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12.1. INTRODUCTION

12.1.1 This report has been prepared by RWDI a specialist wind engineering consultant.

Scope of Assessment

12.1.2 The height of the Proposed Buildings is modest, in terms of wind, and consequently, a desk-based study by an experienced wind engineer was considered sufficient to determine the likely significant effects of the Proposed Development on the wind environment.

12.1.3 The wind assessment considers the background wind climate for the Site and then considers the proposed building massing in order to determine the likely wind microclimate classified in accordance with the widely accepted Lawson Comfort Criteria (see Table 12.1). The assessment considers both pedestrian comfort and the potential for strong winds. The main wind effects are expected within the Site and in the streets immediately surrounding the Site. Consequently, the key receptors would be pedestrians in these areas.

12.1.4 The assessment considers the likely wind environment at ground level around and within the Site. The assessment does not account for landscaping or planting. This is a precautionary approach intended to present a worst-case assessment, because the landscaping and/or planting would have a beneficial effect on wind microclimate.

Data Collection Methodology

12.1.5 The assessment has been informed by the use of:

- a. Professional experience of RWDI; a specialist wind consultant;
- b. Relevant meteorological data for the region obtained from London meteorological stations at Heathrow, Gatwick and Stansted; and

- c. Computer software, BREVe3.2 which models the effect of terrain roughness around the site on the wind characteristics in order to correct the meteorological data to the Site.

12.1.6 The expected wind conditions in and around the Development are described in terms of the Lawson Comfort Criteria, a well-established benchmark used to determine the suitability of the wind microclimate for various pedestrian activities.

Pedestrian Comfort Criteria

12.1.7 The assessment of the wind microclimate requires a 'benchmark' against which the conditions can be compared. The Lawson Comfort Criteria have been established for some thirty years and have been widely used on building developments across UK.

12.1.8 The Criteria (Table 12.1) set out six pedestrian activities and reflect the fact that less active pursuits require more benign wind conditions. The six categories are sitting, standing, entering/leaving a building, walking, business walking and roadway/car park. For each of these categories, a wind speed and frequency of occurrence threshold is defined, beyond which conditions are described as unacceptable for the stated activity. If conditions are below the threshold, then they are described as tolerable (or suitable). It is expected that tolerable conditions will not affect the amenity of a location, whereas unacceptable wind conditions will lead to pedestrians not using an area for its intended purpose and complaints of wind nuisance. An unacceptable result implies that remedial action should be taken to mitigate wind conditions, or that the proposed pedestrian activity at that location should be redefined.

12.1.9 The Criteria are derived for open air conditions where it is expected that pedestrians will be suitably dressed for the season. Table 12.2 presents the Beaufort (B) Land Scale for wind on land.

Table 12.1: Pedestrian Comfort Criteria (Lawson)

Description	Threshold	Suitable Activity
Roads and Car Parks	6% > B5	open areas where pedestrians are not expected to linger
Business Walking	2% > B5	'purposeful' walking or where, in a business district, pedestrians may be more tolerant of the wind because their presence on site is required for work
Leisure Walking	4% > B4	strolling
Pedestrian Standing	6% > B3	waiting at bus-stops, window shopping etc
Entrance Doors	6% > B3	pedestrians entering/leaving a building
Sitting	1% > B3	long-term sitting, for example, sitting outside a café

Table 12.2: Beaufort Land Scale for Wind

Beaufort Force	Hourly Average Wind Speed (m/s)	Description of Wind	Noticeable Wind Effect
0	< 0.45	Calm	Smoke rises Vertically
1	0.45 – 1.55	Light Air	Direction shown by smoke drift but not by vanes
2	1.55 – 3.35	Light Breeze	Wind felt on face; leaves rustle; wind vane moves
3	3.35 – 5.60	Gentle Breeze	Leaves and twigs in motion; wind extends a flag
4	5.60 – 8.25	Moderate Breeze	Raises dust and loose paper; small branches move
5	8.25 – 10.95	Fresh Breeze	Small trees, in leaf, sway
6	10.95 – 14.10	Strong Breeze	Large branches begin to move; telephone wires whistle
7	14.10 – 17.20	Near Gale	Whole trees in motion
8	17.20 – 20.80	Gale	Twigs break off, personal progress impeded
9	20.80 – 24.35	Strong Gale	Slight structural damage; chimney pots removed
10	24.35 – 28.40	Storm	Trees uprooted; considerable structural damage
11	28.40 – 32.40	Violent Storm	Damage is widespread; unusual in the UK
12	>32.40	Hurricane	Countryside is devastated; only occurs in tropical countries

12.1.10 The description of expected wind conditions is based upon the worst-case (generally winter time) season. Experience, gained from conducting hundreds of wind tunnel tests on other schemes, has shown that wind conditions during the summer are typically one category calmer than the classification in the winter because the winds are lighter in the summer. For example, worst case 'leisure walking' conditions become 'pedestrian standing' during the summer.

Strong Wind

12.1.11 Lawson also specifies a lower limit strong wind criterion when the wind speed exceeds the lower wind speed threshold of Beaufort Force 6 (B6). Exceeding this wind speed may indicate a need for remedial measures or a careful assessment of the expected use of that location (e.g. is it reasonable to expect elderly or very young pedestrians to be present at the location on the windiest day of the year).

12.1.12 In the UK, stronger winds are associated with the business walking and car park/roadway classifications of the comfort criteria, which would usually require mitigation in a mixed-use urban development to achieve adequate pedestrian comfort. Consequently, the same mitigation would also reduce or eliminate occurrences of strong winds.

Significance Criteria

12.1.13 The significance criteria are defined, and outlined in Table 12.3 below

Table 12.3: Significance Criteria

Significance Criterion	Description
Adverse Impact of Significant Significance	Wind conditions are 3-steps windier than desired
Adverse Impact of Moderate Significance	Wind conditions are 2-steps windier than desired
Adverse Impact of Low Significance	Wind conditions are 1-step windier than desired
Neutral	Wind conditions are similar to those desired
Beneficial Impact of Low Significance	Wind conditions are 1-step calmer than desired
Beneficial Impact of Moderate Significance	Wind conditions are 2-steps calmer than desired
Beneficial Impact of Significant Significance	Wind conditions are 3-steps calmer than desired

12.1.14 If the desired wind conditions at a particular location are required to be suitable for standing, but the expected wind conditions are identified as being suitable for leisure walking, the difference between the desired and expected wind

condition is 1-step windier than desired. In this case the potential impact would be identified as being adverse, and of low significance.

12.1.15 An adverse impact implies that the wind microclimate would be windier than desired for the intended pedestrian activity whereas a beneficial impact implies that the wind conditions are calmer than required. This is a simple logical means of relating the measured wind microclimate to the desired pedestrian use of an area using the Lawson Comfort Criteria.

Target Wind Conditions

12.1.16 For a mixed-use development in an urban area the target wind microclimate would typically be suitable for leisure walking on main thoroughfares and standing/entrance use at entrances, bus-stops and taxi ranks throughout the year. In other words these areas/activities need to be carried out even during the windiest season

12.1.17 Where there are amenity areas, such as gardens, street benches, street cafes, these should target sitting conditions during the summer months because these areas are expected to be used more frequently by residents/pedestrians in the summer. Achieving the sitting classification in the summer means that these same areas would usually be suitable for standing in the windiest season because of the stronger winds that occur in the winter. In the UK, this situation is considered acceptable as there are usually other climatic factors, such as air temperature and precipitation which influence expectations about the 'usability' of amenity areas in the winter

12.2. POLICY CONTEXT

National Planning Policy

National Planning Policy Framework 2012

12.2.1 There are no policies or statements directly relating to wind microclimate issues; however the benefits of a high quality built environment are emphasised in the NPPF. For example, paragraph 58 states the following: “... *using streetscapes and buildings to create attractive and comfortable places to live, work and visit...*”

Regional Planning Policy

The London Plan Spatial Development Strategy for Greater London, July 2011

12.2.2 Guidance within The London Plan¹ places great importance on the creation and maintenance of a high quality environment for London. As such Policy ‘7.6B - Architecture’ states that: “..*building and structures should:*

a. be of the highest architectural quality;

b. be of a proportion, composition, scale and orientation that enhances, activates and appropriately encloses the public realm; ...

d. not cause unacceptable harm to the amenity of surrounding land and buildings, particularly residential buildings, in relation to privacy, overshadowing, wind and microclimate;

e. incorporate best practice in resource management and climate change mitigation and adaptation;

¹ Greater London Authority, 2011. The London Plan, Spatial Development Strategy for Greater London. Greater London Authority, London.

f. provide high quality indoor and outdoor spaces and integrate well with the surrounding streets and open spaces; and

g. be adaptable to different activities and land uses, particularly at ground level.”

12.2.3 In addition, Policy '7.7 - Location and Design of Tall and Large Buildings' states that:

“A - Tall and large buildings should be part of a plan-led approach to changing or developing an area by the identification of appropriate, sensitive and inappropriate locations. Tall and large buildings should not have an unacceptably harmful impact on their surroundings.

B - Applications for tall or large buildings should include an urban design analysis that demonstrates the proposal is part of a strategy that will meet the criteria below. This is particularly important if the site is not identified as a location for tall or large buildings in the borough's LDF.

C - Tall and Large Buildings should:...

b. only be considered in areas whose character would not be affected adversely by the scale, mass or bulk of a tall or large building;...

f. have ground floor activities that provide a positive relationship to the surrounding streets;

D - Tall buildings:

a. should not affect their surroundings adversely in terms of microclimate, wind turbulence...”.

Revised Alterations to the London Plan, October 2013

12.2.4 The revised alteration to the London plan makes no reference to the wind microclimate.

Sustainable Design and Construction Supplementary Planning Guidance, 2006

12.2.5 Within the Sustainable Design and Construction Supplementary Planning Guidance (SPG)², Section 2.4.5 'Microclimate' stipulates that a wind environment assessment should be carried out for tall buildings. The section advises that a tall building is over 10-storeys in height and that the results of the assessment should show that the Lawson comfort criteria can be met. In addition, the SPG indicates that the preferred outcome is that the wind impacts on neighbouring surrounding buildings should be negligible implying no significant change in the wind conditions.

12.2.6 It goes on to state that the wind microclimate assessment should be designed to predict the wind velocities occurring in the public realm and accessible landscaped areas, for comparison against the Lawson Criteria. The Lawson Criteria defines acceptable windiness for different activities such as sitting, walking and standing. Section 2.4.5 also recommends well-designed landscaping to reduce wind speeds.

Sustainable Design and Construction Supplementary Planning Guidance Draft, 2013

12.2.7 The Sustainable Design and Construction SPG states, in section 2.3.7, that 'Large buildings have the ability to alter their local environment and affect the micro-climate. For example, not only can particularly tall buildings cast a long shadow effecting buildings several streets away, they can influence how wind travels across a site, potentially making it unpleasant at ground level or limiting the potential to naturally ventilate buildings. One way to assess the impact of a

² Greater London Authority, 2006. Sustainable Design and Construction, The London Plan Supplementary Planning Guidance. GLA, London.

large building on the comfort of the street environment is the Lawson Comfort Criteria. This tool sets out a scale for assessing the suitability of wind conditions in the urban environment based upon threshold values of wind speed and frequency of occurrence. It sets out a range of pedestrian activities from sitting through to crossing the road and for each activity defines a wind speed and frequency of occurrence. Where a proposed development is significantly taller than its surrounding environment, developers should carry out an assessment of its potential impact on the conditions at ground level, and ensure the resulting design of the development provides suitable conditions for the intended uses.'

Local Planning Policy

London Borough of Richmond up Thames: Local Development Scheme

12.2.8 There are no references to wind microclimate in this document.

London Borough of Richmond up Thames: Core Strategy

12.2.9 There are a number of generic references which could be interpreted to relate to wind microclimate, e.g. **8.2.2 CP8 Town and Local Centres** '... The Council will improve the local environment to provide centres which are comfortable, attractive and safe for all users ...'.

12.2.10 But otherwise no specific references to wind environment.

London Borough of Richmond up Thames: Adopted Development Management Plan (DMP)

12.2.11 In policy DM DC3: Tall Buildings, the following is stated, '...include safe, attractive, comfortable and accessible amenity/open spaces designed to support social interaction and engender a sense of place...'

12.2.12 But otherwise no specific references to wind environment.

12.3. BASELINE CONDITIONS

Meteorological Data

12.3.1. As shown in Figure 12.1, the prevailing winds are from the south-west which is typical of much of the southern UK. The prevailing winds typically account for around 45% of all wind for the southern part of the UK. There is a cold, secondary wind from the north-east during late spring.

12.3.2. The general meteorological data must be adjusted to account for the reduction in wind speed and increased gustiness that occurs as wind blows into built-up areas. To account for the difference in terrain roughness (i.e. physical obstacles such as hedges, trees and buildings) between the standard meteorological conditions and the Site it is necessary to apply correction factors. Correction factors were computed using the BREVe3 software program for wind directions from 0° through to 330° in 30° increments. The BREVe3 output, i.e. following the application of correction factors for the Site, is summarised in Table 12.4.

Figure 12.1: Meteorological Data (Wind Roses) for London

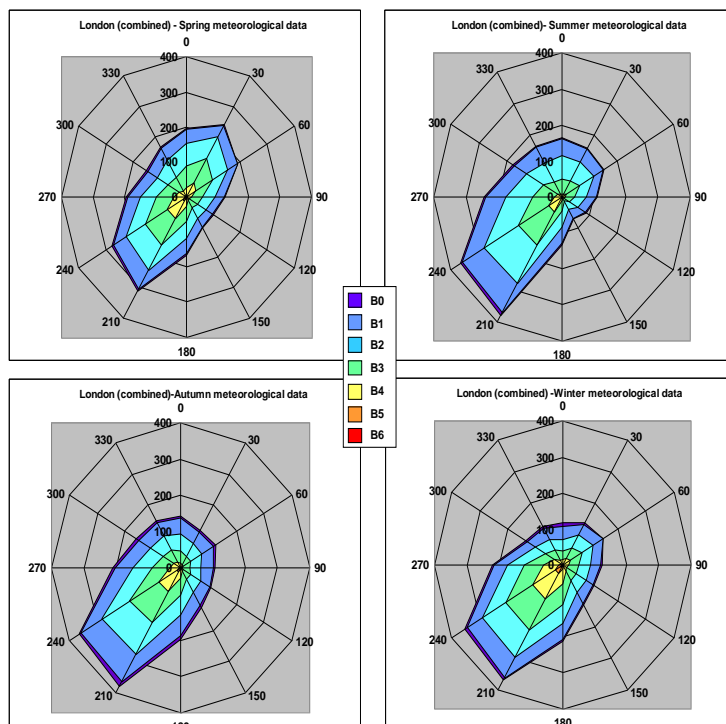


Table 12.4: Terrain Adjustment Factors (Mean Factors)

Height	Wind Direction (degrees east of north)											
	0	30	60	90	120	150	180	210	240	270	300	330
2m	0.58	0.43	0.44	0.43	0.42	0.61	0.73	0.62	0.58	0.42	0.42	0.42
10m	0.89	0.79	0.81	0.80	0.77	0.85	1.01	0.86	0.81	0.79	0.78	0.77

12.3.3. The 'mean factors' for the Site, represent the ratio of wind speed on the Site, at the stated reference height, as a fraction of the wind speed in open, flat countryside at a height of 10m. The mean factors for the Site at 10m above ground for all directions cover a range from 0.77 to 1.01. The former reflects the urban terrain whereas the latter implies an increased exposure when wind blows from the south.

12.4. PREDICTING THE IMPACTS OF DEVELOPMENT

12.4.1 For the wind microclimate the main impacts are generated by the massing of the Proposed buildings and because the buildings are relatively low-rise, the wind impacts are therefore confined to the Site and immediate surrounding streets. All wind impacts are therefore local in terms of their geographical importance.

12.4.2 Once the Proposed Development is operational, the wind regime will be fixed unless there is a change in the background climate or a change in the form of the surrounding buildings. The impacts are therefore considered to be Long-term.

12.4.3 The Proposed Development makes the Site more permeable to the wind because the buildings are aligned to create 'avenues' between the buildings which connect Broom Road with the riverside. The predominance of the south westerly winds means that the west-facing and south-west facing corners of the buildings and the openings through or between buildings are likely to be the windier zones. However, because of the heights of the buildings are modest from the perspective of wind microclimate, the windier areas are expected to be suitable for leisure walking during the windiest season.

12.4.4 The overall wind microclimate for the Proposed Development is summarised in Figure 12.2 for the windiest season.

Figure 12.2: Ground Level Wind Environment (Windiest Season)



Thoroughfares

- 12.4.5 The wind microclimate on thoroughfares across the Proposed Development is suitable for either leisure walking, standing or sitting during the windiest season (Figure 12.2). The northwest elevation of Building A is exposed to south westerly winds; these will be directed northwards, by Building A, to accelerate around the northwest corner whereas the difference in pressure between the northwest and southeast elevations will cause wind to blow through the ground level opening in this Building. In both these areas the wind environment is classified as suitable for leisure walking
- 12.4.6 For similar reasons there are windy corner zones associated with the Villa Buildings (E) and Building D
- 12.4.7 The leisure walking, standing and sitting classifications represent **Neutral, Low Beneficial** and **Moderate Beneficial** impacts respectively. The wind environment would be suitable for or calmer than required for people to walk comfortably around the Proposed Development

Entrances

- 12.4.8 The entrance locations are identified in Figure 12.2 by the orange dots. All the entrances are in areas where the wind environment is classified as suitable for sitting or standing. The entrances to the easternmost residences in the two Villa blocks are adjacent to a 'Leisure Walking' corner zone. However, the entrances are slightly set-back and so locally, conditions are expected to be suitable for an entrance in the windiest season
- 12.4.9 All of the entrances to the buildings are therefore considered to be in areas where the wind microclimate is suitable for standing/entrance use or sitting (blue and green zones in Figure 12.2). These results represent **Neutral** and **Low Beneficial** impacts respectively.

Amenity Areas

12.4.10 The spaces between the buildings and around the Site are landscaped to varying degrees and accessible to residents

12.4.11 The Proposed Development is more open than the existing massing, with ‘avenues’ between the buildings that connect the river to the Broom Road elevation of the Site. Consequently, the riverside elevation is likely to be windier than at the current time.

12.4.12 The wind environment shown in Figure 12.2 is for the windiest season; from experience, the lighter winds that blow in the summer typically produce a one category calming of the wind environment. This means that the majority of the Site is expected to be suitable for sitting with standing conditions in the windier zones (shown in yellow in Figure 12.2).

12.4.13 This predominance of sitting conditions implies that most of the open space around the Site would be compatible with sedentary activity such as long-term sitting in the summer. This represents a **Neutral** impact.

12.4.14 The summary of these impacts is provided in Table 12.5.

Table 12.5: Summary of Impacts

Topic Area (Wind)	Description of Impact	Geographical Importance					Impact	Nature	Significance Before Mitigation
		N	R	S	D	L			
Heading - Thoroughfares - Entrances - Amenity Areas	During Construction					*	At worst Neutral	Short Term	At worst No effect
Heading - Thoroughfares - Entrances - Amenity Areas	Post Development					*	Neutral to Beneficial	Long Term	- No effect to Moderate Beneficial
						*	Neutral to Beneficial		- No effect to Low Beneficial
						*	Neutral to Beneficial		- No effect

KEY:

Geographical Level of Importance	Impact	Nature of Impact	Significance
National	Adverse	Long Term	Significant
Regional	Neutral	Short Term	Moderate
Sub-Regional	Beneficial		Low
District			No Effect
Local			

12.5. MITIGATION

Construction

12.5.1 Demolition of the existing buildings would create an open Site and so areas downwind of the Site will be windier when buildings are cleared. However, the Site hoardings will provide localised shelter to pedestrians walking past the site.

12.5.2 There are no recommendations for mitigation during the construction of the Development.

Completed Development

12.5.3 The wind environment is expected to be suitable of calmer than required for the desired pedestrian use of the site. There are no recommendations for further mitigation. However, it is noted that the proposed landscape plan will provide additional, beneficial shelter during the summer when trees are established and in-leaf.

12.6. RESIDUAL IMPACTS

Construction

12.6.1 There are no recommendations for mitigation during construction and so the residual impacts are the same as the potential impacts reported in the previous section of this report. They are summarised in Table 12.6.

Completed Development

12.6.2 There are no recommendations for mitigation for the completed development and so the residual impacts are the same as the potential impacts reported in the previous section of this report. They are summarised in Table 12.6.

Table 12.6: Summary of Residual Impacts

Topic Area (Wind)	Description of Impact	Geographical Importance					Impact	Nature	Significance After Mitigation
		N	R	S	D	L			
Heading - Thoroughfares - Entrances - Amenity Areas	During Construction					*	At worst Neutral	Short Term	At worst No effect
Heading - Thoroughfares - Entrances - Amenity Areas	Post Development					*	Neutral to Beneficial	Long Term	- No effect to Moderate Beneficial
						*	Neutral to Beneficial		- No effect to Low Beneficial
						*	Neutral to Beneficial		- No effect

KEY:

Geographical Level of Importance	Impact	Nature of Impact	Significance
National	Adverse	Long Term	Significant
Regional	Neutral	Short Term	Moderate
Sub-Regional	Beneficial		Low
District			No Effect
Local			

12.7. CUMULATIVE IMPACTS

Construction

12.7.1 There are no impacts due to cumulative buildings that are expected to alter the wind environment at the Site. Cumulative impacts are expected to be the same as the residual impacts.

Completed Development

12.7.2 There are no impacts due to cumulative buildings that are expected to alter the wind environment at the Site. Cumulative impacts are expected to be the same as the residual impacts.

12.8. SUMMARY AND CONCLUSIONS

- 12.8.1 The meteorological data for the Site indicate prevailing winds from the southwest throughout the year and a secondary wind from the northeast which is most prevalent in the spring.
- 12.8.2 The background exposure of the Site to wind broadly reflects the urban surroundings but there is an increased exposure at low level to winds that blow from the south because of the adjacent playing fields. For the existing site the wind microclimate at ground level is expected to be generally suitable for standing during the windiest season but with leisure walking in the vicinity of the west-facing corners of the existing buildings.
- 12.8.3 For the Proposed Development the wind microclimate at ground level during the windiest season is classified as suitable for leisure walking, standing or sitting.
- 12.8.4 In the windiest season, all the thoroughfares are expected to have a wind microclimate that would be suitable for, at least, leisure walking which is compatible with the target condition for thoroughfares.
- 12.8.5 In the windiest season, all the entrances to the buildings are expected to have a wind microclimate that would be suitable for, at least, standing/entrance use, which is compatible with the target condition outside an entrance.
- 12.8.6 In the summer season, considered to be the season when people most expect to be able to sit comfortably in gardens, the Site is expected to have a wind microclimate that would be suitable for sitting in the garden areas and along the riverfront, which is compatible with the target condition for amenity areas.
- 12.8.7 The wind impacts are therefore **Neutral** where the expected wind environment matches the target condition, **Low Beneficial** or **Moderate Beneficial** in areas which are calmer than the target environment.