CHAPTER 11

MICROCLIMATE

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11.0 MICROCLIMATE

11.1 INTRODUCTION

11.1 AWN were commissioned to prepare a desktop review of the Potential Risks of Elevated Wind speed (microclimate) associated with the proposed residential development. This chapter has been prepared by Dr Fergal Callaghan, Director with AWN Consulting, who holds a BSc in Industrial Chemistry and a PhD in Chemical Engineering. This Chapter makes reference to the B-Fluid Ltd CFD (Computational Fluid Dynamics) modelling study for the proposed development.

11.2 The aim of the assessment was to determine if there was considered to be a risk of elevated wind speeds occurring at ground level as a result of the residential development proposed and, with reference to the B-Fluid report, wind-speeds and the possible impacts on pedestrian comfort and safety.

11.3 This assessment comprises the following:

- Determination from available data of the baseline (current) classification of the site with respect to The Beaufort Scale for Wind on Land.
- Examination of the proposed development and the potential for wind-speed amplification factors.
- Risk assessment of the potential for elevated wind speeds to occur with the residential development in place.
- Determination of impact on pedestrian comfort and safety.

11.2 METHODOLOGY

11.4 This study has been undertaken with reference to relevant guidance including:

- Wind Microclimate Guidelines for Developments in the City of London (August 2019)
- T.V. Lawson in Building Aerodynamics, Imperial College London, Imperial College Press, 2001
- The UK Buildings Research Establishment (BRE Digest 520: Wind Microclimate Around Tall Buildings, BRE, 2011)

11.3 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

11.5 A description of the project is provided in Chapter 2, Description of the Proposed Development.

11.6 The development layout is shown in Figure 11.1 below.

Figure 11.1 Proposed Layout of Building Blocks

11.7 The site location and redline boundary is shown in Figure 11.2 below.

Figure 11.2 Proposed Site Redline Boundary.

11.8 The site elevations are shown as follows:

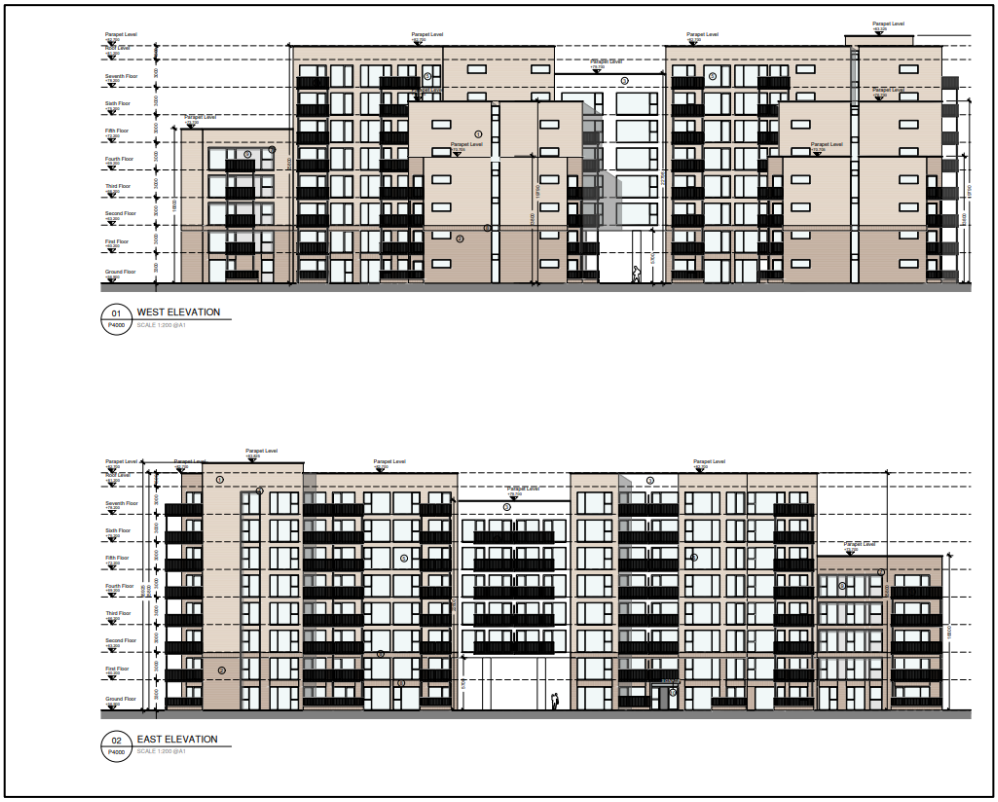

Figure 11.3 West and East Elevations, Block A and B

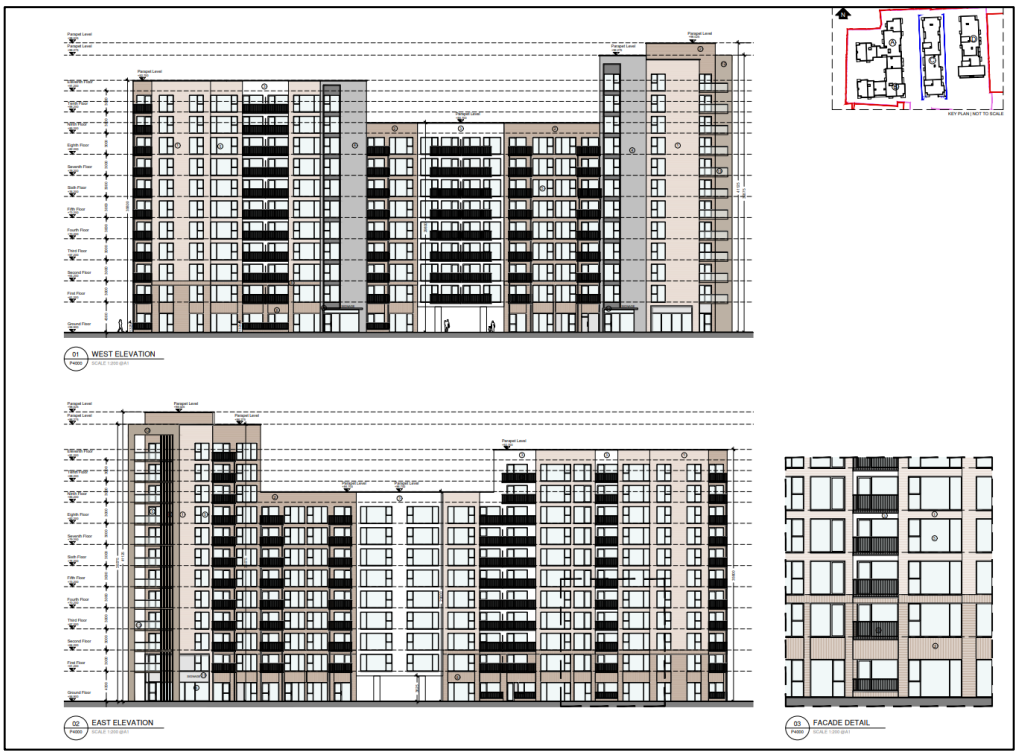

Figure 11.4 West and East Elevations, Block C

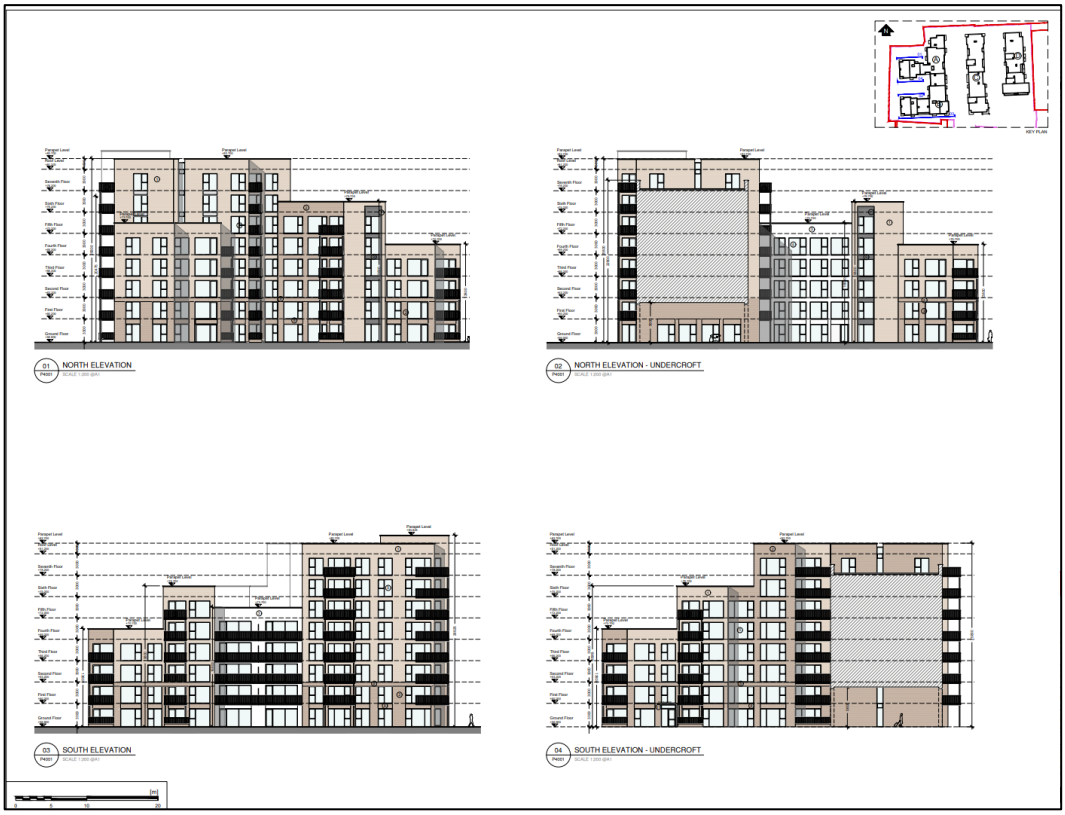

Figure 11.5 South and North Elevations, Block A and B

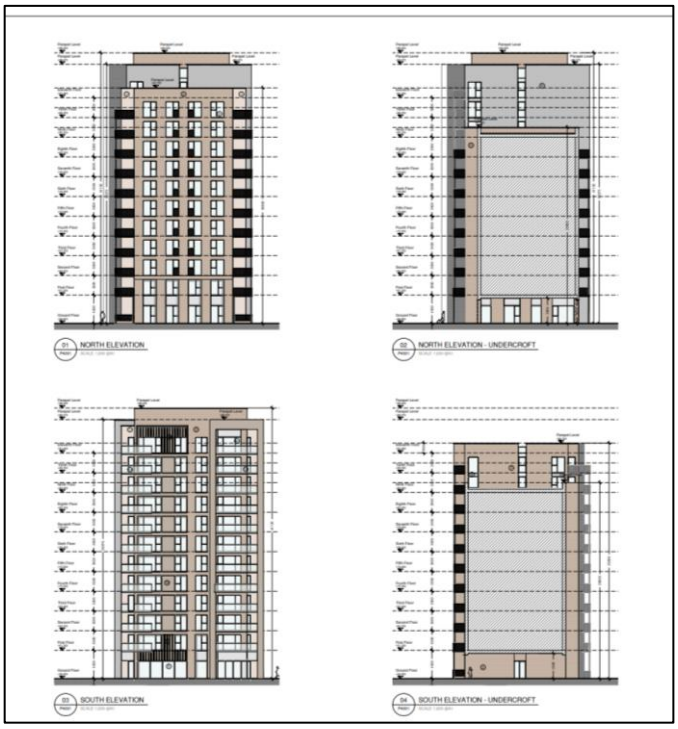

Figure 11.6 North and South Elevations, Block C

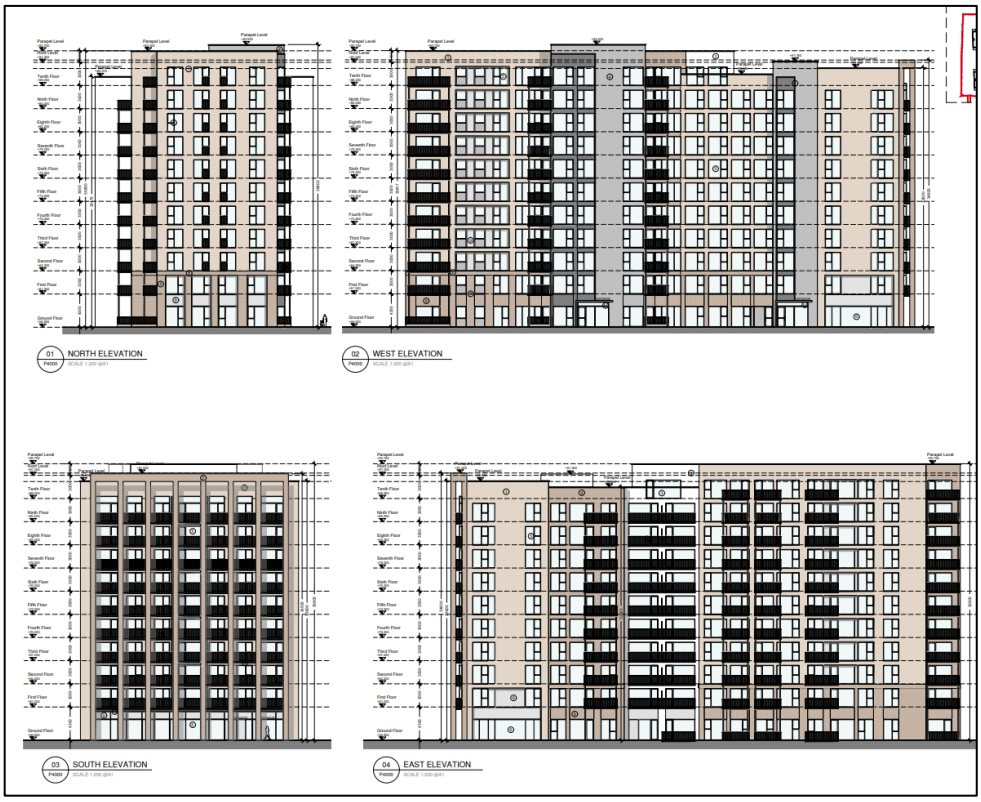

Figure 11.7 North, South, East and West Elevations, Block D

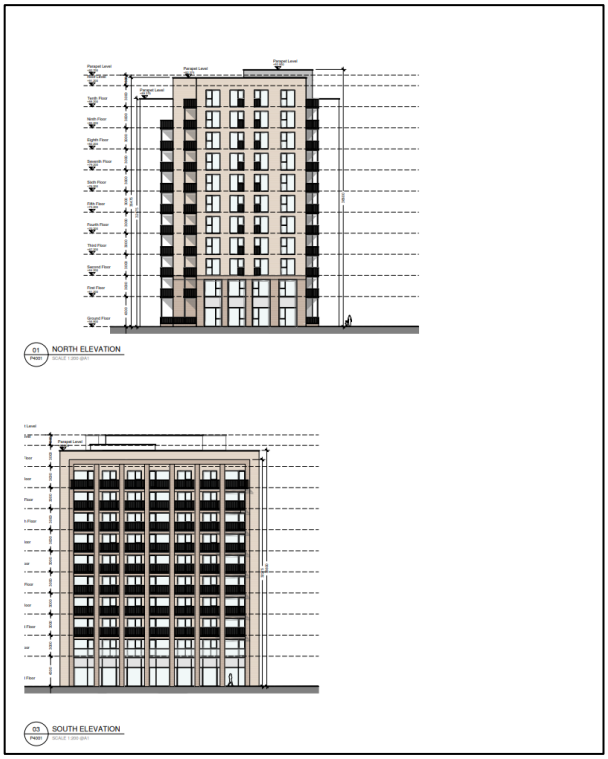

Figure 11.8 North and South Elevations, Block A and B

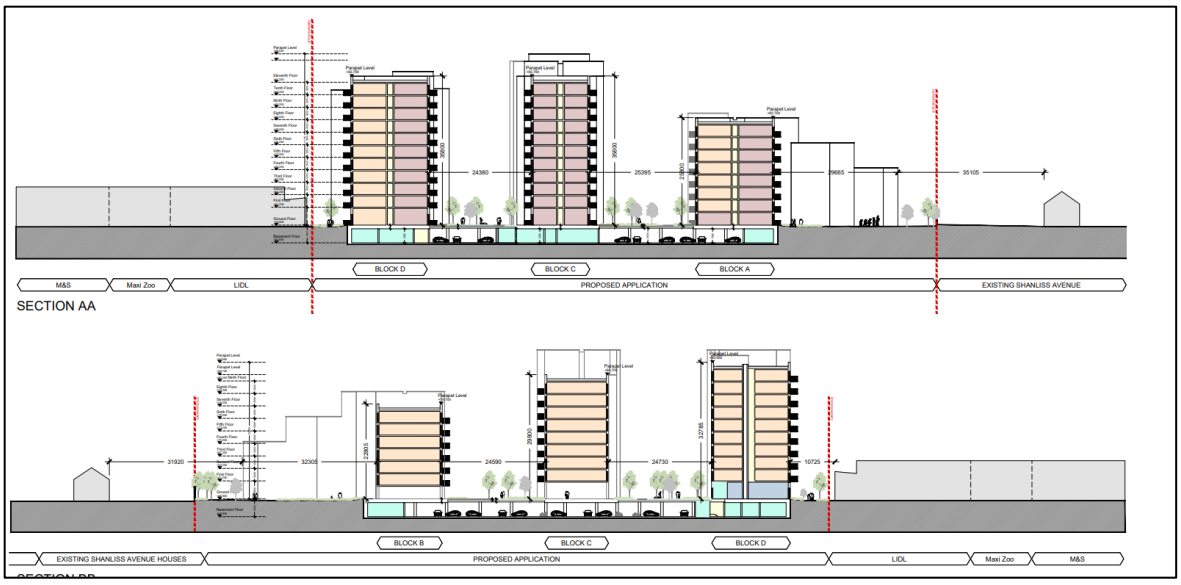

Figure 11.9 Section Through the Site

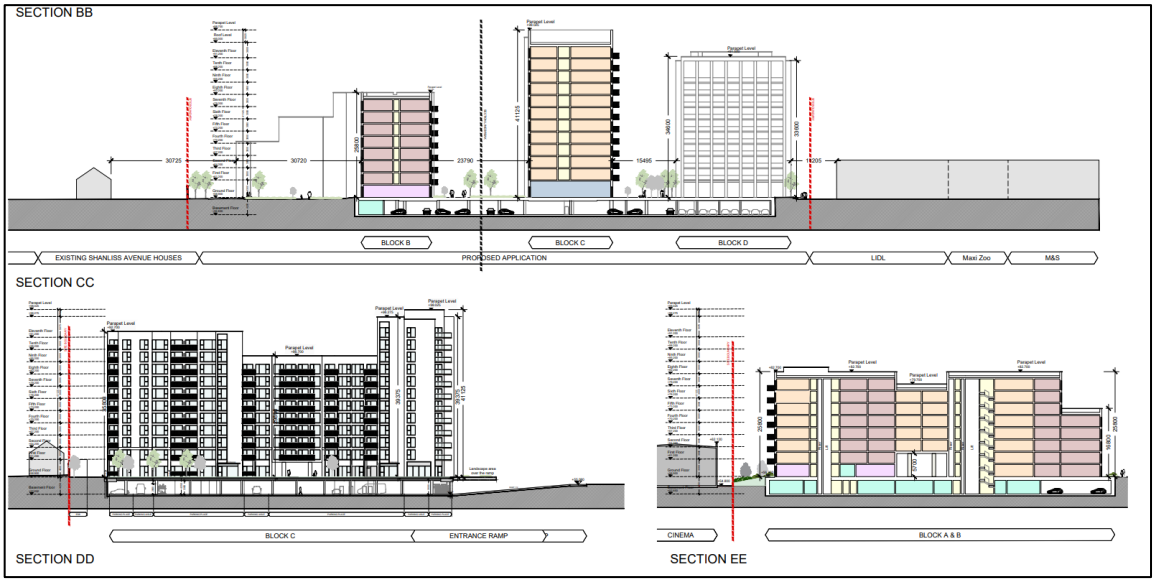

Figure 11.10. Section through the site

11.4 RECEIVING ENVIRONMENT

11.9 The Beaufort Scale for Wind on Land is a scale which is used to express the wind speed velocity recorded as a value which can be related to possible wind related impacts such as tree movement or building damage.

11.10 The nearest representative weather station collating detailed weather records is Dublin Airport, which is located approximately 3 km north of the site. Dublin Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 11.11 below). For data collated during five representative years (2016-2020), the predominant wind direction is west/south-west with an average daily wind speed of approximately 5.3 m/s.

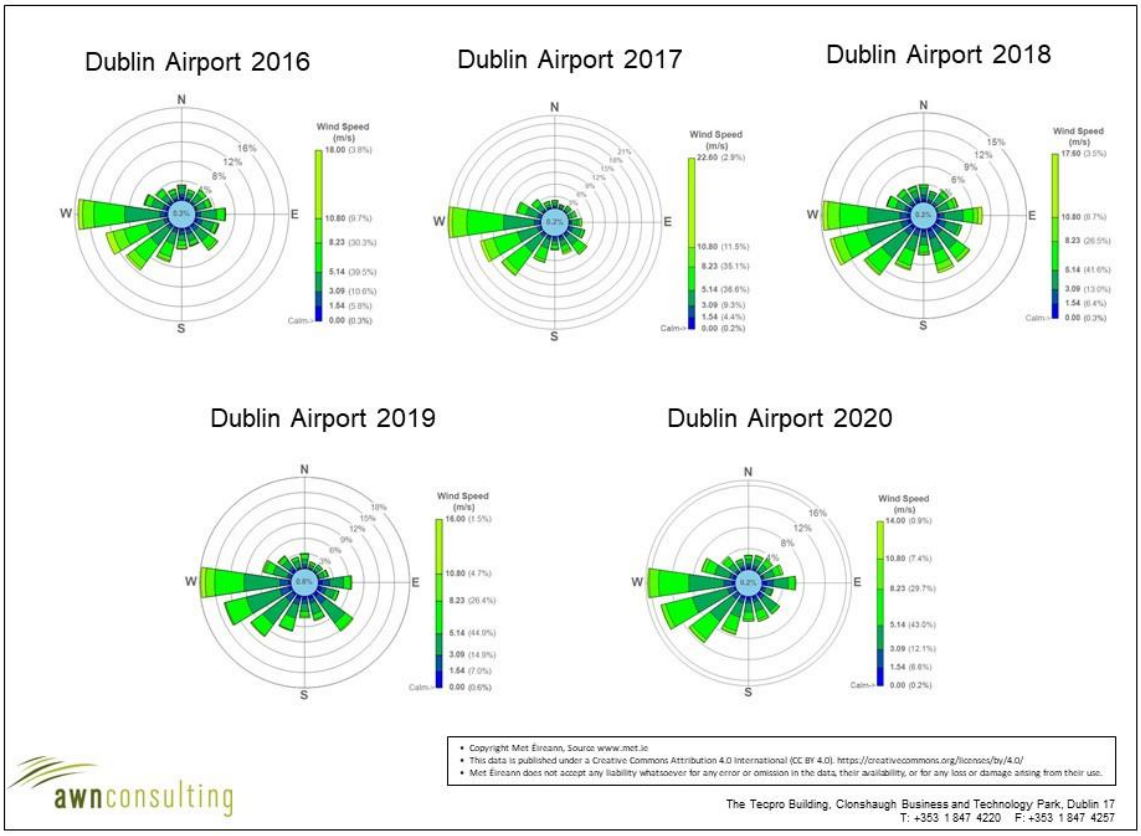

Figure 11.11 Dublin Airport Windspeeds

11.11 The Beaufort scale and its relationship to wind speed in metres/second is shown in Table 11.1 below. It can be seen that the site typically experiences Beaufort 3 (B3) wind conditions for much of the time.

Beaufort Scale	Wind speed(m/s)
0	<0.3
1	0.3 - 1.5
2	1.6 - 3.3
3	3.4 - 5.4
4	5.5 - 7.9
5	8.0 - 10.7
6	10.8 - 13.8
7	13.9 - 17.1
8	17.2 - 20.7
9	20.8 - 24.4
10	24.5 - 28.4
11	28.5 - 32.6

Table 11.1 Beaufort Scale

11.5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT

11.12 The proposed development comprises 4 main blocks; Block A, Block B, Block C and Block D, with heights ranging from 4 to 12 storeys.

11.13 Wind is normally described by its speed, either as a mean or gust speed. However, people sense the effect of the wind force, which is what we can feel, see and hear during windy conditions. Wind force is proportional to wind speed squared, therefore a relatively small increase in the wind speed can have a large effect on pedestrian comfort.

11.14 All buildings obstruct the free flow of the wind, causing it to be deflected and accelerated, resulting in very complex flow patterns. When the wind strikes the front face of a building, it will produce positive pressures that reach a maximum value at a point between about two thirds and three-quarters of the building height.

11.15 Below this height the wind will tend to be deflected down the front face towards the ground, often called 'downwash', and accelerated around the corners at ground level potentially producing areas of high wind speed and strong negative pressure. Above this height the wind will be deflected upwards and accelerated over the roof, again causing areas of high wind speed and increased turbulence. This can be a concern for roof gardens and roof terraces. A significant proportion of the wind will also spill around the side faces. Downwind, the flows around the building will recombine into a region of negative pressure known as the 'wake'.

11.16 Wind speed increases with height above ground; it follows, therefore, that the taller a building the higher the wind speeds acting on it. However, not all tall (where tall is greater than 10 storeys) buildings cause wind problems; what is important is the relative height of the building compared with that of neighbouring buildings.

11.17 A tall building in a group of tall buildings might not cause problems whereas a mid-rise building can cause unacceptable conditions if it is adjacent to an open area or has features or openings at ground level which can accelerate wind speed. When the wind strikes a building, it will generate positive pressures on the windward face and suction on the side, roof and leeward faces.

11.18 The wind will flow in the direction of decreasing pressure gradient, that is, from areas of high pressure to areas of lower pressure. As noted above, this causes wind flow down the front face, which brings high-speed wind from higher levels down to ground level. This can significantly increase ground-level wind speeds. The downwash on the windward face will tend to 'roll up' in front of a building, creating a windward vortex. The highest wind speed-up will occur near the centre of the face a short distance in front of the building, where the wind speed-up factor, S, can vary between about 1.2 and 2.0 depending on the building height. The flow then accelerates around the sides towards the low-pressure area in the wake. The S factor can reach 2.0 to 2.5 close to the corners of tall buildings, although values closer to 1.5 are likely for mid-rise buildings.

11.19 In general, tall, rectangular, sharp-edged buildings will generate the highest local ground-level wind speeds and the largest 'footprint' area of unpleasant wind speeds. The UK Buildings Research Establishment (BRE DG 520: Wind Microclimate Around Buildings) has noted that wind speeds in the vortex between a tall building and a lower building (this occurs in the space in front of a tall building behind the lower building)

can be up to 1.5 times the free wind speed (free wind speed being that measured in an open area with no buildings).

11.20 Wind speeds in the corner streams around either side of a tall building can be up to 2.5 times the free wind speed. A useful document on wind speeds and tall buildings notes that tall buildings are generally taken to mean buildings more than 10 storeys high, "Sustainable Design and Construction, The London Plan Supplementary Planning Guidance, 2006, Mayor of London's Office". Section 2.4.5 notes that a wind environment assessment should be carried out for every tall building (e.g. a building over 10 storeys)". Sustainable Design and Construction, Supplementary Planning Guidance, April 2014" published by the Mayor of London's office provides further guidance in this regard.

11.21 The proposed development comprises 4 main blocks from 4 to 12 storeys in height. The proposed development therefore includes tall buildings and it is considered appropriate to examine the wind effects with regard to microclimate as a precautionary measure.

11.22 It is acknowledged that the construction of new buildings can lead to changes to the local wind environment around the building. Generally elevated wind speeds around tall buildings are generated at three main points; either at ground level in the space behind a lower building and in front of a tall building, at an opening within the building envelope at ground level such as a tunnel or mall through the building, or at building corners. Elevated wind speed can also be generated where a street runs between two tall buildings, leading to a "canyon effect".

11.23 T.V. Lawson in Building Aerodynamics, Imperial College London, Imperial College Press, 2001, has noted that when wind approaches a built-up area it is displaced upwards to roof level and generally flows across the landscape at roof level, with gusts down to street level that are a function of the relative height to width of the street canyon.

11.24 It will be noted from the wind-rose presented as Figure 11.11 that as the predominant wind directions are from the west and from the south west, wind striking the proposed development will therefore already have travelled across the built-up landscape of the north western environs of Dublin City and therefore wind-flow across the landscape will be tend to be predominantly at 2-storey roof level.

11.25 Oke (T.R. Oke, Boundary Layer Climates, Routledge, 1987) has noted when the Height to Width Ratio is greater than 0.7, the Skimming Flow Regime tends to predominate, with little in the way of wind flow down to street level.

11.26 When the H to W ratio drops to 0.4 or less, the wind speed at ground level tends to increase and the street behaves more as if it were in open country, with much more of the wind now gusting down into the street.

11.27 Similarly, the BRE DG 520 document notes that H to W ratio of > 0.65 should be a target to minimise any wind related impacts.

11.28 The area immediately downwind of the proposed development is dominated by commercial residential buildings, predominantly 2-storeys in height.

11.29 The proposed building heights are from 26 to 41 metres above ground. The distance to the nearby residential and commercial units down-wind is some 30 metres. The

lower H to W ratio is therefore is circa (26/30) = 0.86 which is greater than 0.4 and 0.65.

11.30 The general pattern of wind-flow in the area upwind is likely to be above street-level (predominantly defined by the mainly 2-storey high structures up-wind). The proposed development will be some 4 to 12-storeys in height, so wind incident to this structure will tend to be deflected both upwards and downwards. Based on the H to W ratios derived above it can be expected that the skimming regime will dominate, with little in the way of wind flow down to street level and therefore the proposed development is not expected to lead to elevated windspeeds at street level.

11.31 The results and conclusions of the CFD modelling undertaken by B-Fluid are presented in the following table and as can be seen, there will be no impacts with respect to elevated wind-speeds are predicted.

Potential Receptors *(on-site)*	**Baseline Conditions**	**Proposed Development Conditions**
Roads	Conditions are “suitable” for the intended pedestrian use.	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).
Entrances	Not applicable	Conditions are “suitable” for the intended pedestrian use.
Pedestrian circulation areas	On the location designated for this use conditions are “suitable” for the intended pedestrian use.	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).
Balconies	Not applicable	Conditions are “suitable” for the intended use. (short/long-term sitting especially in relation to the balconies and considering the wind roses of the spring/summer seasons).
Ground Amenity areas	Not applicable	Conditions are “suitable” for the intended use. (short/long-term sitting considering the wind roses of the spring/summer season).
Potential Receptors *(off-site)*	**Baseline Conditions**	**Proposed Development Conditions**

Off-Site Area-North	Conditions are suitable for the pedestrian activity intended.	Conditions become calmer than required for the intended pedestrian use (by at least one comfort category).
Off-Site Area-South	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).	Conditions remain the same as in the baseline scenario.
Off-Site Area-East	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).	Conditions remain the same as in the baseline scenario.
Off-Site Area-West	Conditions are calmer than required for the intended pedestrian use (by at least one comfort category).	Conditions remain the same as in the baseline scenario.

11.32 The predicted impact will therefore be neutral, not significant and permanent.

11.5.1 Do Nothing Scenario

11.33 The do nothing impact would be no change to air flow in the area.

11.5.2 Construction Phase

11.34 No microclimate effects are predicted for the construction phase – a building under construction is mostly porous with many openings and the wind tends to blow through these openings rather than be deflected by the building, hence the wind tends to pass through a building under construction relatively unaffected by the structure.

11.5.3 Operational Phase

11.35 The predicted impact will be neutral, not significant and permanent.

11.5.4 Cumulative Impact

11.36 As the proposed development is predicted to have a neutral impact, no cumulative impacts are envisaged.

11.6 REMEDIAL AND MITIGATION MEASURES

11.6.1 Construction Phase

11.37 None are required.

11.6.2 Operational Phase

11.38 None are required.

11.7 RESIDUAL IMPACTS OF THE PROPOSED DEVELOPMENT

11.39 Neutral, not significant and permanent

11.7.1 Do Nothing Scenario

11.40 No change to the existing environment.

11.7.2 Construction Phase

11.41 No predicted effects

11.7.3 Operational Phase

11.42 Neutral, not significant and permanent

11.7.4 Cumulative Impact

11.43 Neutral, not significant and permanent

11.8 MONITORING OR REINSTATEMENT

11.8.1 Construction Phase

11.44 None are required.

11.8.2 Operational Phase

11.45 None are required.