gia
CHARTERED SURVEYORS

WIND MICROCLIMATE ASSESSMENT REPORT

The Oracle, Reading

1 December 2022

GIA No: **2137**

PROJECT DATA:

Client	**Packaged Living**
Project Title	**The Oracle, Reading**
Project Number	**2137**

REPORT DATA:

Report Title	**Wind Microclimate Assessment**
GIA Department	**Wind Microclimate**
Dated	**1 December 2022**
Prepared by	**JW**
Checked by	**CH**

Revisions	No:	Date:	Notes:	Signed:

CHARTERED SURVEYORS

CONTENTS

1 **INTRODUCTION** 2
1.1 SUMMARY 2
1.2 GUIDANCE 2
1.3 DESCRIPTION OF DEVELOPMENT 3

2 **METHOD** 4
2.1 ASSESSMENT METHODOLOGY 4
2.2 ESTABLISHING MICROCLIMATE CONDITIONS 4
2.3 LAWSON COMFORT AND SAFETY CRITERIA 7
2.4 TARGET CONDITIONS 8
2.5 TEST SCENARIOS 8
2.6 LIMITATIONS AND ASSUMPTIONS 8

3 **RESULTS** 9
3.1 BASELINE CONDITIONS 9
3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS 12
3.3 CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS 17

4 **CONCLUSIONS** 21

APPENDIX 01
DETAILED METHODOLOGY

1 INTRODUCTION

This report outlines the results of a wind microclimate analysis for the proposed development known as The Oracle in Reading, UK.

1.1 SUMMARY

Wind microclimate conditions for the proposed development known as The Oracle, Reading were assessed using high resolution CFD.

All ground level wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing seating areas and proposed seating areas.

All wind comfort conditions for the balconies and level 2 terraces on both Yield Hall Place 1 and Yield Hall Place 2 will be suitable for the intended use.

The inclusion of the proposed development reduces the extent and severity of a region of S15 (distress) exceedance to the west of the Riverside Car Park building, but introduces a localised region of S15 (distress) exceedance to the east of the Riverside Car Park building. As the region of the pre-existing S15 exceedance to the west is a relatively populated area, and the region of the introduced S15 exceedance to the east is a back of house area, the overall impact of the proposed development on the wind safety risk in the local area can be viewed as between net even to net beneficial.

The level 12 terrace for Yield Hall Place 2 will require a perimeter screen of 1500-1800mm tall, to ensure that conditions are both safe and suitable for the intended use.

The cumulative impact of local future schemes on the proposed development is negligible.

1.2 GUIDANCE

The assessment was performed using the London Docklands Development Corporation (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.

National Planning Policy Framework

The National Planning Policy Framework (NPFF) 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"

1.3 DESCRIPTION OF DEVELOPMENT

Planning permission is sought for the repurposing and redevelopment of sites at the eastern end of the Oracle to provide a mixed use development comprising residential and town centres uses. The proposals focus around two main sites:

- Former Debenhams department store at the eastern end of the Oracle shopping centre building and northern side of the River Kennet, to be known as Yield Hall Place 1; and
- Vue cinema building on the southern side of the River Kennet and to the east of the Oracle Riverside multi storey car park, to be known as Yield Hall Place 2.

Two detailed planning applications are submitted; one application for Yield Hall Place 1 and one application for Yield Hall Place 2. These applications will be submitted concurrently to Reading Borough Council and expected to be considered and determined in this way by the local planning authority. This report is submitted in respect of both applications and assesses the proposals as a single scheme for the purpose of the technical assessment undertaken. An illustrative plan is submitted with both planning application which identifies the full extent of the proposed developments, and the schemes assessed for the purposes of this report.

Where matters only pertain to one of the planning application sites, these are specifically identified within the report.

Alongside the development proposals on the two sites identified above, a suite of public realm enhancements are proposed within the vicinity of The Oracle, including:

- Junction with London Street and Inner Distributor Road
- Yield Hall Place from junction of London Street to Minister Street
- Oracle Riverside

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.

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 proposed development consists of two blocks, Yield Hall Place 1 and Yield Hall Place 2, 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.

On-site and local wind speeds were combined with wind statistics from 30 years of data recorded at Heathrow 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.

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	1.41	1.42	1.44	1.43	1.39	1.45	1.46	1.51	1.46	1.41	1.41	1.4

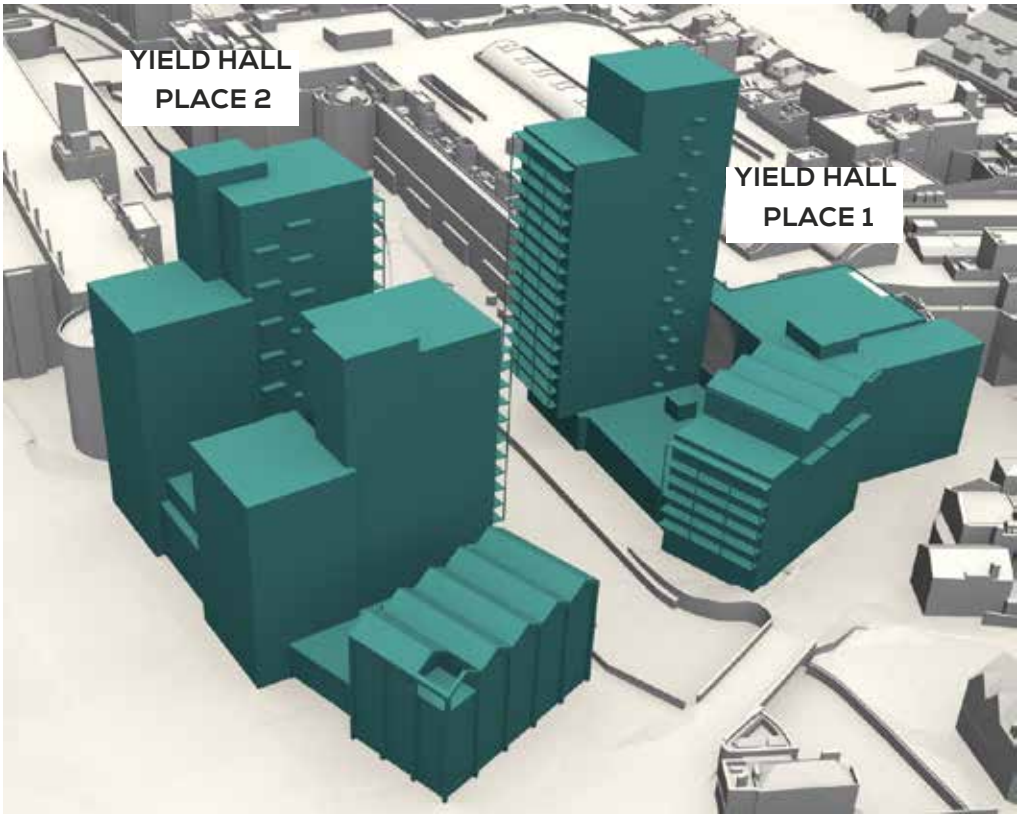

Fig. 01: 3D View of Proposed Development

Fig. 02: Surrounding Context with Existing Surrounds

Fig. 03: Surrounding Context with Cumulative Surrounds

Fig. 04: Key Wind Receptor Locations

2.3 LAWSON COMFORT AND SAFETY CRITERIA

The assessment was graded against the Lawson Comfort and Safety Criteria.

Table 2 and Table 3 show the banding of the various categories within the Lawson Comfort and Safety criteria.

Comfort categories are based on the level of wind speed exceedance for 5% of each season, and safety categories are based on the level of wind speed exceedance for 1.9 hours per year.

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 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 bus stops on Queen's Road and London Street within the study area.

There is proposed enhanced public realm, around the Junction with London Street and Inner Distributor Road, along Yield Hall Place from junction of London Street to Minister Street and on Oracle Riverside. This is targeted to be suitable for a mixture of sitting and standing in summer.

There is a proposed pocket park to the north of Yield Hall Place. This is targeted to be suitable for a mixture of sitting and standing in summer.

There are existing seating areas outside of the restaurants by the Oracle Riverside. These are targeted to be suitable for sitting in summer.

There are proposed break-out seating areas around the proposed development. These are targeted to be suitable for sitting in summer.

There is proposed amenity in the form of terraces, at Level 2 in Yield Hall Place 1 and at Levels 2 and 12 in Yield Hall Place 2. These spaces are targeted to be suitable for a mixture of sitting and standing in summer.

There are proposed balconies. These are private spaces, the use of which can be controlled according to the individual user's preference, so can stand higher wind speeds than communal amenity spaces but are still required to be suitable for sitting or standing in summer conditions.

The locations of the key wind microclimate receptors at ground level are shown in Figure 4.

2.5 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.

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

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

- Broad Street Mall (planning ref. 182137)
- 20 Hosier Street (planning ref. 182054)

2.6 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.

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.

Winter conditions range between sitting, 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 bus stops within the study area (marked "B" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The seating outside of the Oracle Riverside restaurants (marked "S1" in results figures) is suitable for sitting or standing in winter and sitting in summer. This is suitable for the intended use,

There is a localised region of S15 (distress) exceedance at the western end of the Riverside Car Park building (marked "1" in Figure 5). This could pose a potential safety risk to frail individuals or cyclists during times of high wind speeds.

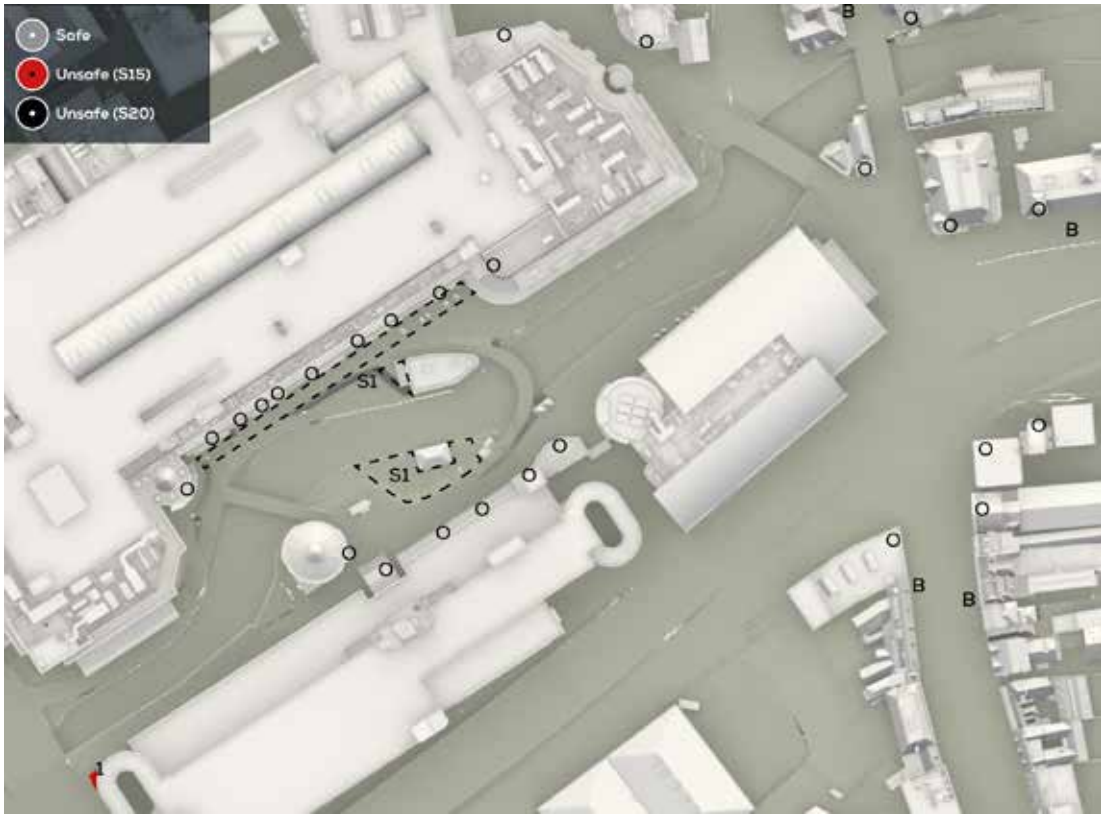

Fig. 05: Annual Safety at Ground Level, Baseline

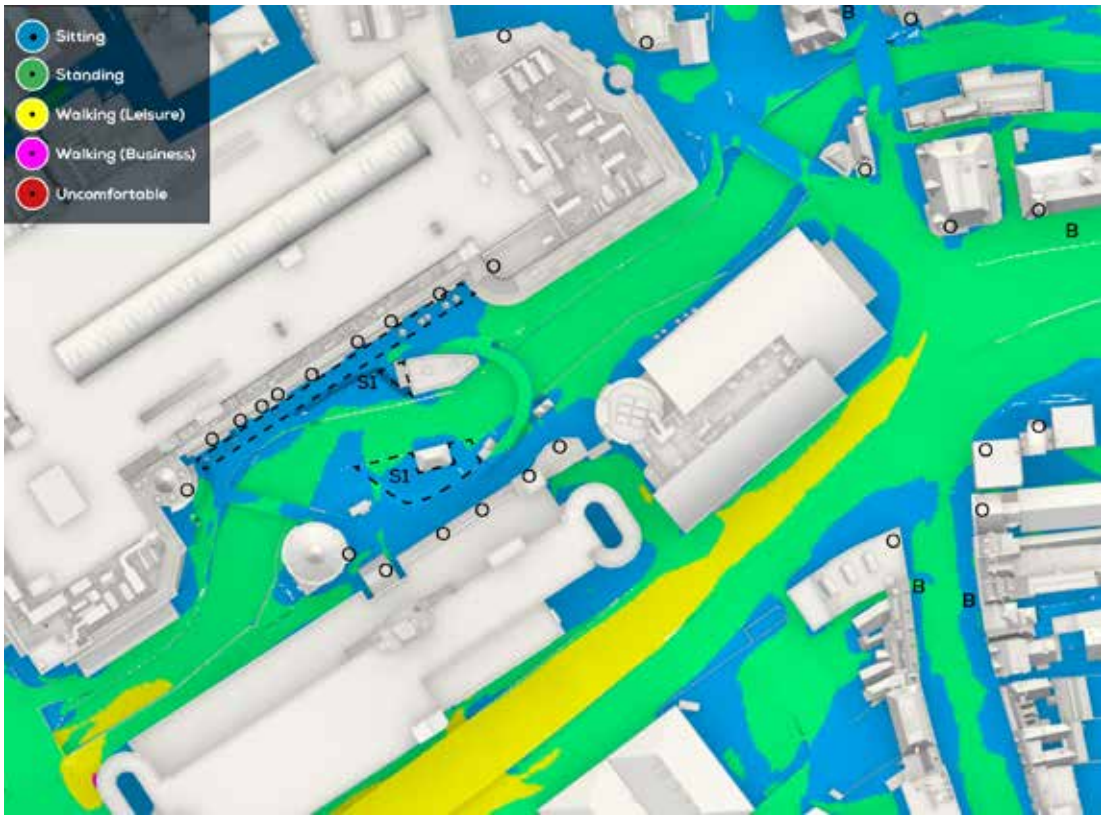

Fig. 06: Winter Comfort at Ground Level, Baseline

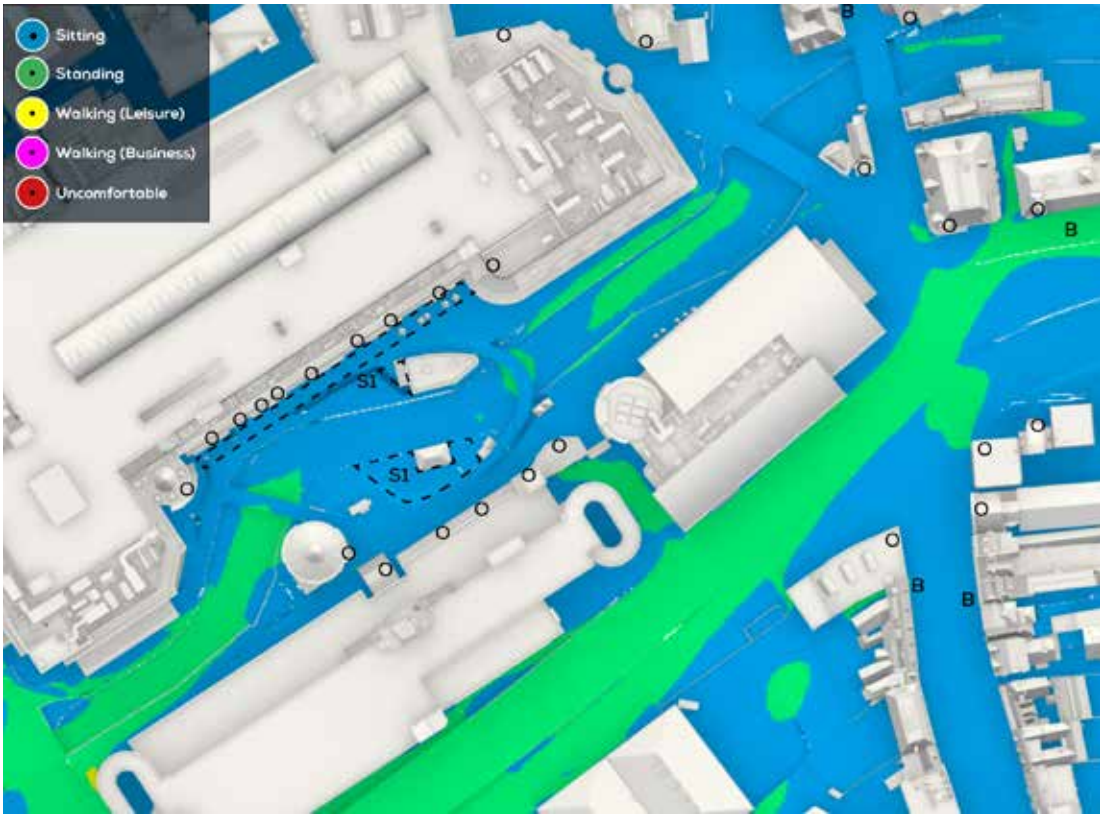

Fig. 07: Summer Comfort at Ground Level, Baseline

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.

Winter conditions range between sitting, 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 bus stops within the study area (marked "B" in results figures) are suitable for either sitting or standing. This is suitable for the intended use.

The seating outside of the Oracle Riverside restaurants (marked "S1" in results figures) is suitable for sitting or standing in winter and sitting in summer. This is suitable for the intended use,

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

The proposed enhanced public realm (marked with solid black lines in results figures) is 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.

The proposed pocket park (marked "P" 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 proposed break-out seating (marked "S2" in results figures) ranges between suitable for sitting and standing in all seasons. There is only a minimal seating area which is suitable for standing, which is both only marginally above the threshold wind speed and located adjacent to significant tree planting. As such, conditions for the seating areas will be suitable for the intended use.

The pre-existing localised region of S15 (distress) exceedance at the western end of the Riverside Car Park building (marked "1" in Figure 8) has been reduced in extent, but a new region of S15 (distress) exceedance has been introduced at the eastern end of the Riverside Car Park building (marked "2" in Figure 8). The net effect to the safety risk around the Riverside Car Park building is therefore negligible, and it should also be noted that location 1 (where the proposal has lowered the wind safety risk) is likely a more populous area than the back-of-house location 2 (where the proposal has increased the wind safety risk, but is on a low-use region that does not intersect the cycle-path between the Riverside Car Park and Yield Hall Place 2).

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

There are no regions of wind safety risk for the Level 2 terraces on either Yield Hall Place 1 or Yield Hall Place 2.

Conditions for the Yield Hall Place 1 level 2 terrace are suitable for a mixture of sitting and standing in all seasons. This is suitable for the intended use.

Conditions for the Yield Hall Place 2 level 2 terrace are suitable for a mixture of sitting, standing and leisure walking in winter and a mixture of sitting and standing in summer. This is suitable for the intended use.

There is a strip across the western and southern edges of the Yield Hall Place 2 level 12 terrace which is subject to S15 (distress) exceedance, as well as being suitable for business walking in winter and leisure walking in winter. Conditions for this region will be windier than required for

the intended use, and also subject to potential risk to the safety of users during times of high winds. It should be noted that the test has been performed in the absence of parapets or balustrades, so represent a worst case scenario. It is intended that this terrace will be fitted with a 1500-1800mm high screen at the perimeter, which will obstruct the airflow onto the terrace and mitigate the unsafe or uncomfortable conditions.

The main section of the Yield Hall Place 2 Level 12 terrace is suitable for leisure walking in winter and standing in summer. This is suitable for use as a viewing terrace, and will be further calmed by the inclusion of the perimeter screening to be also suitable for sitting..

There are no significant regions of wind safety or distress risk at any balcony level. Balcony conditions range between suitable for sitting, standing and leisure walking in winter and between sitting and standing in summer. This is suitable for the intended use.

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

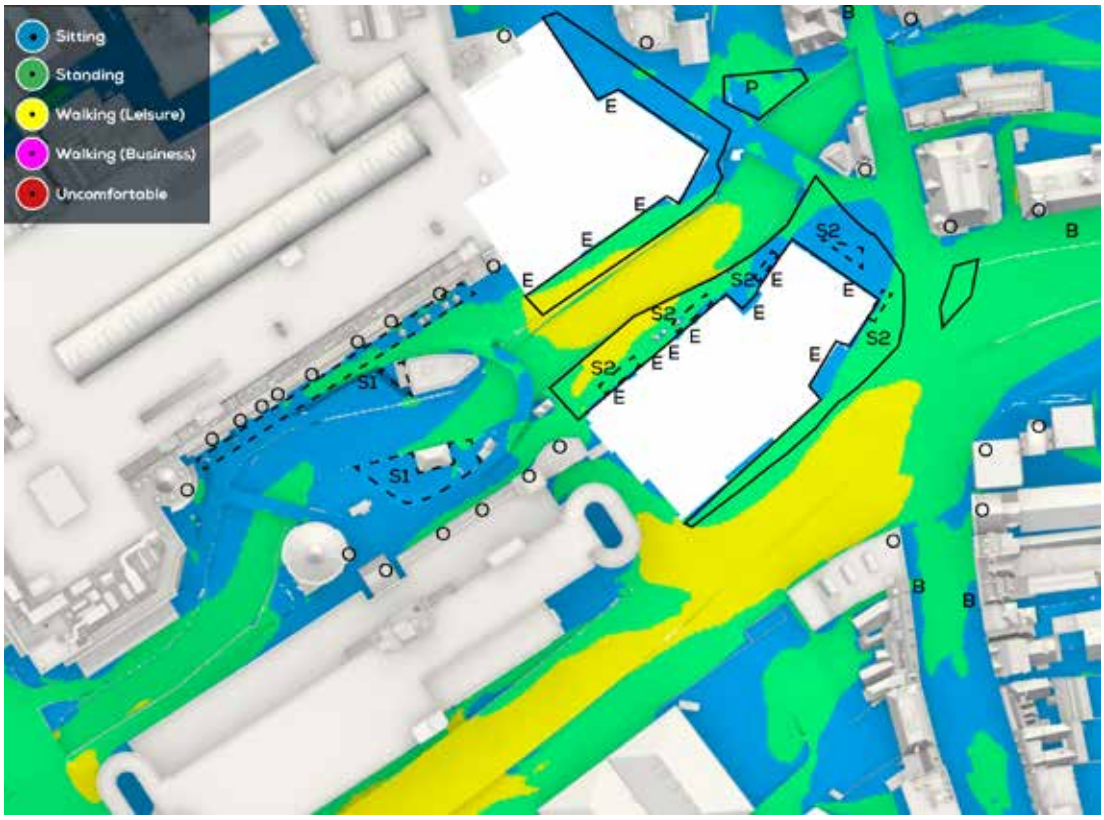

Fig. 09: Winter Comfort at Ground Level, Proposed Development with Existing Surrounds

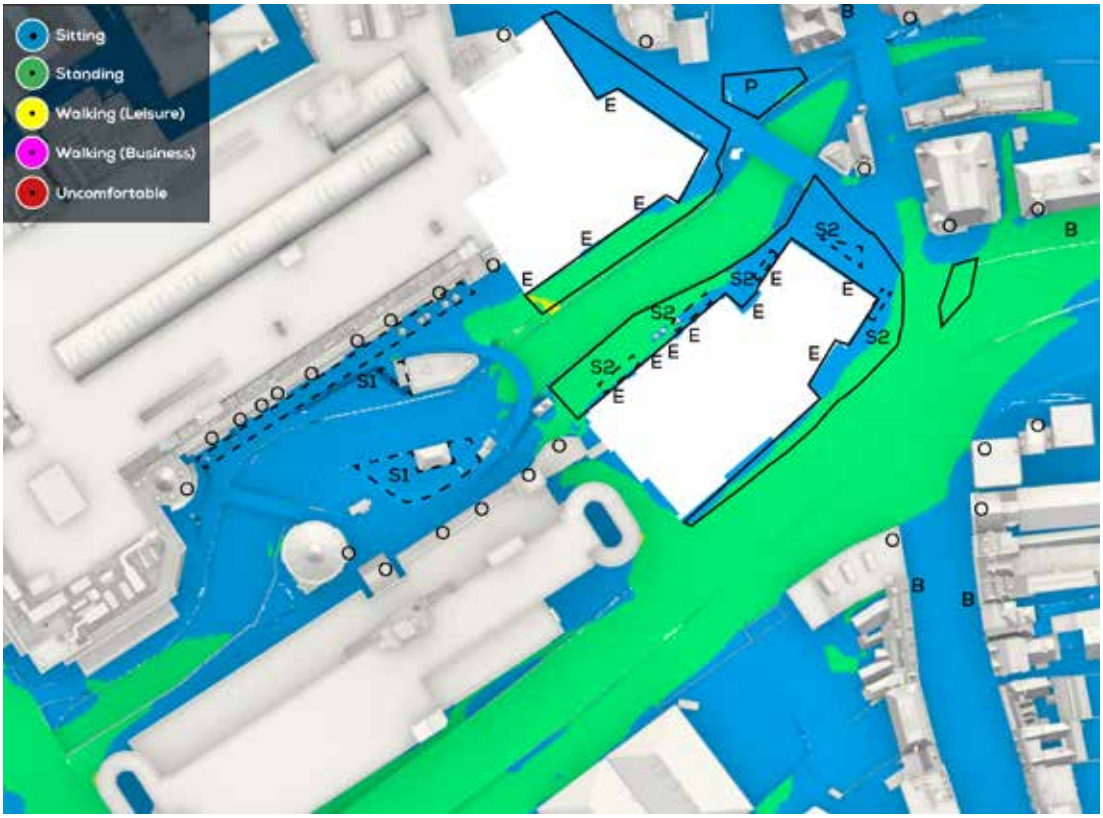

Fig. 11: Summer Comfort at Ground Level, Proposed Development with Existing Surrounds

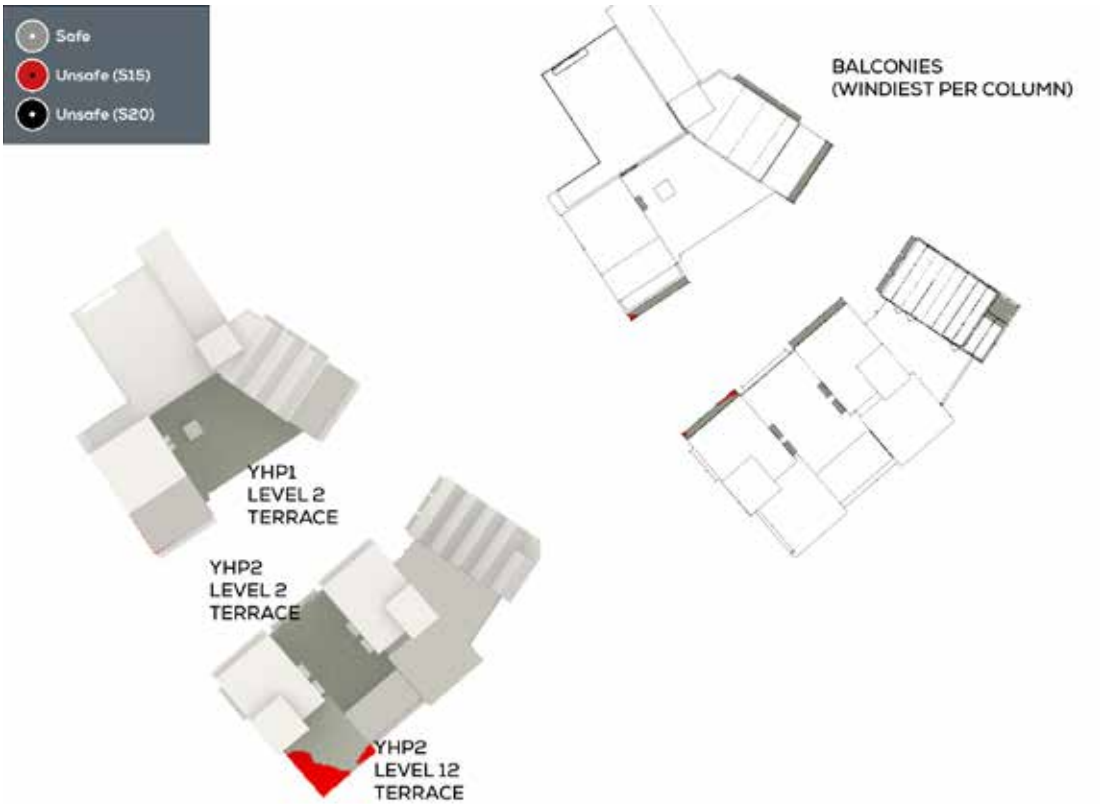

Fig. 10: Annual Safety at Terrace and Balcony Level, Proposed Development with Existing Surrounds

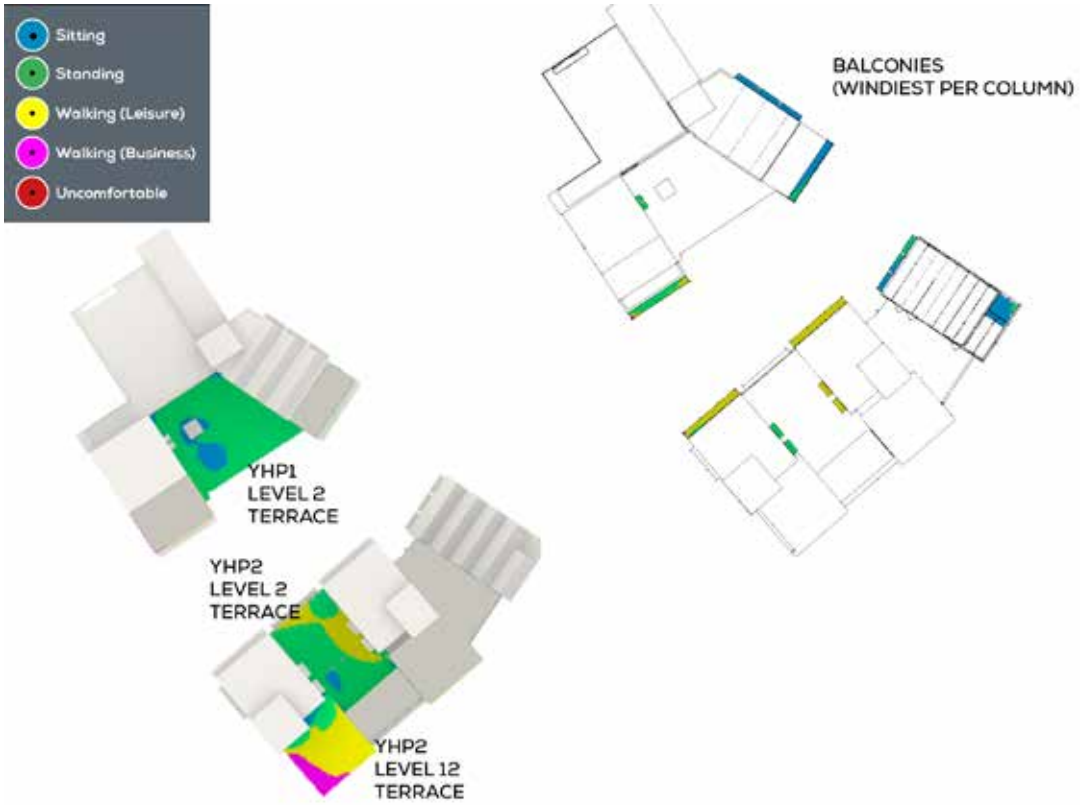

Fig. 12: Winter Comfort at Terrace and Balcony Level, Proposed Development with Existing Surrounds

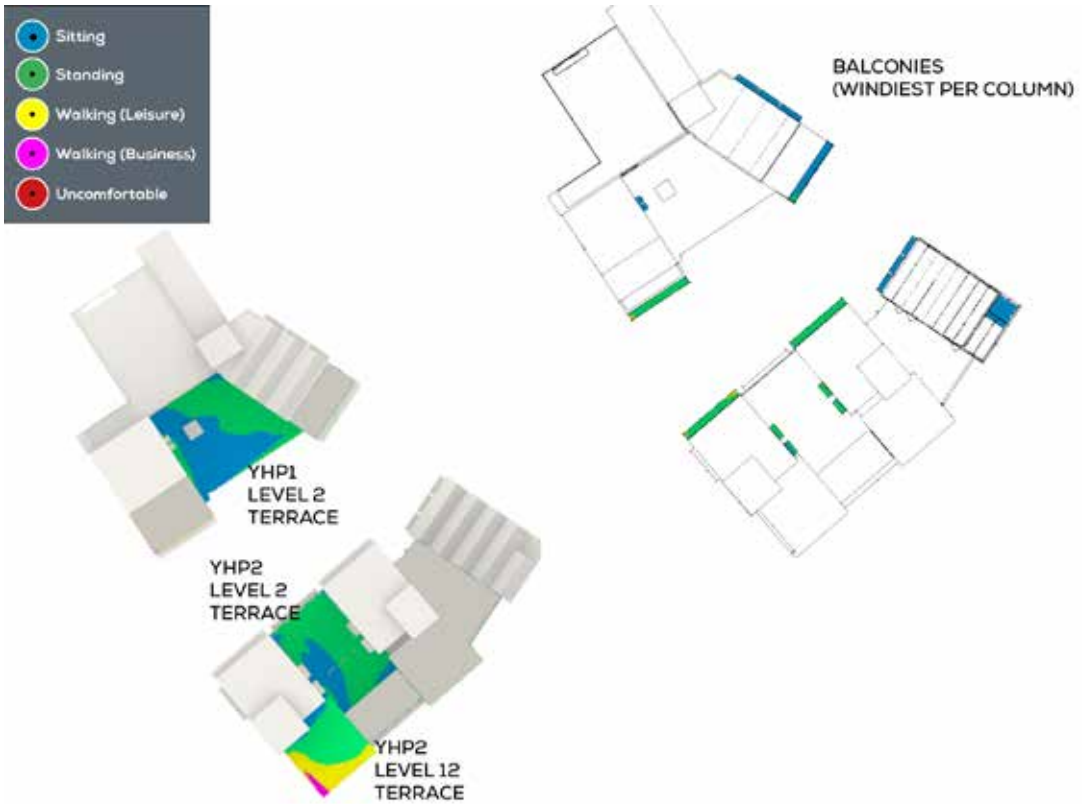

Fig. 13: Summer Comfort at Terrace and Balcony Level, Proposed Development with Existing Surrounds

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.

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

There is no material difference between conditions for the proposed development with existing surrounds and for the proposed development with cumulative surrounds.

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

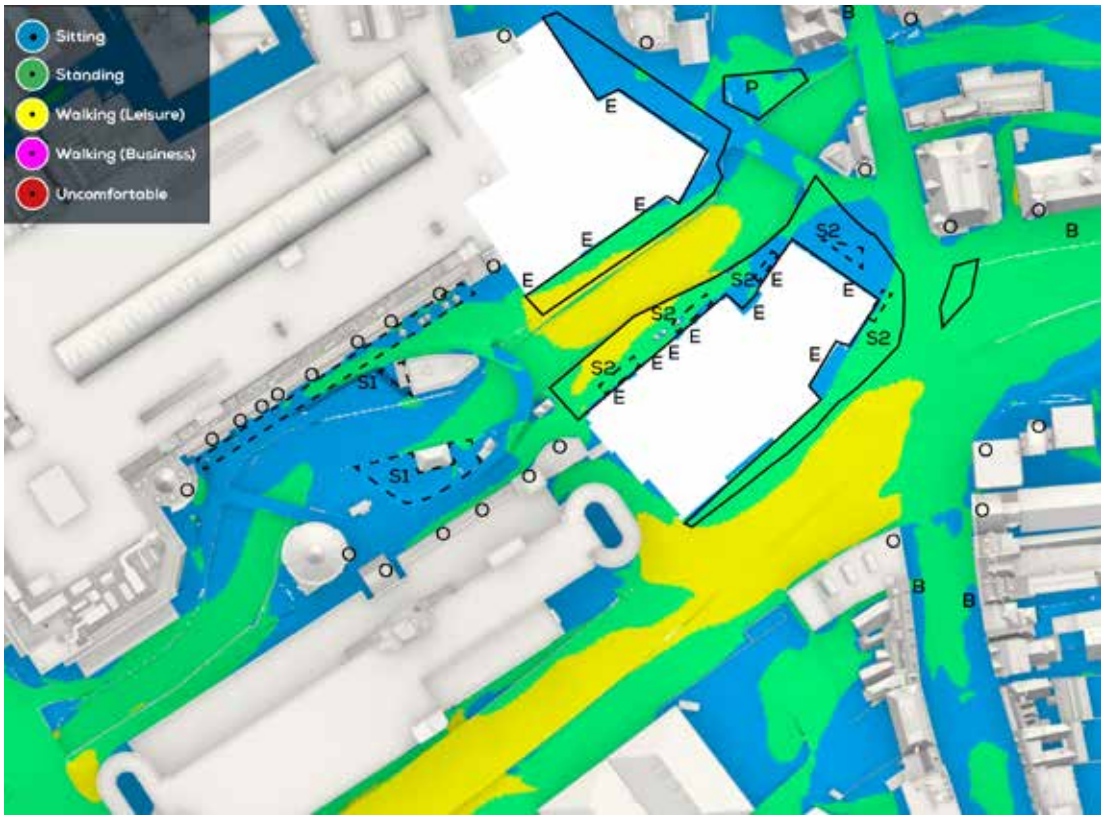

Fig. 15: Winter Comfort at Ground Level, Proposed Development with Cumulative Surrounds

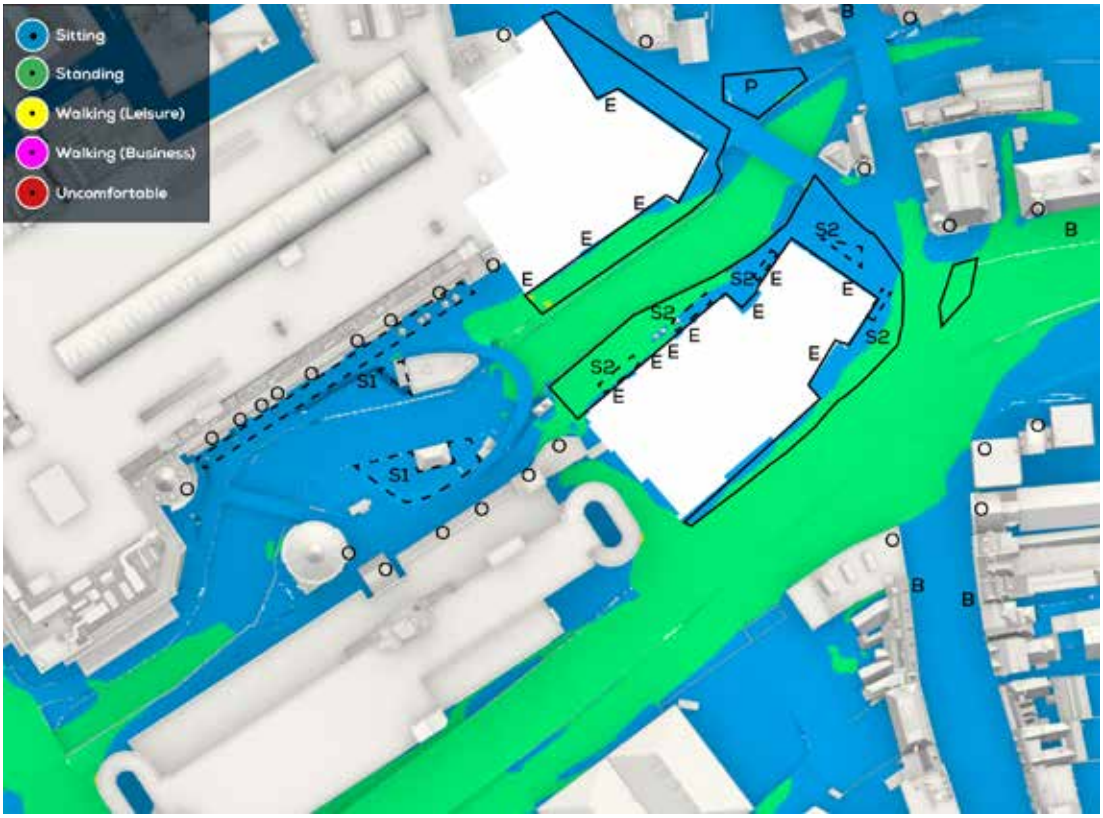

Fig. 17: Summer Comfort at Ground Level, Proposed Development with Cumulative Surrounds

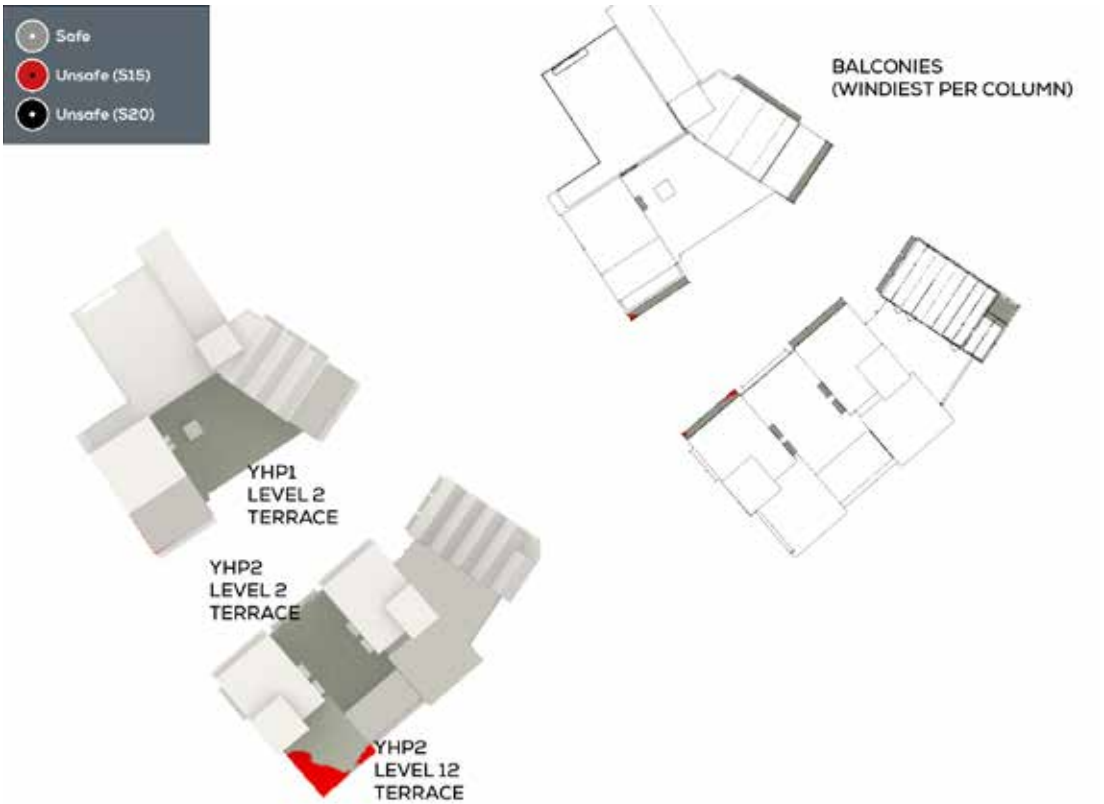

Fig. 16: Annual Safety at Terrace and Balcony Level, Proposed Development with Cumulative Surrounds

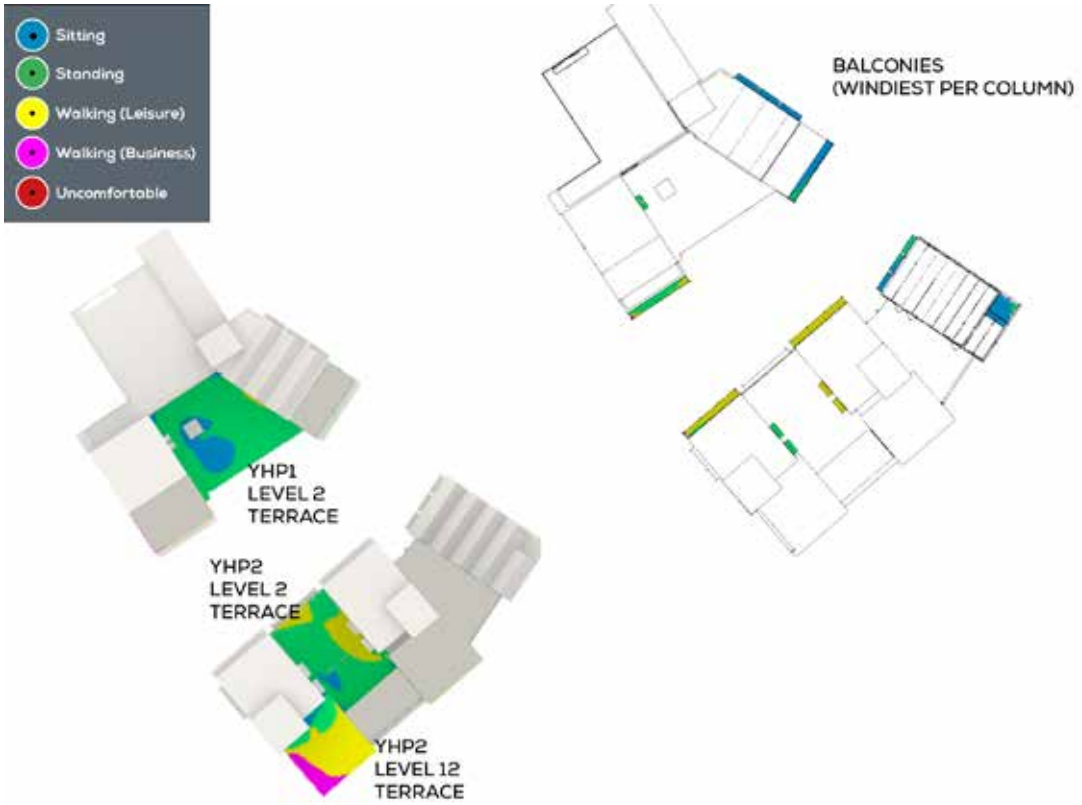

Fig. 18: Winter Comfort at Terrace and Balcony Level, Proposed Development with Cumulative Surrounds

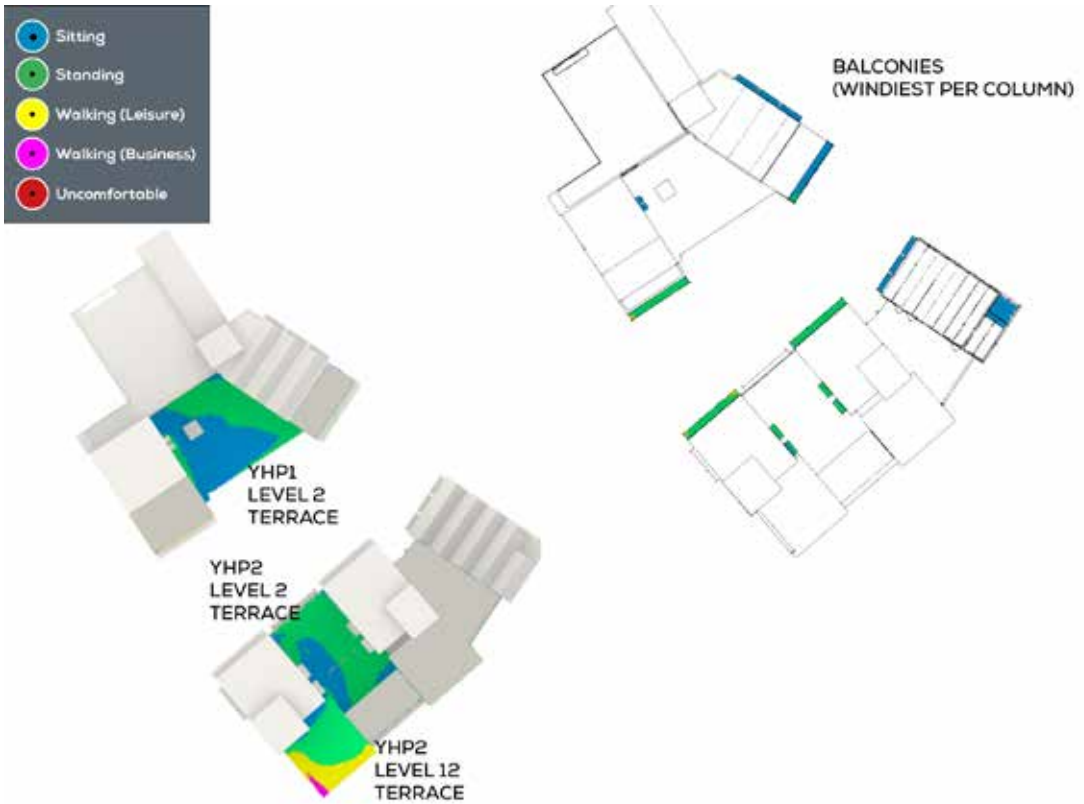

Fig. 19: Summer Comfort at Terrace and Balcony Level, Proposed Development with Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed development known as The Oracle, Reading were assessed using high resolution CFD.

All ground level wind comfort conditions are expected to be suitable, including thoroughfares, on and off-site building entrances, existing seating areas and proposed seating areas.

All wind comfort conditions for the balconies and level 2 terraces on both Yield Hall Place 1 and Yield Hall Place 2 will be suitable for the intended use.

The inclusion of the proposed development reduces the extent and severity of a region of S15 (distress) exceedance to the west of the Riverside Car Park building, but introduces a localised region of S15 (distress) exceedance to the east of the Riverside Car Park building, As the region of the pre-existing S15 exceedance to the west is a relatively populated area, and the region of the introduced S15 exceedance to the east is a back of house area, the overall impact of the proposed development on the wind safety risk in the local area can be viewed as between net even to net beneficial.

The level 12 terrace for Yield Hall Place 2 will require a perimeter screen of 1500-1800mm tall, to ensure that conditions are both safe and suitable for the intended use.

The cumulative impact of local future schemes on the proposed development is negligible.

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 111 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 form 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°,180°,200°,210°,220°,230°,240°, 250°, 260°, 270°, 280°, 300°, 330°.

Seasonal wind roses for London Heathrow are shown in Figure 22.

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 Item01008 '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.

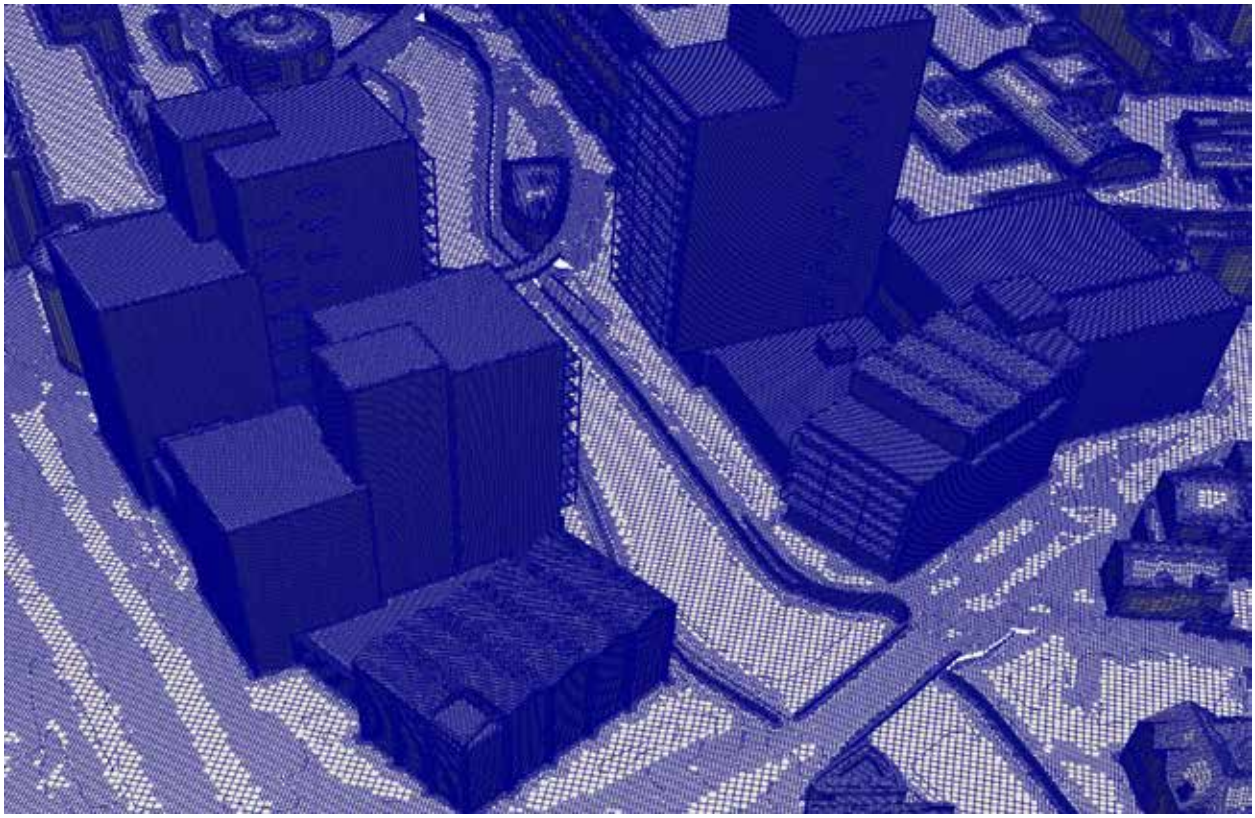

Fig. 20: Mesh Detail on Site Buildings

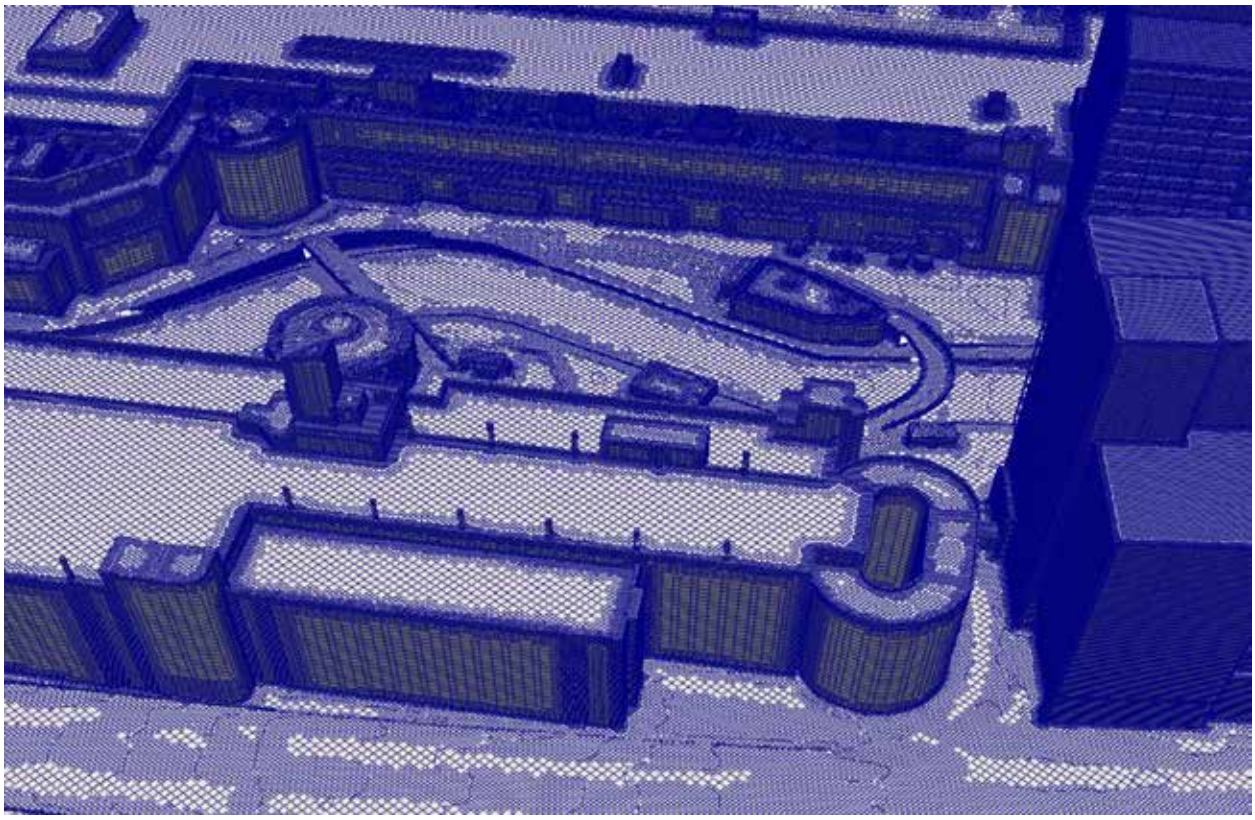

Fig. 21: Mesh Detail on Surrounds

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

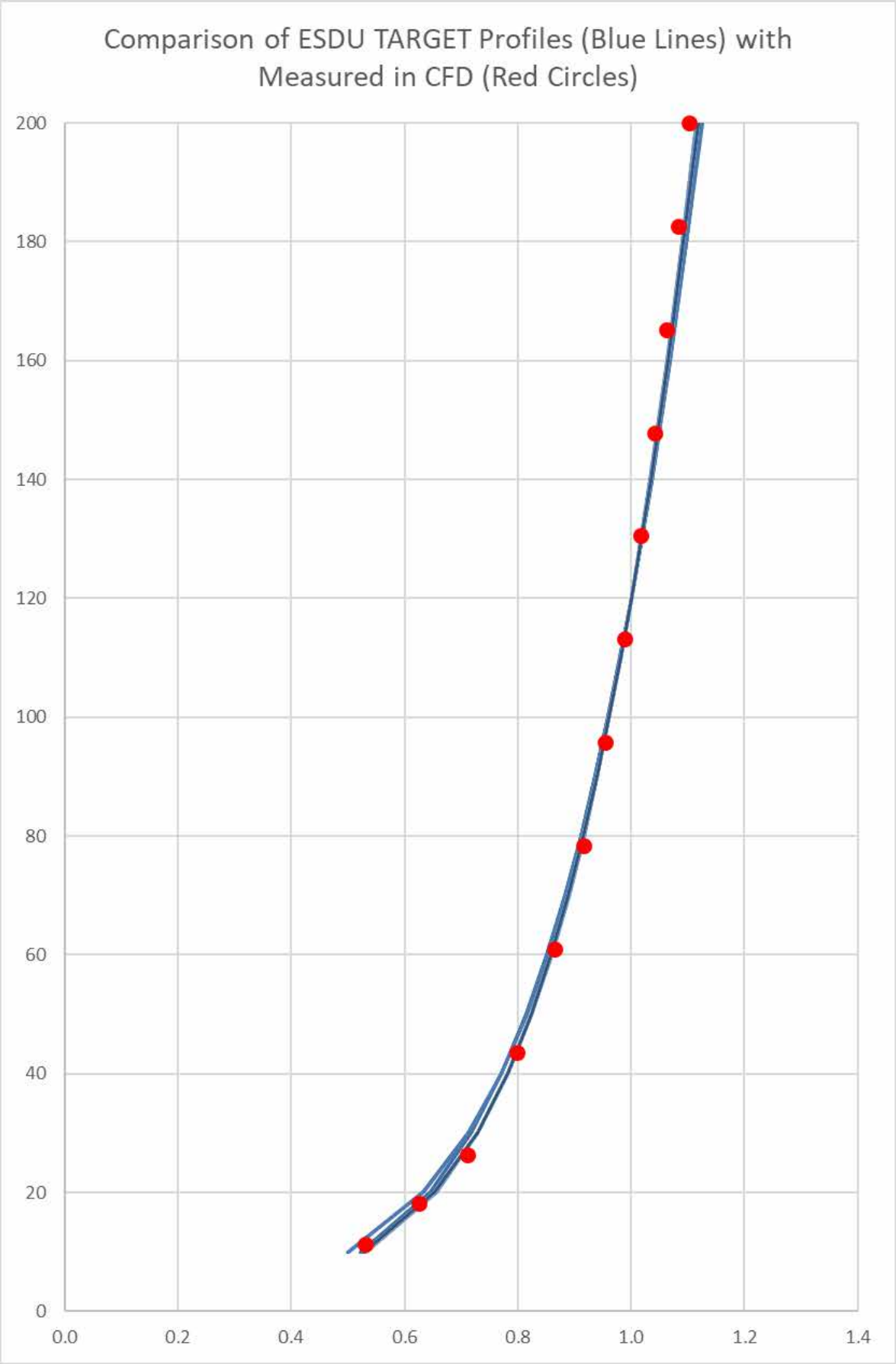

Fig. 23: Wind Profile for Reading

For further details please contact us on:

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