Hydrock

Sutton High Street

Daylight and Sunlight Assessment

For Cassidy Ashton

Date: *1 February 2021*

Doc ref: *16336-HYD-XX-XX-RP-Y-5001*

DOCUMENT CONTROL SHEET

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		Project name	Sutton High Street
		Title	Daylight and Sunlight Assessment
		Doc ref	16336-HYD-XX-XX-RP-Y-5001
		Project no.	C-16336
		Status	Final
		Date	01/02/2021

Document Production Record		
Issue Number	P03	Name
Prepared by		Lara Hopwood
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Approved by		Josh Bullard

Document Revision Record			
Issue Number	Status	Date	Revision Details
P01	Draft	15/10/2020	Initial Report
P02	Final	06/01/2021	Final
P03	Final	01/02/21	Revised Final

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Sutton High Street

Hydrock Consultants has been appointed by Reid Capital to provide a daylight and sunlight assessment for the proposed development at 219-227 Sutton High Street.

1. INTRODUCTION

1.1 Purpose of Report

This report provides the results of a daylight and sunlight assessment that has been undertaken for the proposed development including any adverse impact assessment on surrounding buildings.

The development and impact has been assessed using the criteria set out in the Building Research Establishment's (BRE) 'Site layout planning for daylight and sunlight - a guide to good practice' (BR 209) (Littlefair, 2011). Whilst the guide itself states that its guidelines are not mandatory, they are those predominately referenced for daylight and sunlight standards in the UK.

1.2 Site and Location

The development is located along High Street in Sutton. This road is pedestrianised with the existing buildings consists of retail units on the ground floor and residential on the upper floors. The site currently houses an in-use retail unit, Argos.

The site is bordered to the north by a large ASDA with a rooftop carpark. The ASDA is serviced by lorry delivery yard to the west of the site. Immediately to the south of the site is a new development of apartments currently under construction.

The site location is shown in Figure 1.

1.3 Development Details

The development includes 36 no. apartments with a mix of one and two bedrooms. The development is split across 9 storeys plus a basement, with a communal roof garden at fourth floor level. The ground floor consists of an A1/A3 use commercial unit, and apartment concierge spaces.

1.4 Policy Requirements

Sutton London Borough Council will grant planning permission for a development unless it adversely affects the amenities of future occupiers, those currently occupying adjoining or nearby properties, or has an unacceptable impact on the residents of the surrounding area. Policy 29 of the Sutton Local Plan states that when assessing the impact of the proposed development, the council will take into consideration sunlight, daylight and overshadowing.

The plan advises on the use of Building Research Establishment's Site Layout Planning for Daylight and Sunlight - A Guide to Good Practice (BRE, 2011) in order to meet the policy.

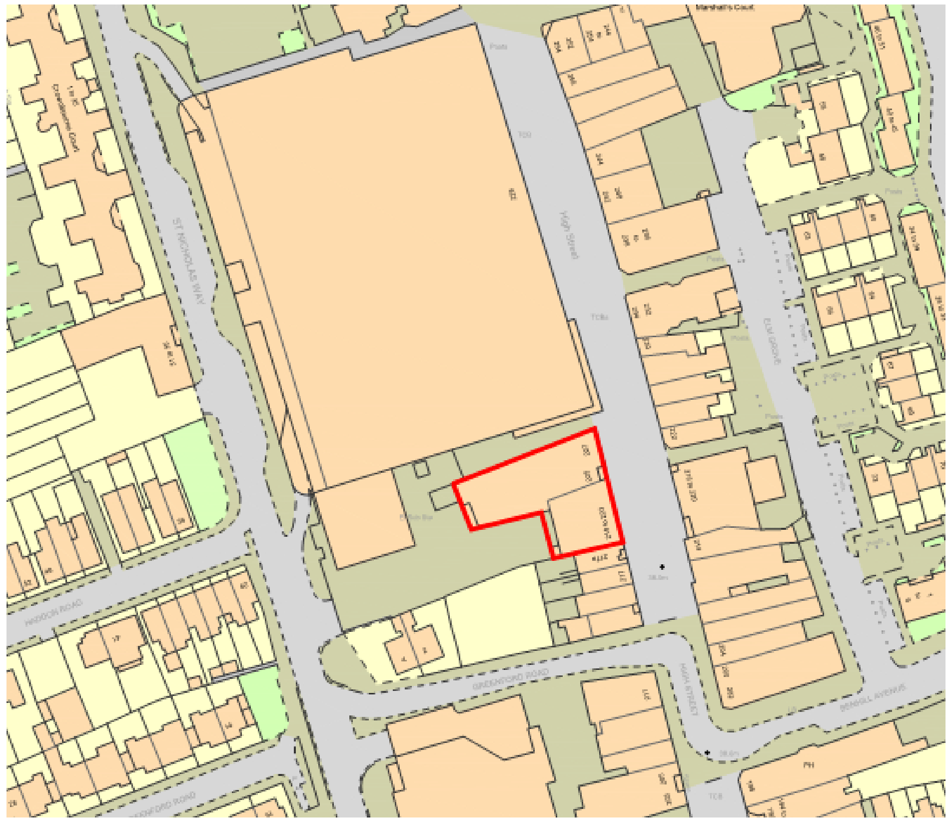


Figure 1 - Site location

Methodology

This second section of the report discusses the relevant daylight and sunlight assessment methods for both the proposed new development, and impact assessment on existing buildings.

2. BACKGROUND

Overshadowing occurs when buildings are in close proximity relative to their size. This results in reduced levels of daylight and sunlight in part, or all, of the affected buildings. Daylight refers to the level of diffuse natural light coming from the surrounding sky or reflected off adjacent surfaces, whereas sunlight refers to direct sunshine. A key difference between the two is that sunlight is highly dependent on orientation, whereas orientation has no effect on daylight.

The potential for daylight at a particular point may be quantified by assessing the proportion of the sky that is 'visible' from that point, i.e. not obscured by objects such as buildings. For points located on vertical surfaces such as walls, this proportion of visible sky is termed the 'vertical sky component' or VSC.

After the VSC, the no sky line can also be used to assess daylight performance. The no sky line is the point on the working plane at which no sky can be viewed. This is often expressed as the percentage of working plane from which the sky can be viewed such as 80% or 0.8.

However, if the details of the building are known, then daylight can be more accurately quantified by calculating the average daylight factor (ADF). This gives a more precise measure of daylight, the results of which can in effect over-ride the VSC results. The ADF is generally only used to calculate daylight in new buildings.

Further, climate-based modelling (CBM) techniques can be utilised to provide a more accurate assessment of predictive visual comfort within buildings. These techniques include spatial daylight autonomy (SDA), which considers percentage of time across a given year where appropriate illuminance levels are achieved, in addition to glare risk assessment.

These CBM techniques require more complex modelling and are more appropriate where the usage and task requirement of the space are known in more detail. For this reason, and the relative modern emergence of CBM modelling techniques, assessment at planning is rare.

Direct sunlight can be calculated by testing the 'annual probable sunlight hours' that a point receives. This is achieved by considering both the complete annual shading variation at the point, and the statistical sunshine averages for the location in question.

The average daylight factor, vertical sky component, no sky line and number of annual probable sunlight hours form the basis of the overshadowing assessment methodology used in the analysis. The average daylight factor is generally only relevant when the internal room layout and use is known.

To achieve objectivity in quantifying daylight and sunlight, the guidelines laid down in the widely accepted BRE guidebook 'Site layout planning for daylight and sunlight: a guide for good practice', 2nd edition, 2011 by P J Littlefair are adhered to.

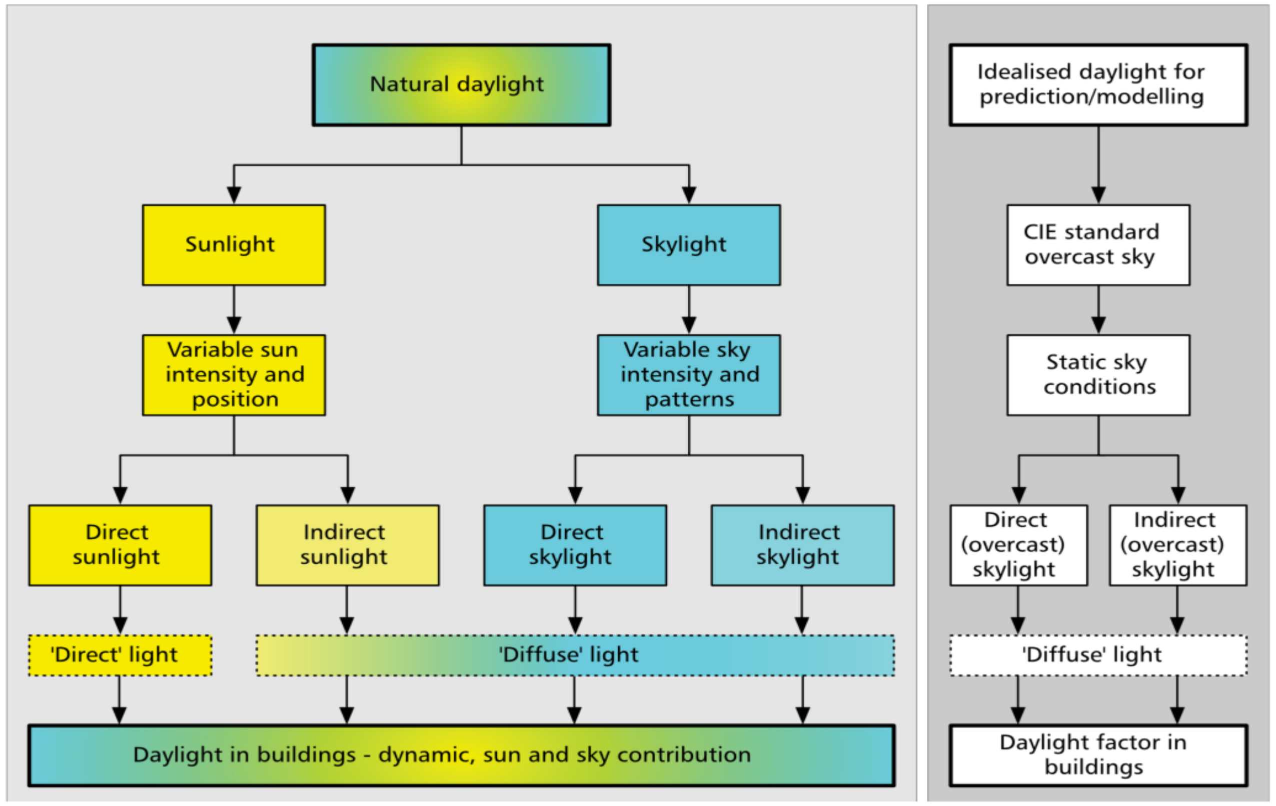


Figure 2 - Natural daylight categories

3. EXISTING BUILDINGS

3.1 Desktop Assessment

The BRE recommend that daylight is safeguarded to nearby buildings to avoid making adjoining properties appear gloomy or unattractive.

Following the recommendations contained in the BRE guide, an initial desktop assessment can be undertaken to confirm which existing dwellings require assessment. This assessment is shown in Figure 3.

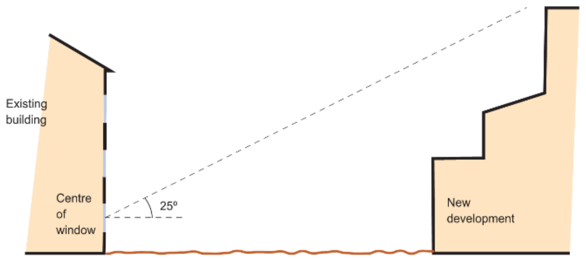


Figure 3: Existing buildings 25° check.

A section is drawn in plane perpendicular to each potential affected window wall of the existing building. The angle to the horizontal subtended by the new development at the level of the centre of the lowest window is drawn.

If this angle is less than 25° for the whole of the development, then it is unlikely to have a significant effect on the daylight enjoyed by the existing building. If for any part of the new development, this angle is greater than 25°, a more detailed check is needed to find the loss of skylight to the existing building. Both the total amount of skylight and its distribution within the building are important.

3.2 Detailed Assessment

If the proposed development is deemed to have a significant impact on existing buildings, or adjoining developments, a more detailed assessment of daylight is required. In this case, the existing buildings should be tested using the VSC criteria in the first instance, then the NSL, and finally ADF as the final option. It should be noted the NSL and ADF can only be used if internal room layouts are known.

3.2.1 Daylight Access

The BRE guidelines provide three different methods for assessing daylight for existing residential accommodation: The Vertical Sky Component (VSC) method, No Sky Line (NSL) and the Average Daylight Factor (ADF) method. In the first instances the VSC is tested, and if required the NSL and ADF can then be tested. The BRE states that for the effect of the proposed building to be minimal, the VSC including the new development needs to be greater than 27%. If the VSC is less than 27% this is acceptable so long as the VSC with the new development is not less than 0.8 of the VSC without the proposed development.

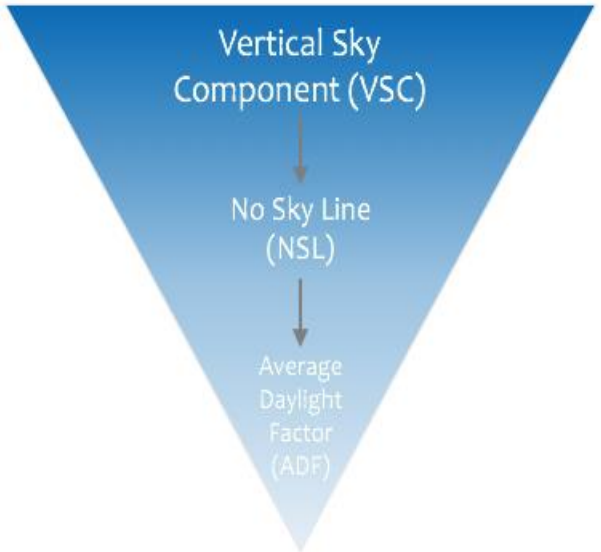


Figure 4 - Sequential testing for daylight

4. CALCULATING DAYLIGHT IN NEW DEVELOPMENT

4.1 Dwellings

The BRE guide cites the recommendations in BS 8206-02 Code of Practice for Daylighting as the minimum values for the ADF in each room of a dwelling. They are shown in Table .

Table 1: BRE recommended ADF (domestic).

Zone	Recommended Minimum ADF
Kitchen	2.0%
Living Room, dining room, study	1.5%
Bedroom	1.0%

4.2 Non-Domestic Buildings

There is a clear link between adequate daylight access and increased occupant visual comfort for working environments.

In addition, suitable provision of daylight will mean that the use of artificial lighting can be reduced and consequently energy consumption. CIBSE estimate (LG10) that if a daylight factor of 5% is achieved in the space then it is commonly found that electric lighting is not needed during the day time. An ADF of between 2% and 5% will result in reduced artificial lighting usage and daylight controls will be suitable as a means to achieve this end.

Climate Based Modelling techniques, such as useful illuminance and spatial daylight autonomy provide a more accurate assessment of the potential for design of daylight and glazing systems and these may be utilised at the next design stage. Initially, the VSC, NSL and ADF metrics will be utilised to approximate daylight performance of each space.

5. SUNLIGHT FOR BOTH EXISTING BUILDINGS AND THE NEW DEVELOPMENT

Window sunlight availability is assessed using the APSH and WPSH. For full details on how this is calculated see Appendix B. The sunlighting of the existing dwelling may be adversely affected, this will be the case if the centre of the window:

- Receives less than 25% of annual probable sunlight hours, or less than 5% of annual probable sunlight hours between 21st September and 21st March; and
- Receives less than 0.8 times its former sunlight hours during either period; and
- Has a reduction in sunlight received over the whole year greater than 4% of annual probable sunlight hours.

For amenity spaces it is recommended that for it to appear adequately sunlit throughout the year, at least half of a garden or amenity area should receive at least two hours of sunlight on 21st March. If as a result of new development an existing garden or amenity area does not meet the above, and the area which can receive two hours of sun on 21st March is less than 0.8 times its former value, then the loss of sunlight is likely to be noticeable.

6. SUMMARY

6.1 Existing Buildings

The existing buildings surrounding the development will be assessed using the criteria detailed in **Error! Reference source not found.**.

6.2 New Development

The proposed development will be assessed against the criteria detailed in Table 3.

Table 2: BRE testing criteria for existing developments.

Criteria	Further Testing
25° rule	If angle from new development to existing is greater than 25 degrees additional testing of the VSC will be required.
43° rule	If angle from new development to proposed adjoining development is above 43 degrees, additional testing of VSC will be required.

Table 3: BRE daylight, sunlight and overshadowing criteria for new developments.

Parameter	Criteria	Acceptability Criteria	Source
Daylight	Angle to sky from horizontal (existing dwellings)	Maximum 25°	BRE (Littlefair)
	Vertical sky component (existing dwellings)	Greater than 27%	BRE (Littlefair)
	No sky line (new dwellings)	80% of rooms receive direct light from the sky	BRE/BS 806 and Code for Sustainable Homes
	Average daylight factor (new dwellings)	Greater than 1-2% depending on room use	BRE/BS 806 and Code for Sustainable Homes
Sunlight	Annual probable sunlight hours	Window receives at least 25%	BRE (Littlefair)
	Winter probable sunlight hours	Window receives at least 5%	BRE (Littlefair)
Overshadowing	Area of amenity space receiving 2 hours of sunlight no March 21st	50% of space	BRE (Littlefair)

Daylight and Sunlight Model

To carry out the daylight and sunlight assessment, a 3D computer model has been generated based on information provided by the Architect.

7. COMPUTER SIMULATION DETAILS

7.1 Accuracy

It is important to note that with any modelling exercise there are assumptions and approximations made. While building performance modelling techniques include detailed hourly simulations, they are predictive methods only, and should not be relied upon as a measure of final building performance. The latter is subject to detailed design, installation, commissioning and operational profiles which are all subject to development. As far as possible, details of all assumptions and approximations used are supplied as part of the report. These should be read and considered carefully.

7.2 Software

The calculations have been carried out using IES Virtual Environment 2019, an accredited Building Performance Modelling (BPM) tool in accordance with CIBSE Guide AM11 (CIBSE, 2015).

IES uses a Radiance based calculation simulation for daylight. This predicts the transport of light in a virtual 3D scene using physically based models for the emission, transmission, reflection and scattering of light. The output, therefore, can inform on how the building might perform; for example, in terms of visual impression and predicted illuminance levels for particular sky conditions. Radiance is capable of producing highly accurate predictions, within 10% of measured illuminance values.

In practical terms however, there are a number of factors that will affect the accuracy and reliability of modelling predictions:

- Model geometry;
- Physical properties;
- Luminous environment;
- Sensor grid/points;
- Simulation parameters; and
- Data output.

7.3 Geometry

Three-dimensional numerical models suitable for daylight/sunlight analysis were constructed to represent the current site conditions and the proposed development. The models included a representation of buildings adjacent to the development site up to a distance judged to have an influence on the availability of natural light. In addition:

- All cladding and overhangs have been taken from architect's context Revit model issued on 17th September 2020
- All existing glazing levels have been estimated based on architect's Revit model and existing asset information.

7.4 Weather

In accordance with BRE guidelines, the ADF has been assessed based on a uniform overcast sky in line with BS 8206 and CIE guidelines.

Solar calculations, for the purpose of sunlight availability, have been carried out based on the most suitable local weather file at the development.

7.5 Glazing and Room Layout

Glazing properties have been assigned in accordance with BS 8206:

- Light transmittance (T) = 0.6 (typical new double-glazed casement)
- Internal Reflectance (R) = 0.80 (pale)
- Room grid margin – 0.5m (in line with CIBSE AM11). This is to avoid artificially high ADF calculation due to high point daylight factor near to windows.

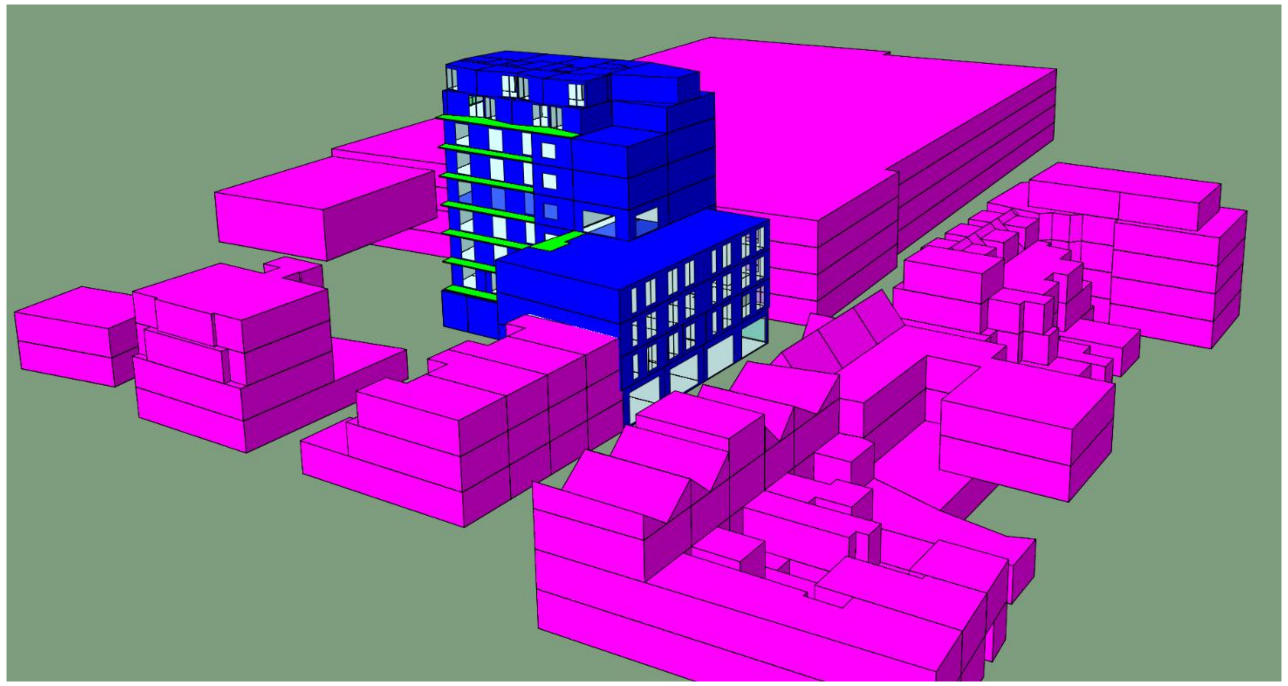


Figure 5 -Proposed development as viewed from the southeast

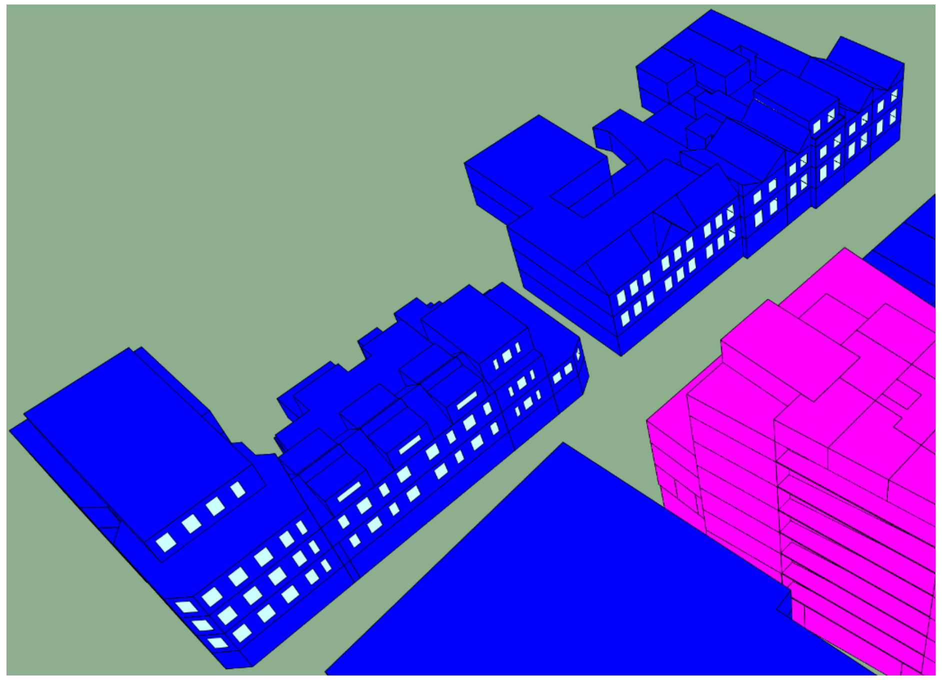


Figure 6 -Existing buildings assessed along Sutton High St

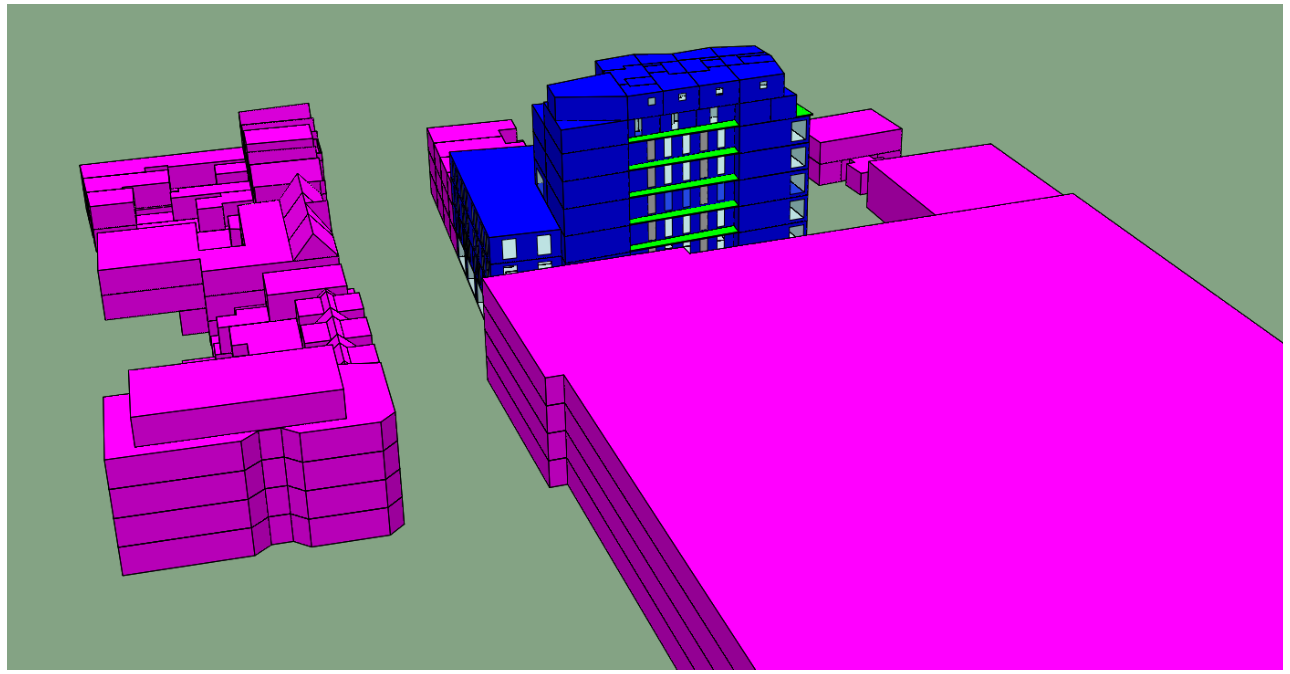


Figure 7 - Proposed development viewed from the north

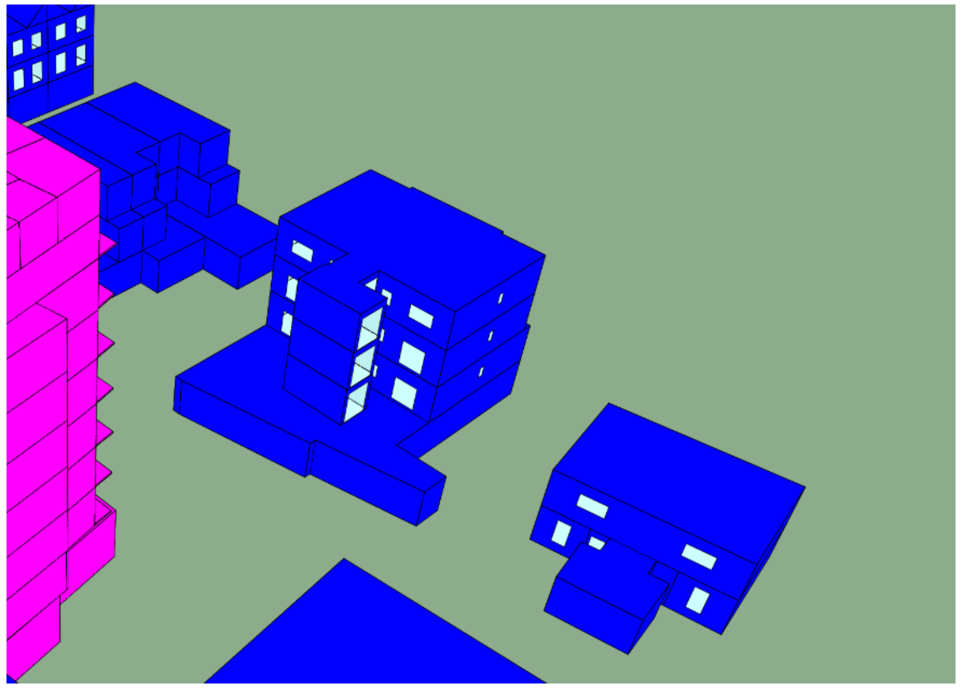


Figure 8 - Existing buildings to the rear of the site

Impact Assessment - Existing Buildings

The impact of the proposed development on the existing dwellings within the vicinity of the site has been assessed. This has been undertaken using a desktop-based approach as outlined in the Methodology. For there to be no significant impact on the existing dwellings, the obstruction angle from the window on the lowest floor of the existing building must be less than 25 degrees.

8. INTRODUCTION

The adjacent buildings which have been assessed are the properties above the shops on Sutton High St, 2b Greenford St to the rear, and the development currently under construction to the rear of the site.

9. DESKTOP ASSESSMENT - 25 DEGREE CHECK

An initial desktop assessment of the surrounding buildings has been carried out. The results are detailed Figures 9 and 10..

Buildings identified as being within 25 degrees of the proposed buildings have been highlighted as needing further assessment.

9.1 25-Degree Check Results

All existing buildings within the vicinity of the site have an obstruction angle of greater than 25 degrees and therefore require further assessment.

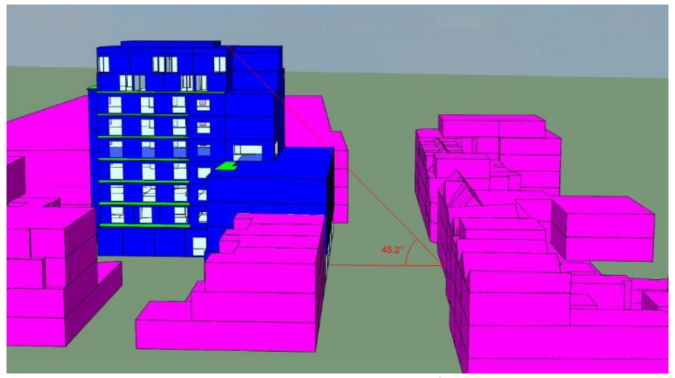


Figure 9 - Sutton High St obstruction angle of 45°

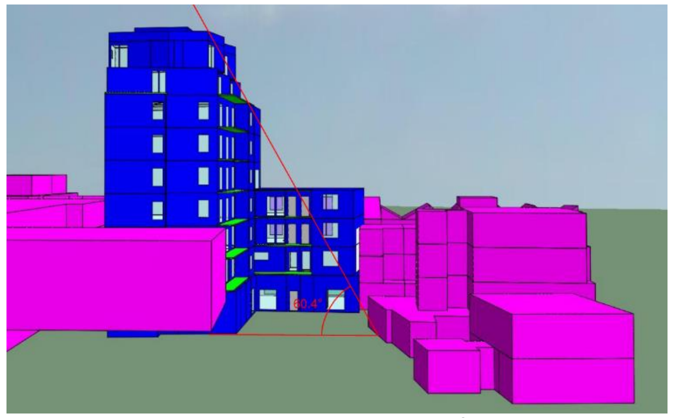


Figure 10 - Greenford road obstruction angle of 60°

10. VERTICAL SKY COMPONENT CHECK

The reduction in VSC caused by the proposed development in the existing buildings has been assessed.

It is worth noting that the assessment outline within the BRE guidance, that forms the basis of this assessment, is for existing residences. The internal layouts of the buildings surrounding the Sutton High Street development could only be obtained for the new development currently under construction to the south of site.

From using publicly available information such as google maps it can be assumed that the existing buildings consist of retail on the ground floor and residential on the upper floors.

Living spaces are considered to be the most important for daylight access and sunlight availability.

10.1 2b Greenford Road

All windows facing the proposed development at 2b Greenford Road were assessed. 3 of the windows will experience a reduction in skylight outside of the recommended levels. However, these are marginally outside of the BRE guidelines which permit a reduction of up to 20% of the existing VSC values. This is not uncommon in this type of urban development.

The impact on 2b Greenford Road will be minor adverse.

10.2 Meadows Plumbing Greenford Road (Under construction)

There was a total of 30 windows tested at the Meadows Plumbing development currently under construction, of these 8 will experience a reduction in skylight outside of the recommended levels. These are marginally outside the BRE guidelines for skylight reduction, and 3 of the 8 windows are attributed to bedrooms where the need for daylight tends to be lower than for kitchens and living spaces.

This impact on Meadows Plumbing will be minor adverse.

10.3 206, 208, 210, 212, and 214 High Street

All windows attributed to the living spaces above the retail unit have been assessed. The VSC reduction caused by the proposed development is minimal and well within the BRE guidelines.

Residents are unlikely to experience any noticeable reduction in skylight due to the new development.

10.4 216-220 High Street

All windows attributed to the living spaces above the retail unit have been assessed. 7 of the windows will experience a reduction in skylight outside of the recommended levels. However, these are only very slightly outside of the BRE guidelines, with values that are no more than a 25% reduction from existing VSC values.

The impact on 216-220 High Street will be minor adverse

10.5 222 and 224 High Street

All windows attributed to the living spaces above the retail unit have been assessed. 3 of the windows from both 222 and 224 High Street will experience a reduction in skylight outside of the recommended levels. However, these are only very slightly outside of the BRE guidelines, with values that are no more than a 24% reduction from existing VSC values.

The impact on 222-224 High Street will be minor adverse.

10.6 226-230 and 232-234 High Street

All windows attributed to the living spaces above the retail unit have been assessed. The VSC reduction caused by the proposed development is minimal and well within the BRE guidelines.

Residents are unlikely to experience any noticeable reduction in skylight due to the new development.

Annual Probable Sunlight Hours

Relevant existing buildings have also been assessed for potential reduction in sunlight availability. It should be noted that some of the affected existing windows are north facing and so currently receive negligible sunlight hours.

It is recommended that dwellings have at least one main window to habitable rooms which receive at least 25% of APSH, or 5% winter possible sunlight hours. For existing buildings in order to safe guard sunlight availability, it is recommended that the window receives at least 0.8 times its former sunlight hours, and any reduction in sunlight availability is limited to 4% of APSH. If these criteria are not met, the dwelling's sunlight availability may be adversely affected.

11. IMPACT ASSESSMENT

Following detailed review of daylight and sunlight reduction, the impact on the existing buildings has been classified according to the methodology outlined in Appendix I of BR 209.

It is worth noting that the assessment of impact depends on a combination of factors and there is no simple rule of thumb that can be applied.

The following is given as guidance:

- Negligible - Where reduction in skylight is well within the guidelines set out within BR 209.
- Minor Adverse – Where loss of skylight only just meets guidelines or areas that fall outside of guidelines are not critical.
- Moderate Adverse – Where loss of skylight is marginally outside the guidelines or a large area of open space/windows are affected.
- Major Adverse – A large number of open space/windows are affected and the loss of skylight is substantial

Based on the above approach, the categories have been applied to each building and shown in the following table.

Table 1 - Existing buildings impact assessment

Existing Building	Impact Assessment
2b Greenford Road	Minor Adverse
Meadows Plumbing (under construction)	Minor Adverse
206 High St	Negligible
208 High St	Negligible
210 High St	Negligible
212 High St	Negligible
214 High St	Negligible
216-220 High St	Negligible
222 High St	Minor Adverse
224 High St	Minor Adverse
226-230 High St	Negligible
232-234 High St	Negligible

Proposed Development Daylight Analysis

This section of the report will provide an analysis of the proposed development daylight performance. This will be quantified in terms of vertical sky component (VSC), no sky line (NSL) and average daylight factor (ADF). To carry out this assessment a representative sample of units have been tested to provide an overview of the building's daylight performance.

12. VERTICAL SKY COMPONENT

All kitchen/lounge and bedroom spaces assessed within the proposed development are currently meeting the recommended VSC level.

The study spaces that are failing to meet the VSC requirement do not have windows therefore cannot meet the criteria.

Table 2 - VSC results for assessed units

	VSC Pass	VSC Fail	Pass Rate
Kitchen/Lounge	25	0	100%
Bedrooms	44	0	100%

13. NO SKY LINE

The majority of units assessed are achieving the NSL criteria with 80% of the room receiving direct light from the sky. There are a small number of cases where this criterion is not met,

this is due to overshadowing caused by adjacent buildings and would not be possible to rectify without significant alterations to the massing of the development.

Table 3 - NSL results for assessed units

	NSL Pass	NSL Fail	Pass Rate
Kitchen/Lounge	24	1	96%
Bedrooms	44	0	100%

14. AVERAGE DAYLIGHT FACTOR

The average daylight factor for each modelled unit has been calculated and assessed against the BRE criteria as follows:

- Kitchens - 2%
- Living rooms 1.5%
- Bedrooms 1%

In this particular development, all of the kitchens are combined living rooms and kitchens. BS 806 Part 2 (the British Standard for Daylight) recommends that where combined kitchens and living rooms are provided, the higher daylight factor should be applied.

However, Hydrock have been involved with discussions with the BRE and in some instances the lower daylight factor can be applied. If the kitchen takes up a small area of the room and does not have a specific requirement for daylight, the 1.5% ADF should be used for the assessment.

Just less than half of the dwellings modelled (48%) are achieving the BRE recommended ADF of 1.5% for combined kitchens and living rooms. Some of these living spaces are performing below the recommended level due to two potential reasons. Firstly, the rooms are too deep compared to the window size/placement. Daylight coming through the windows in these rooms cannot reach the back of the room. Secondly, overshadowing caused by the building itself results in a less daylight coming into the room.

For the purposes of this assessment, units that are meeting the 'lower' daylight factor of 1.5% have been classified as a pass as they will experience adequate levels of daylight in respect to their intended use. In the majority of these spaces the kitchens are located to the back of the room and achieving higher levels of daylight is not feasible.

The bedrooms on site experience greater overshadowing than the kitchens, and are performing less well in terms of daylight at the lower floors within the development. This overshadowing is caused by existing buildings to the north of the site, in order to counteract this there would need to be significant changes to the massing of the scheme, which would impact on apartment layouts, number of apartments and overall scheme viability.

Table 4 - ADF results for assessed units

	ADF Pass	ADF Fail	Pass Rate
Kitchen/Lounge	12	13	48%
Bedrooms	42	2	95%

15. OBSERVATIONS

The overall daylight performance of the proposed development can be deemed to be acceptable taking into account site constraints, and scheme viability.

The majority of the dwellings assessed are meeting the recommended ADF, NSL and VSC for kitchens and living spaces. ADF in the living spaces is falling short of the recommended value. In order to achieve more BRE target, it is recommended that the design incorporates a larger area of windows in these rooms.

Proposed Development - Sunlight Analysis

This section of the report provides an analysis of the development performance in terms of access to sunlight. This will be quantified in terms of amenity sunlight hours and window sunlight. As with the daylight assessment, a representative sample of dwellings have been assessed.

16. AMENITY SUNLIGHT

All communal amenity areas provide as part of the development have been assessed for compliance with the BRE guidelines. This states that amenity spaces should receive at least 2 hours of sunlight on March 21st in 50% of the space.

There is only one communal amenity space, this is provided in the form of the roof top garden on the fourth floor.

16.1 Amenity Sunlight Results

The results of the amenity sunlight analysis for the rooftop garden on 21st March are shown in Figure 12.

The coloured areas in the graph represent 1m grid squares that are receiving more than 2 hours of sunlight on the BRE test day. The rooftop amenity space is meeting the requirements of the BRE for amenity sunlight.

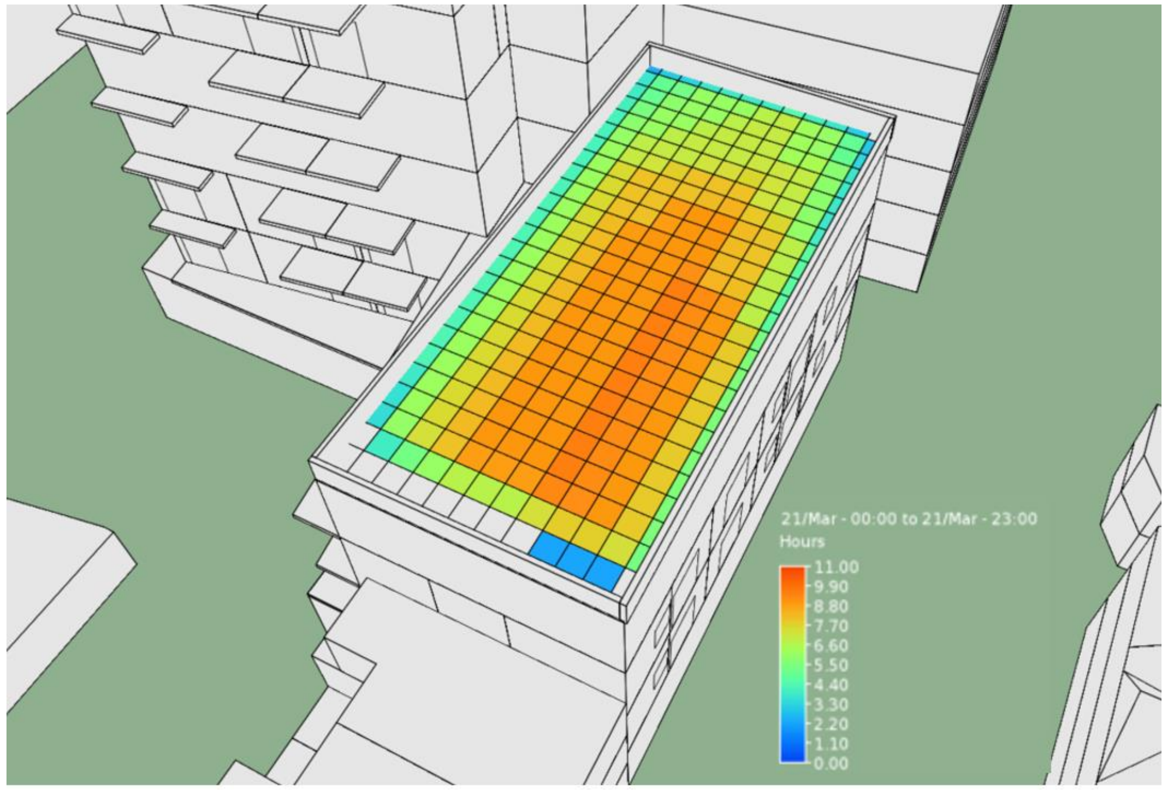


Figure 11 -Amenity sunlight results for roof top communal garden

17. WINDOW SUNLIGHT

17.1 Annual Probable Sunlight Hours

North facing units have been minimised as far as practicable and all dwellings have a window to a main living space that is situated within 90 degrees to the south. The BRE recommend that all dwellings have at least one window to a main living space that achieves at least 35% of annual probable sunlight hours (APSH).

There are no north facing living spaces on site, all north facing windows are attributed to access, and bedrooms.

All dwellings assessed have a main window to a living space that is receiving the recommend 25% APSH.

17.2 Winter Probable Sunlight Hours

In addition to APSH, the BRE also recommend that developments receive at least 5% of winter probable sunlight hours (WPSH).

All dwellings on site have a window within a main living space that is receiving at least 5% of winter probable sunlight hours.

Conclusions

Summary

The design team have carried out an assessment of site layout planning for daylight and sunlight. The team have sought to maximise opportunities for daylight access and sunlight availability in accordance with BRE good practice guidance whilst also taking into account other site requirements and objectives.

The development is generally performing well in terms of daylight and sunlight with the majority of spaces meeting the recommended daylight or sunlight metrics. No specific guidelines or targets are provided in relation to target or thresholds for compliance and while the BRE guidelines have been utilised, these are informative only and should be read in conjunction with other site design requirements.

A summary of the overall performance of the assessed dwellings is shown below. These results have not included the study rooms on the 8th floor as without windows in these rooms they will not be viable.

*Table 5 - Summary of daylight and sunlight performance (*Note that daylight and sunlight modelling calculations are based on a representative sample of dwellings from across the development).APSH and WPSH values are excluding North facing units.*

Daylight Variable	Percentage of Assessed Dwellings Achieving Guidelines
ADF - Kitchen/Lounge	54%
ADF - Bedrooms	89%
NSL	96%
VSC	100%

Sunlight Variable	Percentage of Assessed Areas Achieving Guidelines
Amenity Space	Roof garden is achieving BRE guidelines
APSH	100%
WPSH	100%

Daylight

The daylight performance of a representative sample of dwellings has been assessed across the site. The majority of the kitchens/living rooms and bedrooms contained within these dwellings are passing the BRE guidelines for daylight.

Whilst the site is performing relatively well, it should be noted that the BRE guidelines were designed to be used flexibly, allowing some degree of argument for daylight levels that do not meet the minimum requirements.

Areas of the site that do not meet the minimum levels includes a number of kitchen and living spaces. These are open plan areas which mean that the rooms are exceptionally deep, particularly flat 6 and flat 8 (see Appendix C for reference), causing the back of the rooms to receive minimal light. Without changes to the internal layouts or increasing the area of windows in these rooms it would be difficult to rectify.

Based on the above the daylight performance is deemed to be acceptable, particularly in relation to other site design requirements, objectives and constraints such as:

- Proximity to proposed adjoining development and existing buildings;
- Internal layouts to reduce number of north facing living spaces;
- Development density requirements limiting access to daylight in certain areas; and
- Balanced fabric design criteria to maximise daylight whilst limited winter heat loss and risk of summertime overheating.

Sunlight

Overshadowing of communal amenity space has been considered and tested in detail. The roof top communal garden is passing the BRE guidelines and will receive direct sunlight throughout the year.

Window sunlight has also been assessed. There are no direct north facing units and all assessed dwellings are meeting the required APSH and WPSH levels.

Existing Buildings

An impact assessment has been undertaken to determine if the propose development will have any adverse impact on daylight access and sunlight availability for existing buildings within the vicinity of the site.

The impact on most of the existing buildings is negligible, with the exception of the 2b Greenford Road, Meadows Plumbing development that is under construction, 212-220 and 222-224 High Street which will experience a minor adverse impact. The results of this analysis should be looked at holistically taking into account the overall planning targets for Sutton Borough Council.

This is deemed to be acceptable.

Appendix A: Vertical Sky Component

Vertical Sky Component

The vertical sky component (VSC) is defined in BR 209 (Littlefair, 2011) as follows:

'Ratio of that part of illuminance, at a given point on a given vertical plane, that is received directly from a CIE Standard Overcast Sky, to illuminance on a horizontal plane due to an unobstructed hemisphere of this sky '

(CIE = Commission internationale de l'Eclairage or the International Commission on Illumination).

Sky Distributions

On a sunny day, clearly most of the available light comes from the direction of the sun and the area immediately around it. On a perfectly overcast day the majority of light comes from the zenith of the sky straight above you, which can be up to three times more than at the horizon. Under some conditions, however, the distribution is much more uniform.

To describe this variation the CIE have developed a number of standard sky distributions based on very specific mathematical formula, examples of which are shown immediately below.

As stated in the quote above, the VSC is defined for Overcast Sky Conditions, i.e. the image in the centre, for which the zenith is brighter than the horizon.

Calculating the VSC

The VSC for a point on a wall may be determined by considering all the objects which block a clear 'sight' of unobstructed sky. The wall itself will block out half of the sky hemisphere, so it would seem that the maximum theoretical value for a point on an isolated wall would be 50%. In fact, due to the assumed CIE Overcast Sky Condition, the maximum value attainable is 40% (Littlefair, 2011).

The VSC calculation may be achieved using pen-and-paper methods such as Waldram diagrams as suggested in BR 209 (Littlefair, 2011). However, the computer programme used here is more accurate, reliable and efficient. It performs the calculation by 'spraying' very many imaginary rays from the point and so determines the VSC from the percentage of these which reach the sky dome (with the assumed sky distribution taken into account).

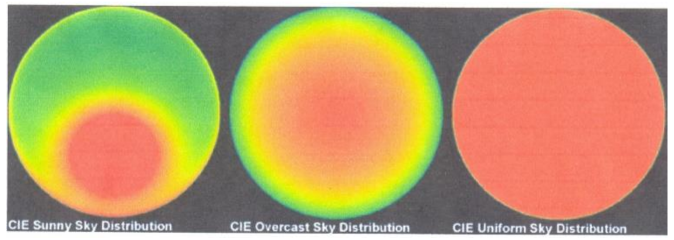


Figure 12 - CIE sky distributions.

Appendix B: Annual Probable Sunlight Hours

To calculate the probable sunlight hours that each reference point receives, the first stage is to quantify the number of hours per day for which each point can potentially receive unobstructed sunlight. This task involves considering each of the 365 days per year in turn, and determining the number of hours between sunrise and sunset on each day that each reference point is in sunlight. One way of performing this task would be to visually inspect shadow cast images for each hour of each day of the year.

In practice, this process would be far too labour-intensive to be contemplated, and even if it were attempted, it would inevitably lead to the probability of human error. However, the computer programme used for the analysis in this report carries out this task automatically and thereby completely eliminates the risk of human error.

The steps listed below are then followed to determine the number of annual probable sunlight hours for each reference point:

- For each month, sum the daily number of hours of potential unobstructed sunlight.
- For each month, sum the daily number of hours between sunrise and sunset.
- Express the monthly sum of potential unobstructed sunlight from 1 as a fraction of total potential hours, by dividing by the answer to 2.
- For each month, multiply the above fraction by the hourly sunshine averages for the location as determined by weather statistics for the area (from MET office data). This gives the number of monthly probable sunlight hours.
- Calculate the number of annual probable sunlight hours by summing all the monthly probable sunlight hours from 2 above. This may be expressed as a percentage by dividing by the total hourly sunshine averages for the location. This percentage may then be compared with the 25% criterion suggested in BR 209 (Littlefair, 2011).
- Calculate the number of probable sunlight hours during the winter months by summing all the monthly probable sunlight hours between October and March (inclusive) from 2 above. This may be expressed as a percentage by dividing by the total hourly sunshine averages for the location. This percentage may then be compared with the 5% criterion suggested in BR 209 (Littlefair, 2011).

Appendix C: Impact Assessment Results

Building	Floor	Surface	Opening	Existing VSC	VSC with Proposed Development	Reduction Factor	Pass/Fail
2b Greenford Road	Ground Floor	2	0	25.04	22.95	0.92	Pass
		2	1	25.63	18.3	0.71	Fail
		3	0	35.05	20.26	0.58	Fail
		3	1	33.93	30.59	0.90	Pass
		3	0	26.52	12.37	0.47	Fail
	First Floor	4	0	24.09	22.46	0.93	Pass
		4	1	26.29	21.81	0.83	Pass
		7	0	30.71	32.79	1.07	Pass
		12	0	15.62	30.85	1.98	Pass
Meadows Plumbing Greenford Road	First Floor	2	0	34.72	32.36	0.93	Pass
		3	0	27.18	16.39	0.60	Fail
		3	1	20.61	10.53	0.51	Fail
		4	0	20.1	15.18	0.76	Fail
		6	0	26.01	20.16	0.78	Fail
		8	0	30.29	30.3	1.00	Pass
		9	0	37.09	37.07	1.00	Pass
		11	0	11.74	11.69	1.00	Pass
		13	0	22.19	20.2	0.91	Pass
		13	1	8.11	7.83	0.97	Pass
"Under Construction"	Second Floor	2	0	33.13	32.95	0.99	Pass
		3	0	39.22	39.07	1.00	Pass
		5	0	38.03	35.99	0.95	Pass
		6	0	30.17	20.03	0.66	Fail
		6	1	22.48	13.05	0.58	Fail
		7	0	22.6	18.41	0.81	Pass
		9	0	29.97	25.02	0.83	Pass
		15	0	12.79	12.86	1.01	Pass
		17	0	25.24	22.53	0.89	Pass
		17	1	9.88	9.62	0.97	Pass
"Under Construction"	Third Floor	2	0	35.31	26.61	0.75	Fail
		2	1	27.09	18.59	0.69	Fail
		3	0	27.65	24.19	0.87	Pass
		5	0	35.23	31.11	0.88	Pass
		7	0	36.66	36.71	1.00	Pass
		8	0	39.61	39.5	1.00	Pass
		14	0	39.07	37.67	0.96	Pass
		15	0	19.09	18.87	0.99	Pass
		17	0	32.49	29.46	0.91	Pass
		17	1	18.76	18.52	0.99	Pass

Building	Floor	Surface	Opening	Existing VSC	VSC with Proposed Development	Reduction Factor	Pass/Fail
206 High Street	First Floor	2	0	37.12	36.01	0.97	Pass
		2	1	36.61	35.24	0.96	Pass
206 High Street	Second Floor	2	0	38.56	37.58	0.97	Pass
		2	1	38.79	37.05	0.96	Pass
208 High Street	First Floor	2	0	36.03	34.56	0.96	Pass
		2	1	35.35	33.88	0.96	Pass
208 High Street	Second Floor	2	0	38.52	36.67	0.95	Pass
		2	1	38.26	36.33	0.95	Pass
210 High Street	First Floor	3	0	34.27	32.65	0.95	Pass
		3	1	33.7	31.83	0.94	Pass
210 High Street	Second Floor	3	0	37.97	36.11	0.95	Pass
		3	1	37.66	35.14	0.93	Pass
210 High Street	Third Floor	2	0	37.69	35.78	0.95	Pass
		2	1	38.57	36.6	0.95	Pass
212 High Street	First Floor	2	0	30.61	28.77	0.94	Pass
		2	1	32.9	30.58	0.93	Pass
212 High Street	Second Floor	2	0	34.82	32.57	0.94	Pass
		2	1	37.31	34.15	0.92	Pass
214 High Street	First Floor	9	0	32.65	29.87	0.91	Pass
		9	1	32.39	28.84	0.89	Pass
214 High Street	Second Floor	2	0	37.18	33.7	0.91	Pass
		2	1	36.96	32.99	0.89	Pass
216-220 High Street	First Floor	2	0	31.09	26.95	0.87	Pass
		2	1	32.32	27.13	0.84	Pass
		2	2	32.49	26.82	0.83	Pass
		2	3	32.33	26.2	0.81	Pass
		2	4	32.08	25.69	0.80	Pass
		2	5	32.06	25.14	0.78	Fail
		2	6	31.62	24.55	0.78	Fail
		2	7	31.5	23.82	0.76	Fail
		2	8	31.21	23.39	0.75	Fail
216-220 High Street	Second Floor	11	0	35.59	30.88	0.87	Pass
		11	1	36.71	31.48	0.86	Pass
		11	2	36.86	30.56	0.83	Pass
		11	3	36.77	30.14	0.82	Pass
		11	4	36.66	29.31	0.80	Pass
		11	5	36.33	28.83	0.79	Pass
		11	6	36.08	28.12	0.78	Fail
		11	7	35.93	27.73	0.77	Fail
		11	8	35.8	27.85	0.78	Fail

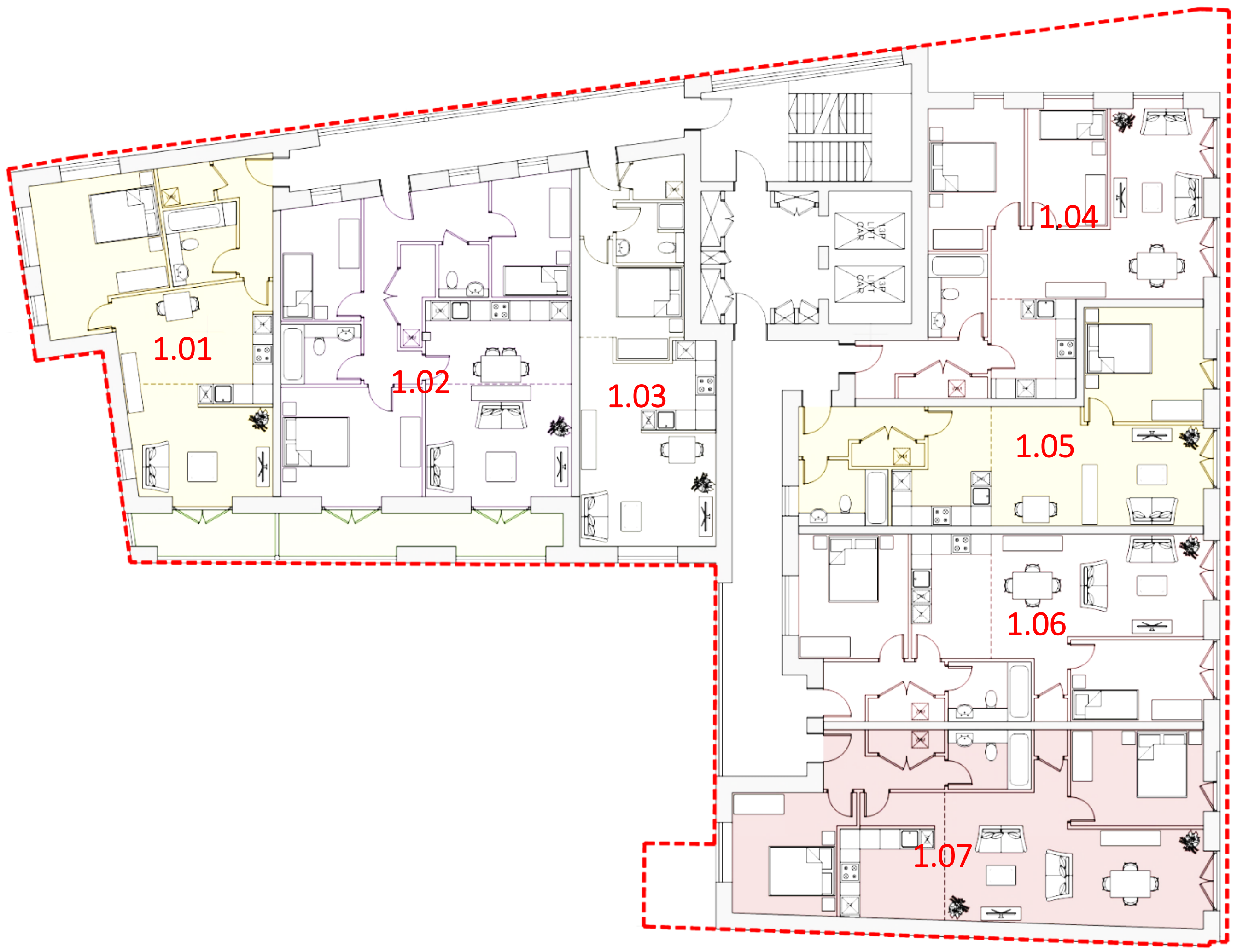
Building	Floor	Surface	Opening	Existing VSC	VSC with Proposed Development	Reduction Factor	Pass/Fail
222 High Street	First Floor	2	0	29.97	22.8	0.76	Fail
		2	1	29.39	22.51	0.77	Fail
		3	0	31.12	24.37	0.78	Fail
		8	0	16.54	15.71	0.95	Pass
		8	1	13.47	12.62	0.94	Pass
224 High Street	First Floor	9	0	28.27	22.29	0.79	Fail
		9	1	27.72	22.22	0.80	Pass
		9	2	27.53	22.45	0.82	Pass
224 High Street	Second Floor	2	0	33.28	26	0.78	Fail
		2	1	32.83	25.88	0.79	Fail
		2	2	32.49	26.21	0.81	Pass
224 High Street	Third Floor	5	0	36.54	30.32	0.83	Pass
		5	1	36.42	30.59	0.84	Pass
		5	2	35.54	30.45	0.86	Pass
226-230 High Street	First Floor	16	0	27.45	21.81	0.79	Pass
		16	1	26.5	21.41	0.81	Pass
		16	2	25.33	20.68	0.82	Pass
		16	3	24.22	20.81	0.86	Pass
		16	4	22.99	20.85	0.91	Pass
		16	5	22.88	20.99	0.92	Pass
		16	6	22.35	21.38	0.96	Pass
		16	7	22.18	21.55	0.97	Pass
226-230 High Street	Second Floor	14	0	32	25.91	0.81	Pass
		14	1	31.07	25.8	0.83	Pass
		14	2	30.27	25.18	0.83	Pass
		14	3	29.15	25.17	0.86	Pass
		14	4	28.27	25.33	0.90	Pass
		14	5	27.74	25.64	0.92	Pass
		14	6	27.34	25.82	0.94	Pass
		14	7	27.42	26.07	0.95	Pass
226-230 High Street	Third Floor/Roof	2	0	35.05	29.84	0.85	Pass
		3	0	33.08	29.78	0.90	Pass
		3	0	32.3	30.5	0.94	Pass
232-234 High Street	First Floor	8	0	36.22	35.95	0.99	Pass
		8	1	35.65	35.58	1.00	Pass
		8	2	35.1	34.76	0.99	Pass
		8	3	33.6	33.7	1.00	Pass
		8	4	31.38	31.36	1.00	Pass
		10	0	19.65	19.79	1.01	Pass
		11	0	20.58	20.56	1.00	Pass
		13	0	10.17	10.39	1.02	Pass
		14	0	22.09	21.69	0.98	Pass
		14	1	22	21.87	0.99	Pass
		14	2	22.61	21.91	0.97	Pass
		14	3	22.53	22.03	0.98	Pass
		14	4	22.82	22.54	0.99	Pass
		16	0	28.95	28.61	0.99	Pass

Building	Floor	Surface	Opening	Existing VSC	VSC with Proposed Development	Reduction Factor	Pass/Fail
232-234 High Street	Second Floor	2	0	14.48	13.98	0.97	Pass
		4	0	28.08	28.49	1.01	Pass
		5	0	29.6	29.34	0.99	Pass
		7	0	38.04	37.63	0.99	Pass
		7	1	37.68	37.5	1.00	Pass
		7	2	37.43	37.07	0.99	Pass
		7	3	37.02	36.91	1.00	Pass
		7	4	36.16	36	1.00	Pass
		14	0	26.84	26.18	0.98	Pass
		14	1	27.13	26.51	0.98	Pass
		14	2	27.33	26.13	0.96	Pass
		14	3	27.34	26.76	0.98	Pass
		14	4	27.8	27.17	0.98	Pass
		16	0	31.92	31.84	1.00	Pass
232-234 High Street	Third Floor	2	0	34.74	34.8	1.00	Pass
		4	0	33.46	33.69	1.01	Pass
		5	0	35.81	35.31	0.99	Pass
		7	0	39.11	38.8	0.99	Pass
		7	1	39.2	38.46	0.98	Pass
		7	2	38.92	38.4	0.99	Pass
		7	3	38.9	38.17	0.98	Pass
		7	4	38.71	38.02	0.98	Pass
		14	0	32.26	30.85	0.96	Pass
		14	1	32.48	31.1	0.96	Pass
		14	2	32.68	31.29	0.96	Pass
		14	3	32.64	31.6	0.97	Pass
		14	4	32.6	32.04	0.98	Pass
		16	0	35.31	35.42	1.00	Pass
232-234 High Street	Fourth Floor	2	0	39.26	38.56	0.98	Pass
		5	0	37.75	35.94	0.95	Pass
		5	1	37.74	36.48	0.97	Pass
		5	2	37.7	36.29	0.96	Pass
		5	3	37.91	36.37	0.96	Pass
		6	0	39.24	38.35	0.98	Pass
		6	1	39.36	38.17	0.97	Pass

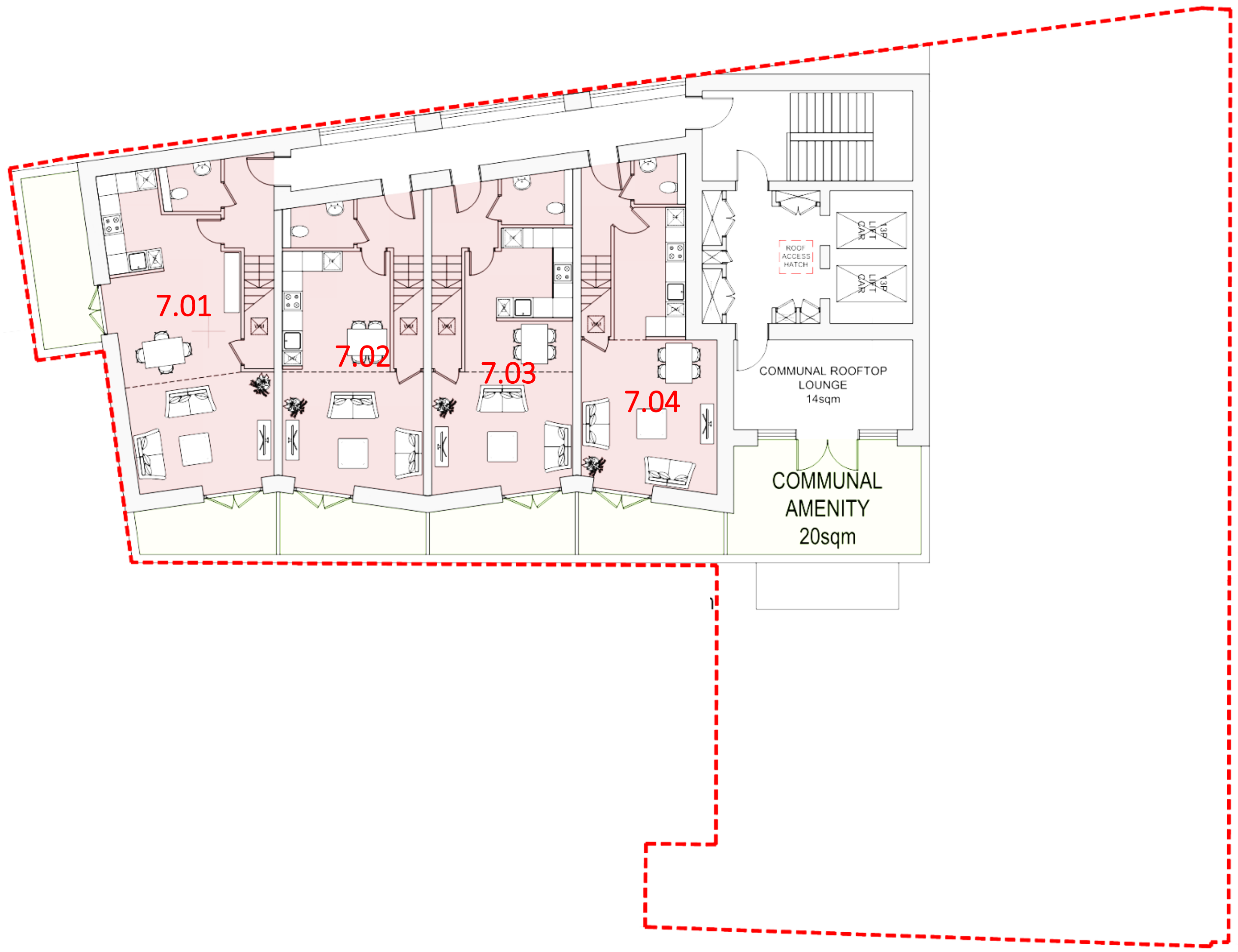
Building	Floor	Surface	Opening	Existing VSC	VSC with Proposed Development	Reduction Factor	Pass/Fail
		2	0	14.48	13.98	0.97	Pass

Appendix D: Flat numbering

Level 1



Level 7



Appendix E: Daylight Results

Flat	Room name	Daylight Factor	NSL	VSC
1-3 floor				
1.01	Bedroom	4.0%	1	
1.01	Kitchen/living	2.6%	1	39.08
1.02	Bedroom	2.3%	1	34.25
1.02	Kitchen/living	2.2%	1	38.97
1.02	Bedroom	3.3%	1	35.34
1.02	Bedroom	2.0%	1	39.45
1.03	Kitchen/living + bedroom	1.2%	1	37.22
1.04	Bedroom	3.0%	1	39.21
1.04	Kitchen/living	7.1%	0.76	39.80
1.04	Bedroom	2.0%	2	35.07
1.05	Bedroom	4.0%	1	39.99
1.05	Kitchen/living	0.7%	1	39.93
1.06	Bedroom	3.3%	1	39.37
1.06	Bedroom	2.4%	1	31.47
1.06	Kitchen/living	1.2%	1	40.02
1.07	Bedroom	4.4%	1	39.30
1.07	Bedroom	2.2%	1	39.93
1.07	Kitchen/living	0.6%	0.99	39.93
7/8 floor				
7.01	Kitchen/living	1.6%	1	39.99
7.02	Kitchen/living	1.6%	1	39.60
7.03	Kitchen/living	1.5%	1	39.69
7.04	Kitchen/living	1.2%	1	39.72
8.01	Bedroom North	2.7%	1	39.86
8.01	Bedroom South	2.9%	1	39.88
8.02	Bedroom North	0.7%	1	39.90
8.02	Bedroom South	3.4%	1	39.92
8.03	Bedroom North	0.8%	1	39.94
8.03	Bedroom South	3.6%	1	39.96
8.04	Bedroom North	1.6%	1	39.92
8.04	Bedroom South	2.7%	1	40.00

Appendix F: Glossary of Terms

Average Daylight Factor

The average daylight factor is the average indoor illuminance (from daylight) on the working plane within a room, expressed as a percentage of the simultaneous outdoor illuminance on a horizontal plane. It is calculated based on a uniform overcast sky.

Glare

Glare is the sensation produced by bright areas within the visual field, such as lit surfaces, parts of the luminaires, windows and/or roof lights. Glare shall be limited to avoid errors, fatigue and accidents. Glare can be experienced either as discomfort glare or as disability glare. In interior work places disability glare is not usually a major problem if discomfort glare limits are met. Glare caused by reflections in specular surfaces is usually known as veiling reflections or reflected glare.

Illuminance

The amount of light falling on a surface per unit area, measured in lux.

Point daylight factor

A point daylight factor is the ratio between the illuminance (from daylight) at a specific point on the working plane within a room, expressed as a percentage of the illuminance received on an outdoor unobstructed horizontal plane.

Uniformity

The uniformity is the ratio between the minimum illuminance (from daylight) on the working plane within a room (or minimum daylight factor) and the average illuminance (from daylight) on the same working plan (or average daylight factor).

View of sky/no sky line

Areas of the working plane have a view of sky when they receive direct light from the sky, i.e. when the sky can be seen from working plane height. The no-sky line divides those areas of the working plane, which can receive direct skylight, from those that cannot.

Working plane

CIBSE LG10 defines the working plane as the horizontal, vertical or inclined plane in which a visual task lies. The working plane is normally taken as 0.7m above the floor for offices and 0.85 m for industry.