throughout the year with isolated regions of strolling conditions during the colder months. The noted conditions are considered acceptable.

Wind conditions over the public sidewalks and on-street surface parking along Avenue K with the existing massing are predicted to be suitable for standing throughout the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are nevertheless considered acceptable along Avenue K.

Neighbouring Existing Surface Parking Lots: Following the introduction of the proposed development, conditions over the neighbouring existing surface parking lot to the northwest of the subject site are predicted to be suitable for standing, or better, during the summer, autumn, and winter, with isolated regions suitable for strolling during the winter, becoming suitable for strolling, or better, during the spring. Conditions over the neighbouring existing surface parking lot to the south of the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for a mix of standing and strolling during the autumn, winter, and spring, with isolated regions suitable for walking during the spring and winter. The noted conditions are considered acceptable.

Under the existing massing, wind conditions over the noted surface parking lot to the northwest are predicted to be suitable for standing, or better, throughout the year, with isolated regions suitable for strolling during the winter and spring, while conditions over the surface parking lot to the south are predicted to be suitable for mostly standing throughout the year with isolated regions suitable for strolling during the winter and spring. While the introduction of the proposed development produces windier conditions in comparison to existing conditions over the noted surface parking lots, wind comfort conditions with the proposed development are nevertheless considered acceptable.

Outdoor Amenity Between Buildings 1 and 2: Wind conditions over the anticipated outdoor amenity situated between Buildings 1 and 2 are predicted to be suitable for strolling, or better, during the summer, with small, isolated regions suitable for walking, becoming suitable for walking, or better, throughout the remainder of the year, including the typical use period, as illustrated in Figure 7.

Notably, a region of uncomfortable conditions is predicted during the winter and spring between Buildings 1 and 2. Specifically, conditions during the winter season within the windier region to the west of Building 2 are predicted to be suitable for walking for approximately 78% of the time, representing a 2% exceedance of the walking threshold, while conditions during the spring season to the west of Building 2 are predicted to be suitable for walking for at least 77% of the time, representing a 3% exceedance of the walking threshold.

Notably, the introduction of future phases of the masterplan development to the north of the subject site would be expected to help improve wind conditions between Buildings 1 and 2, providing sheltering effects to prevailing winds from the northwest.

If feasible in the design of the proposed development, it is recommended that the outdoor amenity be relocated to the calmer areas predicted to be suitable for sitting during the typical use period, such as areas to the east of Building 2 or to the south of Buildings 1 and 2, as illustrated in Figure 7.

If relocation of the amenity is not feasible, mitigation strategies that may be considered by the design team may include canopies that extend from select podia façades, as well as wind screens at grade that diffuse accelerating winds around building corners. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Building Access Points and Walkways: Owing to the protection of the building façade, wind conditions in the vicinity of the building access points serving Buildings 1 and 2 are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. The noted conditions are considered acceptable.



5.2 Wind Comfort Conditions – Common Amenity Terraces

The common amenity terraces serving Buildings 1 and 2 at their respective MPH Levels were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions during the typical use period within the noted common amenity terraces and recommendations regarding mitigation are described as follows:

Building 1, MPH Level Amenity Terrace: With the noted wind mitigation along the terrace perimeter as described in the introductory paragraph, conditions within the common amenity terrace serving Building 1 at the MPH Level are predicted to be suitable for a mix of sitting and standing, with conditions predicted to be suitable for sitting to the east and west and standing within the central terrace area, with an isolated region suitable for strolling along the building façade, as illustrated in Figure 9.

Building 2, MPH Level Amenity Terrace: With the noted wind mitigation along the terrace perimeter as described in the introductory paragraph, conditions within the common amenity terrace serving Building 2 at the MPH Level are predicted to be suitable for sitting over a majority of the terrace, with conditions predicted to be suitable for standing to the west of the terrace, as illustrated in Figure 11.

To improve comfort levels within the MPH Level amenity terraces serving Buildings 1 and 2, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.

The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

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-11. 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) 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 and on-street parking, neighbouring existing surface parking lots, and in the vicinity of building access points, are considered acceptable. The area of interest that is predicted to experience windier conditions is described as follows:
 - a. **Outdoor Amenity Between Buildings 1 and 2:** Wind conditions between Buildings 1 and 2 are predicted to be suitable for strolling, or better, during the summer, with small, isolated regions suitable for walking, becoming suitable for walking, or better, throughout the remainder of the year, including the typical use period (that is, May to October, inclusive). The windiest conditions are situated to the west of Building 2, where a region of uncomfortable conditions is predicted during the winter and spring.
 - Specifically, conditions during the winter season within the noted windier region to the west of Building 2 are predicted to be suitable for walking for approximately 78% of the time, representing a 2% exceedance of the walking threshold, while conditions during the spring season within the noted region are predicted to be suitable for walking for at least 77% of the time, representing a 3% exceedance of the walking threshold.




- Notably, the development of future phases of the masterplan development to the north of the subject site would be expected to help improve wind conditions between Buildings 1 and 2, providing sheltering effects to prevailing winds from the northwest.
 - If feasible in the design of the proposed development, it is recommended that the grade-level outdoor amenity be relocated to the calmer areas predicted to be suitable for sitting during the typical use period, such as to the east of Building 2 or to the south of Buildings 1 and 2, as illustrated in Figure 7.
 - If relocation of the amenity is not feasible, mitigation strategies that may be considered by the design team may include canopies that extend from select podia façades, as well as wind screens at grade that diffuse accelerating winds around building corners. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.
- 2) The common amenity terraces serving Buildings 1 and 2 at their respective MPH Levels were modelled with 1.8-m-tall wind screens along their full perimeters. Wind comfort conditions within the noted amenity terraces during the typical use period and recommendations regarding mitigation are described as follows:
- a. **Building 1, MPH Level Amenity Terrace:** With the noted 1.8-m-tall perimeter wind screen, conditions with the MPH Level terrace serving Building 1 are predicted to be suitable for a mix of sitting and standing, with conditions predicted to be suitable for sitting to the east and west and standing within the central terrace area, with an isolated region suitable for strolling along the building façade.
 - b. **Building 2, MPH Level Amenity Terrace:** With the noted 1.8-m-tall perimeter wind screen, conditions are predicted to be suitable for sitting over a majority of the MPH Level terrace serving Building 2, with conditions predicted to be suitable for standing to the west.

- c. To improve comfort levels within the amenity terraces serving Buildings 1 and 2, mitigation inboard of the terrace perimeters targeted around sensitive areas is recommended, in combination with taller wind screens (that is, greater than 1.8 m as measured from the local walking surface) along the perimeters of the terraces. This inboard mitigation could take the form of inboard wind screens or other common landscape elements.
 - d. The extent of the mitigation measures is dependent on the programming of the terraces. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.
- 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.



David Huitema, M.Eng.
Wind Scientist

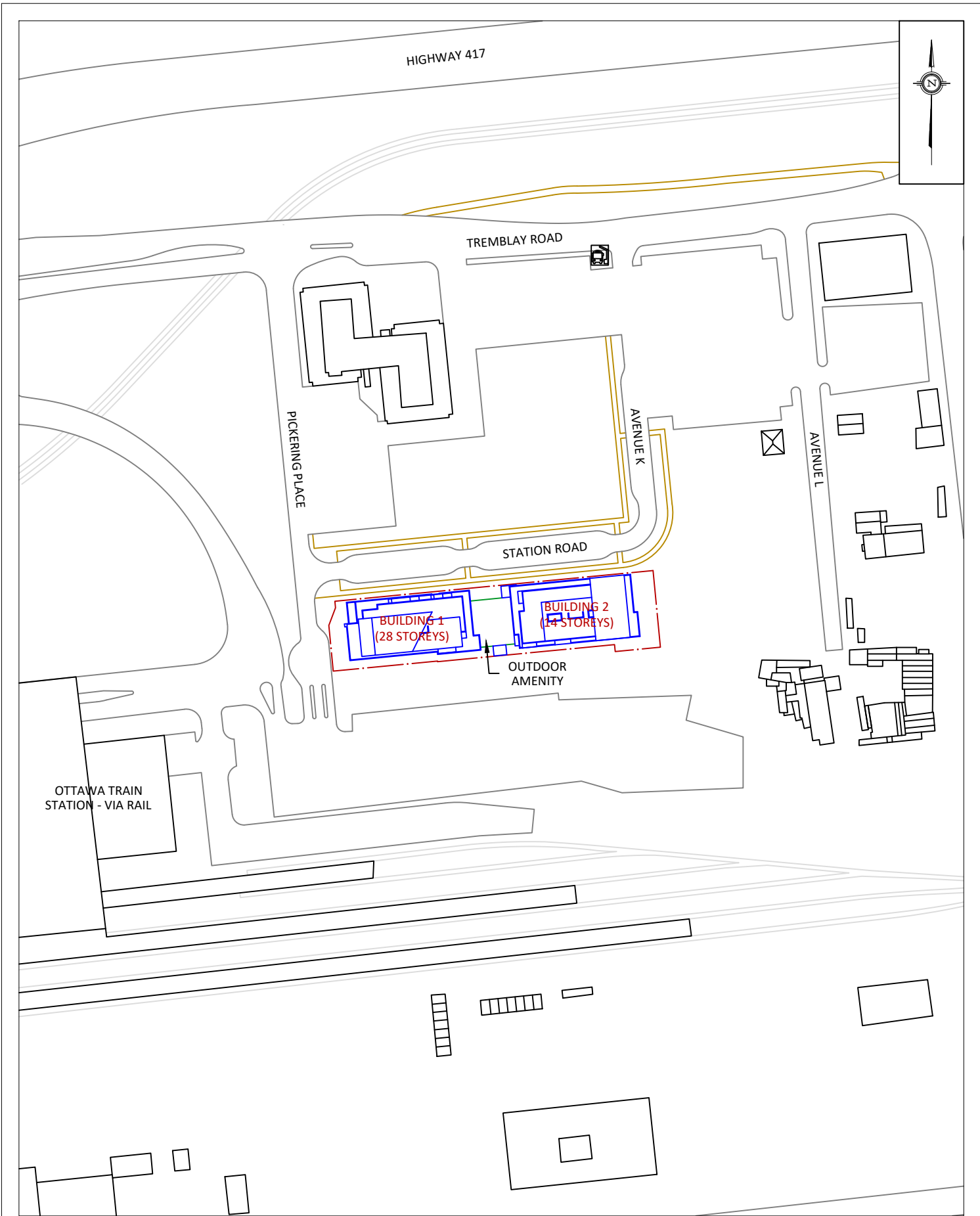


Justin Denne, M.A.Sc.
Junior Wind Scientist



Justin Ferraro, P.Eng.
Principal





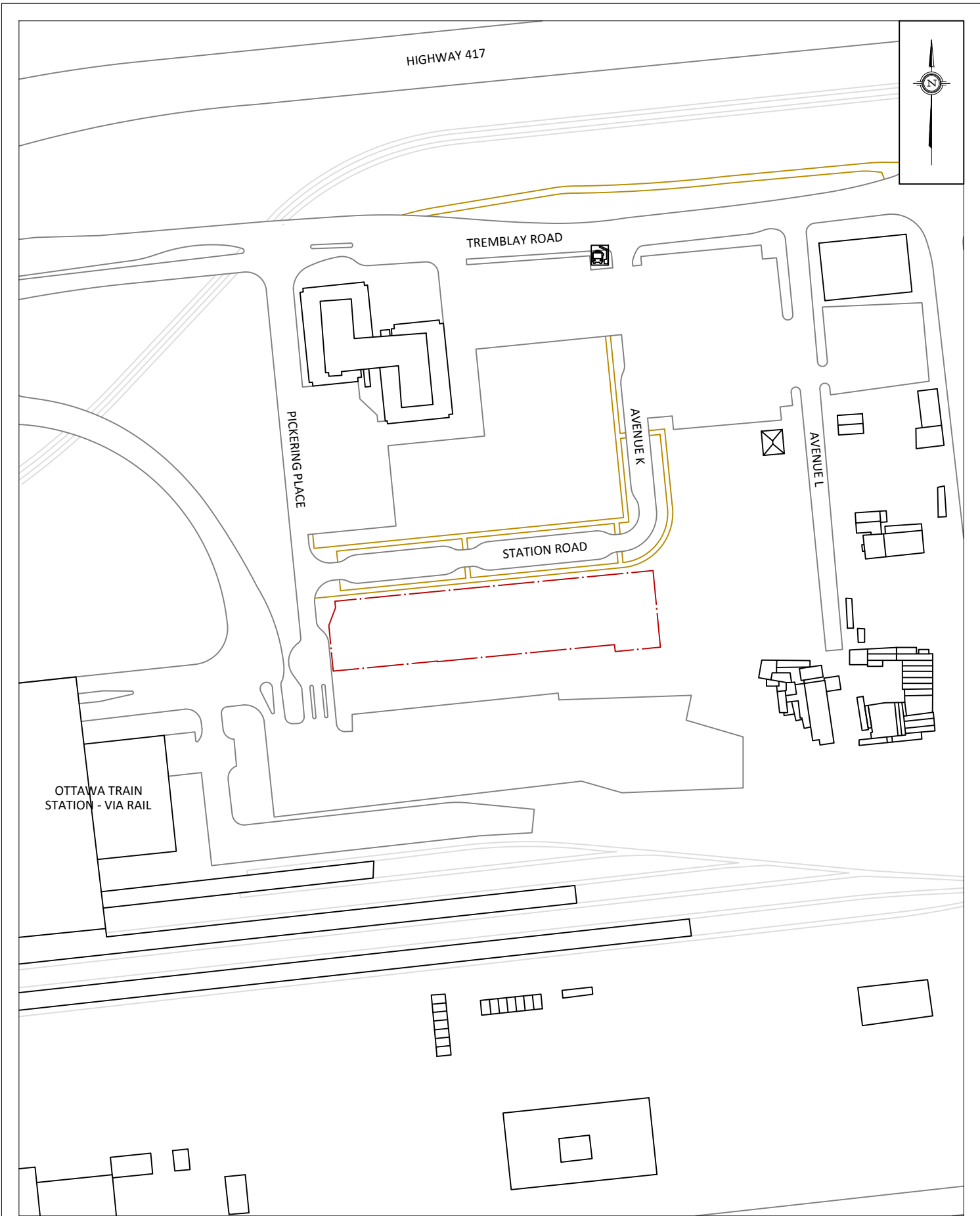
GRADIENTWIND

ENGINEERS & SCIENTISTS

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

PROJECT	25 PICKERING PLACE - PHASE 1, OTTAWA PEDESTRIAN LEVEL WIND STUDY	
SCALE	1:2000	DRAWING NO. 24-031-PLW-1A
DATE	MARCH 20, 2024	DRAWN BY S.K.

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



GRADIENTWIND

ENGINEERS & SCIENTISTS

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

PROJECT

25 PICKERING PLACE - PHASE 1, OTTAWA
PEDESTRIAN LEVEL WIND STUDY

SCALE

1:2000

DRAWING NO.

24-031-PLW-1B

DATE

MARCH 20, 2024

DRAWN BY

S.K.

DESCRIPTION

FIGURE 1B:
EXISTING SITE PLAN AND SURROUNDING CONTEXT

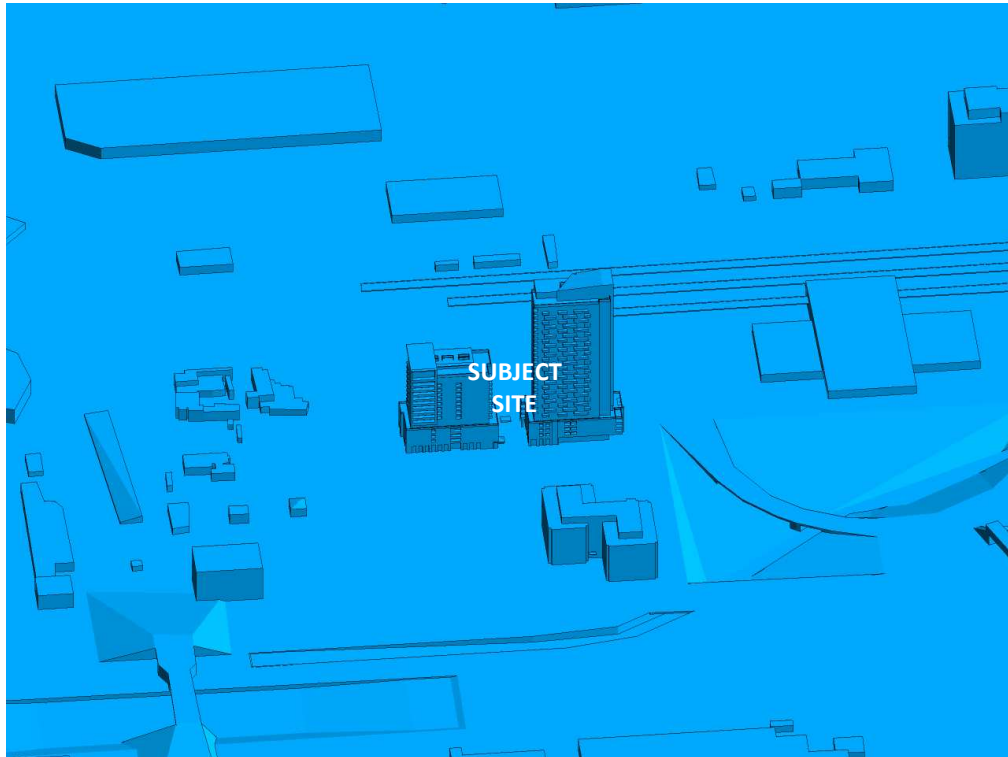


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

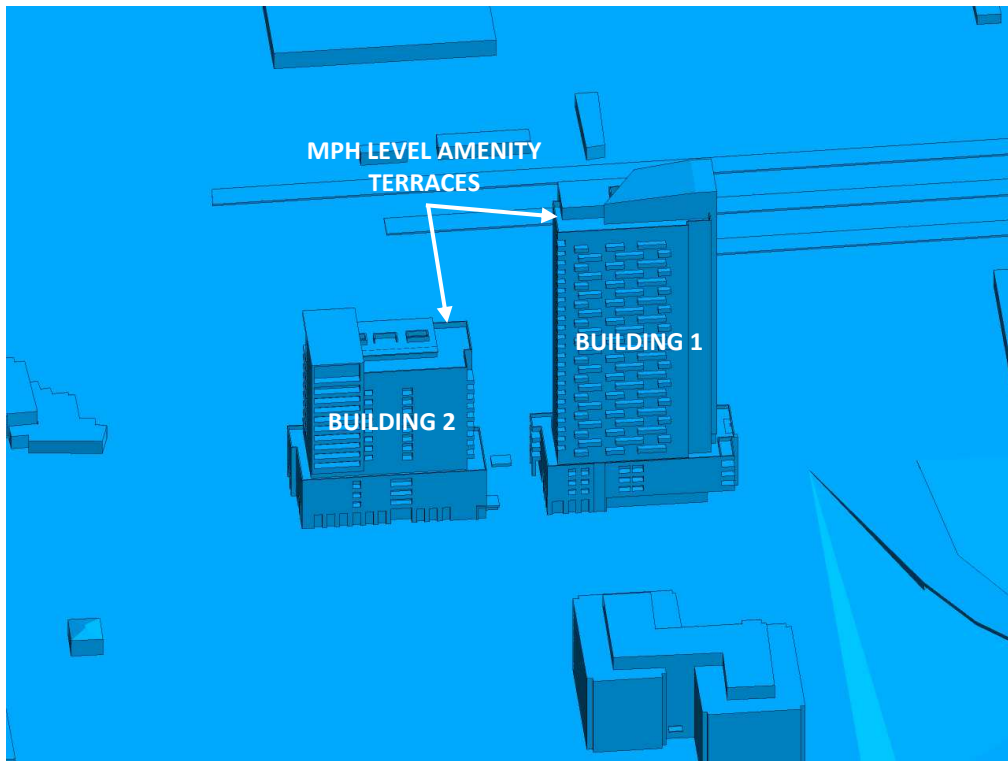


FIGURE 2B: CLOSE UP OF FIGURE 2A



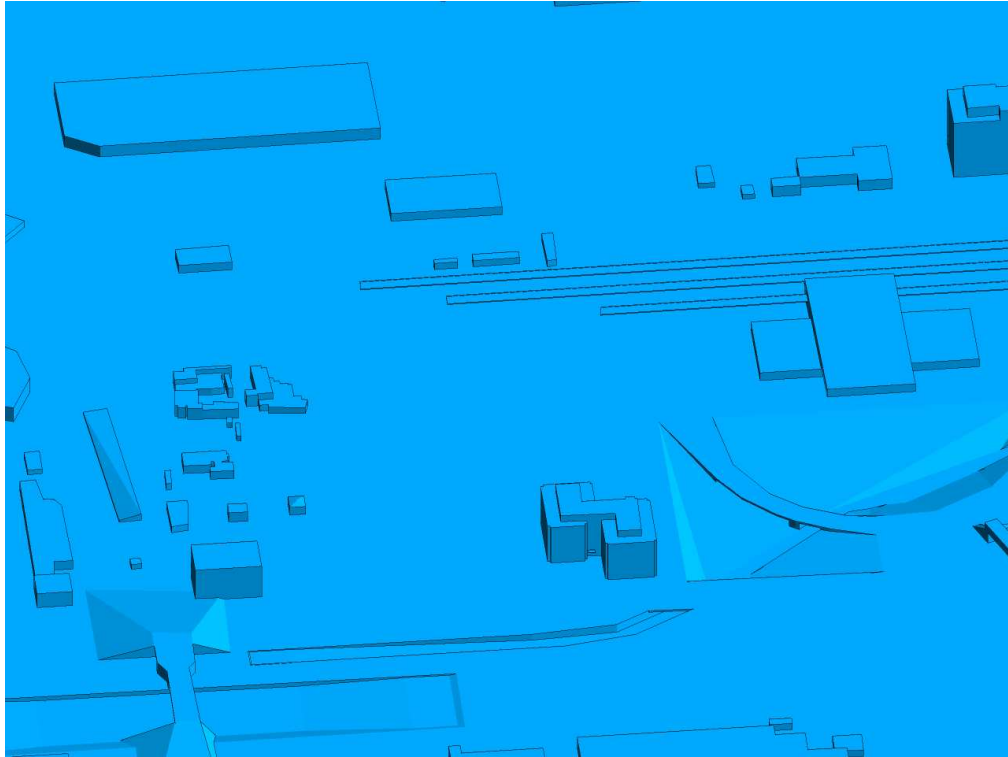


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

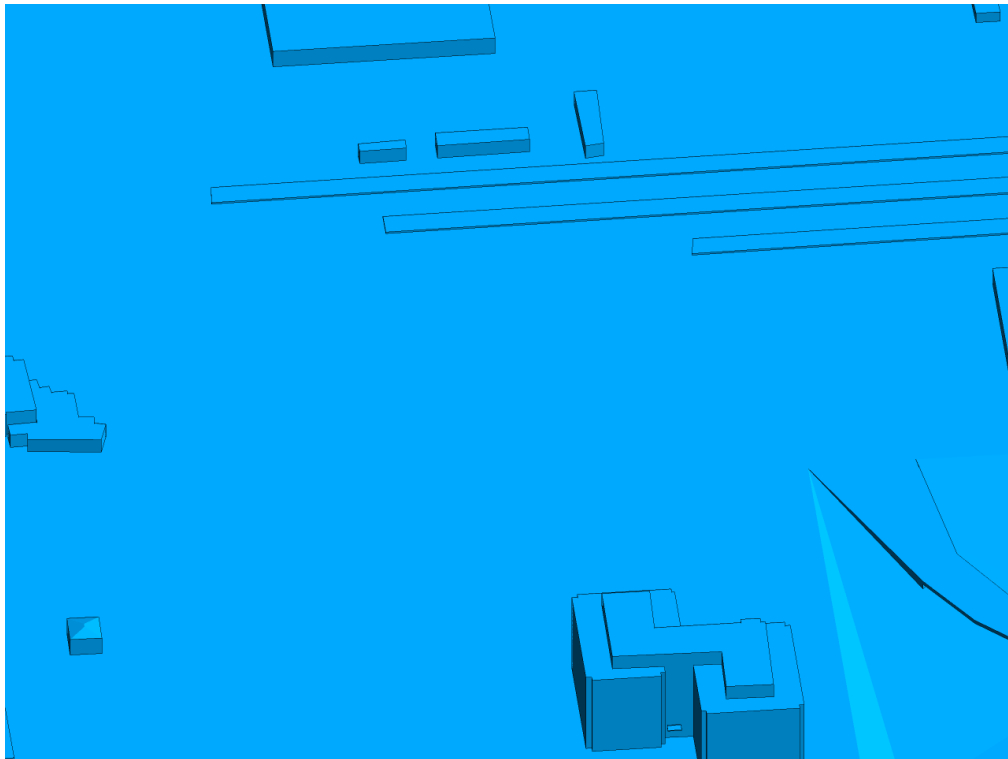


FIGURE 2D: CLOSE UP OF FIGURE 2C



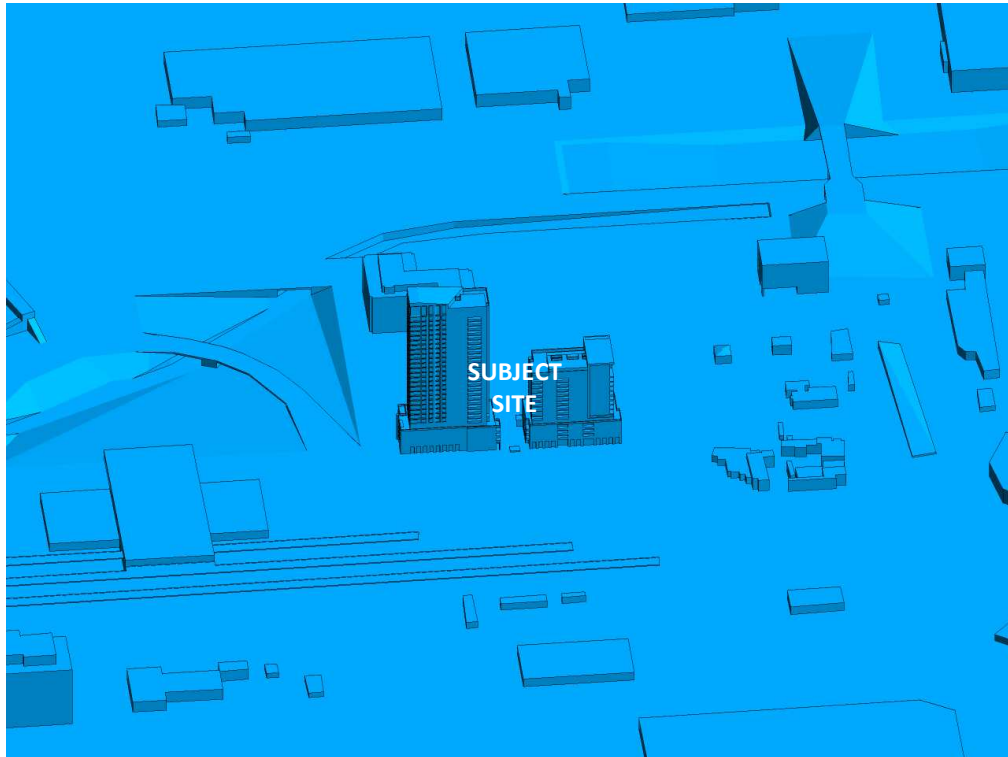


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

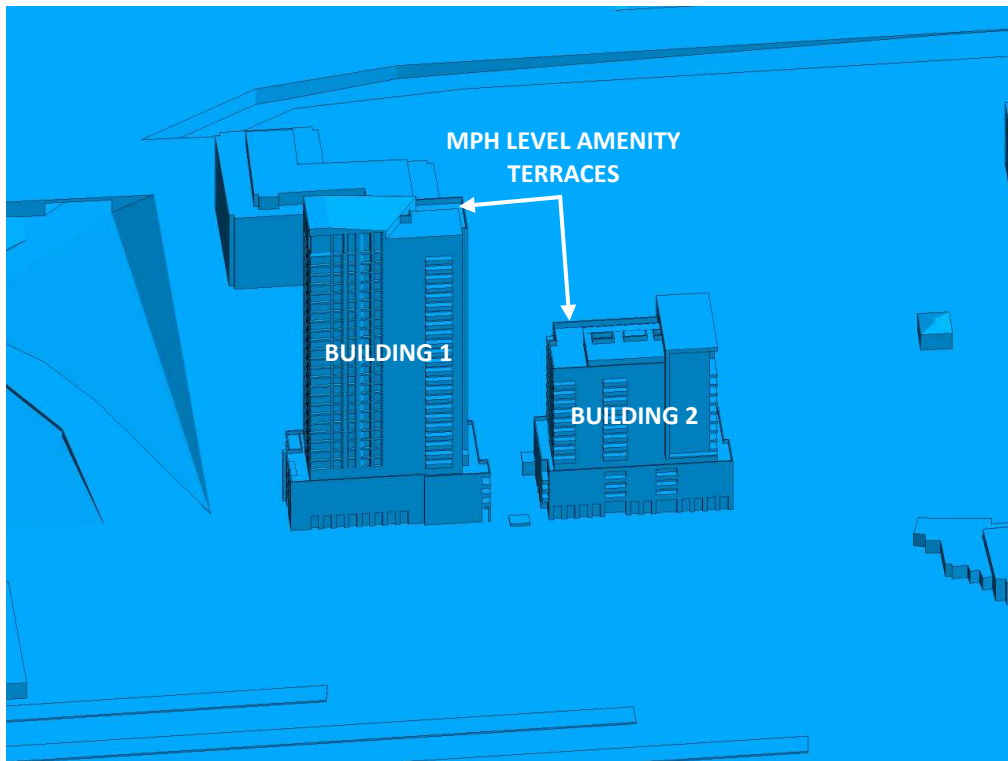


FIGURE 2F: CLOSE UP OF FIGURE 2E



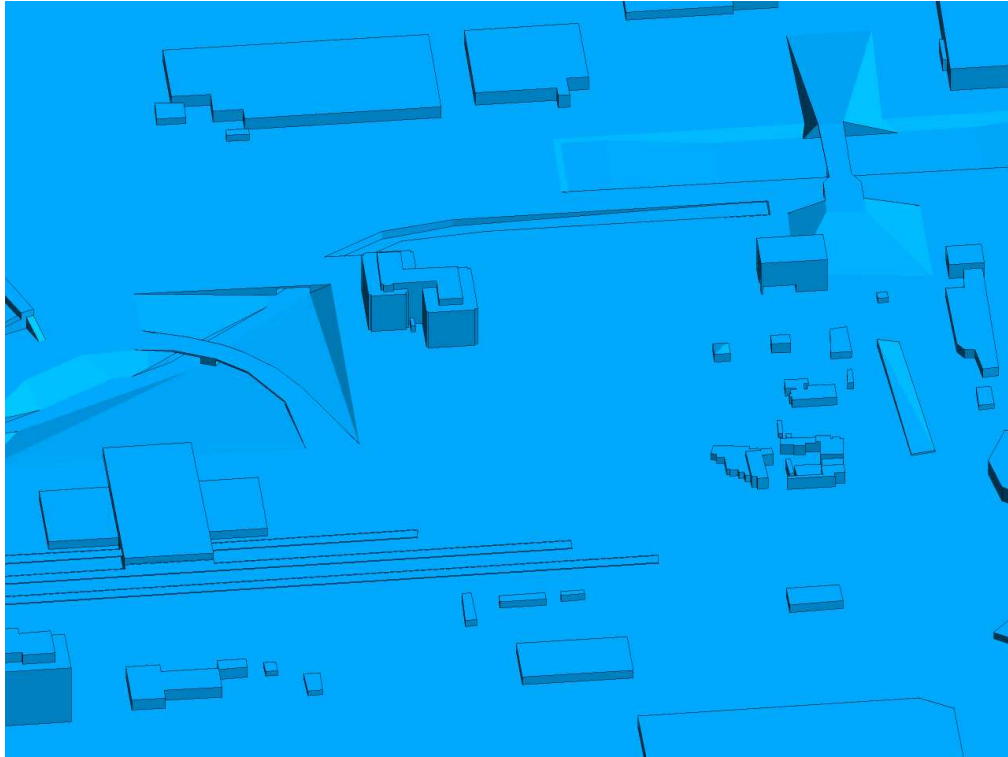


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

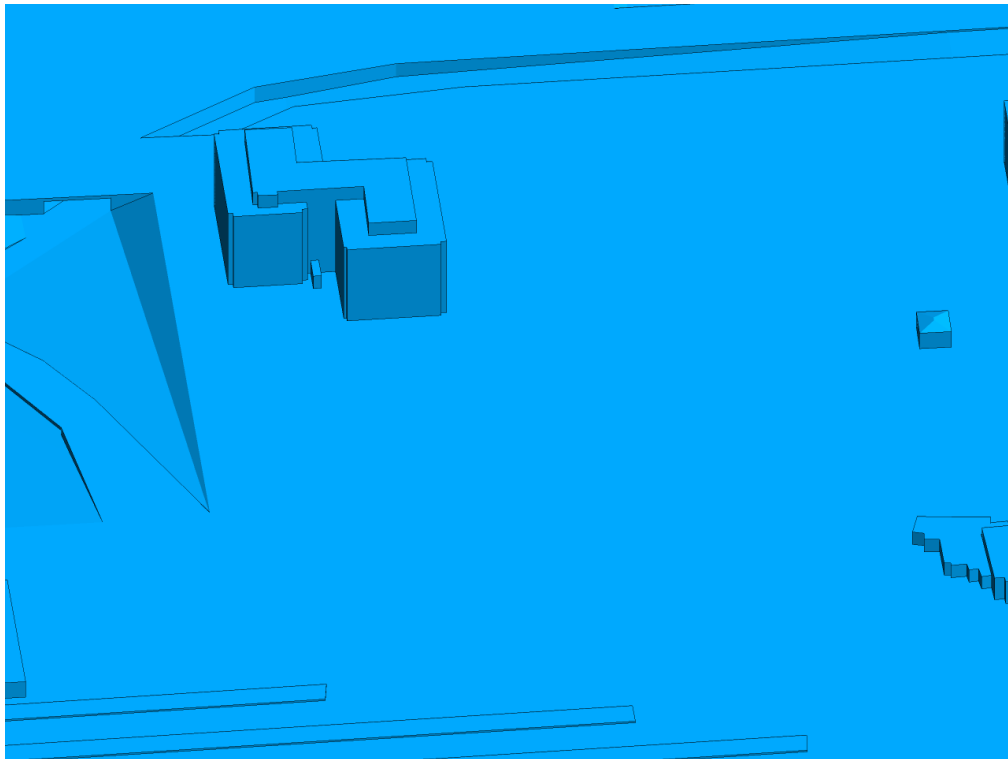


FIGURE 2H: CLOSE UP OF FIGURE 2G



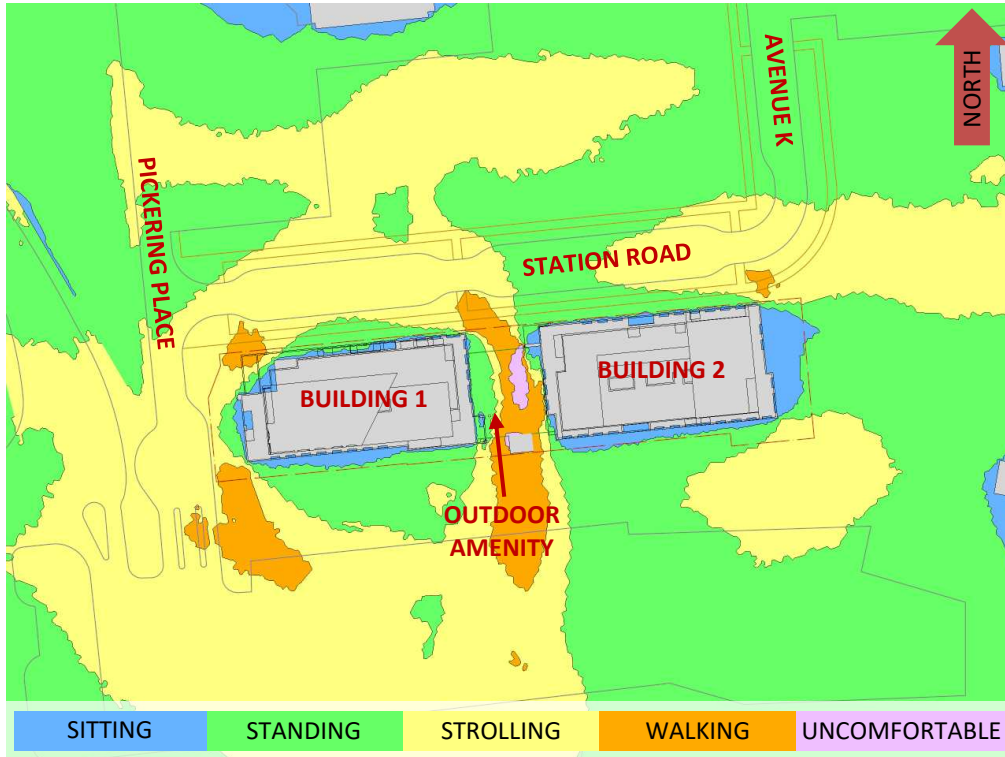


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

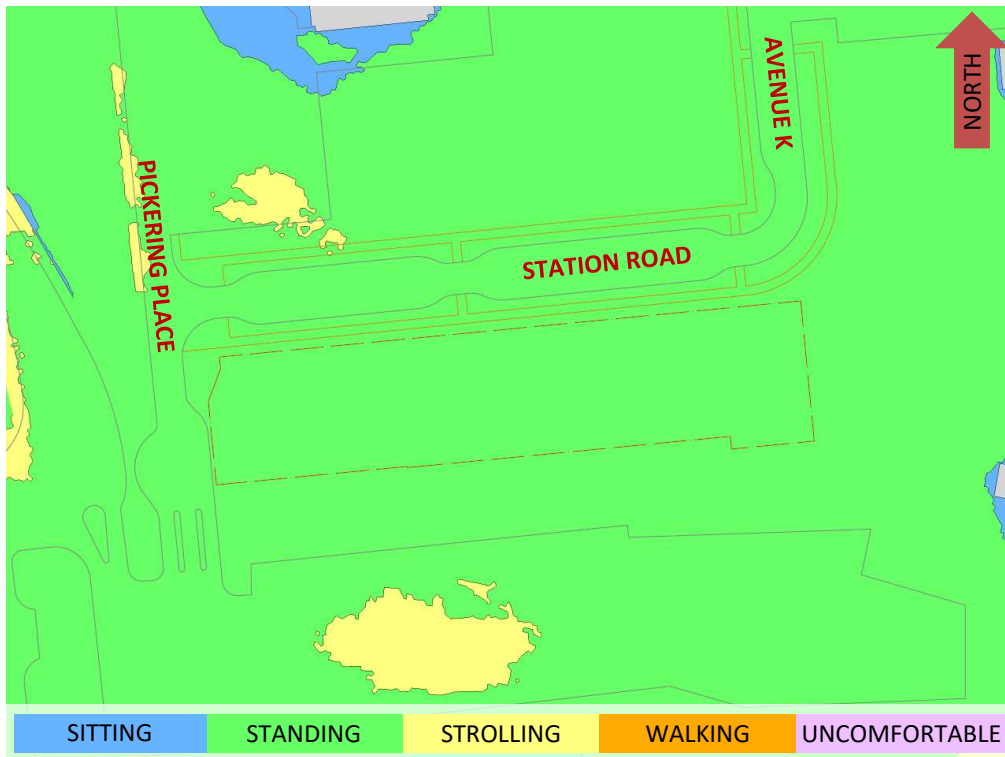


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING



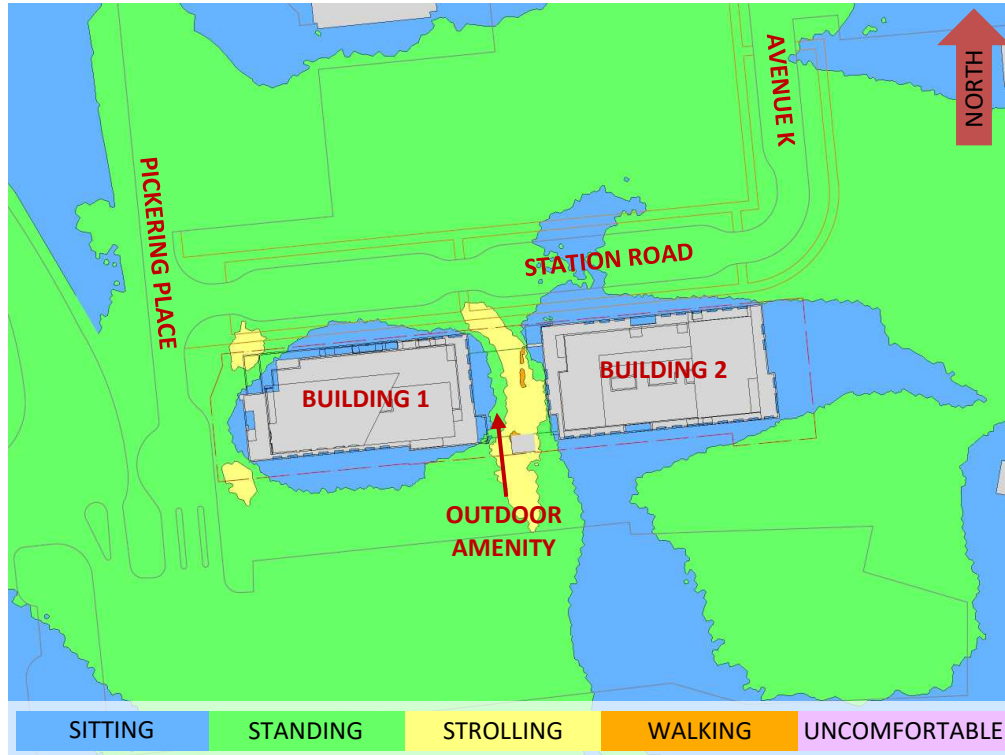


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

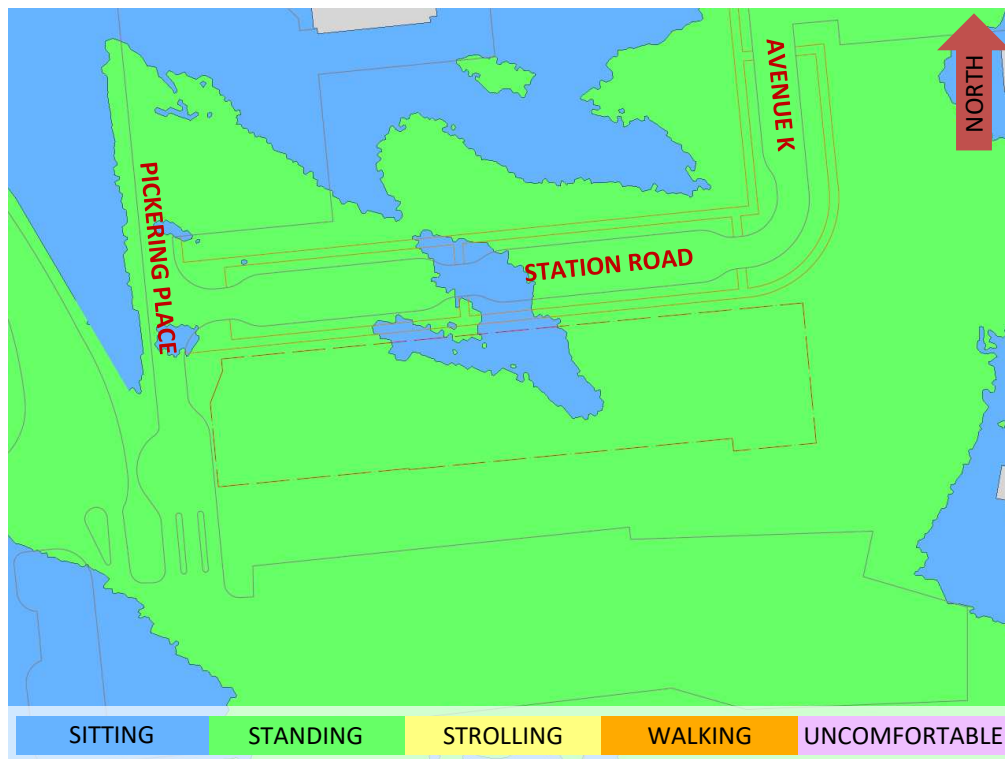


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING



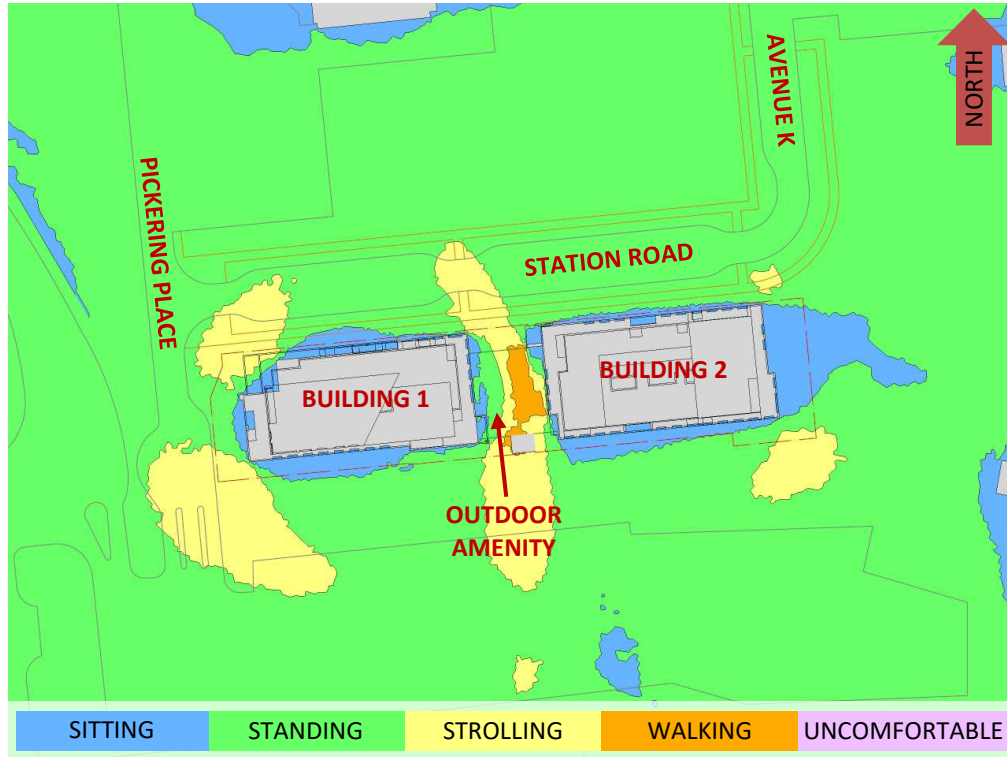


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING



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



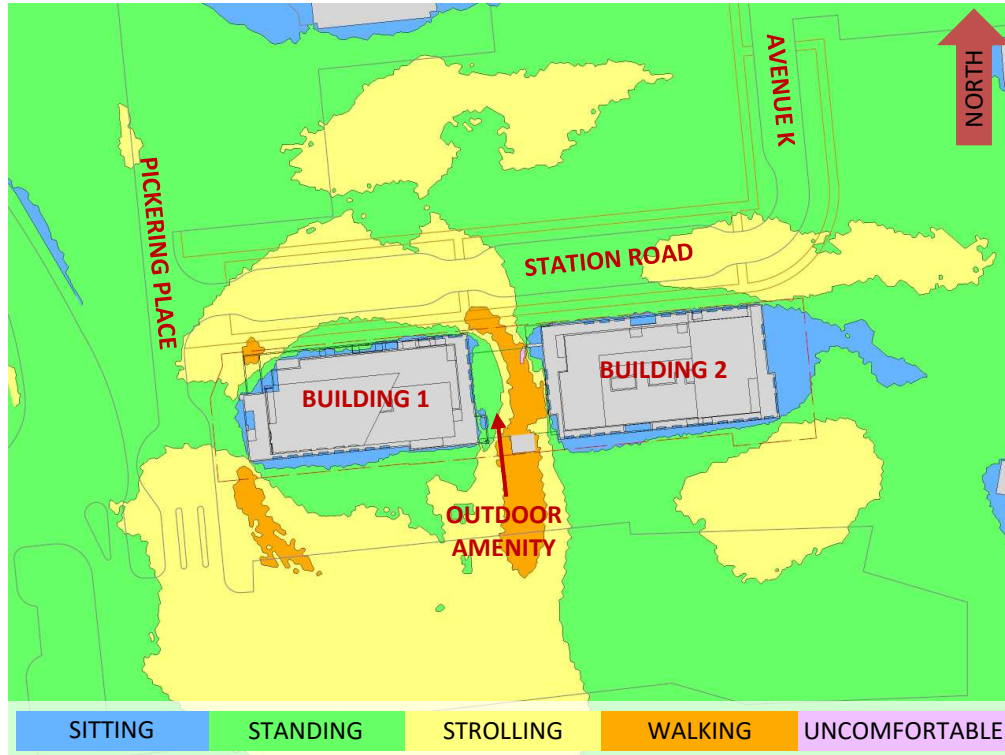


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING



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



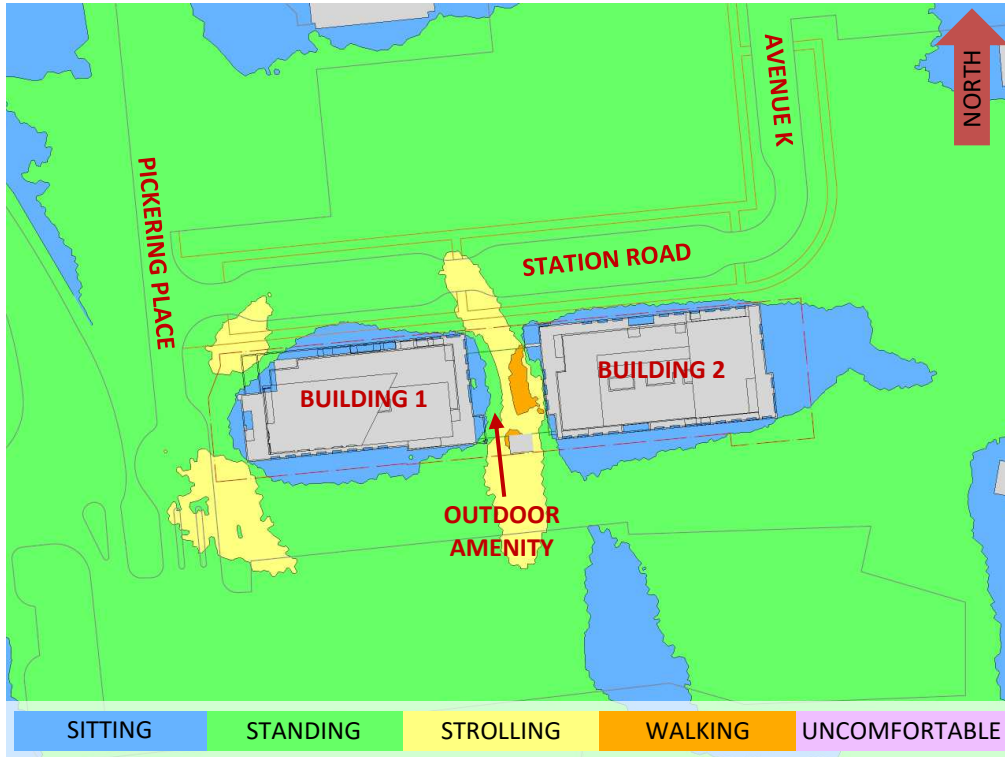


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING



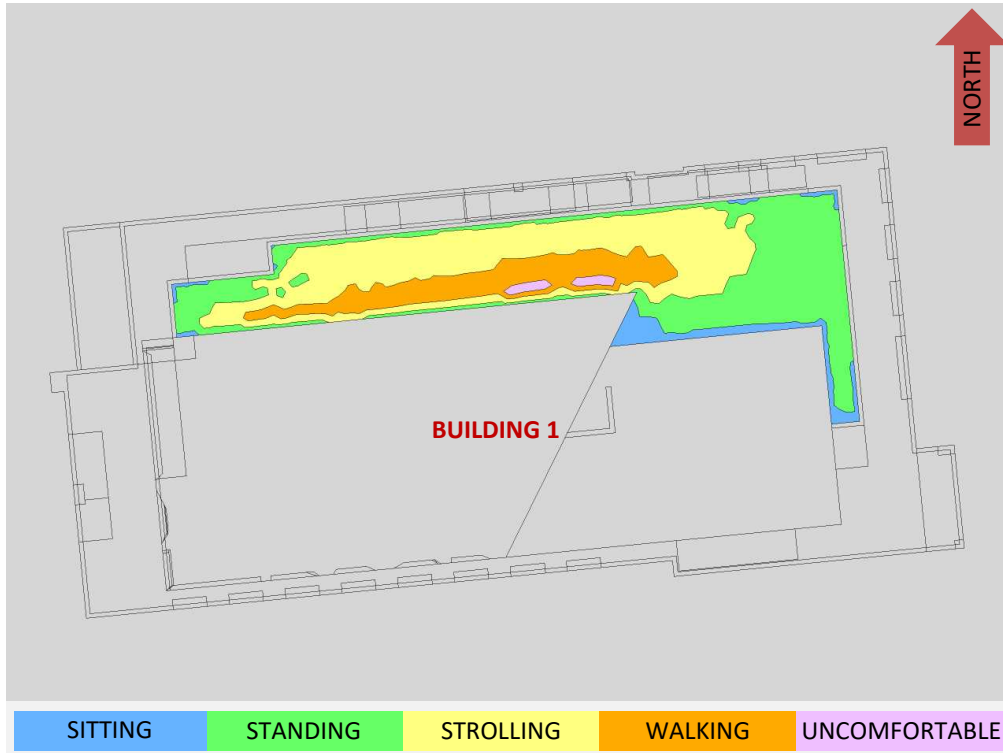


FIGURE 8A: SPRING – WIND COMFORT, MPH LEVEL BUILDING 1 TERRACE

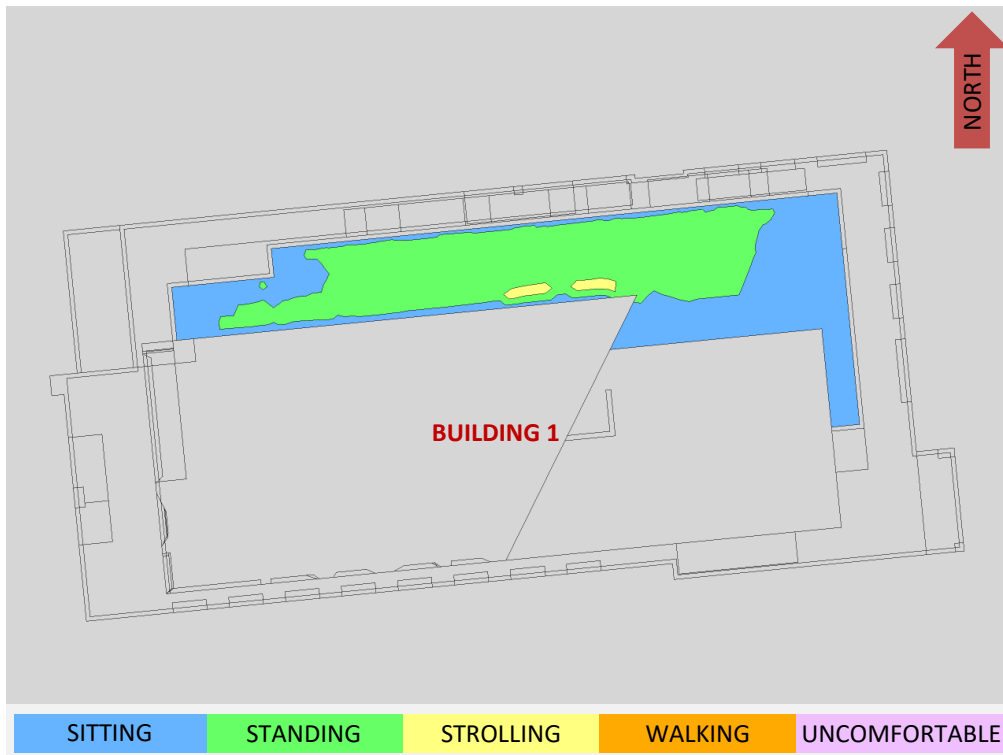


FIGURE 8B: SUMMER – WIND COMFORT, MPH LEVEL BUILDING 1 TERRACE



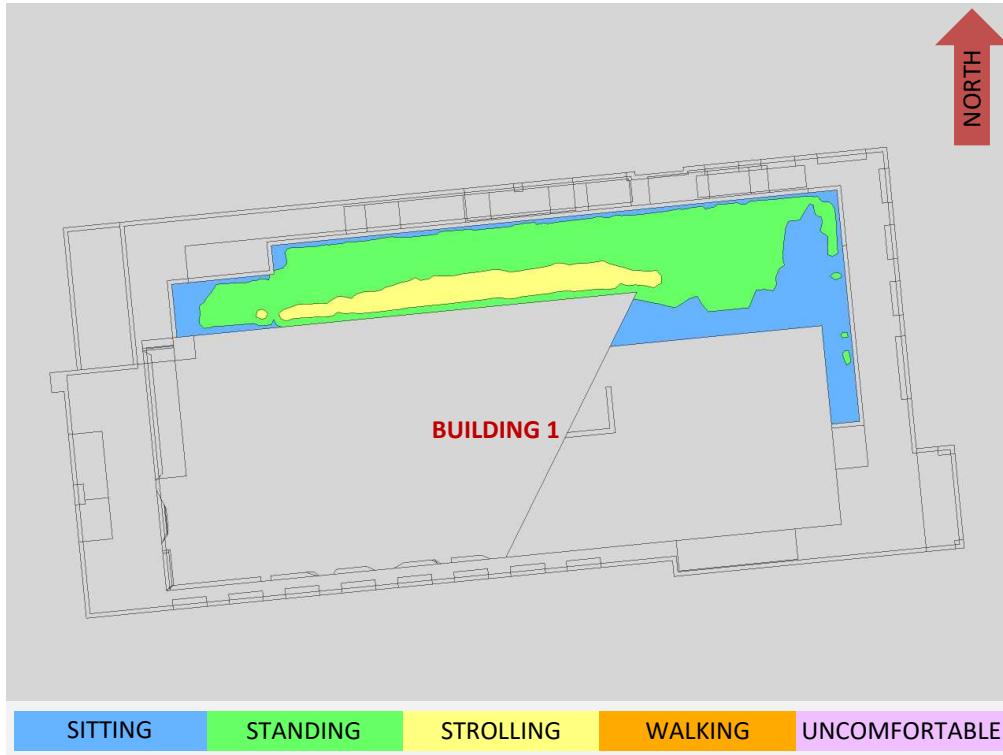


FIGURE 8C: AUTUMN – WIND COMFORT, MPH LEVEL BUILDING 1 TERRACE

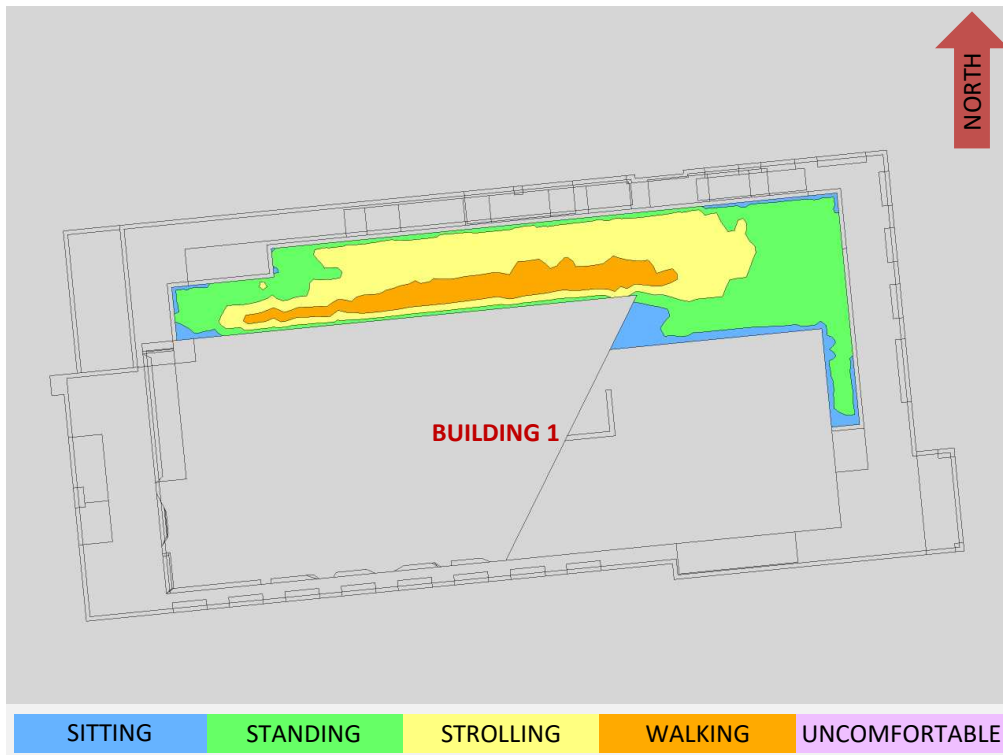


FIGURE 8D: WINTER – WIND COMFORT, MPH LEVEL BUILDING 1 TERRACE



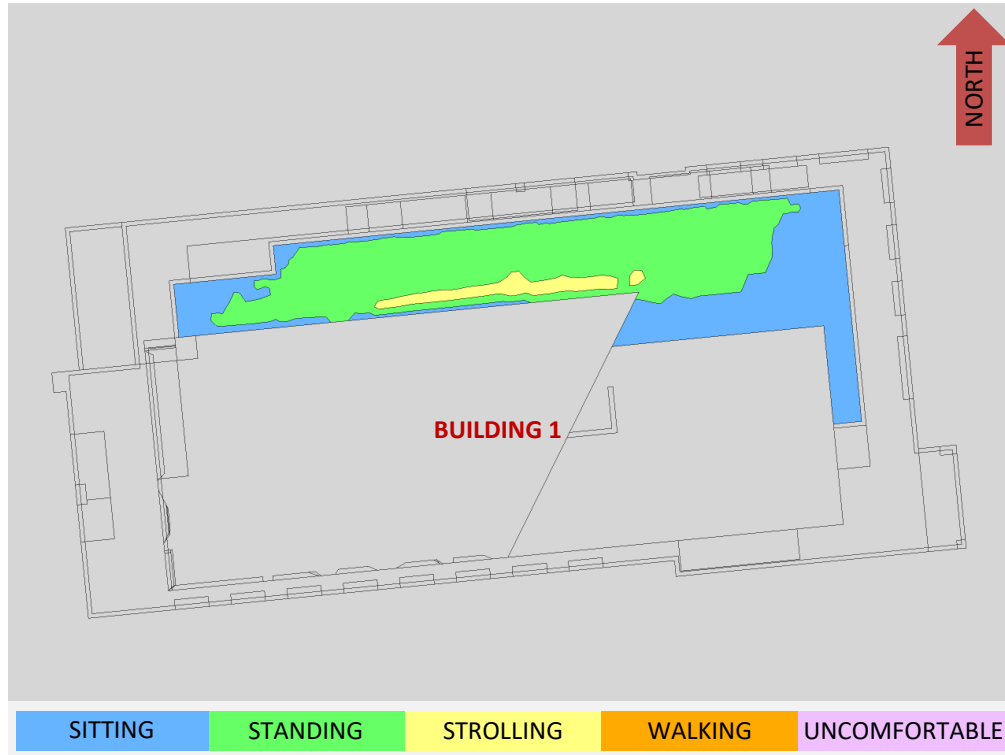


FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, MPH LEVEL BUILDING 1 TERRACE

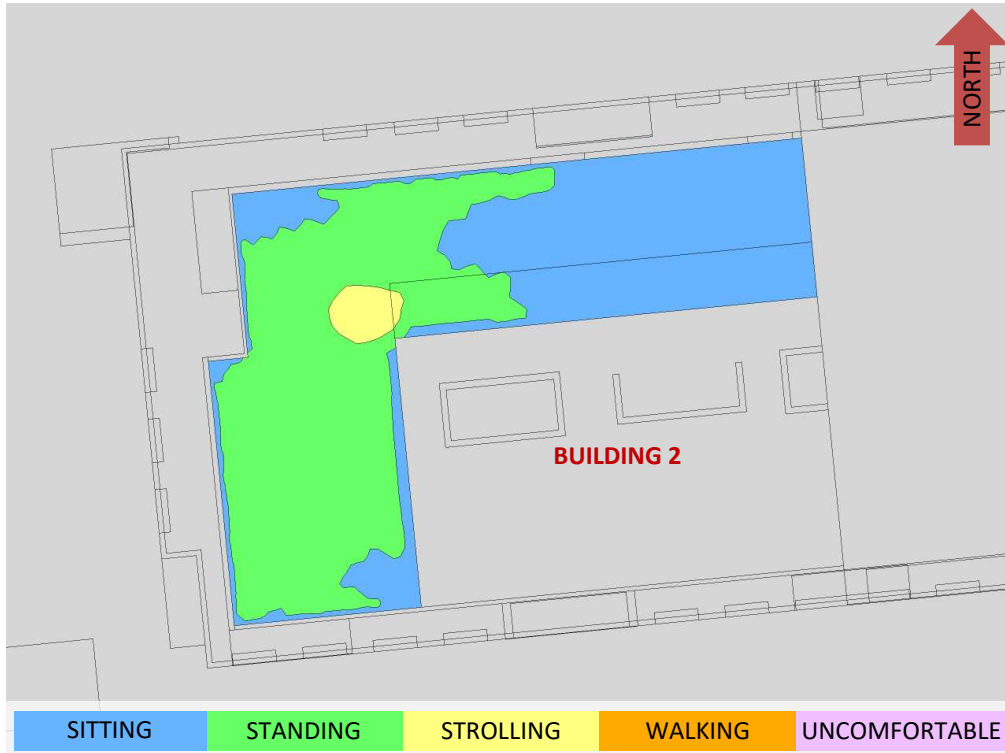


FIGURE 10A: SPRING – WIND COMFORT, MPH LEVEL BUILDING 2 TERRACE

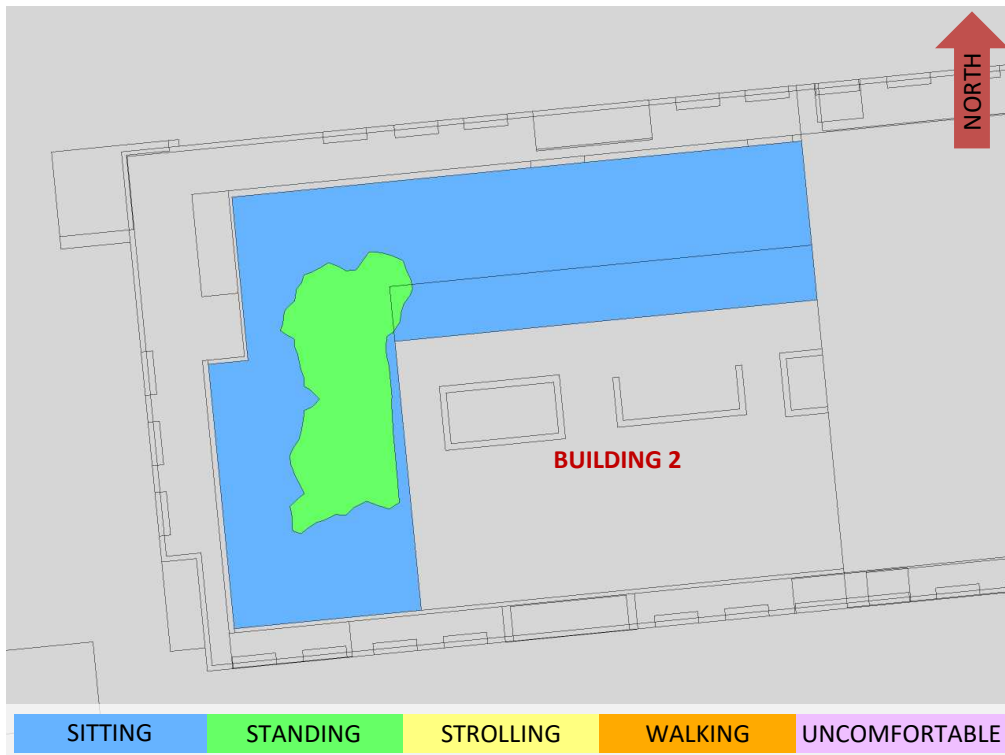


FIGURE 10B: SUMMER – WIND COMFORT, MPH LEVEL BUILDING 2 TERRACE



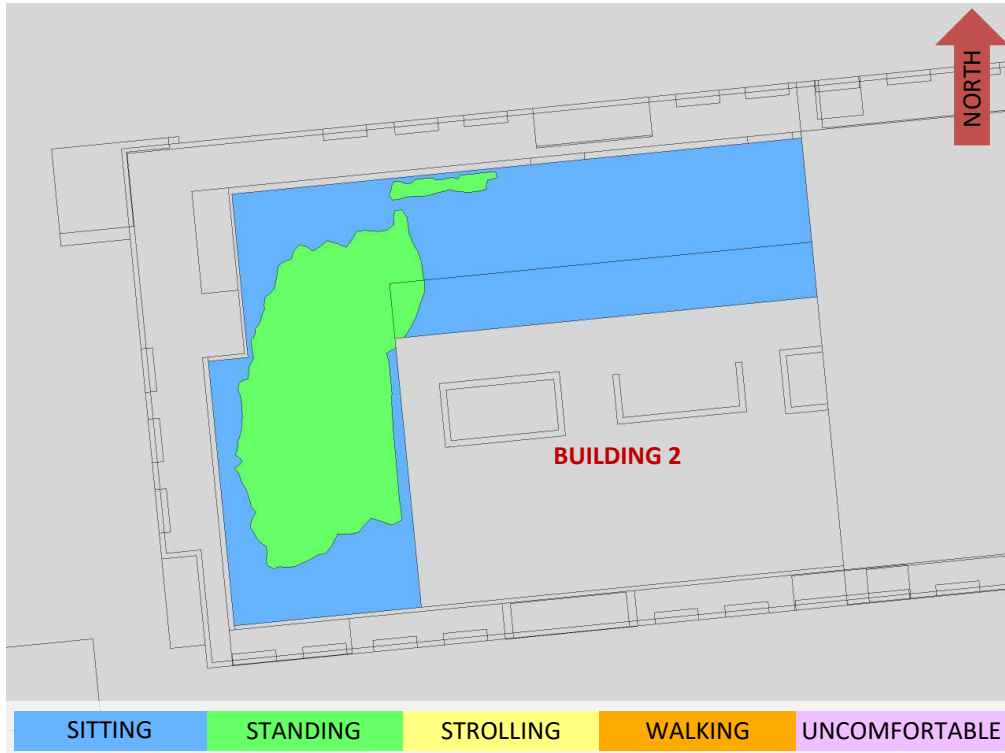


FIGURE 10C: AUTUMN – WIND COMFORT, MPH LEVEL BUILDING 2 TERRACE

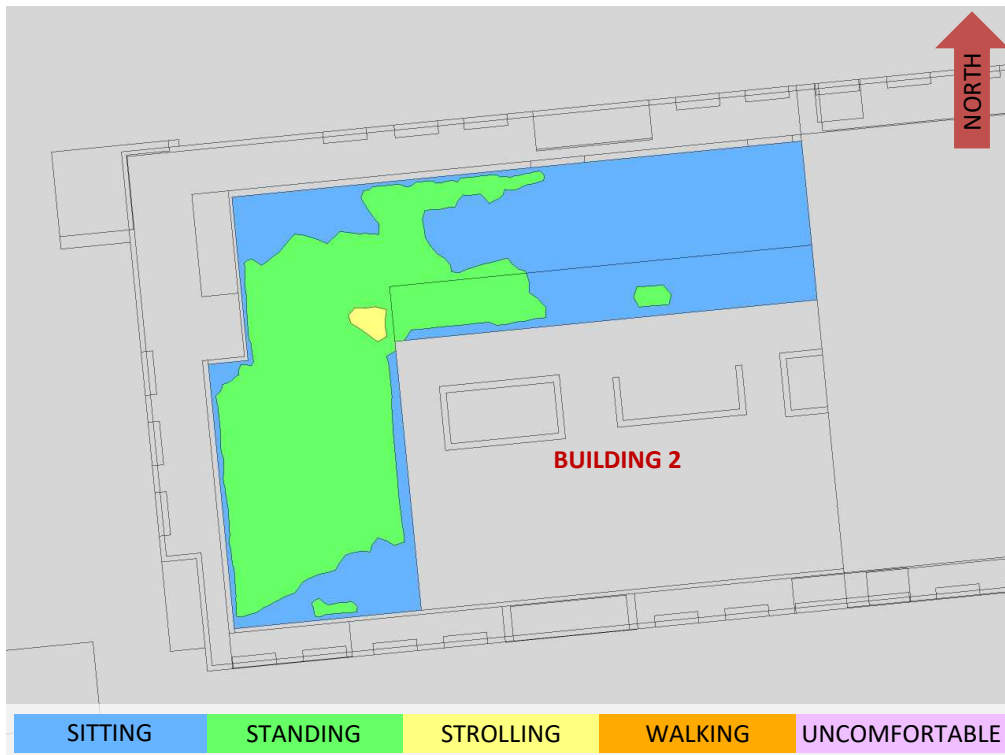


FIGURE 10D: WINTER – WIND COMFORT, MPH LEVEL BUILDING 2 TERRACE



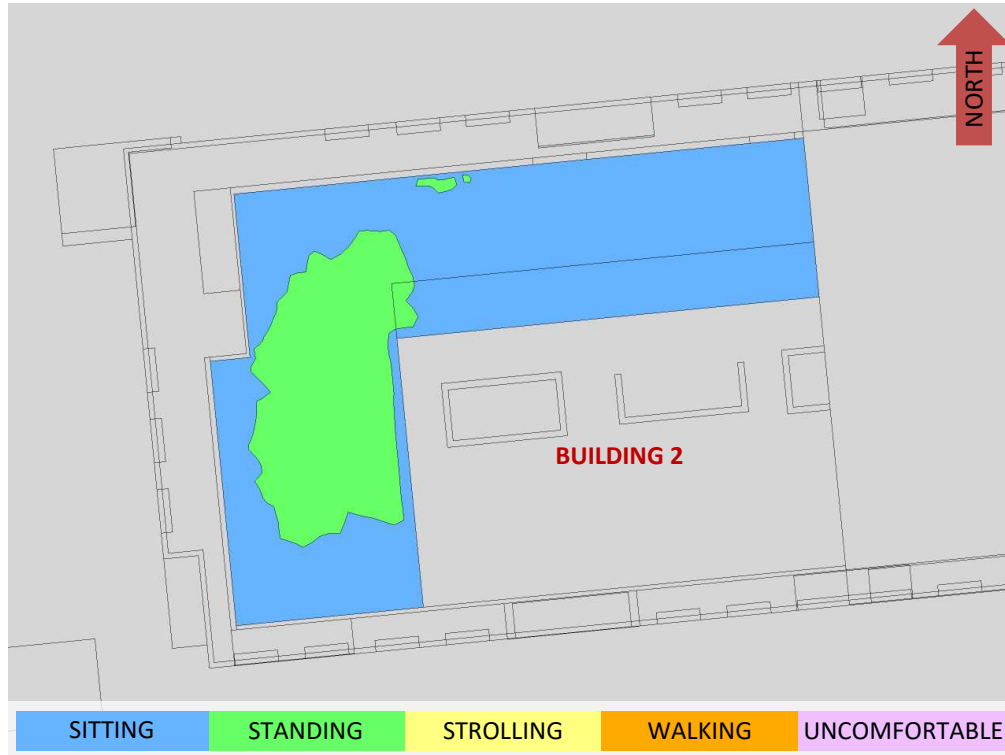


FIGURE 11: TYPICAL USE PERIOD – WIND COMFORT, MPH LEVEL BUILDING 2 TERRACE

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, 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 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	0.24
22.5	0.24
45	0.24
67.5	0.24
90	0.24
112.5	0.24
135	0.23
157.5	0.24
180	0.24
202.5	0.24
225	0.24
247.5	0.22
270	0.22
292.5	0.24
315	0.24
337.5	0.25

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.