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**March 5, 2019**

**Preliminary Pedestrian Level Wind Study**  
**NYX Capital Corp**  
**3016, 3020, 3032 Kirwin Avenue &**  
**3031 Little John Lane Development**  
**Mississauga, Ontario**

**Theakston Project No. 19463**

**Submitted To:**

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**Stephen Pollock, P.Eng.**

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## 1. EXECUTIVE SUMMARY

Based upon our analysis, wind conditions on and around the proposed 3016, 3020, 3032 Kirwin Avenue & 3031 Little John Lane Development Site are considered generally suitable for walking or better in winter and activities requiring longer exposures during the balance of the seasons, in the existing setting.

The Proposed Development occupies a portion of a block of land bounded by Dundas Street East to the southeast, and Kirwin Avenue to the northeast. The site is currently vacant, formerly occupied by 4 single-family dwellings, related open areas, vegetation, and parking. The development site shares the block with low through high-density residential buildings, street related commercial along Dundas Street East, and green space associated with John C. Price Park.

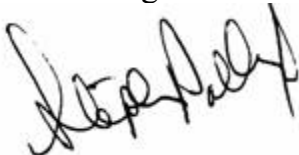
The 3016 Kirwin Street Development involves a proposal to construct three townhouse blocks 3.5 storeys in height. The buildings are organized about a driveway and central courtyard that provides vehicular access from Kirwin Avenue to underground parking and services. The townhouse entrances face the driveway and courtyard. The property abuts Little John Lane to the southwest and pedestrian access to John C. Price Park to the northwest, with the lands to the southwest dedicated to Parkland.

With inclusion of the proposed development, prevailing pedestrian comfort conditions are predicted to remain comfortable and suitable for walking, standing, or better, year round under normal to high ambient wind conditions. Several areas will realise an appreciable improvement to pedestrian comfort conditions, the improvements for the most part attributed to Townhouses sheltering leeward areas that are currently exposed to dominant wind directions.

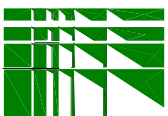
Comfort conditions expected at the proposed Development Site are considered better than those required to suit a suburban context, based upon qualitative analysis. Additional wind mitigation is not required.

Should you have questions or comments, please do not hesitate to call.

Kindest Regards



Stephen Pollock P.Eng



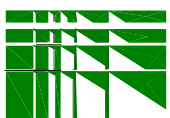
## **2. INTRODUCTION**

We have been retained to conduct a preliminary pedestrian level wind study for the proposed mixed-use residential development of 3016, 3020, 3032 Kirwin Avenue & 3031 Little John Lane Development, herein referred to as the 3016 Kirwin Avenue Development, in Mississauga, Ontario. The assessment is based upon project plans prepared by A & Associates Architects inc. The objective of this primary analysis is to estimate pedestrian level wind conditions resulting from inclusion of the proposed development, relative to comfort and safety. The analysis is based upon the historical wind conditions and our experience with similar microclimatic analyses that were conducted on other properties in the area. The qualitative assessment utilises numerical analysis of local wind data predicted at the site and provides a synopsis of pedestrian comfort conditions anticipated on, and adjacent to, the property. It is a precursor to physical scale model testing, the quantitative analysis that will further define anticipated wind conditions, and mitigation, should such measures be required.

## **3. SITE INFORMATION & PROPOSED DEVELOPMENT**

The Proposed Development occupies a block of land bounded by Dundas Street East to the southeast, Jaguar Valley Drive to the southwest, and Kirwin Avenue to the northeast through northwest. Note: Mississauga's street orientation is relative to the Lake Ontario Shoreline resulting in east/west orientated streets being offset by approximately 60 degrees north. The site is currently vacant, formerly occupied by 4 single-family dwellings, related open areas, vegetation, and parking. The development site shares the block with low through high-density residential buildings, street related commercial, along Dundas Street East and green space associated with John C. Price Park. (Figure 1).

It is proposed that the site be redeveloped to include 3.5 storey townhouse blocks denoted Block A, Block B and Block C. The buildings are organized about a driveway and central courtyard that provides vehicular access from Kirwin Avenue to underground parking and services. Buildings A and B extend from Kirwin Avenue along the northwest and southeast property lines respectively, and Building C makes up the southwest development boundary. The townhouse entrances face the driveway and courtyard, are recessed into the façade of the building, isolated from each other with raised planters and require steps, the number of risers varying to suit the grade. The property abuts Little John Lane to the southwest and pedestrian access to John C. Price Park to the northwest, with the lands to the southwest dedicated to Parkland. (Figure 2).



#### 4. SURROUNDING AREA

Residential and commercial development, related open areas, and mature vegetation, as indicated in Figure 1, for all intents and purposes, surround the site. To the immediate southeast of the Development site a series of 1 and 2 storey buildings flank the northwest side of Dundas Street East, while a mix of relatively higher residential and commercial buildings flank the southeast side of the street, with low-density residential neighbourhoods to the southeast beyond. Low-rise street related commercial and low to mid-rise residential, for all intents and purposes, line Dundas Street East to the immediate northeast and southwest of the site. Kirwin Avenue is flanked by low-density residential dwellings in the immediate vicinity of the proposed Development that increase in density with progression in a northwesterly direction along the street. R. Jones Park, which is dominated by mature deciduous vegetation, is situated to the north of Kirwin Avenue beyond. Lands occupying the quadrant from the northwest through southwest of the development site are assigned to John C. Price Park, which is similarly dominated by mature deciduous vegetation and flanked by high-rise residential buildings beyond.

Urban intensification is in various stages of approval in the area, most notable is the 86 – 90 Dundas Street East Development situated to the south and comprised of a 29 storey residential tower (including podium) with street related commercial at grade along Dundas Street East.



*3016 Kirwin Avenue Development Site Looking South from Kirwin Avenue.*

## 5. METEOROLOGICAL DATA

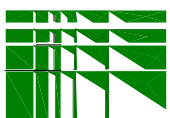
For studies in the City of Toronto, historical weather data recorded at the Pearson International Airport and Billy Bishop Toronto City Island Airport are analysed for the seasons, and the resulting wind roses are presented as velocity and percent frequency in Figure 3. Billy Bishop Airport realises a more significant wind climate, in comparison to Pearson, and is considerably further from the proposed Development site. This considered in concert with the site's distance from Lake Ontario indicate the wind climate at the proposed Development is better represented by Pearson International Airport. From the historical wind data it is apparent that winds can occur from any direction, however, the data indicates the directional characteristics of strong winds at Pearson are most likely to occur from the north through west to southwest with a far less significant easterly component.

The Historical meteorological data presented in the wind roses is measured at an elevation of 10m. This data is numerically processed with AERMET, a meteorological processor that considers wind speed and direction. Thus, representative ground level velocities at a height of 2m, for an urban macroclimate, are 52% of the mean values indicated on the wind rose, (for suburban and rural macroclimates the values are 63% and 78% respectively).

The macroclimate for this area is considered suburban and urban. Figure 3 also depicts wind velocity categories relative to directionality at the airport with strong winds, greater than 29km/h, occurring approximately 6% of the time during the summer and 14% during the winter, and emanating from the aforementioned quadrants during both the winter and summer seasons, with calm conditions occurring approximately 7% of the time during the summer and 5% of the time during winter.

## 6. COMFORT CRITERIA

The assignment of pedestrian comfort takes into consideration pedestrian safety and comfort attributable to mean and gust wind speeds. Gusts have a significant bearing on safety, as they can affect a person's balance, while winds flowing at or near mean velocities have a greater influence upon comfort. The effects of mean and gust wind conditions are described as suitable for Sitting or Standing or Walking over 80% of the time. In order for a point to be rated as suitable for Sitting, for example, the wind conditions must be less than 10 km/h. The rating would include conditions ranging from calm up to wind speeds that would rustle tree leaves or wave flags slightly. As the name infers, the category is recommended for outdoor space such as terraces and patios where people might sit for extended periods and generally applied to the summer months.





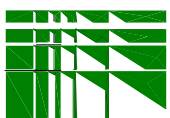
The Standing category is slightly more tolerant of wind, including wind speeds from calm up to 14km/h. In this situation, the wind would rustle tree leaves and, on occasion, move smaller branches while flags would be partially extended. This category would be suitable for locations where people might sit for short periods or stand in relative comfort, such as building entrances and drop-off areas. The Walking category includes wind speeds from calm up to 19km/h. These winds would set tree limbs in motion, lift leaves, litter and dust, and the locations are suitable for sidewalks and parking. The Uncomfortable category covers a broad range of wind conditions, including wind speeds above 19km/h. These winds would set trees in motion, cause inconvenience when walking, and are not generally suitable to activities. Safety concerns are associated with wind speeds that are beyond the uncomfortable category, being sufficient to affect a person's balance.

Many variables contribute to a person's perception of the wind environment beyond the seasonal variations presented. While people are generally more tolerant of wind during the summer months, than during the winter, due to the wind cooling effect, people become acclimatized to a particular wind environment. Persons dwelling near the shore of an ocean, large lake or open field are more tolerant of wind than someone residing in a sheltered wind environment.

## **7. PEDESTRIAN LEVEL WIND ASSESSMENT**

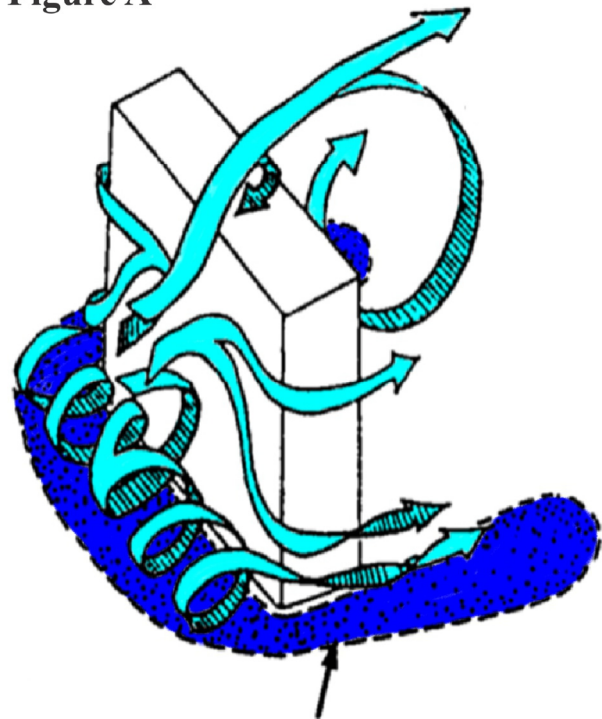
Variables beyond the orientation and conformation of a proposed development must be considered in predicting wind speed and occurrence at a given location. These include the previously discussed historical wind climate, surrounding terrain, and neighbouring buildings, each of which is quantified and/or analysed in the microclimatic analysis of pedestrian level winds. The results of such quantitative analyses have afforded a knowledge base that allows an estimation of pedestrian level wind conditions.

The site and the surrounds, in the present circumstances as a mix of suburban and urban residential neighbourhoods, commercial and industrial developments, and open spaces, have a sympathetic relationship with the existing wind climate. Urban development provides turbulence inducing surface roughness that can be wind friendly, while open settings afford wind the opportunity to accelerate as the wind's boundary layer profile thickens at the pedestrian level, owing to lack of surface roughness. Transition zones from open to urban settings can prove problematic, as winds exacerbated by the open setting are redirected to flow over, down, around and between buildings.



High-rise buildings may exacerbate wind conditions within their immediate vicinity, to varying degrees, by redirecting wind currents to the ground level and along streets and open areas. In general, wind will split upon impact with a high-rise building, with portions flowing down the face of the building to the pedestrian level as downwash, where it is deflected, or otherwise redirected to flow along the building and around its corners, creating localized zones of increased pedestrian level wind. Conversely, points situated to the leeward side, or in the wake of buildings will often enjoy an improvement in pedestrian comfort. As such, it is reasonable to expect inclusion of the proposed development will alter wind conditions under specific wind directions and velocities from those of the existing site condition, resulting in an improvement over the existing conditions at some points, with more windy conditions at others.

**Figure A**



**Area of Strong Surface Wind**

## **Discussion of Northerly Winds**

### **Existing Setting**

Northerly winds make up a significant percentage of the prevailing wind climate; they tend to be of moderate velocity, and are preconditioned upon approach by residential neighbourhoods comprised of single family dwellings flanking Kirwin Avenue and Whitchurch Mews beyond, the latter flanking R. Jones Park, which supports a mixed growth suburban forest. The residential properties and park to the north of the site present a relatively consistent, coarse approach, which will induce turbulence into the wind's approach flow, significantly reducing the wind's energy realized at the site, particularly at the pedestrian level.

The proposed Development site is for all intents and purposes in the aerodynamic shade region of the above-mentioned. This will result in comfortable conditions along Kirwin Avenue proximate to the Development site and on the site proper, suitable for standing or walking along the street in winter, and for activities requiring longer exposures during the remaining seasons.

### **Proposed Setting**

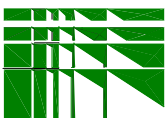
Block A as proposed is a 3.5 storey townhouse block that occupies the northmost corner of the site, and is situated parallel to the northwest development boundary. Block B is to the immediate southeast of Block A and is near parallel to the southeast development boundary and Block C is to the southwest adjacent to Blocks A and B and also along the southwest Development boundary. Blocks A and B are separated from each other by a driveway and from Block C by the front yards, stairs, and gardens associated with the townhouses.

Northerly winds approaching from over the rooftops and the windward low-density residential neighbourhoods that support a mix of mature coniferous and deciduous vegetation will come into contact with the northmost corner of Block A where the wind streamlines will split with portions being deflected to flow up and over the rooftop, and/or along the façades of the building. The southwesterly flow along the northwest façade of Block A will be moderate, given the windward terrain, and will further moderated by plantings in the adjacent park and the irregular texture of the Block's façade, that is punctuated with balconies and features irregular surfaces. The southwesterly flow along the Block's façade will continue along the building, around the corner, and ultimately through the gap between Block A and Block C.

The flow through said gap will encounter resistance from the leeward Block C design features such as the stairs and railings, as well as the landscape, which includes raised planters and plantings. Given the windward terrain, wind mitigative design features of the proposed Development, and landscaping, pedestrian comfort conditions along the windward façades of Block A and in the gap between Blocks A and C will be comfortable, generally suitable for standing during the winter months and sitting during the Summer.

The southeasterly portion of the flow split off the leading edge of Block A will continue along the Kirwin Avenue sidewalk and boulevard with a portion escaping into the gap between Block A and Block B and ultimately around the eastmost corner of Block B. This will result in slightly windier conditions along the street, however, the upset will not be sufficient to change the comfort ratings of the portion of the street influenced by the proposed development, which will remain suitable for walking and better along the Kirwin Avenue sidewalk in winter, and for activities requiring longer exposures during the remaining seasons.

The interior spaces of the proposed Development feature landscape design features that introduce roughness into wind streamlines, and are for the most part in the aerodynamic shade region of Block A and Block C. As such, these areas will realise comfortable conditions, most of the time, suitable for standing or sitting during the summer months and for walking or standing during the winter, suitable for the area's intended purposes.





## **Discussion of Westerly Winds**

Westerly winds similarly make up a significant percentage of the prevailing wind climate; they tend to be of higher velocity, particularly during the winter months, and are preconditioned upon approach by John C. Price Park and mid/high-rise apartment buildings situated along Kirwin Avenue about the Park and Jaguar Valley Drive. The high-density buildings are in the order of 4 to 5 stories with several high-rise slab style buildings, the nearest in the order of 12, 16, and 29 stories. The surroundings also support mature vegetation which when considered in concert present a coarse approach terrain, which will induce turbulence into the wind's approach flow, significantly reducing the wind's energy at the pedestrian level.

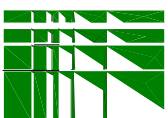
### **Existing Setting**

The proposed Development site is for all intents and purposes in the aerodynamic shade region of the above-mentioned. This will result in comfortable wind conditions along Kirwin Avenue and on the proposed Development site, suitable for standing or walking along the sidewalks of the street in winter, and for activities requiring longer exposures, such as standing, and occasionally sitting, during the remaining seasons.

### **Proposed Setting**

Westerly winds approaching from over and around the windward residential neighbourhoods and John C. Price Park, that support a mix of mature coniferous and deciduous vegetation, will come into contact with the westmost corner of Block C where the wind streamlines will similarly split with portions being deflected to flow up and over the rooftop, and or along the façades of the building. The northeasterly flow will continue along the northwest façade of Block C with a portion escaping through the gap between Block C and Block A. Similar to northerly winds the flow through the gap resulting from westerly winds, and components thereof, will encounter resistance from the building's design features and landscaping. Given the windward terrain, wind mitigative design features of the proposed Development, and landscaping, pedestrian comfort conditions along the windward façades of Blocks A and C, and in the gap between the Blocks, will be comfortable, generally suitable for standing during the winter months and sitting during the Summer.

The westerly wind flow that continues along Block A will pass around the building's northmost corner where it will diffuse over the relatively open setting of Kirwin Avenue. Given the windward terrain, the irregular texture of the Block's façades, and landscaping onsite, the flow around the corner, and ultimately over the street, will not be inordinate, and pedestrian comfort conditions will remain suitable for walking during the winter at the corner and for standing or better along the building, in the aerodynamic shade region created by the proposed Development.



The proposed Development Building C will cause slightly windier conditions along a localised portion of Dundas Street East, however, the upset will not be significant, likely not perceptible relative to the existing setting. Given the windward terrain, existing and proposed landscaping, the Parkland Dedication adjacent to the proposed Development will be comfortable, and appropriate to the area's intended purpose.

The interior spaces of the proposed Development are for the most part in the aerodynamic shade region of Block A and Block C. The area features a wind mitigative landscape design that introduces roughness into winds streamlines, and the areas will realise comfortable conditions, suitable for the areas' intended purposes.

### **Discussion of Southerly Winds**

Southerly winds make up a less significant percentage of the prevailing wind climate and tend to be of lower velocity, however, portions there of are less favourably preconditioned upon approach. This can be attributed to a relatively more open terrain comprised of low-rise commercial buildings, interspaced with the occasional mid-rise slab style residential building, related parking and green space which will allow wind to accelerate, relative to the more coarse terrains associated with the previously discussed wind directions.

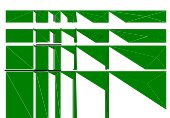
### **Existing Setting**

The proposed Development site is for all intents and purposes in the aerodynamic shade region of the above-mentioned 2 storey strip mall along the northwest side of Dundas Street East. This will result in comfortable wind conditions along Kirwin Avenue, once removed from the intersection, and on the proposed Development site, with pedestrian comfort ratings as suitable for standing along the sidewalks of the street in winter, and for activities requiring longer exposures, during the remaining seasons.

### **Proposed Setting**

Southerly winds approaching from over the 2 storey strip mall along Dundas Street East, will come into contact with the southmost corners of Blocks B and C where the wind's streamlines will again split with portions being deflected to flow up and over the rooftops, and/or along the façades of the buildings. The northwesterly flow along Block C will pass over the Park Dedication, however, given the windward terrain, southerly wind climate, landscaping in the Park and the wind mitigative design features of the Park, pedestrian comfort conditions will be comfortable and suitable to the area's intended purpose.

Southerly winds deflected by Block C to flow in a northeasterly direction will combine with winds deflected to flow in a northwesterly direction by Block B to flow through



the gap created between Block A and Block B. This will result in moderately windy conditions from time to time, on the occasion of high ambient or gusty southerly winds. However, the resulting flow through the gap will encounter resistance from the proposed Development's design features, such as the stairs and railings, as well as the landscape, which includes raised planters and plantings. Given the relatively comfortable southerly wind climate, windward terrain, wind mitigative design features of the proposed Development, and landscaping, pedestrian comfort conditions along the windward façades of Blocks A, B, and C, and the in the gap between Blocks A, B and C, will be comfortable, generally suitable for standing during the winter months and sitting during the Summer.

The northeasterly wind flow that continues along Block B will pass around the building's eastmost corner where it will diffuse over the relatively open setting of Kirwin Avenue. Given the windward terrain, the irregular texture of the Block's façades, and landscaping onsite, the flow around the corner, and ultimately over the street, will not be inordinate, and pedestrian comfort conditions will remain suitable for walking or better during the winter at the corner and for standing or better along the building, in the aerodynamic shade region created by the proposed Development.

### **Discussion of Easterly Winds**

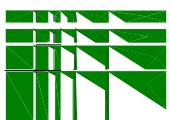
Easterly winds are infrequent, however they can be strong and are often associated with storms. The existing commercial and residential developments to the east of the property, flanking Dundas Street East, and the low density residential beyond, present a relatively more coarse approach than those associated with southerly winds. This terrain will induce more turbulence into the wind's approach flow, significantly reducing the wind's energy at the pedestrian level upon approach.

### **Existing Setting**

The proposed Development site is for all intents and purposes in the aerodynamic shade region of the above-mentioned. This will result in comfortable conditions along Kirwin Avenue proximate to the Development site and on the site proper, suitable for standing or walking along the street adjacent to the site in winter, and for activities requiring longer exposures during the remaining seasons.

### **Proposed Setting**

Easterly winds approaching from over the rooftops of the windward low-density residential neighbourhoods and street related commercial along Dundas Street East will come into contact with the eastmost corners of Blocks A and B where the wind streamlines will split with portions being deflected to flow up and over the rooftops, and/or along the façades of the buildings. The southwesterly flow along the southeast façades of said Blocks will be moderate, given the windward terrain, and the irregular



texture of the Block's façades. The northwesterly flow along the Kirwin Avenue façades will continue along the buildings, around the corners, and ultimately through the gap between Blocks A and B and/or around the northmost corner of Block A.

The windward terrain will moderate winds upon approach and the resulting flow around the corners and through said gap will be further moderated by surface roughness associated with the proposed Development design features, as discussed above. Given the windward terrain, wind mitigative design features of the proposed Development, and landscaping, pedestrian comfort conditions along the windward façades of Block A and Block B, and in the gap between these Blocks will be comfortable, generally suitable for standing during the winter months and sitting during the Summer.

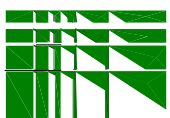
The southwesterly portion of the flow split off the leading edge of Block B will continue along the building and ultimately into the gap between Block A and Block C. This will result in slightly windier conditions in the gap, however, the upset will not be inordinate and the area will remain suitable for standing in winter, and for activities requiring longer exposures during the remaining seasons.

The interior spaces of the proposed Development feature landscape design features that introduce roughness into wind streamlines, and are for the most part in the aerodynamic shade region of Block B. As such, these areas will realise comfortable conditions, most of the time, suitable for standing or sitting during the summer months and for standing during the winter, suitable for the areas' intended purposes.

## **Discussion of Ordinal Winds**

Ordinal Winds approaching from northwesterly, northeasterly, southeasterly, and southwesterly directions will contact the façades of the proposed development at near right angles. This generally results in the propensity for a downwash of wind to the pedestrian level, the magnitude of which is dependent upon several variables. Those variables commanding primary consideration are the building height, and the effective width of the presented façade. It is intuitively obvious that short and/or narrow façades will reduce the propensity for downwash, and the 3.5 storey façades of the proposed Development presented to ordinal winds will display a marked tendency to deflect wind to flow over the buildings.

Mitigation of downwash is well understood and was applied through design whereby the building façades are stepped at the 3rd level. This, in addition to the building being punctuated with balconies, overhangs and other design features, as discussed in the Mitigation Strategies Section of this report, were employed to mitigate the effects of winds at the pedestrian level. At the pedestrian level, landscape features incorporating



raised planters, coarse plantings, fencing, and other features help to control pedestrian comfort conditions.

### **Discussion of Outdoor Amenity**

Outdoor Amenity areas are proposed at grade adjacent to the southwest and southeast façades of Block C, the latter near the southmost corner. The proposed Development, and the neighbouring 2 storey strip mall along Dundas Street East, will isolate the amenity space areas from significant portions of the prevailing wind climate. This will result in comfortable amenity space conditions with winds from said directions. Conversely, the amenity spaces are exposed to winds approaching from specific compass points, however, the immediate windward terrain to said directions do not exacerbate winds; in fact winds approaching the area are moderated by the surroundings on approach.

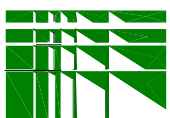
On the occasion of strong winds emanating from easterly, and to a lesser degree, westerly directions, portions of the amenity spaces may realise windy conditions. The amenity spaces are predicted to be suitable for the intended purpose, sitting, during the summer months, most of the time, but portions of the spaces may realise conditions that are less appropriate, on occasion.

A mitigation plan has been incorporated into the amenity areas' landscaping plan to accommodate activities requiring longer exposure. This includes raised planters, fencing, an arbour, and others, that will further moderate winds acting in the area resulting in pedestrian comfort conditions that are appropriate to the area most of the time.

### **Discussion of Residential Entrances**

The residential entrances to the Townhouse Blocks are organised about a central court that provides access to the individual units via a network of sidewalks flanking the driveway from Kirwin Avenue. The entrances are accessed from stairs of various heights, as dictated by the building design and the grade, and are flanked with gardens in raised planters. These design features introduce significant roughness to winds that may be deflected to flow along the façades of the Blocks and past the entrances. The building blocks are organised about the central courtyard such that most of the wind climate does not find its way between the buildings, and the windward surroundings effectively moderate winds from most prevailing directions that may affect the area, upon approach.

Therefore comfort conditions are predicted as suitable for standing or better at the entrances most of the time. The sidewalks providing access to the entrances were





discussed above and found to be comfortable and appropriate to the area's intended purpose.

## **8. MITIGATION STRATEGIES**

The 3016 Kirwin Avenue Development plans establish a context for development in terms of height, massing, and location that allows the assessment of wind issues/problems that may persist once built.

The proposed Development employs wind mitigative design features that include:

- parapet walls
- balconies
- stepped massing
- landscaping
- textured façades

and others, that will increase surface roughness apparent to the wind.

Comfort conditions expected at the proposed Development site are considered better than those required to suit the context, based upon qualitative analysis.

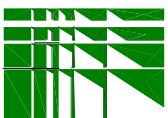




Figure 1: Site Aerial Photo





# Figure 2: Site Plan

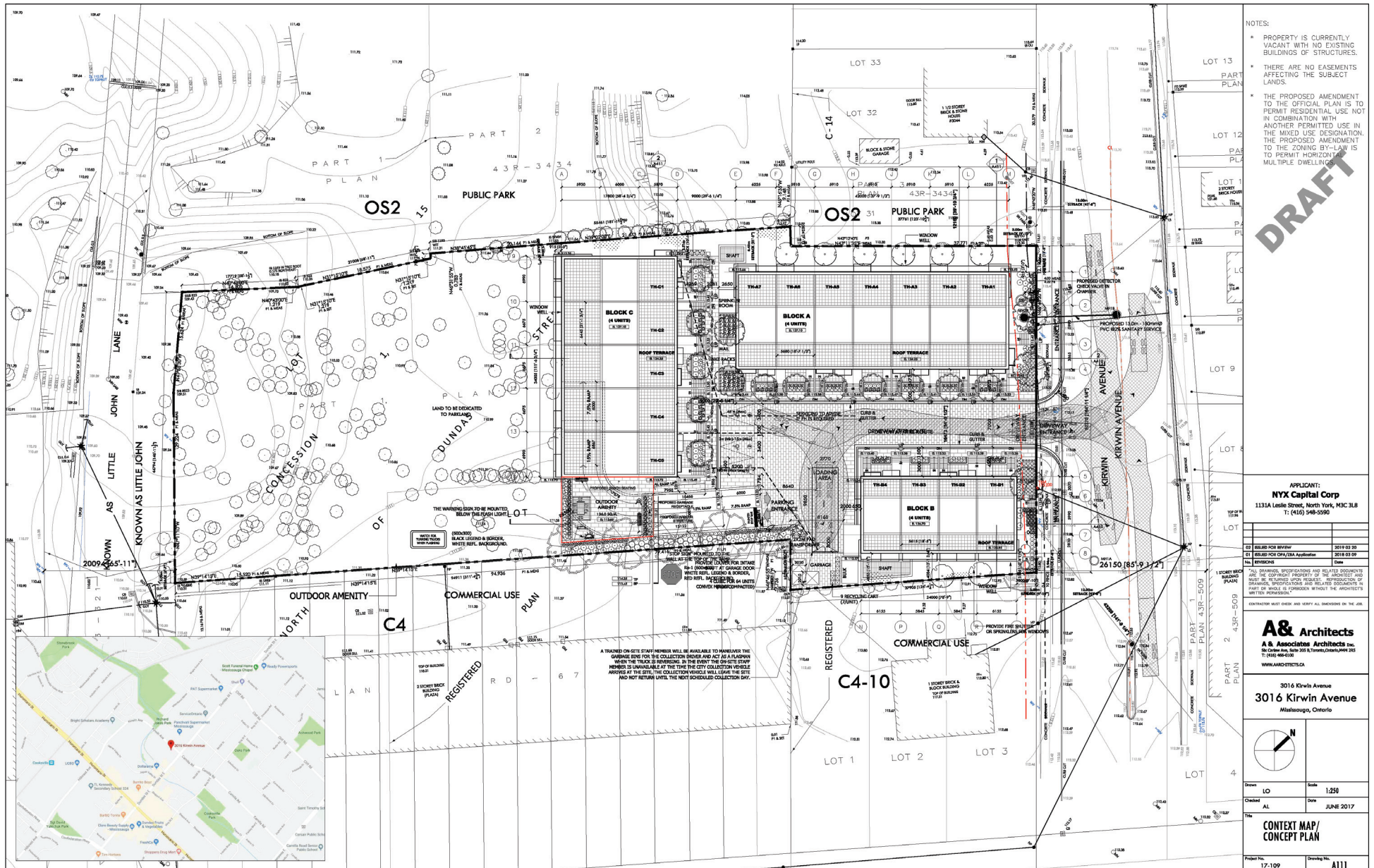
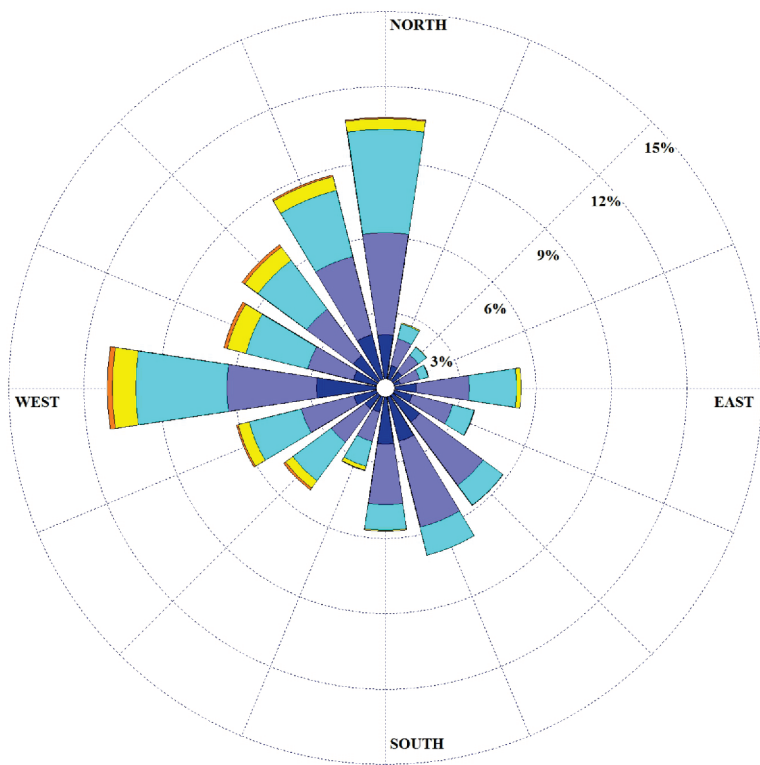
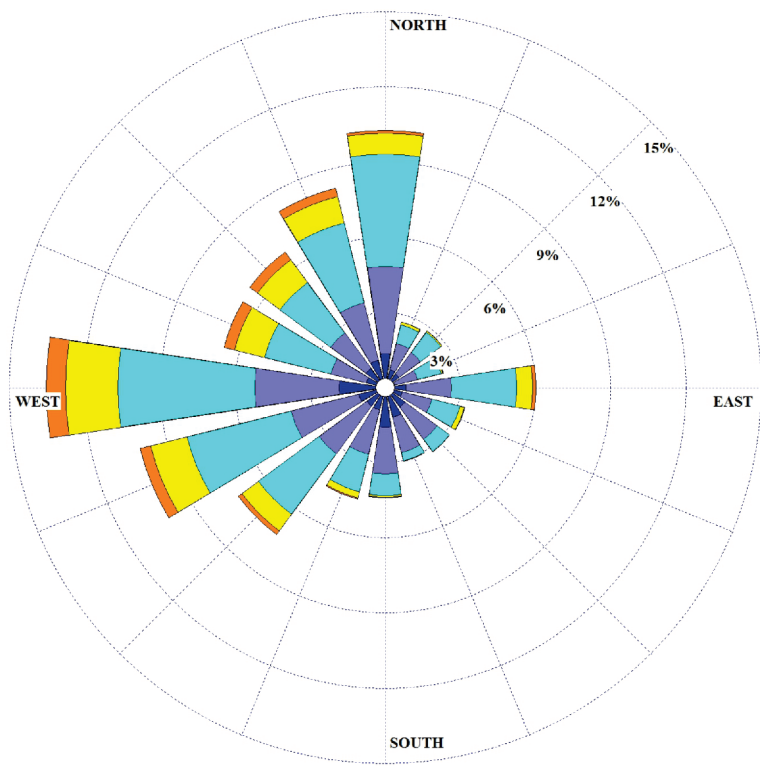


Figure 3: Windrose Toronto Pearson International Airport



Summer - May through October, 1980 to 2012



Winter - November through April, 1980 to 2012

