APPENDIX B

URBAN DESIGN AND VISUAL RESOURCES

- *Pedestrian Wind Study*

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Date: November 19, 2021

To: Astoria Owners, LLC
43 W 47th Street
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Re: **Pedestrian Wind Study**
3-15 26th Avenue
Long Island City, NY
SLR Project #241.30019.00000

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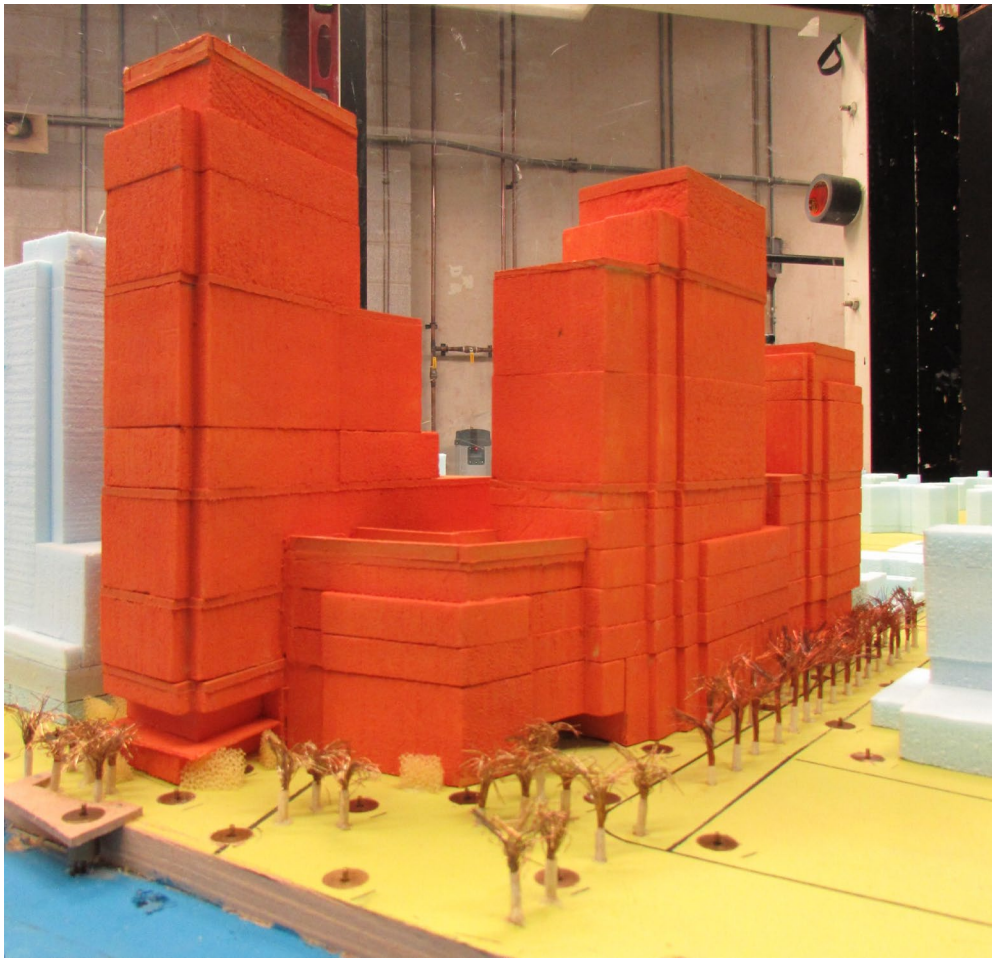

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1.0 INTRODUCTION

SLR Consulting (Canada) Ltd. (SLR) was retained by Astoria Owners LIC to conduct a pedestrian wind study for the proposed development at 3-15 26th Avenue in Long Island City, New York. This report is in support of the design team.

1.1 Existing Site

The proposed development is located on the north side of 26th Avenue, between 3rd and 4th Streets. The site is currently an empty lot. **Figure 1** provides an aerial view of the immediate study area. A virtual site visit was conducted by SLR using Google Earth images dated November 2019; some of these images are included in **Figures 2a** through **2d**.

Immediately surrounding the site are East River to the north, low-rise commercial developments to the east and southeast, a mid-rise commercial development to the south, and low-rise commercial developments to the southwest through west. Beyond the immediate surroundings are mainly low to mid-rise buildings to the southeast through southwest, with the East River to the west through north to northwest.

Typically, developments which are approved or under-construction in the surrounding area are included in the pedestrian wind assessment. For this site, For this assessment, the following approved developments were included: Astoria Cove Development and Hallet's Point.



Figure 1: Aerial view of existing site & surroundings
Credit: Google Earth Pro, dated 8/16/2020



Figure 2a: Along 26th Avenue looking west (site to the right)



Figure 2b: Along 26th Avenue looking southwest (site to the left)

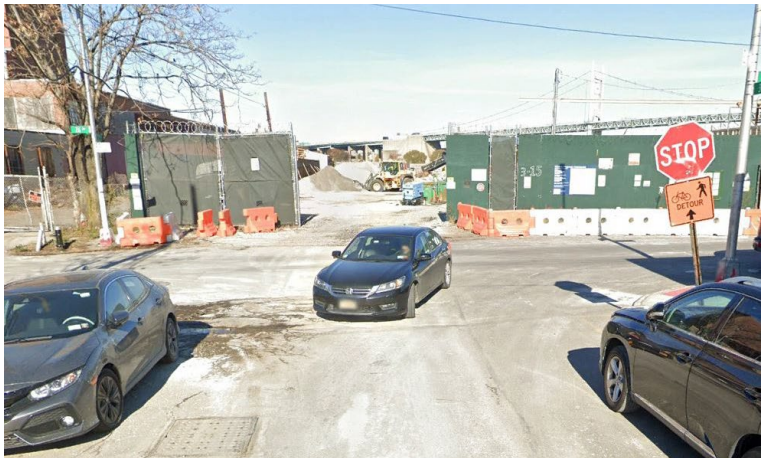


Figure 2c: Along 3rd Street looking northeast at the site



Figure 2d: Along 4th Avenue looking towards 26th Avenue to the northeast

1.2 Proposed Development

The proposed development consists of three connected building segments. Building Segment 1 is located at the south edge of the site and is 23-stories tall with a total height of approximately 238 ft. including mechanical roof. Building Segment 2 is 31-stories tall, approximately 318 ft. in height and located on the west edge of the site. At the north edge of the site is Building Segment 3 at 34-stories tall (approximately 350 ft.). All three buildings are on top of a low-rise podium, and contain multiple stepped facades. Figure 3 shows a rendering of the proposed development.

1.3 Areas of Interest

Areas of interest for pedestrian wind conditions include those areas which pedestrians are expected to use on a frequent basis. Typically these include sidewalks, main entrances, transit stops, plazas and parks.

There are three main residential entrances located along the west and north sides of the building. In addition, there are individual unit entrances along the west facade. Secondary entrances and exits can be found along the south, west and north sides of the building, while the main retail entrance is located near the southwest corner of the site. These areas are shown in Figure 4. In addition, there is a community path along the north side of the development, along the river.



Figure 3: Rendering of proposed development
Credit: Studio V Architecture

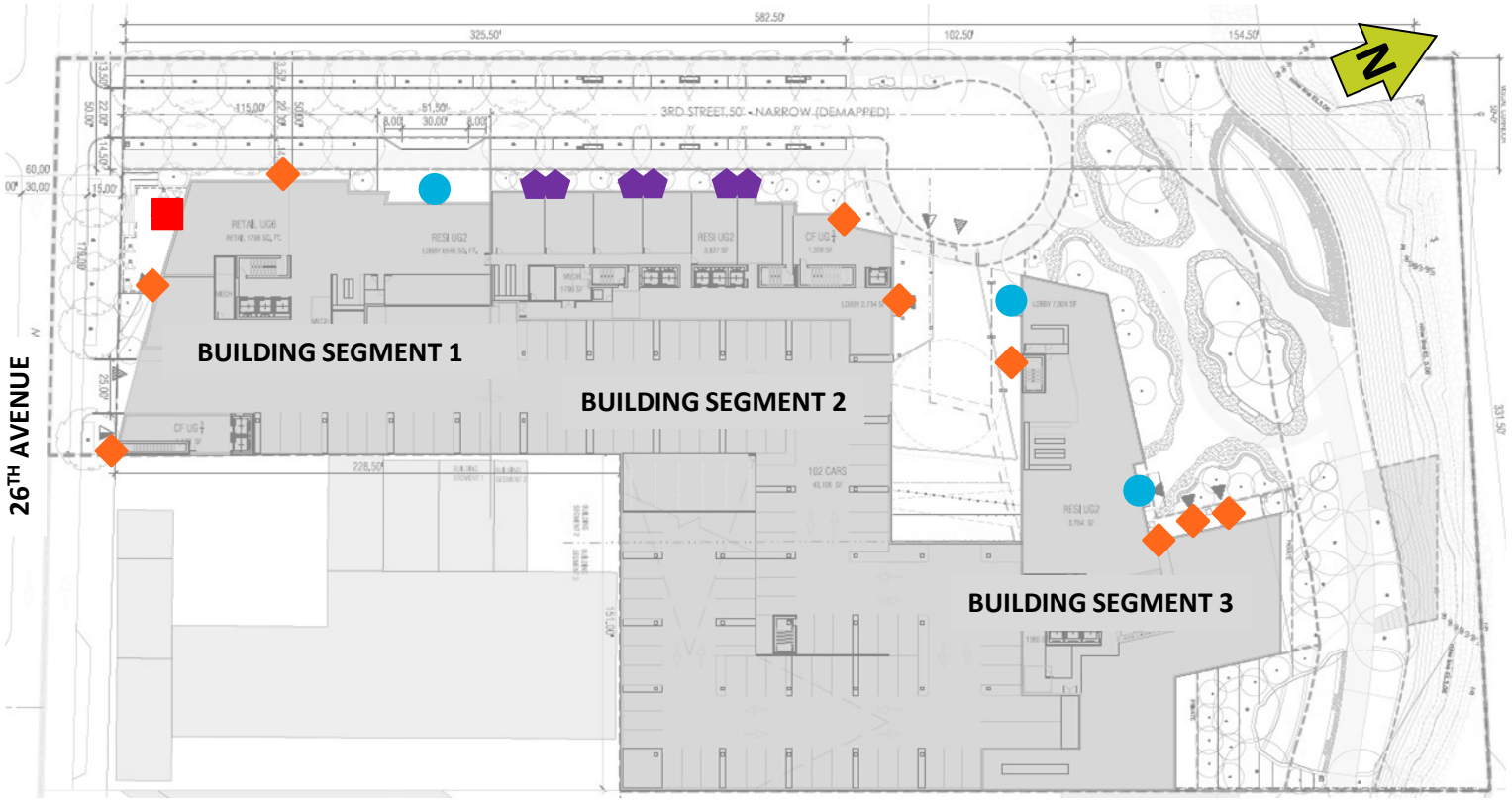


Figure 4: Areas of Interest

2.0 APPROACH

The objective of the wind tunnel study is to assist the design team in making informed decisions about the building form considered and its influence on pedestrian comfort. This quantitative analysis involves the construction of a physical model of the development and surrounding features that influence wind flow. The physical model is instrumented with probes and tested in a wind tunnel. Afterwards, the wind tunnel data are combined with regional meteorological data; this analysis is then compared to the relevant wind criteria and standards in order to determine how appropriate the wind conditions are for the intended pedestrian usage.

2.1 Scale Model Construction

A 1:400 scale model of the proposed 2-15 26th Avenue Development was constructed based on up-to-date drawing information received by SLR on October 20, 2021; The proximity model of the surrounding area was built in block form for a radius of approximately 1600 ft. from the site centre. As existing buildings surrounding the site will influence wind characteristics, existing buildings, those under construction and future buildings with planning approval were included in the model for both the Existing and Proposed Configurations. Information regarding which approved developments to include within the existing surrounds was determined based on discussion with the design team. Grade differences within the limits of the model were found to be minor, thus the site was modeled as flat with a drop for the East River.

SLR tested two configurations in the wind tunnel. These included:

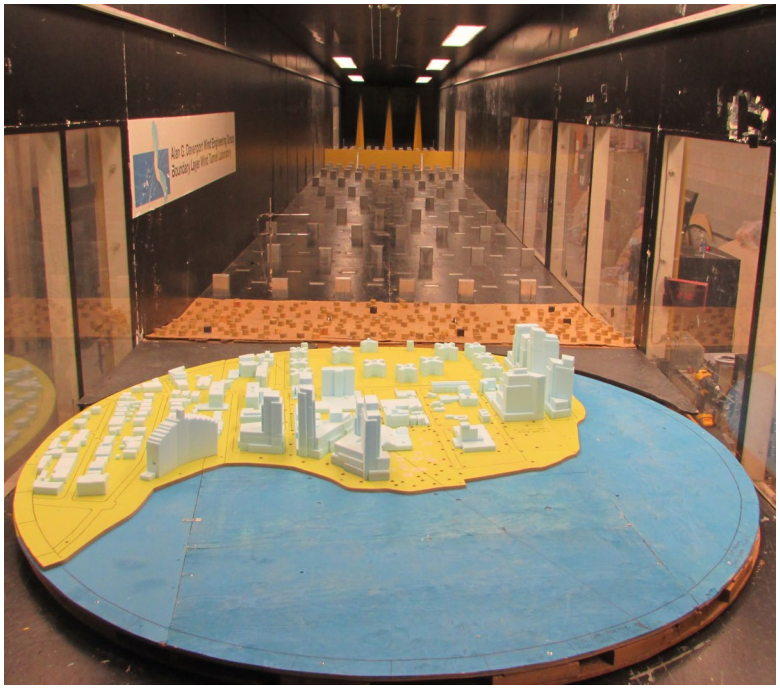
- Existing Configuration: Existing site with existing and approved developments
- Proposed Configuration: Proposed development with proposed landscaping and existing and approved developments

Photographs of the wind tunnel model showing both the Existing and Proposed Configurations are included in Figures 5a and 5b.

2.2 Wind Tunnel

Wind tunnel tests were conducted in the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory at the University of Western Ontario. The upstream test section of the wind tunnel included generic roughness blocks and turbulence-generating spires to modify the wind flow approaching the model. These features develop characteristics of the wind flow that are similar to the actual site. The test model is rotated on a turn-table to simulate different wind directions with the upstream terrain being changed as appropriate to reflect the various upwind conditions encountered around the site.

The test model was equipped with 97 omni-directional probes to record wind speed at the pedestrian-level (approximately 5 feet above grade). The orientation of the model was rotated in 10° intervals on the turn-table to permit measurement of wind speed at each probe location for 36 wind directions. The wind tunnel data were then combined with the wind climate model for this region to predict the occurrence of wind speeds in the pedestrian realm and compare against wind criteria for comfort and safety.





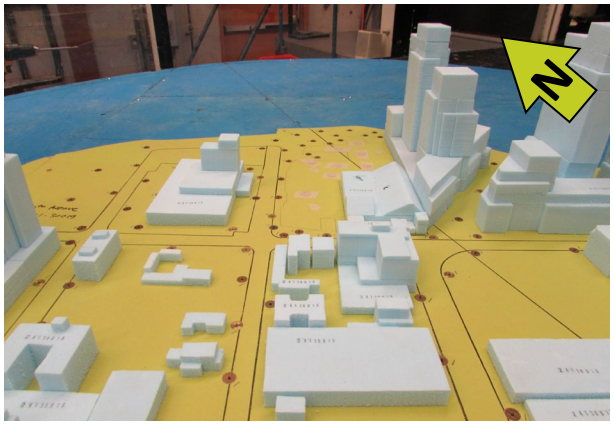
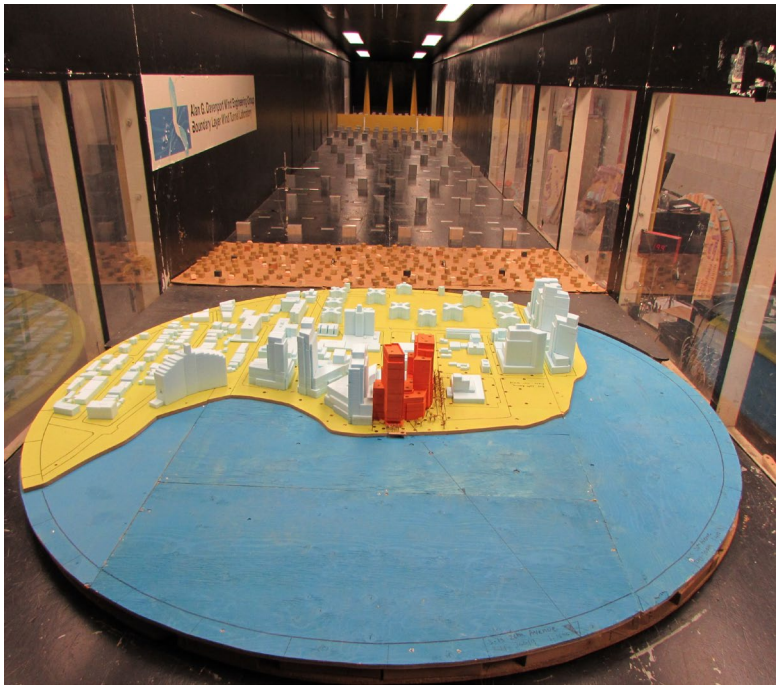


Figure 5a: Existing Configuration





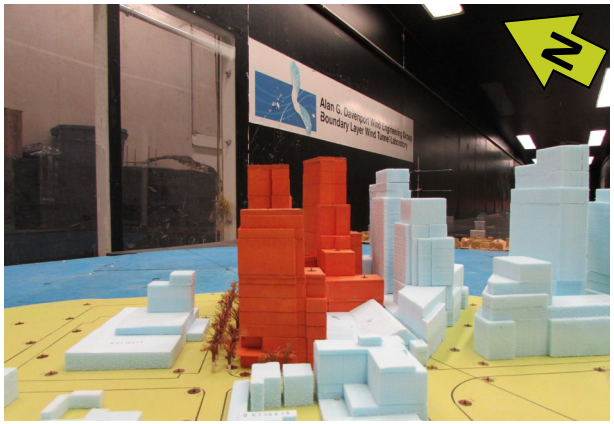


Figure 5b: Proposed (Nov 2021) Configuration

2.3 Wind Climate

Wind data recorded at LaGuardia Airport for the period of 1990 to 2019 were obtained and analysed to create a wind climate model for the region. Annual and seasonal wind distribution diagrams ("wind roses") are shown in Figure 6. These diagrams illustrate the percentage of time wind blows from the 16 main compass directions. Of main interest are the longest peaks that identify the most frequently occurring wind directions. The annual wind rose indicates that wind approaching from the northwest, south and northeast directions are most prevalent. The seasonal wind roses readily show how the prevalent winds shift throughout the year.

The directions from which stronger winds (e.g., > 30 km/h) approach are also of interest as they have the highest potential of creating problematic wind conditions, depending upon site exposure and the building configurations. The wind roses in Figure 6 also identify the directional frequency of these stronger winds, as indicated in the figure's legend colour key. On an annual basis, strong winds occur from the northwest quadrant. All wind speeds and directions were included in the wind climate model.

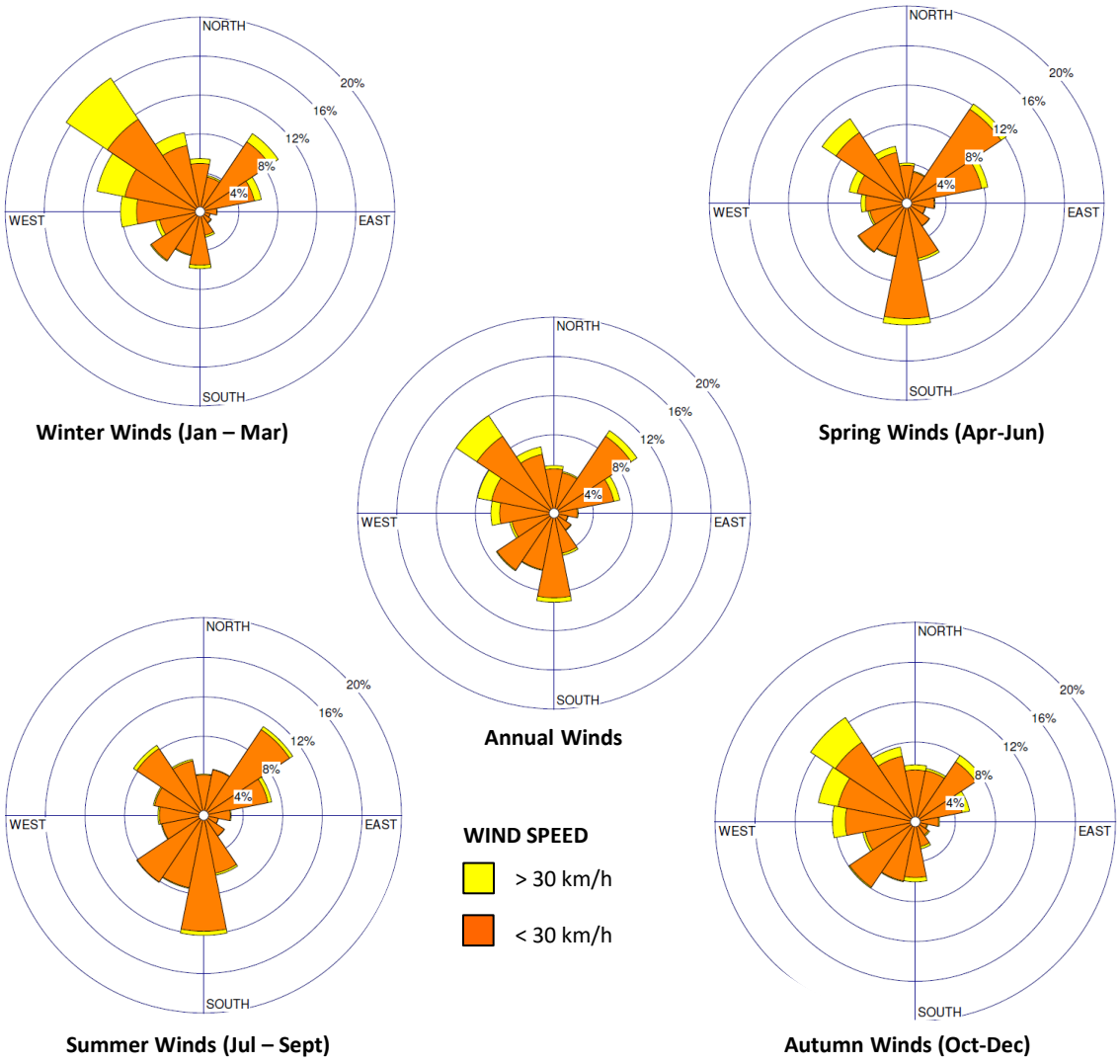


Figure 6: Wind Roses for JFK International Airport (1990-2019)

3.0 PEDESTRIAN WIND CRITERIA

Wind comfort conditions are discussed in terms of being acceptable for certain pedestrian activities and are based on predicted wind force and the expected frequency of occurrence. Wind chill, clothing, humidity and exposure to direct sun, for example, all affect a person's thermal comfort; however, these influences are not considered in the wind comfort criteria.

The comfort criteria, which are based on certain predicted hourly mean wind speeds being exceeded 5% of the time, are summarized in Table 1. Generally, this is equivalent to a wind event of several hours duration occurring about once per week.

The criterion for wind safety in the table is based on hourly mean wind speeds that are exceeded once per year (approximately 0.01% of the time). When more than one event is predicted annually, wind mitigation measures are then advised. The wind safety criterion is shown in Table 2.

The criteria for wind comfort and safety used in this assessment are similar to those developed at the Boundary Layer Wind Tunnel Lab of Western University, together with building officials in London, England. They are broadly based on the Beaufort Scale and on previous criteria that were originally developed by Davenport. Similar criteria are used by the Alan G. Davenport Wind Engineering Group Boundary-Layer Wind Tunnel Laboratory for pedestrian wind study projects located around the globe. For a list of references, describing the criteria and history of its development see Section 7.0.

Table 1: Wind Comfort Criteria

Activity	Comfort Ranges for Mean Wind Speed Exceeded 5% of the Time	Description of Wind Comfort
Sitting	0 to 9 mph	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper comfortably.
Standing	0 to 14 mph	Gentle breezes suitable for main building entrances and transit stops.
Leisurely Walking	0 to 18 mph	Moderate breezes suitable for walking along pedestrian thorough fares.
Fast Walking	0 to 22 mph	Strong breezes that can be tolerated if one's objective is to walk, run or cycle without lingering.
Uncomfortable	> 22 mph	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended.

Table 2: Wind Safety Criterion

Activity	Safety Criterion Mean Wind Speed Exceeded Once Per Year (0.01%)	Description of Wind Effects
Any	45 mph	Excessive gust speeds that can adversely affect a pedestrian's balance and footing. Wind mitigation is typically required.

4.0 RESULTS

Figures 7a, 7b, 9a and 9b present graphical images of the wind comfort conditions for the summer and winter months around the proposed development. These represent the seasonal extremes of best and worst case. The "comfort zones" shown are based on an integration of wind speed and frequency for all 36 wind directions tested with the seasonal wind climate model. The presence of mature trees can lead to wind comfort levels that are marginally more comfortable than shown, during seasons when foliage is present. Full detailed results for the summer and winter can be found in Appendix A, while Appendix B provides the spring and autumn seasons. Annual wind safety is provided in Appendix C.

There are generally accepted wind comfort levels that are desired for various pedestrian uses. However, it some climates these may be difficult to achieve in the winter due to the overall climate. For sidewalks, walkways and pathways, wind comfort suitable for leisurely walking are desirable year-round but may not be feasible in the winter. The presence of benches on a sidewalk, which are an optional usage, does not change the overall wind comfort requirement for sidewalk. Wind conditions of fast walking are satisfactory for loading areas, laneways, and a limited portion of a sidewalk, considering exposure is brief for pedestrians through. For main entrances, transit stops, and public amenity spaces such as parks and playgrounds, wind conditions conducive to standing are preferred throughout the year. For on-site amenity areas, wind conditions suitable for sitting or standing are desirable during the summer, with stronger wind flows, conducive to leisurely walking, tolerated in the winter. The most stringent category of sitting is desirable during the summer for dedicated seating areas, such as patios, where calmer wind is expected for the comfort of patrons.

Note, no data is available for Locations 24 through 32.

4.1 Building Entrances & Walkways (Locations 1–23)

Existing wind conditions on-site are generally comfortable for leisurely walking or better throughout the year. The exceptions are near the northwest corner of the existing building to the east of the project site, where wind conditions are conducive to fast walking or are uncomfortable during the winter (Locations 17, 18 and 23 in Figure 7a).

With the proposed development in place, wind conditions on-site are generally comfortable for leisurely walking or better year-round (Figure 7b). Stronger wind flows, conducive to fast walking in the winter, occur near the southwest corner (Location 3) of the site, as well as along the community walkway to the north (Locations 21 and 22).

Wind conditions at the main residential entrance on the west facade (Location 6) are comfortable for sitting or standing throughout the year. At the main residential entrance on the north facade (Location 14) wind conditions are conducive to standing throughout the year. Wind conditions at the retail entrance (Location 2) and the secondary entrances (Locations 1, 2, 5, 8 and 15) are also suitable for sitting or standing throughout the year (Figure 7b). Additionally, wind conditions at the individual unit entrances (Location 7) are comfortable for sitting in the summer and standing in the winter.

However, wind conditions at two of the building's entrances (Locations 9 and 10) are comfortable for leisurely walking in the summer and are uncomfortable in the winter (Figure 7b). The strong wind flows at these entrances are due to the predominant northwesterly winds that flow through the driveway and up through the open courtyard, or be directed down through the courtyard by the buildings above, and then through the driveway.

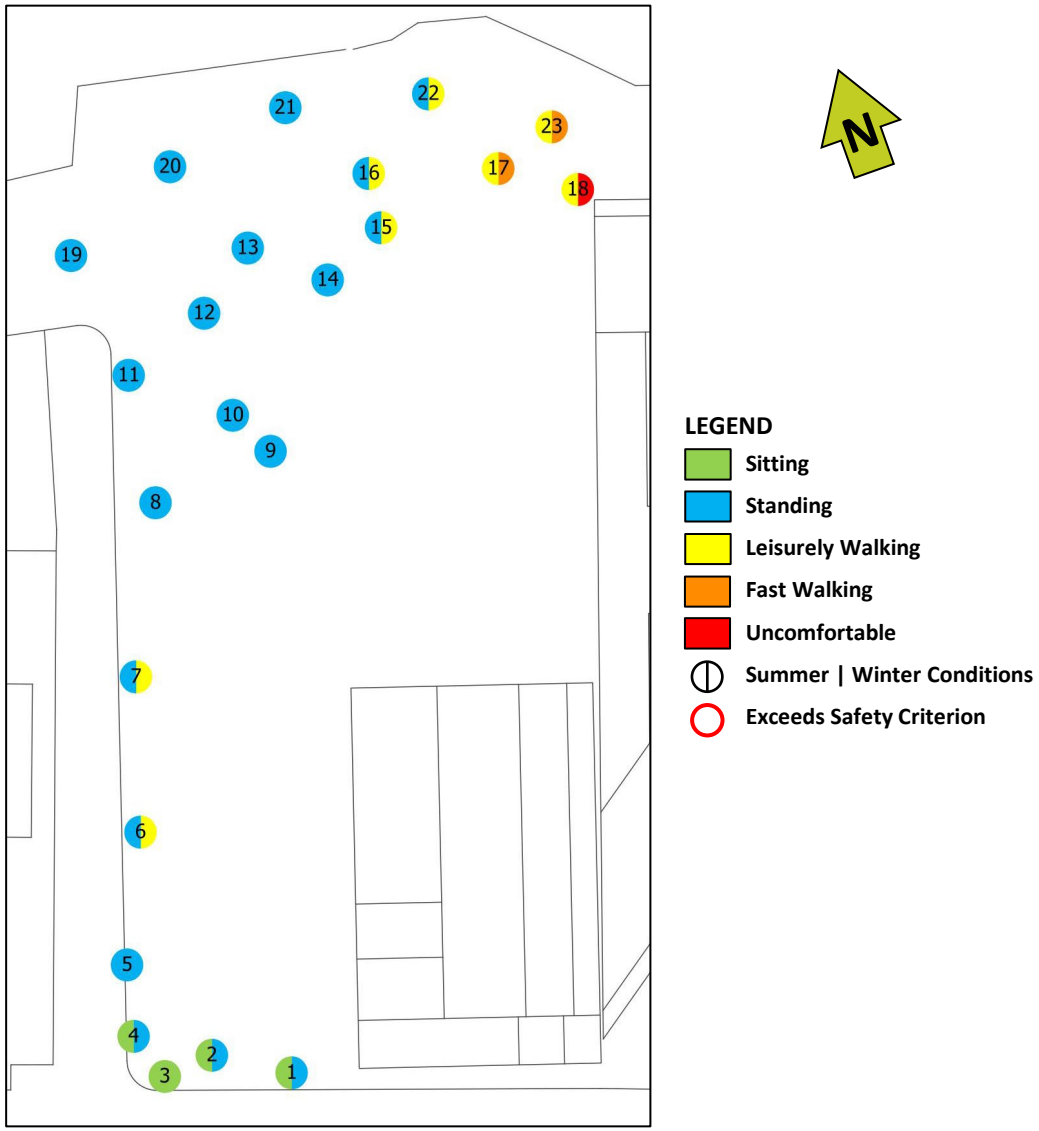


Figure 7a: Existing Configuration – Pedestrian Wind Conditions – On-site

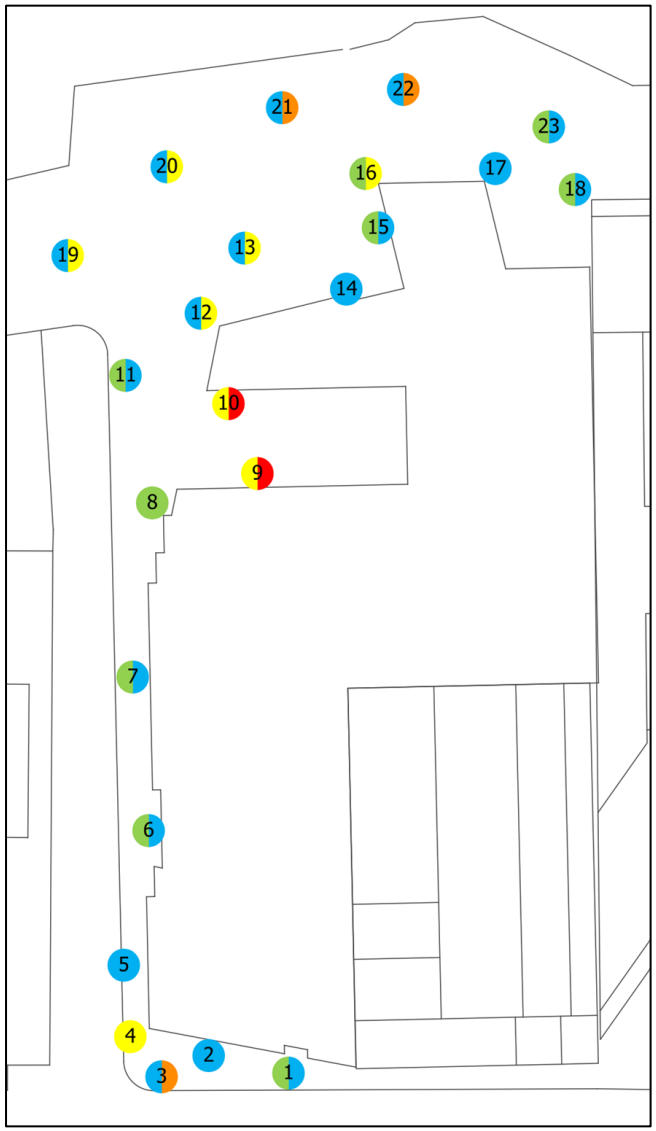
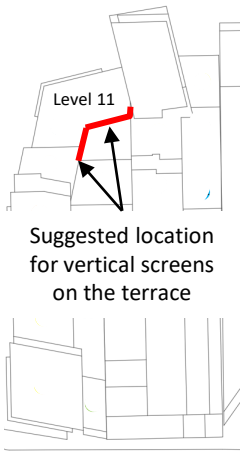


Figure 7b: Proposed Configuration – Pedestrian Wind Conditions – On-site

To improve the wind conditions at these entrances within the driveway (Locations 9 and 10),we recommend the design team consider the following mitigation measures:

- Install tall vertical wind screens (minimum 10 ft. tall, 50% to 70% solid) to the immediate east and west of both doors. These should project at least 6 ft. from the building's facade. The intent is to provide an exterior "vestibule" thus providing local shelter for pedestrians exiting their cars. The inclusion of interior vestibules at both of these entrances is a positive design feature that should be maintained.
- Install tall vertical wind screens (minimum 10 ft. tall, 50% to 60% solid) along the west and south edges of terrace above (the 10-storey element of Building Segment 3). These screens would disrupt the northwesterly winds flows that are pulled down into the courtyard.

Examples of these wind mitigation measures are shown in **Figure 8**.



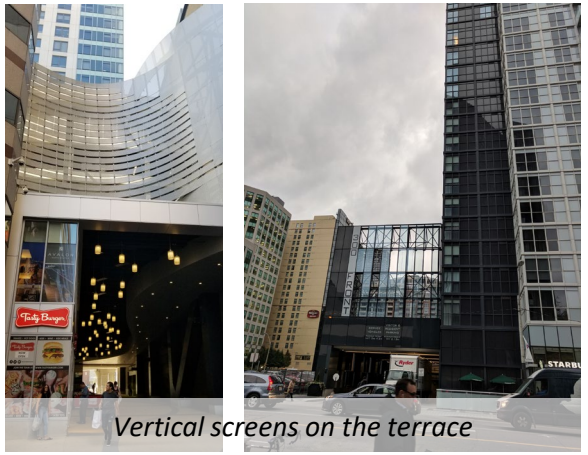




Figure 8: Examples of wind mitigation measures

4.3 Surrounding Sidewalks (Locations 33–97)

Existing wind conditions along the sidewalks of 26th Avenue, 1st, 2nd , 3rd , 4th and 9th Streets are generally comfortable for fast walking or better throughout the year. However, wind conditions are uncomfortable in the winter along the river to the west of the project site (Location 33), as well as along 2nd Street south of 26th Avenue (Locations 59 and 76) during the winters season (**Figure 9a**).

In the Proposed Configuration, wind conditions along the surrounding sidewalks remain comfortable for fast walking or better throughout the year (**Figure 9b**). The uncomfortable wind conditions on the nearby sidewalks(Locations 33, 59 and 76) remain unchanged in the winter (**Figure 9b**).

4.4 Wind Safety

The wind safety criterion was met in all areas on-site and surrounding the project site on an annual basis for both the Existing and Proposed Configurations (**Appendix C**).

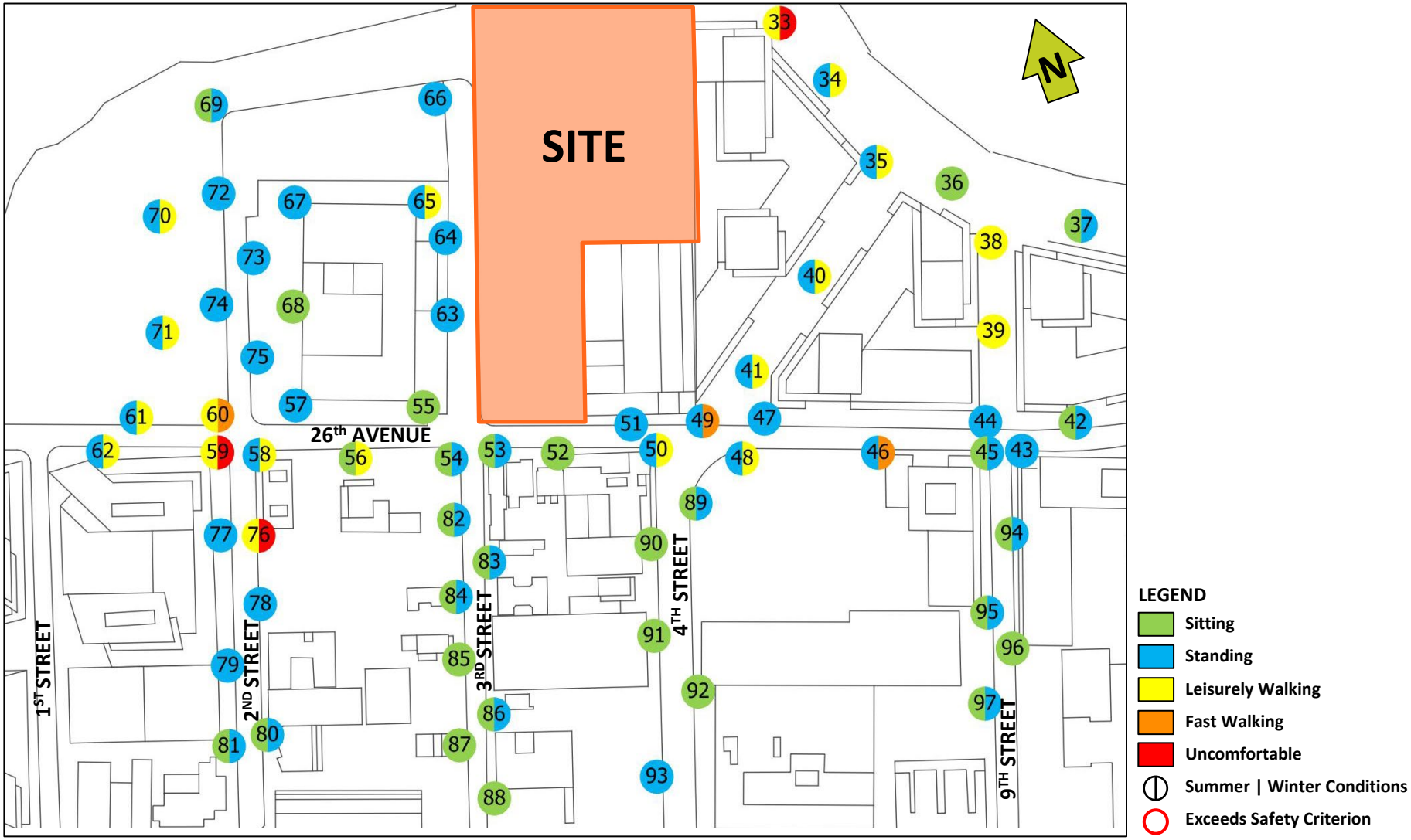


Figure 9a: Existing Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks

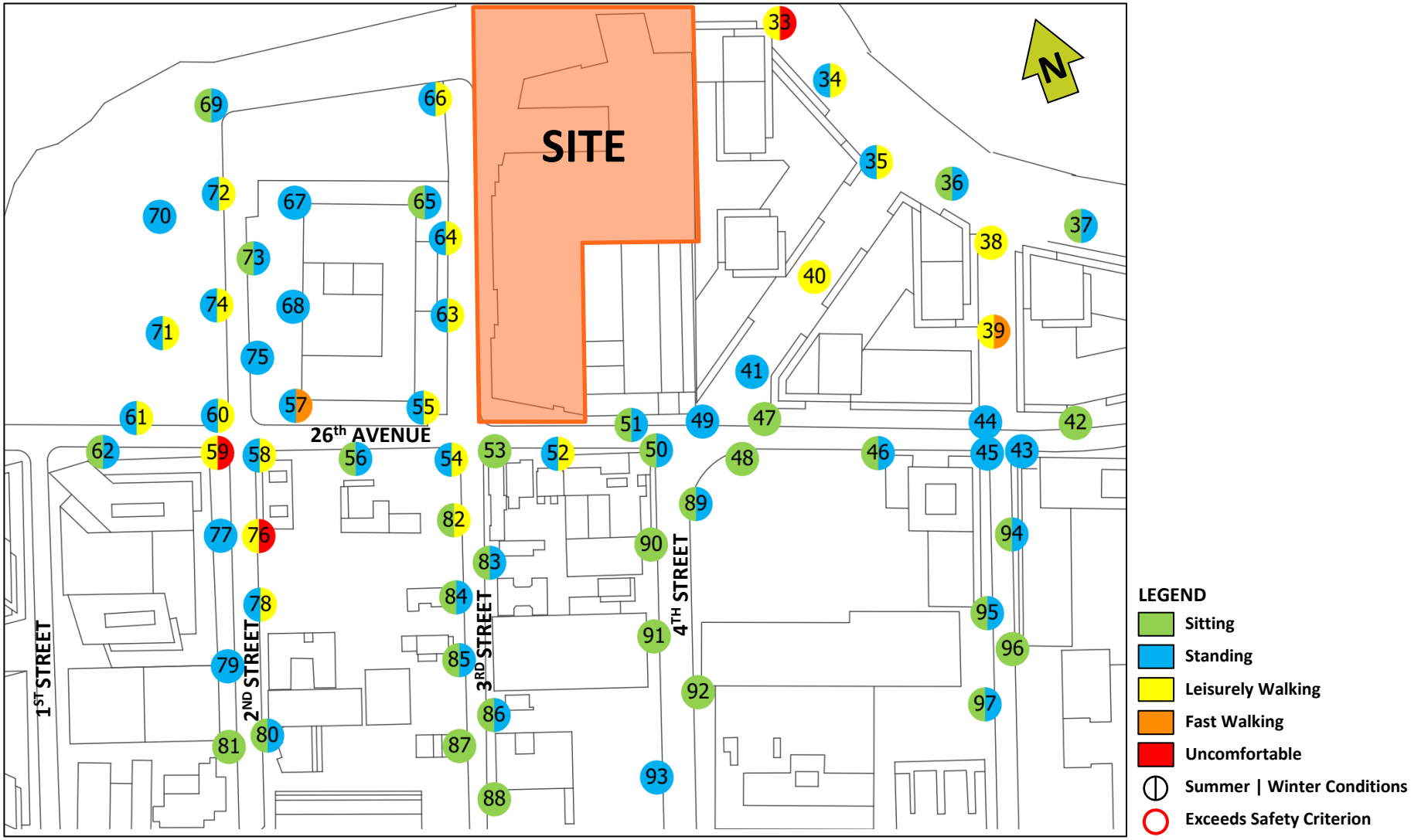


Figure 9b: Proposed Configuration – Pedestrian Wind Conditions – Surrounding Sidewalks

5.0 CONCLUSIONS & RECOMMENDATIONS

The pedestrian wind conditions predicted for the proposed development at 3-15 26th Street in Long Island City in New York have been assessed through wind tunnel modeling techniques. Based on the results of our study, the following conclusions have been reached:

- The wind safety criterion is met at all locations on-site and surrounding the development in both the Existing and Proposed Configurations.
- Wind conditions on the site, including most entrances are suitable for the intended use year-round. Wind mitigation measures are recommended for two main entrances to Building Segment 3.
- On the sidewalks surrounding the proposed development, wind conditions are generally suitable for the intended use.

6.0 ASSESSMENT APPLICABILITY

This assessment is based on computer modeling techniques and provides a quantitative analysis of the pedestrian wind comfort conditions on and surrounding the proposed development site. Any subsequent alterations to the design may influence these findings, possibly requiring further review by SLR. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

Sincerely,

SLR Consulting (Canada) Ltd.



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Microclimate Engineer



Tahrana Lovlin, MAES, P.Eng.
Specialist – Microclimate

7.0 REFERENCES

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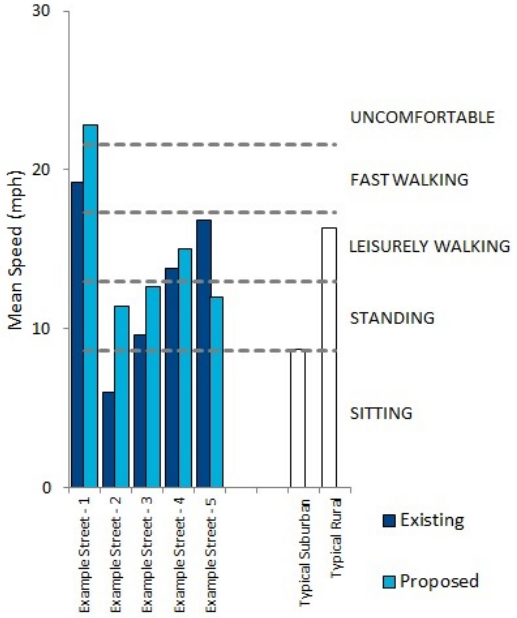
Appendix A

Pedestrian Wind Comfort Graphs

Summer (July – September) & Winter (January – March)

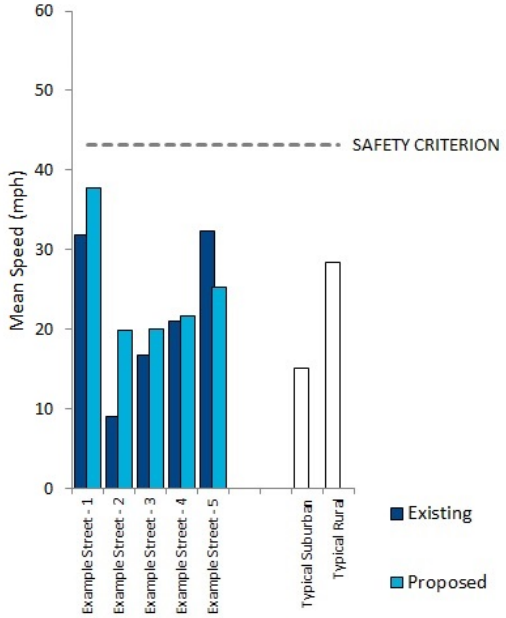
INTERPRETATION OF RESULTS

The figure below illustrates comfort criteria. The vertical bars represent the mean wind speed (in km/h) exceeded 5% of the time for the test configurations at each location. The dashed horizontal lines represent wind speed thresholds for the wind comfort criteria. At the right side of each graph are white bars that represent ambient wind conditions for typical suburban and rural areas of this region.



Example Results – Comfort Criteria (5% Mean Wind Speeds)

The blue bars represent wind conditions in the Existing Configuration, while the green bars represent the Proposed Configuration. For example, wind conditions at Location 2 were suitable for sitting in the Existing Configuration and standing in the Proposed Configuration. The figure below illustrates the safety criteria, which should not exceed 45 mph more than once per year. For example, all sensors passed the wind safety criterion in both configurations.



Example Results – Safety Criteria (Wind Speed Exceeded Once Per Year)

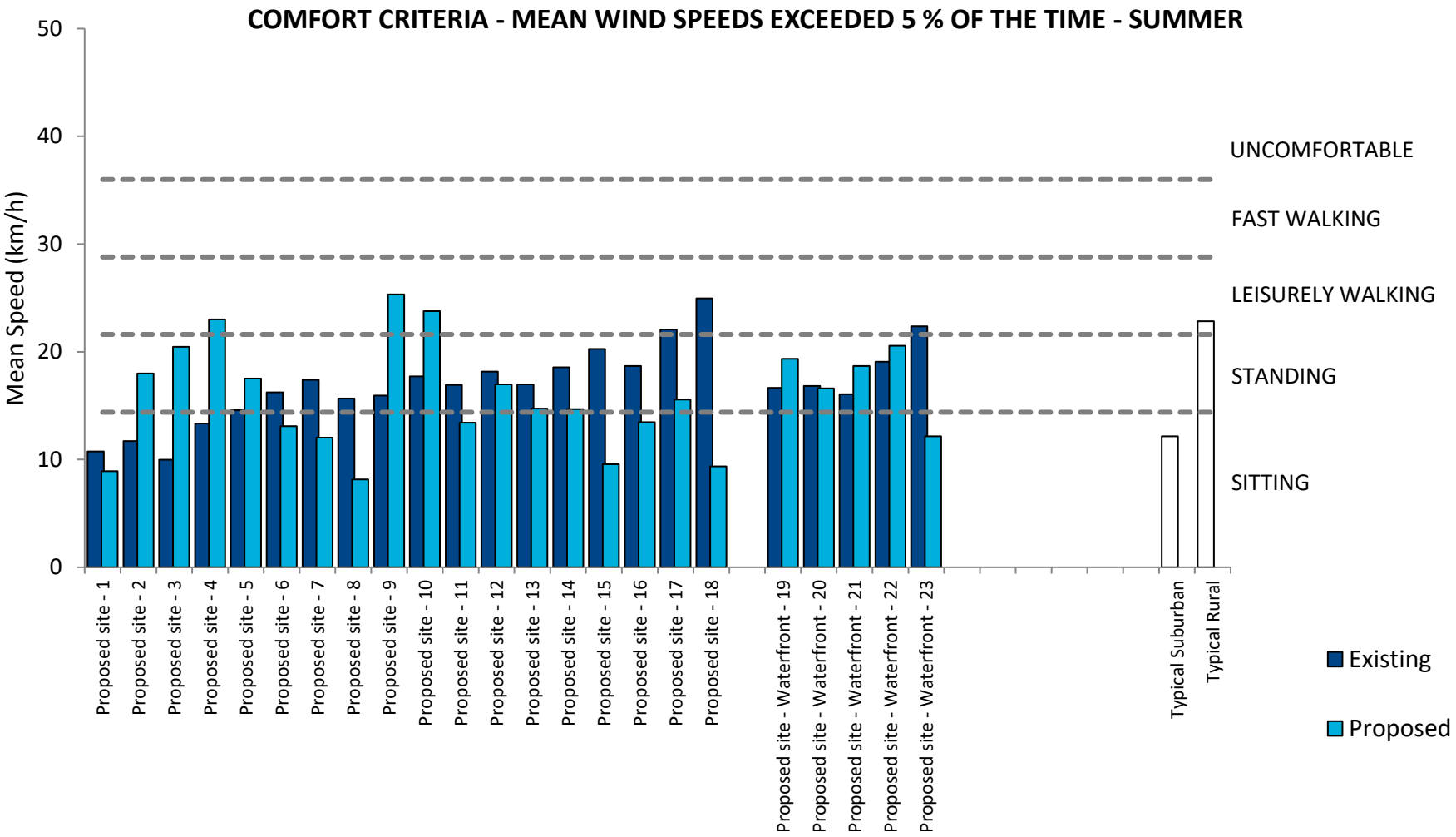


Figure A1a: Pedestrian Wind Conditions – Summer Season – Proposed Site and Waterfront

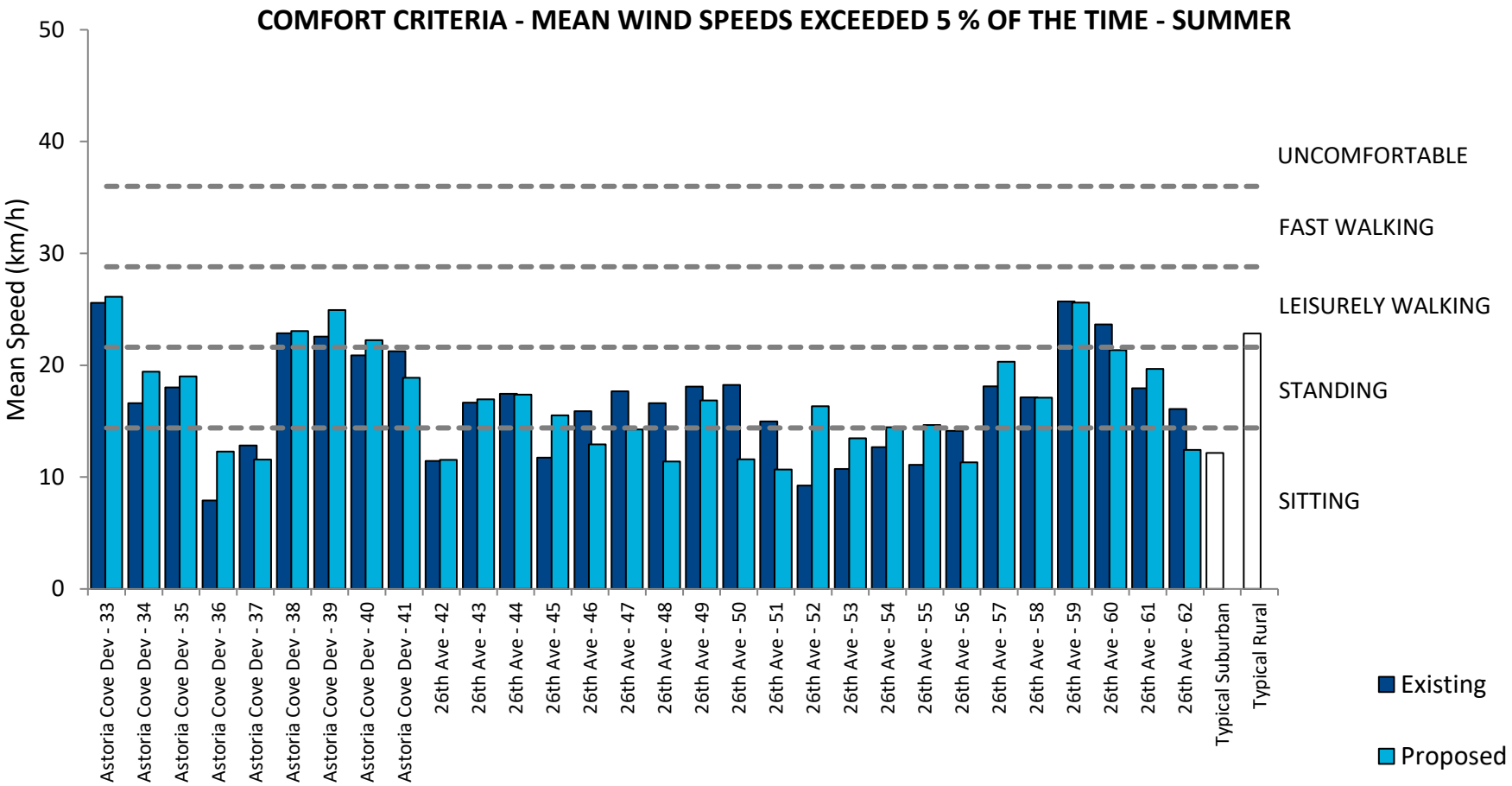


Figure A1b: Pedestrian Wind Conditions – Summer Season – Astoria Cove Development and 26th Avenue

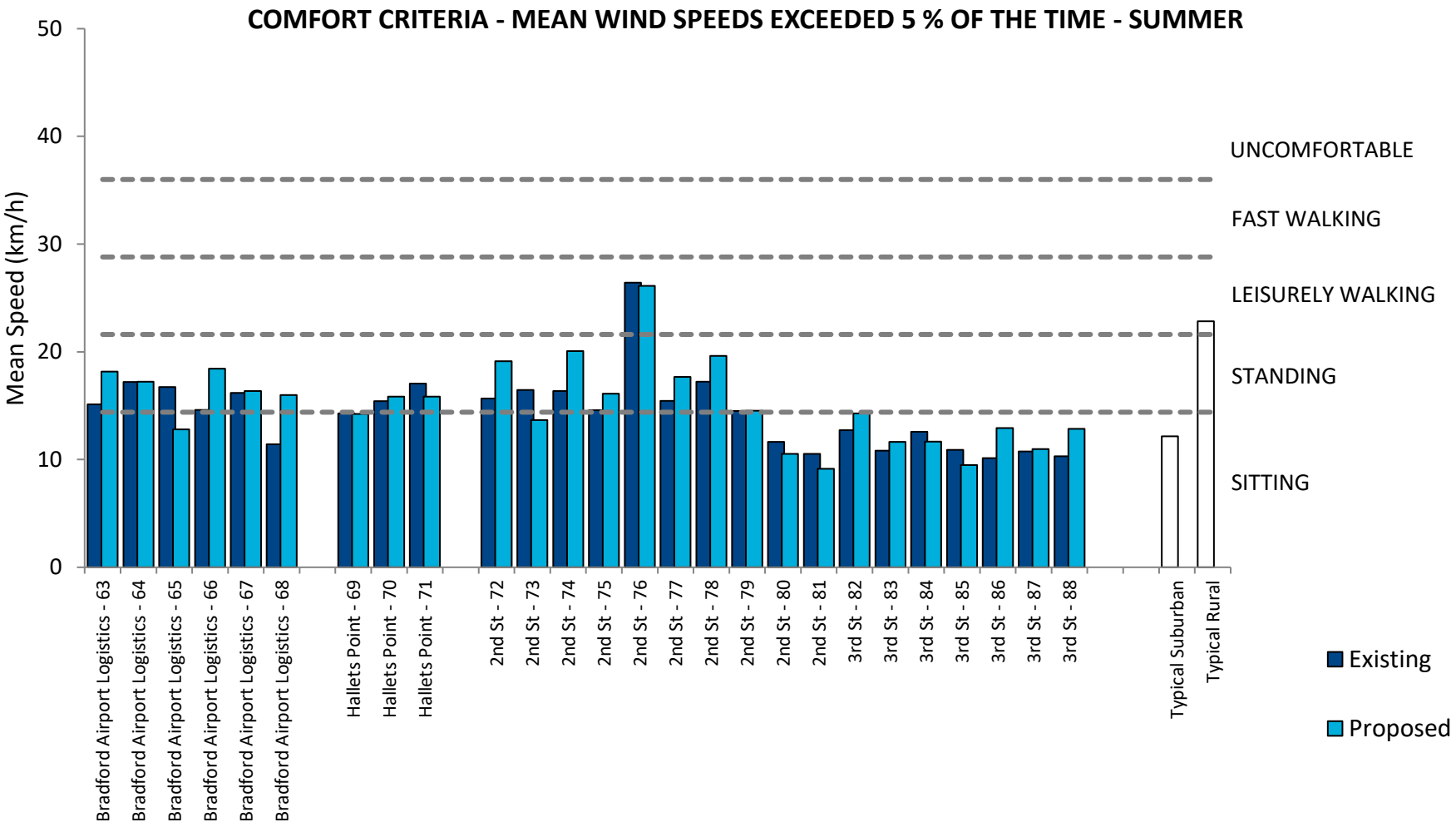


Figure A1c: Pedestrian Wind Conditions – Summer Season – Bradford Airport Logistics, Hallets Point, 2nd Street and 3rd Street

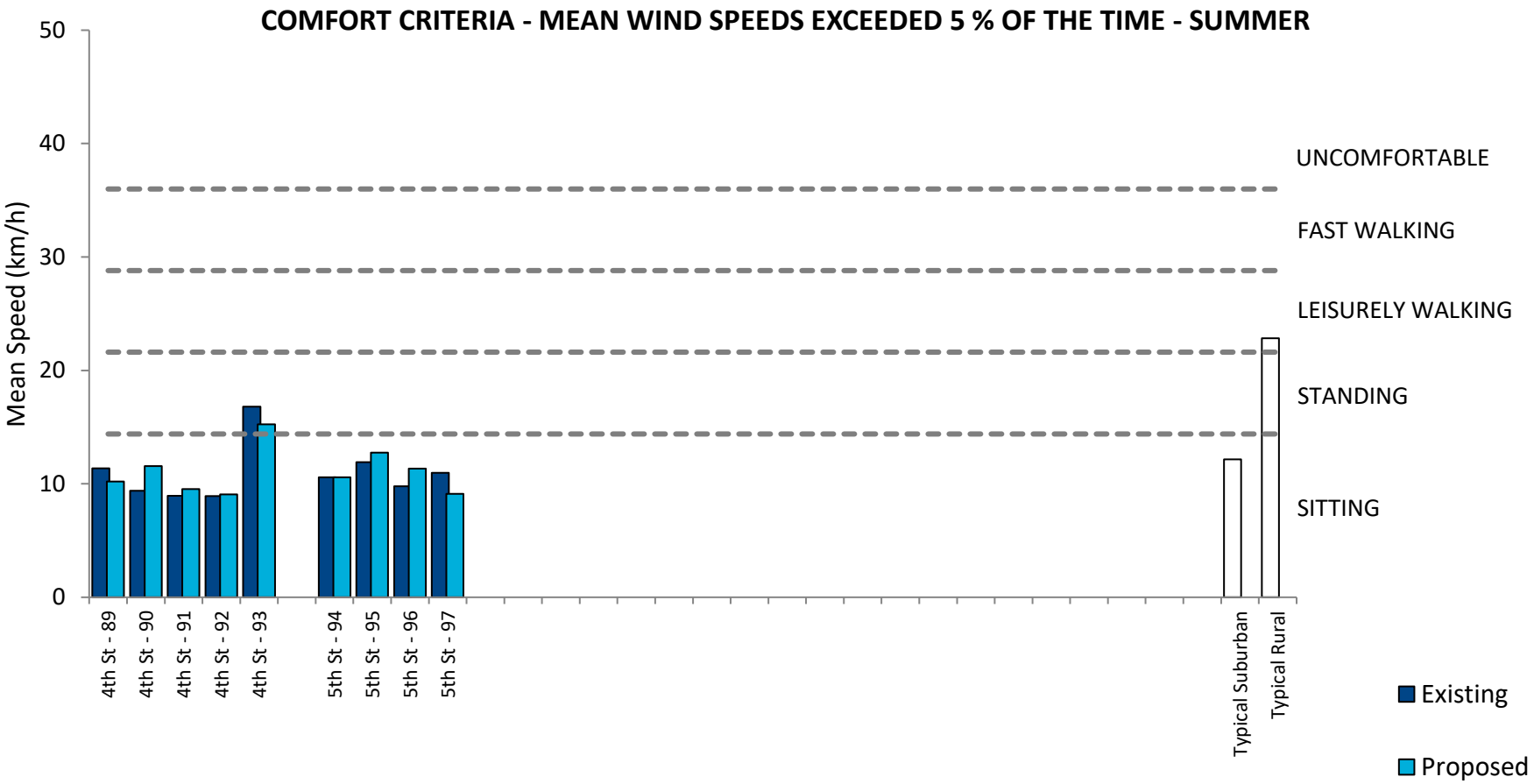


Figure A1d: Pedestrian Wind Conditions – Summer Season – 4th Street and 5th Street

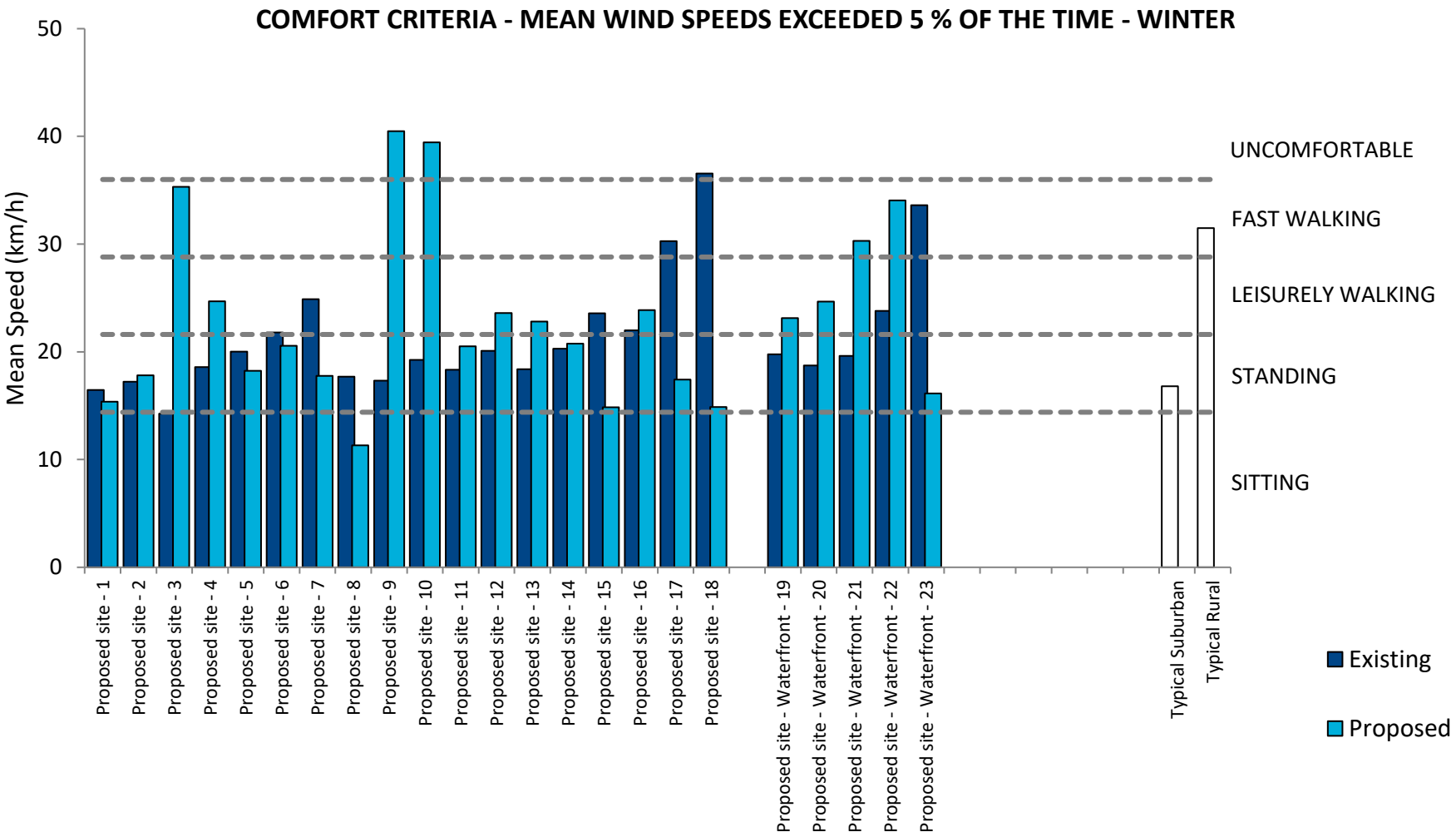


Figure A2a: Pedestrian Wind Conditions – Winter Season – Proposed Site and Waterfront

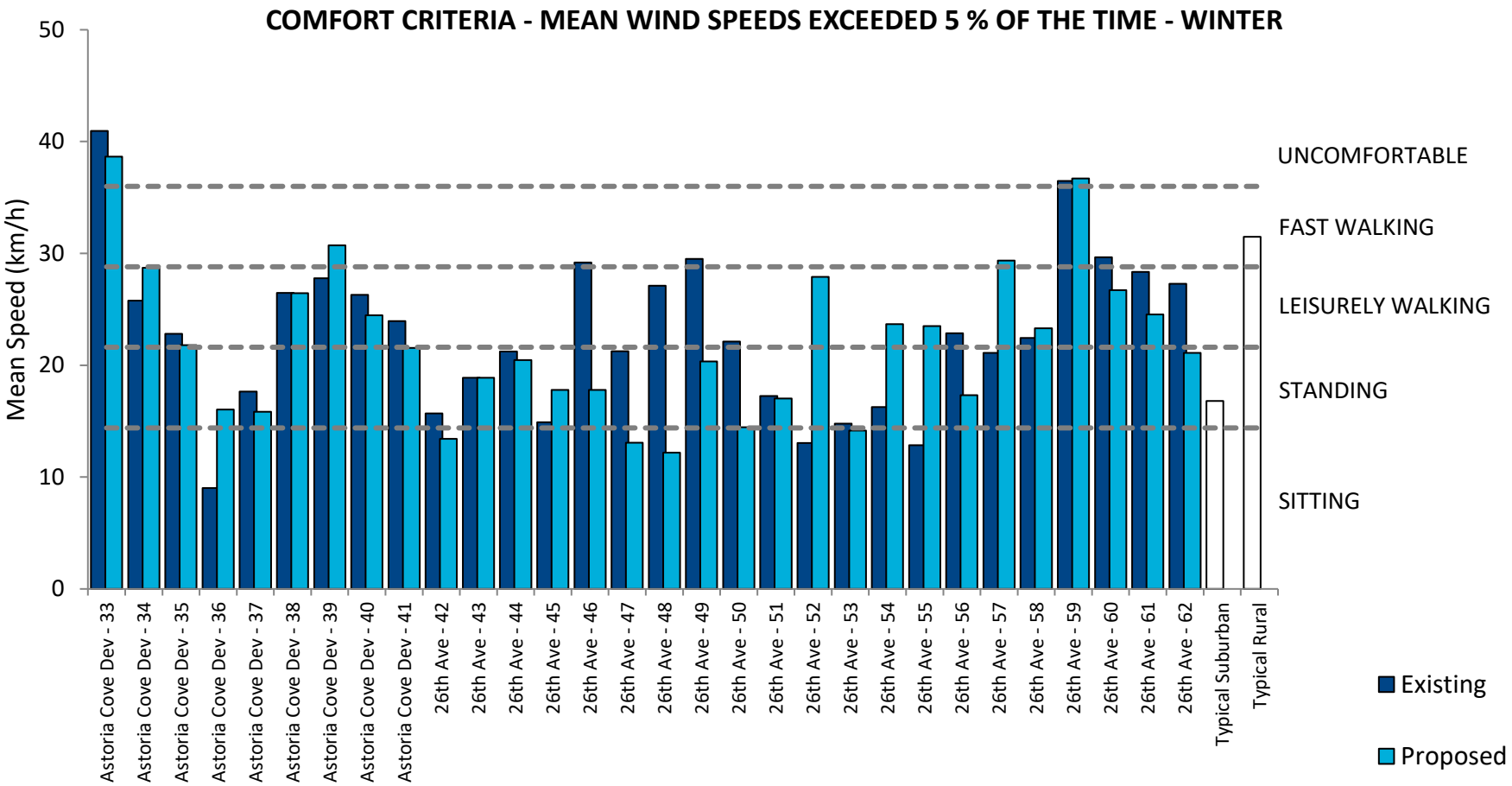


Figure A2b: Pedestrian Wind Conditions – Winter Season – Astoria Cove Development and 26th Avenue

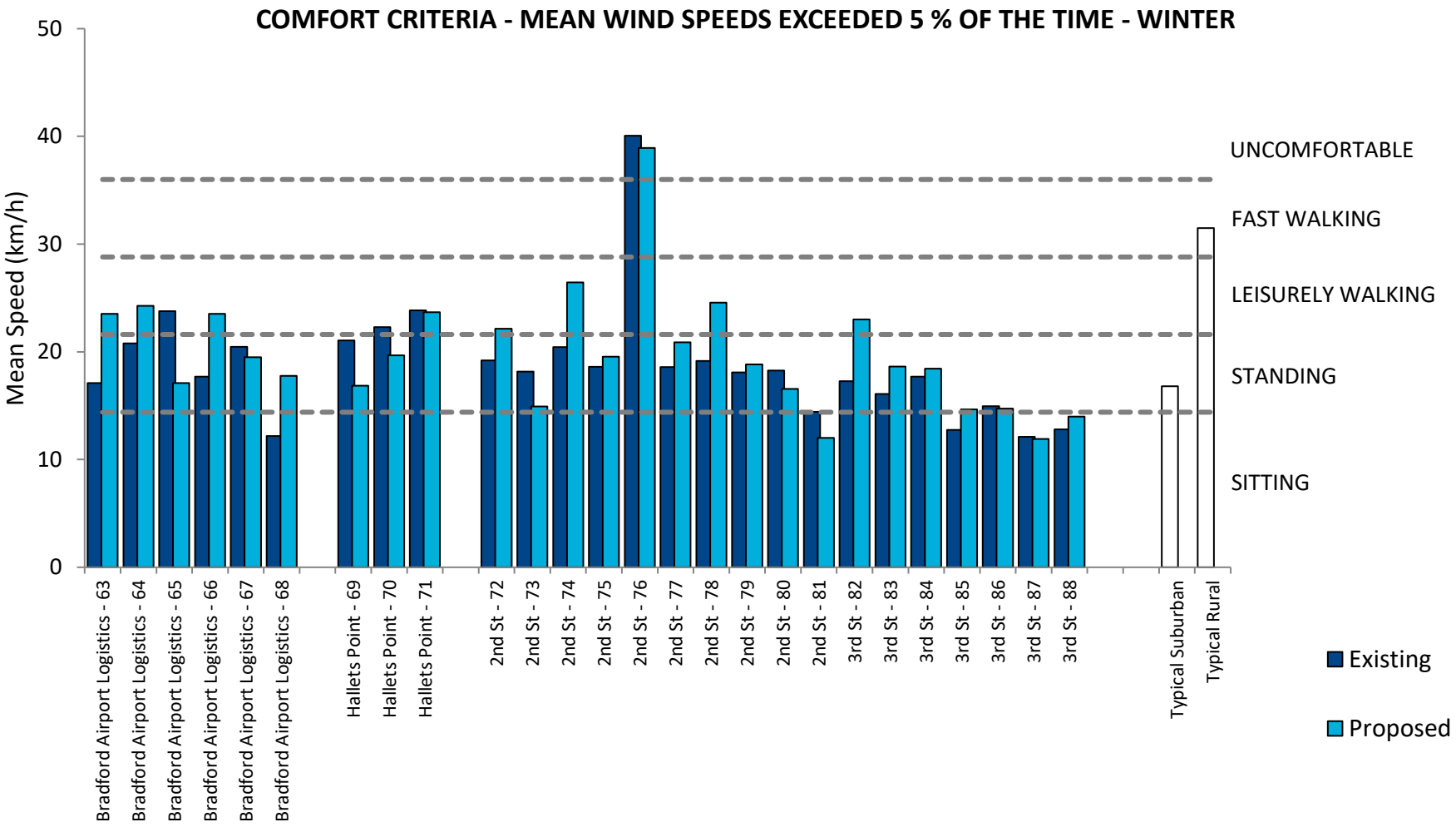


Figure A2c: Pedestrian Wind Conditions – Winter Season – Bradford Airport Logistics, Hallets Point, 2nd Street and 3rd Street

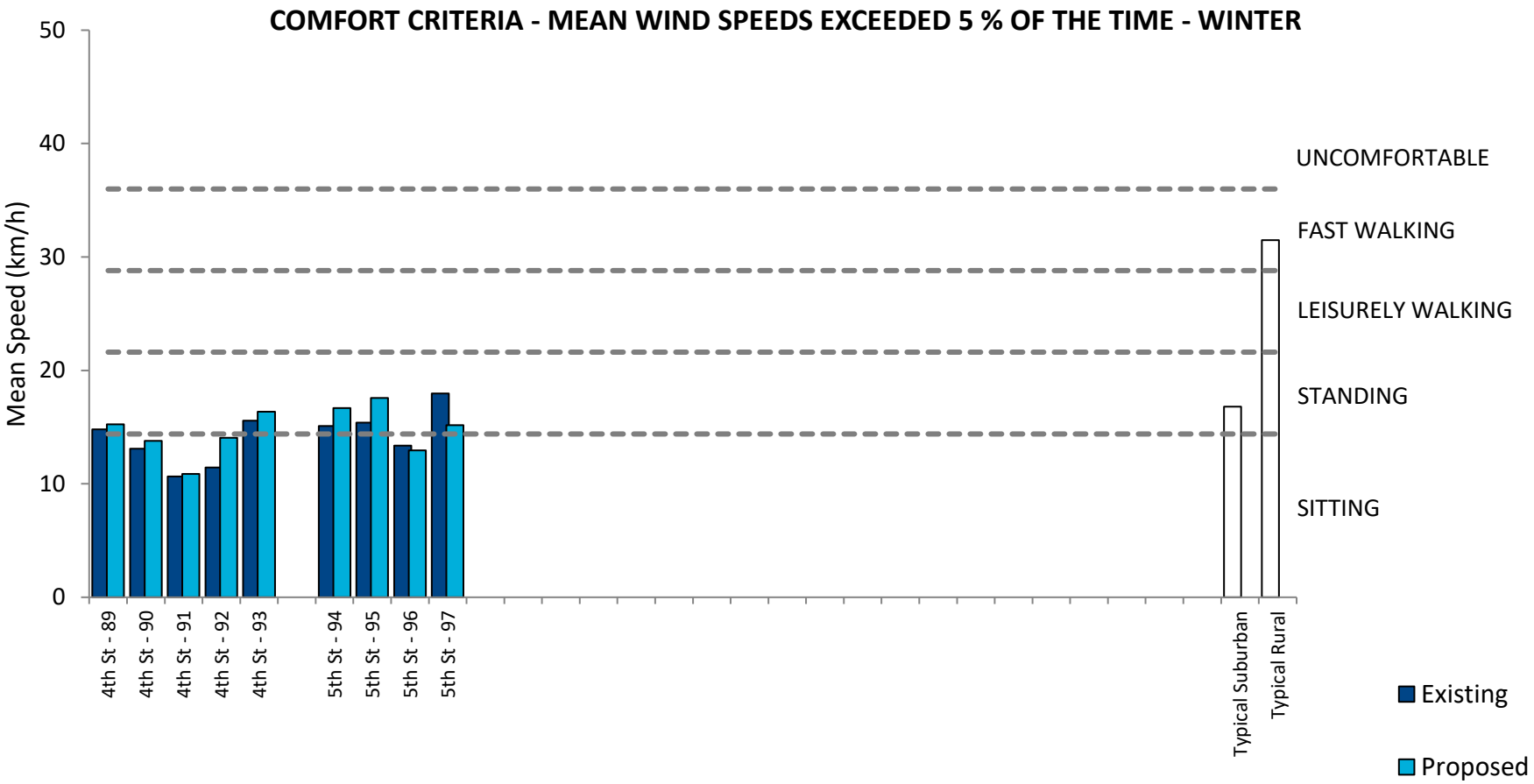


Figure A2d: Pedestrian Wind Conditions – Winter Season – 4th Street and 5th Street

Appendix B

Pedestrian Wind Comfort Graphs

Spring (April – June) and Autumn (October – December)

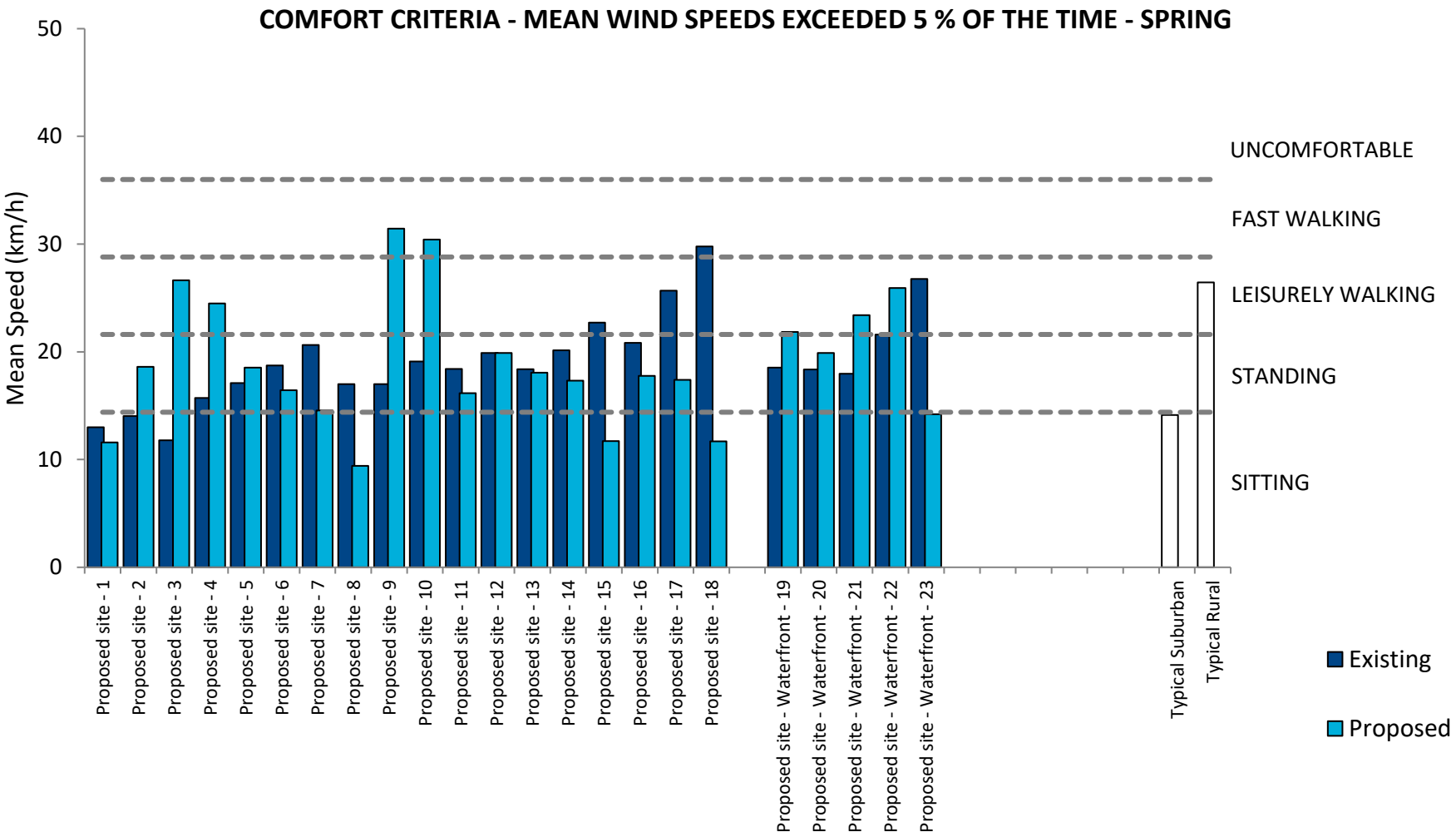


Figure B1a: Pedestrian Wind Conditions – Spring Season – Proposed Site and Waterfront

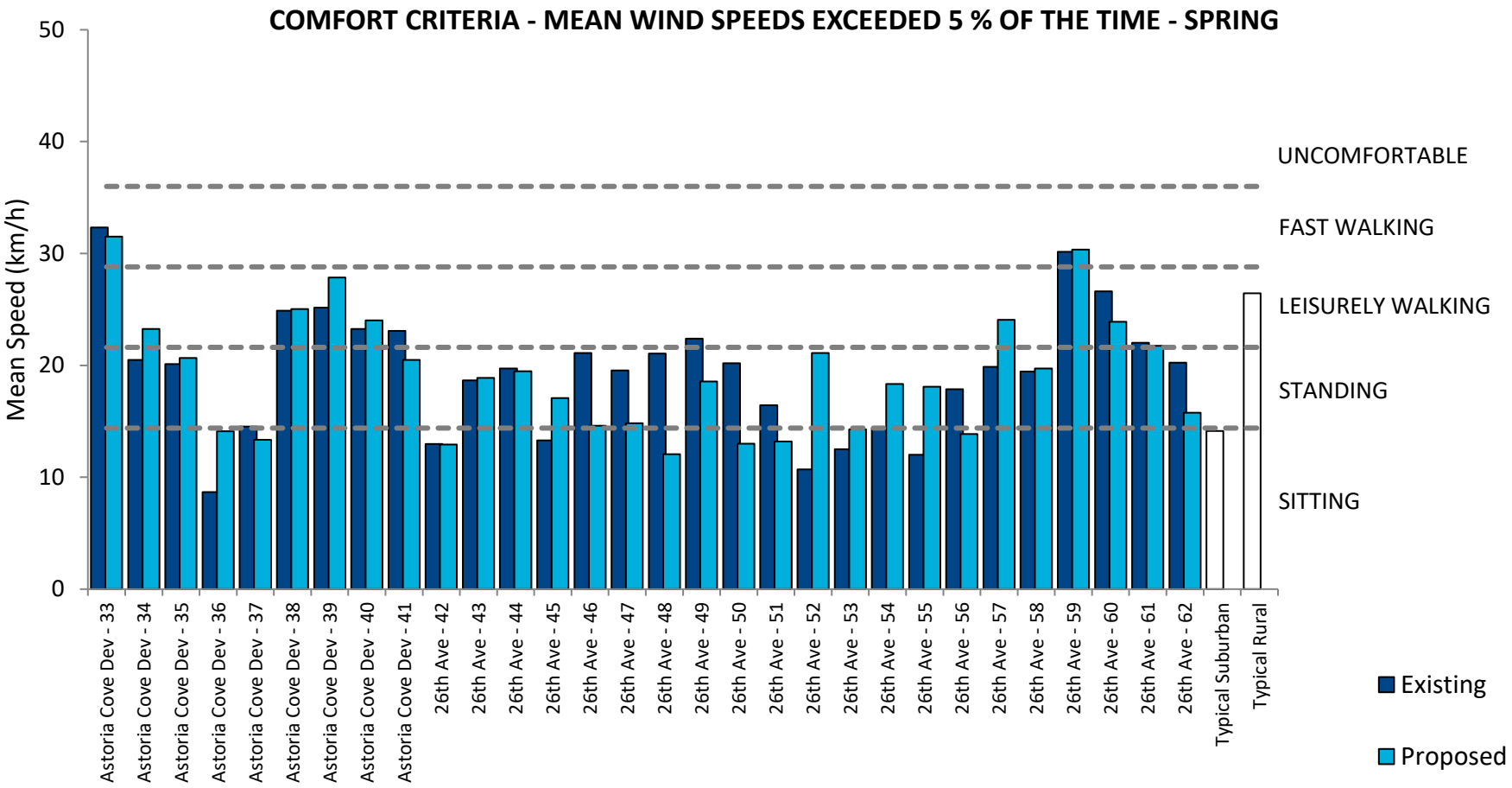


Figure B1b: Pedestrian Wind Conditions – Spring Season – Astoria Cove Development and 26th Avenue

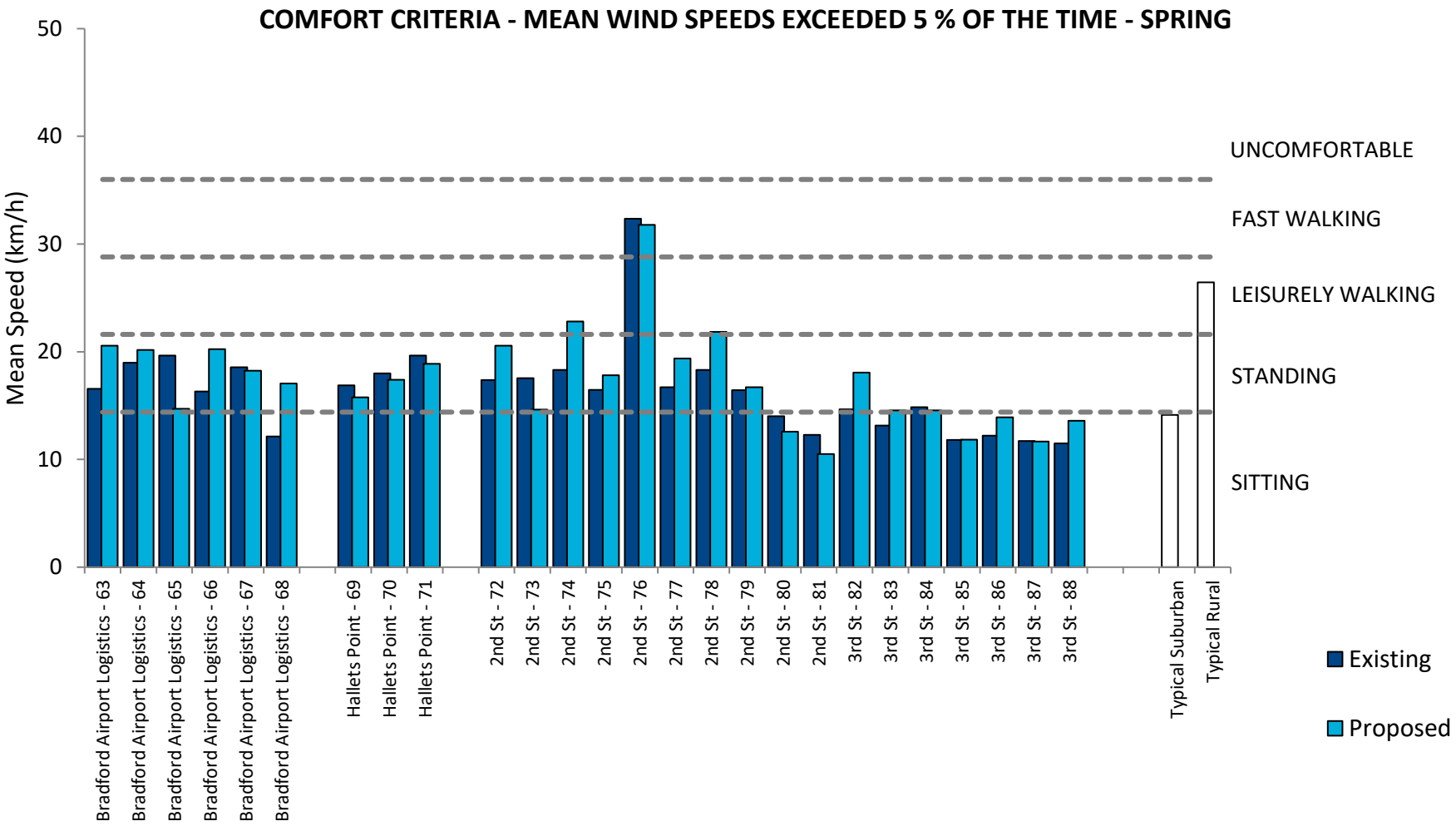


Figure B1c: Pedestrian Wind Conditions – Spring Season - Bradford Airport Logistics, Hallets Point, 2nd Street and 3rd Street

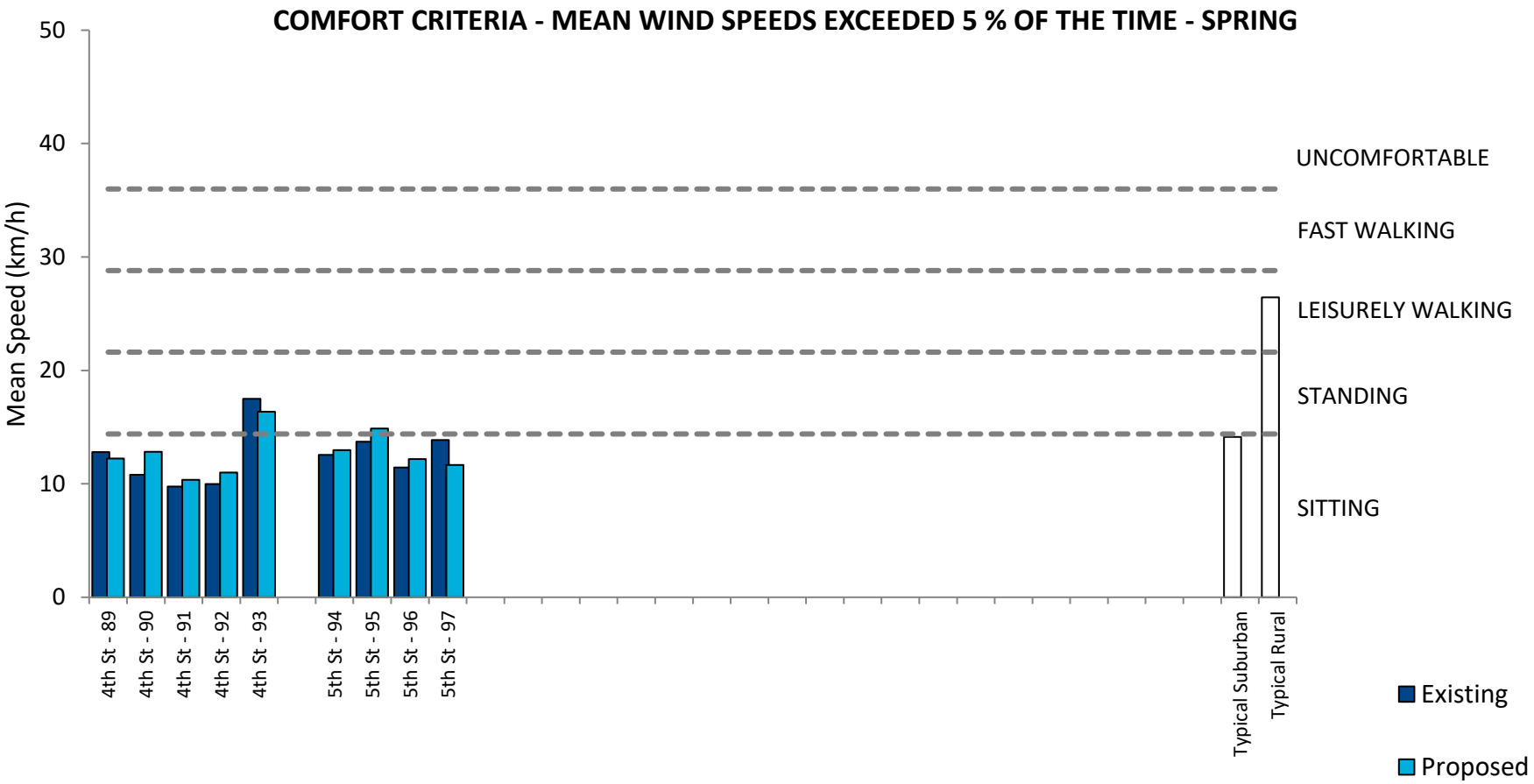


Figure B1d: Pedestrian Wind Conditions – Spring Season – 4th and 5th Street

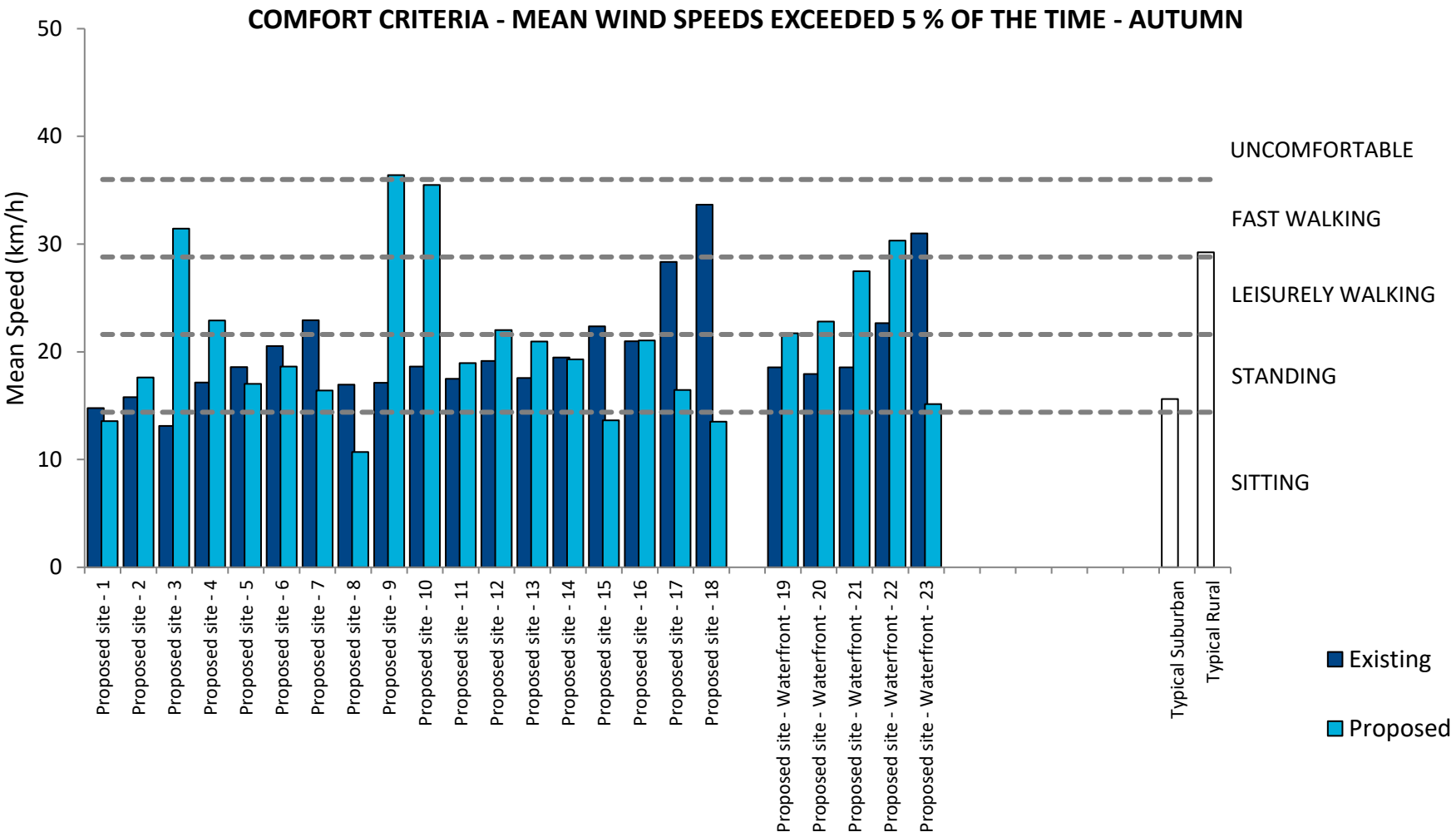


Figure B2a: Pedestrian Wind Conditions – Autumn Season – Proposed Site and Waterfront

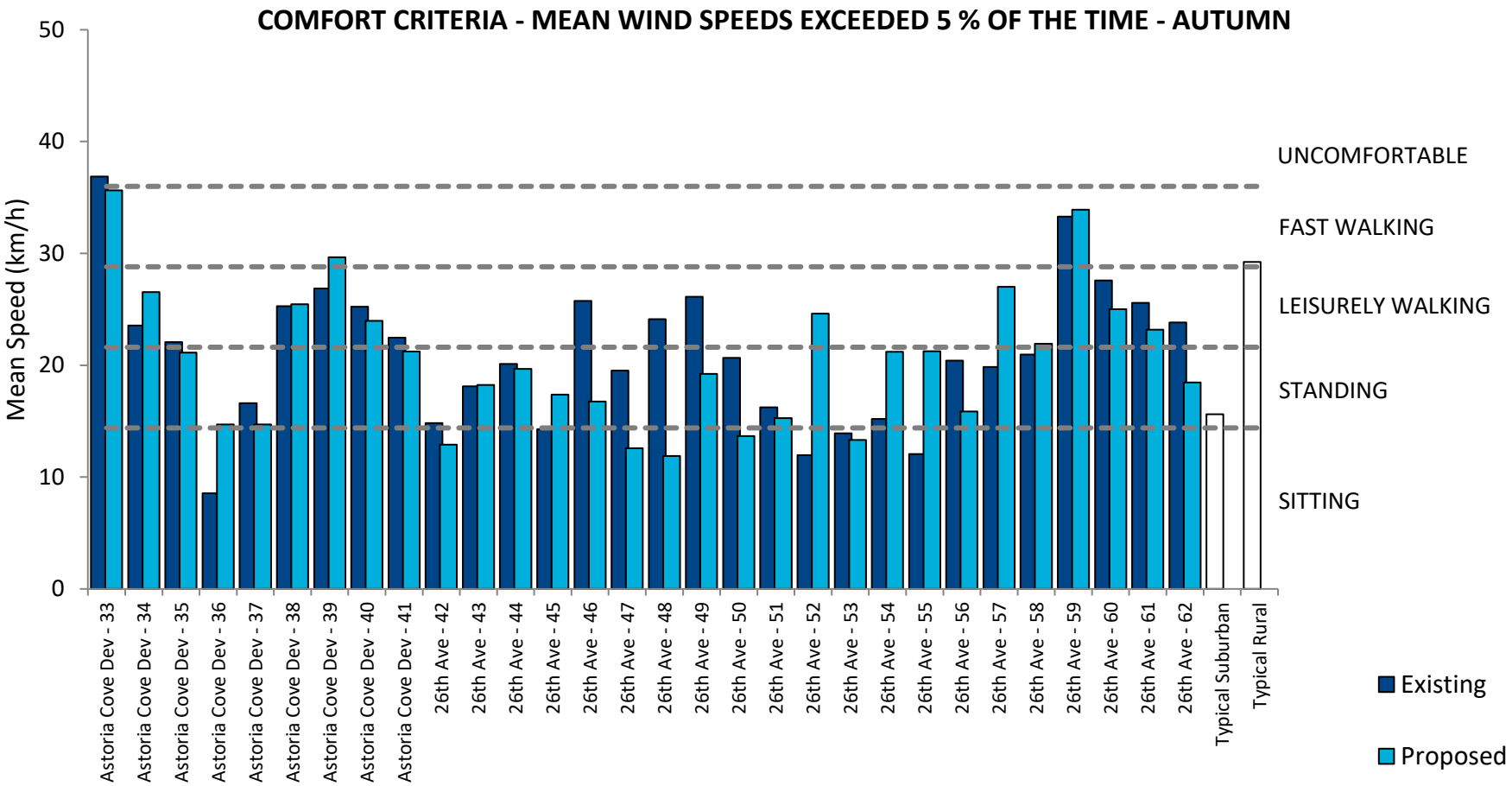


Figure B2b: Pedestrian Wind Conditions – Autumn Season – Astoria Cove Development and 26th Avenue

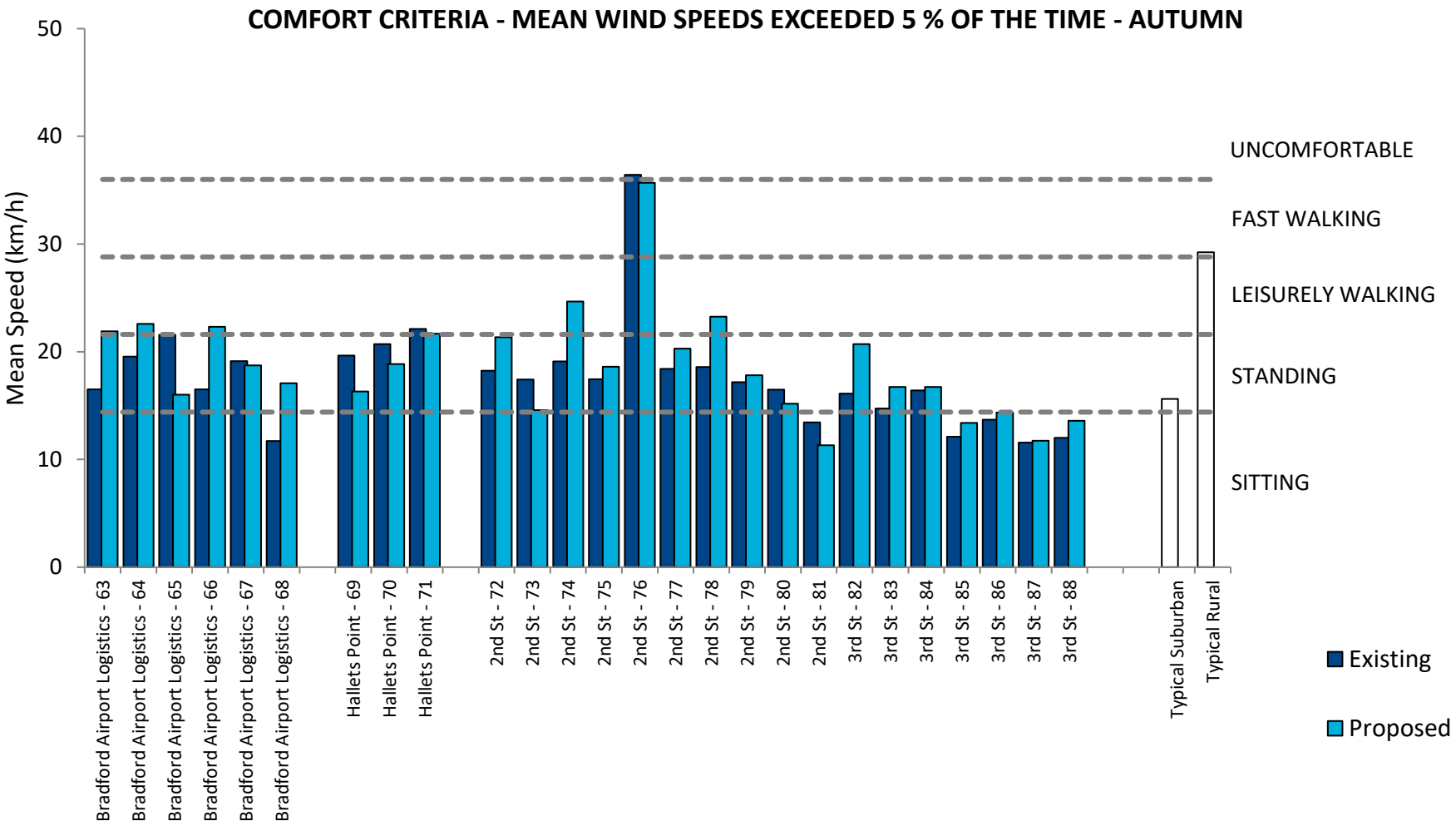


Figure B2c: Pedestrian Wind Conditions – Autumn Season – Bradford Airport Logistics, Hallets Point, 2nd Street and 3rd Street

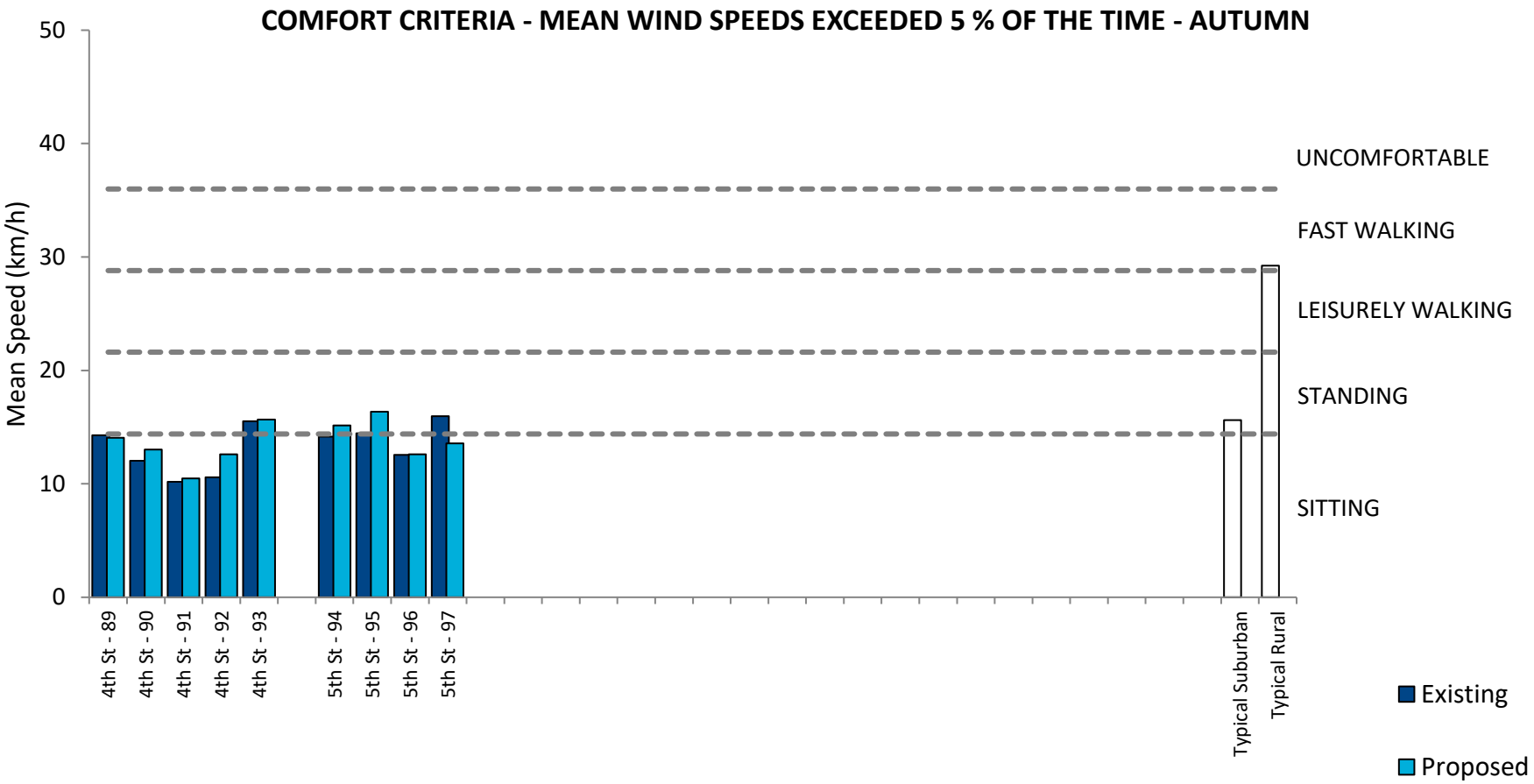


Figure B2d: Pedestrian Wind Conditions – Autumn Season – 4th and 5th Street

Appendix C

Pedestrian Wind Safety Analysis

Annual

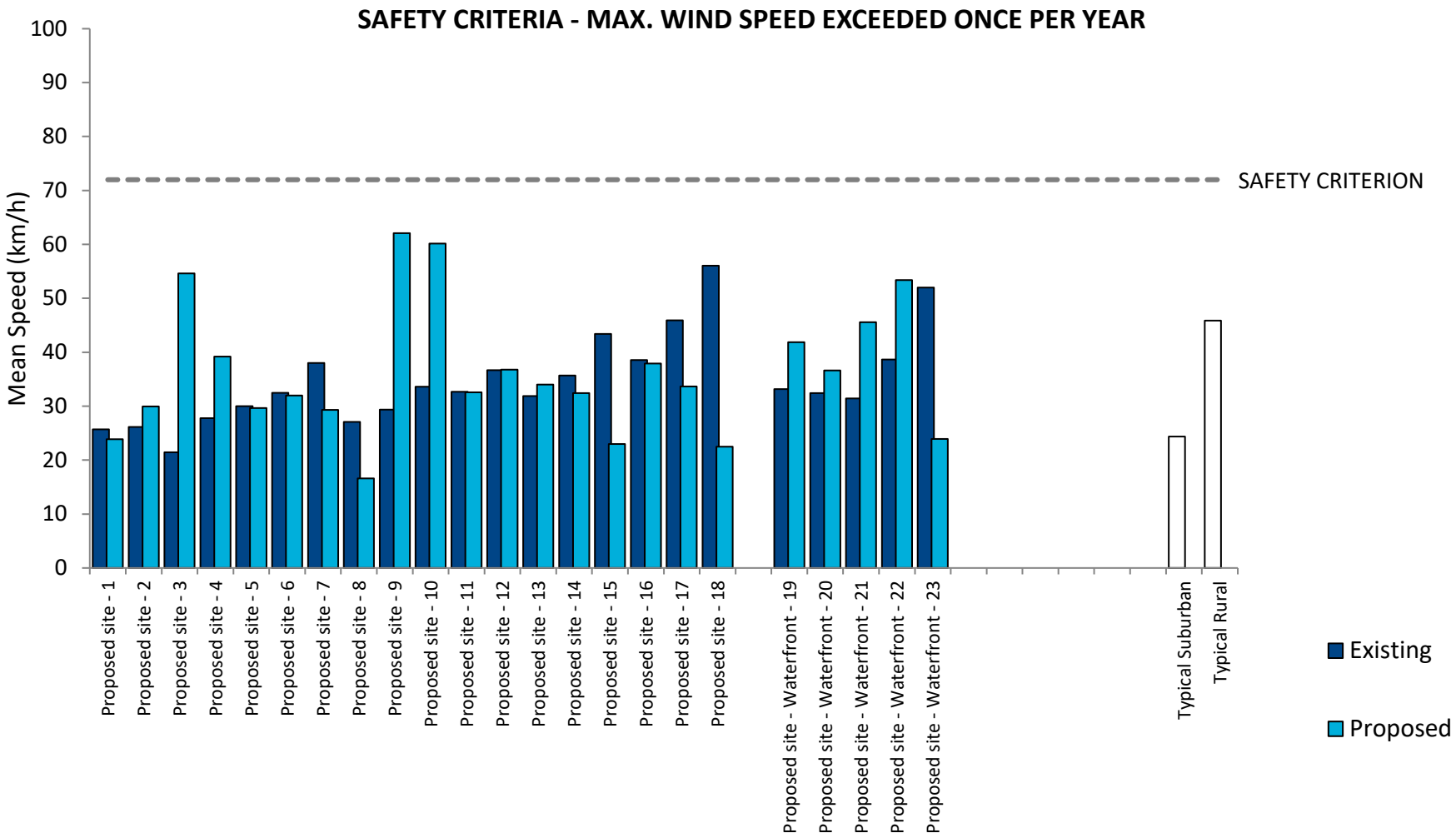


Figure C1a: Pedestrian Wind Safety – Annual – Proposed Site and Waterfront

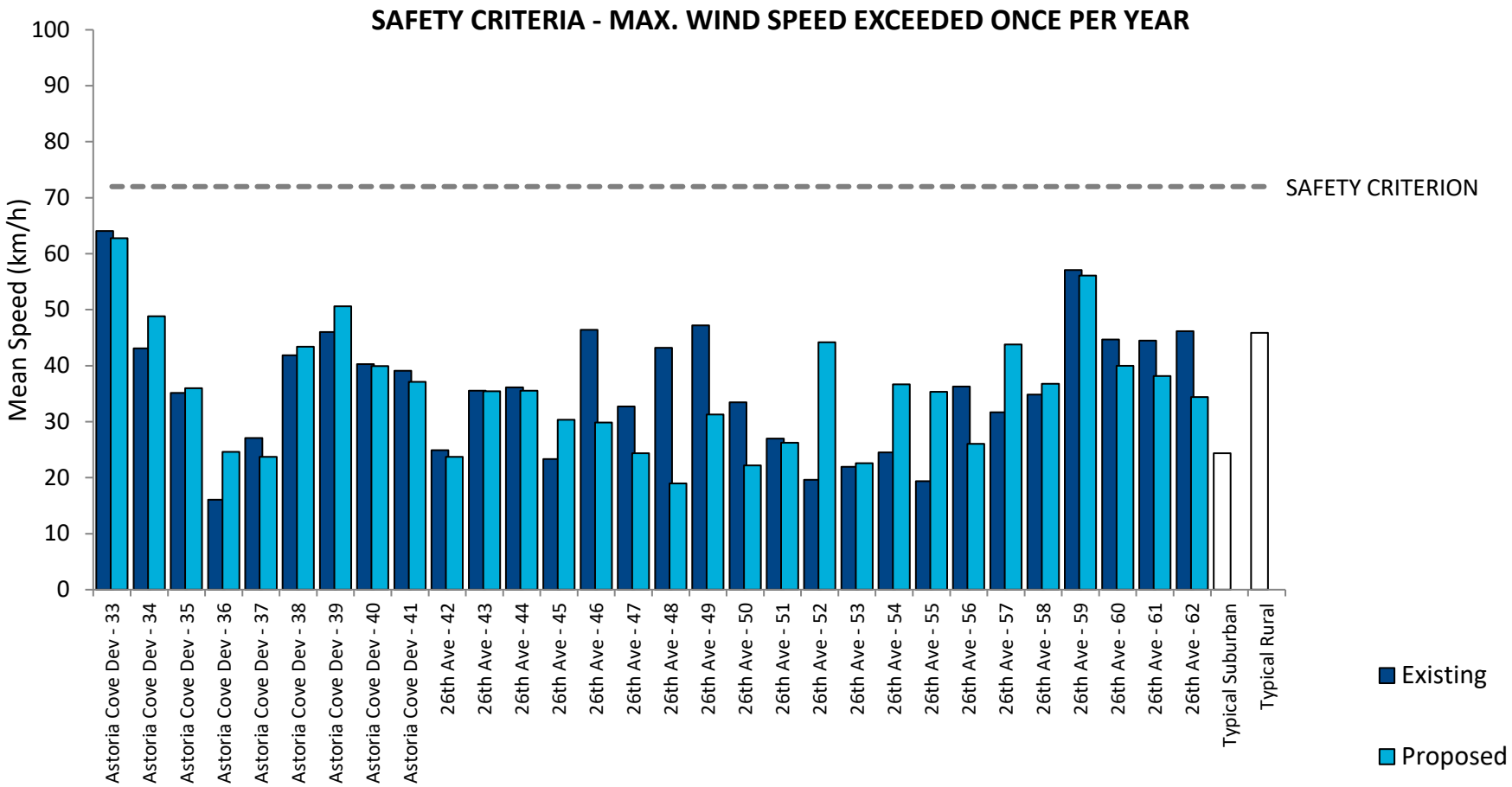


Figure C1b: Pedestrian Wind Safety – Annual – Astoria Cove Development and 26th Avenue

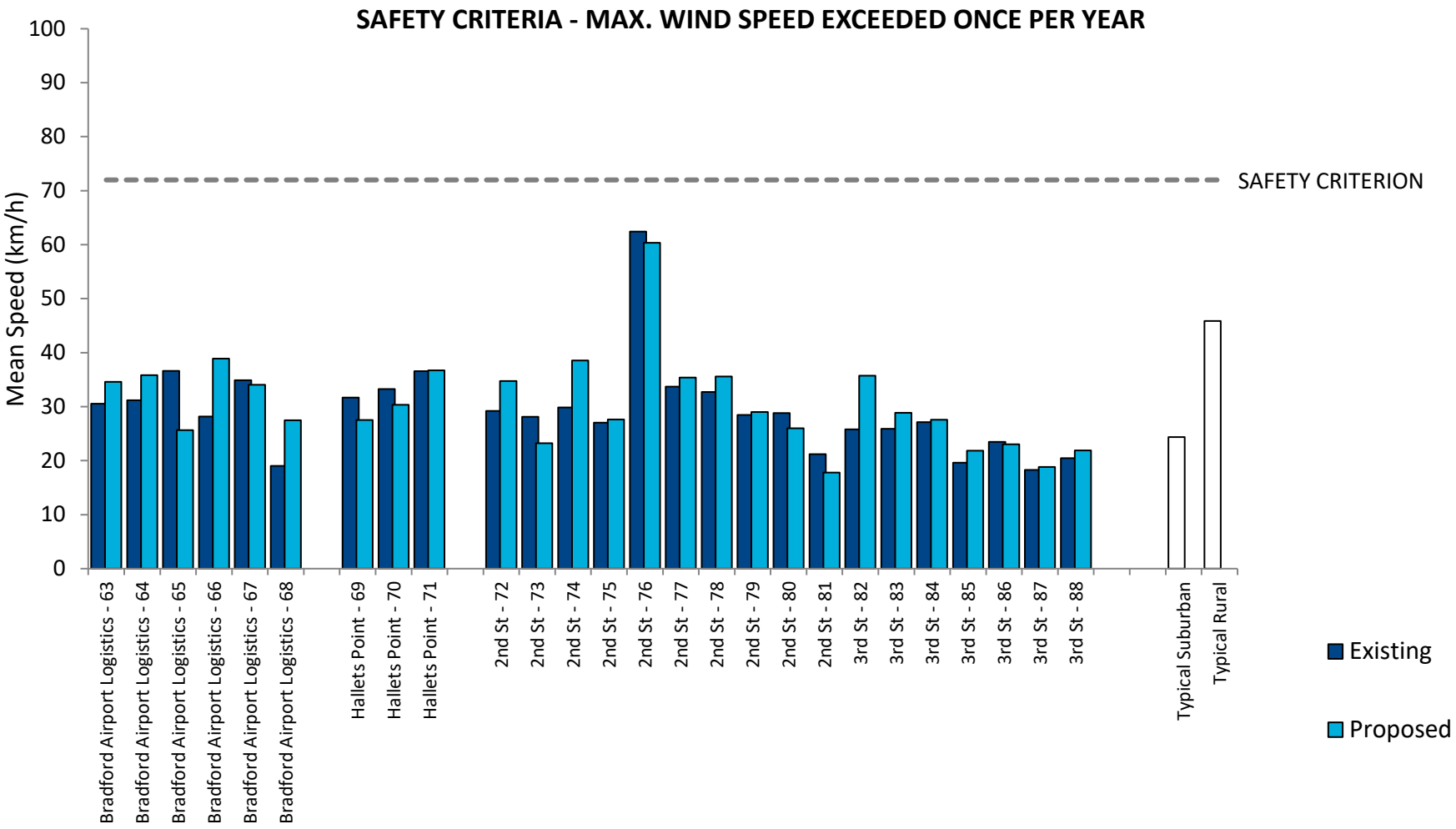


Figure C1c Pedestrian Wind Safety – Annual – Bradford Airport Logistics, Hallets Point, 2nd Street and 3rd Street

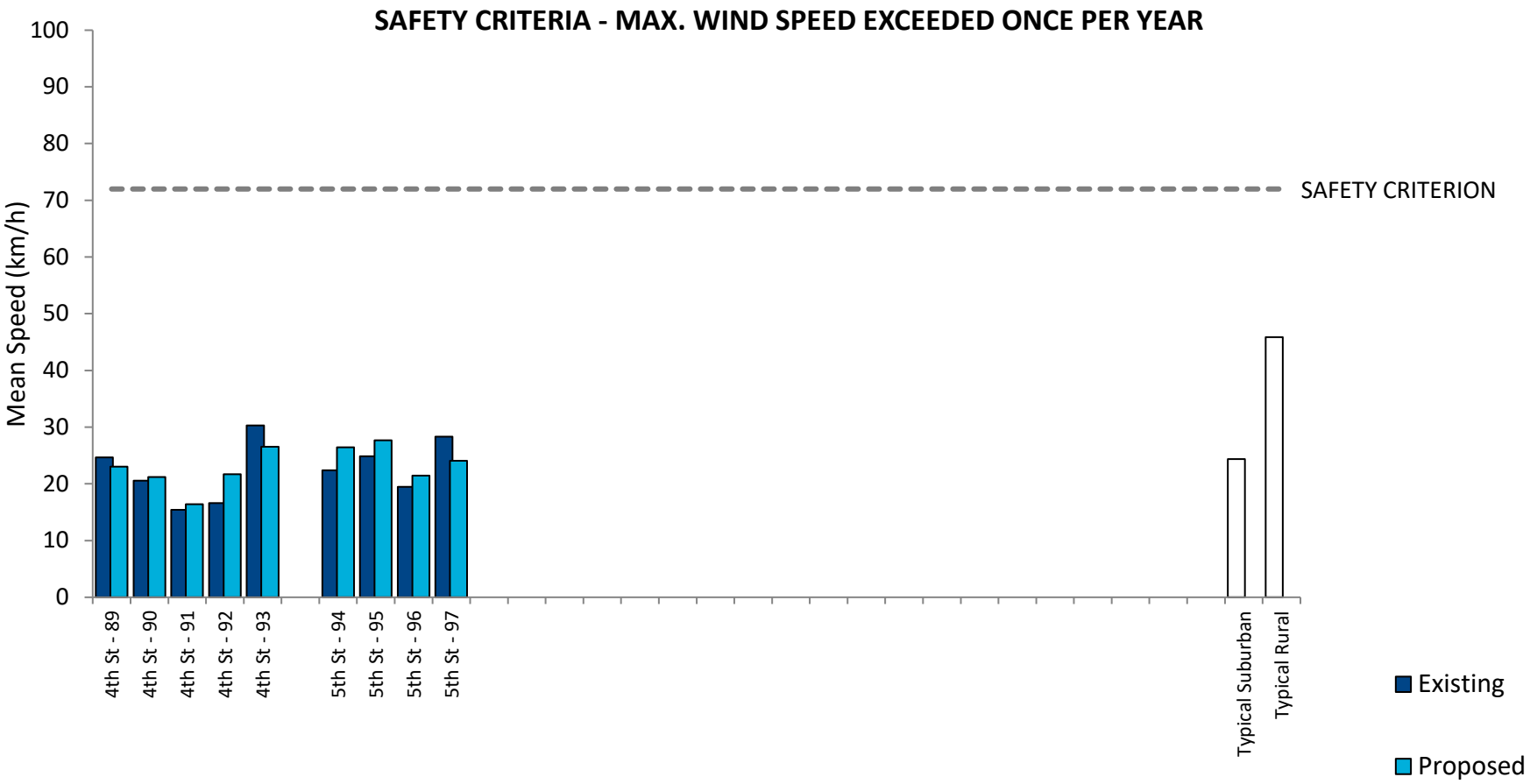


Figure C1d: Pedestrian Wind Safety – Annual – 4th and 5th Street