

REPORT

525 – 565 CONESTOGO ROAD

WATERLOO, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2002470

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SUBMITTED TO

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1. INTRODUCTION



Rowan Williams Davies & Irwin Inc. (RWDI) was retained by GSP Group Inc. to conduct a qualitative desktop wind assessment for a proposed development at 525 – 565 Conestogo Road in Waterloo, Ontario (see **Image 1**). This assessment is in support of the Rezoning Application as required by the City of Waterloo.

This assessment was based on the following:

- a review of regional long-term meteorological data from the Region of Waterloo International Airport;
- design drawings received from ABA Architects Inc. on April 13, 2021;
- wind-tunnel studies undertaken by RWDI for similar projects in the Kitchener Waterloo area;
- our engineering judgement and knowledge of wind flows around buildings¹⁻³; and,
- The 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. To confirm and quantify these wind conditions, refine wind control measures and address phasing, physical scale-model tests are recommended.

Note that other wind issues, such as those related to wind loading, stack effect, air quality, snow accumulations, door operability, solar glare, etc., were not considered in the scope of this assessment.



Image 1: Aerial View of Existing Site and Surrounding (courtesy of Google™ Earth)

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 on Conestoga Road, south of Northfield Drive West and east of the Conestoga Parkway in Waterloo, Ontario.

The project involves the development of eight blocks with individual buildings ranging in height from three to 35 storeys. These will total approximately 315,000 square meters of above-grade residential, retail and office space. Pedestrian areas of interest include the main building entrances, adjacent sidewalks and outdoor amenity spaces. **Image 2** shows a rendered view of the proposed development.

The immediate surroundings are mostly low-rise commercial or industrial buildings. Downtown Waterloo is located approximately four kilometers to the south-southeast and the Region of Waterloo International Airport is approximately 13 kilometers to the southeast.



Image 2: Rendering of Project – Looking Northeast across the Conestoga Parkway (*courtesy of ABA Architects Inc.*)

3. WIND DATA



Meteorological data from the Region of Waterloo International Airport recorded between 1987 and 2017 were used as reference for wind conditions. This is the nearest station to the project site 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 by the wind roses in **Image 3**.

When all winds are considered (regardless of speed), winds from the south-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.

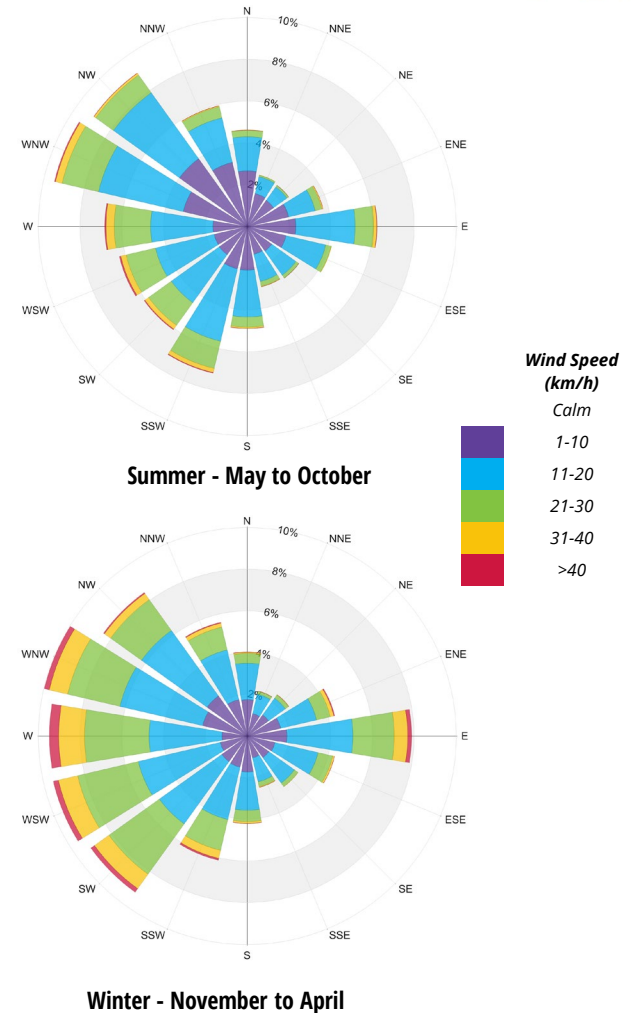


Image 3: Directional Distribution of Winds Approaching Region of Waterloo International Airport (1987 – 2017)

4. 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 Waterloo. The criteria are as follows:

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 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: None of the comfort categories are 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 if 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.

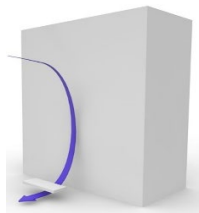
For the current development, wind speeds comfortable for *walking* or *strolling* are appropriate for the parking lot and sidewalks; and lower wind speeds comfortable for *standing* are required for building entrances where pedestrians may linger. *Sitting* / *standing* conditions are preferable for outdoor amenity spaces.

5. PEDESTRIAN WIND CONDITIONS



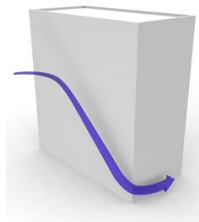
5.1 Background

In our discussion of wind conditions on and around the proposed project, reference may be made to the following generalized wind flows (see **Image 4**). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.



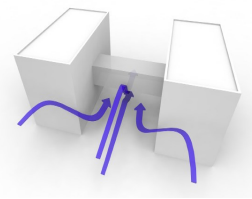
Downwashing

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.



Corner Acceleration

Winds approach at an oblique angle to a tall façade and are deflected down causing a localized increase in the wind activity or corner acceleration around the exposed building corner(s) at pedestrian level.



Channeling

When two buildings are situated side by side or an underpass is created, wind flow tends to accelerate through the space due to channeling effect caused by the narrow gap.

Image 4: Generalized Wind Flows

Design details such as; setting back a tall tower from the edges of a podium, deep canopies close to ground level, wind screens / tall trees with dense landscaping, etc. (**Image 5**) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

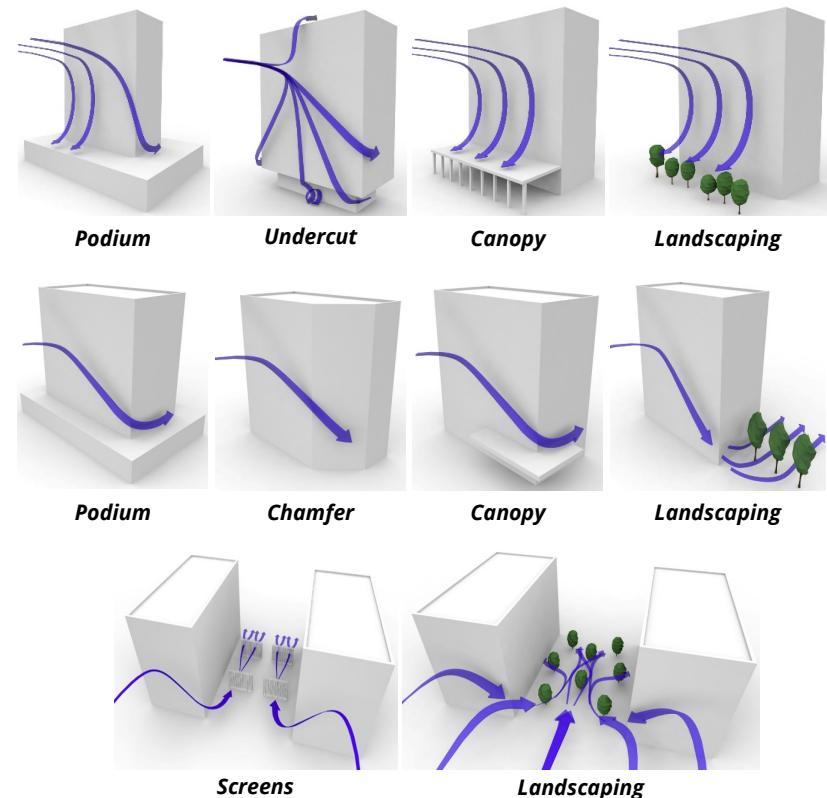


Image 5: Examples of Common Wind Control Measures

5. PEDESTRIAN WIND CONDITIONS



5.2 Existing Conditions

The wind conditions around the existing site are most likely comfortable for *standing* in summer and *strolling* in winter. No exceedances of the wind safety criterion are likely to exist.

5.3 Proposed Conditions

The predicted summer and winter wind comfort conditions during the full-build scenario for this master plan are presented in **Images 6 and 7**, respectively. The locations are focused on building entrances and amenity spaces. The following text discusses the highlights of the expected wind conditions.

1. Given the fact that buildings, taller than their surroundings intercept stronger winds at upper levels and encourage them to flow toward grade level (as per the generic examples of downwashing and corner acceleration in **Image 4**), and multiple buildings tend to interact with the wind in complex ways (as per channeling flows in **Image 4**), a general increase to existing wind speeds is anticipated. There is also potential for some on-site locations to exceed the wind safety criterion. It is therefore recommended that a scale model of this project be wind tunnel tested to confirm and quantify the predictions in this report and develop wind control strategies where required.
2. The proposed project is not expected to have significant impacts on the existing wind conditions in the surrounding neighborhoods.
3. The proposed design includes a number of positive design features from a wind comfort perspective which should be preserved. These include the following:
 - a) reasonable separation distance between the taller towers;
 - b) towers that tend to be more square versus rectangular in plan while those that are rectangular (i.e., Block 6) are well oriented with respect to the prevailing winds; and,
 - c) the use of podiums that allow for tower setbacks which will help reduce the impact of downwashing winds.
4. Public sidewalks are expected to have appropriate wind conditions (i.e., walking or better on an annual basis). This result is in part due to the incorporation of strategically located trellises, canopies, screens and/or trees. These design features are conceptually described in **Image 9** and should be preserved.
5. All the major building entrances have been designed to incorporate positive features with respect to wind protection. These include locating entrances away from building corners, recessed entrances, adding surrounds and/or canopies. These features are also conceptually described in **Image 9** and should be preserved as they will help provide more appropriate wind conditions at the entrances themselves, even when the sidewalk areas in front of the entrances are windier.

5. PEDESTRIAN WIND CONDITIONS



- Predicted *SUMMER* Wind Conditions**
- Sitting / Standing
 - Strolling / Walking
 - Uncomfortable

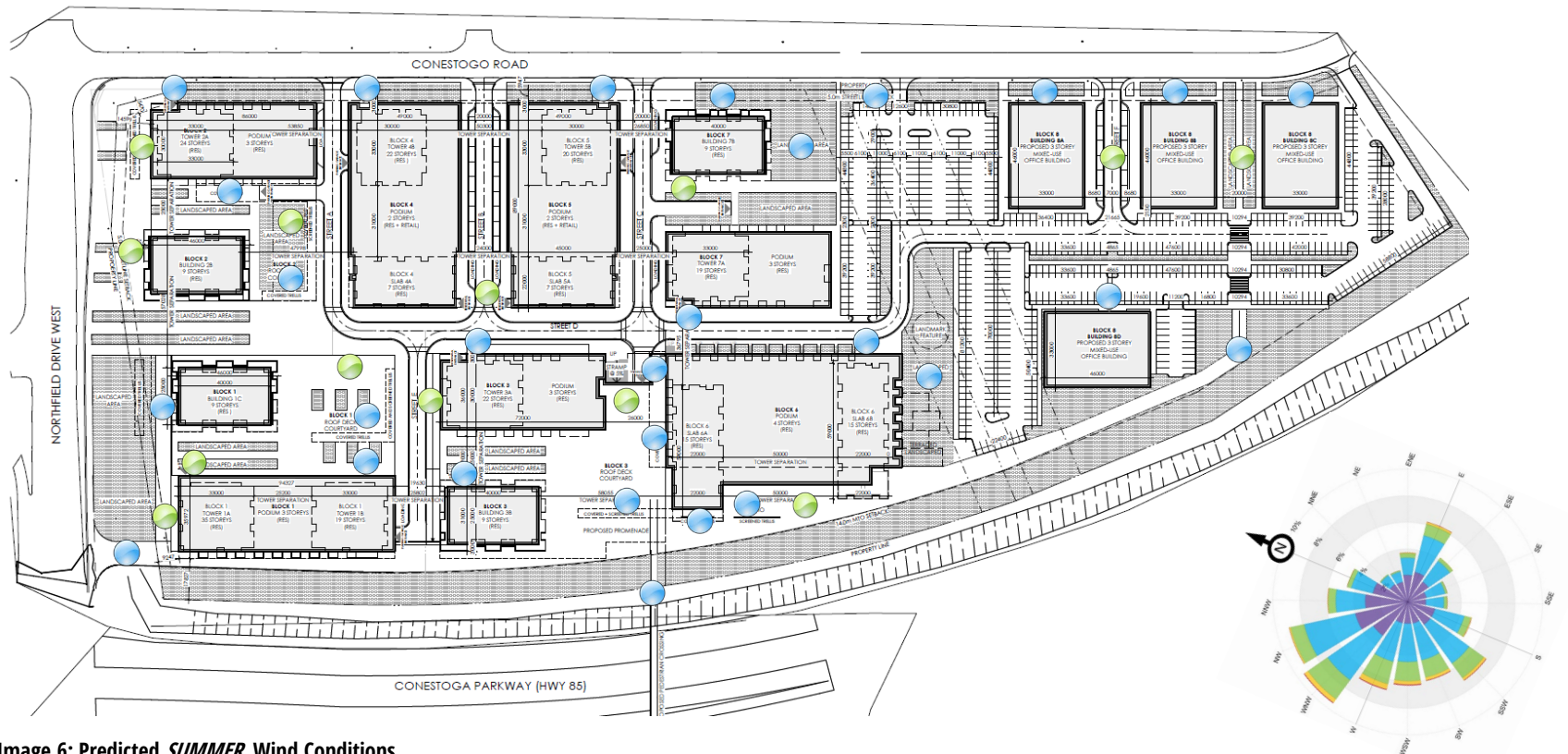


Image 6: Predicted *SUMMER* Wind Conditions

5. PEDESTRIAN WIND CONDITIONS



- Predicted *WINTER* Wind Conditions**
- Sitting / Standing
 - Strolling / Walking
 - Uncomfortable

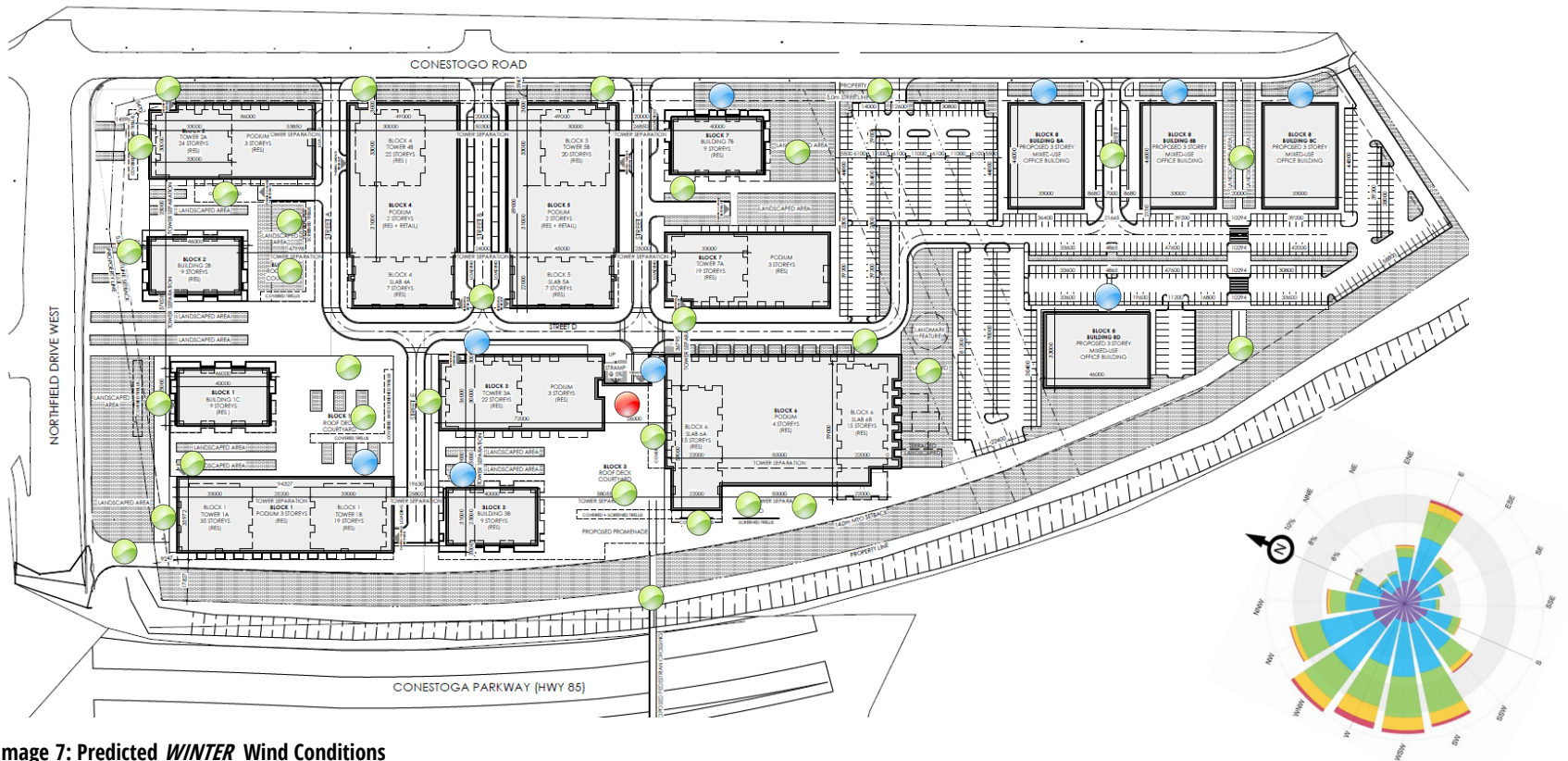


Image 7: Predicted *WINTER* Wind Conditions

5. PEDESTRIAN WIND CONDITIONS



6. Roof deck courtyards are planned in Blocks 1, 2 and 3. Due to their higher elevations and in some cases, proximity to taller towers, the conditions there are expected to range from sitting to walking categories in the summer (**Image 6**). These conditions are likely to be considered appropriate (depending on the ultimate programming and intended usage) and result due to the design team's incorporation of strategically located trellises, canopies and vertical screens to help enhance wind comfort in portions of these courtyards. Stronger winter winds are likely to cause isolated areas of uncomfortable conditions in the Block 3 courtyard (**Image 7**). These conditions may not be of concern as outdoor amenity spaces are unlikely to be used during the winter. If improved conditions are desired, then additional vertical winds screens or landscaping installed using the guidelines shown in **Image 8** should be considered.
7. Given the number of buildings included in this development predicting wind conditions at a screening-level is difficult. These condition should be confirmed and quantified using scale model testing methods. Wind control strategies should be refined if and where required. In addition, the size of this development suggests that phasing considerations will be important and complicated. This is because interim wind conditions may exist for years during which conditions are likely to be less desirable than predicted during the full build-out scenario. The best way to address this issue is to test the wind conditions on a scale model during some assumed phasing scenarios to ensure that interim conditions are properly addressed.

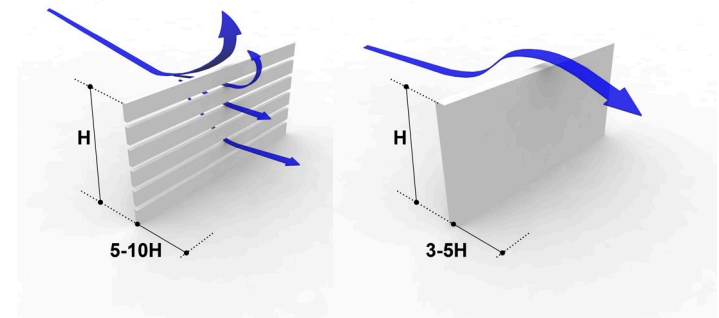


Image 8 – Design Guidelines for Wind Screens

6. INCORPORATED WIND CONTROL



Wind Control Concepts

- A** Massing refinements and/or canopy and/or coniferous trees.
- B** Relocate entrance and/or add vertical wind screens / planters.
- C** Vertical wind screens / planters.
- D** Provide overhead protection in the form of canopy / trellis / trees.

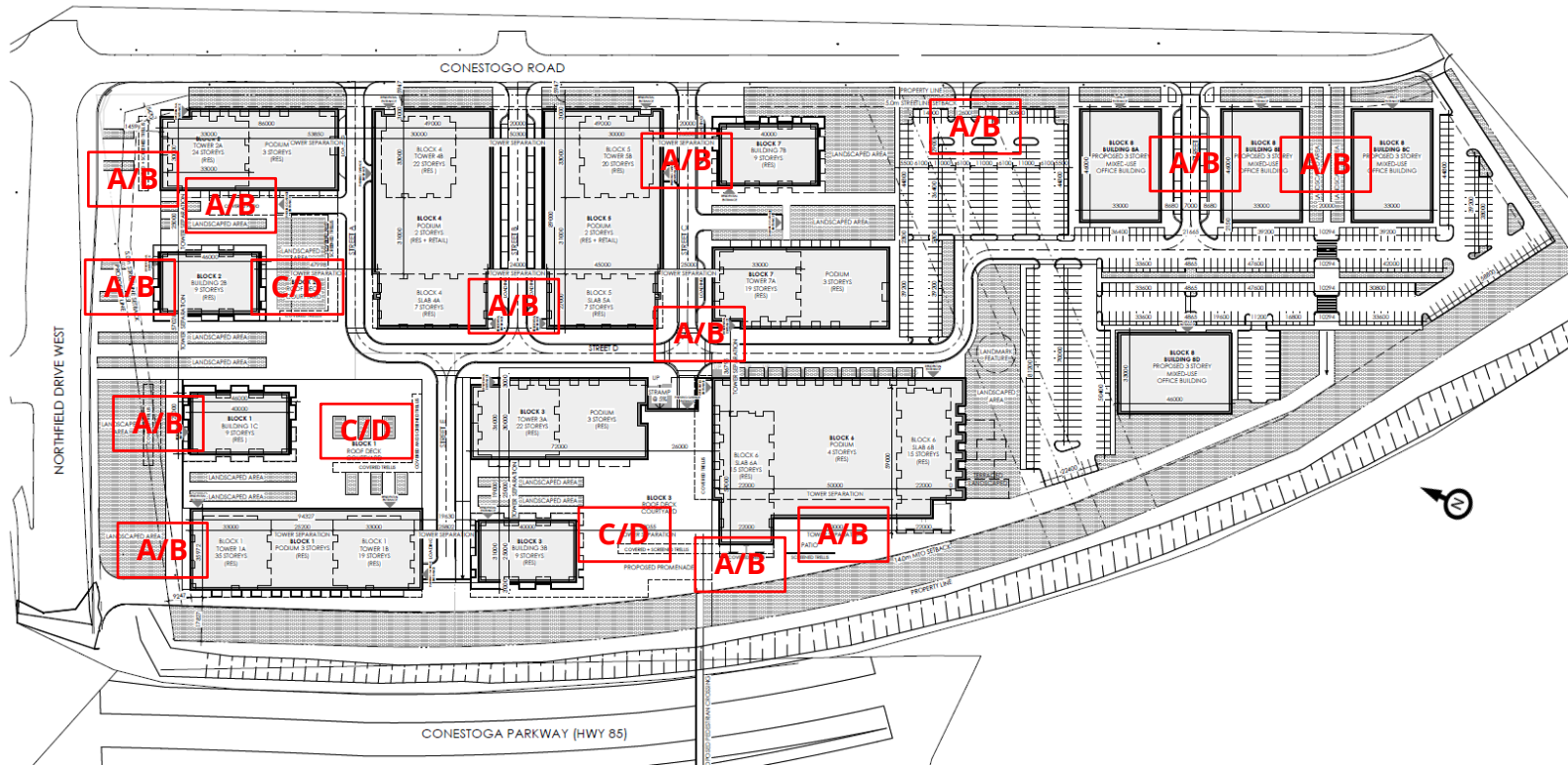


Image 9: Recommended Wind Control Concepts

7. EXAMPLES OF WIND CONTROL STRATEGIES



Image 10 – Examples of Building Massing Refinements and Canopies for Wind Control

7. EXAMPLES OF WIND CONTROL STRATEGIES



Image 11 – Examples of Building Entrance Wind Control Strategies

7. EXAMPLES OF WIND CONTROL STRATEGIES



Image 12 – Examples of Wind Screens on Amenity Decks

8. SUMMARY

Given the number of buildings and the fact that most are taller than the surroundings it is expected that this development will increase existing wind speeds on-site but not have a significant impact on surrounding neighbourhoods.

There is potential for some on-site locations to exceed the wind safety criterion.

Public sidewalks are expected to have appropriate wind conditions.

Supplementary wind control strategies have been incorporated in an effort to improve conditions at some sidewalk areas and most of the major building entrances.

Roof deck courtyards have also incorporated design features in an effort to reduce wind impacts. Winter conditions may still be a challenge in isolated cases however use of outdoor amenities in the winter is less likely.

Scale model testing in a wind tunnel is recommended for this project to confirm and quantify the predictions in this report and refine wind control strategies where required. In addition, the impacts during interim phasing should also be addressed.

9. APPLICABILITY OF RESULTS



The assessment presented in this report is for proposed 525 – 565 Conestogo Road in Waterloo, Ontario and is based on the design drawings and documents received from ABA Architects Inc. on April 13, 2021.

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.