Appendix: Wind Microclimate

Annex 1: Policy and Guidance
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Appendix: Wind Microclimate

Annex 1: Policy and Guidance

Annex 2: Technical Appendix

Legislation and Planning Policy Context

National Policy

National Planning Policy Framework (2021)[1]

13.1 The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally-prepared plans for housing and other development can be produced. It states that the purpose of the planning system is to contribute to the achievement of sustainable development; and that the planning system must meet interdependent overarching objectives summarised as: an economic objective, a social objective and an environmental objective.

13.2 There are no policies or statements that are directly related to the wind microclimate, although the promotion of high-quality built environments was emphasised in the NPPF. For instance, paragraph 8 describes environmental objectives for sustainable development:

- c) "[…] to protect and enhance our natural, built and historic environment […] and mitigating and adapting to climate change".

13.3 Additionally, paragraph 130 states the following:

- "f) 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".

National Planning Practice Guidance (2019)[2]

13.4 The NPPG was published in November 2016 to support the NPPF and was updated in October 2019. There is no guidance within the PPG related to tall buildings and wind microclimate issues.

Regional Policy

The London Plan 2021 – The Spatial Development Strategy for Greater London[3]

13.5 The London Plan 2021 is the Spatial Development Strategy for Greater London. It places importance on the creation and maintenance of a high-quality environment for London. The following policies apply specifically in relation to wind microclimate:

- Policy D3 Optimising site capacity through the design-led approach (Para 3.3.8), states that:
  - "Buildings […] massing, scale and layout […] should complement the existing streetscape and surrounding area. Particular attention should be paid to the design of the parts of a building or public realm that people most frequently see or interact with in terms of its legibility, use, detailing, materials and location of entrances. Creating a comfortable pedestrian environment with regard to levels of […] wind".
- Policy D8 Public realm, Development Plans and development proposals should, states that:
  - "Consideration should also be given to the local microclimate created by buildings, and the impact of service entrances and facades on the public realm."
  - "Ensure that appropriate shade, shelter, seating […] with other microclimatic considerations, including temperature and wind, taken into account in order to encourage people to spend time in a place."
- Policy D9 Tall buildings: Environmental impact, states that:
  - "Wind […] around the building(s) and neighbourhood must be carefully considered and not compromise comfort and the enjoyment of open spaces, including water spaces, around the building";
  - "Air movement affected by the building(s) should […] not adversely affect street-level conditions".
- Policy D9 Tall buildings: Cumulative impacts, states that:
  - "The cumulative visual, functional and environmental impacts of proposed, consented and planned tall buildings in an area must be considered when assessing tall building proposals and when developing plans for an area. Mitigation measures should be identified and designed into the building as integral features from the outset to avoid retro-fitting."

Shaping Neighbourhoods: Play and Informal Recreation SPG (2012)[4]

13.6 In the Shaping Neighbourhoods SPG in Section 4.48 (under Step B5: What types of play space should be provided and how should existing play provision be improved?) the following statement emphasises on wind microclimate:

- "Playable spaces should be properly integrated into new development and the existing context […] If […] windy spaces are utilised, they should be made worthy through innovative design."

Local Policy

Tower Hamlets Local Plan 2031[5]

13.7 Policy S.DH1: Delivering high quality design, states that:

- "Development is required to meet the highest standards of design, layout and construction […]. To achieve this, development must: […] use design and construction techniques to ensure that the development does not result in unacceptably harmful impacts arising from […], wind."

13.8 Policy D.DH6: Tall buildings, states that:

- "Developments with tall buildings are required to […] demonstrate that the development does not adversely impact on the microclimate and amenity of the application site and the surrounding area".

13.9 Section 8.61, states that:

- "Tall buildings can significantly impact the quality and safety of the public realm (for example, […] through generating adverse micro-climatic conditions, such as wind funnelling). They may […] undermine the quality and value of adjacent developments. In low-or-medium rise residential neighbourhoods, tall buildings […] have a negative impact on amenity and views."

13.10 Section 8.66, state that:

- "Proposals involving tall buildings will need to demonstrate how any adverse impacts on the microclimate will be mitigated in relation to wind […] Buildings over 30 metres in height and/or substantially taller than the surrounding area and/or over 150 units must be tested against the industry standard Lawson criteria in relation to wind. The testing of the following scenarios will be required as part of the planning application.
  - Baseline (i.e. the situation at the time of submission).
  - The proposed development without mitigation/landscaping.
  - The development with surrounding cumulative developments without mitigation/landscaping.
  - The development with the inclusion of mitigation/landscaping.
  - The development with surrounding cumulative developments with the inclusion of mitigation/landscaping.
  - Specific details on the required mitigation measures must be provided, including where and how these measures will be implemented.
  - It is essential that any required mitigation measures are tested as part of the application. This is to ensure that the mitigation is adequate, and can therefore be relied upon. The mitigation must be implemented prior to occupation of any part of the development and retained for the duration of the development."

13.11 Section 14.25, states that:

[1] *Department for Communities and Local Government, 2021. Revised National Planning Policy Framework. London. HMSO.*
[2] *Ministry of Housing, Communities & Local Government, 2019. Planning Practice Guidance*
[3] *Greater London Authority, 2021. The London Plan. London. GLA*
[4] *Greater London Authority, 2012. Shaping Neighbourhoods: Play and Informal Recreation Supplementary Planning Guidance. London. GLA*
[5] *London Borough of Tower Hamlets, 2020. Tower Hamlets Local Plan 2031. London. LBTH.*

- "Due to the environmental importance of trees, […]. Their location must be carefully considered to ensure there is no adverse impact on […], wind effects."

High Density Living SPD[6]

13.12 Section 4: Design Guidelines, states that:

- "Healthy neighbourhoods:
  - The scale and form of high density developments can have significant environmental impacts, including […] wind tunnels. Orientation of communal spaces following environmental parameters and design mitigation measures can create more comfortable and enjoyable environments."
- References Intend to Publish London Plan Version 2019 Policy D8 – Public Realm and Tower Hamlets Local Plan 2031 Policy D.DH6 – Tall Buildings, both of which specify that a development does not adversely affect the local microclimate.
- "Design guideline AB.17:
  - The massing, orientation and design of the building and the location of public spaces contributes to a high quality urban microclimate promoting comfort and well-being. It should be designed to achieve good levels of […] wind […] comfort."
- "Design guideline AB.17, Wind:
  - High velocity winds in urban corridors or downdraughts generated by high rise buildings can significantly affect pedestrian comfort."
- "Wind, Design guideline AB.19:
  - Buildings over 30 metres in height and/or substantially taller than the surrounding area and/or over 150 units must be tested against the industry standard Lawson criteria in relation to wind (Local Plan D.DH6).
  - The test might require the need for mitigation measures. Dependant on context and typology this could be achieved through:
  - offset taller elements so the lower element (podium or courtyard block) serves to deflect wind
  - when wind mitigation cannot be achieved through the building massing recess entrances or use canopies to deflect wind from entrances or adjacent open spaces, the design should be integrated into the building language and materiality or consider recess
  - if wind cannot be deflected and impacts public realm, podiums or rooftops use trees or street furniture such as a pergola or large planter"
- Healthy Neighbourhoods
  - Tall buildings can create significant downdraught and localised high windspeeds at ground levels. This can significantly affect pedestrian comfort and safety. The effects must be assessed with an appropriate modelling technique and mitigated."
  - 20% of residents […] who live around high density buildings do not think the external environment around them is pleasant. 32% feel it has worsened wind."
- "Design guideline CS.15:
  - Rooftop play spaces will only be acceptable if:
  - Wind assessment demonstrates low impact levels."
- "Design guideline H.8:
  - Where a wind assessment is required this should assess balcony design. Depending on findings design strategies could include:
  - Solid balustrades
  - Semi-recessed balconies
  - Inset balconies
  - Winter gardens
- "Design guideline H.9:
  - If winter gardens are provided they should:
  - provide effective enclosure from wind."

[6] *London Borough of Tower Hamlets, 2021. High Density Living Supplementary Planning Document. London. LBTH.*

Appendix: Wind Microclimate

Annex 1: Policy and Guidance

Annex 2: Technical Appendix

FINAL REPORT

ABERFELDY VILLAGE MASTERPLAN

LONDON, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT
RWDI #2004108 – REV C
26TH OCTOBER 2021

SUBMITTED TO

Gemma Hale
Gemma.Hale@ecoworldinternational.com

EcoWorld
25 Victoria Street
London
SW1H 0EX

SUBMITTED BY

Hesham Ebrahim
Project Engineer
Hesham.Ebrahim@rwdi.com

Jeniffer Lowther
Project Engineer
Jeniffer.Lowther@rwdi.com

Aimee Crook
Project Manager
Aimee.Crook@rwdi.com

RWDI
Unit 1 Tilers Road
Milton Keynes
MK11 3LH
T: +44 (0)1908 776970

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Report	**Releases**	**Dated**
Reports	Rev A	05th October 2021
	Rev B	22nd October 2021
	Rev C	26th October 2021
Project Team	Hesham Ebrahim	Project Engineer
	Jeniffer Lowther	Project Engineer
	Aimee Crook	Project Manager

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT
ABERFELDY VILLAGE MASTERPLAN
RWDI #2004108 – Rev C
26th October 2021

1 INTRODUCTION

RWDI was retained to conduct a pedestrian level wind microclimate (PLW) assessment for the Proposed Development in London, UK. This report presents the methodology employed by RWDI.

Wind tunnel tests were conducted on a 1:300 scale model of the Proposed Development (referred to as the "Proposed Development" in this report henceforth). The investigation quantifies the wind conditions within and around the Site through comparison of the measured wind velocity and frequency of occurrence with the Lawson Comfort Criteria. Meteorological data for London, UK has been combined, analysed and adjusted to the Site conditions by modelling the effect of upstream terrain roughness on the wind velocities approaching the Site.

Measurements were taken at up to 496 locations for 36 wind directions, in 10° increments. The measurements covered ground level locations along the building façades and at corners, near main entrances, on pedestrian routes within and around the Site, balconies and terraces within and around the Site. The analyses were conducted on seasonal basis, however, the report focuses primarily on the windiest season (i.e. winter) and the summer season results, when pedestrian activity generally requires calmer conditions.

The following list details the configurations tested in the wind tunnel:

- Configuration 1: Existing Site with Existing Surrounding Buildings
- Configuration 2: The Detailed Proposals (Phase A) with Existing Surrounding Buildings
- Configuration 3: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings
- Configuration 4: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings
- Configuration 5: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures
- Configuration 6: Existing Site with Cumulative Surrounding Buildings
- Configuration 7: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings
- Configuration 8: Proposed Development (Outline Proposals plus Detailed Proposals) with Cumulative Surrounding Buildings
- Configuration 9: Proposed Development (Illustrative Scheme) and Phase A with Cumulative Surrounding Buildings
- Configuration 10: Proposed Development (Illustrative Scheme) and Phase A with Cumulative Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures

2 METHODOLOGY AND ASSESSMENT CRITERIA

Wind tunnel testing is a well-established and robust technique to assess the pedestrian wind microclimate of the Proposed Development. It provides the means to quantify the wind conditions at the Site and for the measurements to be classified in accordance with the Lawson Comfort Criteria (outlined in Section 2.5). Wind tunnel investigations were conducted using a 1:300 scale model of the Proposed Development with existing and cumulative surrounding buildings and terrain covering a radius of 360m centred on the Site.

The basic methodology for quantifying the pedestrian level environment is outlined below:

1. Measure the wind speeds at pedestrian level in the wind tunnel relative to a reference wind speed;
2. Adjust standard meteorological data to account for conditions at the Site;
3. Combine these to obtain the expected frequency and magnitude of wind velocities at pedestrian level; and
4. Compare the results with the Lawson Comfort Criteria to 'grade' conditions around the Site.

2.1 Simulation of Atmospheric Winds

The wind is turbulent, or gusty, and this turbulence varies depending upon the Site. It is necessary to reflect these differences in the wind tunnel test. In addition, the atmospheric boundary layer is a shear flow which means that the mean wind speed increases with height.

Modelling these effects is achieved by a combination of spires and floor roughness elements to create a naturally grown boundary layer that is representative of urban or open country conditions, as appropriate. The detailed contoured proximity model around the Site is used to fine-tune the flow and create conditions similar to those expected at full scale (as shown in Figure 1).

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Figure 1: Aerial view of the existing Site (approximate extent of the Site highlighted in yellow)

2.2 Measurement Technique

Wind speed measurements were made using Irwin probes. For pedestrian comfort studies, both the mean wind speed and the peak wind speed are measured at each location at a scaled height of 1.5m above ground level. The typical equivalent full-scale time period for measuring the mean wind speed is around 90 minutes, whereas the peak wind speed is taken as the wind speed exceeded for 1% of the time.

Wind speeds at each location were measured for 36 wind directions in 10° intervals, with 0° representing a wind blowing from the north and 90° a wind blowing from the east.

2.3 Scaling

The length scale of the model was 1:300 and the velocity scale was approximately 1:2 for strong winds. Consequently, the time scale for the tests was 1:150, or in other words 1 second in the wind tunnel is equivalent to 150 seconds at full scale. The sampling frequency for the data acquisition equipment is therefore adjusted for the time scale.

2.4 Meteorological Data

Approximately thirty years' worth of data were obtained from the combined London airports and was categorised by season as demonstrated in Figure 2 as wind roses. The radial axis indicates the percentage hours per season that the wind speed exceeds the particular velocity range. The seasons are defined as spring (March, April and May), summer (June, July and August), autumn (September, October and November) and winter (December, January and February).

The data has been corrected to standard conditions of 10m above open flat level country terrain, over which pedestrian level wind speeds are greatest. The meteorological station data is then adjusted to the Site conditions using the methodology set out in ESDU 01008[1]. Low to medium rise inner city environments increase the turbulence within the atmospheric boundary layer which reduces the mean wind speed, requiring terrain roughness factors to be specified and applied to the meteorological data to account for the variations in terrain surrounding the Site.

The meteorological data indicates prevailing winds from the west throughout the year. There is a secondary peak from the south-east during the autumn and winter seasons.

The combination of meteorological data, Site altitude and velocity ratios permits the percentage of time that wind speeds are exceeded at ground level on the Site to be evaluated. The locations can then be assessed using the Lawson Comfort Criteria, as described below.

To account for the difference in height and terrain roughness between meteorological conditions at the airports and the Site, it is necessary to apply adjustment factors to the wind tunnel velocity ratios. Adjustment factors (mean factors) were computed for wind directions from 0^0 through to 360^o. The reference height in the wind tunnel was at the equivalent full-scale height of 120 metres. Table 1 presents the mean factors for the Site. To put these numbers into perspective, a higher mean factor for angles 0^0-30^0 means that the oncoming wind speeds are higher (likely due to having more open surrounds in these angles).

[1] ESDU International, Computer program for wind speeds and turbulence properties: flat or hilly sites in terrain with roughness changes, ESDU 01008, 2001 01008

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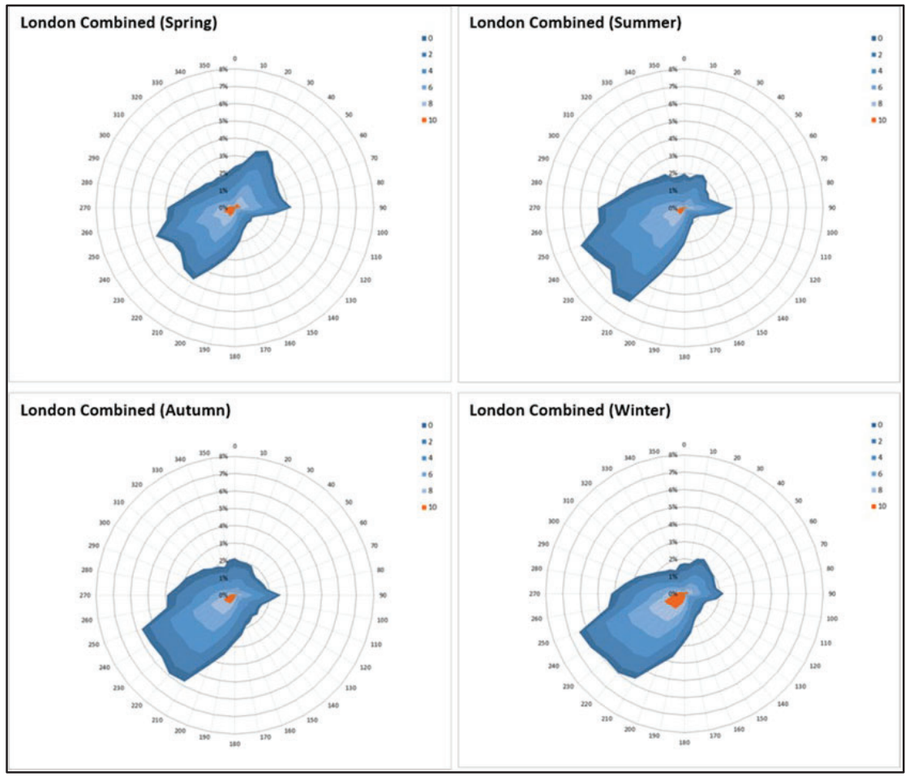

Figure 2: Seasonal wind roses for the London area (in m/s) – (Radial axis indicates the percentage of time for which the stated threshold is exceeded)

Table 1: ESDU Mean Factors at 120m above ground level

Wind Direction	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°
Mean Factor at 120 m	1.21	1.21	1.21	1.21	1.21	1.19	1.19	1.19	1.22	1.24	1.24	1.24
Wind Direction	**120°**	**130°**	**140°**	**150°**	**160°**	**170°**	**180°**	**190°**	**200°**	**210°**	**220°**	**230°**
Mean Factor at 120 m	1.24	1.24	1.21	1.21	1.21	1.21	1.21	1.21	1.15	1.15	1.14	1.14
Wind Direction	**240°**	**250°**	**260°**	**270°**	**280°**	**290°**	**300°**	**310°**	**320°**	**330°**	**340°**	**350°**
Mean Factor at 120 m	1.14	1.12	1.12	1.11	1.11	1.12	1.12	1.15	1.15	1.15	1.21	1.21

2.5 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria[2] that have been established for over thirty years and have been widely used on building developments across the United Kingdom. The comfort criteria seek to define the reaction of an average pedestrian to the wind as described in Table 2. If the measured wind conditions exceed the threshold wind velocity for more than 5% of the time, then they are deemed unacceptable for the intended pedestrian activity. The expectation is that there may be complaints of nuisance or people will not use the area for its intended purpose.

The Criteria sets out four pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The categories are sitting, standing, strolling and walking, in ascending order of activity level, with a fifth category for conditions that are uncomfortable for all pedestrian uses. In other words, the wind conditions in an area for sitting need to be calmer than a location that people merely walk past.

The distinction between strolling and walking is that in the strolling scenario pedestrians are more likely to take on a leisurely pace, with the intention of taking time to move through the area, whereas in the walking scenario pedestrians are intending to move through the area quickly and are therefore expected to be more tolerant of stronger winds.

[2] Lawson T.V. (April 2001), Building Aerodynamics, Imperial College Press

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The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season.

The coloured key in Table 2 corresponds to the presentation of wind tunnel test results described in the results section of this report.

Table 2: Lawson Comfort Criteria

Key	Comfort Category	Threshold	Description
	Sitting	0-4 m/s	Light breezes desired for outdoor restaurants and seating areas where one can read a paper or comfortably sit for long periods
	Standing	4-6 m/s	Gentle breezes acceptable for main building entrances, pick-up/drop-off points and bus stops
	Strolling	6-8 m/s	Moderate breezes that would be appropriate for strolling along a city/town street, plaza or park
	Walking	8-10 m/s	Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering
	Uncomfortable	>10 m/s	Winds of this magnitude are considered a nuisance for most activities, and wind mitigation is typically recommended

2.6 Desired Pedestrian Activity around the Proposed Development

Generally, for a mixed-use development, the target conditions are:

- Strolling during the windiest season on pedestrian thoroughfares;
- Standing/entrance conditions at main entrances, drop off areas or taxi ranks, and bus stops throughout the year;
- Sitting conditions at outdoor seating during the summer season when these areas are more likely to be frequently used by pedestrians; and
- Sitting or standing use conditions during the summer season on balconies and private amenity spaces.

The walking and uncomfortable classifications are usually avoided because of their association with occasional strong winds, unless they are on a minor pedestrian route or a route where pedestrian access could be controlled in the event of strong winds.

Achieving a sitting classification in the summer usually means that the same measurement location would be suitable for standing in the windiest season because winds are stronger during this period. This is considered an acceptable occurrence for the majority of external amenity spaces because other factors such as air temperature and precipitation influence people's perceptions about the 'need' to use seating in the middle of winter.

For a large terrace space, a mix of standing and sitting wind conditions is acceptable provided that any desired seating areas are situated in areas having sitting wind conditions.

Table 3 summarises the expected usage of each probe location.

Table 3: Expected Receptor Usage

Receptor	Location/Receptor Reference (Probe Measurement Number)
Thoroughfares	**On-Site:** 1, 2, 3, 4, 6, 8, 11, 13, 16, 19, 22, 23, 25, 26, 28, 29, 31, 36, 37, 41, 44, 50, 51, 53, 55, 56, 57, 60, 61, 64, 66, 67, 68, 71, 73, 74, 76, 77, 85, 87, 88, 93, 94, 95, 96, 98, 99, 101, 103, 104, 107, 108, 111, 117, 119, 123, 124, 128, 131, 132, 134, 135, 136, 144, 147, 148, 150, 151, 156, 157, 158, 160, 161, 164, 165, 167, 169, 172, 174, 175, 176, 177, 178, 179, 180, 182, 183, 185, 186, 187, 189, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 216, 217, 218, 219, 220, 227, 244, 245, 246, 247, 248, 249, 250, 251, 253, 254, 256, 258, 263, 264, 266, 267, 268, 269, 270, 271, 272, 274, 275, 277, 282, 283, 284, 288, 290, 292, 294, 296, 297, 298, 299, 301, 302, 303, 305, 307, 308, 310, 311, 314, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 329, 331, 332, 334, 336, 341, 342, 344, 345, 347, 350, 351, 354, 355, 358, 359, 363, 365, 368, 369, 371, 372, 373, 375, 376, 384, 391, 392, 394, 396, 398, 400, 402, 404, 405, 406, 407, 408, 409, 411, 413, 415 **Off-Site:** 47, 48, 78, 79, 84, 228, 229, 230, 231, 232, 233, 234, 235, 236, 328, 330, 333, 370, 374, 377, 385, 386, 388, 389
Entrances	**On-Site:** 14, 18, 20, 32, 40, 43, 52, 54, 58, 59, 62, 63, 65, 70, 72, 89, 91, 102, 109, 112, 113, 114, 116, 118, 120, 121, 129, 130, 138, 139, 141, 142, 145, 149, 162, 166, 170, 173, 181, 184, 188, 190, 191, 194, 195, 214, 215, 222, 224, 239, 240, 241, 242, 255, 260, 276, 278, 280, 287, 293, 295, 300, 306, 309, 313, 315, 335, 339, 346, 349, 353, 356, 357, 361, 366, 397, 399, 401, 403
Balconies	**On-Site:** 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 477, 478 **Off-Site:** 479, 480, 481, 488, 489, 490, 491, 492, 493, 494, 495
Roof Terraces	**On-Site:** 416, 417, 418, 422, 423, 424, 425, 426, 427, 431, 432, 433, 434, 435, 436, 473, 474, 475, 476 **Off-Site:** 483, 484, 486, 487, 496
Podium Level	**On-Site:** 419, 420, 421, 428, 429, 430, 437, 438, 439
Ground Level Amenity	**On-Site:** 24, 27, 34, 35, 38, 115, 122, 192, 193, 226, 257, 259, 261, 262, 265, 312, 316, 440 **Off-Site:** 83
Roads/Car Park	**On-Site:** 5, 7, 9, 10, 12, 15, 17, 21, 30, 33, 39, 42, 45, 49, 69, 75, 86, 90, 92, 97, 100, 110, 125, 126, 127, 133, 137, 140, 143, 146, 152, 153, 154, 155, 159, 163, 171, 221, 223, 225, 243, 252, 273, 279, 281, 285, 286, 289, 291, 304, 337, 338, 340, 343, 348, 352, 360, 362, 364, 367, 395, 410, 412, 414 **Off-Site:** 46, 80, 81, 82, 237, 378, 379, 380, 381, 382, 383, 387, 390, 393
Crossings	**On-Site:** 237, 238
Bus Stops	**On-Site:** 105, 106, 168

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2.7 Strong Winds

In addition, the criteria stipulate two strong wind threshold limits; when winds exceed 15m/s or 20m/s for more than 0.025% of the time (approximately 2 hours of the year). The lower limit, 15m/s, if exceeded may require remedial measures depending on the sensitivity of the location i.e. is it reasonable to expect an elderly or very young pedestrian to be present at the location? Wind speeds that exceed the 20m/s threshold for more than approximately 2 hours per year would represent a safety risk for all members of the population and would therefore require mitigation to provide an appropriate wind environment.

In the UK, strong winds are associated with areas which would be classified as uncomfortable for pedestrian use. In a mixed-use, urban development scheme, uncomfortable conditions would not usually form part of the 'target' wind environment and would usually require mitigation due to pedestrian comfort considerations. Mitigation applied to improve pedestrian comfort would also reduce the frequency of, or even eliminate, any strong winds.

Table 4 summarises the probe locations that wind conditions exceed the safety threshold.

Table 4: Annual Exceedance of Strong Winds

Location	Strong Wind Exceedance	Main Wind Direction	Hours per Annum
Configuration 1: Existing Site with Existing Surrounding Buildings			
No occurrences of strong winds within this Configuration.			
Configuration 2: The Detailed Proposals (Phase A) with Existing Surrounding Buildings			
No occurrences of strong winds within this Configuration.			
Configuration 3: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings			
137	S15	270	2.3
140	S15	270	6.8
141	S15	270	9.7
143	S15	260	20.7
158	S15	260	25.1
177	S15	260	4.7
195	S15	270	4.5
265	S15	270	9.1
274	S15	260	2.5
277	S15	270	6.4
281	S15	260	4.6
286	S15	270	2.8
290	S15	270	2.7
305	S15	270	9.2
337	S15	260	3.3

338	S15	260	11.8
339	S15	260	3.7
340	S15	270	3.4
416	S15	220	3.0
426	S15	270	6.2
427	S15	260	4.7
434	S15	250	2.9
Configuration 4: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings			
158	S15	270	14.6
159	S15	270	3.1
177	S15	240	4.0
195	S15	270	3.3
198	S15	270	2.5
266	S15	260	2.3
274	S15	260	4.5
277	S15	270	2.3
281	S15	270	2.4
306	S15	260	21.4
337	S15	250	4.2
338	S15	250	10.8
340	S15	270	5.8
447	S15	270	3.2
453	S15	270	7.2
Configuration 5: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures			
177	S15	250	2.8
Configuration 6: Existing Site with Cumulative Surrounding Buildings			
No occurrences of strong winds within this Configuration.			
Configuration 7: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings			
No occurrences of strong winds within this Configuration.			
Configuration 8: Proposed Development (Outline Proposals plus Detailed Proposals) with Cumulative Surrounding Buildings			
137	S15	270	2.3
140	S15	270	6.7
141	S15	270	9.2
143	S15	270	18.4

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158	S15	260	20.8
177	S15	240	2.7
195	S15	270	3.8
265	S15	270	7.1
277	S15	280	5.4
281	S15	260	3.2
290	S15	280	2.7
305	S15	260	6.0
338	S15	250	7.7
416	S15	220	2.3
426	S15	270	6.3
427	S15	260	3.6
Configuration 9: Proposed Development (Illustrative Scheme) and Phase A with Cumulative Surrounding Buildings			
158	S15	260	12.9
159	S15	270	2.8
177	S15	250	2.6
195	S15	270	2.7
274	S15	250	2.3
306	S15	250	13.4
338	S15	250	6.3
340	S15	270	3.5
453	S15	260	5.3
482	S15	40	27.3
Configuration 10: Proposed Development (Illustrative Scheme) and Phase A with Cumulative Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures			
177	S15	250	2.2

APPENDIX A

APPENDIX A: WIND TUNNEL PHOTOS

Figure 3: Existing Site with Existing Surrounding Buildings (Configuration 1, Board 1) – View in the Wind Tunnel (from the south)

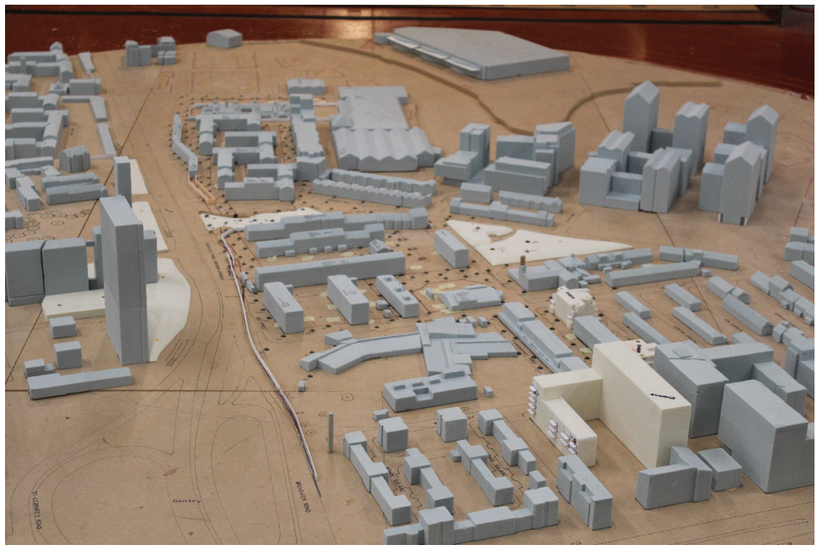

Figure 4: Existing Site with Existing Surrounding Buildings (Configuration 1, Board 1) – View in the Wind Tunnel (from the south)

Figure 5: Existing Site with Existing Surrounding Buildings (Configuration 1, Board 2) – View in the Wind Tunnel (from the south)

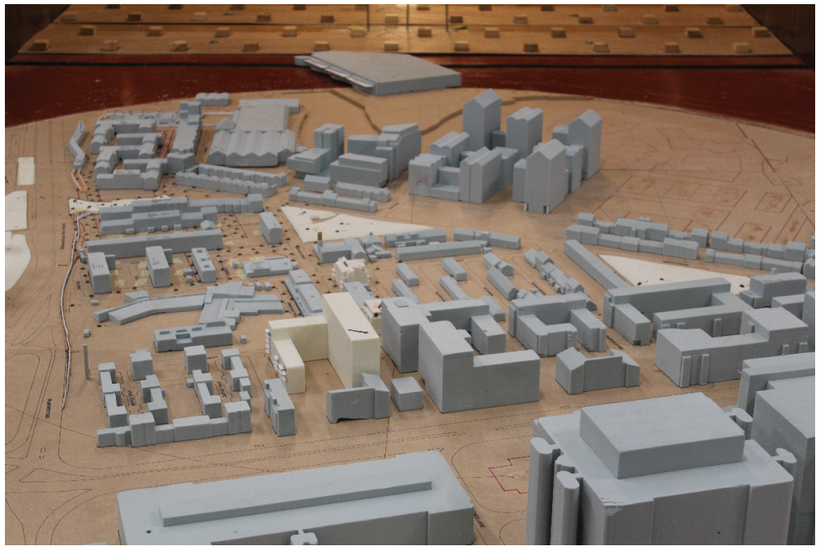

Figure 6: Existing Site with Existing Surrounding Buildings (Configuration 1, Board 2) – View in the Wind Tunnel (from the south)

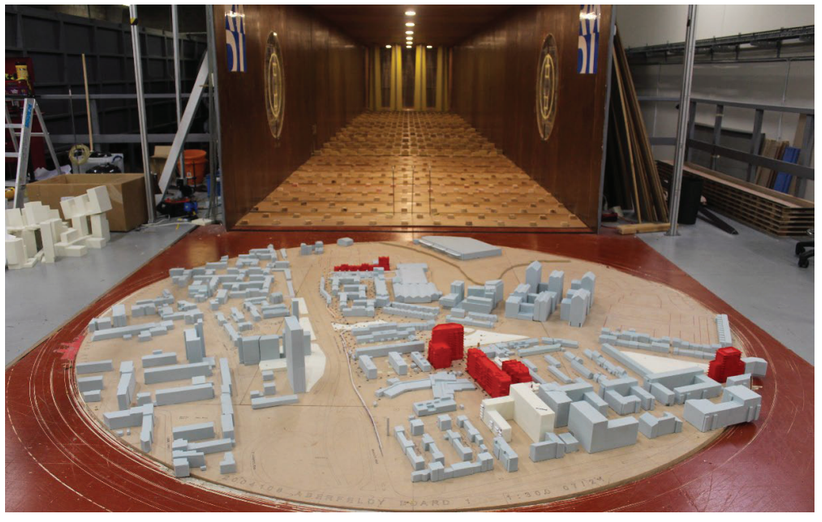

Figure 7: Detailed Proposals (Phase A) with Existing Surrounding Buildings (Configuration 2, Board 1) – View in the Wind Tunnel (from the south)

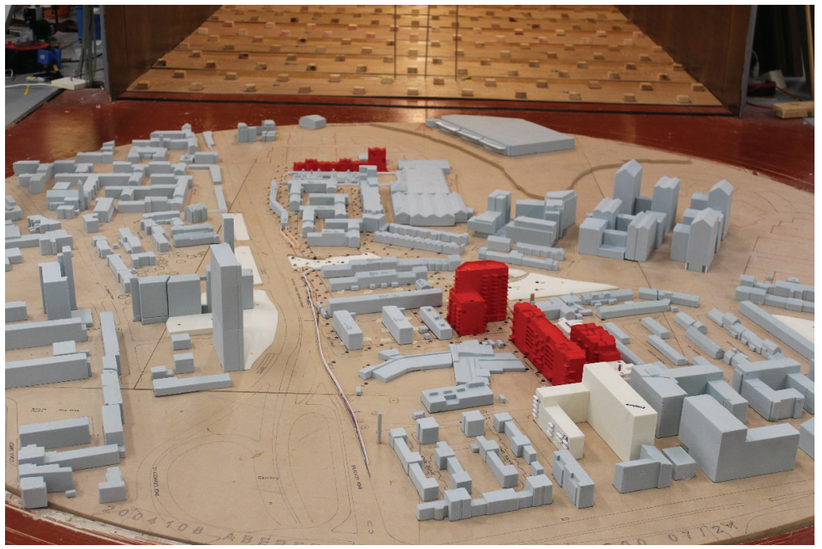

Figure 8: Detailed Proposals (Phase A) with Existing Surrounding Buildings (Configuration 2, Board 1) – View in the Wind Tunnel (from the south)

Figure 9: Detailed Proposals (Phase A) with Existing Surrounding Buildings (Configuration 2, Board 2) – View in the Wind Tunnel (from the south)

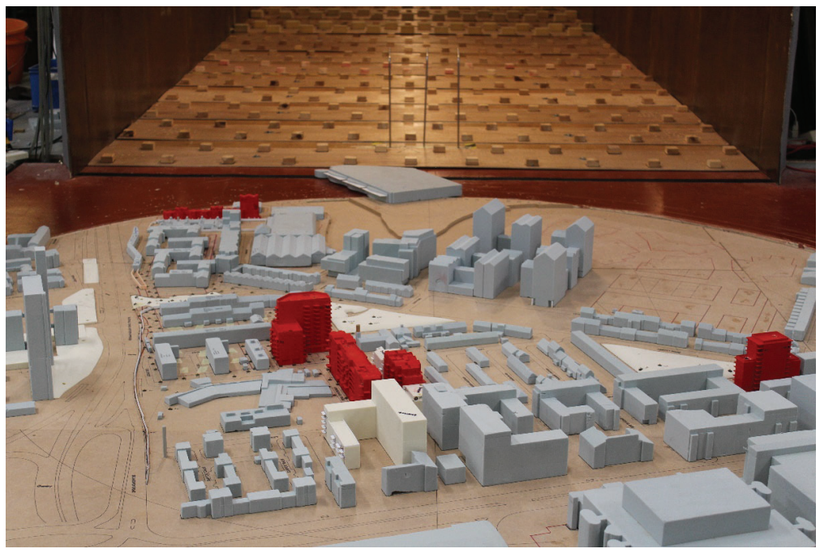

Figure 10: Detailed Proposals (Phase A) with Existing Surrounding Buildings (Configuration 2, Board 2) – View in the Wind Tunnel (from the south)

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Figure 11: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings (Configuration 3, Board 1) – View in the Wind Tunnel (from the south)

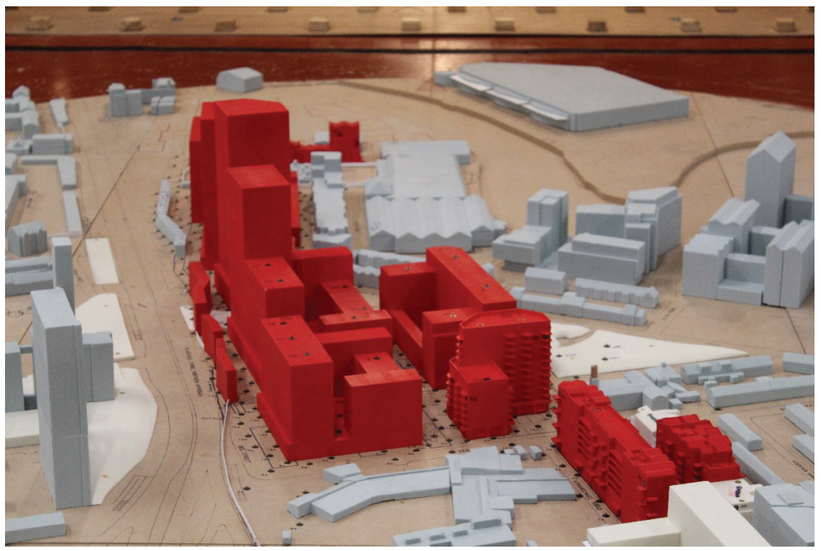

Figure 12: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings (Configuration 3, Board 1) – View in the Wind Tunnel (from the south)

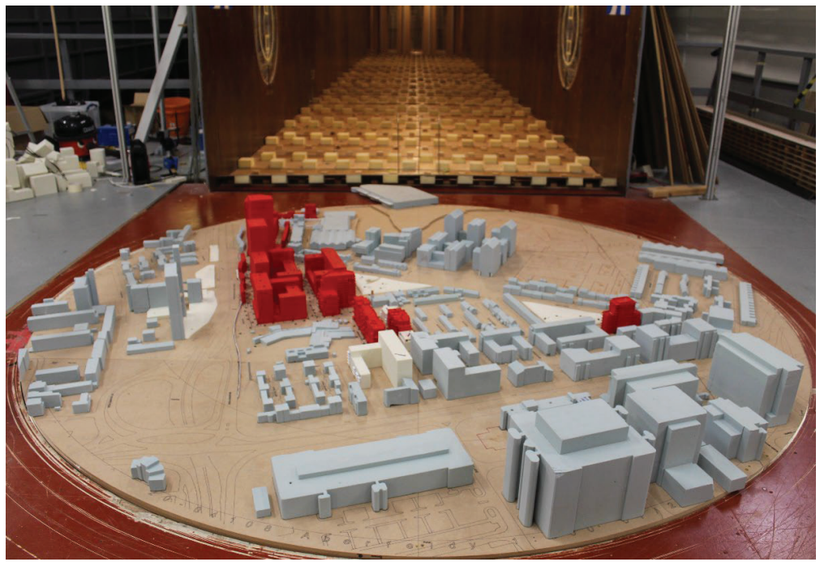

Figure 13: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings (Configuration 3, Board 2) – View in the Wind Tunnel (from the south)

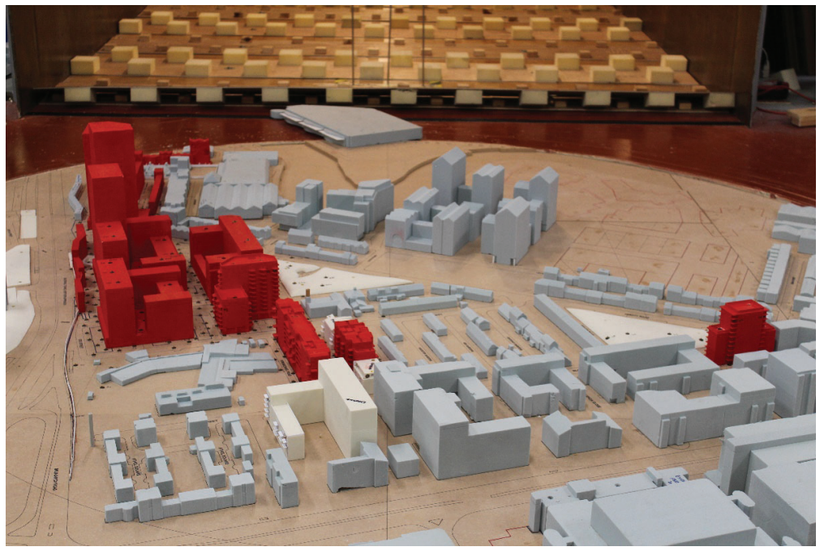

Figure 14: Proposed Development (Outline Proposals plus Detailed Proposals) with Existing Surrounding Buildings (Configuration 3, Board 2) – View in the Wind Tunnel (from the south)

Figure 15: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings (Configuration 4, Board 1) – View in the Wind Tunnel (from the north)

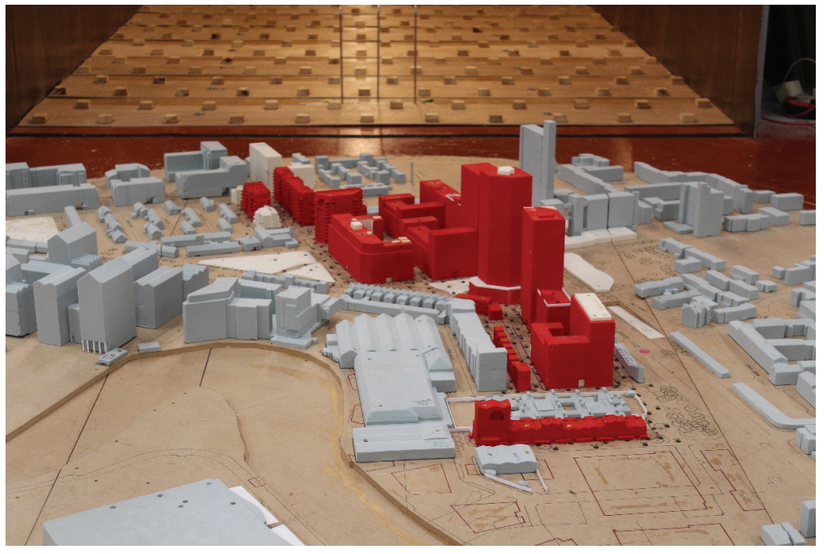

Figure 16: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings (Configuration 4, Board 1) – View in the Wind Tunnel (from the north)

Figure 17: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures (Configuration 5, Board 1) – View in the Wind Tunnel (from the north)

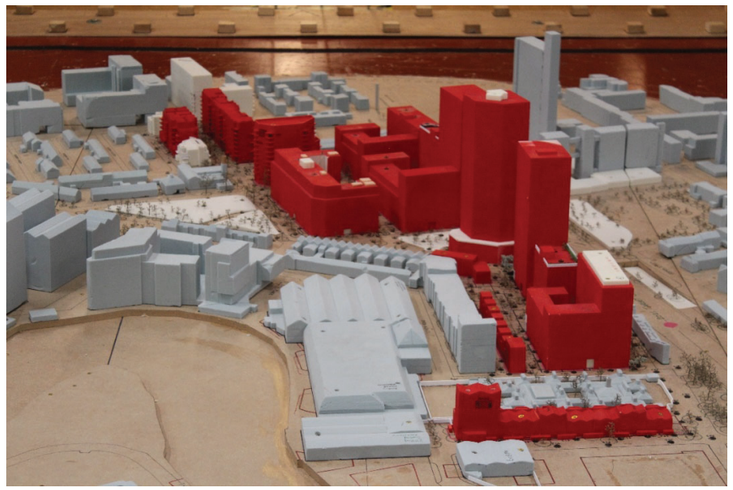

Figure 18: Proposed Development (Illustrative Scheme) and Phase A with Existing Surrounding Buildings, Proposed Landscaping and Wind Mitigation Measures (Configuration 5, Board 1) – View in the Wind Tunnel (from the north)

Figure 19: Existing Site with Cumulative Surrounding Buildings (Configuration 6, Board 1) – View in the Wind Tunnel (from the south)

Figure 20: Existing Site with Cumulative Surrounding Buildings (Configuration 6, Board 1) – View in the Wind Tunnel (from the south)

Figure 21: Existing Site with Cumulative Surrounding Buildings (Configuration 6, Board 2) – View in the Wind Tunnel (from the south)

Figure 22: Existing Site with Cumulative Surrounding Buildings (Configuration 6, Board 2) – View in the Wind Tunnel (from the south)

Figure 23: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings (Configuration 7, Board 1) – View in the Wind Tunnel (from the south)

Figure 24: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings (Configuration 7, Board 1) – View in the Wind Tunnel (from the south)

Figure 25: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings (Configuration 7, Board 2) – View in the Wind Tunnel (from the south)

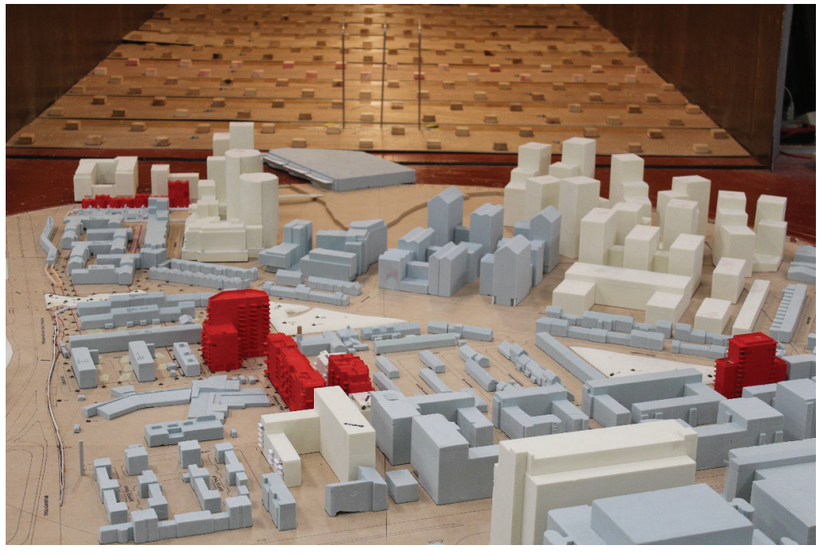

Figure 26: Detailed Proposals (Phase A) with Cumulative Surrounding Buildings (Configuration 7, Board 2) – View in the Wind Tunnel (from the south)

Figure 27: Proposed Development (Outline Proposals plus Detailed Proposals) with Cumulative Surrounding Buildings (Configuration 8, Board 1) – View in the Wind Tunnel (from the south)

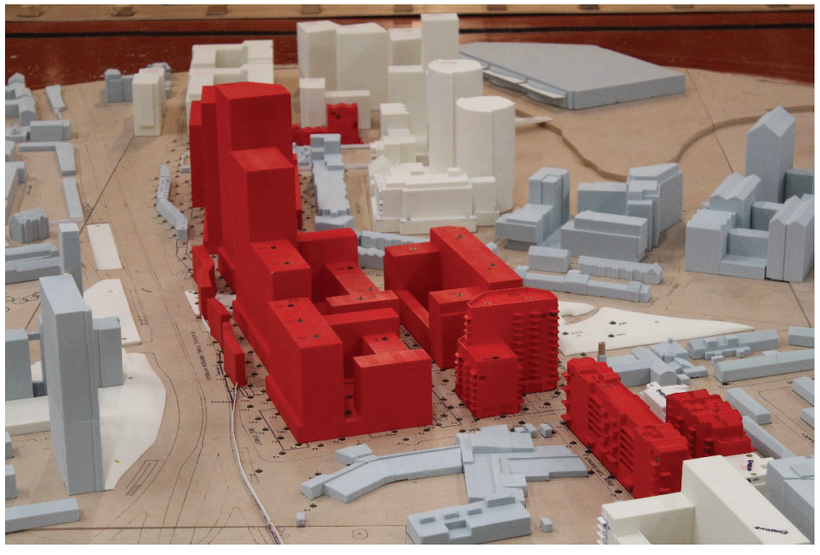

Figure 28: Proposed Development (Outline Proposals plus Detailed Proposals) with Cumulative Surrounding Buildings (Configuration 8, Board 1) – View in the Wind Tunnel (from the south)