



WIND MICROCLIMATE ASSESSMENT REPORT

Land to the West of Rodney Street,
Manchester

8 June 2022

GIA No: 18797

PROJECT DATA:

Client **Wates Construction Ltd**
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1 INTRODUCTION

This report outlines the results of a wind microclimate analysis of the proposed residential development located at Land to the west of Rodney Street in Manchester, UK.

1.1 SUMMARY

Wind microclimate conditions for the proposed residential development on Land to the west of Rodney Street were assessed using high resolution CFD.

No potential wind safety or distress risks that have been identified around the site.

Wind comfort conditions will be suitable for the intended use.

This applies to general thoroughfares, bus stops, existing off-site building entrances, proposed on-site building entrances and amenity spaces (both at ground level and on the end town house roof terraces).

There are no adverse wind effects anticipated relating to the proposed development.

1.2 GUIDANCE

The assessment was performed using the LDDC variant of the Lawson Comfort Criteria. The Lawson Criteria are well-established in the UK for quantifying wind conditions in relation to build developments and, although not a UK 'standard', the criteria are recognised by local authorities as a suitable benchmark for wind assessments. The Lawson Criteria have been adopted for this assessment.

Planning Practice Guidance 6th March 2014. The Department for Communities and Local Government (DCLG) web based Planning Practice Guidance resource includes a section on design and sets out how a building's size and shape can affect the wind microclimate. The section addressing Design - How should buildings and the spaces between them be considered? 'Consider scale' Paragraph O26, states that: "Account should be taken of local climatic conditions, including daylight and sunlight, wind, temperature and frost pockets."

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.

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. 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.

2.2 ESTABLISHING MICROCLIMATE CONDITIONS

Microclimate conditions were established using a high resolution CFD model, extending to a 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 Proposed Development consists of two residential apartment buildings, one of 8 storeys (68 apartments) and one of 5 storeys (50 apartments), giving a total of 118 residential apartments; and 10, 3 storey townhouses; together with car and cycle parking provision, hard and soft landscaping including public realm, access, a substation and other associated works..

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.

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	1.48	1.49	1.49	1.46	1.39	1.31	1.29	1.31	1.29	1.29	1.44	1.40

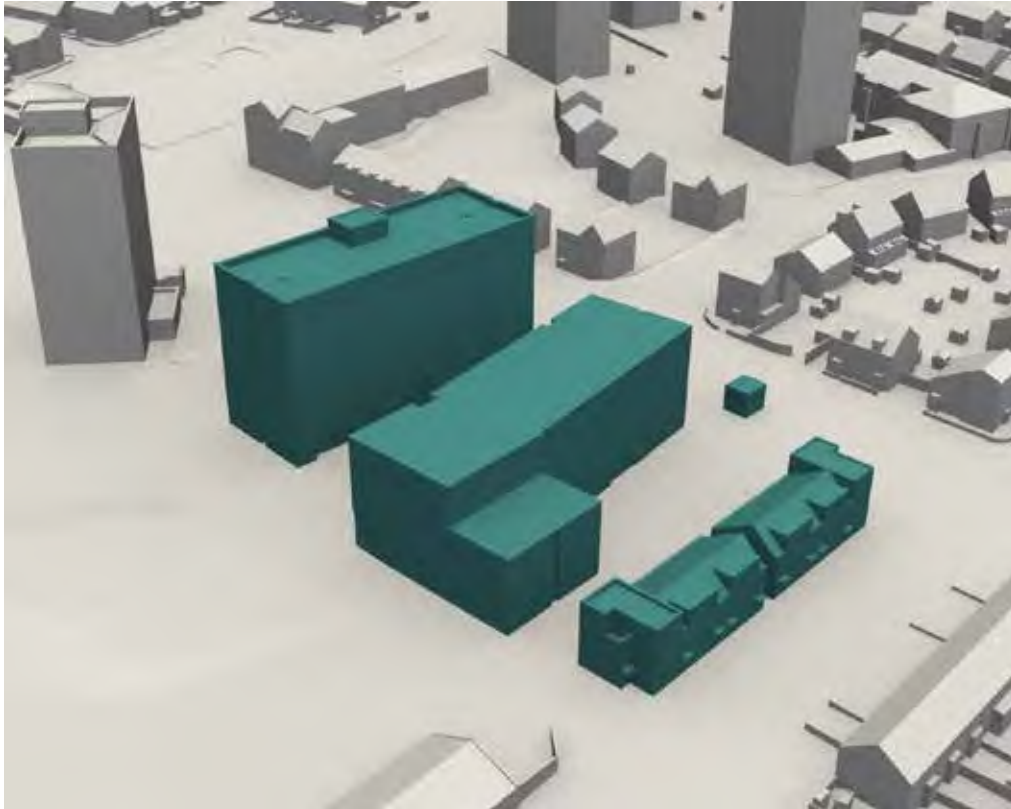


Fig. 01: 3D View of Proposed Development



Fig. 02: Surrounding Context with Existing Surrounds



Fig. 03: Surrounding Context with Cumulative Surrounds

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.

Any bus stops should be suitable for standing. There is a bus stop within the study area on Butler Street to the north of the site

There is existing amenity in the form of Ancoats Green, and proposed amenity at ground level within the proposed development, as well private terraces within the end town houses. These spaces are targeted to be suitable for a mixture of sitting and standing in summer.

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;
- 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.

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

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.

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

3 RESULTS

3.1 BASELINE CONDITIONS

Annual safety for the baseline scenario is shown in Figure 4 Winter comfort for the baseline scenario is shown in Figure 5. Summer comfort for the baseline scenario is shown in Figure 6.

There are no regions of safety concern anywhere within the study area.

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

Conditions for the bus stop on Butler Street (marked "B") are suitable for standing in all seasons. This is suitable for the intended use.

Conditions for Ancoats Green are 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.

Conditions for all off-site entrances within the study area are suitable for either sitting or standing. This is suitable for the intended use.

3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS

Annual safety for the proposed development with existing surrounds is shown in Figure 7 Winter comfort for the proposed development with existing surrounds is shown in Figure 8. Summer comfort for the proposed development with existing surrounds is shown in Figure 9.

There are no regions of safety concern anywhere within the study area.

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

Conditions for the bus stop on Butler Street (marked "B") are suitable for standing in all seasons. This is suitable for the intended use.

Conditions for Ancoats Green are 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.

Conditions for all off-site entrances within the study area are suitable for either sitting or standing. This is suitable for the intended use.

Conditions for the principal entrances to the proposed development (marked "E") are suitable for either standing or sitting in all seasons. This is suitable for the intended use.

Conditions for the proposed on-site amenity 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.

Annual safety at terrace level for the proposed development with existing surrounds is shown in Figure 10 Winter comfort at terrace level for the proposed development with existing surrounds is shown in Figure 11. Summer comfort at terrace level for the proposed development with existing surrounds is shown in Figure 12.

Conditions for the proposed private terraces on the end town houses are suitable for a mixture of sitting and standing in all seasons, and are not subject to any safety exceedances. This is suitable for the intended use.

3.3 **CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS**

Annual safety for the proposed development with cumulative surrounds is shown in Figure 13
Winter comfort for the proposed development with cumulative surrounds is shown in Figure 14
Summer comfort for the proposed development with cumulative surrounds is shown in Figure 15.

There are no regions of safety concern anywhere within the study area.

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

Conditions for the bus stop on Butler Street (marked "B") are suitable for standing in all seasons. This is suitable for the intended use.

Conditions for Ancoats Green are 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.

Conditions for all off-site entrances within the study area are suitable for either sitting or standing. This is suitable for the intended use.

Conditions for the principal entrances to the proposed development (marked "E") are suitable for either standing or sitting in all seasons. This is suitable for the intended use.

Conditions for the proposed on-site amenity 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.

Annual safety at terrace level for the proposed development with cumulative surrounds is shown in Figure 16
Winter comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 17.
Summer comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 18.

Conditions for the proposed private terraces on

the end town houses are suitable for a mixture of sitting and standing in all seasons, and are not subject to any safety exceedances. This is suitable for the intended use.



Fig. 04: Annual Safety, Baseline

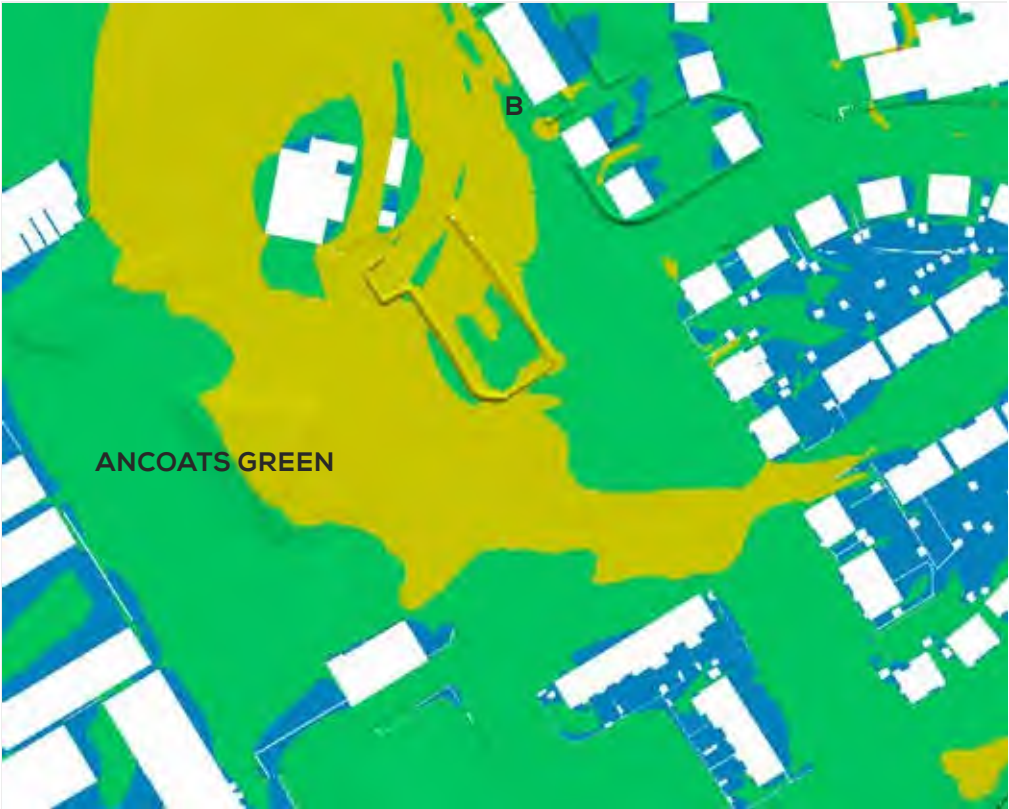
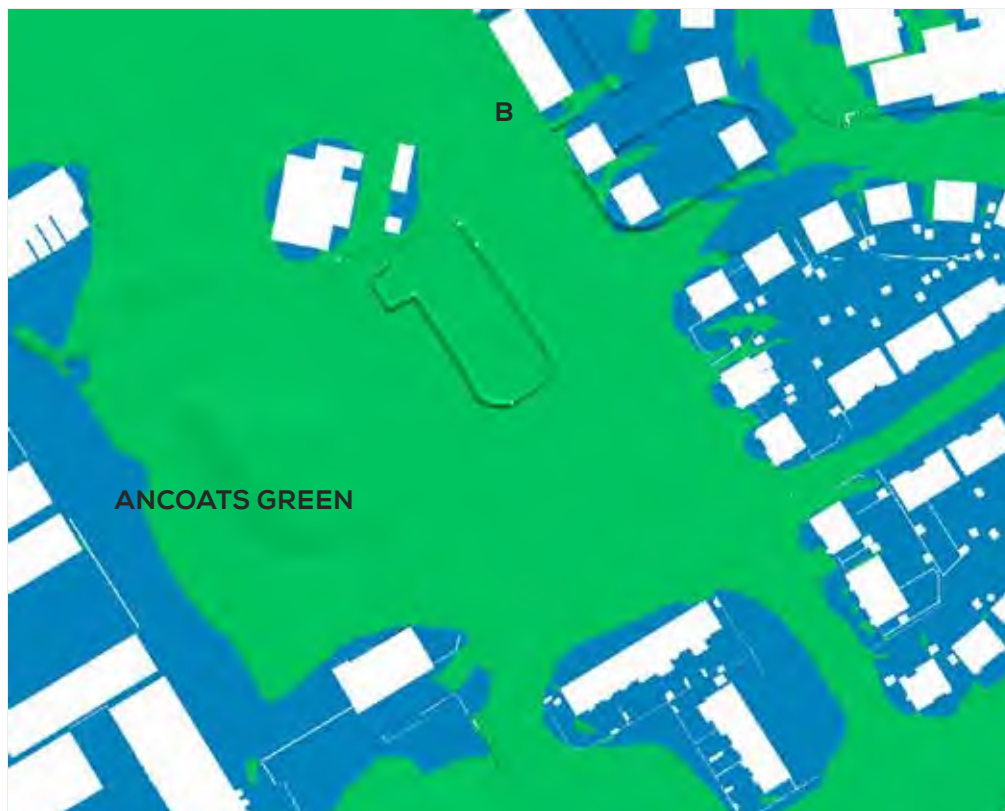


Fig. 05: Winter Comfort, Baseline



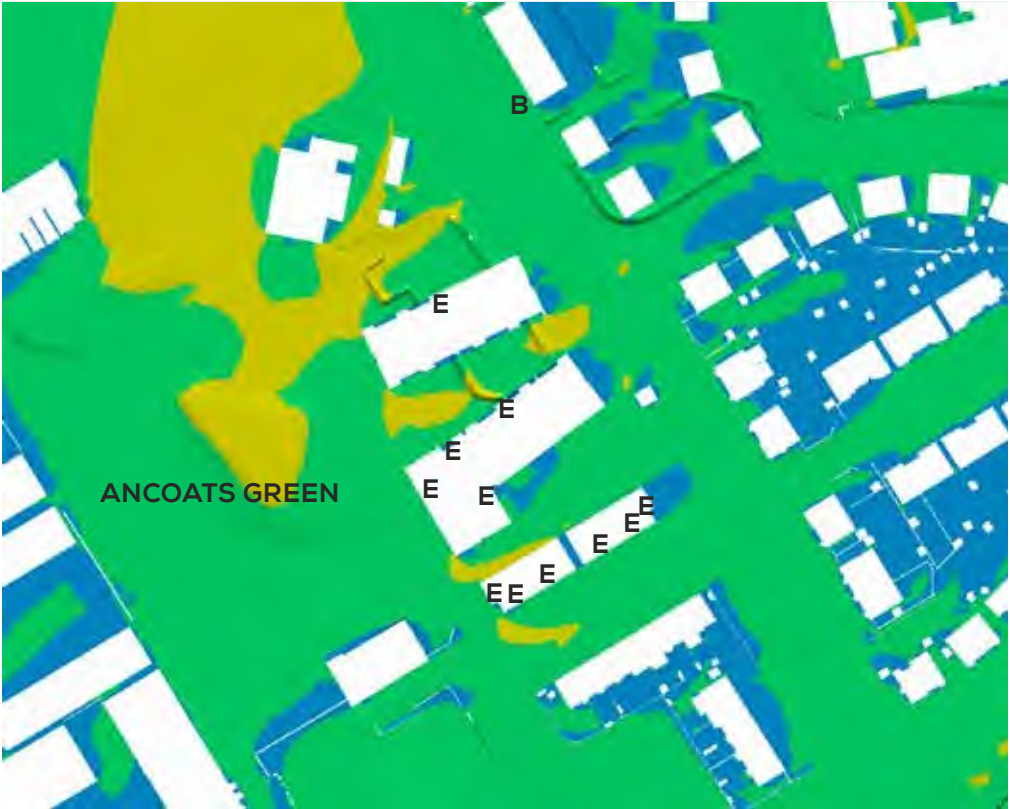
KEY	COMFORT CATEGORY
Blue	Sitting
Green	Standing
Yellow	Walking (leisure)
Pink	Walking (business)
Red	Uncomfortable

Fig. 06: Summer Comfort, Baseline



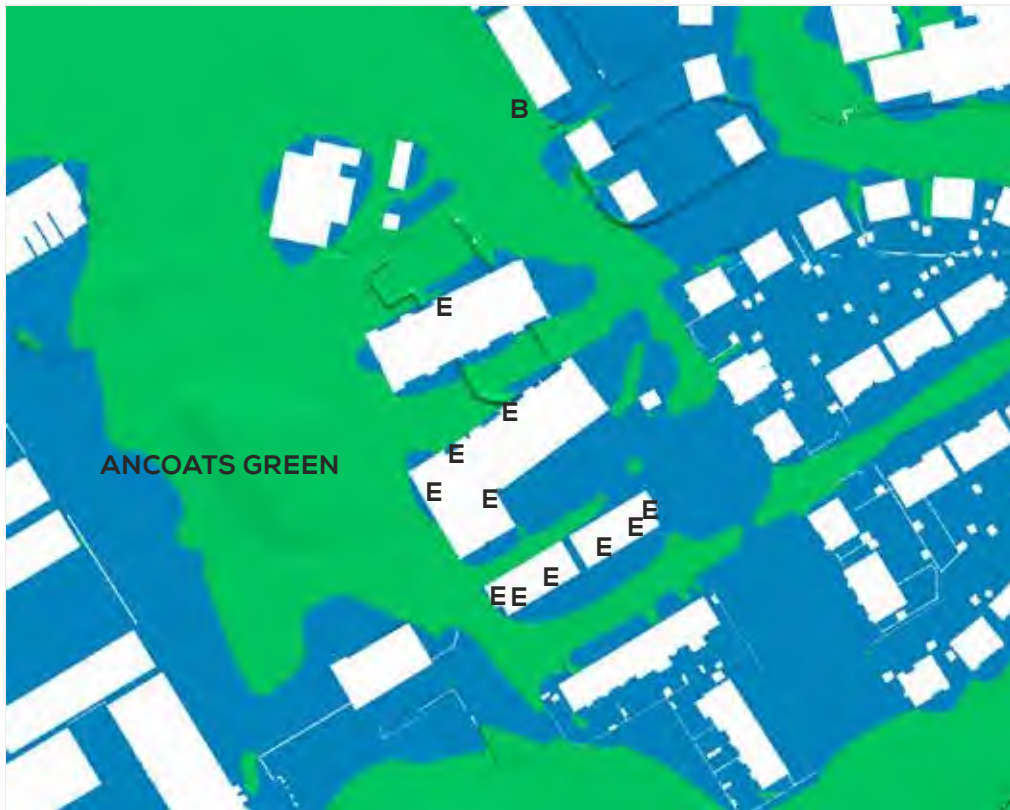
KEY	SAFETY CATEGORY
Grey	No Safety Exceedance
Red	S15 (Distress)
Black	S20 (Safety)

Fig. 07: Annual Safety, Proposed Development with Existing Surrounds



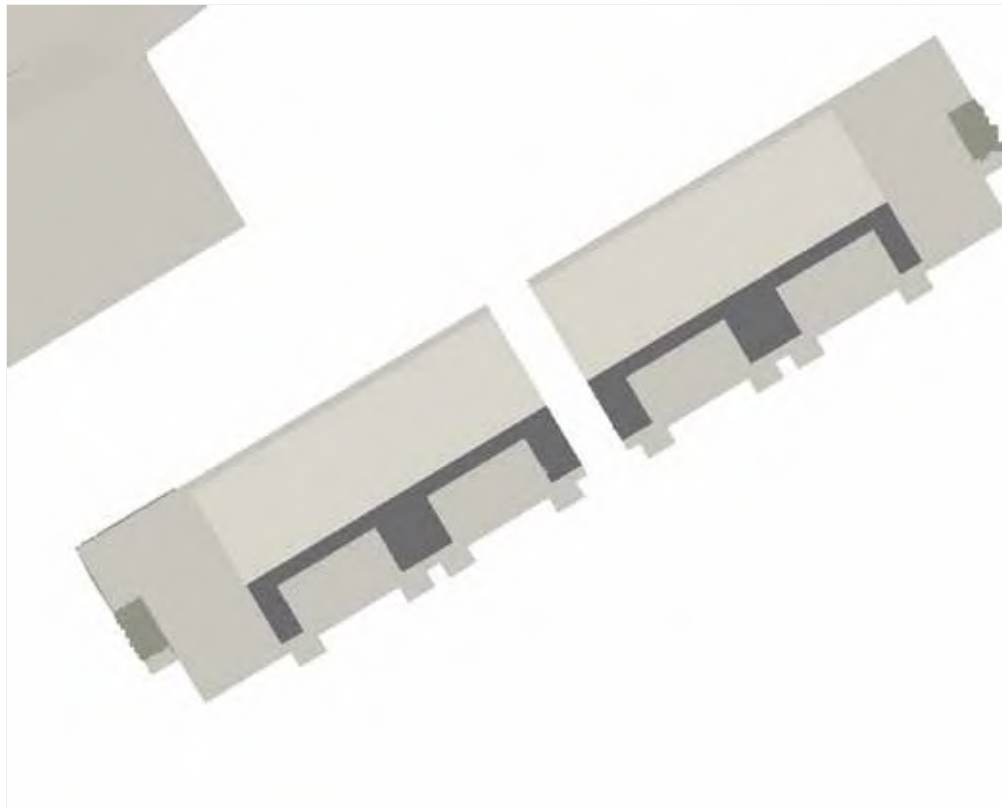
KEY	COMFORT CATEGORY
■	Sitting
■	Standing
■	Walking (leisure)
■	Walking (business)
■	Uncomfortable

Fig. 08: Winter Comfort, Proposed Development with Existing Surrounds



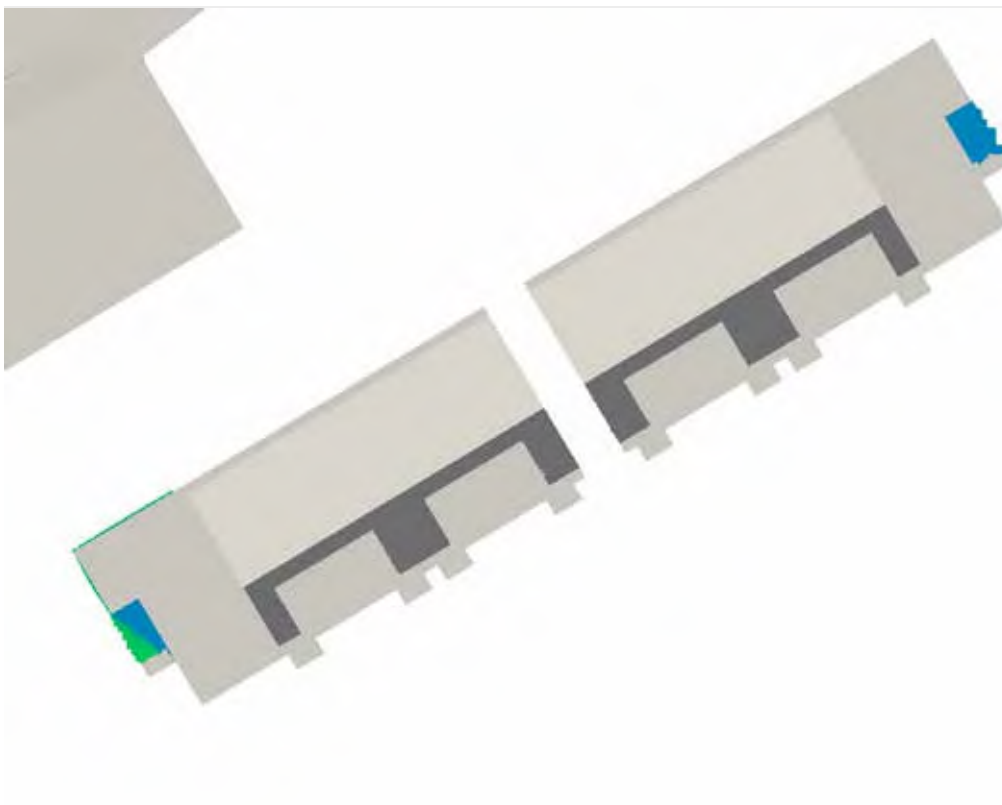
KEY	COMFORT CATEGORY
■	Sitting
■	Standing
■	Walking (leisure)
■	Walking (business)
■	Uncomfortable

Fig. 09: Summer Comfort, Proposed Development with Existing Surrounds



KEY	SAFETY CATEGORY
	No Safety Exceedance
	S15 (Distress)
	S20 (Safety)

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



KEY	COMFORT CATEGORY
	Sitting
	Standing
	Walking (leisure)
	Walking (business)
	Uncomfortable

Fig. 11: Winter Comfort at Terrace Level, Proposed Development with Existing Surrounds

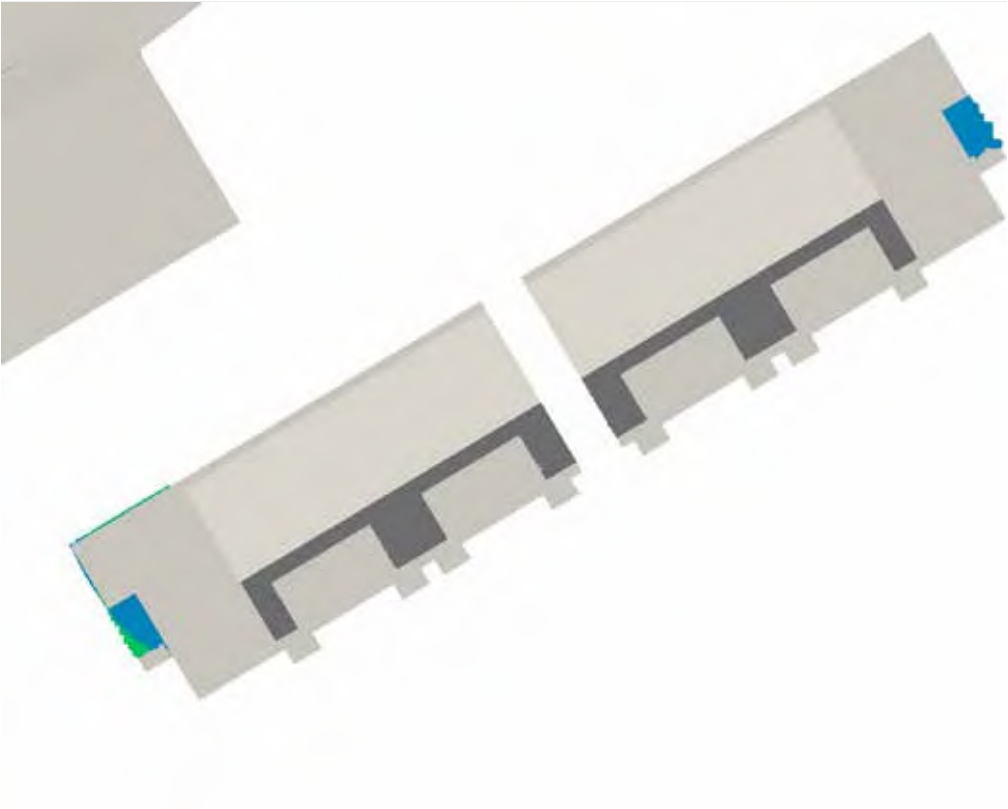


Fig. 12: Summer Comfort at Terrace Level,, Proposed Development with Existing Surrounds

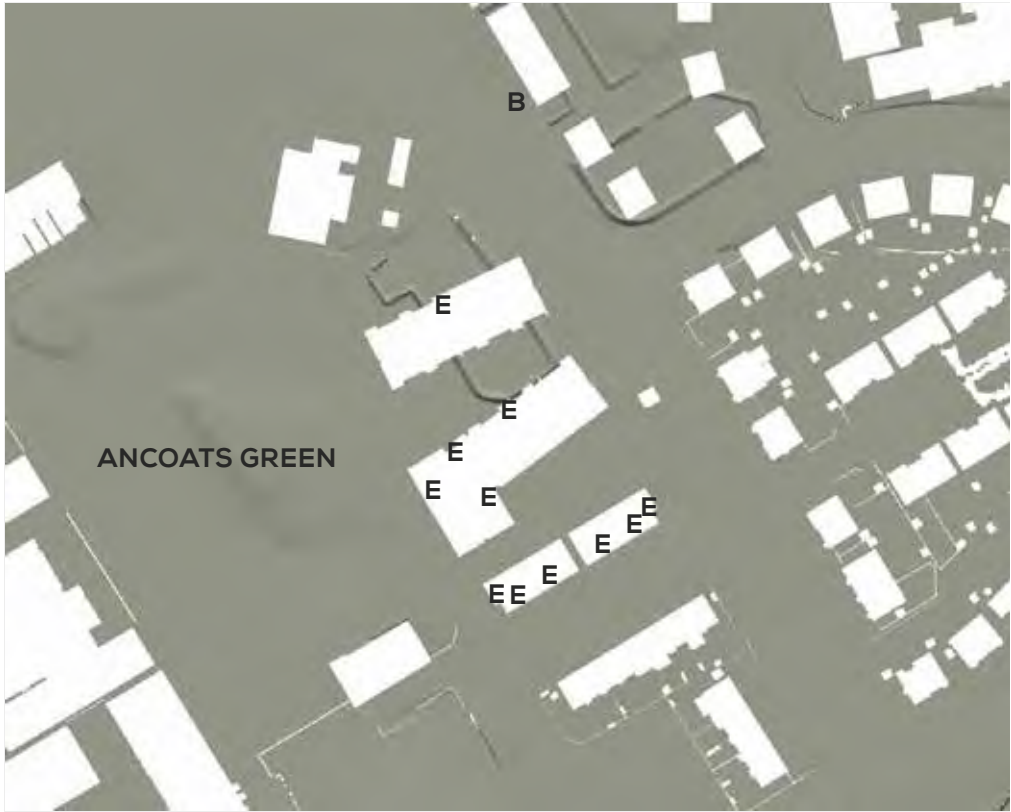
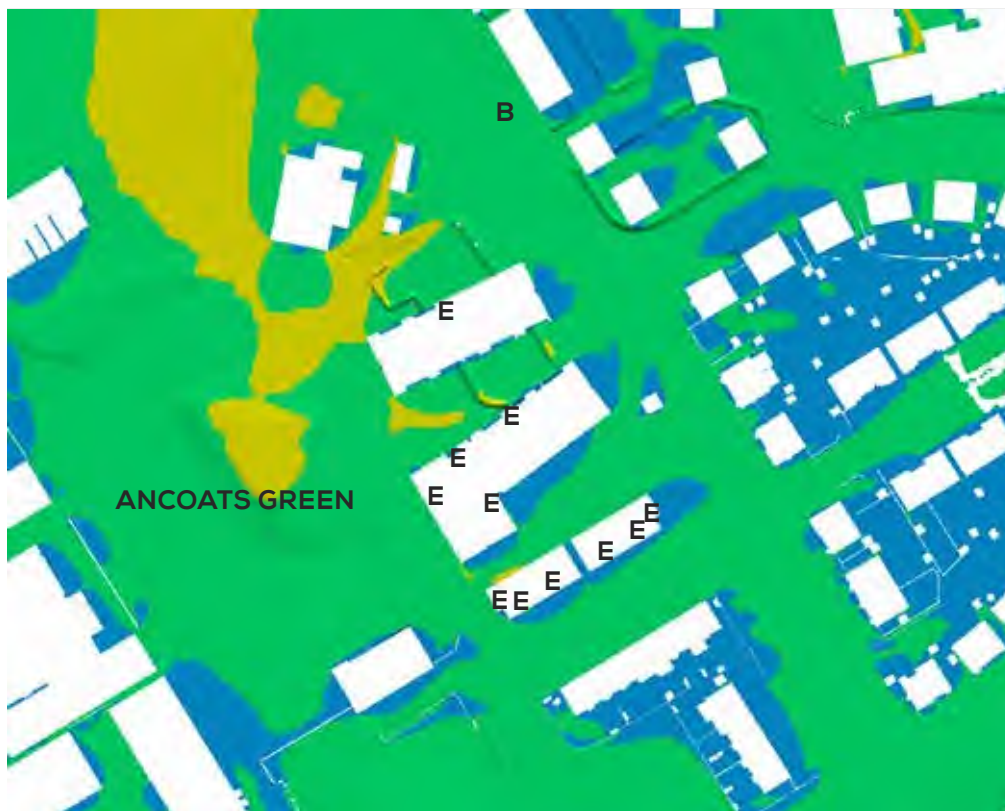
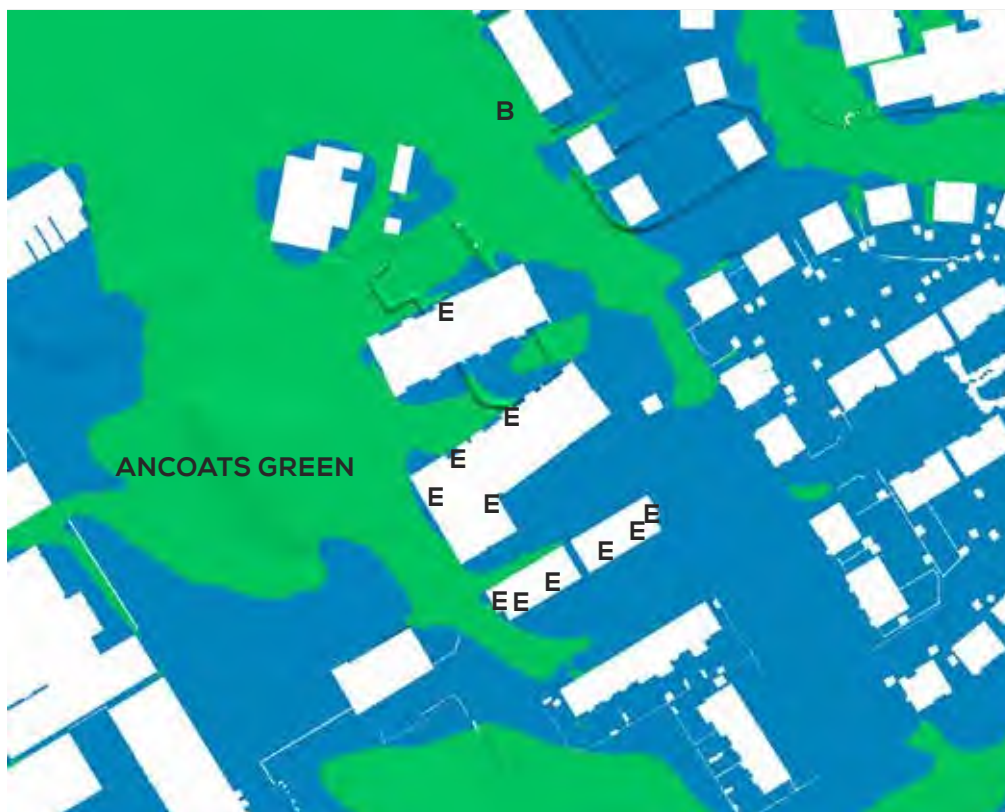


Fig. 13: Annual Safety, Proposed Development with Cumulative Surrounds



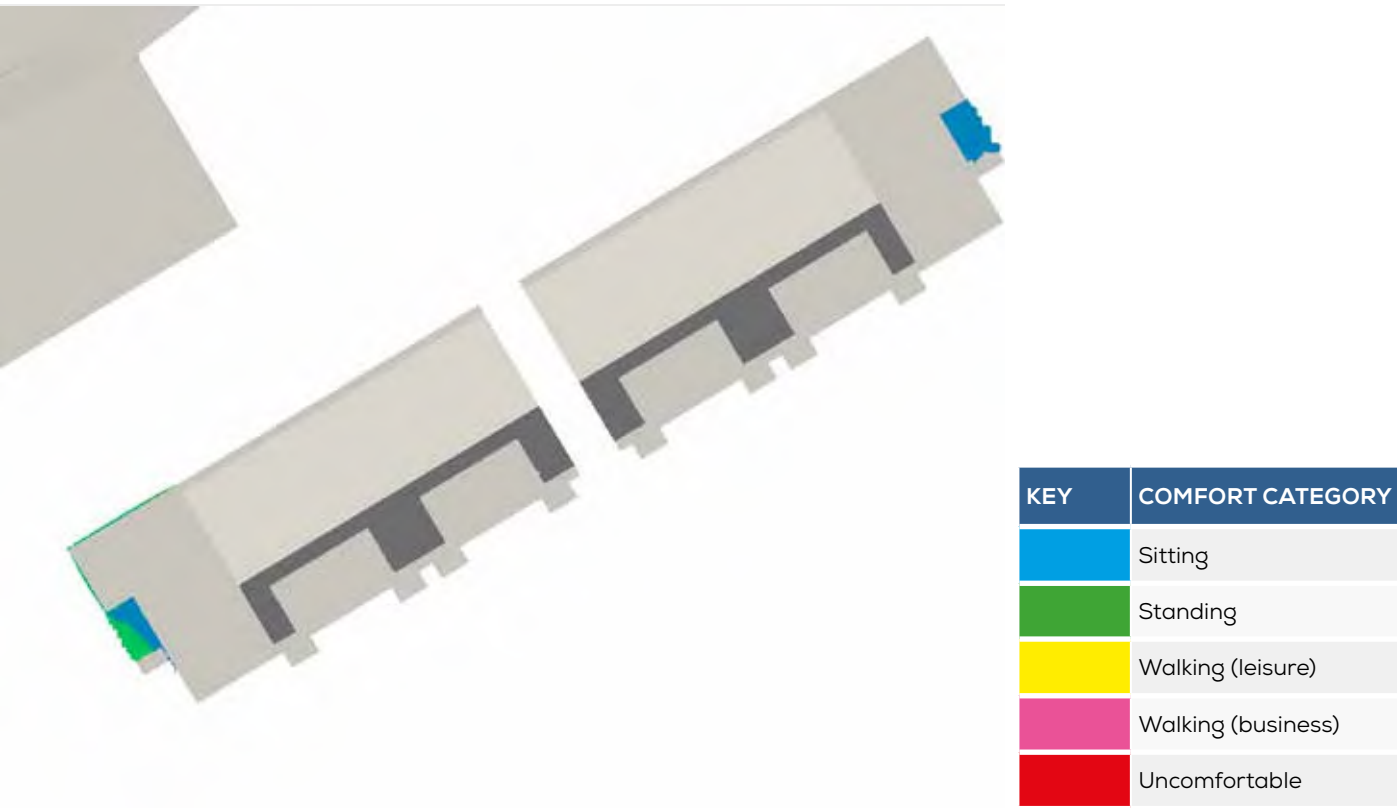
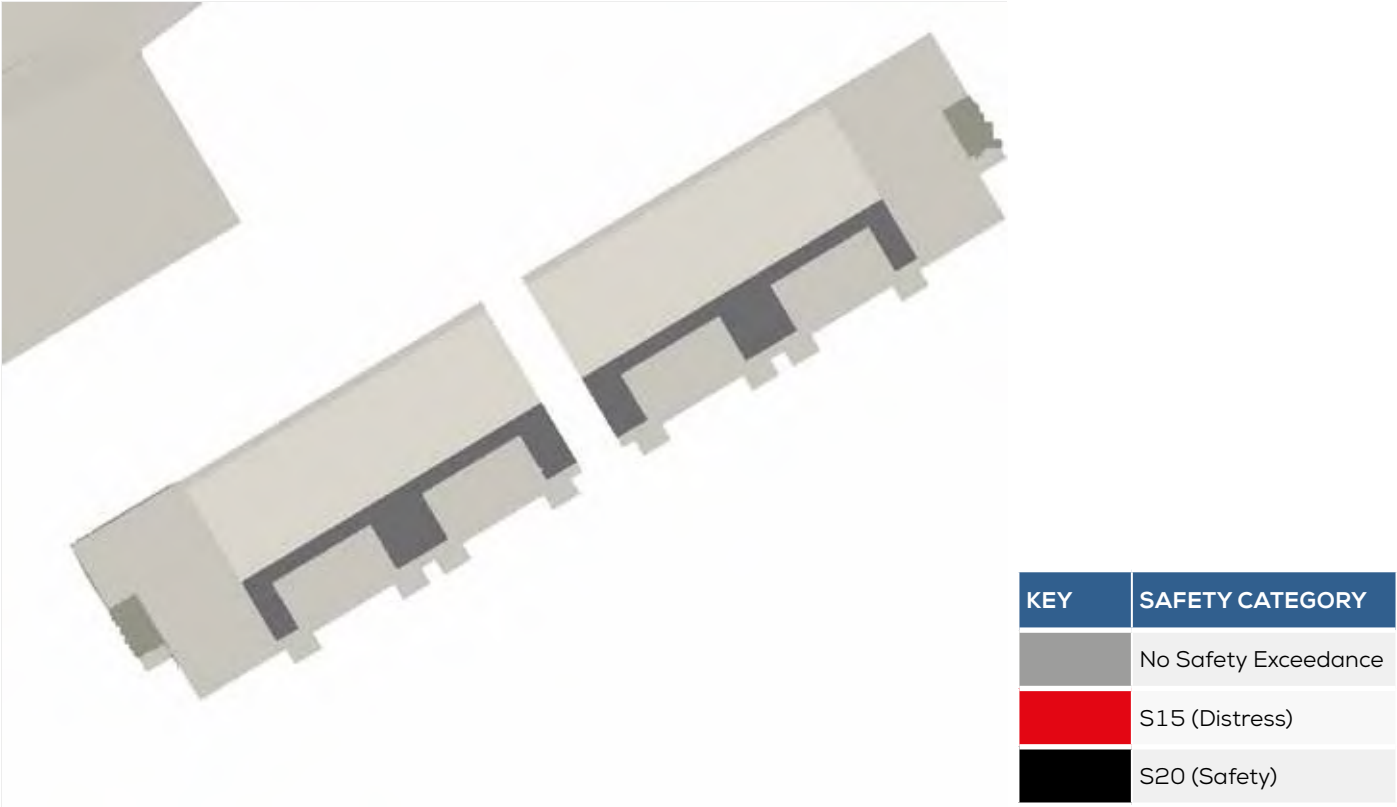
KEY	COMFORT CATEGORY
■	Sitting
■	Standing
■	Walking (leisure)
■	Walking (business)
■	Uncomfortable

Fig. 14: Winter Comfort, Proposed Development with Cumulative Surrounds



KEY	COMFORT CATEGORY
■	Sitting
■	Standing
■	Walking (leisure)
■	Walking (business)
■	Uncomfortable

Fig. 15: Summer Comfort, Proposed Development with Cumulative Surrounds



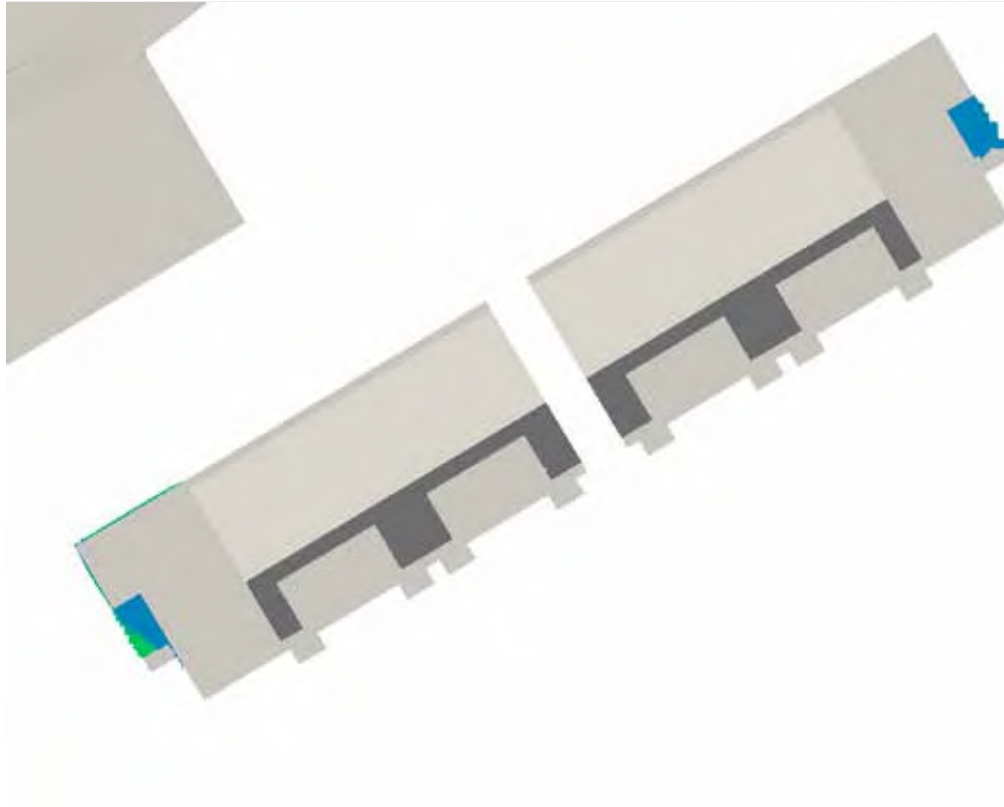


Fig. 18: Summer Comfort at Terrace Level,, Proposed Development with Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed residential development on Land to the west of Rodney Street were assessed using high resolution CFD.

No potential wind safety or distress risks have been identified around the site.

Wind comfort conditions will be suitable for the intended use.

This applies to general thoroughfares, bus stops, existing off-site building entrances, proposed on-site building entrances and amenity spaces (both at ground level and on the end town house roof terraces).

There are no adverse wind effects anticipated relating to the proposed development.

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 78 and 89 million cells. Mesh detail is shown in Figure 19 and Figure 20.

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 22.

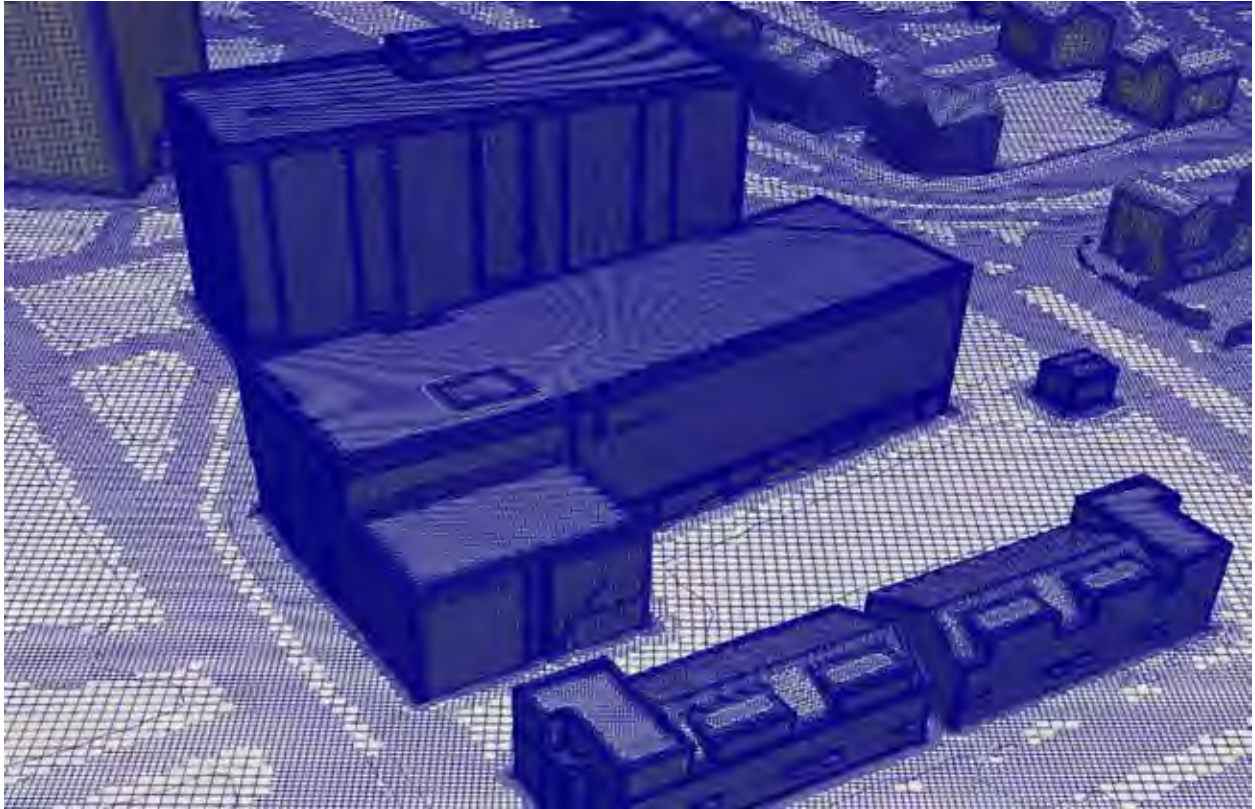


Fig. 19: Mesh Detail on Site Buildings

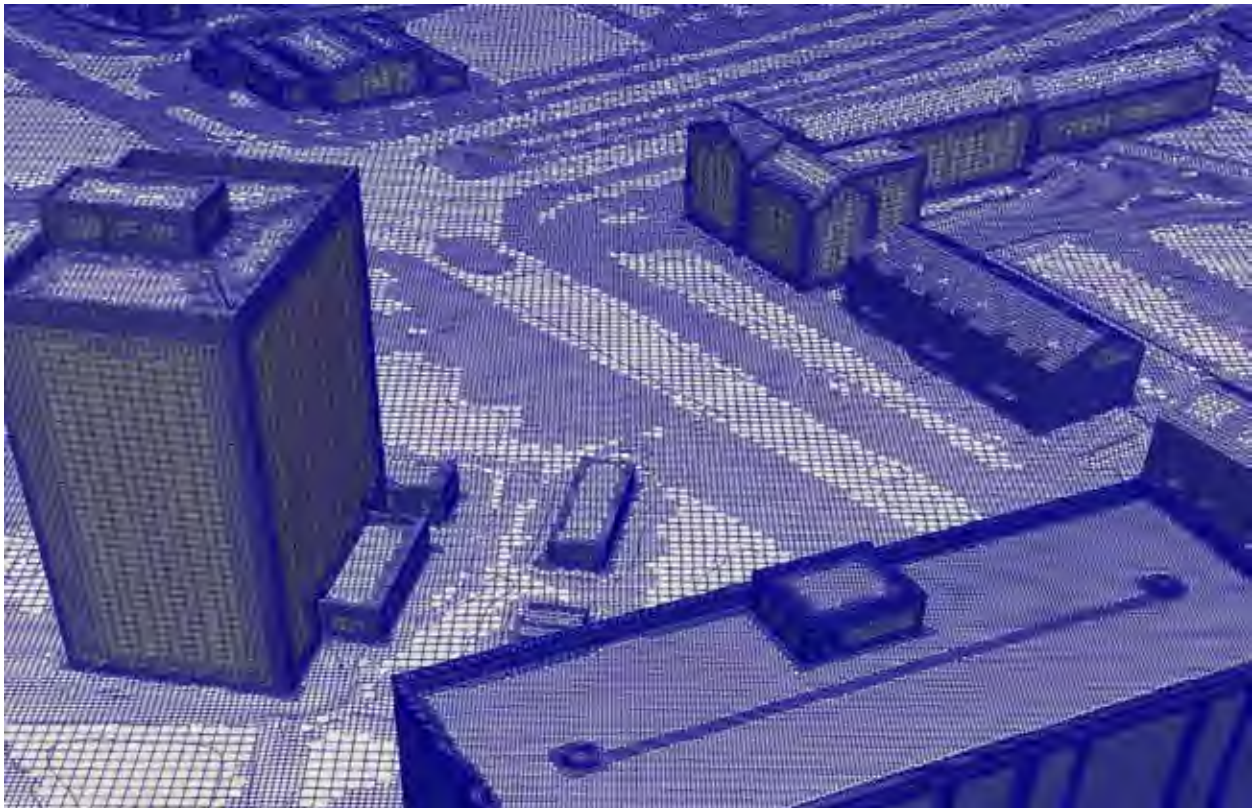


Fig. 20: Mesh Detail on Surrounds

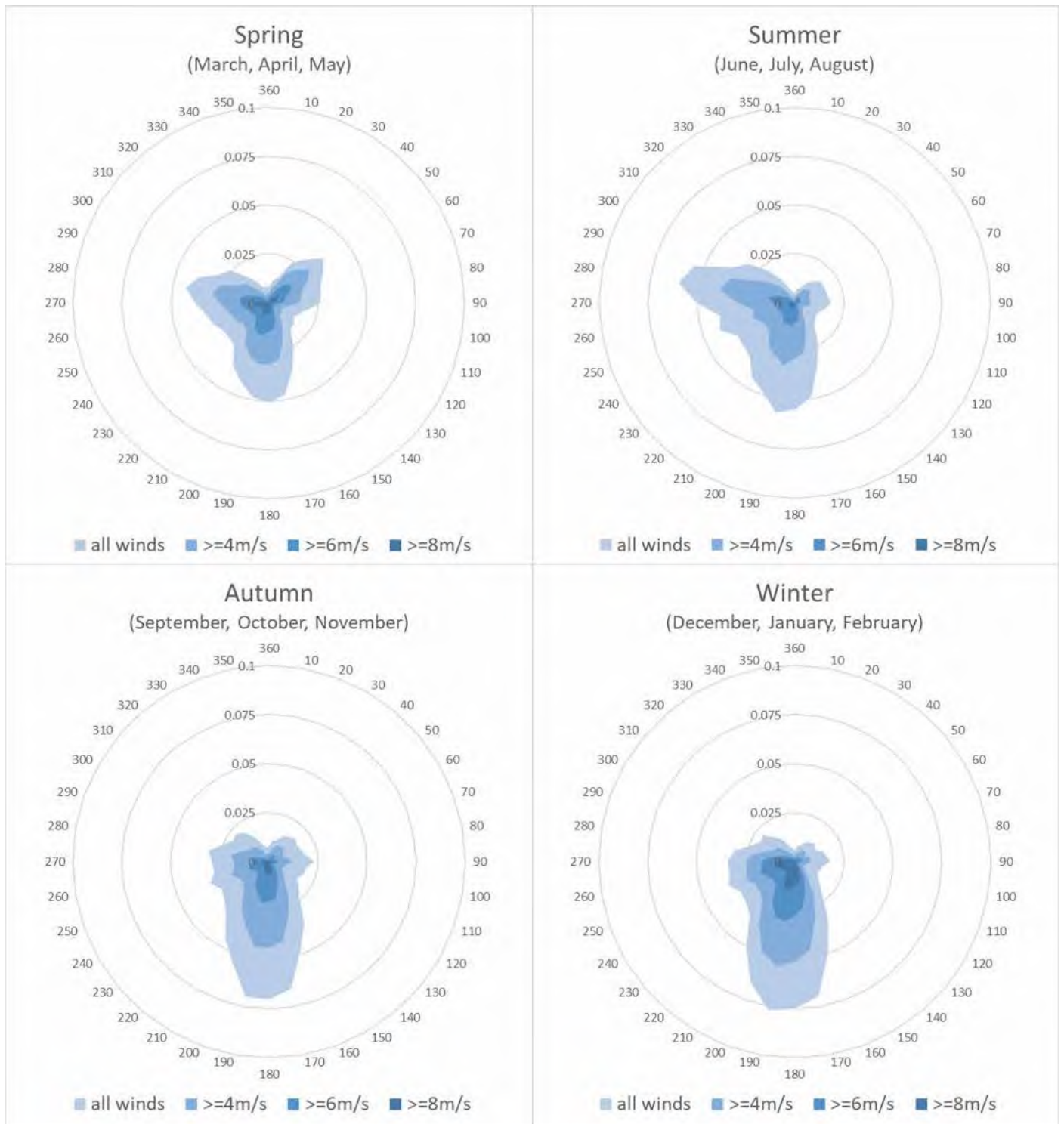


Fig. 21: Seasonal Wind Roses for Manchester International Airport (1990–2020)

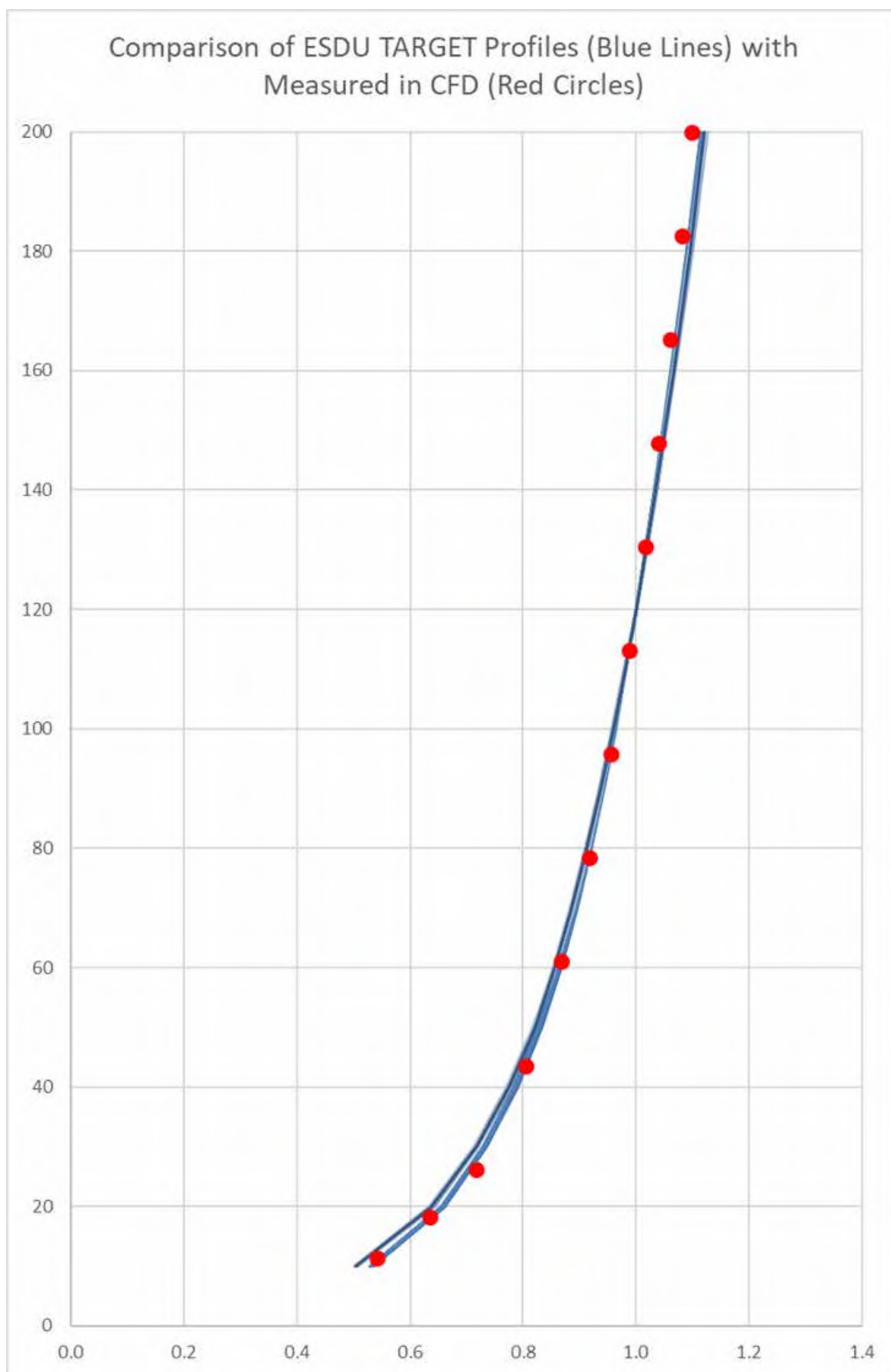


Fig. 22: Wind Profile for Rodney Street

For further details please contact us on:

gia

LONDON

T 020 7202 1400
E mail@gia.uk.com

THE WHITEHOUSE
BELVEDERE ROAD
LONDON SE1 8GA

MANCHESTER

T 0161 672 5100
E manchester@gia.uk.com

2 COMMERCIAL STREET
MANCHESTER
M15 4RQ

BELFAST

T 02890 918 200
E belfast@gia.uk.com

RIVER HOUSE
48-60 HIGH STREET
BELFAST BT1 2BE