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ARCHITECTURE LANDSCAPE ARCHITECTURE PLANNING INTERPRETIVE WAYFINDING BRANDED ENVIRONMENTS

112 Wyse Road Development Wind & Shade Study

To Whom It May Concern,

Issued
July 26, 2019

The proposed 19-storey residential development project is located at the eastern corner of Wyse Road and Nantucket Avenue (see Figure 1). The site is surrounded by commercial retail to the north, a 7-storey hotel and 17-storey office tower to the south, the Halifax Transit Bridge Terminal to the north-east, and the Zatzman Sportsplex immediately adjacent to the south-east.

The following wind assessment analyzes the probable qualitative wind impacts on surrounding properties and public spaces as a result of the proposed development. Wind data gathered at the local Shearwater Airport between 2007 and 2018 to understand the intensity, frequency, and direction of winds at the proposed site. The resulting diagrams (Fig. 1) shows that the highest and most frequent wind speeds annually and then monthly during the 4 seasons. The coastal conditions bring winds from many different directions throughout the year resulting in prevailing winds mostly from south and southwest and from the north and northwest annually. In fact, on an annual basis, only 33% of the winds come from the north-eastern and south-eastern quadrants while 67% comes from the north-western and south-west quadrants.

Figure 1. Proposed 19-Storey location

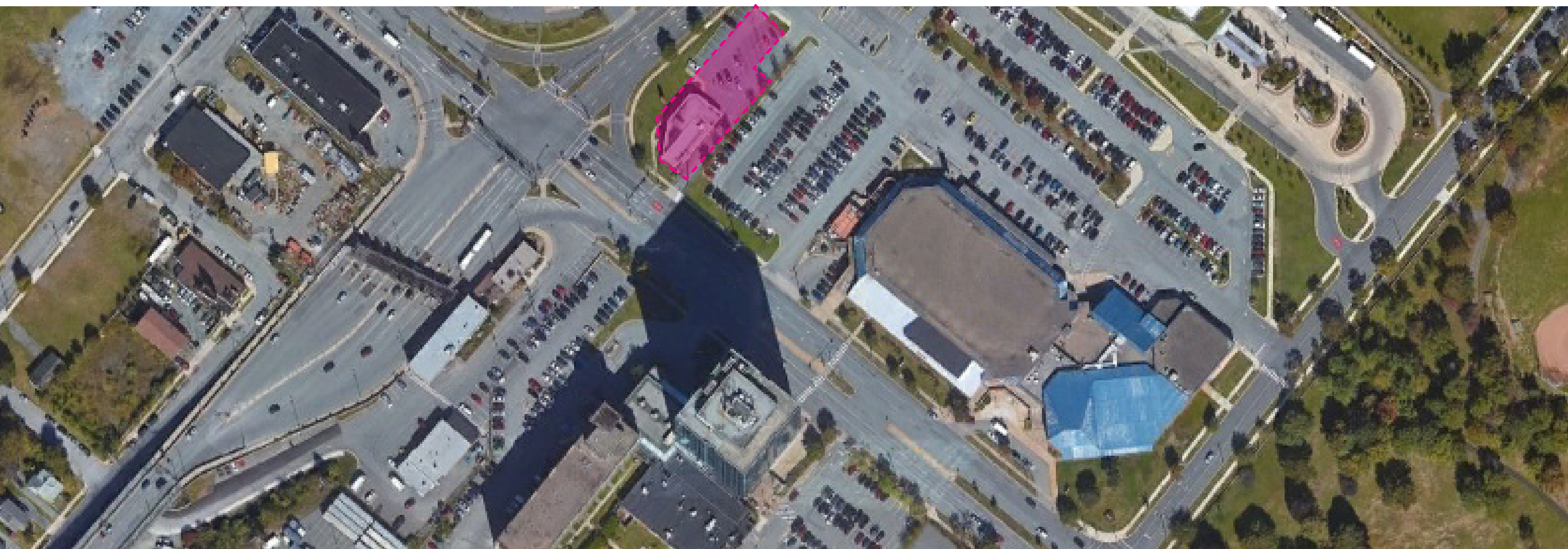
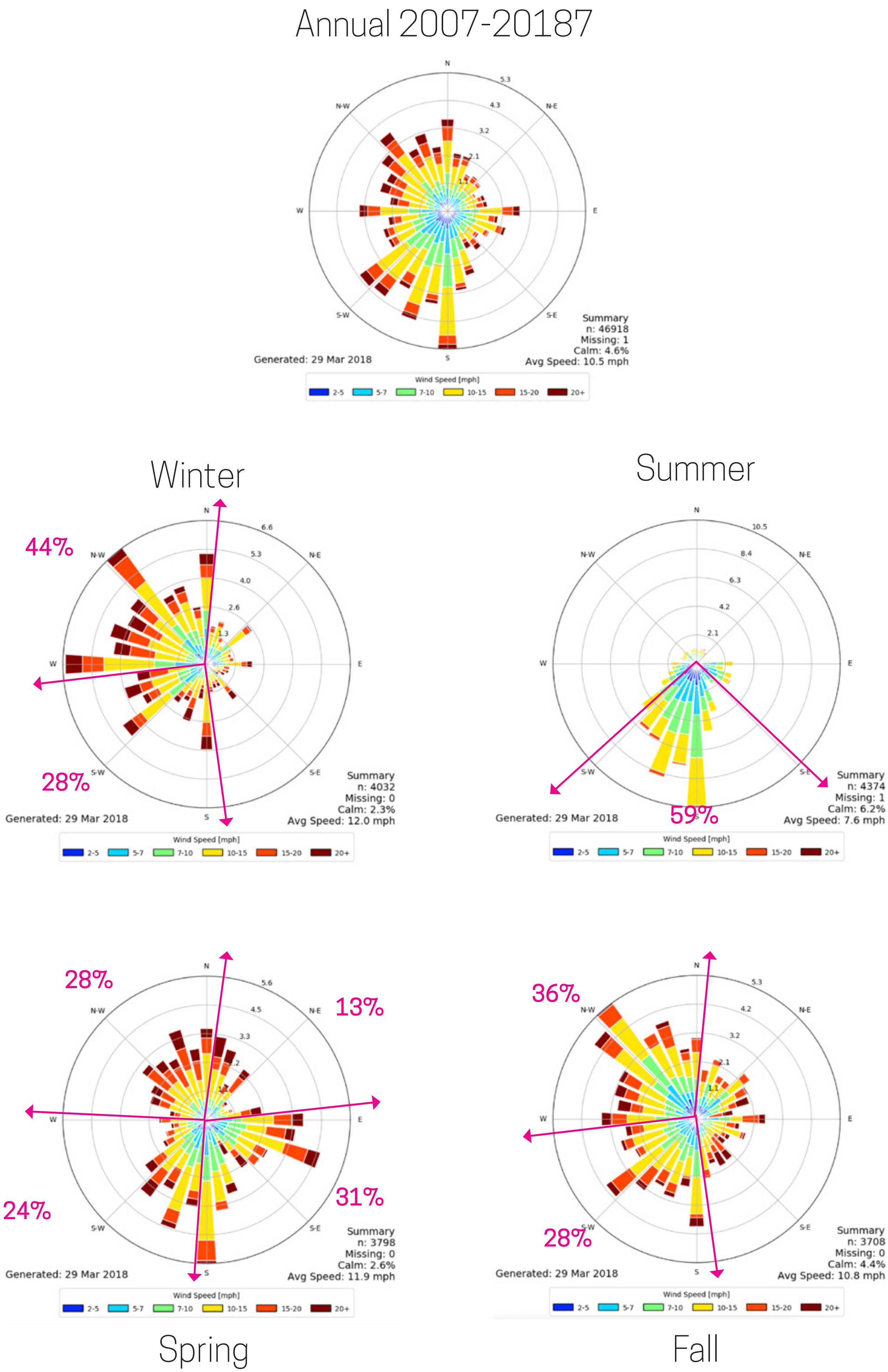


Figure 2. Shearwater Wind Conditions 2007-2018



Winter:

In the winter, prevailing winds come mostly from the north-western quadrant direction 44% of the time. 28% of the time, winds come from the south-western quadrant in the winter. Also, some of the strongest winds come from these directions. 14% of the winds in the north-west quadrant exceed 15 mph. 9% of the winds in the south-western quadrant exceed 15 mph in the winter. In fact, 28.7% of all wind in the winter exceeds 15 mph. Winds that exceed 20 mph occur 11.5% of the time.

Spring :

In the spring, the winds come from many directions with prevailing coming from the south-east 31% of the time, from the north-west 28% of the time, and from the south-west 24% of the time. Similar to the winter, 29.7% of all wind in the spring exceeds 15 mph making the winter and spring some of the windiest seasons. Winds that exceed 20 mph occur 12% of the time making spring in Dartmouth one of the windiest seasons.

Summer:

In the summer, the winds come primarily from the south quadrant 59% of the time. Winds are generally very light with only 3% of all wind exceeding 15 mph.

Fall:

The fall in Dartmouth is much like the spring with winds coming from many directions but prevailing from the north-west quadrant 36% of the time. Wind from the south-west quadrant follows closely at 28% of the time. 21% of the winds in the fall exceed 15 mph making it slightly less windy than the winter or spring. Winds that exceed 20 mph only occur 7% of the time.

Pedestrian Comfort:

Pedestrian comfort and safety is an important consideration in the design of urban neighbourhoods. Building height and massing can have considerable impacts on human thermal comfort at the street impacting the livability and walkability of neighbourhoods, snow loading on adjacent roofs and environmental conditions in neighbourhoods.

The Beaufort scale is an empirical measure that relates wind speed to observed conditions on land and sea. The attached Beaufort scale is a general summary of how wind affects people and different activities, and distinguishes at what points wind speeds can become uncomfortable or dangerous. Wind is only one variable of human thermal comfort as described below.

Beaufort Scale

	2-5 mph	3-8 km/hr	calm	Direction shown by smoke drift but not by wind vanes
	5-7 mph	8-11 km/hr	light breeze	Wind felt on face; leaves rustle; wind vane moved by wind
	7-10 mph	11-16 km/hr	gentle breeze	Leaves and small twigs in constant motion; light flags extended
	10-15 mph	16-24 km/hr	moderate breeze	Raises dust and loose paper; small branches moved.
	15-20 mph	24-32 km/hr	fresh breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.
	+20 mph	> 32 km/hr	strong breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.

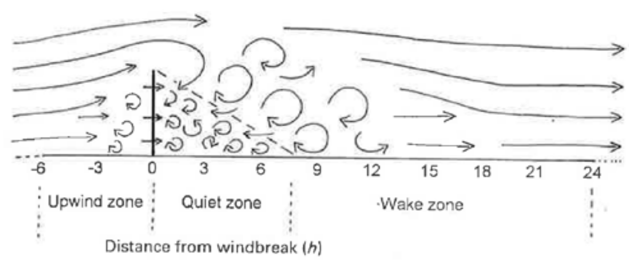
COMFA Model (Brown and Gillespie, 1995)

Dr. Robert Brown of the University of Guelph developed the COMFA model to model human thermal comfort as a result of a number of variables including wind speed. Comfort is a function of wind speed, temperature, metabolic activity level, insulation and permeability value of clothing, relative humidity and solar/terrestrial radiation. A person can be comfortable in windy conditions if they are active, adequately dressed, in the sun and with high relative humidity.

Human thermal comfort is more pronounced during low-activity situations like sitting than during high-activity situations like running. The model is explained in the paper by Brown and LeBlanc (2003). Mr. LeBlanc was also the co-author with Dr. Brown in the 2008 ed. "Landscape Architectural Graphic Standards", Microclimate chapter. This model is the basis for the theoretical assessment of human thermal comfort changes as a result of the building explained below.

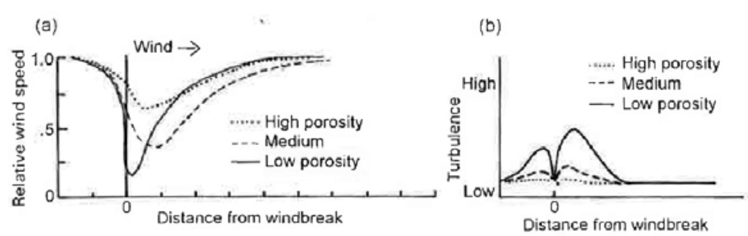
Urban Windbreak Impacts

Wake zones for zero porosity structures can extend 8-30 times the height of a structure. A 19-storey building can generate increased wind speeds between 0.45-1.75km on the downwind side (see Fig. 3). Beyond the wake zone, there is typically more turbulence and eddies as a result of more turbulent air. This can be characterized as being slightly more gusty winds with quiet periods interspersed with gusts of wind. Directly behind the windbreak, the quiet zone can extend from 0 to 8 times the height on the downwind side. In this quiet zone, wind speeds can be somewhat reduced. Around the edges of the building, wind speeds can increase as wind flows around the structure.



Zones with altered airflow caused by a windbreak. Vertical dimension is magnified for illustration. Vertical line indicates windbreak; h = height of windbreak. Large eddies = strong turbulence. Uninterrupted airflow in the open is to the left of the upwind zone, and to the right of the wake zone. Widths of zones are approximate. Based on several sources.

Figure 3. Windbreak Diagram



Effect of windbreak porosity on streamline and turbulent airflows. (a) Streamline airflow based on treebelts of different foliage densities; wind measurements at 1.4 m height. From Heisler & DeWalle (1988) with permission of Elsevier Science Publishers. (b) Generalized expected turbulence pattern based on Robinette (1972), Rosenberg *et al.* (1983), Heisler & DeWalle (1988), McNaughton (1988).

Figure 4. Porosity Diagram

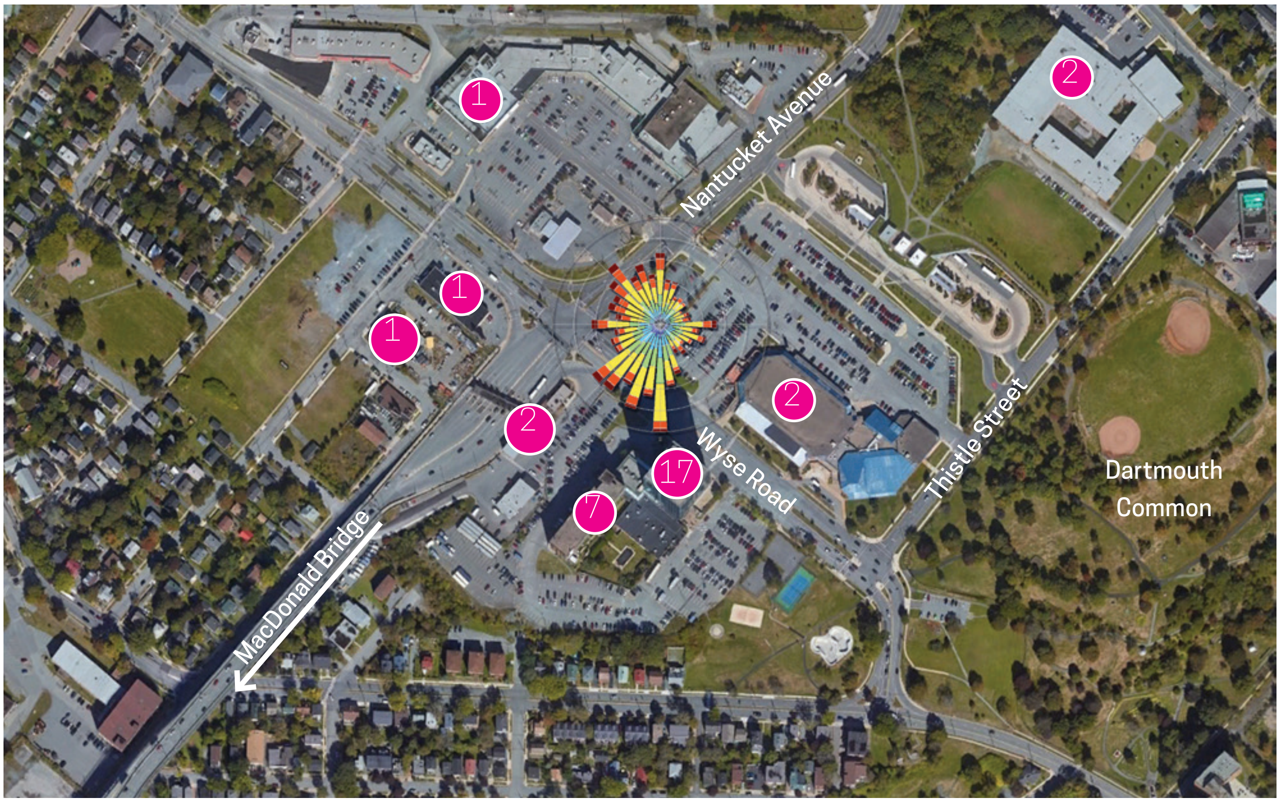
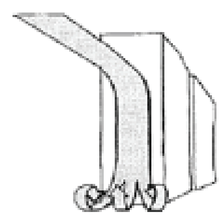


Figure 5. Annual Wind Rose overlain on top of the proposed development site. Pink numbers denote building storeys.

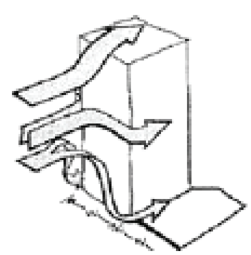
Wind Impacts from tall Buildings

There will be a number of aerodynamic impacts from a new tall building including:

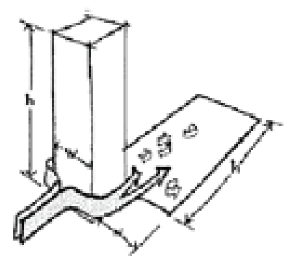
1. **Downwash**: Wind speed increases with the surface area of the building (i.e. height and width) so when a tower is exposed to wind, the pressure differential between the top and the bottom of tower forces the high pressure at the top down the windward face increasing pedestrian wind speeds. The taller the exposed face is, the higher the wind speed will be at the base. The stepback surrounding the proposed tower at the 4th storey will receive the bulk of this downwash.



2. **The corner effect**: at the windward corners of buildings there can be unexpected increases in wind speeds as wind forces around the windward corners from high pressure on the windward face to low pressure on the lee side. Some of the ways to decrease this impact is to create pyramidal steps which increases the surface area of the edges. This has been designed into the proposed tower.



3. **The Wake Effect:** Wake is generally caused by both the downwash and corner effect. The greatest impact area occurs within an area of direct proportion to the tower height and width on the lee side of the wind. Impacts are minimized by creating a stepback base on the building.



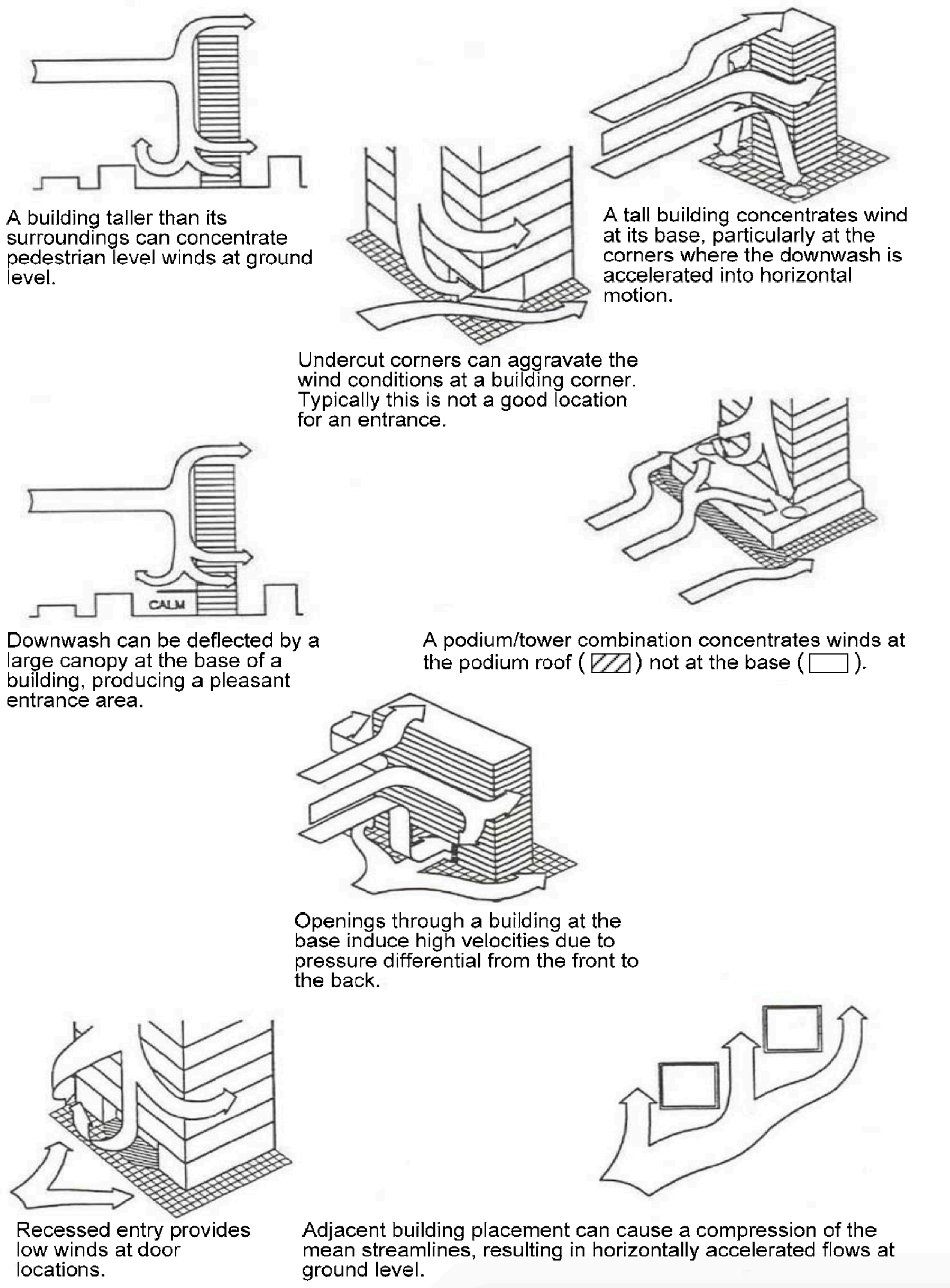
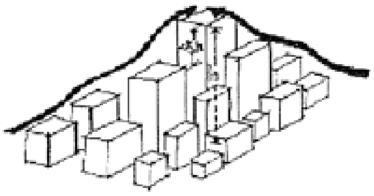


Figure 6. Design features to change and/or ameliorate pedestrian wind conditions, after Cochran (2004).

4. **Building Groups:** The effects that occur individually around buildings cannot be applied directly to groups of buildings. The cumulative effect of many clustered tall buildings, like in this situation, can create a wide range of different wind scenarios that must be modeled as a group to understand the cumulative impacts. The existing 17-storey office building is about 100m south of the site.



19-Storey Street Impacts: Summer:

In reviewing the seasonal wind conditions in Dartmouth as it relates to this particular site, the wind data shows that the building will have very little local impacts in the summer due to the low wind speeds which only exceed 15 mph 3% of the time in the summer months. Wind temperatures, relative humidity and solar/terrestrial radiation are also favorable for thermal comfort. Winds from the south (prevailing in the summer) will create a slightly windier condition on the north side of Nantucket Avenue across from the building on those days when winds exceed 15 mph (24 km/hr) as a result of edge effects. There would be little change in human thermal comfort but the Nantucket crosswalk to the north could be windier on windy days in the summer but there is also the potential for a wind shadow which could reduce the impacts from the existing 17 storeys buildings on the east side of the Nantucket crosswalk. The angle of the building is parallel to the wind direction so the building will create somewhat of a slicing impact for winds in the prevailing direction which reduces the impact of a standard 19-storey tower. The 4th storey podium will receive the bulk of the downwash from prevailing summer winds.

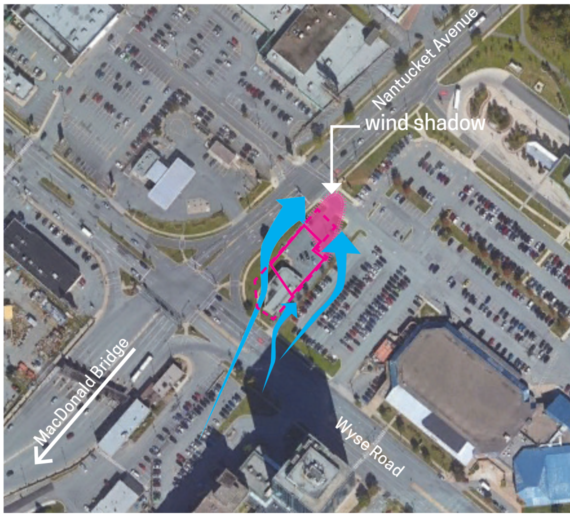


Figure 7. Prevailing winds in the summer

19-Storey Street Impacts: Fall:

The prevailing winds in the fall come from the north west and south west. About 20% of the time the wind speed exceeds 15 mph The streetwall stepback will buffer some of the downdraft from the tower but it will be windier between the 17 storey tower and the sportsplex on Wyse Road in the fall mostly as a result of the corner effects. When winds come from the north west, the new building will not have a wind shadow on the east side of the building in the parking lot but it will be windier and colder at the western corner of the sportsplex than it is today. When winds come from the southwest (28% of the time), the Nantucket crosswalk will be windier than it is today and gusty conditions could extend up to the next crosswalk in front of MacDonalds on extremely windy days. The balconies and stepbacks should significantly mitigate winds from the south west while winds from the north west (36% of the time) will be more pronounced. Winds that exceed 20 mph only happen 7% of the time. The fall in Dartmouth is typically warm and the humidity is relatively high so the extent of discomfort from the new tower on windy days will be pronounced but not frequent.

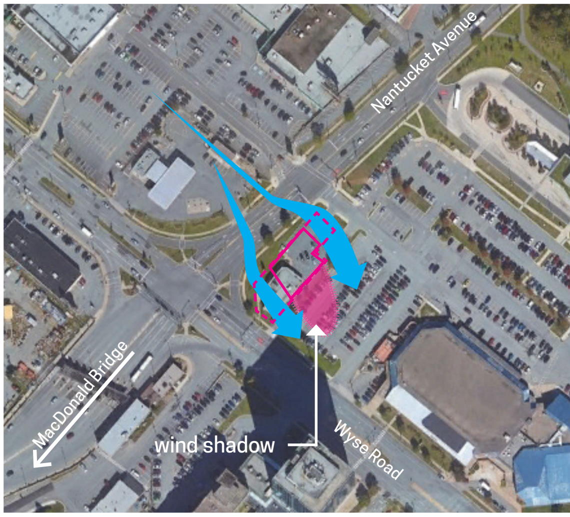


Figure 8. Prevailing winds in the Fall

19-Storey Street Impacts: Winter:

The prevailing winds in the winter come mostly from the north west (31% of the time) and less frequently from south west (28% of the time). About 14% of the time the wind speed exceeds 15 mph. The streetwall stepback will buffer some of the downdraft from the tower but it will be windier at the corner of Nantucket Avenue and Wyse Road on windy days mostly as a result of the corner effects. When winds come from the north west, the Sportsplex parking lot will be windier and colder and single storey commercial on the Wyse Road frontage could experience windy conditions across the base of the building. These winds will be notably more colder and more uncomfortable on both sides of Wyse Road and at the corner of Wyse Road and Nantucket Avenue. When winds come from the southwest (28% of the time), the street corner of Wyse Road and Nantucket Avenue will not see much change in wind speed but the crosswalk on Nantucket will feel windier than today. The 4th storey stepback should significantly mitigate winds mostly from the south west except in some areas on the east side of Nantucket. Winds that exceed 20 mph only happen on average 11.5% of the time and these winds will make the human thermal comfort conditions feel much less comfortable than in the other seasons. There will be less solar radiation, lower relative humidity, and colder temperatures. Insulation levels (clothing) will be higher, buffering some of the discomfort, however the tower will cause some additional discomfort within a roughly 500m radius in the winter months. On very windy days, the tower could impact the windy conditions at the bus terminal but this would be relatively infrequent. The impacts of the existing 17-storey building are already present on the street and winds from the north west are already exacerbated from the existing building. The proposed 19-storey opposite of this existing tower will strengthen north westerly winds on Wyse Road as wind is funneled between the two high rise towers. The smaller plate size on the proposed site (730 sq.m. compared to 1,220 sq.m at the 17 storey site) will reduce the impacts of a larger tower plate.

19-Storey Street Impacts: Spring:

The prevailing winds in the spring come from many directions and it is one of the windiest seasons, but the prevailing wind is from the south east (31% of the time) and less frequently from south west (24% of the time) and north west (28%). About 30% of the time the wind speed exceeds 15 mph making Dartmouth very windy in the spring season. The streetwall stepback will buffer some of the downdraft

Figure 9. Prevailing winds in the Winter from two directions

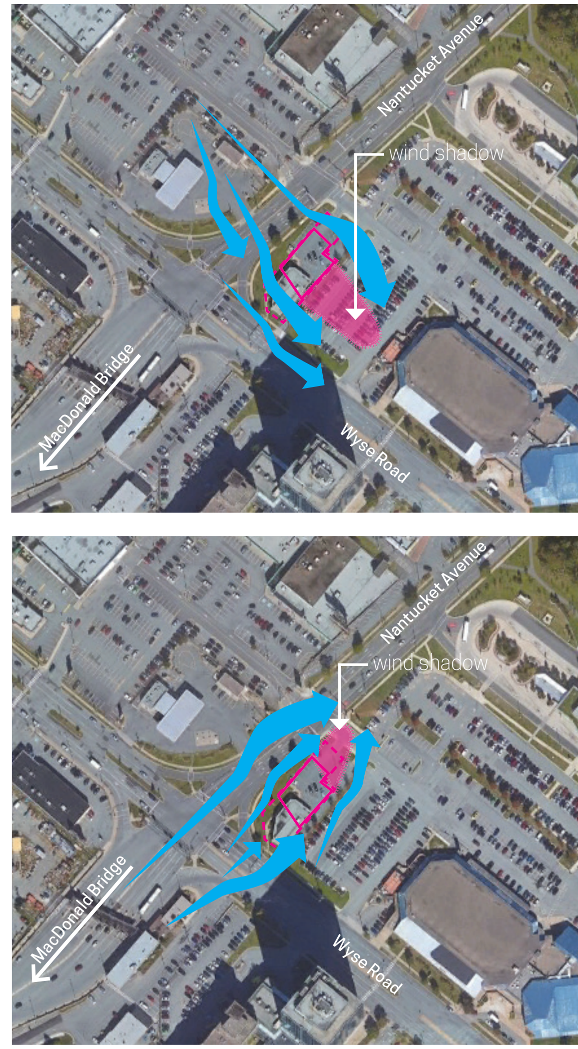
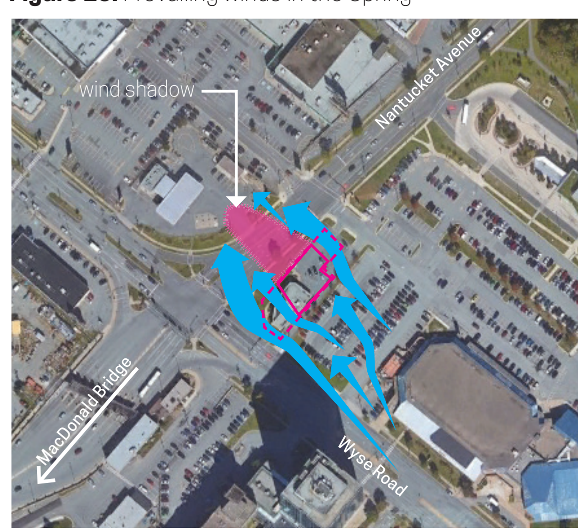


Figure 10. Prevailing winds in the Spring



from the tower but it will be windier on the west side of the street on Wyse Road on windy days as a result of the corner effects. When the wind comes from the north west on windy days, the Nantucket Avenue-Wyse Road intersection will be windier than it is today. When winds come from the north west, wind will accelerate between the existing 17-storey and the new 19-storey making parts of Wyse Road much windier. The balconies and stepbacks should mitigate winds from the south west and the building will create a wind shadow on the Nantucket Avenue side directly north of the building. Winds that exceed 20 mph only happen 12% of the time and these winds will make the human thermal comfort conditions feel much less comfortable than in the other seasons. The spring is usually very wet in Dartmouth and the humidity is lower, winds are higher and the temperatures can still be cold. The building will have its most pronounced thermal comfort impacts felt in the spring for these reasons.

Precedents

There are several similar sized towers in Halifax including the TD Tower, 1801 Hollis, Purdy's 2, Park Vic, Scotia Square, the Trillium, and the Maple. On some of these towers the tower plate size is considerably larger than proposed at Wyse Road and Nantucket Avenue causing more wind impacts. Many of these buildings are also clustered with other tall buildings causing additional turbulent air flows and generally windier conditions. This analysis does not provide quantitative changes in wind speed but it does provide an analysis of the general frequency of uncomfortable wind conditions as a result of this building. The morphology of the building including small tower plate size (742 sq.m.), stepbacks, continues decks which roughen the surface and reduce wind speeds as well as the groundfloor setback on Wyse Road should effectively reduce the wind potential on the surrounding streets and neighbourhoods.

Wind Summary

This proposed building will has been designed to mitigate wind impacts as much as could be expected for a 19-storey structure and there are many examples of similar scaled developments in Halifax that do not cause adverse problems on the public realm even without a 4th storey stepback. The smaller plate size, stepbacks, patio decks, and building entry location have all been designed to minimize wind impacts following HRM's form based codes. The 19-storey building is not anticipated to have any significant change in human thermal comfort for a person travelling through the area. With the prevailing winds in the winter from the northwest and west, the impacts of turbulent gusts on the corner of Nantucket Avenue and Wyse Road will be felt differently than today but we would not expect a drastic change in human thermal comfort.

Figure 11. Equinox (March 21 and September 21) shadow study

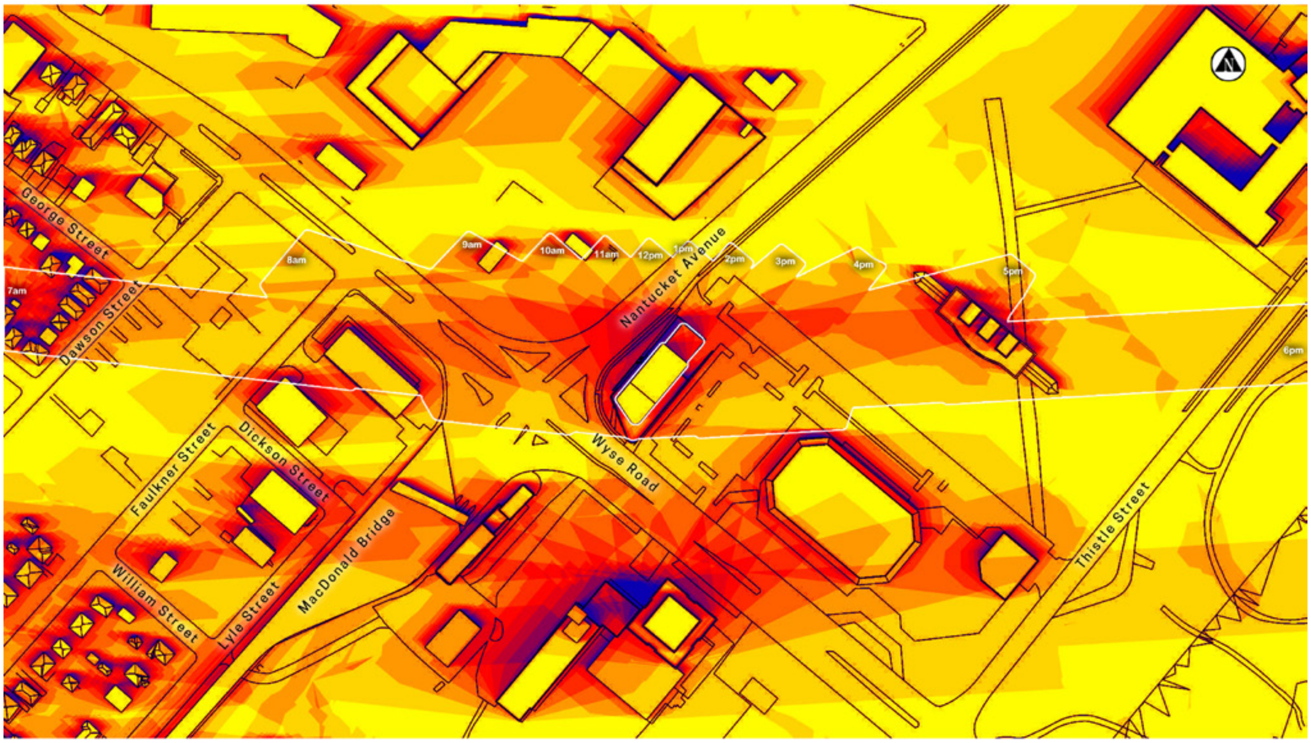


Figure 12. Summer Solstice (June 21) shadow study

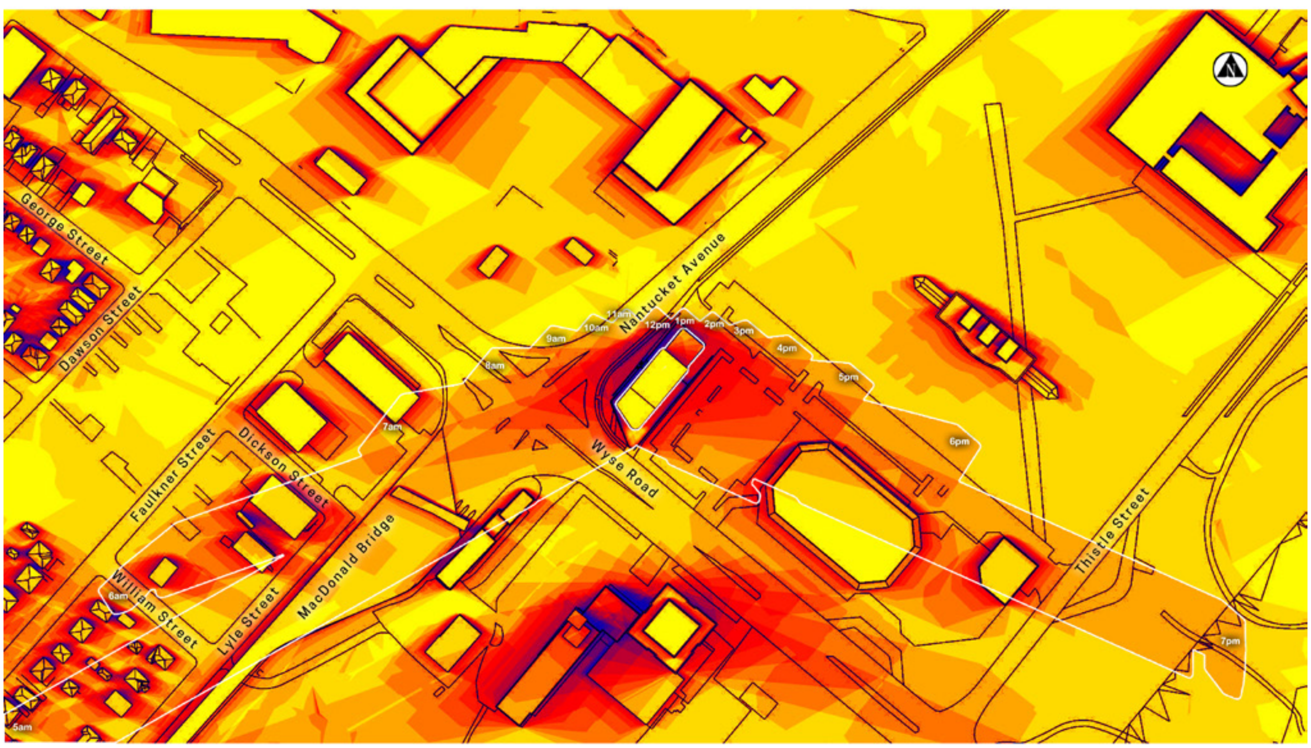
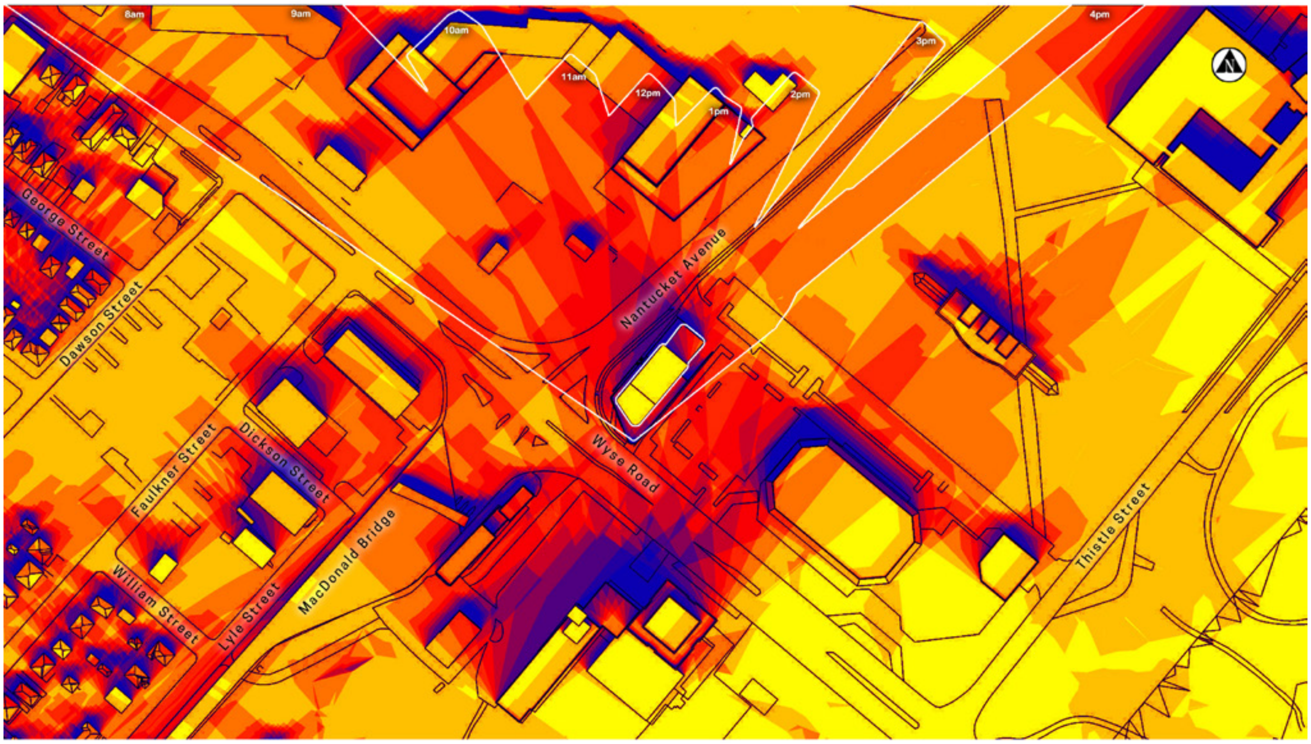


Figure 13. Winter Solstice (December 21) shadow study)



Shadow Study

A shadow study was undertaken to assess the impacts of the proposed 19-storey towers and the 7-storey hotel, 17-storey office tower, and other surrounding low-rise recreational and commercial retail buildings on surrounding properties. A 3D computer model was placed in real-work space and assessed on an hourly basis for the Spring and Fall Equinox (March 21 and September 21), the Summer Solstice (June 21), and the Winter Solstice (December 21) periods. These simulations provide a good overview of the best case conditions (summer solstice where the sun is high and shadows are short) and worst case conditions (winder solstice when the days are short and sun angles are low and shadows are long).

Equinox (March 21 and September 21): In the Equinox, the sunrise is at 7:00am and sundown is at 7:22pm giving only about 12 hours of sunlight. At 8:00am and 7:00pm, the shadows are so long, or in other words the sun angles are so low, that even a tree can shade an area for very long distances up to 10x the height of the object. Because the streets are relatively wide and surrounding buildings are relatively low in the study area, sun will continue to reach most of the site. The south side of the building will remain unchanged with the north side of the building, along the proposed commercial terrace receiving 12 hours of shade. There will be new shadows cast on Nantucket Avenue from approximately 9:30am to approximately 1:30pm.

Summer Solstice (June 21): In the summer, sunrise is at 5:29am and sundown is at 9:04pm giving about 15.5 hours of sunlight. At 6:00am and 9:00pm, the shadows are so long, or the sun angle is so low, that even a tree can shade an area for very long distances up to 10x the height of the object. The shade diagram shows that the proposed building will cast a shadow on the corner or Nantucket Avenue and Wyse Road from 7:00am to 9:00am in the summer. The north corner of the commercial terrace will experience shade for 12 hours of the day including mid-day hours. There will be some shade cast in the adjacent Zatzman Sportsplex parking lot from approximately 4:00pm to 8:00pm in the summer. There will be no additional shadows cast to Nantucket Avenue or Wyse Road directly north or south of the building.

Winter Solstice (December 21): In the winter, sunrise is at 7:48am and sundown is at 4:37pm giving only about 8-hours of sunlight per day. At 8:00am and 4:00pm the shadows are so long, or the sun angle is so low, that even a tree can shade an area for very long distances up to 10x the height of the object. The shade diagram confirms that the building will cast shade across Nantucket Avenue into the existing commercial retail parking lot between the hours of 10:00am and 2:00pm in the winter. The crosswalk at Nantucket will be in shade from 12pm to 2pm in the winter creating colder conditions. Existing buildings in the area already impact the crosswalk at Nantucket in the early afternoon so the change in shade at the sidewalk will be negligible from what occurs today. The Nantucket side of the commercial will be in shade for much of the day in the winter. Some shade may be expected on the south side of the building during the hours of 11:00am and 1:00pm from the 17-storey office building located to the south on Wyse Road.

If you have any questions, please contact me at your convenience.

Sincerely,

Original Signed

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