REPORT

1250 GORDON STREET

GUELPH, ON

PEDESTRIAN WIND STUDY

PROJECT #2002369

MARCH 2, 2020

SUBMITTED TO

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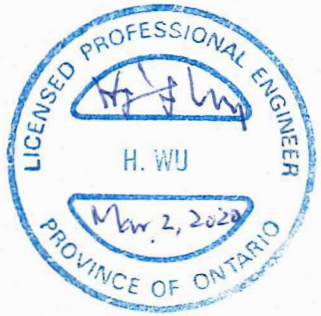

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained by Tricar Developments Inc. to assess the pedestrian wind conditions for the proposed 1250 Gordon Street development in Guelph, ON (see Image 1). This assessment is based on the following:

- a review of regional long-term meteorological data from Waterloo-Wellington International Airport;
- design drawings received from Tricar Developments Inc. on February 5 and 18, 2020;
- wind-tunnel studies undertaken by RWDI for similar building projects;
- 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 to improve wind comfort are recommended, where necessary. In order to quantify these conditions or refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel would be required at a later date.

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

Image 1: 3D View of the Proposed Project (View from West)

1. H. Wu and F. Kriksic (2012). "DeLocal Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
2. H. Wu, C.J. Williams, H.Asigning for Pedestrian Comfort in Response to. 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 1250 Gordon Street, at the intersection with Edinburgh Road South (see Image 2). The site is currently occupied by single family homes.

The immediate surroundings include low rise residential or commercial buildings and empty lands in all directions (Image 2). A few mid-rise residential buildings exist to the south and west of this site.

The proposed development will consist of two residential buildings (Buildings A and B in Image 1) of 12-storeys.

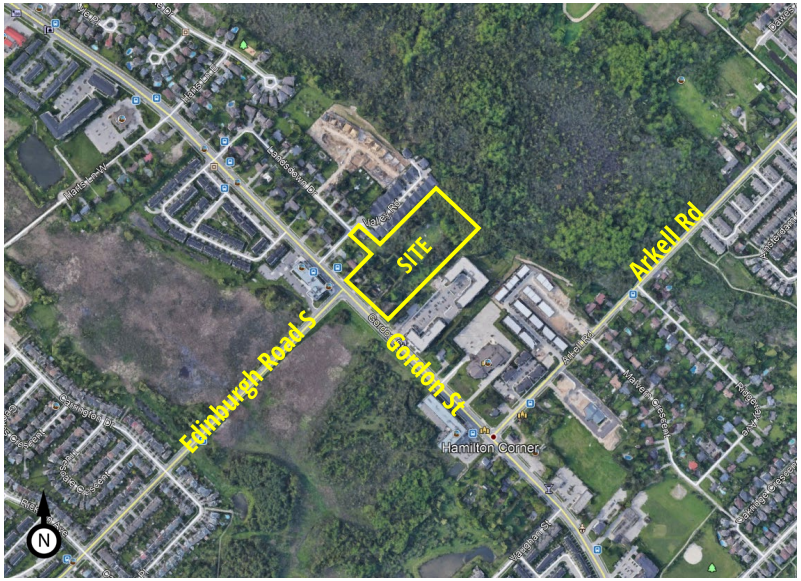


Image 2: Aerial View of Existing Site and Surrounding *(Courtesy of Google™ Earth)*

Pedestrian accessible areas on and around the site include sidewalks, building entrances, Level 1 patios and a ground level common amenity area.

Image 3: Building A West Elevation (top), Building A and B North Elevations (bottom)

3. METEOROLOGICAL DATA

Meteorological data from Waterloo-Wellington International Airport recorded between 1988 and 2017 were used as reference for wind conditions. This is the nearest weather station with long-term wind data.

The distributions of wind frequency and directionality for summer (May through October) and winter (November through April) seasons are shown in the wind roses in Image 4.

When all winds are considered (regardless of speed), winds from the southwest through northwest and east directions are predominant during both summer and winter.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10m) occur more often in the winter than in the summer.

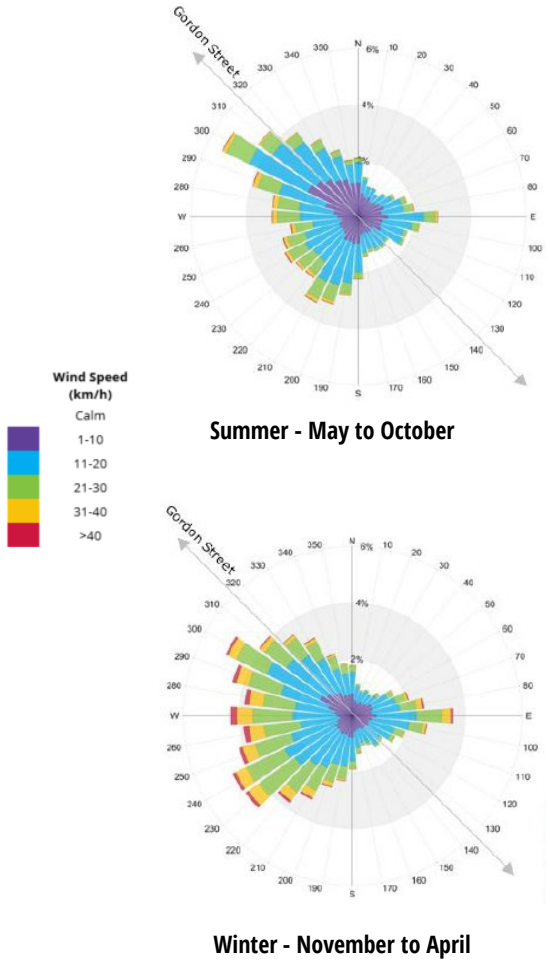


Image 4: Directional Distribution of Winds Approaching Waterloo-Wellington International Airport (1988-2017)

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 by the building design and city planning community, including the City of Guelph. The criteria are described as follows:

Comfort Category	GEM Speed (km/h)	Description
Sitting	≤ 10	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	≤ 15	Gentle breezes suitable for main building entrances, bus stops, plazas, and other places where pedestrians may linger
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 20	Strong winds of this magnitude are considered a nuisance for all pedestrian activities, and wind mitigation is typically recommended

Safety Criterion	Gust Speed (km/h)	Description
Exceeded	> 90	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is required.

Image 5: Wind Comfort and Safety Criteria (taken from *City of Guelph – Pedestrian Level Wind Studies Terms of Reference, May 2019*)

Notes:

1) GEM speeds are equal to the gust speed divided by 1.85, or the mean speed (whichever is larger); and,
2) GEM speeds listed above are based on a seasonal exceedance of 20% of the time between 6:00 and 23:00.

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 are appropriate for sidewalks; and lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger. Wind speeds comfortable for sitting are appropriate for outdoor patios and terraces during the summer, when these areas will be mainly used.

5. PEDESTRIAN WIND CONDITIONS

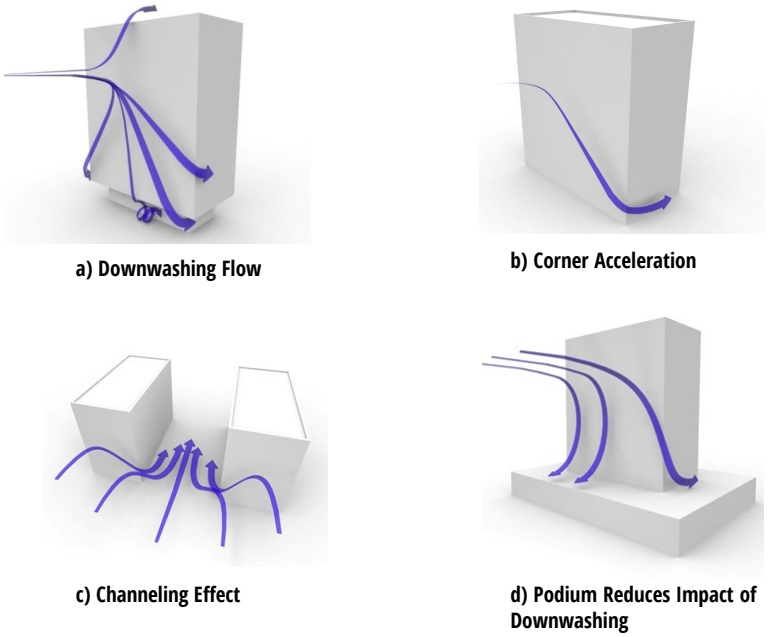
5.1 Background

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 development is taller than its surroundings and exposed to the prevailing winds in all directions. Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. Such a *Downwashing Flow* (Image 6a) 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 or *Corner Acceleration* can be expected around the downwind building corner at pedestrian level (Image 6b). If these building/wind combinations occur for prevailing winds, there is a greater potential for increased wind activity.

When two buildings are situated side by side, wind flows tend to accelerate through the space between the buildings due to *Channeling Effect* (Image 6c). Building setbacks and podiums will reduce the direct impact of downwashing wind flows at grade (see Image 5d); however, while higher wind activities can be expected on the podiums themselves.

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



a) Downwashing Flow

b) Corner Acceleration

c) Channeling Effect

d) Podium Reduces Impact of Downwashing

Image 6: General Wind Flow Patterns

5.2 Existing Wind Conditions

Wind conditions around the existing site are expected to be comfortable for sitting or standing during the summer, and for walking or better during the winter, which is appropriate for the intended use. No exceedance of the safety criteria is likely to exist on this site.

5.3 Proposed Conditions

The introduction of the proposed project will increase wind speeds on the site. Even with this increase we do not expect any winds that exceed the wind safety criterion, however, some areas are expected to have less than desirable conditions. Images 7 and 8 present the predicted wind comfort conditions for the summer and winter seasons respectively.

5.3.1 Walkways

Building A, is closest to Gordon St and has a significant tower setback creating a podium along the west side of the tower. This feature is expected to mitigate wind impacts on the Gordon St sidewalk (see Image 5d) however, the Level 1 patios on top of this podium would benefit from some wind control. Conditions along the Gordon St sidewalk are expected to be appropriate on a year-round basis (see Images 7 and 8).

The sidewalks along the proposed Street A are expected to be comfortable for walking or better.

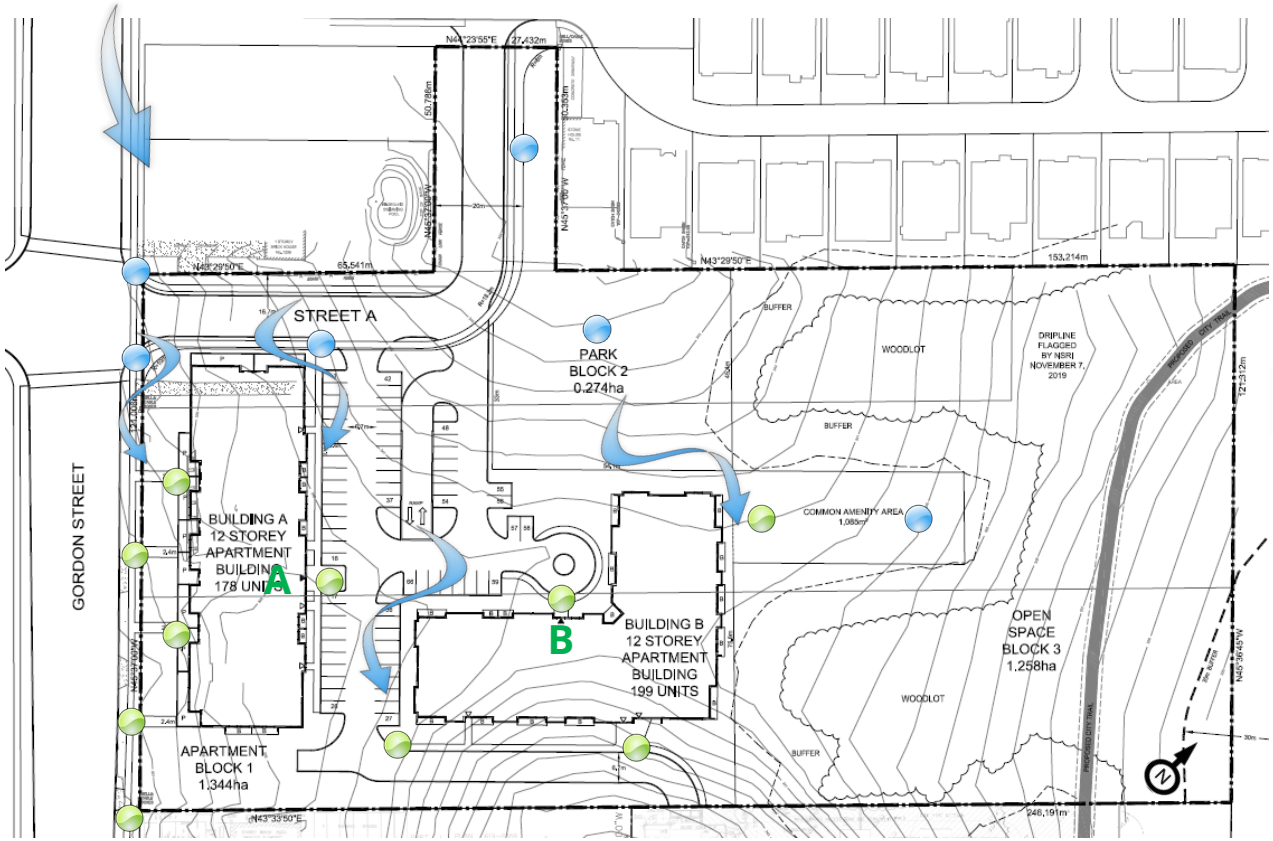
The on-site walkways are for the most part expected to have appropriate wind conditions. The exception is the south corner of Building B where uncomfortable winds are predicted in the winter (see Image 8). These would result from the strong northwesterly winds accelerating around Building A (see Image 6b) and then channeling between Buildings A and B (see Image 6c). To mitigate this condition would require introducing a canopy / trellis feature and/or planting coniferous / marcescent trees and/or installing vertical wind screens to provide local wind protection.

5.3.2 Building Entrances

The main entrance to Building A (location A in Images 7 and 8) is on the leeward side of the tower and conditions are predicted to be comfortable for standing in summer and walking in winter. The winter walking conditions (see Image 7) are not ideal for an entry area and it would benefit from being recessed into the façade or the addition of coniferous / marcescent landscaping or vertical porous wind screens to the north of this entrance area.

Location B in Images 7 and 8 is the main entrance to Building B. This entrance is predicted to be comfortable for standing in both summer and winter due primarily to the canopy above this entry (as shown in the renderings). This canopy feature will be important for wind protection and should be preserved in the design.

5. PEDESTRIAN WIND CONDITIONS



Predicted *SUMMER* Wind Conditions

- Sitting / Standing
- Standing / Walking
- Uncomfortable

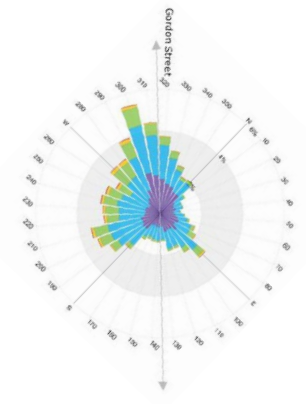
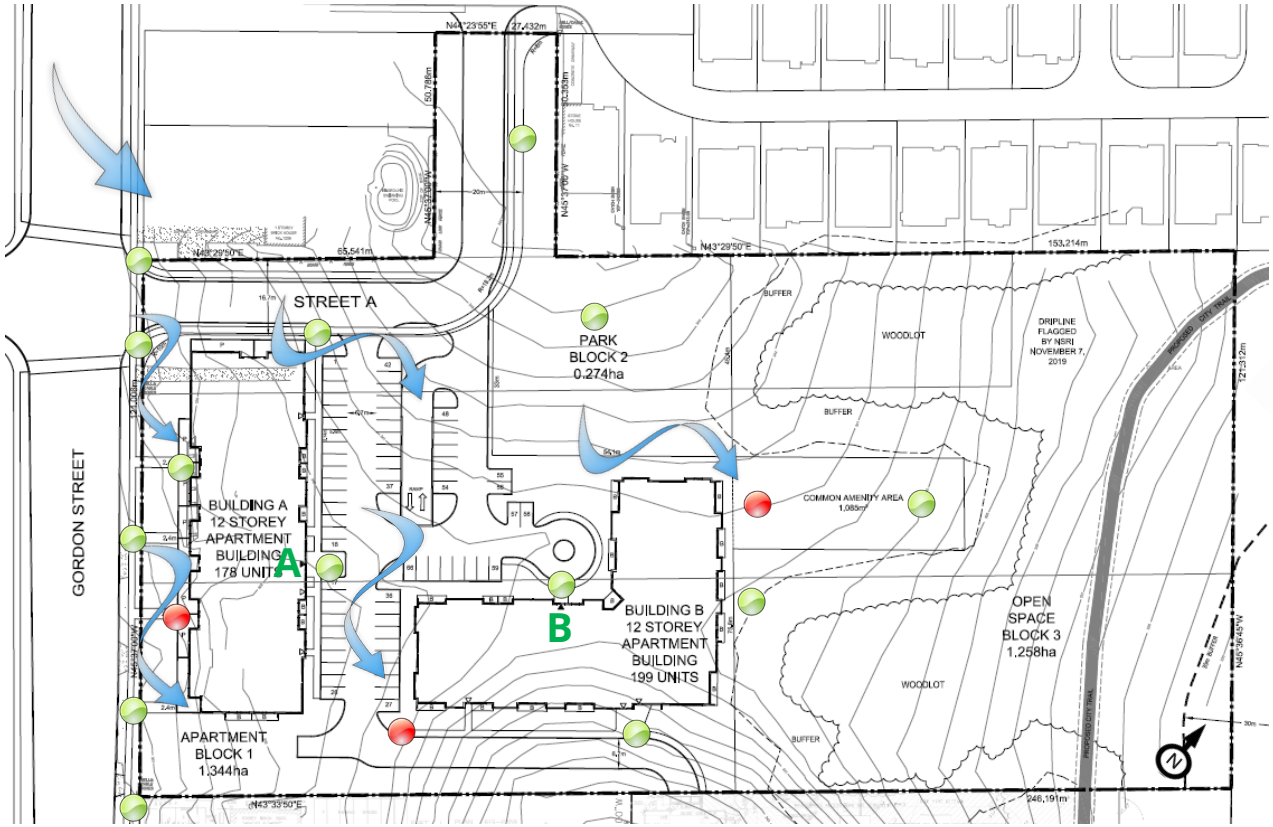


Image 7: Predicted *SUMMER* Wind Conditions (Ground Level)

5. PEDESTRIAN WIND CONDITIONS



Predicted *WINTER* Wind Conditions

- Sitting / Standing
- Standing / Walking
- Uncomfortable

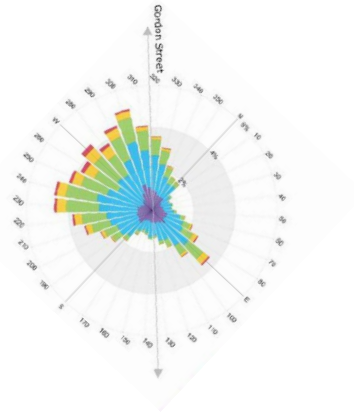


Image 8: Predicted *WINTER* Wind Conditions (Ground Level)

The Level 1 entrances to the townhouses along Gordon St are well situated in recessed pockets in the tower façade. These features will provide additional wind protection and conditions are expected to be acceptable.

5.3.3 Level 1 Patios

As described in section 5.3.1 the Level 1 patios on Building A will be exposed to strong westerly and northwesterly winds being redirected by the tower façade and onto this podium level as per Images 6a and 6b. Summer conditions will likely comfortable for walking which is less than ideal for the intended passive pedestrian use. Wind conditions are likely to be uncomfortable in the winter, especially at the patios closer to the south end of the tower. To improve these conditions would require a combination of overhead canopies / trellises to protect from downwashing winds (Image 6a) and vertical porous wind screens / planters installed perpendicular to the tower façade to provide localized wind protection for each of the patios. Image 9 provides some design guidelines for design of vertical wind screens and Image 10 provides some examples.

The patios at the north end of Building A are likely to have better wind conditions but would still benefit from overheard canopies / trellises to protect from downwashing winds.

5.3.4 Common Amenity Area

As shown in Images 7 and 8, this amenity area will be vulnerable to winds accelerating around the north corner of Building B resulting in conditions comfortable for walking in summer and uncomfortable in winter. The summer conditions are not ideal and can be mitigated by relocating this amenity space away from the building corner or incorporating trees and/or vertical screens to provide areas of localized wind protection (see Images 6b, 9 and 10).

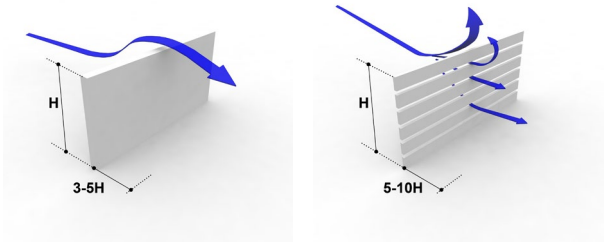


Image 9: Design Guidelines for Solid and Porous Windscreens

6. EXAMPLES OF WIND CONTROL STRATEGIES

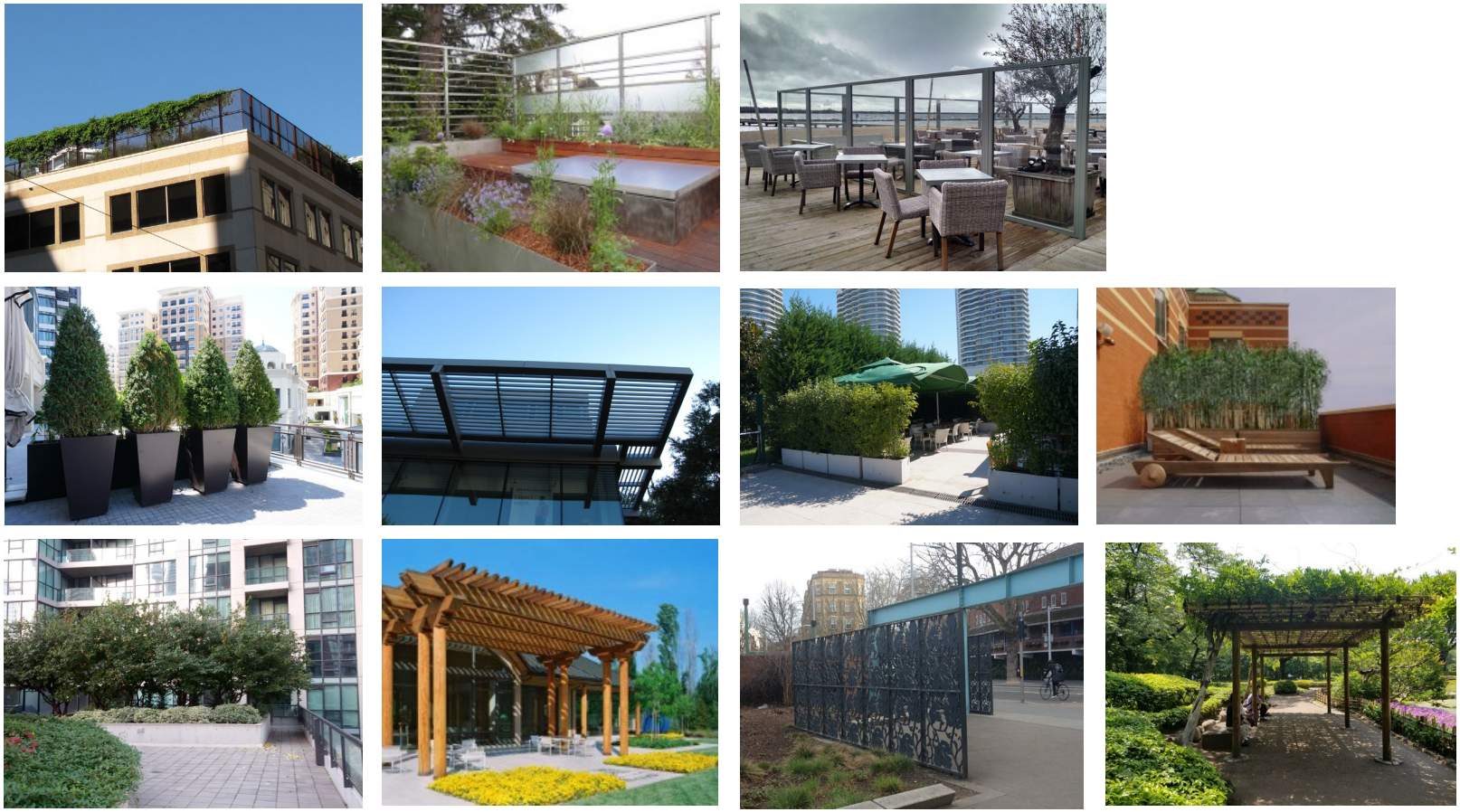


Image 10: Examples of Mitigation Measures for Patios and Terraces

7. SUMMARY

Wind conditions on and around the proposed 1250 Gordon St. development in Guelph, ON are discussed in this report, based on the local wind climate, surrounding buildings and our past experience with wind tunnel testing of similar buildings.

The proposed development has a number of positive design features such a tower setback and podium on the Building A, canopies above entrances and recessed entrances.

Appropriate wind conditions are expected at the sidewalks along Gordon St. within most of the site. An exception exists in the area between Buildings A and B where wind mitigation is suggested. Also, the patios on Level 1 and the common amenity area are predicted to have less than ideal wind conditions where wind control suggestions have been suggested.

Given the risk of uncomfortable winds at some ground level locations and the Level 1 patios, we recommend that wind tunnel testing of a scale model be carried out at a later date to confirm and quantify these conditions, and develop wind control strategies where required.

8. APPLICABILITY OF RESULTS

The assessment presented in this report are for proposed 1250 Gordon St. development in Guelph, ON based on the design drawings and documents received from Tricar Developments Inc. on February 5 and 18, 2020.

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.