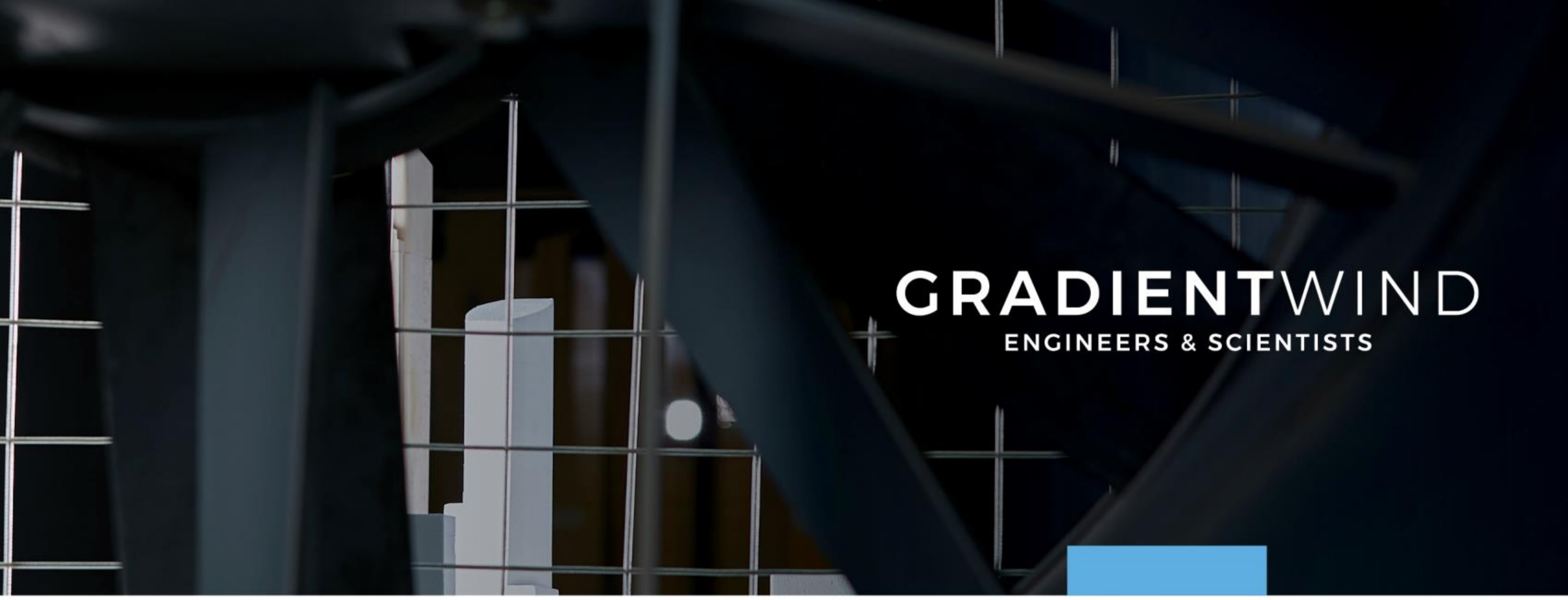
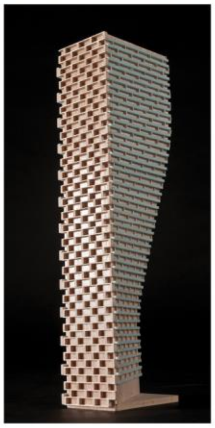
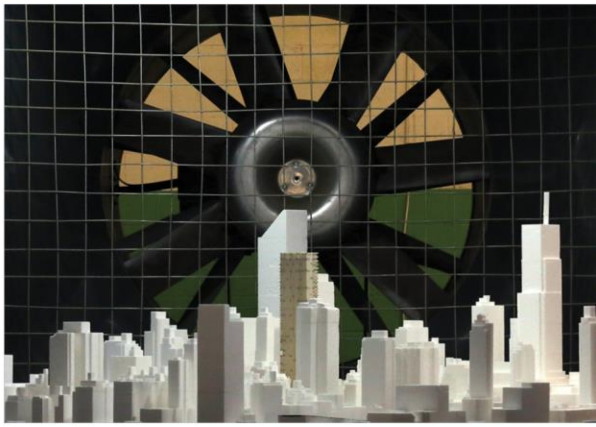


PEDESTRIAN LEVEL WIND STUDY

70 Park Street East
Port Credit, Ontario

REPORT: GW22-347-WTPLW-R1





January 17, 2023

PREPARED FOR
MPCT DIF 70 Park Street East LP
30 Adelaide Street East., Suite 301
Toronto, Ontario
M5C 3H1

PREPARED BY
Logan McFadden, B.Eng., Junior Wind Scientist
Nick Petersen, P.Eng., Wind Engineer

EXECUTIVE SUMMARY

This report describes a wind tunnel pedestrian level wind study undertaken to assess wind conditions for a proposed development located at 23, 25, 27, 29, and 31 Helene Street North, 53 Queen Street East, and 70 Park Street East in Mississauga, 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, laneways, parking areas, landscaped spaces, outdoor amenity areas, transit stops, and building access points. Wind comfort is also evaluated over the Level 2 green roof, and the Level 9 outdoor amenity terrace. 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 provided by IBI Group Architects in November 2022 and January 2023, surrounding street layouts, as well as existing and approved future building massing information 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 4B, as well as Tables A1-A2 and B1-B2 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in Port Credit, we conclude that the future wind conditions over most 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 several primary building access points, and the outdoor daycare amenity to the south, for which mitigation has been recommended as detailed in Section 5.2.

Additionally, the Level 9 outdoor amenity will experience wind conditions comfortable for walking or better throughout the warmer months, with annual wind speeds exceeding the safety criterion at the northwest corner of the terrace. To ensure calm and safe conditions suitable for sitting or more sedentary activities throughout the summer, mitigation is recommended as detailed in Section 5.2.

Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, and with the addition of the recommended mitigation, no areas over the study site were found to experience wind conditions that are 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 residential development located at 70 Park Street East in Port Credit, 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 provided by IBI Group Architects in November 2022 and January 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 mixed-use development located at 70 Park Street East in Port Credit, Ontario. The study site is situated at the west corner of a parcel of land bounded by Queen Street East to the northwest, Helene Street North to the southwest, Park Street East to the southeast and Ann Street to the northeast.

The study building comprises a 38-storey building with an eight-storey podium. Seven levels of below grade parking, as well as a loading zone, are accessible via a laneway to the southeast of the site connecting to Park Street East. Two retail areas are accessible via entrances along the west façade and at the northwest corner of the building. Residential lobbies are located at the southwest corner and the southeast corner of the podium, with the daycare entrance adjacent to the lobby at the southeast corner. Additional outdoor daycare space is provided to the southwest of the building. Levels 2 through 8 of the podium are reserved exclusively for residential occupancy, with the floorplate over the daycare stepping back from the south at Level 2. At Level 9, the building steps back from the east and north elevations to form the typical tower floorplate, accommodating an outdoor amenity terrace on the podium rooftop. Above Level 9, the building rises uniformly to Level 38 where a mechanical penthouse completes the development.

Regarding wind exposures, the near-field surroundings (defined as an area falling within a 200-metre (m) radius of the subject site) comprise a mix of mid- and high-rise buildings in the south quadrant with isolated low-rise buildings in the remaining compass azimuth directions. The Port Credit GO Station is situated directly west of the subject site. Notably, a 22-storey residential building, referred to as "Westport Condos", is under construction at 28 Ann Street, to the immediate east of the subject site. The far-field surroundings (defined as the area beyond the near field and within a 2-kilometre (km) radius) comprise low-rise massing with isolated mid- and high-rise buildings followed by the open exposure of Lake Ontario from the east-northeast clockwise to the south-southwest, with mostly low-rise massing and isolated mid- and high-rise buildings in the remaining directions, and the Credit River flowing approximately 600 m to the southwest.

Grade-level areas investigated include sidewalks, laneways, parking areas, landscaped spaces, outdoor amenity areas, transit stops, and building access points. Wind comfort is also evaluated over the Level 2 Green Roof, and the Level 9 outdoor amenity space. 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 Port Credit 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.

[1] City of Mississauga Urban Design Terms of Reference, Wind Comfort and Safety Studies, June 2014

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 57 sensor locations on the scale model in Gradient Wind's wind tunnel. Of these 57 sensors, 47 were located at grade and the remaining ten sensors were located over the Level 2 and 9 terraces. Wind speed measurements were performed for each of the 57 sensors for 36 wind directions at 10° intervals. Figures 1A and 1B illustrates the *existing* and *proposed* study sites and surrounding context, respectively, while sensor locations used to investigate wind conditions are illustrated in Figures 2A through 4B.

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

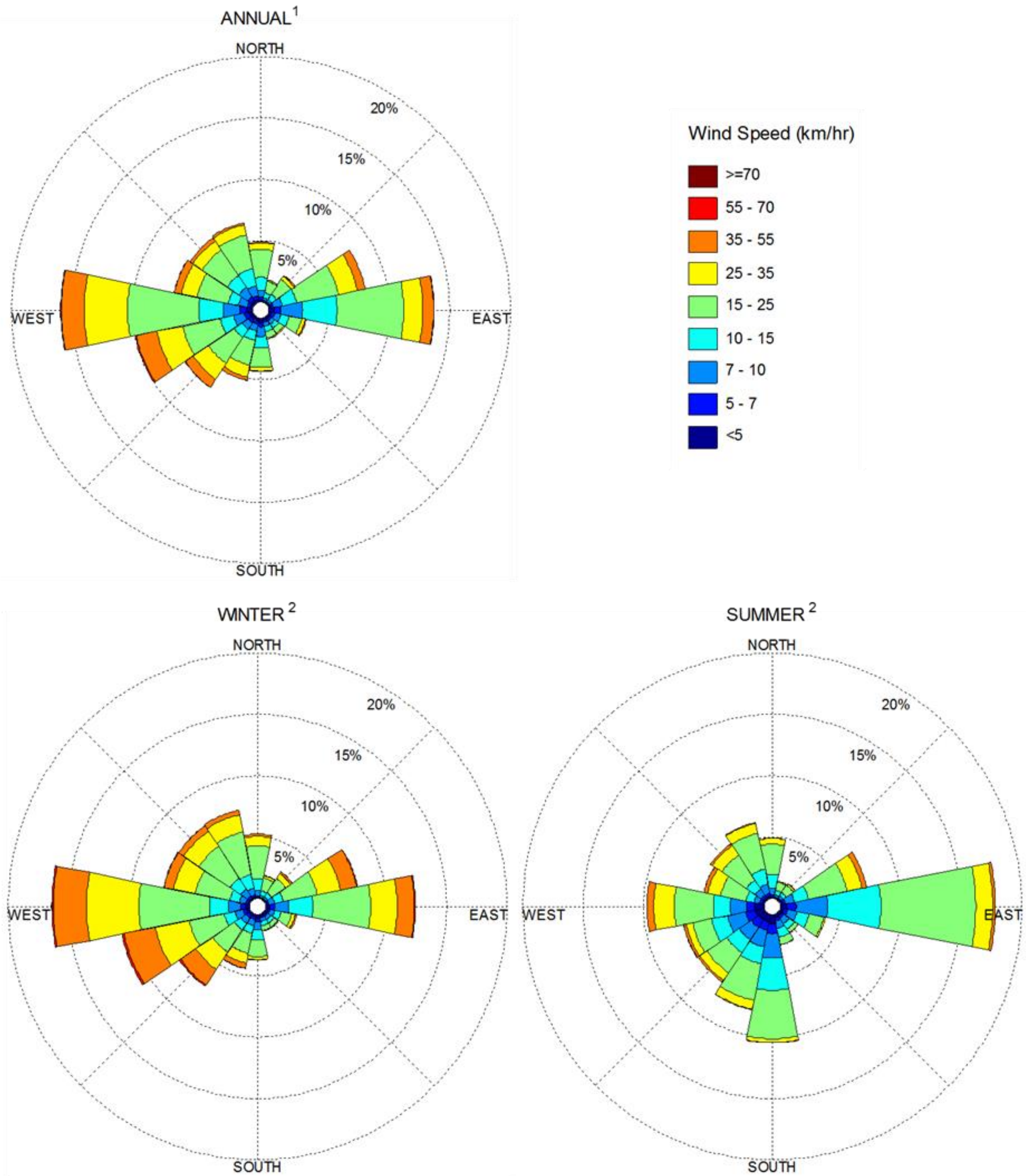
C and D provide greater detail of the theory behind wind speed measurements. Wind tunnel measurements for this project, conducted in Gradient Wind's wind tunnel facility, meet or exceed guidelines found in the National Building Code of Canada 2015 and of 'Wind Tunnel Studies of Buildings and Structures', ASCE Manual 7 Reports on Engineering Practice No 67.

4.3 Meteorological Data Analysis – Billy Bishop Toronto City Airport

A statistical model for winds in Port Credit was developed from approximately 35-years of hourly meteorological wind data recorded at Toronto Island Billy Bishop Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were divided into two distinct seasons, as stipulated in the noted City of Mississauga Urban Design Terms of Reference. More specifically, the summer season is defined as May through October, while the winter season is defined as November through April, inclusive.

The statistical model of the Port Credit 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 preferred wind speeds and directions can be identified by the longer length of the bars. For Port Credit, the most common winds concerning pedestrian comfort during the winter season occur for westerly wind directions, followed by those from the east. The most common winds during the summer season occur for easterly wind directions. The directional preference and relative magnitude of the wind speed varies somewhat from season to season. Also, by convection in microclimate studies, wind direction refers to the wind origin (e.g., a north wind blows from north to south).

SEASONAL DISTRIBUTION OF WINDS FOR VARIOUS PROBABILITIES
BILLY BISHOP TORONTO CITY 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. Since both mean and gust wind speeds affect pedestrian comfort, their combined effect is defined in the City of Mississauga Urban Design Terms of Reference[1]. More specifically, the criteria are defined as a Gust Equivalent Mean (GEM) wind speed, which is the greater of the mean wind speed or the gust wind speed divided by 1.85. The wind speed ranges are selected based on 'The Beaufort Scale' (presented on the following page), which describes the effects of forces produced by varying wind speed levels on objects.

Four pedestrian comfort classes and corresponding GEM wind speed ranges are used to assess pedestrian comfort, which include: (i) Sitting; (ii) Standing; (iii) Walking; and (iv) Uncomfortable. More specifically, the comfort classes, wind speed ranges, and limiting criteria are summarized as follows:

(i) **Sitting** – GEM wind speeds below 10 km/h occurring more than 80% of the time would be considered acceptable for sedentary activities, including sitting.

(ii) **Standing** – GEM wind speeds below 15 km/h (i.e. 10-15 km/h) occurring more than 80% of the time are acceptable for activities such as standing, strolling or more vigorous activities.

(iii) **Walking** – GEM wind speeds below 20 km/h (i.e. 15-20 km/h) occurring more than 80% of the time are acceptable for walking or more vigorous activities.

(iv) **Uncomfortable** – Uncomfortable conditions are characterized by predicted values that fall below the 80% criterion for walking. Brisk walking and exercise, such as jogging, would be acceptable for moderate excesses of this criterion.

Gust wind speeds greater than 90 km/h, occurring more than 0.1% of the time on an annual basis, are 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 a vulnerable member of the population to fall.

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 A2 in Appendix A provide a summary of seasonal comfort predictions for each sensor location under the *existing* massing scenario. Similarly, Tables B1 through B2 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 4B. 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-A2 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, surface parking, laneways, and landscaped areas within and surrounding the proposed development currently experience wind conditions suitable for walking or better during each seasonal period. Exceptions include portions of sidewalk along Helene Street North (Sensors 16 & 18) and existing landscaping to the southeast (Sensor 24), which exceed the walking criterion during the winter months.
2. The GO Transit entrances and adjacent bus terminals to the west (Sensors 7-11), currently experience wind conditions suitable for standing or better throughout the year.

3. The canopied entrance to the adjacent existing apartment building directly southeast of the study building (Sensor 21) currently experiences wind conditions suitable for standing or better throughout the year, which is appropriate.

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-B2 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. Most public sidewalks, surface parking, laneways, and landscaping within and surrounding the proposed development will experience wind conditions suitable for walking or better during each seasonal period, which is acceptable for the intended uses of the spaces. Exceptions occur on portions of the Helene Street North sidewalk to the south of the site (Sensor 14 and 33), the intersection at Queen Street East and Ann Street to the north (Sensor 2), and a portion of the new laneway to the east of the site (Sensor 24) where wind conditions will become uncomfortable for walking during the winter months. Generally, since uncomfortable conditions are limited to the colder months of the year, somewhat pre-existing, and do not exceed the annual safety criteria, mitigation is not considered necessary. If calmer conditions are desired, targeted wind barriers such as coniferous plantings or wind screens may be used to buffer salient easterly and westerly winds.

2. The GO Transit entrances and adjacent bus terminals to the west (Sensors 7-11), will generally continue to experience wind conditions suitable for standing or better throughout the year, with conditions decreasing slightly at the eastmost location (Sensor 7), where wind conditions may marginally exceed the standing criterion intermittently during the colder months. However, considering the marginality of the exceedance, no mitigation is recommended.

3. The canopied entrance to the adjacent existing apartment building directly southeast of the study building (Sensor 21) will continue to experience wind conditions suitable for standing or better throughout the year, which is appropriate.

4. The retail entrances proposed along the west façade (Sensor 43), and at the northwest corner of the building (Sensor 42), will experience wind conditions suitable for standing in the summer, but exceed the standing criterion during the colder months. The entrances at the northwest corner are already recessed and covered so no further mitigation is expected to be required. The retail entrance further south along the west façade is flanked by vertical architectural fins, which will provide some protection, however, it is additionally recommended to provide an overhead canopy, to mitigate downwash flows.

   The lobby and daycare entrances at the southeast corner of the building (Sensor 38) will experience wind condition suitable for sitting throughout the year, which is appropriate. The Lobby entrance located at the southwest corner of the building (Sensor 45) will experience wind conditions suitable for standing during the warmer months, with conditions becoming uncomfortable for walking during the winter months. To provide similarly calm conditions suitable for standing throughout the year it is recommended to flank the entrance with vertical wind barriers and provide a canopy overhead.

   All secondary entrances (including stairwell exits and vehicle access points) will experience wind conditions suitable for walking or better throughout the year, which is appropriate.

5. The outdoor Daycare area at grade (Sensors 35, 36, and 47) was tested without any perimeter barrier or overhead canopy and, as tested, will experience wind conditions suitable far walking or better throughout the warmer months, becoming largely uncomfortable during the winter. To ensure calm conditions within the space, it is recommended to provide vertical wind barriers measuring at least 2.0 metres-tall along the full perimeter of the space, as well as canopy or pergola structures over notably sensitive areas. Such barriers may comprise coniferous plantings, high-solidity windscreens, or a combination thereof. It is notable that more recent iterations of the landscaping and architectural drawings include an overhead canopy and grade-level barriers, which will improve wind comfort and may satisfy the wind comfort requirements.

6. The Level 2 terrace will experience wind conditions suitable for sitting or more sedentary activities throughout the warmer months, which is acceptable, including if the space is to be used for amenity purposes.

7. The Level 9 outdoor amenity terrace will experience a mix of wind conditions suitable for standing or walking throughout the summer months. At the northwest corner of the terrace, wind speeds will exceed the annual safety criterion (Sensor 55). To achieve safe and calm conditions suitable for sitting or more sedentary activities over the entire Level 9 terrace throughout the warmer months, it is recommended to install vertical wind barriers along the full perimeter of the terrace measuring at least 2.2 metres above the walking surface, as well as provide canopy or pergola structures above designated seating areas. Targeted barriers measuring 1.6-metres-tall to the immediate east and west of seating areas is also recommended. Such barriers may comprise high-solidity wind screens, dense coniferous plantings in planters, or a combination thereof. The exact composition and configuration of such mitigation can be coordinated with the design team as the landscape plans develop.

8. Within the context of typical weather patterns, which exclude anomalous localized storm events such as tornadoes and downbursts, and with the addition of the recommended mitigation, no areas over the study site 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 residential development located at 70 Park Street East in Port Credit, 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 4B, as well as Tables A1-A2 and B1-B2 in the appendices. Based on wind tunnel test results, meteorological data analysis, and experience with similar developments in Port Credit, we conclude that the future wind conditions over most 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 several primary building access points, and the outdoor daycare amenity to the south, for which mitigation has been recommended as detailed in Section 5.2.

Additionally, the Level 9 outdoor amenity will experience wind conditions comfortable for walking or better throughout the warmer months, with annual wind speeds exceeding the safety criterion at the northwest corner of the terrace. To ensure calm and safe conditions suitable for sitting or more sedentary activities throughout the summer, mitigation is recommended as detailed in Section 5.2.

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

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

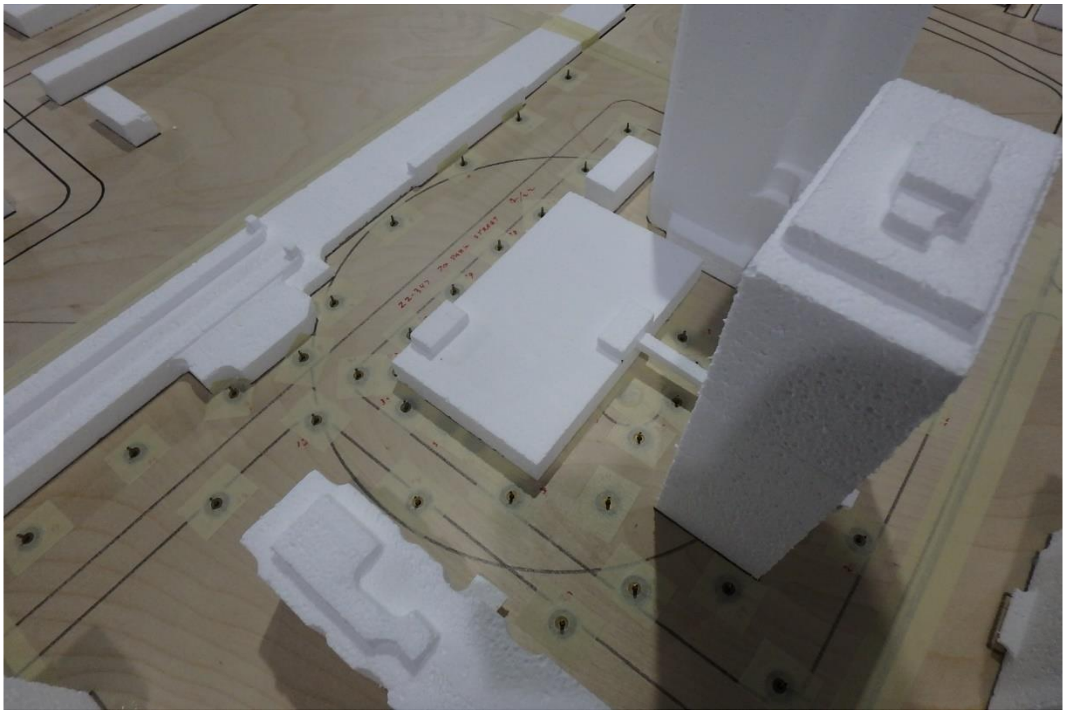
Sincerely,

Gradient Wind Engineering Inc.

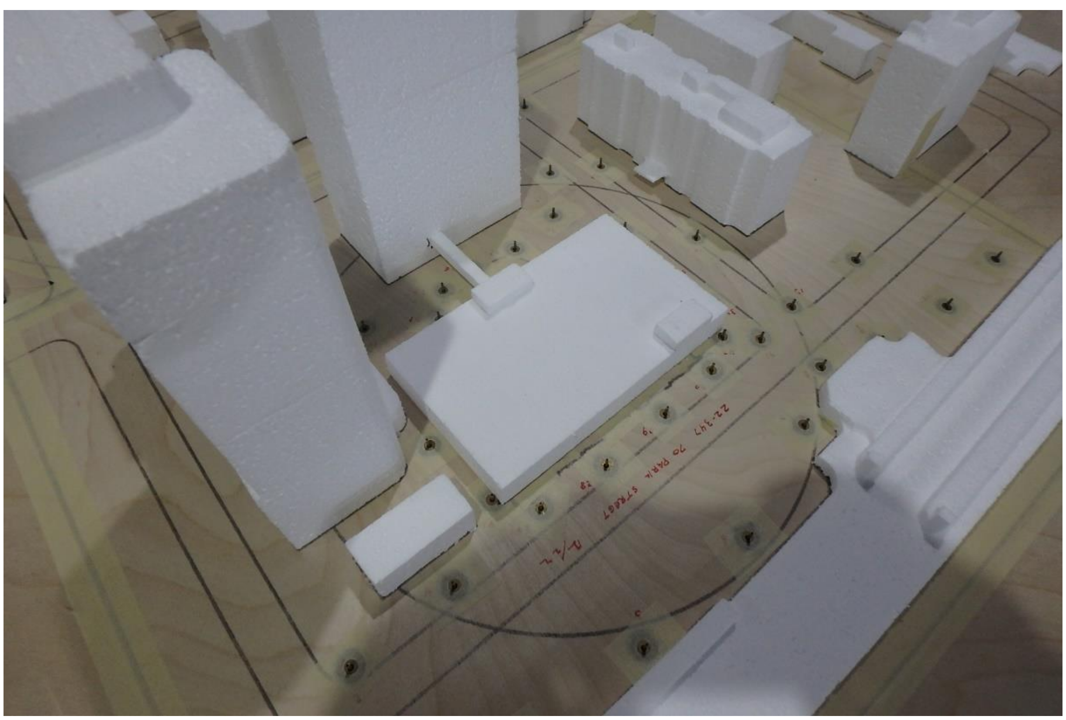
Logan McFadden, B.Eng.,
Junior Wind Scientist

Nick Petersen, P.Eng.,
Wind Engineer

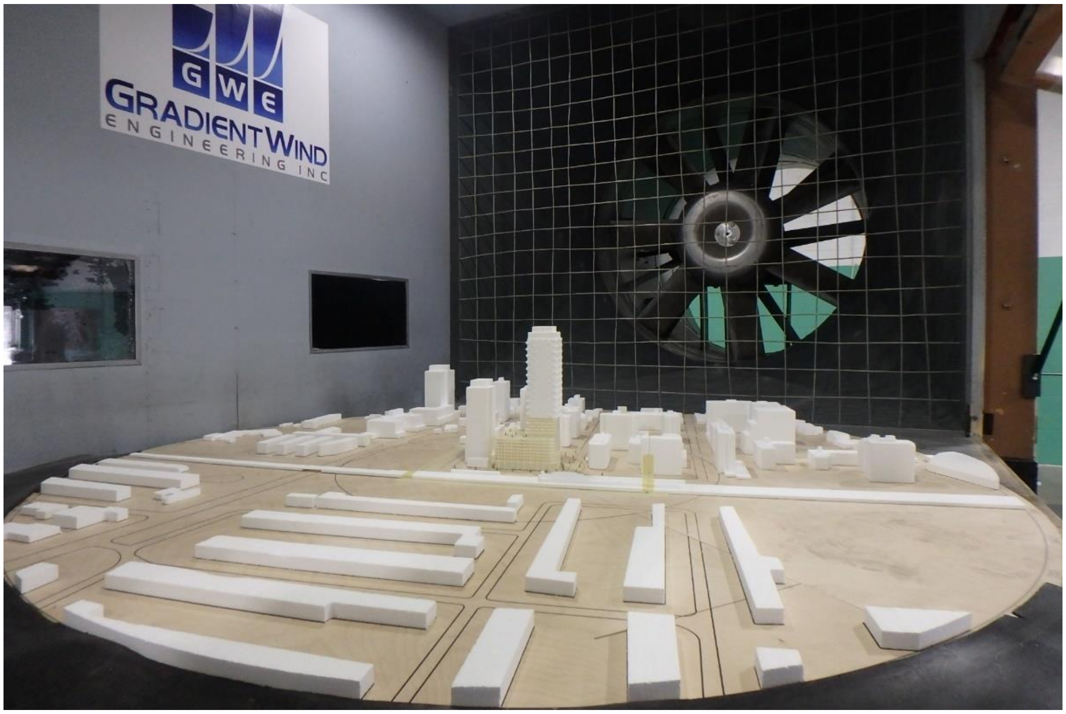
GW22-347-WTPLW-R1



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

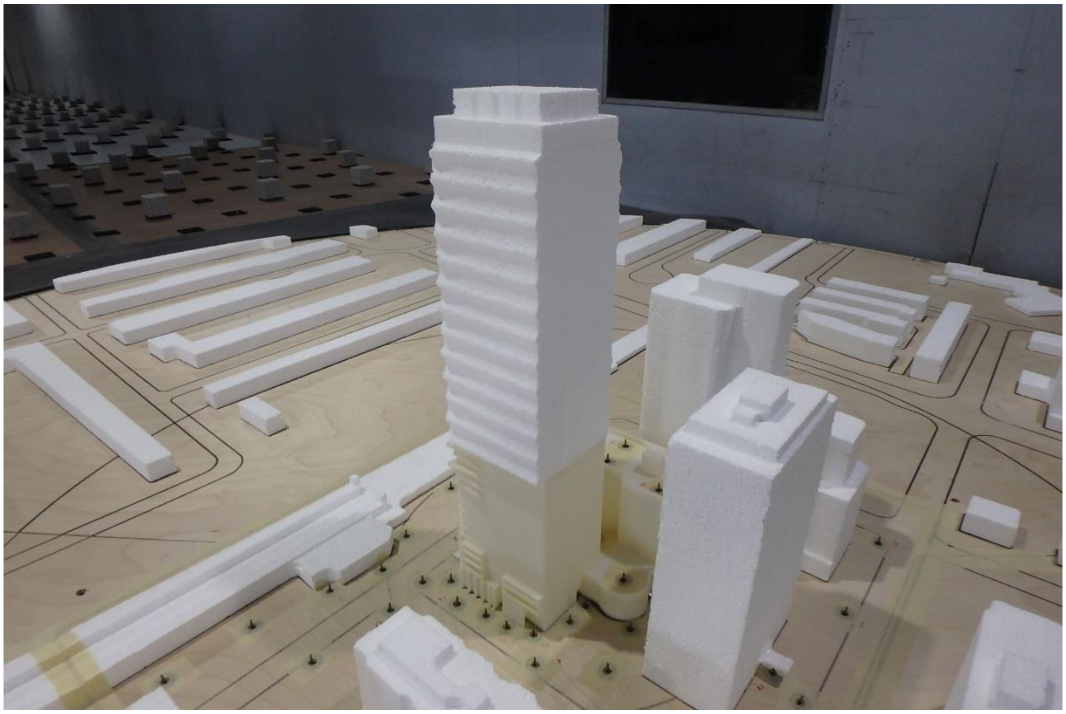


PHOTOGRAPH 2: CLOSE-UP VIEW OF EXISTING CONTEXT MODEL LOOKING SOUTH



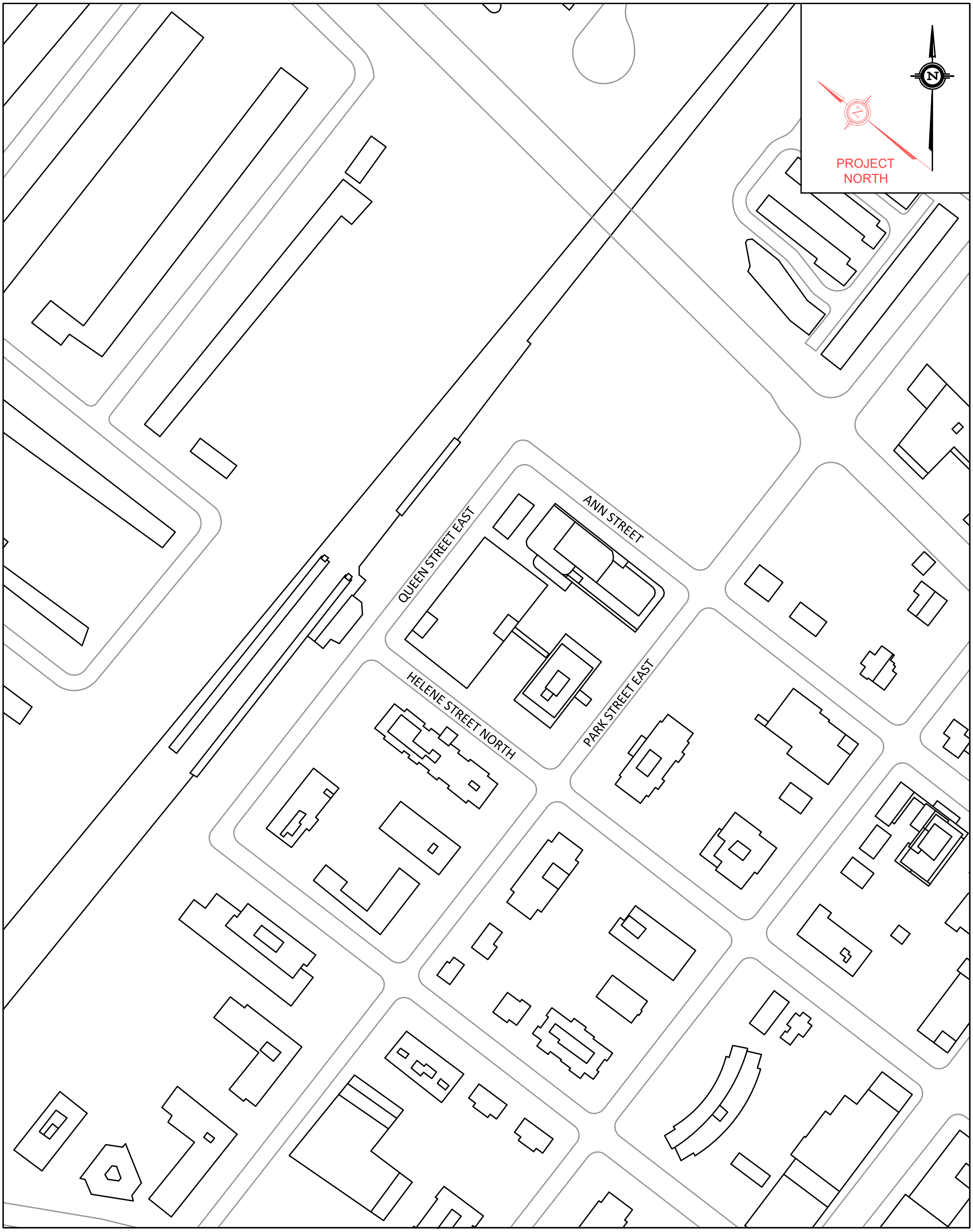
PHOTOGRAPH 3: PROPOSED STUDY MODEL INSIDE THE GWE WIND TUNNEL LOOKING DOWNWIND

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



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

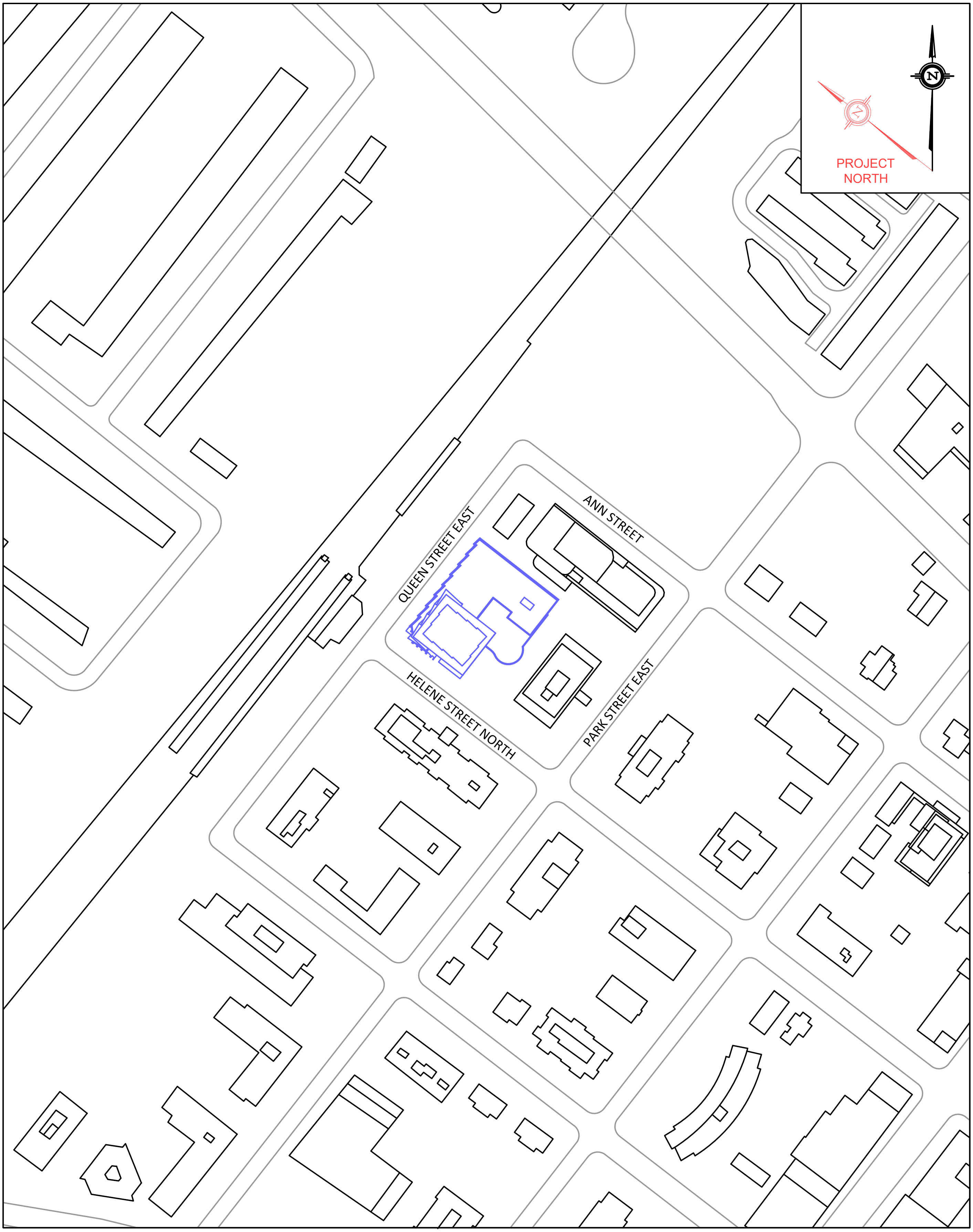
PHOTOGRAPH 6: CLOSE-UP VIEW OF PROPOSED STUDY MODEL LOOKING SOUTH



GRADIENTWIND
ENGINEERS & SCIENTISTS

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

PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY
SCALE	1:2500 (APPROX.)
DRAWING NO.	GW22-347-PLW-1A
DATE	JANUARY 17, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 1A: EXISTING SITE PLAN AND SURROUNDING CONTEXT



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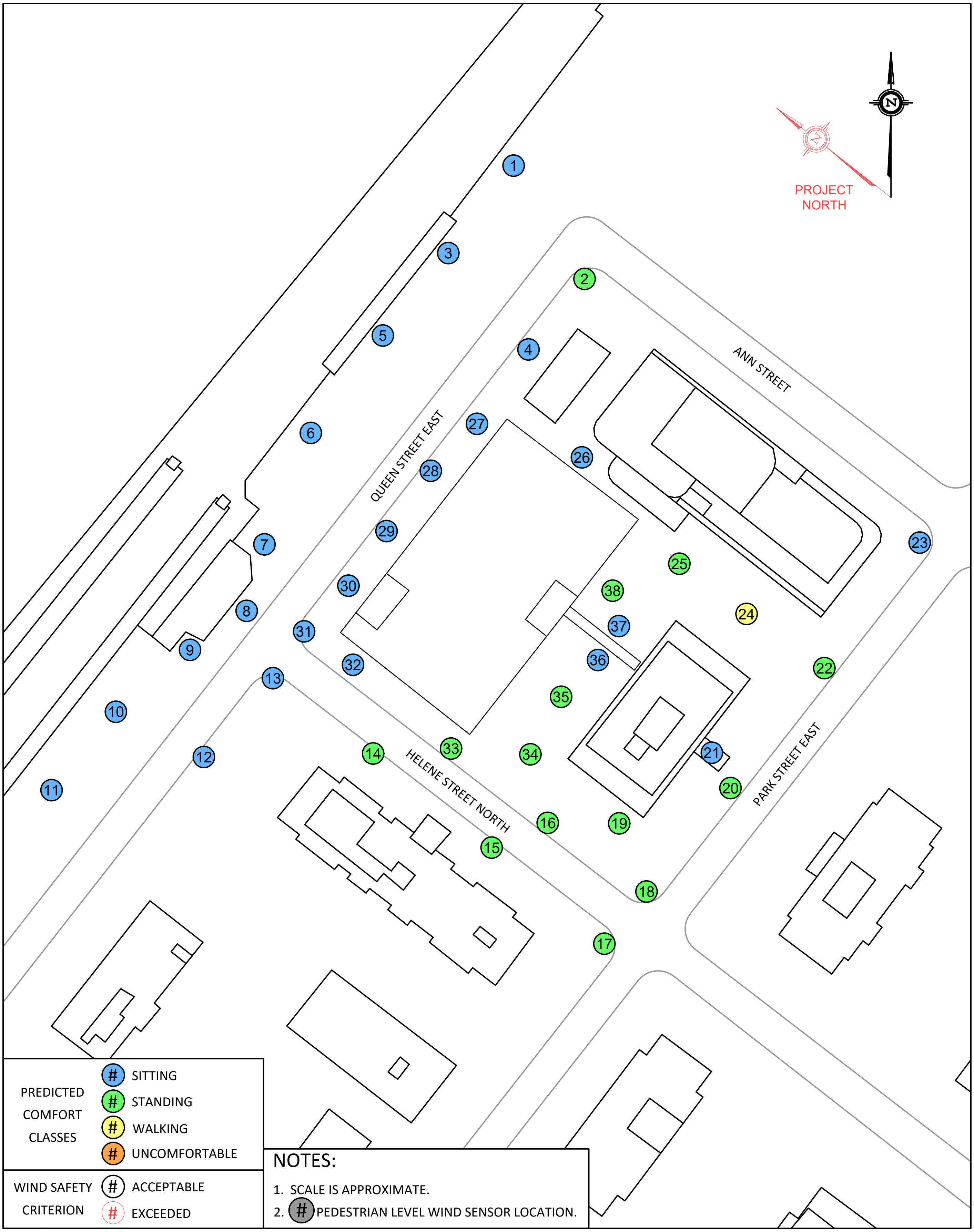
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2500 (APPROX.)	DRAWING NO.	GW22-347-PLW-1B
DATE	JANUARY 17, 2023	DRAWN BY	C.E.

DESCRIPTION

FIGURE 1B:
PROPOSED SITE PLAN
AND SURROUNDING CONTEXT



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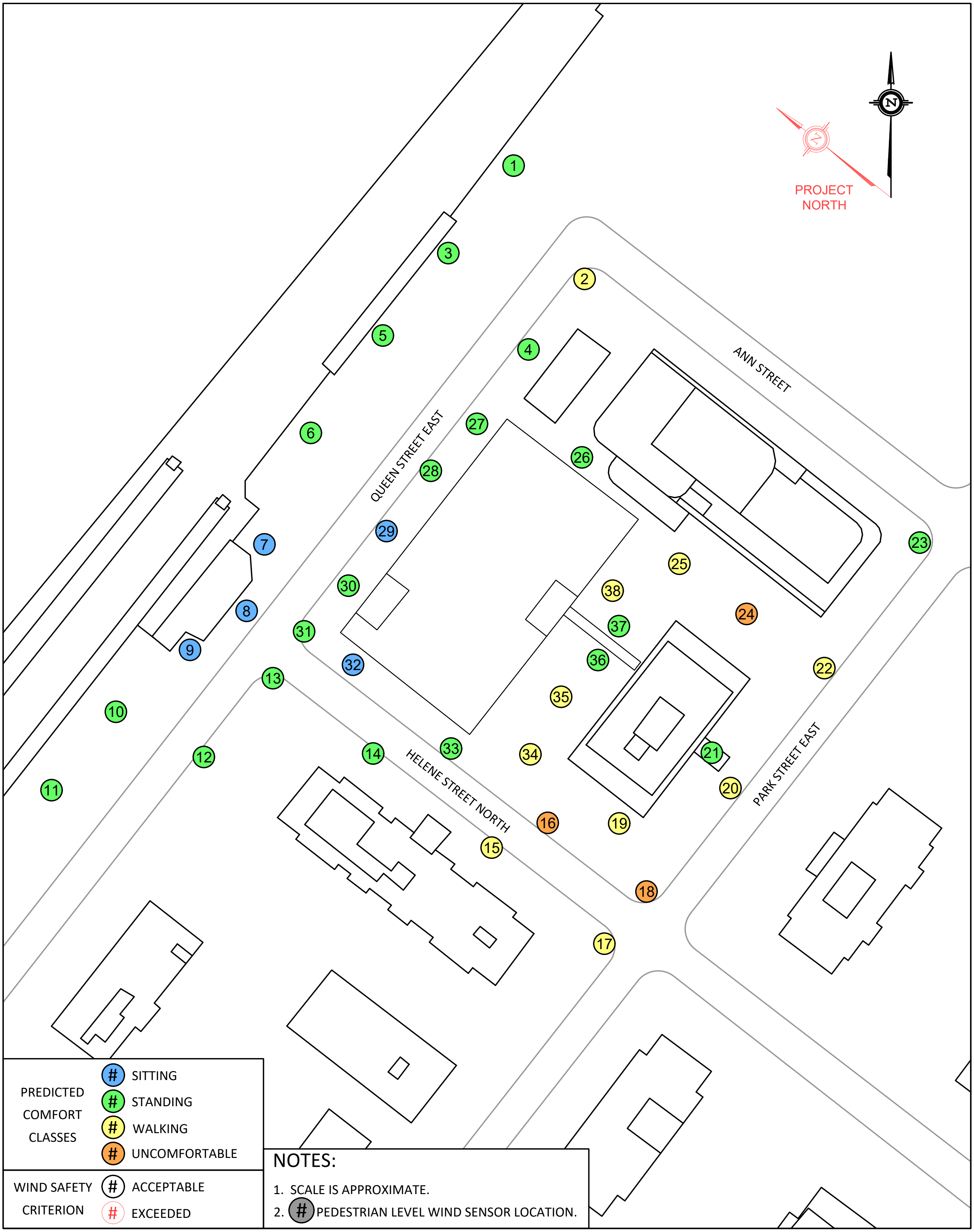
PROJECT		DESCRIPTION
70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY		FIGURE 2A: SUMMER EXISTING GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS
SCALE: 1:1200 (APPROX.)	DRAWING NO. GW22-347-PLW-2A	
DATE: JANUARY 17, 2023	DRAWN BY: C.E.	



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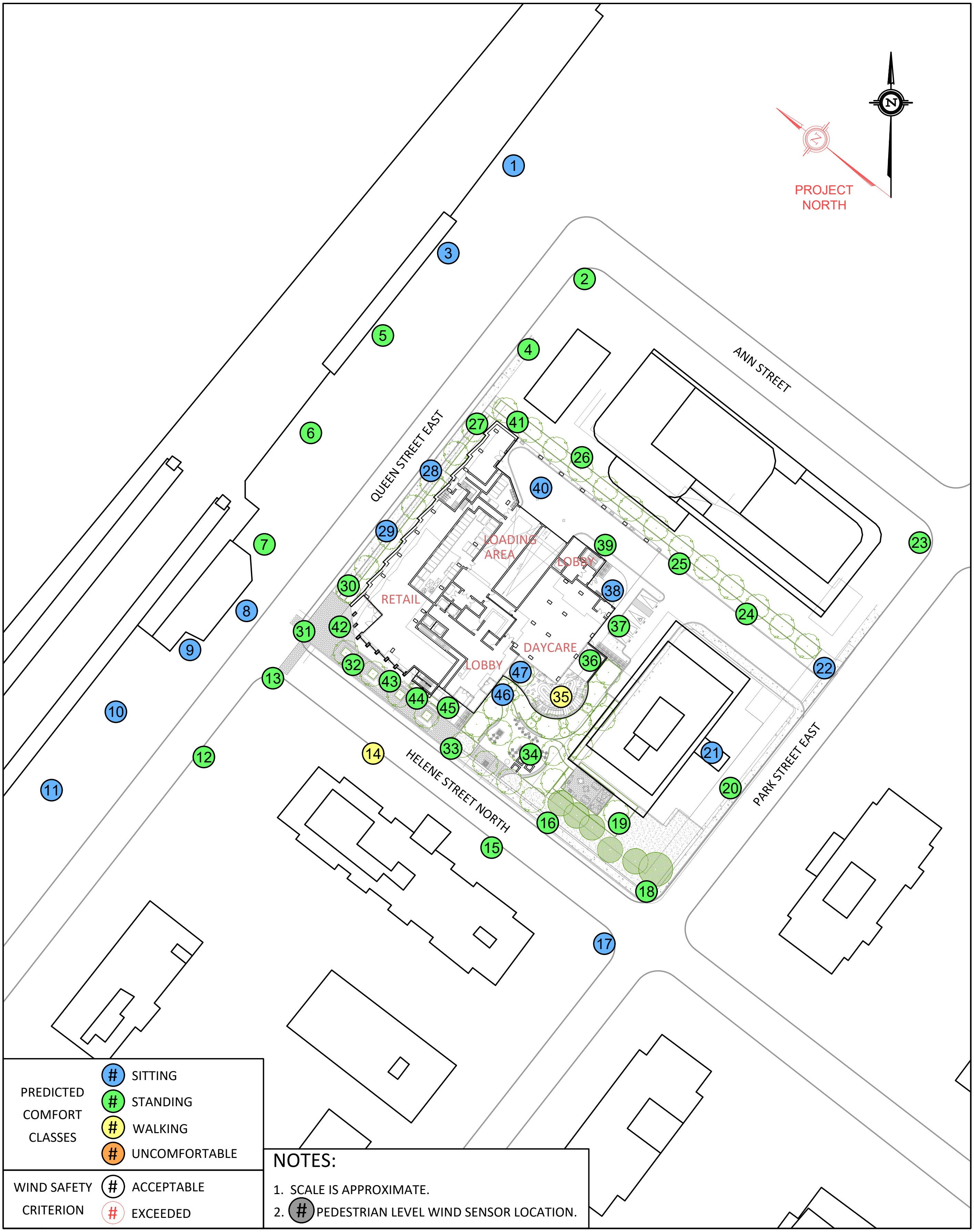
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1200 (APPROX.)
DRAWING NO.	GW22-347-PLW-2B
DATE	JANUARY 17, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 2B: WINTER EXISTING GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



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

WIND SAFETY CRITERION
- # ACCEPTABLE
- # EXCEEDED

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

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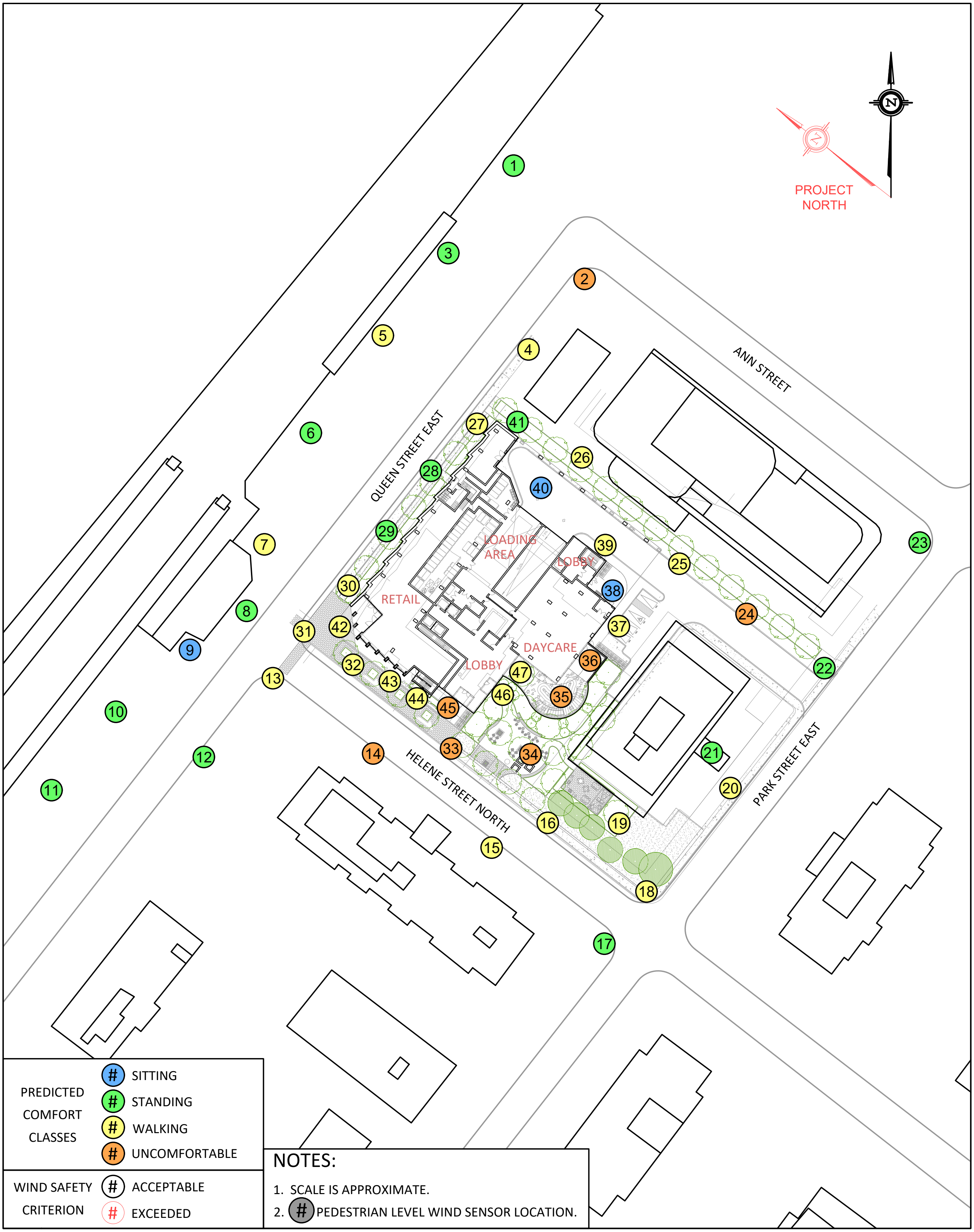
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1200 (APPROX.)
DRAWING NO.	GW22-347-PLW-3A
DATE	JANUARY 17, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 3A: SUMMER PROPOSED GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CLASSES	#	SITTING
	#	STANDING
	#	WALKING
	#	UNCOMFORTABLE
WIND SAFETY CRITERION	#	ACCEPTABLE
	#	EXCEEDED

NOTES:

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

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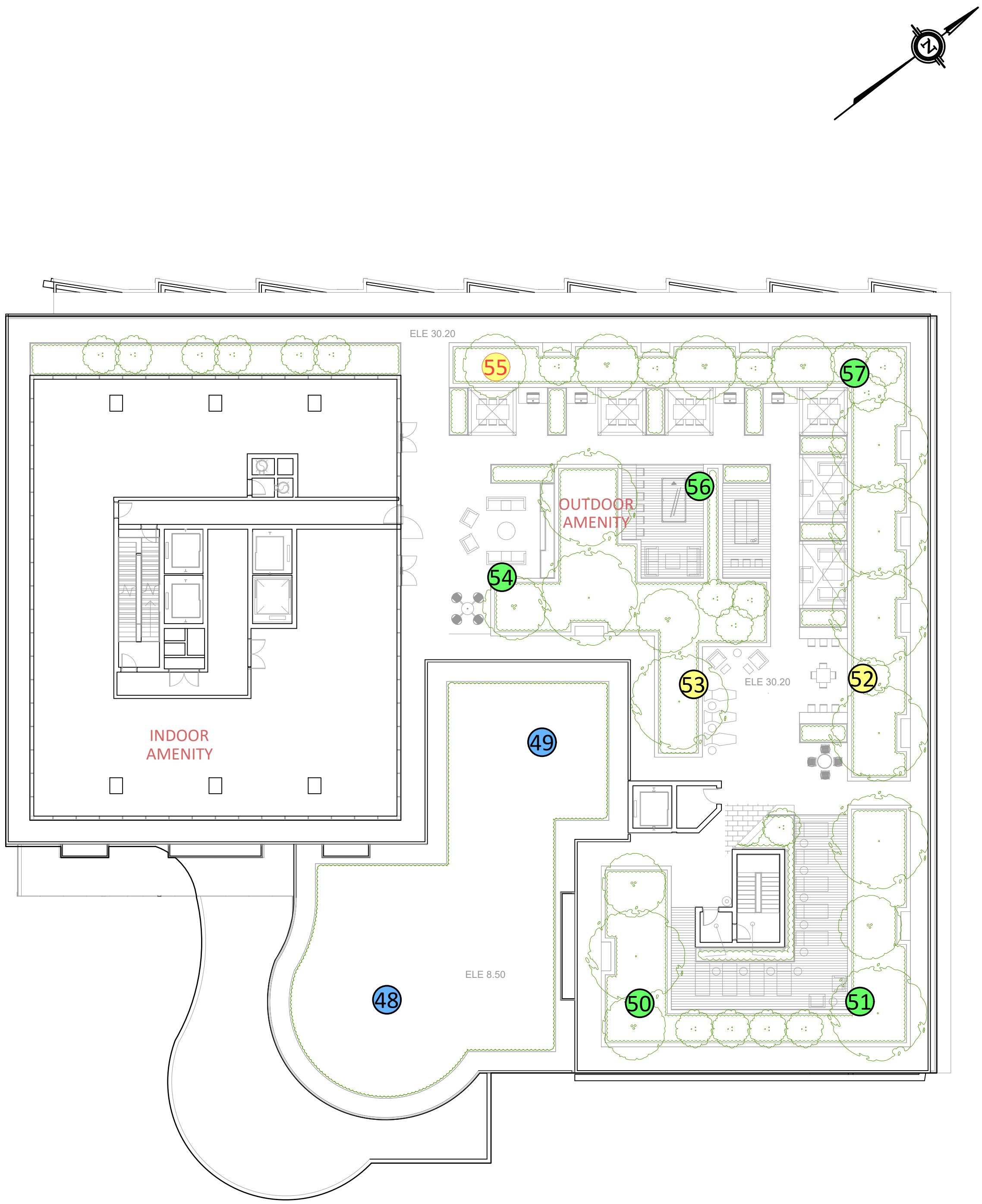
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY
SCALE	1:1200 (APPROX.)
DRAWING NO.	GW22-347-PLW-3B
DATE	JANUARY 17, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 3B: WINTER PROPOSED GROUND FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS



PREDICTED COMFORT CLASSES		
	#	SITTING
	#	STANDING
	#	WALKING
	#	UNCOMFORTABLE
WIND SAFETY CRITERION	#	ACCEPTABLE
	#	EXCEEDED

NOTES:

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

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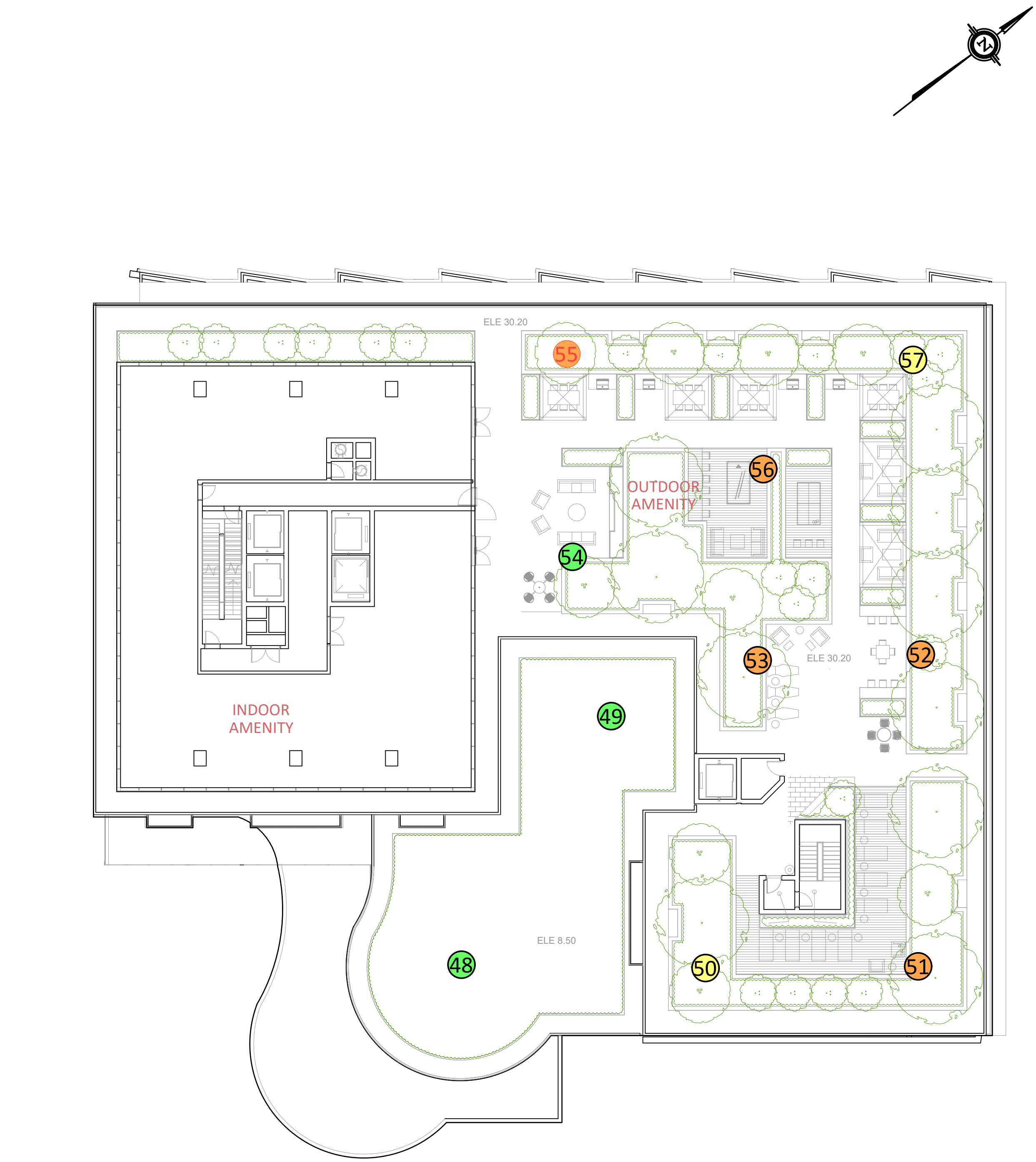
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:400 (APPROX.)	DRAWING NO.	GW22-347-PLW-4A
DATE	JANUARY 17, 2023	DRAWN BY	C.E.

DESCRIPTION

FIGURE 4A: SUMMER
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.

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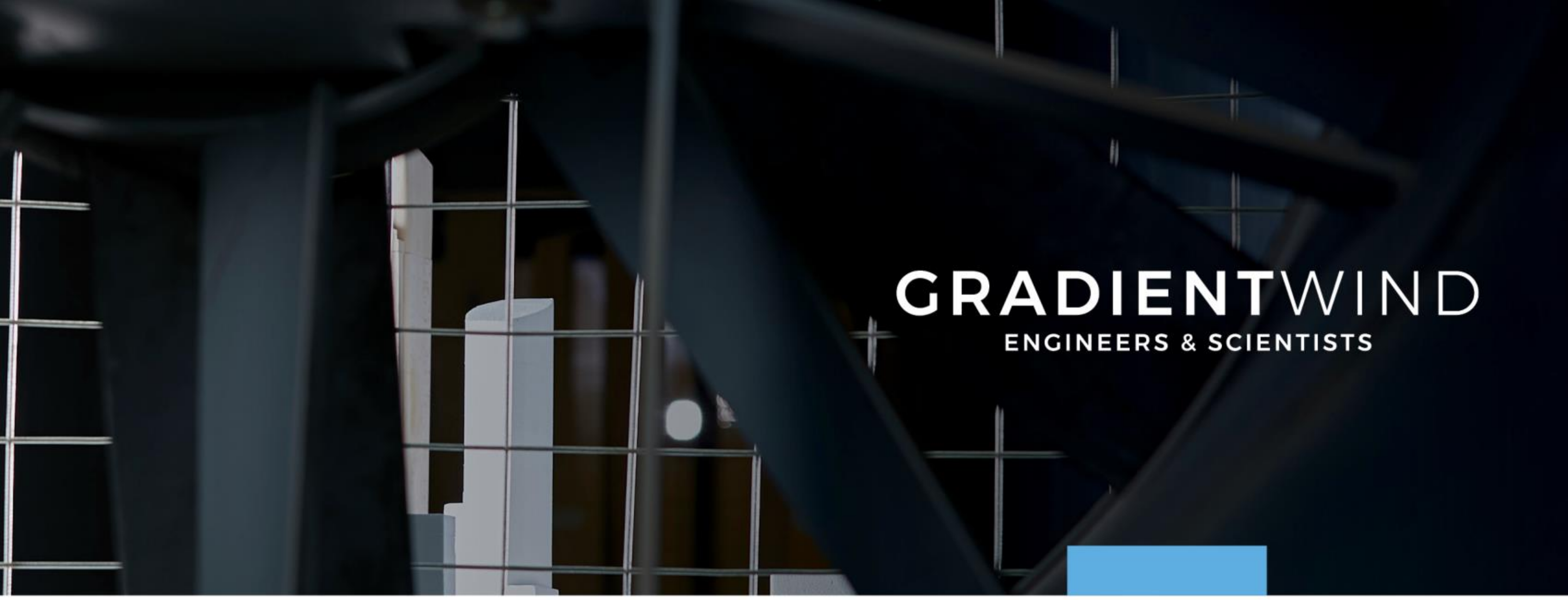
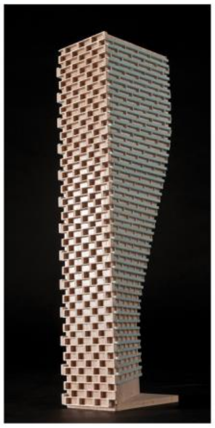
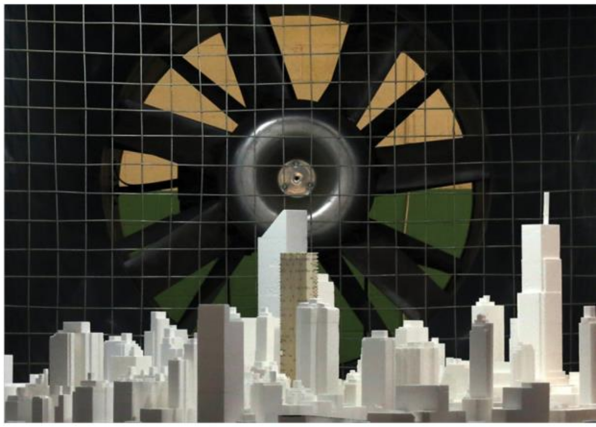
PROJECT	70 PARK STREET EAST, PORT CREDIT PEDESTRIAN LEVEL WIND STUDY
SCALE	1:400 (APPROX.)
DRAWING NO.	GW22-347-PLW-4B
DATE	JANUARY 17, 2023
DRAWN BY	C.E.
DESCRIPTION	FIGURE 4B: WINTER AMENITY FLOOR PLAN PEDESTRIAN COMFORT PREDICTIONS







APPENDIX A

PEDESTRIAN COMFORT SUITABILITY, TABLES A1-A2
(EXISTING SCENARIO)

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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

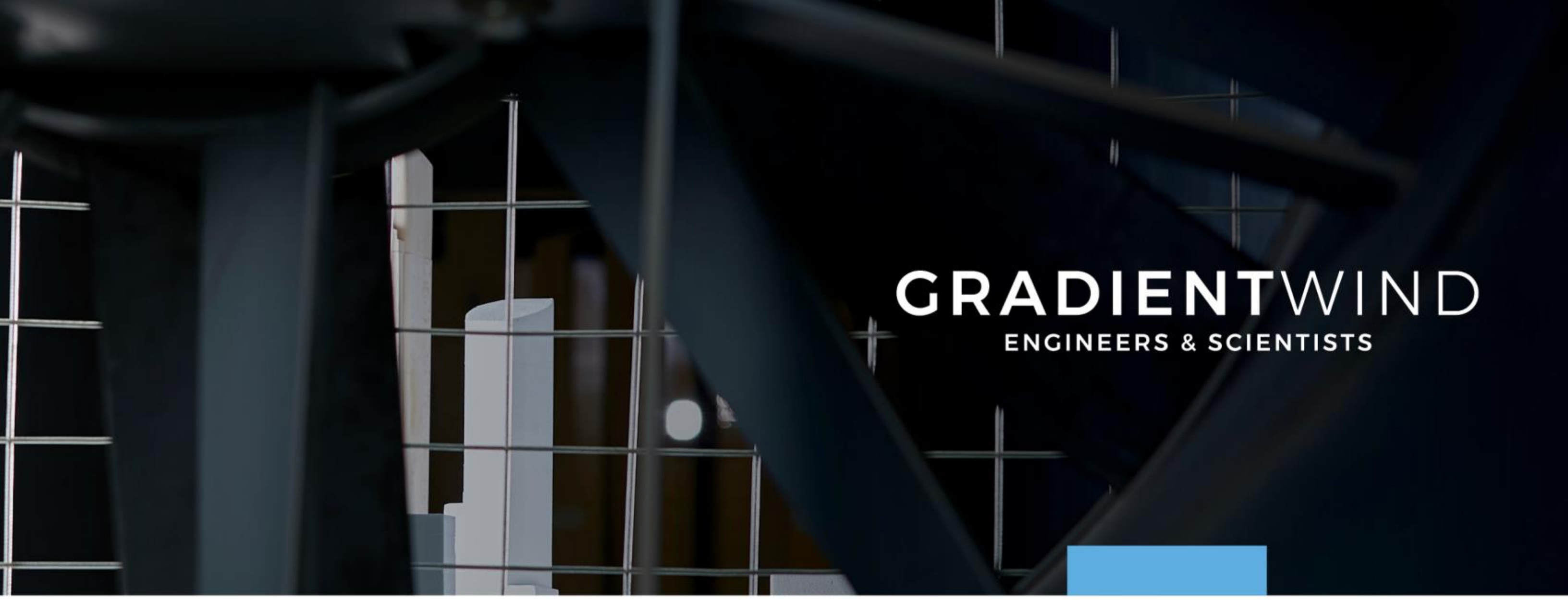
TABLE A1: SUMMARY OF PEDESTRIAN COMFORT (EXISTING SCENARIO)

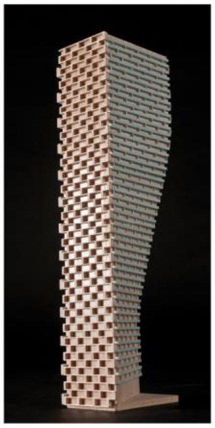
Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	8.8	Sitting	12.5	Standing	39.9	Safe
2	12.9	Standing	18.7	Walking	63.7	Safe
3	8.3	Sitting	11.6	Standing	38.5	Safe
4	8.7	Sitting	13.2	Standing	50.4	Safe
5	9.5	Sitting	12.9	Standing	56.7	Safe
6	7.9	Sitting	10.8	Standing	47.7	Safe
7	7.1	Sitting	9.7	Sitting	33.5	Safe
8	6.6	Sitting	9.5	Sitting	35.6	Safe
9	6.5	Sitting	9.0	Sitting	32.7	Safe
10	7.2	Sitting	10.9	Standing	38.8	Safe
11	7.4	Sitting	11.4	Standing	39.8	Safe
12	9.2	Sitting	14.3	Standing	48.9	Safe
13	8.7	Sitting	12.9	Standing	45.3	Safe
14	10.4	Standing	13.1	Standing	53.3	Safe
15	13.0	Standing	16.8	Walking	59.5	Safe
16	14.9	Standing	22.1	Uncomfortable	70.7	Safe
17	11.5	Standing	15.5	Walking	58.1	Safe
18	14.9	Standing	21.7	Uncomfortable	70.2	Safe
19	10.8	Standing	16.2	Walking	65.8	Safe
20	10.6	Standing	16.8	Walking	62.1	Safe
21	9.9	Sitting	14.7	Standing	52.8	Safe
22	11.0	Standing	18.5	Walking	68.1	Safe
23	9.6	Sitting	13.3	Standing	56.2	Safe
24	16.7	Walking	28.0	Uncomfortable	79.9	Safe
25	11.1	Standing	16.9	Walking	60.0	Safe
26	9.1	Sitting	12.9	Standing	51.3	Safe
27	8.8	Sitting	12.5	Standing	47.1	Safe
28	8.1	Sitting	11.6	Standing	46.9	Safe
29	6.7	Sitting	9.6	Sitting	39.9	Safe
30	7.4	Sitting	10.9	Standing	41.0	Safe
31	8.2	Sitting	11.8	Standing	42.1	Safe
32	6.4	Sitting	8.6	Sitting	33.9	Safe
33	10.1	Standing	13.8	Standing	52.7	Safe
34	11.4	Standing	17.3	Walking	58.8	Safe
35	10.7	Standing	15.2	Walking	53.4	Safe

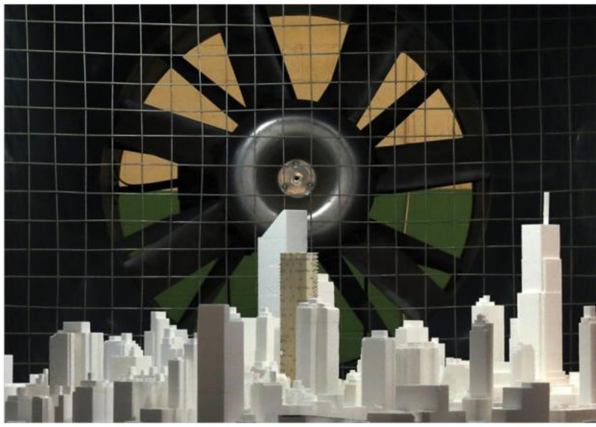
Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE A2: SUMMARY OF PEDESTRIAN COMFORT (EXISTING SCENARIO)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	7.7	Sitting	10.5	Standing	46.8	Safe
37	8.9	Sitting	12.7	Standing	51.3	Safe
38	12.0	Standing	17.6	Walking	70.5	Safe







APPENDIX B

PEDESTRIAN COMFORT SUITABILITY, TABLES B1-B2 (PROPOSED SCENARIO)

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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

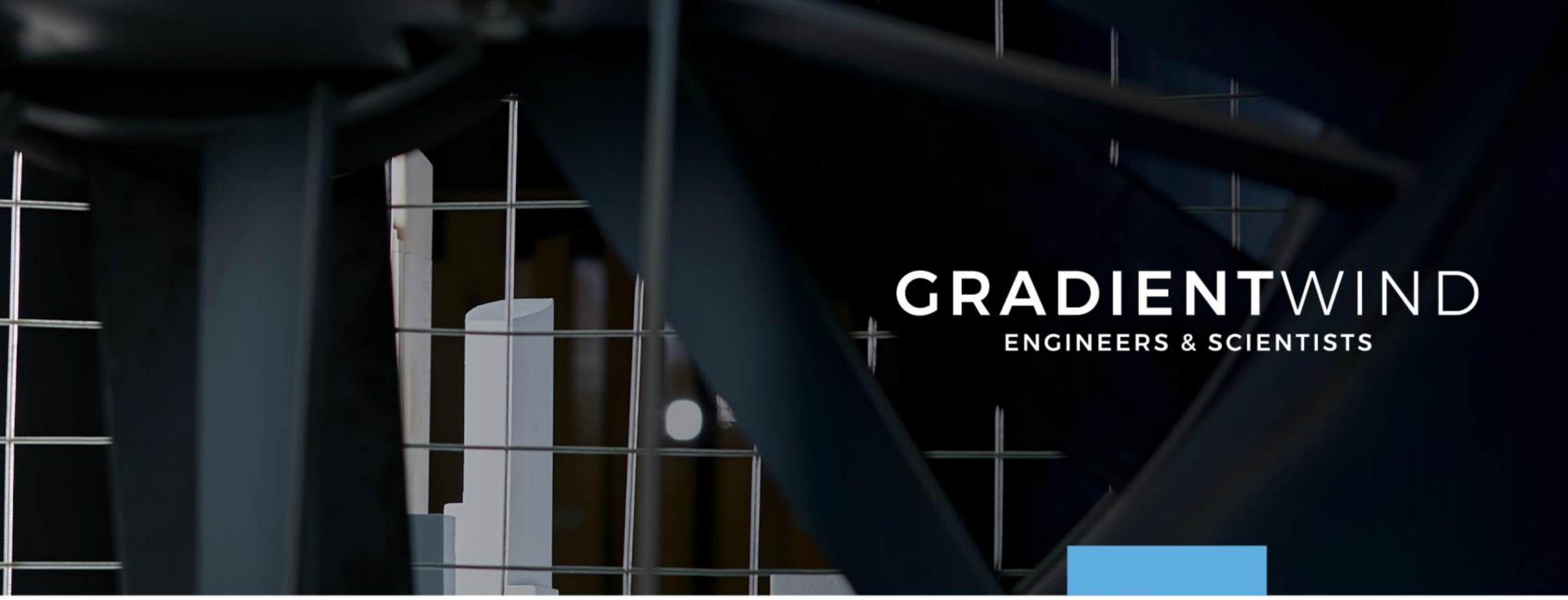
TABLE B1: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED CONDITIONS)

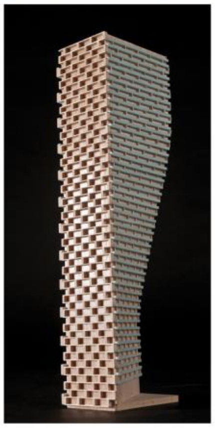
Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
1	9.8	Sitting	14.8	Standing	44.1	Safe
2	14.3	Standing	22.6	Uncomfortable	69.6	Safe
3	8.4	Sitting	12.8	Standing	42.9	Safe
4	10.1	Standing	18.0	Walking	64.6	Safe
5	11.7	Standing	16.4	Walking	62.4	Safe
6	10.9	Standing	14.0	Standing	58.1	Safe
7	11.6	Standing	15.1	Walking	51.7	Safe
8	9.4	Sitting	13.2	Standing	51.4	Safe
9	7.3	Sitting	9.5	Sitting	35.9	Safe
10	7.4	Sitting	10.6	Standing	36.1	Safe
11	8.0	Sitting	11.7	Standing	39.1	Safe
12	10.4	Standing	15.0	Standing	49.6	Safe
13	12.1	Standing	15.9	Walking	55.9	Safe
14	16.4	Walking	24.4	Uncomfortable	71.7	Safe
15	12.2	Standing	16.5	Walking	60.2	Safe
16	13.1	Standing	18.2	Walking	65.8	Safe
17	9.8	Sitting	13.0	Standing	49.8	Safe
18	13.5	Standing	19.7	Walking	59.4	Safe
19	11.1	Standing	18.6	Walking	64.6	Safe
20	10.8	Standing	15.9	Walking	70.0	Safe
21	9.3	Sitting	12.4	Standing	54.1	Safe
22	8.2	Sitting	11.9	Standing	43.5	Safe
23	10.4	Standing	14.0	Standing	56.9	Safe
24	12.7	Standing	22.0	Uncomfortable	79.1	Safe
25	10.8	Standing	15.6	Walking	55.4	Safe
26	14.4	Standing	19.4	Walking	61.7	Safe
27	12.1	Standing	20.0	Walking	67.5	Safe
28	9.9	Sitting	14.1	Standing	53.1	Safe
29	9.4	Sitting	11.7	Standing	47.1	Safe
30	13.1	Standing	17.2	Walking	62.3	Safe
31	13.5	Standing	18.1	Walking	64.0	Safe
32	10.1	Standing	15.4	Walking	66.2	Safe
33	14.6	Standing	23.8	Uncomfortable	71.8	Safe
34	14.4	Standing	20.7	Uncomfortable	67.8	Safe
35	15.7	Walking	23.3	Uncomfortable	82.9	Safe

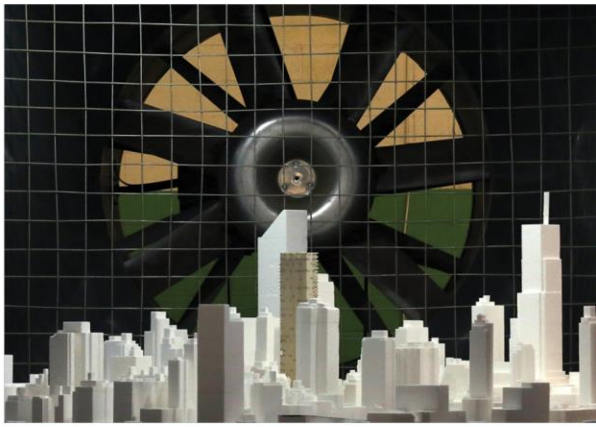
Guidelines	
Pedestrian Comfort	**20% exceedance wind speed** 0-10 km/h = Sitting, 10-15 km/h = Standing, 15-20 km/h = Walking, >20 km/h = Uncomfortable
Pedestrian Safety	**0.1% exceedance wind speed** 0-90 km/h = Safe

TABLE B2: SUMMARY OF PEDESTRIAN COMFORT (PROPOSED CONDITONS)

Sensor	Pedestrian Comfort				Pedestrian Safety	
	Summer		Winter		Annual	
	Wind Speed	Comfort Class	Wind Speed	Comfort Class	Wind Speed	Safety Class
36	14.0	Standing	21.2	Uncomfortable	67.6	Safe
37	13.6	Standing	18.6	Walking	60.3	Safe
38	7.0	Sitting	8.9	Sitting	46.5	Safe
39	12.2	Standing	15.7	Walking	63.4	Safe
40	5.3	Sitting	7.4	Sitting	29.8	Safe
41	11.0	Standing	15.7	Walking	60.8	Safe
42	13.1	Standing	16.8	Walking	78.3	Safe
43	11.9	Standing	19.4	Walking	69.0	Safe
44	10.8	Standing	17.6	Walking	60.3	Safe
45	13.7	Standing	22.1	Uncomfortable	72.1	Safe
46	9.7	Sitting	15.3	Walking	71.2	Safe
47	9.2	Sitting	15.4	Walking	58.7	Safe
48	8.5	Sitting	12.3	Standing	47.4	Safe
49	9.4	Sitting	14.1	Standing	54.2	Safe
50	14.0	Standing	19.9	Walking	63.4	Safe
51	14.0	Standing	20.7	Uncomfortable	64.3	Safe
52	19.1	Walking	27.9	Uncomfortable	84.5	Safe
53	16.9	Walking	23.6	Uncomfortable	84.2	Safe
54	10.6	Standing	14.6	Standing	60.0	Safe
55	17.0	Walking	30.8	Uncomfortable	100.5	Dangerous
56	13.6	Standing	22.2	Uncomfortable	86.2	Safe
57	11.8	Standing	16.0	Walking	54.2	Safe







APPENDIX C

WIND TUNNEL SIMULATION OF THE NATURAL WIND

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.

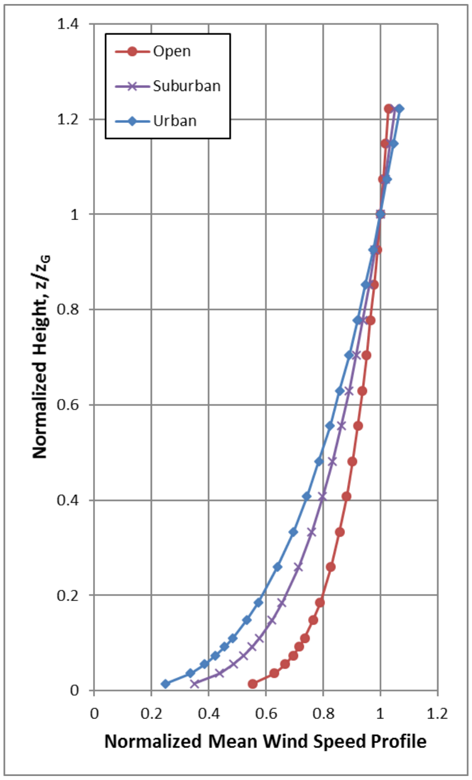
The exponent α varies according to the type of upwind terrain; α ranges from 0.14 for open country to 0.33 for an urban exposure. Figure C2 illustrates the theoretical variation of turbulence for open country, suburban and urban exposures.

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.



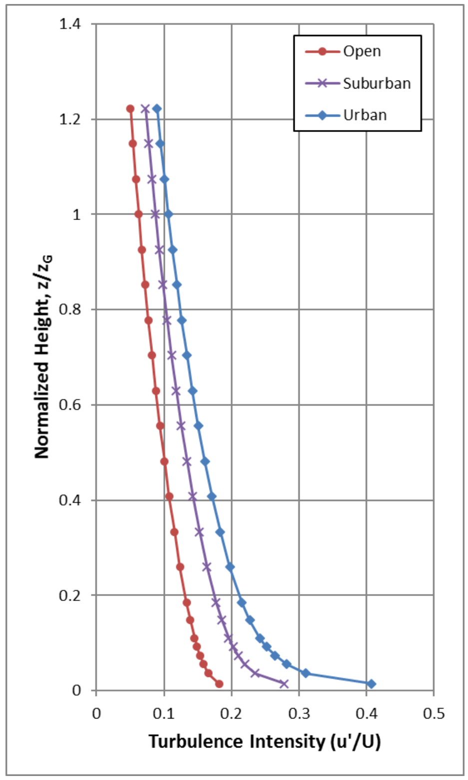


FIGURE C1 (LEFT): MEAN WIND SPEED PROFILES;
FIGURE C2 (RIGHT): TURBULENCE INTENSITY PROFILES

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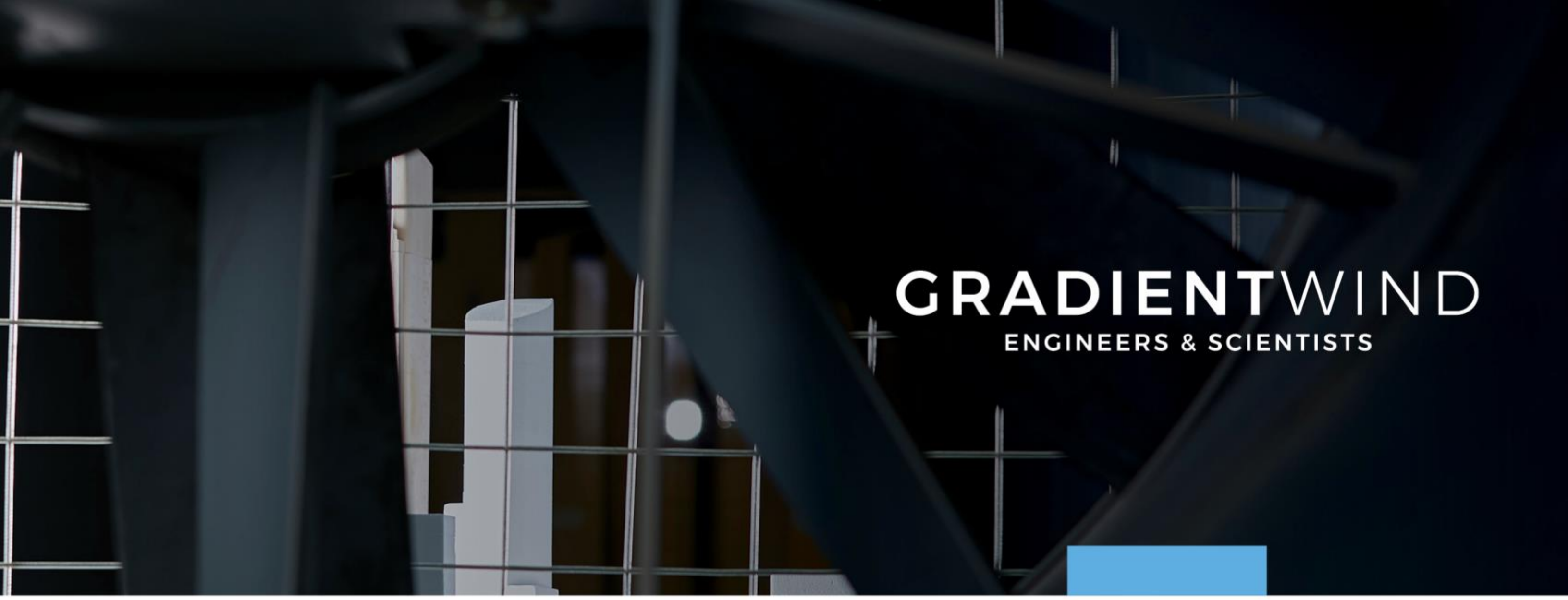

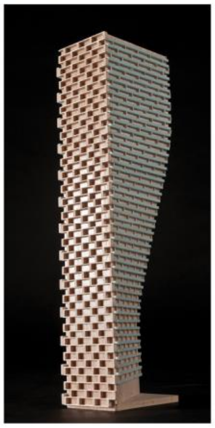

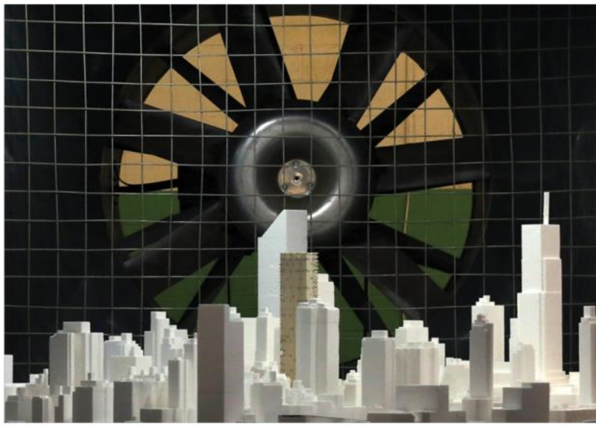

APPENDIX D

PEDESTRIAN LEVEL WIND MEASUREMENT METHODOLOGY

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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:

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

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

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.

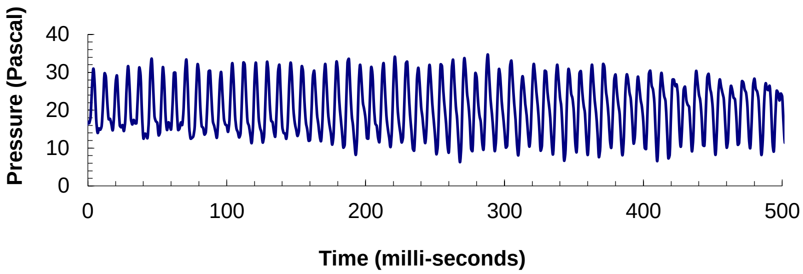

FIGURE D1: TIME VERSUS VELOCITY TRACE FOR A TYPICAL WIND SENSOR

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