Bishopsgate Goodsyard Plot 1

For

Bishopsgate Goodsyard Regeneration Limited

Wind Microclimate Report

0360420rep1v1

08 December 2023

Architectural Aerodynamics Ltd.

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Issue History

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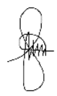
Signature				
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Signature				
Report Number				0360420rep1v1

Table of Contents

Executive Summary

Background

A study has been carried out by Architectural Aerodynamics Ltd. (ArcAero) to assess the wind microclimate for the proposed Bishopsgate Goodsyard Plot 1 development in London, United Kingdom.

The study has employed computational modelling (CFD) to predict the strength of wind speeds that will occur following the introduction of the proposed development.

This suitability of wind conditions is determined using the widely accepted industry standard Lawson criteria to determine the suitability of wind conditions on site and the impact of the proposed development on the surrounding area.

Conclusions

The following conclusions have been drawn:

- Wind conditions within and around the existing site are expected to satisfy the wind safety criteria and are generally comfortable for intended uses.
- With the introduction of the proposed development within existing surrounds, wind conditions are largely suitable for all users. There are two locations where exceedances exist and are minor, localised and seasonal and as such conditions are considered suitable.
- With the introduction of the proposed development within cumulative surrounds, wind safety and comfort conditions remain materially similar to that of the proposed development within existing surrounds.

1 Introduction

A microclimate is defined as the distinctive climate of a small-scale area. The weather variables in a microclimate, such as wind, may be different to the conditions prevailing over the area as a whole. Wind microclimate assessments consider the wind conditions that would result upon the introduction of a new development into an existing space.

Such assessments predict the proportion of time an area will experience wind speeds in excess of threshold values associated with safe and comfortable use by pedestrians and occupants once the development is introduced. It can therefore be shown within the various parts of a new proposal and neighbouring properties whether wind conditions are suitable or unsuitable, and whether design adjustment or mitigation measures are required. It is for this purpose that wind microclimate assessments are undertaken.

This report summarises the results of a CFD study, commissioned by Bishopsgate Goodsyard Regeneration Limited, to assess the wind microclimate for the proposed Bishopsgate Goodsyard Plot 1 development in London, United Kingdom.

2 The Project

2.1 Site Location and Surrounding Area

The Bishopsgate Goodsyard Plot 1 development is bounded by Shoreditch High Street to the west, the A1209 Bethnal Green Road and Sclater Street to the north and Wheeler Street to the east. The southern boundary of the site is currently sports pitches and unused land.

Currently, the site is occupied by the Shoreditch High Street Rail Station, multiple football pitches and temporary two storey retail units along Bethnal Green Road. The East London Line railway and Braithwaite Street run through the centre of the site. Viaducts and listed arches in the southern part of the site are vacant and covered with vegetation and trees.

The immediate surroundings of the site comprised of low-rise developments. Further afield, the area is typically consisting of low-rise developments as well as high-rise developments to southwest of the site, typical of a London suburb.

2.2 The Proposed Development

The proposed development will comprise a 16-storey office building and ground with a mezzanine at level 5.

2.2.1 Updated Proposals during the Assessment

During the course of the assessment a minor update the proposals was undertaken. This involved lowering of the plant enclosure and does not have an impact on the microclimate results, as the change is negligible with respect to wind. As such, the results presented herein are still applicable.

2.3 Drawing Information Describing the Proposed Development

Assessment models have been constructed on the basis of the following drawings received from the design teams:

Table 2-1 – Assessment Model Drawings

Drawing Name	Date
Maximum Parameters.dwg	2nd June 2023
3465-FBA-51-XX-M3-A-GOODSYARD-PARAMETERS_MAXIMUM.dwg	15th September 2023
8264-Model_Arches Only.dwg	20th September 2023
8264-Model_Proposals Only.dwg	20th September 2023
18-TGY-EPA-ZZ-ZZ-M3-A-XX-0001_Wind_Compliant.dwg	27th September 2023
Plot 1 final frozen model BGY-GEN-01-ZZ-M3-A-00805_Opt3.dwg	31st October 2023

The existing surrounding area was based upon information supplied by Temple and supplemented by Ordnance Survey details for the area. Cumulative surrounds were based upon information contained within the Hackney Council and Tower Hamlets Council planning portal.

2.4 Soft Landscaping

The wind microclimate has been assessed for the proposed development with soft landscaping on the platform and elevated terraces and surrounding landscaping. Landscaping proposals are based on the following drawings:

Table 2-2 – Landscaping Drawings

Drawing Name	Date
Plot 1 RMA Landscape and Public Realm Strategy DRAFT, BGY-SPA-SW-ZZ-RP-L-94002	1st November 2023
Plot 1 Level 5, 8418-SK25	28th November 2023
Plot 1 Level 6, 8418-SK26	28th November 2023
Plot 1 Level 12, 8418-SK27	28th November 2023

Landscaping has been tailored to enhance the wind microclimate where needed, some of these key elements are presented within Figure 2. 1, Figure 2.2 and Figure 2.3.

2.5 Cumulative Schemes

A number of cumulative schemes have been considered in the assessment. These schemes are presented in tabular format in Table 2-3.

Table 2-3 – Cumulative Schemes

Development Name	Planning Reference
Truman's Brewery	PA/21/00140/NC
Huntingdon Industrial Estate	PA/20/00557
Shoreditch High Street	2015/2403
Hewett Street	2021/0406
Brick Lane	PA/20/00415

3 Assessment Methodology

3.1 Overview

CFD modelling has employed a steady-state RANS approach This method employs turbulence models to approximate the magnitude of velocity fluctuations about the average wind speeds predicted, in order to derive an estimation of the effect of gusts.

Full details on this approach are provided in Appendix A of this report - salient highlights of this approach are:

- the Shear Stress Transport k-ω turbulence model has been employed.
- Architectural features of 0.5 metres or more have been captured within the geometry modelled.
- Cell sizes of as small as 0.2 metres were utilised to capture flow behaviour in critical locations.
- The region of interest closest to the ground (1.5 metres) incorporated 5 layers of cells.

Modelling has derived mean and gust equivalent mean wind speeds, in accordance with best industry practice. In doing so 36 wind directions were assessed, in 10° increments.

The industry standard criteria for wind microclimate assessments, the LDDC variant of the Lawson criteria (1), has been employed for the study.

3.2 Computational Model

A digital model of the site and surrounds was used for the study. The surrounding area was modelled up to a distance of 450 m and all features which are likely to impact the wind flow to and through the site have been replicated. Details of the model, including the configurations tested, are presented within Appendix B of this report.

3.3 Wind Climate Analysis

Wind microclimate studies require that meteorological data is transposed from a nearby weather station with sufficient wind data to produce accurate wind frequency statistics.

The Wind Microclimate Guidelines for Developments in the City of London contains wind statistics for direct use for developments in the City of London, and as noted in Annex A of the document, data from London Heathrow Airport (LHR) and London City Airport (LCY) has been used in compiling Weibull parameters, presented in Table 2 of the guidelines (2).

The current study employs the wind climate statistics set out within the Wind Microclimate Guidelines for Developments in the City of London (2). The reference height selected for the study was 120 metres, for which Table 1 specifies a further scaling factor of 1.

While not within the City of London, the proposal development is close to the boundary, and the CoL wind statistics therefore represent a viable and appropriate option. It is for this reason that these have been employed.

Full details of the wind climate relevant to the site, the wind properties approaching the site and the modelling of those wind properties in the CFD models are provided in Appendix C of this report. All analysis of wind data and the atmospheric boundary layer has employed the methods of ESDU item 01008 (3), in accordance with best industry practice.

3.4 The LDDC Lawson Criteria

The industry standard criteria for such assessments are commonly referred to as the Lawson criteria. Architectural Aerodynamics use the London Docklands Development Corporation (LDDC) variant of the Lawson Criteria (1).

The LDDC variant of the Lawson criteria applies a single percentage probability of exceedance of a range of wind speeds related to different pedestrian uses.

3.4.1 Safety

A wind speed of 15 metres-per-second occurring once per year is rated as unsafe, with the potential to de-stabilise the less able members of the public including the elderly, cyclists and children.

3.4.2 Comfort

The LLDC variant of the Lawson criteria (1) dictates that wind conditions are suitable for a given activity when the threshold is exceeded no more than 5% of the time in seasons relevant to the activities that will take place in a given area. The value of 5% has been established as giving a reasonable allowance for extreme and relatively infrequent winds that are tolerable within each category. These threshold wind speed values are presented in Table 3-1.

Table 3-1 – LLDC Wind Comfort Thresholds

Threshold Wind Speed [m/s]	Comfort Rating / Activity	
4	C4	Long-term sitting
6	C3	Standing / short-term sitting
8	C2	Strolling
10	C1	Walking
> 10	C0	Uncomfortable

4 Results

4.1 Existing Site Conditions

The results for the existing site conditions are presented graphically within Figure 4.1 for safety, and Figure 4.2 and Figure 4.3 for worst-seasonal and summer conditions respectively.

4.1.1 Safety

Wind conditions within and around the existing site generally satisfy the safety criteria for pedestrian safety.

4.1.2 Comfort

Within the existing site and immediate surrounding areas, wind conditions are substantially suitable for short-term sitting or better. Wind conditions are therefore suitable for existing pedestrian uses including strolling at thoroughfares, standing at entrances, waiting at bus stops and recreational uses as needed.

4.2 Proposed Development within Existing Surrounds

The results for the proposed development within existing surrounds are presented graphically within Figure 4.4, Figure 4.5, Figure 4.6, and Figure 4.7 for safety, Figure 4.8 and Figure 4.9 for worst-seasonal and Figure 4.10, Figure 4.11, Figure 4.12 and Figure 4.13 for summer comfort respectively.

4.2.1 Safety

Upon the introduction of the proposed development, all areas within and around the proposed development satisfy the safety criteria for wind.

4.2.2 Comfort

4.2.2.1 Thoroughfares

Conditions throughout the site at both ground and elevated level are substantially suitable for at least strolling and thus for comfortable pedestrian access to and passage through the site in relation to recreational activities.

4.2.2.2 Bus Stops

Conditions at the bus stops on Bethnal Green Road remain predominantly suitable for standing and thus for awaiting a bus. A minor localised exceedance of these conditions is present at the Bethan Green Road Shoreditch stop, but this is limited to winter and conditions remain tolerable.

4.2.2.3 Entrances

Wind conditions at all entrances within the site are suitable for standing or better, and thus for pedestrian ingress / egress.

4.2.2.4 Recreational Spaces

Wind conditions on all terraces are generally suitable for at least short periods of sitting in summer. A minor exceedance of the criteria is experienced at the northwest corner of level 6 where strolling conditions are present, even here conditions are expected to be tolerable.

4.2.2.5 Balconies

Wind conditions at balconies are generally suitable for short-term sitting or better and thus for proposed use.

4.2.2.6 Surrounding Area

Within the surrounding areas, wind conditions remain substantially suitable for short-term sitting or standing and thus for existing pedestrian activities.

4.3 Proposed Development within Cumulative Surrounds

The results for the proposed development within existing surrounds are presented graphically within Figure 4.14, Figure 4.15, Figure 4.16 and Figure 4.17 for safety, Figure 4.18 and Figure 4.19 for worst-seasonal and Figure 4.20, Figure 4.21, Figure 4.22 and Figure 4.23 for summer comfort respectively.

With the introduction of cumulative surrounds, the wind conditions for both safety and comfort aspects remain materially similar as the proposed development within existing surrounds scenario.

5 Conclusions

The following conclusions have been drawn:

- Wind conditions within and around the existing site are expected to satisfy the wind safety criteria and are generally comfortable for intended uses.
- With the introduction of the proposed development within existing surrounds, wind conditions are largely suitable for all users. There are two locations where exceedances exist and are minor, localised and seasonal and as such conditions are considered suitable.
- With the introduction of the proposed development within cumulative surrounds, wind safety and comfort conditions remain materially similar to that of the proposed development within existing surrounds.

6 References

1. **Lawson, T.V.** *The determination of the wind environment of a building complex before construction.* Bristol : University of Bristol, Department of Aeronautical Engineering, 1990.

2. **London, City of.** *Wind Microclimate Guidelines for Devolopments in the City of London.* London : s.n., 2019.

3. **ESDU (Engineering Science Data Unit).** *Item 01008. Computer Program for wind speeds and turbulence properties: flat or hilly sites in terrain with roughness.* 2001.

4. **F, Menter.** *Zonal Two Equation k-ω Turbulence Models for Aerodynamic Flows.* 1993. AIAA Paper 93-2906.

5. **F, Menter.** *Turbulence Modelling for Engineering Flows.* s.l. : ANSYS Inc., 2011.

6. **Richards, P.J. and Hoxey, R.P.** *Appropriate boundary conditions for computational wind engineering models using the k-ε turbulence model.* s.l. : Journal of Wind Engineering and Industrial Aerodynamics, 1993. vol. 46 & 47, pg. 145 - 153.

7. **Blocken, B. and Carmeliiet, J.** *Pedestrian wind environment around buildings: Literature review and practical examples.* s.l. : Journal of Thermal Envelope and Building Science, 2004.

7 Figures

Figure 2. 1 Landscaping enhancements on the level 5 terrace

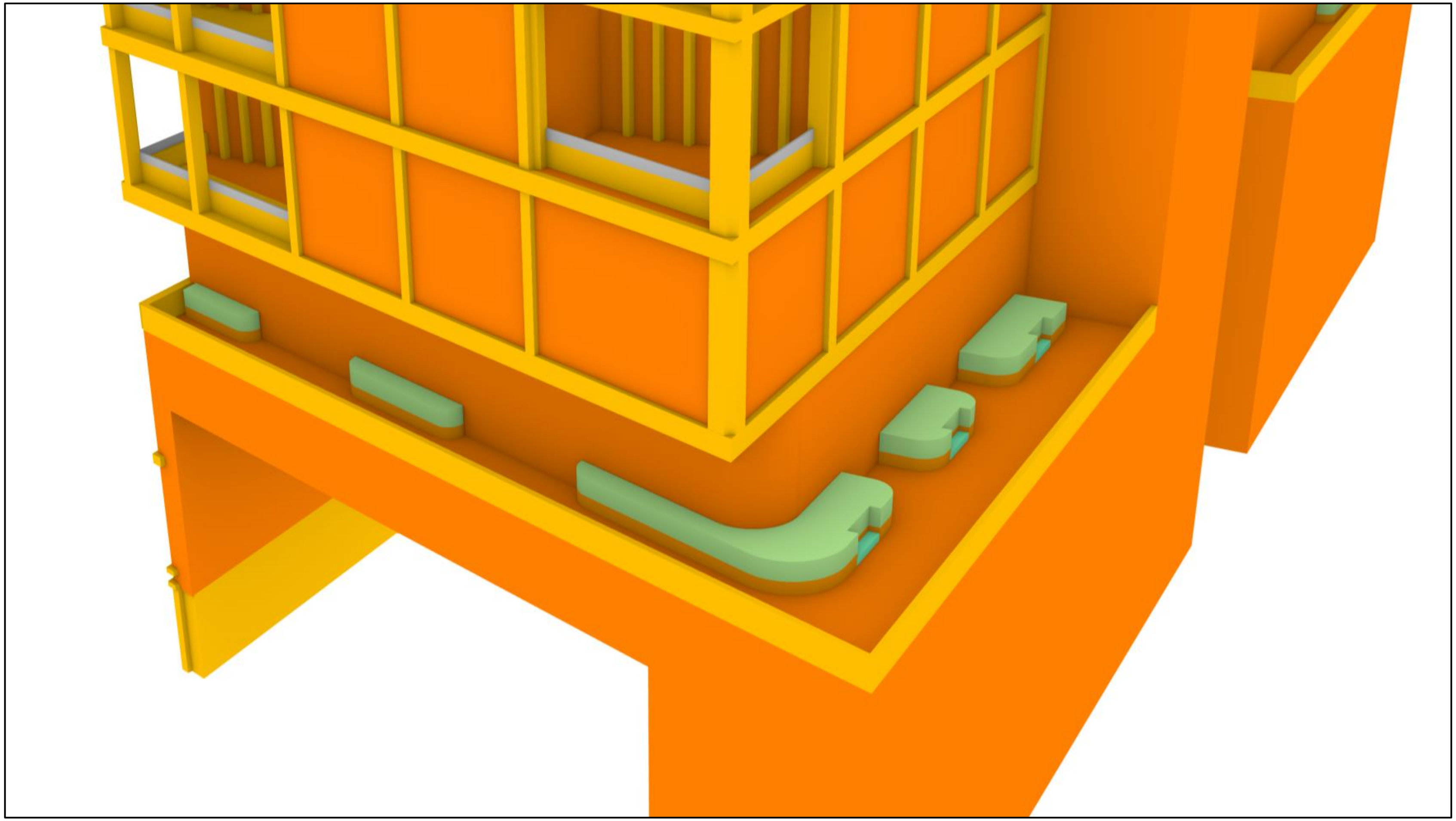


Figure 2.2 Landscaping enhancements on the level 6 terrace

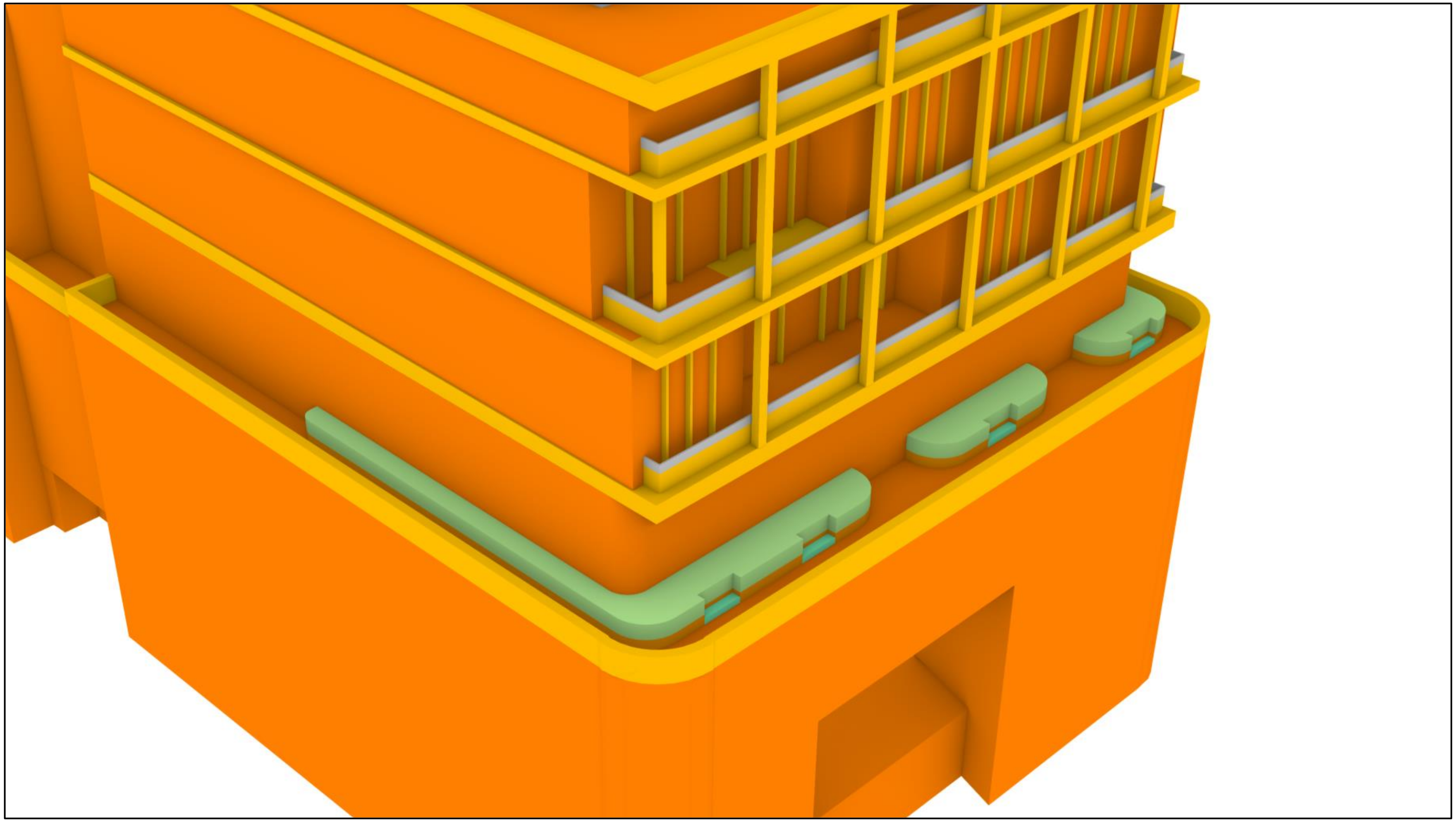


Figure 2.3 Landscaping enhancements on the level 12 terrace

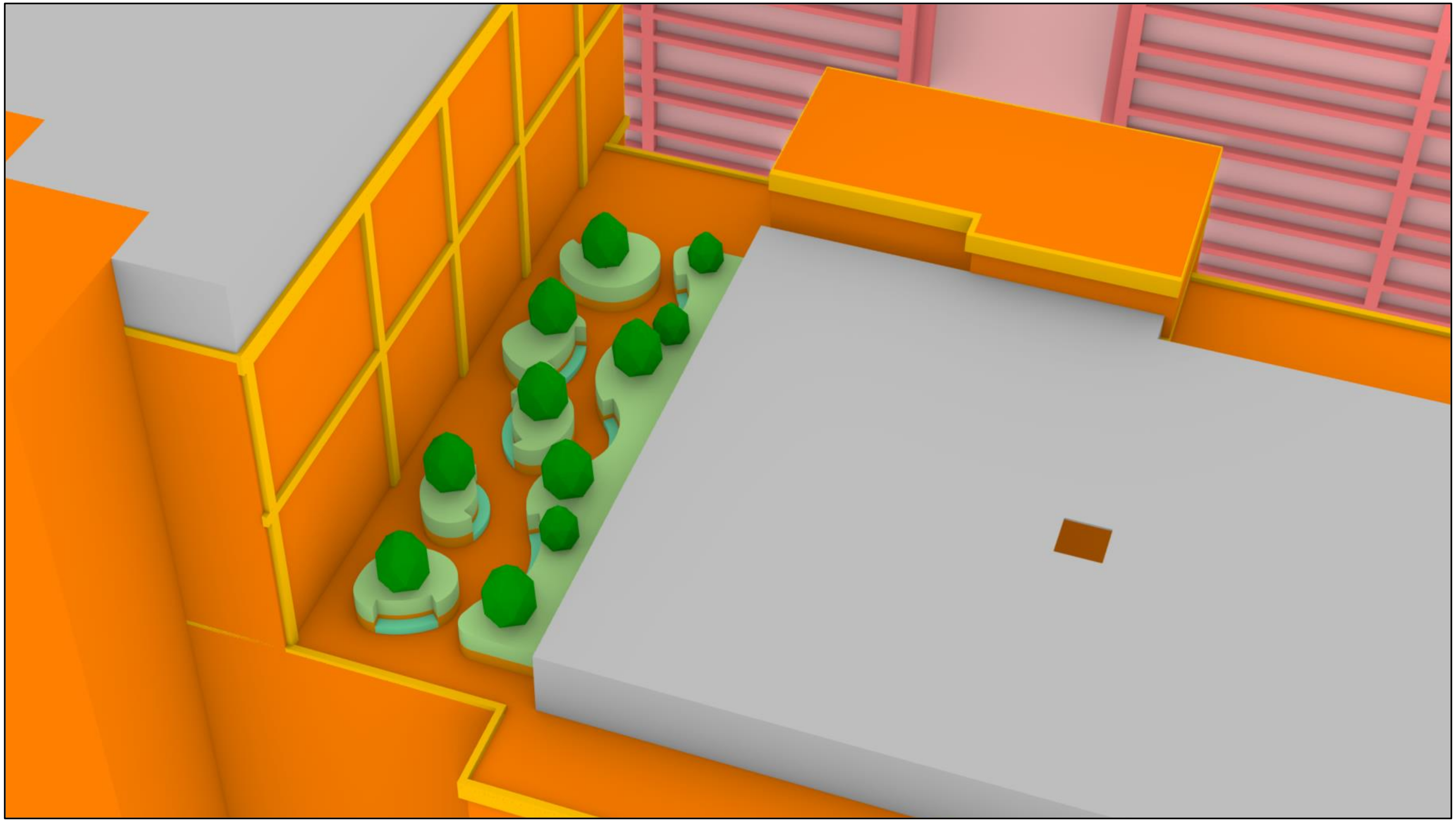
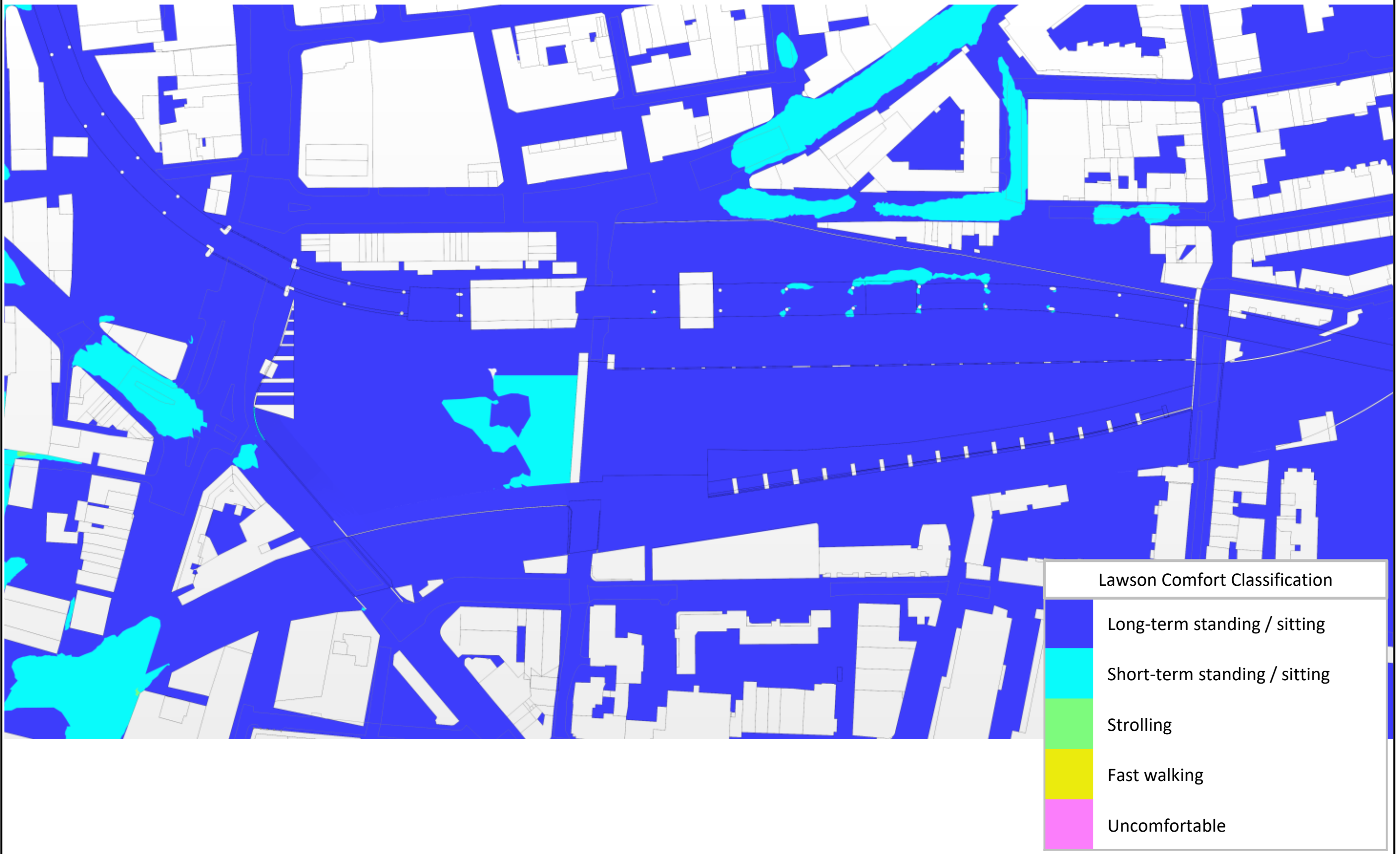


Figure 4.1 Pedestrian wind conditions, existing site within existing surrounds, annual safety

0360420 – Bishopsgate Goodsyard Plot 1 Safety – Existing Site in Existing Surrounds: Ground Level	Drawing No: 0360420/4.1	Date: 07/12/2023	arcaero

Figure 4.2 Pedestrian wind conditions, existing site within existing surrounds, worst case season

Figure 4.3 Pedestrian wind conditions, existing site within existing surrounds, summer season



0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Existing Site in Existing Surrounds: Ground Level	Drawing No: 0360420/4.3	Date: 07/12/2023	arcaero

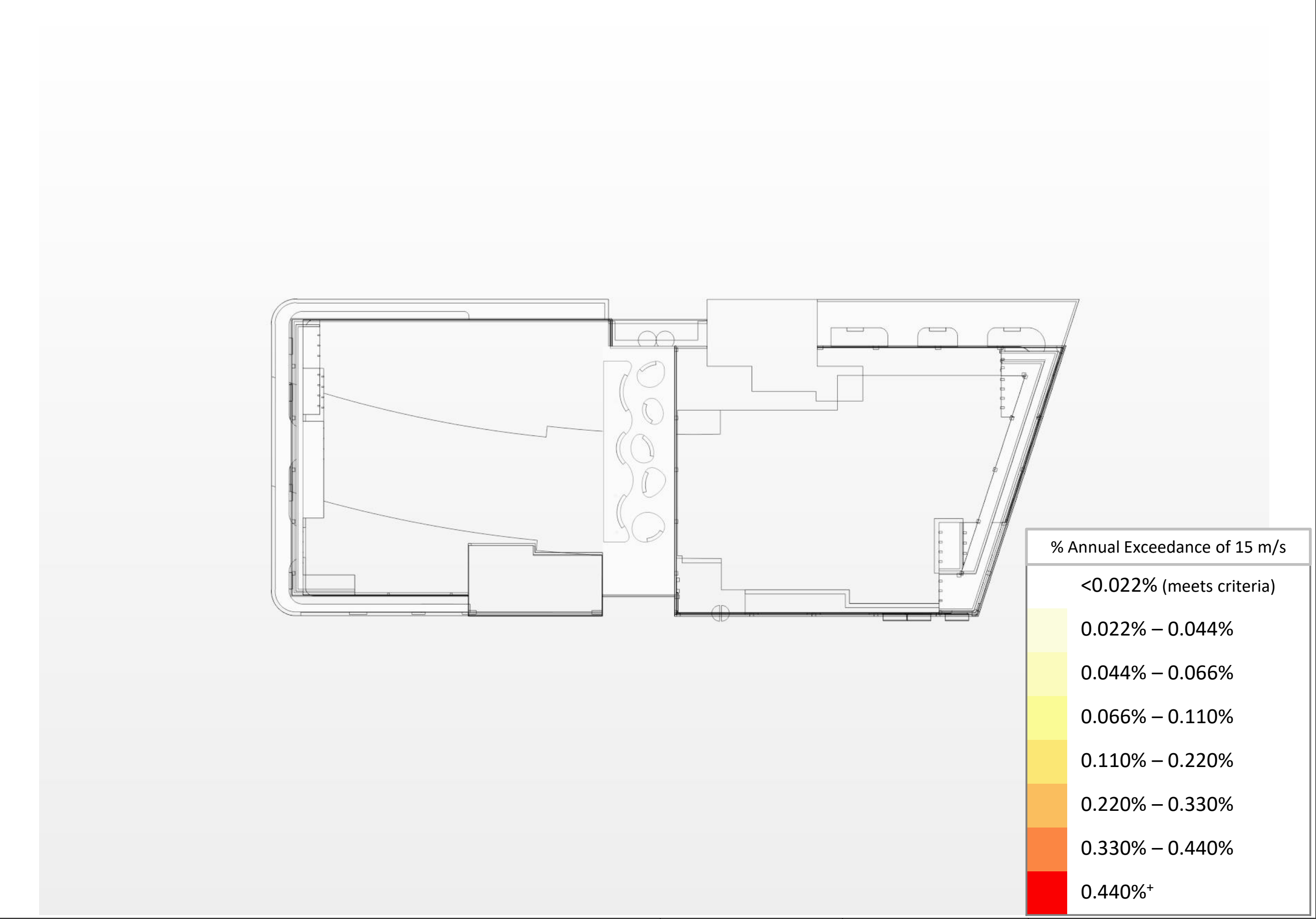
Figure 4.4 Pedestrian wind conditions, proposed development within existing surrounds, annual safety – ground level

0360420 – Bishopsgate Goodsyard Plot 1 Safety – Proposed Development in Existing Surrounds: Ground Level	Drawing No: 0360420/4.4	Date: 07/12/2023	arcaero

Figure 4.5 Pedestrian wind conditions, proposed development within existing surrounds, annual safety – platform level

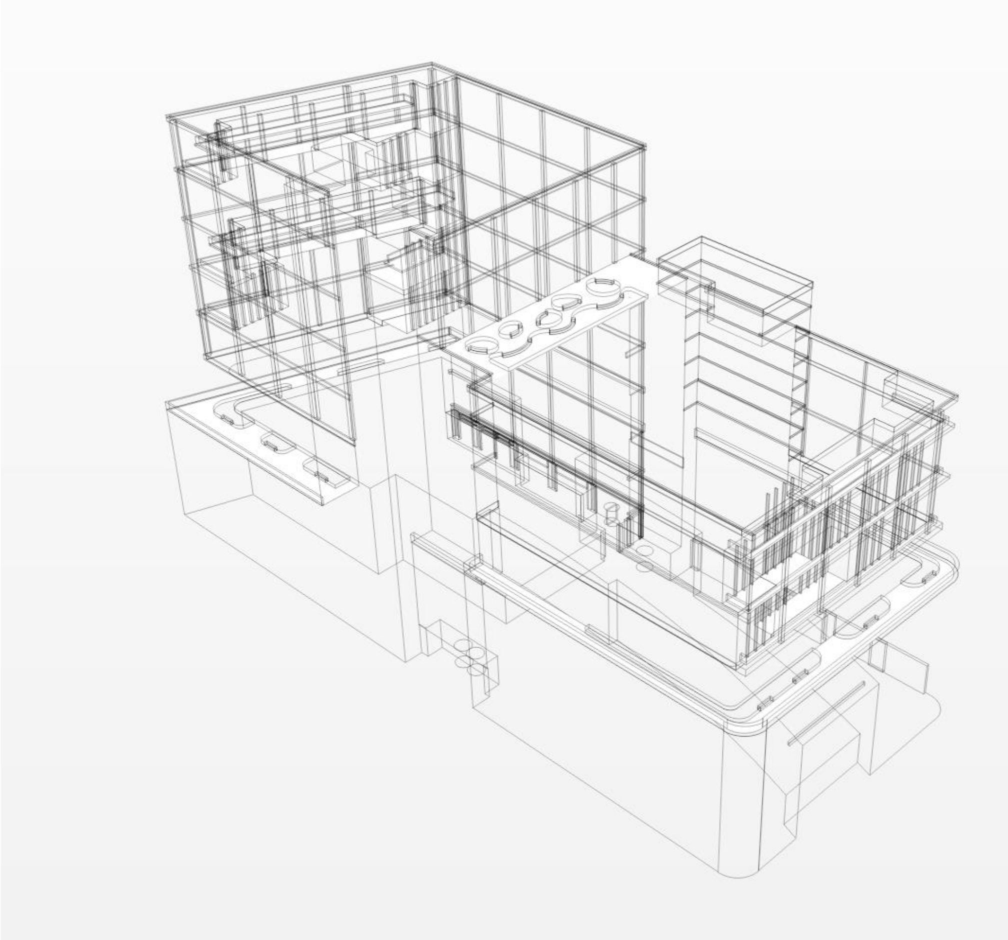
0360420 – Bishopsgate Goodsyard Plot 1 Safety – Proposed Development in Existing Surrounds: Platform level	Drawing No: 0360420/4.5	Date: 07/12/2023	arcaero

Figure 4.6 Pedestrian wind conditions, proposed development within existing surrounds, annual safety – elevated levels



0360420 – Bishopsgate Goodsyard Plot 1 Safety – Prop. Development in Existing Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.6	Date: 07/12/2023	arcaero

Figure 4.7 Pedestrian wind conditions, proposed development within existing surrounds, annual safety, viewed from northwest – elevated levels



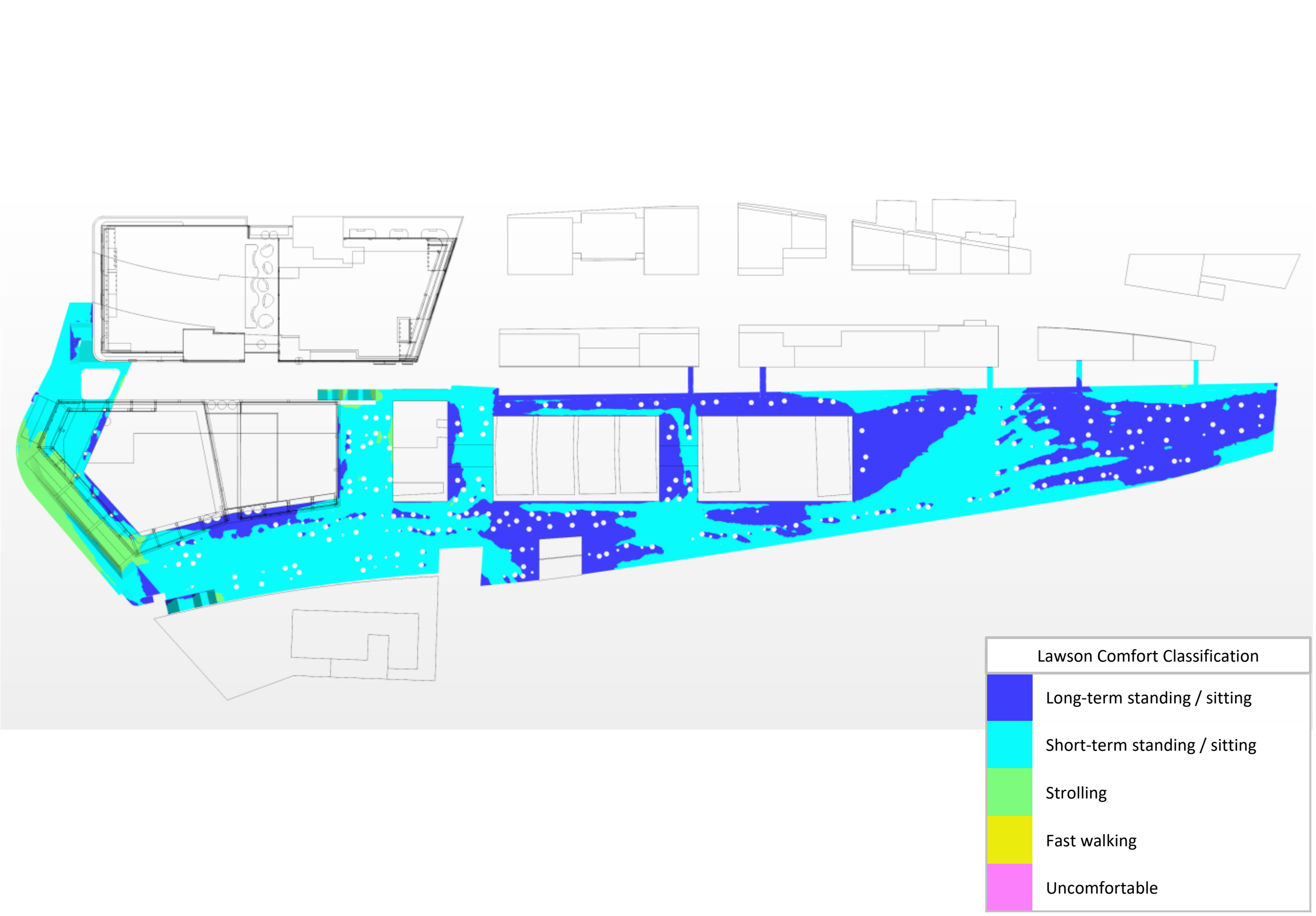
% Annual Exceedance of 15 m/s
<0.022% (meets criteria)
0.022% – 0.044%
0.044% – 0.066%
0.066% – 0.110%
0.110% – 0.220%
0.220% – 0.330%
0.330% – 0.440%
0.440%+

0360420 – Bishopsgate Goodsyard Plot 1 Safety – Prop. Development in Existing Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.7	Date: 07/12/2023	arcaero

Figure 4.8 Pedestrian wind conditions, proposed development within existing surrounds, worst case season – ground level

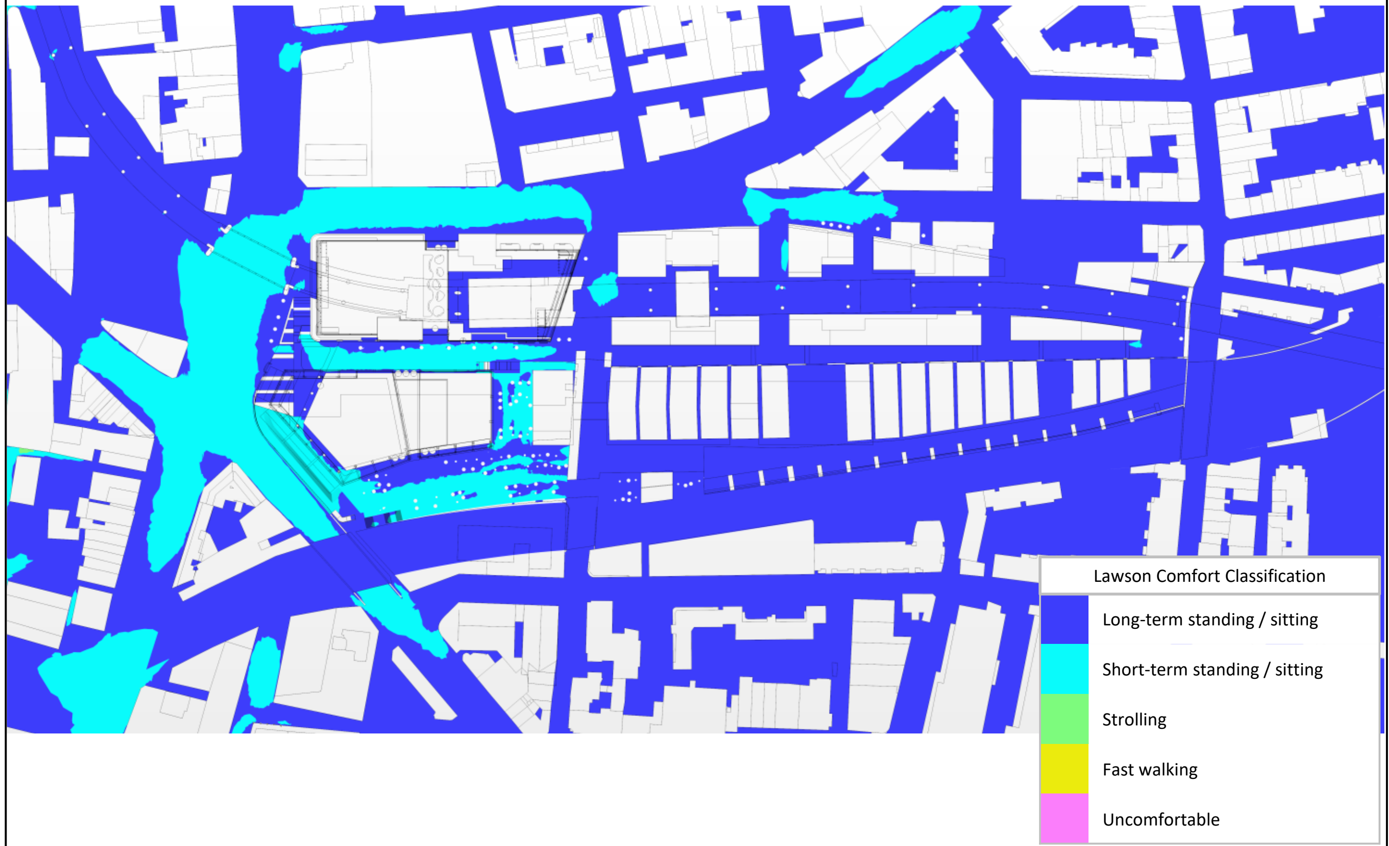
0360420 – Bishopsgate Goodsyard Plot 1 Worst Seasonal Comfort – Prop. Dev. in Existing Surrounds: Ground Level	Drawing No: 0360420/4.8	Date: 07/12/2023

Figure 4.9 Pedestrian wind conditions, proposed development within existing surrounds, worst case season – platform level



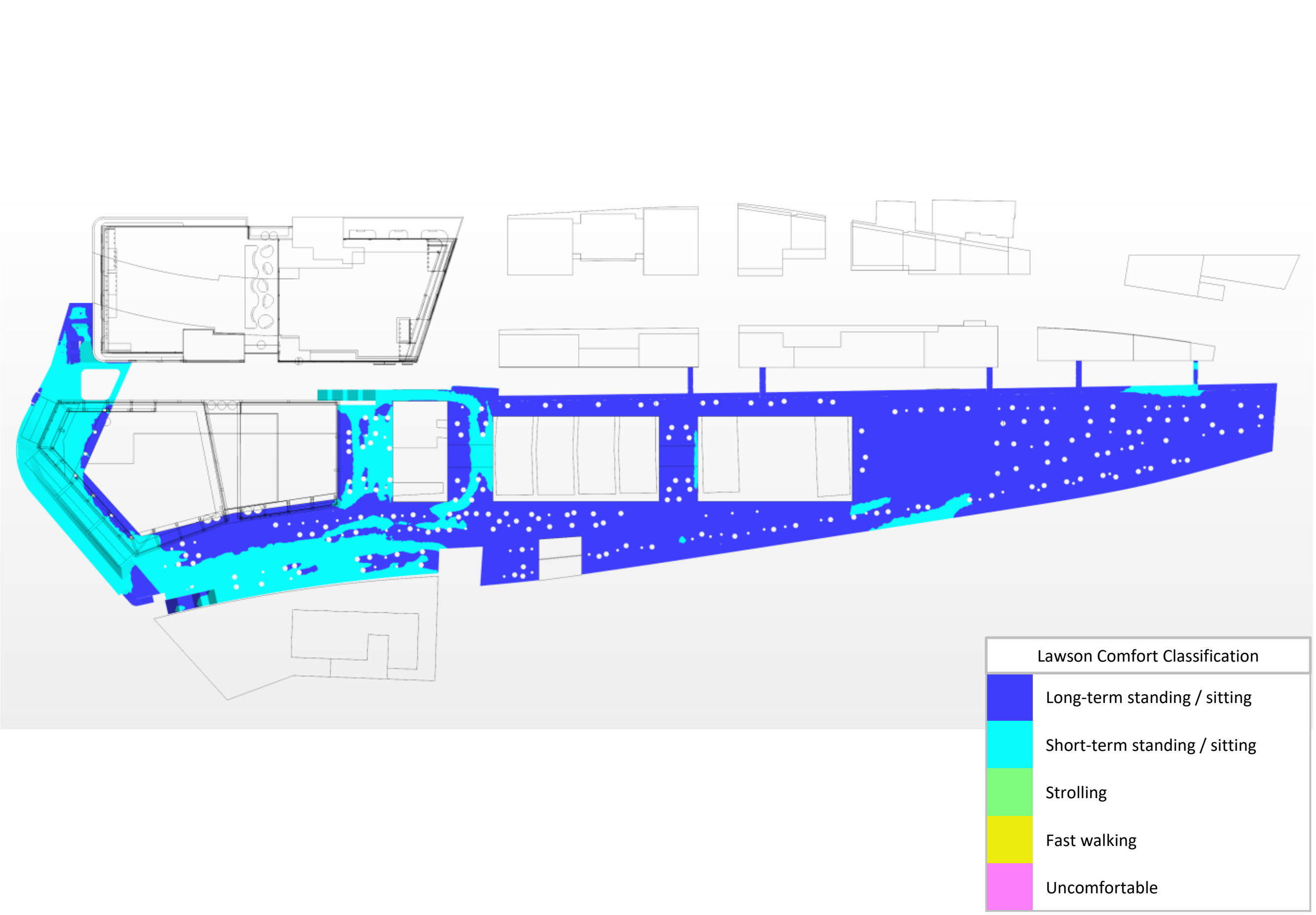
0360420 – Bishopsgate Goodsyard Plot 1 Worst Seasonal Comfort – Prop. Dev. in Existing Surrounds: Platform Level	Drawing No: 0360420/4.9	Date: 07/12/2023	arcaero

Figure 4.10 Pedestrian wind conditions, proposed development within existing surrounds, summer season – ground level



0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Development in Existing Surrounds: Ground Level	Drawing No: 0360420/4.10	Date: 07/12/2023

Figure 4.11 Pedestrian wind conditions, proposed development within existing surrounds, summer season – platform level

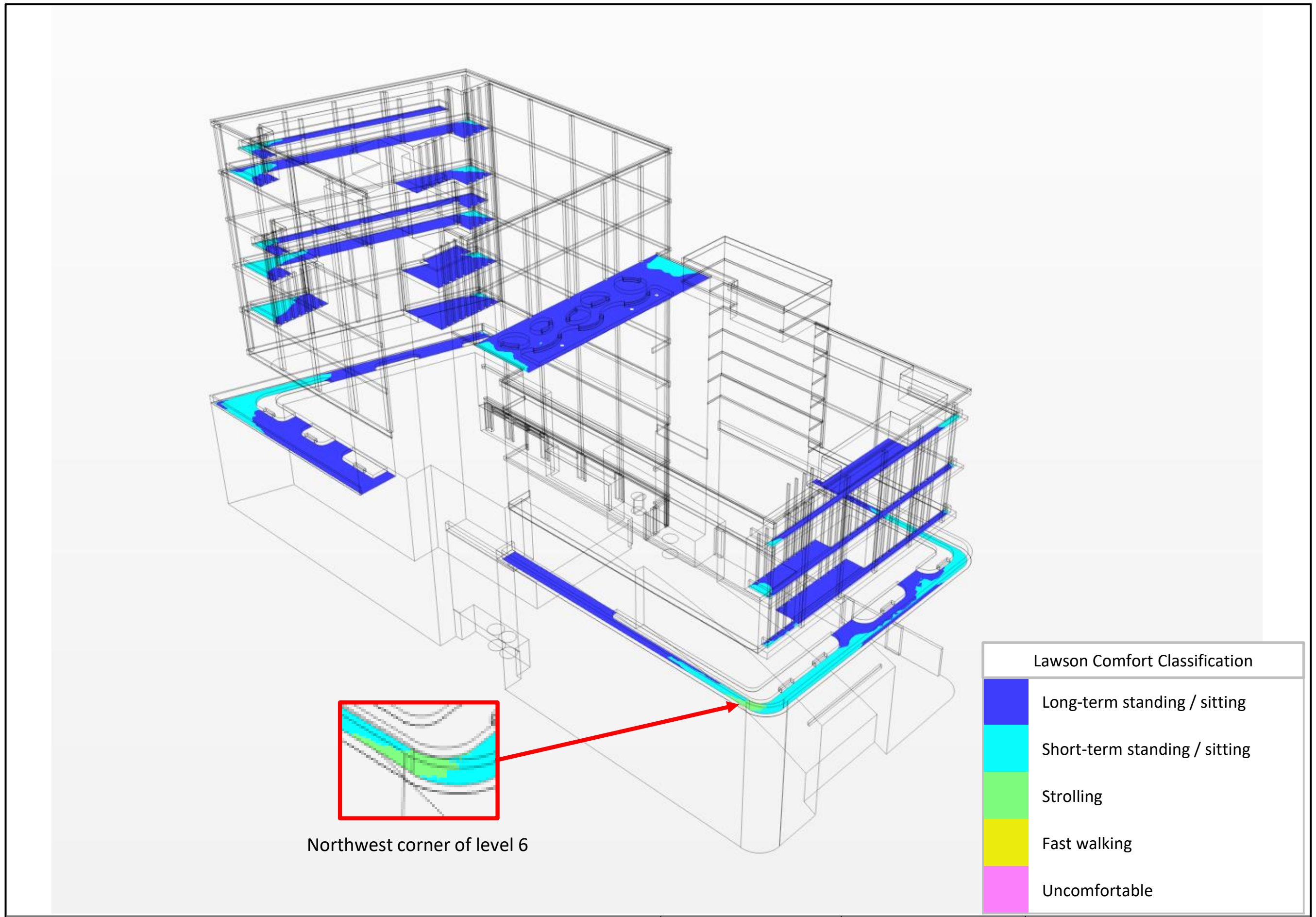


0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Development in Existing Surrounds: Platform Level	Drawing No: 0360420/4.11	Date: 07/12/2023	arcaero

Figure 4.12 Pedestrian wind conditions, proposed development within existing surrounds, summer season – elevated levels

0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Dev. in Existing Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.12	Date: 07/12/2023	arcaero

Figure 4.13 Pedestrian wind conditions, proposed development within existing surrounds, summer season – elevated levels



0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Dev. in Existing Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.13	Date: 07/12/2023	arcaero

Figure 4.14 Pedestrian wind conditions, proposed development within cumulative surrounds, annual safety – ground level

0360420 – Bishopsgate Goodsyard Plot 1 Safety – Proposed Development in Cumulative Surrounds: Ground Level	Drawing No: 0360420/4.14	Date: 07/12/2023

Figure 4.15 Pedestrian wind conditions, proposed development within cumulative surrounds, annual safety – platform level

0360420 – Bishopsgate Goodsyard Plot 1 Safety – Proposed Development in Cumulative Surrounds: Platform Level	Drawing No: 0360420/4.15	Date: 07/12/2023

Figure 4.16 Pedestrian wind conditions, proposed development within cumulative surrounds, annual safety – elevated levels

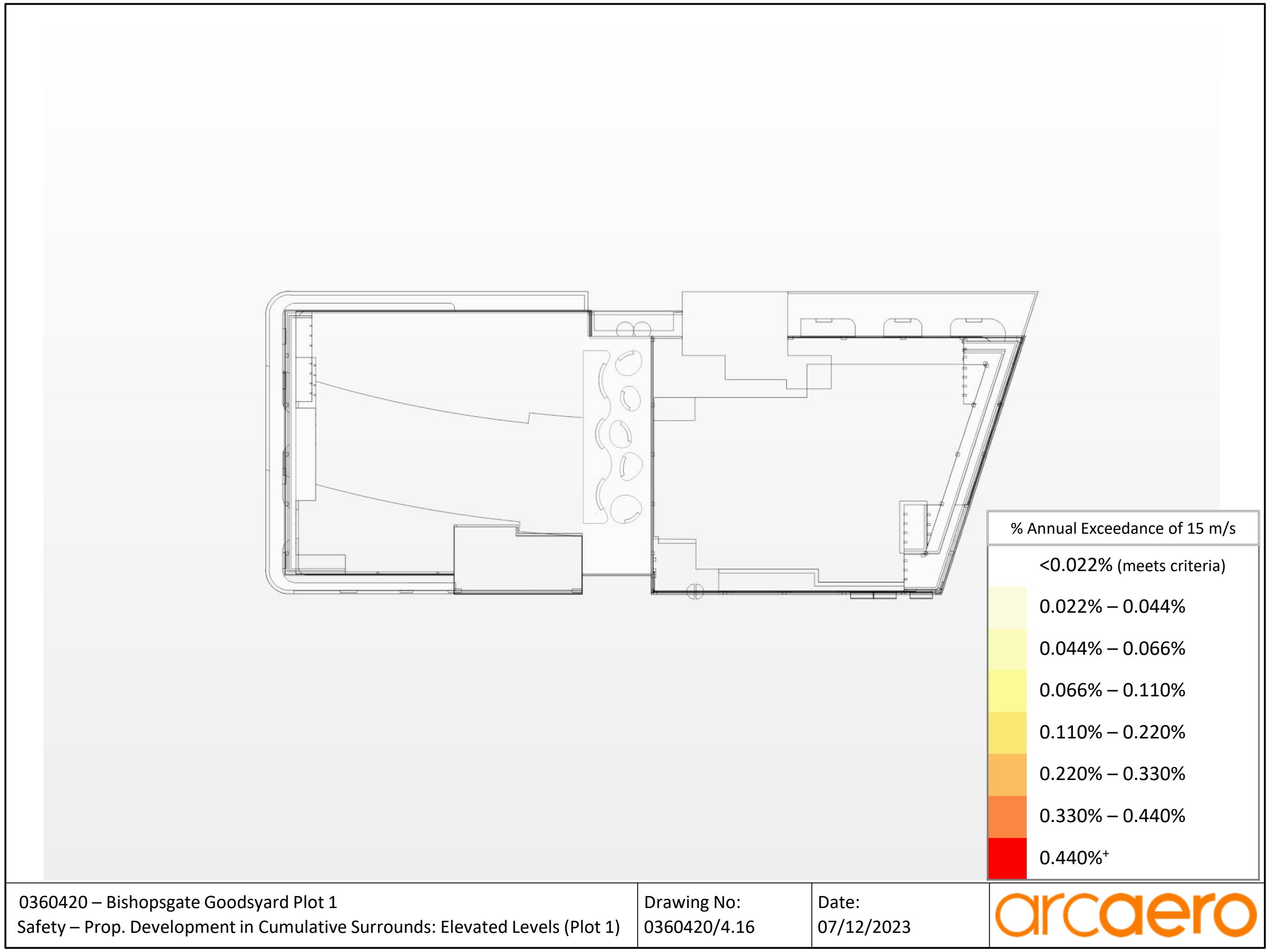
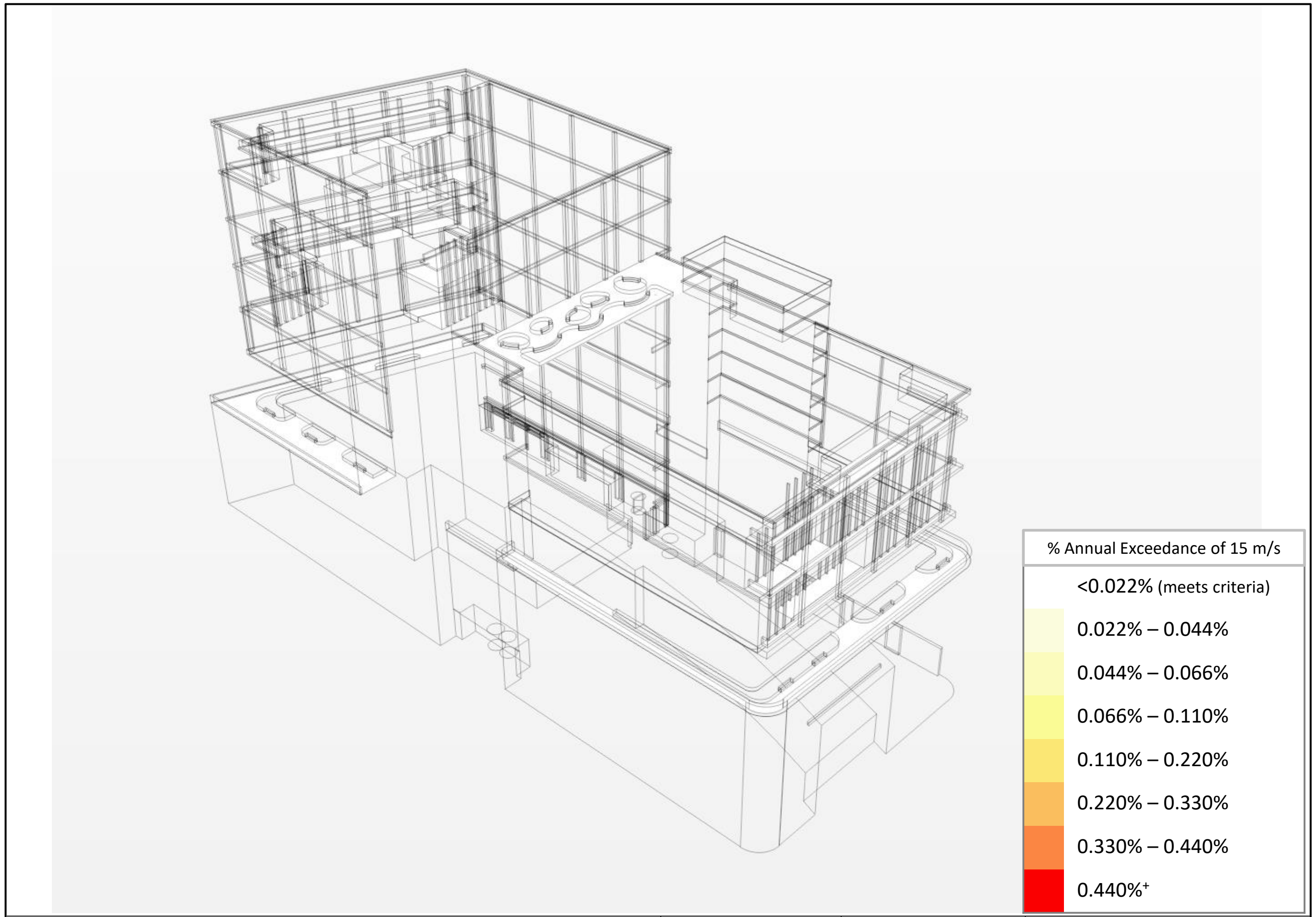
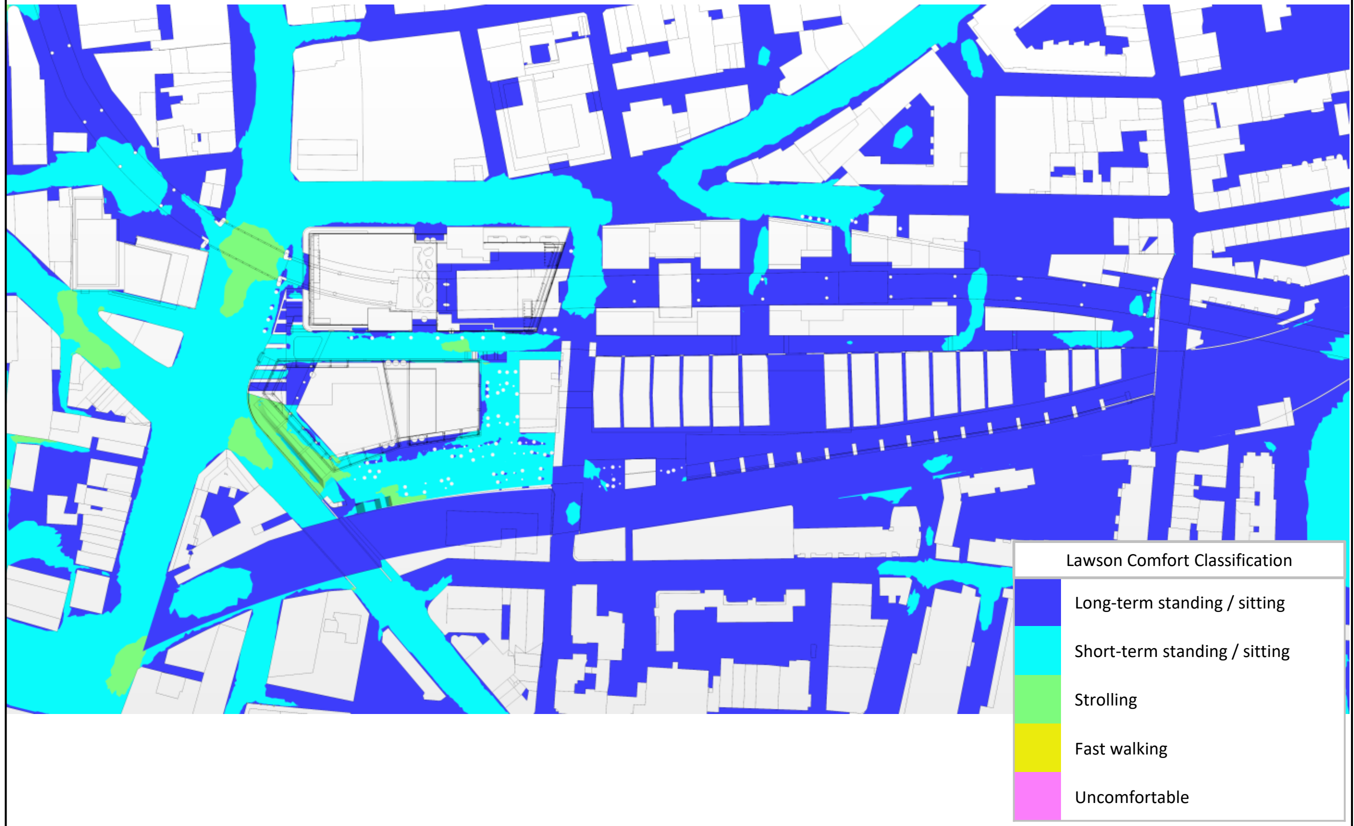


Figure 4.17 Pedestrian wind conditions, proposed development within cumulative surrounds, annual safety – elevated levels



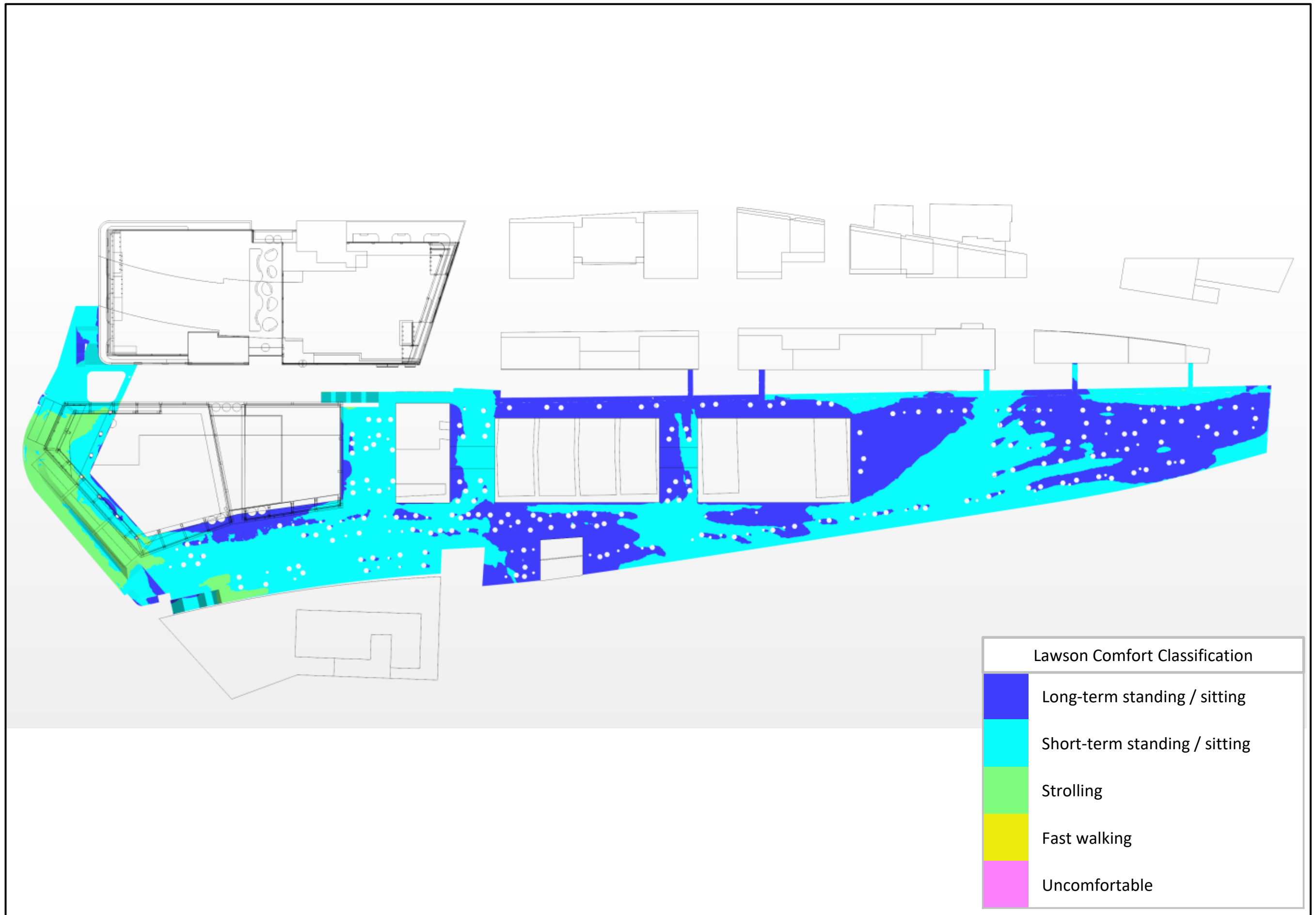
0360420 – Bishopsgate Goodsyard Plot 1 Safety – Prop. Development in Cumulative Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.17	Date: 07/12/2023	arcaero

Figure 4.18 Pedestrian wind conditions, proposed development within cumulative surrounds, worst case season – ground level



0360420 – Bishopsgate Goodsyard Plot 1 Worst Seasonal Comfort – Prop. Dev. in Cumulative Surrounds: Ground Level	Drawing No: 0360420/4.18	Date: 07/12/2023

Figure 4.19 Pedestrian wind conditions, proposed development within cumulative surrounds, worst case season – platform level



0360420 – Bishopsgate Goodsyard Plot 1 Worst Seasonal Comfort – Prop. Dev. in Cumulative Surrounds: Platform Level	Drawing No: 0360420/4.19	Date: 07/12/2023	arcaero

Figure 4.20 Pedestrian wind conditions, proposed development within cumulative surrounds, summer season – ground level

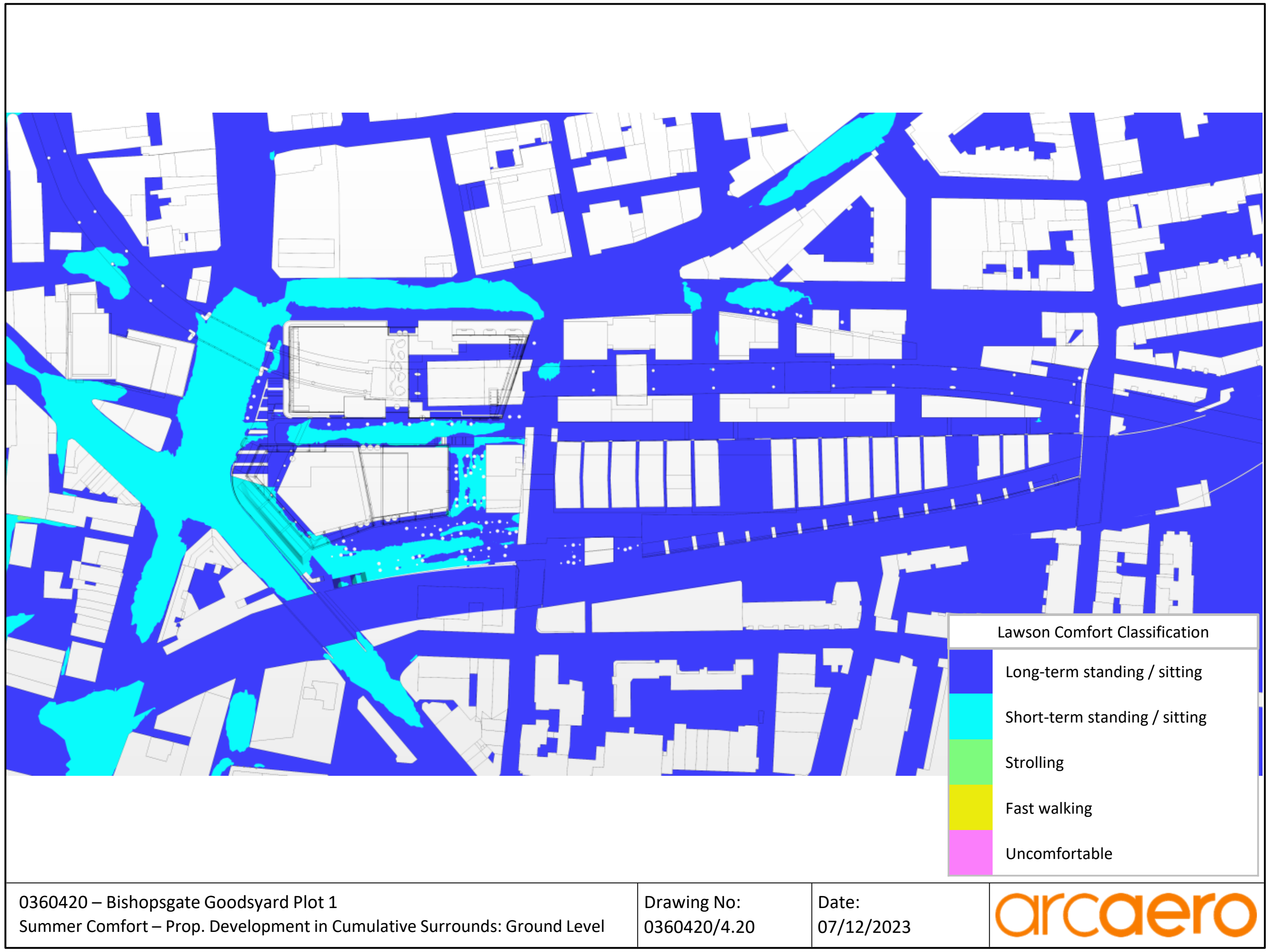
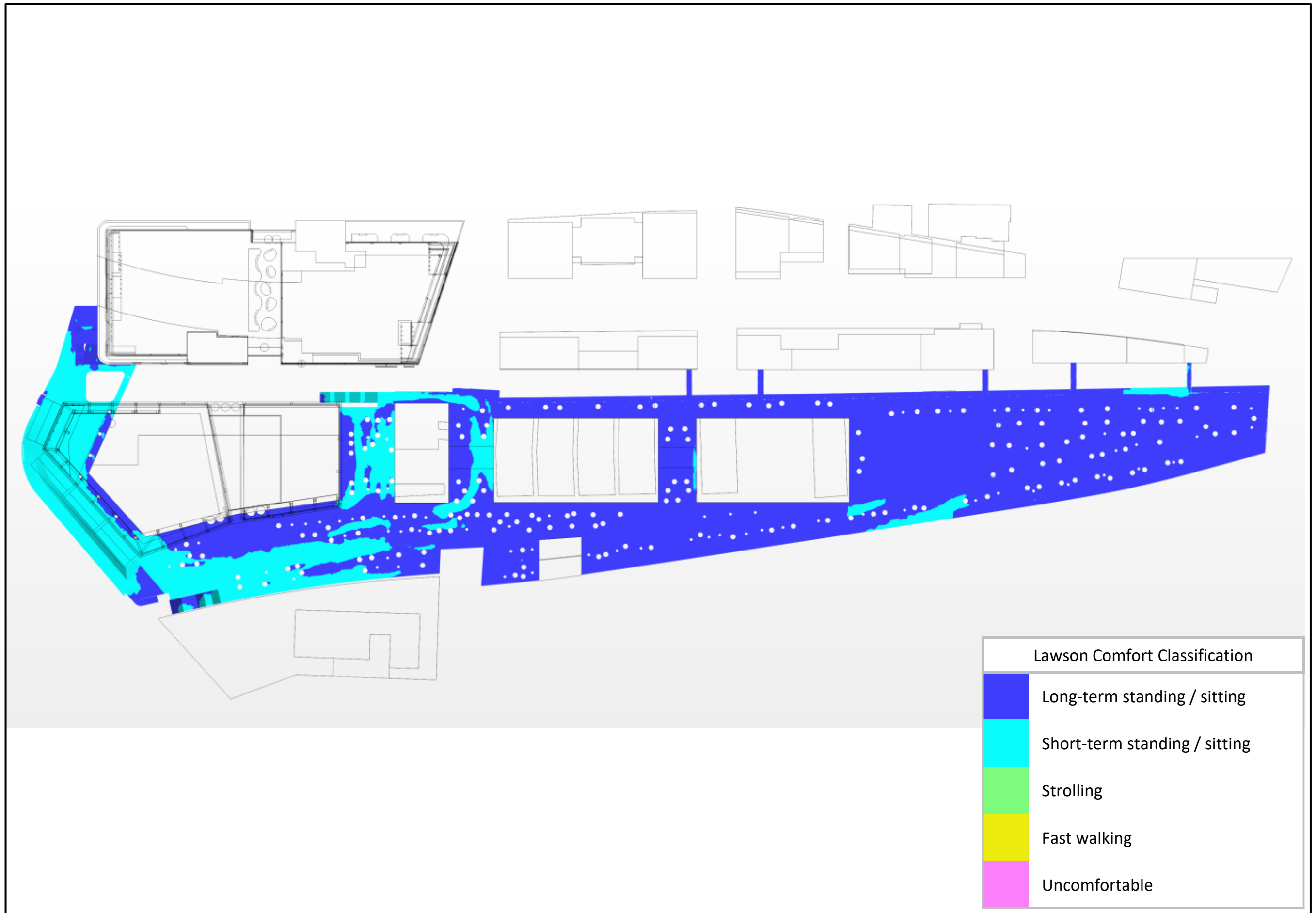
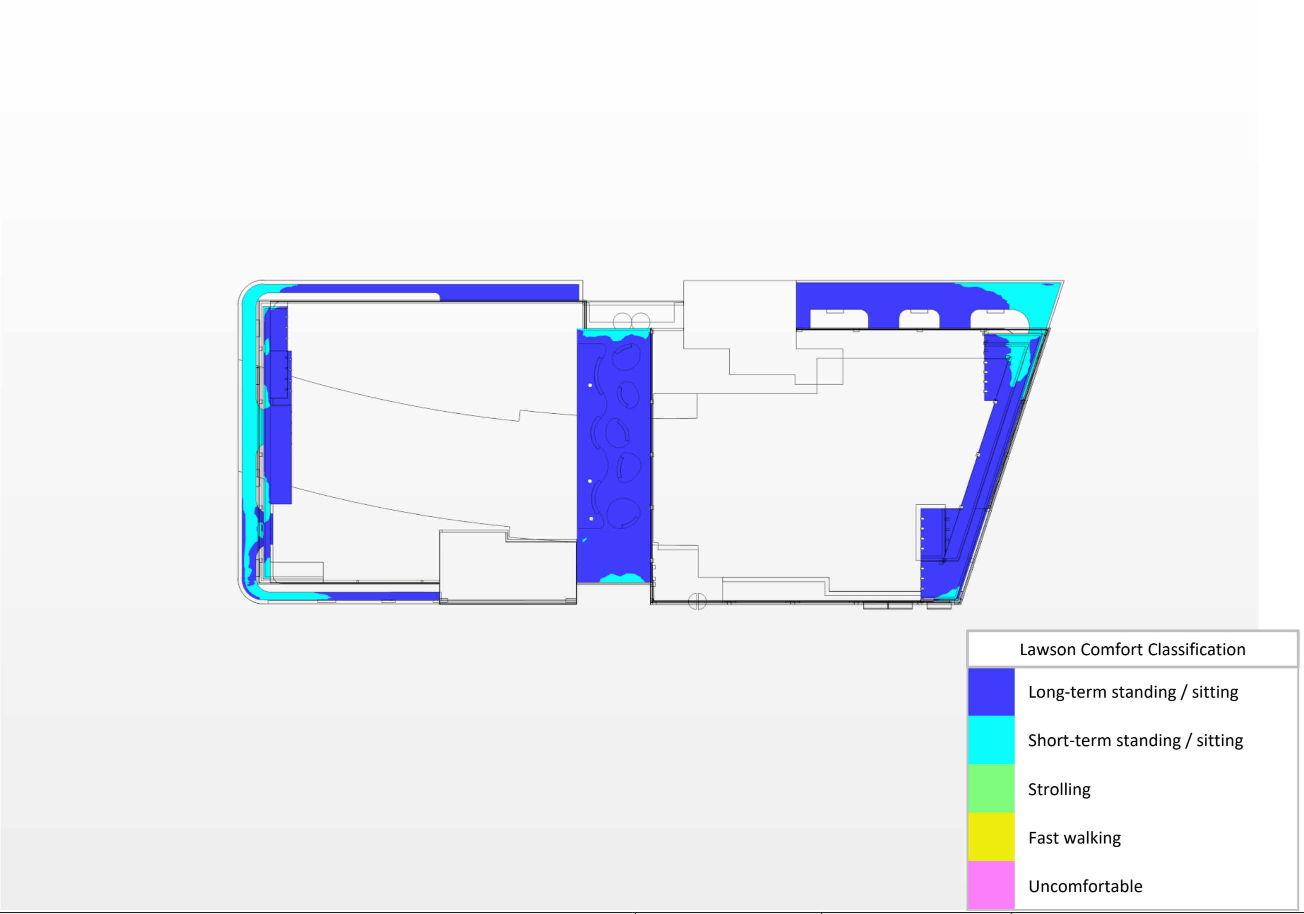


Figure 4.21 Pedestrian wind conditions, proposed development within cumulative surrounds, summer season – platform level



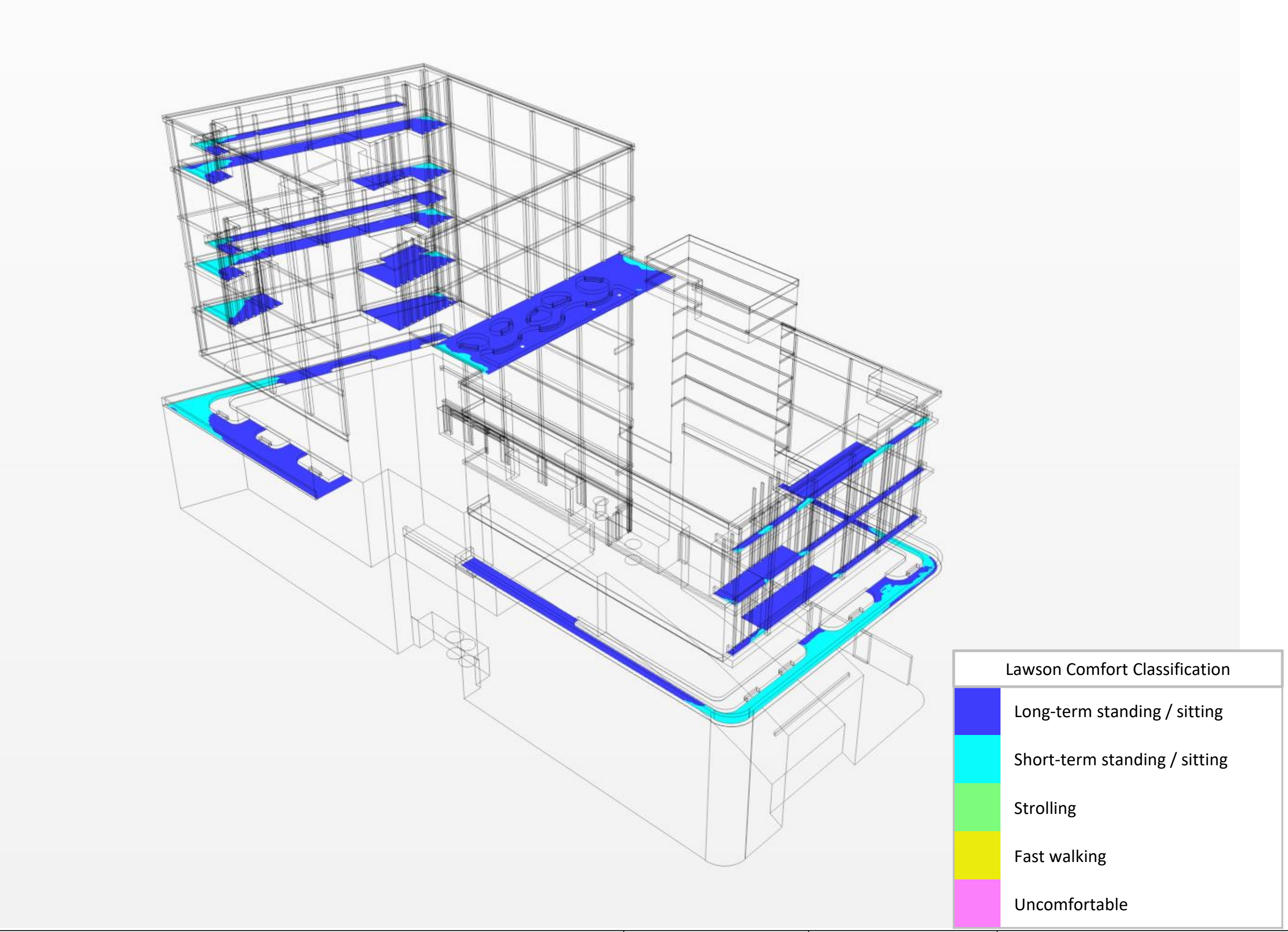
0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Development in Cumulative Surrounds: Platform Level	Drawing No: 0360420/4.21	Date: 07/12/2023

Figure 4.22 Pedestrian wind conditions, proposed development within cumulative surrounds, summer season – elevated levels



0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Dev. in Cumulative Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.22	Date: 07/12/2023	arcaero

Figure 4.23 Pedestrian wind conditions, proposed development within cumulative surrounds, summer season – elevated levels



0360420 – Bishopsgate Goodsyard Plot 1 Summer Comfort – Prop. Dev. in Cumulative Surrounds: Elevated Levels (Plot 1)	Drawing No: 0360420/4.23	Date: 07/12/2023

Appendix A CFD Modelling

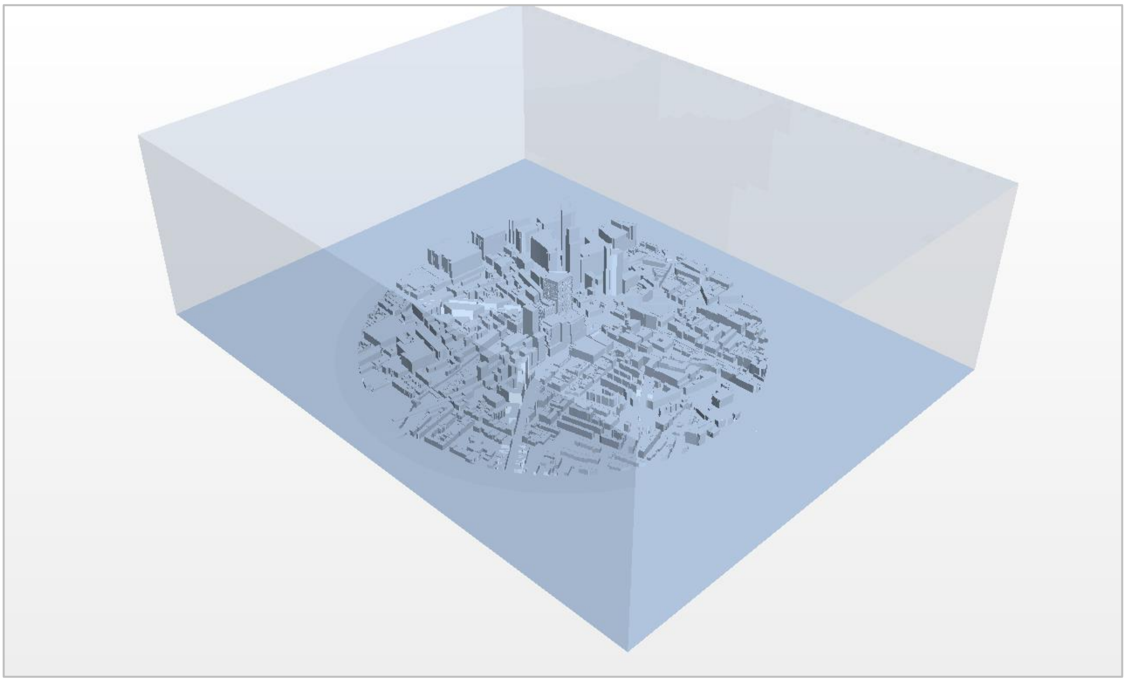
A.1 Spatial discretization

The computational domain was discretised using polyhedral cells for the core mesh, and low aspect-ratio prism cells adjacent to walls and the ground. Computational meshes were constructed for each of the three different study configurations.

The computational domain includes the proposed development site, with surrounding buildings and topographical features within a 450m radius represented explicitly. The full computational domain extends to 1500m in the along-wind direction, 1100m in the across-wind direction, and 450m vertically.

The proposed development and immediate vicinity were meshed down to a cell size of 0.2m in order to capture the detailed geometric features and resulting flow artefacts. The pedestrian ground level surfaces were meshed with a prism layer mesh of 5 layers, which, in the vicinity of the building rise up to a total height of 1.5m above the ground.

Figure A.1 – Computational Domain



A.2 Solution Method

The modelling of an incompressible fluid flow was completed with combinations of semi-implicit method for pressure-linked equations (SIMPLE) algorithms. The resulting flow turbulent features were modelled with introduction of the Shear Stress Transport (SST) k-ω turbulence model. This model was suggested by Menter (4) and is based on a two-equation eddy-viscosity approach, where the SST model formulation combines the use of a k-ω in the inner parts of the boundary layer, but also switches to a k-ε behaviour in the free-stream regions of the solutions. Further details for the selected turbulence model are provided in the work of Menter (5).

A.3 Initial and Boundary Conditions

The atmospheric boundary layer flow was simulated by implementing a logarithmic velocity profile model presented by Richards and Hoxey (6), with the following main assumptions:

- The vertical velocity component at the domain boundary is negligible
- The pressure gradient and shear stress are constant

The model implies the following equation for the mean inlet velocity at the CFD domain:

$$U(z) = \frac{U^*}{\kappa} \cdot ln\left(\frac{z + z_0}{z_0}\right)$$

where:

- κ - is the von Karman's constant
- z - is the distance from the ground surface in vertical direction
- z_o - is the ground surface roughness length in meters

The friction velocity U* is calculated by the following equations:

$$U^* = \kappa \cdot \frac{U_{ref}}{ln\left(\frac{z_{ref} + z_0}{z_0}\right)}$$

where:

- z_{ref} – is the reference height in metres
- U_{ref} - is the reference velocity in m/s measured at z_{ref}

The turbulent velocity fluctuations at the domain inlet are induced by the constant shear stress with height, maintained by the turbulent kinetic energy k equation below:

$$k(z) = \frac{(U^*)^2}{\sqrt{C_\mu}}$$

where:

- $C\mu$ = 0.03 - is a k-ε turbulence model constant

All surface boundary conditions were modelled as smooth walls with a no-slip condition. A no-slip wall boundary condition with a varying roughness length height based on the terrain analysis for the site was applied on the ground surface outside the explicit surrounds area of the domain.

A.4 Gust Equivalent Mean Calculation

The gusts in the wind flow is a major component that may lead to additional danger and discomfort to that caused by the mean wind flow. Thus, the gust wind speed is accounted by a calculation of the equivalent mean wind speed, considering the standard deviation of the mean wind speed, in particular the turbulent kinetic energy, k:

$$\sigma = \sqrt{(k * 2/3)}$$

The GEM is them calculated as:

$$U_{GEM} = \frac{U_{Mean} + 3.5\sigma}{k_g}$$

Where gust factor, k_g= 1.85

The final speedup used in the Lawson criteria is the worst case from U_{GEM} and U_{Mean}.

Appendix B Computational Model

A digital model of the site and surrounds was used for the study. The surrounding area was modelled up to a distance of 450m and all features which are likely to impact the wind flow to and through the site have been replicated. The model was reviewed and approved by the design team prior to the study.

B.1 Model Images

Images of the computational model are presented as follows:

- *Error! Reference source not found.* and **Error! Reference source not found.**:
  Existing site and surrounds**Error! Reference source not found.** and **Error! Reference source not found.**: Proposed development within existing surrounds**Error! Reference source not found.** and **Error! Reference source not found.**:
  Proposed development within cumulative surrounds
- Figure B.7 and Figure B.8: Close-ups of the proposed development

Figure B.1 - Existing site and surrounds, viewed from southeast.

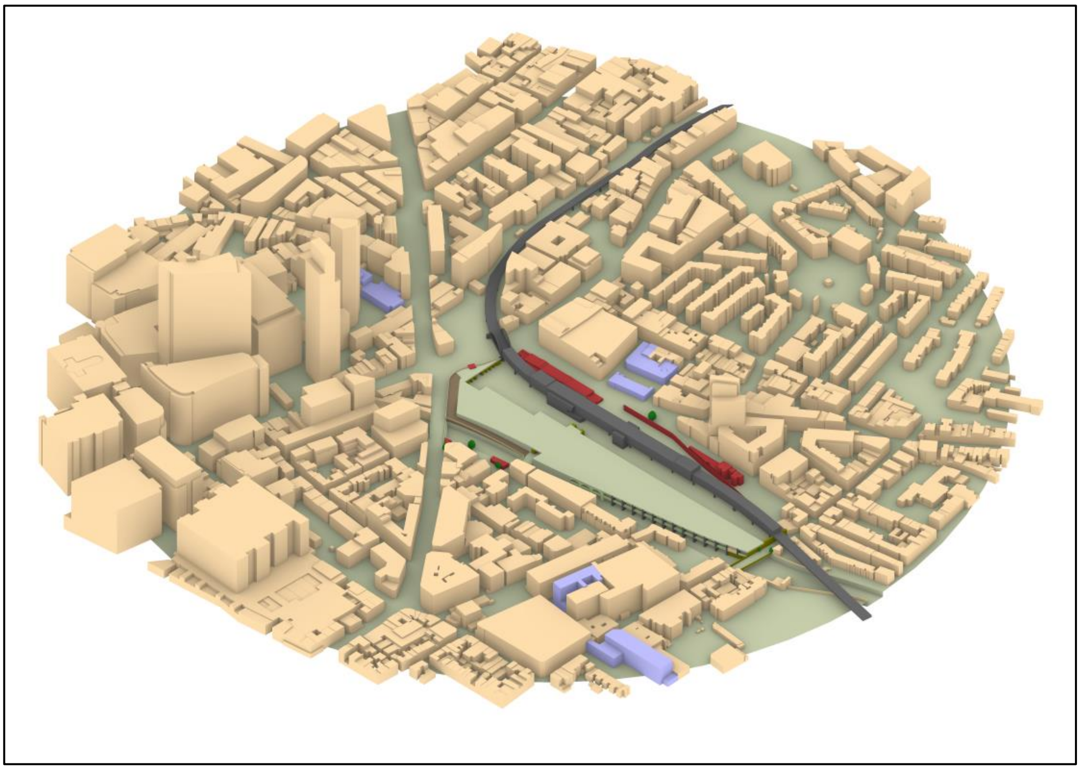


Figure B.2 - Existing site and surrounds, viewed from northwest.

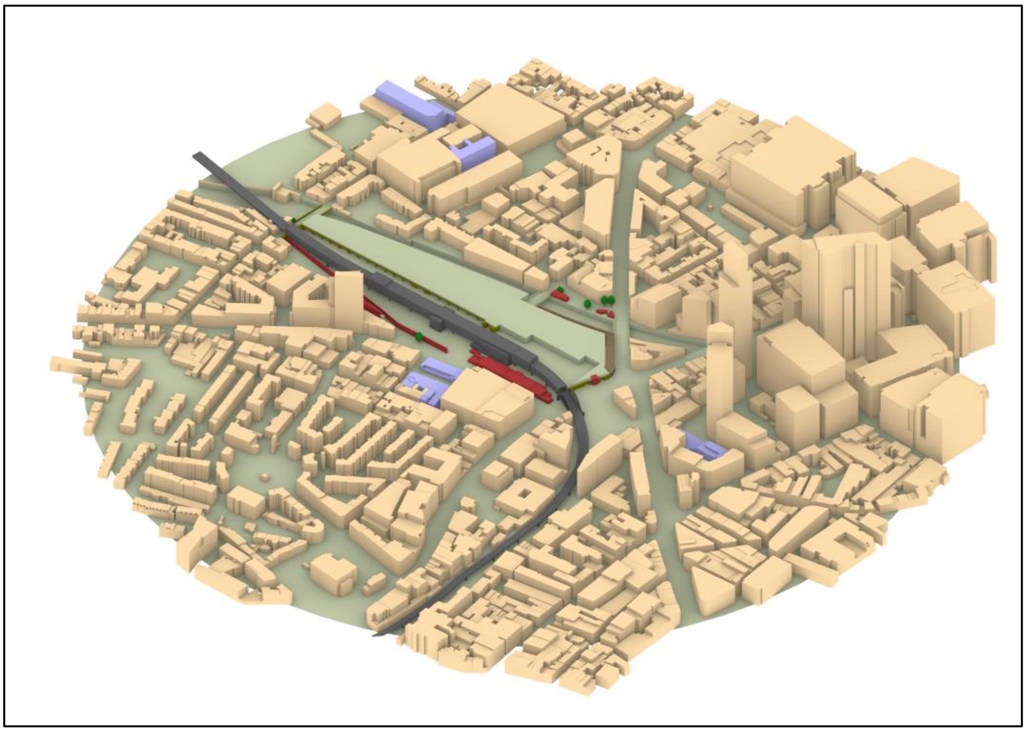


Figure B.3– Proposed development within existing surrounds, viewed from southeast.

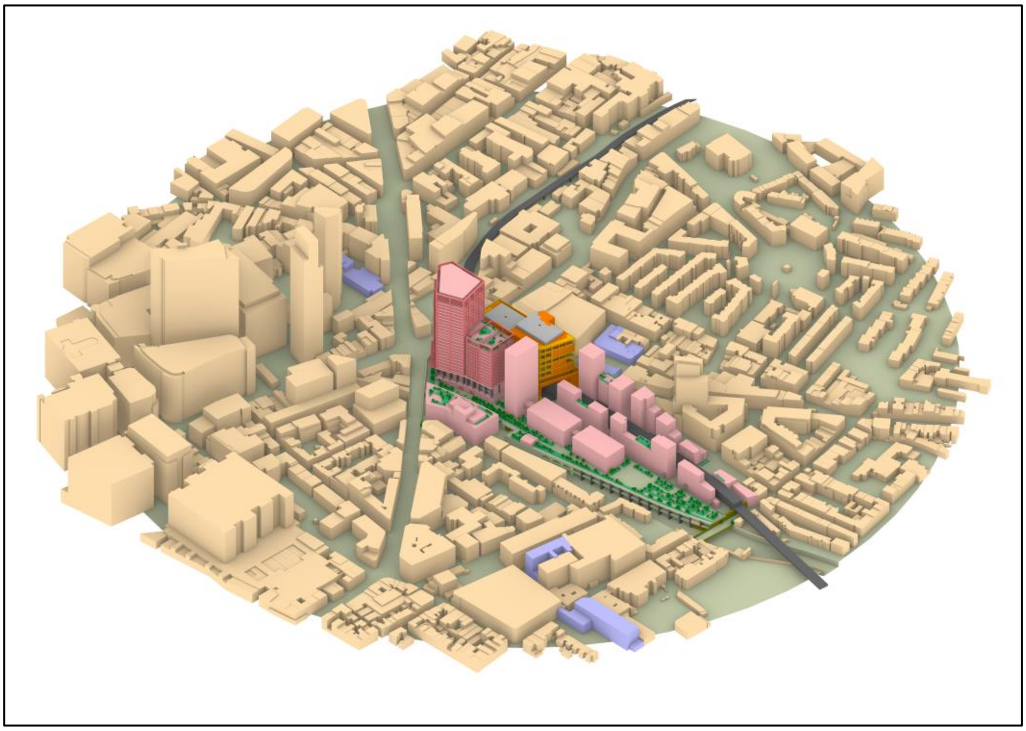


Figure B.4 – Proposed development within existing surrounds, viewed from northwest.

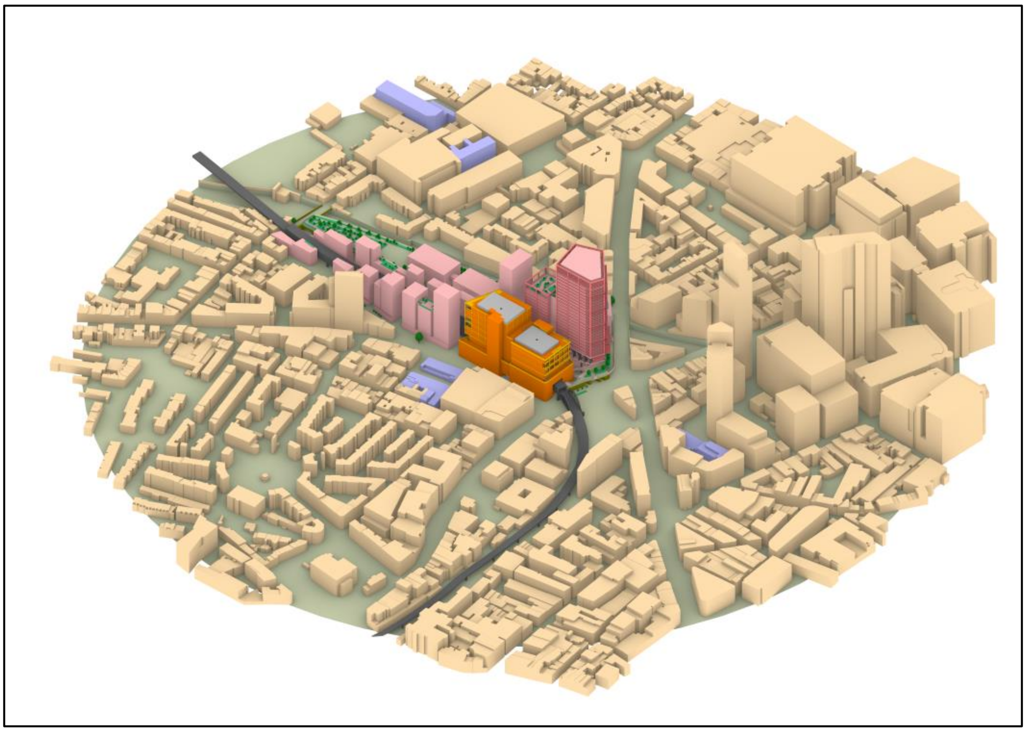


Figure B.5 – Proposed development within cumulative surrounds, viewed from southeast.

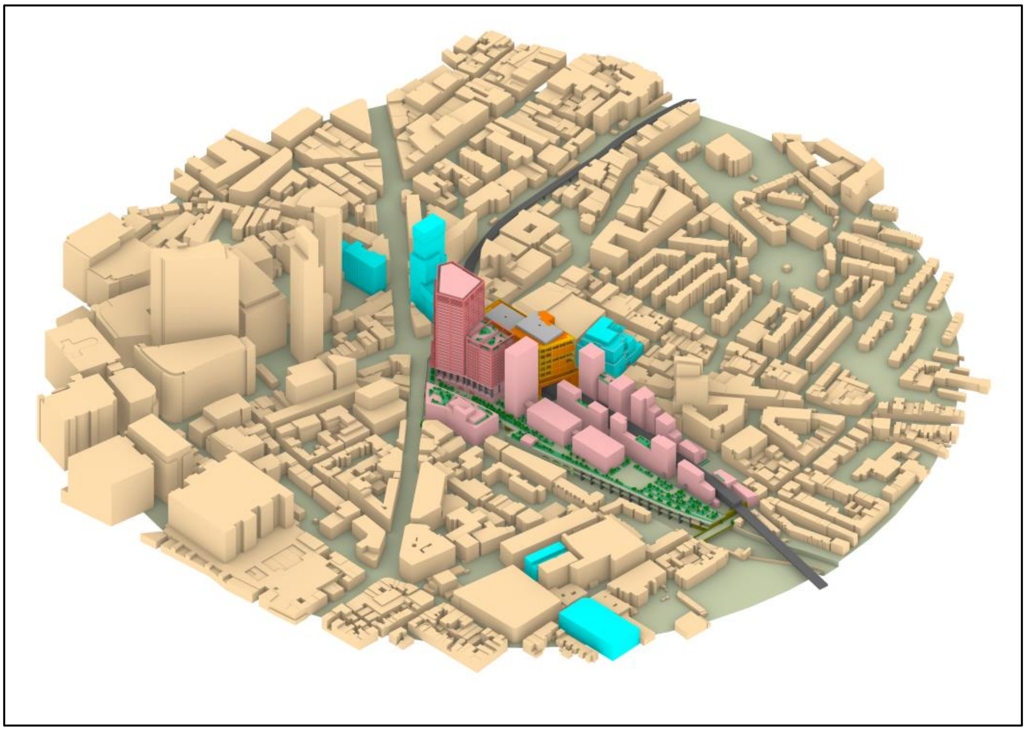


Figure B.6 – Proposed development within cumulative surrounds, viewed from northwest.

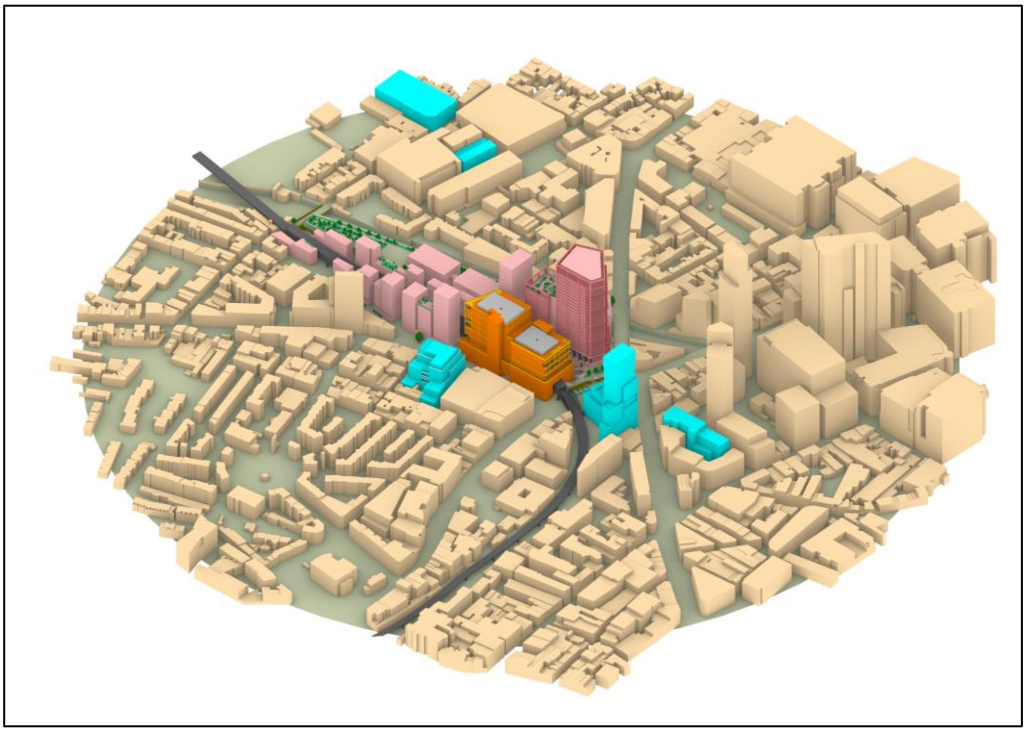


Figure B.7 – Proposed development, close-up from southeast.

Figure B.8 – Proposed development, close-up from northwest.

Appendix C Wind Climate Analysis

C.1 Surrounding Terrain Assessment

A detailed analysis, based on the widely accepted Deaves and Harris model of the atmospheric boundary layer, as defined in ESDU Item 01008 (3), has been carried out to determine the wind properties at the site. From this analysis, a representative profile was defined as a target profile for the CFD simulations.

C.2 Wind Properties at the Site

Upon conducting the ESDU analysis, each angle was replicated within the CFD model. As each angle exhibited very similar wind profiles, a generic wind profile used in the study is presented within Figure C.1.

Figure C.1 – Mean wind speed and turbulence intensity profiles