

OCSC

O'CONNOR · SUTTON · CRONIN

MULTIDISCIPLINARY CONSULTING ENGINEERS

## K455/3: BLACKGLEN ROAD RESIDENTIAL DEVELOPMENT

# PEDESTRIAN WIND COMFORT STUDY

**For**
**ZOLBURY LTD.**

**12 November 2024**

# NOTICE

This document has been produced by O'Connor Sutton Cronin & Associates for its client, Zolbury Ltd. It may not be used for any purpose other than that specified by any other person without the written permission of the authors.

# DOCUMENT CONTROL & HISTORY

| OCSC Job No: K455/3 | Project Code | Originator | Zone Volume | Level | File Type | Role Type | Number | Status / Suitability Code | Revision |
|---|---|---|---|---|---|---|---|---|---|
| | K455/3 | OCSC | XX | XX | RP | YS | 0003 | S4 | P02 |

| Rev. | Status | Authors | Checked | Authorised | Issue Date |
|---|---|---|---|---|---|
| P02 | For Lodgement | JS | PMcV | PMcV | 12/11/2024 |
| P01 | For Lodgement | JS | PMcV | PMcV | 5/06/2024 |

# TABLE OF CONTENTS

**ZOLBURY LTD** .....

**1 EXECUTIVE SUMMARY** ..... 1

**2 INTRODUCTION** ..... 2

**3 PROPOSED DEVELOPMENT** ..... 3

**4 PEDESTRIAN COMFORT COMPLIANCE** ..... 5

**5 ASSESSMENT METHODOLOGY** ..... 6

EXTENT OF CFD STUDY AREA ..... 6

WIND CLIMATE ..... 8

WIND PROFILE ..... 10

WIND FACTOR ..... 11

CFD MODELLING ..... 11

**6 ASSUMPTIONS AND LIMITATIONS** ..... 13

**7 WIND MITIGATION MEASURES** ..... 14

COURTYARD LOCATION ..... 15

LANDSCAPING ..... 16

**8 PEDESTRIAN COMFORT RESULTS** ..... 17

**9 CONCLUSION** ..... 20

**10 VERIFICATION** ..... 21

# APPENDICES

**APPENDIX A** **CFD SIMULATION RESULTS**

# LIST OF FIGURES

Figure 1: Proposed Development Site Plan ..... 4
Figure 2. Extent of CFD Study Area ..... 7
Figure 3. Rendering of CFD Model ..... 7
Figure 4. Percentage of Hours per Wind Direction over 30 years ..... 8
Figure 5. Computational Domain Surrounding the Region of Interest ..... 10
Figure 6: Wind Factor - 0 Degree (N) Wind Orientation ..... 12
Figure 7. Wind Mitigation Measure - Courtyard Location ..... 15
Figure 8. Wind Mitigation Measure - Landscaping Design ..... 16
Figure 9. Pedestrian Wind Comfort Results ..... 17
Figure 10: Percentage of time per year that standing or short-therm sitting is comfortable ..... 18
Figure 11. Pedestrian Wind Comfort Results Frail Pedestrian - Private Balconies & Terraces ..... 19
Figure 12. Dublin Airport Wind Rose Data (1989 – 2019) ..... 22
Figure 13: Wind Factor – 0 Degree (N) Wind Direction ..... 23
Figure 14: Wind Factor – 30 Degree (NNE) Wind Direction ..... 23
Figure 15: Wind Factor – 60 Degree (ENE) Wind Direction ..... 24
Figure 16: Wind Factor – 90 Degree (E) Wind Direction ..... 24
Figure 17: Wind Factor –120 Degree (ESE) Wind Direction ..... 25
Figure 18: Wind Factor – 150 Degree (SSE) Wind Direction ..... 25
Figure 19: Wind Factor – 180 Degree (S) Wind Direction ..... 26
Figure 20: Wind Factor – 210 Degree (SSW) Wind Direction ..... 26
Figure 21: Wind Factor – 240 Degree (WSW) Wind Direction ..... 27
Figure 22: Wind Factor – 270 Degree (W) Wind Direction ..... 27
Figure 23: Wind Factor – 300 Degree (WNW) Wind Direction ..... 28
Figure 24: Wind Factor – 330 Degree (NNW) Wind Direction ..... 28

# LIST OF TABLES

Table 1. Lawson Criteria for Pedetrian Comfort ..... 5
Table 2. Frequency of Wind Velocity Occurrence per Wind Direction ..... 9
Table 3. Summary of CFD Model Settings ..... 12

# 1 EXECUTIVE SUMMARY

This report outlines the predicted climatic wind conditions experienced within and surrounding the proposed Blackglen Road Residential Development.

A conscious effort was made by the design team during the design stages to mitigate the risk of localised increased wind speed conditions due to the proposed development. The introduction of mitigation measures such as the communal courtyard locations as well as the strategic location of extensive landscaping, all assist in reducing the potential development of local increased wind speed and the negative impact on local climatic conditions.

Based on the CFD modelling results, the proposed development will be a comfortable environment for occupants. Certain areas have been highlighted as being potentially uncomfortable for a limited period of time, however, these concerns have been largely addressed through the incorporation of landscaping which will mitigate excessive wind speeds in these areas.

Overall, the proposed development will be a high-quality, comfortable environment for occupants throughout the year.

# 2 INTRODUCTION

The intention of this report is to outline the predicted climatic wind conditions experienced within and surrounding the proposed Blackglen Road Residential Development.

The proposed method for compliance validation is via the industry best practice standard for pedestrian comfort (Lawson Criteria). The Lawson Criteria sets acceptable levels of wind speed and velocity for various human activities.

Given the specific location of the building and recorded metrological data available for the area, and standard interpolation calculation procedures, it is possible to predict the expected wind speeds and their annual occurrence.

# 3 PROPOSED DEVELOPMENT

Zolbury Ltd., intend to apply to Dun Laoghaire Rathdown County Council for permission for development for a Large-Scale Residential Development (LRD) on a site of approx. 3.83ha on lands at Blackglen Road, Sandyford, Dublin 18.

The development will consist of 192 no. residential units ranging from 2-5 storeys in height, associated resident amenity facilities, a childcare facility, all boundary treatment and landscaping works, site services connections and all site development works to include:

a) Construction of 192 no. residential units, in the form of 6 no. new apartment buildings (A1 – B4), 40 duplexes (C1, C2, C2A) and 14 houses (D1 & D2), to include 33 no. 1-beds, 84 no. 2 -beds, 61 no. 3-beds and 14 no. 4-beds as follows:
    - Block A1 (4 storeys) comprising 15 no. apartments (3 no. 1 bed units, 6 no. 2 bed units & 6 no. 3 bed); a crèche facility of approx. 378 sq. m with associated outdoor play space of approx. 170 sq. m; and resident amenity facilities of approx. 33.3 sq. m.
    - Block A2 (3-4 storeys) comprising 26 no. apartments (2 no. 1 bed units, 20 no. 2 bed units and 4 no. no. 3 bed units) and resident amenity facilities of approx. 353.6 sq.m.
    - Blocks B1 and B2 (2-5 storeys) comprising 51 no. apartments (15 no. 1 bed units, 29 no. 2 bed units, 7 no. 3 bed units).
    - Blocks B3 and B4 (2-5 storeys) comprising 46 no. apartments (13 no. 1 bed units, 23 no. 2 bed units and 10 no. 3 bed units).
    - Duplex Units C1 (4 storeys), C2 and C2A (3 storeys) comprising 40 duplexes (6 no. 2 bed units, 20 no. 3 bed units and 14 no. 4 bed units).
    - House Units D1 and D2 (2 storeys) comprising 14 houses (14 no. 3 bed units).
b) Total Open space (approx. 10,854 sqm) is proposed in the form of public open space (approx. 8, 686 sqm), and residential communal open space (approx. 2,168 sqm). Each residential unit is afforded with associated private open space in the form of a garden/terrace / balcony.
c) The development will be served via a new vehicular access via Blackglen Road. This will be designed as a priority junction with pedestrian and cycle crossings where required to tie in with the Blackglen Road Improvement Scheme.
d) A new toucan crossing is proposed across Blackglen Road just to the east of the new vehicular access. This toucan crossing has been designed as per TL607 of the Cycle Design Manual to allow crossing of pedestrians and cyclists to the northern side of Blackglen Road for improved public transport access.
e) Emergency access only is proposed via Woodside Road.
f) A dedicated wildlife corridor is proposed to the east/south-east side of the site and a public open space (approx. 307 m in length) tree trail to the west/north-west side of the site.
g) Basement/Podium car park areas are proposed below Blocks B1, B2, B3 and B4. A total of 234 no. car parking spaces are proposed, which includes 2 no. car club spaces, 12 no. accessible

spaces and 47 no. EV charging spaces (206 no. long-stay spaces, 18 no. visitor space & 10 no. car parking spaces for creche use), in addition to 9 no. motorcycle spaces.

h) A total of 484 no. bicycle spaces are proposed in the form of 442 no. long stay bicycle spaces 42 short-term stay visitor parking.

i) 2 no. ESB substation at surface level.

j) Bin Storage areas for the Duplex blocks are proposed at ground level adjacent to the Duplex blocks.

k) All associated site and infrastructural works to include provision for water services; foul and surface water drainage and connections; internal roads, attenuation proposal; permeable paving; all landscaping works including green infrastructure zones; green roofs; and general plant areas; photovoltaic panels; landscaped boundary treatment; footpaths; public lighting; and electrical services.




*Figure 1: Proposed Development Site Plan*

# 4 PEDESTRIAN COMFORT COMPLIANCE

The Lawson criteria gives guidance to quantify the effect of wind velocity on pedestrian comfort and safety. The Lawson recommended guidance indicates that for the comfort and safety assessment of the wind environment, it is not only the velocity of wind that is considered but also the frequency of occurrence of these velocities. The frequency of occurrences is used here as an indicator of the likely duration of certain wind speeds. The Lawson criteria indicates that the threshold mean hourly wind speed for each pedestrian activity should not be exceeded for more than 5% of the time to maintain pedestrian comfort.

| Pedestrian activity | Threshold mean hourly wind speed not to be exceeded for more than 5% of the time [m/s] |
|---|---|
| **Business Walking** | 10 |
| **Leisurely Walking** | 8 |
| **Standing or Short Term Sitting** | 6 |
| **Long Term Sitting** | 4 |

*Table 1. Lawson Criteria for Pedetrian Comfort*

# 5 ASSESSMENT METHODOLOGY

The methodology adopted for the study combines the use of Computational Fluid Dynamics (CFD) to predict air flow patterns and wind velocities around the proposed development, the use of wind data from the nearest suitable meteorological station and the recommended comfort and safety standards (The Lawson Criteria).

The study considered the following factors:

- The effect of the geometry, height and massing of the proposed development and existing surroundings on local wind speed and direction;
- The wind speed as a function of the local environment such as topography, ground roughness and nearby obstacles (buildings, bridges, etc.);
- The effects of site location (open field, inner city, etc.);
- Orientation of the buildings relative to the prevailing wind direction; and
- The pedestrian activity to be expected (long term sitting, standing or short term sitting, leisure and business walking).

The wind analysis focuses on the potential variation of the wind velocities from the reference wind data due to the proposed development.

## EXTENT OF CFD STUDY AREA

The extent of the built area that is represented in the computational domain is dependent on the influence of the features on the region of interest which includes the site and its nearby surroundings. The analytical CFD model analyses the proposed development. It also includes existing buildings surrounding the development with the extent of the buildings included in the study area illustrated in Figure 2.

The analytical CFD model is assessed against the full Lawson Criteria to identify the pedestrian comfort and safety conditions surrounding the development.

- The analytical CFD model has been constructed based on the information provided below:
- 3D AutoCAD model and plans received from OMP Architects;
- Topographical survey drawings of surrounding buildings;
- Available aerial photographic data via Google Maps;
- Meteorological wind data for Dublin Airport.

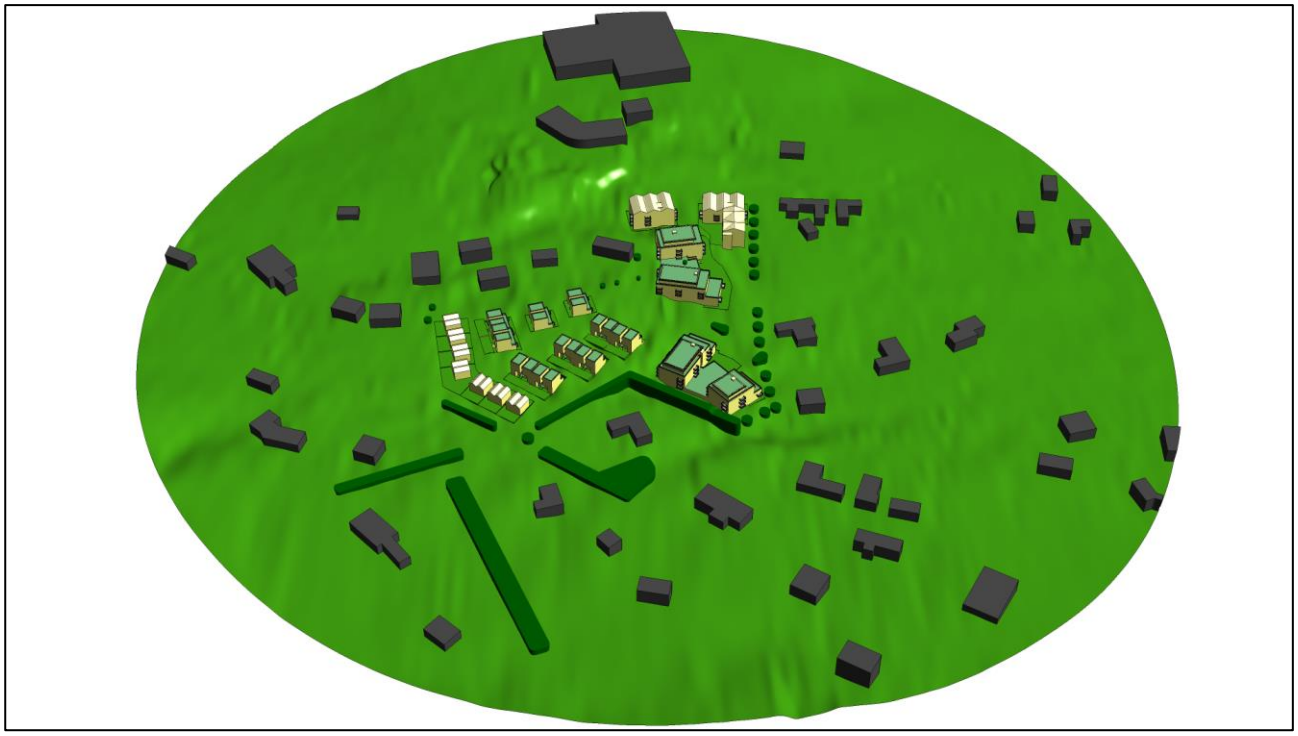


*Figure 2. Extent of CFD Study Area*

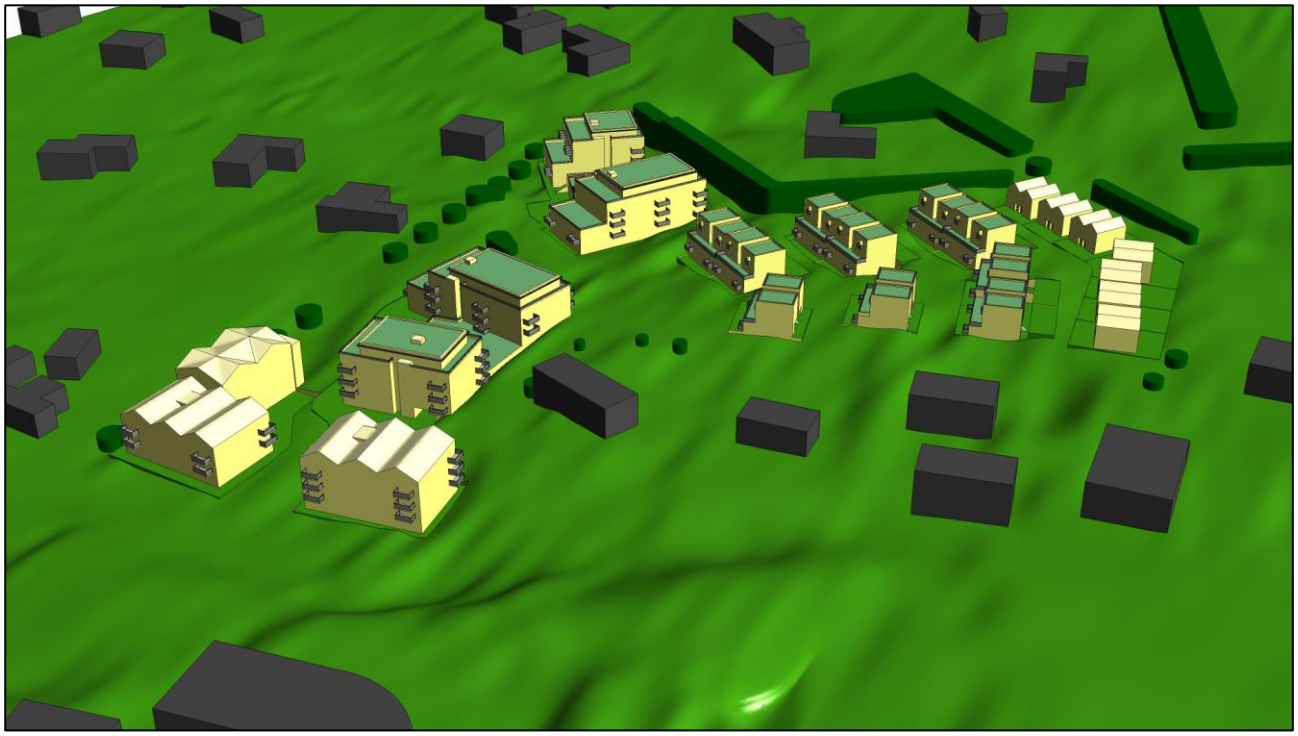


*Figure 3. Rendering of CFD Model*

## WIND CLIMATE

The wind climate analysis is based on the wind data obtained from the Dublin Airport weather station which incorporates hourly wind data over a 30-year period (1989 until 2019). Figure 4 illustrates the percentage of hours per wind direction over a period of 30 years for 12 no. wind directions.

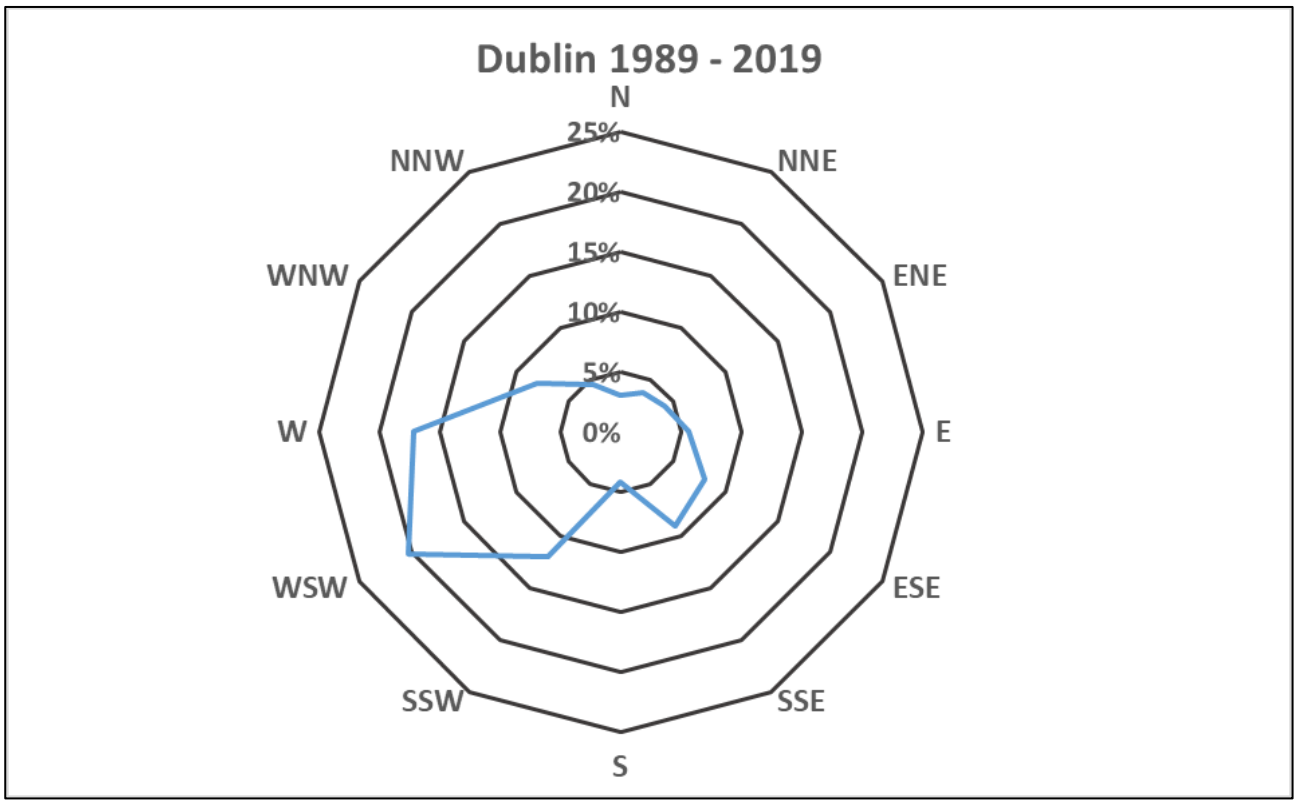



*Figure 4. Percentage of Hours per Wind Direction over 30 years*

The hourly wind data is the basis for the wind climate analysis. The number of hours that wind occurs from a given wind direction and velocity influences the local wind climate. The CFD simulation is used to calculate the wind-factor (local wind velocity relative to reference wind velocity). The wind-factor is a measure to calculate the number of hours that a given threshold wind velocity is exceeded based on statistical wind data. The yearly average frequency of a wind velocity occurrence per wind direction is outlined in Table 2.

| Wind dir. | N | NNE | ENE | E | ESE | SSE | S | SSW | WSW | W | WNW | NNW | n/a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | Still |
| Speed [m/s] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] | [hrs] |
| 0-1 | 24 | 19 | 12 | 23 | 31 | 26 | 16 | 17 | 23 | 30 | 30 | 26 | 43 |
| 1-2 | 52 | 41 | 25 | 53 | 74 | 64 | 34 | 47 | 63 | 70 | 63 | 49 | 0 |
| 2-3 | 51 | 54 | 50 | 87 | 122 | 108 | 51 | 94 | 130 | 143 | 102 | 63 | 0 |
| 3-4 | 43 | 48 | 67 | 92 | 132 | 121 | 49 | 124 | 191 | 194 | 133 | 66 | 0 |
| 4-5 | 32 | 45 | 66 | 75 | 109 | 121 | 43 | 140 | 224 | 219 | 121 | 62 | 0 |
| 5-6 | 24 | 38 | 51 | 53 | 85 | 107 | 42 | 148 | 234 | 211 | 94 | 47 | 0 |
| 6-7 | 16 | 30 | 37 | 37 | 57 | 84 | 38 | 130 | 228 | 169 | 63 | 33 | 0 |
| 7-8 | 10 | 21 | 24 | 25 | 36 | 60 | 30 | 111 | 195 | 134 | 41 | 24 | 0 |
| 8-9 | 6 | 11 | 17 | 18 | 22 | 41 | 22 | 85 | 159 | 105 | 25 | 14 | 0 |
| 9-10 | 4 | 7 | 11 | 12 | 12 | 27 | 17 | 59 | 121 | 80 | 14 | 7 | 0 |
| 10-11 | 2 | 4 | 4 | 8 | 9 | 16 | 11 | 39 | 82 | 56 | 7 | 3 | 0 |
| 11-12 | 1 | 3 | 2 | 5 | 5 | 10 | 6 | 23 | 52 | 36 | 5 | 1 | 0 |
| 12-13 | 0 | 2 | 1 | 2 | 2 | 5 | 3 | 13 | 32 | 21 | 2 | 1 | 0 |
| 13-14 | 0 | 0 | 0 | 1 | 2 | 3 | 1 | 8 | 18 | 11 | 1 | 0 | 0 |
| 14-15 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 5 | 11 | 6 | 1 | 0 | 0 |
| 15-16 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 6 | 4 | 0 | 0 | 0 |
| 16-17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 0 |
| 17-18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 18-19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 19-20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |

*Table 2. Frequency of Wind Velocity Occurrence per Wind Direction*

## WIND PROFILE

A rectangular computational domain was created to simulate the effect of the atmospheric boundary layer surrounding the region of interest. The extents of the computational domain are illustrated in Figure 5, where H is the height of the highest tower within the proposed development.

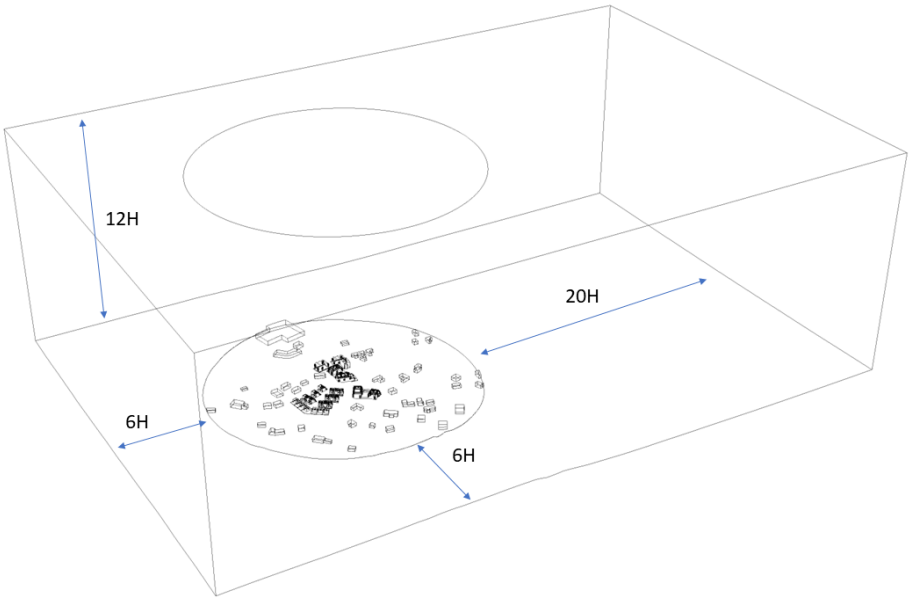



*Figure 5. Computational Domain Surrounding the Region of Interest*

An atmospheric boundary layer wind profile ($v_{wind}$) is applied to the boundaries of the computational model. To incorporate the effect of small height differences and small objects at street level, which are not explicitly included in the model, a roughness has been applied to the ground surface of the detailed CFD model. For the wind profile a roughness length ($z_0$) of 0.4 m has been estimated.

Based on the reference velocity, reference height, and roughness length, a wind profile can be defined. The wind profile $v_{wind}$ is defined as follows.

$$v_{wind} = v_{ref} \cdot \left( \frac{\ln\left(\frac{z}{z_0}\right)}{\ln\left(\frac{z_{ref}}{z_0}\right)} \right)$$

Where:

| | | |
|---|---|---|
| $v_{wind}$ | Wind velocity | [m/s] |
| $v_{ref}$ | Reference velocity | [m/s] |
| $z$ | Height above the ground | [m] |
| $z_0$ | Roughness length | [m] |
| $z_{ref}$ | Reference height | [m] |

## WIND FACTOR

The CFD simulations are used to calculate the wind factor. The wind factor is a factor which indicates if the wind speed is locally increased (wind factor > 1.0) or decreased (wind factor < 1.0) due to buildings (or other geometry), relative to the applied reference wind speed at 10m height. The wind factor is independent of the magnitude of the reference wind speed at 10m height, making the obtained wind factor valid for all wind speeds in a specific wind direction range. Hence, one simulation can be applied per wind direction covering all wind speeds in this direction.

To explain the wind factor in more detail, the wind factor results for the 0-degree wind direction (i.e. North) are illustrated in Figure 6. The wind factor arrows that are coloured green, cyan or dark blue indicate that the local wind speed has been reduced (wind factor < 1.0), while wind factor arrows which are coloured light green/yellow indicate the local wind speed has increased (wind factor > 1.0). Using the wind factors, the quantity of hours that a wind speed is exceeded can be calculated (per wind direction) which is then used to assess compliance against the Lawson Criteria.

The wind factor results for all 12 no. wind directions are included in Appendix A.

## CFD MODELLING

The CFD simulation has been performed using the software package ANSYS CFX version 2023 R1. This software package can be used for a large range of applications and has been extensively validated.

A full 3D CFD model of the proposed development and surrounding buildings was created and split into a large number of control volumes or cells. The standard equations for fluid motion and energy transport are applied to each cell. The equations are then solved using numerical techniques. The CFD settings used for the analysis are summarised in Table 3.

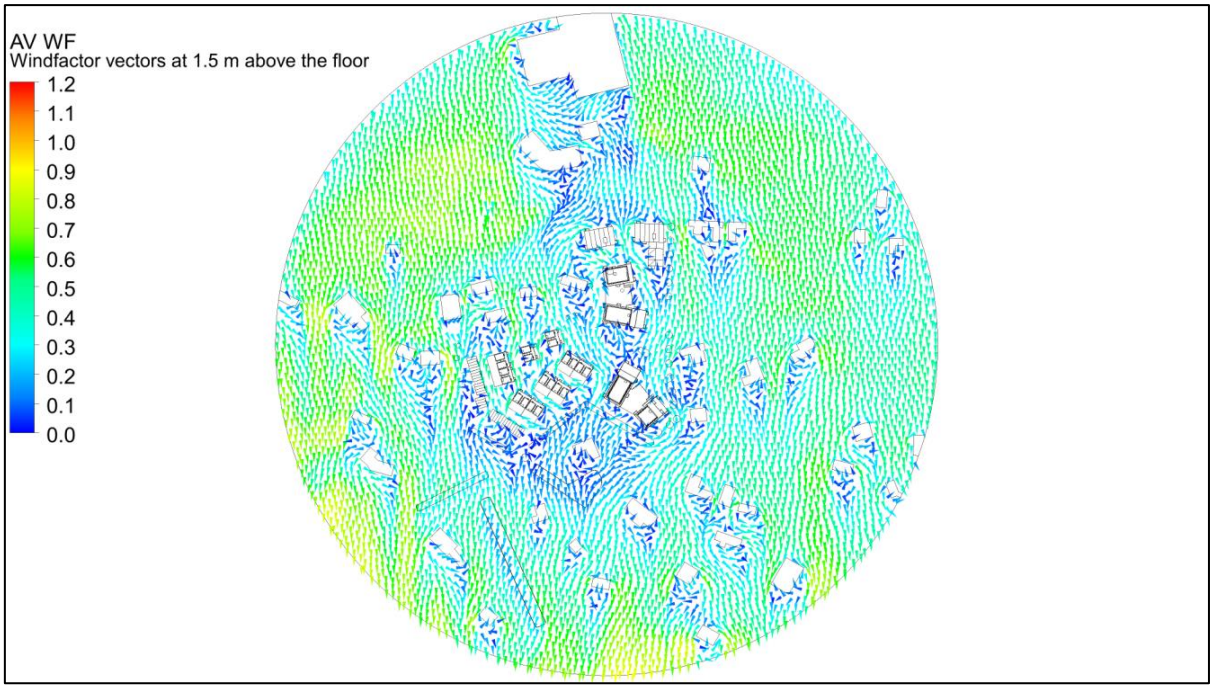



*Figure 6: Wind Factor - 0 Degree (N) Wind Orientation*

| CFD settings | Description |
|---|---|
| **Grid type** | Hybrid, mixture of tetrahedrons, pyramids and prisms |
| **Cell size** | Dynamic, ranging from 0.025 up to 2 m at the building surfaces and streets, growing to 10 m in the volume |
| **Number of cells** | 28.4 million |
| **Simulation type** | Steady state |
| **Convergence** | $< 1 \cdot 10^{-4}$ |
| **Simulation time** | 1500 s |
| **Fluid** | Air fixed properties |
| **Turbulence model** | RANS, RNG Kappa-Epsilon model |
| **Walls** | Smooth, no slip |
| **Wind volume** | Profile for velocity and turbulence |
| **Roughness** | Volumetric sources for momentum and turbulence |
| **Vegetation** | Volumetric loss coefficient |

*Table 3. Summary of CFD Model Settings*

# 6 ASSUMPTIONS AND LIMITATIONS

Computational Fluid Dynamic (CFD) is a widely recognised method for modelling airflow problems and as computer power develops, it increasingly improves its applicability. However, there are some limitations with CFD in relation to the modelling of wind environments. The method uses mean hourly wind values and presents a limitation to capture gusts.

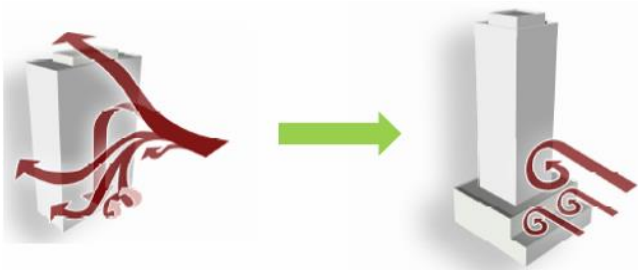
The Lawson criteria for pedestrian comfort focus on the effect of wind and do not factor in other environmental variables such as air temperature, solar radiation and relative humidity. However, overlaying all these factors would be a complex process and Lawson's simplified method presents the best available methodology for anticipating wind effects in the built environment.

The buildings were modelled as blocks, i.e. with smooth surfaces and sharp corners, which is generally sufficient detail to represent buildings in airflow modelling. This assumption is industry accepted as further detail to the model such as the window reveals and façade texture would add an impractical and unnecessary complexity to the model without adding greater quality results. Landscaping features such as pergolas and trellis structures were not modelled within the simulation as they would provide an extra level of complexity to an otherwise large CFD model. Furthermore, a very limited number of trees and hedges were modelled locally to prove their impact on mitigating wind speeds. Incorporating all balconies, trees and hedges would be impractical on a model this size.

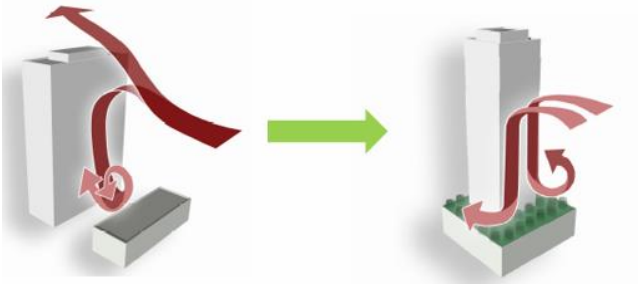
# 7 WIND MITIGATION MEASURES

The following are common strategies to mitigate excessive wind speeds associated with building developments[1].

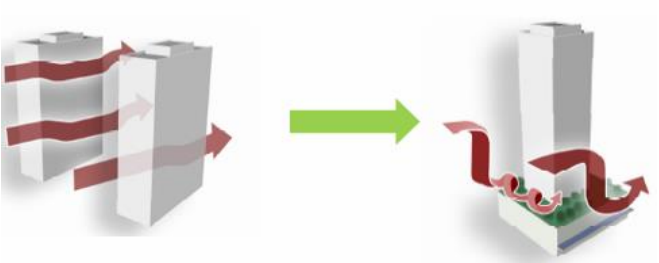
- When wind hits the windward face of a building, the building deflects the wind downwards (downwashing), causing accelerated wind speeds at pedestrian level and around the corners of the building. By introducing a base building or podium, the downward wind flow can be deflected, resulting in a reduction of wind speed at pedestrian level.



- When the leeward face of a low building faces the windward face of a tall building, it causes an increase in the downward wind flow. By landscaping the base building roof, wind speeds can be further reduced.



- Wind speed is accelerated when wind is funneled between two buildings. A horizontal canopy on the windward face of a base building can improve pedestrian comfort conditions.



[1] *Pedestrian Wind Comfort and Safety Studies,* (City of Mississauga, 2014).

The following specific mitigation measures have been incorporated into the proposed design to prevent excessive wind speeds.

## COURTYARD LOCATION

The large central communal courtyards within the development at ground level have been strategically located as they are all sheltered from the predominant south-west wind direction resulting in a comfortable environment for pedestrians using the space.

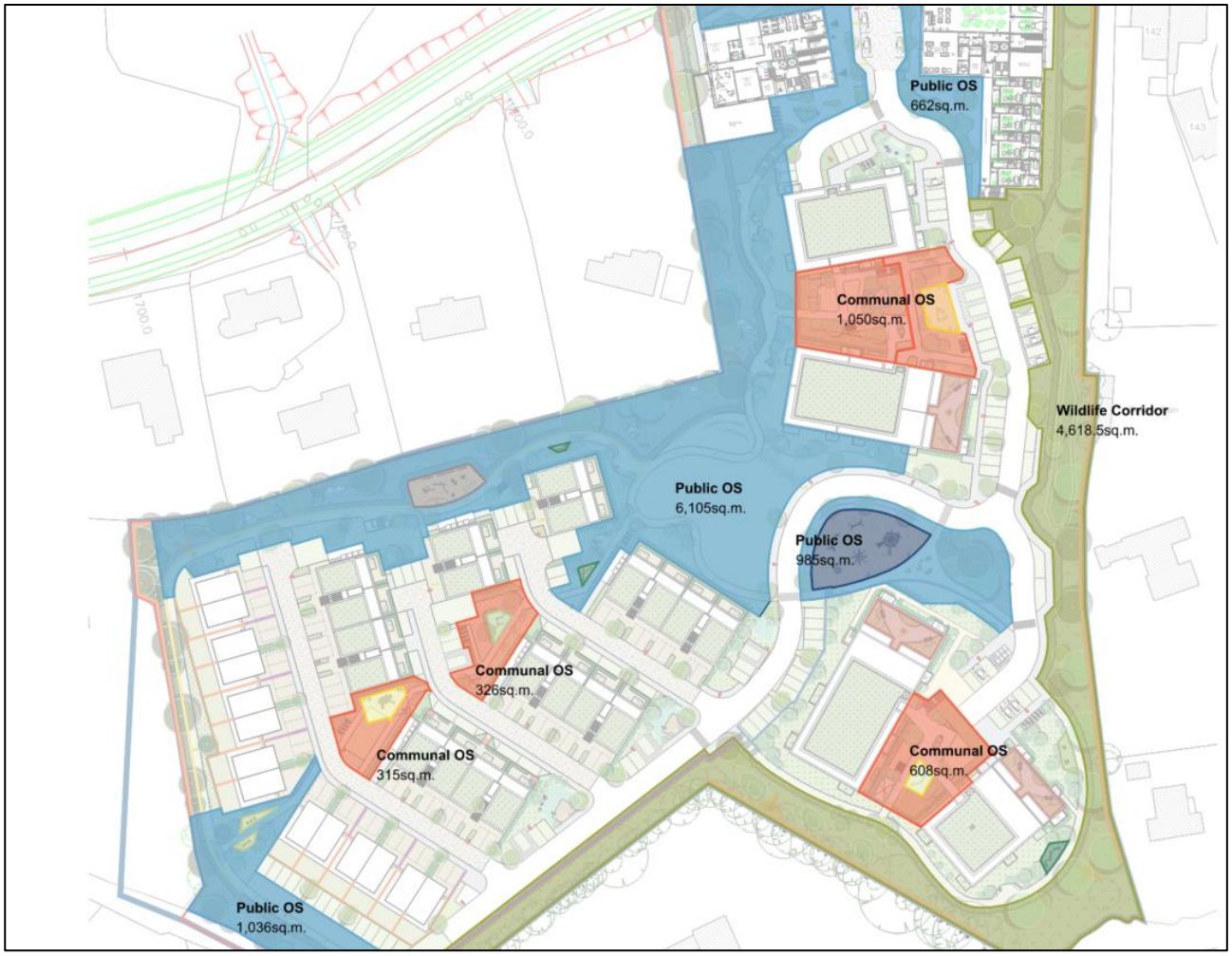



*Figure 7. Wind Mitigation Measure - Courtyard Location*

## LANDSCAPING

The landscaping has been strategically designed to mitigate increased wind speeds and to provide shelter for pedestrians at street level and in the central courtyards. The landscaping design incorporates trees as wind breakers and sheltered seating pockets to act as wind mitigation measures.

The proposed landscaping design is illustrated in Figure 8. Trees are to be planted close to primary entrance ways and along the streetscape, mitigating excessive wind speeds and providing shelter for pedestrians at street level. The use of trees and low-level shrubs all assist in the localised reduction of wind speed.



*Figure 8. Wind Mitigation Measure - Landscaping Design*

# 8 PEDESTRIAN COMFORT RESULTS

The number of hours for all wind directions are summed to calculate the total number of hours that a given pedestrian activity class exceeds the 5% yearly threshold with the results presented in Figure 9.

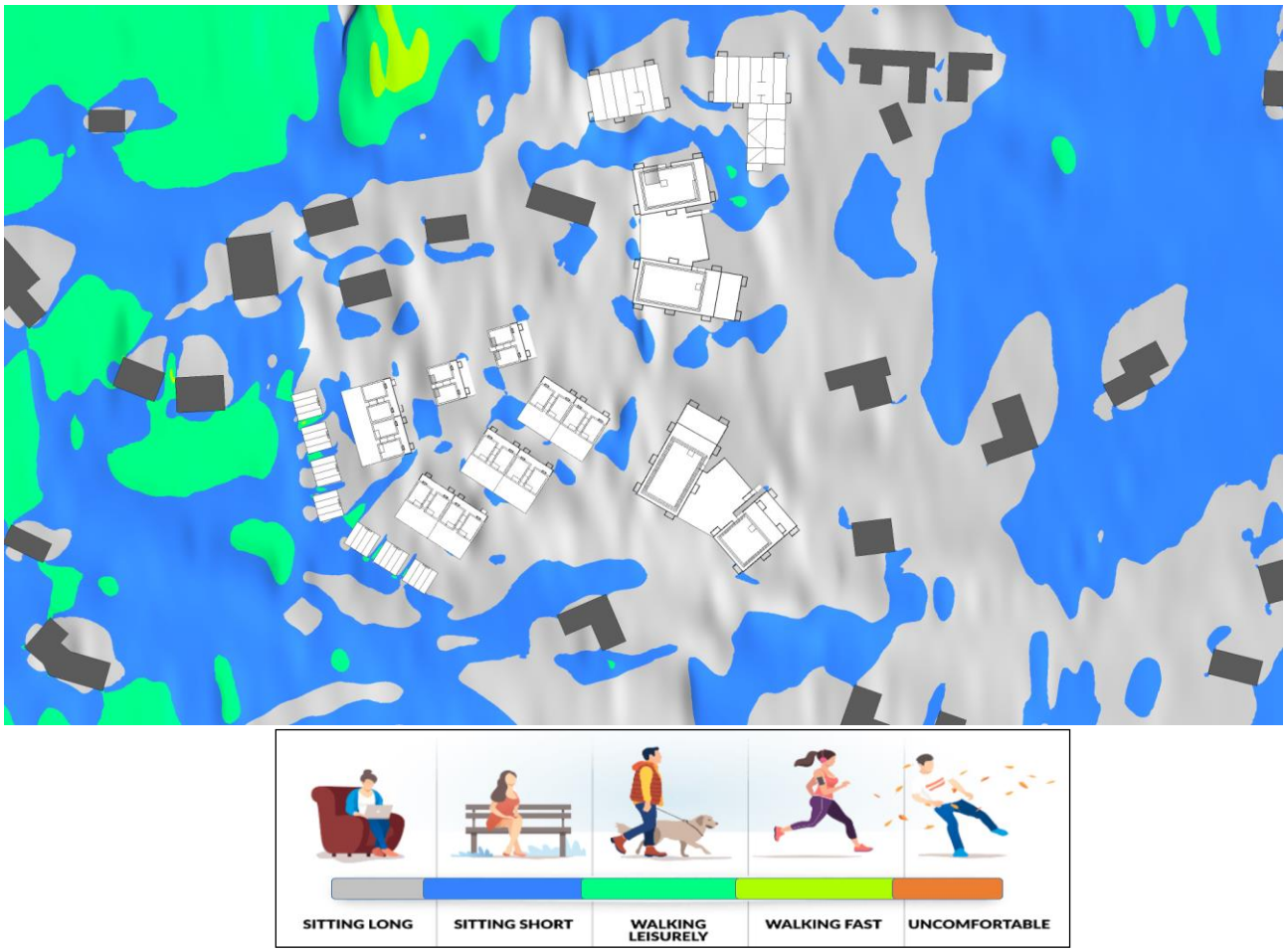



*Figure 9. Pedestrian Wind Comfort Results*

The results of the simulations show that no comfort classes are exceeded for the majority of areas within the proposed developed, with no areas deemed uncomfortable. In certain localised areas, the long term sitting comfort class is marginally exceeded.

Following on from the above summary, it should also be noted that a pedestrian activity class is only a statistical assessment of the local wind climate. When a region does not meet a certain criterion (e.g. sitting), this does not mean that one can never do this activity in this region. It only means that for more than 5% of the time per year the wind speed for this activity is exceeded. The remaining time of the year this activity is possible. For this reason, the percentage of time that "Standing or Short Term Sitting" is comfortable is illustrated in Figure 10. It is evident from this image that "Standing or Short Term Sitting" is comfortable for more than 90% of the year on the vast majority of podium levels, with certain areas at the street level being less comfortable. However, as outlined above, landscaping features such as small trees and hedging were not modelled due to

the complexity they would add to the CFD model. The landscaping design will ensure the areas that exceed the pedestrian classes will be comfortable spaces and will mitigate excessive wind speeds.

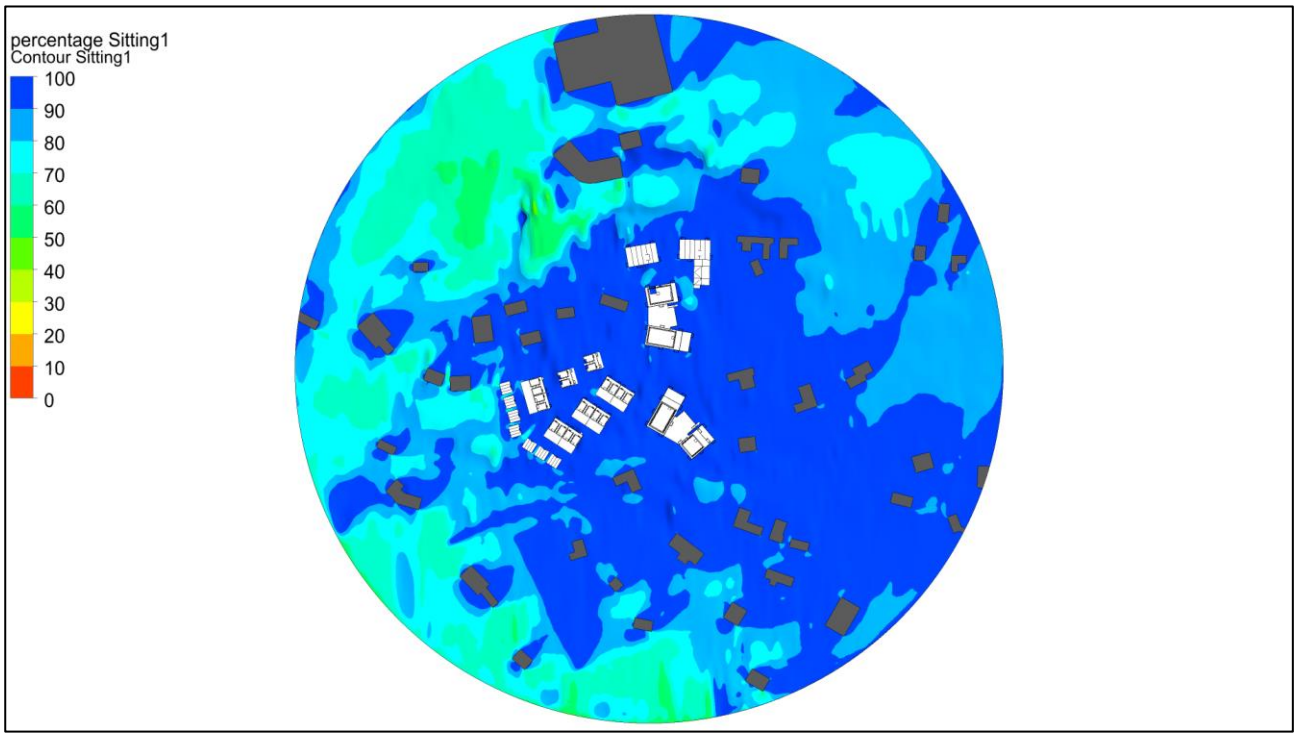



*Figure 10: Percentage of time per year that standing or short-therm sitting is comfortable*

Finally, the wind speed threshold for a certain pedestrian class is only meant to provide guidance on where to locate certain areas where a certain type of activity is expected to be performed. In practice, the experience of the outdoor climate depends on more than just wind speed. Other factors such as clothing, air temperature, solar irradiation, age and relative humidity must also be considered.

**Private Balconies & Terraces Safety:**

As private balconies and terraces are not considered common pedestrian areas, they have not been assessed against the typical comfort classes for pedestrian comfort. However, they have been assessed based on the safety criteria with the most stringent condition being considered, i.e. "sensitive" (refer to Table 2). As shown below, all private balconies and terraces are considered "safe".

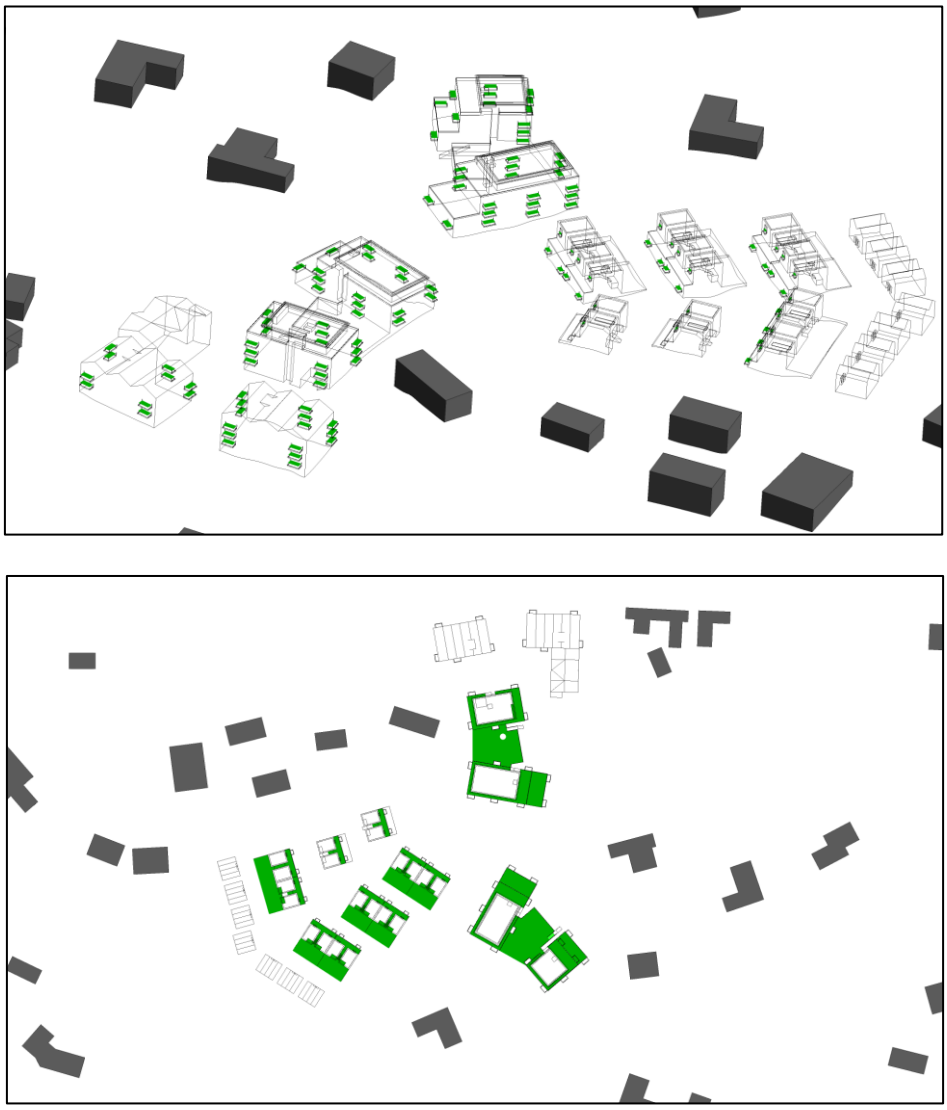



*Figure 11. Pedestrian Wind Comfort Results Frail Pedestrian - Private Balconies & Terraces*

# 9 CONCLUSION

This report outlines the predicted climatic wind conditions experienced within and surrounding the proposed Blackglen Road Residential Development.

As part of this assessment, the industry accepted standard of the Lawson Criteria was utilised. The Lawson Criteria gives guidance to quantify the effect of wind velocity on pedestrian comfort and safety. The wind climate analysis is based on the wind data obtained from the Dublin Airport weather station which incorporates hourly wind data over a 30-year period (1989 until 2019).

A conscious effort was made by the design team during the design stages to mitigate the risk of localised increased wind speed conditions due to the proposed development. The introduction of mitigation measures such as the courtyard locations and strategic location of extensive landscaping, assist in reducing the potential development of local increased wind speed and the negative impact on local climatic conditions.

Based on the CFD modelling results, the proposed development will be a comfortable environment for occupants. Certain areas have been highlighted as being potentially uncomfortable for a limited period of time, however, these concerns have been largely addressed through the incorporation of landscaping which will mitigate excessive wind speeds in these areas.

Overall, the proposed development will be a high-quality, comfortable environment for occupants throughout the year.

# 10 VERIFICATION

This report was compiled and verified by:

*John Shortt*

*Energy Engineer*

*O'Connor Sutton Cronin & Associates*

# Appendix A CFD SIMULATION RESULTS

The CFD wind factor results included in this section are for all 12 No. wind directions as referenced within the body of the report. The wind directions referenced in the wind rose below correspond to the wind directions referenced in the CFD results.

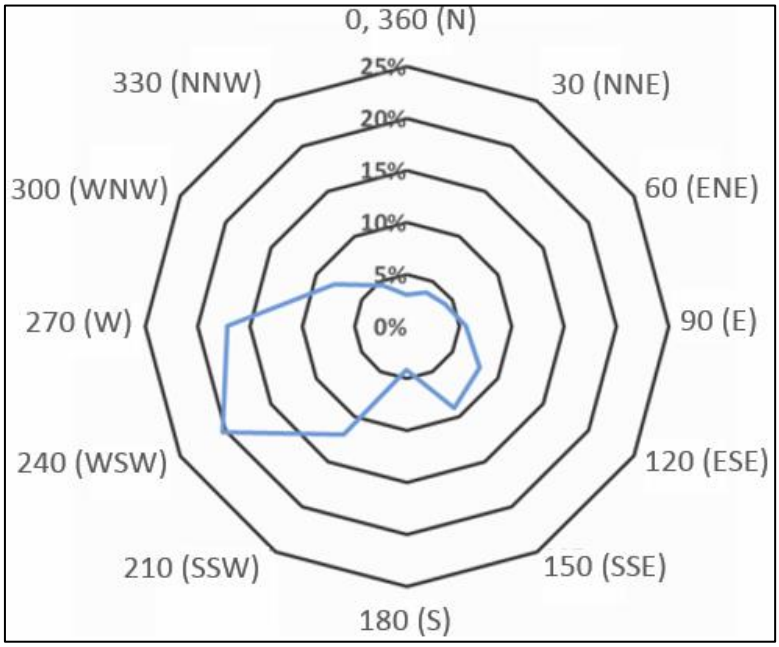



*Figure 12. Dublin Airport Wind Rose Data (1989 – 2019)*

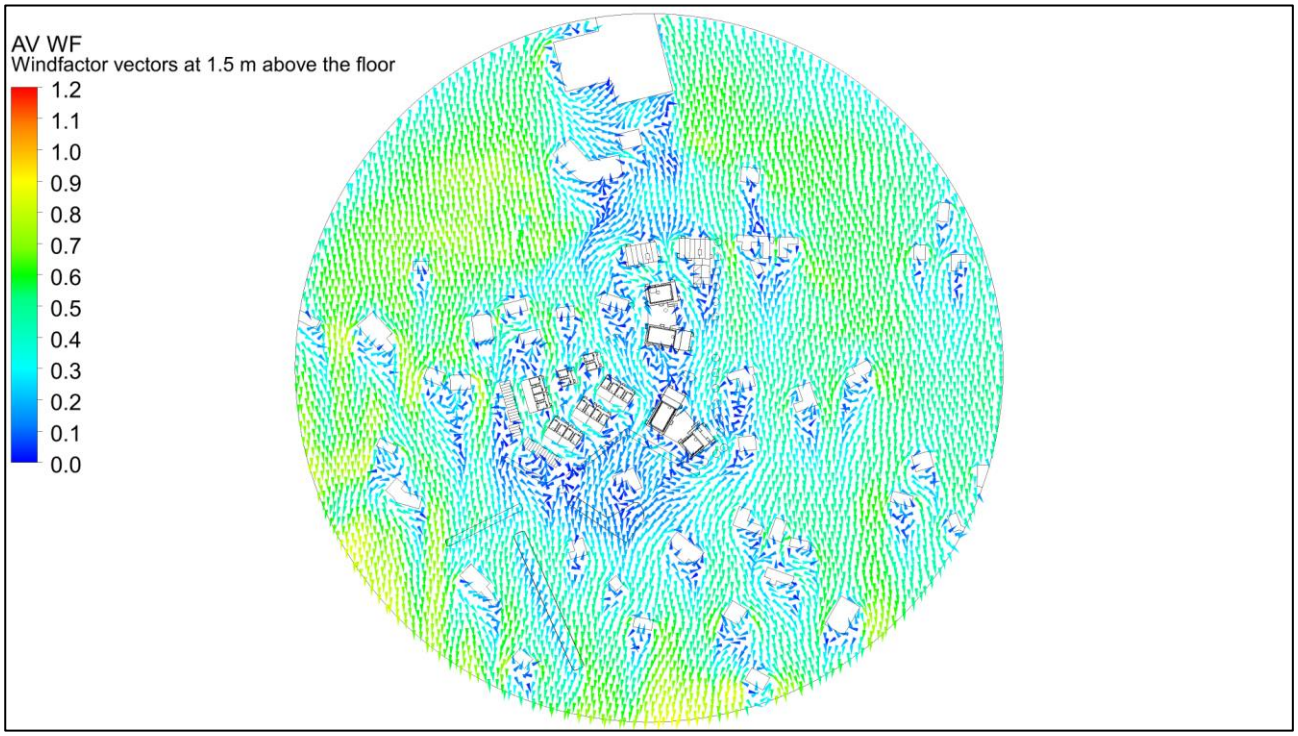



*Figure 13: Wind Factor – 0 Degree (N) Wind Direction*

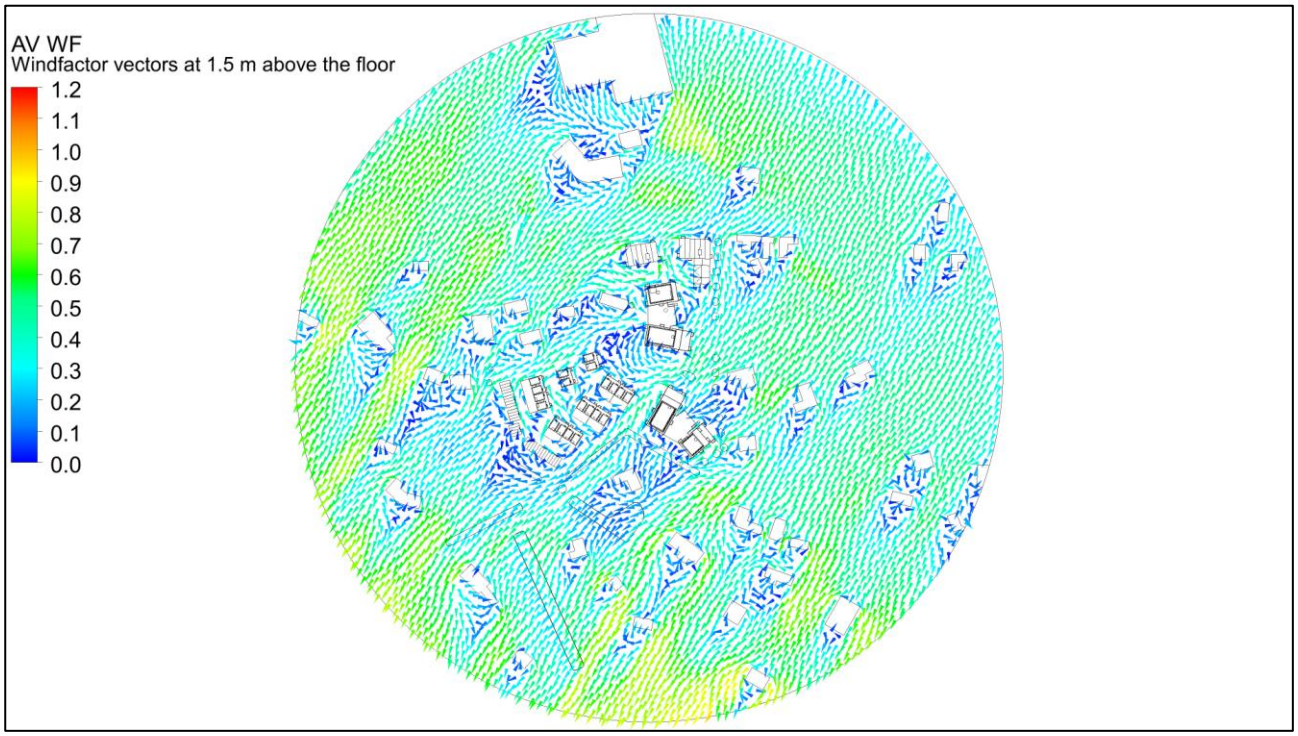



*Figure 14: Wind Factor – 30 Degree (NNE) Wind Direction*

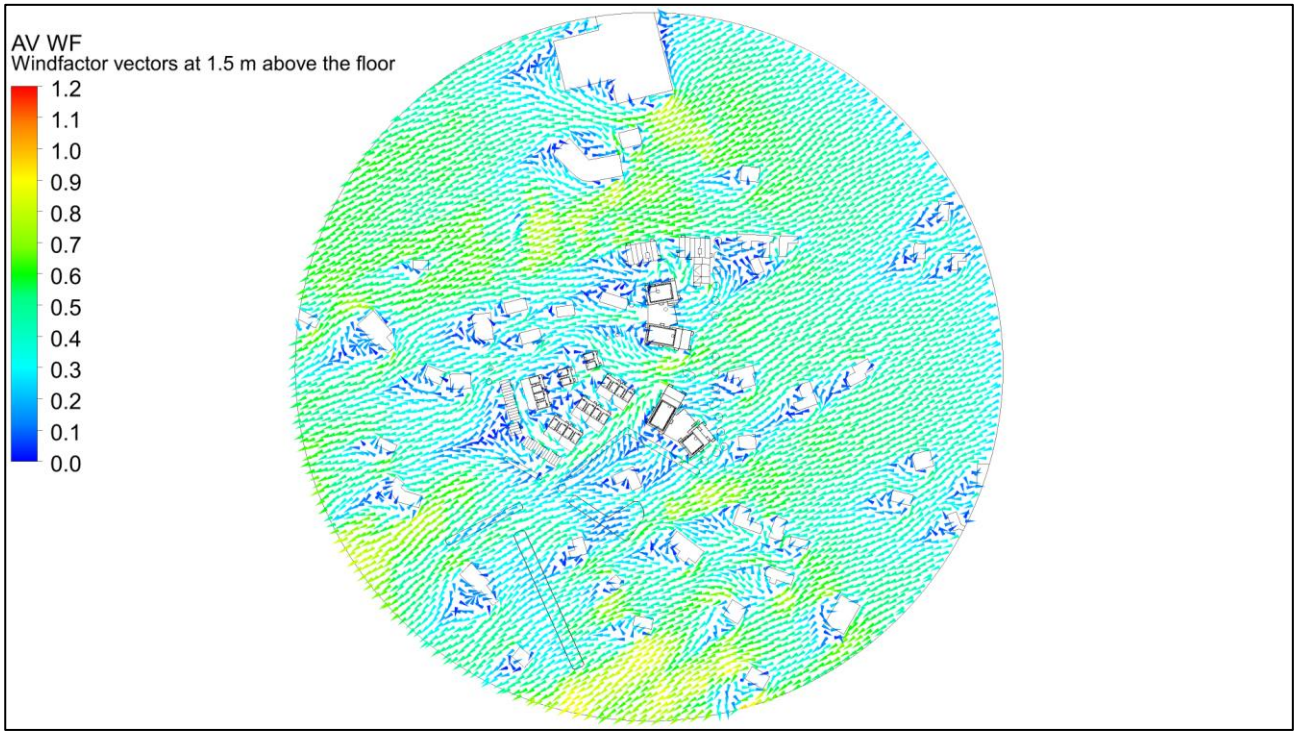



*Figure 15: Wind Factor – 60 Degree (ENE) Wind Direction*

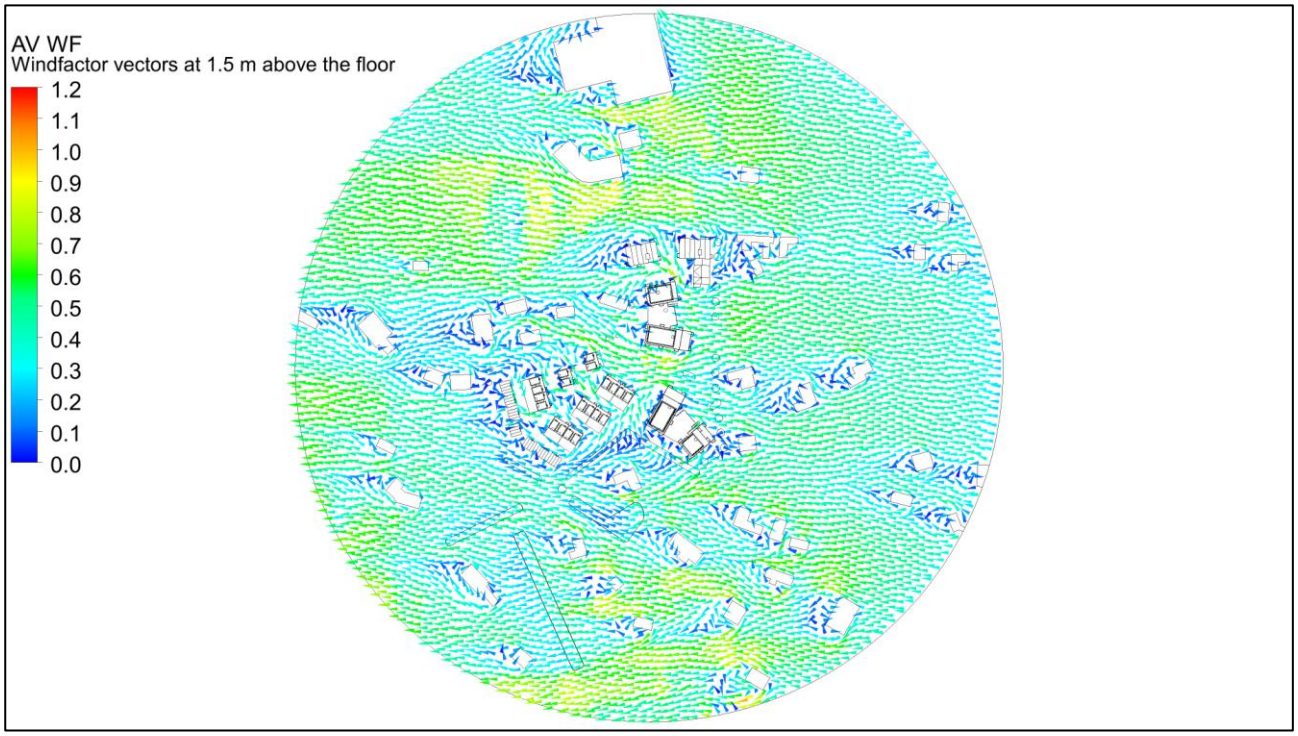



*Figure 16: Wind Factor – 90 Degree (E) Wind Direction*

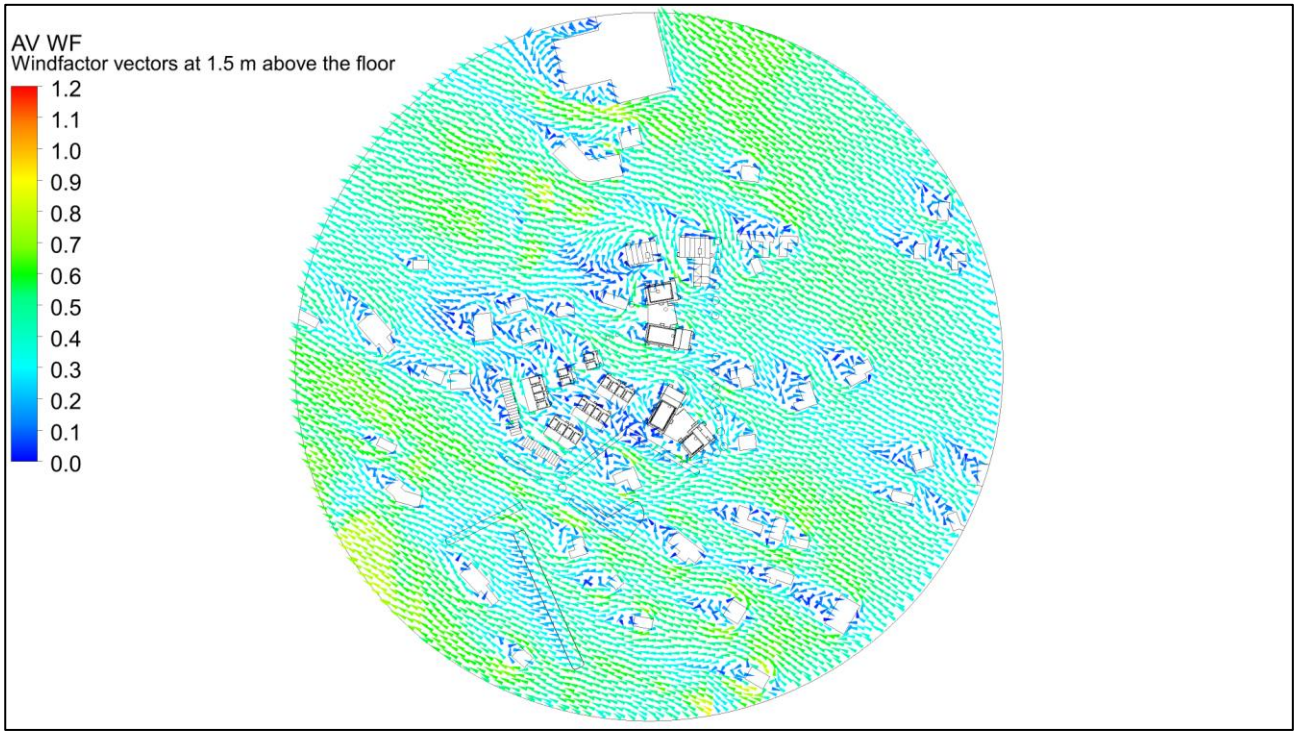



*Figure 17: Wind Factor –120 Degree (ESE) Wind Direction*

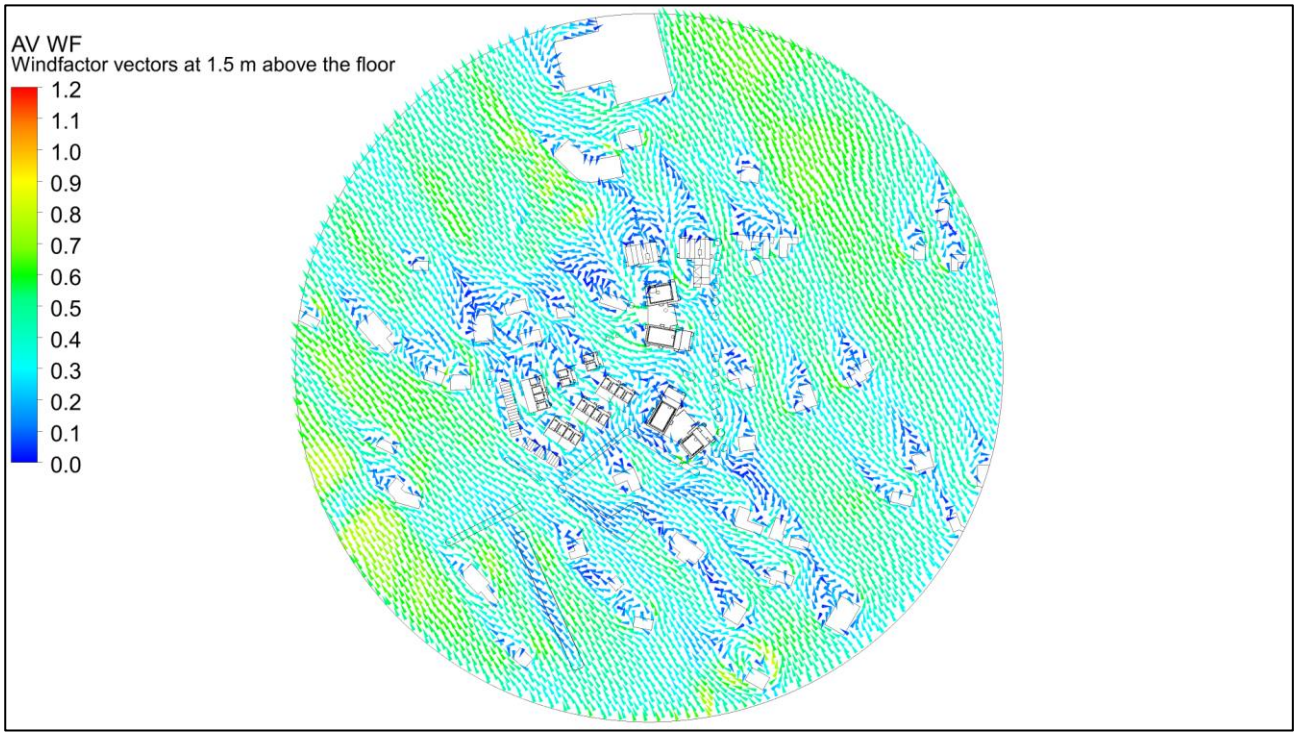



*Figure 18: Wind Factor – 150 Degree (SSE) Wind Direction*

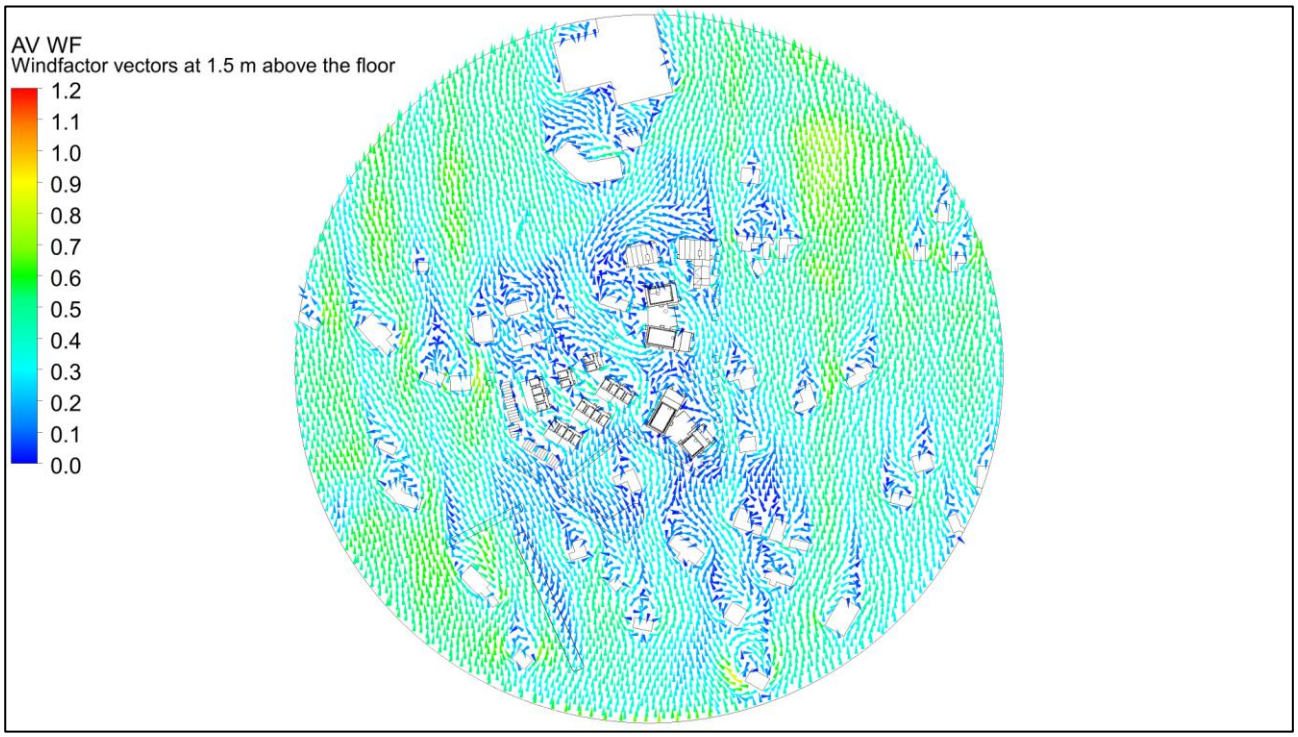



*Figure 19: Wind Factor – 180 Degree (S) Wind Direction*

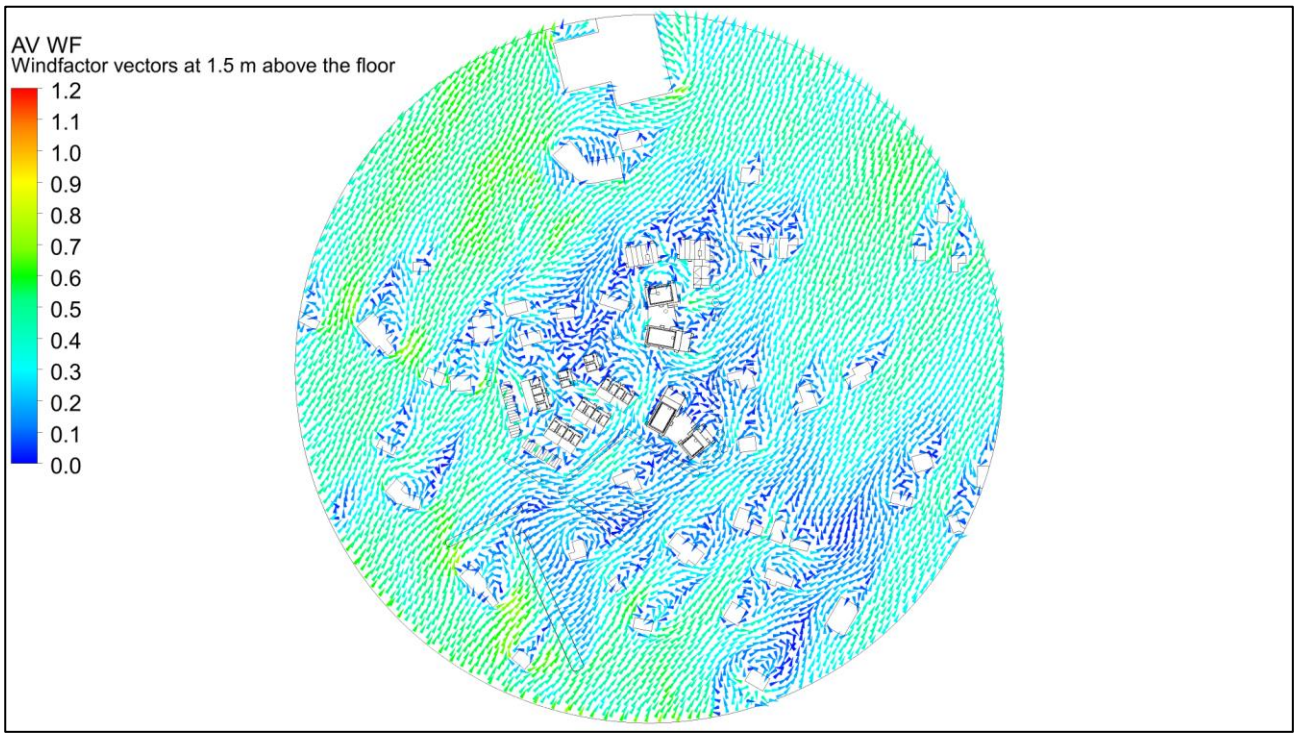



*Figure 20: Wind Factor – 210 Degree (SSW) Wind Direction*

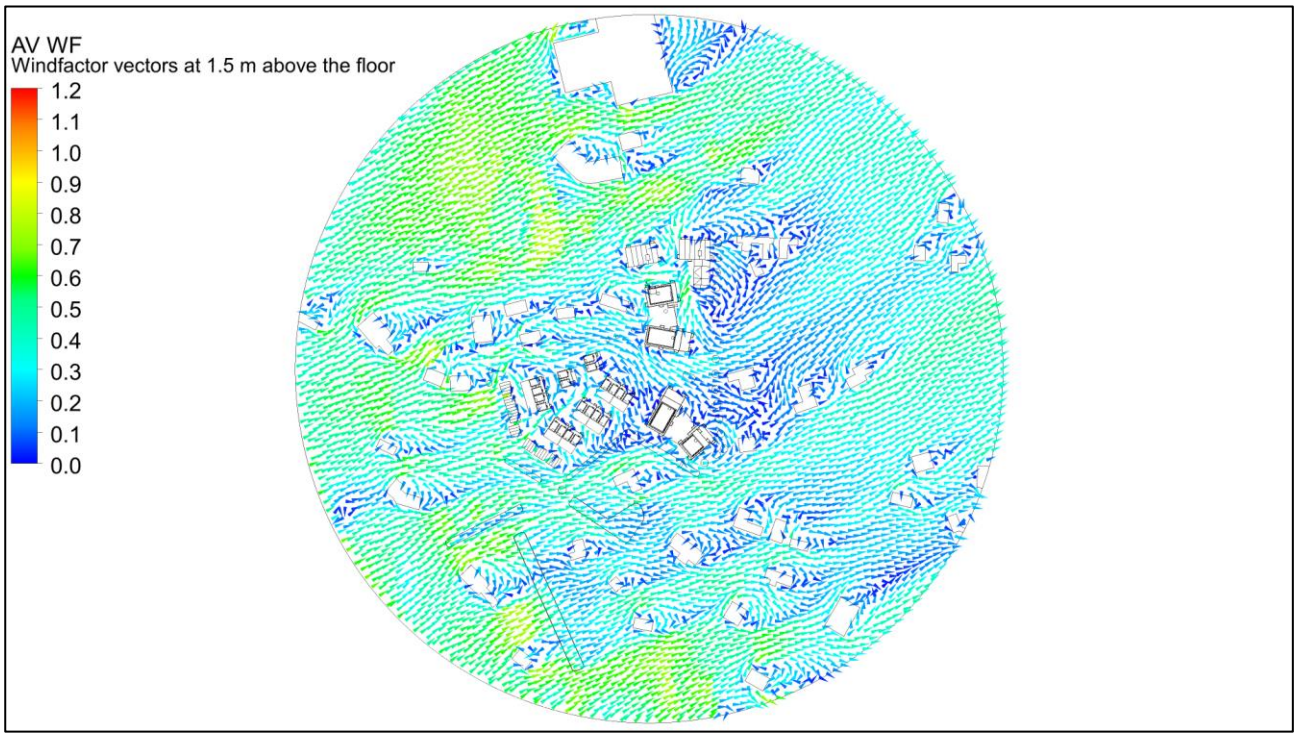



*Figure 21: Wind Factor – 240 Degree (WSW) Wind Direction*

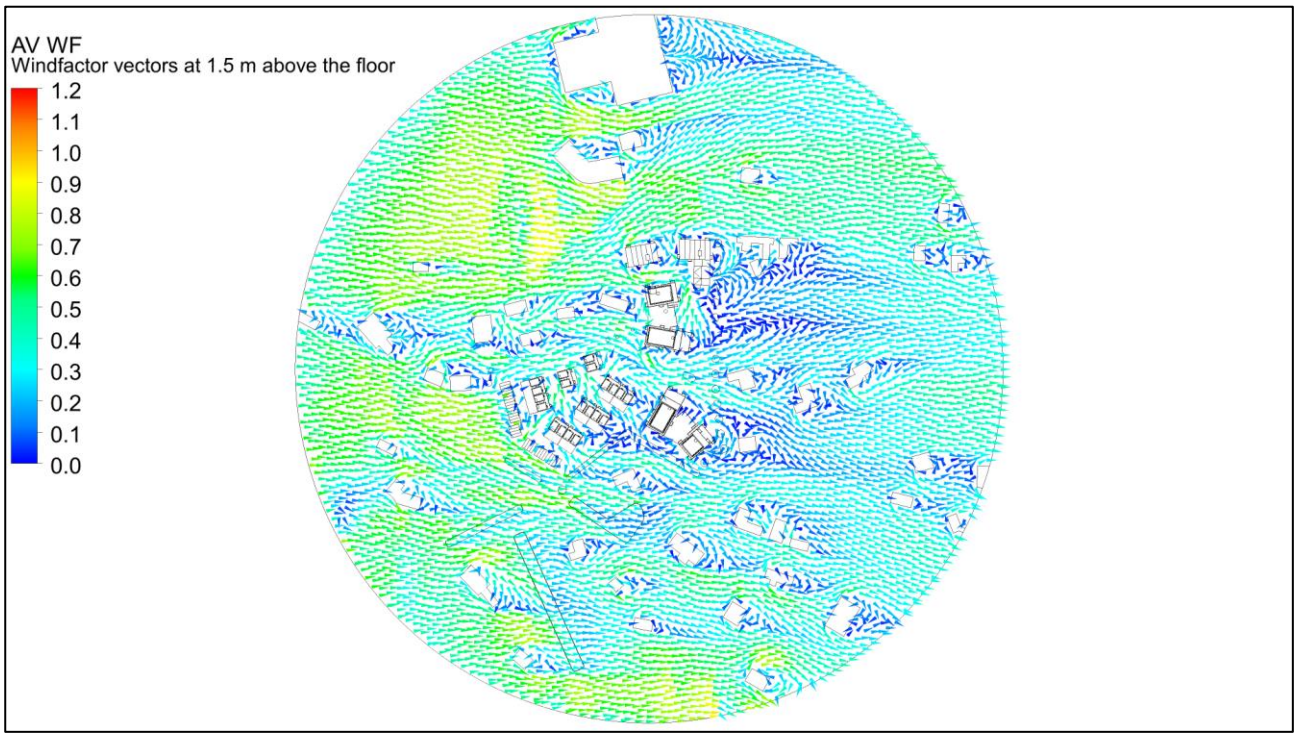



*Figure 22: Wind Factor – 270 Degree (W) Wind Direction*

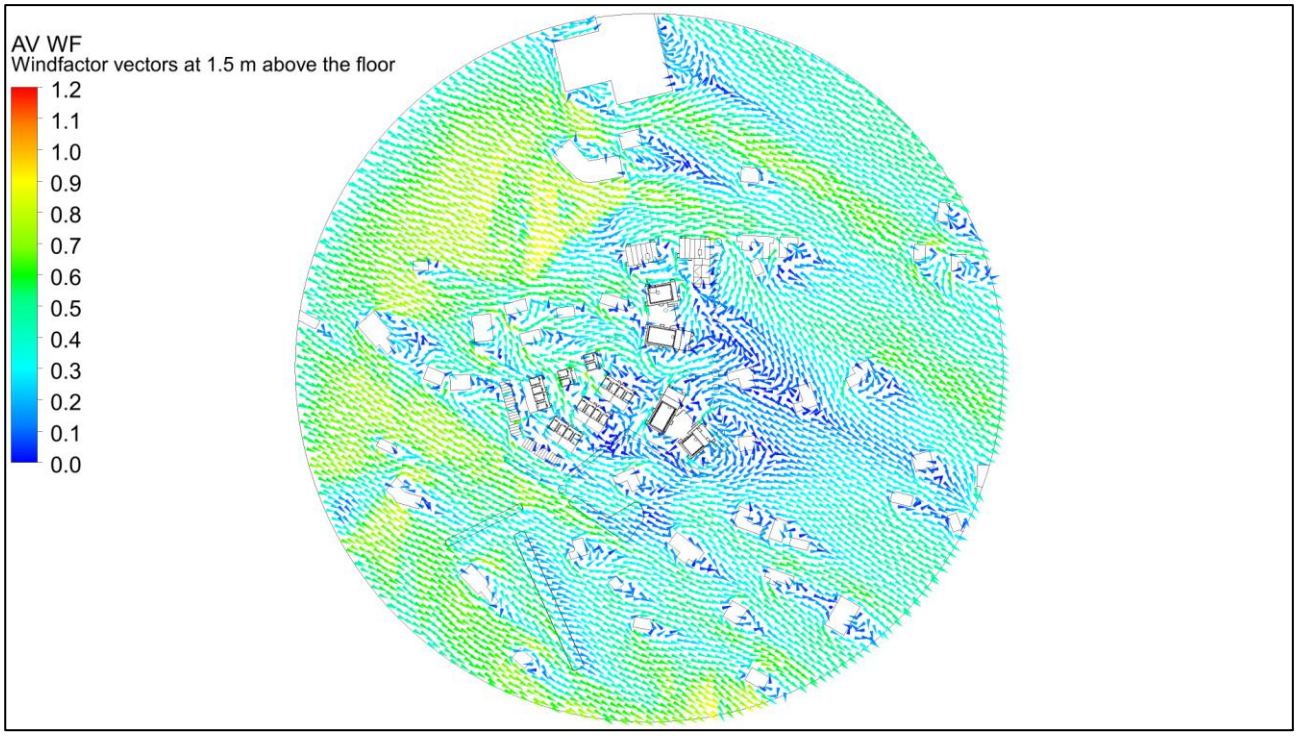



*Figure 23: Wind Factor – 300 Degree (WNW) Wind Direction*

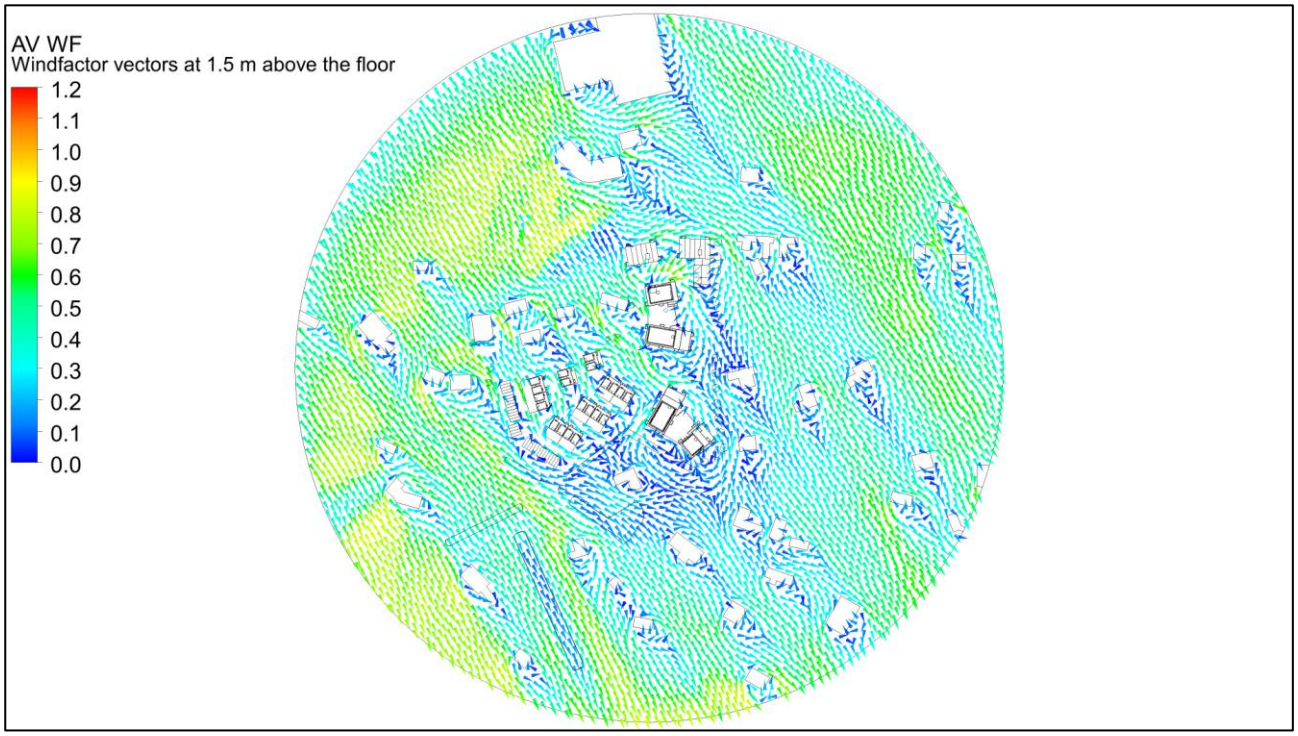



*Figure 24: Wind Factor – 330 Degree (NNW) Wind Direction*

OCSC

O'CONNOR · SUTTON · CRONIN

MULTIDISCIPLINARY CONSULTING ENGINEERS

**Head Office**

9 Prussia Street
Dublin 7
Ireland
D07KT57
T: +353 (0)1 8682000
E: ocsc@ocsc.ie | W: www.ocsc.ie

Civil | Structural | Mechanical | Electrical | Sustainability | Environmental