April 19, 2021

Siderius Developments Ltd.
588 Scotland Road
Odessa, ON K0H 2H0

Attn: Nate Doornekamp
nate@doornekamp.ca

Dear Mr. Doornekamp:

Re: Pedestrian Wind Comfort and Grade-Level Snow Drift Assessment + Roof Snow Loads
40 Sir John A. MacDonald Boulevard, Kingston
Gradient Wind File 20-273

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Siderius Developments Ltd. to provide a professional opinion regarding microclimate engineering considerations for the proposed redevelopment of the development site located at 40 Sir John A. MacDonald Boulevard in Kingston, Ontario. The current scope of work includes a preliminary assessment of (i) anticipated pedestrian wind comfort conditions at grade and on elevated amenity terraces; (ii) snow drifting at grade; and (iii) anticipated roof snow loads on the existing Heating Plant (HP) building following full build-out of the proposed development.

This preliminary assessment is based on site plan drawings prepared by Fotenn Planning + Design, dated March 1, 2021, as well as architectural drawings (floor plans and elevations) for Blocks B, C, and D.

The site comprises 32,835 square meters (m^2) which will be subdivided into five blocks, labelled Block 'A', Block 'B', Block 'C', Block 'D', and Block 'E'. The development is located on the site of the former Prison for Women, on a parcel of land bordered by King Street West to the south, Sir John A. Macdonald Boulevard to the east, Union Street West to the north, and existing residential dwellings to the west.

Block A, at the northeast corner of the site, is currently not designed or part of the rezoning application. It is envisioned that it will consist of two residential high-rise towers situated on four storey podiums with grade level amenity areas located along the north, west and west elevations of the podium retail.

Block B includes the existing prison complex, which will be redeveloped to include terraces and a glass façade on the Annex Building (the south wing). An outdoor amenity area may be located to the east of the 10-storey building. An amenity area will also be located on Level 4 at the southwest corner of the annex building.

Block C, at the west of the site, is a seniors housing continuum of care community which comprises two 10-storey buildings connected by a 2-storey link. The north building (Retirement Home) has a 1-storey expanded footprint at grade. Outdoor amenities are located at grade along the west and east elevations of Block C. A covered terrace is located on the north-west corner at the 2nd floor level dedicated to residents of the supportive living accommodation and an outdoor amenity terrace may be located on the link roof between the two buildings.

Block D includes a proposed 10-storey hotel/residential/retail building. The existing 12.8-m-tall HP building is located approximately 4 m to the south of the noted 10-storey building.

Lastly, Block E, to the south of Block C, includes the West Yard Park, which borders King Street to the south. The property at the southeast of the city block includes the Correctional Service of Canada Museum, which is not part of the subject site. Block E also includes a connecting pathway to Union Street W, which separates Block C from Blocks A, B, and D.

A plan view of the subject site in its surroundings is provided in Figure 1, while Figure 2 illustrates the site plan together with letter tags identifying sensitive pedestrian locations considered in this assessment. The wind conditions within the subject site are influenced by the local wind climate, as illustrated in Figure 3, and by local wind exposures, which are characterized by low-rise suburban buildings from the west clockwise to the east, and mixed open-suburban exposures for the southern half of the compass, owing to the proximity to Lake Ontario.

2. PEDESTRIAN WIND COMFORT

Pedestrian wind comfort is determined by three main factors, including (i) the geometry and orientation of the study buildings; (ii) shielding and channeling effects created by the massing and relative spacing of surrounding buildings; and (iii) the alignment of the study buildings with respect to statistically prominent wind directions. For Kingston, the prominent wind directions occur from the south and northeast during the spring, summer, and autumn seasons, and from the west and northeast during the winter season.

The site is highly exposed to prominent winds from the southwest quadrant. Winds from the northeast, which are also common during the colder seasons, will be reduced somewhat by the suburban massing upwind of the subject site.

Block A: The building massing for Block A is not currently designed. It is envisioned that it will consist of two residential high-rise towers situated on four storey podiums with grade level amenity areas located along the north, west and west elevations of the podium retail. To prevent adverse wind effects at grade, the towers should be set back from the podium to reduce downwash effects at grade from the towers.

The amenity areas on the east, north and west sides of Block A (Figure 2, Tags A, B, & C) may be windy, depending on the building design. Conditions for Block A, and any mitigation, should be confirmed by a detailed pedestrian level wind (PLW) study using the computational fluid dynamics (CFD) technique or via wind tunnel testing on a physical scale model of the subject site in its surroundings. A PLW study is recommended for design development. Mitigation options for the amenity areas and other areas may be considered at this point, if required.

Block B: The overall massing of the 4-storey existing prison building will remain mostly unchanged. The low height of the building is not expected to greatly reduce wind comfort at grade. Conditions on the amenity terrace at Level 4 of the Annex Building (Figure 2, Tag D) will likely be acceptable, given the low height of the building and the shelter provided by the building to the north and east. Conditions within the club room terrace (Figure 2, Tab M) will also likely be acceptable, given the shelter provided by Block B to the west and north and by Block D to the south.

Block C: The large and exposed west elevations of Block C, Buildings A and B, will create downwash effects at grade level. While some downwash winds will be captured by the small 1-storey podium around

Buildings A, Building B is not served by a podium. However, the area will be mostly protected from direct westerly winds by the wall at the western extent of the property. If the wall were to be removed, conditions would be expected to be windier within Block C but may still be acceptable.

Conditions within the outdoor spaces serving Block C (Figure 2, Tags H and I) will be moderately windy. Mitigation should be considered for these areas which could include, in order of decreasing efficacy, building massing modifications, canopies, or a combination of vertical wind screens and coniferous plantings in dense arrangements to protect designated seating areas.

Conditions within the outdoor seating area (Figure 2, Tag L) are expected to be relatively calm during the typical use period of late spring to early autumn. Mitigation will likely not be required.

The link roof between buildings A and B (Figure 2, Tag J), which may include an amenity area, will be exposed to easterly and westerly winds. Downwash and wind channelling between the two buildings will reduce wind comfort within the terrace. Should the terrace include an amenity area, mitigation is expected to be required to achieve conditions suitable for sitting during the typical use period. Mitigation could include raised perimeter guards, canopies, or wind barriers inboard of the perimeter.

The covered terrace at Level 2, at the northwest of Building A (Figure 2, Tag K) is near the building corner, so conditions will be affected by downwash and acceleration of horizontal winds. Mitigation may be required to achieve conditions suitable for sitting during the typical use period. Mitigation could include raised perimeter guards.

Conditions for Block C, and any mitigation, should be confirmed by a detailed pedestrian level wind (PLW) study using the CFD technique on a computational model of the subject site in its surroundings. A PLW study is recommended for design development.

Block D: The proposed 10-storey building will be exposed to prominent southerly and southwesterly winds, as well as northeasterly winds, but will be somewhat protected from direct westerly winds by the Block C massing. In addition, the existing HP building will partially protect the amenity area at the east of the building (Figure 2, Tag F). However, the building setbacks at Level 5 are small (approximately 1.5 m), so downwash effects are expected to impact areas at grade. Conditions within the noted amenity area

are expected to be somewhat windy. Wind comfort could be improved by local mitigation measures, which could include tall vertical wind screens along the perimeter of the amenity area.

While the introduction of the proposed 10-storey building will lead to generally windier conditions within other areas in the immediate vicinity, conditions are expected to be acceptable for the intended uses on a seasonal basis.

Conditions on the amenity terraces on Level 9, on the east and west sides of the 10-storey building (Figure 2, Tag G) will be affected by direct high-level winds and acceleration of winds around the building above. The west terrace will be particularly affected, due to its orientation with respect to the prominent winds in Kingston, and due to the geometry of the mechanical penthouse above. Wind comfort within the west terrace would be improved by introducing 1.6-m tall solid wind screens along the full perimeter.

Block E: The area to the south of the proposed development is expected to experience conditions similar to those that presently exist. If mitigation were required to increase comfort conditions within the typical use period, the area would benefit from several clusters of coniferous plantings in dense arrangements and tall vertical wind screens to shield the area from prominent winds.

3. SNOW DRIFTING AT GRADE

Kingston experiences a moderate amount of annual snowfall, comparable with other municipalities in Eastern Ontario. As illustrated in Figure 4, winds during snowfall events are predominantly from the northeast. However, winds between snowfall events are mostly from the southwest.

Snow is expected to accumulate where prominent southwesterly winds will drift snow from a large source area against west- and south-facing façades. This is considered problematic when large accumulations coincide with sensitive pedestrian areas, such as building entrances or walkways. Most grade-level locations surrounding the subject site are not expected to experience problematic snow drift accumulations for common weather systems.

Regarding Block A, the source area that is expected to contribute to snow accumulations along the southern and western façades is somewhat limited by the massing of Blocks B and C. The degree of snow scouring will depend on the massing configuration of the designed buildings. Nevertheless, snow clearing requirements are not expected to exceed typical and customary measures.

Regarding the existing prison building within Block B, snow is likely to accumulate along the south elevation and the west elevation of the south wing. In particular, the entrance from the grade-level parking area (Figure 2, Tag E) is likely to accumulate snow. However, accumulations in this area are expected to be comparable to those that currently exist for the prison building.

For Block C, the wall along the western edge of the property will limit the source area that can contribute to snow accumulations along the western façade. Should the wall be removed, the step change in elevation to the immediate west of the subject property will likely perform a similar function. In addition, downwash from the western façade will scour snow from the base of the building, helping to reduce snow accumulations. While prominent winds during snowfall events may result in higher-than-average accumulations along the eastern façade, overall drift accumulations are not expected to exceed those commonly seen in Kingston. Snow clearing requirements are not expected to exceed typical and customary measures.

Regarding the 10-storey hotel/residential/retail building within Block D, downwash is expected to scour snow from the base of the building, reducing large drift accumulations. In particular, large drift accumulations are not expected near the primary entrance. Snow clearing requirements are not expected to exceed typical and customary measures.

4. ESTIMATED SNOW LOADS ON EXISTING HEATING PLANT BUILDING

Based on the empirical equations in the National Building Code of Canada (NBCC 2015), the introduction of the proposed 10-storey hotel/residential/retail building (Block D), which is offset from the existing HP building by approximately 4.0 m to the north, is estimated to significantly increase snow loads on the main roof of the HP building. Specifically, the NBCC 2015 recommends a drift snow load over the west half of the HP building of approximately 4.3 kilopascals (kPa) at the north end, reducing linearly to approximately 2.1 kPa over approximately 3.6 m towards the south. The recommended snow load on the remainder of the roof is approximately 2.1 kPa (uniform). Prior to the introduction of the noted proposed building, the NBCC 2015 recommends a uniform snow load of approximately 2.1 kPa over the HP building roof. The plan roof area of the HP building is approximately 440 m^2 (22 m north-south by 20 m east-west).

Based on the historical climate data for Kingston and our experience with snow load studies throughout Canada, including Kingston, via detailed wind and snow simulations, the drift snow loads recommended by the NBCC 2015 for the HP building, as noted above, are considered conservative.

The prominent winds for Kingston during the winter season originate from the south clockwise to west, followed by those from the northeast. During active periods of snowfall, while strong winds originate from southerly and westerly directions, wind flow most often occurs from the north-northeast clockwise to east-northeast.

Based on the historical wind data for Kingston, the HP building roof is expected to receive strong wind flows with the proposed 10-storey building present, inclusive of local acceleration effects. The strong wind flows are expected to frequently scour snow from the HP building roof. As such, with the proposed 10-storey building present, the following roof snow loads are estimated for the HP building:

- Within the west third of the roof area, we recommend a peak snow load of 2.7 kPa at the north perimeter reducing to 2.0 kPa over a drift distance of 3.0 m towards the south.

- A uniform snow load of 2.0 kPa is recommended for the remainder of the roof area.

- The noted snow loads qualitatively consider the influences of snow drifting and aerodynamic effects, specifically snow falling out of suspension in the wake of the proposed 10-storey building.

- If required, a structural engineer with knowledge of the roof structures would evaluate roof capacity to determine whether the specified loads are within safe limits.

- Snow loads in this report represent specified loads corresponding to a 50-year return period, which shall be multiplied by the appropriate principle-load factor or companion-load factor, per the Ontario Building Code (2012) and the National Building Code of Canada (2015), to obtain corresponding structural design loads.

The foregoing opinions are based on knowledge and experience of wind flow patterns and snow accumulations on and around buildings. While these statements are expected to be reliable for the site, a detailed understanding of specific localized conditions requires a quantitative wind and snow analysis.

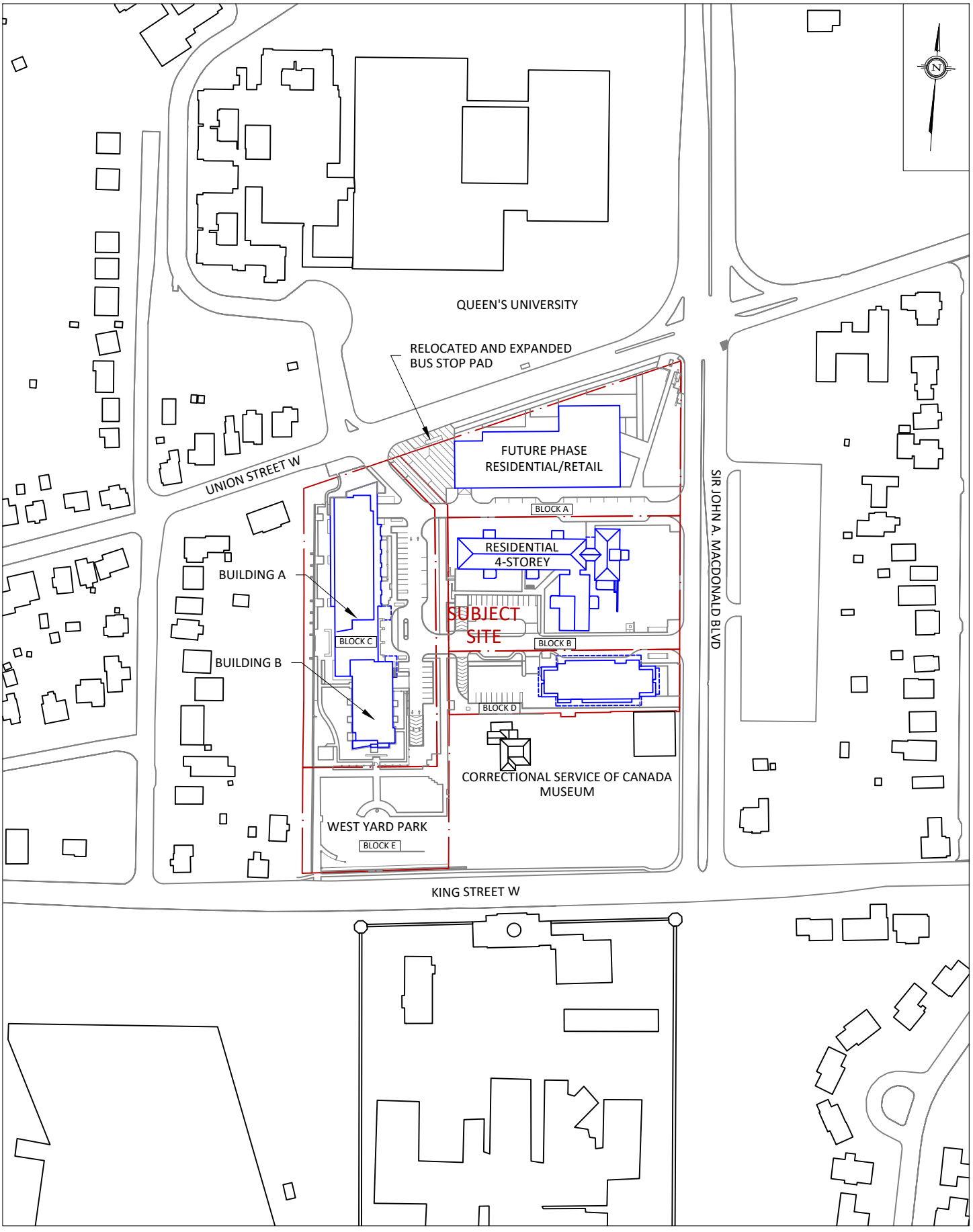
Sincerely,

Gradient Wind Engineering Inc.

LICENSED PROFESSIONAL ENGINEER
J. D. FERRARO
100158495
Apr 19, 2021
PROVINCE OF ONTARIO

Sacha Ruzzante, MASc
Wind Scientist

Justin Ferraro, P.Eng.
Principal



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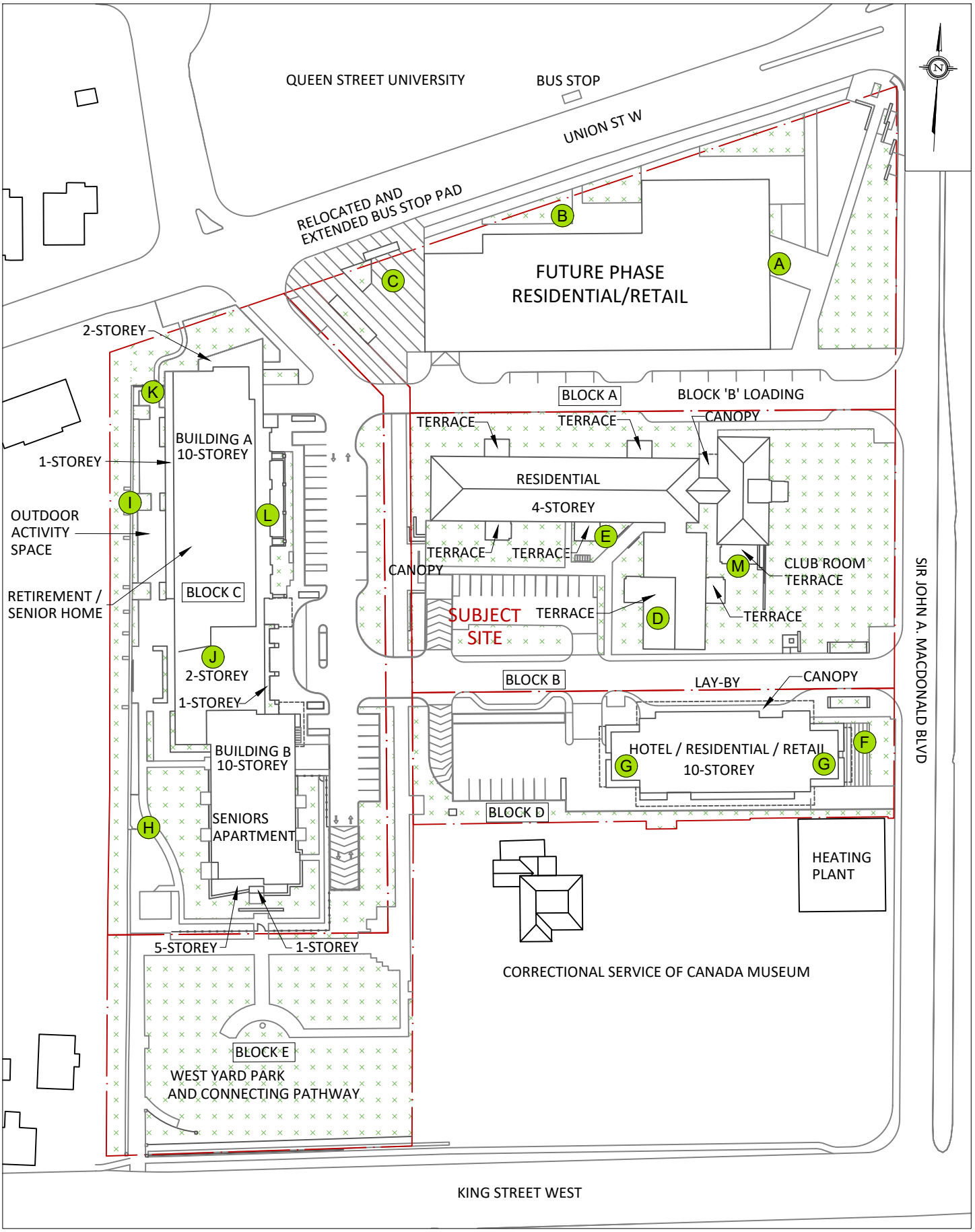
PROJECT	40 SIR JOHN A. MACDONALD BLVD, KINGSTON, ON PEDESTRIAN LEVEL WIND AND SNOW DRIFT ASSESSMENT
SCALE	1:2500
DRAWING NO.	20-273-DTSNOW-1
DATE	MARCH 4, 2021
DRAWN BY	O.R.

DESCRIPTION

FIGURE 1:
PROPOSED SITE PLAN AND SURROUNDING CONTEXT



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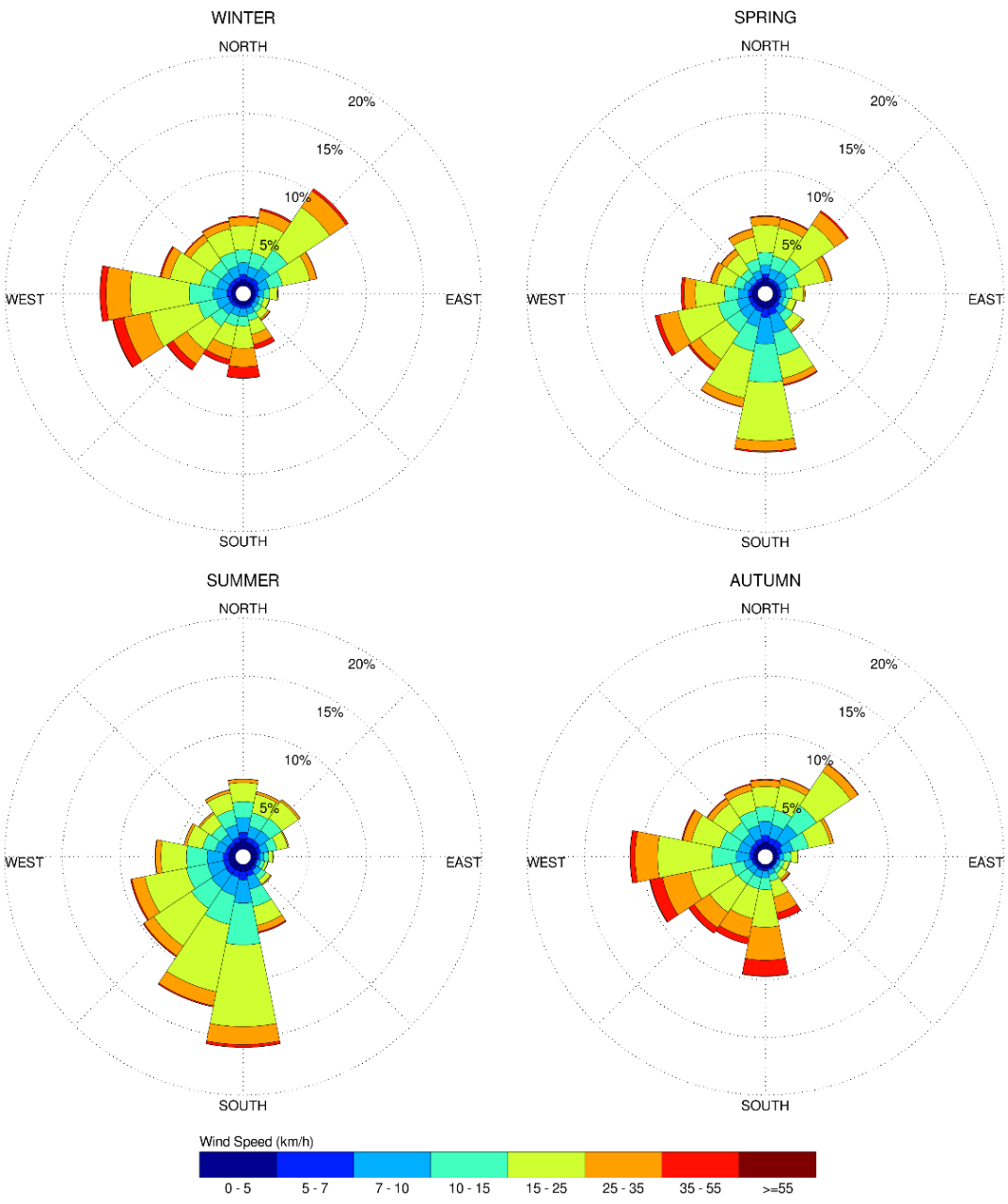
PROJECT	40 SIR JOHN A. MACDONALD BLVD, KINGSTON, ON PEDESTRIAN LEVEL WIND AND SNOW DRIFT ASSESSMENT
SCALE	1:1200
DRAWING NO.	20-273-DTSNOW-2
DATE	MARCH 4, 2021
DRAWN BY	O.R.

DESCRIPTION

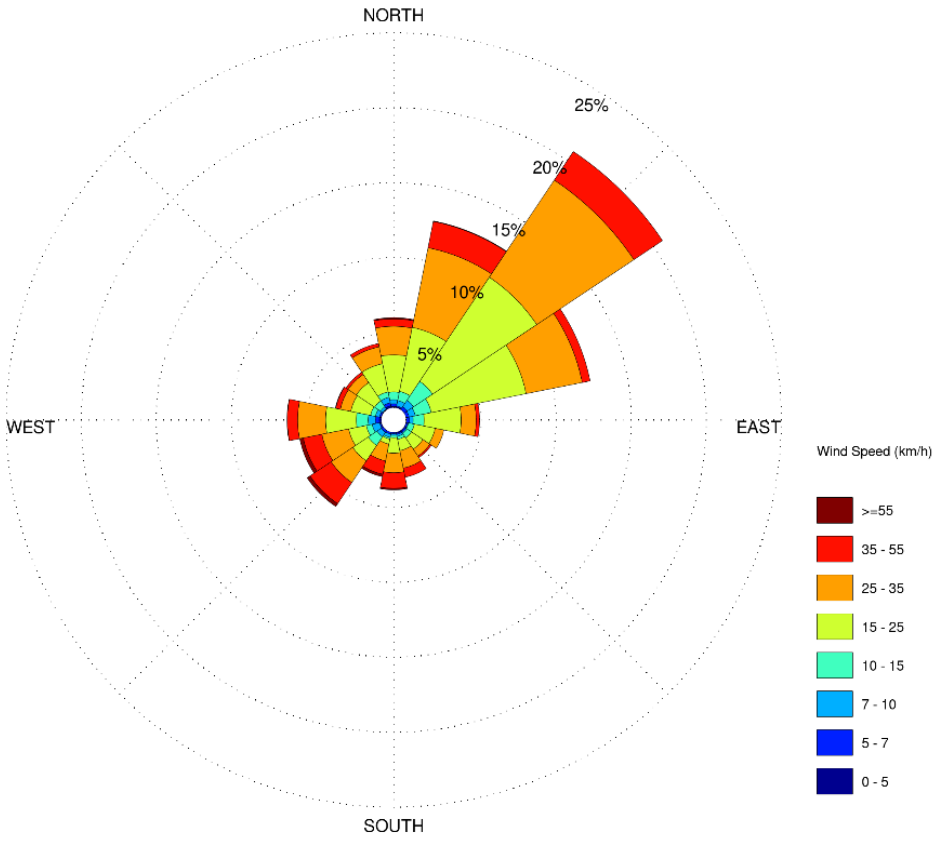
FIGURE 2:
PROPOSED SITE PLAN



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in kilometres per hour (km/h) measured at 10 m above grade.

FIGURE 3: SEASONAL DISTRIBUTION OF WIND
NORMAN ROGERS AIRPORT, KINGSTON (1967-2020)



Notes:

1. Radial distances indicate percentage of time of wind events.
2. Wind speeds are mean hourly in kilometres per hour (km/h) measured at 10 m above grade.

FIGURE 4: DISTRIBUTION OF WINDS DURING SNOWFALL EVENTS
NORMAN ROGERS AIRPORT, KINGSTON (1967-1996)