UTOPIA WEST (5103 GREENLANE ROAD)

BEAMSVILLE, ONTARIO

FINAL PEDESTRIAN WIND ASSESSMENT

PROJECT #2103885
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SUBMITTED TO

Jason Garland
Managing Director
Jason.garland@nhdg.ca

New Horizon Development Group Inc.
200-3170 Harvester Road
Burlington, ON L7N 3W8
T: 905.777.0000

SUBMITTED BY

Leo (Yi) Zeng, M.Eng.
Technical Coordinator
Yi.Zeng@rwdi.com

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

Dan Bacon
Senior Project Manager / Principal
Dan.Bacon@rwdi.com

RWDI
600 Southgate Drive
Guelph, Ontario, N1G 4P6
T: 519.823.1311 x2245
F: 519.823.1316

1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to assess the potential wind conditions at pedestrian levels on and around the proposed Utopia West project at 5103 Greenlane Road in Beamsville, Ontario. The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development in support of the Site Plan Approval (SPA).

The project site is located on the north side of Green Lane, between Ontario Street to the east and Lincoln Avenue to the west. The site is surrounded by low-rise buildings to the south and southeast, with open fields in all other directions (Image 1). A six-storey development is planned to the east of project site and is included as an existing building in this assessment. Lake Ontario is approximately 1.7 km to the north.

The project is a mix-used development that will consist of three 10-storey buildings, one 6-storey building, and one 1-storey retail, all connected from north to south. The building will have a stepped form, which is favourable for reducing wind impacts (Image 2). In addition to sidewalks and properties near the project site, key areas of interest for this assessment include the main entrances to the building, parking lots and outdoor amenity space (Image 3).

Image 1: Aerial View of the Existing Site and Surroundings
Credit: Google Maps

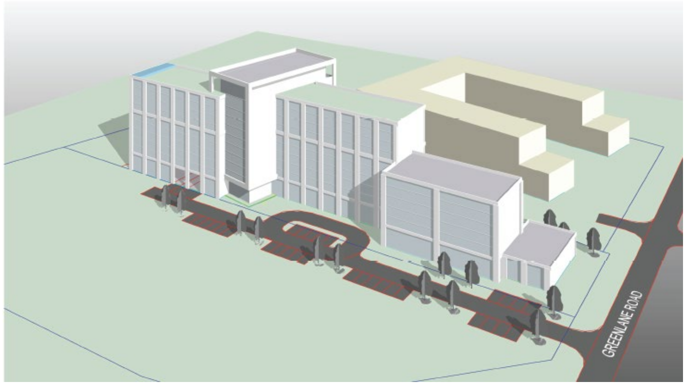


Image 2: Conceptual Massing (View from Southwest)

1. INTRODUCTION

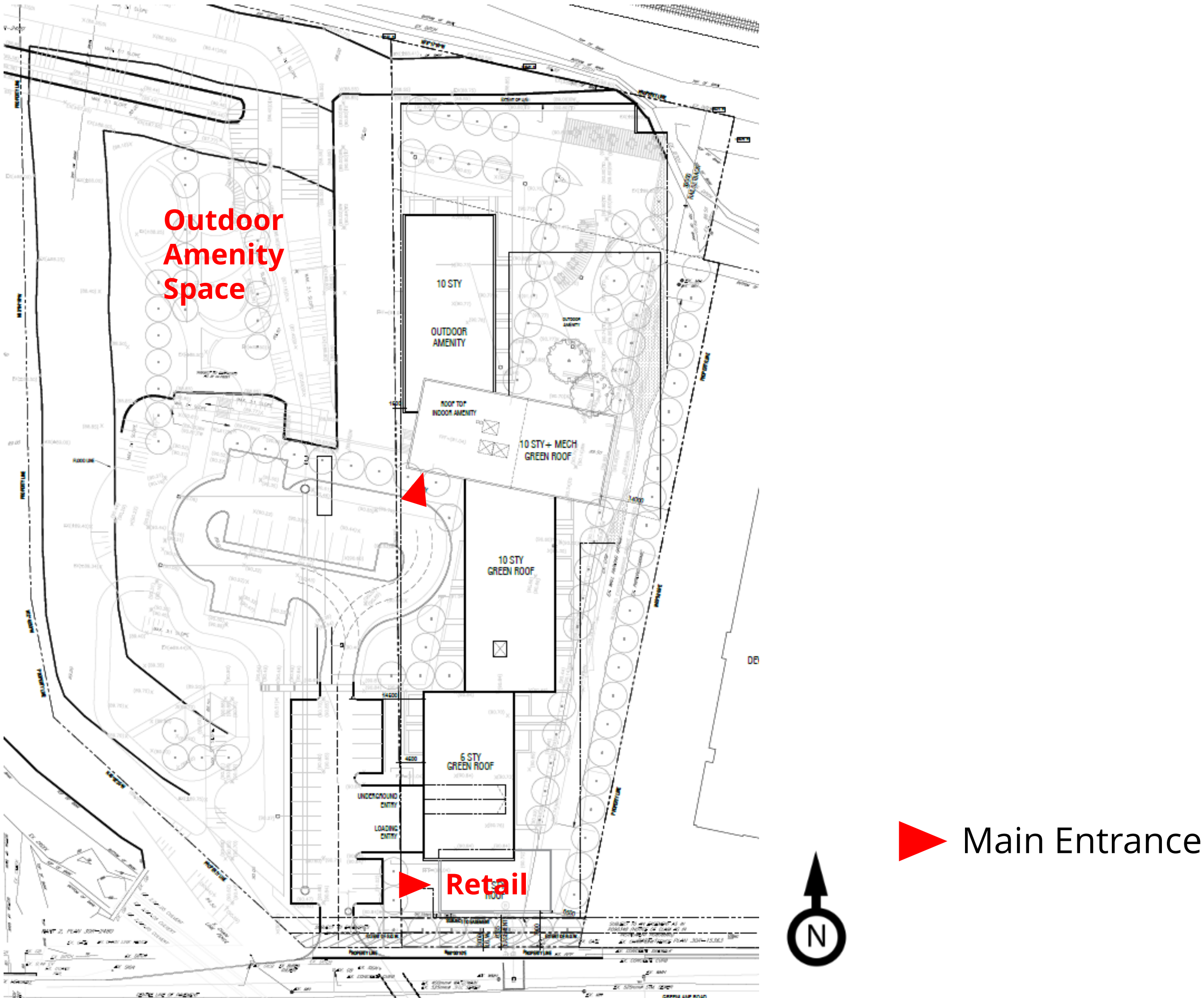


Image 3: Site Plan

2. METHODOLOGY

2.1 Objective

The objective of this assessment is to provide an evaluation of the potential wind impact of the proposed development on pedestrian areas around it. The assessment is based on the following:

- A review of the regional long-term meteorological data from St. Catharines Niagara District Airport;
- 3D e-model and site plan of the proposed project received on August 4, 2021;
- The use of *Orbital Stack*, an in-house computational fluid dynamics (CFD) tool, to aid in the assessment of wind comfort levels;
- The use of RWDI's proprietary tool WindEstimator[1] for estimating the potential wind conditions around building forms;
- The RWDI wind comfort and safety criteria;
- Wind tunnel studies completed by RWDI for similar projects in Niagara region; and,
- Our engineering judgment, experience, and expert knowledge of wind flows around buildings[1-3].

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

2.2 CFD in Urban Wind Modelling

CFD is a numerical modelling technique for simulating wind flow in complex environments. For urban wind modelling, CFD techniques are used to generate a virtual wind tunnel where flows around the site, surroundings and the study building are simulated at full scale. The computational domain that covers the site and surroundings are divided into millions of small cells where calculations are performed, which allows for the "mapping" of wind conditions across the entire study domain. CFD excels as a tool for urban wind modelling for providing early design advice, resolving complex flow physics, and helping diagnose problematic wind conditions. It is useful for the assessment of complex buildings and contexts and provides a good representation of wind conditions which makes it easy to judge or compare designs and site scenarios.

Gust conditions are infrequent but deserve special attention due to their potential impact on pedestrian safety. The computational modeling method used in the current assessment does not quantify the transient behaviour of the wind, including wind gusts. The effect of gust, i.e. wind safety, is predicted qualitatively in this assessment using analytical methods and wind-tunnel-based empirical models[1]. The assessment has been conducted by experienced microclimate specialists in order to provide an accurate prediction of wind conditions.

In order to quantify the transient behavior of wind and refine any conceptual mitigation measures, physical scale-model tests in a boundary-layer wind tunnel or more detailed transient computational modeling would be required.

2. METHODOLOGY

2.3 Simulation Model

Wind flows were simulated using Orbital Stack, an in-house computational fluid dynamics (CFD) tool, for the Existing and Proposed site configurations with the existing surroundings (Images 4 to 6).

For the purposes of this computational study, the 3D models were simplified to include only the necessary building and terrain details that would affect the local wind flows in the area and around the site. Landscaping and other smaller architectural and accessory features were not included in the computer model in order to provide more conservative wind conditions (as is the norm for this level of assessment).

The wind speed profiles in the atmospheric boundary, approaching the modelled area were simulated for 16 directions (starting at 0°, at 22.5° increments around the compass). Wind data in the form of ratios of wind speeds at approximately 1.5m above concerned levels, to the mean wind speed at a reference height were obtained. The data was then combined with meteorological records obtained from St. Catharines Niagara District Airport to determine the wind speeds and frequencies in the simulated areas.

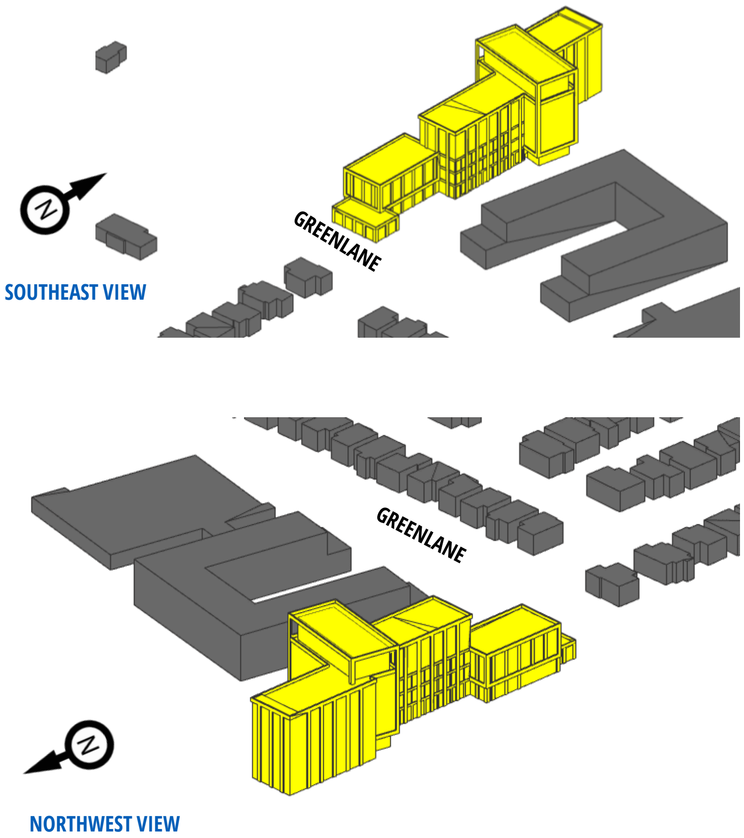


Image 4: Computer Model of the Proposed Project

2. METHODOLOGY

Image 5: Computer Model of the Existing Site and Extended Surroundings

2. METHODOLOGY

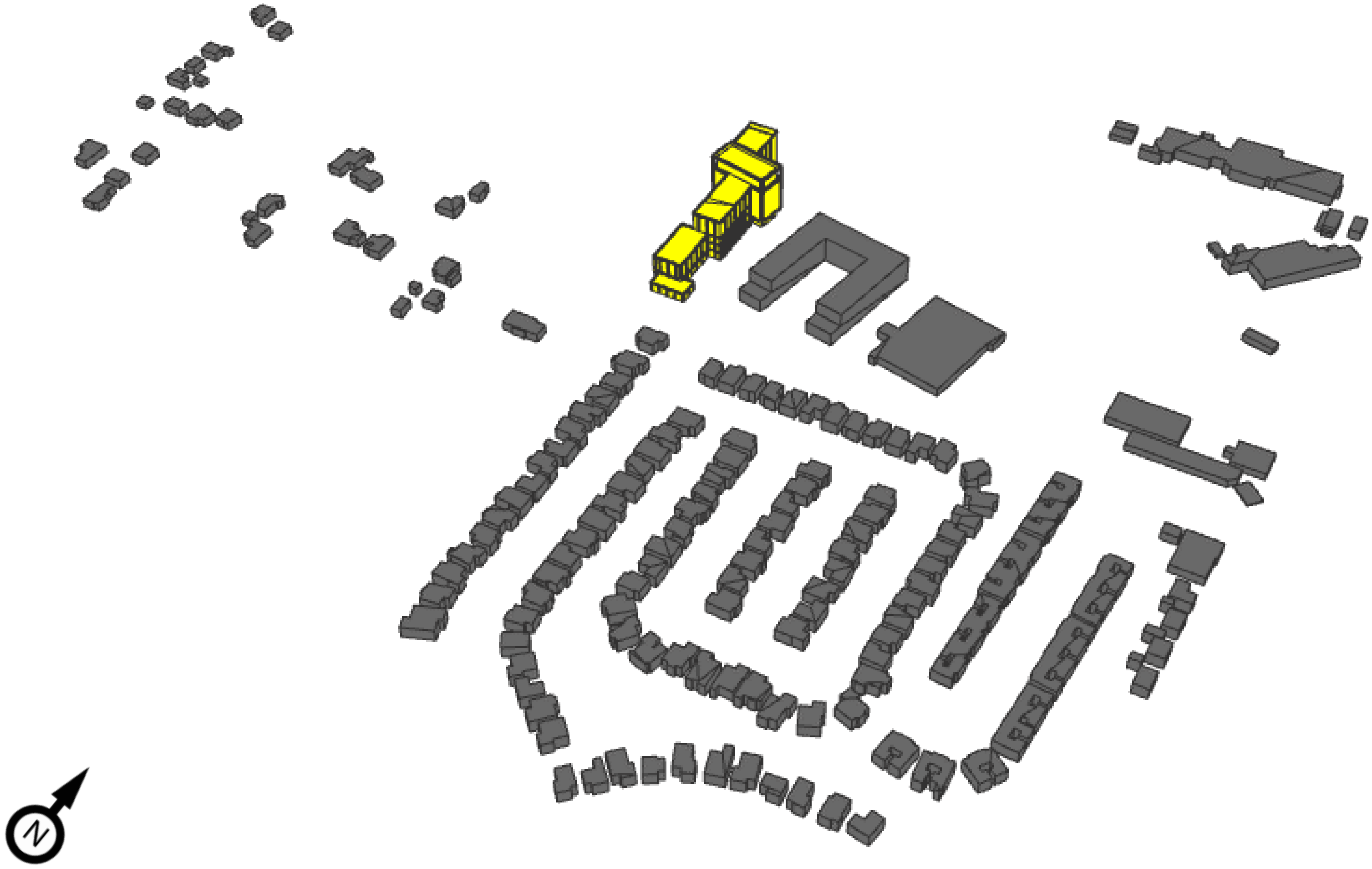


Image 6: Computer Model of the Proposed Project and Extended Surroundings

2. METHODOLOGY

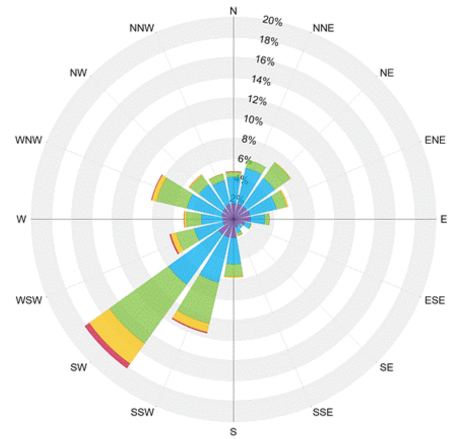
2.4 Meteorological Data

Long-term wind data recorded at St. Catharines Niagara District Airport between 2012 and 2020, inclusive, were analyzed for the summer (May to October) and winter (November to April) months. Image 7 graphically depicts the directional distributions of wind frequencies and speeds for these periods.

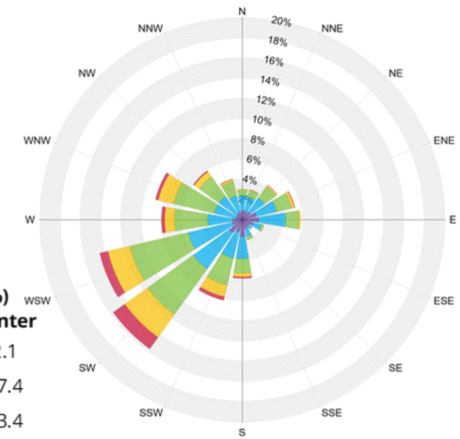
Winds from the southwest direction are predominant throughout the year as indicated by the wind roses (Image 7), with secondary winds from the northwest quadrant.

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 7). These winds potentially could be the source of uncomfortable or severe wind conditions, depending on the site exposure and development design.

Wind statistics were combined with the simulated data to predict the wind conditions at the project site and assessed against the wind criteria for pedestrian comfort.



Summer
(May through October)



Winter
(November through April)

Wind Speed (km/h)	Probability (%) Summer	Winter
Calm	3.1	2.1
1-10	22.6	17.4
11-20	42.4	33.4
21-30	25.9	32.9
31-40	5.2	10.7
>40	0.9	3.4

Image 7: Directional distribution of wind approaching St. Catharines Niagara District Airport (2012 to 2020)

3. 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:

3.1 Pedestrian Safety Criterion

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

3.2 Pedestrian Comfort Criteria

Wind comfort is expressed in terms of typical pedestrian activities that the speeds would be conducive to:

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 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., 1.5m above grade or the concerned floor level), typically lower than those recorded in the airport (10m 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 lots where pedestrians are likely to be active and moving intentionally. Lower wind speeds comfortable for standing are required for building entrances and areas where people engage in passive activities. Calm wind speeds suitable for sitting or standing are desired in areas where prolonged periods of passive activities will occur, such as outdoor amenity spaces, especially during the summer when these areas are typically in use.

4. RESULTS AND DISCUSSION

4.1 Wind Flow Around the Project

Wind tends to flow over buildings of uniform height, without disruption. 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 in the gaps between buildings (*Corner Acceleration* and *Channelling Effect)*. Stepped massing, low roofs and canopies diffuse downwash and reduce the potential wind impact on the ground level. These flow patterns are illustrated in Image 8.

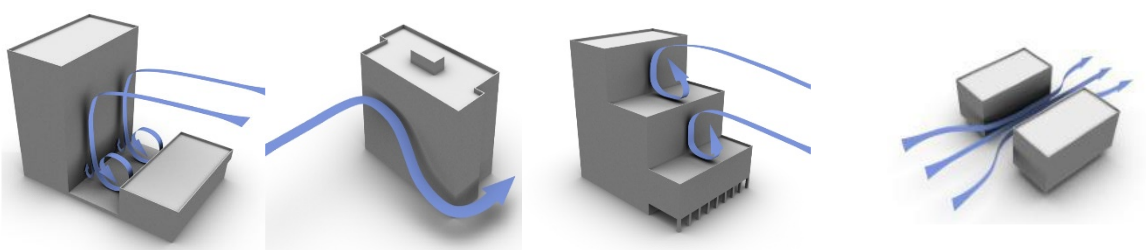
The project, at 10 storeys, will be taller than the buildings that exist in the surrounding area. The project will redirect winds around it; however, potential wind impacts would be moderated by the stepped massing and moderate heights of the buildings.

4.2 Simulation Results

The predicted summer and winter wind comfort conditions for the existing and proposed configurations are presented in Images 9 and 10, respectively. The results are presented as colour contours of wind speeds calculated based on the wind criteria (Section 3.2). The contours represent wind speeds at a horizontal plane approximately 1.5 m above the concerned level.

The assessment against the safety criterion (Section 3.1) was done separately and areas where exceedances to the criterion is predicted are indicated in Image 10.

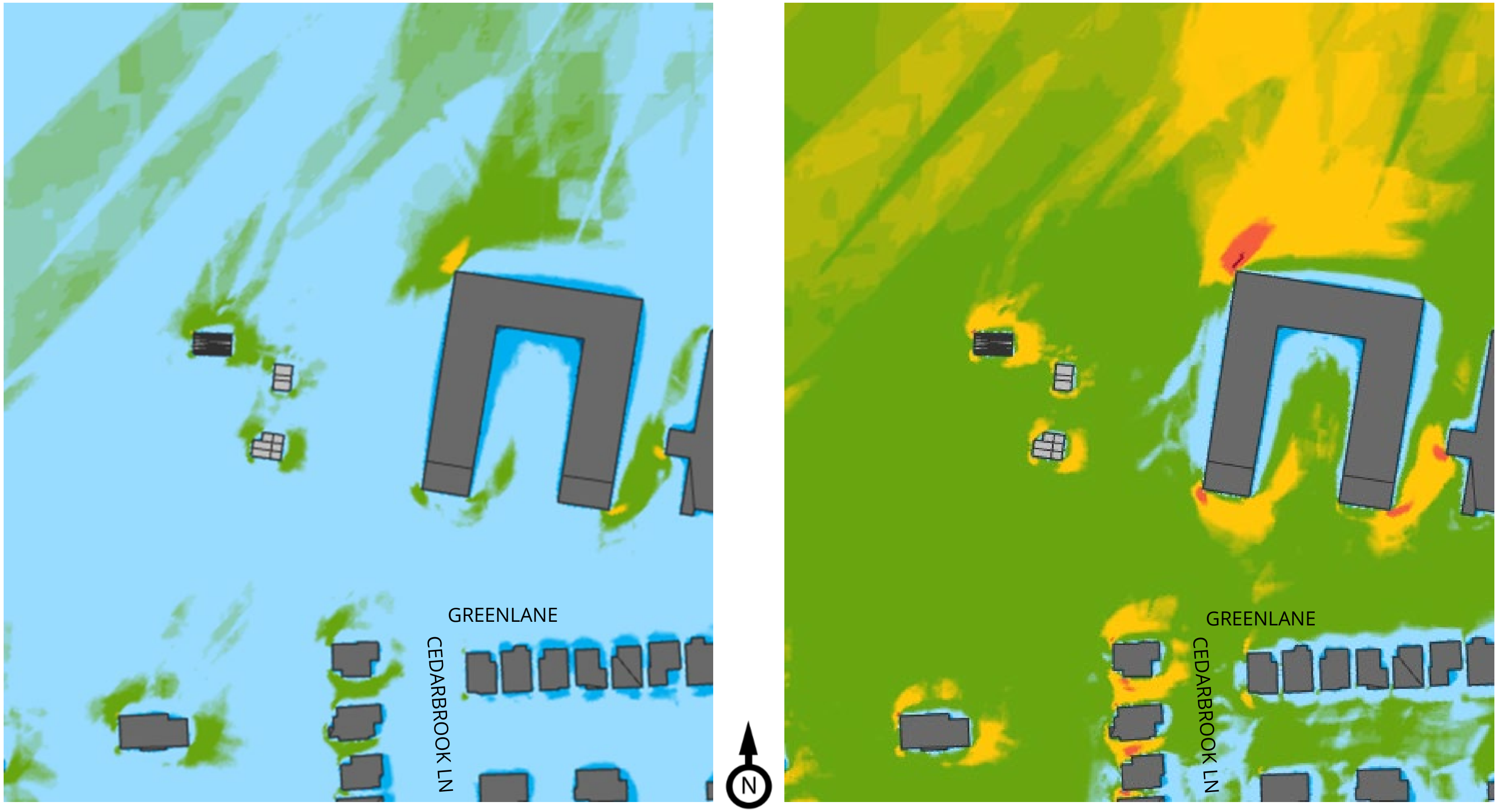
A detailed discussion of the wind conditions with respect to the prescribed criteria and applicability of the results follows in Sections 4.3. and 4.4. The discussion includes recommendations for wind control to reduce the potential for high wind speeds for the design team's consideration.



Downwashing Corner Acceleration Stepped massing and low roofs Channelling Effect

Image 8: Wind flow patterns

4. RESULTS AND DISCUSSION



(a) EXISTING SCENARIO – SUMMER

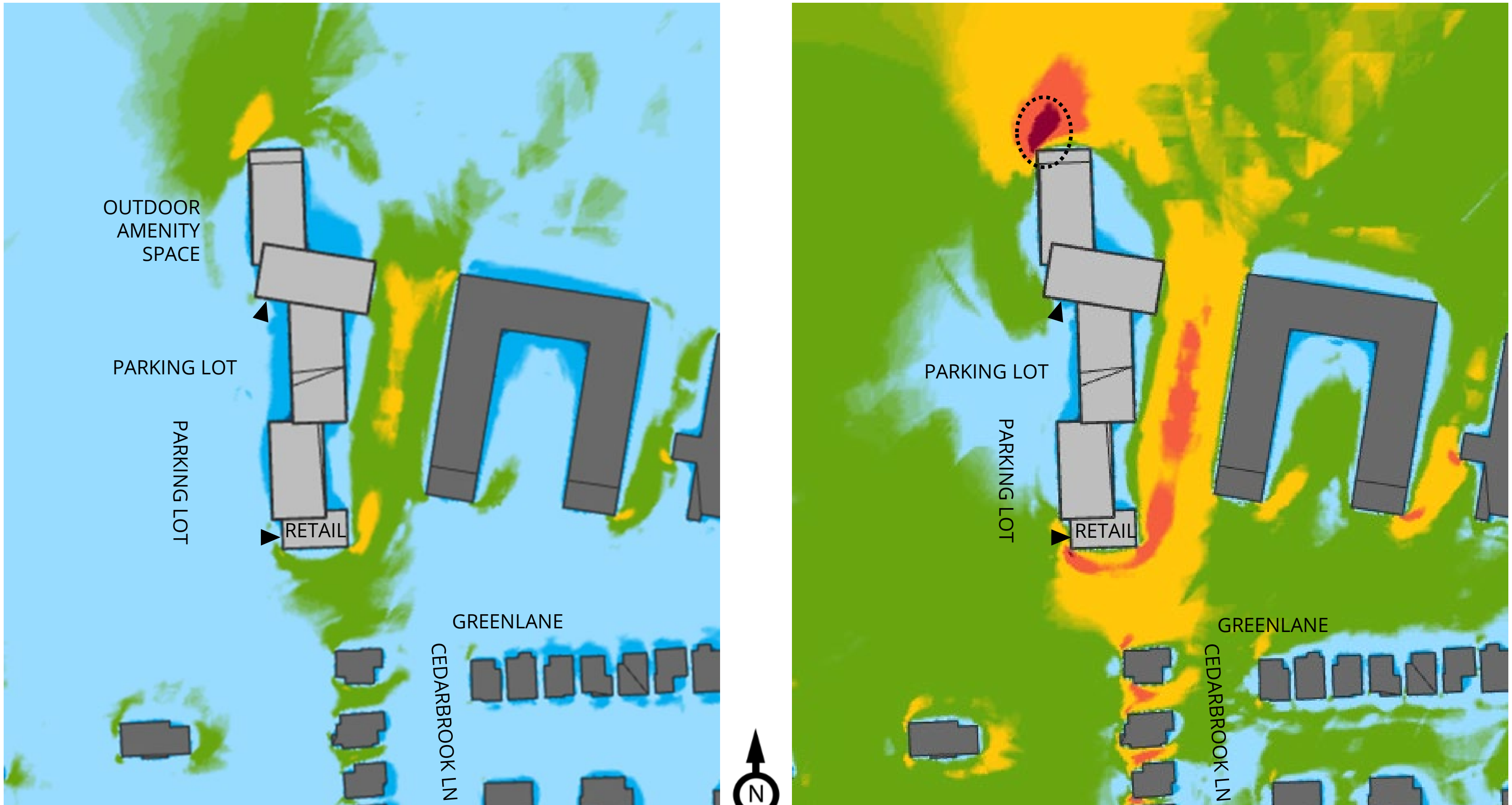
(b) EXISTING SCENARIO – WINTER

COMFORT: SITTING | STANDING | STROLLING | WALKING | UNCOMFORTABL

SAFETY: The criterion are met at all areas.

Image 9: Predicted wind conditions – Existing scenario

4. RESULTS AND DISCUSSION



(a) PROPOSED SCENARIO – SUMMER

(b) PROPOSED SCENARIO – WINTER

COMFORT: SITTING STANDING STROLLING WALKING UNCOMFORTABL

SAFETY: **Areas where the potential for the safety criterion being exceeded**

Image 10: Predicted wind conditions – Proposed scenario

4.3 Existing Scenario

The existing buildings on the site are low-rise, like the neighbouring buildings, and therefore will not redirect winds to create any notable impact. Wind conditions at most areas on and around the existing site are comfortable for standing in the summer (blue regions in Image 9a) and strolling or walking in the winter (green and yellow regions in Image 9b).

Uncomfortable wind conditions occur at the northwest corner of the 6-storey development to the east of the project site (orange region in Image 9b), since this 6-storey building is taller than the existing surrounding buildings. Wind conditions at all areas near the project site are predicted to meet the safety criterion.

4.4 Proposed Scenario

The proposed project, at 10-storey height, will be taller than the buildings that exist in the surrounding area, and will be exposed to the prevailing winds and redirect them around the project.

The impact of the project will be limited to the site and immediate vicinity, and the project will not worsen wind conditions on the neighbouring properties.

4.4.1 Public Sidewalks and On-Site Walkways

In the summer, wind conditions on the project site are predicted to be primarily comfortable for strolling or better (Image 10a), which is suitable for sidewalk, walkway and parking lot use. Wind conditions at the outdoor amenity space will be comfortable for sitting or standing and is considered appropriate for passive activities.

During the winter, wind conditions are comfortable for walking or better at most areas (Image 10b), which is suitable for the intended pedestrian use. However, higher wind speeds that are potentially uncomfortable for pedestrian use are predicted at the northwest corner of the proposed 10-storey north building, on the south side of the 1-storey retail building, and at the area between the proposed project and the 6-storey development to the east of the project site (orange regions in Image 10b). Wind speeds at the northwest corner of the proposed 10-storey north building could also exceed the safety criterion (maroon region in Image 10b).

Elevated wind activity at the northwest corner of the proposed 10-story north building and on the south side of the 1-storey retail building are mainly caused by the prevailing westerly and southwesterly winds downwashing off the west facades of the proposed buildings, and then accelerate at their exposed corners (Image 8 *Downwashing* and *Corner Acceleration*). Chamfered corner, articulation at the corner, tower setback, corner canopy, coniferous landscaping or wind screens can be considered at the corners to deflect or diffuse accelerating winds. Examples of these wind control strategies are shown in Image 11.

4. RESULTS AND DISCUSSION

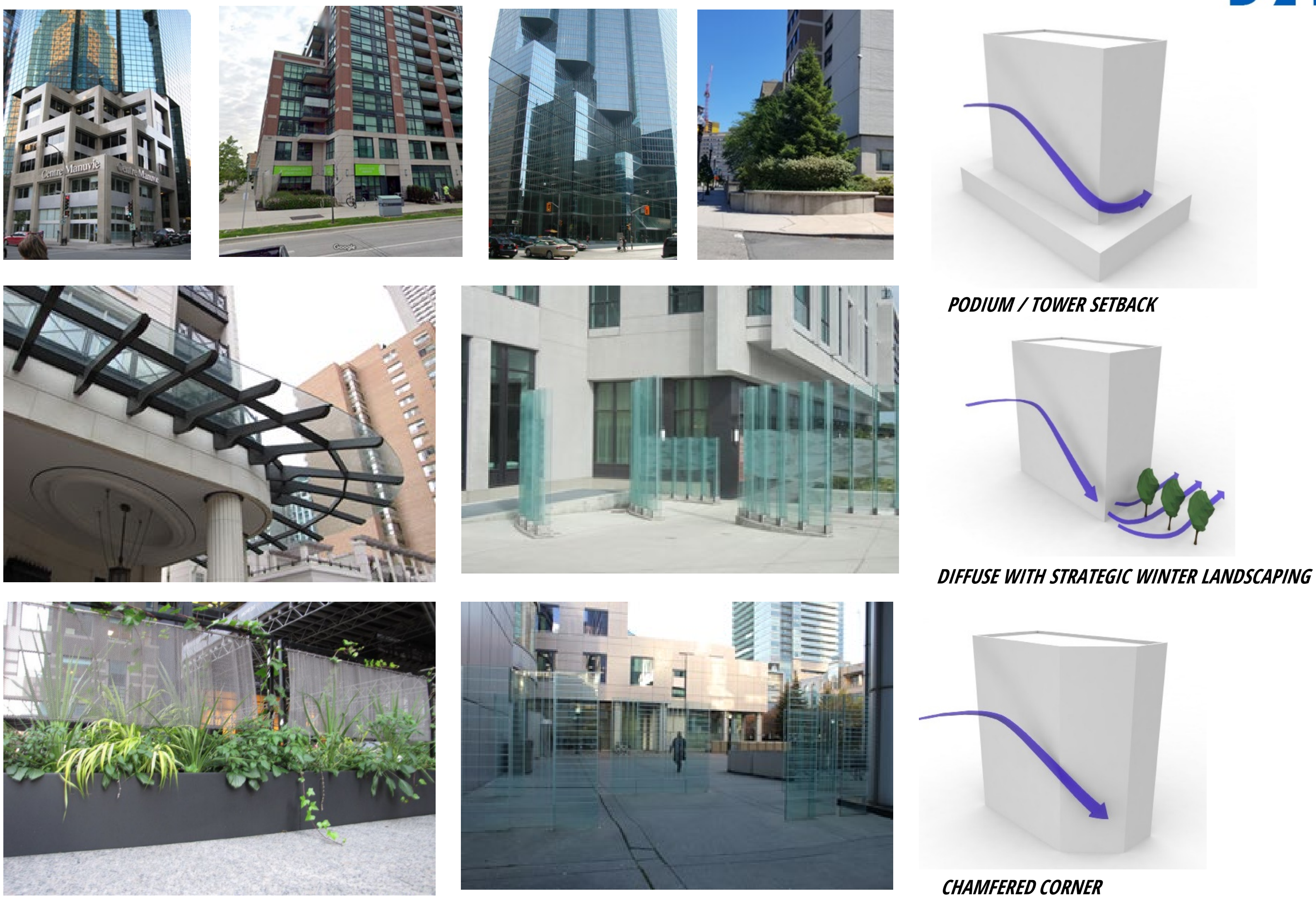


Image 11: Examples of wind control strategies for building corners

4. RESULTS AND DISCUSSION

The potentially uncomfortable wind conditions between the proposed project and the 6-storey development to the east of the project site are primarily the result of the northerly winds and the prevailing southwesterly winds accelerating at the opening between the buildings (Image 8 *Channelling*).

Wind screens and/or coniferous landscaping placed between the two developments can be considered as mitigation strategies, examples are shown in Image 12.

4.4.2 Parking Lots

Wind conditions at the parking lots of the proposed development will be comfortable for standing in the summer (blue regions in Image 10a) and for standing or strolling in winter (blue and green regions in Image 10b), which is suitable for the intended pedestrian use.

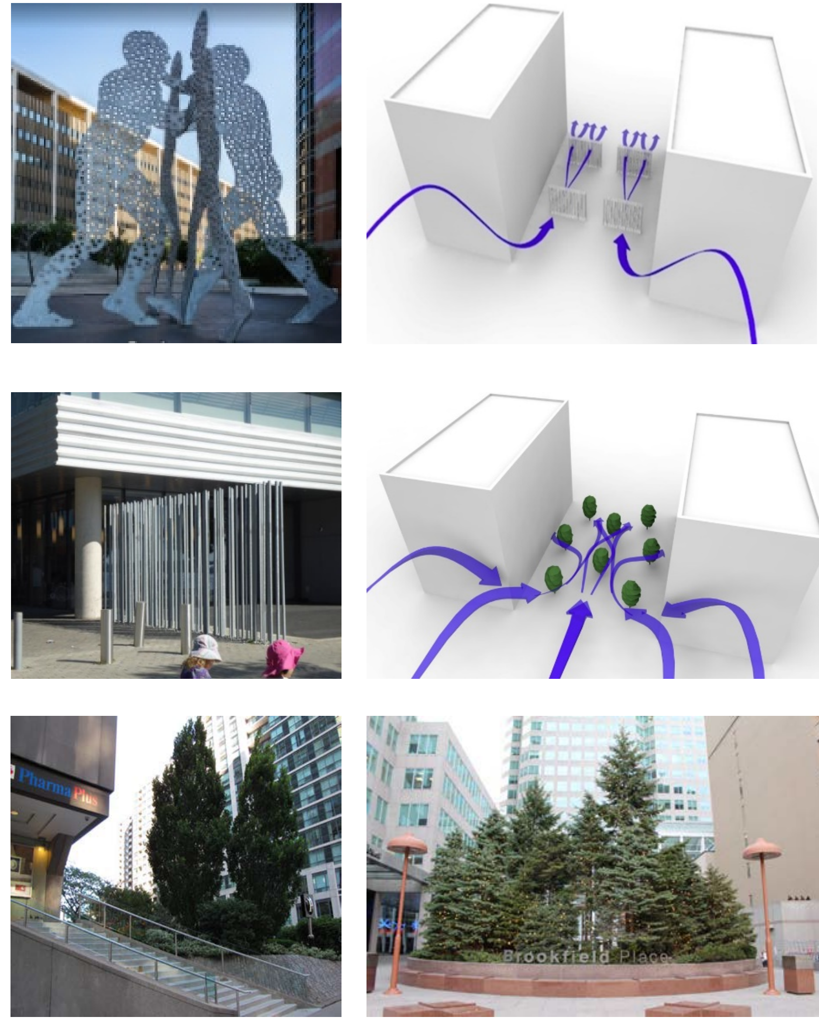


Image 12: Examples of wind control measures for winds between buildings

4.4.3 Entrances

Entrances to the proposed project are identified by black triangles in Image 10. The north entrance is located at the building undercut, which is a positive design feature that provides sheltering for this entrance from the downwashing winds.

In the summer, wind conditions at both entrances will be comfortable for standing, which is suitable for the intended use (Image 10a).

During the winter months, wind conditions at the north entrance will be comfortable for standing and appropriate to the intended use (Image 10b); however, higher than desired wind speeds are predicted at the south retail entrance. The design team may consider moving the entrance further north, away from the building corner, recessing the entrance, adding a canopy above the entrance, in combination with placing wind screens or coniferous/marcescent landscaping on both sides of the entrance to provide localized protection for patron to use. Examples of these wind control measures are shown in Image 13.

Image 13: Examples of wind control measures for entrances

5. SUMMARY

RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed Utopia West project at 5103 Greenlane Road in Beamsville, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, and computational modelling and simulation of wind conditions. Our findings are summarized as follows:

- Due to the stepped massing and moderate heights of the proposed buildings, the impact of the proposed project will be limited to areas adjacent to the site and the project will not impact wind conditions in the extended surroundings.
- Wind conditions at grade level, including outdoor amenity space, parking lots and most of the sidewalks, walkways and entrances will be appropriate for the intended use.
- In the winter, potentially uncomfortable wind speeds are predicted at the northwest corner of the proposed 10-storey north building, on the south side of the 1-storey retail building, and at the area between the proposed project and the 6-storey development to the east of the project site. Wind speeds at the south entrance will also be higher than desired for patron use in the winter.
- Conceptual wind control strategies have been suggested to help reduce wind speeds.

RWDI can help guide the placement of wind control features, including landscaping, to achieve appropriate levels of wind comfort based on the programming of the various outdoor spaces.

6. APPLICABILITY OF RESULTS

The assessment presented in this report is for the proposed Utopia West project at 5103 Greenlane Road, based on the information provided by design team listed in the table below. 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 (mm/dd/yyyy)
1884-21 Utopia West - 3D View - {3D}	DWG	08/04/2021
1884.21 - Utopia West - Site Plan Aug.03.2021	PDF	08/04/2021
UW_Site Plan_210921 (002)	PDF	09/22/2021
1884.21 - Utopia West - Concept A101 - Oct.08.2021	PDF	10/08/2021

7. REFERENCES

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.