Appendix: Daylight, Sunlight, Overshadowing, Light Pollution and Solar Glare

Annex 2

Methodology and Baseline

Methodology

Approach for Daylight, Sunlight, Overshadowing and Light Pollution Assessments

The technical analyses carried out to inform the assessments have been undertaken by creating a digital three dimensional (3D) model of the existing site and Proposed Development, based on measured survey data.

Daylight

Vertical Sky Component

The VSC method of assessment is defined in the BRE Guidelines as the:

> *"ratio of that part of illuminance at a point on a given vertical plane that is received directly from a CIE standard overcast sky, to illuminate on a horizontal plane due to an unobstructed hemisphere of this sky".*

The 3D model uses Waldram Diagrams to establish the VSC and 3D geometric calculations for daylight distribution. This model (which is orientated to north by the use of Ordnance Survey (OS) information) enables the path of the sun to be tracked throughout the year to establish the shadow cast by the existing and proposed buildings, and thus calculate the sun hours on ground in each scenario.

Only those surrounding properties which have windows facing towards the application site were included in the assessment. If a nearby property has no windows facing the application site, these properties would not be affected by the Proposed Development in terms of light.

The assessment is calculated from the centre of a window on the outward face and measures the amount of light available on a vertical wall or window following the introduction of visible barriers, such as buildings.

The maximum VSC value is almost 40% for a completely unobstructed vertical wall or window. In terms of assessment criteria, the BRE Guidelines state that:

> *"If any part of a new building or extension, measured in a vertical section perpendicular to a main window wall of an existing building, from the centre of the lowest window, subtends an angle of more than 25° to the horizontal, then the diffuse daylighting of the existing building may be adversely affected. This will be the case if either:*
>
> - *the VSC measured at the centre of an existing main window is less than 27%, and less than 0.8 times its former value*
> - *the area of the working plane in a room which can receive direct skylight is reduced to less than 0.8 times its former value."*

No Sky Line

The BRE Guidelines state that where room layouts are known, the effect on the daylight distribution can be calculated by plotting the NSL. In terms of the surrounding receptors, it has not been possible to obtain room layouts for all of the properties and therefore layouts have been assumed where information is not available.

The NSL method is a measure of the distribution of daylight at the 'working plane' within a room. The 'working plane' is a horizontal plane 0.85m above finished floor level for residential properties. The NSL divides those areas of the working plane which can receive direct sky light from those which cannot. If a significant area of the working plane lies beyond the NSL (i.e. it receives no direct sky light), then the distribution of daylight in the room may be poor and supplementary electric lighting may be required.

Where actual room layouts were available, these have been considered in the modelling of the internal layouts within the surrounding properties. Obtaining these room layouts enables precise evaluation of the diffuse levels of daylight within each of the rooms via the NSL. Where layout information was not available assumptions have been made as to the use and internal configuration of the rooms (from external observations) behind the fenestration observed. In such

cases a standard 4.2m (14 ft) room depth has been assumed, unless the building form dictated otherwise. This is common practice where access to buildings for surveying is unavailable.

The potential effects of daylighting distribution in an existing building can be found by plotting the NSL in each of the main rooms. For houses, this will include living rooms, dining rooms and kitchens. Bedrooms should also be analysed, although they are less important. The BRE Guidelines identify that if the area of a room that does receive direct sky light is reduced to less than 0.8 times its former value, then this would be noticeable to its occupants.

In relation to deep rooms lit by windows on one side, the BRE Guidelines state (para. 2.2.10):

"If an existing building contains rooms lit from one side only and greater than 5 m deep, then a greater movement of the no sky line may be unavoidable."

Average Daylight Factor

The BRE Guidelines state the following in Appendix C:

"If a predominantly day lit appearance is required, then ADF should be 5% or more if there is no supplementary electric lighting, or 2% or more if supplementary electric lighting is provided. There are additional recommendations for dwellings of 2% for kitchens, 1.5% for living rooms and 1% for bedrooms. These additional recommendations are minimum values of Average Daylight Factor, and should be attained even if a predominantly day lit appearance is not achievable."

This method of assessment takes into account the total glazed area to the room, the visible light transmittance of the glazing proposed, the total area of the room surfaces including ceilings and floors, and the internal average reflectance for the room being assessed. The method also takes into account the VSC and the quantum of reflected light.

This is, therefore, a significantly more detailed method of assessment than the VSC method.

The BRE Guidelines state that this method of assessment for daylight should be applied to new developments rather than existing neighbouring buildings, unless the internal subdivision of the properties is known; whereby the ADF may be used to inform the light potential.

The ADF gives a more detailed assessment of the daylight within a room and takes into account the highest number of factors in establishing a quantitative output.

Sunlight

Annual Probable Sunlight Hours

APSH is measured using a sun indicator containing 100 spots, each representing 1% of APSH. Therefore, where no obstruction exists the total annual probable sunlight hours would amount to 1486 hours and therefore each spot equates to 14.86 hours of the total annual sunlight hours.

The number of spots is calculated for the baseline and Proposed Development scenarios during the year and also during the winter period, and a comparison made between the two. This provides a percentage of APSH for each window assessed.

The BRE Guidelines note that:

"In housing, the main requirement for sunlight is in living rooms, where it is valued at any time of day, but especially in the afternoon.";

"all main living rooms of dwellings…should be checked if they have a window facing within 90° of due south. Kitchens and bedrooms are less important, although care should be taken not to block too much sun.";

"If the main living room to a dwelling has a main window facing within 90° of due north, but a secondary window facing within 90° of due south, sunlight to the secondary window should be checked."; and

"…a south facing window will, in general, receive most sunlight, while a north facing one will receive it only on a handful of occasions. East and west facing windows will receive sunlight only at certain times of day".

In relation to existing surrounding receptors, the BRE Guidelines state that a window may be adversely affected if a point at the centre of the window receives for the whole year, less than

25% of the APSH, including at least 5% of the APSH during the winter months (21st September to 21st March) and less than 0.8 times its former sunlight hours during either period, and if there is a reduction in total APSH which is greater than 4%.

It is often not possible to determine the room uses within each of the neighbouring properties, nor is it clear which windows should be considered as the 'main windows'. Therefore, regardless of use, all the rooms with windows facing the site and within 90° of due south have been considered in the assessment.

Summary of Criteria for Daylight and Sunlight

The following table provides a summary of the criteria set out within the BRE Guidelines for daylight and sunlight.

Table 9.1 Summary of Daylight and Sunlight Assessment Criteria

Method	BRE Criteria
VSC	A window may be adversely affected if its VSC measured at the centre of the window is less than 27% and less than 0.8 times is former value.
NSL	A room may be adversely affected if the daylight distribution (NSL) is reduced beyond 0.8 times its existing area.
ADF	Bedroom 1%, Living room 1.5% and kitchen 2%.
APSH	A window may be adversely affected if a point at the centre of the window received for the whole year, less than 25% of the APSH including at least 5% of the APSH during the winter months (21st September to 21st March) and less than 0.8 times its former sunlight hours during either period, and for existing neighbouring buildings, if there is a reduction in total APSH which is greater than 4%.

Transient Overshadowing

Where a Proposed Development includes tall buildings, these may affect the sunlight availability to gardens or open spaces in close proximity to the site. Owing to the southerly location of the sun path, only amenity areas located within 90° of due north of the Proposed Development have the potential to be affected by overshadowing from tall buildings and therefore taken into consideration in this assessment.

The 2011 BRE guidelines suggest plotting a series of shadow plans illustrating the location of shadows cast from those buildings at different times of the day and period of the year to assess the potential overshadowing effects. To this end, the overshadowing plots are mapped for the three key dates listed below:

- 21st March (Spring Equinox);
- 21 st June (Summer Solstice); and
- 21 st December (Winter Solstice).

The 21st September (Autumn Equinox) is not assessed owing to the identical solar altitude and therefore equivalent outcomes of overshadowing to those presented for 21 st March.

For each of these dates, the overshadowing is calculated at hourly intervals throughout daylight hours from sunrise to sunset. On 21st December, the sun is at its lowest altitude consequently creating long shadows to be cast and represents the worst-case scenario in terms of overshadowing.

The analysis described above varies according to different latitudes. The Site is located within London, which is at a latitude of 51.5° north.

Sun Hours on Ground

The BRE Guidelines suggest that Sun Hours on Ground assessments should be undertaken on the Equinox (21st March and 21st September). Using specialist software, the path of the sun is tracked to determine where the sun would reach the ground and where it would not.

It is recommended that at least half of a garden or amenity area should receive at least 2 hours of sunlight on 21st March or the area which receives 2 hours of direct sunlight should not be reduced to less than 0.8 times its former value (i.e. there should be no more than a 20% reduction).

Solar Glare Technical Assessment

The potential for reflected solar glare or dazzle from glazed or reflective façades from the Proposed Development has been assessed using specialist lighting software, Radiance, showing the path of the sun for the entire year. From this, two computer generated angular images have been produced for each selected viewpoint, indicating the area which sees the reflection of the sun path at any point during the year. A modified diagram portraying a standardised extent of human vision is then overlaid onto the image.

The viewpoints are generally located at the minimum stopping distance and at the driver's eye height. The focal point is a relevant traffic element, such as signals or incoming traffic.The stopping distance is calculated as the combination of thinking and breaking distances Dtotal = Dthinking + Dbreaking = V*T + V2/(2μ*g), where each component is:

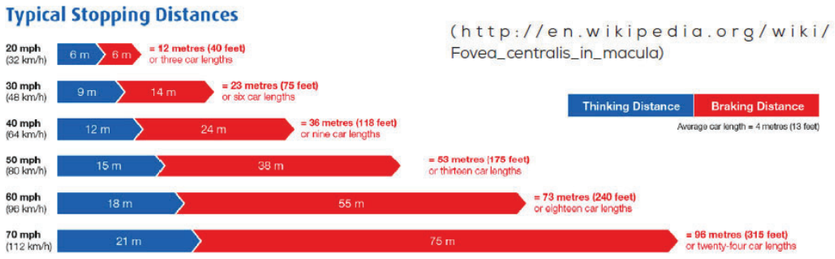
V = Relevant vehicle speed, typically the road speed limit.

T = Thinking time (0.67 sec)

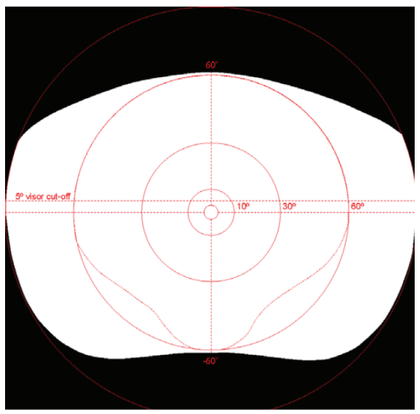
μ = Breaking effort (considered 0.65 for cars, 0.5 for

buses and 0.031 for trains)

g = Gravity acceleration.



The below highlights the degrees of vision corresponding to the foveal view, with a red circle of 3° of angle in order to identify the area most sensitive to reflected solar glare. Another red circle represents the incidence of the 30° radius of our typical field of view in order to identify a secondary area of sensitivity to potential reflected glare instances.



As stated in the International Commission on Illumination (CIE) CIE Collection on Glare (CIE 146:2002), occurrences at angles beyond 30° would be of little significance in most situations but may be relevant in exceptional circumstances. When seated in a driving seat of a typical car, for example, the limits of the windscreen would generally obstruct the driver's view at angles beyond 30° from the line of sight.

The methodology for solar glare is not aimed at addressing the intensity of an instance of reflected solar glare, but rather its occurrence, duration throughout the year and the location of this occurrence in respect of an individual's line of sight. It is also to be noted that the hours presented reflect solar time and therefore do not take Daylight Saving Hours into account.

It must be noted that the solar glare assessments undertaken assume a worst-case scenario whereby the sun will shine every day during daylight hours which is not the case within the UK.

	VERTICAL SKY COMPONENT		NO SKY LINE		ANNUAL PROBABLE SUNLIGHT HOURS	
	WINDOWS		ROOMS		WINDOWS	
	TOTAL	PASS	TOTAL	PASS	TOTAL	PASS
110-126 LEVEN ROAD	95	59	36	36	59	59
128-132 LEVEN ROAD	35	25	24	19	25	25
134-144 LEVEN ROAD	56	22	24	21	32	32
177-195 ABBOTT ROAD	85	42	48	41	42	41
199-225 ABBOTT ROAD	179	72	90	77	94	75
49-67 ABBOTT ROAD	70	45	41	35	37	36
ABERFELDY ESTATE PHASE ONE BLOCK A	57	9	45	34	12	0
ABERFELDY ESTATE PHASE ONE BLOCK C	98	16	61	34	43	17
ABERFELDY ESTATE PHASE THREE BLOCK G	47	14	25	16	22	0
ABERFELDY ESTATE PHASE THREE BLOCK J	111	44	56	56	27	13
ABERFELDY ESTATE PHASE TWO BLOCK D	57	23	35	31	4	2
AILSA WHARF BLOCK A	45	12	21	20	42	16
AILSA WHARF BLOCK D	228	67	88	74	147	87
AILSA WHARF BLOCKS K L	62	10	27	11	25	14
ATELIER COURT	117	72	97	95	110	82
BALFRON TOWER	62	42	54	26	8	4
BROMLEY HALL	100	54	31	29	34	28
CARRADALE HOUSE	77	55	44	44	22	11
CULLODEN PRIMARY SCHOOL	90	16	21	0	43	15
DEWBERRY STREET 16-46	72	50	44	44	48	46
DEWBERRY STREET 2-14	44	17	25	19	37	34
DEVONS WHARF	169	42	91	77	69	51
JOSHUA STREET 1-15	77	28	31	23	26	16
JOSHUA STREET 17-33	55	36	36	34	33	30
JOSHUA STREET 35-41	30	15	17	17	19	16
JOSHUA STREET 4	4	0	2	2	1	0
JOSHUA STREET 6-14	27	10	17	17	20	15
LANSBURY GARDENS 2-12	43	30	18	18	22	22
LEVEN ROAD PHASE THREE	73	30	62	58	44	28
LOREN APPARTMENTS	26	15	18	16	26	13
MILLS GROVE 1-9	25	17	17	14	11	11
MILLS GROVE 12-20	25	5	15	14	8	2
MILLS GROVE 17-25	27	13	15	15	8	7
MILLS GROVE 2-10	25	7	15	14	9	5
MILLS GROVE 9-15	22	14	12	11	6	4
ST LEONARDS ROAD 118-132	40	22	23	23	9	8
ST LEONARDS ROAD 134-146	43	25	28	28	7	7
ST LEONARDS ROAD 148-154	20	10	10	10	4	3
SHERMAN HOUSE	69	48	43	43	35	35
ST.NICHOLAS CHURCH	59	35	31	31	37	33
WOOSTER GARDENS 1-7	33	10	16	14	29	16
WOOSTER GARDENS 9-15	20	19	16	16	16	16
TOTALS	2699	1197	1470	1257	1352	975