929 RICHMOND ROAD

OTTAWA, ON

PEDESTRIAN WIND ASSESSMENT
PROJECT #1800803
NOVEMBER 15, 2017

SUBMITTED TO

Robert Verch, C.P.T.
rverch@rodericklahey.ca

Roderick Lahey Architect Inc.
56 Beech Street
Ottawa, ON K1S 3J6
T: 613.724.9932 x249
F: 613.724.1209

SUBMITTED BY

Saba Saneinejad, Ph.D.
Senior Technical Coordinator
Saba.Saneinejad@rwdi.com

John Alberico, M.Sc., CCEP, WELL AP
Senior Project Manager/ Principal
John.Alberico@rwdi.com

RWDI
600 Southgate Drive
Guelph, ON N1G 4P6
T: 519.823.1311
F: 519.823.1316

1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Roderick Lahey Architect Inc. to assess the pedestrian wind conditions for the proposed development at 929 Richmond Rd. in Ottawa, ON (see Image 1).

This Preliminary Wind Analysis was completed in support of the Site Plan Approval application for the City of Ottawa as required under the City's Terms of Reference - Wind Analysis, and was based on the following:

- a review of regional long-term meteorological data for Ottawa;
- design drawings received from Roderick Lahey Architect Inc. on November 9, 2017;
- wind-tunnel studies undertaken by RWDI for similar projects in the Ottawa Area;
- our engineering judgement and knowledge of wind flows around buildings[1-3]; and
- use of software developed by RWDI (Windestimator[2]) for estimating the potential wind conditions around generalized building forms.

This approach provides an estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. To quantify these conditions or refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel would be required.

Note that other wind issues such as those related to wind loads, air quality, snow drifting, etc., are not considered in the scope of this assessment.

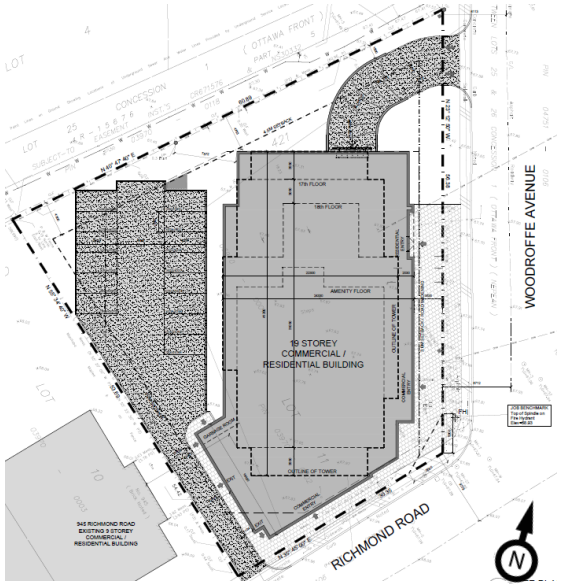


Image 1 – Site Plan

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 proposed development is located at the northwest corner of the intersection of Richmond Rd. and Woodroffe Ave. in Ottawa, ON (see Image 2). The site is currently occupied by a 1-storey building.

The site is generally surrounded by low-rise buildings in all directions with the exception of a mid-rise building to the southwest and a cluster of high-rise buildings farther to the southwest. Ottawa River is approximately 400 m to the northwest and Downtown Ottawa is approximal 7 km to the northeast.

The proposed development is a 19-storey mixed-used building (see Images 1 and 3). Public pedestrian areas on and around the development include the building entrances, sidewalks, parking lot and outdoor amenity area at Level 19.

Image 2 - Aerial View of Existing Site and Surrounding *(Courtesy of Google™ earth).*

Image 3 – East Elevation (Left) and North Elevation (Right)

3. METEOROLOGICAL DATA

Meteorological data from Ottawa Macdonald-Cartier International Airport for the period from 1985 to 2015 were used as a reference for wind conditions in the area. Wind data from other stations in the Ottawa area were also reviewed and it was deemed that the data set from the airport were most applicable.

This airport is located approximately 6 km to the south of the project site. Local wind speeds and directions are affected by the nearby Ottawa River because there is the potential for winds to accelerate along the river valley, resulting in increased wind activity on site. This exposure is taken into account in the subsequent pedestrian wind analysis.

The distributions of wind frequency and directionality for four seasons are shown in Figure 4. When all winds are considered, winds from the west-northwest, east-northeast and southwest directions are predominant for all seasons.

Strong winds of a mean speed greater than 30 km/h measured at the airport (red and yellow bands) occur most often in the winter and least often in the summer. Strong winds from the west-northwest and east-northeast are prevalent throughout the year. Winds from these directions potentially could be the source of uncomfortable or even unsafe wind conditions, depending upon the site exposure or development design.

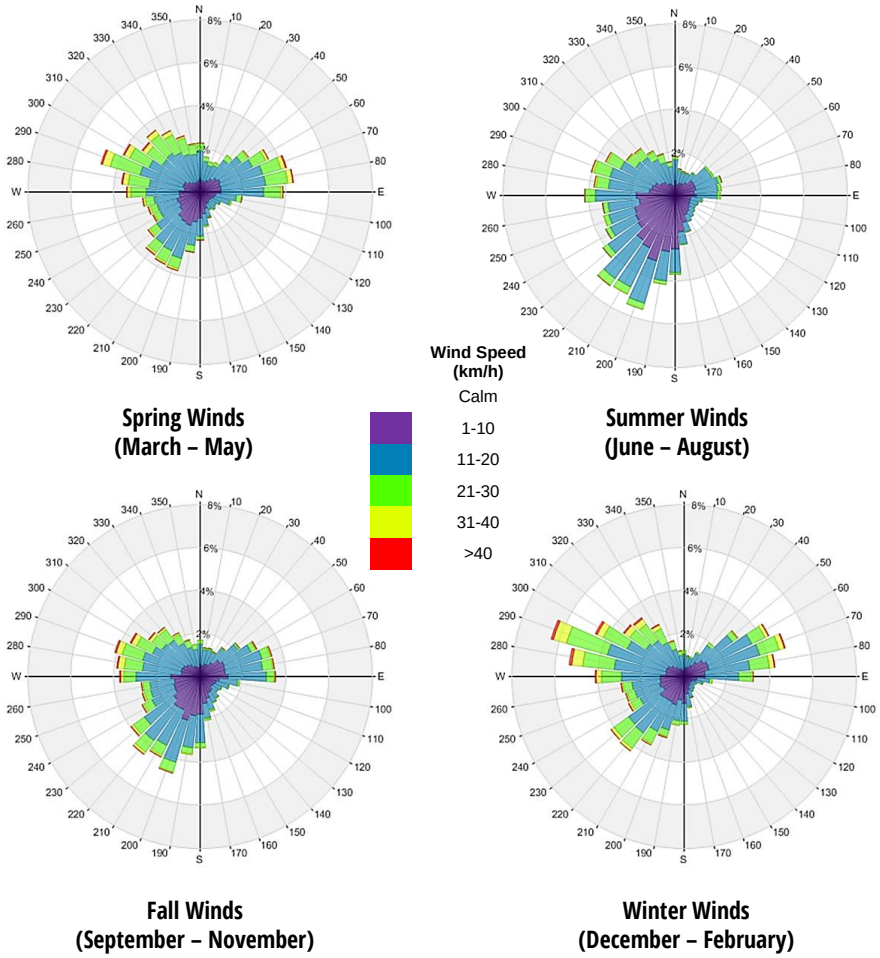


Image 4 – Directional Distribution of Winds Recorded at Ottawa Macdonald-Cartier International Airport (1985 to 2015)

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 municipal authorities and the building design and city planning community including the City of Ottawa. The criteria are as follows:

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.

Pedestrian Comfort

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 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 and parking lot; lower wind speeds comfortable for standing are required for building entrances, where pedestrians may linger. Low wind speeds comfortable for sitting are desired for outdoor amenity area in the summer when these areas will be in use.

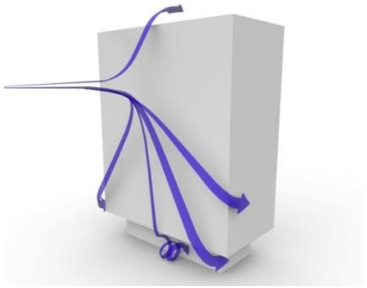
5. PEDESTRIAN WIND CONDITIONS

5.1 Background

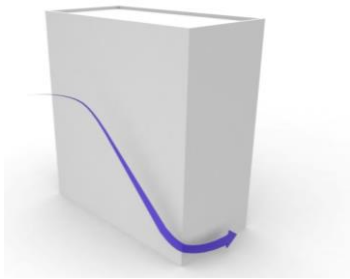
Predicting wind speeds and occurrence frequencies is complicated. It involves building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind-tunnel model studies regarding pedestrian wind 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.

The proposed building is teller than its immediate surroundings and therefore is exposed to the prevailing winds. Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a downwashing flow (see Image 5a) is the main cause for increased wind activity around tall buildings at the grade level. When oblique winds are deflected down by a building, a localized increase in the wind activity can be expected around the downwind building corner at pedestrian level (see Image 5b). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity. Tower setbacks on a podium will reduce the direct impact of downwashing wind flows at grade. However, higher wind speeds are expected at the podium level (see Image 5c).

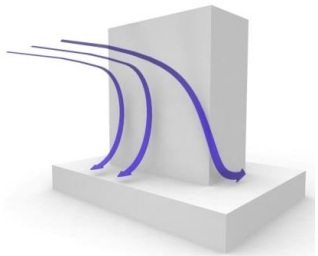
Detailed discussions on the potential wind comfort conditions at key pedestrian areas are provided in the next subsections.



(a) Downwashing Flow



(b) Corner Acceleration



(c) Podiums for Reducing Wind Impact at Grade

Image 5 – Typical Wind Flows around Tall Buildings

5.2 Sidewalks

The sidewalks along Richmond Rd. and Woodroffe Ave. are generally protected from the prevailing west-northwesterly and southwesterly winds by the building massing itself. However, the east-northeasterly winds are expected to reach the ground level after they are directed down by the east building façade (see Image 5a). The building has a setback from Woodroffe Ave. at grade level, which is a positive feature as the sidewalks will be less impacted by the local accelerations around the building (see Image 5c). Wind conditions along the sidewalks are expected to be comfortable for standing or strolling during summer and fall and comfortable for strolling or walking during winter and spring, which are considered appropriate for the intended usage.

5.3 Main and Retail Entrances

The main residential entrance is location along Woodroffe Ave. (marked by red triangle in Image 6). The entrance is equipped with a vestibule, which is a positive design feature as it provides a space for patrons to take shelter on windy days. Commercial entrances are located along Woodroffe Ave. and Richmond Rd. (marked by green triangles in Image 6).

The main and retail entrances are protected from the prevailing west-northwesterly and southwesterly winds by the building itself; however, they will be impacted by winds downwashing off the east façade reaching grade (see Image 5a). Wind speeds at the entrances along Woodroffe Ave. are expected to be higher than desired in particularly during the winter and spring seasons.

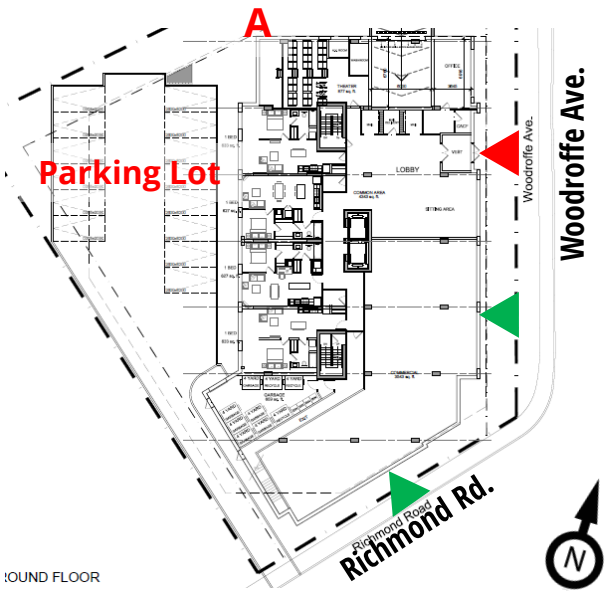


Image 6 – Ground Floor Plan Showing Location of Main Entrances (red triangles) and Retail Entrances (green triangles)

It is recommended that either i) canopies be installed above the Woodroffe Ave. entrances with wind screens or coniferous planters installed to the north of these entrances, or ii) these two entrances be recessed them from the building façade. Examples of these wind control features are shown in Image 7.

Appropriate wind conditions are expected at the commercial entrance along Richmond Rd.

Wind Screens beside an Entrance

Recessed Entrance

Entrance Canopy

Landscaping around an Entrance

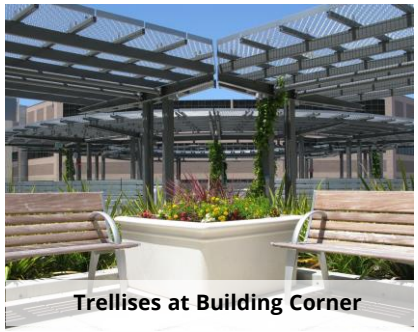
Image 7 – Examples of Wind Control Features for the Entrances along Woodroffe Ave.

5.4 Parking Lot

Wind conditions at the parking lot to the west of the proposed development (see Image 6) are generally expected to be comfortable for strolling or walking during the summer and fall, while uncomfortable conditions are expected during the spring and winter. These high wind speeds are a result of exposure to the west-northwesterly winds. These winds will be accelerated down the west façade and reach grade level. Accelerated wind speeds, which could potentially exceed the safety criterion during spring and winter are expected at the northwest corner of the building as a result of exposure to both west-northwesterly and east-northeasterly winds (Location A in Image 6).

It is recommended that a canopy or trellis be installed along the west building façade that wraps around the corner to keep winds away from the ground. Alternatively, porous wind screens or planters with coniferous landscaping installed at the building corner and throughout the parking lot can help to improve the possibly unsafe wind conditions. Examples of these mitigation measures are shown in Image 8.

Canopy above Building Corner



Trellises at Building Corner

Wind Screens at Building Corner

Landscaping at Building Corner

Image 8 – Examples of Wind Control Features at the Parking Lot and at the Northwest Building Corner

5.5 Level 19 Outdoor Amenity Area

The outdoor amenity area is located on the north, wrapping around the east and west sides of the building at Level 19 (see Image 9). This area is exposed to all prevailing winds. Wind conditions during the summer are expected to be comfortable for sitting or standing as a result of seasonally lower wind speeds in the region. These conditions are appropriate for the intended use. However; wind speeds during the shoulder seasons and winter are expected to be higher than desired for passive pedestrian activities. High wind speeds during the winter are acceptable since this area will not be frequently used during the colder winter months. To improve the conditions to be appropriate during the shoulder seasons, it is recommended that 2 to 2.5m tall parapets be installed around the perimeter of the amenity area. Examples of this wind control feature are shown in the top photographs in Image 10.

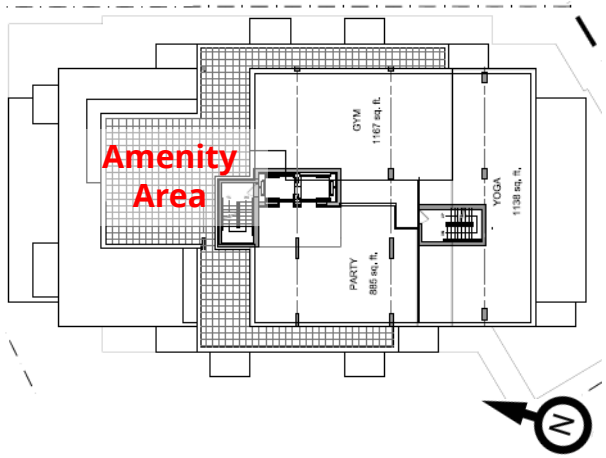


Image 9 – Level 19 Floor Plan

5. PEDESTRIAN WIND CONDITIONS

In addition, localized hard or soft landscaping elements, such as planters, wind screens or trellises in this area, should be placed around seating areas to help to improve the spring, summer and fall wind conditions. Examples of these recommended wind control features are shown in the bottom photographs in Image 10.

Image 10 – Examples of Wind Control Features at the Outdoor Amenity Area

6. SUMMARY

RWDI completed a Preliminary Wind Analysis for the proposed 929 Richmond Street development in Ottawa, ON in support of the SPA submission.

The wind assessment was based on the local wind climate, surrounding buildings, our past experience with wind tunnel testing of similar buildings, and screening-level 3D modelling of wind flows around the development.

The proposed development includes several positive design features such as the building setback from Woodroffe Ave., the vestibule at the residential entrance and the tower setback on the podium. Wind conditions are expected to be suitable for the intended usage at the sidewalks and the commercial entrance along Richmond Rd.

Higher than desired wind speeds are expected at the residential and commercial entrances along Woodroffe Ave, and at the outdoor amenity area at Level 19. Wind speeds in the parking lot might also be slightly higher than desired during the winter and may exceed the safety criterion at the northwest building corner.

Conceptual wind mitigation measures to improve wind conditions are discussed and photograph examples are provided for reference.

7. APPLICABILITY OF RESULTS

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.