349 DAVIS ROAD

OAKVILLE, ONTARIO

PEDESTRIAN WIND ASSESSMENT

PROJECT #2203169
OCTOBER 14, 2022

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to conduct a qualitative assessment of the pedestrian wind conditions expected around the proposed project at 349 Davis Road in Oakville, Ontario. This effort is intended to inform good design and has been conducted in support of Zoning By-Law Amendment Application for the project.

The project site is located at the intersection of Davis Road and South Service Road neat Queen Elizabeth Way and Trafalgar Road (Image 1). Located approximately 2 km from Lake Ontario, the site is currently occupied by a one-storey office building and surrounded by low-rise buildings and roadways in all directions, except a mid-rise office building across Davis Road (Image 1).

Image 1: Project Site and Surroundings (Photo Credit: Corbett Land Strategies)

The project consists of a 58-storey tower with setbacks at Levels 6 and 41, as shown in Images 2 and 3. Pedestrian areas of interest include building entrances, sidewalks and walkways, a patio, parking spaces at grade and outdoor amenities at Levels 6 and 41.

Image 2: Project Rendering

1. INTRODUCTION

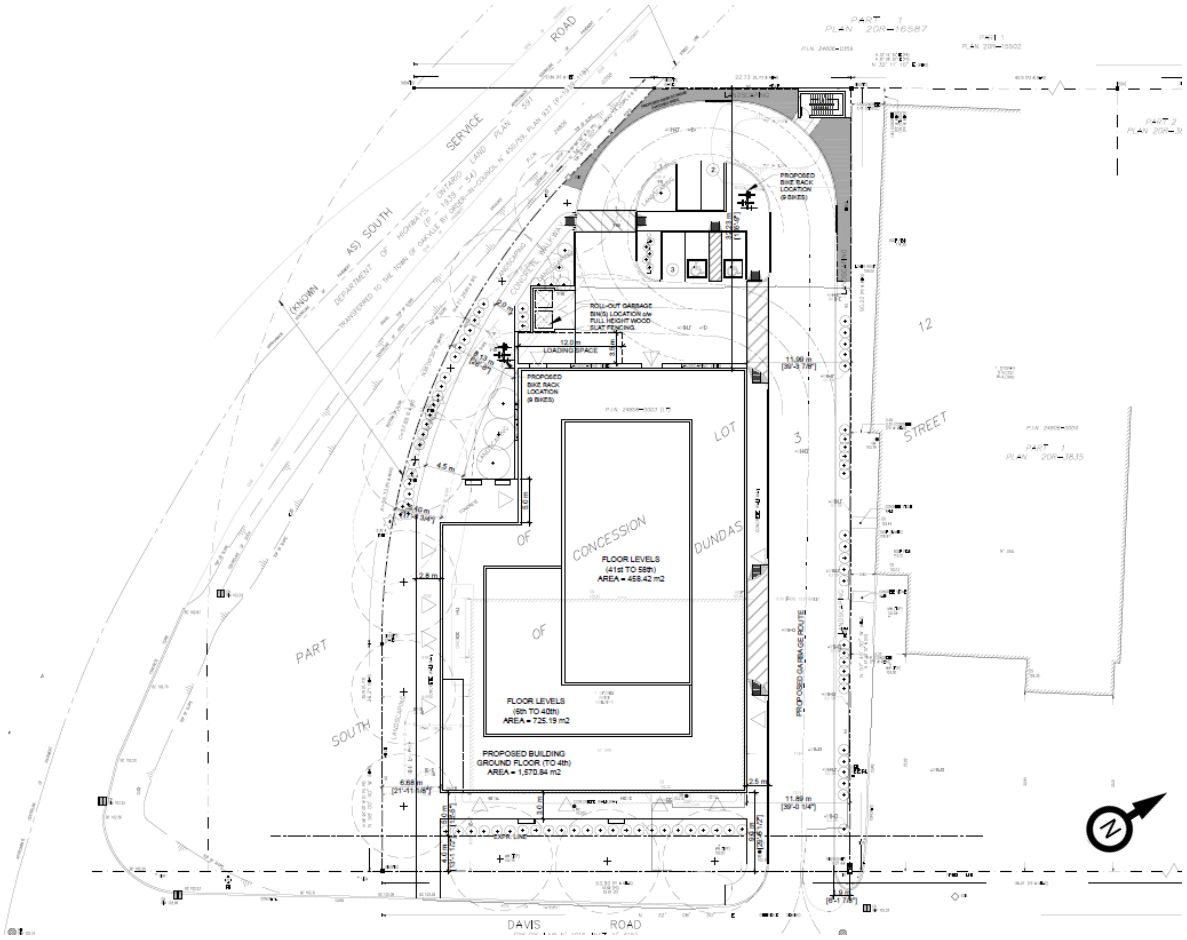


Image 3: Site Plan

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex. It involves the combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate.

Over the years, RWDI has conducted thousands of wind-tunnel model studies on pedestrian wind conditions around buildings, yielding a broad knowledge base. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify and confirm the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's assessment is based on the following:

- Design drawings received on October 3, 2022;
- A review of the regional long-term meteorological data from Billy Bishop Toronto City Airport;
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects in the area;
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3]; and,
- RWDI Criteria for pedestrian wind comfort and safety.

Note that other microclimate issues such as those relating to cladding and structural wind loads, building air quality, noise, vibration, etc. are not part of the scope of this assessment.

1. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

3. METEOROLOGICAL DATA

Meteorological data from Billy Bishop Toronto City Airport for the period from 1992 to 2021 were used as a reference for wind conditions in the area. The distributions of wind frequency and directionality for the summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 4.

In the summer, winds from the east-northeast direction are predominant, with frequent winds also from the southwest and northwest quadrants. In the winter, winds from the west, southwest and northwest are significantly more frequent in addition to winds from the east-northeast direction.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10m) are more frequent in the winter (red and yellow bands in Image 4). These winds potentially could be the source of uncomfortable or severe wind conditions, depending on the site exposure and development design.

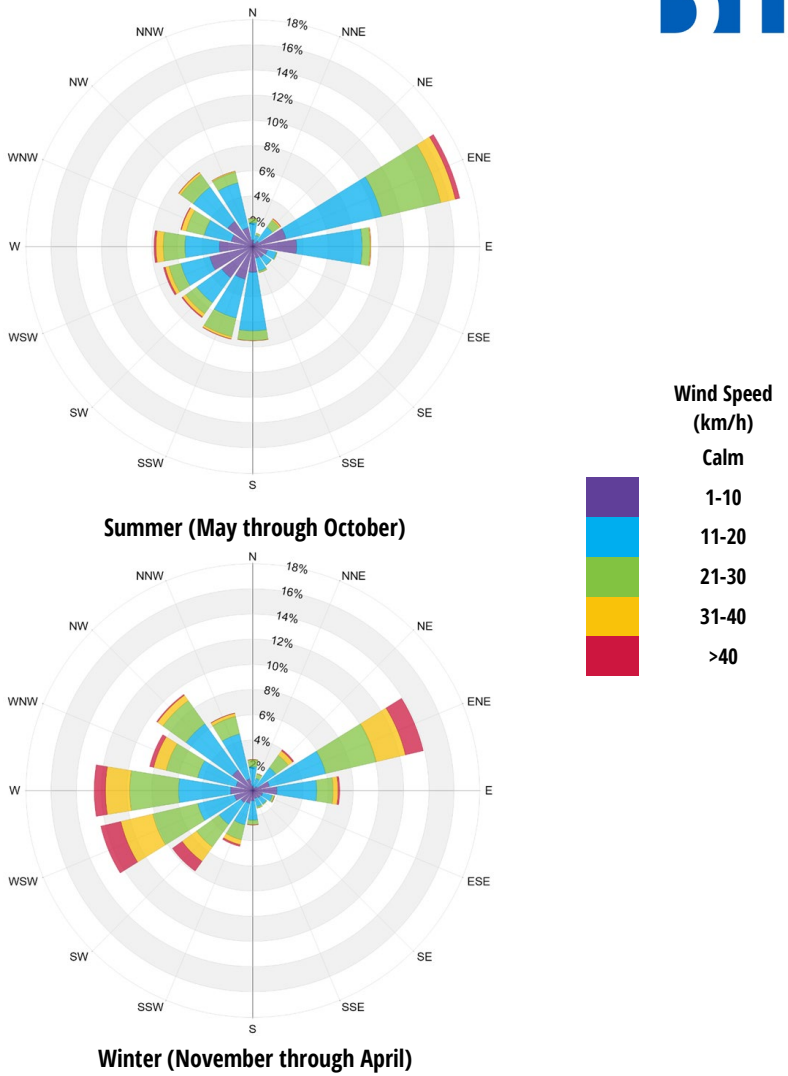


Image 4: Directional Distribution of Winds Approaching Billy Bishop Toronto City Airport (1992 to 2021)

4. WIND CRITERIA

The RWDI pedestrian wind criteria are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities, building designers and the city planning community. The criteria are as follows:

4.1 Safety Criterion

Pedestrian safety is associate with excessive gust that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (> **90 km/h**) occur more than **0.1%** of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort Criteria

Wind comfort can be categorized by typical pedestrian activities:

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.

Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: The comfort category for walking is not met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated mean wind speeds are expected for at least four out of five days (**80% of the time**). Wind control measures are typically required at locations where winds are rated as uncomfortable, or they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for walking or strolling are appropriate for sidewalks, walkways and parking spaces; lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger, and calm wind speeds suitable for sitting are desired outdoor amenities at and above ground, especially in the summer when these areas are typically in use.

5. RESULTS AND DISCUSSION

5.1 Wind Flow Around Buildings

Buildings that are taller than their surroundings tend to intercept and redirect winds around them. The mechanism in which winds are directed down the height of a building is called Downwashing. These flows subsequently move around exposed building corners and through the gaps between buildings, causing localized increases in wind activity.

Low podiums, tower setbacks and large canopies are positive design features to reduce the direct wind impact on the ground. These flow patterns are schematically illustrated in Image 5.

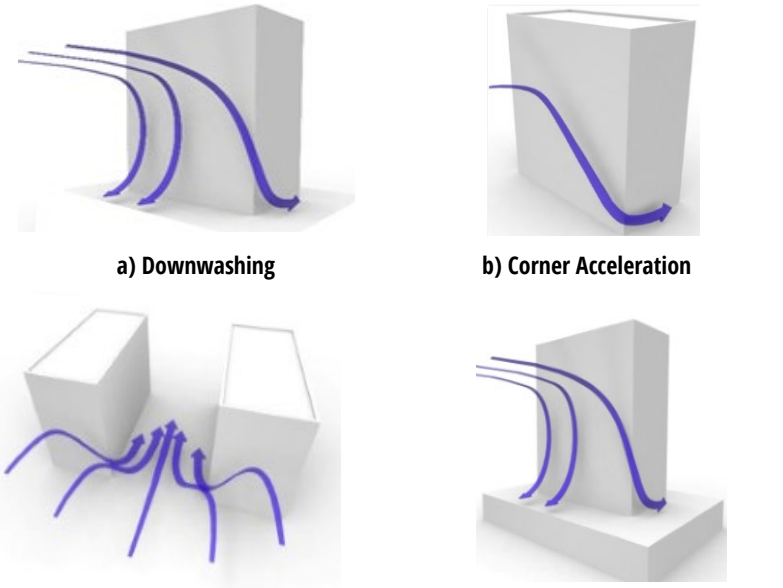
5.2 Existing Scenario

The existing buildings on the project site and in the surrounding areas are relatively low. As such, there are no significant structures that would deflect ambient winds to the ground to cause adverse wind impacts. Currently, wind conditions on and around the site are considered comfortable for standing or strolling in the summer and for strolling or walking in the winter, due to the site exposure and local climate.

Slightly higher wind speeds are likely to exist at the base of the mid-rise building across Davis Road, but wind conditions exceeding the safety or comfort limits are not expected around any existing buildings.

5.3 Proposed Scenario

The proposed building, at 58 storeys, is significantly taller than the existing surroundings. Therefore, the tower will be fully exposed to winds from all directions. Although there are several positive design features for wind control, including the large canopies, podiums and tower setbacks. the potential wind speeds around the project are predicted to be high, as shown in Images 6a and 6b for the summer and winter seasons, respectively.



a) Downwashing

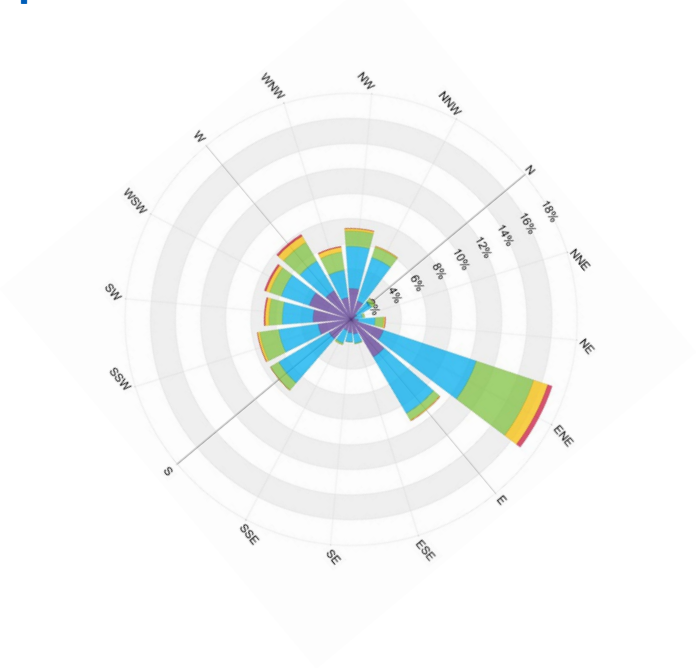
b) Corner Acceleration

c) Channelling Effect

d) Large Podium and Tower Setback

Image 5: Generalized Wind Flows

5.4 Proposed Scenario: Predicted Wind Conditions



WIND CATEGORIES

- Sitting / Standing
- Strolling / Walking
- Uncomfortable
- Uncomfortable and Potential Safety Exceedance

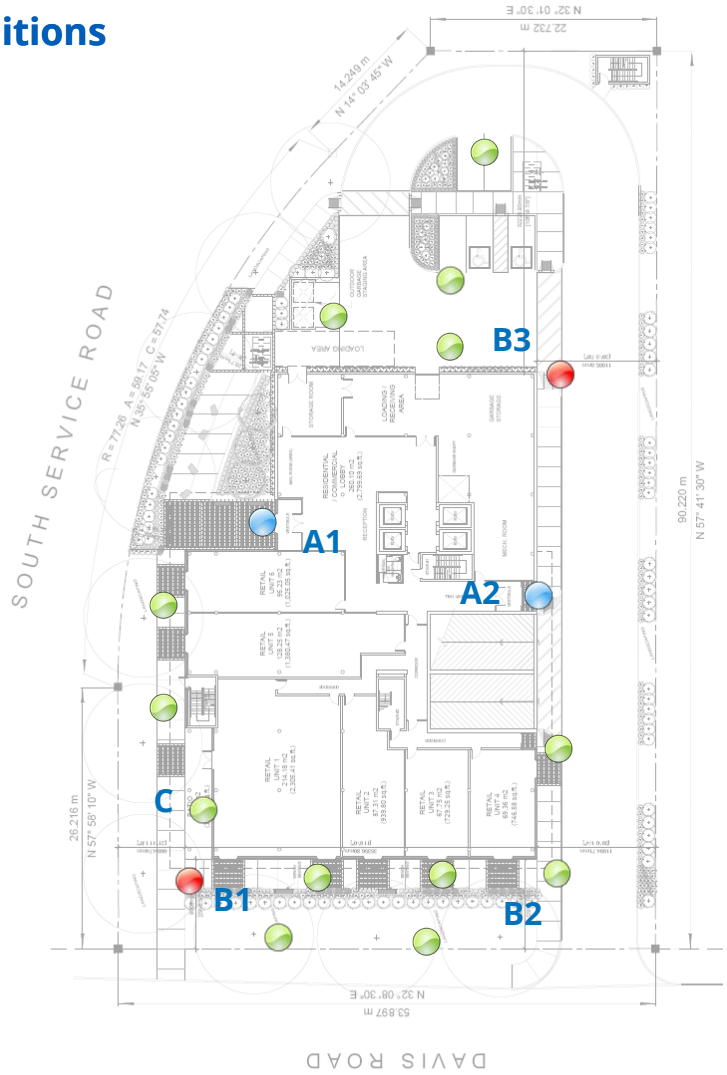
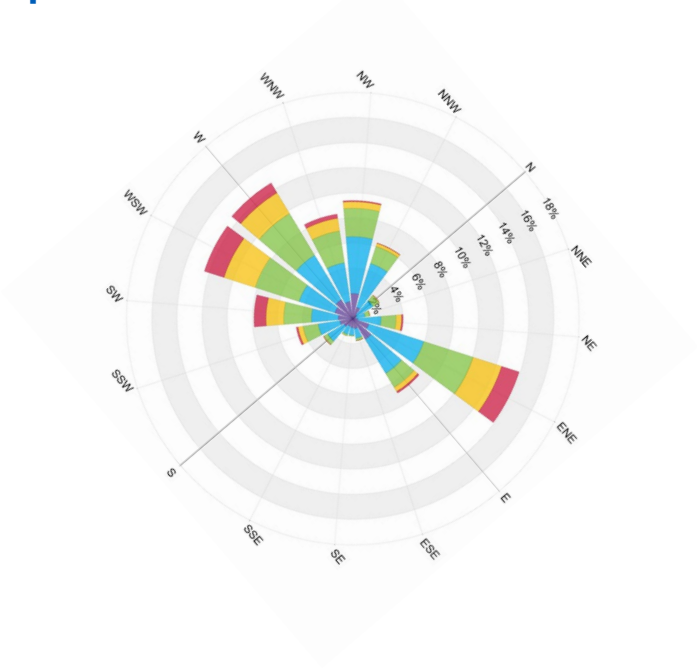


Image 6a: Predicted Wind Conditions at Grade - Summer

5.4 Proposed Scenario: Predicted Wind Conditions



WIND CATEGORIES

- Sitting / Standing
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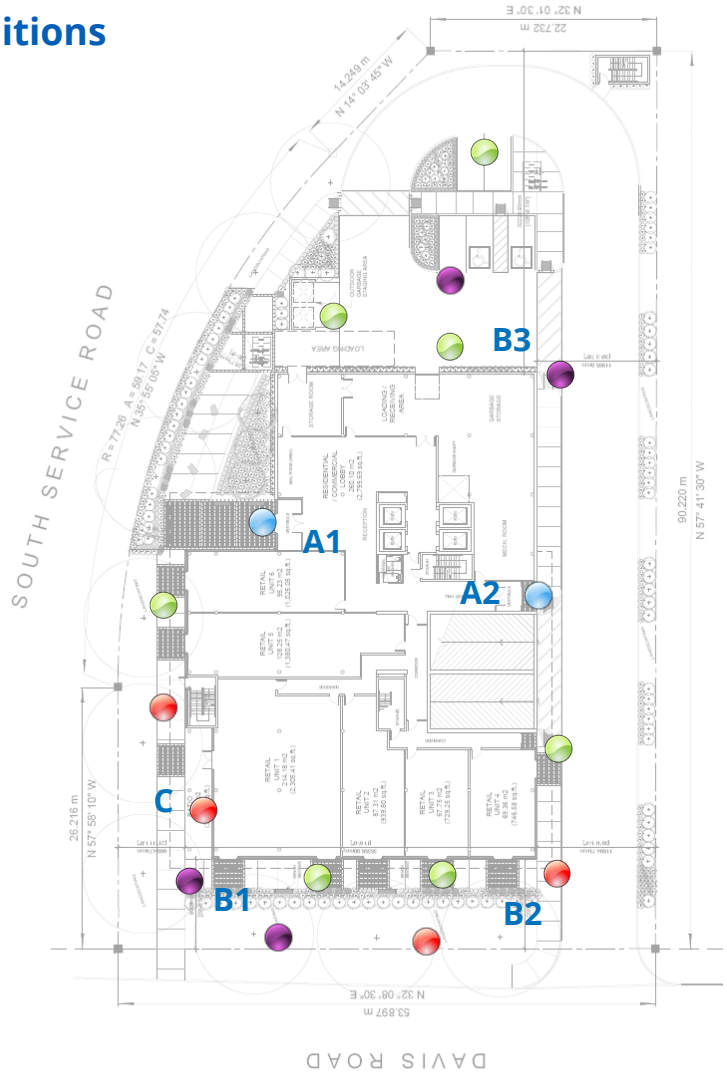

Image 6b: Predicted Wind Conditions at Grade - Winter

5.5 Proposed Scenario: Wind Safety

At 58 storeys, the proposed building is considerably taller than the existing buildings in surrounding areas and it will deflect winds down to the lower levels, causing increased wind speeds around building corners on the podiums and at grade levels, as shown in Image 7, as an example.

The proposed podiums and tower setbacks are positive design features to reduce the wind downwashing. The large canopies at the base of the proposed building are also positive in creating local wind protection. However, due to the height of the proposed building and low/open surroundings, there is a potential for gust wind speeds exceeding the safety criterion at the exposed tower corners at grade (Image 6b) and above grade (to be discussed in Section 5.7).

These extreme wind events primarily occur during the winter months. Wind-tunnel tests should be conducted at a later design stage to quantify these wind conditions and to determine the need and extent for wind mitigation.

Image 7: Flow Pattern of Prevailing Winds

5.6 Proposed Scenario: Wind Comfort

5.6.1 Entrances

The main entrance to the proposed building (Location A1 in Images 6a and 6b) is located in a recessed building corner under a large canopy (left diagram in Image 8). As a result, suitable wind conditions are predicted at this entrance in both the summer and winter seasons (Images 6a and 6b).

Suitable wind conditions are also expected around the lobby entrance on the other side of the building (A2), due to wind sheltering offered by the recessed entrance design, the canopy, the existing building across the street and the proposed building itself.

The proposed vestibules are a positive design feature in improving door operability and reducing air infiltration. They should be kept in the final design.

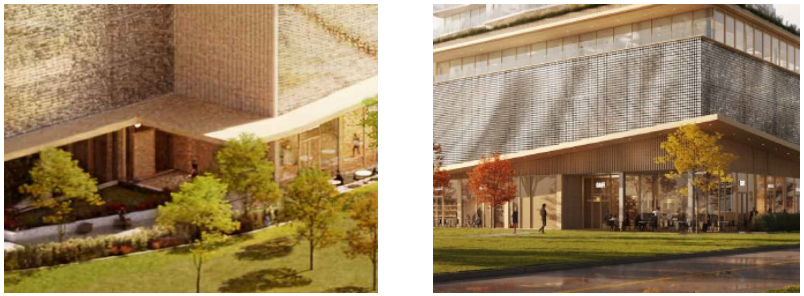

Image 8: Main Entrance (left) and Outdoor Patio (right)

5.6.2 Sidewalks, Walkways and Parking Spaces

Suitable wind conditions are predicted at all sidewalks, walkways and parking spaces in the summer, except the northeast and southwest building corners where uncomfortable wind speeds may occur (Image 6a). In the winter, due to seasonal wind climate in the area, uncomfortable and unsafe wind conditions may occur around building corners (Locations B1, B2 and B3 in Image 6b). They are caused by the prevailing southwest/west and northeast/east winds being deflected down by the proposed building and accelerating around the exposed corners and between the existing and proposed buildings (Image 7).

Again, wind-tunnel tests should be conducted to quantify these wind conditions. In addition to tower setbacks and canopies, other wind control measures may include building corner articulations, arcades, wind screens, street art and so on. If feasible, landscaping elements may also be considered to reduce the wind speeds and/or to keep pedestrians away from the windy areas – see Image 9 for examples.

5.6.3 Outdoor Patio

There is an outdoor patio proposed at grade (right diagram in Image 8), where higher-than-desired wind speeds are expected in the summer and winter seasons (Location C in Images 6a and 6b).

The patio is partially sheltered by the proposed building and canopy, but it is close to a windy building corner. Tall wind screens or landscaping rows are recommended along the other two sides for wind protection - see examples in image 9.

5. RESULTS AND DISCUSSION

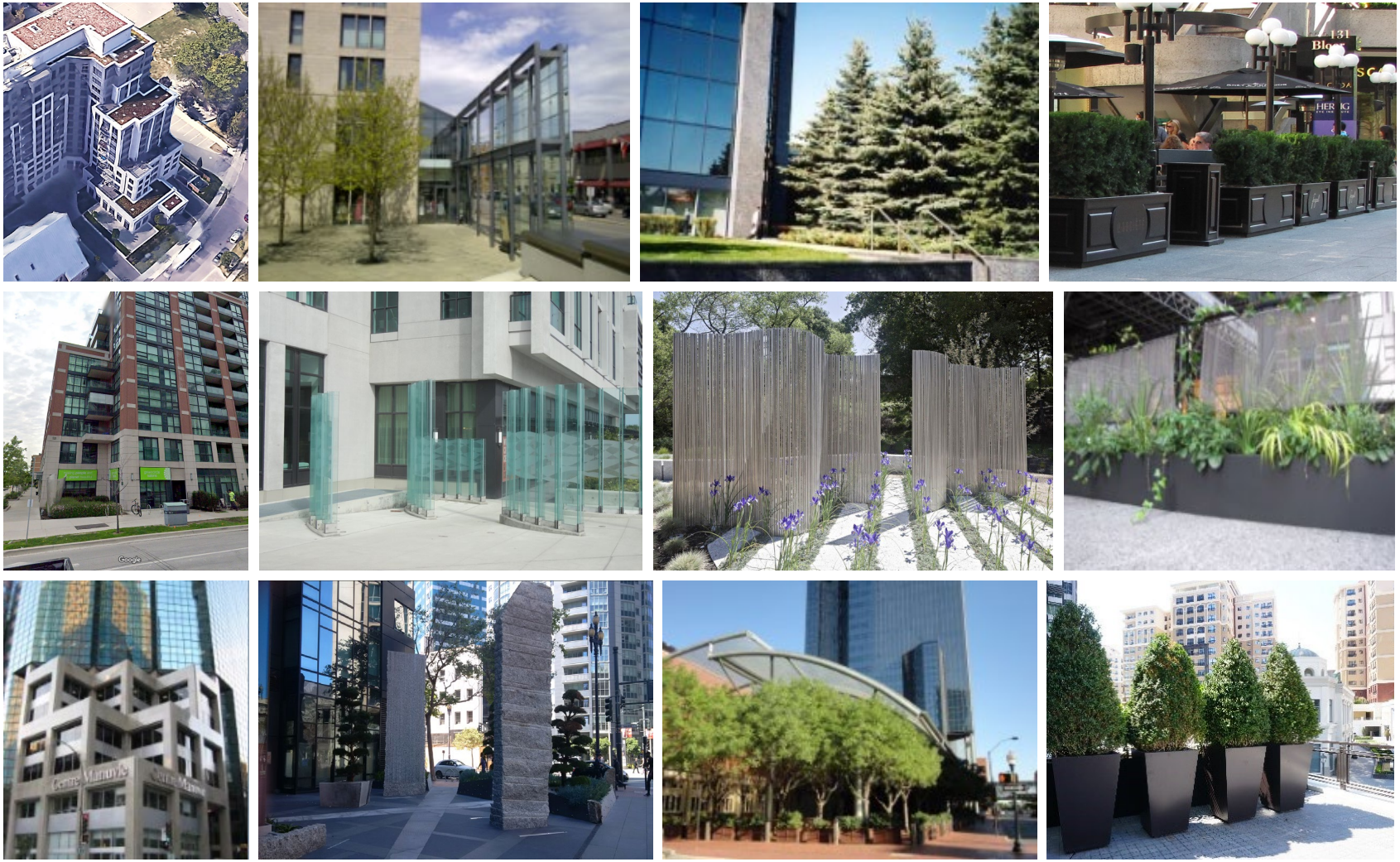

Image 9: Examples of Wind Control Measures at Building Corners and the Proposed Patio

5.7 Wind Comfort on Above-grade Areas

While podiums and tower setbacks are positive design features to reduce wind speeds on the ground, high wind speeds may be generated on these podiums where low wind speeds are often desired for passive activities.

The proposed development include landscaping rows along the perimeters of outdoor amenities at Levels 6 and 41, with additional trees around tower corners, as shown in Images 2 and 7. These landscaping elements, if of proper density and height, will reduce the wind activity on the podium terraces, potentially creating suitable wind comfort conditions during the summer season.

In the winter, conditions are predicted to be windy for outdoor use. These conditions may be acceptable as these areas are not expected to be used for passive activities in the cold months.

If lower wind speeds in the summer or extended use of these areas to the shoulder seasons are desired, additional wind control measures may be considered and they may include tall guardrails, wind screens, partitions, trellises and so on. Examples of wind control elements that can be considered for terraces are shown in Image 10.

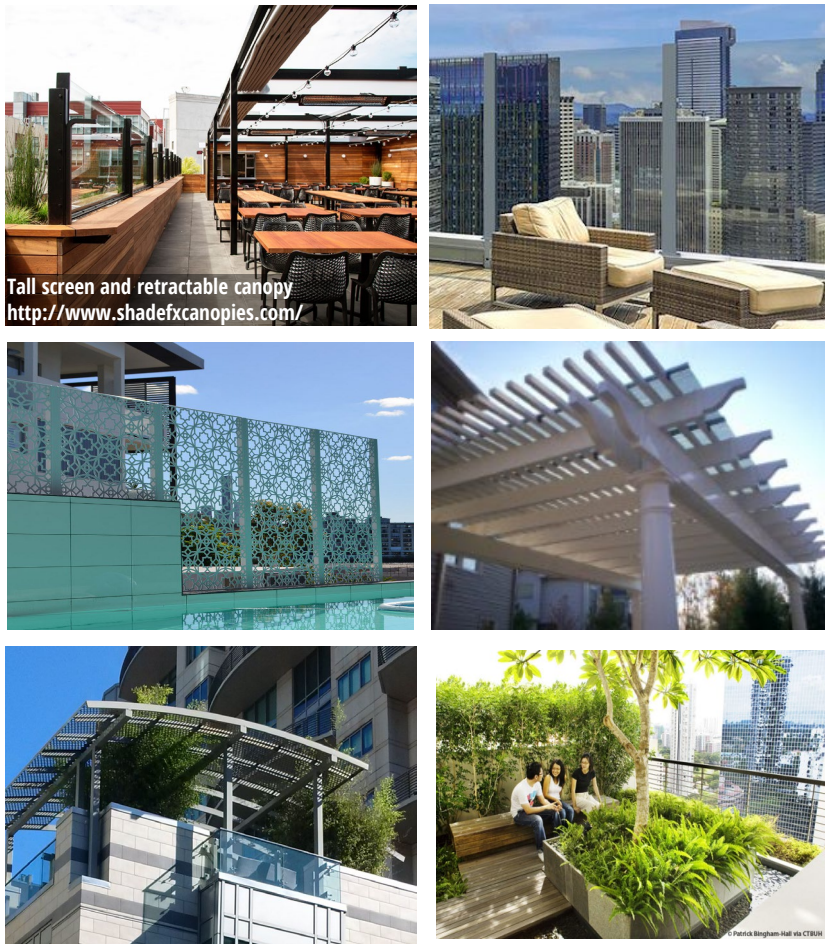

Image 10: Additional Wind Control Features for Podium Amenities

6. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian wind impact of the proposed project at 349 Davis Road in Oakville, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling of wind flow around buildings.

Our findings are summarized as follows:

- The proposed 58-storey building is significantly taller than the existing surroundings and, therefore, will cause an increase in wind speeds around it.
- The building design incorporated several wind-responsive features such as podiums, tower setbacks and canopies, which will moderate the potential wind impacts on the site and surroundings.
- Suitable wind conditions are predicted for both residential entrances throughout the year.
- Suitable wind conditions are also predicted in the summer on all sidewalks, walkways and parking spaces, except the areas around the northeast and southwest building corners where uncomfortable wind speeds may occur.
- During the winter, wind speeds around exposed building corners are predicted to be uncomfortable and potentially exceed the wind safety criterion.
- Wind speeds are predicted to be higher than desired for passive use on the ground-level patio and on above-ground terraces.
- Additional wind control measures have been discussed, where necessary. Wind-tunnel tests should be conducted at a later design stage to quantify these wind conditions, confirm the need for wind control features and optimize mitigation efforts.

7. APPLICABILITY OF RESULTS

Design Assumptions

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in October 2022. Should the details of the proposed fit out design and/or geometry of the building change significantly, results may vary.

File Name	File Type	Date Received (mm/dd/yyyy)
2022-09-14_22003 Davis Rd Arch OPA	pdf	10/03/2022

Changes to the Design or Environment

It should be noted that wind comfort is subjective and can be sensitive to changes in building design and operation that are possible during the life of a building. These could be, for example: outdoor programming, operation of doors, elevators, and shafts pressurizing the tower, changes in furniture layout, etc.. In the event of changes to the design, construction, or operation of the building in the future, RWDI could provide an assessment of their impact on the discussions included in this report. It is the responsibility of Others to contact RWDI to initiate this process.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for Corbett Land Strategies ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein and authorized scope. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared.

Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.