Chapter 11

Microclimate and Wind

11.0 MICROCLIMATE AND WIND

11.1 INTRODUCTION

This chapter assesses the microclimate effects associated with the proposed development, for which a seven year permission is sought, which comprises a Strategic Housing Development of 645 no. residential units (comprising 208 no. 1 bedroom units, 410 no. 2 bedroom units, and 27 no. 3 bedroom units), in 10 no. apartment buildings, with heights ranging from 4 no. storeys to 10 no. storeys, including undercroft / basement levels (for 6 no. of the buildings). The proposals include 1 no. community facility in Block 1, 1 no. childcare facility in Block 3, and 5 no. commercial units (for Class 1-Shop, or Class 2- Office / Professional Services or Class 11- Gym or Restaurant / Café use, including ancillary takeaway use) in Blocks 4 and 8.

AWN were commissioned to prepare a review of the Potential Risks of Elevated Wind speed (microclimate) associated with this proposed 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. He has undertaken numerous microclimate assessments for planning applications over the last 15 years including many commercial and residential developments across Dublin and other locations.

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 proposed development.

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.
- Assessment for the potential for elevated wind speeds to occur.

11.2 STUDY METHODOLOGY

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

- Sustainable Design and Construction, The London Plan Supplementary Planning Guidance, 2006, Mayor of London's Office,
- 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)

The study has focused on the dimensions and building heights, and assessed the likelihood of elevated windspeeds being generated by reference to methodologies established by Lawson and BRE which allow calculation of likely increases in wind-speed post-development.

11.3 THE EXISTING RECEIVING ENVIRONMENT (BASELINE SITUATION)

The Beaufort Scale for Wind on Land is which 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.

The nearest representative weather station collating detailed weather records is Dublin Airport, which is located approximately 2.5km south 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 11.1 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.

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.

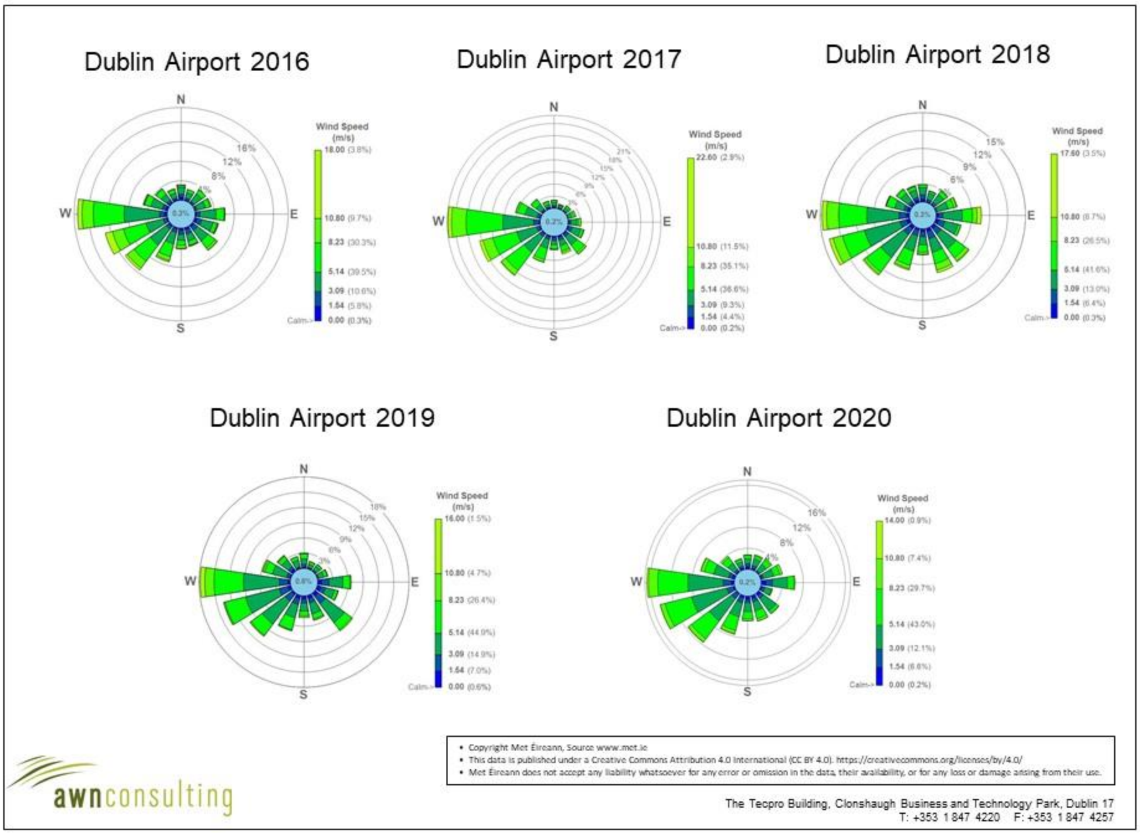

Figure 11.1: Dublin Airport Windspeeds

Table 11.1 Beaufort Scale and Wind speed

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
12	>32.7

The site the proposed residential development can be characterised as a site which experiences average wind speeds of B3, which corresponds to gentle breeze on the Beaufort Scale.

11.4 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The development, for which a seven year permission is sought, will consist of the following:

The proposed development comprises a Strategic Housing Development of 645 no. residential units (comprising 208 no. 1 bedroom units, 410 no. 2 bedroom units, and 27 no. 3 bedroom units), in 10 no. apartment buildings, with heights ranging from 4 no. storeys to 10 no. storeys, including undercroft / basement levels (for 6 no. of the buildings). The proposals include 1 no. community facility in Block 1, 1 no. childcare facility in Block 3, and 5 no. commercial units (for Class 1-Shop, or Class 2- Office / Professional Services or Class 11- Gym or Restaurant / Café use, including ancillary takeaway use) in Blocks 4 and 8.

- Block 1 comprises 29 no. residential units, within a four storey building (with a pitched roof), including 8 no. 1 bedroom units and 21 no. 2 bedroom units. A community facility (191.8 sq.m) is provided at ground floor level.
- Block 2 comprises 23 no. residential units, within a four storey building (with a pitched roof), including 8 no. 1 bedroom units and 15 no. 2 bedroom units.
- Block 3 comprises 24 no. residential units, within a four storey building (with a pitched roof), including 6 no. 1 bedroom units and 18 no. 2 bedroom units. A childcare facility (609.7 sq.m) is provided at ground floor level.
- Block 4 comprises 93 no. residential units, within a part seven, part eight, and part nine storey building, with an undercroft level, including 34 no. 1 bedroom units, 54 no. 2 bedroom units, and 5 no. 3 bedroom units. 3 no. commercial units (632.2 sq.m) are provided at ground floor level.
- Block 5 comprises 91 no. residential units, within a part six, part seven, and part eight storey building, with an undercroft level, including 34 no. 1 bedroom units, 55 no. 2 bedroom units, and 2 no. 3 bedroom units.
- Block 6 comprises 54 units, within a part eight, part nine storey building, with an undercroft level, including 13 no. 1 bedroom units, 38 no. 2 bedroom units, and 3 no. 3 bedroom units.
- Block 7 comprises 117 no. residential units, within a part seven, part eight, and part nine storey building height, over a basement level, including 40 no. 1 bedroom units, 76 no. 2 bedroom units, and 1 no. 3 bedroom unit.
- Block 8 comprises 94 no. residential units, within a part six, part seven, part eight, and part nine storey building, over a basement level, including 33 no. 1 bedroom units, 58 no. 2 bedroom units, and 3 no. 3 bedroom units. A commercial unit (698.2 sq.m) is provided at ground floor level.
- Block 9 comprises 74 no. residential units, within a part seven, part eight, part nine, and part ten storey building, over a basement level, including 23 no. 1 bedroom units, 48 no. 2 bedroom units, and 4 no. 3 bedroom units.
- Block 10 comprises 45 no. residential units, within a part nine, part ten storey building, including 9 no. 1 bedroom units, 27 no. 2 bedroom units, and 9 no. 3 bedroom units.

The development includes a total of 363 no. car parking spaces (63 at surface level and 300 at undercroft / basement level). 1,519 no. bicycle parking spaces are provided at surface level, undercroft / basement level, and at ground floor level within the blocks. Bin stores and plant rooms are located at ground floor level of the blocks and at undercroft / basement level. The proposal includes private amenity space in the form of balconies / terraces for all apartments. The proposal includes hard and soft landscaping, lighting, boundary treatments, the provision of public and communal open space including 2 no. playing pitches, children's play areas, and an ancillary play area for the childcare facility.

The proposed development includes road upgrades, alterations and improvements to the Dublin Road / R132, including construction of a new temporary vehicular access, with provision of a new left in, left out junction to the Dublin Road / R132, and construction of a new signalised pedestrian crossing point, and associated works to facilitate same. The temporary vehicular access will be closed when vehicular access to the lands is made available from the lands to the north. The proposal includes internal roads, cycle paths, footpaths, vehicular access to the undercroft / basement car park, with proposed infrastructure provided up to the application site boundary to facilitate potential future connections to adjoining lands.

The development includes foul and surface water drainage, green roofs and PV panels at roof level, 5 no. ESB substations and control rooms (1 no. at basement level and 4 no. at ground floor level within blocks 2, 4, 7, and 8), services and all associated and ancillary site works and development.

11.5 POTENTIAL IMPACT OF THE PROPOSED DEVELOPMENT

Construction phase

A building under construction is largely porous to the wind due to window openings and is surrounded by scaffolding which is also porous, therefore wind tends to flow through a building under construction and therefore there are no construction microclimate impacts of significance associated with the construction phase.

Operational Phase

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.

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.

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’.

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.

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. When the wind strikes a building, it will generate positive pressures on the windward face and suctions on the side, roof and leeward faces.

The wind will flow in the direction of decreasing pressure gradient, that is, from areas of high pressure to areas of lower pressure. 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.

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.

Circular or multi-faceted buildings provide a more aerodynamic profile to the wind and so tend to cause less downwash because more air is spilled around the sides.

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).

Wind speeds in the corner streams around either side of a tall building can be up to 2.5 times the free wind speed. Emplacement of barriers and landscaping ensure these impacts are minimised.

A relevant guidance 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.

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 two main points, either at ground level in the space behind a lower building and in front of a tall 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”.

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 landscape at roof level, with gusts down to street level that are a function of the relative height to width of the street canyon.

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.

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.

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.

None of the buildings meet the criteria therefore of “tall building” as defined earlier in this Chapter, i.e. they are 10 storeys or lower. The two 10 storey buildings are on the down-wind side of the development. From a microclimate point of view the development is considered relatively low-rise, as shown in Table 11.2 below which summarises the different buildings proposed.

Block	Storeys	Height above Ground (m)	Tall Building?
1	4	18	No
2	4	18	No
3	4	18	No
4	9	30	No
5	8	29	No
6	9	30	No
7	9	33	No
8	9	33	No
9	10	35	No
10	10	37	No

Table 11.2 Building Heights and Comparison with "Tall Building Criteria"

The proposed maximum building height is up to 10-storeys which is c. 37 metres above the lowest ground level,

With respect to the likely impact of the proposed development on pedestrian comfort and the area outside the site, it was noted that the area to the east and north-east (down-wind) of the proposed development is denoted by the R132 road which has associated footpaths and further east by open fields.

It is approximately 50 metres from the nearest building to the footpath on the opposite side of the R132. With a building height of circa 35 metres this is a H to W ratio of 0.7m so it can there be expected that the skimming regime will dominate, with little in the way of wind flow down to street level at the R132 and therefore the proposed development is not expected to lead to elevated windspeeds at street level.

The internal wind environment within the development has also been examined and is described in the following sections. It is useful for this assessment to refer to the proposed development layout in Figure 11.2 below.

Figure 11.2: Layout of Proposed Development (Landscape Masterplan Extract)

It can be seen that the western boundary of the site is defined by the façade of Block 5, a 7 to 8 storey building. The predominant wind direction is westerly/south westerly so wind will generally strike the façade of this building and be deflected upwards to travel across the roof-top with shelter being provided for the open spaces on the eastern side of Block 5. The gap between block 5 and block 4 will tend to have slightly elevated windspeeds but given it is an area predominantly used for walking through this is not expected to be an issue. The open areas between Block 5 and Block 4 and 6 will tend to be sheltered from the prevailing winds. The height of Block 5 is some 29 metres above ground and the distance between Block 5 and Block 6 is approximately 20m, giving a H:W ratio of 1.45, well above 0.65, so it can be expected that the skimming regime will predominate and wind will pass over the open spaces between Blocks 5, 6 and 4 and this area will be suitable for use as amenity open space including sitting.

Similarly, the distance between Block 6 and Block 7 is circa 15m, so with Block 6 having a height of some 30 metres the H:W ratio is 2 and therefore the wind flow will tend to be predominantly at roof height and the open space between the building will be a comfortable space for sitting and leisure use.

Block 7 has a height of up to 33m and there is an open amenity space downwind of it, between Blocks 7 and 9, this space is circa 25 metres wide, giving a H:W ratio of 1.32, so again the skimming regime at roof level will be expected to dominate and this open space will provide a comfortable space for sitting and leisure use.

There is an open space approximately 30m across, between Block 4 and Block 8. Block 4 is between 6 and 9 storeys so even taking the lower (6 storey element) this is some 25m above ground, which is a H:W ratio of 0.83, well above 0.65 and therefore for this open space also the skimming regime will predominate and the open space can be expected to provide a comfortable space for sitting and for leisure use.

As one rises vertically from the ground windspeed tends to increase as one moves further away from the friction the earth's surface exerts on wind-flow.

The wind-rose data points from Dublin Airport are measured wind-speeds at 10m above the ground at Dublin Airport. The proposed building heights are up to 37m above ground with balconies on the western facades which could be up to 30 metres above the ground.

The Danish Wind Industry Association Online windspeed calculator [1]indicates that for a Roughness Class 3 landscape (a landscape defined by low rise buildings as opposed to a city scape defined by tall buildings) a windspeed range of 3-5 m/sec at 10m above ground will be a windspeed of circa. 5 to 7m/second at circa. 30m above ground – the approximate height above ground of the top balcony. This corresponds to Beaufort B4 (Moderate Wind Speed, will raise dust and papers and move small branches on trees) – it is therefore considered that this is a relatively minor increase in wind-speed likely to be experienced and it is considered to be acceptable with regard to the proposed balcony use.

Having regard to the assessment of the baseline and the detailed assessment of the nature of the proposed development a full Computational Fluid Dynamics (CFD) Model was not executed for the development and is not required to meet the requirements of the Guidelines consulted.

11.6 POTENTIAL CUMULATIVE IMPACTS

AWN have reviewed the other developments proposed for the area, and described in Chapter 2 of this EIAR. Following our review we have determined that none of the developments, including the permitted development to the north and the existing residential developments to the south and east (which are low rise) will give rise to significant cumulative effects.

11.7 'DO NOTHING' IMPACT

The Do-Nothing scenario involved the site not being developed and therefore, the microclimate at the site would remain as it currently is.

11.8 AVOIDANCE, REMEDIAL & MITIGATION MEASURES

Design related mitigation measures have been incorporated into the scheme design, primarily as part of the landscaping proposals and also through the architectural design, such as the insetting of balconies in appropriate

[1] http://xn--drmstrre-64ad.dk/wp-content/wind/miller/windpower%20web/en/

locations, and are reflected in the application drawings / proposals submitted for approval. No additional construction or operational related mitigation measures are recommended.

Construction Phase

No mitigation measures required.

Operational Phase

No mitigation measures required.

11.9 PREDICTED IMPACTS OF THE PROPOSED DEVELOPMENT

11.9.1 Construction Phase

As noted above, there are no significant microclimate impacts predicted, with no mitigation measures required. The residual impact will be not significant.

11.9.2 Operational Phase

The impact of the proposed development on microclimate will be imperceptible having regard to the assessment carried out above and the details included in the landscape and architectural design. It is noted that the planting in the courtyard and open space areas will enhance shelter from the wind. The building orientation noted above means that the open spaces between buildings will be sheltered from wind effects. The assessment concludes that there are no significant adverse impacts predicted.

11.10 MONITORING

No monitoring will be required.

11.11 REINSTATEMENT

No re-instatement is required.

11.12 INTERACTIONS

The interactions in respect to Microclimate and Wind occurred during the design development of the scheme, with PCOT and Arrow Architects and Mitchell + Associates Landscape Architects.

11.13 DIFFICULTIES ENCOUNTERED IN COMPILING

No difficulties were encountered.

11.14 REFERENCES

T.V. Lawson in Building Aerodynamics, Imperial College London, Imperial College Press, 2001

Oke (T.R. Oke, Boundary Layer Climates, Routledge, 1987)