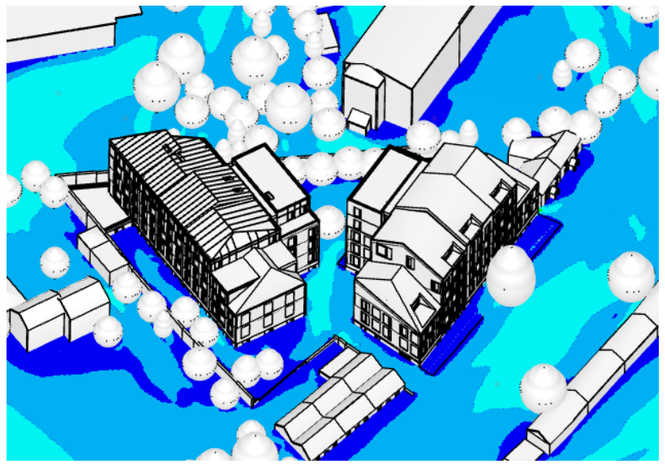
Proposed Student Residence
at
Gowan Motors Compound
Merrion Road
Dublin 4



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2438

28/08/2024

REV 01

Revision History

Date	Revision	Description
21/08/2024	00	Draft Issued for comment / Awaiting Development Description
28/08/2024	01	Issued for formal LRD Submission

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1.0 Executive Summary

This report compiles the results of Microclimatic Wind Analysis and Pedestrian Comfort Conditions undertaken by IN2 Engineering Design Partnership for the proposed student residence at Gowan Motors Compound (GMC), Merrion Road, Dublin 4, comprising of assessments for predicted Wind Conditions to the local environment.

The proposed development site is located in a suburban area to the South/East of central Dublin. The site terrain is primarily low lying with suburban housing to the West of the site and coastal areas to the East.

The report summarises the analysis undertaken, and conclusions determined from sophisticated Building Simulations performed with regards to Wind/ Pedestrian Comfort, in all cases validating results in accordance with robust Best Practice Guidelines to ensure compliance in accordance with the methodologies described in Section 3.0. The proposed amenity areas assessed in this analysis have also been outlined in Section 3.3 along with a description of their intended use.

Wind Analysis was assessed utilising Airflow Simulation techniques through Simscale Computational Fluid Dynamics (CFD) software for the proposed development as, detailed in Section 4.0, utilising Revit 3D modelling information as received from MDO Architects. This determined regions of positive and negative pressures and associated predicted wind velocities for the proposed development for varying wind speeds and directions.

These wind simulations were then compiled and assessed against Lawson Criteria Methodology- an assessment method for Pedestrian Comfort in order to predict activity suitability (sitting/ standing etc.) for persons in the vicinity of the development throughout the entire year as outlined in Section 5.0.

The analysis illustrated how conditions for pedestrians at all Amenity spaces were determined to have comfortable wind conditions suitable for “Outdoor Dining” or “Pedestrian Sitting” with no adverse wind affects predicted to occur nor mitigation effects required. This was found to be the case due to the existing high boundary wall (3.0 to 5.5 m high) on the site – particularly as it would shelter proposed amenity spaces from the prevailing westerly winds.

Overall, the proposed development was determined to not negatively impact on its receiving environment in terms of wind microclimate.

2.0 Development Description

Planning permission is sought for a Large Scale Residential Development delivering 200 no. student residential units within two blocks. The blocks range in height up to 6 storeys with a basement below. All associated internal and external amenity space, car and cycle parking, landscaping, bin stores, service provision and vehicular and pedestrian accesses are also proposed.

3.0 Methodology

3.1 Wind Analysis

In order to determine the predicted wind patterns around the proposed development, airflow simulations were undertaken using Computational Fluid Dynamics (CFD) software (Simscale). This enabled an assessment of the site wind conditions: highlighting zones of high pressure, negative pressure, and air movement for varying wind conditions.

An initial 3D representational model of the existing buildings and their immediate surroundings was created, and simulations undertaken for 12 cardinal wind directions.

Wind Climate Data was taken from the Global Wind Atlas. This utilises a microscale modelling system, enabling localised wind data to be obtained for high resolution (250m grid) topography, including representation of both natural landscaping such as hills, ridges, as well as urban environments.

Fig 3.1.1 illustrates Global Wind Atlas data for the general Dublin area, indicating average wind speed at 10m height. The relative sheltering of the Urban area can be seen, in contrast to Dublin Airport to the North, and Dublin/ Wicklow mountains to the South, and exposed coastal locations.

Recorded wind speeds for Dublin Airport are relatively high- in what is one of Europe's windier meteorological weather station locations. However, the identified GMC site at Merrion Road, Dublin 4 is seen to be in a relatively sheltered area as highlighted in Fig 3.1.1. On a macro level, the site is surrounded by commercial/residential spaces to the south/west and coastal areas enclosing the remaining areas.

The CFD simulations utilised wind profiles accounting for terrain effects. Allowing for the nature of the site and location, a surface roughness layer profile representative of "Low Crops, occasional large obstacles (z_0=1m height)" was utilised, derived from GIS survey analysis [1].

Figures 3.1.2 and 3.1.3 indicates the modelled long-term annual "Wind Rose" obtained from the Global Wind Atlas for the GMC site at Merrion Road, Dublin 4. The rose diagrams illustrate the frequency that wind will be from a certain direction and at what speed. It can be seen how the prevailing Westerly winds entirely predominate due to the Atlantic gulf stream, with only lower occurrence from other directions, including lower velocity off shore breezes from the South-East.

[1] European Space Agency's Climate Change Initiative Land Cover (CCI-LC) dataset v2.0.7.

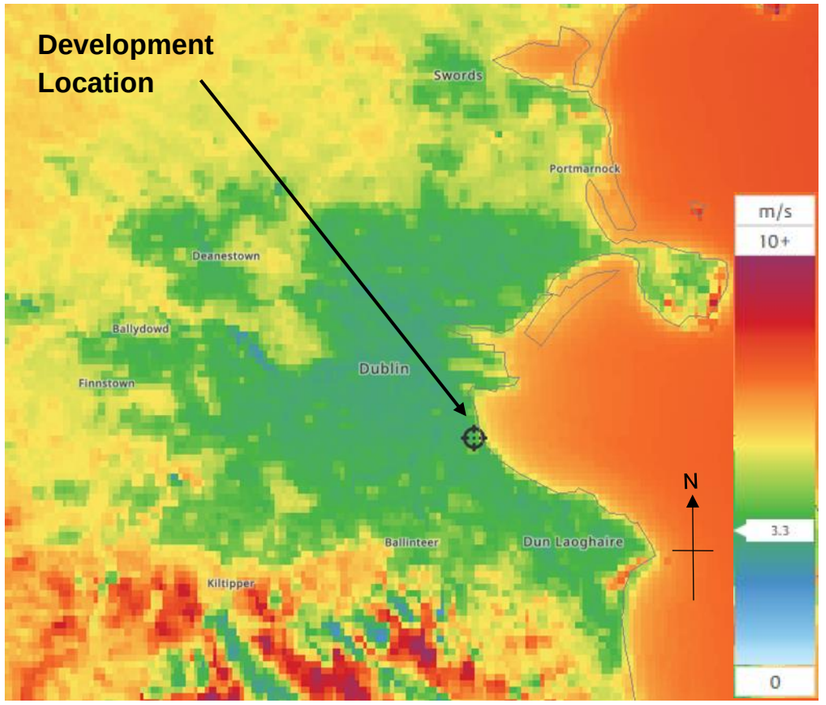

Fig 3.1.1 – Mean Wind Speeds across Dublin at 10m Height– Global Wind Atlas

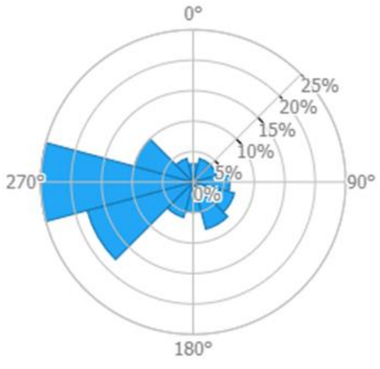

Fig 3.1.2 – Wind Frequency Rose for GMC Merrion Road – Global Wind Atlas

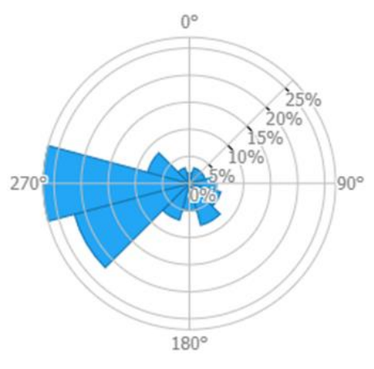

Fig 3.1.3 – Wind Speed Rose for GMC Merrion Road – Global Wind Atlas

3.0 Methodology

3.1 Wind Analysis (Cont'd)

As per Fig 3.1.4, 3D representational model of the proposed development and its surroundings was created, and simulations undertaken for 12 cardinal wind directions. The analysis included representational models of adjacent houses and developments, including existing boundary wall.

The CFD simulations form the basis of the Pedestrian Wind Comfort Analysis undertaken, which is described in detail in Section 3.2 below.

The methodology calculates predicted airflow patterns around buildings for all wind orientations and calculates average velocity applying weighting based on probability of occurrence throughout the year. It should be noted that wind effects around buildings for prevailing W wind conditions are deemed to have more of a potential impact to pedestrian discomfort, as these will occur on a more regular occurrence.

However, it should be noted that the methodology assesses averaged (hourly) wind conditions for the purposes of general pedestrian comfort and does not intend to predict gusting, abnormal nor potential future climate change conditions.

Nevertheless, the Lawson Criteria methodology basis, as described in detail below, has been proven to be a robust means of analysing Pedestrian Comfort and its basis has been successfully adapted and implemented in both National Standards (Netherlands NEN.8100) and Design Guidelines (City of London – Wind Microclimate Guidelines (2019)). There are currently no Irish or European Standards for Pedestrian Comfort.

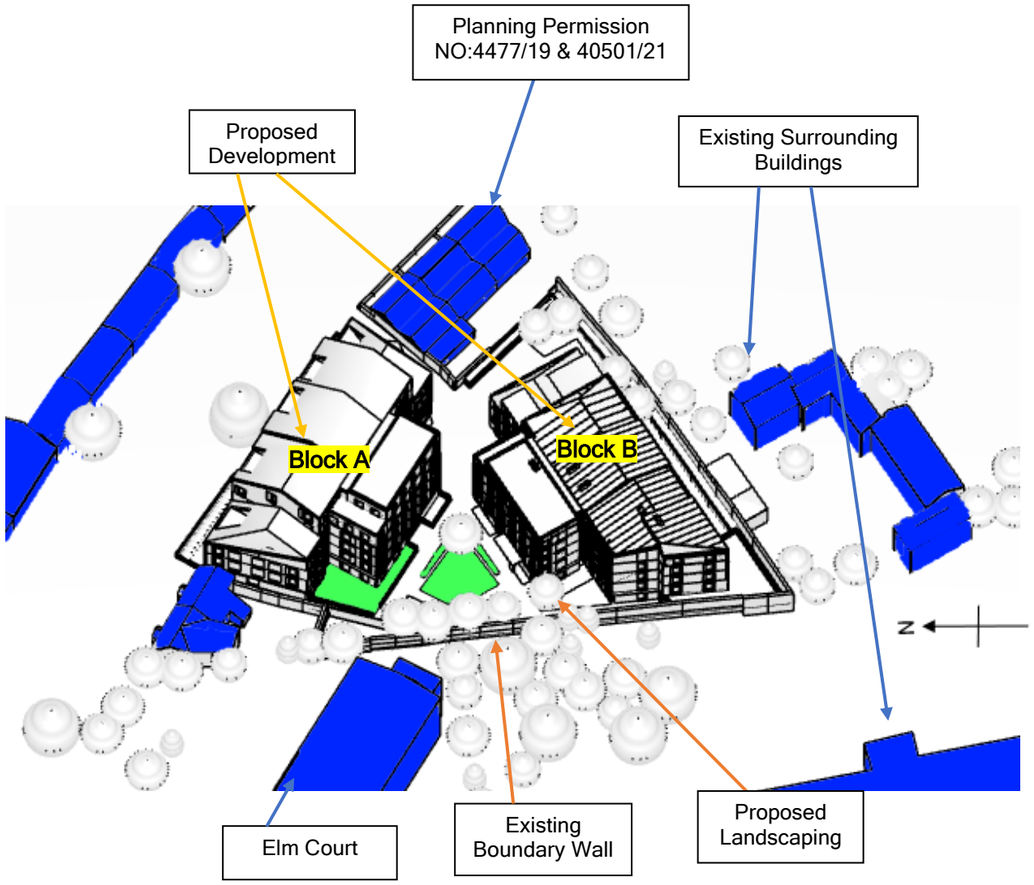

Fig 3.1.4 – 3D Model of Proposed Student Residence and Neighbouring Buildings, including existing boundary wall

3.0 Methodology

3.2 Pedestrian Comfort

Pedestrian Wind Comfort was assessed utilising the “Lawson Criteria” scale, which has been developed as a means of assessing the long-term suitability of urban areas for walking or sitting, accounting for both microclimatic wind effects (i.e. site location and prevailing winds) and microclimatic air movement associated with wind forces influenced by the localised built environment forms and landscaping effects.

The original Lawson Criteria (as described in Building Aerodynamics, Tom Lawson, Imperial College Press, 2001) assesses probability of wind discomfort based on the Beaufort Scale as referenced in Figure 3.2.1.

Figure 3.2.2 illustrates the Lawson Criteria scale, as developed, and implemented to the City of London Guidelines as utilised and assessed within the report, which ranges from areas deemed suitable for long-term sitting through to regions uncomfortable for pedestrian comfort. “Pedestrian Walking” areas, for example, are defined as areas that would not experience wind velocities in excess of 8m/s for more than 5% of the year, whereas uncomfortable areas would experience averaged wind velocities greater than 10m/s for more than 5% of the year.

The assessment identifies areas where potential wind occurrence, based on probability of wind direction and speed, would either be mitigated (Outdoor Dining/ Pedestrian Sitting and Standing) or exacerbated (Business Walking/ Uncomfortable) due to proposed massing from potential developments.

However, it should be noted that in terms of pedestrian comfort, the Lawson Criteria assesses solely for wind/associated air velocity effects. Therefore, other environmental aspects that may influence a space’s microclimate, such as exposure to sunlight and envisaged temperature variation throughout the year are not accounted for within this methodology.

Beaufort Force	Hourly-Average Windspeed m/s	Description of Wind	Noticable Effect of Wind
0	<0.45	Calm	Smoke rises vertically
1	0.45 - 1.55	Light	Direction shown by Smoke drift but not by vanes
2	1.55 - 3.35	Light	Wind felt on faces: leaves rustle: wind vane moves
3	3.35 - 5.60	Light	Leaves and twigs in motion: wind extends a flag
4	5.60 - 8.25	Moderate	Raises dust and loose paper: small branches move
5	8.25 - 10.95	Fresh	Small trees in leaf sway
6	10.95 - 14.10	Strong	Large branches begin to move: telephone wires whistle
7	14.10 - 17.20	Strong	Whole trees in motion

Fig 3.2.1 Beaufort Scale

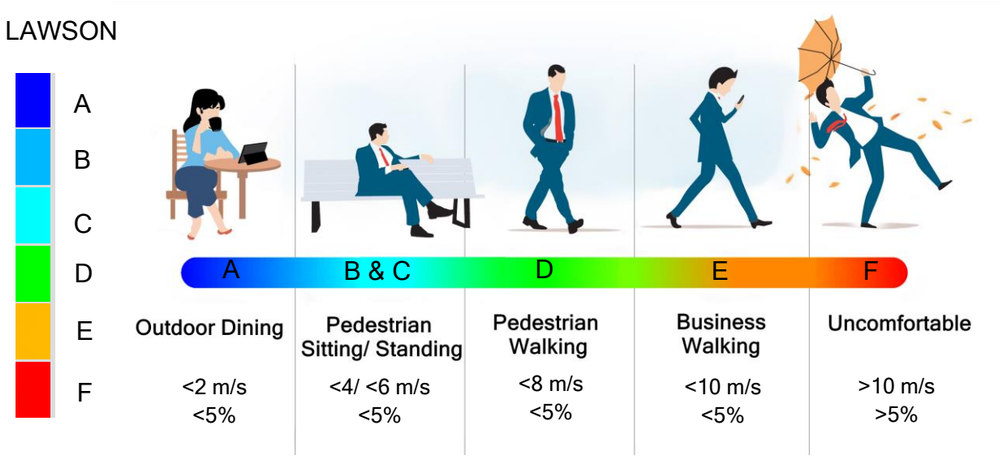

Fig 3.2.2 Lawson Scale

3.0 Methodology

3.3 Areas of Assessment

All outdoor spaces where there is expected to be pedestrian activity have been assessed for pedestrian comfort.

In addition, particular emphasis has been placed on ensuring two identified spaces are suitable for amenity usage as below and illustrated in Fig 3.3.:

1. Ground Level Public Amenity (1)
2. Basement Level Public Amenity (2)

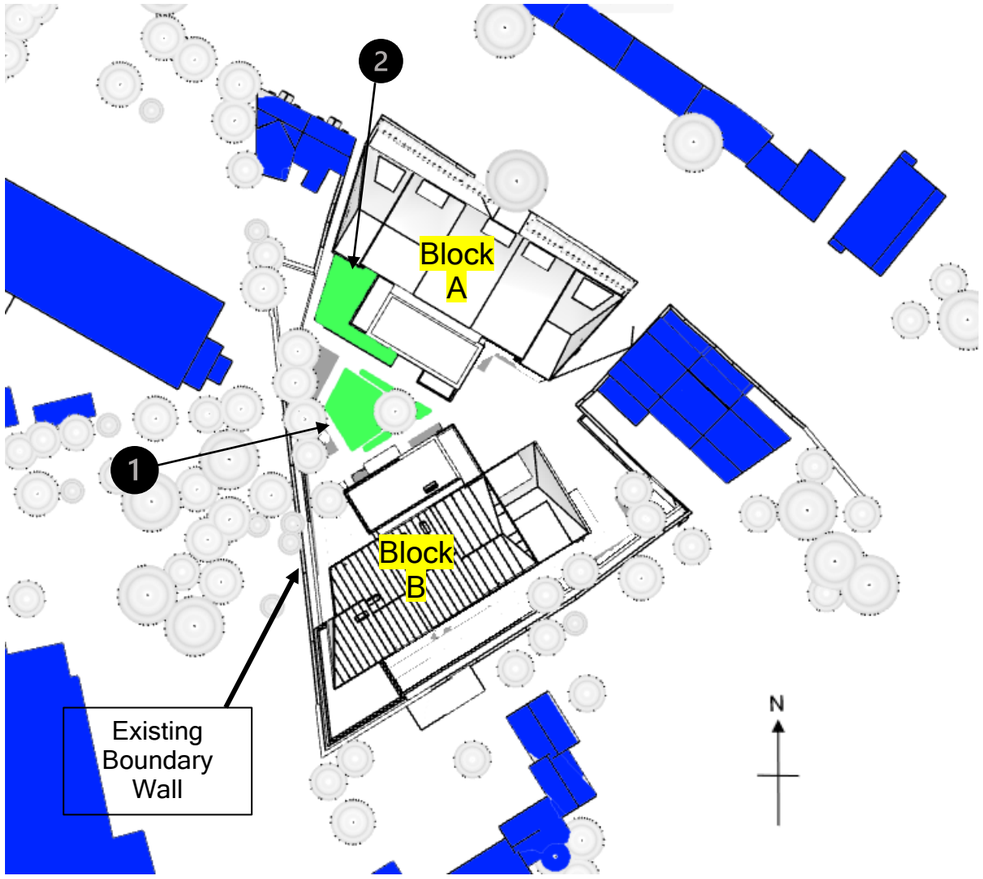

Fig 3.3.1 External Amenity Spaces

4.0 Pressures and Velocities

4.1 Ground Level

Figures 4.1.1 and 4.1.2 illustrate the predicted wind pressures and velocities across the development under prevailing 270° (westerly) wind direction at 1.5m above ground level with the proposed landscaping.

The wind pressures in Fig 4.1.1 exhibit higher pressure zones forming at the west (prevailing wind) of Block A and B but a zone of low-pressure is seen at the east between A and B. As illustrated by the vector arrows, air will flow from regions of high-pressure to low-pressure. Due to the pressure difference seen from west to east between Block A and B, some localised acceleration was predicted to occur in this area.

As illustrated in the wind velocities shown in Fig 4.1.2, there is acceleration seen between Block A and B due to the pressure differential, however this acceleration was not found to result in predicted pedestrian discomfort as analysed below.

In particular, the existing boundary wall, ranging in 3.0 to 5.5m in height, in conjunction with tree plating in place, was found to be effective in sheltering the proposed developments external areas.

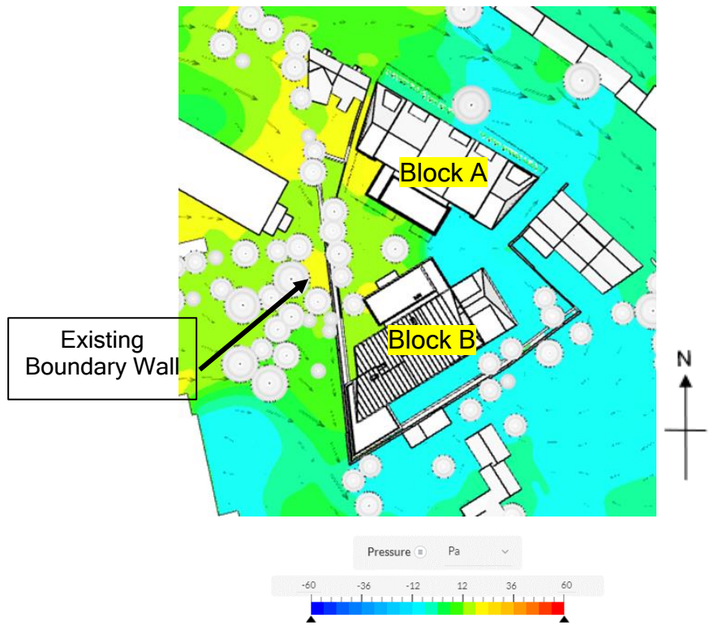

Fig. 4.1.1 – Wind Pressures at 1.5m Above Ground Level

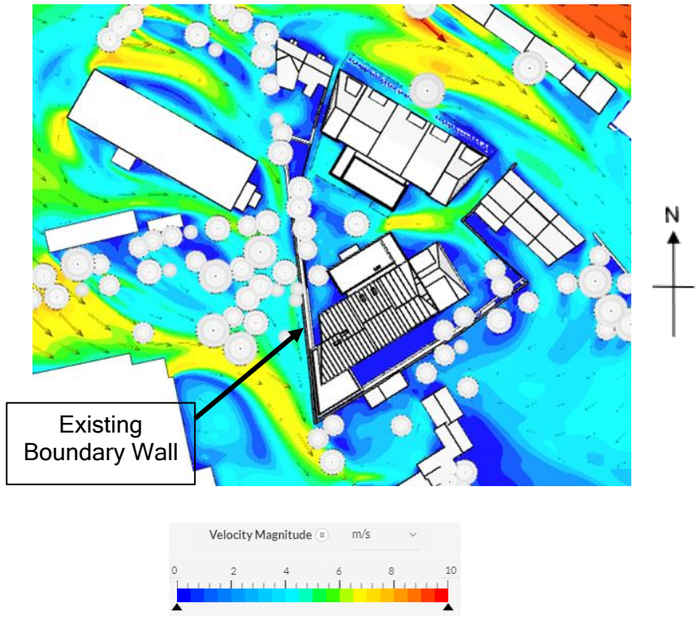

Fig. 4.1.2 – Wind Velocities at 1.5m Above Ground Level

5.0 Pedestrian Comfort

5.1 Ground Level Open Space

The results of the CFD simulations were developed to determine the Lawson Criteria results for the proposed development. Pedestrian comfort at the Community/Cultural Terrace was assessed by predicting Lawson Criteria values at 1.5m above the Ground Level.

Fig 5.1.1 outlines the Lawson Criteria Scale utilised. Blue contours illustrate the most sheltered regions, areas deemed “Suitable for Outdoor Dining”. Light Blue/ Cyan contours indicate regions “Suitable for Pedestrian Sitting” and “Pedestrian Standing” respectively. Green contours indicate areas “Suitable for Pedestrian Walking”, with orange illustrative of being “Suitable for Business Walking”. Red areas highlight zones as “Uncomfortable”.

It can be seen from Fig 5.1.2 that no uncomfortable or unsuitable comfort levels were predicted by the analysis (which would be indicated by red/orange contours)

Overall, the majority of the site was deemed to be suitable for “Pedestrian Sitting/Outdoor Dining/Pedestrian Standing”. This would provide good conditions for pedestrian usage and indicates that no adverse wind effects were predicted to occur. Throughout the development with the existing boundary wall/landscaping being instrumental in ensuring excessive wind effects would be mitigated.

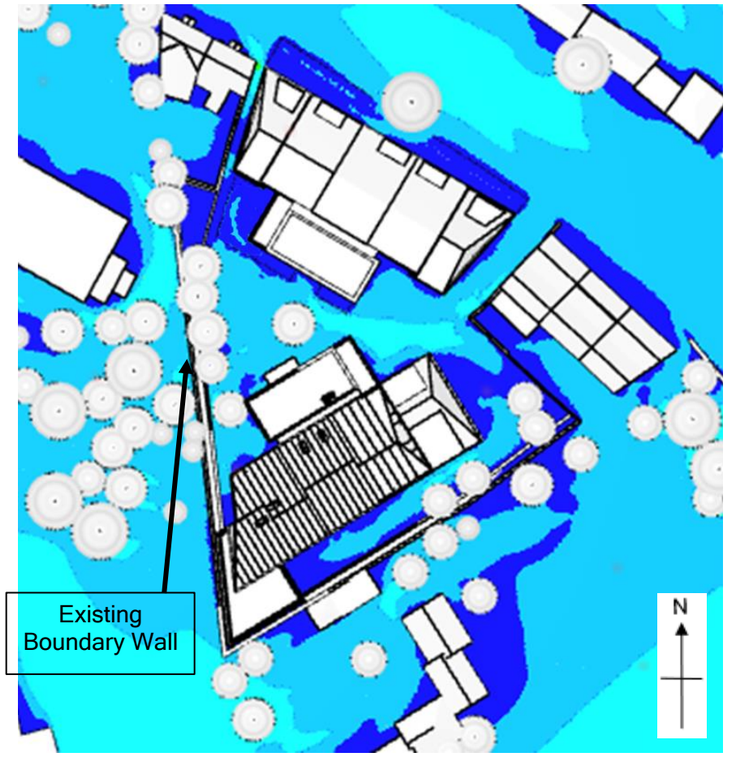

Fig. 5.1.2 – Predicted Lawson Criteria at 1.5m Above Ground Level

A	2 m/s	< 5%	Outdoor Dining
B	4 m/s	< 5%	Pedestrian Sitting
C	6 m/s	< 5%	Pedestrian Standing
D	8 m/s	< 5%	Pedestrian Walking
E	10 m/s	< 5%	Business Walking
U	10 m/s	> 5%	Uncomfortable

Fig. 5.1.1 – Lawson Criteria

5.2 Amenity Spaces

The development's two amenity areas were assessed. The first, identified as Number 1 in Fig. 5.2.1, is a communal area at ground level, and the second, identified as Number 2 in Fig. 5.2.1, is located on the basement level and will be further protected from prevailing winds due to being at a lower level.

The pedestrian comfort was assessed by predicting the Lawson Criteria values at 1.5m above the floor level. The existing wall and landscaping were both included in the analysis, both providing shelter to the amenity spaces.

As per the Lawson Criteria results displayed in Fig 5.2.2, the Ground Floor Amenity space was determined to enable comfortable conditions with respect to wind, in accordance with its intended use as an outdoor amenity space. The simulations determined that the spaces would be deemed suitable for “Pedestrian Sitting”.

The Basement Level Amenity space was found to have suitable wind conditions in line with its intended use as an outdoor amenity space, based on the Lawson Criteria results shown in Fig. 5.2.3. The area would be considered appropriate for "Pedestrian Sitting/Outdoor dining," according to the simulations. This would provide good conditions for pedestrian usage and indicates that no adverse wind effects were predicted to occur.

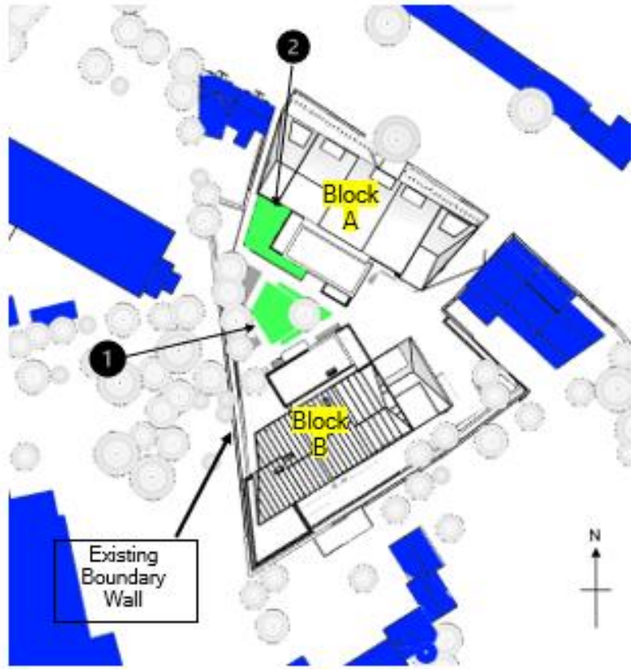

Fig. 5.2.1 – External Amenity Spaces

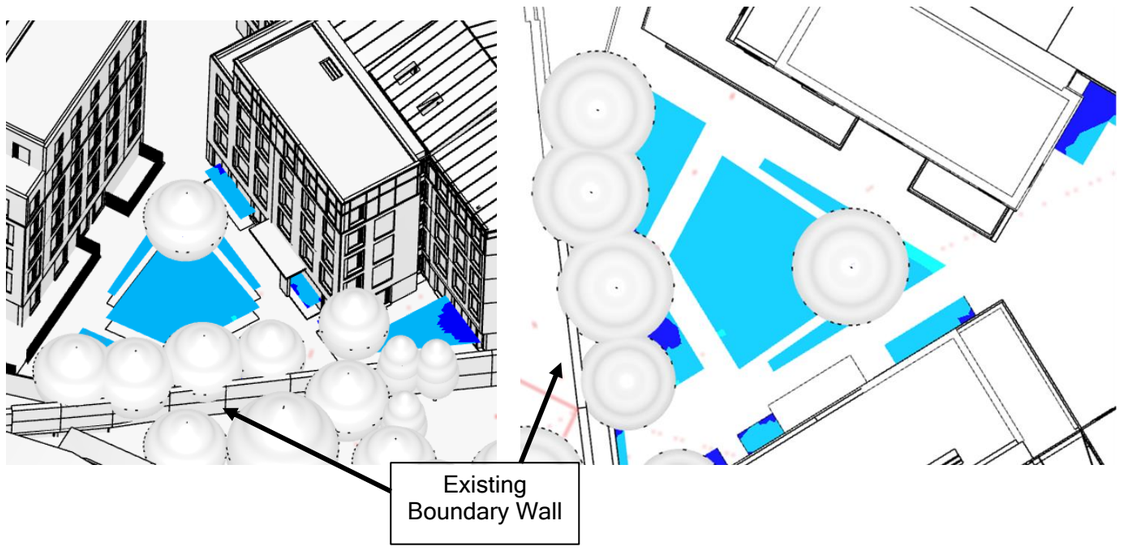

Fig. 5.2.2 – Lawson Criteria Results at 1.5m above the Ground Level Communal Open Space

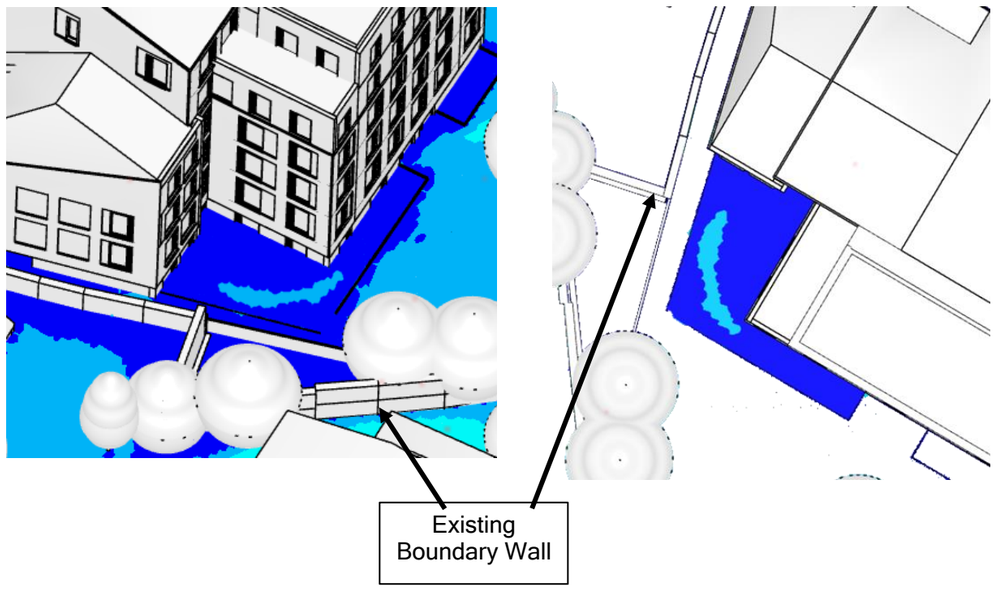

Fig. 5.2.3 – Lawson Criteria Results at 1.5m above Basement Communal Open Space

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