# FINAL REPORT



# ST LAURENCE'S PARK

DUBLIN, IRELAND

PEDESTRIAN LEVEL WIND DESK-BASED ASSESSMENT RWDI #1803749E AUGUST 5<sup>TH</sup>, 2020

## SUBMITTED TO

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### August 5<sup>th</sup>, 2020

# **VERSION HISTORY**

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Engineer	Releases	Dated	Reviewed By				
J. Lowther	Rev A	11/13/2018	D. Hackett				
J. Lowther	Rev B	01/25/2019	K. Jayyaratnam				
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# 1 EXECUTIVE SUMMARY

This is a qualitative assessment of the likely wind conditions around the proposed St Laurence's Park development in Dublin, Ireland. The report outlines the overall methodology and the use of the RWDI Criteria to describe the expected on-Site wind conditions. The assessment is based upon analysis of meteorological conditions for Dublin, adjusted to the Site, and a review of the scheme drawings in the context of the meteorological data.

The Site description is used mainly to identify building massing and features that are pertinent to the wind microclimate on Site. The expected main flow interactions around the Site are then described and categorised in terms of the RWDI Criteria for pedestrian comfort and safety.

The meteorological data for the Site indicates prevailing winds predominantly from the south-west throughout the year. Winds from other directions do occur, and are considered within the assessment; however, their impact on the overall wind microclimate conditions tend to be low, due to being relatively infrequent (compared to the prevailing directions).

Wind conditions around the Proposed Development are expected to be suitable for their intended use with several design features expected to be particularly beneficial to the wind microclimate:

- Sheltering/recessing of entrances with planters and/or canopies
  - This creates localised sheltered areas at entrances where calm wind conditions suitable for standing use are required
- Proposed soft landscaping
  - The trees to the north of the garden and to the north of Block B will help to alleviate channelling winds between the two buildings.
- Winter gardens at corner locations
  - Windy conditions are typically expected at corner balconies where winds can easily accelerate through the space. Making this an internal space avoids potentially uncomfortable amenity spaces.

We anticipate that there will be no occurrences of strong winds exceeding the safety threshold throughout the Site.

The cumulative schemes are expected to provide shelter to several areas of the Site, particularly to the southeast corner of Block B.

Overall, wind conditions are suitable for the intended use at ground and balcony levels of the Proposed Development.



# 2 INTRODUCTION

RWDI was retained by ABK Architects to conduct a desk-based assessment of the proposed St Laurence's Park development (hereafter referred to as the 'Proposed Development'), in Dublin, Ireland. This report presents the background, objectives, results and recommendations from RWDI's assessment. A summary of the overall recommendations from the study are presented in Section 8, "Concluding Remarks".

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# **3 SITE DESCRIPTION**

# 3.1 Site and Surroundings

The Site is currently occupied by vacant residential buildings and Stillorgan Library, and is bounded by Stillorgan Road to the east, Lower Kilmacud Road to the south, St Laurence's Park to the north and a low-rise existing building to the west.

The scheme is mostly surrounded by low-rise residential and commercial buildings. There are large trees (over 10m tall) to the east of the Site which are to be retained.

It is also noted that there are two cumulative developments within close proximity to the Proposed Development, the Blakes development to the south and the Leisure Plex development to the west. Both of these developments are significantly taller than the existing surrounding area and are expected to have a significant impact on the wind conditions at the Site. Therefore, an assessment of the cumulative (future) scenario has also been discussed in this report.

Figure 1 below shows an aerial view of the existing Site and surrounding buildings.



Figure 1: Aerial photograph of the existing Site (approximate extent of the Site highlighted in yellow)

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## 3.2 The Proposed Development

The Proposed Development is a residential-led scheme which comprises two blocks of up to 9 floors in height, with a library in the southern lower section of Block C. There is residential and library parking to the east of the Proposed Development. The library entrance is located to the south of the library parking (south east of the Proposed Development) and residential access to Block C is located to the west of Block B, and within the internal residential carpark to the east. Block A entrances are located to the north west and north east of the Block.

A communal garden is situated in the middle of the Site bounded by Block B to the east and south, and the library to the south. A cycle store to the west and Block B to the north (with access to St Laurence's Park between Blocks A and B to the north-east of the Site).

Balconies and winter gardens are also located at Blocks A, B and C from the 1<sup>st</sup> to 8<sup>th</sup> floors, where all of the balconies are recessed with a combination of solid masonry and metal balustrade. On the eastern side of Blocks B and C, there are also terraces which have a combination of solid masonry and metal balustrades.



Figure 2: View from south of the Proposed Development with Existing Surrounding Buildings (without proposed landscaping)

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# 4 METHODOLOGY AND ASSESSMENT CRITERIA

Knowledge of the prevailing wind direction focuses attention on the likely impact of these winds on the Site except where the proposed building massing/layout indicates that winds from other directions are likely to be important.

# 4.1 General Meteorological Data

Meteorological data derived from the meteorological station at Dublin Airport in combination with roughness values to take into account the surrounding terrain have been corrected to 2m and 10m above ground.

Wind statistics recorded at Dublin Airport between 1973 and 2013 were analysed for two seasons. The assessment presented in this report focusses on winter, the windiest season, representing a 'worst-case' season for windy conditions between November and April and a summer season (representing a time of the year when amenity spaces are expected to be usable between May and October). Figure 3 graphically depicts the distribution of wind frequency and directionality for the two seasons.

The meteorological data indicate that the prevailing wind direction throughout the year is from the westsouthwest with a secondary peak for south easterly winds. Based upon the background wind climate, Dublin is a relatively windy city (by comparison with London, for example) prior to any further wind-building interactions that might occur.



Figure 3: Directional Distribution (%) of Winds (Blowing From) Dublin Airport 1973-2013 (Radial axis indicates the percentage time for which the stated velocity range is exceeded)



## 4.2 Terrain Roughness

Another consideration is the terrain roughness in each wind direction because wide, open spaces permit the wind to flow smoothly at ground level generating conditions similar to those of open countryside even within a built-up area. An assessment of the terrain roughness for the Site was conducted using the BREVe3.2 software package.

Table 1 presents the 'mean factors' for the Site where the mean factor represents the ratio of wind speed on site, at the stated reference height, as a fraction of the wind speed in open, flat countryside at a height of 2m and 10m. The table shows that the terrain is fairly consistent across all directions in relation to its effect on wind speed.

Wind Direction (N°)	0	30	60	90	120	150	180	210	240	270	300	330
Mean Factor at 2m	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Mean Factor at 10m	0.58	0.58	0.57	0.58	0.57	0.57	0.57	0.58	0.57	0.57	0.57	0.58

## 4.2.1 Table 1: BREVe3 mean factors at 2m and 10m above ground level

## 4.3 Comfort Criteria

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the RWDI Criteria, which have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities as well as by the building design and city planning community throughout the world.

The comfort criteria aim to define the reaction of an average pedestrian to the wind, these were then used to set threshold values for particular pedestrian activities. The criteria account for the fact that the wind conditions perceived as tolerable by pedestrians depend on the activity they are engaged in. The criteria define five pedestrian activities arranged in ascending order of transient activity: sitting, standing, strolling, walking and uncomfortable. In other words, the wind conditions in an area for sitting need to be more benign than a location that people merely walk past. The distinction between walking and uncomfortable conditions is that in the walking scenario, where pedestrians are on site because their livelihood depends upon it, they will be more tolerant of stronger winds, whereas uncomfortable conditions would be considered windier than desired for the majority of pursuits.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

Both mean and gust speeds can affect pedestrian's comfort, however for safety criteria only gust winds need to be considered in the wind safety criterion. These are usually rare events but deserve special attention in city planning and building design due to their potential safety impact on pedestrians.

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It is worth noting, these criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

	Table	2:	RWDI	Crite	ria
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Comfort Category	Threshold	Description
Sitting	≤ 10	Calm or light breezes desired for outdoor restaurants and seating areas where one can read a paper without having it blown away
Standing	≤ 14	Gentle breezes acceptable for main building entrances and bus stops
Strolling	≤ 17	Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park
Walking	≤ 20	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
Uncomfortable	> 20	Strong winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

Generally, the target conditions are:

- Strolling use during the windiest season on pedestrian thoroughfares (with walking conditions potentially being tolerated in areas where pedestrians would not linger);
- Standing conditions at entrances, drop off areas or taxi ranks, and bus stops throughout the year; and
- Sitting use conditions at outdoor seating and amenity areas during the summer season when these areas are more likely to be frequently used by pedestrians. It is noted that in large mixed-use amenity spaces a mixture of sitting use and standing / entrance use can be considered acceptable as users can choose to sit in 'calmer' areas, with 'windier' areas acceptable for more active pursuits.

The wind conditions in an area for sitting need to be calmer than a location that people merely walk past and this is reflected in the Comfort Criteria. The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. The criteria address the force of the wind on a person, or activity, they do not take account of thermal factors.

## 4.4 Strong Winds

Previous experience has shown that the walking or uncomfortable classifications are associated with relatively strong winds during the windiest season. Wind conditions in excess of 90km/h would be expected to require mitigation in an urban environment.

In a mixed-use urban development scheme, walking and uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. This mitigation would also reduce the frequency of, or even eliminate, any strong winds.

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# 5 EXISTING SITE WITH EXISTING SURROUNDING BUILDINGS

Often a new development will alter the pedestrian activity (i.e. intended use) on site. Occasionally, although wind conditions may not change after the Proposed Development is completed (e.g. stay suitable for strolling), mitigation would still be required if, on the new development, the location of interest is intended for a critical activity (e.g. a main entrance) for which the wind condition would be unsuitable. Assessment in terms of the desired pedestrian activity on, or around, a site takes into consideration any change of use and this is where the comfort criteria are particularly helpful.

## 5.1 Pedestrian Comfort

Based on the terrain roughness analysis presented in section 4.2, the baseline conditions at 2m above ground level at an idealised "empty" Site would be acceptable for standing use in the windiest season and sitting use in summer.

The Site is currently occupied by vacant residential buildings and a one storey library. These low-rise buildings are not expected to generate any unacceptable wind conditions. The wind conditions at the existing Site are expected to be classified as standing category at ground level, and therefore anticipated to be suitable for standing and thoroughfare use.

# 5.2 Strong Winds

Strong winds in excess of 15m/s are not expected to occur at the existing Site for more than 2 hours per year.

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# 6 THE PROPOSED DEVELOPMENT WITH EXISTING SURROUNDING BUILDINGS

The assessment made below includes the addition of design features which were informed by a desk-based wind assessment to be beneficial to the wind microclimate at the Site. These beneficial features include:

- Sheltering/recessing of entrances with planters and/or canopies
  - This creates localised sheltered areas at entrances where calm wind conditions suitable for standing use are required
- Proposed soft landscaping (Figure 4)
  - The trees to the north of the garden and to the north of Block B will help to alleviate channelling winds between the two buildings.
- Winter gardens at corner locations
  - Windy conditions are typically expected at corner balconies where winds can easily accelerate through the space. Making this an internal space avoids potentially uncomfortable amenity spaces.



Figure 4: Ground Level Landscaping Received January 24th, 2019

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# 6.1 Typical Wind - Building Interactions

The wind conditions at the Proposed Development are expected to be due to either one, or a combination of, two generalised flow behaviours.

**Down-washing** (Figure 5a) of the wind occurs when a building is taller than its surrounding buildings. The taller scheme forces high level winds to ground level where they create locally high wind speeds in the pedestrian realm.

**Channelling** (Figure 5b) of the wind occurs between buildings of similar height when in close proximity to each other. Windy conditions occur at pedestrian level since the flow accelerates as it is "squeezed" between the buildings.

**Corner acceleration** (Figure 5c) around building corners may occur due to the difference in pressure on the upwind and downwind façades (low pressure zones on the leeward side and zones of higher pressure on the windward side of the building). This effect is particularly pronounced around sharp corners which create localised windy areas in the vicinity of the corner where the flow is accelerated around the building.







Figure 5a: Down-washing

Figure 5b: Channelling

Figure 5c: Corner acceleration

# 6.2 Pedestrian Comfort

The terrain roughness analysis presented in Section 4.2 provides a baseline, with conditions at 2m above ground level at an empty site acceptable for standing use during the windiest season. Wind is expected to accelerate when interacting with building corners or when channelled between buildings of a similar height. Down-washing winds may also occur when prevailing winds are met with a building façade which is significantly taller than the surrounding area. Calmer conditions are expected downwind of buildings, where the massing of the building provides shelter from the prevailing winds.

## Thoroughfares (Figure 6)

Thoroughfare wind conditions are expected to range from suitable for sitting use to walking use during the windiest season. Walking use wind conditions are acceptable at thoroughfare locations where pedestrians are expected to pass in a hurry. However, walking use wind conditions are one category windier than required for general thoroughfare use, where pedestrians are expected to linger/stroll, and mitigation measures would be required to achieve a suitable wind microclimate.

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The area between Blocks A and B is expected to experience downwashing and channelling wind. The downwashing and channelling winds will be partly alleviated by the canopies on the western façade and the trees within the garden area and to the north of Block B; however, wind conditions suitable for walking use are still expected to prevail within this area. It is not expected that pedestrians will linger within the small area which may be suitable for walking use and therefore wind conditions are considered to be tolerable at the thoroughfare between Blocks A and B. Wind conditions could be enhanced in this area, by replacing deciduous trees with an evergreen variety, or the introduction of further shrubs or trellises of at least 1.2m height scattered in the area between Blocks A and B.

### Entrances (Figure 6)

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Many entrances are suitable for standing use or calmer during the windiest season, where several entrances are expected to have calm wind conditions as they are recessed and/or have canopies above (creating localised sheltered areas).

The only exception to this is at the north-western entrance of Block A, where strolling wind conditions are expected. This entrance is a services entrance for a substation and therefore one category windier (strolling) conditions are tolerable at this location. As such, no mitigation measures are required at this location.

#### **Ground Level Amenity (Figure 7)**

The garden area to the west of Block B and C is expected to generally be suitable for sitting to standing use during the summer season. A mixture of sitting use and standing use wind conditions is considered suitable for larger amenity areas, where those using the space can choose to sit in the calmer areas.

#### **Balconies (Figures 8)**

The balcony locations are expected to have wind conditions suitable for sitting use during the summer season. The balconies benefit from being recessed which creates localised sheltered areas where it is too difficult for the wind to travel through.

Where the potential for windier conditions occur, such as at corner balconies, (where wind can easily travel through and accelerate around the corner), winter gardens have been used.

## 6.3 Safety

The small area between Blocks A and B which is expected to have walking use wind conditions, and therefore strong winds may occur at this location. However, it is not expected that these strong winds will exceed the safety threshold. Therefore, no further mitigation is required at the Site.

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# 7 THE PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDING BUILDINGS

The only additional schemes considered based on the received information is the inclusion of the proposed Leisureplex Development to the west and approved Blake's scheme to the south of the Site.

The close proximity of the cumulative developments, and their upwind location in relation to the prevailing wind direction, means it is likely that the future developments will have an effect on the wind conditions on-Site. It is expected that the cumulative developments will provide shelter to several areas of the Site from the prevailing south-westerly winds, and therefore may improve wind conditions at several areas.

# 7.1 Pedestrian Comfort

Wind conditions for the cumulative scenario have been shown in Figure 11 for the windiest season (at ground level), and Figures 12 to 15 for the summer season.

### **Thoroughfares (Figure 9)**

Thoroughfare wind conditions are expected to range from suitable for sitting use to walking use during the windiest season. As discussed in Section 6.1, walking use wind conditions are acceptable when pedestrians are expected to pass through the area quickly.

As in the context of existing surrounding buildings, the area between Blocks A and B are still expected to experience downwashing and channelling winds, as the cumulative buildings will not provide shelter from the prevailing south westerly winds in this area. Wind conditions suitable for walking use may still occur in a small area between Blocks A and B, however as the area is small and pedestrians are not expected to linger, these wind conditions are considered to be tolerable. As discussed in Section 6.1, the microclimate in the area could be enhanced with the introduction of evergreen trees (rather than deciduous), or other soft/hard landscaping measures of at least 1.2m height.

### Entrances (Figure 9)

All residential entrances are expected to have wind conditions suitable for standing use or calmer. Therefore, no mitigation is required at entrance locations.

### **Ground Level Amenity (Figure 10)**

As for the scenario in the context of existing surrounding buildings, the garden area to the west of Block B is expected to generally be suitable for sitting to standing use during the summer season, which is suitable for the intended use.

### **Balconies (Figures 11)**

As for the Proposed Development in the context of existing surrounding buildings, all open balconies are suitable for sitting use. The location of winter gardens is also beneficial in this configuration as they are located where the windiest conditions are expected to occur.



# 7.2 Safety

Strong winds exceeding the safety threshold are not expected to occur at the Site, therefore further mitigation measures are not required.



# 8 CONCLUDING REMARKS

#### In conclusion:

- 1. The meteorological data for the Site indicates prevailing winds from the south-west throughout the year, with secondary winds from the north-east.
- 2. For the existing site, the wind microclimate at ground level is expected to be acceptable for the current use throughout the year.
- 3. Wind conditions in and around the Proposed Development are expected to be suitable for the intended use. Several design features are expected to be particularly beneficial at alleviating potentially uncomfortable wind conditions:
  - a. Sheltering/recessing of entrances with planters and/or canopies
    - i. Creating localised sheltered areas at entrances.
  - b. Proposed soft landscaping
    - i. The trees to the north of the garden and to the north of Block B will help to alleviate channelling winds between the two buildings.
  - c. Winter gardens at corner locations
    - i. Windy conditions are typically expected at corner balconies where winds can easily accelerate through the space. Making this an internal space avoids potentially uncomfortable wind conditions.
- 4. Strong winds exceeding to the safety threshold are not expected to exceed the safety threshold.
- 5. The cumulative schemes are expected provide shelter to several areas of the Site.
- 6. Overall, wind conditions in and around the Proposed Development are expected to be suitable for the intended use and no further mitigation measures are required.



# **FIGURES**















St Laurence's Park - Dublin, Ireland