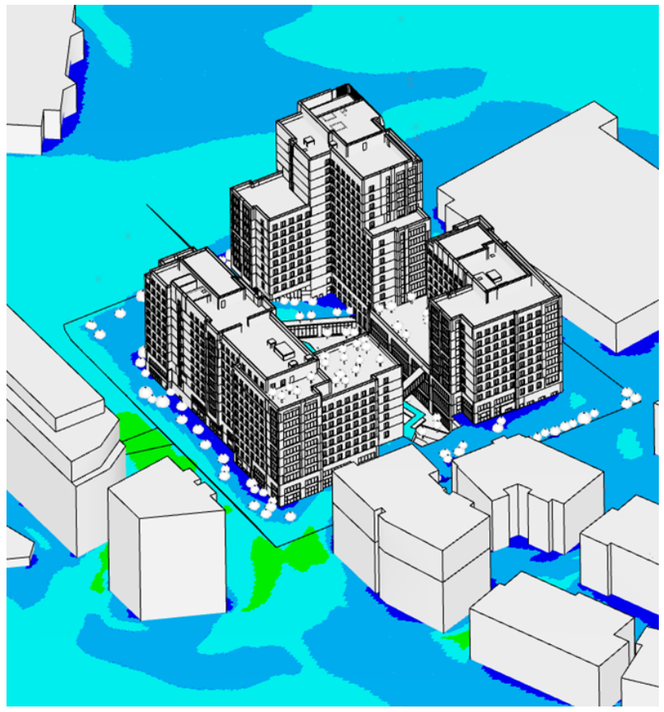
Gowan House
Naas Rd.
Dublin 12



Microclimatic Wind Analysis and Pedestrian Comfort Report

IN2 Project No. D2343

06/10/2023

REV03

Revision History

Date	Revision	Description
30/08/2023	00	Issued for comment
30/08/2023	01	Updated for comments received from design team
07/09/2023	02	Updated for changes to student amenity spaces
06/10/2023	03	Finalised for Planning Submission

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1.0 Executive Summary

This report compiles the results of Microclimatic Wind Analysis undertaken by IN2 Engineering Design Partnership for the proposed Student Accommodation Development at Gowan House, Dublin 12, based on 3D modelling information received from HKR Architects, comprising of assessments for predicted Wind Conditions to the local environment.

The proposed development site is located in a commercial/ light industrial/ suburban area to the west of central Dublin. The site terrain is primarily low lying with terraced housing to the north/east of the site and primarily commercial/ light industrial buildings to the south/west. Section 2.0 provides a complete development description for the proposed development.

Additionally, the constructed Carriglea Phase 1 Section 34 Application (DCC Ref: 4244/15), under construction Carriglea Phase 2 Strategic Housing Development (SHD) (Ref: TA29S.311606) to the south of the site and the Concorde SHD (Ref: TA29S.312218) to the west which has been granted permission have been included in the analysis.

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 3.0 along with a description of their intended use.

Wind Analysis was assessed utilising Airflow Simulation techniques through Computational Fluid Dynamics (CFD) Simscale software, for the proposed development as detailed in Section 4.0. 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 as outlined in Section 5.0.

The analysis illustrated how conditions for pedestrians at all assessed outdoor amenity spaces were determined to have comfortable wind conditions suitable for “Outdoor Dining” or “Pedestrian Sitting/ Standing” with no adverse wind affects predicted to occur.

The Community/Cultural Terrace at the basement level of Block 2 was first assessed with conditions predicted to be favourable for “Outdoor Dining” due to being in a well sheltered location.

The Block 1 basement level and ground level Student Amenity Terraces were assessed next. Both Terraces were determined to be relatively sheltered from possible adverse wind effects. The majority of the area assessed on both Amenity Terraces were predicted to have pleasant conditions for occupants with the conditions suited to “Outdoor Dining/Pedestrian Sitting”.

Both rooftop gardens, one on the 2nd floor of Block 1 and one on the 9th floor of Block 2 were also assessed for pedestrian comfort with the conditions predicted to suit “Outdoor Dining/Pedestrian Sitting”.

Finally, the Ground Level Open Spaces for the proposed development along with the surrounding areas was assessed. The majority of the site shows sheltered conditions suitable for “Pedestrian Sitting/Outdoor Dining”. This provides good conditions for pedestrian usage and identifies that no adverse wind effects predicted to occur.

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

2.0 Development Description

Malclose Limited intend to apply to Dublin City Council for a 7-year permission for a large-scale residential development principally comprising student accommodation at this 0.962 Ha. site at Gowan House, Carriglea Business Park, Naas Road, Dublin 12, D12 RCC4.

Works to upgrade of the access road to the west of the site on an area measuring c. 0.081 Ha are also proposed comprising new surfacing to the carriageway, the provision of inbound and outbound bicycle lanes from the development entrance to the Naas Road, the provision of a controlled pedestrian crossing on the access road at the Naas Road junction, and the provision of a further uncontrolled pedestrian and bicycle crossing linking the subject site with the approved Concorde SHD development (ABP Ref: TA29S.312218) to the west.

On the Naas Road, works are proposed on an area measuring c. 0.086 Ha comprising the realignment and widening of the existing pedestrian footpath along the westbound carriageway of the Naas Road and the provision of linkages from the realigned footpath to the development site, and the provision of new controlled pedestrian crossings across the eastbound and westbound carriages of the Naas Road and the provision of a new uncontrolled crossing of the Luas tracks.

The development site area and roadworks areas will provide a total application site area of c. 1.13 Ha.

The proposed development will principally consist of: the demolition of the existing two-storey office/warehouse building and outbuilding (5,172 sq m); and the construction of a development in two blocks (Block 1 (eastern block) is part 2 No. storeys to part 15 No. storeys over lower ground floor and basement levels with roof plant over and Block 2 (western block) is part 9 No. storeys to part 11 No. storeys over basement with roof plant over) principally comprising 941 No. Student Accommodation bedspaces (871 No. standards rooms, 47 No. accessible studio rooms and 23 No. studios) with associated facilities, which will be utilised for short-term lets during student holiday periods. The 871No. standard rooms are provided in 123 No. clusters ranging in size from 3 No. bedspaces to 8 No. bedspaces, and all clusters are served by a communal living/kitchen/dining room.

The development also provides: ancillary internal and external communal student amenity spaces and support facilities; cultural and community floor space (1,422 sq m internal and 131 sq m external) principally comprising a digital hub and co-working space with ancillary cafe; a retail unit (250 sq m); public open space; the daylighting of the culverted River Camac through the site; an elevated walkway above the River Camac at ground floor level; a pedestrian bridge link at first floor level between Blocks 1 and 2; vehicular access at the south-western corner; the provision of 7 No. car-parking spaces, 2 No. motorcycle parking spaces and 2 No. set down areas; bicycle stores at ground and lower ground floor levels; visitor cycle parking spaces; bin stores; substations; hard and soft landscaping; green and blue roofs; new telecommunications infrastructure at roof level of Block 1 including antennas and microwave link dishes, 18 No. antennas and 6 No. transmission dishes, together with all associated equipment; boundary treatments; plant; lift overruns; and all associated works above and below ground.

The gross floor area of the development is c. 33,140 sq m comprising c. 30,386 sq m above lower ground and basement level.

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. The identified site at Naas Rd, Dublin 12 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/industrial spaces to the south/west and suburban housing 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 site at Gowan House, Naas Rd, Dublin 12. 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 South-Westerly winds entirely predominate due to the Atlantic gulf stream, with only lower occurrence from other directions.

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

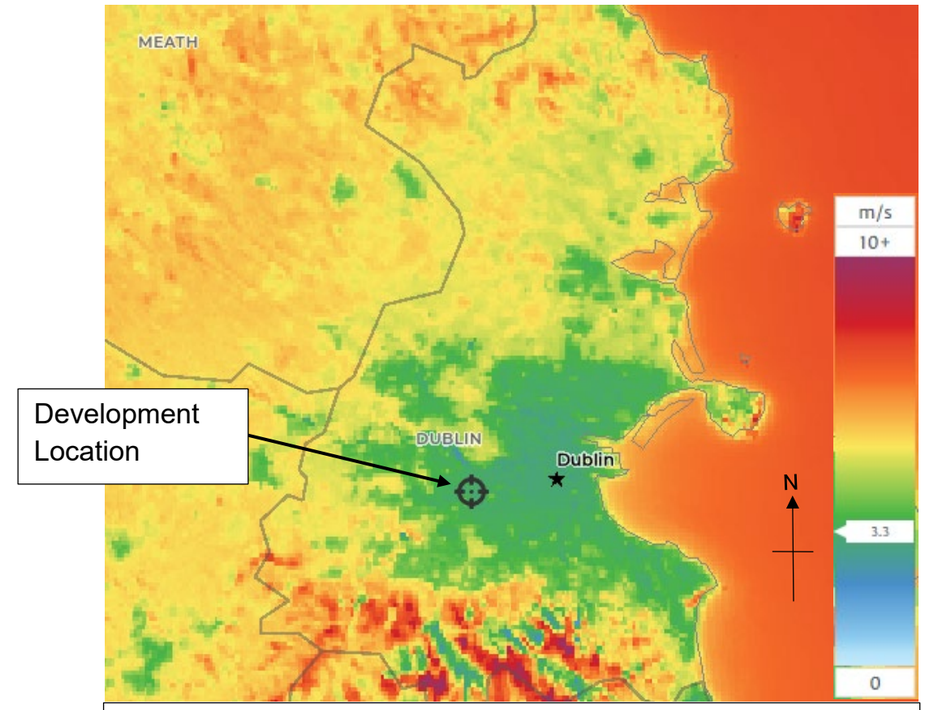

Fig 3.1.1 – Mean Wind Speeds across Dublin – Global Wind Atlas

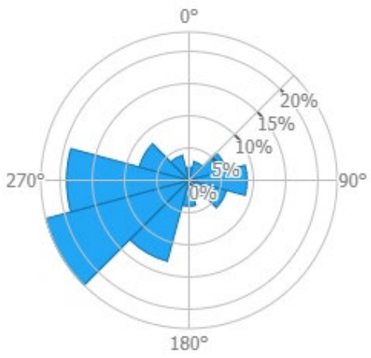

Fig 3.1.2 – Wind Frequency Rose for Gowan House – Global Wind Atlas

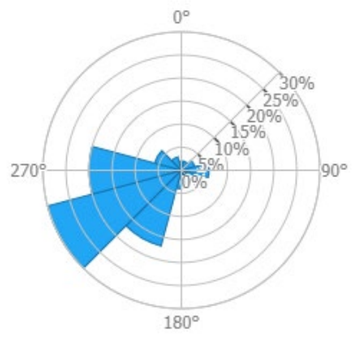

Fig 3.1.3 – Wind Speed Rose for Gowan House – Global Wind Atlas

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 SHD's and Section 34 applications to the West and South of the proposed site, namely Concorde and Carriglea respectively.

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 SW 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.

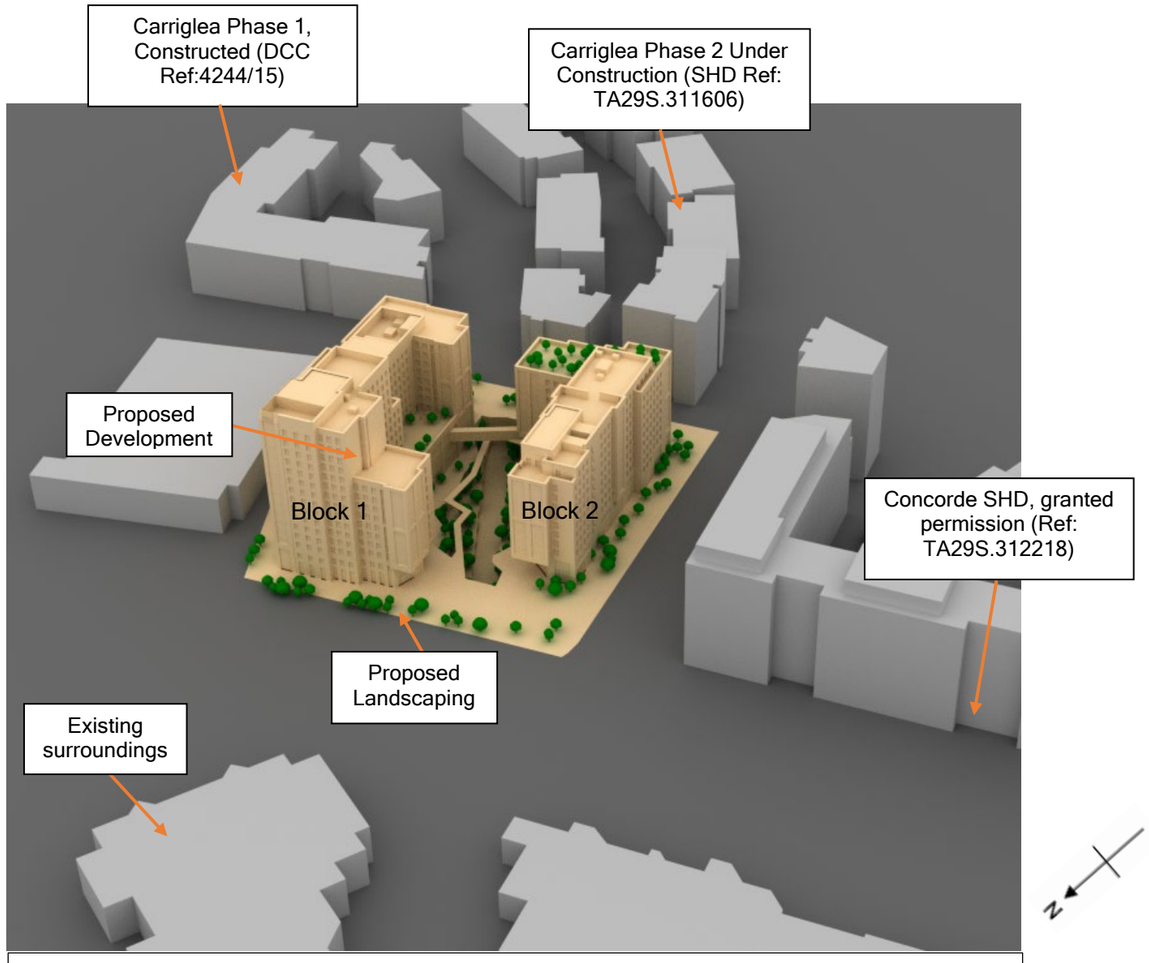

Fig 3.1.4 – 3D Model of Proposed Gowan House Development and Neighbouring Buildings

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

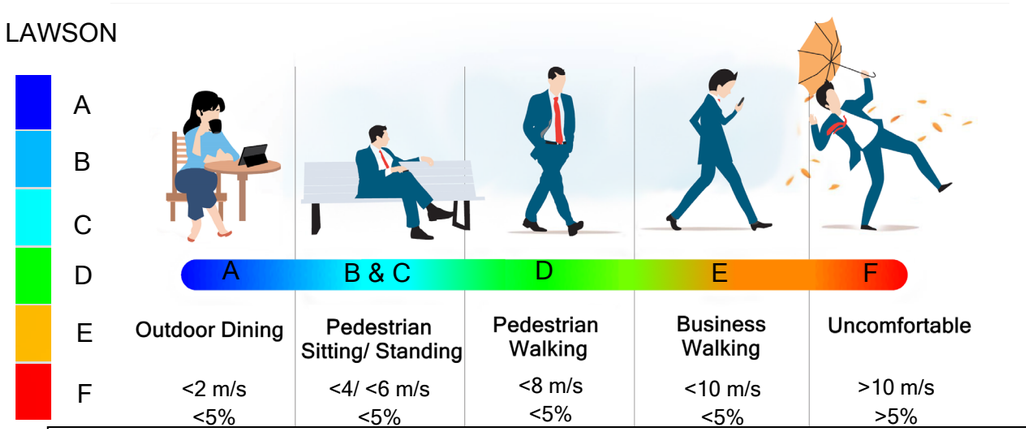

Fig 3.2.2 Lawson Scale

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.

For the Pedestrian Comfort Analysis, the assessed spaces have been grouped into 3 sections:

1. Community/Cultural Terrace (Cultural External Space): As outlined in Fig 3.3.1 (Yellow shading/No.1)
2. Student Amenity Terrace (Basement): This amenity terrace for students is located at Block 1 basement level (Pink Shading/No.2 in Fig 3.3.1)
3. Student Amenity Terrace (Ground): Highlighted at the ground level of Block 1 (Orange shading/No.3 in Fig 3.3.1)
4. Rooftop Gardens: These are two rooftop gardens, one on the 2nd floor of Block 1 and second one on the 9th floor of Block 2 (Blue Shading/No.4 in Fig 3.3.1)
5. Public Open space: The public external spaces in the development shown in Fig 3.3.1 (No. 5) are all located on the ground floor level.

The riparian zone (green shading) area is not accessible to people and has therefore been excluded from the pedestrian comfort analysis.

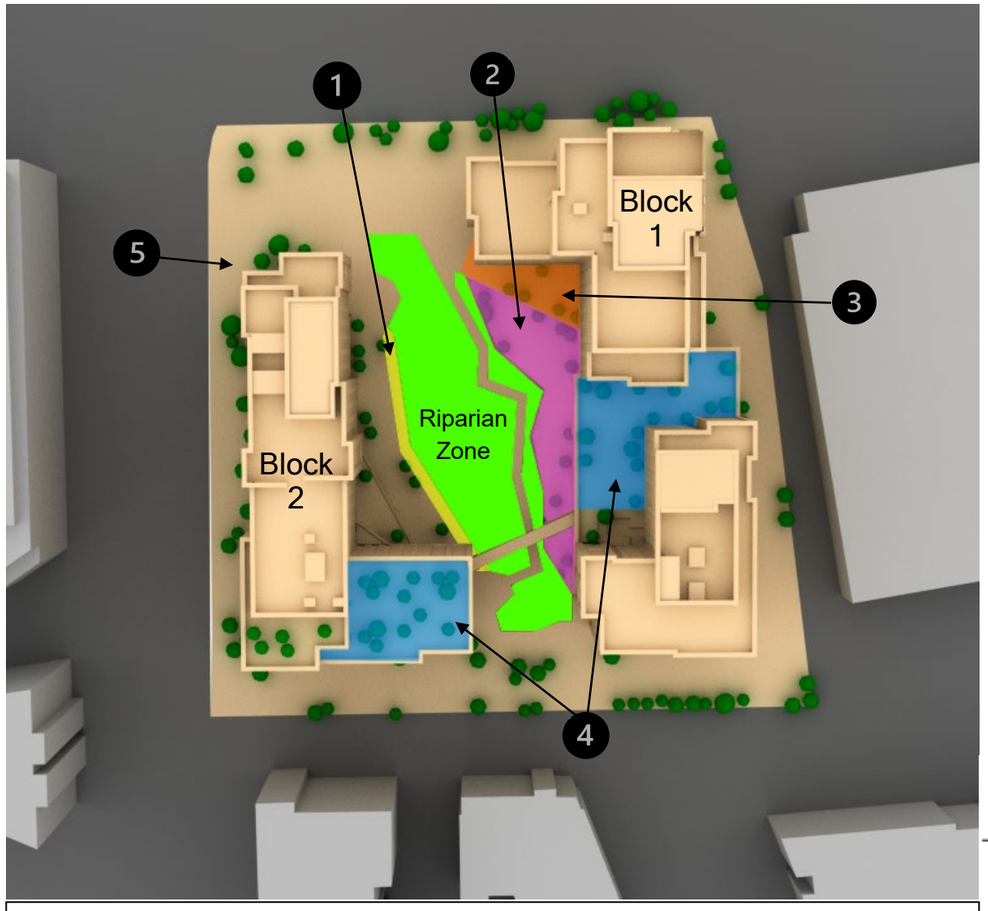

Fig 3.3.1 External Amenity Spaces

4.0 Wind Analysis – Prevailing Winds (Velocities)

4.1 Basement Level Amenity Terrace and Community/Cultural Terrace

Figure 4.1.1 illustrates the predicted wind velocities across the basement level student Amenity Terrace at Block 1 and the Community/Cultural Terrace at the basement of Block 2 (both outlined in an orange border) under the prevailing 240° (south-west) wind direction with the proposed landscaping.

Due to being surrounded by Blocks 1 and 2 along with the terrain being below ground level, the outlined basement level spaces are predicted to be relatively sheltered, resulting in lower wind speed conditions.

There is a minor effect of “downwash” occurring due to the prevailing wind deflecting downwards as it approached Block 1. The streamline image in Fig 4.1.2 provides an illustration of these prevailing winds that would provide some downwash towards the basement level terraces. However, the resultant average wind velocities would still be at average wind speed conditions (5m/s).

These CFD simulations form the basis of the Pedestrian Comfort Analysis undertaken, which is described in Section 5.0.

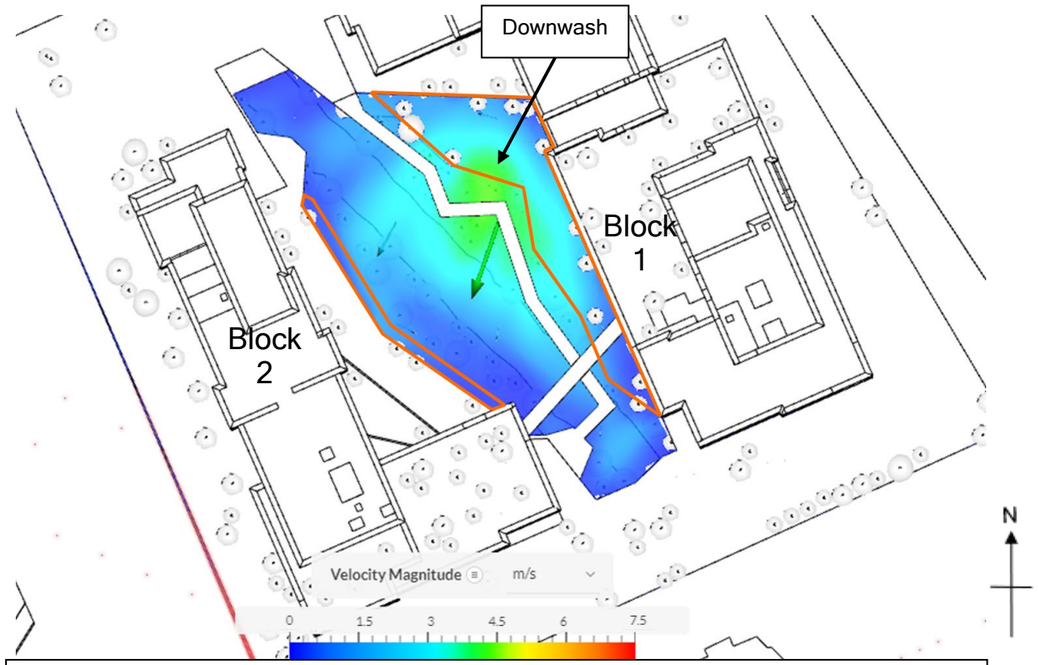

Fig 4.1.1 – Wind Velocities at Basement Level Area

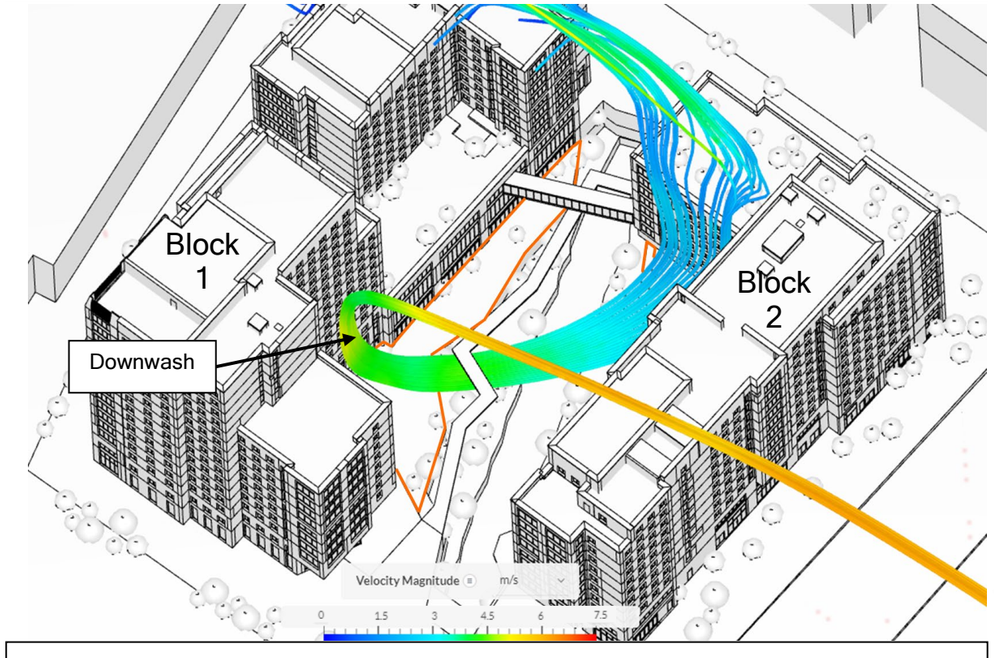

Fig 4.1.2 Streamlines illustrating Prevailing Wind flow Across Basement Level

4.2 Block 1 2nd Floor and Block 2 9th Floor Rooftop Gardens

Figure 4.2.1 displays the predicted wind velocites at the Block 1 Rooftop Garden along with the highlighted prevailing wind flows that are predicted to pass over Block 2 and flow downwards through the opening between both cores of Block 1.

The rooftop garden in Block 1 is predicted to have relatively low wind velocites due to the shelter provided by Block 2 from the prevailing winds and there is no predicted wind acceleration effects due to the opening between both cores of Block 1.

Similarly, in Fig 4.2.2 the predicted wind velocites at the Block 2 rooftop garden are illustrated. Since this rooftop gardenis located on the leeward side of Block 2, it is well sheltered from the prevailing winds and any possible wind acceleration effects.

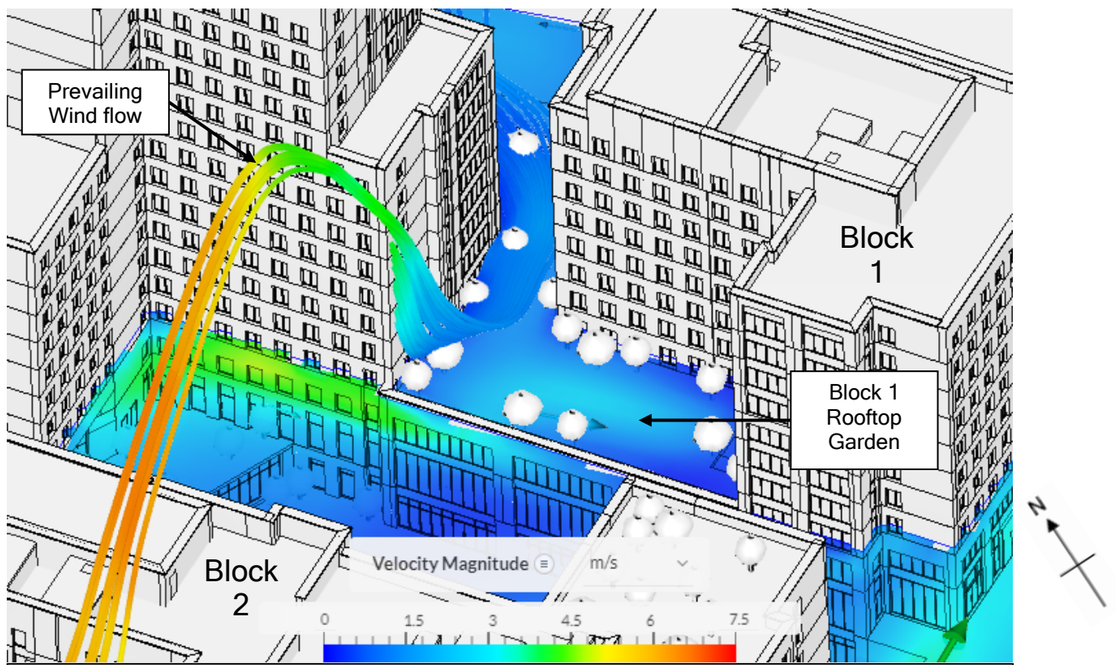

Fig 4.2.1 Wind Velocities and Prevailing Wind Flow at Block 1 Rooftop Garden

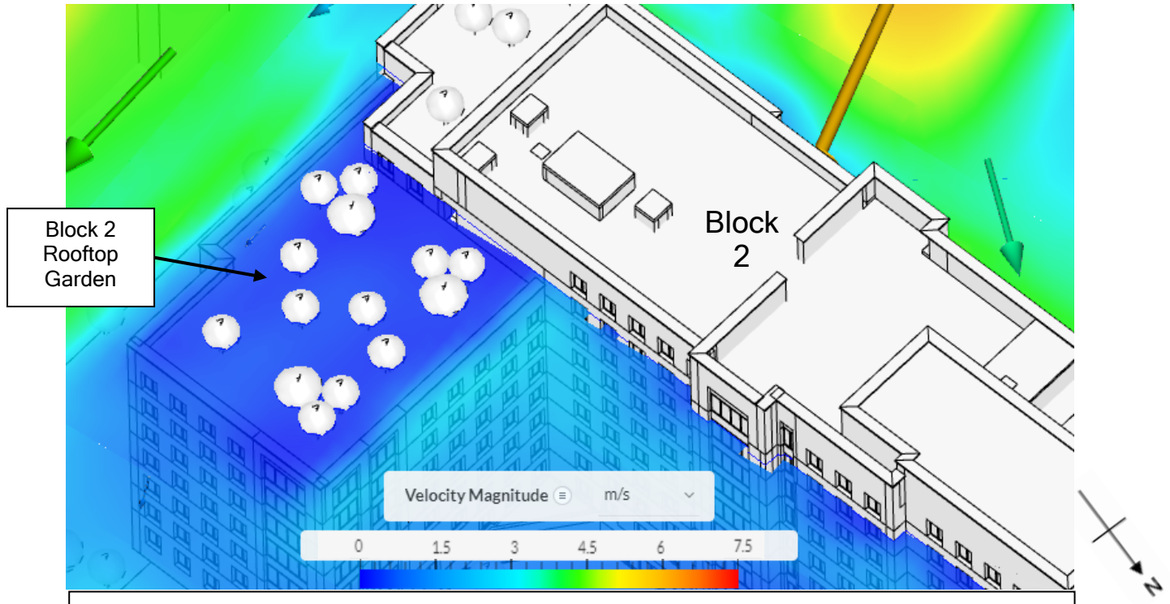

Fig 4.2.2 Wind Velocities at Block 2 Amenity Terrace

4.3 Ground Level Amenity Terrace and Open Space

Figure 4.3.1 illustrates the predicted wind velocities across the proposed development under the prevailing 240° (south-westerly) wind direction at 1.5m above ground level with the proposed landscaping.

The majority of wind speeds across the development were predicted to be relatively benign. Prevailing wind flows to the proposed development were determined to approach from the south-west, splitting towards the north/east after deflecting from Block 2.

The ground level Student Amenity Terrace highlighted in Fig 4.3.1 is illustrated to be in a sheltered space and determined to not be subjected to any adverse wind effects.

Along the western façade of Block 2, there is a small effect of wind acceleration occurring due to the prevailing winds deflecting off Block 2 as it flows towards Naas Rd, however, these were still determined to be within acceptable conditions in terms of pedestrian comfort analysis, which is described in detail in Section 5.0 below.

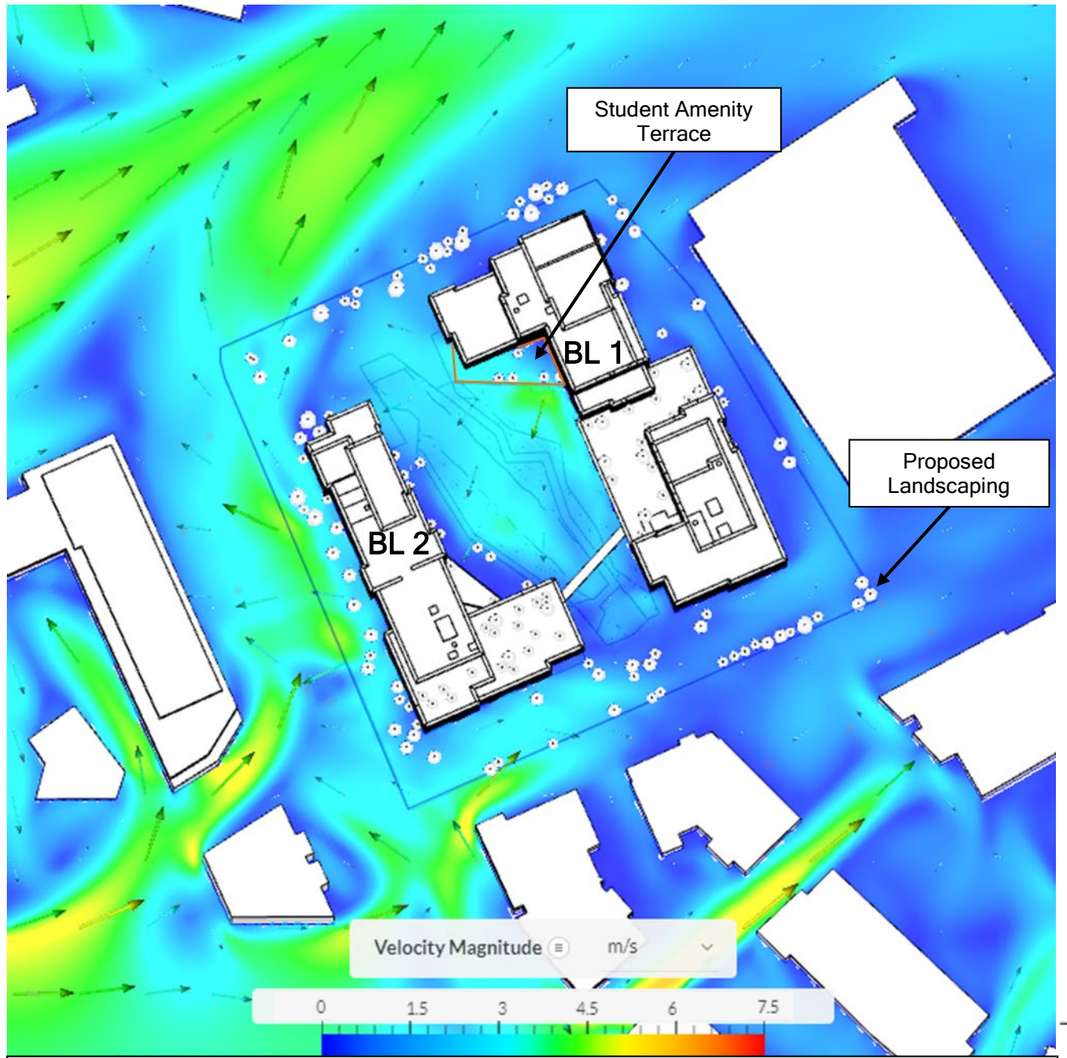

Fig 4.3.1 Wind Velocities at 1.5m above Ground Level

5.0 Pedestrian Comfort

5.1 Community/Cultural Terrace (Block 2 Basement Level)

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 basement level of Block 2.

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”.

Figure 5.1.2 illustrates the resultant Lawson Criteria for the Community/Cultural Terrace at Block 2. Due to being in a highly sheltered location the conditions were predicted to be suited to “Outdoor Dining” which presents pleasant conditions for occupants in terms of wind effects and sheltering.

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

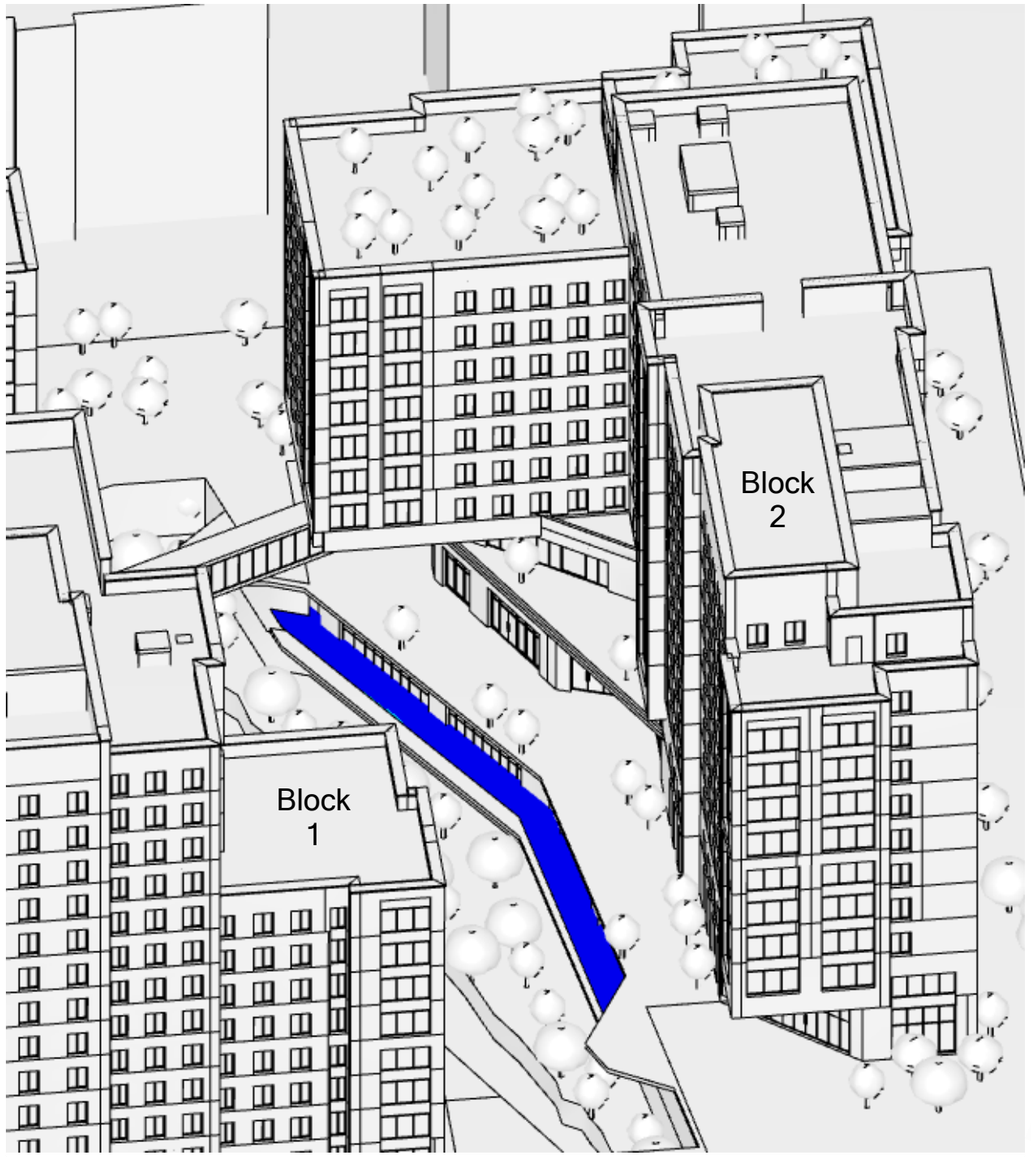

Fig. 5.1.2 – Lawson Criteria at 1.5m Above Block 2 Basement Level Community Terrace

5.2 Block 1 Basement Level Student Amenity Terrace

The Block 1 basement level student Amenity Terrace in the development was also assessed. The pedestrian comfort was assessed by predicting the Lawson Criteria values at 1.5m above the Terrace floor level. The proposed landscaping was also included in the assessment.

The scale in Fig 5.2.1 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”.

As per the Lawson Criteria results displayed in Fig 5.2.2, the Terrace was determined to enable comfortable conditions with respect to wind, in accordance with its intended use as an outdoor amenity space. The majority of the areas assessed were determined to be suited to “Outdoor Dining/Pedestrian Sitting”.

	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. 5.2.1 – Lawson Criteria

Fig. 5.2.2 – Lawson Criteria Results for Student Amenity Terraces

5.3 Block 1 Ground Level Student Amenity Terrace

The Pedestrian Comfort at the ground level Student Amenity Terrace was assessed by predicting the Lawson Criteria values at 1.5m above ground level and with the inclusion of the proposed landscaping.

The scale in Fig 5.3.1 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”.

The Lawson Criteria results in Fig 5.3.2 determined that the Amenity Terrace is predicted to be relatively sheltered from any adverse wind effects. The majority of the area is predicted to have conditions suited towards “Outdoor Dining/Pedestrian Sitting” which is in accordance with its intended use as an outdoor amenity space.

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. 5.3.1 – Lawson Criteria

Fig. 5.3.2 – Lawson Criteria Results at 1.5m above Ground Level

5.4 Block 1 2nd Floor and Block 2 9th Floor Rooftop Gardens

The Pedestrian Comfort at the Rooftop Gardens for the proposed development was assessed by predicting the Lawson Criteria values at 1.5m above the rooftop levels and with the inclusion of the proposed landscaping.

The scale in Fig 5.4.1 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”.

The Lawson Criteria results for both Rooftop Gardens are shown in Fig 5.4.2. The simulations undertaken determine that the majority of the assessed spaces would be deemed suitable for “Pedestrian Sitting/Outdoor Dining”. This would provide good conditions for pedestrian usage and indicates that no adverse wind effects were predicted to occur.

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. 5.4.1 – Lawson Criteria

Fig. 5.4.2 – Lawson Criteria Results at 1.5m above Ground Level

5.5 Ground Level Open Space

Finally, the Pedestrian Comfort at the ground level for the proposed development and its surrounding areas was assessed by predicting the Lawson Criteria values at 1.5m above ground level and with the inclusion of the proposed landscaping.

The scale in Fig 5.5.1 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”.

The Lawson Criteria results for ground level are shown in Fig 5.5.2. The simulations undertaken determine that the majority of the site would be deemed suitable for “Pedestrian Sitting/Outdoor Dining”. This would provide good conditions for pedestrian usage and indicates that no adverse wind effects were predicted to occur.

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. 5.5.1 – Lawson Criteria

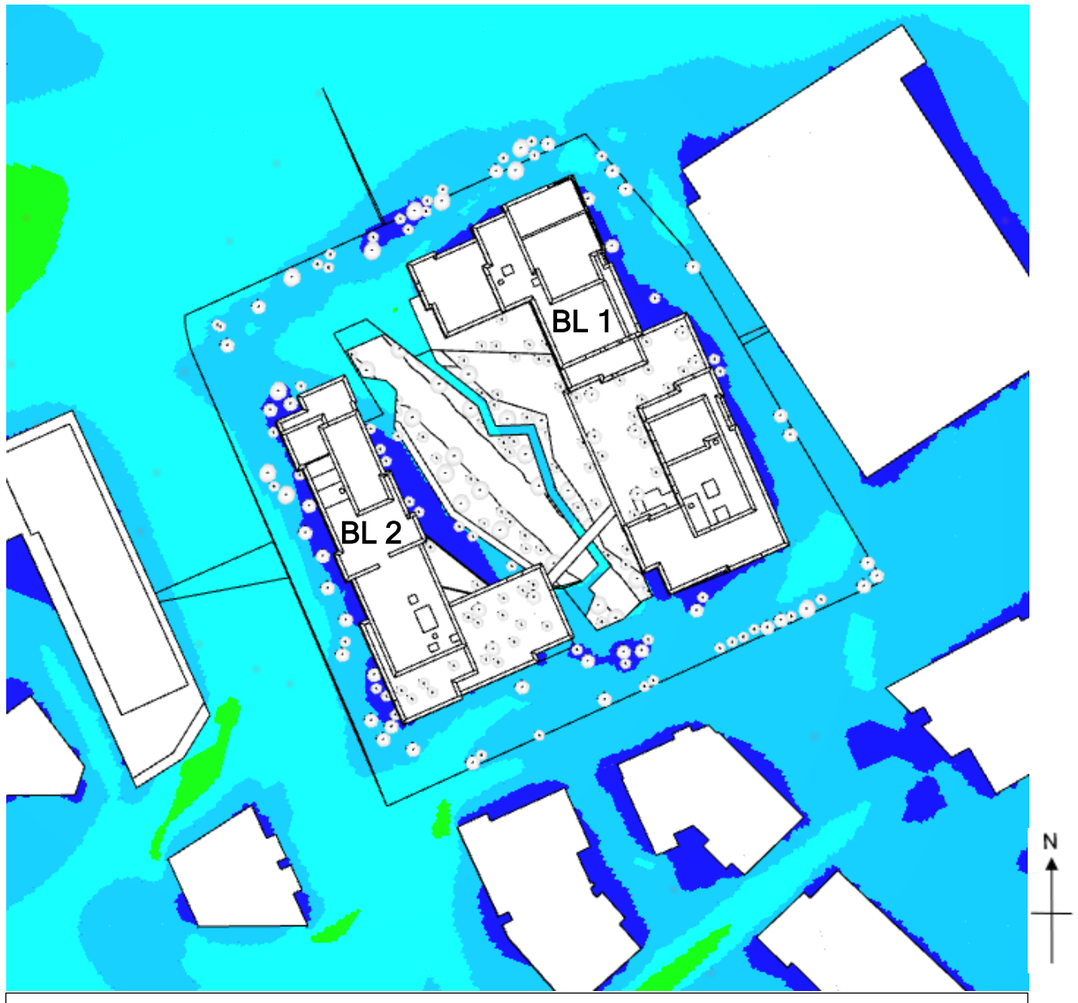

Fig. 5.5.2 – Lawson Criteria Results at 1.5m above Ground Level

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