PEDESTRIAN WIND STUDY

441 MAPLE AVENUE

BURLINGTON, ON

RWDI PROJECT #1900412

6 DECEMBER 2018

SUBMITTED TO

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EXECUTIVE SUMMARY

Wind conditions on and around the proposed project at 441 Maple Avenue in Burlington, Ontario, are discussed in this report. Our assessment is based on the review of the local wind climate, the current design of the proposed development, the existing and proposed surrounding buildings, combined with our experience with wind tunnel testing of similar buildings.

The proposed development site and building design includes several features that are considered positive for wind control including:

- building orientation with its narrower facades facing the predominant winds,
- setbacks from the property lines and nearby properties,
- recessed passenger drop-off area,
- deep overhang above the main entrance,
- proposed trees, and
- stepped façade above the amenity terrace.

As such, the project is not expected to alter wind conditions in the surrounding areas beyond the immediate vicinity.

Wind conditions at most areas on site are expected to be appropriate for pedestrian use throughout the year. However, the greatest impact expected is at the southwest corner of the project site at the Maple Avenue entrance. The 10th Floor amenity terrace is also expected to be windy for use during the summer.

Suitable wind conditions can be achieved at the building's southwest corner and the 10th floor amenity terrace through the use of wind control measures.

1. INTRODUCTION

RWDI was retained by Better Life Retirement Residences Inc. to conduct a Pedestrian Wind Study for the proposed project at 441Maple Avenue in Burlington, Ontario (see **Image 1**). The City of Burlington has requested a Wind Impact Study in support of Official Plan and Zoning By-law Amendment (ZBA) applications.

The proposed development consists of an 11-storey residential tower with a 10th floor rooftop amenity area. The location of the proposed development is near the intersection of Maple Avenue and Lakeshore Road.

The study considers wind conditions without (pre-development) and with the proposed development (post-development) in place. This wind assessment was based on the following:

- a review of regional long-term meteorological data from a nearby airport and weather stations;
- Drawings received on December 6 and 3D e-model received on November 28, 2018, from MHBC ;
- wind-tunnel studies undertaken by RWDI for similar projects in the area;
- our engineering judgement and knowledge of wind flows around buildings[1-3]; and
- use of 3D software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind conditions. Conceptual wind control measures are recommended to improve wind conditions, where advisable. To quantify these conditions and refine wind control solutions, physical scale model tests in a boundary-layer wind tunnel would be required.

Note that other wind issues such as those relating to cladding and structural wind loads, snow loading, snow drifting, falling ice and snow, door operability, etc. are not part of this pedestrian wind assessment.



Image 1: Concept rendering of the proposed project and surroundings

1. 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.
2. 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.
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.

2. BUILDING AND SITE INFORMATION

The project site is located at 441 Maple Avenue, between Elgin Street and Lakeshore Road, facing Lake Ontario (see **Image 2**). The site is currently occupied by a two-storey long-term care centre. Note that, in the current project, geographic north differs from project north, as shown in **Images 2 and 3**. In our discussions, building and street orientations refer to project north and wind directions are based on geographic north.

Surroundings include a 11-storey building on the neighbouring property to the south, several buildings ranging in height between six to 20-storeys to the north and south-southwest, Lake Ontario to the south and primarily low-rise suburban development in all other directions (see **Image 3**).

RWDI understands that the proposed project consists of the construction of a new 11-storey plus mechanical penthouse residential building. The building will include three levels of underground parking and a 10th floor outdoor amenity terrace. Other key pedestrian areas on and around the site include the main lobby entrances, nearby parking lots to the northeast, adjacent walkways and bus stops on Maple Avenue.

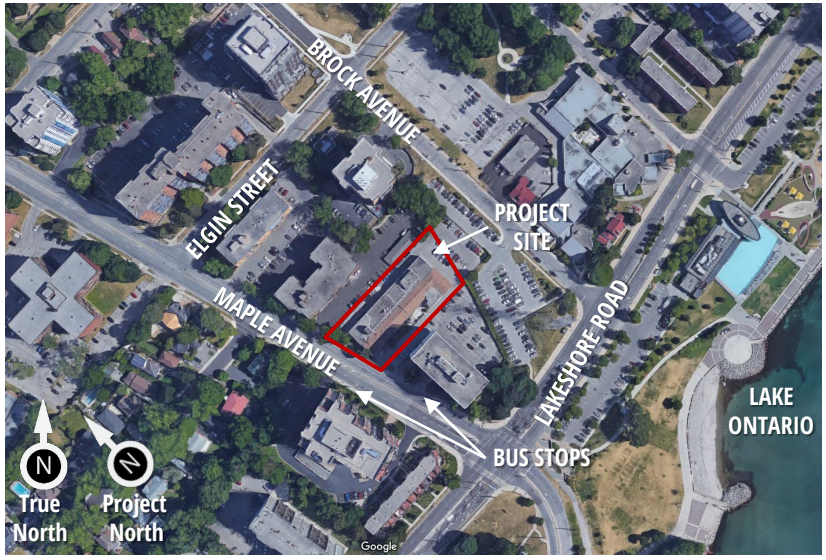


Image 2: Aerial view of the existing site and surroundings (Source: Google™ Earth)



Image 3: Proposed building in the surrounding context

3. LOCAL WIND CLIMATE

Wind statistics recorded at Hamilton International Airport between 1975 and 2015, inclusive, were analyzed for the summer (May through September) and winter (October through April) seasons. The seasonal data are presented in the form of wind roses in **Image 4**, where the sectors show the frequency of winds blowing from different directions. It can be noted that winds in the area are predominantly from the southwesterly and northeasterly directions throughout the year.

Strong winds of speeds greater than 30 km/h (yellow and red bands in **Image 4**) occur more often in the winter (13.8% of the time) than in the summer (3.9%), and they are primarily from the southwesterly and northeasterly directions.

Wind records from major airports are typically measured in open fields for a long term and with high quality. They are often used as a reference of wind climate for building projects in the surrounding area.

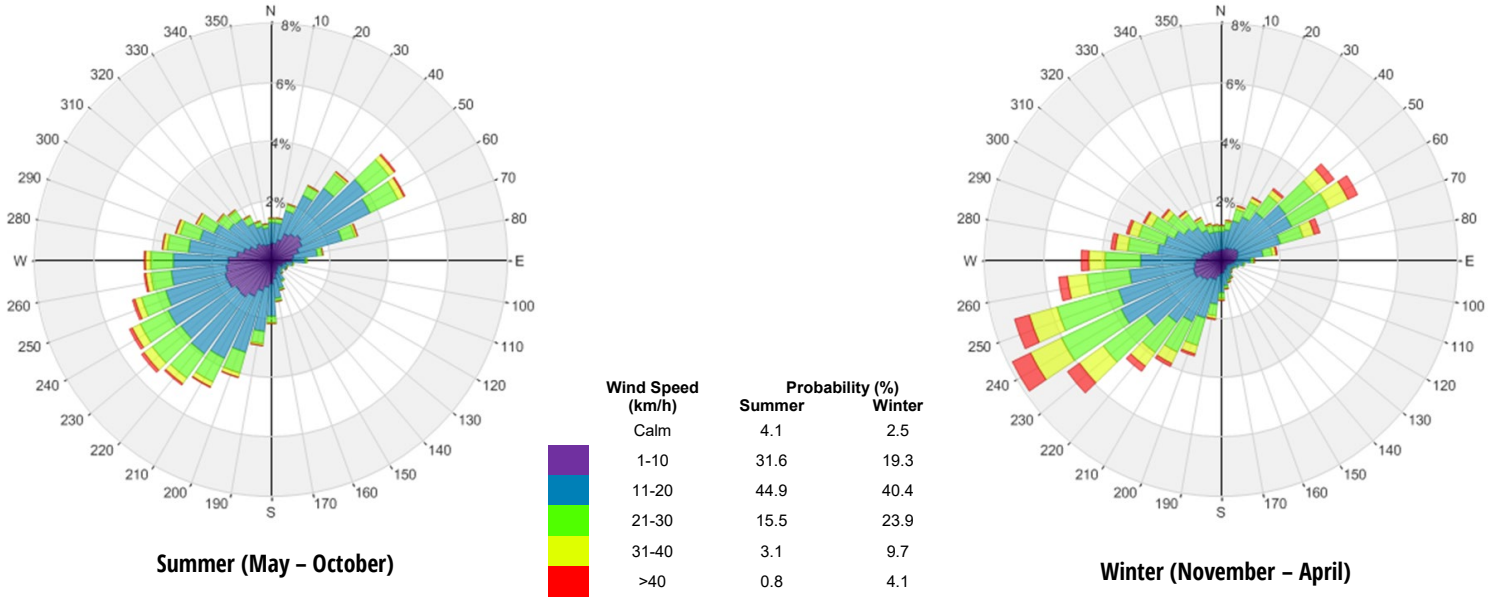
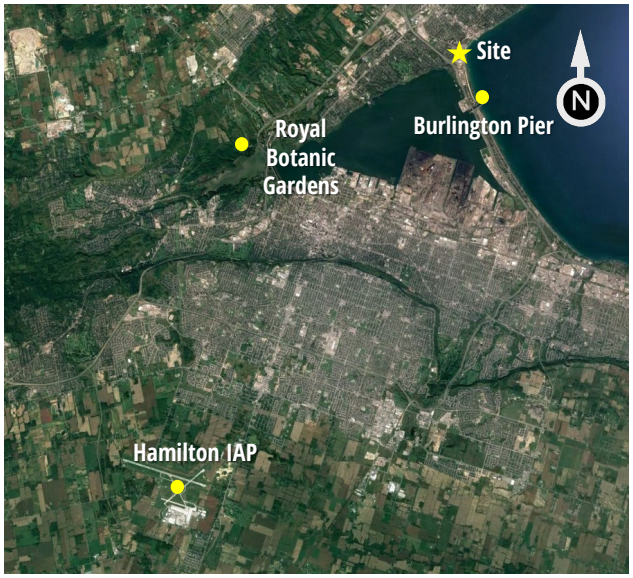


Image 4: Distribution of winds recorded at Hamilton International Airport (1975–2015)

3. LOCAL WIND CLIMATE

Wind data from two nearby weather stations (Burlington Pier and Royal Botanic Gardens (RBG) as shown in **Image 5a**) were also analyzed to confirm the local wind directionality. As shown in **Image 5b**, winds at these two stations are also from the southwesterly and northeasterly directions in general. The primary difference is that the wind speeds at these two stations are lower than those measured at Hamilton Airport, which is likely due to more surrounding obstacles, lower measurement heights, and local topography at the Burlington Pier and RBG stations.



(photo credit: Google™ Earth)

Image 5a: Locations of weather stations referenced

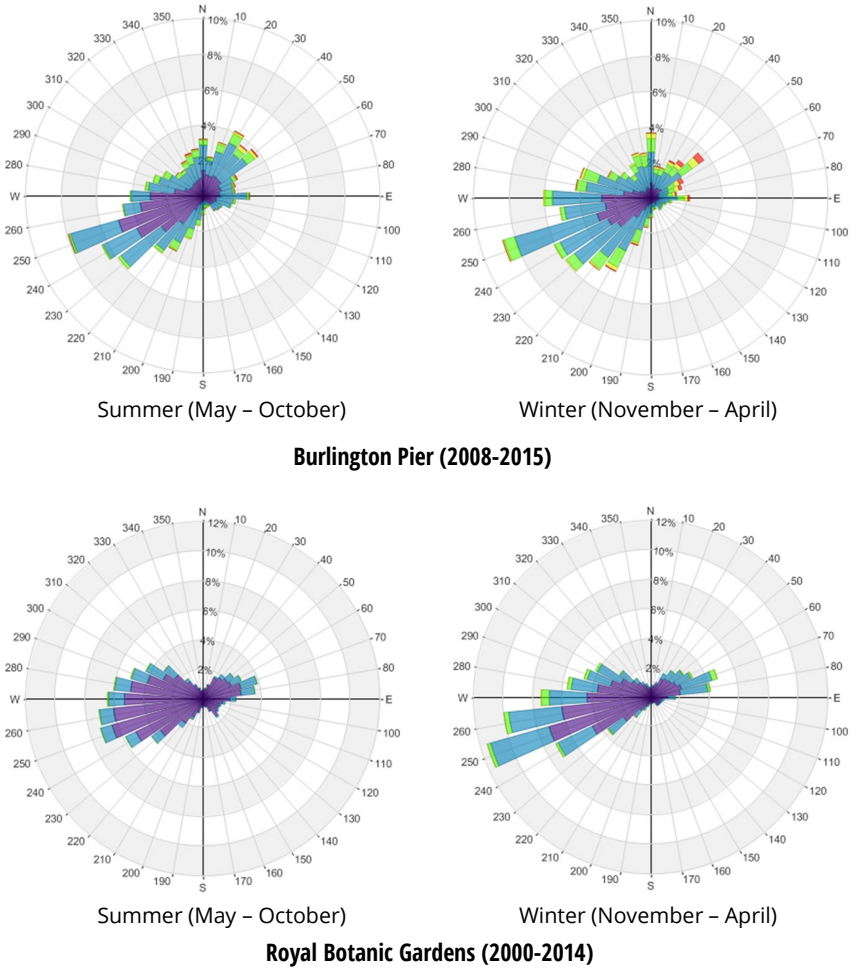


Image 5b: Distribution of winds recorded at Burlington Pier and Royal Botanic Gardens

4. PEDESTRIAN 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 the building design community, city planners, and municipal authorities including the City of Burlington.

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds 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

Wind comfort levels are categorized by their suitability for certain common 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: None of the comfort categories are met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the 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 higher than those recommended for their intended use, 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 the walking surface), 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 affect people's perception of the wind climate.

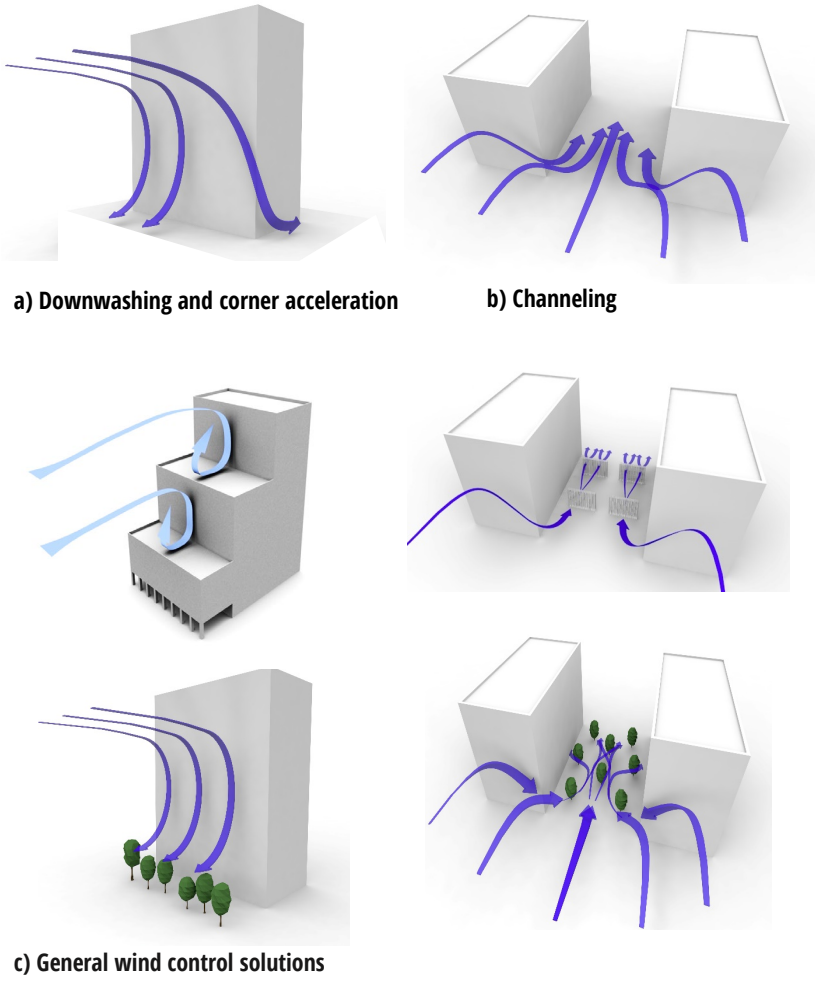
For the current development, wind speeds comfortable for walking are appropriate for sidewalks and parking lots where pedestrians would be active. Lower wind speeds comfortable for sitting or standing are desirable around building entrances where pedestrians may linger. Low wind speeds comfortable for sitting are desirable at outdoor amenity areas during the summer to be conducive to passive activities; higher wind speeds are considered appropriate in these areas in the winter as their usage is not anticipated in the colder months.

5.1 Background

Predicting wind speeds and occurrence frequencies is complicated. It involves the assessment of geometry, orientation, position and height of buildings in the master plan, 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. This knowledge has been incorporated into RWDI's proprietary software that allows, in many situations, for a qualitative, screening-level numerical estimation of pedestrian wind conditions without wind tunnel testing.

Taller buildings tend to intercept stronger winds at higher elevations and redirect them to ground level referred to as a Downwashing Effect. These flows subsequently accelerate around downwind building corners creating Corner Accelerations. Such redirected winds (see **Image 6a**) are often the main cause for increased wind activity around the base of taller buildings. When two buildings are situated side by side, wind flows tend to accelerate through the space between the buildings due to the Channelling Effect (see **Image 6b**). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and uncomfortable or even adverse conditions.

Large trees with wide crowns, wind screens, raised planters, canopies (or other overhead cover), stepped facades, etc. are some general localized wind control measures used to counteract wind impacts (see **Image 6c**). The necessity and applications of these control measures are discussed in Section 5.3.



a) Downwashing and corner acceleration **b) Channeling**

c) General wind control solutions

Image 6: General wind flow patterns around buildings and wind control solutions

5.2 Existing Conditions (Pre-development)

The site is exposed to prevailing winds from the southwest and northeast due to its orientation, and low surroundings in the prevailing wind directions (see **Image 7**). Wind conditions on the site and surrounding area are considered to be comfortable for standing and strolling in the summer and for strolling and walking in the winter. The taller 11 and 14-storey buildings nearby redirect winds to the streets, whereby, on particularly windy days, winds near the corners of those buildings are uncomfortable for pedestrian use.

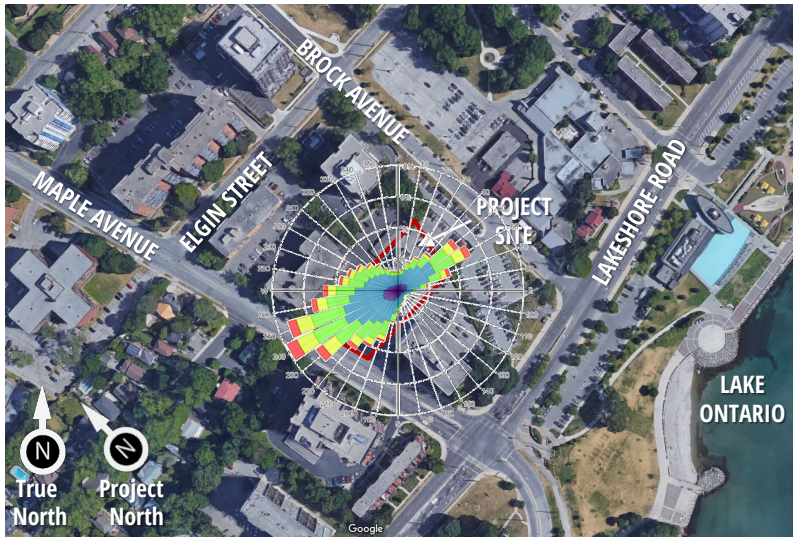


Image 7: Winter wind rose overlaid on the site (aerial view credit: Google™ Earth)

5.3 Future Conditions (Post-development)

The proposed 11 storeys building is comparable to tall buildings in the area. The narrow faces of the building faces the predominant winds; this is positive as there is a smaller area for winds to downwash on. Nevertheless, the exposure to prevailing winds and the proposed height of the building are expected to result in downwashing winds (see **Image 5a**). Due to the orientation and proximity of the project and neighbouring building to the south, winds are also expected to accelerate around the upwind corners and channel along the proposed laneway between them (see **Image 5b**). This flow pattern is illustrated in **Image 8** and its effects on key pedestrian areas are discussed in the following sections.

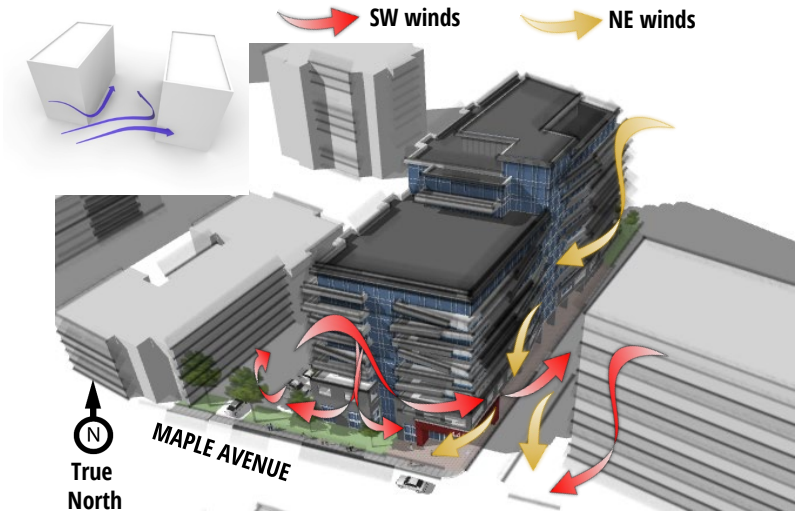


Image 8: Predicted flow pattern of the prevailing winds around the project

5.3.1 Main Entrance

The entry lobby is located at the southwest corner of the building and the entrances are on the east and west sides of the lobby – one faces Maple Avenue and the other a recessed drop-off area (see **Image 9**).

The west entrance and the drop-off area are recessed from the main building façade and therefore not expected to be severely affected by the accelerated wind flows. The wind conditions are expected to be comfortable for standing during the summer and winter, which is considered appropriate for an entrance.

The Maple Avenue entrance design, with a large overhang feature is positive for reducing impacts of downwashing flows. However, as illustrated in **Image 8**, the entrance area is expected to be subjected to complex flows due to corner acceleration and channelling of the southwest and northeast winds. Wind speeds here are expected to uncomfortable, which is higher than desirable for an entrance where standing conditions are recommended. The winds maybe strong enough, particularly in the winter, to cause damage to the doors. Potential wind control measures to be considered are presented in Section 5.3.3.



Main entrance on Maple Avenue

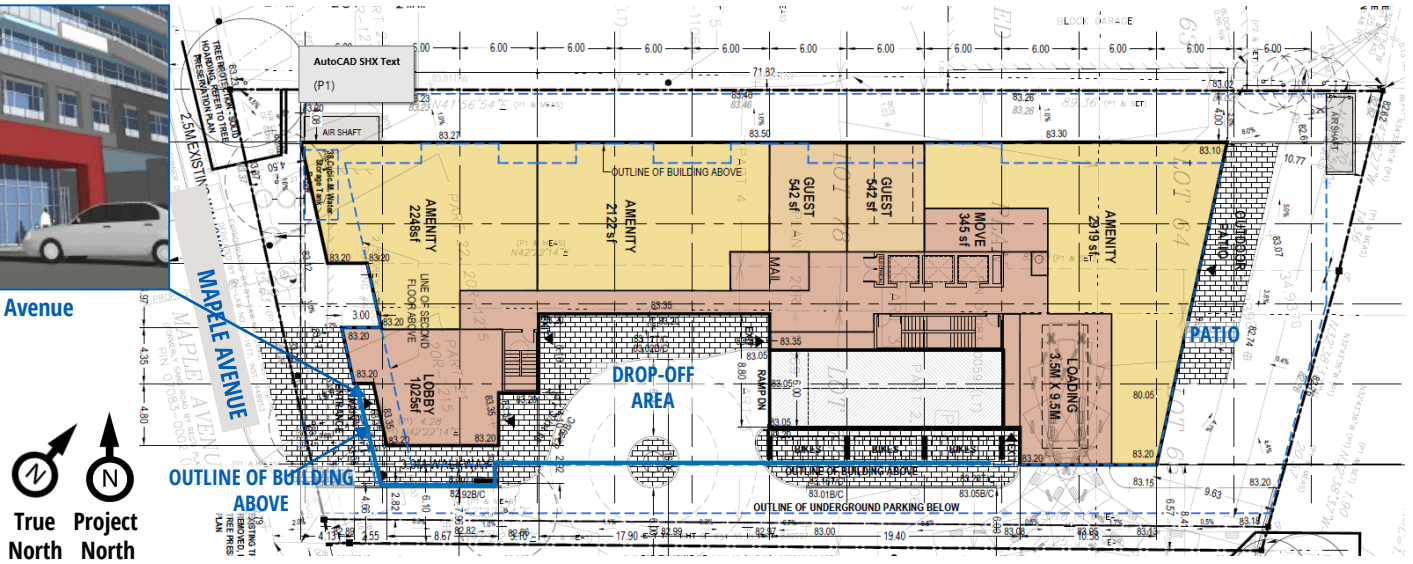


Image 9: Ground floor plan and main entrance detail

5.3.2. Adjacent Walkways, Laneways and Parking Lot

The proposed building appears to be set back at least 4 m from all property lines, and farther from the public walkway on Maple Avenue, the parking lot and walkways. This helps to minimize wind impact of the building on the walkways. We understand that tall, large trees are proposed along the north and east boundaries of the project (see **Image 9**). Healthy trees with large crowns, similar to those that exist along Maple Avenue, are favourable for disrupting downwashing flows in the summer. The design team is encouraged to include trees along the west side of the project on Maple Avenue as well, if feasible. The use of coniferous or marcescent trees can help extend the wind control benefits to the winter season as well. The proposed trees are expected to reduce wind impact in the portions of the walkways and laneways near them.

Due to the proposed trees, and distance of the building from the public walkway on Maple Avenue and the parking lots on the adjacent properties to the north and east, wind conditions in these areas are predicted to be comfortable for standing or strolling in the summer and strolling or walking in the winter. These conditions would be similar to conditions around the existing site and are conducive to the expected pedestrian activity on walkways.

The walkway proposed within the property line, closer to the building and wrapping around the southwest corner would be subjected to the same complex wind flows that are described to impact the Maple Avenue entrance in Section 5.3.1. Hence, wind conditions in this area are expected to be comfortable for strolling and walking most of the time throughout the year. However, on particularly windy days in the winter, it is probable for wind speeds at the southwest corner of the building and the area of the laneway between the project and the neighbouring building to the south to be uncomfortable. It is also predicted that winds in these areas will exceed the recommended wind safety criterion. Potential wind control measures are discussed in Section 5.3.3.

5.3.3. Wind Control measures for the Southwest Corner

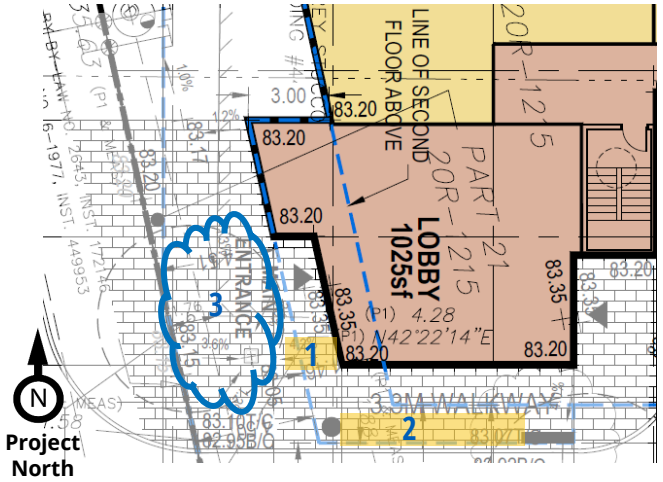
The following is recommended to alleviate unsafe winds at the southwest corner of the building and improve wind conditions at the main entrance:

1. Install raised planters or windscreens immediately south of the Maple Avenue entrance and to the south and west of any area where people may be expected to standing, wait, linger, etc.,
2. Plant tall coniferous planters along the south border of the site, and
3. Plant tall shrubs or install wind screens to the west of the entrance, staggered in the paved entry courtyard to diffuse winds in the area.

Examples and areas where these measures should be applied are presented in **Image 10.**

5. PEDESTRIAN WIND CONDITIONS

LOCATIONS OF WIND CONTROL FEATURES







NOTE: All vertical features like screens and plants, should be at least 2m tall and approximately 30% open for effective wind control. At 2 m, the features are taller than an average person.





Image 10: Location and examples of wind control measures recommended in Section 5.3.3

5.3.4. Outdoor Patio

An outdoor patio is proposed on the east side of the building at ground level (see **Image 9**). The patio is located on the downwind side of the building with respect to the predominant winds from the southwest quadrant and therefore, protected from those winds. The proposed tree line along the eastern site boundary would greatly reduce the exposure of the patio to northeast winds as well during the summer when the trees are in full leaf and the space will be used most often.

Wind conditions in the patio are expected to be comfortable for sitting most of the time in the summer. The area may become breezy from time to time when strong winds approaching from the northeast are downwashed by the building into the area. The addition of any overhead features like arbors, trellises, umbrellas or trees with a large canopy will help reduce downwashing impacts (refer to the lower image in **Image 5c)**.

5.3.5. Amenity Terrace

An outdoor amenity terrace is proposed on the west half of the 10th floor (see **Image 11**). The terrace is exposed to prevailing summer winds from the southwest that would make it windy for an amenity area. The walkway along the perimeter of the outdoor area would be affected by corner accelerations and the direct exposure to the prevailing summer winds. To reduce wind exposure of the perimeter walkway, tall wind-screens and/or landscaping may be incorporated along the outer edge of the terrace. Alternatively, the walkway may be relocated to the interior of the landscaped area to allow space for trees or hedges along its outer edge.

Landscaping or windscreens should also be added along the south and west boundaries of the main amenity area to make the area more comfortable in the summer for sitting and standing activities. These features should be at least 2 m tall and about 30% porous for effective wind control. Examples are shown in **Image 12**.

5.3.3. Surrounding area

The proposed project is similar in height and mass to several taller buildings in the neighbourhood. Its wind impact is predicted to be localized to the area immediately surrounding it as discussed in the previous sub-sections. The project is not expected to affect wind conditions on other streets or properties.

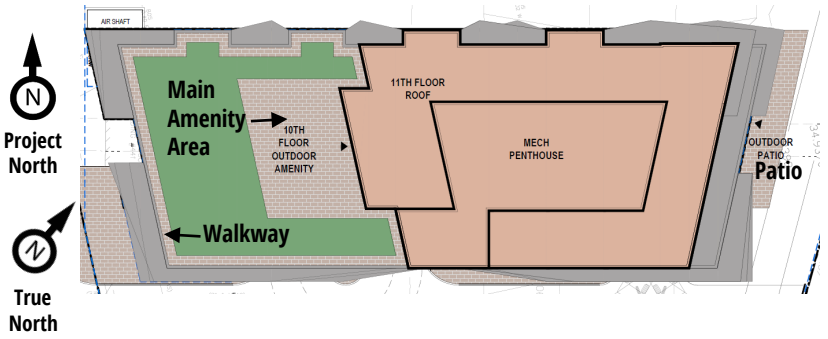


Image 11: Roof plan

5. PEDESTRIAN WIND CONDITIONS



Image 12: Examples of wind control measures for terraces

6. APPLICABILITY OF RESULTS

The assessment presented in this report are for the proposed project at 441 Maple Avenue in Burlington, Ontario. The information listed below were received from MHBC and were used for our assessment. Discussion and recommendations are specific to this design.

In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

File Name	File Type	Date Received (dd/mm/yyyy)
441 Maple – Dec-05-18-A03	PDF	06/12/2018
441 Maple – Dec-05-18-SP1	PDF	06/12/2018
441 Maple – Dec-05-18-A02	PDF	06/12/2018
441 Maple - 3D	Sketchup	23/11/2018