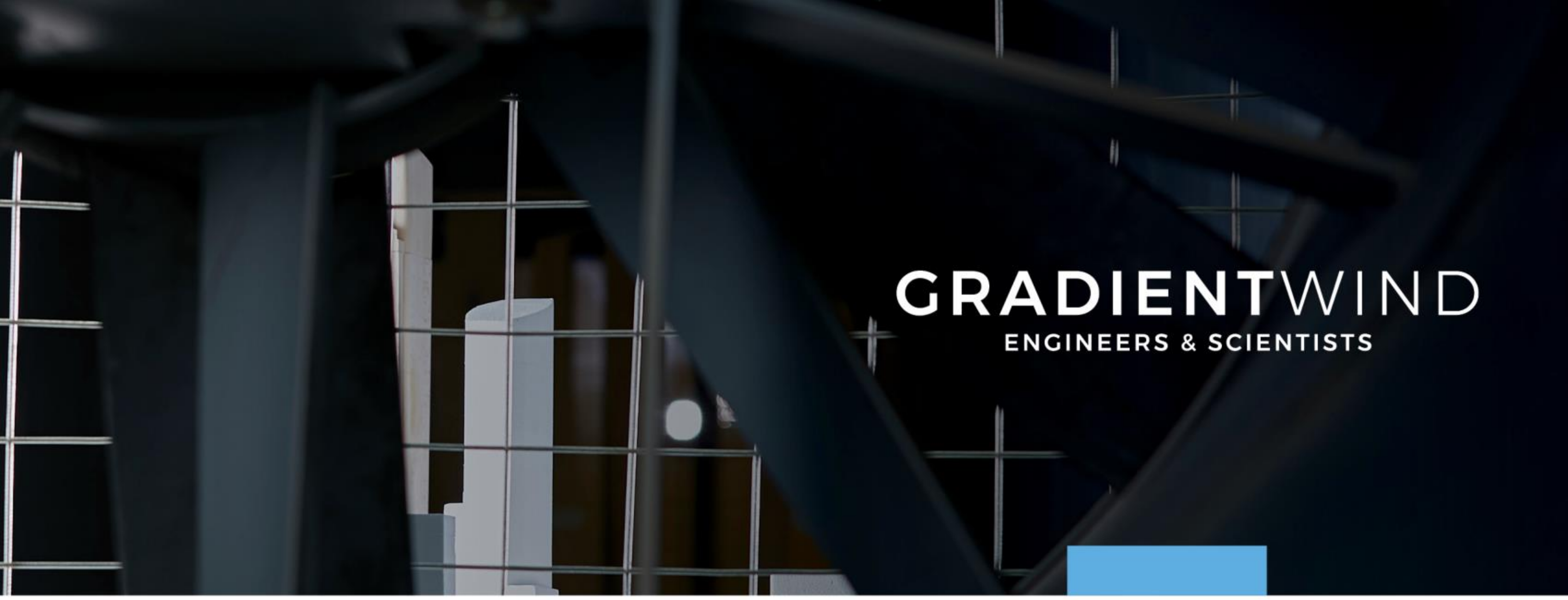
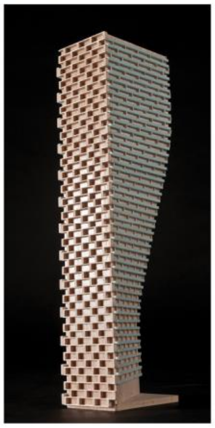
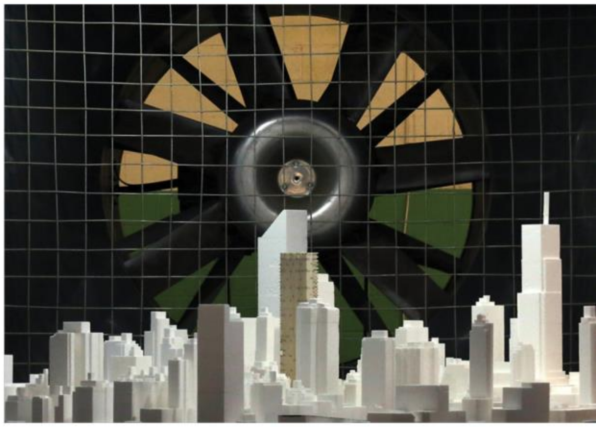


PEDESTRIAN LEVEL WIND STUDY

1531 St. Laurent Boulevard
Ottawa, Ontario

Report: 23-136-PLW-2024





July 15, 2024

PREPARED FOR
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GRADIENTWIND.COM

EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study undertaken to satisfy Site Plan Control application resubmission requirements for the proposed mixed-use residential development located at 1531 St. Laurent Boulevard 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-9, and summarized as follows:

1) While the introduction of the proposed development is predicted to produce generally windier conditions at grade, most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, transit stops, nearby surface parking lots, proposed surface parking, in the vicinity of building access points, and over most of the proposed drive aisle and walkways, are considered acceptable. The two areas that are predicted to experience windier conditions are described as follows:

    a. **Walkway West of Tower B:** An isolated area to the west of Tower B is predicted to occasionally receive wind that may occasionally be uncomfortable for walking during the spring and winter seasons.

        - The noted area is predicted to exceed the walking threshold for approximately 3% and 2% of the time during the spring and winter seasons, respectively. The noted conditions are predicted to impact an isolated section of the walkway to the west of Tower B.

- The noted walkway is expected to serve as a transitional area from Belfast Road and pedestrians are not expected to linger in this area. As such and given the marginal exceedances of the walking threshold and the limited extent of uncomfortable conditions, the noted conditions may be considered satisfactory.

b. **Parkland Dedication:** During the typical use period, wind comfort conditions over the parkland dedication to the northeast of Tower B are predicted to be suitable for sitting to the south and west and suitable for standing to the north and east.

- Depending on programming, the noted conditions may be considered acceptable. Specifically, if the windier areas to the north and east will not accommodate seating or lounging activities, the noted wind conditions would be considered acceptable.
- If required by programming, landscaping elements such as wind barriers or dense arrangements of coniferous plantings that are targeted around sensitive areas may be implemented to extend sitting conditions, in combination with high-back bench seating or other common landscape elements.

2) Regarding the common amenity terraces serving Tower B at Level 5 and at the MPH Level, which were modelled with wind screens along their full perimeters rising to 1.8 metres (m) above the local walking surface, conditions during the typical use period (that is, May to October, inclusive) are predicted to be suitable for sitting. The noted conditions are considered acceptable.

3) During the typical use period, conditions within the amenity terrace serving Tower A at Level 7 are predicted to be suitable for mostly sitting with an isolated region of standing conditions to the southwest, while conditions over the MPH Level terrace serving Tower A are predicted to be suitable for sitting over the majority of the terrace, with isolated regions suitable for standing to the east. Of note, the MPH Level terrace was modelled with 1.8-m-tall wind screens along its full perimeter.

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

b. If required by programming, sitting conditions may be extended within the Level 7 terrace by implementing 1.8-m-tall screens along its southwest perimeter. Conditions within the MPH Level terrace may be improved by implementing taller perimeter wind screens (that is, greater than 1.8 m in height), as well as mitigation inboard of the perimeter, which could take the form of wind barriers or clusters of coniferous plantings in dense arrangements. Canopies above designated seating areas could also be beneficial to achieve the sitting comfort class within the terrace.

4) 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.

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ENGINEERS & SCIENTISTS

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by 1531 St-Laurent Limited Partnership to undertake a pedestrian level wind (PLW) study to satisfy Site Plan Control application resubmission requirements for the proposed mixed-use residential development located at 1531 St. Laurent Boulevard in Ottawa, Ontario (hereinafter referred to as "subject site" or "proposed development"). A PLW study was conducted in June 2023[1] for the previous design of the proposed development. Our mandate within the current 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 Figurr Architects Collective in March 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 1531 St. Laurent Boulevard in Ottawa, situated on a parcel of land bounded by St. Laurent Boulevard to the west, Belfast Road to the north, Lagan Way to the east, and low-rise commercial buildings to the south. The proposed development comprises two towers, Tower A and Tower B, situated on the west and east of the subject site, respectively. Tower A rises to 25 storeys, inclusive of a six-storey podium, and Tower B rises to 20 storeys, inclusive of a four-storey podium. The two towers share underground parking levels and are topped by mechanical penthouses (MPH). A parkland dedication is located to the northeast of Tower B.

The ground floor of Tower A comprises a nominally rectangular planform with its long axis oriented along St. Laurent Boulevard and includes a residential main entrance at the northwest corner, shared building support spaces and surface parking to the east, a garbage room to the south, and retail spaces to the west. Access to the shared underground parking levels is provided by a ramp at the southeast corner of Tower A,

[1] Gradient Wind Engineering Inc., '*1531 St. Laurent Boulevard – Pedestrian Level Wind Study*', [June 12, 2023]

accessed via a drive aisle extending from Belfast Road to Lagan Way. The ground floor of Tower B comprises a nominally 'L'-shaped planform and includes a residential main entrance to the west, a kid's room to the north, residential units to the east, and shared building support spaces throughout the remainder of the level. Tower A steps back from the south elevation at Level 7 and from the east and south elevations at the MPH Level, and Tower B steps back from the east elevation at Level 5 and from the north elevation at the MPH Level, accommodating common amenity terraces. The Level 5 amenity terrace serving Tower B includes a pool area to the north.

The near-field surroundings, defined as an area within 200-metres (m) of the subject site, include low-rise commercial and industrial buildings in all compass directions. 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 low-rise massing in all compass directions with isolated mid- and high-rise buildings from the east clockwise to the north, and green space from the northeast clockwise to the southeast. The Ottawa Hospital General Campus is situated approximately 1.6 km to the southwest.

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 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. 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 480 m. The process was performed for two context massing scenarios, as noted in Section 2.

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

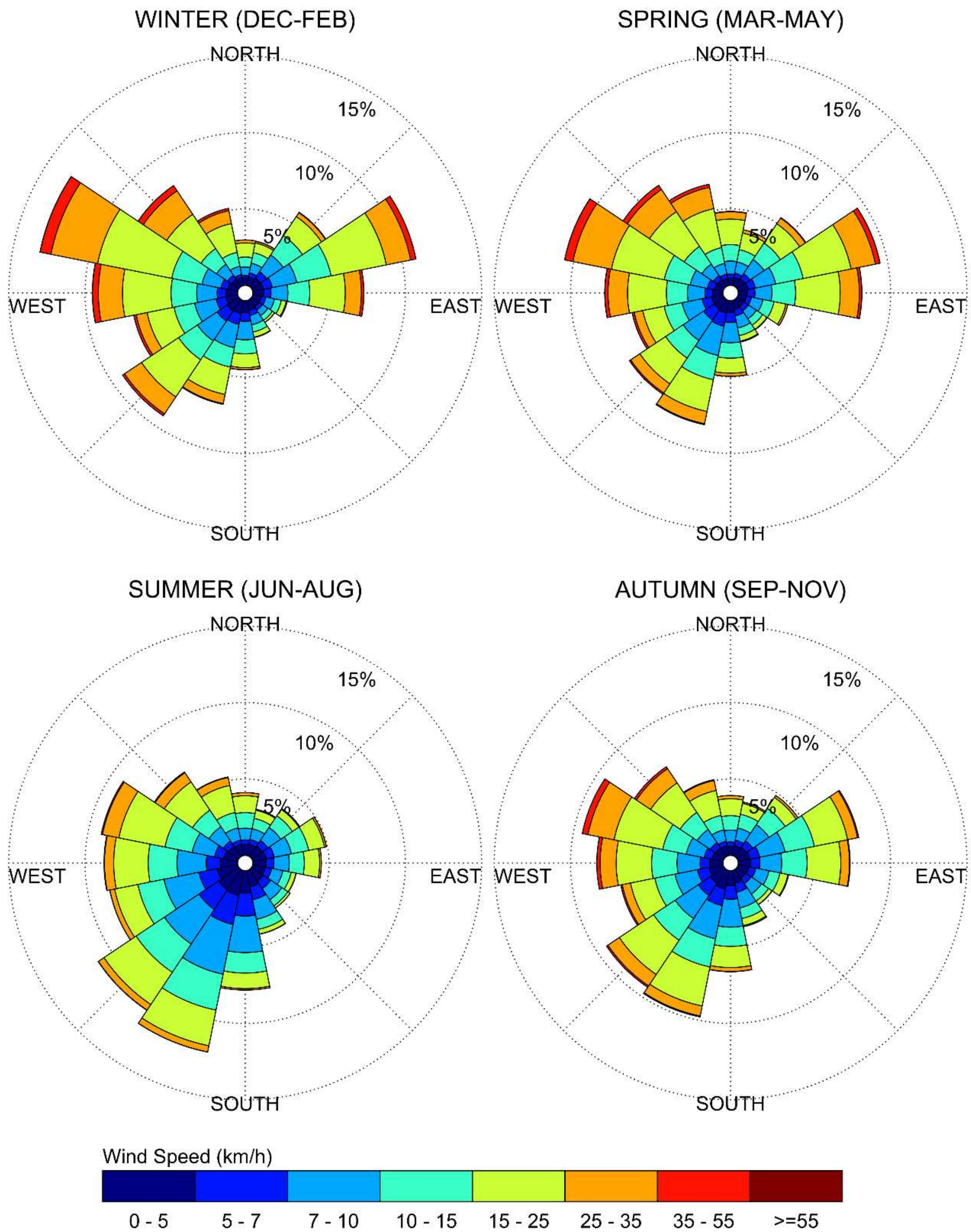
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and over the common amenity terraces serving the proposed development 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 during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into four distinct seasons, as stipulated in the wind criteria. Specifically, the spring season is defined as March through May, the summer season is defined as June through August, the autumn season is defined as September through November, and the winter season is defined as December through February, inclusive.

The statistical model of the Ottawa area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in kilometers per hour (km/h). Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The prominent wind speeds and directions can be identified by the longer length of the bars. For Ottawa, the most common winds occur for westerly wind directions, followed by those from the east, while the most common wind speeds are below 36 km/h. The directional prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
OTTAWA MACDONALD-CARTIER INTERNATIONAL AIRPORT



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in km/h, measured at 10 m above the ground.

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Ottawa

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

PEDESTRIAN WIND COMFORT CLASS DEFINITIONS

Wind Comfort Class	Mean Speed (km/h)	Description
SITTING	≤ 10	Mean wind speeds no greater than 10 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 16 km/h.
STANDING	≤ 14	Mean wind speeds no greater than 14 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 22 km/h.
STROLLING	≤ 17	Mean wind speeds no greater than 17 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 27 km/h.
WALKING	≤ 20	Mean wind speeds no greater than 20 km/h occurring at least 80% of the time. The equivalent gust wind speed is approximately 32 km/h.
UNCOMFORTABLE	> 20	Uncomfortable conditions are characterized by predicted values that fall below the 80% target for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

Regarding wind safety, the pedestrian safety wind speed criterion is based on the approximate threshold that would cause a vulnerable member of the population to fall. A 0.1% exceedance gust wind speed of 90 km/h is classified as dangerous. From calculations of stability, it can be shown that gust wind speeds of 90 km/h would be the approximate threshold wind speed that would cause an average elderly person in good health to fall. Notably, pedestrians tend to be more sensitive to wind gusts than to steady winds for lower wind speed ranges. For strong winds approaching dangerous levels, this effect is less important because the mean wind can also create problems for pedestrians.

Experience and research on people's perception of mechanical wind effects has shown that if the wind speed levels are exceeded for more than 20% of the time, the activity level would be judged to be uncomfortable by most people. For instance, if a mean wind speed of 10 km/h (equivalent gust wind speed of approximately 16 km/h) were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if mean wind speed of 20 km/h (equivalent gust wind speed of approximately 32 km/h) at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As these criteria are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

Once the pedestrian wind speed predictions have been established throughout the subject site, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for discrete regions within and surrounding the subject site. This step involves comparing the predicted comfort classes to the target comfort classes, which are dictated by the location type for each region (that is, a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their typical windiest target comfort classes are summarized on the following page. Depending on the programming of a space, the desired comfort class may differ from this table.

TARGET PEDESTRIAN WIND COMFORT CLASSES FOR VARIOUS LOCATION TYPES

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

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-6B, which illustrate wind conditions at grade level for the proposed and existing massing scenarios. Figures 8A-8D illustrate conditions over the common amenity terraces serving Towers A and B at Levels 7 and 5, respectively, as well as at the MPH Levels for both towers. Conditions are presented as continuous contours of wind comfort throughout the subject site and correspond to the comfort classes presented in Section 4.4.

Wind comfort conditions are also reported for the typical use period, which is defined as May to October, inclusive. Figures 7 and 9 illustrate comfort conditions at grade level and over the noted amenity terraces, respectively, consistent with the comfort classes in Section 4.4.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks and Transit Stops along St. Laurent Boulevard: Following the introduction of the proposed development, wind comfort conditions over the public sidewalks along St. Laurent Boulevard are predicted to be suitable for standing, or better, during the summer, becoming suitable for standing during the autumn, with isolated regions suitable for strolling during the two seasons. Conditions over the noted sidewalks are predicted to be suitable for a mix of standing and strolling during the spring and winter, with isolated regions suitable for walking.

Conditions in the vicinity of the nearby southbound transit stop to the west of St. Laurent Boulevard are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing throughout the remainder of the year, while conditions in the vicinity of the nearby northbound transit stop are predicted to be suitable for a mix of standing and strolling during the summer, becoming suitable for strolling during the autumn, and suitable for a mix of strolling and walking during the spring and winter. Notably, these two transit stops are served by typical transit shelters that provide pedestrians with a means to seek relief from the elements, including during periods of strong wind activity. The noted conditions are considered acceptable.

Conditions along St. Laurent Boulevard and over the noted transit stops under the existing massing are predicted to be suitable for standing, or better, throughout the year. While the introduction of the proposed development produces windier conditions along St. Laurent Boulevard in comparison to existing conditions, conditions with the proposed development over the sidewalks and transit stops along St. Laurent Boulevard are nevertheless considered acceptable.

Sidewalks along Belfast Road: Following the introduction of the proposed development, wind conditions over the public sidewalks along Belfast Road are predicted to be suitable for standing, or better, during the summer, with an isolated region suitable for strolling, becoming suitable for mostly standing during the autumn, with isolated regions suitable for strolling. During the spring and winter, conditions along Belfast Road are predicted to be suitable for a mix of standing and strolling during the spring and winter, with isolated regions suitable for walking. The noted conditions are considered acceptable.

Conditions along Belfast Road under the existing massing are predicted to be suitable for standing, or better, throughout the year**.** While the introduction of the proposed development produces windier conditions along Belfast Road in comparison to existing conditions, conditions with the proposed development over the sidewalks along Belfast Road are nevertheless considered acceptable.

Lagan Way: Following the introduction of the proposed development, wind conditions over Lagan Way are predicted to be suitable for standing, or better, during the summer, becoming suitable for strolling, or better, during the spring, autumn, and winter. The noted conditions are considered acceptable.

Conditions along Lagan Way under the existing massing are predicted to be suitable for mostly sitting during the summer, becoming suitable for a mix of sitting and standing throughout the remainder of the year**.** While the introduction of the proposed development produces windier conditions along Lagan Way in comparison to existing conditions, conditions with the proposed development are nevertheless considered acceptable.

Neighbouring Existing Surface Parking Lots: Prior to the introduction of the proposed development, wind conditions over the nearby existing surface parking lots neighbouring the subject site are predicted to be suitable for a mix of sitting and standing throughout the year.

Following the introduction of the proposed development, conditions over the noted nearby existing surface parking lots are predicted to be suitable for mostly standing, or better, during the summer and autumn, becoming suitable for strolling, or better, during the spring and winter. While the introduction of the proposed development produces windier conditions over the nearby surface parking lots in comparison to existing conditions, conditions with the proposed development are nevertheless considered acceptable.

Surface Parking East of Tower A: Wind conditions over the surface parking along the east elevation of Tower A are predicted to be suitable for standing during the summer, becoming suitable for a mix of mostly standing and strolling throughout the remainder of the year. The noted conditions are considered acceptable.

Drive Aisle and Walkways: Conditions over the drive aisle and walkways within the subject site are predicted to be suitable for strolling, or better, during the summer and autumn, with isolated regions suitable for walking, becoming suitable for walking, or better, during the spring and winter. Conditions that may occasionally be considered uncomfortable for walking during the spring and winter are predicted over an isolated area of the drive aisle and walkway to the west of Tower B. Where conditions may be considered uncomfortable for walking, they are predicted to be suitable for walking for approximately 77% and 78% of the time during the spring and winter seasons, respectively, representing exceedances of 3% and 2% of the walking comfort threshold.

The noted walkway is expected to serve as a transitional area from Belfast Road and pedestrians are not expected to linger in this area. As such and given the marginal exceedances of the walking threshold and the limited extent of uncomfortable conditions, the noted conditions may be considered satisfactory.

Parkland Dedication: During the typical use period, wind comfort conditions over the parkland dedication to the northeast of Tower B are predicted to be suitable for sitting to the south and west and suitable for standing to the north and east. Depending on the programming of the space, the noted conditions may be considered acceptable. Specifically, if the windier areas to the north and east will not accommodate seating or lounging activities, the noted wind conditions would be considered acceptable.

If required by programming, sitting conditions may be extended to sensitive areas with landscaping elements such as wind barriers or dense arrangements of coniferous plantings that are targeted around sensitive areas, in combination with high-back bench seating or other common landscape elements.

Building Access Points: Owing to the protection of the building façades, conditions in the vicinity of the 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, which is considered acceptable.

5.2 Wind Comfort Conditions – Common Amenity Terraces

Tower A is served by a common amenity terrace at Level 7, Tower B is served by a common amenity terrace at Level 5, and both towers are served by common amenity terraces at their respective MPH Levels. The amenity terrace serving Tower A at the MPH Level and the noted amenity terraces serving Tower B were modelled with 1.8-m-tall wind screens along their full perimeters. Wind conditions during the typical use period, as illustrated in Figure 9, and recommendations regarding mitigation, where required, are described as follows:

Tower A: Conditions within the common amenity terrace serving Tower A at Level 7 are predicted to be suitable for mostly sitting, with an isolated region of conditions predicted to be suitable for standing to the southwest. Following the introduction of the above-noted perimeter wind screen, conditions within the terrace serving Tower A 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 east.

Depending on the programming of the common amenity terraces serving Tower A, the noted conditions may be considered acceptable. Specifically, if the noted windier areas will not accommodate seating or lounging activities, the noted wind conditions would be considered acceptable.

If required by programming, sitting conditions may be extended within the terraces serving Tower A by implementing 1.8-m-tall screens along the southwest perimeter of the Level 7 terrace, and by implementing taller wind screens (that is, greater than 1.8-m-tall) along the perimeters of the MPH Level terrace. Additionally, for the MPH Level terrace, mitigation inboard of the perimeter of the terrace, which could take the form of wind barriers or clusters of coniferous plantings in dense arrangements, and/or canopies above designated seating areas could be beneficial to achieve the sitting comfort class within the terrace.

Tower B: Following the introduction of the above-noted perimeter wind screens, conditions within the amenity terraces serving Tower B at Level 5 and at the MPH Level are predicted to be suitable for sitting, which is considered acceptable.

5.3 Wind Safety

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

5.4 Applicability of Results

Pedestrian wind comfort and safety have been quantified for the specific configuration of existing and foreseeable construction around the subject site. Future changes (that is, construction or demolition) of these surroundings may cause changes to the wind effects in two ways, namely: (i) changes beyond the immediate vicinity of the subject site would alter the wind profile approaching the subject site; and (ii) development in proximity to the subject site would cause changes to local flow patterns.

6. CONCLUSIONS AND RECOMMENDATIONS

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

1) While the introduction of the proposed development is predicted to produce generally windier conditions at grade, most grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, transit stops, nearby surface parking lots, proposed surface parking, in the vicinity of building access points, and over most of the proposed drive aisle and walkways, are considered acceptable. The two areas that are predicted to experience windier conditions are described as follows:

    a. **Walkway West of Tower B:** An isolated area to the west of Tower B is predicted to occasionally receive wind that may occasionally be uncomfortable for walking during the spring and winter seasons.

        - The noted area is predicted to exceed the walking threshold for approximately 3% and 2% of the time during the spring and winter seasons, respectively. The noted conditions are predicted to impact an isolated section of the walkway to the west of Tower B.

        - The noted walkway is expected to serve as a transitional area from Belfast Road and pedestrians are not expected to linger in this area. As such and given the marginal exceedances of the walking threshold and the limited extent of uncomfortable conditions, the noted conditions may be considered satisfactory.

    b. **Parkland Dedication:** During the typical use period, wind comfort conditions over the parkland dedication to the northeast of Tower B are predicted to be suitable for sitting to the south and west and suitable for standing to the north and east.

- Depending on programming, the noted conditions may be considered acceptable. Specifically, if the windier areas to the north and east will not accommodate seating or lounging activities, the noted wind conditions would be considered acceptable.
- If required by programming, landscaping elements such as wind barriers or dense arrangements of coniferous plantings that are targeted around sensitive areas may be implemented to extend sitting conditions, in combination with high-back bench seating or other common landscape elements.

2) Regarding the common amenity terraces serving Tower B at Level 5 and at the MPH Level, which were modelled with wind screens along their full perimeters rising to 1.8 metres (m) above the local walking surface, conditions during the typical use period (that is, May to October, inclusive) are predicted to be suitable for sitting. The noted conditions are considered acceptable.

3) During the typical use period, conditions within the amenity terrace serving Tower A at Level 7 are predicted to be suitable for mostly sitting with an isolated region of standing conditions to the southwest, while conditions over the MPH Level terrace serving Tower A are predicted to be suitable for sitting over the majority of the terrace, with isolated regions suitable for standing to the east. Of note, the MPH Level terrace was modelled with 1.8-m-tall wind screens along its full perimeter.

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

    b. If required by programming, sitting conditions may be extended within the Level 7 terrace by implementing 1.8-m-tall screens along its southwest perimeter. Conditions within the MPH Level terrace may be improved by implementing taller perimeter wind screens (that is, greater than 1.8 m in height), as well as mitigation inboard of the perimeter, which could take the form of wind barriers or clusters of coniferous plantings in dense arrangements. Canopies above designated seating areas could also be beneficial to achieve the sitting comfort class within the terrace.

4) The foregoing statements and conclusions apply to common weather systems, during which no dangerous wind conditions, as defined in Section 4.4, are expected anywhere over the subject site. During extreme weather events, (for example, thunderstorms, tornadoes, and downbursts), pedestrian safety is the main concern. However, these events are generally short-lived and infrequent and there is often sufficient warning for pedestrians to take appropriate cover.

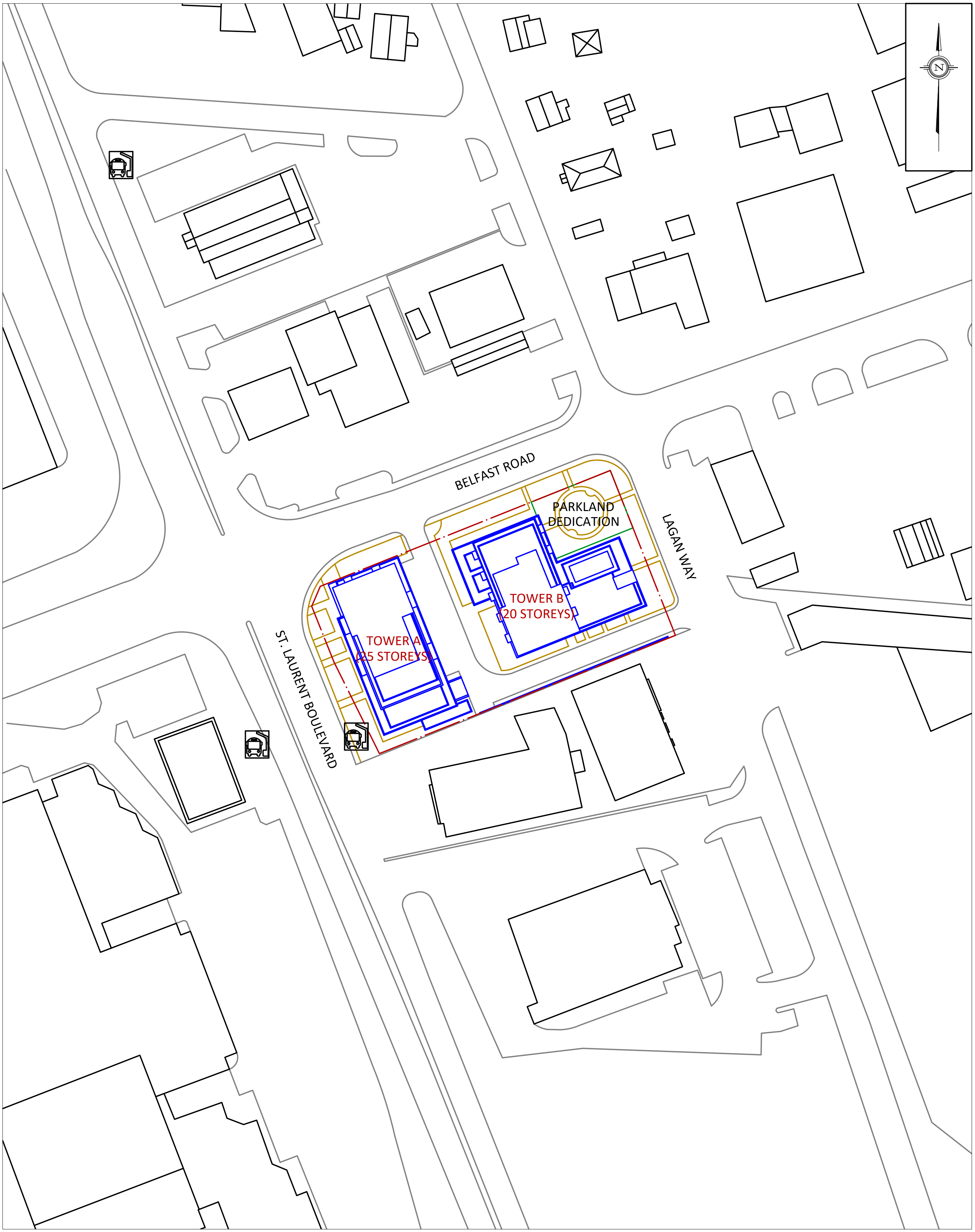
Sincerely,

Gradient Wind Engineering Inc.

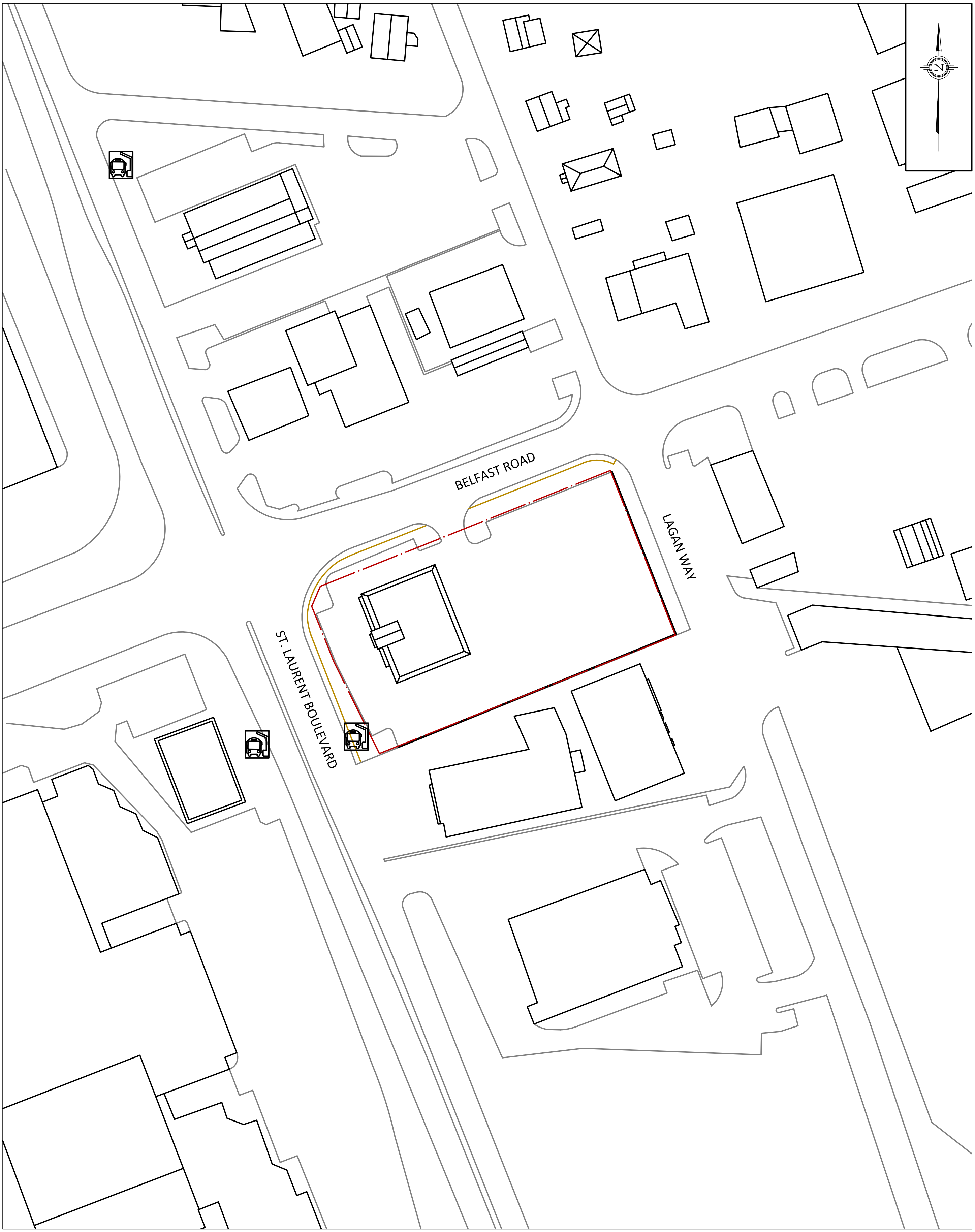
Justin Denne, M.A.Sc.
Junior Wind Scientist

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

Sunny Kang, B.A.S.
Project Coordinator



GRADIENTWIND ENGINEERS & SCIENTISTS 127 WALGREEN ROAD, OTTAWA, ON 613 836 0934 • GRADIENTWIND.COM	PROJECT: 1531 ST. LAURENT BOULEVARD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: PROPOSED SITE PLAN AND SURROUNDING CONTEXT
	SCALE: 1:1500	DRAWING NO.: 23-136-PLW-2024-1A	
	DATE: JULY 15, 2024	DRAWN BY: S.K.	



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PROJECT	1531 ST. LAURENT BOULEVARD, OTTAWA PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 1B: EXISTING SITE PLAN AND SURROUNDING CONTEXT
SCALE	1:1500	DRAWING NO. 23-136-PLW-2024-1B	
DATE	JULY 15, 2024	DRAWN BY S.K.	

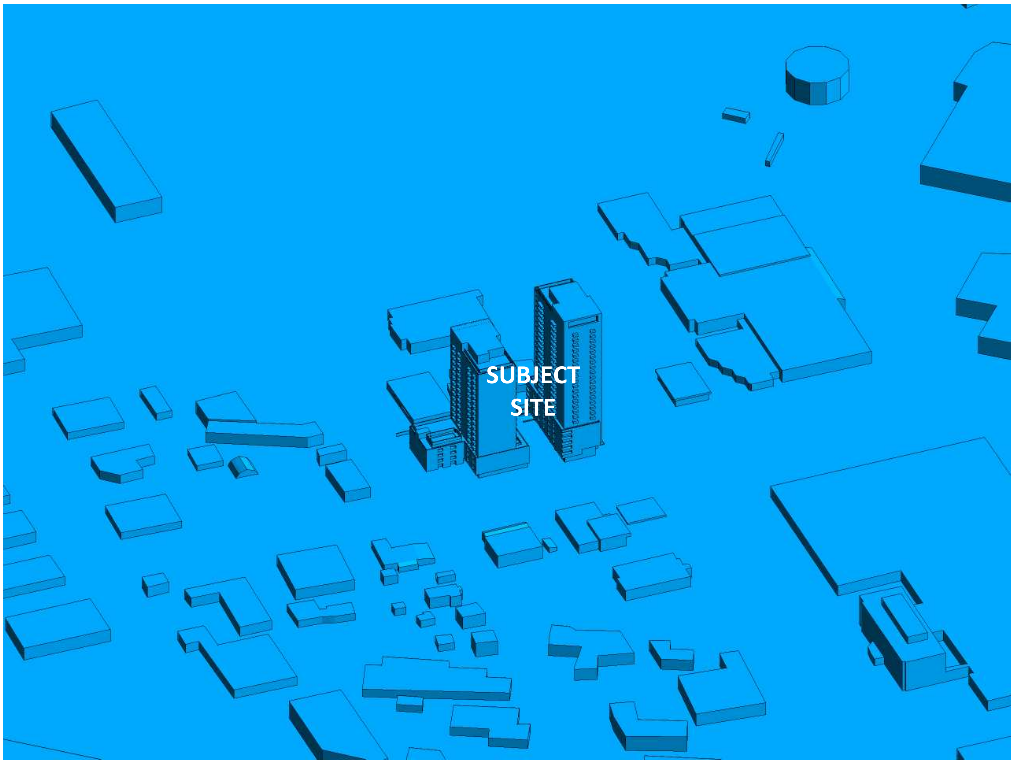


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTH PERSPECTIVE

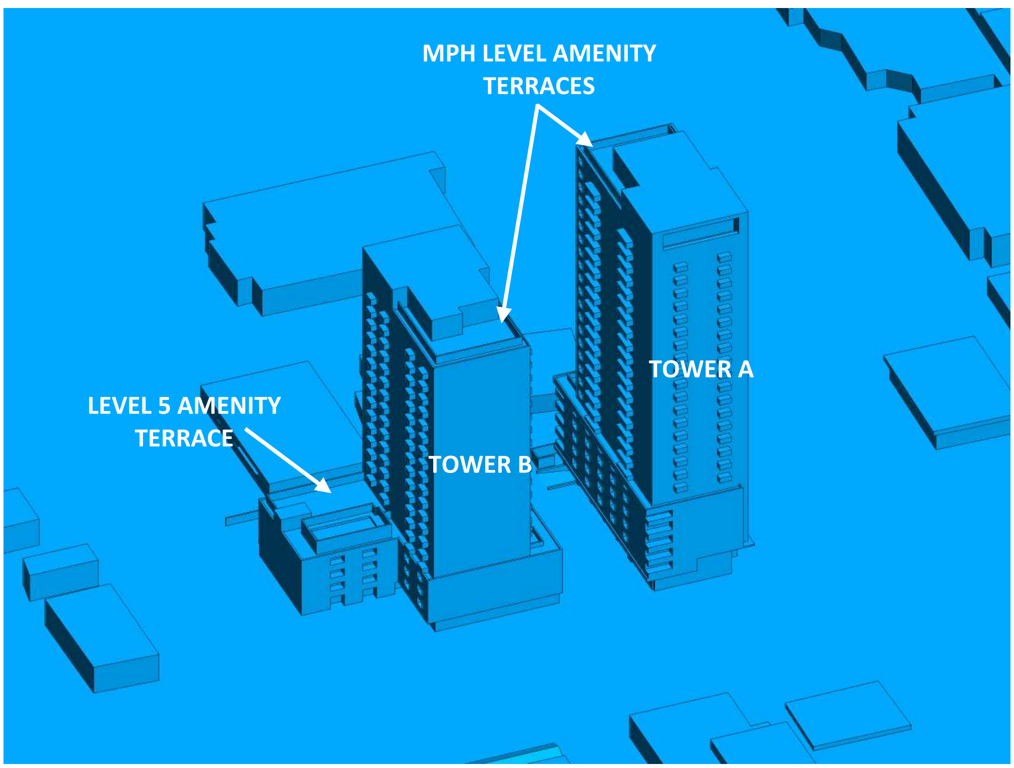


FIGURE 2B: CLOSE UP OF FIGURE 2A

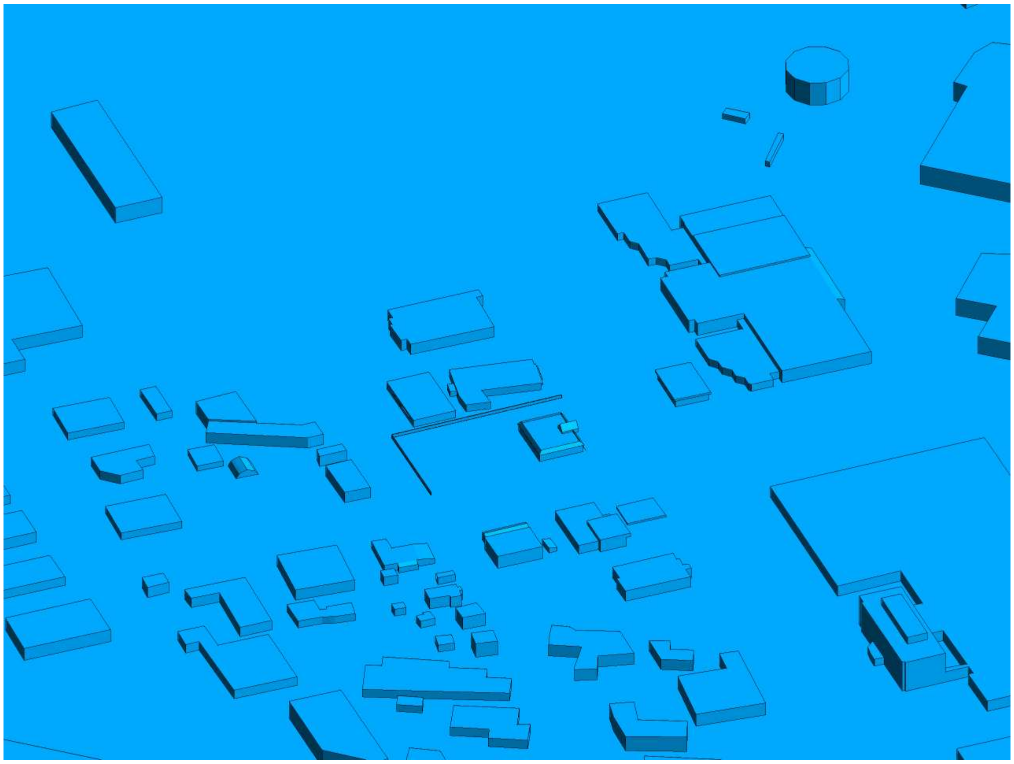


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, NORTH PERSPECTIVE

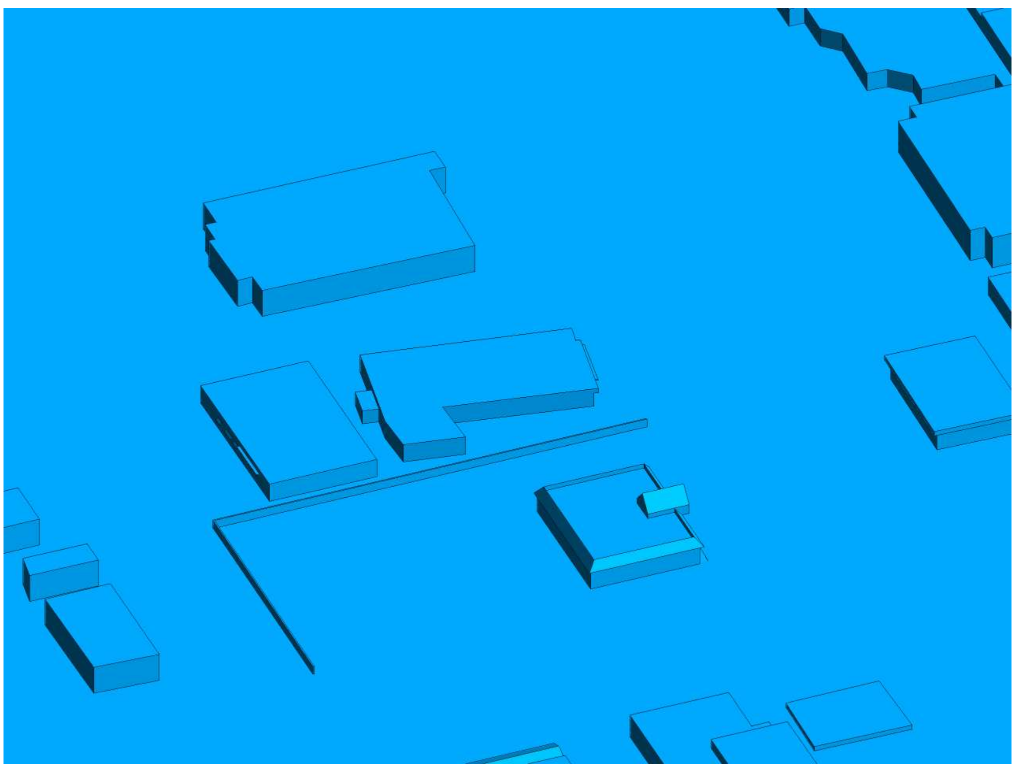


FIGURE 2D: CLOSE UP OF FIGURE 2C

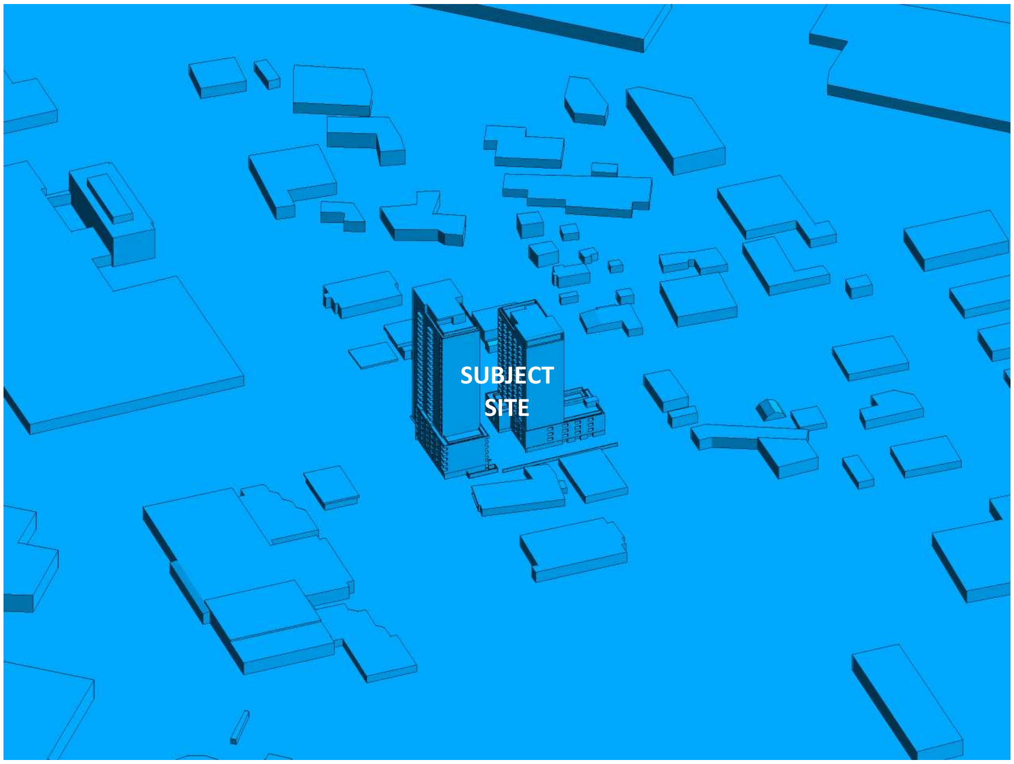


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTH PERSPECTIVE

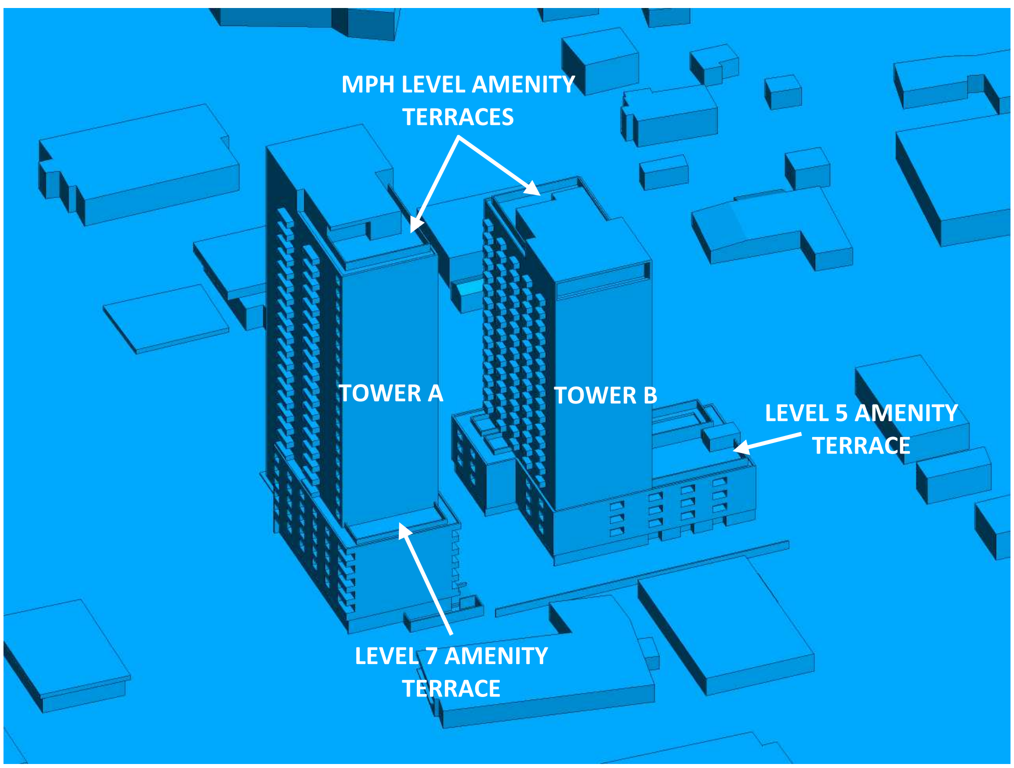


FIGURE 2F: CLOSE UP OF FIGURE 2E

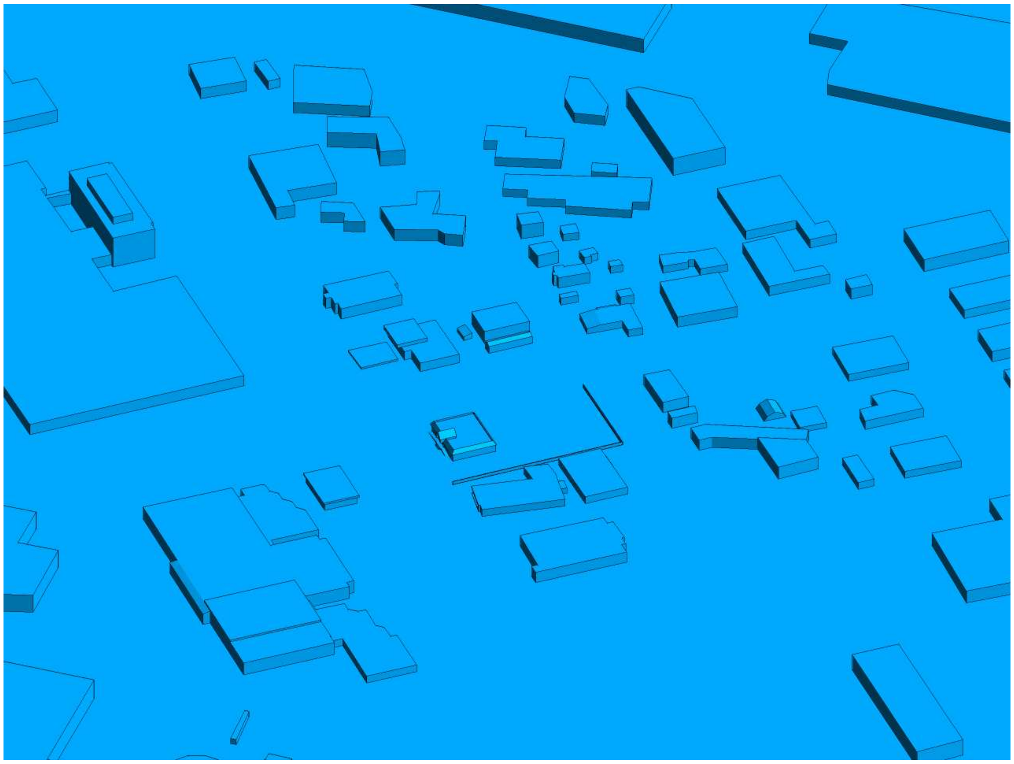


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTH PERSPECTIVE

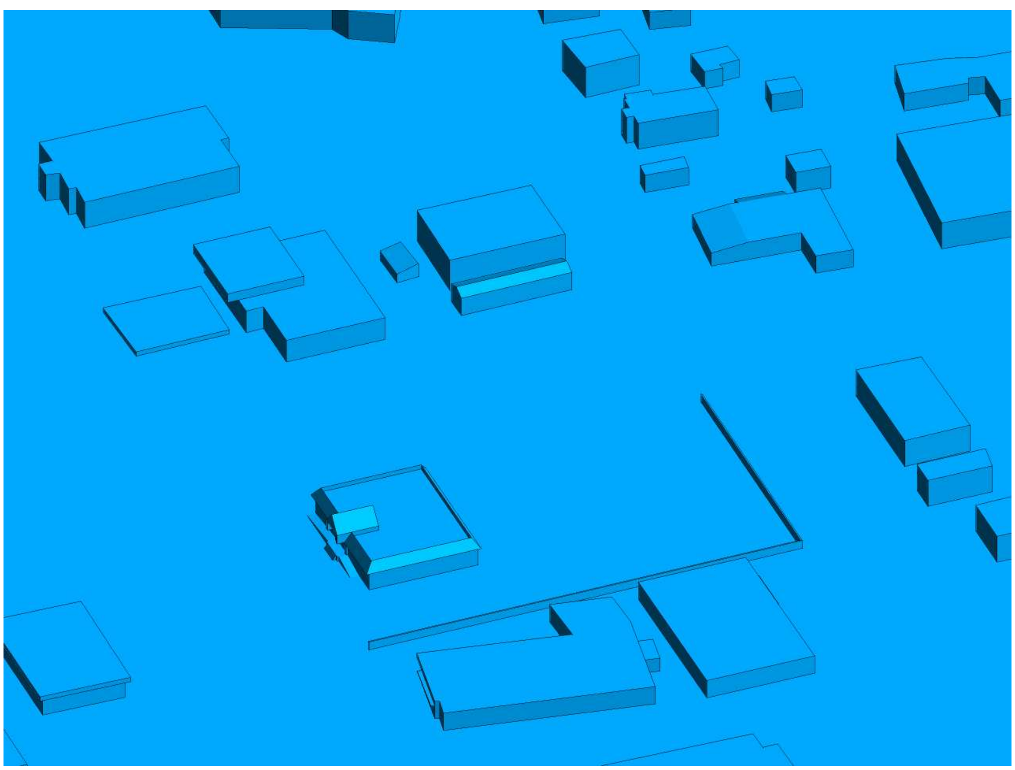


FIGURE 2H: CLOSE UP OF FIGURE 2G

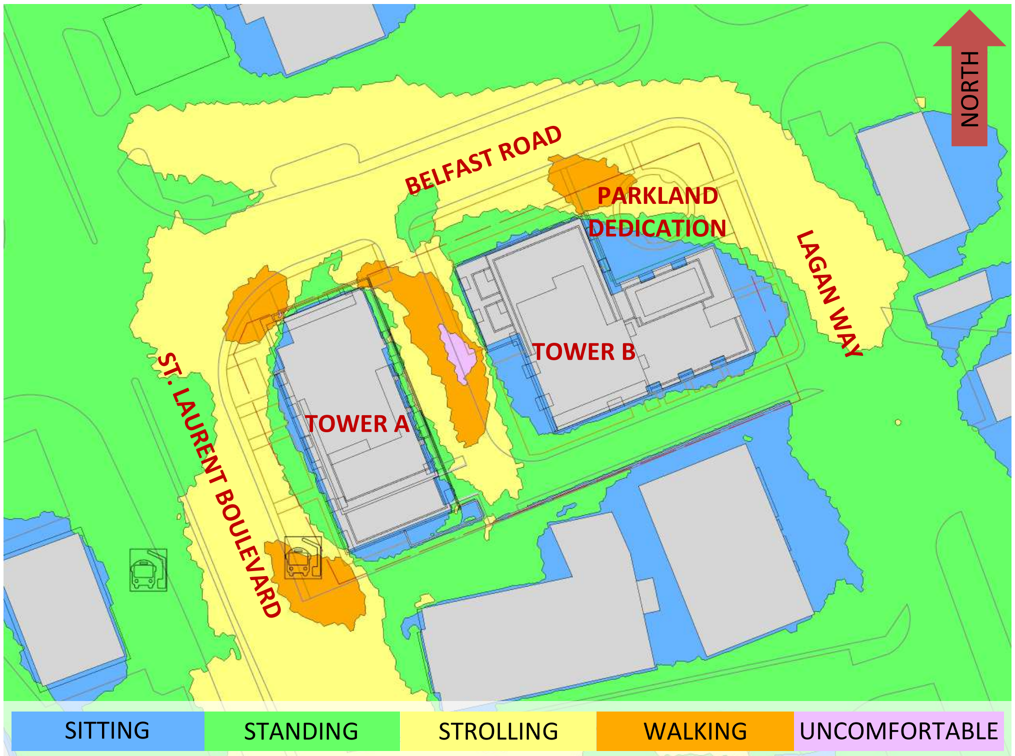


FIGURE 3A: SPRING – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

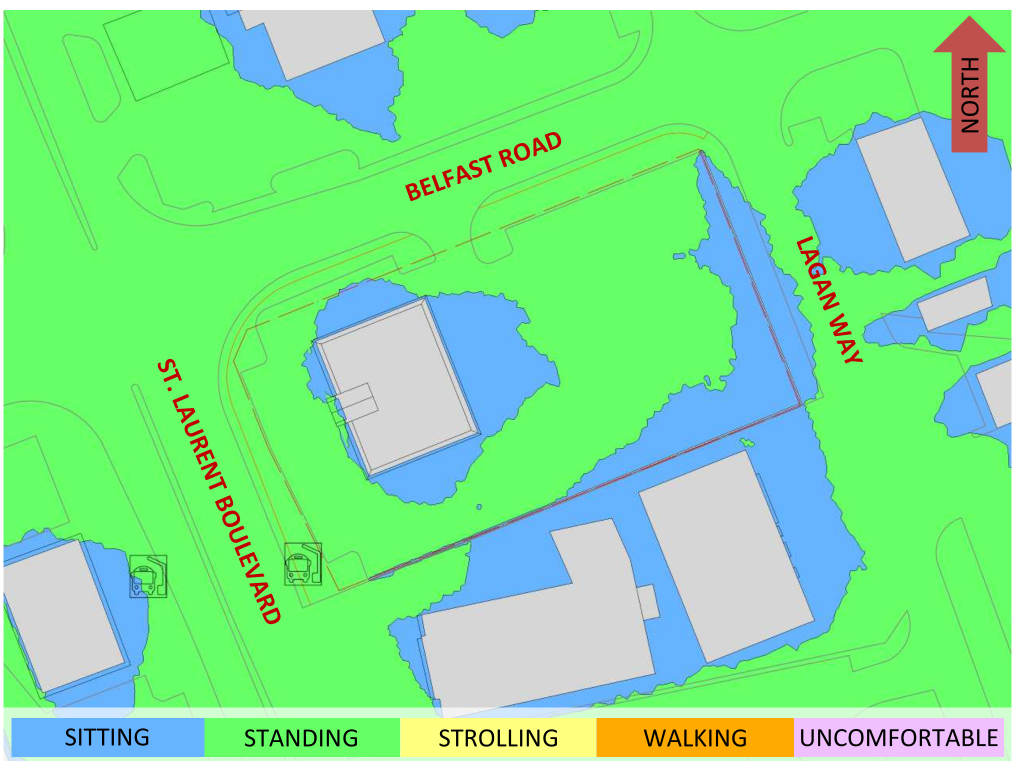


FIGURE 3B: SPRING – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

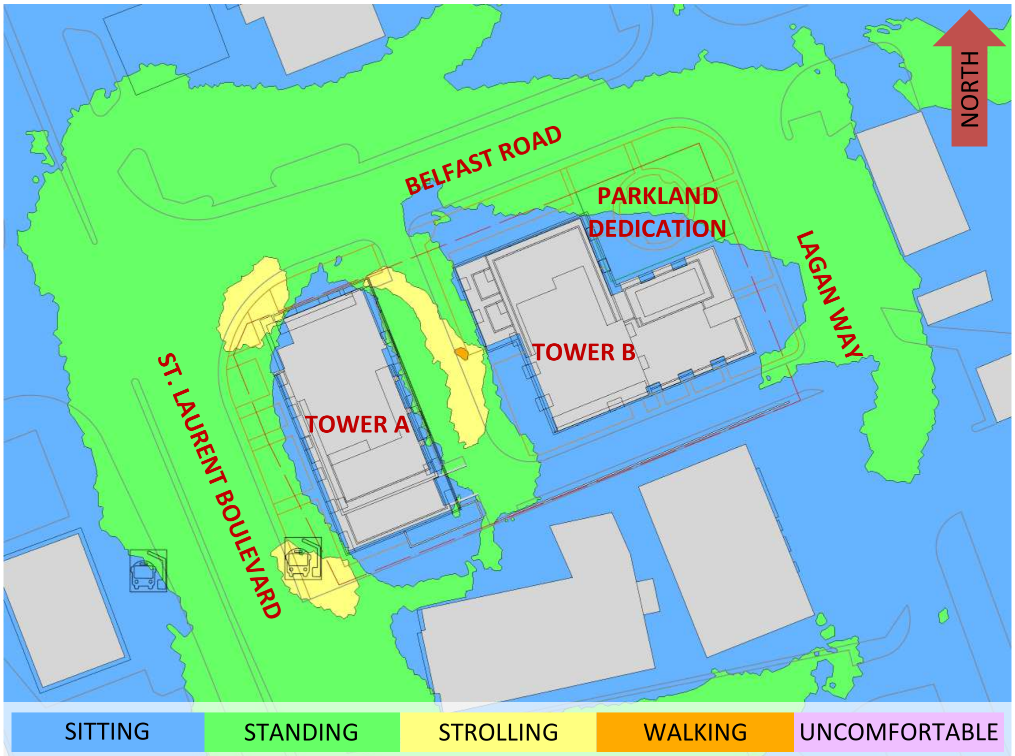


FIGURE 4A: SUMMER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

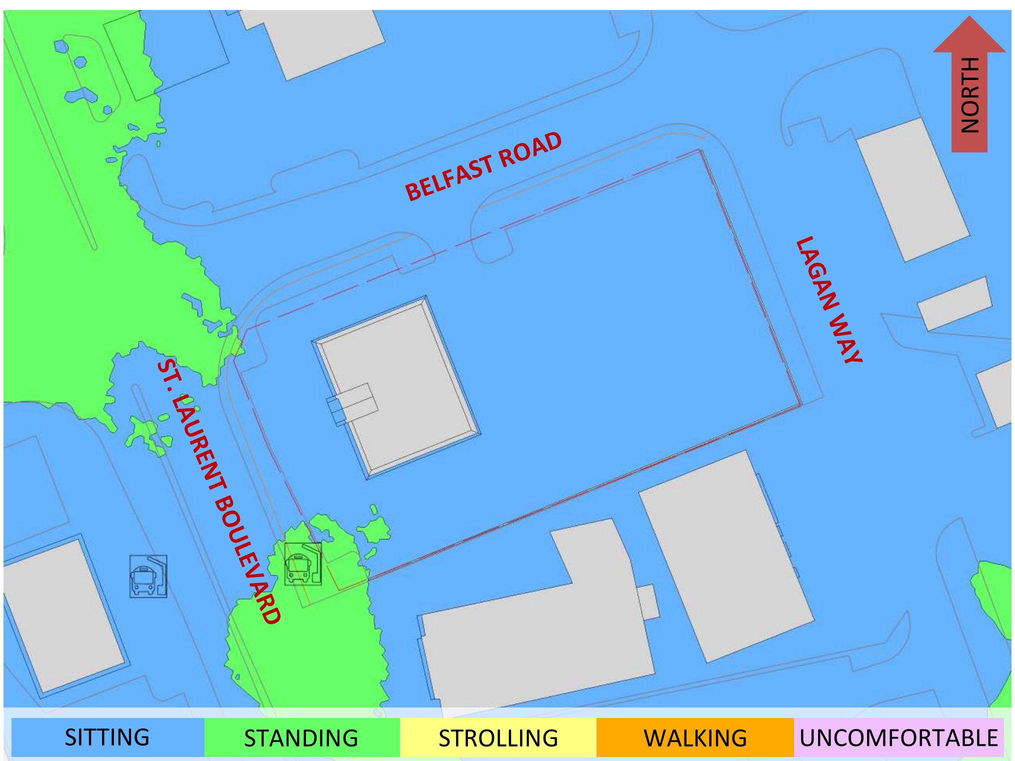


FIGURE 4B: SUMMER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

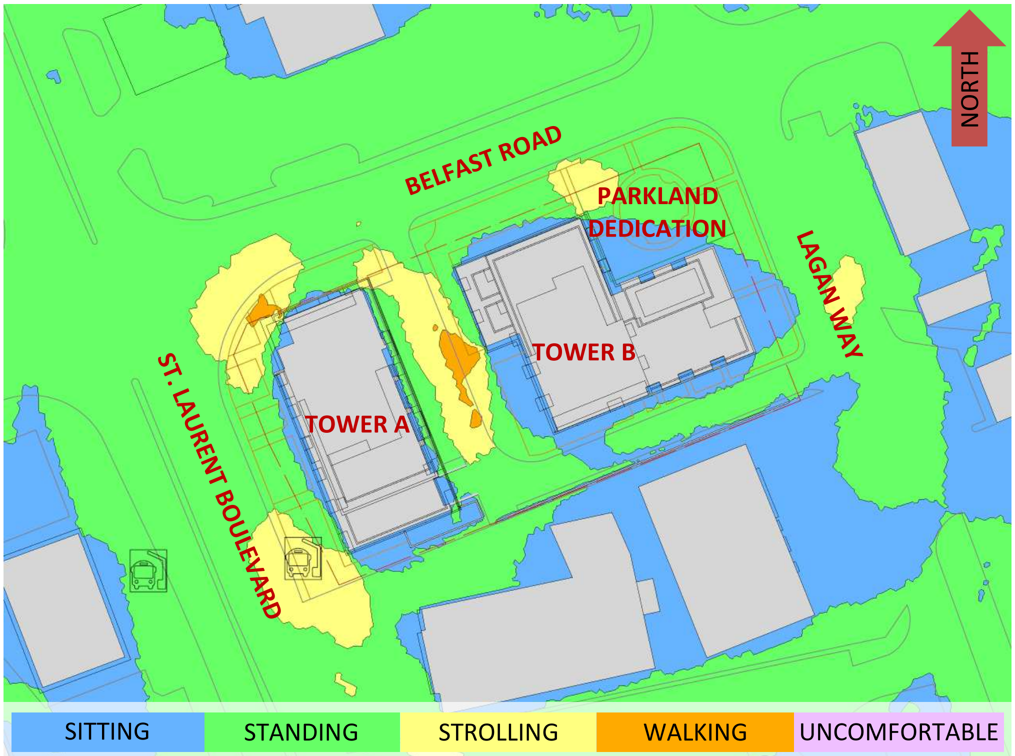


FIGURE 5A: AUTUMN – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

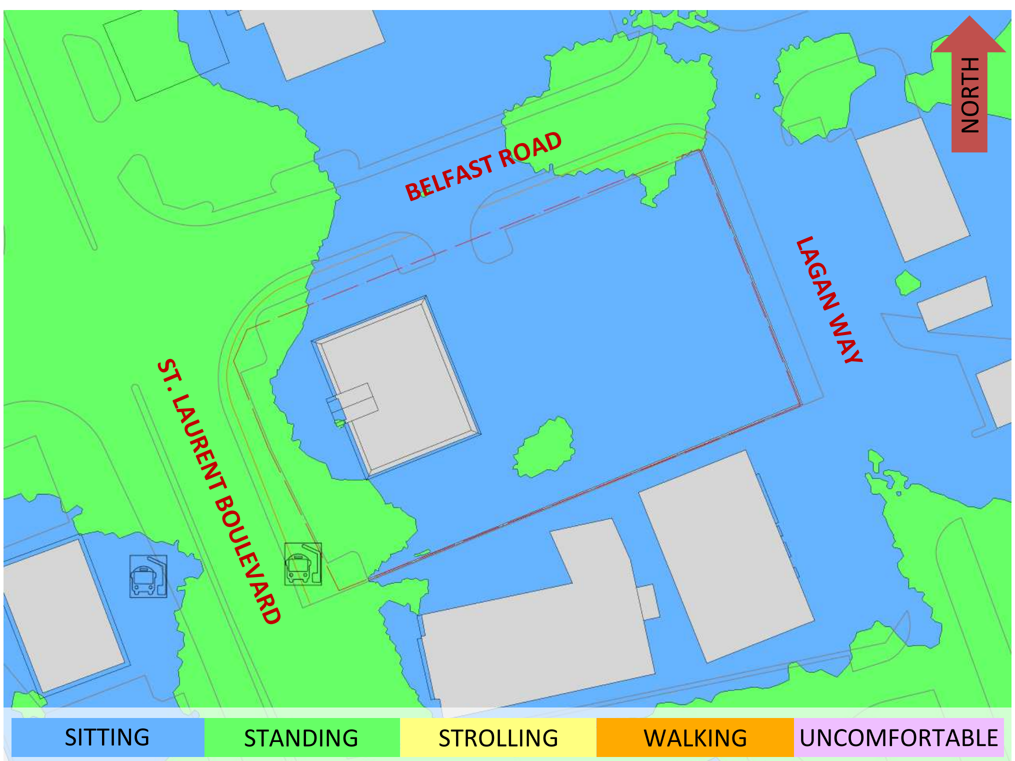


FIGURE 5B: AUTUMN – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

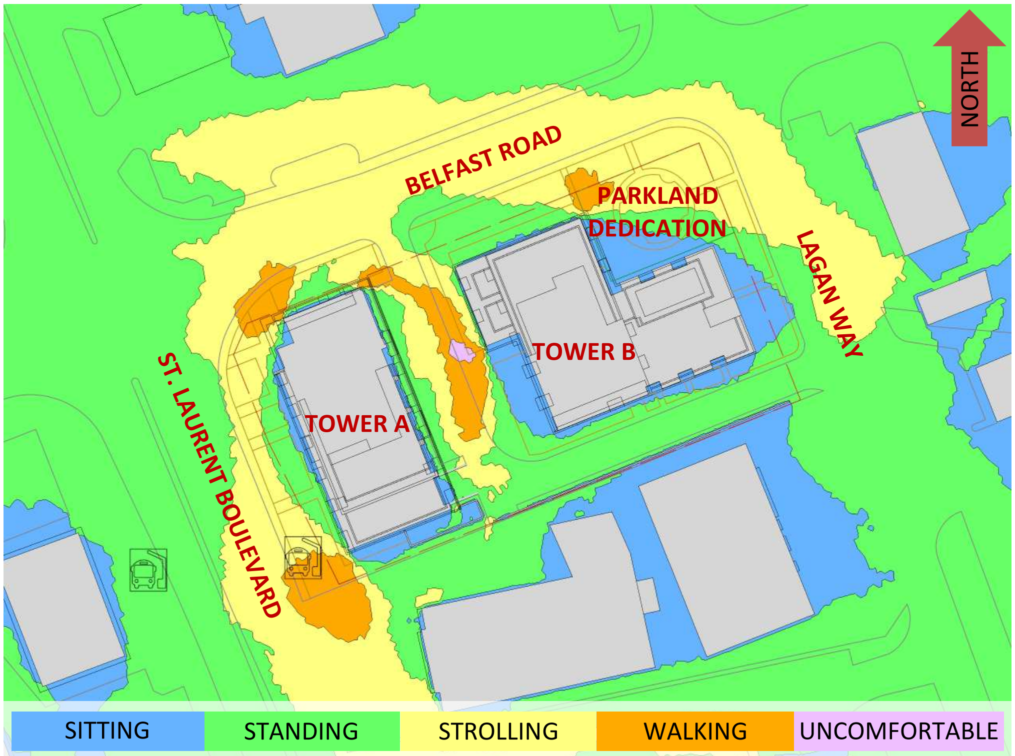


FIGURE 6A: WINTER – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

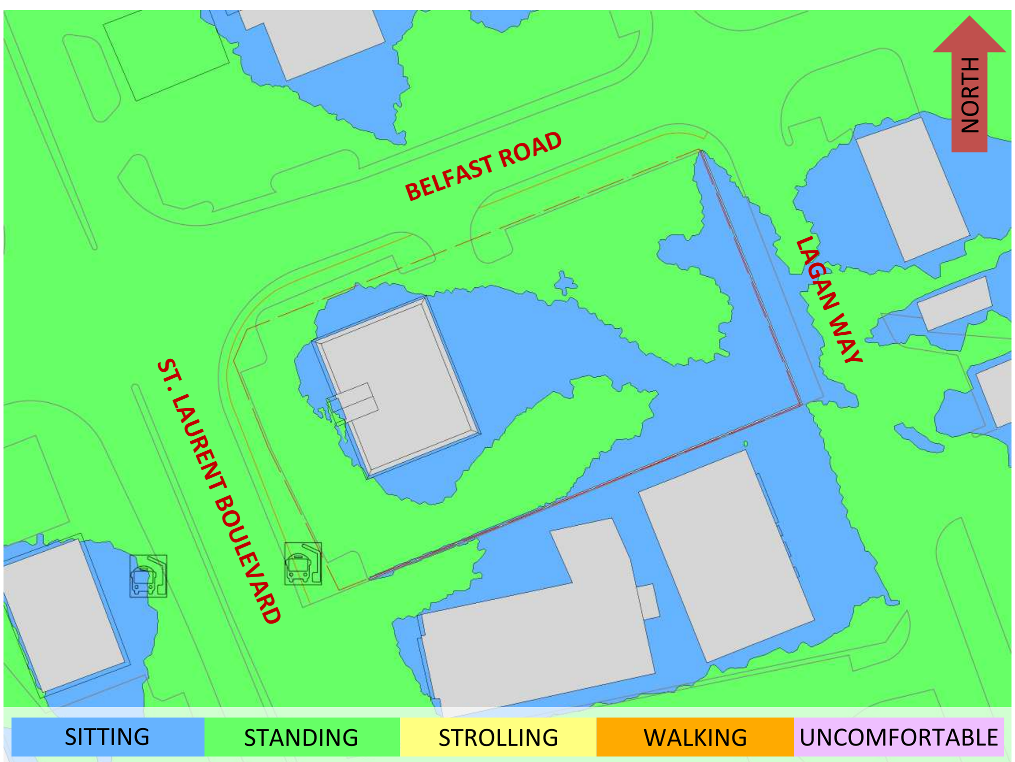


FIGURE 6B: WINTER – WIND COMFORT, GRADE LEVEL – EXISTING MASSING

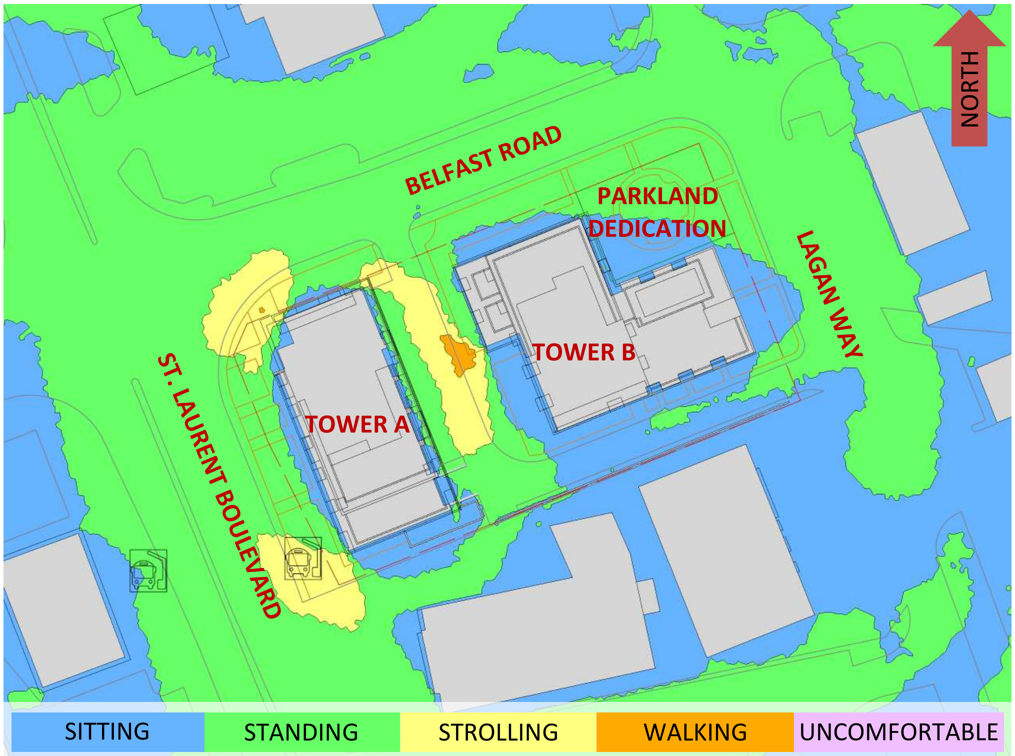


FIGURE 7: TYPICAL USE PERIOD – WIND COMFORT, GRADE LEVEL – PROPOSED MASSING

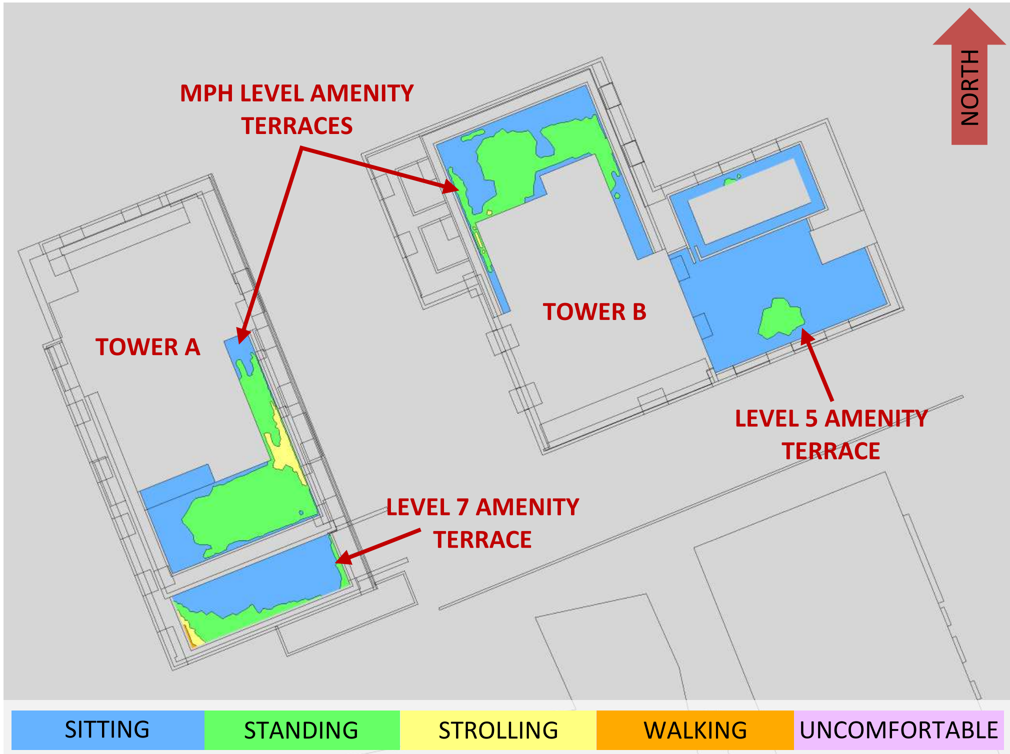


FIGURE 8A: SPRING – WIND COMFORT, COMMON AMENITY TERRACES

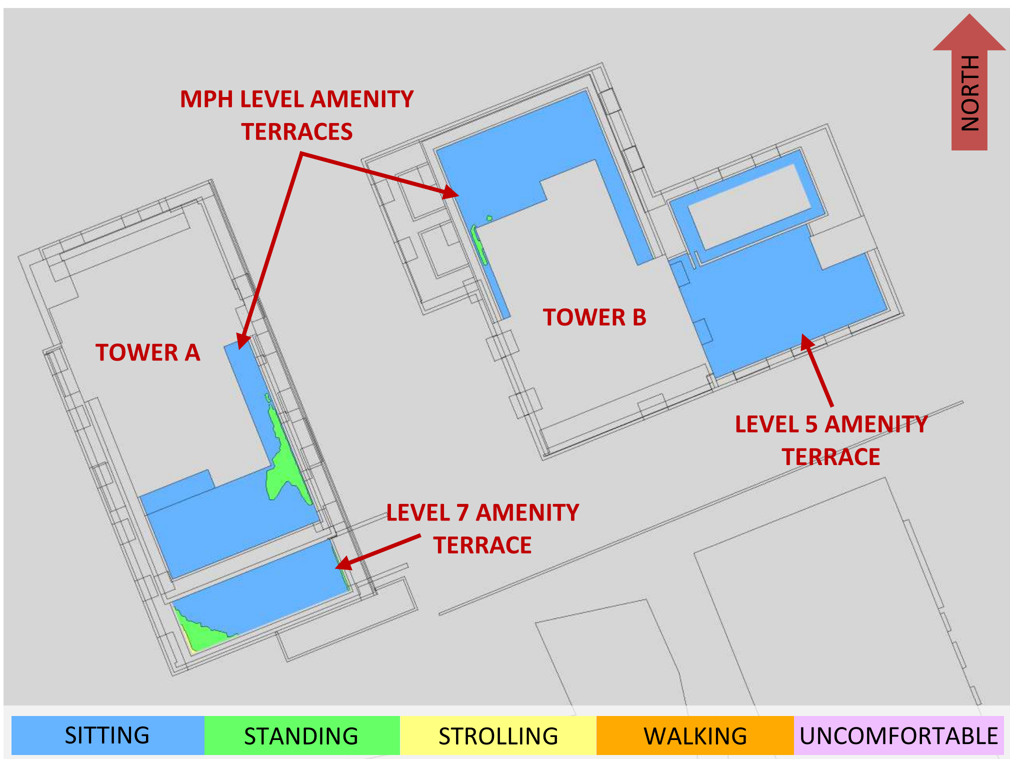


FIGURE 8B: SUMMER – WIND COMFORT, COMMON AMENITY TERRACES

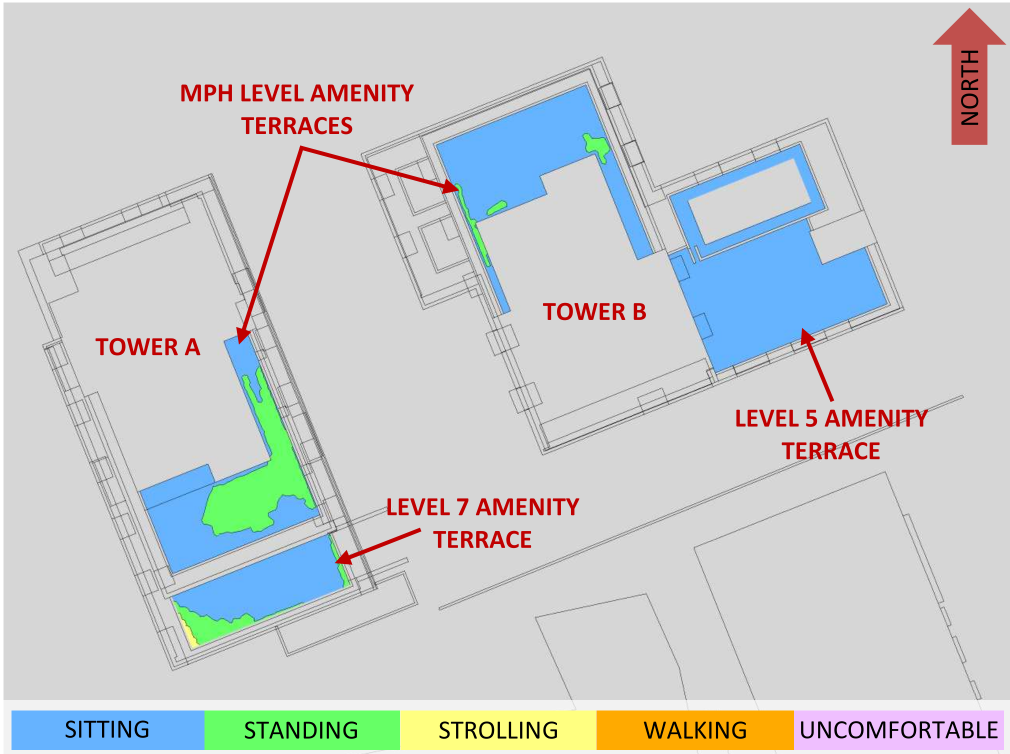


FIGURE 8C: AUTUMN – WIND COMFORT, COMMON AMENITY TERRACES

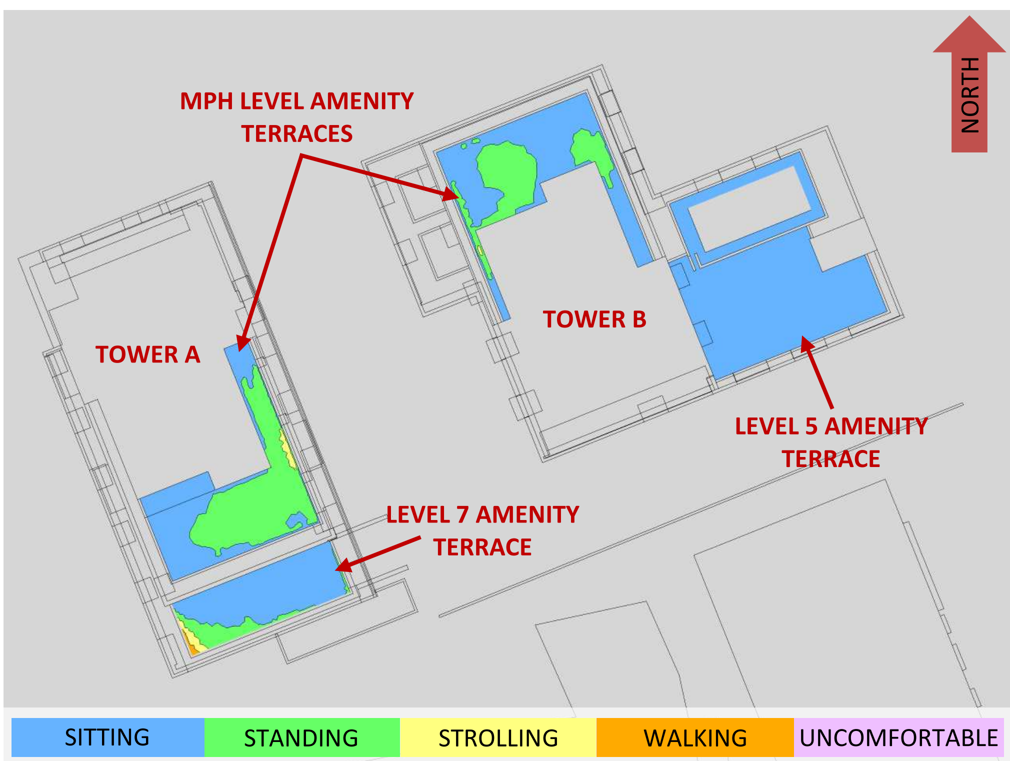


FIGURE 8D: WINTER – WIND COMFORT, COMMON AMENITY TERRACES

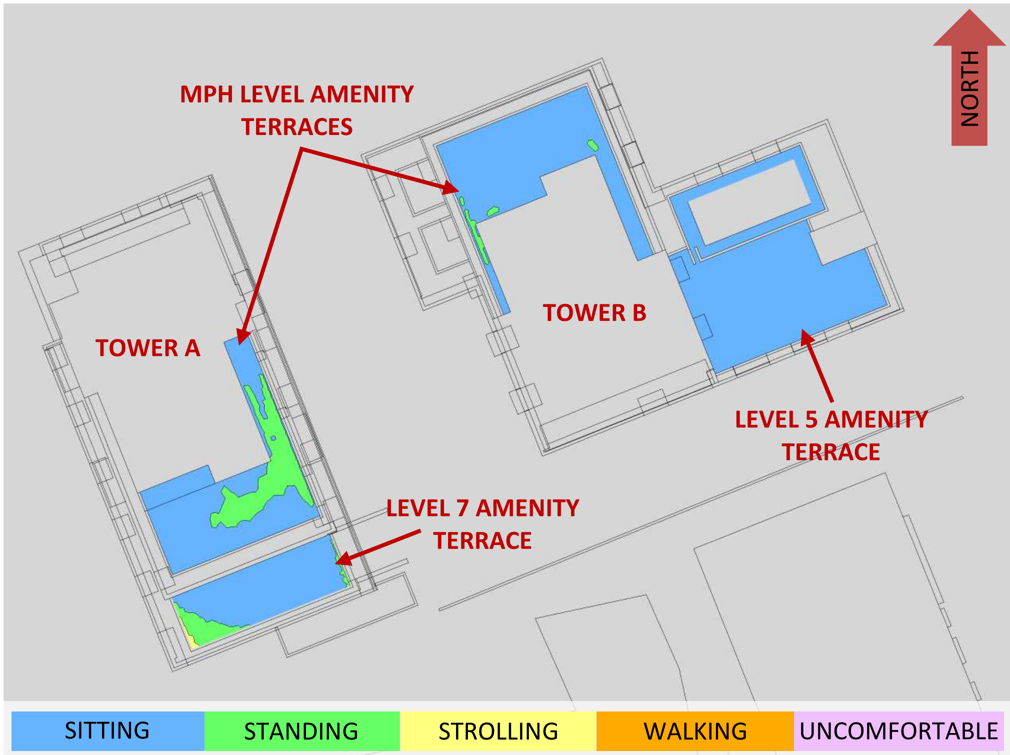
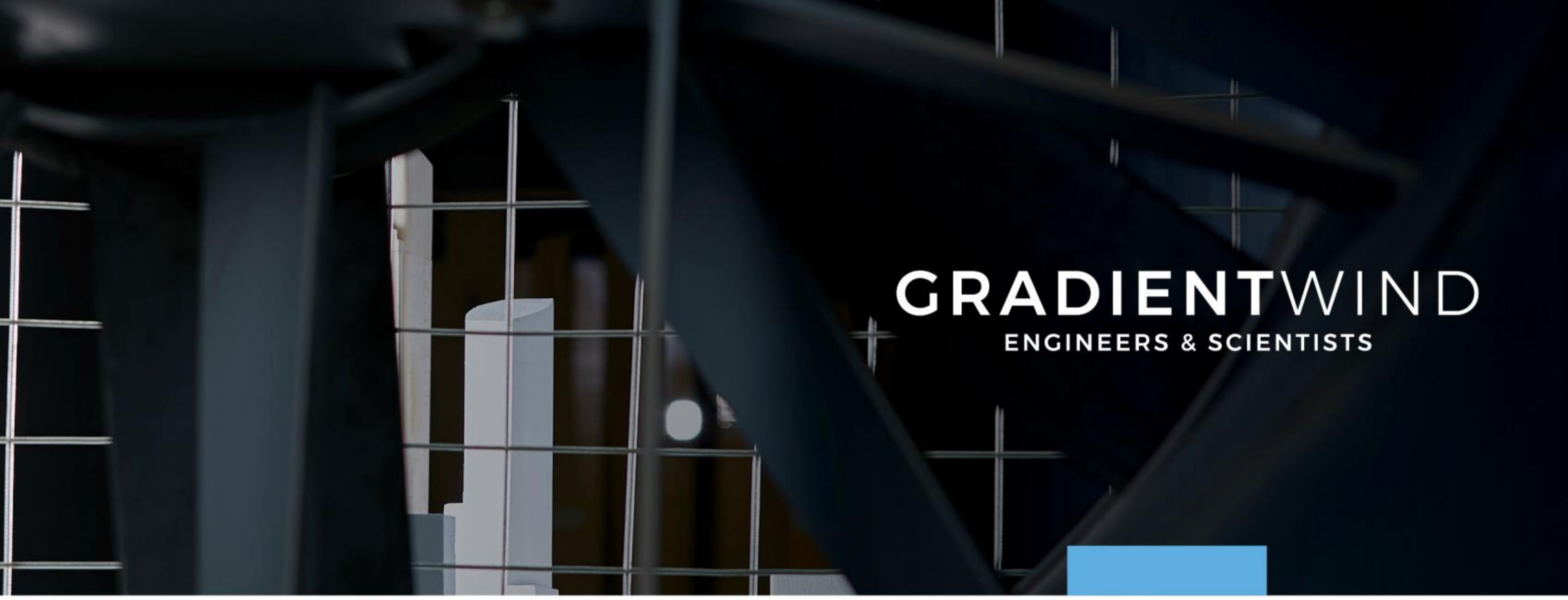


FIGURE 9: TYPICAL USE PERIOD – WIND COMFORT, COMMON AMENITY TERRACES



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	0.23
49	0.23
74	0.23
103	0.23
167	0.23
197	0.23
217	0.24
237	0.24
262	0.24
282	0.24
301	0.24
324	0.22

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

Upstream Exposure Type	Alpha Value (α)
Open Water	0.14-0.15
Open Field	0.16-0.19
Light Suburban	0.21-0.24
Heavy Suburban	0.24-0.27
Light Urban	0.28-0.30
Heavy Urban	0.31-0.33

The turbulence model in the computational fluid dynamics (CFD) simulations is a two-equation shear-stress transport (SST) model, and thus the ABL turbulence profile requires that two parameters be defined at the inlet of the domain. The turbulence profile is defined following the recommendations of the Architectural Institute of Japan for flat terrain (3).

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

Equation (2)

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

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.