



WIND MICROCLIMATE ASSESSMENT REPORT

1NQ, Tariff Street, Manchester

21 April 2023

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1 INTRODUCTION

This report outlines the results of a wind microclimate analysis for the proposed 1NQ, Tariff Street development in Manchester, UK.

1.1 SUMMARY

Wind microclimate conditions for the proposed 1NQ, Tariff Street development were assessed using high resolution CFD.

There are no wind safety risks associated with the proposed development when tested with the existing surrounds..

All wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing and proposed ground floor amenity spaces and roof terraces.

When tested with the cumulative surrounds, there are two regions of potential S15 (distress) exceedance within the site of the consented neighbouring Port Street development (132489/FO/2021). In the absence of appropriate mitigation this could pose a safety risk to frail individuals during times of strong winds, but the inclusion of the proposed landscaping scheme for 132489/FO/2021 (which included dense tree planting within the key wind flow path for this issue) will resolve this issue and ensure that there is not a significant safety risk.

1.2 GUIDANCE

National Planning Policy Framework

The National Planning Policy Framework (NPPF) was revised in July 2021 by the Department of Communities and Local Government (DCLG). The relevant paragraphs are as follows:

Paragraph 130 of the National Planning Policy Framework states that:

“Planning policies and decisions should ensure that developments:[...]create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users; and where crime and disorder, and the fear of crime, do not undermine the quality of life or community cohesion and resilience.”

There is no specific planning policy guidance dealing with microclimate in terms of pedestrian comfort set out in the revised NPPF

Planning Practice Guidance

The Planning Practice Guidance (2021) identifies the potential for tall and large buildings to affect wind microclimate. The National Design Guide (2021) states in Paragraph 71 that:

“Proposals for tall buildings (and other buildings with a significantly larger scale or bulk than their surroundings) require special consideration. This includes their [...] environmental impacts, such as [...] wind. These need to be resolved satisfactorily”

Greater Manchester Joint Development Plan

The Greater Manchester Combined Authority Joint Development Plan, ‘Places for Everyone’ was published in 2021.

‘Policy JP-P-1 Sustainable Places’ states that “all development [...] should be consistent with: [...] comfortable and inviting, with indoor and outdoor environments: [...] addressing microclimate issues such as sunlight, indoor air quality, overheating, shade, wind and shelter”.

Manchester Core Strategy (2012 – 2027)

Policy EN2 – Tall Buildings – States that, by their very size, tall buildings can have a significant impact on the local environment and its microclimate. It is therefore expected that this impact be modelled and that submissions for tall buildings also include appropriate measures to create an attractive, pedestrian friendly local environment.

2 METHOD

To identify the likely effect of the proposed development on the pedestrian level wind environment, a 3D CFD model of the development and surrounding site was created. This section describes the methodology for the creation of this model and the inputs used.

2.1 ASSESSMENT METHODOLOGY

The assessment was performed using GIA's high-resolution Computational Fluid Dynamics (CFD) modelling.

CFD is a digital modelling technique, which simulates the effect of wind for the built environment. The air is divided into hundreds of millions of "cells", within which the equations of motion are solved. GIA uses cloud computing from Amazon Web Services (AWS) to run the simulations, to ensure vast scalability and appropriate resource availability for any project.

A full description of the test methodology is included in Appendix 01.

On-site and local wind speeds were combined with wind statistics from 30 years of data recorded at Manchester International Airport corrected for variations in terrain between the airport and the site, to obtain annual and seasonal frequency and magnitude of wind speeds across the model. This allows the 'grading' of the pedestrian level winds according to the Lawson Comfort Criteria, which are explained later in this report.

The correction factors between the airport (measured 10m above ground) and the Site (at a reference height of 120m) are shown in Table 1. It should be noted that the terrain analysis has been performed using sectors of 30°, which is presented here.

2.2 ESTABLISHING MICROCLIMATE CONDITIONS

Microclimate conditions were established using a high resolution CFD model, extending 400m radius from the Site.

A model of the Development was included within the CFD model and tested to determine the conditions at and around the Site. The model used is shown in Figure 1, Figure 2 and Figure 3.

The development consists of two blocks, named as shown in Figure 1.

The model was run at full scale from 18 wind angles, spaced using 10° or 30° increments such that no sector contributes more than 10% of the annual wind. The wind angles which were run are indicated in Appendix 01.

Wind speeds were measured at 1.5m above any surfaces expected to be used for pedestrian activity.

The wind microclimate effects are assessed annually, for the winter months (December, January and February) and for the summer months (June, July, August). Winter conditions are reported as this is the season when the strongest winds are expected, summer conditions are reported as this is the season when pedestrian usage of outdoor spaces is expected to be highest.

Table 01: Site Wind Correction Factors

DIRECTION (°N)	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Corr. Factor	1.56	1.48	1.48	1.44	1.35	1.32	1.32	1.32	1.32	1.29	1.42	1.40

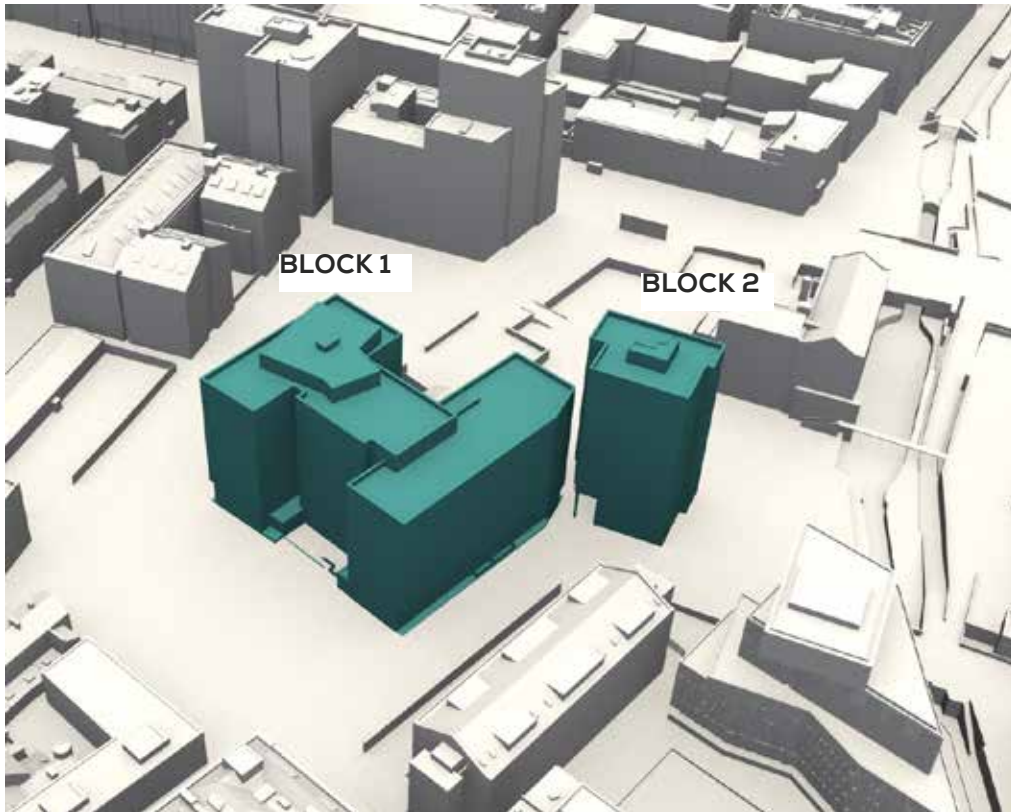


Fig. 01: 3D View of Proposed Development

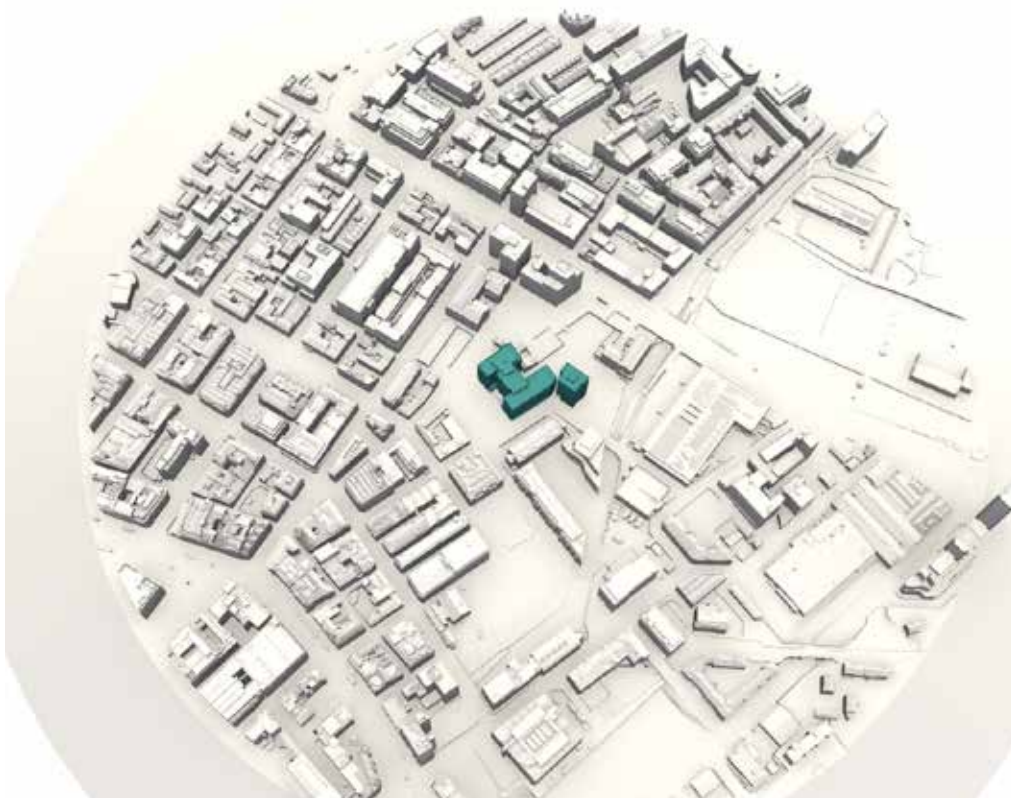


Fig. 02: Surrounding Context with Existing Surrounds



Fig. 03: Surrounding Context with Cumulative Surrounds



Fig. 04: Key Wind Receptor Locations

2.3 TARGET CONDITIONS

For a mixed-use urban area within which the Site is located, the desired wind microclimate would typically need to have areas acceptable for sitting, standing (including at entrances of buildings) and walking use. A description of the comfort categories to classify wind conditions in accordance with is given below.

Any areas which show up as either unsafe (annually) or uncomfortable (for winter) will require mitigation, unless they are in locations where pedestrian access can be controlled in the event of strong winds. This applies to all thoroughfares (for pedestrians) and roads (for cyclists) around the Development.

Any entrances should be suitable for standing, to create a buffer between internal and external conditions.

Bus stops should be suitable for standing, There are no bus stops within the study area.

There is existing local amenity in the form of the canal towpath (marked RC in Figure 4) and courtyards for the Avro building (marked AV in Figure 4). These spaces are targeted to be suitable for a mixture of sitting and standing in summer.

There is cumulative local amenity in the form of ground level amenity space for Port Street (132489/FO/2021) which is immediately east of the site and marked PS in Figure 4. This space is targeted to be suitable for a mixture of sitting and standing in summer.

There is proposed amenity in the form of terraces, both at ground floor level (marked GF in Figure 4) and at level 10 (marked L10 in figure 4). These spaces are targeted to be suitable for a mixture of sitting and standing in summer.

The locations of the key wind microclimate receptors is shown in Figure 4.

Table 02: Lawson Comfort Criteria (LDDC variant)

KEY	COMFORT CATEGORY	MEAN WIND SPEED (5% EXCEEDANCE)	DESCRIPTION
	Sitting	4 m/s	Acceptable for outdoor sitting use (e.g. cafes, benches, balconies and terraces)
	Standing	6 m/s	Acceptable for main building entrances, pick-up / drop-off points and bus stops
	Walking (leisure)	8 m/s	Acceptable for strolling
	Walking (business)	10 m/s	Acceptable for external pavements, walking purposefully without lingering
	Uncomfortable	>10 m/s	Not comfortable for regular pedestrian access

Table 03: Lawson Safety Criteria (LDDC variant)

KEY	SAFETY CATEGORY	MEAN WIND SPEED (0.022% EXCEEDANCE)	DESCRIPTION
	No Safety Exceedance	<15 m/s	
	S15 (Distress)	>15 m/s	Unsafe for frail individuals, or cyclists
	S20 (Safety)	>20m/s	Wind conditions considered unsafe for all users

2.4 TEST SCENARIOS

The purpose of these tests was to compare conditions with and without the proposed development.

The following scenarios were tested:

- 1 Baseline: The site (as existing) with the existing buildings surrounding the site;
- 2 Proposed Development, Existing Surrounds: The completed and operational development with the baseline conditions surrounding the site; and
- 3 Proposed Development, Cumulative Surrounds: The completed and operational development with the baseline conditions surrounding the site as well as any local consented schemes which have not yet started construction, or key proposed schemes which are still awaiting determination.

Trees and soft landscaping were not included in the model, to ensure reasonable worst-case conditions were captured.

The following local consented schemes were considered sufficiently advanced to be included in the baseline surrounds:

- 32-34 Laystall Street 128911/FO/2020
- 57-59 Ducie Street 120149/FO/2018

The following local consented schemes were included in the cumulative surrounds only:

- Store Street 126608/FO/2020
- Eider House 115178/FO/2017
- Port Street 132489/FO/2021
- Tokyo Inn 121014/FO/2018
- Piccadilly Gdns Hotel 127535/FO/2020
- Hotel Indigo 112667/FO/2016
- Indigo Hotel Piccadilly 112670/FO/2016
- The Foundry 133523/FO/2022

2.5 LIMITATIONS AND ASSUMPTIONS

The accuracy of the results is dependent upon the accuracy of the CAD used to construct the model.

There is an inherent assumption that on-site wind speeds will scale linearly with the measured wind speeds at the airport.

There is an inherent assumption that the wind speed statistics for the past 30 years will remain applicable for the foreseeable future.

2.6 DESIGN UPDATES

There have been some minor modifications to the design of the proposed development between the design which was used for the wind assessment and the design as submitted for planning.

These modifications can be described as follows:

- Rationalisation of the lower ground and ground floor design to better respond to the levels, with the external landscaping staying the same but simply moving up 3m from lower ground (which is being removed) to ground floor.
- Reduction of the floor-to-floor heights of the scheme from 3m floor to floor to 2.85m. Parapet heights onto Tariff St will also reduce from 1.1m to 0.3m. The net effect on Block 1 is an overall reduction in height by 1.7m and in the case of Block 2 there is an overall reduction in height of 2.7m.

The above changes would result in a marginal decrease in the heights of both blocks, and a small change to the levels at ground floor. Neither of the above would be sufficient to have a significant impact on wind conditions, so the assessment reported here would remain robust.

3 RESULTS

3.1 BASELINE CONDITIONS

Annual safety for the baseline scenario is shown in Figure 5. Winter comfort for the baseline scenario is shown in Figure 6. Summer comfort for the baseline scenario is shown in Figure 7.

There are no regions of safety or distress exceedance within the study area,

Winter conditions range between sitting and standing. Summer conditions range between sitting and standing.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The Rochdale Canal towpath (marked "RC" in results figures) is suitable for a mixture of sitting and standing in winter, and for sitting in summer. This is suitable for the intended use.

The Avro building courtyard (marked "AV" in results figures) is suitable for a mixture of sitting and standing in winter, and for sitting in summer. This is suitable for the intended use.



Fig. 05: Annual Safety at Ground Level, Baseline

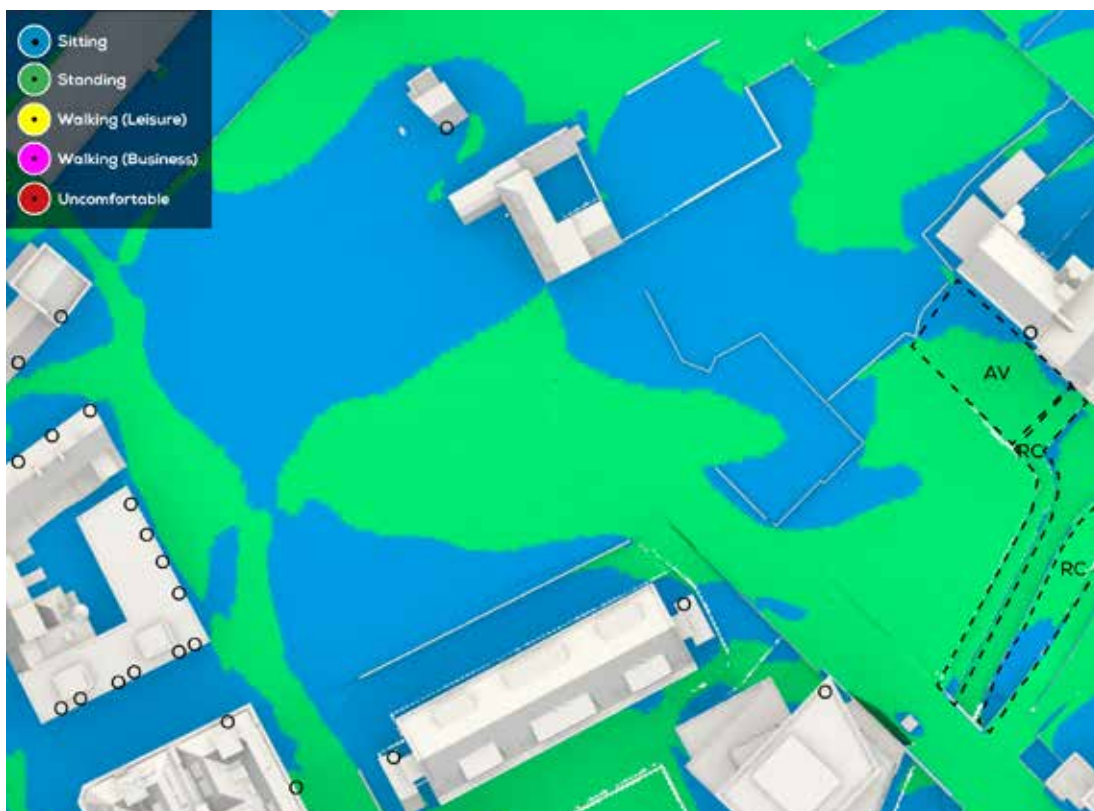


Fig. 06: Winter Comfort at Ground Level, Baseline

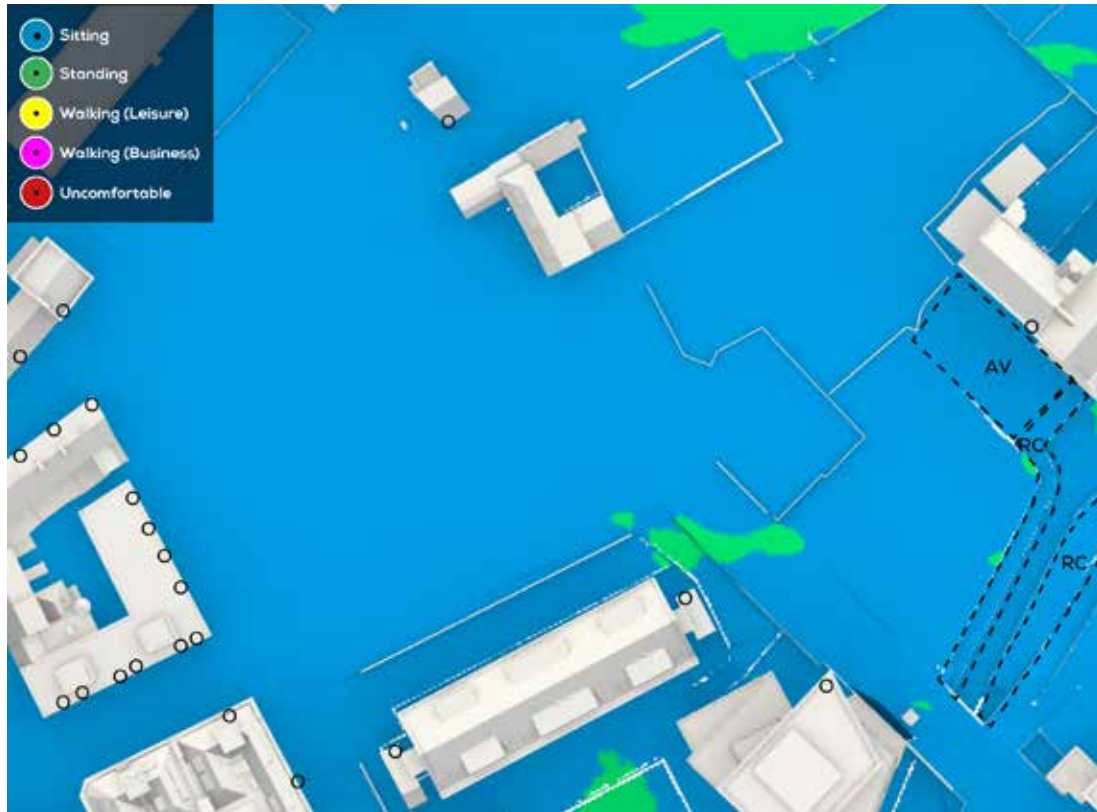


Fig. 07: Summer Comfort at Ground Level, Baseline

3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS

Annual safety at ground level for the proposed development with existing surrounds is shown in Figure 8. Winter comfort at ground level for the proposed development with existing surrounds is shown in Figure 9. Summer comfort at ground level for the proposed development with existing surrounds is shown in Figure 10.

There are no regions of safety or distress exceedance within the study area,

Winter conditions range between sitting and standing and leisure walking. Summer conditions range between sitting and standing.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

All principal proposed entrances (marked "E" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The proposed ground floor terraces (marked "GF" in results figures) are suitable for either sitting or standing in winter and for either a mixture of sitting and standing or sitting in summer. This is suitable for the intended use,

The Rochdale Canal towpath (marked "RC" in results figures) is suitable for a mixture of sitting and standing in winter, and for sitting in summer. This is suitable for the intended use.

The Avro building courtyard (marked "AV" in results figures) is suitable for a mixture of sitting and standing in winter, and for sitting in summer. This is suitable for the intended use.

Annual safety at terrace level for the proposed development with existing surrounds is shown in Figure 11. Winter comfort at terrace level for the proposed development with existing surrounds is shown in Figure 12. Summer comfort at terrace level for the proposed development with existing surrounds is shown in Figure 13

There are no significant regions of wind safety risk at terrace level.

There is a highly localised region of S15(distress) exceedance at the eastern extremity of the level 12 terrace on Block 2. This is sufficiently localised that it will not impact on the safety of terrace users.

Conditions for the proposed level 10 terraces on Block 1 are suitable for a mixture of sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use.

Conditions for the proposed level 12 terrace on Block 2 are suitable for a mixture of sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use.



Fig. 08: Annual Safety at Ground Level, Proposed Development with Existing Surrounds

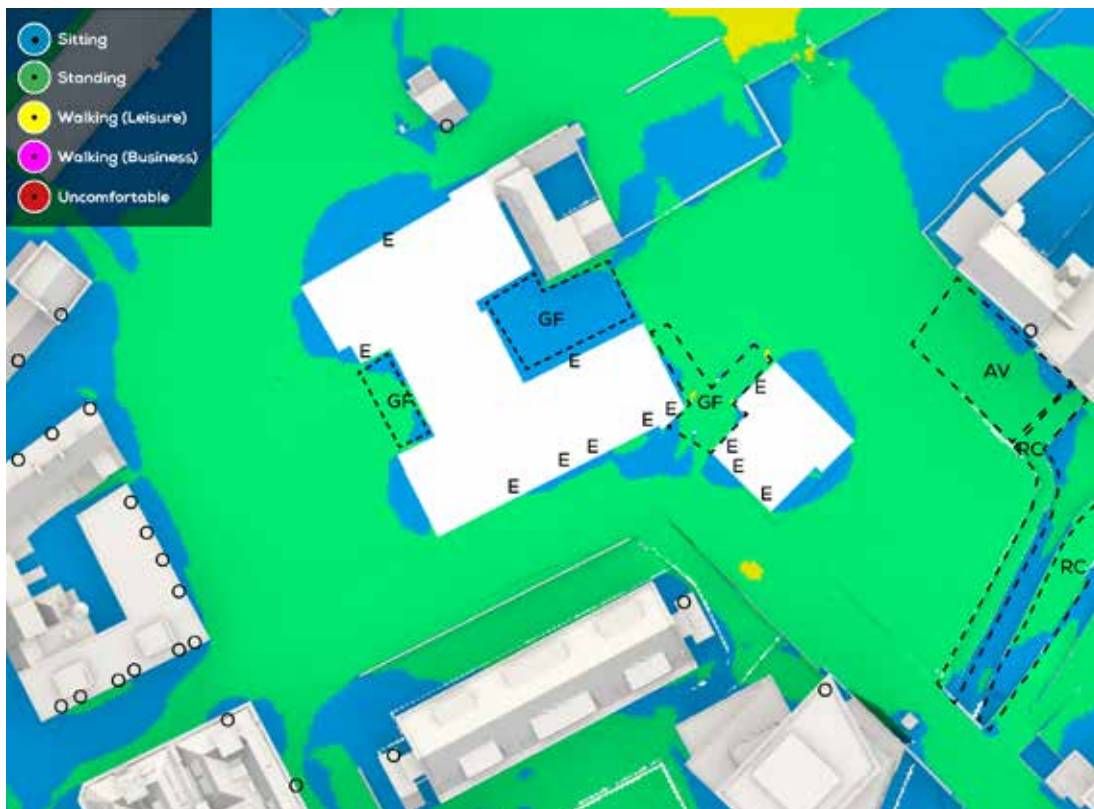


Fig. 09: Winter Comfort at Ground Level, Proposed Development with Existing Surrounds

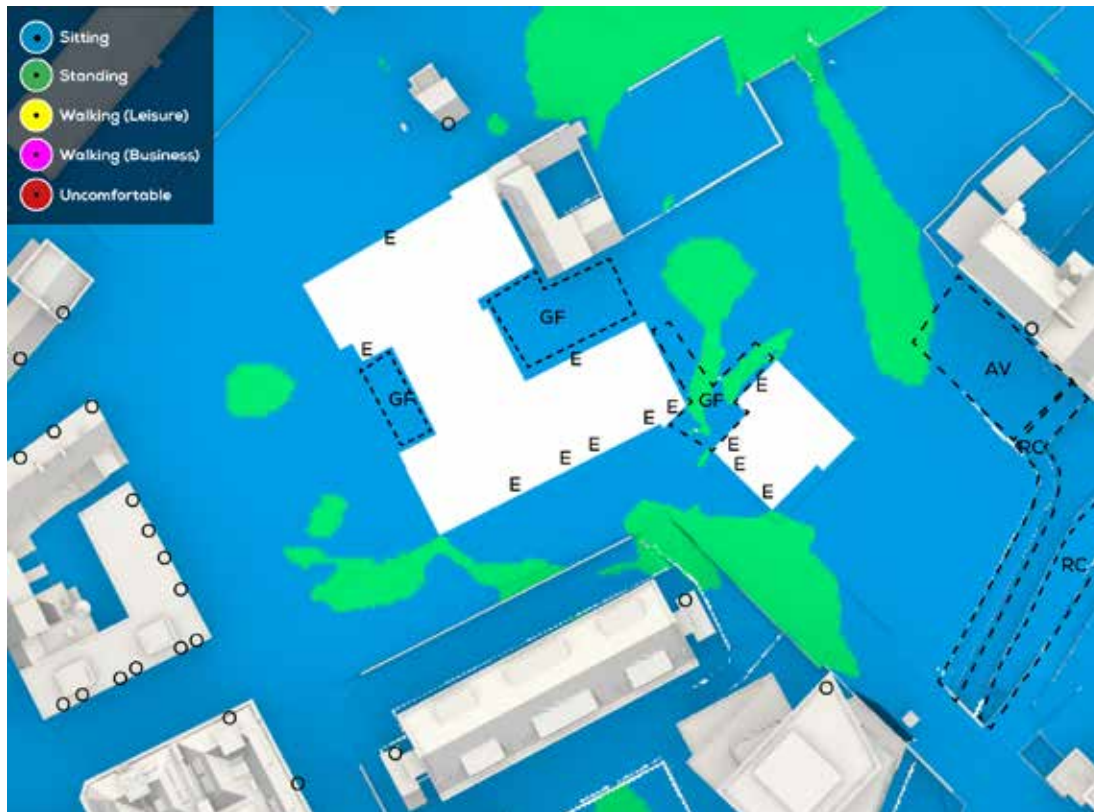


Fig. 11: Summer Comfort at Ground Level, Proposed Development with Existing Surrounds



Fig. 10: Annual Safety at Terrace Level, Proposed Development with Existing Surrounds

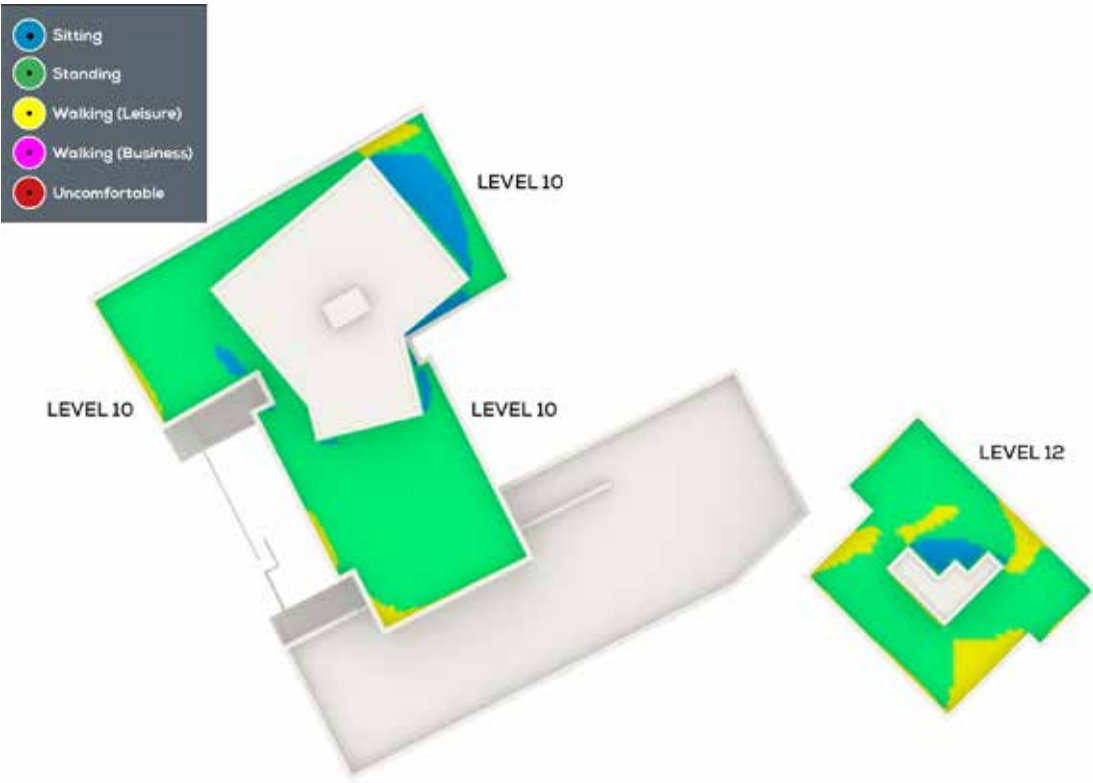


Fig. 12: Winter Comfort at Terrace Level, Proposed Development with Existing Surrounds

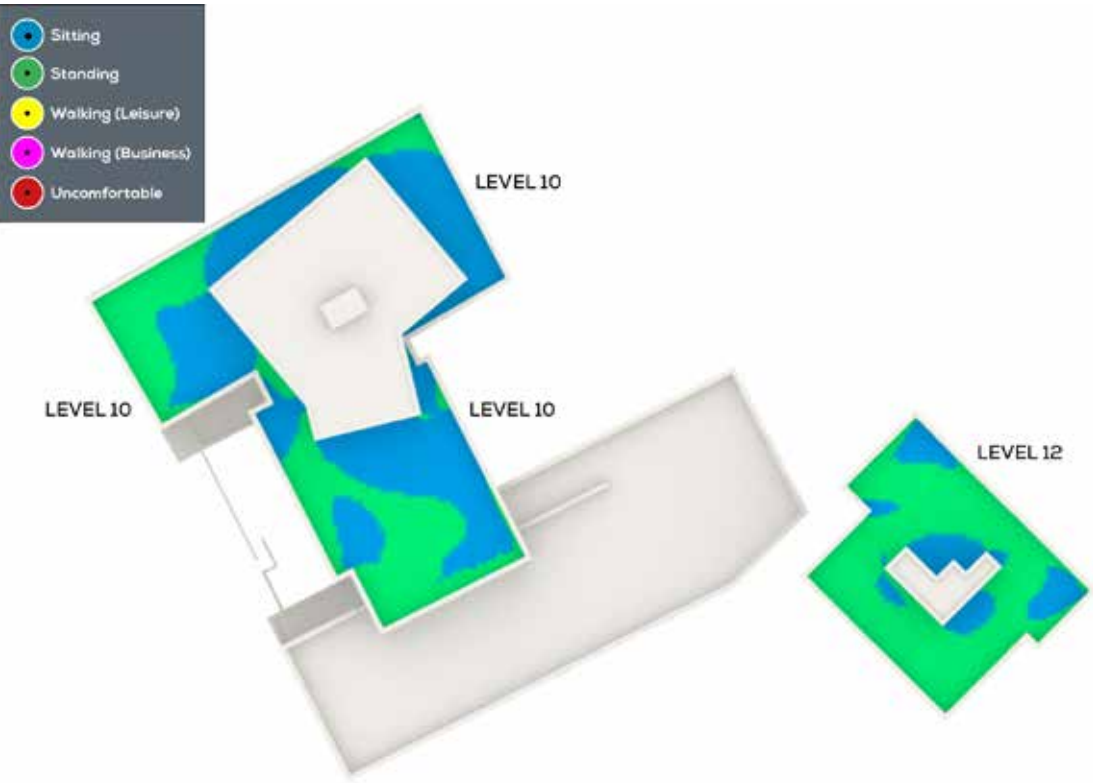


Fig. 13: Summer Comfort at Terrace Level, Proposed Development with Existing Surrounds

3.3 CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS

Annual safety at ground level for the proposed development with cumulative surrounds is shown in Figure 14. Winter comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 15. Summer comfort at ground level for the proposed development with cumulative surrounds is shown in Figure 16.

There are two regions of S15 (distress) exceedance within the site of the neighbouring Port Street development (132489/FO/2021), which are located within the proposed public realm to the south west of the Port Street site. These would pose a potential safety risk to frail users of this space, but it should be noted that this assessment has been performed in the absence of the proposed landscaping scheme for (132489/FO/2021), which includes dense tree planting in this region and would be expected to resolve the issue.

There are no other regions of safety or distress exceedance within the study area,

Winter conditions range between sitting and standing and leisure walking (with some highly localised regions of business walking). Summer conditions range between sitting, standing and leisure walking.

All principal off-site entrances (marked "O" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

All principal proposed entrances (marked "E" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The proposed ground floor terraces (marked "GF" in results figures) range between suitable for sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use,

The Rochdale Canal towpath (marked "RC" in results figures) is suitable for a mixture of sitting and standing in all seasons. This is

suitable for the intended use.

The Avro building courtyard (marked "AV" in results figures) is suitable for a mixture of standing and leisure walking in winter, and for a mixture of sitting and standing in summer. This is suitable for the intended use.

The cumulative Port Street amenity space (marked "PS" in results figures) is suitable for a mixture of sitting, standing and leisure walking in winter or summer. The region which is suitable for leisure walking in summer is a category windier than required for the intended use but, as with the potential safety risk in the same area, it is expected that the inclusion of the proposed dense tree planting in this region would resolve this issue.

Annual safety at terrace level for the proposed development with cumulative surrounds is shown in Figure 17. Winter comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 18. Summer comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 19.

There are no significant regions of wind safety risk at terrace level.

There is a highly localised region of S15 (distress) exceedance at the eastern extremity of the level 12 terrace on Block 2. This is sufficiently localised that it will not impact on the safety of terrace users.

Conditions for the proposed level 10 terraces on Block 1 are suitable for a mixture of sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use.

Conditions for the proposed level 12 terrace on Block 2 are suitable for a mixture of sitting, standing and leisure walking in winter and for a mixture of sitting and standing in summer. This is suitable for the intended use.



Fig. 14: Annual Safety at Ground Level, Proposed Development with Cumulative Surrounds

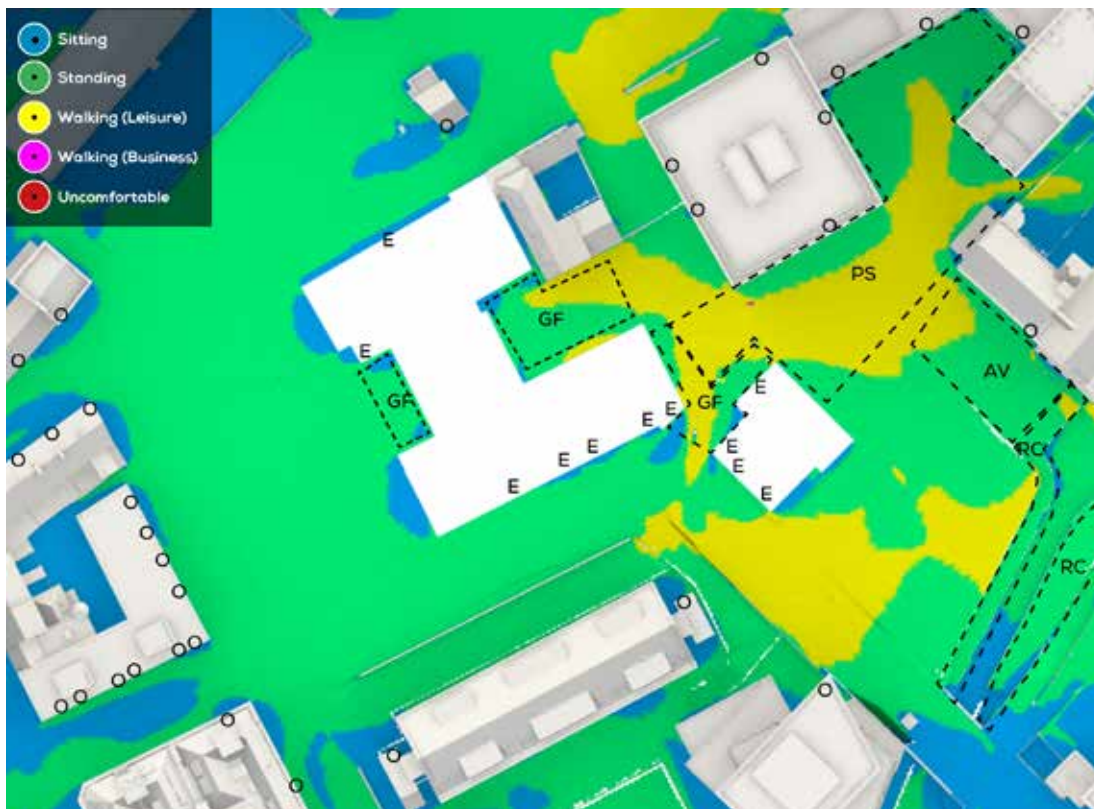


Fig. 15: Winter Comfort at Ground Level, Proposed Development with Cumulative Surrounds

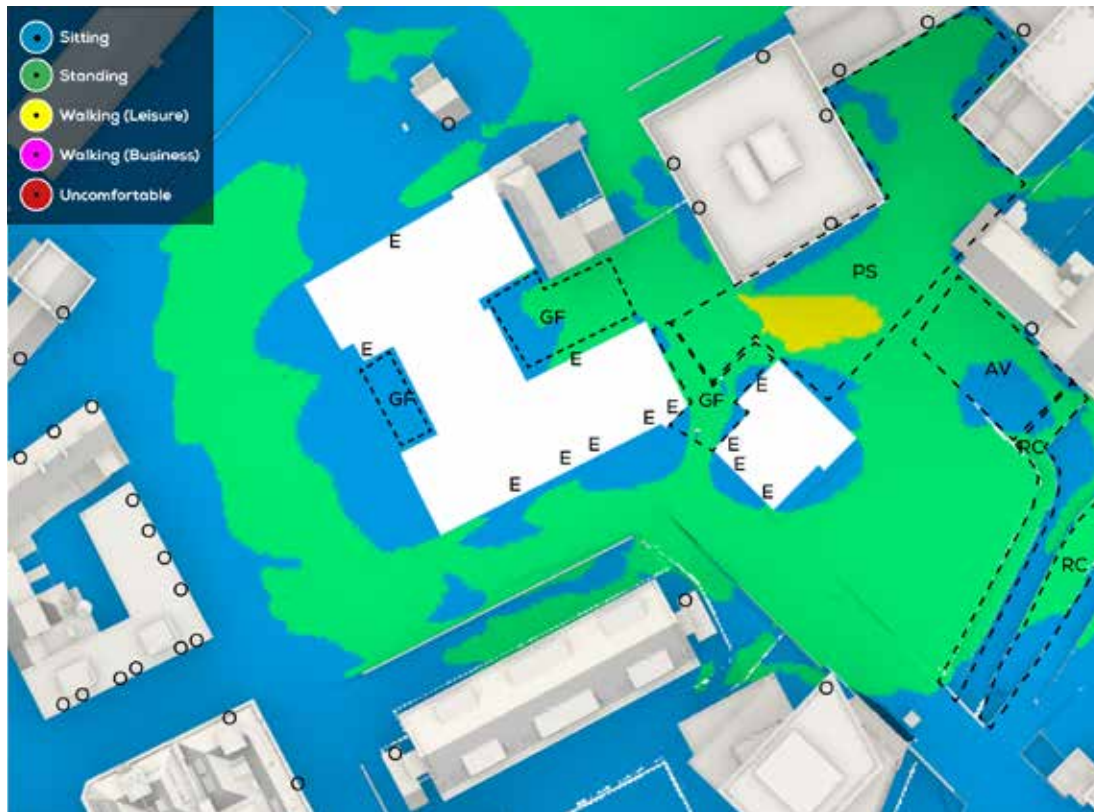


Fig. 17: Summer Comfort at Ground Level, Proposed Development with Cumulative Surrounds



Fig. 16: Annual Safety at Terrace Level, Proposed Development with Cumulative Surrounds

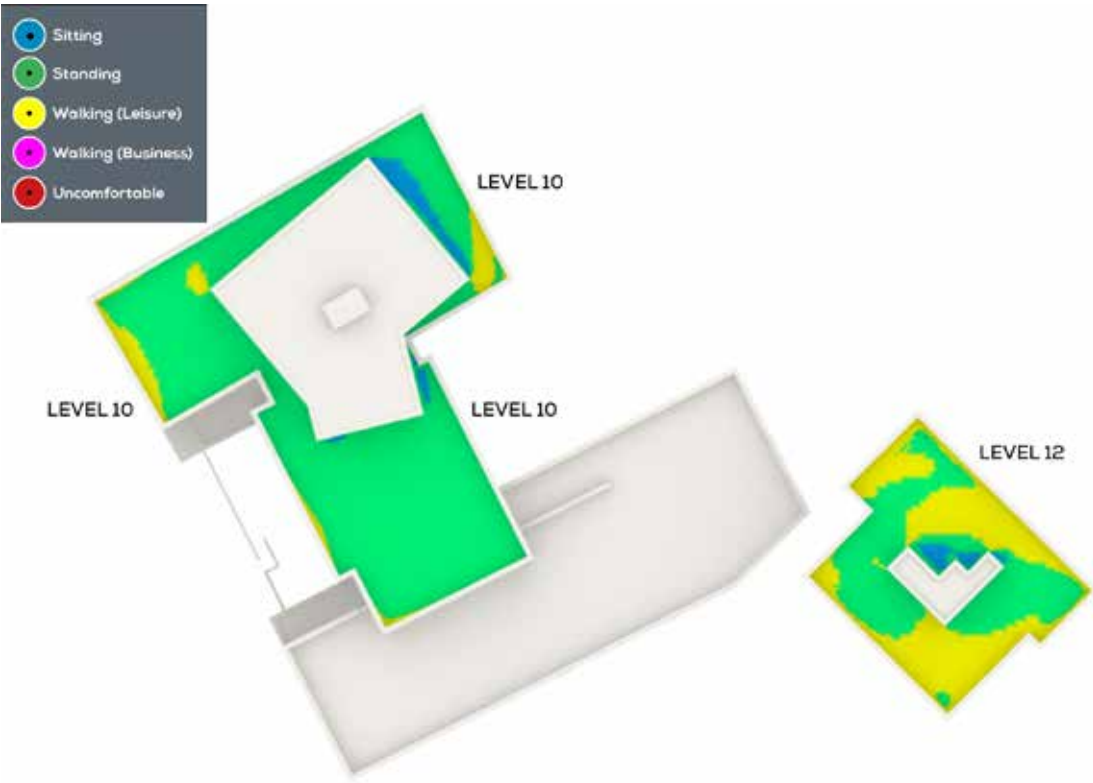


Fig. 18: Winter Comfort at Terrace Level, Proposed Development with Cumulative Surrounds

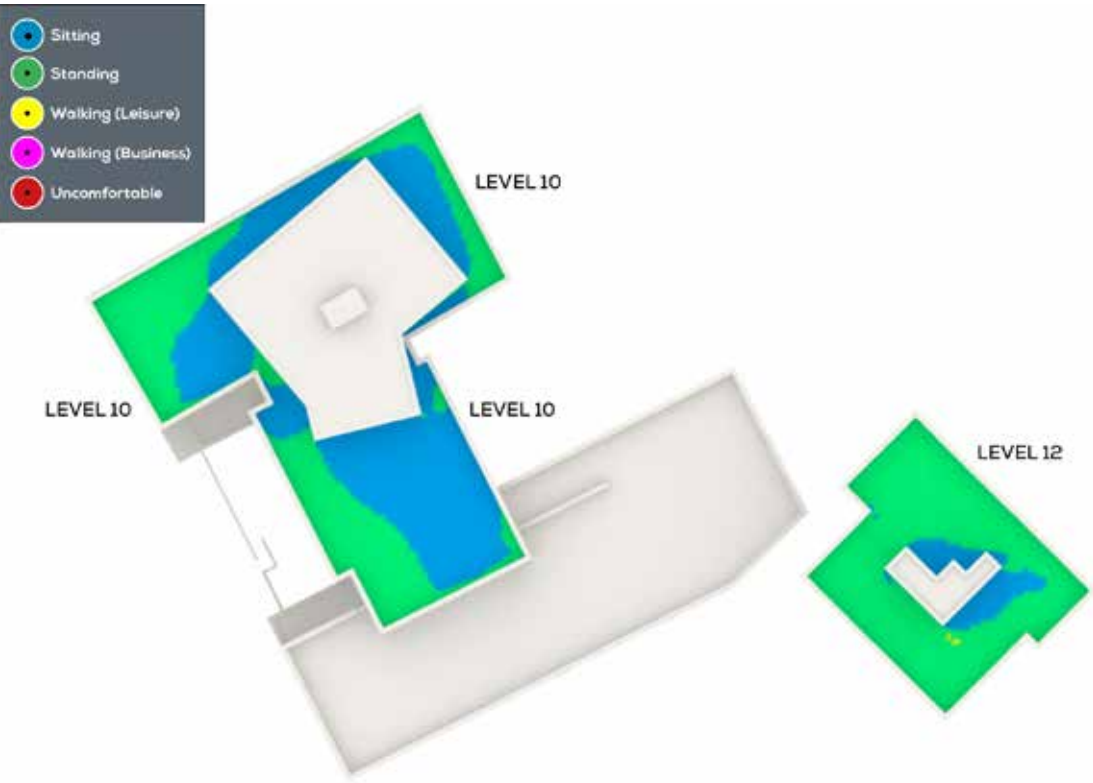


Fig. 19: Summer Comfort at Terrace Level, Proposed Development with Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed 1NQ, Tariff Street development were assessed using high resolution CFD.

There are no significant wind safety risks associated with the proposed development when tested with the existing surrounds..

All wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing and proposed ground floor amenity spaces and roof terraces.

When tested with the cumulative surrounds, there are two regions of potential S15 (distress) exceedance within the site of the consented neighbouring Port Street development (132489/FO/2021). In the absence of appropriate mitigation this could pose a safety risk to frail individuals during times of strong winds, but the inclusion of the proposed landscaping scheme for 132489/FO/2021 (which included dense tree planting within the key wind flow path for this issue) will resolve this issue and ensure that there is not a significant safety risk.

APPENDIX 01 **DETAILED METHODOLOGY**

CFD METHODOLOGY

The CFD was performed using OpenFOAM.

Meshed using a hybrid mesh of hexahedral, polyhedral, tetrahedral and prismatic elements:

- On site building edge length: 0.05m – 0.25m
- Surrounding context edge length: 0.25m – 1m

Prismatic cells were used in the boundary layer region, with 4 layers of cells growing with an expansion ratio of 1.15 and aspect ratios between 0.1 and 0.4.

The total mesh size was between 107 and 118 million cells. Mesh detail is shown in Figure 20 and Figure 21.

Buildings within 400m of the site were included.

The domain was 5000mx5000m, with a blockage ratio of 0.5%

The blockage ratio uses a “test section” of 600mx200m (within which detail is captured).

Run using the SST turbulence model with high Re wall functions to ensure mesh suitability.

The simulations were steady state and isothermal.

2nd order discretisation schemes were used.

Convergence was measured as the residuals of the continuity, x-velocity, y-velocity, z-velocity, k and omega equations all falling by at least 2 orders of magnitude, and by measured static pressure on the site buildings varying by less than 1% over the final 100 iterations.

The wind speed is corrected into a “gust-equivalent” mean. The gust-equivalent mean is calculated using an empirical relationship between the gust and mean ratios recorded at over 13,000 data points from wind tunnel tests. This method is found to give a significant correlation improvement over the more traditional methods based on the CFD turbulent kinetic energy field.

WIND CLIMATE METHODOLOGY

The simulations were performed from 18 wind directions, spaced such that no single direction contributed more than 10% of the annual winds.

The directions simulated were 0°, 30°, 60°, 90°, 120°, 150°, 170°, 180°, 190°, 200°, 210°, 220°, 240°, 260°, 270°, 280°, 300°, 330°.

Seasonal wind roses for Manchester International Airport are shown in Figure 21.

Target wind profiles for the site, from each wind direction, were generated using sectoral analysis of the terrain surrounding the site and the local weather stations with ESDU 2010 Item 01008 ‘Computer program for wind speeds and turbulent properties: flat or hilly sites in terrain with roughness changes’. The target wind profiles, compared to the wind speeds measured from the CFD model are shown in Figure 23.

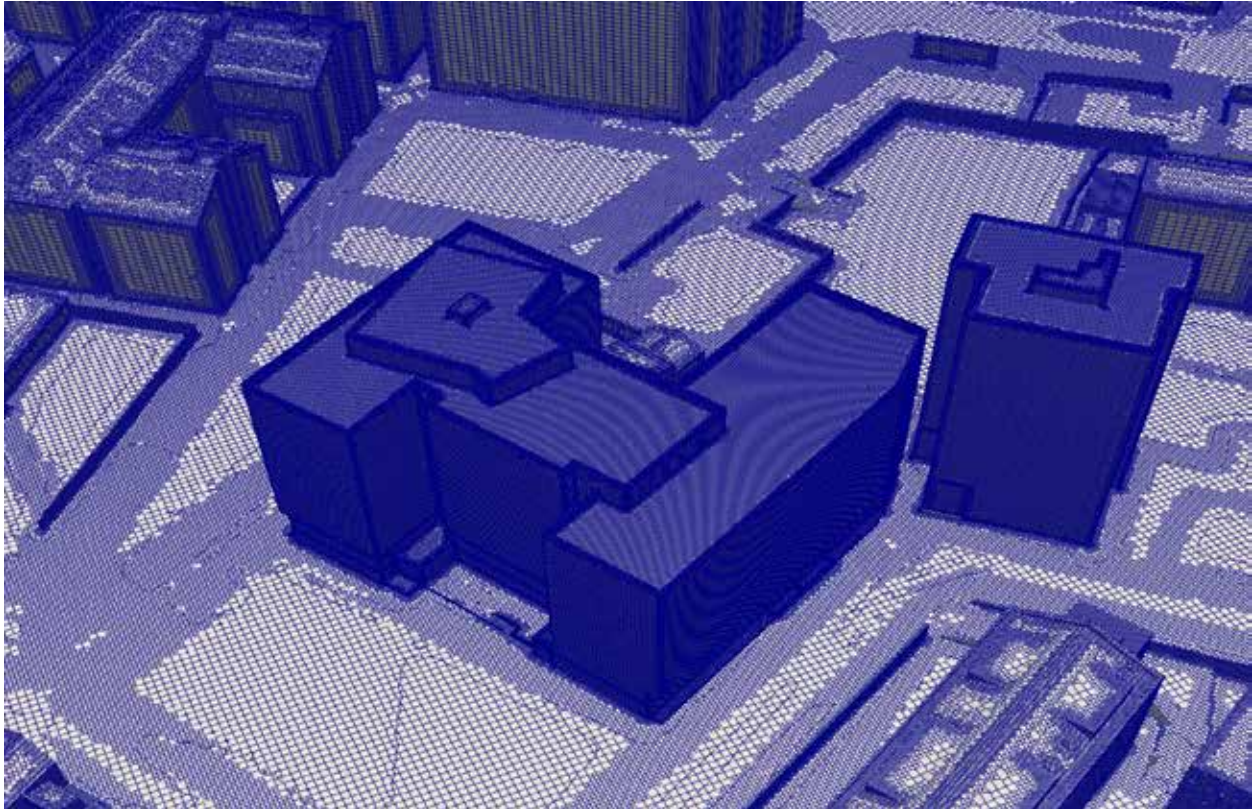


Fig. 20: Mesh Detail on Site Buildings

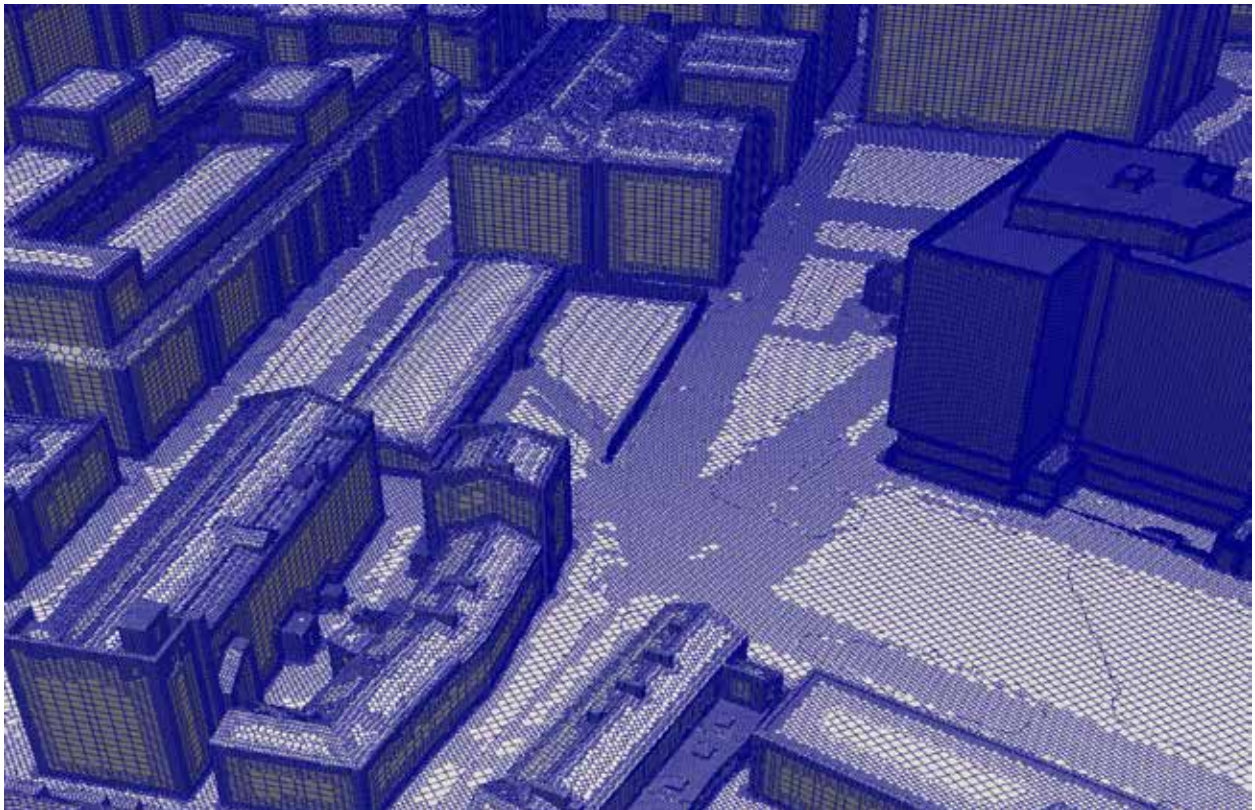


Fig. 21: Mesh Detail on Surrounds

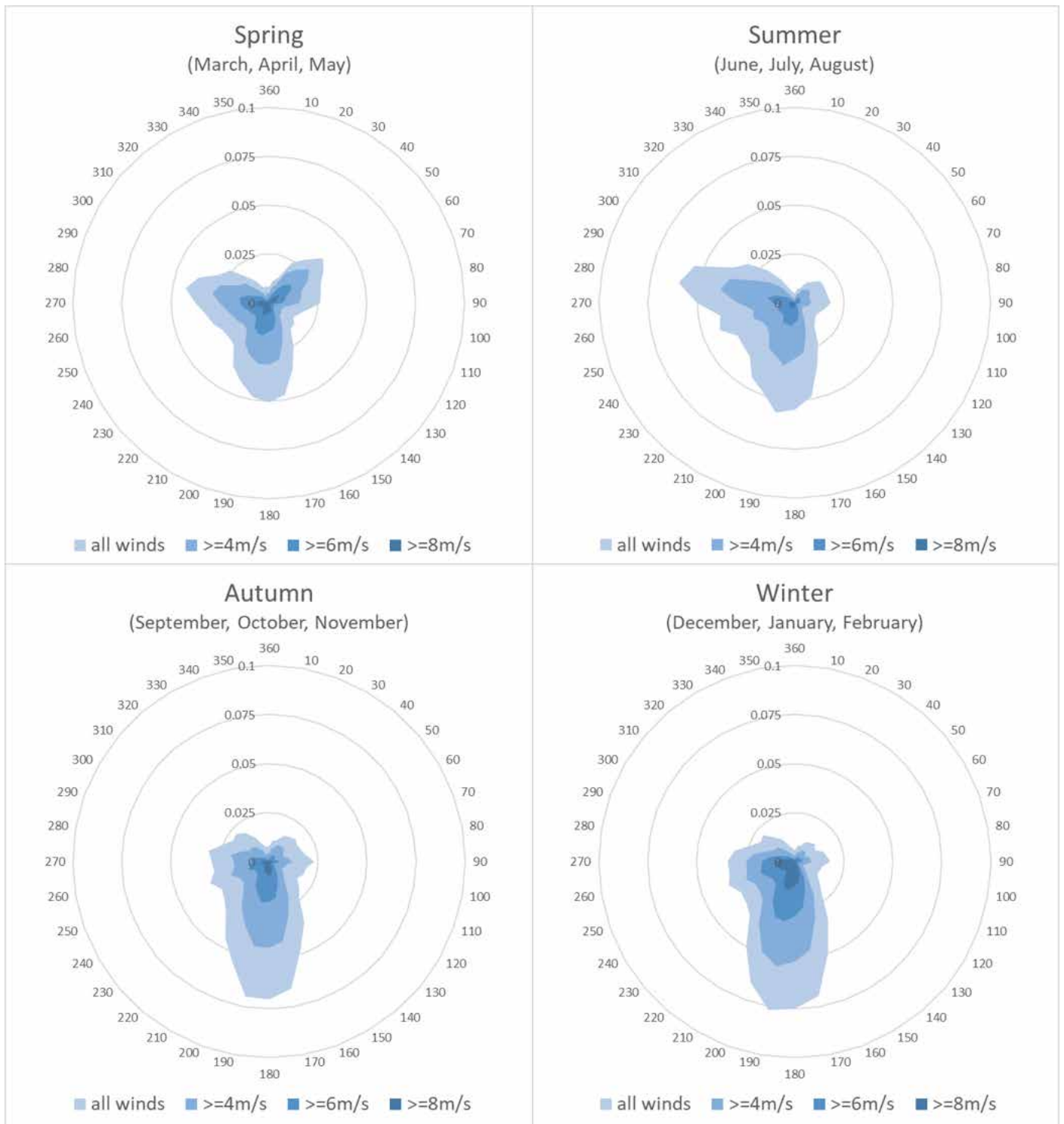


Fig. 22: Seasonal Wind Roses for Manchester International Airport (1990-2020)

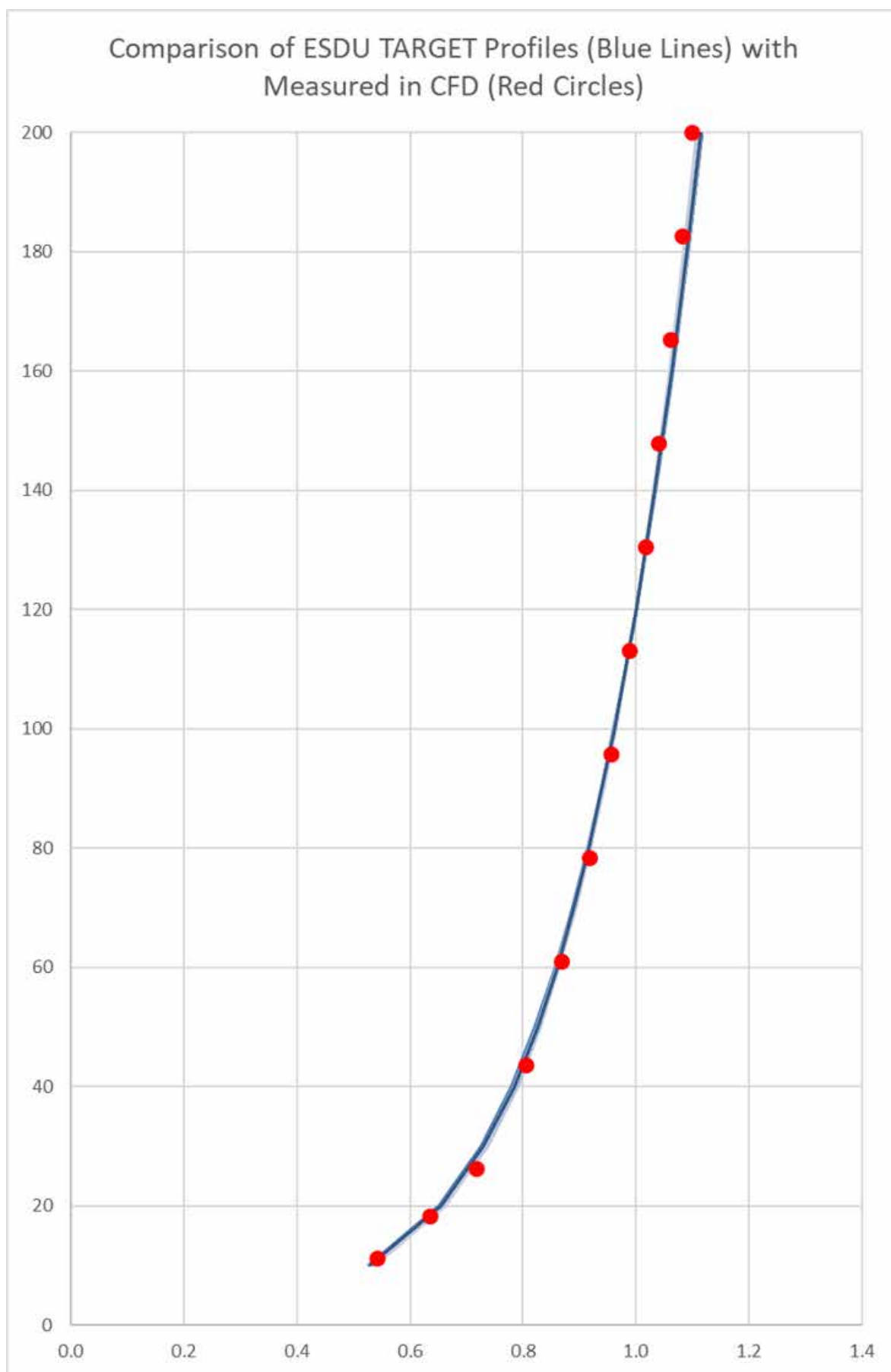


Fig. 23: Wind Profile for Laystall Street

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