

Daylight, Sunlight and Overshadowing Study

MIX Manchester

CBRE Limited

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ADMINISTRATION PAGE

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EXECUTIVE SUMMARY

Report Purpose

Pager Power has been retained to assess the potential effects of overshadowing upon a proposed building development at Enterprise Way, Manchester. This assessment presents analysis to determine the predicted skylight and sunlight within the proposed development and neighbouring buildings.

Assessment Conclusions – Neighbouring Buildings

With respect to skylight, for all windows the predicted decrease in the vertical sky component, relative to the baseline value, is less than the BRE recommended threshold of 20%. Therefore, all windows are predicted to retain at least 80% of their existing skylight. A low impact is predicted and mitigation is not recommended.

With respect to sunlight, for all windows the predicted decrease in the annual probable sunlight hours, relative to the baseline value, is less than the BRE recommended threshold of 20%. Therefore, these windows are predicted to retain at least 80% of their existing sunlight. A low impact is predicted and mitigation is not recommended.

Assessment Conclusions – Proposed Development

With respect to skylight, most windows are predicted to meet the recommended threshold of 27% of the vertical sky component. For windows which do not meet the threshold, significant mitigating factors have been identified:

- Many of these windows are glass doors which will likely lead onto a corridor or less sensitive rooms;
- Many of these windows are taller than conventional, 2.8m and many are wide allowing for improved lighting compared to typical designs;
- For any remaining windows, internal design can be adapted to ensure any room with these windows have at least one other window, allowing for improved lighting.

A low impact is predicted and mitigation is not recommended.

With respect to sunlight, most windows are predicted to meet the recommended threshold of 25% annual probable sunlight hours and 5% winter sunlight hours. Significant mitigating factors have been identified.

North facing windows are not predicted to meet the thresholds for sunlight. This is to be expected and is acknowledged within the associated guidance.

A low impact is predicted and mitigation is not recommended.

Overall Conclusions

Significant overshadowing upon existing neighbouring properties is not predicted as a result of the proposed development with consideration of mitigating factors.

The development is predicted to comply with BRE guidance, the findings of this report should be considered when designing internal layouts to maximise use of available daylight.

Mitigation is not recommended.

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ABOUT PAGER POWER

Pager Power is a specialist technical consultancy based in the United Kingdom and has been providing independent expertise on planning issues for solar, wind, and building developments for over 20 years.

Established in 1997, the company initially specialised in assessing the impact of wind turbines on radar systems. Pager Power has since expanded into a multidisciplinary technical planning consultancy that offers a comprehensive range of services and has supported renewable and building projects in more than 60 countries.

Pager Power's core competencies now include:

- Aviation and Radar;
- Daylight, Sunlight and Overshadowing;
- Glint and Glare;
- Shadow Flicker;
- Telecommunications.

Using proprietary modelling software, each study is tailored to the individual project, ensuring that results are relevant, defensible, and aligned with current national and international standards. The company also provides planning support and stakeholder consultation across all service areas, helping clients to understand constraints, explore potential mitigation options, and forge a path forward for their projects.

Pager Power's work helps our clients identify potential risks, inform project design, and support the decision-making process, and can provide support at any stage of a project, from initial feasibility through to completion. Pager Power's assessments – recognised for their objectivity, accuracy, and technical integrity – are designed to withstand legal scrutiny and trusted by developers and stakeholders alike.

1 INTRODUCTION

1.1 Introduction

Pager Power has been retained to assess the potential effects of overshadowing upon a proposed building development at Enterprise Way, Manchester. This assessment presents analysis to determine the predicted skylight and sunlight within the proposed development and neighbouring buildings.

This report contains the following:

- Proposed building details;
- Explanation of daylight, sunlight, and overshadowing;
- Overview of relevant guidance;
- Assessment methodology;
- Modelling of the existing surrounding environment;
- Identification of receptors;
- Skylight and sunlight assessment for identified receptors;
- Results discussion;
- Conclusions and recommendations.

1.2 Pager Power's Experience

Pager Power has undertaken technical assessments for solar, wind and building developments in the UK and internationally. Pager Power is experienced in assisting developers with the planning process and working with stakeholders to minimise the technical impact of developments.

1.3 Daylight, Sunlight, and Overshadowing Definitions

The definitions¹ of skylight, sunlight, and overshadowing are as follows:

- Skylight – the part of sky radiation capable of causing a visual sensation;
- Sunlight – the part of direct solar radiation capable of causing a visual sensation;
- Overshadowing – the effect upon skylight and sunlight at an observer's location, from neighbouring buildings or obstructions.

The term 'daylight' is used to refer to all visible parts of global solar radiation i.e. skylight and sunlight.

¹ These definitions are aligned with those used in BS EN 17037:2018 and BRE 209 (Site layout planning for daylight and sunlight).



2 PROPOSED DEVELOPMENT DETAILS

2.1 Overview

Four commercial units and one multi-storey car park (MSCP) are proposed. Figure 1 below shows the footprint² of the proposed development, overlaid upon aerial imagery.

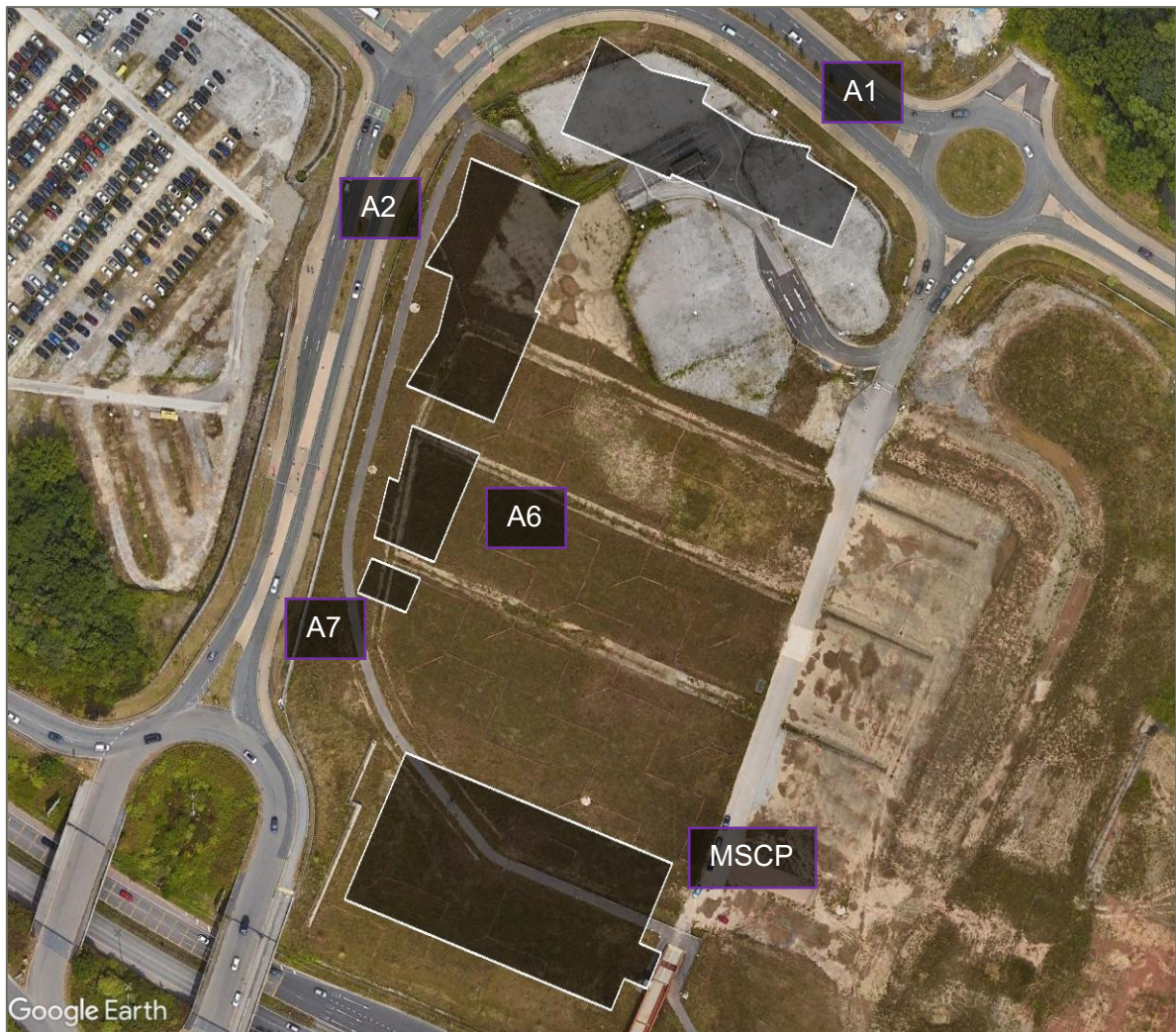


Figure 1 *site footprint*

2.2 Elevations

Figures 2 to 6 on the following pages show a representation of proposed elevations of the whole development. Figure 7 on page 16 shows the layout plans of the development. The internal layout for the development has not been confirmed.

² Source: 23019-GAA-ZZ-00-DR-T-2000.pdf

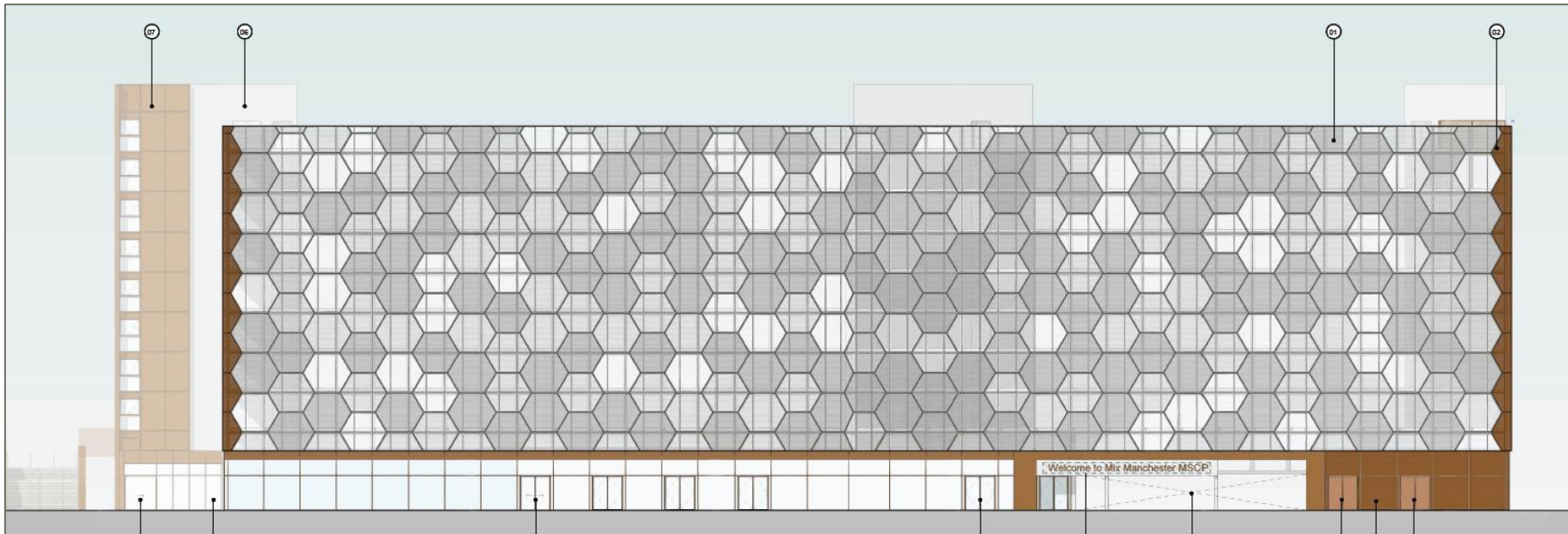


Figure 2 Elevation Diagrams – MSCP



Figure 3 Elevation Diagrams – A1



Figure 4 *Elevation Diagrams – A2*

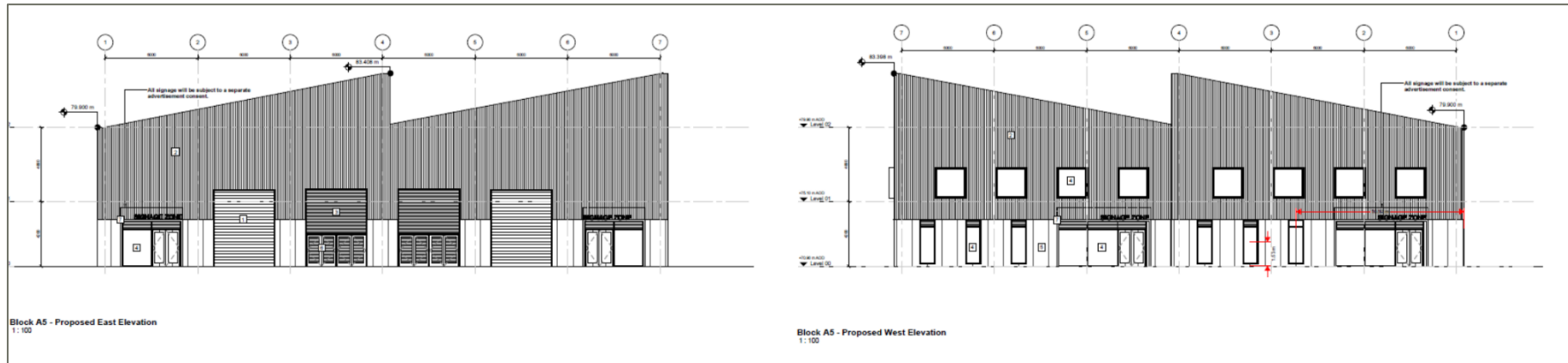


Figure 5 Elevation Diagrams – A6

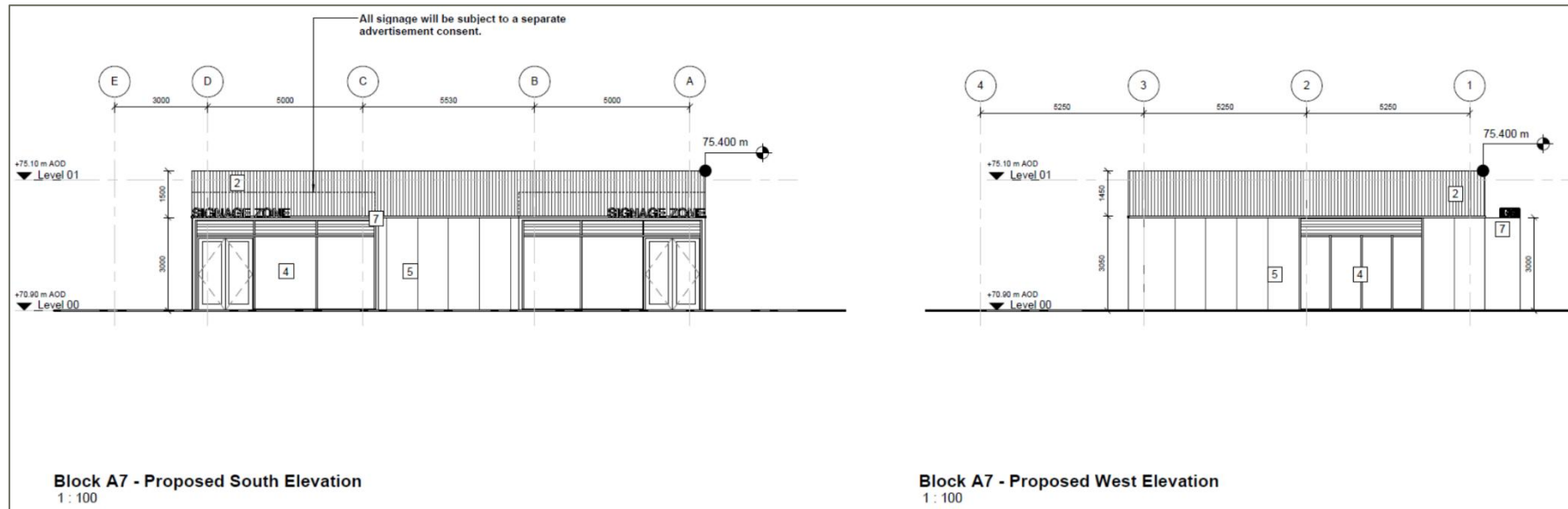


Figure 6 Elevation Diagrams – A7

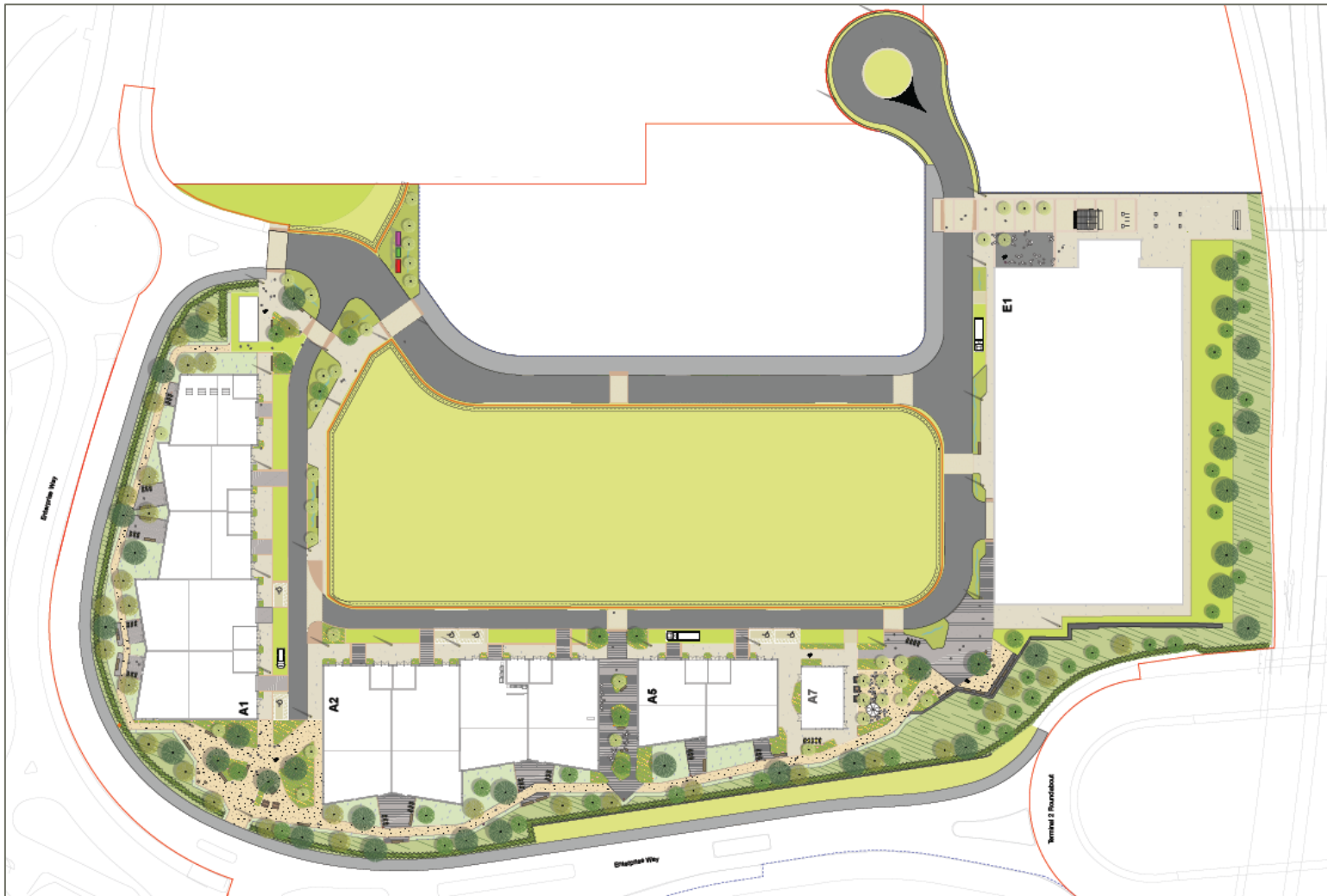


Figure 7 Proposed development layout

2.3 3D Visualisation

Building coordinates and heights are extrapolated from the site drawings, a summary of which are presented in Appendix C.

Figure 8 shows a simplified 3D visualisation of the proposed development in the context of existing development utilising Google Earth's 3D imagery.

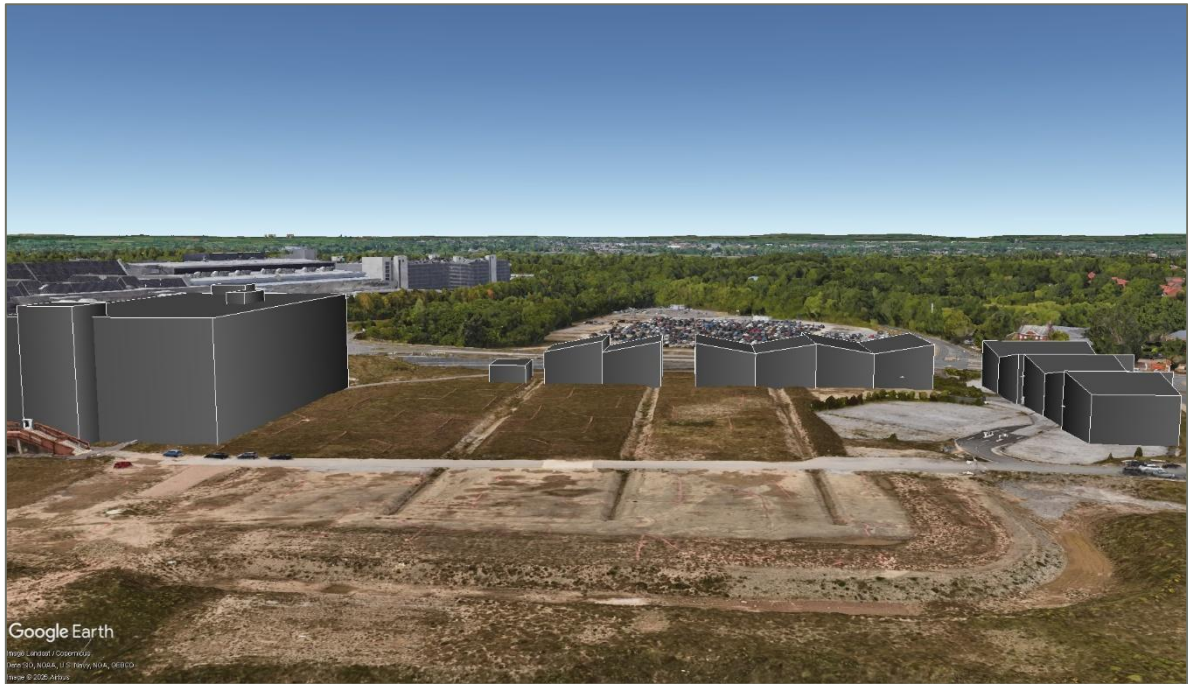


Figure 8 *Proposed structures – 3D visualisation*

3 SKYLIGHT AND SUNLIGHT ASSESSMENT METHODOLOGY

3.1 Guidance

Appendix A presents a review of relevant guidance with regard to daylight and sunlight overshadowing issues.

3.2 Methodology

The daylight, sunlight assessment methodology has been based on BRE 209³ and BS EN 17037:2018⁴. The methodology outlined in these documents is an industry standard and is widely accepted as the most relevant method of assessing overshadowing considerations in the UK.

The general methodology for this assessment is as follows:

1. Identify the receptors of concern. In this instance the concern is overshadowing from the proposed development upon itself and surrounding existing buildings;
2. Choose appropriate receptor locations. For most buildings this will be window locations, but where large expanses of glazing are present, an appropriate resolution may be used);
3. Undertake geometric calculations to determine skylight and sunlight for the identified window receptors with both a pre- and post-construction case;
4. If overshadowing can occur, determine whether:
 - a) The identified receptors would experience levels of skylight/sunlight below the relevant thresholds; and/or
 - b) The difference between the pre- and post-construction case is significant (i.e. the post-construction case is less than 0.8 times the pre-construction value, equivalent to a 20% reduction);
5. If a scenario is possible that presents the potential for significant overshadowing, consider other mitigating factors such as whether alternative target values are appropriate;
6. Determine whether the overshadowing is likely to result in a significant loss of amenity factoring in all of the above;
7. Consider mitigation, if appropriate.

³ Littlefair P.J. et al, 'Sun layout planning for daylight and sunlight', BRE BR209, (1991, Third edition 2022).

⁴ British Standards Institution, 'Daylight in buildings'.



3.3 Assumptions and Limitations

Key assumptions and limitations regarding the analysis of windows in this report are listed below:

- The assessment assumes that all identified obstructions are solid objects which do not contain any transparent or translucent areas. Most buildings will contain areas of glazing which could allow skylight and/or sunlight to be transmitted through the obstruction in certain conditions;
 - Where trees and other vegetation have been modelled as obstructions, a level of transparency is assumed based upon the species of the vegetation and in accordance with Appendix G of BRE 209;
- The modelling software does not consider the effect of reflective surfaces or other elements of the surrounding environment, which may positively affect the amount of daylight that a window would receive;
- It is often difficult to discern the use and dimensions of buildings and/or individual rooms within buildings. For this reason, all identified receptors are assessed as the most sensitive receptor type unless their use can be confidently ascertained.

Considering these points, the modelling output is therefore conservative and further interpretation of the results may be required to provide a more accurate result and determine any impact (see Section 6).

4 IDENTIFICATION OF RECEPTORS

4.1 External Receptors

External receptors refer to windows within existing neighbouring buildings which have the potential to be overshadowed by the proposed development.

4.1.1 Skylight Receptors

There is formal guidance produced by BRE with regard to the maximum distance at which overshadowing impacts upon skylight and sunlight should be assessed. This is stated to be three times the height of the proposed development relative to the lowest window. This assessment area has been mapped and relevant windows identified within this area are considered for geometric modelling. The window receptor used to assess skylight effects are shown in Section 4.1.3.

4.1.2 Sunlight Receptors

According to the BRE guidance, windows are only required to be assessed for sunlight considerations where they face within 90° of south and are further north than the southern-most point of the proposed development.

Sunlight effects have been assessed for all windows identified for skylight effects, for completeness. The window receptor used to assess sunlight effects are shown in Section 4.1.3.

4.1.3 Identified Window Receptors

Coordinates and heights for the surrounding buildings and their windows have been obtained using and available Google Earth imagery and publicly available records. The receptor details are presented within Appendix D, terrain elevations have been interpolated based upon the Ordinance survey data.

A total of 72 windows have been identified for geometric modelling, all belonging to the north and west facing walls of the Tribe Hotel. All external windows have been considered as serving hotel accommodation.



4.2 Internal Receptors

Internal receptors refer to windows within the proposed development to assess the predicted daylight available in proposed units.

4.2.1 Skylight Receptors

All windows within the proposed development have been taken forward for assessment of skylight. An internal layout of the proposed development has not been confirmed, therefore this assessment has assumed all windows of the proposed development are for office spaces, as a worst case scenario.

4.2.2 Sunlight Receptors

According to the BRE guidance, windows are only required to be assessed for sunlight considerations where they face within 90° of south.

Sunlight effects have been assessed for all windows identified for skylight effects, for completeness. The window receptors used to assess sunlight effects are shown in Section 4.2.3.

4.2.3 Identified Internal Receptors

In total, 158 windows have been identified across the five proposed plots.

Window receptors are identified using the following labels, "Plot number - Floor Level (ground level or first floor) – Window Number". For example, window receptor "A7 G 2" is the second window of the ground floor of Plot A7.

The height above finished floor level of each window has been estimated using the elevation drawings of the proposed development. It is not expected that minor alterations to the window heights would have a significant effect upon the skylight and sunlight modelling results.

5 OBSTRUCTION DETAILS

5.1 Overview

The existing buildings and obstructions around the assessed windows contribute significantly to the baseline scenario for skylight and sunlight and may be significant in the overall impact post-construction. Pager Power's modelling only considers existing buildings and obstructions where a receptor has line of sight to them and where they are likely to significantly obstruct views from an assessed receptor.

The geometry of obstructions is simplified where it does not impact the modelling results, such as dormer windows and chimneys.

5.2 Proposed Development

The proposed development has been considered in the post-construction scenario. A visualisation of the proposed development is presented in Section 2.3.

The building co-ordinates and heights have been extrapolated from the site plans and topographical survey data. It has been assumed that the buildings will have no protruding elements and will be perpendicular (90 degrees) to the horizontal (ground). Co-ordinate data for the proposed development is presented in Appendix C.

Overall, the modelling results are considered conservative. Further assumptions are presented in Section 3.3.

5.3 Existing Buildings and Obstructions

Considering the height and orientation of the assessed windows, the relevant obstructions include the Dekota Hotel (currently under construction), the Tribe Hotel and the nearby footbridge.

Figure 9 on the following page shows a summary of the modelled obstructions. Existing (and under construction) buildings are shown in blue. The proposed development is shown in grey for reference.



Figure 9 *Modelled obstructions, overview*

6 GEOMETRIC ASSESSMENT RESULTS AND DISCUSSION

6.1 Skylight Results

6.1.1 Impact Significance Determination

The process for quantifying the impact significance of skylight overshadowing is outlined in Appendix B. The key considerations are:

- Whether overshadowing is predicted to be experienced in practice;
- The vertical sky component (VSC) at the affected window;
 - Relative to the threshold of 27% VSC;
 - A 20% reduction in VSC from the baseline conditions;
 - The No Sky Line in the affected room, relative to a 20% reduction to the area of the working plane which can see the sky.

Where effects are predicted to keep VSC above 27% **and** keep the VSC to at least 80% of baseline conditions, the impact significance is negligible, and mitigation is not recommended.

Where effects are predicted to either keep VSC above 27% or keep the VSC to at least 80% of baseline conditions, **and** the area of the working plane which can see the sky remains at least 80% of the baseline value, the impact significance is low, and mitigation is not recommended.

Where effects are predicted to reduce the VSC to below 27% and less than 80% of baseline conditions **and/or** reduce the area of the working plane which can see the sky to less than 80% of the baseline value, expert assessment of the following factors is required to determine the impact significance and mitigation requirement:

- The extent of VSC and working plane reduction. A smaller reduction is more likely to be considered acceptable in the presence of other mitigating factors;
- The proportion of VSC and working plane remaining. If the total values remain high, a reduction could be considered less significant;
- Whether an affected room looks to have other windows which could provide daylight. It may be that even if one window is shaded, an adjacent window may allow daylight;
- The design of the affected building, and the baseline conditions. If the affected building is sited close to the boundary, or has overhangs which would obstruct daylight, it may be infeasible to avoid a large reduction in daylight;
- The height of existing nearby buildings. A larger reduction of daylight may be necessary to enable a development to match the size of surrounding buildings.

Following consideration of these factors, where the overshadowing is not deemed significant, a low impact is predicted, and mitigation is not recommended. Where the overshadowing is deemed significant, the impact significance is moderate, and mitigation is recommended.

If there are no mitigating factors and the effects are predicted to reduce the VSC to below 15% **and** reduce the area of the working plane which can see the sky to less than 80% of the baseline value, the impact significance is high, and mitigation is required.

If the VSC is predicted to be below 5%, the impact significance is high and it is likely to be impossible to ensure adequate daylight, even with mitigation measures.

6.1.2 Results Discussion – External Receptors

A summary of the modelling results for external window receptors is shown in Table 1 on the following page, which identifies the overall results for each assessed window. Full results are presented in Appendix E.

The proposed development is not predicted to significantly overshadow the skylight received by the Tribe Hotel. A negligible impact is predicted upon this building and mitigation is not recommended.

Building (Total windows)	Modelling Result (VSC)	Associated Number of Windows	Commentary	Impact Significance
Tribe Hotel (72)	Ratio ≥ 0.8 and/or $>27\%$	72	No significant overshadowing of skylight is predicted	Negligible impact
	Ratio < 0.8 and/or $<27\%$	0		

Table 1 Results summary – External receptors – Skylight



6.1.3 Results Discussion – Internal Receptors

A summary of the modelling results is shown in Table 2 on the following page, which identifies the overall results for each assessed window. Full results are presented in Appendix E.

149 of the 158 windows, proportion of 94.3%, pass the 27% threshold for vertical sky component.

For windows which do not meet the threshold, significant mitigating factors have been identified:

- Many of these windows are glass doors which will likely lead onto a corridor or less sensitive rooms;
- Many of these windows are taller than conventional, 2.8m and many are wide allowing for improved lighting compared to typical designs;
- For any remaining windows, internal design can be adapted to ensure any room with these windows have at least one other window, allowing for improved lighting.

While a moderate impact is predicted upon some windows when assessed in isolation, an overall low impact is predicted when considered in the wider context of the development.

Overall, it is deemed that the proposed development will receive a sufficient level of skylight despite not all windows meeting the recommended thresholds, with consideration of mitigating factors.

A low impact is predicted and mitigation is not recommended.

Plot (Total windows)	Modelling Result (VSC)	Associated Number of Windows	Commentary	Impact Significance
A1 (63)	>27%	59	The recommended threshold is exceeded	Negligible impact
	<27%	4	Three windows are taller than conventional, 2.8m allowing for improved lighting compared to typical designs All of these windows have a VSC >20%	Low impact
A2	>27%	65	The recommended threshold is exceeded	Negligible impact
	<27%	1	The window is taller than conventional, 2.8m allowing for improved lighting compared to typical designs This window has a VSC of 26.2%, very close to the threshold	Low impact
A6	>27%	20	The recommended threshold is exceeded	Negligible impact
	<27%	2	1 window is taller than conventional, 2.8m allowing for improved lighting compared to typical designs The remaining window has a VSC of 25.6%	Low impact



Plot (Total windows)	Modelling Result (VSC)	Associated Number of Windows	Commentary	Impact Significance
A7 (66)	>27%	4	The recommended threshold is exceeded	Negligible impact
	<27%	2	Both windows are taller than conventional, 2.8m allowing for improved lighting compared to typical designs	Low impact

Table 2 Results summary – Internal receptors – Skylight



6.2 Sunlight Results

6.2.1 Impact Significance Determination

The process for quantifying the impact significance of sunlight overshadowing is outlined in Appendix B. The key considerations are:

- Whether overshadowing is predicted to be experienced in practice;
- The predicted reduction of annual probable sunlight hours (APSH), either for the full year or the period between the autumn and spring equinox (whichever is greater), relative to a threshold of:
 - A 20% reduction;
- The proportion of total APSH predicted at the receptor, relative to thresholds of:
 - 25% of total APSH per year;
 - 5% of total APSH between the autumn and winter equinox (winter sunlight).

Where overshadowing is geometrically possible but expected to be screened by existing obstructions, no impact is predicted, and mitigation is not required.

Where effects are predicted to reduce experienced APSH by 20% or less, and this reduction will not reduce the proportion of total APSH to less than 25% per year and 5% between the autumn and winter equinox, the impact significance is low, and mitigation is not recommended.

Where effects are predicted to reduce experienced APSH by more than 20% **and/or** reduce the proportion of total APSH to less than 25% per year or 5% between the autumn and winter equinox, expert assessment of the following factors is required to determine the impact significance and mitigation requirement:

- The extent of APSH reduction. A smaller reduction is more likely to be considered acceptable in the presence of other mitigating factors;
- The proportion of total APSH remaining. If the total proportion of APSH remains significantly greater than 25%, a reduction in experienced APSH could be considered less significant;
- Whether the dwelling appears to have windows facing the position of the sun at the time of predicted overshadowing. An observer may need to look at an acute angle to observe the sun from the window, and therefore the sunlight would not be expected to reach far into the room;
- Whether an affected room looks to have other windows which could provide sunlight. It may be that even if one window is shaded, an adjacent window may allow sunlight;
- The design of the affected building, and the baseline conditions. If the affected building is sited close to the boundary, or has overhangs which would obstruct sunlight, it may be infeasible to avoid a large reduction in sunlight;
- The height of existing nearby buildings. A larger reduction of sunlight may be necessary to enable a development to match the size of surrounding buildings.



Following consideration of these factors, where the overshadowing is not deemed significant, a low impact is predicted, and mitigation is not recommended. Where the overshadowing is deemed significant, the impact significance is moderate, and mitigation is recommended.

If there are no mitigating factors and the effects are predicted to reduce experienced APSH by greater than 20% **and** reduce the proportion of total APSH to less than 25% per year or 5% between the autumn and winter equinox, the impact significance is high, and mitigation is required.

6.2.2 Results Discussion – External Receptors

A summary of the modelling results for external window receptors is shown in Table 3 on the following page, which identifies the overall results for each assessed window. Full results are presented in Appendix E.

The proposed development is not predicted to significantly overshadow the sunlight received by existing neighbouring windows.

At worst, a low impact is predicted and mitigation is not recommended.

Building (Total windows)	Modelling Result		Associated Number of Windows	Commentary	Impact Significance
Tribe Hotel (72)	APSH	Ratio ≥ 0.8 and/or $>25\%$	72	Overshadowing is not geometrically possible	No impact
		Ratio < 0.8 and/or $<25\%$	0		
	WSH	Ratio ≥ 0.8 and/or $>5\%$	72	Overshadowing is not geometrically possible	No impact
		Ratio < 0.8 and/or $<5\%$	0		

Table 3 Results summary – External receptors – Sunlight



6.2.3 Results Discussion – Internal Receptors

A summary of the modelling results for internal window receptors is shown in Table 4 on the following page, which identifies the overall results for each assessed window. Full results are presented in Appendix E.

A high proportion of the flats meet and exceed the recommended thresholds for sunlight. Where windows do not meet the thresholds, significant mitigating factors have been identified:

- Living rooms typically perform better than bedrooms, reflecting best practice design;
- Windows are taller than typical, (2.1m) and many are wide allowing for improved lighting compared to conventional designs;
- Many living rooms and some bedrooms are dual aspect allowing lighting from a wider range of angles;
- Vegetation at the site boundary obstructs the key angles from which the sun would shine upon the window. However, trees are less intrusive obstruction than a building as they produce dappled shade rather than blocking all light;
- Windows are north facing and therefore are not expected to receive significant sunlight, as acknowledged within the associated guidance.

Overall, it is deemed that the proposed flats will receive a sufficient level of sunlight despite not all windows meeting the recommended thresholds, with consideration of mitigating factors and living rooms performing on average better than bedrooms reflecting good design.

A low impact is predicted and mitigation is not recommended.

Building (Total windows)	Modelling Result		Associated Number of Windows	Commentary	Impact Significance
A1 (63)	APSH	>25%	13	The recommended threshold is exceeded	Low impact
		<25%	50	48 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
				For the remaining two windows, both windows are taller than conventional, 2.8m allowing for improved lighting compared to typical designs	
	WSH	>5%	7	The recommended threshold is exceeded	Low impact
		<5%	56	52 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
				For three of the four windows, the windows are taller than conventional, 2.8m allowing for improved lighting compared to typical designs For the remaining window, design changes can be incorporated to reduce the overall impact, such as putting a less sensitive room behind it, or ensuring multiple windows lead onto the same room	



Building (Total windows)	Modelling Result		Associated Number of Windows	Commentary	Impact Significance
A2 (66)	APSH	>25%	46	The recommended threshold is exceeded	Low impact
		<25%	20	All 20 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
	WSH	>5%	46	The recommended threshold is exceeded	Low impact
		<5%	20	All 20 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
A6 (22)	APSH	>25%	18	The recommended threshold is exceeded	Low impact
		<25%	4	All 4 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
	WSH	>5%	16	The recommended threshold is exceeded	Low impact
		<5%	6	All 6 windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	



Building (Total windows)	Modelling Result		Associated Number of Windows	Commentary	Impact Significance
A7 (6)	APSH	>25%	4	The recommended threshold is exceeded	Low impact
		<25%	2	Both windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	
	WSH	>5%	4	No significant overshadowing of winter sunlight is predicted	Low impact
		<5%	2	Both windows are north facing. The guidance acknowledges it is very difficult for north facing windows to receive significant sunlight	

Table 4 Results summary – Internal receptors – Sunlight



7 OVERALL CONCLUSIONS

7.1 Assessment Conclusions – Neighbouring Buildings

With respect to skylight, for all windows the predicted decrease in the vertical sky component, relative to the baseline value, is less than the BRE recommended threshold of 20%. Therefore, all windows are predicted to retain at least 80% of their existing skylight. A low impact is predicted and mitigation is not recommended.

With respect to sunlight, for all windows the predicted decrease in the annual probable sunlight hours, relative to the baseline value, is less than the BRE recommended threshold of 20%. Therefore, these windows are predicted to retain at least 80% of their existing sunlight. A low impact is predicted and mitigation is not recommended.

7.2 Assessment Conclusions – Proposed Development

With respect to skylight, most windows are predicted to meet the recommended threshold of 27% of the vertical sky component. For windows which do not meet the threshold, significant mitigating factors have been identified:

- Many of these windows are glass doors which will likely lead onto a corridor or less sensitive rooms;
- Many of these windows are taller than conventional, 2.8m and many are wide allowing for improved lighting compared to typical designs;
- For any remaining windows, internal design can be adapted to ensure any room with these windows have at least one other window, allowing for improved lighting.

A low impact is predicted and mitigation is not recommended.

With respect to sunlight, most windows are predicted to meet the recommended threshold of 25% annual probable sunlight hours and 5% winter sunlight hours. Significant mitigating factors have been identified.

North facing windows are not predicted to meet the thresholds for sunlight. This is to be expected and is acknowledged within the associated guidance.

A low impact is predicted and mitigation is not recommended.

7.3 Overall Conclusions

Significant overshadowing upon existing neighbouring properties is not predicted as a result of the proposed development with consideration of mitigating factors.

The development is predicted to comply with BRE guidance, the findings of this report should be considered when designing internal layouts to maximise use of available daylight.

Mitigation is not recommended.



APPENDIX A – OVERVIEW OF DAYLIGHT, SUNLIGHT AND OVERSHADOWING GUIDANCE

Overview

The most relevant guidance and regulations relating to Daylight, Sunlight, and Overshadowing are BRE 209 and BS 17037:2018.

An overview of this guidance is presented below. This is not a comprehensive review of the sources, rather it is intended to give an overview of the important parameters and considerations that have informed this assessment.

BRE 209

The third edition of BRE 209 was issued in 2022, updating the guidance to better follow the requirements of BS 17037. The document contains guidance regarding the provision of daylight within proposed developments, existing buildings nearby, and nearby development land. It is an advisory document, rather than formal policy, and there is recognition within the guidance that target values may be altered to meet the requirements of individual developments and surrounding environments. There is also recognition that for large developments in urban areas, it is infeasible to expect full compliance with the guidance in all situations. The document states⁵:

The guide is intended for building designers and their clients, consultants, and planning officials. The advice given here is not mandatory and the guide should not be seen as an instrument of planning policy; its aim is to help rather than constrain the designer. Although it gives numerical guidelines, these should be interpreted flexibly since natural lighting is only one of many factors in site layout design. In special circumstances the developer or planning authority may wish to use different target values. For example, in a historic city centre, or in an area with modern high-rise buildings, a higher degree of obstruction may be unavoidable if new developments are to match the height and proportions of existing buildings. Alternatively, where natural light is of special importance, less obstruction and hence more sunlight and daylight may be deemed necessary.

This guidance document, whilst not policy, is considered an industry standard and has been heavily relied upon to influence Pager Power's approach to daylight and sunlight assessment, as shown in Section 6 of this report.

⁵ BRE 209, 1.6

Assessment of Skylight

BRE 209 recommends assessment of windows for skylight which are part of the proposed development, and those which are part of nearby existing buildings. For windows in new developments, the guidance recommends an initial assessment of Vertical Sky Component (VSC) in order to determine the likelihood of adequate daylighting⁶:

Obstructions can limit access to light from the sky. This can be checked at an early design stage by measuring or calculating the angle of visible sky θ , angle of obstruction or vertical sky component (VSC) at the centre of the lowest window where daylight is required. If VSC is:

- at least 27% (θ is greater than 65° , obstruction angle less than 25°) conventional window design will usually give reasonable results.*
- between 15% and 27% (θ is between 45° and 65° , obstruction angle between 25° and 45°) special measures (larger windows, changes to room layout) are usually needed to provide adequate daylight.*
- between 5% and 15% (θ is between 25° and 45° , obstruction angle between 45° and 65°) it is very difficult to provide adequate daylight unless very large windows are used.*
- less than 5% (θ less than 25° , obstruction angle more than 65°) it is often impossible to achieve reasonable daylight, even if the whole window wall is glazed.*

BRE further recommends that daylight factor or interior illuminance can be calculated to ensure that new rooms comply with BS EN 17037.⁷

Regarding existing buildings, it is recommended that windows should be assessed where the horizontal distance to the new development is no more than three times the height of the development above the relevant window. Furthermore, windows may be assumed not to be significantly impacted if no part of the proposed development subtends more than 25° vertically from the window (relative to the horizontal). If a window falls within this range, the VSC can be calculated in order to give an indication of the likely effect of the proposed development upon skylight at the neighbouring window. In addition to the thresholds presented for proposed development windows, effects upon existing buildings can be considered with reference to the baseline scenario, with significant effects predicted where the post-construction VSC is less than 0.80 the baseline value (a 20% reduction).

The BRE guidance also recommends that the 'no sky line' is assessed where room dimensions are available for existing buildings.⁸ This quantifies the proportion of the working plane within a room (considered to be 0.85m in residential rooms and 0.7m in offices) which has direct sight of the unobstructed sky. It is not recommended that these calculations are undertaken where room and window dimensions are unknown or estimated.

⁶ BRE 209, 2.1.21

⁷ BRE 209, 2.1.22

⁸ BRE 209, 2.2.10

Assessment of Sunlight

Similarly to skylight considerations, BRE 209 recommends that sunlight is assessed for windows which make up proposed new buildings along with surrounding existing buildings. For new developments it is considered that the most important factor affecting the provision of sunlight is site layout, and it is preferable to site as many rooms as possible to contain south-facing windows.⁹ It will not always be possible to avoid residences with predominantly north-facing windows, especially in large developments, but it is important to minimise the proportion of residences without south-facing windows.

Overshadowing can also have a significant effect upon the sunlight received by new developments, both from the proposed development upon itself and from surrounding buildings. It is recommended that windows should receive a minimum of 1.5 hours of sunlight on the equinox.¹⁰ This applies equally to all windows but is less likely to be achievable for north-facing windows.¹¹

Another measure which can provide a more comprehensive assessment of sunlight across the year (rather than just on the equinox) is to measure annual probable sunlight hours (APSH). This is the recommended method to assess the effect upon existing buildings, with windows requiring assessment where¹²:

- *Some part of a new development is situated within 90° of due south of a main window wall of an existing building.*
- *In the section drawn perpendicular to this existing window wall, the new development subtends an angle greater than 25° to the horizontal measured from the centre of the lowest window to a main living room).*

Windows must also face within 90° of south in order to be assessed¹³, and full assessment is not required where a window has an azimuth between 160° and 200° and has a VSC greater than 27%¹⁴.

Windows are considered to receive adequate sunlight where the APSH is greater than 25% and a window receives greater than 5% of APSH between the autumn and spring equinoxes.¹⁵ As with skylight considerations, effects upon existing buildings can be considered with reference to the baseline scenario, with significant effects predicted where the post-construction APSH is less than 0.80 the baseline value (a 20% reduction).

⁹ BRE 209, 3.1.5

¹⁰ BRE 209, 3.1.10

¹¹ BRE 209, 3.1.11

¹² BRE 209, 3.2.2

¹³ BRE 209, 3.2.3

¹⁴ BRE 209, 3.2.9

¹⁵ BRE 209, 3.2.6

British Standard 17037:2018

BS EN 17037 replaced the previous standard relating to daylighting (BS 8206-2) in 2019, introducing a more complex modelling requirement for daylighting in new developments. This British Standard is considered in the third edition of BRE 209, and the updated BRE guidance adopts the new requirements in this publication.

This document provides reference tables for daylight factors in different UK and international locations, which correspond to the target illuminance values for rooms in new buildings. This has been incorporated into the BRE Guidance and is included in the previous section.

APPENDIX B – OVERSHADOWING IMPACT SIGNIFICANCE

Overview

The significance of overshadowing will vary for different receptors. The following section presents a general overview of the significance criteria with respect to experiencing overshadowing.

Impact Significance Definition

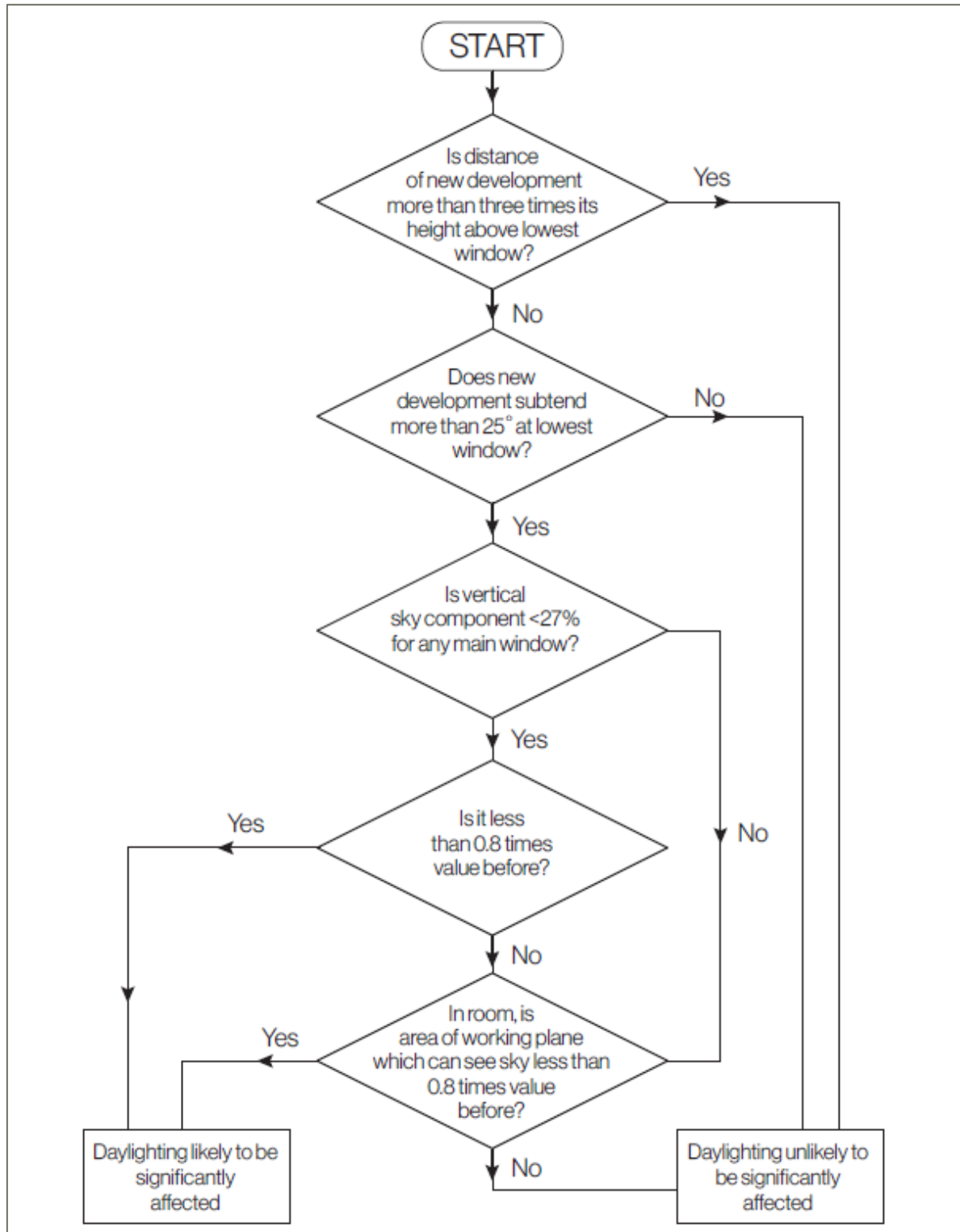
The table below presents the recommended definition of ‘impact significance’ in overshadowing terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation
No Impact	Overshadowing is not geometrically possible or will not be visible from the assessed receptor.	No mitigation required
Low	Overshadowing is geometrically possible however any impact is considered to be small such that mitigation is not required i.e. the effects are small and would not reduce conditions at the receptor beneath recommended threshold levels.	No mitigation recommended
Moderate	Overshadowing is geometrically possible however it occurs under conditions that do not represent a worst-case given individual receptor criteria.	Mitigation recommended
High	Overshadowing is geometrically possible under worst-case conditions that will produce a significant impact given individual receptor criteria.	Mitigation required

Impact significance definition

Impact Significance Determination for Daylight Overshadowing of Windows

The flow chart shows BRE's recommended methodology for determining the impact significance for daylight overshadowing of windows. Pager Power's process is based on this guidance, and is further explained in Section 6 of this report.



Assessment process for daylight considerations for external receptors

APPENDIX C – PROPOSED DEVELOPMENT DETAILS

Proposed Development Data

Coordinates of the proposed development were extrapolated from site plans. The footprint coordinates of the proposed development can be provided upon request.



APPENDIX D – ASSESSED RECEPTOR DETAILS

External Window Receptor Data

Coordinates and heights of the external window receptors used for this assessment can be provided upon request.

Internal Window Receptor Data

Coordinates and heights of the internal window receptors used for this assessment can be provided upon request.

APPENDIX E – FULL SKYLIGHT AND SUNLIGHT RESULTS

External Receptors

Skylight

The following table shows the full skylight results for each of the assessed window receptors, located in surrounding existing buildings. Results for the Baseline (BL) scenario and Post-Construction (PC) are presented.

The Vertical Sky Component (VSC) is assessed against a threshold of 27%, and a ratio of 0.8 times the baseline value (a 20% reduction).

Window	BL VSC (%)	PC VSC (%)	Ratio	Pass / Fail
T W 1	31.8	31.8	1	Pass
T W 2	29.8	29.7	1	Pass
T W 3	26.7	26.6	1	Pass
T W 4	21	20.8	0.99	Pass
T W 5	19.1	18.9	0.99	Pass
T W 6	40	39.2	0.98	Pass
T W 7	40	39.2	0.98	Pass
T W 8	40	39.1	0.98	Pass
T W 9	40	39	0.98	Pass
T W 10	40	39	0.98	Pass
T W 11	40	39.5	0.99	Pass
T W 12	40	39.4	0.98	Pass
T W 13	40	39.4	0.98	Pass
T W 14	40	39.4	0.98	Pass
T W 15	40	39.3	0.98	Pass
T W 16	40	39.7	0.99	Pass
T W 17	40	39.7	0.99	Pass
T W 18	40	39.7	0.99	Pass
T W 19	40	39.7	0.99	Pass
T W 20	40	39.6	0.99	Pass
T N 1	37.2	36	0.97	Pass
T N 2	38	36.6	0.96	Pass

Window	BL VSC (%)	PC VSC (%)	Ratio	Pass / Fail
T N 3	38.5	36.9	0.96	Pass
T N 4	38.8	37.2	0.96	Pass
T N 5	39	37.4	0.96	Pass
T N 6	39.1	37.5	0.96	Pass
T N 7	39.2	37.7	0.96	Pass
T N 8	39.3	37.8	0.96	Pass
T N 9	39.3	38	0.97	Pass
T N 10	39.4	38.1	0.97	Pass
T N 11	39.5	38.2	0.97	Pass
T N 12	39.5	38.3	0.97	Pass
T N 13	39.6	38.4	0.97	Pass
T N 14	39.9	37.8	0.95	Pass
T N 15	39.9	37.9	0.95	Pass
T N 16	39.9	38.1	0.95	Pass
T N 17	39.9	38.2	0.96	Pass
T N 18	39.9	38.2	0.96	Pass
T N 19	39.9	38.3	0.96	Pass
T N 20	39.9	38.4	0.96	Pass
T N 21	39.9	38.5	0.96	Pass
T N 22	39.9	38.6	0.97	Pass
T N 23	39.9	38.7	0.97	Pass
T N 24	39.9	38.7	0.97	Pass
T N 25	39.9	38.8	0.97	Pass
T N 26	39.9	38.9	0.97	Pass
T N 27	39.9	38.5	0.96	Pass
T N 28	39.9	38.6	0.97	Pass
T N 29	39.9	38.7	0.97	Pass
T N 30	39.9	38.8	0.97	Pass
T N 31	39.9	38.8	0.97	Pass
T N 32	39.9	38.9	0.97	Pass
T N 33	39.9	38.9	0.97	Pass

Window	BL VSC (%)	PC VSC (%)	Ratio	Pass / Fail
T N 34	39.9	39	0.98	Pass
T N 35	39.9	39.1	0.98	Pass
T N 36	39.9	39.1	0.98	Pass
T N 37	39.9	39.2	0.98	Pass
T N 38	39.9	39.2	0.98	Pass
T N 39	39.9	39.3	0.98	Pass
T N 40	40	39.2	0.98	Pass
T N 41	40	39.3	0.98	Pass
T N 42	40	39.3	0.98	Pass
T N 43	40	39.4	0.98	Pass
T N 44	40	39.4	0.98	Pass
T N 45	40	39.4	0.98	Pass
T N 46	40	39.4	0.98	Pass
T N 47	40	39.5	0.99	Pass
T N 48	40	39.5	0.99	Pass
T N 49	40	39.5	0.99	Pass
T N 50	40	39.5	0.99	Pass
T N 51	40	39.6	0.99	Pass
T N 52	40	39.6	0.99	Pass

Skylight results – External receptors

Sunlight

The following table shows the full annual sunlight results for each of the assessed window receptors, located in surrounding existing buildings. Results for the Baseline (BL) scenario and Post-Construction (PC) are presented.

The proportion of Annual Probable Sunlight Hours (APSH) is assessed against a threshold of 25%, and a ratio of 0.8 times the baseline value (a 20% reduction). The proportion of Winter Sunlight Hours (WSH) is assessed against a threshold of 5%, and a ratio of 0.8 times the baseline value (a 20% reduction).

Window	BL APSH		PC APSH		Ratio	Pass / Fail	BL WSH %	PC WSH %	Ratio	Pass / Fail
	%	Hours	%	Hours						
T W 1	31	461	31	461	1	Pass	7	7	1	Pass
T W 2	30	446	30	446	1	Pass	7	7	1	Pass
T W 3	30	446	30	446	1	Pass	7	7	1	Pass
T W 4	26	386	26	386	1	Pass	7	7	1	Pass
T W 5	17	253	17	253	1	Pass	4	4	1	Pass
T W 6	36	535	36	535	1	Pass	7	7	1	Pass
T W 7	36	535	36	535	1	Pass	7	7	1	Pass
T W 8	36	535	36	535	1	Pass	7	7	1	Pass
T W 9	36	535	36	535	1	Pass	7	7	1	Pass
T W 10	36	535	36	535	1	Pass	7	7	1	Pass
T W 11	36	535	36	535	1	Pass	7	7	1	Pass
T W 12	36	535	36	535	1	Pass	7	7	1	Pass
T W 13	36	535	36	535	1	Pass	7	7	1	Pass
T W 14	36	535	36	535	1	Pass	7	7	1	Pass
T W 15	36	535	36	535	1	Pass	7	7	1	Pass
T W 16	36	535	36	535	1	Pass	7	7	1	Pass
T W 17	36	535	36	535	1	Pass	7	7	1	Pass
T W 18	36	535	36	535	1	Pass	7	7	1	Pass
T W 19	36	535	36	535	1	Pass	7	7	1	Pass
T W 20	36	535	36	535	1	Pass	7	7	1	Pass
T N 1	14	208	14	208	1	Pass	1	1	1	Pass
T N 2	14	208	14	208	1	Pass	1	1	1	Pass
T N 3	15	223	15	223	1	Pass	1	1	1	Pass
T N 4	15	223	15	223	1	Pass	1	1	1	Pass
T N 5	15	223	15	223	1	Pass	1	1	1	Pass
T N 6	15	223	15	223	1	Pass	1	1	1	Pass
T N 7	15	223	15	223	1	Pass	1	1	1	Pass
T N 8	15	223	15	223	1	Pass	1	1	1	Pass
T N 9	15	223	15	223	1	Pass	1	1	1	Pass
T N 10	15	223	15	223	1	Pass	1	1	1	Pass

Window	BL APSH		PC APSH		Ratio	Pass / Fail	BL WSH %	PC WSH %	Ratio	Pass / Fail
	%	Hours	%	Hours						
T N 11	15	223	15	223	1	Pass	1	1	1	Pass
T N 12	15	223	15	223	1	Pass	1	1	1	Pass
T N 13	15	223	15	223	1	Pass	1	1	1	Pass
T N 14	15	223	15	223	1	Pass	1	1	1	Pass
T N 15	15	223	15	223	1	Pass	1	1	1	Pass
T N 16	15	223	15	223	1	Pass	1	1	1	Pass
T N 17	15	223	15	223	1	Pass	1	1	1	Pass
T N 18	15	223	15	223	1	Pass	1	1	1	Pass
T N 19	15	223	15	223	1	Pass	1	1	1	Pass
T N 20	15	223	15	223	1	Pass	1	1	1	Pass
T N 21	15	223	15	223	1	Pass	1	1	1	Pass
T N 22	15	223	15	223	1	Pass	1	1	1	Pass
T N 23	15	223	15	223	1	Pass	1	1	1	Pass
T N 24	15	223	15	223	1	Pass	1	1	1	Pass
T N 25	15	223	15	223	1	Pass	1	1	1	Pass
T N 26	15	223	15	223	1	Pass	1	1	1	Pass
T N 27	15	223	15	223	1	Pass	1	1	1	Pass
T N 28	15	223	15	223	1	Pass	1	1	1	Pass
T N 29	15	223	15	223	1	Pass	1	1	1	Pass
T N 30	15	223	15	223	1	Pass	1	1	1	Pass
T N 31	15	223	15	223	1	Pass	1	1	1	Pass
T N 32	15	223	15	223	1	Pass	1	1	1	Pass
T N 33	15	223	15	223	1	Pass	1	1	1	Pass
T N 34	15	223	15	223	1	Pass	1	1	1	Pass
T N 35	15	223	15	223	1	Pass	1	1	1	Pass
T N 36	15	223	15	223	1	Pass	1	1	1	Pass
T N 37	15	223	15	223	1	Pass	1	1	1	Pass
T N 38	15	223	15	223	1	Pass	1	1	1	Pass
T N 39	15	223	15	223	1	Pass	1	1	1	Pass
T N 40	15	223	15	223	1	Pass	1	1	1	Pass

Window	BL APSH		PC APSH		Ratio	Pass / Fail	BL WSH %	PC WSH %	Ratio	Pass / Fail
	%	Hours	%	Hours						
T N 41	15	223	15	223	1	Pass	1	1	1	Pass
T N 42	15	223	15	223	1	Pass	1	1	1	Pass
T N 43	15	223	15	223	1	Pass	1	1	1	Pass
T N 44	15	223	15	223	1	Pass	1	1	1	Pass
T N 45	15	223	15	223	1	Pass	1	1	1	Pass
T N 46	15	223	15	223	1	Pass	1	1	1	Pass
T N 47	15	223	15	223	1	Pass	1	1	1	Pass
T N 48	15	223	15	223	1	Pass	1	1	1	Pass
T N 49	15	223	15	223	1	Pass	1	1	1	Pass
T N 50	15	223	15	223	1	Pass	1	1	1	Pass
T N 51	15	223	15	223	1	Pass	1	1	1	Pass
T N 52	15	223	15	223	1	Pass	1	1	1	Pass

Sunlight results – External Receptors

Internal Receptors

Skylight and Sunlight

The following tables show the full skylight and sunlight results for each of the assessed window receptors proposed as part of the proposed development.

The Annual Probable Sunlight Hours (APSH) figure is assessed against a threshold of 25%. The Winter Sunlight Hours (WSH) figure is assessed against a threshold of 5%.

The Vertical Sky Component (VSC) is assessed against thresholds of 27% (likely to be acceptable) and 15% (special measures likely to be required). Where the results pass the upper value, they are coloured green in the tables presented below. Where VSC results fall between the upper and lower thresholds, the results are shown in yellow.

Where VSC results fail the lower threshold, or APSH values fail the threshold, results are shown in red. It is often not possible to provide adequate sunlight for rooms with only north-facing windows, and given the design of the building, it would not be expected for all windows to meet the sunlight threshold.

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A1 G 1	34.4	Pass	17	253	Fail	1	Fail
A1 G 2	34.2	Pass	15	223	Fail	0	Fail
A1 G 3	33.8	Pass	14	208	Fail	0	Fail
A1 G 4	33.6	Pass	13	193	Fail	0	Fail
A1 G 5	33.2	Pass	11	163	Fail	0	Fail
A1 G 6	32.8	Pass	11	163	Fail	0	Fail
A1 G 7	33.2	Pass	11	163	Fail	0	Fail
A1 G 8	33	Pass	11	163	Fail	0	Fail
A1 G 9	32.7	Pass	11	163	Fail	0	Fail
A1 G 10	32.4	Pass	11	163	Fail	0	Fail
A1 G 11	32.2	Pass	10	149	Fail	0	Fail
A1 G 12	25.4	Fail	24	357	Fail	1	Fail
A1 G 13	21.9	Fail	18	267	Fail	0	Fail
A1 G 14	27.4	Pass	17	253	Fail	0	Fail
A1 G 15	30.4	Pass	16	238	Fail	0	Fail
A1 G 16	31.8	Pass	15	223	Fail	0	Fail
A1 G 17	32.6	Pass	13	193	Fail	0	Fail
A1 G 18	32.7	Pass	12	178	Fail	0	Fail

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A1 G 19	32.8	Pass	9	134	Fail	0	Fail
A1 G 20	33.2	Pass	9	134	Fail	0	Fail
A1 G 21	33.5	Pass	9	134	Fail	0	Fail
A1 G 22	33.8	Pass	9	134	Fail	0	Fail
A1 G 23	34	Pass	9	134	Fail	0	Fail
A1 G 24	28.4	Pass	27	401	Pass	4	Fail
A1 G 25	23.3	Fail	20	297	Fail	2	Fail
A1 G 26	27.5	Pass	20	297	Fail	2	Fail
A1 G 27	32.7	Pass	20	297	Fail	2	Fail
A1 G 28	34.7	Pass	20	297	Fail	2	Fail
A1 G 29	35.6	Pass	20	297	Fail	2	Fail
A1 G 30	36.2	Pass	20	297	Fail	2	Fail
A1 G 31	36.6	Pass	20	297	Fail	2	Fail
A1 G 32	27.8	Pass	68	1010	Pass	14	Pass
A1 G 33	35.9	Pass	81	1204	Pass	26	Pass
A1 G 34	35.4	Pass	76	1129	Pass	26	Pass
A1 G 35	35.3	Pass	71	1055	Pass	25	Pass
A1 G 36	37.9	Pass	85	1263	Pass	29	Pass
A1 G 37	39.7	Pass	35	520	Pass	6	Pass
A1 G 38	39.6	Pass	34	505	Pass	5	Pass
A1 F 1	39.6	Pass	34	505	Pass	5	Pass
A1 F 2	39.7	Pass	34	505	Pass	5	Pass
A1 F 3	39.8	Pass	34	505	Pass	5	Pass
A1 F 4	35.4	Pass	18	267	Fail	2	Fail
A1 F 5	35	Pass	17	253	Fail	1	Fail
A1 F 6	34.7	Pass	16	238	Fail	0	Fail
A1 F 7	34.4	Pass	14	208	Fail	0	Fail
A1 F 8	34.5	Pass	11	163	Fail	0	Fail
A1 F 9	34.3	Pass	11	163	Fail	0	Fail
A1 F 10	34	Pass	11	163	Fail	0	Fail
A1 F 11	33.7	Pass	12	178	Fail	0	Fail

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A1 F 12	27.9	Pass	29	431	Pass	3	Fail
A1 F 13	27	Pass	19	282	Fail	1	Fail
A1 F 14	32.2	Pass	19	282	Fail	1	Fail
A1 F 15	33.8	Pass	18	267	Fail	0	Fail
A1 F 16	34.4	Pass	15	223	Fail	0	Fail
A1 F 17	34.2	Pass	9	134	Fail	0	Fail
A1 F 18	34.7	Pass	9	134	Fail	0	Fail
A1 F 19	34.9	Pass	9	134	Fail	0	Fail
A1 F 20	35.1	Pass	11	163	Fail	0	Fail
A1 F 21	31.7	Pass	20	297	Fail	2	Fail
A1 F 22	35.7	Pass	20	297	Fail	2	Fail
A1 F 23	36.7	Pass	20	297	Fail	2	Fail
A1 F 24	37.2	Pass	20	297	Fail	2	Fail
A1 F 25	40	Pass	64	951	Pass	23	Pass
A2 G 1	31.5	Pass	70	1040	Pass	16	Pass
A2 G 2	39.5	Pass	33	490	Pass	6	Pass
A2 G 3	39.4	Pass	33	490	Pass	6	Pass
A2 G 4	39.2	Pass	33	490	Pass	6	Pass
A2 G 5	38.9	Pass	33	490	Pass	6	Pass
A2 G 6	38.4	Pass	33	490	Pass	6	Pass
A2 G 7	37.7	Pass	33	490	Pass	6	Pass
A2 G 8	37.9	Pass	35	520	Pass	6	Pass
A2 G 9	37	Pass	36	535	Pass	6	Pass
A2 G 10	35.1	Pass	38	565	Pass	7	Pass
A2 G 11	31.8	Pass	39	580	Pass	8	Pass
A2 G 12	26.2	Fail	39	580	Pass	8	Pass
A2 G 13	30.5	Pass	54	802	Pass	13	Pass
A2 G 14	39.9	Pass	33	490	Pass	6	Pass
A2 G 15	39.9	Pass	33	490	Pass	6	Pass
A2 G 16	39.8	Pass	33	490	Pass	6	Pass
A2 G 17	39.8	Pass	33	490	Pass	6	Pass

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A2 G 18	39.6	Pass	33	490	Pass	6	Pass
A2 G 19	39.3	Pass	33	490	Pass	6	Pass
A2 G 20	39.6	Pass	35	520	Pass	6	Pass
A2 G 21	39.8	Pass	36	535	Pass	6	Pass
A2 G 22	39.8	Pass	38	565	Pass	7	Pass
A2 G 23	39.9	Pass	39	580	Pass	8	Pass
A2 G 24	39.9	Pass	39	580	Pass	8	Pass
A2 G 25	36.6	Pass	11	163	Fail	1	Fail
A2 G 26	36.2	Pass	11	163	Fail	1	Fail
A2 G 27	35.8	Pass	11	163	Fail	1	Fail
A2 G 28	35.3	Pass	11	163	Fail	1	Fail
A2 G 29	34.8	Pass	11	163	Fail	1	Fail
A2 G 30	34.2	Pass	11	163	Fail	1	Fail
A2 G 31	33.5	Pass	11	163	Fail	1	Fail
A2 G 32	32.5	Pass	11	163	Fail	1	Fail
A2 G 33	31.2	Pass	11	163	Fail	1	Fail
A2 G 34	30.1	Pass	11	163	Fail	1	Fail
A2 G 35	29.4	Pass	12	178	Fail	1	Fail
A2 G 36	28.7	Pass	12	178	Fail	1	Fail
A2 G 37	36.4	Pass	59	877	Pass	21	Pass
A2 G 38	38.6	Pass	63	936	Pass	23	Pass
A2 G 39	38.7	Pass	64	951	Pass	23	Pass
A2 F 1	34.4	Pass	75	1114	Pass	19	Pass
A2 F 2	39.7	Pass	33	490	Pass	6	Pass
A2 F 3	39.6	Pass	33	490	Pass	6	Pass
A2 F 4	39.4	Pass	33	490	Pass	6	Pass
A2 F 5	38.9	Pass	33	490	Pass	6	Pass
A2 F 6	38.9	Pass	36	535	Pass	6	Pass
A2 F 7	38.3	Pass	39	580	Pass	8	Pass
A2 F 8	36.1	Pass	40	594	Pass	9	Pass
A2 F 9	30.5	Pass	41	609	Pass	10	Pass

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A2 F 10	33.7	Pass	64	951	Pass	18	Pass
A2 F 11	40	Pass	33	490	Pass	6	Pass
A2 F 12	39.9	Pass	33	490	Pass	6	Pass
A2 F 13	39.9	Pass	33	490	Pass	6	Pass
A2 F 14	39.7	Pass	33	490	Pass	6	Pass
A2 F 15	39.7	Pass	36	535	Pass	6	Pass
A2 F 16	39.9	Pass	39	580	Pass	8	Pass
A2 F 17	39.9	Pass	40	594	Pass	9	Pass
A2 F 18	40	Pass	41	609	Pass	10	Pass
A2 F 19	37.9	Pass	14	208	Fail	1	Fail
A2 F 20	37.6	Pass	13	193	Fail	1	Fail
A2 F 21	37.3	Pass	14	208	Fail	1	Fail
A2 F 22	37	Pass	14	208	Fail	1	Fail
A2 F 23	36.5	Pass	14	208	Fail	1	Fail
A2 F 24	35.6	Pass	14	208	Fail	1	Fail
A2 F 25	34.9	Pass	14	208	Fail	1	Fail
A2 F 26	34.5	Pass	14	208	Fail	1	Fail
A2 F 27	38.1	Pass	63	936	Pass	23	Pass
A6 G 1	40	Pass	42	624	Pass	10	Pass
A6 G 2	40	Pass	42	624	Pass	10	Pass
A6 G 3	40	Pass	42	624	Pass	10	Pass
A6 G 4	40	Pass	42	624	Pass	10	Pass
A6 G 5	40	Pass	42	624	Pass	10	Pass
A6 G 6	34.9	Pass	20	297	Fail	1	Fail
A6 G 7	38	Pass	29	431	Pass	5	Pass
A6 G 8	39	Pass	35	520	Pass	6	Pass
A6 G 9	39.2	Pass	37	550	Pass	6	Pass
A6 G 10	39.1	Pass	39	580	Pass	7	Pass
A6 G 11	19.4	Fail	12	178	Fail	1	Fail
A6 G 12	38.4	Pass	62	921	Pass	21	Pass
A6 G 13	37.2	Pass	58	862	Pass	17	Pass

Window	VSC (%)	Pass / Fail	APSH (%)	APSH (Hours)	Pass / Fail	WSH %	Pass / Fail
A6 F 1	40	Pass	42	624	Pass	10	Pass
A6 F 2	40	Pass	42	624	Pass	10	Pass
A6 F 3	40	Pass	42	624	Pass	10	Pass
A6 F 4	40	Pass	42	624	Pass	10	Pass
A6 F 5	30.9	Pass	14	208	Fail	0	Fail
A6 F 6	38.2	Pass	31	461	Pass	4	Fail
A6 F 7	39.3	Pass	38	565	Pass	6	Pass
A6 F 8	39.4	Pass	40	594	Pass	8	Pass
A6 F 9	25.6	Fail	13	193	Fail	1	Fail
A7 G 1	39.9	Pass	36	535	Pass	7	Pass
A7 G 2	17.2	Fail	8	119	Fail	0	Fail
A7 G 3	17.2	Fail	14	208	Fail	0	Fail
A7 G 4	35.7	Pass	55	817	Pass	14	Pass
A7 G 5	34.4	Pass	77	1144	Pass	21	Pass
A7 G 6	35.6	Pass	79	1174	Pass	23	Pass

Skylight and Sunlight results – Internal receptors

APPENDIX F – MODELLING RESULT CHARTS

Overview

The Pager Power charts for receptors are shown on the following pages. Example charts are shown for each case, and further modelling charts can be provided upon request. Each chart shows:

- The receptor name and result – top text. This shows which receptor is shown and whether the baseline or post-construction case is displayed in the chart. It also shows the result for the receptor;
- Receptor details – bottom right corner. This text displays the latitude, longitude, height and azimuth of the assessed window.

Waldram Diagrams show in addition the receptor details:

- The modelling output – centre image. The diagram shows whether the sky is visible or blocked at different azimuths and elevations from the centre of the window. Shaded areas represent azimuths and elevations where the sky is not visible from the window, unshaded areas represent those angles where the sky can be seen, contributing towards the VSC for that window;
- Areas proportional to VSC. The unshaded area is directly proportional to the VSC at the centre of the window. If the chart is completely unshaded, this value is about 40%, if half of it is shaded, the VSC is about 20%;
- Chart axes. The horizontal axis values represent the azimuth angle, in degrees, left or right of the centre of the window. The vertical axis values represent the elevation angle, in degrees, above the centre of the window;
- Distortion of chart axes. Note that the horizontal and vertical axis intervals are not the same size. The axes have been distorted so that each unit area on the diagram has equal contribution towards the VSC. The distortion comes from some azimuths and elevations of sky having a greater contribution to the VSC for a window than others, in accordance with the CIE standard sky model.

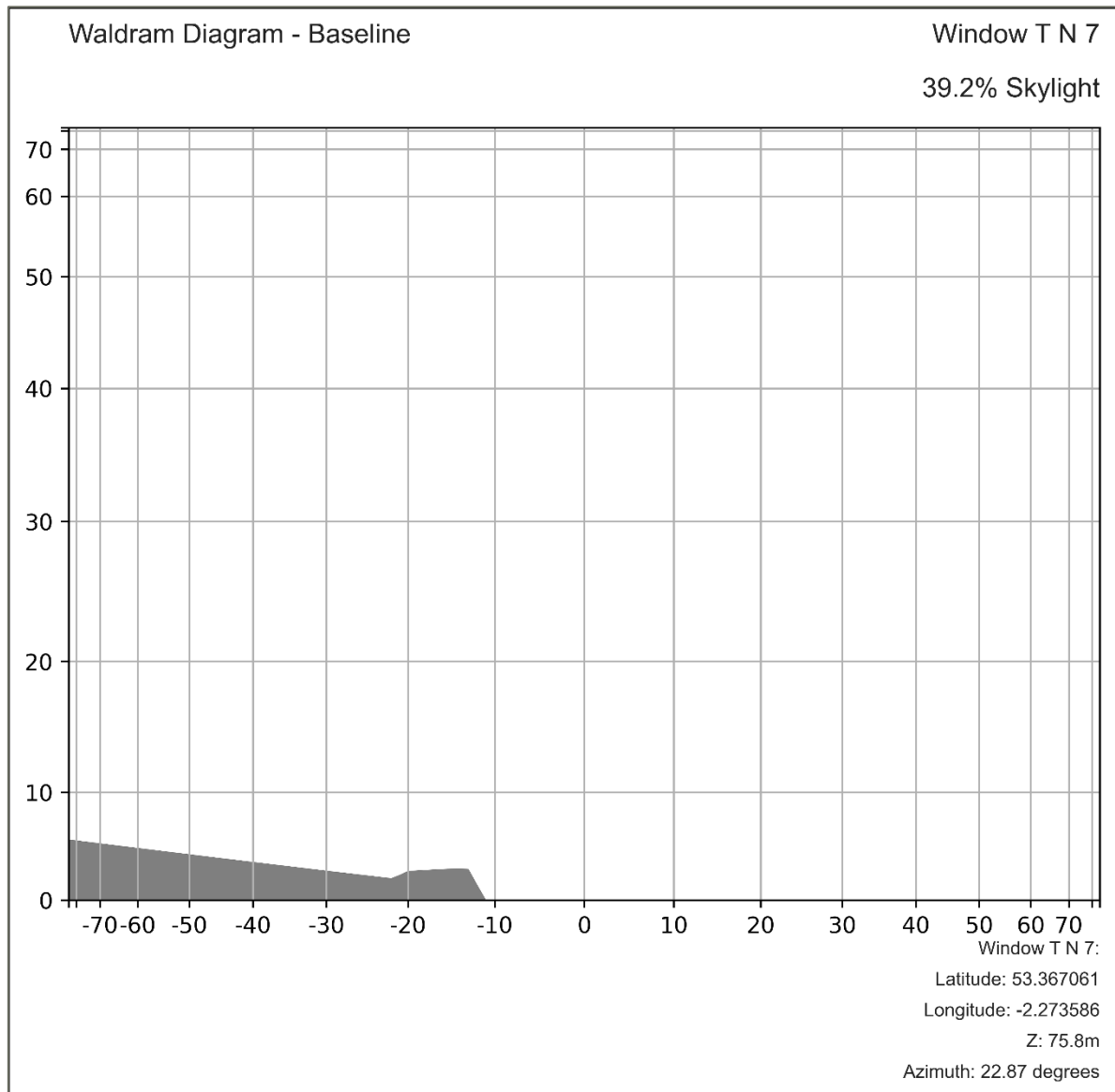
Sunlight indicators show in addition to the receptor details:

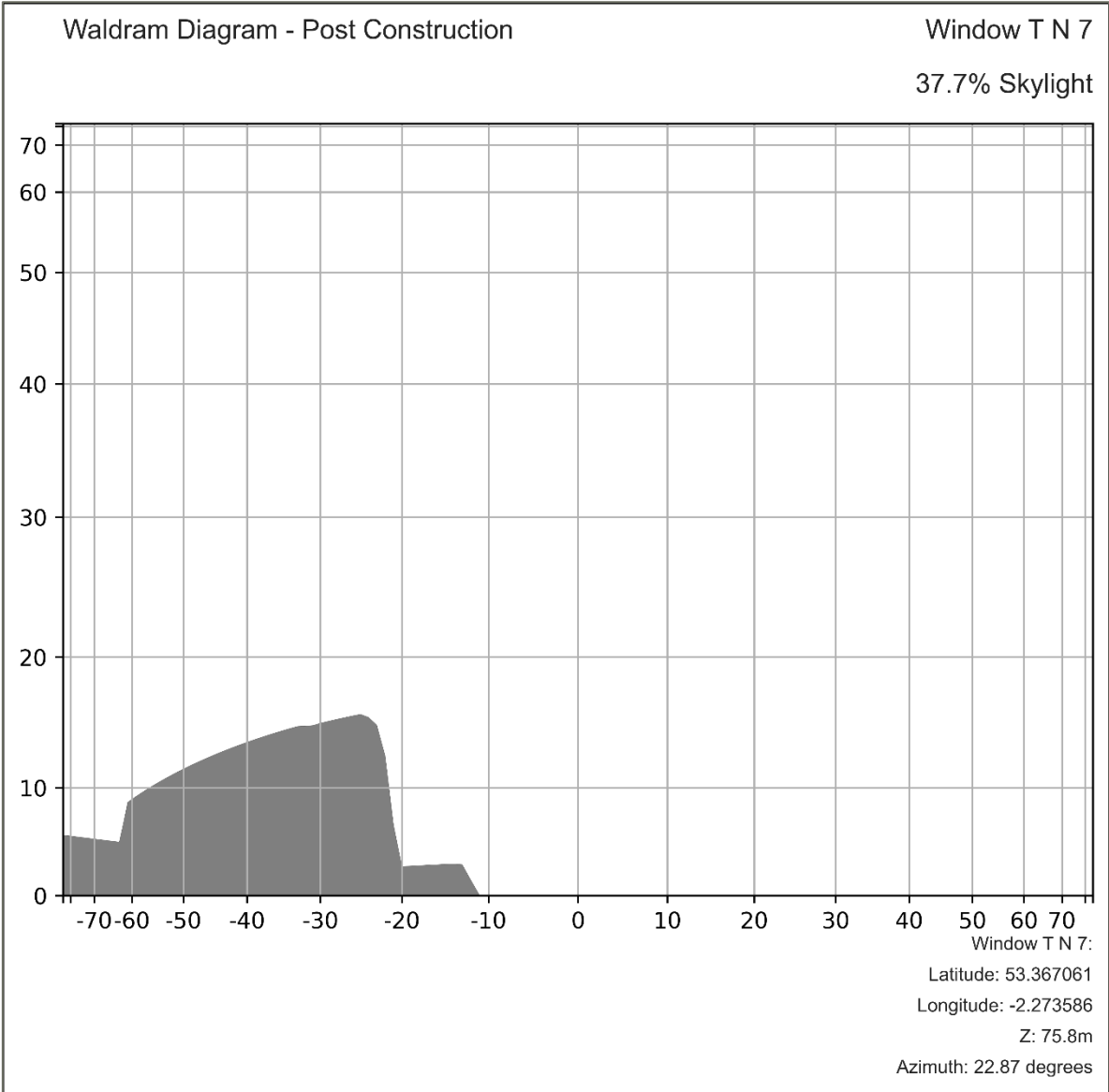
- The modelling output – centre image. The window location is indicated at the top centre of the semicircle, and the relevant obstructions are shown as the shaded polygons. These polygons are shown as a function of their height above the assessed window, divided by the horizontal distance between them;
- Skylight/sunlight crosses. The skylight and sunlight indicators both contain a number of blue crosses. For skylight indicators there are 80 crosses, each corresponding to 0.5% VSC. For sunlight indicators there are 100 crosses, each corresponding to 1% APSH (note that charts will not show all 100 crosses, as these crosses cover a greater than 180° splay).

Waldram Diagrams

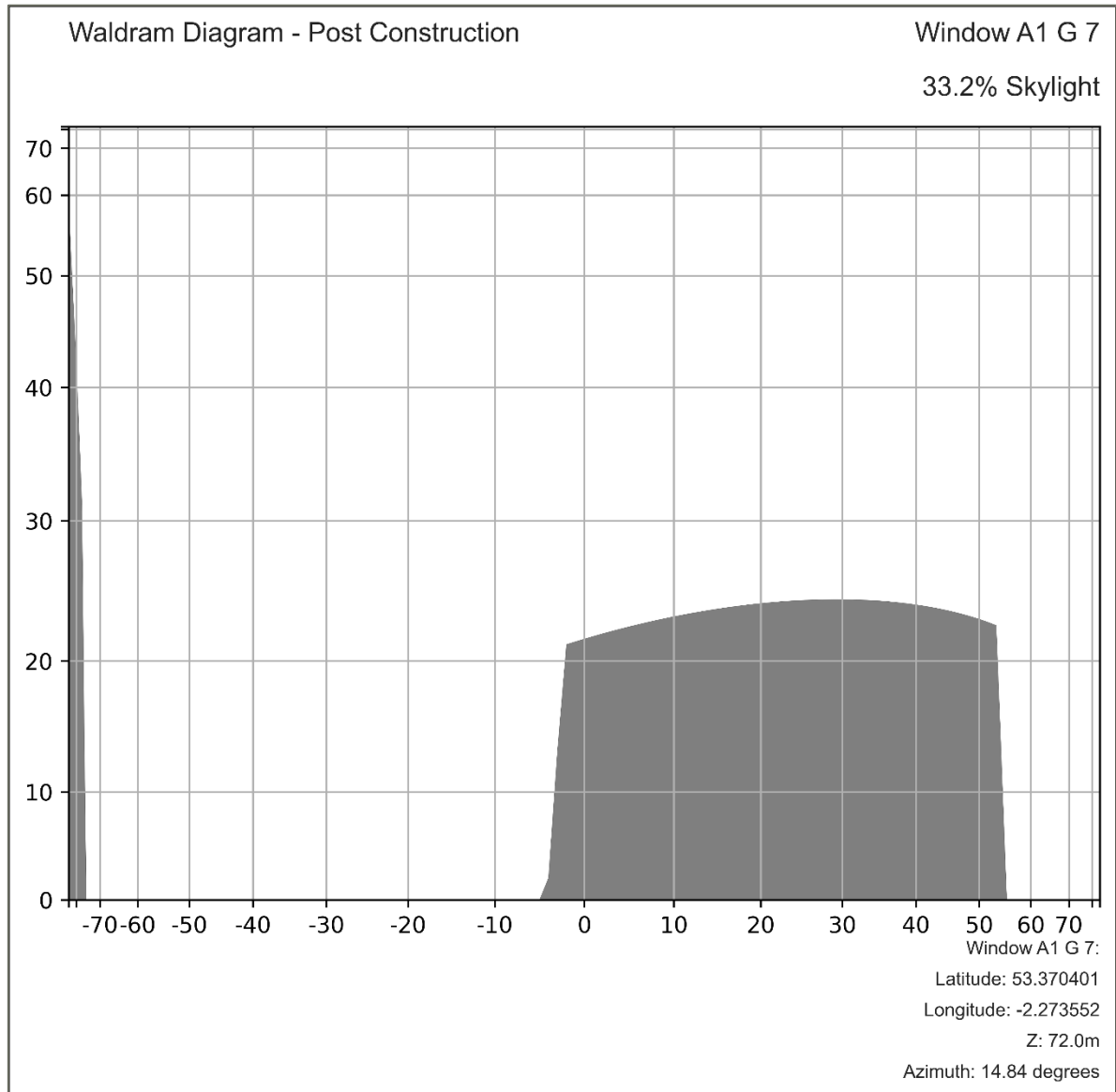
Modelling results are presented for a selection of representative windows.

External Receptors





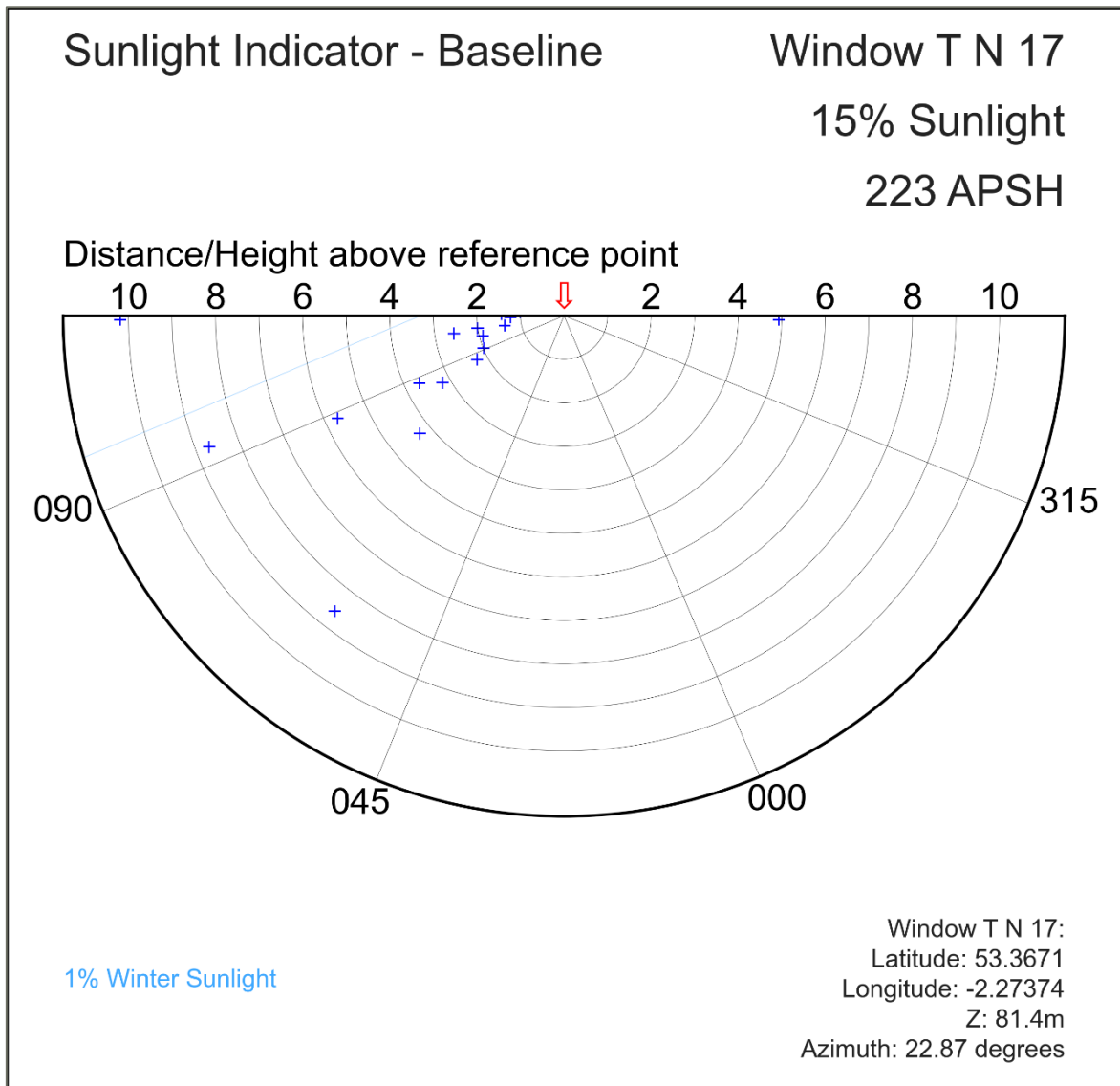
Internal Receptors



Sunlight Charts

Modelling results are presented for a selection of representative windows.

External Receptors

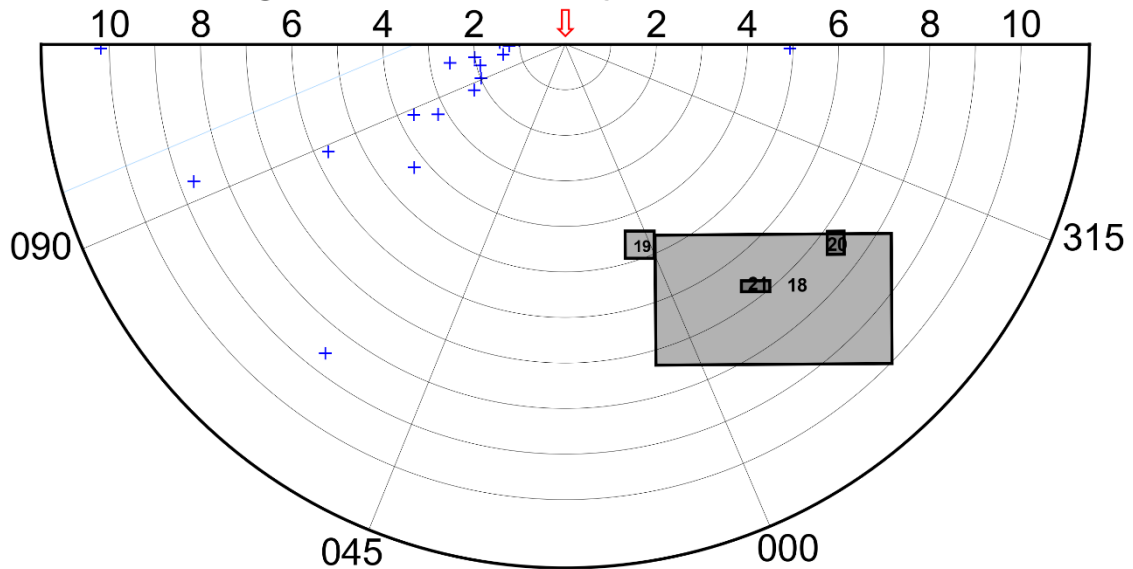


Sunlight Indicator - Post-Construction Window T N 17

15% Sunlight

223 APSH

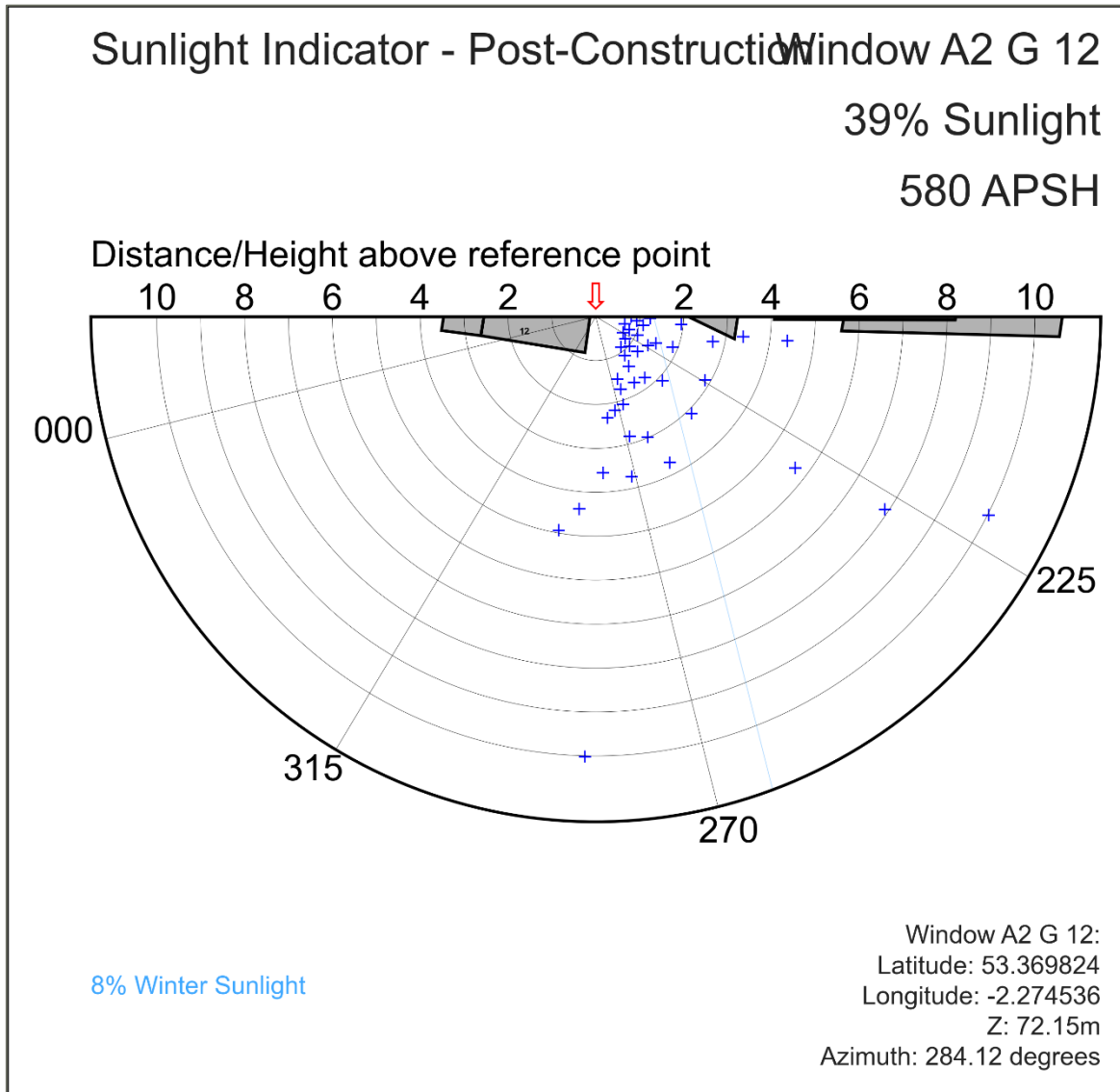
Distance/Height above reference point



1% Winter Sunlight

Window T N 17:
Latitude: 53.3671
Longitude: -2.27374
Z: 81.4m
Azimuth: 22.87 degrees

Internal Receptors





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