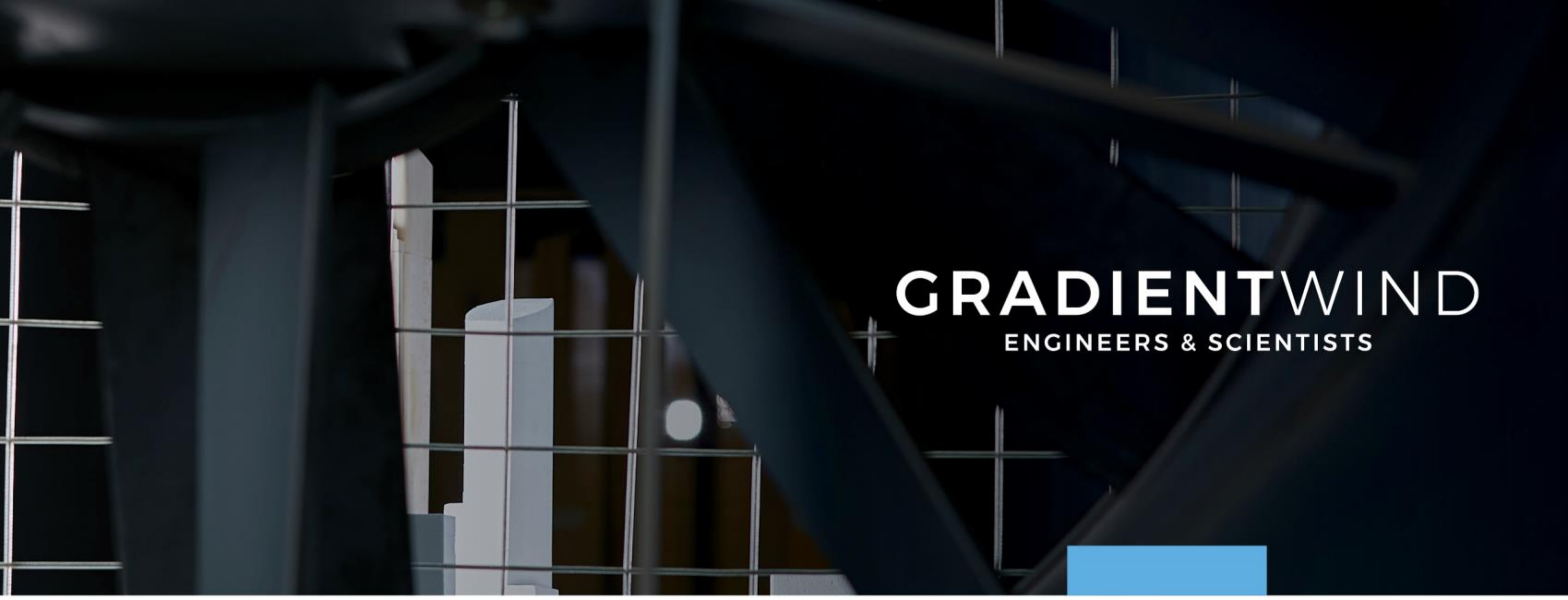
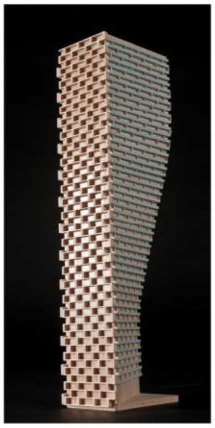
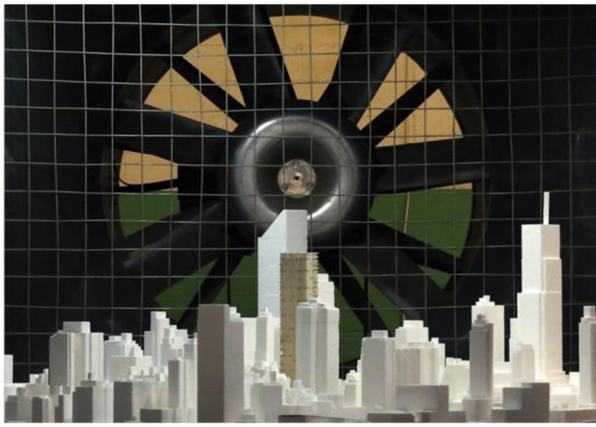


PEDESTRIAN LEVEL WIND STUDY

5 & 15 Tangreen Court
North York (Toronto), Ontario

REPORT: GW22-369-WTPLW





March 8, 2023

PREPARED FOR
CAPREIT 2 Limited Partnership
11 Church Street
Toronto, Ontario
M5E 1W1

PREPARED BY
Angelina Gomes, B.Eng., EIT, Junior Wind Scientist
Andrew Sliasas, M.A.Sc., P.Eng., Principal

EXECUTIVE SUMMARY

This report describes a wind tunnel pedestrian level wind study undertaken to assess wind conditions for a proposed multi-building development located at 5 & 15 Tangreen Court in North York (Toronto), Ontario. Two configurations were studied: (i) *existing scenario*, including all approved, surrounding developments and without the proposed development, and (ii) *proposed scenario* with the proposed development in place. The study involves wind tunnel measurements of pedestrian wind speeds using a physical scale model, combined with meteorological data integration, to assess pedestrian comfort at key areas within and surrounding the study site. Grade-level areas investigated include sidewalks, walkways, laneways, parking areas, green space, outdoor amenity areas, nearby transit stops, the Newtonbrook Secondary School yard, and building access points. Wind comfort is also evaluated over the various podium rooftops. The results and recommendations derived from these considerations are summarized in the following paragraphs and detailed in the subsequent report.

Our work is based on industry standard wind tunnel testing and data analysis procedures, architectural drawings prepared by IBI Group Architects in February 2023, surrounding street layouts, as well as existing and approved future building massing information obtained from the City of Toronto, and recent site imagery.

A complete summary of the predicted wind conditions is provided in Section 5 of this report and is also illustrated in Figures 2A through 4D, as well as Tables A1-A3 and B1-B5 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in Toronto, we conclude that the future wind conditions over many grade-level pedestrian wind-sensitive areas within and surrounding the study site will be acceptable for the intended uses on a seasonal basis. Exceptions include various walkways internal to the site, lobby entrances to Towers A, B, and F, as well as several other potential primary building access points, the mitigation for which is recommended as described in Section 5.2.

Should any podium rooftop terraces throughout the development be utilized for outdoor amenity, mitigation would be recommended as described in Section 5.2 to ensure safe conditions comfortable for sitting or more sedentary activities throughout the warmer months.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site apart from the noted grade level corridor between Towers A and B, and the northwest corners of the Tower B and Tower E podium rooftops, were found to experience conditions that could be considered unsafe.

TABLE OF CONTENTS

1. INTRODUCTION

This report describes a wind tunnel pedestrian level wind (PLW) study undertaken to assess wind conditions for a proposed multi-building development located at 5 & 15 Tangreen Court in North York, Ontario. Two configurations were studied: (i) *existing scenario*, including all approved, surrounding developments and without the proposed development, and (ii) *proposed scenario* with the proposed development in place. The study was performed in accordance with industry standard wind tunnel testing techniques, architectural drawings prepared by IBI Group Architects in February 2023, surrounding street layouts and existing and approved future building massing information, as well as recent site imagery.

2. TERMS OF REFERENCE

The focus of this wind tunnel pedestrian wind study is the proposed multi-building development located at 5 & 15 Tangreen Court in North York, Ontario. The study site is situated at the southeast corner of the intersection of Tangreen Court and Steeles Avenue West.

The development comprises seven residential towers labelled Towers A-G, ranging from 25 to 55-storeys, located to the west of the Centerpoint Mall. At grade, a proposed laneway from Steeles Ave bisects the development site north-south, and further links Tangreen Court to the west, and the Centrepoint Mall parking area to the east.

At the northeast corner of the site, Tower A and Tower B rise 55-storeys and 40-storeys, respectively, on separate 9-storey podia. The ground floor of each building consists of townhouses along the east elevation, indoor amenities and loading areas on the west side, and residential lobbies fronting the walkway between the two buildings. Tower A also features retail space at the northeast corner of the ground floor, and an outdoor amenity on the west side. Above, the buildings rise to Level 10, where the podia set back to base of each tower, before the towers continue to rise to their respective full heights.

South of Tower B, across a laneway, Towers C and D both rise 25 storeys on a shared 7-storey podium. The ground floor of the podium is bisected into north and south portions by a walkway, with townhouses along the east and south elevations, residential lobbies on the west site, and indoor amenities and building support services in the remaining spaces. The podium connects at Level 3 and rises uniformly to Level 8, where it sets back to the base of each tower. Above Level 8, Towers C and D rise uniformly to full height.

At the northwest corner of the site, Towers E, F, and G rise 55-, 45-, and 35-storeys, respectively, each from 9-storey podia, with Towers F and G sharing a podium. At grade, the towers feature residential lobbies on the west side, with retail space along the north elevation of Tower E, indoor amenities on the east side of Towers F and G, and outdoor amenities to the south of Towers E and F. The shared podium of Towers F and G is bisected at grade, before connecting at Level 3. Both podia set back at Level 10 to the base of each tower. Above Level 10, Towers E, F, and G rise uniformly to their respective full heights.

Regarding wind exposures, the near-field surroundings of the development (defined as an area falling within a 200-metre radius of the site) comprise low-rise commercial buildings and parking areas from the northwest clockwise to the southeast, the Newtonbrook Secondary School yard to the immediate south, an 11-storey building at 175 Hilda Avenue to the southwest, and Carrington Tower (34-storeys) to the west, as well as 15 Tangreen (18-storeys) at the southwest corner of the study site. The far-field surroundings (defined as the area beyond the near field and within a two-kilometer radius) are characterized as low-rise residential in all directions, with clusters of mid- and high-rise buildings to the north and south along Yonge Street and to the west along Steeles Avenue West.

Grade-level areas investigated include sidewalks, walkways, laneways, parking areas, green space, outdoor amenity areas, nearby transit stops, the Newtonbrook Secondary School yard, and building access points. Wind comfort is also evaluated over the various podium rooftops. Figures 1A and 1B illustrates the *existing* and *proposed* study sites and surrounding context, respectively, and Photographs 1 through 6 depict the wind tunnel model used to conduct the study.

3. OBJECTIVES

The principal objectives of this study are to (i) determine pedestrian level wind comfort and safety conditions at key areas within and surrounding the development site; (ii) identify areas where wind conditions may interfere with the intended uses of outdoor spaces; (iii) recommend suitable mitigation measures, where required; and (iv) evaluate the influence of the proposed development on the existing wind conditions.

4. METHODOLOGY

The approach followed to quantify pedestrian wind conditions over the site is based on wind tunnel measurements of wind speeds at selected locations on a reduced-scale physical model, meteorological analysis of the Toronto area wind climate and synthesis of wind tunnel data with industry-accepted guidelines[1]. The following sections describe the analysis procedures, including a discussion of the pedestrian comfort and safety guidelines.

4.1 Wind Tunnel Context Modelling

A detailed PLW study is performed to determine the influence of local winds at the pedestrian level for a proposed development. The physical model of the proposed development and relevant surroundings, illustrated in Photographs 1 through 6 following the main text, was constructed at a scale of 1:400. The wind tunnel model includes all existing buildings and approved future developments within a full-scale diameter of approximately 840 metres. The general concept and approach to wind tunnel modelling is to provide building and topographic detail in the immediate vicinity of the study site on the surrounding model, and to rely on a length of wind tunnel upwind of the model to develop wind properties consistent with known turbulent intensity profiles that represent the surrounding terrain.

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

4.2 Wind Speed Measurements

The PLW study was performed by testing a total of 165 sensor locations on the scale model in Gradient Wind's wind tunnel. Of these 165 sensors, 148 were located at grade and the remaining 17 sensors were located over the various podium rooftops. Wind speed measurements were performed for each of the 165 sensors for 36 wind directions at 10° intervals. Figures 1A and 1B illustrates the *existing* and *proposed*

[1] Pedestrian Level Wind Study Terms of Reference Guide, 2022

study sites and surrounding context, respectively, while sensor locations used to investigate wind conditions are illustrated in Figures 2A through 4D.

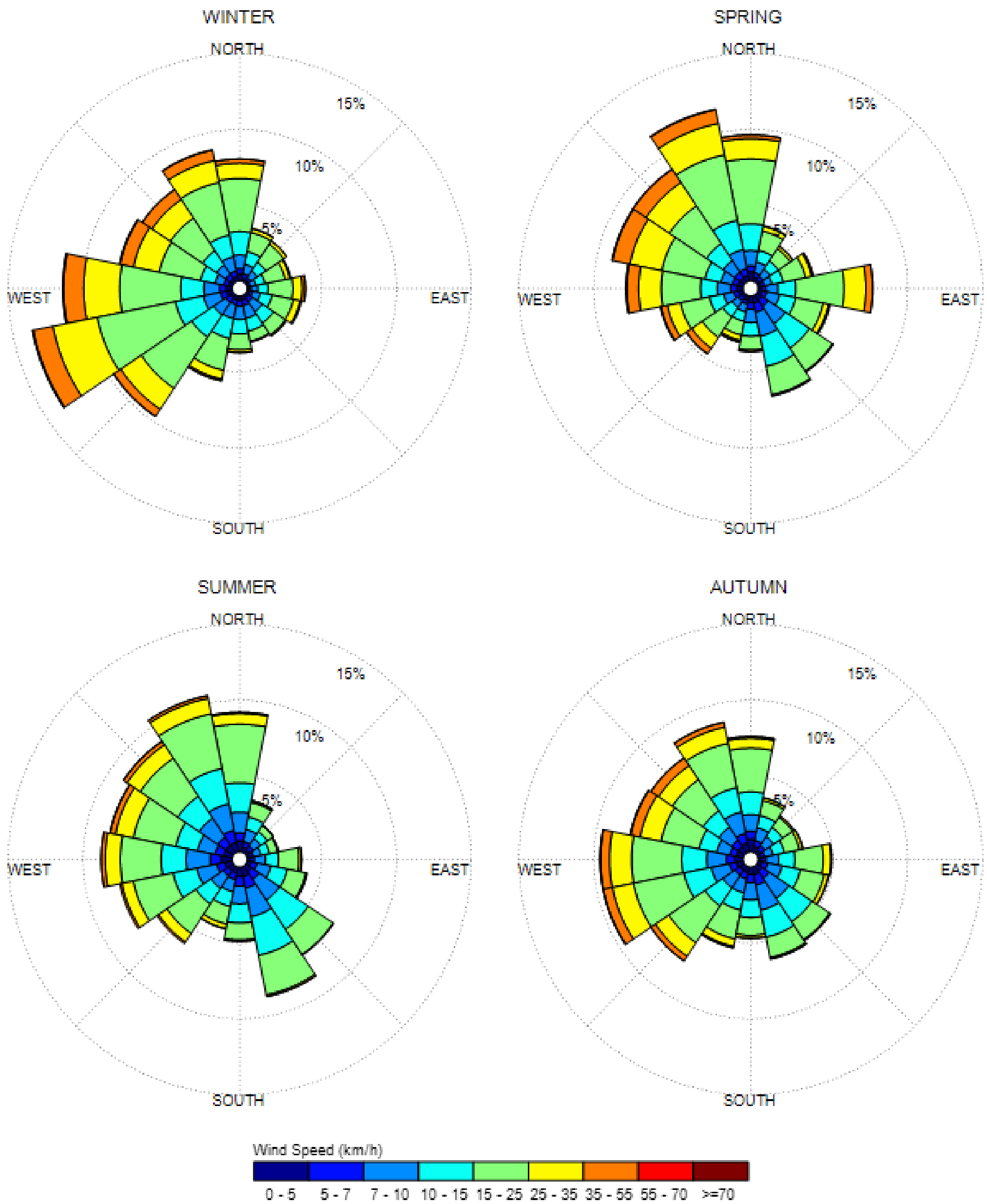
Mean and peak wind speed values for each location and wind direction were calculated from real-time pressure measurements, recorded at a sample rate of 500 samples per second, and taken over a 60-second time period. This period at model-scale corresponds approximately to one hour in full-scale, which matches the time frame of full-scale meteorological observations. Measured mean and gust wind speeds at grade were referenced to the wind speed measured near the ceiling of the wind tunnel to generate mean and peak wind speed ratios. Ceiling height in the wind tunnel represents the depth of the boundary layer of wind flowing over the earth's surface, referred to as the gradient height. Within this boundary layer, mean wind speed increases up to the gradient height and remains constant thereafter. Appendices C and D provide greater detail of the theory behind wind speed measurements. Wind tunnel measurements for this project, conducted in Gradient Wind's wind tunnel facility, meet or exceed guidelines found in the National Building Code of Canada 2015 and of 'Wind Tunnel Studies of Buildings and Structures', ASCE Manual 7 Reports on Engineering Practice No 67.

4.3 Meteorological Data Analysis - Pearson International Airport

A statistical model for winds in Toronto was developed from over 50 years of hourly meteorological wind data recorded at Pearson International Airport. Wind speed and direction data were analyzed for each month of the year in order to determine the statistically prominent wind directions and corresponding speeds, and to characterize similarities between monthly weather patterns. Based on this portion of the analysis, the four seasons are represented by grouping data from consecutive months based on similarity of weather patterns, and not according to the traditional calendar method.

The statistical model of the Toronto area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in km/h. Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The preferred wind speeds and directions can be identified by the longer length of the bars. For Pearson International Airport, the most common winds concerning pedestrian comfort occur from the southwest clockwise to the north, as well as those from the east. The directional preference and relative magnitude of the wind speed varies somewhat from season to season, with the summer months displaying the calmest winds relative to the remaining seasonal periods.

SEASONAL DISTRIBUTION OF WINDS FOR VARIOUS PROBABILITIES
PEARSON INTERNATIONAL AIRPORT, TORONTO, ONTARIO



Notes:

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

4.4 Pedestrian Comfort and Safety Guidelines

Pedestrian comfort and safety guidelines are based on the mechanical effects of wind without consideration of other meteorological conditions (i.e. temperature, relative humidity). The comfort guidelines assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Four pedestrian comfort classes are based on 80% non-exceedance Guest Equivalent Mean (GEM) wind speed ranges, which include (i) Sitting; (ii) Standing; (iii) Walking; and (iv) Uncomfortable. More specifically, the comfort classes and associated GEM wind speed ranges are summarized as follows:

(i) **Sitting** – A wind speed below 10 km/h (i.e. 0 – 10 km/h) would be considered acceptable for sedentary activities, including sitting.

(ii) **Standing** – A wind speed below 15 km/h (i.e. 10 km/h – 15 km/h) is acceptable for activities such as standing or leisurely strolling.

(iii) **Walking** – A wind speed below 20 km/h (i.e. 15 km/h – 20 km/h) is acceptable for walking or more vigorous activities.

(iv) **Uncomfortable** – A wind speed over 20 km/h is classified as uncomfortable from a pedestrian comfort standpoint. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

The pedestrian safety wind speed guideline 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 greater than 90 km/h is classified as dangerous.

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 wind speeds of 10 km/h were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting or more sedentary activities. Similarly, if 20 km/h at a location were exceeded for more than 20% of the time, walking or less vigorous activities would be considered uncomfortable. As most of 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 at tested locations, the assessment of pedestrian comfort involves determining the suitability of the predicted wind conditions for their associated spaces. This step involves comparing the predicted comfort class to the desired comfort class, which is dictated by the location type represented by the sensor (i.e. a sidewalk, building entrance, amenity space, or other). An overview of common pedestrian location types and their desired comfort classes are summarized below.

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

Location Types	Desired Comfort Classes
Primary Building Entrance	Standing
Secondary Building Access Point	Walking
Public Sidewalks / Pedestrian Walkways	Walking
Outdoor Amenity Spaces	Sitting / Standing
Cafés / Patios / Benches / Gardens	Sitting / Standing
Plazas	Standing / Walking
Transit Stops	Standing
Public Parks	Sitting / Walking
Garage / Service Entrances	Walking
Vehicular Drop-Off Zones	Walking
Laneways / Loading Zones	Walking

5. RESULTS AND DISCUSSION

Tables A1 through A3 in Appendix A provide a summary of seasonal comfort predictions for each sensor location under the *existing* massing scenario. Similarly, Tables B1 through B5 in Appendix B provide the seasonal comfort predictions for under the *proposed* massing scenario. The tables indicate the 80% non-exceedance GEM wind speeds and corresponding comfort classifications as defined in Section 4.4. In other words, a wind speed threshold of 19.1 for the summer season indicates that 80% of the measured data falls at or below 19.1 km/h during the summer months and conditions are therefore suitable for walking, as the 80% threshold value falls within the exceedance range of 15-20 km/h for walking. The tables include the predicted threshold values for each sensor location during each season, accompanied by the corresponding predicted comfort class (i.e. sitting, standing, walking, etc.).

The most significant findings of the PLW study are summarized in Sections 5.1 and 5.2. To assist with understanding and interpretation, predicted conditions for the proposed development are also illustrated in colour-coded format in Figures 2A through 4D. Conditions suitable for sitting are represented by the colour blue, while standing is represented by green, and walking by yellow. Conditions considered uncomfortable for walking are represented by the colour orange. For locations where the wind safety criterion is exceeded, the sensor is highlighted in red.

5.1 Pedestrian Comfort Suitability – *Existing Scenario*

Based on the analysis of the measured data, consideration of local climate data, and the suitability descriptors provided in Tables A1-A3 in Appendix A and illustrated in Figures 2A through 2D, this section summarizes the significant findings of the PLW study with respect to the *existing scenario*, as follows:

1. Most public sidewalks, walkways, green space, laneways, and parking areas within and surrounding the proposed development currently experience wind conditions suitable for walking or better during each seasonal period. One exception is a parking area directly north of 15 Tangreen Court (Sensor 67) where conditions become marginally uncomfortable for walking during the winter.

2. The transit stops along Steeles Avenue West (Sensors 9 and 19) currently experience standing conditions during the summer and autumn, and walking conditions during the winter and spring. It is noteworthy that these stops are currently equipped with pedestrian transit shelters.

3. The tested areas of the Newtonbrook Secondary School yard to the south (Sensors 28-31) currently experience standing conditions during the summer and autumn, and walking or better conditions during the winter and spring.

4. Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site were found to experience wind conditions that are considered unsafe.

5.2 Pedestrian Comfort Suitability – *Proposed Scenario*

Based on the analysis of the measured data, consideration of local climate data, and the suitability descriptors provided in Tables B1-B5 in Appendix B and illustrated in Figures 3A through 4D, this section summarizes the significant findings of the PLW study with respect to the *proposed scenario*, as follows:

1. Many public sidewalks, walkways, green space, laneways, and parking areas within and surrounding the proposed development will experience wind conditions suitable for walking or better during each seasonal period. Exceptions include the following, where conditions transition to uncomfortable for walking during the colder months:

    - Portions of sidewalk along Steeles Avenue West (Sensors 6, 10, and 11),
    - Portions of sidewalk along Tangreen Court (Sensors 21, 23, and 57),
    - Areas along the laneway between Towers B and C (Sensors 83, 86, 88, and 89),
    - The walkway between Towers A and B (Sensors 96-100),
    - Areas along the north-south laneway from Steeles Avenue West (Sensors 104, 106, 108, and 120),
    - The walkway between Towers E and F (Sensors 114 and 116-118),
    - An area directly north of Tower G (Sensor 131),
    - And an area between Towers C and D (Sensor 143);

    Further, the area between Towers A and B denoted by Sensors 96 and 97 will not achieve the annual safety criterion. It is relevant that multiple noted locations are not expected to be frequented by pedestrian traffic, such as laneways and parking areas, therefore the marginally uncomfortable conditions are considered acceptable. Similarly, the sidewalk areas along Steeles Avenue West and Tangreen Court (Sensors 6, 10, 11, 21, 23, & 57) only marginally exceed the walking criterion on a limited basis during the colder months and are considered "Safe", as defined in Section 4.4, therefore mitigation is not considered to be necessary. For areas that will be frequented by pedestrian use, such as sidewalks and walkways, it is recommended to integrate staggered wind barriers throughout the landscape plan to interrupt prominent wind flows channelled between the buildings. Barriers may take the form of high-solidity windscreens, dense coniferous plantings in raised planters, or a combination thereof, and should rise at least 1.8-2.0 metres at the time of installation. For windy areas at the base of buildings, it is also recommended to provide overhead canopies extending at least 2.0 metres from the tower facades to buffer downwash, particularly along the corridor between Towers A and B (Sensors 96-100). The exact placement and composition of such mitigation can be coordinated with the design team at a later date as the landscape plan progresses.

2. Many lobby entrances throughout the development will be comfortable for standing or better throughout the year. Exceptions include the primary residential entrances to Towers A, B, and F (Sensors 100, 95, and 54, respectively), where conditions transition to become unsuitable for standing during the colder months. To ensure these entrances will be comfortable for standing throughout the year, it is recommended to either recess the entrances within the building facades, or flank the doorways with vertical wind barriers and install canopies overhead.

   Considering other potential primary building access points throughout the development, the retail facades on the north side of Towers A and E (Sensors 42-51, 105, and 107) will generally be suitable for standing or better during each seasonal period, with the northwest and northeast corners (Sensors 43, 44, 46, 50, 51, and 105) experiencing walking, and in some areas uncomfortable for walking, conditions during the colder seasons. To ensure conditions suitable for standing on a seasonal basis, it is recommended to locate retail entrances toward the centre of the north and east facades of Tower A (Sensor 42 and 45), and towards the northeast corner of Tower E (Sensors 47-49 and 107), where conditions are calmer. Alternatively, retail entrances in the noted windier areas should be recessed within the façade, equipped with flanking barriers and overhead canopies, or have swing doors substituted with sliding or revolving options.

   Most townhouse frontages throughout the development will be comfortable for standing or better throughout the year. It is recommended to avoid placing townhouse entrances along the corridors between Towers A and B (Sensors 97 and 98), and Towers C and D (Sensors 141 and 142), as well as on the west side of Tower G (Sensor 57), where walking and uncomfortable for walking conditions are experienced during the colder seasons.

3. The majority of the various grade-level amenities southwest of Tower A (Sensor 103), and south of Towers E (Sensors 109 & 111-112) and F (Sensors 124-127) will be comfortable for sitting for

more sedentary activities during the summer, with marginal standing conditions over the south end of Tower A (Sensor 102) and Tower E (Sensor 110). The noted conditions are considered acceptable for intended uses of the spaces.

4. The transit stops along Steeles Avenue West (Sensors 9 and 19) will continue to experience a mix of standing or waking conditions throughout the year. Given that these conditions are generally existing and these stops are already equipped with pedestrian transit shelters, the noted conditions are considered acceptable.

5. The tested areas of the Newtonbrook Secondary School yard to the south (Sensors 28-31) will continue to experience standing or better conditions during the summer, with conditions becoming suitable for walking or better throughout the rest of the year, which is appropriate.

6. Most areas of the various podium rooftops (Sensors 149-165) will be comfortable for standing or better during the summer months. Exceptions include areas near the northwest corners of Tower B (Sensors 153 and 154) and Tower E (Sensor 159), as well as areas to the north of Towers F and G (Sensors 161 and 165, respectively), where wind conditions are either suitable for walking or uncomfortable for walking (Sensor 159) during the summer. Further, the areas denoted by Sensors 153, 154, and 159 will not achieve the annual safety criterion. Should any podium rooftops be utilized as outdoor amenity terraces, mitigation in the form of raised perimeter guards, targeted wind barriers, and overhead canopy/pergola structures, will be required to ensure calm conditions suitable for sitting during the warmer months. The exact placement and composition of such mitigation, if needed, can be coordinated with the design team as the landscaping plan progresses.

7. Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site, apart from the noted grade level corridor between Towers A and B, and the northwest corners of the Tower B and Tower E podium rooftops, were found to experience wind conditions that are considered unsafe.

6. CONCLUSIONS AND RECOMMENDATIONS

This report summarizes the methodology, results, and recommendations related to a pedestrian level wind study for the proposed multi-building development located at 5 & 15 Tangreen Court in North York, Ontario. The study was performed in accordance with industry standard wind tunnel testing and data analysis procedures.

A complete summary of the predicted wind conditions is provided in Section 5 of this report and is also illustrated in Figures 2A through 4D, as well as Tables A1-A3 and B1-B5 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in North York, we conclude that the future wind conditions over many grade-level pedestrian wind-sensitive areas within and surrounding the study site will be acceptable for the intended uses on a seasonal basis. Exceptions include various walkways internal to the site, lobby entrances to Towers A, B, and F, as well as several other potential primary building access points, the mitigation for which is recommended as described in Section 5.2.

Should any podium rooftop terraces throughout the development be utilized for outdoor amenity, mitigation would be recommended as described in Section 5.2 to ensure safe conditions comfortable for sitting or more sedentary activities throughout the warmer months.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, no areas over the study site apart from the noted grade level corridor between Towers A and B, and the northwest corners of the Tower B and Tower E podium rooftops, were found to experience conditions that could be considered unsafe.

This concludes our pedestrian level wind study and report. Please advise the undersigned of any questions or comments.

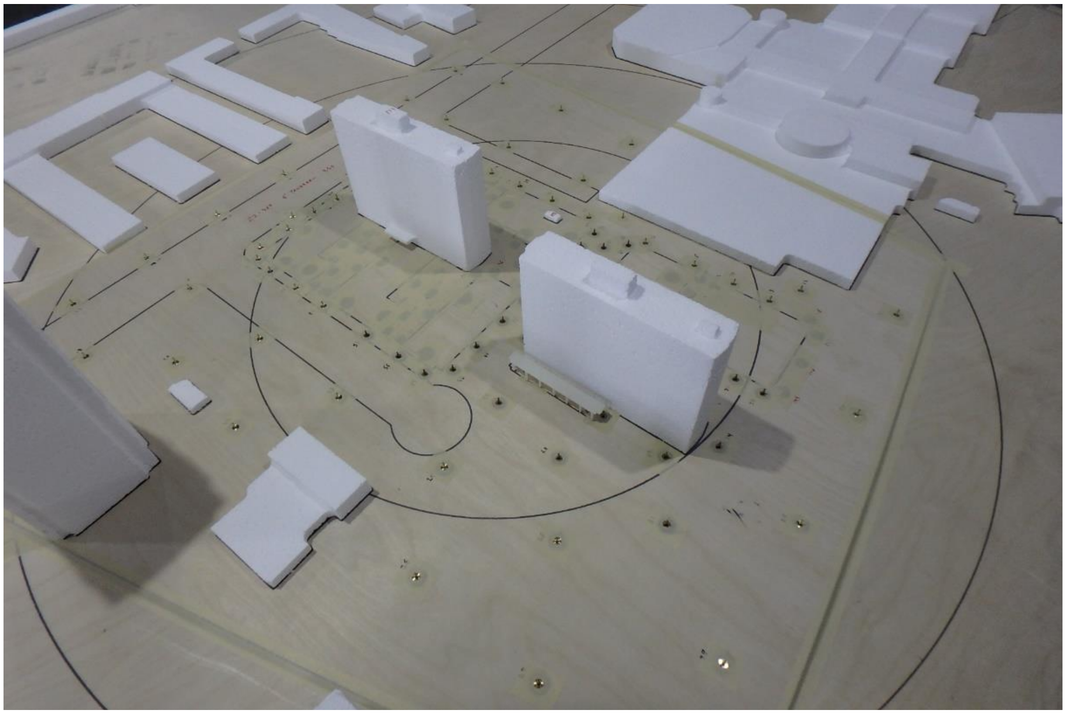
Sincerely,

Gradient Wind Engineering Inc.

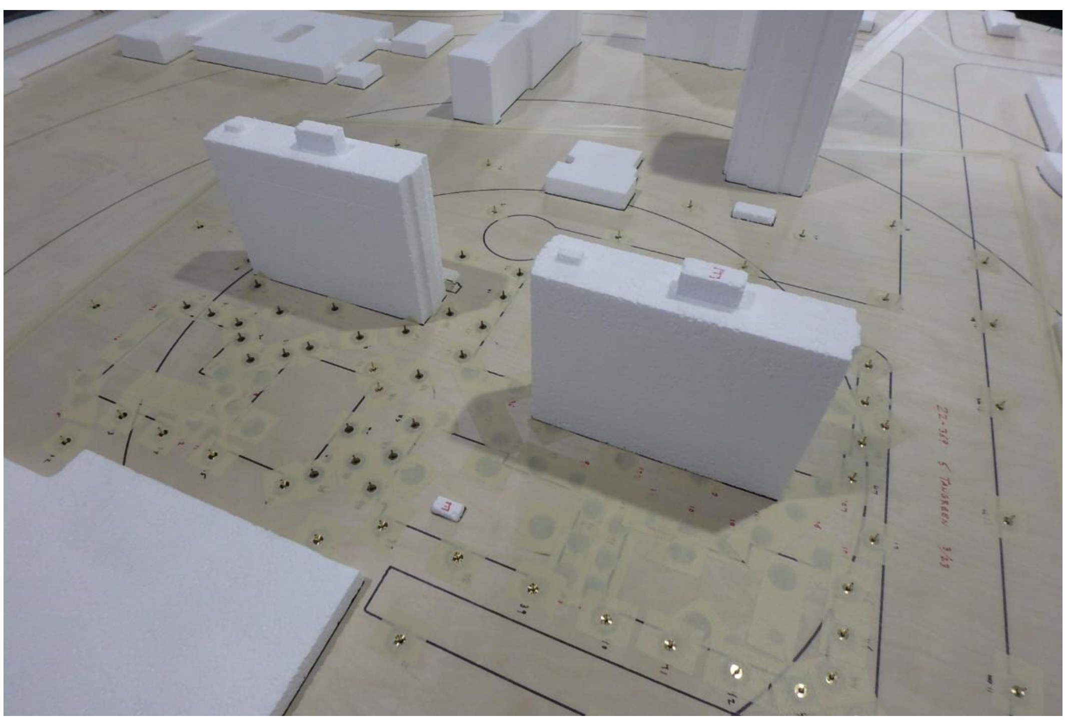
Angelina Gomes, B.Eng., EIT
Junior Wind Scientist

Andrew Sliasas, M.A.Sc., P.Eng.,
Principal

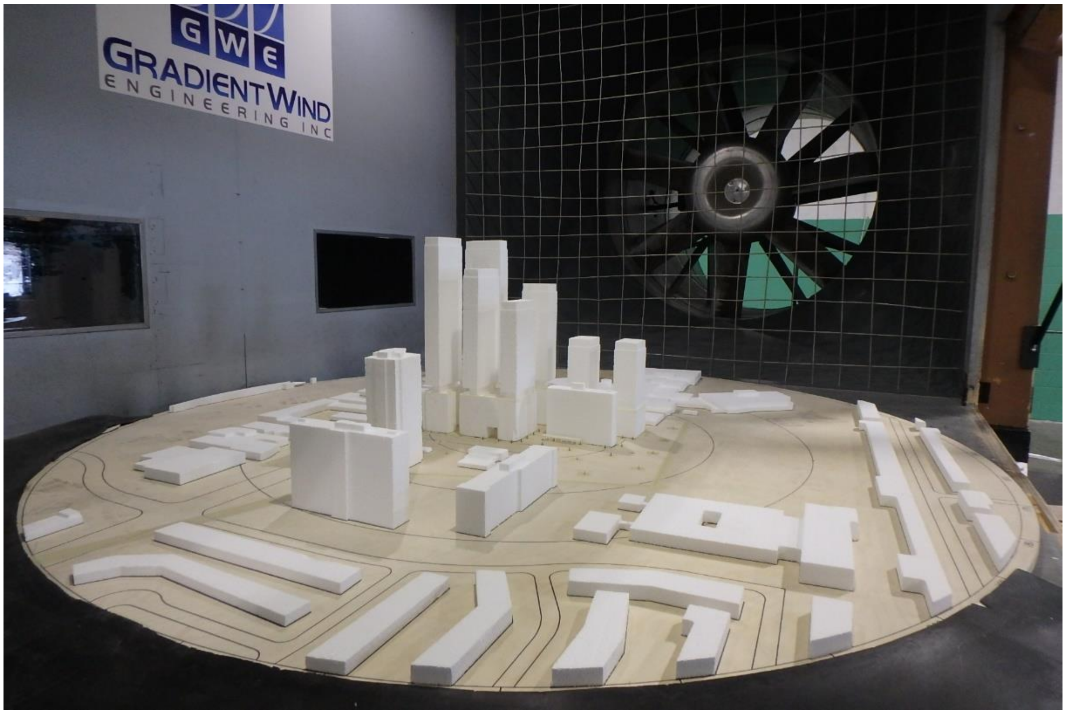
GW22-369-WTPLW



PHOTOGRAPH 1: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING NORTHEAST

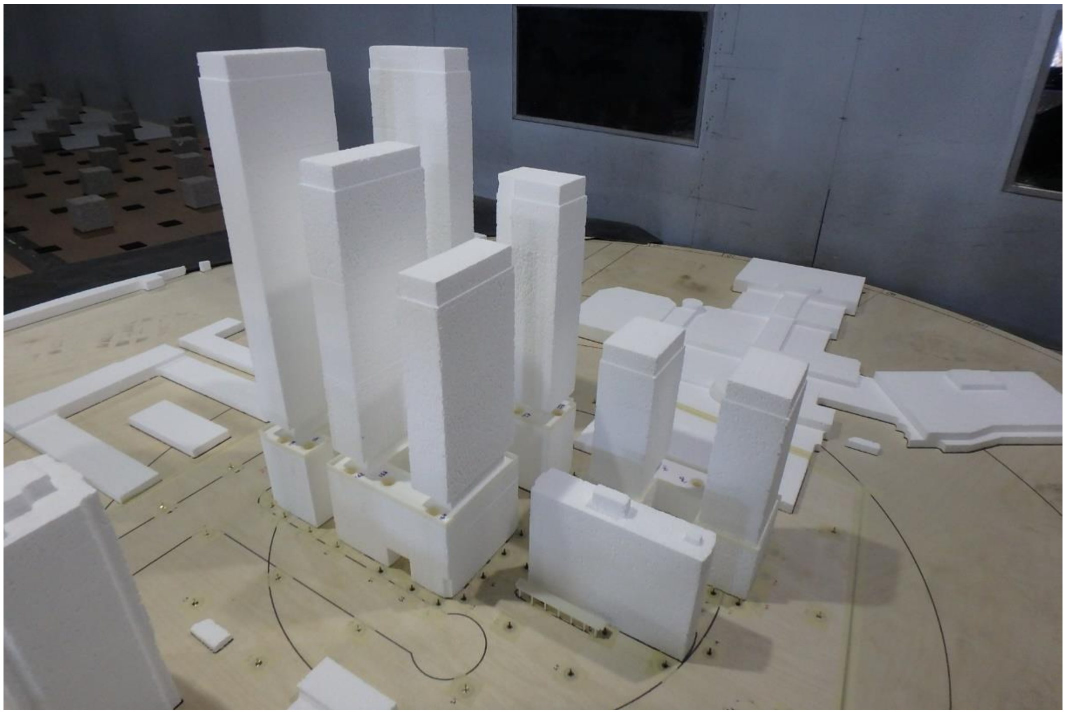


PHOTOGRAPH 2: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING SOUTHWEST

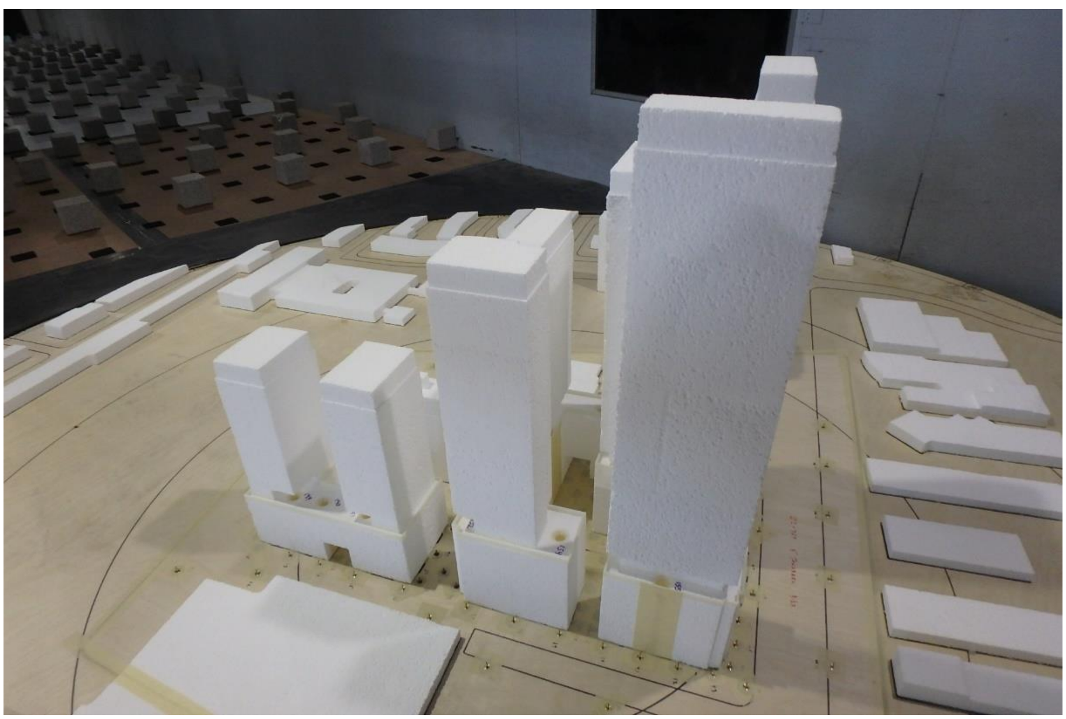


PHOTOGRAPH 3: PROPOSED STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING DOWNWIND

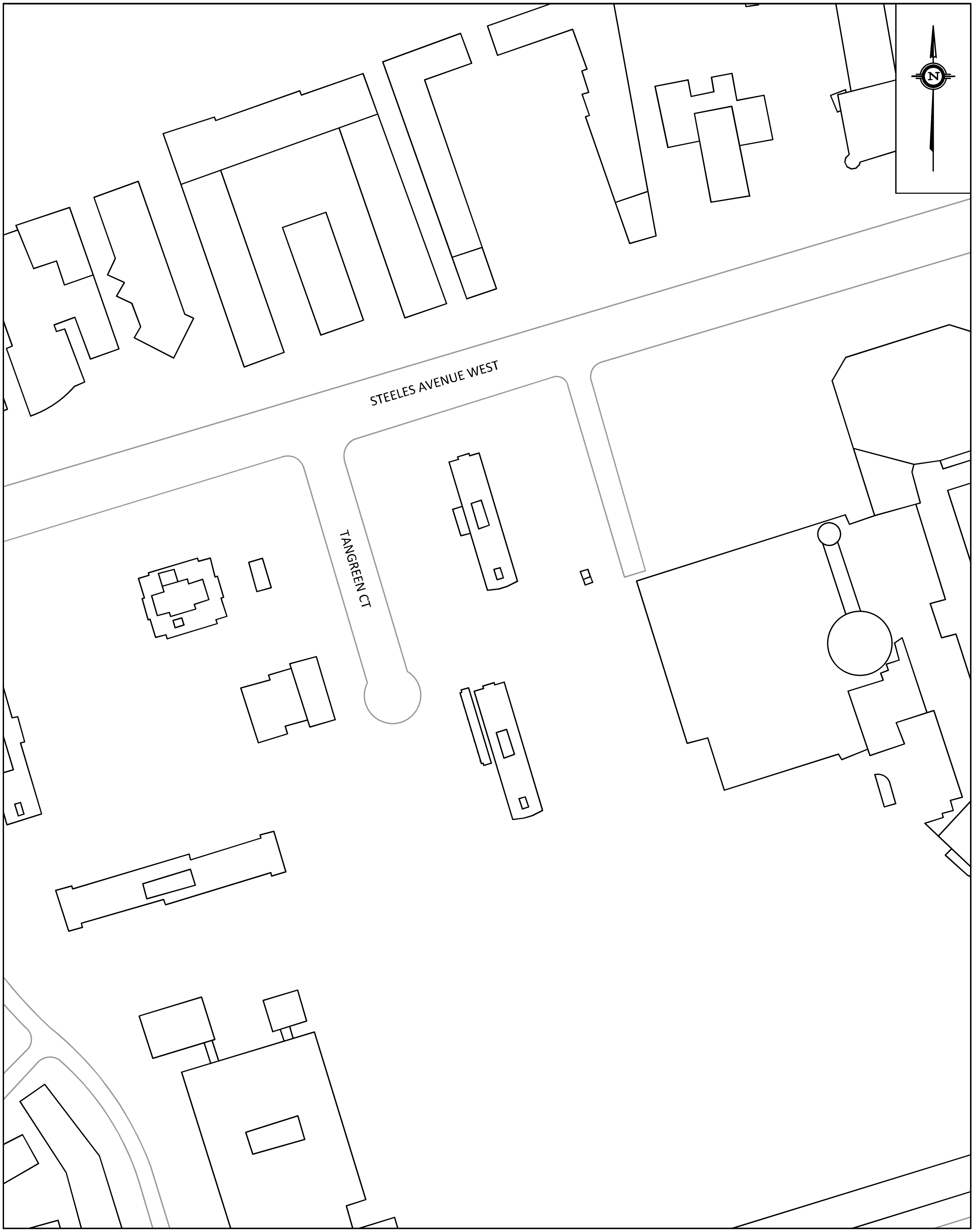
PHOTOGRAPH 4: PROPOSED STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING UPWIND



PHOTOGRAPH 5: CLOSE-UP VIEW OF PROPOSED STUDY MODEL LOOKING NORTHEAST



PHOTOGRAPH 6: CLOSE-UP VIEW OF PROPOSED STUDY MODEL LOOKING SOUTHWEST



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

PROJECT: 5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1A: SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2500 (APPROX.)	DRAWING NO.: GW22-369-PLW-1A	
DATE: MARCH 7, 2023	DRAWN BY: C.E.	

GRADIENTWIND
ENGINEERS & SCIENTISTS

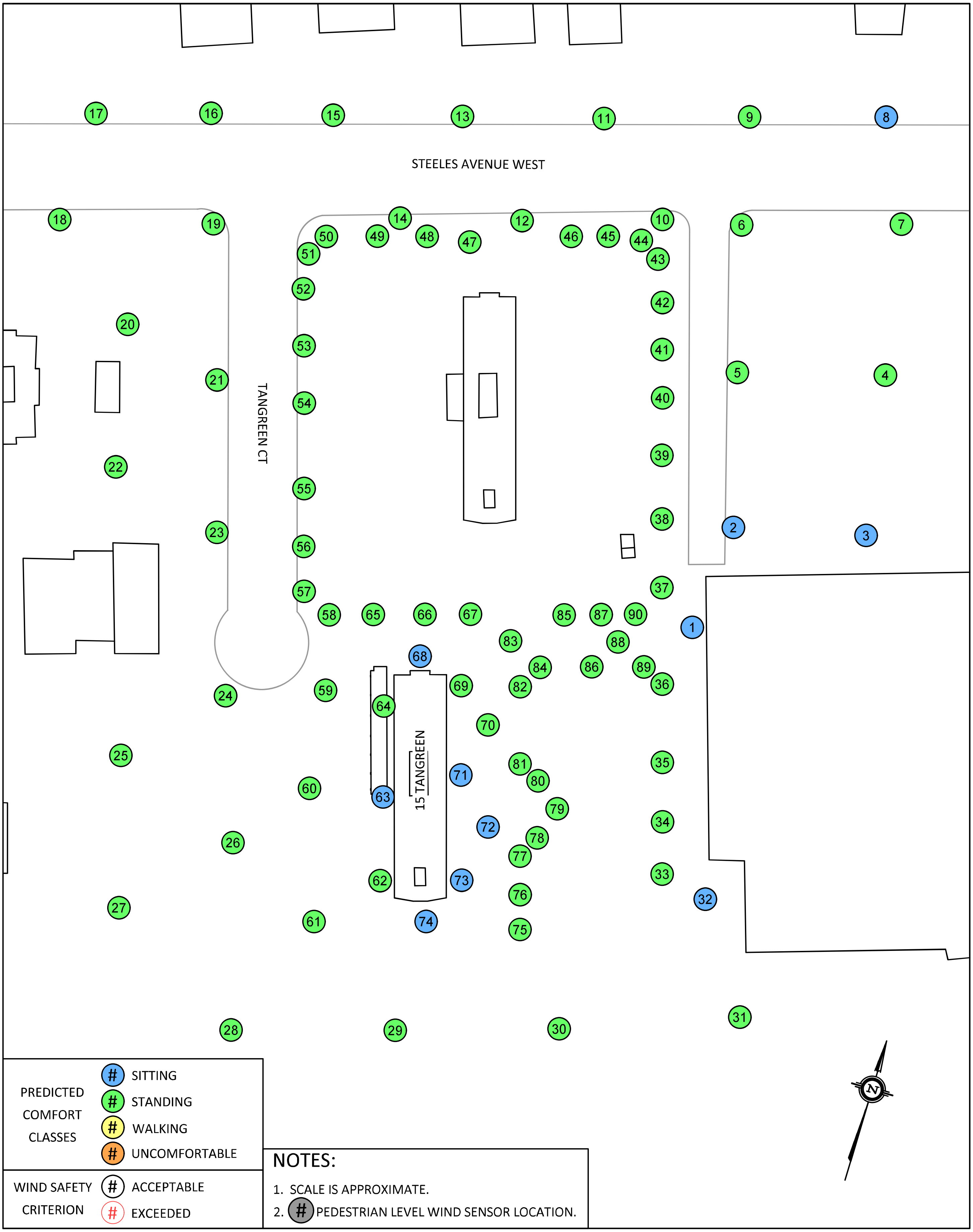
127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT: 5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 1B: SITE PLAN AND SURROUNDING CONTEXT
SCALE: 1:2500 (APPROX.)	DRAWING NO.: GW22-369-PLW-1B	
DATE: MARCH 7, 2023	DRAWN BY: C.E.	

GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500 (APPROX.)
DRAWING NO.	GW22-369-PLW-2A
DATE	MARCH 7, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 2A: SPRING EXISTING GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS

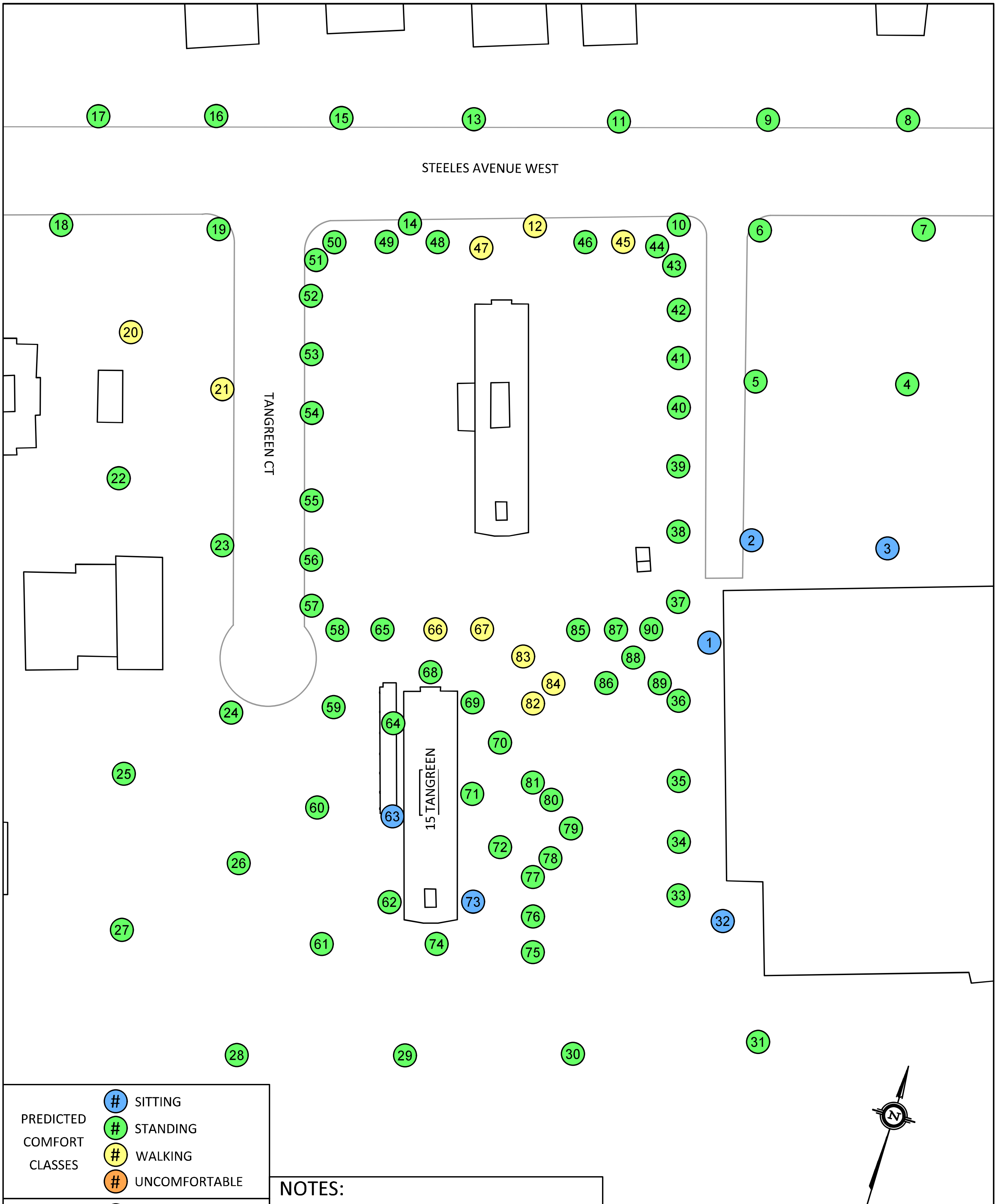


GRADIENTWIND
ENGINEERS & SCIENTISTS
127 WALGREEN ROAD, OTTAWA, ON
613 836 0934 • GRADIENTWIND.COM

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GW22-369-PLW-2B
DATE	MARCH 7, 2023	DRAWN BY	C.E.

DESCRIPTION

FIGURE 2B: SUMMER
EXISTING GROUND FLOOR PLAN
PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CLASSES

- # SITTING
- # STANDING
- # WALKING
- # UNCOMFORTABLE

WIND SAFETY CRITERION

- # ACCEPTABLE
- # EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

GRADIENTWIND
ENGINEERS & SCIENTISTS

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

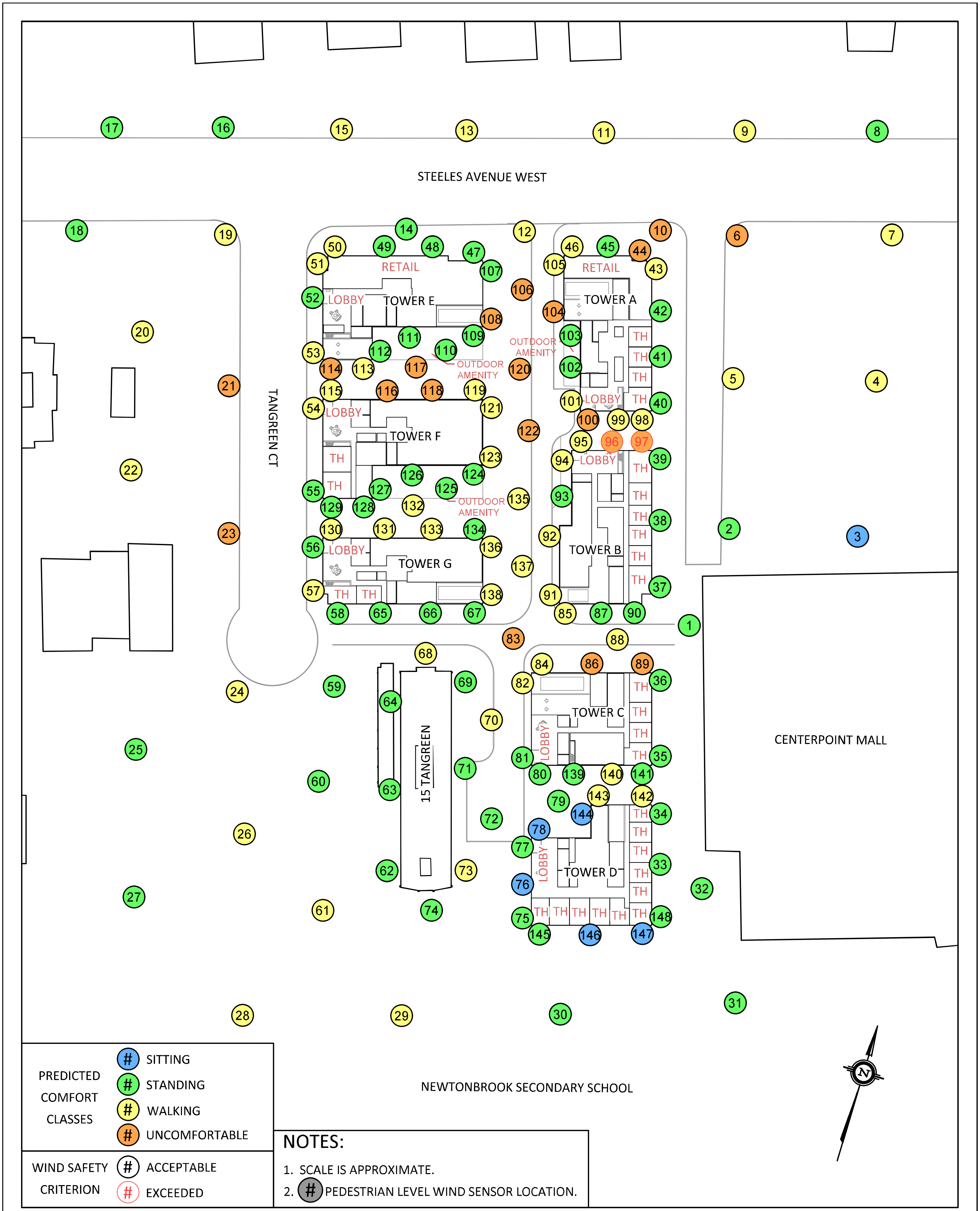
PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GW22-369-PLW-2C
DATE	MARCH 7, 2023	DRAWN BY	C.E.

DESCRIPTION

FIGURE 2C: AUTUMN
EXISTING GROUND FLOOR PLAN
PEDESTRIAN COMFORT PREDICTIONS

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

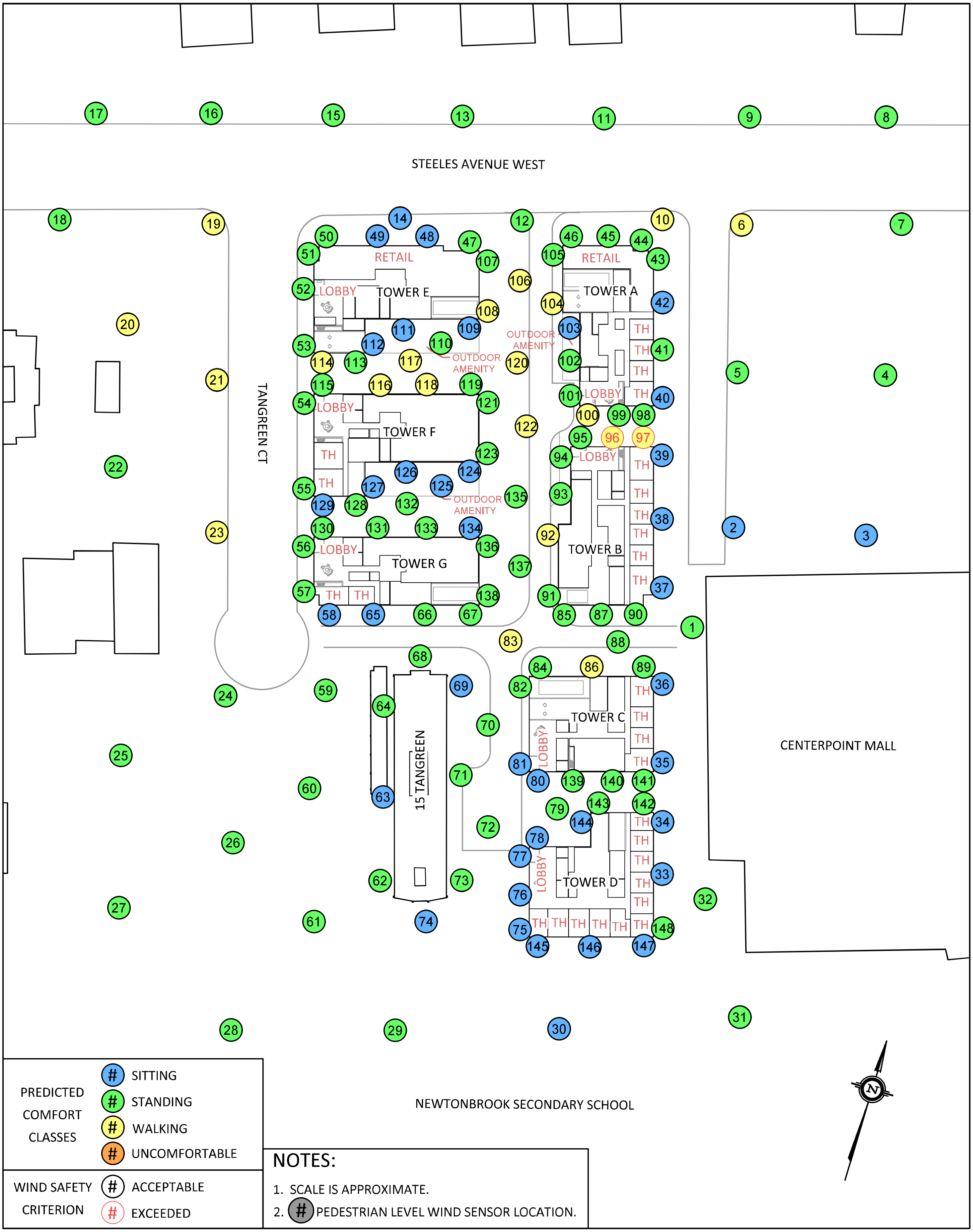
PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION
SCALE	1:1500 (APPROX.)	DRAWING NO. GW22-369-PLW-2D	FIGURE 2D: WINTER EXISTING GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS
DATE	MARCH 7, 2023	DRAWN BY C.E.	



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500 (APPROX.)
DRAWING NO.	GW22-369-PLW-3A
DATE	MARCH 7, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 3A: SPRING PROPOSED GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



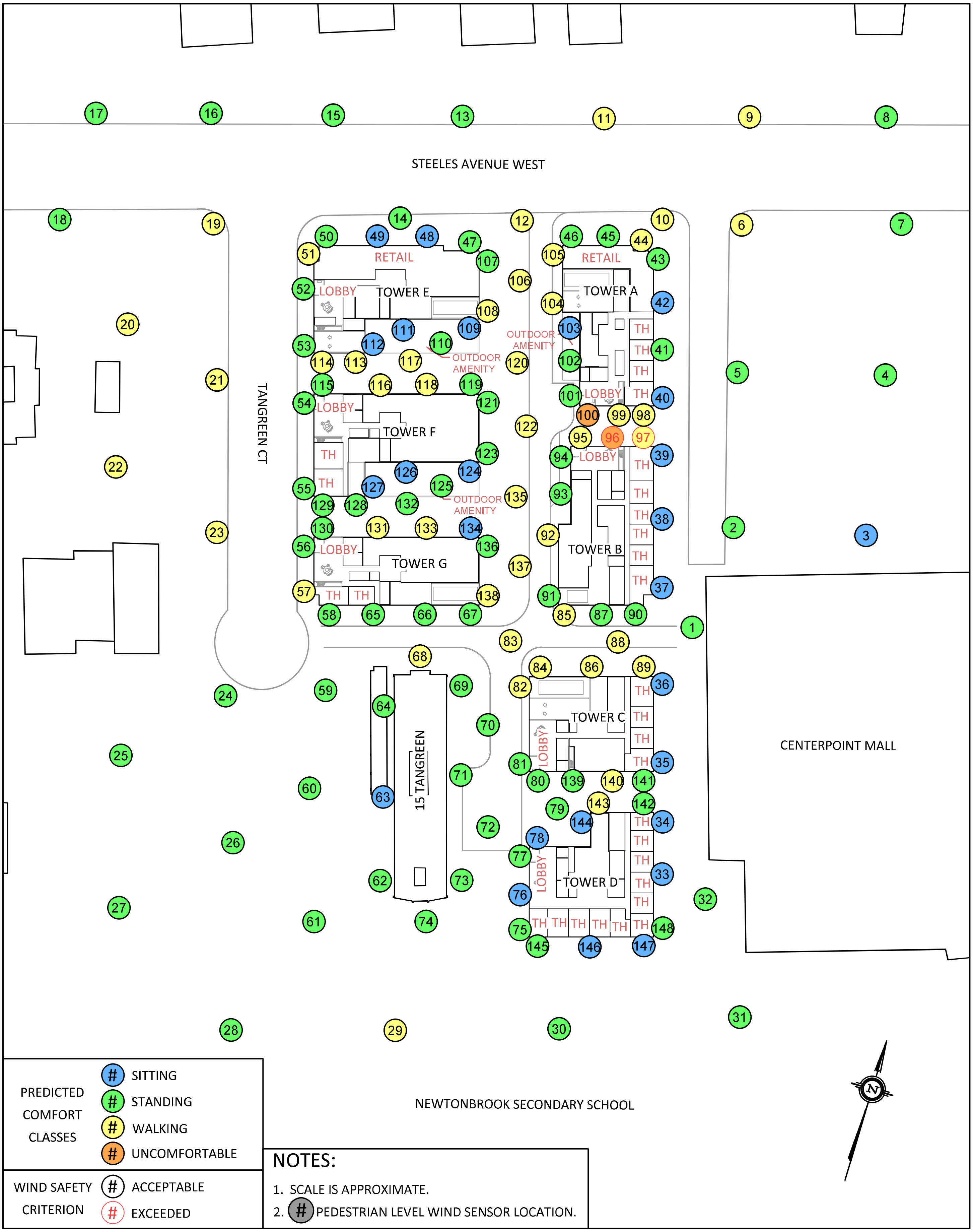
GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:1500 (APPROX.)	DRAWING NO.	GW22-369-PLW-3B
DATE	MARCH 7, 2023	DRAWN BY	C.E.

DESCRIPTION

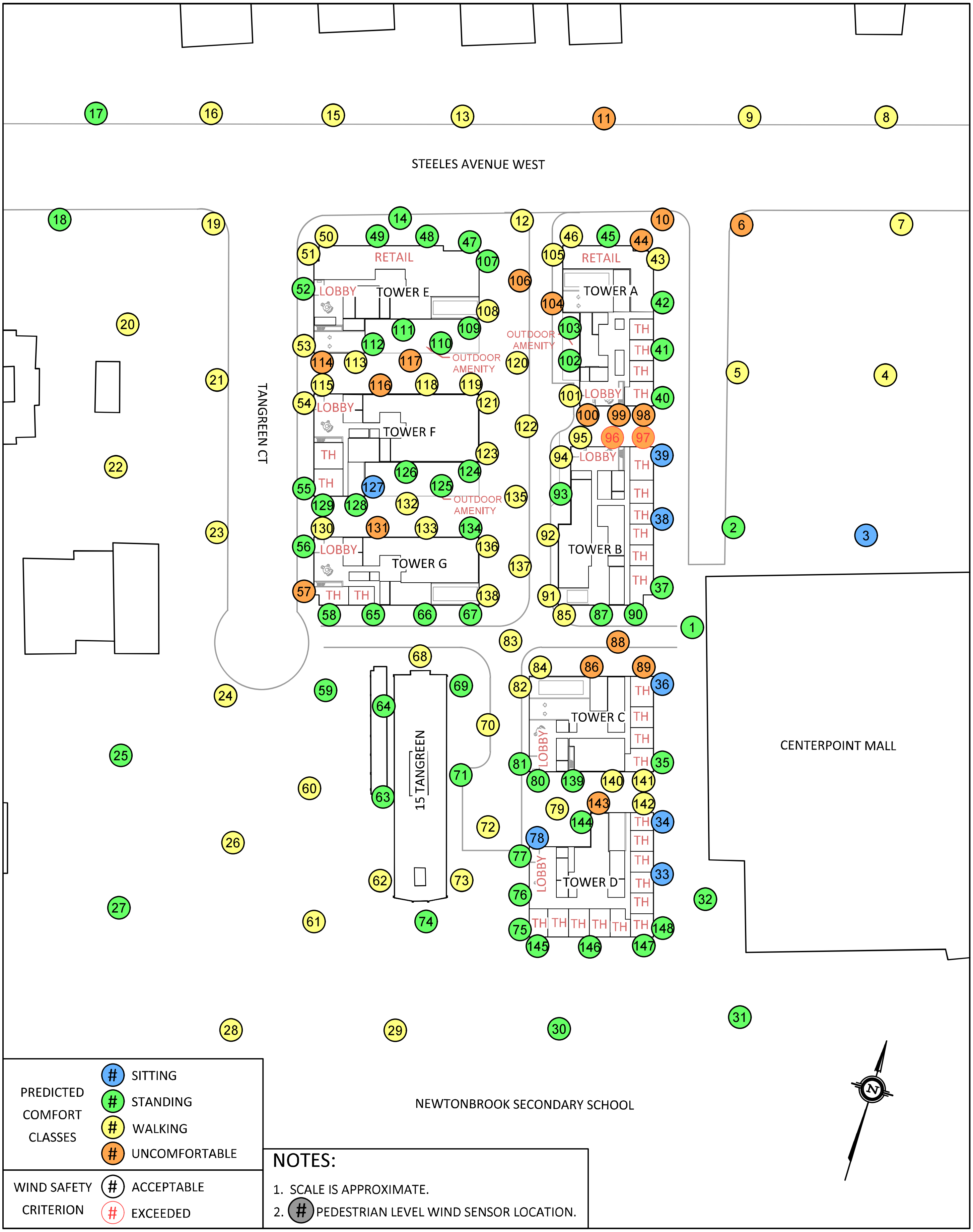
FIGURE 3B: SUMMER
PROPOSED GROUND FLOOR PLAN
PEDESTRIAN COMFORT PREDICTIONS



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

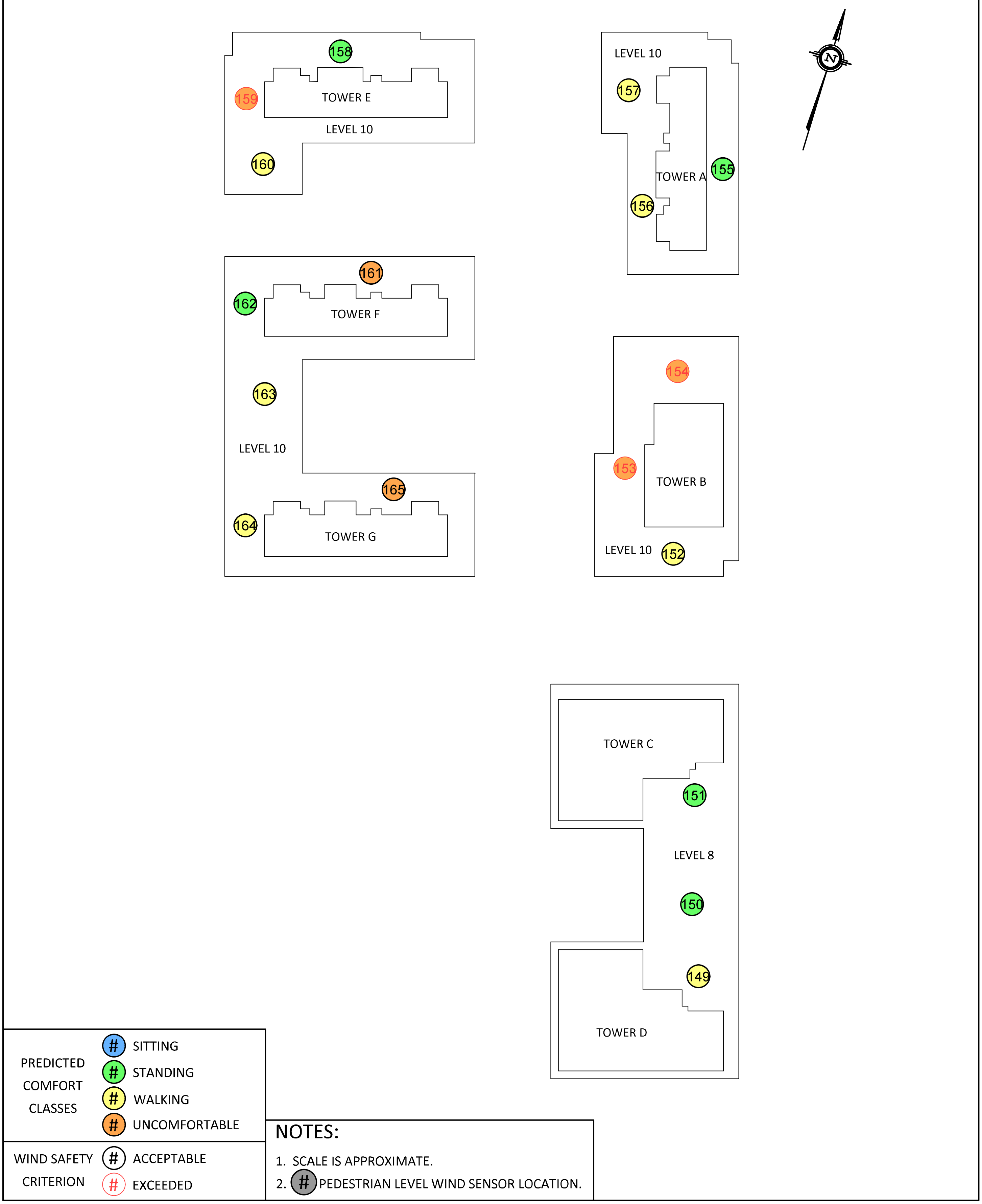
PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 3C: AUTUMN PROPOSED GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS
SCALE	1:1500 (APPROX.)	DRAWING NO. GW22-369-PLW-3C	
DATE	MARCH 7, 2023	DRAWN BY C.E.	



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1500 (APPROX.)
DRAWING NO.	GW22-369-PLW-3D
DATE	MARCH 7, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 3D: WINTER PROPOSED GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS

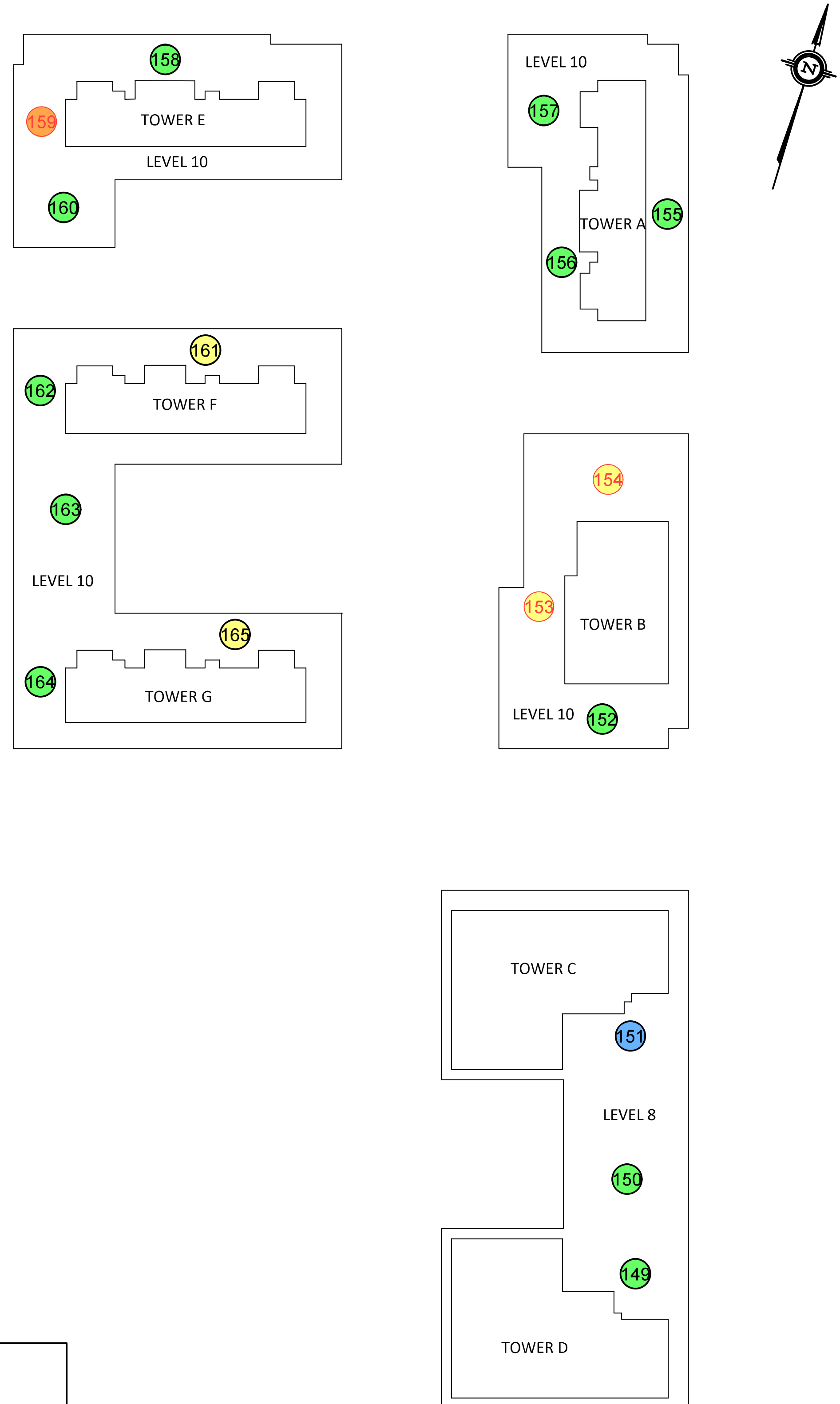


NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-369-PLW-4A
DATE	MARCH 7, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 4A: SPRING OUTDOOR AMENITY FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CLASSES: # SITTING; # STANDING; # WALKING; # UNCOMFORTABLE

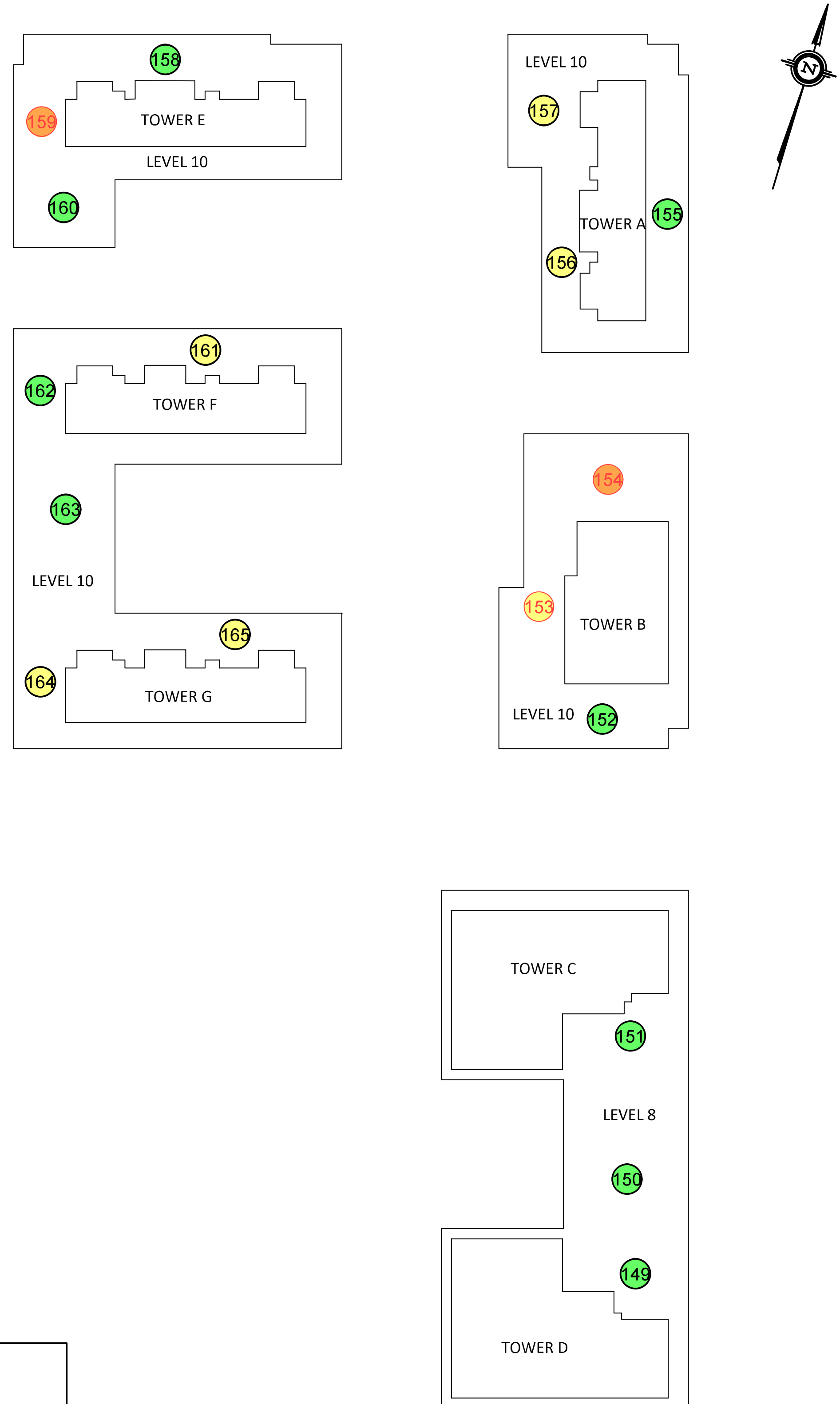
WIND SAFETY CRITERION: # ACCEPTABLE; # EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1000 (APPROX.)
DRAWING NO.	GW22-369-PLW-4B
DATE	MARCH 7, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 4B: SUMMER OUTDOOR AMENITY FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CLASSES
- # SITTING
- # STANDING
- # WALKING
- # UNCOMFORTABLE

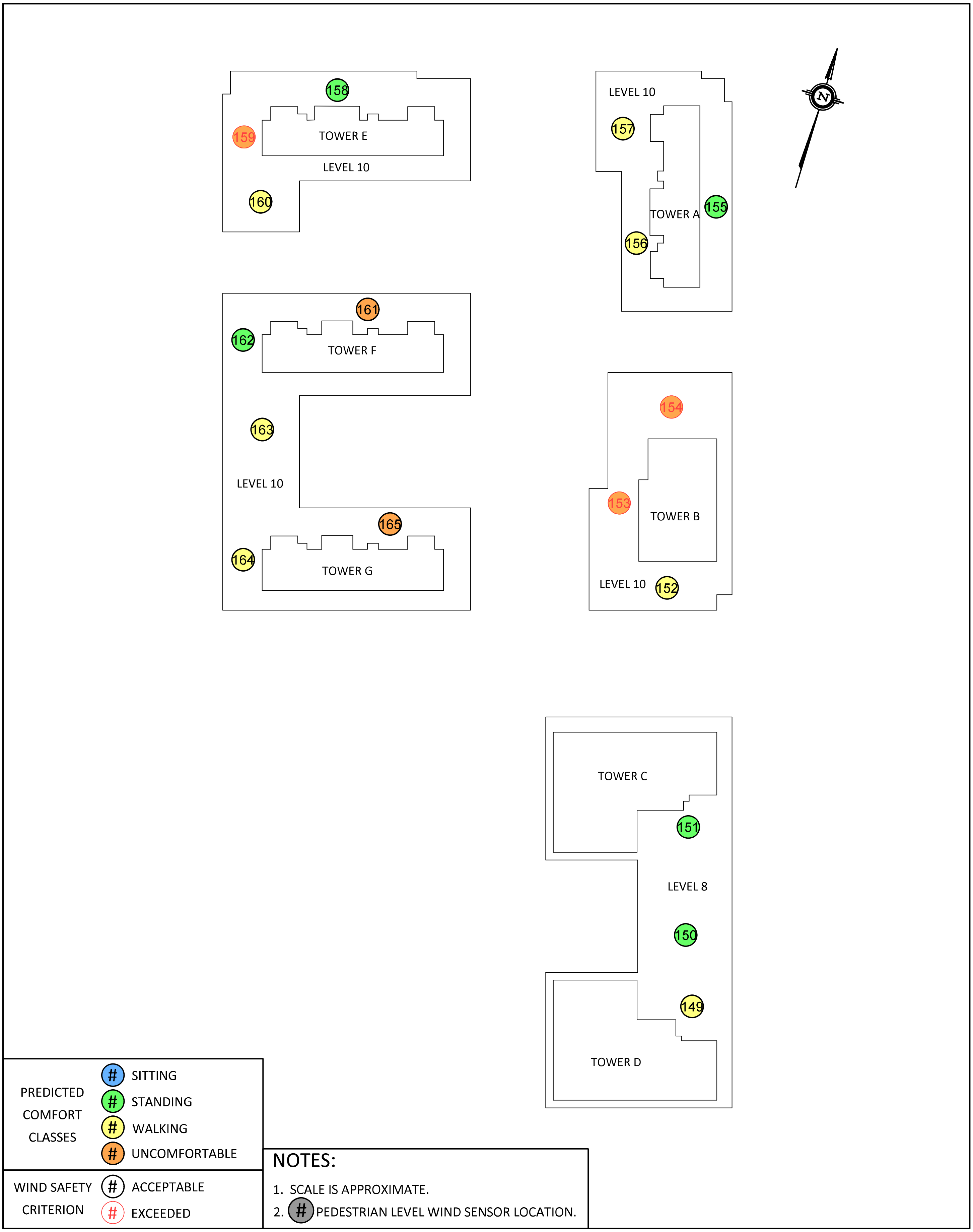
WIND SAFETY CRITERION
- # ACCEPTABLE
- # EXCEEDED

NOTES:

1. SCALE IS APPROXIMATE.
2. # PEDESTRIAN LEVEL WIND SENSOR LOCATION.

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

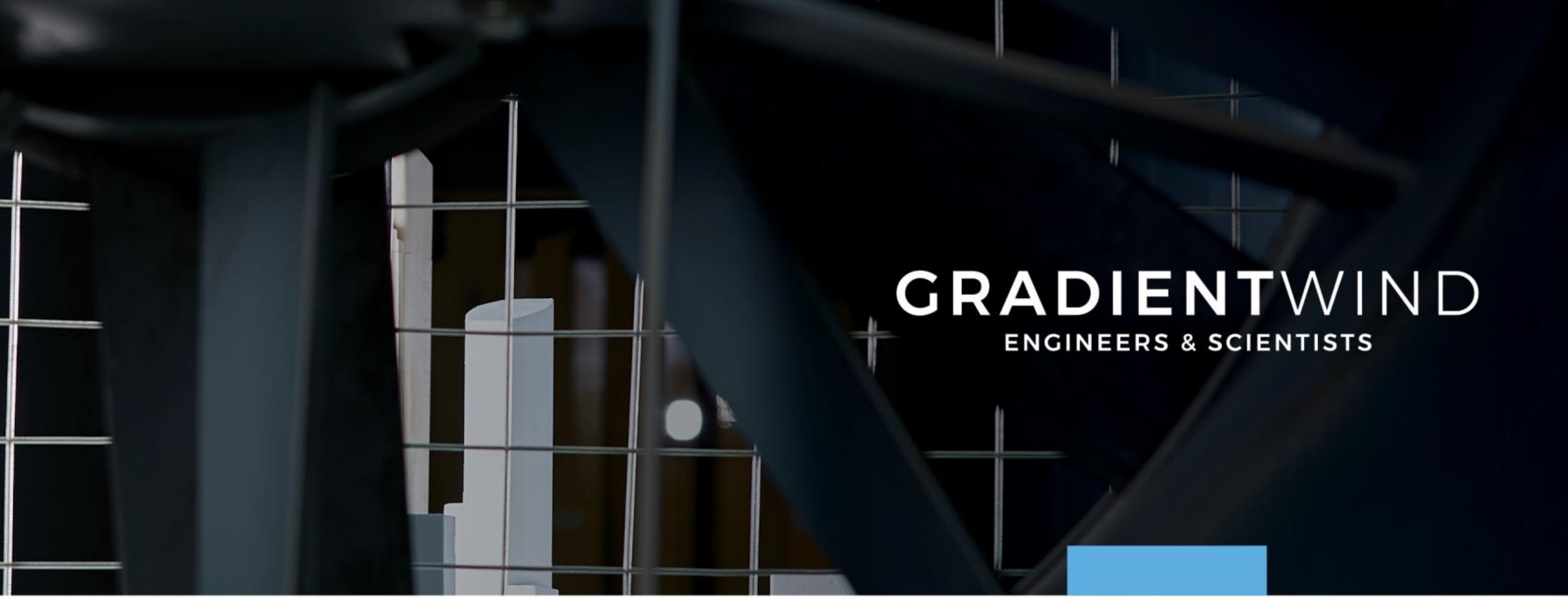
PROJECT: 5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION: FIGURE 4C: AUTUMN OUTDOOR AMENITY FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS
SCALE: 1:1000 (APPROX.)	DRAWING NO.: GW22-369-PLW-4C	
DATE: MARCH 7, 2023	DRAWN BY: C.E.	



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	5 TANGREEN CT, NORTH YORK PEDESTRIAN LEVEL WIND STUDY		DESCRIPTION FIGURE 4D: WINTER OUTDOOR AMENITY FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS
SCALE	1:1000 (APPROX.)	DRAWING NO. GW22-369-PLW-4D	
DATE	MARCH 7, 2023	DRAWN BY C.E.	



APPENDIX A

**PEDESTRIAN COMFORT SUITABILITY, TABLES A1-A3
(EXISTING SCENARIO)**

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A1: SUMMARY OF PEDESTRIAN COMFORT (EXISTING SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	10.5	Standing	9.1	Sitting	9.5	Sitting	10.7	Standing	43.0	Safe
2	12.0	Standing	9.4	Sitting	10.0	Sitting	11.9	Standing	45.9	Safe
3	8.3	Sitting	6.4	Sitting	7.0	Sitting	8.3	Sitting	34.0	Safe
4	14.2	Standing	11.2	Standing	12.1	Standing	14.0	Standing	52.3	Safe
5	15.3	Walking	12.3	Standing	13.0	Standing	15.1	Walking	60.2	Safe
6	14.9	Standing	12.1	Standing	12.9	Standing	15.3	Walking	54.8	Safe
7	14.3	Standing	11.4	Standing	12.3	Standing	14.7	Standing	49.8	Safe
8	12.4	Standing	9.8	Sitting	11.1	Standing	13.1	Standing	49.6	Safe
9	15.6	Walking	12.4	Standing	13.3	Standing	15.7	Walking	53.8	Safe
10	16.2	Walking	12.7	Standing	13.8	Standing	16.9	Walking	59.9	Safe
11	14.6	Standing	11.8	Standing	13.6	Standing	16.4	Walking	58.5	Safe
12	17.9	Walking	13.3	Standing	15.9	Walking	19.5	Walking	66.2	Safe
13	14.3	Standing	10.7	Standing	13.1	Standing	15.9	Walking	58.3	Safe
14	14.5	Standing	11.8	Standing	13.3	Standing	16.1	Walking	54.7	Safe
15	13.5	Standing	10.8	Standing	12.2	Standing	14.6	Standing	51.6	Safe
16	13.5	Standing	10.6	Standing	12.2	Standing	14.9	Standing	51.3	Safe
17	13.2	Standing	10.5	Standing	12.2	Standing	14.7	Standing	54.3	Safe
18	15.7	Walking	12.6	Standing	14.3	Standing	16.9	Walking	60.2	Safe
19	15.3	Walking	12.3	Standing	13.7	Standing	16.1	Walking	54.6	Safe
20	19.2	Walking	14.7	Standing	16.1	Walking	19.7	Walking	72.1	Safe
21	18.6	Walking	14.6	Standing	15.7	Walking	18.2	Walking	67.3	Safe
22	15.9	Walking	13.0	Standing	13.7	Standing	15.7	Walking	61.4	Safe
23	16.7	Walking	12.8	Standing	13.4	Standing	15.7	Walking	65.9	Safe
24	14.3	Standing	11.0	Standing	11.6	Standing	13.5	Standing	54.3	Safe
25	14.2	Standing	10.9	Standing	11.9	Standing	13.8	Standing	58.7	Safe
26	16.3	Walking	12.6	Standing	13.3	Standing	15.0	Standing	56.8	Safe
27	14.6	Standing	11.5	Standing	12.3	Standing	14.3	Standing	54.9	Safe
28	15.4	Walking	11.8	Standing	13.1	Standing	15.4	Walking	53.4	Safe
29	15.8	Walking	12.0	Standing	14.1	Standing	17.2	Walking	60.2	Safe
30	14.7	Standing	12.0	Standing	13.3	Standing	15.6	Walking	53.8	Safe
31	13.0	Standing	10.6	Standing	11.8	Standing	13.9	Standing	50.6	Safe
32	11.2	Standing	9.3	Sitting	9.8	Sitting	11.2	Standing	46.4	Safe
33	14.0	Standing	11.8	Standing	12.4	Standing	14.0	Standing	54.6	Safe
34	15.2	Walking	12.6	Standing	13.3	Standing	15.1	Walking	58.2	Safe
35	14.2	Standing	11.7	Standing	12.5	Standing	14.2	Standing	56.2	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

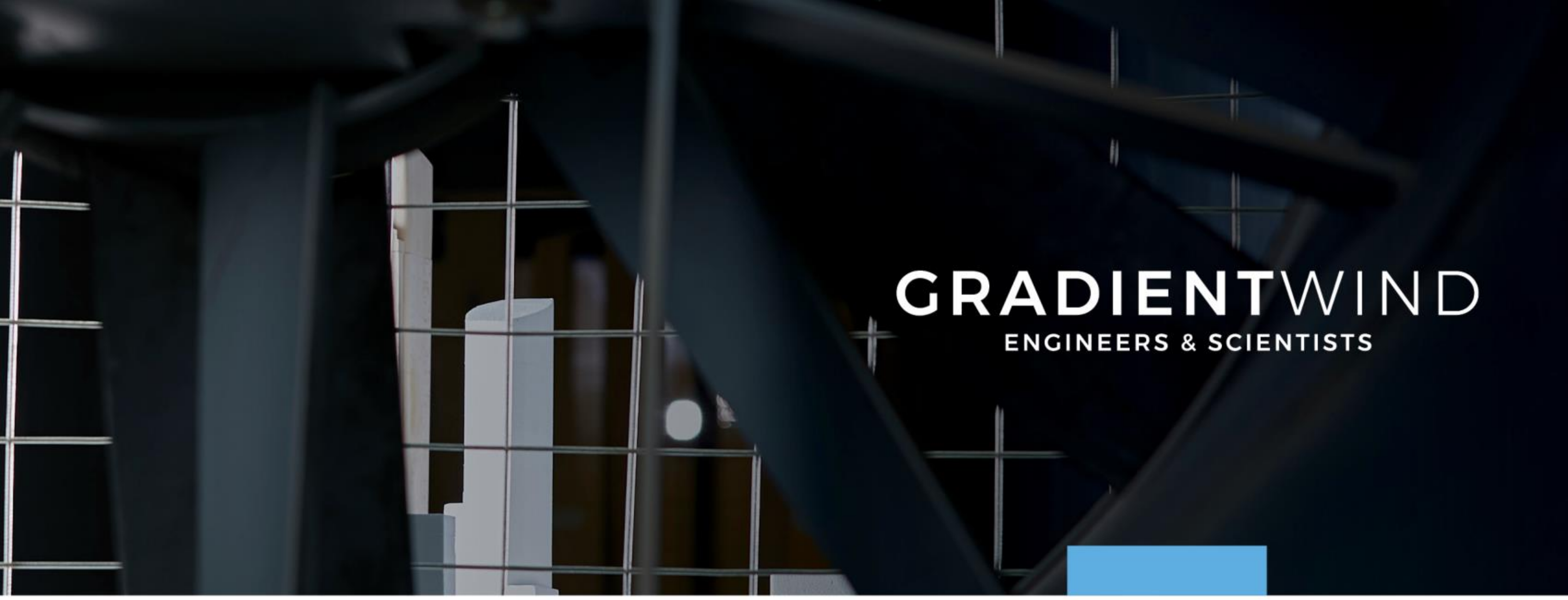
TABLE A2: SUMMARY OF PEDESTRIAN COMFORT (EXISTING SCENARIO)

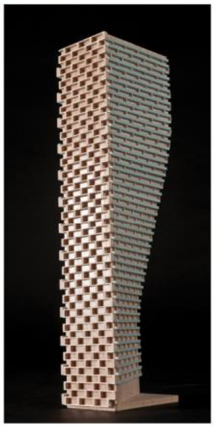
Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	11.9	Standing	10.1	Standing	10.3	Standing	11.6	Standing	46.6	Safe
37	14.1	Standing	11.9	Standing	11.9	Standing	13.7	Standing	51.7	Safe
38	14.6	Standing	12.1	Standing	12.8	Standing	14.8	Standing	53.4	Safe
39	14.5	Standing	12.0	Standing	12.6	Standing	14.4	Standing	60.6	Safe
40	15.0	Standing	12.1	Standing	12.4	Standing	14.3	Standing	70.7	Safe
41	17.1	Walking	13.5	Standing	14.3	Standing	17.0	Walking	71.2	Safe
42	16.0	Walking	12.6	Standing	13.7	Standing	16.8	Walking	69.8	Safe
43	16.1	Walking	12.6	Standing	13.8	Standing	17.1	Walking	63.4	Safe
44	16.6	Walking	13.0	Standing	14.4	Standing	17.3	Walking	60.3	Safe
45	17.4	Walking	13.5	Standing	15.2	Walking	18.0	Walking	61.8	Safe
46	17.3	Walking	13.0	Standing	14.9	Standing	17.8	Walking	63.5	Safe
47	16.5	Walking	12.9	Standing	15.6	Walking	19.5	Walking	68.2	Safe
48	14.7	Standing	11.9	Standing	13.8	Standing	16.5	Walking	58.5	Safe
49	15.1	Walking	12.2	Standing	13.6	Standing	16.1	Walking	51.4	Safe
50	16.0	Walking	12.9	Standing	14.1	Standing	16.6	Walking	51.4	Safe
51	15.2	Walking	12.2	Standing	13.4	Standing	15.7	Walking	50.2	Safe
52	15.8	Walking	12.8	Standing	13.9	Standing	16.0	Walking	50.4	Safe
53	16.4	Walking	12.9	Standing	13.6	Standing	15.7	Walking	52.2	Safe
54	17.9	Walking	13.9	Standing	14.7	Standing	16.7	Walking	56.6	Safe
55	17.3	Walking	13.0	Standing	13.8	Standing	15.7	Walking	59.8	Safe
56	16.7	Walking	12.7	Standing	13.7	Standing	15.5	Walking	59.1	Safe
57	16.0	Walking	12.4	Standing	13.1	Standing	15.1	Walking	57.2	Safe
58	14.3	Standing	11.3	Standing	12.3	Standing	14.3	Standing	52.2	Safe
59	14.7	Standing	11.7	Standing	12.2	Standing	14.2	Standing	53.5	Safe
60	14.8	Standing	12.3	Standing	12.8	Standing	14.6	Standing	55.2	Safe
61	16.2	Walking	12.3	Standing	13.5	Standing	15.5	Walking	56.3	Safe
62	14.1	Standing	11.8	Standing	12.4	Standing	14.5	Standing	56.7	Safe
63	10.6	Standing	8.5	Sitting	9.1	Sitting	10.6	Standing	46.8	Safe
64	15.6	Walking	12.8	Standing	14.2	Standing	16.7	Walking	60.8	Safe
65	15.4	Walking	11.5	Standing	13.4	Standing	15.9	Walking	58.3	Safe
66	17.4	Walking	12.7	Standing	15.3	Walking	18.8	Walking	62.6	Safe
67	19.4	Walking	14.3	Standing	17.1	Walking	21.5	Uncomfortable	75.8	Safe
68	12.3	Standing	9.6	Sitting	11.1	Standing	13.9	Standing	57.1	Safe
69	17.5	Walking	12.8	Standing	13.6	Standing	15.9	Walking	81.4	Safe
70	15.6	Walking	11.8	Standing	12.3	Standing	14.3	Standing	73.3	Safe

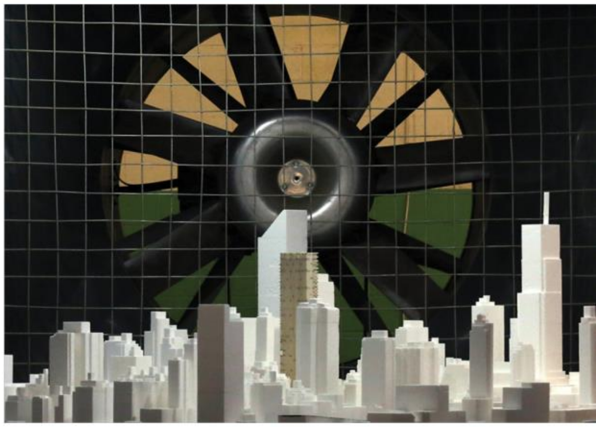
Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A3: SUMMARY OF PEDESTRIAN COMFORT (EXISTING SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
71	11.8	Standing	9.6	Sitting	10.2	Standing	11.5	Standing	45.5	Safe
72	12.4	Standing	9.9	Sitting	10.1	Standing	11.5	Standing	51.7	Safe
73	11.4	Standing	9.3	Sitting	9.3	Sitting	10.3	Standing	43.4	Safe
74	12.8	Standing	9.9	Sitting	12.0	Standing	14.4	Standing	61.5	Safe
75	14.8	Standing	12.4	Standing	13.5	Standing	15.8	Walking	57.9	Safe
76	14.4	Standing	12.2	Standing	13.2	Standing	15.2	Walking	55.5	Safe
77	15.3	Walking	12.5	Standing	13.2	Standing	14.8	Standing	55.7	Safe
78	14.1	Standing	11.6	Standing	12.0	Standing	13.5	Standing	53.3	Safe
79	15.8	Walking	13.0	Standing	13.3	Standing	15.2	Walking	60.4	Safe
80	15.8	Walking	12.9	Standing	13.4	Standing	15.4	Walking	62.2	Safe
81	15.8	Walking	12.5	Standing	12.8	Standing	14.7	Standing	62.6	Safe
82	18.1	Walking	14.0	Standing	15.5	Walking	19.3	Walking	77.5	Safe
83	17.1	Walking	13.3	Standing	15.4	Walking	19.4	Walking	80.3	Safe
84	17.6	Walking	14.1	Standing	15.6	Walking	19.2	Walking	76.4	Safe
85	14.6	Standing	12.1	Standing	13.2	Standing	16.0	Walking	64.1	Safe
86	16.0	Walking	13.3	Standing	14.2	Standing	16.9	Walking	63.8	Safe
87	13.2	Standing	10.9	Standing	11.5	Standing	13.5	Standing	50.6	Safe
88	13.6	Standing	11.3	Standing	11.9	Standing	13.8	Standing	50.9	Safe
89	13.6	Standing	11.4	Standing	11.8	Standing	13.6	Standing	50.2	Safe
90	13.5	Standing	11.3	Standing	11.7	Standing	13.5	Standing	49.0	Safe







APPENDIX B

PEDESTRIAN COMFORT SUITABILITY, TABLES B1-B5 (PROPOSED SCENARIO)

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B1: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	14.5	Standing	11.5	Standing	12.4	Standing	14.5	Standing	52.6	Safe
2	12.4	Standing	9.5	Sitting	10.2	Standing	12.1	Standing	53.0	Safe
3	9.6	Sitting	7.4	Sitting	7.9	Sitting	9.2	Sitting	49.0	Safe
4	17.1	Walking	13.6	Standing	14.1	Standing	16.4	Walking	73.7	Safe
5	16.7	Walking	13.3	Standing	14.1	Standing	16.6	Walking	71.9	Safe
6	21.0	Uncomfortable	15.5	Walking	17.3	Walking	20.9	Uncomfortable	73.3	Safe
7	16.8	Walking	13.0	Standing	14.2	Standing	17.7	Walking	62.6	Safe
8	14.9	Standing	11.8	Standing	13.4	Standing	16.3	Walking	58.3	Safe
9	18.6	Walking	14.0	Standing	16.2	Walking	19.4	Walking	62.6	Safe
10	24.2	Uncomfortable	17.1	Walking	19.7	Walking	23.7	Uncomfortable	79.0	Safe
11	20.0	Walking	14.6	Standing	17.5	Walking	21.5	Uncomfortable	68.8	Safe
12	17.9	Walking	14.4	Standing	16.0	Walking	18.7	Walking	61.6	Safe
13	16.0	Walking	11.7	Standing	14.5	Standing	17.4	Walking	70.8	Safe
14	12.2	Standing	9.3	Sitting	10.8	Standing	13.7	Standing	55.9	Safe
15	15.2	Walking	12.3	Standing	14.2	Standing	17.5	Walking	63.2	Safe
16	14.0	Standing	11.8	Standing	13.3	Standing	15.9	Walking	53.9	Safe
17	12.9	Standing	11.1	Standing	12.1	Standing	14.0	Standing	50.8	Safe
18	14.4	Standing	12.1	Standing	12.9	Standing	14.8	Standing	50.8	Safe
19	17.9	Walking	15.1	Walking	15.8	Walking	18.1	Walking	62.8	Safe
20	19.2	Walking	15.6	Walking	16.7	Walking	19.1	Walking	63.1	Safe
21	20.4	Uncomfortable	16.4	Walking	17.2	Walking	19.6	Walking	72.4	Safe
22	19.0	Walking	14.4	Standing	15.1	Walking	17.6	Walking	65.4	Safe
23	20.6	Uncomfortable	16.0	Walking	17.0	Walking	19.9	Walking	72.0	Safe
24	15.9	Walking	12.5	Standing	13.2	Standing	15.9	Walking	67.0	Safe
25	14.9	Standing	11.8	Standing	12.2	Standing	14.0	Standing	55.6	Safe
26	15.7	Walking	12.1	Standing	13.0	Standing	15.1	Walking	57.3	Safe
27	14.8	Standing	11.1	Standing	12.1	Standing	14.0	Standing	59.8	Safe
28	15.2	Walking	11.0	Standing	12.7	Standing	15.4	Walking	58.0	Safe
29	18.3	Walking	13.1	Standing	15.7	Walking	19.7	Walking	74.7	Safe
30	12.5	Standing	9.3	Sitting	11.6	Standing	14.6	Standing	59.1	Safe
31	12.9	Standing	10.6	Standing	11.8	Standing	13.9	Standing	52.8	Safe
32	12.5	Standing	10.3	Standing	10.4	Standing	11.5	Standing	47.4	Safe
33	10.4	Standing	8.3	Sitting	8.5	Sitting	10.0	Sitting	51.5	Safe
34	10.6	Standing	8.2	Sitting	8.6	Sitting	9.9	Sitting	45.3	Safe
35	10.7	Standing	8.2	Sitting	8.6	Sitting	10.2	Standing	55.8	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B2: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	11.1	Standing	8.0	Sitting	8.5	Sitting	9.7	Sitting	47.4	Safe
37	12.2	Standing	9.7	Sitting	9.9	Sitting	11.5	Standing	53.7	Safe
38	10.3	Standing	8.1	Sitting	8.5	Sitting	9.8	Sitting	45.4	Safe
39	11.1	Standing	8.1	Sitting	8.7	Sitting	9.5	Sitting	47.1	Safe
40	12.0	Standing	9.1	Sitting	9.5	Sitting	11.1	Standing	48.2	Safe
41	13.6	Standing	10.7	Standing	11.5	Standing	13.3	Standing	52.5	Safe
42	12.3	Standing	9.2	Sitting	10.0	Sitting	11.1	Standing	54.0	Safe
43	19.4	Walking	13.9	Standing	14.2	Standing	16.4	Walking	84.6	Safe
44	20.7	Uncomfortable	13.5	Standing	16.0	Walking	20.1	Uncomfortable	78.6	Safe
45	13.5	Standing	10.1	Standing	11.6	Standing	14.9	Standing	65.9	Safe
46	15.7	Walking	12.3	Standing	13.9	Standing	18.0	Walking	68.5	Safe
47	13.9	Standing	10.3	Standing	11.2	Standing	13.6	Standing	60.3	Safe
48	10.8	Standing	8.3	Sitting	9.8	Sitting	12.0	Standing	49.0	Safe
49	10.8	Standing	8.3	Sitting	9.6	Sitting	11.9	Standing	49.5	Safe
50	16.2	Walking	12.5	Standing	13.5	Standing	17.5	Walking	64.1	Safe
51	17.3	Walking	14.7	Standing	15.6	Walking	18.3	Walking	87.4	Safe
52	13.5	Standing	11.8	Standing	12.7	Standing	14.2	Standing	64.3	Safe
53	16.0	Walking	13.1	Standing	14.0	Standing	16.3	Walking	73.1	Safe
54	15.3	Walking	12.3	Standing	13.7	Standing	15.8	Walking	65.8	Safe
55	14.0	Standing	11.1	Standing	12.0	Standing	15.0	Standing	68.2	Safe
56	14.1	Standing	11.2	Standing	12.3	Standing	15.0	Standing	65.5	Safe
57	18.4	Walking	14.8	Standing	16.8	Walking	21.0	Uncomfortable	85.6	Safe
58	11.6	Standing	8.8	Sitting	10.4	Standing	12.5	Standing	61.7	Safe
59	13.9	Standing	10.7	Standing	11.8	Standing	14.6	Standing	76.8	Safe
60	13.9	Standing	11.1	Standing	12.4	Standing	15.2	Walking	64.4	Safe
61	17.3	Walking	12.7	Standing	14.4	Standing	17.3	Walking	63.6	Safe
62	14.2	Standing	11.6	Standing	13.2	Standing	17.3	Walking	74.4	Safe
63	10.3	Standing	8.3	Sitting	9.5	Sitting	12.6	Standing	59.3	Safe
64	12.5	Standing	10.3	Standing	11.4	Standing	14.0	Standing	59.3	Safe
65	13.0	Standing	9.4	Sitting	11.2	Standing	13.4	Standing	59.9	Safe
66	14.4	Standing	10.7	Standing	12.7	Standing	14.9	Standing	57.2	Safe
67	13.8	Standing	11.0	Standing	12.7	Standing	15.0	Standing	57.4	Safe
68	17.5	Walking	13.0	Standing	15.3	Walking	18.8	Walking	74.2	Safe
69	13.1	Standing	9.9	Sitting	11.1	Standing	13.2	Standing	47.8	Safe
70	15.6	Walking	12.0	Standing	12.9	Standing	15.5	Walking	65.2	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B3: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
71	15.0	Standing	11.3	Standing	12.1	Standing	14.0	Standing	54.9	Safe
72	14.7	Standing	12.2	Standing	13.1	Standing	15.3	Walking	58.6	Safe
73	15.1	Walking	12.7	Standing	13.3	Standing	15.1	Walking	54.3	Safe
74	11.6	Standing	8.8	Sitting	10.6	Standing	12.5	Standing	52.8	Safe
75	11.5	Standing	10.0	Sitting	10.6	Standing	12.9	Standing	53.8	Safe
76	9.9	Sitting	8.5	Sitting	9.2	Sitting	10.8	Standing	44.2	Safe
77	11.3	Standing	9.6	Sitting	10.6	Standing	12.7	Standing	52.3	Safe
78	8.2	Sitting	6.5	Sitting	7.6	Sitting	9.3	Sitting	40.5	Safe
79	14.5	Standing	11.3	Standing	13.1	Standing	15.5	Walking	58.6	Safe
80	12.0	Standing	8.9	Sitting	10.4	Standing	12.1	Standing	54.5	Safe
81	11.2	Standing	9.4	Sitting	10.5	Standing	12.6	Standing	48.7	Safe
82	18.8	Walking	14.2	Standing	15.4	Walking	18.4	Walking	88.3	Safe
83	20.5	Uncomfortable	15.6	Walking	17.3	Walking	20.0	Walking	67.7	Safe
84	18.2	Walking	14.2	Standing	15.9	Walking	18.6	Walking	63.3	Safe
85	16.3	Walking	13.6	Standing	16.1	Walking	19.7	Walking	69.2	Safe
86	23.0	Uncomfortable	17.2	Walking	19.4	Walking	23.3	Uncomfortable	77.6	Safe
87	12.7	Standing	10.1	Standing	12.1	Standing	13.9	Standing	62.0	Safe
88	19.0	Walking	14.3	Standing	17.0	Walking	20.1	Uncomfortable	66.9	Safe
89	20.2	Uncomfortable	14.8	Standing	17.3	Walking	20.9	Uncomfortable	75.5	Safe
90	13.3	Standing	10.5	Standing	12.4	Standing	14.4	Standing	63.0	Safe
91	15.3	Walking	11.8	Standing	13.0	Standing	15.9	Walking	69.0	Safe
92	19.3	Walking	15.1	Walking	16.4	Walking	19.1	Walking	88.6	Safe
93	14.4	Standing	11.6	Standing	12.6	Standing	14.5	Standing	61.4	Safe
94	16.9	Walking	13.7	Standing	15.0	Standing	17.5	Walking	73.6	Safe
95	18.5	Walking	13.5	Standing	15.2	Walking	18.5	Walking	64.3	Safe
96	26.1	Uncomfortable	19.9	Walking	21.5	Uncomfortable	26.6	Uncomfortable	99.4	Dangerous
97	24.1	Uncomfortable	17.4	Walking	19.7	Walking	24.7	Uncomfortable	91.2	Dangerous
98	19.8	Walking	14.4	Standing	17.1	Walking	20.4	Uncomfortable	68.7	Safe
99	19.1	Walking	14.6	Standing	17.6	Walking	20.8	Uncomfortable	70.5	Safe
100	23.9	Uncomfortable	17.9	Walking	21.0	Uncomfortable	25.3	Uncomfortable	83.1	Safe
101	16.8	Walking	12.9	Standing	14.6	Standing	18.2	Walking	81.9	Safe
102	14.3	Standing	11.3	Standing	12.2	Standing	14.0	Standing	65.7	Safe
103	10.2	Standing	8.3	Sitting	9.0	Sitting	10.3	Standing	44.8	Safe
104	22.0	Uncomfortable	17.4	Walking	18.1	Walking	20.7	Uncomfortable	82.9	Safe
105	16.8	Walking	14.3	Standing	15.2	Walking	18.5	Walking	72.2	Safe

Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

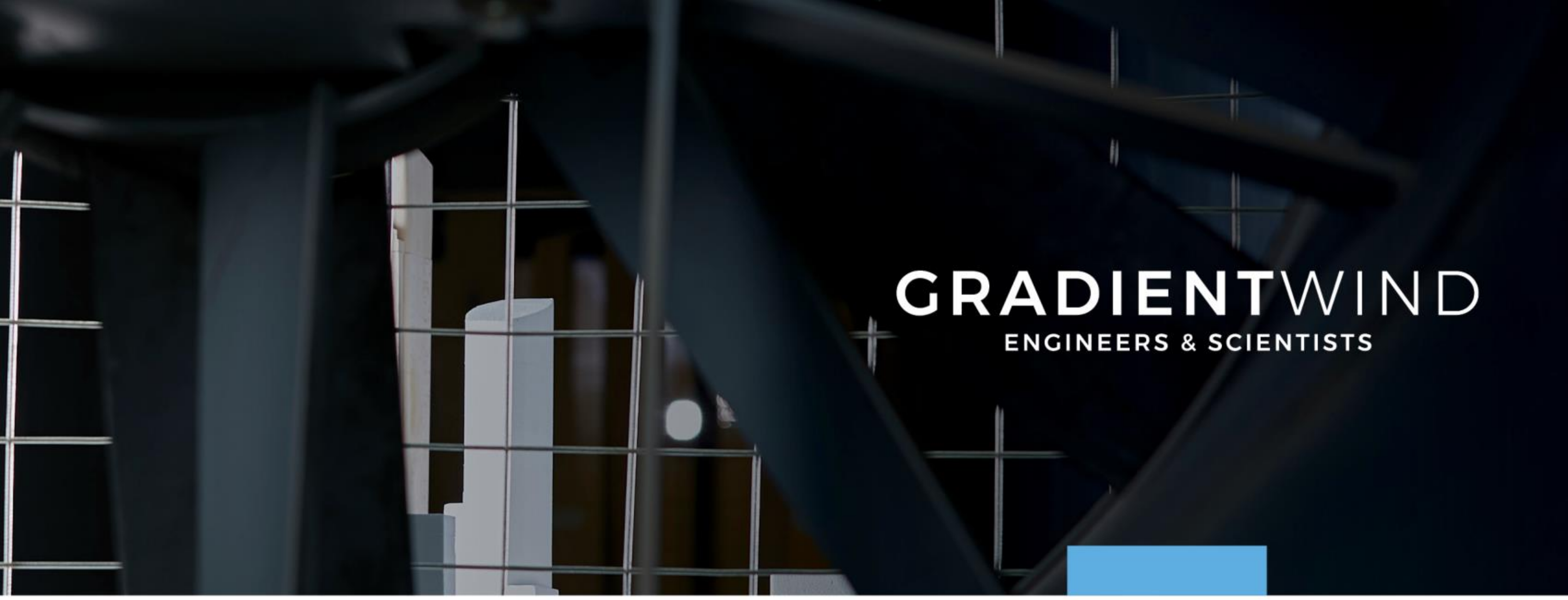
TABLE B4: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

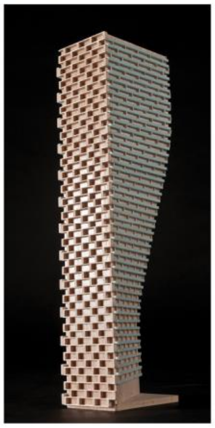
Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
106	24.5	Uncomfortable	19.2	Walking	19.7	Walking	22.9	Uncomfortable	86.3	Safe
107	14.4	Standing	11.4	Standing	12.1	Standing	13.4	Standing	59.2	Safe
108	20.9	Uncomfortable	15.1	Walking	16.3	Walking	18.8	Walking	76.1	Safe
109	11.5	Standing	8.8	Sitting	10.0	Sitting	11.8	Standing	48.0	Safe
110	14.8	Standing	10.8	Standing	12.6	Standing	14.8	Standing	59.8	Safe
111	11.8	Standing	8.6	Sitting	9.6	Sitting	11.0	Standing	49.8	Safe
112	11.5	Standing	8.2	Sitting	8.9	Sitting	10.2	Standing	47.9	Safe
113	18.7	Walking	14.5	Standing	16.7	Walking	19.6	Walking	71.6	Safe
114	20.4	Uncomfortable	15.7	Walking	18.0	Walking	21.9	Uncomfortable	83.8	Safe
115	17.3	Walking	13.0	Standing	14.6	Standing	17.6	Walking	67.3	Safe
116	23.6	Uncomfortable	18.4	Walking	20.0	Walking	24.1	Uncomfortable	84.8	Safe
117	22.0	Uncomfortable	17.4	Walking	19.0	Walking	22.7	Uncomfortable	82.4	Safe
118	20.9	Uncomfortable	15.4	Walking	16.1	Walking	19.3	Walking	83.9	Safe
119	15.6	Walking	11.5	Standing	12.7	Standing	15.2	Walking	62.9	Safe
120	20.7	Uncomfortable	15.4	Walking	16.1	Walking	18.7	Walking	81.1	Safe
121	17.2	Walking	12.6	Standing	13.5	Standing	15.7	Walking	67.1	Safe
122	20.5	Uncomfortable	15.1	Walking	16.7	Walking	20.0	Walking	78.3	Safe
123	18.4	Walking	13.4	Standing	14.1	Standing	16.9	Walking	69.4	Safe
124	11.9	Standing	8.8	Sitting	9.7	Sitting	11.3	Standing	47.9	Safe
125	13.1	Standing	9.7	Sitting	10.2	Standing	12.3	Standing	59.8	Safe
126	12.4	Standing	9.0	Sitting	9.5	Sitting	11.2	Standing	65.6	Safe
127	10.2	Standing	7.5	Sitting	8.0	Sitting	9.5	Sitting	55.9	Safe
128	12.8	Standing	10.6	Standing	12.0	Standing	14.6	Standing	65.4	Safe
129	12.1	Standing	9.7	Sitting	10.7	Standing	13.1	Standing	52.8	Safe
130	15.6	Walking	12.1	Standing	13.5	Standing	16.2	Walking	58.0	Safe
131	19.2	Walking	14.8	Standing	17.1	Walking	22.1	Uncomfortable	85.6	Safe
132	15.4	Walking	12.2	Standing	13.7	Standing	16.2	Walking	61.3	Safe
133	19.9	Walking	15.0	Standing	15.6	Walking	18.9	Walking	81.2	Safe
134	11.4	Standing	8.6	Sitting	9.6	Sitting	11.4	Standing	51.4	Safe
135	18.5	Walking	14.2	Standing	15.3	Walking	17.9	Walking	68.7	Safe
136	17.4	Walking	12.4	Standing	13.4	Standing	15.5	Walking	64.0	Safe
137	18.2	Walking	14.3	Standing	15.1	Walking	17.6	Walking	73.0	Safe
138	18.8	Walking	15.0	Standing	15.2	Walking	17.7	Walking	67.3	Safe
139	13.7	Standing	11.0	Standing	12.6	Standing	14.2	Standing	59.8	Safe
140	16.8	Walking	13.4	Standing	16.3	Walking	19.9	Walking	69.9	Safe

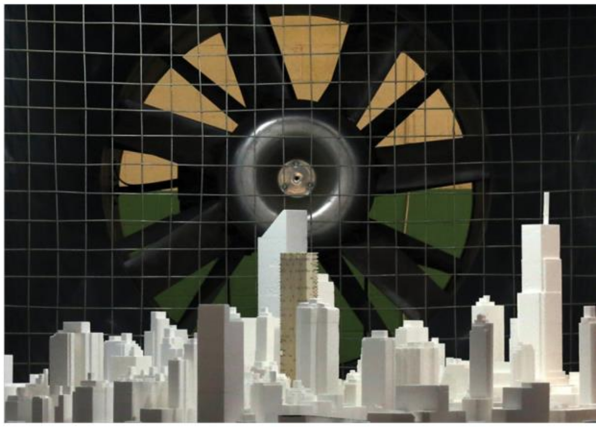
Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B5: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED SCENARIO)

Sensor	Pedestrian Comfort								Pedestrian Safety	
	Spring		Summer		Autumn		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
141	14.6	Standing	11.4	Standing	14.5	Standing	17.9	Walking	67.0	Safe
142	16.4	Walking	12.4	Standing	14.6	Standing	17.4	Walking	66.2	Safe
143	19.5	Walking	14.0	Standing	16.2	Walking	20.1	Uncomfortable	68.9	Safe
144	8.9	Sitting	7.9	Sitting	8.7	Sitting	10.3	Standing	42.6	Safe
145	11.0	Standing	8.7	Sitting	10.4	Standing	12.7	Standing	56.3	Safe
146	8.7	Sitting	6.8	Sitting	8.2	Sitting	10.1	Standing	49.3	Safe
147	9.6	Sitting	7.7	Sitting	9.3	Sitting	11.1	Standing	53.9	Safe
148	13.5	Standing	11.2	Standing	10.8	Standing	11.9	Standing	58.2	Safe
149	15.5	Walking	10.9	Standing	13.0	Standing	15.8	Walking	82.4	Safe
150	12.8	Standing	10.1	Standing	11.3	Standing	13.7	Standing	52.9	Safe
151	12.0	Standing	9.0	Sitting	10.9	Standing	12.9	Standing	61.5	Safe
152	15.3	Walking	12.2	Standing	14.4	Standing	16.7	Walking	79.5	Safe
153	22.7	Uncomfortable	18.5	Walking	20.0	Walking	23.5	Uncomfortable	96.8	Dangerous
154	22.9	Uncomfortable	17.9	Walking	21.1	Uncomfortable	25.8	Uncomfortable	90.0	Dangerous
155	14.5	Standing	11.0	Standing	11.8	Standing	13.1	Standing	48.7	Safe
156	18.5	Walking	14.4	Standing	15.7	Walking	18.6	Walking	84.8	Safe
157	18.5	Walking	14.5	Standing	15.2	Walking	18.5	Walking	75.5	Safe
158	12.8	Standing	10.1	Standing	11.4	Standing	13.9	Standing	53.5	Safe
159	28.6	Uncomfortable	21.8	Uncomfortable	22.7	Uncomfortable	26.5	Uncomfortable	110.7	Dangerous
160	17.7	Walking	13.0	Standing	14.6	Standing	17.9	Walking	81.3	Safe
161	22.7	Uncomfortable	16.9	Walking	18.2	Walking	22.8	Uncomfortable	78.1	Safe
162	12.6	Standing	10.3	Standing	11.9	Standing	14.5	Standing	57.5	Safe
163	17.1	Walking	12.8	Standing	14.4	Standing	18.4	Walking	88.2	Safe
164	17.1	Walking	14.6	Standing	15.4	Walking	17.5	Walking	66.7	Safe
165	22.4	Uncomfortable	17.2	Walking	18.8	Walking	23.1	Uncomfortable	84.7	Safe







APPENDIX C

WIND TUNNEL SIMULATION OF THE NATURAL WIND

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

WIND TUNNEL SIMULATION OF THE NATURAL WIND

Wind flowing over the surface of the earth develops a boundary layer due to the drag produced by surface features such as vegetation and man-made structures. Within this boundary layer, the mean wind speed varies from zero at the surface to the gradient wind speed at the top of the layer. The height of the top of the boundary layer is referred to as the gradient height, above which the velocity remains more-or-less constant for a given synoptic weather system. The mean wind speed is taken to be the average value over one hour. Superimposed on the mean wind speed are fluctuating (or turbulent) components in the longitudinal (i.e. along wind), vertical and lateral directions. Although turbulence varies according to the roughness of the surface, the turbulence level generally increases from nearly zero (smooth flow) at gradient height to maximum values near the ground. While for a calm ocean the maximum could be 20%, the maximum for a very rough surface such as the center of a city could be 100%, or equal to the local mean wind speed. The height of the boundary layer varies in time and over different terrain roughness within the range of 400 metres (m) to 600 m.

Simulating real wind behaviour in a wind tunnel requires simulating the variation of mean wind speed with height, simulating the turbulence intensity, and matching the typical length scales of turbulence. It is the ratio between wind tunnel turbulence length scales and turbulence scales in the atmosphere that determines the geometric scales that models can assume in a wind tunnel. Hence, when a 1:200 scale model is quoted, this implies that the turbulence scales in the wind tunnel and the atmosphere have the same ratios. Some flexibility in this requirement has been shown to produce reasonable wind tunnel predictions compared to full scale. In model scale the mean and turbulence characteristics of the wind are obtained with the use of spires at one end of the tunnel and roughness elements along the floor of the tunnel. The fan is located at the model end and wind is pulled over the spires, roughness elements and model. It has been found that, to a good approximation, the mean wind profile can be represented by a power law relation, shown below, giving height above ground versus wind speed.

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

Where; U = mean wind speed, U_g = gradient wind speed, Z = height above ground, Z_g = depth of the boundary layer (gradient height) and α is the power law exponent.

Figure B1 on the following page plots three velocity profiles for open country, and suburban and urban exposures.

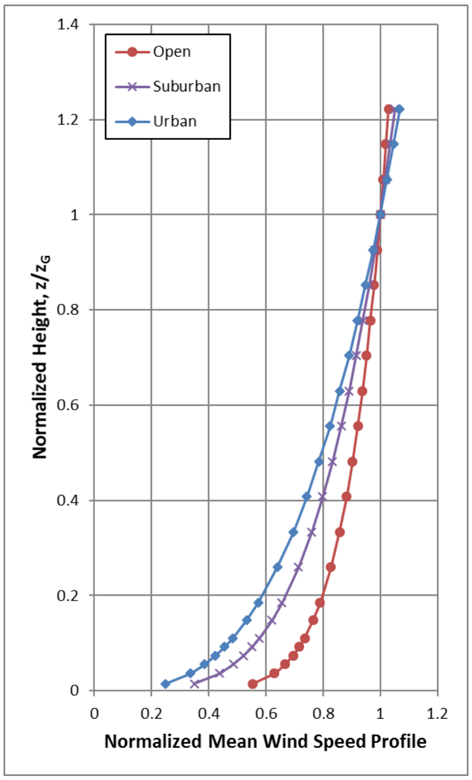
The exponent α varies according to the type of upwind terrain; α ranges from 0.14 for open country to 0.33 for an urban exposure. Figure C2 illustrates the theoretical variation of turbulence for open country, suburban and urban exposures.

The integral length scale of turbulence can be thought of as an average size of gust in the atmosphere. Although it varies with height and ground roughness, it has been found to generally be in the range of 100 m to 200 m in the upper half of the boundary layer. Thus, for a 1:300 scale, the model value should be between 1/3 and 2/3 of a metre. Integral length scales are derived from power spectra, which describe the energy content of wind as a function of frequency. There are several ways of determining integral length scales of turbulence. One way is by comparison of a measured power spectrum in model scale to a non-dimensional theoretical spectrum such as the Davenport spectrum of longitudinal turbulence. Using the Davenport spectrum, which agrees well with full-scale spectra, one can estimate the integral scale by plotting the theoretical spectrum with varying L until it matches as closely as possible the measured spectrum:

$$f \times S(f) = \frac{\dfrac{4(Lf)^2}{U_{10}{}^2}}{\left[1 + \dfrac{4(Lf)^2}{U_{10}{}^2}\right]^{\frac{4}{3}}}$$

Where, f is frequency, S(f) is the spectrum value at frequency f, U10 is the wind speed 10 m above ground level, and L is the characteristic length of turbulence.

Once the wind simulation is correct, the model, constructed to a suitable scale, is installed at the center of the working section of the wind tunnel. Different wind directions are represented by rotating the model to align with the wind tunnel center-line axis.



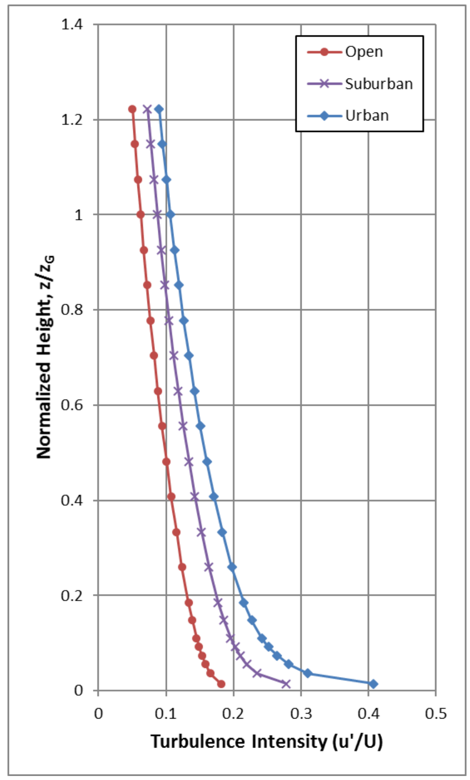


FIGURE C1 (LEFT): MEAN WIND SPEED PROFILES;
FIGURE C2 (RIGHT): TURBULENCE INTENSITY PROFILES

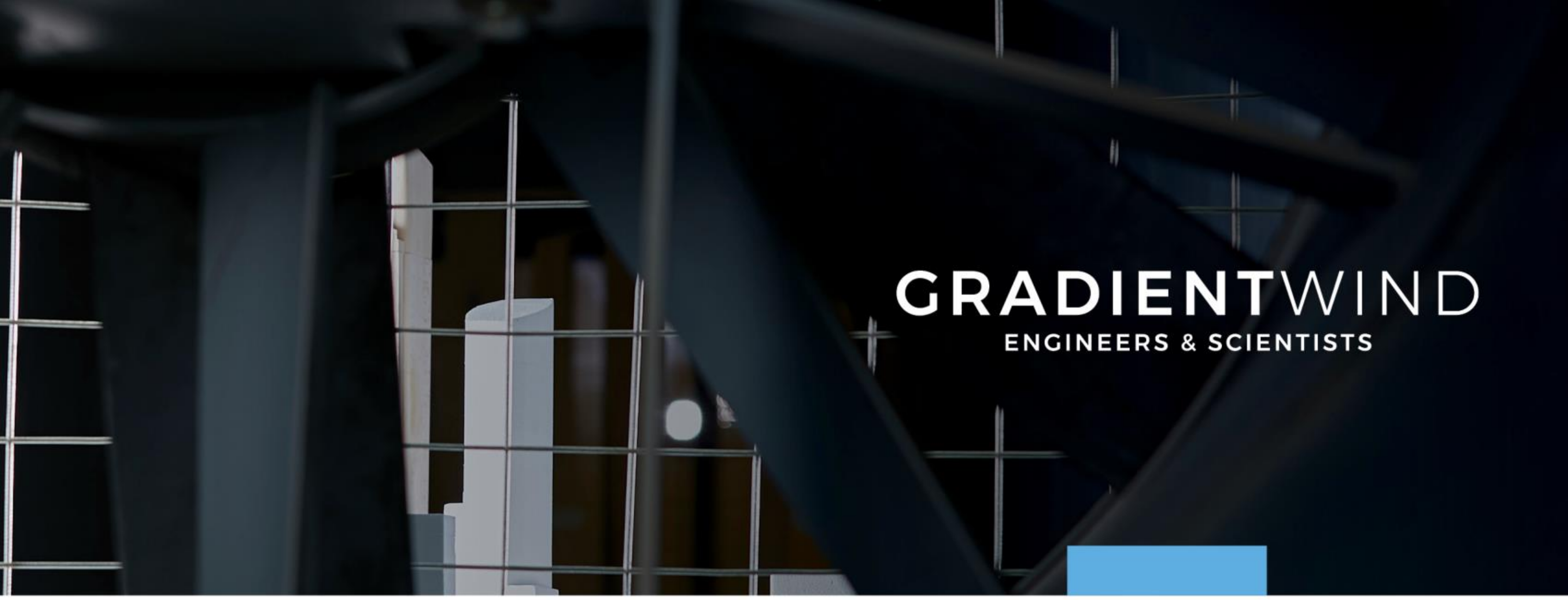
REFERENCES

1. Teunissen, H.W., ‘Characteristics of The Mean Wind And Turbulence In The Planetary Boundary Layer’, Institute For Aerospace Studies, University Of Toronto, UTIAS # 32, Oct. 1970

2. Flay, R.G., Stevenson, D.C., ‘Integral Length Scales in an Atmospheric Boundary Layer Near The Ground’, 9th Australian Fluid Mechanics Conference, Auckland, Dec. 1966

3. ESDU, ‘Characteristics of Atmospheric Turbulence Near the Ground’, 74030

4. Bradley, E.F., Coppin, P.A., Katen, P.C., ‘*Turbulent Wind Structure Above Very Rugged Terrain*’, 9th Australian Fluid Mechanics Conference, Auckland, Dec. 1966



APPENDIX D

PEDESTRIAN LEVEL WIND MEASUREMENT METHODOLOGY

127 WALGREEN ROAD, OTTAWA, ON, CANADA K0A 1L0 | 613 836 0934
GRADIENTWIND.COM

PEDESTRIAN LEVEL WIND MEASUREMENT METHODOLOGY

Pedestrian level wind studies are performed in a wind tunnel on a physical model of the study buildings at a suitable scale. Instantaneous wind speed measurements are recorded at a model height corresponding to 1.5 m full scale using either a hot wire anemometer or a pressure-based transducer. Measurements are performed at any number of locations on the model and usually for 36 wind directions. For each wind direction, the roughness of the upwind terrain is matched in the wind tunnel to generate the correct mean and turbulent wind profiles approaching the model.

The hot wire anemometer is an instrument consisting of a thin metallic wire conducting an electric current. It is an omni-directional device equally sensitive to wind approaching from any direction in the horizontal plane. By compensating for the cooling effect of wind flowing over the wire, the associated electronics produce an analog voltage signal that can be calibrated against velocity of the air stream. For all measurements, the wire is oriented vertically so as to be sensitive to wind approaching from all directions in a horizontal plane.

The pressure sensor is a small cylindrical device that measures instantaneous pressure differences over a small area. The sensor is connected via tubing to a transducer that translates the pressure to a voltage signal that is recorded by computer. With appropriately designed tubing, the sensor is sensitive to a suitable range of fluctuating velocities.

For a given wind direction and location on the model, a time history of the wind speed is recorded for a period of time equal to one hour in full-scale. The analog signal produced by the hot wire or pressure sensor is digitized at a rate of 400 samples per second. A sample recording for several seconds is illustrated in Figure D1. This data is analyzed to extract the mean, root-mean-square (rms) and the peak of the signal. The peak value, or gust wind speed, is formed by averaging a number of peaks obtained from sub-intervals of the sampling period. The mean and gust speeds are then normalized by the wind tunnel gradient wind speed, which is the speed at the top of the model boundary layer, to obtain mean and gust ratios. At each location, the measurements are repeated for 36 wind directions to produce normalized polar plots, which will be provided upon request.

In order to determine the duration of various wind speeds at full scale for a given measurement location the gust ratios are combined with a statistical (mathematical) model of the wind climate for the project site. This mathematical model is based on hourly wind data obtained from one or more meteorological stations (usually airports) close to the project location. The probability model used to represent the data is the Weibull distribution expressed as:

$$P\left(>U_g\right) = A_\theta \bullet \exp\left[\left(-\frac{U_g}{C_\theta}\right)^{K_\theta}\right]$$

Where,

P (> U_g) is the probability, fraction of time, that the gradient wind speed ***U_g*** is exceeded; ***θ*** is the wind direction measured clockwise from true north, ***A***, ***C***, ***K*** are the Weibull coefficients, (Units: A - dimensionless, C - wind speed units [km/h] for instance, K - dimensionless). ***A_θ*** is the fraction of time wind blows from a 10° sector centered on ***θ***.

Analysis of the hourly wind data recorded for a length of time, on the order of 10 to 30 years, yields the ***A_θ, C_θ*** and ***K_θ*** values. The probability of exceeding a chosen wind speed level, say 20 km/h, at sensor *N* is given by the following expression:

$$P_N(>20) = \Sigma_\theta P\left[\frac{(>20)}{\left(\frac{U_N}{U_g}\right)}\right]$$

$$P_N(>20) = \Sigma_\theta P\{>20/(U_N/U_g)\}$$

Where, ***U_N/U_g*** is the gust velocity ratios, where the summation is taken over all 36 wind directions at 10° intervals.

If there are significant seasonal variations in the weather data, as determined by inspection of the $\boldsymbol{C_{\theta}}$ and $\boldsymbol{K_{\theta}}$ values, then the analysis is performed separately for two or more times corresponding to the groupings of seasonal wind data. Wind speed levels of interest for predicting pedestrian comfort are based on the comfort guidelines chosen to represent various pedestrian activity levels as discussed in the main text.

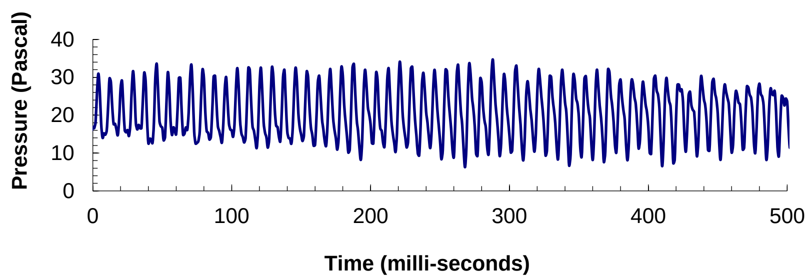


FIGURE D1: TIME VERSUS VELOCITY TRACE FOR A TYPICAL WIND SENSOR

REFERENCES

1. Davenport, A.G., '*The Dependence of Wind Loading on Meteorological Parameters*', Proc. of Int. Res. Seminar, Wind Effects on Buildings & Structures, NRC, Ottawa, 1967, University of Toronto Press.

2. Wu, S., Bose, N., 'An *Extended Power Law Model for the Calibration of Hot-wire/Hot-film Constant Temperature Probes*', Int. J. of Heat Mass Transfer, Vol.17, No.3, pp.437-442, Pergamon Press.