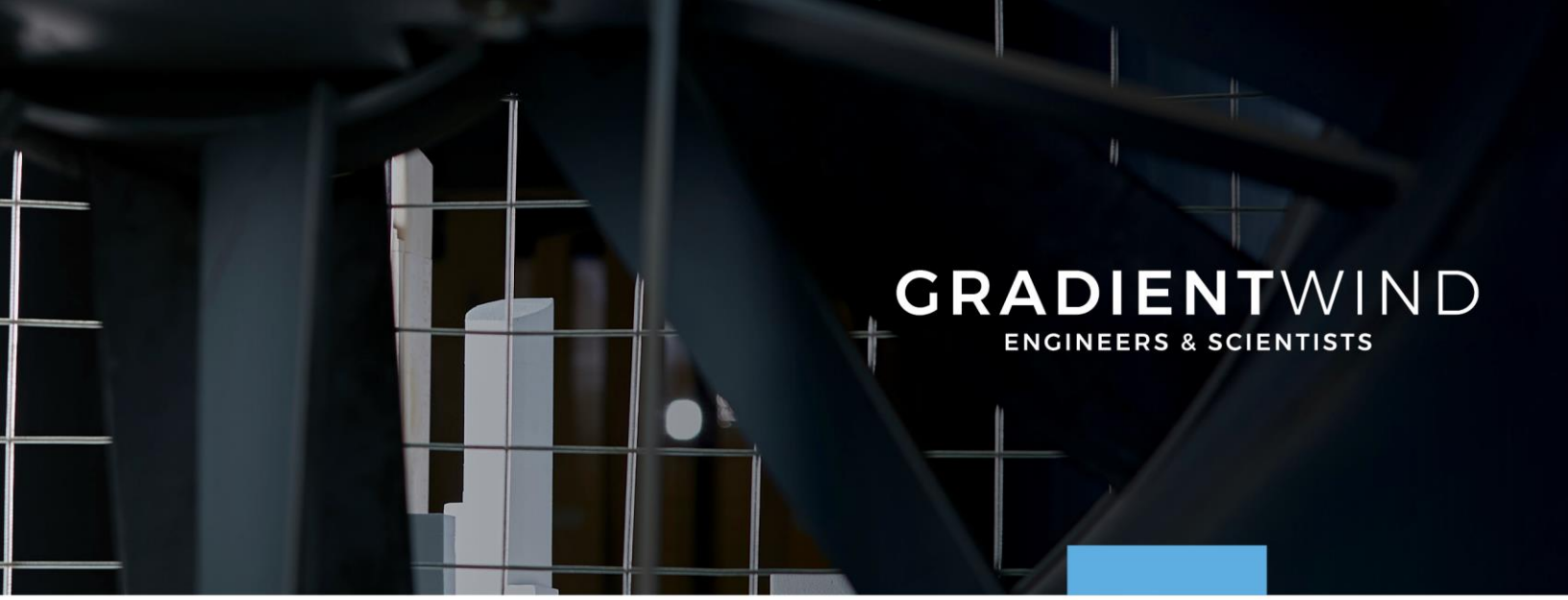
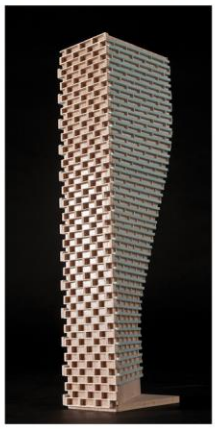


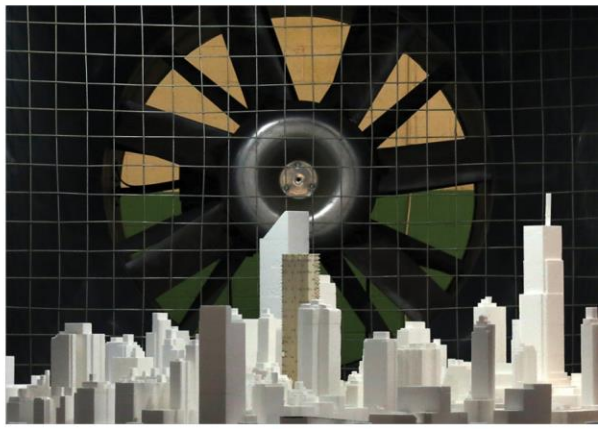
GRADIENTWIND
ENGINEERS & SCIENTISTS

PEDESTRIAN LEVEL WIND STUDY

2475 Regina Street
Ottawa, Ontario

Report: 22-068-PLW-2024





February 6, 2024

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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Site Plan Control application submission requirements for the proposed multi-building residential development located at 2475 Regina Street 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 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-6, 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 the Pinecrest Creek Pathway to the north, internal driveways, surface parking, and loading areas, most internal walkways serving the subject site, the terrace to the west of Building A1, and in the vicinity of most building access points, are considered acceptable. The areas of interest that are predicted to experience windier conditions are described as follows:

    a. The subject site is exposed to prevailing winds from the west-southwest clockwise to the north-northwest, and winds from the east and northeast, with the open wind exposures of the Britannia Conservation Area and the Ottawa River from the southwest clockwise to the north. Prominent easterly and northeasterly winds are predicted to accelerate around the exposed northeast corner of Tower T2, while those from the west-southwest clockwise to the north-northwest are predicted to downwash over the façades of Tower T2 and the existing 16-storey building to the southeast at 1275 Richmond Road, accelerating around the exposed southwest corner of Tower T2 and channelling between Tower T2 and 1275 Richmond Road.

b. **Pinecrest Creek Pathway to the East and the Walkway South of Tower T2:** The windiest conditions at grade are situated near the northeast corner of Tower T2 and to the south of Tower T2, where isolated regions of uncomfortable conditions are predicted during the colder months. Specifically, conditions during the winter season are predicted to be suitable for walking for approximately 77% of the time to the northeast of Tower T2, representing a 3% exceedance of the walking threshold. To the south of Tower T2, an isolated region of uncomfortable conditions is predicted during the spring, autumn, and winter seasons with conditions predicted to be suitable for walking for approximately 77%, 79%, and 73% of the time, respectively, during these seasons, representing 3%, 1%, and 7% exceedances of the walking threshold, respectively.

    - Notably, the portion of the Pinecrest Creek Pathway that is located to the northeast of Tower T2 will not receive winter maintenance. Given that the windiest conditions over this pathway occur during the winter season when the pathway will not be maintained, and pedestrian usage is thus expected to be infrequent and limited, the noted conditions may be considered satisfactory.

    - The windiest conditions to the south of Tower T2 are located away from pedestrian-accessible areas. Over the noted walkway, conditions are predicted to be suitable for walking, or better, throughout the year, with a small, isolated area during the winter that is predicted to exceed the walking comfort threshold by 1%. As the walking percentage exceedance is considered marginal, the noted conditions over the walkway may be considered satisfactory.

c. **Community Green and Exterior Communal Amenity Spaces.** During the typical use period, conditions within the community green and exterior communal amenity spaces situated to the northwest and southwest of Tower T2, respectively, are predicted to be suitable for mostly standing with conditions suitable for sitting closer to the building façade.

- Depending on programming, the noted wind conditions may be considered acceptable. Specifically, if these spaces will not accommodate seating or lounging activities, the noted conditions may be considered acceptable.

- If required by programming, comfort levels may be improved by implementing landscaping elements around sensitive areas, such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

- The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

d. **Primary Building Entrance Northeast of Tower T1.** Conditions along the east elevation of Tower T1 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for strolling during the winter and spring. It is recommended that the primary building entrance at the northeast corner of Tower T1 be recessed into the building façade by at least 1.5 m.

2) Wind comfort conditions within the common amenity terraces serving Building A1 at Level 3 and Towers T1 and T2 at Level 2 are predicted to be suitable for sitting during the typical use period, which is considered acceptable.

3) Regarding the common amenity terrace serving Tower T2 at the MPH Level, which was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace, wind comfort conditions are predicted to be suitable for mostly sitting during the typical use period. As conditions are predicted to be suitable for sitting over the majority of the noted amenity terrace, and the sitting percentage exceedance is considered marginal, the noted conditions are considered acceptable.

4) Regarding the common amenity terrace serving Tower T1 at the MPH Level, which was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace, conditions are predicted to be suitable for mostly sitting with conditions suitable for standing near the northwest and southwest corners of the tower during the typical use period.

    a. Depending on the programming of the noted amenity terrace, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable.

    b. If required by programming, conditions suitable for sitting may be extended over the full terrace area by implementing targeted landscaping elements around sensitive areas such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

5) The foregoing statements and conclusions apply to common weather systems, during which one area may be expected to experience dangerous wind conditions, as defined in Section 4.4. Specifically, the safety criterion may be exceeded on an annual basis within an isolated region at the above-noted windier area to the south of Tower T2, where conditions are predicted to occasionally be uncomfortable for walking. Further investigation, which may include additional wind simulations and testing, may be required to develop an appropriate strategy to improve wind comfort and to resolve safety conditions within the noted area.

TABLE OF CONTENTS

1. INTRODUCTION 1

2. TERMS OF REFERENCE 1

3. OBJECTIVES 3

4. METHODOLOGY 3

4.1 Computer-Based Context Modelling 3

4.2 Wind Speed Measurements 4

4.3 Historical Wind Speed and Direction Data 4

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa 7

5. RESULTS AND DISCUSSION 9

5.1 Wind Comfort Conditions – Grade Level 10

5.2 Wind Comfort Conditions – Common Amenity Terraces 14

5.3 Wind Safety 15

5.4 Applicability of Results 15

6. CONCLUSIONS AND RECOMMENDATIONS 16

FIGURES

APPENDICES

Appendix A – Simulation of the Atmospheric Boundary Layer

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Parkway House Development LP to undertake a pedestrian level wind (PLW) study to satisfy Site Plan Control application submission requirements for the proposed multi-building residential development located at 2475 Regina Street in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). A PLW study was conducted in May 2022[1] for the previous design of the proposed development (submitted for Zoning By-law Amendment application). 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 Diamond Schmitt Architects in January 2024 and landscape drawings prepared by Stantec Consulting Ltd. in January 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 2475 Regina Street in Ottawa, situated on a parcel of land bounded by Regina Street to the south, Lincoln Heights Road to the west, and Pinecrest Creek Pathway to the north and east. The proposed development is divided into two phases: Phase 1 comprises Building A1 (7 storeys) and Tower T1 (16 storeys), situated at the northwest corner and to the south of the subject site, respectively; Phase 2 comprises Tower T2 (28 storeys), situated to the east of the subject site. All three buildings are served by two shared below-grade parking levels and are topped with a mechanical penthouse (MPH).

The ground floor of Building A1 comprises a nominally 'L'-shaped planform with its long axis-oriented to the north and includes residential units along the north elevation, a main entrance at the southeast corner, residential units and offices to the south, a lounge, a kitchen, a dining area, and a loading area at the southwest corner, and shared building support spaces throughout the remainder of the level. A terrace to the west at grade-level serves Building A1.

[1] Gradient Wind Engineering Inc., '*2475 Regina Street – Pedestrian Level Wind Study*', [May 12, 2022]

Surface parking is located to the south of the short-axis of the building. Levels 2-7 include residential units, with indoor amenities near the southwest corner at Levels 2 and 3. The building steps back from the north elevation at Level 2 and from the west elevation at Levels 5-7 to accommodate private terraces and from the south elevation at Level 3 to accommodate a common amenity terrace.

The ground floor of Tower T1 comprises a near rectangular planform and includes a main entrance at the northeast corner, a loading area and shared building support spaces to the east, residential units to the south and west, and an office at the northwest corner. Access to the shared underground parking levels is provided by a ramp at the southwest corner of Tower T1 via a driveway from Regina Street. Level 2 includes residential units to the north and indoor amenities to the south. The building extends from the west elevation at Level 2 to accommodate a common amenity terrace. Levels 3-16 rise with a typical residential planform. The MPH Level is served by a common amenity terrace to the west and a green roof to the east.

The ground floor of Tower T2 comprises a near rectangular planform and includes a main entrance and shared building support spaces to the west, residential units to the north and east, and a loading area at the southwest corner. A community green space is located at the northwest corner, an exterior communal amenity space is located at the southwest corner, and private yards are located at the northwest corner and to the east of Tower T2. Level 2 includes residential units to the north and indoor amenities to the south. The building extends from the east elevation at Level 2 to accommodate a common amenity terrace. Levels 3-16 are reserved for residential use. The building steps back from the north elevation at Levels 8-10 to accommodate private terraces. The MPH Level is served by a common amenity terrace to the east and a green roof to the west.

The near-field surroundings, defined as an area within 200 metres (m) of the subject site, include two mid-rise residential buildings as well as low-rise commercial and community buildings to the south, low-rise residential buildings to the southwest and west, and green spaces in the remaining compass directions. Notably, Pinecrest Creek Pathway extends from the southeast, branching off to the north and northwest, and is located to the immediate north and east of the subject site.

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 primarily by low-rise buildings with isolated mid- and high-rise buildings to the northeast, east, and southwest. In addition, the Ottawa River flows from the west to the northeast, approximately 540 m to the north of the subject site.

A site plan for the proposed massing scenario is illustrated in Figure 1, while Figures 2A-2D illustrate the computational model used to conduct the study.

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 criteria[2]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

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.

[2] City of Ottawa Terms of References: Wind Analysis
https://documents.ottawa.ca/sites/default/files/torwindanalysis_en.pdf

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

An industry standard practice is to omit trees, vegetation, and other existing and planned landscape elements from the model due to the difficulty of providing accurate seasonal representation of vegetation. The omission of trees and other landscaping elements produces slightly stronger wind speeds.

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the site for 12 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 510 m. The process was performed for the proposed massing scenario, as noted in Section 2.

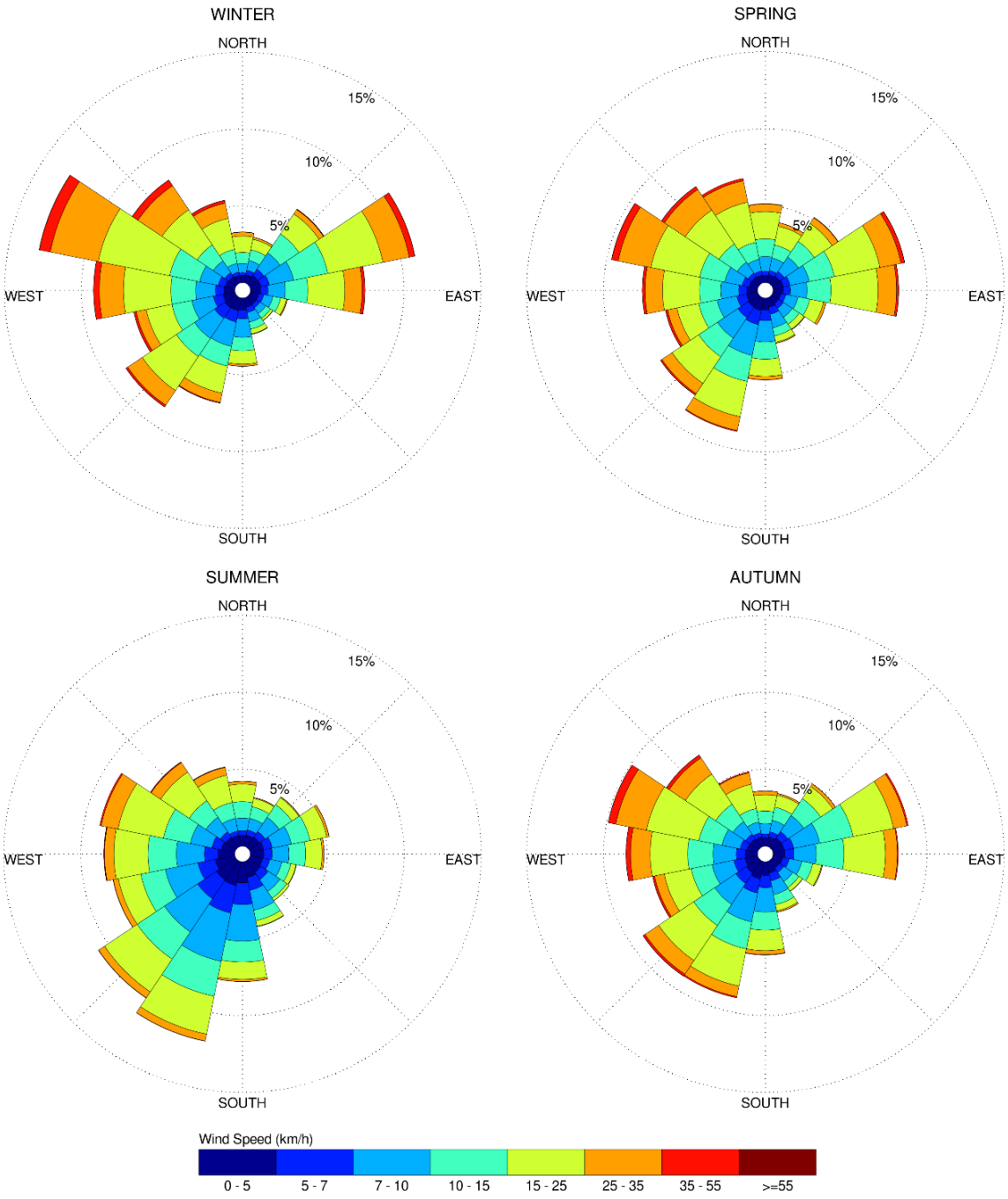
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the common amenity terraces serving the proposed development 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 for each month of the year to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns.

The statistical model of the 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	GEM 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-3D, illustrating wind conditions at grade level for the proposed massing scenario, and by Figures 5A-5D, which illustrate conditions over the common amenity terrace serving Building A1 at Level 3 and the common amenity terraces serving Towers T1 and T2 at Level 2 and 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 4 and 6 illustrate wind comfort conditions at grade level and over the noted common amenity terraces serving the proposed development, 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

Pinecrest Creek Pathway North of Subject Site: Following the introduction of the proposed development, wind comfort conditions over the Pinecrest Creek Pathway to the north of the subject site are predicted to be suitable for mostly sitting during the summer, becoming suitable for standing, or better, during the autumn, and suitable for strolling, or better, during the winter and spring. The noted conditions are considered acceptable.

The introduction of the proposed development is predicted to improve comfort levels over the Pinecrest Creek Pathway to the north in comparison to existing conditions (refer to Section 5 of the previous PLW report noted in Section 1 for a detailed description of the predicted wind comfort conditions for the existing massing scenario), and wind comfort conditions with the proposed development over the areas of the Pinecrest Creek Pathway to the north of the subject site are considered acceptable.

Pinecrest Creek Pathway East of Subject Site: The introduction of the proposed development produces windier conditions over Pinecrest Creek Pathway to the east in comparison to existing conditions (refer to Section 5 of the previous PLW report noted in Section 1 for a detailed description of the predicted wind comfort conditions for the existing massing scenario).

Specifically, following the introduction of the proposed development, wind conditions over the Pinecrest Creek Pathway to the east 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 throughout the remainder of the year with a region suitable for walking.

The windiest conditions are situated near the northeast corner of Tower T2, where an isolated region of conditions that may be considered uncomfortable for walking is predicted during the winter. Specifically, conditions during the winter season are predicted to be suitable for walking for approximately 77% of the time, representing a 3% exceedance of the walking threshold. The noted conditions are predicted to impact a section of the Pinecrest Creek Pathway.

The proposed development is exposed to prevailing winds from multiple directions, including the open exposure of the subject site to winds from the open areas of the Britannia Conservation Area and the Ottawa River from the west-southwest clockwise to the north-northwest. The windy conditions to the northeast of Tower T2 are attributed to the acceleration of salient winds around the exposed northeast corner of Tower T2, with the limited built-up massing in the near-field surroundings to the northeast and east providing less shielding of the subject site from prominent winds from these directions.

Notably, the portion of the Pinecrest Creek Pathway that is located to the northeast of Tower T2 will not receive winter maintenance. Given that the windiest conditions over this pathway occur during the winter season when the pathway will not be maintained, and pedestrian usage is thus expected to be infrequent and limited, the noted conditions may be considered satisfactory.

Sidewalks Along Regina Street: Following the introduction of the proposed development, conditions over the nearby public sidewalks along Regina Street are predicted to be suitable for standing, or better, throughout the year, with an isolated region suitable for strolling during the winter. While the introduction of the proposed development produces slightly windier conditions over Regina Street in comparison to existing conditions (refer to Section 5 of the noted previous PLW report mentioned in Section 1 for a detailed description of the predicted wind comfort conditions for the existing massing scenario), wind conditions with the proposed development are nevertheless considered acceptable.

Community Green and Exterior Communal Amenity Spaces: Wind comfort conditions during the typical use period within the community green and exterior communal amenity spaces situated to the northwest and southwest of Tower T2, respectively, are predicted to be suitable for mostly standing with conditions suitable for sitting closer to the building façade. Depending on the programming of these spaces, the noted wind conditions may be considered acceptable. Specifically, if these spaces will not accommodate seating or lounging activities, the noted conditions may be considered acceptable.

If required by programming, comfort levels within the noted spaces may be improved by implementing landscaping elements around sensitive areas such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

Terrace: Wind conditions within the terrace to the west of Building A1 are predicted to be suitable for mostly sitting during the typical use period. The noted conditions are considered acceptable.

Driveway, Walkways, Surface Parking, and Loading Areas within Subject Site: Conditions over the driveway within the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the autumn, and suitable for walking, or better, during the winter and spring. Conditions over the surface parking situated to the south of the short-axis of Building A1 are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, throughout the remainder of the year. Conditions over the loading area to the east of Tower T1 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for strolling during the winter and spring. Conditions over the loading area to the southwest of Tower T2 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the spring and autumn, and suitable for a mix of strolling and walking during the winter. The noted conditions are considered acceptable.

Wind conditions over the walkways within the subject site are predicted to be suitable for standing, or better, during the summer, becoming suitable for mostly strolling, or better, during the autumn, and suitable for walking, or better, during the winter and spring. The windiest conditions are situated to the south of Tower T2, where an isolated region of uncomfortable conditions is predicted during the spring, autumn, and winter. Specifically, conditions during the spring season are predicted to be suitable for walking for at least 77% of the time, representing a 3% exceedance of the walking threshold, conditions during the autumn season are predicted to be suitable for walking for approximately 79% of the time, representing a 1% exceedance of the walking threshold, and conditions during the winter season are predicted to be suitable for walking for approximately 73% of the time, representing a 7% exceedance of the walking threshold.

These conditions are attributed to the prevailing winds from the west-southwest clockwise to the north-northwest, as noted above, which are predicted to downwash over the façades of Tower T2 and the existing 16-storey building to the southeast at 1275 Richmond Road ("Richmond Park Square"), in combination with the acceleration of the prominent winds around the exposed southwest corner of Tower T2 and between the gap between Tower T2 and the Richmond Park Square building.

However, the windiest conditions are mostly located away from the walkway along the south elevation of Tower T2. Pedestrian access to the windiest areas away from the walkway is expected to be limited. Over the walkway and pedestrian-accessible areas, conditions are predicted to be suitable for mostly suitable for walking, or better, throughout the year, with a small, isolated area during the winter season that is predicted to be suitable for walking for approximately 79% of the time, representing a 1% exceedance of the walking threshold. As the walking percentage exceedance over the walkway is considered marginal, the noted conditions may be considered satisfactory.

Building Access Points: Wind conditions in the vicinity of the building access points along the east elevation of Tower T1 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for strolling during the winter and spring. It is recommended that the primary building entrance at the northeast corner of Tower T1 be recessed into the building façade by at least 1.5 m.

Conditions in the vicinity of the remaining building access points serving the proposed development 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

Building A1, Level 3 Amenity Terrace: Conditions over the common amenity terrace serving Building A1 at Level 3 are predicted to be suitable for sitting during the typical use period, as illustrated in Figure 6. The noted conditions are considered acceptable.

Tower T1, Level 2 Amenity Terrace: Conditions over the common amenity terrace serving Tower T1 at Level 2 are predicted to be suitable for sitting throughout the year, which is considered acceptable.

Tower T1, MPH Level Amenity Terrace: The common amenity terrace serving Tower T1 at the MPH Level was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace. With the noted wind screens, conditions within the terrace are predicted to be suitable for mostly sitting with conditions suitable for standing near the northwest and southwest corners of the MPH during the typical use period, as illustrated in Figure 6.Where conditions are suitable for standing, they are also suitable for sitting for at least 79% of the time within the standing area near the northwest corner of the tower and 76% of the time within the standing area near the southwest corner of the tower during the same period, where the target is 80% to achieve the sitting comfort class.

Depending on the programming of the MPH Level amenity terrace serving Tower T1, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable. If required by programming, conditions suitable for sitting may be extended over the full terrace area by implementing targeted landscaping elements around sensitive areas such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

Tower T2, Level 2 Amenity Terrace: Conditions over the common amenity terrace serving Tower T2 at Level 2 are predicted to be suitable for sitting during the typical use period, as illustrated in Figure 6. The noted conditions are considered acceptable.

Tower T2, MPH Level Amenity Terrace: The common amenity terrace serving Tower T2 at the MPH Level was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace. With the noted wind screens, conditions within the terrace are predicted to be suitable for mostly sitting with an isolated region of conditions suitable for standing to the east of the MPH during the typical use period, as illustrated in

Figure 6. The noted isolated region of standing conditions is also suitable for sitting for at least 79% of the time during the same period, where the target is 80% to achieve the sitting comfort class. As conditions are predicted to be suitable for sitting over most of the MPH Level amenity terrace serving Tower T2, and the sitting percentage exceedance is considered marginal, the noted conditions are considered acceptable.

5.3 Wind Safety

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, one pedestrian area within or surrounding the subject site may experience conditions that could be considered dangerous, as defined in Section 4.4. Specifically, the safety criterion may be exceeded on an annual basis within an isolated region at the above-noted windier area to the south of Tower T2, where conditions are predicted to occasionally be uncomfortable for walking. Further investigation, which may include additional wind simulations and testing, may be required to develop an appropriate strategy to improve wind comfort and to resolve safety conditions within the noted area.

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-6. 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 the Pinecrest Creek Pathway to the north, internal driveways, most internal walkways serving the subject site, surface parking, and loading areas, the terrace to the west of Building A1, and in the vicinity of most building access points, are considered acceptable. The areas of interest that are predicted to experience windier conditions are described as follows:

    a. The subject site is exposed to prevailing winds from the west-southwest clockwise to the north-northwest, and winds from the east and northeast, with the open wind exposures of the Britannia Conservation Area and the Ottawa River further from the subject site from the southwest clockwise to the north. Prominent easterly and northeasterly winds are predicted to accelerate around the exposed northeast corner of Tower T2, while those from the west-southwest clockwise to the north-northwest are predicted to downwash over the façades of Tower T2 and the existing 16-storey building to the southeast at 1275 Richmond Road, accelerating around the exposed southwest corner of Tower T2 and channelling between Tower T2 and 1275 Richmond Road.

    b. **Pinecrest Creek Pathway to the East and the Walkway South of Tower T2:** The windiest conditions at grade are situated near the northeast corner of Tower T2 and to the south of Tower T2, where isolated regions of uncomfortable conditions are predicted during the colder months. Specifically, conditions during the winter season are predicted to be suitable for walking for approximately 77% of the time to the northeast of Tower T2, representing a 3% exceedance of the walking threshold.

To the south of Tower T2, an isolated region of uncomfortable conditions is predicted during the spring, autumn, and winter seasons with conditions predicted to be suitable for walking for approximately 77%, 79%, and 73% of the time, respectively, during these seasons, representing 3%, 1%, and 7% exceedances of the walking threshold, respectively.

- Notably, the portion of the Pinecrest Creek Pathway that is located to the northeast of Tower T2 will not receive winter maintenance. Given that the windiest conditions over this pathway occur during the winter season when the pathway will not be maintained, and pedestrian usage is thus expected to be infrequent and limited, the noted conditions may be considered satisfactory.

- The windiest conditions to the south of Tower T2 are located away from pedestrian-accessible areas. Over the noted walkway, conditions are predicted to be suitable for walking, or better, throughout the year, with a small, isolated area during the winter that is predicted to exceed the walking comfort threshold by 1%. As the walking percentage exceedance is considered marginal, the noted conditions over the walkway may be considered satisfactory.

c. **Community Green and Exterior Communal Amenity Spaces.** During the typical use period, conditions within the community green and exterior communal amenity spaces situated to the northwest and southwest of Tower T2, respectively, are predicted to be suitable for mostly standing with conditions suitable for sitting closer to the building façade.

- Depending on programming, the noted wind conditions may be considered acceptable. Specifically, if these spaces will not accommodate seating or lounging activities, the noted conditions may be considered acceptable.

- If required by programming, comfort levels may be improved by implementing landscaping elements around sensitive areas, such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

- The extent of the mitigation measures is dependent on the programming of the noted spaces. If required by programming, an appropriate mitigation strategy will be developed in collaboration with the building and landscape architects as the design of the proposed development progresses.

d. **Primary Building Entrance Northeast of Tower T1.** Conditions along the east elevation of Tower T1 are predicted to be suitable for standing during the summer, becoming suitable for a mix of standing and strolling during the autumn, and suitable for strolling during the winter and spring. It is recommended that the primary building entrance at the northeast corner of Tower T1 be recessed into the building façade by at least 1.5 m.

2) Wind comfort conditions within the common amenity terraces serving Building A1 at Level 3 and Towers T1 and T2 at Level 2 are predicted to be suitable for sitting during the typical use period, which is considered acceptable.

3) Regarding the common amenity terrace serving Tower T2 at the MPH Level, which was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace, wind comfort conditions are predicted to be suitable for mostly sitting during the typical use period. As conditions are predicted to be suitable for sitting over the majority of the noted amenity terrace, and the sitting percentage exceedance is considered marginal, the noted conditions are considered acceptable.

4) Regarding the common amenity terrace serving Tower T1 at the MPH Level, which was modelled with 1.8-m-tall wind screens along the full perimeter of the terrace, conditions are predicted to be suitable for mostly sitting with conditions suitable for standing near the northwest and southwest corners of the tower during the typical use period.

a. Depending on the programming of the noted amenity terrace, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or more sedentary activities, the noted wind conditions would be considered acceptable.

b. If required by programming, conditions suitable for sitting may be extended over the full terrace area by implementing targeted landscaping elements around sensitive areas such as tall wind screens and coniferous plantings in dense arrangements, in combination with other local wind mitigation.

5) The foregoing statements and conclusions apply to common weather systems, during which one area may be expected to experience dangerous wind conditions, as defined in Section 4.4. Specifically, the safety criterion may be exceeded on an annual basis within an isolated region at the above-noted windier area to the south of Tower T2, where conditions are predicted to occasionally be uncomfortable for walking. Further investigation, which may include additional wind simulations and testing, may be required to develop an appropriate strategy to improve wind comfort and to resolve safety conditions within the noted area.

Sincerely,

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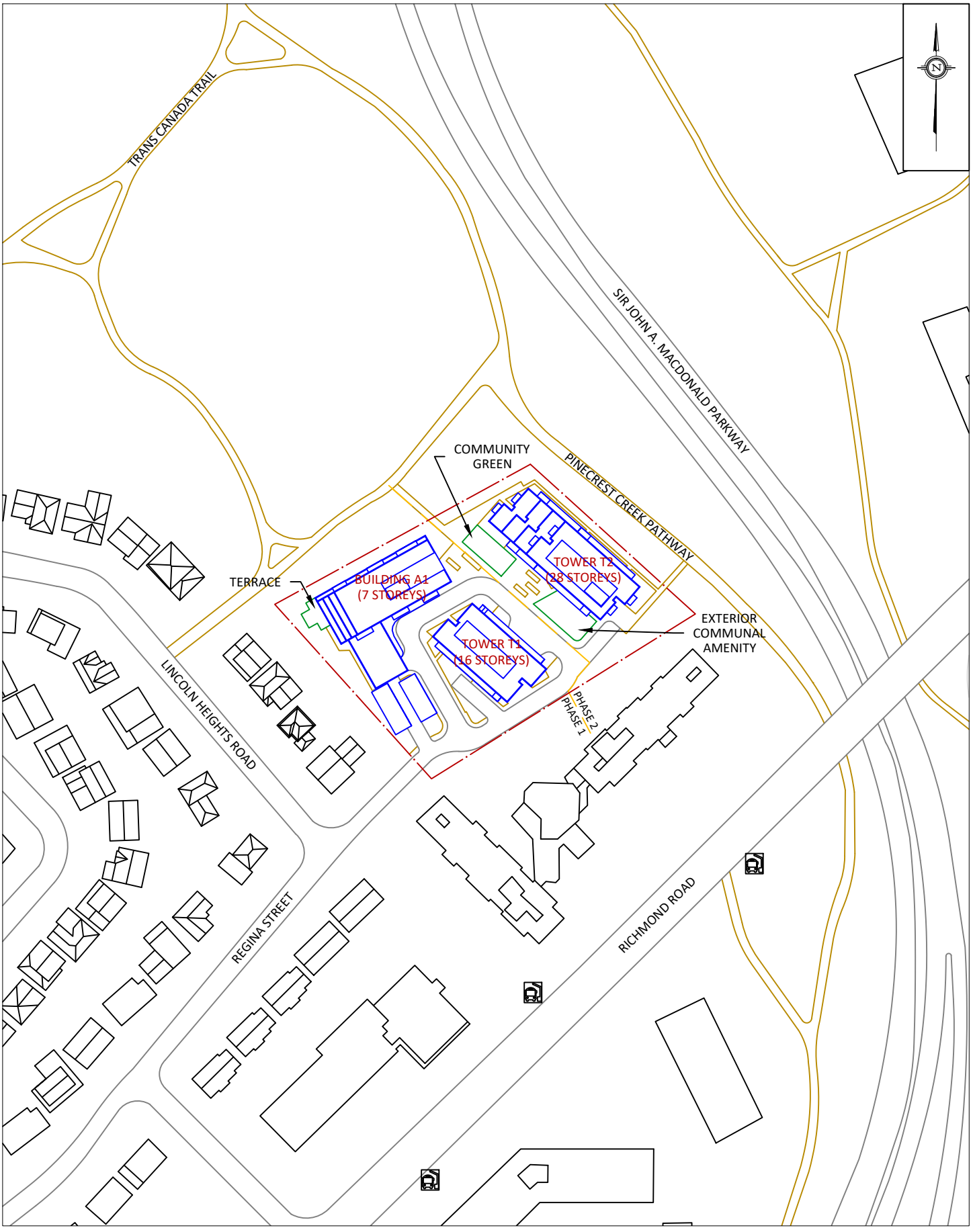

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PROJECT	2475 REGINA STREET, OTTAWA PEDESTRIAN LEVEL WIND STUDY
SCALE	1:2000
DRAWING NO.	22-068-PLW-2024-1
DATE	FEBRUARY 6, 2024
DRAWN BY	S.K.

DESCRIPTION

FIGURE 1:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT

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

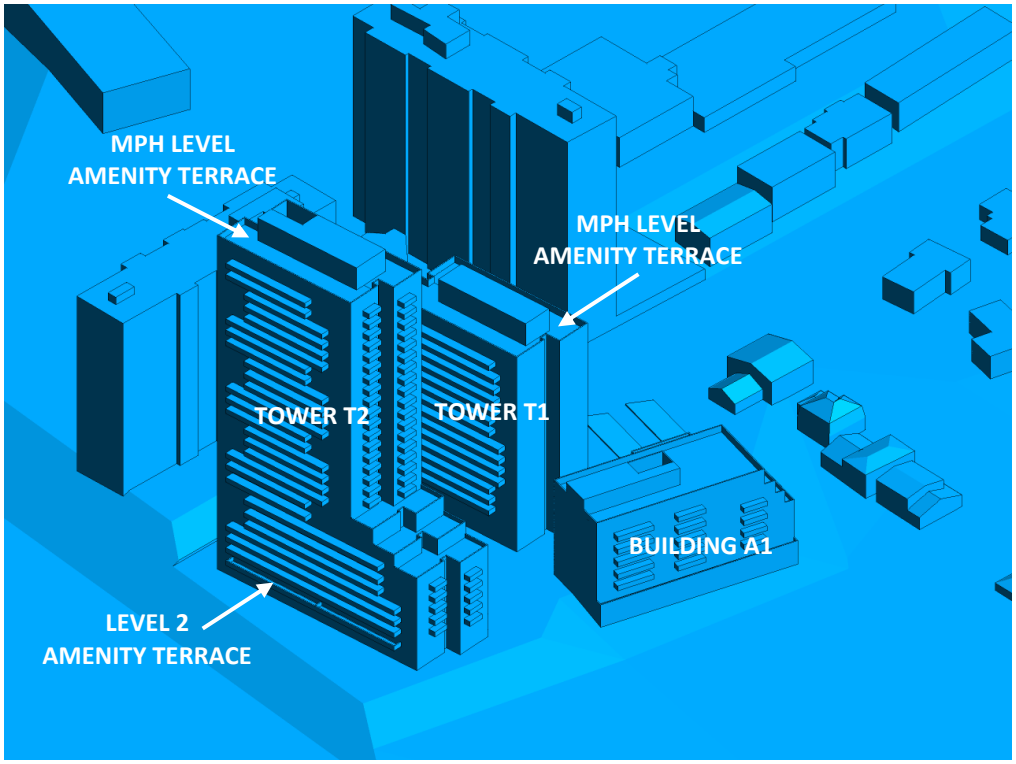


FIGURE 2B: CLOSE UP OF FIGURE 2A

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

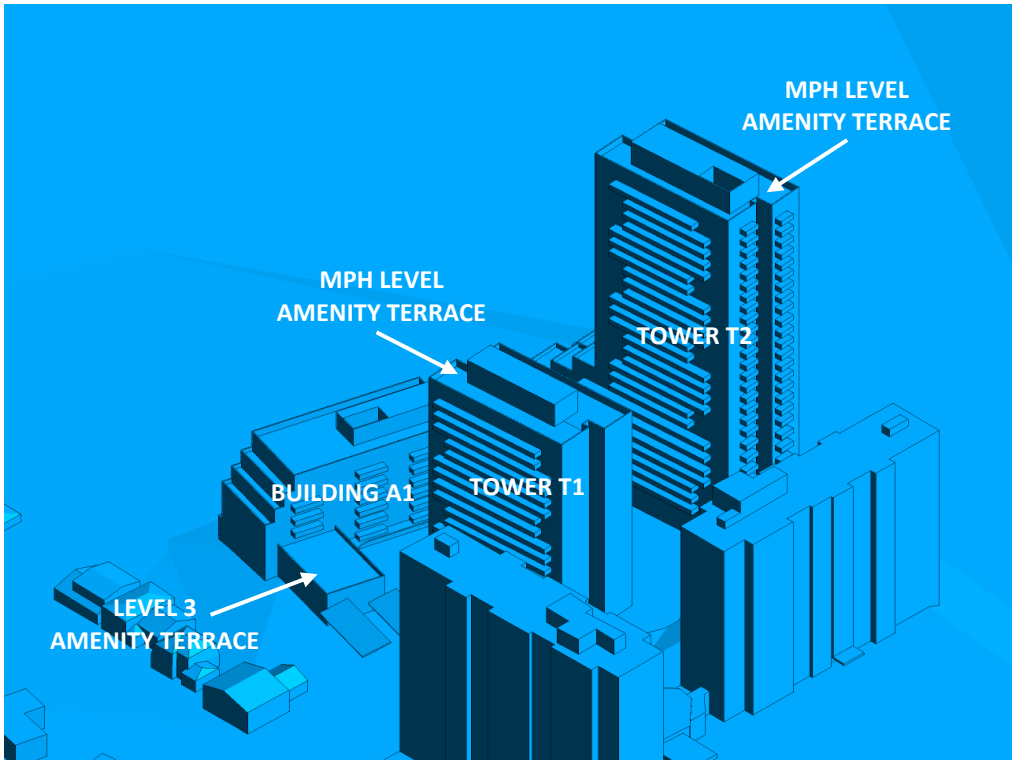


FIGURE 2D: CLOSE UP OF FIGURE 2C

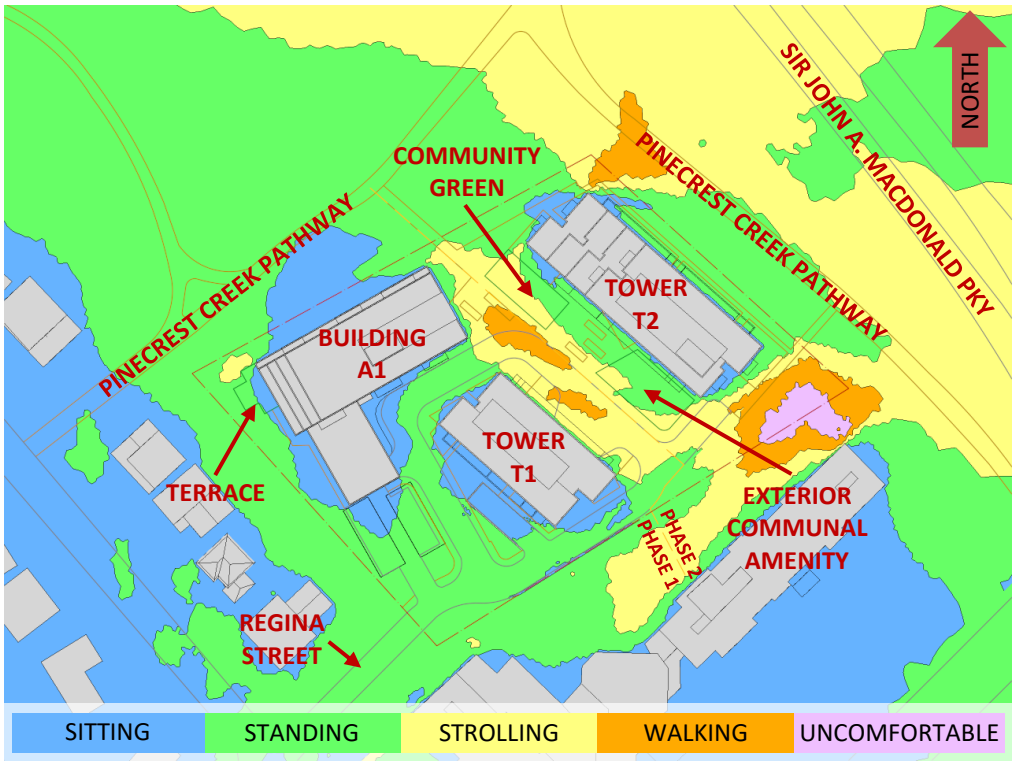


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

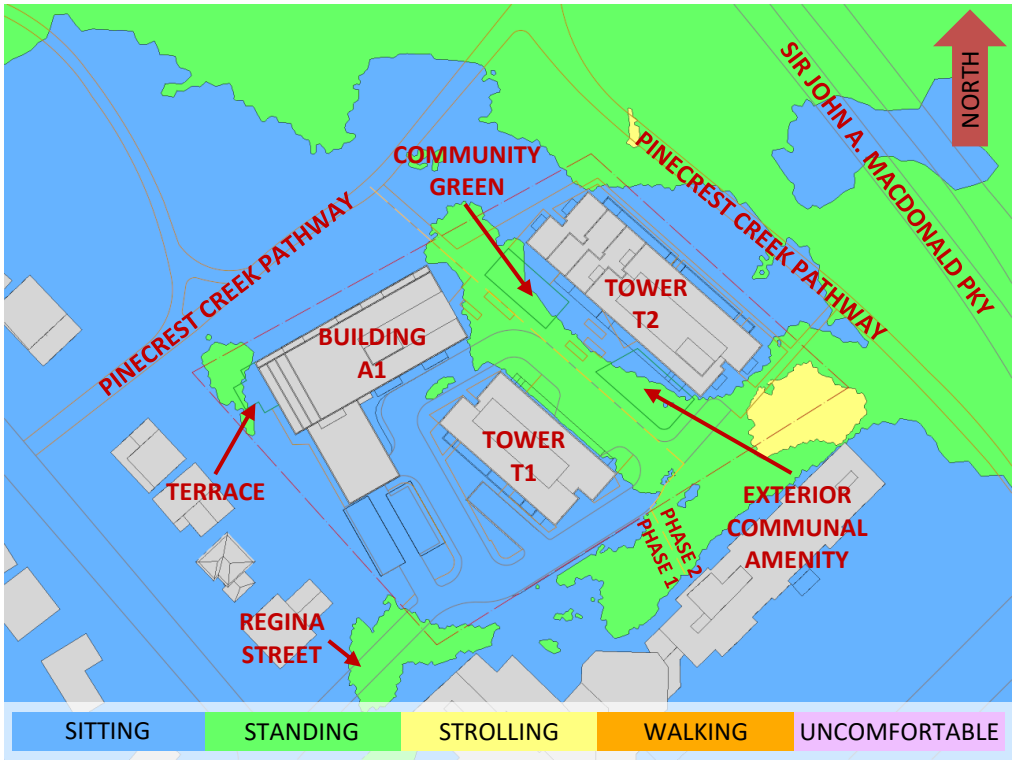


FIGURE 3B: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

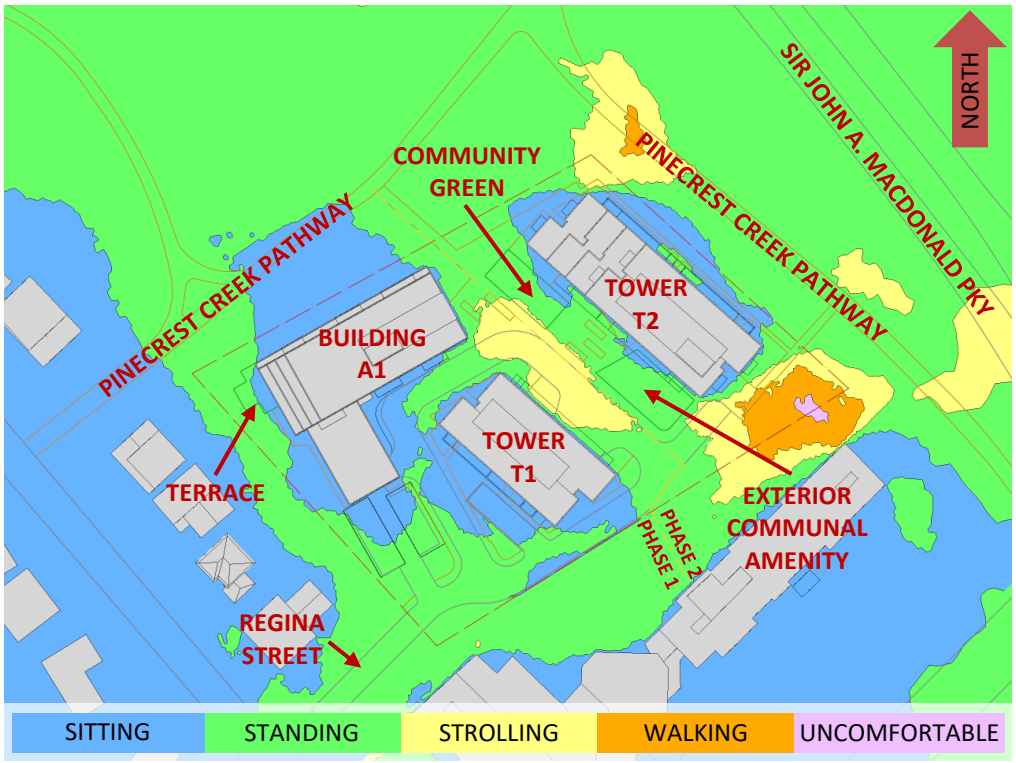


FIGURE 3C: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

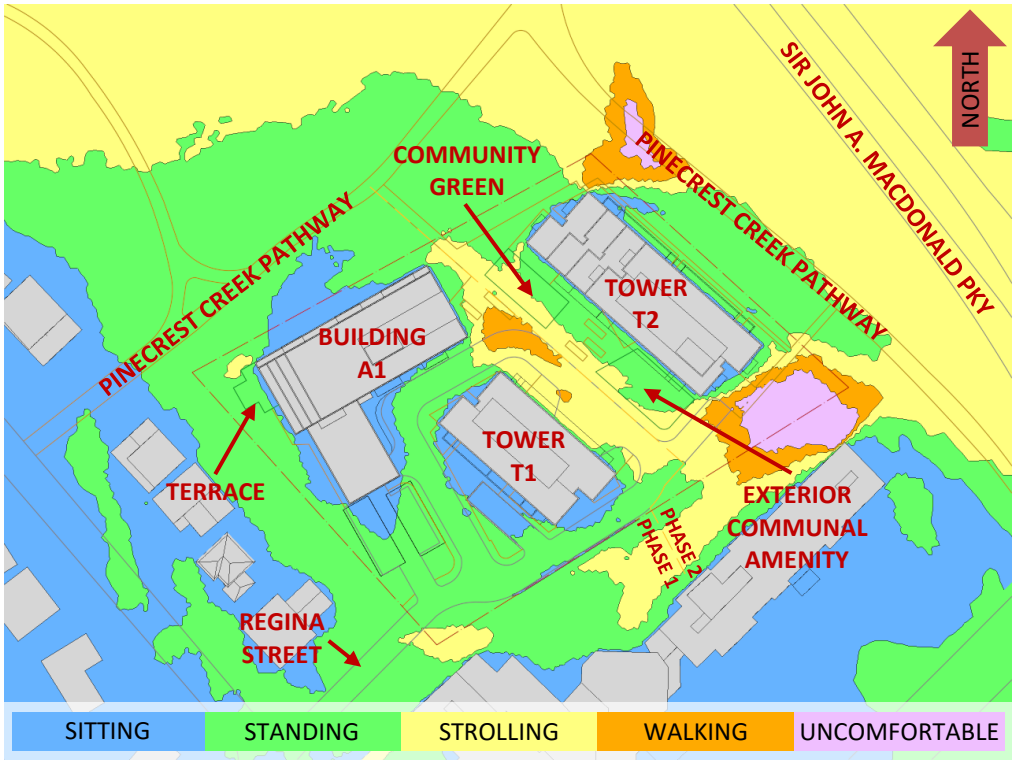


FIGURE 3D: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

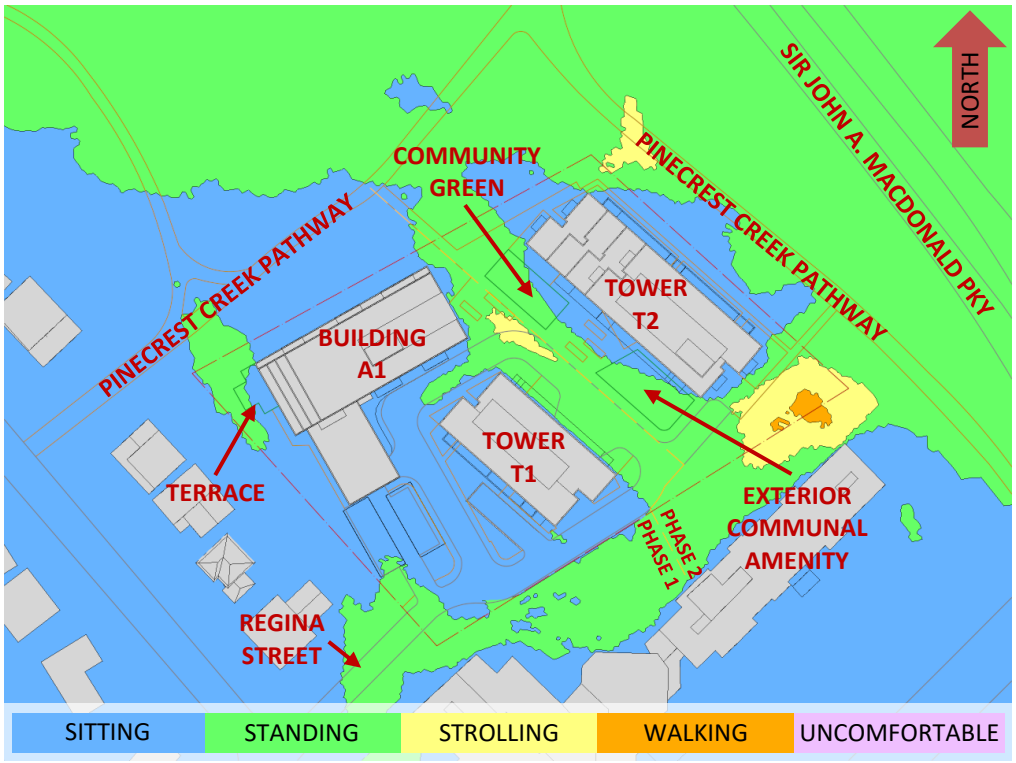


FIGURE 4: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

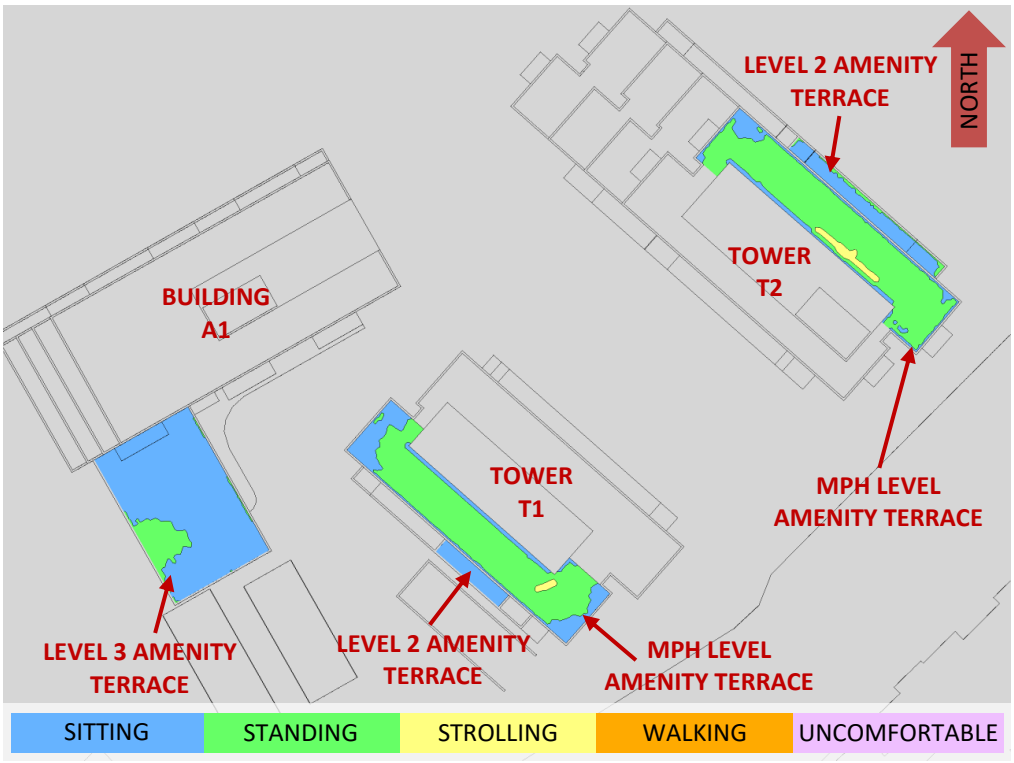


FIGURE 5A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

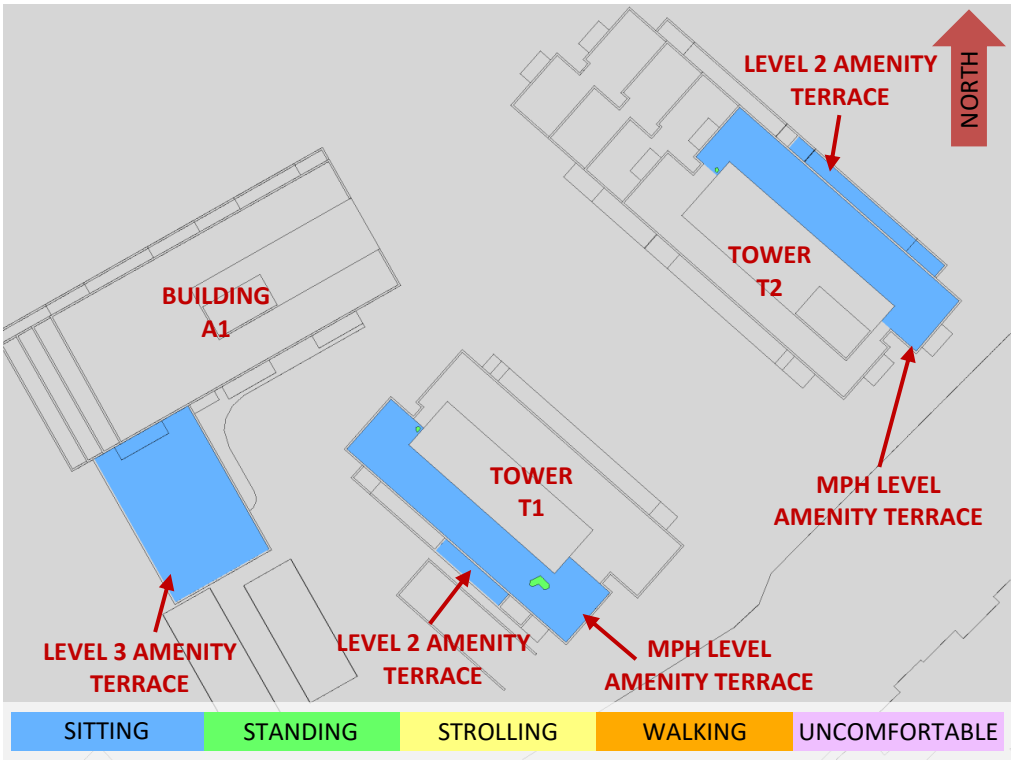


FIGURE 5B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

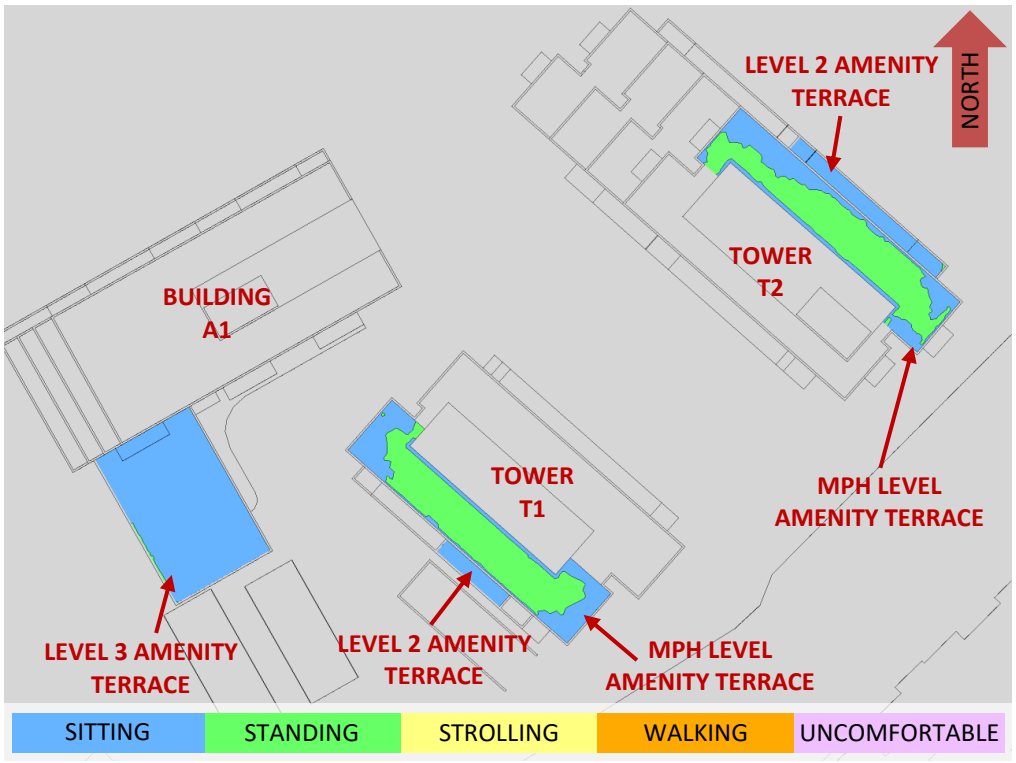


FIGURE 5C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

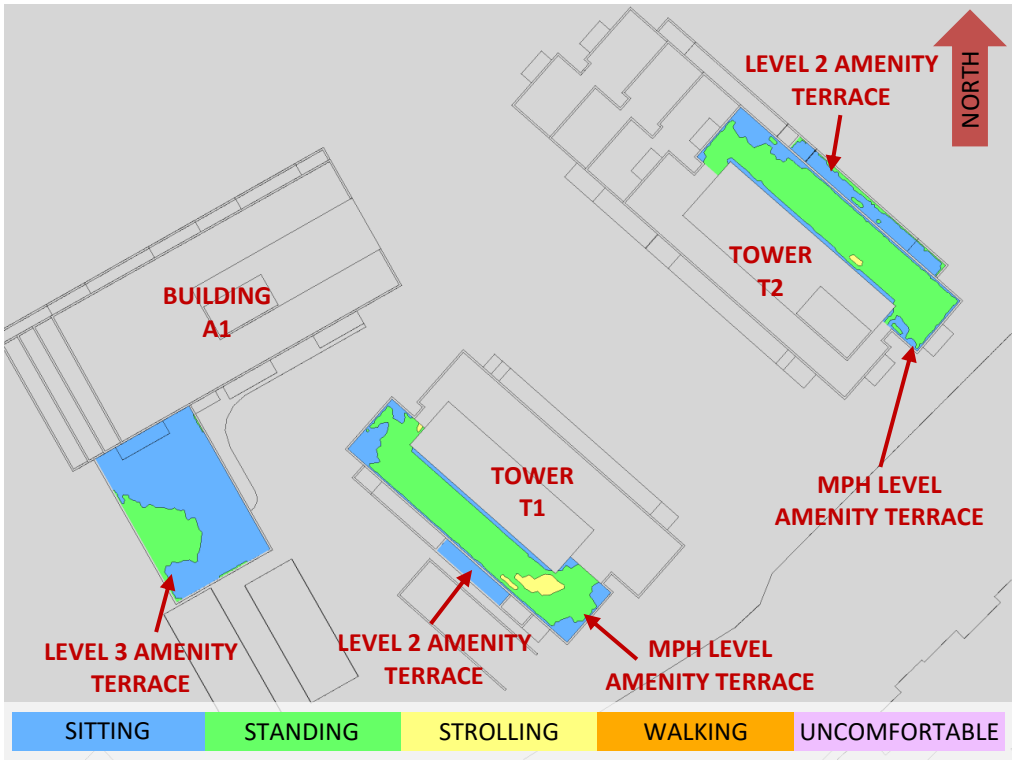


FIGURE 5D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

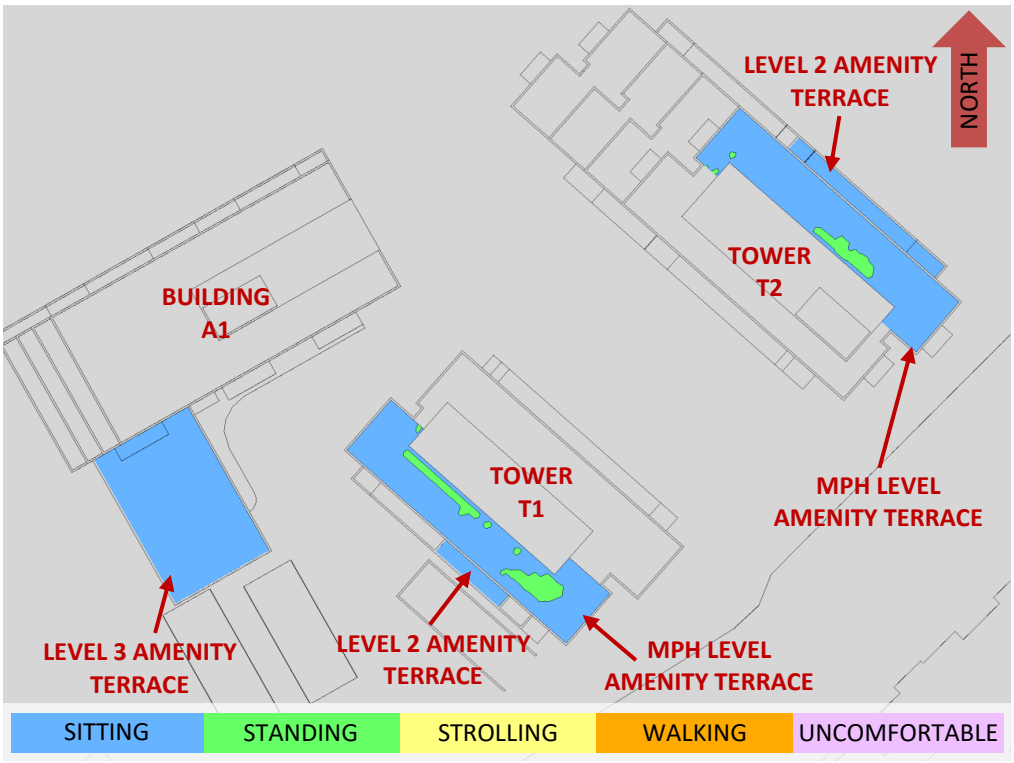
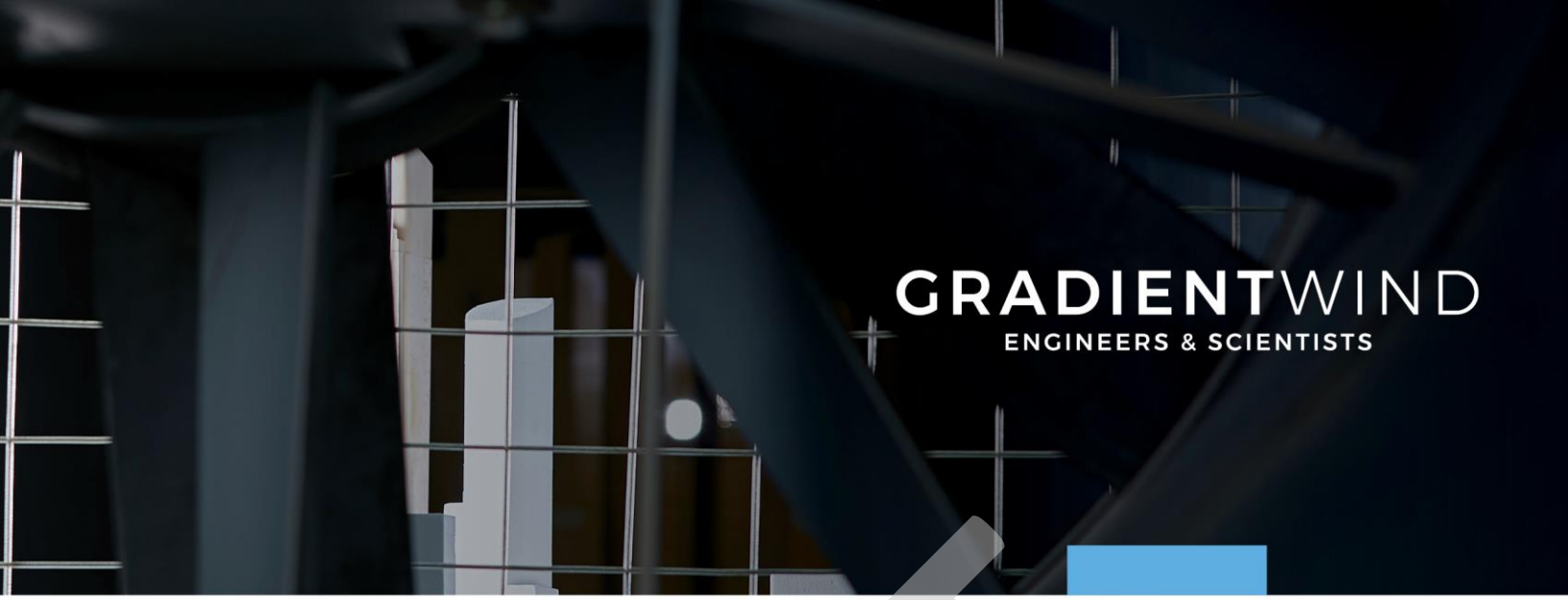


FIGURE 6: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES



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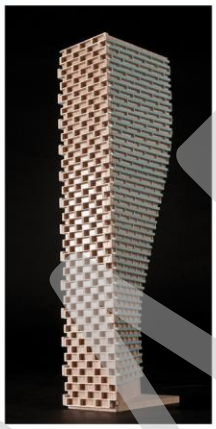

APPENDIX A

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 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	0.16
49	0.25
74	0.25
103	0.25
167	0.24
197	0.24
217	0.24
237	0.22
262	0.17
282	0.17
301	0.20
324	0.19

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, $\boldsymbol{L_t}$ = 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.

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[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.