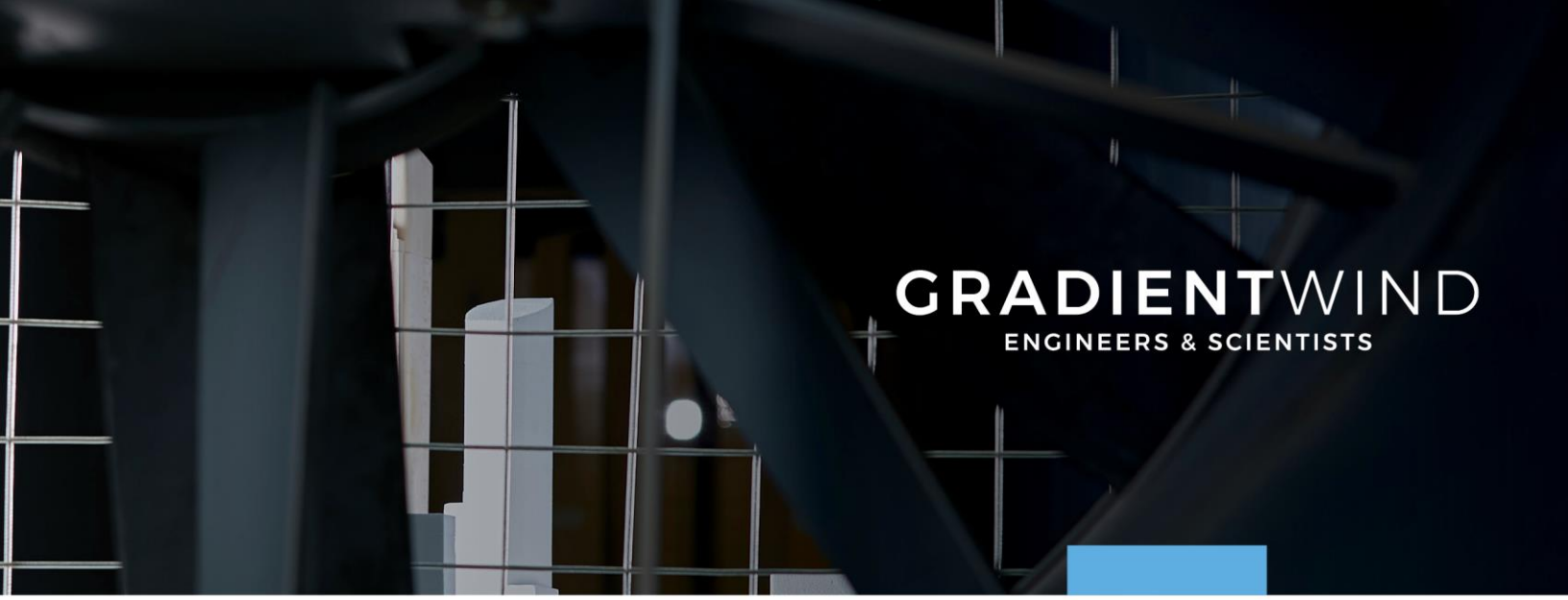
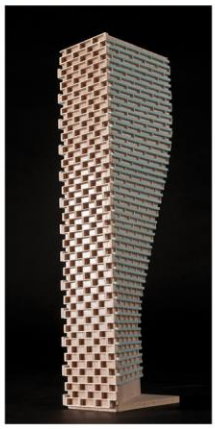


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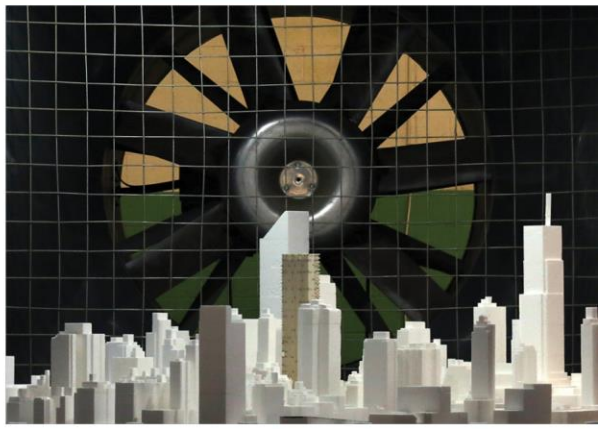
PEDESTRIAN LEVEL WIND STUDY

Jasper Tower
121 Street NW & Jasper Avenue
Edmonton, Alberta

Report: 22-163-PLW







May 19, 2023

DRAFT

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EXECUTIVE SUMMARY

This report describes a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment (ZBLA) application requirements for the proposed mixed-use residential development, referred to as "Jasper Tower", located at the southeast intersection of 121 Street NW and Jasper Avenue in Edmonton, Alberta (hereinafter referred to as the "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study involves simulation of wind speeds for sixteen (16) wind directions in a three-dimensional (3D) computer model using the computational fluid dynamics (CFD) technique, combined with meteorological data integration, to assess pedestrian wind comfort and safety within and surrounding the subject site according to City of Edmonton wind comfort and safety criteria. A complete summary of the predicted wind conditions is provided in Section 5 and illustrated in Figures 3A-5B, and is summarized as follows:

1) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, pedestrian crossing, visitor parking, bike track, nearby bus stops, existing parking lots, the promenade, and in the vicinity of building access points, are considered acceptable. One exception is described as follows:

    a. Conditions within the outdoor amenity serving the restaurant to the southwest of the proposed development are predicted to be mostly suitable for standing during the summer, as illustrated in Figure 3A. Comfort levels over the outdoor amenity may be improved by implementing landscaping features such as tall wind screens and coniferous plantings in dense arrangements and/or canopies around the area.

    b. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

2) The present study considers the potential common amenity terraces that may serve the proposed development. Wind conditions for these potential common amenity terraces are provided as a preliminary review, subject to the future Site Plan Control review. The wind conditions for the potential common amenity terraces, and recommendations regarding mitigation, where required, are described as follows:

    a. The potential common amenity terraces serving the proposed development at Level 33 and at the MPH Level were modelled with 1.8-m-tall wind screens along their full perimeters. With the noted mitigation, wind conditions within the noted potential common amenity terraces are predicted to be suitable for sitting during the summer, with a small, isolated region predicted to be suitable for standing over the MPH Level common amenity, as illustrated in Figure 5A. The noted conditions are considered acceptable.

    b. During the summer, wind conditions within the potential common amenity terrace serving the proposed development at the podium rooftop are predicted to be suitable for sitting within the majority of the terrace, with regions predicted to be suitable for stranding to the south, west, and at the northeast corner of the terrace, as illustrated in Figure 5A. To improve wind comfort conditions within the terrace, mitigation in the form of tall perimeter wind screens, typically glazed and solid, in combination with in-board wind barriers and canopies around sensitive and designated seating areas is recommended.

    c. The extent of mitigation measures is dependent on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

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

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Appendix A – Simulation of the Atmospheric Boundary Layer

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by TBD Architecture + Urban Planning to undertake a pedestrian level wind (PLW) study to satisfy Zoning By-law Amendment (ZBLA) application requirements for the proposed mixed-use residential development, referred to as "Jasper Tower", located at the southeast intersection of 121 Street NW and Jasper Avenue in Edmonton, Alberta (hereinafter referred to as the "subject site" or "proposed development"). Our mandate within this study is to investigate pedestrian wind conditions within and surrounding the subject site, and to identify areas where wind conditions may interfere with certain pedestrian activities so that mitigation measures may be considered, where required.

The study is based on industry standard computer simulations using the computational fluid dynamics (CFD) technique and data analysis procedures, architectural drawings provided by TBD Architecture + Urban Planning in April 2023, surrounding street layouts and existing and approved future building massing information obtained from the City of Edmonton, and recent site imagery.

2. TERMS OF REFERENCE

The subject site is located at the southeast intersection of 121 Street NW and Jasper Avenue in Edmonton, bordered by Jasper Avenue to the north, an existing 12-storey building known as "Jasper House" to the east, 100 Avenue NW to the south, and 121 Street NW to the west. The proposed development comprises a near rectangular 33-storey mixed-use residential tower, rising through a 2-storey podium, and topped with a mechanical penthouse (MPH).

Above below-grade parking, the ground floor of the proposed development includes main entrances at the southeast and northeast corners, commercial space to the north, a central elevator core, and a restaurant to the west and south. The restaurant is served by an outdoor amenity to the southwest of the subject site. Surface visitor parking is situated to the southeast and access to below-grade parking is provided by a ramp to the east from 100 Avenue NW. The building steps back from all elevations at Level 3, from the west elevation at Level 33, and from the south elevation at the MPH Level.

Regarding wind exposures, the near-field surroundings of the development (defined as an area falling within a 200-metre (m) radius of the subject site) are characterized by a mix of low-, mid-, and high-rise buildings from the west clockwise to the east, with most of the high-rise buildings located along Jasper Avenue, and by the open exposure of the Victoria Park from the east clockwise to the west. Notably, River Valley slopes downward form north to south by approximately 40 m to the south of the subject site. Additionally, a 32-storey building, referred to as "CNIB Redevelopment" is under construction at 12024 Jasper Avenue approximately 40 m to the northeast, and an existing 36-storey building, referred to as "The Pearl", is located at 11949 Jasper Avenue approximately 70 m to the 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 a mix of low- and mid-rise massing from the southwest clockwise to the east, with a cluster of high-rise buildings to the east, and by a mix of low-rise massing and open exposure for the remaining compass directions, with a cluster of high-rise buildings to the south. The North Saskatchewan River flows east to west approximately 600 m to the south of the subject site.

Figure 1A illustrates the subject site and surrounding context, representing the proposed future massing scenario, while Figure 1B illustrates the subject site and surrounding context, representing the existing massing scenario. Figures 2A-2H illustrate the computational models used to conduct the study.

3. OBJECTIVES

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

4. METHODOLOGY

The approach followed to quantify wind conditions over the site is based on CFD simulations of wind speeds across the subject site within a virtual environment, meteorological analysis of the Edmonton area wind climate, and synthesis of computational data with City of Edmonton wind criteria[1]. The following sections describe the analysis procedures, including a discussion of the noted pedestrian wind criteria.

[1] Edmonton, *Wind Impact Assessments Terms of Reference*, 2021 https://www.edmonton.ca/sites/default/files/public-files/assets/Wind_Impact_Assessments_TermsofReference.pdf

4.1 Computer-Based Context Modelling

A computer based PLW study was performed to determine the influence of the wind environment on pedestrian comfort over the proposed development site. Pedestrian comfort predictions, based on the mechanical effects of wind, were determined by combining measured wind speed data from CFD simulations with statistical weather data obtained from Edmonton International Airport in Edmonton, Alberta. The general concept and approach to CFD modelling is to represent building and topographic details in the immediate vicinity of the subject site on the surrounding model, and to create suitable atmospheric wind profiles at the model boundary. The wind profiles are designed to have similar mean and turbulent wind properties consistent with actual site exposures.

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

4.2 Wind Speed Measurements

The PLW analysis was performed by simulating wind flows and gathering velocity data over a CFD model of the subject site for 16 wind directions. The CFD simulation model was centered on the proposed development, complete with surrounding massing within a radius of 480 m. The process was performed for two context massing scenarios, as noted in section 2.

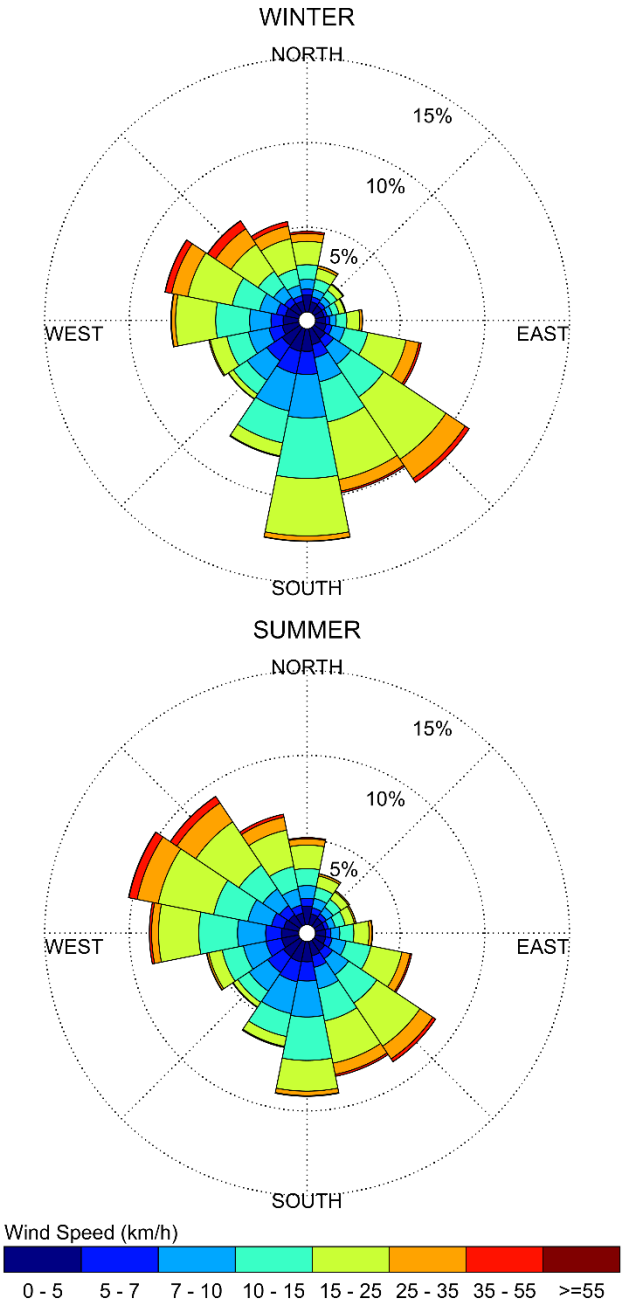
Mean and peak wind speed data obtained over the subject site for each wind direction were interpolated to 36 wind directions at 10° intervals, representing the full compass azimuth. Measured wind speeds approximately 1.5 m above local grade and the common amenity terraces serving the proposed development were referenced to the wind speed at gradient height to generate mean and peak velocity ratios, which were used to calculate full-scale values. Gradient height represents the theoretical depth of the boundary layer of the earth's atmosphere, above which the mean wind speed remains constant. Further details of the wind flow simulation technique are presented in Appendix A.

4.3 Historical Wind Speed and Direction Data

A statistical model for winds in Edmonton was developed from approximately 40 years of hourly meteorological wind data recorded at Edmonton International Airport and obtained from Environment and Climate Change Canada. Wind speed and direction data were analyzed during the appropriate hours of pedestrian usage (that is, between 06:00 and 23:00) and divided into two distinct seasons, as stipulated in the wind criteria. Specifically, the summer season is defined as May through October and the winter season is defined as November through April, inclusive.

The statistical model of the Edmonton area wind climate, which indicates the directional character of local winds on a seasonal basis, is illustrated on the following page. The plots illustrate seasonal distribution of measured wind speeds and directions in kilometers per hour (km/h). Probabilities of occurrence of different wind speeds are represented as stacked polar bars in sixteen azimuth divisions. The radial direction represents the percentage of time for various wind speed ranges per wind direction during the measurement period. The prominent winds can be identified by the longer length of the bars. For Edmonton, the most common winds occur for southeasterly and northwesterly wind directions, while the most common wind speeds are below 25 km/h. The directional prominence and relative magnitude of wind speed changes somewhat from season to season.

SEASONAL DISTRIBUTION OF WIND
EDMONTON INTERNATIONAL AIRPORT, EDMONTON, ALBERTA



Notes:

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

4.4 Pedestrian Wind Comfort and Safety Criteria – City of Edmonton

Pedestrian wind comfort and safety criteria are based on the mechanical effects of wind without consideration of other meteorological conditions (that is, temperature and relative humidity). The comfort criteria assume that pedestrians are appropriately dressed for a specified outdoor activity during any given season. Since both mean and gust wind speeds affect pedestrian comfort, their combined effect is defined in the City of Edmonton Wind Impact Assessments Terms of Reference. 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 gust wind speed ranges are used to assess pedestrian comfort: (1) Sitting; (2) Standing; (3) Walking; and (4) Uncomfortable. Specifically, the comfort classes, associated wind speed ranges, and limiting criteria are summarized as follows:

1) **Sitting:** GEM wind speeds no greater than 10 km/h in the summer and 8 km/h in the winter occurring at least 80% of the time would be considered acceptable for sedentary activities, including sitting.

2) **Standing:** GEM wind speeds no greater than 15 km/h in the summer and 12 km/h in the winter occurring at least 80% of the time are acceptable for activities such as standing, strolling or more vigorous activities.

3) **Walking:** GEM wind speeds no greater than 20 km/h in the summer and 16 km/h in the winter occurring at least 80% of the time are acceptable for walking or more vigorous activities.

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

Regarding wind safety, gust wind speeds greater than 90 km/h, occurring more than 0.1% of the time on an annual basis (based on wind events recorded for 24 hours a day), 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 an average elderly person in good health to fall.

THE BEAUFORT SCALE

Number	Description	Gust Wind Speed (km/h)	Description
2	Light Breeze	9-17	Wind felt on faces
3	Gentle Breeze	18-29	Leaves and small twigs in constant motion; wind extends light flags
4	Moderate Breeze	30-42	Wind raises dust and loose paper; small branches are moved
5	Fresh Breeze	43-57	Small trees in leaf begin to sway
6	Strong Breeze	58-74	Large branches in motion; Whistling heard in electrical wires; umbrellas used with difficulty
7	Moderate Gale	75-92	Whole trees in motion; inconvenient walking against wind
8	Gale	93-111	Breaks twigs off trees; generally impedes progress

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 GEM wind speeds of 10 km/h during the summer season were exceeded for more than 20% of the time most pedestrians would judge that location to be too windy for sitting. Similarly, if GEM wind speeds of 20 km/h at a location were exceeded for more than 20% of the time during the summer, walking or less vigorous activities would be considered uncomfortable. As these criteria are based on subjective reactions of a population to wind forces, their application is partly based on experience and judgment.

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

DESIRED PEDESTRIAN COMFORT CLASSES FOR VARIOUS LOCATION TYPES

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

5. RESULTS AND DISCUSSION

The following discussion of the predicted pedestrian wind conditions for the subject site is accompanied by Figures 3A-4B, which illustrate wind conditions at grade level for the proposed and existing massing scenarios, and by Figures 5A and 5B, which illustrate wind conditions over the common amenity terraces serving the proposed development. Conditions are presented as continuous contours of wind comfort within and surrounding the subject site and correspond to the various comfort classes noted in Section 4.4. Wind conditions suitable for sitting are represented by the colour blue, standing by green, and walking by yellow; uncomfortable conditions are represented by the colour orange, consistent with the City of Edmonton Terms of Reference. The details of these conditions are summarized in the following pages for each area of interest.

5.1 Wind Comfort Conditions – Grade Level

Sidewalks and Bus Stops Along Jasper Avenue: Following the introduction of the proposed development, conditions over the public sidewalks along Jasper Avenue are predicted to be mostly suitable for sitting during the summer, with regions predicted to be suitable for standing near the northeast and northwest corners of the building, becoming mostly suitable for standing during the winter. The noted conditions are considered acceptable.

Conditions over the sidewalks along Jasper Avenue with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Prior to the introduction of the proposed development, conditions over the existing sheltered bus stop to the immediate north of the subject site are predicted to be suitable for sitting throughout the year. The noted existing bus stop will be relocated approximately 5 m to the northeast, where conditions are predicted to be mostly suitable for sitting during the summer, becoming suitable for standing during the winter following the introduction of the proposed development. The noted conditions are considered acceptable.

Following the introduction of the proposed development, conditions over the bus stop to the north of Jasper Avenue are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the winter. The noted conditions are considered acceptable.

Conditions over the bus stop to the north of Jasper Avenue with the existing massing are predicted to be suitable for sitting throughout the year. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Walkways, Pedestrian Crossing, and Visitor Parking Along East Elevation: Conditions over the proposed walkways, pedestrian crossing, and visitor surface parking along the east elevation of the proposed development are predicted to be suitable for a mix of sitting and standing during the summer, becoming

suitable for standing during the winter, with a small, isolated region predicted to be suitable for walking near the northwest corner of the ramp. The noted conditions are considered acceptable.

Sidewalks and Bike Track Along 100 Avenue NW: Following the introduction of the proposed development, wind conditions over the public sidewalks and bike track along 100 Avenue NW are predicted to be suitable for a mix of sitting and standing during the summer, becoming suitable for standing during the winter, with a region predicted to be suitable for walking near the southwest corner of the proposed development. The noted conditions are considered acceptable.

Conditions over the public sidewalks and bike track along 100 Avenue NW with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing during the winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Sidewalks and Bike Track Along 121 Street NW: Following the introduction of the proposed development, conditions over the public sidewalks and bike track along 121 Street NW are predicted to be mostly suitable for standing during the summer, becoming suitable for walking, or better, during the winter. The noted conditions are considered acceptable.

Conditions over the public sidewalks and bike track along 121 Street NW with the existing massing are predicted to be suitable for sitting during the summer, becoming suitable for standing during the winter. While the introduction of the proposed development produces windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Existing Parking Lot East of Subject Site: Following the introduction of the proposed development, conditions over the existing parking lot serving the Jasper House to the east are predicted to be suitable for sitting throughout the year, with a region predicted to be suitable for standing to the north of the parking lot during the winter. The noted conditions are considered acceptable.

Conditions over the existing parking lot serving the Jasper House to the east with the existing massing are predicted to be suitable for sitting throughout the year. While the introduction of the proposed development produces slightly windier conditions in comparison to existing conditions, wind comfort conditions are considered acceptable.

Existing Parking Lot Southwest of Subject Site: For both massing scenarios, conditions over the existing parking lot to the southwest of the subject site are predicted to be suitable for sitting during the summer, becoming suitable for standing, or better, during the winter. The noted conditions are considered acceptable.

Outdoor Amenity: Conditions within the outdoor amenity serving the restaurant to the southwest of the proposed development are predicted to be mostly suitable for standing during the summer, as illustrated in Figure 3A. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 65% of the time during the summer, where the target is 80% to achieve the sitting comfort criterion.

Comfort levels over the outdoor amenity may be improved by implementing landscaping features such as tall wind screens and coniferous plantings in dense arrangements and/or canopies around the area. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

The Promenade South of Subject Site: Following the introduction of the proposed development, most of the seating areas along the promenade to the south of the subject site are predicted to be suitable for sitting during the summer, with some regions predicted to be suitable for standing, as illustrated in Figure 3A. The areas that are predicted to be suitable for standing are also predicted to be suitable for sitting for at least 77% of the time during the summer, where the target is 80% to achieve the sitting comfort criterion. Since most of the seating areas along the promenade are predicted to experience calm conditions during the summer, and since the regions predicted to be suitable for standing are close to achieve the sitting comfort class during the same season, wind comfort conditions are considered acceptable.

Building Access: Conditions in the vicinity of all building access points serving the proposed development are predicted to be suitable for sitting throughout the year. The only exception is the secondary building access point to the west of the proposed development, where conditions are predicted to be suitable for a mix of sitting and standing during the winter. The noted conditions are considered acceptable.

5.2 Wind Comfort Conditions – Potential Common Amenity Terraces

The 2-storey podium rooftop, as well as the Level 33 and the MPH Level terraces, were considered as common amenity terraces. Wind conditions for these potential amenity terraces are provided as a preliminary review, subject to the future Site Plan Control review. The wind conditions for the noted potential common amenity terraces are described as follows:

Podium Rooftop Common Amenity Terrace: During the summer, wind conditions within the potential common amenity terrace serving the proposed development at the podium rooftop are predicted to be suitable for sitting within the majority of the terrace, with regions predicted to be suitable for stranding to the south, west, and at the northeast corner of the terrace, as illustrated in Figure 5A.

To improve wind comfort conditions within the terrace, mitigation in the form of tall perimeter wind screens, typically glazed and solid, in combination with in-board wind barriers and canopies around sensitive and designated seating areas is recommended.

The extent of mitigation measures is dependent on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

Level 33 and MPH Level Common Amenity Terraces: The potential common amenity terraces serving the proposed development at Level 33 and at the MPH Level were modelled with 1.8-m-tall wind screens along their full perimeters.

With the noted mitigation, wind conditions within the noted potential common amenity terraces are predicted to be suitable for sitting during the summer, with a small, isolated region predicted to be suitable for standing over the MPH Level common amenity, as illustrated in Figure 5A. The noted conditions are considered acceptable.

5.3 Wind Safety

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

5.4 Applicability of Results

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

Regarding primary and secondary building access points, wind conditions predicted in this study are only applicable to pedestrian comfort and safety. As such, the results should not be construed to indicate wind loading on doors and associated hardware.

6. SUMMARY AND RECOMMENDATIONS

A complete summary of the predicted wind conditions is provided in Section 5 of this report and illustrated in Figures 3A-5B. Based on computer simulations using the CFD technique, meteorological data analysis, and experience with numerous similar developments, the study concludes the following:

1) All grade-level areas within and surrounding the subject site are predicted to experience conditions that are considered acceptable for the intended pedestrian uses throughout the year. Specifically, conditions over surrounding sidewalks, walkways, pedestrian crossing, visitor parking, bike track, nearby bus stops, existing parking lots, the promenade, and in the vicinity of building access points, are considered acceptable. One exception is described as follows:

    a. Conditions within the outdoor amenity serving the restaurant to the southwest of the proposed development are predicted to be mostly suitable for standing during the summer, as illustrated in Figure 3A. Comfort levels over the outdoor amenity may be

improved by implementing landscaping features such as tall wind screens and coniferous plantings in dense arrangements and/or canopies around the area.

b. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

2) The present study considers the potential common amenity terraces that may serve the proposed development. Wind conditions for these potential common amenity terraces are provided as a preliminary review, subject to the future Site Plan Control review. The wind conditions for the potential common amenity terraces, and recommendations regarding mitigation, where required, are described as follows:

a. The potential common amenity terraces serving the proposed development at Level 33 and at the MPH Level were modelled with 1.8-m-tall wind screens along their full perimeters. With the noted mitigation, wind conditions within the noted potential common amenity terraces are predicted to be suitable for sitting during the summer, with a small, isolated region predicted to be suitable for standing over the MPH Level common amenity, as illustrated in Figure 5A. The noted conditions are considered acceptable.

b. During the summer, wind conditions within the potential common amenity terrace serving the proposed development at the podium rooftop are predicted to be suitable for sitting within the majority of the terrace, with regions predicted to be suitable for stranding to the south, west, and at the northeast corner of the terrace, as illustrated in Figure 5A. To improve wind comfort conditions within the terrace, mitigation in the form of tall perimeter wind screens, typically glazed and solid, in combination with in-board wind barriers and canopies around sensitive and designated seating areas is recommended.

c. The extent of mitigation measures is dependent on the programming of the terrace. An appropriate mitigation strategy will be developed in collaboration with the building and landscape architects. This work is expected to support the future Site Plan Control application submission.

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

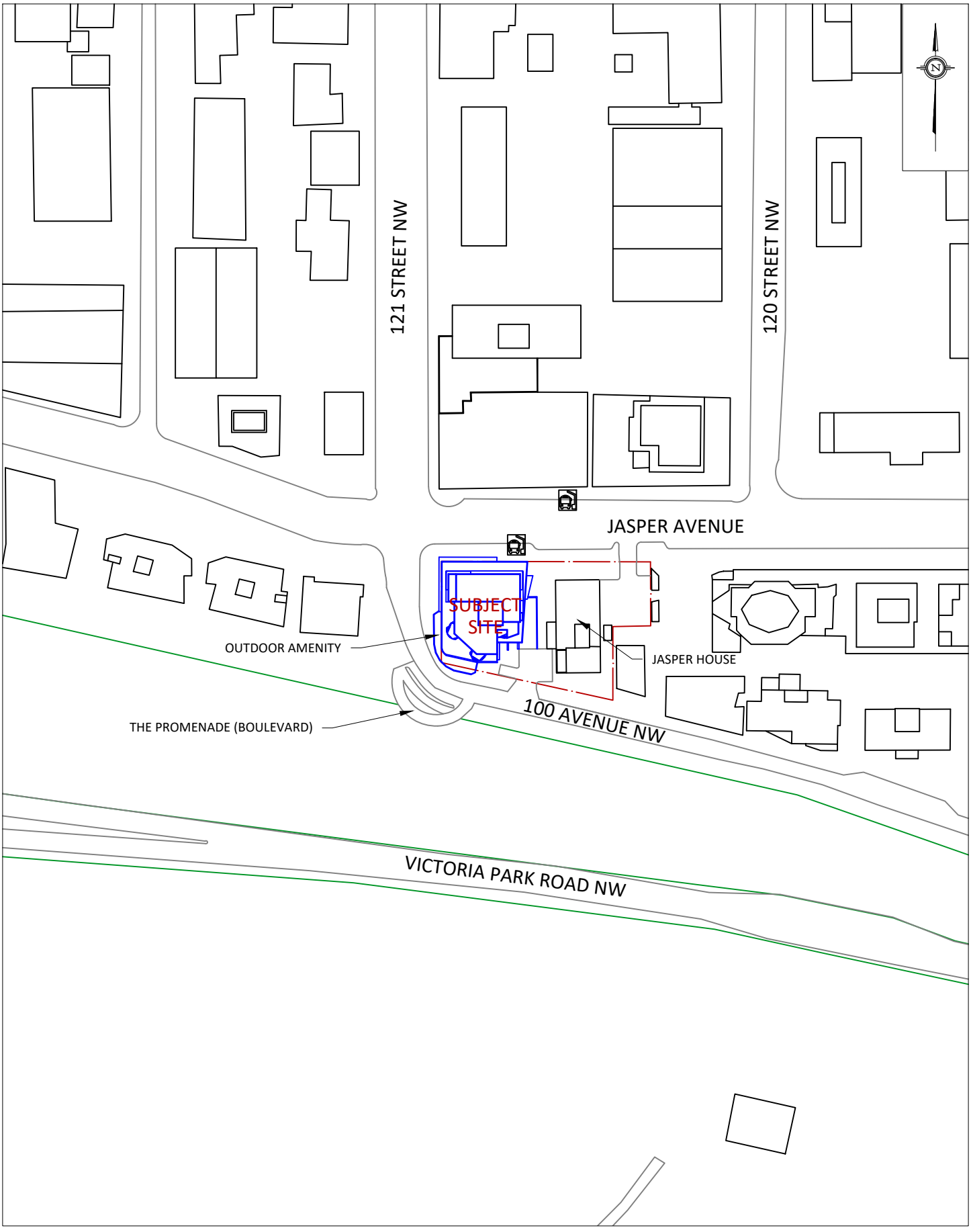
Sincerely,

Gradient Wind Engineering Inc.

DRAFT

Daniel Davalos, MESc.
Junior Wind Scientist

Justin Ferraro, P.Eng.
Principal



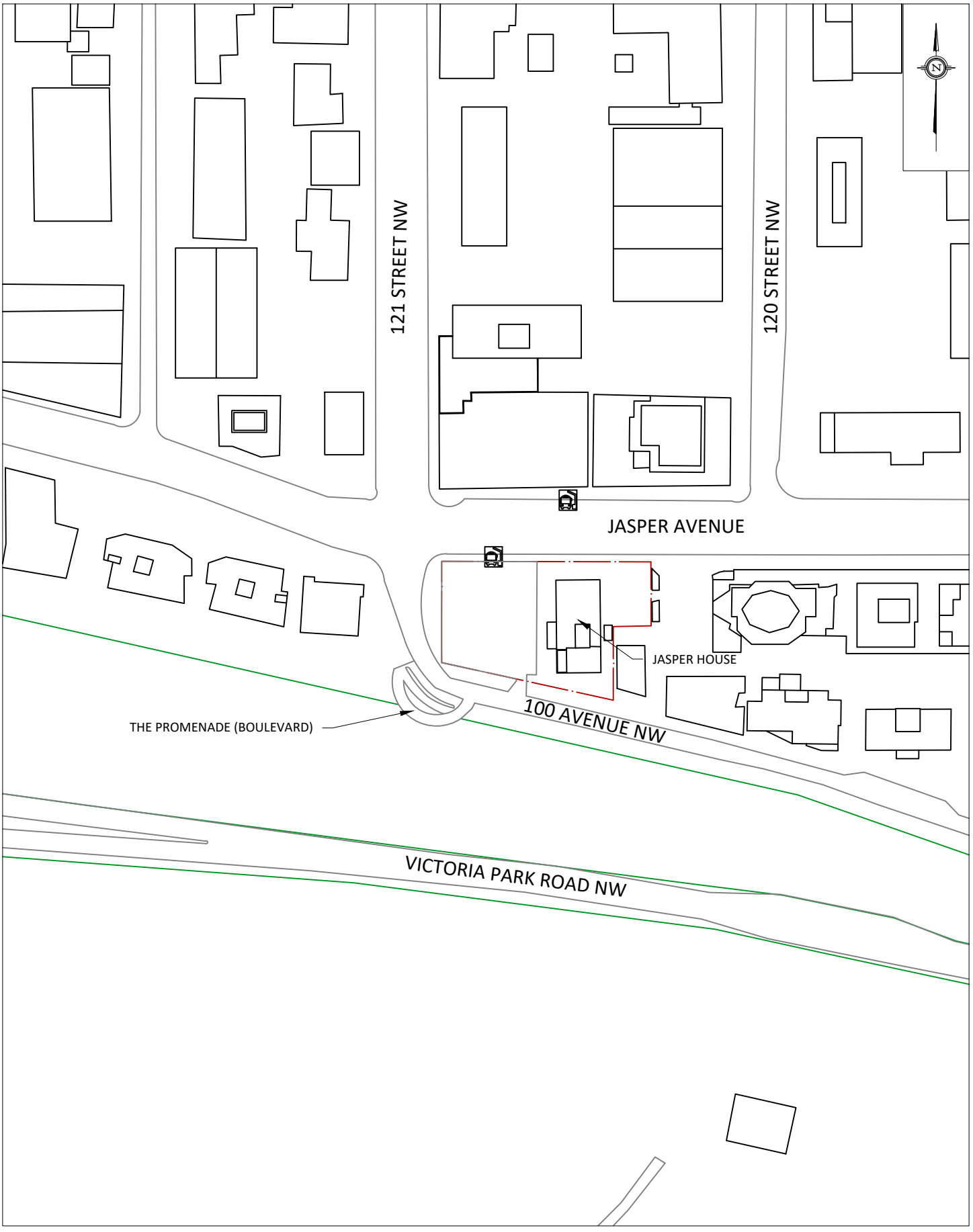
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PROJECT	JASPER TOWER, EDMONTON PEDESTRIAN LEVEL WIND STUDY		
SCALE	1:2000	DRAWING NO.	22-163-PLW-1A
DATE	MAY 18, 2023	DRAWN BY	A.K.

DESCRIPTION

FIGURE 1A:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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SCALE	1:2000
DRAWING NO.	22-163-PLW-1B
DATE	MAY 18, 2023
DRAWN BY	A.K.

DESCRIPTION

FIGURE 1B:
EXISTING SITE PLAN AND SURROUNDING CONTEXT

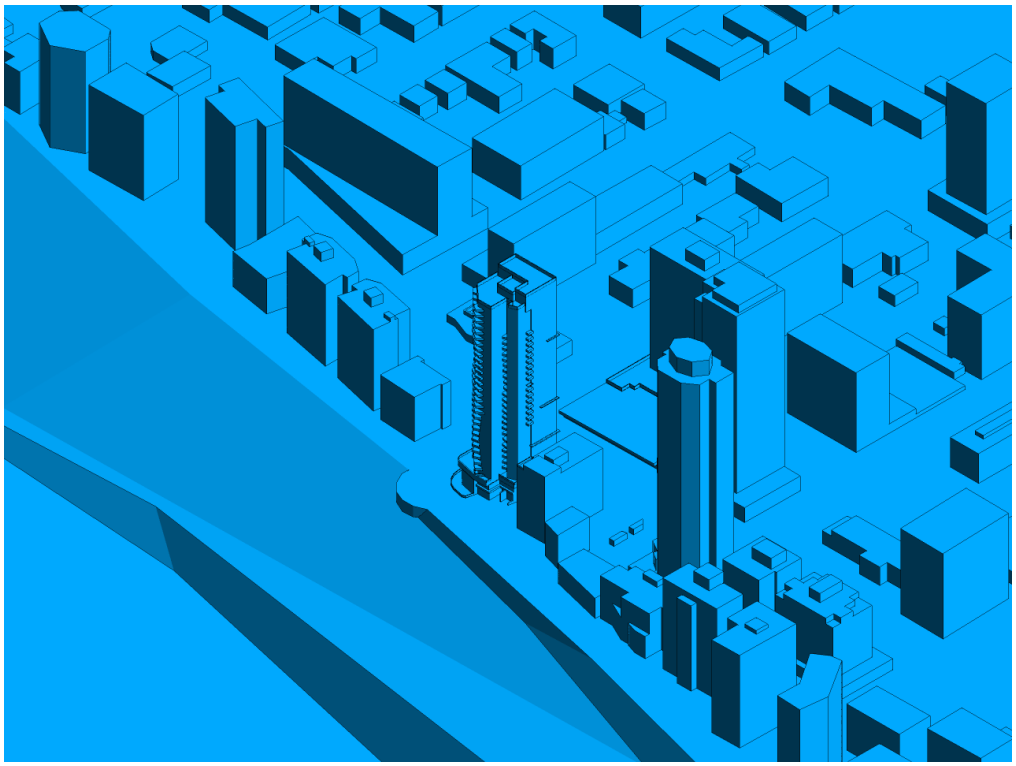


FIGURE 2A: COMPUTATIONAL MODEL, PROPOSED MASSING, SOUTHEAST PERSPECTIVE

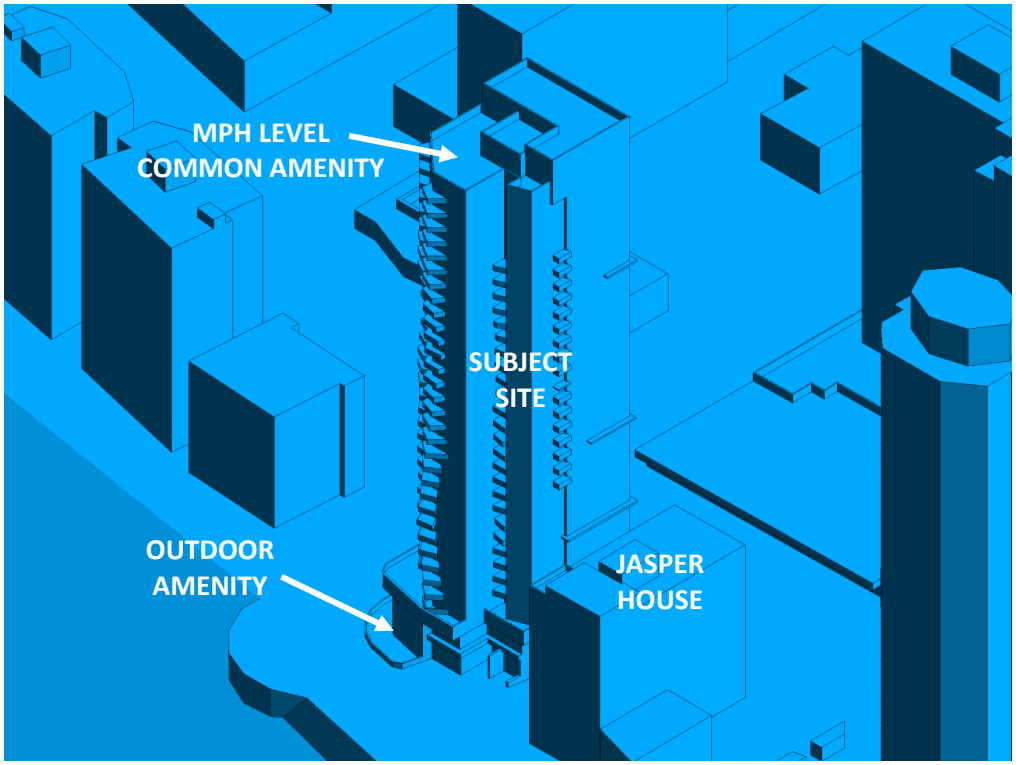


FIGURE 2B: CLOSE-UP VIEW OF FIGURE 2A

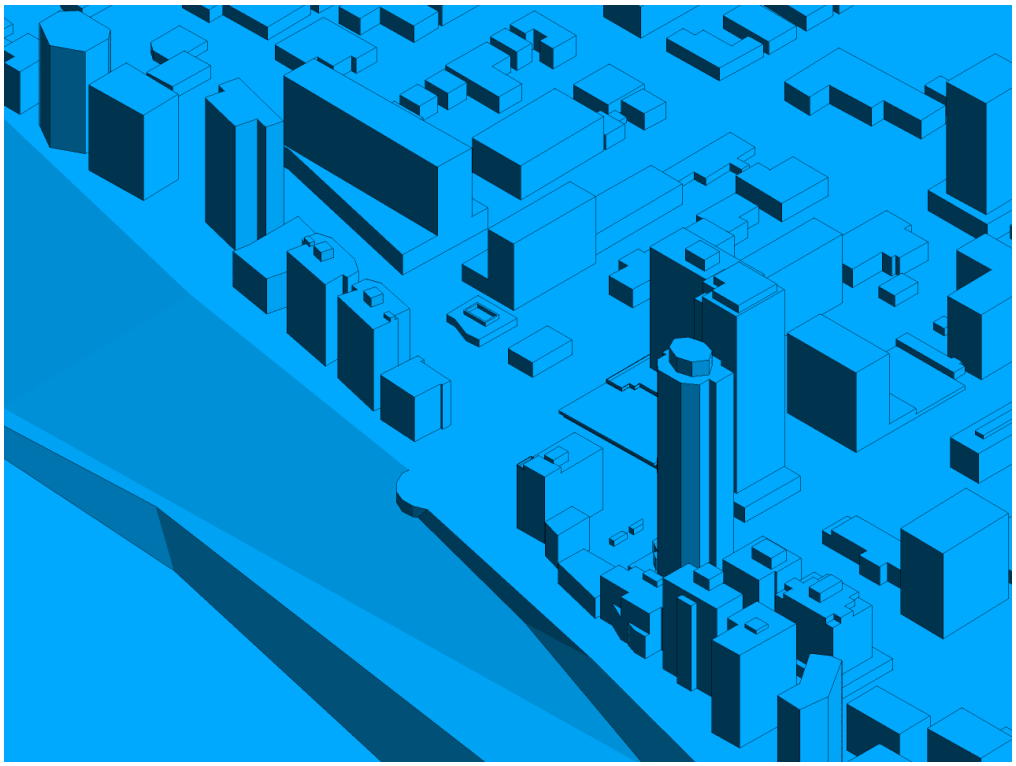


FIGURE 2C: COMPUTATIONAL MODEL, EXISTING MASSING, SOUTHEAST PERSPECTIVE

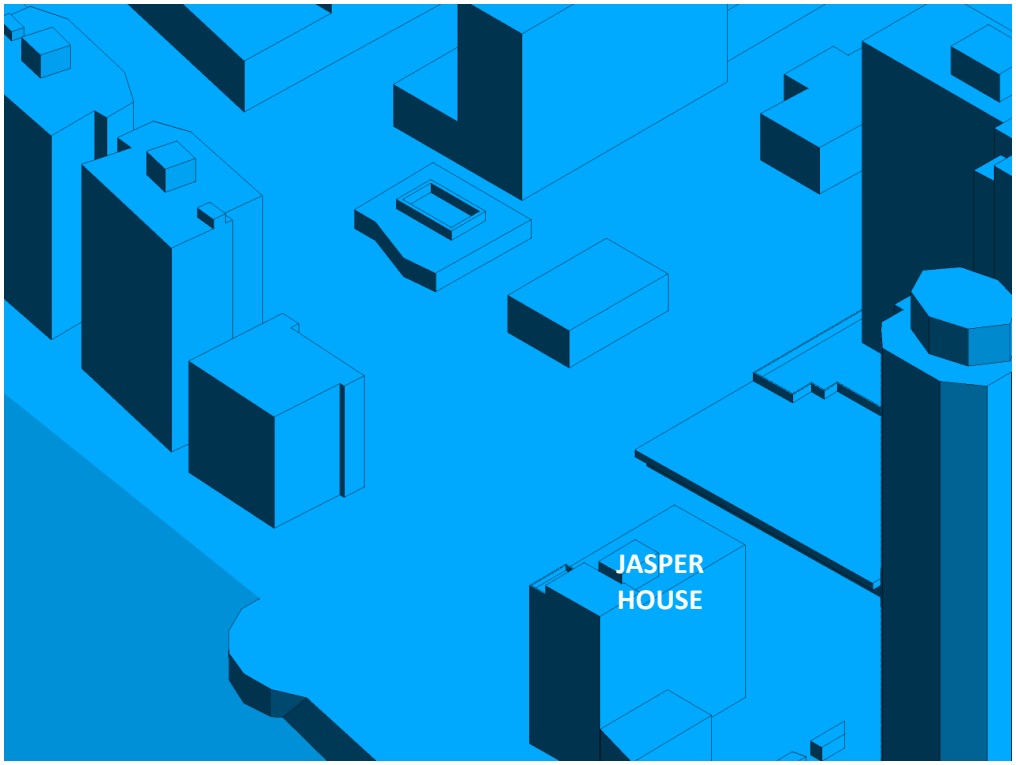


FIGURE 2D: CLOSE-UP VIEW OF FIGURE 2C

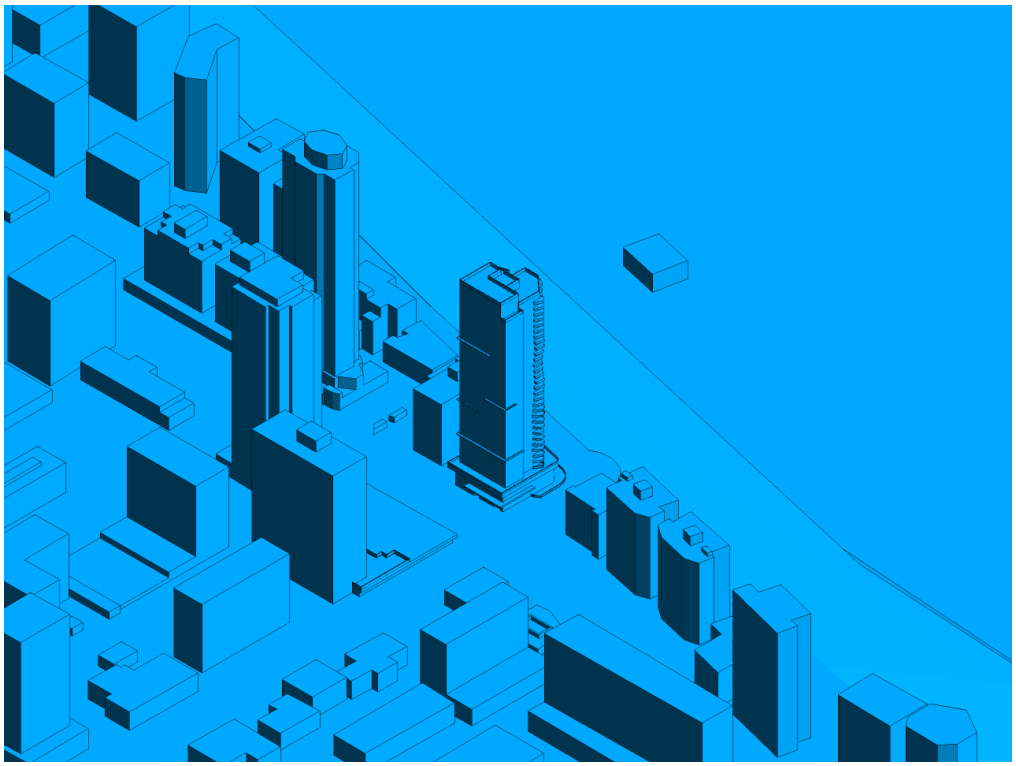


FIGURE 2E: COMPUTATIONAL MODEL, PROPOSED MASSING, NORTHWEST PERSPECTIVE

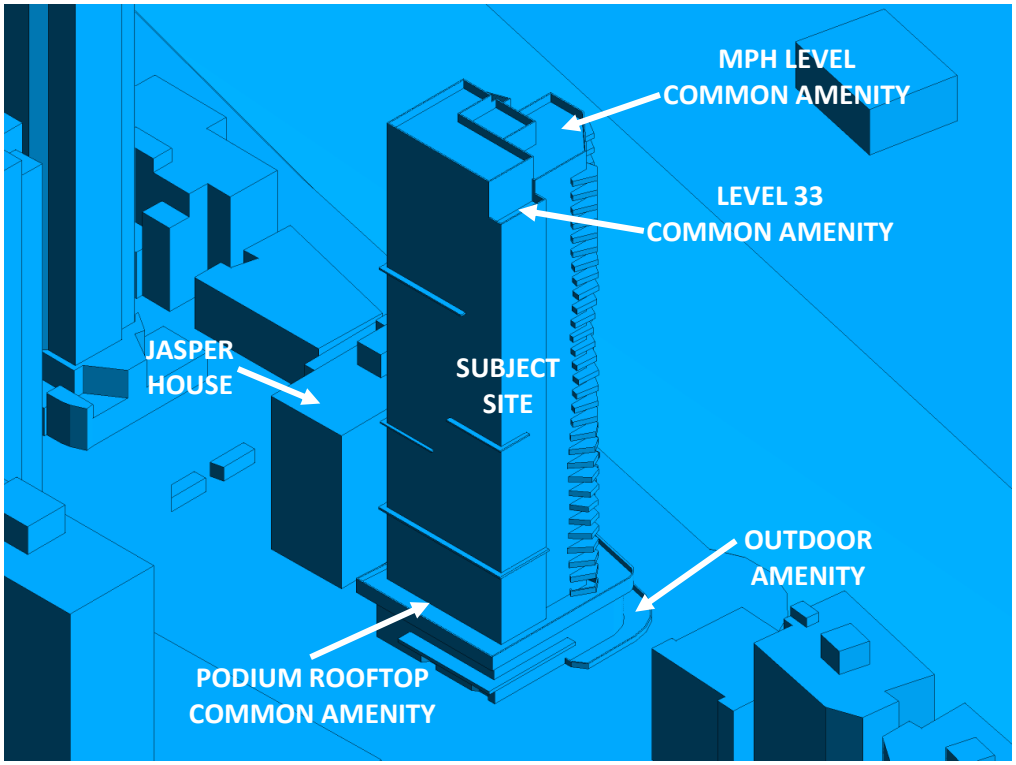


FIGURE 2F: CLOSE-UP VIEW OF FIGURE 2E

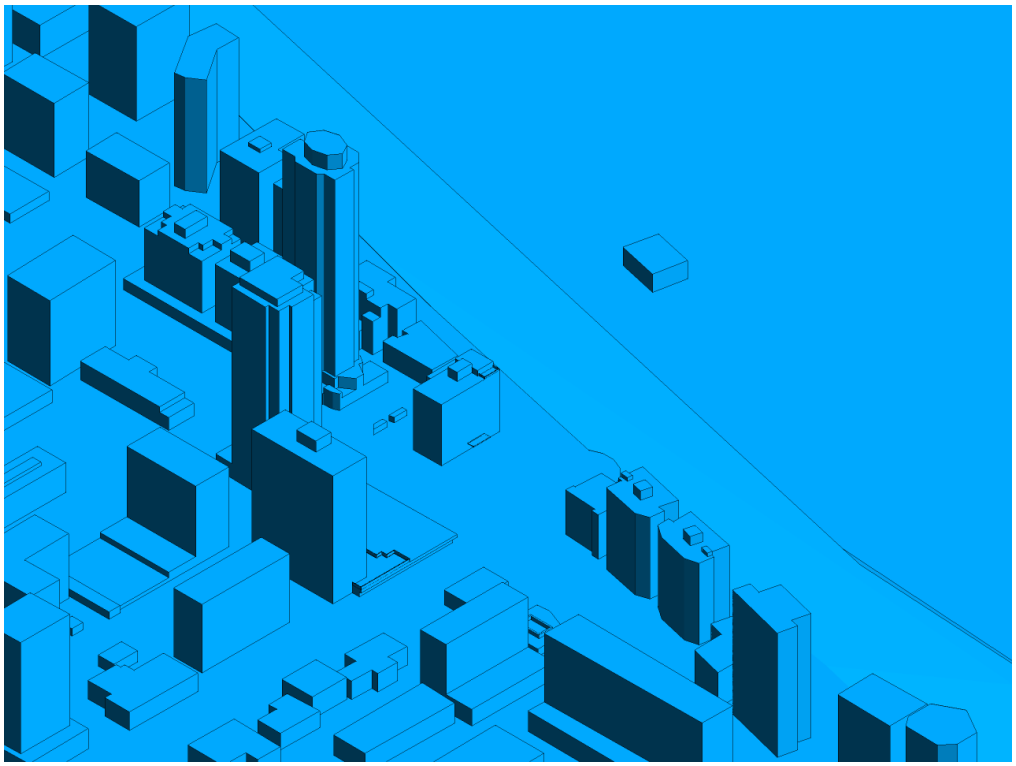


FIGURE 2G: COMPUTATIONAL MODEL, EXISTING MASSING, NORTHWEST PERSPECTIVE

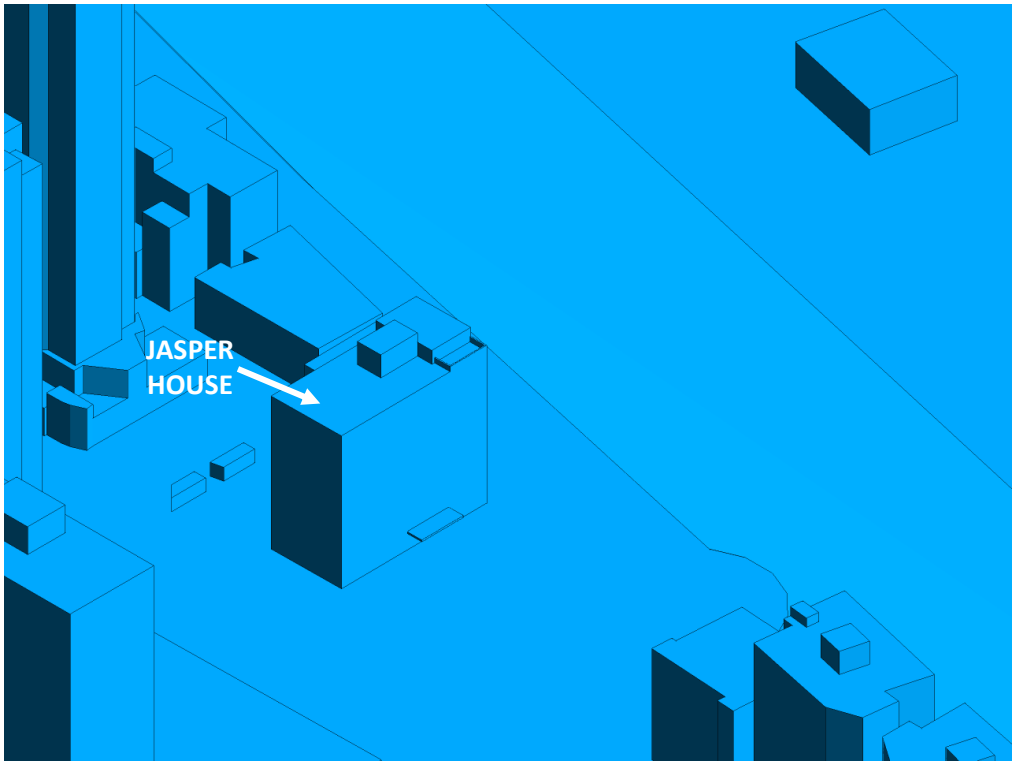


FIGURE 2H: CLOSE-UP VIEW OF FIGURE 2G

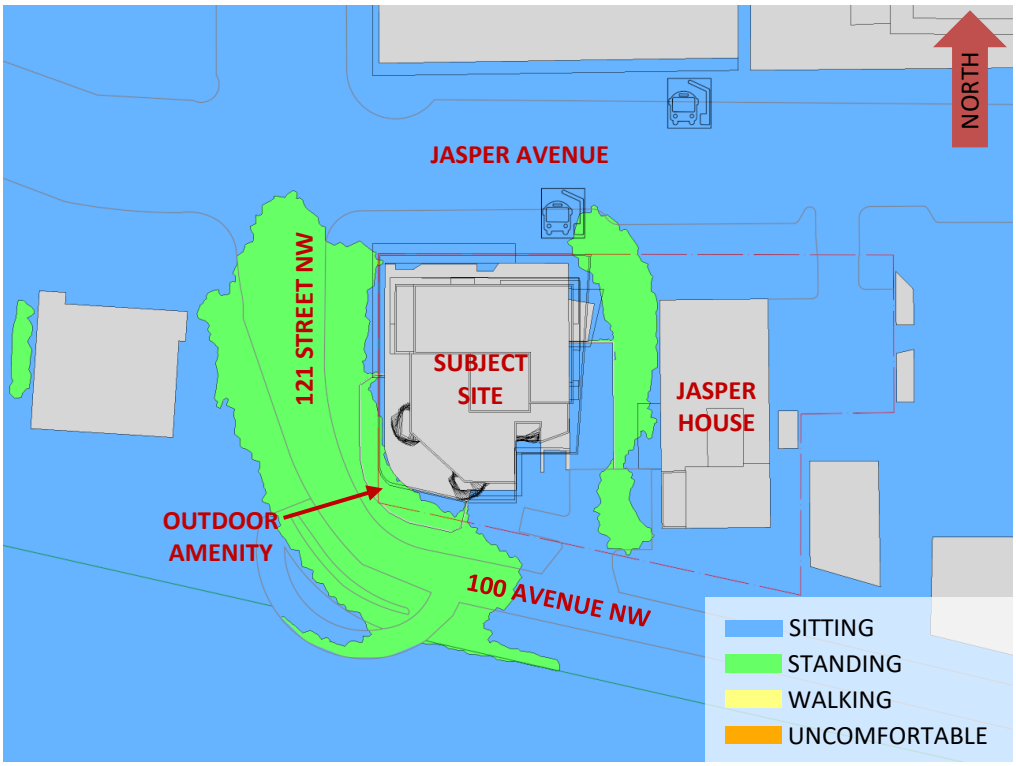


FIGURE 3A: SUMMER – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

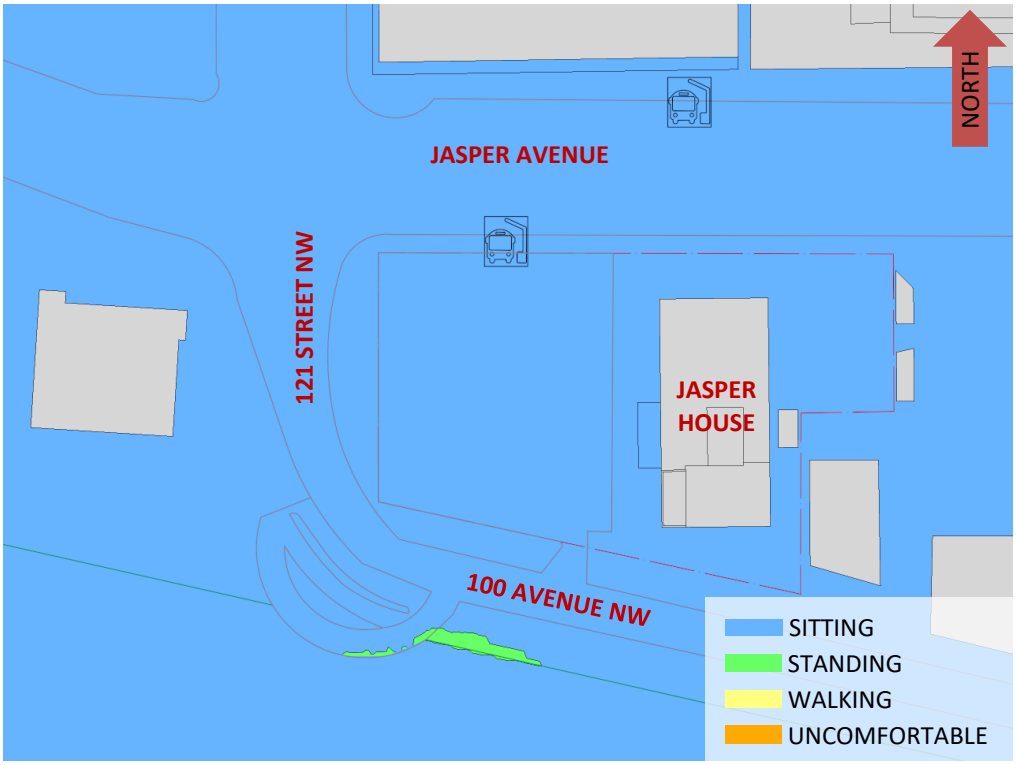


FIGURE 3B: SUMMER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

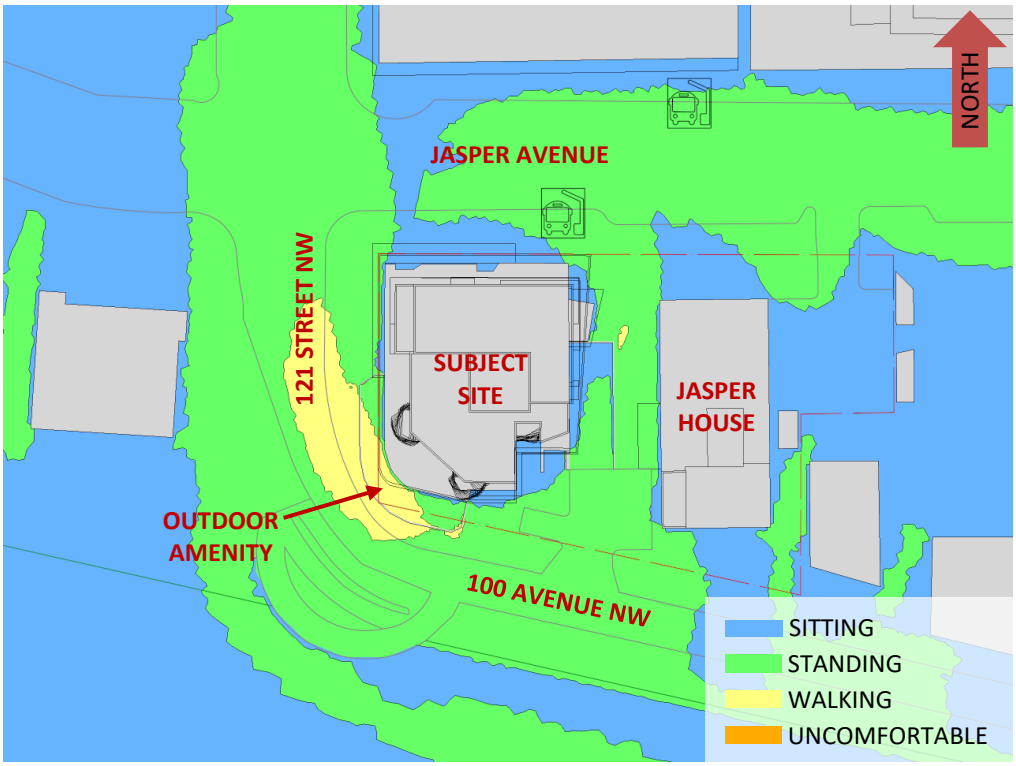


FIGURE 4A: WINTER – PROPOSED MASSING – WIND COMFORT, GRADE LEVEL

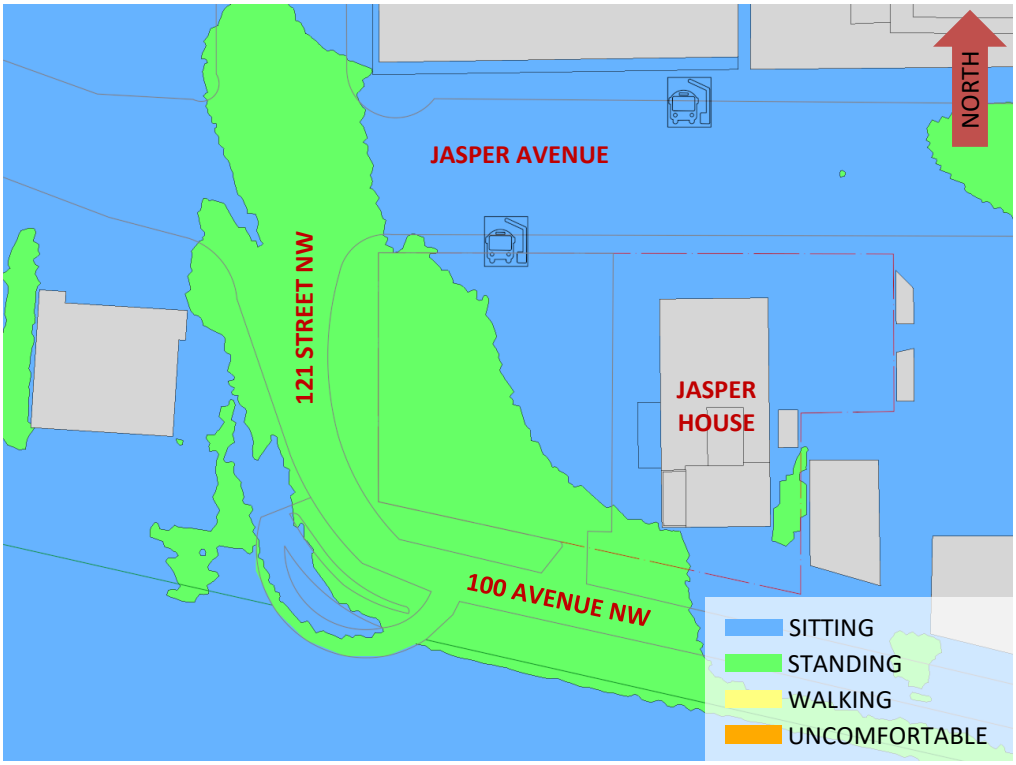


FIGURE 4B: WINTER – EXISTING MASSING – WIND COMFORT, GRADE LEVEL

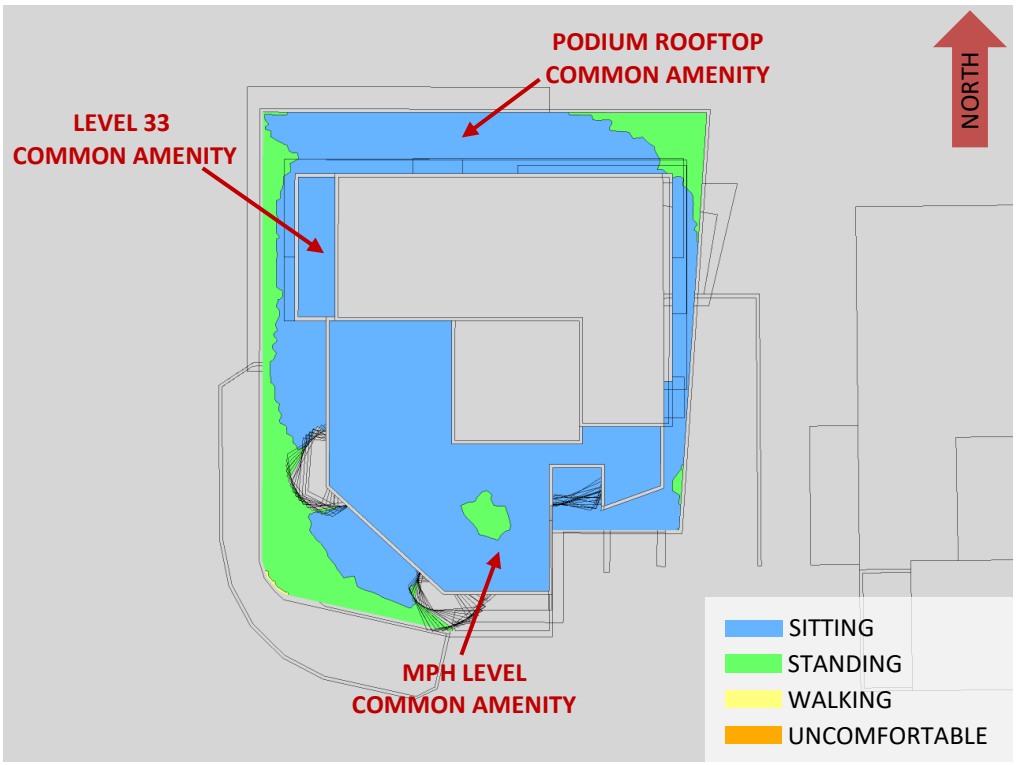


FIGURE 5A: SUMMER – WIND COMFORT, POTENTIAL COMMON AMENITY TERRACES

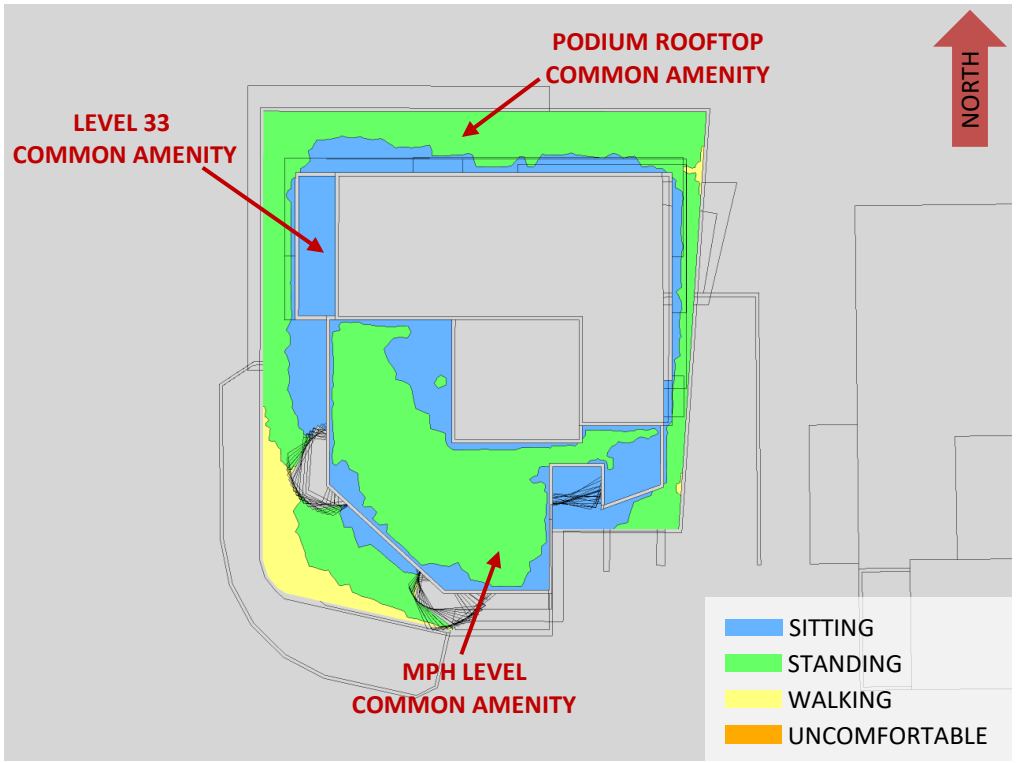


FIGURE 5B: WINTER – WIND COMFORT, POTENTIAL COMMON AMENITY TERRACES



APPENDIX A

SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

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SIMULATION OF THE ATMOSPHERIC BOUNDARY LAYER

The atmospheric boundary layer (ABL) is defined by the velocity and turbulence profiles according to industry standard practices. The mean wind profile can be represented, to a good approximation, by a power law relation, Equation (1), giving height above ground versus wind speed [1], [2].

$$U = U_g \left(\frac{Z}{Z_g}\right)^{\alpha} \qquad \text{Equation (1)}$$

where, $\boldsymbol{U}$ = mean wind speed, $\boldsymbol{U_g}$ = gradient wind speed, $\boldsymbol{Z}$ = height above ground, $\boldsymbol{Z_g}$ = depth of the boundary layer (gradient height), and α is the power law exponent.

For the model, U_g is set to 6.5 metres per second (m/s), which approximately corresponds to the 60% mean wind speed for Edmonton based on historical climate data and statistical analyses. When the results are normalized by this velocity, they are relatively insensitive to the selection of gradient wind speed.

Z_g is set to 540 m. The selection of gradient height is relatively unimportant, so long as it exceeds the building heights surrounding the subject site. The value has been selected to correspond to our physical wind tunnel reference value.

α is determined based on the upstream exposure of the far-field surroundings (that is, the area that is not captured within the simulation model).

Table 1 presents the values of α used in this study, while Table 2 presents several reference values of α. When the upstream exposure of the far-field surroundings is a mixture of multiple types of terrain, the α values are a weighted average with terrain that is closer to the subject site given greater weight.

TABLE 1: UPSTREAM EXPOSURE (ALPHA VALUE) VS TRUE WIND DIRECTION

Wind Direction (Degrees True)	Alpha Value (α)
0	0.27
22.5	0.25
45	0.25
67.5	0.27
90	0.28
112.5	0.26
135	0.20
157.5	0.22
180	0.23
202.5	0.21
225	0.19
247.5	0.20
270	0.23
292.5	0.25
315	0.25
337.5	0.26

TABLE 2: DEFINITION OF UPSTREAM EXPOSURE (ALPHA VALUE)

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

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

$$I(Z) = \begin{cases} 0.1\left(\frac{Z}{Z_g}\right)^{-\alpha-0.05}, & Z > 10\ \text{m} \\ 0.1\left(\frac{10}{Z_g}\right)^{-\alpha-0.05}, & Z \leq 10\ \text{m} \end{cases} \qquad \text{Equation (2)}$$

$$L_t(Z) = \begin{cases} 100\ \text{m}\sqrt{\frac{Z}{30}}, & Z > 30\ \text{m} \\ 100\ \text{m}, & Z \leq 30\ \text{m} \end{cases} \qquad \text{Equation (3)}$$

where, I = turbulence intensity, L_t = turbulence length scale, Z = height above ground, and α is the power law exponent used for the velocity profile in Equation (1).

Boundary conditions on all other domain boundaries are defined as follows: the ground is a no-slip surface; the side walls of the domain have a symmetry boundary condition; the top of the domain has a specified shear, which maintains a constant wind speed at gradient height; and the outlet has a static pressure boundary condition.

REFERENCES

[1] P. Arya, "Chapter 10: Near-neutral Boundary Layers," in *Introduction to Micrometeorology*, San Diego, California, Academic Press, 2001.

[2] S. A. Hsu, E. A. Meindl and D. B. Gilhousen, "Determining the Power-Law Wind Profile Exponent under Near-neutral Stability Conditions at Sea," vol. 33, no. 6, 1994.

[3] Y. Tamura, H. Kawai, Y. Uematsu, K. Kondo and T. Okhuma, "Revision of AIJ Recommendations for Wind Loads on Buildings," in *The International Wind Engineering Symposium, IWES 2003*, Taiwan, 2003.