

35-39 FRIAR STREET

READING, UK

PEDESTRIAN LEVEL WIND MICROCLIMATE ASSESSMENT

RWDI #2200857

23RD JUNE 2023

SUBMITTED TO

Keith Mapingire

Design & Development Manager

keith@elmsbrook.com

Shaviram Group

First Floor Offices, Farley Court

Allsop Place, London

NW1 5LG

T: +44 (0)207 1234 250

M: +44 (0)7511 050 711

SUBMITTED BY

Induja Ashok

Project Engineer

Induja.Ashok@rwdi.com

Zain Khan

Project Engineer

Zain.Khan@rwdi.com

Andrew Proud

Project Engineer

Andrew.Proud@rwdi.com

Richard Stainton

Project Manager

Richard.Stainton@rwdi.com

RWDI

Unit 1 Tilers Road

Milton Keynes

MK11 3LH

T: +44 (0)1908 776970



TABLE OF CONTENTS

TABLE OF CONTENTS	2
1 EXECUTIVE SUMMARY	4
2 INTRODUCTION.....	5
3 BACKGROUND AND APPROACH.....	6
3.1 Site Description and Surroundings	6
3.2 The Proposed Development	7
3.3 Post-Assessment Amendments	8
4 METHODOLOGY AND ASSESSMENT CRITERIA.....	9
4.1 Simulation of Atmospheric Winds	9
4.2 Measurement Technique.....	9
4.3 Scaling	10
4.4 Meteorological Data.....	10
4.5 Pedestrian Comfort.....	10
4.6 Strong Winds	11
5 RESULTS	12
5.1 Details of Analysis.....	12
5.2 Desired Pedestrian Activity around the Proposed Development	12
5.3 Performance against the Lawson Comfort Criteria	12
5.4 Expected Intended uses	13
6 DISCUSSION	15
6.1 Configuration 1: Existing Site with Existing Surrounding Buildings.....	15
6.2 Configuration 2: Proposed Development with Existing Surrounding Buildings	16
6.3 Configuration 3: Proposed Development with Cumulative Surrounding Buildings	17
7 WIND MITIGATION AND POST-ASSESSMENT AMENDMENTS.....	20
8 CONCLUSIONS.....	21
9 STATEMENT OF LIMITATIONS.....	22



APPENDICES

Appendix A Wind Tunnel Photos

Appendix B Meteorological Data

Appendix C Post-Assessment Amendments

1 EXECUTIVE SUMMARY

The objective of this study was to determine the ground, terrace and balcony level wind environment within and around the proposed 35-39 Friar Street development (hereafter referred to as the “Proposed Development”) in Reading, UK.

This report presents a description of the methodology used and the results of three configurations tested in the wind tunnel, namely:

- Configuration 1: Existing Site with Existing Surrounding Buildings ;
- Configuration 2: Proposed Development with Existing Surrounding Buildings ; and
- Configuration 3: Proposed Development with Cumulative Surrounding Buildings.

The meteorological data for Reading indicate prevailing winds from the south-west quadrant throughout the year with secondary winds from the north-east direction which are more prevalent during the spring months.

In the Baseline scenario (Configuration 1), wind conditions range from suitable for sitting to strolling use during the windiest season. During the summer season, wind conditions are generally one category calmer, with a larger area of the Site suitable for sitting use. All locations have suitable conditions for their current uses. There are no strong wind exceedances which pose safety concerns for more vulnerable pedestrians or cyclists.

With the Proposed Development built out (Configuration 2), all locations at ground level at the Site and in the surrounding areas would have suitable wind conditions for the intended uses. At elevated levels, whilst the majority of the locations would be suitable, there would be seating on the 7th floor terrace (represented by measurement location 125) which would have standing use conditions during the summer season, one category windier than suitable. However, the inclusion of a proposed louvred plant screen and the proposed landscaping scheme would be expected to provide beneficial shelter and result in suitable wind conditions at this terrace space. Further wind mitigation measures would not be required. There would be no strong wind exceedances which pose safety concerns for more vulnerable pedestrians or cyclists.

The introduction of cumulative surrounding buildings (Configuration 3) would improve wind conditions on Friar Street and the neighbouring Station Hill Site in comparison to Configuration 2. Conditions on Garrard Street at the north-western corner of Garrard House would be windier than in Configuration 2, however, would remain suitable for a pedestrian thoroughfare. All locations at ground and elevated levels would be suitable for the intended uses, with no strong wind exceedances that would pose safety concerns for more vulnerable pedestrians or cyclists.

Overall, wind conditions with the introduction of the Proposed Development would be relatively calm, with no potential safety concerns. One seating location was identified at the 7th floor terrace that would have windier than suitable conditions; however, this would be made suitable for the intended use through implementation of a louvred plant screen and the proposed landscaping scheme. All locations would therefore have suitable wind conditions and no further assessment is required.

2 INTRODUCTION

RWDI was retained by Shaviram Group to conduct a pedestrian level wind microclimate (PLW) assessment for the proposed 35-39 Friar Street development in Reading, UK. This report presents the background, objectives, methodology, results, and discussion from RWDI's assessment.

The assessment has been conducted in line with the Reading Borough Local Plan¹, which states the following:

CC8: Safeguarding Amenity, states:

- *"Development will not cause a detrimental impact on the living environment of existing residential properties or unacceptable living conditions for new residential properties, in terms of:
 - o Wind, where the proposals involve new development of more than 8 storeys."*

CR10: Tall Buildings, states:

- *"In Reading, tall buildings are defined as 10 storeys of commercial floorspace or 12 storeys of residential (equating to 36 metres tall) or above. Tall buildings will meet all the requirements below.
 - o v) Mitigate any wind speed or turbulence or overshadowing effects through design and siting."*

Section 5.3.45 – Street environment, states:

- *"Tall buildings need not prejudice the creation or retention of a human scale street environment, provided that they [...] have regard to the effects on the microclimate. There are a number of design solutions that can be used to assist in creating a human scale street environment:
 - o Stepping down a large mass to its neighbours;
 - o [...];
 - o Mitigating against the adverse impacts a tall building can often make on the microclimate;
 - o [...];
 - o Providing green infrastructure for a comfortable microclimate."*

Section 5.3.47 – Wind and Solar effects on tall buildings, states:

- *"Tall buildings can adversely affect the environmental quality of surrounding areas, particularly through the diversion of high-speed winds to ground level [...]. However, good design and siting can successfully mitigate these impacts. A building, or grouping of buildings, should be modelled and simulated within its surrounding context, to examine environmental performance at an early design stage to highlight any potential issues that need to be addressed. Wind should be assessed against the Lawson Criteria."*

Section 5.3.48 states:

- *"In terms of wind effects, the use of architectural devices such as screens, terraces and awnings as well as façade set-backs can be used to minimise the effects of high wind speed at the base of a tall building."*

A summary of the overall recommendations from the investigation are presented in Section 8 "Conclusions".

¹ Reading Borough Council, 2019. Reading Borough Local Plan. Reading. RBC

3 BACKGROUND AND APPROACH

Wind tunnel tests were conducted on a 1:300 scale model of the Proposed Development. 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 Heathrow Airport was 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 141 locations for 36 wind directions, in 10° increments. The measurements covered ground level locations along the building façades and at corners, near main entrances, waiting areas (such as bus stops), on pedestrian routes within and around the Site, and at terraces and balconies within 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.

This report presents a description of the methodology used and the results of three configurations tested in the wind tunnel, namely:

- Configuration 1: Existing Site with Existing Surrounding Buildings ;
- Configuration 2: Proposed Development with Existing Surrounding Buildings ; and
- Configuration 3: Proposed Development with Cumulative Surrounding Buildings.

3.1 Site Description and Surroundings

The site is located in Reading town centre, fronting Friar Street to the south, and is located within the Major Opportunity Areas of CR11 being just outside of the Tall Buildings Cluster (CR10) around Reading Station and the Station Hill Development Site. The Site is bounded by Friar Street to the south, commercial developments to the east and west, and the Garrard Street multi storey car park to the north. The Ordnance Survey Landranger grid reference is SU714737.

The surrounding buildings are generally low to medium rise, which represents a suburban terrain. This results in a relatively greater levels of turbulence (i.e., higher 'gustiness') wind environment with a lower mean wind speed compared to an open terrain (such as by the coast) where the mean wind speed will be higher and the turbulence or 'gustiness' will be lower.

An aerial view of the approximate location of the Site is highlighted in yellow with its surroundings in Figure 1.



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

3.2 The Proposed Development

The proposals are for a residential-led mixed use scheme of up to 11 storeys with commercial elements at ground floor level. The main entrance to the Proposed Development would be situated on the western façade. Secondary entrances would be situated on the western and southern façades. In terms of amenity spaces, at ground level there is potential for mixed-use amenity west of the Proposed Development. The podium space on the first floor and the terrace on the 7th floor would be accessible spaces for occupants. The ultimate roof level would be inaccessible. Balconies would be situated on all elevations.

Figure 2 shows the wind tunnel model of the Proposed Development (Configuration 2) from the south.

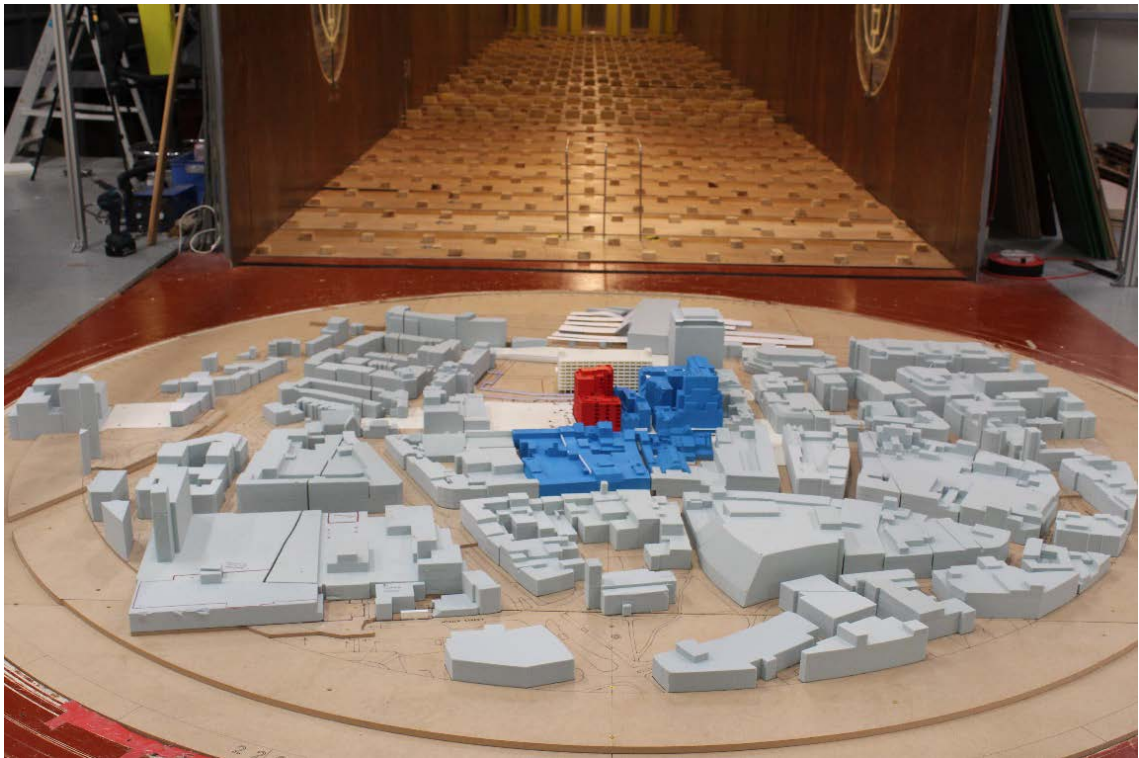


Figure 2: View from the south of the Proposed Development (in red) with Existing Surrounding Buildings (in blue) in wind tunnel

3.3 Post-Assessment Amendments

Following the wind microclimate assessment, RWDI were informed of amendments to the Proposed Development. These amendments would comprise:

- Addition of a one storey tall massing at the north-eastern corner at ground level;
- Implementation of an open louvered plant screen on the 7th floor terrace;
- Relocated the entrances from north to the southern and western façade of the Development;
- Seating locations at the roof level terrace location moved and
- Removal of several upper-level balconies between levels 7 – 10 on the southern, western and eastern façades.

An image of the updated model can be found in Appendix C Figure 18. The expected wind microclimate effects of these changes are discussed in Section 7 “Mitigation and Post-Assessment Amendments”.

4 METHODOLOGY AND ASSESSMENT CRITERIA

Wind tunnel testing is a well-established and robust technique to assess the pedestrian wind microclimate with the Proposed Development in place. 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 4.5). 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.

4.1 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 (as shown in Figure 2) is used to fine-tune the flow and create conditions similar to those expected at full scale.

4.2 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.

4.3 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 one second in the wind tunnel is equivalent to 150 seconds at full scale.

4.4 Meteorological Data

Meteorological data reveal the prevailing wind direction throughout the year to focus the attention on the possible influence of these winds on the Site with the exception of the building massing and layout that may indicate that winds from other directions may be equally important.

The meteorological data for this report was derived from the meteorological station at London Heathrow airport and has been revised to standard conditions of 10m above open flat level country terrain. The set of data is then adjusted to the Site conditions using the methodology implemented in the BREVe3.2 software package.

Approximately thirty years' worth of data obtained from London Heathrow airport is presented in Appendix B, Figure 27 as seasonal wind roses. The radial axis indicates the cumulative number of hours that the wind velocity exceeds the particular Beaufort Force in a full circle per season. 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 indicates that the prevailing wind direction throughout the year is from south-west, which is typical for many areas of south-east England. In addition, there is a secondary peak from the north-east during the spring season. Combination of this meteorological dataset and the velocity ratios obtained from the Site using the wind tunnel permits the percentage of time that wind speeds are exceeded.

4.5 Pedestrian Comfort

The assessment of the wind conditions requires a standard against which the measurements can be compared. This report uses the Lawson Comfort Criteria² 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 1. 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.

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

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.

The Criteria are derived for open air conditions and assume that pedestrians will be suitably dressed for the season. Thermal comfort is discussed with reference to acceptable wind environments but not evaluated as part of the assessment.

The coloured key in Table 1 corresponds to the presentation of wind tunnel test results described in the results section of this report.

Table 1: 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

4.6 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 2.2 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, such as one in the Proposed Development, 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.

5 RESULTS

5.1 Details of Analysis

To account for the difference in height and terrain roughness between meteorological conditions at the meteorological station 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° through to 360°. The reference height in the wind tunnel was at the equivalent full-scale height of 120 metres. Table 3 in Appendix B presents the mean factors for the Site.

5.2 Desired Pedestrian Activity around the Proposed Development

Generally, for a Proposed Development, the target conditions are:

- Strolling during the windiest season on pedestrian thoroughfares and secondary entrances;
- Standing/entrance conditions at main entrances and bus stops throughout the year;
- Sitting conditions at designated 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 and large roof terraces.

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. In addition, standing use conditions are also considered tolerable at private amenity areas (such as balconies) where the occupant has control over the use of the space.

5.3 Performance against the Lawson Comfort Criteria

The wind microclimate within and around the Site has been assessed and classified using the Lawson Comfort Criteria defined in Table 1. The results of the assessment for each configuration against Lawson Comfort Criteria are described below and presented graphically in Figures 3 to 10.

5.3.1 Configuration 1 – Existing Site with Existing Surrounding Buildings

The wind microclimate results for Configuration 1 are shown in the following figures:

- Figure 3: Windiest Season (Ground Level); and
- Figure 4: Summer Season (Ground Level).

5.3.2 Configuration 2 – Proposed Development with Existing Surrounding Buildings

The wind microclimate results for Configuration 2 are shown in the following figures:

- Figure 5: Windiest Season (Ground Level);
- Figure 6: Summer Season (Ground Level); and
- Figure 7: Summer Season (Elevated Levels).

5.3.3 Configuration 3 – Proposed Development with Cumulative Surrounding Buildings

The wind microclimate results for Configuration 3 are shown in the following figures:

- Figure 8: Windiest Season (Ground Level);
- Figure 9: Summer Season (Ground Level); and
- Figure 10: Summer Season (Elevated Levels).

The following consented cumulative surrounding developments were included in this configuration:

- Reading Station Hill (Planning Ref:201537);
- Station Hill Reading (Planning Ref: 201536);
- 52-55 Friar Street (Planning Ref: 162210);
- 29-35 Station Road (Planning Ref: 181930);
- Broad Street Mall (Planning Ref: 182137);
- 20 Hosier Street (Planning Ref: 182054);
- Weldale Street (Planning Ref: 170326); and
- Bristol and West Arcade (Planning Ref: 180358).

5.4 Expected Intended Uses

An assessment of the suitability of wind conditions at the Proposed Development is dependent on knowing the intended pedestrian use of any given area at or surrounding the Site. The table below outlines the expected intended pedestrian uses of the Site and surrounding area as understood by RWDI for the purposes of this assessment in reference to the measurement locations.

Table 2: Expected intended pedestrian use table

Expected Intended Use	Measurement Locations
Thoroughfares	1,2,4,7,8,11-13,15,16,24,26,32-35,40,41,46-57,64,65,68,69,72,75-91,93-96,98,99,101-104,106-109,111,113,114,116,117
Entrances	18,19,21,22,25,30,36,38,39,43,44,59,60,74,105,110,112,115
Bus Stops	3,5,9,28,37,45
Roads	6,10,14,17,20,23,27,29,31,92,97,100
Ground Level Amenity (mixed use)	58,61-63,66,67,70,71,73
Ground Level Amenity (Seating)	42
Balconies	129-137
Terrace Amenity (mixed use)	118,120-122,124,126,128,
Terrace Amenity (Seating)	119,123,125,127
Inaccessible (except to maintenance workers)	138-141

6 DISCUSSION

This discussion compares the measured wind conditions (shown in Figures 3-10) to the anticipated usage of the Site, to provide an assessment of whether the conditions are suitable or too windy for the intended use. Any receptors not specifically mentioned are suitable or calmer than required for the desired pedestrian usage. Locations that are windier than desired for their intended pedestrian use would require mitigation.

6.1 Configuration 1: Existing Site with Existing Surrounding Buildings

The following discussion of the wind microclimate is based on the results shown in Figures 3 and 4 for the windiest and summer seasons for the ground level respectively.

6.1.1 Pedestrian Comfort

The baseline scenario (i.e., Configuration 1) indicates that the Site and nearby surrounding area has conditions ranging from suitable for sitting to strolling use during the windiest season. Generally during the summer season, wind conditions are one category calmer, and thus a larger area surrounding the Site fulfils the sitting criteria.

Thoroughfares (Figure 3)

All thoroughfare locations within and around the Site have wind conditions suitable for sitting to standing use during the windiest season.

Entrances (Figure 3)

Existing entrances have wind conditions suitable for sitting to standing use during the windiest season.

Bus Stops (Figure 3)

Bus stops have wind conditions suitable for sitting to standing use during the windiest season.

Ground Level Amenity (Figure 4)

Existing benches on Friar Street to the south-west of the Site (measurement location 42) have wind conditions suitable for sitting use during the windiest season.

6.1.2 Strong Winds

There are no instances of strong winds exceeding the safety threshold in this configuration.

6.2 Configuration 2: Proposed Development with Existing Surrounding Buildings

The following discussion of the wind microclimate is based on the results shown in Figures 5 and 6 during the windiest and summer seasons for ground level respectively. Figure 7 shows the summer season results for elevated levels.

6.2.1 Pedestrian Comfort

With the Proposed Development built out, wind conditions would be slightly windier than the baseline scenario locally around the Proposed Development. Wind conditions would range from suitable for sitting to strolling use during the windiest season, with conditions during the summer season generally one category calmer due to the calmer winds experienced during this time of year.

Thoroughfares (Figure 5)

Wind conditions on thoroughfares would range from suitable for sitting to strolling use during the windiest season, with conditions materially the same as the baseline scenario. Thoroughfares around the Proposed Development would be suitable for the intended use.

Entrances (Figure 5)

Entrances to the Proposed Development would have wind conditions ranging from suitable for sitting to standing use during the windiest season, suitable for the intended use. Off-Site entrances would also have wind conditions suitable for sitting use during the windiest season.

The reallocated entrances would have probes covering the area and would have wind conditions suitable for sitting use during the windiest season, suitable for the intended use.

Bus Stops (Figure 5)

Existing bus stops on Friar Street would have the same windier conditions as Configuration 1, ranging from suitable for sitting to standing use during the windiest season.

Ground Level Amenity (Figure 6)

Wind conditions at existing ground level seating on Friar Street (measurement location 42) would be suitable for sitting use during the summer season, suitable for the intended use.

Terrace Amenity (Figure 7)

Wind conditions at terrace levels would range from suitable for sitting to standing use during the summer season. Standing conditions would occur at seating on the 7th floor terrace, represented by measurement location 125, which would be one category windier than suitable for a seating area. The post-assessment amendments to the Proposed Development discussed in section 3.2 include an open louvered plant screen in front of measurement location 125; this would be expected to provide beneficial shelter and result in suitable wind conditions, requiring no further mitigation measures.

The reallocated seating areas at the terrace levels would have wind conditions range from suitable for sitting to standing use during the summer season. Standing conditions would still occur at seating on the 7th floor terrace, represented by measurement location 125, which would be one category windier than suitable for a seating area. As discussed in the above paragraph, the post-assessment amendments would result in suitable wind conditions, requiring no further mitigation measures.

Balconies (Figure 7)

All balconies at the Proposed Development would have wind conditions suitable for sitting use during the summer season. These wind conditions would be appropriate for private amenity use.

6.2.2 Strong Winds

There would be no instances of strong winds exceeding the safety threshold in this configuration.

6.3 Configuration 3: Proposed Development with Cumulative Surrounding Buildings

The following discussion of the wind microclimate is based on the results shown in Figures 8 and 9 during the windiest and summer seasons for ground level respectively. Figure 10 shows results for the elevated levels during the summer season. This configuration includes the following consented developments that have been identified within 360m radius centred at the Proposed Development:

- Reading Station Hill (Planning Ref:201537);
- Station Hill Reading (Planning Ref: 201536);
- 52-55 Friar Street (Planning Ref: 162210);
- 29-35 Station Road (Planning Ref: 181930);

- Broad Street Mall (Planning Ref: 182137);
- 20 Hosier Street (Planning Ref: 182054);
- Weldale Street (Planning Ref: 170326); and
- Bristol and West Arcade (Planning Ref: 180358).

6.3.1 Pedestrian Comfort

The introduction of the cumulative surrounding buildings would provide some shelter to the south-west of the Site during the windiest season. There would however be isolated locations on Garrard Street (measurement locations 100 and 101) which would become one category windier than in the context of the existing surrounding buildings, with strolling use conditions during the windiest season. Wind conditions would range from suitable for sitting to strolling use during the windiest season and from sitting to standing use during the summer season.

Thoroughfares (Figure 8)

The majority of wind conditions on thoroughfares would range from sitting to standing use during the windiest season, suitable for the intended use. The exception to this would be on Garrard Street to the north-east of the Site at the north-western corner of Garrard House (measurement location 101). Wind conditions would be suitable for strolling use during the windiest season which would remain suitable for a pedestrian thoroughfare.

Entrances (Figure 8)

Entrances to the Proposed Developed would have wind conditions suitable for sitting use during the windiest season, suitable for the intended use. Off-Site entrances would also have conditions suitable for sitting use during the windiest season, suitable for the intended use.

The reallocated entrances would have probes covering the area and would have wind conditions suitable for sitting use during the windiest season, suitable for the intended use.

Bus Stops (Figure 8)

Bus stops on Friar Street would have the same wind conditions as in Configuration 2, ranging from suitable for sitting to standing use during the windiest season.

Ground Level Amenity (Figure 9)

Wind conditions at ground level amenity spaces on Friar Street and within the neighbouring Station Hill south development would be suitable for sitting use during the summer season. These conditions would be suitable for amenity use.

Roof Terrace Amenity (Figure 10)

Wind conditions at roof terraces would be suitable for sitting use during the summer season. Therefore, no mitigation measures would be required when the cumulative schemes are in situ.

The reallocated seating areas at the terraces levels would have wind conditions range from suitable for sitting use during the summer season when the cumulative schemes are in situ, thus no mitigation measures required.

Balconies (Figure 7)

All balconies at the Proposed Development would have wind conditions suitable for sitting use during the summer season. Sitting use conditions would be appropriate for private balcony amenity spaces.

6.3.2 Strong Winds

There would be no instances of strong winds exceeding the safety threshold in this configuration.

7 WIND MITIGATION AND POST-ASSESSMENT AMENDMENTS

Further to wind tunnel testing of the Proposed Development, amendments have been proposed that would have the potential to influence the outcomes of the wind microclimate assessment. RWDI understand the following changes have been made to the Proposed Development:

- Addition of a one storey tall massing at the north-eastern corner at ground level;
- Implementation of an open louvered plant screen on the 7th floor terrace;
- Relocated the entrances from north to the southern and western façade of the Development;
- Seating locations at the roof level terrace location moved; and
- Removal of several upper-level balconies between levels 7 – 10 on the southern, western and eastern façades.

The wind tunnel assessment was carried out for three configurations devoid of landscaping scheme in order to provide a worst-case (i.e. windy) scenario at the Site. The assessment identified the terrace amenity seating on the 7th floor (represented by location 125) would be one category windier than suitable for the intended use in the summer season. However, further to the assessment, amendments to the Proposed Development would include the implementation of a louvred plant screen within the 7th floor terrace. In conjunction with the proposed landscaping scheme, this would be expected to provide beneficial shelter at measurement location 125, therefore requiring no further mitigation measures.

An additional single storey tall massing located at the north-eastern corner of Site at ground level has been introduced subsequent to the wind tunnel testing. This additional massing would not be expected to materially change wind conditions, as the scale of the building is small and would not be expected to substantially influence wind conditions, which would be expected to remain similar to those in the absence of the additional massing. Wind conditions would therefore be expected to remain suitable for sitting use during the windiest season.

These additional changes would not be expected to change the wind conditions materially and would likely be suitable for the intended use with the proposed landscaping scheme in place.

8 CONCLUSIONS

In conclusion:

- The meteorological data for the Site indicates prevailing winds from the south-west quadrant throughout the year with secondary winds from the north-east which are more prevalent during the spring months.
- In the Baseline scenario (Configuration 1), wind conditions would range from suitable for sitting to standing use during the windiest season. During the summer season, wind conditions would generally be one category calmer and thus a larger area of the Site would fulfil the sitting use criteria.
- With the Proposed Development built out, wind conditions on Friar Street, Merchant Place and Garrard St would be similar to those at the existing Site with no potential safety concerns for cyclists or more vulnerable pedestrians. As such, wind conditions at the Proposed Development would be suitable for the intended use at ground level throughout the year. At elevated levels, whilst the majority of terraces and balconies would have suitable wind conditions, there would be seating at the 7th floor terrace with wind conditions one category windier than suitable. However, the inclusion of a proposed louvred plant screen and the proposed landscaping scheme would be expected to provide beneficial shelter and result in suitable wind conditions at this terrace space. No further mitigation measures would be required.
- The introduction of the Cumulative surrounding buildings would improve wind conditions around the majority of the Site, however, windier conditions would occur north-east of the Site on Garrard Street. Wind conditions would, however, range from suitable for sitting to strolling use during the windiest season and therefore all locations at ground and elevated levels would have suitable wind conditions, with no potential safety concerns for more vulnerable pedestrians or cyclists.
- Overall, wind conditions with the introduction of the Proposed Development would be relatively calm, with no safety concerns. There would be one seating location at the 7th floor terrace with windier than suitable conditions; however, this would be resolved through the implementation of the proposed louvred plant screen and proposed landscaping scheme. All locations would have suitable wind conditions with the amendments to the scheme and no further assessment or mitigation would be required.

9 STATEMENT OF LIMITATIONS

This report entitled Pedestrian Level Wind Microclimate Assessment dated June 23rd June, 2023, was prepared by RWDI for Shaviram Group ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the development described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final design stage to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilise the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

FIGURES





LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 1: Existing Site with Existing Surrounding Buildings

Windiest Season

2200857 35-39 Friar Street - Reading, UK



Figure: 3



LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 1: Existing Site with Existing Surrounding Buildings

Summer Season

2200857 35-39 Friar Street - Reading, UK



Figure: 4



LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 2: Proposed Development with Existing Surrounding Buildings

Windiest Season

2200857 35-39 Friar Street - Reading, UK



Figure: 5



LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 2: Proposed Development with Existing Surrounding Buildings

Summer Season

2200857 35-39 Friar Street - Reading, UK



Figure: 6



LDDC COMFORT CATEGORIES:

- Sitting ————
- Standing ————
- Strolling ————
- Walking ————
- Uncomfortable ————

Pedestrian Wind Comfort Conditions - Elevated Levels
Configuration 2: Proposed Development with Existing Surrounding Buildings
Summer Season
2200857 35-39 Friar Street - Reading, UK



Figure: 7



LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

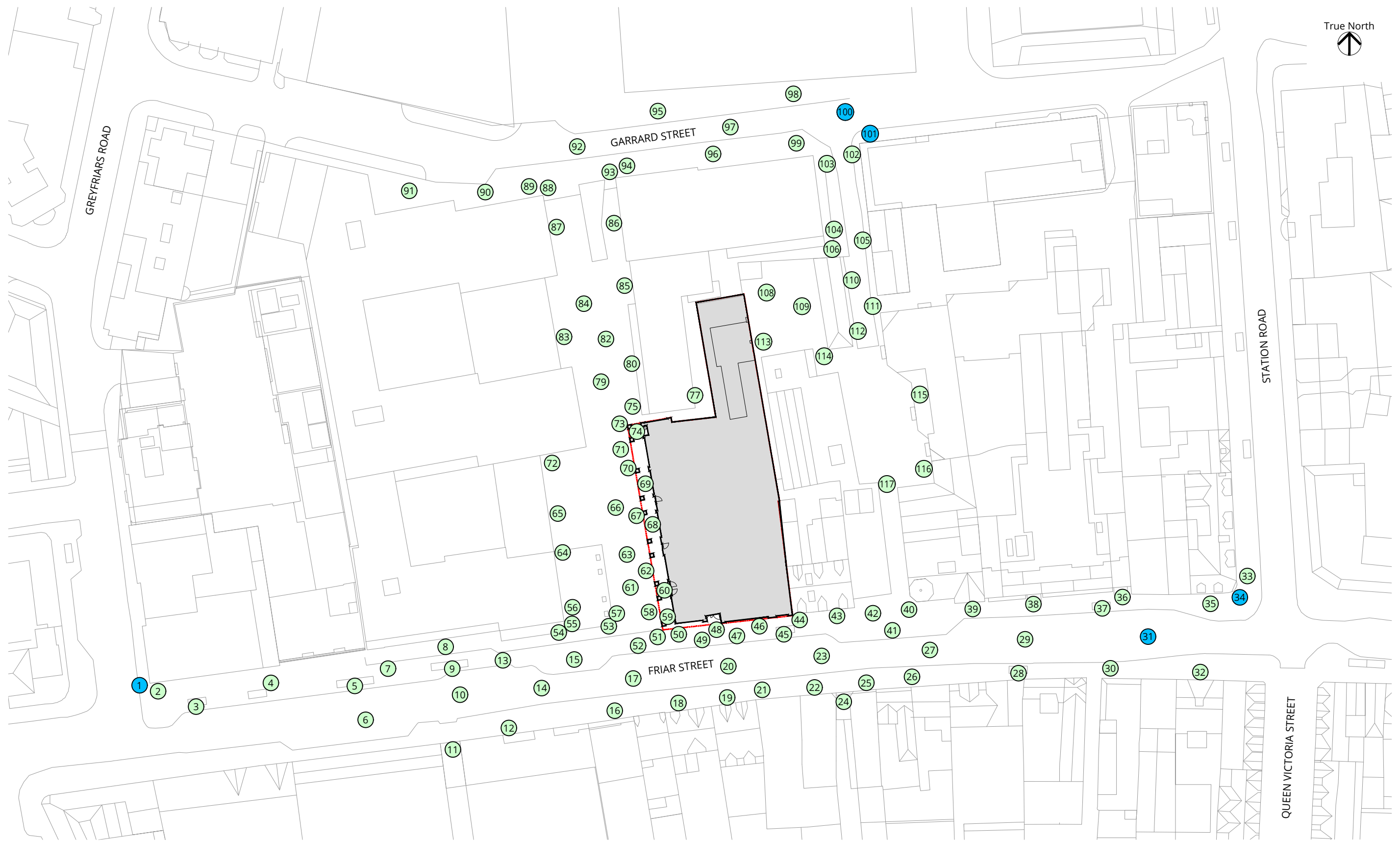
Configuration 3: Proposed Development with Cumulative Surrounding Buildings

Windiest Season

2200857 35-39 Friar Street - Reading, UK



Figure: 8



LDDC COMFORT CATEGORIES:

Sitting	
Standing	
Strolling	
Walking	
Uncomfortable	

Pedestrian Wind Comfort Conditions - Ground Floor

Configuration 3: Proposed Development with Cumulative Surrounding Buildings

Summer Season

2200857 35-39 Friar Street - Reading, UK



Figure: 9



LDDC COMFORT CATEGORIES:

- Sitting ————
- Standing ————
- Strolling ————
- Walking ————
- Uncomfortable ————

Pedestrian Wind Comfort Conditions - Elevated Levels

Configuration 3: Proposed Development with Cumulative Surrounding Buildings

Summer Season

2200857 35-39 Friar Street - Reading, UK



Figure: 10

APPENDIX A



APPENDIX A: WIND TUNNEL PHOTOS

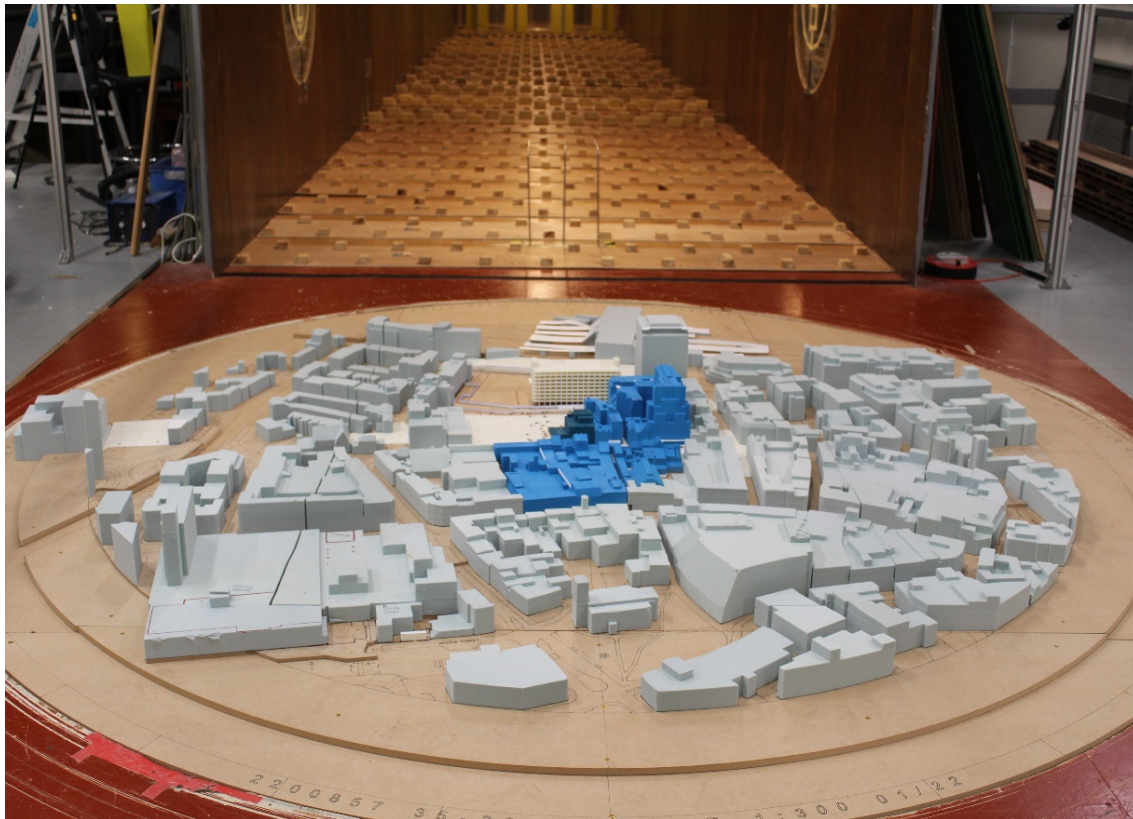


Figure 11: Existing Site with Existing Surrounding Buildings (Configuration 1) – View in the Wind Tunnel (from the south)

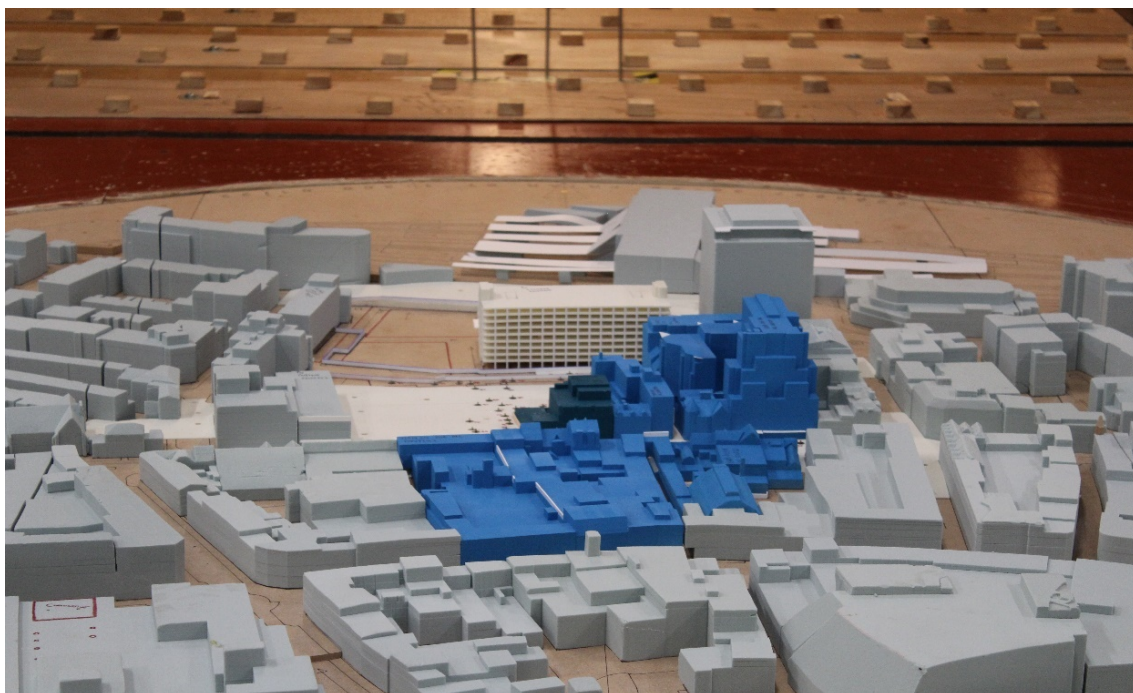


Figure 12: Existing Site with Existing Surrounding Buildings (Configuration 1) – View in the Wind Tunnel (from the south)



Figure 13: Proposed Development (in Red) with Existing Surrounding Buildings (Configuration 2) – View in the Wind Tunnel (from the south)

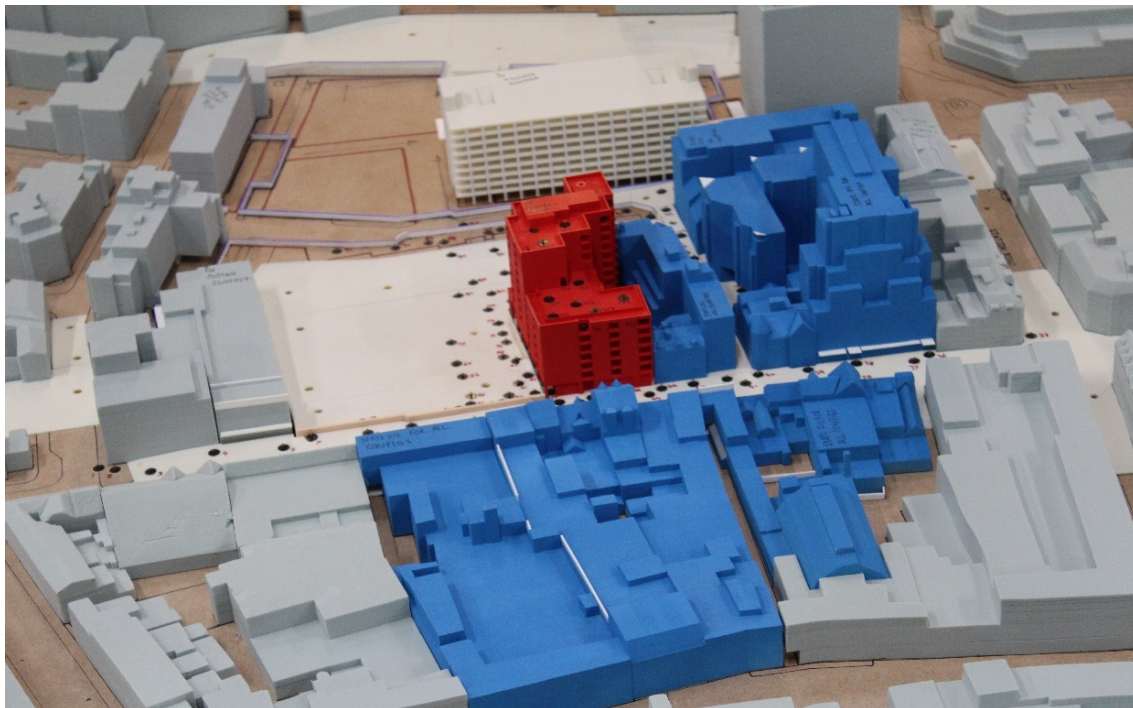


Figure 14: Proposed Development (in Red) with Existing Surrounding Buildings (Configuration 2) – View in the Wind Tunnel (from the south)



Figure 15: Proposed Development with Cumulative Surrounding Buildings (Configuration 3) - View in the Wind Tunnel (from the south)



Figure 16: Proposed Development with Cumulative Surrounding Buildings (Configuration 3) - View in the Wind Tunnel (from the south)

APPENDIX B



APPENDIX B: METEOROLOGICAL DATA

Table 3: BREVe3 mean factors at 120m above ground level

Wind Direction	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°
Mean Factor at 120 m	1.412	1.423	1.437	1.425	1.391	1.451	1.459	1.507	1.455	1.411	1.406	1.397

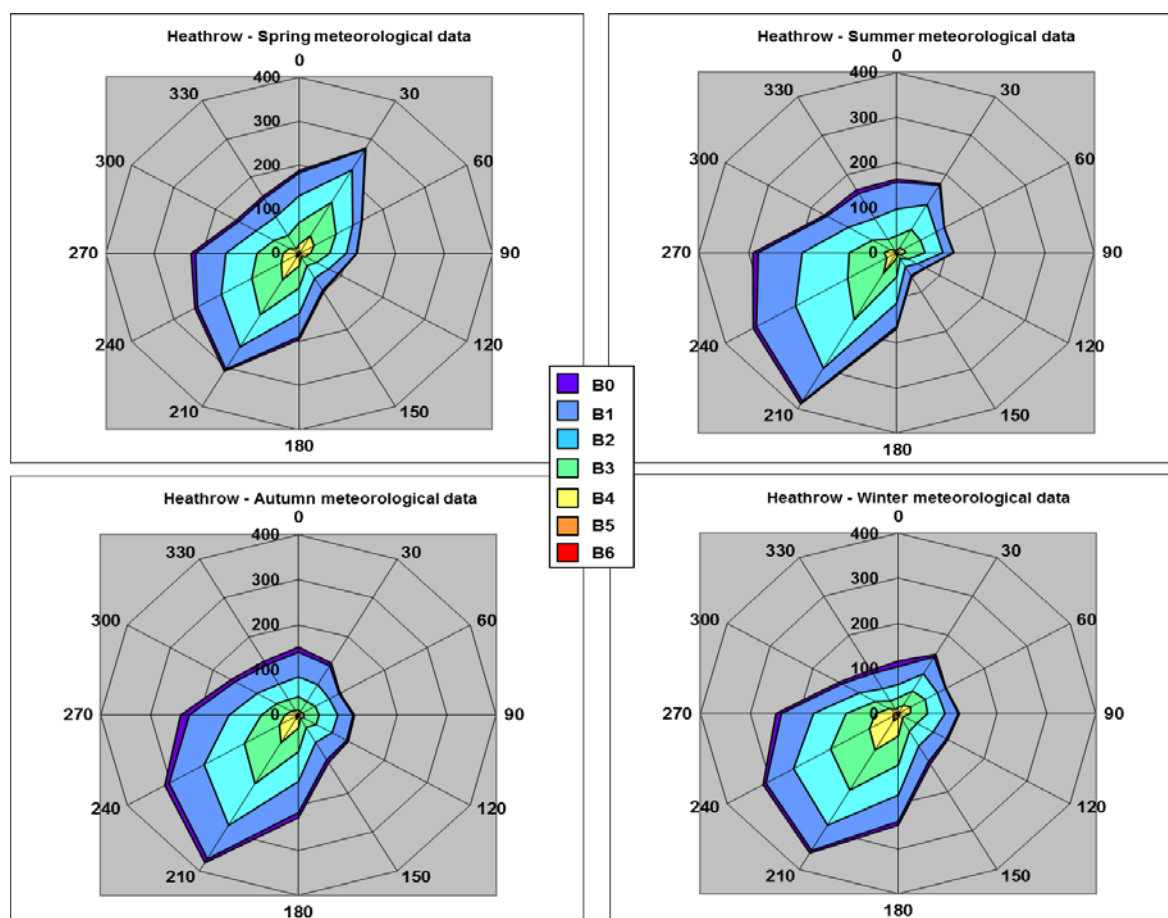


Figure 17: Seasonal wind roses for London Heathrow Airport (in Beaufort Force) - (Radial axis indicates the hours for which the stated Beaufort Range is exceeded)

APPENDIX C



APPENDIX C: UPDATED PROPOSED DEVELOPMENT

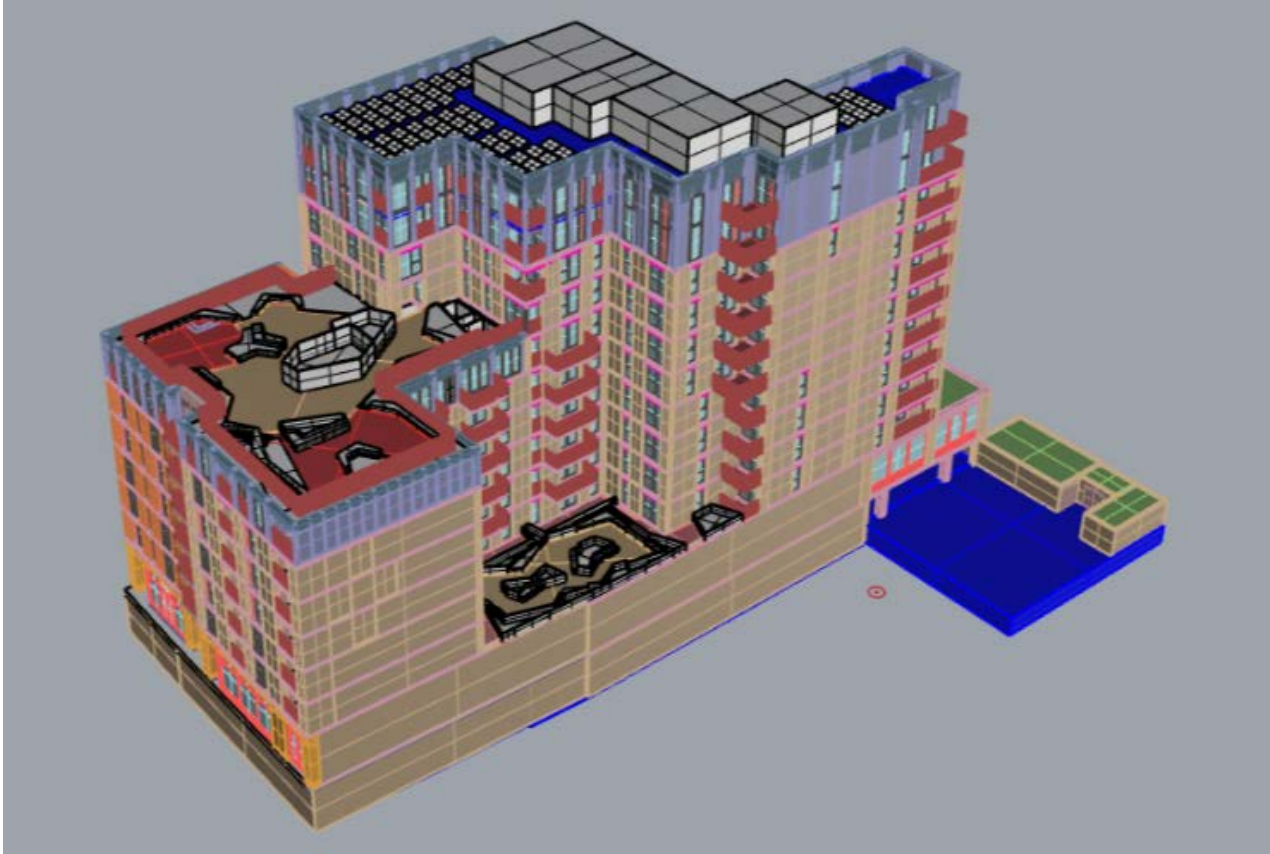


Figure 18: Updated Proposed Development received by RWDI on 18th April 2023