



WIND MICROCLIMATE ASSESSMENT REPORT

Cornbrook, Manchester

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1 INTRODUCTION

This report outlines the results of a wind microclimate analysis for the proposed development at Cornbrook, Manchester

1.1 EXECUTIVE SUMMARY

Wind microclimate conditions for the proposed Cornbrook development in Manchester were assessed using high resolution Computational Fluid Dynamics (CFD).

The following mitigation measures have been proposed and found to be sufficient to ensure that the proposed development does not have any adverse impact on wind conditions:

- 7m tall deciduous “Liquidamber” trees in the locations shown in Figure 23;
- Six 1500mm x 1500mm 50% porous screens in the locations shown in blue in Figure 23; and
- One 1500mm x 3000mm 50% porous screen in the location shown in red in Figure 23.

The proposed development will have a beneficial impact on conditions for the roof terrace of the neighbouring Vox building.

Ground level wind conditions will be suitable for the intended use (or consistent with the baseline) for all thoroughfares, existing building entrances, proposed entrances, tram stops, spill out seating and roof terraces around the site.

Conditions around the site will not be significantly impacted by the inclusion of consented cumulative schemes, although once the proposed Pomona Island regeneration comes forwards it is expected to result in calmer wind conditions around the site.

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. The Lawson Criteria have been adopted for this assessment.

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”.

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 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 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 mean correction factors between the site and the airport are shown in Table 1.

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.

2.3 LIMITATIONS AND ASSUMPTIONS

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

The assessment herein is valid to the design as supplied to GIA at the time of the assessment, and does not cover future variations in the design.

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 01: Site Wind Correction Factors

DIRECTION (°N)	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Corr. Factor	1.46	1.46	1.42	1.39	1.32	1.30	1.31	1.30	1.31	1.39	1.55	1.40

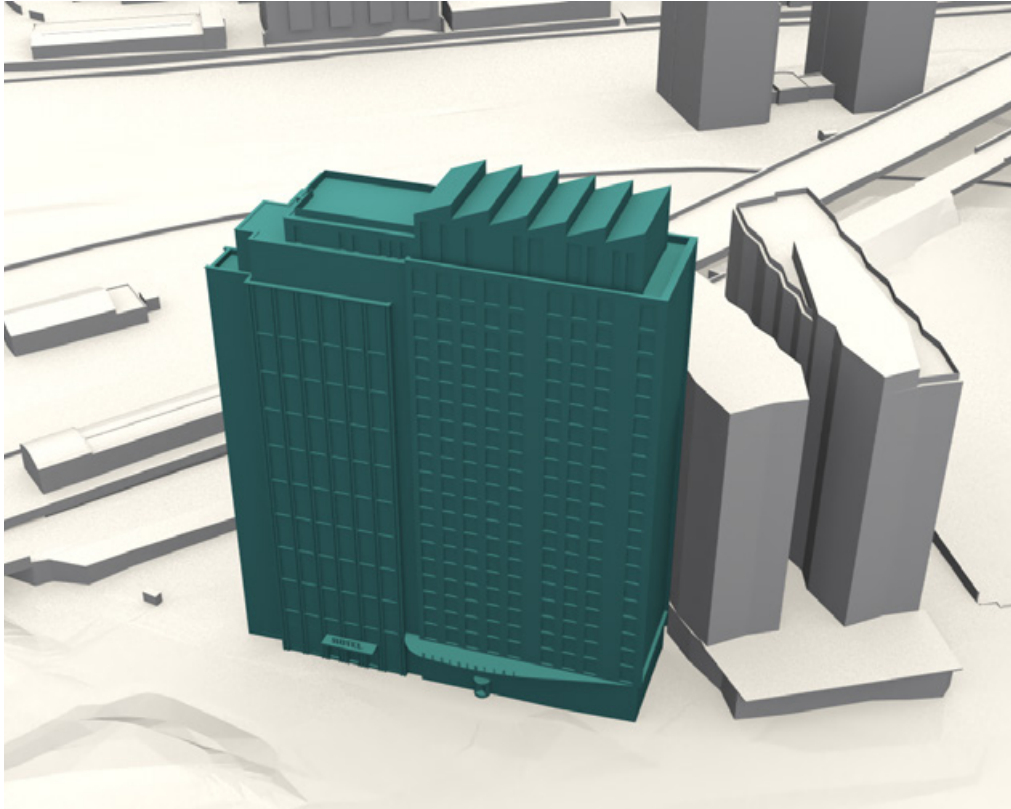


Fig. 01: 3D View of proposed Development



Fig. 02: Proposed Development with Existing Surrounds



Fig. 03: Proposed Development with Cumulative Surrounds

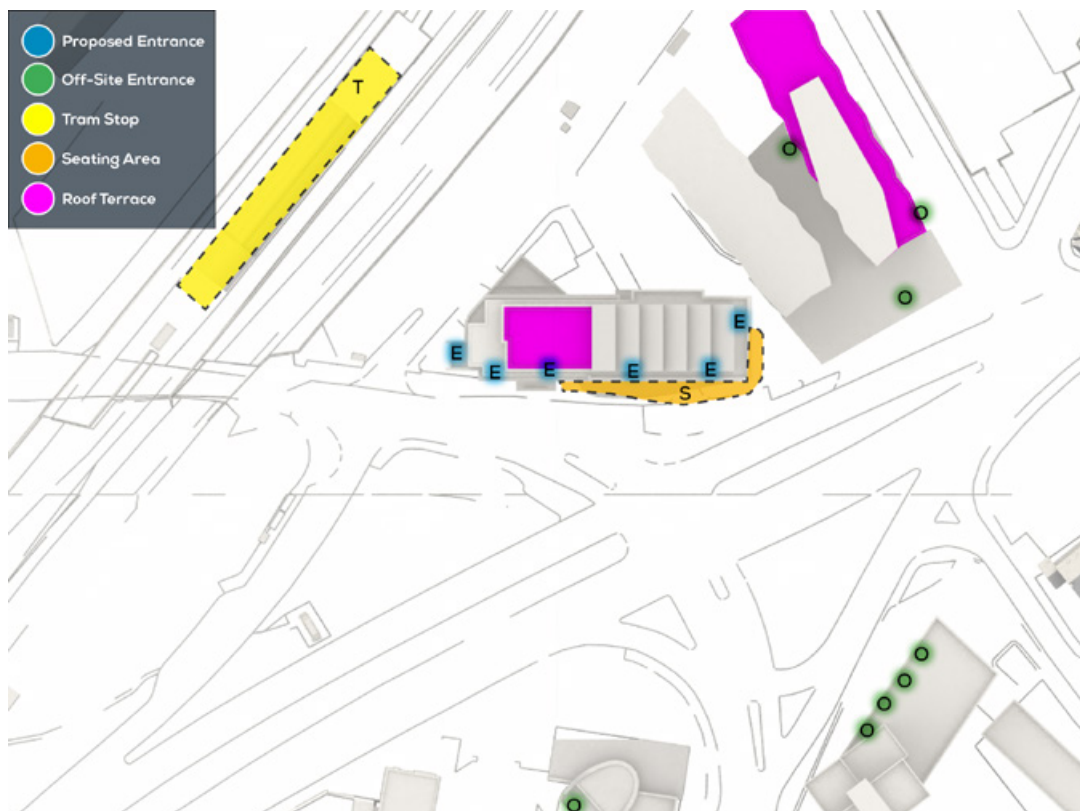


Fig. 04: Sensitive Wind Receptors

2.4 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. cafés, 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 (0.025% 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

2.5 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 used to classify wind conditions 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.

The areas immediately outside any building entrances should be suitable for standing use during winter to provide a “buffer” between the still conditions in interior spaces and the general thoroughfare. The core entrances to the proposed development are marked “E” on Figure 4, and principal off-site entrances are marked “O”.

There are tram platforms within the study area associated with Cornbrook tram stop (marked “T” in Figure 4). These are targeted to be suitable for standing.

There is proposed spill-out seating associated with the cafe/coffee shop (marked “S” in Figure 4). This is targeted to be suitable for sitting in summer.

There is a proposed roof terrace within the proposed development, as well as an existing roof terrace on the neighbouring Vox development. These are targeted to be suitable for a mixture of sitting and standing in summer.

The locations of key sensitive receptors are shown in Figure 4.

2.6 TEST SCENARIOS

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

The following scenarios were tested:

- Baseline: The existing building on site, with the existing surrounds (including any planning consented schemes which are under construction at the time of writing);
- Proposed Development with Existing Surrounds: The completed and operational development with the existing surrounds; and
- Proposed Development with Cumulative Surrounds: The completed and operational development with the existing surrounds plus local planning consented schemes. and
- Proposed Development with Landscaping, Mitigation and Cumulative Surrounds: As the previous scenario, but with proposed landscaping and wind mitigation measures included.

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

- Merchants Wharf (17/70278/FUL)
- The Dye Works (20/76684/FUL)

The following local consented schemes were included in the cumulative assessment, but not the baseline:

- Thorncroft Close (113473/FO/2016)
- Gallery Gardens (124302/FO/2019)
- Phoenix House (129127/FO/2021)
- Talbot Mill (134192/NMC/2022)

In addition to the above, consideration has also been given to the proposed Pomona Island regeneration. The Pomona Island development is not sufficiently advanced to be included in the modelling, but due to the relative location (to the north and west of the site) and expected scale, it is expected that it will provide shelter from westerly and north westerly winds and result in calmer wind conditions around the Cornbrook site once the regeneration scheme is complete.

3 RESULTS

3.1 BASELINE CONDITIONS

Conditions at Ground Level

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

There are two pre-existing safety exceedances within the under-croft of the neighbouring Vox development (marked "1" and "2" on Figure 5).

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

There are no uncomfortable regions on any thoroughfares or roadways. This is suitable for the intended use.

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

The platforms of Cornbrook tram stop (marked "T" in results figures) are suitable for standing in winter and sitting or standing in summer. This is suitable for the intended use.

Conditions at Terrace Level

Annual safety at terrace level for the baseline scenario is shown in Figure 8. Winter comfort at terrace level for the baseline scenario is shown in Figure 9. Summer comfort at terrace level for the baseline scenario is shown in Figure 10.

There are no wind safety exceedances within the balustrade line of any roof terrace, so there is no risk to terrace users due to wind safety.

Conditions for the Vox roof terrace are suitable for a mixture of standing and leisure walking in winter and for a mix of sitting and standing in summer. This is suitable for the intended use.



Fig. 05: Annual Safety at Ground Level, Baseline

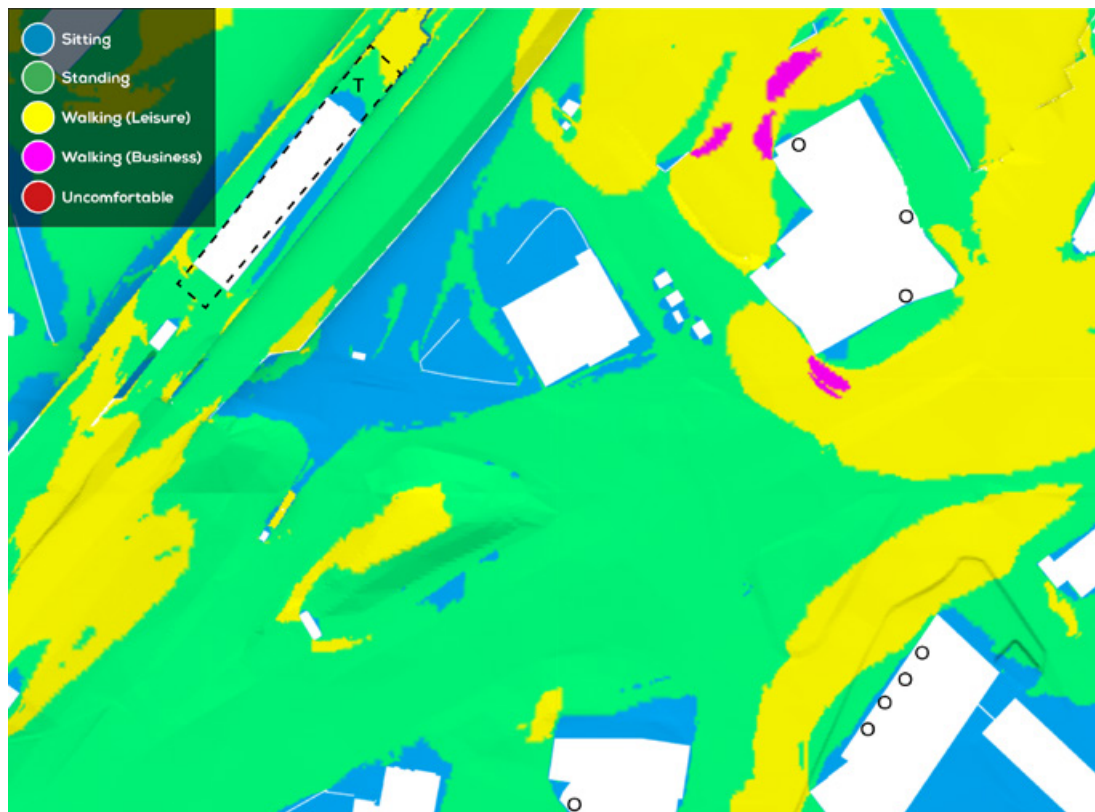


Fig. 06: Winter Comfort at Ground Level, Baseline

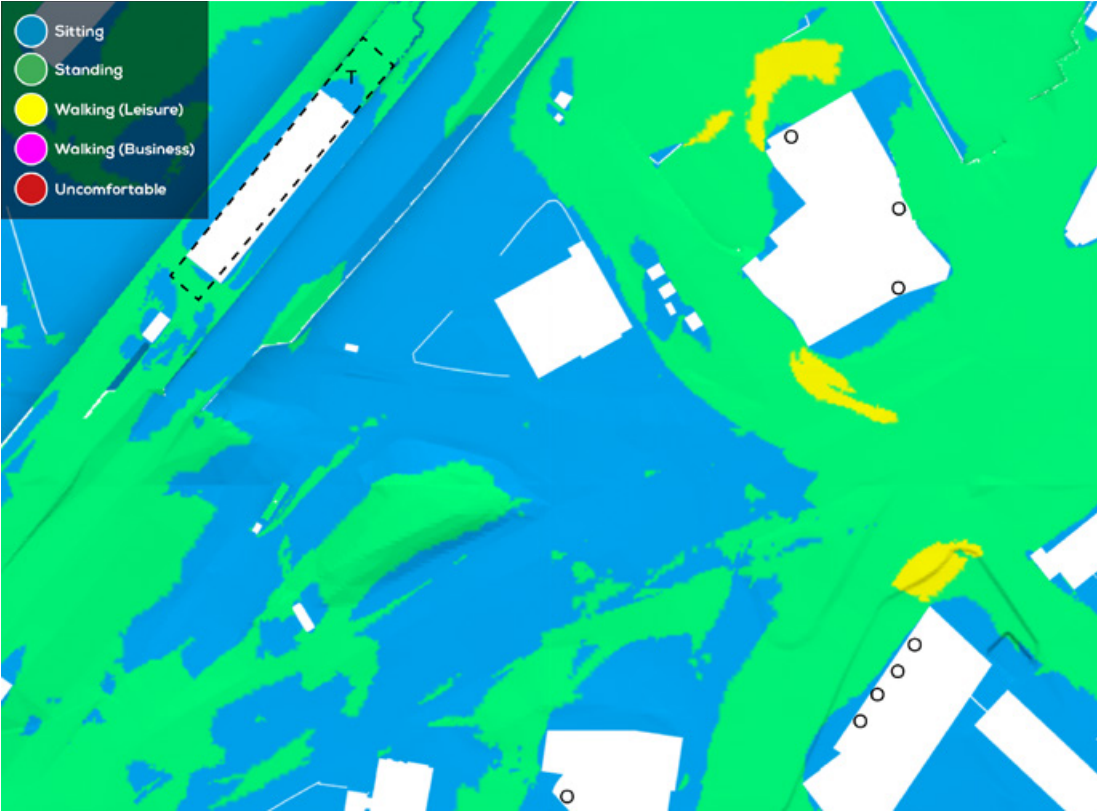


Fig. 07: Summer Comfort at Ground Level, Baseline

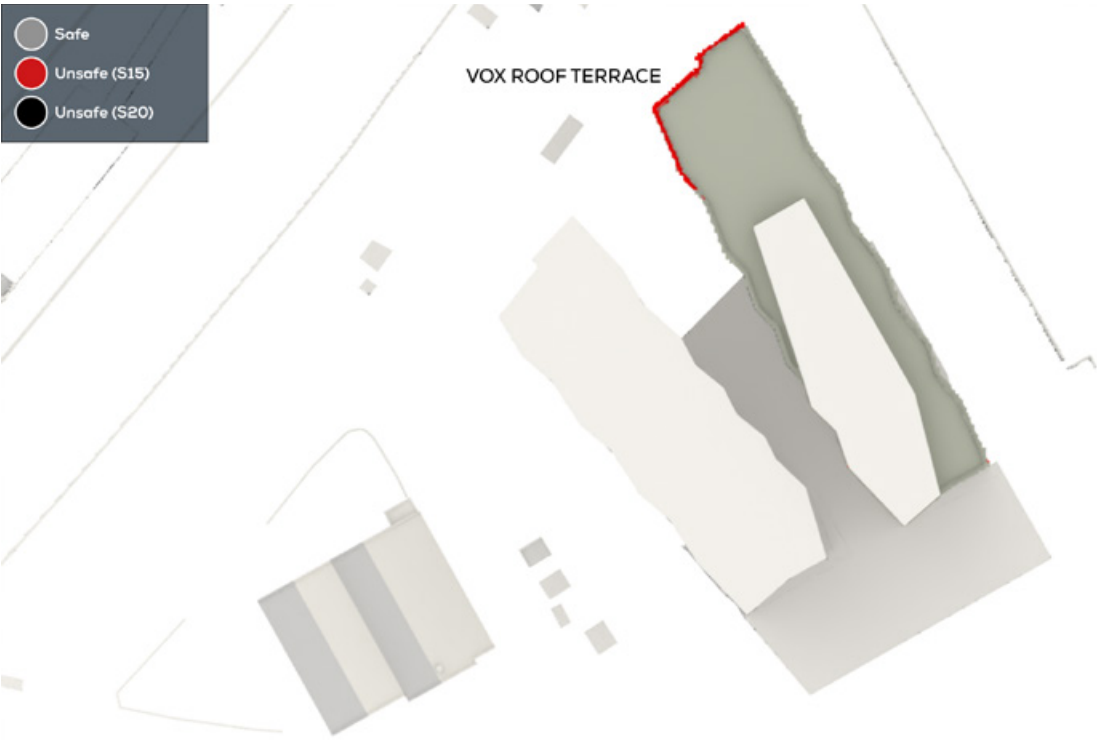


Fig. 08: Annual Safety at Terrace Level, Baseline

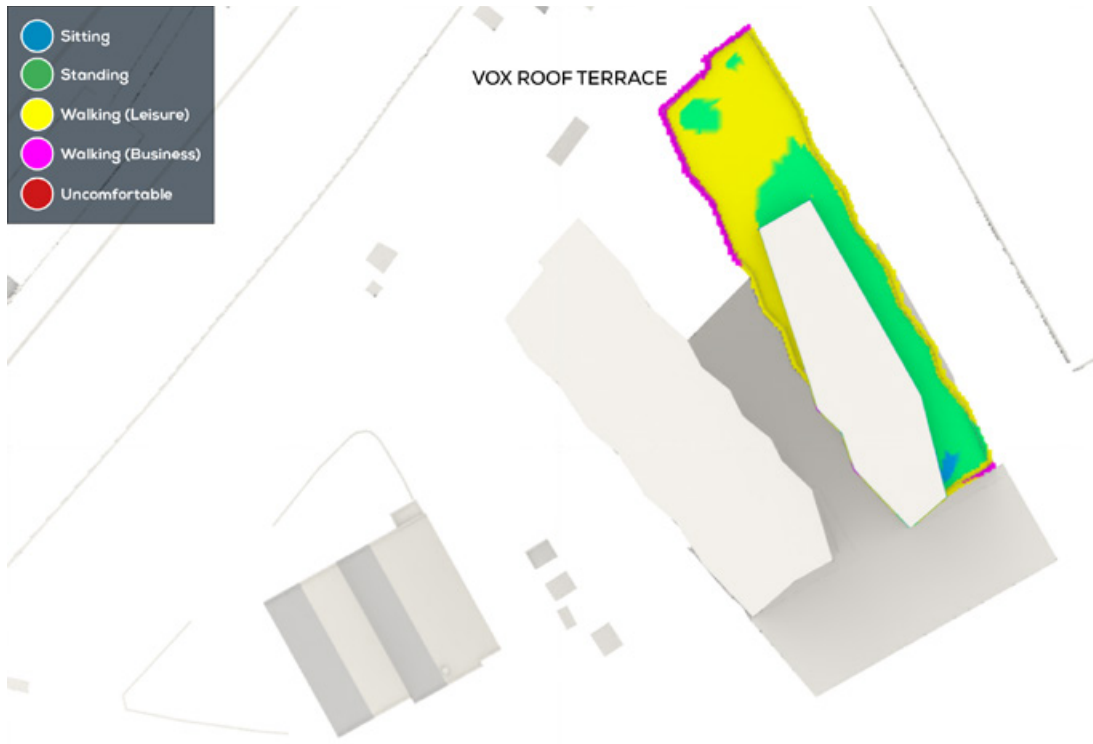


Fig. 09: Winter Comfort at Terrace Level, Baseline

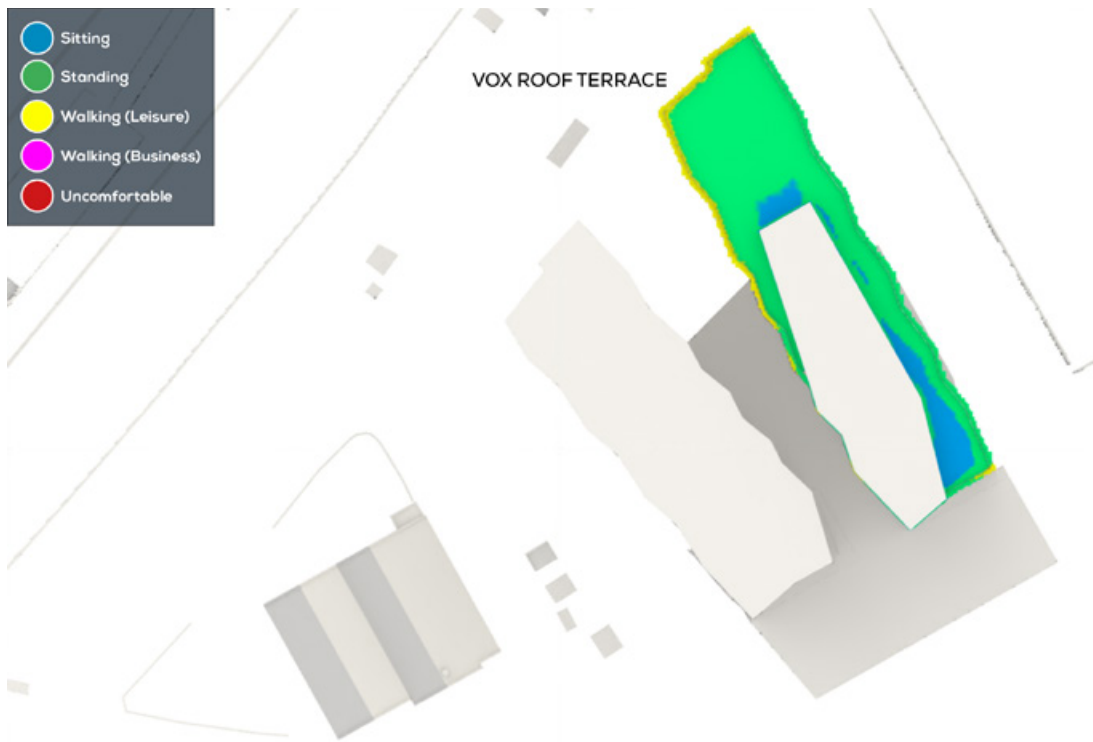


Fig. 10: Summer Comfort at Terrace Level, Baseline

3.2 CONDITIONS FOR PROPOSED DEVELOPMENT WITH EXISTING SURROUNDS

Conditions at Ground Level

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

There are two pre-existing safety exceedances within the under-croft of the neighbouring Vox development (marked "1" and "2" on Figure 11). These are consistent with the baseline so are not attributable to the proposed development.

There are two new regions of S15 (distress) exceedance, by the south east corner of the site (marked "3" on Figure 11) and off-site on Bridgewater Way (marked "4" on Figure 11). These would pose a safety risk to cyclists or frail individuals and will require mitigation.

These issues are caused by south westerly winds which are deflected by the southern elevation of the proposed development. Mitigation measures for these issues are set out in Section 3.4.

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

There are no uncomfortable regions on any thoroughfares or roadways. This is suitable for the intended use.

The southern entrance to the cafe/coffee shop (marked "E" and circled in Figure 12) is adjacent to a region which is suitable for leisure walking in winter. This is a category windier than the target condition. Mitigation measures for this issue are set out in Section 3.4.

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

for the intended use.

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

The platforms of Cornbrook tram stop (marked "T" in results figures) are suitable for standing in winter and sitting or standing in summer. This is suitable for the intended use.

Conditions for the proposed spill-out seating (marked "S" in results figures) are suitable for standing in winter and sitting in summer to the east of the proposed development, and for leisure walking in winter and standing in summer to the south of the proposed development. The seating to the east is suitable for the intended use, but those to the south are a category too windy and mitigation measures for this issue are set out in Section 3.4.

Conditions at Terrace Level

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

There are no wind safety exceedances within the balustrade line of any roof terrace, so there is no risk to terrace users due to wind safety..

Conditions for the proposed roof terrace are suitable for standing in winter and for a mix of sitting and standing in summer. This is suitable for the intended use.

Conditions for the Vox roof terrace are suitable for a mixture of standing and leisure walking in winter and for a mix of sitting and standing in summer. This is suitable for the intended use, and it should be noted that the extent of the roof terrace which is suitable for sitting has increased relative to the baseline, which is a beneficial impact of the proposed development..



Fig. 11: Annual Safety at Ground Level, Proposed Development with Existing Surrounds

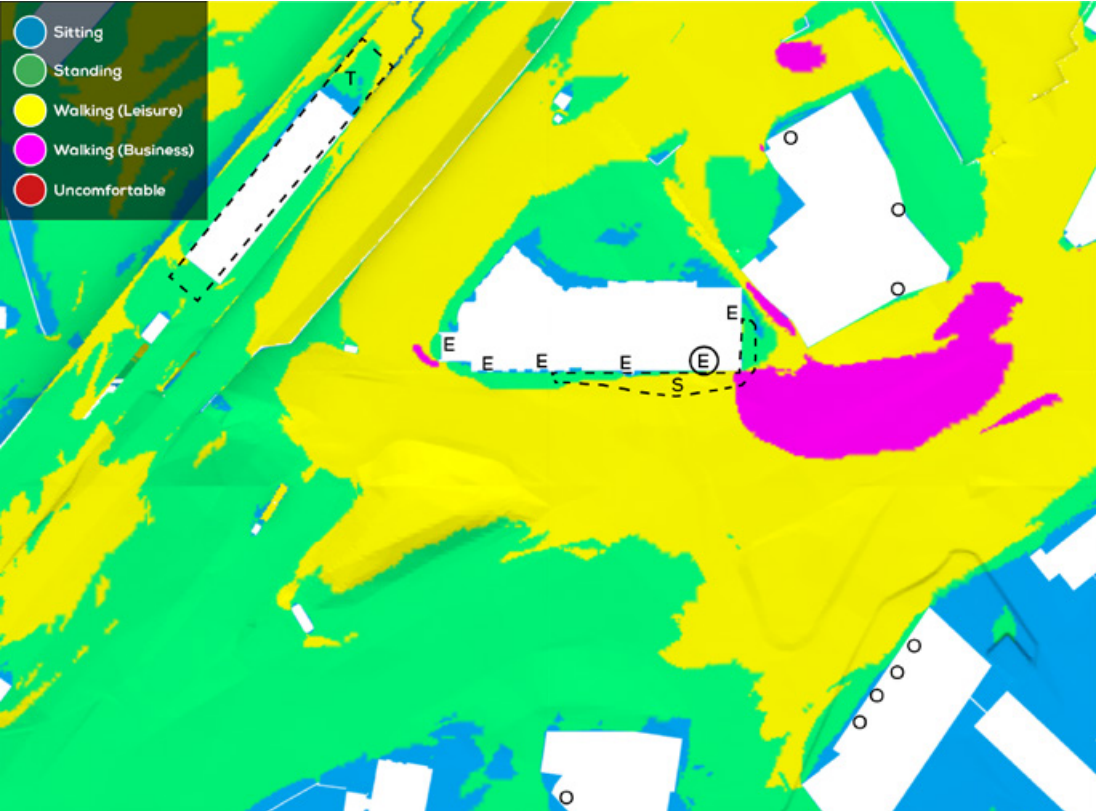


Fig. 12: Winter Comfort at Ground Level, Proposed Development with Existing Surrounds

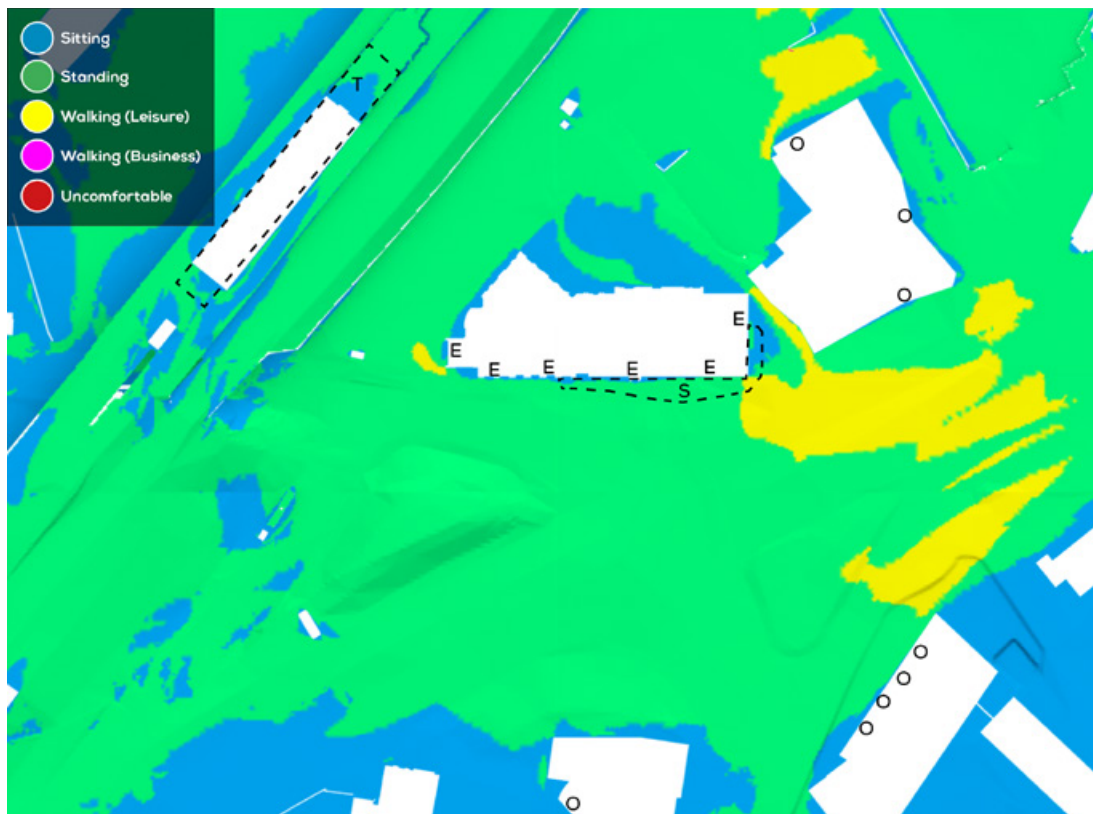


Fig. 13: Summer Comfort at Ground Level, Proposed Development with Existing Surrounds

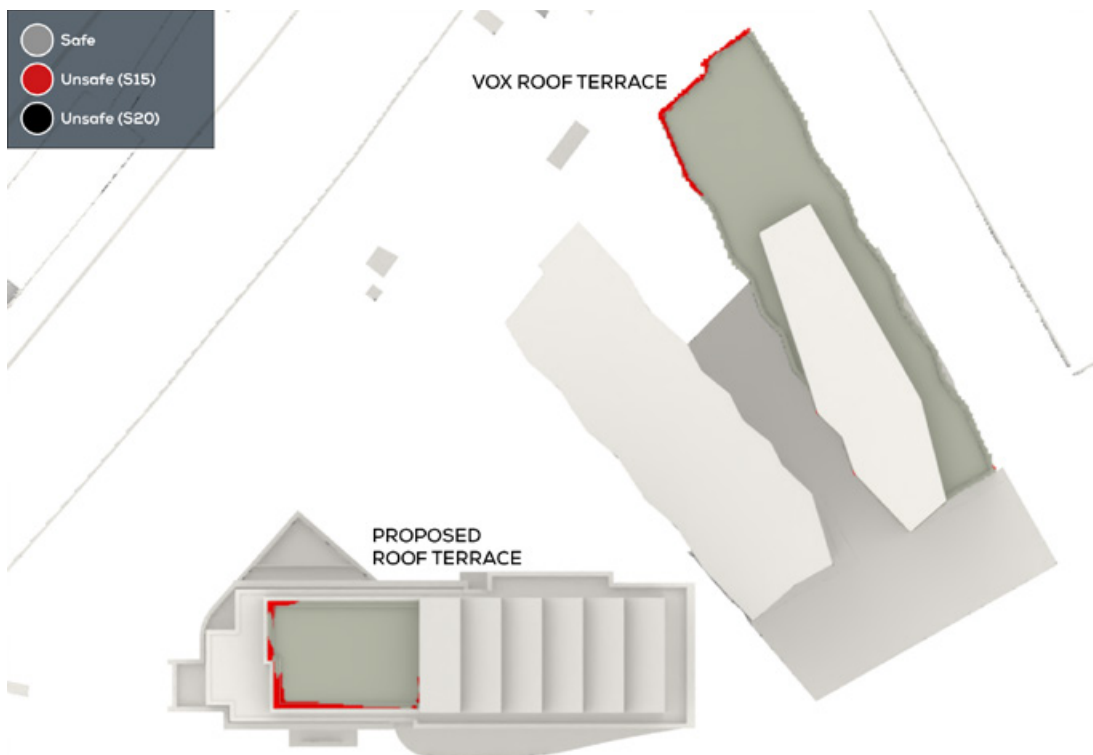


Fig. 14: Annual Safety at Terrace Level, Proposed Development with Existing Surrounds

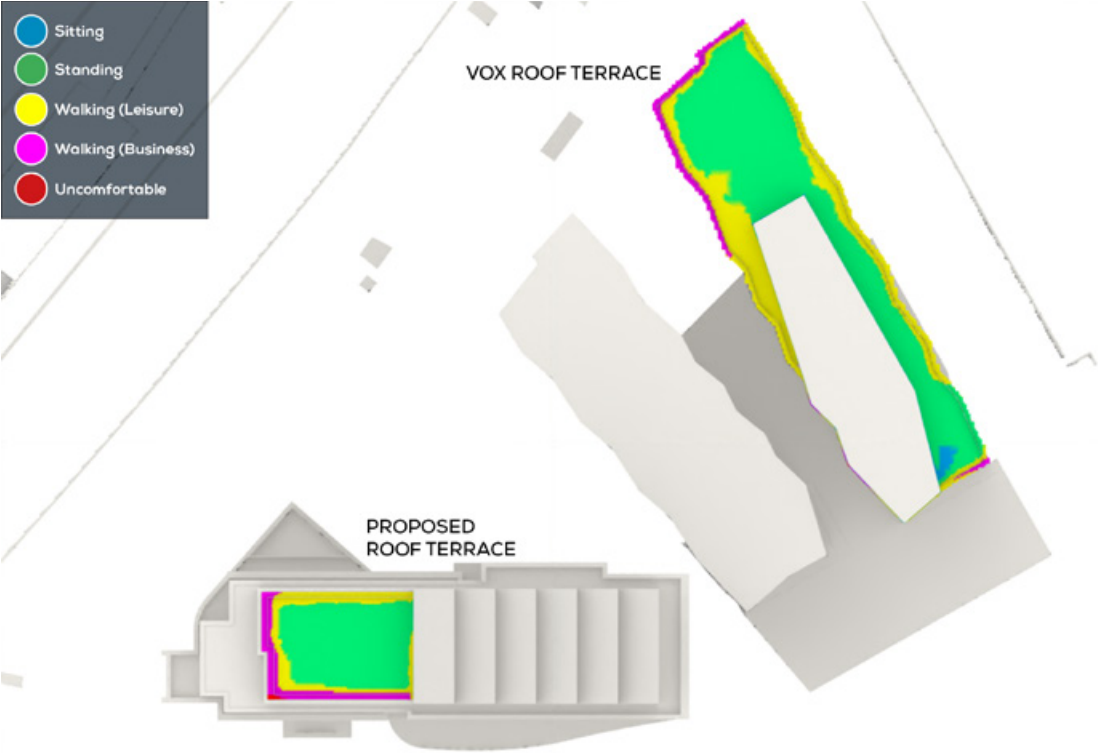


Fig. 15: Winter Comfort at Terrace Level, Proposed Development with Existing Surrounds

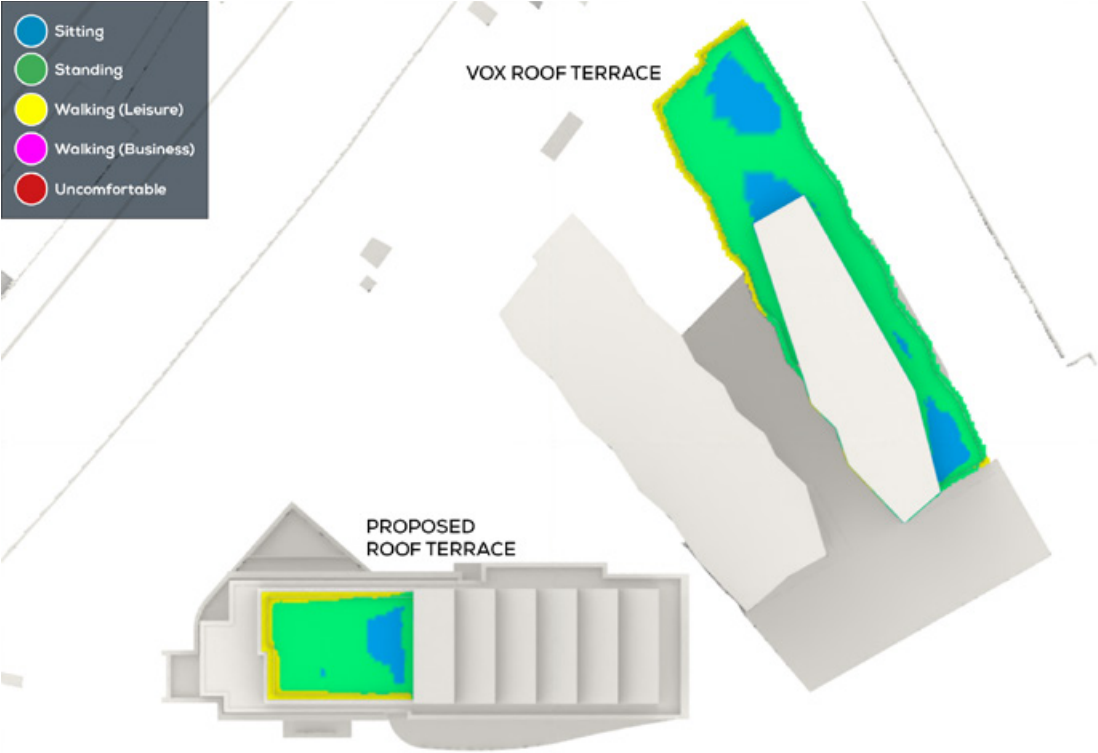


Fig. 16: Summer Comfort at Terrace Level, Proposed Development with Existing Surrounds

3.3 CONDITIONS FOR PROPOSED DEVELOPMENT WITH CUMULATIVE SURROUNDS

Conditions at Ground Level

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

Compared to the scenario for the proposal with existing surrounds, conditions are slightly windier to the east of the site.

There are, however, no material differences in conditions immediately around the site, and the suitability of all receptors is unchanged.

Conditions at Terrace Level

Annual safety at terrace level for the proposed development with cumulative surrounds is shown in Figure 19. Winter comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 20. Summer comfort at terrace level for the proposed development with cumulative surrounds is shown in Figure 21.

Compared to the scenario for the proposal with existing surrounds, conditions are slightly calmer on the roof terraces.

There are, however, no material differences in terrace level conditions and the suitability of all receptors is unchanged.

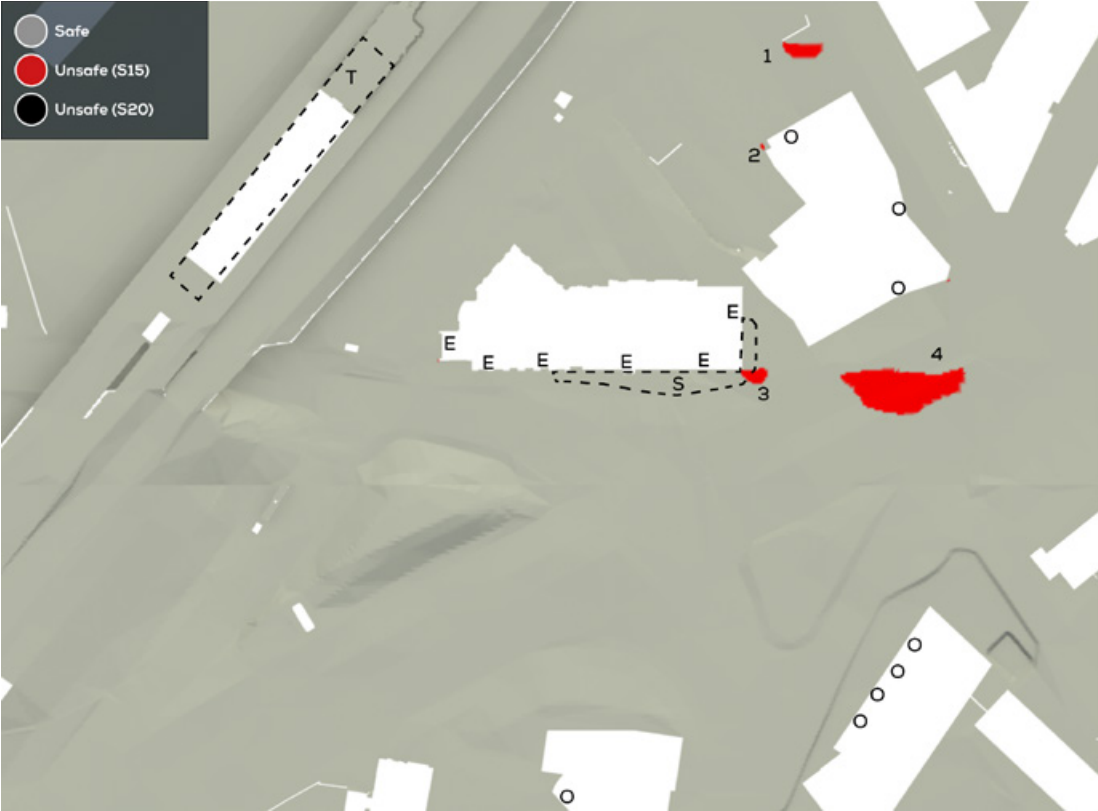


Fig. 17: Annual Safety at Ground Level, Proposed Development with Cumulative Surrounds

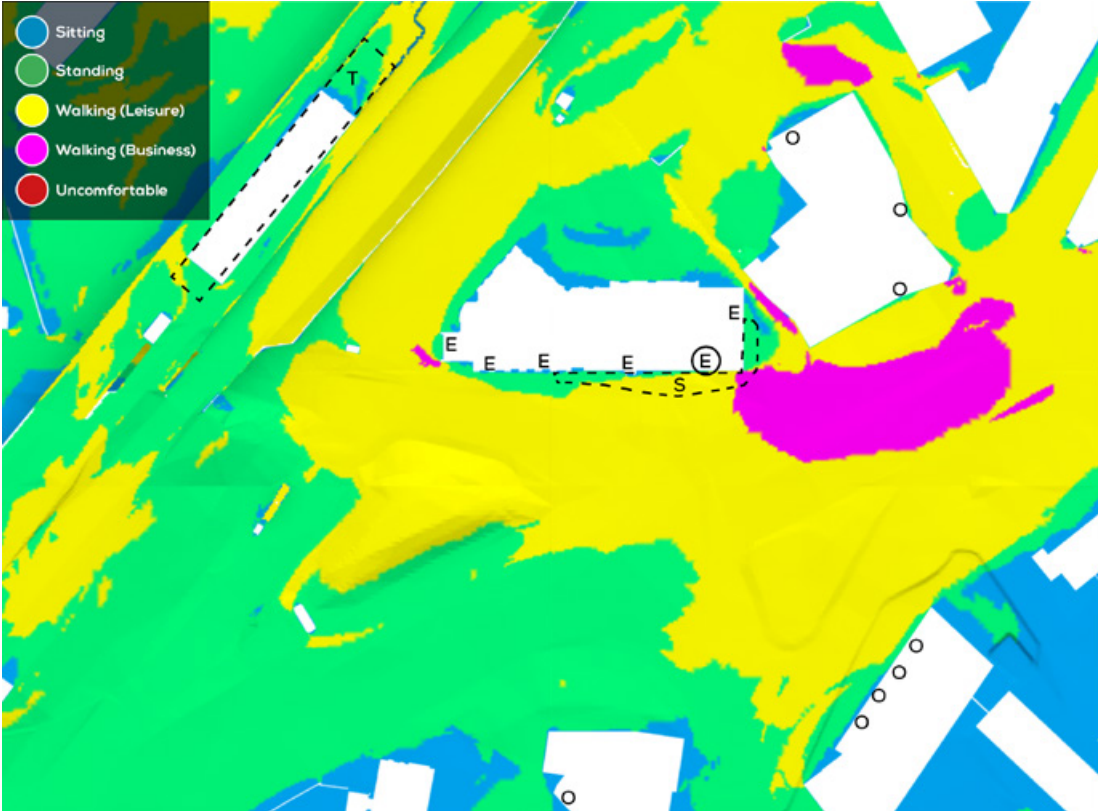


Fig. 18: Winter Comfort at Ground Level, Proposed Development with Cumulative Surrounds

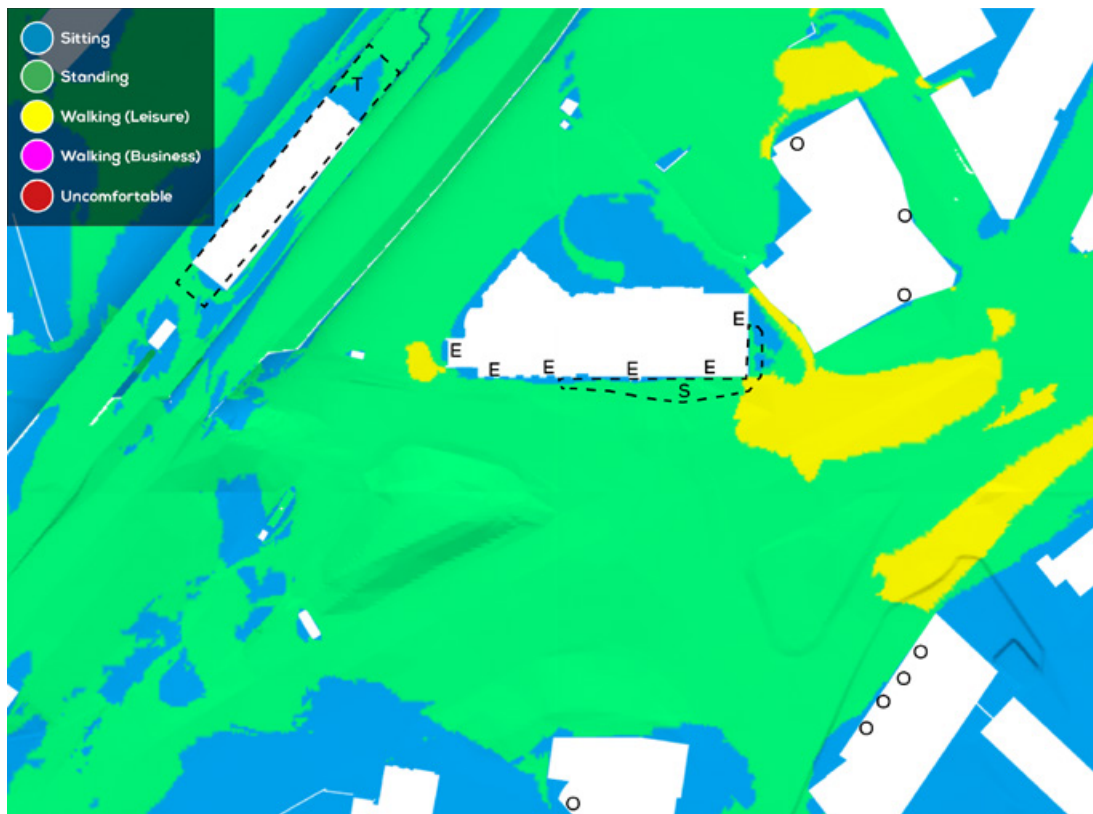


Fig. 19: Summer Comfort at Ground Level, Proposed Development with Cumulative Surrounds

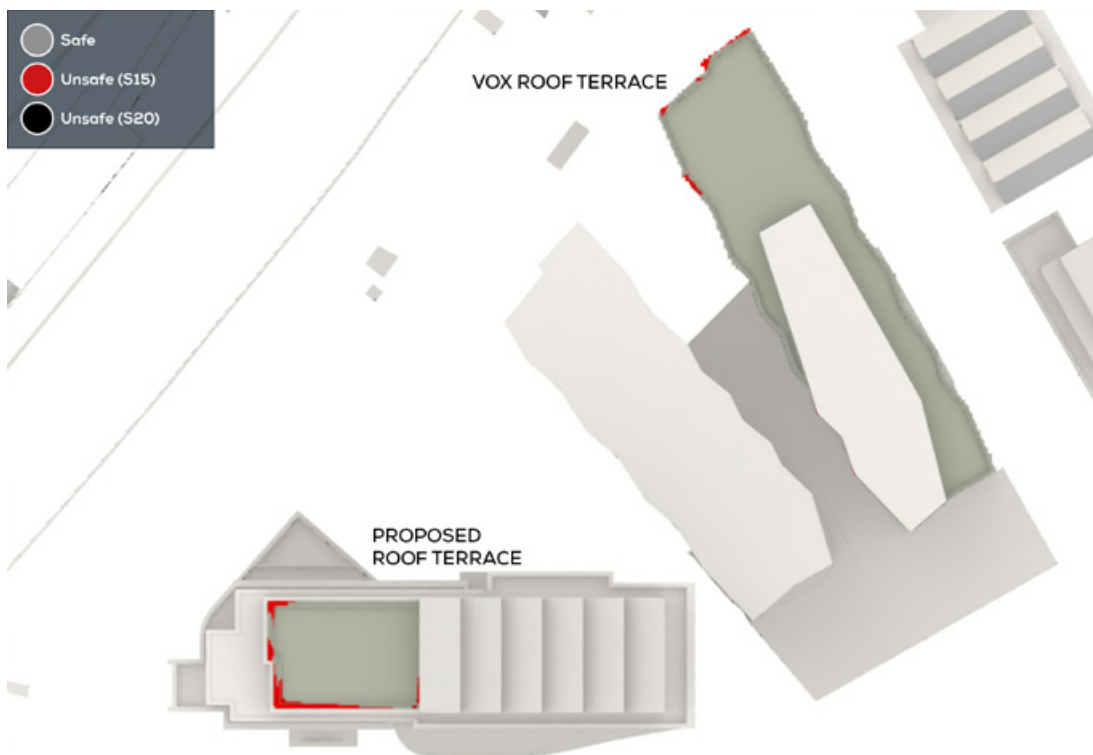


Fig. 20: Annual Safety at Terrace Level, Proposed Development with Cumulative Surrounds

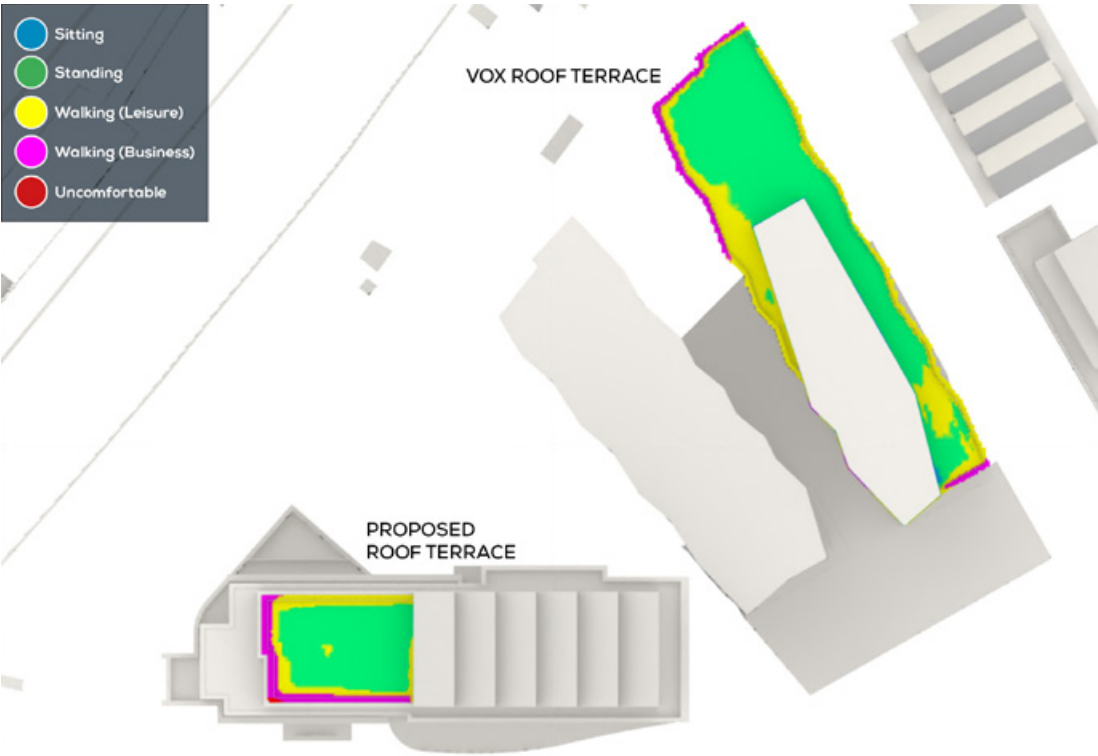


Fig. 21: Winter Comfort at Terrace Level, Proposed Development with Cumulative Surrounds

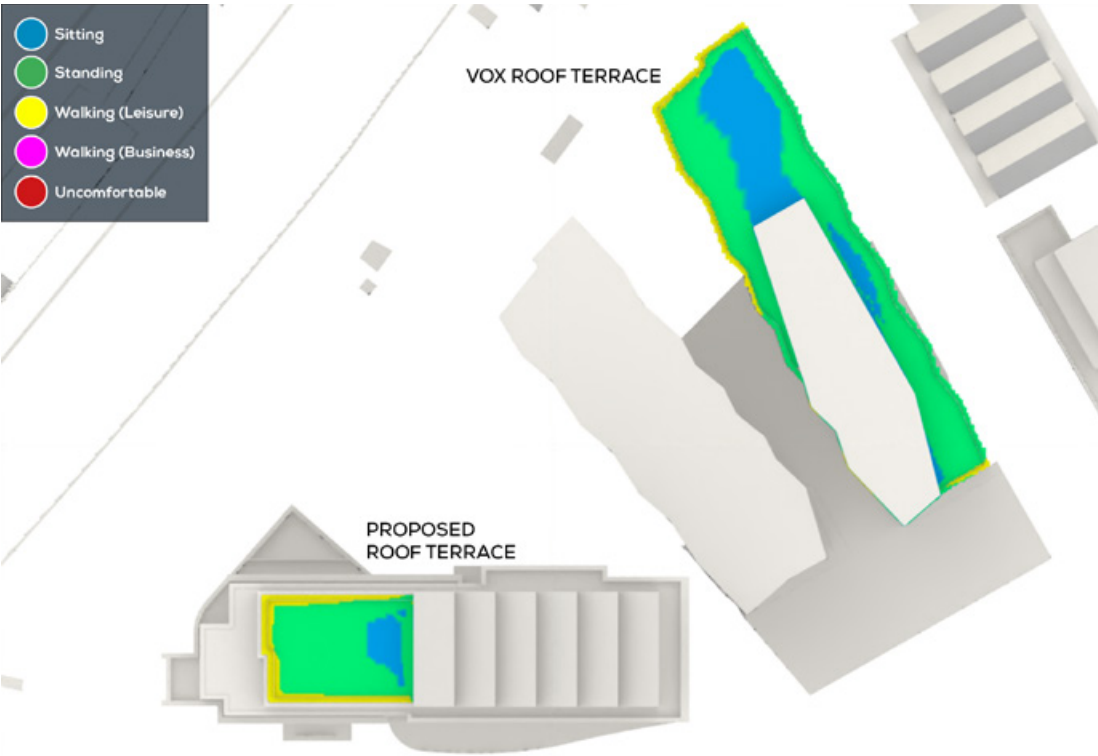


Fig. 22: Summer Comfort at Terrace Level, Proposed Development with Cumulative Surrounds

3.4 CONDITIONS FOR PROPOSED DEVELOPMENT WITH LANDSCAPING, MITIGATION AND CUMULATIVE SURROUNDS

Landscaping and Mitigation

The proposed landscaping masterplan was updated (as shown in Figure 23) to incorporate wind mitigation in the following forms:

- 7m tall deciduous “Liquidamber” trees in the locations shown;
- Six 1500mm x 1500mm 50% porous screens in the locations shown in blue in Figure 23; and
- One 1500mm x 3000mm 50% porous screen in the location shown in red in Figure 23.

It should be noted that, subsequent to the wind testing, the proposed landscaping masterplan was updated further. The updated plan (as submitted) is shown in Figure 24. It should be noted that the proposed trees and screens along the southern frontage of the proposed development are consistent between the two layouts, so the impact on wind conditions would not be altered and the following results remain robust.

An additional scenario was tested (with cumulative surrounds, as this was the worst case for the safety exceedances) and is reported below.

The reporting below is focused on the areas which were not compliant in the initial testing (safety exceedances, the southern cafe/coffee shop entrance and the spill out seating).

Conditions at Ground Level

Annual safety at ground level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 25. Winter comfort at ground level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 26. Summer comfort at ground level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 27.

There are two pre-existing safety exceedances within the under-croft of the neighbouring Vox development (marked “1” and “2” on Figure 11). These are consistent with the baseline so are not attributable to the proposed development.

The two previously identified regions of S15 (distress) exceedance, by the south east corner of the site (marked “3” on Figure 24) and off-site on Bridgewater Way (marked “4” on Figure 25) have both been eradicated.

The southern entrance to the cafe/coffee shop (marked “E” and circled in Figure 12) is now suitable for standing at worst. This is suitable for the intended use.

Conditions for the proposed spill-out seating (marked “S” in results figures) are suitable for standing in winter and sitting in summer to the east of the proposed development, and for a mix of standing and leisure walking in winter and a mix of sitting standing in summer (with the majority of the space suitable for sitting in summer) to the south of the proposed development. This is now suitable for the intended use.

Conditions at Terrace Level

Annual safety at terrace level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 28. Winter comfort at terrace level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 29. Summer comfort at terrace level for the proposed development with landscaping, mitigation and cumulative surrounds is shown in Figure 30.

There are no material differences in terrace level conditions when compared to the scenario without mitigation and the suitability of all receptors is unchanged.



Fig. 23: Proposed Landscaping with Wind Mitigation Included (as tested)

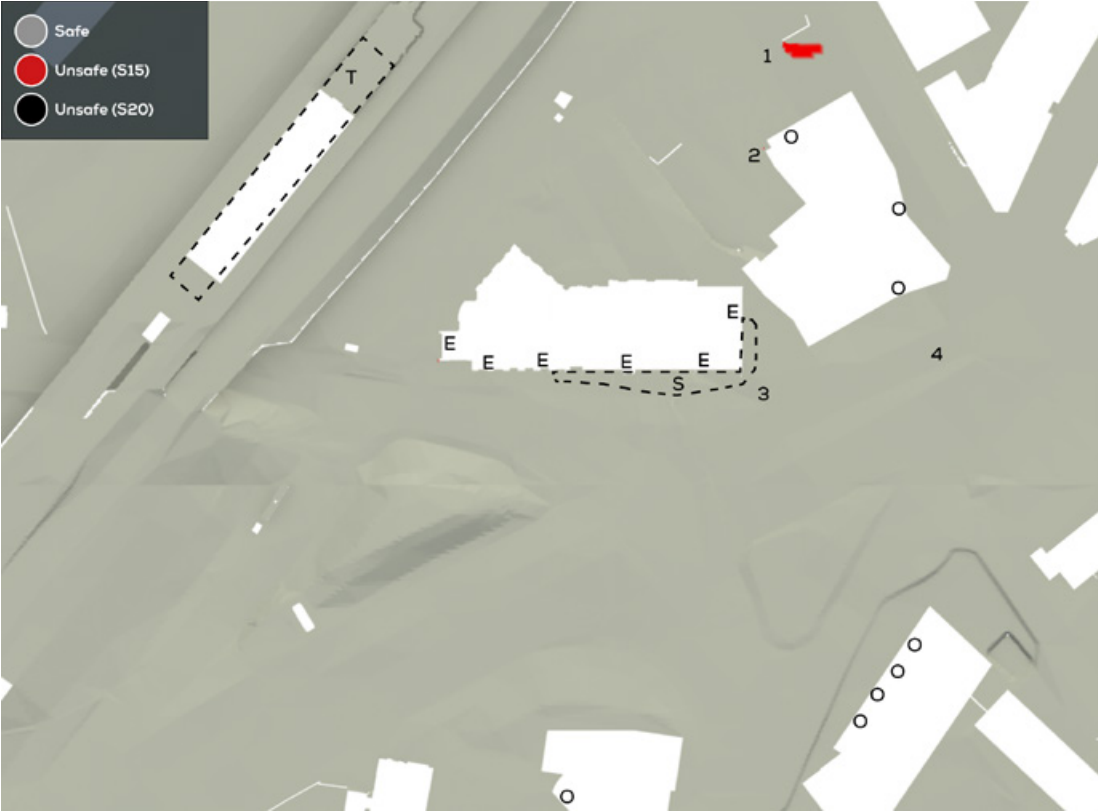


Fig. 25: Annual Safety at Ground Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

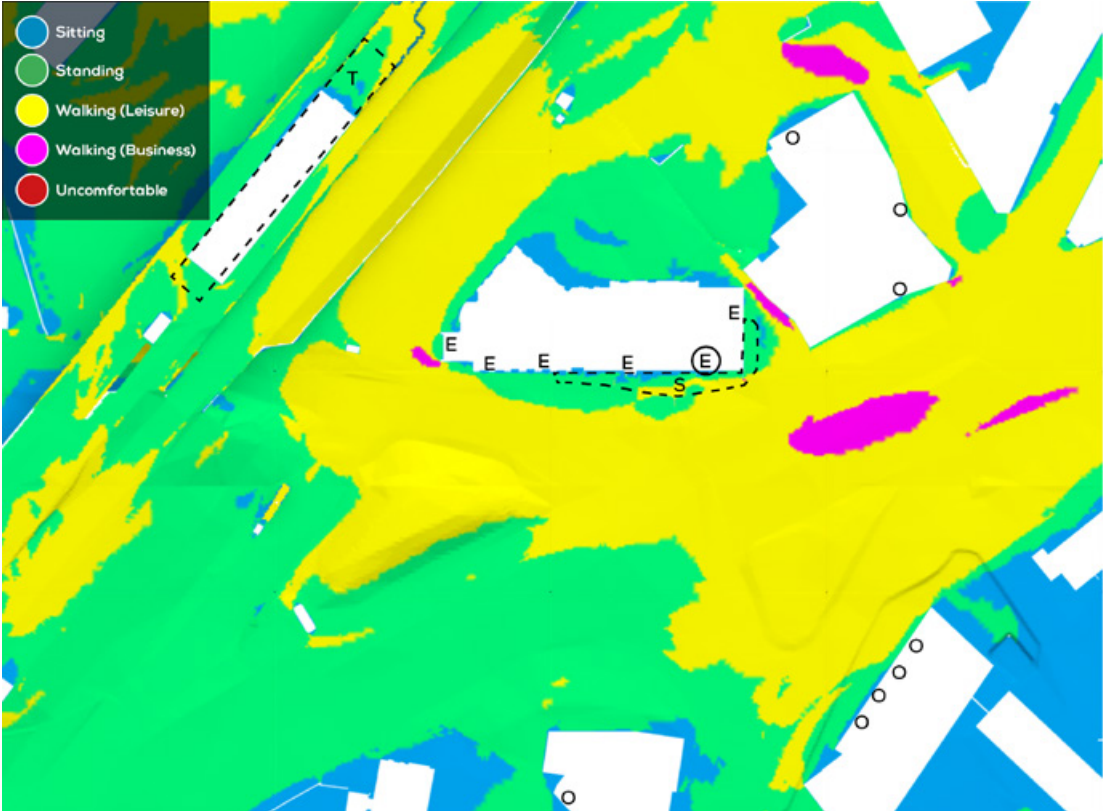


Fig. 26: Winter Comfort at Ground Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

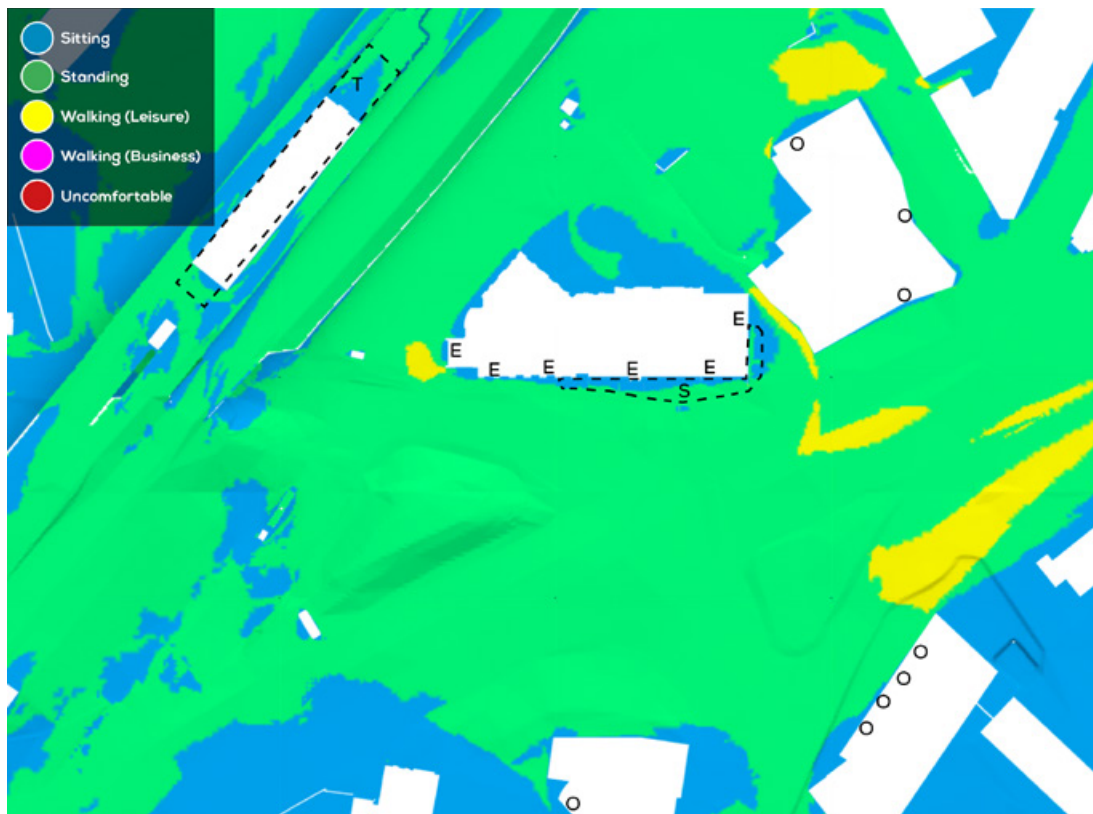


Fig. 27: Summer Comfort at Ground Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

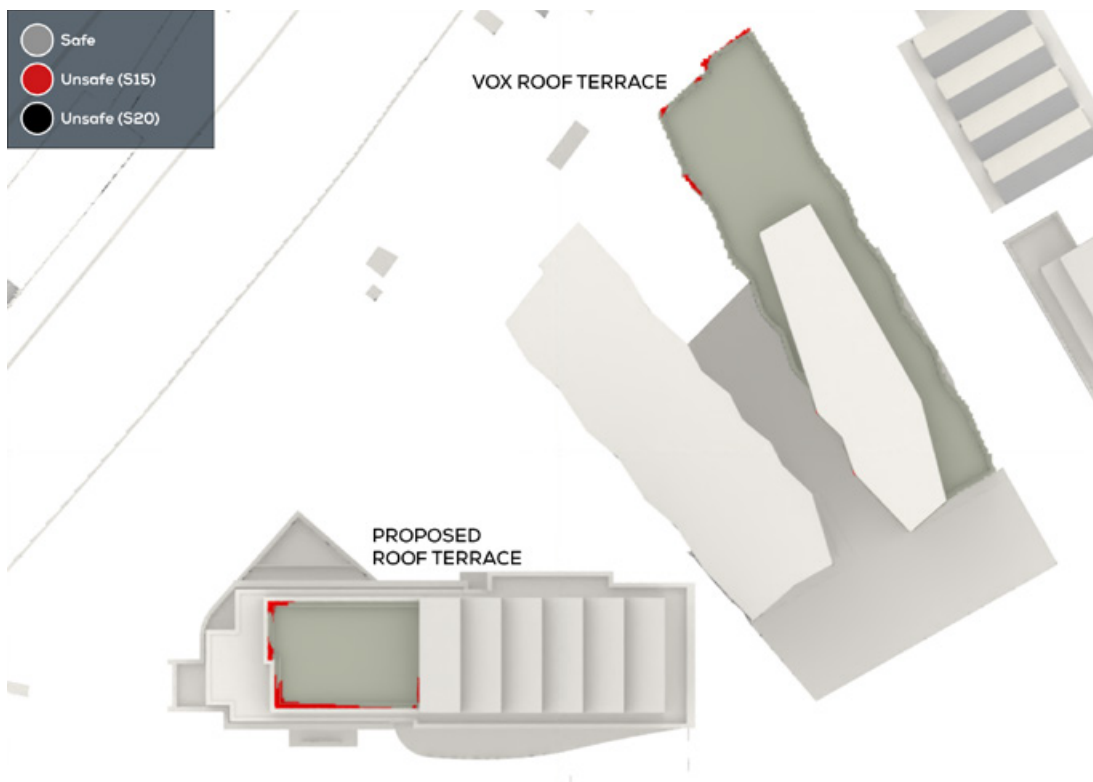


Fig. 28: Annual Safety at Terrace Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

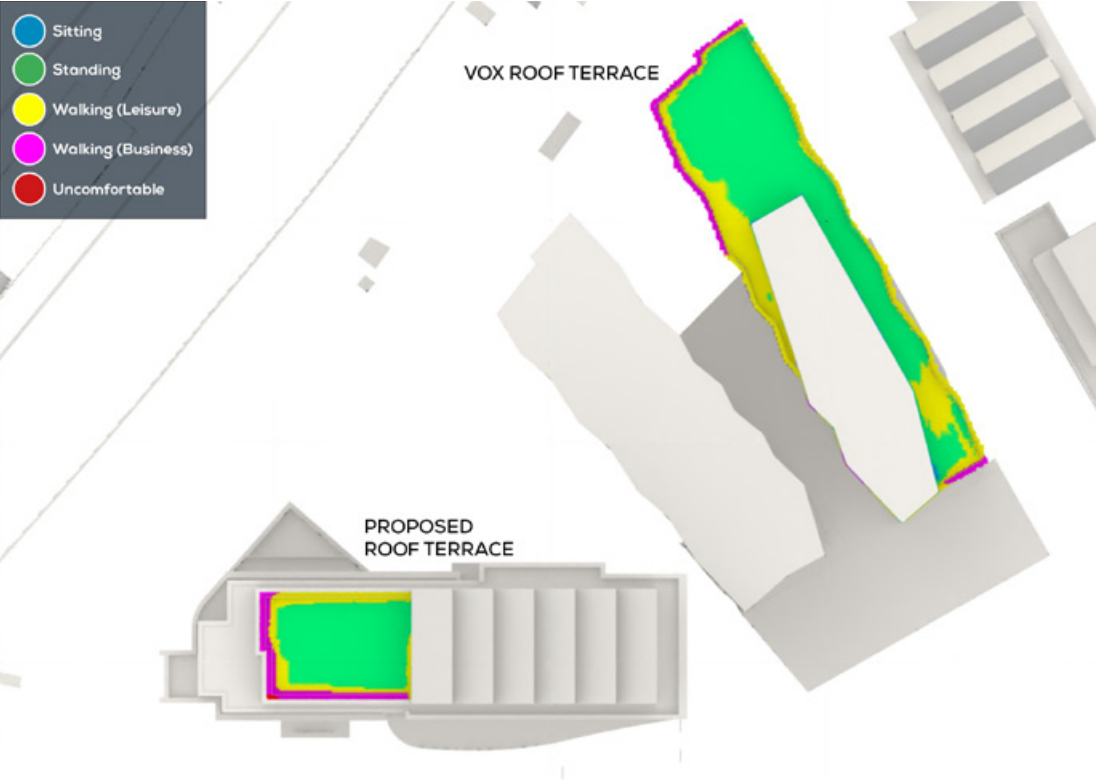


Fig. 29: Winter Comfort at Terrace Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

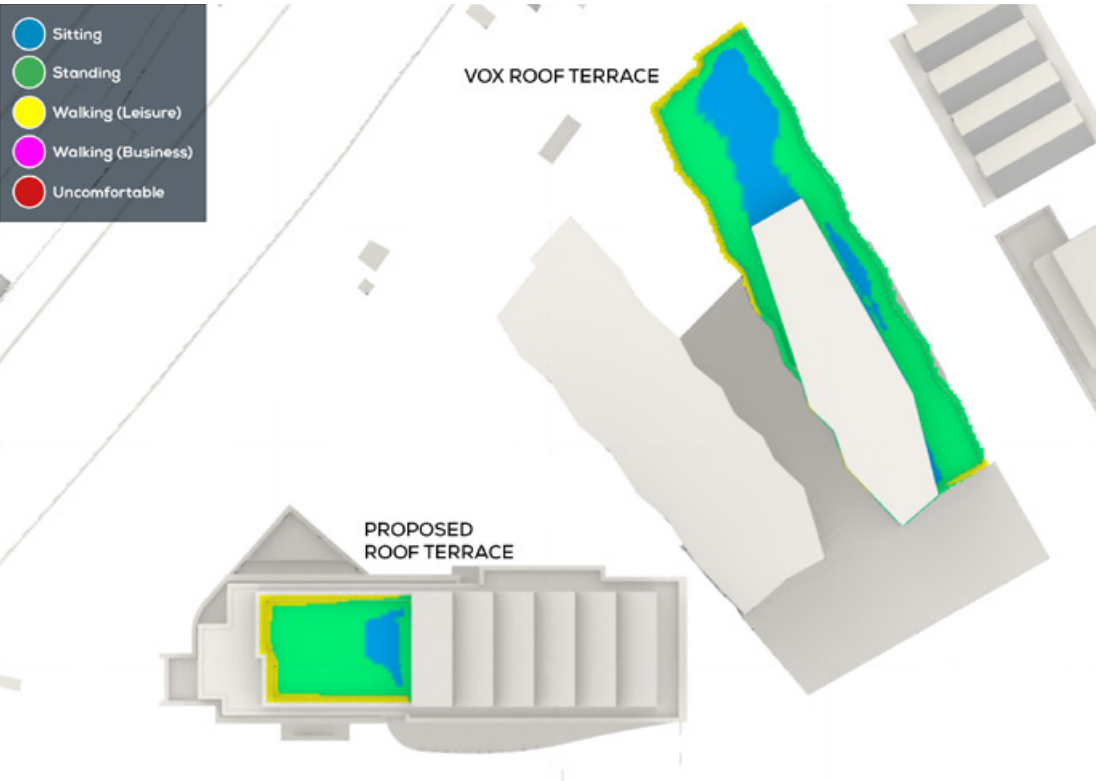


Fig. 30: Summer Comfort at Terrace Level, Proposed Development with Landscaping, Mitigation and Cumulative Surrounds

4 CONCLUSIONS

Wind microclimate conditions for the proposed Cornbrook development in Manchester were assessed using high resolution Computational Fluid Dynamics (CFD).

The following mitigation measures have been proposed and found to be sufficient to ensure that the proposed development does not have any adverse impact on wind conditions:

- 7m tall deciduous “Liquidamber” trees in the locations shown in Figure 23;
- Six 1500mm x 1500mm 50% porous screens in the locations shown in blue in Figure 23; and
- One 1500mm x 3000mm 50% porous screen in the location shown in red in Figure 23.

The proposed development will have a beneficial impact on conditions for the roof terrace of the neighbouring Vox building.

Ground level wind conditions will be suitable for the intended use (or consistent with the baseline) for all thoroughfares, existing building entrances, proposed entrances, tram stops, spill out seating and roof terraces around the site.

Conditions around the site will not be significantly impacted by the inclusion of consented cumulative schemes, although once the proposed Pomona Island regeneration comes forwards it is expected to result in calmer wind conditions around the site.

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 82 and 104 million cells. Mesh detail is shown in Figure 31 and Figure 32.

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 33.

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 34.

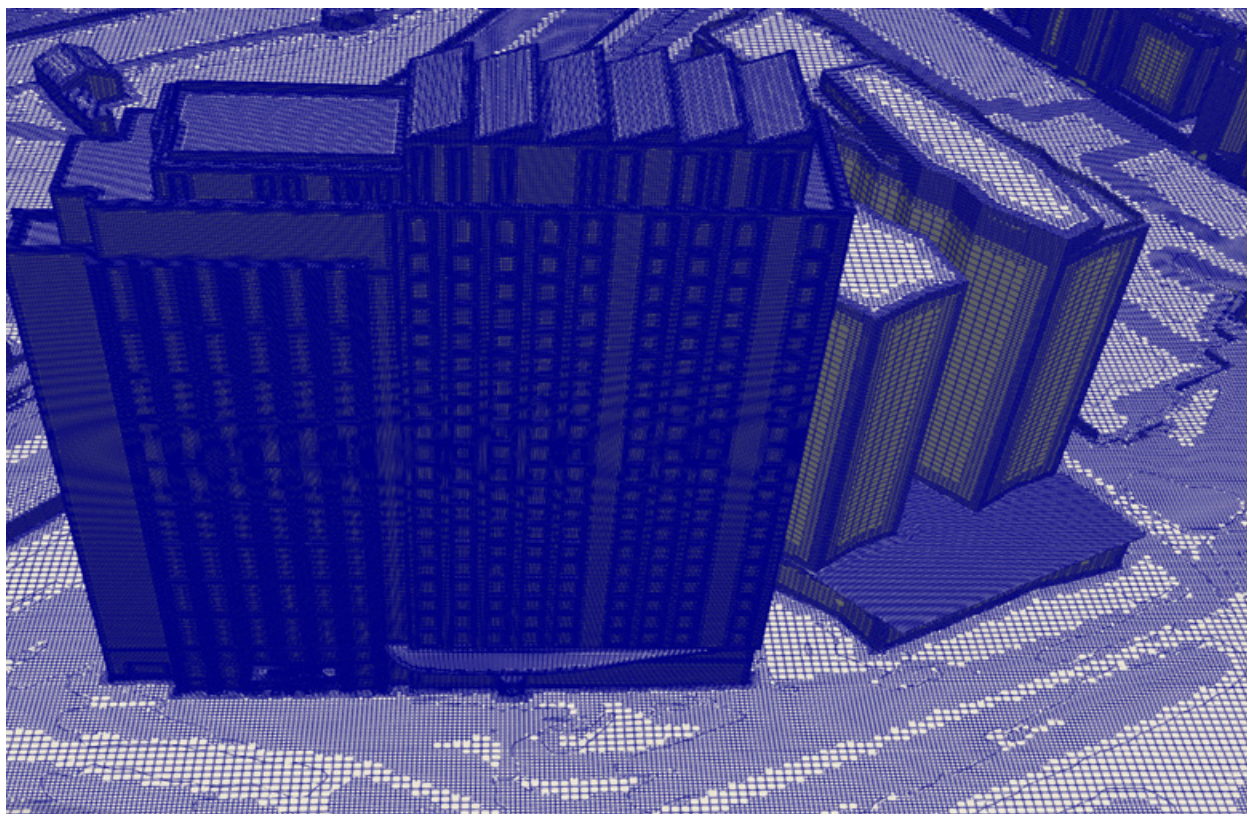


Fig. 31: Mesh Detail on Site Buildings

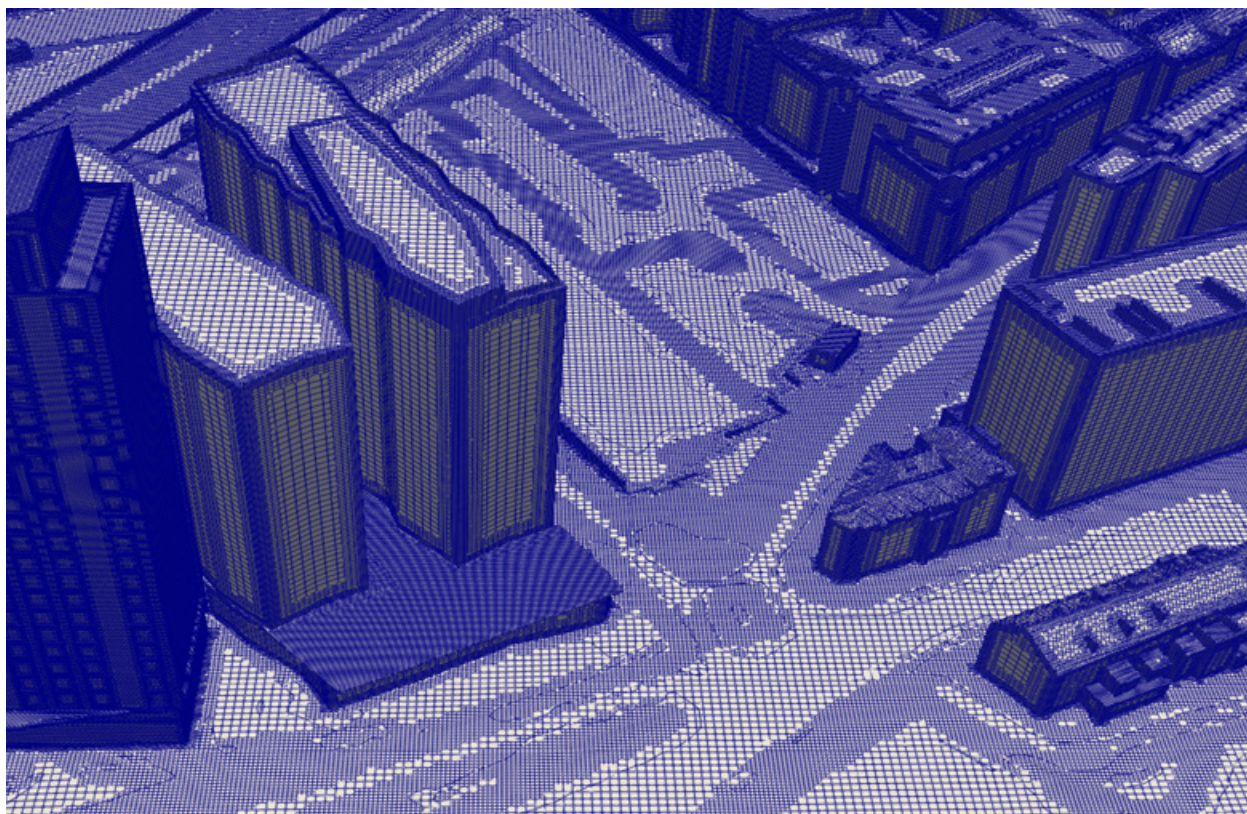


Fig. 32: Mesh Detail on Surrounds

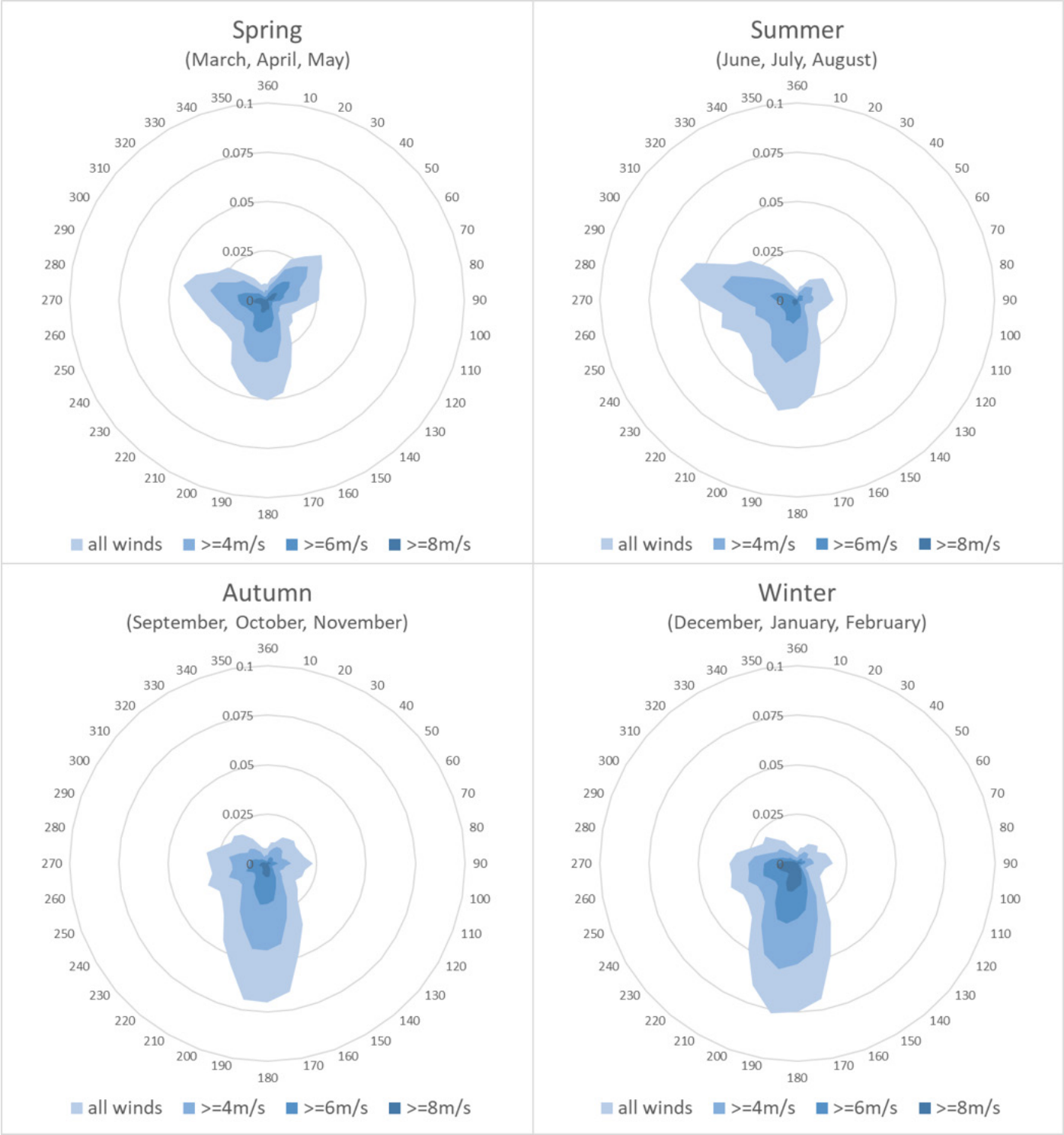


Fig. 33: Seasonal Wind Roses for Manchester International Airport (1990–2020)

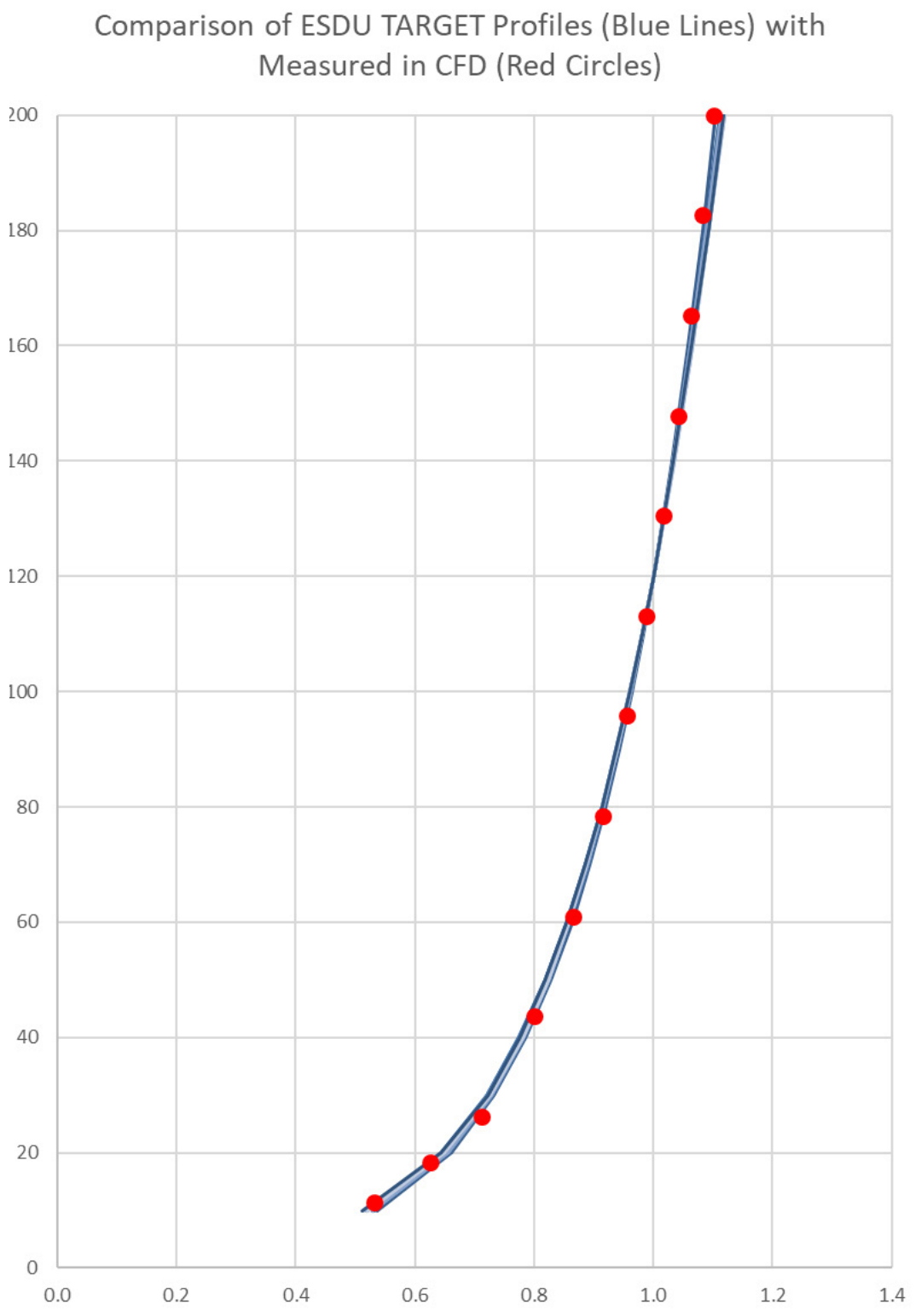


Fig. 34: Wind Profile for Central Manchester



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